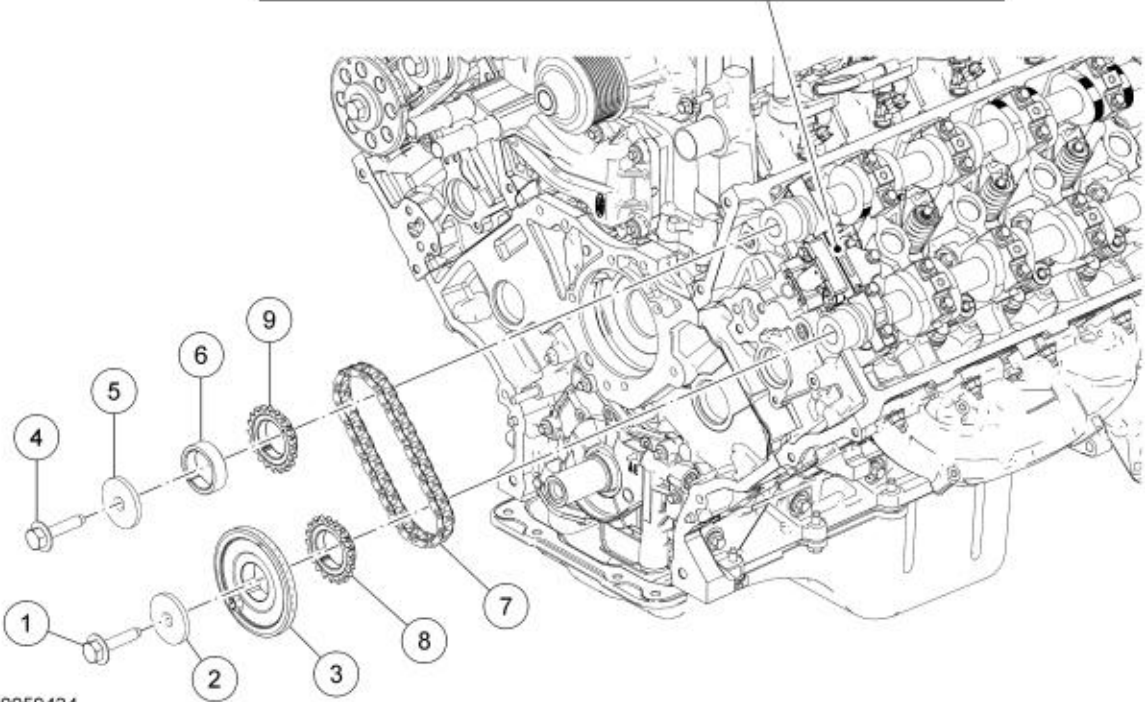
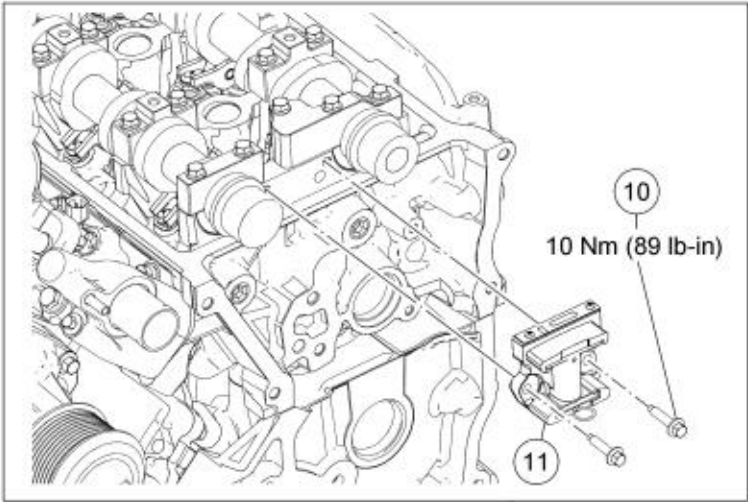


Camshaft — LH

Special Tool(s)	
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)

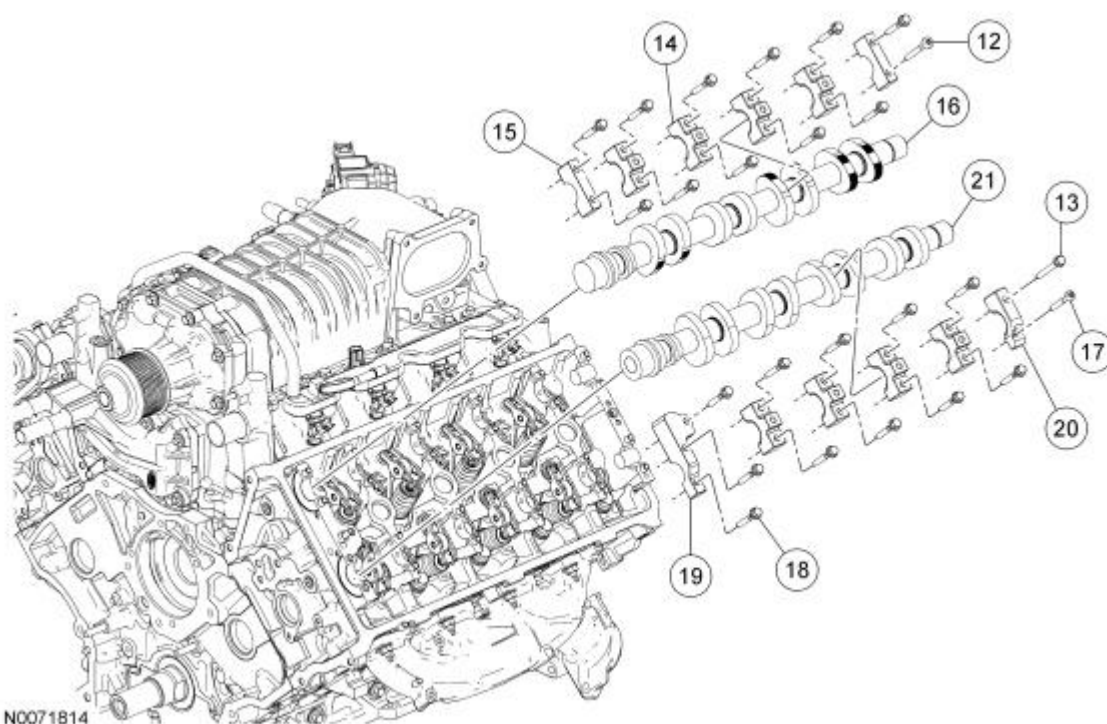
Material	
Item	Specification
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT	WSS-M2C931-C

LH Camshaft (View 1 of 2)



Item	Part Number	Description
1	N811085	Camshaft drive sprocket bolt
2	N806164	Camshaft drive sprocket washer
3	6C253	Camshaft drive sprocket
4	N811085	Camshaft drive sprocket bolt
5	N806164	Camshaft drive sprocket washer
6	6265	Camshaft drive sprocket spacer
7	6268	Secondary timing chain
8	6256	Exhaust camshaft drive sprocket
9	6256	Intake camshaft drive sprocket
10	W500215	LH secondary timing chain tensioner bolt (2 required)
11	6C271	LH secondary timing chain tensioner

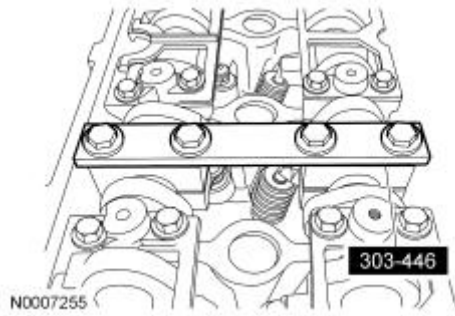
## LH Camshaft (View 2 of 2)



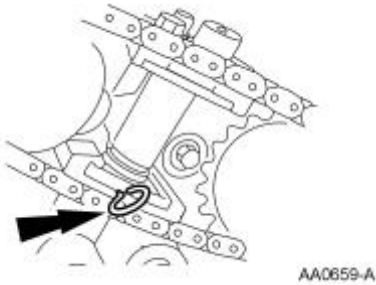
Item	Part Number	Description
12	W710990	Intake camshaft bearing cap bolt
13	N807352	Intake/exhaust camshaft bearing cap bolt (22 required)
14	6B277	Intake/exhaust camshaft bearing cap (8 required)
15	6B277	Intake camshaft bearing cap (2 required)
16	6A271	LH intake camshaft
17	W710991	Exhaust camshaft bearing cap bolt
18	W705438	Exhaust camshaft bearing cap bolt (3 required)
19	6B278	Exhaust camshaft bearing cap
20	6B278	Exhaust camshaft bearing cap
21	6A273	LH exhaust camshaft

## Removal

1. Remove the timing drive components. Refer to Timing Drive Components.
2. Install the Camshaft Holding Tool.



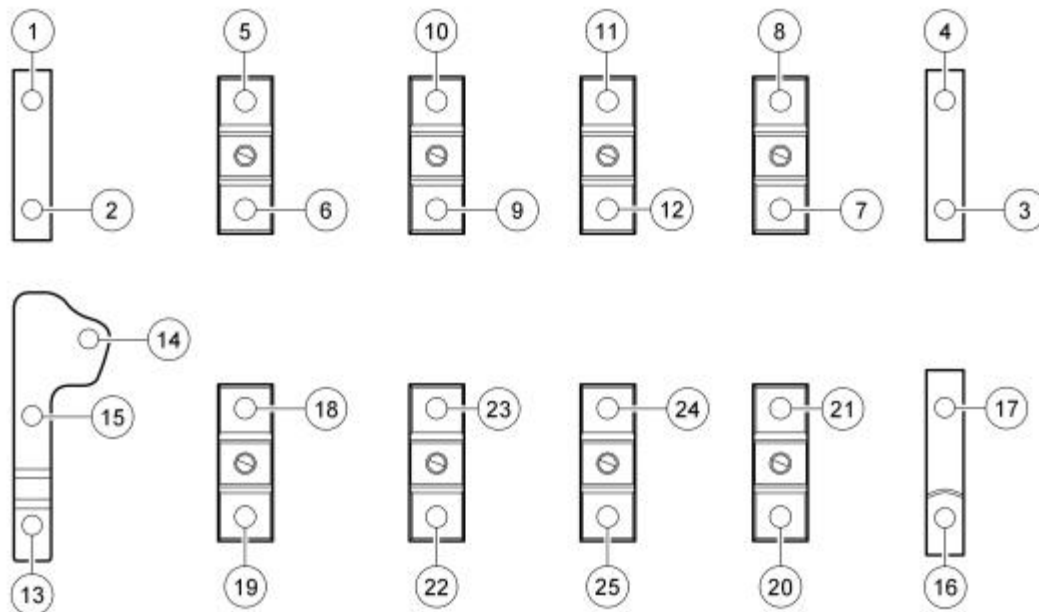
3. Remove the bolt, washer and camshaft drive sprocket.
4. Remove the bolt, washer and camshaft sprocket spacer.
5. Compress the secondary timing chain tensioner and install a lockpin.



