SECTION 4

Diagnostic Subroutines

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SECTION 4

Diagnostic Subroutines

Contents (Continued)

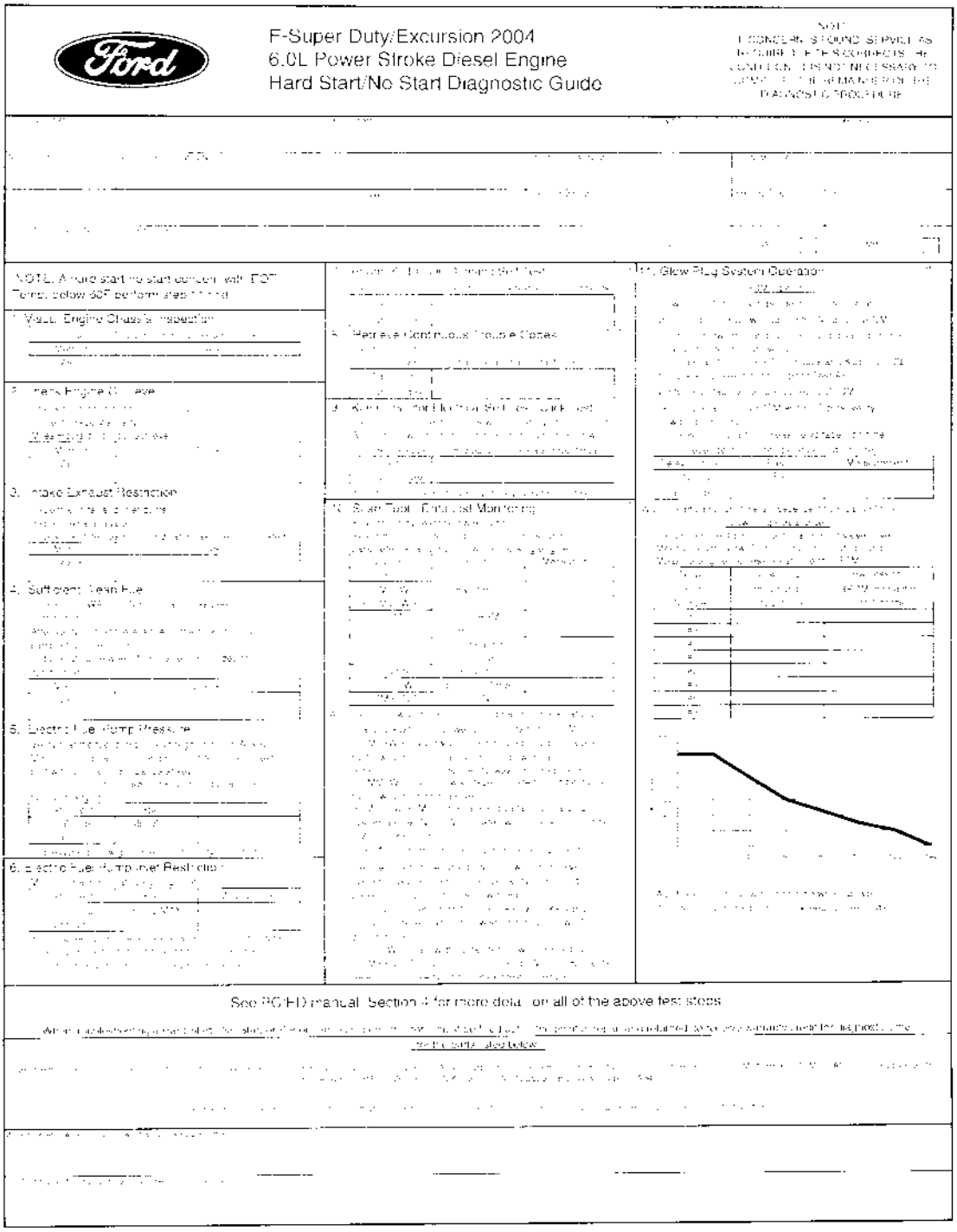
SECTION 4

Diagnostic Subroutines

Contents (Continued)

Hard Start/No Start Diagnostic Procedures

F-SuperDuty/Excursion — Early Build



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Hard Start/No Start Diagnostic Procedures

E-Series or F-SuperDuty/Excursion — Late Build (Built After 9/2003)

F-Super Duty/Excursion/Econoline 2004.25
6.0L Power Stroke Diesel Engine
Hard Start/No Start 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

NOTE: A hard start/no start concern with EOT Temp below 60°F perform step 11 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 restriction indicator has been activated (F-Super Duty/Excursion)

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 gnd at key on
Measure fuel pressure at the fuel filter housing test port with a 0-160 PSI gauge at key on
Fuel pump runs for 20 sec at key on and pressure falls after key off

Instrument	Spec
0-160 PSI Gauge	45 PSI min

If pressure is 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" Hg MAX	

- If > 6" Hg restriction, check lines between pump and fuel tank
- If < 6" Hg, inspect both fuel lines; if lines are OK, check fuel regulator. If regulator and lines are OK replace fuel 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 Trouble 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 DTC's will be displayed at test end
All injectors will momentarily click, then each injector will click in sequence 1-8. Sequence repeats three times

Injector Trouble Codes	

If test codes are retrieved go to appropriate Pinpoint test

10. Scan Tool - Data List Monitoring

Scan tool may reset below 9.5 volts
Select the parameters indicated from the scan tool parameter list and monitor while cranking engine

	Parameter	Spec	Measurement
A	B+		
B	FICMLPWR	8 volt min	
C	FICMVPWR		
D	RPM	100 RPM min	
E	ICP	4.5 MPa min (500 PSI)	
F	ICP volts	.80 V min	
G	FUEL PW	500 uS - 2 mS	
H	FICMSYNC	Yes/No	

- A - B+ - If low voltage condition is present, check battery, charging system, or power/ground circuits to the PCM
- B - FICMLPWR - No/low voltage indicated could be caused by 12 way connector issue or logic power fuse. Refer to Pinpoint Test for detailed 12 way connector diagnostics
- C - FICMVPWR - No/low voltage indicated could be caused by 12 way connector issues
- D - RPM - Low RPM can be caused by starting/charging system issues. No RPM indicated while cranking could be CMP or CKP faults
- E - ICP - A minimum of 500 PSI (3.5 mPa) is required for the injectors to be enabled. No or low ICP in the system, system leakage, injector O-Rings, faulty IPR, or high pressure pump could cause low pressure. IPR duty cycle defaults to 14% (500 PSI) w/o CKP signal.
- F - ICP V - Voltage reading below spec indicates low ICP during crank
- G - 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.

11. 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 131°F.
Using a scan tool, check Continuous and KOEO DTC's. If codes are present go to Pinpoint Test AF
Verify B+ voltage is being supplied to GPCM
Using the scan tool GPCTM and EOT pids, verify glow plug "on" time
Turn key to run position measure voltage (on time)
(Dependent on oil temperature and altitude)

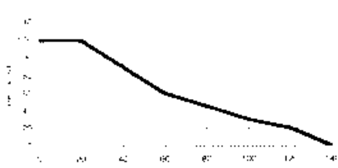
Relay on time	Spec	Measurement
1 to 120 seconds	B+	

Wait to Start Lamp "on" time is independent from glow plug "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, not to exceed 120 seconds

See PC/ED manual. Section 4 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 for diagnostic time for the parts listed below.

Fuel injectors (9E527), injection control pressure sensor (9C968), fuel assembly high pressure oil (9A543), turbocharger assembly (6K682), fuel control module (9C262), FICM (12B599), PCM (12A650), EGR valve (9F482), CKP sensor (6C315), CMP sensor (12K073), GPCM (12B533), and Glow Plugs (12A342)

Some labor operations are listed in more than one category. These operations must be filled out completely and can be claimed only once.

What was done to determine failure:

List Part Name, Number and Number of parts replaced

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Hard Start/No Start Diagnostic Procedures

Note: A hard start/no start concern with the engine oil temperature (EOT) below 15°C (60°F) perform Step 11 first.

1. Visual Engine/Chassis Inspection

Purpose:

The purpose of this test is to check the general condition of the engine and look for obvious causes of a hard start or no start condition.

Fuel Oil Coolant Electrical Hoses Leaks

Method	Check
Visual	

Recommended Procedure:

Inspect the fuel system including the fuel tank and the fuel lines for kinks, bends and/or leakage. Inspect for coolant leaks at the radiator and the heater hoses and check the coolant level. Inspect the manifold absolute pressure (MAP) sensor and the intercooler for pinched hoses and leaks. Inspect wiring for correct routing and make sure no rubbing or chafing has occurred. Inspect the engine harness, fuel injector control module (FICM), powertrain control module (PCM) and sensor connectors to make sure they are completely seated and in good condition.

Possible Causes:

- Loose or leaking fuel supply lines could cause fuel system to lose prime
- Kinked or blocked fuel supply lines will create fuel restriction
- Fuel or oil leaks could contribute to no start conditions
- Coolant leaks could indicate engine problems
- Electronic connectors may be damaged or not properly installed causing a no start condition. The camshaft position (CMP) sensor, crankshaft position (CKP) sensor, injection pressure regulator (IPR) and the PCM connectors are the most critical electronic sensors/actuators to inspect in no start situations
- Pinched or open MAP sensor hose
- Pinched or open intercooler hose

Tools Required:

Inspection light

Hard Start/No Start Diagnostic Procedures

2. Check Engine Oil Level

Purpose:

The purpose of this test is to verify the oil quality and determine if there is sufficient oil to operate the injectors.

Check Engine Oil Level

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

Method	Check
Visual	

Recommended Procedure:

Check the oil level using the dipstick with the vehicle on level ground. If there is no oil or very little oil in the crankcase, the injectors will not operate.

If the oil level on the dipstick is overfull, it is possible the engine was incorrectly serviced or fuel/coolant is diluting the oil and filling the crankcase.

Inspect the oil for color. A milky white oil indicates possible coolant contamination and will have an ethylene glycol odor.

WARNING:

SMOKING OR OPEN FLAME OF ANY TYPE MUST NOT BE PRESENT WHEN WORKING NEAR FUEL OR FUEL VAPOR. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

Oil contaminated with diesel fuel will have a diesel fuel odor and will increase the engine oil level. If the engine oil level is above "Max" due to diesel fuel dilution, the oil will appear thin and watery.

If the oil level is overfilled, drain the oil and the fuel filter housing. Isolate either cylinder head by removing the corresponding fuel line from the fuel filter housing. Remove the fuel pressure test port plug from the secondary filter housing. Install the plug in the outlet port. Install Fuel Pressure Adapter (303-765) and Gauge 0-1.1 MPa (0-160 psi) Bar 014-00761 or equivalent at the test port to confirm constant fuel pressure.

Using the scan tool, access OSC and command the fuel pump ON. Watch for fuel to drain out of the oil pan drain hole. Depending on the severity of the leak, it may take some time before a leak is noticeable. Remove the valve cover at the suspect cylinder head and inspect the injector area for leaks.

Hard Start/No Start Diagnostic Procedures

Check the service records for correct oil type and viscosity for the vehicle operating temperature. Single weight or 15W-40 oil is not recommended for cold ambient temperatures. 10W-30 oil is recommended for cold ambient temperatures. Oil that has had extended drain intervals will have increased viscosity (become thicker) and will make engine cranking more difficult and starting less reliable at temperatures below freezing. Refer to the lube oil chart in the Workshop Manual or Owner Literature for the correct oil selection for temperature conditions.

Possible Causes:

- Loss of lube oil pressure
- Oil level low — oil leak, oil consumption, incorrect servicing
- Oil level high — incorrect servicing, fuel dilution from injector O-rings
- Oil contamination with coolant — oil cooler, head gasket, porosity

Tool Required:

Adapter 303-765 or equivalent

Gauge 0-1.1 MPa (0-160 psi) Bar (part of Pressure Adapter Kit 014-00761 or equivalent)

Scan tool

3. Intake/Exhaust Restriction

Purpose:

This purpose of this test is to determine if an air intake or exhaust restriction is contributing to a no start or hard start condition. If the engine does start with a high air intake or exhaust restriction, a considerable amount of black/blue smoke is produced.

Intake/Exhaust Restriction

- Inspect the air filter and inlet ducts.
- Inspect the exhaust system.
- Check for illumination of the air filter restriction indicator (F-SuperDuty/Excursion)

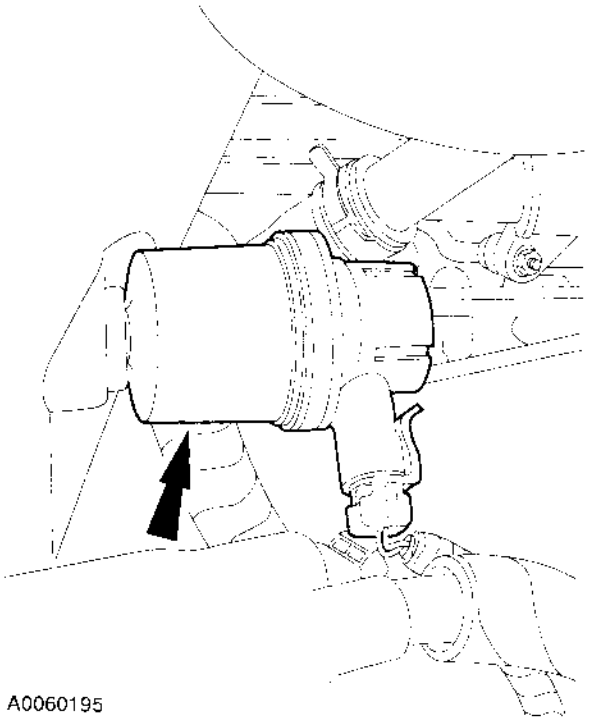
Method	Check
Visual	

Recommended Procedure:

Inspect the air cleaner inlet and ducting to verify it is not blocked or collapsed. Inspect the air cleaner housing and filter for proper installation. Inspect the air filter restriction gauge to ensure the intake restriction is below the red marks. Inspect the exhaust system for damaged or blocked pipes.

Hard Start/No Start Diagnostic Procedures

F-SuperDuty/Excursion



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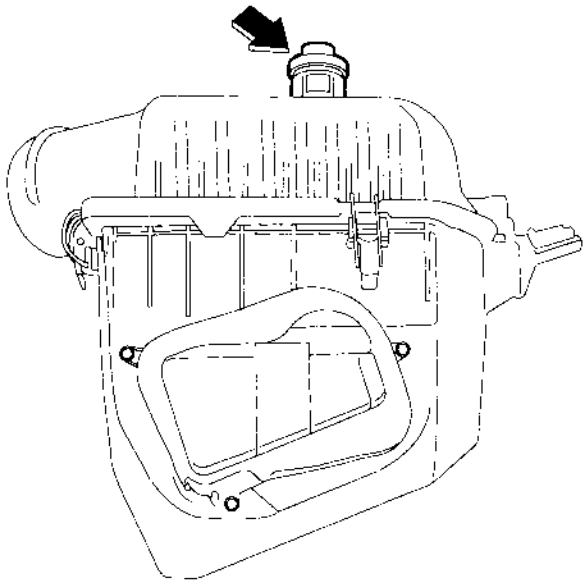
Hard Start/No Start Diagnostic Procedures

E-Series



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Possible Causes:

Note: Reset the air filter restriction gauge after repairing a restriction concern.

- Snow, plastic bags or other foreign material may restrict airflow at the air inlet
- Misrouted air cleaner ducting
- On engines recently repaired, rags or cap plugs may have been inadvertently left in an air inlet pipe
- Tailpipe or muffler may have collapsed or been damaged

Tools Required:

None

4. Sufficient Clean Fuel

Purpose:

The purpose of this test is to verify the fuel quality.

Hard Start/No Start Diagnostic Procedures

Sufficient Clean Fuel

- Check for illumination of the WATER IN FUEL indicator.
- After verifying that there is fuel in the tank, drain a sample from the fuel control module.
- A cetane rating between 40 and 50 is recommended for optimum performance.

Method	Check
Visual	

Recommended Procedure:

Open the drain valve on the fuel control module and fill a clear container until it is half full. Close the drain valve.

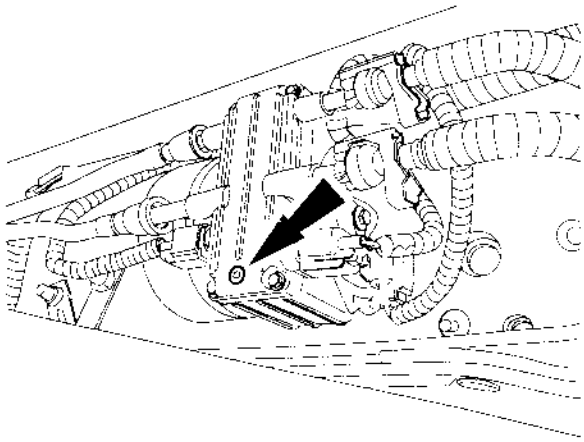
Observe WATER IN FUEL indicator. If the indicator is illuminated, the fuel is probably contaminated with water.

Flow out of the drain should be a steady stream. Insufficient flow could indicate fuel supply or fuel system problems.

Inspect the fuel in the container. It should be clear, not cloudy. It also should be free of water and contaminants. Dyed red or blue fuel indicates off-highway fuel.

Some sediment and water may be present in the fuel sample if the fuel filter has not been serviced for a prolonged period of time and/or if the sediment and water have not been drained recently. If that is the case, a second sample may be required to determine fuel quality.

