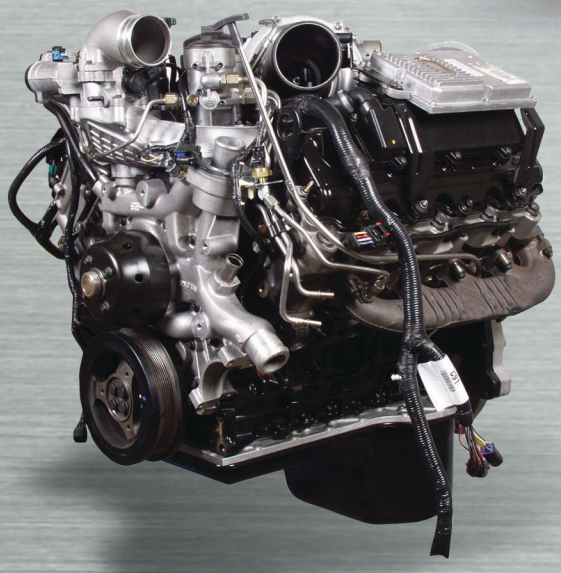
POWER STROKE V8
TURBO DIESEL

6.0L Power Stroke Diesel

Direct Injection Turbocharged Diesel Engine

F-Series Super Duty Truck

E-Series Econoline Van



6.0L Power Stroke Diesel

New 2004 F&E Series Super Duty

Features, Descriptions,
Unique Service Procedures
and General Diagnostics

FORWARD

This publication is intended to provide technicians and service personnel with an overview of technical advancements in the 6.0L *POWER STROKE*® Diesel Engine. The information contained in this publication will supplement information contained in available service literature.

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as, the personal safety of the individual performing the work. This manual provides general directions for accomplishing service repair work with tested, effective techniques. Following the directions will assure reliability. There are numerous variations in the procedures; techniques, tools, parts for servicing vehicles and the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that they do not compromise their personal safety or the vehicle integrity by their choice of methods, tools or parts.

The following list contains some general **WARNINGS** that you should follow when you work on a vehicle.

Always wear safety glasses for eye protection.

Use safety stands whenever a procedure requires you to be under the vehicle.

Be sure that the ignition switch is always in the **OFF** position, unless otherwise required by the procedure.

Never perform any service to the engine with the air cleaner removed and the engine running unless a turbocharger compressor inlet shield is installed.

Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in **PARK** unless instructed otherwise for a specific service operation. If you have a manual transmission, it should be in **REVERSE** (engine OFF) or **NEUTRAL** (engine ON) unless instructed otherwise for a specific service operation.

Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.

Keep yourself and your clothing away from moving parts when the engine is running, especially the fan, belts, and the turbocharger compressor.

To prevent serious burns, avoid contact with hot metal parts such as the radiator, turbocharger pipes, exhaust manifold, tail pipe, catalytic converter and muffler.

Do not smoke while working on the vehicle.

To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind the head.

Keep hands and other objects clear of the radiator fan blades.

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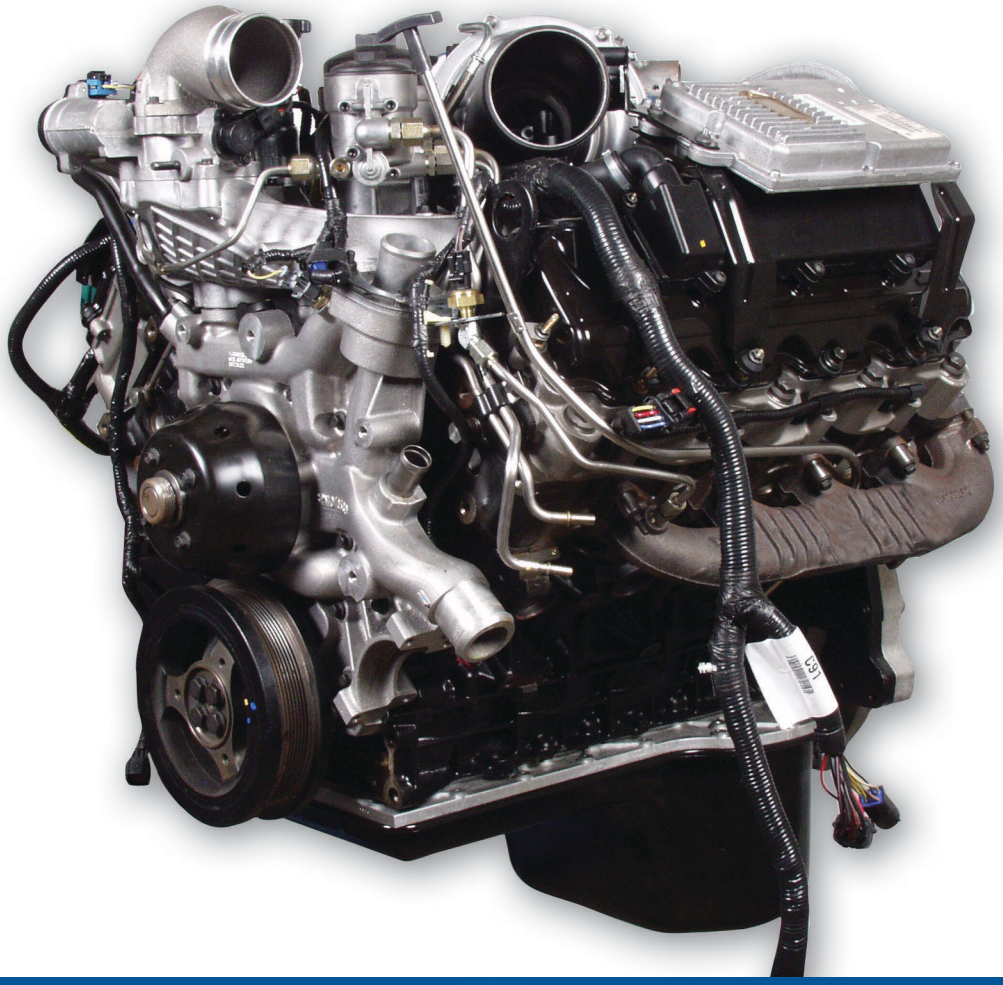

6.0L POWER STROKE® V8

DIRECT INJECTION TURBOCHARGED DIESEL ENGINE

6.0L *Power Stroke*® Engine

- This Publication is not intended to replace the Service Manual but to introduce the updates to the 6.0L *Power Stroke*® engine.

New 6.0L Engine Features

- Due to more stringent federal emissions standards, the 6.0L Power Stroke® engine has undergone many updates during the 2004 model year.
- The 6.0L Power Stroke® engines are manufactured at two locations: Indianapolis Engine Plant in Indianapolis, Indiana and International Diesel of Alabama in Huntsville, Alabama. The serial number breaks for the updated 2004 6.0L engines are 6155637 for Indianapolis built engines and 0094580 for Huntsville built engines.
- The begining production date for the updated 2004 Power Stroke® engine was on September 29, 2003.

Horsepower and Torque

- Horsepower and torque will remain unchanged throughout the 2004 model year on F-Series Super Duty trucks.
- The 6.0L Power Stroke® engine creates 325 HP at 3300 RPM and 560 ft/lb of torque at 2000 RPM.

6.0L *Power Stroke*®
Direct Injection Turbocharged Diesel Engine

- 2003 Mid-Year Improvements
- 2004 Running Changes and Updates
- 2004 6.0L Econoline
- Updated 6.0L Engine Specifications

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Update Features

- **EGRTP (Exhaust Gas Recirculation Throttle Plate)**
- **Redesigned High-Pressure Oil Rail and Delivery System**
- **Redesigned EGR Cooler**
- **DLC Coating on Injector Plunger**

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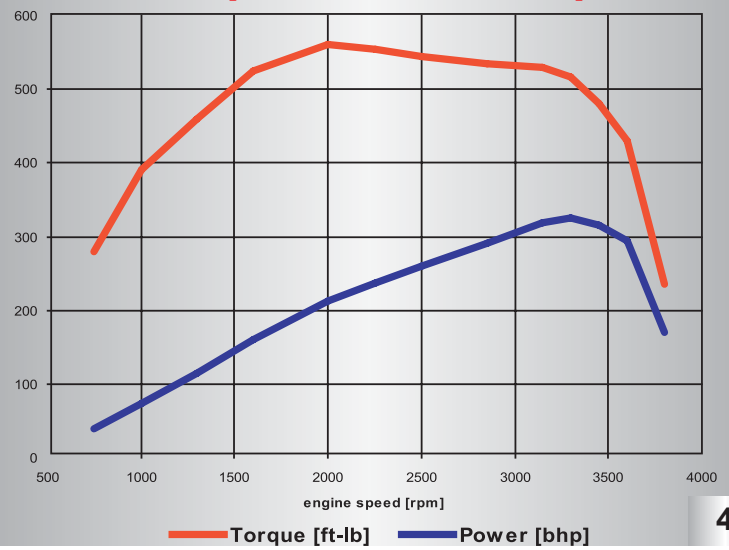
Horsepower and Torque



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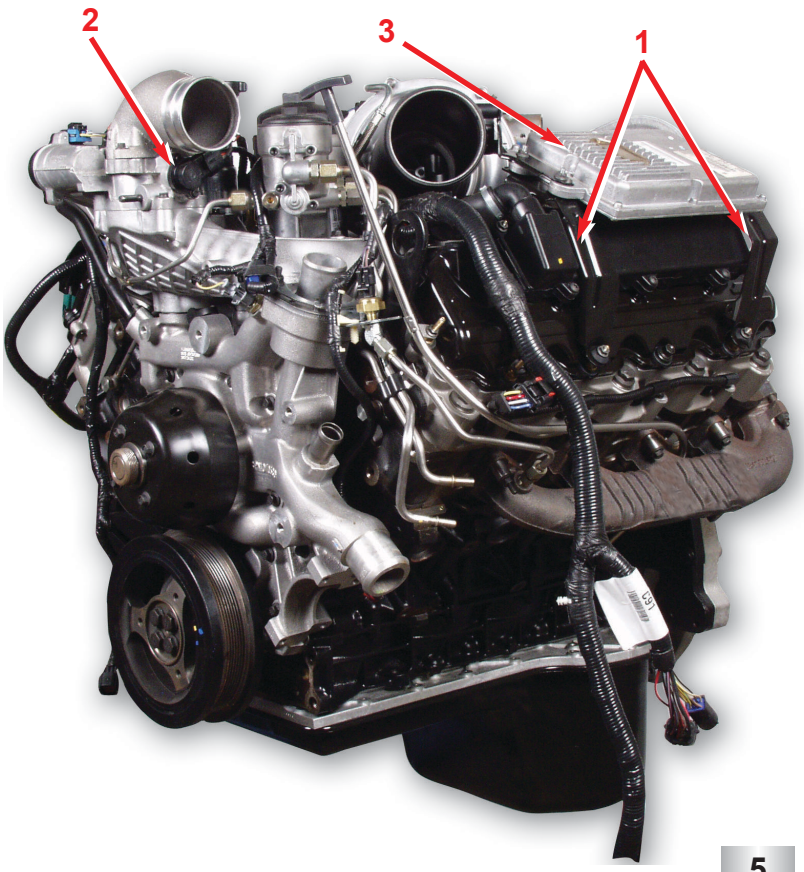

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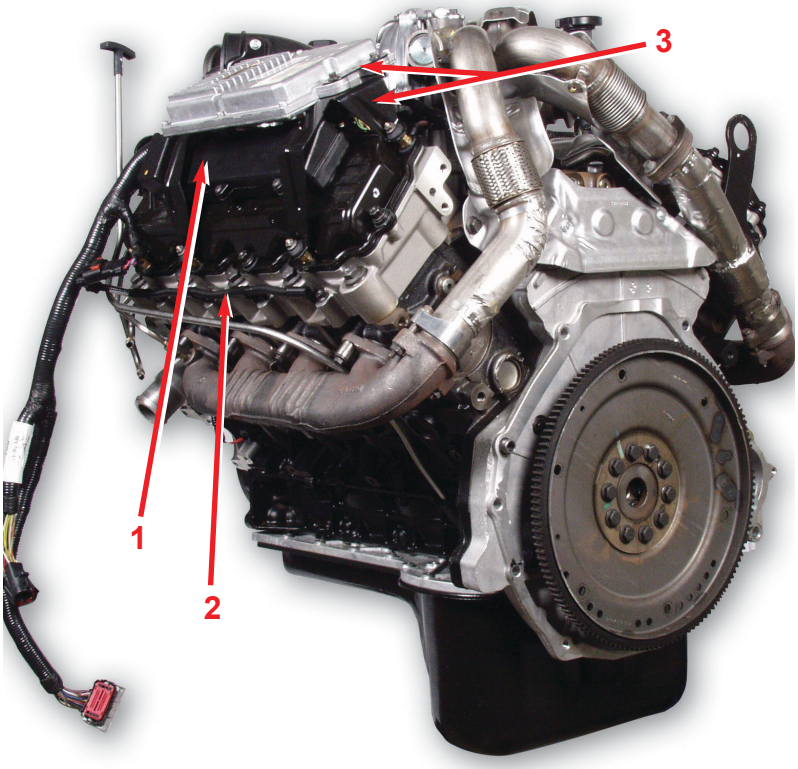
Left Front of Engine

1. FICM (Fuel Injection Control Module) Mounting Brackets
2. EGR Throttle Position Sensor
3. FICM (Fuel Injection Control Module)



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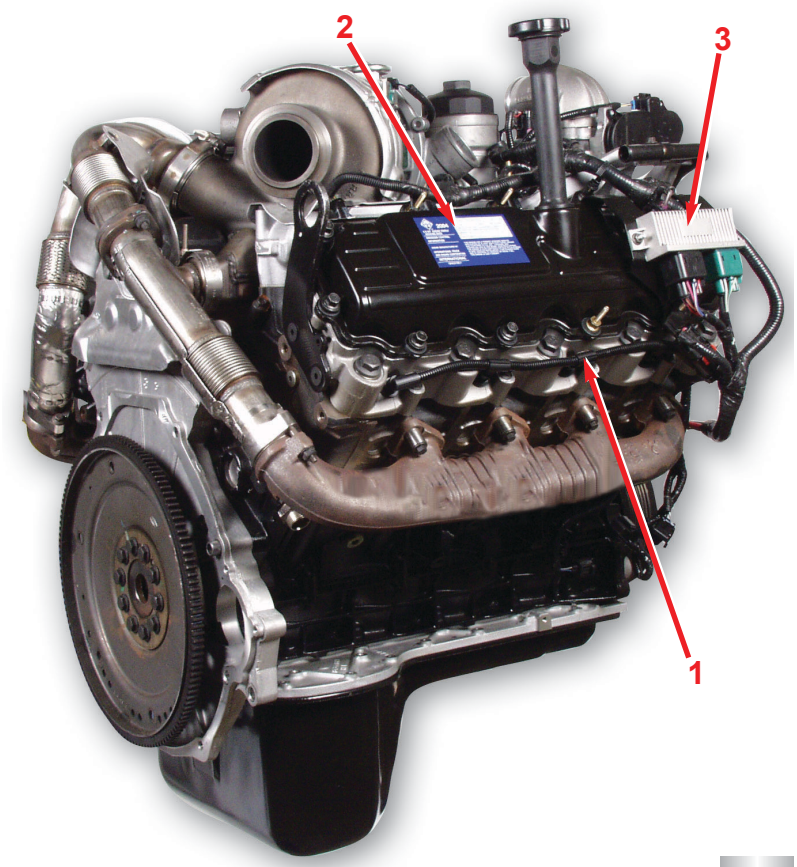
Left Rear of Engine

1. Crankcase Breather
2. Glow Plug Harness
3. Rear FICM mounting bracket

COMPONENT LOCATIONS

Right Rear of Engine

1. Glow Plug Harness
2. Emissions Label
3. Glow Plug Control Module (GPCM)



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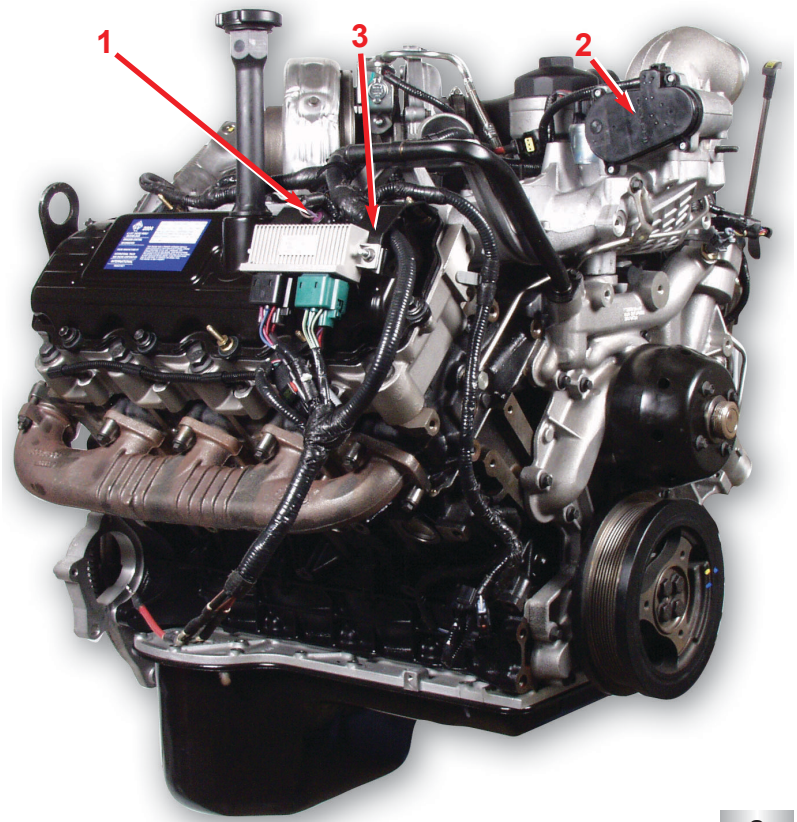
Right Front of Engine

1. ICP Sensor
2. EGRTP (EGR Throttle Plate) Actuator
3. GPCM bracket



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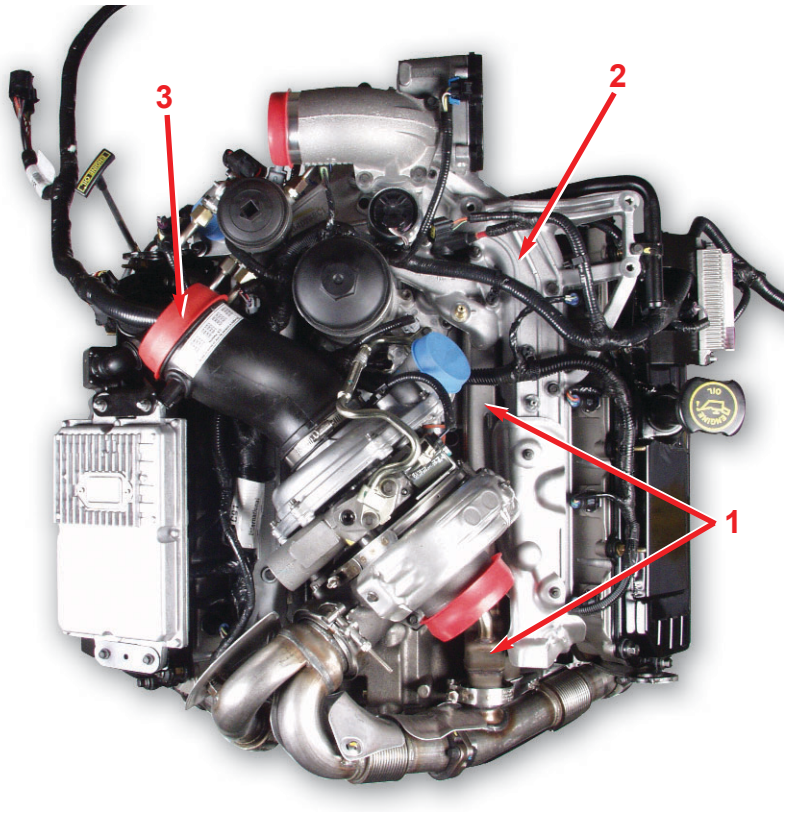

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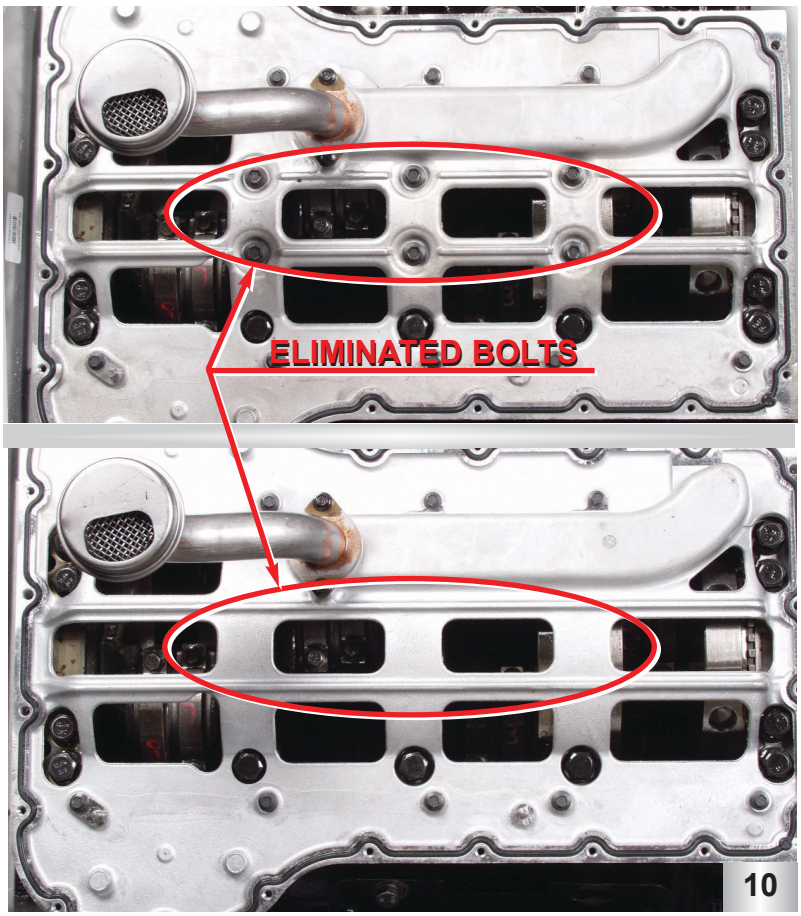
Top of Engine

1. EGR Cooler
2. Intake Manifold
3. Compressor Inlet Hose



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Upper Oil Pan

- The six M8 bolts which were placed in the center of the upper oil pan have been eliminated.
- Additional strength has been cast into the upper oil pan.
- An upper oil pan which has bolt holes present should always be assembled with the six specified M8 bolts. Failure to do so will result in a vibration related noise caused from the upper oil pan vibrating against the bed plate.
- An upper oil pan which has had the bolt holes eliminated, can be utilized as a service part to replace the earlier part.

Camshaft

- The lobe separation angle, lobe lift, and duration have changed to improve combustion characteristics.
- Changes have been made to the camshaft to increase the efficiency of the 6.0L engine, allowing it to meet tighter emissions standards.
- It is not recommended that the updated 2004 MY camshaft be installed into an earlier version of the 6.0L engine. Emissions will be impacted.

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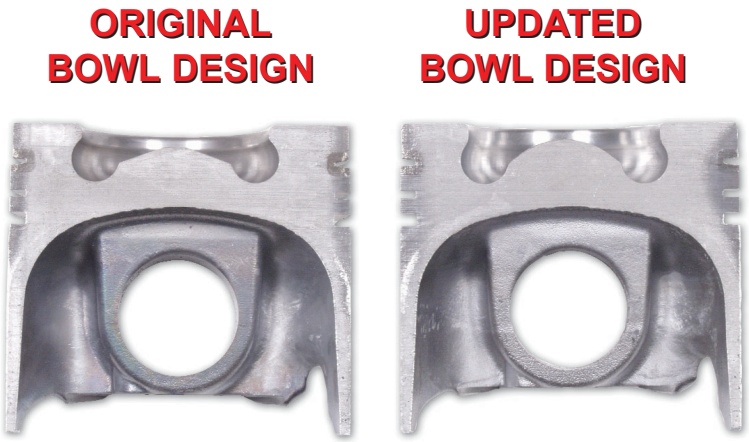
Piston/Combustion Chamber

- The combustion chamber on the piston has been modified.
- This modification increases the efficiency of the combustion process, allowing the 6.0L engine to meet tighter emissions standards.



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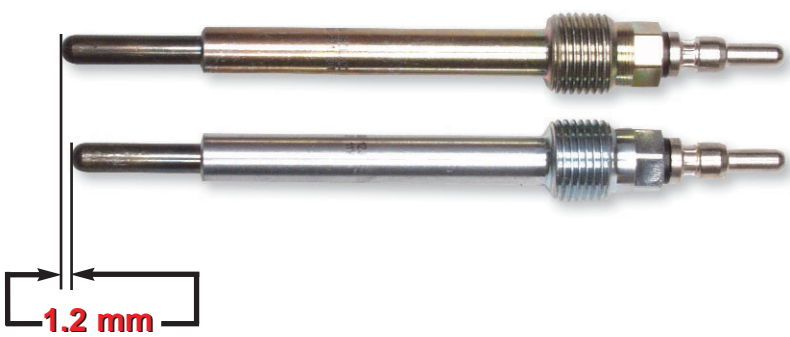
Glow Plugs

- Due to the design change of the piston, the glow plug has been made shorter by 1.2 mm.



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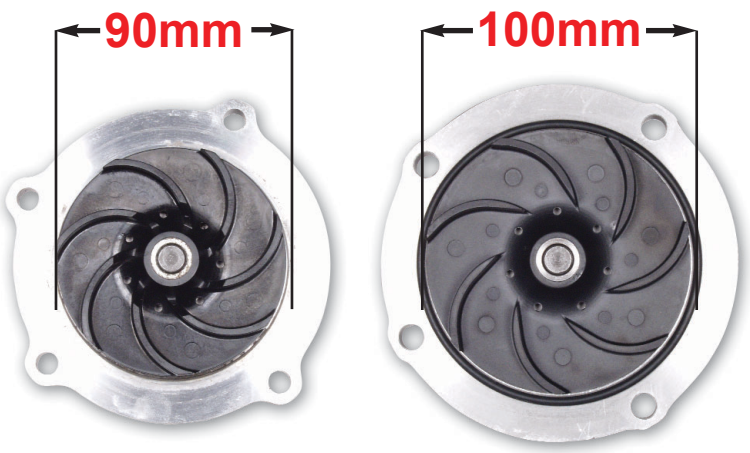
- **NOTE: If the longer glow plugs are installed into an engine with updated pistons, glow plug to piston contact will result, ending in potential catostrophic engine failure.**



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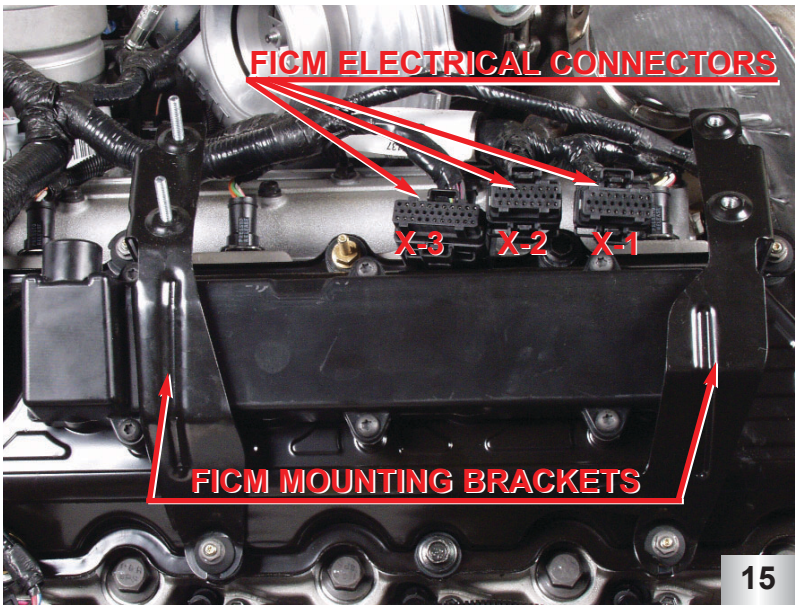
Water Pump/Front Cover

- The water pump impeller diameter has increased in size to 100 mm from 90 mm.
- The larger impeller will increase coolant flow through the engine which will offset higher heat rejection.
- **Note: Both water pumps have the same bolt pattern, but a different sealing area. As a result, the smaller water pump has the physical ability to be installed into an updated front cover. If this is done, a coolant leak and over heating of the engine may result.**



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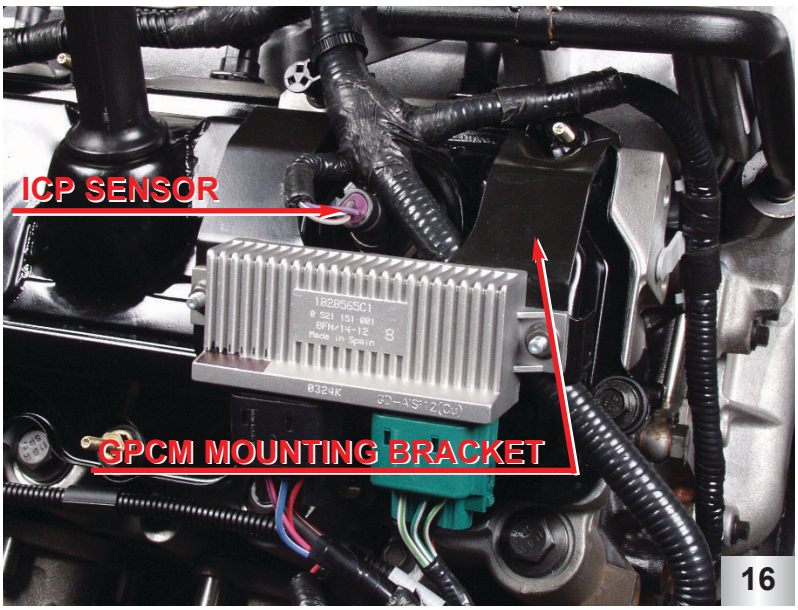
FICM (Fuel Injection Control Module) Brackets

- The FICM brackets are now composed of two bottom pieces and two smaller top pieces. The bottom brackets are pictured here. They slide over valve cover bolt studs as did the previous brackets.
- The new brackets have larger vibration insulators at each valve cover mounting point.



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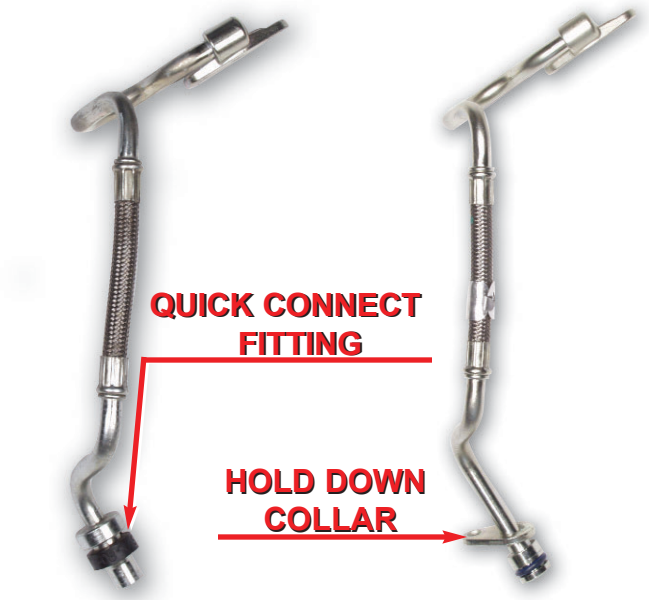
GPCM (Glow Plug Control Module) Bracket

- The GPCM bracket has been modified to accept the repositioning of the ICP Sensor.
- An earlier GPCM bracket will not work on an updated 2004 MY engine.

NOTES



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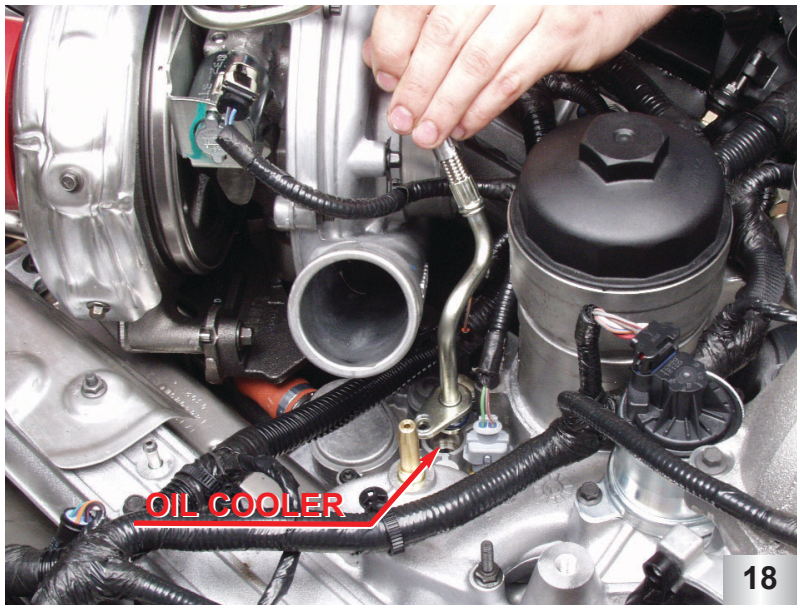
Turbocharger Oil Supply Line

- Part way through the 2003 model year, the turbo oil supply line changed in design.
- The early design was a quick-connect/ disconnect style (left). The improved design (right) provides a larger o-ring seal and is held in place with a bolted down collar.
- The new design improves the line's long term reliability and reduces risk of oil leaks between the oil cooler assembly and the supply line.



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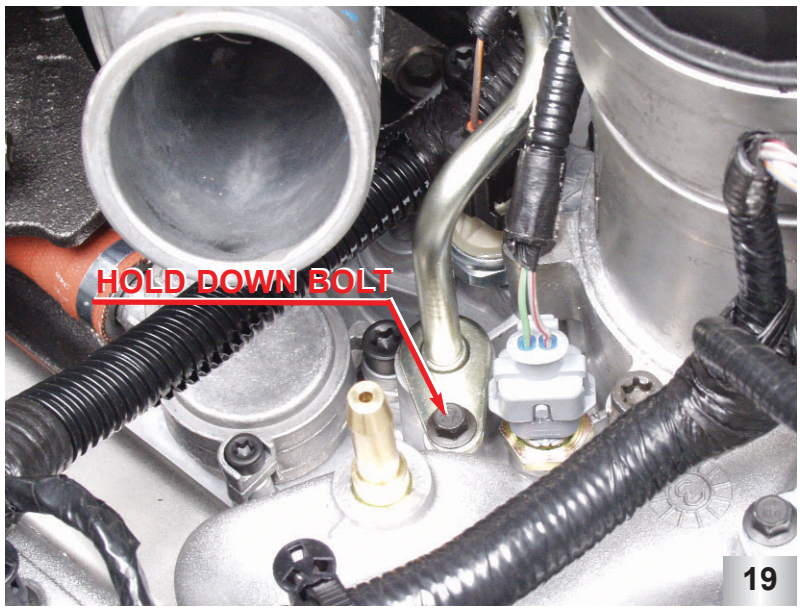
Turbocharger Oil Supply Line: Installation

- First, apply oil to the oil supply line o-ring.
- Orient the supply line where it will be positioned once fully installed.
- Press the supply line/o-ring into the cooler.



