
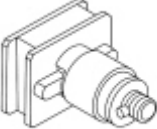
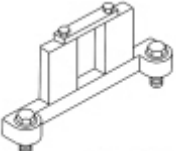
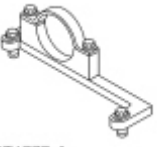




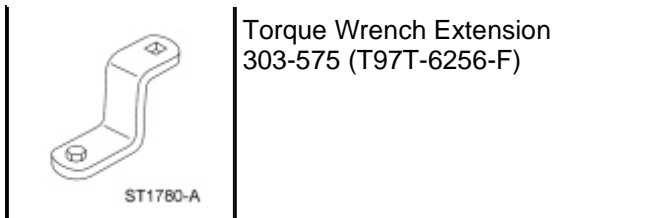


## Cylinder Head

### Special Tool(s)

 ST1776-A	Adapter for 303-564 303-578 (T97T-6256-A)
 ST1779-A	Adapter for 303-577 303-576 (T97T-6256-D)
 ST1778-A	Holding Tool, Camshaft 303-577 (T97T-6256-C)
 ST1777-A	Holding Tool, Camshaft Sprocket 303-564 (T97T-6256-B)
 ST1394-A	Remover, Spark Plug Wire 303-106 (T74P-6666A)
 ST1781-A	Socket, Camshaft Sprocket Nut 303-565 (T97T-6256-G)
 ST1774-A	Tensioner, Timing Chain 303-571 (T97T-6K254-A)
 ST1775-A	Timing Tool, Crankshaft TDC 303-573 (T97T-6303-A)



### Material

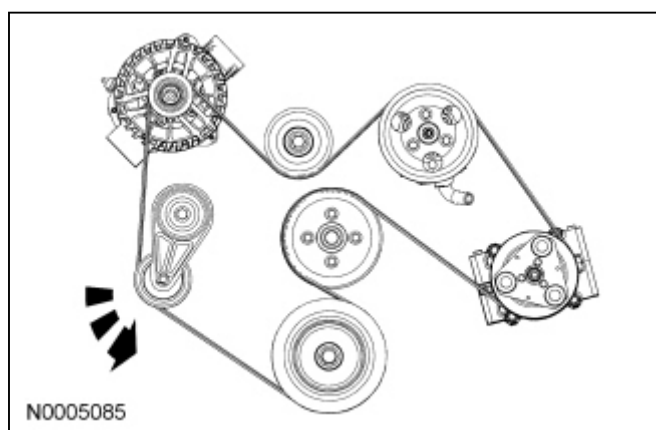
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-30 Premium Synthetic Blend Motor Oil XO-5W30-QSP (US); Motorcraft® SAE 5W-30 Super Premium Motor Oil CXO-5W30-LSP12 (Canada); or equivalent	WSS-M2C929-A
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
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.

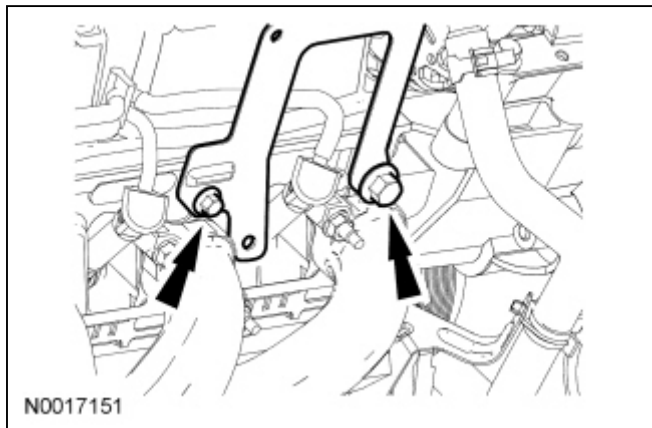
### Both sides

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Release the fuel system pressure. For additional information, refer to [Section 310-00](#).
3. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
4. Remove the intake manifold. For additional information, refer to [Intake Manifold](#) in this section.
5. Remove the hydraulic lash adjusters. For additional information, refer to [Hydraulic Lash Adjuster](#) in this section.
6. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.

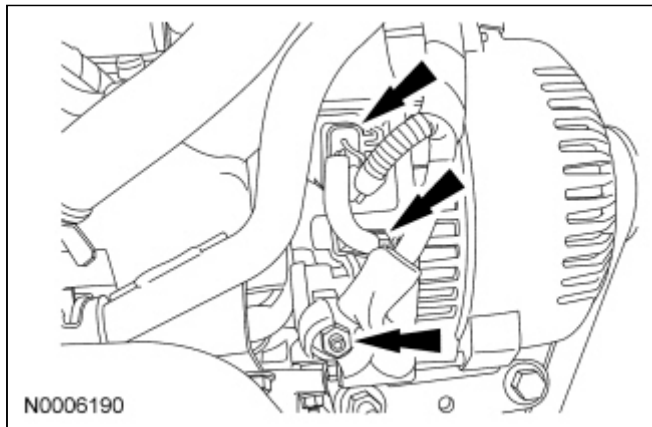


## RH side

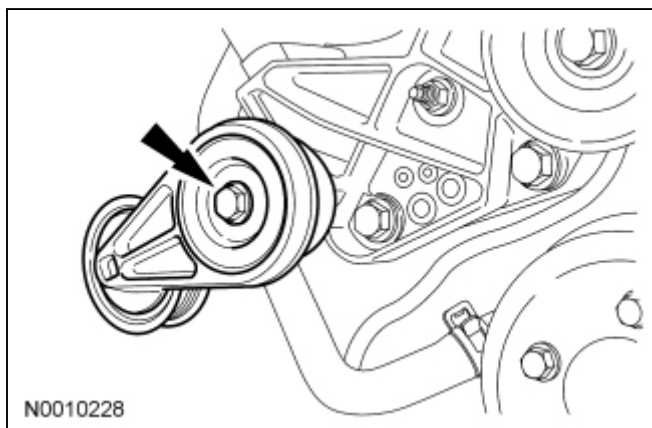
7. Remove the 2 coolant tube bracket bolts.



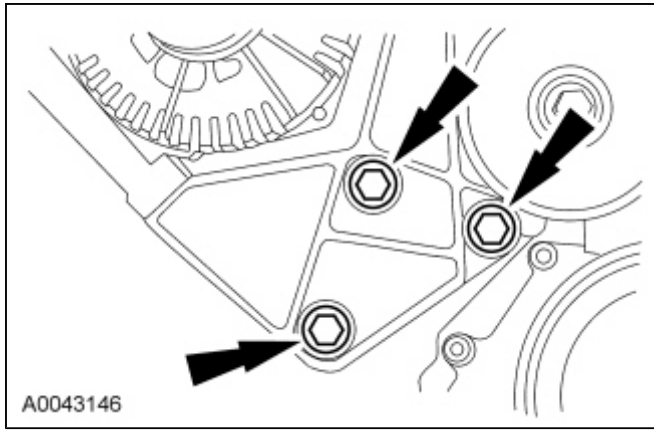
8. Disconnect the generator electrical connector, remove the nut and detach the B+ terminal.
  - Detach the pin-type retainer.



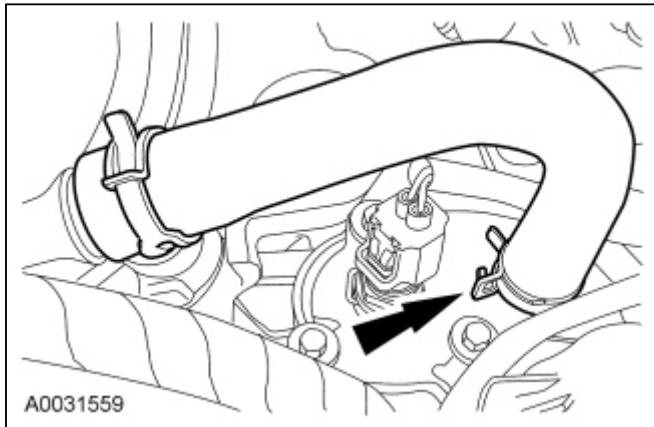
9. Remove the bolt and the accessory drive belt tensioner.



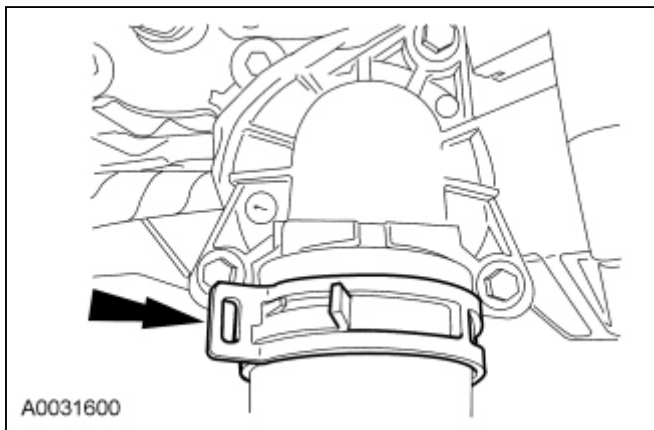
10. Remove the nut, the 2 bolts and the generator mounting bracket assembly.



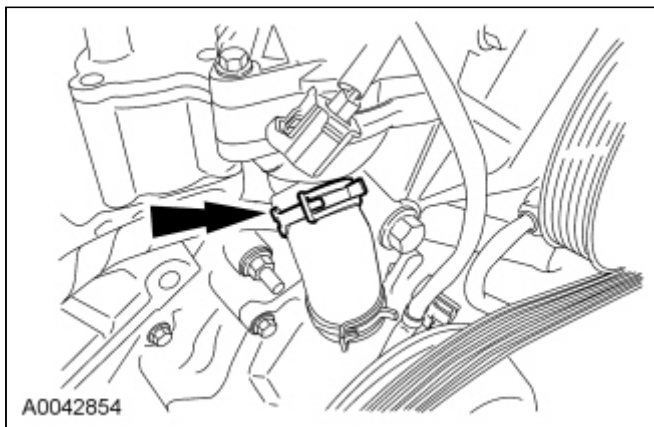
11. Disconnect the heater hose from the thermostat housing.



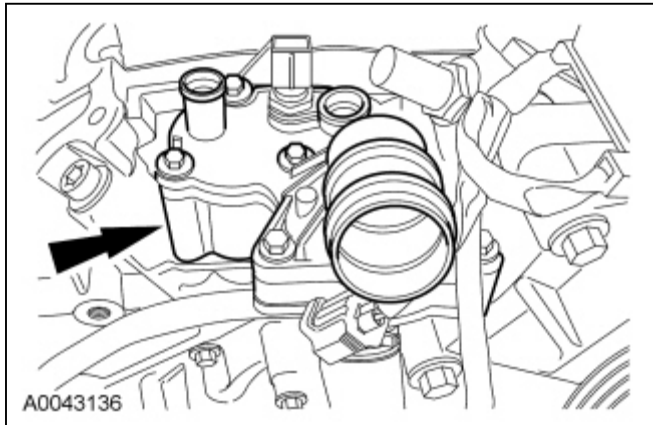
12. Disconnect the upper radiator hose.