F-SuperDuty/Excursion



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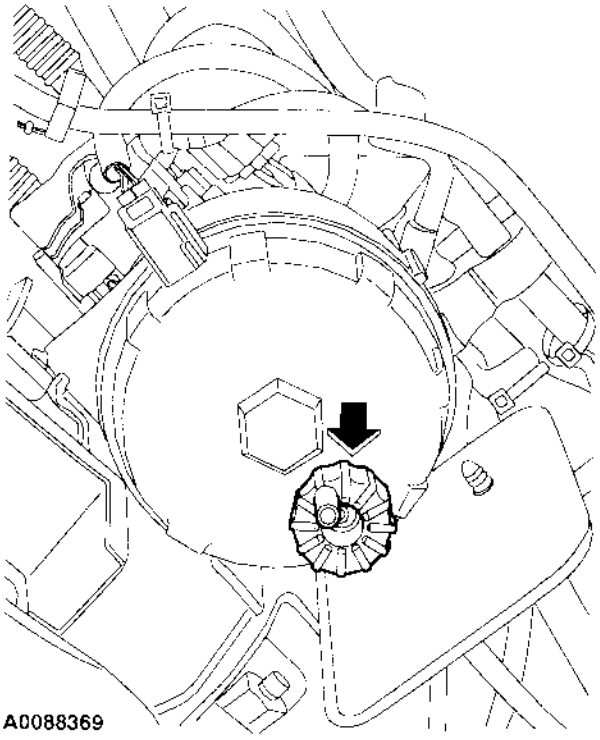
Hard Start/No Start Diagnostic Procedures

E-Series



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Possible Causes:

- No fuel in the tank
- Fuel supply line could be broken or crimped
- Fuel could be jelled (most likely in cold weather with No. 2 fuel)
- Pickup tube screen in tank could be clogged
- Restricted fuel filters

Cloudy fuel indicates that the fuel may not be a suitable grade for cold temperatures.

Excessive water or contaminants may indicate that the tank and fuel system may need to be flushed and cleaned.

Tools Required:

Clear container — approximately 0.95L (1-quart)

Hard Start/No Start Diagnostic Procedures

5. Electric Fuel Pump Pressure

Purpose:

The purpose of this test is to verify there is sufficient fuel pressure for starting.

Electric Fuel Pump Pressure

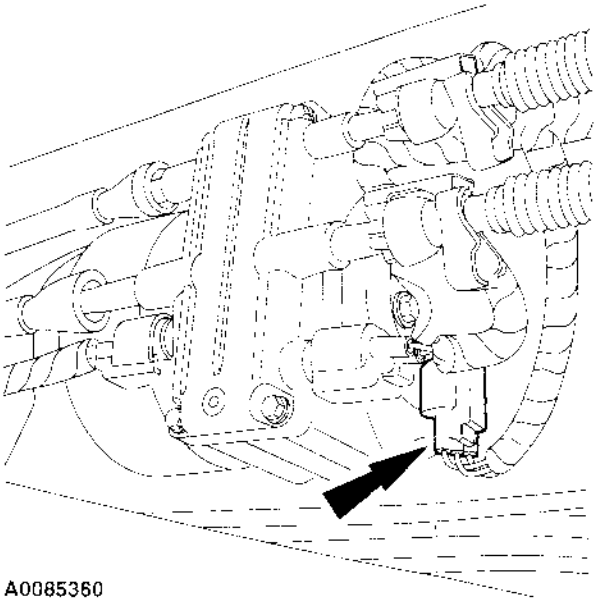
- Verify there is fuel in the tank.
- Check the fuel pump power and ground circuits.
- Measure the fuel pressure at the engine fuel filter housing test port with a 0-101 MPa (0-160 psi) gauge.
- Fuel pump will run for 20 seconds at initial key on and then pressure will decrease.

Instrument	Specification	Measurement
0-1.1 MPa (0-160 psi) gauge	310 kPa (45 psi minimum)	

Recommended Procedure:

Verify there is fuel in the tank and battery voltage at the fuel pump. Using a digital multimeter, measure the voltage between the fuel pump power and ground circuits. Battery voltage will be present for approximately 20 seconds after the ignition key is turned on. If no voltage is present, GO to Pinpoint Test M.

F-SuperDuty/Excursion



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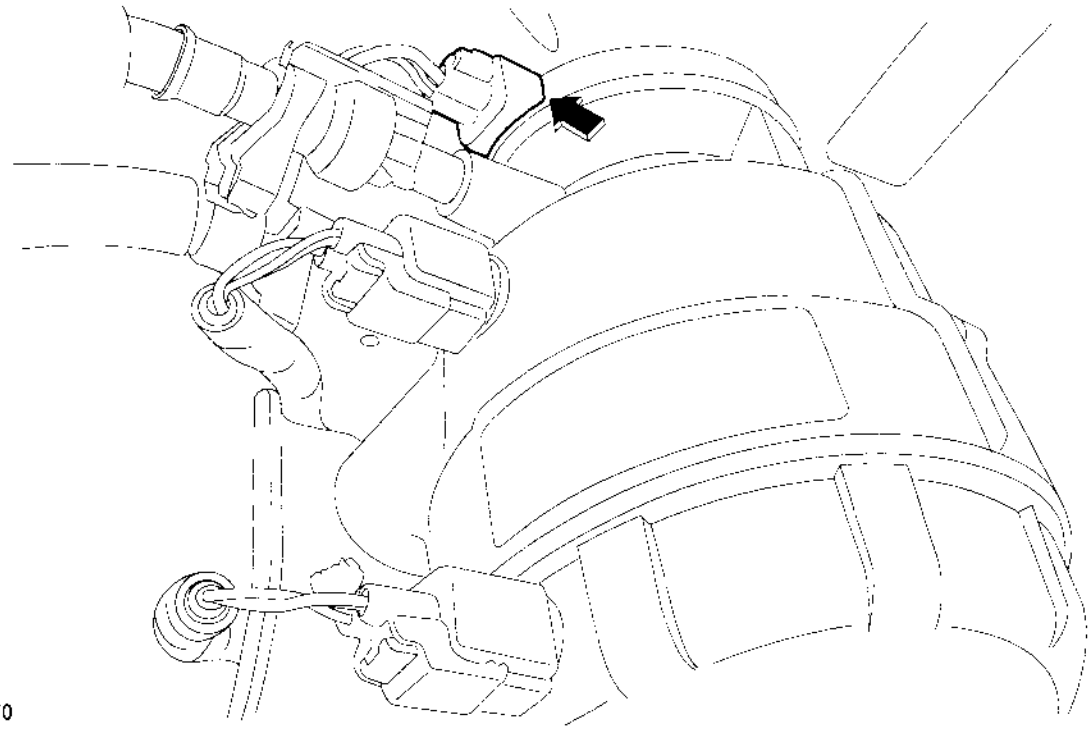
Hard Start/No Start Diagnostic Procedures

E-Series



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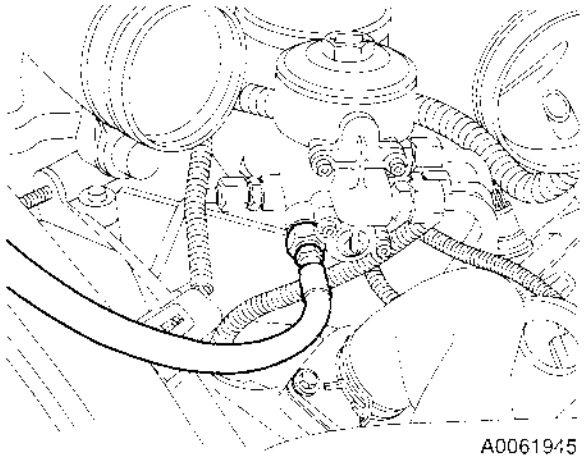
Remove the plug from the front of the fuel filter housing. Install Adapter 303-765 and Gauge 0-1.1 MPa (0-160 psi) Bar 014-00761 or equivalent. Measure fuel pressure in crank or run. If fuel pressure is below the specification of 310 kPa (45 psi), go to the next step to verify no restriction.



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Hard Start/No Start Diagnostic Procedures

Possible Causes

- Fuel pump relay
- Inertia switch

Tools Required:

Adapter 303-765 or equivalent

Gauge 0-1.1 MPa (0-160 psi) Bar (part of Pressure Adapter Kit 014-00761 or equivalent)

6. Electric Fuel Pump Inlet Restriction

Purpose:

The purpose of this test is to isolate the cause of low fuel pressure.

Electric Fuel Pump Inlet Restriction

Measure restriction at fuel pump inlet.

Instrument	Specification	Measurement
(0-30 in Hg) Vacuum	6 in Hg maximum	

Recommend Procedure:

Remove the fuel line to the inlet side of the fuel pump. Install Fuel Pump Adapter 310-111 or equivalent between the fuel inlet line and the electric fuel pump. Connect the test adapter to gauge 0-762 mm Hg (0-30 in Hg) vacuum. Measure restriction at wide open throttle (WOT) (maximum engine speed out of gear with the brakes set and the wheels blocked). If restriction is greater than 152 mm Hg (6 in Hg), there is a restriction between the fuel pump and the fuel tank. If restriction is less than 152 mm Hg (6 in Hg), inspect both fuel filters. If filters are OK, inspect the fuel regulator valve. If regulator and filters are OK, install a new fuel pump.

Possible Causes:

- Fuel line restriction
- Fuel pressure regulator valve
- Fuel filters
- Fuel pump

Tools Required:

Fuel Pump Adapter 310-111 or equivalent

Hard Start/No Start Diagnostic Procedures

Vacuum Gauge (part of Pressure Adapter Kit 014-00761 or equivalent)

7. Perform Key On Engine Off (KOEO) On-Demand Self-Test

Purpose:

The purpose of this test is to determine if the PCM has detected any fault conditions that would cause a hard start or no start condition.

Perform KOEO On-Demand Test

- Use the scan tool. Diagnostic trouble codes (DTCs) set during this test are current faults.

Diagnostic Trouble Codes (DTCs)	

Recommended Procedure:

Note: To ensure that the DTC is a hard fault, first clear continuous DTCs (be sure to record all DTCs and Freeze Frame information before clearing). Rerun KOEO On-Demand Self Test. If the DTC is set again, a hard fault has occurred.

Connect the scan tool. Turn off all accessories. If the vehicle is equipped with an auxiliary powertrain control module (APCM), it must be turned off to perform the self-test.

- Perform the necessary vehicle preparation and a visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine off.
- Wait 4 seconds for the transmission control module (TCM), PCM and the FICM to initialize.
- Follow the operating instructions from the diagnostic menu.
- Perform a KOEO On Demand Self-Test.
- Record the DTCs and Freeze Frame information and refer to the appropriate pinpoint test.

Possible Causes:

The most likely PCM detectable faults that will cause a no start or hard start condition are:

- CMP sensor inactive fault
- CKP sensor inactive fault
- IPR output circuit check fault
- FICM ENABLE circuit fault

Hard Start/No Start Diagnostic Procedures

Tools Required:

Scan tool

8. Retrieve Continuous DTCs

Purpose:

The purpose of this test is to determine if the PCM has detected any historical or intermittent fault conditions that would cause a hard start/no start symptom. The condition that caused a continuous DTC may no longer exist.

Retrieve Continuous DTCs

- DTCs retrieved during this test are historical faults.

Diagnostic Trouble Codes (DTCs)	

Recommended Procedure:

Connect the scan tool. Turn off all accessories. If the vehicle is equipped with an APCM, it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and a visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine off.
- Follow operating instructions from the menu.
- Record the continuous DTCs and Freeze Frame information and perform the appropriate pinpoint test for continuous DTC diagnostics.
- Continuous DTCs must be cleared after a repair.

Tools Required:

Scan tool

9. KOEO Injector Electrical Self-Test (Click Test)

Purpose:

Note: If unable to perform KOEO Injector Electrical Self-Test (Click Test), disconnect the FICM connector and check injector for shorts or opens.

Hard Start/No Start Diagnostic Procedures

The purpose of this test is to determine if the injector solenoids and valves are functioning by clicking all injectors together and then each injector in numerical sequence (1 through 8).

KOEO Injector Electrical Self-Test (Click Test)

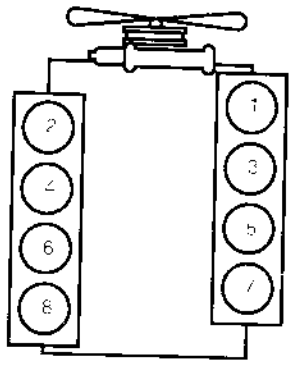
- Use the scan tool. Injector DTCs will be displayed after the self-test is completed.
- Note: Sequence repeats three times.

All injectors will momentarily click, then each injector will click in sequence 1 through 8.

Note: DTCs can be historical if not cleared from a previous test.

Injector Trouble Codes	

6.0L Engine, Cylinder and Fuel Injector Location



FIRING ORDER
1-2-7-3-4-5-6-8

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Recommended Procedure:

This test determines if the injector circuits and solenoids are electrically operating without fault. All injectors will first click together for approximately 2 seconds, then each injector will click for approximately 1 second in numerical order (1 through 8). If a fault is detected, a DTC will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault DTC will be displayed.

Connect the scan tool. Turn off accessories. If vehicle is equipped with an APCM, it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and a visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine off.

Hard Start/No Start Diagnostic Procedures

- Follow the operating instructions from the diagnostic menu.
- Perform the KOEO Injector Electrical Self-Test (Click Test).
- Record the DTCs and refer to the appropriate pinpoint test.

Possible Causes:

- Open or shorted injector circuit
- Injector connector
- Injector solenoid
- FICM power or ground circuit
- FICM

Tools Required:

Scan tool

10a. Check VPWR During Cranking

Purpose:

The purpose of this test is to verify PCM power during cranking.

Scan Tool — Data List Monitoring

- Scan tool may reset below 9.5 volts.
- Select the parameters indicated from the scan tool parameter list and monitor while cranking the engine.

Note: The 8 volt specification represents the minimum battery voltage required for engine starting. Greater than average crank times will be encountered if the battery voltage is less than 9.5 volts. If excessive crank time is a concern, verify battery voltage is greater than 9.5 volts.

Note: You may need to use an outside power source for the scan tool.

Parameter	Specification	Measurement
B+[A]	8 volts minimum	

A If a low voltage condition is present, check the battery, charging system or power and ground circuits to the PCM.

Hard Start/No Start Diagnostic Procedures

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access and monitor the B+ PID while cranking the engine.

Possible Causes:

- Battery cables
- Low battery voltage
- Charging system problem
- Power circuit and ground faults to the PCM
- PCM relay

GO to Pinpoint Test A to diagnose a voltage concern.

Note: Battery voltage below 9.5 volts may cause the scan tool to reset. If the scan tool resets during a self-test or while PID monitoring, it may be necessary to install a battery charger to maintain correct system voltage.

Tools Required:

Scan tool

10b and 10c. Check FICM Power During Cranking

Purpose:

The purpose of this test is to verify FICM power during cranking.

Scan Tool — Data List Monitoring

- Scan tool may reset below 9.5 volts.
- Select the parameters indicated from the scan tool parameter list and monitor while cranking the engine.

Note: You may need to use an outside power source for the scan tool.

Hard Start/No Start Diagnostic Procedures

Parameter	Specification	Measurement
FICMLPWR[B]	8 volts minimum	
FICMVPWR[C]	8 volts minimum	

B No or low voltage indicated could be caused by a 12-way connector issue or logic power fuse. GO to Pinpoint Test S.
C No or low voltage indicated could be caused by a 12-way connector issues.

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access and monitor the FICMLPWR and FICMVPWR PIDS while cranking the engine.

Possible Causes:

- Low or no battery voltage to the FICM
- High resistance or an open FICM power circuit
- FICM power relay

GO to Pinpoint Test AS for FICMVPWR diagnosis.

Tools Required:

Scan tool

10d. Check The RPM Signal While Cranking

Purpose:

The purpose of this test is to verify the CMP and CKP sensors and circuits are functioning.

Scan Tool — Data List Monitoring

- Scan tool may reset below 9.5 volts.
- Select the parameters indicated from the scan tool parameter list and monitor while cranking engine.

Note: You may need to use an outside power source for the scan tool.

Hard Start/No Start Diagnostic Procedures

Parameter	Specification	Measurement
RPM[D]	100 RPM minimum	

D Low RPM may be caused by starting or charging system concerns. No RPM indicated while cranking may be a CMP or CKP fault.

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access and monitor the RPM PID while cranking the engine.

Possible Causes:

- Weak battery or starter
- Circuitry
- CKP sensor
- CMP sensor

GO to Pinpoint Test D for CKP sensor diagnosis.

GO to Pinpoint Test V for CMP sensor diagnosis.

Tools Required:

Scan tool

10e. and 10f. Monitor The ICP While Cranking

Purpose:

The purpose of this test is to determine if the injection control system can supply enough injection control pressure to sustain starting.

Scan Tool — Data List Monitoring

- Scan tool may reset below 9.5 volts.
- Select the parameters indicated from the scan tool parameter list and monitor while cranking engine.

Hard Start/No Start Diagnostic Procedures

Parameter	Specification	Measurement
ICP[E]	3.5 MPa (500 psi) minimum	
ICP VOLTS[F]	0.80 volts minimum	

E A minimum of 3.5 MPa (500 psi) is required before the injectors are enabled. No or low oil in the system, system leakage, injector O-rings, faulty IPR or high pressure pump could cause low pressure. **IPR duty cycle defaults to 14% without a CKP signal.**

F Voltage reading below specification indicates low ICP during crank.

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access and monitor the ICP and IPR PIDS while cranking the engine.

Note: A CKP signal is required before the IPR is commanded above 14%.

If the ICP does not meet the minimum specification of 3.5 mPa (500 psi), the injectors will not be enabled by the PCM because of insufficient rail pressure.

If the IPR duty cycle is greater than 14%, ICP pressure should increase above 3.5 MPa (500 psi) provided that the IPR valve is not stuck open, the high pressure pump is building pressure and there is not an injection control pressure leak between the high pressure pump and the injectors.

Possible Causes:

- Low base engine oil pressure
- Injection control pressure system leak
- IPR failure
- Faulty high pressure pump
- Injector O-ring leaking

Purpose:

Isolate the cause of low injection control pressure.

