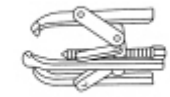
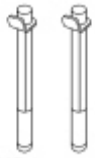
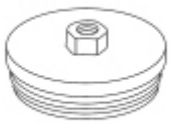
Engine

Special Tool(s)

 ST1184-A	3-Jaw Puller 303-D121 or equivalent
 ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

Material

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

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

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.**

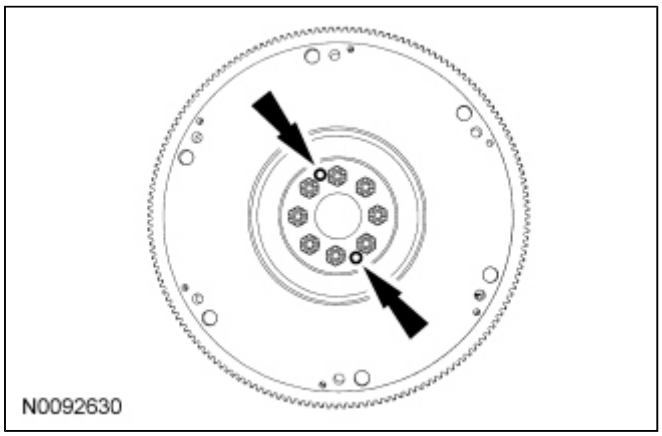
NOTE: The flywheel, crankshaft rear oil slinger, crankshaft rear seal and crankshaft rear seal retainer plate must be removed before mounting the engine on the engine stand.

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

1. Remove the 8 flywheel bolts.

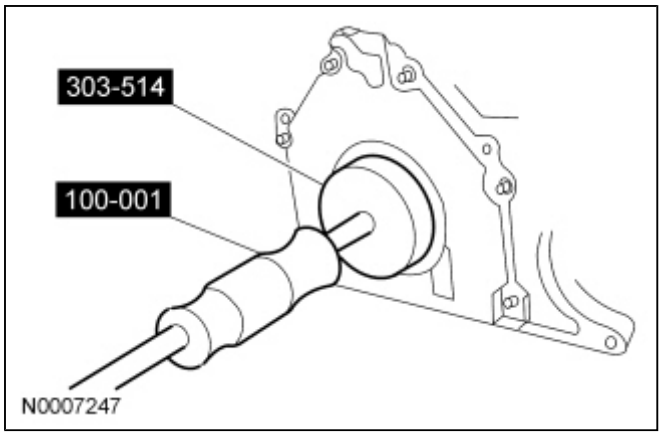
2. ***NOTICE:*** **The flywheel is a press fit on the crankshaft pilot. Do not use screwdrivers or prybars to remove the flywheel or damage to the flywheel or engine may occur.**

   Remove the flywheel.
   - Install 2 of the removed flywheel bolts in the 2 holes shown on the flywheel flange.
   - Tighten the 2 bolts evenly to push the flywheel off the crankshaft pilot.

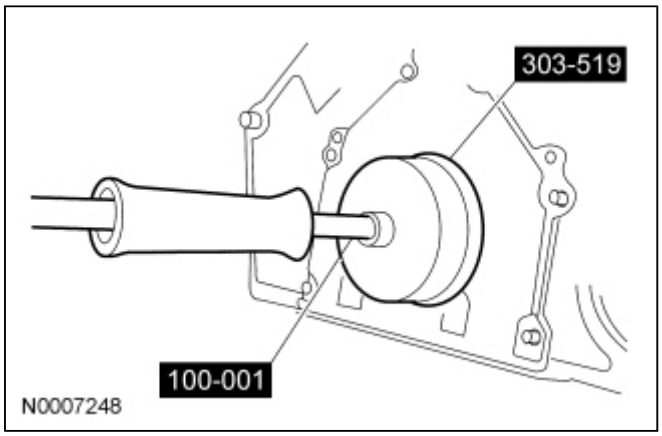


3. Remove the engine/transmission spacer plate.

4. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove the crankshaft rear oil slinger.

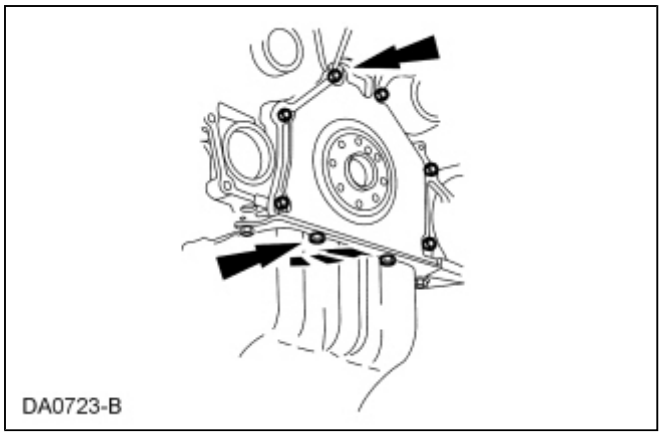


5. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove the crankshaft rear seal.

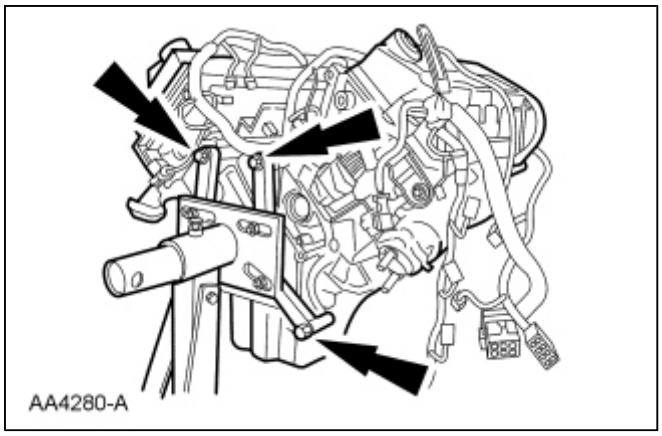


6. Remove the 8 bolts and the rear seal retainer plate.
    - ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

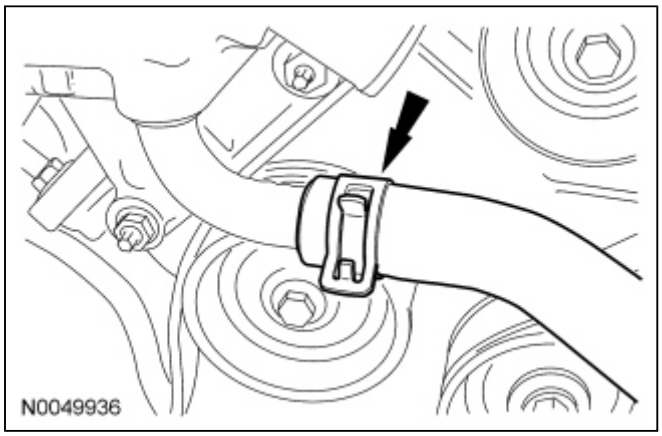
      Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.



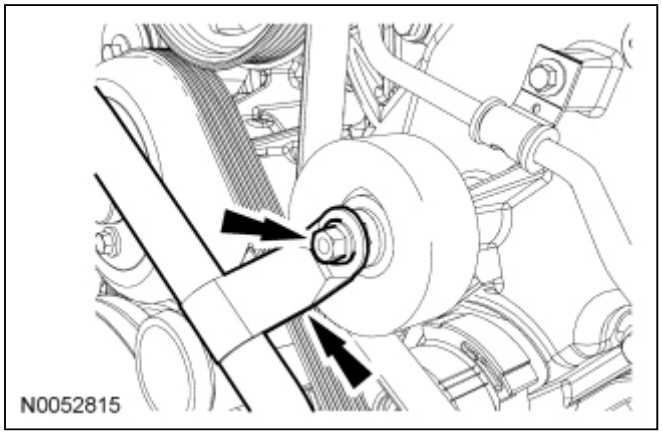
7. Mount the engine on a suitable work stand.



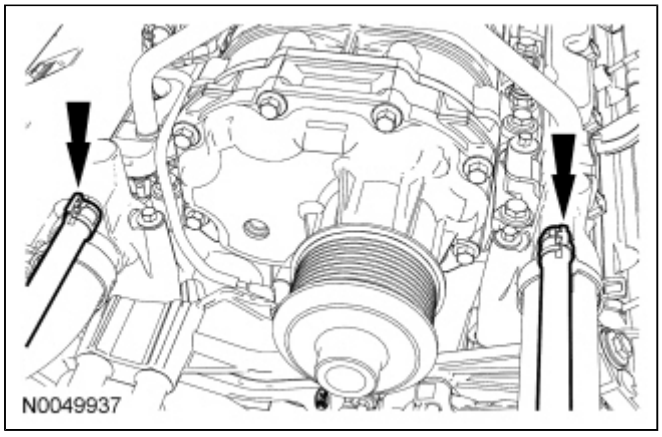
8. Disconnect the coolant hose from the thermostat housing.



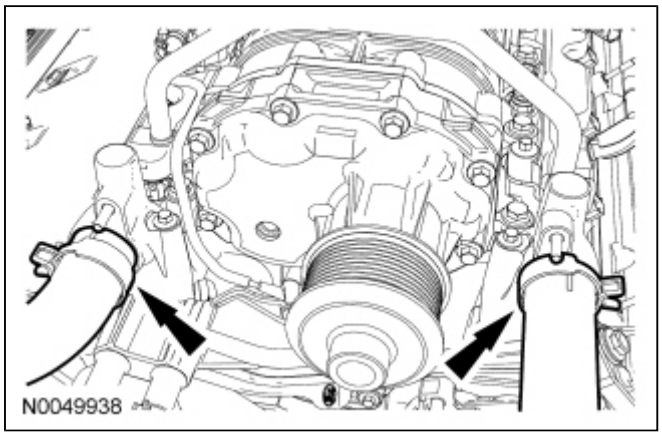
9. Remove the coolant tube bracket nut.



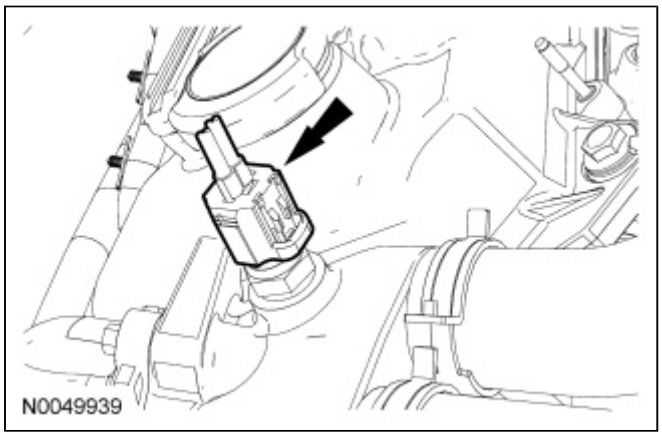
10. Disconnect the 2 coolant vent hoses from the intake manifold.



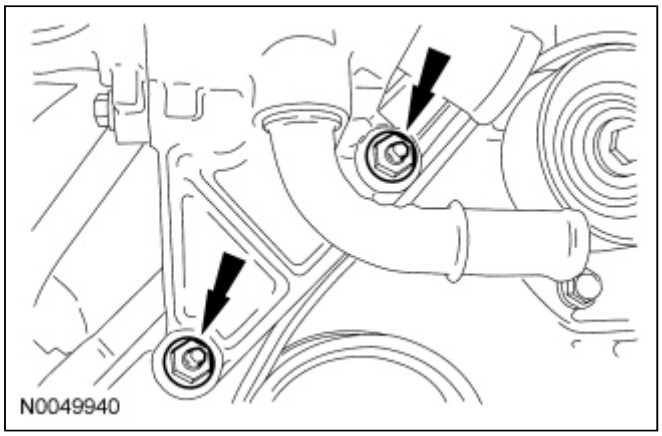
11. Disconnect the 2 upper radiator hoses from the intake manifold.



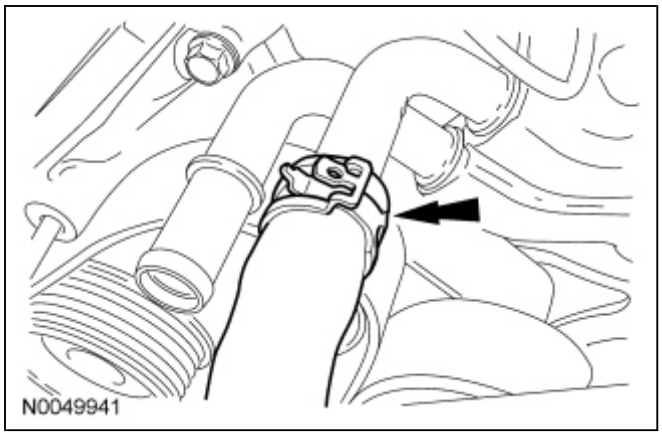
12. Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.



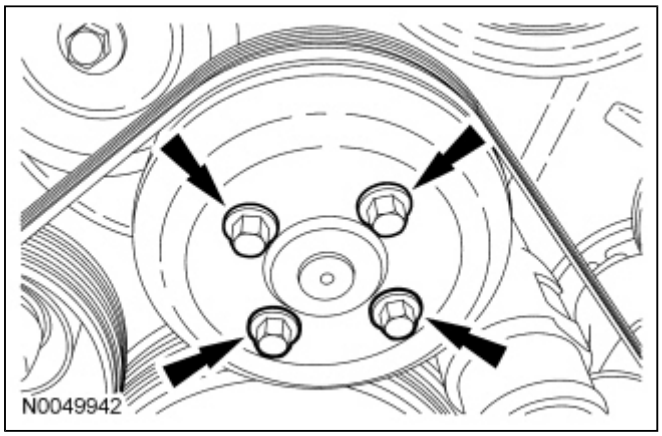
13. Remove the 2 nuts and the thermostat housing assembly.