13. Position the coolant bypass hose clamp aside.

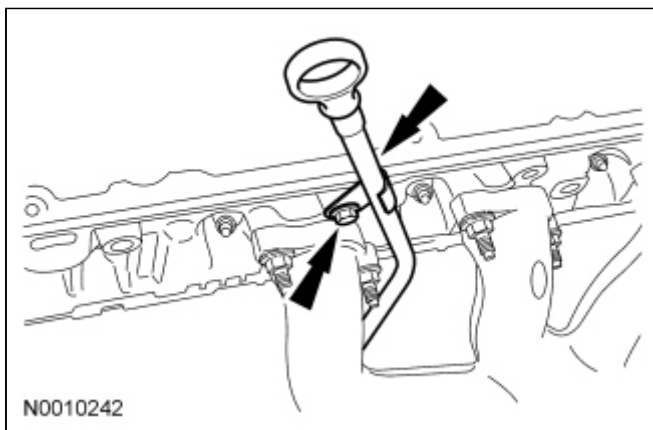


14. Remove the 3 bolts and the thermostat housing.
  - Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.

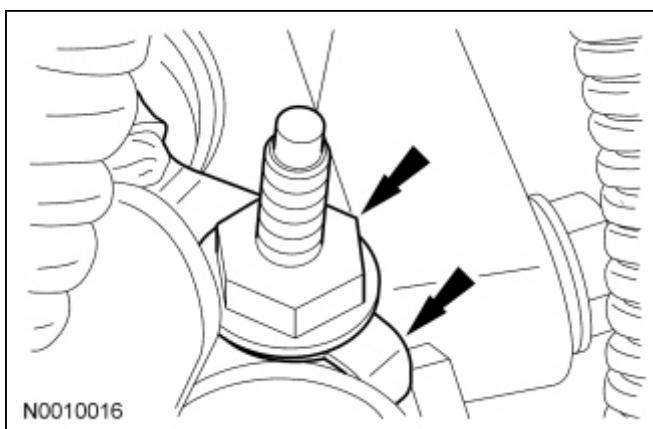


**LH side**

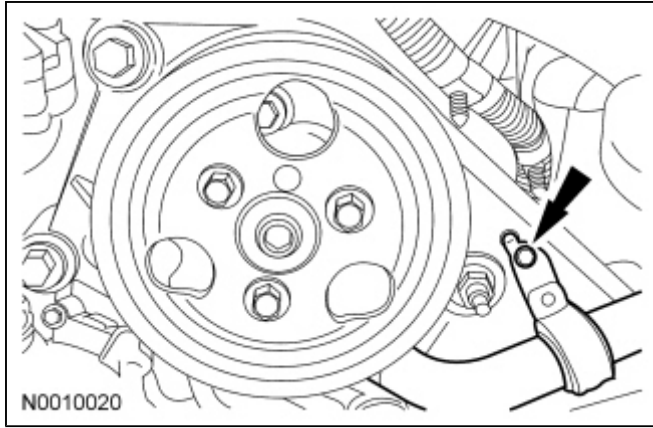
15. Remove the bolt and the oil level indicator tube.



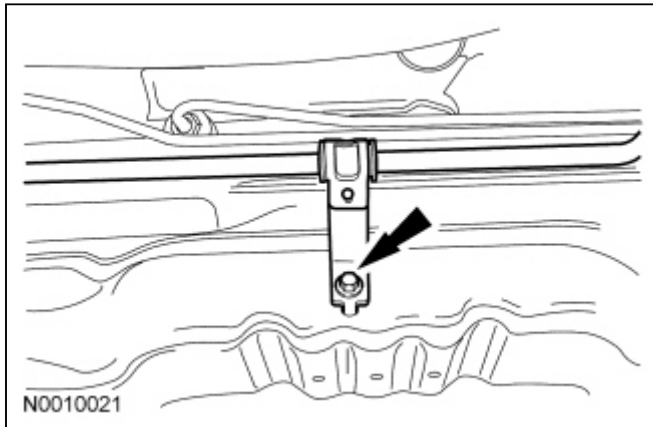
16. Remove the stud bolt and detach the ground strap.
  - Position the ground strap aside.



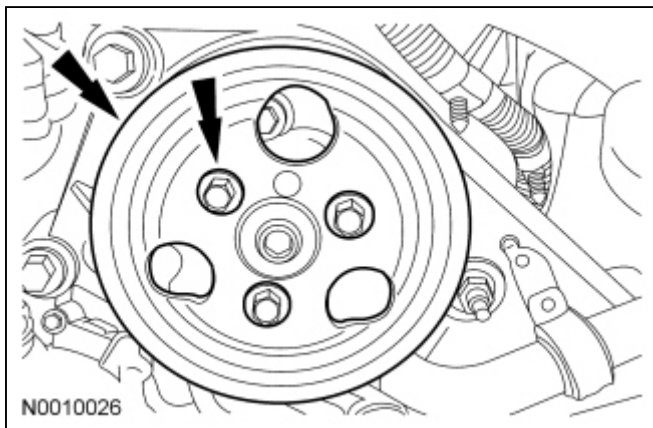
17. Remove the bolt and detach the power steering supply hose bracket from the Front End Accessory Drive (FEAD) bracket.



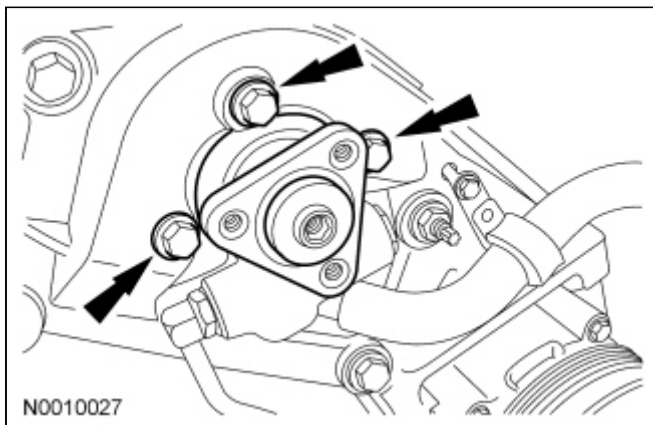
18. Remove the bolt and detach the Power Steering Pressure (PSP) tube bracket from the crossmember.



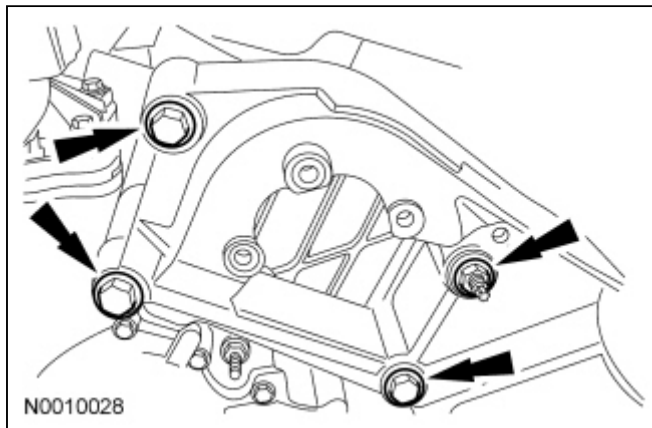
19. Remove the 3 bolts and the power steering pump pulley.



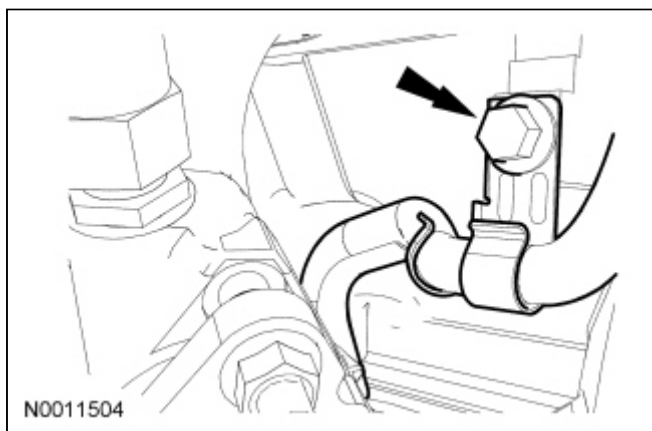
20. Remove the 3 bolts and position the power steering pump aside.



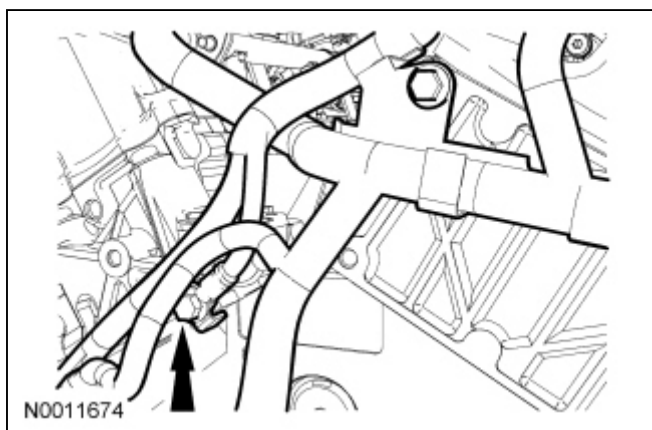
21. Remove the 3 bolts, the nut and position the **FEAD** bracket and A/C compressor aside.



22. Remove the bolt and detach the starter motor wiring retainer bracket.



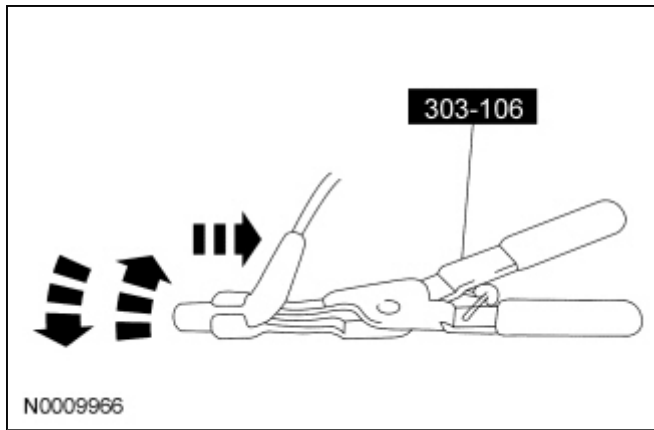
23. Remove the ground strap bolt and detach the wiring harness retainer from the backside of the cylinder head.



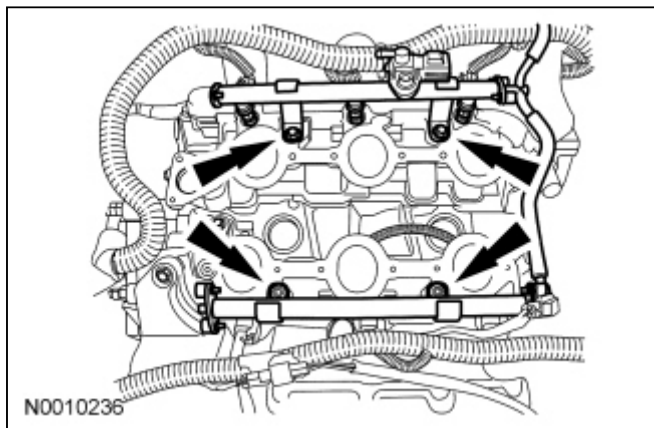
#### Both sides

24. **NOTICE:** It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wires.

