

Diagnosis and Testing

Special Tool(s) / General Equipment

	Socket, Spark Plug 303-499
	Dial Indicator Gauge (Metric) 205-069
	Holding Fixture, Dial Indicator Gauge 205-070
Ford diagnostic equipment	
Ultraviolet (UV) leak tester	

Materials

Name	Specification
Adhesive - Loctite 243	WSK-M2G349-A7

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 (noise, vibration and harshness).

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical 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 that the latest Ford diagnostic equipment software release is used.
If the cause is not visually evident, refer to the Ford diagnostic equipment to diagnose the system.
5. If no DTCs related to the concern are retrieved, GO to Symptom Chart - Engine Performance.

Inspection and Verification - NVH

1. Verify the customer concern.
2. 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.
3. Visually inspect for obvious signs of mechanical damage.
4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. NOTE: Make sure that the latest Ford diagnostic equipment software release is used.
If the cause is not visually evident, refer to the Ford diagnostic equipment to diagnose the system.
6. 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.

When a customer concern has been identified as an abnormal engine noise, it is critical to determine the location of the specific noise. Use a 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.

- Fuel injector(s)
- Upper end of engine
- Lower end of engine

Fuel injector noise

A common source of an engine ticking noise can be related to the fuel injection pump or fuel injector(s). This is normal engine noise that can be verified by listening to another vehicle. If the fuel injector noise is excessive or irregular, use a stethoscope to isolate the noise to a specific fuel injector.

Upper end engine noise

A common source of upper end engine noise (ticking, knocking or rattle) include the camshaft(s) and valve train. Upper end engine noise can be determined using a stethoscope on the valve cover bolts. If the noise is loudest from the valve cover bolts, then the noise is upper end. A stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder. Removal of the valve cover will be required to pinpoint the source of the noise.

Lower end engine noise

A common source of lower end engine noise (ticking or knocking) include the crankshaft, connecting rod(s) and bearings. Lower end noises can be determined by using the oil pan or lower cylinder block. 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.

Some other noises from the front of the engine (ticking, tapping or rattle) may be internal to the engine. Use a 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.

Symptom Chart

Symptom	Possible Sources	Action
Loss of oil	* Oil leaks on components that are either coated in oil themselves or on components local to them.	* CHECK for evidence of oil leaks on components. Use an ultraviolet (UV) leak tester if an oil leak is not evident. INSTALL new gaskets or components as required.
	* Internal or external leak at the engine oil cooler.	* CHECK the coolant expansion tank for a film of oil on the coolant surface. INSTALL a new engine oil cooler or engine oil cooler gasket.
	* Crankshaft front seal.	* INSTALL a new crankshaft front seal. REFER to: Crankshaft Front Seal (303-01B Engine, Removal and Installation).
	* Leaks from oil carrying components or basic engine.	* CHECK for cracks in oil carrying components of the basic engine by means of an ultraviolet UV leak tester. INSTALL new components or seals as necessary.
Oil consumption	* Use of the wrong type of engine oil.	* INSTALL a new engine oil filter and the correct engine oil. REFER to: Specifications (303-01B Engine, Specifications).
	* Faulty positive crankcase ventilation (PCV) system. - Hoses or ventilation or breather valves are blocked. This causes excessive pressure in the crankcase which causes more oil to enter the combustion chamber. - PCV oil separator is faulty and engine oil can enter the combustion chamber through the intake manifold.	* CHECK if the PCV system is operating correctly and repair as necessary. REFER to: Engine Emission Control (303-08A Engine Emission Control, Diagnosis and Testing).
	* Damaged gaskets or mating surfaces. - Cylinder head gasket is damaged or mating face are warped.	* Remove the cylinder head. REFER to: Cylinder Head (303-01B Engine, Removal and Installation). CHECK the mating faces, cylinder head gasket and the evenness of the cylinder head and engine block mating faces.
	* Valve stem seals. - Engine oil can enter the combustion chamber between the valve stem and the valve stem guide.	* INSTALL new valve stem seals.
	* Piston ring or cylinder liner wear.	* INSTALL new components as necessary.
	* Damaged cylinder liners or excessive clearance of engine components. - Pistons - Piston rings (clearance in groove and end gap) - Cylinder liners	* CHECK the running surfaces and clearances of the individual engine components. INSTALL new components as necessary. INSTALL a new cylinder block if necessary. * CHECK the pistons. * CHECK the piston rings.
Coolant consumption	* Cooling system components.	* CHECK the cooling system. REFER to: Engine Cooling (303-03B Engine Cooling, Diagnosis and Testing).
	* Engine oil cooler.	* INSTALL a new engine oil cooler.
	* Damaged gaskets or warped mating faces.	* Remove the cylinder head. REFER to: Cylinder Head (303-01B Engine, Removal and Installation). CHECK the mating faces, cylinder head gasket and the evenness

