

# OREGON FUEL INJECTION, INC.

## 6.5L Diagnostics

To properly diagnose a 6.5L vehicle with the DS model pump you will need a scan tool. The 1994 and 1995 are OBD1 and the 1996 through the 2000 model year is OBD2, so the diagnostic codes are different depending on the year range.

### LOW POWER

1. Low or no fuel supply pump pressure
2. Dirty fuel filter
3. Wastegate control solenoid

### WHITE SMOKE

1. Low or no fuel supply pump pressure

### BLACK SMOKE

1. Dirty air filter
2. Waste gate control solenoid failure, or low vacuum.
3. Worn injectors (excess carbon on the nozzle tips)
4. Low or no fuel supply pump pressure
5. If this occurred after the plenum chamber (intake) was removed, check the EGR tower gasket, if not seated EGR gases enter the engine unrestricted and in excessive quantity.
6. Restricted exhaust system, if the vehicle has been “babied”, the cat will partially plug. Take the vehicle out for several full throttle accelerations to clear out the exhaust

### HARD START HOT

1. If the complaint is a hard start after a hot soak, not a stalling condition then hard start, check for a minimum cranking speed hot of 200 rpm.

### MISS

1. Worn injectors
2. If the engine was overheated, check for a head gasket problem, usually on the turbocharger side (usually #4 & #6).
3. See Misfire Codes further below.

### NO START, DIES INTERMITTENTLY OR STALLING

This is often caused by a bad PMD (Pump Mounted Driver or Fuel Control Solenoid Driver); however it is unusual to have multiple failures of the PMD. A bad Fuel control Solenoid (part of the injection pump) can cause the same symptoms and codes. A bad EGR, EGR vent, wastegate control, and transmission solenoid are on the same quad driver circuit and can cause intermittent stalling.

Follow the trouble shooting below to help pinpoint a possible bad PMD. (**GM Bulletin #77-63-06A**)

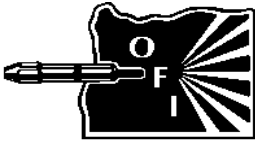
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1. Check fuel system for air (check at fuel return from pump), supply pump pressure, and fuel filter condition.
2. Check the PCM and injection pump wiring harness for chaffing and/or loose terminals at the PCM connector, the 15 pin connector and the PMD connector. See the WIRE HARNESS CONNECTIONS section for more information.
3. Check all engine and vehicle harness grounds.
4. Check for loss of ignition voltage on terminal "D" at the fuel solenoid driver connection to the injection pump. Refer to ENGINE CONTROLS IN THE 1998 SERVICE MANUAL FOR ALL MODEL YEARS.
5. Verify that the condition is still present:
  - A. If the condition is no longer present, the vehicle is repaired
  - B. If the condition is still present, and there are active DTC's set, go to step 6.
  - C. If the condition is still present, and there are NO active DTC's set, go to step 7.
6. For active DTC's 35 or P1216, refer to Engine Controls in the 1998 Service Manual for all model years. If the DTC diagnostic table flow chart directs you to replace the injection pump, replace the PMD (Pump Mounted Driver) which is also called the Fuel Solenoid Driver. Go to step 9.
7. For stall condition, disconnect the Optical Sensor (Encoder Sensor) and operate the engine in back up fuel mode (you will experience an extended crank time during engine start, up to 15 seconds). A bad noise suppression harness or no noise suppression harness can also cause a stalling condition. If the condition is still present replace the PMD only. Go to step 9.
8. For a no start condition, check injection pulse width (94-95) or C-Time (96-2000 Fuel Solenoid Closure Time) with a scan tool, while cranking the engine (maintain minimum cranking speed 100 rpm cold and 200 rpm hot). If C-Time is 1.95ms (94-95) or 0.01ms (96-2000) replace the PMD. Go to step 9.
9. Replacing the PMD (Fuel Solenoid Driver):

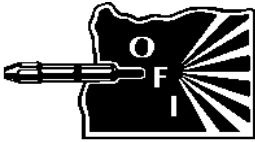
The PMD must be mounted to a "heat sink" of some kind. Stanadyne (Injection Pump Manufacture) states that the PMD must be mounted to the injection pump with the heat pad underneath it. In order to mount the PMD to the injection pump you must remove the intake manifold.