Using the Spark Plug Wire Remover, disconnect the 6 spark plug wires from the spark plugs.



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

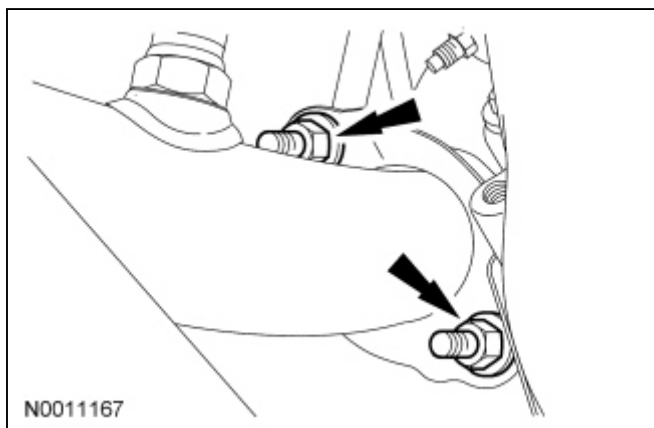


26. Separate the 6 fuel injectors from the fuel rail and discard the O-ring seals.

27. **NOTE:** LH side shown, RH side similar.

Remove the 4 catalytic converter-to-manifold nuts.

- Discard the nuts.

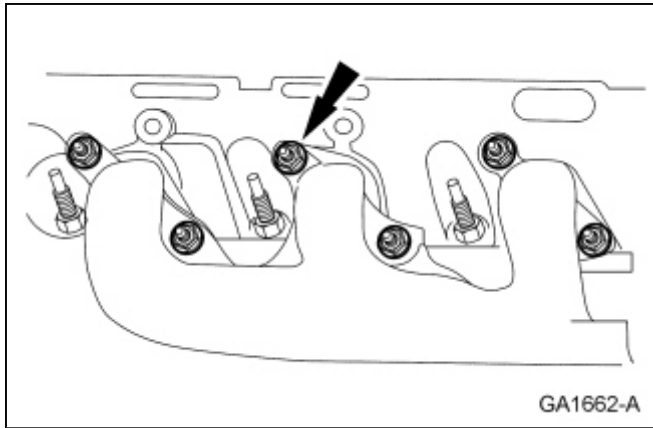


28. **NOTE:** LH side shown, RH side similar.

Remove the 12 nuts and the exhaust manifolds and gaskets.

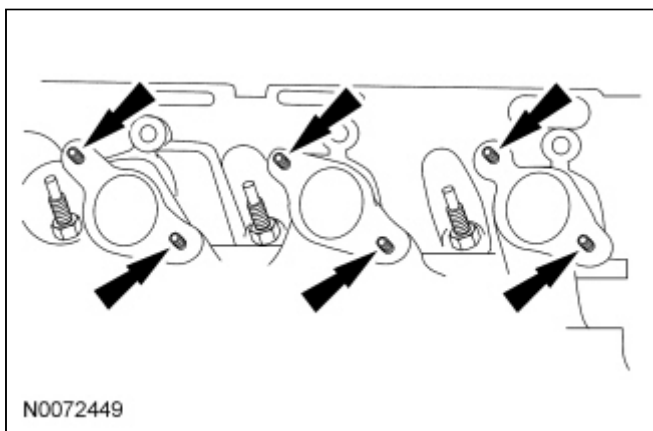
- Discard the nuts and gaskets.





29. **NOTE:** LH side shown, RH side similar.

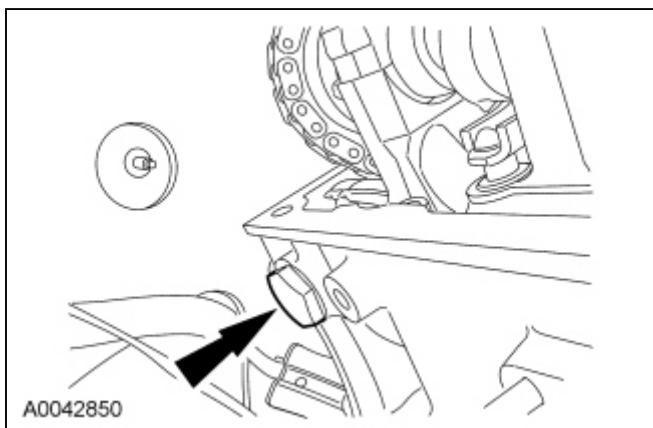
Remove and discard the 12 exhaust manifold studs.



#### RH side

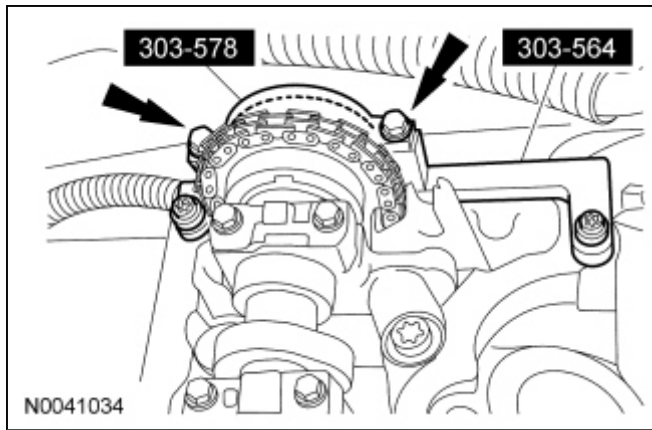
30. Remove the RH side hydraulic chain tensioner.

- Remove and discard the washer.



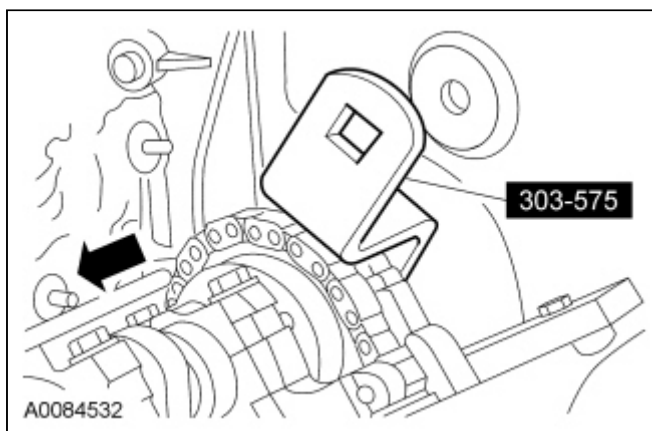
31. Install the Camshaft Sprocket Holding Tool and Adapter.

- Tighten the top clamp bolts to 10 Nm (89 lb-in).

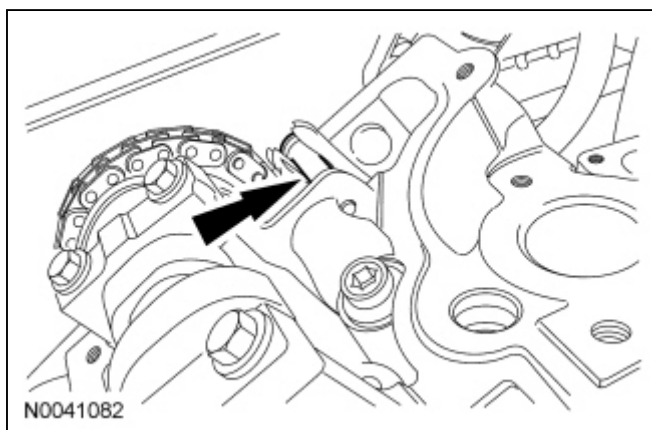


32. **NOTE:** The RH camshaft sprocket bolt is a LH-threaded bolt.

Using the Torque Wrench Extension with the Camshaft Sprocket Nut Socket 303-565, remove the RH camshaft bolt.



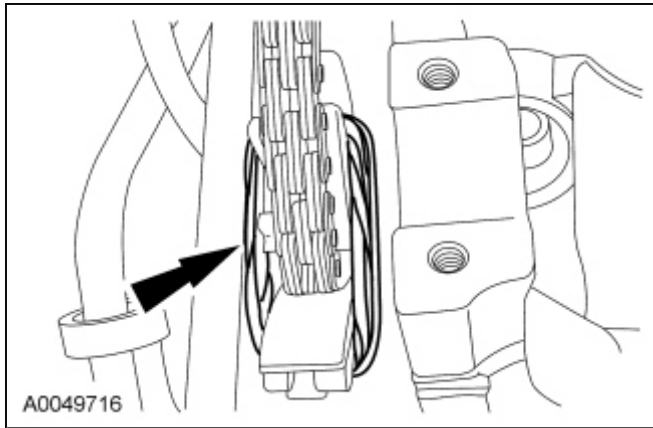
33. Remove the RH side cassette bolt.



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

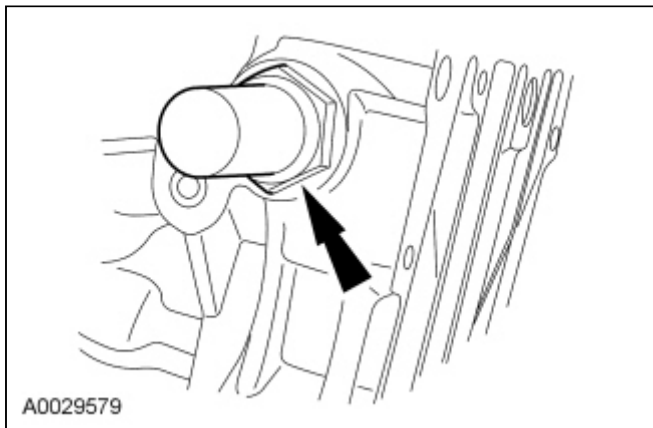
**NOTE:** Hold the timing chain and cassette with a rubber band to aid in removal and to prevent the timing chain from falling into the cylinder block.

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

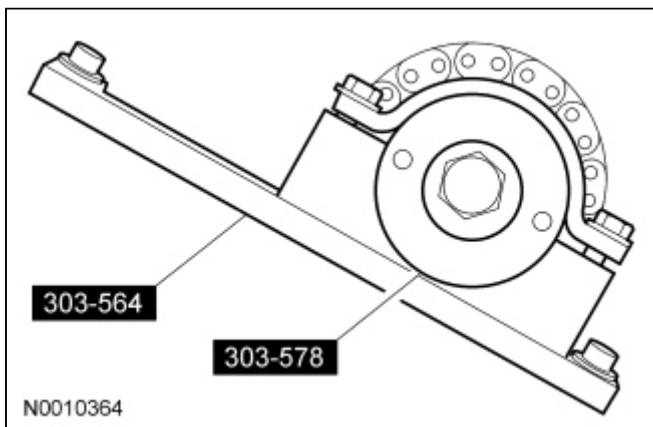


**LH side**

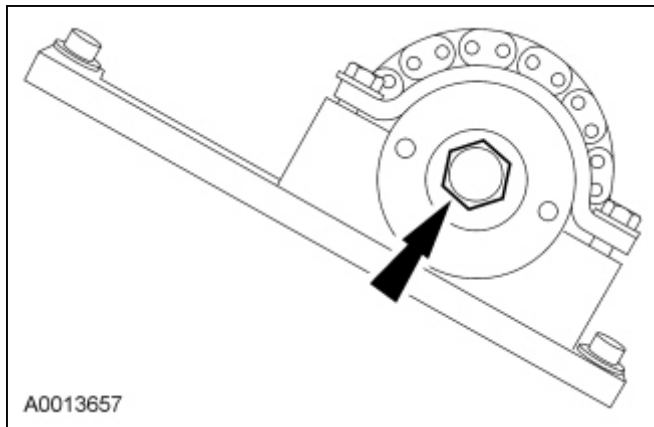
35. Remove the LH side hydraulic chain tensioner.
  - Remove and discard the washer.



