**All genuine O.E.M. or aftermarket parts can be purchased at Jerseydieselparts.com. You can contact us at 888-303-3331 for assistance.**

In order to do proper diagnostics you will need a scan tool, diagnostic service information and some special tools available from;

**Ford Resources**

- www.fordspecialtools.com Ford/Rotunda/SPX special tools
- www.motorcraftservice.com Scan tool information and service information, you can purchase three days, a month or year.
- Mitchell, Motors, and Identifix also offer online service information
- www.helminc.com Printed publications such as manuals and TSB, as well as online subscription choices.
- If you don't have service information you can buy a subscription online at
- alldatadiy.com
- eAutorepair.net.
- forscan.org
- Ford SPX
- Freedom Racing Tool
- www.forddoctorsdts.com Many different articles to help with diagnosing the Ford Powerstroke

Note* that 1 MPa is equal to approximately 145 PSI, 100 kpa is about 14.5 PSI

## 2011 – 2016 6.7 L Powerstroke

## CAUTION

The fuel system contains high pressure fuel up to 29,000 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. Document all codes before proceding!

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. Excessive smoke from the tailpipe with a DPF installed usually means the DPF is damaged and may need replaced. If it is smoking into the DPF it will clog the filter.

## 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 and the pressure regulating valve in the rail control rail pressure. The injectors have a piezo stack instead of an electro-magnetic solenoid. When energized, the piezo crystals expand, lifting the control valve off of its seat via a hydraulic coupler (connecting plunger below) to begin injection. If the valve seat in the injector is leaking or the pressure regulating valve leaks then it will not build enough rail pressure to start the engine.

## .No Start or Hard Start

1. This system needs 5000 PSI of fuel pressure to open the injectors. Use a scan tool to monitor rail pressure while cranking. Actual pressure should meet desired pressure under all conditions. If actual meets desired and the engine still won't start, diagnose any other codes that are in the PCM.
2. If your scan tool shows low fuel pressure cranking, check the low pressure fuel supply first. This can be done by monitoring the fuel delivery switch on your scan tool. This switch will read "low" if the low fuel pressure is not correct. If the low side pressure is good, it will read "not low". It is also a good idea to check supply pressure with a gauge. The minimum pressure allowed before the fuel delivery switch engages is 52 PSI. Normal pressure is between 53-73 PSI per Ford.
3. If the low side is good, inspect the fuel filters, see TSB 11-10-10 for contaminated fuel if the fuel filters appear to be plugged and/or contaminated. If there is no contamination, remove the return hose from the Pressure Control Valve in the left fuel rail. Plug the hose leading to the fuel return system. Crank the engine and watch for fuel flow from the valve. If there is a measurable amount of return, the valve is bad. If not, the valve is holding pressure.
4. Check the injectors for excessive return. Remove the return rails and plug the rails with a suitable tool, then crank the engine while watching the injector returns. A small amount of return is normal, but more than 3 ml in 15 seconds while cranking or at idle is considered excessive. (GM LML Duramax spec. Ford does not specify a return specification or injector return diagnostic procedures.) .

5. Verify the fuel injector return line pressure is greater than 3 BAR (see “Fuel Injectors” for more information).
6. Remove the high pressure regulator from the high pressure pump and check for metal debris. If there is metal found, the entire high pressure fuel system must be checked for metal and replaced as needed. Ford recommends replacing the injection pump, rails, high pressure fuel lines, fuel injectors and fuel return rails if metal is found.(See picture under High Pressure Pump).
7. Start and die, then no start. Engine sounds like it is cranking faster than usual. Check the EGR Throttle Plate for a sticking butterfly, causing an air restriction and loss of compression.

## 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. Excessive smoke from the tailpipe with a DPF installed usually means the DPF is damaged and may need replaced.**

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 or unusual rushing or whooshing air sound under load.
4. Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage.
5. Inspect for the EGR valve sticking open.
6. Inspect the turbo to be sure the VGT actuator is functioning normally. (see P1247)

## Misses /Cuts Out

1. Use scan tool to isolate one cylinder at a time. Monitor power balance to find a suspect injector.
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. Inspect for an intermittent Fuel Rail Pressure sensor signal by wiggling the harness between the sensor and the ECM with the ignition ON and the engine OFF, while **monitoring the parameter with a scan tool.**

## Knock

1. Use scan tool to isolate one cylinder at a time. Monitor power balance to find a suspect injector.
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: Watch actual vs. desired rail pressure. If the actual deviates more than +-300 PSI from desired, the regulator could be sticky.
2. Inspect for an intermittent FRP sensor signal by wiggling the harness between the sensor and the ECM with the ignition ON and the engine OFF, while monitoring the parameter with a scan tool.
3. Air or other contamination in the fuel system.

## White or blue smoke at idle

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 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. Inspect the engine coolant temperature (ECT) sensor. Use the scan tool in order to compare the ECT with the ambient air temperature on a cold engine. The readings should be within 5 degrees on one another.
4. Check the coolant level in the reservoir. White coolant smoke may be mistaken for blue/gray smoke. If the coolant level is low, diagnose the cooling system. Coolant smoke will smell sweet and not burn your eyes like fuel smoke.
5. 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.
6. In cold ambient temperatures it is normal to see some white vapor from the exhaust when the PCM is performing a regeneration due to the very high exhaust temperatures.

## 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 drain into the oil. 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 electric fuel pump in the fuel conditioning module draws fuel from the fuel tank through the fuel supply line. When the fuel enters the fuel conditioning module, water is separated from the fuel before it flows through the 10 micron fuel filter which separates particles from the fuel. The separated water collects at the bottom of the pump. If enough water is collected, the WIF sensor detects it and the PCM illuminates the WIF indicator. The conditioned fuel is then delivered to the secondary fuel filter.

The vented fuel from the fuel pressure control valve returns from the secondary fuel filter through the fuel return port and enters the unfiltered side of the fuel conditioning module. Depending on the fuel temperature returning from the secondary fuel filter, the recirculation thermostat directs the fuel to the fuel tank or through the fuel conditioning module back to the inlet of the primary filter.

The 6.7L engines use a “fuel delivery pressure switch” to monitor fuel supply pressure and to warn the driver if the pressure drops below a threshold. This helps to protect the CP4 high pressure pump, which is susceptible to damage from a lack of fuel supply pressure. It is a normally closed switch that monitors the fuel delivery system pressure prior to the high pressure fuel injection pump. The fuel delivery pressure switch opens when the fuel system pressure reaches 365 kPa (53 psi) or above. If the fuel delivery system pressure drops below 365 kPa (53 psi) the switch closes, and if the fuel delivery pressure switch remains closed for more than 60 seconds, the PCM notifies the driver by displaying a low fuel pressure warning in the message center, and an engine derate occurs. The fuel delivery pressure switch is located at the top left of the engine in the fuel injection pump supply tube, forward of the secondary fuel filter.

2015 and newer 6.7L engines use an “integrated fuel pressure and temperature sensor” in the tube assembly that supplies fuel to the high pressure pump. The integrated fuel pressure and temperature sensor provides fuel temperature input to the PCM to control fuel system operating parameters, and makes sure the minimum fuel supply pressure required by the high pressure fuel injection pump is being achieved.

# High Pressure Injection Pump (CP4.2 Pump)

**Note: The CP4.2 pumps are not as durable as the CP3 pumps. Poor fuel supply, contamination, and/or running them out of fuel (plugged fuel filter) will cause them to fail. When they fail it is often catastrophic and they send metal particles throughout the high pressure side of the fuel system, causing further damage.**

1. Check the fuel supply system first: see “Fuel Supply” above.
2. Before condemning the pump for a starting issue you need to be certain that the high pressure fuel system is not leaking the pressure. Check the injector return and the pressure control valve in the fuel rail.
3. 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 as well if the pump is damaged.
4. If the pump will not build the desired pressure while cranking and everything else checks OK, remove the regulator from the pump and inspect for metal (see picture below). If there is metal debris, the entire fuel system will need to be cleaned and/or replaced.
5.