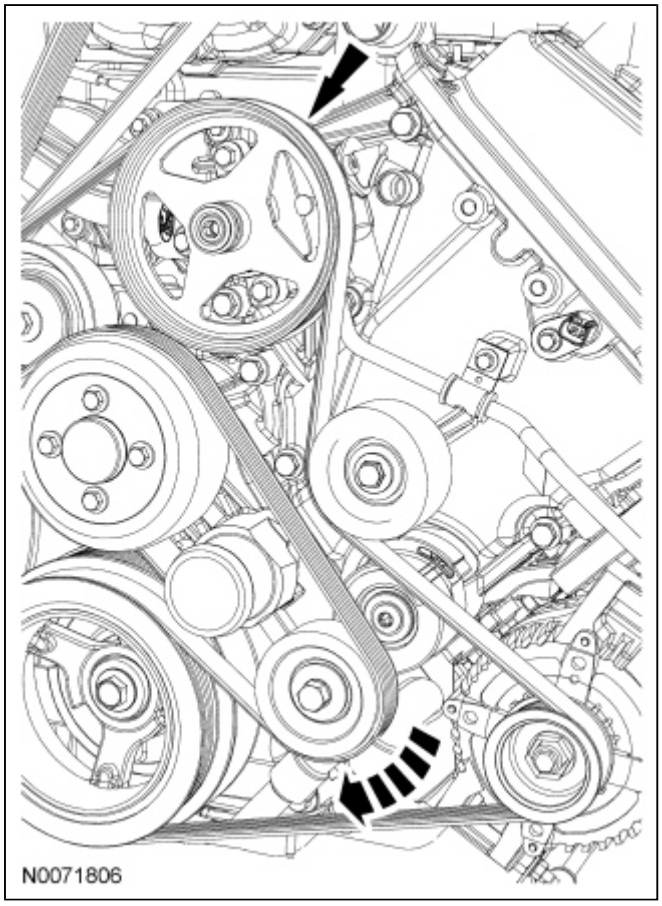
14. Disconnect the coolant hose from the Charge Air Cooler (CAC).



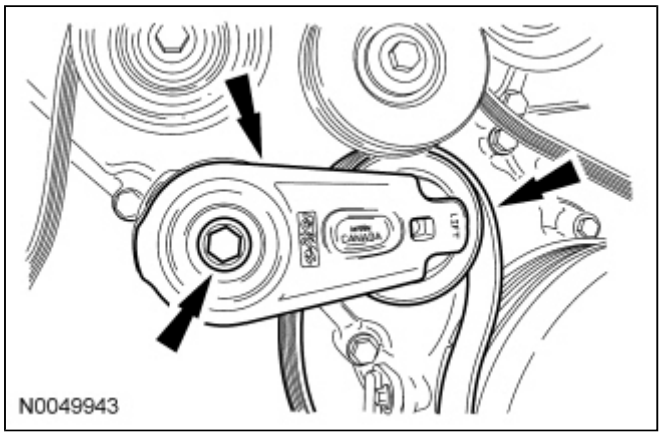
15. Loosen the 4 coolant pump pulley bolts.



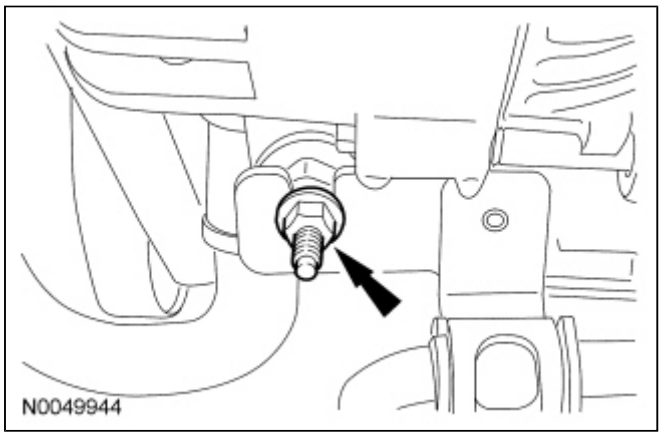
16. Rotate the accessory drive belt tensioner clockwise and remove the accessory drive belt.



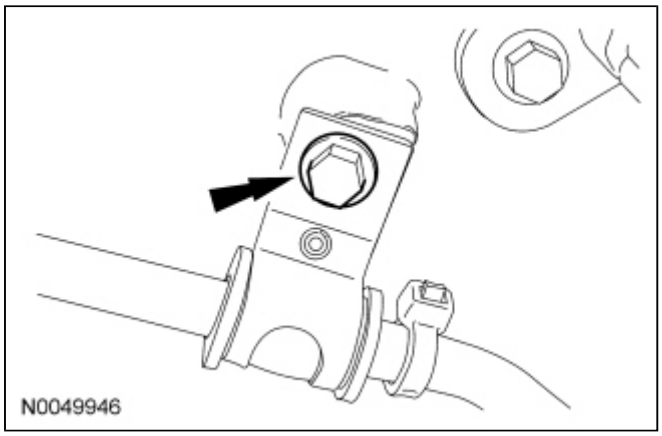
17. Remove the bolt, Supercharger (SC) drive belt tensioner and the SC drive belt.



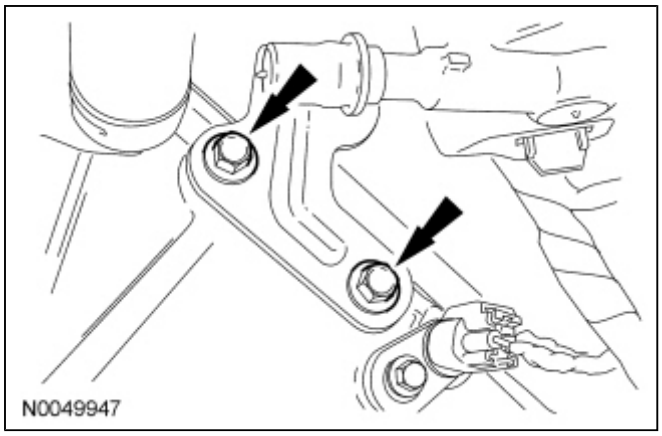
18. Remove the power steering tube bracket nut.



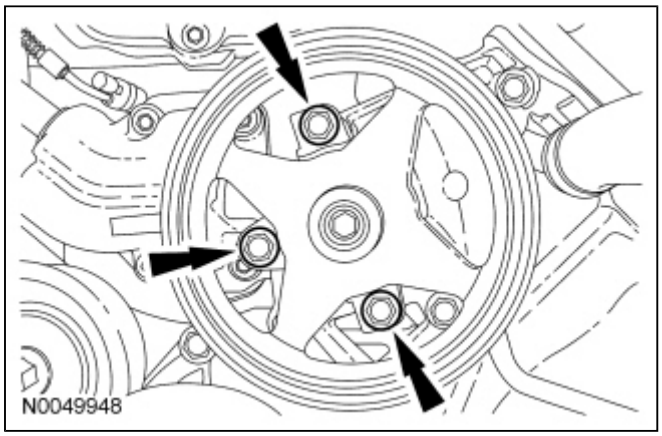
19. Remove the power steering tube bracket bolt.



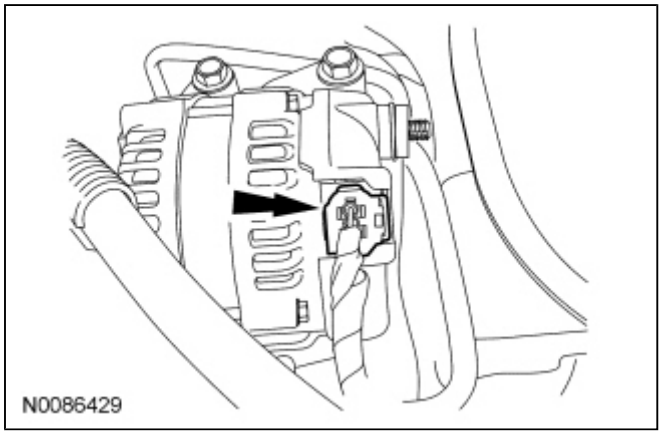
20. Remove the 2 power steering reservoir bracket bolts.



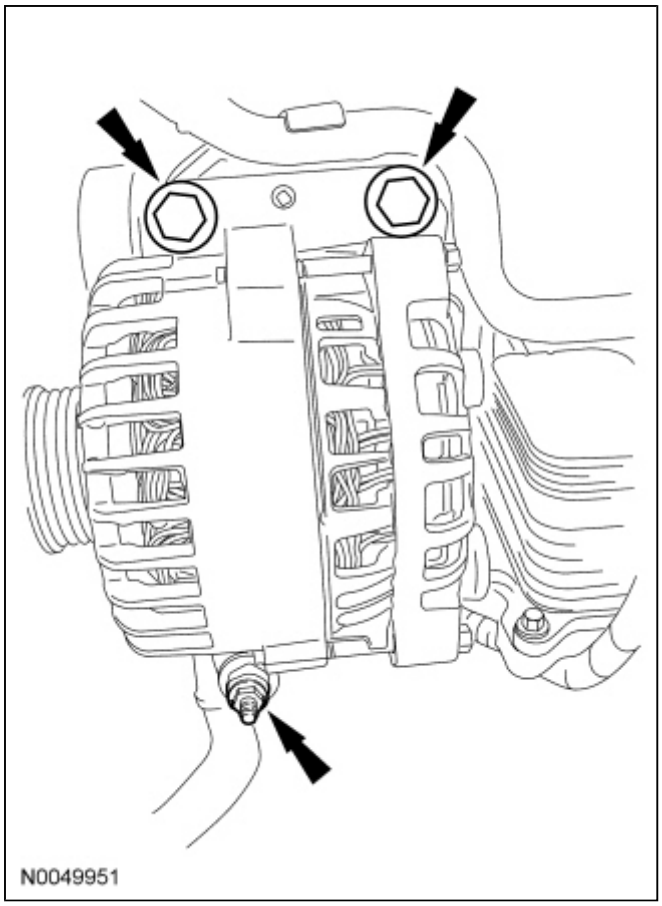
21. Remove the 3 bolts and the power steering pump and reservoir assembly.



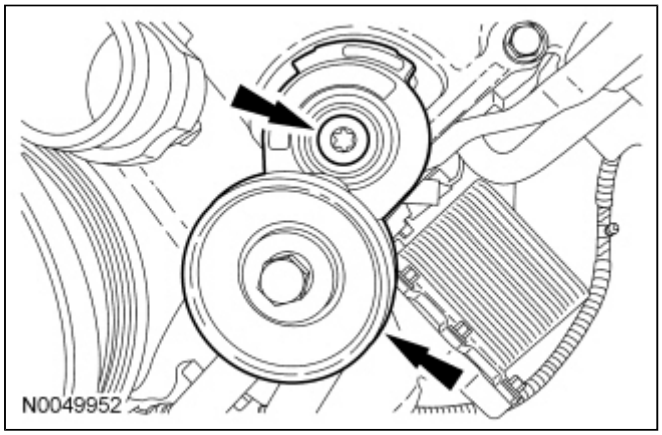
22. Disconnect the generator electrical connector.



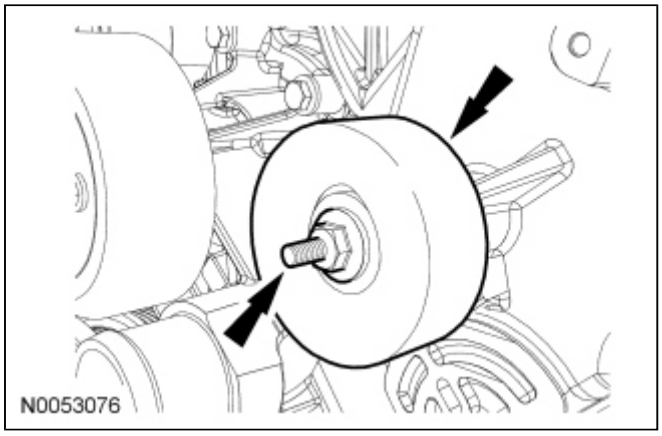
23. Remove the stud bolt, 2 bolts and the generator.



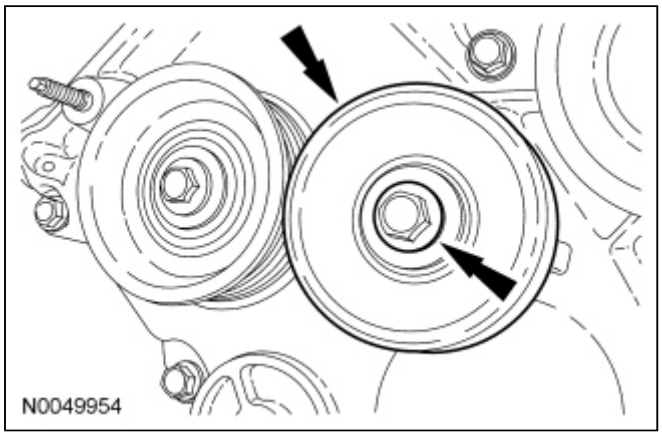
24. Remove the bolt and the accessory drive belt tensioner.



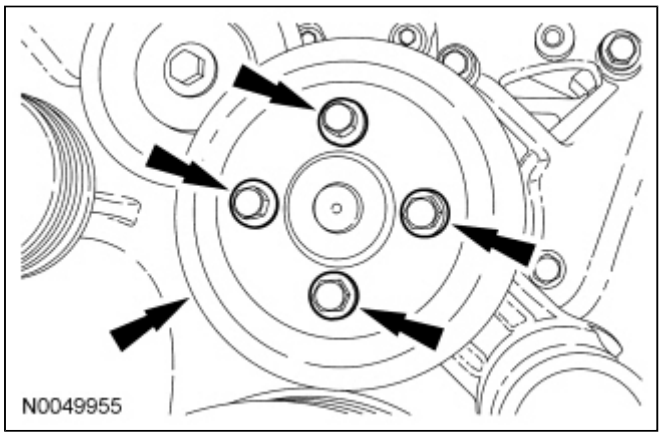
25. Remove the stud bolt and the accessory drive belt idler pulley (smooth).