Recommended Procedure: (F-SuperDuty/Excursion — Early Build)

- Air Pressure Check (F-SuperDuty/Excursion — Early Build)

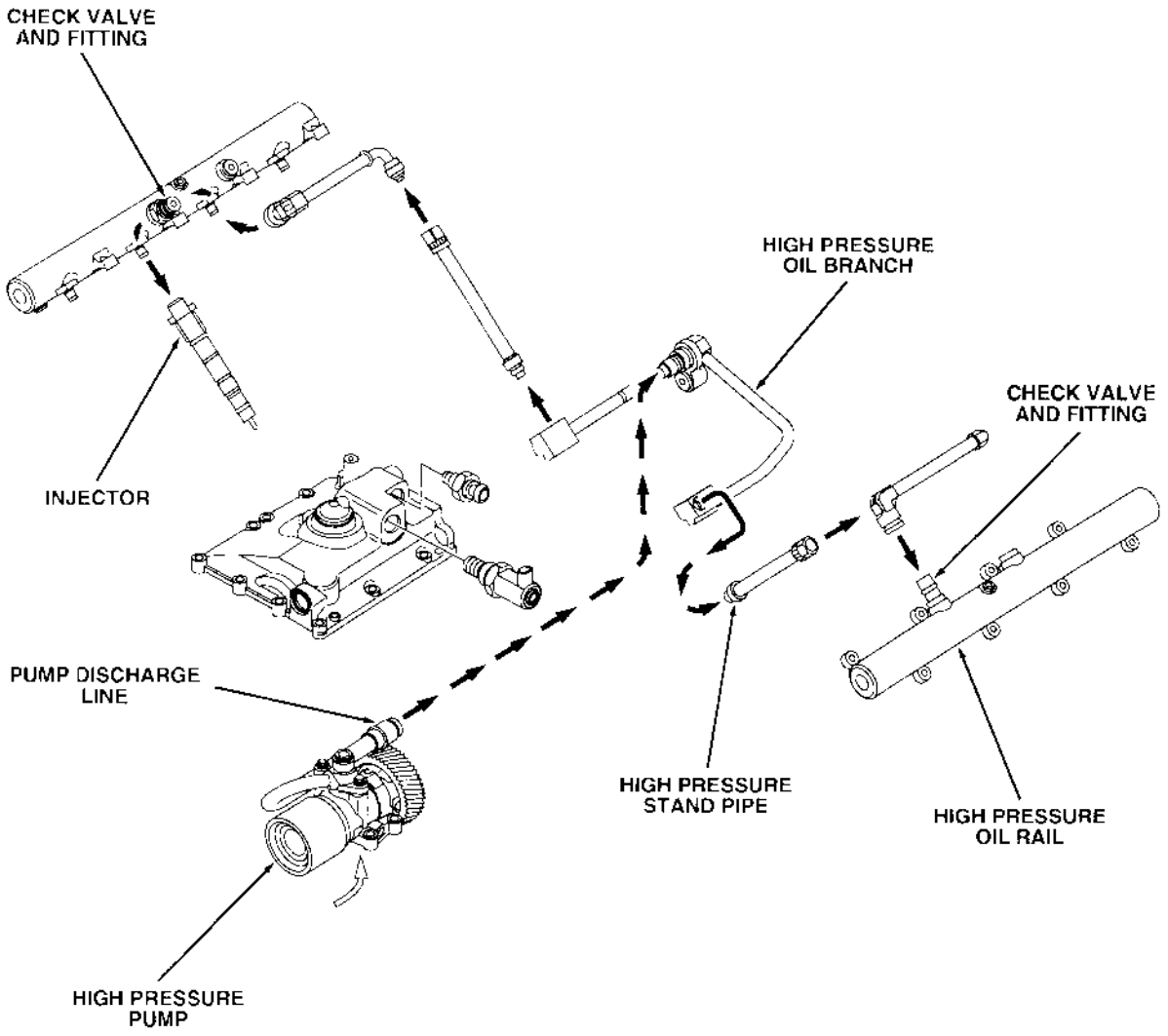
Hard Start/No Start Diagnostic Procedures

Note: An air leak on the high pressure oil pump shaft lip seal is normal while performing this procedure. This is not an indication of a high pressure oil leak and the high pressure pump should not be replaced for this condition.

- Verify base engine oil pressure. Refer to Workshop Manual Section 303 for additional information.
- Check the operation of the IPR valve. Remove one of the valve covers from the engine. Apply regulated shop-air pressure to the high pressure oil rail using the adapter from the Oil High Pressure Leakage Test Adapter Set 303-766. With air pressure applied, an air leak will result from the IPR valve's normally open state. With KOEO, use the scan tool to increase the IPR valve duty cycle. The IPR valve should close and block the air leak. If no change is heard, the IPR valve is not functioning as commanded. GO to Pinpoint Test R for IPR circuit DTCs. If no DTCs are present, install a new IPR valve and retest.
- With the IPR commanded closed, check the high pressure oil system for leaks. A leak may exist in the following areas:

Hard Start/No Start Diagnostic Procedures

High Pressure Oil System (F-SuperDuty/Excursion — Early Build)



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- Cracked/broken check valve and fitting in high pressure oil rail. under either valve cover.
- Disconnected high pressure hoses under the valve covers.
- Standpipe from high pressure hose to tappet gallery (O-ring at the bottom may be cut/torn or missing).
- O-ring in-between discharge tube and high pressure pump.

Hard Start/No Start Diagnostic Procedures

- O-ring around discharge tube that fits inside high pressure pump cover.
- High pressure inlet O-ring.
- Branch tube from high pressure pump to stand pipe in tappet gallery.

Right Cylinder Head Check (F-SuperDuty/Excursion -- Early Build)

Remove the RH valve cover. For additional information, refer to the workshop manual. Remove the high pressure hose from the right oil manifold using Quick Disconnect Tool 303-755. and cover the fitting on the oil manifold. Install the plug from the Oil High Pressure Leakage Test Adapter Set 303-756 into the high pressure hose to block it off. Crank the engine and monitor the ICP PID. If the ICP/EBC Adapter Cable D94T-50-A is connected to the ICP sensor. connect a digital multimeter between signal return and ICP signal wires on the adapter cable. Crank the engine and monitor the signal. The digital multimeter should read 1 to 4 volts.

CAUTION

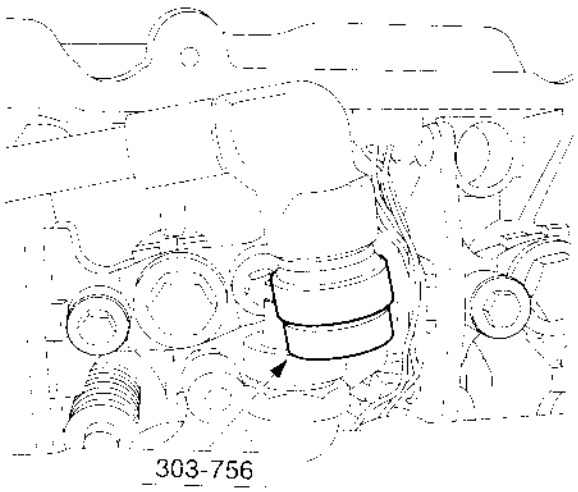
The engine may start.

If the engine starts or if injection control pressure is now within specification, the injection control pressure leak has been isolated to the right cylinder head.

CAUTION

Oil is under high pressure.

F-SuperDuty/Excursion — Early Build



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Hard Start/No Start Diagnostic Procedures

Left Cylinder Head Check (F-SuperDuty/Excursion — Early Build)

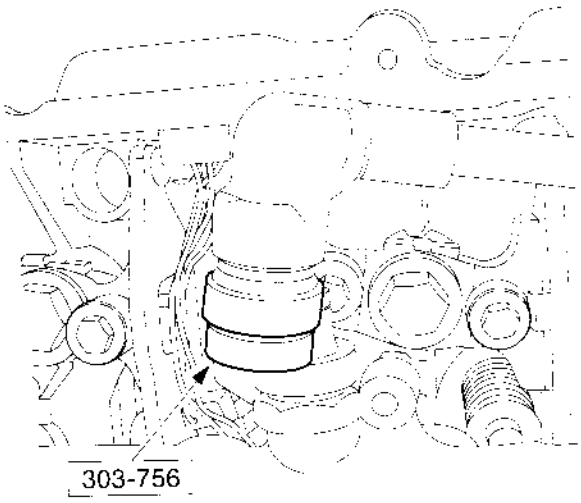
Remove the LH valve cover. For additional information, refer to the workshop manual. Remove the cap and plug, then reinstall the high pressure hose to the right oil manifold. Remove the high pressure hose from the left oil manifold using Quick Disconnect Tool 303-755, and cover the fitting on the oil manifold. Install 303-756 into the high pressure hose. Crank the engine and monitor the ICP PID. If the ICP/EBC Adapter Cable D94T-50-A is connected to the ICP sensor, connect a digital multimeter between the signal return and ICP signal wires of the adapter cable. Crank the engine and monitor the signal. The digital multimeter should read 1 to 4 volts.

CAUTION

The engine may start.

If the engine starts or if injection control pressure is now within specification, the injection control pressure leak has been isolated to the left cylinder head.

F-SuperDuty/Excursion — Early Build



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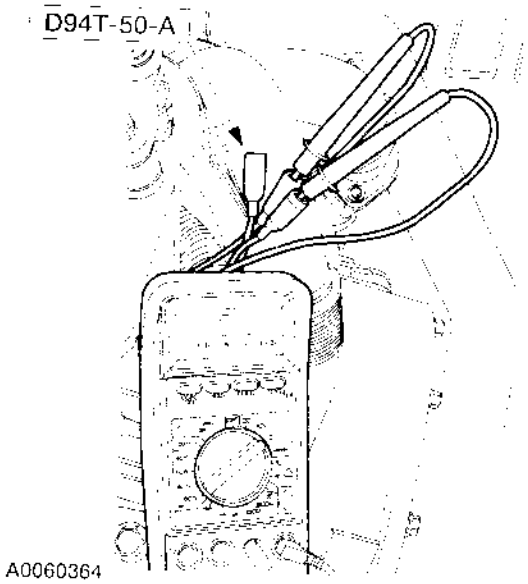
Hard Start/No Start Diagnostic Procedures

IPR and High Pressure Pump Test (F-SuperDuty/Excursion — Early Build)

If injection control pressure is still low after ruling out both cylinder heads as the source of injection control pressure leakage, perform the following steps to isolate the cause. Remove the high pressure hose from the right oil manifold and cover the fitting. Install the plug from the Oil High Pressure Leakage Test Adapter Set 303-756 into the high pressure hose to block it off. With the high pressure pump effectively deadheaded, crank the engine and monitor the ICP PID. If a low pressure condition still exists, the problem is most likely with the high pressure pump or the high pressure pump drive gear.



Recommended Procedure (E-Series or F-SuperDuty/Excursion — Late Build)

Air Pressure Check (E-Series or F-SuperDuty/Excursion — Late Build)

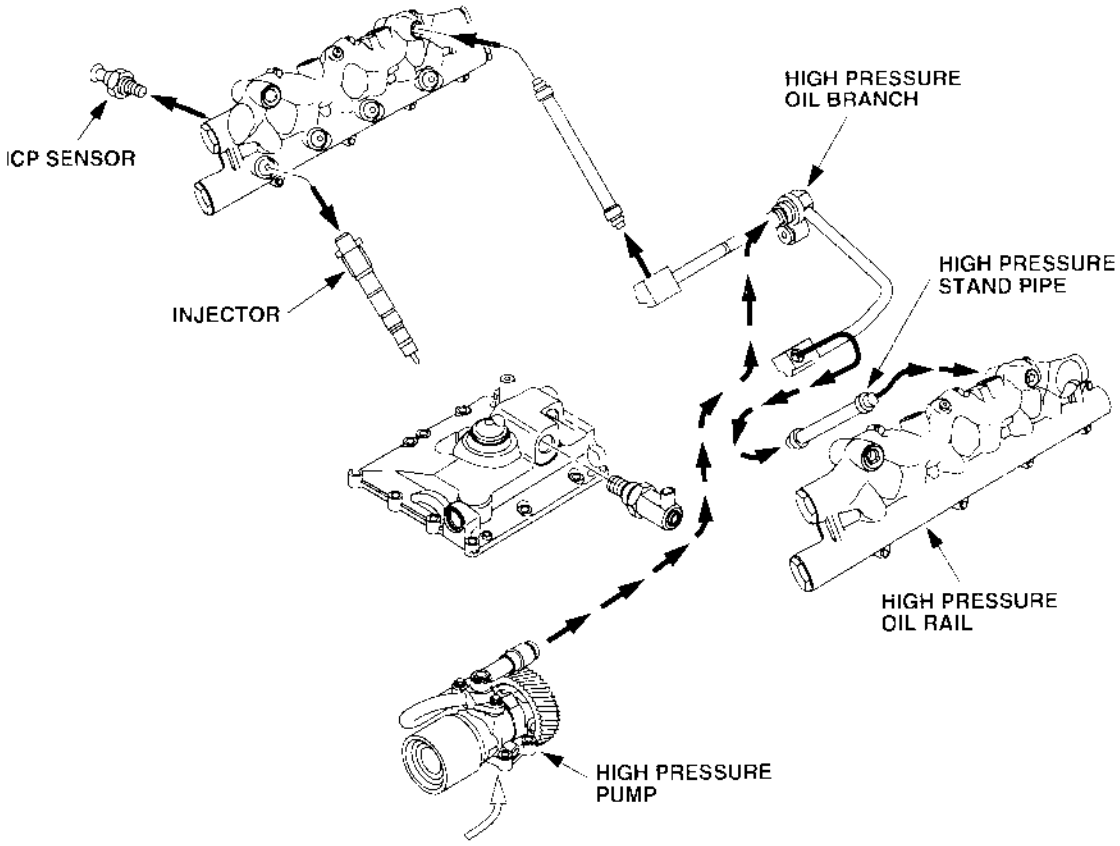
Note: An air leak on the high pressure oil pump shaft lip seal is normal while performing this procedure. This is not an indication of a high pressure oil leak and the high pressure oil pump should not be replaced for this condition.

- Verify base engine oil pressure. Refer to Workshop Manual Section 303 for additional information.
- Remove the left valve cover from the engine. Refer to Workshop Manual 303 for additional information.
- Apply regulated shop-air pressure to the high pressure oil rail using the adapter from the Test Adapter Set 303-766. With air pressure applied, an air leak will result from the IPR valve's normally open state.

Hard Start/No Start Diagnostic Procedures

- With KOEO, use the scan tool to increase the IPR valve duty cycle. The IPR valve should close and block the air leak. If no change is heard, the IPR valve is not functioning as commanded. GO to Pinpoint Test R for IPR circuit DTCs. If no DTCs are present, install a new IPR valve and retest.
- With the IPR commanded closed, check the high pressure oil system for leaks. A stethoscope may be used to help identify a leak. A leak may exist in the following areas:

High Pressure Oil System (E-Series or F-SuperDuty/Excursion — Late Build)



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- Standpipe from high pressure hose to tappet gallery (O-rings may be cut/torn or missing).
- O-ring between discharge tube and high pressure pump.
- O-ring around discharge tube that fits inside high pressure pump cover.
- High pressure inlet O-ring.
- Branch tube and O-ring from high pressure pump to stand pipe in tappet gallery.
- O-ring on the top of the injector where the high pressure rail seats into the injector.

Hard Start/No Start Diagnostic Procedures

Left Cylinder Head Check (E-Series or F-SuperDuty/Excursion — Late Build)

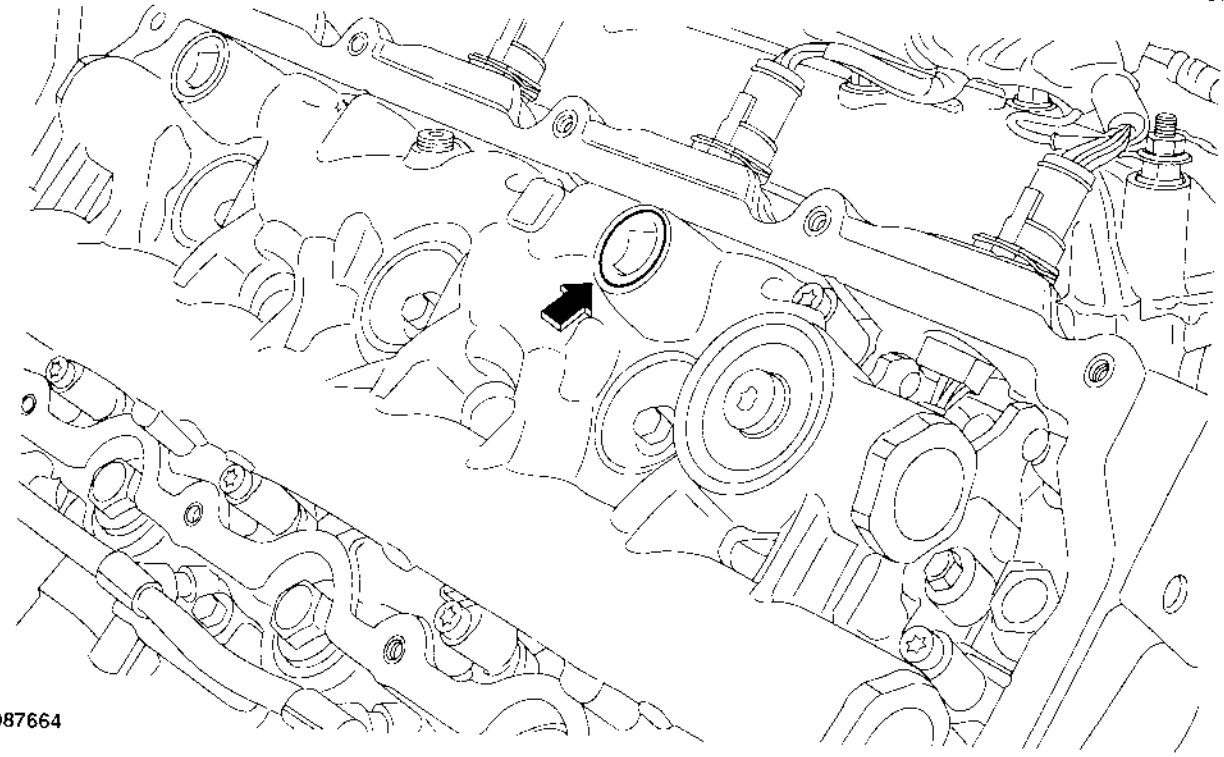
CAUTION

The engine may start.

CAUTION

Oil is under high pressure.

- Remove the LH valve cover. Refer to Workshop Manual Section 303 for additional information.



