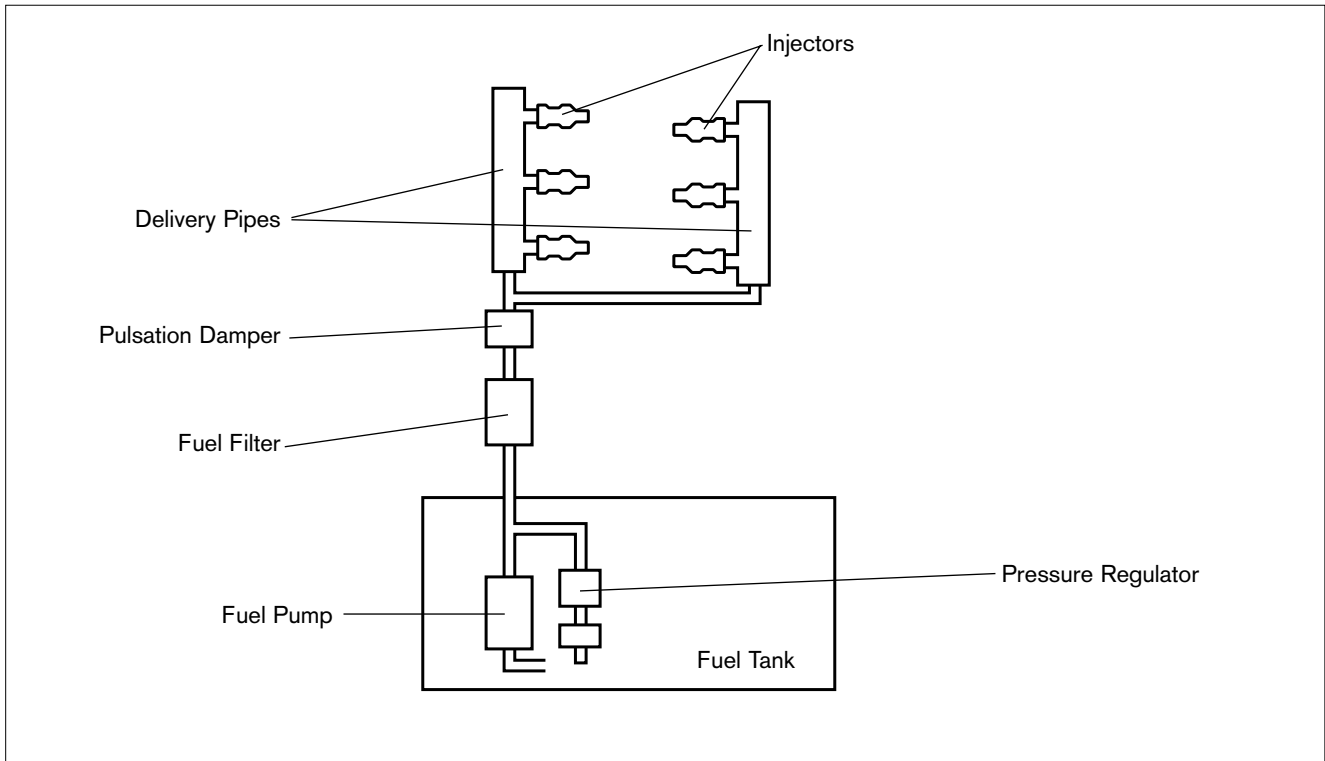
