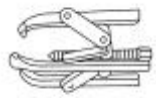
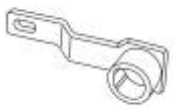
Cylinder Head

Special Tool(s)	
 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

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

Removal

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: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

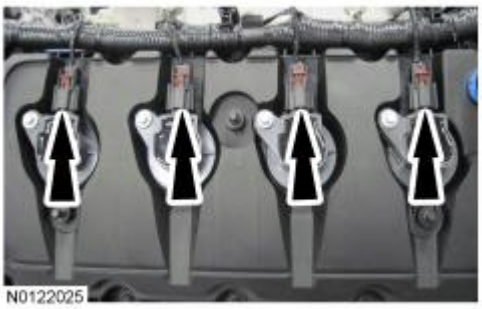
All cylinder heads

1. Remove the engine. For additional information, refer to Engine in this section.

2. Mount the engine on a work stand.

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

   Disconnect the 8 ignition coil electrical connectors.

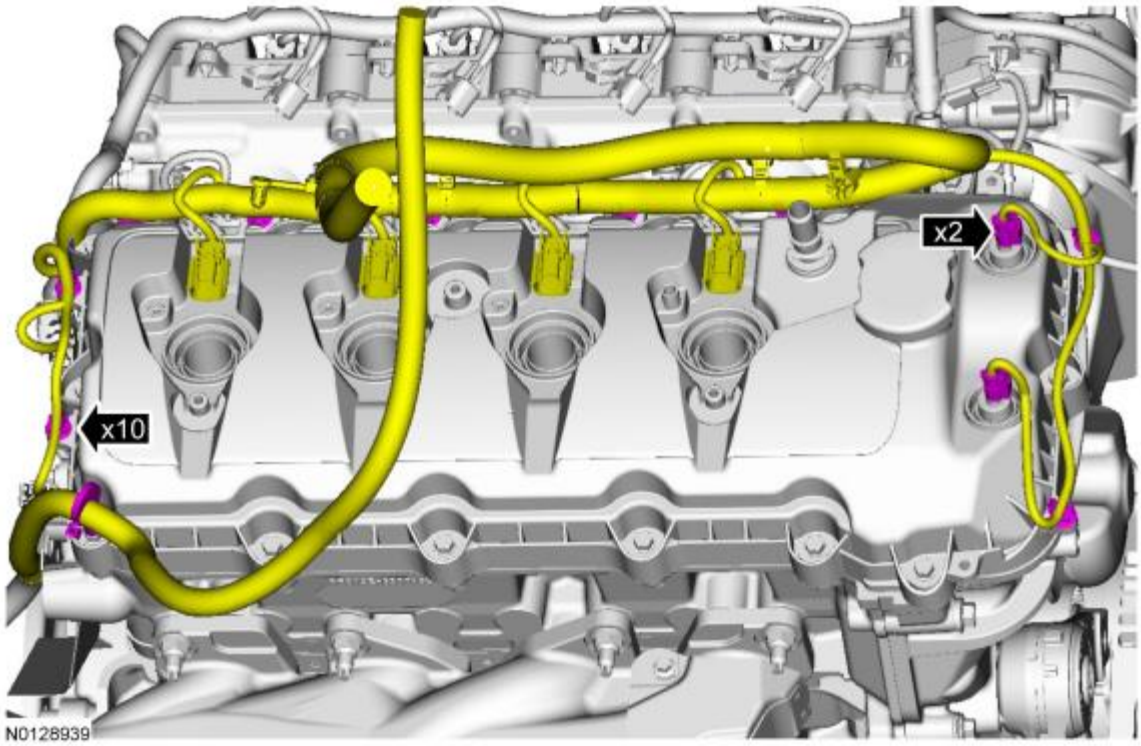


4. **NOTE:** RH shown, LH similar.

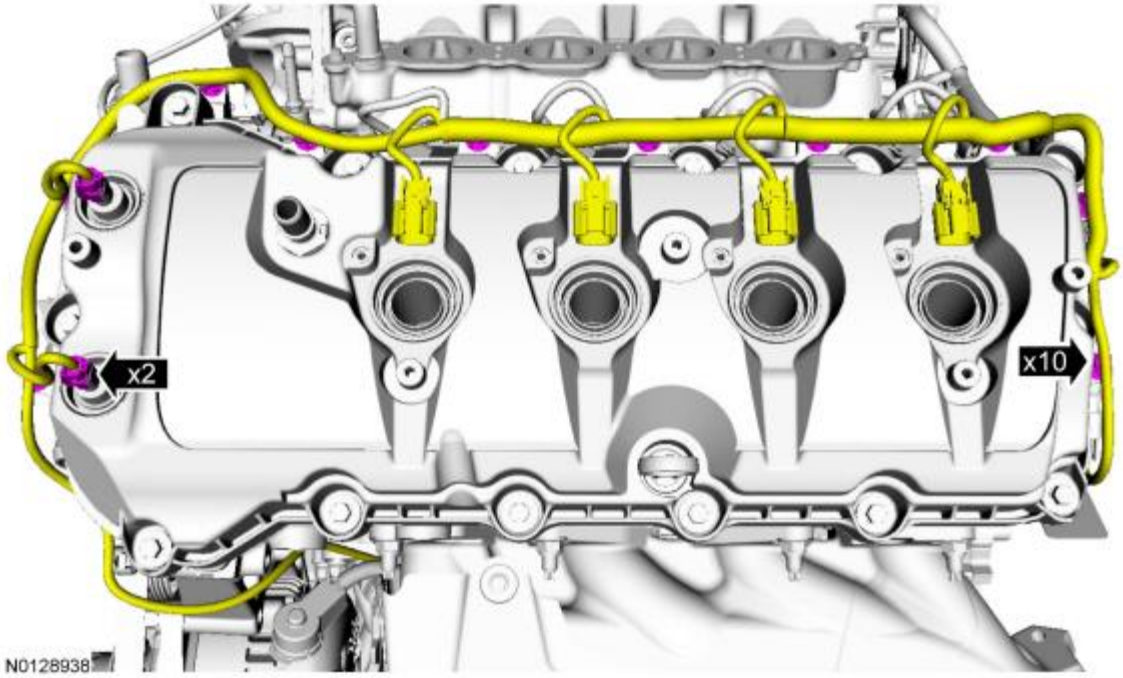
   NOTE: When removing the ignition coils, a slight twisting motion will break the seal and ease removal. RH shown, LH similar.

   Remove the 8 bolts and the 8 ignition coils.

5. Disconnect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers from the RH valve cover.



6. Disconnect the 2 VCT variable force solenoid electrical connectors.
    - Detach the 10 wiring harness retainers from the LH valve cover.



7. ***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.**

   Loosen the 14 fasteners and remove the RH valve cover and gasket.

   - Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
   - Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

8. Remove the oil level indicator.

9. ***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.**

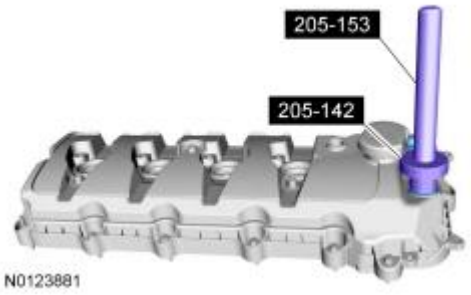
Loosen the 14 fasteners and remove the LH valve cover and gasket.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

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

    Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.

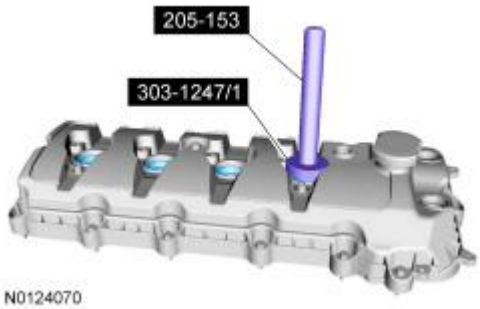
    - Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



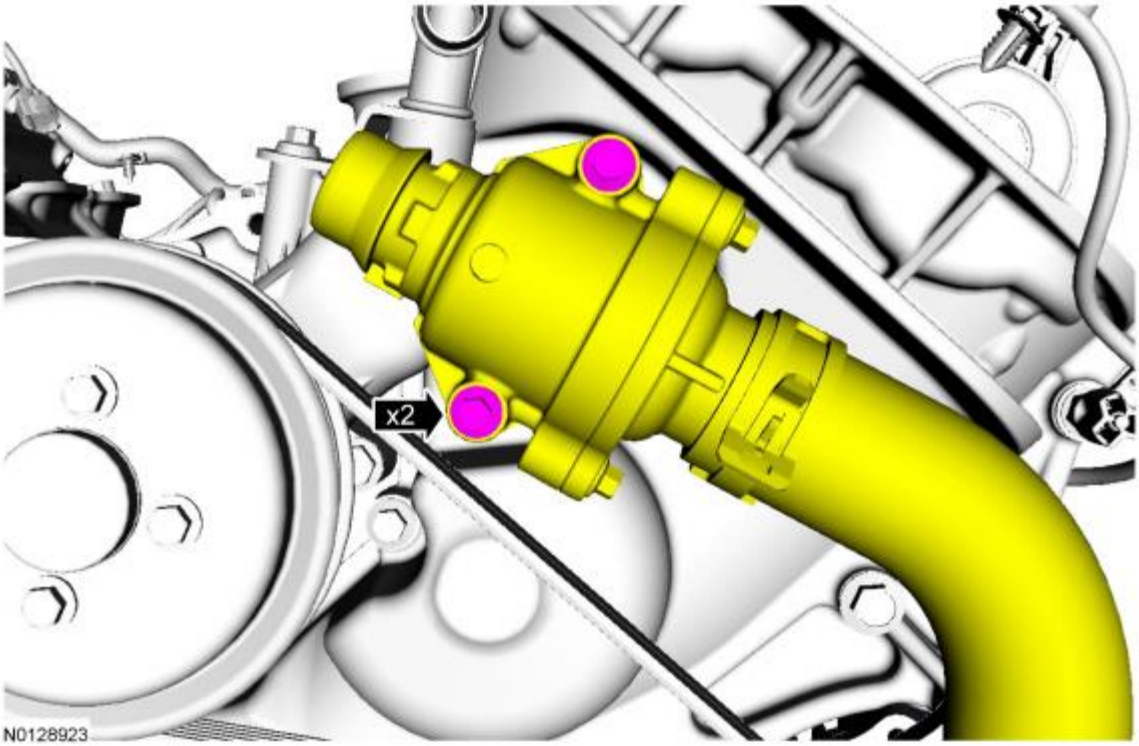
11. **NOTE:** RH shown, LH similar.

