

Engine

Inspection and Verification - Engine Performance

NOTE: There are 2 diagnostic paths that can be followed depending on the type of engine concern. Carry out Inspection and Verification - Engine Performance or Inspection and Verification - NVH.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE:** Make sure to use the latest scan tool software release.

If the cause is not visually evident, connect the scan tool to the DLC.

5. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM.

If the scan tool does not communicate with the VCM:

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM.
- check for No Power To The Scan Tool, to diagnose no power to the scan tool,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).

6. If the scan tool does not communicate with the vehicle:
 - verify the ignition key is in the ON position.
 - verify the scan tool operation with a known good vehicle.
 - to diagnose no response from the PCM,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).
7. Carry out the network test.
 - If the scan tool responds with no communication for one or more modules,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).
 - If the network test passes, retrieve and record continuous memory DTCs.
8. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.
9. If the DTCs retrieved are related to the concern,
REFER to: Electronic Engine Controls (303-14B Electronic Engine Controls - 6.7L Power Stroke Diesel, Diagnosis and Testing).
10. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Engine Performance.

Inspection and Verification - NVH

1. NVH symptoms should be identified using the diagnostic tools and techniques that are available. For a list of these techniques, tools, an explanation of their uses and a glossary of common terms,
REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing).
Since it is possible that any one of multiple systems may be the cause of the symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system.
2. Verify the customer concern by operating the engine to duplicate the condition.
3. Inspect the engine for installation of an aftermarket oil filter. Review oil and filter maintenance history to make sure the vehicle has not gone beyond the standard Ford recommended oil change interval.
4. Check the engine oil level and check the oil for contamination. Low engine oil level or contaminated oil are a common cause of engine noise. If the oil is contaminated, the source of the contamination must be identified and repaired as necessary.
5. Visually inspect for obvious signs of mechanical damage.
6. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
7. **NOTE:** Make sure to use the latest scan tool software release.
If the cause is not visually evident, connect the scan tool to the DLC.
8. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM.
If the scan tool does not communicate with the VCM:
 - check the VCM connection to the vehicle.
 - check the scan tool connection to the VCM.
 - check for No Power To The Scan Tool, to diagnose no power to the scan tool,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).
9. If the scan tool does not communicate with the vehicle:
 - verify the ignition key is in the ON position.
 - verify the scan tool operation with a known good vehicle.
 - to diagnose no response from the PCM,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).
10. Carry out the network test.
 - If the scan tool responds with no communication for one or more modules,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).
 - If the network test passes, retrieve and record continuous memory DTCs.
11. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.
12. If the DTCs retrieved are related to the concern,
REFER to: Communications Network (418-00 Module Communications Network, Diagnosis and Testing).
13. If no DTCs related to the concern are retrieved, continue the inspection and verification if a noise concern is related to the engine. For vibration concerns and noise concerns such as powertrain mounts, air intake system and starter
GO to Symptom Chart - NVH.

In some cases, a noise may be a normal characteristic of that engine type. In other cases the noise may require further investigation. Comparing the noise to a similar year/model vehicle equipped with the same engine will aid in determining if the noise is normal or abnormal.

Once a customer concern has been identified as an abnormal engine noise, it is critical to determine the location of the specific noise. Use the EngineEAR/ChassisEAR or stethoscope (the noise will always be louder closer to the noise source) to isolate the location of the noise to one of the following areas.

- Upper end of engine
- Lower end of engine

- Front of engine
- Rear of engine

Upper end engine noise

The fuel system, camshaft, timing drive components and valve train are common sources of upper end engine noise (ticking, knocking or rattle). Upper end engine noise can be determined using the EngineEAR/ChassisEAR or stethoscope on the valve cover bolts. If the noise is loudest from the valve cover bolts, then the noise is upper end. The EngineEAR/ChassisEAR or stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder. Removal of the valve covers will be required to pinpoint the source of the noise.

Fuel system noise

A common source of engine ticking noise is the switching of the fuel pressure control valve to fuel volume control valve. After the vehicle is started the high-pressure fuel injection pump switches modes and it makes a louder noise than when the vehicle was first started. There is an inherent ticking noise that comes from the high-pressure fuel injection pump as it switches to the more fuel efficient mode using fuel volume control valve only. This noise may be characteristic of the fuel system switching from the fuel pressure control valve to the fuel volume control valve. This noise may be more noticeable as the normal diesel engine noise diminishes. This is normal engine noise that can be verified by listening to another vehicle. If the noise is excessive or irregular, use the EngineEAR/ChassisEAR or stethoscope to isolate the noise.

Valve train

Hydraulic lash adjusters can make an engine ticking or tapping noise noticeable at any engine rpm or temperature and is audible through the wheel well or an open hood. However, with the hood down, hydraulic lash adjuster noise can be heard as a light tapping noise through the wheel well and is considered normal. The EngineEAR/ChassisEAR or stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder, some disassembly of the engine may be required to inspect for damage or wear.

Turbocharger noise

Some vehicles may exhibit a turbocharger spool-down (hoot) noise on engine throttle tip-out when engine oil temperature is below 65Â°C (150Â°F) and/or an oscillating turbocharger whine at idle with engine oil temperature below 10Â°C (50Â°F). The 6.7L diesel includes design improvements to reduce overall inherent diesel engine noise. These sound reduction improvements enable certain characteristic noises to be more easily heard. Using the incorrect engine oil can negatively impact the level of noise.

Lower end engine noise

The crankshaft, connecting rod(s) and bearings are common sources of lower end engine noise (tick/tap or typewriter noise). This noise should be considered characteristic as it is not detrimental to engine durability. The 6.7L diesel includes design improvements to reduce overall inherent diesel engine noise. These sound reductions improvements enable certain characteristic noises to be more easily heard. Lower end noises can be determined by using the oil pan or cylinder block lug bosses. If the noise is loudest from these areas then the noise is lower end. If an engine noise is isolated to the lower end, some disassembly of the engine may be required to inspect for damage or wear. Using the incorrect engine oil can negatively impact the level of noise.

Front of engine noise

A common source of noise from the front of the engine (squeal, chirp, whine or hoot) is the FEAD components. To isolate FEAD noise, carry out the Engine Accessory Test, REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing).

Oil pump noise

The oil pump may whine due to air getting into the lubrication system near the oil pump. One source of an oil pump whine are cut gaskets between the upper oil pan and the engine front cover (the 2 gaskets that seal the oil pump). Another cause is oil aeration which could be a missing O-ring seal on the oil pick-up tube or a cracked oil pick-up tube. Removal of the upper oil pan may be necessary to inspect internal engine components.

Some other noises from the front of the engine (ticking, tapping or rattle) may be internal to the engine. Use the EngineEAR/ChassisEAR or stethoscope on the engine front cover to determine if the noise is internal to the engine. Removal of the engine front cover may be necessary to inspect internal engine components.

Rear of engine noise

A common source of noise from the rear of the engine (knocking) is the flexplate. Inspection of the flexplate will be necessary.

Follow the steps below to help identify the source of engine noise. Compare the characteristics of the engine noise to those listed in the NVH chart.

NOTE: This procedure uses multiple tools/methods to help locate the source of engine noise. It may be necessary to repeatedly compare the sound between the tools/methods to help locate the source of the noise.

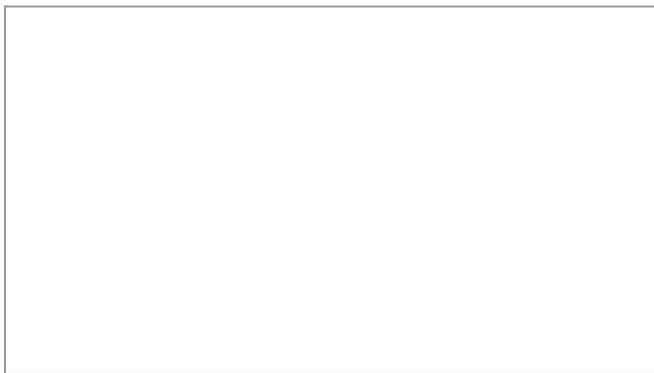
14. Using a stethoscope, try to locate the source of the engine noise. Note the location of any suspected noises heard with the stethoscope.