# Fuel Injectors

**Note: The injectors are a piezo type CR injector (see first page). Diagnosis is much different than the earlier generations.**

The engine control module (ECM) supplies a high voltage supply circuit and a high voltage control circuit for each fuel injector. The injector high voltage supply circuit and the high voltage control circuit are both controlled by the ECM. The ECM energizes each fuel injector by grounding the control circuit and supplying each fuel injector with up to 250 V and 20 amps on the voltage supply circuit to activate the piezo type fuel injectors. This is controlled by boost capacitors in the ECM. During the 250 V boost phase the capacitor is used to charge the injector piezo stack allowing for injector opening. The injector is then held open with this high voltage. At the end of the injection event the ECM closes the injector by discharging the injector piezo stack.

1. The injectors are cooled by a calibrated amount of fuel flow through the injector body to the injector return lines. If the injectors are worn, damaged, or contaminated, the amount of fuel flowing through the injector body may increase, resulting in improper injector performance. The maximum allowable leakage for one injector is 3 ml in 15 seconds, cranking or at idle.
2. The injectors require a minimum of 3 BAR (45 psi) of pressure in the return system. The return fuel from the fuel injectors flows through the injector return hose to a tee containing an orifice controlling the backpressure on the injectors, and from the tee back into the secondary fuel filter inlet fitting. During engine cranking, fuel pressure

from the diesel fuel conditioning module is applied to the injector return connectors through this return hose to create the backpressure necessary for the injectors to function. During normal operation, injector return fuel flowing though the orifice creates the required backpressure.

## Other Injector Notes

- Power balance, when checked in Park or Drive, should indicate bad injectors or cylinder performance issues.
- Miss, smoke or rough run usually indicate that the injectors are the cause. 6.7L engines with a DPF may not show any smoke, but frequent DPF regen events would suggest poor combustion.
- The PCM uses a strategy called “zero fuel calibration” to determine injector wear and adjust accordingly. Zero fuel calibration is an algorithm used to detect deviations in individual fuel injector performance from nominal. In an overrun decel fuel shut off condition, fuel rail pressure is set to 3000 kPa (4351 psi) and small injections are made from a single fuel injector. The observed acceleration in crankshaft speed is detected and compared to the expected acceleration. If the observed acceleration deviates from the expected acceleration by more than 50%, then an additional routine is called that adjusts the injection energizing time until observed acceleration matches expected. This information is then used to adjust all injections on that fuel injector for a correct fuel delivery. If the absolute energizing time observed for the test injection to yield the expected acceleration exceeds minimum or maximum limits, a DTC sets.

# Turbo

The dual boost turbo used on the wide frame vehicles (pick-up) through 2014 model year is a 3 wheel design with a single turbine and 2 compressors placed back to back. The 2 compressor wheels are similar to each other. They have the same diameter and are optimized to reduce pressure differences that could cause noise or air flow issues. The standard 2 wheel design is used on the narrow frame (chassis cab) vehicles.

The turbocharger uses variable vanes that surround the turbine wheel to dynamically adjust turbo speed using exhaust gases. During engine operation at low speeds and load, the vanes are closed to accelerate exhaust gases across the turbine wheel to help quickly increase turbo wheel speed. At high speeds the vanes open to prevent turbocharger over speed conditions.

The turbocharger uses a ball bearing cartridge that surrounds the turbocharger shaft to help provide a decrease in spool up times. Separate oil and water feeds flow through the turbo mounting pedestal to lubricate and cool the turbocharger to eliminate as many external connections as possible. The front of the pedestal houses the turbocharger oil filter.

The turbocharger provides up to approximately 206.84 kPa (30 psi) boost at up to 130,000 RPM.

The 2015 and newer model year F-250/350 pick-ups use a more conventional Garrett VGT turbo similar to those used on the 6.0L Powerstroke and LLY through LML Duramax engines.

## Diesel Exhaust Fluid

Diesel exhaust fluid (DEF), AKA reductant or urea, is injected into the exhaust gases prior to entering the SCR (selective catalyst reduction) stage. Within the SCR, No2 (Nitrogen dioxide) is converted to nitrogen, carbon dioxide, and water vapor through a catalytic reduction fueled by the injected DEF.

DEF is a mixture of 66% deionized water and 34% urea and will freeze at temperatures below 32 degrees. There are 3 reductant heaters. Reductant heater 1 is in the reductant reservoir, reductant heater 2 is in the supply line to the reductant injector, and reductant heater 3 is at the reductant pump. The ECM monitors the reductant temperature sensor located within the reservoir in order to determine if reductant temperature is below its freeze point. If the ECM determines that the reductant may be frozen, it signals the Glow Plug Control Module (GPCM) to energize the reductant heaters.

Optimum NOx reduction occurs at SCR temperatures above 250°C (480°F). At temperatures below 250°C, the incomplete conversion of urea forms sulfates that can poison the catalyst. To prevent this poisoning, the ECM suspends DEF injection when exhaust temperature falls below a calibrated limit. Because of this, any issues with the EGT sensors will affect DEF system operation. EGT sensor and DEF system codes set at the same time are likely related.

**In order to properly diagnose and repair the DEF system, a Ford IDS scan tool and Ford service information is required. There are many safeguards and reset procedures that must be completed when repairs are made in order for the systems to function normally.**

## Other notes:

A leak in the reductant system can be located by inspecting for a build-up of crystallized diesel exhaust fluid.

## 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 unless the DPF has been replaced or cleaned (removed and cleaned, not regenerated in the vehicle) or the service information instructs you to. 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.

## Secondary Cooling System

One of the unique features of the 6.7L Powerstroke engine is the secondary cooling system. The secondary cooling system uses coolant flowing in a circuit separate from the primary engine cooling system. This system cools the exhaust gasses for the EGR system, the transmission fluid, the fuel, and the air charge entering the engine via the air/water charge air cooler (CAC). A secondary engine-driven coolant pump provides for coolant flow. A secondary, 2-stage radiator is mounted in front of the primary engine cooling system radiator. Two thermostats, one mounted on each side of the

secondary radiator, operate independently to regulate the temperature of the coolant flowing to the various components.

System coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the cooling components. In order to obtain these protections, maintain the coolant at the correct concentration and fluid level in the degas bottle.

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

## DTC Codes

**P008A** Low Pressure Fuel System Pressure- Too Low

- Commonly sets when the fuel filters are plugged, the fuel supply pump has failed, or after replacing fuel filters and not bleeding the system correctly.
- See Hard Start/No Start above

**P0087** Fuel Rail Pressure Too Low

- See P008A
- See Hard Start/No Start above
- Check the primary fuel filter (on frame rail) to be sure lid is fully seated and sealed properly.
- Some aftermarket secondary filters (on engine) have been known to collapse under pressure and cause a restriction. Use OEM fuel filters and re-test.

**P04E3** Crankcase Ventilation Hose Connection Sensor Circuit High

- Usually caused by a defective crank case vent pressure sensor. The vent assembly must be replaced.

**P0401** EGR Insufficient Flow

- Refer to Ford TSB 13-6-5
- The  most common theory for the issue of plugging EGR coolers is that the secondary cooling system, which cools the EGR cooler, runs too cool and allows the carbon build up to occur in the cooler.

1. Check for ECM updates, update as required.
2. Using a scan tool, check all continuous memory DTCs to verify that P0401 is set.

3. If it is, use a scan tool to perform a key on engine running (KOER) self test. If DTC P2457 sets, replace the EGR cooler core. It is also a good idea to replace the EGR valve.

**P1247** Turbocharger Boost Pressure Low

- Diagnose any DPF or Fuel System related codes first if there is any
- Check for a restricted air filter and/or air intake. Snow can pack into the air intake in some cases and cause a restriction.
- Inspect charge air (intercooler) hoses and tubes for damage causing boost leaks.
- If no other problems are found, it is likely a turbo issue.

**P1291** Injector High Side Short To GND Or VBATT – Bank 1

- Refer to Ford TSB 11-10-10. An internally shorted fuel injector can be caused by DEF contamination in the fuel or by fuel gelling.

1. To check for DEF contamination in the fuel, remove the conditioning module mounted fuel filter and bowl. Allow them to dry for 2 hours and then inspect for a white powdery/crystalline material. If this is observed, there is DEF in the fuel. The fuel system will need to be replaced.

**P1292** Injector High Side Short To GND Or VBATT – Bank 2

- See P1291

**P132B** Turbocharger/Supercharger Boost Control A Performance

- See P1247

**P200C** Diesel Particulate Filter Over Temperature (Bank 1)

- This code may cause a no start/no crank condition.

