2003-2007 Cummins 5.9L Diagnostics

High Pressure Common Rail Basic Information

The high pressure pump builds the high pressure and delivers it to the fuel rail manifold where it flows through the injector lines and injector connector tubes to the injectors. The fuel pressure regulator (fuel control actuator) in the high pressure pump controls fuel 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 injector connector tubes, where they seat into the injectors, leak or the check ball in the injector is leaking or the high pressure limit valve then it will not build enough rail pressure to start the engine. It takes approximately 4000 PSI rail pressure to start the engine.

CAUTION

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

Preliminary checks

1. Record and repair any active DTC, they may be related to complaint
2. Ensure that you have a good clean fuel supply and good fuel supply pressure.

No Start or Hard Start

1. No or low fuel supply to the high pressure pump (CP3)
2. Monitor rail pressure and see if you have over 4000 PSI during cranking, if not one or more injectors can cause a hard start, see injector section for further diagnostics. No smoke from the tailpipe after about 10 seconds of cranking means no fuel is getting into the cylinders.
3. Injector connector tube not seated in injector, bad tube or improper torque on nut.
4. Leaking fuel pressure limit valve, should not leak at idle or during cranking.
5. Verify high pressure pump output volume (see high pressure pump info). You can also cap off all the injectors and see how quickly the rail pressure climbs. It takes about 4000 PSI rail pressure in order to start.
6. Shorted fan clutch, unplug fan and try starting again.

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.

Misses

1. Use scan tool to isolate one cylinder at a time.
2. A bad or incorrect torque on an injector connector tube, missing or damaged chamber gasket,

low compression or excessive valve lash could all cause a miss.

Knocks

1. Use scan tool to isolate one cylinder at a time
2. Use cap off tool 9011 to block off one injector at a time.

Surge at idle

1. Low or no fuel supply pump pressure to the high pressure pump
2. Actual pressure versus desired pressure too far apart, map the fuel pressure graph, may be a bad FCA (fuel control actuator). If you have a fluctuation over 500 PSI this can cause a surge.

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

1. Possible bad injector, leaking at the nozzle tip. Use the scan tool to kill one injector at a time to isolate. However, this does not reduce rail pressure in the injector and the tip can still leak fuel. Cap off the rail one line at a time (cap is tool # 9011) to pinpoint injector.
2. The intake air temperature, engine coolant temperature, inlet air temperature and battery temperature should all display normal ambient temperatures when cold. If not, repair as necessary.
3. Check intake heater operation when cold.
4. Check rail pressure when engine is off, it should be 0 PSI (+/- 500 PSI).
5. Low or no fuel supply pressure, supply pump or fuel filter etc.
6. Excessive idle time can cause white smoke when cold due to carbon build up on injector tips. More than 20% idle time is excessive.

Dilution

1. Upper injector o-ring
2. Cracked injector, remove valve cover and inspect for leaks while the engine is running. A leak will often look like a fog or haze of fuel.
3. Leak at the high pressure pump driveshaft seal.

Fuel Supply Pump

- 2003 and 2004 model years originally had the fuel supply pump mounted on the fuel filter housing. 2005 through 2007 5.9L had the fuel supply pump mounted in the tank. There are replacement fuel supply pumps for 2003 and 2004 that mount on the fuel filter housing, but have been updated to a different style. There are also fuel supply pumps that mount on the frame rail and replace the in tank supply pumps, such as the FASS pump and the BD Max-Flow pump. Test the fuel supply pressure at the inlet to the CP3 pump. Normal pressure is 10 PSI at idle and they typically drop close to zero PSI under load. Zero supply pump pressure will not

damage the CP3 high pressure pump like it does to the earlier VP44 pump

High Pressure Pump (CP3 Pump)

1. Most starting problems due to low pressure are caused by bad (check ball seat) injectors. You can unplug the fuel control actuator and the pressure should default to maximum pressure (23,500 PSI), however if there is a leak in the high pressure system then the pump will not build enough pressure. 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 also went through the CP3 pump.
2. Volume test; the CP3 pump should discharge 70 ml (at 150 rpm or 90 ml at 200 rpm), from the CP3 to rail manifold fuel line, in 3 10 second cranking intervals (total of 30 seconds cranking). Remove the fuel discharge line from the CP3 pump to test out put.
3. If the cascade over flow valve is bad this can send fuel out the return line instead of to the charging circuit of the CP3 pump.

Injectors

It takes about 4000 PSI rail pressure in order for the injectors to deliver fuel and the engine to start.

1. Maximum allowable leakage for all injectors combined is 160 ml per minute: check when engine coolant temperature is above 180 degrees, 1200 rpm and fuel rail pressure is equal to 20,305 PSI.
2. Any injector contributing more than 40 ml is excessive. IE: if total leakage is 200 ml and blocking off number one injector reduces the total leakage to 160 ml, cylinder number one injector has excessive leakage and is bad.
3. If you have a no start condition, maximum allowable return is 90 ml per minute at 200 rpm cranking speed, be careful not to over heat the starter during testing.
4. Damaged or loose high pressure injector connectors can cause excessive leakage.
5. Excessive leakage usually results in a starting issue, which could occur hot or cold, but usually occurs hot because the fuel is thinner when hot.

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 P0148; high pressure common rail checksum, which is a deviation between the fuel pressure set point and the actual fuel pressure.

1. FCA, check for rust on the fuel control actuator, which could indicate other fuel system problems caused by water contamination.
2. Fuel pressure sensor
3. Lift pump or fuel supply issues, check fuel supply pressure and fuel filter condition.
4. Cascade over flow valve
5. Pressure limit valve
6. Injectors, excessive return, see injectors

7. High pressure pump (CP3)

DTC P0300 – P0306; injector misfire, all and 1 through 6

1. Low fuel supply pressure
2. Use scan tool to isolate each cylinder

DTC P0217; decreased engine performance due to a engine overheat condition

1. Check ECT sensor
2. Restricted air flow (caked dirt and bugs) through the intercooler and radiator.

DTC P0251; CP3 pump regulator control, ECM detects a discrepancy between PWM signal supplied to FCA and the PWM returned from FCA

1. Low or no fuel supply pressure (bad supply pump or plugged filter)
2. Fuel Control Actuator (FCA) bad, use the scan tool to verify rail pressure set point versus fuel pressure. Normal idle pressure is 6000 – 7000 PSI. If you have a fluctuation over 500 PSI this can cause a surge as well.

DTC P0336; crank position sensor (CKP) signal, CLP below calibrated value

1. Excessive cranking with a no start condition
2. CKP sensor
3. CKP wiring issue