6. Remove the timing chain and the 2 camshaft sprockets.
7. Remove the 2 bolts and the secondary timing chain tensioner.
8. **NOTICE:** The camshaft bearing cap bolts vary in length and head design and must be installed in their original positions. Camshaft bearing caps are not interchangeable and must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.

Remove the camshaft bearing cap bolts in the sequence shown.

- Loosen the camshaft bearing cap bolts, in sequence one turn at a time until all tension is released from the camshaft bearing caps.
- Remove the camshaft bearing caps.
- Remove the camshafts.



N0142771

## Installation

1. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

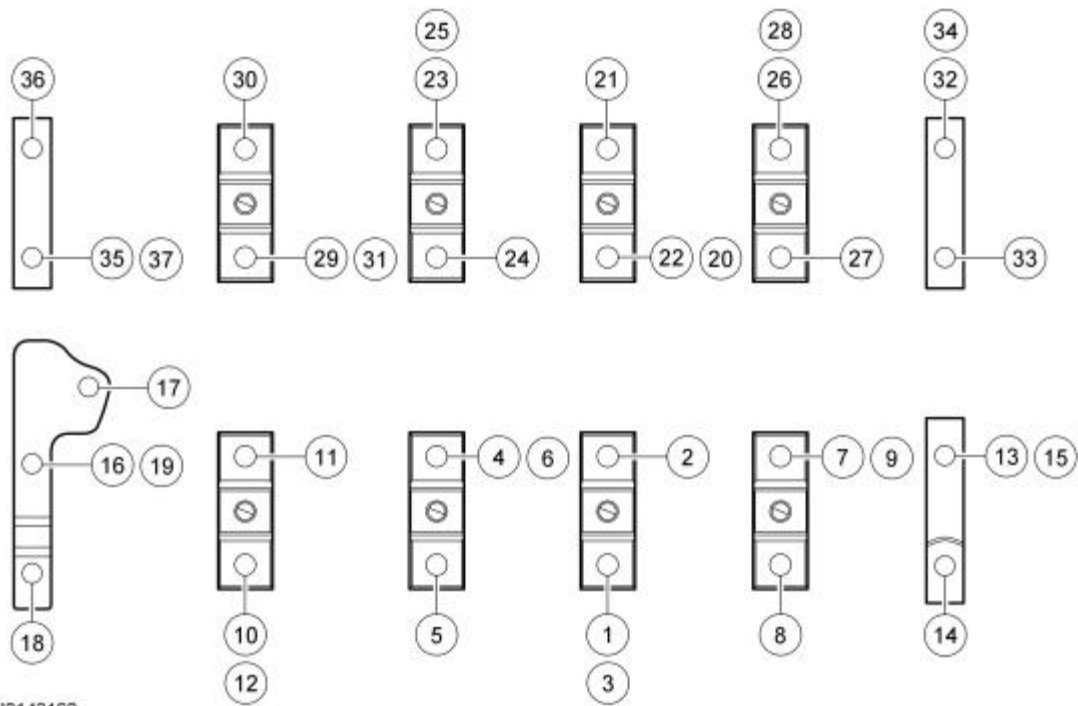
Install the camshafts.

2. **NOTICE:** The camshaft bearing cap bolts vary in length and head design and must be installed in their original positions. Camshaft bearing caps are not interchangeable and must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.

**NOTE:** Lubricate the camshaft bearing cap bearing surfaces with clean engine oil prior to installation.

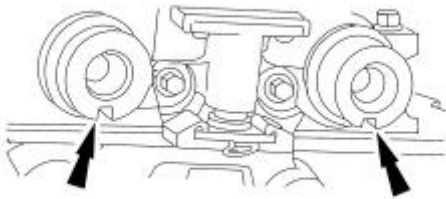
Install the camshaft bearing caps and bearing cap bolts. Tighten in the sequence shown in 2 stages.

- Stage 1: Tighten the camshaft bearing cap bolts one turn at a time, until finger tight.
- Stage 2: Tighten to 10 Nm (89 lb-in).



N0143162

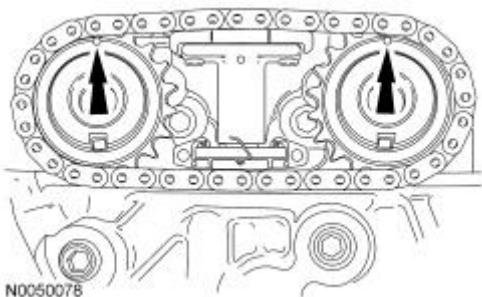
3. Install the secondary timing chain tensioner and the bolts.
  - Tighten to 10 Nm (89 lb-in).
4. Index the keyways on the camshafts to the 6 o'clock position.



N0050077

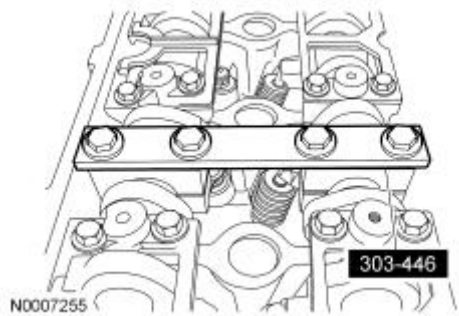
5. **NOTICE:** Timing marks must be at the 12 o'clock position or damage to the engine may occur.

Install the camshaft sprockets and the chain as an assembly.



N0050078

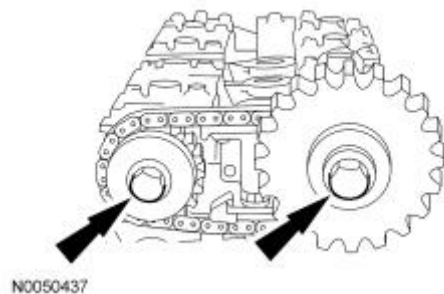
6. Install the Camshaft Holding Tool.



7. Install the camshaft sprocket spacer, washer and bolt, and hand-tighten the bolt.

8. Install the camshaft drive sprocket, washer and bolt, and hand-tighten the bolt.

9. Tighten the bolts in 2 stages:
- Stage 1: Tighten to 40 Nm (30 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



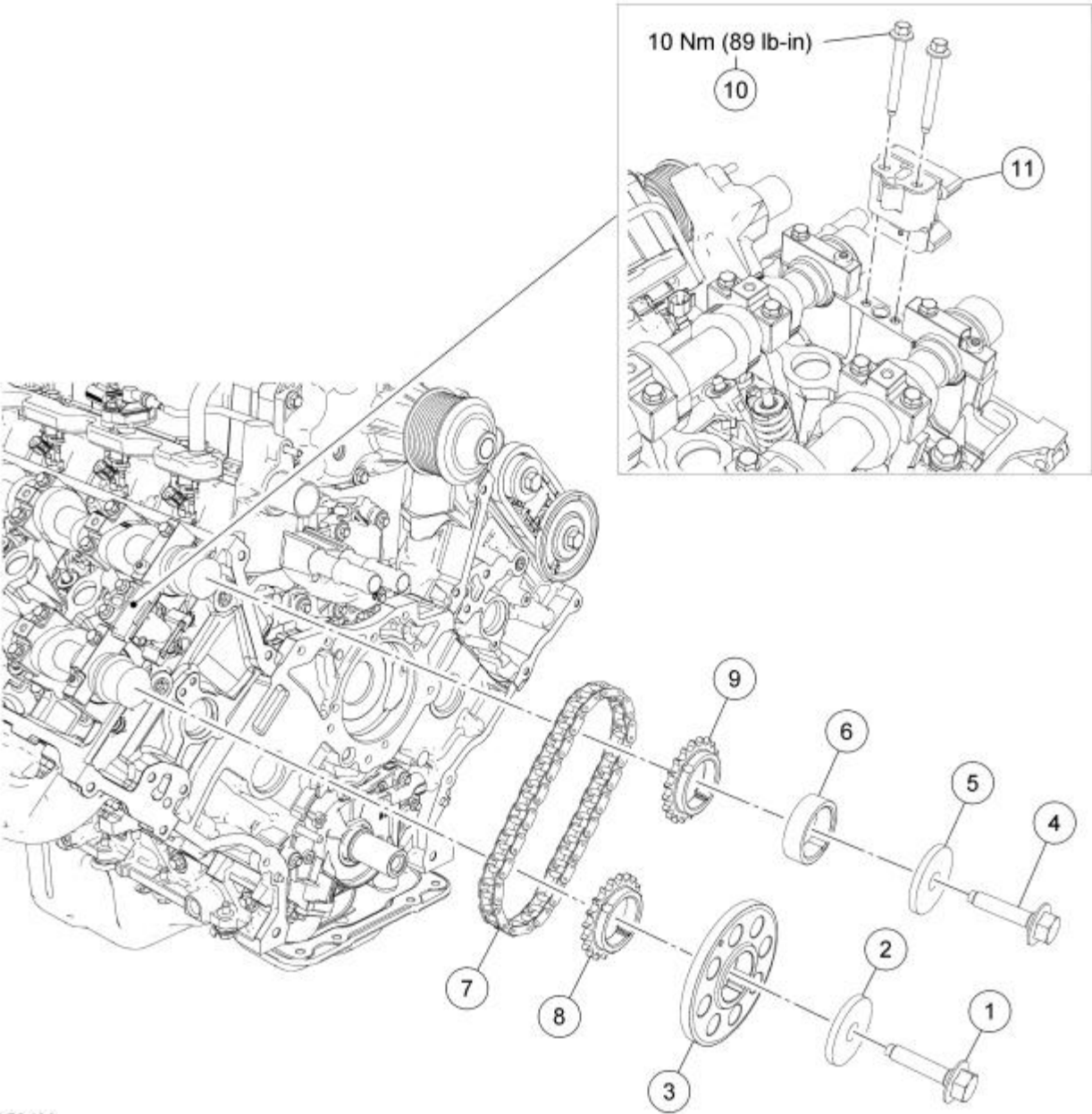
10. Install the timing drive components. Refer to Timing Drive Components.