1. Before extensive testing, allow the vehicle to get to ambient temperature.
2. Then, monitor the 4 exhaust gas temperature sensors. They should all read close to ambient temperature.
3. If one of the four reads out of range compared to the others, swap that sensor with one of the other 3. If the bad reading moves, replace the failed sensor.
4. If it does not move, perform further diagnostics of the wire harness.

**P200E** Catalyst System Over Temperature (Bank 1)

- See P200C

**P20BA** Reductant Heater A Control Performance

- Most commonly caused by a failed DEF heater element in the DEF tank. Check the resistance across terminals 1 (Blue/Orange) and 2 (Black/White) of C3616 at Diesel Exhaust Fluid (DEF) tank. The resistance should be 1.0-2.5 ohms. If not, the heater will most likely need replaced.

**P20E8** Reductant Pressure Too Low / Too High

- There is a pressure sensor that monitors how much pressure the pump produces. It needs to produce 51 PSI within 45 seconds from the time the pump is commanded on. Code P20E8 suggests the pump did not reach that target.

1. If the vehicle was built before 8/3/2011, reference Ford Technical Service Bulletin (TSB) 11-12-3 for these codes and the concern.
2. Using the IDS scan tool, activate the pump and see how much pressure it is producing. If the pump is running, but does not achieve the target goal, replace the pump as per the TSB.
   If the pump is still not reaching its target goal, unplug the reductant dosing module (injector), remove it, and see if it leaks when the pump is commanded on.
   If it does, replace the injector.

**P2033** EGT Sensor 2 Circuit High Voltage

- Sensor 2 is between the DOC and SCR/DPF

1. Using the scan tool, monitor all of the EGT sensors with the exhaust system at ambient temperature. Any sensor that does not fall in line with the others is likely defective and needs replaced.
2. Unplug this sensor and put your volt meter across the connector coming to the sensor. With the key on, your volt meter should read close to 5 volts. Wiggle test the harness all the way back to the PCM to ensure this voltage does not change.
3. If the voltage is OK, clear the codes, road test and recheck. If the P2033 code resets right away, suspect a failed sensor.

**P207F** Reductant Quality Performance

- Check the Diesel Exhaust Fluid (DEF) for hydrocarbons (fuel). If there is fuel in the system, the entire DEF system will need to be replaced. If there is no diesel fuel in the DEF system, drain the tank and refill with new DEF fluid. Clear the code and drive the vehicle to clear the warning message. In some cases, it may be necessary to reset the DEF system using a scan tool. If the code resets, reference TSB 13-11-6 for this concern.

**P2073** Manifold Absolute Pressure/Mass Air Flow – Throttle Position Correlation at Idle

1. Carefully check the air intake system. Air box, filter, tubes. Look for damaged, loose, or aftermarket components that may affect airflow through the MAF sensor.
2. Use a scan tool to monitor the MAF hertz at idle and at 2000 RPM. Ensure the EGR valve and the turbo are unplugged. With the EGR valve closed, the MAF hertz at idle should be 3.5 to 3.8 kilohertz, and at 2000 RPM 5.9 to 6.2.
3. If the value is outside this range, check for a stuck open EGR valve before suspecting a failed MAF sensor.

**P2269** Water In Fuel Condition

- The engine may have very low power, similar to a limp mode. The P2269 code sets right away after clearing.

1. Access and unplug the water in fuel sensor.
2. Use a volt meter to check voltage on the harness side of the connector. There should be reference voltage of about 5 volts. If there is no voltage the wires are likely damaged between the PCM and the sensor.
3. If the harness side checks OK, the water in fuel sensor may be at fault or there is contaminated fuel in the system.

**P2291** Injector Control Pressure Too Low – Engine Cranking

- See Hard Start/No Start above

**P2463** DPF Soot Level Accumulation

1. Perform stationary regeneration procedure, then recheck for the issue.
2. The DPF may need to be removed and cleaned or replaced.

**P259F** Turbocharger A Boost Control Position At High Limit

- Most commonly caused by a dirty air filter or a poor quality aftermarket filter that is too restrictive. May also be caused by boost leaks, exhaust leaks, or other air flow related problems.

## Other Useful Tips

On regular pickups, the EGT sensors are in a logical sequence of 1, 2, 3 and 4, with the front most sensor being #1. On cab and chassis vehicles however, the sequence is 1, 2, 4 and 3 front to rear.

## 2008 – 2010 6.4 L Powerstroke

All genuine O.E.M. or aftermarket parts can be purchased at Jerseydieselparts.com. You can contact us at 888-303-3331 for assistance.

# 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. Record Data.**

**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.**

## 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.
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)
   b. high pressure injection 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

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.
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.
6.

## 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.

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.

## 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. 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.

## Fuel 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.

## Fuel Injector Notes:

- Fuel trims, or TFTs, should indicate bad injectors. Any injectors that are more than +-10 on fuel trim 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.

## 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. When removing the low pressure fuel lines and high pressure fuel tubes from the high pressure pump, use a backup 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. (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.

**2003 – 2007 6.0 L Powerstroke**

All genuine O.E.M. or aftermarket parts can be purchased at Jerseydieselparts.com. You can contact us at 888-303-3331 for assistance.

The 6.0L Powerstroke diesel engine was an update over the previous generation 7.3L diesel engine. There is really no commonality between the two engines besides the name. The 6.0L uses a second generation HEUI injection system which also utilizes high pressure oil to actuate the injectors. The turbocharger was changed to a Variable Geometry (VGT) type turbo and Exhaust Gas Recirculation (EGR) was added to improve emissions performance. These changes make for a very different diagnostic process from the 7.3L Powerstroke Engine.

## Some important notes:

- You must be able to use the Ford factory IDS scan tool for 6.0L diagnostics due to the number of PCM updates. There are so many drivability issues that are solved with a new PCM calibration that attempting repairs without the IDS scan tool is an exercise in futility. Be aware that after the PCM is re-flashed it may take up to 1000 miles for the PCM to re-learn how you drive. During this re-learn procedure it is very likely that your mileage will drop. Ford does not have a quick learn procedure like GM or Chrysler, they are “slow learners”.
- There have been many changes to the 6.0L and getting the correct parts for it depends on the engine serial number range. The serial number is located on the FICM which is on the top of the left valve cover. If the FICM has been replaced you may need to get the serial number off of the engine block. The serial number is stamped into the block at the left rear of the engine just under the head.
- Diagnosing starting problems and drivability problems requires that you start at the basics. The HEUI system uses engine oil to actuate the injectors; if you are low on oil you will have problems.
- Check the oil and change the oil if it is due. If the oil is worn out from excessive change interval, you will have problems. Oil change intervals are critical.
- Fuel filter plugging will cause issues. Has it been more than 10,000 miles since you changed the fuel filters? Change the filters before proceeding with further diagnostics.

- Air in the fuel will cause injector failures. Inspect the fuel for signs of contamination and/or air intrusion when you change the filters.
- Avoid long idle times; long idle times will cause the EGR and turbo to carbon up excessively. Besides the proper scan tool you will need good service information and the correct tools to work on the 6.0L. There are many TSB related to drivability issues that you need current service information for, besides the ability to re-flash the PCM.

## No Crank

- Check batteries and connections, voltage should stay above 10 volts during cranking
- The PCM controls the starter, so if PCM voltage drops below 9.5v the PCM shuts off and won't control the starter.
- If the fan clutch shorts out it will draw the PCM voltage to zero, and thus you will have a no crank situation.
- If the EBP sensor (or other 5 volt reference sensor) is shorted out it will cause the PCM to shut down.

## No Start

Several parameters are necessary for starting, not including glow plug operation and good compression. Perform the following steps to diagnose a "No Start" concern.