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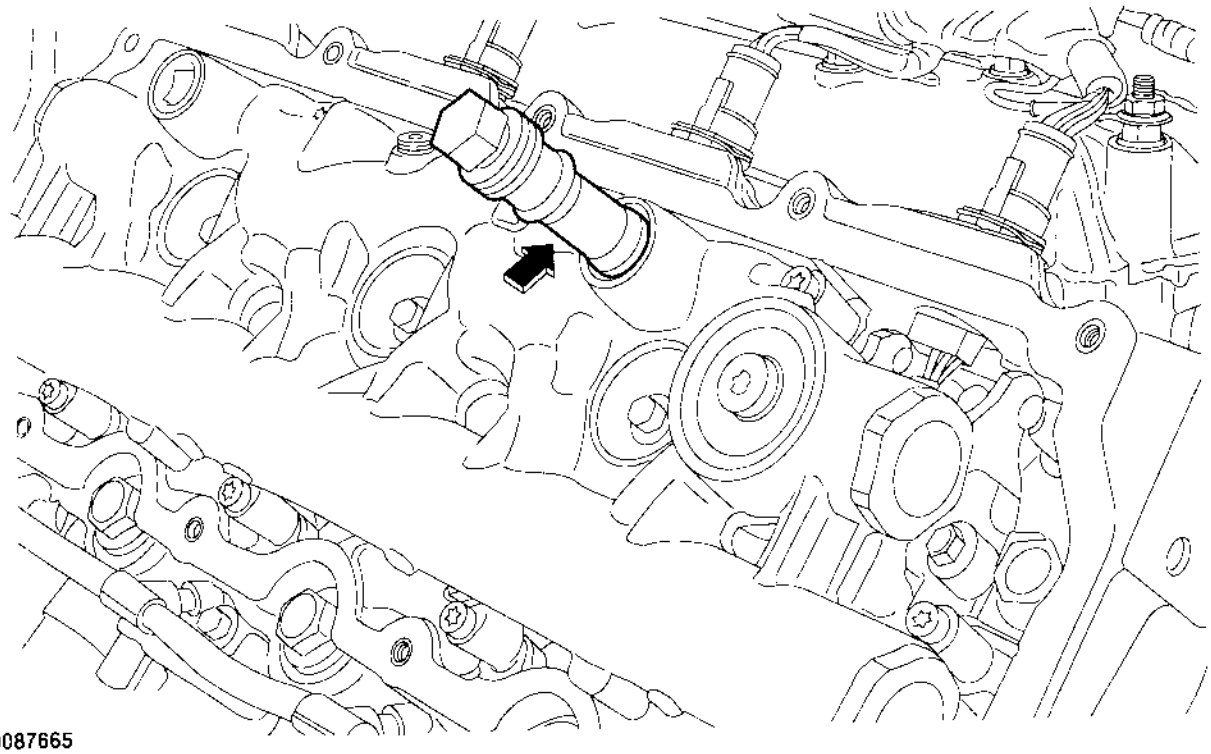
- Remove the existing pipe plug.

Hard Start/No Start Diagnostic Procedures



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- Install the Oil High Pressure Leakage Test Adapter 303-1071/2 (solid block-off tool).
- Access and monitor the ICP PID while cranking the engine.
- If the engine starts or if injection control pressure is now within specification, the injection control pressure leak has been isolated to the left cylinder head. If the pressure is not within specification, remove the test adapter (303-1071/2), reinstall the original pipe plug and perform the right cylinder head check.

Right Cylinder Head Check (E-Series or F-SuperDuty/Excursion — Late Build)

CAUTION

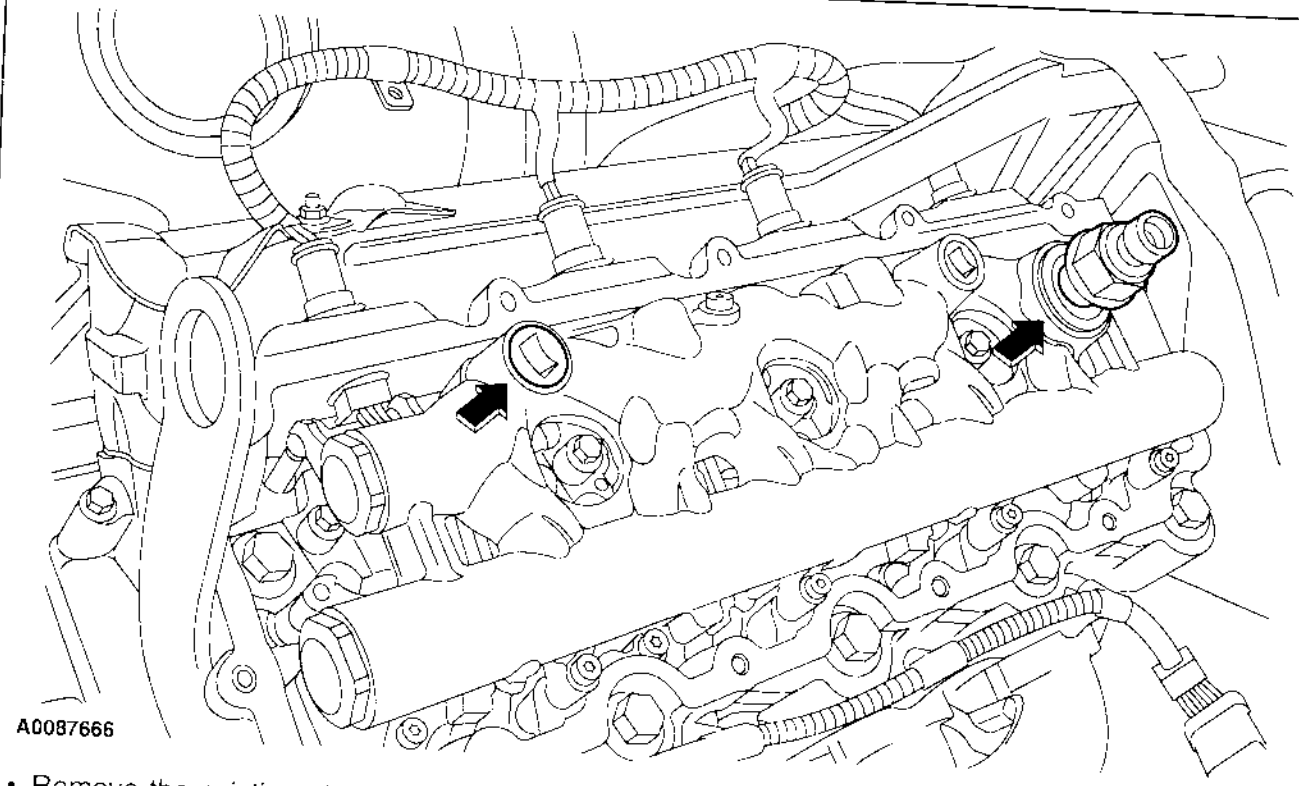
The engine may start.

CAUTION

Oil is under high pressure.

- Remove the RH valve cover. Refer to Workshop Manual Section 303 for additional information.

Hard Start/No Start Diagnostic Procedures



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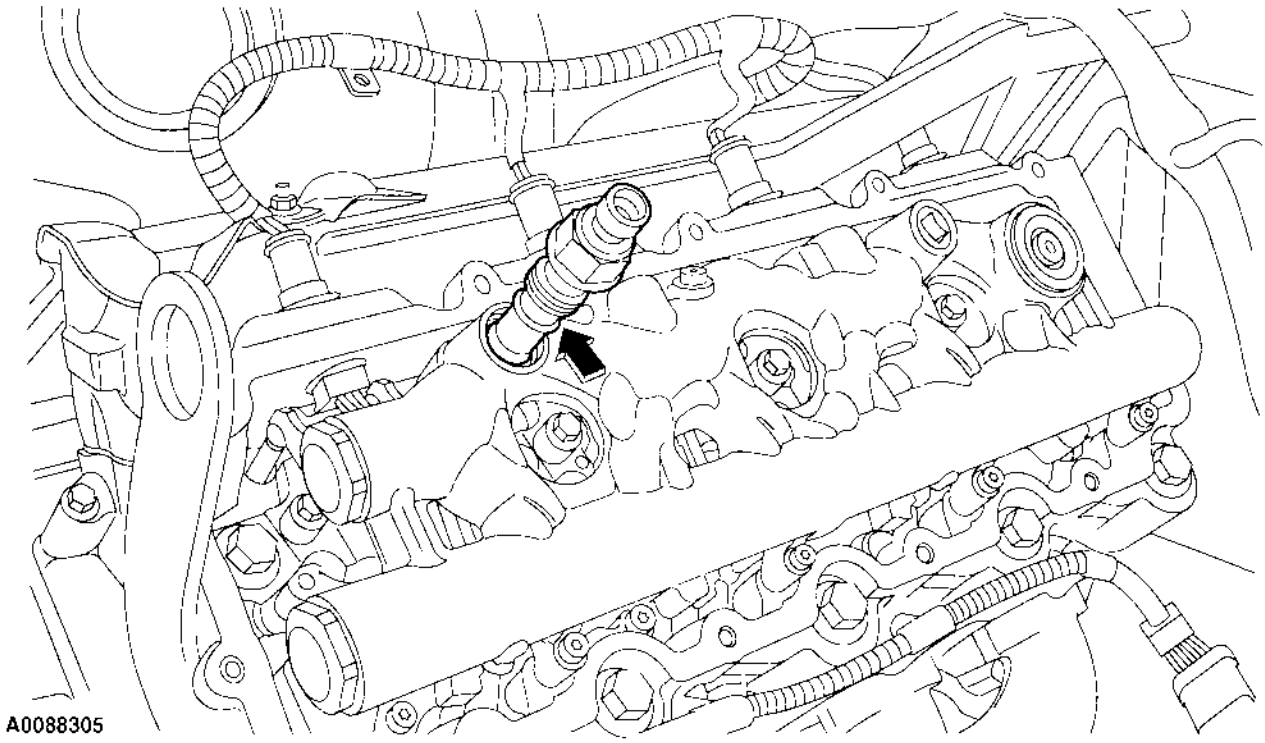
- Remove the existing pipe plug.
- Remove the ICP sensor from the high pressure rail.

Hard Start/No Start Diagnostic Procedures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- Install the ICP sensor into the Oil High Pressure Leakage Test Adapter 303-1071/1 (open-ended block-off tool).
- Install the Oil High Pressure Leakage Test Adapter 303-1071/1.
- Connect the ICP/EBC Adapter Cable 418-D003 to the wiring harness and the ICP sensor.
- Access and monitor the ICP PID while cranking the engine.

If the engine starts or if injection control pressure is now within specifications, the injection control pressure leak has been isolated to the right cylinder head. If the pressure is not within specifications, perform the IPR and high pressure pump test.

IPR And High Pressure Pump Test (E-Series or F-SuperDuty/Excursion — Late Build)

If injection control pressure is still low after ruling out both cylinder heads as the source of injection control pressure leakage, perform the following to isolate the cause.

- Reinstall the left cylinder head Oil High Pressure Leakage Test Adapter 303-1071/2 (solid block-off tool).
- With the high pressure pump effectively deadheaded, crank the engine and monitor the ICP PID.
- If a low pressure condition still exists, the problem is most likely with the high pressure pump or the high pressure drive gear. If the injection control pressure is now within specifications, inspect all components carrying high pressure oil on both engine banks.

Hard Start/No Start Diagnostic Procedures

- The leak could also be in the discharge tube, branch tube, or stand pipes. Perform the air pressure check if this procedure has not already been completed. If the concern is related to a leaking standpipe, branch tube or discharge tube, this test should identify the leak.

Tools Required:

- ICP/EBC Adapter Cable 418-D003 (D94T-50-A) or equivalent
- Oil High Pressure Leakage Test Adapter Set 303-756 or equivalent
- Oil High Pressure Leakage Test Adapter Set 303-1071 or equivalent
- Multimeter 105-00050 or equivalent
- Quick Disconnect Tool 303-755

10g. Check Fuel Pulse Width While Cranking

Purpose:

The purpose of this test is to verify the fuel delivery signal is correct.

Scan Tool — Data List Monitoring

- Scan tool may reset below 9.5 volts.
- Select the parameters indicated from the scan tool parameter list and monitor while cranking engine.

Parameter	Specification	Measurement
FUEL PW[G]	5 µS to 2 mS	

G Pulse width defaults to 0 with no CMP or CKP signal.

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access and monitor the FUEL PW PID while cranking the engine.

No fuel command signal when the ICP, RPM and VPWR signals are correct usually indicates a loss of the CMP signal. GO to Pinpoint Test V.

A 5 µs to 2 ms fuel pulse width (FUEL PW) will be sent to the FICM if the system voltage is greater than 8 volts during cranking, engine cranking speed is above 100 RPM, injection control pressure is above 3.5 MPa (500 psi) and is in sync. Note that low fuel pressure or no glow plug operation could still be the cause of the No Start or Hard Start condition. A 0 ms fuel pulse width (a no fueling pulse) will be sent by the PCM when a sync pulse has not been received from the CMP sensor and if insufficient injection control pressure is present.

Hard Start/No Start Diagnostic Procedures

Possible Causes:

- PCM
- FICM
- CKP signal
- CMP signal

Tools Required:

Scan tool

10h. Check FICM Synchronization While Cranking

Purpose:

The purpose of this test is to verify the PCM and FICM synchronization.

Scan Tool — Data List Monitoring

- Scan tool may reset below 9.5 volts.
- Select the parameters indicated from the scan tool parameter list and monitor while cranking the engine.

Parameter	Spec.	Measurement
FICMSYNC[H]	YES/NO	

H No synchronization could be caused by a CMP or CKP fault.

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access and monitor the FICMSYNC PID while cranking the engine.

No synchronization while cranking the engine with the ICP, RPM and VPWR signals correct usually indicates a loss of the CMP or CKP synchronization signal. Refer to the appropriate pinpoint test for diagnosis.

Hard Start/No Start Diagnostic Procedures

Possible Causes:

- PCM
- FICM
- CKP synchronization signal
- CMP synchronization signal

Tools Required:

Scan tool

11. Glow Plug System Operation

Purpose:

The purpose of this test is to verify the glow plug system operation.

Glow Plug System Operation

- Glow Plug Control Module (GPCM) Operation
  - — Glow plug ON time is dependent on oil temperature and altitude. The GPCM will command the glow plugs on for 1 to 120 seconds. The GPCM does not operate if the oil temperature is above 55°C (131°F).
  - — Connect the scan tool. Access and retrieve the KOEO and continuous DTCs. If GPCM DTCs are present, GO to Pinpoint Test AF.
  - — Verify B+ voltage is supplied to the GPCM.
  - — Access and monitor the GPCTM and EOT PIDS to verify sufficient glow plug "ON" time.
  - — Turn the key to the ON position and measure the glow plug voltage ("ON" time).

Note: The Wait To Start indicator "ON" time (1-10 seconds) is independent from glow plug "ON" time.

On Time	Specification	Measurement
1 to 120 seconds	B+	

Hard Start/No Start Diagnostic Procedures

- **Glow Plug Resistance**
  - — Disconnect the glow plug bus bar connector.
  - — Measure the resistance between the glow plug bus bar connector, component side and battery ground.
  - — Disconnect the GPCM.
  - — Measure the resistance between the GPCM connector, harness side and the glow plug bus bar connector, harness side.

Glow Plug Number	Glow Plug to Ground (0.1 to 2 ohms)	Glow Plug Connector to GPCM Connector (less than 5 ohms)
1		
3		
5		
7		
2		
4		
6		
8		

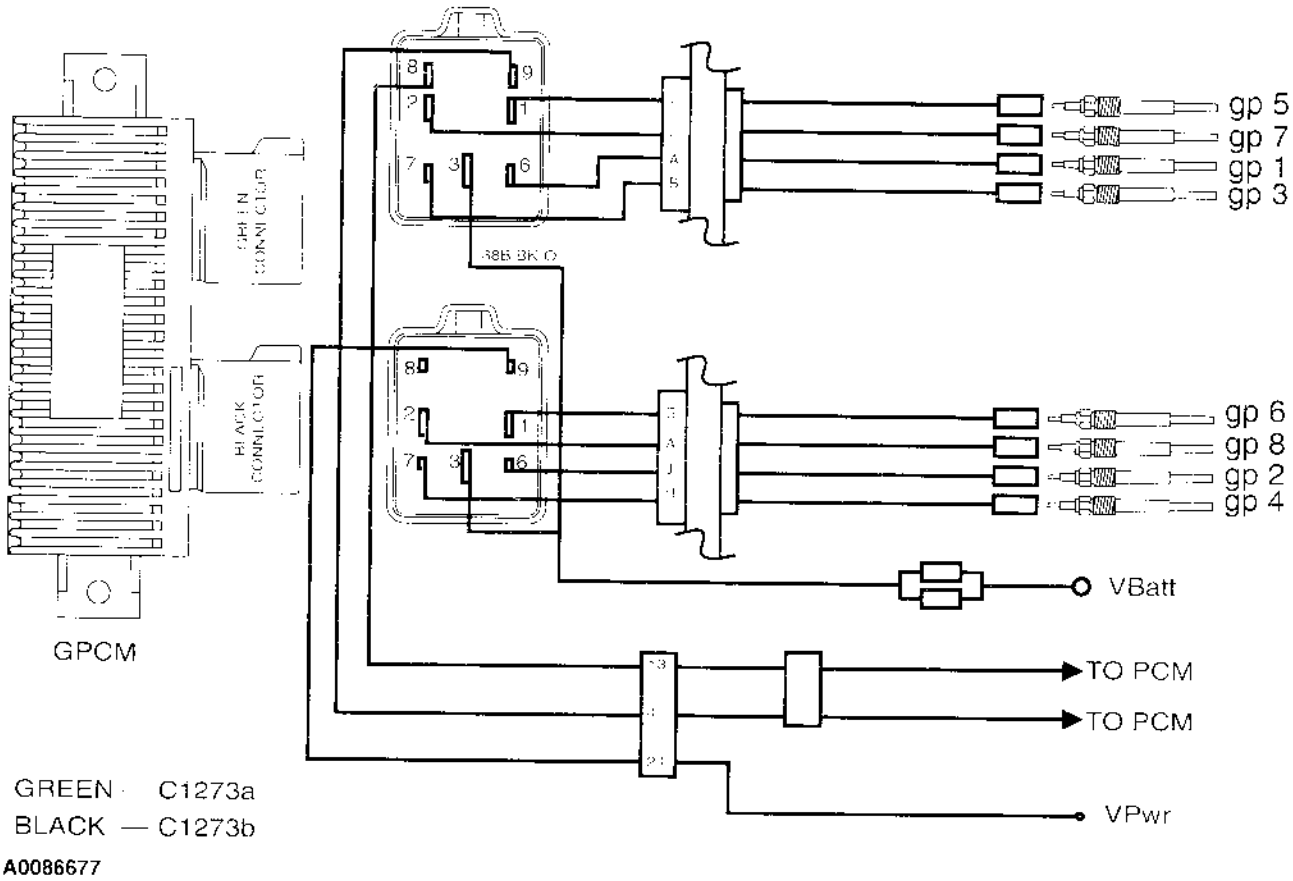
Recommended Procedure:

Note: Check for poor connections or loose fitting pins.

