

C. ELECTRICAL TROUBLESHOOTING - FUEL INJECTION

SUBJECT	PAGE NO.
INTRODUCTION	C-2
Checking for Trouble Codes	C-3
Retrieving Trouble Codes	C-5
Tools	C-9
Diagnosing System Problems	C-12
Diagnostic Check	C-16
CHART A-1, No Check Engine Lamp	C-18
CHART A-2, Check Engine Lamp On Continuously	C-21
CHART A-3, Engine Cranks But Will Not Start	C-23
CHART A-4, No ECM Power	C-27
CHART B-1, Fuel System Electrical Test	C-30
CHART B-2, Fuel Pressure Test	C-35
CHART C-1, Idle Speed Control	C-38
CHART C-2, Misfire at Idle or Under Load	C-40
TROUBLE CODE 11, Throttle Position Sensor	C-42
TROUBLE CODE 12, Barometric Pressure Sensor	C-44
TROUBLE CODE 14, Engine Temperature Sensor	C-46
TROUBLE CODE 15, Intake Air Temperature Sensor	C-48
TROUBLE CODE 16, Battery Voltage	C-50
TROUBLE CODES 23 and 32, Fuel Injector	C-52
TROUBLE CODES 24 and 25, Ignition Coil	C-55
TROUBLE CODE 33, Fuel Pump Relay	C-58
TROUBLE CODES 52, 53, 54 and 55, ECM Failure	C-60
TROUBLE CODE 56, Crank Position and Cam Position Sensor Timing	C-61

INTRODUCTION

GENERAL

All system problems fall into at least one of three general categories.

No Start: The engine cranks over freely, but will not start. This does not include situations where the engine will not crank, such as a bad starter, dead battery, etc., and assumes that all obvious checks are made- there is sufficient fuel in the tank, etc.

Poor Performance: The engine starts but there are performance problems, such as poor fuel economy, rough idle, engine misfire, engine hesitation, severe spark knock, etc.

Check Engine Lamp: The lamp indicates the existence of a fault condition. There may also be starting or performance problems.

To resolve system problems, five basic steps are involved. In the order of occurrence, they are:

- Checking for Trouble Codes (through observation of the Check Engine Lamp). See CHECKING FOR TROUBLE CODES, page C-3.
- Retrieving Trouble Codes (with the Scanalyzer or the Check Engine Lamp Diagnostics). See RETRIEVING TROUBLE CODES, page C-5.
- Diagnosing System Problems (with the use of the Diagnostic Flow Charts, Scanalyzer and other special tools). See TOOLS and DIAGNOSING SYSTEM PROBLEMS, pages C-9 and C-12, respectively.
- Correcting Problems through replacement and/or repair (see SECTION 9C, REMOVAL/REPLACEMENT in the 1998 FLT Service Manual).
- Validating Repairs (clearing trouble codes and confirming proper vehicle operation without recurrence of the fault condition, as indicated by the behavior of the Check Engine Lamp).

CHECKING FOR TROUBLE CODES

CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the Check Engine Lamp. See Figure C-1.

When the Ignition Switch is turned ON (Key ON) after being off for 10 seconds or more, the Check Engine Lamp will illuminate for approximately four seconds and then turn off.

NOTE

“Key ON” or Ignition Switch ON means that the Ignition/Light Key Switch is turned to IGNITION and the handlebar Engine Stop Switch is in the RUN position (although the engine is NOT running).

NOTE

If the Check Engine Lamp is not illuminated at Key ON or if it fails to go OFF after the initial four second ON period, then a problem exists in the lamp circuit. See CHARTS A-1 or A-2 under DIAGNOSING SYSTEM PROBLEMS.

When the lamp turns off after being illuminated for the first four second period, it will remain off if there are no fault conditions or trouble codes currently detected by the ECM. See A in Figure C-2.

If the Check Engine Lamp stays off for only 4 seconds and then comes back on for an 8 second period, then a functional error is stored (although no current trouble code exists). See B in Figure C-2. A functional error indicates an internal problem with the ECM (trouble codes 52 through 55) or with the crankshaft or camshaft sensors/timing (trouble code 56).

If the Check Engine Lamp remains on beyond the 8 second period, then a current trouble code exists. See C in Figure C-2.

NOTE

Trouble codes relating to the fuel injectors or the ignition coil can only be fully diagnosed during actuation. For example, a problem with an ignition coil will be considered a current fault even after the problem is corrected, since the ECM will not know of its resolution until after the coil is exercised by a vehicle start sequence. In this manner, there may sometimes be a false indication of a current trouble code.

If a particular problem happens to resolve itself, the active status is dropped and it becomes a “historic,” rather than a “current” fault. Historic trouble codes are stored for a length of time to assist in the diagnosis of intermittent faults. The Check Engine Lamp will not indicate the existence of only historic trouble codes.

While the trouble codes are stored (whether current, historic or functional), they can be read using either the Scanalyzer or the Check Engine Lamp Diagnostics. All trouble codes reside in the memory of the ECM until the code is cleared by use of the Scanalyzer or a total of 50 trips has elapsed. A “trip” consists of a start and run cycle, the run cycle lasting at least 30 seconds. After the 50 trip retention period, the trouble code is

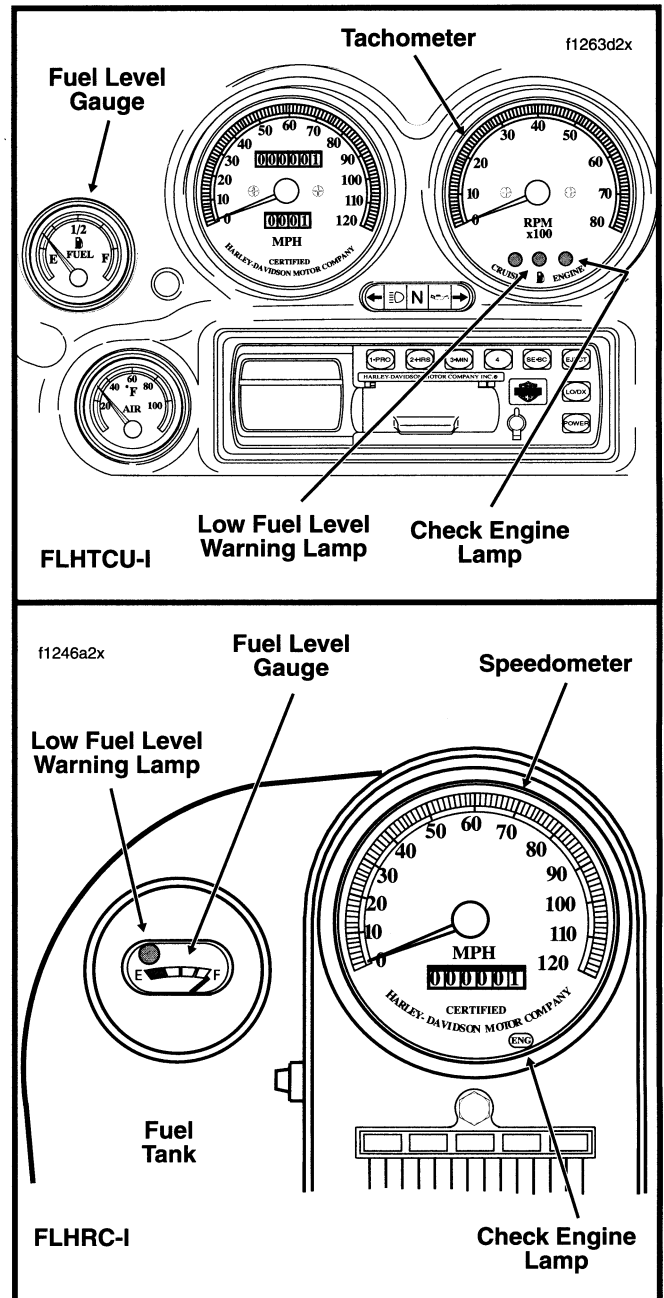


Figure C-1. Instruments/Indicator Lamps

automatically erased from memory (that is, assuming no subsequent faults of the same type are detected in that period).

IMPORTANT NOTE

It is important to note that historic trouble codes may also be present whenever the system indicates the existence of a CURRENT fault. Always refer to your authorized Harley-Davidson dealer if multiple trouble codes are found.

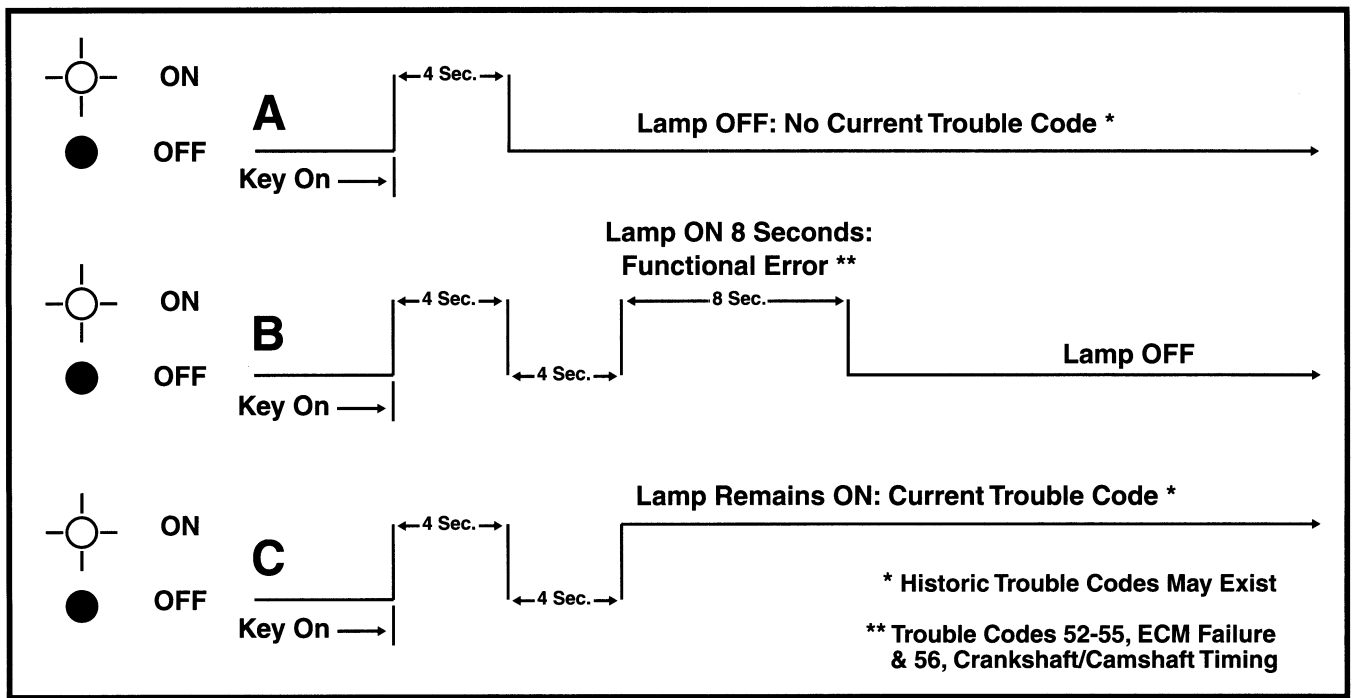


Figure C-2. Check Engine Lamp Timing Diagram

RETRIEVING TROUBLE CODES

DATA LINK CONNECTOR

The behavior of the Check Engine Lamp as described under CHECKING FOR TROUBLE CODES indicates the existence of a fault condition. Turn the Ignition/Light Key Switch to OFF (FLHTC/U-I, FLTR-I) or LOCK (FLHRC-I) and proceed as follows:

DIAGNOSTIC MODES

The Electronic Fuel Injection (EFI) System provides two levels of system diagnostics.

In the more sophisticated mode, a portable Scan Tool called a "Scanalyzer" (HD-41325) plugs into the Data Link Connector and facilitates the diagnosis of system problems through a direct interface with the ECM. Using a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data and enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs. See Figure C-3.

At the second level, the Check Engine Lamp is observed by the user after being placed in the diagnostic mode. The lamp blinks a code which correlates to a particular problem area.

SCANALYZER

NOTE

All vehicles feature quick-release fasteners to facilitate saddlebag removal and installation.

1. Raise lid of right side saddlebag. To free saddlebag from mounting brackets on saddlebag support and frame, grasp bail wire inside saddlebag and rotate each stud a full 1/4 turn in a counter-clockwise direction. Remove bail head studs with flat washers. Remove saddlebag.
2. Gently pull side cover from frame downtubes (no tools required).
3. Note the Data Link connector (pin side of 4-place Deutsch) on the electrical bracket. See Figure C-4. Push connector up to disengage small end of slot on attachment clip from T-stud on bracket. Lift connector off T-stud.
4. Remove rubber protective plug from open end of Data Link connector.

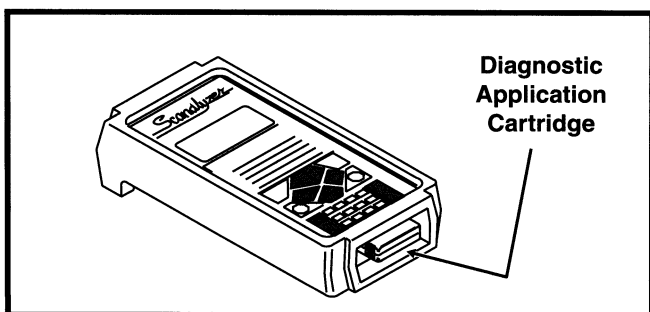


Figure C-3. Scanalyzer (HD-41325)

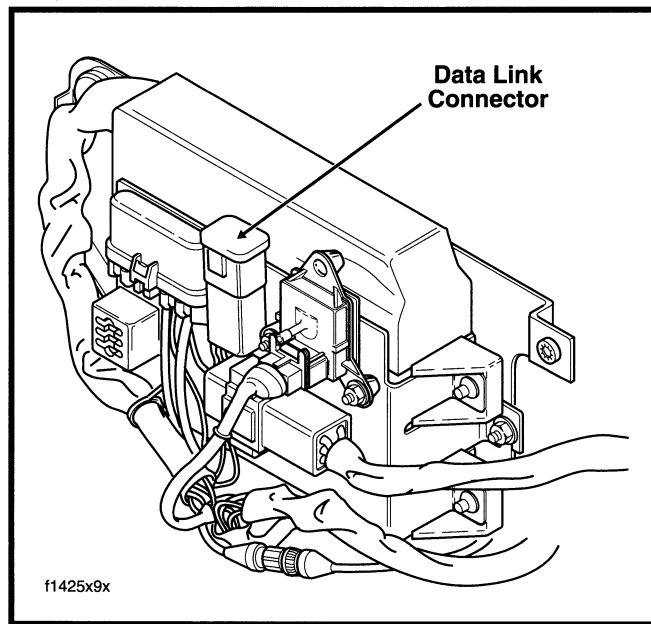


Figure C-4. Electrical Bracket Assembly

5. Plug the Scanalyzer (HD-41325) into the Data Link Connector.
6. Turn the Ignition/Light Key Switch to IGNITION. Turn the handlebar mounted Engine Stop Switch to the RUN position (but do not start the engine).
7. Insert the diagnostic application cartridge into the Scanalyzer. During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the ECM. Once communications is established with the ECM, the Diagnostic Menu appears. See Figure C-5.
8. The Diagnostic Menu, which consists of seven items, is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.
9. From the Diagnostic Menu, press the number "2" to access the Trouble Codes Menu. At this point, the unit allows the operator to display current trouble codes (by pressing the number "1"), display historic codes (number "2") or clear trouble codes (number "3"). Unlike the Check Engine Lamp Diagnostics, note that the Scanalyzer **does** allow the operator to clear trouble codes from memory as well as differentiate between current and historic codes.
10. After reading trouble codes, simply press the Mode key to return to the Trouble Codes Menu. Press the Mode key again to return to the Diagnostic Menu. In this manner, regardless of where the operator is in the program, the Mode key need only be pressed once or twice to return to the main menu.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

11. Write down all trouble codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
12. If trouble codes are present, reference the table shown in Figure C-8 to identify the source of the fault condition and then see the applicable flow chart under DIAGNOSING SYSTEM PROBLEMS. A Scanalyzer icon appears

at those points in the flow chart where use of the Scanalyzer would be most convenient or desirable. If necessary, turn to Section 9C of the 1998 FLT Service Manual for removal and replacement procedures, as well as information on the location of all components.

13. If trouble codes are NOT present, but starting or driveability problems are evident, see the Symptoms Chart under DIAGNOSTIC CHECK, page C-17, and then refer to CHARTS A-1 thru C-2 for help in diagnosing system problems.

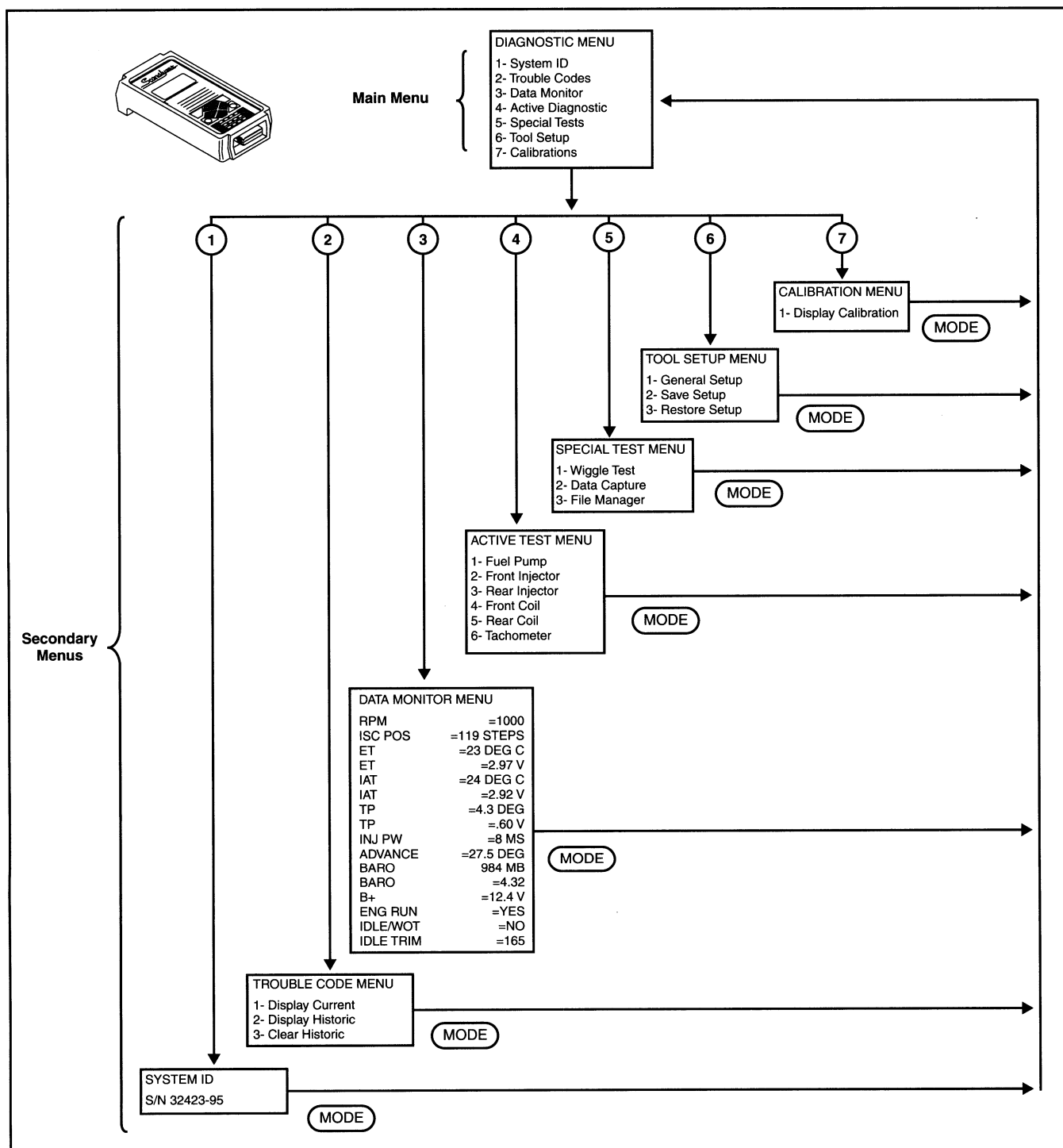


Figure C-5. Scanalyzer Menu Selections

14. After correcting system problems, clear trouble codes using the Trouble Codes Menu of the Scanalyzer.

NOTE

Trouble codes cannot be cleared while the engine is running. Turn the engine off, but leave the Ignition/Light Key Switch in the IGNITION position and return the handlebar Engine Stop Switch to RUN.

15. Turn the Ignition/Light Key Switch to OFF or LOCK. Turn the handlebar mounted Engine Stop Switch to the OFF position.
16. Unplug the Scanalyzer from the Data Link Connector. Install protective plug over pin side of Data Link Connector.
17. Place large end of slot on attachment clip over T-stud on electrical bracket. Push connector toward wire end to engage small end of slot.
18. Align barbed studs in side cover with grommets in frame downtubes and push firmly into place (no tools required).
19. Position right side saddlebag on vehicle. Verify that molded rubber insert at bottom of saddlebag fits snugly on lower saddlebag support rail.
20. Place flat washers on bail head studs. With groove at end of stud held in a horizontal position, insert stud through holes in saddlebag and front mounting bracket. When groove engages wire form of spring plate on inboard side of bracket, turn stud clockwise a full 1/4 turn until it snaps in place. Install rear bail head stud in the same manner.
21. Road test the vehicle and observe the Check Engine Lamp to confirm proper operation without the reoccurrence of trouble codes. See CHECKING FOR TROUBLE CODES, page C-3.

CHECK ENGINE LAMP DIAGNOSTICS

NOTE

Use of the Check Engine Lamp Diagnostics assumes that the Scanalyzer (HD-41325) is not available.

1. To activate the diagnostic feature of the Check Engine Lamp, proceed as follows:
 - a. Turn the Ignition/Light Key Switch to IGNITION for three seconds (one second pause after the fuel pump stops running), and then turn switch back to the OFF (FLHTC/U-I, FLTR-I) or LOCK (FLHRC-I) position for three seconds.
 - b. Repeat the instructions under step 1a. above.
 - c. Turn the Ignition/Light Key Switch to IGNITION and wait approximately eight seconds for the Check Engine Lamp to start flashing. See Figure C-6.
2. All trouble codes are sent out as a series of flashes. See Figure C-7.

The transmission of a trouble code is always preceded by a series of rapid flashes (about 3 per second). This "intermission" is followed by a 2 second pause in which

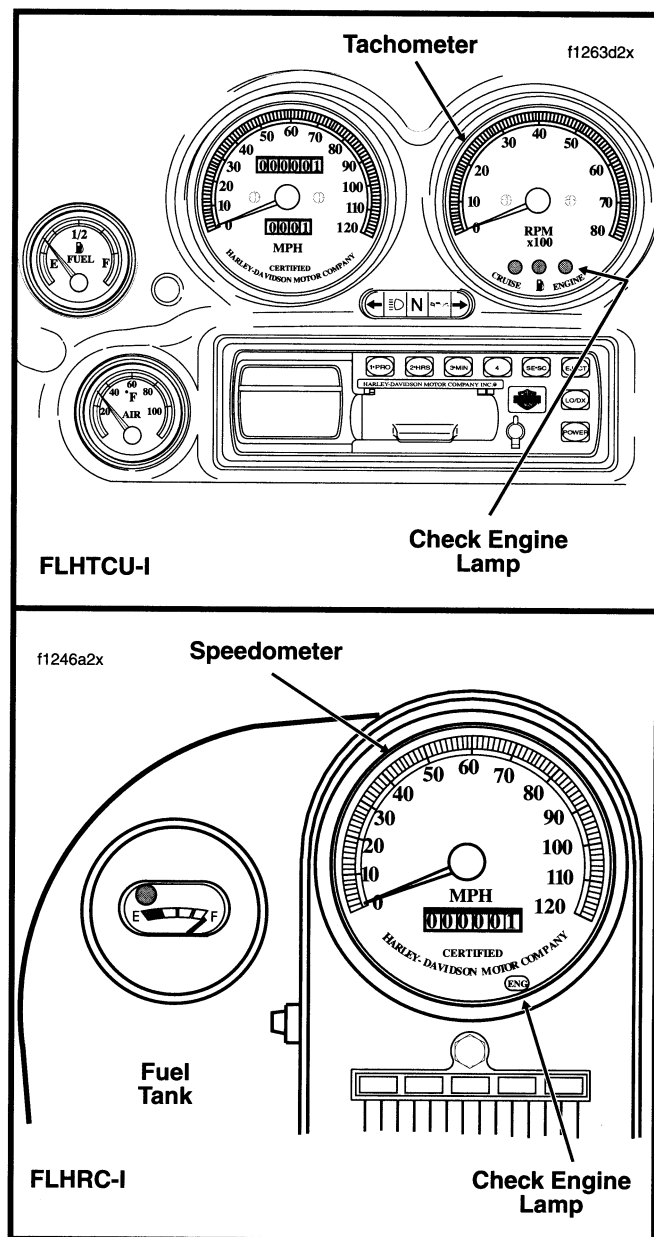


Figure C-6. Check Engine Lamp

the lamp is off. The lamp will then flash one or more times to indicate the first digit of the trouble code. The length of time the lamp is illuminated and the length of time in which it is off are each about 1 second in duration. Simply count the number of times the lamp flashes in order to retrieve the first digit of the trouble code.

3. Following transmission of the first digit, there is another 2 second pause in which the lamp is off. The lamp will then flash one or more times to indicate the second digit of the trouble code. Count the number of times the lamp flashes to retrieve the second digit.

Following transmission of the second digit, there is a third 2 second pause in which the lamp is off. After the pause comes the intermission, which is followed by transmission of the next recorded trouble code. All subsequent codes are sent in the same manner, each separated from the next by the intermission.

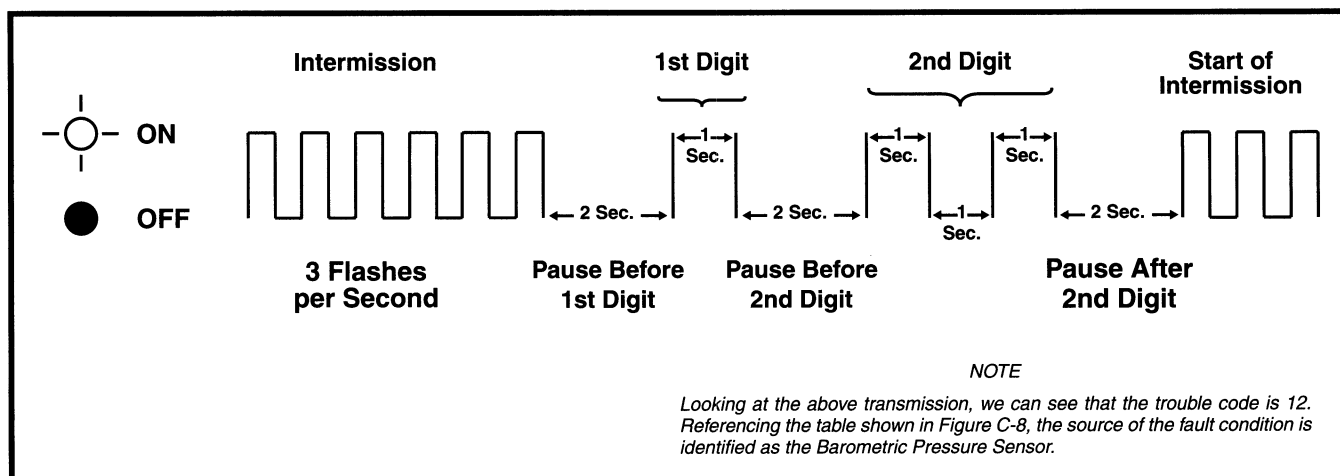


Figure C-7. Check Engine Lamp Diagnostics Timing Diagram

4. Write down the trouble codes on a piece of paper. Once all codes have been sent, the data string is repeated. When you have recorded the same trouble code twice, it is an indication that the transmission has been restarted and that all trouble codes have been retrieved.

NOTE

If the lamp flashes at a rate faster than normal, then you are observing the "Intermission" only, which means that no trouble codes are present.

5. If trouble codes are present, reference the table shown in Figure C-8 to identify the source of the fault condition and then see the applicable flow chart under DIAGNOSING SYSTEM PROBLEMS. If necessary, turn to Section 9C of the 1998 FLT Service Manual for removal and replacement procedures, as well as information on the location of all components.

Trouble Code	Fault Condition	Applicable Flow Chart
11	Throttle Position Sensor	page C-42
12	Barometric Pressure Sensor	page C-44
14	Engine Temperature Sensor	page C-46
15	Intake Air Temperature Sensor	page C-48
16	Battery Positive Voltage	page C-50
23	Front Injector	page C-52
24	Front Ignition Coil	page C-55
25	Rear Ignition Coil	page C-55
32	Rear Injector	page C-52
33	Fuel Pump Relay	page C-58
52	ECM RAM Error	ECM Replacement Required page C-60
53	ECM ROM Error	
54	EEPROM Error	
55	Microprocessor Malfunction	
56	Crank Position Sensor/Cam Position Sensor Signal Error	page C-61

Figure C-8. Diagnostic Trouble Codes

If trouble codes are NOT present, but starting or driveability problems are evident, see the Symptoms Chart under DIAGNOSTIC CHECK, page C-17, and then refer to CHARTS A-1 thru C-2 for help in diagnosing system problems.

6. Turn the Ignition/Light Key Switch to OFF (FLHTC/U-I, FLTR-I) or LOCK (FLHRC-I). Wait 10 seconds for the ECM relay to click. Vehicle can now be started normally.

IMPORTANT NOTE

Engine operation is disabled when trouble codes are retrieved using the Check Engine Lamp Diagnostics. The Ignition/Light Key Switch must be turned to the OFF (FLHTC/U-I, FLTR-I) or LOCK (FLHRC-I) position for a minimum of 10 seconds before the engine can be started normally.

7. After correcting system problems, clear trouble codes. If the Scanalyzer is not available, perform 50 start and run cycles. To execute one run cycle, start the vehicle, let it run for at least 30 seconds and then turn the engine off for a minimum of 10 seconds.
8. Road test the vehicle and observe the Check Engine Lamp to confirm proper operation without the reoccurrence of trouble codes. See CHECKING FOR TROUBLE CODES, page C-3.

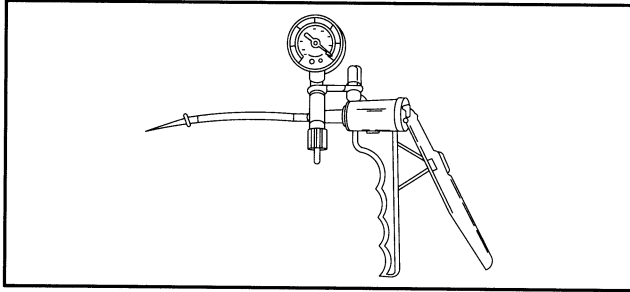
MULTIPLE TROUBLE CODES

The BARO, TP and CKP/CMP sensors are all connected to the same reference line (+5v Vref). If the line goes to ground or open, multiple trouble codes will be set, that is, trouble codes 11, 12 and 56.

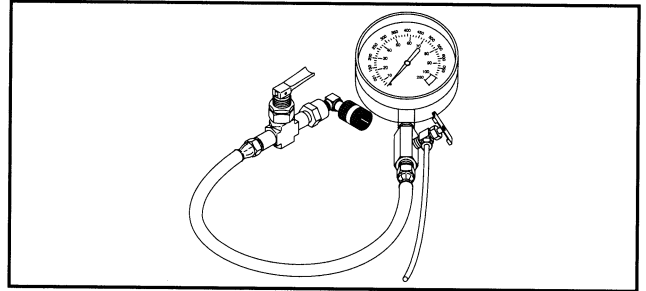
Also, the fuel pump, fuel injectors and ignition coil all receive +12 volts from the fuel pump relay. If this line should go to ground or open, some or all trouble codes may be set, that is, codes 23, 24, 25, 32 and 33. Different combinations of these codes suggest a loss of power from the fuel pump relay to the respective device.

Start with the trouble code having the lowest numerical value and refer to the corresponding flow chart.

