2008– 2010 6.4L Ford Powerstroke

In order to do proper diagnostics you will need a scan tool, preferably Ford IDS, and some special tools. 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.

6.4L High Pressure Common Rail Basic Information

The high pressure fuel injection pump increases the fuel pressure up to 169.96 MPa (24,650 psi) and delivers fuel to the fuel rails through 2 high pressure lines, 1 per bank. The system pressure generated by the high pressure fuel injection pump is constantly adjusted by the powertrain control module (PCM) for every operational condition. However, due to the storage volume of the fuel rails, the injection pressure remains constant over the duration of the injection process. Each fuel rail is connected to 4 injectors through individual high pressure pipes. The injectors are controlled by the PCM and are capable of delivering exact fuel quantity based on the operational demands. The fuel injectors are operated in 3 stages: fill stage, main injection stage and end of main injection stage. The fill stage (pre-injection) reduces the combustion noise, mechanical load and exhaust emissions.

When the PCM commands the fuel injector on, the piezo actuator is energized and pushes the valve piston downward. The downward force of the valve piston pushes the fuel injector valve and fuel injector valve return spring down which opens up a bore hole that connects the control piston chamber with the fuel return chamber. When this happens a small amount of fuel flows from the control piston chamber to the fuel return chamber reducing the pressure and the downward force of the control piston. The pressure drop is enough for the upward force in the high pressure chamber to overcome the downward force of the control piston which allows the nozzle needle to move up, the fuel to atomize and enter the combustion chamber.

CAUTION

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

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, No Crank

- If the EGT sensor(s) are unplugged and an attempt is made to turn the key on or start the engine the PCM will disable the starter and not allow the engine to crank.
- Exhaust gas temperature sensor failures on sensors 1 and 2 will cause the PCM to enter a "limp" mode. If sensor 3 fails, however, the PCM will enter an inhibit mode and keep the engine from cranking until the failure is resolved.
- If codes P242D and P200E are set, diagnose these first. See DTC diagnostics blow.

No Start or Hard Start

1. Excessive fuel restriction, check or change fuel filter. Buy OEM Quality Fuel Filters
2. Check low pressure fuel supply, should be 5-10 PSI
3. Check for air in fuel system
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 6.4 Powerstroke Injectors
    b. high pressure injection pump Buy K16 6.4 Powerstroke High Pressure Pump
6. Before condemning the high pressure pump you need to make sure there are no high pressure fuel leaks.
7. See P0003 diagnostics below if the code is set
8. Print out and perform the Ford Hard Start/No Start diagnostic sheet

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 or block off tools 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.
5. Leaking injector nozzle tips.

Misses

1. Use scan tool to isolate one cylinder at a time. Run the cylinder contribution test to isolate cylinders. Run the test both cold and hot (after a hard drive)
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.

4. Perform a relative compression test to see if one or more cylinders are out of range. A failed relative compression test usually indicates a base engine problem. It is common for pistons to crack and cause loss of compression, especially if the engine has aftermarket ECM performance programming.
5. Broken rocker arms

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.
4. Broken rocker arms, a common issue for the 6.4l, can sometimes make a popping or knocking sound.

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. Also look at the fuel trims, if the tip is leaking fuel then the fuel trims 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. Buy 6.4 Powerstroke Injectors
2. Check glow plug operation when cold.
3. Check engine compression. It is always a good idea to check compression on these engines prior to replacing injectors. Low compression may present like bad injectors and cause a misdiagnosis.
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. We suggest no more than

5,000 miles of normal use, or 3,000 miles if experiencing frequent regenerations or a lot of short trips.

2. Leak at the high pressure pump drive shaft seal.
3. Leaks at the injector lines and/or fuel rails.

Fuel Supply and Fuel Conditioning Module

Fuel is pumped from the fuel tank to the primary fuel filter by the electric fuel pump (both located in the fuel conditioning module). Pressurized and filtered, approximately 34.5-69 kPa (5-10 psi) during engine idle, the fuel is pumped through the fuel supply line to the secondary fuel filter (the secondary fuel filter housing is located on the front left side of the engine). The filtered fuel leaves the secondary fuel filter and flows to the high pressure pump. The pressure regulator (located in the secondary fuel filter) relieves the pressure, sending some of the fuel back through the fuel return line to the fuel conditioning module and to the fuel tank.

