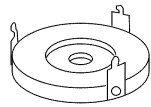
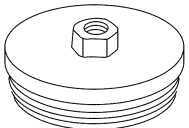

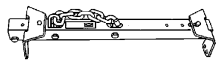
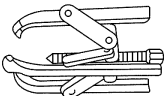
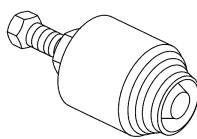


DISASSEMBLY

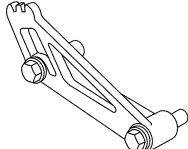
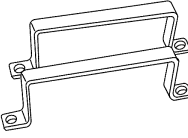
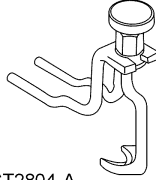
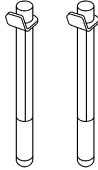
Engine

Special Tool(s)

 ST1481-A	Remover, Crankshaft Rear Slinger 303-514 (T95P-6701-AH)
 ST1382-A	Remover, Crankshaft Rear Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1377-A	Modular Engine Lift Bracket 303-F047 (014-00073)
 ST1184-A	3-Jaw Puller 303-D121
 ST1730-A	Remover, Crankshaft Front Seal 303-107 (T74P-6700-A)

(Continued)

Special Tool(s)

 ST2807-A	Locking Tool, Camshaft Phaser Sprocket 303-1046
 ST1668-A	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)
 ST2804-A	Compressor, Valve Spring 303-1039
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)

Material

Item	Specification
Silicone Gasket Remover ZC-30	—
Motorcraft Metal Surface Prep ZC-31	—

DISASSEMBLY (Continued)

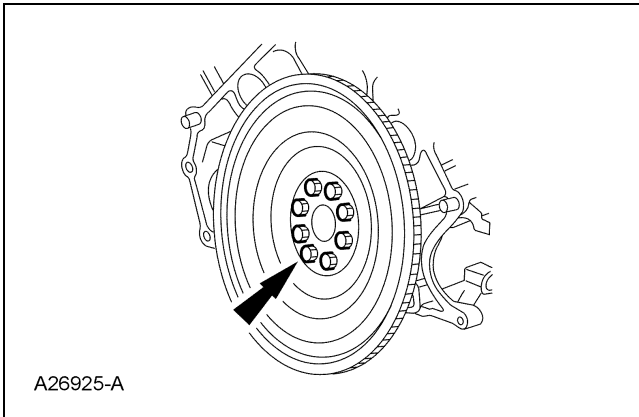
⚠ CAUTION: Remove the cylinder heads before removing the crankshaft. Failure to do so can result in engine damage.

⚠ CAUTION: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

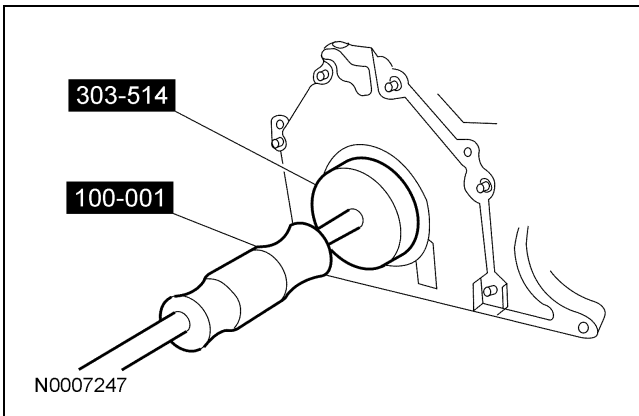
NOTE: The flexplate, crankshaft rear seal and the crankshaft rear oil slinger must be removed before mounting the engine on the engine stand.

NOTE: For additional information, refer to the exploded view under the assembly procedure in this section.

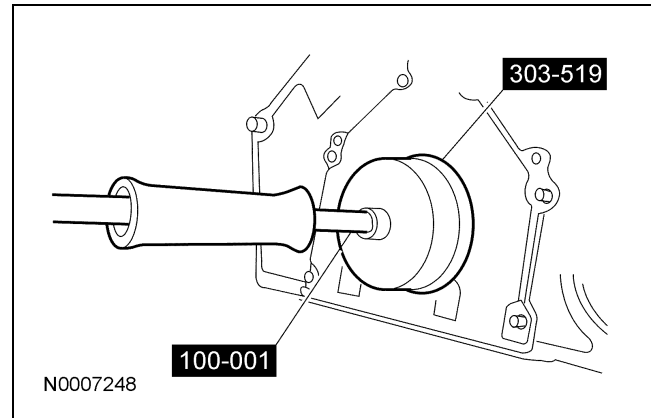
- NOTE:** Flexplate shown, flywheel similar.
Remove the 6 bolts and the flexplate or flywheel.



- Using the special tools, remove the crankshaft rear oil slinger.

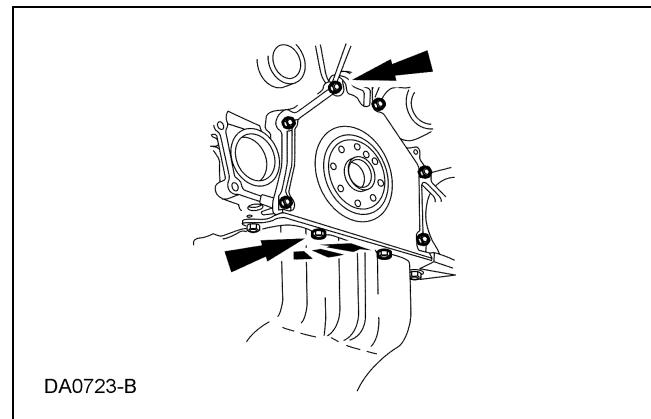


- Using the special tools, remove the crankshaft rear seal.



- Remove the 8 bolts and the crankshaft rear seal retainer plate.

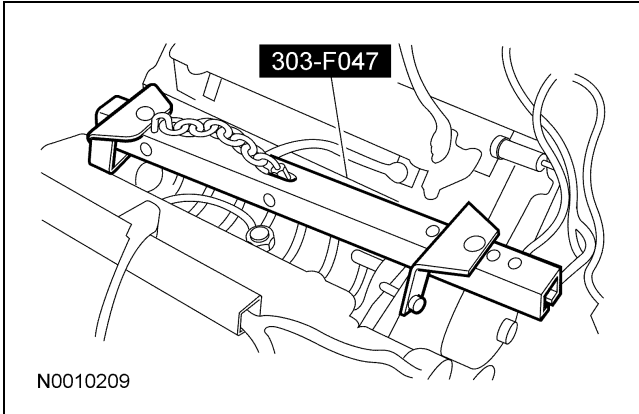
- ⚠ CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant. Clean and inspect the sealing surfaces.



- Mount the engine on a suitable work stand.

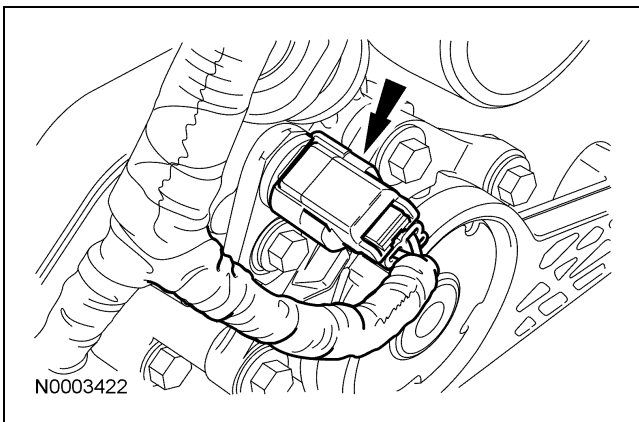
DISASSEMBLY (Continued)

6. Remove the special tool.



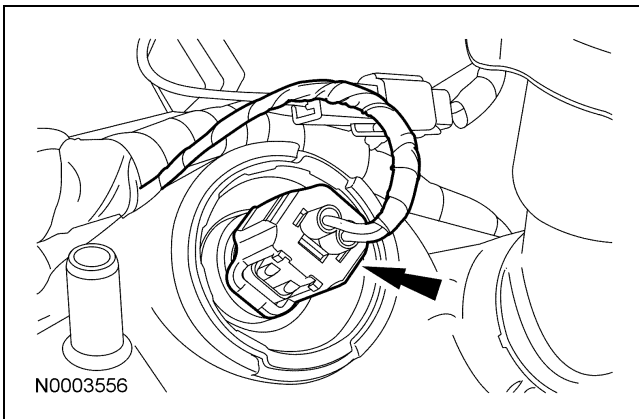
7. **NOTE:** RH shown, LH similar.

Disconnect the RH and LH camshaft position (CMP) sensor electrical connectors.

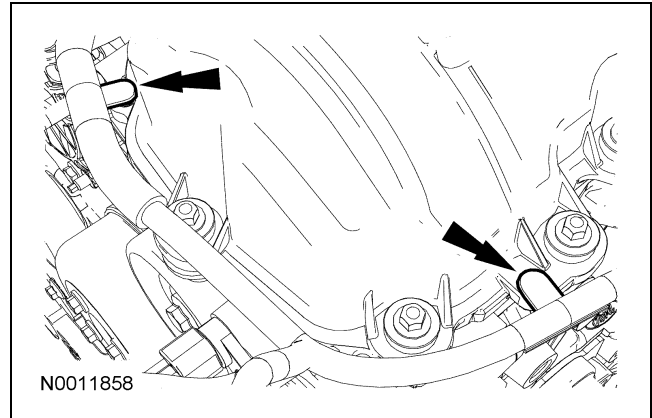


8. **NOTE:** RH shown, LH similar.

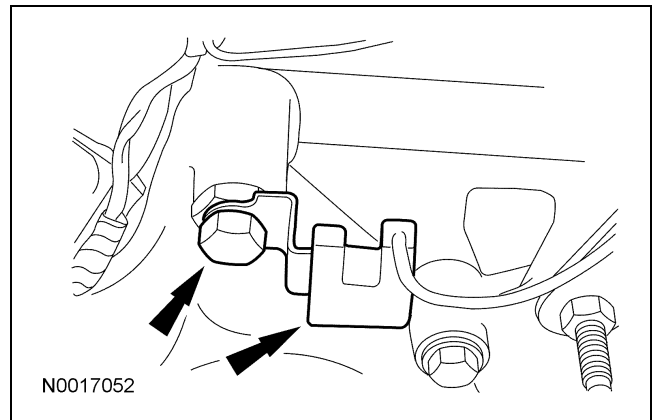
Disconnect the RH and LH variable camshaft timing (VCT) solenoid electrical connectors.




9. Detach the engine wiring harness pin-type retainers.



10. Remove the nut and the RH radio ignition interference capacitor.



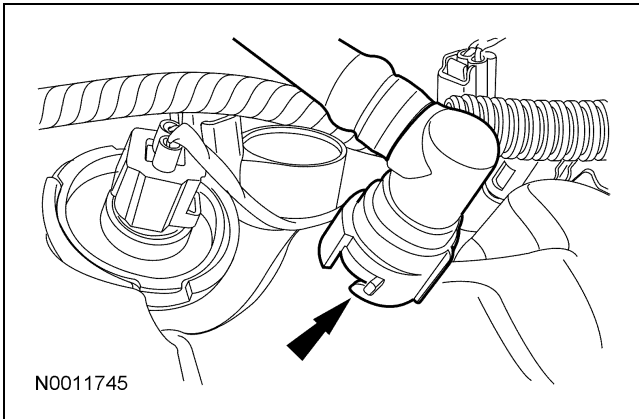
DISASSEMBLY (Continued)

11.  **CAUTION:** When reusing liquid or vapor tube connectors, make sure to use compressed air to remove any foreign material from the connector retaining clip area before separating from the tube.