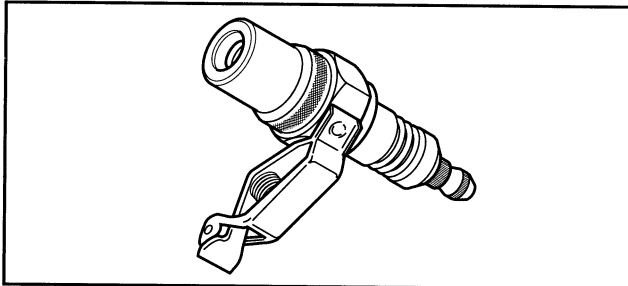
TOOLS



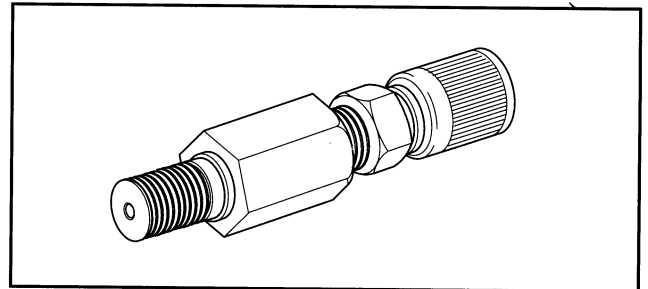
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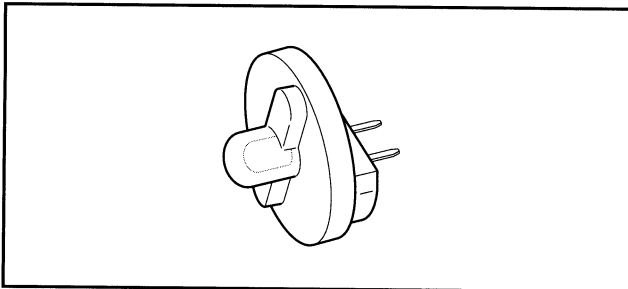
Part No. HD-41182 Fuel Pressure Gauge



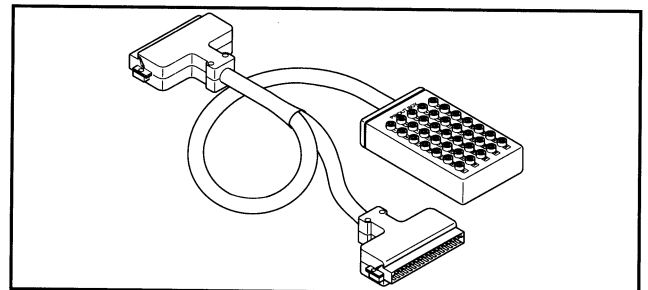
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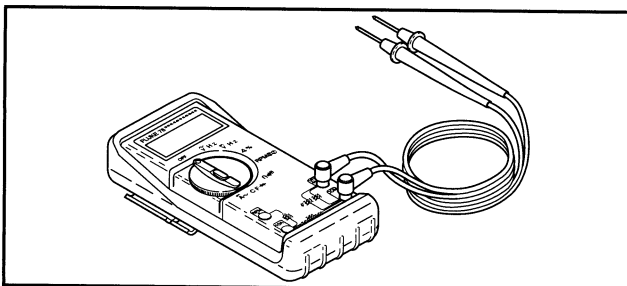
Part No. HD-41182-1 Fuel Pressure Gauge Adapter



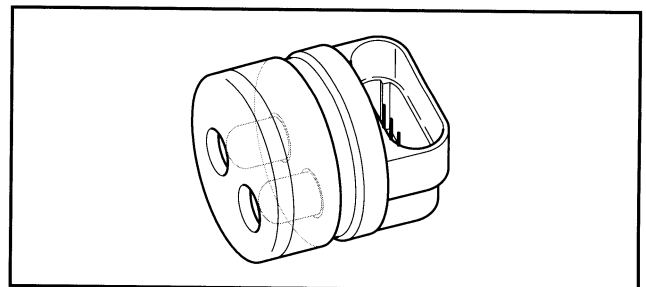
Part No. HD-34730-2C Fuel Injector Test Lamp



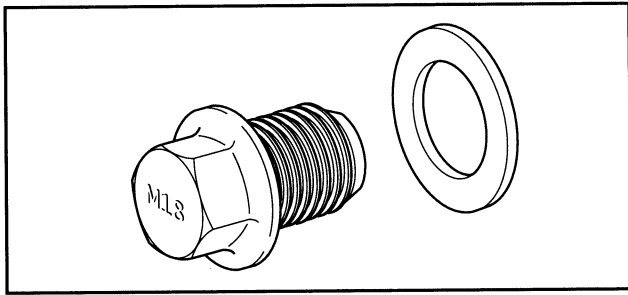
**Part No. HD-41198 Breakout Box
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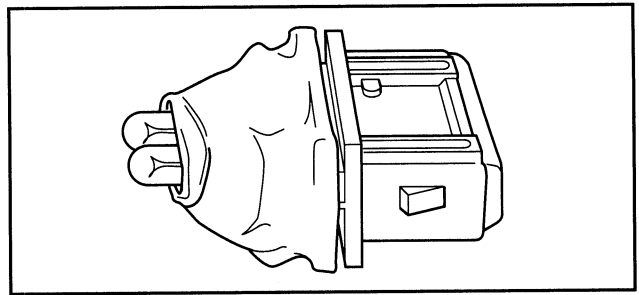
**Part No. HD-39978 Fluke 78 Multimeter (DVOM)
Use with HD-41198.**



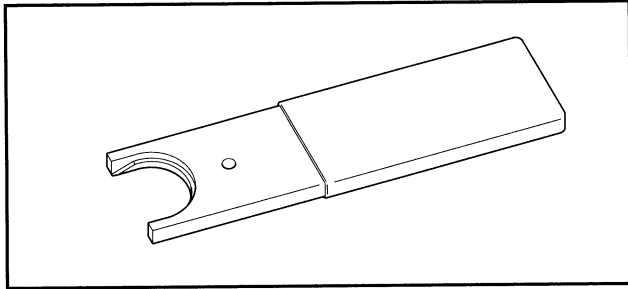
**Part No. HD-41199-3 Idle Speed Control Actuator
Test Lamp**



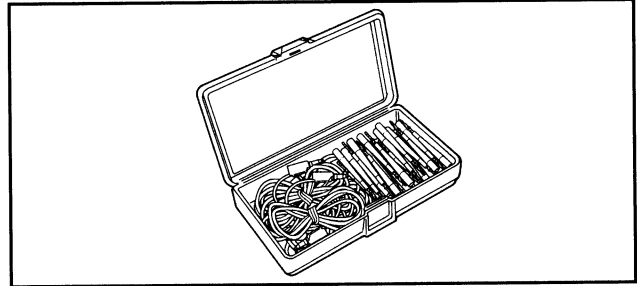
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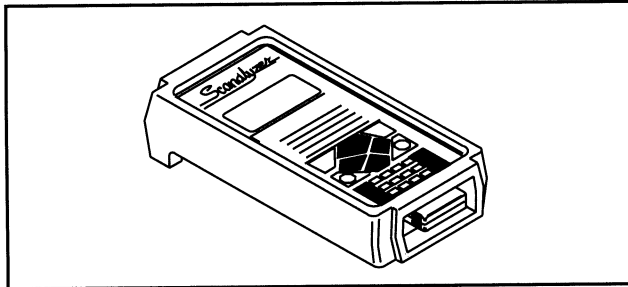
Part No. HD-41402 Ignition Coil Test Lamp



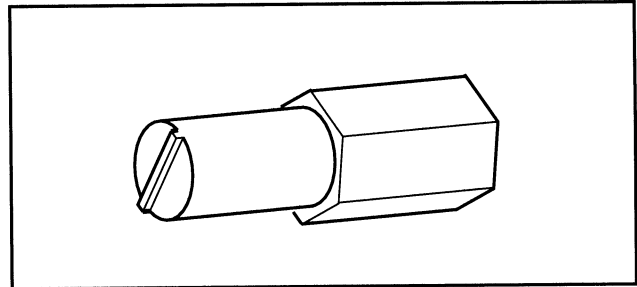
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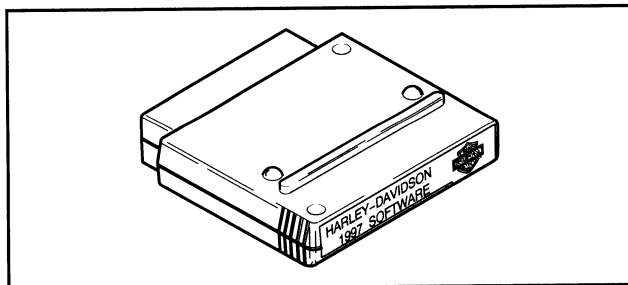
Part No. HD-41404 EFI Harness Connector Test Kit



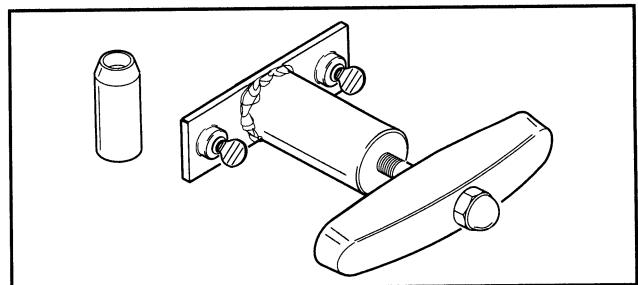
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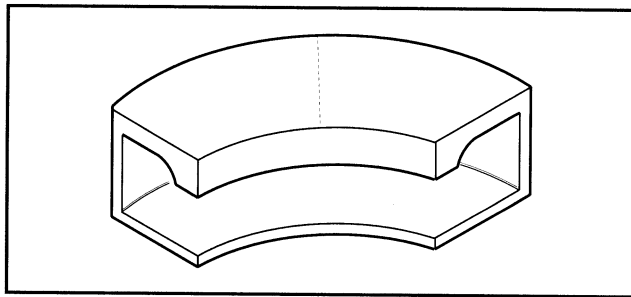
Part No. HD-41538 Check Valve Remover/Installer



Part No. HD-41325-95A Scanalyzer Diagnostic Application Cartridge Upgrade



Part No. HD-41771 Rotor Remover/Installer



Part No. HD-42122 Flywheel Protective Cover

TOOLS

Mity-Vac Vacuum Gauge (HD-23738A). A self-lubricating, maintenance-free, sealed, non-corrosive unit with a pumping rate of one cubic inch per stroke that easily attains a vacuum of 25 inches of mercury in just a few seconds. Used for testing the fuel pressure regulator and Barometric Pressure Sensor.

Spark Tester (HD-26792). Used to verify acceptable secondary voltage (25,000 volts) without removing the spark plug from the engine.

Fuel Injector Test Lamp (HD-34730-2C). Plugged directly into the injector harness connector, the test lamp flashes to confirm that voltage is being supplied to the fuel injector.

Fluke 78 Multimeter (HD-39978). Used with the Breakout Box to perform circuit diagnosis. Referred to as a "DVOM" throughout this document.

Fuel Pressure Gauge (HD-41182). Used with a special adapter, the gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis.

Fuel Pressure Gauge Adapter (HD-41182-1). The adapter allows the fuel pressure gauge to be attached to the external fuel supply line for fuel injector and fuel system pressure diagnosis.

Breakout Box (HD-41198). The unit plugs directly into the 35-place ECM connector to allow for circuit diagnosis of the wiring harness and connections without having to probe with sharp objects. Hooks in line so that the vehicle can be run during testing. Used with a DVOM, which is not included.

Idle Speed Control Actuator Test Lamp (HD-41199-3). Plugged directly into the harness connector, the test lamp flashes to confirm that proper voltage is being supplied to the ISC actuator.

Fuel Tank Plugs (HD-41298). Threaded plugs with nylon washers ensure that no leakage occurs when the fuel tank is removed for service.

Fuel Injector Remover (HD-41320). Enables the user to remove the fuel injectors from the induction module without damage to the plastic construction.

Scanalyzer (HD-41325). A portable unit that plugs directly into the Data Link Connector and facilitates the diagnosis of system problems through a direct interface with the ECM. Using a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data and enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

Scanalyzer Diagnostic Application Cartridge Upgrade (HD-41325-95A). Plugged into the Scanalyzer, the application cartridge is updated for use on 1998 and all earlier models.

Ignition Coil Test Lamp (HD-41402). Plugged directly into the harness connector, the test lamp flashes to confirm that voltage is being supplied to the ignition coil.

EFI Harness Connector Test Kit (HD-41404). Includes jumper wires and probe connectors for use with a DVOM (not included) to test connector and wiring harness integrity.

Check Valve Remover/Installer (HD-41538). Used to remove and install the supply and/or return check valves in the in-tank fuel fittings.

Rotor Remover/Installer (HD-41771). Since the laminated high-output rotor used on fuel injected vehicles (FLHRC-I excepted) contains magnets that are considerably more powerful than those found in the rotors of most carbureted models, the tool is required to prevent parts damage and possible personal injury during rotor removal and installation.

Flywheel Protective Cover (HD-42122). Install the cover on the left side flywheel cheek to prevent damage to the teeth during removal, installation and truing.

DIAGNOSING SYSTEM PROBLEMS

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with the **DIAGNOSTIC CHECK** on page C-16. Read the General Information and then work your way through the chart box by box.

If a numbered circle appears adjacent to a box, then more information is offered in the **Diagnostic Notes**. Many Diagnostic Notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes**, which are similar to the Diagnostic Notes, but are restricted to information on the use of the Scanalyzer.

When working through a flow chart, refer to the illustrations, the associated **Circuit Diagram** and the **Wire Harness Con-**

necter table as necessary. The wire harness connector table opposite each flow chart identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box (HD-41198) and a DVOM (HD-39978) are required. To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

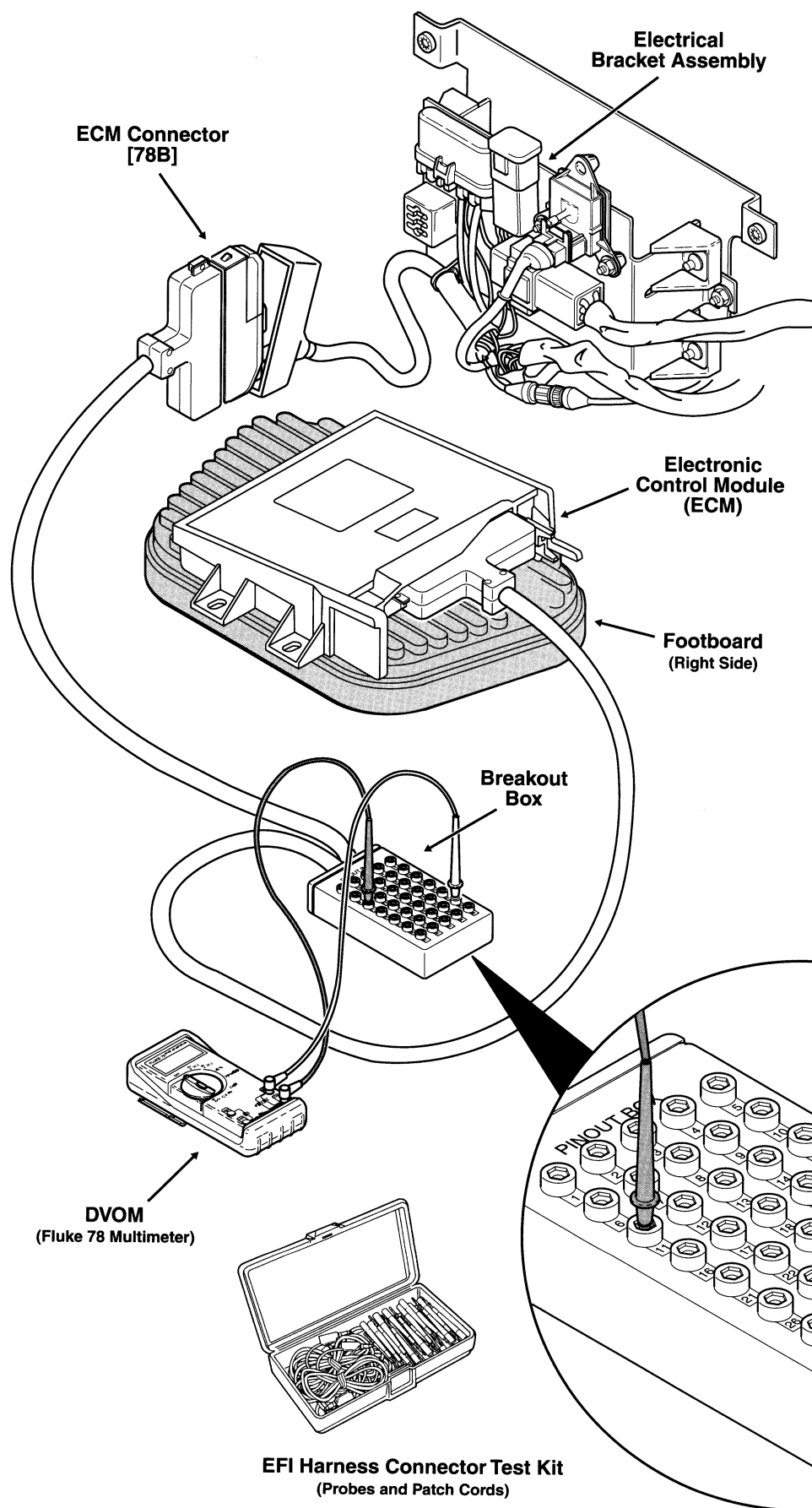
As an introduction to these topics, see Breakout Box Installation below and then refer to the following table in conjunction with Figure C-10.

Breakout Box Installation

1. Raise lid of right side saddle bag. Grasp bail wire inside saddlebag and rotate each stud a full 1/4 turn in a counter-clockwise direction. Remove bail head studs with flat washers. Remove saddlebag.
2. Gently pull side cover from frame downtubes (no tools required).

WIRE HARNESS CONNECTORS

No.	Description	Models	Type	Location	Probe
[1]	Main Harness to Interconnect	FLHTC/U-I	12 - Place Deutsch	Inner Fairing (Front of Right Fairing Bracket)	Black
		FLTR-I	12 - Place Deutsch	Inner Fairing (Below Radio)	Black
[8]	Main Harness to ECM Harness	All	8 - Place Deutsch	Under Right Side Cover	Black
[13]	Fuel Gauge Sending Unit	FLHTC/U-I FLTR-I	2 - Place Multilock	Under Seat	Not Applicable
		FLHRC-I	2 - Place Multilock	Below Fuel Tank (Left Side)	Not Applicable
[14]	CMP Sensor	All	3 - Place Deutsch	Bottom Frame Cross Member (Right Side)	Black
[20]	Main Harness to Console	FLHRC-I	12 - Place Multilock	Under Left Side Cover	Gray Socket Probe Only
[22]	Interconnect to Right Handlebar	FLHRC-I	6 - Place Deutsch	Inside Headlamp Nacelle	Black
[78]	ECM	All	35 - Place Amp	Under Right Side Cover	Purple
[79]	CKP Sensor	All	3 - Place Conxall	Under Right Side Cover Below Electrical Bracket	Brown
[80]	BARO Sensor	All	3 - Place Amp	Under Right Side Cover	Purple
[83]	Ignition Coil	All	3 - Place Amp	Below Fuel Tank	Purple
[84]	Front Injector	All	2 - Place Packard	Below Fuel Tank	Purple
[85]	Rear Injector	All	2 - Place Packard	Below Fuel Tank	Purple
[86]	Fuel Pump	All	1 - Place Amp	Under Seat	Not Applicable
[87]	ISC Actuator	All	4 - Place Packard	Below Fuel Tank	Gray
[88]	TP Sensor	All	3 - Place Packard	Below Fuel Tank	Gray
[89]	IAT Sensor	All	2 - Place Packard	Below Fuel Tank	Gray
[90]	ET Sensor	All	2 - Place Packard	Below Fuel Tank	Gray
[91]	Data Link	All	4 - Place Deutsch	Under Right Side Cover	Black
[108]	Interconnect to Tachometer	FLHTC/U-I	6 - Place Multilock	Inner Fairing (Above Radio)	Not Applicable
	[108A, 108D] Tachometer to Jumper Harness	FLTR-I	6 - Place Multilock	Instrument Nacelle (Under Bezel)	Not Applicable
	[108C, 108B] Jumper Harness to Interconnect		6 - Place Multilock	Inner Fairing (Below Radio)	Not Applicable
-	Electrical Relays	All	-	Under Seat	Red
-	Breakout Box	-	-	-	Purple



Electronic Control Module (ECM) Pin Connector Functions	
Pin	Function
1	Front Coil
2	Idle Speed Control Actuator
3	Idle Speed Control Actuator
4	ECM Relay
5	Tachometer Signal
6	Check Engine Light
7	Not Used
8	Vehicle Speed Signal (Inactive)
9	Not Used
10	Receive Data (Rx)
11	Crankshaft Position Sensor
12	Not Used
13	Engine Temperature Sensor
14	Vref (+5v) Sensor Supply
15	Transmit Data (Tx)
16	Sensor Ground
17	Not Used
18	Front Injector
19	Rear Coil
20	Idle Speed Control Actuator
21	Idle Speed Control Actuator
22	Not Used
23	Fuel Pump Relay
24	Rear Injector
25	Not Used
26	Key on Power (Power Latch)
27	Camshaft Position Sensor
28	Crankshaft Position Sensor
29	Not Used
30	Throttle Position Sensor
31	Intake Air Temperature Sensor
32	Barometric Pressure Sensor
33	Case Ground
34	Power Ground
35	ECM Power (12v)

Figure C-9. Breakout Box Installation

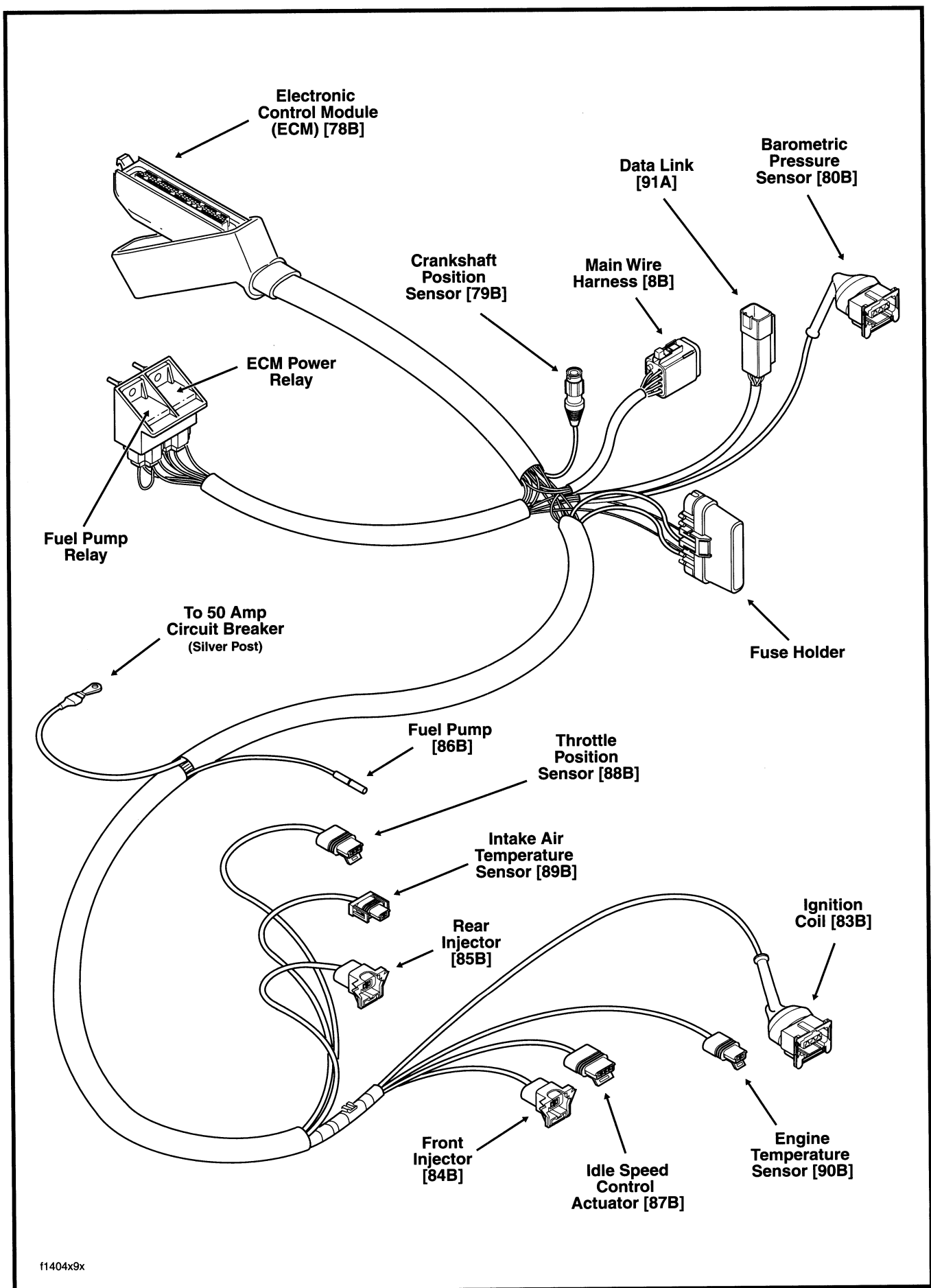


Figure C-10. EFI Wire Harness Connectors

⚠CAUTION

Always remove electrical bracket before disconnecting 35-place ECM connector. Removing connector with bracket installed may result in pin damage.

3. Remove two nuts to detach electrical bracket and ECM from studs on right side of battery box. Place assembly on rear footboard.
4. Pull back boot to reveal 35-place harness connector. Gently pull back spring lock on ECM to disengage locking tab on connector housing. Work that side of connector free. Disengage hook on opposite side of connector housing from hinge on ECM.
5. Remove mounting tabs on ECM from four boots anchored to electrical bracket. Reinstall electrical bracket on studs and start nuts.
6. Connect Breakout Box between EFI wire harness and ECM. See Figure C-9.

⚠CAUTION

Do not disassemble the ECM connector or back probe wire leads to locate faulty circuits. Opening the sealed connector and/or piercing the wires will lead to corrosion and premature failure. Use a Breakout Box (HD-41198) with a DVOM (HD-39978) where necessary.

7. Wherever applicable, use the special probe tips and jumper wires provided with the EFI Harness Connector Test Kit (HD-41404). The probe tips, which are color coded for ease of identification, will prevent damage to the wire connector and Breakout Box terminals.

⚠CAUTION

To prevent damage to the connector terminals and/or probe tips, proceed as follows:

- **Use the proper color probe as shown in the table on page C-12.**
- **Insert the probe tip straight into the cavity and keep the probe stable during testing.**
- **Do not wiggle or move the probe tip once it has been inserted into the terminal.**
- **Do not insert more than one probe tip into any single terminal.**

DIAGNOSTIC CHECK

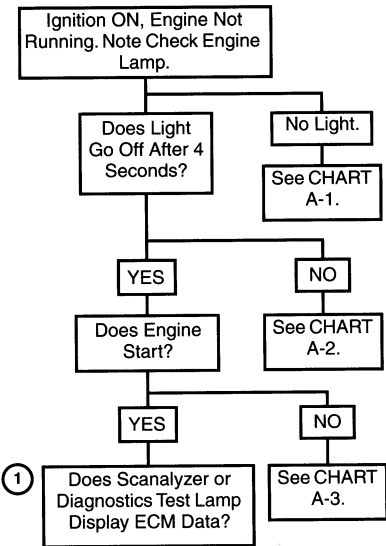
GENERAL

The diagnostic check is an organized approach to identifying a problem caused by an electronic control system malfunction. If no problems are found after completion of the Diagnostic Check, a comparison of Scanalyzer parameters may be used to help locate intermittents and out-of-specification sensors. See TYPICAL SCAN VALUES table on page C-17.

If the Scanalyzer is not working properly, check operation on another vehicle. If OK, check Data Link Connector for 12 volts and proper ground. If Scanalyzer reads "No Response" with the Ignition Switch turned to ON (Engine Stop Switch at RUN with the engine off), check serial data wire for an open or short to ground between Data Link terminal "1" and ECM. Also check for an open diagnostic test terminal between Data Link terminal "3" and ECM. With Ignition Switch turned to ON, Transmit Data line should have between 11-12 volts and Receive Data line between 5-6 volts.

NOTE

If the Check Engine Lamp Diagnostics are used in lieu of the Scanalyzer, the ECM is placed in a Diagnostics Mode where the engine will not start. The Ignition/Light Key Switch must be turned to OFF (FLHTC/U-I, FLTR-I) or LOCK (FLHRC-I) for a minimum of 10 seconds before the engine can be started normally.



Wire Harness Connectors

No.	Description	Type	Location
[78]	ECM	35 - Place Amp	Under Right Side Cover
[91]	Data Link	4 - Place Deutsch	Under Right Side Cover

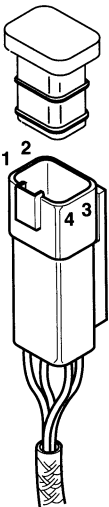


Figure C-12. Data Link Connector [91A]

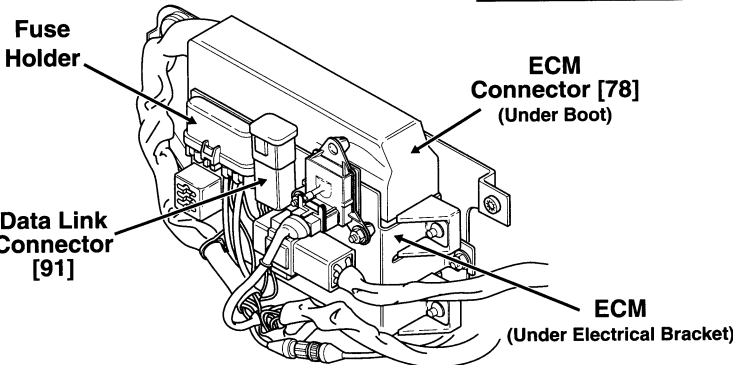
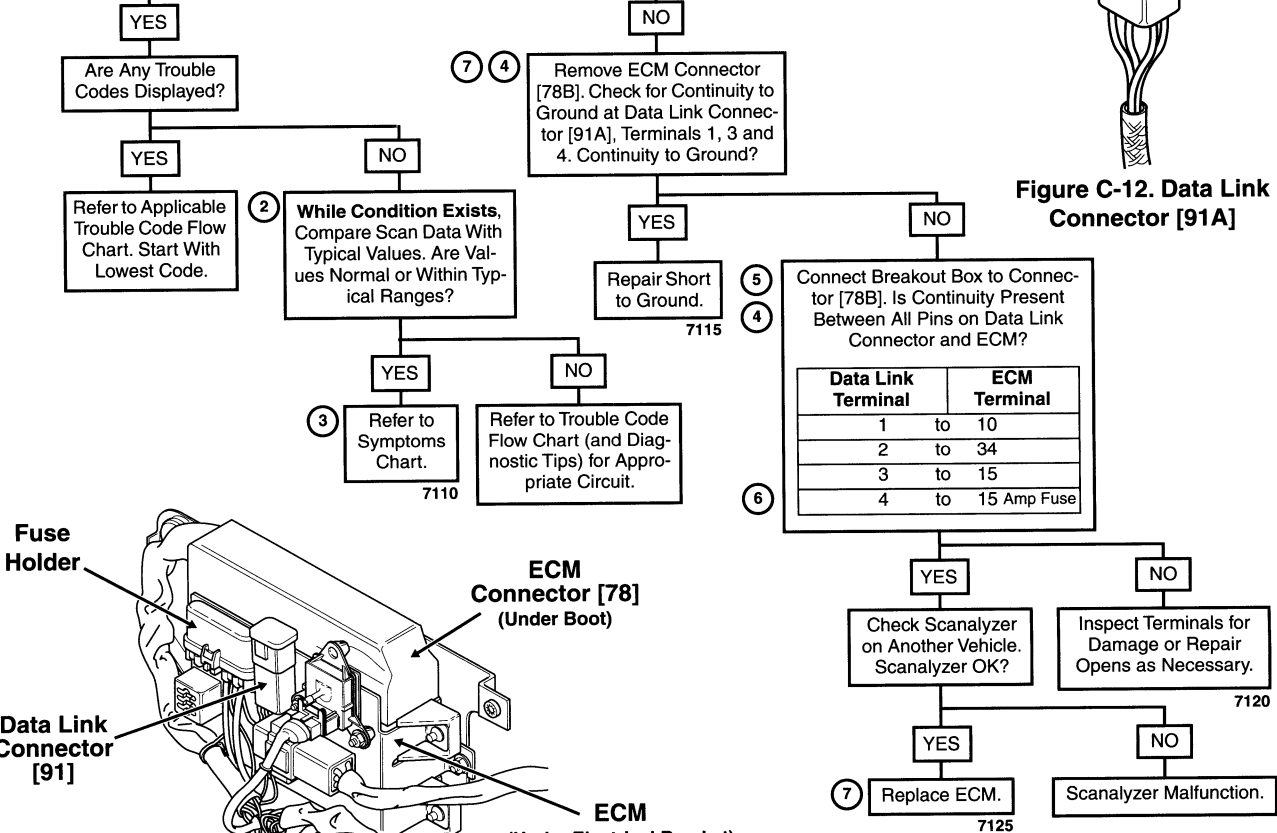


Figure C-11. Electrical Bracket Assembly

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

① See Retrieving Trouble Codes, page C-5.

② See Typical Scan Values Chart Below.