Click here to view engine noise diagnosis using a stethoscope.

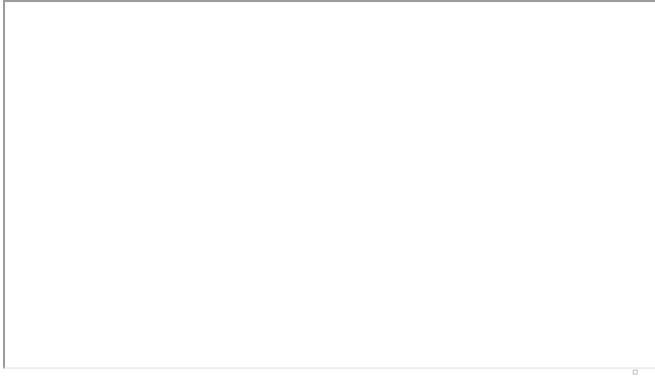


15. If the noise is unclear using a stethoscope, attach ChassisEAR to multiple locations of the engine. Attach ChassisEAR to suspected areas of the noise and areas not suspected as the source of the noise for comparison purposes. ChassisEAR allow up to 6 clamps to locate the source of the noise. Instead of or in addition to using the ChassisEAR, EngineEAR can also be used. Wave or hold the EngineEAR over suspected areas of the engine to help identify the suspected noise.

Click here to view engine noise diagnosis using ChassisEAR.

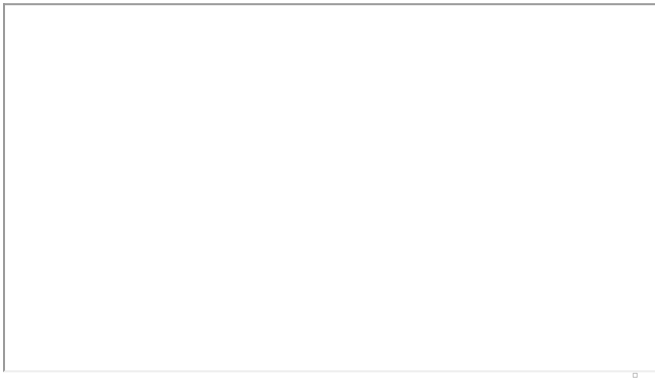


[Click here to view engine noise diagnosis using EngineEAR.](#)



16. If the noise is still unclear using the stethoscope, ChassisEAR or EngineEAR, connect the scan tool. Use the VCMM oscilloscope function to view and graph noise. Attach the VCMM accelerometers at the loudest suspected locations as determined previously by using the stethoscope, Chassis Ears or EngineEAR. Using the scan tool and VCMM accelerometers, graph the noise through the oscilloscope and determine if the noise is an upper or lower engine noise. For upper engine noise, place the accelerometers at either end of the valve cover. For lower engine noises, place the accelerometers at either end or side to side of the engine block.

[Click here to view engine noise diagnosis using VCMM and accelerometers.](#)



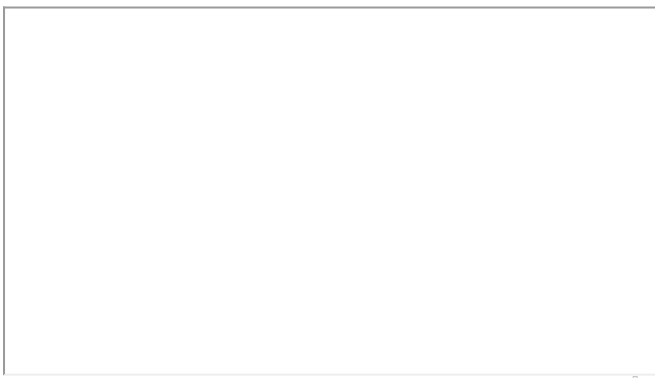
17. **NOTE:** ChassisEAR and EngineEAR allow the use of a microphone for listening. These tools may be connected directly to the VCMM by using a 3.5 mm male to RCA female adapter.

If the noise remains unclear or to verify the suspected noise from the stethoscope ChassisEAR, EngineEAR or graphed accelerometers, using a 3.5mm male to RCA female adapter, attach the ChassisEAR or EngineEAR to the VCMM. Graph all or some of the noises, as like the accelerometers.

[Click here to view engine noise diagnosis using VCMM and ChassisEAR.](#)



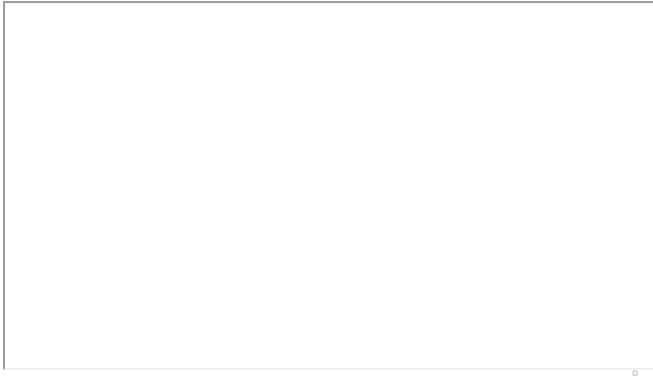
[Click here to view engine noise diagnosis using VCMM and EngineEAR.](#)



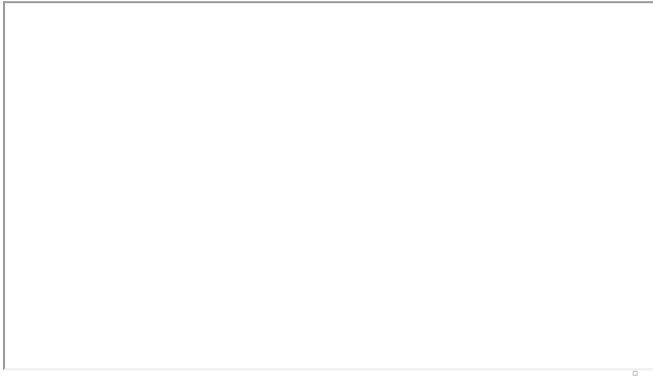
18. If the suspected noise location still cannot be determined, using the oscilloscope function of the VCMM, graph any combination of the accelerometer(s), ChassisEAR and/or EngineEAR to compare or identify the suspected noise.

All 4 ports on the VCMM may be utilized for graphing noise.

[Click here to view engine noise diagnosis using VCMM and ChassisEAR and accelerometer\(s\).](#)



[Click here to view engine noise diagnosis using VCMM and EngineEAR and accelerometer\(s\).](#)



19. After the noise is localized, note the characteristics of the noise, including type of noise, frequency and conditions when the noise occurs and GO to Symptom Chart - NVH.

