

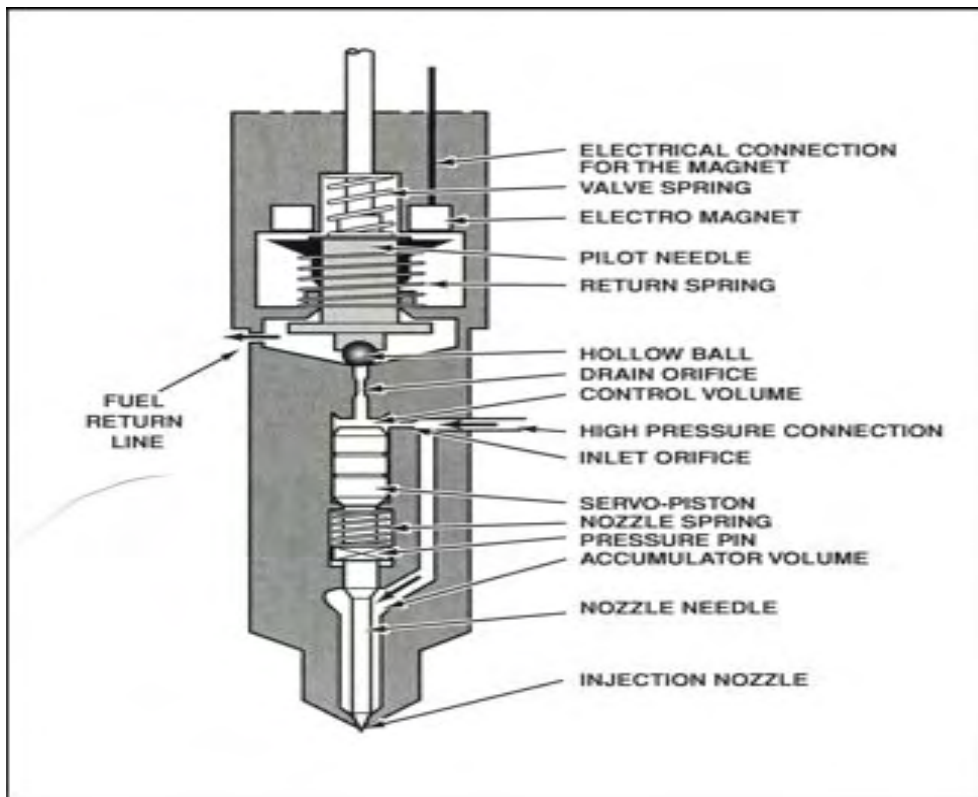
## 2001 – 2007 6.6L Duramax Diagnostics

In order to do proper diagnostics you will need a scan tool and some special tools such as a vacuum test gauge J44638 available from GM Special Tools

<http://gmspecialservicetools.spx.com/> . Also note that 1 Mpa (megapascal) is equal to approximately 145 PSI.

### High Pressure Common Rail Basic Information

The high pressure pump builds rail pressure and delivers it to the fuel rail manifold where it flows through the injector lines to the injectors. The fuel pressure regulator in the high pressure pump controls rail pressure. The injectors have a hollow check ball that holds high pressure fuel until the fuel solenoid is actuated by the ECM, this allows the check ball to rise off its seat and an injection to take place. If the check ball in the injector is leaking due to erosion on the seat or the high pressure limit valve leaks then it will not build enough rail pressure to start the engine. It takes approximately 2500 PSI 2500 PSI rail pressure to start the engine.



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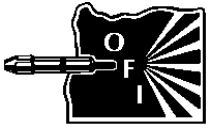


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## CAUTION

The fuel system contains high pressure fuel up to 25,000 PSI. **Do Not** use your fingers to find fuel leaks! High pressure fuel entering your bloodstream may result in amputation or loss of life.

## Preliminary checks

1. Check engine oil level, LB7 engines have the injectors under the valve cover and are very susceptible to dilution.
2. Check and record any DTC, look at snap shot data or save, do not erase codes prior to doing repairs, you will erase the snapshot data.

## No Start or Hard Start

1. Excessive fuel restriction, check or change fuel filter
2. Use vacuum pressure gauge, check the suction, you should have no more than 5 inches Hg at WOT (wide open throttle) or 7-8 inches Hg under load. If you have too much suction the restriction could also be the sock in the tank. Too little vacuum (less than 2 inches Hg) means that it could be sucking air.
3. Check for air in fuel system, install clear lines to check.
4. Confirm actual versus desired rail pressure, even under crank no start conditions
5. If the above are ok, then it comes down to the following.
  - a. fuel injectors (see injectors for more diagnostic information)
  - b. high pressure pump
  - c. Fuel pressure regulator, check to make sure it is not stuck.
  - d. fuel pressure relief valve (high pressure limit valve), check to make sure it is not leaking into the return system when rail pressure is 160 Mpa
6. Before condemning the high pressure pump you need to make sure there are no high pressure fuel leaks. Use the EN-47589 (same block-off caps as #9011 SPX Miller tools) cap set to cap off the injector rail to isolate the injectors from the injector return system.