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## Camshaft — RH

Special Tool(s)	
 <p>ST1715-A</p>	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)

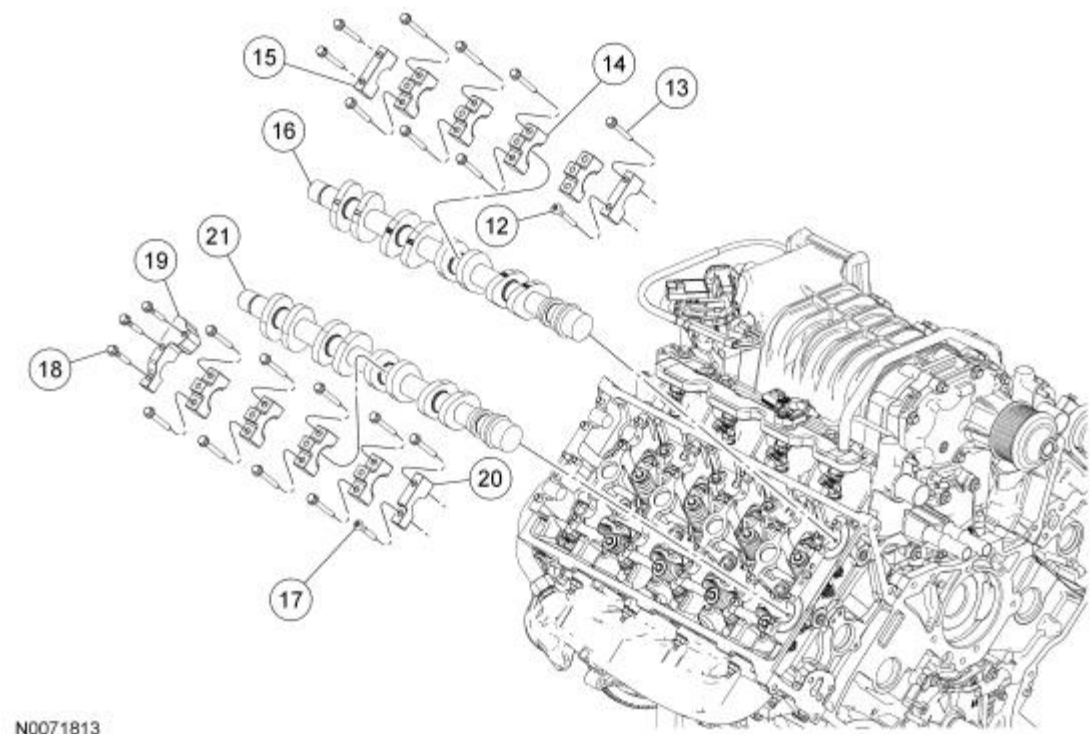
Material		
Item		Specification
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT		WSS-M2C931-C



N0050432

Item	Part Number	Description
1	N811085	Camshaft drive sprocket bolt
2	N806164	Camshaft drive sprocket washer
3	6C253	Camshaft drive sprocket
4	N811085	Camshaft drive sprocket bolt
5	N806164	Camshaft drive sprocket washer
6	6265	Camshaft drive sprocket spacer
7	6268	Secondary timing chain
8	6256	Exhaust camshaft drive sprocket
9	6256	Intake camshaft drive sprocket
10	W500304	RH secondary timing chain tensioner bolt (2 required)
11	6C270	RH secondary timing chain tensioner

RH Camshaft (View 2 of 2)

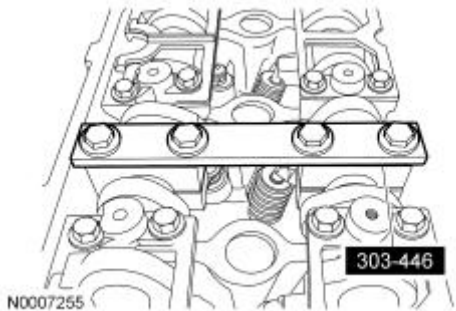


N0071813

Item	Part Number	Description
12	W710990	Intake camshaft bearing cap bolt
13	N807352	Intake/exhaust camshaft bearing cap bolt (22 required)
14	6B277	Intake/exhaust camshaft bearing cap (8 required)
15	6B277	Intake camshaft bearing cap (2 required)
16	6A270	RH intake camshaft
17	W710991	Exhaust camshaft bearing cap bolt
18	W705438	Exhaust camshaft bearing cap bolt (3 required)
19	6B278	Exhaust camshaft bearing cap
20	6B278	Exhaust camshaft bearing cap
21	6A272	RH exhaust camshaft

Removal

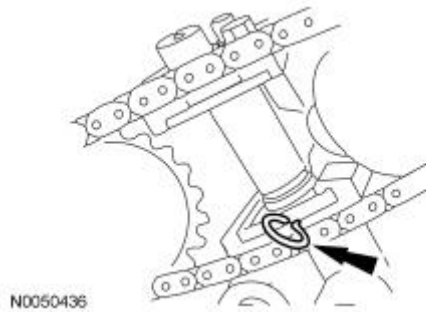
1. Remove the timing drive components. Refer to Timing Drive Components.
2. Install the Camshaft Holding Tool.



3. Remove the bolt, washer and camshaft drive sprocket.
4. Remove the bolt, washer and camshaft sprocket spacer.



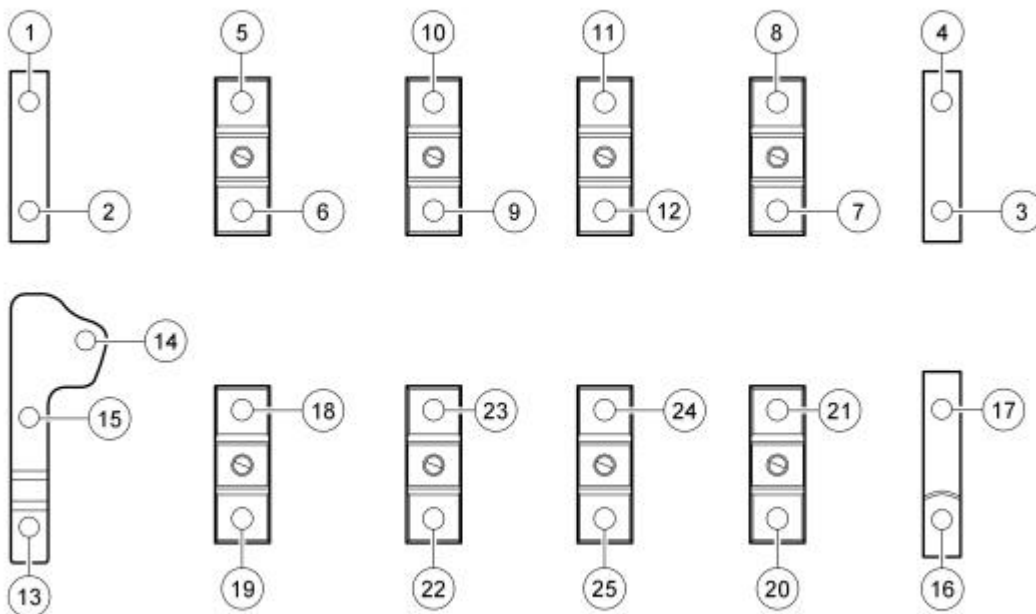
5. Compress the secondary timing chain tensioner and install a lockpin.



6. Remove the secondary timing chain and the 2 camshaft sprockets.
7. Remove the 2 bolts and the secondary timing chain tensioner.
8. **NOTICE:** The camshaft bearing cap bolts vary in length and head design and must be installed in their original positions. Camshaft bearing caps are not interchangeable and must be installed in their original positions. If not reassembled in their original positions, severe engine damage may occur.

Remove the camshaft bearing cap bolts in the sequence shown.

- Loosen the camshaft bearing cap bolts, in sequence one turn at a time until all tension is released from the camshaft bearing caps.
- Remove the camshaft bearing caps.
- Remove the camshafts.



## Installation

1. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

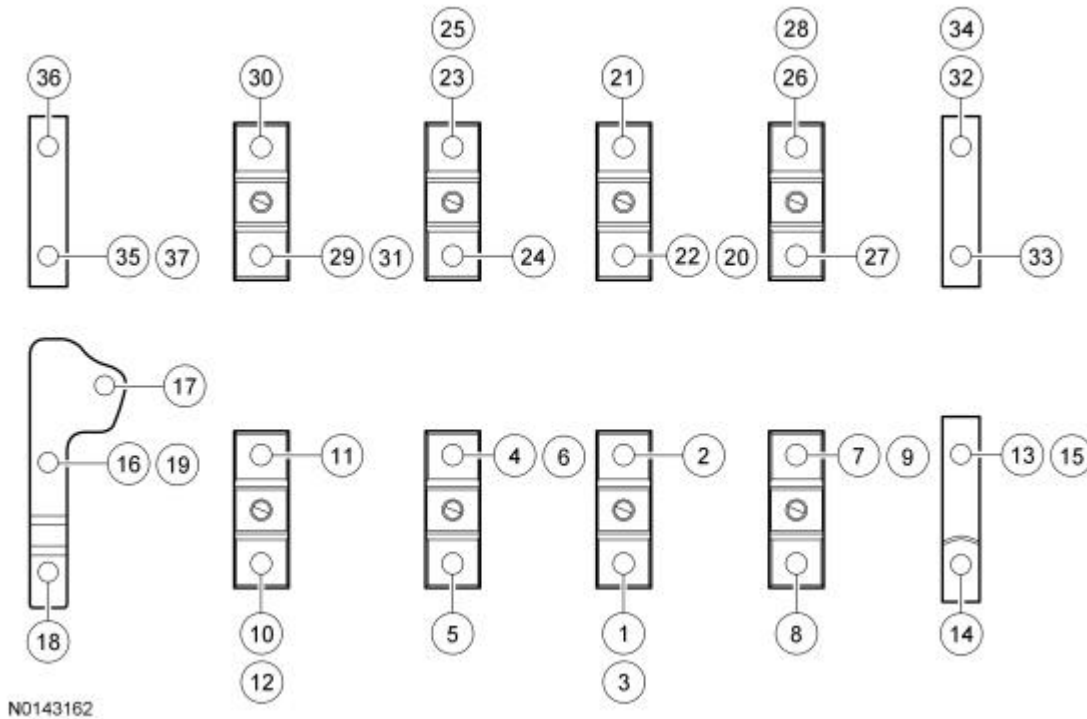
Install the camshafts.

