

Engine

Special Tool(s)

 <p>ST1776-A</p>	Adapter for 303-564 303-578 (T97T-6256-A)
 <p>ST1330-A</p>	Compressor, Valve Spring 303-581 (T97T-6565-A)
 <p>ST1777-A</p>	Holding Tool, Camshaft Sprocket 303-564 (T97T-6256-B)
 <p>ST1288-A</p>	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 <p>ST1784-A</p>	Remover, Crankshaft Vibration Damper 303-101 (T74P-3616-A)
 <p>ST2897-A</p>	Remover, Crankshaft Vibration Damper 303-773
 <p>ST2191-A</p>	Socket, Rear Jack Shaft 303-634
 <p>ST1438-A</p>	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

General Equipment

8 mm x 1.25 x 100 mm bolts (2 required)

Material

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

All vehicles

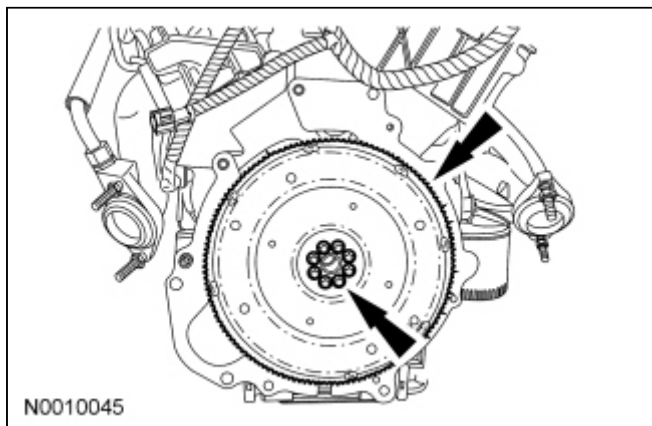
NOTICE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

NOTICE: Remove the cylinder heads before removing the crankshaft. Failure to do so may result in engine damage.

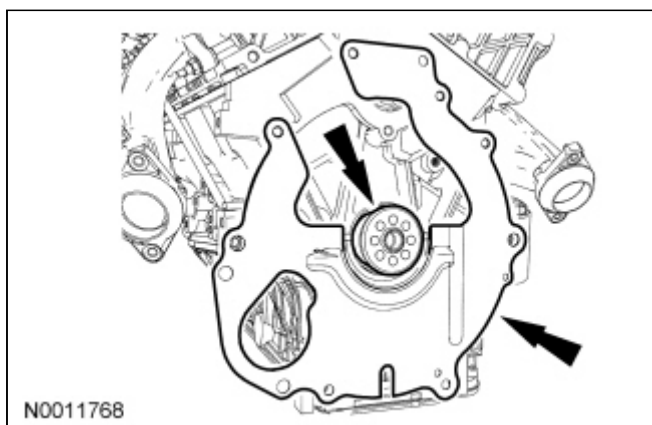
NOTICE: If the fuel rail is used as a leverage device, damage may occur to the fuel rail. Care must be taken when working around the fuel rail.

NOTE: For additional information, refer to the exploded views under [Engine](#) in the Assembly portion of this section.

1. Remove the 8 bolts and the flexplate or flywheel.
 - Discard the bolts.



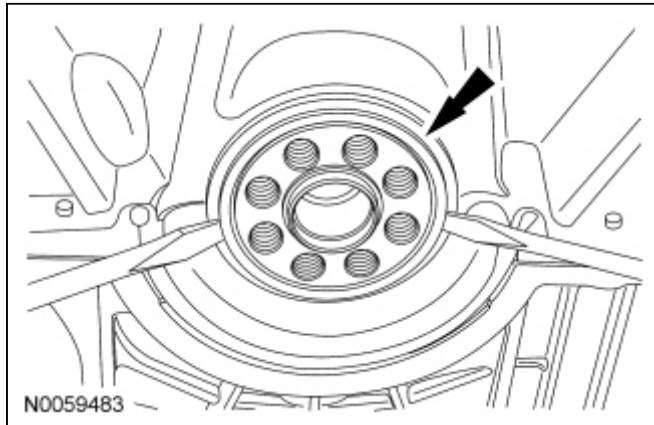
2. Remove the spacer plate and if equipped, the flexplate-to-crankshaft spacer.



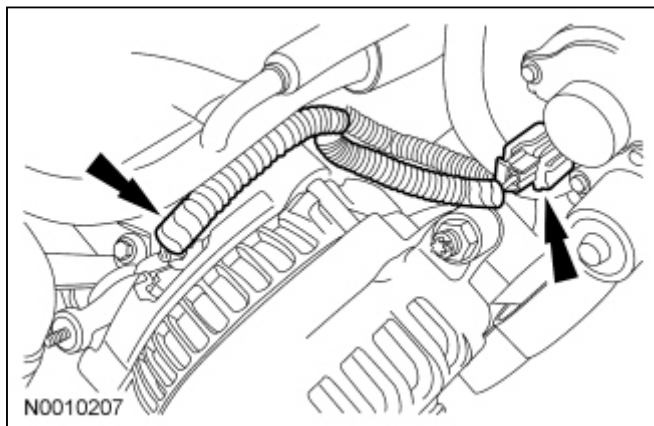
3. **NOTE:** The original crankshaft rear seal does not have a speedy sleeve. Only a new replacement crankshaft rear seal comes with a speedy sleeve.

NOTE: The crankshaft rear seal may have a metal speedy sleeve. This sleeve must be removed before engine disassembly.

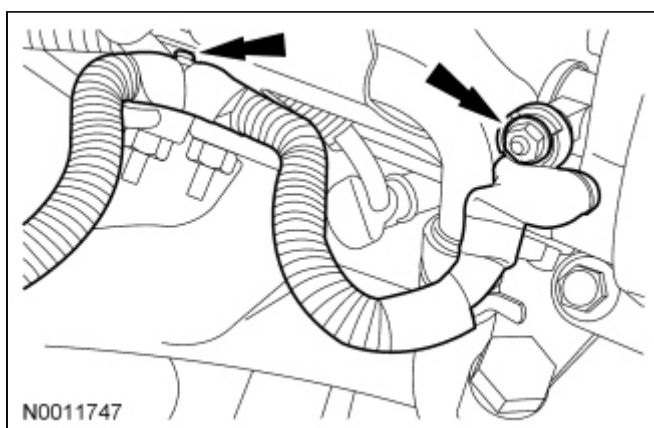
If necessary, remove the speedy sleeve using 2 screwdrivers or small pry bars.



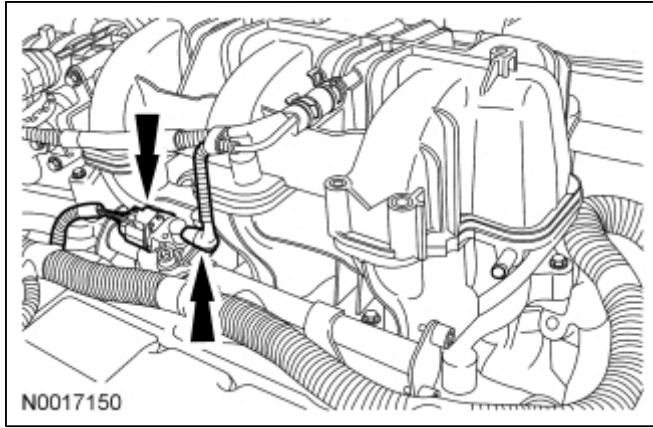
4. Mount the engine on a suitable engine stand.
5. Disconnect the generator and Throttle Body (TB) electrical connectors.



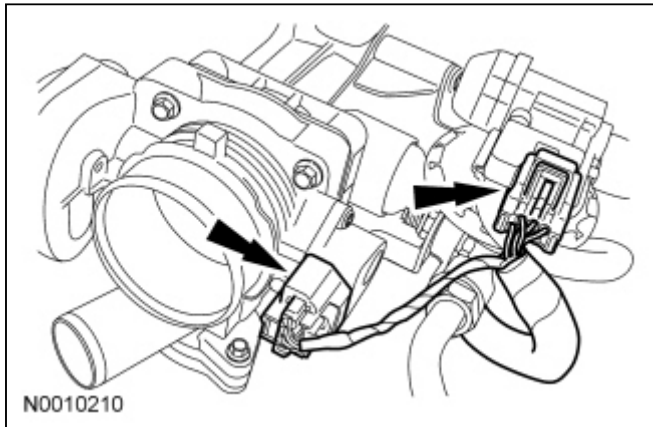
6. Remove the nut and detach the B+ terminal from the generator.
 - Detach the wiring retainer from the coolant tube bracket.



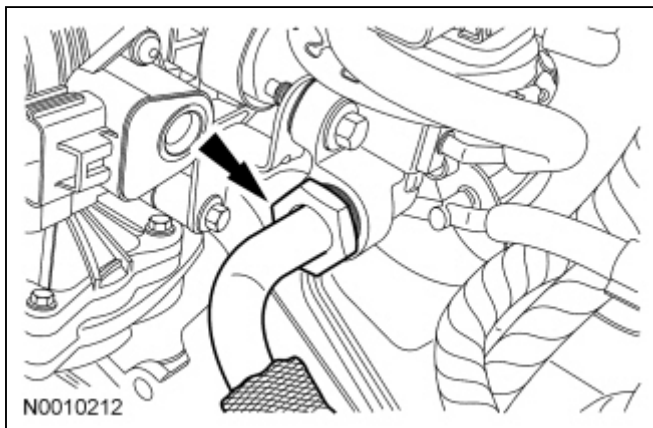
7. Disconnect the vacuum tube and the fuel rail pressure and temperature sensor electrical connector.



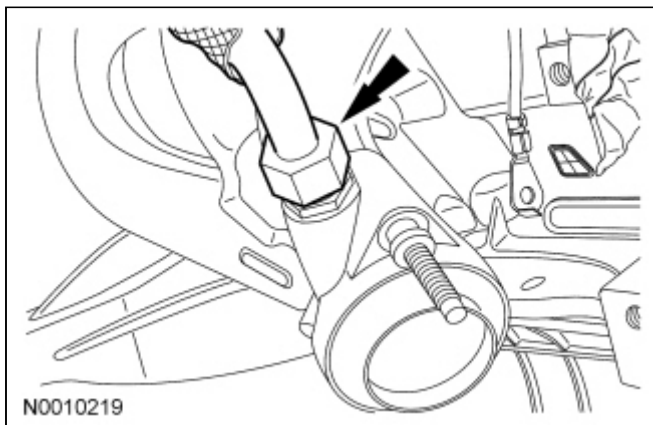
8. Disconnect the EGR system module and Throttle Position (TP) sensor electrical connectors.



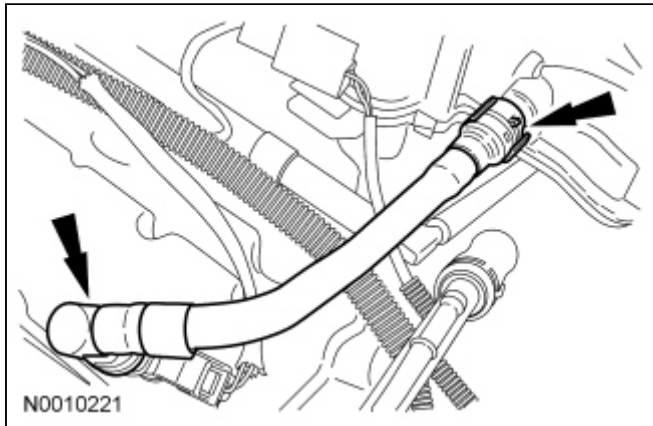
9. Disconnect the EGR tube fitting from the EGR system module.



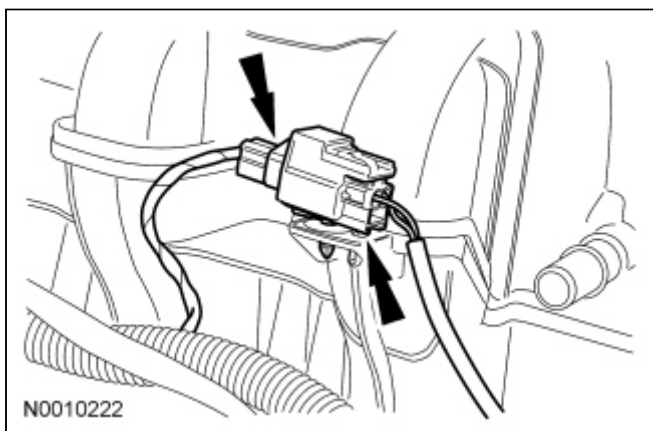
10. Disconnect the EGR tube fitting from the LH exhaust manifold and remove the tube.