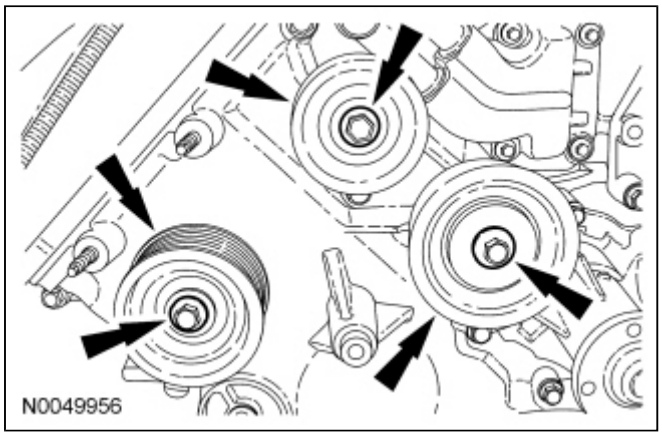
26. Remove the bolt and the accessory drive belt idler pulley (grooved).



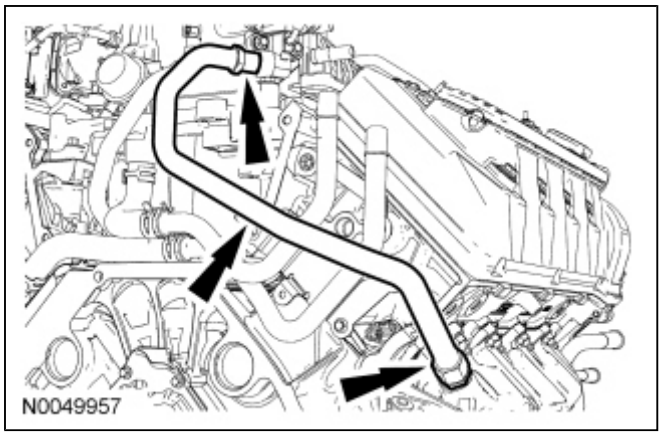
27. Remove the 4 bolts and the coolant pump pulley.



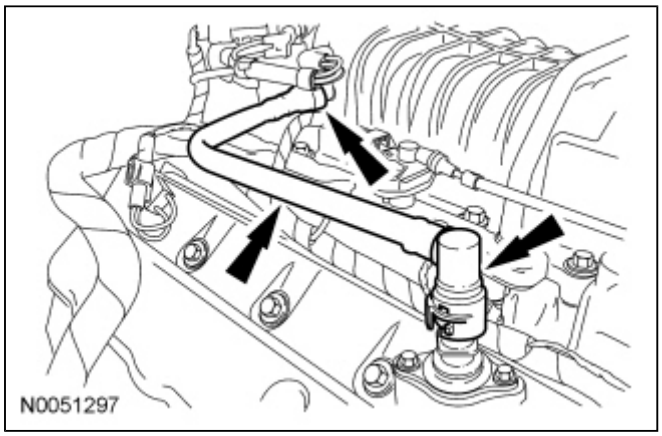
28. Remove the 3 bolts and the 3 SC drive belt idler pulleys.



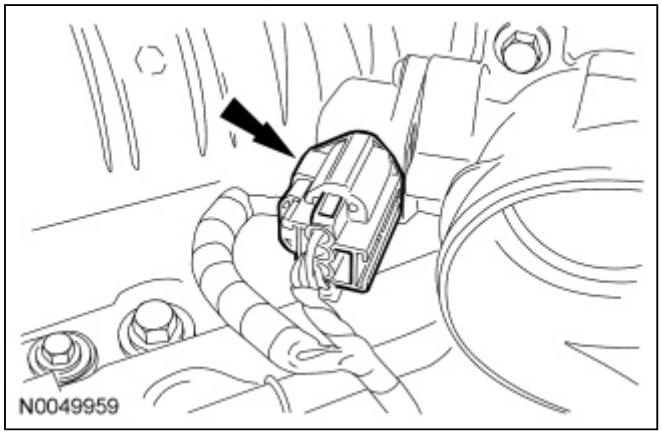
29. Disconnect the 2 EGR tube fittings.
    - Remove the EGR tube.



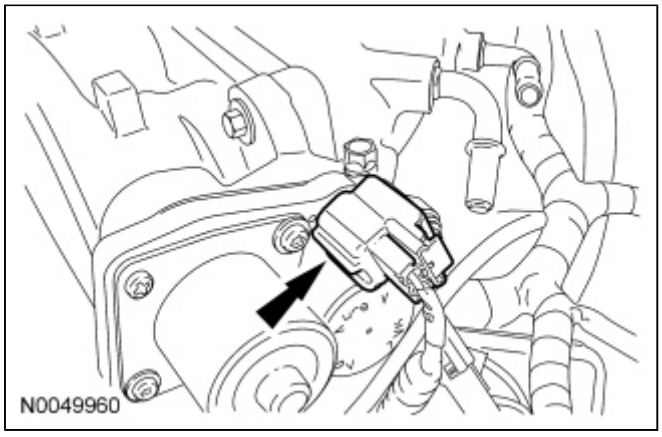
30. Disconnect and remove the crankcase ventilation tube.



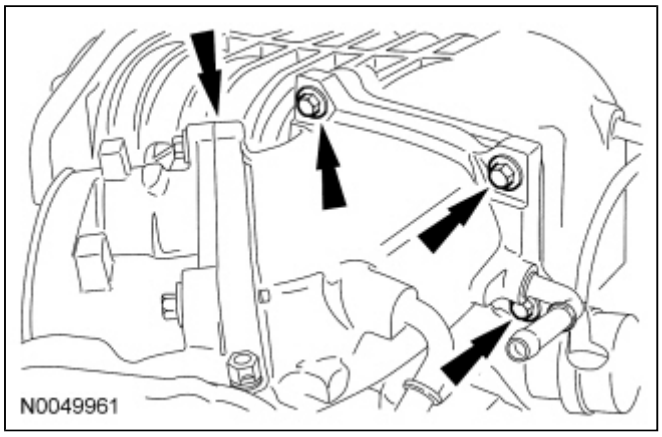
31. Disconnect the Throttle Position (TP) sensor electrical connector.



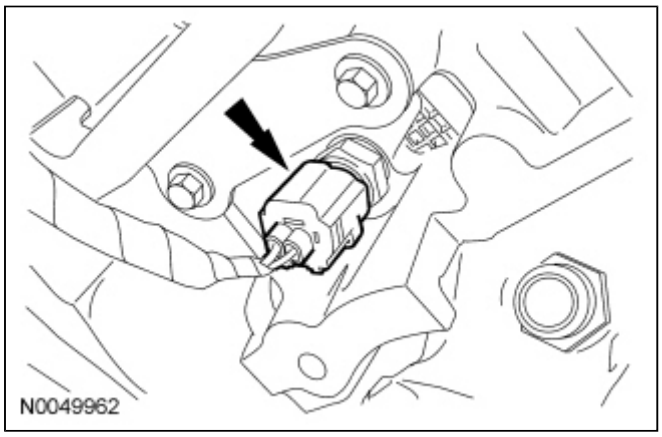
32. Disconnect the electronic throttle control electrical connector.



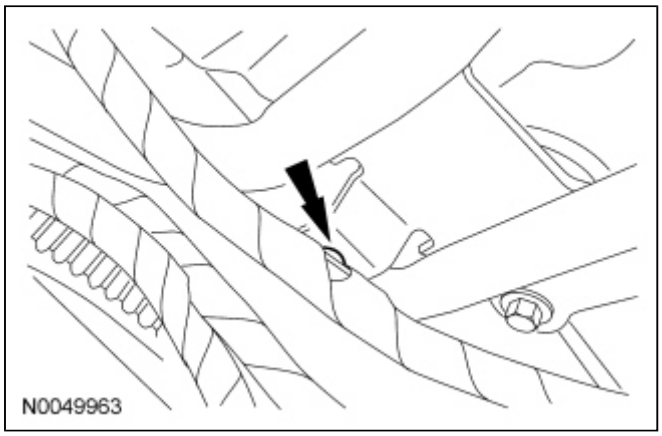
33. Remove the 4 bolts and the TB and spacer assembly.



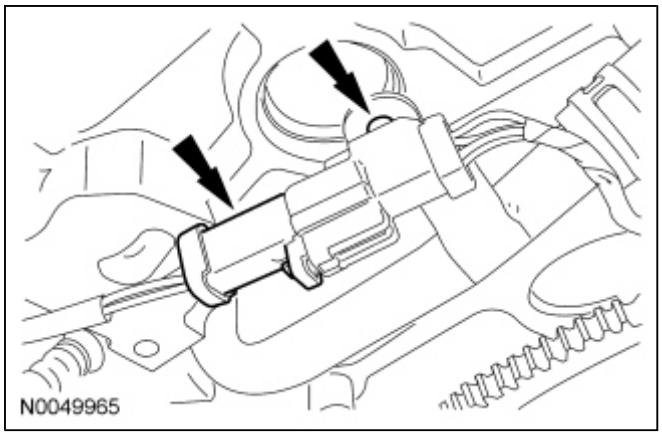
34. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



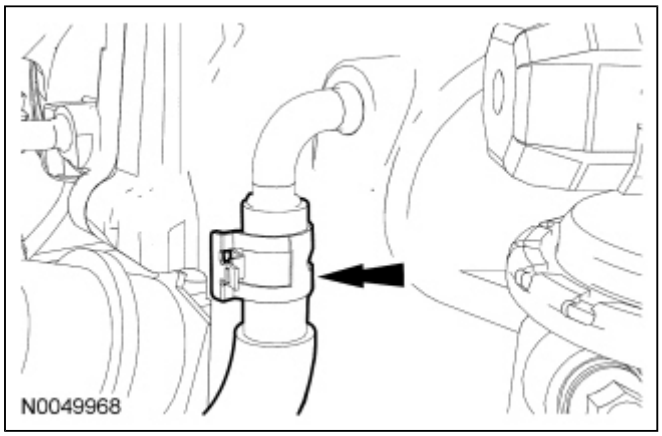
35. Detach the 2 wiring harness pin-type retainers (1 shown) from the coolant tube assembly bracket.



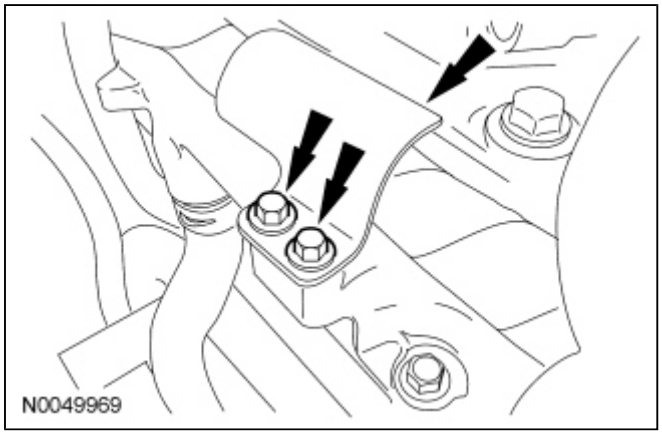
36. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector and pin-type retainer.



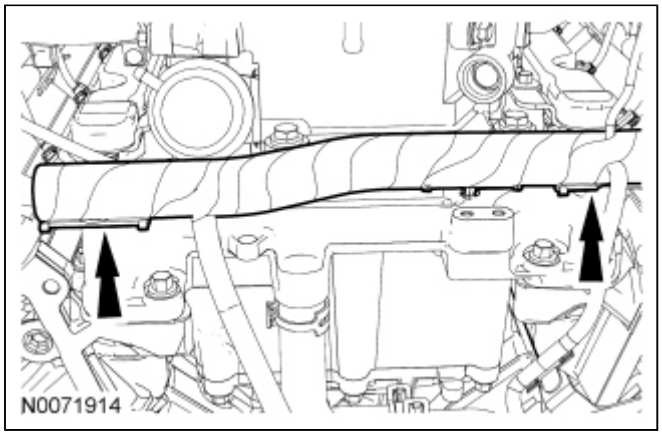
37. Disconnect the bubbler tube from the SC .



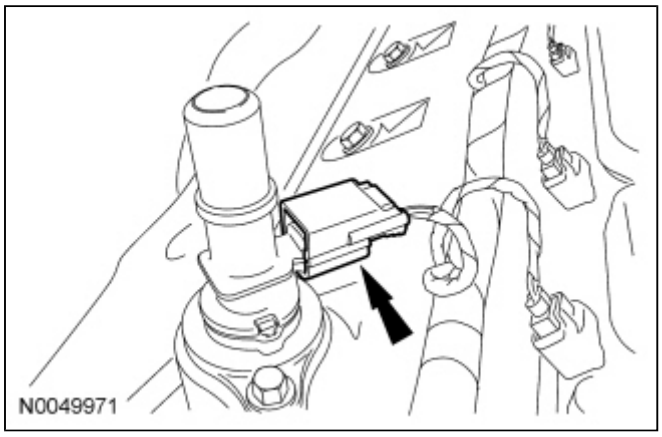
38. Remove the 2 bolts and the wiring harness retaining bracket.



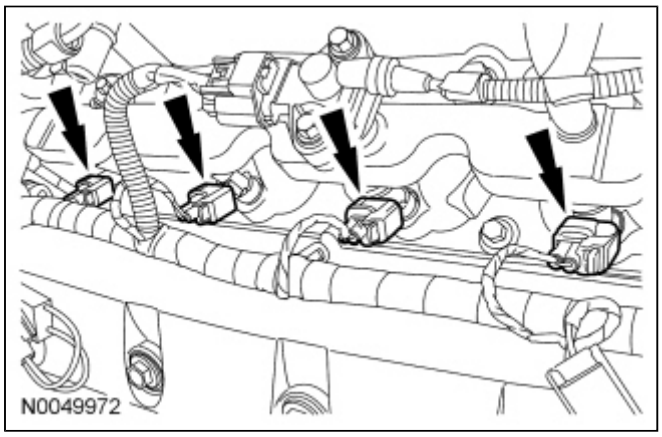
39. Detach the 2 wiring harness pin-type retainers.