2. **NOTICE:** The camshaft bearing cap bolts vary in length and head design and must be installed in their original positions. Camshaft bearing caps are not interchangeable and must be installed in their original positions. If not assembled in their original positions, severe engine damage may occur.

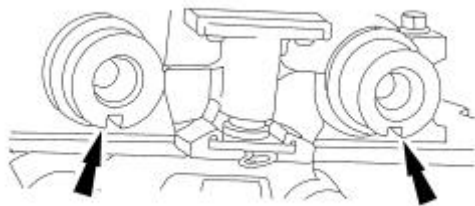
**NOTE:** Lubricate the camshaft bearing cap bearing surfaces with clean engine oil prior to installation.

Install the camshaft bearing caps and bearing cap bolts. Tighten in the sequence shown in 2 stages.

- Stage 1: Tighten the camshaft bearing cap bolts one turn at a time, until finger tight.
- Stage 2: Tighten to 10 Nm (89 lb-in).



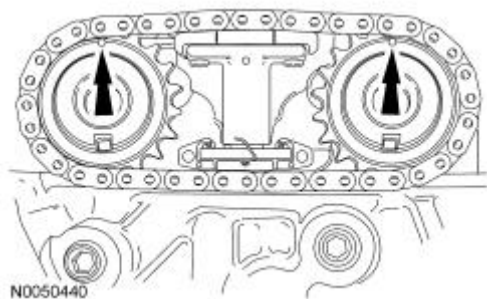
3. Install the secondary timing chain tensioner and the bolts.
  - Tighten to 10 Nm (89 lb-in).
4. Index the keyways on the camshafts to the 6 o'clock position.



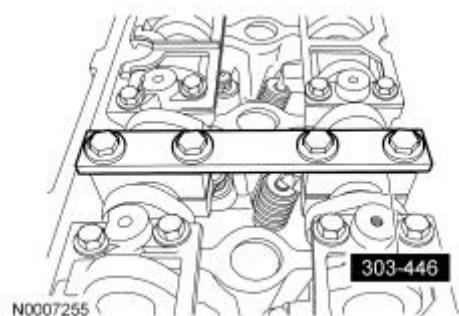
5. **NOTICE:** Timing marks must be at the 12 o'clock position or damage to the engine may occur.

Install the camshaft sprockets and the secondary timing chain as an assembly.

- Remove the lockpin from the secondary timing chain tensioner.



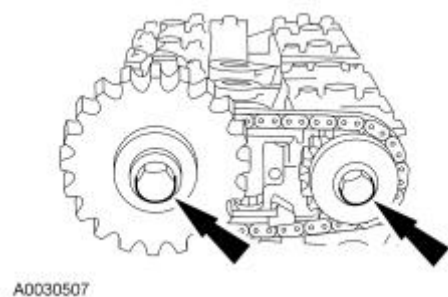
6. Install the Camshaft Holding Tool.



7. Install the camshaft drive sprocket spacer, washer and bolt, and hand-tighten the bolt.

8. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.

9. Tighten the bolts in 2 stages:
- Stage 1: Tighten to 40 Nm (30 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



10. Install the timing drive components. Refer to Timing Drive Components.
-

## Timing Drive Components

### Special Tool(s)



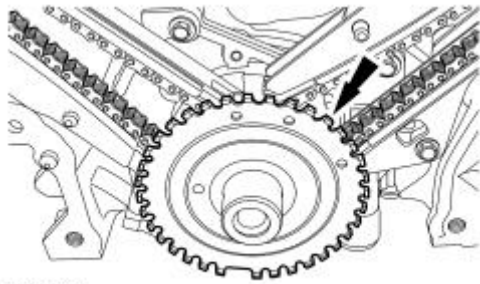
ST1335-A

Holding Tool, Crankshaft  
303-448 (T93P-6303-A)

### Removal

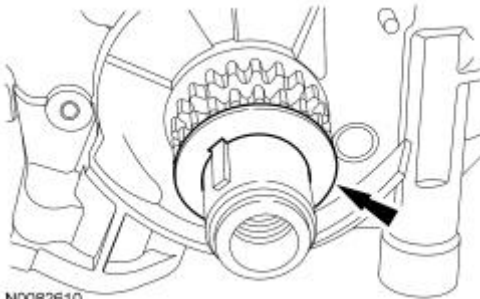
**NOTICE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.
2. Remove the camshaft roller followers. For additional information, refer to Valve Train Components — Exploded View and Camshaft Roller Follower in this section.
3. Remove the crankshaft sensor ring.



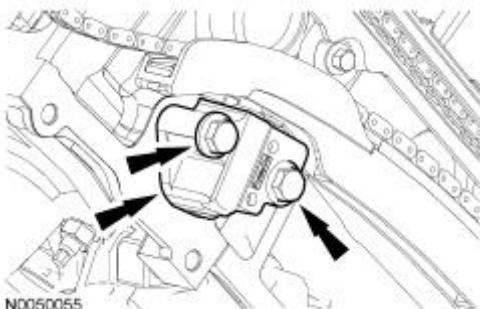
N0050053

4. Remove the crankshaft washer.



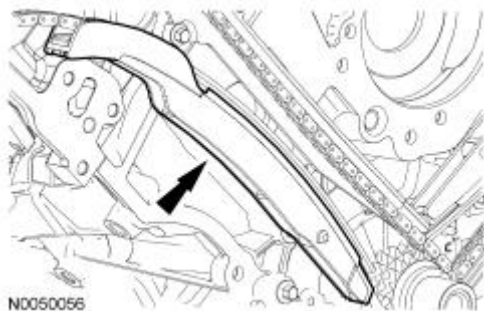
N0082610

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

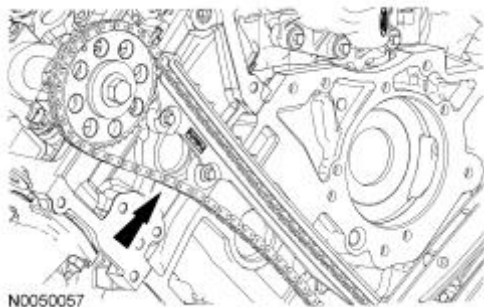


N0050055

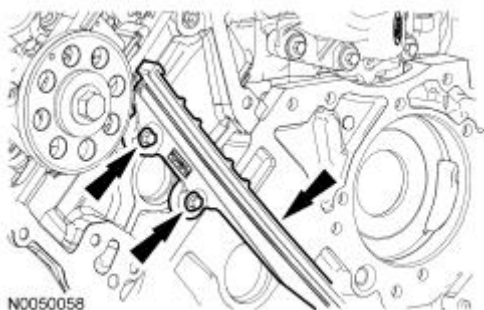
6. Remove the RH primary timing chain tensioner arm.



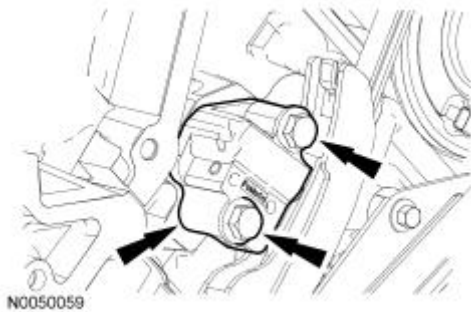
7. Remove the RH primary timing chain.



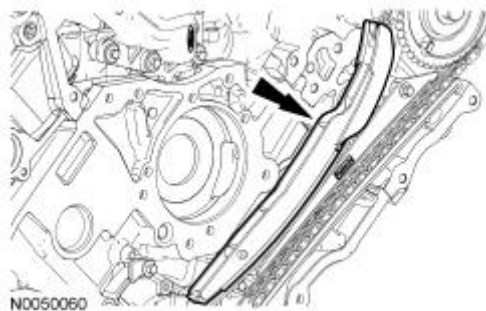
8. Remove the 2 bolts and the RH primary timing chain guide.



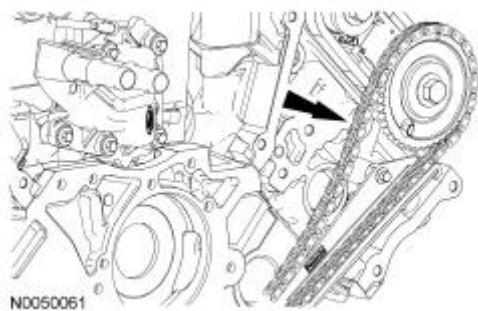
9. Remove the 2 bolts and the LH primary timing chain tensioner.



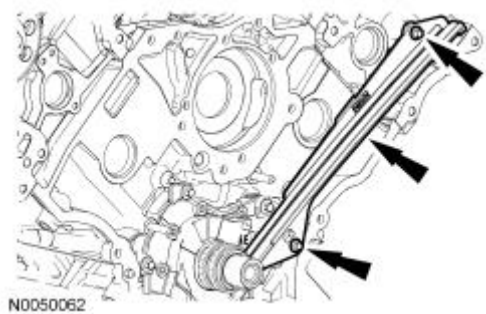
10. Remove the LH primary timing chain tensioner arm.



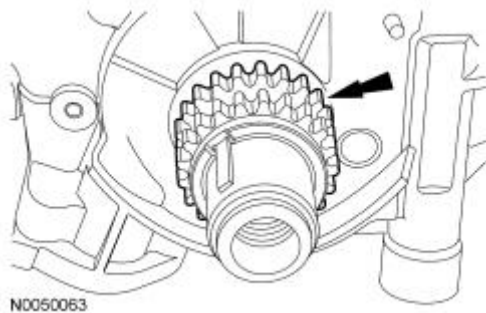
11. Remove the LH primary timing chain.