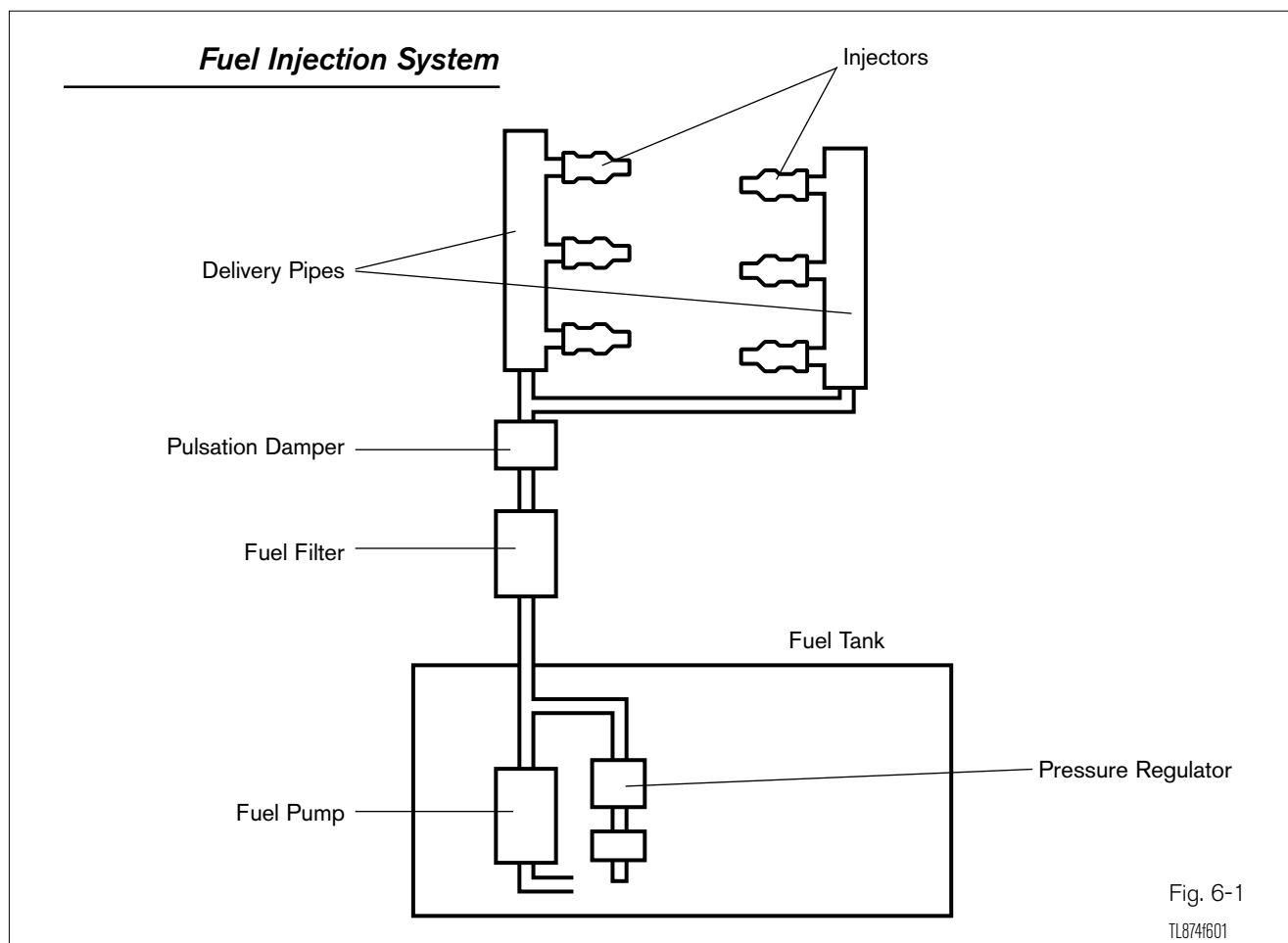