1. Initial tests will require monitoring several data PIDs on your scan tool.
1. FICM SYNC (needs to say "yes" when cranking)
2. FICM L power (needs to be above 11.5 volts)
3. FICM V power (needs to be above 11.5 volts)
4. FICM M power (needs to be 45 volts or above)
5. ICP or injection control pressure, needs to match the ICP Desired reading.
6. IPR or injection pressure regulator (should not reach and maintain 85%)
2. If the FICM SYNC always says no, there is a loss of camshaft position signal or crankshaft position signal.
3. If FICM L or V power is below 11.5, load test the batteries.
4. If FICM M power is significantly below 45 volts and L and V power were above 11.5, suspect a FICM module concern. The voltage would have to be quite low to create no start, 35 volts or lower may create a no start condition.
5. If the ICP pressure is not matching the ICP Desired reading, and the IPR is 85%, the high pressure oil system is the cause of the no start, the high pressure system will need to be tested. S
6. If all the above tests pass, yet the engine still will not start, check the fuel pressure. See the attached picture for the fuel pressure port. The fuel pressure should be 45 PSI or higher.

7. If all is good so far, then run an injector self test and see if there are any codes. If there are no codes, access the fuel injector connectors, put an inductive amp probe around each wire, one at a time at the injectors, leave the connector plugged in. Then crank the engine, if the FICM is firing the injectors, there should be a 20 amp pulse going to each injector.
8. Also amp current check the glow plugs, each glow plug should draw about 17 to 20 amps.
9. If the injectors are being pulsed properly, the fuel pressure and high pressure oil is all passing, perform a bubble test to check for compression getting into the fuel system.
10. If all is passing, but the engine still won't start, drop the exhaust. If it still won't start, pull the glow plugs out to check engine compression. Compression will usually range between 300 and 400 PSI.
11. If all tests have passed but the engine will not start and you have good quality diesel fuel, then the injectors will have to be flow tested or replaced to rule out injectors as the cause of the no start.

- The fuel supply pump has an inertia switch in the circuit, located under the passenger side kick panel. The switch can sometimes trip if the truck hits a violent bump or is kicked from the inside of the vehicle. It is reset by simply pushing the button on the top of the switch.
- Try unplugging the ICP sensor it can cause a not start problem without setting any codes
- Monitor the oil pressure gauge on the dash, it should move up during cranking. If it shows no oil pressure then there could be a problem with the low oil pressure side.
- IPR duty cycle of 14% or less during cranking means no crank (CKP) signal (and no sync)
- Check for loose connections at the FICM- the harness connector retainers tend to break during repairs and, if not repaired, can allow the connectors to back out of the FICM
- A shorted EBP sensor (or any 5 volt reference sensor) can cause the PCM to shutdown
- Glow Plug control module connector problems (pin tension, water intrusion, bent pins)
- EGR valve, if stuck open over 60% can cause a no start.

## Hard Start Cold or Hot

- Leak in the high pressure oil circuit, takes excessive cranking to build minimum ICP pressure, see ICP.
- Cranking speed should be 175 rpm cold and 215 rpm warm.
- The glow plugs should pull approximately 160 amps total on a cold start, which will drop to about 120 amps after about 15 seconds. If the amp draw is below 17-20 amps per glow plug then you will need to replace some glow plugs. CAUTION; upon

removal of the glow plugs, the glow plug sleeve will sometimes pull out with the glow plug. This will require that the head be pulled in order to replace the glow plug sleeve.
- Injector spool valves sticky (stiction)
- A 2004 model year with an intake throttle plate that is stuck closed can cause a hard start or no start.
- Glow plug harness chaffing
- Glow Plug control module connector problems (pin tension, water intrusion, bent pins)
- Low or no fuel supply pressure

## ICP Pressure and IPR information

The IPR valve is normally open; it takes a 12 volt pulse width modulated ground signal to actuate the IPR. ts

- Monitor the ICP and IPR while cranking. If ICP is .4v to .5v (200 psi) and IPR is 85%, it is possibly a stuck IPR. The system will build 200 psi even if the IPR is open. Make sure that oil pressure registers on the dash gauge while cranking, if not you may not have enough low oil pressure.
- If the ICP is .6v to .7v (400 psi) and the IPR is at 85% then it is very likely that you have a high pressure leak
- Compare actual to desired ICP on the scan tool, if actual is below desired use shop air (in the rail on 2003 through early 2004,  through the ICP sensor hole on 2004 and later engines no pressurize the oil system and find the leaks. The IPR valve must be commanded closed with a scan tool or forced closed with battery voltage and ground applied via an IPR connector pigtail). If this is not done air will just dump into the crankcase. When the IPR is commanded from open to closed position there should be a noticeable decrease in air noise coming from the IPR. If not, the IPR is most likely stuck and should be inspected. (see below) Common leak points are at the injectors, stand pipes, rail plugs, high pressure pump connection (STC fitting, on 2005 and up), at the high pressure pump on the 2003 models. It is normal to have a slight hiss from the injector spool valves.
- If the IPR fails the air test, remove it and check for metal on the screen. If you have metal on the IPR screen then the high pressure pump and IPR will need to be replaced. You will also need to check the screen under the oil cooler, toward the front of the valley, and clean or replace as necessary. The oil rails and check valves will need to be flushed to remove any debris. Of course the debris may have gotten into the injectors as well and could cause problems with a miss or rough run.
- The ICP should be stable and not erratic. If it is erratic, then you could have a defective ICP sensor, ICP sensor pigtail, high pressure side leak, a sticky IPR valve (requires replacement), or debris in the oil rail (03-04) or stand pipe check valves (04 ¼ up) which will require replacement as well.

- The ICP sensor can leak oil, if this happens replace both the sensor and the ICP pigtail connector
- ICP sensor should read .16 – .28 volts (less than 70 psi) KOEO at normal operating temperature after the engine has been off for at least 2 minutes.
- 2004 ¼ and up should be updated to the latest oil standpipe design if removed for other repairs.
- It is a good idea to replace the oil rail nipple seals when the rails are removed to service other parts. If the seals are leaking it can lead to erosion of the upper injector o rings.
- It is normal to see oil or hear/feel air coming out of the IPR drain hole on the high pressure pump while testing for leaks.. The hole location is shown in the below picture.

## Miss, Rough Run, Vibration or Flutter

- Make sure the PCM and FICM are flashed to the latest calibration.
- Injectors can cause a miss, rough run or surge when cold if the spool valves are sticking and/or FICM voltage is low. There is currently a re-flash to operate the injector spool valves during the glow plug cycle time in order to heat and free up the spool valves. Excessive oil change intervals can cause the spool valves to stick.
- Perform a relative compression test and a power balance test to verify a miss on a particular cylinder. If relative compression is OK, the problem is most likely injector related.
- Low fuel supply pressure, particularly when cold. Supply pressure should be 45 psi minimum KOEO and 45 psi minimum on hard acceleration.
- Check valves in the high pressure oil circuit that feeds each injector rail can break. The check valve (snubber) plates have 3 small tabs; if any of the tabs are broken they can stick in the oil inlet to the injectors. You will need to flush the oil rail to find any missing tabs.
- Dual mass flywheel bad (used in 2003 & 2004)
- If the FICM has low voltage it will often cause a hard start and rough run when cold, but the problem may clear up as the engine warms.

## Low Power

- Make sure the PCM and FICM are flashed to the latest calibration.
- Dirty or plugged air filter
- Boost leaks: The charge air hoses at the turbo compressor outlet commonly tear and leak. Other common areas are the plastic charge air tubes on the driver's side and the plastic end tanks on the intercooler.
- Exhaust leaks, often accompanied by a hiss, squeal or exhaust smell. The expansion bellows on the turbocharger inlet pipes commonly crack and leak. The inlet to the EGR cooler and turbocharger are also problem areas.
- Injector spool valves sticking

- Biased MAP sensor
- Low ICP due to oil dilution, aeration, ICP leaks, skewed ICP sensor, ETC.
- Fuel aeration and/or low fuel supply pressure
- Low FICM voltage

## Injectors

- Make sure the PCM and FICM are flashed to the latest calibration.
- Bad injectors can cause a surge, hard start, cold rough run, low power, black smoke or a miss. Address oil and fuel maintenance issues and aeration before replacing injectors.
- Injector installation is critical, improper torque will cause injector chamber gasket failures.
- Injector chamber gasket failures will result in aeration in the fuel galley from combustion gases. Perform the compression bubble test to check for air in the fuel system, information on how to perform the test can be found here; http://www.forddoctorsdts.com/articles/
- Failure to remove the oil from the hold down bolt hole will result in improper torque.
- Broken injector starter housings, when the two bolts that holds the starter housing to the injector body break, are caused by aeration.
- 2004 ¼ and up vehicles need to update the stand pipes when replacing injectors.
- There has been cases of the injectors causing fuel to leak into the engine oil, either from excessive plunger clearance or nozzle nut O-rings degrading.