		of the cylinder head and engine block mating faces.
	* Cracks or fractures in engine components surrounded by coolant, such as cylinder liners and cylinder head combustion chamber.	* DETERMINE the damaged engine component(s) and install new component(s) as necessary.
Engine does not crank	* Passive anti-theft system (PATS).	* CHECK the PATS LED extinguishes within 3 seconds when the ignition is turned on. REFER to: Passive Anti-Theft System (PATS) (419-01C Passive Anti-Theft System (PATS), Diagnosis and Testing).
	* Starting system.	* CHECK the starting system. REFER to: Starting System (303-06B Starting System, Diagnosis and Testing).
	* Ignition switch.	* REFER to the Wiring Diagrams.
	* Powertrain control module (PCM).	* Carry out a full engine diagnosis using the symptom based diagnostic menu in the Ford diagnostic equipment.
Engine cranks but does not start	* Fuel tank fuel level low.	* CHECK the fuel level.
	* Fuel filter blocked.	* INSTALL a new fuel filter.
	* Engine intake air system.	* CHECK the intake air system. REFER to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering, Diagnosis and Testing).
	* Engine management system.	* CHECK the engine management system. REFER to: Electronic Engine Controls (303-14B Electronic Engine Controls, Diagnosis and Testing).
	* Ignition system.	* CHECK the ignition system. REFER to: Engine Ignition (303-07B Engine Ignition, Diagnosis and Testing).
	* Incorrect valve timing.	* CHECK and adjust the valve timing. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
	* Broken or damaged timing belt or pulley(s).	* CHECK the timing belt and pulley(s). INSTALL new components as necessary. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
Very poor power output or fuel consumption too high or engine running rough	* Fuel system.	* CHECK the fuel system. REFER to: Fuel System (310-00B Fuel System - General Information, Diagnosis and Testing).
	* Engine intake air system.	* CHECK the intake air system. REFER to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering, Diagnosis and Testing).
	* Exhaust system blocked.	* CHECK the exhaust system.
	* Engine management system.	* CHECK the engine management system. REFER to: Electronic Engine Controls (303-14B Electronic Engine Controls, Diagnosis and Testing).
	* Fault in ignition system.	* CHECK the ignition system. REFER to: Engine Ignition (303-07B Engine Ignition, Diagnosis and Testing).
	* Incorrect valve timing.	* CHECK and adjust the valve timing. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
	* Broken or damaged timing belt or pulley(s).	* CHECK the timing belt and pulley(s). INSTALL new components as necessary. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
Noisy running	* Engine auxiliary components loose or damaged.	* CHECK engine auxiliary components for damage or looseness.
Noisy running, misfiring, backfiring or knocking	* Incorrect fuel	* DETERMINE which type of fuel was last put in the tank (note the country specific fuel specifications).
	* Water in fuel or fuel contaminated.	* CHECK the fuel system for water or other contamination.
	* Incorrect valve timing.	* CHECK and adjust the valve timing. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
	* Broken or damaged timing belt or pulley(s).	* CHECK the timing belt and pulley(s). INSTALL new components as necessary. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
Noisy running or valve train noise	* Valve clearance too large due to faulty valve tappets or worn valve train components.	* CHECK and adjust the valve clearances. REFER to: Valve Clearance Adjustment (303-01B Engine, General Procedures).
	* Timing belt damaged.	* INSTALL a new timing belt. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
	* Timing belt incorrectly tensioned.	* CHECK the timing belt tensioner. INSTALL a new timing belt tensioner or timing belt as necessary. REFER to: Timing Belt (303-01B Engine, Removal and Installation).
Noisy running or engine noise	* Engine components - Pistons - Piston rings - Connecting rod big end, main bearing or thrust bearing journals - Connecting rods bent or damaged.	* CHECK the engine components for wear or damage. Make sure all components are within specification. INSTALL new components as necessary.

NOTE: Before installing new gaskets or seals, make sure that the fault is clearly established.
If the oil leak cannot be identified clearly by a visual inspection, carry out an ultraviolet (UV) test:

Ultraviolet (UV) Testing

1. Clean the engine and transmission with a suitable cleaning fluid.
2. Pour the UV-test fluid in accordance with the quantity specified by the manufacturer through the oil filler neck into the engine and install the oil filler cap.



WARNING: Vehicles with manual transaxle, shift the transaxle into Neutral. Failure to follow this instruction may result in personal injury.

3. Start the engine and let it run for about five minutes.
4. Switch off the engine.

NOTE: If no leak can be found, road test the vehicle under various loads and check the engine for leaks again.