If you don't want to remove the intake manifold, you could purchase a remote mount kit such as the BD remote mount kit, and an aftermarket PMD. This would allow you to replace the PMD without removing the intake manifold.

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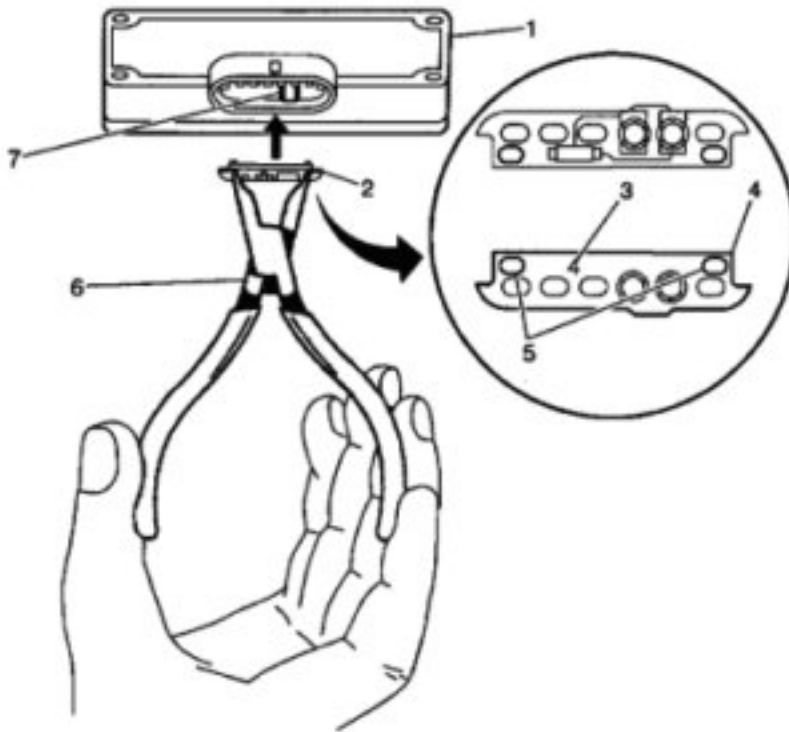
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Stanadyne has finally come out with a new PMD it is completely redesigned from the original PMD. Since the wire harness connections are different as well as the calibration resistor, the intake manifold must be removed in order to replace the PMD, because the wire harness between the PMD and the Fuel Control Solenoid will have to be replaced.

Removing the PMD requires a T15 TORX bit. Replace the heat transfer pad and use snap ring pliers to remove the calibration resistor. Install the calibration resistor into the new PMD.



1. Fuel Solenoid Driver
2. Fuel Solenoid Driver Calibrating Resistor
3. Fuel Solenoid Driver Calibrating Resistor Identification Number
4. Fuel Solenoid Driver Calibrating Resistor Index Notch
5. Fuel Solenoid Driver Calibrating Resistor Removal Holes
6. Needle Nose Pliers
7. Fuel Solenoid Driver Index Notch for Calibrating Resistor

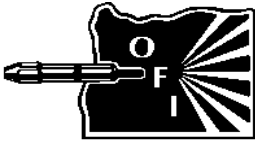
If the calibration resistor is damaged, there is an identification number on it (1 through 9) and we have them available.

**IMPORTANT: IF THE FUEL SOLENOID DRIVER CALIBRATING RESISTOR IS MISSING, DTC 56 (1994 1995) OR P1218 (1996-1998) WILL SET.**

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**INSTALL FUEL SOLENOID DRIVER:** Align the mounting screws on the PMD with the holes on the injection pump (or on the remote mount PMD heat sink) Torque the mounting screws to 23 LB-IN.

