

2007.5 – 2010 6.6L LMM Duramax Diagnostics

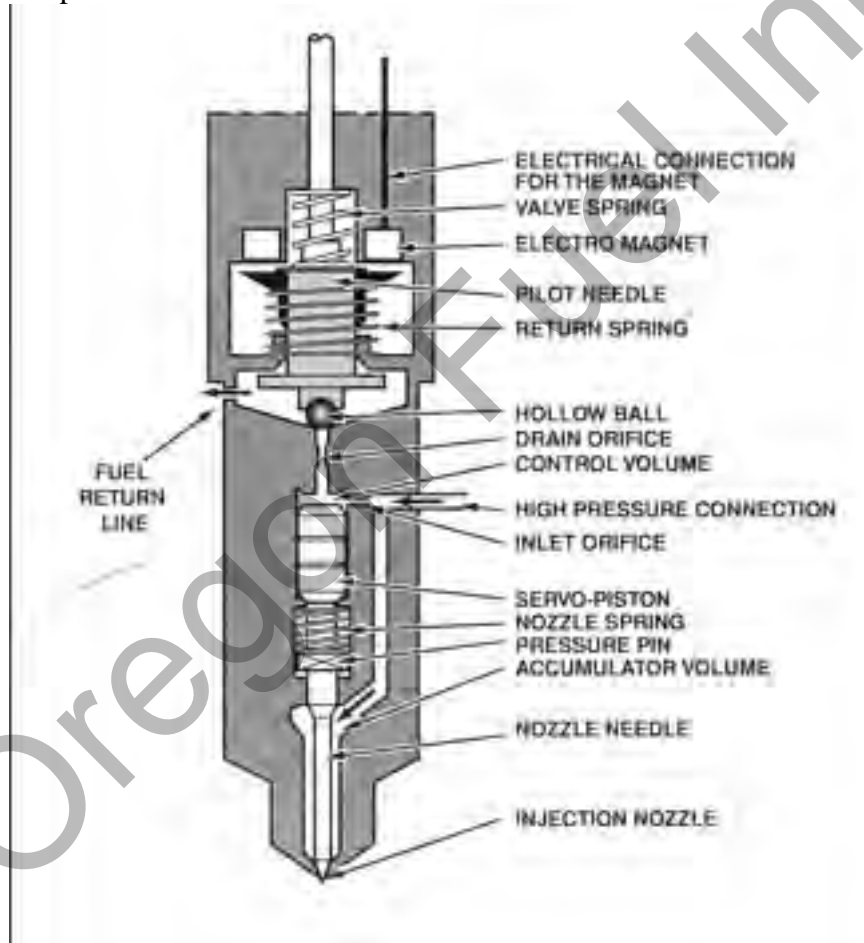
In order to do proper diagnostics you will need a scan tool and some special tools such as a vacuum test gauge J44638 (OTC 6754) available from GM Special Tools

<https://gmtoolsandequipment.com/>. Also note that 1 MPa (megapascal) is equal to approximately 145 PSI, 100 kpa is roughly 14.5 PSI.

If you don't have service information you can buy a subscription online at alldatadiy.com or eAutorepair.net.

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 rail pressure to start.

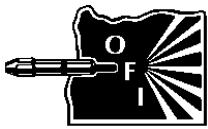


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CAUTION

The fuel system contains high pressure fuel up to 26,000 PSI. Do not use your fingers to find fuel leaks! High pressure fuel entering your bloodstream may result in amputation or loss of life.

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 and other relevant data.

No Start or Hard Start

1. Excessive fuel restriction, check or change fuel filter. [Buy OEM Racor Replacement Fuel Filter](#)
2. Use a vacuum gauge to check the suction side of the fuel system. You should have no more than 5 inches Hg at WOT (wide open throttle) or 7-8 inches Hg under load. If you still have too much restriction after changing the filter, check for collapsing soft fuel lines by the drivers side valve cover and under the truck near the transmission. The fuel tank pick up may also be plugged. 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 before and after the filter housing to check for air in the lines. [Buy OEM Racor Fuel Filter Assembly](#)
4. Confirm actual versus desired rail pressure, even under crank no start conditions
5. If the above are OK, then it comes down the following.
 - a. fuel injectors (see injectors for more diagnostic information) [Buy Bosch 6.6 LMM Injectors](#)
 - b. high pressure injection pump [Buy Bosch Reman CP3 Pump](#)
 - c. Fuel pressure regulator, check to make sure it is not stuck. [Buy Fuel Pressure Regulator](#)
 - 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. [Buy 6.6 Relief Valve](#)
6. Before condemning the high pressure pump you need to make sure there are no high pressure fuel leaks.