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



13. Remove the crankshaft sprocket.

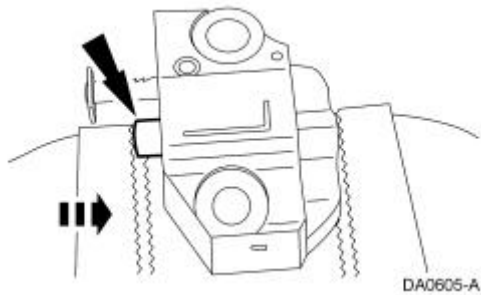


## Installation

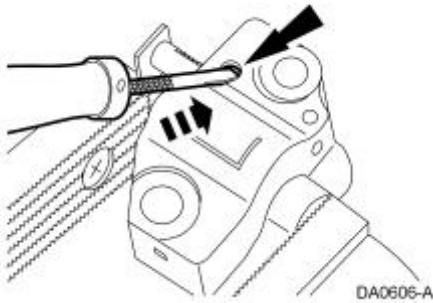
1. **NOTICE:** Do not compress the ratchet assembly. This will damage the ratchet assembly.

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

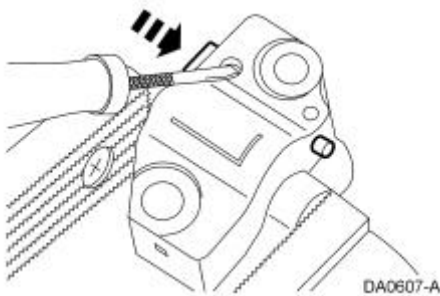
Compress each tensioner plunger, using an edge of a vise.



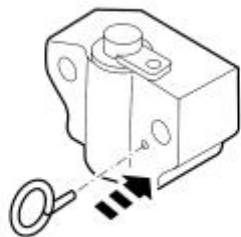
2. Using a small screwdriver or pick, push back and hold the ratchet mechanism.



3. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.

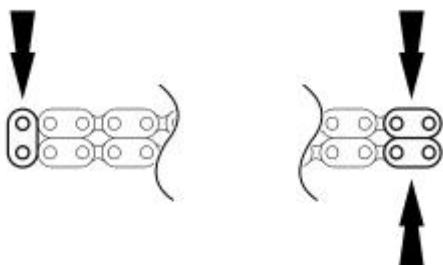


4. Install a suitable pin into the hole of each tensioner housing to hold the ratchet assembly and plunger in place during installation.
- Remove the tensioner from the vise.



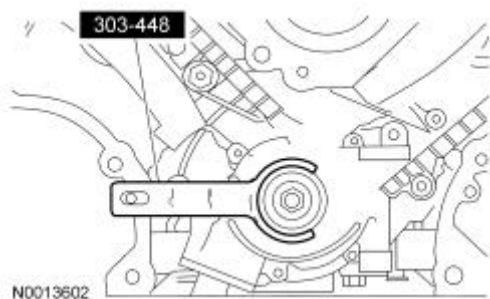
A26917-A

5. If the colored links are not visible, mark one link on one end and 2 links on the other end, and use as timing marks.



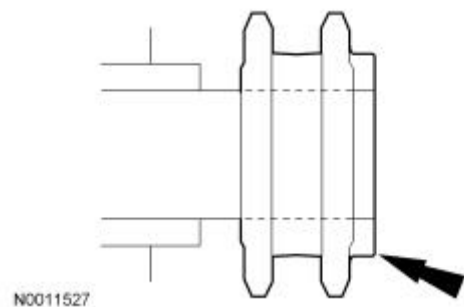
A0038720

6. Using the Crankshaft Holding Tool, position the crankshaft.



N0013602

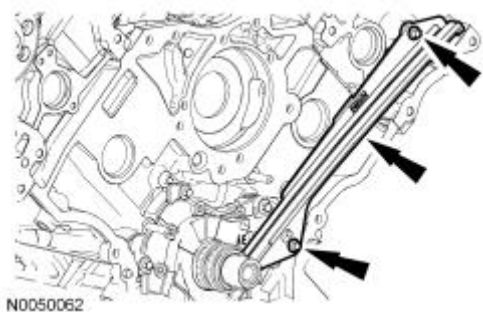
7. Install the crankshaft sprocket with the flange facing forward.



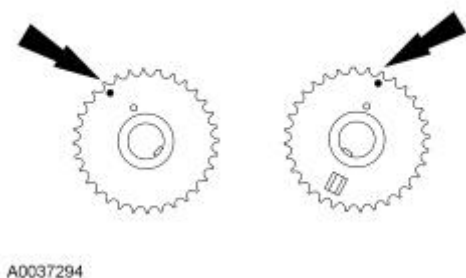
N0011527



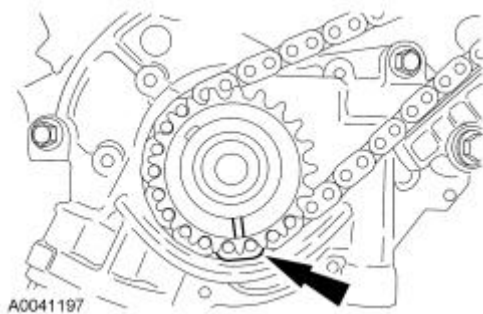
8. Install the LH primary timing chain guide and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).



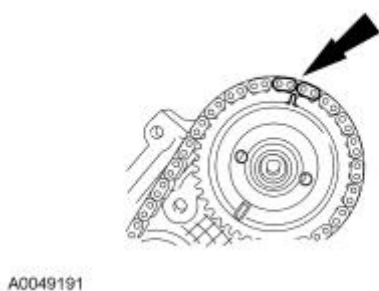
9. Position the camshaft sprocket timing marks as shown.



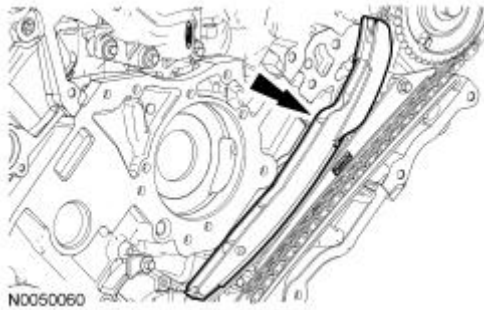
10. Position the LH (inner) timing chain onto the crankshaft sprocket, aligning the one colored link on the timing chain with the slot on the crankshaft sprocket.



11. Install the LH timing chain on the camshaft sprocket, aligning the 2 colored links with the timing mark on the sprocket.

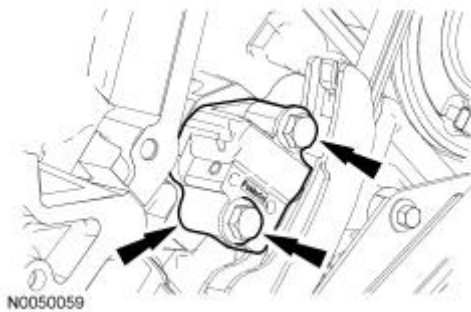


12. Install the LH primary timing chain tensioner arm.



13. Install the LH primary timing chain tensioner and the 2 bolts.

- Tighten to 25 Nm (18 lb-ft).
- Remove the pin from the tensioner.

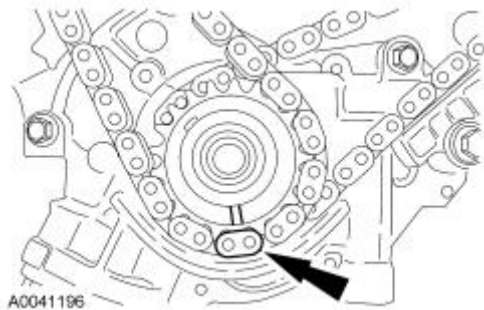


14. Install the RH primary timing chain guide and the 2 bolts.

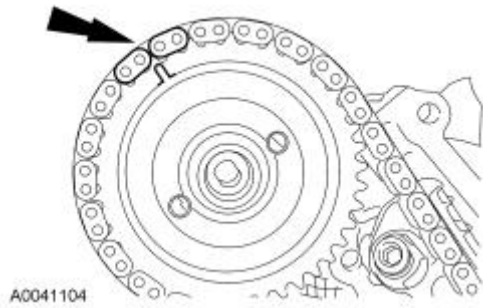
- Tighten to 10 Nm (89 lb-in).



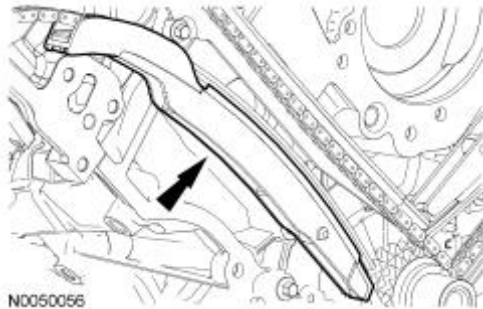
15. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the colored link with the timing marks on the sprocket.



16. Install the RH timing chain on the camshaft sprocket, aligning the 2 colored links with the timing mark on the sprocket.

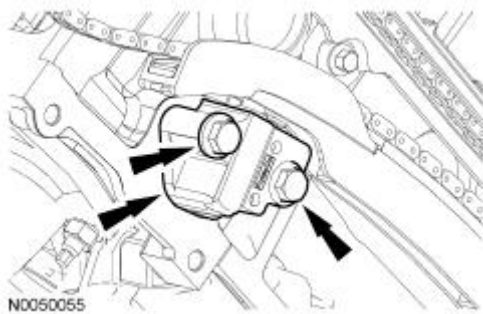


17. Install the RH primary timing chain tensioner arm.

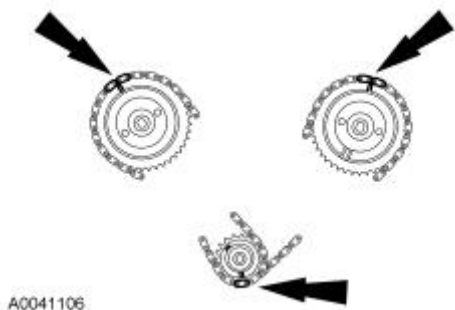


18. Install the RH primary timing chain tensioner and the 2 bolts.

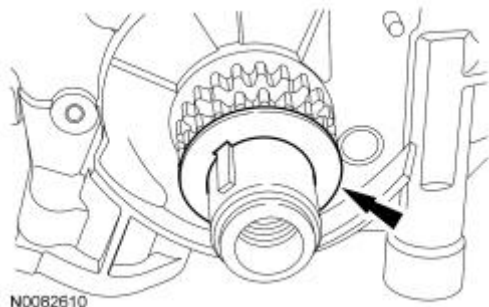
- Tighten to 25 Nm (18 lb-ft).
- Remove the pin from the tensioner.