Note: Incorrect measurements will result if all glow plug connectors are not disconnected.

Hard Start/No Start Diagnostic Procedures

The glow plug monitor self-test is a KOER functional test of the glow plug system. The self-test is performed on-demand with the engine running and the A/C off. The PCM will activate the GPCM which monitors the glow plugs. The pedal may be used to increase the engine speed to increase voltage if needed. For fault detection, the self-test requires a fault present at the time of testing.



Possible Causes:

- GPCM power circuits
- Glow plugs
- Glow plug bus bar
- GPCM
- Circuitry

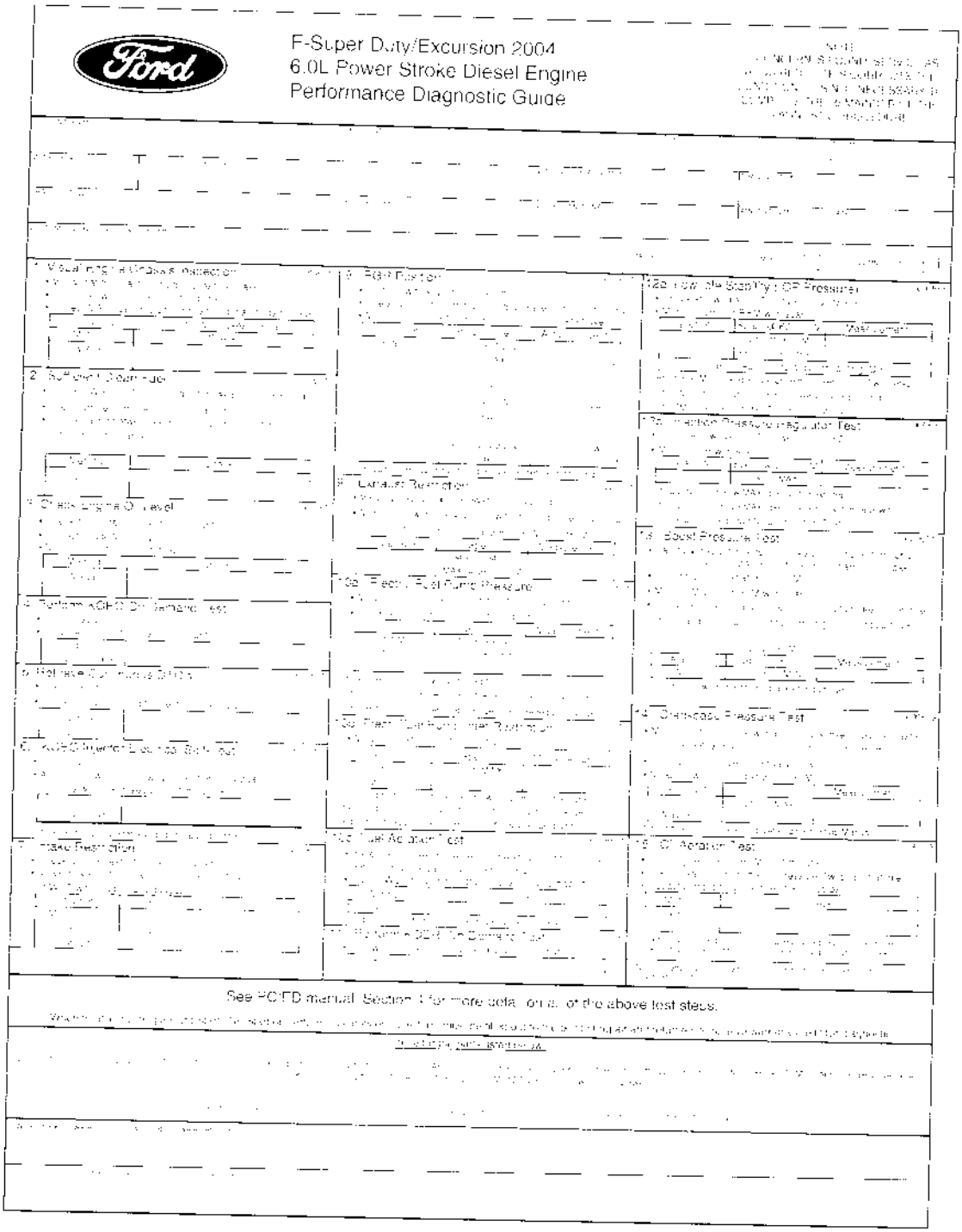
Hard Start/No Start Diagnostic Procedures

Tools Required:

- Multimeter 105-00050 or equivalent
- Scan tool

Performance Diagnostic Procedures

F-SuperDuty/Excursion — Early Build



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Performance Diagnostic Procedures

E-Series or F-SuperDuty/Excursion — Late Build (Built After 9/2003)

F-Super Duty/Excursion/Econoline 2004.25
6.0L Power Stroke Diesel Engine
Performance 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

1. Visual Engine/Chassis Inspection 6005F
- 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 6005F10
- 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 6005F
- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/hours on oil, correct level.

Method	Check
Visual	

4. Perform KOEO On Demand Test 6005F
- Use the scan tool.
- DTCs set during this test are current faults.

Diagnostic Trouble Codes	

5. Retrieve Continuous DTC's 6005F1
- Use the scan tool.
- DTCs retrieved during this test are historical faults.

Diagnostic Trouble Codes	

6. KOEO Injector Electrical Self-Test 6005F2
- Use the scan tool.
- All injectors will momentarily click, then 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 6005F14
- Check air filter restriction gauge/indicator.
- Measure vacuum on clean side of air inlet system at WOT with magnehelic gauge.

Instrument	Spec.	Check
Magnehelic		
Filter Restriction Gauge	2.25" H2O	

8. EGR Position 6005F20
- Perform with key on engine off.
- Use scan tool to command Output State Control for EGP.
- Monitor EGR position sensor (EP) and calculate travel.

Instrument	Spec. Percent	Actual Percent
Scan tool	0% (0.6-1.2 V) Closed	Closed
	95%-100% (4.0-4.5 V) Open	Open
	90% and 3.2 V Travel	Travel

- Repair issues causing out of spec values before continuing.

9. Exhaust Restriction 6005F14
- Visually inspect exhaust system for damage.
- Monitor EP with the scan tool with the engine temperature at 70°C (158°F) minimum at 3,800 RPM in park/neutral.

Parameter	Spec	Measurement
EP/EBP	344 kPa (50 PSI) MAX @ 3800 RPM	

10a. Electric Fuel Pump Pressure 6005F18
- Measure fuel pressure at engine filter housing test port.
- Road Test - engine at full load condition.

Instrument	Spec.	Measurement
0-1 Mpa 0-160 PSI Gauge	310-379 kPa (45-55 PSI) min.	

- If fuel pressure is low, go to step 10b.
- If pressure is above spec, check fuel return lines for restriction. If no restriction is present, replace fuel pressure regulator valve.

10b. Elect. Fuel Pump Inlet Restriction 6005F19
- Measure restriction at fuel pump inlet.

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

- If over 6" Hg restriction, check lines between pump and fuel tank.
- If less than 6" Hg, inspect both fuel filters. If filters are OK, check fuel regulator. If regulator and filters are OK, replace fuel pump.

10c. Fuel Aeration Test 6005F21
- Install clear hose on fuel return line at fuel control module. Refer to shop manual for approved procedure.
- Run at WOT for 2 min. Return fuel should be free of bubbles.

Method	Check
Visual	

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

11. Perform KOER On Demand Test 6005F6
- This will test the ICP, EGR and VGT performance.

KOER DTC	

12a. Low Idle Stability (ICP Pressure) 6005F8
- Check at low idle, EOT above 70°C (158°F).
- Monitor ICP and RPM with scan tool.

Parameter	Spec. @ 670 RPM	Measurement
ICP	4.0-5.0 Mpa (580-725 PSI)	

- Take reading before disconnecting ICP.
- If engine RPM is unstable, disconnect ICP sensor (ICP will default).
- If RPM is still unstable, reconnect sensor and go to 12b.
- If RPM smooths out, the ICP sensor is at fault.

12b. Injection Pressure Regulator Test 6005F22
- 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 leaks with procedure in Hard Start/No Start section Test 10c.

13. Boost Pressure Test 6005F12
- 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 long or climbing hill or loaded truck.

Parameter	3300 RPM Spec PSIG	Measurement
MGP	22 PSIG MIN F-Series; 20 PSIG MIN Econoline	

- If boost is low, inspect turbo blades for damage.

14. Crankcase Pressure Test 6005F9
- Measure at oil fill tube with 6.0L Crankcase Pressure Tester (303-750) with engine at 70°C (158°F) minimum.
- Block breather tube on left valve cover.
- Measure with no load at 3,300 RPM.

Instrument	Spec	Measurement
0-15" H2O Magnehelic	8" H2O MAX	

- If more than 8" H2O refer to base engine in Shop Manual.

15. Oil Aeration Test 6005F25
- 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 incorrect oil additives, pick up tube leak, front cover seal leak, or upper pan seal leak.

Note: [illegible]

See PC/ED manual, Section 4 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 for diagnostic time for the parts listed below.

Fuel Injectors (9E527), regulator injector control pressure (9C968), pump assembly-high pressure oil (6A543), turbo charger assembly (6K682), fuel control module (9G792), FICM (12B599), PCM (12A650), EGR valve (9F472), CKP sensor (6C315), CMP sensor (12K073), GPCM (12B533), and Glow Plugs (12A342).

Some labor operations are listed in more than one test step. These operations include time for all necessary tests and can only be claimed once.

What concerns were found and what repairs were performed?

List Part Name, Number and Serial Number of parts replaced

A0093476

Performance Diagnostic Procedures

1. Visual Engine/Chassis Inspection

Purpose:

The purpose of this test is to check the general condition of the engine and chassis.

Visual Engine/Chassis Inspection

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

Fuel Oil Coolant Electrical Hoses Leaks	
Method	Check
Visual	

Recommended Procedure:

- Inspect for a hole in the MAP sensor hose or a pinched hose.
- Inspect the fuel system, including the fuel tank, fuel pump, fuel filter housing and fuel lines, for kinks, bends or leakage.
- Inspect for coolant leaks at the radiator and coolant hoses. Check the coolant level.
- Inspect wiring for correct routing, and verify no rubbing or chafing has occurred.
- Inspect all sensors, and verify the connectors are properly secured.
- Inspect the intercooler hoses for leaks.

Possible Causes:

- Loose or leaking fuel lines
- Kinked or blocked fuel lines
- Fuel or oil leaks
- Coolant leaks could indicate engine problems
- Pinched or open MAP sensor hose
- Pinched or open intercooler hose
- Improper connections

Tools Required:

Inspection light

Performance Diagnostic Procedures

2. Sufficient Clean Fuel

Purpose:

The purpose of this test is to verify the fuel quality.

Sufficient Clean Fuel

- Check for illumination of the WATER IN FUEL indicator.
- Drain a fuel sample from the fuel control module.
- A cetane rating between 40 and 50 is recommended for optimum performance.

Method	Check
Visual	

Recommended Procedure:

Open the drain valve on the fuel control module and fill a clear container until it is half full. Close the drain valve.

Observe the WATER IN FUEL indicator. If the indicator is illuminated, the fuel is probably contaminated with water.

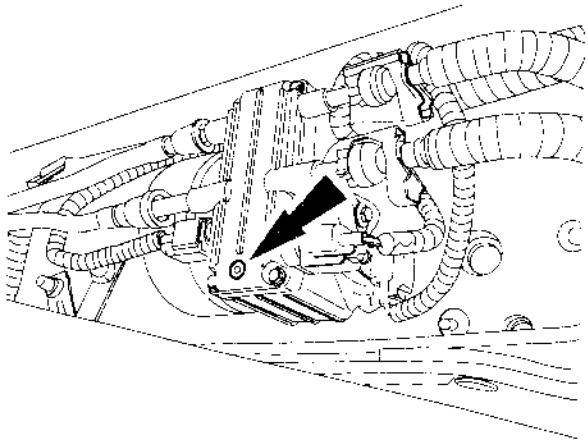
Flow out of the drain should be a steady stream. Insufficient flow could indicate fuel supply or fuel system problems.

Inspect the fuel in the container. It should be clear, not cloudy. It also should be free of water and contaminants. Dyed red or blue fuel indicates off-highway fuel.

Some sediment and water may be present in the fuel sample if the fuel filter has not been serviced for a prolonged period of time and/or if the sediment and water have not been drained recently. If that is the case, a second sample may be required to determine fuel quality.

Performance Diagnostic Procedures

F-SuperDuty/Excursion



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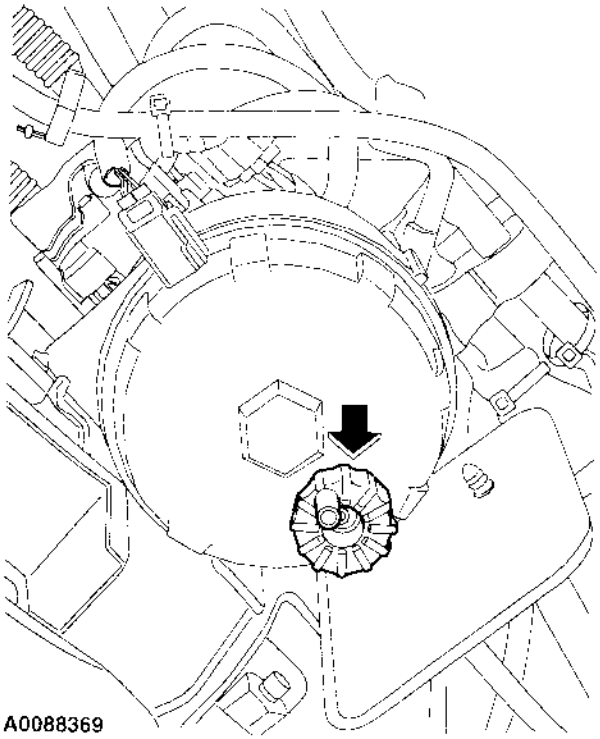
E-Series



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Performance Diagnostic Procedures

Possible Causes:

- No fuel in tank
- Fuel supply line could be broken or crimped
- Fuel could be jelled (most likely in cold weather with No. 2 fuel)
- Pickup tube screen in tank could be clogged

Cloudy fuel indicates that the fuel may not be a suitable grade for cold temperatures.

Excess ve water or contaminants may indicate that the tank and fuel system may need to be flushed and cleaned.

Tools Required:

Clear container — approximately 0.95L (1-quart)

3. Check Engine Oil Level

Purpose:

The purpose of this test is to verify oil quality and determine if there is sufficient oil to operate the injectors.

Check Engine Oil Level

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

Method	Check
Visual	

Recommended Procedure:

Check the oil level using the dipstick with the vehicle on level ground. If there is no oil or very little oil in the crankcase, the injectors will not operate.

If the oil level is overfull, it is possible the engine was incorrectly serviced or fuel is diluting the oil and filling the crankcase.

Performance Diagnostic Procedures

Inspect oil for color. A milky white oil indicates possible coolant contamination which will have an ethylene glycol odor.

WARNING:

SMOKING OR OPEN FLAME OF ANY TYPE MUST NOT BE PRESENT WHEN WORKING NEAR FUEL OR FUEL VAPOR. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

Oil contaminated with diesel fuel will have a diesel fuel odor and will increase the engine oil level. If the engine oil level is above "Max" due to diesel fuel dilution, the oil will appear thin and watery.

If the oil level is overfilled, drain the oil and the fuel filter housing. Isolate either cylinder head by removing the corresponding fuel line from the fuel filter housing. Remove the fuel pressure test port plug from the secondary filter housing. Install the plug in the outlet port. Install Fuel Pressure Adapter (303-765) and Gauge 0-1.1 MPa (0-160 psi) Bar 014-00761 or equivalent at the test port to confirm constant fuel pressure.

Using the scan tool, access OSC and command the fuel pump ON. Watch for fuel to drain out of the oil pan drain hole. Depending on the severity of the leak, it may take some time before a leak is noticeable. Remove the valve cover at the suspect cylinder head and inspect the injector area for leaks.

Check service records for correct oil type and viscosity for the vehicle operating temperature. Single weight or 15W-40 oil is not recommended for cold ambient temperatures. 10W-30 oil is recommended for cold ambient temperatures. Oil that has had extended drain intervals will have increased viscosity (become thicker) and will make engine cranking more difficult and starting less reliable at temperatures below freezing. Refer to the lube oil chart in the Workshop Manual or Owner Literature for the correct oil selection for temperature conditions.

Possible Causes:

- Oil level low — oil leak, oil consumption, incorrect servicing
- Oil level high — incorrect servicing, fuel dilution from injector O-rings
- Oil contamination with coolant — oil cooler, head gasket, porosity

Tools Required:

Adapter 303-765 or equivalent

Gauge 0-1.1 MPa (0-160 psi) Bar (part of Pressure Adapter Kit 014-00761 or equivalent)

Scan tool

Performance Diagnostic Procedures

4. Perform KOEO On-Demand Self-Test

Purpose:

The purpose of this test is to determine if the PCM has detected any fault conditions that would cause a performance problem.

Perform KOEO On-Demand Test

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

Diagnostic Trouble Codes	

Recommended Procedure:

Note: To ensure that the DTC is a hard fault, first clear Continuous DTCs (be sure to record all DTCs and Freeze Frame information before clearing). Rerun KOEO On-Demand Self Test. If the DTC is set again, a hard fault has occurred.

Connect the scan tool. Turn off all accessories. If the vehicle is equipped with an auxiliary powertrain control module (APCM), it must be turned off to perform the self-test.