NOTE: LH shown, RH similar.

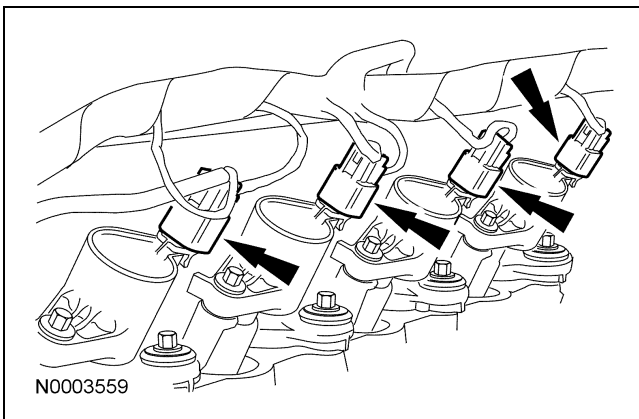
Remove the positive crankcase ventilation (PCV) tubes from the LH and RH valve covers.

- Disconnect the quick connect fittings.
 - Push the connector toward the valve cover to release pressure.
 - Push the release tab clockwise.
 - Disconnect the quick connect fitting.

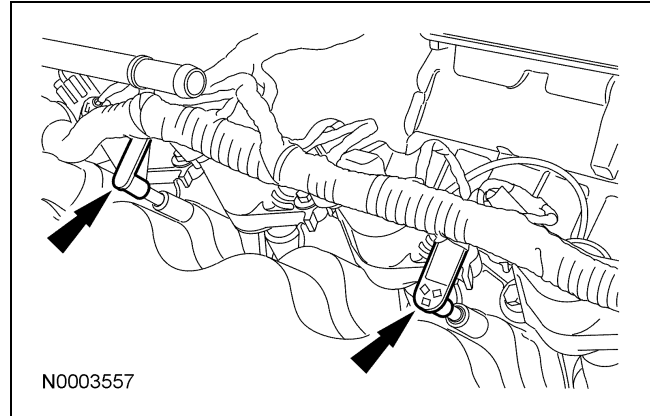


12. **NOTE:** RH shown, LH similar.

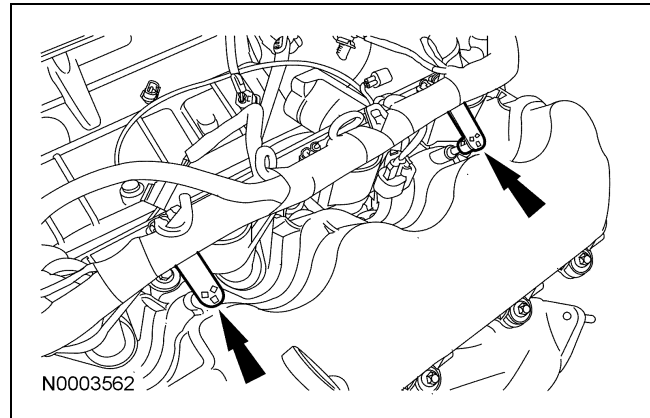
Disconnect the 4 RH and 4 LH ignition coil electrical connectors.



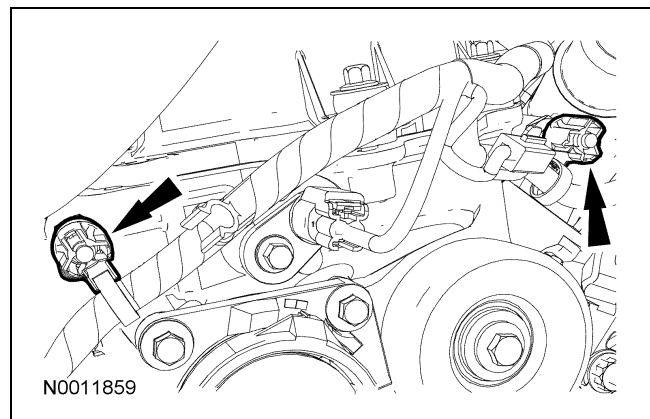
13. Disconnect the 2 engine wiring harness retainers from the RH valve cover studs.



14. Disconnect the 2 engine wiring harness retainers from the LH valve cover studs.

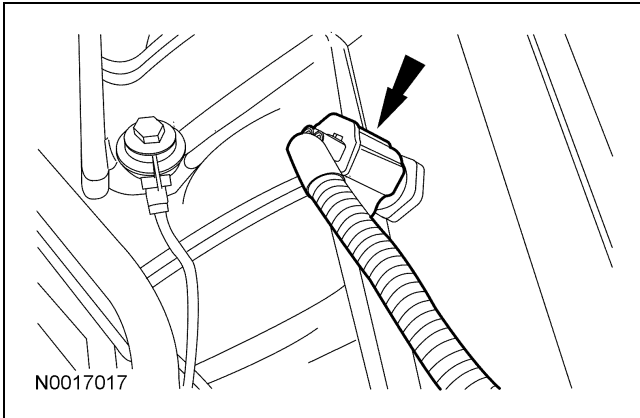


15. Detach the engine wiring harness pin-type retainers.

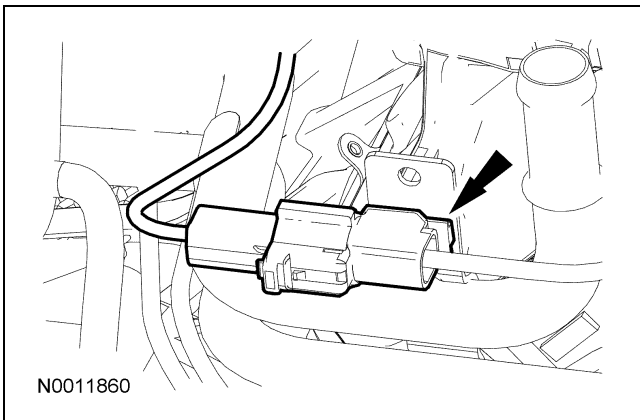


DISASSEMBLY (Continued)

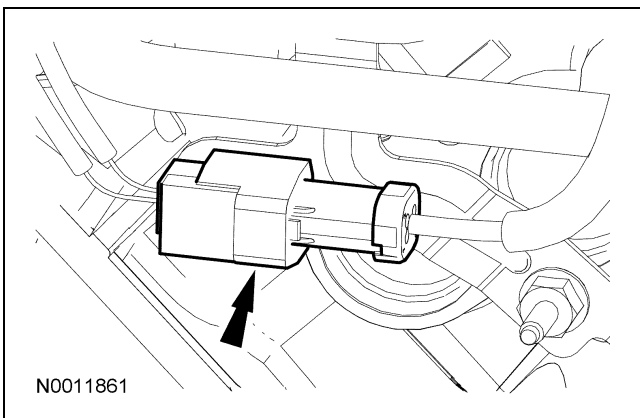
16. Disconnect the cylinder head temperature (CHT) sensor electrical connector.



17. Detach the CHT sensor jumper harness electrical connector pin-type retainer.

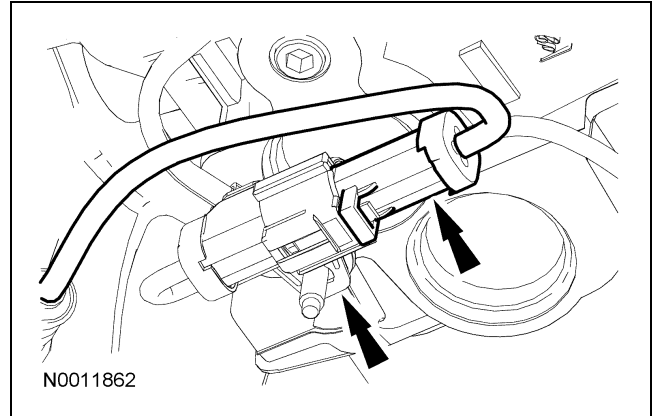


18. Disconnect the knock sensor (KS) electrical connector and pin-type retainer.

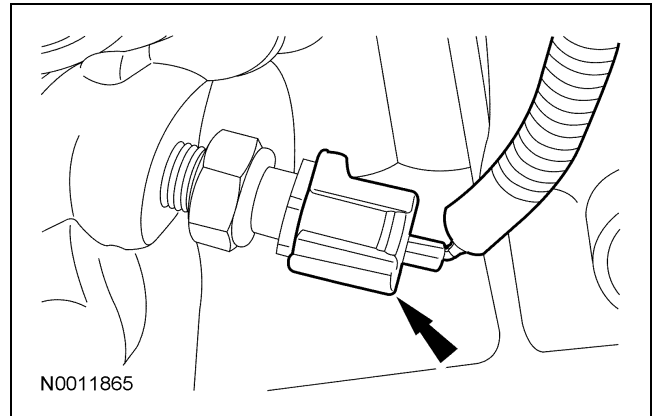


19. Disconnect the LH heated oxygen sensor (HO2S) electrical connector.

- Detach the engine wiring harness retainer from the stud bolt.

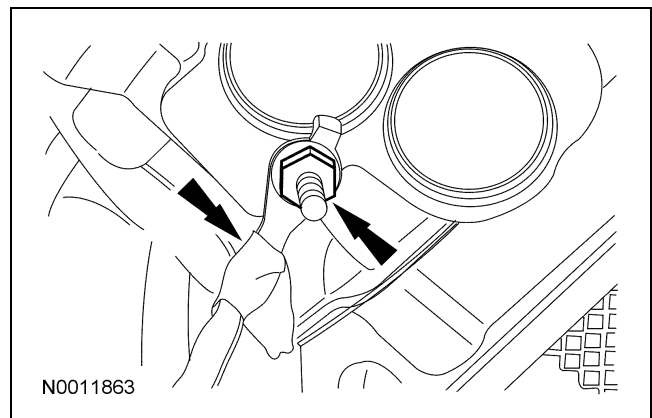


20. Disconnect the engine oil pressure sensor electrical connector.



21. Remove the engine wiring harness from the engine.

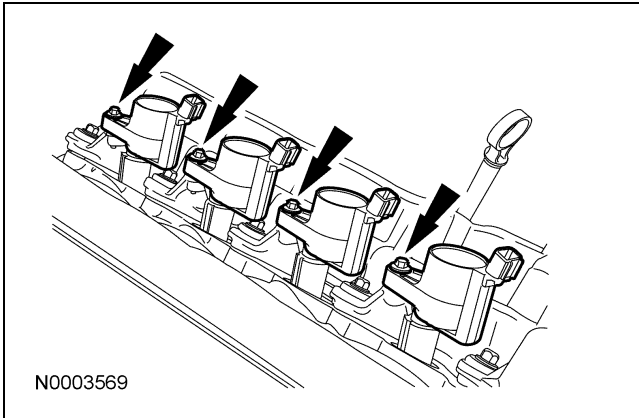
22. Remove the nut and ground strap from the stud bolt.



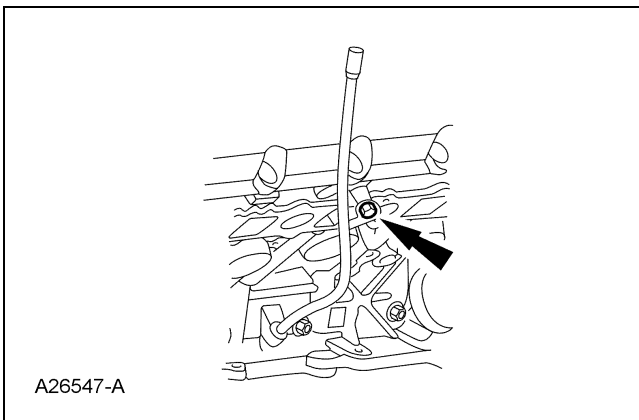
DISASSEMBLY (Continued)

23. **NOTE:** LH shown, RH similar.