TYPICAL SCAN VALUES				Range
	95-98 DOM	95-96 HDI	97-98 HDI	
RPM	1000	1000	1000	-
ISC	0 Steps	0 Steps	0 Steps	0 - 240 Steps
ET	> 284° F.	> 140° C.	> 140° C.	Ambient to 284° F.
ET	0.1 Volt	0.1 Volt	0.1 Volt	2.97 - 0.1 Volt
IAT	Approx. 40° Above Ambient	Approx. 4° C. Above Ambient	Approx. 4° C. Above Ambient	-
IAT	Approx. 1 Volt	Approx. 1 Volt	Approx. 1 Volt	Ambient to 158° F.
TP	3.1° - 3.3°	3.1° - 3.3°	3.1° - 3.3°	Idle - 88°
TP	0.35 - 0.41 Volt	0.35 - 0.41 Volt	0.35 - 0.41 Volt	0.275 - 4.97 Volt
INJ PW	3.5 - 4.1 mS	3.5 - 4.1 mS	3.0 - 3.5 mS	-
ADVANCE	14° - 16°	14° - 16°	6°	8° - 44°
BARO	Ambient	Ambient	Ambient	3.0 - 4.8 Volts
BARO	29.8 in.Hg = 4.46 Volts	75.7 cm Hg = 4.46 Volts	75.7 cm Hg = 4.46 Volts	-
B+	14 Volts	14 Volts	14 Volts	6.2- 15.5 Volts
ENG RUN	YES	YES	YES	-
IDLE/WOT	YES	YES	YES	-
IDLE TRIM	128	128	128	-

③ See Symptoms Chart Below.

SYMPTOMS	
STARTS HARD	
Engine Temperature Circuit.	See TROUBLE CODE 14, page C-46.
ISC Improperly Adjusted or Inoperative.	See Air Cleaner Assembly, Warm-Slow Idle Speed Adjustment, Page 9-106 of the Service Manual or CHART C-1, page C-38.
Improper Fuel Pressure.	See CHART B-2, Fuel Pressure Test, page C-35.
Spark Plugs and/or Plug Wires.	See CHART C-2, page C-40.
Battery Discharged.	See Charging System Troubleshooting in Section 8 of the Service Manual.
CKP/CMP Sensors.	See TROUBLE CODE 56, page C-61.
Manifold Leak.	Spray Water Around Induction Module Seals While Idling Engine. If RPM Changes, Replace Seals.
Water or Dirt in Fuel System.	Drain and Refill With Fresh Fuel.
Ignition Coil.	See CHART C-2, page C-40.
Leaky Injector(s).	Remove air cleaner. With throttle wide open, turn Key ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See Fuel Injectors, Removal/Installation, Page 9-113 of the Service Manual.
Valve Sticking.	See Section 3 of the Service Manual.

SYMPTOMS (Cont'd)

HESITATES, STUMBLES, SURGES, MISFIRES AND/OR SLUGGISH PERFORMANCE

Engine Temperature Circuit.	See TROUBLE CODE 14, page C-46.
CKP/CMP Sensors.	See TROUBLE CODE 56, page C-61.
Spark Plugs and/or Plug Wires.	See CHART C-2, page C-40.
Improper Fuel Pressure.	See CHART B-2, Fuel Pressure Test, page C-35.
Improper TPS Adjustment.	See Throttle Position Sensor, Installation/Adjustment, Page 9-115 of the Service Manual.
Manifold Leak.	Spray Water Around Induction Module Seals While Idling Engine. If RPM Changes, Replace Seals.
Throttle Plates Not Opening Fully.	See Throttle Cable Adjustment in Section 2 of the Service Manual.
BARO Sensor Plugged or Not Operating Properly.	See TROUBLE CODE 12, page C-44.
EVAP Hose Disconnected From Induction Module (Calif. Models)	Connect.
Water or Dirt in Fuel System.	Drain and Refill With Fresh Fuel.

ENGINE EXHAUST EMITS BLACK SMOKE OR FOULS PLUGS

Engine Temperature Circuit.	See TROUBLE CODE 14, page C-46.
Clogged Air Filter.	See Air Cleaner, Page 9-105 of the Service Manual.
Improper TPS Adjustment.	See Throttle Position Sensor, Installation/Adjustment, Page 9-115 of the Service Manual.
Leaky Injector(s).	Remove air cleaner. With throttle wide open, turn Key ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See the FLT Service Manual.
BARO Sensor Plugged or Not Operating Properly.	See TROUBLE CODE 12, page C-44.
Improper Fuel Pressure.	See CHART B-2, Fuel Pressure Test, page C-35.

④ Use Harness Connector Test Kit (HD-41404), black socket probe and patch cord.

⑤ Connect Breakout Box (HD-41198) to EFI wire harness **only** (leave ECM disconnected). See Breakout Box Installation, page C-12.

⑥ Touch meter probe to contact at top of fuse. See Figure C-13. If no power through the fuse, then fuse is blown. Probe the contact on the outboard side - if no power to the fuse, then look for a broken or damaged wire.

⑦ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.

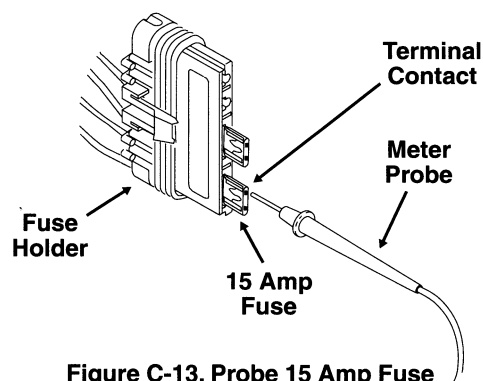


Figure C-13. Probe 15 Amp Fuse

CHART A-1, NO CHECK ENGINE LAMP AT KEY ON

GENERAL

When the Ignition Switch is turned to ON (Engine Stop Switch at RUN with the engine off), the Check Engine Lamp should illuminate for 4 seconds. Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the ECM through the BK/Y wire. A lack of power to the ECM will cause the Check Engine Lamp to be inoperative and also create a no start situation.

DIAGNOSTIC TIPS

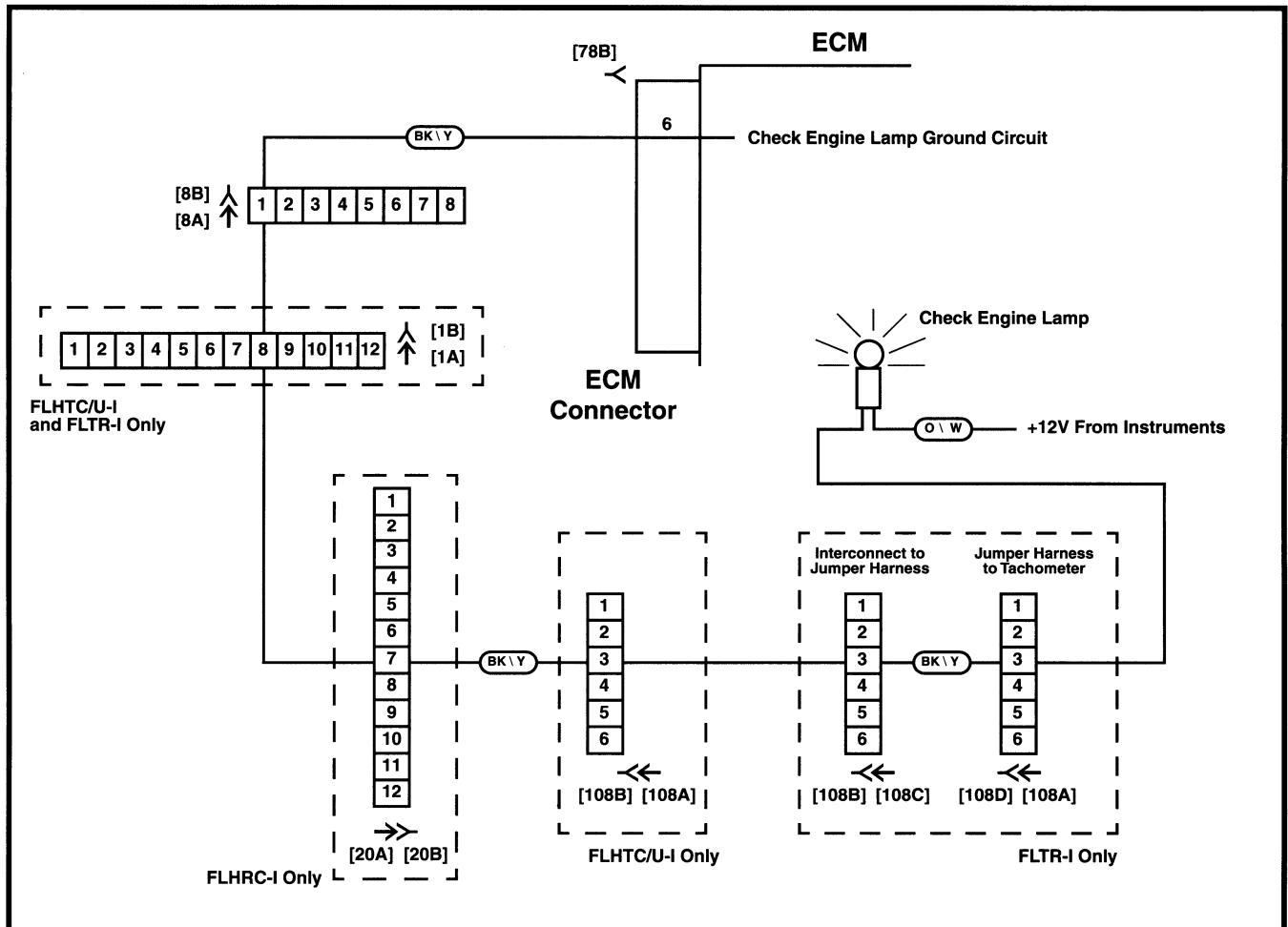
- Check for faulty lamp bulb.
- Check for open in BK/Y wire.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

- ① Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ② Use Harness Connector Test Kit (HD-41404), purple pin probe and patch cord. Look for slot in socket terminal of Breakout Box to insert pin blade.

- ③ Repair faulty ECM connection or replace ECM. If ECM requires replacement, see Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ④ Use Harness Connector Test Kit (HD-41404), black socket probe and patch cord.
- ⑤ Check continuity. If continuity present, then most likely short to voltage; if no continuity, then open.
- ⑥ Remove outer fairing on FLHTC/U-I and FLTR-I models. See Upper Fairing/Windshield, Outer Fairing, Removal, FLHT/C/U or FLTR, in Section 2 of the 1998 FLT Service Manual.
- ⑦ Use Harness Connector Test Kit (HD-41404), black pin probe and patch cord.
- ⑧ Use Harness Connector Test Kit (HD-41404), gray socket probe and patch cord.
- ⑨ Use special pick (Snap-On Tool TT600-3) as described under Amp Multilock Electrical Connectors in Section D of this book.



Check Engine Lamp Circuit Diagram

Chart A-1, No Check Engine Lamp at Key On (1 of 2)

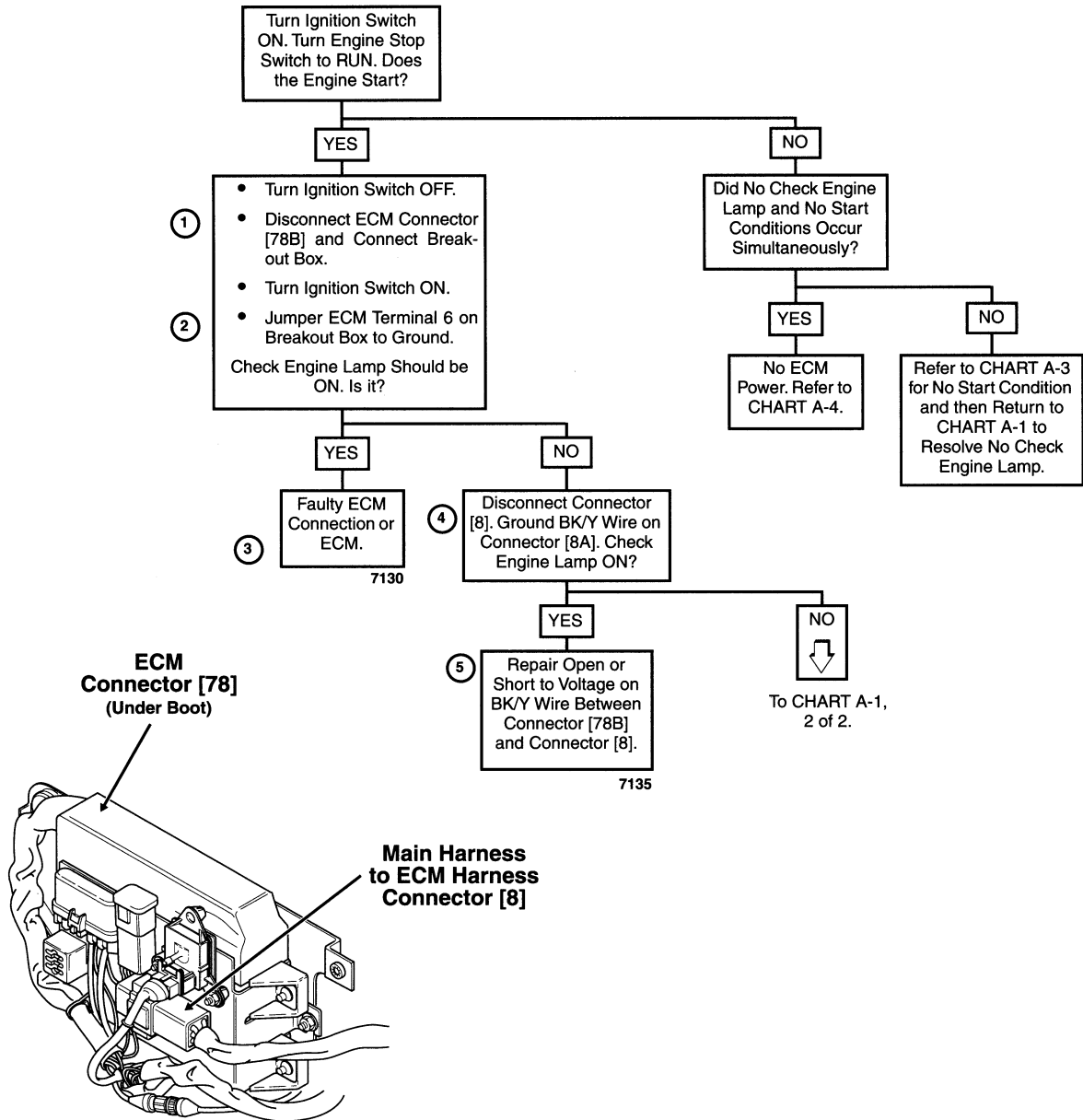


Figure C-14. Electrical Bracket Assembly

Wire Harness Connectors

No.	Description		Models	Type	Location
[1]	Main Harness to Interconnect		FLHTC/U-I	12 - Place Deutsch	Inner Fairing (Front of Right Fairing Bracket)
			FLTR-I	12 - Place Deutsch	Inner Fairing (Below Radio)
[8]	Main Harness to ECM Harness		All	8 - Place Deutsch	Under Right Side Cover
[20]	Main Harness to Console		FLHRC-I	12 - Place Multilock	Under Left Side Cover
[78]	ECM		All	35 - Place Amp	Under Right Side Cover
[108]	Interconnect to Tachometer		FLHTC/U-I	6 - Place Multilock	Inner Fairing (Above Radio)
	[108A, 108D]	Tachometer to Jumper Harness	FLTR-I	6 - Place Multilock	Instrument Nacelle (Under Bezel)
	[108C, 108B]	Jumper Harness to Interconnect		6 - Place Multilock	Inner Fairing (Below Radio)

Chart A-1, No Check Engine Lamp (2 of 2)

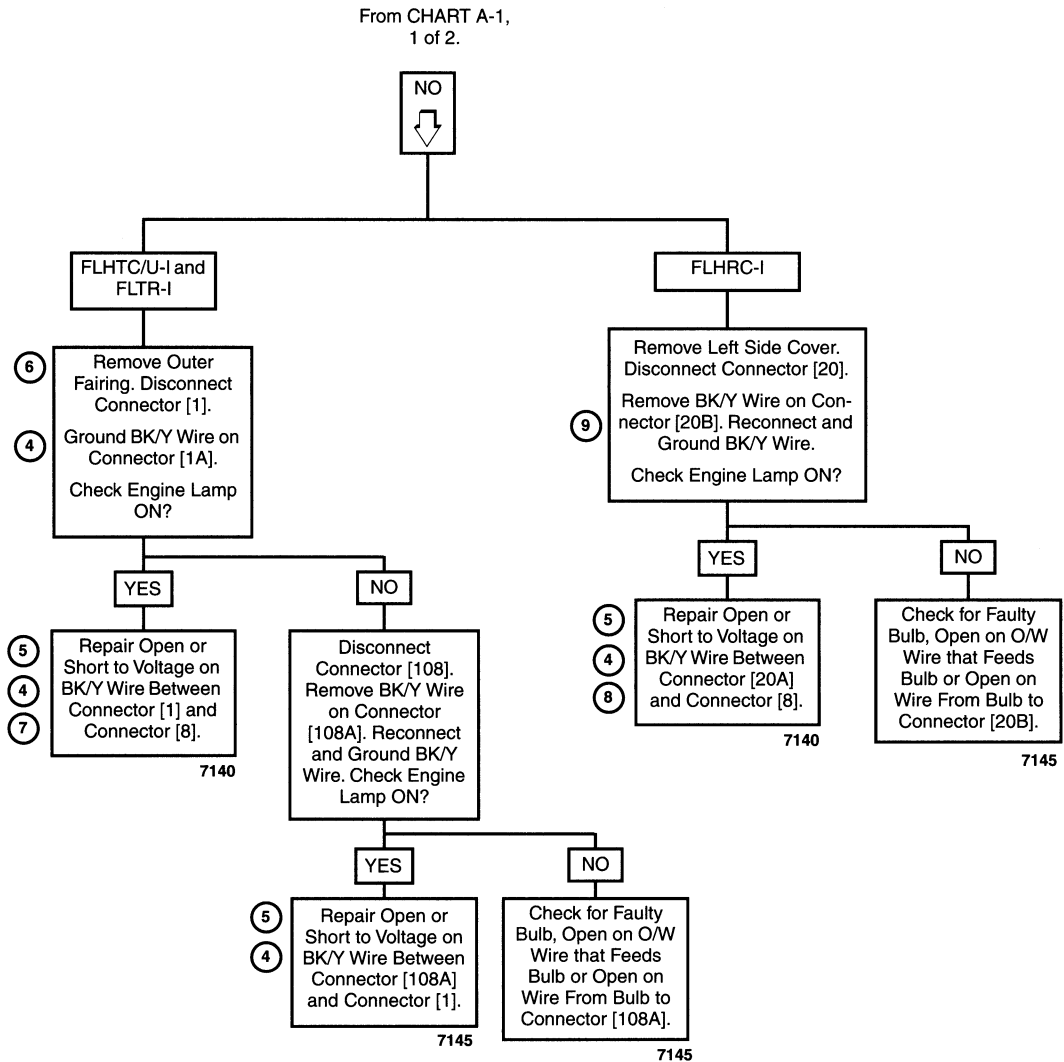


CHART A-2, CHECK ENGINE LAMP ON CONTINUOUSLY

The Check Engine Lamp should illuminate for 4 seconds when the Ignition Switch is turned to ON (with the Engine Stop Switch at RUN and the engine off). Following the initial period of illumination, the lamp should go off for 4 seconds. It may then come back on for an 8 second period (for a stored functional error) or remain on continuously (current error).

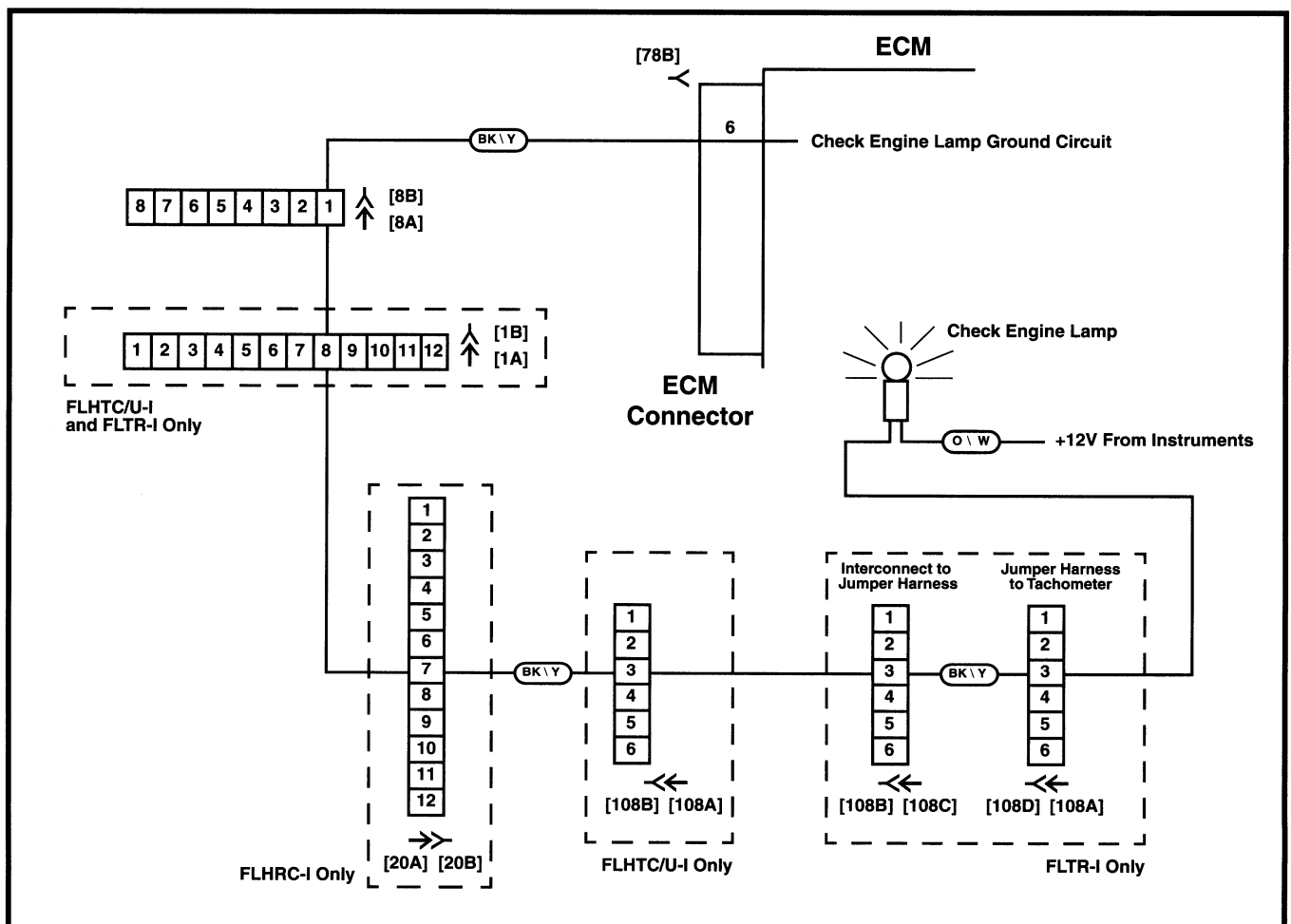
Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the ECM through the BK/Y wire. A steady light may indicate a short to ground on the BK/Y wire.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

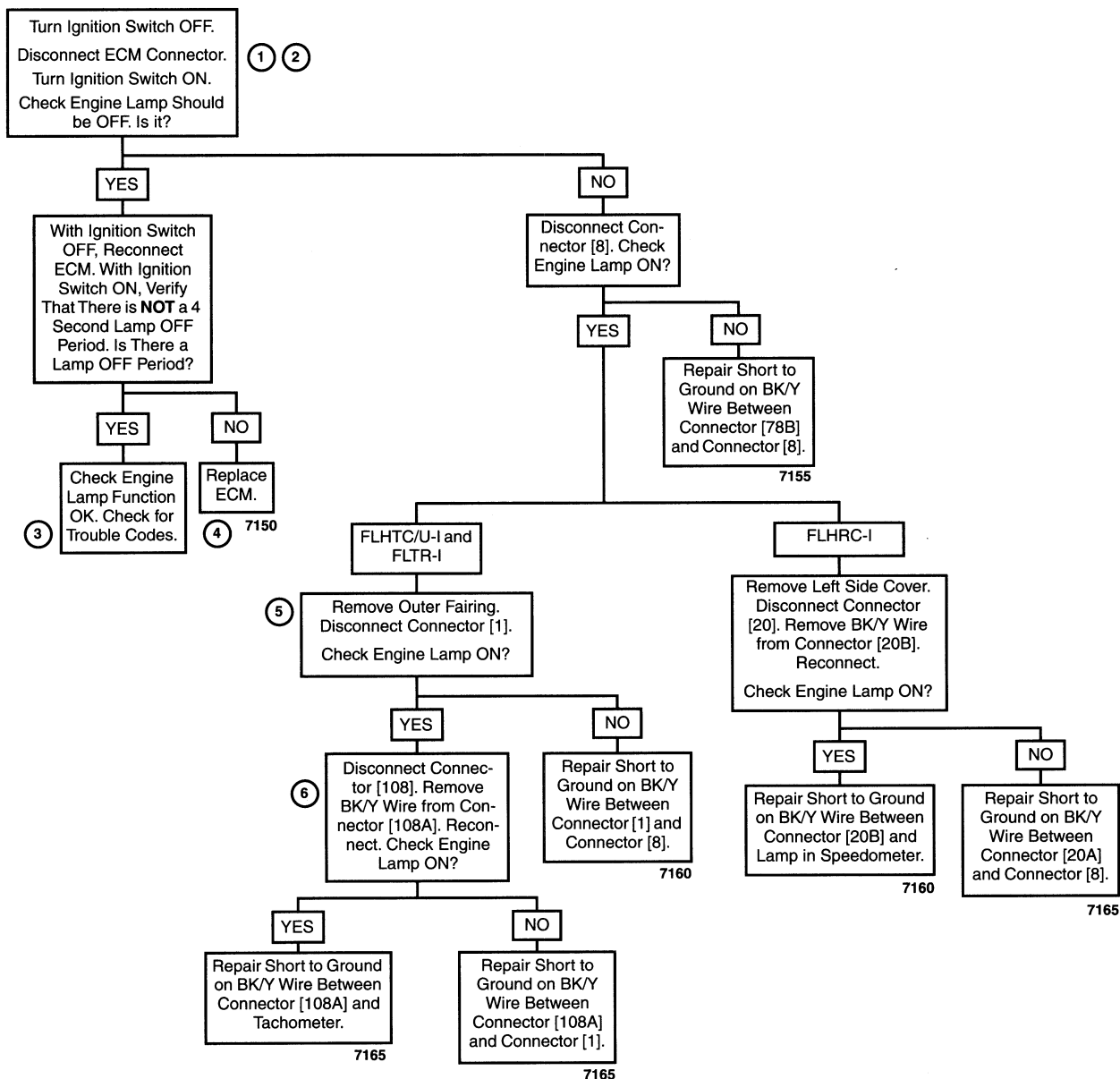
- ① See Electronic Control Module (ECM), Removal, page 9-77 of the 1998 FLT Service Manual.
- ② If the lamp goes off when ECM connector is unplugged, BK/Y wire is not shorted to ground.

- ③ See Retrieving Trouble Codes, page C-5.
- ④ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ⑤ Remove outer fairing on FLHTC/U-I and FLTR-I models. See Upper Fairing/Windshield, Outer Fairing, Removal, FLHT/C/U or FLTR, in Section 2 of the 1998 FLT Service Manual.
- ⑥ Use special pick (Snap-On Tool TT600-3) as described under Amp Multilock Electrical Connectors in Section D of this book.



Check Engine Lamp Circuit Diagram

Chart A-2, Check Engine Lamp On Continuously



Wire Harness Connectors

No.	Description		Models	Type	Location
[1]	Main Harness to Interconnect		FLHTC/U-I	12 - Place Deutsch	Inner Fairing (Front of Right Fairing Bracket)
			FLTR-I	12 - Place Deutsch	Inner Fairing (Below Radio)
[8]	Main Harness to ECM Harness		All	8 - Place Deutsch	Under Right Side Cover
[20]	Main Harness to Console		FLHRC-I	12 - Place Multilock	Under Left Side Cover
[78]	ECM		All	35 - Place Amp	Under Right Side Cover
[108]	Interconnect to Tachometer		FLHTC/U-I	6 - Place Multilock	Inner Fairing (Above Radio)
	[108A, 108D]	Tachometer to Jumper Harness	FLTR-I	6 - Place Multilock	Instrument Nacelle (Under Bezel)
	[108C, 108B]	Jumper Harness to Interconnect		6 - Place Multilock	Inner Fairing (Below Radio)

CHART A-3, ENGINE CRANKS BUT WILL NOT START

GENERAL

NOTE

If starter will not crank engine, the problem is **not** EFI related. Refer to Section 5 of the Service Manual, Electric Starter.

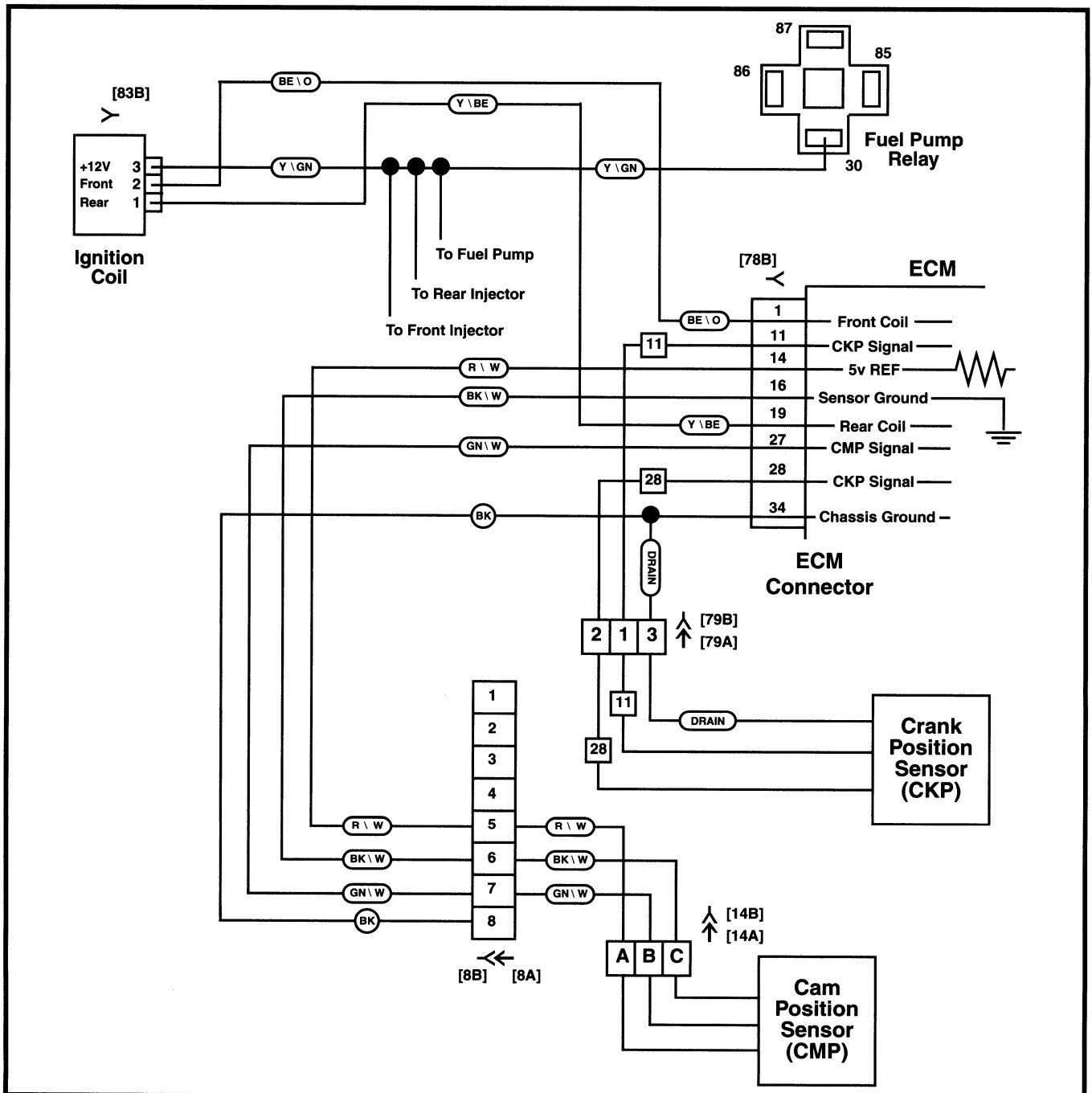
NOTE

Engine will not start if Diagnostics Test Lamp is installed or if Receive Data Line is grounded. Ignition/Light Key Switch must be turned to OFF for 10 seconds after test lamp is removed.