## Turbo failure diagnostics

- **The 2003 and early 2004 engines need to perform a VGT "learn" function before the turbo will work correctly. This needs to be done after clearing codes, reprogramming the PCM, ETC. When the conditions are correct, the engine needs to sit and idle for a few minutes to learn VGT operation. If this is not done the turbo will exhibit symptoms similar to a sticking turbo.**
- Normal boost 25 – 29 psi (22-25 psi in 3rd gear at WOT, per Ford)
- The Variable Vane Turbo (VGT) that is on the 6.0L uses engine oil to move the vane positions in order to improve turbo response and control turbo boost.
- If you have a squealing noise, particularly when using a scan tool to close the vanes, look for leaks at the EGR cooler connections, turbine inlet and turbine outlet. If the turbo has been recently replaced check for misaligned pipes and other leak points as noted above. If the turbo is responsible for a squealing noise, expect to find the wheels rubbing the housings and bearing failure.
- A "bark" or "chuffing" sound from the turbo usually indicates the turbo vane unison ring is stuck or sticky. Often caused by excessive idle time, low load operation, failing injectors, failing FICM, and EGR related problems.

- Turbo vane unison ring failures (sticking) can cause EGR codes to set.
- Run the KOER EGR and VGT test multiple times to check for erratic operation or sticking.
- Sticky vanes can cause exhaust back pressure as high as 80 psi, which can cause EGR cooler failures.
- There is no vane position sensor in the turbocharger and the PCM ignores actual EBP readings in favor of inferred readings on the 03-05 models. If boost is low the PCM tells the vanes to close in order to create more turbo boost (MAP), causing excessive drive pressures and turbo over speed conditions.
- The oil line feeding the turbo can plug which will result in actuator or turbo bearing failure. Turbo bearing failure due to oil starvation from plugged oil feed line will repeat itself and is not a warrant-able turbo failure.
- A squealing noise could be vanes sticking closed, a boost leak or an exhaust leak. The left side “Y” pipe is known to crack and cause a squeal.

## EGR and EGR Codes

- Make sure the PCM and FICM are flashed to the latest calibration.
- Check the turbo (see “Turbo failure diagnostics”), if the vanes are sticky, that will affect MAF and possibly set EGR codes, such as P0404
- Check the air filter, a dirty air filter will affect MAF and could cause EGR codes to set.
- Some performance air intake systems will set EGR and MAF codes (they affect MAF right?)
- A dirty IAT2 sensor in the intake manifold can cause EGR codes because the PCM expects to see and increased temp reading when the EGR is turned on. If the temperature increase doesn’t change fast enough it can effect turbo operation as well as EGR operation.
- EGR coking can be reduced by using a crankcase vent filter kit (such as the BD 1032175) to remove the oil vapor from the intake system.
- EGR coking can be caused by excessive idle time.
- EGR coking can also be reduced by using Stanadyne Performance formula to improve combustion and reduce carbon in the exhaust.
- If the EGR valve fails the system test, replace it DO NOT just clean it. It will fail again.

## Coolant Loss

Do not continue to drive the vehicle if you are losing coolant and don’t see any leaks. The longer you put off getting it checked, the more likely a bad EGR cooler will lead to head gasket and/or other engine failures.

- Refer to Ford TSB 08-3-7and TSB 07-21-5 for the Ford recommended diagnostic procedures.

- Check the EGR cooler; remove the EGR valve and inspect, is it wet with coolant? Raise the rear of the vehicle to see if any coolant flows into the EGR hole from the EGR cooler. Pressurize the coolant system using the proper tools and inspect for leaks.
- If the EGR cooler is leaking, many times it was caused by excessive back pressure. See the turbo section for diagnosing excessive back pressure.
- EGR cooler failure is also caused by a restriction in the engine oil cooler, resulting in reduced coolant flow to the EGR cooler. This causes overheating and cracking of the EGR cooler. The maximum difference in temperature between the engine oil and the coolant, under hard acceleration, is 15 degrees. If the oil temperature is too high it will lead to early EGR cooler and head gasket failures.
- A howling or “blowing through a reed” sound under load is usually caused by the cooling system venting pressure through the cap on the reservoir. Another good indication is coolant or coolant residue on and around the overflow bottle after driving.
- The 2003 and early 2004 engines seem to have more of a tendency to crack heads. When this happens cooling system pressures spike very quickly and cause the coolant to vent from the overflow bottle.

## Stalling/Dies, No start or Hard start

- Cracked/stuck open injector nozzle or leaking chamber gasket. Either will cause aeration of the fuel galley.
- High pressure oil system leak, which will usually happen more often when the oil is warm because it is thinner.
- Fuel in the oil, crank case over full. The combination of too much oil and the oil being too thin will cause the engine to die from aerating and thinning the oil. This usually happens at high RPM, high load conditions.

## Surge

- Make sure the PCM and FICM are flashed to the latest calibration.
- Injector spool valves (see injector section)
- Turbo (see the turbo section)
- ICP sensor. Check for oil leaking through the sensor causing the connector to short out. Buy 6.0
- Low fuel supply pressure. Fuel supply pressure should maintain at 45 PSI minimum.

## White Smoke Cold

- White smoke cold could be caused by the spool valves sticking in the injectors, see “Miss Rough Run” section for more information.
- Low FICM voltage
- Defective glow plugs and/or controller

- Low compression

## White Smoke Hot/At all times

- Leaking EGR cooler
- Cracked or stuck open injector nozzle
- Improperly torqued injector(s)
- Injector Chamber gasket not seated, allowing combustion gasses to aerate the fuel galley.
- Low compression

## Wire Chaffing Issues

- Wire chaffing can cause a variety of drivability problems, common locations are valve cover bolts, near the FICM, or intake bolts where the wire harness is routed under the air intake hose. Other possible problem areas are the thermostat housing, idler pulleys, glow plug relay brace, relay box braces, and near the PCM by the battery.

## Common DTC (trouble codes)

- P0263 #1 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0266 #2 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0269 #3 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0272 #4 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0275 #5 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0276 #6 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0281 #7 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0284 #8 Cylinder Contribution/Balance
  - Typically caused by injector spool valve stiction or FICM failures.
- P0299 Turbocharger under boost
  - See turbo info above and P132B
  - Can be caused by sticking vanes, boost leaks, exhaust leaks, or sometimes injector, fuel system or high pressure oil system failures.
- P0401 EGR Insufficient flow
  - (see EGR info)
  - A defective EGR valve may cause this code to set

- EGR deletes will cause this code to set
- P0402 EGR Excessive flow
- (see EGR info)
- Almost always sets due to an EGR valve that is stuck open
- P0611 FICM Performance
- Typically sets when FICM injector output voltage drops below specification. Often sets in conjunction with injector circuit/performance codes.
- Check FICM voltage either with a scan tool (best) or manually with a DVOM.
- Make sure battery voltage is over 11 volts at the FICM.
- If at any time voltage drops below 45, replace the FICM.
- P0671-P0678 Glow Plug circuit codes
- Ohm through the glow plug harness connectors. If the glow plugs ohm open or have very high resistance (more than 3 ohms), replace the glow plug(s). If the glow plugs are OK, the controller is likely bad.
- P132B Turbocharger/Supercharger Boost Control A Performance
- Almost always sets due to sticking turbo vanes, but it can also be caused by boost leaks, exhaust leaks, or other engine issues.

1. Check the intercooler, tubes, and hoses to verify none are leaking.
2. Check very closely for any exhaust leaks, especially at the Y-pipe that connects the exhaust from the manifolds to the turbo inlet. It is very common for this pipe to crack or leak at a connection point and even the smallest of exhaust leaks will cause the Powertrain Control Module (PCM) to not learn the turbo operation properly and cause low boost.
3. Drive the engine to load it and when the turbo is building 3 PSI of boost, the exhaust back pressure should not be over roughly 25 PSI (it is typical for the exhaust back pressure to increase about 1 PSI for every pound of turbo boost). The voltage at 25 PSI (15 PSI of atmospheric pressure and 10 PSI of back pressure) should be roughly 2.0 V.
4. If the exhaust back pressure reading is high, check for a malfunctioning Variable Geometry Turbocharger (VGT). Refer to TSB 08-16-13 for information on cleaning/inspecting the turbo if it is the problem.
5. If the exhaust back pressure is not going abnormally high, verify the Exhaust Gas Recirculation (EGR) valve is closed (should show a voltage around 0.8 V when closed) and that it’s not opening when not commanded. If it is stuck open or opening when it should not, clean or replace it as needed and re-check operation.