**IMPORTANT: DO NOT INSTALL THE FUEL SOLENOID DRIVER WITHOUT A NEW HEAT TRANSFER PAD. DO NOT REUSE A HEAT TRANSFER PAD. USE A NEW HEAT TRANSFER PAD ONLY. THE HEAT TRANSFER PAD IS REQUIRED TO PREVENT RAPID FAILURE OF THE FUEL SOLENOID DRIVER FROM OVERHEATING.**

**NOTICE: DO NOT OVER TIGHTEN FUEL SOLENOID DRIVER MOUNTING SCREWS. DAMAGE TO THE FUEL SOLENOID DRIVER WILL RESULT.**

**For Other Starting Issues, Check the high resolution signal, cam signal (from the injection pump) and crank signal.**

<b>High Res. signal</b>	<b>X</b>	<b>0</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Cam signal</b>	<b>X</b>	<b>X</b>	<b>0</b>	<b>X</b>	<b>0</b>
<b>Crank signal</b>	<b>0</b>	<b>X</b>	<b>X</b>	<b>0</b>	<b>X</b>
<b>Will it start?</b>	<b>Yes, extended crank</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes, noisy on startup</b>

**X = good signal, 0 = no signal**

## Hertz Readings (HZ) while cranking and at idle

<b>RPM</b>	<b>140</b>	<b>160</b>	<b>180</b>	<b>200</b>	<b>700</b>	<b>800</b>
<b>High Res. Signal</b>	<b>597 Hz</b>	<b>683 Hz</b>	<b>768 Hz</b>	<b>853 Hz</b>	<b>2987 Hz</b>	<b>3413 Hz</b>
<b>Cam and Crank Signal</b>	<b>9 Hz</b>	<b>11 Hz</b>	<b>12 Hz</b>	<b>13 Hz</b>	<b>47 Hz</b>	<b>53 Hz</b>

## EGR

Light duty engines utilize an EGR system to help the engine meet emissions. The EGR flow calculation on some models uses the MAF sensor. If there are any “air intake leaks” either MAF or EGR codes can set. A missing or improperly sealing EGR tower gasket can cause either or both codes to set.

Low or no vacuum from the vacuum pump can also cause EGR codes to set. A missing EGR tower gasket can cause a MAF low code to set, along with excessive black smoke, because it is pulling exhaust gases instead of clean air through the air filter.

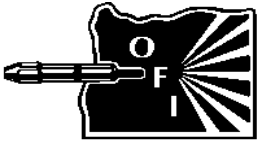
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Failure to remove the block off plates from the intake manifold gaskets for a light duty engine can cause EGR codes because there will be no exhaust gases getting to the EGR valve.

## FUEL SUPPLY PUMP

The fuel supply pump operates during cranking and after the engine oil pressure comes up. The supply pump is driven from a relay on the firewall or in the under hood fuse/relay center. The engine oil pressure sensor also includes a switch to operate the supply pump once engine oil pressure comes up after starting.

The fuel supply pressure should be between 5-7 psi at idle. Test the pressure at the fuel filter drain at the front of the engine near the coolant crossover. Be aware that this is a pressure test on the dirty side of the fuel filter and if the filter is dirty the actual supply pressure to the injection pump will be lower.

If the fuel supply pressure is zero, remove the fuel supply pump relay and jump #30 & #80 connector, this will send power to the supply pump with the ignition on. If you have good supply pressure now, then the most likely cause is a bad oil pressure sending switch.