Symptom Chart - Engine Performance

Symptom Chart - Engine Performance

Symptom	Possible Sources	Action
• Difficult starting	• Inoperative or damaged glow plug system	• Refer to the appropriate section in Group 303 for the procedure. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Inoperative or damaged fuel system	
	• Inoperative or damaged starting system	
	• Damaged charging system/ battery	
	• Burnt valve	
	• Worn piston	• INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	• Worn piston rings	• INSTALL a new piston. TEST the system for normal operation after the repair.
	• Worn cylinder	• INSTALL new piston rings. TEST the system for normal operation after the repair.
	• Damaged head gasket	• INSTALL a new cylinder block. TEST the system for normal operation after the repair.
• Poor idling	• Damaged head gasket	• INSTALL a new cylinder head gasket. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	• Inoperative or damaged EGR system	• Refer to the appropriate section in Group 303 for the procedure. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	• Inoperative or damaged cooling system	• Refer to the appropriate section in Group 303 for the procedure.
	• Inoperative or damaged fuel system	
	• Damaged hydraulic lash adjuster	• INSTALL a new hydraulic lash adjuster. TEST the system for normal operation after the repair.
	• Incorrect valve-to-valve seat contact	• INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	• Damaged head gasket	• INSTALL a new cylinder head gasket. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.

Engine runs rough	- Inoperative or damaged fuel system - Leaking or damaged CAC, intake manifold or gaskets - EGR system fault - Inoperative or damaged cooling system - Malfunctioning or damaged air intake system	Refer to the appropriate section in Group 303 for the procedure.
	Damaged hydraulic lash adjuster	INSTALL a new hydraulic lash adjuster. REFER to: Hydraulic Lash Adjuster (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Burnt or sticking valve	INSTALL a new valve. TEST the system for normal operation after the repair.
	Weak or broken valve spring	INSTALL a new valve spring. TEST the system for normal operation after the repair.
	Worn valve guides, valves and seals	INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
Excessive oil consumption	Leaking oil	REPAIR oil leakage. TEST the system for normal operation after the repair.
	Turbocharger oil seals leaking	REFER to Turbocharger Internal Oil Leak Test. REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Diagnosis and Testing). TEST the system for normal operation after the repair.
	Malfunctioning crankcase vent oil separator	REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.
	Oil dilution (fuel)	CHANGE oil to correct specification. TEST the system for normal operation after the repair.
	Worn valve stem seal	INSTALL a new valve stem seal. TEST the system for normal operation after the repair.
	Worn valve stem or valve guide	INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Sticking piston rings	INSTALL new piston rings. TEST the system for normal operation after the repair.
	Worn piston ring groove	INSTALL a new piston and piston pin. TEST the system for normal operation after the repair.
	Worn piston or cylinder	INSTALL a new piston or cylinder block. TEST the system for normal operation after the repair.
Insufficient power	- Air intake system blockage - Boost leaks or blockage - Inoperative or damaged fuel system	Refer to the appropriate section in Group 303 for the procedure. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
	Turbocharger damage	INSPECT the turbocharger. REFER to the Check for Free Rotation. REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Diagnosis and Testing). TEST the system for normal operation after the repair.
	Damaged exhaust or exhaust leaks at turbocharger housing or exhaust manifold	INSPECT for leaks. Leaks can be detected audibly or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as necessary. TEST the system for normal operation after the repair.
	Oil level too high	DRAIN oil to correct level.
	Incorrect engine oil	INSTALL correct specification engine oil. TEST the system for normal operation after the repair.
	Low oil pressure	CARRY OUT the Oil Pressure Test in this section. Compare to specifications, repair as necessary. TEST the system for normal operation after the repair.
	- Excessive accessory drive belt loading - Inoperative or damaged cooling system	Refer to the appropriate section in Group 303 for the procedure.
	Damaged or plugged exhaust system	INSPECT exhaust system. TEST the system for normal operation after the repair.
	Incorrect tire size	REFER to: Identification Codes (100-01 Identification Codes, Description and Operation). TEST the system for normal operation after the repair.
	Dragging brakes	REFER to: Brake System (206-00 Brake System - General Information, Diagnosis and Testing). TEST the system for normal operation after the repair.
	Slipping transmission	Refer to the appropriate section in Group 307 for the procedure.
	Malfunctioning hydraulic lash adjuster	INSTALL a new hydraulic lash adjuster. REFER to: Hydraulic Lash Adjuster (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	- Compression leakage at valve seat - Seized valve stem	INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Weak or broken valve spring	INSTALL a new valve spring. TEST the system for normal operation after the repair.
	Worn or damaged camshaft	INSTALL a new camshaft. TEST the system for normal operation after the repair.

	Damaged head gasket	INSTALL a new head gasket. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Cracked or distorted cylinder head	INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Damaged, worn or sticking piston ring(s)	INSTALL a new piston ring(s). TEST the system for normal operation after the repair.
	Worn or damaged piston	INSTALL a new piston and piston pin. TEST the system for normal operation after the repair.
	Worn or damaged cylinder	INSPECT the cylinder for wear or damage. Repair as necessary. TEST the system for normal operation after the repair.
Low oil pressure	Inaccurate gauge reading	DIAGNOSE the IPC. REFER to: Instrumentation, Message Center and Warning Chimes (413-01 Instrumentation, Message Center and Warning Chimes, Diagnosis and Testing).
	Low oil level	ADJUST the oil level.
	Oil dilution (fuel)	INSPECT the fuel injectors. REFER to: Fuel Injectors LH (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Fuel Injectors RH (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Removal and Installation). Repair as necessary. TEST the system for normal operation after the repair.
	Stuck open oil pressure regulator	INSTALL a new oil pump. REFER to: Oil Pump (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Scored/damaged oil pump	INSTALL a new oil pump. REFER to: Oil Pump (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Broken or damaged piston cooling tubes	REMOVE the upper oil pan. REFER to: Upper Oil Pan (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the piston cooling tubes. REPAIR as necessary. TEST the system for normal operation after the repair.
	Front cover gasket leaks	REMOVE the engine front cover. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the gasket. REPAIR as necessary. TEST the system for normal operation after the repair.
	Leaking/missing core plugs	INSPECT for leaking/missing core plugs. REFER to: Cylinder Block Core Plug Replacement (303-00 Engine System - General Information, General Procedures). REPAIR as necessary. TEST the system for normal operation after the repair.
	Worn/damaged/missing bearing shell(s)	CHECK the crankshaft main bearings and connecting rod bearings. CARRY OUT the REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). and REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). REPAIR as necessary. TEST the system for normal operation after the repair.
	Restriction in the pickup tube or oil pan	REMOVE the upper oil pan. REFER to: Upper Oil Pan (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the oil pan and pickup tube. REPAIR as necessary. TEST the system for normal operation after the repair.
	External oil leaks	INSPECT the engine for oil leaks. REPAIR as necessary. TEST the system for normal operation after the repair.
	Restriction in the oil pressure feedback tube	REMOVE the oil pressure feedback tube. REFER to: Oil Pressure Feedback Tube (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the oil pressure feedback tube. REPAIR as necessary. TEST the system for normal operation after the repair.
Engine emits excessive black smoke	Clogged Air Cleaner (ACL) element	INSTALL a new ACL element. TEST the system for normal operation after the repair.
	Malfunctioning fuel injection system	INSPECT the fuel injection system. REFER to: Fuel Charging and Controls (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Diagnosis and Testing). TEST the system for normal operation after the repair.
Engine emits excessive white smoke	Damaged cylinder head	INSTALL a new cylinder head. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01C Engine - 7.3L 2V DEVCT V8 (239kW/320PS) (J0), Removal and Installation). TEST the system for normal operation after the repair.
	Damaged head gasket	INSTALL a new cylinder head gasket. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01C Engine - 7.3L 2V DEVCT V8 (239kW/320PS) (J0), Removal and Installation). TEST the system for normal operation after the repair.
	Cracked engine block	INSTALL a new engine. TEST the system for normal operation after the repair.
	Condensation build up in exhaust	Smoke dissipates after start up and doesn't continue after driving/running. Normal no repair needed.
	Overheating engine	INSPECT the cooling system. REFER to: Engine Cooling (303-03B Engine Cooling - 6.7L Power Stroke Diesel, Diagnosis and Testing). ;REFER to: Powertrain Secondary Cooling (303-03C Powertrain Secondary Cooling - 6.7L Power Stroke Diesel, Diagnosis and Testing). REPAIR as necessary. TEST the system for normal operation after the repair.