5. Check the engine for oil leaks using a suitable UV lamp.
6. Rectify any leaks found and check the engine for oil leaks.

Measure the Compression Pressure



WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and can ignite. Failure to follow these instructions may result in personal injury.

NOTE: The powertrain control module (PCM) receives an error message when the fuel pump relay is removed or electrical components are disconnected. This error message must be deleted from the fault memory using the Ford diagnostic equipment after completing the compression test.

NOTE: Valve clearance must be set correctly before carrying out a compression test. Make sure that the engine is at the normal operating temperature.

NOTE: The varying design of compression checking devices and fluctuating starter motor speeds normally only allows for a comparison to be made of the compression pressures in all cylinders.

NOTE: The readings from the compression pressure check should be used as an indication of cylinder balance. If one or more of the readings is significantly lower than the others, investigate that particular cylinder for concerns.

1. Open the **BJB (battery junction box)** and remove fuse 56 - fuel pump relay.
2. Start and run the engine at idle speed until the engine stops.
3. Disconnect the electronic ignition (EI) coil connector from the EI coil.

NOTE: Twist the spark plug connectors slightly before disconnecting them. Pull on the connector and not on the cable.

4. Disconnect the spark plug connectors.
5. Using the special tool, remove the spark plugs.

NOTE: Operate the starter motor with wide open throttle until the reading on the compression tester stops rising.

6. Carry out the measurement in accordance with the instructions supplied with the measuring device on every cylinder using a suitable compression pressure recorder with a suitable adapter.
7. Using the special tool, install the spark plugs.
8. Connect the spark plug connectors.
9. Connect the EI coil electrical connector to the EI coil.
10. Install fuse 56 (fuel pump relay) and close the **BJB**.
11. Using the Ford diagnostic equipment, clear the DTC(s) from the PCM.

Measure the Oil Pressure

NOTE: The oil pressure depends on various factors (engine speed, oil temperature, oil viscosity, extent of oil filter contamination).

NOTE: Measure the oil pressure at the specified engine speed.

1. Raise and support the vehicle.
REFER to: [Jacking and Lifting](#) (100-02 Jacking and Lifting, Description and Operation).
2. Disconnect the oil pressure switch electrical connector from the oil pressure switch.
3. Remove the oil pressure switch.
4. Attach the oil pressure gauge with the oil pressure gauge connector to the oil pressure switch bore, and position it to allow reading from above.
5. Lower the vehicle.
6. **NOTE:** Measure the oil pressure at an oil temperature of 80°C.
NOTE: Oil pressure at 2000 rpm: 2.0 bar.
Measure the oil pressure.
7. Raise and support the vehicle.
REFER to: [Jacking and Lifting](#) (100-02 Jacking and Lifting, Description and Operation).
8. Detach the oil pressure gauge and connector from the oil pressure switch bore.
9. Coat the oil pressure switch with [adhesive](#).
10. Install the oil pressure switch.
11. Connect the oil pressure switch electrical connector to the oil pressure switch.
12. Lower the vehicle.

Valve Train Analysis

The following component tests are used to diagnose valve train concerns.

Valve Train Analysis - Engine Off, Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure that correct parts are used with the static engine analysis as follows.

Valve Train Analysis - Camshafts and Valve Tappets

- Check for broken or damaged parts.
- Check for loose mounting bolts on camshaft caps.
- Check for worn or damaged valve tappets.

Valve Train Analysis - Valve Springs, Valve Tappets Removed

- Check for broken or damaged parts.

Valve Train Analysis - Valve Spring Retainer and Valve Spring Retainer Keys, Valve Tappets Removed

- 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.

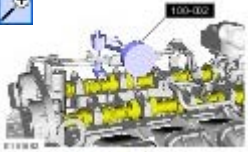
Valve Train Analysis - Valves and Cylinder Head, Valve Tappets Removed

- Check for blocked oil drain back holes.
- Check for worn or damaged valve tips.
- Check for missing or damaged valve stem seals or guide-mounted valve stem seal.
- Check for missing or worn valve spring seats.

Valve Train Analysis - Camshaft Lobe Lift

Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the spark plugs.
2. Install the Dial Indicator Gauge (100-002 or 205-069) with Holding Fixture (205-070) so the rounded tip of the dial indicator is on top of the camshaft lobe and on the same plane as the valve tappet.



3. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.
4. Zero the dial indicator. Continue to rotate the crankshaft until the high-lift point of the camshaft lobe is in the fully raised position (highest indicator reading).
5. To check the accuracy of the original dial 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 Steps 2 through 5.
6. If the lift on any lobe is below specified service limits, install a new camshaft and valve tappets.
7. Install the spark plugs.

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