11. Disconnect the PCV tube fittings and remove the tube.

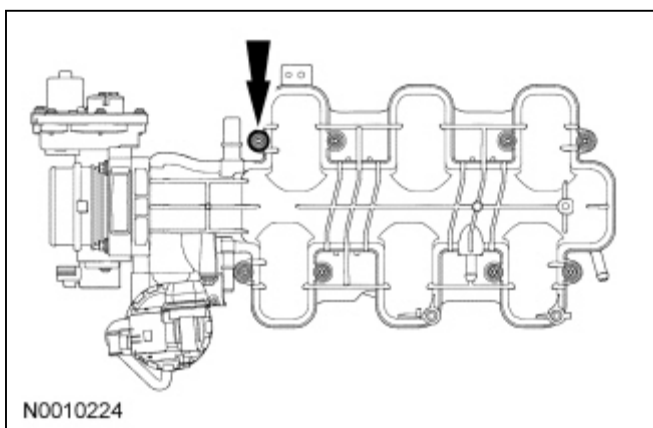


12. Disconnect the Knock Sensor (KS) electrical connector and detach the wiring retainer.

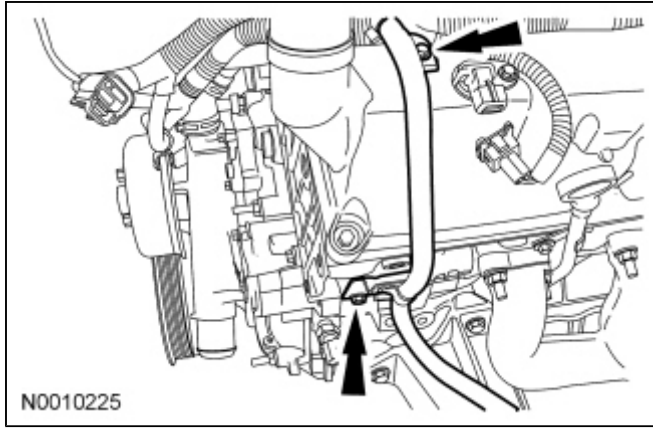


13. **NOTICE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

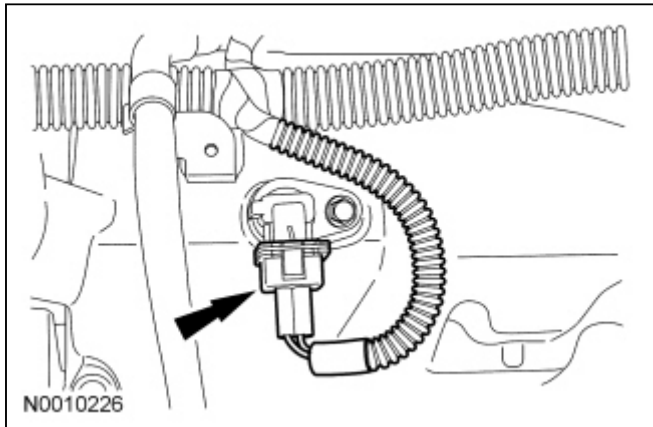
Remove the 8 bolts and the intake manifold.



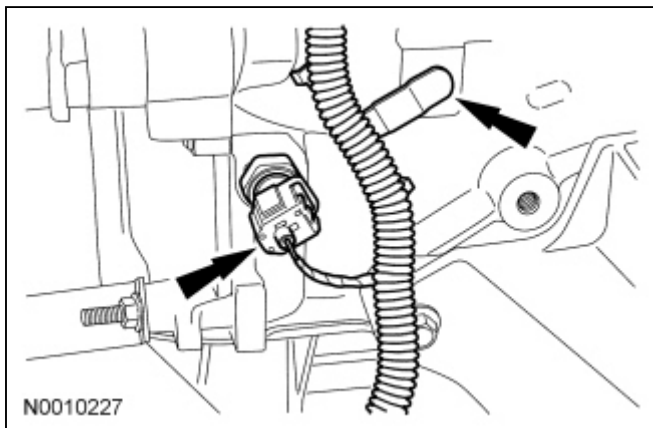
14. Remove the 2 fuel supply tube bracket bolts.



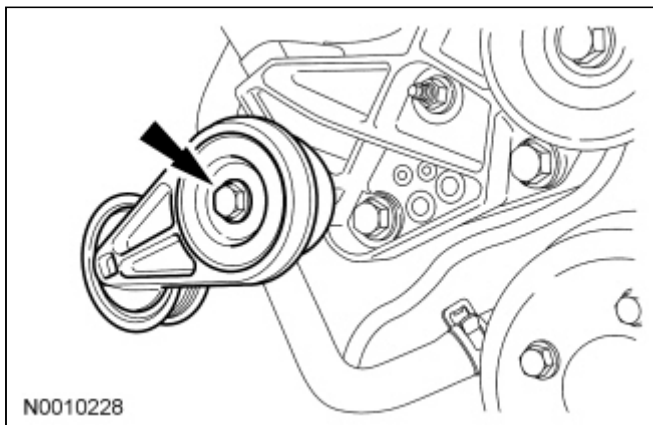
15. Disconnect the Camshaft Position (CMP) electrical connector.



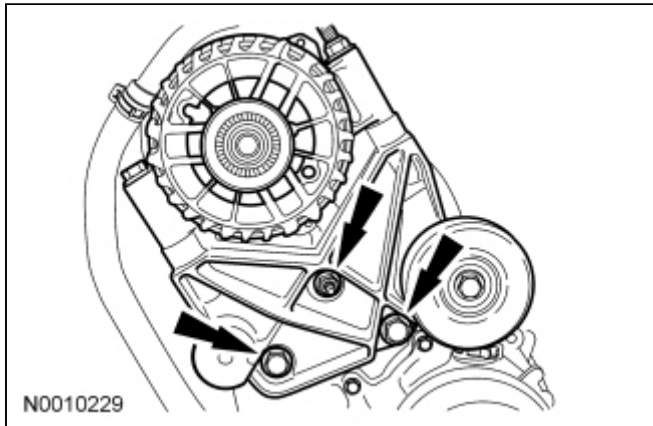
16. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and detach the wiring retainer.



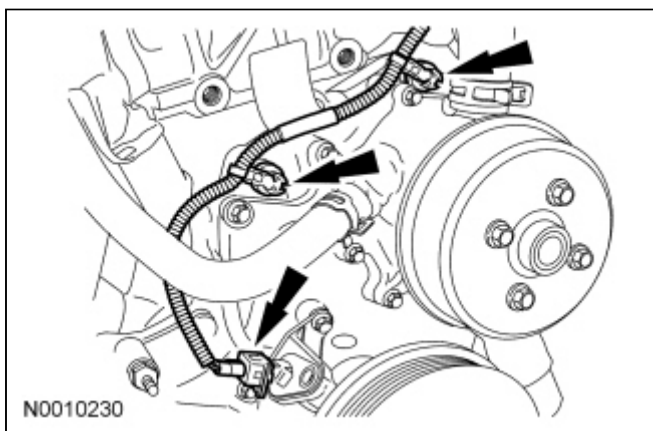
17. Remove the bolt and the accessory drive belt tensioner.



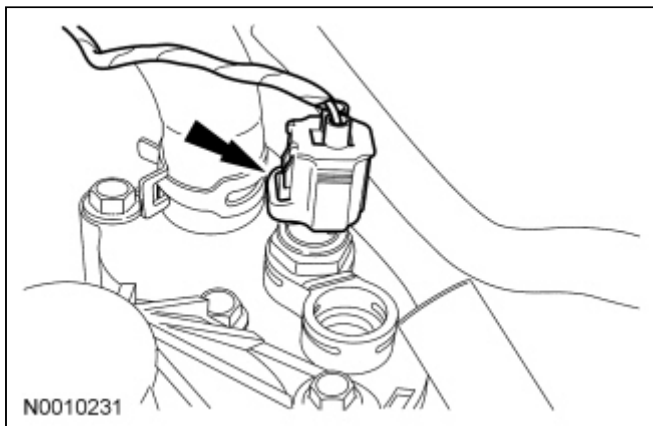
18. Remove the 2 bolts, the nut and the generator and bracket.



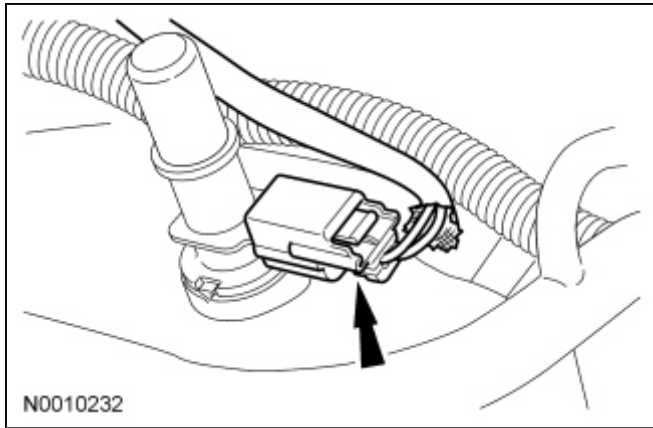
19. Disconnect the Crankshaft Position (CKP) sensor electrical connector and detach the 2 wiring retainers.



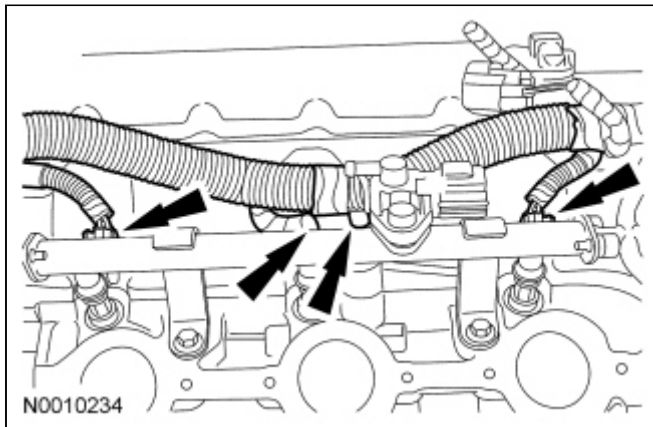
20. Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.



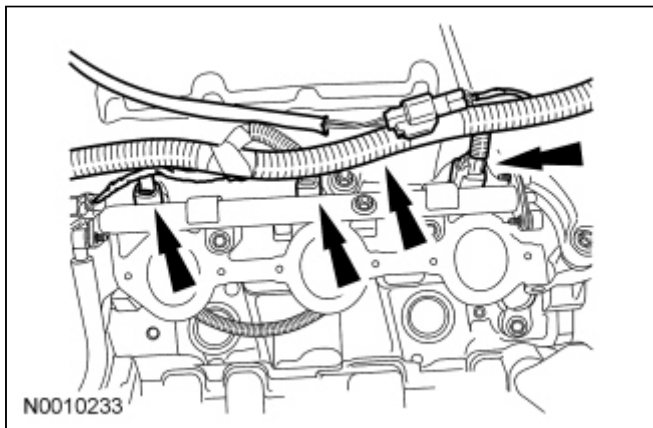
21. Disconnect the PCV valve electrical connector.



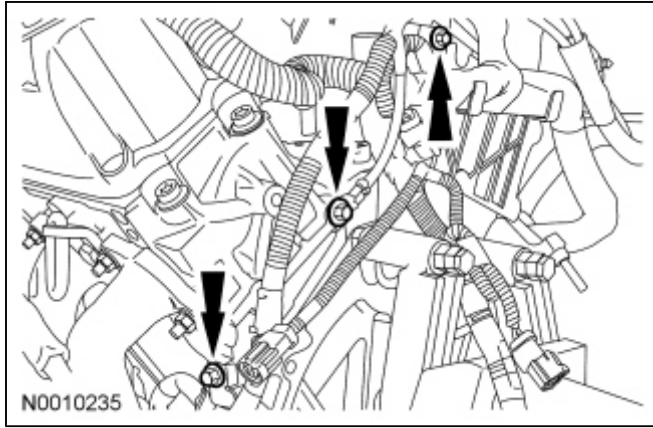
22. Disconnect the 3 LH fuel injector electrical connectors and detach the wiring retainer from the valve cover stud bolt.



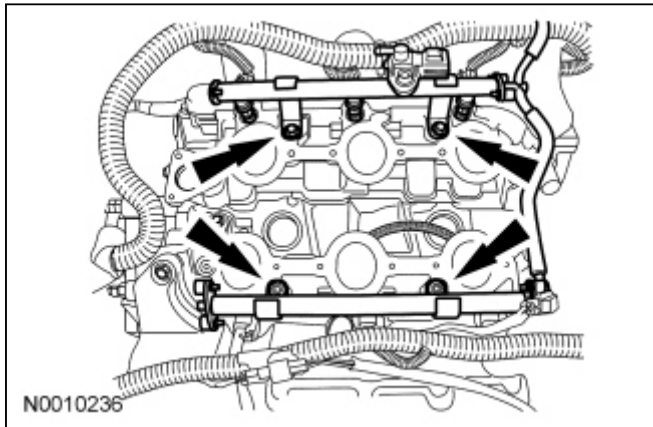
23. Disconnect the 3 RH fuel injector electrical connectors and detach the wiring retainer from the valve cover stud bolt.



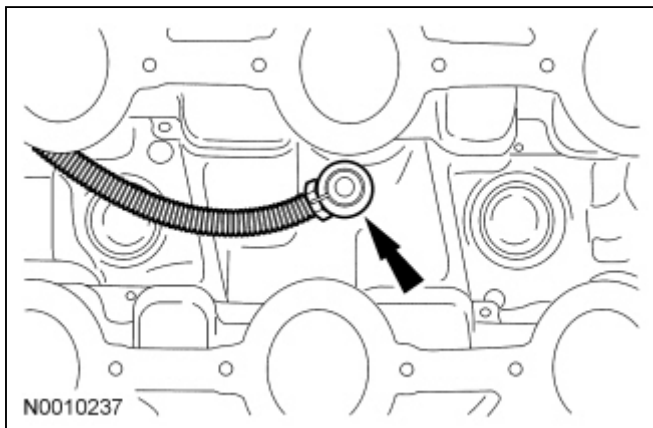
24. Remove the 3 bolts, detach the wiring retainers and remove the main engine wiring harness.