Fuel System Diagnosis



- Learning Objectives:**
1. Determine fuel system response and corrective actions.
 2. Determine the causes of a rich fuel trim condition.
 3. Determine the causes of a lean fuel trim condition.

Fuel System Diagnosis



Overview The ECM adjusts the amount of fuel injected into the cylinder to meet a variety of operating conditions. The fuel system's purpose is to deliver and inject the proper amount of fuel at the correct time. The ECM can provide a limited correction for variances in the fuel system. The fuel system monitor reports the amount of the correction.

Fuel system problems are usually no fuel or an inadequate amount of fuel.

Fuel System Monitor

Fuel trim refers to the feedback compensation value compared against the basic injection time. Fuel trim includes short-term and long-term fuel trim. The ECM monitors its ability to control fuel trim.

The ECM fuel system monitor looks at the total or sum of both the short term and long term fuel trim to monitor its ability to control the A/F mixture. Should the ECM be forced to take both short term and long term fuel trim to the extreme rich or lean limit of control, a fault is recorded and a DTC will be set on the next trip if the condition is still present. The fuel trim monitor is a continuous monitor.

Fuel Trim Monitor P0171, P0172

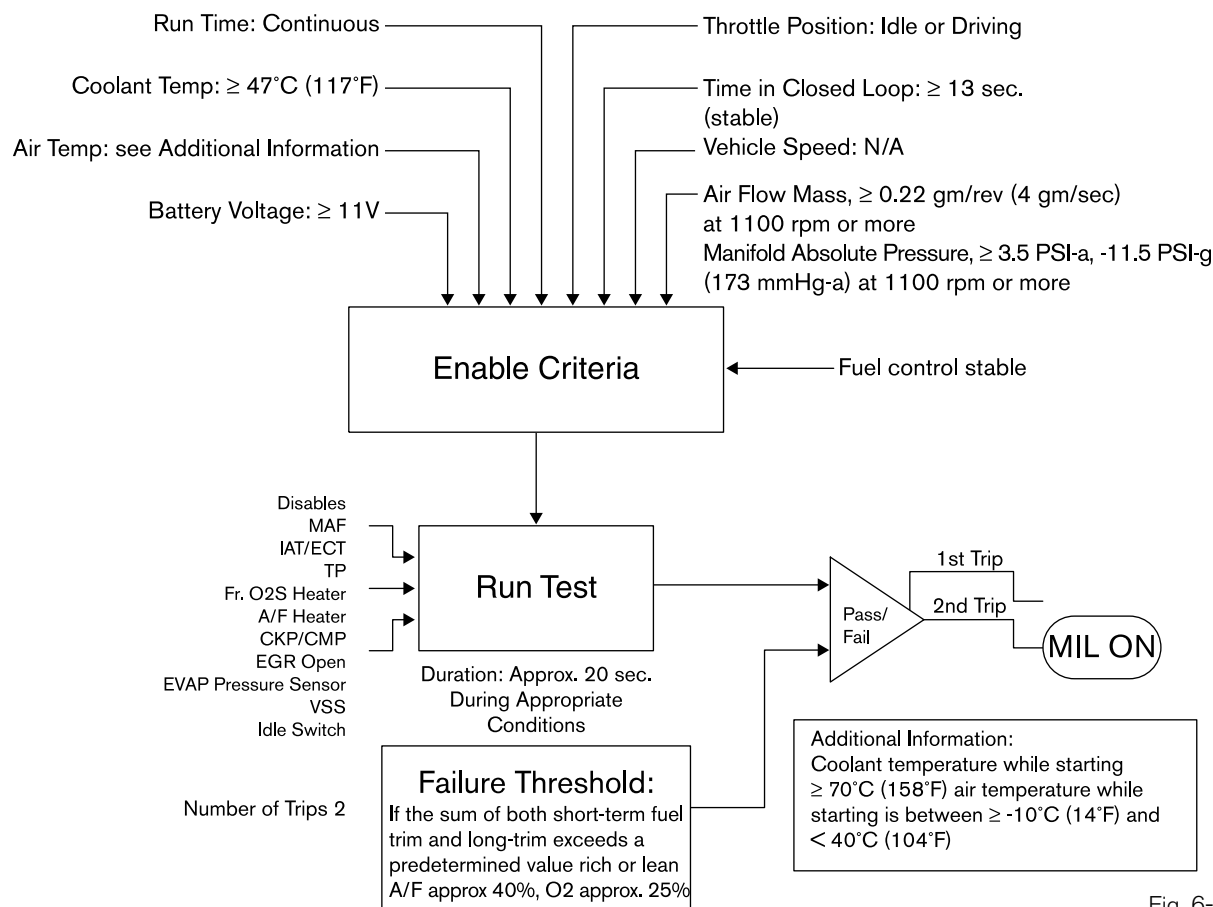


Fig. 6-2

TL874f602

Fuel Trim DTC(s)

P0171, P0174: System Too Lean When the A/F Ratio feedback is stable after the engine is at operating temperature and the fuel trim has reached its limit of correction to the rich side. (two trip logic)

P0172, P0175: System Too Rich When the A/F Ratio feedback is stable after the engine is at operating temperature and the fuel trim has reached its limit of correction to the lean side. (two trip logic)

Exhaust Oxygen Content	Fuel Trim Correction	If Correction Exceeds Failure Threshold
High →	Fuel Trim percentage increases (adds fuel)	→ P0171, P0174
Low →	Fuel Trim percentage decreases (subtracts fuel)	→ P0172, P0175

Feedback from the O₂ or A/F sensor influences short-term fuel trim and short-term fuel trim influences long trim fuel trim. Short-term values are temporary and not stored when the ignition key is turned off. Long-term values are stored in memory because they are part of the basic injection duration. Long term values affect injection duration in closed and open loop because they are used to calculate basic injection duration. It is important to remember that the actual fuel trim will be the opposite of the DTC. A system too lean, DTC P0171 will mean the ECM is making a + or rich correction.