Remove the 8 bolts and the 8 ignition coils.



24. Remove the bolt and the oil level indicator tube.



25. **⚠ CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

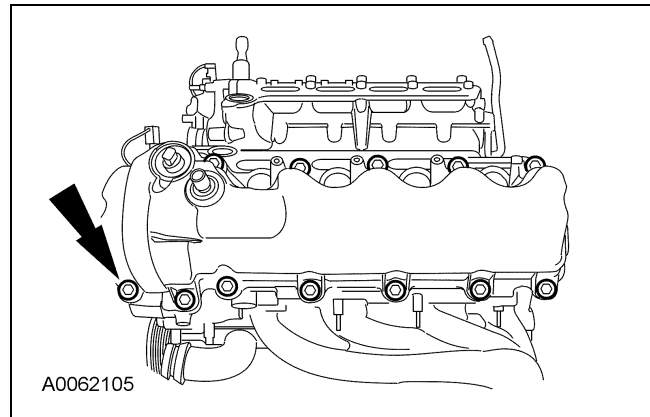
⚠ CAUTION: When removing the valve cover, make sure to avoid damaging the variable camshaft timing (VCT) solenoid.

NOTE: The bolts are part of the valve cover and should not be removed.

NOTE: LH shown, RH similar.

Loosen the 29 bolts and remove the valve covers.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the valve cover gasket. If the gasket is damaged, remove and discard the gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

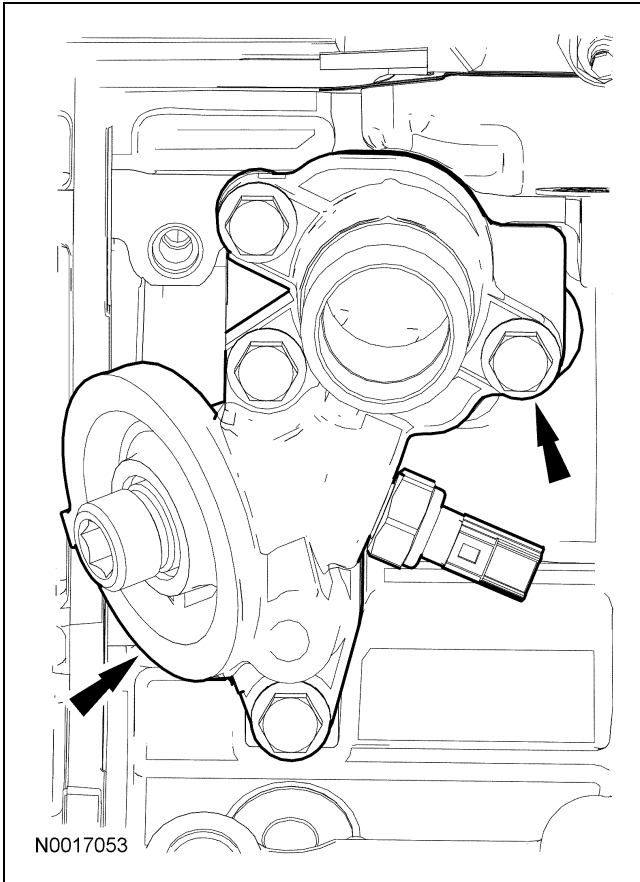


26. Remove and discard the oil filter.

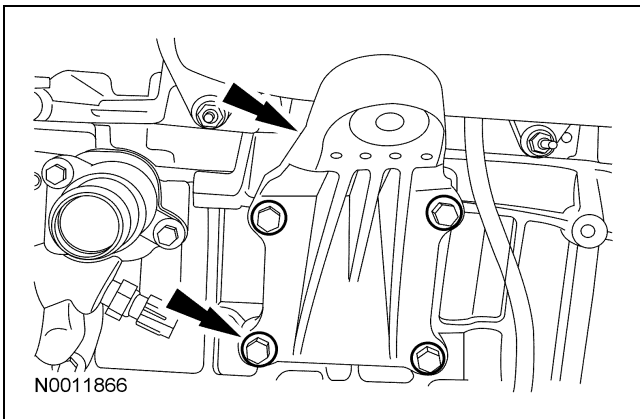
DISASSEMBLY (Continued)

27. Remove the 4 bolts and the oil filter adapter.

- Discard the gasket.

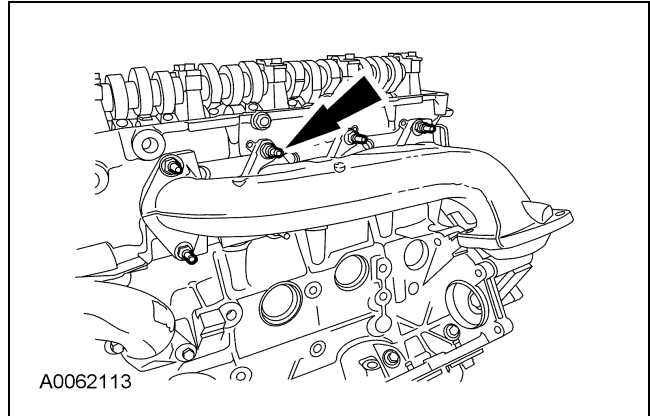


28. Remove the 4 bolts and the LH motor mount bracket.

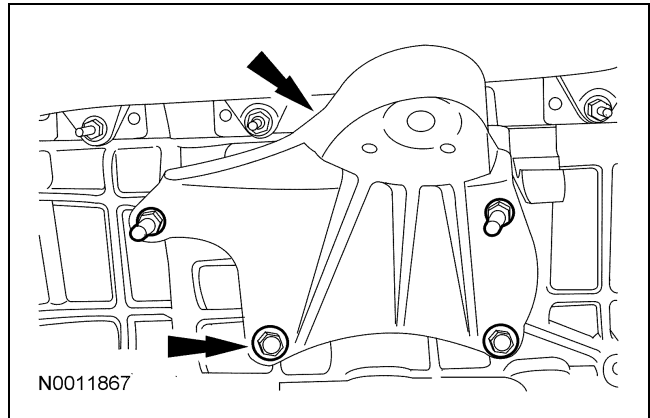


29. Remove the 8 nuts and the LH exhaust manifold.

- Discard the gasket.

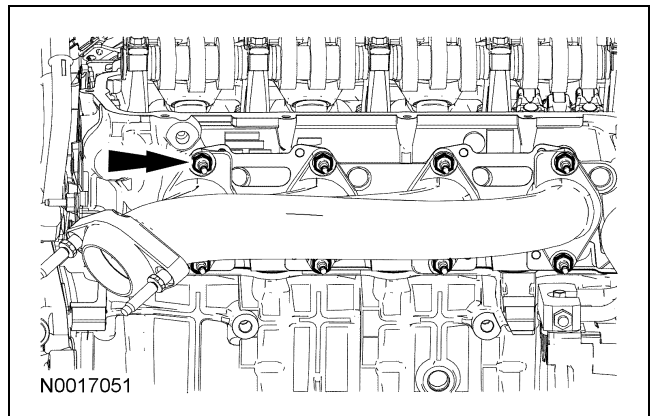


30. Remove the 2 bolts, 2 stud bolts and the RH motor mount bracket.



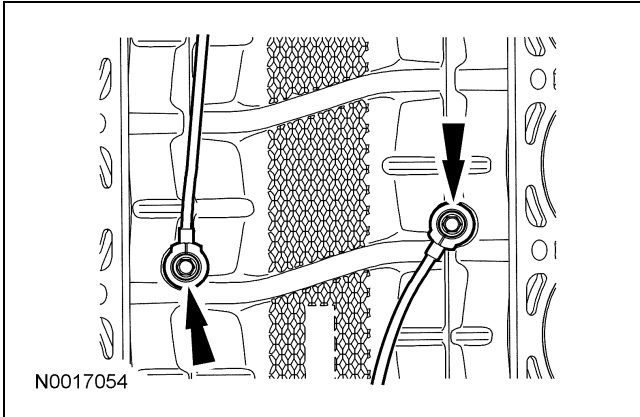
31. Remove the 8 nuts and the RH exhaust manifold.

- Discard the gasket.

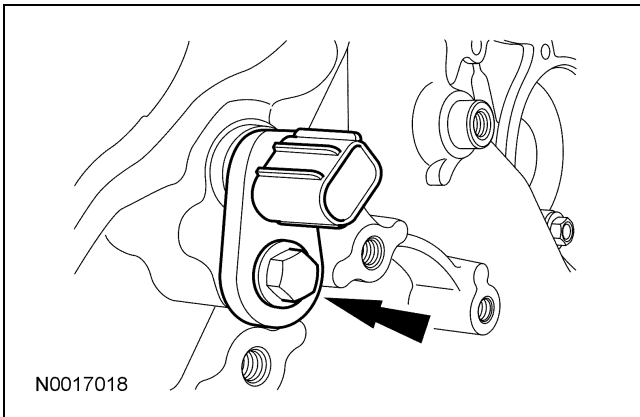


DISASSEMBLY (Continued)

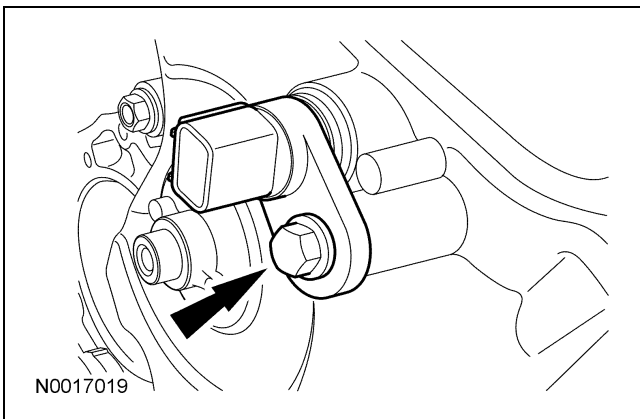
32. Remove the 2 bolts and the KS.



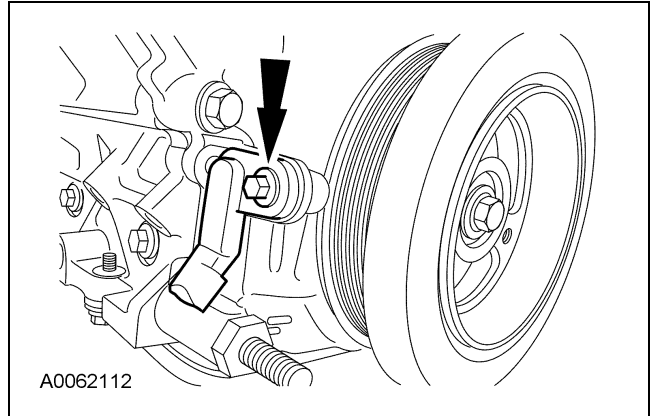
33. Remove the bolt and the RH CMP sensor.



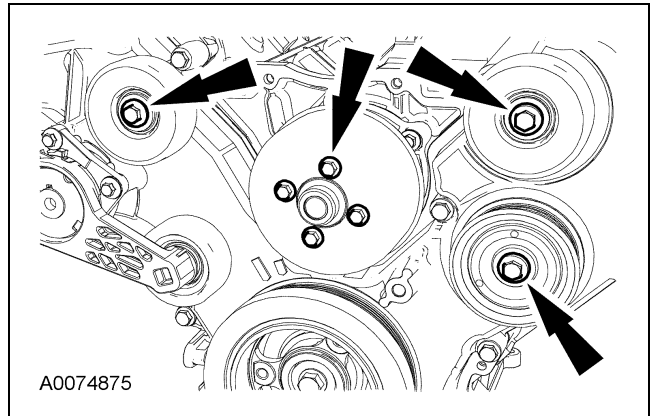
34. Remove the bolt and the LH CMP sensor.