- P1334 EGR Throttle MIN Stop Performance
- 2004 Model year only. Sets when the intake throttle plate is stuck in a closed position.
- P2269 Water in fuel condition
- Change fuel filters and check for signs of water contamination.
- Disassemble the HFCM and clean. Debris tend to build up around the water in fuel sensor and can cause this code to set along with the WIF light.
- P2284 ICP sensor CKT range/performance
- see ICP info above

- see P2285
- P2285 ICP sensor circuit low
- see ICP info above

1. Access the Injection Control Pressure (ICP) sensor and disconnect it. Inspect the wire harness connector and sensor for any signs of oil, indicating a leaking sensor. If found, replace the sensor and connector as necessary.
2. If the sensor is not leaking, monitor the ICP sensor voltage on the scanner. The voltage should be about 0.2 volts key on engine off, around 1 volt at idle, and increase under load. If the voltage ever drops below 0.2 volts, check for an intermittent short to ground on the Dark Blue/Light Green wire between the ICP sensor and Powertrain Control Module (PCM).
3. If the wire is not shorting to ground, check for an intermittent open in the connector terminals, and if OK, replace the ICP sensor.

- P2290 ICP too low, P2291 ICP too low- cranking
- Indicates a high pressure oil system failure.
- See “ICP” above
- P2614 Camshaft position output circuit, P2617 Crankshaft position output circuit
- If set with other codes diagnose other codes first. These codes can set when cranking an engine that won’t start.
- Monitor FICM sync while cranking. If it says “Yes”, these circuits are OK.

Ford 6.0 L Cylinder location and Firing Order

## 1994-2003 7.3 L Powerstroke

All genuine O.E.M. or aftermarket parts can be purchased at Jerseydieselparts.com. You can contact us at 888-303-3331 for assistance.

## **********PERFORMANCE BOXES AND CHIPS**********

Performance boxes that tap into or connect into the vehicle wiring should be removed to make certain that they are not causing any of the following complaints. Also chips, including downloaded ones like Superchips, can cause false MAP readings on the scan tool. They will cause the actual EBP and MAP to go higher due to more fuel delivery. A chip that plugs into the back of the PCM should be removed prior to any diagnostics to eliminate the chance of the chip being at fault. It is relatively common for the chips to fail and cause a multitude of issues.

## OIL LEVEL

Low or dirty oil can cause intermittent low power, miss, rough run, no start etc. Make sure the oil level is correct and the oil is in good condition (less than 3000 miles) before trying to cure any other drivability or starting issues.

## DIAGNOSTIC CODES

Most Powerstrokes that we see, with starting or performance issues don't set codes, if you have DTC codes, proceed to the DTC code section first. If you don't have a scan tool, the diagnostics, other than visual examination or parts changing, is difficult at best.

## No Start

1. DTC P0340 and/or P0344- Usually a bad Cam Position Sensor.
2. Are you getting smoke while cranking (after about 10 seconds)? If no smoke then no fuel is getting into the combustion chamber.
3. Low oil level
4. Fuel supply pressure low; Plugged fuel filter or no fuel in tank, minimum 20 PSI cranking, and 99-03 should be 50 PSI cranking
5. Refer to Hard Start or No Start Issues below

## No Start or Hard Start Cold

1. Check to make sure that 10.8 or more volts are going the glow plugs from the relay. The glow plugs don't cycle until EOT (engine oil temp.) is below specification, which varies by vehicle year. The engine should start without the glow plugs energized down to about 40 degrees. Look at the volt gauge in the dash, the glow plugs will cycle up to 120 seconds depending on EOT.
2. Refer to No Start or Hard Start Issues below
3. Bad wire harness connections at the valve cover gaskets, internal or external connections. Examine the connections, do pin tension tests also smell for burnt wires.
4. Injectors bad; Injectors with high miles (200,000 miles or more) can fail to operate cold. If correct PW displays while cranking you can remove the valve cover and watch the oil spill discharge, every injector should discharge oil when pulsed by the IDM during cranking. If no pulse of oil then the injector isn't activating and putting fuel into the cylinders. Running several buzz tests cold will sometimes free up the injectors. This is a typical high miles problem particularly with inadequate oil change intervals.

## No Start or Hard Start Hot

1. Refer to other hard start or no start issues below
2. IPR (Injection Pressure Regulator) bad, will cause low ICP.
3. IPR O-rings bad, will cause low ICP.
4. Injector O-rings bad, will cause low ICP. Should also show up as black fuel (from oil in fuel) in fuel filter canister.
5. High pressure oil pump bad, will show up as low ICP.
6. Engine oil worn out or too thin
7. Cranking speed too slow, should be 180 rpm minimum when warm

## Other No Start or Hard Start Issues

When trying to diagnose hard start or no start issues a scan tool is needed to check and monitor the ICP (Injection Control Pressure), RPM (From the CMP) Vehicle Voltage during cranking and PW (Pulse Width) signal.

1. RPM, minimum 100 rpm cranking speed (When warm it should be over 180 rpm)
2. ICP, minimum required for starting 500 PSI if no rpm signal, ICP won't go over 400 PSI
3. Voltage during cranking 7-10 volts minimum depending on year
4. Pulse Width; 0 ms means no sync, 1994-1997 .42 ms indicates that PCM and IDM are in sync (on 99-03 it should be .60 ms) and the PCM is waiting on the ICP to reach the minimum of 500 PSI. When min. ICP is reached PW should change to 1-6 ms
5. If any of the above doesn't meet the minimum specification, solve the problem as-per the appropriate Ford Diagnostic Manual.

## HIGH PRESSURE OIL PUMP and IPR; checks for hard start, no start condition

1. To check for high pressure oil leaks block off one bank at a time with the proper tools and note IPR% for each bank. If the engine starts while one bank is blocked off, the other bank is where the high pressure leak is occurring. If the IPR is 2% higher on one bank then you have a high pressure leak on that bank.
2. If the engine still will not start, dead head the high pressure oil pump and note ICP, it should be over 2500 PSI during cranking. If not then the high pressure pump, IPR or IPR seals are causing the lack of high pressure oil.

## Low Power Poor Mileage

1. Fuel filter dirty; recommend changing every 8-10,000 miles. Air Filter dirty; the filter minders don't always work, visually inspect the air filter for excessive contamination. CAUTION; When inspecting or changing the air filter on the 94-97 Powerstroke,

make sure to clean out the air filter housing, because setting the filter back in on top of the bugs and dirt that dropped off will result in turbo or engine damage from unfiltered air.
2. Damaged compressor wheel, stuck waste gate, stuck EBP valve, or worn turbo. Exhaust leak before the turbo at the turbo feed pipes or the donuts that seal them.
3. Fuel filter housing return screen, in the 1994-1997 the screen will become plugged not allowing aerated fuel to return to the tank.
4. Throttle voltage should be 3.85-3.95 volts at WOT; check floor mats or a bad throttle assembly
5. Fuel supply pressure below 50 PSI can cause a low power or hesitation problem.
6. Check at idle and at WOT a plugged fuel filter, bad fuel pressure regulator, bad supply pump or a restriction in the tank can cause low pressure.