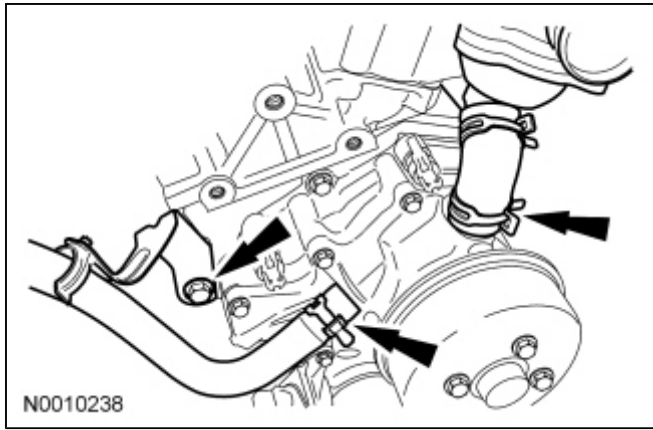
25. Remove the 4 bolts and then remove the fuel rail and injectors.



26. Remove the bolt and the KS.



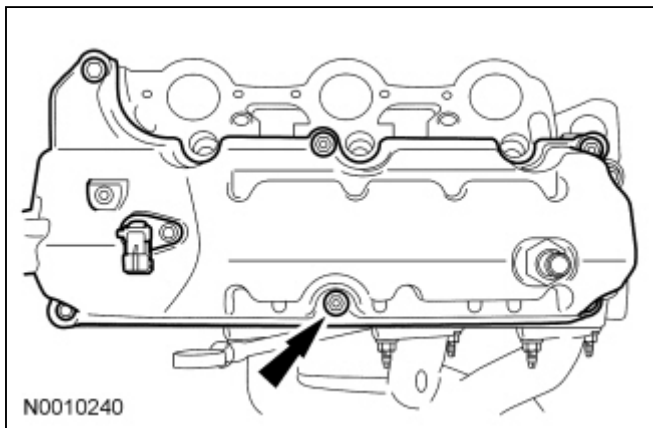
27. Remove the bolt and then disconnect the coolant bypass hose and the heater hose from the coolant pump.



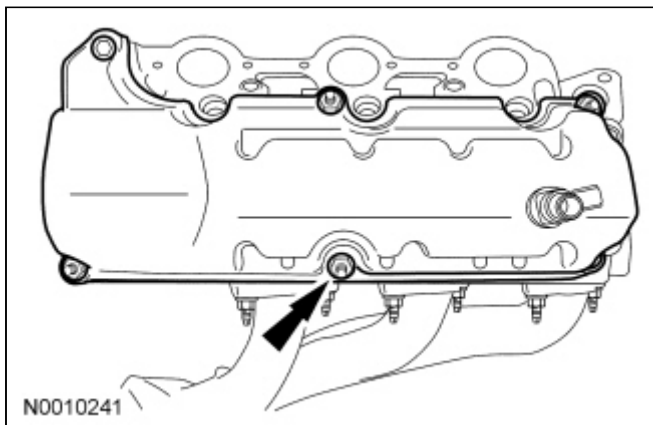
28. Remove the 3 bolts and then remove the thermostat housing, hoses and coolant tube.



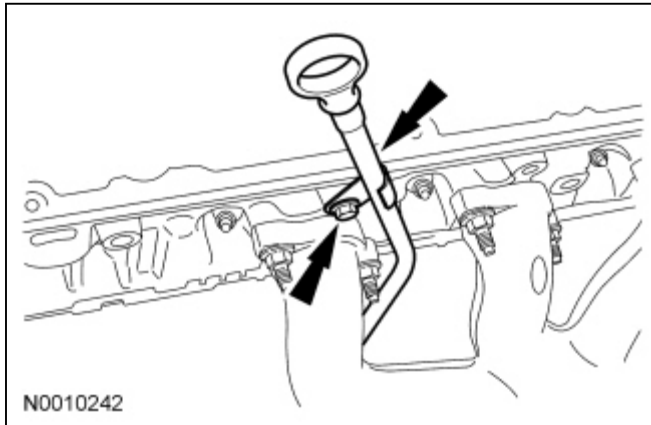
29. Remove the 3 bolts, 3 stud bolts and the LH valve cover.



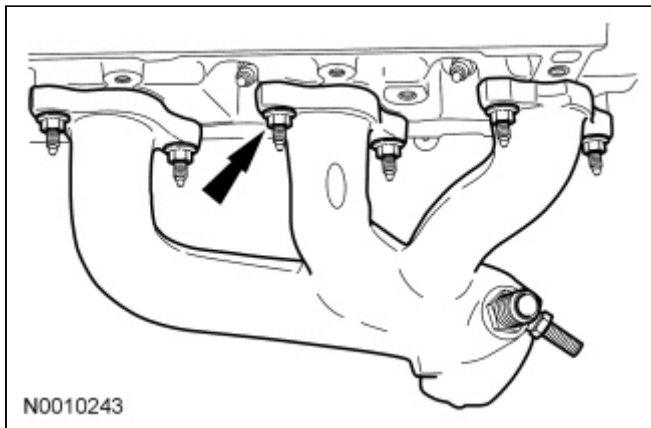
30. Remove the 2 bolts, 4 stud bolts and the RH valve cover.



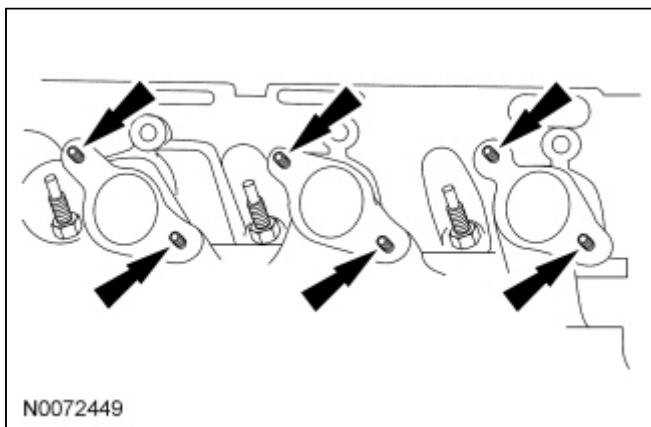
31. Remove the bolt and the oil level indicator tube.
- Discard the oil level indicator tube O-ring seal.



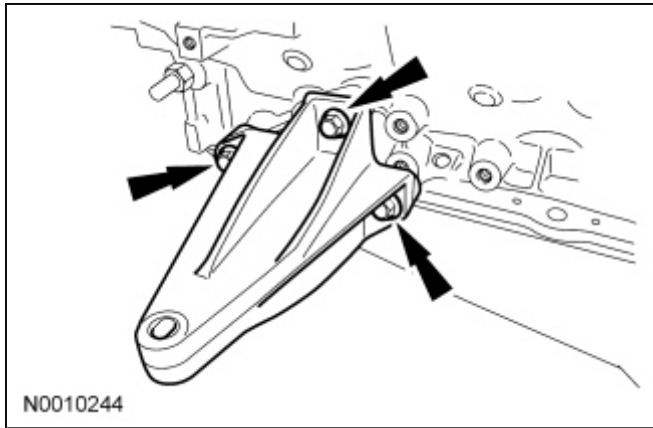
32. Remove the 6 nuts and the LH exhaust manifold and gasket.
- Discard the nuts and the LH exhaust manifold gasket.



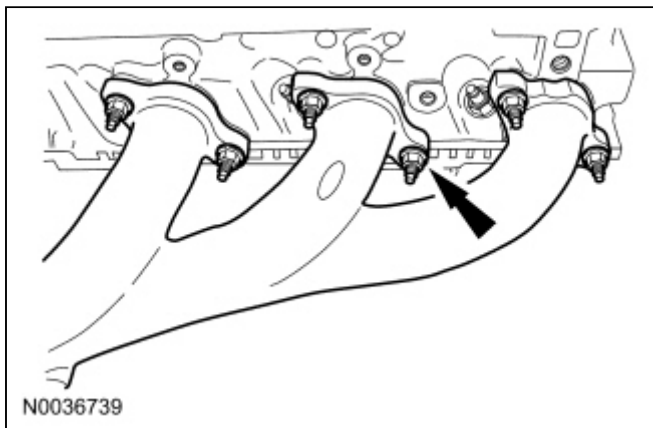
33. Remove and discard the 6 LH exhaust manifold studs.



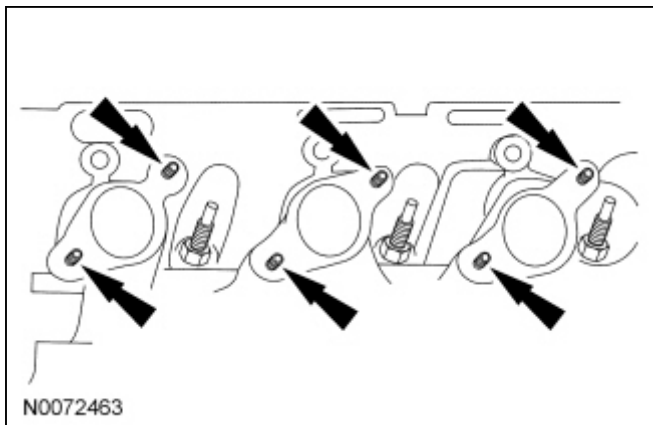
34. Remove the 3 bolts and the LH engine mount bracket.



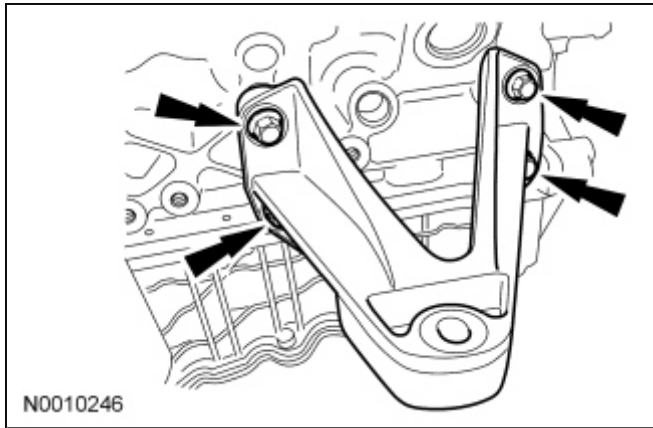
35. Remove the 6 nuts and the RH exhaust manifold and gasket.
 - Discard the nuts and the RH exhaust manifold gasket.



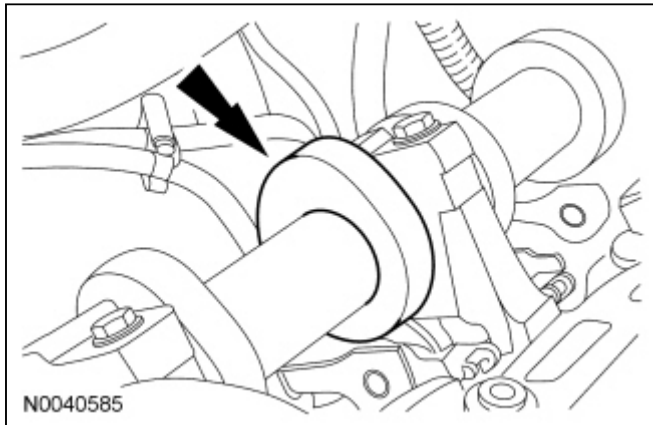
36. Remove and discard the 6 RH exhaust manifold studs.



37. Clean and inspect the LH and RH exhaust manifolds. For additional information, refer to [Section 303-00](#).
38. Remove the 4 bolts and the RH engine mount bracket.

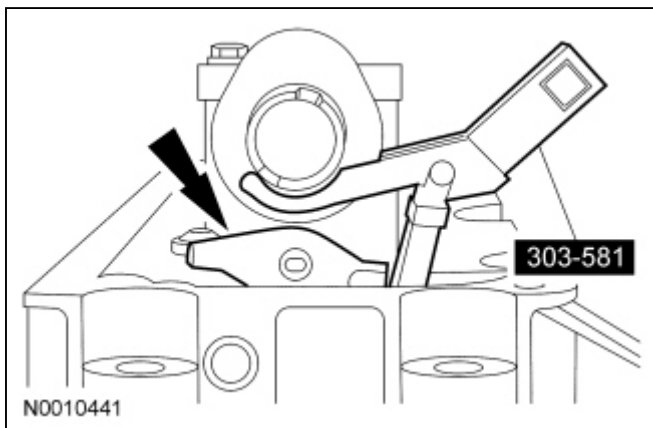


39. Rotate the crankshaft until the cam lobe of the cylinder being serviced is in the upward position.



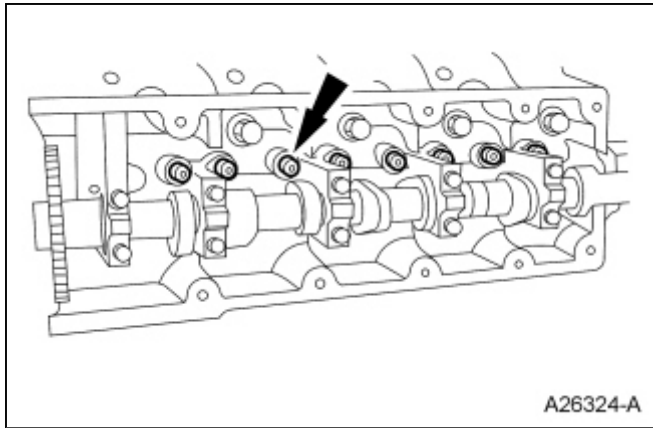
40. **NOTE:** Mark each camshaft roller follower to make sure it is installed in its original position during reassembly.