    Inspect the spark plug tube seals. Remove any damaged seals.

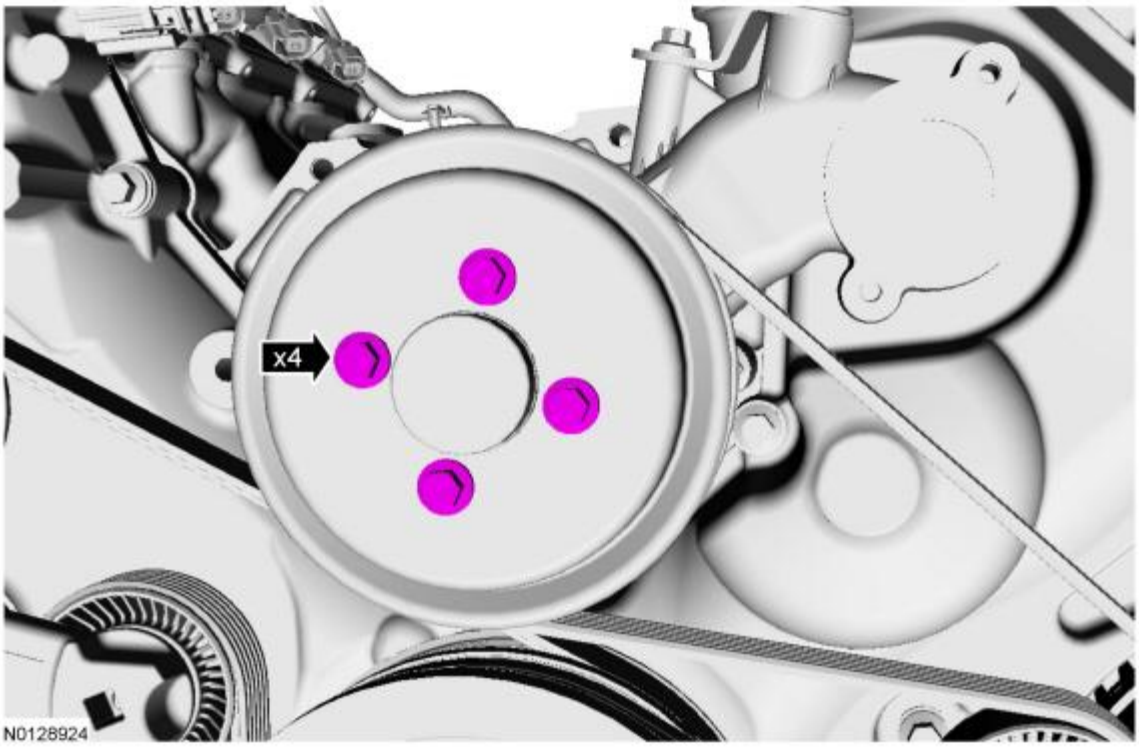
    - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



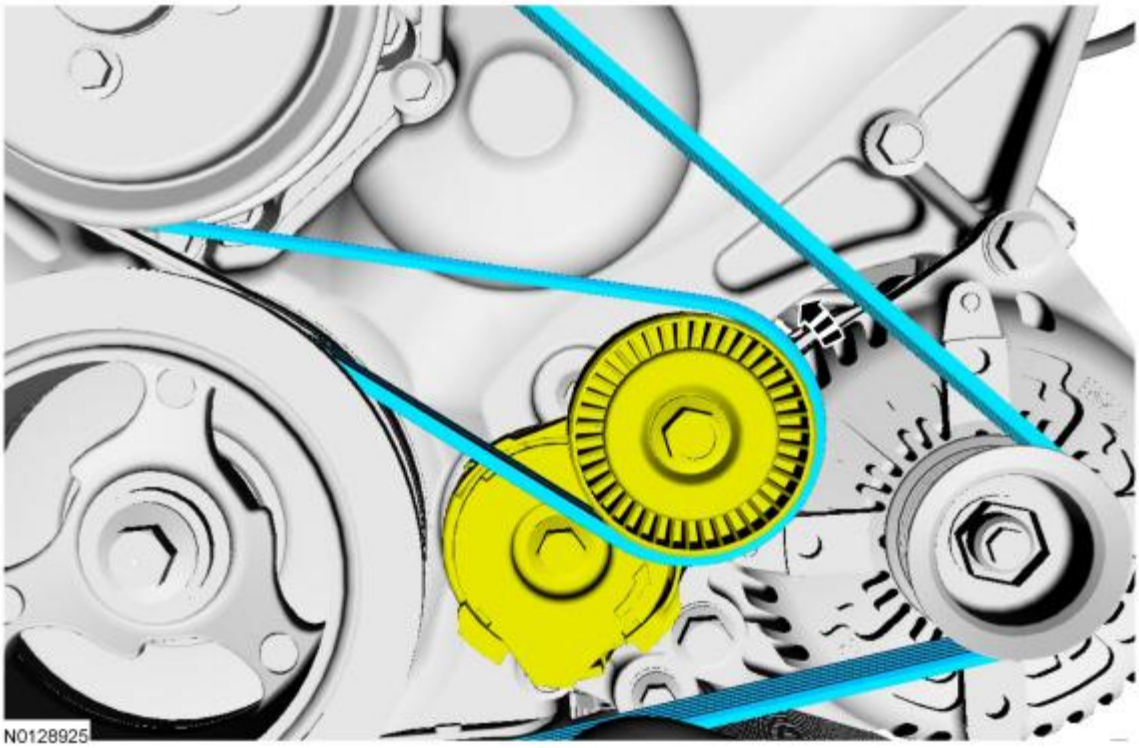
12. Remove the 2 bolts and position the thermostat housing and lower radiator hose aside.
    - Remove and discard the thermostat housing O-ring seal.



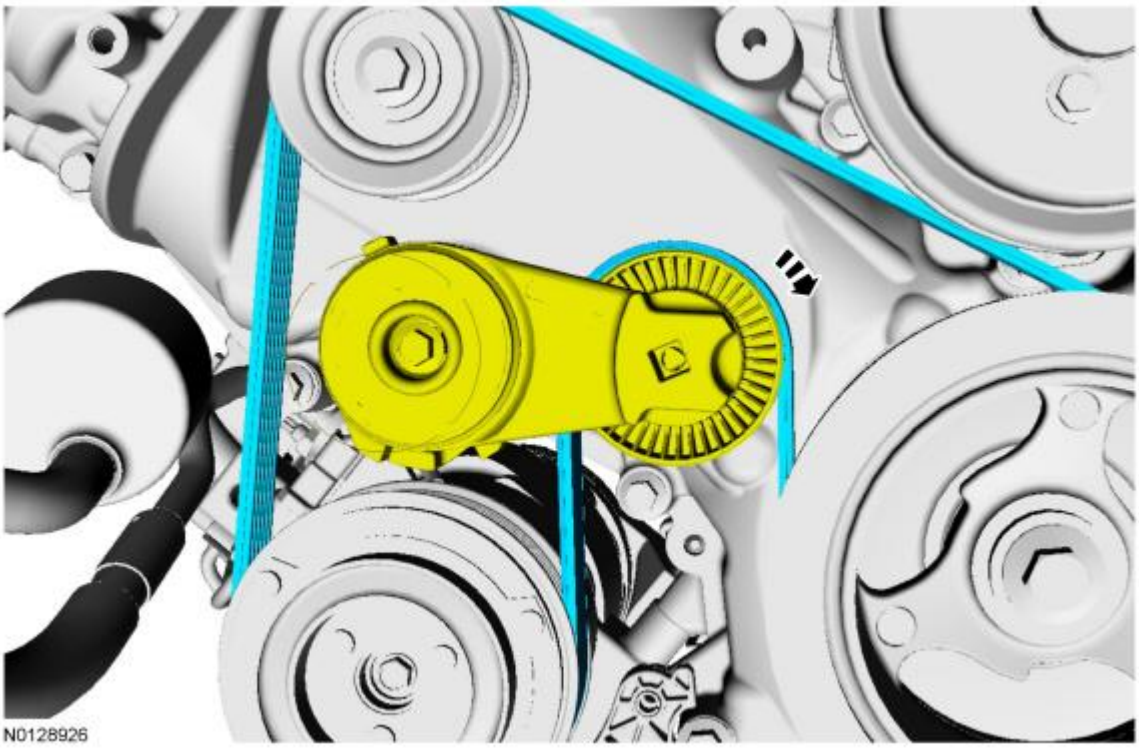
13. Loosen the 4 coolant pump pulley bolts.



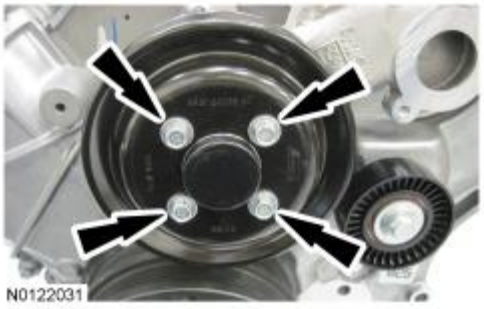
14. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.