• Engine emits excessive blue smoke	• Engine wear (piston rings, valve guides)	• REPAIR as necessary. TEST the system for normal operation after the repair.
	• turbo	• Install a new turbo. REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	• Blocked or restricted turbocharger oil drain pipe	• INSPECT the turbocharger oil drain pipe. REPAIR as necessary. TEST the system for normal operation after the repair.
	• Turbocharger oil seals leaking	• REFER to Turbocharger Internal Oil Leak Test. REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Diagnosis and Testing). TEST the system for normal operation after the repair.
	• Plugged crankcase ventilation system	• Visually INSPECT the crankcase ventilation system
	• Worn valve seals	• REPAIR as necessary. TEST the system for normal operation after the repair.
	• Incorrect type or grade of oil	• DRAIN and FILL with specified oil.
• Engine emits excessive gray smoke	• Blocked or restricted turbocharger oil drain pipe	• INSPECT the turbocharger oil drain pipe. REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Diagnosis and Testing). REPAIR as necessary. TEST the system for normal operation after the repair.
	• Damaged/restricted or leaking turbocharger CAC assembly	• REPAIR or INSTALL a new CAC assembly as necessary. TEST the system for normal operation after the repair.
	• Plugged crankcase ventilation system	• Visually INSPECT the crankcase ventilation system
	• Turbocharger oil seals leaking	• REFER to Turbocharger Internal Oil Leak Test. REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Diagnosis and Testing). TEST the system for normal operation after the repair.
	• Transmission fluid burning on exhaust	• INSPECT the transmission for a leak. Refer to the appropriate section in Group 307 for the procedure. REPAIR as necessary. TEST the system for normal operation after the repair.
• Black soot	• Exhaust tailpipe GTDI engines	• Normal condition from rich air/fuel mixture under low load conditions.
• Oil in coolant	• Damaged cylinder head gasket(s)	• REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the cylinder head gasket(s). REPAIR as necessary. TEST the system for normal operation after the repair.
	• Damaged cylinder head(s)	• REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the cylinder head(s). REPAIR as necessary. TEST the system for normal operation after the repair.
	• Damaged cylinder block	• REFER to: Engine (303-01B Engine - 6.7L Power Stroke Diesel, Disassembly). INSPECT the cylinder block. REPAIR as necessary. TEST the system for normal operation after the repair.
	• Leaking oil cooler	• REFER to: Oil Cooler (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the oil cooler and gaskets for damage. INSTALL new components as necessary. TEST the system for normal operation after the repair.
• Coolant in oil	• Damaged cylinder head gasket(s)	• REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the cylinder head gasket(s). REPAIR as necessary. TEST the system for normal operation after the repair.
	• Damaged cylinder head(s)	• REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the cylinder head(s). REPAIR as necessary. TEST the system for normal operation after the repair.
	• Damaged cylinder block	• REFER to: Engine (303-01B Engine - 6.7L Power Stroke Diesel, Disassembly). INSPECT the cylinder block. REPAIR as necessary. TEST the system for normal operation after the repair.
	• Leaking oil cooler	• REFER to: Oil Cooler (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the oil cooler and gaskets for damage. INSTALL new components as necessary. TEST the system for normal operation after the repair.
	• Leaking turbocharger base gasket.	• REFER to: Turbocharger (303-04C Fuel Charging and Controls - Turbocharger - 6.7L Power Stroke Diesel, Diagnosis and Testing). INSPECT the turbocharger base gasket. REPAIR as necessary. TEST the system for normal operation after the repair.
	• RH valve cover or gasket.	• REFER to: Valve Cover RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the valve cover and the gasket. REPAIR as necessary. TEST the system for normal operation after the repair.
	• Engine front cover	• REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the engine front cover gaskets. REPAIR as necessary. TEST the system for normal operation after the repair.

Symptom Chart - NVH

Symptom Chart - NVH

Symptom	Possible Sources	Action
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NOTE: Possible sources and their listed actions are not limited to the symptoms provided below. Noise may be telegraphed from other areas or excited from associated parts and/or assemblies. The below chart of sources and actions are strictly suggestions and should be used as a guide.

Rattle - occurs at idle or at light acceleration from a stop	Powertrain mount(s)	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transmission, Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.
Whine/moan type noise - pitch increases or changes with vehicle speed	Powertrain mount(s)	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transmission, Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.
Clunk - occurs when shifting from PARK or between REVERSE and DRIVE	Powertrain mounts	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transmission, Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.
	Driveshaft universal joint	INSPECT the driveshaft universal joints. REPAIR as necessary. TEST the system for normal operation after the repair.
Drone type noise	Powertrain mount(s)	CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure. REFER to: Powertrain/Drivetrain Mount Neutralizing (303-00 Engine System - General Information, General Procedures). TEST the system for normal operation after the repair.
	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
Drumming noise - occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent	Engine vibration excites the body resonances inducing interior noise	CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure. REFER to: Powertrain/Drivetrain Mount Neutralizing (303-00 Engine System - General Information, General Procedures). TEST the system for normal operation after the repair.
	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
Engine drumming noise - accompanied by vibration	Powertrain mount(s)	CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure. TEST the system for normal operation after the repair.
Rattle	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	- Lower end, excessive clearance between the connecting rod bearings and the crankshaft - Lower end, worn or damaged crankshaft main bearings	- CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). - CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
	Valvetrain	CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Rattle - occurs at idle or at light acceleration from a stop	Powertrain mount(s)	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transaxle, Refer to the appropriate section in Group 307 or Group 308 for the procedure. TEST the system for normal operation after the repair.
Moaning	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
Whine/moan type noise - pitch increases or changes with vehicle speed	Powertrain mount(s)	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transaxle, Refer to the appropriate section in Group 307 or Group 308 for the procedure. TEST the system for normal operation after the repair.
Clunk	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
Clunk - occurs when shifting from PARK or between REVERSE and DRIVE	Powertrain mounts	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transaxle, Refer to the appropriate section in Group 307 or Group 308 for the procedure. TEST the system for normal operation after the repair.
	Idle speed is too high	CHECK for the correct idle speed. TEST the system for normal operation after the repair.
Hooting	Air induction	CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. CHECK the TC and CAC tubes for leaks, correct alignment and damage. REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.

