

## 6.0L Diagnostic Information

### Scan tool;

You must be able to use the Ford factory IDS (or WDS) 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".

### Engine serial number;

There have been many changes to the 6.0L and getting the correct parts for it depends on the engine serial number range. The s/n 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 s/n off of the engine block. The s/n is stamped into the block at the left rear of the engine just under the head.

### Basic Information

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 when you change the filters.
- Avoid long idle times; long idle times will cause the EGR and turbo to carbon up excessively.

### Resources

-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.

[www.fordspecialtools.com](http://www.fordspecialtools.com)

for Ford special tools

[www.motorcraftservice.com](http://www.motorcraftservice.com)

for scan tool information and service information, you can purchase three days, a month or year.

-Mitchell and Motors also offer online service information

[www.helminc.com](http://www.helminc.com)

they have printed publications such as manuals and TSB, as well as online subscription choices.

<http://www.forddoctorsdts.com/articles/>

many different articles to help with diagnosing the Ford Powerstroke

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## 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.
- EBP sensor shorted out will shutdown PCM

## No Start

Several parameters are necessary for starting, not including glow plug operation and good compression.

1. ICP 520 psi min. (0.8v minimum)
2. PCM sync = Yes which means that the CKP and CMP sensors are sending a signal to the PCM and are working correctly.
3. FICM sync = Yes which means that the PCM and FICM are in sync
4. Pulse Width signal to the injectors
5. Minimum cranking speed of 100 rpm

- The fuel supply pump has an inertia switch in the circuit, located under the passenger side kick panel
- 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
- A shorted EBP sensor can cause the PCM to shutdown
- FICM faulty
- 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

- Leak in the high pressure oil circuit, takes excessive cranking to build minimum ICP pressure, see ICP.
- Minimum cranking speed should be 175 rpm cold and 215 rpm warm.
- Glow plugs; they should pull approx 170-180 amps total on a cold start, which will drop to about 120 amps after about 15 seconds. If the amp draw is below 10-12 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
- 2004 with a sticky intake throttle plate can cause a hard start.

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- Glow plug harness chaffing
- Glow Plug control module connector problems (pin tension, water intrusion, bent pins)

## 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.

-Monitor the ICP while cranking, if it is .4v to .5v (200 psi) it is a possible 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) 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 through the ICP sensor hole on 2004 and later engines to pressurize the oil system and find the leaks. The IPR valve must be commanded or powered closed or air will just dump into the crankcase. Common leaks are at the injectors, high pressure pump connection (on 2004 ¼ and up) or at the high pressure pump on the 2003 models. It is normal to have a slight hiss from the injector spool valves.

-If ICP is low remove IPR 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 high pressure side leak or a sticky IPR valve (requires replacement), or debris in the check valves 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.

## Miss, rough run, vibration or flutter

-PCM is flashed to the latest calibration?

-Injectors can cause a miss, rough run or surge when cold if the spool valves are sticking. There is currently a re-flash to operate the injector spool valves during the glow plug cycle time in order to free up the spool valves. Excessive oil change interval can cause the spool valves to stick.

-perform a relative compression test and a power balance test to verify miss on a particular cylinder.

-Low fuel supply pressure, particularly when cold. Supply pressure should be 45 psi minimum, KOEO and 45 psi minimum on WOT hard acceleration.

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-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)

-FICM if bad should miss at all temperature ranges

## Low Power

-Is the PCM flashed to the latest calibration?

-Dirty air filter / Dirty fuel filter

-Boost leaks

-Exhaust leaks (hiss, squeal or smell)

-Injector spool valves sticking

-Biased MAP sensor

-Boost leaks

-Oil aeration

-Fuel aeration

-Low FICM voltage

## Injectors

-PCM at 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 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 stator housings, when the two bolts that holds the stator housing to the injector body break, are caused by aeration.

-2004 1/4 vehicles need to update the stand pipes when replacing injectors.

## Turbo failure diagnostics

-Normal boost 25 – 29 psi (22-25 psi in 3<sup>rd</sup> 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 point as noted

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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 vanes are stuck or sticky. Often caused by excessive idle time,
- Turbo vane failures (sticking) can cause EGR codes to set.
- Run the KOER EGR and VGT test multiple times to check for erratic operation or sticking.
- Excessive exhaust back pressure due to sticky vanes can cause pressures as high as 80 psi, which can cause EGR cooler failures.
- There is no vane position sensor and the system ignores EBP on the 03-05 models so if boost is low the PCM tells the vanes to close in order to create more turbo boost (MAP).
- Boost leaks (intake, intercooler or piping) can also cause high or excessive back pressure because the vanes close to create more boost.
- 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 warrantable turbo failure.
- Squeal 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

- Is the PCM re-flashed to the latest calibration?
- Check the turbo, 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 codes (they affect MAF right)
- A dirty IAT2 sensor 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
- 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 you find a condition where the EGR was causing a surge or stalling and disconnecting the EGR corrects it, check VGT turbo performance. Use the IDS to run the VGT from 0 – 80% and verify. The turbo could pass the KOER & VGT test even with a bad VGT control valve.
- If the EGR valve fails the system test, replace it don't just clean it.

## Coolant loss

- 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

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caused by a restriction in the engine oil cooler resulting in reduced coolant flow to the EGR cooler and overheating and cracking of the EGR cooler.

## Stalling and Dies

- FICM voltage should be 48 volts, if it drops below 45 volts it could be a connection issue, in need of a re-flash, or a bad FICM
- High pressure oil leak, which will usually happen more often when the oil is warm because it is thinner then.