15. Rotate the A/C compressor belt tensioner clockwise and remove the A/C compressor belt.



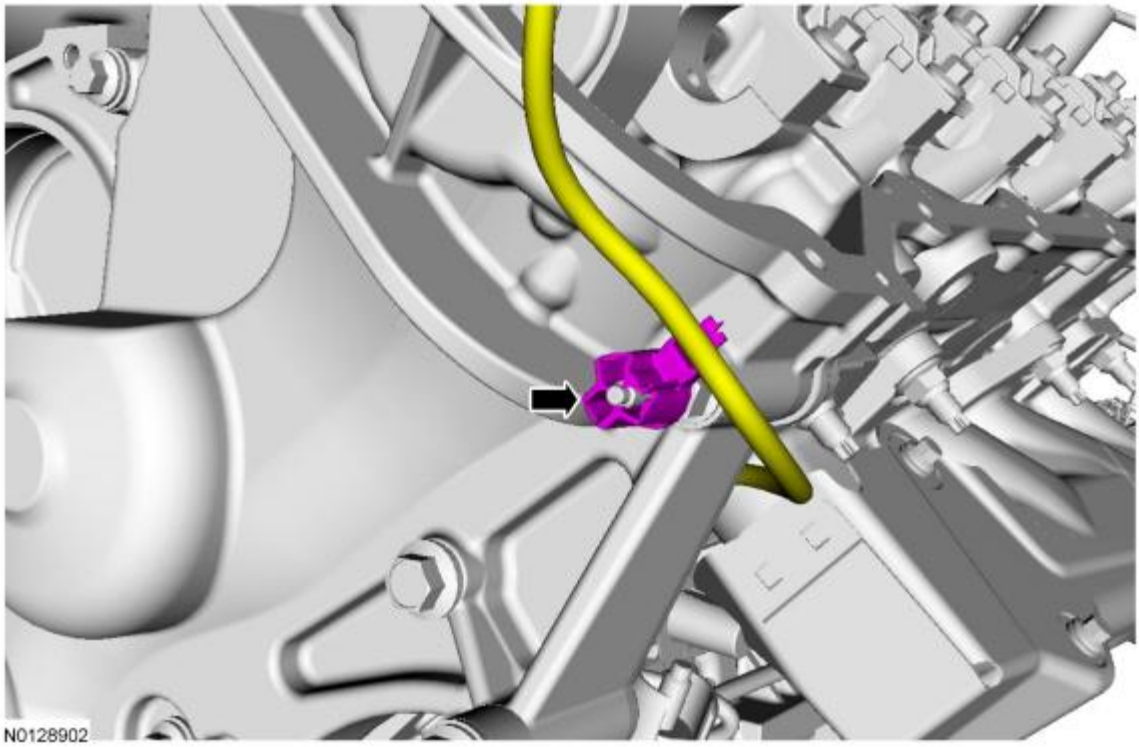
16. Remove the 4 bolts and the coolant pump pulley.



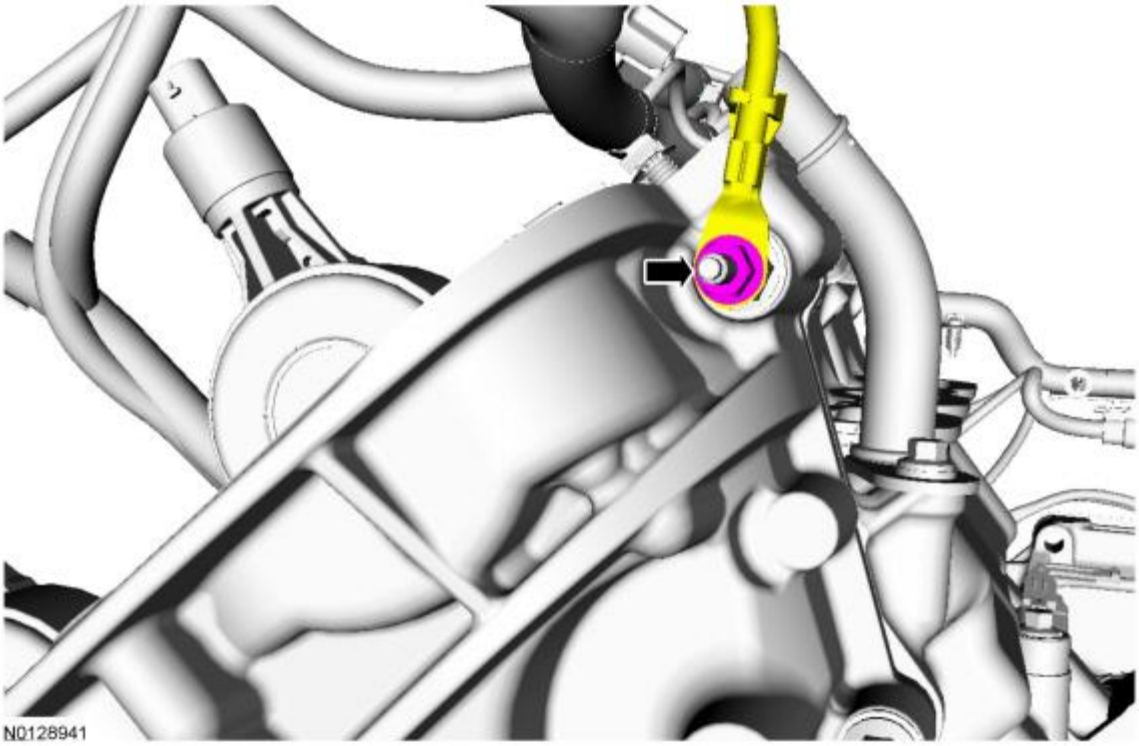
17. Remove the 4 bolts and the coolant pump.
    - Remove and discard the O-ring seal.

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

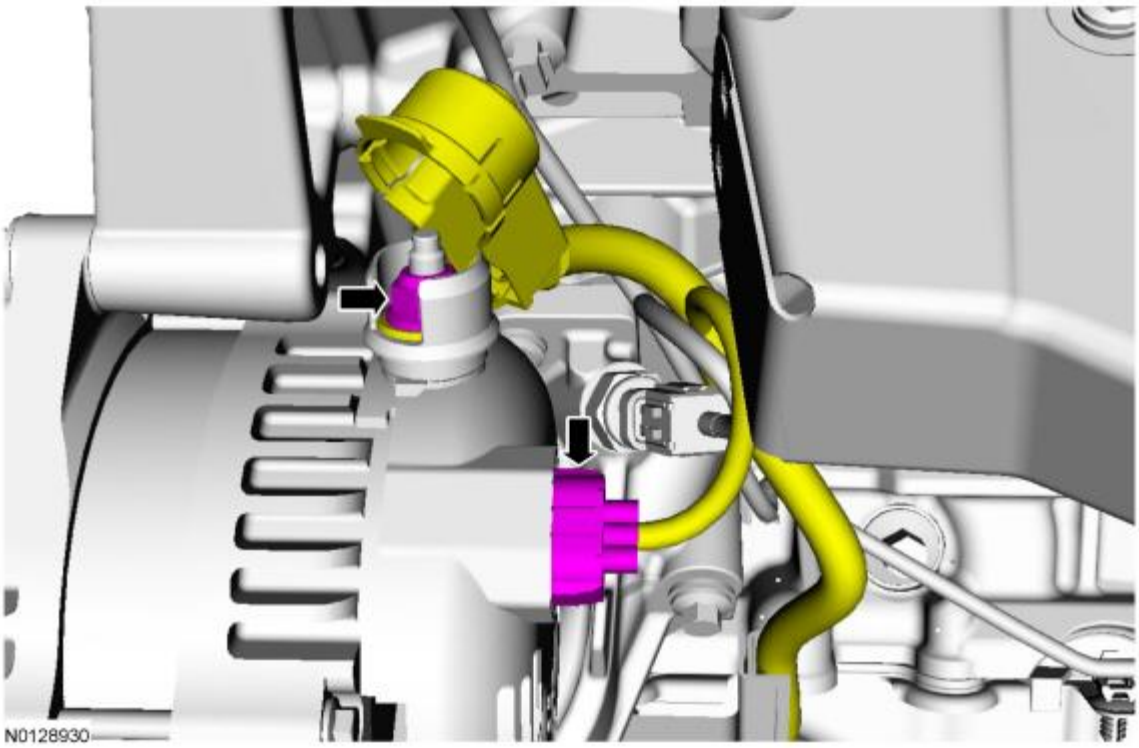
19. Detach the wiring harness retainer from the engine front cover stud bolt.



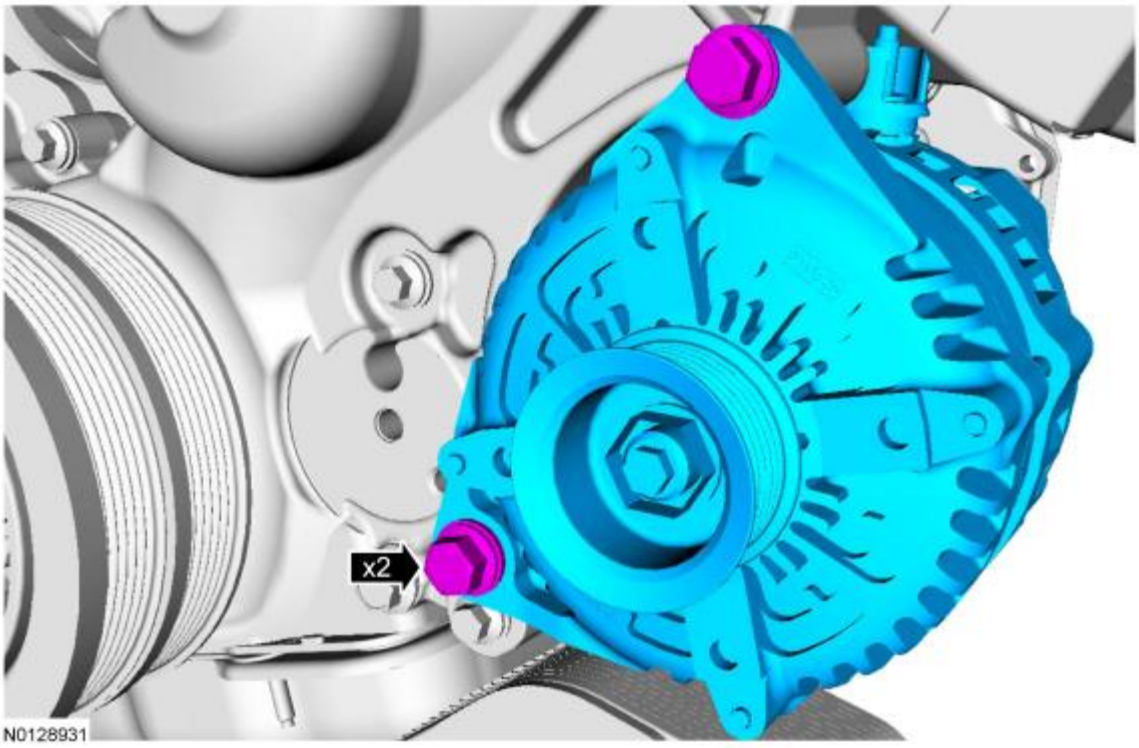
20. Remove the nut and the ground wire from the engine front cover stud bolt.