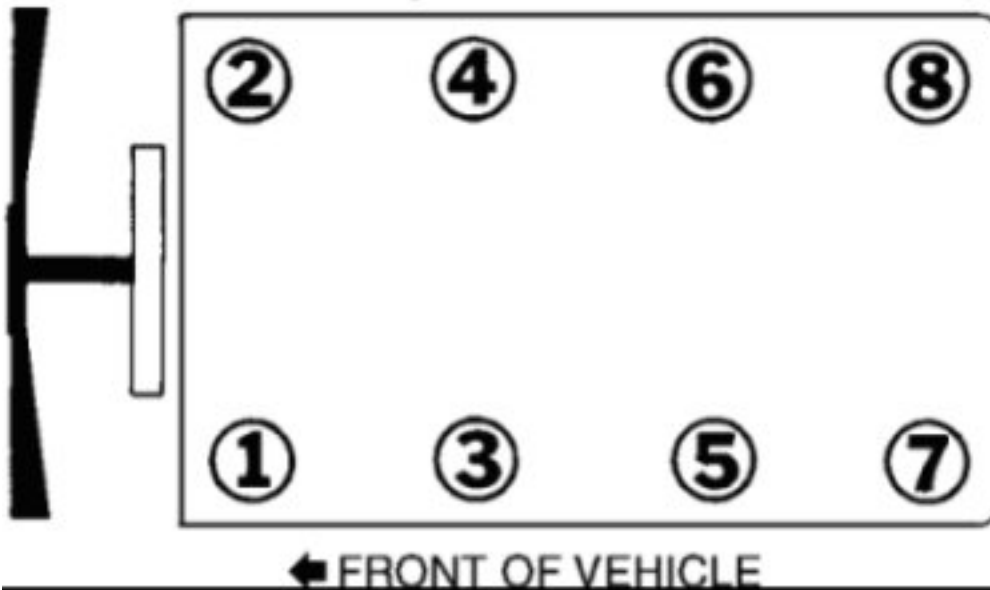
Low fuel supply pressure can cause DTC 17 (P0370) and 18 (P0251) to set due to aeration in the fuel, after all it is an optical sensor and it can't see through an air fuel mix.

## MISFIRE CODES

Misfire codes are handled differently for different years. Some misfire codes go by firing number order, in other words a misfire code for #2 would be #8 cylinder because it is the #2 cylinder in firing order. Check the service manual for the year you are working on.

Firing order is

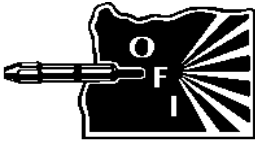
Firing Order 1-8-7-2-6-5-4-3



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## INJECTORS

The injectors on the 6.5L are usually only good for about 100,000 miles. They get a lot of carbon blown up inside of the nozzle tip. This results in poor atomization and poor spray patterns.

## PMD (pump mounted driver)

The pump mounted driver gets 12 volt power when the key is on from a fuse in the \_\_\_\_\_  
The PCM then sends a signal to the PMD to close the fuel control solenoid. When the fuel control solenoid closes it sends a signal back to the PMD and that is relayed to the PCM. The response time of the closure signal is called C-time.

C-Time should change when the engine is accelerated or decelerated. A fixed C-Time can indicate a bad Fuel Control Solenoid. If the C-Time is erratic when the engine RPM is stable then this usually indicates a bad PMD. See Wire Harness Testing for other possible problems.

## ENCODER SENSOR

If you have a no start condition, disconnect the encoder (optical) sensor and crank the engine for 15-20 seconds. If the engine starts then the problem is with the optical sensor. The encoder sensor has to be able to see through the fuel inside the pump, if there is any air in the fuel it can cause trouble codes to set. Dirty fuel, SVO, no fuel supply pressure (air in system) or dyed fuel can all cause a problem with the encoder sensor "reading" the windows in the cam disk. There are 8 windows in the low resolution circuit and 512 windows in the high resolution circuit. In one minute at idle the high resolution circuit needs to read about 180,000 windows, in order to not set a code.

## TDC OFFSET LEARN

The pump to engine timing must be set with a scan tool. You need to do the TDC offset learn procedure in order to set base pump to engine timing.