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Turbocharger Oil Supply Line: Installation

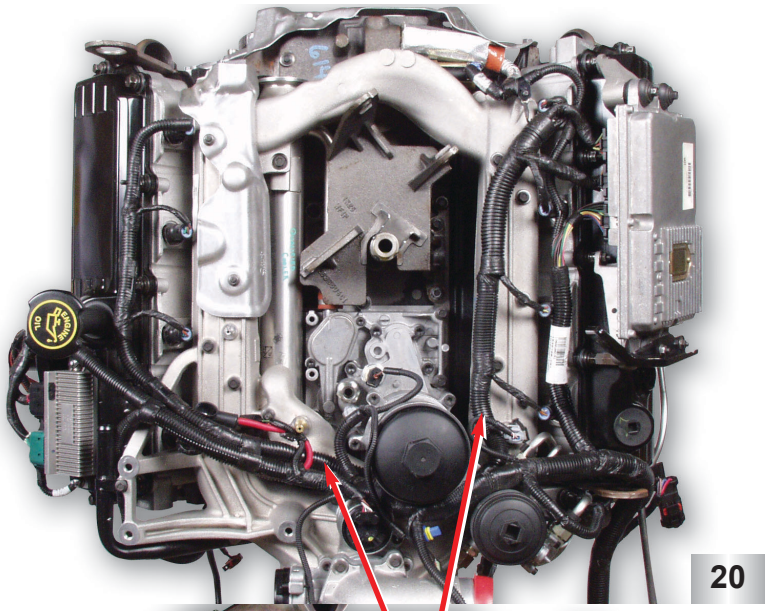
- Once the oil supply line has been pressed into the cooler, the collar should be positioned and the retaining bolt installed.
- Prior to tightening the retaining bolt, reposition the oil supply line, as necessary, in order to install the two turbo mounted oil supply line bolts, located on the center section of the turbo.
- Torque all bolts to specification.

2003 MY RUNNING CHANGES

Wiring Harness Routing

*Early Production 2003

- From the beginning of the production of the 6.0L Power Stroke engine, the wiring harness has been comprised of two combined smaller harnesses.
- Both of these smaller harnesses were routed between the oil filter housing and the secondary fuel filter housing.



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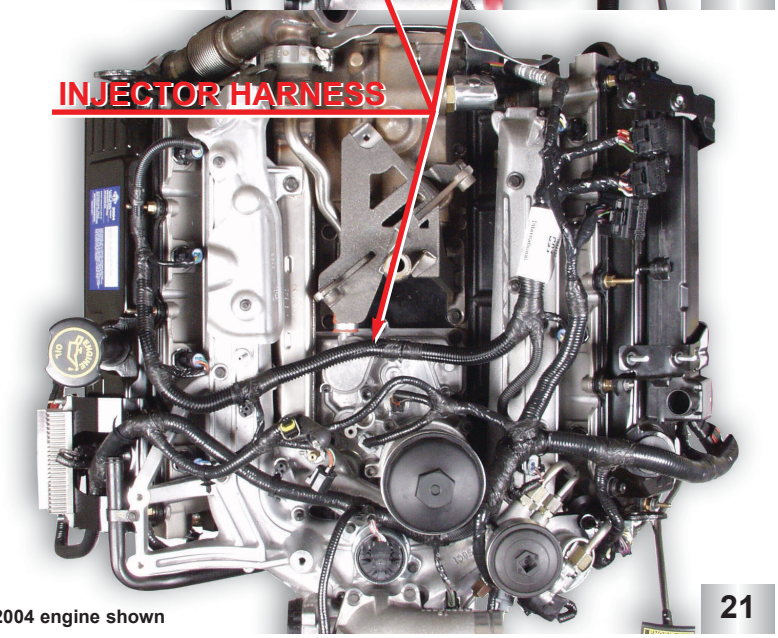
*Late Production 2003 and 2004 MY

- In order to increase serviceability and long term reliability of the engine wiring harness, the two harnesses were separated.
- The injector harness, which runs from the FICM to each of the eight injectors, is now routed between the oil filter housing and the compressor housing of the turbocharger.



*2004 engine shown

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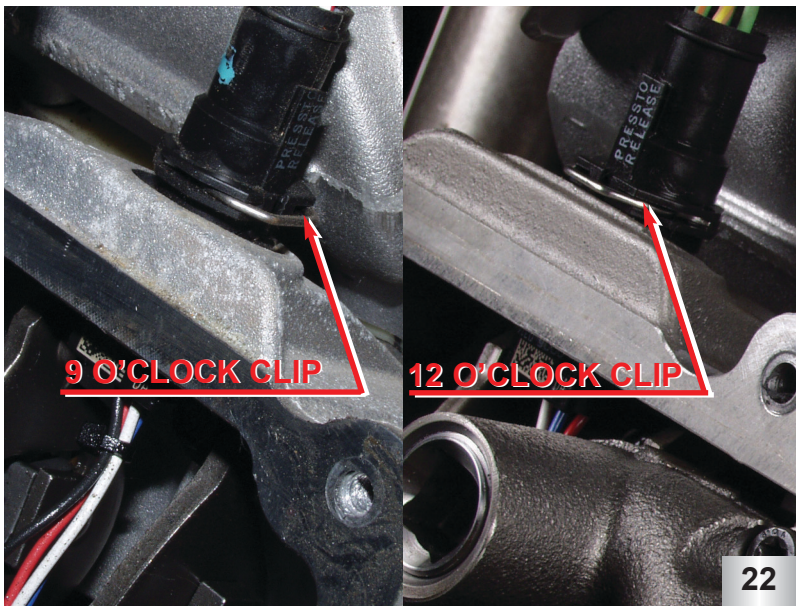
Injector Clip Orientation

- The orientation of the injector connector retaining clip has been repositioned in order to improve serviceability.
- Prior to this change, the clip was positioned on the side (9 o'clock position) of the connector. This made removal and installation of the injector connector more difficult on some cylinders.



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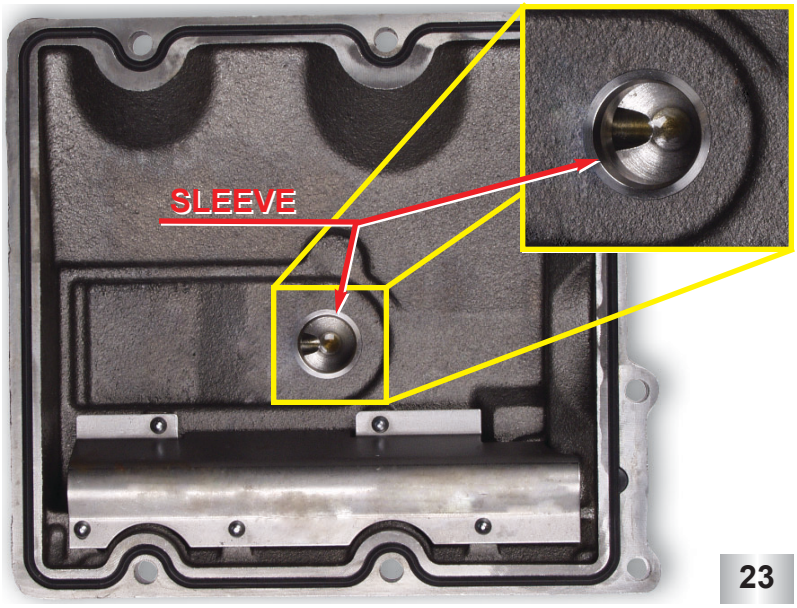

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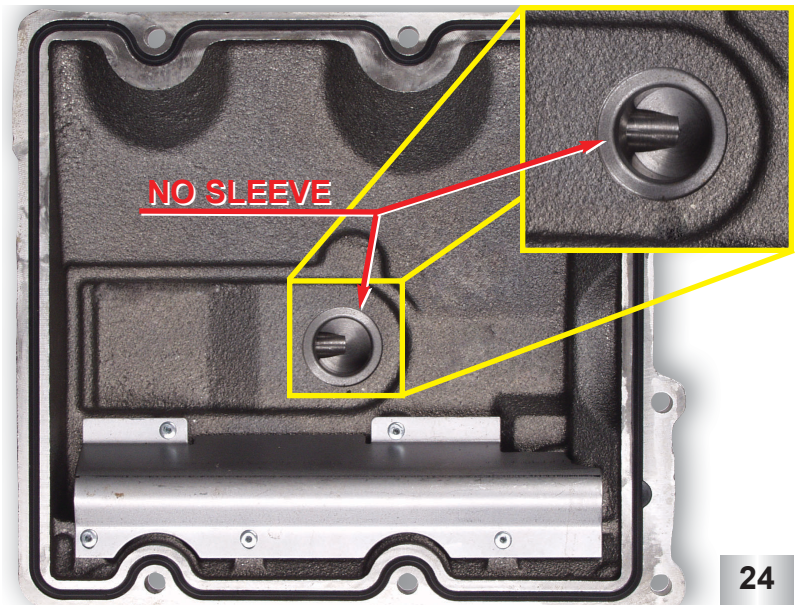
High-Pressure Pump Cover with Sleeve

- From the beginning of production, the high-pressure pump cover retains a sleeve which provides a sealing surface for the o-ring on the high-pressure oil discharge tube.



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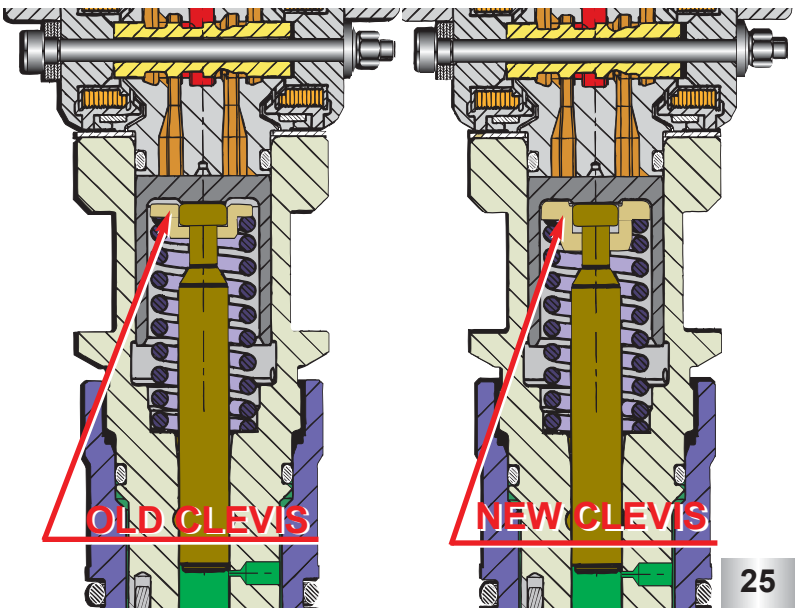
High-Pressure Pump Cover without Sleeve

- Mid-way through 2003 MY, the sleeve in the high-pressure pump cover was removed.
- The sealing surface for the high-pressure oil discharge tube is now totally machined for the o-ring seal.



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Injector Clevis

- A change was made to the injector clevis mid-way through the 2003 MY.
- The revised clevis in the injector improves the lateral support of the plunger and dramatically reduces injector scuffing.

NOTES

6.0L Air Management System Features

- External Mounted Crankcase Breather
- Redesigned Intake Manifold
- Improved Turbocharger Sound Characteristics
- Redesigned EGR Cooler.

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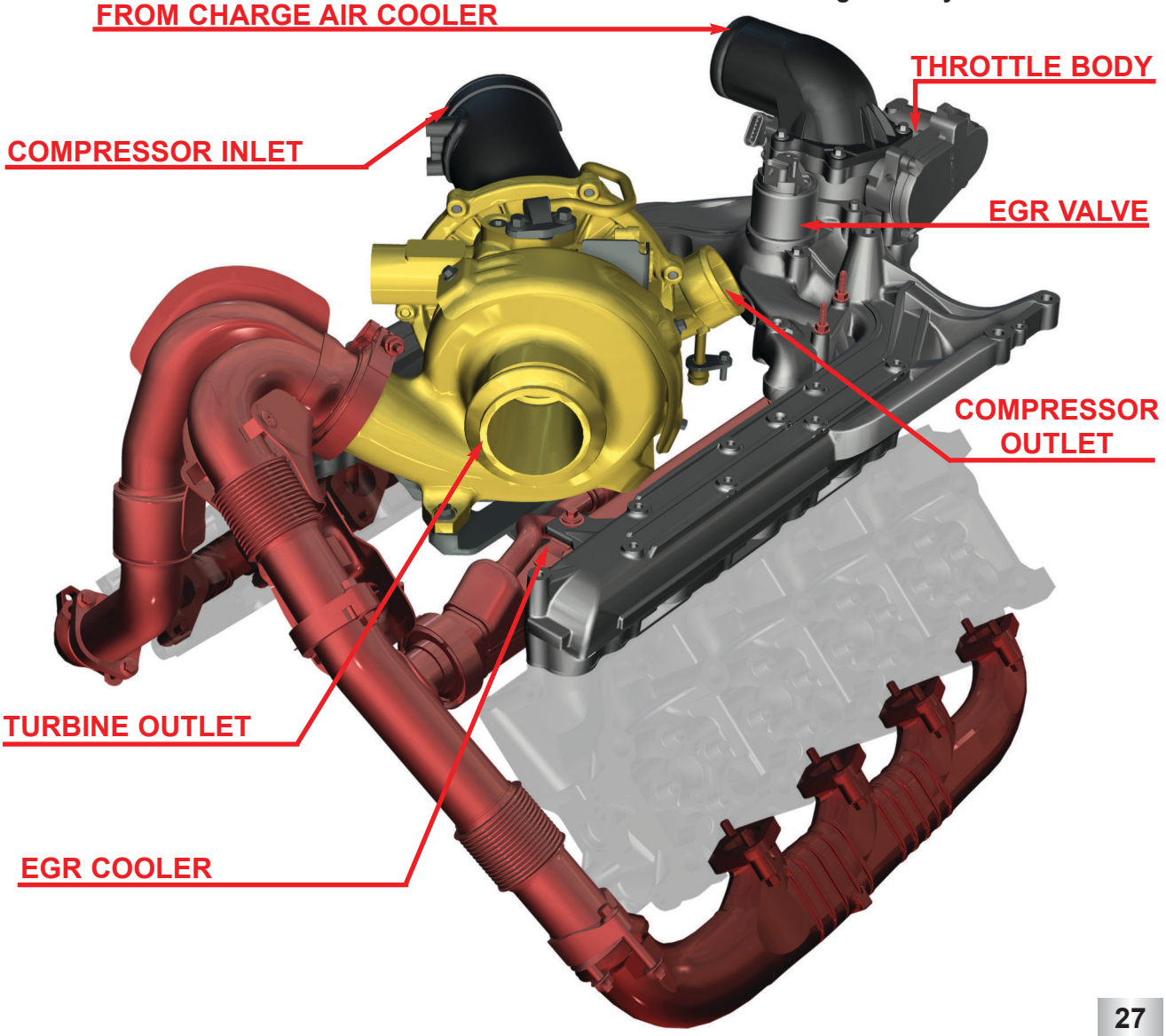
Air Management System Features

- The crankcase breather has been externally mounted on the left valve cover.
- The rear cross over section has been removed from the intake manifold
- The updated 2004 MY Power Stroke® engine has been equipped with a EGR Throttle Plate.

Air Management System Flow



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AIR MANAGEMENT SYSTEM

Compressor Inlet Hose/Crankcase Breather Hose

- In order to accommodate the change from an internal crankcase breather to an externally mounted crankcase breather, the compressor inlet hose has been modified.
- The compressor inlet hose bracket is also utilized as a retaining bracket for the front two mounting points of the FICM.

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Compressor Inlet Hose: Removal

- To disconnect the crankcase ventilation tube from the engine, remove the air inlet tube from the compressor inlet and rotate the vent hose counter clockwise until it releases.
- **Note: Since the 6.0L *POWER STROKE*® engine uses a closed crankcase ventilation system, it is normal to see oil carry over in the inlet air system.**

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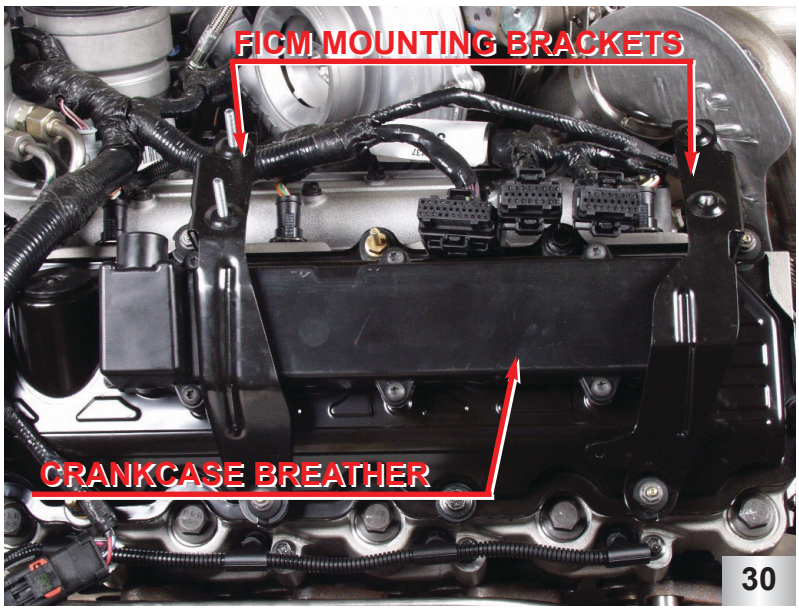
External Mounted Crankcase Breather

- The crankcase breather was externally mounted on the valve cover because of the redesign of the high-pressure oil rail.



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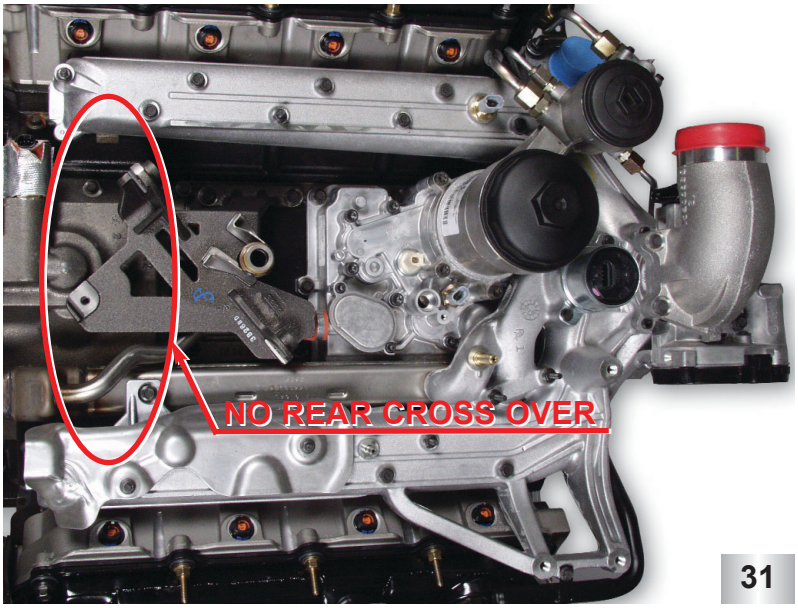

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Intake Manifold

- The intake manifold has been modified for the updated 2004 MY.
- The cross over section at the rear of the manifold has been eliminated.

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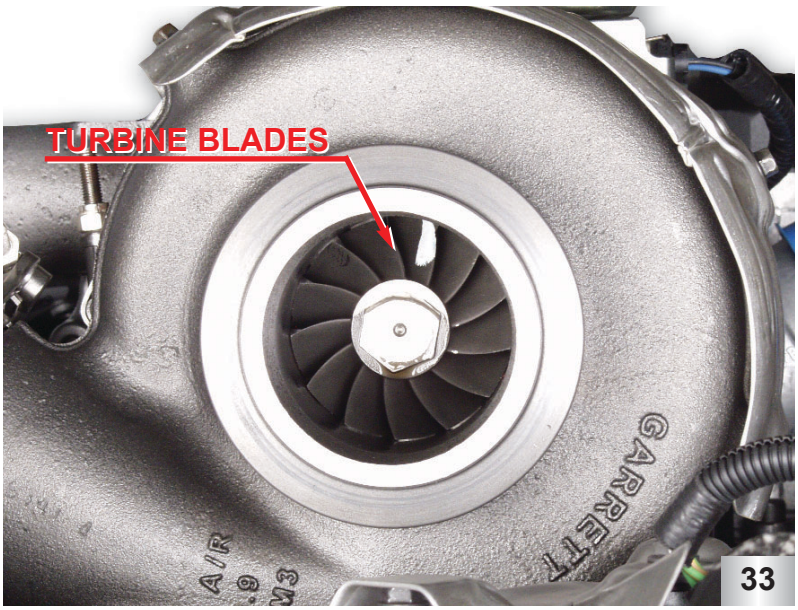
EGR Throttle Plate

- The intake manifold is now equipped with an EGR throttle plate.
- The purpose of this plate is to lower the manifold pressure which will allow exhaust gases from EGR to flow freely into the intake manifold.
- **NOTE: The PCM will activate the EGRTP actuator and perform a full sweep of the throttle plate for each key cycle with the IAT temperature greater than 0 degrees Celsius (32 deg. F.)**



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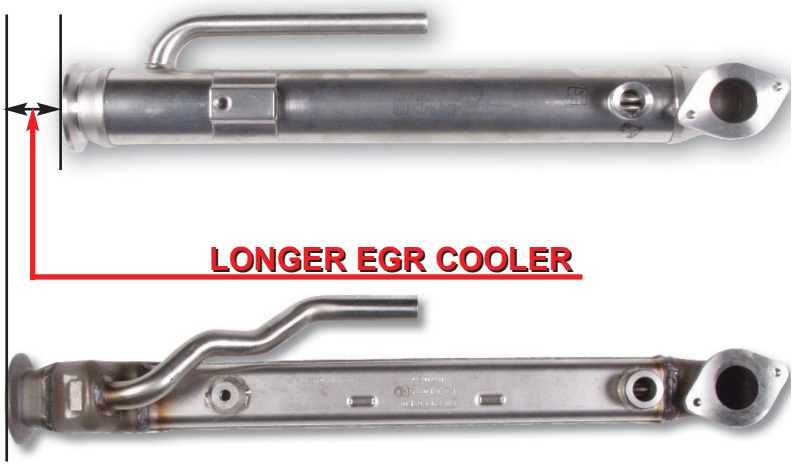
Turbocharger Exhaust Turbine Wheel

- Three fins have been added to the turbine wheel of the turbocharger.
- These additional fins were added to the turbine wheel in order to improve the turbocharger's sound characteristics.

EGR Coolers

- The EGR cooler has been lengthened for the updated 2004 MY engine.
- The changes to the EGR cooler will cause the exhaust gases to be cooler before entering into the intake manifold.



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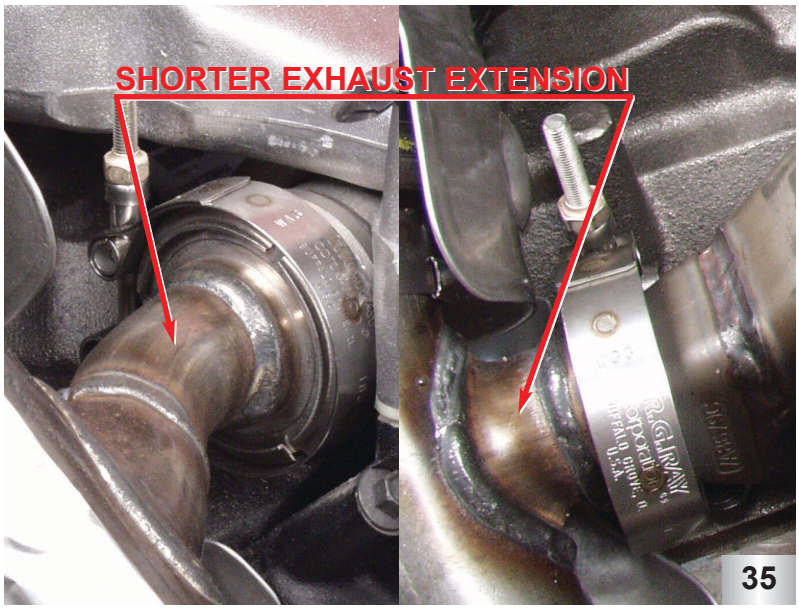
EGR Cooler Exhaust Connection

- Because the new EGR cooler is longer than the original, the exhaust up-pipe is shorter in length at the EGR cooler connection than the original up-pipe.
- The new EGR cooler still utilizes the same v-band clamp.



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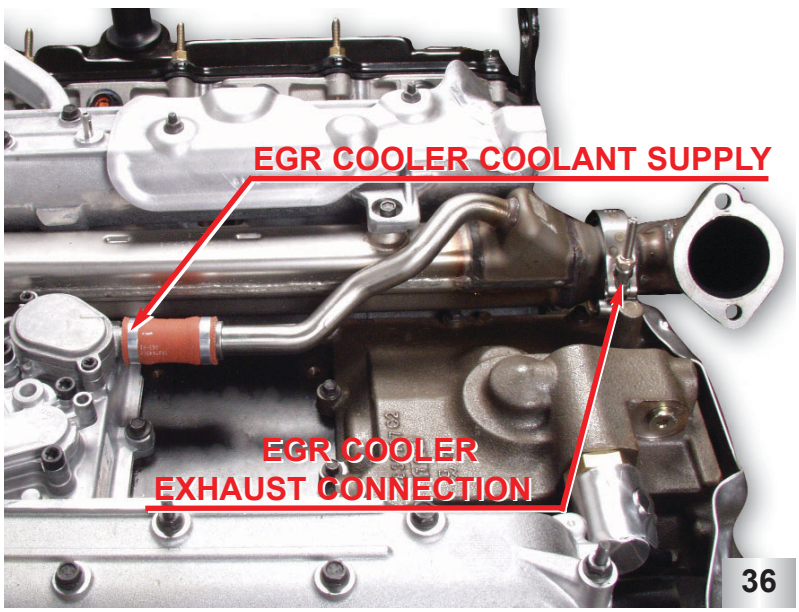
Updated EGR Cooler Mounting

- With exception to the exhaust up-pipe connection, the updated 2004 EGR cooler installs in the same location as the original EGR cooler.



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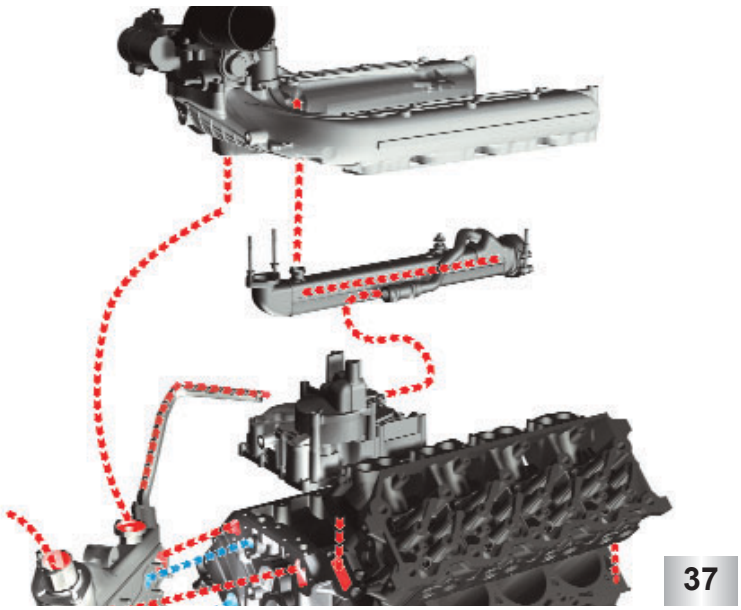

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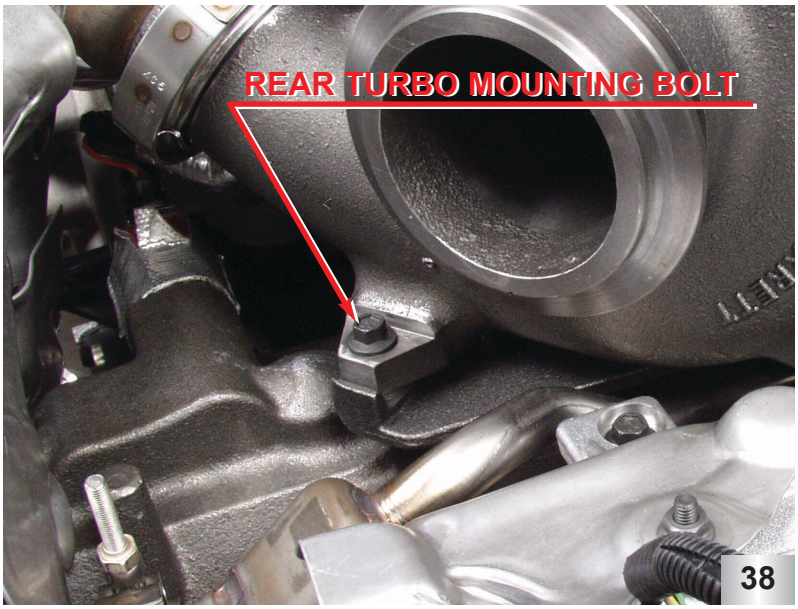
EGR Cooler: Cooling System Flow

- Coolant flows out of the filter base and into the EGR cooler through a tube that directs the coolant to the back of the EGR cooler.
- Coolant flows through the EGR cooler and removes heat from the exhaust gasses before the gasses arrive at the EGR valve.
- Coolant exits the front of the EGR cooler and enters the coolant passage of the intake manifold. The intake manifold directs the coolant back into the front cover.



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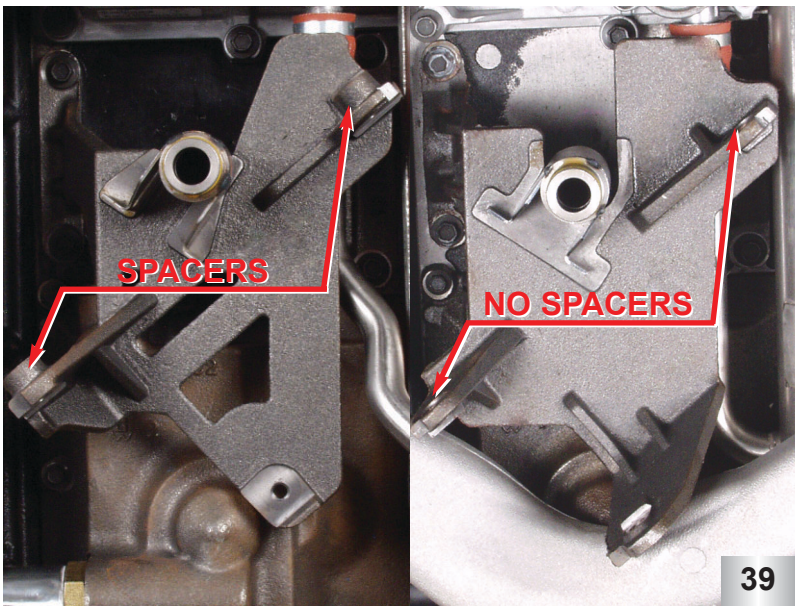
Turbocharger Mounting Bolt

- The turbo mounting joints have been modified. The mounting bolts no longer need spacers on the new turbo.



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Turbocharger Mounting Bracket

- A new turbo mounting bracket has been implemented with the mounting bolt spacers incorporated into the bracket. These spacers are utilized to achieve the necessary clamp load on the turbocharger mounting bolts.

NOTES

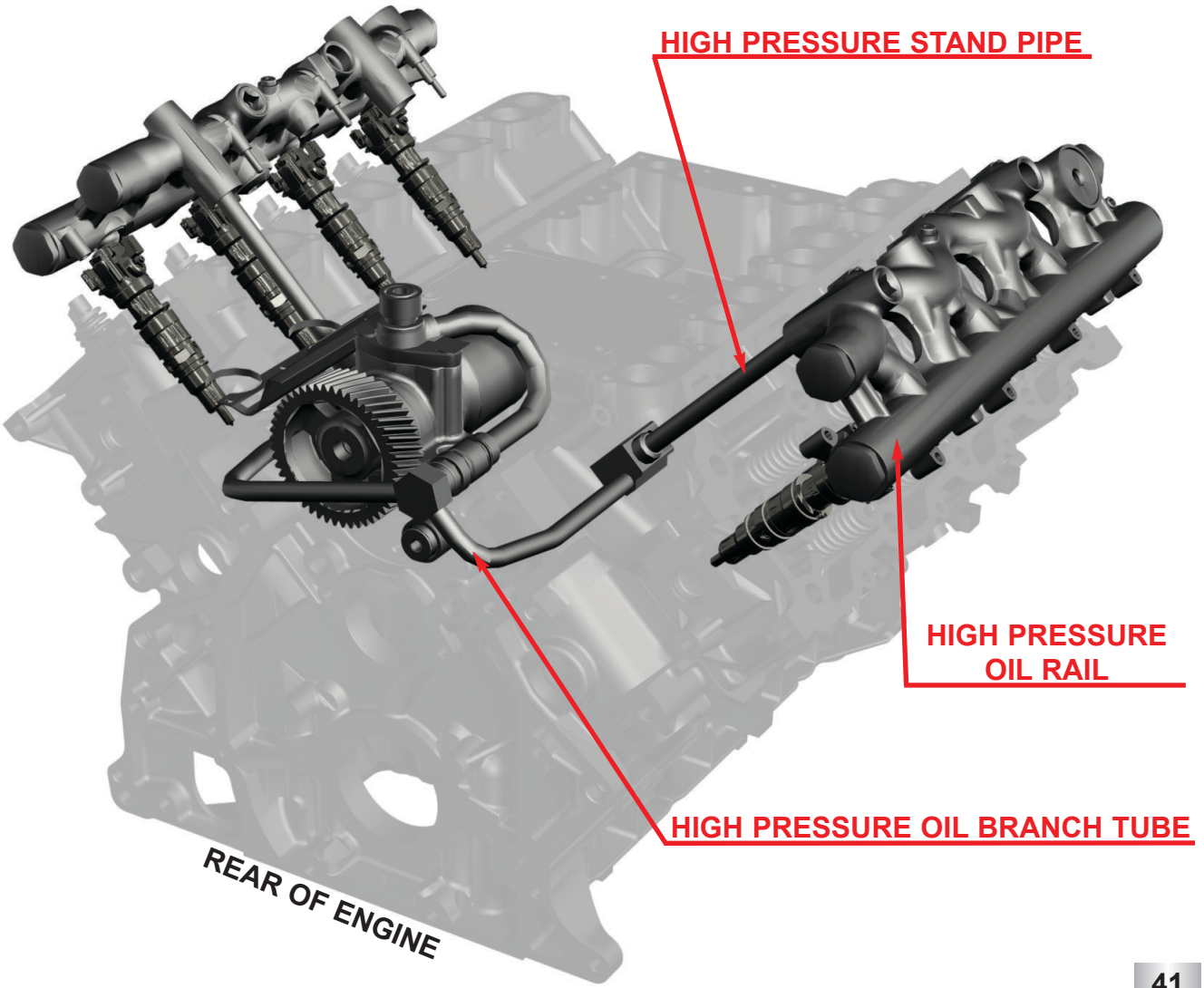
6.0L High-Pressure Oil System

- **Wavy High-Pressure Oil Rail**
- **Redesigned Stand Pipe/Branch Tube**
- **Relocated ICP Sensor**
- **DLC Coated Injectors**

High-Pressure Oil System

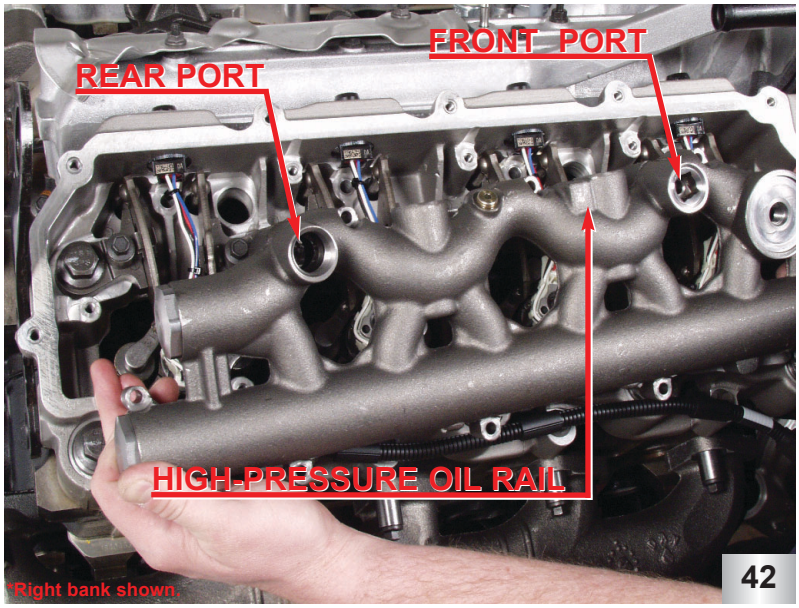
- The high-pressure oil rail has been redesigned to increase oil capacity and to reduce noise.
- The stand pipes' serviceability has been improved.
- The ICP sensor has been relocated to the right valve cover/high-pressure rail.
- DLC (Diamond Like Carbon) coated injectors.