Black Smoke

******Diagnosing smoke related issues on trucks equipped with diesel particulate filters may require temporarily disconnecting the filter or installing a test pipe to see the smoke.**

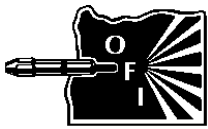
1. If at idle, use the scan tool to cut out one cylinder at a time and see if the smoke disappears.
2. Dirty air filter

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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.

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 cause a miss.
3. Crankcase overfull (fuel dilution) can cause a rough run and balance rates out of specification.

Knock

1. Use scan tool to isolate one cylinder at a time.
2. Use cap off tools to block off one injector at a time.
3. A slight knock can start occurring due to injector problems, often after a contaminated fuel problem.

Surge or Lope at idle

1. Fuel pressure regulator: Map actual versus desired rail pressure, if the graph has a “shark tooth” pattern and there is no air in the system, it is usually caused by a bad fuel pressure regulator. [Buy High Pressure Regulator](#)
2. Air in the fuel system (see fuel supply and filter housing section)

White - Blue smoke at idle when cold

******Diagnosing smoke related issues on trucks equipped with diesel particulate filters may require temporarily disconnecting the filter or installing a test pipe to see the smoke.**

If the smoke clears in less than 1 minute, this could 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.

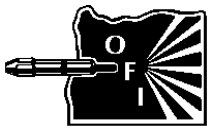
1. Possible bad injector, use the scan tool to cancel one cylinder at a time and see if the smoke clears up. However, using the scan tool to kill the injector does not reduce rail pressure in the injector and the tip can still leak fuel, cap off lines one at a time to pinpoint injector (Miller 9864 Cap off tool). Also look at the balance rates, if the tip is leaking fuel then the balance rates may be out of specification. Try increasing the rail pressure, we find injector nozzles that leak at idle pressure, but do not leak at higher pressure.
2. Check glow plug operation when cold.
3. Check rail pressure when engine is off, it should be 0 PSI.

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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.
5. An EGR cooler that is leaking internally can cause white coolant smoke, often after sitting overnight or for several hours during the day. Coolant smoke will smell sweet and not burn your eyes like fuel smoke.

Dilution

1. Some dilution is normal for DPF equipped engines. Regeneration cycles will cause some fuel to leak past the piston rings in the cylinder and into the oil pan. Normal oil change intervals are critical for this reason.
2. Leak at the high pressure pump drive shaft seal.

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. [Buy OEM Racor Fuel Filter Housing Assembly](#)

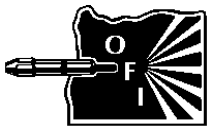
1. Install fuel vacuum test tool.
2. Prime the fuel system with the hand primer until 10 PSI is indicated on the gauge, check for external leaks and repair. If the pressure drops from 10 PSI to 2 PSI in less than 1 minute, remove the fuel outlet line from the filter and cap it. Remove the ignition 1 relay and crank the engine for 2 - 15 second intervals, the high pressure pump should pull at least 12 inches of Hg vacuum. If air gets into the system it will cause a false/low reading.
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, drain valve, rubber hoses and quick 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 black rubber lines to find air, your only other option is to bounce around and replace parts.
5. In some cases the "Filter Life Indicator" will be triggered prematurely, sometimes within 1000-5000 miles after changing the fuel filter. If this problem occurs even though the fuel filter is not restricted, it can be caused by excessive leakage on the high pressure side of the fuel system or other supply side issues. Verify there is no air in the supply system and restriction is not excessive under all load conditions. If these things check ok, diagnose the high pressure side as if there is low rail pressure codes. It seems that fuel flow is calculated in the ECM and is used to calculate fuel filter life. If the calculated flow is high, the ECM assumes a larger quantity of fuel has been filtered.

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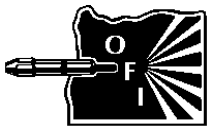
High Pressure Injection Pump (CP3 Pump) [Buy Bosch CP3 Injection Pump](#)

1. Before condemning the pump for a starting issue you need to be certain that the rest of the high pressure fuel system is not leaking the pressure. Perform the injector return flow test.
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. The injectors are typically damaged first, but any contamination that got into the injectors went through the CP3 pump first.
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.
4. Other Notes:
 - If the vehicle has starting issues then the injectors are the most likely cause. Perform the injector return flow test.
 - If the vehicle only acts up during a hard pull with a load and there are no restriction issues then it is more likely a HP pump causing the problem. A bad limit valve could also cause this problem.

Injectors [Buy Bosch LMM Fuel 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. 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. Excessive leakage from the injectors can also cause a DTC P0087 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.
3. 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 canceled will also need to be replaced and are likely to cause low rail pressure during cranking.
4. **Enhanced Injector Return Flow Test-** GM has come up with a test for use on the later Duramax engines. The test steps are listed below-
 - A. Engine at normal operating temperature, 181-189 deg. F.
 - B. Remove return hoses from one bank of injectors.
 - C. Use adapters to run hoses off of injector returns in to individual graduated containers.