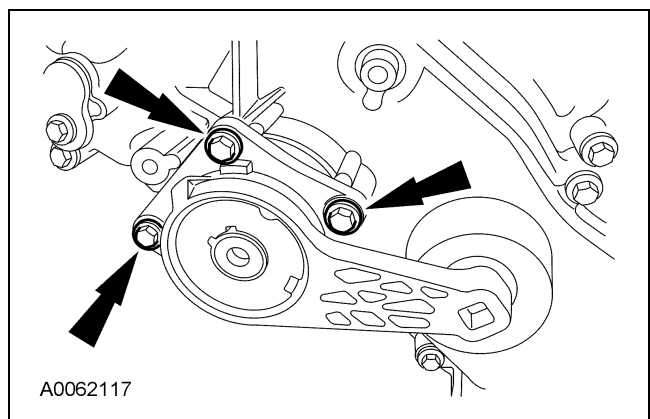
35. Remove the bolt and the CKP sensor.



36. Remove the 7 bolts, the coolant pump pulley and the 3 accessory drive belt idler pulleys.

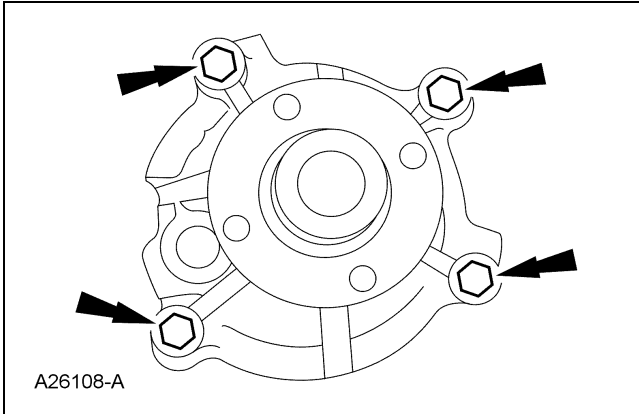


37. Remove the 3 bolts and the accessory drive belt tensioner.



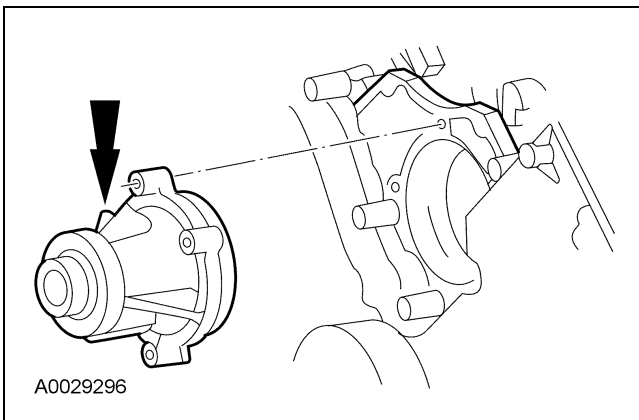
DISASSEMBLY (Continued)

38. Remove the 4 coolant pump bolts.



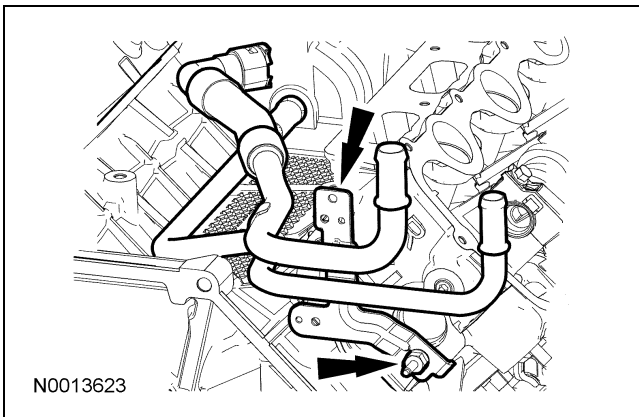
39. Remove the coolant pump from the cylinder block.

- Discard the O-ring seal.

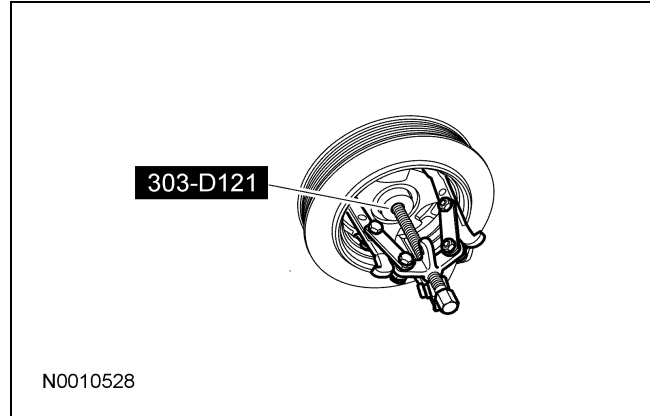


40. Remove the stud bolt and the coolant tube assembly.

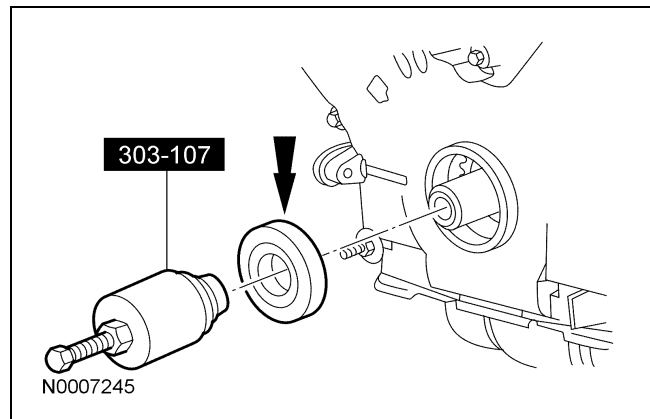
- Discard the O-ring seal.



41. Remove and discard the crankshaft pulley bolt. Using the special tool, remove the crankshaft pulley.



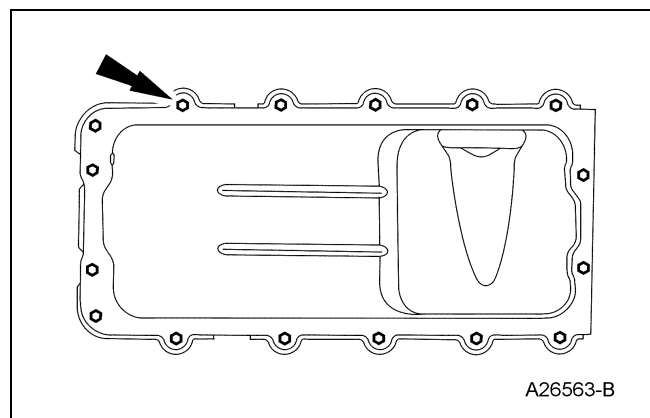
42. Using the special tool, remove the crankshaft front oil seal.



43. Remove the bolts, oil pan and oil pan gasket.

- **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

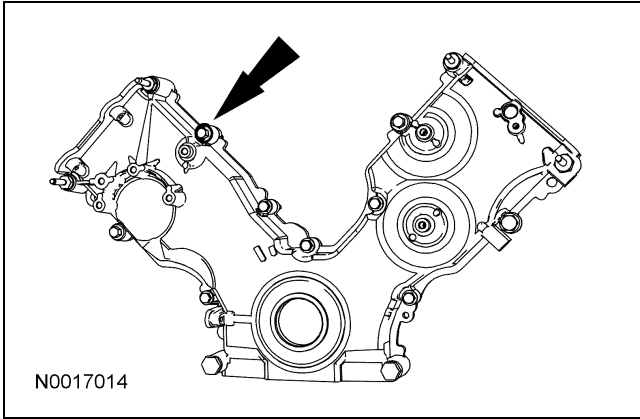
Clean and inspect the sealing surfaces.



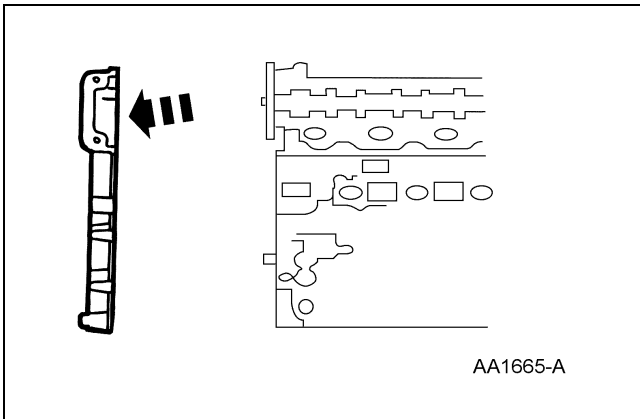
DISASSEMBLY (Continued)

44. **NOTE:** Correct fastener location is essential for the assembly procedure. Record fastener location.

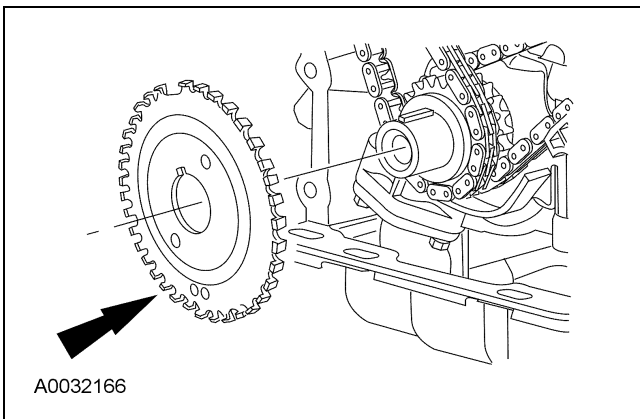
Remove the engine front cover fasteners.



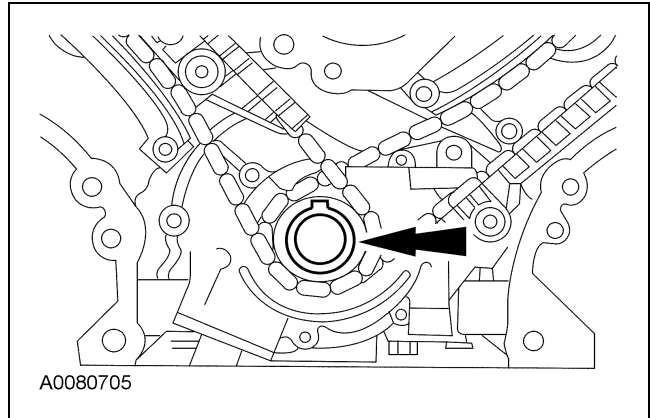
45. Remove the engine front cover from the cylinder block.



46. Remove the crankshaft sensor ring from the crankshaft.

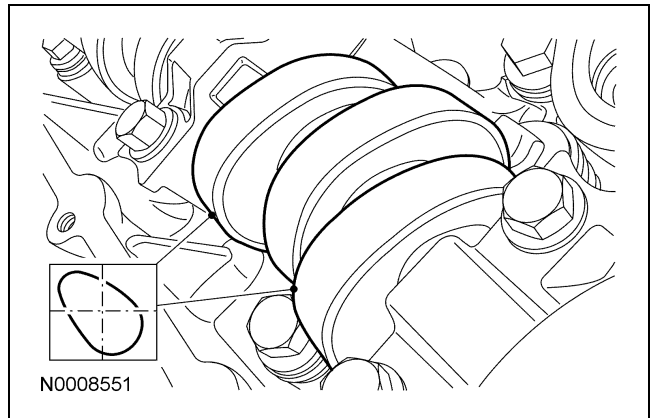


47. Position the crankshaft keyway at the 12 o'clock position.




48. **NOTE:** If the camshaft lobes are not exactly positioned as shown, the crankshaft will require one full additional rotation to the 12 o'clock position.