High-Pressure Oil System Flow



Wavy High-Pressure Rail

- The high-pressure rail has been redesigned to reduce noise through the high-pressure oil system.
- The volume wavy high-pressure rail has increased from 15 cubic inches to 30 cubic inches. This reduces pressure fall-off during injection and improved emissions and fuel economy.
- **NOTE: The larger volume oil rail will increase engine start time after the high-pressure oil rail has been drained during the process of any repairs.**



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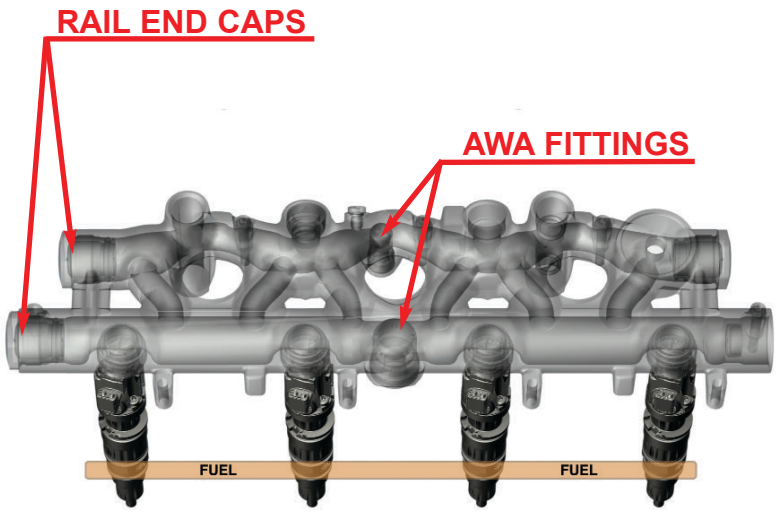
Wavy High-Pressure Oil Rail with Dual AWA Fittings

- The wavy high-pressure oil rail has special AWA (Acoustic Wave Attenuation) features to dampen hydraulic noises.
- The wavy high-pressure rail uses two AWA fittings, a large one and a small one. The AWA fittings are placed in the center of the rail. The smaller AWA fitting is placed in the wavy portion of the rail while the larger AWA fitting is placed in the original portion of the rail.
- The wavy high-pressure rail utilizes four specially designed end caps in conjunction with the AWA fittings.



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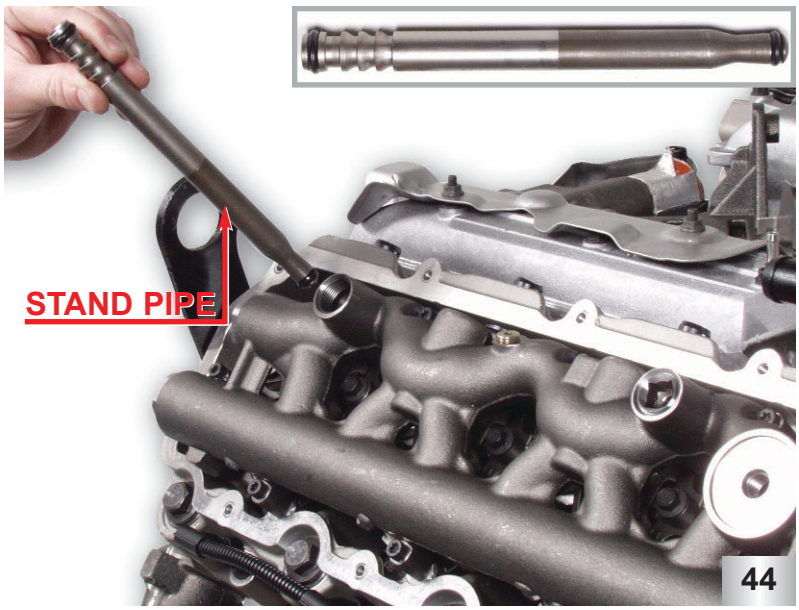
High-Pressure Stand Pipe

- The high-pressure stand pipe is a two piece pipe that is sealed to the high-pressure rail and high-pressure branch by o-rings.
- The stand pipe is installed after the new wavy high-pressure oil rail has been installed and torqued to specification.
- The stand pipe has a check valve inside to limit hydraulic disturbance (feed back from injector operation).
- **NOTE: Do not disassemble the high-pressure stand pipe. This will cause damage to the internal components of the pipe. If at any point, a stand pipe is disassembled, discard and replace it.**



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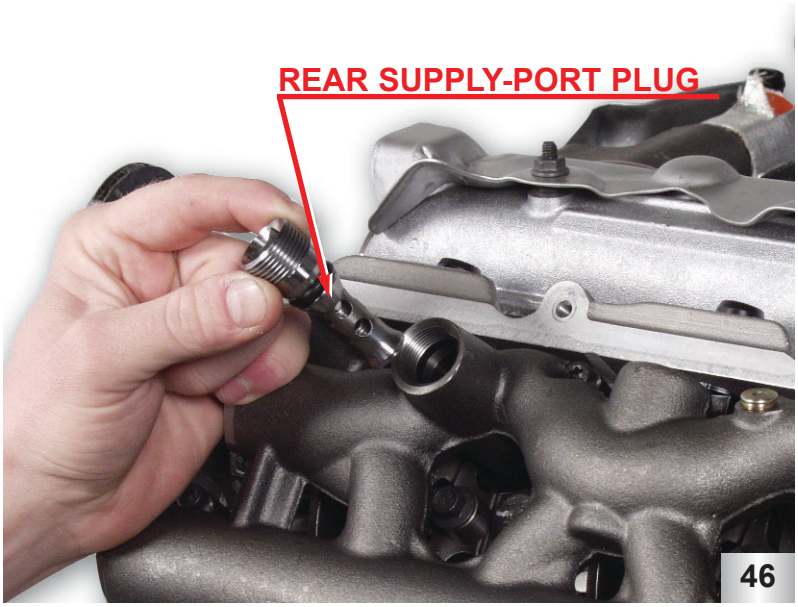
High-Pressure Rail Plugs

- There are two new high-pressure oil rail plugs introduced with the redesign of the rail.
- The rear supply-port plug (on the right) allows high-pressure oil to flow into the high-pressure rail.
- The same high-pressure oil rail is used on both banks of the engine. As a result the front port plug (on the left) is used to block off the non-utilized supply port in the high-pressure oil rail.



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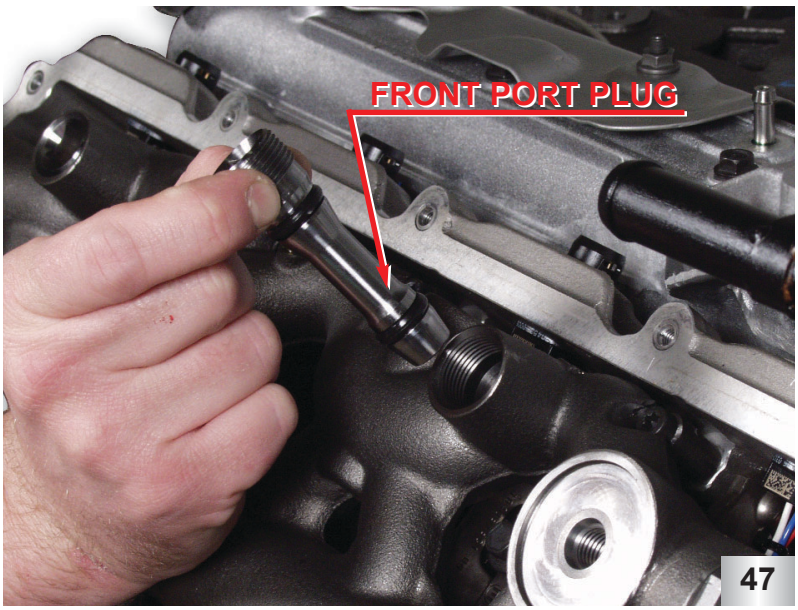
Rear Supply-Port Plug

- The rear supply-port plug is located towards the rear of engine on the high-pressure rail. It's purpose is to allow high-pressure oil to flow into the high-pressure rail.
- During engine operation, a small gap remains between the rear supply-port plug and the stand pipe. The force of the hydraulic pressure keeps the stand pipe seated into the branch tube.
- The plug will assure that the stand pipe remains in place when the engine is shut off and not operating.



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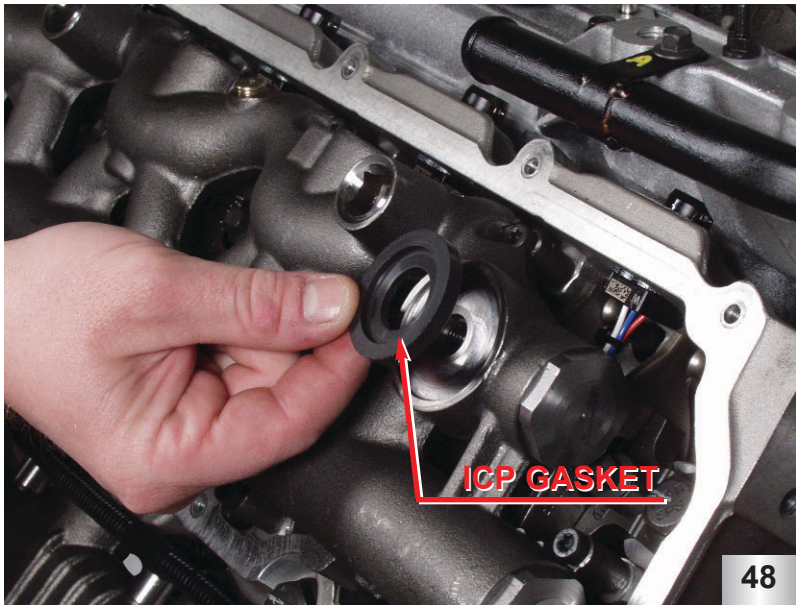
Front Port Plug

- The front port plug is located towards the front of the high-pressure oil rail.
- The rail was designed to be universal for both sides of the engine. One side of the high-pressure rail must be blocked off when not being used with the stand pipe.
- **NOTE: The front port plug is longer then the rear supply port plug. If the front plug is installed into the rear port opening, damage to the stand pipe and branch tube can result.**

ICP Sensor Gasket

- The ICP sensor has a new gasket.
- The purpose of the ICP gasket is to seal the valve cover to the high-pressure rail and prevent the release of crankcase vapors or splash oil.

- **NOTE: It is important to apply a thin layer of oil to both sides of the ICP sensor gasket during installation to prevent damaging the gasket.**



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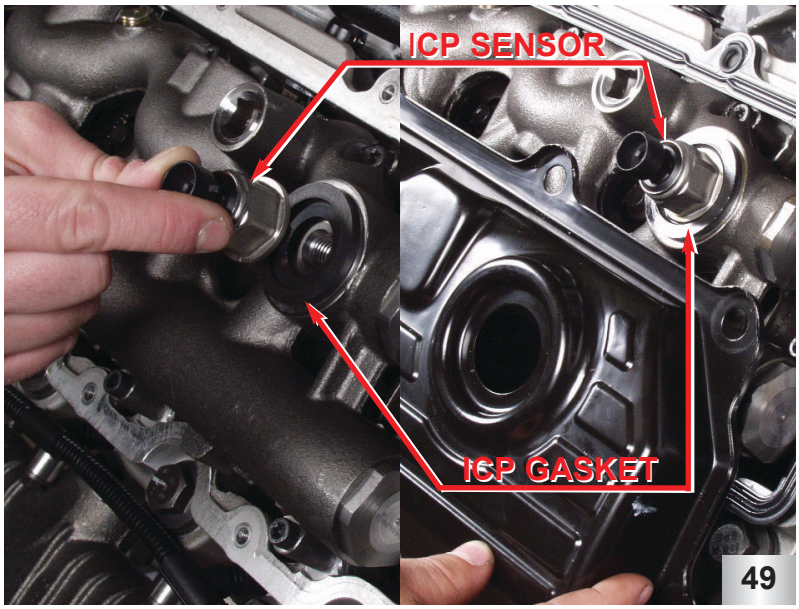
ICP Sensor/Valve Cover Assembly

- The ICP sensor is installed over the gasket.
- The ICP sensor can be removed and installed without the removal of the valve cover.
- After torquing the ICP sensor to specification, the valve cover gasket and valve cover can be installed over the sensor.



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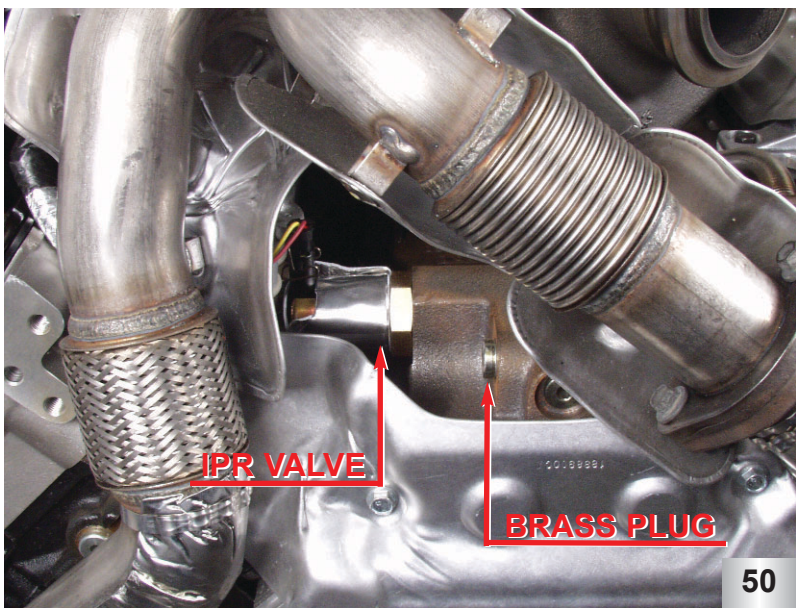
High-Pressure Pump Cover

- The same high-pressure pump cover is used.
- Since the ICP sensor has been relocated to the right bank high-pressure rail, a brass plug will replace the ICP sensor.



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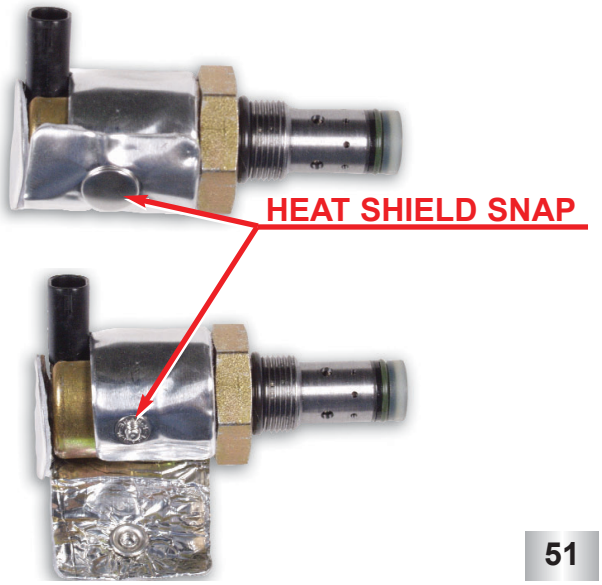

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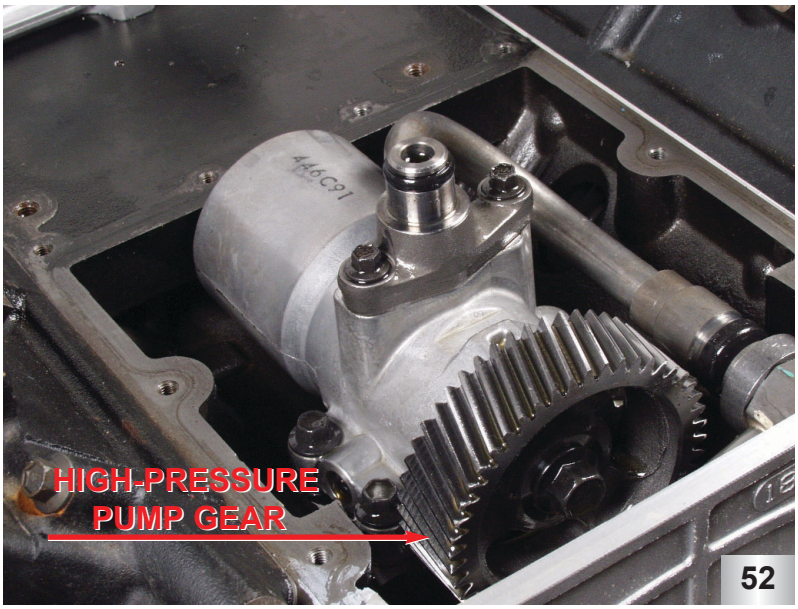
IPR Heat Shield

- The IPR has a new removable heat shield wrapped around it to help block excessive heat from the exhaust.
- If the IPR has to be replaced the shielding will have to be removed from the old IPR and installed on the new one.
- Simply unsnap the button and slide the shield off.



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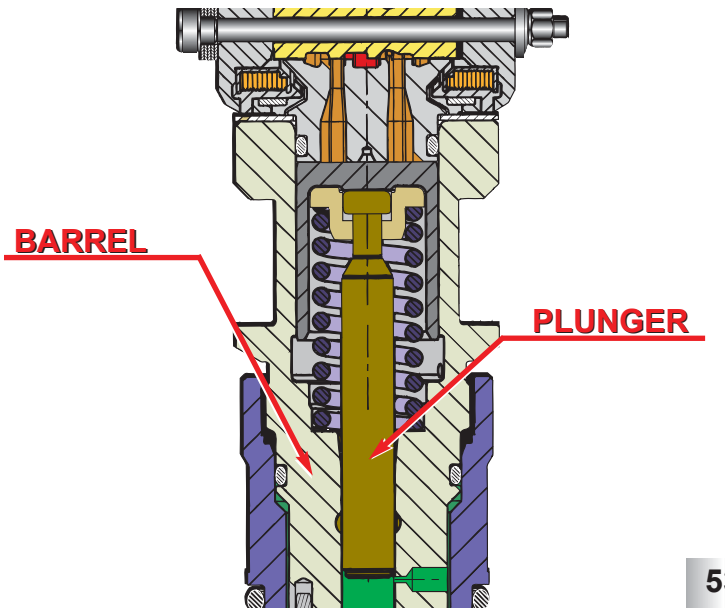
High-Pressure Pump

- The high-pressure pump utilized with the new wavy high-pressure rails will have the capability to produce increased oil pressure over the original high-pressure pump.



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DLC (Diamond Like Carbon) Coated Plunger

- The injector plunger has had a DLC coating applied to it.
- The coating will further increase the robustness of the injector against poor fuel quality/water intrusion and will reduce the risk of internal scuffing.

NOTES

Electrical Components

- **Sensors**
- **Actuators**
- **Glow Plug System**
- **PCM**
- **FICM**

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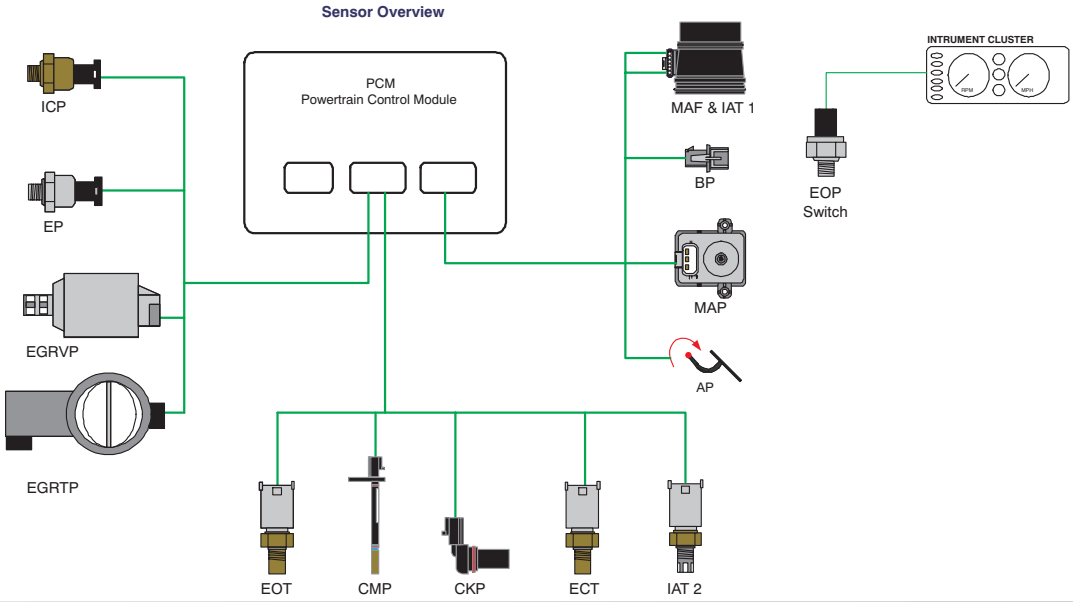
Generation II Electrical Components

- The PCM uses information from the sensors to decide which commands to send to the FICM, the actuators, and the glow plug system.
- Modifications and additions have been made to some electrical components.



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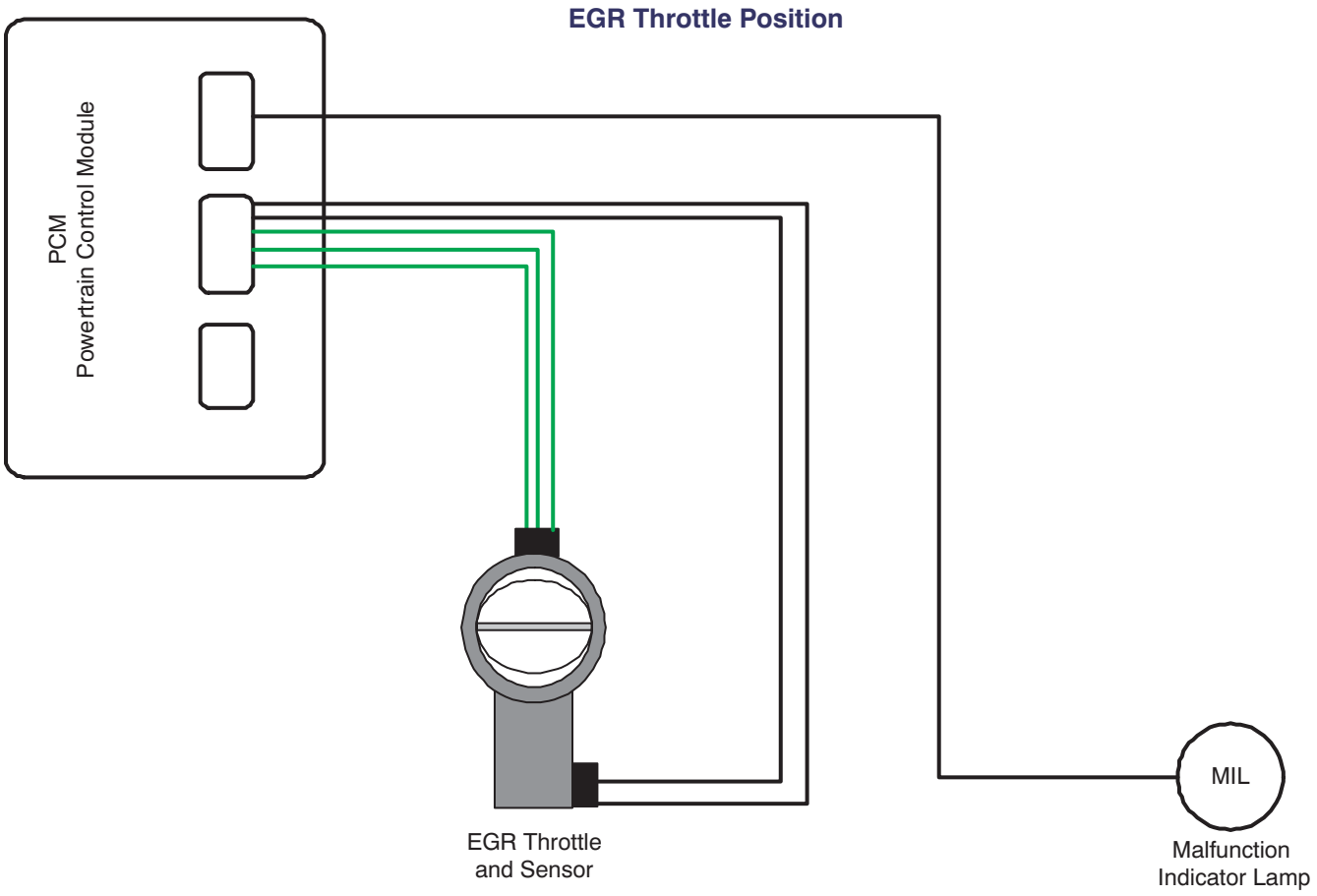
Sensor Overview

- The PCM sends a Vref of 5.0 volts to four engine mounted sensors: ICP, EP, EGRVP, and EGRTP. It also sends a 5.0 volt reference signal to four chassis mounted sensors: MAF, BP, MAP, and AP.
- The PCM uses 5 volts in order to maintain consistency throughout all operating conditions.
- The Vref is conditioned by the sensors then returned to the PCM for use in determining the fueling strategy and/or actuator duty cycle.
- **The EGRTP (Exhaust Gas Recirculation Throttle Position) Sensor is added.**
- IAT1 is not used in any engine control. The IAT1 signal is used to assist in the operation of the air conditioning and engine cooling fan.
- MAF is not used in any engine control. MAF is used in the EGR monitor strategy to calculate the total clean air going into the engine. Once the total clean air is known, the amount of EGR required can be calculated.
- NOTE: Failure in either or both of these components has no effect on engine performance.



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EGRTP (Exhaust Gas Recirculation Throttle Position) Sensor

- The EGR throttle position (EGRTP) sensor is a potentiometer that provides a feedback signal to the PCM.
- The input signal is an analog voltage proportional to the rotary position (angle) of the throttle plate located within the throttle body.

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Actuators

- Injection Pressure Regulator (IPR)
- Exhaust Gas Recirculation Valve (EGR)
- Variable Geometry Turbocharger Control Valve (VGTCV)
- Glow Plug Control Module (GPCM)
- Exhaust Gas Recirculation Throttle Plate (EGRTP)

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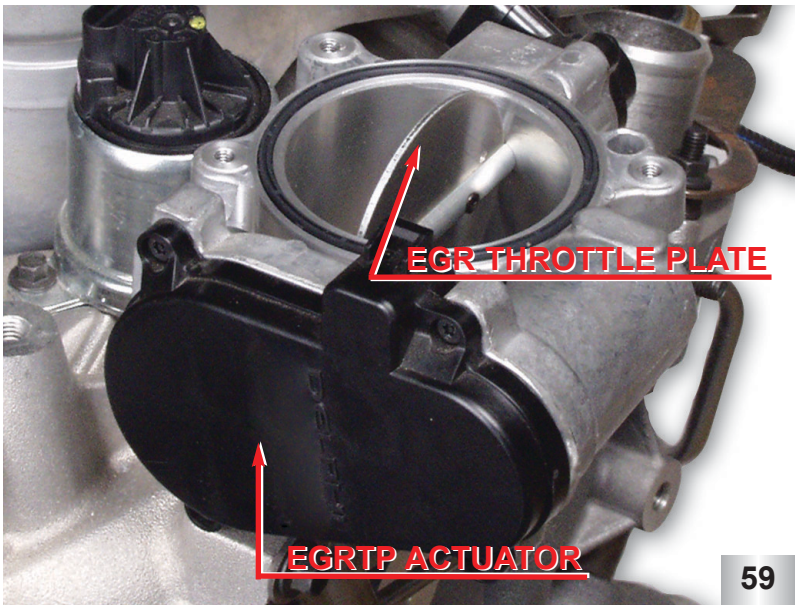

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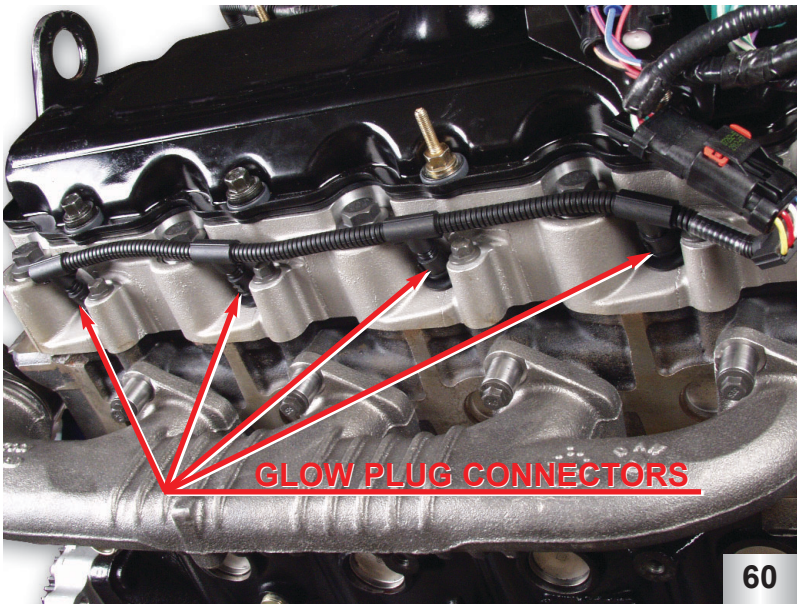

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Actuators

- Actuators convert electrical output from the PCM to hydraulic, mechanical, or electronic work.
- The 6.0L Power Stroke® engine now uses five (5) actuators: Injection Pressure Regulator (IPR), Exhaust Gas Recirculation (EGR) Valve, Variable Geometry Turbocharger Control Valve (VGTCV), Glow Plug Control Module (GPCM), and the Exhaust Gas Recirculation Throttle Plate (EGRTP) Actuator.

EGRTP (Exhaust Gas Recirculation Throttle Plate)

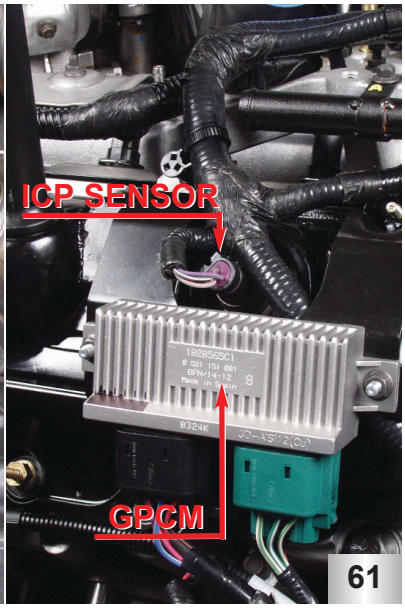
- The EGR throttle plate is designed to assist with EGR operation.
- The EGRTP actuator modifies the intake airflow from the charge air cooler into the intake manifold.
- The EGRTP actuator regulates the rotary motion of the throttle plate located within the throttle body.
- The control of intake airflow provides increased EGR system efficiency with the throttle plate position determined by a signal from the EGRTP sensor.

Glow Plug Wiring Harness

- In order to increase the serviceability of the glow plugs, the glow plug buss bar has been replaced with a new glow plug harness. This will provide flexibility in the harness, to ease removal of glow plugs.
- In addition, the rocker-arm carrier has been modified to improve accessibility to the glow plug harness.
- **NOTE: The glow plug buss bar and the glow plug wiring harness are not interchangeable parts and should only be replaced with the correct replacement part.**

ICP Sensor

- The ICP sensor is no longer located in the high-pressure pump cover.
- It has been relocated to the front on the right high-pressure oil rail.
- The valve cover and GPCM bracket sets over the ICP Sensor.



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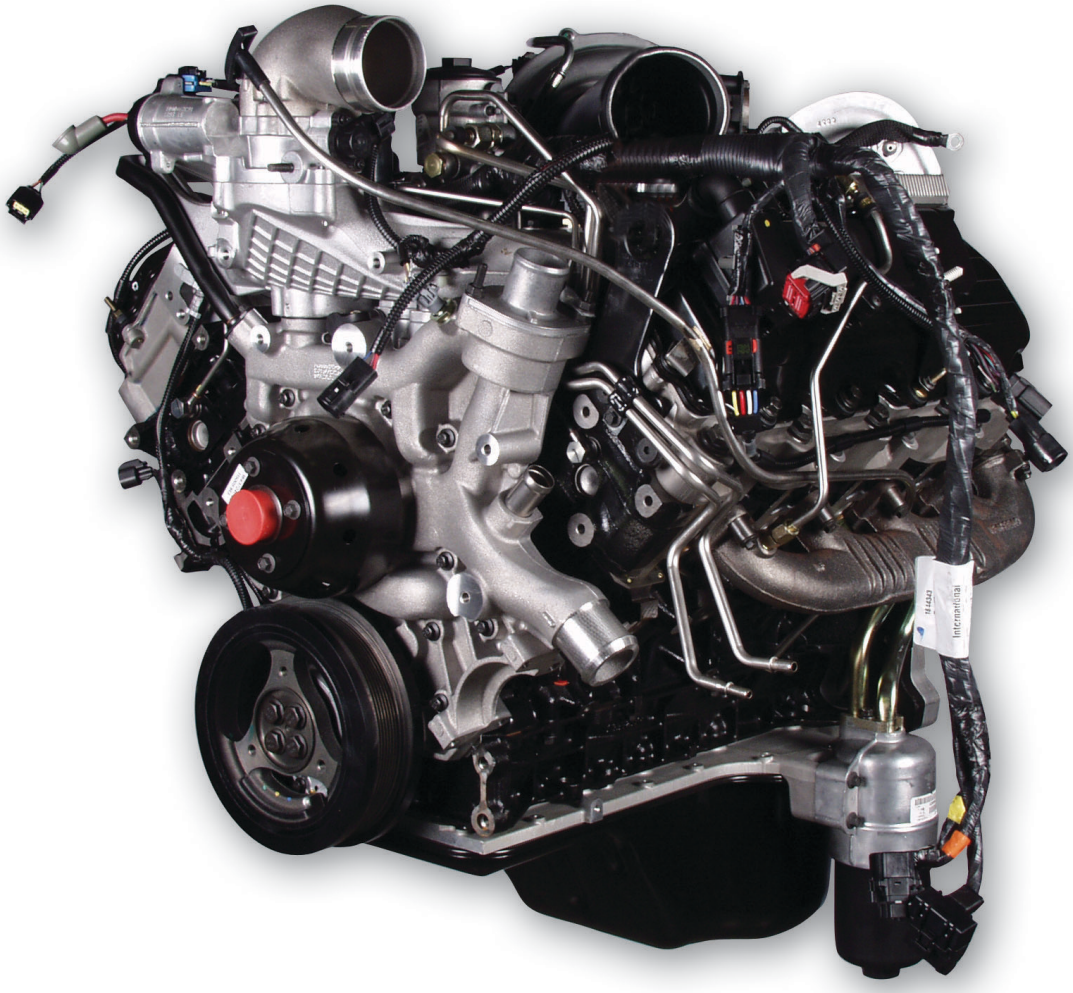

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Econoline® 6.0L POWER STROKE® DIESEL

2004 6.0L Econoline Features

- **Remote Mount Oil Filter**
- **Charge Air Cooled**
- **Chassis Mounted FICM**

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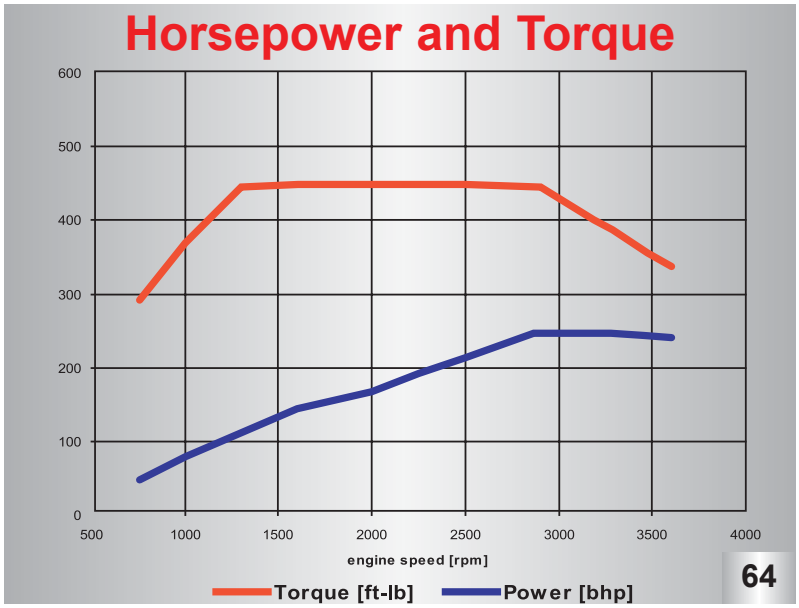
2004 6.0L Econoline Features

- The 6.0L diesel engine will be a new addition to the Econoline starting in 2004.
- The Econoline will feature a charge-air-cooler for the first time.
- The Econoline 6.0L diesel engine will feature visual differences versus the F-series.
- The Econoline 6.0L utilizes a remote mount oil filter.