DIAGNOSTIC NOTES

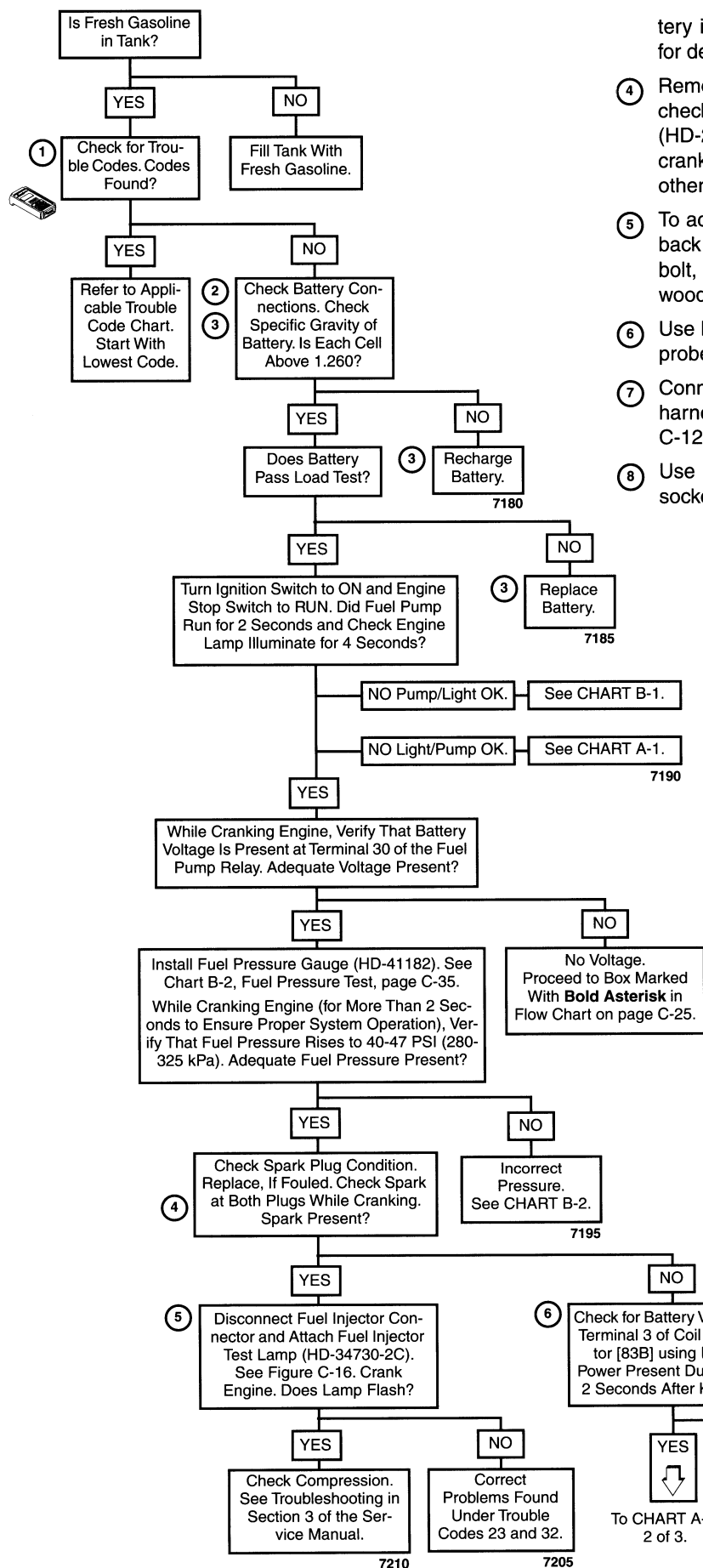
The reference numbers below correlate with those on the diagnostic flow chart.

- ① See Retrieving Trouble Codes, page C-5.
- ② See Seat, Removal in Section 2 of the 1998 FLT Service Manual.
- ③ Check the condition of the battery. Perform a hydrometer test and recharge if any cell is below 1.240. Check battery connections and perform load test. Replace the bat-



Circuit Diagram

Chart A-3, Engine Cranks But Will Not Start (1 of 3)



tery if necessary. See Section 8 of the Service Manual for detailed information.

- ④ Remove spark plug cable from spark plug. Visually check condition of plug. Attach cable to Spark Tester (HD-26792). Clip tester to cylinder head bolt. While cranking engine, look for spark. Repeat procedure on other spark plug cable.
- ⑤ To access fuel injector connectors, remove two bolts on back tab of fuel tank, loosen fuel tank front mounting bolt, cut cable straps and elevate tank slightly with wooden blocks.
- ⑥ Use Harness Connector Test Kit (HD-41404), purple pin probe and patch cord.
- ⑦ Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ⑧ Use Harness Connector Test Kit (HD-41404), brown socket probes and patch cords.

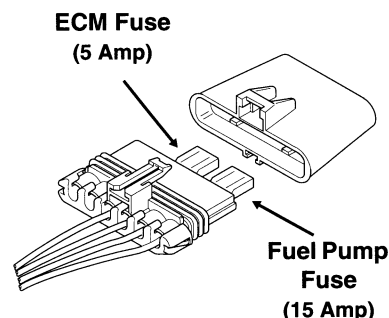


Figure C-15. Fuse Holder

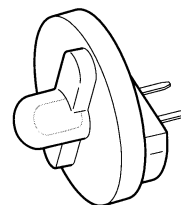


Figure C-16. Fuel Injector Test Lamp (HD-34730-2C)

Chart A-3, Engine Cranks But Will Not Start (2 of 3)

From CHART A-3,
1 of 3.



Install Coil Test Lamp
(HD-41402). See Figure
C-17. Do Coil Test
Lights Flash While
Cranking Engine?

YES

Faulty Coil Connection, Spark Plug
Wires or Coil.

Proceed as follows:

- Check Coil Connections.
- Test Spark Plug Cable Resistance. See Chart C-2, Spark Plug Cable Resistance Test, page C-40.
- Check Coil by Substituting One Known To Be Good

OR

Check Coil Resistance. See
Troubleshooting, page C-57.

7220

7
6

Measure Resistance Between
Ignition Coil Terminal 2 [83B] and
ECM Pin 1 on Breakout Box, and
Between Ignition Coil Terminal 1
[83B] and ECM Pin 19 on Break-
out Box. Resistance Should be
Less than 0.5 Ohm. Is it?

YES

*

No Input Signals from Crank
Position Sensor or Cam
Position Sensor.

Check Connectors for Mois-
ture and Corrosion. Check
Wires for Chafing.

Connect DVOM to ECM Pins
11 and 28 on Breakout Box
and Set It for AC Volts. Crank
Engine. Meter Should Read 1
VAC Minimum. Does it?

YES

To CHART A-3,
3 of 3.

NO

8

Disconnect Connector
[79] and Repeat
Test on Terminals 1
and 2 on Connector
[79A]. Meter Should
Read 1 VAC
Minimum. Does It?

YES

9

Replace Crank
Position Harness
Connector
(Connector Kit
No. 72351-95).

7230

NO

With Meter Still
Connected, Check
for Resistance.
Should be Between
510-850 Ohms. Is
it?

YES

Loose
Sensor at
Crankcase.

7235

NO

Replace
Crank
Position
Sensor.

7230

Fuse
Holder

ECM
Connector [78]
(Under Boot)

CKP Sensor
Connector [79]

ECM
(Under Electrical Bracket)

Figure C-18. Electrical Bracket Assembly

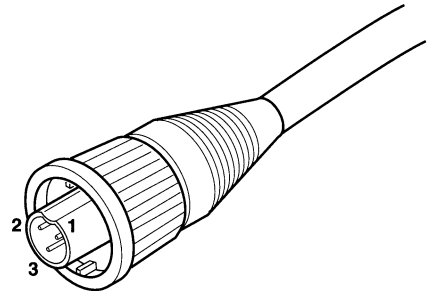


Figure C-19. CKP Sensor
Connector [79A]

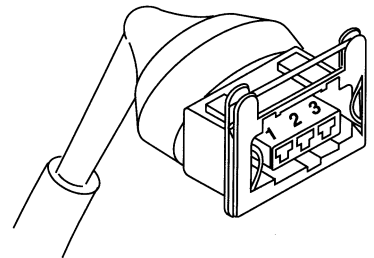


Figure C-20. Ignition Coil
Connector [83B]

*

At some point in the flow chart you may
be instructed to jump directly to the box
marked by an asterisk. Disregard the
asterisk (but not the instruction box) if
your normal progression through the
chart brings you to this location.

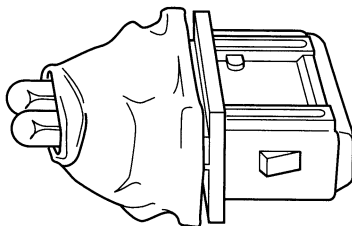


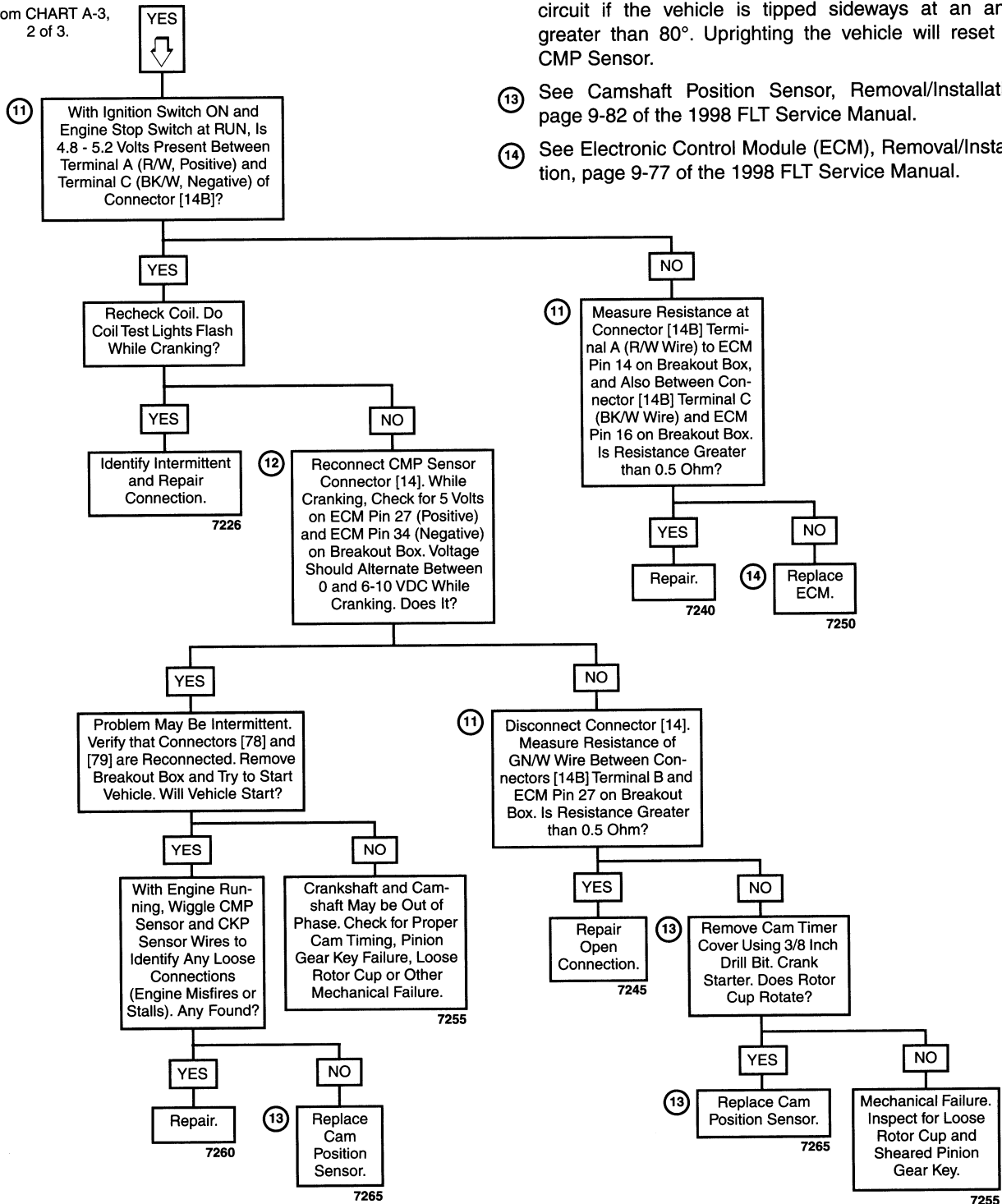
Figure C-17. Ignition Coil Test Lamp
(HD-41402)

Wire Harness Connectors

No.	Description	Type	Location
[14]	CMP Sensor	3 - Place Deutsch	Bottom Frame Cross Member (Right Side)
[78]	ECM	35 - Place Amp	Under Right Side Cover
[79]	CKP Sensor	3 - Place Conxall	Under Right Side Cover Below Electrical Bracket
[83]	Ignition Coil	3 - Place Amp	Below Fuel Tank

Chart A-3, Engine Cranks But Will Not Start (3 of 3)

From CHART A-3,
2 of 3.



- 9 See Crankshaft Position Sensor Harness Connector, Replacement, page 9-87 of the 1998 FLT Service Manual.
- 10 See Crankshaft Position Sensor, Removal/Installation, page 9-85 of the 1998 FLT Service Manual.
- 11 Use Harness Connector Test Kit (HD-41404), black pin probes and patch cords.
- 12 In a no spark situation, the Camshaft Position Sensor (CMP Sensor) may be at fault. The CMP Sensor incorporates a Vehicle Attitude Sensor, which opens the CMP circuit if the vehicle is tipped sideways at an angle greater than 80°. Uprighting the vehicle will reset the CMP Sensor.
- 13 See Camshaft Position Sensor, Removal/Installation, page 9-82 of the 1998 FLT Service Manual.
- 14 See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.

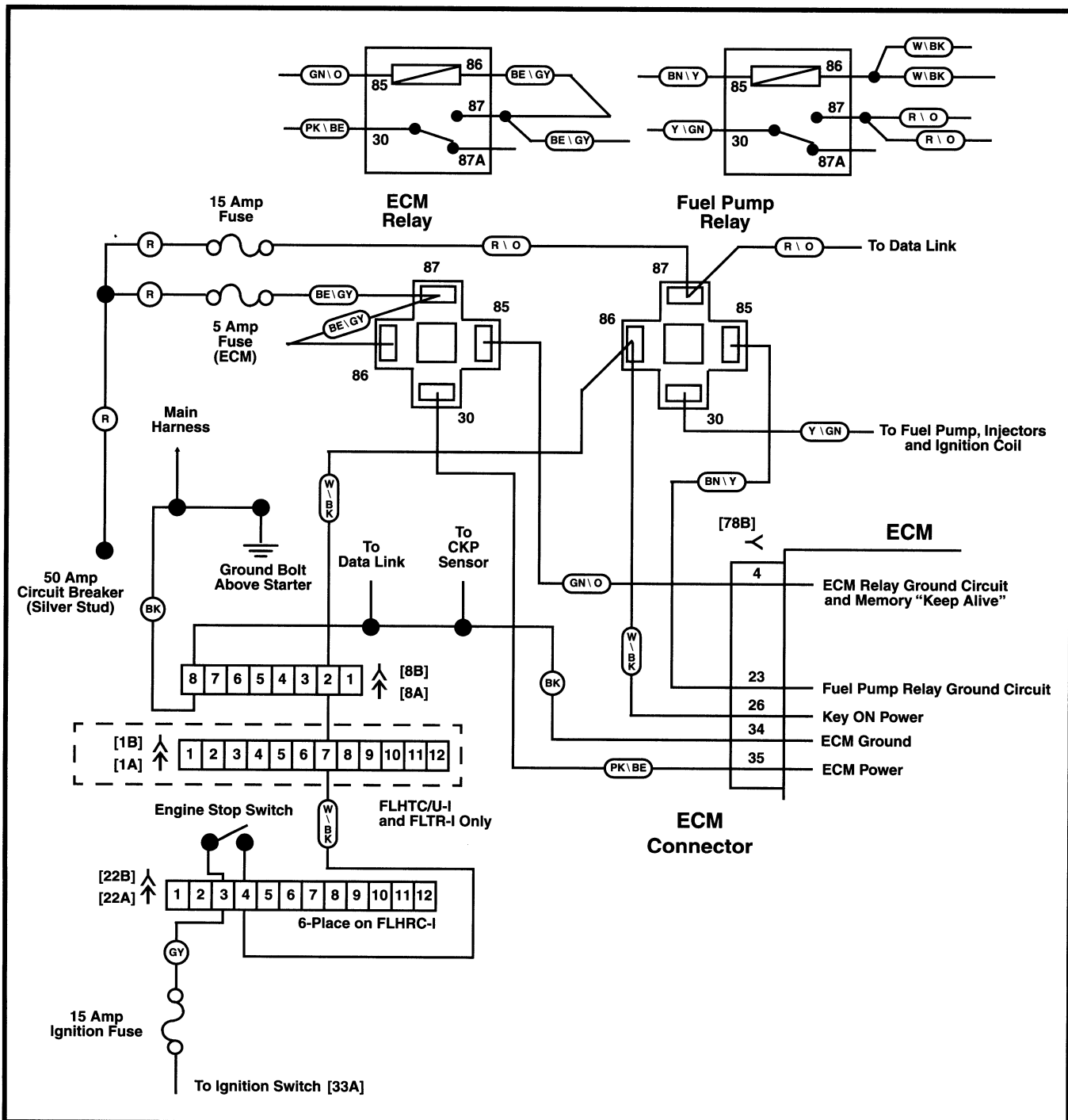
CHART A-4, NO ECM POWER

The ECM relay is turned on by grounding terminal 4 inside the ECM. This is done when the ECM sees power at terminal 26. When the Ignition Switch is turned OFF, the ECM keeps the relay latched on for approximately 10 seconds so that the ECM can reset the ISC actuator for the next start sequence. Also, to provide power for ECM RAM, the ECM relay continuously provides a small amount of current to the ECM whenever the Ignition Switch is turned OFF.

DIAGNOSTIC NOTES

The reference numbers which follow correlate with those on the diagnostic flow chart.

- ① See Fuses, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.
- ② Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ③ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.



No ECM Power Circuit Diagram

NOTE

With one exception (noted in flow chart), always turn Key ON with Engine Stop Switch at RUN prior to probing terminals with test lamp.

Chart A-4, No ECM Power (1 of 2)

- ④ See Side Cover Removal, page 9-75 of the 1998 FLT Service Manual, steps 3-4.
- ⑤ See Electrical Relays, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.
- ⑥ Remove outer fairing on FLHTC/U-I and FLTR-I models. See Upper Fairing/Windshield, Outer Fairing, Removal, FLHTC/U or FLTR, in Section 2 of the 1998 FLT Service Manual.

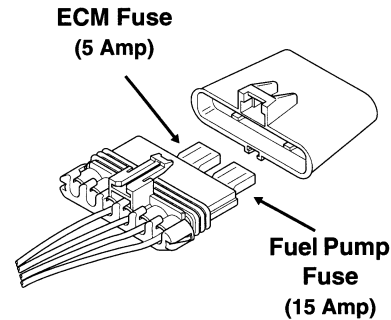
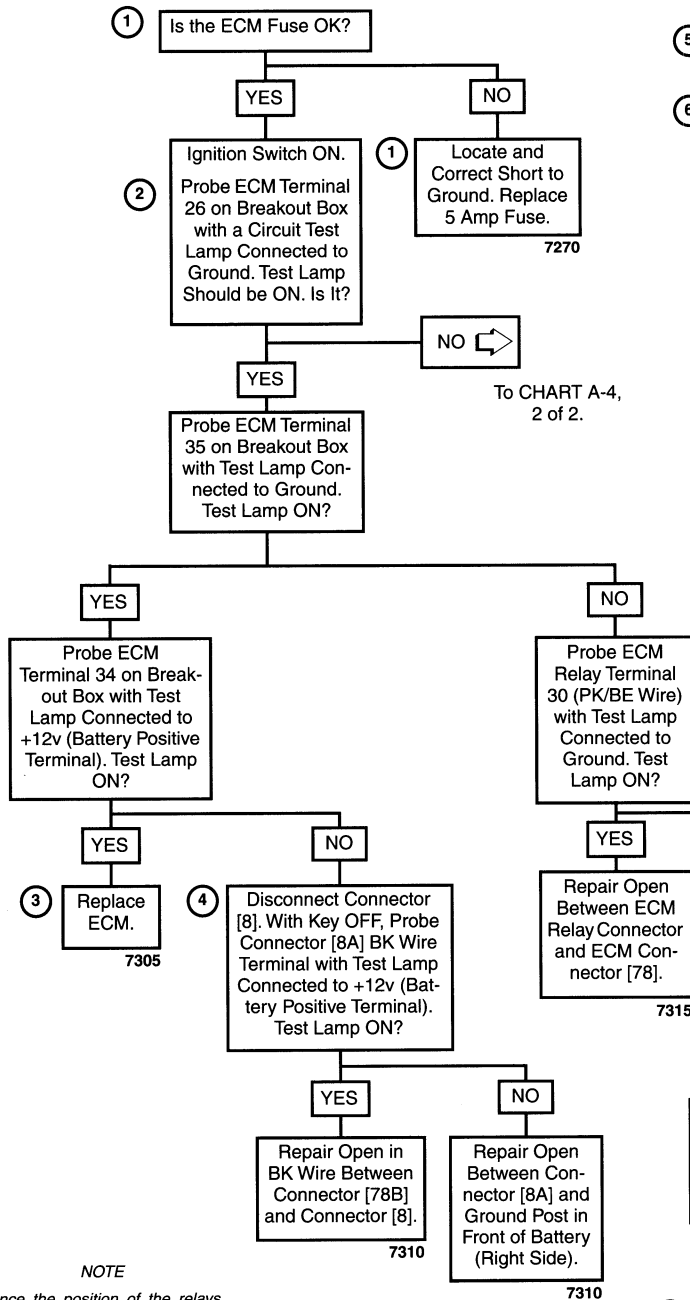


Figure C-21. Fuse Holder

NOTE

Since the position of the relays may be reversed, check the wire tags for positive identification.

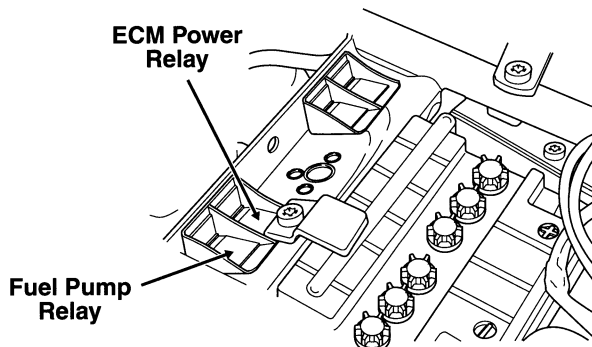
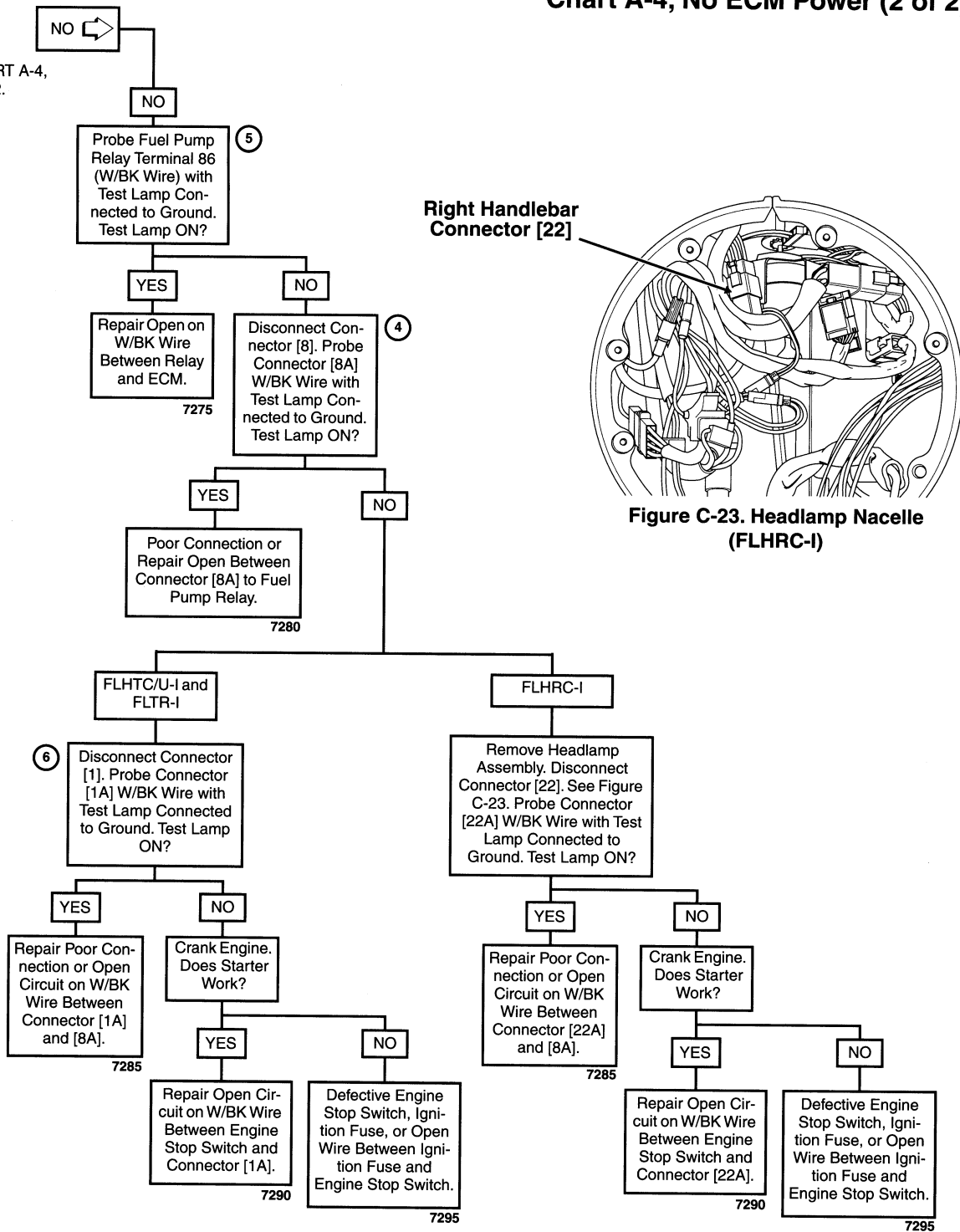


Figure C-22. Electrical Relays (Under Seat)

Chart A-4, No ECM Power (2 of 2)

From CHART A-4,
1 of 2.



Wire Harness Connectors

No.	Description	Models	Type	Location
[1]	Main Harness to Interconnect	FLHTC/U-I	12 - Place Deutsch	Inner Fairing (Front of Right Fairing Bracket)
		FLTR-I	12 - Place Deutsch	Inner Fairing (Below Radio)
[8]	Main Harness to ECM Harness	All	8 - Place Deutsch	Under Right Side Cover
[22]	Interconnect to Right Handlebar	FLHRC-I	6 - Place Deutsch	Inside Headlamp Nacelle
[78]	ECM	All	35 - Place Amp	Under Right Side Cover

CHART B-1, FUEL SYSTEM ELECTRICAL TEST

With the Ignition Switch ON (and the Engine Stop Switch at RUN), the ECM will energize the fuel pump relay to complete the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses. If there are no reference pulses, the ECM will de-energize the fuel pump relay within 2 seconds after ignition is on, or immediately after the engine is stopped.

The fuel pump delivers fuel to the induction module and injectors and then to the pressure regulator, where the system pressure is controlled. Excess fuel flow is bypassed back to the fuel tank. When the engine is stopped, the pump can be turned on by applying battery voltage to the fuel pump connector [86A] or by using the Scanalyzer (see Scanalyzer Notes). The fuel pump connector is located under the seat at the rear of the fuel tank. See Figure C-24. Improper fuel system pressure may contribute to one or all of the following symptoms.

- Engine cranks, but won't run.
- Engine cuts out (may feel like ignition problems).
- Hesitation, loss of power and poor fuel economy.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

- ① See Fuses, Removal, page 9-76 of the 1998 FLT Service Manual. If a fuse is blown, a short to ground is present between the fuse and fuel pump relay, between the fuel pump relay and fuel pump, coil or injectors, or the fuel pump itself may be the cause.
- ② Locate fuel pump connector and separate pin and socket halves. See Figure C-24. Perform test to determine if the fuel pump circuit is being controlled by the ECM. ECM should energize fuel pump relay. Since engine is not cranking or running, ECM should de-energize relay within 2 seconds after ignition is turned on.
- ③ Turns on fuel pump if wiring is OK. If pump runs, problem is in basic fuel delivery.
- ④ See Fuel Pump, Removal/Installation, page 9-98 of the 1998 FLT Service Manual.
- ⑤ This test will determine if short to ground on fuel pump relay circuit caused the fuse to blow. To prevent misdiagnosis, ensure that fuel pump is disconnected before proceeding with test.
- ⑥ See Electrical Relays, Removal, page 9-76 of the 1998 FLT Service Manual. This test checks for a short to ground in the fuel pump relay harness circuit.
- ⑦ See Fuel Injectors, Removal/Installation, page 9-113 or Ignition Coil, Removal/Installation, page 9-120 of the 1998 FLT Service Manual.
- ⑧ See Console Pod/Canopy, Removal, page 9-96 of the 1998 FLT Service Manual, steps 5-9.

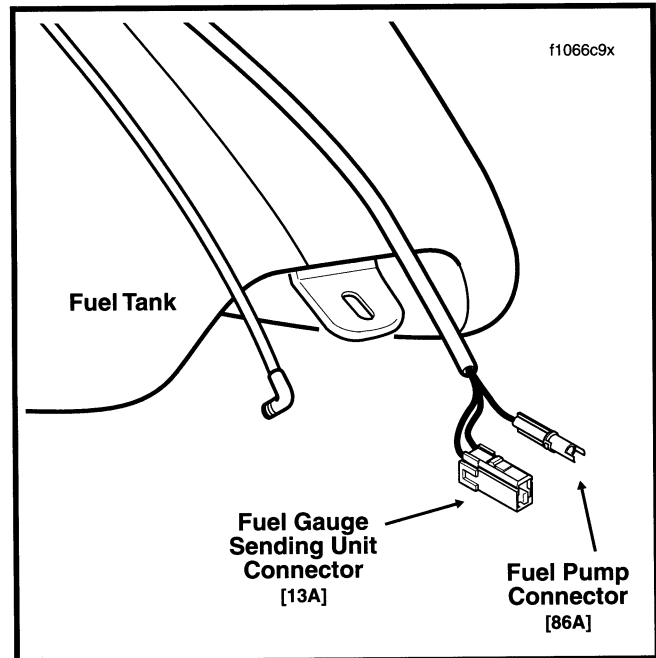


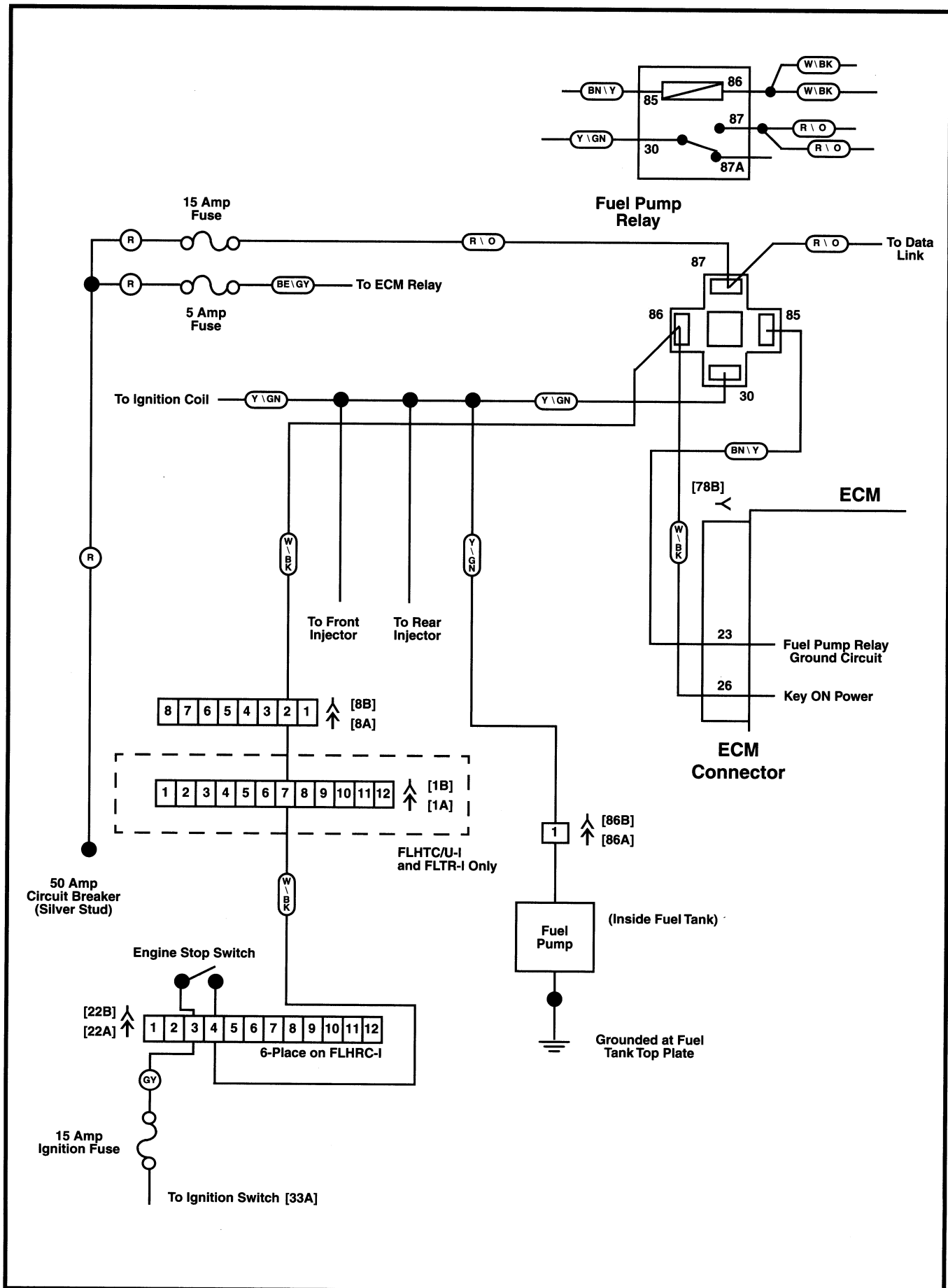
Figure C-24. Fuel Pump Connector (FLHTC/U-I)

SCANALYZER NOTES

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow.