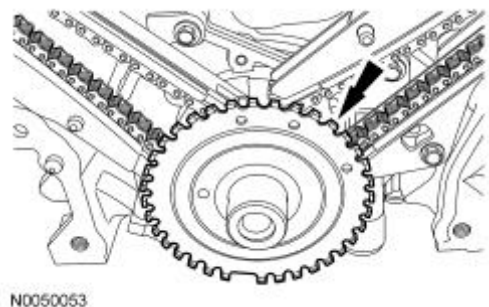
19. As a post-check, verify correct alignment of all timing marks. Make sure that the colored links are lined up with the marks on the crankshaft sprocket and the camshaft sprockets.



20. Install the crankshaft washer.



21. Install the crankshaft sensor ring.

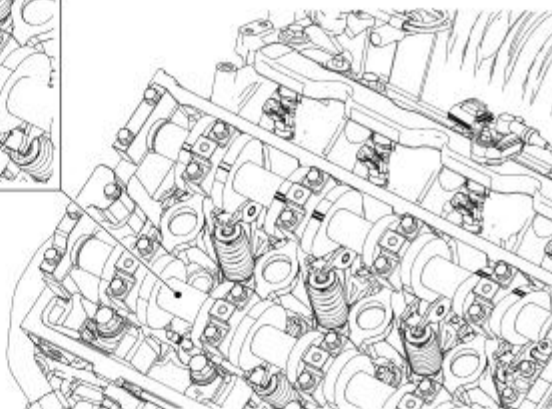
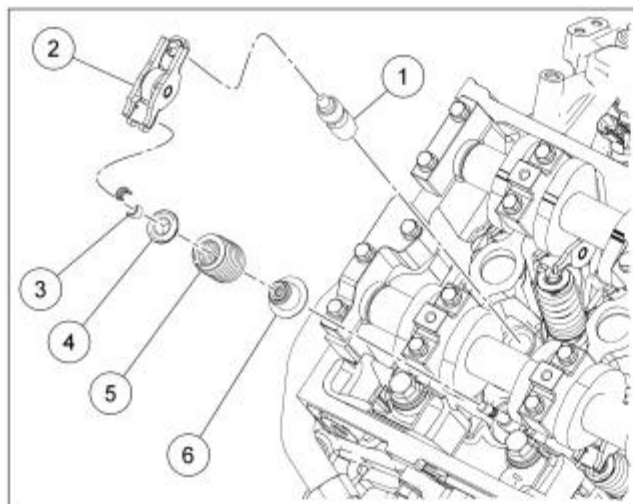


22. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

23. Install the camshaft roller followers. For additional information, refer to Valve Train Components — Exploded View and Camshaft Roller Follower in this section.

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## Valve Train Components — Exploded View




Item	Part Number	Description
1	6C501	Hydraulic lash adjuster (32 required)
2	6529	Camshaft roller follower (32 required)
3	6518	Valve spring retainer key (64 required)
4	6514	Valve spring retainer (32 required)
5	6513	Valve spring (32 required)
6	6A517	Valve seal (32 required)

1. For additional information, refer to the procedures in this section.

## Camshaft Roller Follower

### Special Tool(s)

 <p>ST1718-A</p>	Compressor, Valve Spring 303-452 (T93P-6565-AR)
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### Material

Item	Specification
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT	WSS-M2C931-C

## Removal and Installation

**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.

1. **NOTE:** If servicing both the RH and LH cylinder head camshaft roller followers, the LH valve cover procedure must be completed prior to the RH valve cover procedure.

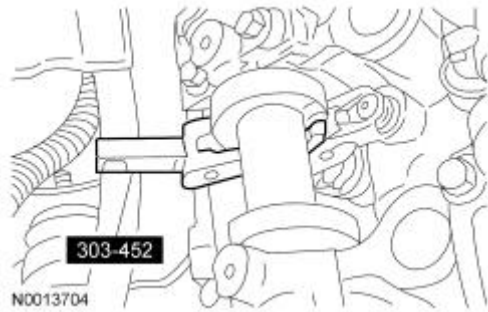
Depending on which cylinder head is being serviced, remove the RH or LH valve cover. For additional information, refer to Valve Cover — RH or Valve Cover — LH in this section.

2. **NOTE:** If the engine is difficult to rotate while positioning the piston to the bottom of the cylinder, remove the spark plugs.

Position the camshaft lobe at base circle.

3. **NOTICE:** If the roller followers are to be reinstalled, they must be installed in their original positions. Mark the roller followers 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.

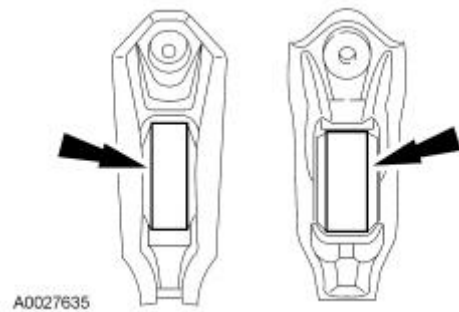


4. Repeat the previous 2 steps to remove each of the roller followers.
  - Inspect the roller followers. For additional information, refer to Section 303-00.
5. To install, reverse the removal procedure.
  - Lubricate each of the roller followers with clean engine oil prior to installation.





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## Roller Follower Inspection

1. Inspect the roller follower for flat spots or scoring. If any damage is found, inspect the camshaft lobes and hydraulic lash adjuster for damage.

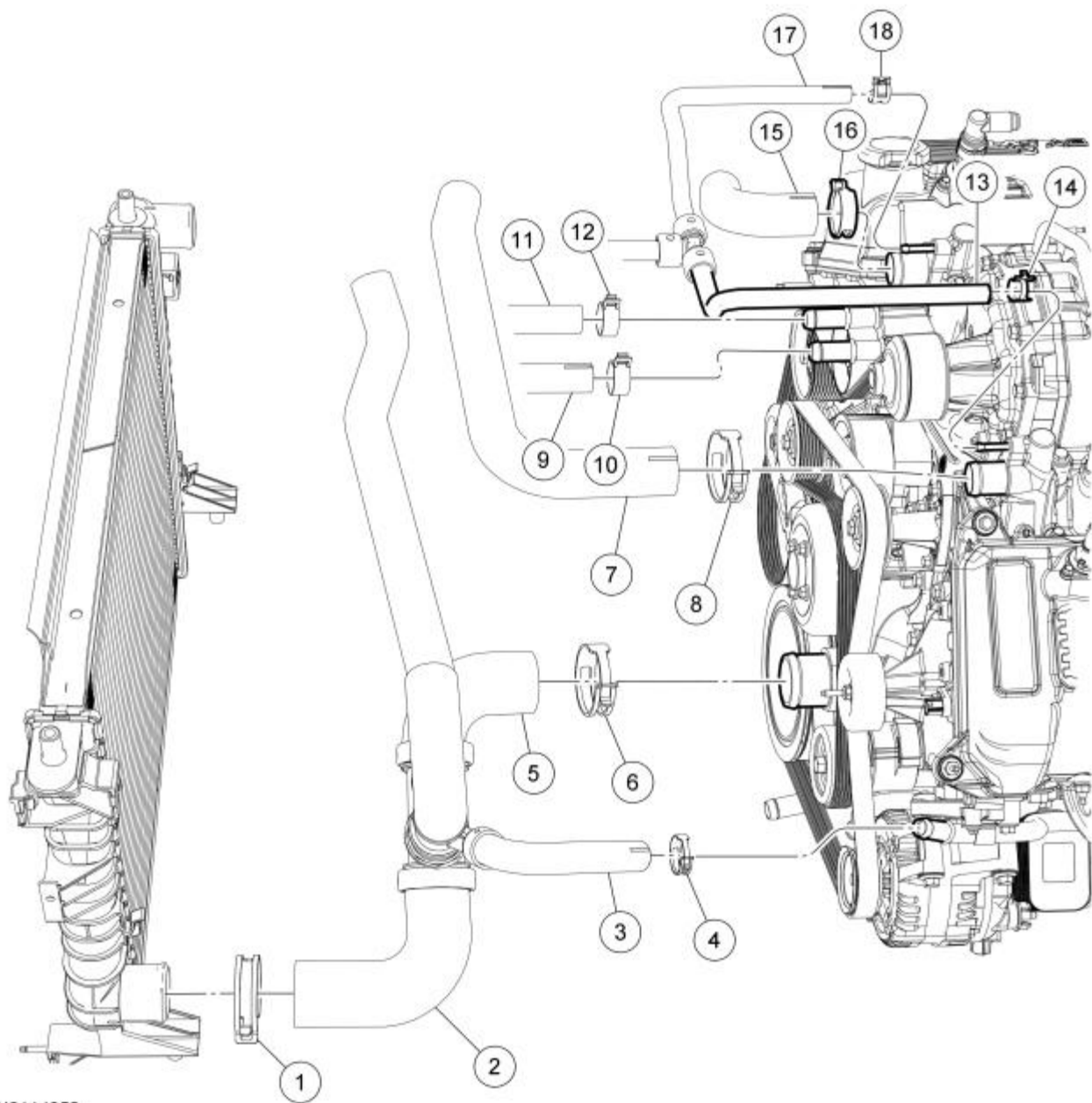


Engine Front Cover

Special Tool(s)	
 ST1603-A	Lifting Bracket, Engine (2 required) 303-D087 (D93P-6001-A1) or equivalent
 ST2176-B	Support Bar, Engine 303-F070
 ST2425-A	Support Bar, Engine 303-F072
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material	
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT	WSS-M2C931-C
Motorcraft® Silicone Gasket Remover ZC-30	—