Fuel Trim

In this screen, P0171 was set when the Long Term Fuel Trim reached 35%.

```

TROUBLE CODE..... P0171
CALC LOAD..... 45%
MAP..... 46KPa-a
ENGINE SPD..... 647rpm
COOLANT TEMP..... 197.6°F
INTAKE AIR..... 77.0°F
CTP SW..... ON
VEHICLE SPD..... 0MPH
SHORT FT #1..... 0.7%
LONG FT #1..... 35.8%
FUEL SYS #1..... CL
FUEL SYS #2..... UNUSED
FC IDL..... OFF
STARTER SIG..... OFF
A/C SIG..... OFF
PNP SW [NSW]..... OFF
ELECT LOAD SIG..... OFF
STOP LIGHT SW..... ON
PS OIL PRESS SW..... OFF
PS SIGNAL..... ON
ENG RUN TIME..... 92

```

Fig. 6-3
TL874603

Fuel System Checks

A fuel system monitor DTC does not mean the fuel system itself is at fault, but that there is a condition that is driving the fuel trim out of range. For example, excessively high fuel system pressure could cause the fuel trim to decrease beyond the parameter stored in the ECM. A misfiring cylinder may cause the fuel trim to go rich.

Checking Fuel Pressure

A pressure gauge is used to obtain accurate fuel pressure readings. If the pressure is too high, it is typically the fuel pressure regulator. If too low, the fuel hoses, fuel pump, filter and pressure regulator needs to be checked.

Residual fuel pressure is also checked. After the engine is shut off, there needs to be a residual pressure in the system.

After the engine has been off for a period of time (usually five minutes), the pressure is checked. If pressure is not as specified, the fuel pump, connectors, hoses, regulator and injectors need to be checked.

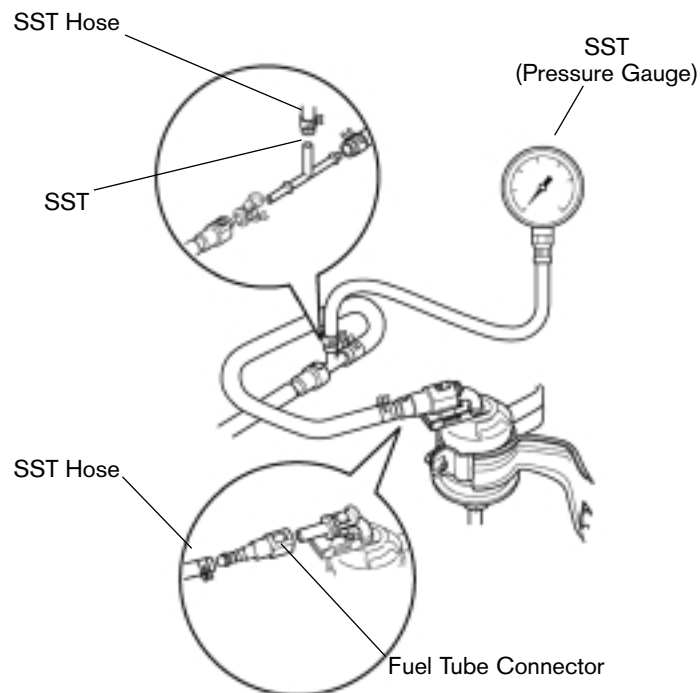


Fig. 6-4

TL6741604

Fuel Delivery System Inspection

Use a fuel pressure gauge or observe pulsation damper bolt head to confirm adequate pressure (see Course 852). Normal pressure confirms fuel pump operation and the electrical circuit between relay and pump.

Circuit Inspection Using V-BoB: Inspect the following signals for behavior as indicated above; STA, Fc (where applicable), +B, NE. Refer to the appropriate Repair Manual circuit inspection charts and to the Engine Control System schematic in the EWD for troubleshooting details.

Applicable Active Tests (OBD II only): Fuel Pump test, performed with ignition ON, will confirm circuit opening relay, all related wiring, and ECM control functions.

For NE signal inspection, use oscilloscope display.

Fuel Injector Drive System

When the engine is cranked, the injectors are pulsed by the ECM to supply the desired cranking A/F Ratio. Injection pulse width is based on inputs from the crankshaft speed sensor (NE), crankshaft position sensor [G], and engine coolant temperature (THW). The ECM also monitors the IGF signal for fuel injection Fail-Safe control in the event that adequate ignition is not maintained.

The ECM pulses the fuel injectors either simultaneously, in groups, or sequentially, depending on application and operating conditions. The injector driver circuits energize the injectors by providing a ground path for current flow.