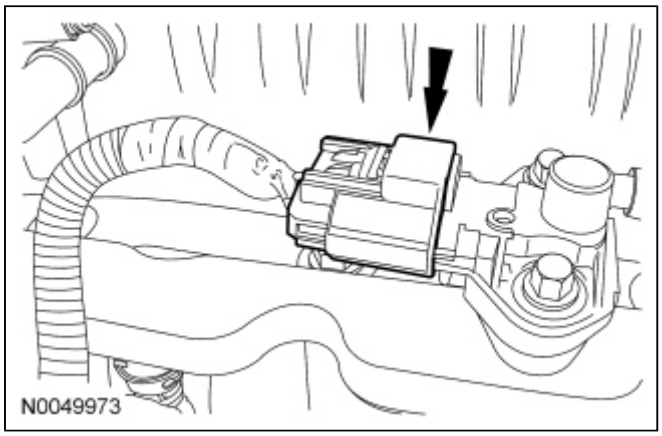
40. Disconnect the PCV valve electrical connector.



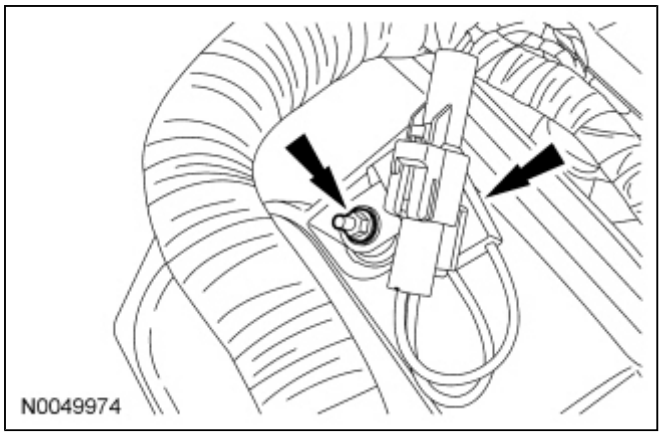
41. Disconnect the 4 RH fuel injector electrical connectors.



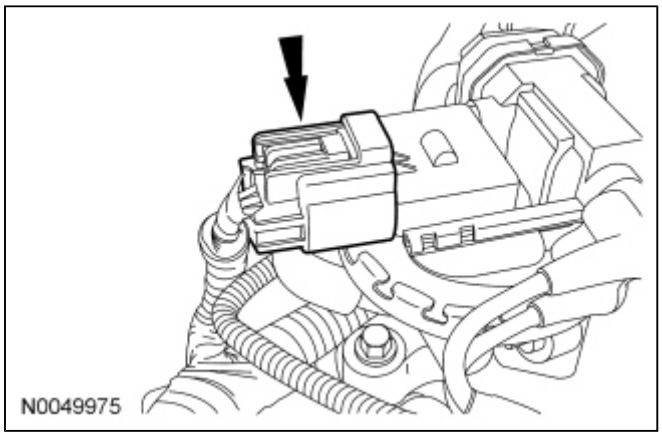
42. Disconnect the fuel rail pressure and temperature sensor electrical connector.



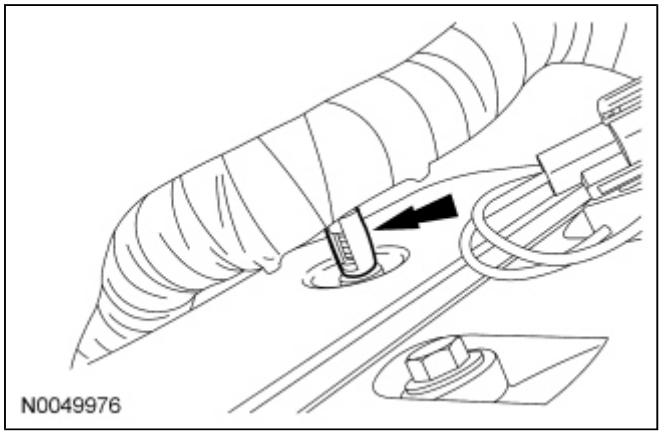
43. Remove the nut and the RH radio interference capacitor.



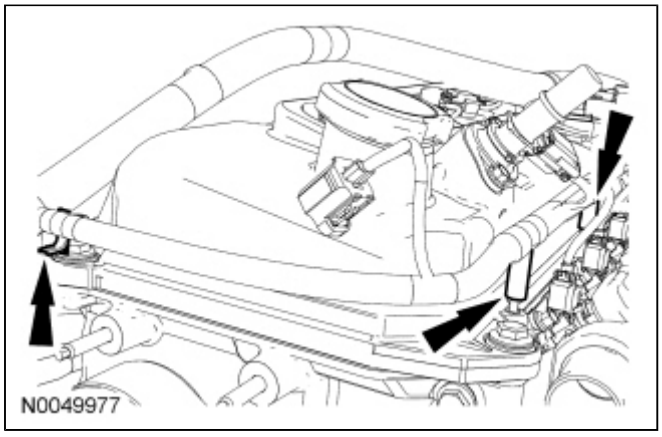
44. Disconnect the EGR valve electrical connector.



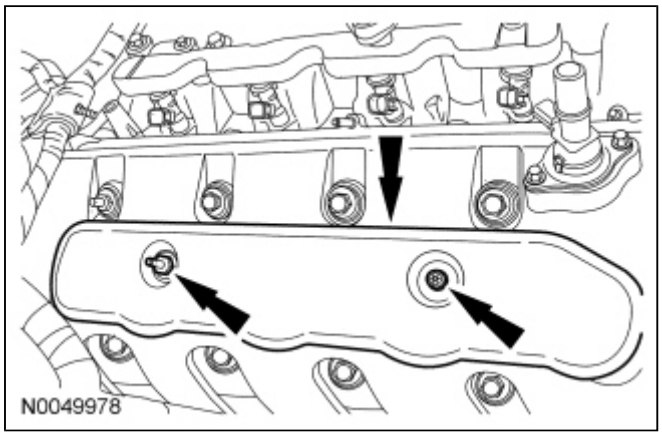
45. Detach the wiring harness from the RH coil-on-plug cover stud bolt.



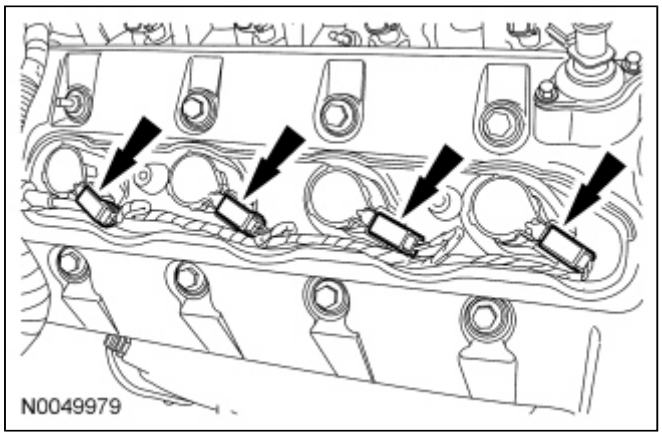
46. Detach the wiring harness retainers from the RH valve cover stud bolts.



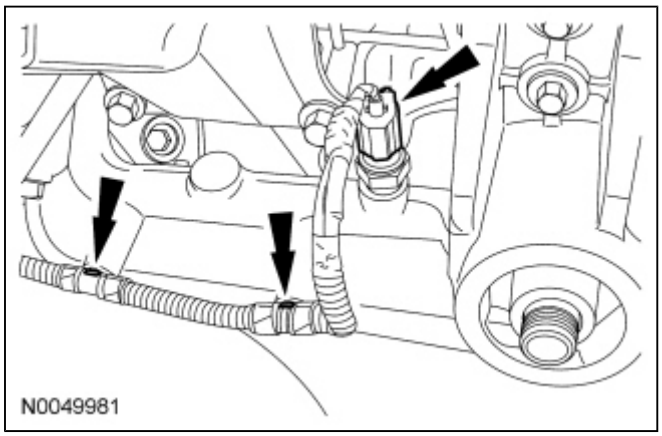
47. Remove the bolt, stud bolt and the RH coil-on-plug cover.



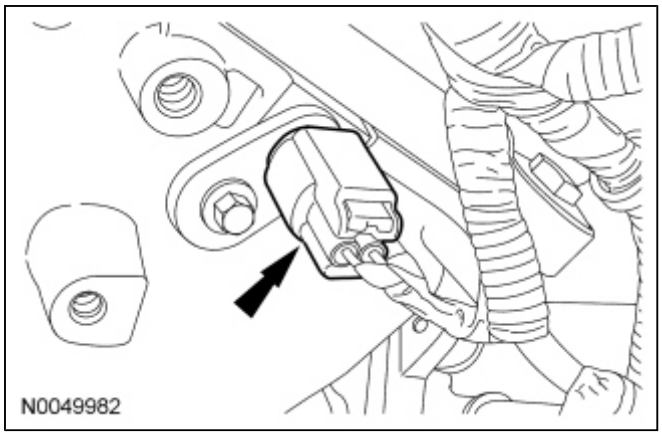
48. Disconnect the 4 RH coil-on-plug electrical connectors.
    - Remove the 4 RH coil-on-plugs.



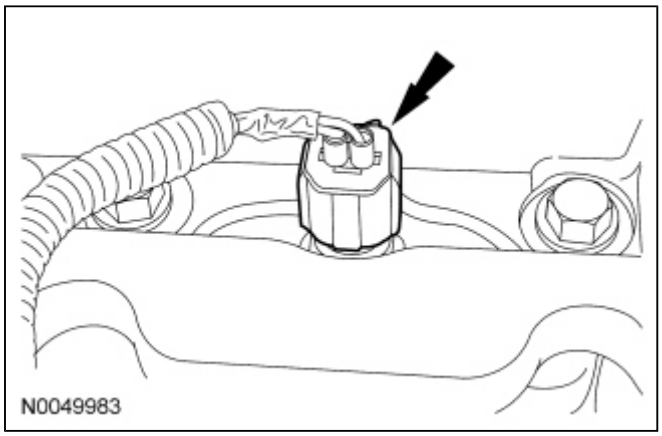
49. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the 2 wiring harness pin-type retainers.



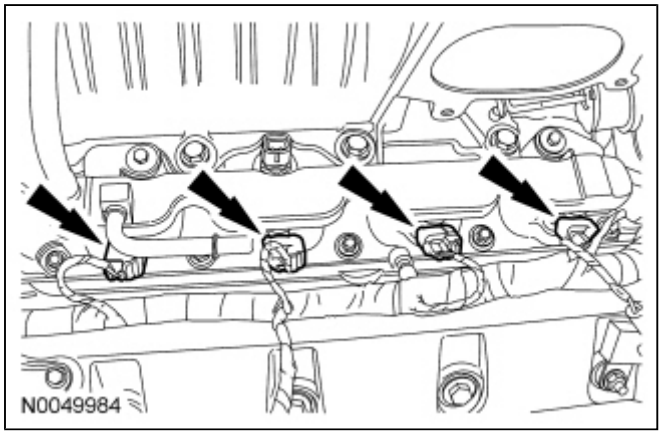
50. Disconnect the Camshaft Position (CMP) sensor electrical connector.



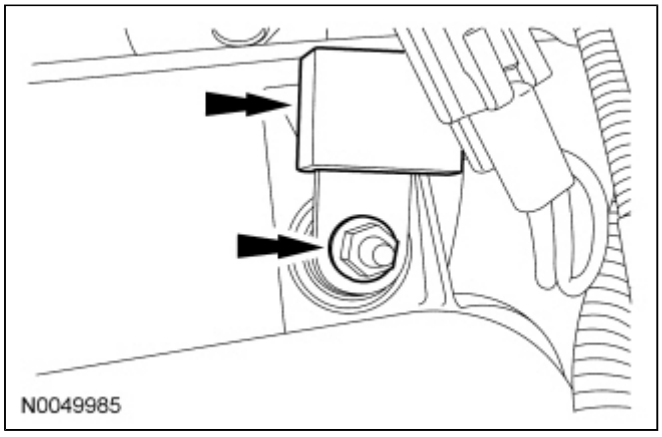
51. Disconnect the Intake Air Temperature 2 (IAT2) sensor electrical connector.



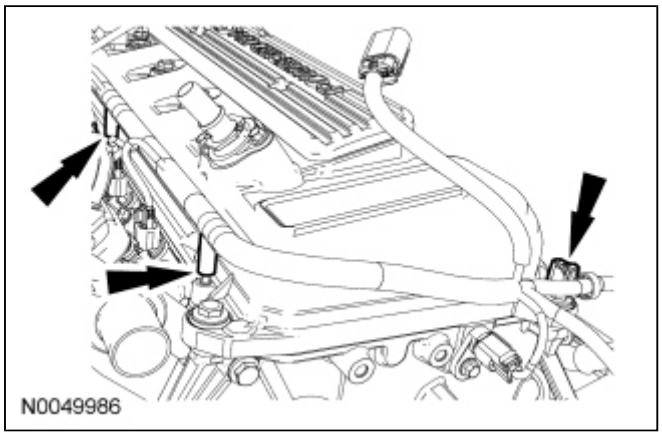
52. Disconnect the 4 LH fuel injector electrical connectors.



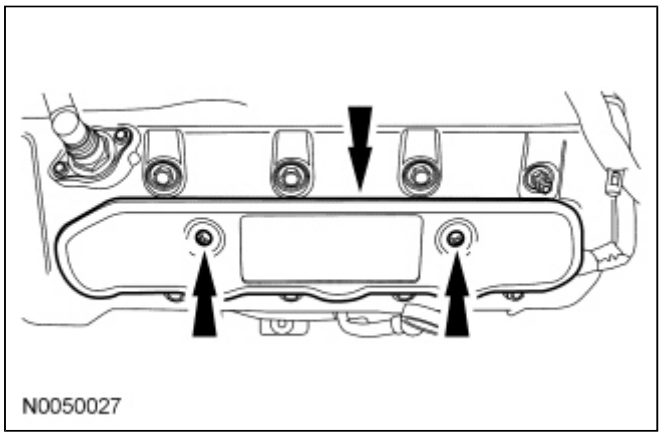
53. Remove the nut and the LH radio interference capacitor.