With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds.



Fuel Pump Circuit Diagram

Chart B-1, Fuel System Electrical Test (1 of 3)

Wire Harness Connectors

No.	Description	Type	Location
[13]	Fuel Gauge Sending Unit	2 - Place Multilock	Under Seat
[86]	Fuel Pump	1 - Place Amp	Under Seat

ECM Fuse (5 Amp)

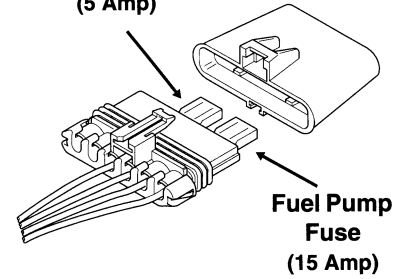


Figure C-25. Fuse Holder

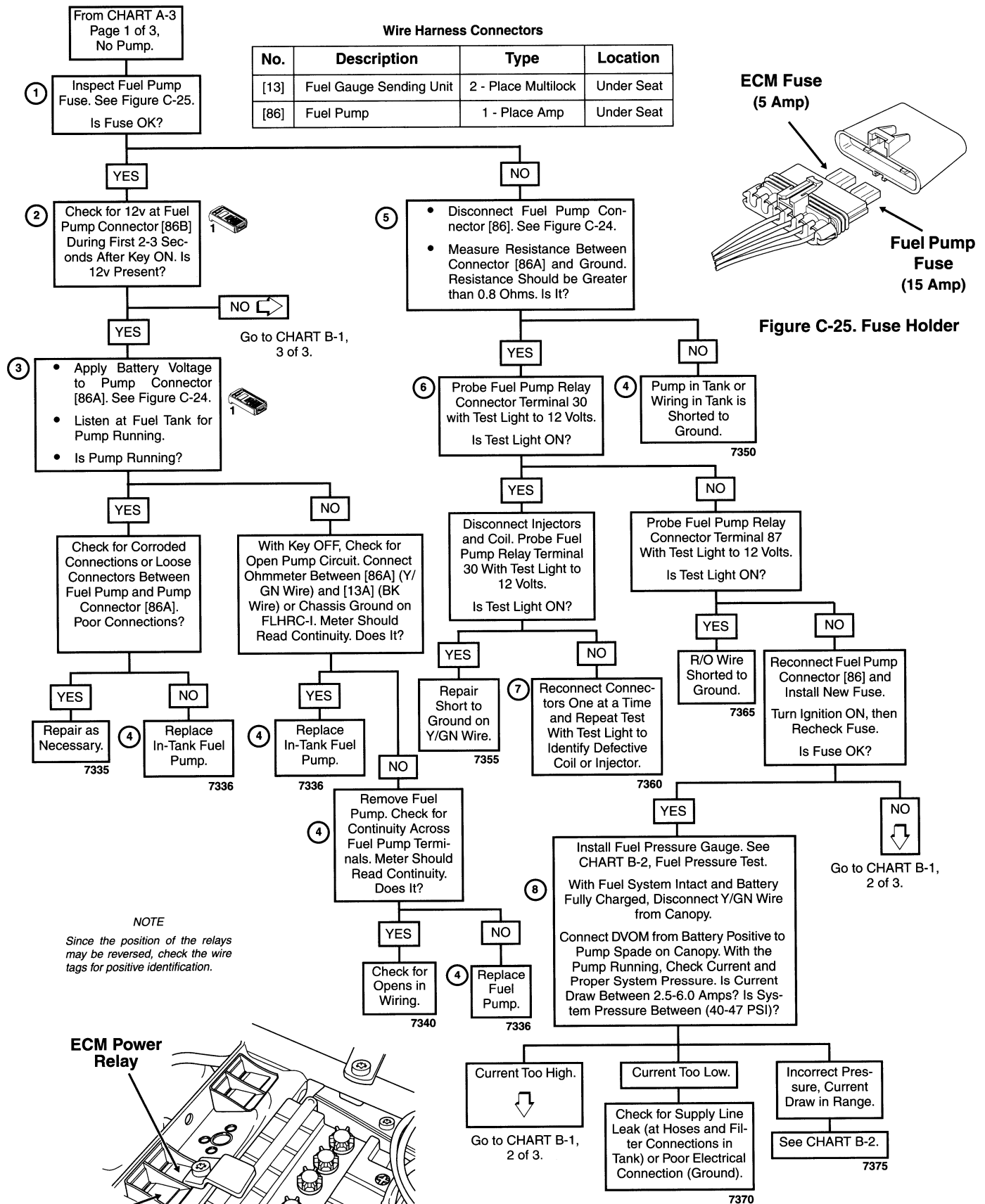


Figure C-26. Electrical Relays (Under Seat)

Chart B-1, Fuel System Electrical Test (2 of 3)

DIAGNOSTIC NOTES (CONT'D)

The reference numbers below correlate with those on the diagnostic flow chart.

- ⑨ See Fuel Supply/Return Check Valves, Removal/Installation, page 9-100 of the 1998 FLT Service Manual.
- ⑩ See Fuel Supply/Return Lines, Removal/Installation, page 9-111 of the 1998 FLT Service Manual.
- ⑪ See Induction Module, Removal/Installation, page 9-109 of the 1998 FLT Service Manual. Removal, cleaning and installation not included under condition code 7410.

From CHART B-1,
1 of 3.

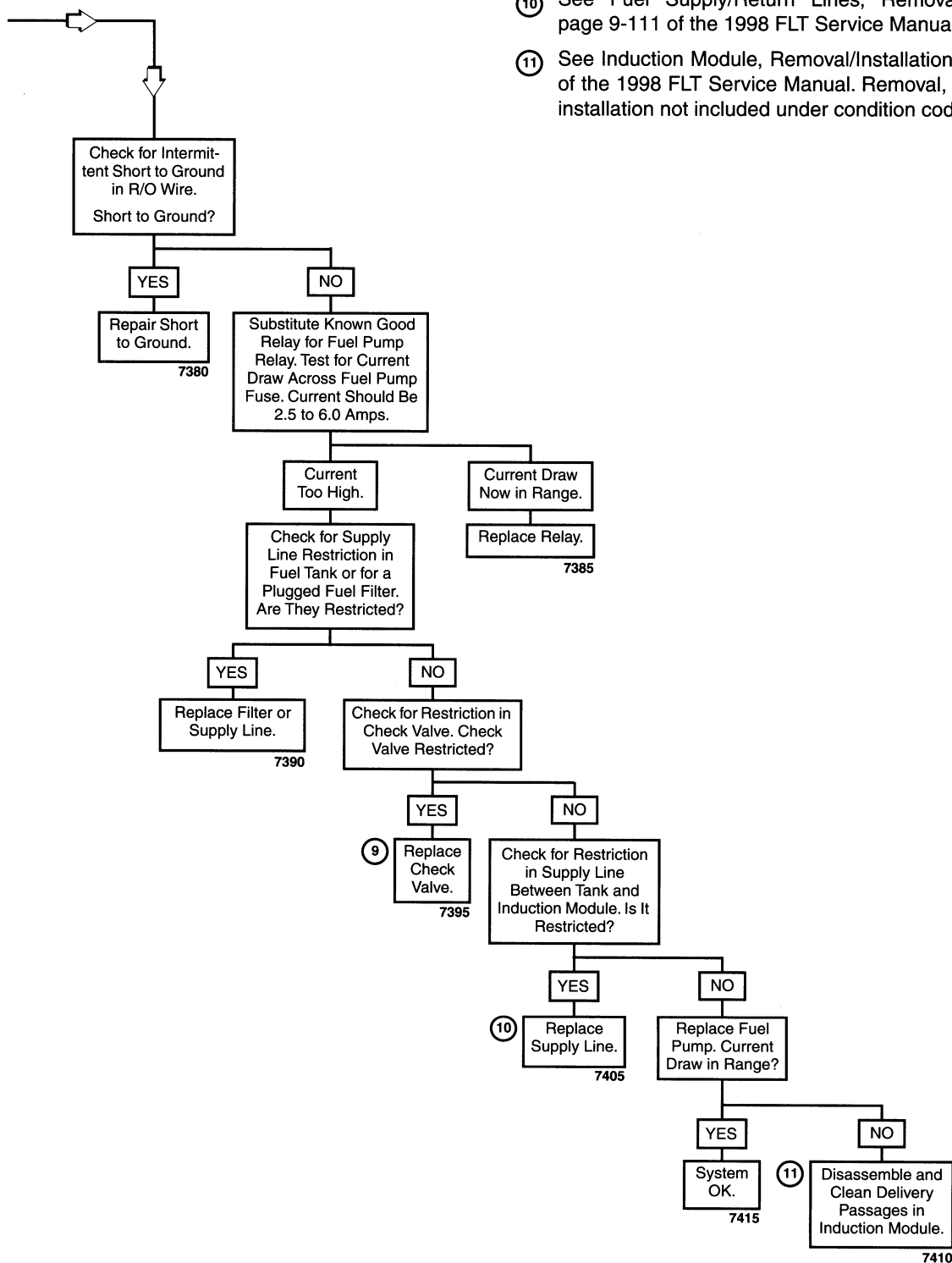


Chart B-1, Fuel System Electrical Test (3 of 3)

DIAGNOSTIC NOTES (CONT.'D)

When the Ignition Switch is turned ON, the ECM will energize the fuel pump relay, which completes the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving crank position sensor and cam position sensor inputs. If there are no input signals, the ECM will de-energize the fuel pump relay within 2 seconds after ignition is on, or the engine is stopped.

! WARNING


To reduce the risk of vehicle fire and/or personal injury, always relieve fuel system pressure before servicing any fuel system components.

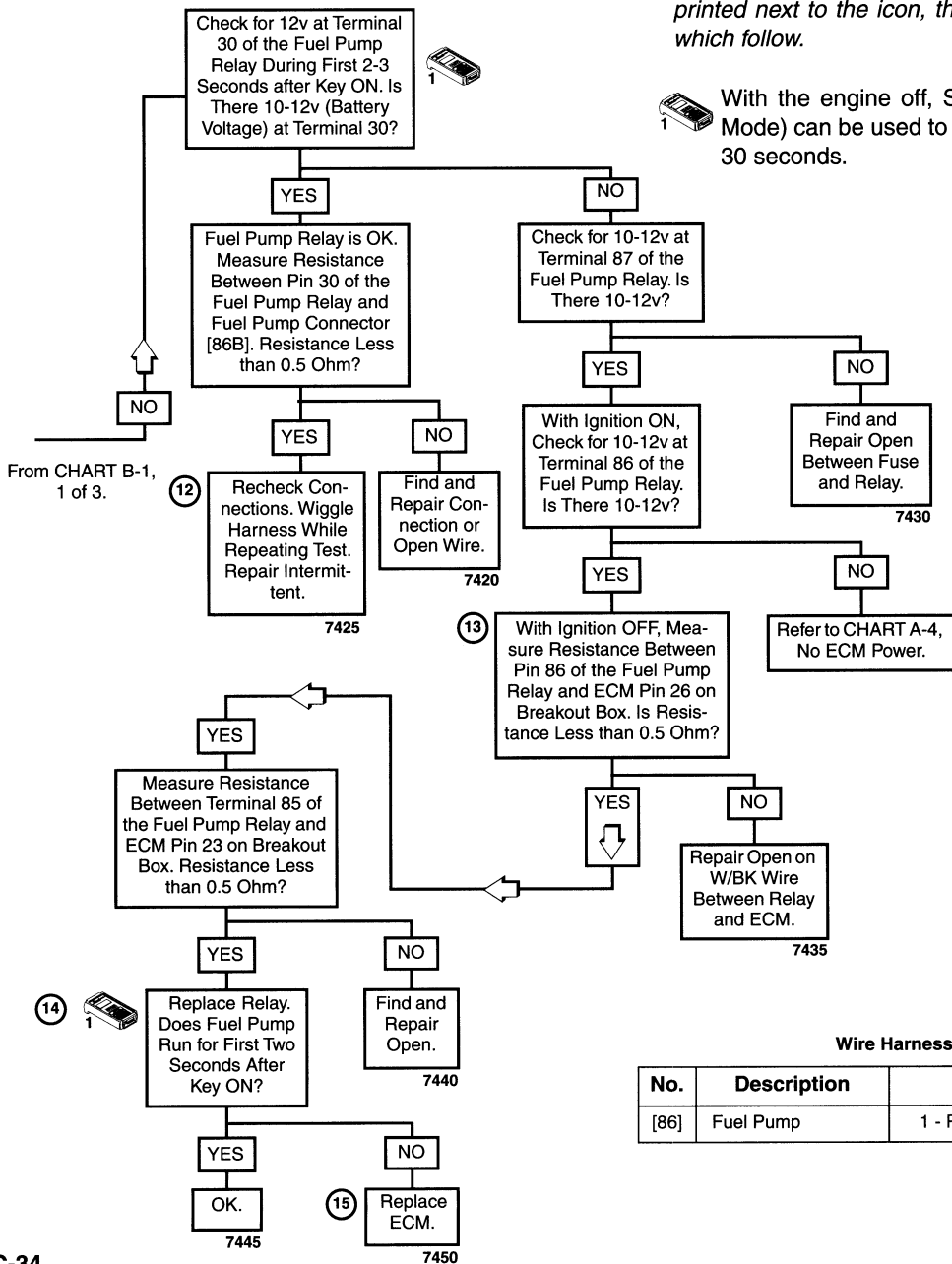
The reference numbers below correlate with those on the diagnostic flow chart.

- ⑫ Shake or wiggle harness between fuel pump relay and fuel pump connector [86B] while measuring resistance to detect intermittents.
- ⑬ Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ⑭ See Electrical Relays, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.
- ⑮ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.

SCANALYZER NOTES

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow.

 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds.



Wire Harness Connectors

No.	Description	Type	Location
[86]	Fuel Pump	1 - Place Amp	Under Seat

CHART B-2, FUEL PRESSURE TEST

GENERAL

The fuel pump delivers fuel to the fuel line, to a cavity in the induction module that supplies the fuel injectors and to the pressure regulator, where the system pressure is controlled. Excess fuel pressure is bypassed back to the fuel tank through the return line. The fuel pump wire harness connector [86] is located under the seat behind the fuel tank. See Figure C-27. The fuel pump can be turned on with the Scana-lyzer or by applying battery voltage to the connector [86].

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

Fuel Pressure Test

The fuel pressure gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis. A special adapter allows the gauge to be attached to the external fuel supply line. Check the fuel system pressure as follows:

1. Remove the seat. See SEAT, REMOVAL in Section 2 of the Service Manual.

⚠ WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (43.5 psi). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing the plug in the supply line fitting. Inadequate safety precautions may result in personal injury and/or property damage.

2. Purge the fuel supply line of high pressure gas as follows:

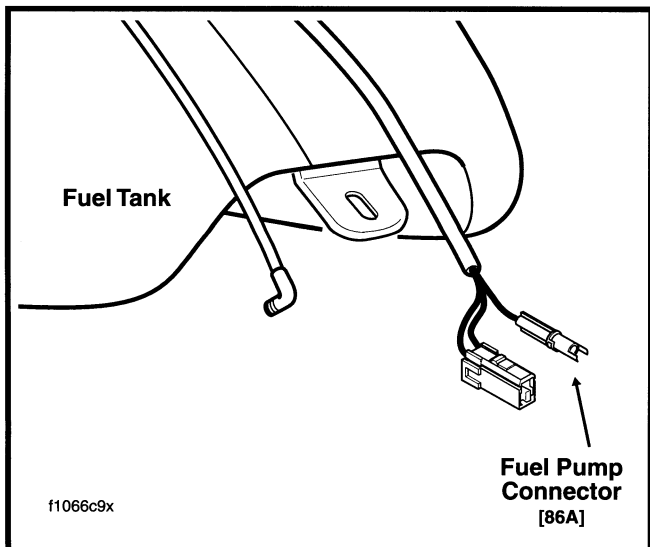


Figure C-27. Fuel Pump Connector (FLHTC/U-I Model Shown)

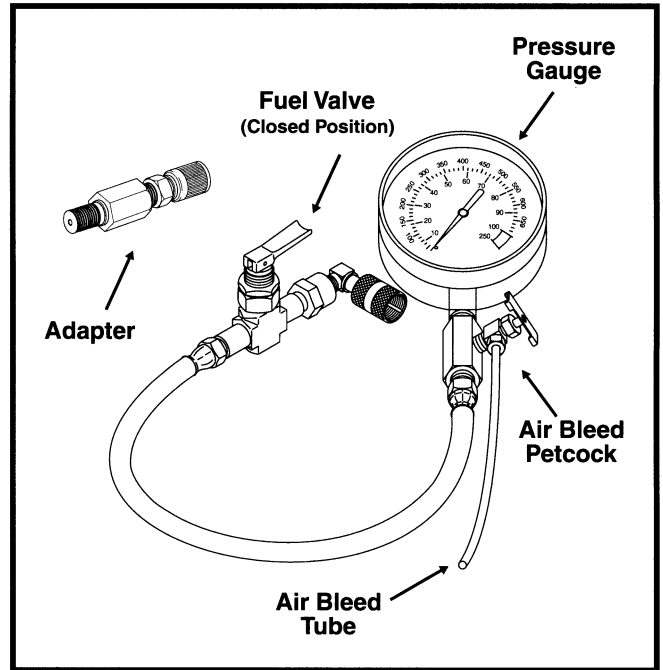


Figure C-28. Fuel Pressure Gauge (HD-41182) with Adapter (HD-41182-1)

- a. Disconnect the fuel pump connector [86] from the main wiring harness. Locate the black one-place electrical connector in front of the battery. Pull both external latches outward to separate pin and socket halves. See Figure C-27.
 - b. Start the engine and allow the vehicle to run.
 - c. When the engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines.
3. Wrap a shop towel around the fuel supply line fitting (left side of vehicle).

⚠ WARNING

A small amount of gasoline will drain from the fitting when the plug is removed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

4. Position a beaker below the fitting. Holding the hex on the fitting with an open end wrench, use a 5/32 inch allen wrench to remove the plug.
5. Thread the Fuel Pressure Gauge Adapter (HD-41182-1) into the fitting. See Figure C-28. Hold the hex on the fuel tank fitting while tightening the adapter.
6. Verify that the fuel valve and air bleed petcock on the Fuel Pressure Gauge (HD-41182) are closed.

⚠WARNING

A small amount of gasoline will drain from the adapter when the gauge is installed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Inadequate safety precautions may result in personal injury and/or property damage.

7. Remove the protective cap from the free end of the adapter. Thread the Fuel Pressure Gauge (HD-41182) onto the adapter.
8. Locate the one-place electrical connector [86] in front of the battery. Press the pin and socket halves together to connect the fuel pump to the main wiring harness.
9. Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge. See Figure C-28.
10. Position the clear tube in the beaker and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
11. Open throttle and rev engine. Note the reading of the pressure gauge. Fuel pressure should remain steady at 40-47 psi (280-325 kPa).
12. Turn the engine off. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.
13. Remove the pressure gauge from the adapter.

⚠WARNING

A small amount of gasoline will drain from the fitting when the adapter is removed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Inadequate safety precautions may result in personal injury and/or property damage.

14. Holding the hex on the fuel tank fitting with an open end wrench, remove the adapter.
15. Apply a small amount of Hylomar or Liquid Teflon Pipe Sealant on the threads of the allen plug and install.
16. Install the seat. See SEAT, INSTALLATION in Section 2 of the 1998 FLT Service Manual.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

- ① See Fuel Pressure Test on page C-35.
- ② The application of 12-14 inches Hg vacuum to the pressure regulator should result in reduced fuel pressure. To facilitate installation of the Vacuum Pump (HD-23738A), first install a 6 inch length of thin-wall vacuum line onto the atmospheric pressure port. See Figure C-29.
- ③ If regulator is faulty, see Fuel Pressure Regulator, Removal/Installation, page 9-113 of the 1998 FLT Service Manual.
- ④ If fuel system has pressure, but it is less than specification, condition may be caused by one of the following.
 - The amount of fuel to the injectors is OK, but pressure is too low. Also, hard starting cold and overall poor performance condition may exist.
 - Restricted fuel flow causing pressure drop. Normally, a vehicle with fuel pressure of less than 24 psi (170 kPa) at idle will not be driveable. However, if pressure drop occurs only while driving, engine may surge and lose power as pressure begins to drop rapidly.
- ⑤ See Fuel Filter Canister, Removal/Installation, page 9-99 of the 1998 FLT Service Manual.
- ⑥ See Fuel Pump, Removal/Installation, page 9-98 of the 1998 FLT Service Manual.
- ⑦ This condition may be identified when the fuel level is low and the fuel pump is turned on for the first two seconds after Key On. A metallic ringing sound can be heard as the high pressure fuel is sprayed against the inside wall of the fuel tank.
- ⑧ See Fuel Supply/Return Check Valves, Removal/Installation, page 9-100 of the 1998 FLT Service Manual.
- ⑨ See Fuel Supply/Return Lines, Removal/Installation, page 9-111 of the 1998 FLT Service Manual.

Chart B-2, Fuel Pressure Test

SCANALYZER NOTES

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow.

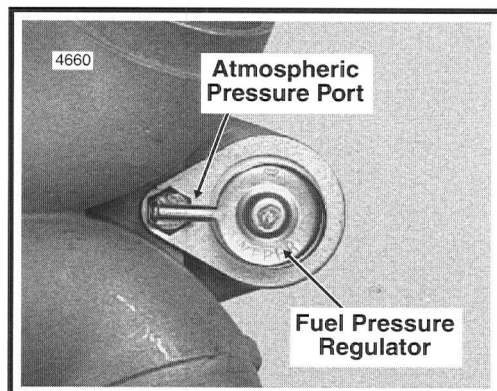
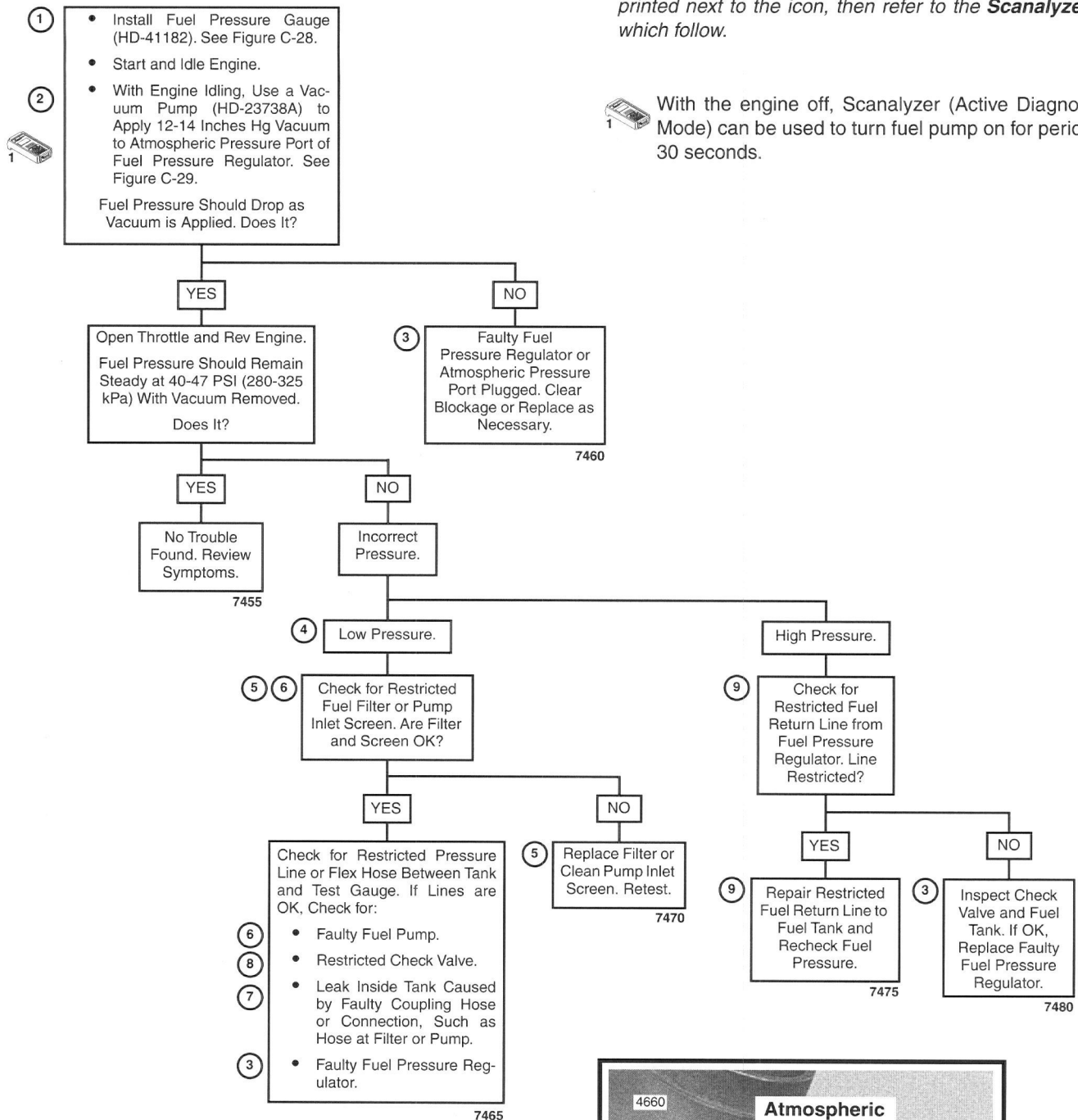


Figure C-29. Induction Module (Bottom View)

CHART C-1, IDLE SPEED CONTROL

NOTE

Warm idle speed is controlled by a set screw. See Warm-Slow Idle Speed Adjustment procedure under Section 9C-4, Air Cleaner Assembly.

The ECM will control cold engine idle speed by moving the idle speed control lever to open or close the throttle plate. It does this by sending voltage pulses to the proper motor winding of the ISC actuator. This will cause the actuator shaft to move in or out of the actuator a given distance for each pulse received. The ISC position is measured in counts. This can be monitored on the Data Monitor Display of the Scanalyzer. A high number of counts is a fully extended pintel (high air flow), zero counts is a fully retracted pintel (minimal airflow). To increase idle speed, the ECM will send a signal to extend the throttle lever and allow more air to flow through the manifold. This will increase the ISC counts. To decrease idle speed the ECM will send a signal to retract the throttle lever to reduce airflow through the manifold. This will reduce the ISC counts to zero once the vehicle warms up.

Each time the ignition is turned on and then the ignition is turned off, the ECM will reset the ISC actuator. This is done by sending enough pulses to retract the throttle lever to the warm-idle position (zero counts). The fully retracted value is the ECM reference zero. A given number of counts are then calculated by the ECM. This is how the ECM knows what the actuator position is for a given temperature to obtain a proper idle speed.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic chart.

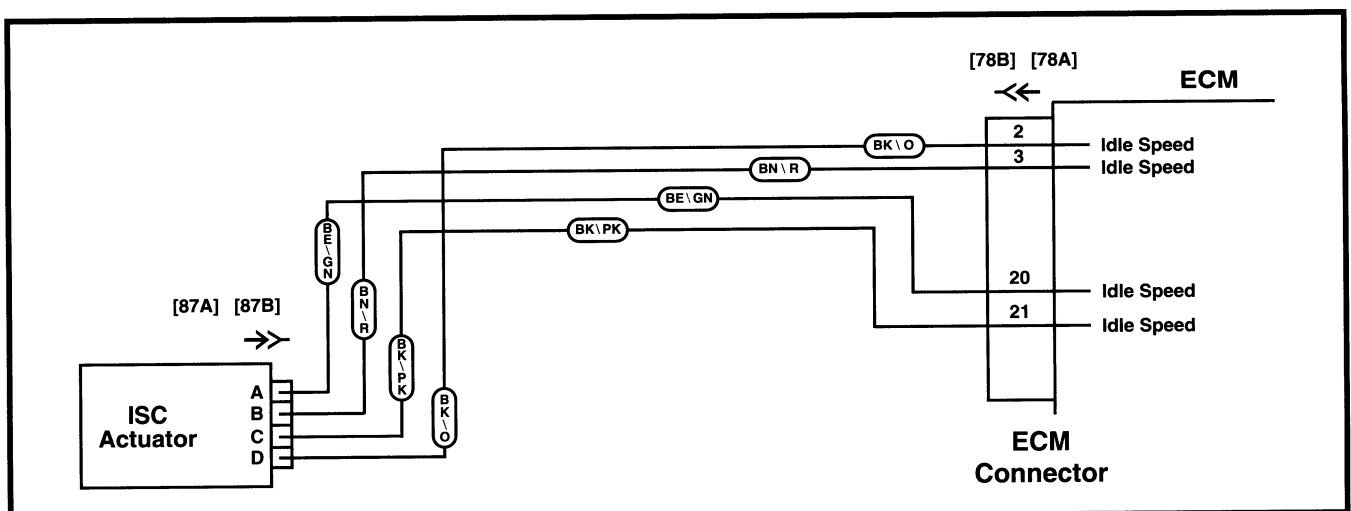
- ① See Air Cleaner, Removal, page 9-105 of the 1998 FLT Service Manual.
- ② When the engine is stopped, the ISC actuator retracts and then extends to a fixed "Park" position for increased airflow and idle speed during the next engine start sequence. This Key OFF reset procedure takes 8-10 seconds to perform.
- ③ See Warm-Slow and Cold Idle Speed Adjustment, pages 9-106 and 9-107 of the 1998 FLT Service Manual.

- ④ At Key On, test lights will alternately flash and then remain steady on to confirm ECM signals. At Key Off, lights alternately flash and go out.
- ⑤ Connect Breakout Box (HD-41198) to EFI wire harness **only** (leave ECM disconnected). See Breakout Box Installation, page C-12.
- ⑥ Use Harness Connector Test Kit (HD-41404), gray pin probe and patch cord.
- ⑦ Turn the Ignition ON and then OFF while placing a finger on the relay. An audible click will be heard or a sensation felt when the relay shuts off.
- ⑧ Repair faulty ECM connection or replace ECM. If ECM requires replacement, see Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ⑨ There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition on. Probe terminals to check for this condition.
- ⑩ Repair faulty connection or replace ISC actuator. If actuator requires replacement, see Idle Speed Control Actuator, Removal/Installation, page 9-116 of the 1998 FLT Service Manual.

DIAGNOSTIC TIPS

Engine idle speed can be adversely affected by the following:

- Leaking injectors will cause fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. (To check for leaky injectors, first remove the air cleaner. See Air Cleaner, Removal, page 9-105 of the 1998 FLT Service Manual. Then, with the throttle wide open, turn Key ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See Fuel Injectors, Removal/Installation, page 9-113 of the 1998 FLT Service Manual.)
- Vacuum leaks can affect idle. (To check for vacuum leaks, spray water around the Induction Module seals while idling the engine. If RPM changes, replace seals.)
- Contaminated fuel can adversely affect idle.