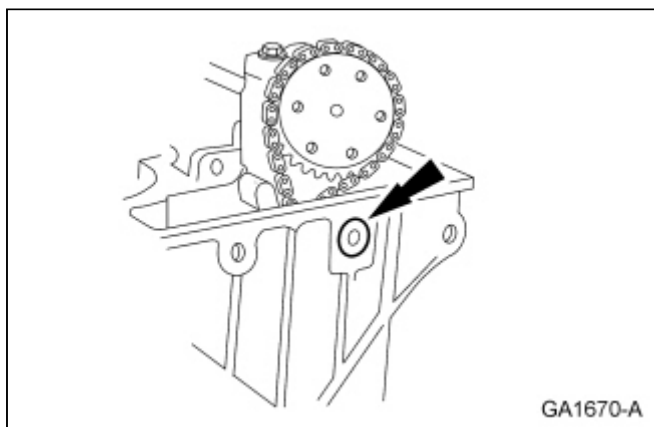
36. Install the Camshaft Sprocket Holding Tool and Adapter.
  - Tighten to 10 Nm (89 lb-in).



37. Remove the LH side camshaft sprocket bolt.



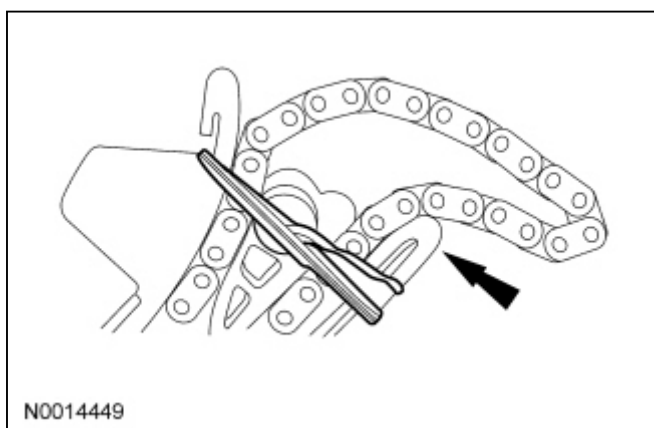
38. Remove the LH side cassette bolt.



39. **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.



#### Both sides

40. **NOTE:** To avoid damage to the timing chain cassette, an assistant will be required to help lift the cylinder head from the vehicle.

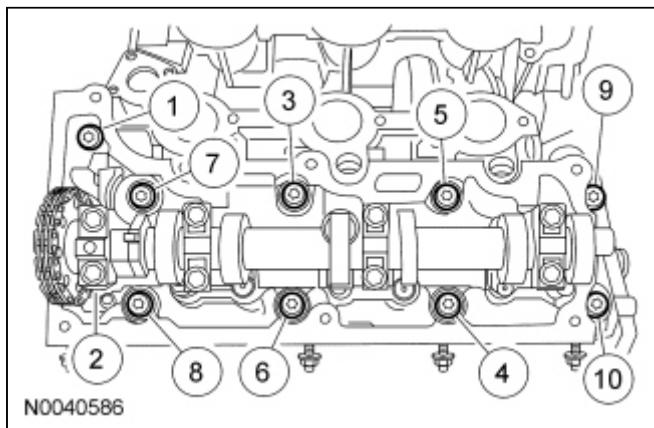
**NOTE:** On the RH side, when lifting the cylinder head, be careful to avoid contacting the A/C tube.

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

reused.

Remove the cylinder heads.

- Remove the cylinder head bolts in the sequence shown. Discard all the bolts.
- Remove and discard the head gaskets.



41. **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.

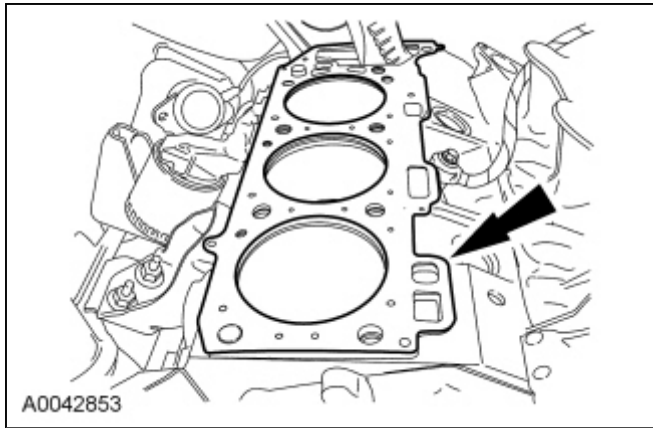
Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block in the following sequence.

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 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 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.
42. 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](#).

## Installation

### Both sides

1. Clean the cylinder head bolt holes in the cylinder block. Make sure all coolant, oil or other foreign material is removed.
2. Position the cylinder head gaskets on the block.



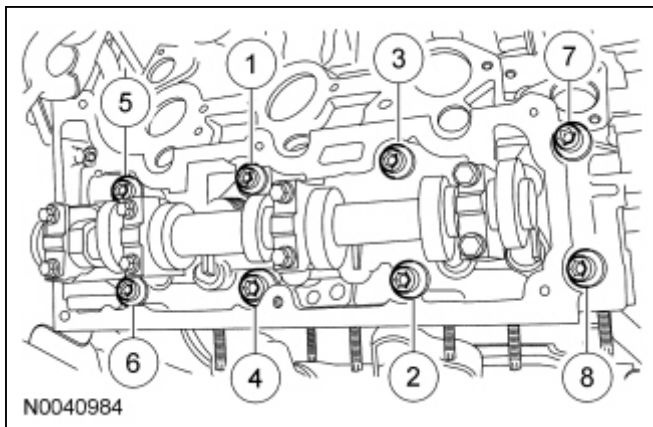
### RH side

- NOTE:** To avoid damage to the timing chain cassette, an assistant will be required to help position the cylinder head in the vehicle.

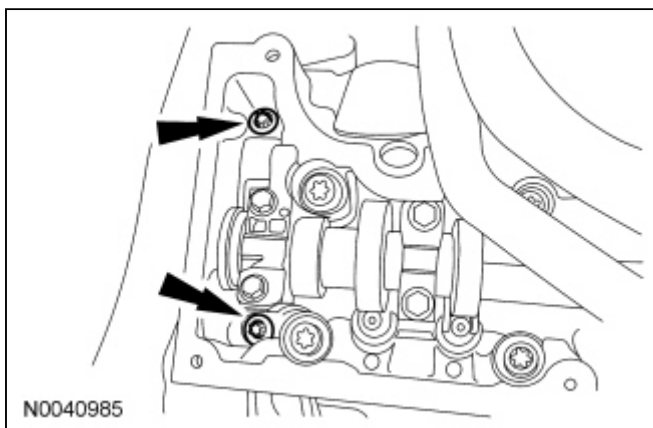
**NOTE:** New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

Position the RH cylinder head. Install 8 new M12 bolts and tighten in the sequence shown in 2 stages.

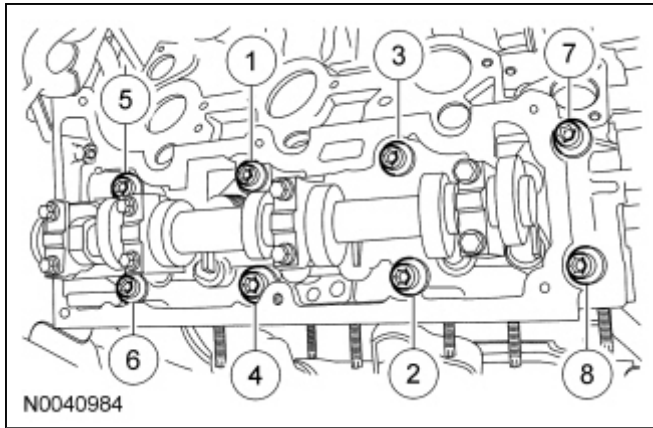
- Stage 1: Tighten to 12 Nm (106 lb-in).
- Stage 2: Tighten to 25 Nm (18 lb-ft).



- Install 2 new M8 bolts.
  - Tighten to 32 Nm (24 lb-ft).



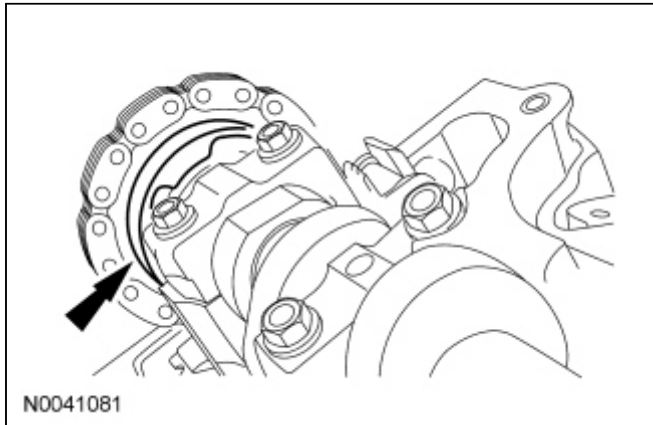
- Tighten the 8 M12 bolts in the sequence shown in 2 stages.
  - Stage 1: Tighten 90 degrees.
  - Stage 2: Tighten an additional 90 degrees.



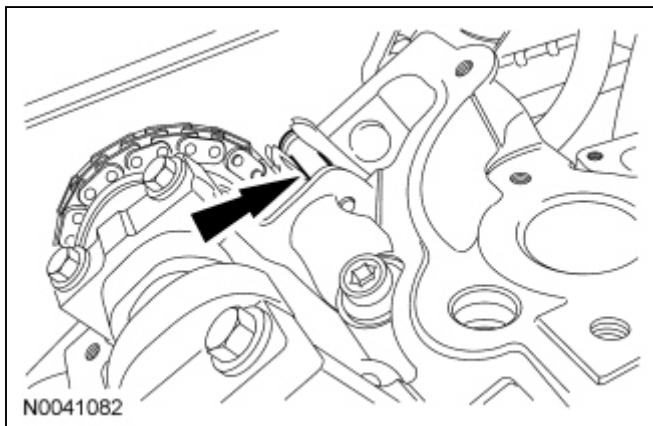
6. **NOTE:** The camshaft gear must turn freely on the camshaft. Do not tighten the bolt at this time.

**NOTE:** The right-hand camshaft sprocket bolt is a left-hand threaded bolt.

Remove the rubber band, position the camshaft sprocket and chain. Loosely install the bolt.