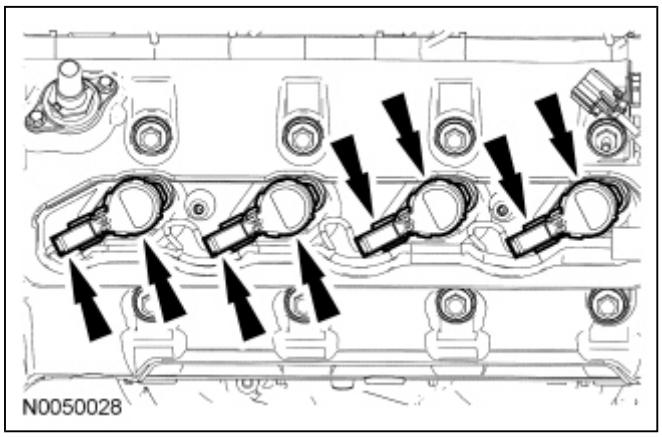
54. Detach the wiring harness retainers from the LH valve cover stud bolts.



55. Remove the 2 bolts and the LH coil-on-plug cover.

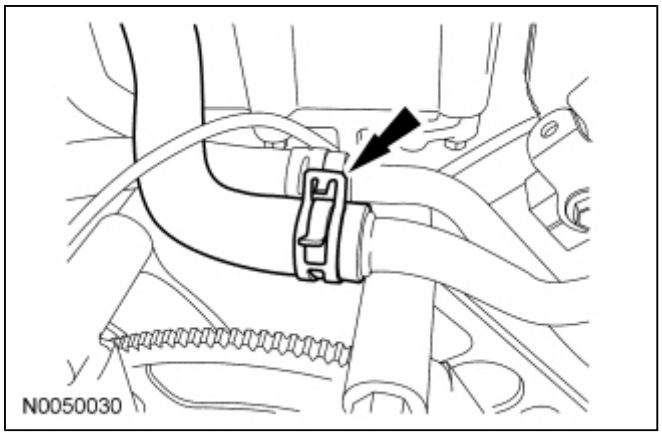


56. Disconnect the 4 LH coil-on-plug electrical connectors.
    - Remove the 4 LH coil-on-plugs.



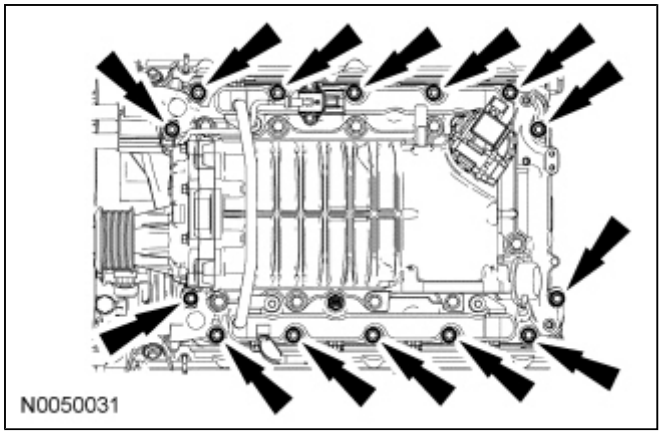
57. Remove the wiring harness assembly from the engine.

58. Disconnect the intake manifold-to-coolant tube assembly hose.

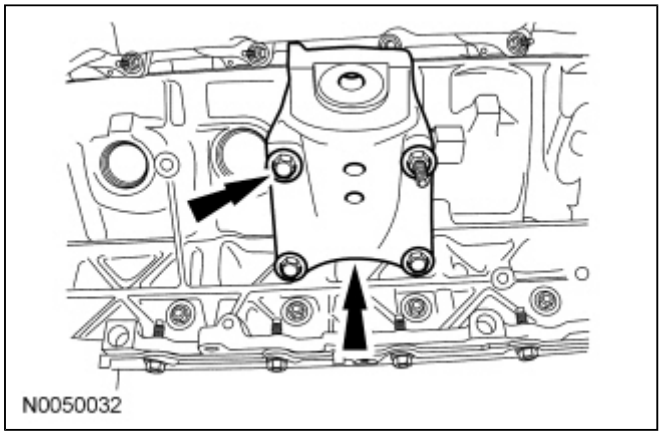


59. ***NOTICE:*** **If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

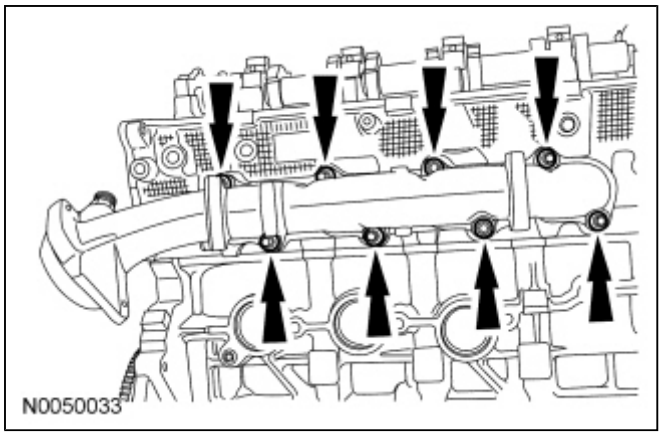
    Remove the 14 bolts and the intake manifold assembly.
    - Remove and discard the 2 intake manifold gaskets.



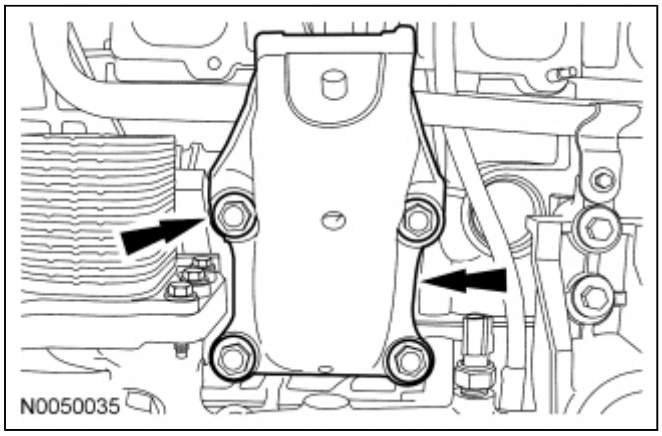
60. Remove the stud bolt, 3 bolts and the RH engine support insulator bracket.



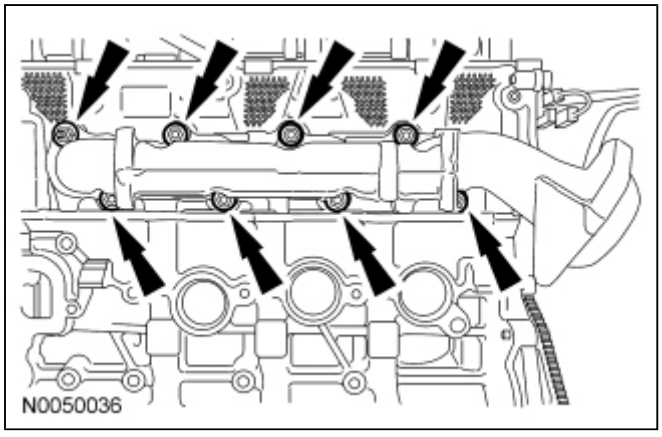
61. Remove 8 nuts and the RH exhaust manifold.
    - Discard the nuts and gaskets.



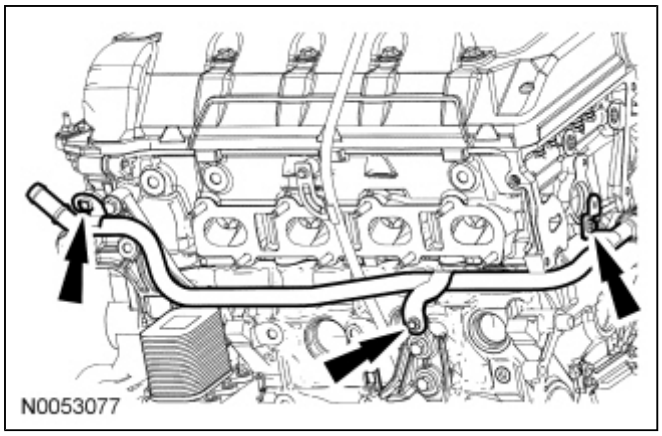
62. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .
63. Remove and discard the 8 RH exhaust manifold studs.
64. Remove the 4 bolts and the LH engine support insulator bracket.



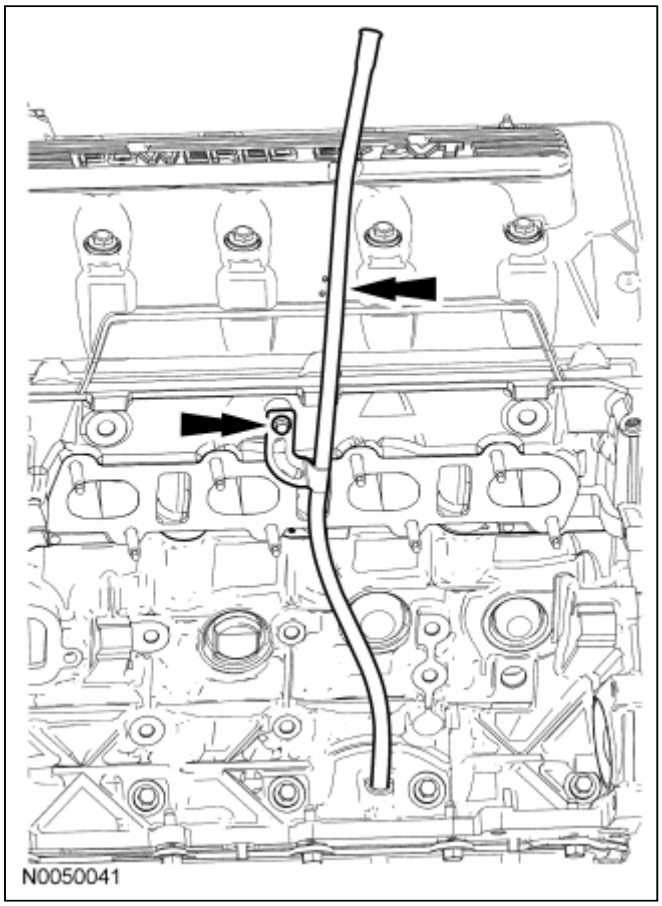
65. Remove 8 nuts and the LH exhaust manifold.
    - Discard the nuts and gaskets.



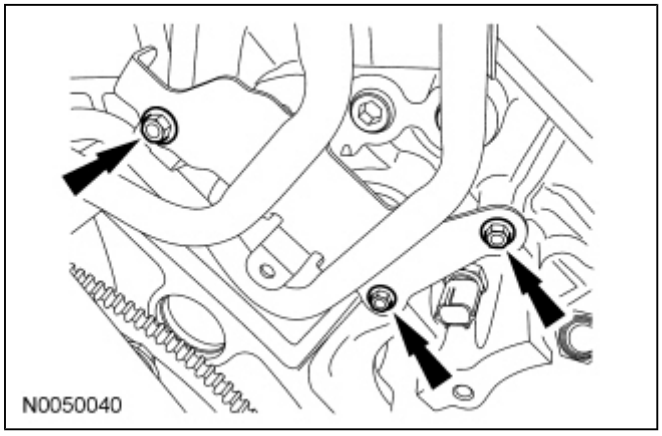
66. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00 .
67. Remove and discard the 8 LH exhaust manifold studs.
68. Remove the 3 coolant tube assembly bolts.



69. Remove the oil level indicator, the bolt and the oil level indicator tube.
    - Remove and discard the oil level indicator tube O-ring seal.



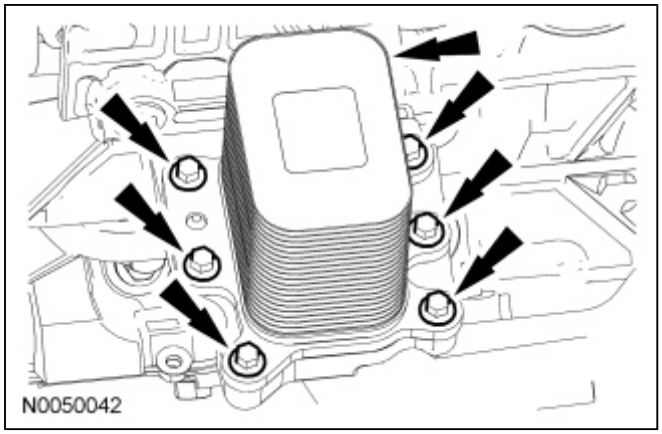
70. Remove the 3 bolts and the coolant tube assembly.



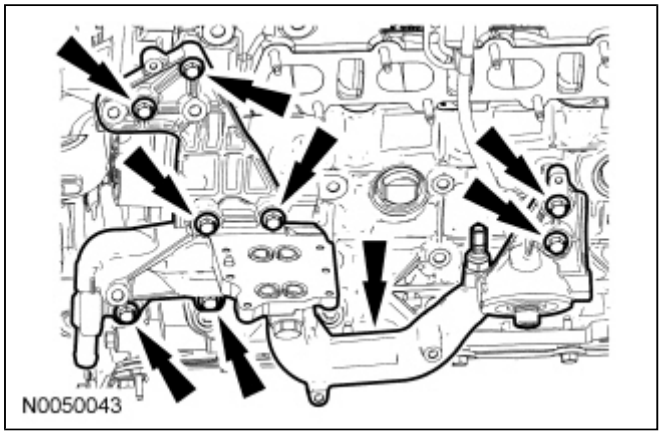
71. ***NOTICE:*** **A new oil cooler must be installed or severe damage to the engine can occur.**

Remove the 6 bolts and the oil cooler.

- Discard the oil cooler and the gaskets.