Engine Front Cover (View 1 of 4)



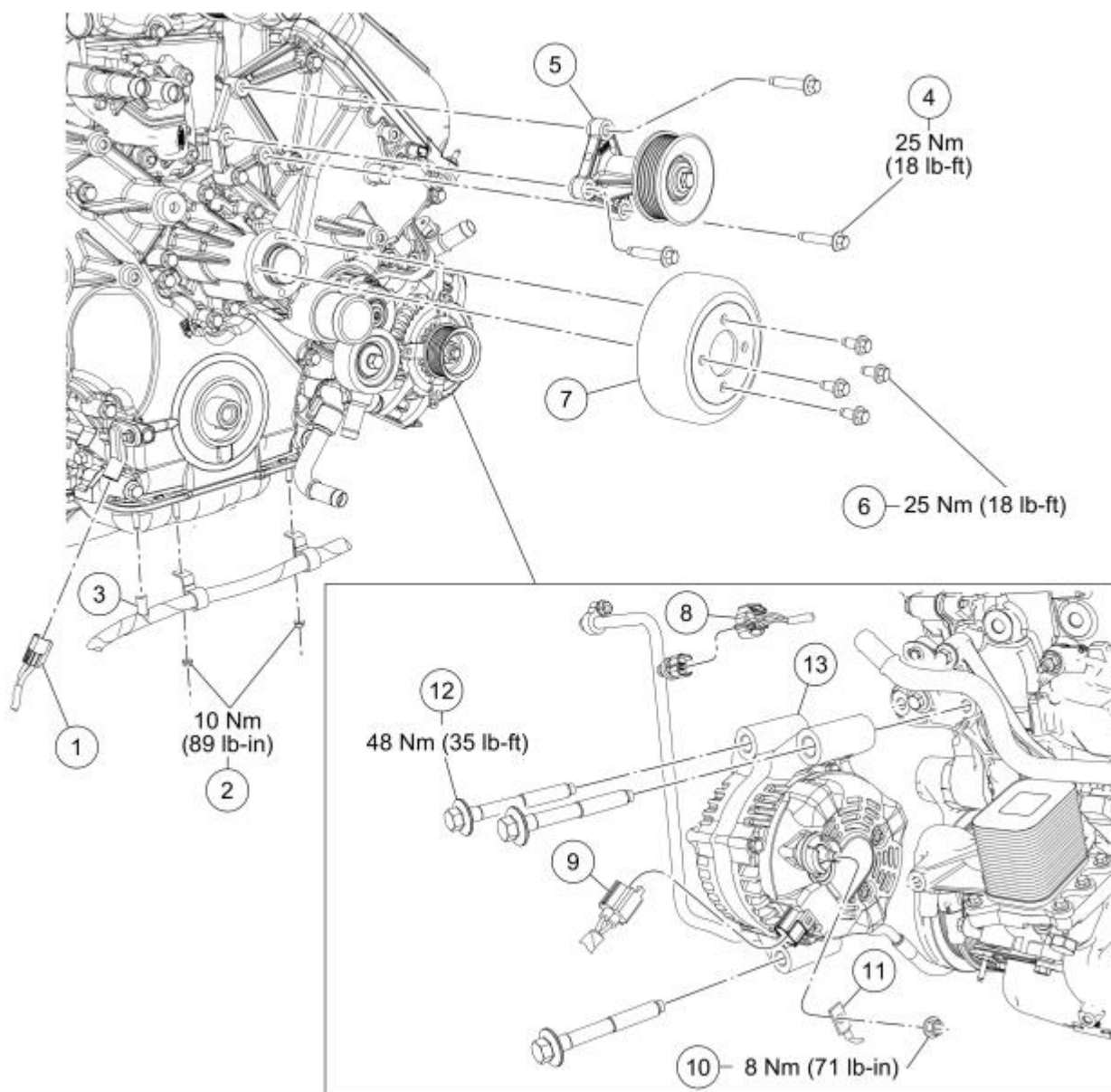
N0114958

Item	Part Number	Description
1	15161	Lower radiator hose assembly-to-radiator clamp
2	8B273	Lower radiator hose assembly-to-radiator
3	8B273	Lower radiator hose assembly-to-coolant tube assembly
4	15161	Lower radiator hose assembly-to-coolant tube assembly clamp
5	8B273	Lower radiator hose assembly-to-coolant pump
6	15161	Lower radiator hose assembly-to-coolant pump clamp
7	8A586	Upper radiator hose
8	15161	Upper radiator hose clamp
9	8D031	Charge Air Cooler (CAC) coolant hose
10	W527362	CAC coolant hose clamp
11	8D030	CAC coolant hose
12	W527362	CAC coolant hose clamp
13	8276	Coolant vent hose



14	W527352	Coolant vent hose clamp
15	8A586	Upper radiator hose
16	15161	Upper radiator hose clamp
17	8276	Coolant vent hose
18	W527352	Coolant vent hose clamp

## Engine Front Cover (View 2 of 4)



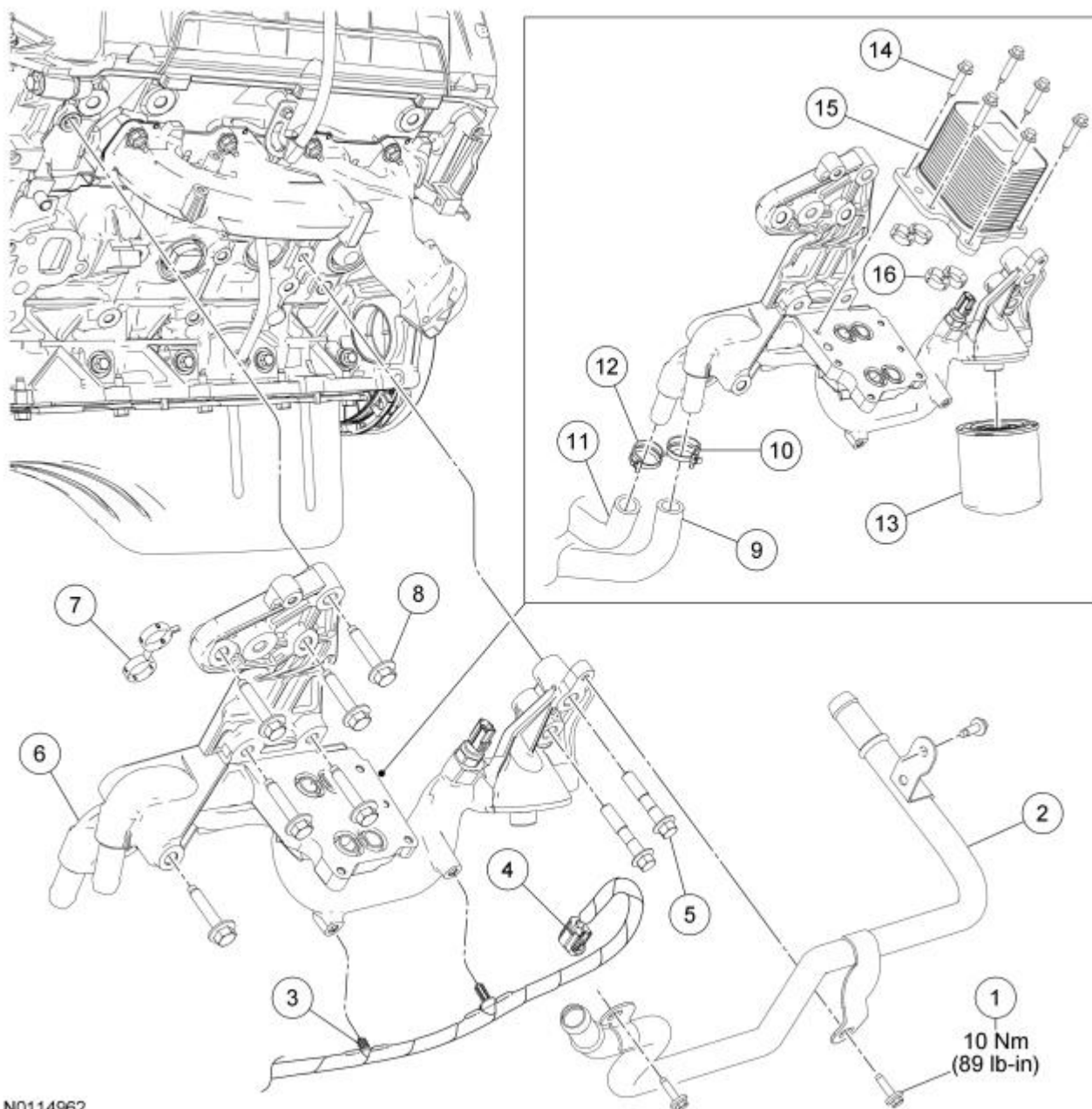
N0143380

Item	Part Number	Description
1	—	Crankshaft Position (CKP) sensor electrical connector (part of 12B637)
2	W701852	Wire harness retainer bracket nuts
3	—	Wire harness retainer (part of 12B637)
4	W500310	Accessory drive idler pulley and bracket bolt (3 required)
5	6A553	Accessory drive idler pulley and bracket assembly

6	N806282	Coolant pump pulley bolt (4 required)
7	8A528	Coolant pump pulley
8	—	A/C pressure transducer electrical connector (part of 12B637)
9	—	Generator electrical connector (part of 12B637)
10	W705790	B+ wire terminal nut
11	—	B+ wire terminal (part of 14305)
12	N805424	Generator bolt (3 required)
13	10300	Generator