Horsepower and Torque

- The Econoline®6.0L Power Stroke® Engine creates 235 HP at 3150 RPM and 440 ft/lb of torque at 1600 RPM.



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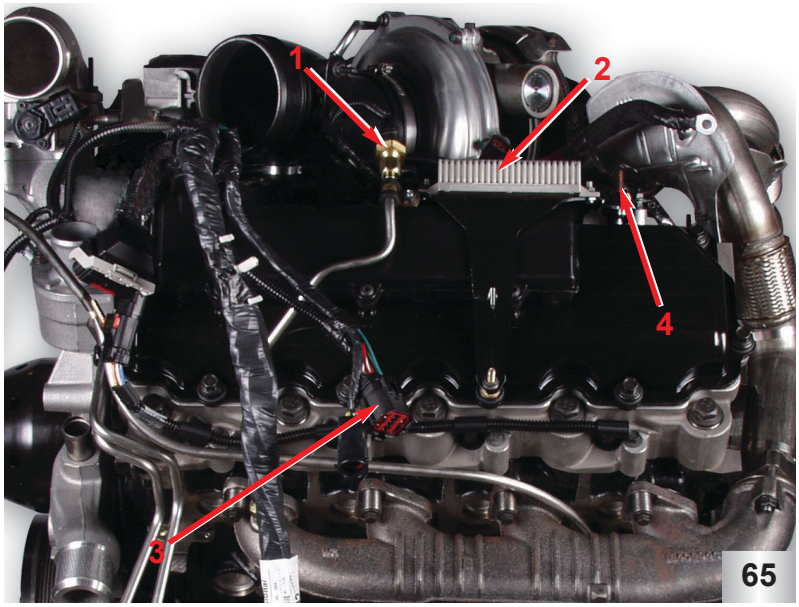
Left of Engine

1. EP (Exhaust Pressure) Sensor
2. GPCM (Glow Plug Control Module)
3. 12-way Connector
4. Battery Power Junction Point



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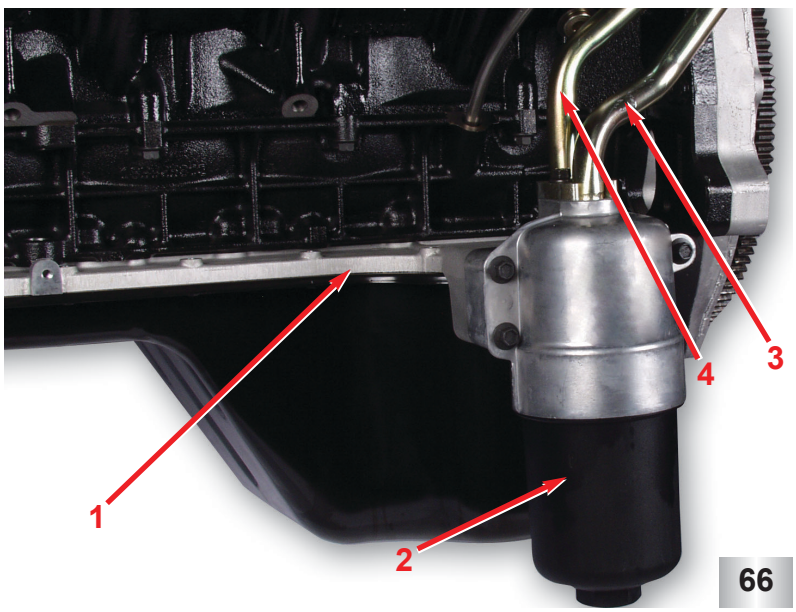
Remote Mount Oil Filter

1. Upper Oil Pan
2. Oil Filter Cap
3. Oil to Filter Supply Line
4. Clean Oil to Engine Line



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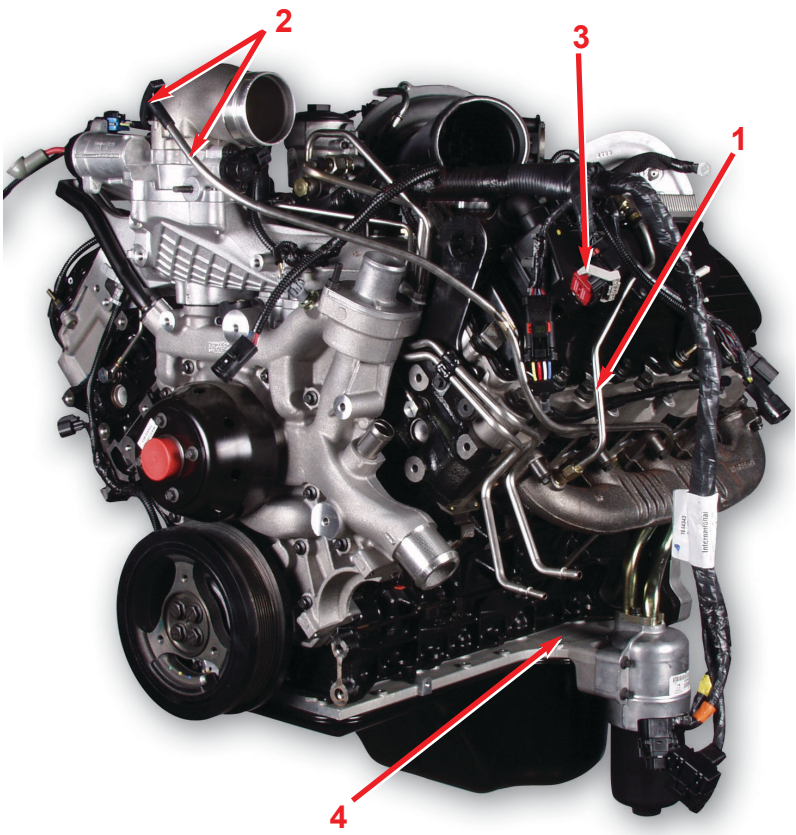

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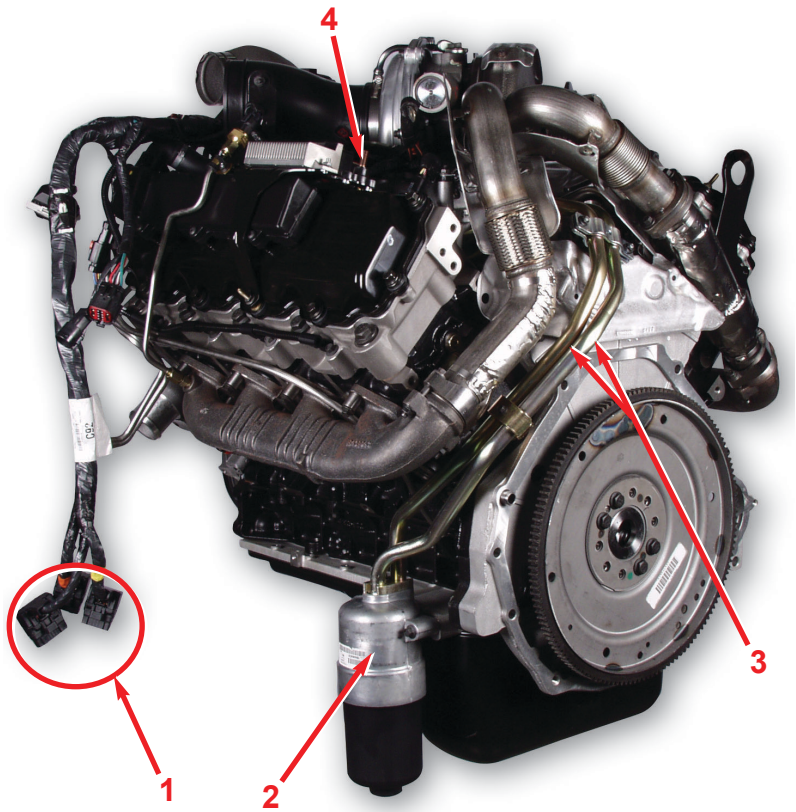
Left Front of Engine

1. EP (Exhaust Pressure) Tube
2. Oil Level Gauge and Tube
3. 46-way PCM Connector
4. Upper Oil Pan



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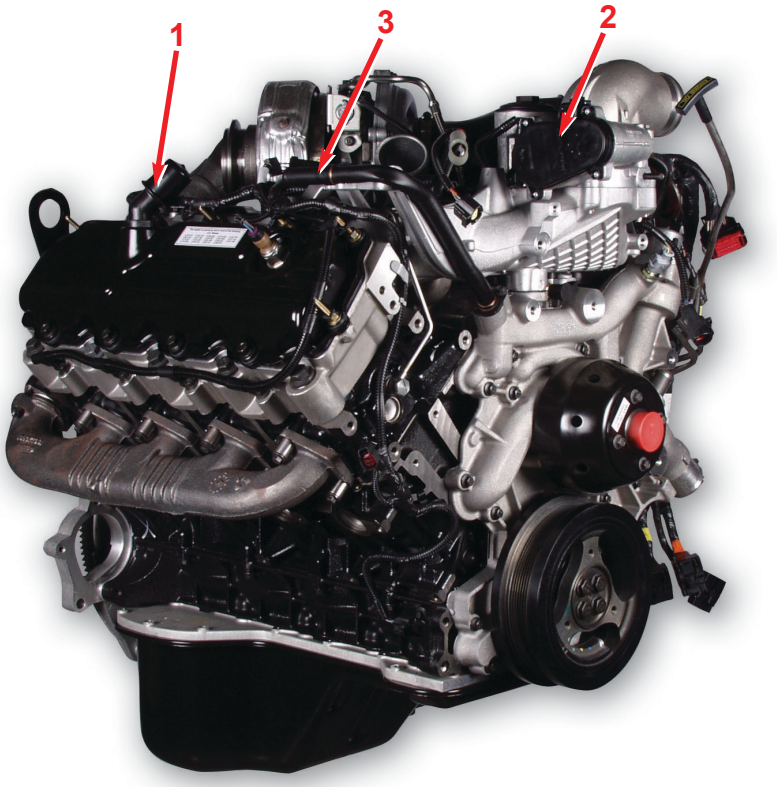
Left Rear of Engine

1. FICM Electrical Connectors
2. Oil Filter Housing
3. Remote Mount Oil Filter Oil Lines
4. Vehicle Battery Power Junction Point

Right Front of Engine

1. Oil Fill Adapter
2. EGR Throttle Actuator
3. Heater Return



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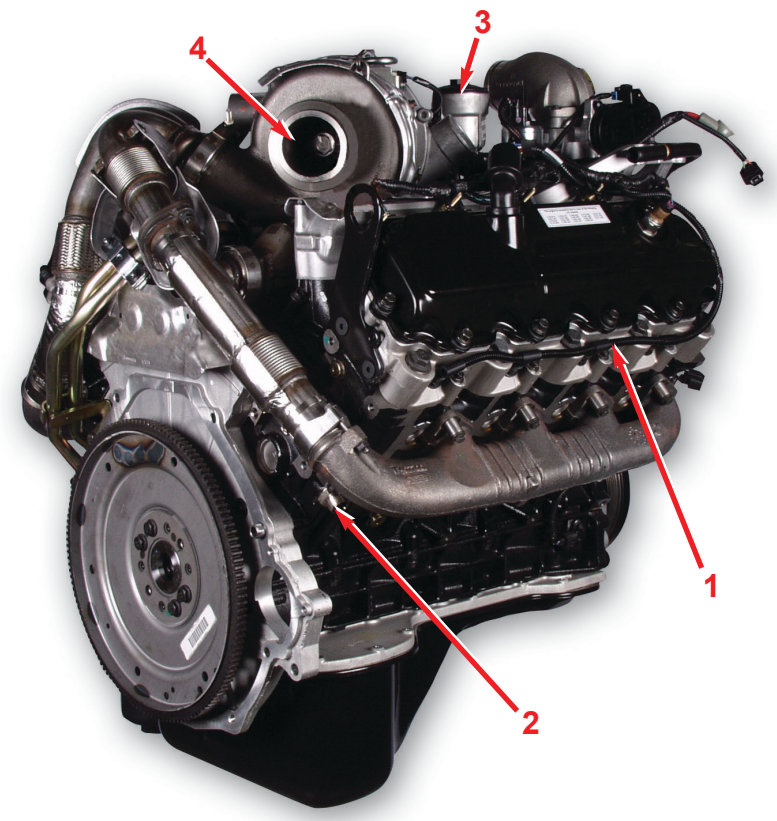
Right Rear of Engine

1. Glow Plug Harness
2. Block Heater
3. Secondary Fuel Filter Housing
4. Turbine Outlet



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Lubrication System Features

- Integrated Oil Cooler
- Remote Mount Oil Filter
- Canister Style Oil Filter

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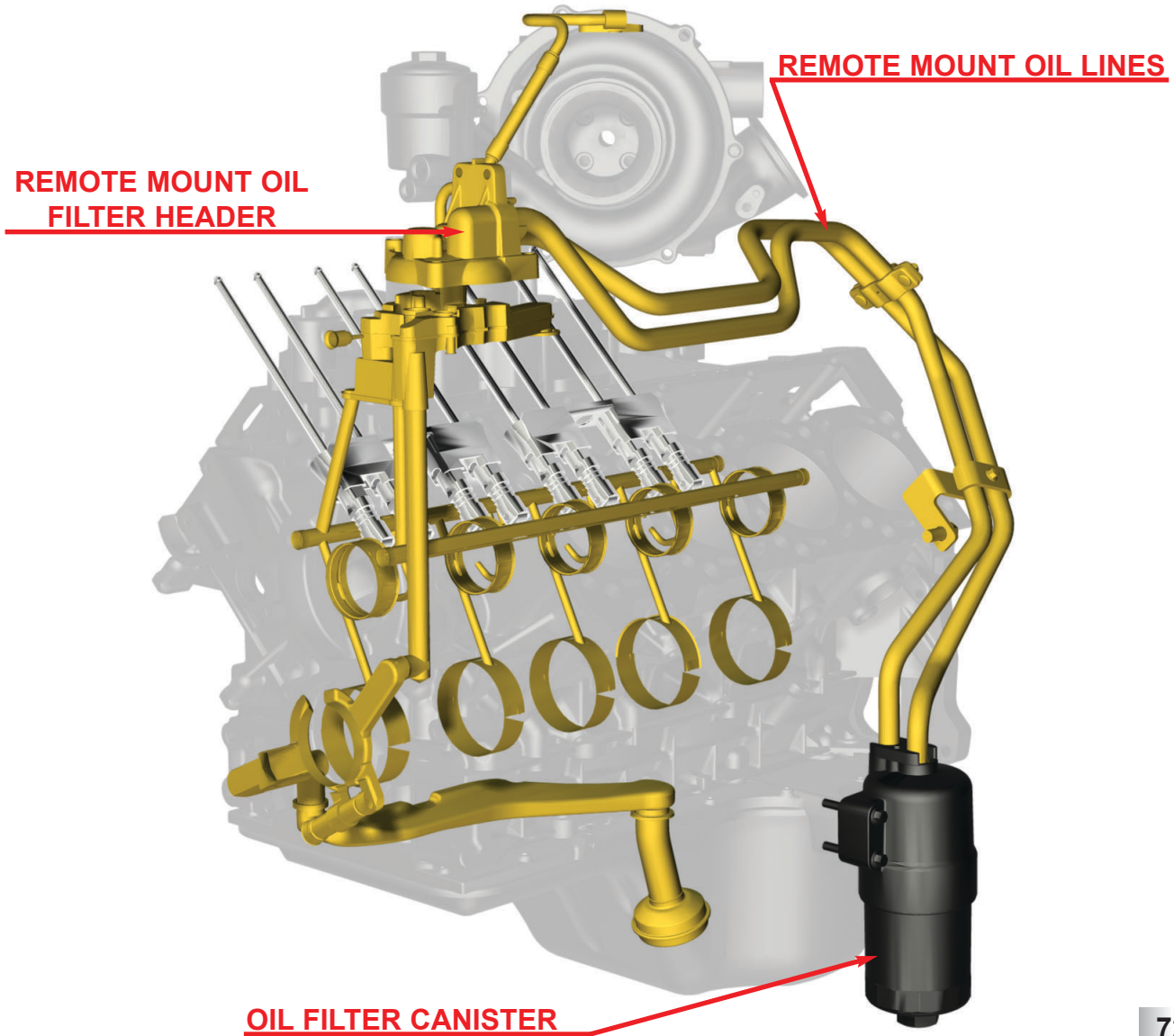
Lubrication System Features

- The 2004 Econoline® 6.0L utilizes the same integrated oil cooler that is used in the F-Series application.
- Do to space limitations, the canister style oil filter must be remote mounted to the upper oil pan on the driver side of the engine.

Lubrication System Flow



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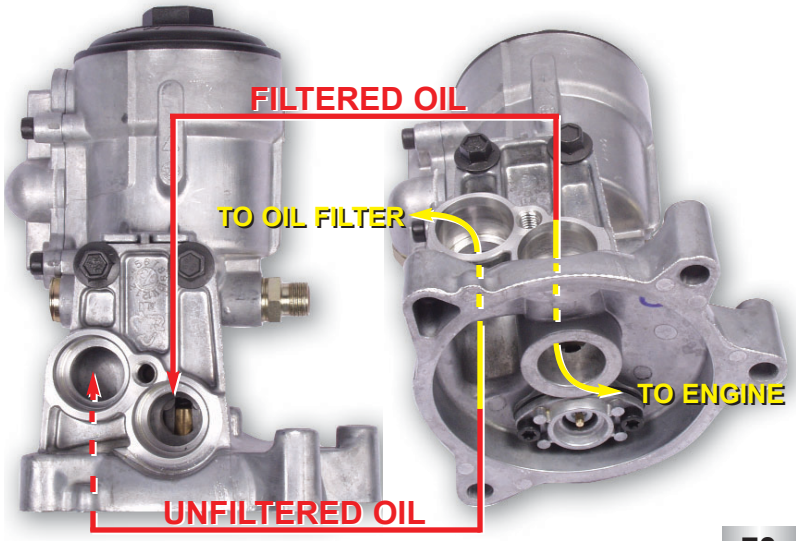
Remote Mount Oil Filter Header/ Fuel Filter Housing

- To accommodate the relocated oil filter, there is a redesigned oil filter/fuel filter assembly bolted to the oil cooler.
- This oil filter header has two access holes for oil lines to transport oil to the oil filter housing at the left rear of the engine upper oil pan.



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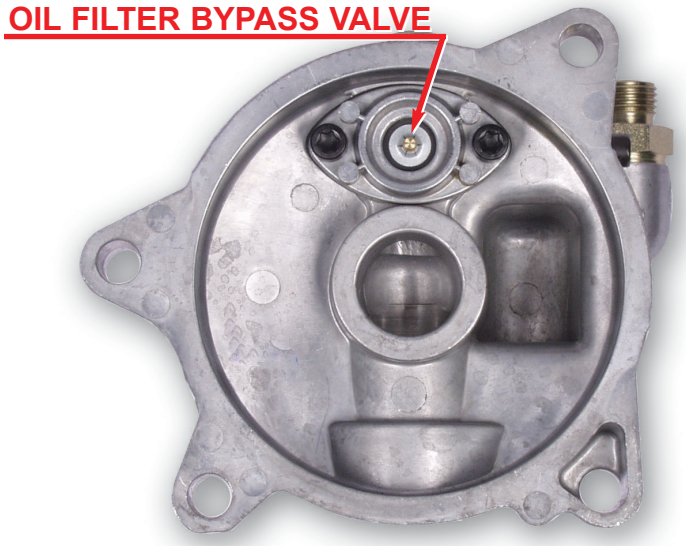
Oil Filter Bypass

- The oil filter bypass is located at the bottom of the remote mount oil filter header.
- If the oil filter becomes plugged or if the oil line become restricted, the oil will pass though this bypass to feed unfiltered lube oil to the engine.



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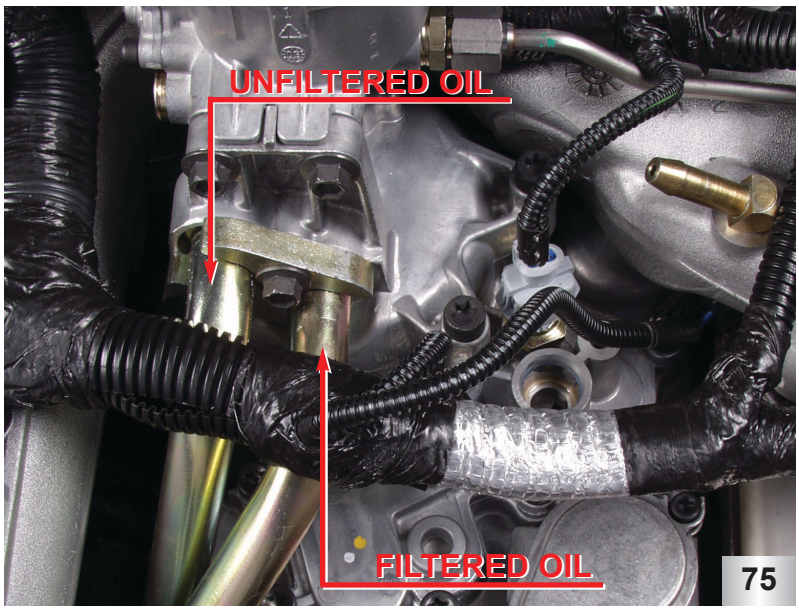
Remote Mount Oil Lines

- Since the space is limited on the Econoline® chassis, the oil filter housing has been relocated to left rear corner of the engine's upper oil pan.
- Steel lines are used to route oil to the remote mounted oil filter.



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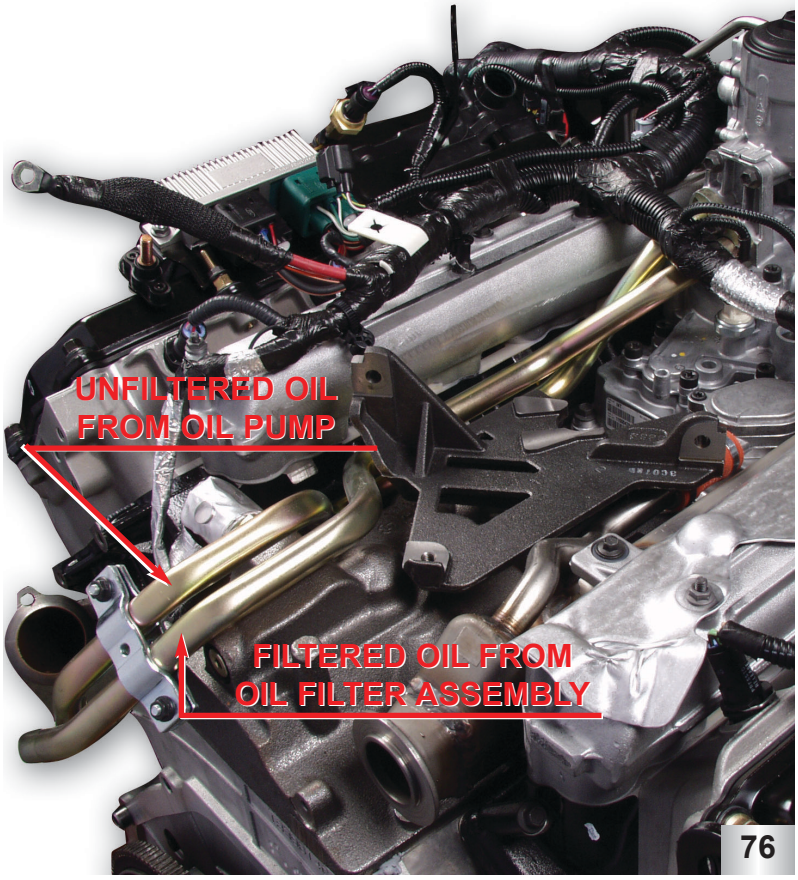


Oil Line Routing: Engine Valley

- As the oil line leaves the oil filter header, it drops down and passes under the turbocharger mounting bracket.
- As the oil line reaches the rear of the engine it rises over the high-pressure pump cover.
- The oil lines have been positioned toward the center of the high-pressure pump cover in order to avoid restricting access to the IPR (Injection Pressure Regulator) valve.

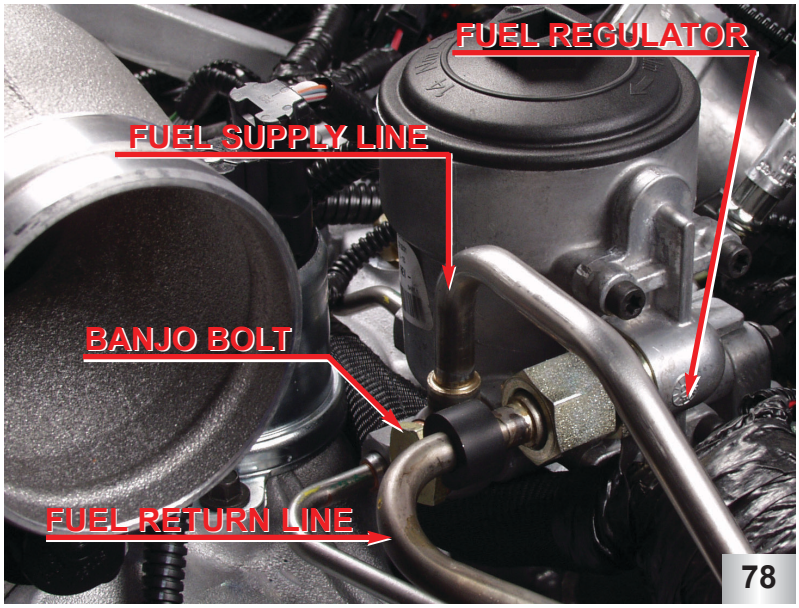
Oil Line Routing: Rear

- The oil line is routed down the right rear of the engine, staying clear of the IPR valve, and under the right side exhaust up-pipe.
- The oil line enters the oil filter housing near the outside edge of the housing. Clean oil exits through the top, center of the oil filter housing.
- The clean oil line returns to the oil filter header, where the oil will be distributed to the engine lube system and the high-pressure oil reservoir.

- **NOTE: The remote mount oil filter lines must be removed in order to remove the turbocharger mounting bracket.**

Fuel Filter Housing

- The fuel filter housing has been modified to accommodate the Econoline® chassis.
- The regulator has been repositioned to provide accessibility in chassis.
- The fuel supply line now has a banjo bolt with two copper washers connecting it to the fuel filter housing.



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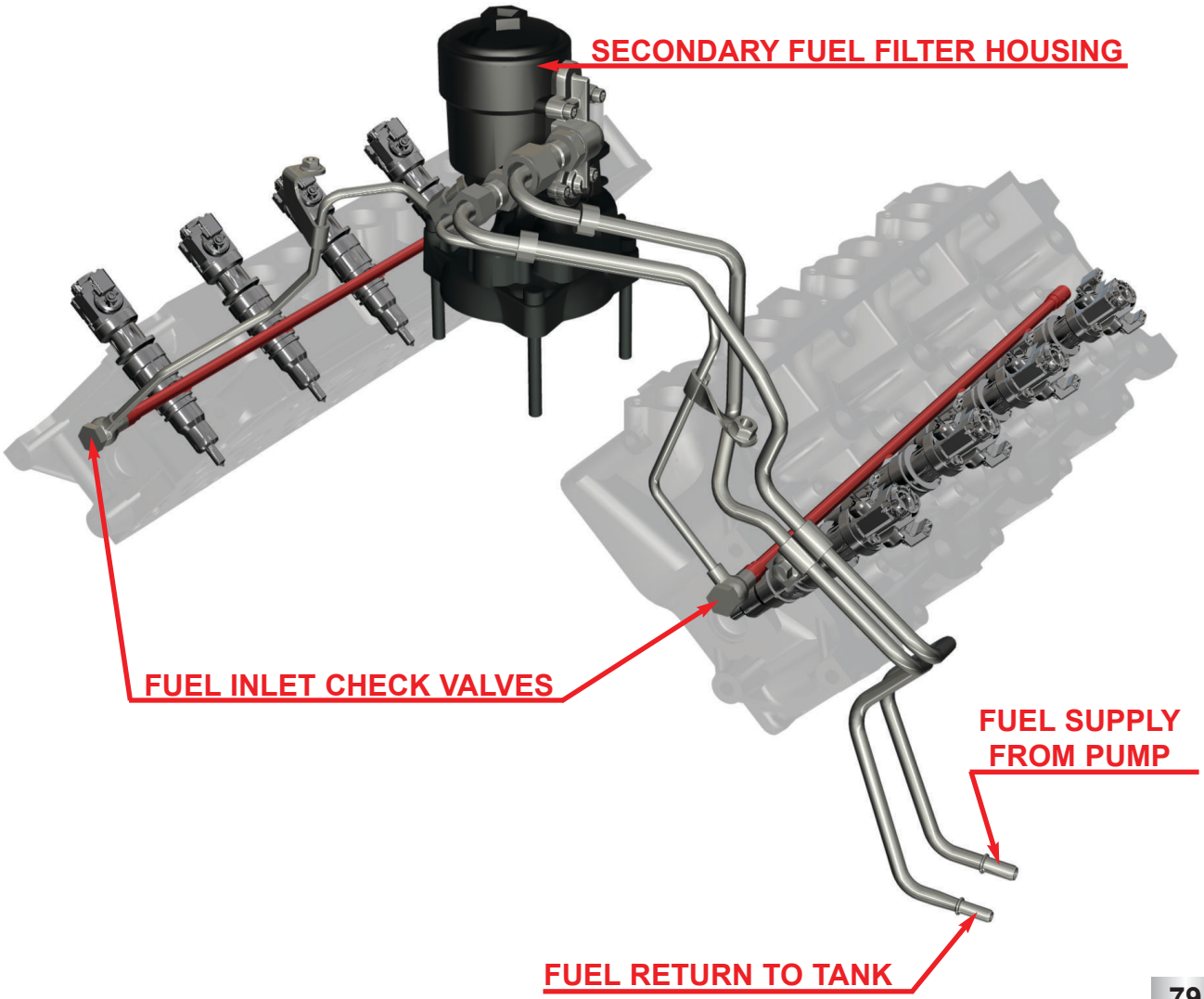
Engine Fuel System Flow



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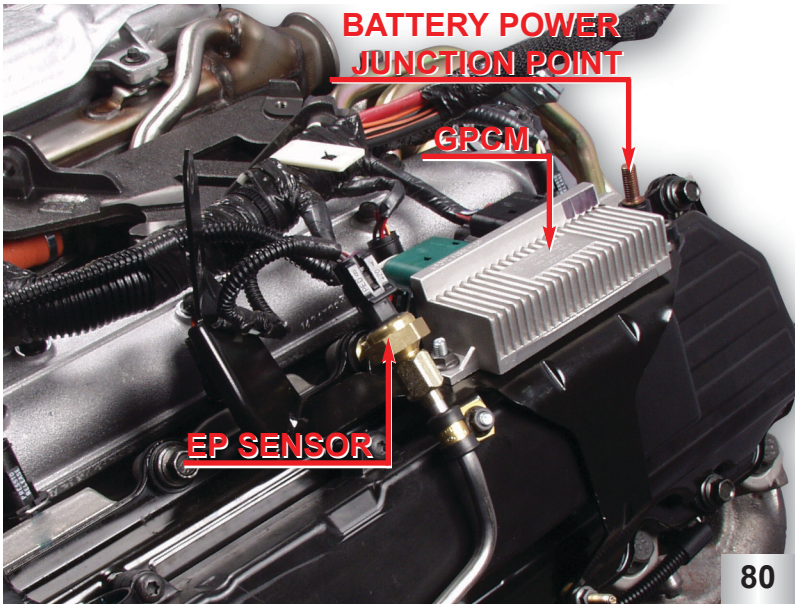
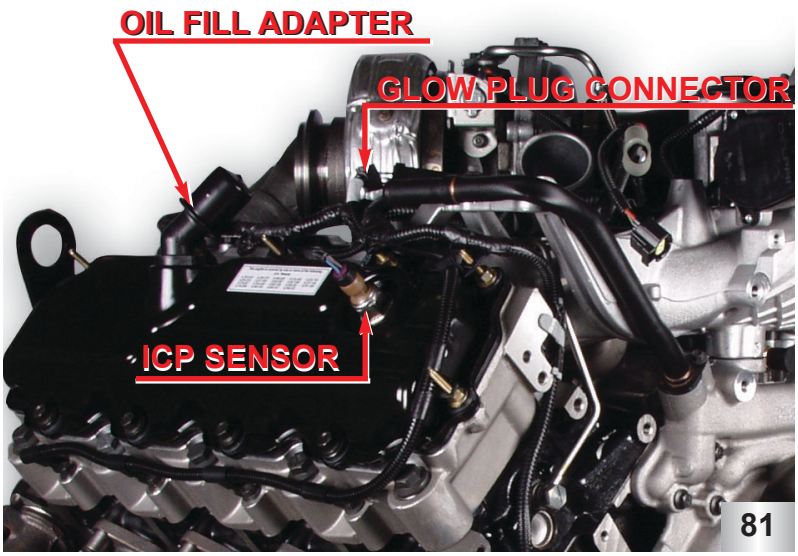


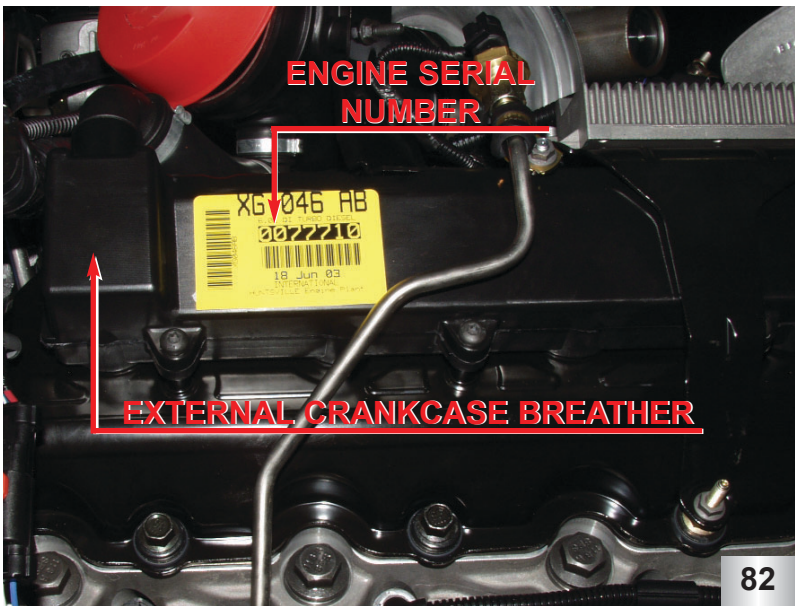
EP Sensor/GPCM

- The EP (exhaust pressure) sensor and tube have been repositioned to adapt for the chassis.
- The GPCM bracket has been relocated to the left valve cover.
- The GPCM, EP sensor, and power junction point all share a common stamped steel mounting bracket. The mounting bracket is also utilized to secure the compressor inlet hose.



Oil Fill Adapter/Glow Plug Connector/ICP Sensor

- Oil fill tube adapter is now pointed to the front of the engine for accessibility.
- The glow plug harness has been lengthened on the Econoline® chassis to increase accessibility to the harness connector.
- The location of the ICP sensor is the same as on the F-Series.



Engine Serial Number/Chassis Mounted FICM

- The engine serial number is now located on the external crankcase breather.
- The FICM has been relocated by the brake booster on the Econoline chassis.