Strategy As the engine is cranked, the ECM looks for the STA signal, which indicates that the engine is cranking. Basic injection is calculated using the Engine Coolant Temperature (ECT) sensor as primary input.

Next the ECM looks for a crankshaft position signal to determine injector sequence and the crankshaft speed signal to determine pulse frequency.

Finally, the ECM compares the ignition confirmation (IGF) signal with the ignition trigger (IGT) signal to confirm that ignition events are taking place. If these signals are all present, the ECM will pulse the fuel injectors (#10, #20....#etc.) based on a starting enrichment program.

Inspection **Quick Checks:**

- To determine if injector(s) are being pulsed, connect an injector test light (noid light) across an injector wire harness. A blinking light indicates normal driver circuit operation.
- Do not rely on an injection pulse signal from serial data stream for this test. During IGF fuel cut Fail-Safe, serial data may display an injection pulse even though the injector drivers are not operating. Repair any IGF problems before troubleshooting the injectors.
- To determine if fuel delivery is taking place – after cranking, remove a spark plug and check for fuel.
- Using Diagnostic Tester serial data, observe the STA and ENGINE SPD signals while cranking the engine.
- Circuit Inspection Using a DVOM or V-BoB: Inspect the following signals for behavior as indicated above; STA, (THW), NE, G, IGF, IGT, #10, #20...#etc. Refer to the appropriate Repair Manual circuit inspection charts and to the Engine Control System schematic in the EWD for troubleshooting details.

- For inspection of NE, G, IGF, and IGT signals, use oscilloscope display or a DVOM.

Fuel Injector Testing

Using SSTs, the fuel injector is tested for volume and leakage. Both specifications are given in the Repair Manual.

The volume is a measurement of how much fuel comes out of the injector in a given time period.

The leakage test checks for leaks and a loss of pressure in a given time period.

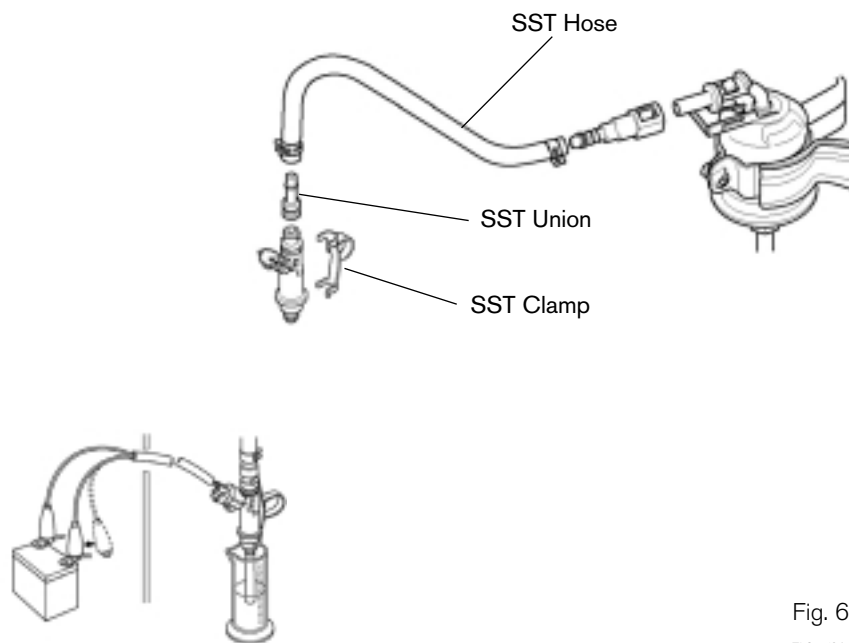


Fig. 6-5

TL8741605

Other Checks There are other systems and components that can cause the fuel trim to go out of range. The following is a general list. Always consult the Repair Manual for specific procedures.

- **Air Induction System:** Check that all components are in place and properly sealed. Inspect hoses for damage. Inspect the air filter.
- **PCV System:** Inspect hose and system.
- **Inspect the Engine Coolant Temperature Sensor:** The ECT sensor circuit with abnormal resistance can cause the fuel trim to go out of range. ECT readings should match engine temperature.
- **Ignition System:** Cylinder misfire can drive the fuel trim out of range.
- **Exhaust System Leak:** A leaking exhaust system can change the oxygen or A/F sensor signal. Inspect and repair any leaks.
- **Check O2 Sensor or A/F Sensor Response:** Do this after confirming all other systems are good.