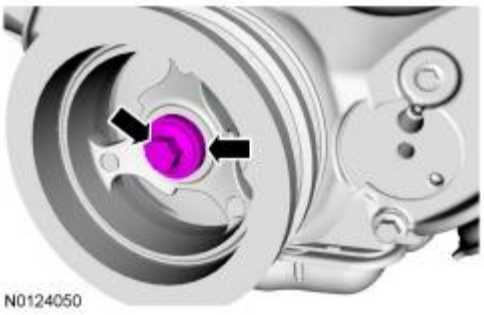
21. Remove the nut and the B+ wire from the generator.
    - Disconnect the wiring harness connector from the generator.



22. Remove the 2 bolts and the generator.



23. Remove the crankshaft pulley bolt and washer.

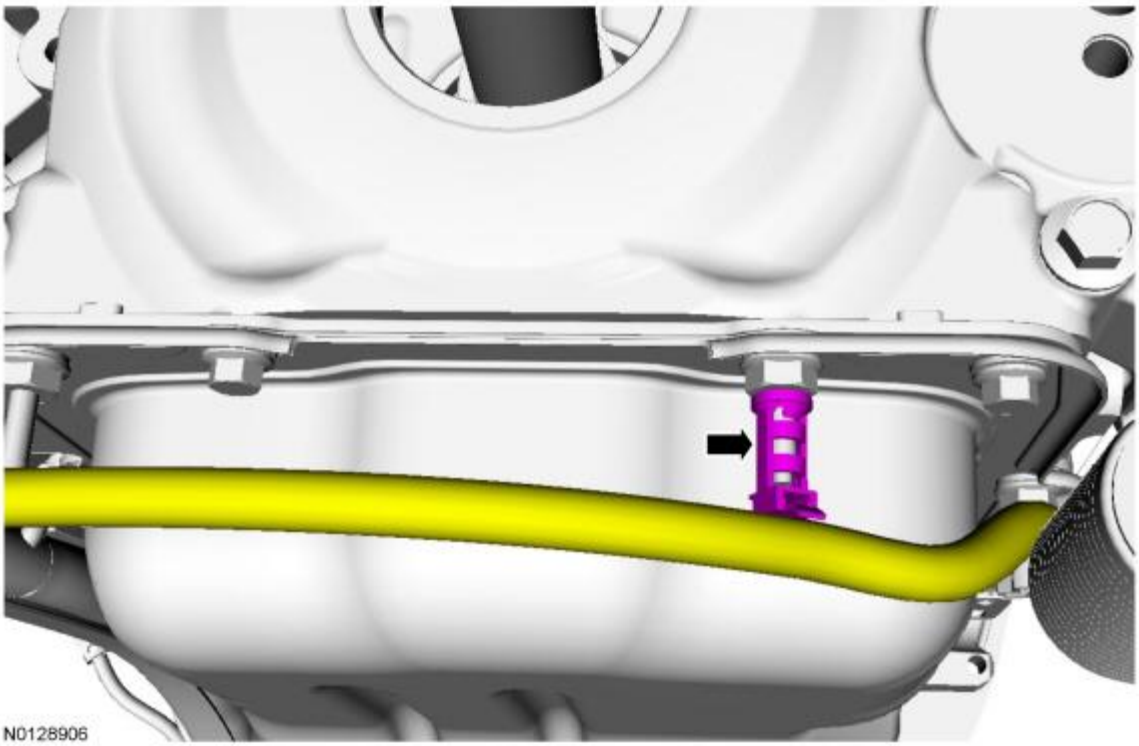


24. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
    - Discard the crankshaft pulley bolt.

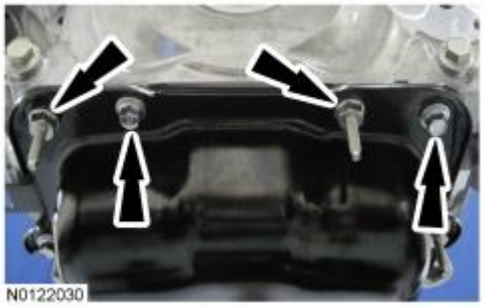
25. ***NOTICE:*** **Use care not to damage the engine front cover or the crankshaft when removing the seal.**

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

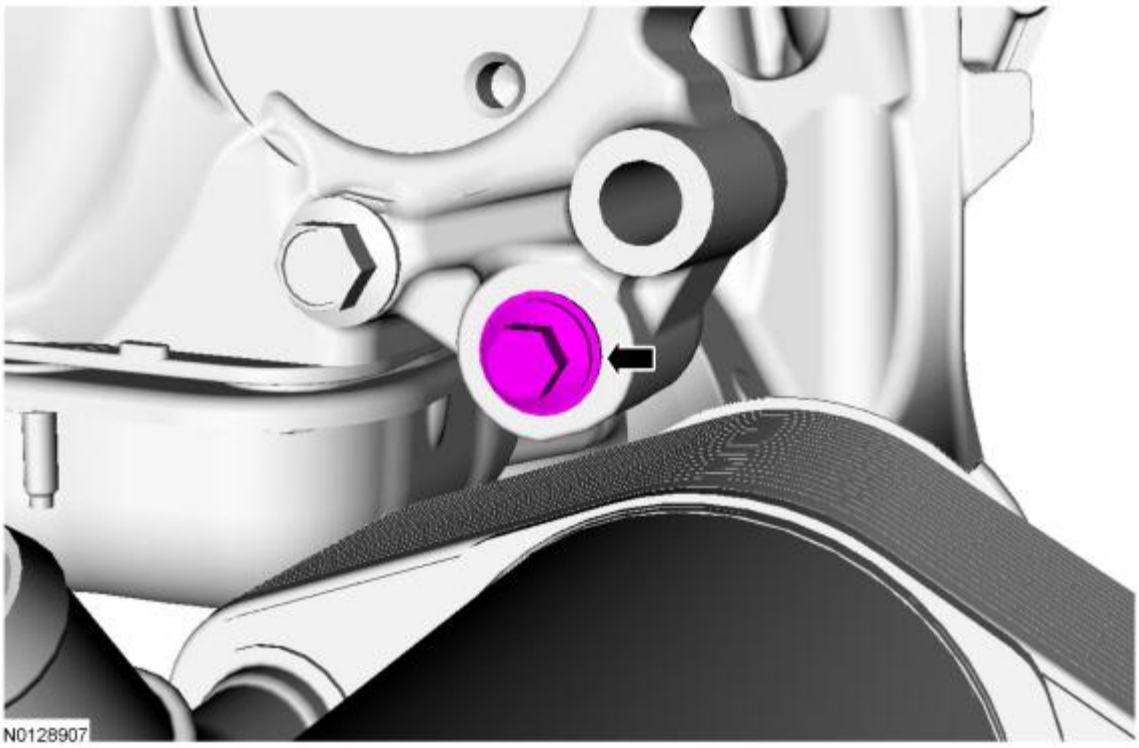
26. Detach the wiring harness retainer from the oil pan stud bolt.



27. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.

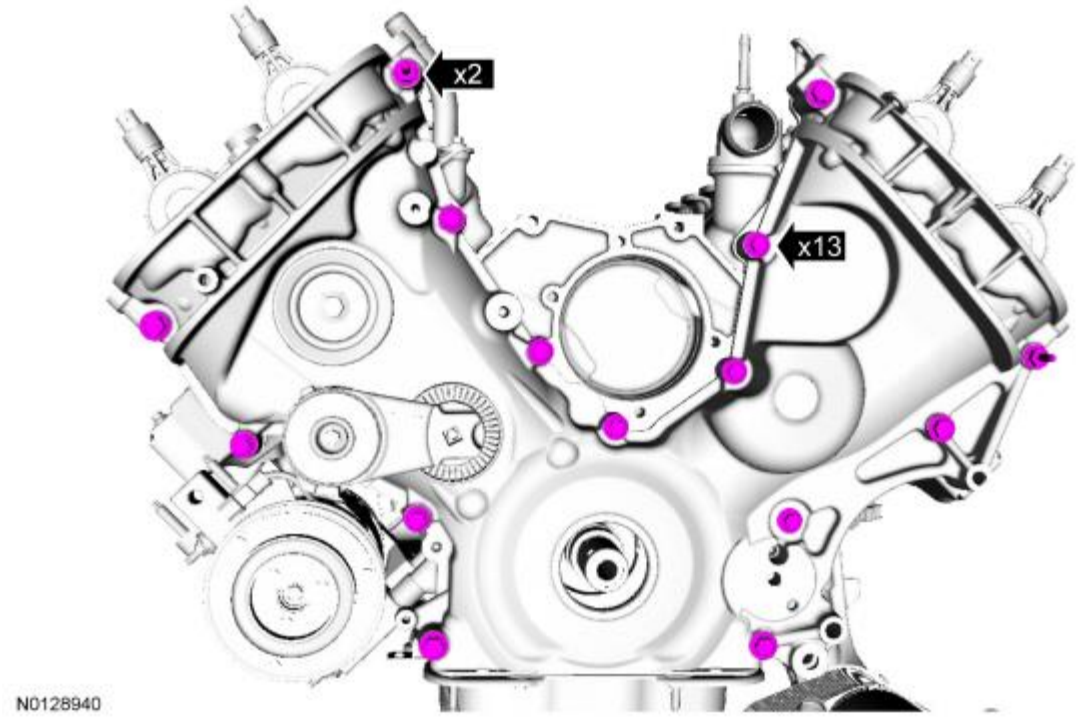


28. Remove the engine front cover-to-oil filter adapter bolt.



29. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.