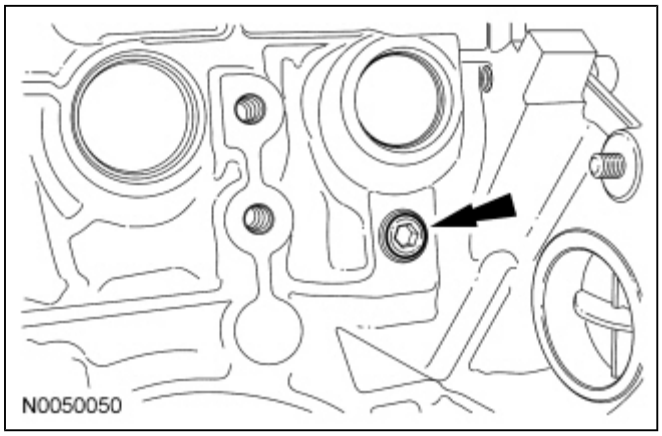


72. Remove the 8 bolts and the oil filter adapter.
    - Discard the oil filter adapter gasket.



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

Remove the LH and RH block drain plugs.

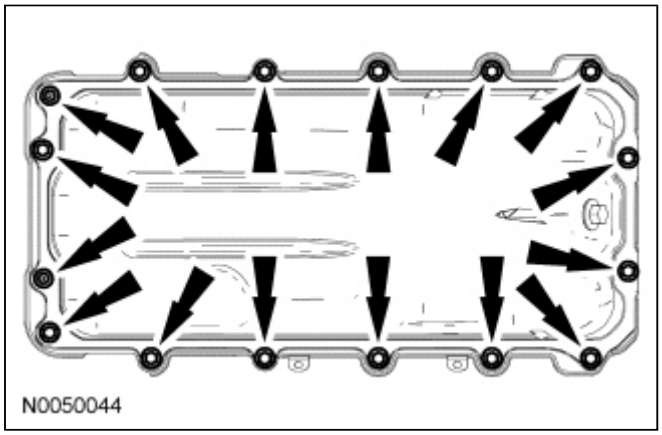


74. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

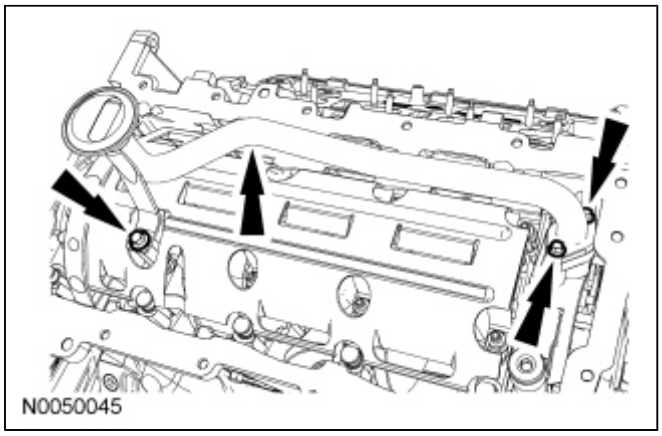
Remove the 14 bolts, 2 stud bolts and the oil pan.

- Remove and discard the oil pan gasket.

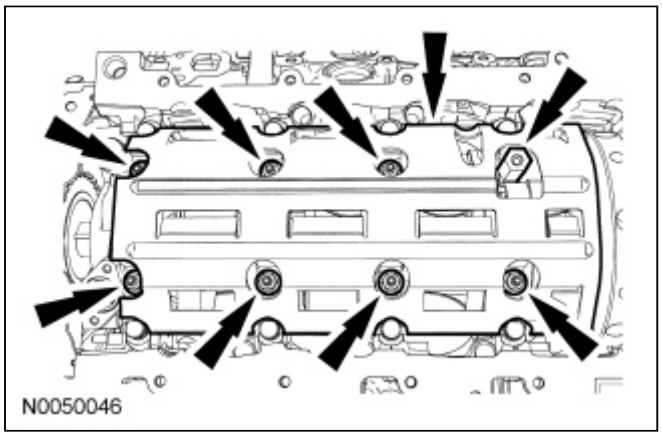
- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.



75. Remove the 3 bolts and the oil pump screen and pickup tube assembly.
    - Discard the O-ring seal.

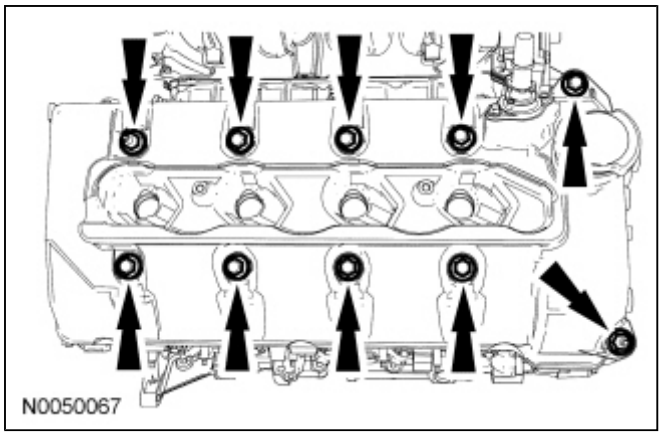


76. Remove the spacer, 7 nuts and the windage tray.



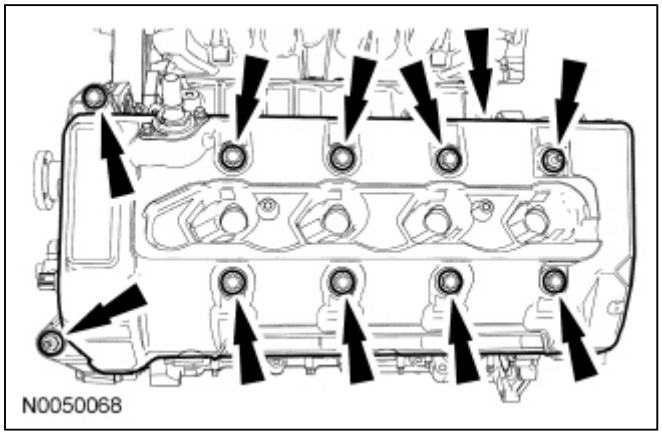
77. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Remove the bolts, stud bolts and RH valve cover.
    - Remove and discard the gaskets.
    - Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.

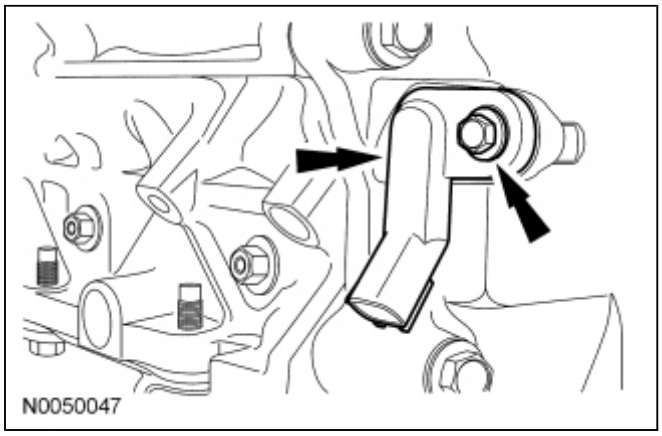


78. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

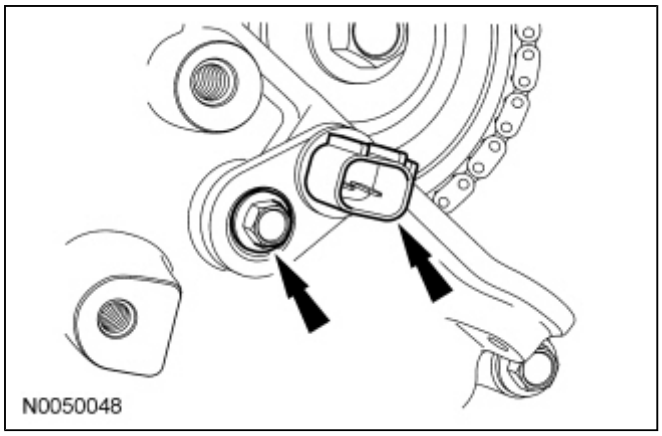
    Remove the bolts, stud bolts and LH valve cover.
    - Remove and discard the gaskets.
    - Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.



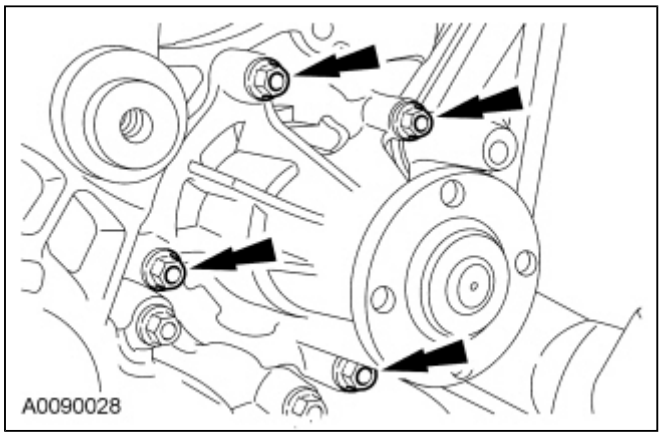
79. Remove the bolt and the Crankshaft Position (CKP) sensor.



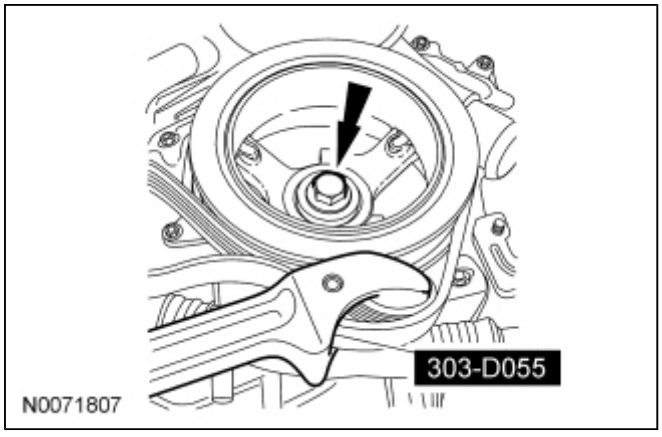
80. Remove the bolt and the CMP sensor.



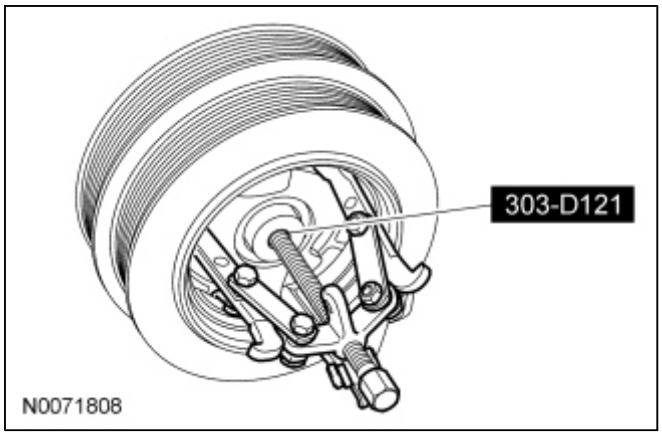
81. Remove the 4 bolts and the coolant pump.



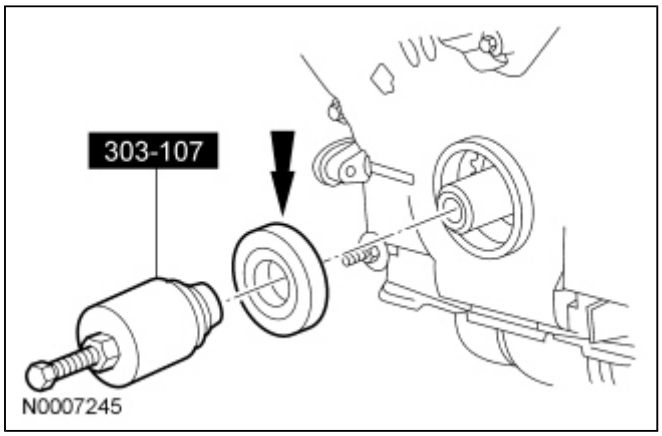
82. Using the Strap Wrench, remove the crankshaft pulley bolt and the washer.
    - Discard the bolt.



83. Using the 3-Jaw Puller, remove the crankshaft pulley.



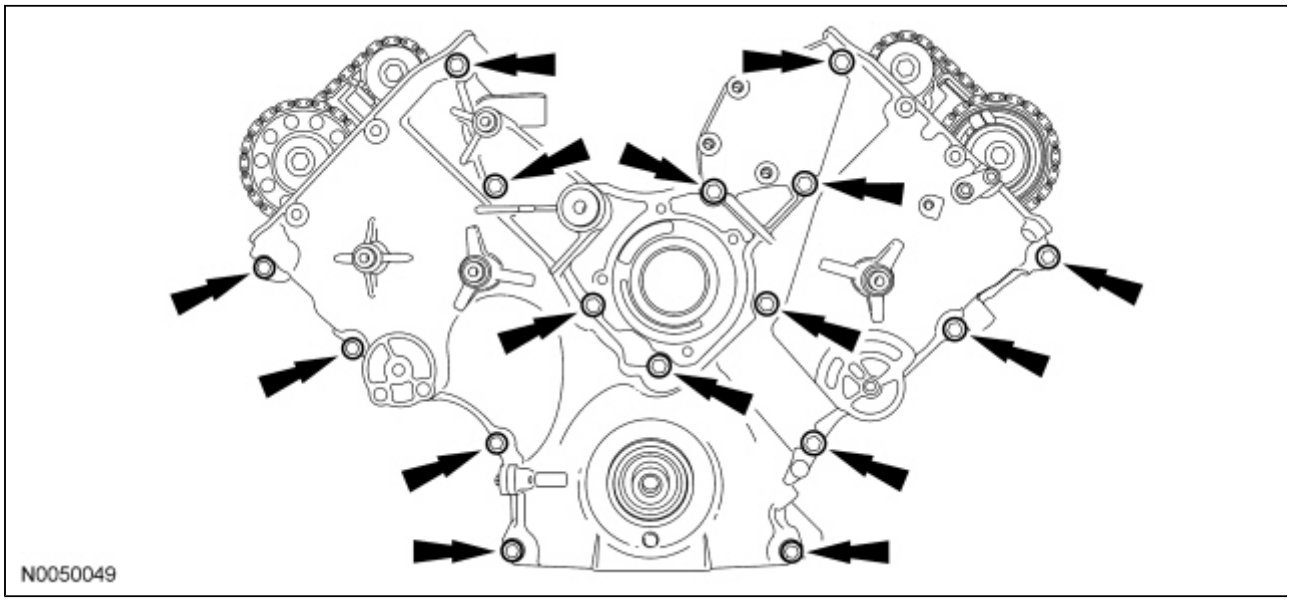
84. Using the Crankshaft Front Oil Seal Remover, remove the crankshaft front seal.