7. Install the RH side cassette bolt.
- Tighten to 12 Nm (106 lb-in).



### LH side

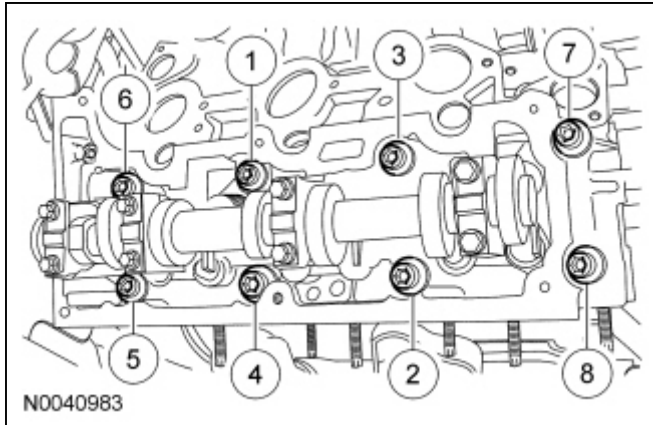
8. **NOTE:** To avoid damage to the timing chain cassette, an assistant will be required to help position the cylinder head in the vehicle.

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

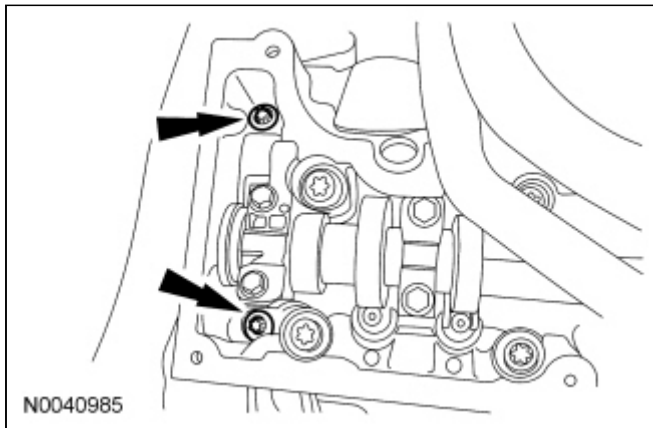
Position the LH cylinder head. Install 8 new M12 bolts and tighten in the sequence shown in 2 stages.

- Stage 1: Tighten to 12 Nm (106 lb-in).

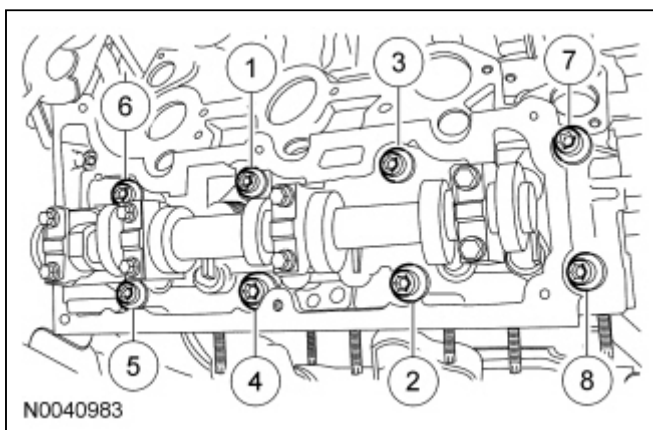
- Stage 2: Tighten to 25 Nm (18 lb-ft).



9. Install 2 new M8 bolts.
  - Tighten to 32 Nm (24 lb-ft).

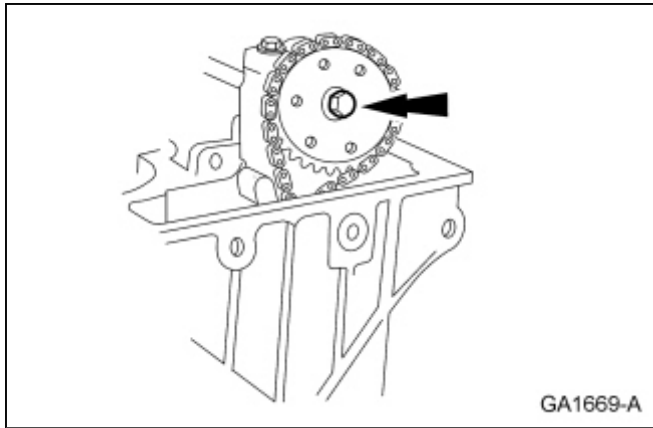


10. Tighten the 8 M12 bolts in the sequence shown in 2 stages.
  - Stage 1: Tighten 90 degrees.
  - Stage 2: Tighten an additional 90 degrees.

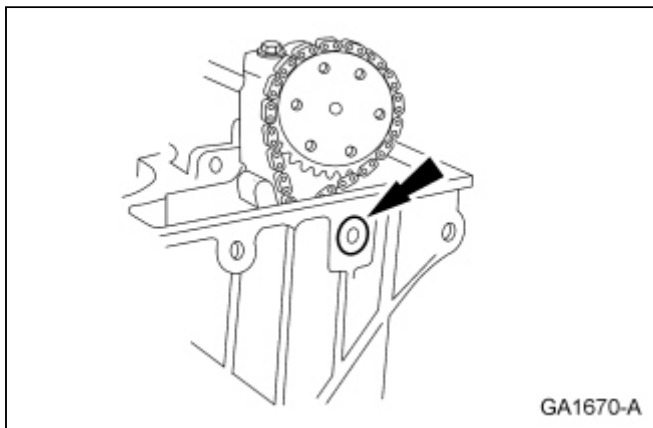


11. **NOTE:** The camshaft gear must turn freely on the camshaft. Do not tighten the bolt at this time.  
Remove the rubber band, position the camshaft sprocket and chain. Loosely install the bolt.





12. Install the LH side cassette bolt.
  - Tighten to 19 Nm (168 lb-in).

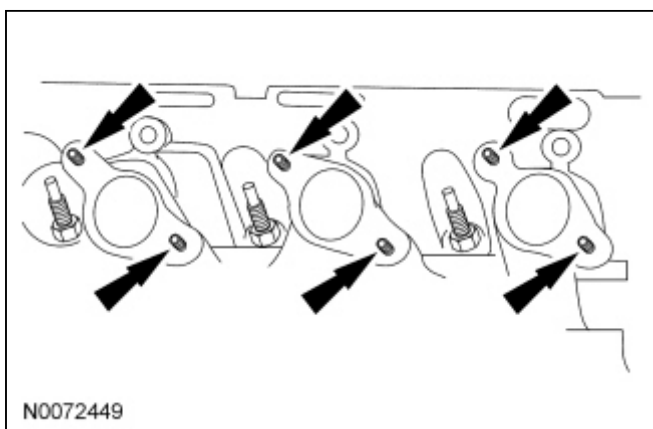


### Both sides

13. **NOTE:** LH side shown, RH side similar.

Install the 12 exhaust manifold studs.

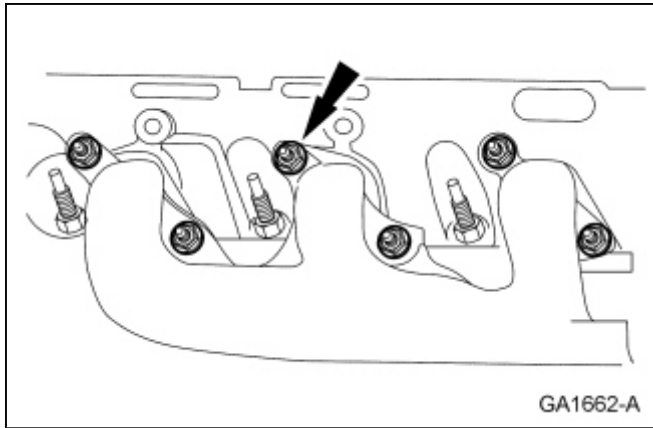
- Tighten to 12 Nm (106 lb-in).



14. **NOTE:** LH side shown, RH side similar.

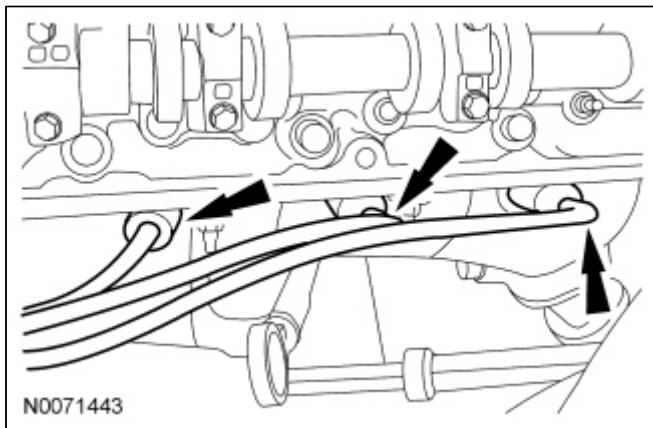
Position new gaskets and the exhaust manifolds. Install the 12 new nuts.

- Tighten to 23 Nm (17 lb-ft).



15. **NOTE:** Apply dielectric compound to the inside of the spark plug wire boots.

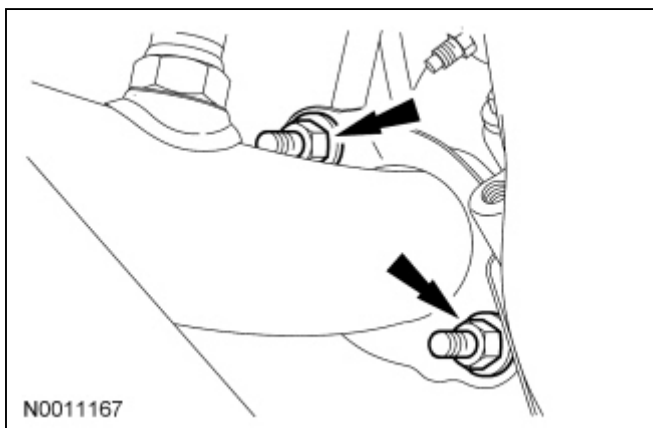
Connect the 6 spark plug wires to the spark plugs.



16. **NOTE:** LH side shown, RH side similar.

Install the 4 new catalytic converter-to-exhaust manifold nuts.

- Tighten to 45 Nm (33 lb-ft).



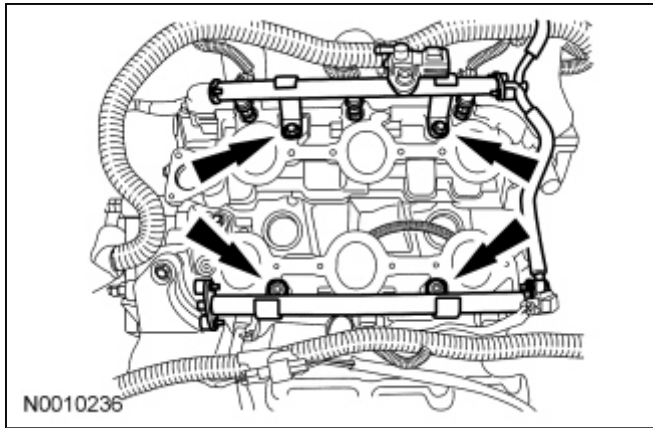
17. **NOTE:** Lubricate the new O-ring seals with clean engine oil.