Circuit Diagram

Chart C-1, Idle Speed Control

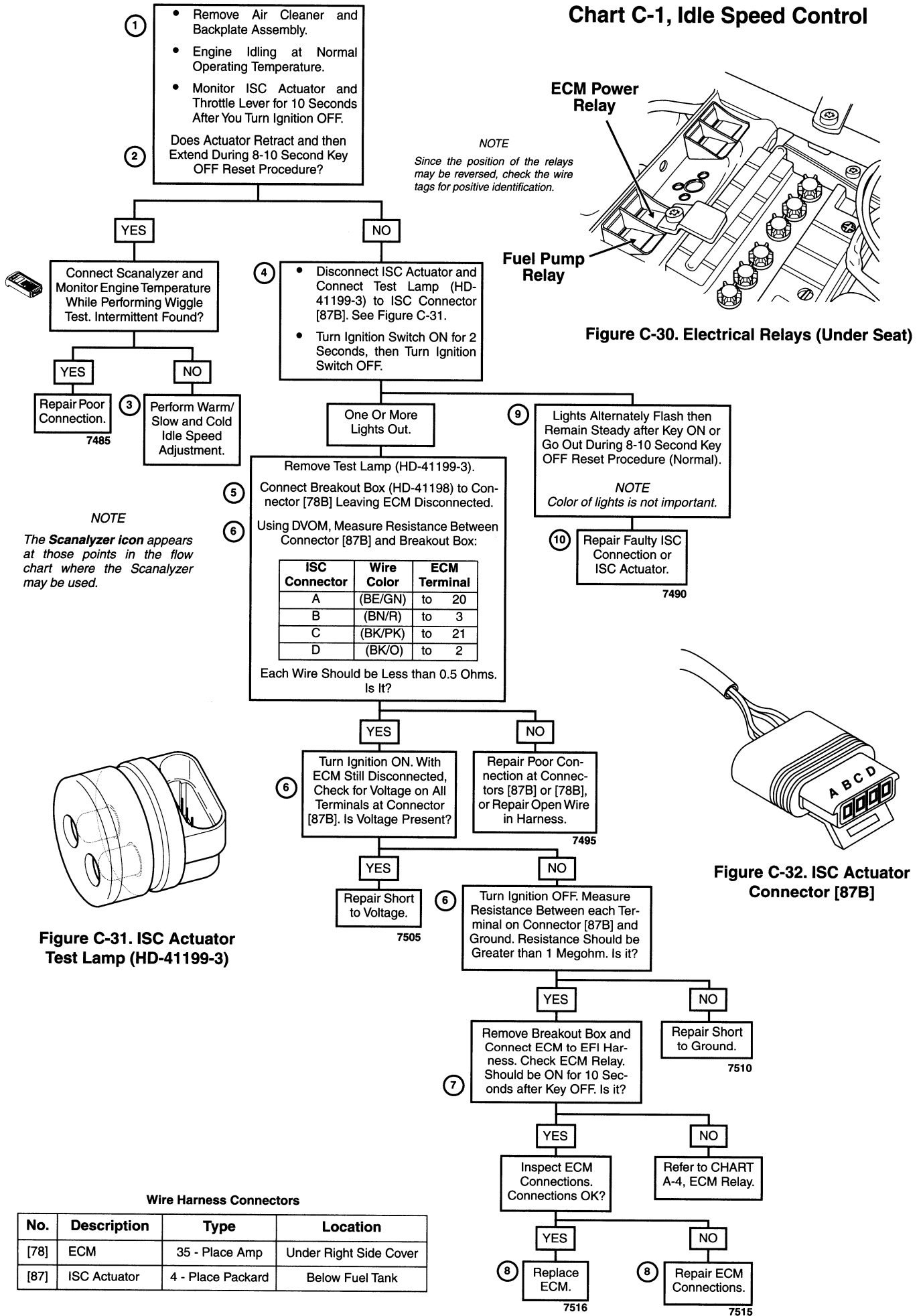


CHART C-2, MISFIRE AT IDLE OR UNDER LOAD

GENERAL

Battery condition and connections may also cause misfires. See Battery in Section 8 of the Service Manual for more information.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

⚠ WARNING

Any open spark around gasoline or other combustibles may result in fire or explosion causing personal injury and/or property damage. Thoroughly wipe up any spilt fuel and dispose of rags in a suitable manner.

- ① A Spark Tester (HD-26792) must be used to verify adequate available secondary voltage at the spark plug (25,000 volts). Remove spark plug cable from spark plug. Visually check condition of plug. Attach cable to Spark Tester (HD-26792). Clip tester to cylinder head bolt. While cranking engine, look for spark. Repeat procedure on other spark plug cable.

- ② **SPARK PLUG CABLE RESISTANCE TEST:** Remove spark plug cable from spark plug and ignition coil. Using an ohmmeter, touch probes to terminals on each end of plug wire. Resistance must be 4750-11077 ohms for 19 inch (483 mm) cables. Reinstall and repeat on other cable. For best results, use a needle nose pliers for removal and installation on coil. Gently grasp cable as close to terminals as possible.
- ③ If carbon tracking is evident, replace the ignition coil and be sure spark plug wire to that coil is clean and tight. Excessive wire resistance or faulty connections can cause coil damage. See Ignition Coil, Removal/Installation, page 9-120 of the 1998 FLT Service Manual.
- ④ If the misfire condition follows the suspected coil, then the coil is faulty. See Ignition Coil, Removal/Installation, page 9-120 of the 1998 FLT Service Manual. This test can also be performed by substituting a known good coil for the one causing the no spark condition. The coil does not require full installation to be functional. Verify faulty coil by performing resistance test (see Troubleshooting, page C-57).
- ⑤ Use Harness Connector Test Kit (HD-41404), red pin probe and patch cord to relay and a purple pin probe and patch cord to the coil connector [83B].

NOTE

Fuel system problems may also cause misfires. Refer to CHART B-2. If fuel pressure is within range, see SYMPTOMS chart on page C-17.

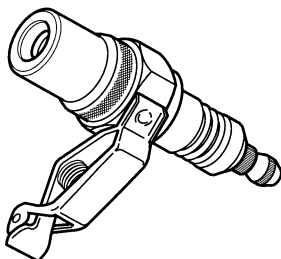
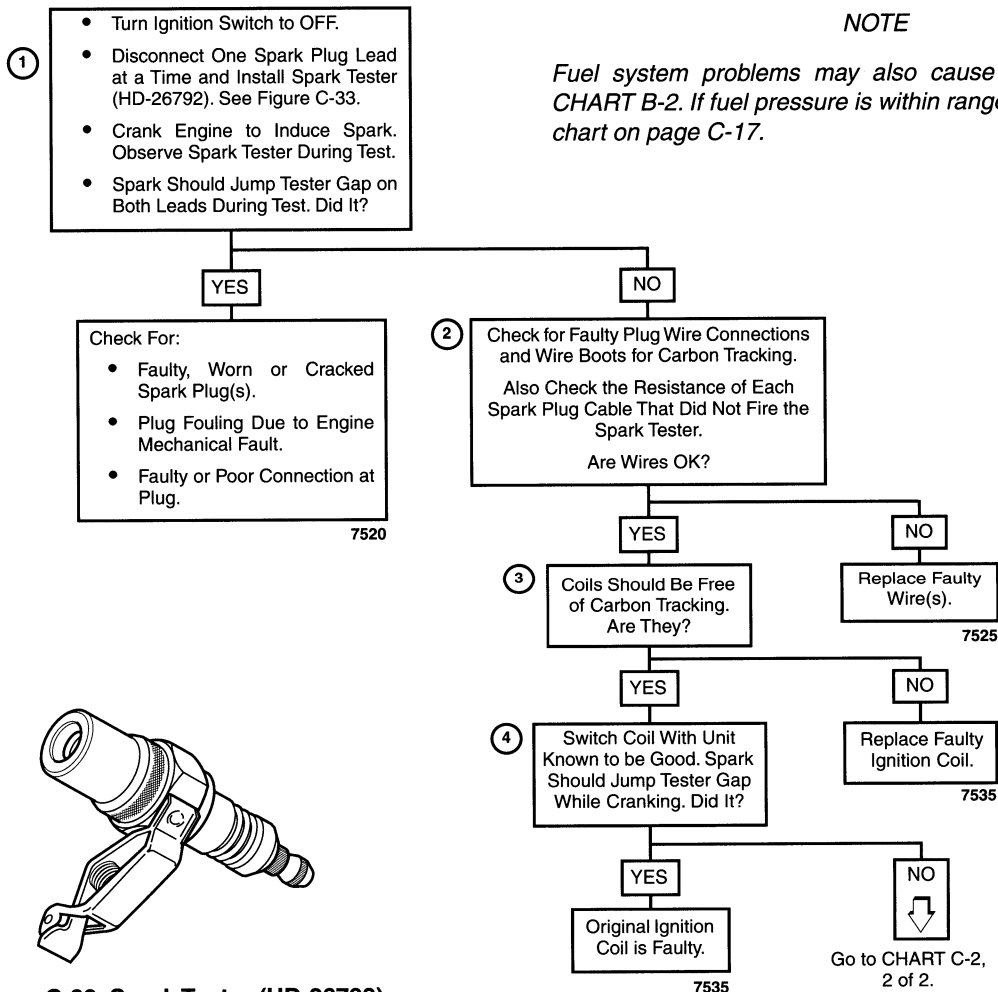
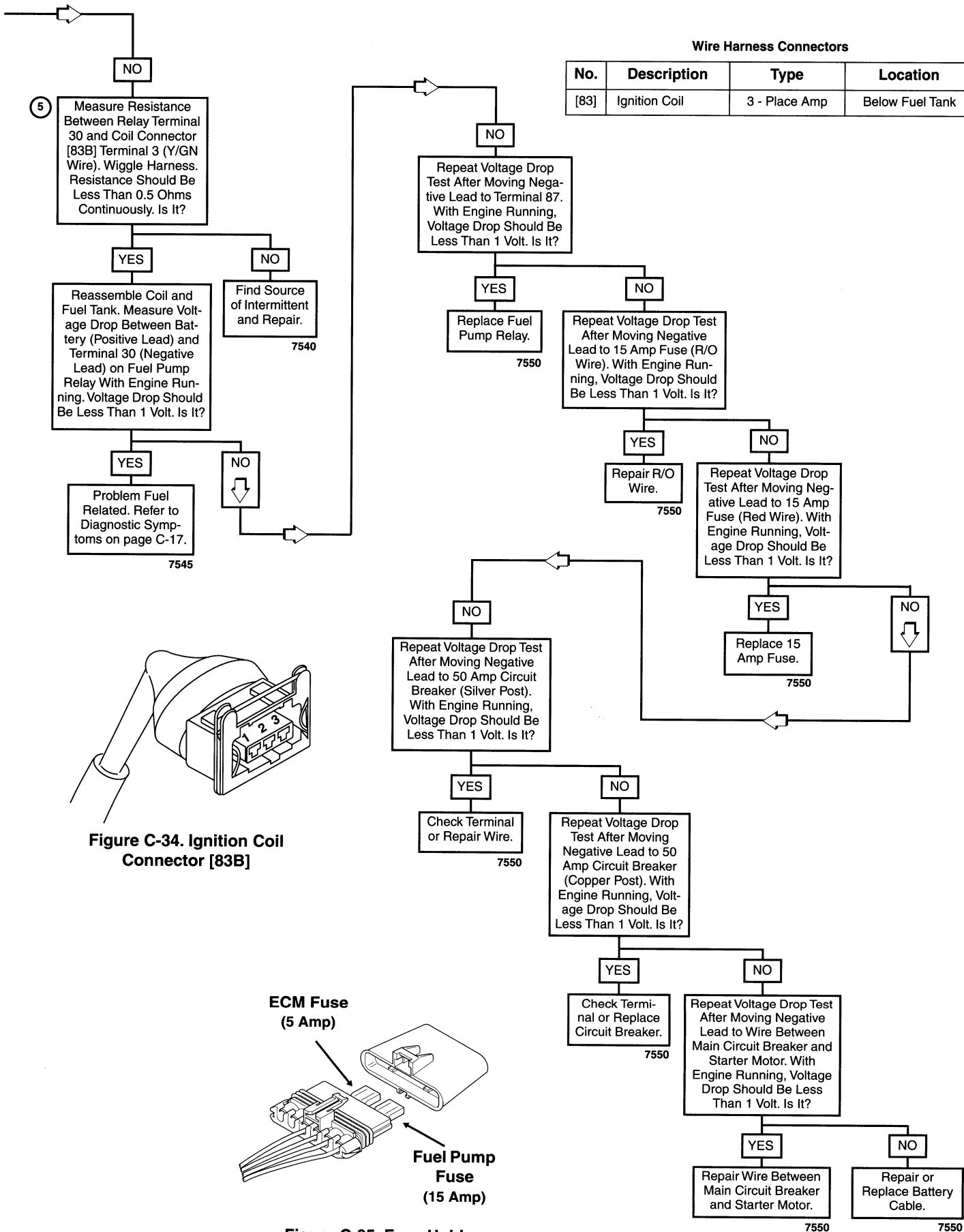


Figure C-33. Spark Tester (HD-26792)

Chart C-2, Misfire At Idle Or Under Load (2 of 2)

Wire Harness Connectors

No.	Description	Type	Location
[83]	Ignition Coil	3 - Place Amp	Below Fuel Tank



TROUBLE CODE 11, THROTTLE POSITION SENSOR

GENERAL

The Throttle Position Sensor (TP Sensor) is supplied 5 volts from the ECM (5v REF) and sends a signal back to the ECM (TP Sensor Signal) which varies according to throttle position. The output signal from the TP Sensor varies from 0.2-0.4 volts at idle (closed throttle) to 4.6-4.9 volts at wide open throttle. A Code 11 will set if the TP Sensor signal voltage does not fall within the acceptable range.

DIAGNOSTIC TIPS

The Scanalyzer or DVOM reads throttle position in volts (the Scanalyzer can also read throttle position as a percentage of throttle opening). Voltage should increase at a steady rate as throttle is moved from idle to wide open throttle. An open or short to ground in R/W or GY/V wires will also result in a Code 11. A short to ground on R/W wire (5v REF) will set multiple codes.

Check for the following conditions:

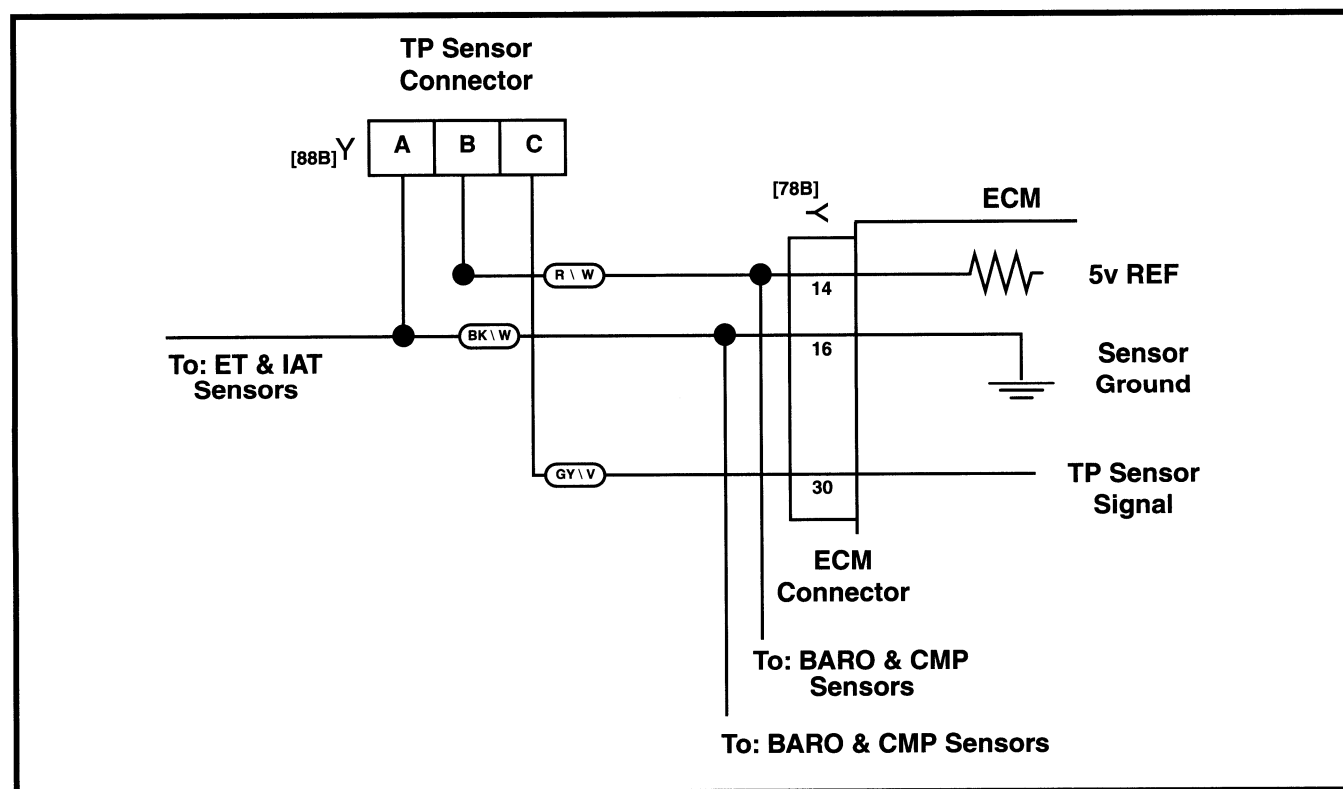
- Poor Connection - Inspect ECM harness connector [78B] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- Perform Wiggle Test to Locate Intermittents - If connections and harness check out OK, monitor TP Sensor voltage using a Scanalyzer or DVOM while moving related connectors and wiring harness. If the failure is induced, the TP Sensor display will change.

- TP Sensor Scaling - Observe the TP Sensor voltage display while opening the throttle with engine stopped and Ignition Switch ON. Display should vary from closed throttle TP Sensor voltage (when throttle is closed) to greater than 4.5 volts (when throttle is held wide open). As the throttle is slowly moved, the voltage should change gradually without spikes or low voltages being observed.

DIAGNOSTIC NOTES

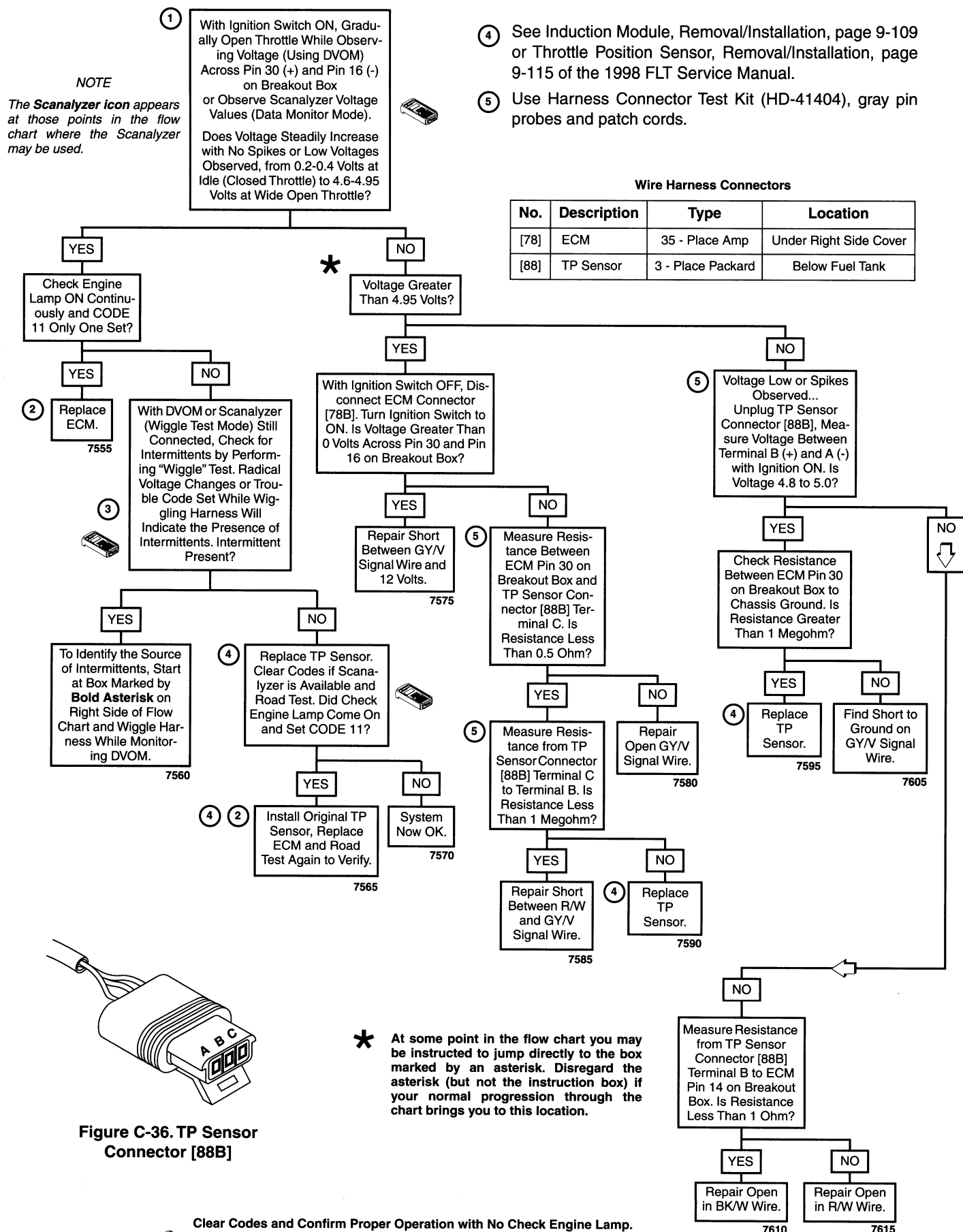
The reference numbers below correlate with those on the diagnostic flow chart.

- ① Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ② See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ③ Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)



Throttle Position Sensor Circuit Diagram

Code 11, Throttle Position Sensor



TROUBLE CODE 12, BAROMETRIC PRESSURE SENSOR

The Barometric Pressure Sensor (BARO Sensor) is supplied 5 volts from the ECM and sends a signal back to the ECM which varies in accordance with atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude. For example, the output signal from the BARO Sensor will vary from about 3 volts at an altitude of 13,000 ft. (low pressure) to about 4-4.8 volts at sea level (high pressure).

DIAGNOSTIC TIPS

- Code 12 will set if the BARO Sensor signal is out of range.
- With the BARO Sensor disconnected, the ECM and Scanalyzer should recognize a low voltage. If low voltage is observed , the ECM and harness are not at fault.
- Gently place a jumper wire across BARO Sensor connector [80B] terminals 1 and 3 using Harness Connector Test Kit (HD-41404), purple male probes and patch cord. With the BARO Sensor connector jumper in place, the ECM and Scanalyzer should recognize a high voltage. If high voltage is observed and connector terminal 2 has a resistance of less than 1 ohm to ground, the ECM and harness are not at fault.
- BARO Sensor Output Check. Using the vacuum pump (HD-23738A), apply a vacuum to the atmospheric pressure port of the BARO Sensor (see Figure C-37). The signal voltage/pressure should lower as the vacuum is applied.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

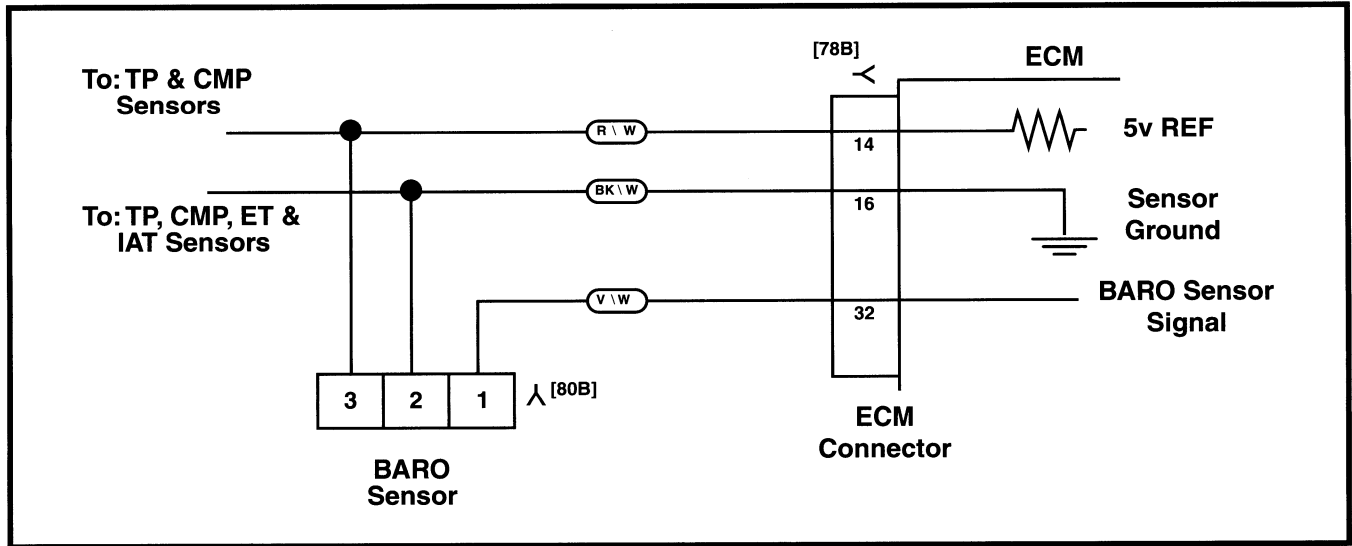
- ① Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.

NOTE

All voltage values are approximate and influenced by barometric pressure.

Barometric Pressure Sensor Table		
Altitude (M)	Altitude (FT)	Voltage Out
Below 305	Below 1000	4.2-4.8
305-610	1000-2000	4.1-4.7
610-914	2000-3000	4.0-4.6
914-1219	3000-4000	3.8-4.4
1219-1524	4000-5000	3.7-4.3
1524-1829	5000-6000	3.6-4.2
1829-2134	6000-7000	3.5-4.1
2134-2438	7000-8000	3.3-3.9
2438-2743	8000-9000	3.2-3.8
2743-3048	9000-10000	3.1-3.7
3048-3353	10000-11000	3.0-3.6
3353-3658	11000-12000	2.8-3.4
3658-3962	12000-13000	2.7-3.3
Low Altitude = High Pressure = High Voltage		

- ② Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)



Barometric Pressure Sensor Circuit Diagram

Code 12, Barometric Pressure Sensor

NOTE

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used.

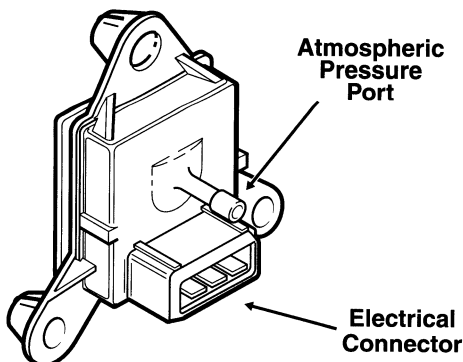
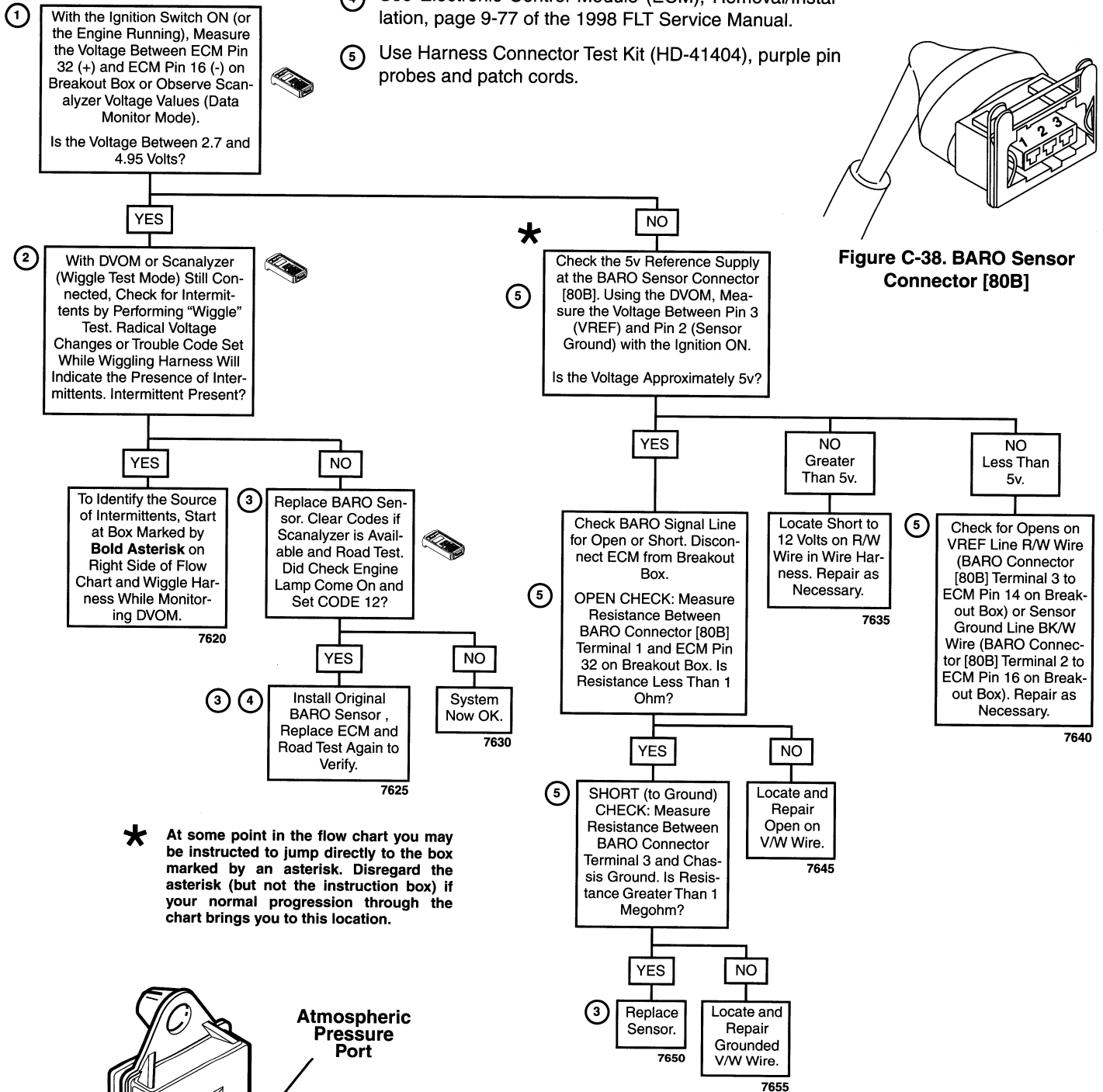


Figure C-37. BARO Sensor

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.

Wire Harness Connectors

No.	Description	Type	Location
[80]	BARO Sensor	3 - Place Amp	Under Right Side Cover

TROUBLE CODE 14, ENGINE TEMPERATURE SENSOR

The ECM supplies and monitors a 5 volt signal (Pin 13) to one side of the Engine Temperature Sensor (ET Sensor). The other side of the ET Sensor is connected to a common sensor ground, which is also connected to the ECM (Pin 16).

The ET Sensor is a thermistor device, which means that at a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the supplied voltage (Pin 13). At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on Pin 13. Conversely, at low temperatures, the resistance is very high, allowing the voltage to rise close to the supplied voltage of 5 volts.

The ECM monitors this voltage to compensate for various operating conditions. The ECM also uses the sensor input as a reference for determining ISC actuator position.

DIAGNOSTIC TIPS

The Scanalyzer displays engine temperature in degrees. Once the engine is started, the temperature should rise steadily.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:

- Poor Connection - Inspect ECM harness connector [78] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- Shifted Sensor - The Temperature-to-Resistance Values table may be used to test the engine temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

- ① Connect Breakout Box (HD-41198) to EFI wire harness **only** (leave ECM disconnected). See Breakout Box Installation, page C-12.

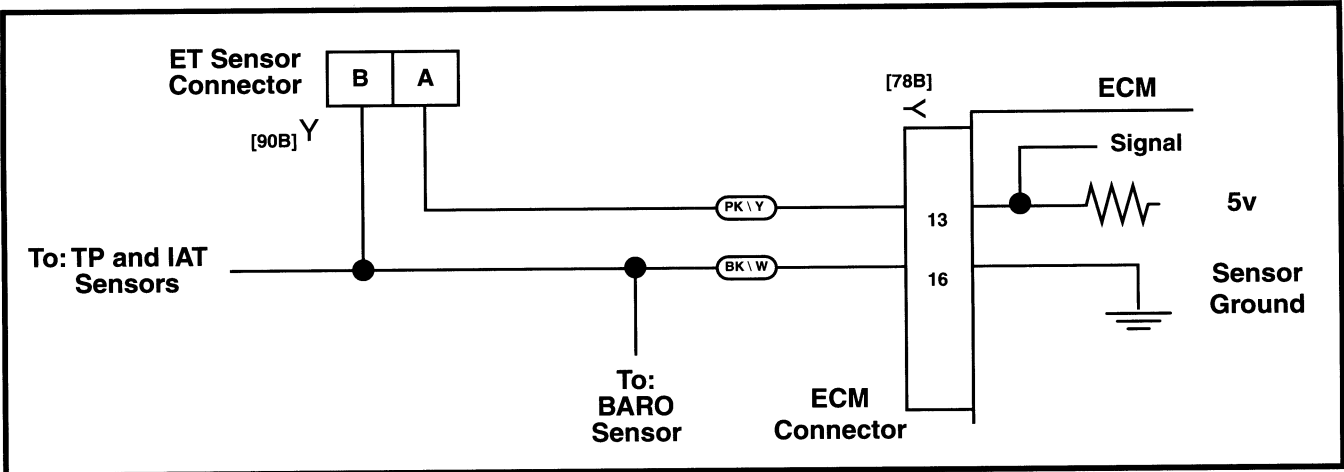
NOTE

All voltage and resistance values are approximate (+/- 20%).