85. ***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 which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Remove the 16 bolts and the engine front cover.

- Remove and discard the engine front cover gaskets.
- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.

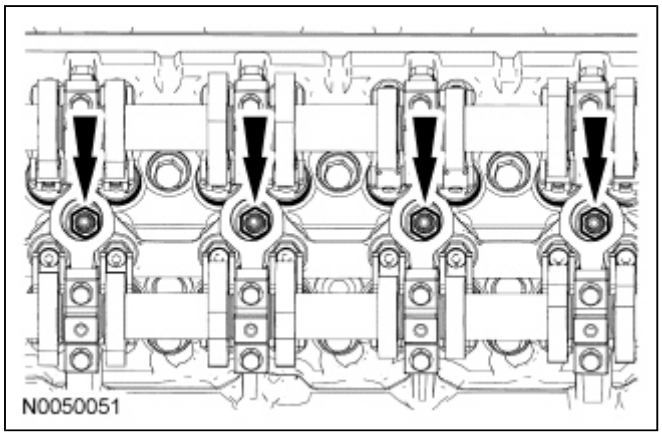


86. ***NOTICE:*** **Only use hand tools when removing or installing the spark plugs, or damage may occur to the cylinder head or spark plugs.**

NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

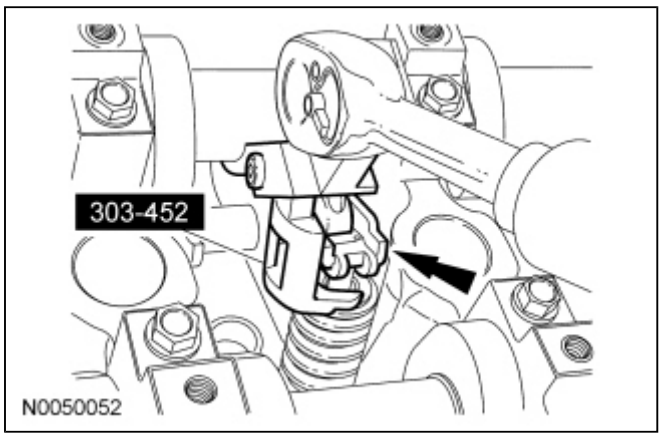
NOTE: RH shown, LH similar.

Remove the 8 spark plugs.



87. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in their original positions. Mark the components for installation into their original locations. Failure to follow these instructions may result in engine damage.**

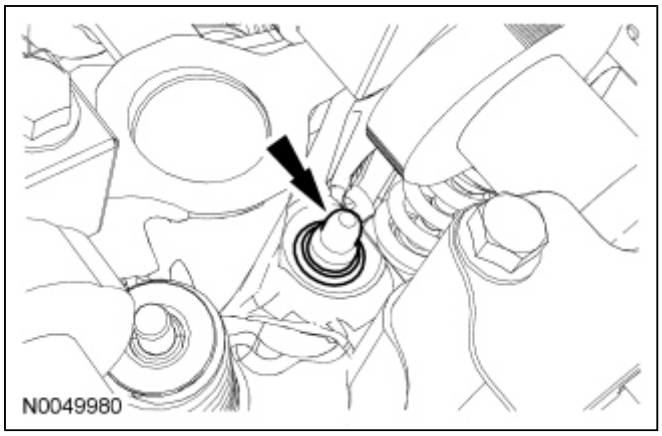
    Using the Valve Spring Compressor, compress the valve spring and remove the roller follower.



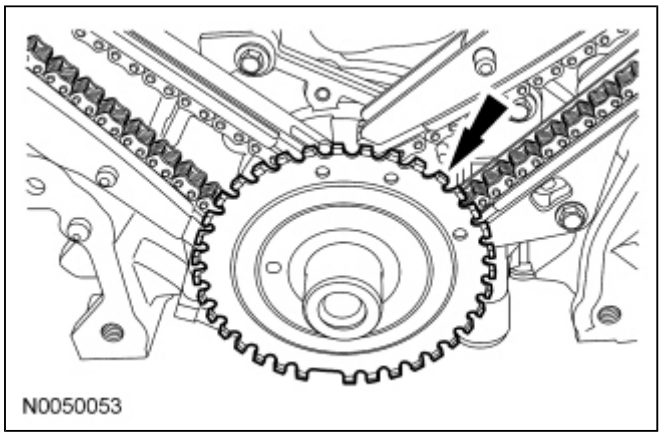
88. Repeat the previous step to remove each of the roller followers. Inspect the roller followers. For additional information, refer to Section 303-00 .

89. ***NOTICE:*** **If the components are to be reinstalled, they must be installed in their original positions. Mark the components for installation into their original locations. Failure to follow these instructions may result in engine damage.**

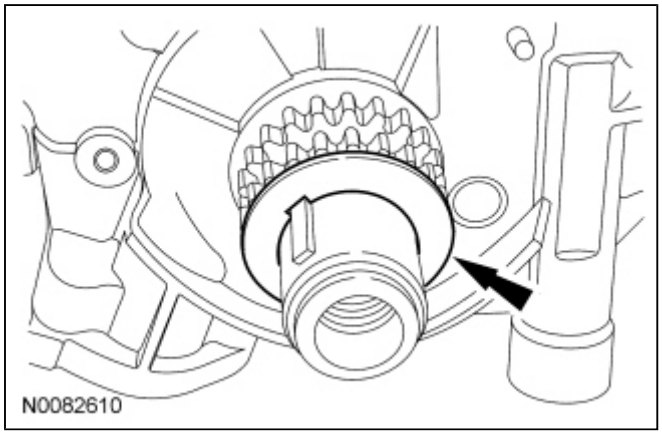
    Remove the hydraulic lash adjusters.
    - Inspect the hydraulic lash adjusters. For additional information, refer to Section 303-00 .



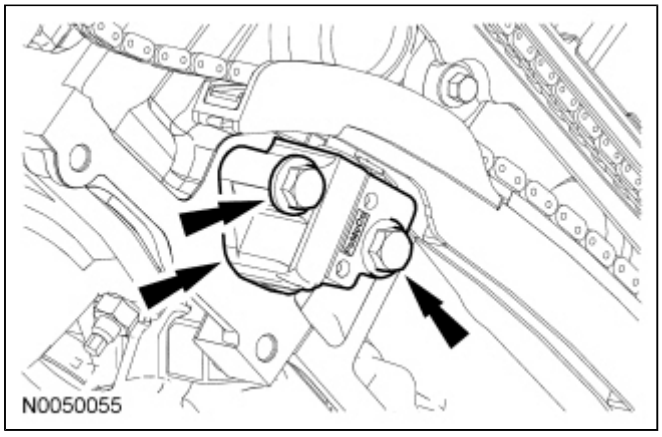
90. Remove the crankshaft sensor ring.



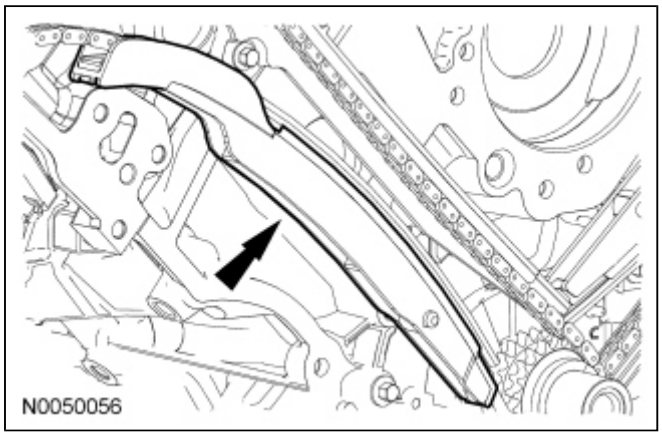
91. Remove the crankshaft washer.



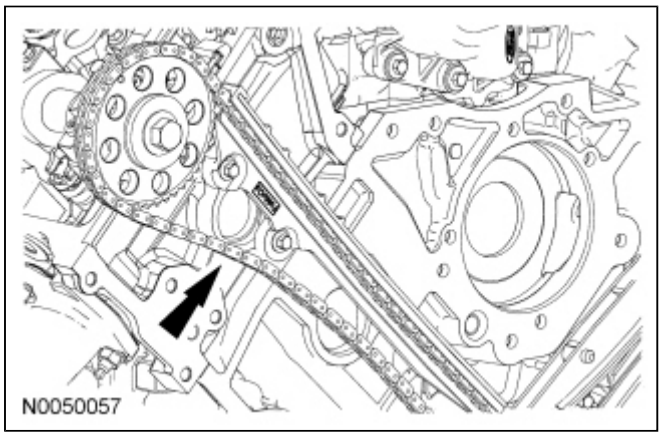
92. Remove the 2 bolts and the RH primary timing chain tensioner.



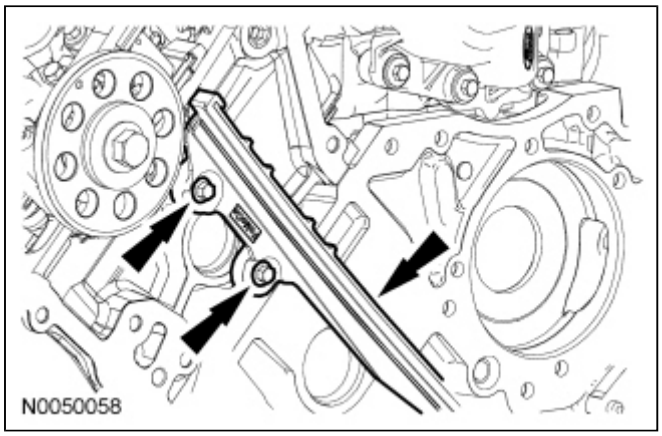
93. Remove the RH primary timing chain tensioner arm.



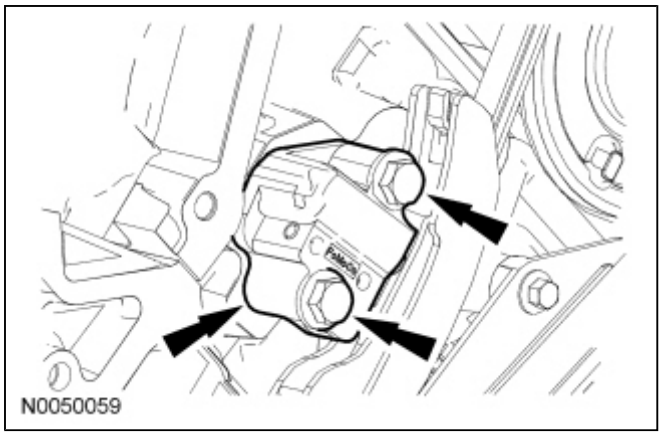
94. Remove the RH primary timing chain.



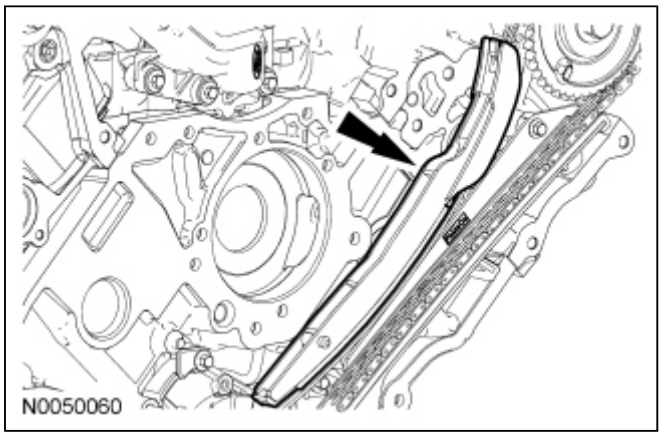
95. Remove the 2 bolts and the RH primary timing chain guide.



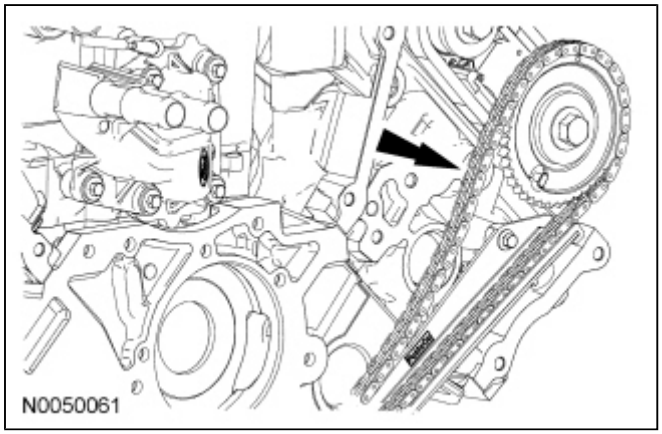
96. Remove the 2 bolts and the LH primary timing chain tensioner.