Using the Valve Spring Compressor, remove the camshaft roller followers.

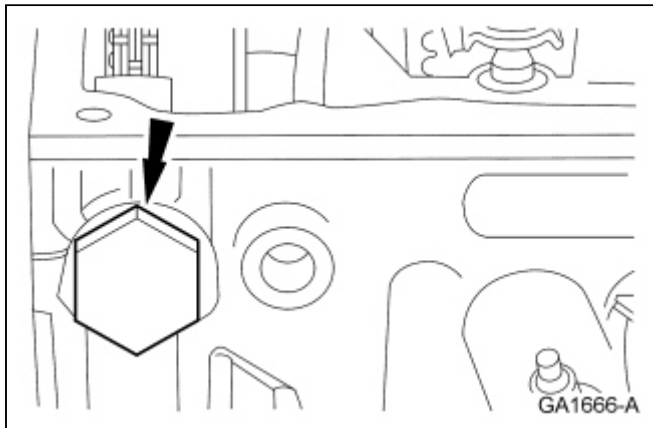


41. **NOTE:** Mark each hydraulic lash adjuster to make sure it is installed in its original position.

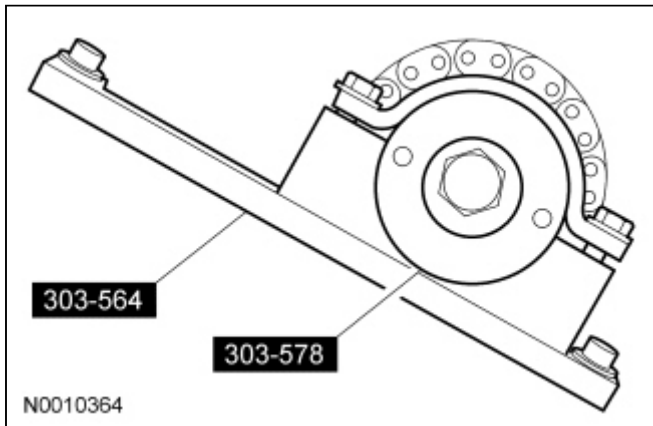
Remove the hydraulic lash adjusters.



42. Remove the RH hydraulic chain tensioner.
- Remove and discard the washer.

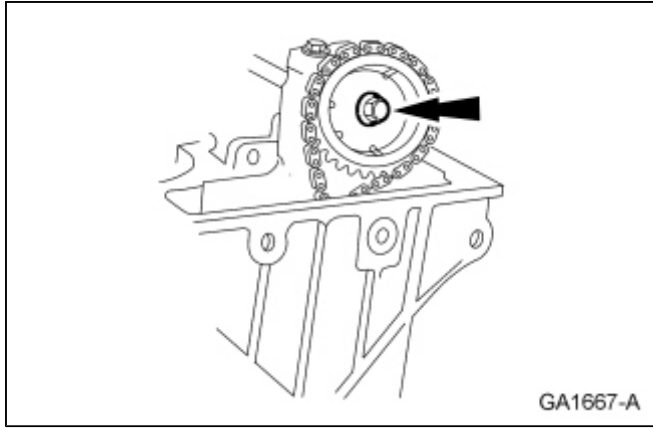


43. Install the Camshaft Sprocket Holding Tool and Adapter on the RH cylinder head and tighten the top 2 clamp bolts to 10 Nm (89 lb-in).

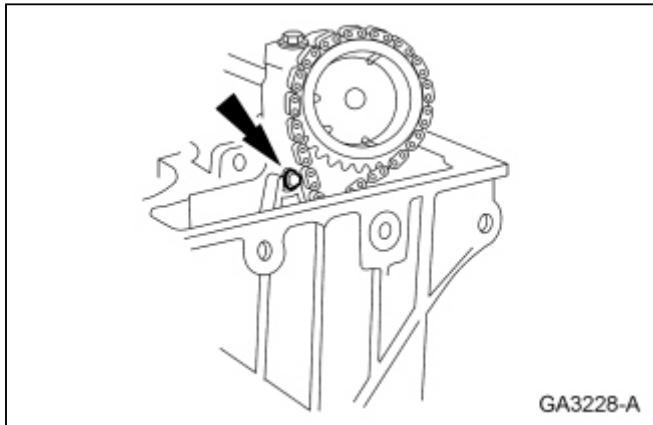


44. **NOTE:** The RH camshaft sprocket bolt is a LH-threaded bolt.

Remove the RH camshaft sprocket bolt.



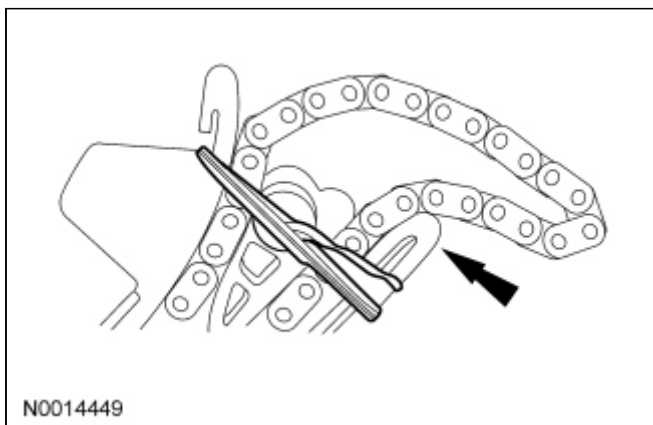
45. Remove the RH cassette bolt.



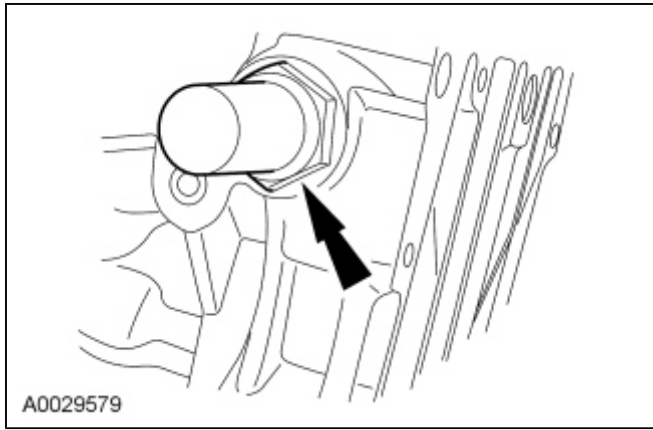
46. **NOTE:** Remove the camshaft sprocket from the timing chain to gain clearance to remove the cylinder head.

NOTE: Hold the timing chain and cassette with a rubber band to aid in removal and to prevent the timing chain from falling into the cylinder block.

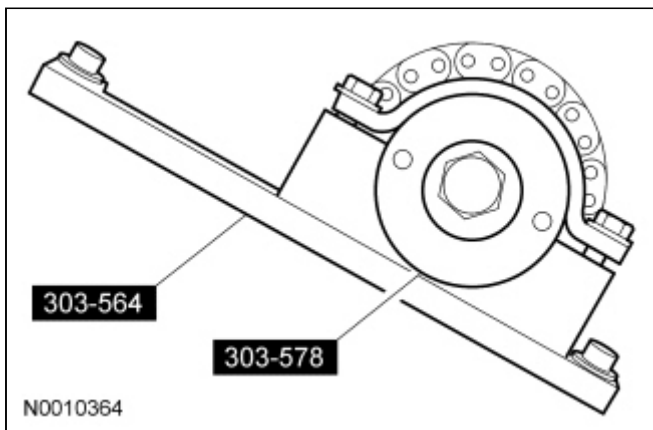
Remove the RH camshaft sprocket from the timing chain. Install a rubber band around the cassette and the timing chain.



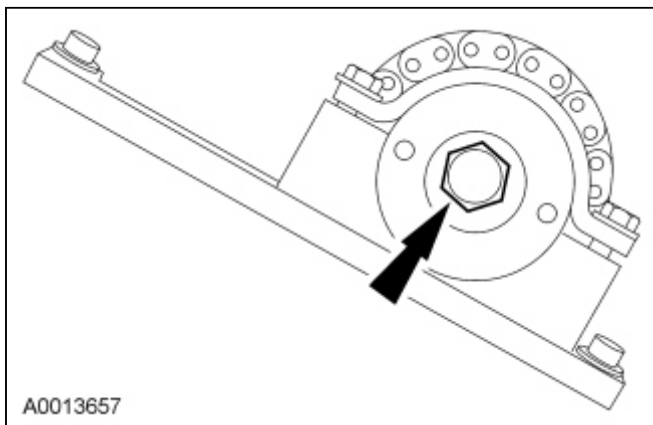
47. Remove the LH hydraulic chain tensioner.
- Remove and discard the washer.



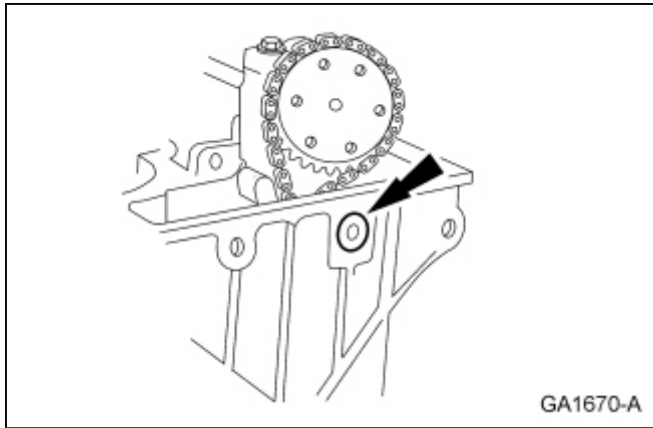
48. Install the Camshaft Sprocket Holding Tool and Adapter on the LH cylinder head and tighten the top 2 clamp bolts to 10 Nm (89 lb-in).



49. Remove the LH camshaft sprocket bolt.



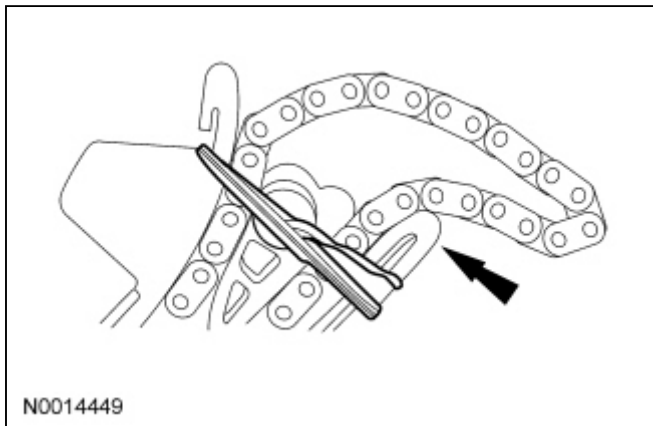
50. Remove the LH cassette bolt.



51. **NOTE:** Remove the camshaft sprocket from the timing chain to gain clearance to remove the cylinder head.

NOTE: Hold the timing chain and cassette with a rubber band to aid in removal and to prevent the timing chain from falling into the cylinder block.

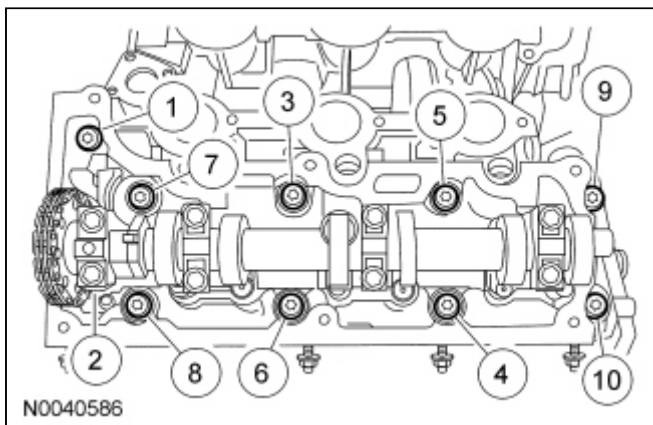
Remove the LH camshaft sprocket from the timing chain. Install a rubber band around the cassette and the timing chain.



52. **NOTE:** New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

Remove the bolts in the sequence shown and remove the cylinder heads.

- Discard the gaskets and the bolts.



53. **NOTICE:** Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow these instructions may result in engine damage.