Engine Temperature Sensor Table			
Temp. ° C.	Resistance	Voltage	Temp. ° F.
-10	16599	4.5	14
0	9750	4.1	32
10	5970	3.8	50
20	3747	3.3	68
25	3000	3.0	77
30	2417	2.7	86
40	1598	2.2	104
50	1080	1.8	122
60	746	1.4	140
70	526	1.0	158
80	377	0.8	176
90	275	0.6	194
100	204	0.5	212
110	153	0.4	230

Engine Temperature Sensor is Measured Between Terminal 13 and System Ground (Terminal 16)

- ② Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)
- ③ See Engine Temperature Sensor, Removal/Installation, page 9-88 of the 1998 FLT Service Manual.



Engine Temperature Sensor Circuit Diagram

Code 14, Engine Temperature Sensor

- ④ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ⑤ Use Harness Connector Test Kit (HD-41404), gray pin probes and patch cord.
- ⑥ Use Harness Connector Test Kit (HD-41404), gray socket probes and patch cord.

★ At some point in the flow chart you may be instructed to jump directly to the boxes marked by an asterisk. Disregard the asterisks (but not the instruction boxes) if your normal progression through the chart brings you to this location.

NOTE

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used.

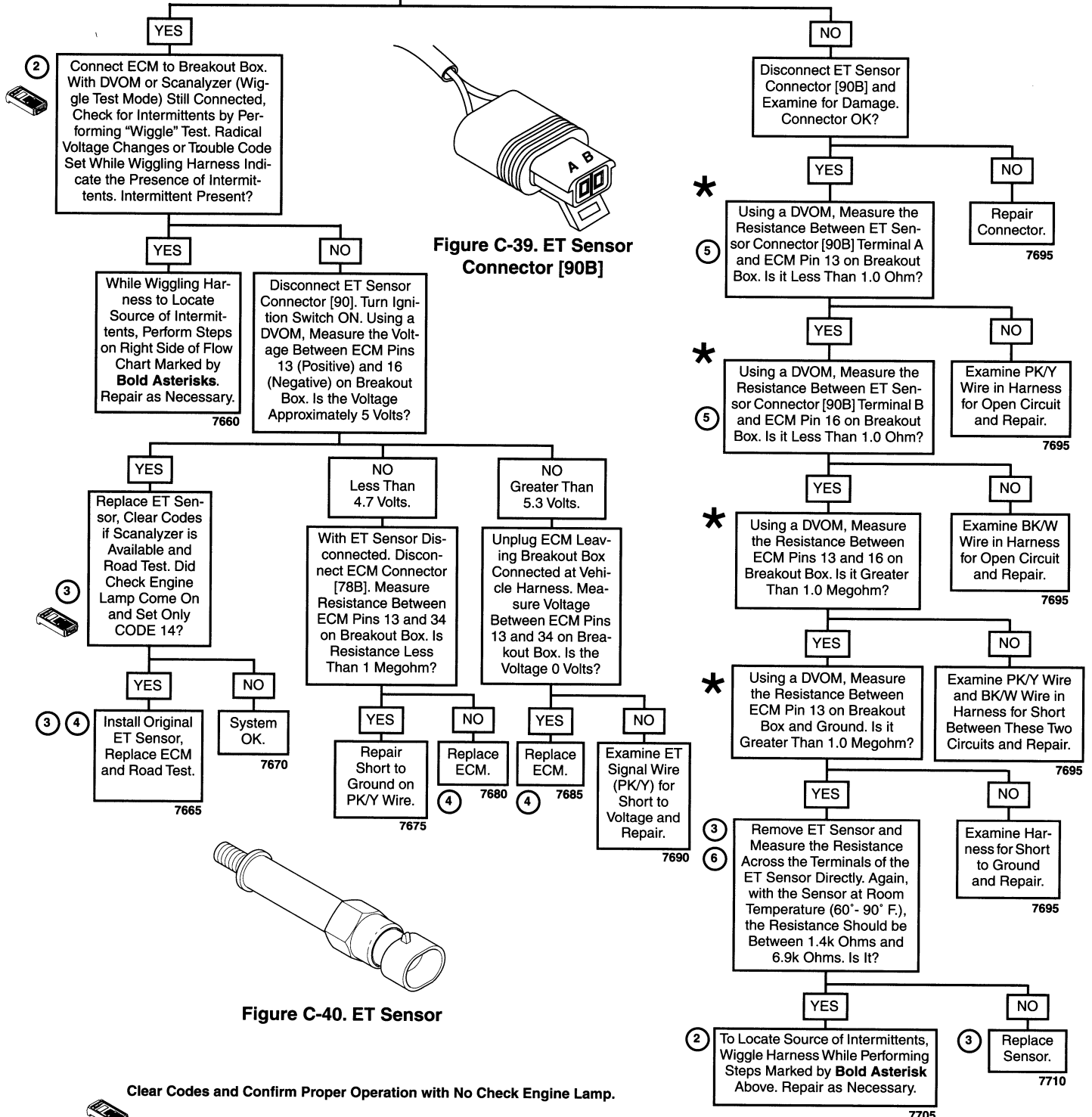
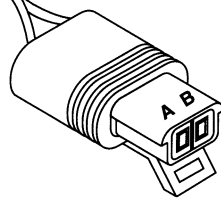
- ① Connect Breakout Box (HD-41198) to Connector [78B] Leaving ECM Disconnected. With Engine at Room Temperature (60° - 90° F.), Use a DVOM to Measure the Resistance Across Pins 13 and 16 on Breakout Box. Is the Resistance Between 1.4k Ohms and 6.9k Ohms?

NOTE

If Engine has Not Been Operated for a Minimum of 4 Hours, the Measured Resistance Should be Very Close to the Measured Resistance Across the IAT Sensor, which is Pins 31 and 16 on Breakout Box. Scanalyzer Values (Data Monitor Mode) Will be Approximately the Same if Code is Historic. Current Code Will Read Default Value.



Figure C-39. ET Sensor Connector [90B]



TROUBLE CODE 15, INTAKE AIR TEMPERATURE SENSOR

The ECM supplies and monitors a 5 volt signal (Pin 31) to one side of the Intake Air Temperature Sensor (IAT Sensor). The other side of the IAT Sensor is connected to a common sensor ground, which is also connected to the ECM (Pin 16).

The IAT Sensor is a thermistor device, meaning that at a specific temperature, it will have a specific resistance across its terminals. As this resistance varies, so does the supplied voltage (Pin 31). At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on Pin 31. Conversely, at low temperatures, the resistance is very high, allowing the voltage to rise close to the supplied voltage of 5 volts.

The ECM monitors this voltage to compensate for various operating conditions.

DIAGNOSTIC TIPS

The Scanalyzer displays intake air temperature in degrees.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:

- Poor Connection - Inspect ECM harness connector [78] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- Perform Wiggle Test to Locate Intermittents - If connections and harness check out OK, use the Scanalyzer to check the intake air temperature reading while moving related connectors and wiring harness. If the failure is induced, the intake air temperature display will change.
- Shifted Sensor - The Temperature-to-Resistance Values table may be used to test the intake air temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

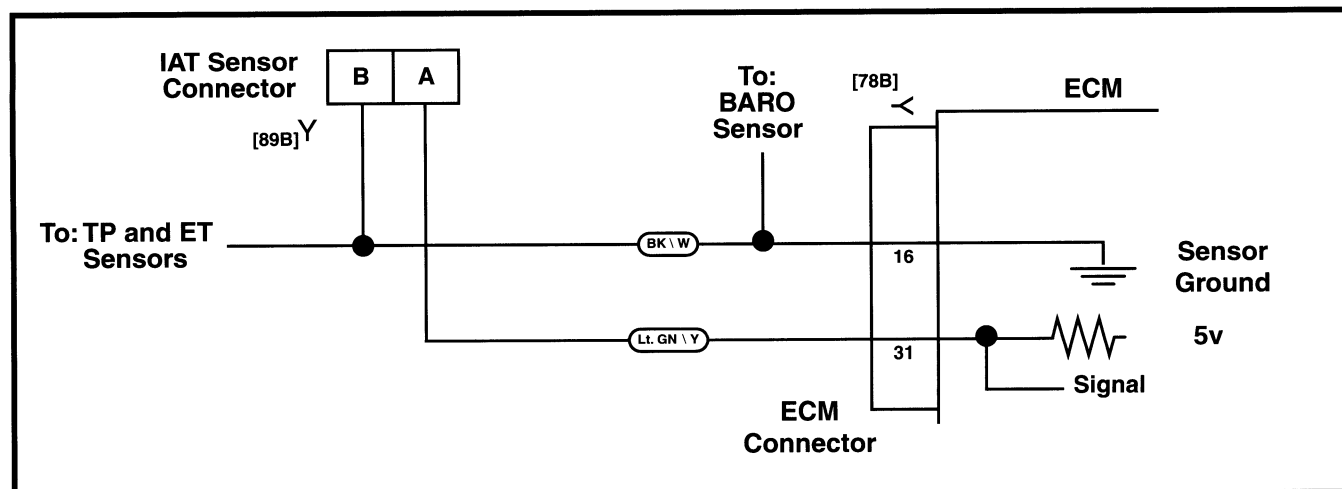
NOTE

All voltage and resistance values are approximate (+/- 20%).

Intake Air Temperature Sensor Table			
Temp. ° C.	Resistance	Voltage	Temp. ° F.
-40	100950	4.9	-40
-30	53100	4.8	-22
-20	29121	4.7	-4
-10	16599	4.5	14
0	9750	4.2	32
10	5970	3.8	50
20	3747	3.3	68
25	3000	3.0	77
30	2417	2.7	86
40	1598	2.2	104
50	1080	1.8	122
60	746	1.4	140
70	526	1.0	158

Intake Air Temperature Sensor is Measured Between Terminal 31 and System Ground (Terminal 16)

- ① Connect Breakout Box (HD-41198) to EFI wire harness **only** (leave ECM disconnected). See Breakout Box Installation, page C-12.
- ② Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear



Intake Air Temperature Sensor Circuit Diagram

NOTE

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used.

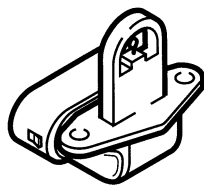


Figure C-41. IAT Sensor

- ① Connect Breakout Box (HD-41198) to Connector [78B] Leaving ECM Disconnected. With Engine at Room Temperature (60° - 90° F.), Use a DVOM to Measure the Resistance Across Pins 31 and 16 on Breakout Box. Is the Resistance Between 1.4k Ohms and 6.9k Ohms?
- NOTE
- If Engine has Not Been Operated for a Minimum of 4 Hours, the Measured Resistance Should be Very Close to the Measured Resistance Across the ET Sensor, which is Pins 13 and 16 on Breakout Box. Scanalyzer Values (Data Monitor Mode) Will be Approximately the Same if Code is Historic. Current Code Will Read Default Value.

Code 15, Intake Air Temperature Sensor

trouble codes and then perform wiggle test with vehicle running.)

- ③ See Air Cleaner, Removal/Installation, page 9-105 of the 1998 FLT Service Manual.
- ④ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ⑤ Use Harness Connector Test Kit (HD-41404), gray pin probes and patch cord.
- ⑥ Use Harness Connector Test Kit (HD-41404), gray socket probes and patch cord.

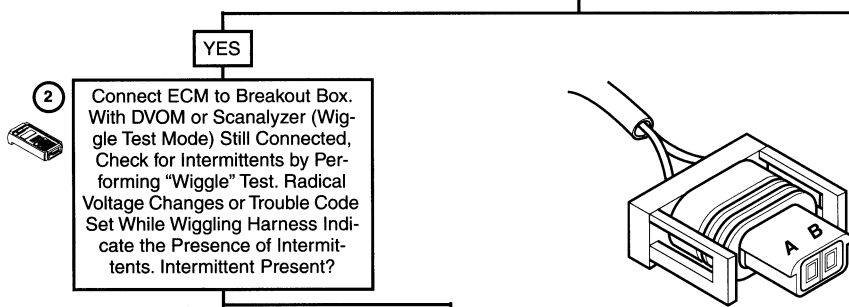
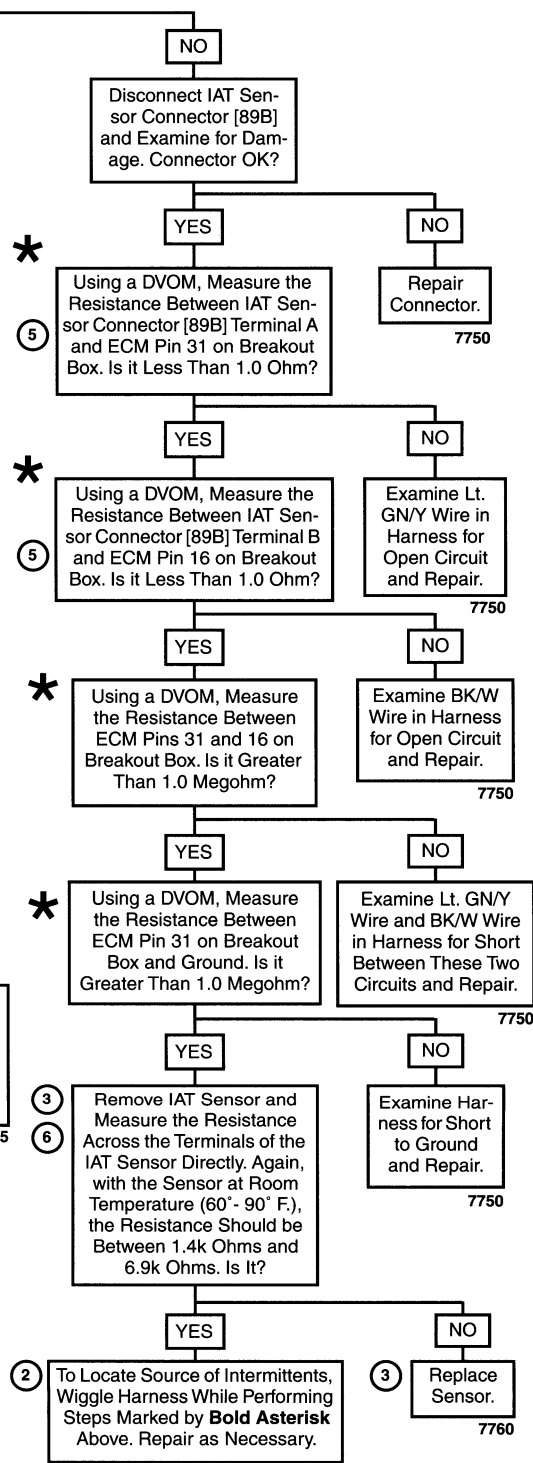


Figure C-42. IAT Sensor Connector [89B]



Wire Harness Connectors

No.	Description	Type	Location
[78]	ECM	35 - Place Amp	Under Right Side Cover
[89]	IAT Sensor	2 - Place Packard	Below Fuel Tank

* At some point in the flow chart you may be instructed to jump directly to the boxes marked by an asterisk. Disregard the asterisks (but not the instruction boxes) if your normal progression through the chart brings you to this location.

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.



TROUBLE CODE 16, BATTERY VOLTAGE

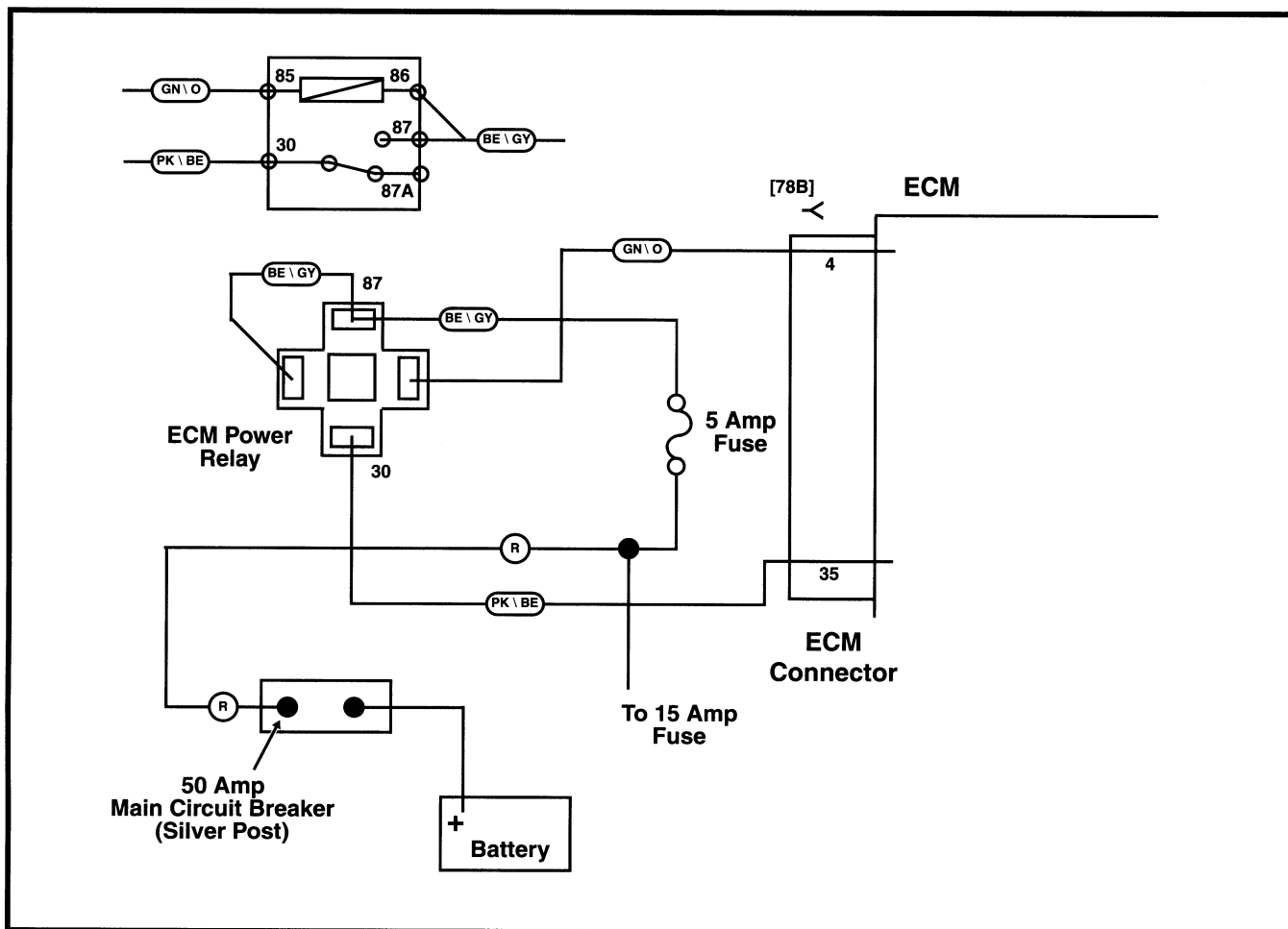
A Code 16 is set if the ECM sees battery positive voltage less than 6.2 or greater than 15.5 volts. A low voltage condition typically occurs during activation of the starter or generally indicates loose wire connections. A high voltage condition is usually caused by a faulty voltage regulator.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

- ① See Charging System Troubleshooting in Section 8 of the 1998 FLT Service Manual.
- ② Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ③ The ECM is monitoring voltage at ECM connector terminal 35.
- ④ This checks for voltage drops in the ECM power circuit. If a significant voltage drop is not present, condition may be caused by excessive starter current draw.

- ⑤ See Starter Current Draw Test in Section 5 of the 1998 FLT Service Manual.
- ⑥ See Electrical Relays, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.
- ⑦ See Fuses, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.



Battery Voltage Circuit Diagram

Code 16, Battery Voltage Test

NOTE

Since the position of the relays may be reversed, check the wire tags for positive identification.

ECM Power Relay

Fuel Pump Relay

Figure C-43. Electrical Relays (Under Seat)

Was Battery Allowed to Discharge? Was Battery Drawn Down by Starting Problem?

YES

Charge Battery and Diagnose Problem.

NO

1 Perform Charging System Tests. Charging System OK?

YES

NO

Repair Charging System.

2 3 Remove Spark Plug Cables From Spark Plugs. Measure Voltage at ECM Pin 35 (Positive) and Pin 34 (Negative) on Breakout Box While Cranking Engine. Disregard Reading During First 2 Seconds of Cranking. Is Voltage Above 6.2 Volts?

NOTE

The **Scanalyzer** icon appears at those points in the flow chart where the Scanalyzer may be used.

YES

NO

Check for Chafed Regulator Wire, Poor Connections or Faulty Main Breaker. Conditions Found?

YES

Repair.
7770

NO

1 With Engine Hot, Check for Overcharge Condition. Condition Found?

YES

Repair Charging System.

NO

System OK.
7770

4

With Key ON, Measure Voltage Drop Between Battery Positive Terminal and ECM Pin 35 on Breakout Box. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

Measure Voltage Drop Between Battery Positive Terminal (+) and Terminal 30 (-) on ECM Power Relay With Key ON. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

Measure Voltage Drop Between Battery Positive Terminal (+) and Terminal 87 (-) on ECM Power Relay With Key ON. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

Measure Voltage Drop Between Battery Positive Terminal (+) and BE/GY Terminal (-) on 5 Amp ECM Fuse With Key ON. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

Measure Voltage Drop Between Battery Positive Terminal (+) and Red Terminal on 5 Amp ECM Fuse (-) With Key ON. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

7 Replace Fuse or Fuse Terminals.
7780

Replace BE/GY Wire or Terminals.
7780

Replace PK/BE Wire or Terminals.
7780

6 Replace ECM Relay.
7780

Replace Poor Ground Circuit.
7775

With Key ON, Measure Voltage Drop Between Battery Negative Terminal and Main Ground. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

Repair Poor Ground Circuit.
7775

5 Check for Intermittent/Poor Connection or Excessive Starter Current Draw. Repair as Necessary.
7775

YES

NO

Measure Voltage Drop Between Battery Positive Terminal (+) and Silver Post on Main Circuit Breaker (-) With Key ON. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

Measure Voltage Drop Between Battery Positive Terminal (+) and Copper Post on Main Circuit Breaker (-) With Key ON. Is Voltage Drop Greater than 0.5 Volt?

YES

NO

High Resistance Between 50 Amp Circuit Breaker and Battery. Replace Wire or Terminals.
7780

Replace Circuit Breaker.
7780

ECM Fuse (5 Amp)

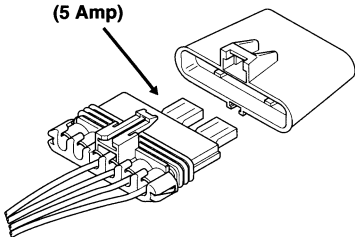


Figure C-44. Fuse Holder

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.



TROUBLE CODES 23 AND 32, FUEL INJECTOR

Code 23 = Front Injector

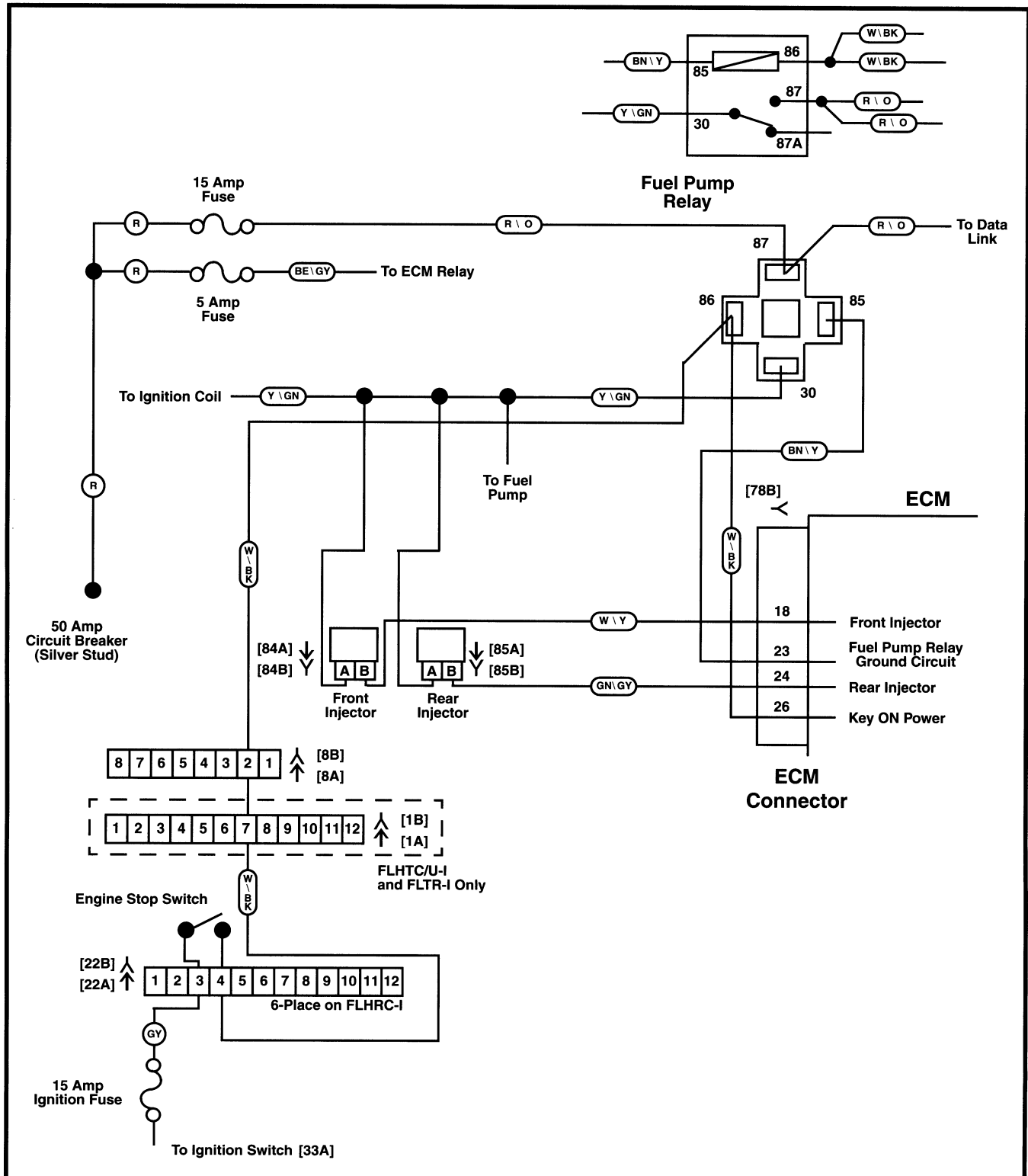
Code 32 = Rear Injector

The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and are triggered sequentially. The power for the injectors comes from the fuel pump relay. The fuel pump relay also

provides power for the fuel pump and the ignition coil. The ECM provides the path to ground to trigger the injectors.

NOTE

System fuse and system relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils and fuel pump.



Fuel Injector Circuit Diagram

The reference numbers below correlate with those on the diagnostic flow chart.

- ① To access fuel injector connectors, remove bolt on back tab of fuel tank, loosen fuel tank front mounting bolt, cut cable straps and elevate tank slightly with wooden blocks.
- ② See Fuel Injectors, Removal/Installation, page 9-113 of the 1998 FLT Service Manual.
- ③ Use Harness Connector Test Kit (HD-41404), purple pin probe and patch cord.

- ④ Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ⑤ Use Harness Connector Test Kit (HD-41404), purple pin probes and patch cord to Breakout Box and gray socket probes and patch cord to Fuel Injector Test Lamp (HD-34730-2C).
- ⑥ Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble

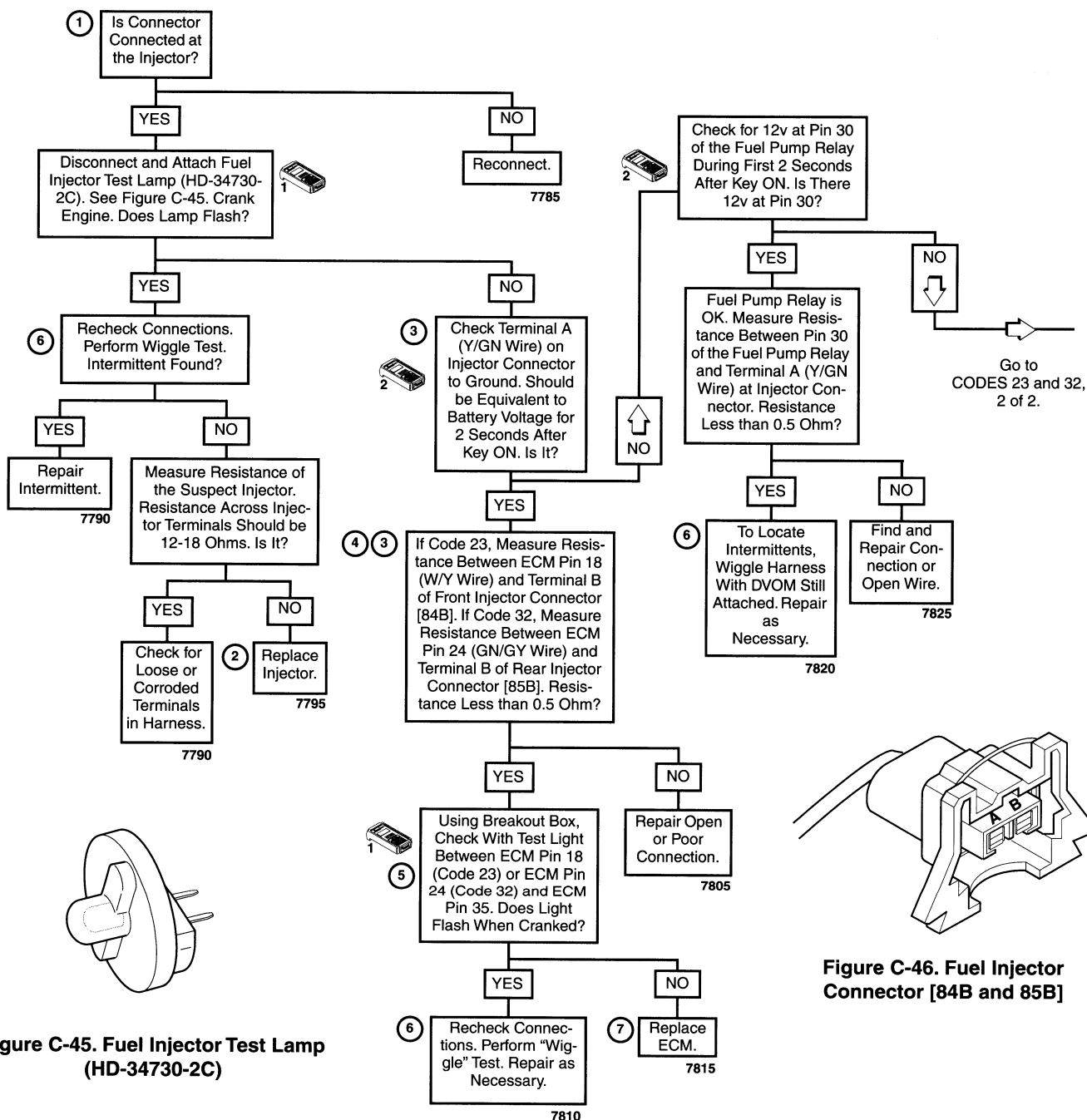


Figure C-45. Fuel Injector Test Lamp (HD-34730-2C)

Figure C-46. Fuel Injector Connector [84B and 85B]

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.

code is detected. (If a current trouble code is already present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)

- ⑦ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ⑧ See Electrical Relays, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.

Codes 23 and 32, Fuel Injector (2 of 2)

SCANALYZER NOTES

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow.



With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear injector once each second for a total of 5 seconds.



With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds. Power to the pump also includes power to the fuel injectors and ignition coil.

From
CODES 23 and 32,
1 of 2.

Wire Harness Connectors

No.	Description	Type	Location
[84]	Front Injector	2 - Place Packard	Below Fuel Tank
[85]	Rear Injector	2 - Place Packard	Below Fuel Tank

NOTE

Since the position of the relays may be reversed, check the wire tags for positive identification.