NOTES

Diagnostic Procedures and Service Tips

- No Start Diagnostics
- Fuel in Oil
- ICP Test
- CKP Trigger Wheel Test
- ICP Block-Off Tools
- Cylinder Balance

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Diagnostic Procedures and Service Tips

- The information in this section is not intended to replace any portion of the Ford Motor Company Service Manual, but should be used in conjunction.
- Please see Ford Motor Company Service Manual for complete diagnostic and test procedures.

No Start Diagnostics

This procedure is a method to diagnose an engine crank, no start condition and to describe what is required for a 6.0L diesel engine to start. With the WDS, access the DATALOGGER screen. Highlight PIDs listed below. Before cranking the engine, hook up a mechanical fuel pressure gauge to the diagnostic port located on the secondary fuel filter housing. Monitor fuel pressure and the highlighted PIDs to determine the cause of the no start concern.

- **VPWR (battery power)** - If low voltage condition is present, check battery, charging system, or power/gnd circuits to the PCM.
- **FICMLPWR (FICM logic power)** - No/low voltage indicated could be caused by the 12-way connector or logic power fuse. Refer to Pinpoint S for detailed 12-way conn. diagnostics.
- **FICMVPWR** - No or low voltage indicated could be caused by 12-way connector or the key power circuit. Voltage drop from the battery to the FICM should not exceed a 2-5% difference.
- **RPM** - Low RPM can be caused by starting/charging system issues. No RPM indicated while cranking could be CKP fault.
- **ICP** - A minimum of 500 PSI (3.5 mPa) is required for the injectors to be enabled. No or low oil in the hp system or reservoir, system leakage, faulty IPR, or high-pressure pump could cause low pressure.
- **IPR duty cycle -** Typically will increase to 80-84% within a couple of seconds of starting. Defaults to 14% (300 PSI) w/o CKP signal.
- **ICP V (ICP voltage)** - Voltage reading below spec indicates low ICP during crank.
- **FUEL PW (fuel pulse width)** - Pulse width defaults to 0 w/o CKP signal, RPM below minimum spec, or low ICP.
- **FICMSYNC**- No FICM sync could be caused by the PCM, FICM, or engine wiring harness.
- **SYNC** - No sync could be caused by CKP, CMP faults, PCM, or engine wiring harness.

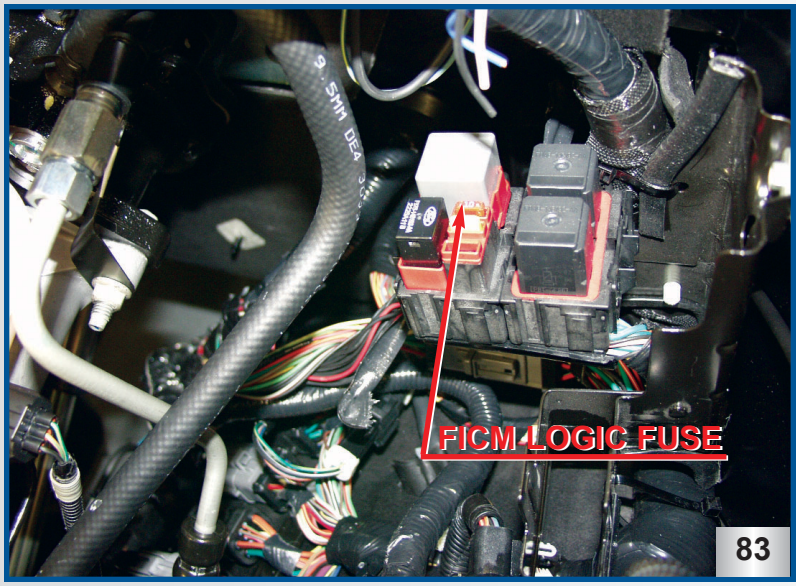
Parameter	Specification	Measurement
VPOWER	8 VOLT MIN.	
FICMLPOWER	8 VOLT MIN.	
FICMVPOWER	8 VOLT MIN.	
RPM	100 RPM MIN.	
ICP PRESSURE	500 PSI (3.5 mPa)	
ICP VOLTAGE	.80 VOLTS MIN.	
FUEL PW	500 uS - 2mS	
FICMSYNC	YES/NO	
SYNC	YES/NO	
FUEL PRESSURE	45 psi MIN.	

*NOTE: These specifications are minimum values. A minimum value may result in an extended crank time.

- **NOTE: If the FICM has been replaced with a service part, it will need to be programmed. The service part does not come programmed. The injectors will not rattle when the key is cycled until the FICM has been successfully programmed.**

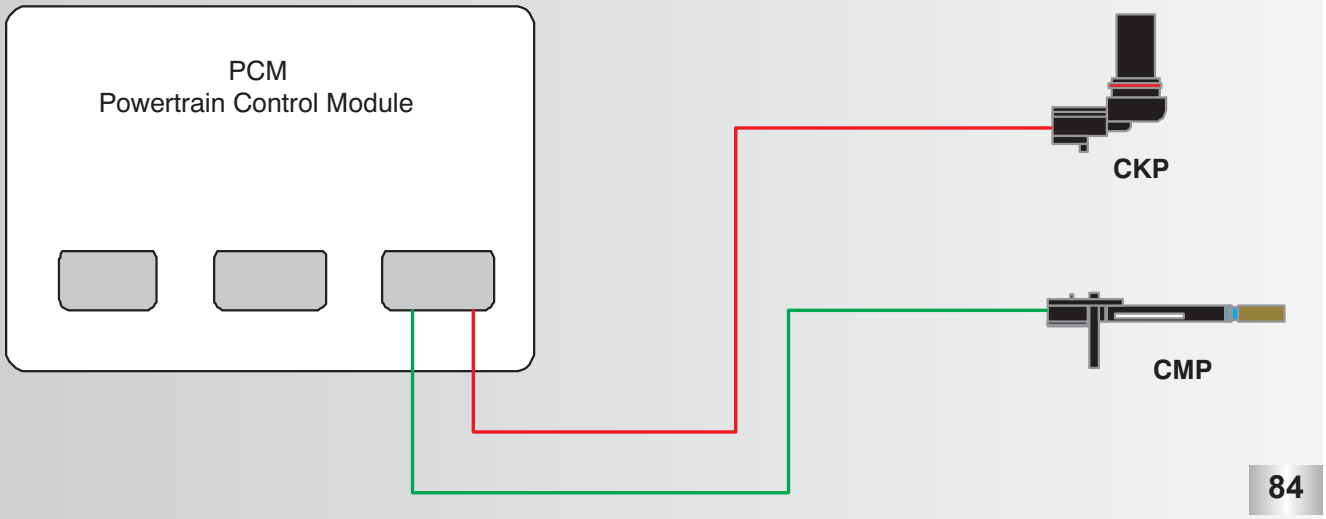
Diagnosing FICM Logic Power:

- **NOTE: If there is no FICM logic power to the FICM, the injectors will still buzz once the key is cycled but the engine will not start. There will be no other symptoms related to a no start condition.**
- With the WDS, select DATALOGGER PID FICMLPWR. This PID will show how much voltage is being supplied to the FICM. If less than eight volts check for short/open or low battery.
- If no voltage is being supplied, check logic power fuse located in the relay center box. This box is mounted on the driver's side towards the firewall.
- No voltage could also be caused by the FICM logic circuit through the 12-way connector.



SYNC:

- SYNC is achieved when the PCM receives a signal from the Crankshaft sensor and Camshaft sensor indicating they are working and in time. If the Crankshaft and Camshaft sensors are working improperly, the PCM cannot calculate engine speed or cylinder position, preventing fuel delivery.

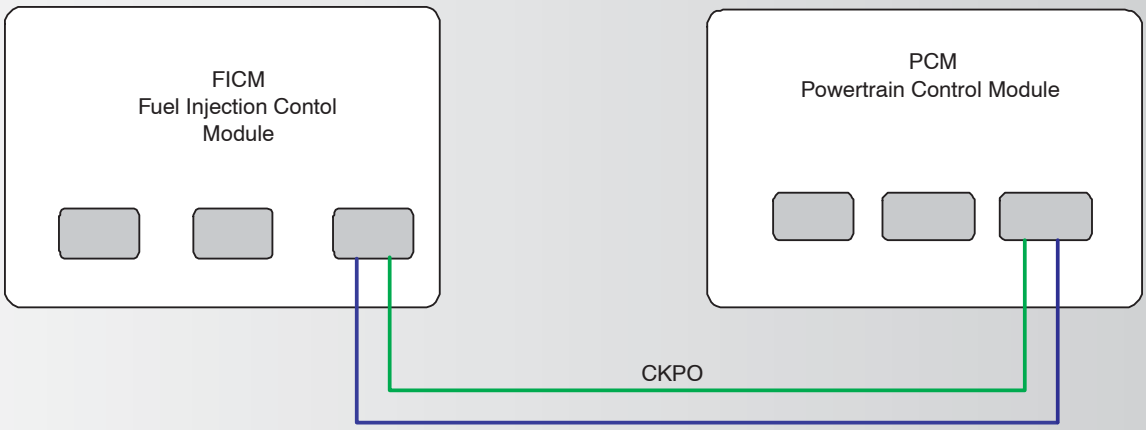


Diagnosing SYNC:

- No SYNC with an RPM signal typically is a faulty CMP sensor/circuit problem.
- No SYNC and no RPM signal, typically is a faulty CKP sensor/circuit problem.

FICM SYNC:

- The FICM uses CMPO (Camshaft Position Sensor Output) and CKPO (Crankshaft Position Sensor Output) signals, which are sent by the PCM, to calculate FICM SYNC. FICM SYNC is calculated by the FICM and is the correlation between the camshaft pin and the crankshaft triggers. Once FICM SYNC is achieved, the FICM uses engine speed, MFDES (Mass Fuel Desired), EOT, and ICP to calculate fuel timing, pulse width, and pilot injection usage.



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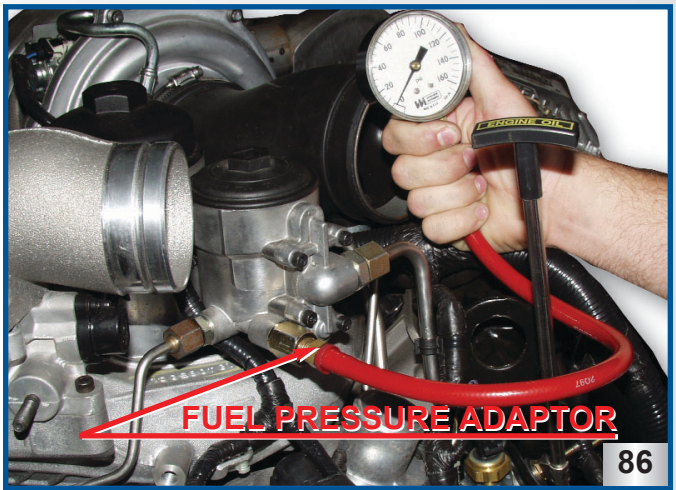
Diagnosing FICM SYNC:

- If there is no FICM SYNC while cranking the engine, then the problem is limited to the circuit illustrated above. The FICM SYNC circuit relays information from the PCM to the FICM.
- **Engine Wiring Harness**: FICM SYNC occurs through two circuits between the FICM and PCM. Verify engine wiring harness circuits CMPO and CKPO. If one of these two circuits has a short/open, FICM SYNC will not occur.
- **PCM**: If the PCM is not working properly, FICM SYNC may not occur.
- **FICM**: If the FICM is not working properly, FICM SYNC may not occur.

Fuel Pressure:

- There must be an adequate amount of fuel flow and fuel pressure present before the engine will start. Areas listed below can cause low fuel pressure/flow:
  - Faulty Fuel Pump
  - Pinched/Clogged Fuel Lines
  - Broken/Clogged Banjo Bolt
  - Clogged Fuel Filter(s)
  - Aerated Fuel
- Fuel quality should also be examined for a possible no start condition.



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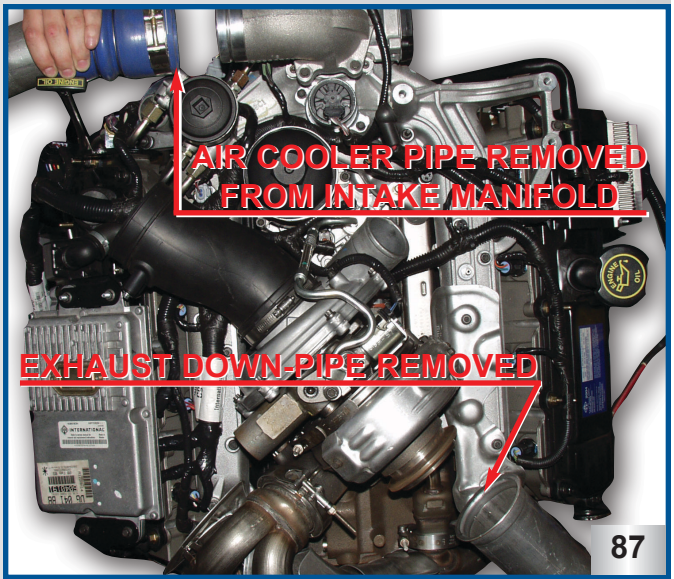
Air Inlet and Exhaust Restrictions:

- Be aware of air inlet or exhaust restrictions. If necessary, eliminate these possibilities by removing the charge-air-cooler pipe/hose from the intake manifold inlet and the exhaust down pipe from the turbine side of the turbo, for testing purpose only.



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FUEL IN OIL DIANOSTIC PROCEDURE

DIESEL FUEL IN ENGINE OIL DIAGNOSTICS

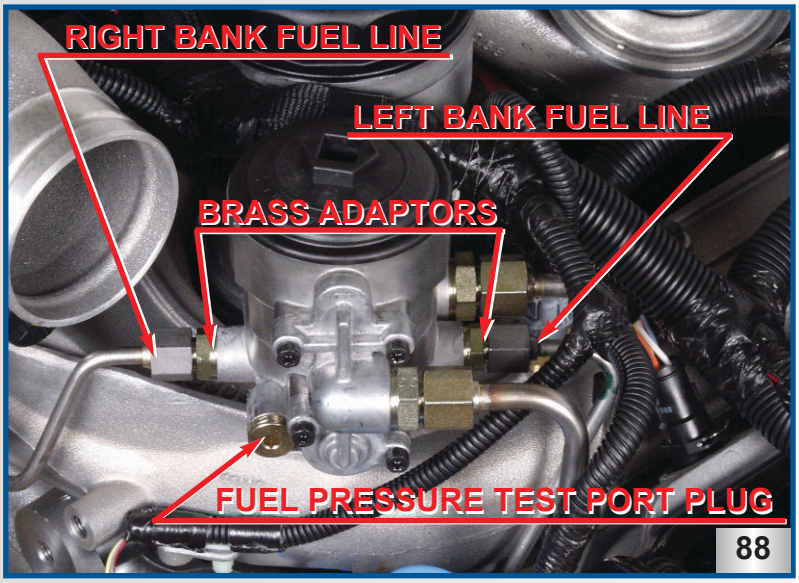
ISSUE/CAUSE: Some vehicles equipped with the 6.0L diesel engine may exhibit diluted oil, runs rough and/or low power. This may be caused by fuel leaking into the engine from the injectors.

- NOTE: THIS PROCEDURE MUST BE FOLLOWED COMPLETELY AND EXACTLY AS WRITTEN. FAILURE TO DO SO MAY RESULT IN MIS-DIAGNOSIS, INCOMPLETE REPAIR OR UNNECESSARY PART REPLACEMENT.

- Before starting the engine, check engine oil level on dipstick. If the oil level is above 'max' due to dilution with diesel fuel, the oil will appear thin and watery. Due to the design of the dipstick, it may be difficult to use for confirming an over full condition. If an over full condition is suspected, insert a clean dipstick leaving it one inch above the seated position. Remove the dipstick and check the oil level. Continue this process, leaving the dipstick one inch higher each time. If the oil level is determined to be over full, pull the drain plug and let the oil/fuel drain out until it stops dripping (be sure to also drain the oil filter housing). Measure the amount of fluid drained from the crankcase.

- **Note: For 6.0L Power Stroke® diesel engines with engine oil diluted with four or more quarts of diesel fuel, the turbocharger endplay needs to be checked (.001"- .004" allowable). Also check radial shaft movement by lifting the shaft up and rotating the shaft to check for compressor or turbine wheel housing contact. If any wheel contact is noticed, the turbocharger must be replaced.**

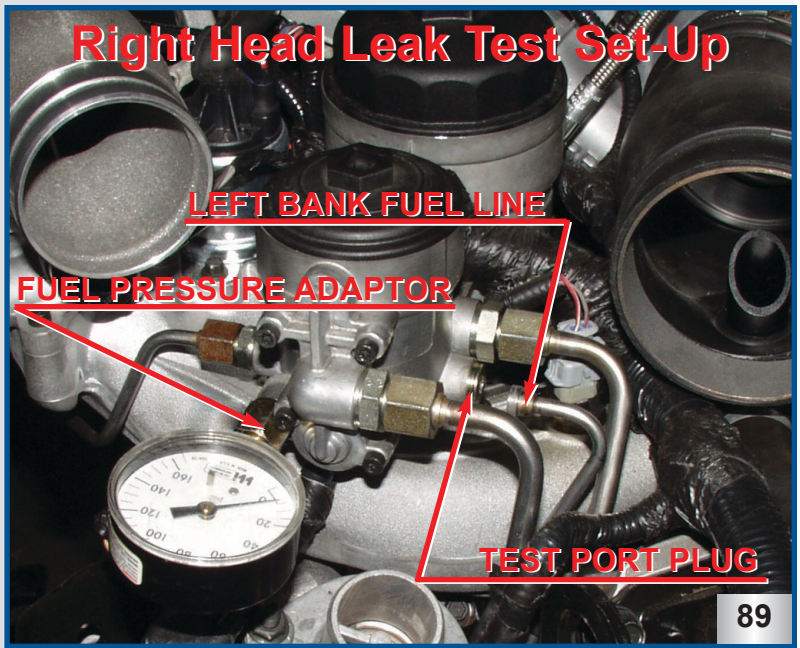
- Check the PCM for Cylinder Contribution/Balance Diagnostic Trouble Codes (DTC's). Diagnose Cylinder Contribution/Balance DTC's per pinpoint test P15. Cylinder Contribution/Balance DTC's will not be set for all injector related concerns resulting in fuel dilution. Continue with remaining steps.



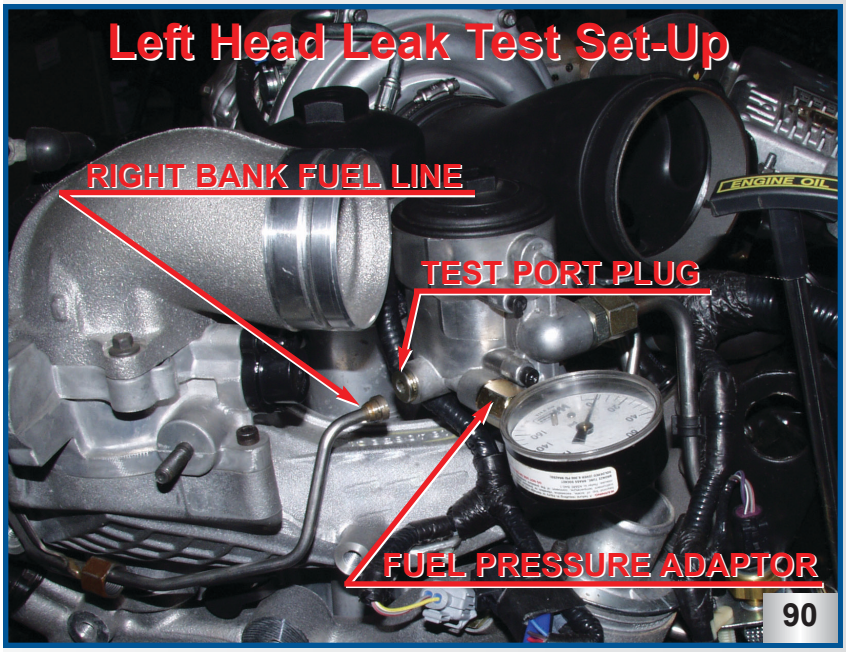
- Block the fuel line to the left head at the fuel filter housing. To do this, remove the fuel line from the connection point at the secondary fuel filter housing. Remove the brass adaptor that is screwed into the filter housing. Remove the fuel pressure test port plug from the front of the secondary fuel filter housing. Install the plug in the left bank outlet port. The fuel pressure adaptor (#303-765) and fuel pressure gauge should be installed at the test port in order to confirm constant pressure.

- Run the fuel pump using WDS 'Active Commands' in order to maintain constant pressure.

- Watch for fuel to drain out of the oil pan drain hole. Depending on the severity of the leak, it may take some time to leak enough fuel to run down to the pan. Allow the fuel pump to run for up to 10 minutes.It is possible that the leak indication may not occur when the engine is cold (cool). If this is the case, it will be necessary to perform the leak test on a warm engine. The block heater may be used to increase the coolant temperature to induce the leak if necessary in the case where the engine cannot be idled to warm-up prior to leak evaluation.



FUEL IN OIL DIANOSTIC PROCEDURE



- If fuel is present suspect at least one injector or injector o-ring leaking in the right head. Turn off the fuel pump at this time.
- Reverse the test at this time, blocking the right bank fuel line at the fuel filter housing. Use the same procedure as described in step 3 (move the plug from the left supply port to the right bank supply port). It may also be necessary to loosen or remove the fuel line-retaining bolt secured to the front of the intake manifold.
- Run the fuel pump using WDS 'Active Commands'.
- Watch for fuel to drain out of the oil pan drain hole. Depending on the severity of the leak, it may take some time to leak enough fuel to run down to the pan. Allow th efuel pump to run for up to 10 minutes.

- If fuel is present suspect at least one injector or injector o-ring is leaking in the left head. Turn off the fuel pump at this time. Reconnect the fuel line.
- Remove the appropriate valve cover/s. If a fuel leak was not identified on the right or left bank, remove both valve covers for additional inspection.
- Remove the high-pressure oil rail. Check the torque of each injector hold down bolt. Refer to the Workshop Manual Section 303-04D for torque specifications. If an injector is found loose remove the injector. Inspect the injector body, injector body o-rings, and copper washer (at injector tip) for damage. Replace as necessary.

  CAUTION: Installation and removal of an injector should not be completed with air/power tools. Excessive speed can damage the injector o-rings.

- Clean the top of the head with brake clean and dry it thoroughly especially on the down side of each injector.
- Turn on the fuel pump. Inspect injector body o-ring area. Look carefully to see if fuel is leaking from the small weep hole just above the top injector body o-ring. Use a mirror to help look for fuel leaking from individual injectors. If a leak is not detected within 5 minutes, install 1 oz. of oil dye and continue your inspections.

  Note: Adding 1 oz. of oil dye to the fuel filter housing in conjunction with use of a black light may aid in identifying the fuel leak.

- If fuel is observed leaking from the injector body o-ring area replace the two injector body o-rings. If fuel is leaking from the small weep hole just above the top injector body o-ring replace the injector.

  CAUTION: Installation and removal of an injector should not be completed with air/power tools. Excessive speed can damage the injector o-rings.

- Following any repair, retest to confirm repair.
- Check the Charge Air Cooler (CAC) for fuel and/or oil. Clean the CAC and air dry with shop air thoroughly before reinstalling.
- Re-install the oil pan drain plug. Refill engine with oil and change oil filter.
- Drive vehicle approximately 20 miles.
- Change engine oil and filter. Be sure to drain the oil out of the oil filter housing. Repeat final steps (maximum of two engine oil flushes).

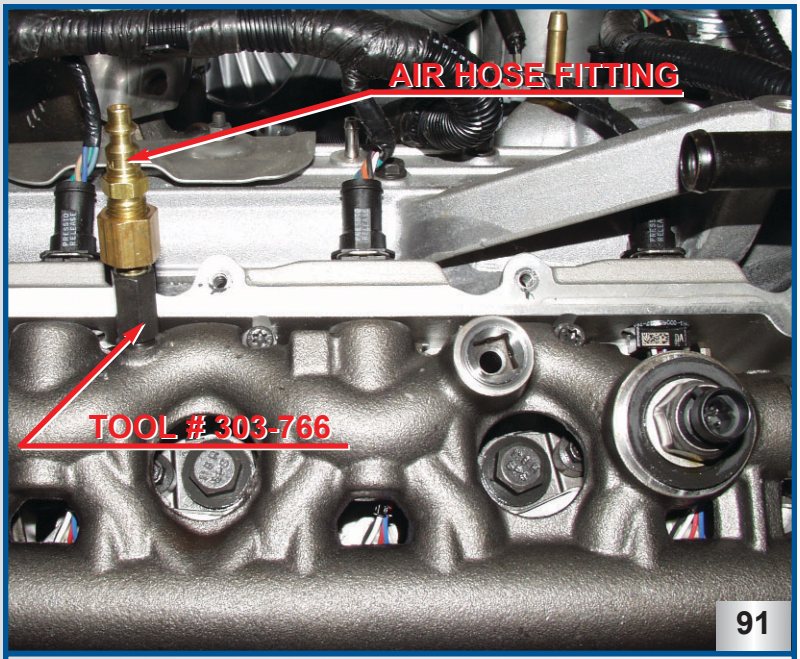
HIGH-PRESSURE OIL LEAK DIAGNOSTIC PROCEDURE

Symptoms:

- Driveability - Runs Rough, Stalls, No Start When Hot
- DTCs P2284, P2290 Or P2291

6.0L Diesel Engine - High-Pressure Oil System Diagnostics:

- Verify nature of concern.
- Verify lube oil supply pressure.
- If the nature of the concern exists hot only (hot no starts), safely bring the vehicle up to necessary temperature range. Monitor IPR (Injection Pressure Regulator) duty cycle as EOT (engine oil temperature) increases. A high-pressure oil leak should be indicated by a rising IPR duty cycle. As EOT increases and the leak rate increases, ICP pressure can begin to drop as the IPR is no longer capable of compensating.
- Check the operation of the IPR valve. Remove one of the valve covers from the engine. Apply shop-air pressure to the high-pressure rail using special tool adapter #303-766. When the air pressure is applied, there will be a noticable air leak do to the IPR valve being in an open state.
- With the WDS, increase the duty cycle of the IPR valve. This should block that air leak. If no change is heard, the IPR valve is not functioning as commanded. Your concern could be the IPR valve or the PCM to IPR circuit. If a change in the air leak is heard, the IPR valve is operating and investigation for the high-pressure oil leak begins.
- With the IPR blocking the air leak to the oil pan, listen for the position of the air leak in the engine. A stethoscope can improve your ability to narrow down the location of the leak.



NOTE: Air may leak past the high-pressure oil pump shaft seal. This is normal and DOES NOT require pump replacement.

The leak can exist in the following areas:

Early model:

- Cracked/broken check valve and fitting in high-pressure oil rail, under either valve cover(s).
- Disconnected high-pressure hose(s) under valve cover(s).
- Stand pipe from high-pressure hose to the branch tube in the tappet gallery (o-ring at the bottom could be cut/torn or missing).

Wavy rail:

- O-rings on the top and bottom of each stand pipe and/or all four plugs in the high-pressure rail.

All Models:

- O-ring in between discharge tube and high-pressure pump.
- O-ring around discharge tube that fits inside high-pressure pump cover.
- High-pressure pump inlet o-ring.
- Branch tube from high-pressure pump to stand pipe in the tappet gallery.
- High-pressure oil injector o-ring (high-pressure rail connects to the injector).

BENT/DAMAGED CRANKSHAFT TRIGGER WHEEL

Symptoms:

- This procedure is intended to identify a bent/damage crankshaft trigger wheel. The most common symptom is a rough idle.The EOT (Engine Oil Temperature) does not affect the rough idle concern.

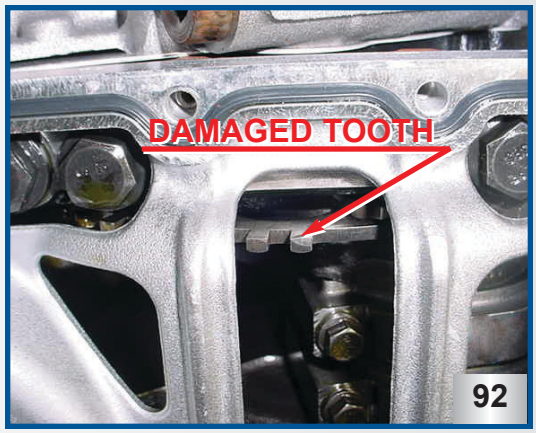
Diagnostics:

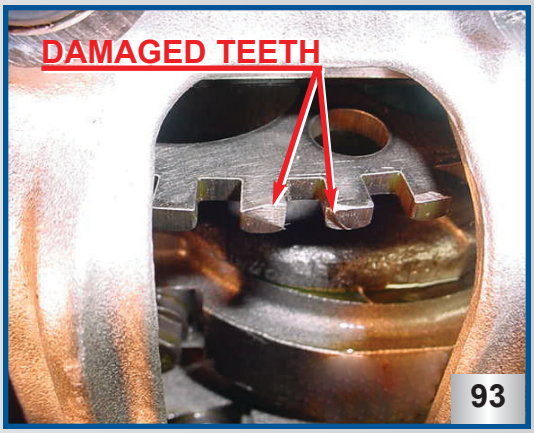
- Assure there are no codes present. If there are any codes, repair as necessary before continuing with the following procedure.
- Start engine and verify rough idle concern. Slightly accelerate engine off of idle, does the engine smooth out? If it does, proceed with the following diagnostics.
- Using WDS (World Diagnostic System) monitor Power Balance. Typically there are two injectors indicating weak cylinders. These two injectors will be 180 degrees off in firing order (firing order is 1,2,7,3,4,5,6,8). For example, #3 & #8 will indicate weak cylinders.
- Perform a Mass Fuel Desire Test to verify these injectors are contributing correctly.
- If they indicate no problem found, select #1 INJ PID. With the solid border surrounding the PID, enable active command control for injector cancel. Take control of the Active Command but DO NOT toggle "+/-" to disable/cancel the injector.
- Notice the idle quality while performing this function. If the engine smoothes out, this is a good indication of a bent trigger wheel.

Verify:

TO VERIFY THE CRANKCHAFT TRIGGER WHEEL IS DAMAGED FOLLOW THE PROCEDURE BELOW.

- Disconnect battery cables.
- Drain oil out of oil pan.
- Remove both turbocharger cooler pipes.
- Remove the radiator stator shroud.
- Loosen engine mount bolts from chassis. Lift engine off of chassis until turbo is against the heat shield on the cowl.
- Remove all the oil pan bolts. Drop oil pan down to remove bolts in the pick up tube. Remove the oil pan by backing it out towards the transmission.
- The crankshaft trigger wheel is located at the front of the crankshaft. Manually turn engine over while inspecting every tooth on the trigger wheel.
- If there is any visual damage to the teeth (see example below) contact the Ford Technical Service Hotline for instructions.

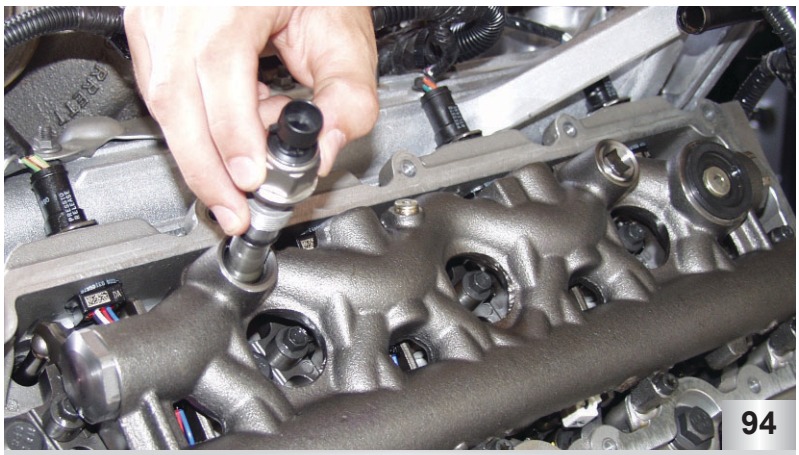




ICP BLOCK-OFF TOOLS

Right Bank Block-Off with ICP Sensor

- This block-off tool is used on the right bank only.
- The ICP sensor break-out harness (Tool # 418-D003) is utilized to extend the reach of the wiring harness so pressure/voltage can be read using the WDS.
- This tool will enable you to eliminate the right bank high-pressure rail and injectors while testing the integrity of the remaining high-pressure oil system.
- To utilize the tool properly, the ICP sensor is removed from the high-pressure oil rail and is placed in the block off tool.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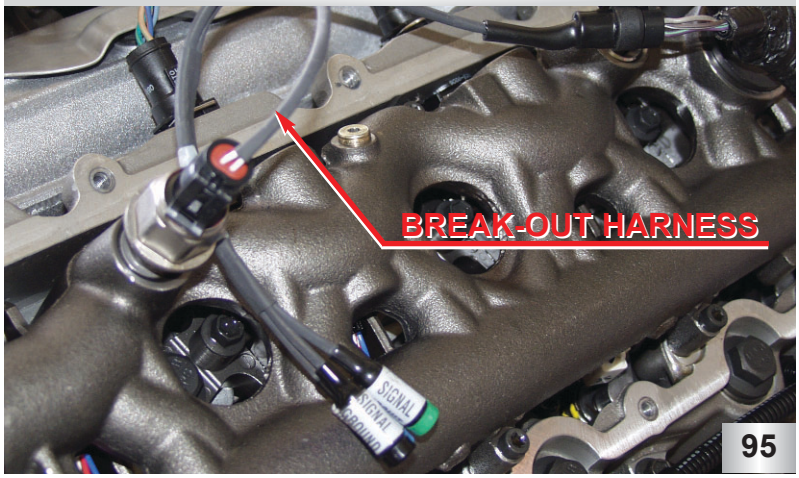

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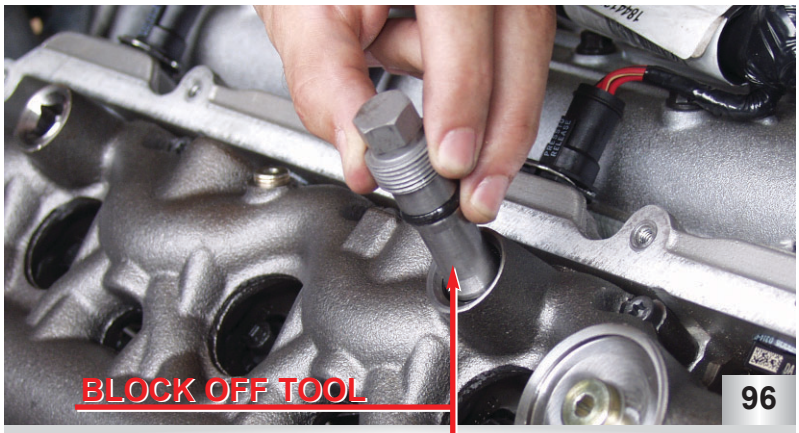
Left Bank Block-Off Tool

- The solid block-off tool is used in the left bank high-pressure oil rail only.
- It enables you to eliminate the left high-pressure oil rail and the left bank injectors while testing the integrity of the remaining high-pressure oil system.
- ICP pressure is measured using the ICP sensor installed in the right bank high-pressure oil rail or the right bank block-off tool.