NOTICE: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means

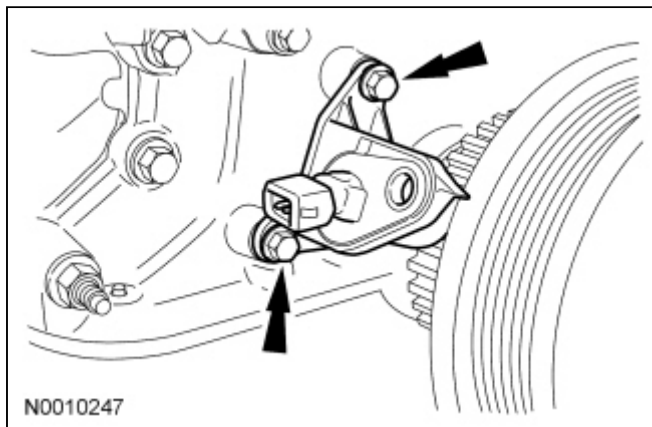
to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

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

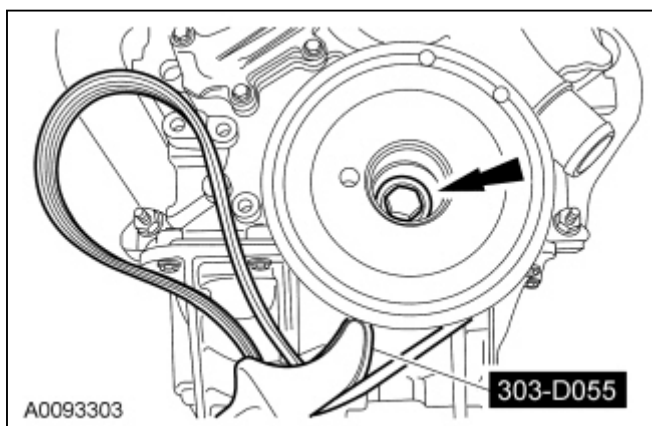
NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

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 remove 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 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.
54. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to [Section 303-00](#).
55. Remove the 2 bolts and the [CKP](#).



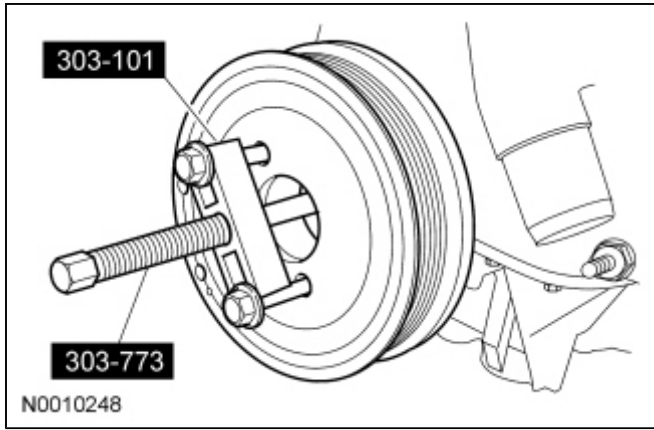
56. Using the Strap Wrench, hold the crankshaft pulley, remove the bolt and washer.



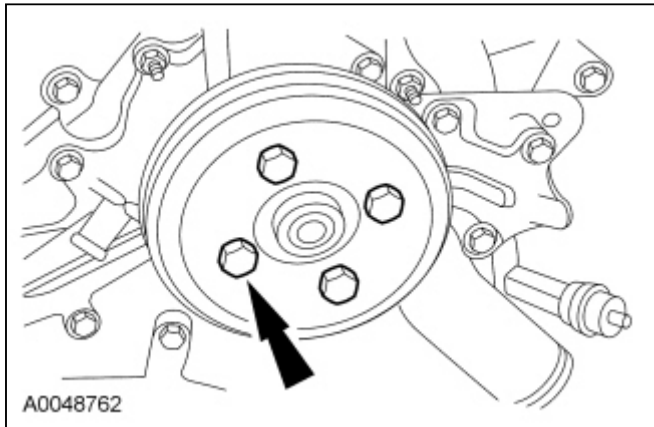
57. **NOTE:** If the pulley bolt is not installed, the Crankshaft Vibration Damper Removers will bottom out before the pulley is off.

Install the crankshaft pulley bolt 2 to 3 turns. Using the Crankshaft Vibration Damper Removers and the two 8-mm bolts, remove the crankshaft pulley.

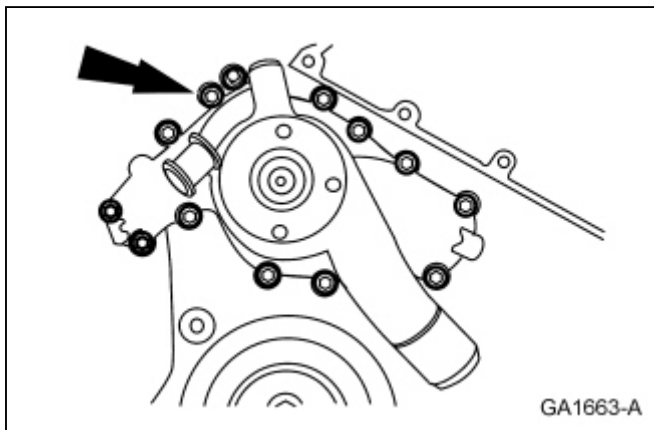
- Discard the crankshaft pulley bolt.



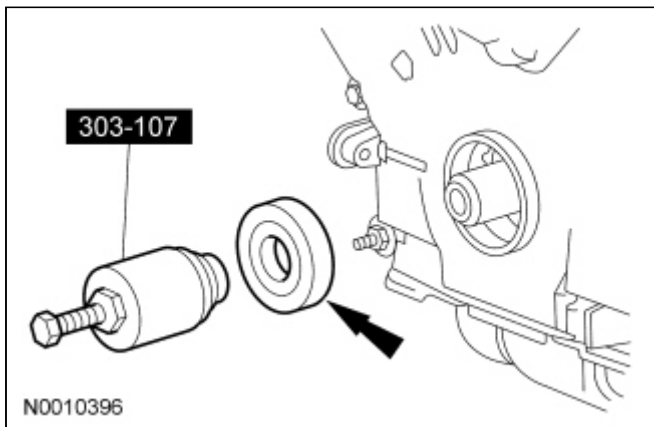
58. Remove the 4 bolts and the coolant pump pulley.



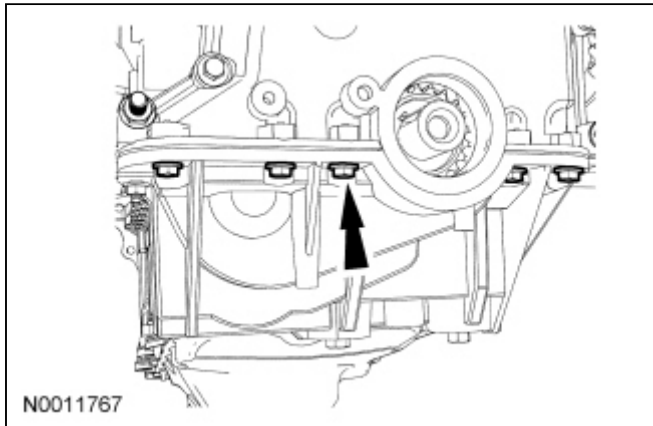
59. Remove the 13 bolts and the coolant pump.



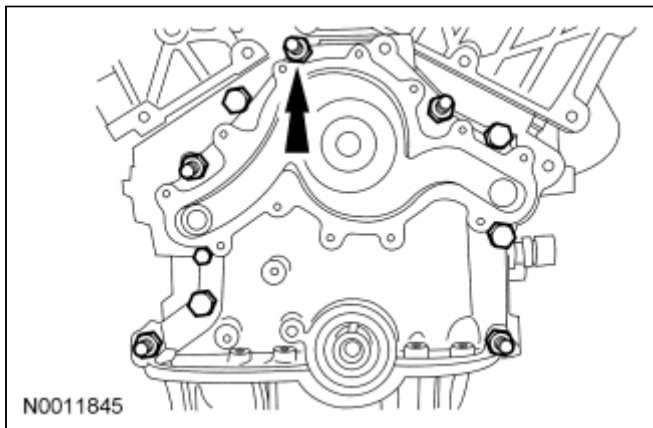
60. Using the Crankshaft Front Oil Seal Remover, remove the crankshaft front oil seal.



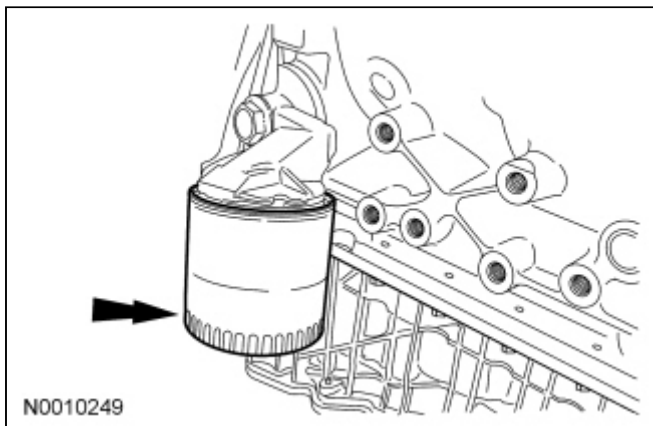
61. Remove the 5 cylinder block cradle-to-engine front cover bolts.



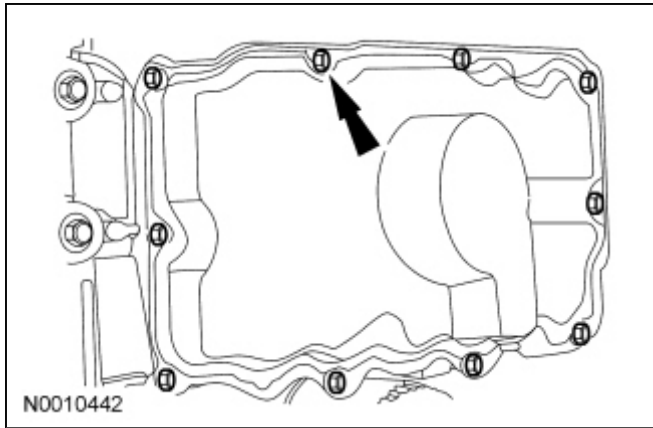
62. Remove the 5 bolts, 5 stud bolts and the engine front cover.



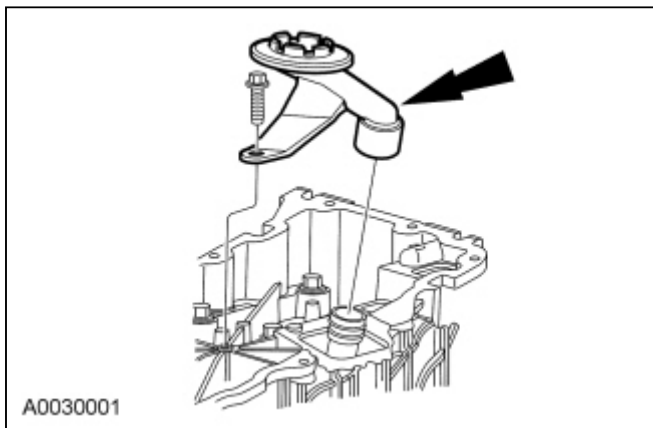
63. Remove and discard the engine oil filter.



64. Remove the bolts and the oil pan.

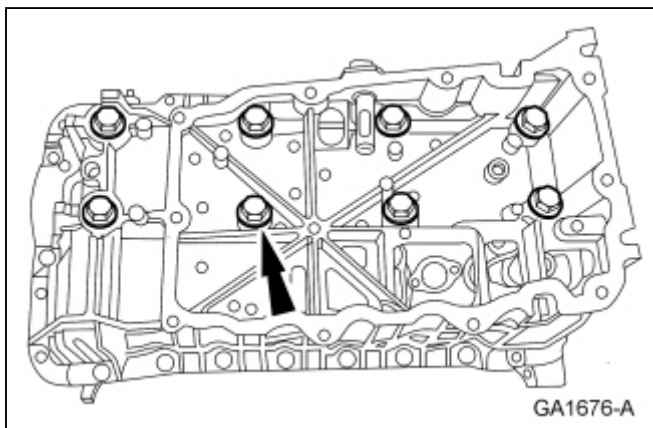


65. Remove the bolt and the oil pump screen cover and tube.

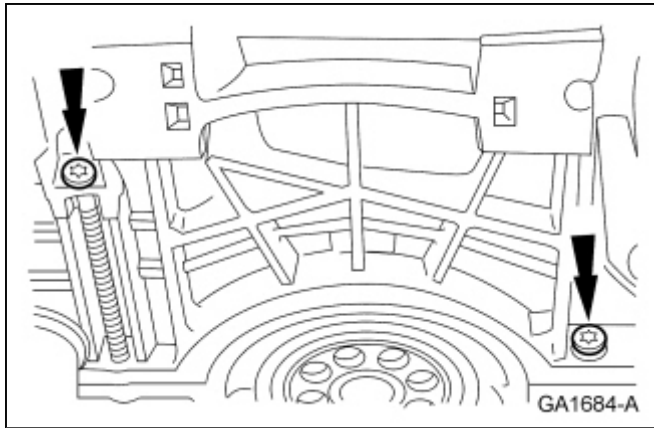


66. **NOTE:** Note the location of the 2 silver-colored bolts with the washer seals. These bolts must be installed in the same position from which they were removed with new washer seals.