High Pressure Pump

The high pressure fuel injection pump is gear driven by the camshaft gear and is located at the rear of the engine. It increases the fuel pressure from approximately 34.5-41.3 kPa (5-6 psi) up to 169.96 MPa (24,650 psi) and delivers it to the fuel rails.

The high pressure pump also contains the pressure control valve (PCV, high pressure side control valve) and volume control valve (VCV, controls volume of low pressure fuel supplied to high pressure stage of the pump). These parts are not serviceable separately from the high pressure pump at this time.

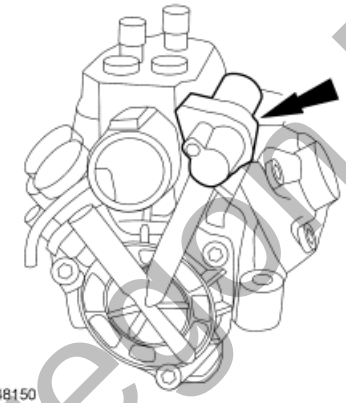

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Illustration 1: VCV Location

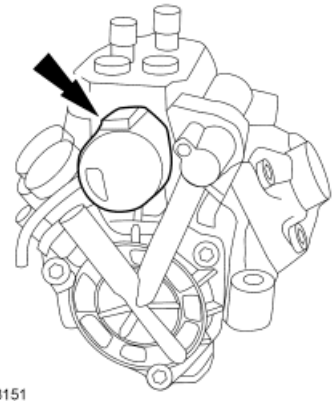

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Illustration 2: PCV Location

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 pump first.
3. The most common failure of the high pressure pump is the inability to maintain appropriate rail pressure for a given condition. This problem will usually set a P0088 or P0087 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 fuel supply issues then it is more likely a HP pump causing the problem.
    - Buy 6.4 High Pressure Injection Pump

Coolant Loss

- The radiators are known to leak at the lower left corner. There is several Ford TSBs related to this concern. Aftermarket aluminum radiators are a good upgrade to prevent this problem. Also replace the thermostats when replacing a radiator.
- The 6.4l engine is equipped with two EGR coolers. Either one can fail and allow coolant to enter the exhaust or exhaust to enter the cooling system and cause coolant to vent from the overflow bottle. The horizontal cooler tends to fail more often than the vertical cooler. Buy Bulletproof EGR Coolers
- Check for excessive cooling system pressure under load. The head gaskets tend to fail in a similar manner to the 6.0l engines.
- Check for coolant in the engine oil. The front cover can erode behind the water pump and leak into the crank case.

Injectors

The fuel injectors are connected to the high pressure fuel rail and deliver a calibrated amount of fuel directly into the combustion chamber. The injectors on and off time is controlled by the piezo actuator device which allows extreme precision during the injection cycle. The piezo actuator is commanded on by the PCM during the main injection stage for approximately 0-400 micro seconds. Buy 6.4 Powerstroke Injectors

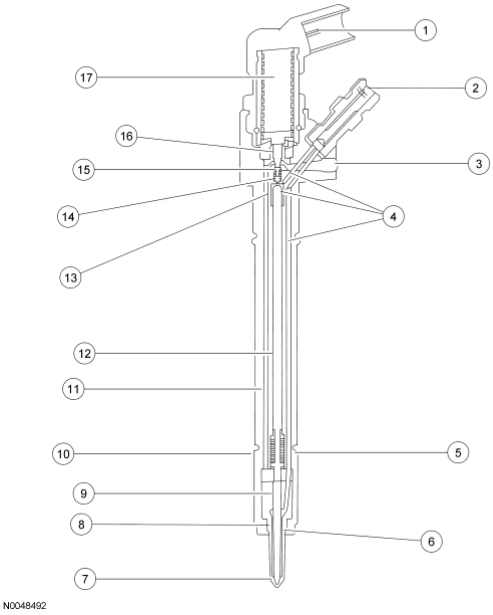


Illustration 3:

1. Electrical harness connector 2. High pressure fuel in from the fuel rail 3. Fuel return chamber 4. High pressure fuel

5. Needle control spring 6. Steel combustion gasket 7. Spray holes (6) 8. High pressure chamber 9. Nozzle needle 10. O-ring 11. Fuel return passage 12. Control piston 13. Control piston chamber 14. Fuel injector valve return spring 15. Fuel injector valve 16. Valve piston 17. Piezo actuator (Courtesy Ford)