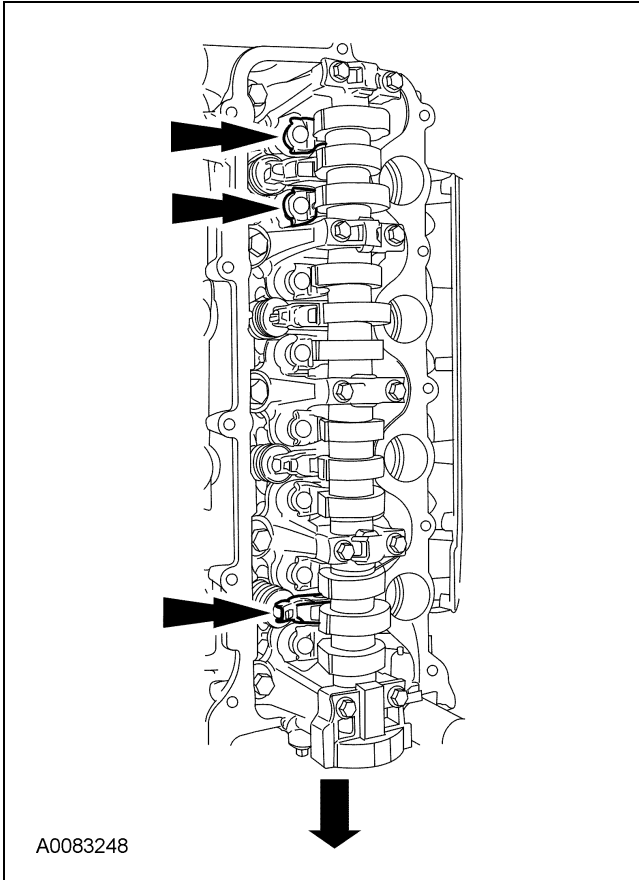
The No. 1 cylinder camshaft exhaust lobe must be coming up on the exhaust stroke. Verify by noting the position of the 2 intake lobes and the exhaust lobe on the No. 1 cylinder.




DISASSEMBLY (Continued)

49.  **CAUTION:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

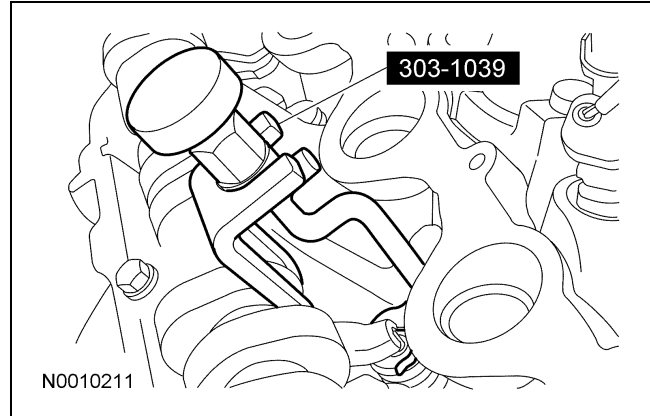
Remove only the 3 roller followers shown in the illustration from the RH cylinder head.




50.  **CAUTION:** Do not allow the valve keepers to fall off the valve or the valve may drop into the cylinder.

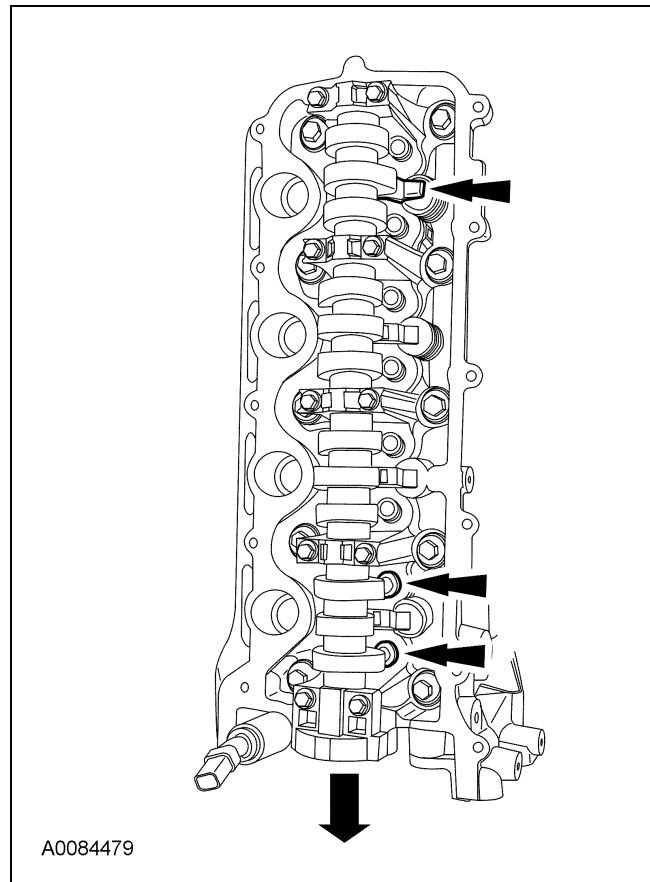
NOTE: It may be necessary to push the valve down while compressing the spring.

Using the special tool, remove the 3 roller followers designated in the previous step from the RH cylinder head.




51.  **CAUTION:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove only the 3 roller followers shown in the illustration from the LH cylinder head.

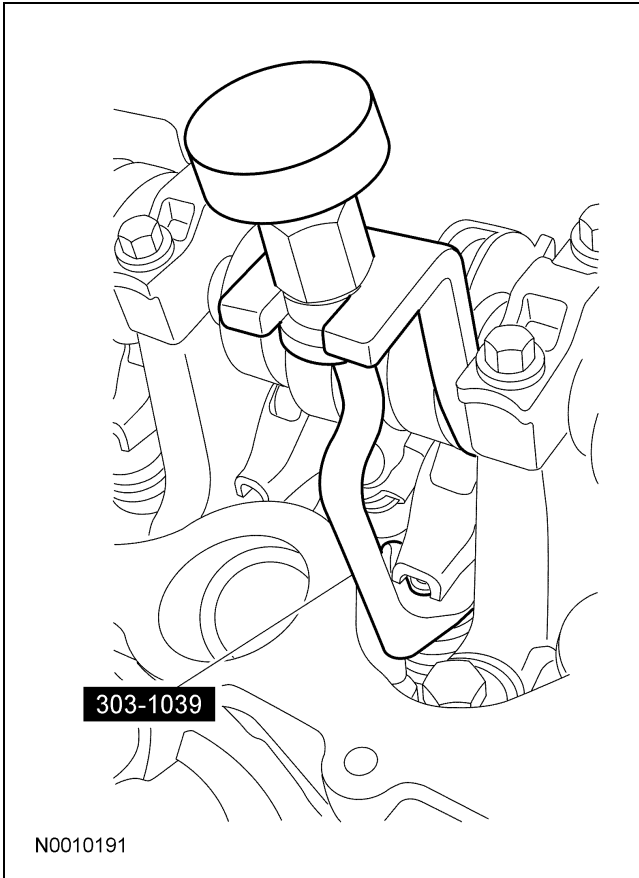



DISASSEMBLY (Continued)

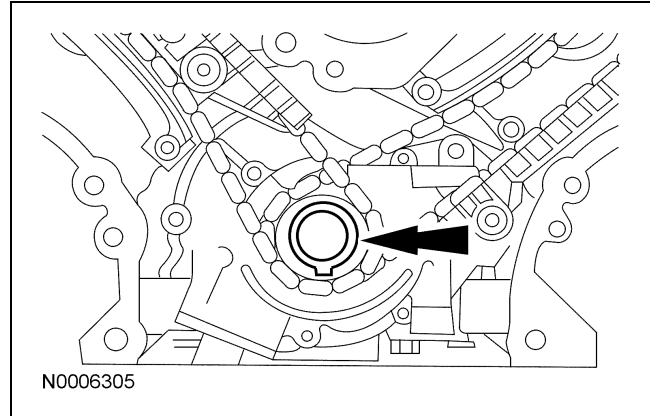
52.  **CAUTION:** Do not allow the valve keepers to fall off the valve or the valve may drop into the cylinder.

NOTE: It may be necessary to push the valve down while compressing the spring.

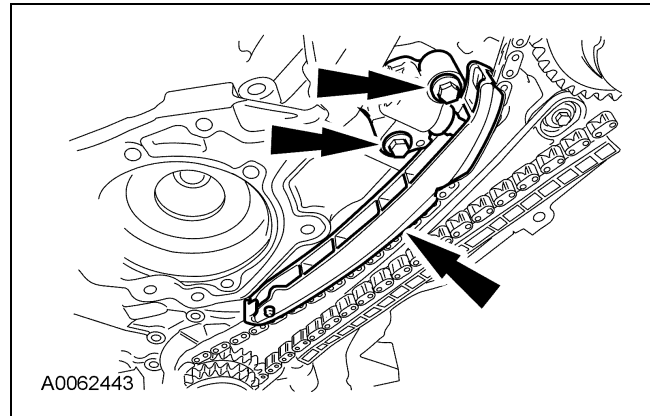
Using the special tool, remove the 3 roller followers designated in the previous step from the LH cylinder head.



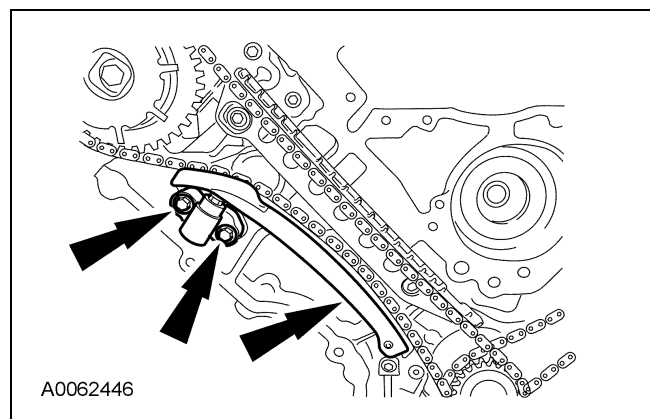
53.  **CAUTION:** The crankshaft cannot be moved past the 6 o'clock position once set. Rotate the crankshaft clockwise and position the crankshaft keyway at the 6 o'clock position.