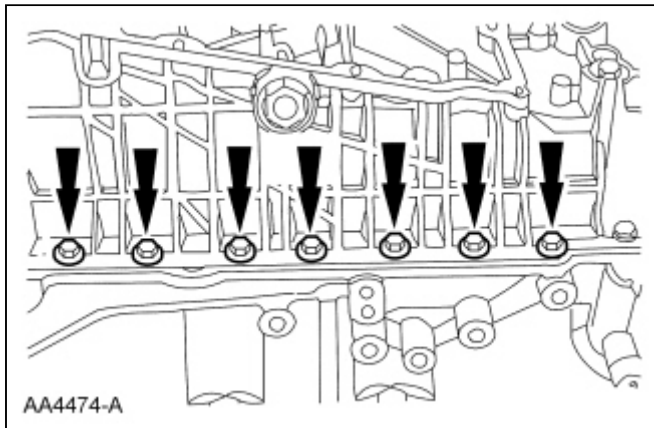
Remove the 8 cylinder block cradle inner bolts. Remove and discard the 2 washer seals.



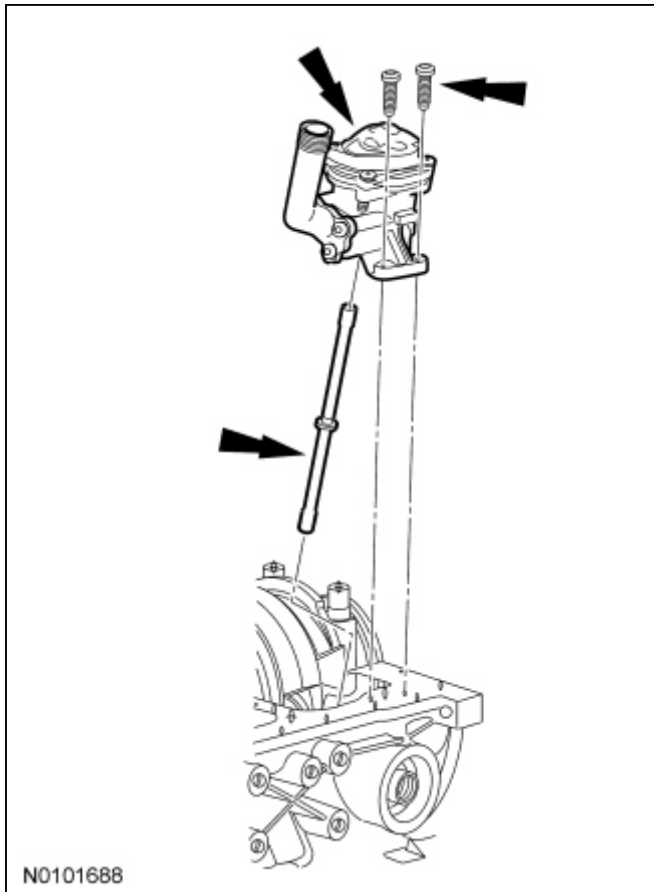
67. Remove the 2 cylinder block cradle Torx bolts.



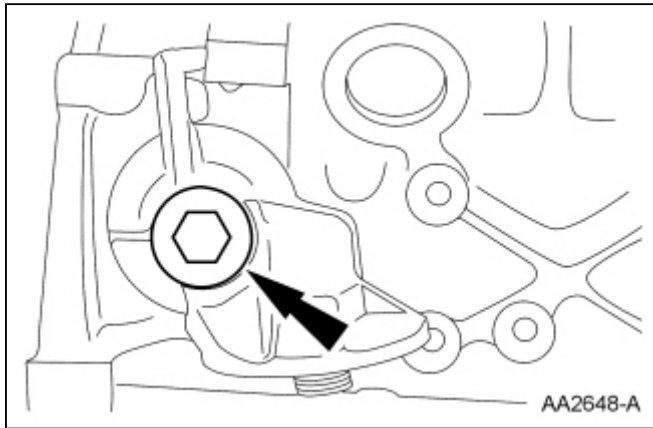
68. Remove the 15 bolts and the 2 nuts.
- Remove the cylinder block cradle.



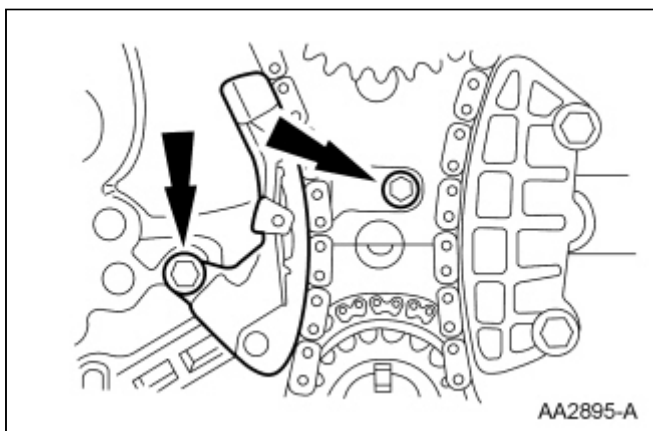
69. Remove the 2 bolts, the oil pump pickup tube and the oil pump intermediate shaft.



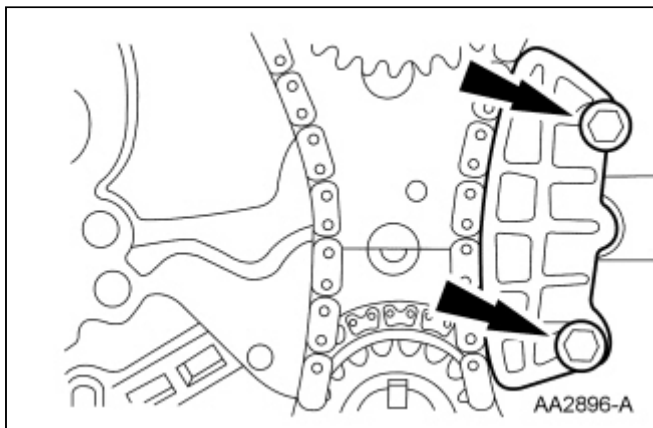
70. Remove the oil filter adapter.



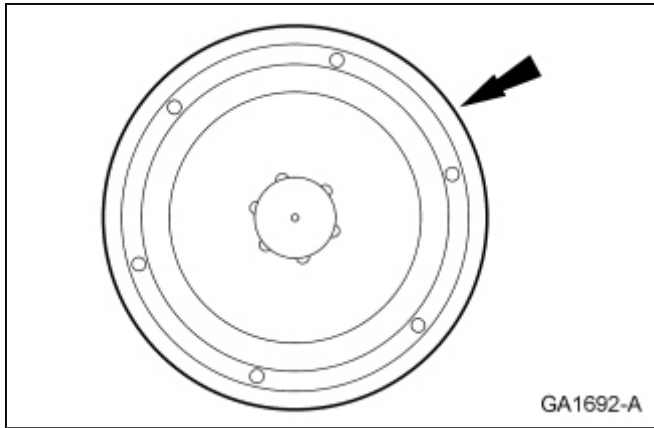
71. Remove the 2 bolts and the jackshaft chain tensioner.



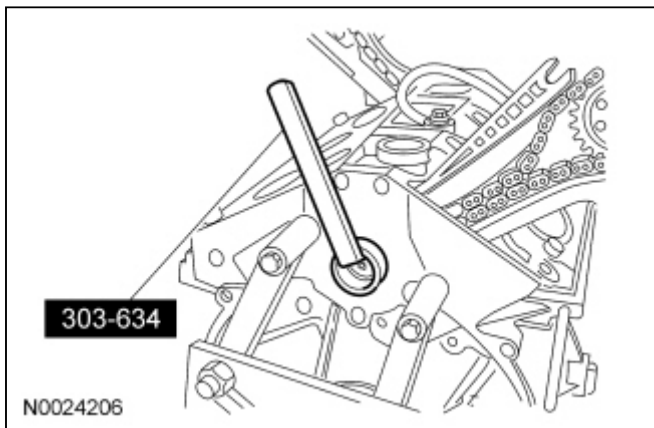
72. Remove the 2 bolts and the jackshaft chain guide.



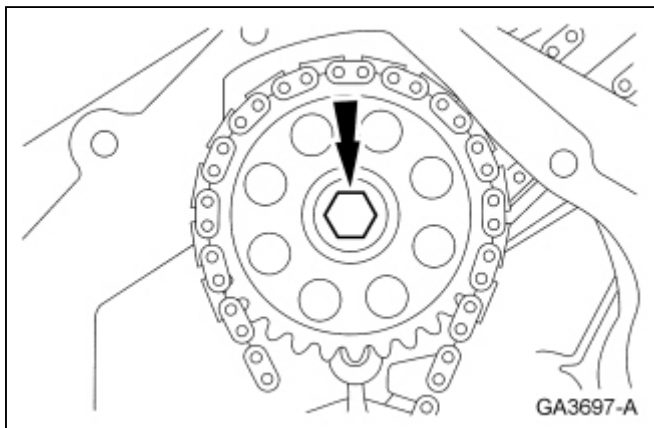
73. Remove the jackshaft rear plug.



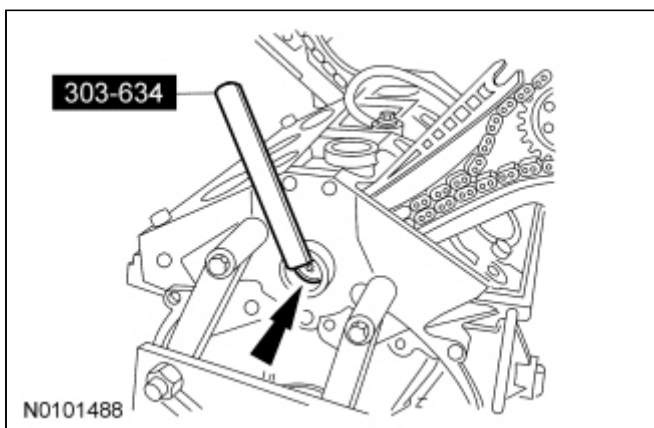
74. Install the Rear Jack Shaft Socket on the rear of the jackshaft.



75. Using the Rear Jack Shaft Socket to hold the jackshaft, loosen the jackshaft sprocket bolt.

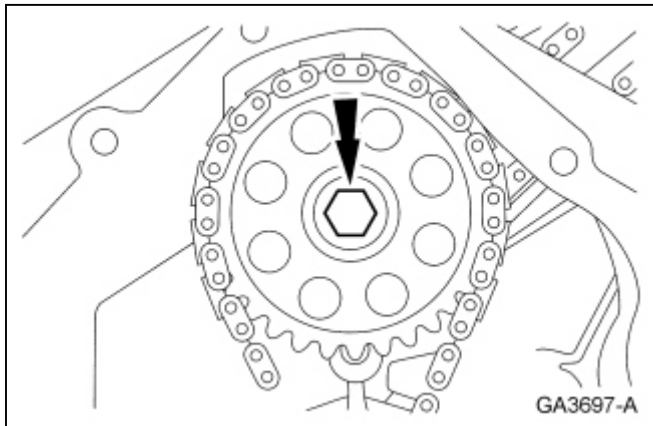


76. Using the Rear Jack Shaft Socket to hold the jackshaft, loosen the rear jackshaft sprocket bolt.

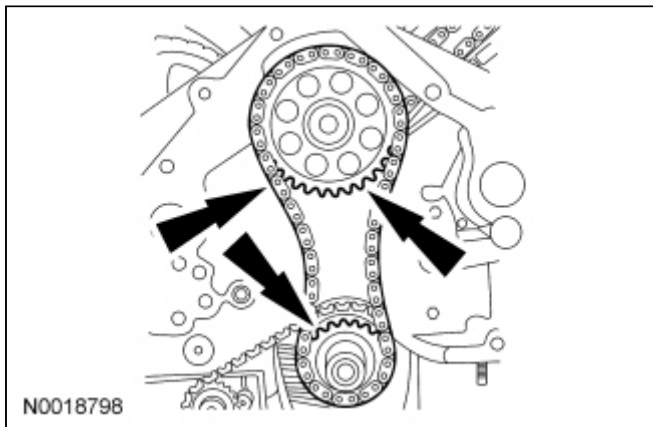


77. **NOTE:** It may be necessary to hold the oil pump intermediate shaft, using an E-12 external Torx socket, in order to remove the bolt if the bolt does not turn out easily at this time.

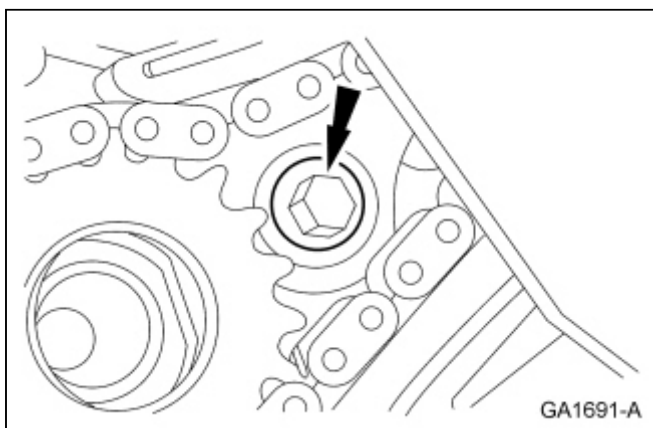
Remove the jackshaft sprocket bolt.