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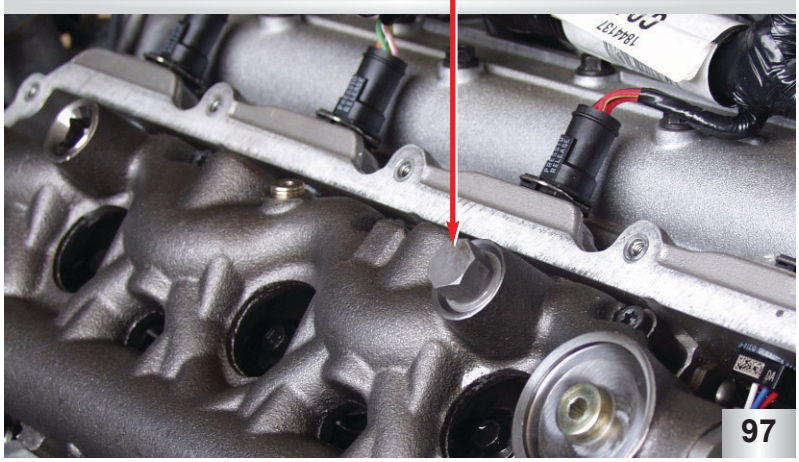
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- **NOTE: Both block-off tools can be used at the same time to eliminate both high-pressure oil rails and all eight injectors. ICP pressure/voltage will be monitored using the ICP sensor installed in the right bank block-off tool, the ICP break-out harness (as pictured above), and the WDS.**

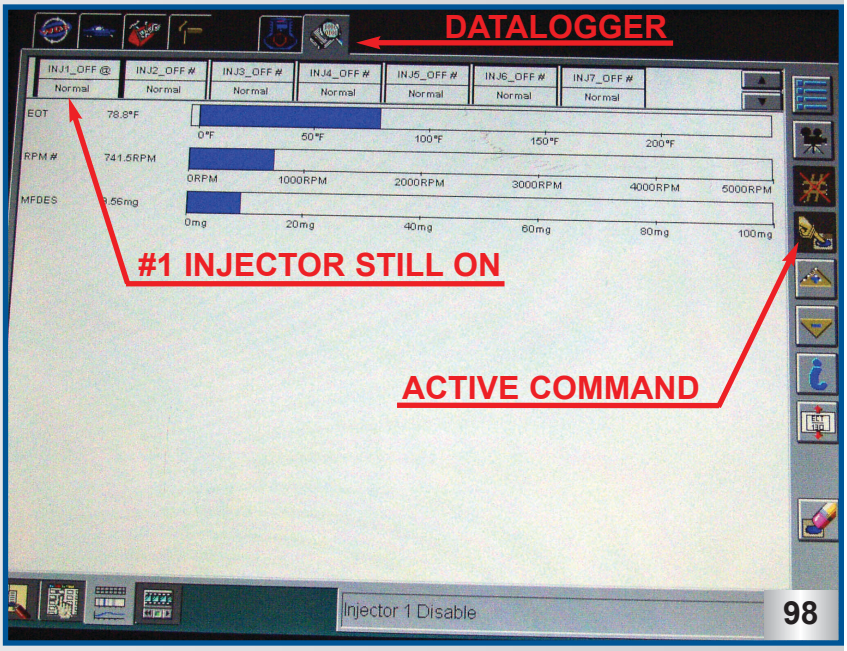
CYLINDER BALANCE TEST

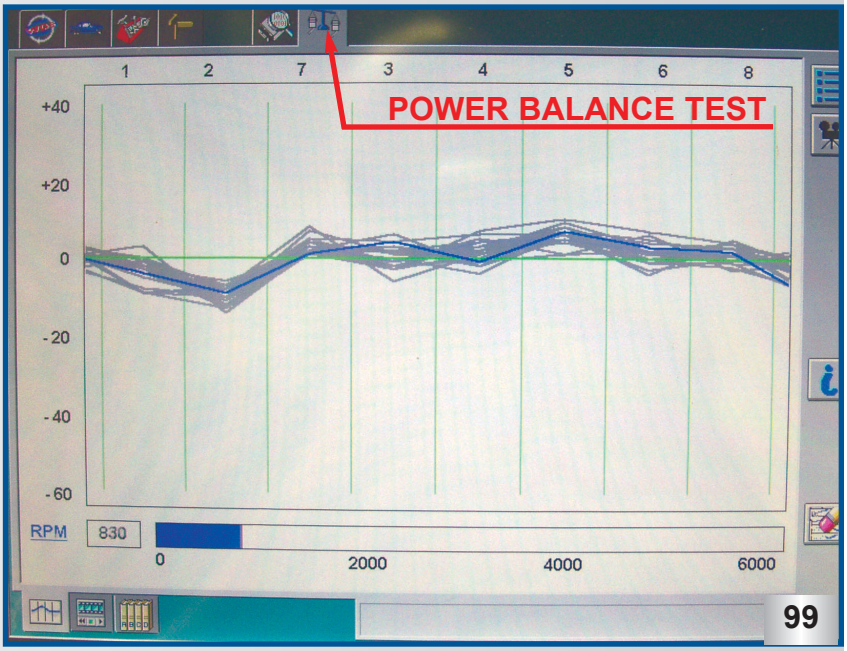
Cylinder Balance Test:

- Before using Cylinder Balance Test, Performance Diagnostic routines should be followed to insure no other performance concerns are present.
- Cylinder Balance Test measures the increase of engine RPM during each firing cycle. The test then compares the RPM contribution of each individual cylinder to determine a weak cylinder.

When performing Cylinder Balance you should use the following procedure:

- Using WDS, connect to the vehicle and perform a POWER BALANCE TEST.
- With POWER BALANCE still running switch to DATALOGGER and select an injector PID (1-8, it doesn't matter which one). Highlight the injector pid and take active command of the pid. **Do not shut the injector off.**
- The FICM has a fuel correction feature that is used to smooth idle operation by adding fuel to any cylinder that lowers engine speed during a firing cycle.
- Following these steps will disable the FICM's fuel correction feature. Taking active command of an injector will cause all eight injectors to use a base line fuel rate.
- Using the tabs at the top of the screen switch back to the POWER BALANCE and look for any injector that falls below 15 RPM.
- If a cylinder drops below 15 RPM perform an INJECTOR ELECTRICAL TEST and a RELATIVE COMPRESSION TEST to check for base engine problems. If no other problems are found replace the injector for the indicated cylinder.
- **Note: Active command will only disable fuel correction for about 1 min.**





NOTES

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SPECIAL TORQUE CHART

COMPONENT	STANDARD	METRIC
Air inlet duct clamp	44 lbf/in	5 Nm
Camshaft follower retaining device bolt	10 lbf/ft	13 Nm
Camshaft position (CMP) sensor	96 lbf/in	11 Nm
Camshaft thrust plate mounting bolts	23 lbf/ft	31 Nm
Connecting rod bolt (Initial)	33 lbf/ft	45 Nm
(Final)	50 lbf/ft	68 Nm
Coolant (block) heater	30 lbf/ft	41 Nm
Crankcase breather	62 lbf/in	7 Nm
Crankcase Plug (M16)	15 lbf/ft	20 Nm
Crankshaft position (CKP) sensor	96 lbf/in	11 Nm
*Cylinder head bolts (see figure A)	figure A	figure A
EGR cooler coolant supply port cover (on oil filter base) (M6)	89 lbf/in	10 Nm
EGR cooler V-band clamp	48 lbf/in	6 Nm
EGR cooler flange (studs) (see note 1)	10 lbf/ft	13 Nm
EGR cooler support (see note 1)	23 lbf/ft	31 Nm
EGR valve mounting bolts	10 lbf/ft	13 Nm
Engine coolant temperature sensor (ECT)	108 lbf/in	12 Nm
Engine oil pressure switch (EOP)	108 lbf/in	12 Nm
Exhaust manifold flange (to up pipe) (see note 2)	20 lbf/ft	27 Nm
Exhaust manifold (see note 2)	28 lbf/ft	38 Nm
Exhaust pressure (EP) sensor bracket	106 lbf/in	12 Nm
Exhaust pressure (EP) sensor	108 lbf/in	12 Nm
Exhaust pressure (EP) tube nuts (see note 2)	11 lbf/ft	15 Nm
Exhaust up pipe coupling on right side	20 lbf/ft	27 Nm
*Flywheel bolts (see figure B)	69 lbf/ft	94 Nm
Front cover module bolts	18 lbf/ft	24 Nm
Fuel check valve (banjo bolt)	28 lbf/ft	38 Nm
Fuel filter supply and return lines	32 lbf/ft	43 Nm
Fuel filter supply to head lines	19 lbf/ft	26 Nm
Fuel injector hold down	24 lbf/ft	33 Nm
Fuel rail plug (rear of head)	20 lbf/ft	27 Nm
Fuel Supply Line Banjo bolt (Econoline only)	26 lbf/ft	35 Nm
Glow plug	14 lbf/ft	19 Nm
Glow plug control module (GPCM)	71 lbf/in	8 Nm
Heat shield for intake manifold (M6 nut)	96 lbf/in	11 Nm
Heat shield bolts for rear (M6 thread forming)	96 lbf/in	11 Nm
(M10)	36 lbf/ft	49 Nm
High pressure discharge tube mounting bolts	71 lbf/in	8 Nm
High pressure rail front port plug	60 lbf/ft	82 Nm
High pressure rail supply port plug	60 lbf/ft	82 Nm
High pressure oil rail plug (M14)	33 lbf/ft	45 Nm
(M8)	96 lbf/in	11 Nm
High pressure oil rail bolt (see figure C)	120 lbf/in	14 Nm
High pressure pump cover bolts	96 lbf/in	11 Nm
High pressure pump cover plug	26 lbf/ft	35 Nm
High pressure pump drive gear bolt	95 lbf/ft	129 Nm
High pressure pump mounting bolts	18 lbf/ft	24 Nm
Injection control pressure (ICP) sensor	108 lbf/in	12 Nm
Injection pressure regulator (IPR)	37 lbf/ft	50 Nm
Intake air temperature 2 (IAT2) sensor	13 lbf/ft	18 Nm
Intake manifold (see figure D)	96 lbf/in	11 Nm
Lifting eye bolts	30 lbf/ft	41 Nm
Lower crankcase main bolts (see figure E)	figure A	figure A
Lower crankcase outer bolts(M8)	18 lbf/in	24 Nm

SPECIAL TORQUE CHART

COMPONENT	STANDARD	METRIC
Oil cooler mounting bolts (M8)	16 lbf/ft	22 Nm
(M6)	89 lbf/in	10 Nm
Oil filter cap	18 lbf/ft	24 Nm
Oil filter drain (Econoline only)	7-8 lbf/ft	10 Nm
Oil filter housing bolts	11 lbf/ft	15 Nm
Oil filter stand pipe bolt (new)	53 lbf/in	6 Nm
(reinstallation)	27 lbf/in	3 Nm
Oil pan drain plug (see note 3)	18 lbf/ft	25 Nm
Oil pickup tube flange bolts	18 lbf/ft	24 Nm
Oil pump housing bolts	72 lbf/in	8 Nm
Oil pressure regulator plug	19-21 lbf/ft	26-29 Nm
Piston cooling jet (see note 4)	10 lbf/ft	13 Nm
Rocker arm fulcrum bolts	23 lbf/ft	31 Nm
Water pump bolts (M8)	17 lbf/ft	23 Nm
Water pump plugs	26-28 lbf/ft	35-38 Nm
Water pump pulley bolts	23 lbf/ft	31 Nm
Thermostat housing bolts	17 lbf/ft	23 Nm
Turbo exhaust adapter v-band clamp	108 lbf/in	12 Nm
Turbo oil supply bolts	18 lbf/ft	24 Nm
Turbo oil supply line, flange retaining bolt	7 lbf/ft	10 Nm
Turbo to mounting bracket bolts (see note 2)	23 lbf/ft	31 Nm
Turbo bracket to crankcase mounting bolts	23 lbf/ft	31 Nm
Valve cover bolts	72 lbf/in	9 Nm
*Vibration damper (see note 5) (initial)	50 lbf/ft	68 Nm
(Final)	additional 90 degrees rotation	

*Only use new bolts. Once these bolts have been loaded to the initial value, do not reuse.

STANDARD TORQUE CHART

Thread Diameter	Torque lbf/ft	Torque Nm	Wrench Size (mm)
Hex Flange Head			
M6 x 1	8	11	8
M8 x 1.25	18	24	10
M10 x 1.5	36	49	13
M12 x 1.75	61	83	15
M16 x 2	154	208	21
Hex Head			
M6 x 1	6	8	10
M8 x 1.25	15	20	13
M10 x 1.5	30	40	16
M12 x 1.75	51	69	18
M16 x 2	128	173	24
Pipe Thread			
1/8” NPT	7	10.2	
1/4” NPT	10	13.6	
3/8” NPT	15	20.4	
1/2” NPT	25	34.0	
3/4” NPT	30	40.8	

Torque Chart Notes

- **1)** Tighten 2 M6 studs in front EGR cooler flange first then install M8 EGR cooler support bolt.
- **2)** Apply High Temperature Nickel Anti-Seize Lubricant (F6AZ-9L494-AA) to threads of bolts prior to assembly.
- **3)** Lightly coat o-ring with engine oil before installing.
- **4)** Apply Threadlock 262 to bolt threads prior to assembly
- **5)** Tighten bolts across center of crankshaft.

- **All figures on next page.**

SPECIAL TORQUE CHART

Cylinder Head Bolts

- **NOTE: Once bolts have been loaded to the initial value, they may not be reused. Use only new bolts.**
- Step 1: Torque the M14 (1-10) cylinder head bolts to 65 lbf/ft (88 Nm) in the numerical sequence shown.
- Step 2: Torque the M14 cylinder head bolts 1, 3, 5, 7, & 9 to 85 lbf/ft (115 Nm) in the numerical sequence shown.
- Step 3: Tighten the M14 cylinder head bolts an additional 90^{o} clockwise in the numerical sequence shown.

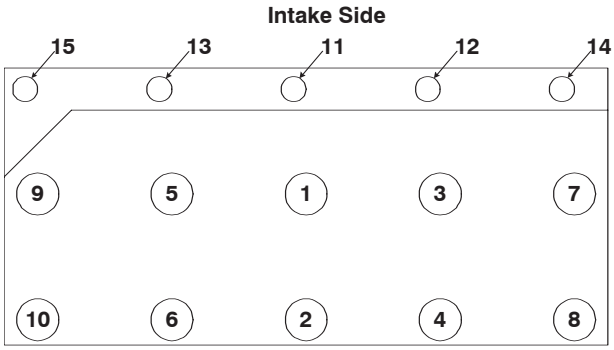


Figure A

- Step 4: Tighten the M14 cylinder head bolts an additional 90^{o} clockwise in the numerical sequence shown.
- Step 5: Tighten the M14 cylinder head bolts an additional 90^{o} clockwise in the numerical sequence shown.
- Step 6: Torque the M8 (11-15) cylinder head bolts to 18 lbf/ft (24 Nm) in the numerical sequence shown.
- Final Step: Torque the M8 cylinder head bolts to 23 lbf/ft (31 Nm) in the numerical sequence shown.

Flywheel Bolts

- **NOTE: Once bolts have been loaded to the initial value, they may not be reused. Use only new bolts.**
- Step 1: Torque the bolts to 1-5 lbf/ft (1.4-7 Nm) in the numerical sequence shown above.
- Final step: Torque the bolts to 69 lbf/ft (94 Nm) in the numerical sequence shown above.

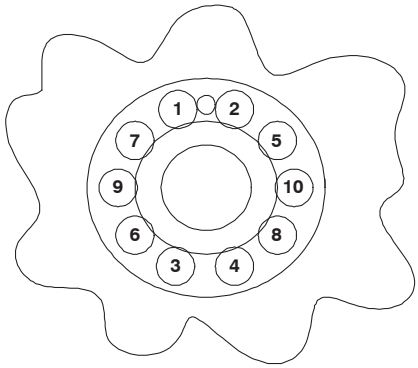


Figure B

Intake Manifold Bolts

- Step 1: Install bolts 1 through 8 finger tight.
- Step 2: Torque bolts 9 though 16 to 8 lbf/ft (11 Nm).
- Final step: Torque all bolts to 8 lbf/ft (11 Nm) in the numerical sequence shown.

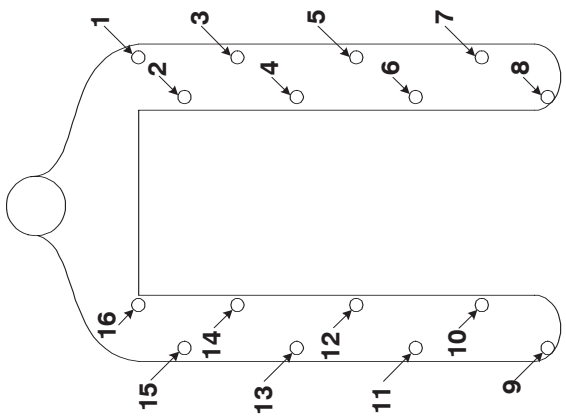


Figure D

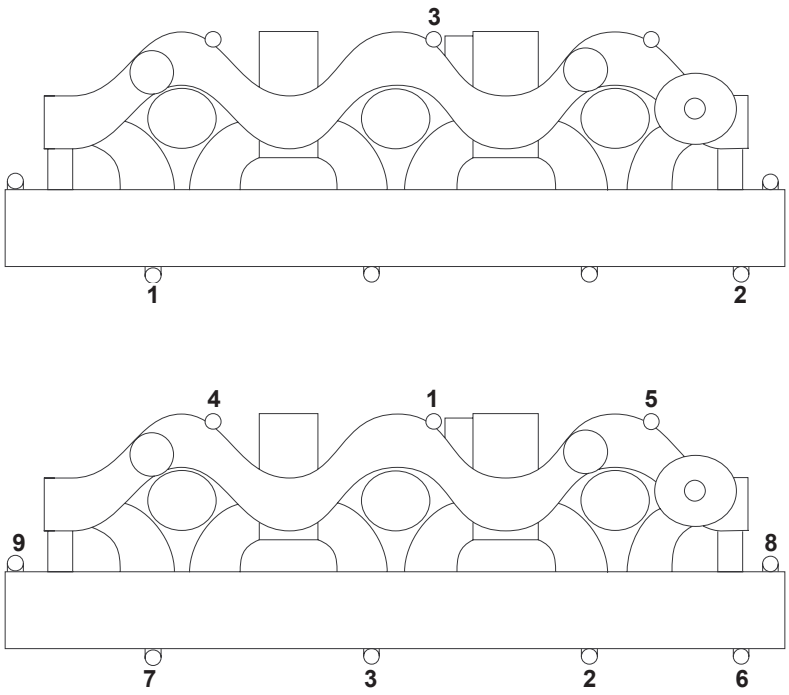


Figure C

Wavy High Pressure Oil Rail Installation and Torque Procedure

- Step 1: Place the oil rail on top of the carrier so that the four single ball tubes are engaging the injector lead angle.
- Step 2: Insert 3 guide bolts-- two on the ends of the straight side of the oil rail and one in the middle of the wavy side of the oil rail. See figure to the left.
- Step 3: After the 3 guide bolts are threaded in 6 or 7 turns, press the rail into the injectors.
- Step 4: Once the oil rail has completely engaged the injectors, the oil rail mounting feet should be flat against the carrier mounting surfaces. Now insert the remaining 6 bolts.
- Step 5: Turn all 9 bolts until snug.
- Step 6: Torque all bolts to 120 in/lbs. starting with the center bolt on the wavy side of the oil rail. Follow sequence shown in Figure C.

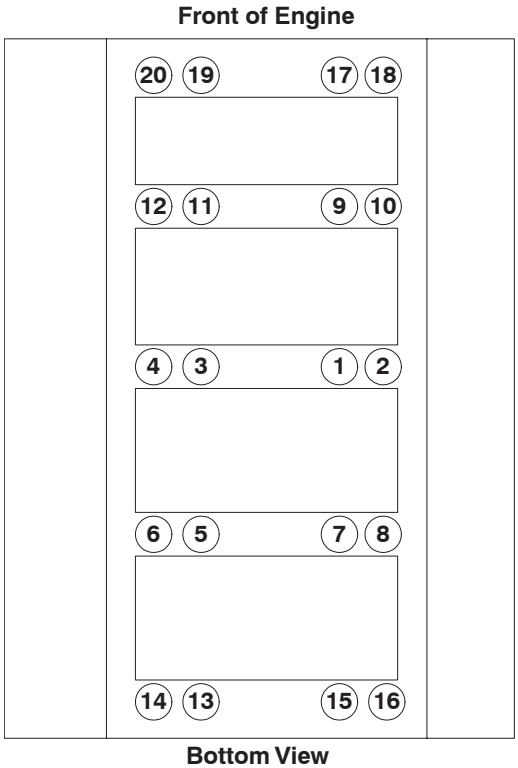


Figure E

Main Bearing Bolts

- **NOTE: Bolts must contain a light film of oil on the bearing surface (under the head) and threads prior to assembly.**
- Step 1: Torque the bolts to 110 lbf/ft (149 Nm) in the numerical sequence shown.
- Step 2: Torque the bolts to 130 lbf/ft (176 Nm) in the numerical sequence shown.
- Final step: Torque the bolts to 170 lbf/ft (231 Nm) in the numerical sequence shown.

HARD START/NO START DIAGNOSTICS

F-Series/Excursion/Econoline Powerstroke 2004.25
6.0L Power Stroke Diesel Engine Diagnostic Guide

-NOTE-
IF CONCERN IS FOUND, SERVICE AS REQUIRED. IF THIS CORRECTS THE CONDITION, IT IS NOT NECESSARY TO COMPLETE THE REMAINDER OF THE DIAGNOSTIC PROCEDURE.

CUSTOMER NAME | MODEL YEAR | CHASSIS

Customer Concerns (Please list in this box)

DEALER NAME | P & A CODE | 1863 CLAIM NUMBER | DATE

ENGINE SERIAL NUMBER | ODOMETER | TYPE OF SERVICE

VEHICLE GVW | TRANSMISSION | AMBIENT TEMPERATURE | PERSONAL ☐ COMMERCIAL ☐

NOTE : A hard start/ No start concern with EOT temp. below 60F perform step 10 first .

1. Visual Engine/Chassis Inspection

Fuel	Oil	Coolant	Electrical	Hoses	Leaks
Method	Check				
Visual					

2. Check Engine Oil Level

- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil, correct level.

Method	Check
Visual	

3. Intake/Exhaust Restriction

- Inspect air filter and inlet ducts.
- Inspect exhaust system.
- Check if air filter minder indicator has been illuminated

Method	Check
Visual	

4. Sufficient Clean Fuel

- Check if the WATER IN FUEL lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel control module.
- Cetane rating between 40-50 is recommended for optimum start.

Method	Check
Visual	

5. Electric Fuel Pump Pressure

- Verify that the fuel pump has voltage and ground with key on.
- Measure fuel pressure at engine fuel filter housing test port with a (0-160 PSI) gauge at key on. Fuel pump runs for 20 sec. at key on. Pressure falls after key off.

Instrument	Spec.	Measurement
0-160 PSI Gauge	45 psi min.	

If pressure fails low go to next step to verify no restriction

6. Electric Fuel Pump Inlet Restriction

- Measure restriction at fuel pump inlet.

Instrument	Spec.	Measurement
0-30 " Hg vacuum	6" MAX	

» If > 6" Hg restriction, check lines between pump and fuel tank.
» If < 6" Hg, check fuel filters. If filters OK, check fuel regulator. If regulator and filters are OK, replace pump.

7. Perform KOEO On-Demand Self Test

- Use scan tool. DTC's set during this test are current faults

Diagnostic Trouble Codes	

8. Retrieve Continuous Memory Codes

- Use the scan tool.
- DTC's retrieved during this test are historical faults

Diagnostic Trouble Codes	

9. KOEO Injector Electrical Self Test (Click Test)

- Use scan tool. Injector buzz will be displayed at test end.
- All injectors will momentarily click, then each injector will click in sequence 1-8. Sequence repeats three times.

Diagnostic Trouble Codes	

» If self test codes are retrieved, go to appropriate PPT test.

10. Scan Tool - Data List Monitoring

Some codes may reset below 9 volts.

Select the parameter indicated on the scan tool parameter list and monitor the cranking engine.

Parameter	Spec.	Measurement
VPWR	9 volts min.	
FICMLPWR		
FICMVPWR		
RPM	100 RPM minimum	
ICP	3.5 mPa min. (500 PSI)	
ICP volts	.80 V min.	
FUEL PW	500 uS - 2 mS	
FICMSYNC	Yes	

A - RPM - If low voltage condition is present, check battery, charging system, or power/ground circuits to the PCM.
FICMVPWR - No/low voltage indicated could be caused by 12 way connector issue or logic power fuse.
» Refer to Pinpoint Test AE for detailed 12-way conn. diagnostics
FICMVPWR - No or low voltage indicated could be caused by 12-way connector issues.
D - RPM - Low RPM could be caused by starting/charging system issues. No RPM indicated while cranking could be CMP or CKP related.
E - ICP - A minimum of 500 PSI (3.5 mPa) is required for the injectors to be enabled. No or low oil in the system, system voltage, injector O-Rings, faulty IPR, or high pressure pump could cause low pressure.
PCM will cycle defaults to 14% (300 PSI) w/o CKP signal.
F - ICP - Voltage reading below spec indicates low ICP during crank.
FUEL PW - Pulse width defaults to 0 w/o CKP signal
H - FICMSYNC- No sync could be caused CMP or CKP faults.
» Refer to PC/ED section 4 for detailed test procedures.

Glow Plug System Operation

GPCM Operation

Glow Plug ON time is dependent on oil temperature and altitude. The Glow Plug Control Module (GPCM) comes on between 1 and 120 sec., and does not come on at all if oil temp is above 140 F.
- Using a scan tool, check Continuous and KOEO DTC's. If codes are present go to Pinpoint Test AF.
- Verify voltage is being supplied to GPCM.
- Using the scan tool GPCTM and EOT pids, verify glow plug "on" time.
- With key to run position, measure voltage ("on"time) (Dependent on oil temperature and altitude)

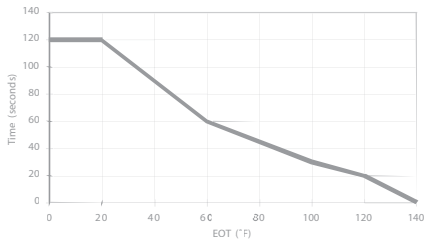
Glow plug on time	Spec.	Measurement
1 to 120 seconds	B +	

Wait to Start Lamp "on" time is indepedent from g/p "on" time

Glow Plug Resistance

- Disconnect the 4 pin connector at front of valve cover
- Measure each Glow Plug resistance to Bat. ground.
- Measure engine harness resistance to GPCM

Glow Plug Number	Glow Plug to Ground .1 to 2 ohms	Harness to GPCM connector 0 to 1 ohms
#1		
#3		
#5		
#7		
#2		
#4		
#6		
#8		



- Add 5 seconds to glow plug on time when above 7000 feet in altitude, but not to exceed 120 seconds.

See PC/ED manual, Section 4A for more detail on all of the above test steps.

When troubleshooting a Hard Start/No Start/Performance concern, this form must be filled out to the point of repair and returned to receive warranty credit and diagnostic time for the following parts: Fuel Injectors (9E527), regulator, control pressure(9C968), turbo assembly high pressure oil (9A543), turbo charger assembly/pedestal (6K684), fuel pump (9350), FICM (12B599) and PCM (EEC)(12A650
Labor operations listed more than once are a continuation of the diagnostic procedure and should be claimed only once.

What problems were found and what repairs were performed?

List Part Name, Number and Serial Number of parts replaced.

F-Series/Excursion/Econoline Powerstroke 2004.25
6.0L Power Stroke Diesel Engine Diagnostic Guide

-NOTE-
IF CONCERN IS FOUND, SERVICE AS REQUIRED. IF THIS CORRECTS THE CONDITION, IT IS NOT NECESSARY TO COMPLETE THE REMAINDER OF THE DIAGNOSTIC PROCEDURE.

CUSTOMER NAME
MODEL YEAR
CHASSIS

Customer Concerns (Please list in this box)

DEALER NAME	P & A CODE	1863 CLAIM NUMBER	DATE
	ENGINE SERIAL NUMBER	ODOMETER	TYPE OF SERVICE
VEHICLE GVW	TRANSMISSION	AMBIENT TEMPERATURE	PERSONAL ☐ COMMERCIAL ☐

1. Visual Engine/Chassis Inspection

- Verify that there are no fluid or pressure leaks.
- Inspect all wire connections for damage.
- Inspect MAP hose, intercooler hose, and manifolds for leaks.

Fuel	Oil	Coolant	Electrical	Hoses	Leaks
Method	Check				
Visual					

2. Sufficient Clean Fuel

- Check if WATER IN FUEL indicator has been illuminated.
- Drain sample from fuel control module housing.
- Cetane rating between 40-50 is recommended for optimum performance

Method	Check
Visual	

3. Check Engine Oil Level

- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/hours on oil, correct level.

Method	Check
Visual	

4. Perform KOEO On Demand Test

- Use the scan tool.
- DTCs set during this test are current faults.

Diagnostic Trouble Codes	

5. Retrieve Continuous DTC's

- Use the scan tool.
- DTCs retrieved during this test are historic faults.

Diagnostic Trouble Codes	

6. KOEO Injector Electrical Self-Test

- Use the scan tool.
- All injectors will momentarily click. Individual injectors will click in sequence 1 through 8.

Injector Trouble Codes	

» If self test codes are retrieved, go to appropriate PPT.

7. Intake Restriction

- Check filter minder switch/indicator.
- Measure vacuum on clean side of air inlet system at WOT with magnehelic gauge.

Instrument	Spec.	Check
Magnehelic Filter Minder	2"-25" H_2O	

8. EGR Position

- Perform with key on, engine off.
- Use scan tool to command Output State Control for EGR.
- Monitor EGR position sensor PID and actual travel.

Instrument	Spec.	Actual Percent
Scan tool	0% (0.6–1.2 V) Closed	
	100% (3.0–4.0 V) Open	
	90 % and 3.2 V Travel	Travel

» Repair issue if reading out of spec. value before test.

9. Exhaust Restriction

- Visually inspect exhaust system for damage.
- Monitor EGT with the scan tool with the engine temperature above 70° C (158° F) minimum at 3,800 RPM in park/neutral.

Parameter	Spec.	Measurement
EGT	244° C (35 PSI) MAX @ 3,800 RPM.	

10a. Electric Fuel Pump Pressure

- Measure fuel pressure at engine filter housing test port.
- Road Test- engine full load condition

Instrument	Spec.	Measurement
0-1 MPa (0-1 [illegible] Gauge	310-379 kPa (45-55 PSI)	

» If fuel pressure fails low, Go to step10b.
» If pressure is above spec, check fuel [illegible] for restriction.
If restriction is present, replace fuel pressure regulator valve.

10b. Electric Fuel Pump Inlet Restriction

Measure restriction at fuel pump inlet.

Instrument	Spec.	Measurement
0-30 "Hg vacuum	6" Hg MAX	

If 6" Hg restriction [illegible] between pump and fuel tank.
If < 6" Hg, inspect [illegible] filters. If filters are OK, check fuel regulator. If regulator and filters are OK, replace fuel pump.

10c. Fuel Aeration Test

- Install clear [illegible] fuel return line at fuel control module.
Refer to PC/ED manual for approved procedure.
- Run at WOT [illegible] min. Return fuel should be free of bubbles.

[illegible]	Check
[illegible]	

» If air is present in return fuel, inspect fuel system for leaks.

11. Perform KOER On Demand Test

This will test the ICP, EGR and VGT performance.

KOER DTC	

[illegible] Low Idle Stability (ICP Pressure)

- Check at low idle, EOT above 70° C (158° F)
- Monitor ICP and RPM with scan tool.

Parameter	Spec. @ 670 RPM	Measurement
ICP	4.5-5.5 MPa ± .3 MPa (580-725 PSI ± 45 PSI)	
Take reading before disconnecting ICP		

If engine RPM is unstable, disconnect ICP sensor (ICP will default).
» If RPM [illegible] unstable, re-connect sensor and go to 12b.
» If [illegible] smoothes out, the ICP sensor is at fault.

12b. Injection Pressure Regulator Test

- Check at low idle, EOT above 70° C (158° F)
- Monitor IPR with scan tool.

Parameter	Spec. @ 670 RPM	Measurement
IPR	30 % MAX	

» If duty cycle is below MAX spec go to next step.
If duty cycle is above MAX spec, check for system leak with procedure in Hard Start/No Start section. Test 10c.

13. Boost Pressure Test

- Carefully inspect intercooler tubes/connections, turbocharger connections, and MAP hose for signs of damage or leaks. Perform boost test at 3300 RPM.
- Monitor MGP and RPM with scan tool.
- Road Test - select appropriate gear to obtain desired engine speed and full load on engine climbing hill or loaded truck.

3300 RPM

Parameter	Spec. PSIG	Measurement
MGP	22 PSI G MIN F-Series	
	20 PSIG MIN Econoline	

» If test fails low, inspect turbo blades for damage.

14. Crankcase Pressure Test

- Measure at oil fill tube with 6.0L Crankcase Pressure Tester p/n 303-758, with engine at 70° C (170° F) minimum.
- Block breather tube on left valve cover.
- Measure at WOT with no load at 3,000 RPM.

Instrument	Spec.	Measurement
(0-60" H_2O) Magnehelic	8" H_2O MAX	

If more than 8" H_2O, refer to base engine in Shop Manual

15. Oil Aeration Test

- Run engine at 3000 RPM for 1 minute.
- Take oil sample from the Oil Pressure Switch port at idle.
- Inspect sample for presence of air bubbles.

Method	Check
Visual	

» Excessive oil aeration can be caused by depleated oil additives, pick-up tube leak, front cover seal leak, or upper pan seal leak.

Note: If performance concern still exists, refer to Enhanced Injector Diagnostics in this section.

See PC/ED manual, Section 4A for more detail on all of the above test steps.