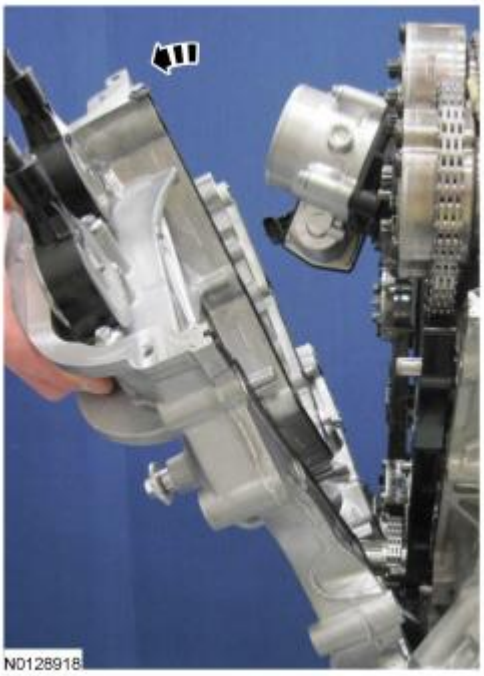
30. Remove the 13 engine front cover bolts and the 2 stud bolts.



31. ***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 engine front cover.

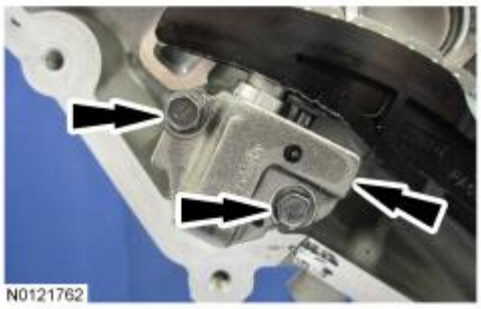
    - Remove and discard the engine front cover gaskets.
    - Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
    - Inspect the mating surfaces.



32. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.

33. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

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



35. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

    Remove the RH timing chain tensioner arm.

36. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

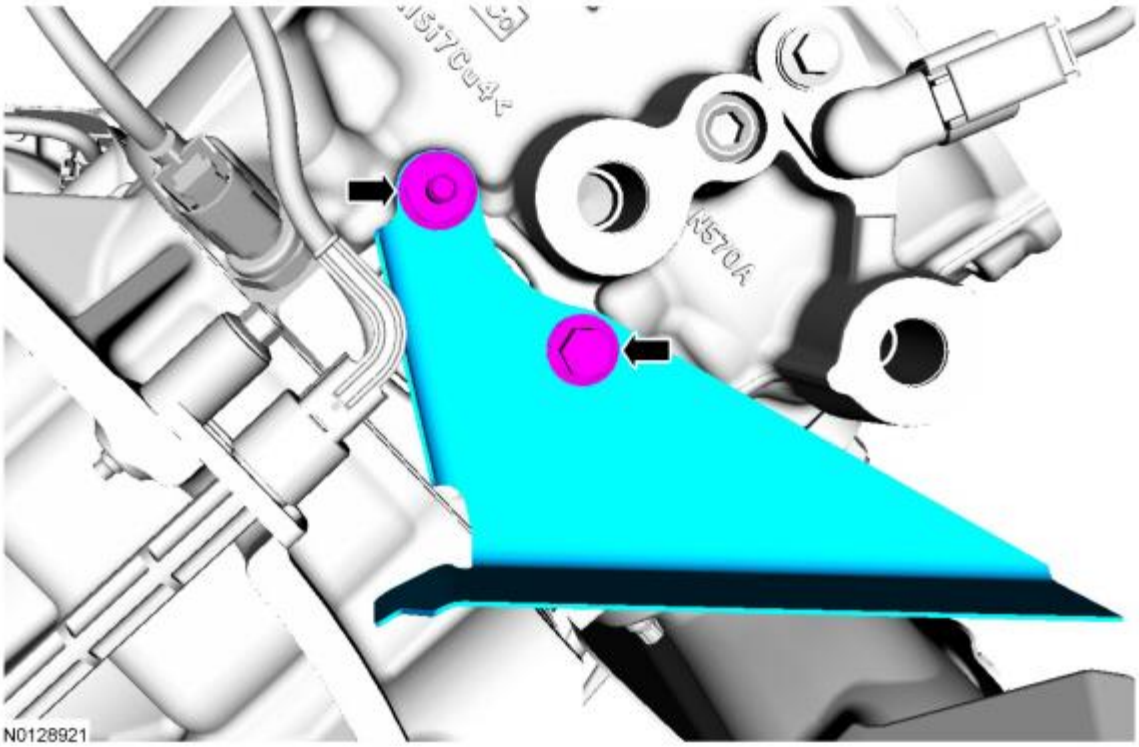
    Remove the bolt and the RH timing chain guide.

37. Remove the RH primary timing chain.

RH cylinder head

38. Remove the bolt and the coolant outlet pipe from the RH cylinder head.
    - Remove and discard the O-ring seal.

39. Remove the bolt, stud bolt and heat shield from the RH cylinder head.

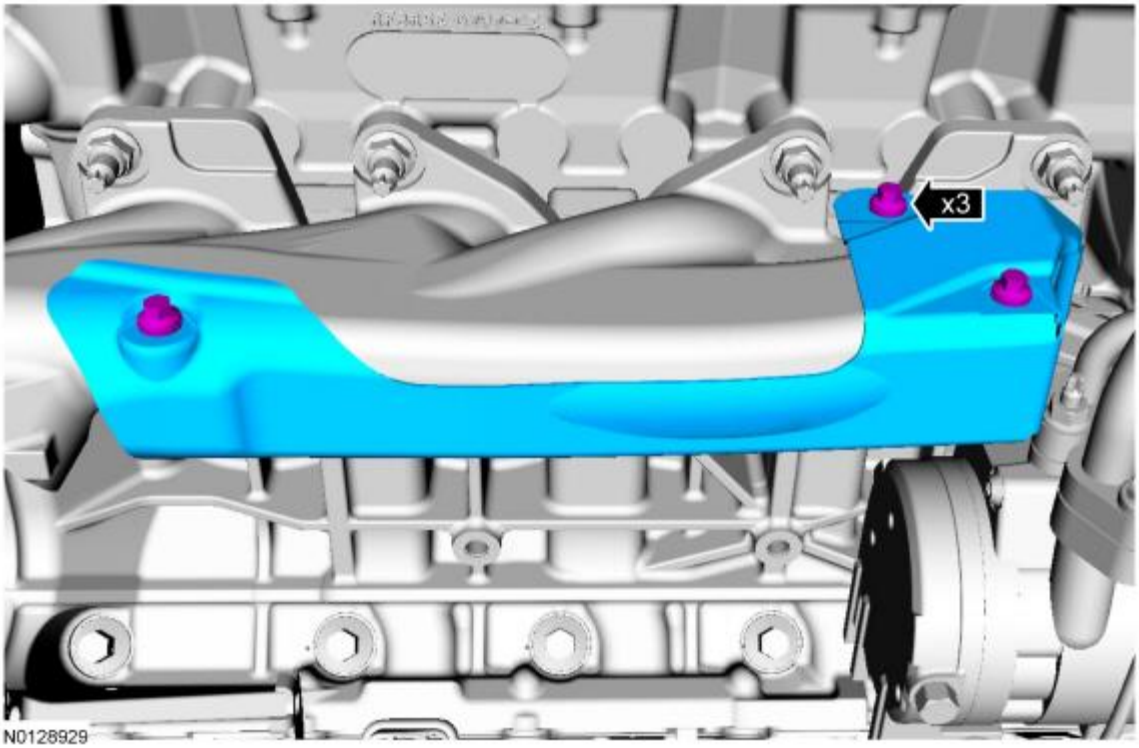


40. Disconnect the RH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
    - Remove the 2 bolts and the RH intake and exhaust CMP sensors.

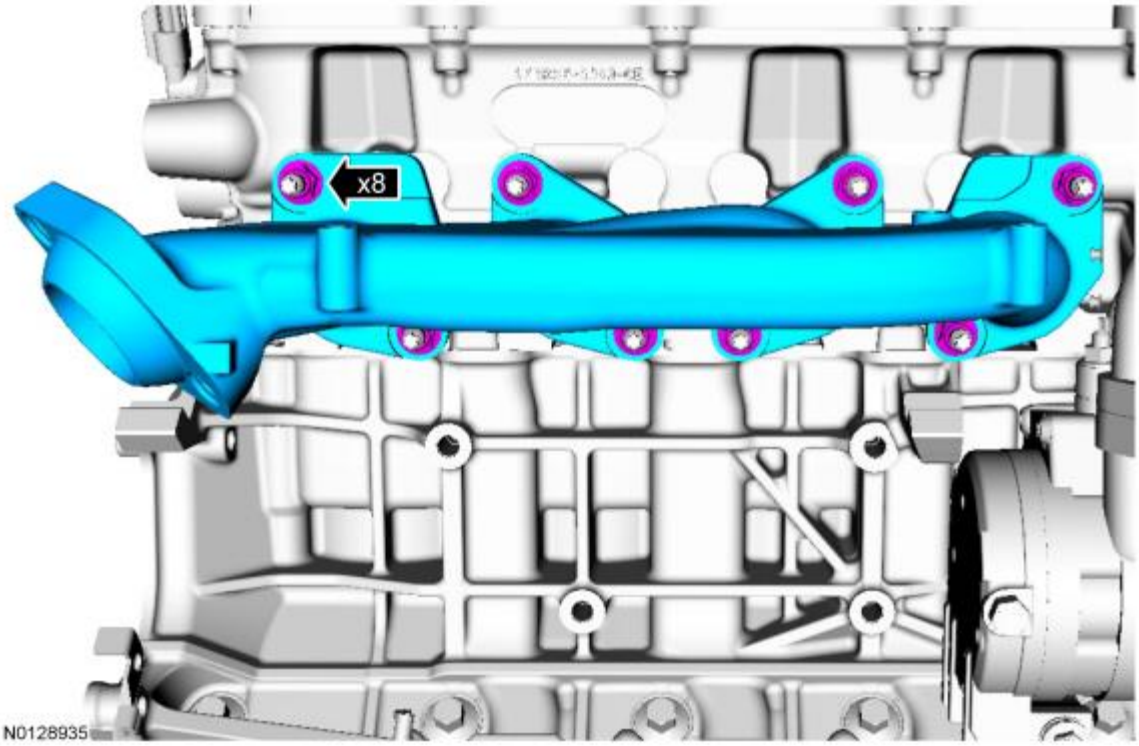
41. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.