54. Remove the 2 bolts, the LH timing chain tensioner and tensioner arm.



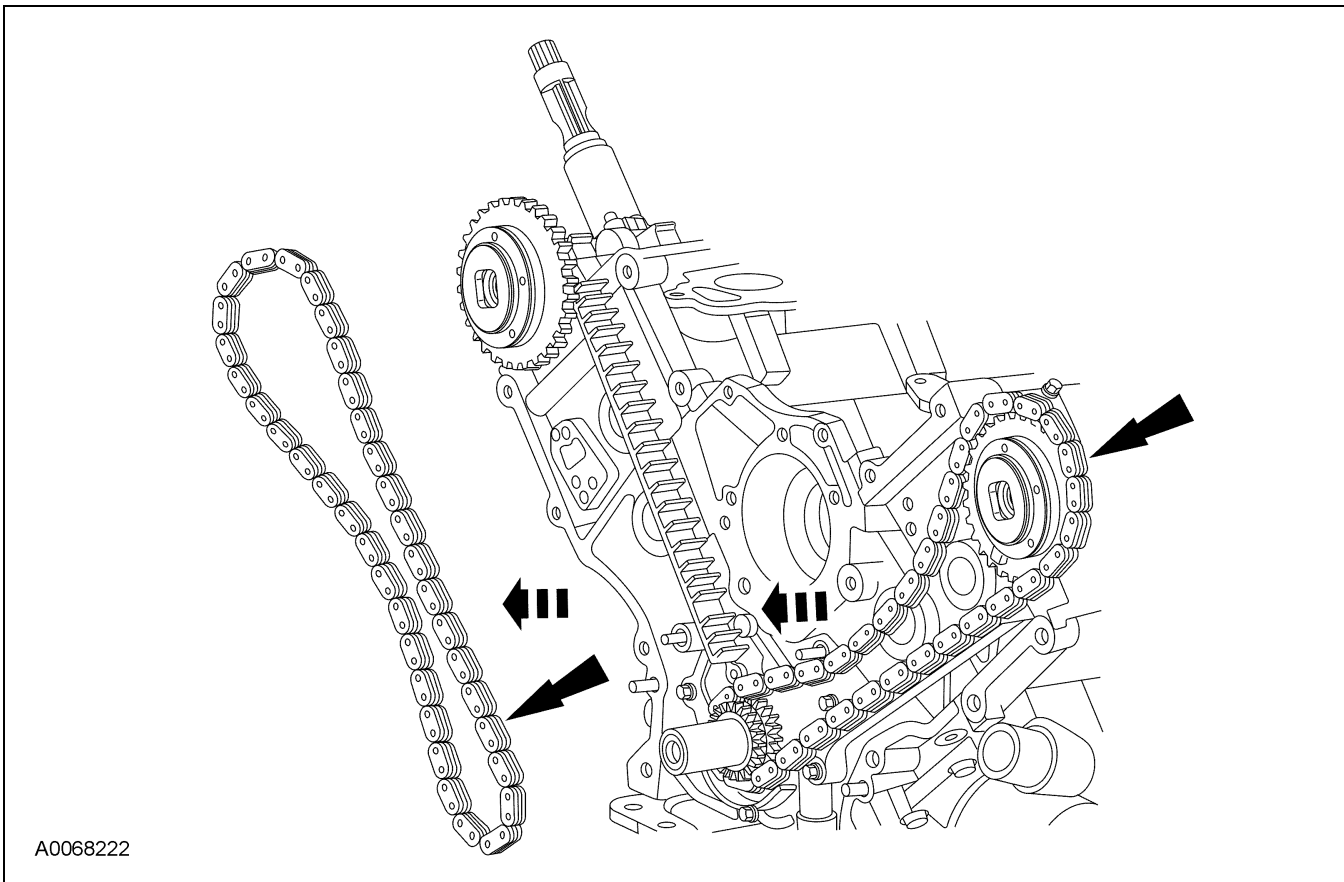
55. Remove the 2 bolts, the RH timing chain tensioner and tensioner arm.



DISASSEMBLY (Continued)

56. Remove the RH and LH timing chains and the crankshaft sprocket.

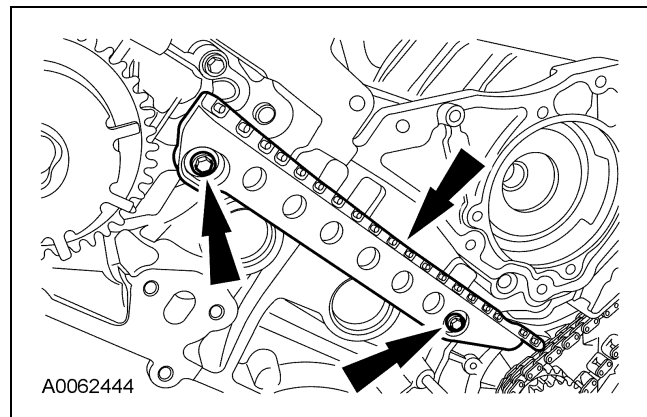
- Remove the RH timing chain from the camshaft sprocket.
- Remove the RH timing chain from the crankshaft sprocket.
- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain and crankshaft sprocket.



57. **NOTE:** RH shown, LH similar.

Remove the LH and RH timing chain guides.

- Remove the 2 bolts.
- Remove both timing chain guides.



DISASSEMBLY (Continued)

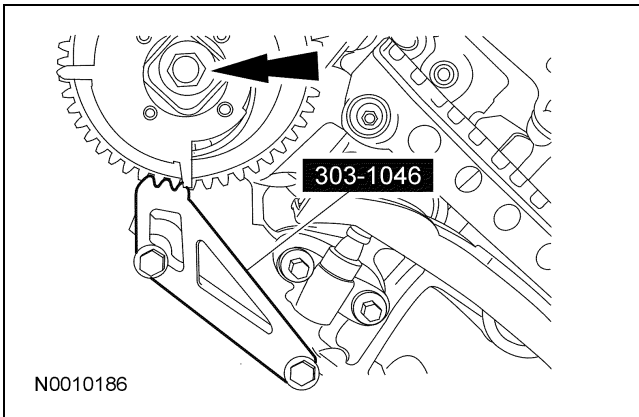
58. ⚠ **CAUTION:** Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

⚠ **CAUTION:** Only use hand tools to remove the camshaft phaser sprocket assembly or damage may occur to the camshaft or camshaft phaser unit.

⚠ **CAUTION:** Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

Using the special tool, remove the bolt and the RH camshaft phaser sprocket assembly.

- Discard the camshaft phaser sprocket bolt.



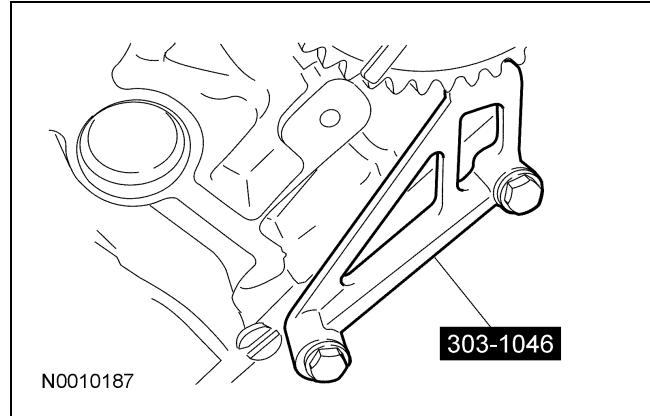
59. ⚠ **CAUTION:** Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

⚠ **CAUTION:** Only use hand tools to remove the camshaft phaser sprocket assembly or damage may occur to the camshaft or camshaft phaser unit.

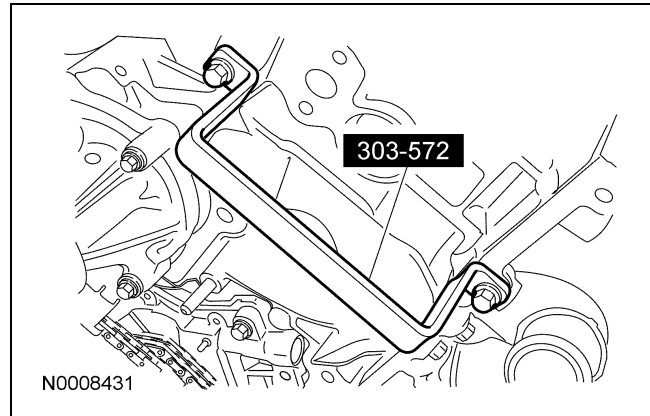
⚠ **CAUTION:** Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

Using the special tool, remove the bolt and the LH camshaft phaser sprocket assembly.

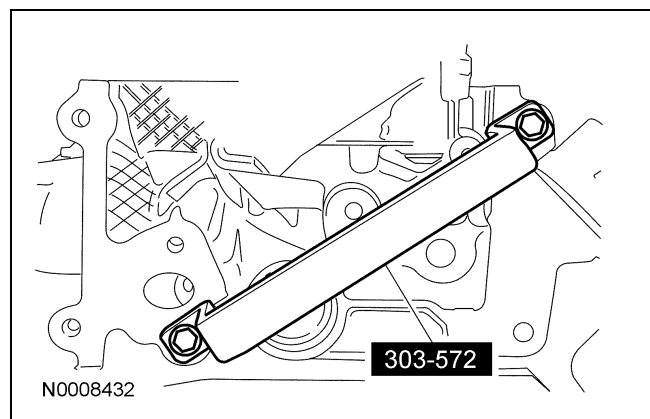
- Discard the camshaft phaser sprocket bolt.




60. Install the special tool onto the LH cylinder head.



61. Install the special tool onto the RH cylinder head.



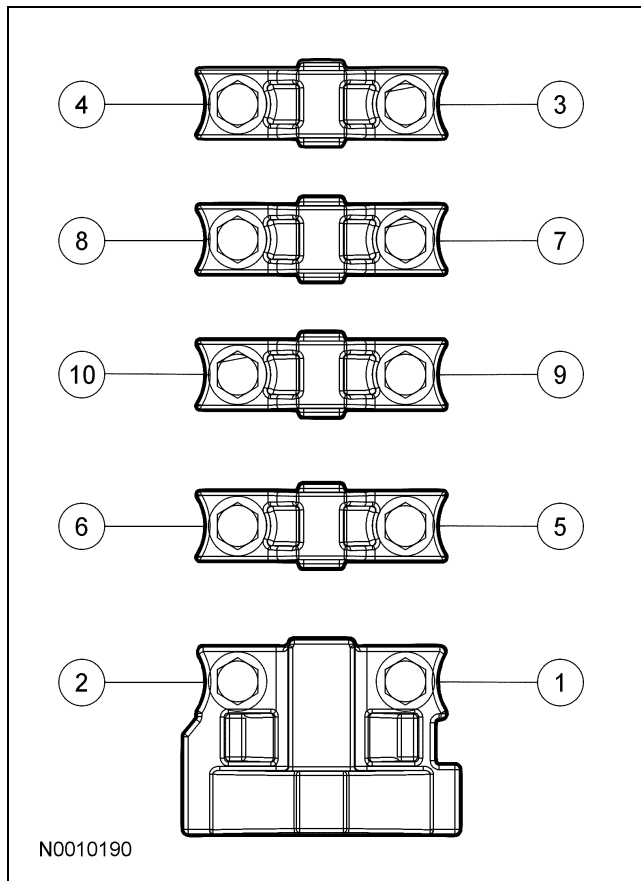
DISASSEMBLY (Continued)

62.  **CAUTION:** Remove the front thrust camshaft bearing cap straight upward from the bearing towers, or the bearing cap may be damaged from sideloading.

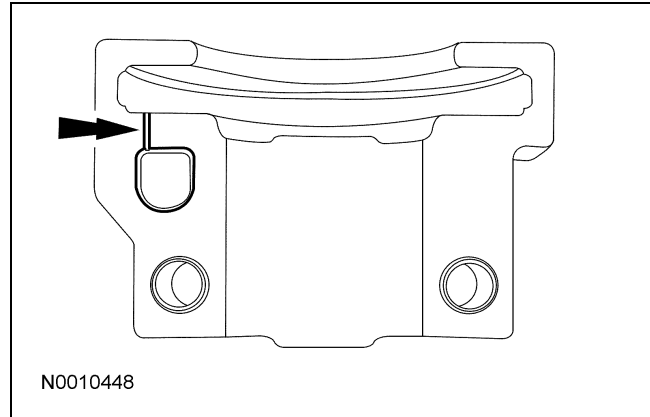
NOTE: The camshaft bearing caps must be installed in their original locations. Record camshaft bearing cap locations.