**LOW POWER POOR MILEAGE**

To make further checks you need to monitor the following PIDs with a scan tool. Normal readings for EBP (exhaust back pressure) MAP (manifold air pressure, boost) and BARO (barometric pressure) Note; all readings are in absolute pressure, so you must subtract KOEO (key on, engine off) MAP readings from WOT (Wide open throttle) readings to get gauge pressure. The following readings are for about 500-1000 foot elevation, higher elevation will give lower base readings due to lower atmospheric pressure.
IE: At 5000 foot elevation BARO would be about 12.1 PSI

**NOTE;** at KOEO all three readings should be within .2/10ths, if not repair or replace the bad sensor before continuing. BARO won't change with the engine running

| 1994-1997 | KOEO | IDLE | WOT, HARD ACCELERATION |
|---|---|---|---|
| EBP | 14.2 | 14.3-14.4 | 28.0-32.5 psi |
| MAP | 14.2 | 14.0-14.1 | 27.5-30.0 psi |
| BARO | 14.2 | | |

Boost pressure, net (gauge) is 13 psi minimum

| 1999-2003 | KOEO | IDLE | WOT, HARD ACCELERATION |
|---|---|---|---|

| | | | |
|---|---|---|---|
| EBP | 14.2 | 14.5-14.8 | 38.0-43.0 psi |
| MAP | 14.2 | 14.0-14.1 | 30.0-32.0 psi |
| BARO | 14.2 | | |

- Boost pressure, net (gauge) is 16 PSI minimum
- EBP; Will typically gain .2 PSI on 94-97 and .5 PSI on 99-03 from key on engine off to idle
- Low readings at WOT mean that there isn't enough exhaust gas velocity to spin the turbo up to full boost
- High readings at idle mean that the exhaust isn't flowing or the turbo isn't spinning, some sort of exhaust flow restriction. Early 99 may have 2 PSI more EBP due to the cat. Converter

## Map

- Low readings with normal EBP usually mean a boost leak at the intercooler hoses or at the manifolds
- Low readings with low EBP usually mean another cause, did you check the list above
- Next check ICP (injection control pressure) and IPR (injection pressure regulator), because low oil pressure can cause low power. Pressures are approximate. If the IPR duty cycle % is high, but the ICP is low, it usually means some sort of high pressure oil leak. WOT in neutral readings are taken after 3 minutes of running at WOT no load (neutral)

| 1994-2003 | IDLE | WOT in Neutral | HARD ACCELERATION |
|---|---|---|---|
| ICP | 575-600 | 1300-1400 | 2450-2700 psi |
| IPR | 11-14% | 18-21% | 35-40% |

1996-1997 California emissions is like the 1999-2003 specification

| 1999-2003 | IDLE | WOT in neutral | HARD ACCELERATION |
|---|---|---|---|

| | | | |
|---|---|---|---|
| ICP | 475-490 | 1100-1200** | 2450-2750 psi |
| IPR | 9-11% | 18-21% | 35-40% |

** After engine s/n 896812 maximum no load after 3 minutes would be 1800 psi
The ICP will default to 725 psi at idle if the PCM isn't getting the signal

ICP LOW; if the IPR duty cycle % is high, but the ICP is low, it usually means some sort of high pressure oil leak or bad IPR. This can also be caused by IPR o-rings, high pressure pump, or injector O-rings. Follow the Ford Service information to diagnose high pressure oil leaks or lack of pressure.

## Miss or Rough Run

1. Check valve cover connectors for burnt or bad connections, perform a pin tension test.
2. Manual Transmissions; check for bad dual mass flywheel, this will cause false cylinder contribution codes if the flywheel is bouncing around.
3. Run a cylinder contribution test.
4. Check the turbo compressor wheel, if dusted or damaged from poor air inlet filtration, run a compression test before replacing any injectors. Low compression will cause a rough run.
5. Rough run and miss cold is either lack of heat (compression low or glow plugs) or injectors are badly worn (see hard start cold).

## Stalling Intermittent

1. DTC P0344 CMP sensor erratic
2. Loose IPR Solenoid or chaffed wires at solenoid
3. Low engine oil
4. Bad or loose performance chip in PCM

## Knock or Cackle

1. Low fuel supply pressure, Normal as follows;
   1994-1997; 50 PSI at idle and 55 PSI at WOT
   1999-2003; 50 PSI at idle and 45 PSI at WOT
2. Aeration in the oil

## Chirp or Compressor Surge at Shift Points

When a 99 ½ to 2003 has been “hopped up” it can cause the compressor wheel to chirp or surge at higher boost levels (25 PSI or so). You need to replace the compressor wheel with the same wheel used in the 1994-1997 turbos.

## FUEL IN COOLANT

Normally a cracked injector sleeve will cause this because fuel pressure is higher than coolant pressure. If this occurs we recommend replacing all the Injector sleeves.

## Excess Engine Oil Consumption

1. Bad injector O-rings, on the 94-97 oil from the leaking O-rings will return back to the fuel filter housing and the fuel will be black from oil. Internal O-rings can cause excessive oil consumption and not show up as black fuel.
2. 99-03 engines don’t have a fuel return off the heads, so in the unlikely event of injector o-ring failures, the fuel will not be black from oil.
3. Turbo; this is a closed crank vent system, which means it pulls crank vent fumes into the inlet of the turbo. You must compare the amount of oil at the compressor inlet with the amount of oil at the compressor outlet, before condemning a turbo. Excessive blow by will be pushed out the crank vent and pulled in by the turbocharger.

## Surge at Idle

1. ICP circuit problem, disconnect the ICP sensor, if the surge goes away then you possibly have a bad ICP sensor.
2. AA code injectors installed into a engine that require AB code injectors will cause a surge (California emissions in 96 and 97 require AB injectors)
3. 94-97; if you have any transmission range sensor codes repair these first. A bad transmission range sensor can back feed to the IPR valve and cause a surge in park, but not in neutral.

## DTC Codes

**DTC P0301 – P0308** cylinder misfire detected (cylinder 1-8)

1. Injector weak, not contributing.
2. Cylinder weak

**DTC P0340**

1. Usually a bad CMP (cam position sensor)

**DTC P0344**

1. Usually a bad CMP
2. Can be caused by excessive cranking

**DTC P0470**

1. EBP Sensor malfunction

**DTC P0476**

1. Can set if the vehicle is equipped with an exhaust brake.
2. Check the EBP Reading KOEO, if not within .2 PSI vs. MAP and BARO, repair EBP tube or replace sensor.
3. Exhaust leaks at the turbo feed pipes will cause this code.

**DTC P0603;** KAM (keep alive memory)

1. If the batteries were previously disconnected, this code will set and be stored until cleared.
2. If the PCM was unplugged this may cause this code to set.

**DTC P0605**

1. If there is a chip plugged into the PCM that will cause this code.
2. Excessive cranking can cause this code.

**DTC P1211;** Indicates that the injection control pressure was above or below command desired during self test mode.

1. Check Oil level.
2. Possible bad IPR or IPR O-rings
3. Low fuel supply pressure will also cause this code, we have seen this several times.

**DTC P1212;** will set if 725 psi ICP is not detected in 6-15 seconds of cranking.

1. Check oil level.
2. Possible bad IPR or IPR O-rings. 11/24/10

**DTC P1261 to 1268 LOW side to battery +**

1. Check valve cover wire harness connections first, including under the valve cover.

**DTC P1271-1278** Low to high side open

1. Check wire harness connections and pin tension of valve cover connections

**DTC P1280** ICP Circuit low, PCM will default to 725 PSI at idle

**DTC P1298**

1. If other codes are present repair those first.
2. IDM likely bad, replace

Miscellaneous Information

Oil Change Intervals; Oil changes done at 5000 miles when the vehicle is driven in the severe service category (3000 mile change interval) will result in premature failures of the turbo, IPR, High Pressure Oil Pump, and Injectors.

## 1983-1994 IDI

All genuine O.E.M. or aftermarket parts can be purchased at Jerseydieselparts.com. You can contact us at 888-303-3331 for assistance.

## Hard Start/No Start Cold – White Smoke

- The fact there is smoke indicates that there is fuel in the cylinders, so it is likely a cylinder heat, compression, or timing issue.

1. Check glow plug operation- Verify there is voltage at the relay terminals and glow plug terminals when the key is cycled to the on position and the glow plug lamp is illuminated. If not, the relay and/or controller are likely bad. Glow plug cycle time should be around 8-10 seconds.
2. If there is voltage, ohm the glow plugs with the wires disconnected. The ohm readings should be between .4-.8 ohms typically. If the reading is high or open, the glow plug is bad. Open or high resistance can cause short cycle times with the later Ford solid state controllers.
3. If the glow plugs are operating normally: Low engine compression, incorrect injection pump to engine timing, poor quality/incorrect fuel will all also cause a hard start cold with white smoke.
4. Verify that cranking speed is at least 100 RPM.