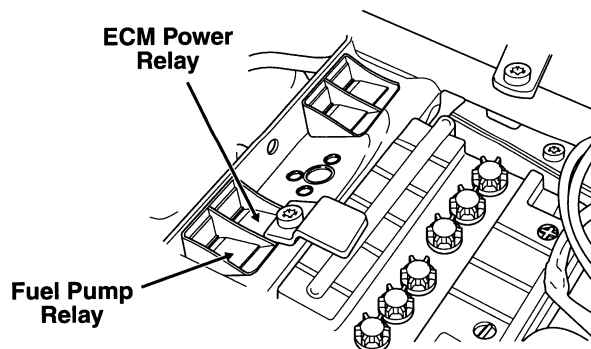
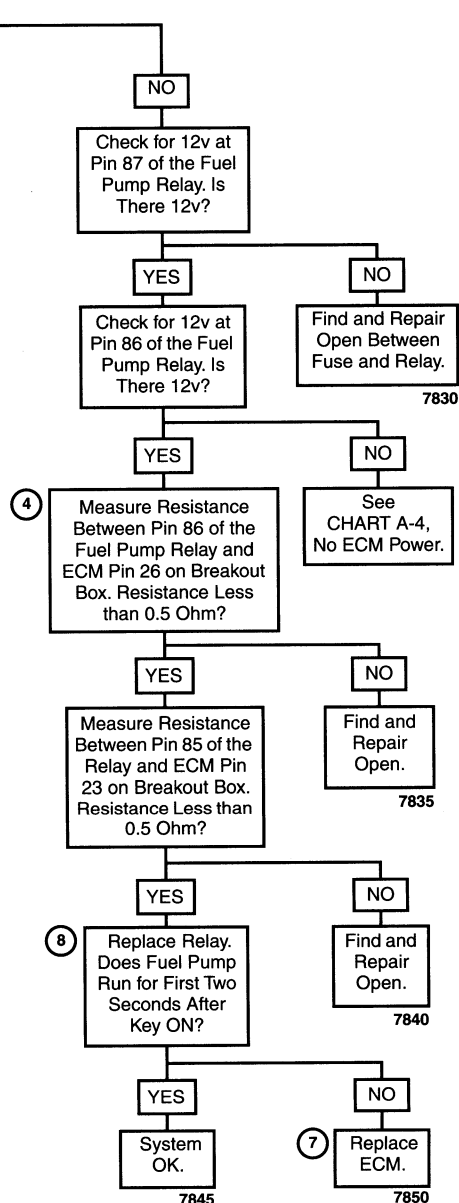


Figure C-47. Electrical Relays (Under Seat)



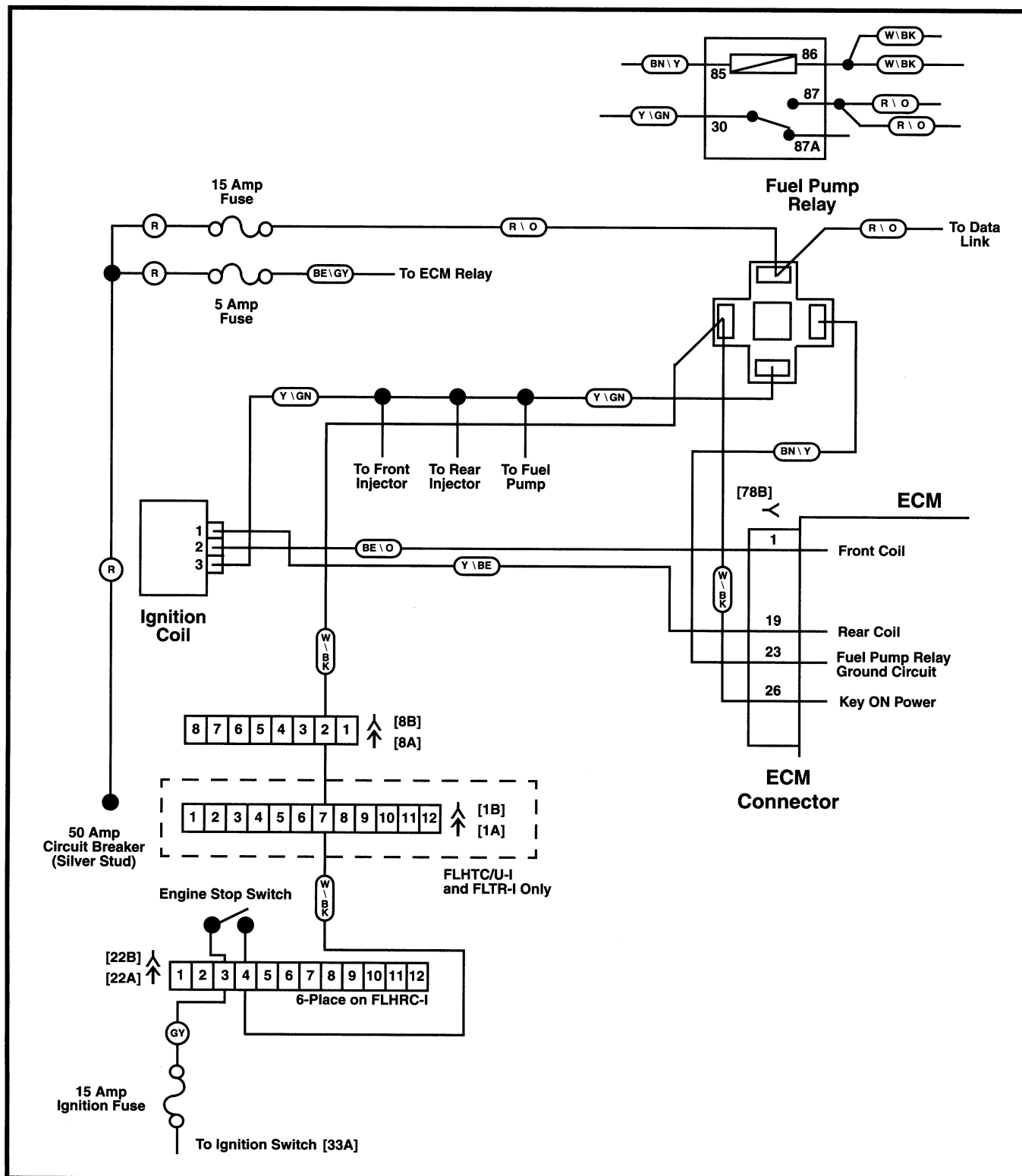
TROUBLE CODES 24 AND 25, IGNITION COIL

Code 24 = Front Coil

Code 25 = Rear Coil

A Code 24 or 25 will set if the ignition coil charge time is out of range. This could occur if there is an open coil or loss of power to the coil. The coil receives power from the fuel pump relay at the same time that the fuel pump and injectors are activated. The fuel pump relay is active for the first two seconds

after the Ignition Switch is turned to ON, and then shuts off until RPM is detected from the crank and cam position sensors, at which time it is reactivated. The ECM is responsible for turning the fuel pump relay on by providing the ground to activate the relay, which in turn powers the coils. If both codes are set, it is likely a coil power failure or a coil failure.



Ignition Coil Circuit Diagram

The reference numbers below correlate with those on the diagnostic flow chart.

- ① See Ignition Coil, Removal/Installation, page 9-120 of the 1998 FLT Service Manual.
- ② Use Harness Connector Test Kit (HD-41404), purple pin probe and patch cord.
- ③ Connect Breakout Box (HD-41198) between EFI wire harness and ECM. See Breakout Box Installation, page C-12.
- ④ Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)

- ⑤ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.

SCANALYZER NOTES

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow.

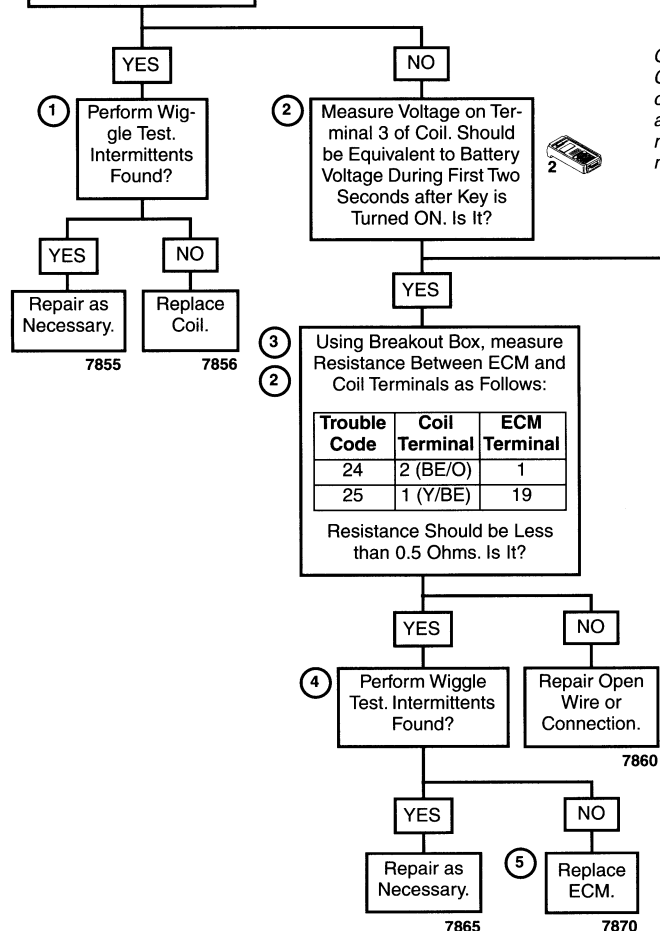


With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear coil once each second for a total of 5 seconds.



With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds. Power to the pump also includes power to the fuel injectors and ignition coil.

Disconnect Coil Connector [83B]. Connect Coil Test Lamp (HD-41402) to Connector [83B]. See Figure C-48. Crank Engine. Do Lights Flash when Cranked?



Wire Harness Connectors

No.	Description	Type	Location
[83]	Ignition Coil	3 - Place Amp	Below Fuel Tank

NOTE

Cranking the engine with the Ignition Coil Test Lamp in place of the ignition coil can sometimes cause a Code 24 and/or Code 25. This condition is normal and does not by itself indicate a malfunction.

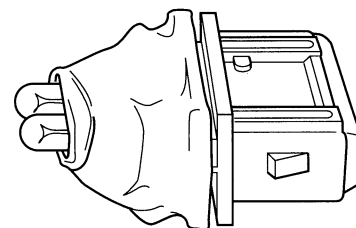


Figure C-48. Ignition Coil Test Lamp (HD-41402)

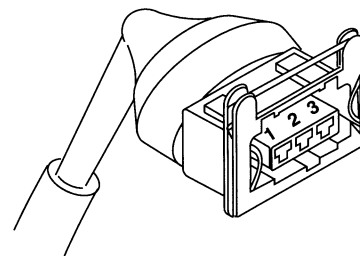


Figure C-49. Ignition Coil Connector [83B]

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.

GENERAL

The ignition coil is a pulse type transformer that transforms or steps up low battery voltage to the high voltage necessary to jump the electrode at the spark plug in the cylinder head. Internally the coil consists of primary and secondary windings with a laminated iron core and sealed in waterproof insulating compound. The ignition coil cannot be taken apart or repaired. If the ignition coil is faulty it must be replaced.

Troubleshooting

When the engine will not start or when hard starting or missing indicates a faulty ignition system, see CHART C-2 in this section or follow the procedure listed under TROUBLESHOOTING in Section 5 of the Service Manual. If the condition persists, check primary and secondary resistance of ignition coil with an ohmmeter. See Wiring Diagram in Figure C-50.

Resistances should be within the following limits: primary resistance 0.4-0.6 ohms, secondary resistance 5,000-6,000 ohms. Check ignition coil with a coil tester.

If a coil tester is not available, temporarily substitute a new ignition coil by attaching it at any convenient point near the old coil (coil will function without being secured). Transfer terminal wires to new coil. See Wiring Diagram in Figure C-50.

Attach new spark plug cables to coil and plugs. If ignition trouble is eliminated by the temporary installation of new coil, carefully inspect old coil for damaged cables and insulation. The insulation on cables may be cracked or otherwise damaged allowing high tension current to short to metal parts. This is most noticeable in wet weather or after motorcycle has been washed.

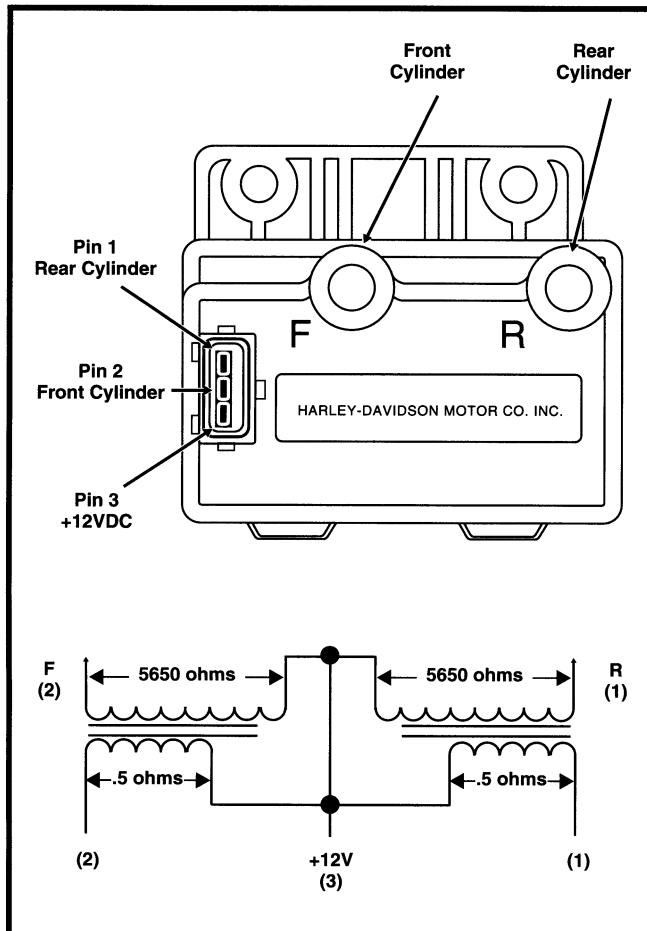


Figure C-50. Ignition Coil Wiring Diagram

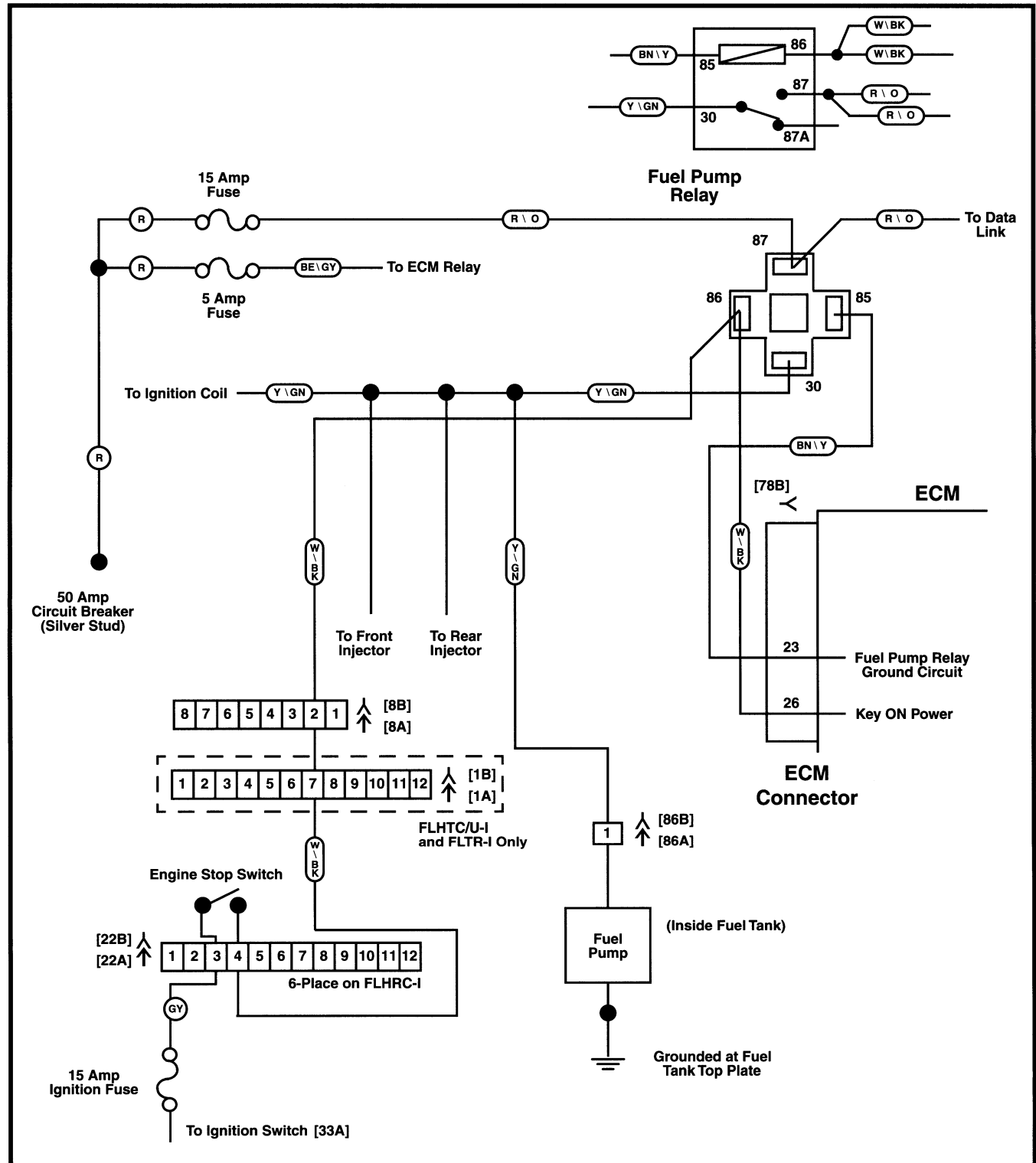
TROUBLE CODE 33, FUEL PUMP RELAY

ECM Pin 23 provides the ground to the fuel pump relay. Code 33 will set if the BN/Y wire is shorted to 12 volts.

DIAGNOSTIC NOTES

The reference numbers which follow correlate with those on the diagnostic flow chart.

- Shake or wiggle harness with DVOM or Scanalyzer connected. Radical voltage changes on the DVOM will indicate the presence of intermittents, while the Scanalyzer (in Wiggle Test Mode) will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. (If a current trouble code is present when the wiggle test is entered, the Scanalyzer will



Fuel Pump Circuit Diagram

respond as described immediately upon entering the wiggle test mode. With Key On and engine off, clear trouble codes and then perform wiggle test with vehicle running.)

Code 33, Fuel Pump Relay

- ② See Electrical Relays, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.
- ③ See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.
- ④ Use Harness Connector Test Kit (HD-41404), red pin probe and patch cord.

NOTE

Since the position of the relays may be reversed, check the wire tags for positive identification.

NOTE

The **Scanalyzer icon** appears at those points in the flow chart where the Scanalyzer may be used.

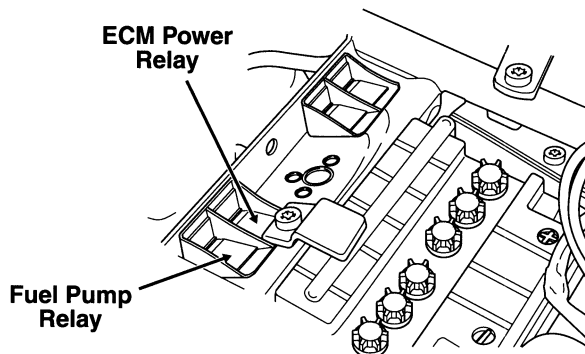
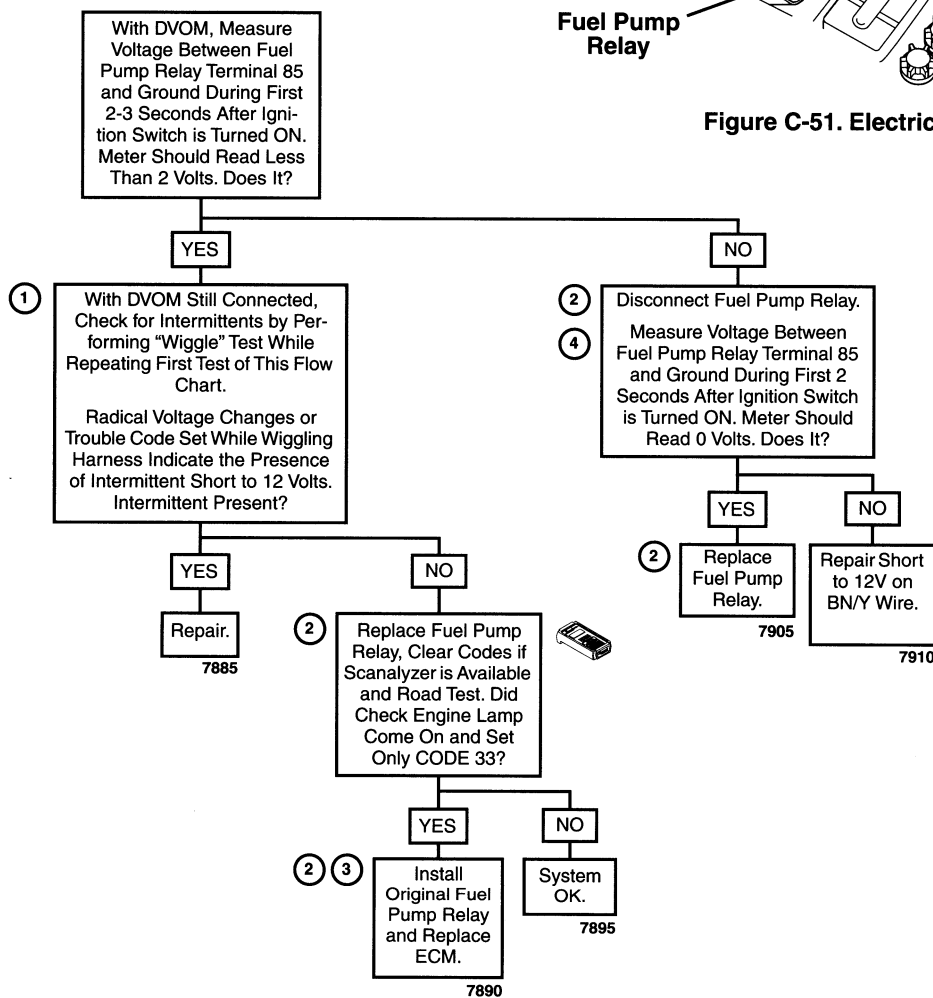


Figure C-51. Electrical Relays (Under Seat)



Clear Codes and Confirm Proper Operation with No Check Engine Lamp.



TROUBLE CODES 52, 53, 54 AND 55, ECM FAILURE

GENERAL

All of the following codes indicate a failure which requires replacement of the ECM.

- Code 52 - RAM Failure
- Code 53 - ROM Failure
- Code 54 - EE PROM Failure
- Code 55 - Microprocessor Failure

See Electronic Control Module (ECM), Removal/Installation, page 9-77 of the 1998 FLT Service Manual.

TROUBLE CODE 56, CRANK POSITION SENSOR AND CAM POSITION SENSOR TIMING

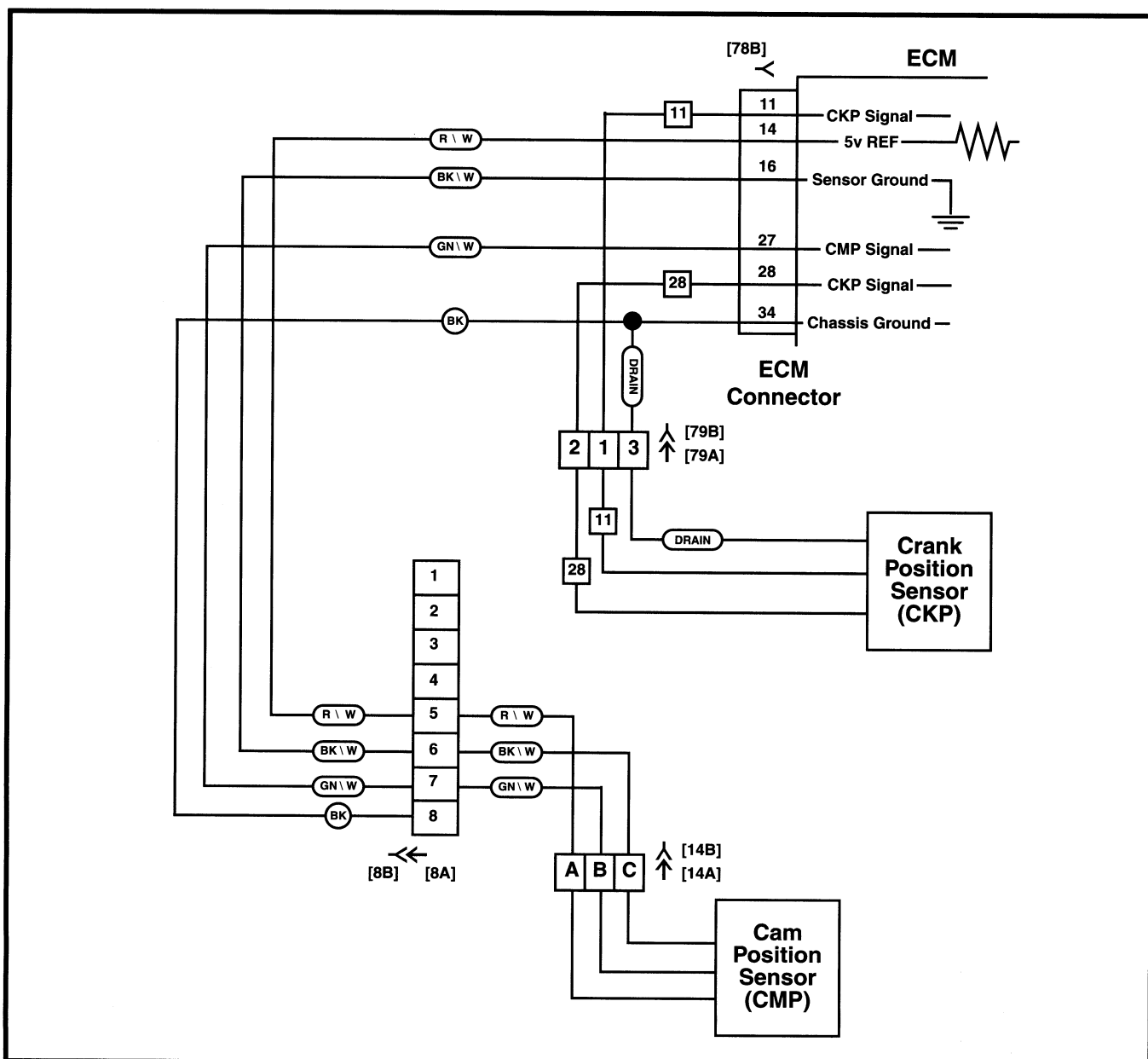
A Code 56 will set if the Crankshaft Position Sensor (CKP Sensor) and Camshaft Position Sensor (CMP Sensor) are not timed properly or if the CKP Sensor signal is weak or absent.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

- ① Connect Breakout Box (HD-41198) to EFI wire harness **only** (leave ECM disconnected). See Breakout Box Installation, page C-12.
- ② Use Harness Connector Test Kit (HD-41404), brown pin probes and patch cords.
- ③ One megohm is very high resistance. Some meters will read ∞ , OL, etc.

- ④ See Electrical Relays, Removal/Installation, page 9-76 of the 1998 FLT Service Manual.
- ⑤ Use Harness Connector Test Kit (HD-41404), black pin probes and patch cords.
- ⑥ See Camshaft Position Sensor, Removal/Installation, page 9-82 of the 1998 FLT Service Manual.
- ⑦ See Crankshaft Position Sensor Harness Connector, Replacement, page 9-87 of the 1998 FLT Service Manual.
- ⑧ See Crankshaft Position Sensor, Removal/Installation, page 9-85 of the 1998 FLT Service Manual.
- ⑨ Use Harness Connector Test Kit (HD-41404), brown socket probes and patch cords.



Crankshaft Position Sensor and Camshaft Position Sensor Circuit Diagram

Wire Harness Connectors

No.	Description	Type	Location
[14]	CMP Sensor	3 - Place Deutsch	Bottom Frame Cross Member (Right Side)
[78]	ECM	35 - Place Amp	Under Right Side Cover
[79]	CKP Sensor	3 - Place Conxall	Under Right Side Cover Below Electrical Bracket

Code 56, Crank Position Sensor and Cam Position Sensor Timing

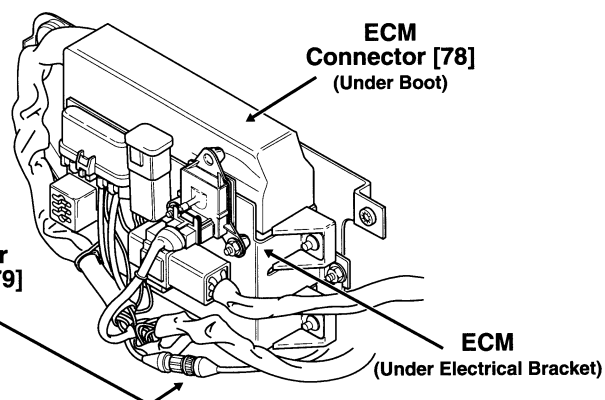


Figure C-52. Electrical Bracket Assembly

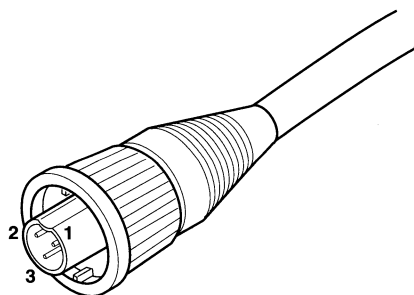
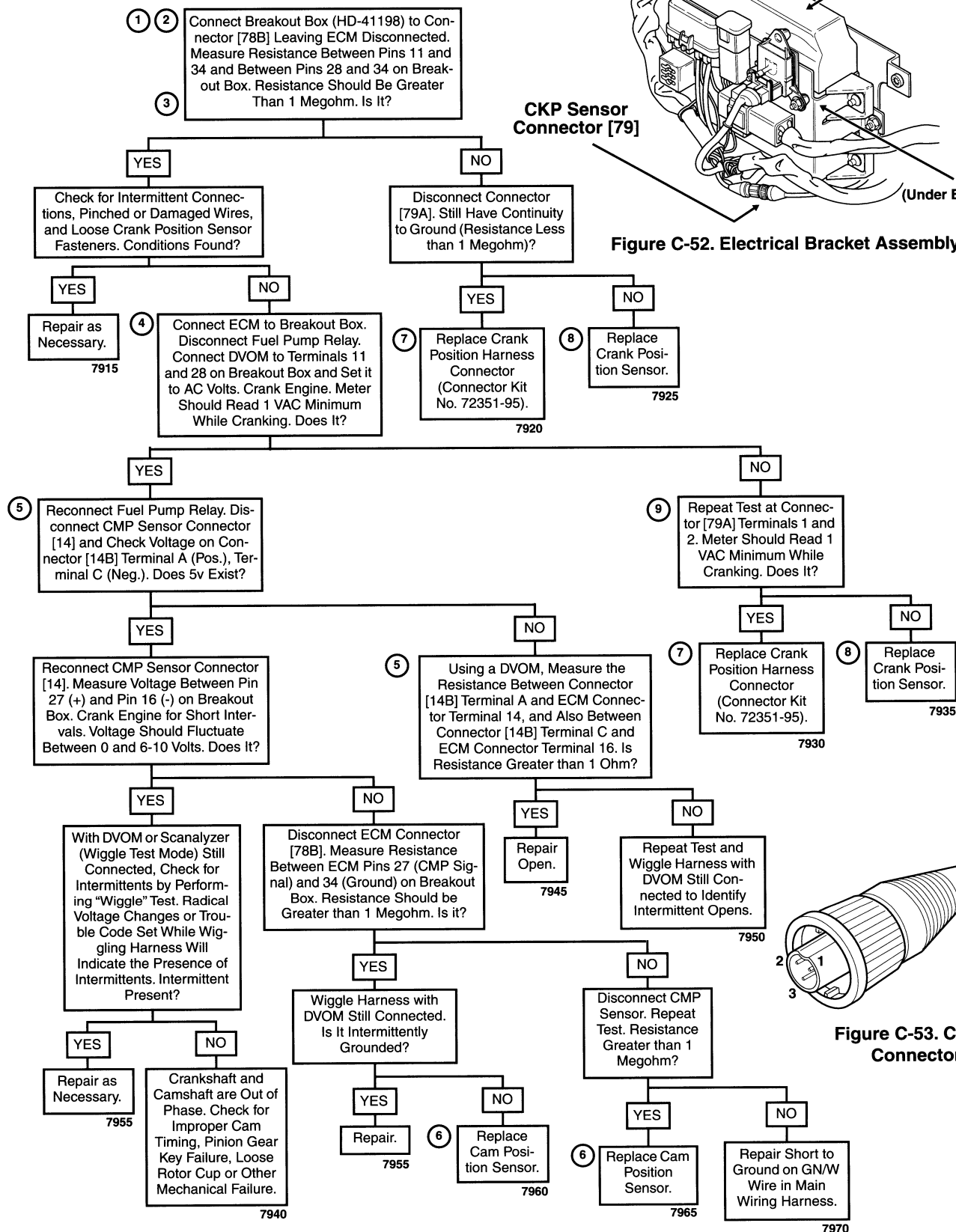


Figure C-53. CKP Sensor Connector [79A]

Clear Codes and Confirm Proper Operation with No Check Engine Lamp.