Remove the bolts in the sequence shown.


Remove the RH cylinder head front camshaft bearing cap, then the remaining bearing caps.




63. Clean and inspect the RH camshaft bearing caps.
- The camshaft front thrust bearing cap contains an oil metering groove. Make sure the groove is free of foreign material.



64. Remove the RH camshaft.


65.  **CAUTION:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the remaining roller followers from the RH cylinder head.

66.  **CAUTION:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the hydraulic lash adjusters from the RH cylinder head.

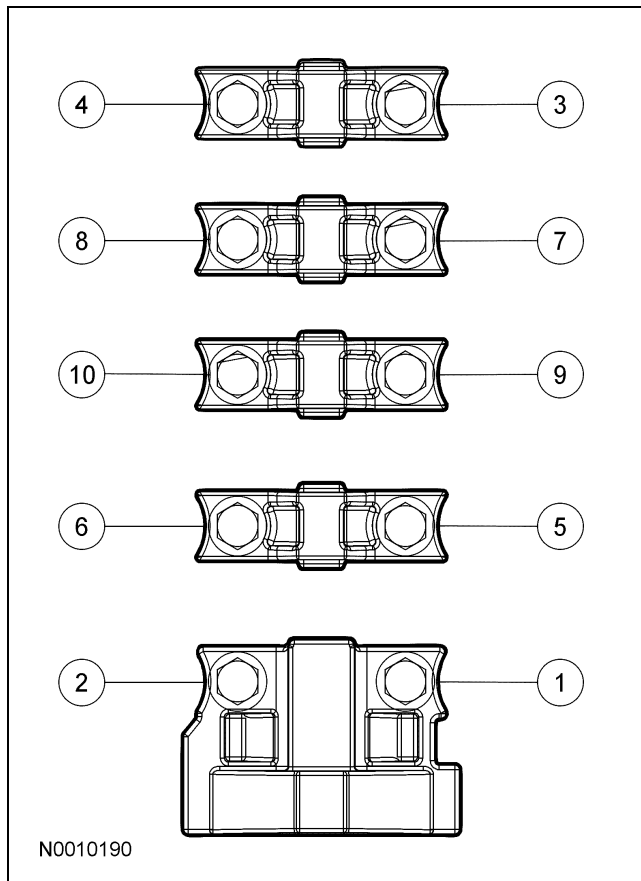
DISASSEMBLY (Continued)

67.  **CAUTION:** Remove the front thrust camshaft bearing cap straight upward from the bearing towers, or the bearing cap may be damaged from sideloading.

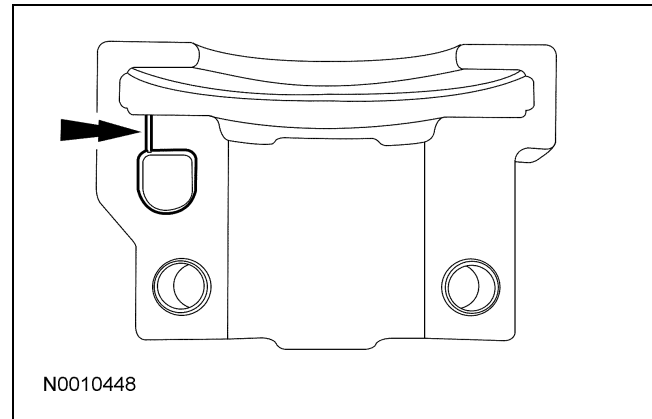
NOTE: The camshaft bearing caps must be installed in their original locations. Record camshaft bearing cap locations.

Remove the bolts in the sequence shown.


Remove the LH cylinder head front camshaft bearing cap, then the remaining bearing caps.




68. Clean and inspect the LH camshaft bearing caps.
- The camshaft front thrust bearing cap contains an oil metering groove. Make sure the groove is free of foreign material.



69. Remove the LH camshaft.

70.  **CAUTION:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the remaining roller followers from the LH cylinder head.

71.  **CAUTION:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the hydraulic lash adjusters from the LH cylinder head.

DISASSEMBLY (Continued)

72. ⚠ **CAUTION:** The cylinder head must be cool before removing it from the engine. Cylinder head warpage can result if a warm or hot cylinder head is removed.

⚠ **CAUTION:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

⚠ **CAUTION:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.

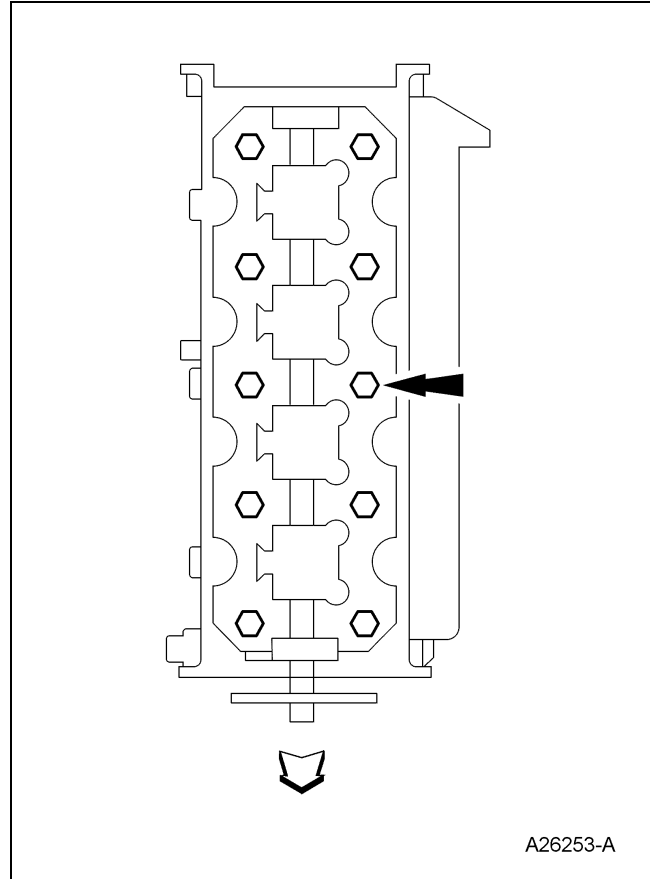
⚠ **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

⚠ **CAUTION:** Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

NOTE: RH shown, LH similar.


Remove the 20 bolts and the cylinder heads.


- Discard the cylinder head gaskets.
- Discard the cylinder head bolts.



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DISASSEMBLY (Continued)

73.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

 **CAUTION:** Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block.

- 1 Remove any large deposits of silicone or gasket material with a plastic scraper.
- 2 Apply silicone gasket remover, following package directions and allow to set for several minutes.
- 3 Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
- 4 Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

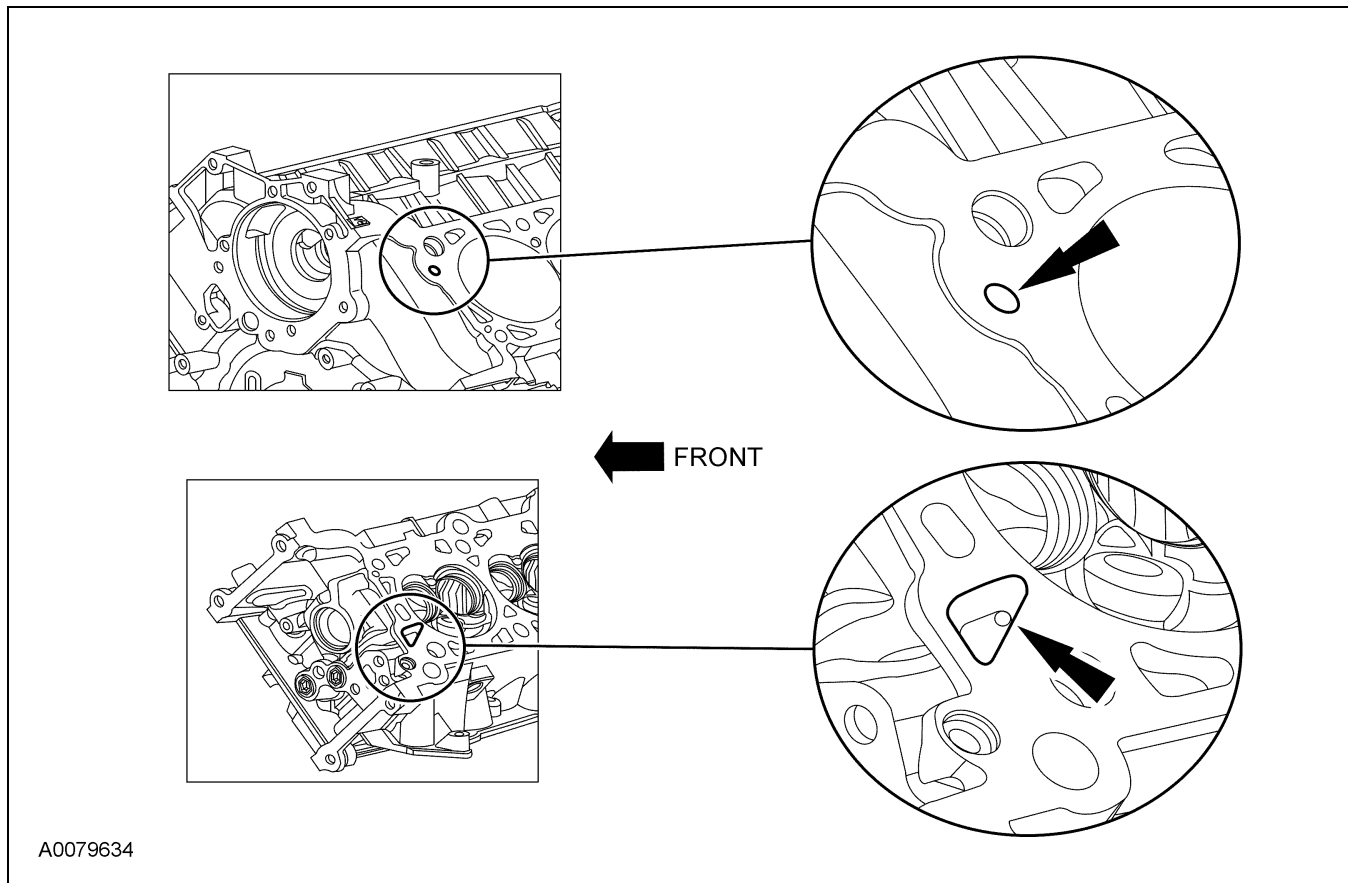
DISASSEMBLY (Continued)

74. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

NOTE: LH shown, RH similar.