When troubleshooting a Hard Start/No Start or Performance concern this form must be filled out to the point of repair and returned to receive warranty credit and diagnostic time for the following parts: Fuel Injectors (9E527), regulator (9F593), injection control pressure(9C968), pump assembly high pressure oil (9A543), turbo charger assembly/pedestal (6K684), fuel pump (9350), FICM (12B599) and PCM (EEC)(12A650
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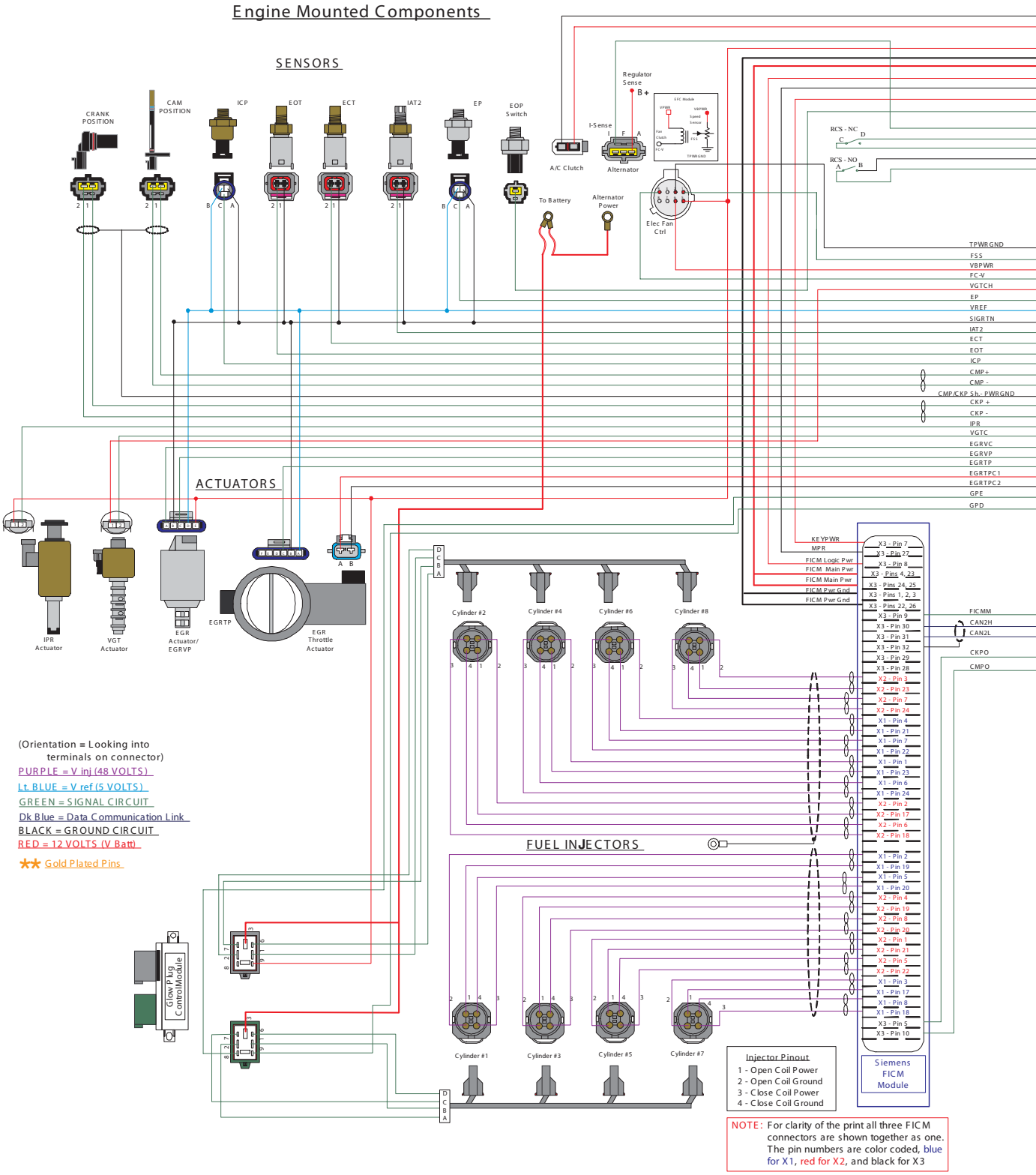
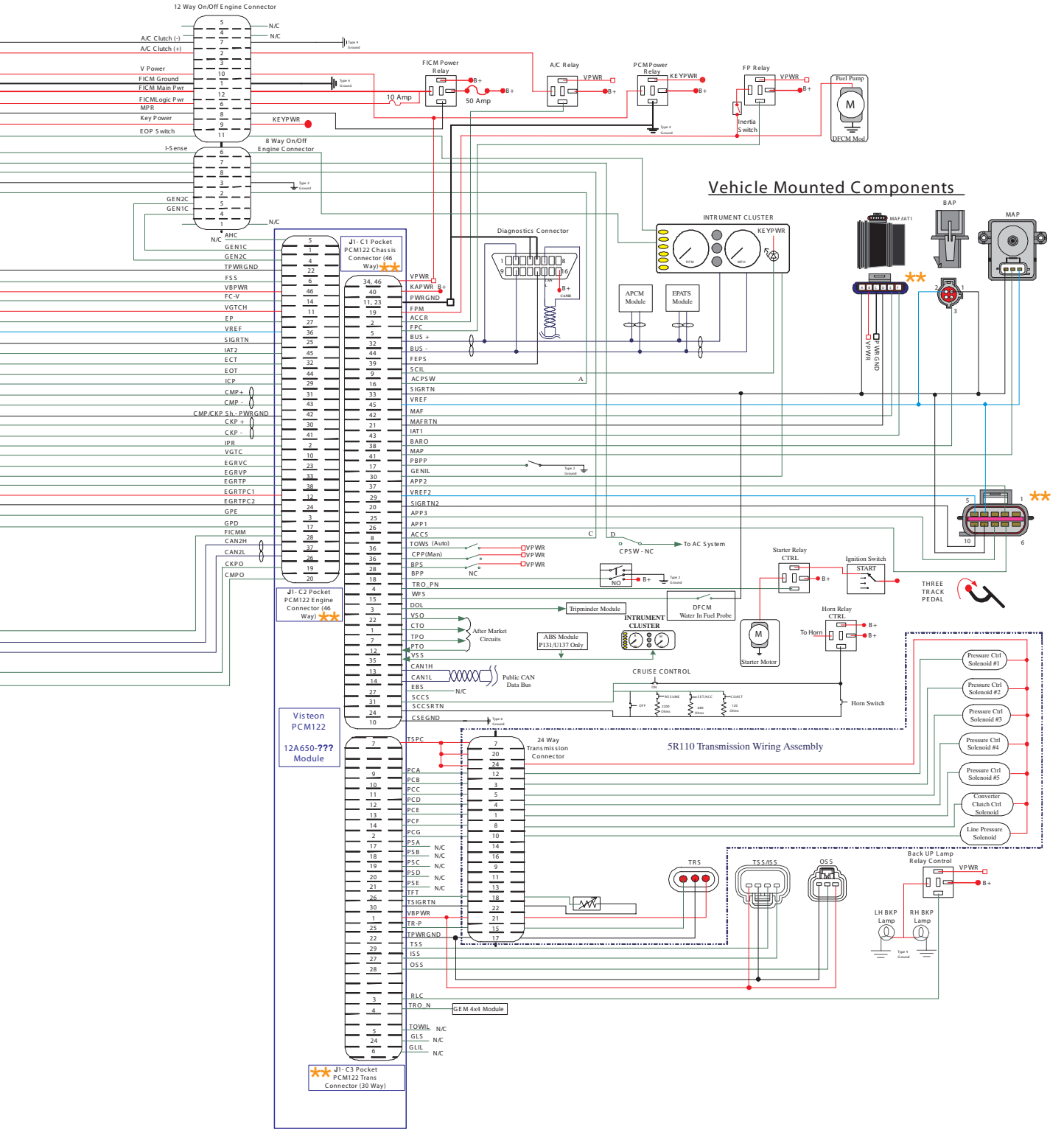
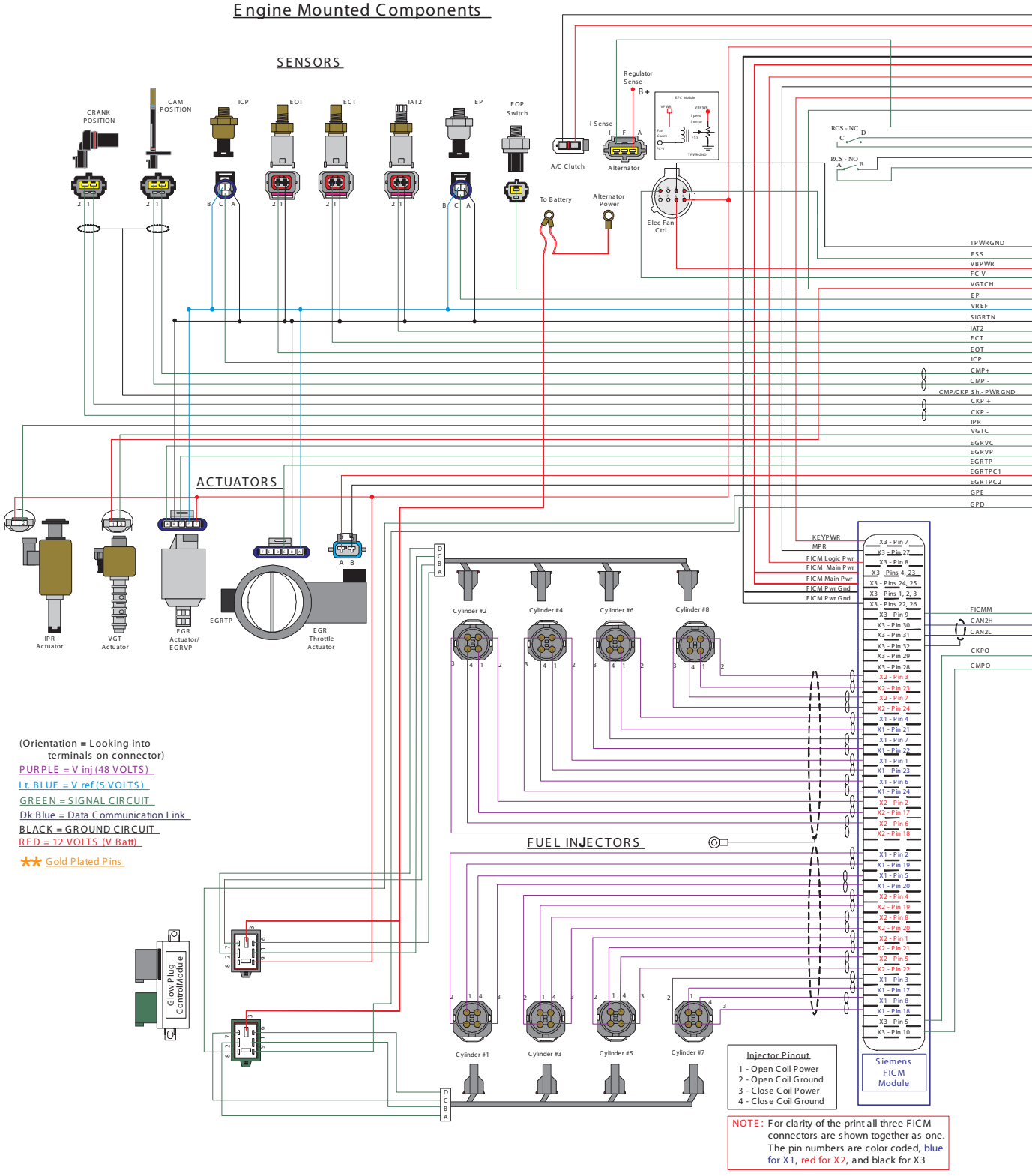
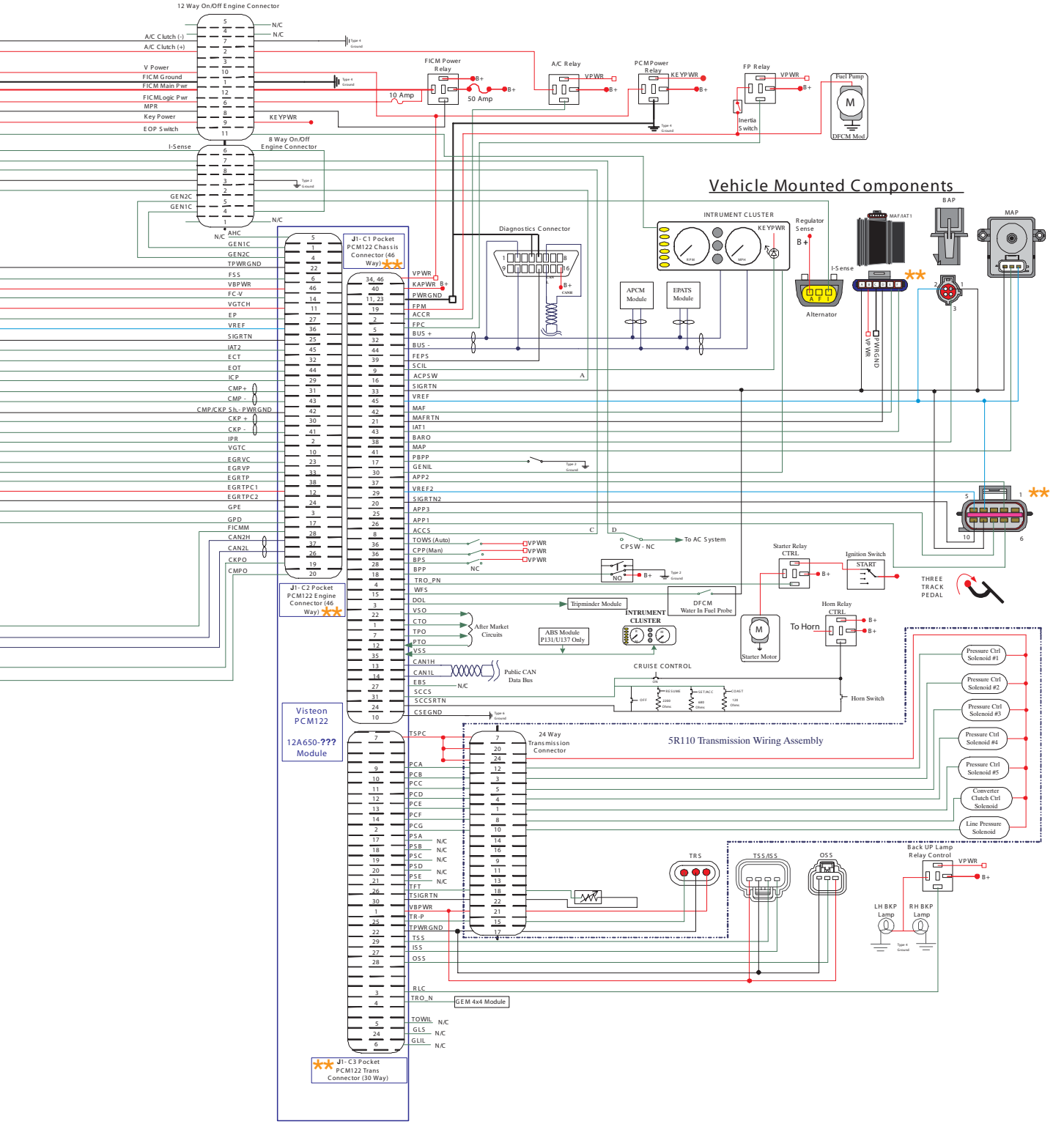
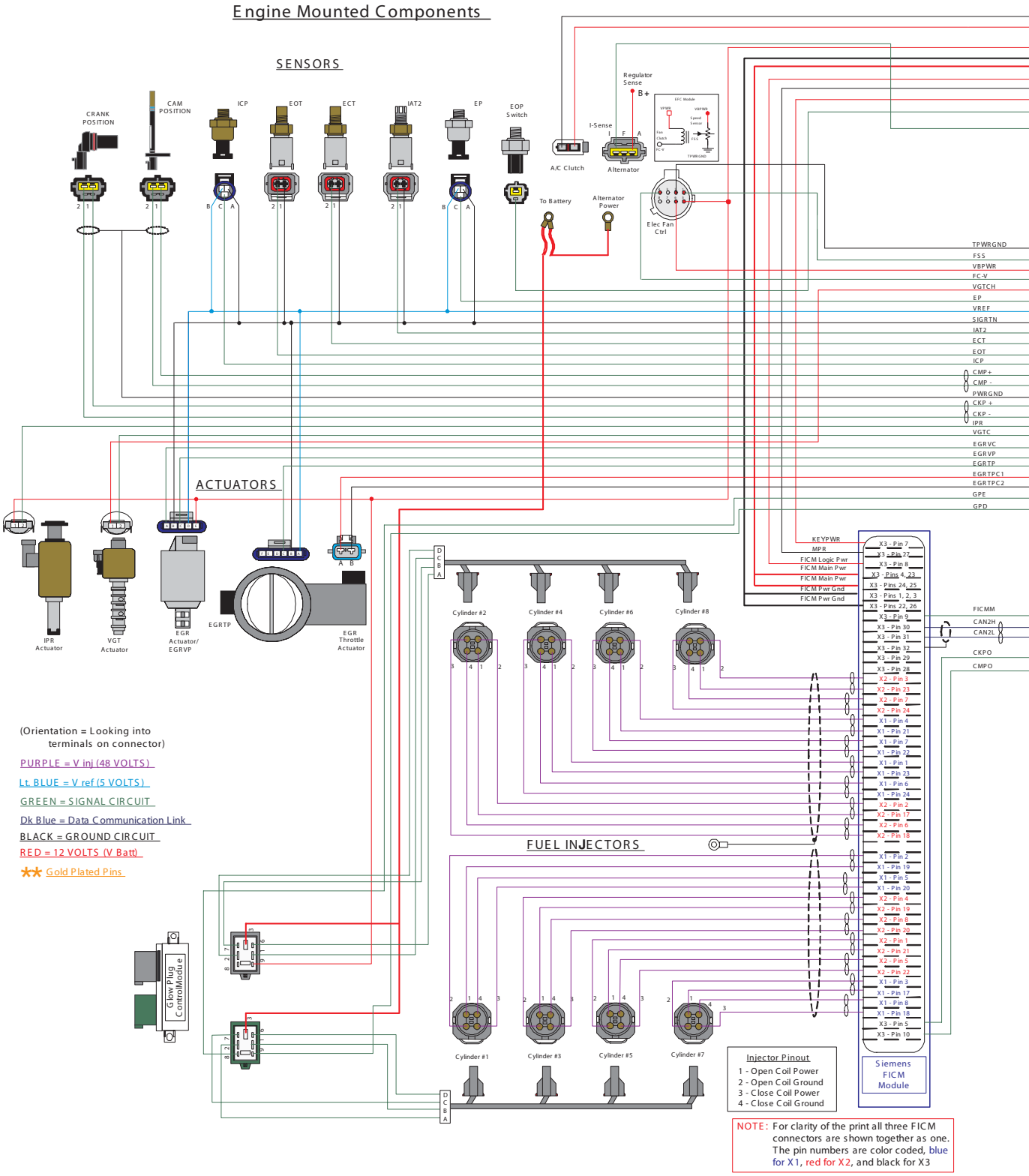

Engine Mounted Components
SENSORS
CRANK POSITION
CAM POSITION
ICP
EOT
ECT
IAT2
EP
EOP Switch
A/C Clutch
I-Sense
Regulator Sense
B+
Alternator
To Battery
Alternator Power
Elec Fan Ctrl
RCS - NC
RCS - NO
TPWRGND
FSS
VBPWR
FC-V
VGTCH
EP
VREF
SIGRTN
IAT2
ECT
EOT
ICP
CMP+
CMP -
CMP/CKP Sh.- PWRGND
CKP +
CKP -
IPR
VGTC
EGRVC
EGRVP
EGRTP
EGRTPC1
EGRTPC2
GPE
GPD
ACTUATORS
IPR Actuator
VGT Actuator
EGR Actuator/ EGRVP
EGRTP
EGR Throttle Actuator
KEYPWR
MPR
FICM Logic Pwr
FICM Main Pwr
FICM Main Pwr
FICM Pwr Gnd
FICM Pwr Gnd
FICMM
CAN2H
CAN2L
CKPO
CMPO
Cylinder #2
Cylinder #4
Cylinder #6
Cylinder #8
Cylinder #1
Cylinder #3
Cylinder #5
Cylinder #7
FUEL INJECTORS
Glow Plug Control Module
(Orientation = Looking into terminals on connector)
PURPLE = V inj (48 VOLTS)
Lt. BLUE = V ref (5 VOLTS)
GREEN = SIGNAL CIRCUIT
Dk Blue = Data Communication Link
BLACK = GROUND CIRCUIT
RED = 12 VOLTS (V Batt)
** Gold Plated Pins
Injector Pinout
1 - Open Coil Power
2 - Open Coil Ground
3 - Close Coil Power
4 - Close Coil Ground
Siemens FICM Module
NOTE: For clarity of the print all three FICM connectors are shown together as one. The pin numbers are color coded, blue for X1, red for X2, and black for X3


Vehicle Mounted Components
12 Way On/Off Engine Connector
8 Way On/Off Engine Connector
FICM Power Relay
A/C Relay
PCM Power Relay
FP Relay
Fuel Pump
DFCM Mod
Inertia Switch
10 Amp
50 Amp
KEYPWR
VPWR
INTRUMENT CLUSTER
Diagnostics Connector
APCM Module
EPATS Module
BAP
MAP
MAF/IAT1
J1- C1 Pocket PCM122 Chassis Connector (46 Way)
J1- C2 Pocket PCM122 Engine Connector (46 Way)
J1- C3 Pocket PCM122 Trans Connector (30 Way)
Visteon PCM122
12A650-??? Module
GEM 4x4 Module
TOWS (Auto)
CPP(Man)
BPS
BPP
CPSW - NC
To AC System
Tripminder Module
DFCM Water In Fuel Probe
ABS Module P131/U137 Only
After Market Circuits
Public CAN Data Bus
CRUISE CONTROL
Starter Relay CTRL
Ignition Switch
START
THREE TRACK PEDAL
Starter Motor
Horn Relay CTRL
To Horn
Horn Switch
24 Way Transmission Connector
5R110 Transmission Wiring Assembly
Pressure Ctrl Solenoid #1
Pressure Ctrl Solenoid #2
Pressure Ctrl Solenoid #3
Pressure Ctrl Solenoid #4
Pressure Ctrl Solenoid #5
Converter Clutch Ctrl Solenoid
Line Pressure Solenoid
TRS
TSS/ISS
OSS
Back UP Lamp Relay Control
LH BKP Lamp
RH BKP Lamp


Engine Mounted Components
SENSORS
CRANK POSITION
CAM POSITION
ICP
EOT
ECT
IAT2
EP
EOP Switch
A/C Clutch
Regulator Sense
B+
I-Sense
Alternator
To Battery
Alternator Power
Elec Fan Ctrl
RCS - NC
RCS - NO
TPWRGND
FSS
VBPWR
FC-V
VGTCH
EP
VREF
SIGRTN
IAT2
ECT
EOT
ICP
CMP+
CMP -
CMP/CKP Sh. - PWRGND
CKP +
CKP -
IPR
VGTC
EGRVC
EGRVP
EGRTP
EGRTPC1
EGRTPC2
GPE
GPD
ACTUATORS
IPR Actuator
VGT Actuator
EGR Actuator/ EGRVP
EGRTP
EGR Throttle Actuator
KEYPWR
MPR
FICM Logic Pwr
FICM Main Pwr
FICM Main Pwr
FICM Pwr Gnd
FICM Pwr Gnd
X3 - Pin 7
X3 - Pin 27
X3 - Pin 8
X3 - Pins 4, 23
X3 - Pins 24, 25
X3 - Pins 1, 2, 3
X3 - Pins 22, 26
X3 - Pin 9
X3 - Pin 30
X3 - Pin 31
X3 - Pin 32
X3 - Pin 29
X3 - Pin 28
X2 - Pin 3
X2 - Pin 23
X2 - Pin 7
X2 - Pin 24
X1 - Pin 4
X1 - Pin 21
X1 - Pin 7
X1 - Pin 22
X1 - Pin 1
X1 - Pin 23
X1 - Pin 6
X1 - Pin 24
X2 - Pin 2
X2 - Pin 17
X2 - Pin 6
X2 - Pin 18
X1 - Pin 2
X1 - Pin 19
X1 - Pin 5
X1 - Pin 20
X2 - Pin 4
X2 - Pin 19
X2 - Pin 8
X2 - Pin 20
X2 - Pin 1
X2 - Pin 21
X2 - Pin 5
X2 - Pin 22
X1 - Pin 3
X1 - Pin 17
X1 - Pin 8
X1 - Pin 18
X3 - Pin 5
X3 - Pin 10
FICMM
CAN2H
CAN2L
CKPO
CMPO
Siemens FICM Module
Cylinder #2
Cylinder #4
Cylinder #6
Cylinder #8
Cylinder #1
Cylinder #3
Cylinder #5
Cylinder #7
FUEL INJECTORS
Glow Plug ControlModule
Injector Pinout
1 - Open Coil Power
2 - Open Coil Ground
3 - Close Coil Power
4 - Close Coil Ground
(Orientation = Looking into terminals on connector)
PURPLE = V inj (48 VOLTS)
Lt BLUE = V ref (5 VOLTS)
GREEN = SIGNAL CIRCUIT
Dk Blue = Data Communication Link
BLACK = GROUND CIRCUIT
RED = 12 VOLTS (V Batt)
** Gold Plated Pins
NOTE: For clarity of the print all three FICM connectors are shown together as one. The pin numbers are color coded, blue for X1, red for X2, and black for X3


12 Way On/Off Engine Connector
A/C Clutch (-)
A/C Clutch (+)
V Power
FICM Ground
FICM Main Pwr
FICMLogic Pwr
MPR
Key Power
EOP Switch
I-Sense
8 Way On/Off Engine Connector
GEN2C
GEN1C
N/C
AHC
FICM Power Relay
10 Amp
50 Amp
A/C Relay
PCM Power Relay
FP Relay
Inertia Switch
Fuel Pump
DFCM Mod
KEYPWR
VPWR
B+
Vehicle Mounted Components
INTRUMENT CLUSTER
Regulator Sense
Alternator
I-Sense
MAF/IAT1
BAP
MAP
Diagnostics Connector
APCM Module
EPATS Module
J1- C1 Pocket PCM122 Chassis Connector (46 Way)
J1- C2 Pocket PCM122 Engine Connector (46 Way)
J1- C3 Pocket PCM122 Trans Connector (30 Way)
Visteon PCM122
12A650-??? Module
GEN1C
GEN2C
TPWRGND
FSS
VBPWR
FC-V
VGTCH
EP
VREF
SIGRTN
IAT2
ECT
EOT
ICP
CMP+
CMP -
CMP/CKP Sh.-PWRGND
CKP +
CKP -
IPR
VGTC
EGRVC
EGRVP
EGRTP
EGRTPC1
EGRTPC2
GPE
GPD
FICMM
CAN2H
CAN2L
CKPO
CMPO
KAPWR
PWRGND
FPM
ACCR
FPC
BUS +
BUS -
FEPS
SCIL
ACPSW
SIGRTN
VREF
MAF
MAFRTN
IAT1
BARO
MAP
PBPP
GENIL
APP2
VREF2
SIGRTN2
APP3
APP1
ACCS
TOWS (Auto)
CPP(Man)
BPS
BPP
TRO_PN
WFS
DOL
VSO
CTO
TPO
PTO
VSS
CAN1H
CAN1L
EBS
SCCS
SCCSRTN
CSEGND
CPSW - NC
To AC System
Tripminder Module
DFCM Water In Fuel Probe
After Market Circuits
Public CAN Data Bus
ABS Module P131/U137 Only
INSTRUMENT CLUSTER
CRUISE CONTROL
Starter Relay CTRL
Ignition Switch
START
THREE TRACK PEDAL
Starter Motor
Horn Relay CTRL
To Horn
Horn Switch
TSPC
PCA
PCB
PCC
PCD
PCE
PCF
PCG
PSA
PSB
PSC
PSD
PSE
TFT
TSIGRTN
VBPWR
TR-P
TPWRGND
TSS
ISS
OSS
RLC
TRO_N
GEM 4x4 Module
TOWIL
GLS
GLIL
24 Way Transmission Connector
5R110 Transmission Wiring Assembly
Pressure Ctrl Solenoid #1
Pressure Ctrl Solenoid #2
Pressure Ctrl Solenoid #3
Pressure Ctrl Solenoid #4
Pressure Ctrl Solenoid #5
Converter Clutch Ctrl Solenoid
Line Pressure Solenoid
TRS
TSS/ISS
OSS
Back UP Lamp Relay Control
LH BKP Lamp
RH BKP Lamp


Engine Mounted Components
SENSORS
CRANK POSITION
CAM POSITION
ICP
EOT
ECT
IAT2
EP
EOP Switch
A/C Clutch
I-Sense
Regulator Sense
B+
Alternator
To Battery
Alternator Power
Elec Fan Ctrl
TPWRGND
FSS
VBPWR
FC-V
VGTCH
EP
VREF
SIGRTN
IAT2
ECT
EOT
ICP
CMP+
CMP -
PWRGND
CKP +
CKP -
IPR
VGTC
EGRVC
EGRVP
EGRTP
EGRTPC1
EGRTPC2
GPE
GPD
ACTUATORS
IPR Actuator
VGT Actuator
EGR Actuator/ EGRVP
EGRTP
EGR Throttle Actuator
KEYPWR
MPR
FICM Logic Pwr
FICM Main Pwr
FICM Main Pwr
FICM Pwr Gnd
FICM Pwr Gnd
FICMM
CAN2H
CAN2L
CKPO
CMPO
Cylinder #2
Cylinder #4
Cylinder #6
Cylinder #8
FUEL INJECTORS
Cylinder #1
Cylinder #3
Cylinder #5
Cylinder #7
Glow Plug ControlModule
(Orientation = Looking into terminals on connector)
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Lt. BLUE = V ref (5 VOLTS)
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Siemens FICM Module
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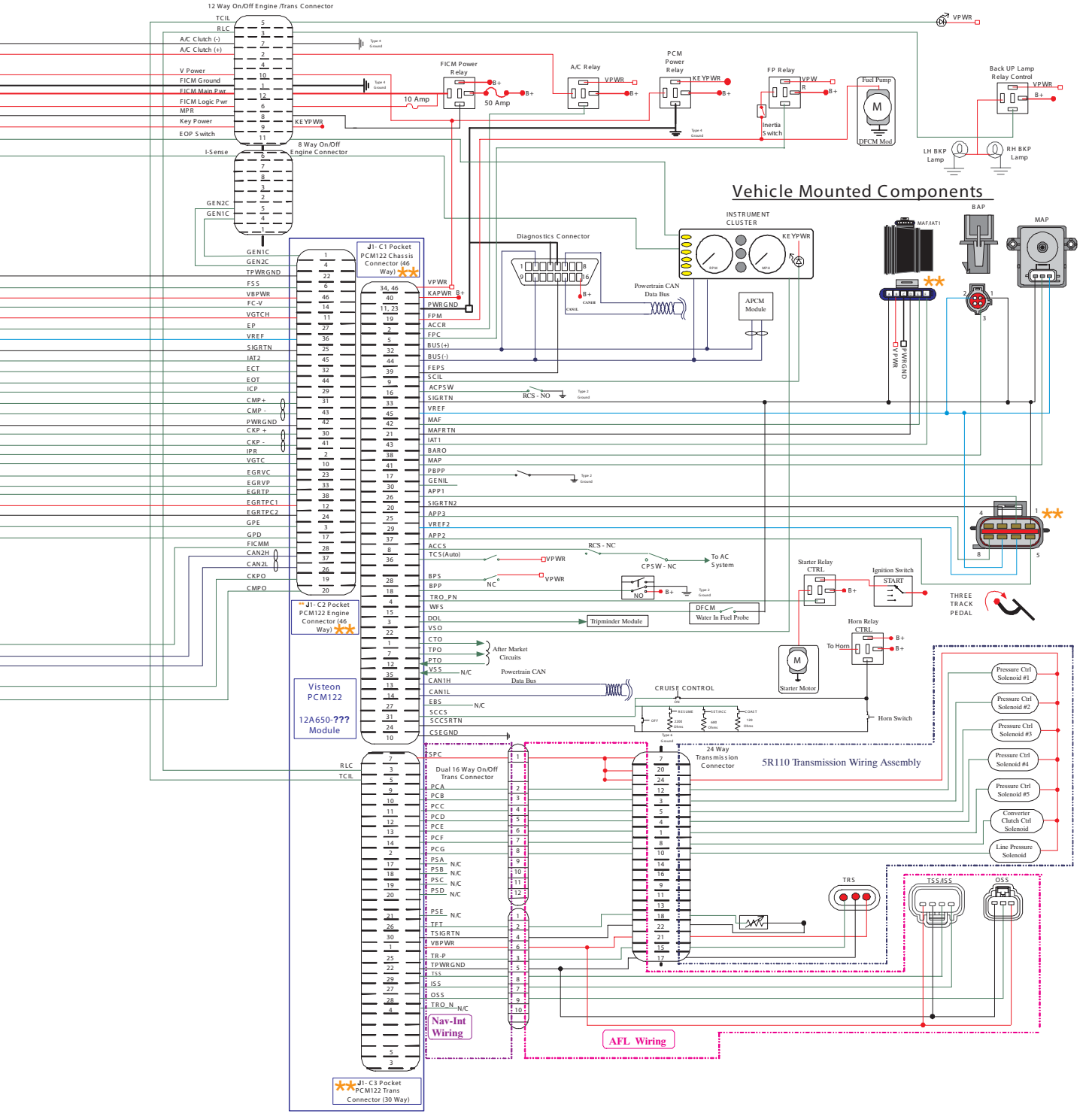
12 Way On/Off Engine /Trans Connector
TCIL
RLC
A/C Clutch (-)
A/C Clutch (+)
V Power
FICM Ground
FICM Main Pwr
FICM Logic Pwr
MPR
Key Power
EOP Switch
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8 Way On/Off Engine Connector
GEN2C
GEN1C
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FICM Power Relay
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50 Amp
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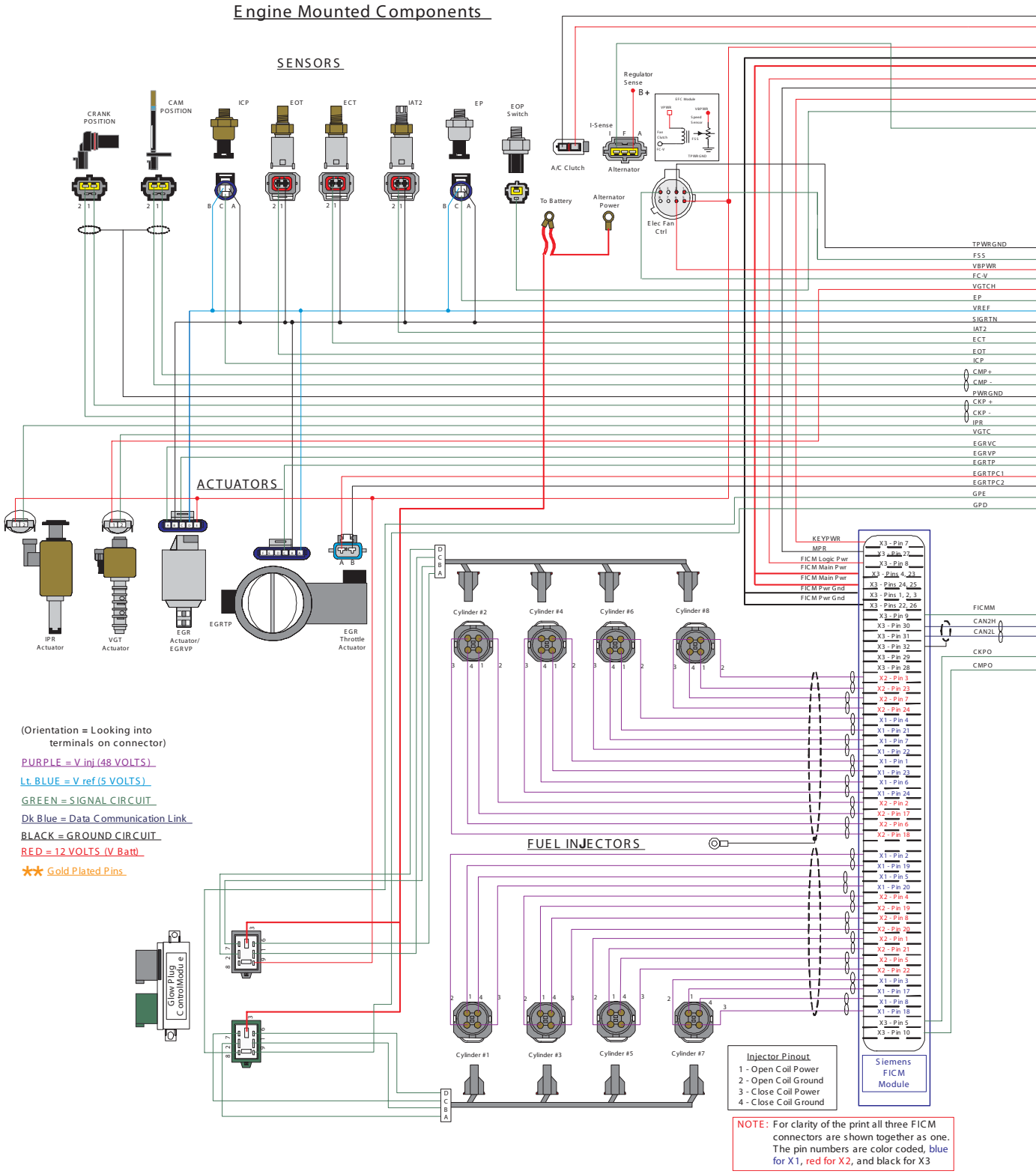
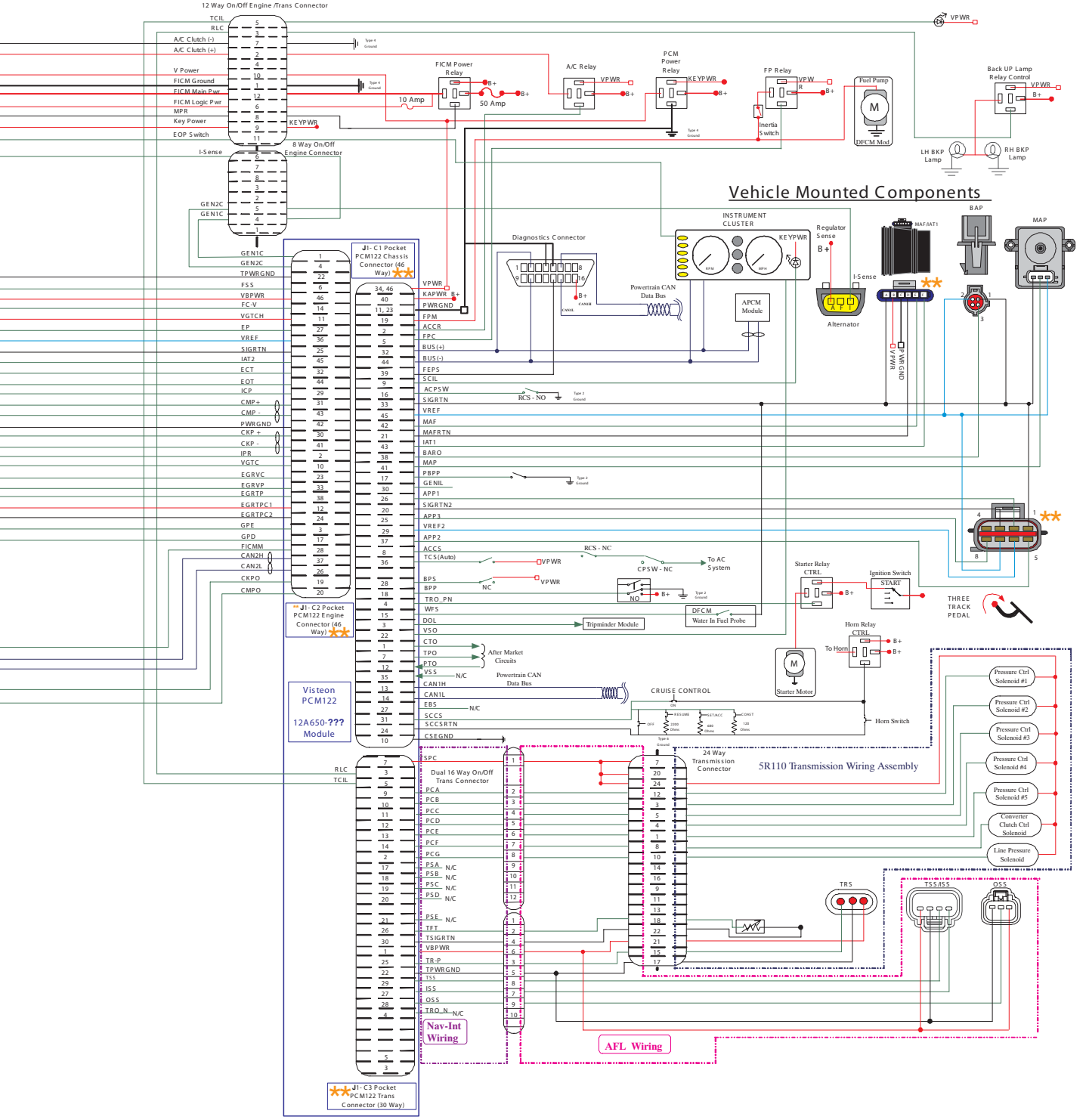
PCM Power Relay
FP Relay
Inertia Switch
Fuel Pump
DFCM Mod
Back UP Lamp Relay Control
LH BKP Lamp
RH BKP Lamp
VPWR
Vehicle Mounted Components
INSTRUMENT CLUSTER
Diagnostics Connector
Powertrain CAN Data Bus
APCM Module
BAP
MAP
MAF/IAT1
J1- C1 Pocket PCM122 Chassis Connector (46 Way)
J1- C2 Pocket PCM122 Engine Connector (46 Way)
Visteon PCM122
12A650-??? Module
RCS - NO
RCS - NC
CPS W - NC
To AC System
Tripminder Module
DFCM Water In Fuel Probe
Starter Relay CTRL
Ignition Switch
START
THREE TRACK PEDAL
Horn Relay CTRL
To Horn
Horn Switch
Starter Motor
After Market Circuits
CRUISE CONTROL
Dual 16 Way On/Off Trans Connector
24 Way Transmission Connector
5R110 Transmission Wiring Assembly
Pressure Ctrl Solenoid #1
Pressure Ctrl Solenoid #2
Pressure Ctrl Solenoid #3
Pressure Ctrl Solenoid #4
Pressure Ctrl Solenoid #5
Converter Clutch Ctrl Solenoid
Line Pressure Solenoid
TRS
TSS/ISS
OSS
Nav-Int Wiring
AFL Wiring
J1- C3 Pocket PCM122 Trans Connector (30 Way)

ECONOLINE® (DUAL ALT.)