## TURBOCHARGER

The turbocharger on the 6.5L EFI engine has a wastegate actuator that is controlled by vacuum. The wastegate actuator on the 94-2000 turbo does not have a spring, when no vacuum is applied the wastegate will "flop" back and forth. If the wastegate actuator holds a vacuum and it moves freely back and forth then there is nothing wrong with the wastegate actuator. A turbo boost problem and DTC78 (P0236) is normally caused by low vacuum (need 20 inches HG) or a bad wastegate control solenoid.

To inspect the turbo, remove the inlet hose from the compressor inlet and make sure the turbo spins freely and that the compressor wheel does not rub on the housing when pushed to the side. Some side play is normal, because the bearings "float" on oil from the engine when the oil pressure is up.

The turbocharger pulls crankcase fumes from the engine through the CDR valve. It is normal for the turbo to discharge oil from the compressor housing. You have to

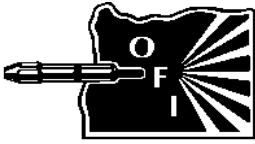
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determine if you have more oil coming out versus going into the compressor housing. A plugged air filter or bad CDR valve can cause excessive oil to be pulled out of the engine and discharged from the turbo back into the intake. If the silicone hose connecting the compressor discharge is not sealed with a minor amount of silicone sealant than the hose connection will weep oil past the hose.

## **WASTEGATE CONTROL SOLENOID**

The wastegate (WG) control solenoid controls the amount of vacuum going to the wastegate actuator on the turbocharger. The WG solenoid is controlled via a pulse width modulated signal from the PCM.

## **WIRE HARNESS TESTING**

Poor electrical connections or wiring can cause most intermittent problems. Perform a careful check of the suspected circuit for the following:

Inspect and ensure the integrity of all related wiring harness connectors. If the wiring harness connectors are not properly put together or engaged before they are locked together, numerous types of conditions may occur. This may include many intermittent symptoms and DTC codes.

The first step in any type of electrical diagnosis is that a visual and physical inspection be completed of the wiring harness connectors for integrity. Many times, the vehicle may be repaired just by disconnecting and reconnecting the connectors. As with all repairs to wiring harness connectors and terminals, a pin test of the terminals within the connector should be performed. A pin test is performed by inserting the proper size terminal test tool (not a paper clip), into the terminal to determine whether or not the terminal is making good contact, or whether it has been damaged from prior improper connection, multiple connections or lack of connection.

## **COMMON CODES**

Note; multiple codes can set for just one fault, as if the other codes wanted to come to the party. On an OBD2 system use the Tech 2 scan tool to determine which code set first and under what condition, A DTC17 (370) can trip a DTC18 (P0251), a DTC18 can trip a 19 (P0335) and a DTC19 can trip a DTC35 (P1216) or DTC36 (P

DTC17 (P0370) high resolution circuit fault can be caused by aeration in the fuel from a plugged fuel filter or low fuel supply pump pressure.

DTC18 (P0251) Pump cam reference error

DTC19 (P0335) crankshaft position reference error

DTC34 (P0216) injection timing stepper motor, watch the stepper motor and make sure it retracts when activating TDC learn.

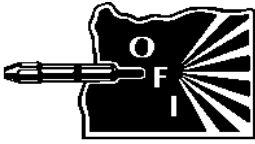
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DTC35 (P1216) fuel solenoid response time too short, less than 1.2 ms or .75ms on later years.

DTC36 (P1217) fuel solenoid response time too long, more that 2.5 ms, can be caused by a weak fuel control solenoid.

DTC56 (P1218) injection pump calibration resistor error. Usually is caused by a missing resistor, and this codes sometimes only sets after attempting TDC offset learn.

DTC78 (P0236) turbo boost performance, this is usually caused by a bad wastegate control solenoid or low vacuum.

DTC84 (P1125) APP can set if foot is on throttle and brake when key is turned on.

DTC88 (P1214) TDC offset error, the pump to engine timing must be within plus/minus 2 or 2.5 degrees when doing TDC offset learn or this code will set. This code could also set if the starter was used to crank the engine over while installing the injection pump, this will sometimes partially shear the crankshaft timing chain gear key.

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