Other Injector Notes:

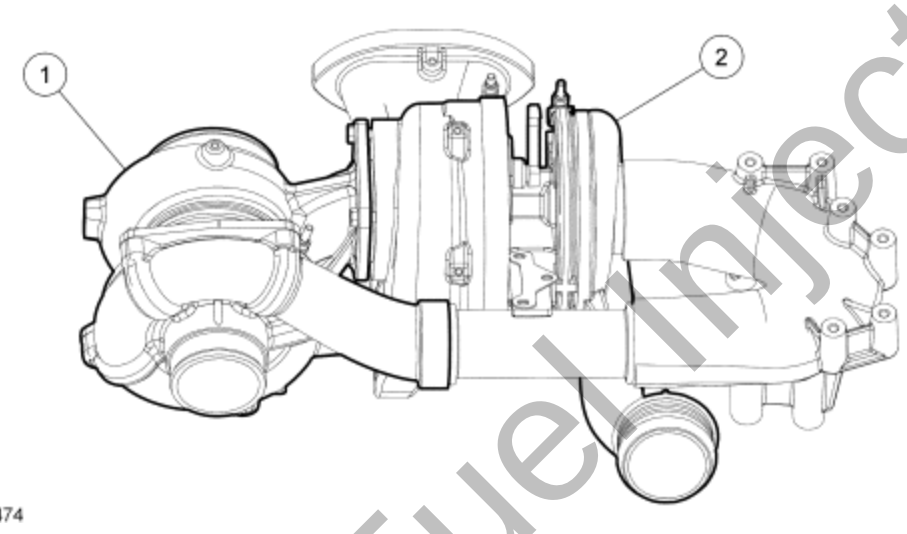
- Fuel trims, or TFTs, should indicate bad injectors. Any injectors that are more than +-10 are a possible cause for rough run, excessive regeneration events, smoke, and poor performance.
- Miss, smoke or rough run usually indicate that the injectors are the cause. Engines with a DPF may not show any smoke, but frequent DPF regeneration events would suggest poor combustion.

Turbochargers

The two stage variable turbocharger geometry is controlled by the turbocharger actuator, from the powertrain control module (PCM) commands through the controller area network (CAN). The turbocharger control is a closed-loop system that uses the exhaust pressure (EP) sensor to provide feedback to the PCM. In response to engine

speed, load, manifold pressure and barometric pressure, the PCM controls the turbocharger actuator position to match manifold boost to the requirements of the engine.

Filtered air enters the low pressure turbocharger and is compressed and delivered to the high pressure turbocharger (variable turbocharger geometry). The high pressure turbocharger delivers the heated compressed air to the charge air cooler (CAC). Considerably more air is forced into the intake manifold causing the pressure to be much greater than normal atmospheric pressure. This results in increased power, fuel efficiency and the ability to maintain power at higher altitudes.



1. 6.4l turbos are known to have problems with leaking oil in to the charge air system. If the engine is using an excessive amount of oil and/or there is oily smoke from the exhaust, remove the CAC tubes and inspect for oil. A residue is normal, but puddles of oil are excessive. If there is nothing in the intake side, remove the downpipe and check for excessive oil. Oil in the exhaust usually indicates a turbo failure, as long as the engine is ok internally.
2. Vane position sensor codes indicate sticky or stuck vanes, unison ring wear, VGT actuator failure, or a VGT position sensor failure.
3. **Buy 6.4 Powerstroke Twin Turbo Assembly**

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, 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 PCM 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

P0003 Fuel Volume Regulator Control Circuit Low

- Perform diagnostics outlined in TSB 7-26-2

1. Unplug connector C1926 near the high pressure fuel pump cover.
2. Check pin 4 green/white and pin 2 yellow wires for a short to ground.
    - If either one is shorted to ground, remove the high pressure fuel pump cover and replace the pump cover gasket/harness that contains the grounded wire ONLY. The high pressure fuel pump does not need to be removed and replaced. Buy 6.4 Powerstroke High Pressure Fuel Pump Install Kit

- When removing the low pressure fuel lines and high pressure fuel tubes from the high pressure pump, use a back up wrench on the high pressure pump fittings to make certain that the fittings are not loose as the cap nuts and high pressure fuel tubes are removed (this may cause a fuel leak).
- When installing the new high pressure pump cover gasket/harness, verify that the VCV wires are wrapped in either high temperature convolute or a mesh style abrasion wrap.
- When making electrical connections to the high pressure fuel pump, pull the connectors to verify connectors are locked in place.