	Powertrain mounts	powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transaxle, Refer to the appropriate section in Group 307 or Group 308 for the procedure. TEST the system for normal operation after the repair.
Accessory drive bearing hoot - occurs at idle or high idle in cold temperatures of approximately 4Â°C (40Â°F) or colder at the first start of the day	Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and the bearing race	- CARRY OUT the Engine Cold Soak procedure. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - PLACE the EngineEAR probe directly on the idler/ tensioner center post or bolt to verify which bearing is making the noise. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). INSTALL new parts as necessary. REFER to: Accessory Drive Belt (303-05B Accessory Drive - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Accessory Drive Belt Tensioner (303-05B Accessory Drive - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
Accessory drive belt noise, squeal or chirping	- Defective/worn or incorrect accessory drive belt - Misaligned pulley(s) - Pulley runout - Damaged or worn accessory drive component or idler - Fluid contamination of the accessory drive belt or pulleys - Damaged or worn accessory drive belt tensioner - Damaged pulley grooves - Damaged or worn coolant pump pulley	CARRY OUT the Engine Accessory Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). INSPECT components and INSTALL new parts as necessary. REFER to: Accessory Drive Belt (303-05B Accessory Drive - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Accessory Drive Belt Tensioner (303-05B Accessory Drive - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
Clunking/roaring/grinding noise	Coolant pump has excessive end play or imbalance	CHECK the coolant pump for excessive end play. INSPECT the coolant pump for imbalance with the drive belt off. INSTALL a new coolant pump as necessary. REFER to: Coolant Pump (303-03B Engine Cooling - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Coolant Pump (303-03C Powertrain Secondary Cooling - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
Humming	Air Induction	CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. CHECK the TC and CAC tubes for leaks, correct alignment and damage. REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.
	Powertrain mounts	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transaxle, Refer to the appropriate section in Group 307 or Group 308 for the procedure. TEST the system for normal operation after the repair.
Whining	FEAD	CARRY OUT the Engine Accessory Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). INSPECT components and INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Whine or moaning noise	Air intake system	CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. TEST the system for normal operation after the repair.
Whistling noise - normally accompanied with poor idle condition	Air intake system	CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. TEST the system for normal operation after the repair.
	Turbocharger intake tube assembly leaking	REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.
	Loose connections or damage to air intake hoses and tubes	TIGHTEN hose clamps. INSPECT for damage and REPAIR as necessary. TEST the system for normal operation after the repair.
	Air leaks at turbine housing, blown joints or damaged exhaust	INSPECT for leaks. Leaks can usually be detected audibly or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as necessary. TEST the system for normal operation after the repair.
	Carbon build up in the turbine housing	INSPECT the TC REFER to the Check for Free Rotation. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Turbocharger imbalance due to foreign object/damage	REPAIR as necessary. TEST the system for normal operation after the repair.
Whine or air rush type noise	TC	Acceptable condition. Some whine or air noise is common.
	Air Induction	CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. CHECK the turbocharger and CAC tubes for leaks, correct alignment and damage. REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.

Hissing noise	Air Induction	CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. CHECK the turbocharger and CAC tubes for leaks, correct alignment and damage. REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.
Hissing noise - occurs during idle or high idle that is apparent with the hood open	Boost leak noise	Use the Ultrasonic Leak Detector/EngineEAR to locate the source. Scan the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component. TEST the system for normal operation after the repair.
	Composite intake manifold	Acceptable condition. Some composite manifolds exhibit this noise, which is the effect of the composite manifold.
Grinding noise - occurs during engine cranking	Incorrect starter motor mounting	INSPECT the starter motor for correct mounting. REPAIR as necessary. REFER to: Starter Motor (303-06B Starting System - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Starter motor	CHECK the starter motor. INSTALL a new starter motor as necessary. REFER to: Starter Motor (303-06B Starting System - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	- Incorrect starter motor drive engagement - Damage flexplate	- INSPECT the starter motor drive for wear or damage. INSTALL a new starter motor as necessary. REFER to: Starter Motor (303-06B Starting System - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair. - INSPECT the flexplate for wear or damage. INSTALL a new flexplate as necessary. REFER to: Flexplate (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
Engine noise, front of engine - knocking noise from lower front of engine	Damaged or separated crankshaft pulley/damper	CHECK for obvious signs of damage or wobble during operation. INSTALL new as necessary. TEST the system for normal operation after the repair.
Tapping	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	Piston	CARRY OUT the Piston Diameter procedure. REFER to: Piston Diameter (303-00 Engine System - General Information, General Procedures). Measure the cylinder bore diameter. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance. REFER to the appropriate 303-01 Section for specifications. MEASURE the piston pin bore and the piston pin in 2 directions on each side. REFER to the appropriate 303-01 Section for specifications.
Engine noise, front of engine - ticking, tapping or rattling noise from the front of the engine	- Timing drive components - Damaged oil pump	- REMOVE the accessory drive belt. REFER to: Accessory Drive Belt (303-05B Accessory Drive - 6.7L Power Stroke Diesel, Removal and Installation). - USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT the timing drive components. INSTALL new parts as necessary. TEST the system for normal operation after the repair.
Engine noise, upper end - ticking noise near the valve cover	Fuel injector	USE the EngineEAR to isolate the noisy injector(s). INSTALL a new injector(s) as necessary. REFER to: Fuel Injectors LH (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Fuel Injectors RH (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
Engine noise, upper end - ticking, knocking or rattle noise that occurs during idle or high idle during the first cold start of the day and may disappear as the engine warms	Valve train noise	CARRY OUT the Valve Train Analysis in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Engine noise, upper end - rattling noise from the valve train. Worse when the engine is cold	Low oil level	CHECK the oil level. FILL as necessary.
	Thin or diluted oil	INSPECT the oil for contamination. If the oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter. TEST the system for normal operation after the repair.
	Low oil pressure	CARRY OUT the Oil Pressure Test in this section. If not within specifications, REMOVE the engine oil pan. REFER to: Upper Oil Pan (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSPECT for a blocked oil pickup tube. Inspect the oil pressure feedback tube. REFER to: Oil Pressure Feedback Tube (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Worn valve train components	CARRY OUT the Valve Train Analysis in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Worn valve guides	CARRY OUT the Valve Guide Inner Diameter procedure. REFER to: Valve Guide Inner Diameter (303-00 Engine System - General Information, General Procedures).

	Excessive runout of the valve seats on the valve face	INSPECT for abnormalities on the valve face and valve seat. INSTALL a new cylinder head assembly if abnormalities are found.
Engine noise, lower end - ticking or knocking noise near the engine front cover	Oil pump	USE the EngineEAR to verify the oil pump as the source of the noise at low rpm. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Engine noise, lower end - light knocking noise, also described as piston slap. Noise is most noticeable when the engine is cold with light to medium acceleration. The noise disappears as the engine warms	Excessive clearance between the piston and the cylinder wall	CARRY OUT the Piston Diameter procedure. REFER to: Piston Diameter (303-00 Engine System - General Information, General Procedures). Measure the cylinder bore diameter. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance. REFER to the appropriate 303-01 Section for specifications.
Engine noise, lower end - light double knock or sharp rap sound. Occurs mostly with a warm engine at idle or low speeds in drive. Increases in relation to engine load. Associated with a poor lubrication history	Excessive clearance between the piston and the piston pin	MEASURE the piston pin bore and the piston pin in 2 directions on each side. REFER to the appropriate 303-01 Section for specifications.
Engine noise, lower end - light knocking noise. The noise is most noticeable when the engine is warm. The noise tends to decrease when the vehicle is coasting or in neutral	Excessive clearance between the connecting rod bearings and the crankshaft	CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
Engine noise, lower end - deep knocking noise. The noise is most noticeable when the engine is warm, at lower rpm and under a light load and then at float	Worn or damaged crankshaft main bearings	CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
Engine noise, rear of engine - knocking noise at rear of engine	Damaged flexplate	INSPECT the flexplate for wear or damage. INSTALL a new flexplate as necessary. REFER to: Flexplate (303-01A Engine - 6.2L V8, Removal and Installation). TEST the system for normal operation after the repair.
Slapping	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	Piston	CARRY OUT the Piston Diameter procedure. REFER to: Piston Diameter (303-00 Engine System - General Information, General Procedures). Measure the cylinder bore diameter. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance. REFER to the appropriate 303-01 Section for specifications. MEASURE the piston pin bore and the piston pin in 2 directions on each side. REFER to the appropriate 303-01 Section for specifications.
Knocking	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
Engine vibration - vibration felt at all times	Excessive engine pulley runout	CARRY OUT the Engine Accessory Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). INSTALL a new engine pulley as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Damaged or worn accessory component	CARRY OUT the Engine Accessory Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). REPAIR or INSTALL a new component as necessary. TEST the system for normal operation after the repair.
Engine vibration - at idle, a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/ floorpan	Cylinder misfire	Using the scan tool, CARRY OUT the cylinder power balance and the relative compression test. REPAIR as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Engine or torque converter out of balance	VERIFY the torque converter to crankshaft pilot clearance is correct. REPAIR as necessary. RE-INDEX the torque converter on the flex plate by 120 degrees for a 3- bolt converter or 180 degrees for a 4-bolt converter. Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.
Engine vibration - is felt with increases and decreases in engine rpm	Powertrain mount(s)	CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. REFER to: Engine Mount LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). REFER to: Engine Mount RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). For transmission, Refer to the appropriate section in Group 307 or Group 308 for the procedure. TEST the system for normal operation after the repair.
	Engine or transmission grounded to chassis	INSPECT the powertrain/ drivetrain for correct clearances. REPAIR as necessary. TEST the system for normal operation after the repair.
Engine vibration - increases intensity as the engine rpm is increased	Engine out-of-balance	CARRY OUT the NERU Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). ROTATE the torque converter, 120 degrees for 3- bolt or 180 degrees for 4- bolt. INSPECT the torque converter pilot outer diameter-to-crankshaft pilot inner diameter. REPAIR as necessary. Refer to the appropriate section in Group 307 for the procedure. TEST the system for normal operation after the repair.
Engine vibration - mostly at coast/neutral coast. Condition improves with vehicle acceleration	Combustion instability	CHECK the ignition system. INSTALL new components as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Engine vibration or shudder - occurs with light to medium acceleration above 56 km/h (35 mph)	Worn or damaged glow plugs	INSPECT the spark plugs for cracks, high resistance or broken insulators. INSTALL a new glow plug(s) as necessary. REFER to: Glow Plugs (303-07C Glow Plug System - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Plugged fuel injector	REPAIR or INSTALL a new injector as necessary. REFER to: Fuel Injectors LH (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Fuel Injectors RH (303-04B Fuel Charging and Controls - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.