## Surge

- Is the PCM flashed to the latest calibration specification?
- Injector spool valves (see injector section)
- Turbo, see the turbo section

## 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.

## 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; cylinder balance #1
- P0266; cylinder balance #2
- P0269; cylinder balance #3
- P0272; cylinder balance #4
- P0275; cylinder balance #5
- P0278; cylinder balance #6
- P0281; cylinder balance #7
- P0284; cylinder balance #8
- P0299; turbo under boost (see turbo info)
- P0336; CKP range/performance
- P0341; CMP range/Performance
- P0401; EGR Insufficient flow (see EGR info)
- P0402; EGR Excessive flow (see EGR info)
- P0611; FICM Performance (replace FICM)

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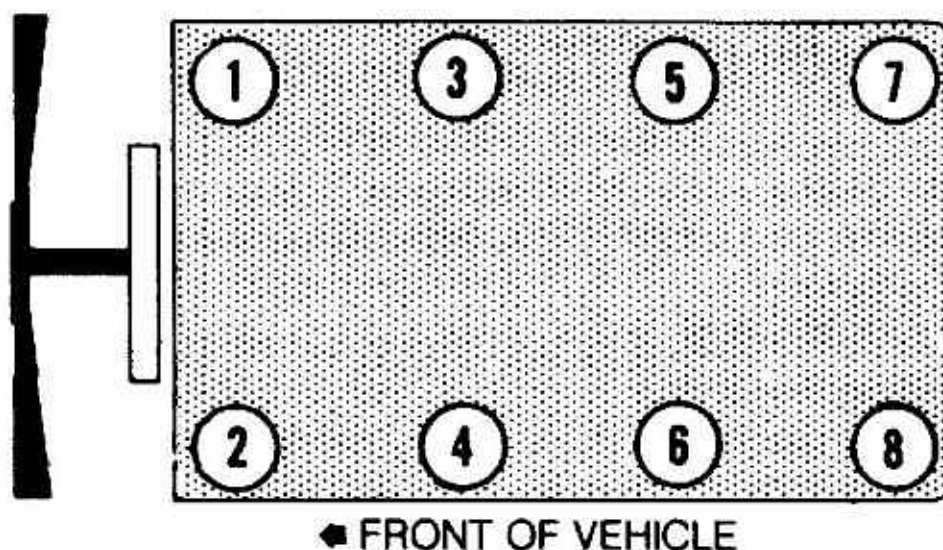
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- P0671-P0678; Glow Plug circuit codes
- P1334; EGR Throttle MIN Stop Performance (2004 throttle plate stuck)
- P2269; Water in fuel
- P2284; ICP sensor CKT range/performance (see ICP info)
- P2285; ICP sensor CKT low (see ICP info)
- P2614 & P2617, if set with other codes diagnose other codes first, these can set with a chaffed harness or low fuel pressure.

## Ford 6.0 L Cylinder location and Firing Order

Ford Diesel 7.3L IDI, 7.3L  
& 6.0L Powerstroke

Firing Order 1-2-7-3-4-5-6-8



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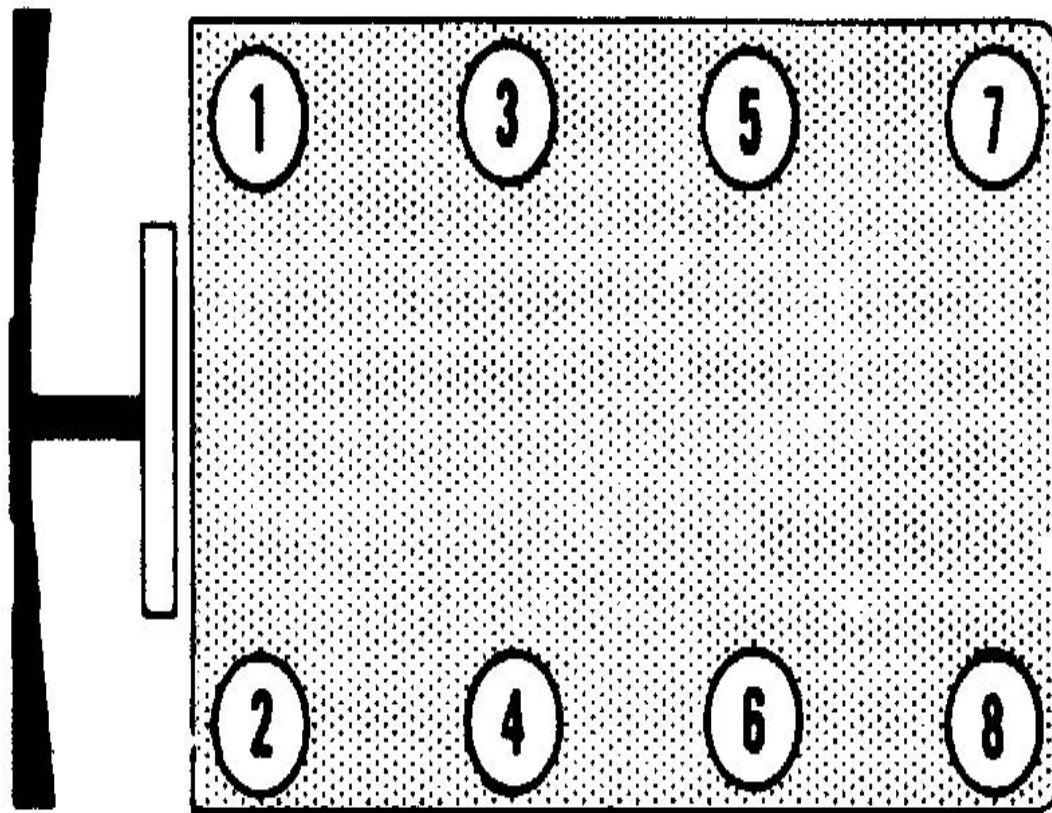
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Firing Order 1-2-7-3-4-5-6-8



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