12 Way On/Off Engine /Trans Connector
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Visteon PCM122
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EP
VREF
SIGRTN
IAT2
ECT
EOT
ICP
CMP+
CMP -
PWRGND
CKP +
CKP -
IPR
VGTC
EGRVC
EGRVP
EGRTP
EGRTPC1
EGRTPC2
GPE
GPD
FICMM
CAN2H
CAN2L
CKPO
CMPO
VPWR
KAPWR
PWRGND
FPM
ACCR
FPC
BUS(+)
BUS(-)
FEPS
SCIL
ACPSW
SIGRTN
VREF
MAF
MAFRTN
IAT1
BARO
MAP
PBPP
GENIL
APP1
SIGRTN2
APP3
VREF2
APP2
ACCS
TCS(Auto)
BPS
BPP
TRO_PN
WFS
DOL
VSO
CTO
TPO
PTO
VSS
CAN1H
CAN1L
EBS
SCCS
SCCSRTN
CSEGND
RCS - NO
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To AC System
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Dual 16 Way On/Off Trans Connector
SPC
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PCB
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PCE
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TFT
TSIGRTN
VBPWR
TR-P
TPWRGND
TSS
ISS
OSS
TRO_N
N/C
24 Way Transmission Connector
5R110 Transmission Wiring Assembly
Pressure Ctrl Solenoid #1
Pressure Ctrl Solenoid #2
Pressure Ctrl Solenoid #3
Pressure Ctrl Solenoid #4
Pressure Ctrl Solenoid #5
Converter Clutch Ctrl Solenoid
Line Pressure Solenoid
TRS
TSS
ISS
OSS
Nav-Int Wiring
AFL Wiring
J1- C3 Pocket PCM122 Trans Connector (30 Way)

DIAGNOSTIC CODES

C - Continuous Operation
O - Self Test - Key On Engine Off (KOEO)
R - Self Test - Key On Engine Running (KOER)

* - MIL (Malfunction Indicator Light) Illuminates
^ - O/D cancel flashes
[] - Assigned but not used
- Added/Changed for 2004 MY

DTC	How Set			Condition Description	Fault Trigger/Comments	Probable Causes
P0046	C*	O	R	Turbo/Super Charger Boost Control Solenoid Circuit Range/Performance	Internal to PCM. VGT Actuator Circuit check.	Diagnostic circuit associated with 1 Amp driver checks for open circuit, short to ground, and short to power.
P0069	C*			MAP/BARO Correlation	30 kPa (4.4 PSI)/Compares BP and MAP at idle.	VGT, BP, MAP, EGR - System Fault, Biased Sensor, Circuit Integrity.
P0096	C*			Intake Air Temperature Sensor 2 Circuit Range/Performance	5 deg.C (41 deg.F)/Checks for minimum change in IAT2	IAT 2 Biased Sensor, System Fault, PCM.
P0097	C*	O	R	Intake Air Temperature Sensor 2 Circuit Low Input	EGR disabled, less than 0.15 volts.	MAT signal circuit, shorted to ground or defective sensor.
P0098	C*	O	R	Intake Air Temperature Sensor 2 Circuit High Input	EGR disabled, greater than 4.8 volts.	MAT signal circuit, open, short to power or defective sensor.
P0101	C*			Mass or Volume Air Flow Circuit Range/Performance	Indicates a MAF range/performance problem was detected during normal driving conditions when MAF is enabled. 4.0 volts when RPM is less than 1500, 4.9 volts when RPm is greater than 1500 RPM.	Damaged MAF sensor-plugged or restricted sensor supply tube-MAF, PCM.
P0102	C*		R	Mass or Volume Air Flow Circuit Low Input	Indicates MAF sensor circuit low input was detected during KOEO Self Test or during continuous diagnostic monitoring. MAF voltage less than 0.35 volts.	Open MAF sensor circuit-biased sensor, PCM-short to SIGN RTN or PWR GND on MAF sensor circuit-open in VREF circuit.
P0103	C*	O	R	Mass or Volume Air Flow Circuit High Input	Indicates MAF sensor circuit high input detected during KOEO On-Demand Self Test or during continuous diagnostic monitoring. MAF voltage is greater than 4.95V.	Biased sensor, PCM-MAF circuit shorted to VREF.
P0107	C*	O		Manifold Absolute Pressure/BARO Sensor Low Input	Checks BP for a signal lower than a specified barometric pressure expected for normal operations when BP is less than 0.04 volts. Default 101 kpa (14.6 PSI).	Circuit is open, shorted to ground.
P0108	C*	O		Manifold Absolute Pressure/BARO Sensor High Input	Checks BP for a signal greater than a specified barometric pressure expected for normal operations when BP is greater than 4.9 volts. Default 101 kpa (14.6 PSI).	Circuit is shorted to power
P0112	C*	O	R	Intake Air Temperature Circuit Low Input	Checks sensor output for a value higher than a maximum probable temperature when IAT voltage is less than 0.15 volts. Default 77deg.F/25deg. C.	Shorted to ground.
P0113	C*	O	R	Intake Air Temperature Circuit High Input	Checks sensor output for a value lower than a minimum probable temperature when IAT voltage is greater than 4.9 volts. Default 77deg. F/25deg. C.	Open in circuit, short to power.
P0117	C*	O	R	Engine Coolant Temperature Circuit Low Input	Checks ECT for a temperature higher than a specified oil temperature expected for normal operation when ECT voltage is greater than 0.15 volts. Default 180deg. F/82deg. C - no fast idle.	Short to ground on the circuit.
P0118	C*	O	R	Engine Coolant Temperature High Input	Checks ECT for a temperature lower than a specified oil temperature expected for normal operation when ECT voltage is greater than 4.78 volts. Default 180deg. F/82deg.C - no fast idle.	Open in circuit, short to power.
P0148	C			Fueling Error	Engine RPM has exceeded requested RPM.	Alternative fuel source, Interference on CKP & CMP, Faulty PCM.
P0196	C*		R	Engine Oil Temperature Sensor Circuit Range/Performance	Checks for an EOT temperature signal which is unable to reach the EOT cold minimum limit whin a specified amount of time. Function of initial EOT. (in-range fault based off of a change in EOT and MFDES)	Faulty, Biased sensor, circuit fault, PCM.
P0197	C*	O	R	Engine Oil Temperature Sensor Circuit Low Input	Checks EOT for a temperature higher than a specified oil temperature expected for normal operations when EOT voltage is less than 0.15 volts. Default 212deg. F/100deg.C - no fast idle.	Shorted to ground on the circuit.
P0198	C*	O	R	Engine Oil Temperature Sensor Circuit High Input	Checks EOT for a temperature lower than a specified oil temperature expected for normal operations when EOT voltage is greater than 4.76 volts. Default 212 deg. F/100 deg. C - no fast idle.	Open in circuit, short to power.
P0219	C			Engine Overspeed Condition	PCM recorded excessive engine speed greater than 4300 RPM for more than 5 seconds.	Improper downshift, Interference on CKP & CMP, Faulty PCM.
P0230	C	O	R	Fuel Pump Primary Circuit	Fuel Pump Relay driver failure.	Open control circuit, failed fuel pump relay or PCM.
P0231	C*	O	R	Fuel Pump Secondary Circuit Low	No voltage present at the Fuel Pump monitor circuit when it has been commanded “on” for more than 1 second.	Indicates open, short circuit, relay, inertia switch or fuel pump.
P0232	C	O	R	Fuel Pump Secondary Circuit High	Voltage present at the Fuel Pump monitor circuit when it has NOT been commanded “on” for more than 1 second.	Indicates short to power,sticking relay.
P0236	C*	O		Turbo/Super Charger Boost Sensor A Circuit Range/Performance	Default inferred MAP - low power, slow acceleration, greater than 120kpa(2.7PSI) at low idle.	MAP sensor plugged, defective sensor.
P0237	C*	O	R	Turbo/Super Charger Boost Sensor A Circuit Low	Default inferred MAP - low power, slow acceleration, MAP voltage is less than 0.039 volts.	MAP circuit short to ground or open, defective sensor.
P0238	C*	O	R	Turbo/Super Charger Boost Sensor A Circuit High	Default inferred MAP - low power, slow acceleration, MAP voltage is greater than 4.91	MAP circuit short to Vref or Vbat, defective sensor.
P0261	C*	O	R	Cylinder #1 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0262	C	O	R	Cylinder #1 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0263	C			Cylinder #1 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0264	C*	O	R	Cylinder #2 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0265	C	O	R	Cylinder #2 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0266	C			Cylinder #2 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0267	C*	O	R	Cylinder #3 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0268	C	O	R	Cylinder #3 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0269	C			Cylinder #3 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0270	C*	O	R	Cylinder #4 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0271	C	O	R	Cylinder #4 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0272	C			Cylinder #4 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0273	C*	O	R	Cylinder #5 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0274	C	O	R	Cylinder #5 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0275	C			Cylinder #5 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	

P0276	C*	O	R	Cylinder #6 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0277	C	O	R	Cylinder #6 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0278	C			Cylinder #6 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0279	C*	O	R	Cylinder #7 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0280	C	O	R	Cylinder #7 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0281	C			Cylinder #7 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0282	C*	O	R	Cylinder #8 Injector Circuit Low	FICM detected a short in an injector circuit to ground.	Injector circuit short to ground, defective coil.
P0283	C	O	R	Cylinder #8 Injector Circuit High	FICM detected an open injector circuit.	Injector circuit open, defective coil
P0284	C			Cylinder #8 Contribution/Balance	When maximum/minimum pulse width adder is exceeded and cylinder does not converge a fault is set.	
P0297	C			Vehicle Overspeed Condition	Vehicle has been driven at speeds above limited speeds	Faulty PCM, Interference on VSS.
P0298	C*			Engine Oil Over Temperature Condition	Function of initial EOT	Checks for an EOT temperature signal which is unable to reach th EOT hot minimum limit (EOT_HOT_LMN) within a specified amou of time.
P0299	C*			Turbo / Super Charger Underboost	Fault sets when the difference between EP and commanded EP exceeds the limit for > 30 seconds.	Faulty EP sensor, VGT control valve slow to respond, Stuck VGT valve, faulty PCM.
P0300	C*			Random Misfire Detected	Unknown or random misfire when calculated instantaneous crankshaft acceleration exceeds a specified value a misfire event is detected.	
P0301	C*			Cylinder #1 Misfire Detected	Indicates when cylinder 1 is misfiring due to a loss of compression.	
P0302	C*			Cylinder #2 Misfire Detected	Indicates when cylinder 2 is misfiring due to a loss of compression.	
P0303	C*			Cylinder #3 Misfire Detected	Indicates when cylinder 3 is misfiring due to a loss of compression.	
P0304	C*			Cylinder #4 Misfire Detected	Indicates when cylinder 4 is misfiring due to a loss of compression.	
P0305	C*			Cylinder #5 Misfire Detected	Indicates when cylinder 5 is misfiring due to a loss of compression.	
P0306	C*			Cylinder #6 Misfire Detected	Indicates when cylinder 6 is misfiring due to a loss of compression.	
P0307	C*			Cylinder #7 Misfire Detected	Indicates when cylinder 7 is misfiring due to a loss of compression.	
P0308	C*			Cylinder #8 Misfire Detected	Indicates when cylinder 8 is misfiring due to a loss of compression.	
P0335	C*		R	Crankshaft Position Sensor A Circuit	PCM monitors CKP signal for a unique pattern to indicate piston position. Checks for total absence of the CKP signal.	Poor connection, defective sensor, electrical noise.
P0336	C*		R	Crankshaft Position Sensor Circuit A Range/Performance	CKP signal intermittent.	Poor connection, defective sensor, electrical noise.
P0340	C*		R	Camshaft Position Sensor A Circuit (Bank 1 or single sensor)	PCM monitors CMP signal for a unique pattern to indicate piston position. Checks for total absence of the CMP signal.	Poor connection, defective sensor, electrical noise.
P0341	C*		R	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor)	CMP signal intermittent.	Poor connection, defective sensor, electrical noise.
P0381	C*	O		Glow Plug/Heater Indicator Circuit	Indicator Circuit Check - Instrument cluster driver checks for open circuit, or short circuit when lamp turns on and off.	Open/Short circuit, lamp, fuse, PCM.
P0401	C*			Exhaust Gas Recirculation Flow Insufficient Detected	EGR Valve Position does not match desired, limits based on engine speed / load.	EGR Valve stuck or sticking - EGR Valve Position Sensor Bias - EP Sensor bias.
P0402	C*			Exhaust Gas Recirculation Flow Excessive Detected	EGR Valve Position does not match desired, limits based on engine speed / load.	EGR Valve stuck or sticking - EGR Valve Position Sensor Bias - EP Sensor bias.
P0403	C*	O	R	Exhaust Gas Recirculation Control Circuit	EGR actuator circuit check. Diagnostic circuit associated with 1 Amp driver Internal to PCM.	Open circuit, short to ground, and short to power.
P0404	C*			Exhaust Gas Recirculation Control Circuit Range/Performance	+/- 0.10 EGRP error from commanded to actual EGRP during normal driving conditions.	Faulty EGR sensor, valve or PCM integrity of EGR position circuit
P0405	C*	O	R	Exhaust Gas Recirculation Sensor A Circuit Low	EGR is disabled when EGR voltage is less than 0.30 volts.	EGRP circuit short to ground or open, defective sensor.
P0406	C*	O	R	Exhaust Gas Recirculation Sensor A Circuit High	EGR is disabled when EGR voltage is greater than 4.9 volts.	EGRP circuit short to Vref or Vbat, defective sensor.
P0407	C*	O	R	Exhaust Gas Recirculation Sensor B Circuit Low	Checks EGRP for a lower than a specified position for normal operation.	Circuit is shorted to ground.
P0408	C*	0	R	Exhaust Gas Recirculation Sensor B Circuit High	Checks EGRP for a higher than a specified position for normal operation.	Circuit is shorted to 5V.
P0460	C*	O	R	Fuel Level Sensor Circuit	Fuel Level Indicator (FLI) Circuit Check - Instrument cluster driver checks for open circuit, or short circuit.	"REFER to the appropriate section in the Workshop Manual."
P0470	C*	O		Exhaust Pressure Sensor	Maximum EP when the engine is not running 150 kpa (21.8 PSI) absolute.	Faulty EP Sensor, PCM.
P0471	C*			Exhaust Pressure Sensor Range/Performance	Minimum EP when the engine is running, Pressure difference of +/-10 kPa (1.5 PSI) from desired.	Faulty EP Sensor, PCM or VGT.
P0472	C*	O	R	Exhaust Pressure Sensor Low Input	EGR disabled, default inferred for VGT operation when EGR voltage is less than 0.03 volts.	EP circuit is short to ground or open, defective sensor.
P0473	C*	O	R	Exhaust Pressure Sensor High Input	EGR disabled, default inferred for VGT operation when EGR voltage is greater than 4.8 volts.	EP circuit is short to Vref or Vbat, defective sensor.
P0478	C*			Exhaust Pressure Control Valve High Input	EP is higher than EP desired by 260 kpa (37.7 PSI) for greater than 30 seconds.	Faulty EP sensor, VGT control valve slow to respond, Stuck VGT valve, faulty PCM.
P0480	C		R	Fan 1 Control Circuit		
P0487	C*	O	R	EGR Throttle Position Control Circuit	EGR actuator circuit check.	open circuit, short to ground, and short to power.
P0488	C*			EGR Throttle Position Control Range/Performance	Checks for a difference in commanded and actual EGRTP	Fault sets when the difference between EGRTP and commanded EGRTP exceeds the limit for a specified time.
P0500	C			Vehicle Speed Sensor A	Vehicle speed sensor malfunction.	Sensor, circuit, PSM, PSOM, low transmission fluid.
P0528	C		R	Fan Speed Sensor Circuit No Signal		
P0562	C*	O	R	System Voltage Low	PCM voltage less than 7v - cause of no start/misfire.	Low VBAT, loose connections/resistance in circuit, Vref engine concerns.
P0563	C	O	R	System Voltage High	PCM voltage continuously more than 23.3v.	Charging system fault.
P0565	C	O	R	Cruise Control ON Signal	KOER switch test(code set if cruise not present).	Open/short circuit, switch failure, PCM failure.
P0566	C	O	R	Cruise Control OFF Signal	KOER switch test(code set if cruise not present).	Open/short circuit, switch failure, PCM failure.
P0567		O		Cruise Control RESUME Signal	KOER switch test(code set if cruise not present).	Open/short circuit, switch failure, PCM failure.
P0568		O		Cruise Control SET Signal	KOER switch test(code set if cruise not present).	Open/short circuit, switch failure, PCM failure.
P0569		O		Cruise Control COAST Signal	KOER switch test(code set if cruise not present).	Open/short circuit, switch failure, PCM failure.

P0571		O		Brake Switch A Circuit	Brake switch A circuit malfunction	Cruise control code will be set on every switch test on vehicles not equipped with cruise control.
P0603	C			Powertrain Control Module Keep Alive Memory (KAM) Error	No historical faults output during self test.	Disconnected/Discharged Battery, Open PCM pin, faulty PCM.
P0605		O		Powertrain Control Module Read Only Memory (ROM) Error	PCM failure	Defective PCM.
P0606	C*	O	R	ECM / PCM Processor		
P0611	C*	O	R	Fuel Injector Control Module Performance	FICM memory fault will set if a RAM or ROM fault exists.	
P0620	C	O	R	Generator 1 Control Circuit		
P0623	C	O	R	Generator Lamp Control Circuit		
P0645	C	O	R	A/C Clutch Relay Control Circuit		
P0649	C	O	R	Cruise Control Lamp Control Circuit		
P0670	C*	O	R	Glow Plug Module Control Circuit	Glow plug control module control line failure	Open/grounded circuit, open/shorted GPCM, failed PCM
P0671	C*	O	R	Cylinder 1 Glow Plug Circuit	Glow plug #1 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0672	C*	O	R	Cylinder 2 Glow Plug Circuit	Glow plug #2 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0673	C*	O	R	Cylinder 3 Glow Plug Circuit	Glow plug #3 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0674	C*	O	R	Cylinder 4 Glow Plug Circuit	Glow plug #4 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0675	C*	O	R	Cylinder 5 Glow Plug Circuit	Glow plug #5 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0676	C*	O	R	Cylinder 6 Glow Plug Circuit	Glow plug #6 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0677	C*	O	R	Cylinder 7 Glow Plug Circuit	Glow plug #7 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0678	C*	O	R	Cylinder 8 Glow Plug Circuit	Glow plug #8 failure	Open/shorted circuit, faulty glow plug, failed GPCM
P0683	C*	O	R	Glow Plug Control Module to PCM Communication Circuit	GPCM glow plug control module communication line failure	Open/shorted circuit, failed GPCM, failed PCM
P0700	C	O	R	Transmission Control System (MIL Request)		
P0703			R	Brake Switch B Input Circuit	KOER switch test.	Open/short circuit, switch, PCM, failed to activate during KOER switch test.
P0704	C		R	Clutch Switch Input Circuit	KOER switch test.	Open/short circuit, switch, PCM, failed to activate during KOER switch test.
P1000	C	O	R	OBD Systems Readiness Test Not Complete	Drive cycle is not complete.	
P1001			R	KOER not able to complete, KOER aborted	Conditions not met.	A/C, Parking Brake, Clutch, PRNDL, (EOT, ETC.)
P1102	C*			Mass Air Flow Sensor In Range But Lower Than Expected		
P1139	C	O	R	Water in Fuel Indicator Circuit	Indicates fault in circuit.	Faulty sensor, Open or Short in circuit.
P1148	C	O	R	Generator 2 Control Circuit		
P1149	C*	O	R	Generator 2 Control Circuit High		
P1184			R	Engine Oil Temperature Sensor Out Of Self Test Range	Engine not warm enough to run KOEO CCT - aborts test.	Engine not warm enough, leaking thermostat, circuit failure.
P1260	C			Theft Detected, Vehicle Immobilized		
P1284			R	Aborted KOER - Injector Control Pressure Regulator	ICP failure--Aborts KOER CCT test	See codes P2284, P2285, P2286, P2288, P2623
P1334	C		R	EGR Throttle Position Sensor Minimum Stop Performance	Checks for a maximum closed and a minimum open position voltage.	
P1335	C		R	EGR Position Sensor Minimum Stop Performance	Fault sets when the EGRP closed position exceeds the maximum limit at initial key on.	
P1378	C	O	R	FICM Supply Voltage Circuit Low	IDM detects logic power low, less than 7 volts.	Low batteries, loose connections/resistance in circuit, defective relay.
P1379	C	O	R	FICM Supply Voltage Circuit High	IDM detects excessive voltage, greater than 16 volts.	Charging system fault.
P1397			R	System Voltage Out Of Self Test Range		Voltage too high or low for glow plug monitor test.
P1408			R	EGR Flow Out Of Self Test Range	EGRC output circuit check - engine off test only	EGR Control circuit open, short to Vref, Vbat, ground, defective coil.
P1464		O	R	A/C Demand Out Of Self Test Range	Aborts KOER Test.	A/C switch not in "off" position, A/C circuit short to power.
P1501		O	R	Vehicle Speed Sensor Out Of Self Test Range	Aborts test - KOER on demand, CCT, or switch test.	Vehicle speed detected during test, faulty VSS, PCM.
P1502		O	R	Invalid Test - Auxiliary Power Control Module Functioning	Aborts test - KOER on demand, CCT, or switch test.	APCM active while KOER test is running.
P1531			R	Invalid Test - Accelerator Pedal Movement	Aborts test - KOER on demand, CCT test.	Accelerator pedal incorrect position during test, faulty AP, PCM.
P1536			R	Parking Brake Switch Circuit	KOER switch test.	Failed to activate switch during test, circuit, switch, PCM.
P1639	C*	O	R	Vehicle ID Block Corrupted, Not Programmed		
P1703		O	R	Brake Switch Out Of Self Test Range		
P1705		O	R	Transmission Range Circuit Not Indicating Park/Neutral During Self Test	Not in park during KOEO or KOER.	Operator error, circuit failure, faulty sensor, PCM.
P1725			R	Insufficient Engine Speed Increase During Self Test		
P1726			R	Insufficient Engine Speed Decrease During Self Test		
P2122	C	O	R	Throttle/Pedal Position Sensor/Switch D Circuit Low Input		
P2123	C	O	R	Throttle/Pedal Position Sensor/Switch D Circuit High Input		
P2127	C	O	R	Throttle/Pedal Position Sensor/Switch E Circuit Low Input		
P2128	C	O	R	Throttle/Pedal Position Sensor/Switch E Circuit High Input		
P2132	C	O	R	Throttle/Pedal Position Sensor/Switch F Circuit Low Input		
P2133	C	O	R	Throttle/Pedal Position Sensor/Switch F Circuit High Input		
P2138	C	O	R	Throttle/Pedal Position Sensor/Switch D / E Voltage Correlation		Pedal Sensors will use SAE D,E,F codes
P2139	C	O	R	Throttle/Pedal Position Sensor/Switch D / F Voltage Correlation		Pedal Sensors will use SAE D,E,F codes
P2140	C	O	R	Throttle/Pedal Position Sensor/Switch E / F Voltage Correlation		Pedal Sensors will use SAE D,E,F codes
P2199	C*			Intake Air Temperature 1/2 Correlation	Correlation between IAT1 and IAT2 are not at expected values.	Open/shorted circuit, bias sensor, PCM
P2262	C*			Turbo/Super Charger Boost Pressure not Detected - Mechanical	No boost pressure increase was detected.	MAP hose, MAP sensor, CAC system leaks, Intake leaks, EP sensor, exhaust restriction.
P2263	C*			Turbo/Super Charger System Performance		MAP hose, MAP sensor, CAC system leaks, Intake leaks, EP sensor, exhaust restriction, exhaust leaks.
P2269	C	O	R	Water in Fuel Condition	Indicates water in fuel.	Drain water in fuel separator, defective WIF sensor, circuit integrity.
P2284	C		R	Injector Control Pressure Sensor Circuit Range/Performance	Default inferred ICP, ICP desired does not equal ICP signal, difference of 362psi/2.5mpa.	See diagnostic manual - ICP system.

P2285	C	O	R	Injector Control Pressure Sensor Circuit Low	Default open loop control - underrun at idle, ICP is less than 0.04 volts.	ICP circuit short to ground or open, defective sensor.
P2286	C	O	R	Injector Control Pressure Sensor Circuit High	Default open loop control - underrun at idle, ICP is greater than 4.91 volts.	ICP circuit short, Vref or Vbat, defective sensor.
P2288	C		R	Injector Control Pressure Too High	Default inferred ICP is used, ICP is greater than 3675psi/25mpa.	See diagnostic manual - ICP system.
P2289	C	O		Injector Control Pressure Too High - Engine Off	Default inferred ICP, KOEO ICP is greater than 1161psi/8mpa.	ICP signal ground, circuit open, defective sensor.
P2290	C	O		Injector Control Pressure Too Low	Default inferred ICP is used, ICP is below desired pressure	See diagnostic manual - ICP system.
P2291	C			Injector Control Pressure Too Low - Engine Cranking	No start ICP is less than 725psi/5mpa.	See diagnostic manual - ICP system
P2552	C	O	R	FICMM Circuit - Throttle/Fuel Inhibit Circuit	No signal from the FICM Monitor circuit	Circuit open/short, FICM, PCM
P2614	C	O	R	Camshaft Position Output Circuit	CMPO signal intermittent	Poor connection, electrical noise. In CMPO from PCM
P2617	C	O	R	Crankshaft Position Output Circuit	CKPO signal intermittent	Poor connection, electrical noise. In CKPO from PCM
P2623	C*	O	R	Injector Control Pressure Regulator Circuit	IPR circuit failure	Open/grounded circuit, stuck IPR, loose connection
U0101	C	O	R	Lost Communication with TCM		
U0105	C	O	R	Lost Communication with FICM		
U0155	C	O	R	Lost Communication with Instrument Cluster		
U0306	C	O	R	Software Incompatibility with Fuel Injector Control Module		

GLOSSARY

Actuator
A device which delivers motion in response to an electrical signal.

Analog
A continuously variable voltage.

APS Accelerator Position Sensor
A potentiometer style sensor that indicates the operator's pedal position.

AWA Feature
A feature built into the high pressure oil rails used to dampen noises that can be caused by the hydraulic system.

BARO Barometric Pressure Sensor
An analog device which indicates atmospheric pressure which allows the PCM to compensate for altitude. A BARO sensor has three connections, signal return(gnd), BARO signal, and Vref.

CAC Charge Air Cooling
A process of cooling the air coming out of the turbocharger before it enters the engine.

Canister Style Oil Filter
An oil filter that requires only the element be replaced and not the housing.

CAN
A communication protocol for data transfer between the control modules.

CKP Crankshaft Position Sensor
A magnetic pickup sensor that creates a sine wave voltage when the timing wheel on the crankshaft breaks its magnetic field. The CKP determines crankshaft position and speed.

Closed Crankcase Breather
A ventilation system that recirculates crankcase vapors into the intake air system.

CMP Camshaft Position Sensor
A magnetic pickup sensor that creates a sine wave voltage when a peg on the camshaft breaks its magnetic field. The CMP determines which cycle the piston is in (compression or exhaust).

Digital Fuel Injection
A fuel injection system that uses both an open and close signal to control fuel injectors.

Dual Timing System
A timing system that uses both a CKP and CMP sensors to determine engine speed and rotational position.

DVOM Digital Volt Ohm Meter
A meter that uses a digital display to indicate a measured value. Preferred for use on microprocessor systems because a DVOM has a very high internal impedance and will not load down the circuit being measured.

ECT Engine Coolant Temperature Sensor
A thermistor style sensor used to indicate engine coolant temperature.

EGR Cooler
A device used to cool exhaust gases before they are returned to the intake air system.

EGR Exhaust Gas Recirculation Valve
A valve used to control the flow of exhaust gases into the intake manifold.

EGRP Exhaust Gas Recirculation Valve Position Sensor
A potentiometer style sensor that indicates the amount of movement of the EGR valve.

EOT Engine Oil Temperature
A thermistor type sensor that indicates engine temperature.

EVRT® Control Valve
See VGTCV Variable Geometry Turbocharger Control Valve.

EVRT®
The International Truck and Engine Corporation’s trademark for its electronically-controlled turbocharger.

FICM Fuel Injection Control Module
An electronic unit which has the primary function of an electronic distributor for the injectors. It also is the power supply for the injectors.

Glow Plug Sleeves
Stainless steel sleeves used to protect the glow plugs from coolant.

GPCM Glow Plug Control Module
Module which supplies power to the glow plugs and identifies variation in current flow to the glow plugs.

IAT Intake Air Temperature Sensor
A thermistor style sensor used to indicate air temperature before the charge air cooler.

ICP Injection Control Pressure
A variable capacitance style sensor used to indicate high pressure oil system pressure.

IAT2 Intake Air Temperature 2 Sensor
A thermistor style sensor used to indicate air temperature after passing through the charge air cooler.

Impedance
A form of opposition to AC current flow measured in Ohms.

I/O Injector Test
A test that can be performed using the WDS to disable one injector at a time while watching Mfdes to determine a weak contributing injector.

IPR Injection Pressure Regulator
Controls injection oil pressure. An electrical signal to a solenoid creates a magnetic field which applies a variable force on a poppet to control pressure. The quantity of fuel delivered to the combustion chamber is proportional to injection control pressure.

IVS Idle Validation Switch
An on/off switch that indicates when the accelerator pedal is in the idle position.

KOEO Key on Engine Off Test
A self-test operation that is performed with the ignition switch in the ON position with the engine OFF.

KOER Key on Engine Running Test
A self-test operation that is performed with the ignition switch in the ON position and the engine RUNNING.

Long Life Ethylene Glycol Coolant
A premium coolant, with an Ethylene Glycol base, that can be used in a cooling system for an extended time without needing to be changed. Long life coolants do not require the use of extenders. Long life coolants can be identified by its yellow color.

Main Power Relays
(Two) Battery power relay switches for the PCM and FICM (modules) that are key power initiated and controlled by the corresponding powered module.

MAP Manifold Absolute Pressure
A MAP sensor generates a digital frequency that indicates manifold boost pressure above atmospheric pressure. The signal is created by switching action caused by manifold pressure of a diaphragm connected to a capacitor circuit in the sensor. The digital frequency increases as pressure increases. A MAP sensor has three connection: signal return(gnd), MAP signal, and Vref.

Misfire Detection
Uses engine RPM changes during a firing cycle to determine a low contributing cylinder.

Modular Water Pump
Is a water pump that uses the front cover as a housing and only the hub and impeller are replaceable.

Normally Closed
Refers to a switch or a solenoid that is closed when no control or force is acting on it.

Normally Open
Refers to a switch or a solenoid that is open when no control or force is acting on it.

PCM Powertrain Control Module
The housing that contains the micro computer, Vref regulator, input conditioners and output drivers.

POT Potentiometer
Converts a mechanical motion to a voltage value. Most often used to sense the position of a component. This sensor works as a variable voltage divider. The wiper arm is mechanically connected to the component desired to be sensed. Potentiometers have three connections: Vref, signal out, and ground.

Pulse Width
The length of time an actuator, such as an injector, remains energized.

Relative Compression Test
A test that can be run with the WDS to measure compression of a cylinder relative to the other cylinders in the engine. This test is accomplished by comparing the rpm of the engine during each compression stroke.

Rocker Arm Carrier
A housing that the rocker arms and their fulcrums are mounted to.

Thermistor
Sensor used to determine temperature. A thermistor changes it's resistance value in relation to temperature change. Increasing temperature results in decreasing resistance, decreasing temperature results in increasing resistance. The thermistor in conjunction with a current limiting resistor in the PCM forms a voltage divider that provides a voltage signal indicating temperature. Since the top half of the voltage divider is the current limiting resistor and is internal to the PCM, a thermistor sensor only has two connections, signal return and ground.

Variable Capacitance Sensor
A sensor that is used to determine pressure. A variable capacitance sensor changes it capacitance value in relation pressure change. Increasing pressure results in a lower capacitance, thus increasing return voltage. Decreasing pressure results in a higher capacitance and a lower voltage. Variable capacitance sensors are 3 wire sensors.

VBAT
Battery voltage.

VGT Variable Geometry Turbocharger
A turbocharger that has a turbine housing that can change sizes through electronically controlled hydraulics.

VGTCV Variable Geometry Turbocharger Control Valve
Could also be called EVRTCV. Controls oil flow in and out of the VGT actuator in order to change the effective size of its turbine housing.

VPWR
Battery voltage.

VSS Vehicle Speed Sensor
Normally a magnetic pickup style sensor that is mounted on the tailshaft of the transmission to indicate ground speed.

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