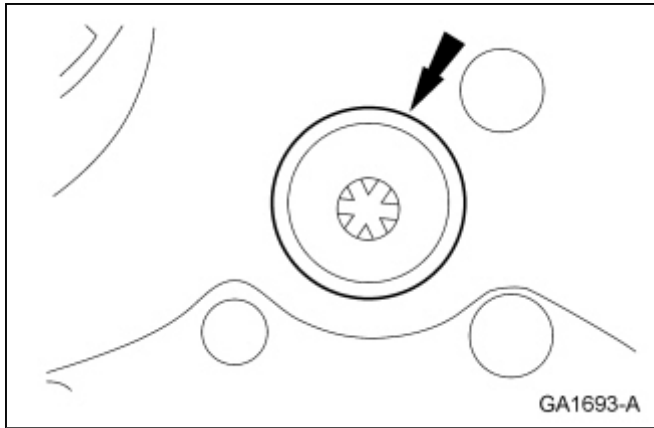
78. Remove the jackshaft and crankshaft sprockets and the chain.
- Remove the crankshaft key.



79. Remove the bolt and the LH camshaft drive cassette.

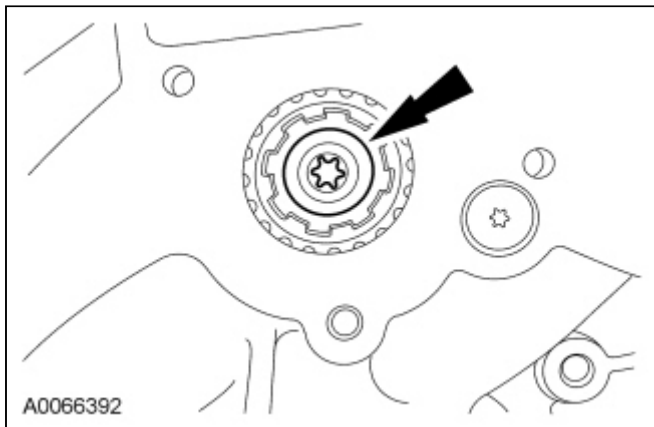


80. Remove the RH camshaft drive cassette bolt and spacer.

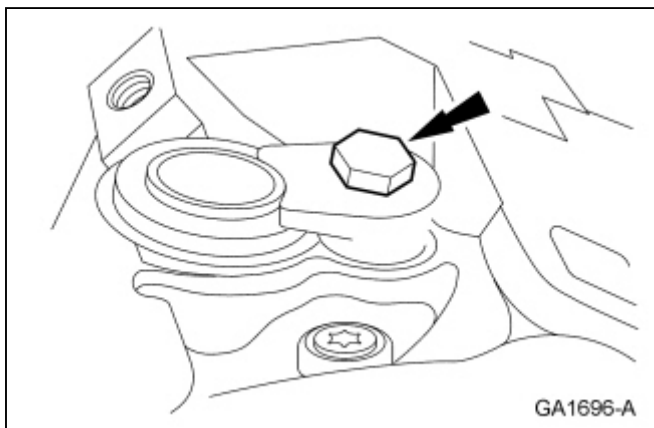


81. **NOTE:** It may be necessary to hold the oil pump intermediate shaft, using an E-12 external Torx socket, in order to remove the bolt if the bolt does not turn out easily at this time.

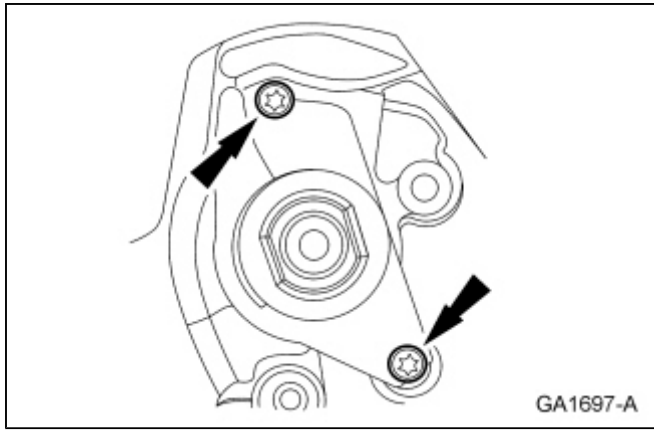
Remove the rear jackshaft sprocket bolt and remove the RH camshaft drive cassette.



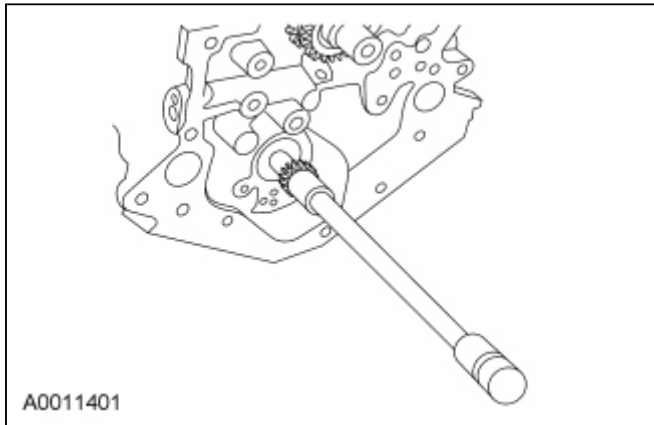
82. Remove the bolt, the hold down and the oil pump drive.



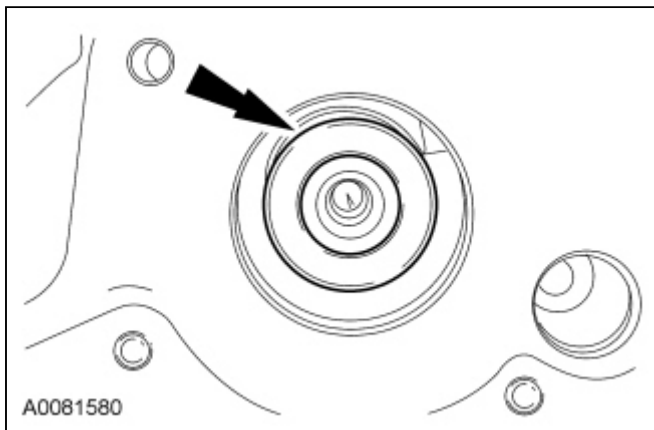
83. Remove the 2 bolts and the jackshaft thrust plate.



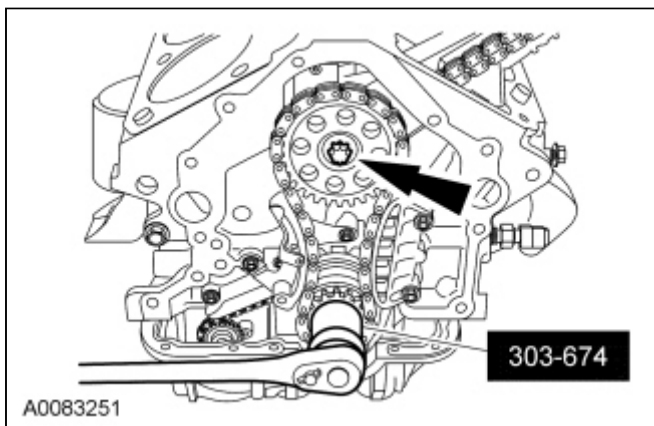
84. Remove the jackshaft.



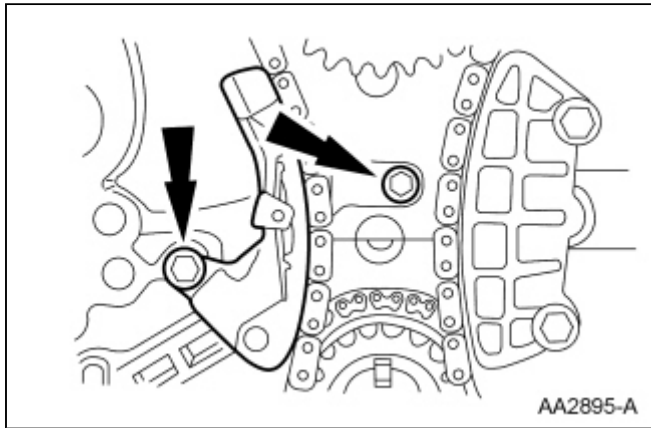
85. Remove the jackshaft spacer.



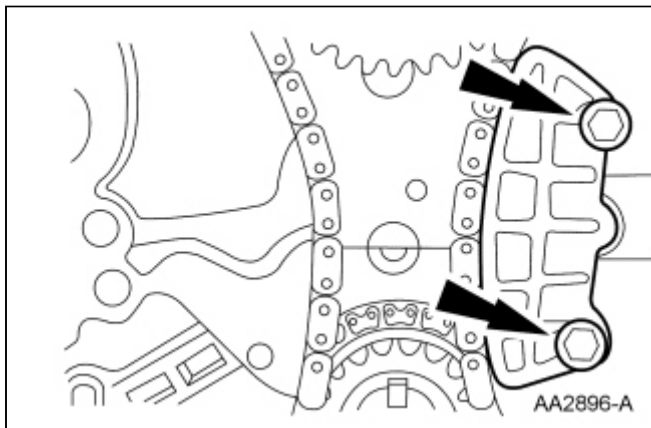
86. Using the Crankshaft Holding Tool, loosen the front sprocket retaining bolt.



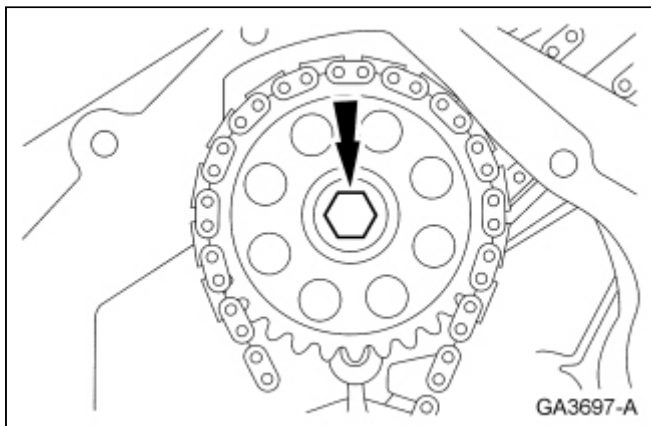
87. Remove the bolts and the chain tensioner.



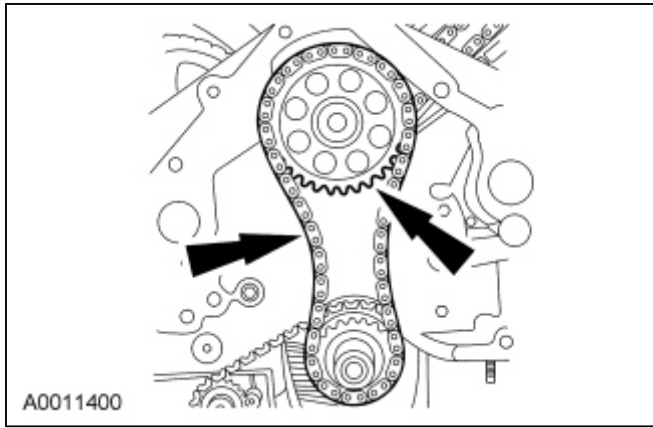
88. Remove the chain guide.



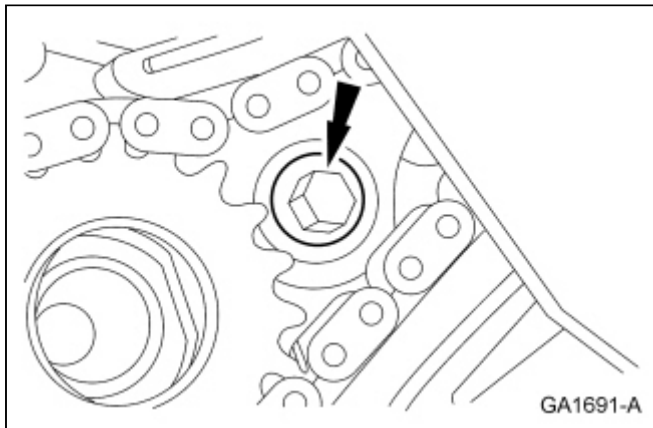
89. Remove the bolt.



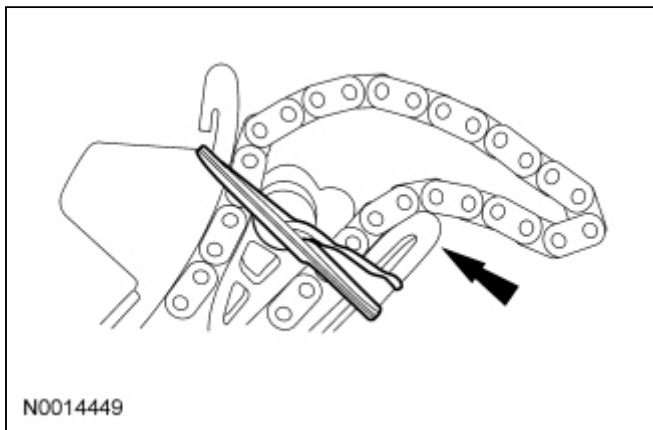
90. Remove the jackshaft sprocket and chain.