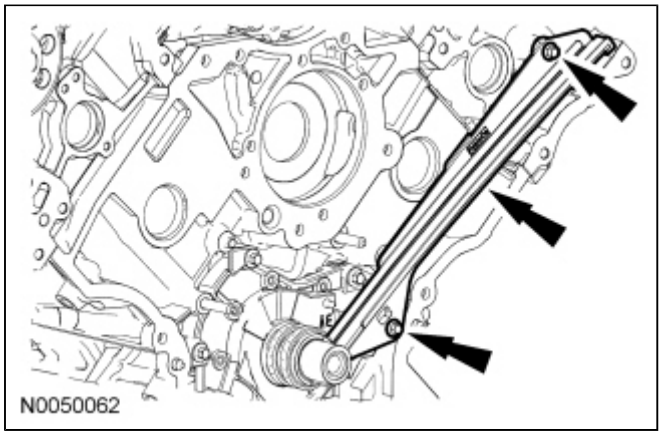
97. Remove the LH primary timing chain tensioner arm.



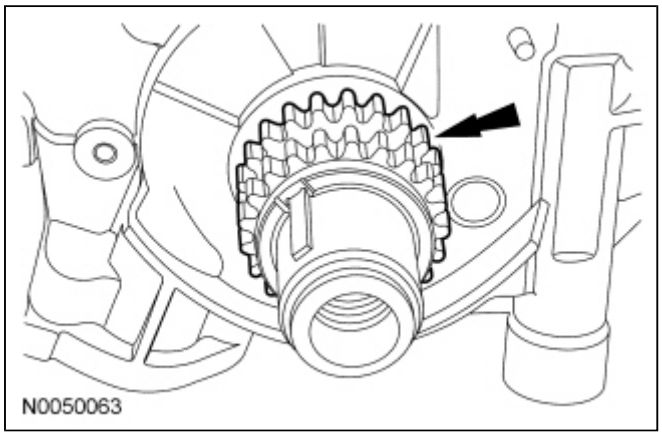
98. Remove the LH primary timing chain.



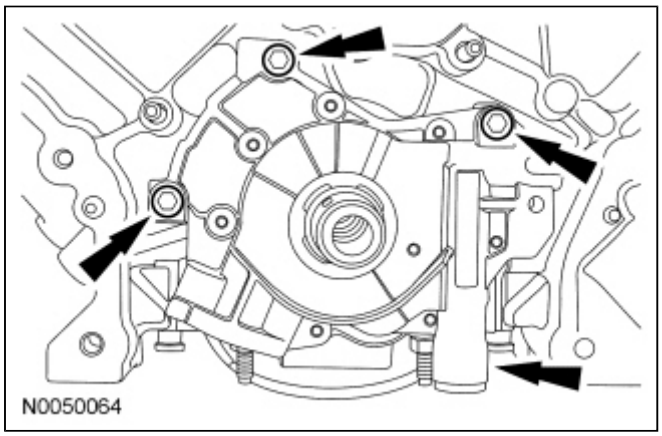
99. Remove the 2 bolts and the LH primary timing chain guide.



100. Remove the crankshaft sprocket.



101. Remove the 3 bolts and the oil pump.



102. ***NOTICE:*** **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.**

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

NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

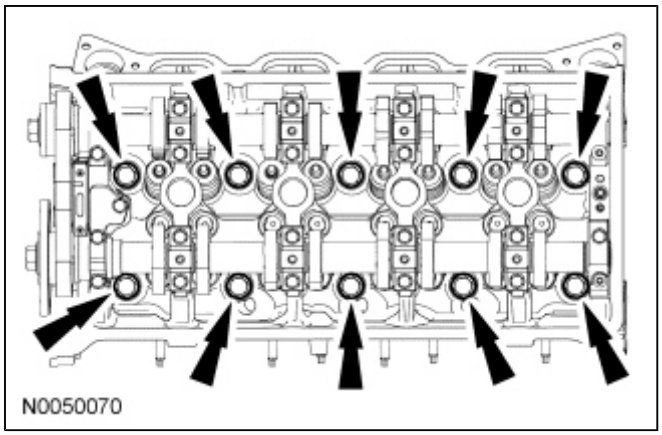
NOTICE: **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

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

NOTE: LH shown, RH similar.

Remove the bolts, the RH cylinder head and the LH cylinder head.

- Discard the bolts.
- Remove and discard the cylinder head gaskets.



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

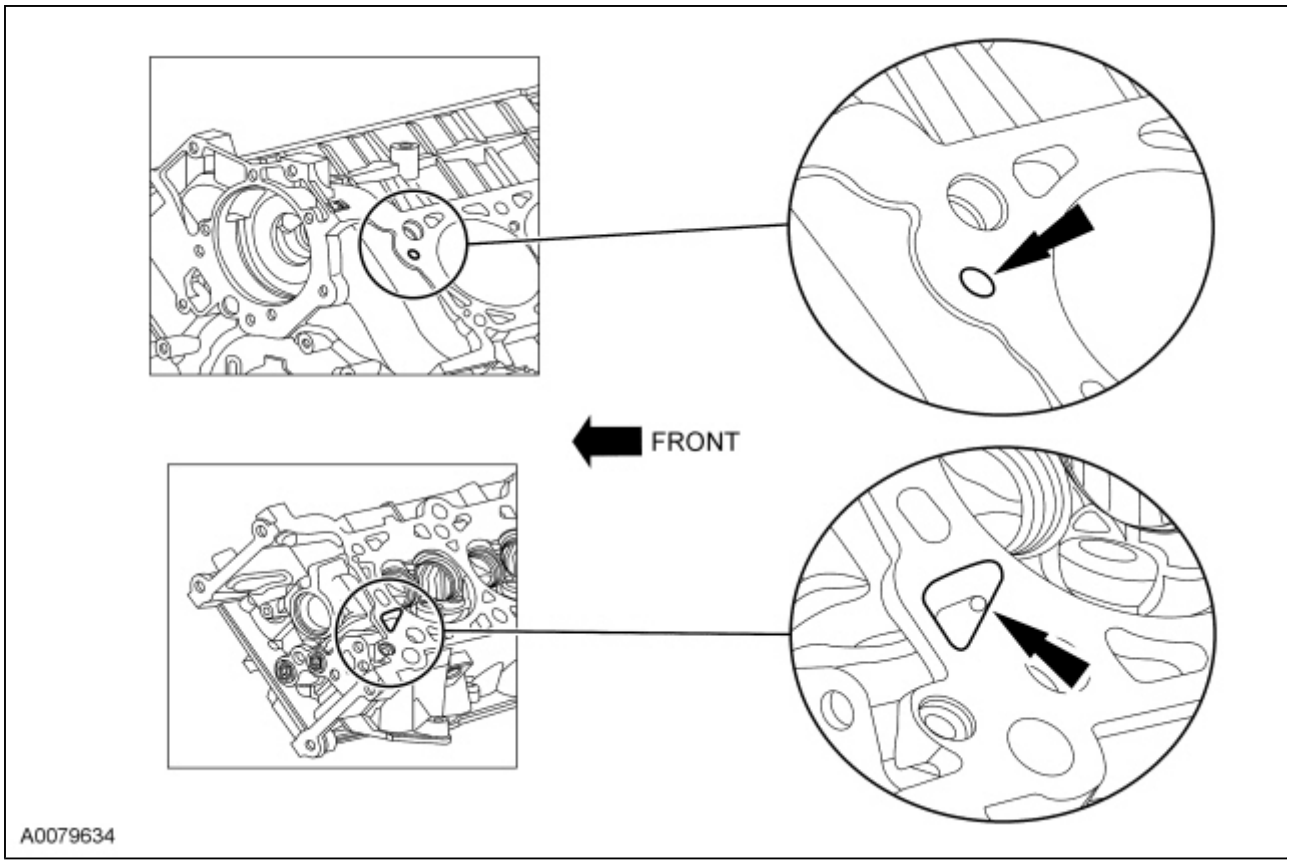
NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

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

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

Support the cylinder heads on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to Section 303-00 .

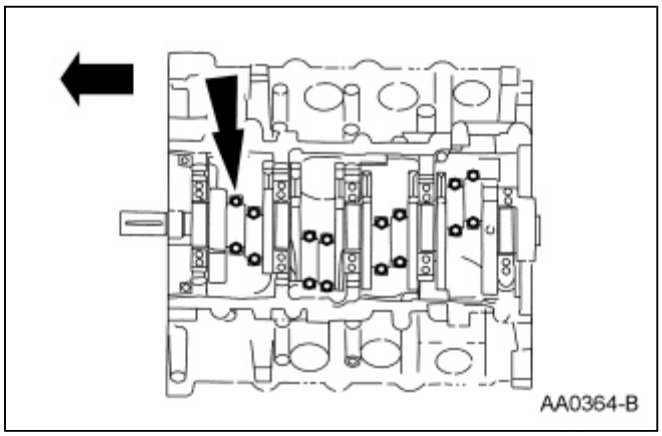


105. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

106. **NOTE:** 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

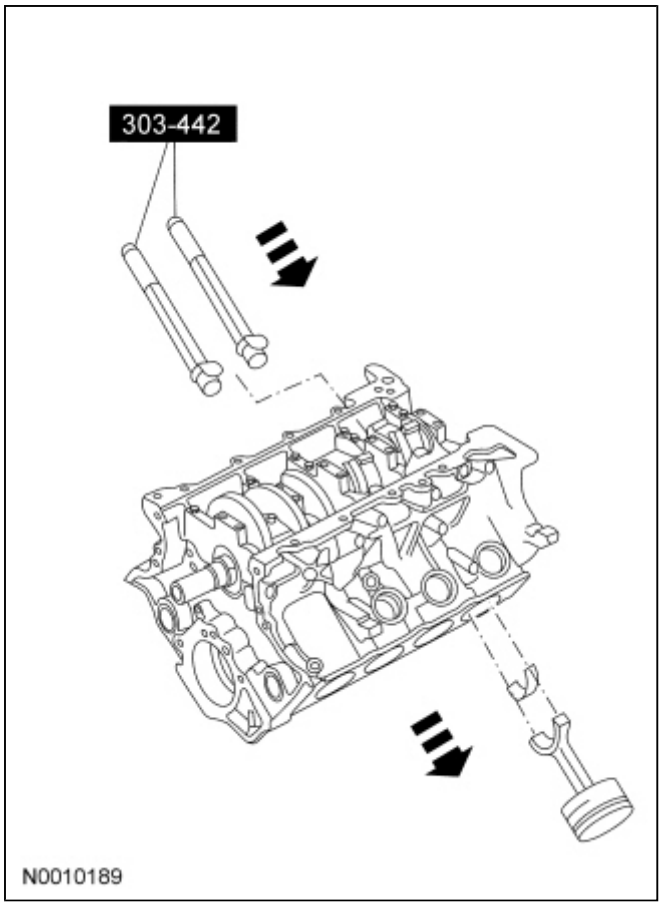
Remove the bolts and the connecting rod caps for pistons No. 1 and No. 6.

- Carefully tap the connecting rod bolts out of the connecting rod caps. Avoid damaging the rod caps.



107. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

Using the Connecting Rod Installer, push pistons 1 through 6 through the top of the cylinder block.

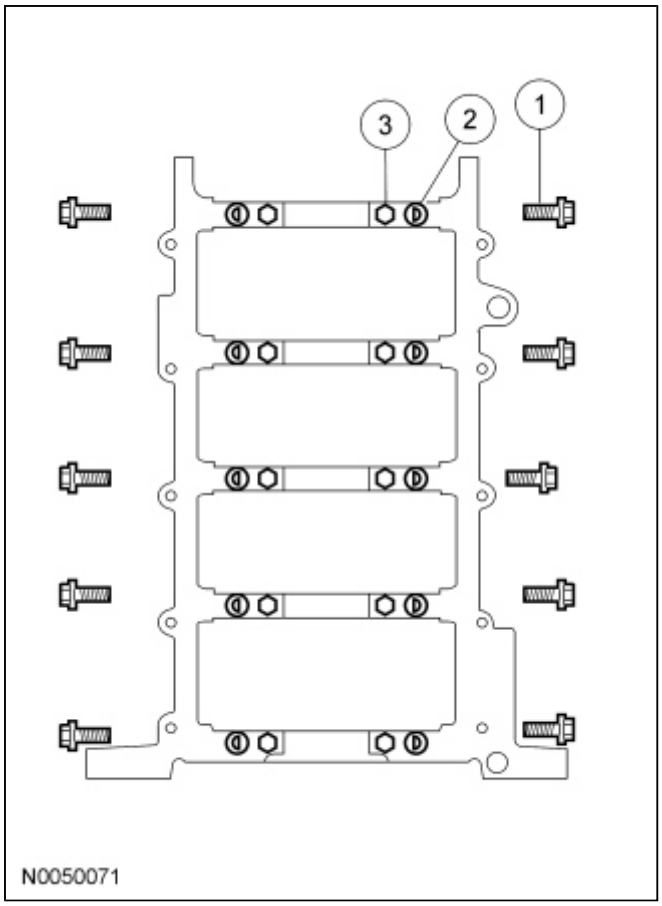


108. To remove pistons 2, 3, 4, 5, 7 and 8, turn the crankshaft 90 degrees and repeat the previous steps.

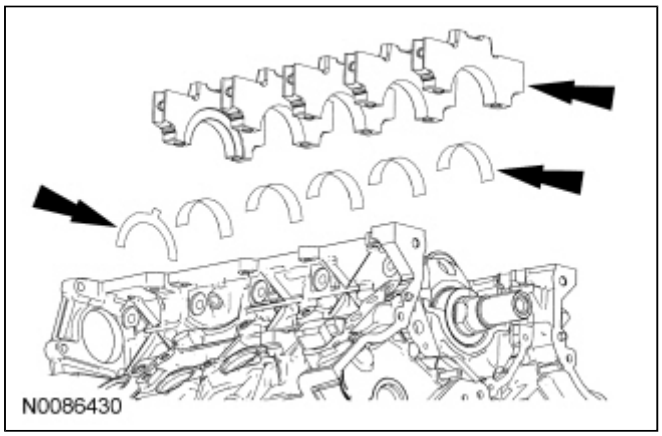
109. ***NOTICE:*** **Remove the cylinder heads before removing the crankshaft. Failure to do so can result in engine damage.**

Remove the crankshaft main bearing cap fasteners.

1. Remove and discard the side bolts.
2. Remove and discard the main bearing cap bolts.
3. Remove the dowel pins.



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



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