- Perform the necessary vehicle preparation and a visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine off.
- Wait 4 seconds for the transmission control module (TCM), powertrain control module (PCM) and the fuel injector control module (FICM) to initialize.
- Follow the operating instructions from the diagnostic menu.
- Perform a KOEO On Demand Self-Test.
- Record the DTCs and Freeze Frame information and refer to the appropriate pinpoint test.

Tools Required:

Scan tool

Performance Diagnostic Procedures

5. Retrieve Continuous DTCs

Purpose:

The purpose of this test is to determine if the PCM has detected any historical or intermittent fault conditions that would cause a performance problem. The condition that caused a continuous DTC may no longer exist.

Retrieve Continuous DTCs

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

Diagnostic Trouble Codes (DTCs)	

Recommended Procedure:

Connect the scan tool. Turn off all accessories. If the vehicle is equipped with an APCM, it must be turned off to perform self-tests.

- Perform the necessary vehicle preparation and a visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine off.
- Follow operating instructions from the menu.
- Record the continuous DTCs and Freeze Frame information from the PCM and TCM and refer to the appropriate pinpoint test for continuous DTC diagnostics.
- Continuous DTCs must be cleared after a repair is made.

Tools Required:

Scan tool

6. KOEO Injector Electrical Self-Test (Click Test)

Purpose:

Note: If unable to perform KOEO Injector Electrical Self-Test (Click Test), disconnect the FICM connector and check injectors for shorts or opens.

The purpose of this test is to determine if the injector solenoids and valves are functioning by clicking all injectors together and then each injector in numerical sequence (1 through 8).

Performance Diagnostic Procedures

KOEO Injector Electrical Self-Test (Click Test)

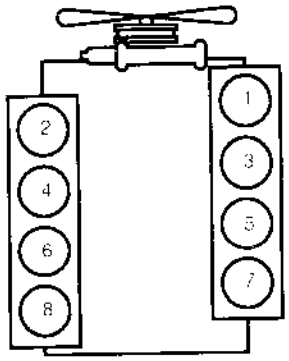
- Use the scan tool. Injector DTCs will be transmitted after the self-test is completed.
- All injectors will momentarily click, then each injector will click in sequence 1 through 8.

Note: Sequence repeats three times.

Note: DTCs can be historical if not cleared from a previous test.

Injector Trouble Codes	

6.0L Engine, Cylinder and Fuel Injector Location



FIRING ORDER
1-2-7-3-4-5-6-8

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Recommended Procedure:

This test determines if the injector circuits and solenoids are electrically operating without fault. All injectors will first click together for approximately 2 seconds, then each injector will click for approximately 1 second in numerical order (1 through 8). If a fault is detected, a DTC will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault DTC will be displayed.

Connect the scan tool. Turn off accessories. If vehicle is equipped with an APCM, it must be turned off to perform self-tests.

- Perform the necessary vehicle preparation and a visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine off.

Performance Diagnostic Procedures

- Follow the operating instructions from the menu.
- Perform the KOEO Injector Electrical Self-Test (Click Test).
- Record the DTCs and perform the appropriate pinpoint test.

Possible Causes:

- Open or shorted injector circuit
- Injector connector
- Injector solenoid
- FICM power or ground circuit
- FICM

Tools Required:

Scan tool

7. Intake Restriction

Purpose:

This purpose of this test is verify an air intake or exhaust restriction is not contributing to a low power condition. If the engine does have a high air intake restriction, a considerable amount of black or blue smoke may be produced.

Intake Restriction

- Check air filter restriction gauge/indicator.
- Measure the vacuum on clean side of air inlet system at WOT with Magnehelic® gauge.

Instrument	Specification	Measurement
Magnehelic/Filter Restriction Gauge	3.7-46.7 mm Hg (2.25 H_2O)	

Recommended Procedure:

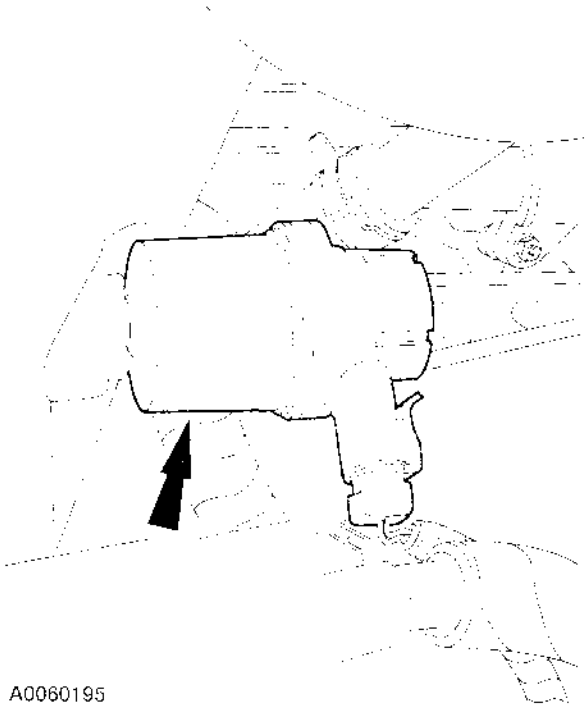
Inspect the air cleaner inlet and ducting to ensure that it is not blocked or collapsed. Inspect the air cleaner housing and filter for proper installation.

Inspect for any indication of water intrusion into air cleaner/filter.

If necessary, use Pressure Adapter Kit 014-00761 or equivalent to install a Magnehelic® gauge on the port on the air cleaner and measure restriction at high idle.

Performance Diagnostic Procedures

F-SuperDuty/Excursion



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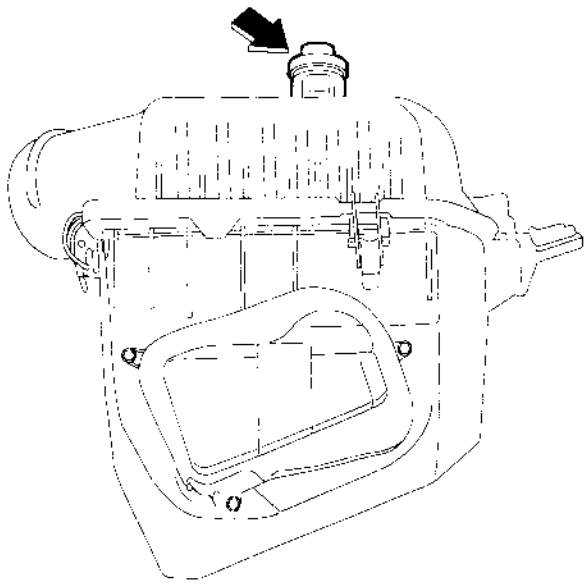
Performance Diagnostic Procedures

E-Series



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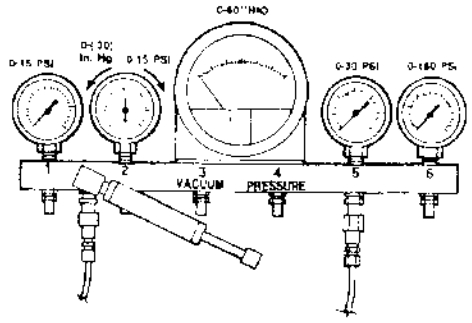
Magnehelic ® Gauge



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Possible Causes:

- Snow, plastic bags or other foreign material may restrict airflow at the air inlet
- Misrouted air cleaner ducting
- On engines recently repaired, rags or cap plugs may have been inadvertently left in an air inlet pipe

Performance Diagnostic Procedures

Tools Required:

Magnehelic ‹ gauge (part of Pressure Adapter Kit 014-00761 or equivalent)

8. EGR Position

Purpose:

The purpose of this test is to check the EGR closed, open and travel positions.

EGR Position

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

Instrument	Specification (Percent)	Actual Percent
Scan Tool	0% (0.6-1.2V) Closed	____ Closed
	90-100% (4.0-4.52V) Open	____ Open
	90% and 3.2V Travel	___ Travel

Correct concern causing out of specification values before continuing.

Recommended Procedure:

- Connect the scan tool.
- Key on, engine off.
- Access the EGR PID and record the closed EGR position.
- Access Output State Control and open the EGR valve.
- Record the valve position.
- Subtract the open valve from the closed valve position.
- If both valve travel and travel voltage are below specification, install a new EGR valve and retest.

Possible Causes:

- EGR control circuit
- EGR valve
- PCM

Performance Diagnostic Procedures

Tools Required:

Scan tool

9. Exhaust Restriction

Purpose:

The purpose of this test is to determine if an exhaust system restriction is causing a performance problem.

Exhaust Restriction

- Visually inspect the exhaust system for damage.
- Monitor the EP PID with scan tool and the engine temperature greater than 70 C (158 F) at 3,800 RPM with the vehicle in PARK/NEUTRAL.

Parameter	Specification	Measurement
EP	234 kPa (34 psi) MAX @ 3,800 RPM (F-SuperDuty/ Excursion — Early Build) 244 kPa (35 psi) MAX @ 3,800 RPM (E-Series or F-SuperDuty/ Excursion — Late Build)	

Recommended Procedure:

Connect the scan tool. Access and monitor the EP and RPM PIDS.

- Run engine at 3,800 RPM.
- Record the EP PID value.
- A low RPM or an EP PID greater than 234 kPa (34 psi) (F-SuperDuty/Excursion — Early Build) or 244 kPa (35 psi) (E-Series or F-SuperDuty/Excursion — Late Build) indicates a restricted exhaust condition.

Possible Causes:

- Collapsed tail pipe
- Clogged tail pipe

Performance Diagnostic Procedures

- Clogged catalytic converter
- Damaged muffler
- Turbocharger

Tools Required:

Scan tool

10a. Electric Fuel Pump Pressure

Purpose:

The purpose of this test is to verify the fuel system pressure.

Electric Fuel Pump Pressure

- Measure the fuel system pressure at the engine filter housing test port.
- Road test the vehicle with the engine at full load condition.

Instrument	Specification	Measurement
0-1.1 MPa (0-160 psi) gauge	310-379 kPa (45-55 psi) minimum	

If pressure fails low, go to step 10b.

If fuel pressure is above specification, check fuel return lines for restriction.

If no restriction is present, install a new fuel pressure regulator valve.

Recommended Procedure:

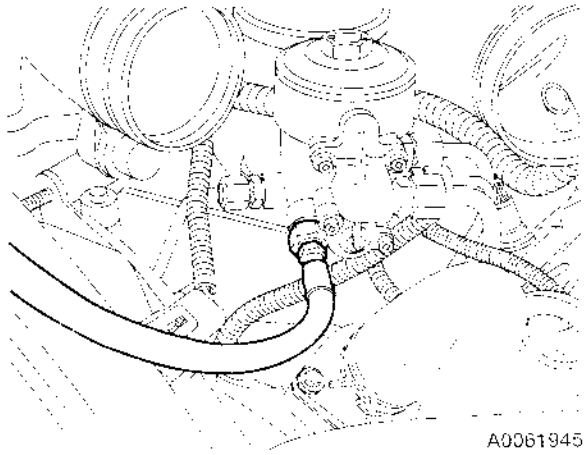
- Verify there is fuel in the tank.
- Remove the plug from the front of the engine fuel filter housing. Install Adapter 303-765 and Gauge 0-1.1 MPa (0-160 psi) Bar 014-00761 or equivalent.
- Road test the vehicle at a full load condition.

If pressure fails low, go to step 10b.

If fuel pressure is above specification, check the fuel return lines for a restriction.

Performance Diagnostic Procedures

If no restriction is present, install a new fuel pressure regulator valve.



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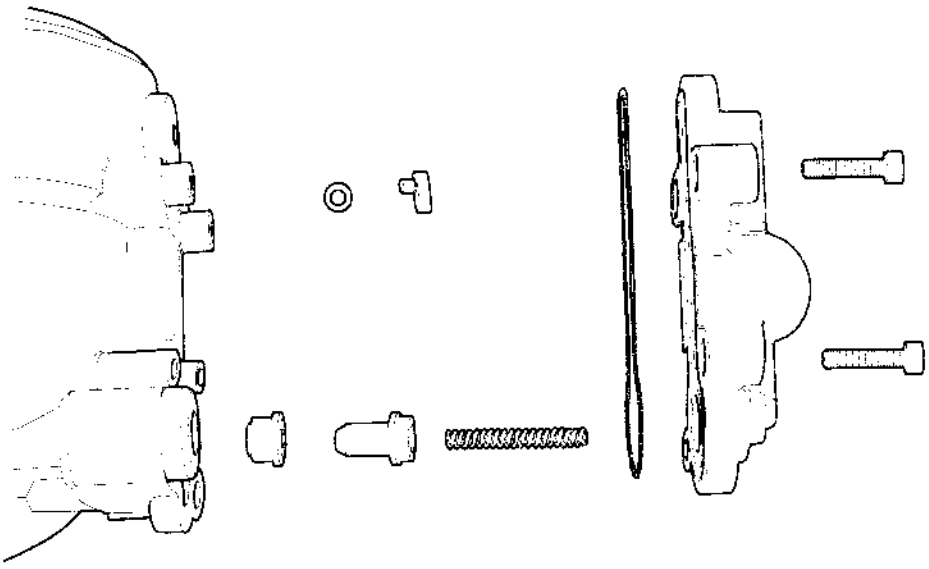

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Possible Causes:

- Fuel return line restriction
- Fuel pressure regulator valve

Tools Required:

Adapter 303-765 or equivalent

Gauge 0-1.1 MPa (0-160 psi) Bar (part of Pressure Adapter Kit 014-00761 or equivalent)

Performance Diagnostic Procedures

10b. Electric Fuel Pump Inlet Restriction

Purpose:

The purpose of this test is to isolate the cause of low fuel pressure.

Electric Fuel Pump Inlet Restriction

Measure restriction at fuel pump inlet.

Instrument	Specification	Measurement
(0-30 in Hg) Vacuum gauge	6 in Hg MAX	

Recommended Procedure:

Remove the fuel line to the inlet side of the fuel pump. Install Fuel Pump Adapter 310-111 or equivalent between the fuel inlet line and the electric fuel pump. Connect test adapter to a 0-762 mm Hg (0-30 in Hg) vacuum gauge. Measure restriction at WOT (maximum engine speed out of gear with the brakes set and the wheels blocked). If restriction is greater than 152 mm Hg (6 in Hg), there is a restriction between the fuel pump and the fuel tank. If restriction is less than 152 mm Hg (6 in Hg), inspect both fuel filters. If the filters are OK, inspect the fuel regulator valve. If the regulator and filters are OK, install a new fuel pump.

Possible Causes:

- Fuel line restriction
- Fuel pressure regulator valve
- Fuel filters
- Fuel pump

Tools Required:

Fuel Pump Adapter 310-111 or equivalent

Vacuum Gauge (part of Pressure Adapter Kit 014-00761 or equivalent)

10c: Fuel Aeration Test

Purpose

To determine if the fuel is aerated and causing a poor idle condition.

Fuel Aeration Test

Install a clear hose on the fuel return line at the fuel control module.

Performance Diagnostic Procedures

Refer to Workshop Manual Section 303.

Run at the engine at WOT for 2 minutes.

Return fuel should be free of bubbles.

Method	Check
Visual	

1. Remove the fuel return line at the fuel control module.
2. Attach a 1/4-inch diameter hose (clear) to the fuel control module and place the other end of the hose into Rotunda Tool 034-00005 or equivalent.
3. Turn the ignition on. The fuel pump will cycle on. then off. Diesel fuel may not flow out through the attached hose after only one key cycle. Repeat the key cycle until fuel flows from the attached hose.
4. Start the engine.
5. Run at WOT for 2 minutes. Return fuel should be free of bubbles.
6. If the fuel has air in it. the fuel returning to the tank will appear white. foamy or non-transparent. If no or very little air is present in the fuel. the fuel will appear clear/transparent.
7. If air is present in the return fuel, inspect the fuel system for leaks.

Possible Causes:

Note: Air can enter the fuel system at any point where there is suction in the fuel system.

- Fuel pickup in the fuel tank
- Fuel supply line entering the fuel module from the fuel tank
- Fuel return line entering the fuel module from the engine

Tools Required:

Rotunda Tool 034-00005 or equivalent

11. Perform KOER On-Demand Self Test

Purpose:

The purpose of this test is to determine if the PCM has detected any fault conditions that would cause a performance problem while the engine is running. The KOER self-test will perform step tests on the injection control pressure system and the exhaust back pressure system.

Performance Diagnostic Procedures

Step tests are PCM controlled tests where the PCM commands a specific exhaust back pressure or injection control pressure and then measures the result. If a predetermined threshold is not reached, a DTC will be generated. This test can be performed at any engine temperature.

Perform KOER On-Demand Self Test

Note: Before performing the KOER On-Demand Self-Test make sure the high pressure oil passages are free of air. A recent repair to the system may allow air to enter the oil passages. To remove the air, drive the vehicle (with deceleration and acceleration cycles) at highway speeds for 32 km (20 miles).

- The self-test will verify the ICP, EGR and VGT systems performance.

KOER DTC	

Recommended Procedure:

Note: Engine will run rough during this test.

Connect the scan tool. Turn off all accessories. If the vehicle is equipped with an APCM, it must be turned off to perform the self-test.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation.
- Refer to the scan tool operating manual for instructions.
- Key on, engine running.
- Follow the operating instructions from the diagnostic menu.
- Perform a KOER On Demand Self-Test.
- Record the DTCs and refer to the appropriate pinpoint test.

Tools Required:

Scan tool

12a. Low Idle Stability (ICP Pressure)

Purpose:

The purpose of this test is to determine if idle stability or low power is caused by a stuck or dirty IPR or faulty ICP signal.

Low Idle Stability (ICP Pressure)

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

Performance Diagnostic Procedures

Parameter	Specification @ 670 RPM	Measurement
ICP	4.5 - 5.5 MPa ± 0.3 MPa (650-800 psi ± 45 psi) (F-SuperDuty/ Excursion Early Build) 4.0 - 5.0 MPa ± 0.3 MPa (580-725 psi ±45 psi) (E-Series or F-SuperDuty/ Excursion — Late Build)	
Take reading before disconnecting ICP sensor.		

If engine RPM is unstable, disconnect the ICP sensor.

- ICP will default to 5.0 MPa (725 psi) when disconnected.
  - — If RPM smooths out. the ICP sensor or circuit is suspect.
  - — If RPM is still unstable, reconnect the ICP sensor and go to step 12b.

Recommended Procedure:

Note: The engine must be at operating temperature.