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- D. Run engine until fuel flows from all four injector return hoses. Then with the engine at idle, command rail pressure to 17,400 PSI with the scan tool. Place the hoses in the graduated containers for 30 seconds.
 - E. Turn off ignition and record measurements.
 - F. Repeat above steps on the other bank of injectors.
 - G. Add up all recorded measurements to determine total injector return volume. If the return volume is less than 144 ml for all 8 injectors, refer to the high pressure pump test. If the return volume is greater than 72 ml per bank, replace any individual injector with return volume greater than 18 ml.
5. Other Injector Notes:
- Balance Rates, when checked hot in park or neutral, should indicate bad injectors. Any injectors that are more than +4/-6.9 are a possible cause for rough run and will set codes (see DTC's)
 - Miss, smoke or rough run usually indicate that the injectors are the cause. LMM engines with a DPF may not show any smoke, but frequent DPF regeneration events would suggest poor combustion.
 - We have seen a couple of vehicles with no starting issues, but injector return is excessive at higher rail pressures which may cause the P0087 to set.
 - There is a thirteen digit IQA code unique to each injector that must be programmed into the ECM with a scan tool after installation. The IQA code must be programmed to the cylinder number in which it was installed.

Turbo [Buy LMM Turbo and Parts](#)

1. LMM turbos have a vane position sensor, check actual versus desired.
2. Vane position sensor codes indicate sticky or stuck vanes, unison ring wear, VGT actuator failure, restricted oil supply, or a VGT position sensor failure. The design of these turbos is nearly identical to 6.0l Powerstroke turbos which are known for this type of failure. The turbos may free up at higher rpm due in part to additional oil pressure/volume to drive the vane actuator piston. Sticking unison rings are much more common than actuator or vane position sensor failures.

Diesel Particulate Filter

The diesel particulate filter traps soot from the exhaust to lower particulate emissions. During certain driving conditions the engine will perform a regeneration cycle, which will use additional fuel injections and the catalyst to heat up the exhaust temperatures to the point where the soot will be burnt out and form ash. Over time the DPF will become "ash loaded" and need replaced or cleaned.

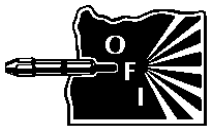
Any engine drive-ability issues or fuel system failures will cause premature plugging or failure of the DPF. If the DPF is plugging repeatedly or requiring excessive regeneration cycles there is probably another problem with the engine, turbocharger,

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fuel system, or EGR system. Repair all other problems PRIOR to addressing the DPF issues.

1. DO NOT reset the DPF timer unless the DPF has been replaced or cleaned (removed and cleaned, not regenerated in the vehicle). The ECM keeps track of fuel used, soot, and ash load. Excess soot and ash load will result if the timer is reset without replacing or cleaning the DPF.
2. If the DPF has been deleted, customers will have run-ability issues if they do not have the correct software. We have also seen EGR related issues that do not set codes with delete software installed. These problems may cause heavy smoke and low power, as well as some other symptoms.
3. A plugged DPF can cause a turbo failure by forcing exhaust under excess pressure around the turbine shaft seals. Low boost/low power complaints must be diagnosed properly and completely prior to repairs!
4. Excessive idle time will also cause DPF restriction due to particulate build up at idle. This will cause poor mileage (zero MPG when idling) due to more frequent regeneration events. Excess idle time could be defined as leaving the pick up running while hooking up a trailer.
5. Using Stanadyne Performance Formula fuel additive, which improves cetane, will reduce regeneration events and improve mileage around town. This is due to a better burn when cold and fewer particulates getting to the DPF.

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 Codes

P003A Turbo Boost Control Position Not Learned

1. Usually sets in conjunction with a P2563 Turbo Boost Control Sensor Performance code. This code usually sets when the unison ring in the turbo is sticking.
2. A defective VGT position sensor can also cause this code to set.
3. Use a Tech2 scan tool to attempt VGT learn. If it will not learn, the unison ring is likely sticky or stuck.
4. The vane position may not change at idle, when commanded, but does change sluggishly at higher RPM. This is usually caused by a sticking unison ring. Higher oil pressure and volume at higher rpm will force the unison ring to move. The turbo needs to be replaced.
5. Also see P2563 below.

P0087 Fuel Rail Pressure Too Low

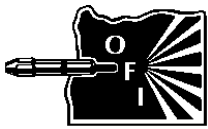
See Enhanced Injector Return Flow Test above also.