42. Remove the CHT sensor.

43. Remove the 3 bolts and the RH exhaust manifold heat shield.

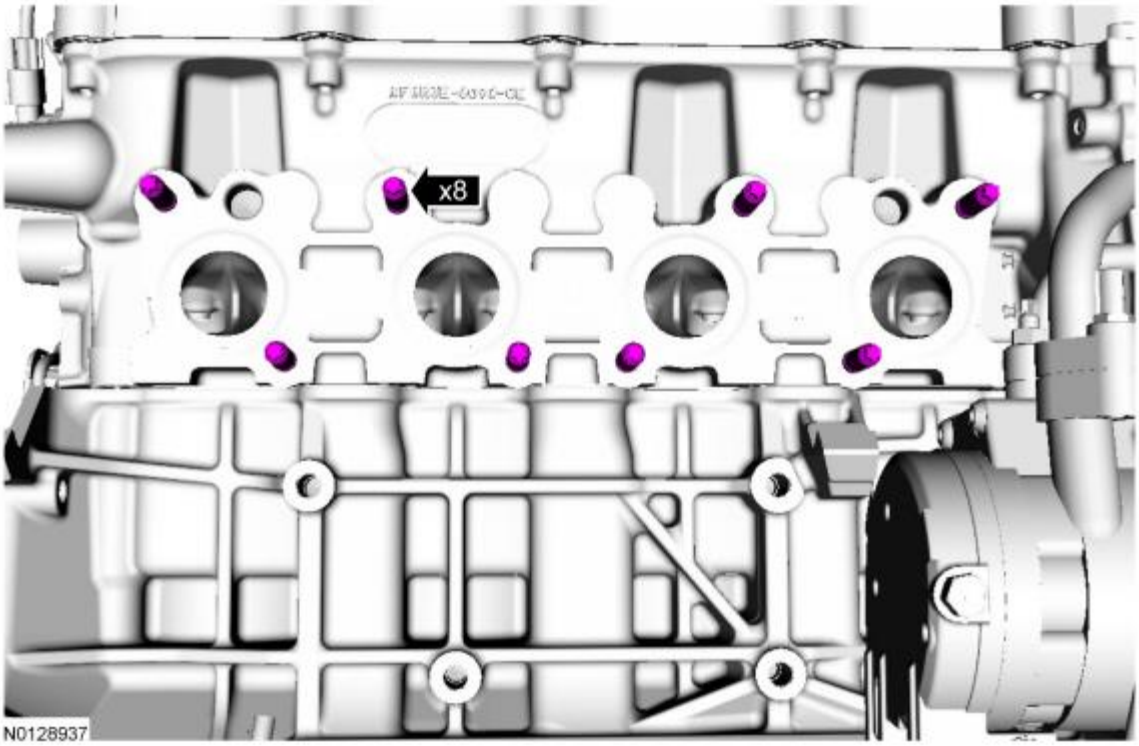


44. Remove the 8 nuts and the RH exhaust manifold.
    - Discard the gasket.



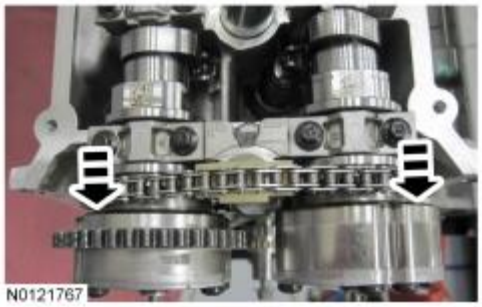
45. Clean and inspect the RH exhaust manifold. For additional information, refer to Section 303-00 .

46. Remove and discard the 8 RH exhaust manifold studs.



47. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.

48. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).

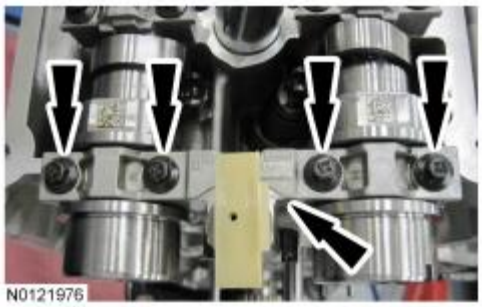


49. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.

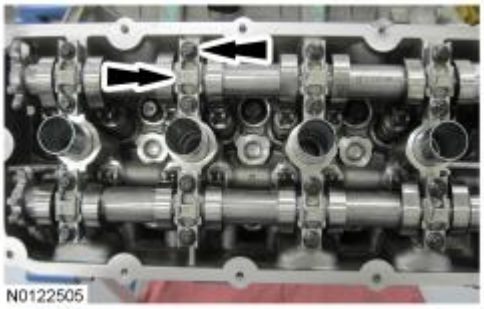
50. Remove the RH VCT assemblies and the RH secondary timing chain.

51. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the RH front camshaft bearing mega cap.



52. Remove the 16 bolts and the 8 camshaft bearing caps.



53. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

    Remove the VCT system oil filter from the intake and exhaust camshafts.

54. Remove the RH intake and exhaust camshafts.

55. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

56. ***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.**

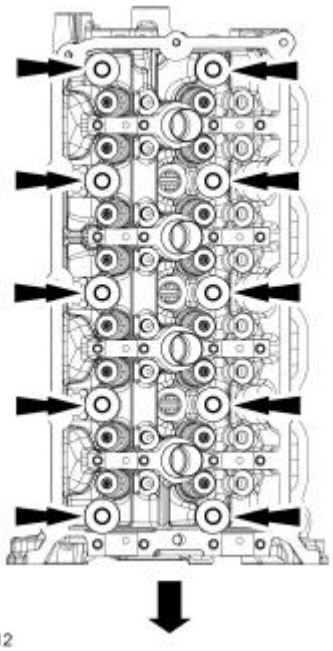
    NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

    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.**

    Remove the 10 bolts and the RH cylinder head.

    - Discard the bolts and the cylinder head gasket.



57. ***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 notices 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.

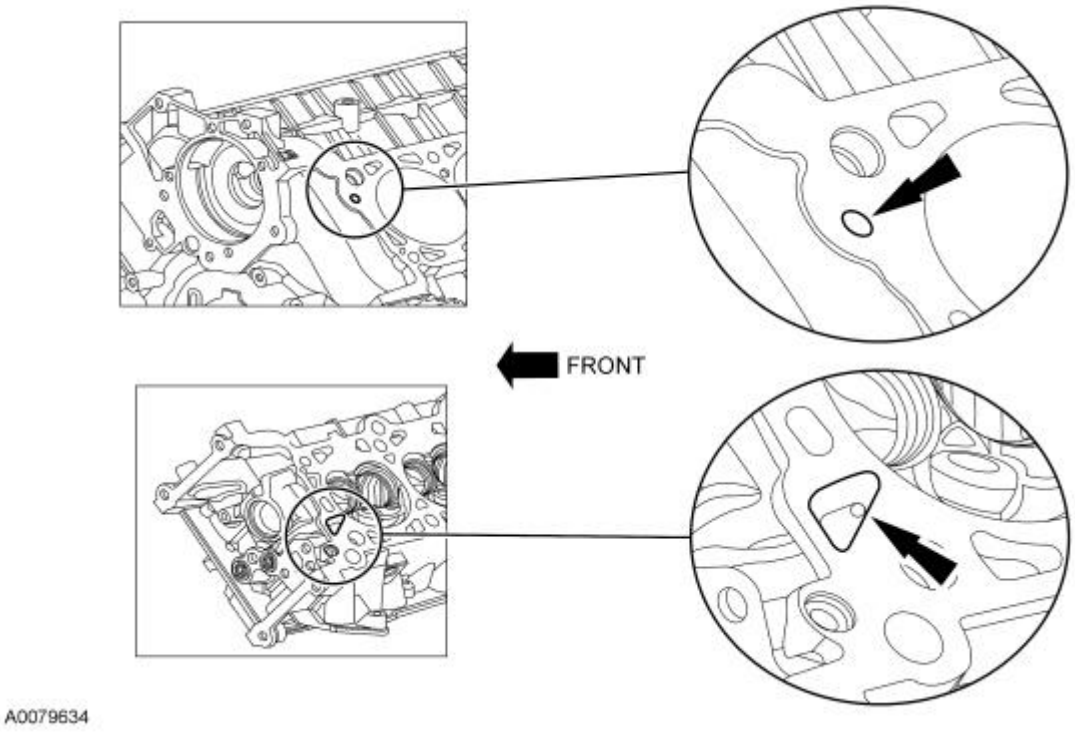
    3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.

    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.

58. **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.