	Contaminated fuel	INSPECT the fuel for contamination. DRAIN the fuel system and refill. REFER to: Fuel Tank Draining (310-00B Fuel System - General Information - 6.7L Power Stroke Diesel, General Procedures). TEST the system for normal operation after the repair.
Bongo	Balance shaft	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Chatter	Valvetrain	CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Chirping	FEAD	CARRY OUT the Engine Accessory Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). INSPECT components and INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Piston Rings	Inspect the piston, piston rings and piston ring area for damage, and excessive wear. Check that the piston rings move freely. REFER to: Piston Inspection (303-00 Engine System - General Information, General Procedures). REFER to: Piston Ring End Gap (303-00 Engine System - General Information, General Procedures). Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Valvetrain	CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Clicking	Fuel	Check for normal condition of fuel injectors used in direct injected engines. CHECK that any noise insulators are installed correctly in the correct positions.
	PCV	Acceptable condition for the PCV system. If excessive noise is suspected, REFER to PC/ED for PCV diagnosis.
	Valvetrain	CARRY OUT the Valve Train Analysis Component Test in this section. INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Clatter	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Piston	CARRY OUT the Piston Diameter procedure. REFER to: Piston Diameter (303-00 Engine System - General Information, General Procedures). Measure the cylinder bore diameter. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance. REFER to the appropriate 303-01 Section for specifications. MEASURE the piston pin bore and the piston pin in 2 directions on each side. REFER to the appropriate 303-01 Section for specifications.
Crickets	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Dieseling	- Lower end, excessive clearance between the connecting rod bearings and the crankshaft - Lower end, worn or damaged crankshaft main bearings	- CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). - CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
	Piston	CARRY OUT the Piston Diameter procedure. REFER to: Piston Diameter (303-00 Engine System - General Information, General Procedures). Measure the cylinder bore diameter. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance. REFER to the appropriate 303-01 Section for specifications. MEASURE the piston pin bore and the piston pin in 2 directions on each side. REFER to the appropriate 303-01 Section for specifications.
Quacking	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.

	FEAD	CARRY OUT the Engine Accessory Test. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). INSPECT components and INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
Scratching	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	- Lower end, excessive clearance between the connecting rod bearings and the crankshaft - Lower end, worn or damaged crankshaft main bearings	- CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). - CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
Squeaking	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	- Lower end, excessive clearance between the connecting rod bearings and the crankshaft - Lower end, worn or damaged crankshaft main bearings	- CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). - CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
Squealing	Cam Drive	- USE the EngineEAR to isolate the noise to the engine front cover. REFER to: Noise, Vibration and Harshness (NVH) (100-04 Noise, Vibration and Harshness, Diagnosis and Testing). - REMOVE the engine front cover and INSPECT the timing drive components. REFER to: Engine Front Cover (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). INSTALL new parts as necessary. Refer to the appropriate section in Group 303 for the procedure. TEST the system for normal operation after the repair.
	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	- Lower end, excessive clearance between the connecting rod bearings and the crankshaft - Lower end, worn or damaged crankshaft main bearings	- CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). - CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
Thumping	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	- Lower end, excessive clearance between the connecting rod bearings and the crankshaft - Lower end, worn or damaged crankshaft main bearings	- CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: Connecting Rod Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures). - CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: Crankshaft Main Bearing Journal Clearance (303-00 Engine System - General Information, General Procedures).
Tin-Like	Drivetrain	Refer to the appropriate section in Group 205, 307 or 308 for drivetrain diagnosis.
	Cylinder Head	INSPECT the cylinder head components. INSTALL new engine components as necessary. REFER to: Cylinder Head LH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). or REFER to: Cylinder Head RH (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation). TEST the system for normal operation after the repair.
	Manifold	Acceptable condition from expansion and contraction of exhaust components.

Component Tests

The following component tests are used to diagnose engine concerns.

Engine Oil Leaks

NOTE: If an overnight drive is done, the fan air or road air blast can cause erroneous readings.

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean the cylinder block, cylinder heads, valve covers, oil pan and flexplate with a suitable solvent to remove all traces of oil.

Engine Oil Leaks - Fluorescent Oil Additive Method

NOTE: If the factory fill engine oil with dye is present, change the engine oil and the oil filter prior to using the Dye-Lite.Â® Oil-Based Fluid Dye (164-TP33200008).

NOTE: Oil leaks form drops of oil and while seepage does not. Oil seepage is considered normal.

Use the UV Long-Wave W/12-foot Cord & Alligator Clips (164-R3748) or Leak Tracker UV-LED Leak Detection Flashlight (164-TP8695) to carry out the following procedure for oil leak diagnosis.

1. Add 237 ml (8 Fl Oz) of Dye-Lite[®] Oil-Based Fluid Dye (164-TP33200008) to a minimum of 0.47L (1/2 qt) and a maximum of 0.95L (1 qt) engine oil. Thoroughly premix the oil based fluid dye or it will not have enough time to reach the crankcase, oil galleries and seal surfaces during this particular 15 minute test. The additive must be added through the oil fill. Check the level on the oil level indicator to determine what amount of oil to premix. If it is in the middle of the crosshatch area or below the full mark, use 0.95L (1 qt). If it is at the full mark, use 0.47L (1/2 qt).
2. **NOTE:** For best results allow the customer to drive the vehicle for a day.

Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Leak Detector Kit. A fluoresces white area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.
3. At the end of test, make sure the oil level is within the upper and lower oil indicator marks. Remove oil as necessary if it registers above the full mark.

Leakage Points - Underhood

NOTE: Check for oil in the valley of the engine that may have accumulated on the engine front cover or ran through the valley drain hole on the right front of the engine.

Examine the following areas for oil leakage:

- Valve cover gaskets
- Cylinder head gaskets
- Engine front cover
- Oil level indicator tube
- Crankcase vent oil separator
- Turbocharger pedestal
- Turbocharger oil supply tube

Leakage Points - Under Engine, With Vehicle on Hoist

NOTE: Verify that the oil leak is not from the upper engine area.