Install the 6 fuel injectors.

- Install new O-ring seals on the injectors.
- Install the injectors.

18. Position the fuel rail and injectors and install the 4 bolts.

- Tighten to 23 Nm (17 lb-ft).



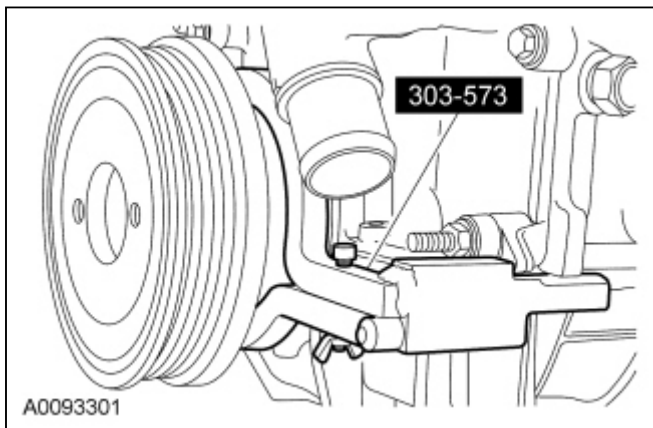
19. **NOTE:** The LH and RH camshafts must be retimed when either camshaft is disturbed.

Turn the crankshaft clockwise to position the No. 1 cylinder at Top Dead Center (TDC).

20. **NOTICE:** Do not rotate the engine counterclockwise. Rotating the engine counterclockwise will result in damage to the damper crank sensor speed wheel and incorrect timing to the engine.

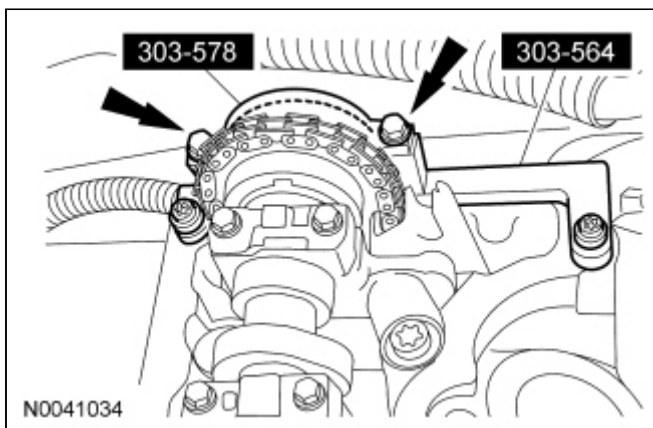
**NOTE:** The Crankshaft TDC Timing Tool must be installed on the damper and should contact the engine block, this positions the engine at TDC.

Install the Crankshaft TDC Timing Tool.



21. **NOTE:** Leave the top 2 Camshaft Sprocket Holding Tool clamp bolts loose.

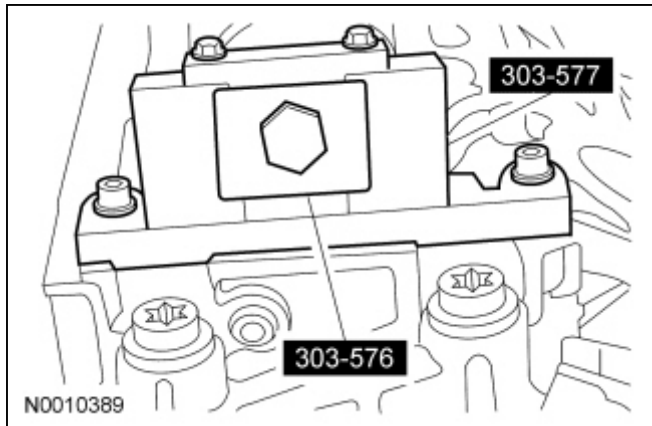
Install the Camshaft Sprocket Holding Tool and Adapter on the rear of the RH cylinder head.



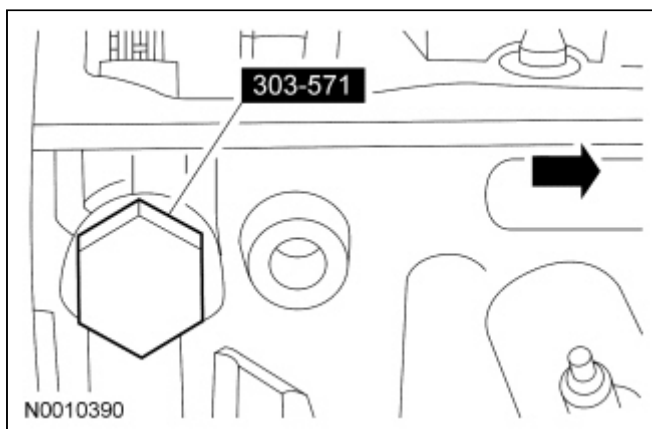
22. **NOTE:** The camshaft timing slots are off-center.

Position the camshaft timing slots below the centerline of the camshaft to correctly fit the Camshaft

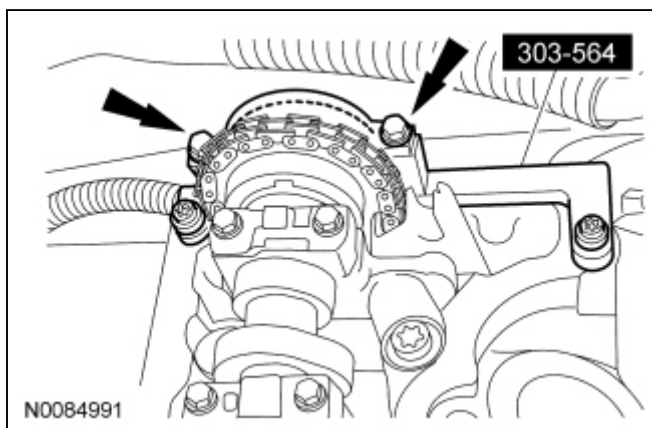
Holding Tool and Adapter, and install the Camshaft Holding Tool and Adapters on the front of the RH cylinder head.



23. Install the Timing Chain Tensioner.

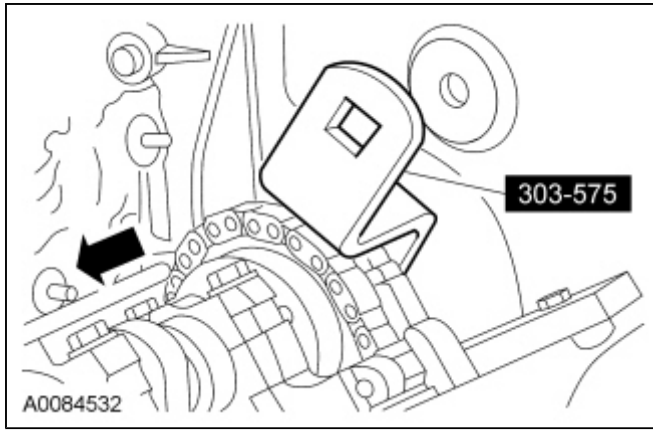


24. Tighten the 2 top Camshaft Sprocket Holding Tool bolts to 10 Nm (89 lb-in).

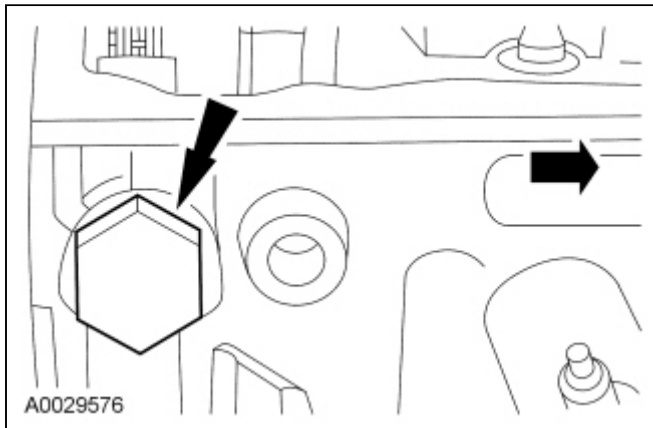


25. **NOTE:** The RH camshaft sprocket bolt is a LH-threaded bolt.

Using the Torque Wrench Extension with the Camshaft Sprocket Nut Socket 303-565, tighten the camshaft bolt to 85 Nm (63 lb-ft).

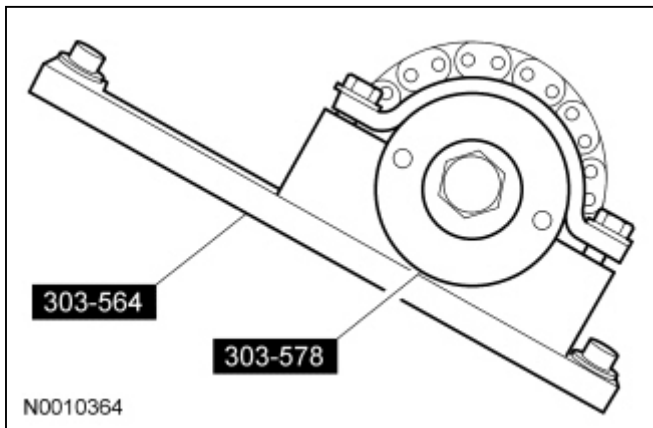


26. Install a new washer and the RH camshaft tensioner.
- Tighten to 44 Nm (32 lb-ft).



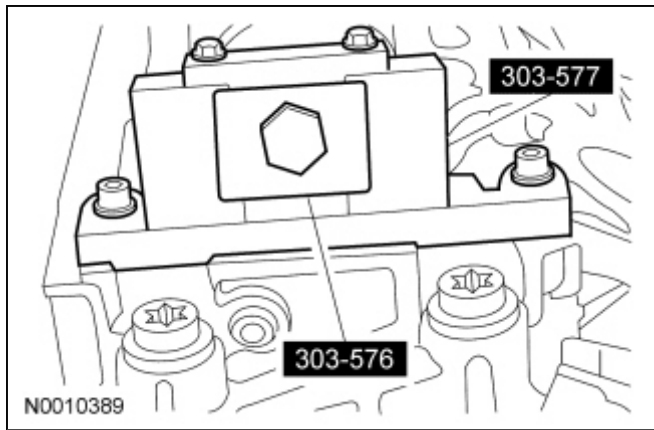
27. **NOTE:** Leave the top 2 Camshaft Sprocket Holding Tool clamp bolts loose.

Install the Camshaft Sprocket Holding Tool and Adapter on the front of the LH cylinder head.

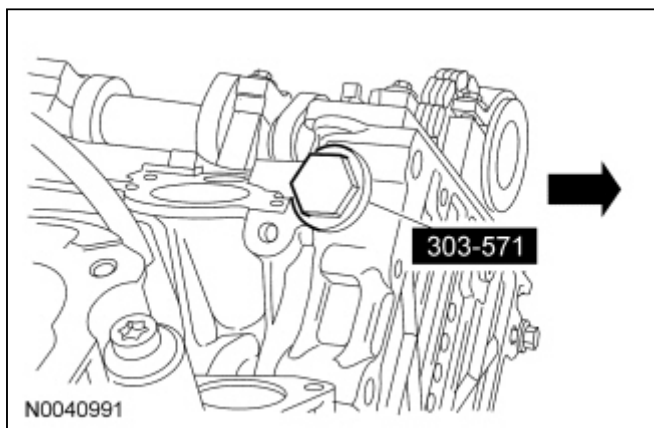


28. **NOTE:** The camshaft timing slots are off-center.