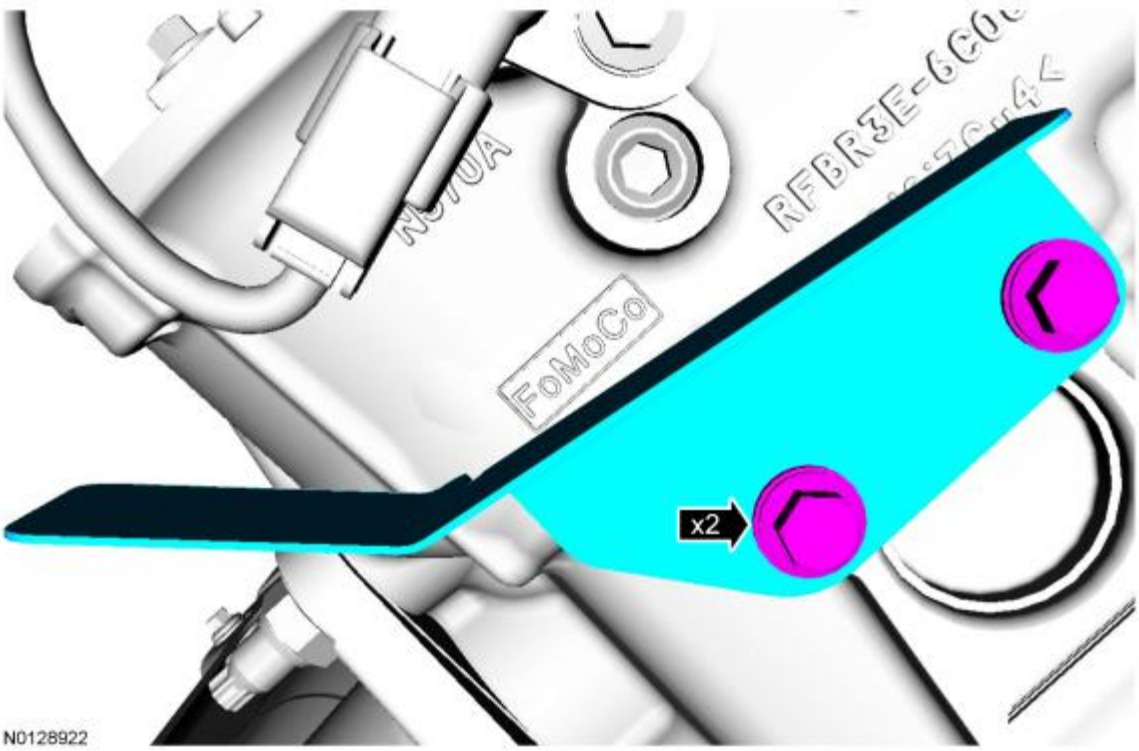
Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to Section 303-00 .



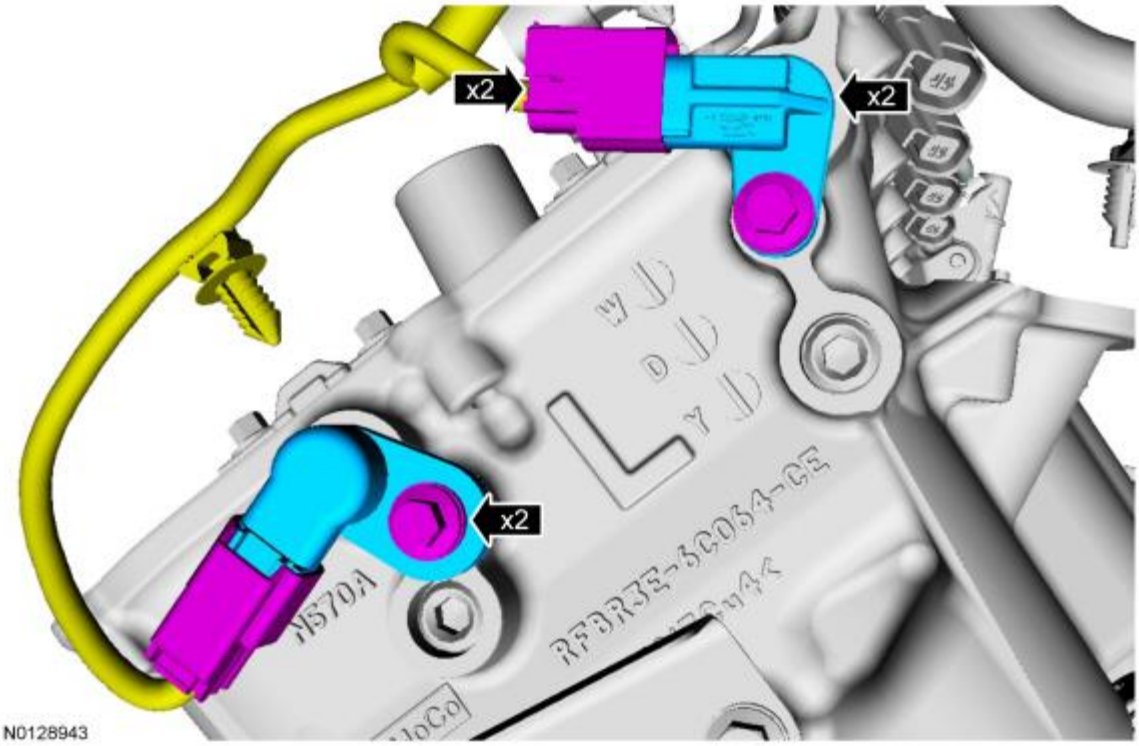
LH cylinder head

59. Remove the 2 bolts and the coolant outlet from the LH cylinder head.
    - Remove and discard the gasket.

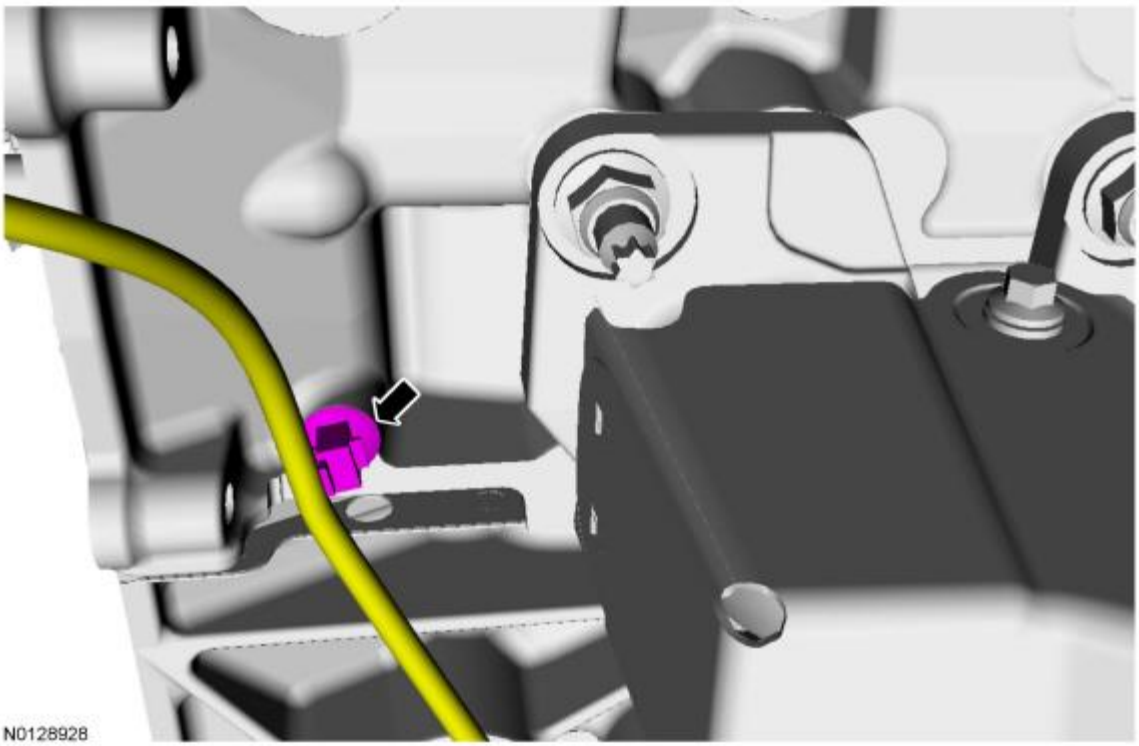
60. Remove the 2 bolts and the heat shield from the LH cylinder head.



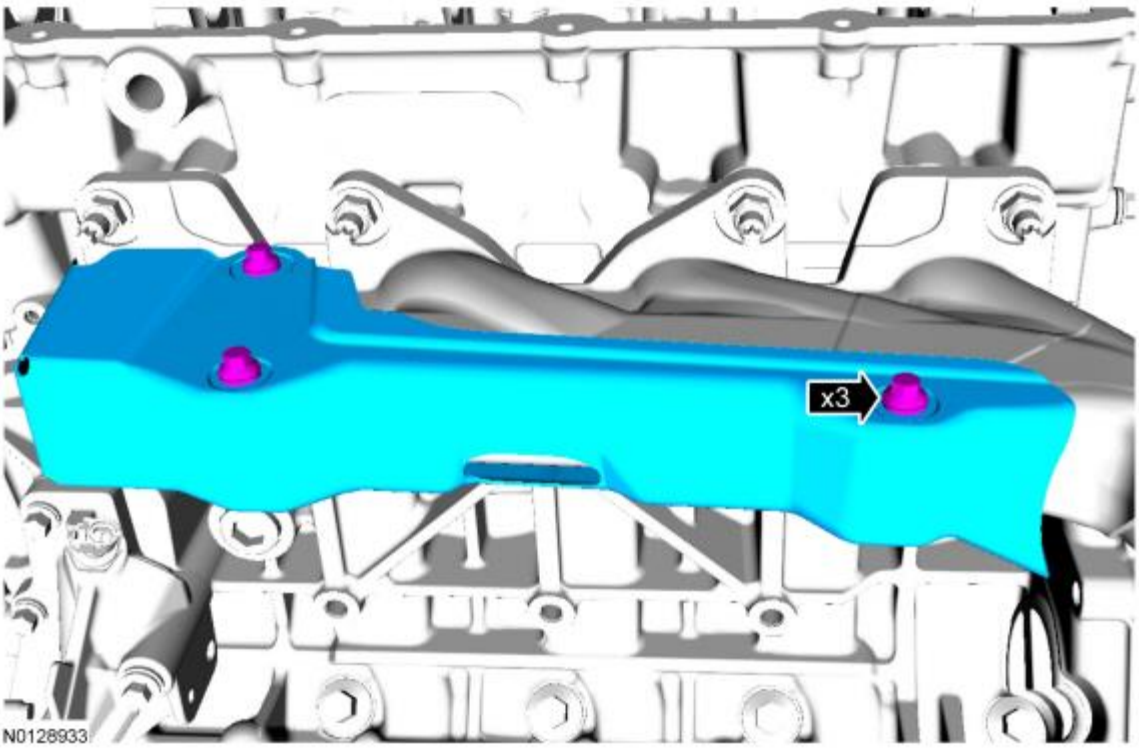
61. Disconnect the LH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
    - Remove the 2 bolts and the LH intake and exhaust CMP sensors.