## Hard Start, Cold or Hot – No Smoke

- The lack of smoke generally means no or insufficient fuel is entering the cylinder.

1. Verify that cranking speed is at least 180-200 RPM if engine is hot, minimum 100 rpm cold.
2. Check for 12 volts at the shut off solenoid connection on the injection pump with the key on. Also listen for a “click” when power is applied.
3. Verify that there is a good, clean, and not aerated fuel supply at the injection pump. Tee in a gauge and clear line at the pump inlet or as close as possible to the pump inlet to get a pressure reading and visually check for air bubbles. Fuel supply pressure should be roughly 4-8 PSI for most all DB2 model pumps.
4. If the pump was just installed and not properly bled there could be an airlock. Loosen one injection line and plug in/unplug the shutoff solenoid a few times until you get fuel out the line then tighten that line and go to the next injection and repeat to be sure there is not an airlock.
5. Loosen several injection lines at the injector end and crank the engine. If there is good fuel supply to the pump and no fuel being delivered within 30 seconds total of cranking, then the pump is likely defective.

## Surges while Running

- Surging can be caused by either fuel supply problems or mechanical problems within the injection pump itself.

1. Check for air in the fuel supply system. Check for air at the bleeder valve on the filter head. If air comes out when the bleeder is opened there is air in the system.
2. To find the source of the air, install a clear line at the suction side of the supply pump and start the engine. If there is air in the fuel, move the clear line to the next available location in the supply line from the fuel tank, such as a primary filter, hose connection at a tank switch valve, ETC. When you stop seeing air in the fuel, then the component you have isolated is at fault. Common items that suck air are old fuel lines, bad o rings in quick connect fittings, tank switch valves, primary fuel filters (especially early 6.9l Fords), and fuel supply pumps.
3. If there is no air in the fuel supply and the engine is surging, it is very likely that there are worn or sticking governor components in the injection pump.
4. If the cold advance solenoid is stuck on with constant power due to a bad cold start switch, the engine may surge.

## Starts and Then Dies

- A start and die issue is normally caused by a drain back issue in the fuel supply system or low idle speed. If the engine started right away it is typically not a glow plug issue.

1. If the engine runs for less than 1 or 2 seconds, dies, and restarts immediately then the problem is usually too low of an idle speed, no cold start fast idle, or incorrect timing.
2. If the engine runs for ½ -10 seconds then dies and is difficult to re-start, it is most likely a drain back issue. External fuel leaks can indicate a problem area. Check the injection pump throttle shaft, advance plunger seal, injector returns and fuel supply lines. If you are seeing damp areas, but no visible fuel, this could still cause the drain back issue because air can get in where fuel can't get out. The fuel filter check valve on 7.3L engines is also known problem area for this complaint. The longer the engine runs before it dies, the further back toward the tank the problem is.
3. If the return fitting on the injection pump is plugged or the return to the tank is restricted it will also cause a start then die issue.

## Dies on Deceleration

- This is a common problem with low lubricity fuels, which cause slow response from the metering valve in the injection pump or when a vehicle has been sitting unused for some time.

1. If the engine dies when the operator lets off of the throttle but the engine easily restarts, it is possible that the idle RPM are just set a little too low. It could also be low lubricity fuel. Try using fuel additive; this will often solve a "dies on deceleration" problem after just a short drive.
2. If the engine dies and then is slow to restart, the problem could be a sticking metering valve in the injection pump. Low lubricity fuels, old gummy fuel, or water contamination can lead to this problem. Check the fuel filter for signs of water or other contamination which would indicate a likely pump failure. Use a lubricity additive (Power Service, Howes Diesel Additive) and see if the problem clears up. If not, the injection pump may need replaced.

## White Smoke or Blue – White Smoke

- White smoke with a fuel smell is caused by incomplete combustion in the cylinder. Unburned fuel smoke will burn your eyes.

1. Verify pump to engine timing: Use a timing meter or timing light with a diesel adapter to verify dynamic injection pump timing. Retarded timing or timing that is too far out of range either way will cause white smoke. IF the smoke is mainly when the engine is cold, make sure the cold advance solenoid in the injection pump is receiving power until the engine reaches approximately 120 degrees coolant temperature.
2. Make sure the fuel supply is clean, not aerated, and the correct fuel. Old poor quality fuel or a gas/diesel mix will cause white smoke due to incomplete/incorrect combustion.

3. Coolant or oil in the combustion chamber can cause white smoke, but this smoke usually smells sweet (coolant) or oily (oil). If it is oil smoke; how many miles per quart of oil burned?
4. Low engine compression will cause white smoke.
5. An injector with a leaking or stuck nozzle may cause white smoke and is usually accompanied by a fuel knock. Crack open fuel lines to see if knock goes away. A worn injection pump can cause white smoke at all times.

## Black Smoke

- Black smoke is caused by excessive fuel or a lack of air flow (or both) into the cylinder, causing a fuel “rich” condition. It should also be noted that some light black smoke at high RPM, under load, and/or at higher altitudes is typical of a naturally aspirated IDI diesel engine.

1. Check the air filter. This is often overlooked and is a simple fix.
2. Verify pump to engine timing. Over advanced timing can contribute to black smoke.
3. If the engine is turbo charged, after market or OEM, verify boost pressure is within specification (usually 8-12 PSI). If not, look for exhaust leaks pre-turbo, exhaust restriction post-turbo, air inlet restriction, or boost leaks.
4. Worn injectors may cause black smoke due to poor spray patterns, leaking tips, and/or incorrect timing (low opening pressures). A worn injection pump can cause black smoke due to worn advance components, worn governing parts, and/or incorrect calibration. If the engine is equipped with EGR (some 6.2l and 6.5l engines), the system can malfunction and cause black smoke and low power.
5. Aerated fuel may cause black smoke without surging or dying (usually on the 7.3L).

## Miss, Rough Run

- A miss that can be isolated to one cylinder is probably not an injection pump issue, more commonly it will be an injector or base engine problem. A miss that cannot be isolated to one cylinder is most likely an injection pump related problem or engine balance issue (dual mass flywheel, balancer, ETC.).

1. Try to isolate the problem to one cylinder by cracking the injection lines one at a time while the engine is running and listening for a change in the engine. If there is no or very little change, that is the problem cylinder. Check all components related to that cylinder specifically, such as the injector, valve train, and compression.
2. If the problem can not be isolated, check the flywheel (manual transmission), flex plate (auto transmission), vibration dampener (balancer), fan clutch, ETC. for any signs of failure or excessive play.
3. Check idle speed: Too low of an idle speed can make the engine feel like it is running rough, especially when the transmission is in gear or the engine is loaded at idle (A/C compressor).

4. If no other problems are found, it is likely an injection pump problem.

## Low Power

1. Make sure the injection pump is getting full throttle travel. Worn linkages, cables, and levers can limit throttle travel.
2. Check pump to engine timing.
3. If turbocharged, see “Black Smoke”
4. Verify a good fuel supply to the injection pump, 4-6 PSI supply pressure with no aeration.
5. Check/test the injectors. Low opening pressures, poor spray patterns, and worn nozzles will contribute to low power.
6. Determine the condition of the injection pump by measuring return fuel from the return fitting at the injection pump. If return quantity exceeds 450 cc in one minute at idle, then the injection pump is worn out.
7. If the engine is equipped with EGR (some 6.2l and 6.5l engines), the system can malfunction and cause black smoke and low power.

## Dies While Driving

- If the engine dies or has a sever power loss power while under a load the problem is most likely fuel supply related.

1. CHANGE THE FUEL FILTER. Verify that the injection pump has a good, clean, not aerated fuel supply. Check pressure while driving. If the pressure falls off when the problem occurs then there is a problem in the supply system.
2. Check for a restriction on the suction side of the fuel system (supply pump inlet). A normally operating fuel system will have less than 5” of restriction under load. If it is higher, there is a restriction in the fuel lines or fuel tank. There is normally a pick up sock or fuel strainer in the tank. If restriction is OK, the fuel filter is clean, there’s no air in the fuel supply, and there’s still a fuel supply pressure problem, then change the fuel supply pump.