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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. Check the fuel lines on the drivers side valve cover and between the transmission and frame for kinking.
3. If restriction 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.
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. Check fuel return from the high pressure limit valve or fuel pressure relief valve. If it is leaking then it will need to be replaced. We have also heard of race plugs leaking, even if you have a race plug, you may want to check for leakage at max rail pressure.
6. 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 and balance rates are excessive. Perform the enhanced injector return test.
7. Disconnect the fuel rail pressure sensor the fuel pressure should be greater than 175 MPa as displayed on the scan tool.
8. 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 heavy load is usually caused by a bad high pressure pump.

P0101 MAF Sensor Performance

1. Most commonly sets due to an aftermarket air filter or intake kit/modifications.
2. Check for ECM updates
3. May cause the engine to go into a limp mode.

P0191 Fuel Rail Pressure Sensor Performance

1. Most commonly caused by a defective rail pressure sensor or sensor pigtail
2. Bad batteries or battery cable connections have been known to cause this code

P029D Injector 1 Leak, P02A1 Injector 2 Leak, P02A5 Injector 3 Leak, P02A9 Injector 4 Leak, P02AD Injector 5 Leak, P02B1 Injector 6 Leak, P02B5 Injector 7 Leak, P02B9 Injector 8 Leak

1. If an injector balance rate exceeds -7.0 these codes will set.

P0401 EGR Insufficient Flow

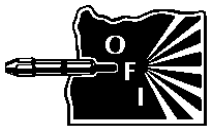
1. Check for ECM updates

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2. EGR coolers commonly will plug up and cause this code to set.
3. EGR valve failure may cause this code to set.
4. Aftermarket air intake kits or filters can cause MAF related codes to set.

P0546 EGT Sensor 1 Circuit High Voltage

1. See P2033, similar procedure, different sensor.

P0571 Cruise Control Brake Switch Circuit Malfunction

1. Almost always sets due to a bad brake lamp switch but can also be a third brake light, fuse, or cruise control switch, among other possible causes.
2. This code will keep the ECM from performing regeneration and will often lead to other DPF related codes (P1448, P244B, P2463)

P1448 DPF Regeneration Frequency Too Low

1. If regeneration cycles are not completed as requested by the ECM, this code will set. Short drive cycles and other codes that may stop regeneration are the typical causes.
2. Often sets in conjunction with P2463 and P244B.

P20E2 EGT Sensor 1-2 Correlation

1. Sets in conjunction with P0546/P2033 or other EGT related codes
2. Diagnose sensor codes first

P2033 EGT Sensor 2 Circuit High Voltage

- Sensor 2 is between the DOC and DPF
1. Most commonly caused by a bad EGT 2 sensor, although it can also be a wiring issue.
 2. If the EGT reads 1800+ degrees KOEO, use a fused jumper wire to jump the two EGT sensor wires at the harness connector. The temp should read less than -40 degrees. If it does, replace the EGT sensor. If not, check wire harness and connector.
 3. This code will keep the DPF from regenerating.

P2146, P2149, P2152, P2155 Injector Positive Voltage Control Circuit Group 1-4

- Group 1–DTC P2146 with injectors 1 and 4
 - Group 2–DTC P2149 with injectors 6 and 7
 - Group 3–DTC P2152 with injectors 2 and 5
 - Group 4–DTC P2155 with injectors 3 and 8
1. Shorted injector solenoids or wire harnesses may cause these codes to set.

P244B DPF Differential Pressure Too High

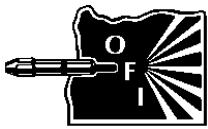
1. Perform service regeneration procedure

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2. Make sure there are no other engine or drive train codes that will keep the ECM from performing regular regeneration cycles.

P2463 DPF Soot Level Accumulation

1. Perform service regeneration procedure
2. Refer to GM TSB 10-06-05-002
3. The DPF may need to be removed and cleaned or replaced

P2563 Turbo Boost Control Sensor Performance

1. Commonly sets when the unison ring is sticking in the turbo. Usually sets in conjunction with a P003A Turbo Boost Control Position Not Learned code.
2. A defective VGT position sensor can also cause this code to set. Remove the sensor and manually push the plunger in while monitoring VGT position with a scan tool. It should smoothly range from 0% to 100%, and spring back to 0% when released. If not, replace the sensor.

Other Useful Tips

- Medium Duty GM trucks (C4500+) may have a rear axle steer switch located in the center of the dash. If this switch is turned on, the engine will have low power, low boost, and low rail pressure readings. *This switch will also be in trucks without rear steer!*
- Chassis Cab and Medium Duty trucks with a PTO will exhibit the same symptoms as listed above if the switch is on.
- Injector commanded pulse width can be used to determine injector/cylinder issues. As a general rule, anything under .30 ms at idle in gear will indicate an over fueling injector. Anything over .50 will indicate an under fueling injector or weak cylinder.
- Firing Order 1-2-7-8-4-5-6-3

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