Examine the following areas for oil leakage:

- Oil pan gaskets
- Oil pan sealer
- Engine front cover gasket
- Crankshaft front seal
- Crankshaft rear seal
- Oil filter adapter
- Oil cooler
- Engine oil and pressure sensor

Leakage Points - With Transmission and Flywheel/Flexplate Removed

Examine the following areas for oil leakage:

- Crankshaft rear oil seal
- Flexplate mounting bolt holes (with flexplate installed)
- Pipe plugs at the end of oil passages
- Core plugs

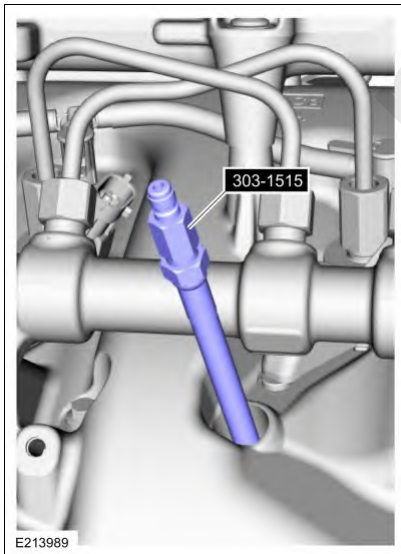
Compression Test

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level.
2. Operate the engine until it is at normal operating temperature. Turn the ignition switch to the OFF position.
3. **NOTE:** Failure to remove all glow plugs may result in inconsistent test results.

Remove the glow plugs.
REFER to: Glow Plugs (303-07C Glow Plug System - 6.7L Power Stroke Diesel, Removal and Installation).

NOTE: The battery charger must be left connected during the compression test and disconnected when the test is complete.

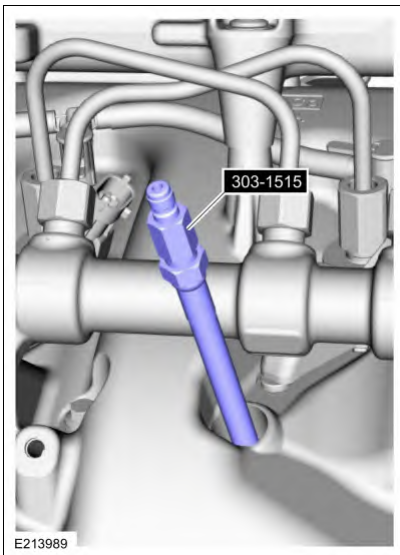
4. Connect a battery charger to the battery.



5. Install the Compression Test Adapter (303-1515) and a commercially available diesel compression tester.

NOTE: Note the approximate number of compression strokes necessary to obtain the highest reading.

6. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, crank the engine a consistent number of strokes (minimum of 2 compression strokes to 12 compression strokes). Record the readings.
7. Repeat the test on each cylinder, cranking the engine the same number of compression strokes, record the readings. Compare the readings of the 8 cylinders.
 - There must be a minimum cylinder pressure of 2068.4 kpa (300 psi) and have no more than a 20% difference from the average on any given cylinder.
8. Investigate and repair any cylinder(s) that are outside the 20% range.



9. Remove the Compression Test Adapter (303-1515) and the commercially available diesel compression tester.
10. Disconnect the battery charger from the battery.
11. Install the glow plugs.
REFER to: Glow Plugs (303-07C Glow Plug System - 6.7L Power Stroke Diesel, Removal and Installation).

Cylinder Leakage Detection

When a cylinder produces a low reading, use of a cylinder leakage tester will be helpful in pinpointing the exact cause.

The leakage tester is inserted in the glow plug hole, the piston is brought up to TDC on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, the leakage tester gauge will read the percentage of leakage. Leakage exceeding 20% is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve will be heard in the TB (throttle body). A leak at the exhaust valve can be heard at the tailpipe. Leakage past the piston rings will be audible at the crankcase vent oil separator connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the glow plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator.

Excessive Engine Oil Consumption

Nearly all engines consume oil, which is essential for normal lubrication of the cylinder bore walls and pistons and rings. Determining the level of oil consumption may require testing by recording how much oil is being added over a given set of miles.

Customer driving habits greatly influence oil consumption. Mileage accumulated during towing or heavy loading generates extra heat. Frequent short trips, stop-and-go type traffic or extensive idling, prevent the engine from reaching normal operating temperature. This prevents component clearances from reaching specified operating ranges.

The following diagnostic procedure may be utilized to determine internal oil consumption. Make sure that the concern is related to internal oil consumption, and not external leakage, which also consumes oil. Verify there are no leaks before carrying out the test. Once verified, the rate of internal oil consumption can be tested.

A new engine may require extra oil in the early stages of operation. Internal piston-to-bore clearances and sealing characteristics improve as the engine breaks in. Engines are designed for close tolerances and do not require break-in oils or additives. Use the oil specified in the Owner's Literature. Ambient temperatures may determine the oil viscosity specification. Verify that the correct oil is being used for the vehicle in the geographic region in which it is driven.

Basic Pre-checks

1. For persistent complaints of oil consumption, interview the customer to determine the oil consumption characteristics. If possible, determine the brand and grade of oil currently in the oil pan. Look at the oil filter or oil-change station tags to determine if Ford-recommended maintenance schedules have been followed. Make sure that the oil has been changed at the specified mileage intervals. If vehicle mileage is past the first recommended drain interval, the OEM (original equipment manufacturer) production filter should have been changed.
2. Ask how the most current mileage was accumulated. That is, determine whether the vehicle was driven under the following conditions:
 - Extended idling or curbside engine operation
 - Stop-and-go traffic or taxi operation
 - Towing a trailer or vehicle loaded heavily
 - Frequent short trips (engine not up to normal operating temperature)
 - Excessive throttling or high engine-rpm driving
3. Verify that there are no external leaks. If necessary, review the diagnostic procedure under Engine Oil Leaks in the Diagnosis and Testing portion of this section.
4. Inspect the crankcase ventilation system for:
 - disconnected hoses at the valve cover or ACL (air cleaner).
 - loose or missing valve cover fill cap.
 - missing or incorrectly seated engine oil level indicator.
 - incorrect or damaged crankcase vent oil separator.
5. Inspect for signs of sludge. Sludge affects crankcase vent oil separator performance and can plug or restrict cylinder head drainback wells. It can also increase oil pressure by restricting passages and reducing the drainback capability of piston oil control rings.
6. Inspect the air filter for dirt, sludge or damage. A hole in the filter element will allow unfiltered air to bypass into the air induction system. This can cause premature internal wear (engine dusting), allowing oil to escape past rings, pistons, valves and guides.
7. If the engine is hot or was recently shut down, wait at least 20-minutes to allow the oil to drain back. Ask the customer if this requirement has been followed. Adding oil without this wait period can cause an overfill condition, leading to excessive oil consumption and foaming which may cause engine damage.
8. Make sure the oil level indicator (dipstick) is correctly and fully seated in the indicator tube. Remove the oil level indicator and record the oil level.

Detailed Pre-checks

1. Check the thermostat opening temperature to make sure that the cooling system is operating at the specified temperature. If it is low, internal engine parts are not running at specified internal operating clearances.

Oil Consumption Test

1. **NOTE:** Once all of the previous conditions are met, carry out an oil consumption test.

Drain the engine oil and remove the oil filter. Install a new manufacturer-specified oil filter. Make sure the vehicle is positioned on a level surface. Refill the oil pan to a level one liter (quart) less than the specified fill level, using manufacturer-specified oil.

2. Run the engine for 3 minutes (if hot) or 10 minutes (if cold). Allow for a minimum 20-minute drainback period and then record the oil level shown on the oil level indicator. Place a mark on the backside of the oil level indicator noting the oil level location.
3. Add the final one liter (quart) to complete the normal oil fill. Restart the engine and allow it to idle for 2 minutes. Shut the engine down.