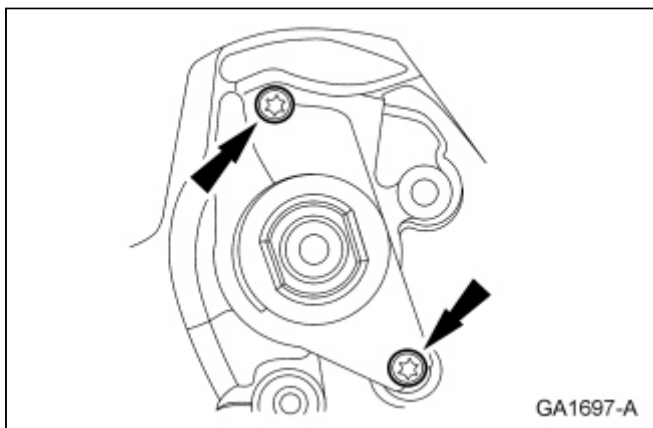
91. Remove the LH cassette bolt.



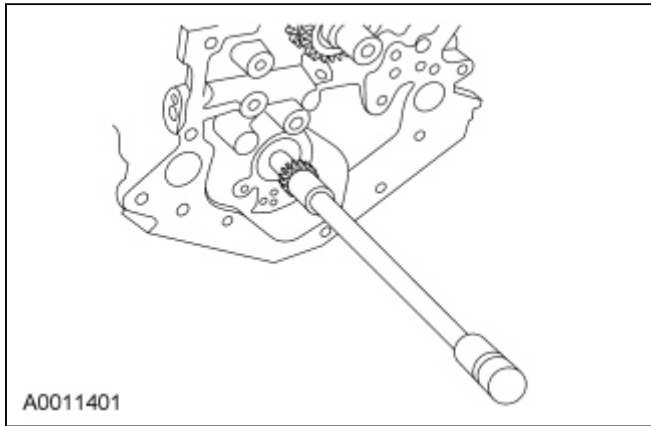
92. Remove the LH cassette.



93. Remove the jackshaft thrust plate.



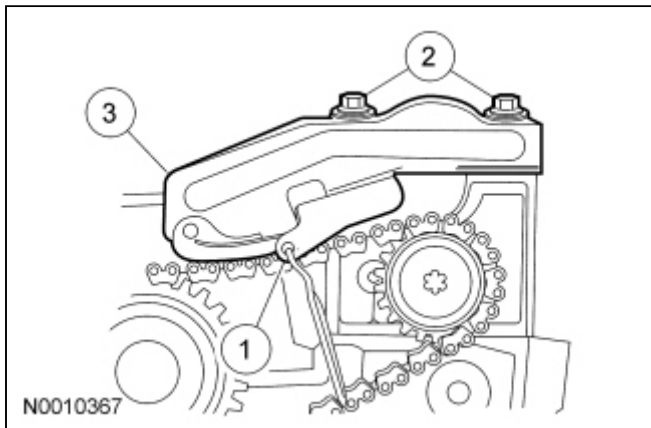
94. Remove the jackshaft.



Vehicles equipped with a balance shaft

95. Remove the balance shaft tensioner.

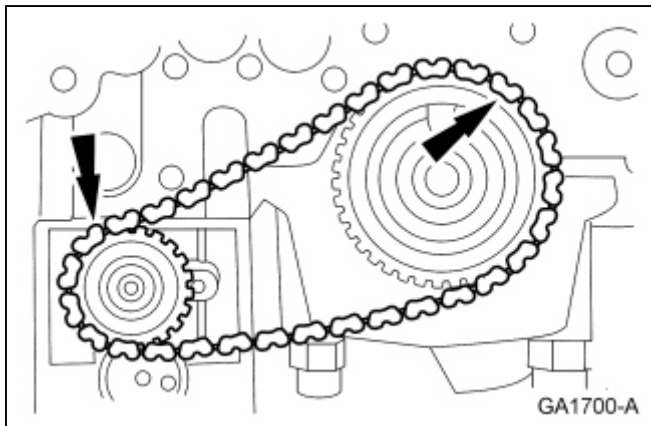
1. Install a pin in the balance shaft tensioner.
2. Remove the 2 bolts.
3. Remove the balance shaft tensioner.



96. Remove the 2 bolts and the balance shaft chain guide.

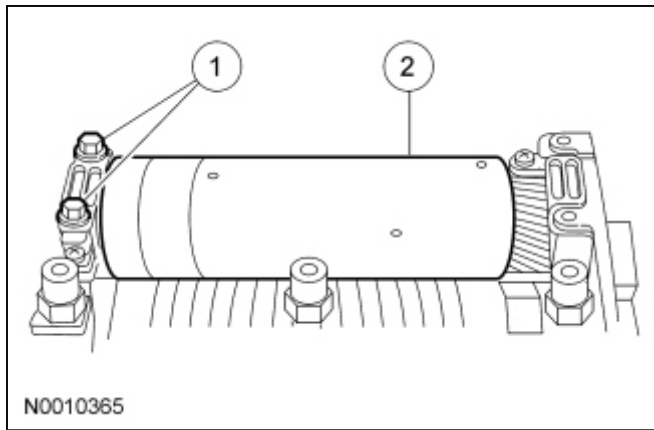
97. **NOTE:** DO NOT remove the balance shaft sprocket bolt.

Remove the balance shaft chain and crankshaft sprocket.



98. Remove the balance shaft.

1. Remove the 2 bolts.
2. Remove the balance shaft.



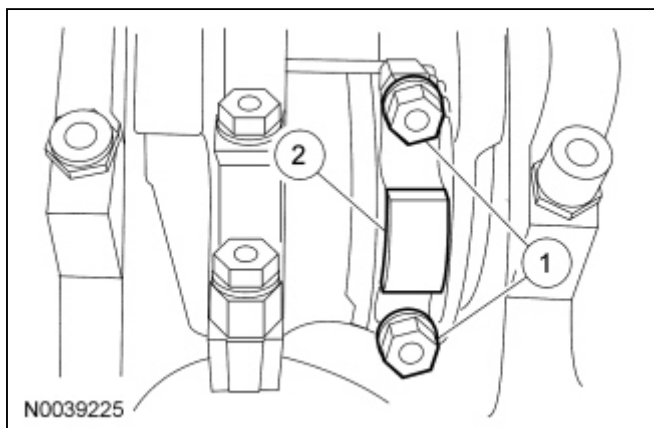
All vehicles

99. 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's instructions.

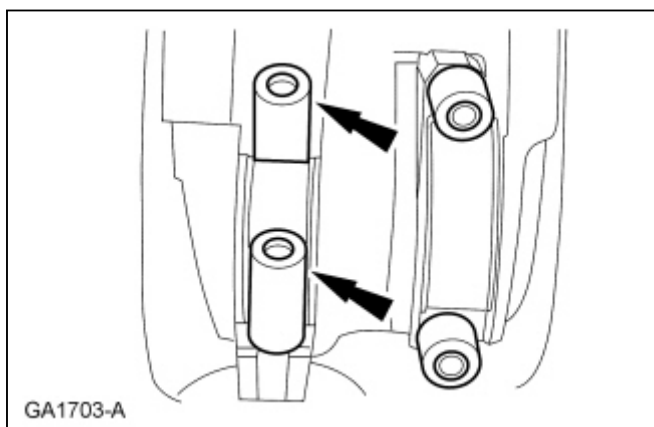
100. **NOTE:** Clearly mark the connecting rods and rod caps in numerical order for correct reassembly.

Remove the connecting rod caps.

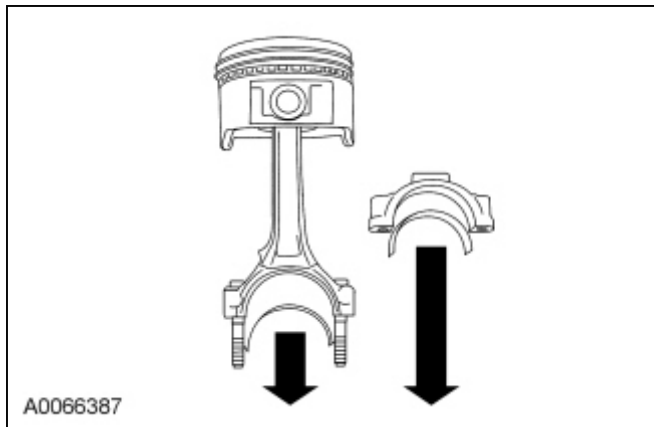
1. Remove the connecting rod nuts.
2. Remove the connecting rod caps.



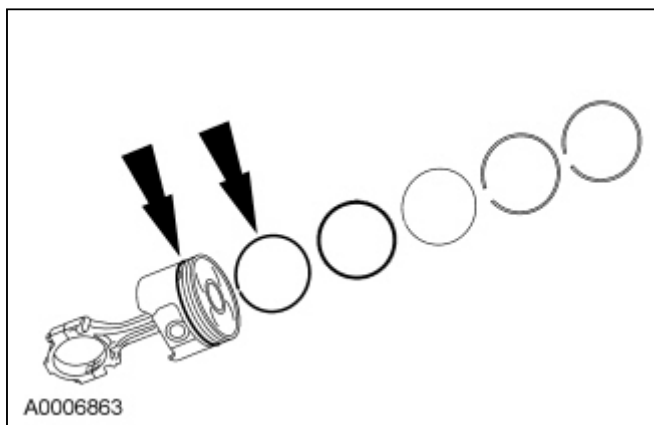
101. Install rubber hose pieces on the bolts to protect the crankshaft and remove the pistons.



102. Remove the connecting rod bearings.



103. Remove the piston rings.

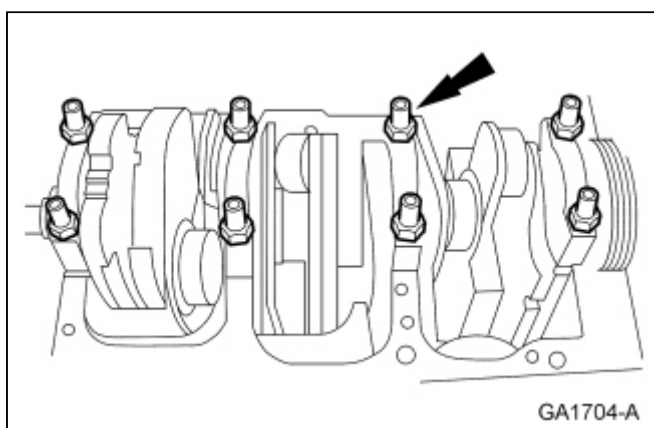


104. Clean and inspect the pistons. For additional information, refer to [Section 303-00](#).

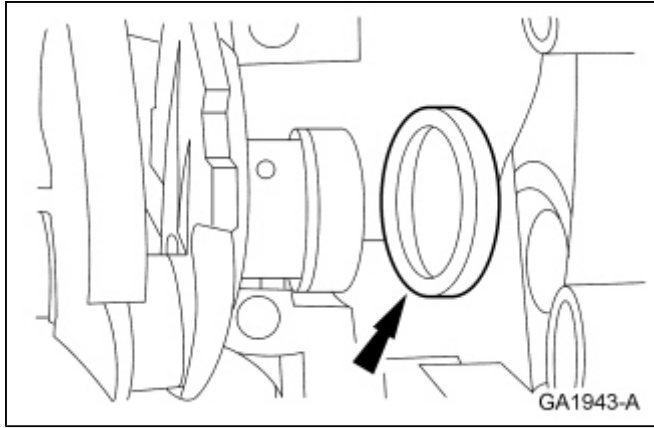
105. **NOTICE:** Remove the cylinder heads before removing the crankshaft. Failure to do so can result in engine damage.

NOTE: Number (or mark) the crankshaft bearing caps before removing them.

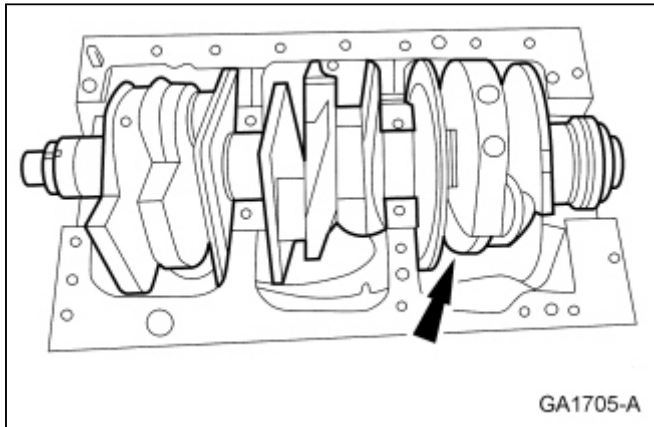
Remove the bolts and the crankshaft main bearing caps.



106. Remove the crankshaft rear oil seal from the crankshaft.



107. Remove the crankshaft.



108. Remove the crankshaft main bearings and the thrust bearing.