## Black Smoke

1. If at idle, use the scan tool to cut out one cylinder at a time and see if the smoke disappears.
2. Dirty air filter
3. Exhaust leaks or Boost leaks, you can usually hear a boost leak as a high pitched squeal under load.
4. EGR and or MAF problems or intake leaks after the MAF sensor.

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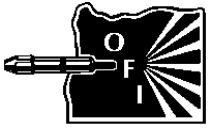
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## Misses

1. Use scan tool to isolate one cylinder at a time. Run the injector balance test, running the test hot (after a hard drive) and in drive will give the most consistent results.
2. A missing or damaged chamber gasket or low compression could all cause a miss.

## Knock

1. Use scan tool to isolate one cylinder at a time.
2. Use cap off tool EN-47589 to block off one injector at a time.

## Surge at idle

1. Map actual versus desired rail pressure, if the graph is wavy and there is no air in the system it is usually caused by a bad fuel pressure regulator.
2. Air in the fuel system (see fuel supply and filter housing section)

## White / Blue smoke at idle when cold

If the smoke clears in less than 1 minute, this would be normal depending on temperature and altitude. Blue white smoke that burns your eyes is un-burnt fuel; cold temperatures, high altitude and excessive idle time all mean cold combustion and white smoke.

1. Possible bad injector, use the scan tool to cancel one cylinder at a time and see if the smoke clears up. However, using the scan tool to kill the injector does not reduce rail pressure in the injector and the tip can still leak fuel, cap off lines one at a time (cap is tool # EN-47589) to pinpoint injector. Also look at the balance rates, if the tip is leaking fuel then the balance rates may be out of specification.
2. Check glow plug operation when cold.
3. Check rail pressure when engine is off, it should 1.0-1.8 Mpa, depending on the engine model.
4. Excessive idle time can cause white smoke when cold due to carbon build up on injector tips. More than 20% idle time is excessive. If the injectors have excessive carbon on the nozzle tip then balance rates should be high on that cylinder.

## Dilution

1. Cracked injector
2. Injector return lines are under the valve cover on LB7 engines. Pressurize the return circuit with the valve covers off and look for bubbles or vacuum test the return circuit off of each head, the return should hold 15 inches Hg of vacuum.
3. On the LB7 dilution problems that occur after you have replaced the injectors could be return line leaks under the valve cover or leaks at the injector line to

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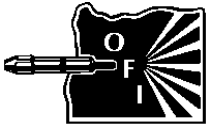
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injector connection. The green coated injector lines are more susceptible to leaks versus the polished steel colored lines.

4. Leak at the high pressure pump driveshaft seal.
5. You can also use a dye in the fuel and black light kit to try to pinpoint leaks at the injectors on an LB7 engine. Follow the “fuel leaks inside of engine” GM service information.

## **Fuel Supply and Fuel Filter Housing**

The fuel filter housing is on the suction side (there is not a supply pump from the factory) and are prone to suck air. Follow the GM fuel system diagnosis in the service manual.

1. Install fuel vacuum test tool.
2. Prime the fuel system with the hand primer until 10 PSI is indicated on the gauge, check for external leaks and repair. If the pressure drops from 10 PSI to 2 PSI in less than 1 minute, remove the fuel outlet line from the filter and cap it. Remove the ignition 1 relay and crank the engine for 2 - 15 second intervals, the high pressure pump should pull at least 12 inches of Hg vacuum.
3. Install clear hoses at the inlet and outlet of the fuel filter housing. Re-prime the system and then start the engine, there should be very little air going into or coming out of the fuel filter housing.
4. Common air ingestion places are the filter housing, plugged filter, drain valve, rubber hoses and connections. You need to use clear lines to isolate where the air is coming from and work your way back toward the tank until you don't have any more air coming through the clear line. Unless you know where to get the tool that sees through back rubber lines to find air, your only other option is to bounce around and replace parts.

## **High Pressure Pump (CP3 Pump)**

1. Before condemning the high pressure pump for a starting issue you need to make sure that the high pressure fuel system is not leaking the pressure.
2. If there has been a major contamination issue with dirt and or water then it is very likely that the high pressure pump will need to be replaced. However, the injectors are typically damaged first, but any contamination that got into the injectors also went through the CP3 pump.
3. The most common failure of the high pressure pump is the inability to keep up with high fuel demand such as towing a trailer up a hill. This problem will usually set a low rail pressure code.

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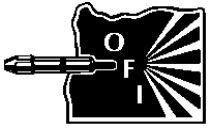
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## Injectors

It takes about 2500 PSI rail pressure for the injectors to deliver fuel and the engine to start.