Position the camshaft timing slots below the centerline of the camshaft to correctly fit the Adapters, and install the Camshaft Holding Tool and Adapter on the rear of the LH cylinder head.

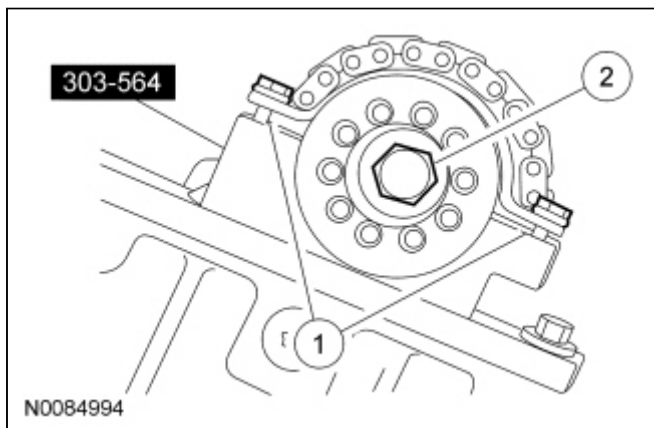


29. Install the Timing Chain Tensioner.



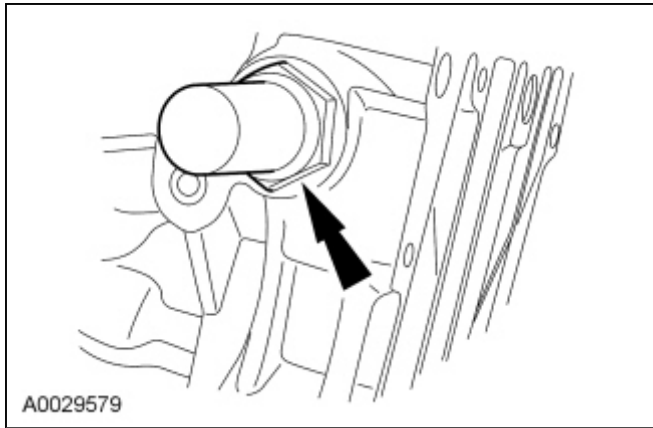
30. Tighten the bolts.

1. Tighten the Camshaft Sprocket Holding Tool top 2 bolts to 10 Nm (89 lb-in).
2. Tighten the camshaft sprocket bolt to 85 Nm (63 lb-ft).



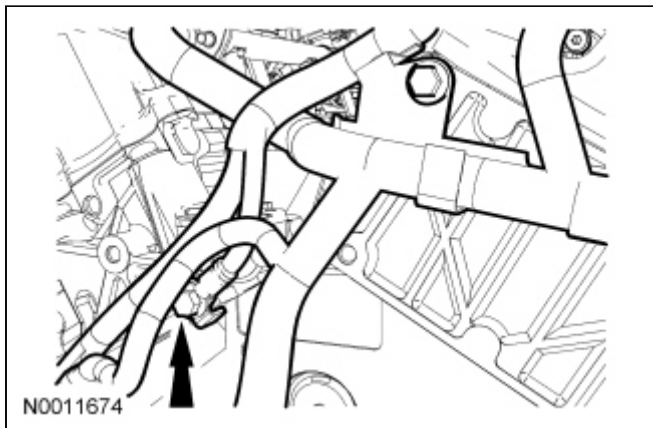
31. Install a new washer and the LH camshaft tensioner.

- Tighten to 44 Nm (32 lb-ft).

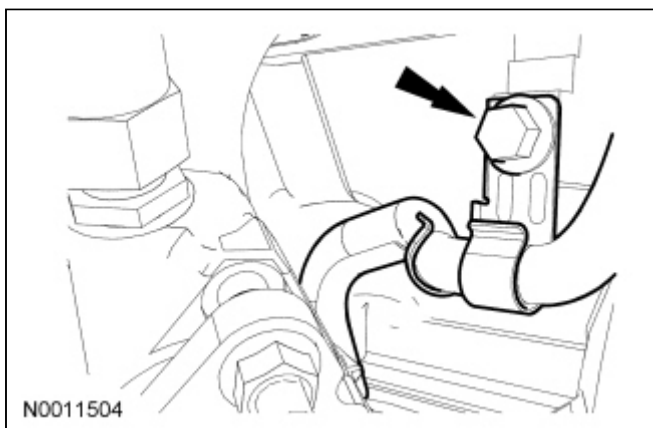


### LH side

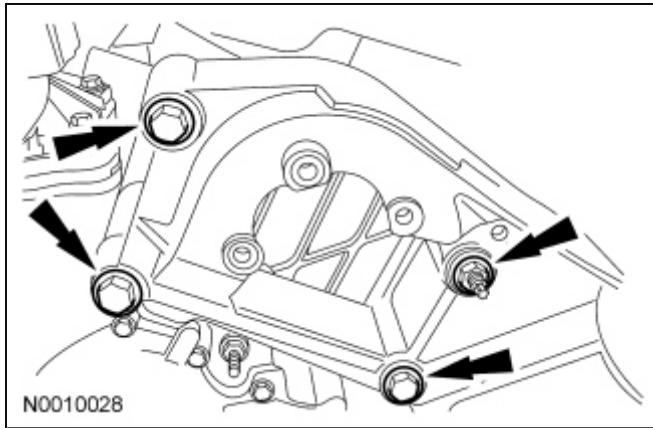
32. Position the ground strap and install the bolt.
  - Tighten to 40 Nm (30 lb-ft).
  - Attach the wiring harness retainer to the backside of the cylinder head.



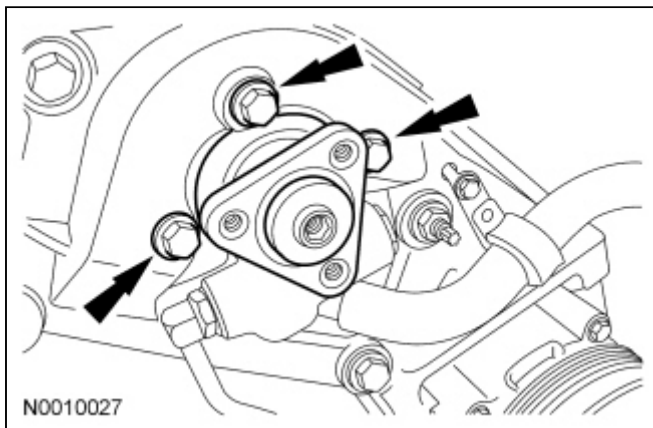
33. Position the starter motor wiring retainer bracket and install the bolt.
  - Tighten to 40 Nm (30 lb-ft).



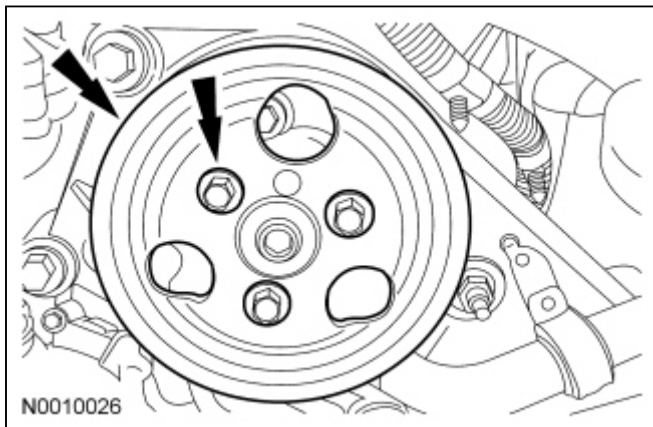
34. Position the **FEAD** bracket and A/C compressor. Install the 3 bolts and the nut.
  - Tighten to 48 Nm (35 lb-ft).



35. Position the power steering pump and install the 3 bolts.
- Tighten to 25 Nm (18 lb-ft).

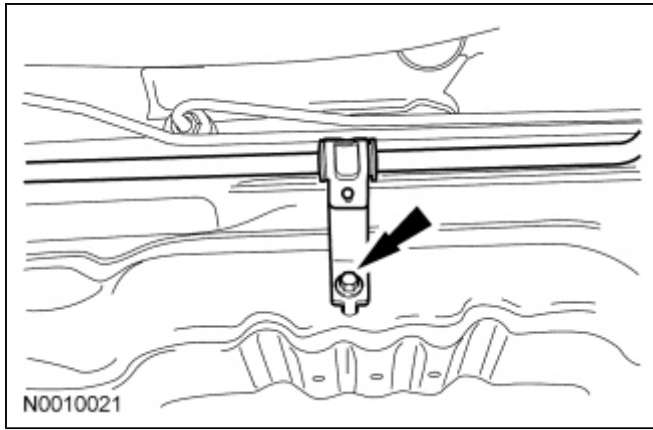


36. Position the power steering pump pulley and install the 3 bolts.
- Tighten to 25 Nm (18 lb-ft).

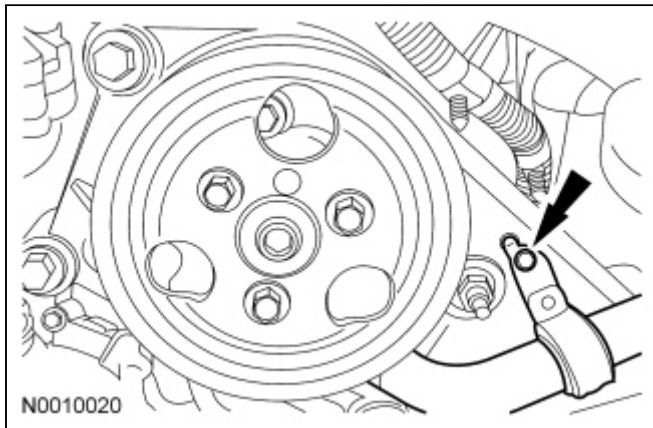


37. Attach [PSP](#) tube bracket to the crossmember and install the bolt.
- Tighten to 11 Nm (97 lb-in).

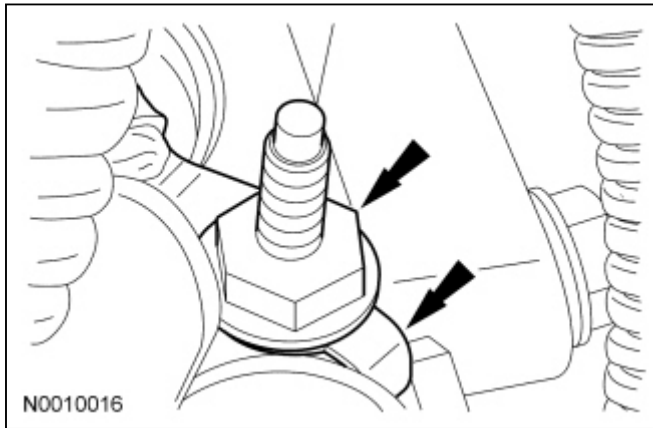




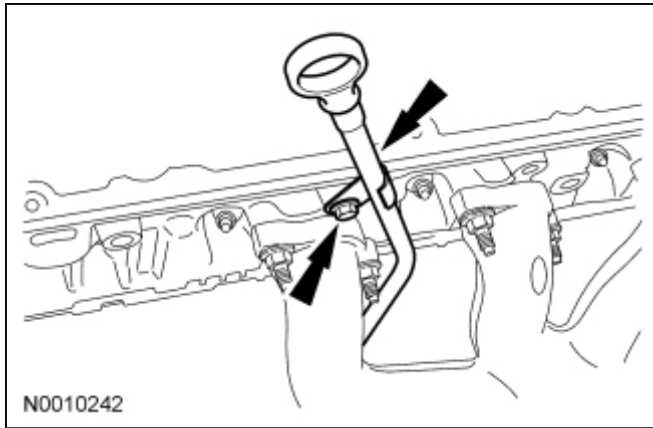
38. Attach the power steering supply hose bracket to the **FEAD** bracket and install the bolt.
- Tighten to 11 Nm (97 lb-in).