- Connect the scan tool.
- Key on, engine running.
- Access and monitor the ICP and RPM PIDS.
- Operate the engine at low idle speed.

If engine does not stabilize, disconnect the ICP sensor. If low idle speed stabilizes with the ICP sensor disconnected, the problem is most likely in the ICP sensor circuit. GO to Pinpoint Test Q. If RPM does not stabilize, reconnect the sensor and GO to 12b.

Possible Causes:

- Debris stuck in the IPR
- ICP sensor
- Circuitry

Tools Required:

Scan tool

Performance Diagnostic Procedures

12b. Injection Pressure Regulator Test

Purpose:

The purpose of this test is to determine if idle stability or low power is caused by a stuck or dirty IPR.

Low Idle Stability (ICP Pressure)

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

Parameter	Specification @ 670 RPM	Measurement
IPR	30% MAX	

Recommended Procedure:

Note: The engine must be at operating temperature.

- Connect the scan tool.
- Key on, engine running.
- Access and monitor the IPR and RPM PIDS.
- Operate the engine at low idle speed.

If the IPR duty cycle is less than the MAX specification, go to the next step. If the IPR duty cycle is greater than the MAX specification, go to Test 10e of the Hard Start/No Start Diagnostics and check for an injection control system leak.

Possible Causes:

- Debris stuck in the IPR
- Injection control system leak

Tools Required:

Scan tool

13. Boost Pressure Test

Purpose:

The purpose of this test is to determine if the engine can develop sufficient boost to obtain specific power.

Performance Diagnostic Procedures

Boost Pressure Test

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

Parameter	Specification	Measurement
MGP	22 PSIG minimum (F-SuperDuty/ Excursion) 20 PSIG minimum (E-Series)	

Recommended Procedure:

Note: If test fails low, inspect the turbocharge blades for damage. GO to Pinpoint Test KA to check the variable geometry turbocharger (VGT) operation.

Boost pressure will level out after 3,300 RPM. This is best accomplished either climbing a hill or with the vehicle fully loaded.

- Connect the scan tool.
- Key on, engine running.
- Access and monitor the MGP and RPM PIDS.
- After the engine is up to operating temperature, find an open section of road and select the best gear to achieve a 3,300 RPM acceleration.
- With the accelerator at WOT, record the highest boost pressure reading while accelerating through the 2,500-3,300 RPM range.

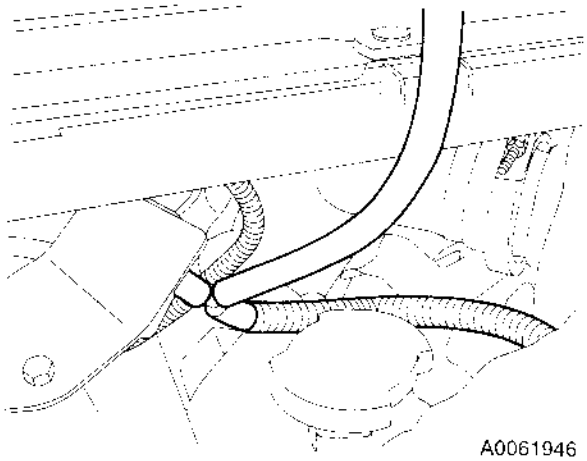
Alternate Procedure:

Install a T (manufactured locally out of common fittings) into the MAP sensor line that comes from the intake manifold. Make sure the MAP sensor is hooked up for this test.

Connect a T to a 0-30 psi gauge that is temporarily installed in the cab. Route the hose so that it is not crimped and does not come in contact with any hot surface.

Performance Diagnostic Procedures

F-SuperDuty/Excursion



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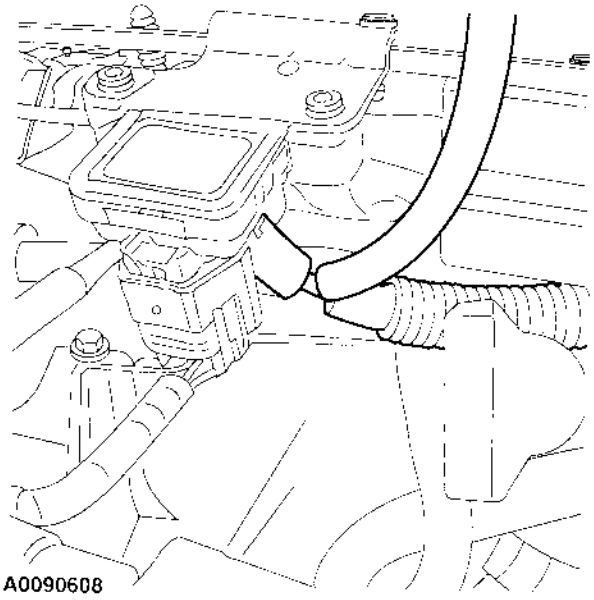
E-Series



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Possible Causes:

- MAP hose pinched or open
- Leaking intake, hoses or fittings
- Turbocharger
- Base engine

Performance Diagnostic Procedures

- Intercooler hoses leaking
- Intercooler
- EGR sticking

Tools Required

Scan tool

14. Crankcase Pressure Test

Purpose:

The purpose of this test is to measure the crankcase pressure. Crankcase pressure is a measure of how well the cylinders are sealing.

Crankcase Pressure Test - F-SuperDuty/Excursion

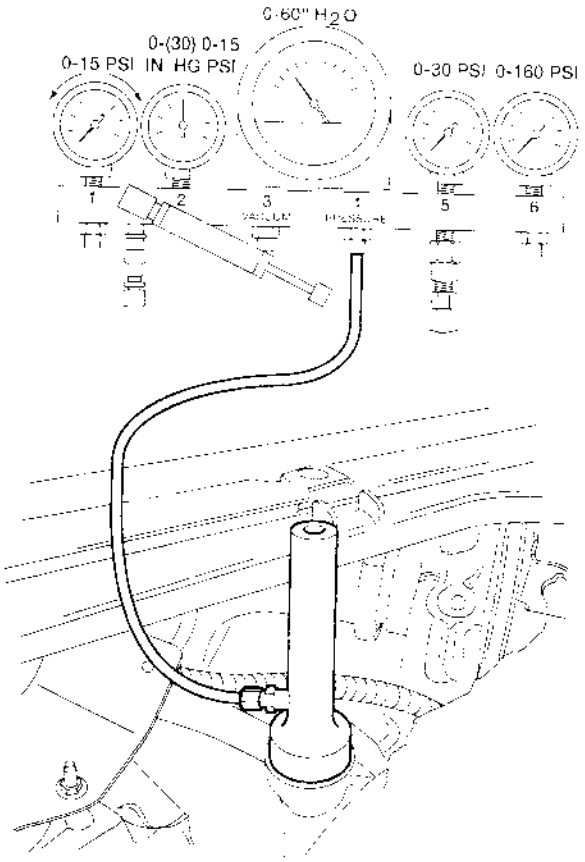
- Measure the pressure at the oil fill tube with 6.0L Crankcase Pressure Tester p/n 303-758, with engine at 70° C (158° F) minimum.
- Block the breather tube on the left valve cover.
- Measure with no load at 3,000 RPM.

Instrument	Specification.	Measurement
0-112 mm Hg (0 to 60 H_2O) Magnehelic® gauge	Less than 15 mm Hg (8 H_2O)	

If greater than 15 mm Hg (8 H_2O), refer to the base engine section in the workshop manual.

Performance Diagnostic Procedures

F-SuperDuty/Excursion



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Recommended Procedure - F-SuperDuty/Excursion:

Note: Do not plug hole on Crankcase Pressure Test Adapter 303-758.

Make sure the engine is at operating temperature. A cold engine will give higher readings. Remove the ducting to the turbocharger inlet pipe and remove the inlet pipe and elbow that connects to the breather box. Block the outlet at the valve cover with the cap provided in Pressure Test Adapter Kit 014-00761 or equivalent. Install a protective screen over the turbocharger inlet.

Screw the Crankcase Pressure Test Adapter 303-758 in the oil fill cap hole. Plumb to the Magnehelic® gauge in the gauge block. Make sure the Magnehelic® gauge has been zeroed.

Start the engine and operate at 3,000 RPM. Hold for 30 seconds minimum and take a stabilized reading. Do not block the hole at the top of the restrictor tool.

Performance Diagnostic Procedures

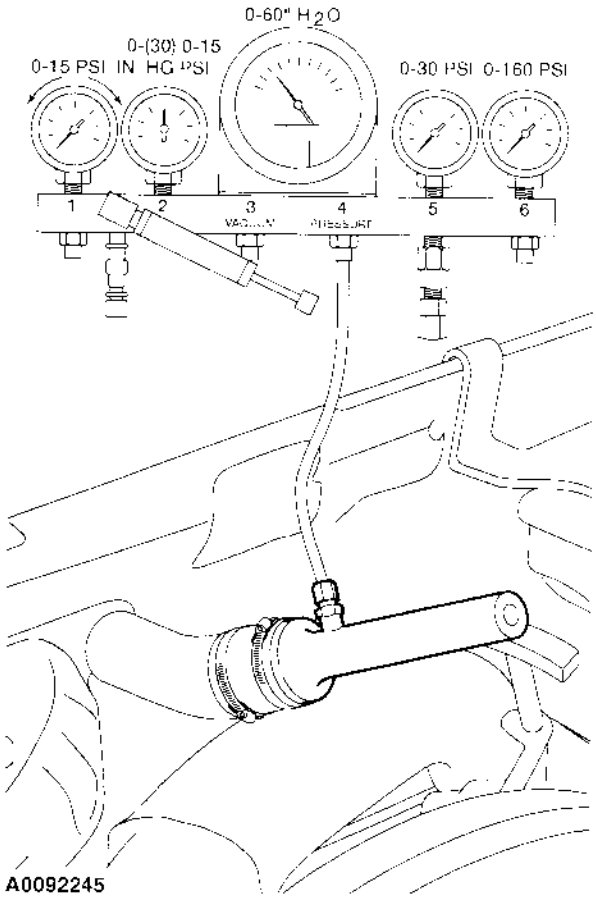
Crankcase Pressure Test - E-Series

- Measure the pressure at the oil fill tube with 6.0L Crankcase Pressure Tester p/n 303-758, with engine at 70°C (158°F) minimum.
- Block the breather tube on the left valve cover.
- Measure with no load at 3,000 RPM.

Instrument	Specification.	Measurement
0-112 mm Hg (0 to 60 H_2O) Magnehelic® gauge	Less than 15 mm Hg (8 H_2O)	

If greater than 15 mm Hg (8 H_2O), refer to the base engine section in the workshop manual.

E-Series



Performance Diagnostic Procedures

Recommended Procedure - E-Series:

Note: Do not plug hole on Crankcase Pressure Test Adapter 303-758.

Make sure the engine is at operating temperature. A cold engine will give higher readings. Remove the air cleaner assembly. Remove the ducting to the turbocharger inlet pipe. Remove the inlet pipe and elbow that connects to the breather box. For additional information, refer to Workshop Manual Section 303. Block the outlet at the valve cover with the cap provided in Pressure Test Adapter Kit 014-00761 or equivalent. Install a protective screen over the turbocharger inlet.

CAUTION

Excessive screw clamp torque may damage the oil fill tube.

Install the Crankcase Pressure Test Adapter 303-758 to the oil fill tube using an appropriate diameter hose and secure with screw clamps. Start by connecting one end of the hose to the knurled surface of Crankcase Pressure Test Adapter 303-758 and the opposite end of the hose to the oil fill tube and secure with screw clamps.

Plumb to the Magnehelic® gauge in the gauge block. Make sure the Magnehelic® gauge has been zeroed.

Start the engine and operate at 3,000 RPM. Hold for 30 seconds minimum and take a stabilized reading. Do not block the hole at the top of the restrictor tool.

Possible Causes:

- Broken or worn compression rings
- Polished cylinder bores
- Leaking or bent valves

Inspect the air induction system. If the air induction system allows dirt to enter the cylinders, it will quickly "dust" the engine causing high crankcase pressure.

Tools Required:

- Crankcase Pressure Test Adapter 303-758 or equivalent
- Magnehelic® gauge (part of Pressure Test Kit 014-00761)
- Protective screen
- Hose
- Screw clamps

Performance Diagnostic Procedures

15. Oil Aeration Test

Purpose:

The purpose of this test is to determine if the engine lube oil is aerated and causing poor idle quality.

Oil Aeration Test

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

Method	Check
Visual	

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

Recommended Procedure:

Note: The engine must be at operating temperature.

Operate the engine at 3,000 RPM for 1 minute.

Possible Causes:

- Extended oil drain intervals — the anti-foam additives in the oil may be depleted from severe use or extended intervals.
- Air may be present due to recent engine repair on injection control pressure system. It may be necessary to run the vehicle aggressively for 24-32 kilometers (15-20 miles) to remove excess air.
- Incorrect type or grade of oil.

Tools Required:

Clear container — approximately 0.95L (1-quart)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
P0046	Turbo/Super Charger Boost Control Solenoid Circuit Range/Performance	GO to Pinpoint Test AK.		
P0069	MAP/BARO Correlation	GO to Pinpoint Test AU.		
P0096	Intake Air Temperature Sensor 2 Circuit Range/Performance	GO to **G2**.		
P0097	Intake Air Temperature Sensor 2 Circuit Low Input	GO to **G6**.		
P0098	Intake Air Temperature Sensor 2 Circuit High Input	GO to **G8**.		
P0101	Mass or Volume Air Flow Circuit Range/Performance	GO to **J2**.		
P0103	Mass or Volume Air Flow Circuit High Input	GO to **J8**.		
P0107	Manifold Absolute Pressure/BARO Sensor Low Input	GO to **H2**.		
P0108	Manifold Absolute Pressure/BARO Sensor High Input	GO to **H6**.		
P0112	Intake Air Temperature Circuit Low Input	GO to **F2**.		
P0113	Intake Air Temperature Circuit High Input	GO to **F4**.		
P0117	Engine Coolant Temperature Circuit Low Input	GO to **K2**.		
P0118	Engine Coolant Temperature High Input	GO to **K4**.		
P0148	Fueling Error	GO to Pinpoint Test AT.		
P0196	Engine Oil Temperature Sensor Circuit Range/Performance	GO to **L2**.		
P0197	Engine Oil Temperature Sensor Circuit Low Input	GO to **L7**.		
P0198	Engine Oil Temperature Sensor Circuit High Input	GO to **L9**.		
P0219	Engine Overspeed Condition	[a]		
P0230	Fuel Pump Primary Circuit	GO to **M2**.		
P0231	Fuel Pump Secondary Circuit Low	GO to **M6**.		
P0232	Fuel Pump Secondary Circuit High	GO to **M10**.		
P0236	Turbo/Super Charger Boost Sensor A Circuit Range/Performance	GO to **E2**.		
P0237	Turbo/Super Charger Boost Sensor A Circuit Low	GO to **E6**.		
P0238	Turbo/Super Charger Boost Sensor A Circuit High	GO to **E10**.		
P0261	Cylinder #1 Injector Circuit Low	GO to **P1**.		
P0262	Cylinder #1 Injector Circuit High	GO to **P1**.		
P0263	Cylinder #1 Contribution/Balance	GO to **P1**.		
P0264	Cylinder #2 Injector Circuit Low	GO to **P1**.		
P0265	Cylinder #2 Injector Circuit High	GO to **P1**		

(Continued)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
P0266	Cylinder #2 Contribution/Balance	GO to **P1**.		
P0267	Cylinder #3 Injector Circuit Low	GO to **P1**.		
P0268	Cylinder #3 Injector Circuit High	GO to **P1**.		
P0269	Cylinder #3 Contribution/Balance	GO to **P1**.		
P0270	Cylinder #4 Injector Circuit Low	GO to **P1**.		
P0271	Cylinder #4 Injector Circuit High	GO to **P1**.		
P0272	Cylinder #4 Contribution/Balance	GO to **P1**.		
P0273	Cylinder #5 Injector Circuit Low	GO to **P1**.		
P0274	Cylinder #5 Injector Circuit High	GO to **P1**.		
P0275	Cylinder #5 Contribution/Balance	GO to **P1**.		
P0276	Cylinder #6 Injector Circuit Low	GO to **P1**.		
P0277	Cylinder #6 Injector Circuit High	GO to **P1**.		
P0278	Cylinder #6 Contribution/Balance	GO to **P1**.		
P0279	Cylinder #7 Injector Circuit Low	GO to **P1**.		
P0280	Cylinder #7 Injector Circuit High	GO to **P1**.		
P0281	Cylinder #7 Contribution/Balance	GO to **P1**.		
P0282	Cylinder #8 Injector Circuit Low	GO to **P1**.		
P0283	Cylinder #8 Injector Circuit High	GO to **P1**.		
P0284	Cylinder #8 Contribution/Balance	GO to **P1**.		
P0297	Vehicle Overspeed Condition	[a]		
P0298	Engine Oil Overtemperature Condition	GO to **L19**.		
P0299	Turbo/SuperCharger Under Boost	GO to Pinpoint Test KA.		
P0300	Random Misfire Detected	GO to Pinpoint Test AR.		
P0301	Cylinder #1 Misfire Detected	GO to **P7**.		
P0302	Cylinder #2 Misfire Detected	GO to **P7**.		
P0303	Cylinder #3 Misfire Detected	GO to **P7**.		
P0304	Cylinder #4 Misfire Detected	GO to **P7**.		
P0305	Cylinder #5 Misfire Detected	GO to **P7**.		
P0306	Cylinder #6 Misfire Detected	GO to **P7**.		
P0307	Cylinder #7 Misfire Detected	GO to **P7**.		
P0308	Cylinder #8 Misfire Detected	GO to **P7**.		
P0335	Crankshaft Position Sensor A Circuit	GO to Pinpoint Test D.		
P0336	Crankshaft Position Sensor A Circuit Range/Performance	GO to Pinpoint Test D.		
P0340	Camshaft Position Sensor A Circuit (Bank 1 or single sensor)	GO to Pinpoint Test V.		
P0341	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor)	GO to Pinpoint Test V.		
P0381	Glow Plug/Heater Indicator Circuit	[a]		