1. Injector return flow; maximum allowable leakage for one injector is 5 ml in 15 seconds, maximum per bank is 20 ml: check when cranking, with the FICM disabled, pressure should be 114 – 135 Mpa during cranking. Specifications are for API rating of 40-44.
2. GM only provides a specification for return fuel when cranking however, we have done some testing on a good running LB7 and found that injector return flow at idle from one bank was 95 – 110 ml in one minute at 21,000 PSI.
3. Excessive leakage from the injectors usually results in a starting issue, which could occur hot or cold, but usually occurs hot because the fuel is thinner when hot. However, excessive leakage from the injectors can also cause a DTC P0087, P0093 or a P1093 to set. When using the scan tool to increase rail pressure at idle, if you can't get to 21,000 PSI then the injectors are usually bad.
4. You can also use balance rates to help determine if you have any bad injectors. If an injector is leaking excessively into the return the balance rates are often at the edge of specification. Injectors that have a poor cylinder power contribution or a noise or smoke change when cancelled will also need to be replaced and are likely to cause low rail pressure during cranking.

## Turbocharger

1. 2001-2006; turbocharger bearing failure may be caused by a spun camshaft bearing. Inspect for a spun number 4 camshaft bearing, refer to TSB 03-06-93-001B.
2. 2004.5 and newer turbochargers have a vane position sensor, check actual versus desired.

Use the following information regarding diagnostic trouble codes in addition to the normal diagnostic procedures outlined in the service manual or technical service bulletins.

DTC P0087; fuel rail pressure less than 22.5 MPa at more than 600 RPM, fuel rail pressure too low.

1. Excessive restriction, fuel supply, plugged filter or sucking air. Install special tool J44638 to check vacuum restriction on fuel supply to the high pressure pump. Maximum restriction at WOT (wide open throttle) is 5 inches HG in park. When driving under hard acceleration maximum would be 7-8 inches Hg. If too high replace the fuel filter and retest.
2. If it is only a couple of inches vacuum, that could indicate that the fuel supply system is sucking air, use clear fuel lines at the filter head to check for air.

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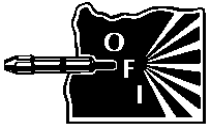


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3. Excessive restriction could also cause a DTCP1093 to set at the same time.
4. Rail pressure should read 1-1.8 MPa with key on and engine off. If out of range replace the rail pressure sensor.
5. With the engine up to operating temperature, use the scan tool to command rail pressure to 21,000 PSI, if the rail pressure will not achieve 21,000 PSI at idle you most likely have a problem with the injectors, Especially if you are having a hard start, miss, rough run or smoke.
6. Disconnect the fuel rail pressure sensor the fuel pressure should be greater than 175 Mpa as displayed on the scan tool.
7. If these codes set only on hard acceleration or when pulling a hill with a load, check fuel supply issues first. Then see if rail pressure will reach 21,000 PSI at idle, if it does then the low rail pressure under a hard load is usually caused by a bad high pressure pump.

DTC P0093 on 2001, P1093 on later vehicles; Difference between commanded fuel pressure and actual pressure is greater than 20 Mpa.

1. If P0087 is set solve P0087 first
2. Similar diagnostics to DTC P0087

DTC P0201 – P0208 misfire codes

1. Can be caused by the FICM wire harness rubbing on the back of the alternator, alternator bracket or FICM harness retaining bracket.
2. Air in the fuel system can also cause misfire codes.

DTC P2146 or 2149; cylinder bank shut down

1. Can be caused by the FICM wire harness rubbing on the back of the alternator, alternator bracket or FICM harness retaining bracket.
2. LLY engine (2004.5-2005), #2 (P0202) and #7 (P0207) misfire codes set with codes P2146 and P2149. Refer to TSB 05-06-04-047B to repair the injector harness brackets and connectors (part # 98017958) for #2 and #7 before replacing the FICM or the injectors.

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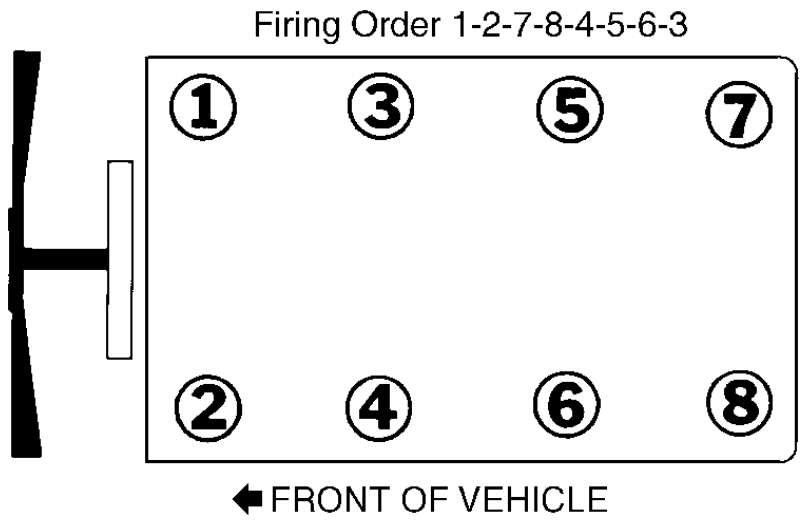
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