P0087 Fuel Rail Pressure Too Low

1. Check the fuel supply system for pressure, volume, and contamination
2. Check for a skewed rail pressure sensor. It should read 0 KOEO
3. Reset adaptive learning tables for the PCV and VCV
4. If the problem still occurs, it is probably a defective high pressure pump and/or pump cover gasket

P0088 Fuel Rail/System Pressure Too High

1. Perform re-flash per TSB 12-7-7
2. Check the fuel supply system for pressure, volume, and contamination
3. Check for a skewed rail pressure sensor. It should read 0 KOEO
4. Reset adaptive learning tables for the PCV and VCV
5. If the problem still occurs, it is probably a defective high pressure pump and/or pump cover gasket

P0128 Coolant Temperature Below Thermostat Regulating Temperature

- Verify that the engine does not reach operating temperature
- It is likely the thermostat is stuck open. This can keep the regeneration system from cleaning the particulate filter, which will cause smoke and a lack of power. Repair the P0128 before any further tests are performed.

P200E Catalyst System Over Temperature Bank 1

- See P242D

P242D Exhaust Gas Temperature Sensor Circuit High (Bank 1 Sensor 3)

1. Access the exhaust gas temperature sensor that is setting the code.
2. Unplug the sensor, check the resistance of the sensor, if it is open circuit, replace that sensor. Buy EGT Sensor 6.4 Powerstroke (3 total sensors)
3. If the sensor resistance is not open, back probe the sensor voltage wire, see a wiring schematic for reference. If the voltage exceeds 4.75 it will set this code. If the voltage does exceed this range, back probe a ground into the ground circuit of the sensor, if the voltage is still above 4.75, suspect a faulty sensor.
4. A plugged particulate filter or converter may also cause similar issues. In that case, the engine would start fine after the code is cleared, but as soon as the

exhaust begins to get too hot, a exhaust temperature sensor code may set and put the engine into limp mode. Then once the engine is shut off, it will not start again until the exhaust cools off. In most cases, a particulate filter code will set with the temperature codes if this is the cause of the failure.

P0401 EGR Insufficient Flow

1. Check for ECM updates
2. EGR coolers may 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.

P2002 Particle Filter Efficiency Below Threshold

1. Check for any air inlet restrictions such as a plugged air filter, and make sure there are no leaks in any of the Charge Air Cooler (CAC) hoses or connections. Also check for aftermarket air filters, intake kits, or exhaust modifications. These may cause this code to set.
2. If the air inlet is OK, remove the Diesel Particulate Filter (DPF) and the Diesel Oxidation Catalyst (DOC). If a scanner is available to command it, perform an exhaust regeneration (Regen) and recheck operation. If the function is not available through a scanner, the vehicle will need to be driven, normally at cruise speeds, until the Powertrain Control Module (PCM) puts in to the Regen mode, then drive until the procedure is done and recheck operation.
3. If the DPF has been replaced in the last 3000-4000 miles Ford recommends resetting the DPF parameters and retesting. The PCM basically ignores DPF pressure readings for the first 3,100 miles until the DPF is “conditioned”.

P20E2 EGT Sensor 1-2 Correlation

- Refer to TSB 12-12-10

P2291 Injection Control Pressure Too Low- Cranking

- This code may indicate a high pressure system failure. Verify the low pressure fuel supply system is OK, then proceed with high pressure system diagnosis.

P2463 DPF Soot Level Accumulation

1. First try to verify that the Powertrain Control Module (PCM) is updated to the latest calibration. Ford has had several PCM updates to adjust the regeneration (regen) strategy. If the PCM is updated and still sets a code P2463, suspect that the Diesel Particulate Filter (DPF) is excessively restricted.
2. Use a scan tool to attempt a manual regeneration. If it will not complete or will not allow access to the procedure and the code P2463 returns, suspect the DPF is excessively restricted. In some cases the DPF can be removed, baked, and

cleaned. Otherwise, the DPF will need to be replaced, and the DPF reset procedure done with a factory scanner or equivalent.

Other useful information:

- The 6.4l engines have similar architecture to the 6.0l engines and therefore have some similar issues, such as head gasket failures and engine oil cooler failures.