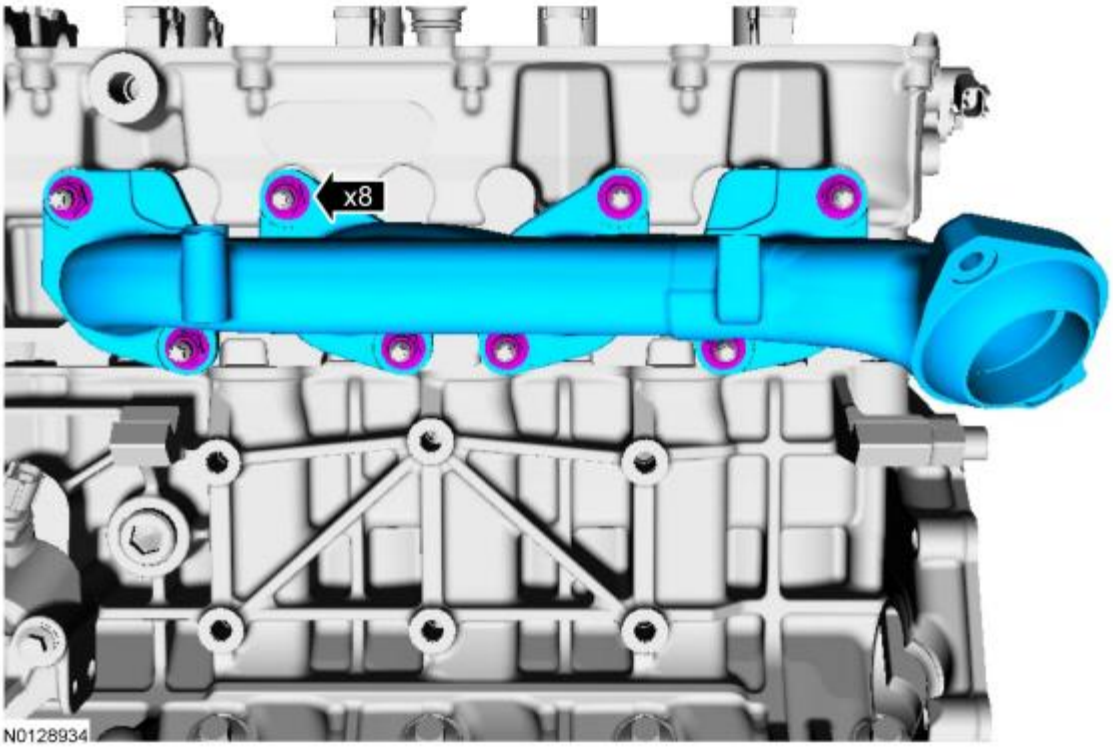
62. Detach the wiring harness retainer from the LH cylinder head.



63. Remove the 3 bolts and the LH exhaust manifold heat shield.

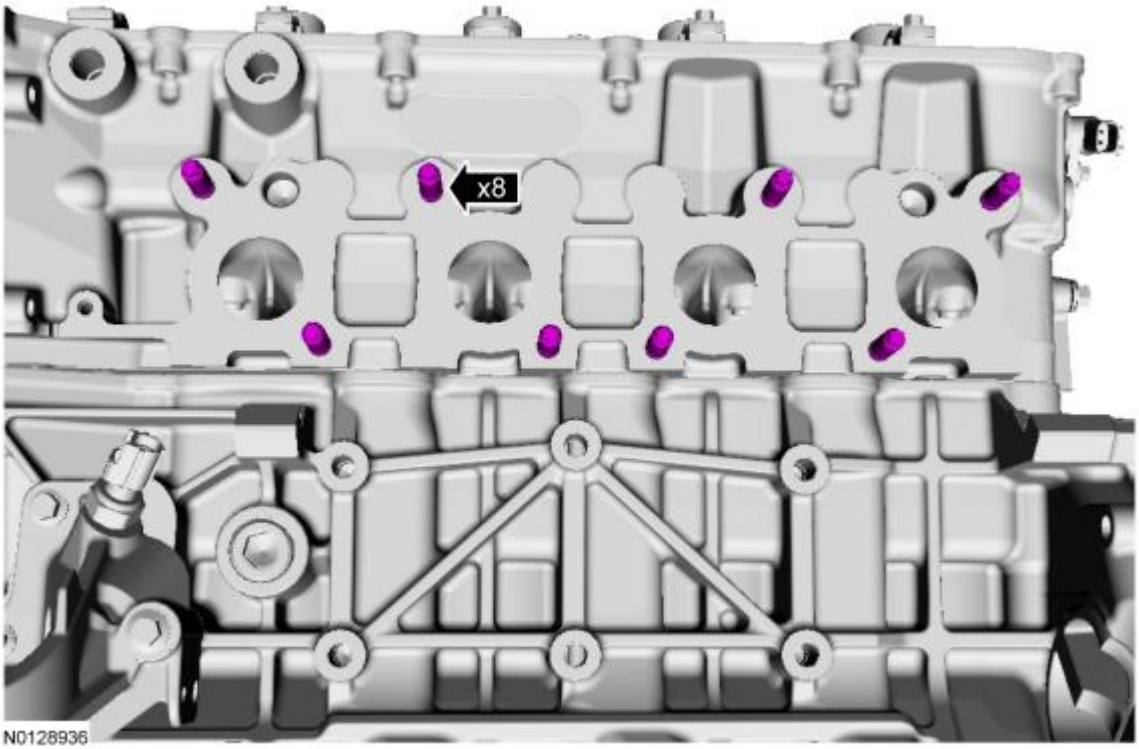


64. Remove the 8 nuts and the LH exhaust manifold.
    - Discard the gasket.



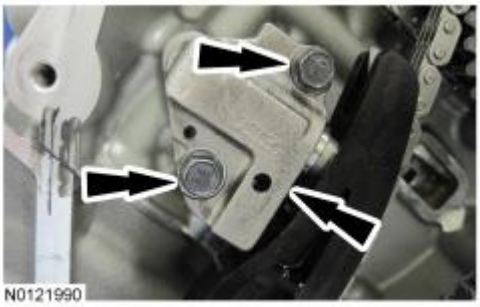
65. Clean and inspect the LH exhaust manifold. For additional information, refer to Section 303-00
.

66. Remove and discard the 8 LH exhaust manifold studs.



67. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.

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



69. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

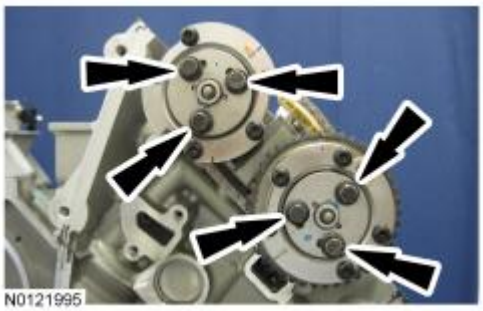
    Remove the LH timing chain tensioner arm.

70. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

    Remove the bolt and the LH timing chain guide.

71. Remove the LH primary timing chain.

72. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



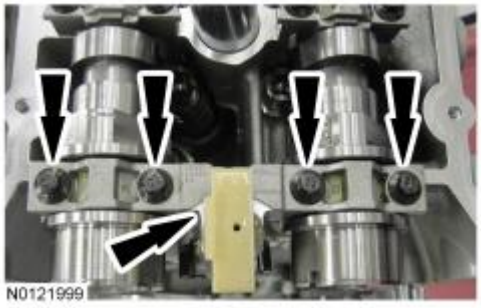
73. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).

74. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.

75. Remove the LH VCT assemblies and the LH secondary timing chain.

76. ***NOTICE:*** **The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.**

    Remove the 4 bolts and the LH front camshaft bearing mega cap.

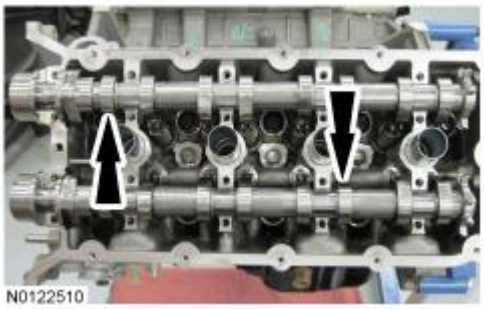


77. Remove the 16 bolts and the 8 camshaft bearing caps.

78. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

    Remove the VCT system oil filter from the intake and exhaust camshafts.

79. Remove the LH intake and exhaust camshafts.



80. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

81. ***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.**

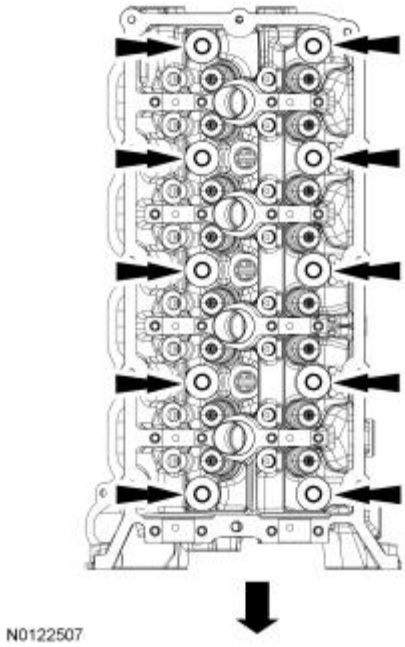
    NOTICE: **The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.**

    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.**

    Remove the 10 bolts and the LH cylinder head.

    - Discard the bolts and the cylinder head gasket.



82. ***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 notices 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.

83. **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.

    Support the cylinder head 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 .