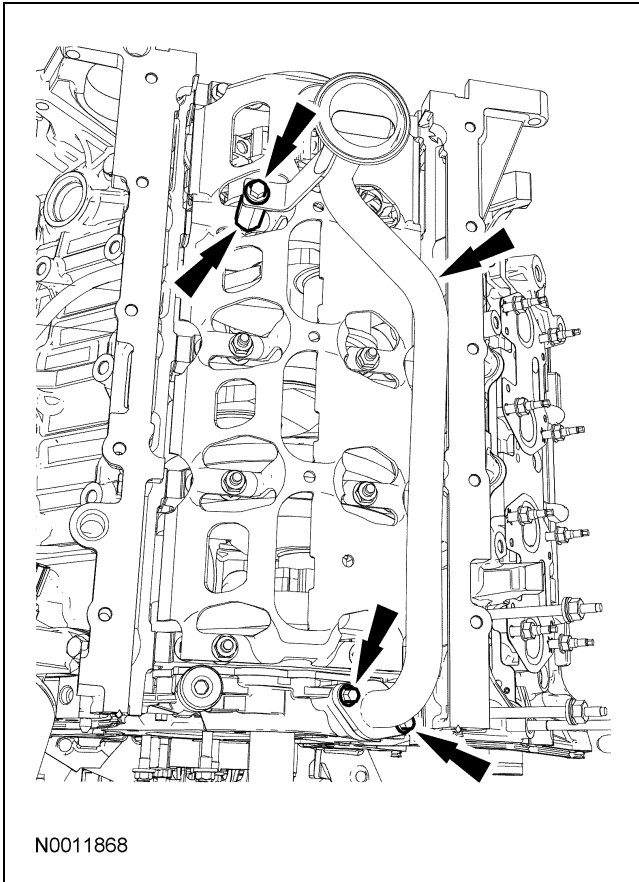
Support the cylinder heads on a bench with the head gasket side up. Inspect all areas of the deck face with a straightedge, paying particular attention to the oil pressure feed area. The cylinder heads must not have depressions deeper than 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area, or scratches longer than 0.0254 mm (0.001 in).



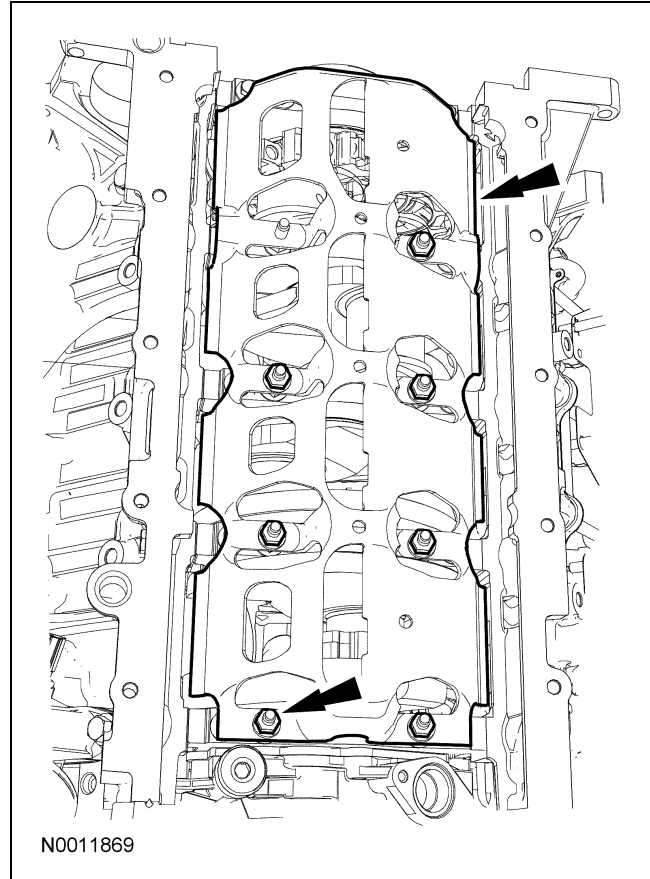
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DISASSEMBLY (Continued)

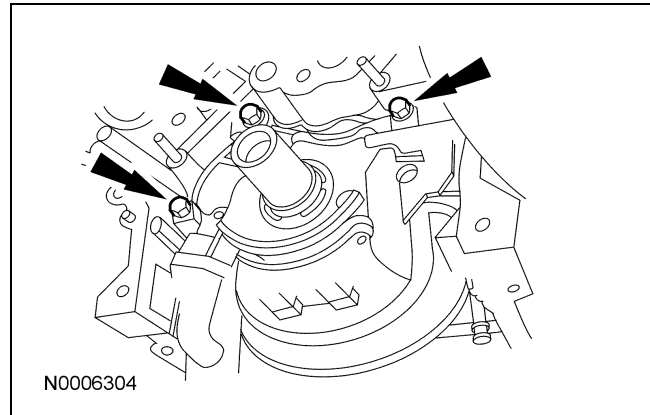
75. Remove the bolts, the oil pump screen and pickup tube and the spacer.



76. Remove the 7 nuts and the windage tray.




77. Remove the 3 bolts and the oil pump.

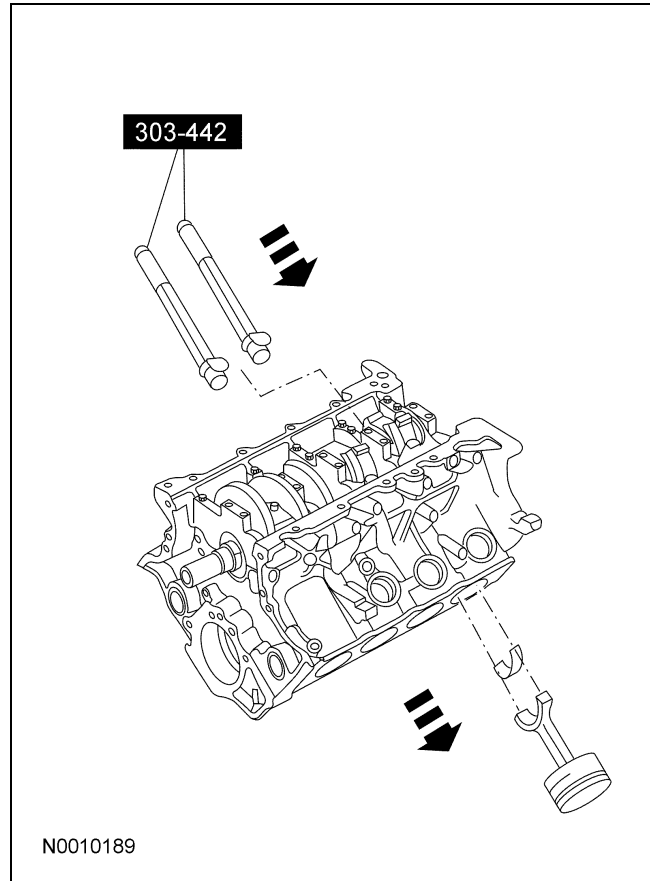
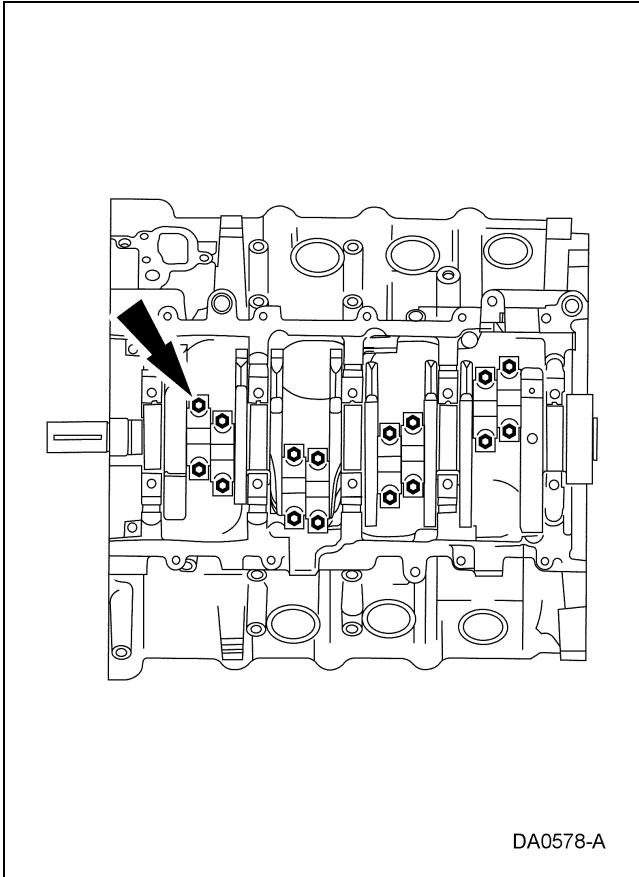


78. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following the manufacturer instructions.


DISASSEMBLY (Continued)

79.  **CAUTION:** Verify that the connecting rods and rod caps have orientation numbers cast into them. If not, number the connecting rods and rod caps for correct orientation.

Remove the bolts and the connecting rod caps.
Discard the bolts.



81. Disassemble the 8 pistons. For additional information, refer to Piston in this section.

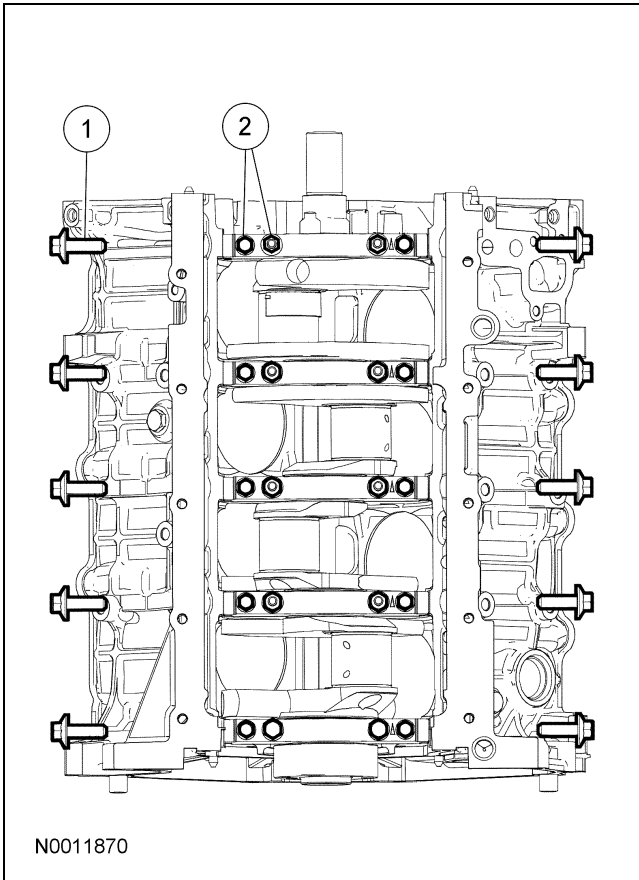
80.  **CAUTION:** Do not scratch the cylinder walls or crankshaft journals with the connecting rod.

Use the special tool to push the piston through the top of the cylinder block.

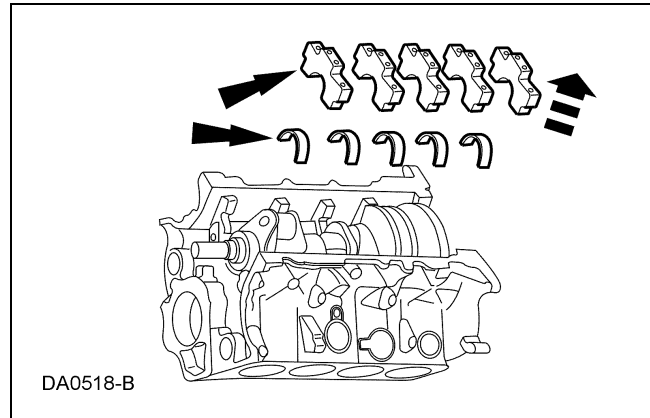
DISASSEMBLY (Continued)

82. Remove the fasteners.

- 1 Remove and discard the cross-mounted main cap bolts.
- 2 Remove and discard the main bearing cap bolts and stud bolts.



83. Remove the 5 main bearing caps, the lower crankshaft main bearings and the lower thrust washer.



84. Remove the crankshaft, the upper crankshaft main bearings and the upper thrust washers from the cylinder block.