(Continued)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
P0401	Exhaust Gas Recirculation Flow Insufficient Detected	GO to **W2**.		
P0402	Exhaust Gas Recirculation Flow Excessive Detected	GO to **W2**.		
P0403	Exhaust Gas Recirculation Control Circuit	GO to **W4**.		
P0404	Exhaust Gas Recirculation Control Circuit Range/Performance	GO to **W9**.		
P0405	Exhaust Gas Recirculation Sensor A Circuit Low	GO to **W10**.		
P0406	Exhaust Gas Recirculation Sensor A Circuit High	GO to **W14**.		
P0407	Exhaust Gas Recirculation Sensor B Circuit Low	GO to Pinpoint Test AX.		
P0408	Exhaust Gas Recirculation Sensor B Circuit High	GO to Pinpoint Test AX.		
P0460	Fuel Level Sensor Circuit	[a]		
P0461	Fuel Level Sensor Circuit Range/Performance	[a]		
P0470	Exhaust Pressure Sensor	GO to **X2**.		
P0471	Exhaust Pressure Sensor Range/Performance	GO to **X6**.		
P0472	Exhaust Pressure Sensor Low Input	GO to **X10**.		
P0473	Exhaust Pressure Sensor High Input	GO to **X15**.		
P0478	Exhaust Pressure Control Valve High Input	GO to Pinpoint Test KA.		
P0480	Fan 1 Control Circuit	GO to Pinpoint Test AH.		
P0487	EGR Throttle Position Control Circuit	GO to Pinpoint Test AX.		
P0488	EGR Throttle Position Range/Performance	GO to Pinpoint Test AX.		
P0500	Vehicle Speed Sensor A	[c]		
P0528	Fan Speed Sensor Circuit No Signal	GO to Pinpoint Test AH.		
P0560	System Voltage	GO to Pinpoint Test A.		
P0562	System Voltage Low	GO to Pinpoint Test A.		
P0563	System Voltage High	GO to Pinpoint Test A.		
P0565	Cruise Control ON Signal	GO to Pinpoint Test Y.		
P0566	Cruise Control OFF Signal	GO to Pinpoint Test Y.		
P0567	Cruise Control RESUME Signal	GO to Pinpoint Test Y.		
P0568	Cruise Control SET Signal	GO to Pinpoint Test Y.		
P0569	Cruise Control COAST Signal	GO to Pinpoint Test Y.		
P0603	Powertrain Control Module Keep Alive Memory (KAM) Error	GO to Pinpoint Test Z.		
P0605	Powertrain Control Module Read Only Memory (ROM) Error	GO to Pinpoint Test AA.		
P0606	ECM/PCM Processor	[b]		
P0611	Fuel Injector Control Module Performance	Replace FICM.		
P0620	Generator 1 Control Circuit	[g]		

(Continued)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
P0623	Generator Lamp Control Circuit	g		
P0645	A/C Clutch Relay Control Circuit	GO to Pinpoint Test AV.		
P0649	Cruise Control Lamp Control Circuit	d		
P0670	Glow Plug Module Control Circuit	GO to Pinpoint Test AF.		
P0671	Cylinder 1 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0672	Cylinder 2 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0673	Cylinder 3 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0674	Cylinder 4 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0675	Cylinder 5 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0676	Cylinder 6 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0677	Cylinder 7 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0678	Cylinder 8 Glow Plug Circuit	GO to Pinpoint Test AF.		
P0683	Glow Plug Control Module to PCM Communication Circuit	GO to Pinpoint Test AF.		
P0700	Transmission Control System (MIL Request)	h		
P0703	Brake Switch B Input Circuit	GO to Pinpoint Test AY.		
P0704	Clutch Switch Input Circuit	GO to Pinpoint Test C.		
P1000	OBD Systems Readiness Test Not Complete	GO to Pinpoint Test AC.		
P1001	KOER Not Able To Complete. KOER Aborted	a		
P1102	Mass Air Flow Sensor In Range But Lower Than Expected	GO to Pinpoint Test J.		
P1139	Water in Fuel Indicator Circuit	d		
P1148	Generator 2 Control Circuit	g		
P1149	Generator 2 Control Circuit High	g		
P1184	Engine Oil Temperature Sensor Out Of Self Test Range	GO to **L13**.		
P1260	Theft Detected. Vehicle Immobilized	j		
P1334	EGR Throttle Position Sensor Minimum Stop Performance	GO to Pinpoint Test AX.		
P1335	EGR Position Sensor Minimum Stop Performance	GO to Pinpoint Test W.		
P1378	FICM Supply Voltage Circuit Low	GO to **S2**.		
P1379	FICM Supply Voltage Circuit High	GO to **S7**.		
P1408	Exhaust Gas Recirculation Flow Out Of Self-Test Range	k		
P1464	A/C Demand Out Of Self-Test Range	GO to Pinpoint Test AM.		
P1501	Vehicle Speed Sensor Out Of Self-Test Range	e		
P1502	Invalid Test -- Auxiliary Power Control Module Functioning	GO to Pinpoint Test AE.		
P1531	Invalid Test — Accelerator Pedal Movement	Repeat the self-test.		

(Continued)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
P1536	Parking Brake Switch Circuit	GO to Pinpoint Test I.		
P1635	Tire/Axle Out Of Acceptable Range	c		
P1639	Vehicle ID Block Corrupted, Not Programmed	c		
P1703	Brake Switch Out Of Self-Test Range	GO to Pinpoint Test AI.		
P1705	Transmission Range Circuit Not Indicating Park/Neutral During Self-Test	GO to Pinpoint Test AL.		
P1725	Insufficient Engine Speed Increase During Self-Test	m		
P1726	Insufficient Engine Speed Decrease During Self-Test	m		
P2122	Throttle/Pedal Position Sensor/Switch D Circuit Low Input	GO to **AG2**.		
P2123	Throttle/Pedal Position Sensor/Switch D Circuit High Input	GO to **AG8**.		
P2127	Throttle/Pedal Position Sensor/Switch E Circuit Low Input	GO to **AG2**.		
P2128	Throttle/Pedal Position Sensor/Switch E Circuit High Input	GO to **AG8**.		
P2132	Throttle/Pedal Position Sensor/Switch F Circuit Low Input	GO to **AG2**.		
P2133	Throttle/Pedal Position Sensor/Switch F Circuit High Input	GO to **AG8**.		
P2138	Throttle/Pedal Position Sensor/Switch D/E Voltage Correlation	GO to **AG13**.		
P2139	Throttle/Pedal Position Sensor/Switch D/F Voltage Correlation	GO to **AG13**.		
P2140	Throttle/Pedal Position Sensor/Switch E/F Voltage Correlation	GO to **AG13**.		
P2199	Intake Air Temperature 1/2 Correlation	GO to Pinpoint Test AW.		
P2262	Turbo/Super Charger Boost Pressure Not Detected — Mechanical	GO to Pinpoint Test KA.		
P2263	Turbo/Super Charger System Performance	GO to Pinpoint Test KA.		
P2269	Water in Fuel Condition	GO to Pinpoint Test O.		
P2284	Injector Control Pressure Sensor Circuit Range/Performance	GO to Pinpoint Test AO.		
P2285	Injector Control Pressure Sensor Circuit Low	GO to **Q2**.		
P2286	Injector Control Pressure Sensor Circuit High	GO to **Q6**.		
P2288	Injector Control Pressure Too High	GO to Pinpoint Test AO.		
P2289	Injector Control Pressure Too High - Engine Off	GO to Pinpoint Test AP.		
P2290	Injector Control Pressure Too Low	GO to **AO9**.		
P2291	Injector Control Pressure Too Low - Engine Cranking	GO to Pinpoint Test AQ.		
P2552	FICMM Circuit Throttle/Fuel Inhibit Circuit	GO to Pinpoint Test AT.		

(Continued)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
P2614	Camshaft Position Output Circuit	GO to Pinpoint Test V.		
P2617	Crankshaft Position Output Circuit	GO to Pinpoint Test D.		
P2623	Injector Control Pressure Regulator Circuit	GO to Pinpoint Test R.		
U0101	Lost Communication with TCM	Replace PCM.		
U0105	Lost Communication with FICM	GO to Pinpoint Test AS.		
U0155	Lost Communication with Instrument Cluster	↓		
U0306	Software Incompatibility with Fuel Injector Control Module	↓		
B1213	Less than two keys programmed to the system	↓		
B1342	ECU damaged (EEPROM in PCM not working, replace PCM)	↓		
B1600	PATS Ignition Key Transponder Signal Is Not Received	↓		
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	↓		
B1602	PATS Received Invalid Format Of Key-Code From Ignition Key Transponder	↓		
B1681	PATS Transceiver Module Signal Is Not Received	↓		
B2103	Antenna Not Connected	↓		
B2431	Transponder Programming Failed	↓		
P1610	Interactive Reprogramming Code — Replace PCM module	Reflash the module.		
P1611	Interactive Reprogramming Code — Diagnose Further	Reflash the module.		
P1615	Interactive Reprogramming Code — Flash Erase Error	Reflash the module.		
P1616	Interactive Reprogramming Code — Flash Erase Error, Low Voltage	Reflash the module.		
P1617	Interactive Reprogramming Code — Block Programming Error	Reflash the module.		
P1618	Interactive Reprogramming Code — Block Programming Error, Low Voltage	Reflash the module.		

(Continued)

Diagnostic Trouble Code (DTC) Descriptions

4-Digit	Description	Pinpoint Test Step GO to Direction		
		KOEO	KOER	Continuous
	Malfunction Indicator	f		

a Rerun self-test, refer to Symptom Quick Test for further diagnostic information.
d Refer to the Workshop Manual Section 413 for diagnostic procedures.
e For F-SuperDuty/Excursion, vehicle speed information is provided by the anti-lock brake system. Refer to Workshop Manual Section 206. For E-Series, refer to Workshop Manual Section 307.
b Clear the DTCs. Repeat the self-test. If the DTC is retrieved again, install a new PCM.
g Refer to Workshop Manual Section 414 for diagnostic procedures.
h Refer to Workshop Manual Section 307 for diagnostic procedures.
j Refer to Workshop Manual Section 419 for diagnostic procedures.
k Refer to Performance Diagnostic Procedures for further diagnostics.
c Refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory — Flash EEPROM
m If the Glow Plug Monitor Self-Test aborts and this DTC is present, repeat the Glow Plug Monitor Self-Test.
l Refer to Workshop Manual Section 418 for diagnostic procedures.
f Malfunction indicator lamp concerns. Refer to Section 3, Symptom Chart

Injector Interrupt for Enhanced Diagnostics

Diagnose Rough Idle Only

This test will help diagnose weak cylinders/injectors by allowing the scan tool operator to interrupt injectors individually. This is performed by using scan tools to interrupt injector output to the engine cylinder that corresponds to the number on the injector PID.

A performance diagnostic sheet should be completed before using this tool. High ICP after the high idle test (test 12 on the performance diagnostics sheet to indicate oil aeration), low fuel pressure, bad dual-mass flywheel, and high crankcase pressure are just a few of the possibilities that can cause a rough idle. After completing the performance diagnostic sheet, if there is no direction given for corrective action and rough idle is present, use the enhanced diagnostic ability of the Injector Interrupt.

Diagnose Rough Idle (Only)

Start the engine and monitor the EOT — the EOT is to be maintained within -15°C (5°F) during the test. The test must be performed while rough idle is occurring. Record the MFDES reading before interrupting any injectors; this will be the baseline for the rest of the test. The MFDES reading will not steady and will fluctuate rapidly. Take a five second snapshot of the PID information and record the high and low MFDES readings on the Injector Interrupt Tool Enhanced diagnostics sheet, using only MFDES numbers that have appeared at lease two times during the recording. After recording a baseline, interrupt each injector individually and repeat the above steps to obtain the high and low readings while each injector is interrupted. These numbers should be recorded on the Injector Interrupt Tool Enhanced diagnostic sheet.

The enhanced diagnostic sheet is intended to be photocopied and then completed for each vehicle that is tested. A completed performance diagnostic sheet and enhanced diagnostic sheet must accompany any returned warranty parts and cores.

The following example illustrates the use of a scan tool to monitor the MFDES, as described in the paragraph above.

Injector Off	MFDES	Average MFDES	Deviation
Baseline = 0	10.1-10.1 mg	10.1	
1	10.7-10.9 mg	10.8	0.7
2	10.6-10.9 mg	10.9	0.7
3	10.5-11.0 mg	10.8	0.7
4	9.8-10.5 mg[a]	10.2	0.1
5	10.5-10.9 mg	10.7	0.6

(Continued)

Injector Interrupt for Enhanced Diagnostics

Injector Off	MFDES	Average MFDES	Deviation
6	10.2-10.6 mg[a]	10.4	0.3
7	10.4-11.0 mg	10.7	0.6
8	10.6-10.8 mg	10.7	0.6

a Low cylinder contributor

EOT = 176 F

mg = milligrams

Complete the enhanced diagnostic graph to illustrate the difference between cylinders and help identify weak cylinders/injectors. To start this process, derive the average for each of the MFDES readings by adding the high and low numbers together and dividing by two. For example, cylinder No. 5 has a reading of 10.5-10.9. Therefore, the equation would be: 10.5 + 10.9 = 21.4 divided by 2 = 10.7 (if needed, round the number up to the nearest tenth). Record this number on the enhanced diagnostic sheet for the appropriate cylinder. Now, subtract his number from the average MFDES recorded for the baseline. For example, cylinder No. 5 has an average MFDES of 10.7 and if the baseline MFDES was 10.1, the equation would be: 10.7-10.1 = 0.6. Therefore, 0.6 would be the deviation from the baseline. Perform these calculations for all cylinder readings.

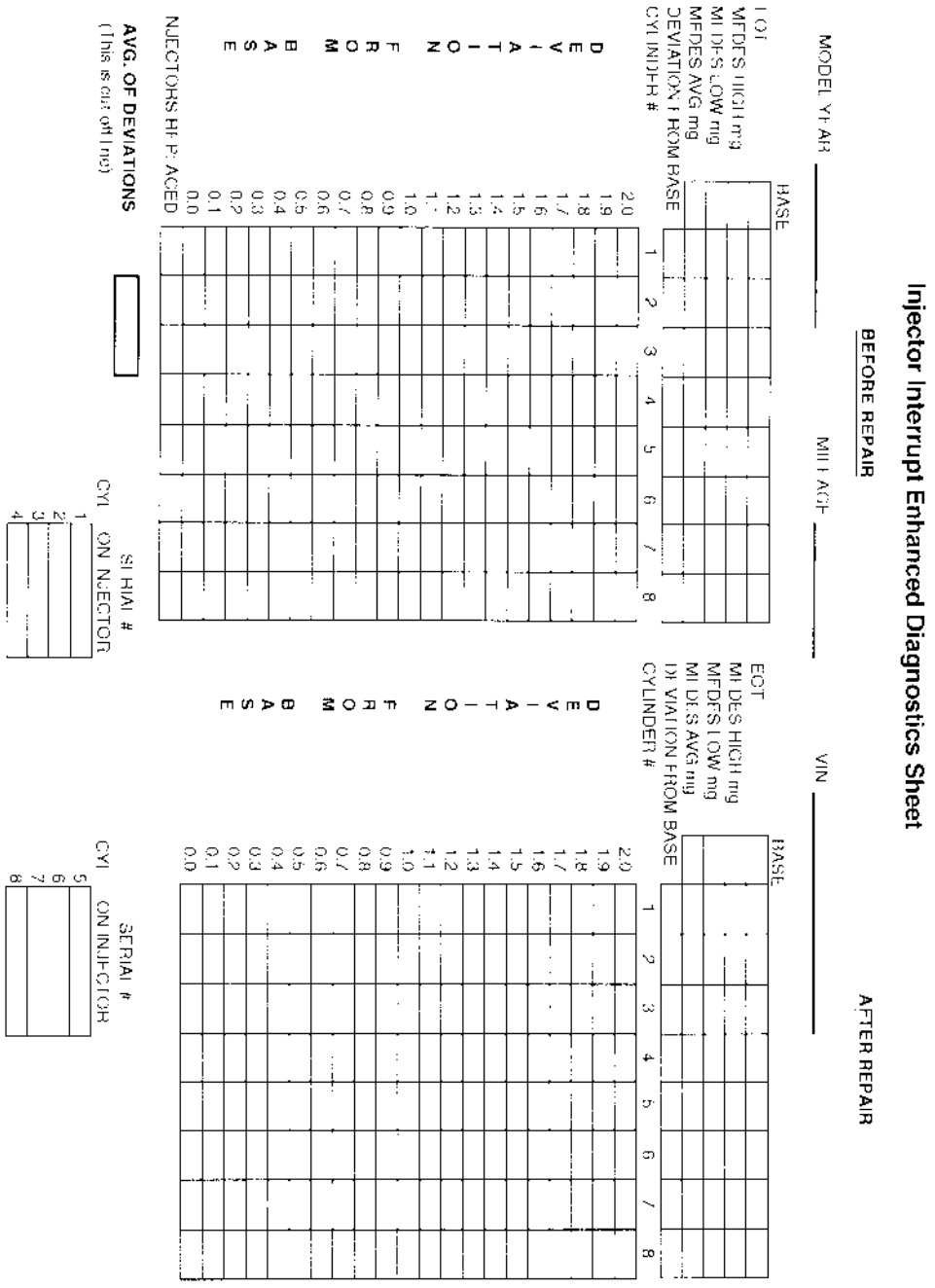
In order to get the cutoff number, average all of the deviations. For example, as in the sample, we would add the following numbers: 0.7 + 0.7 + 0.7 + 0.1 + 0.6 +0.3 +0.6 + 0.6 = 4.3. Divide the sum by eight and round to the nearest tenth: 4.3 ‡ 8 = 0.5375 ~ 0.5. Therefore, 0.5 would be the cutoff line for weak cylinders/injectors. By using this test, cylinders No. 4 and 6 have been identified as being weak.

Perform a relative compression test using a scan tool or check compression with a mechanical gauge on the weak cylinders and one or two of the strong contributing cylinders. Compare the weak cylinder readings against the strong contributing cylinders to verify that the power cylinder is mechanically sound. If the compression readings are within 20% of each other, the power cylinders can be considered good.

After injector replacement, test drive the vehicle for at least 20 miles and confirm that the rough idle concern has been corrected, do not retest.

Injector Interrupt for Enhanced Diagnostics

If a rough idle persists, the test should be performed again. After all tests are run, all DTCs should be cleared before returning the vehicle to the customer.



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