4. **NOTE:** Both marks should be very close to the MIN-MAX upper and lower limits or the upper and lower holes on the oil level indicator. These marks will exactly measure the engine's use of oil, with a one quart differential between the new marks.

After a 20-minute drainback period, record the location of the oil level again. Mark the oil level indicator with the new oil level location. Demonstrate to the customer that the factory-calibrated marks on the oil level indicator are where the oil should fall after an oil change with the specified fill amount. Explain however, that this may vary slightly between MIN-MAX or the upper and lower holes on the oil level indicator.

5. Record the vehicle mileage.
6. Advise the customer that oil level indicator readings must be taken every 320 km (200 mi) or weekly, using the revised marks as drawn. Remind the customer that the engine needs a minimum 20-minute drainback for an accurate reading and that the oil level indicator must be firmly seated in the tube prior to taking the reading.
7. When the subsequent indicator readings demonstrate a full liter (quart) has been used, record the vehicle mileage. The mileage driven should not be less than 1,440 km (900 mi). The drive cycle the vehicle has been operated under must be considered when making this calculation. It may be necessary to have the customer bring the vehicle in for a periodic oil level indicator reading to closely monitor oil usage.

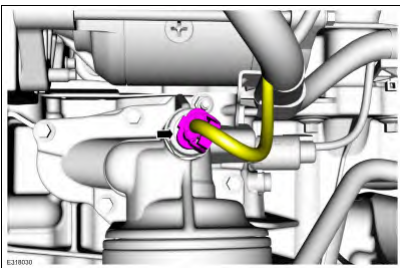
Post Checks, Evaluation and Corrective Action

1. If test results indicate excessive oil consumption, carry out a Compression Test. The compression test should be carried out with a fully charged battery and all glow plugs removed.
2. Compression should be consistent across all cylinders. If compression tested within the specifications found in this section, the excessive oil consumption may be due to wear on the valve guides, valves or valve seals.
3. A cylinder leak detection test can be carried out using a cylinder leakage detector. This can help identify valves, piston rings, or worn valve guides/valve stems, inoperative valve stem seals or other related areas as the source of oil consumption.
4. If an internal engine part is isolated as the root cause, determine if the repair will exceed cost limits and proceed with a repair strategy as required.
5. Once corrective action to engine is complete and verifying that all pre-check items were eliminated in the original diagnosis, repeat the Oil Consumption Test as described above and verify consumption results.

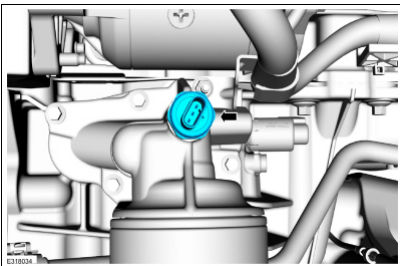
Oil Pressure Test

1. **NOTICE:** Inspect the engine for installation of an aftermarket oil filter. Review oil and filter maintenance history to make sure that the vehicle has not gone beyond the standard Ford recommended oil change intervals. Check the engine oil level and check the oil for contamination. If the oil is contaminated, engine damage can occur, the source of the contamination must be identified and repaired as necessary.

Run the engine until normal operating temperature is reached.



2. Disconnect the EOP sensor electrical connector.



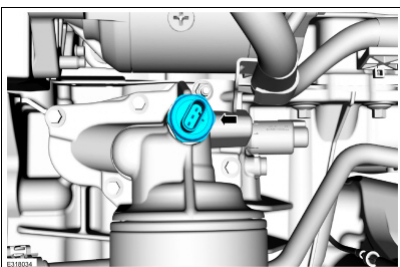
3. Remove the EOP sensor.
4. Connect an commercially available Oil Pressure Gauge to the oil pressure switch port.
5. Record the oil pressure gauge reading at 700 RPM, 1,200 RPM and 1800 RPM.
6. Compare the oil pressure recordings to the specifications, REFER to: Specifications (303-01B Engine - 6.7L Power Stroke Diesel, Specifications).
7. **NOTE:** The oil pump and the oil pressure regulator are mounted internally to the engine front cover and are serviced only with the engine front cover. There are no parts available for service.

If the pressure is not within specification, check the following possible sources:

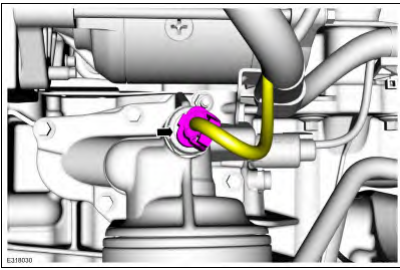
- Insufficient oil
- Oil leakage
- Worn or damaged oil pump
- Oil pump screen and pickup tube
- Excessive main bearing clearance
- Excessive connecting rod bearing clearance
- Damaged or missing piston cooling tube

If the concern is not evident, verify the symptom. GO to the Engine Performance Symptom Chart.

8. Remove the commercially available Oil Pressure Gauge from the oil pressure switch port.



9. Install the EOP sensor. Torque: 89 lb.in (10 Nm)



10. Install the EOP sensor electrical connector.

Valve Train Analysis

The following inspection is used to diagnose valve train concerns.

Valve Train Analysis - Valve Cover Removed

Check for damaged or severely worn parts rocker arm assemblies and push rods.

Valve Train Analysis - Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis - Valve Spring Retainer and Valve Spring Retainer Keys

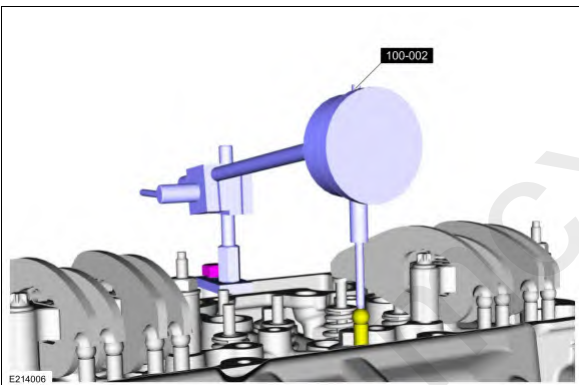
- Check for correct seating of the valve spring retainer key on the valve stem and in valve spring retainer.
- Check for correct seating on the valve stem.

Valve Train Analysis - Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged guide-mounted valve stem seal.
- Check for damaged hydraulic lash adjuster.
- Check installed valve spring height.
- Check for missing or worn valve spring seats.

Valve Train Analysis - Camshaft Lobe Lift

1. Perform visual inspection. Check for damaged or severely worn parts and correct assembly.
2. Remove the glow plugs.
REFER to: Glow Plugs (303-07C Glow Plug System - 6.7L Power Stroke Diesel, Removal and Installation).
3. Remove the rocker arm assemblies for the affected cylinders.
REFER to: Rocker Arm (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation).



4. Install the Dial Indicator Gauge with Holding Fixture so the needle tip of indicator is on top of the push rod.
5. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retaining bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.
6. Zero the Dial Indicator Gauge. Continue to rotate the crankshaft until the high lift point of the rocker arm is in the fully raised position (highest indicator reading).
7. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat the measurement.
8. If the lift on any lobe is below specified service limits, install a new camshaft and valve tappets.
REFER to: Specifications (303-01B Engine - 6.7L Power Stroke Diesel, Specifications).
9. Install the rocker arm assemblies.
REFER to: Rocker Arm (303-01B Engine - 6.7L Power Stroke Diesel, Removal and Installation).
10. Install the glow plugs.
REFER to: Glow Plugs (303-07C Glow Plug System - 6.7L Power Stroke Diesel, Removal and Installation).