39. Position the ground strap and install the stud bolt.
- Tighten to 10 Nm (89 lb-in).



40. Install the oil level indicator tube and bolt.
- Tighten to 11 Nm (97 lb-in).

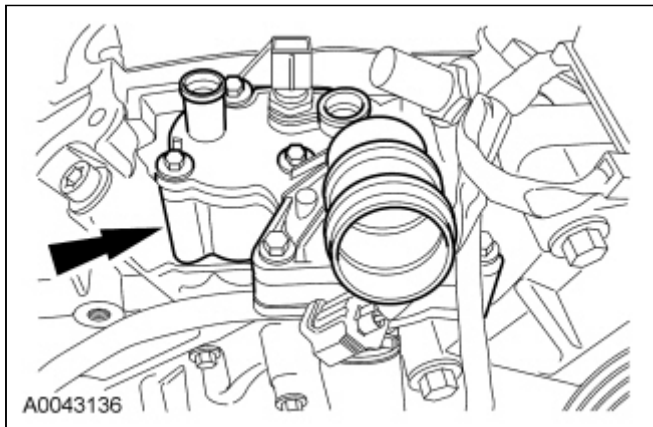


**RH side**

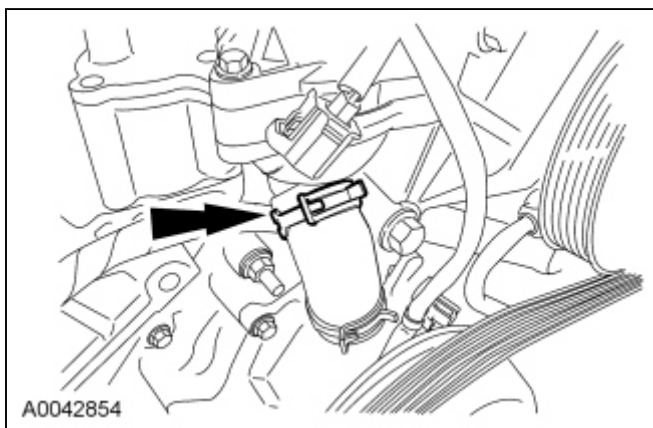
41. **NOTE:** Inspect the O-ring seal. Install a new O-ring seal if necessary.

Position the thermostat housing and install the 3 bolts.

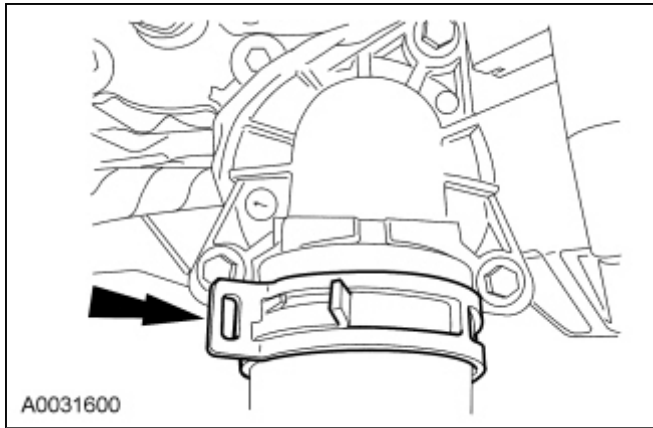
- Tighten to 11 Nm (97 lb-in).



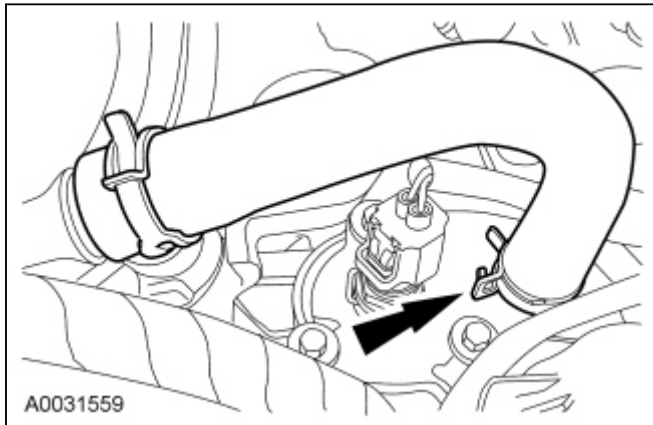
42. Position the coolant bypass hose clamp and connect the ECT sensor electrical connector.



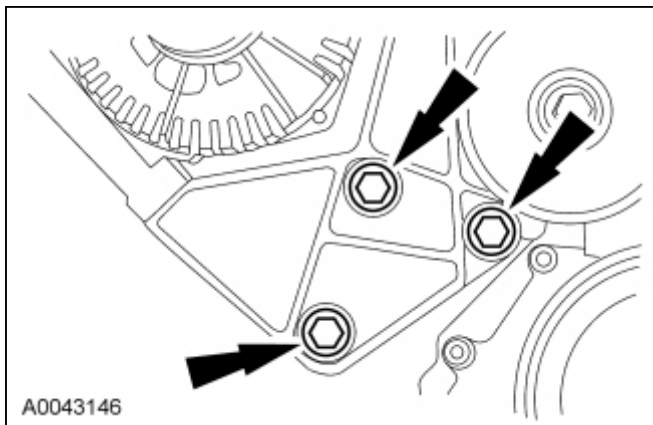
43. Install the upper radiator hose.



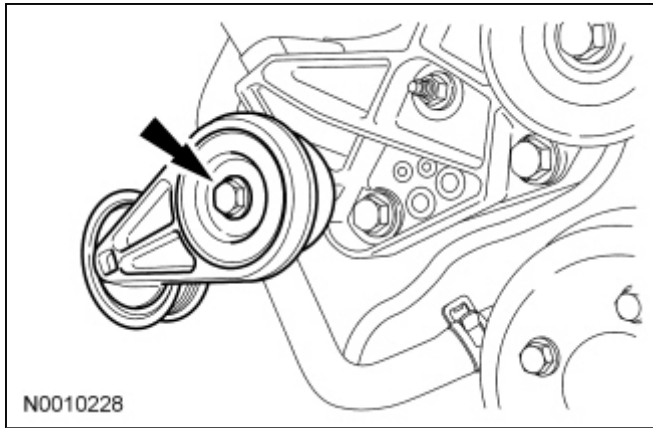
44. Connect the heater hose to the thermostat housing.



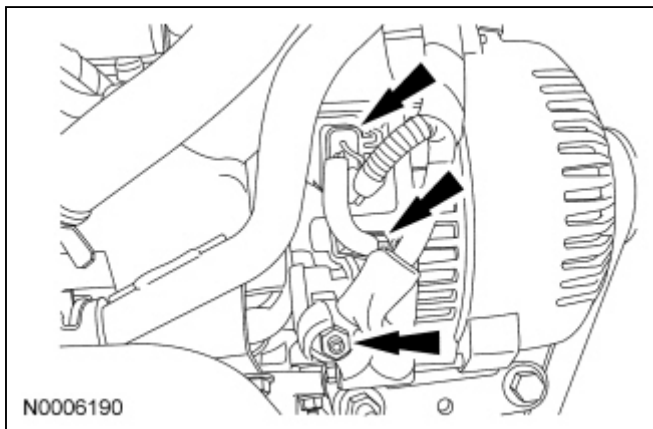
45. Position the generator mounting bracket assembly and install the 2 bolts and the nut.
- Tighten to 47 Nm (35 lb-ft).



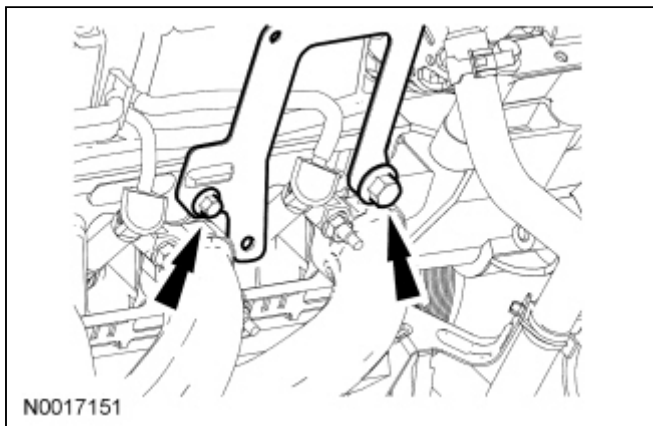
46. Install the accessory drive belt tensioner and bolt.
- Tighten to 47 Nm (35 lb-ft).



47. Connect the generator electrical connector. Position the B+ terminal and install the nut.
- Tighten to 8 Nm (71 lb-in).
  - Attach the pin-type retainer.

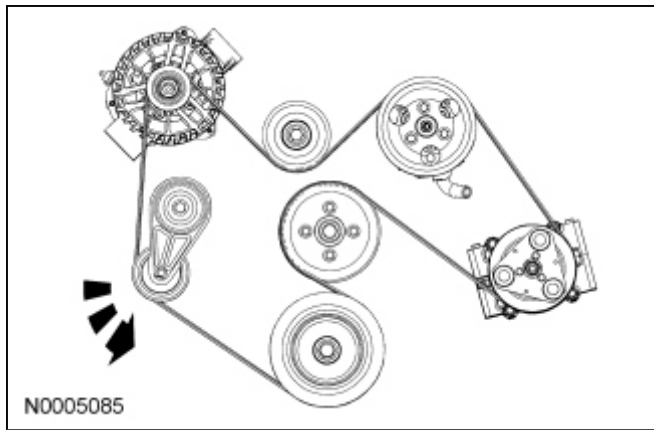


48. Install the 2 coolant tube bracket bolts.
- Tighten the M12 bolt to 34 Nm (25 lb-ft).
  - Tighten the M8 bolt to 23 Nm (17 lb-ft).



#### **Both sides**

49. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.



50. Install the hydraulic lash adjusters. For additional information, refer to [Hydraulic Lash Adjuster](#) in this section.
  51. Install the intake manifold. For additional information, refer to [Intake Manifold](#) in this section.
  52. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).
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