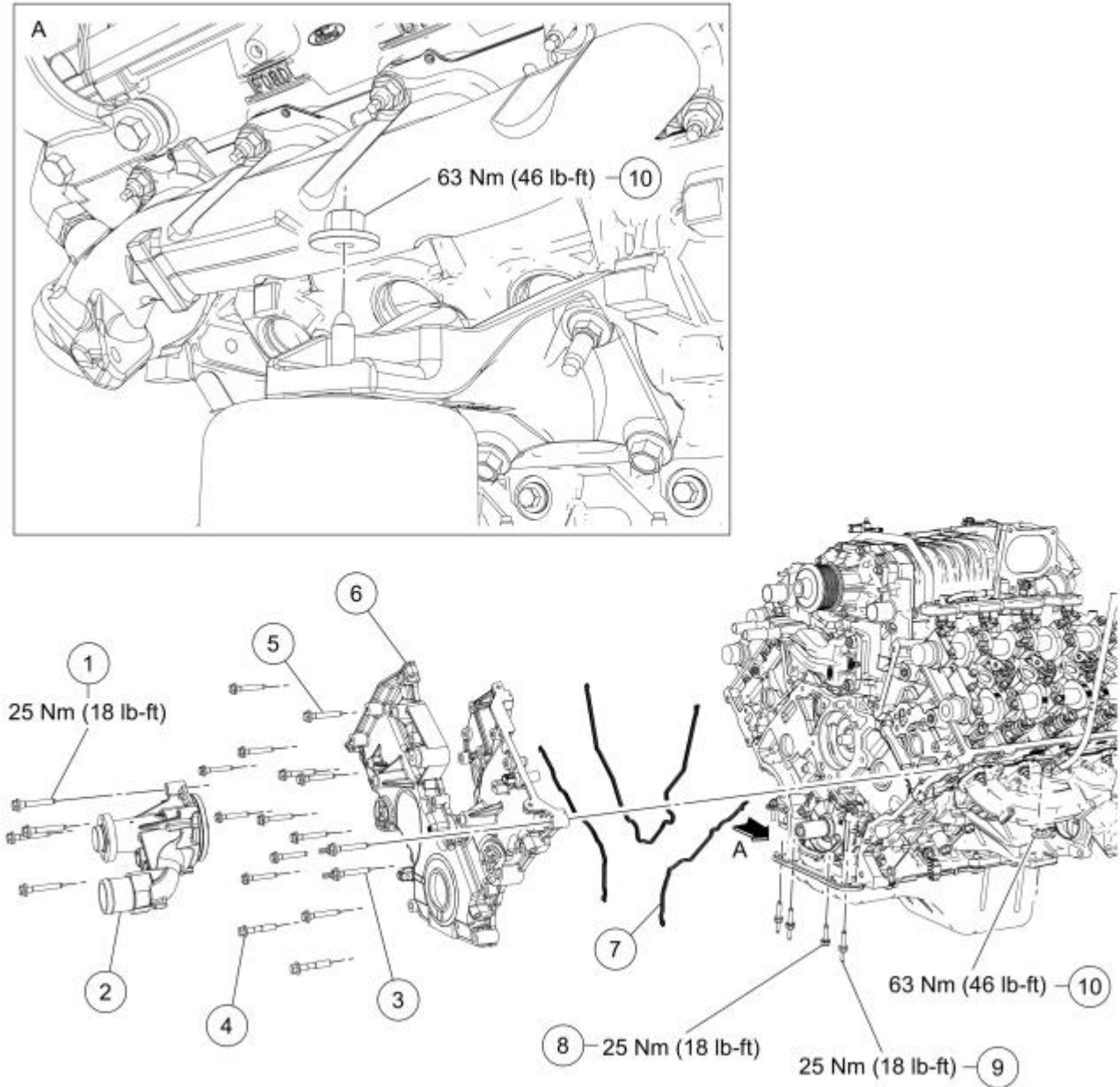
### Engine Front Cover (View 3 of 4)

**NOTE:** Oil cooler shown, oil cooler thermostat similar.



Item	Part Number	Description
1	N605891	Coolant tube assembly-to-oil filter adapter bolt (3 required)
2	18663	Coolant tube assembly
3	—	Wiring harness retainer (2 required) (part of 12B637)
4	—	Engine Oil Pressure (EOP) switch electrical connector (part of 12B637)
5	N807274	Oil filter adapter bolt (2 required)
6	6884	Oil filter adapter
7	6A636	Oil filter adapter gasket
8	W500325	Oil filter adapter bolt (6 required)
9	6B850	Coolant hose-to-oil filter adapter
10	15161	Coolant hose-to-oil filter adapter clamp
11	6B851	Lower radiator hose assembly-to-oil filter adapter
12	15161	Lower radiator hose assembly-to-oil filter adapter clamp
13	6714	Engine oil filter
14	N605893	Oil cooler bolt (6 required)
15	6A642	Oil cooler
16	6N818	Oil cooler gasket (4 required)

Engine Front Cover (View 4 of 4)



N0146243

Item	Part Number	Description
1	N806177	Coolant pump bolt (4 required)
2	8501	Coolant pump
3	N808586	Engine front cover stud bolt (2 required)
4	N606063	Engine front cover bolt (2 required)
5	N806177	Engine front cover bolt (12 required)
6	6C086	Engine front cover
7	6D081	Engine front cover gasket
8	W701605	Oil pan-to-engine front cover bolt
9	W701606	Oil pan-to-engine front cover stud bolt (3 required)
10	W712530	RH engine support insulator nut
11	W712530	LH engine support insulator nut

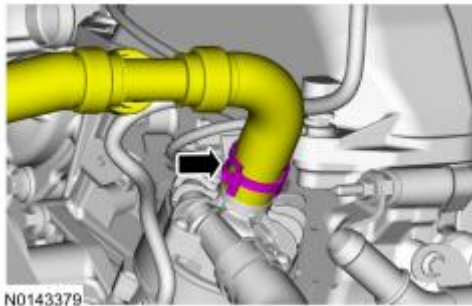
## Removal

### All vehicles

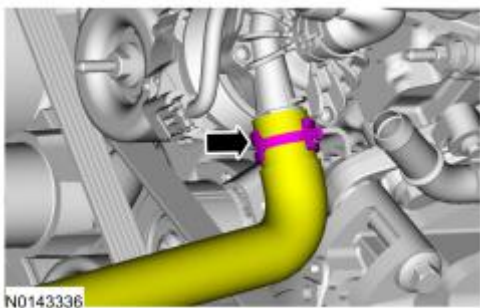
1. With the vehicle in NEUTRAL, position it on a hoist. Refer to Section 100-02.
2. Release the fuel system pressure. Refer to Section 310-00.
3. Remove the engine coolant degas bottle. Refer to Section 303-03A.
4. Remove the Supercharger (SC) coolant degas bottle. Refer to Section 303-03B.
5. Drain the SC cooling system. Refer to Section 303-03B
6. Remove the thermostat housing. Refer to Section 303-03A.
7. Loosen the 4 coolant pump pulley bolts.



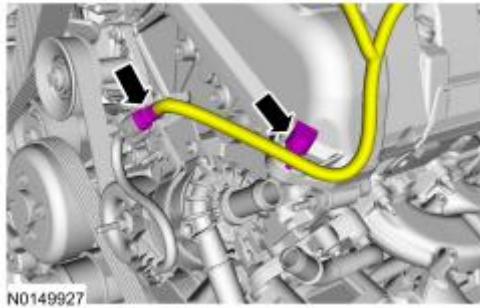
8. Remove the accessory drive belt, the 2 accessory drive belt idler pulleys and the accessory drive belt tensioner. Refer to Section 303-05.
9. Remove the 4 bolts and the coolant pump pulley.
10. Disconnect the upper coolant hose from the SC coolant pump.



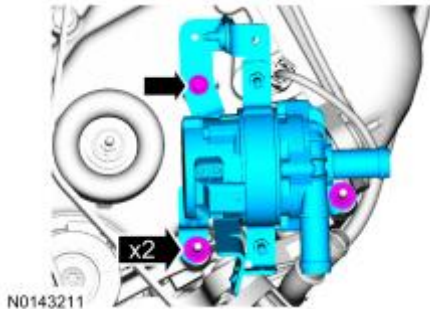
11. Disconnect the lower coolant hose from the SC coolant pump.



12. Disconnect the SC coolant pump electrical connector and wire retainer.

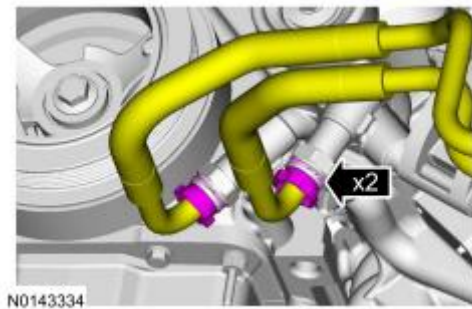


13. Remove the 2 nuts, bolt and the SC coolant pump.



#### Vehicle equipped with the cooling package

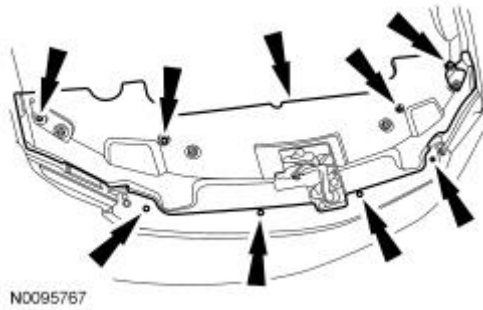
14. Remove the 2 retaining clips and disconnect the 2 oil hoses from the oil filter adapter.



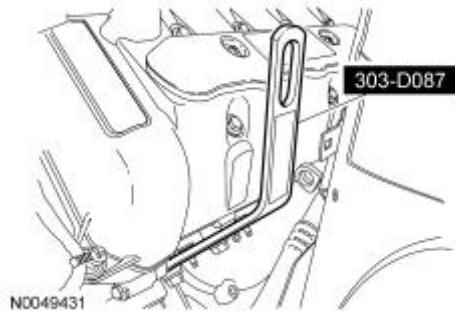
#### All vehicles

15. Remove the RH and LH valve covers. Refer to Valve Cover — RH and Valve Cover — LH.
16. Remove the SC drive belt, SC drive belt tensioner and the 3 SC drive belt idler pulleys. Refer to Section 303-05.
17. Remove the crankshaft front seal. Refer to Crankshaft Front Seal.
18. Disconnect the 2 coolant vent hoses from the intake manifold.
19. Disconnect the 2 upper radiator hoses from the intake manifold.
20. Disconnect the coolant hoses from the Charge Air Cooler (CAC).
21. Disconnect the lower radiator hose assembly from the coolant pump, radiator, oil filter adapter (if equipped) and the coolant tube assembly (located above the generator).
  - Remove the lower radiator hose assembly from the vehicle.
22. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

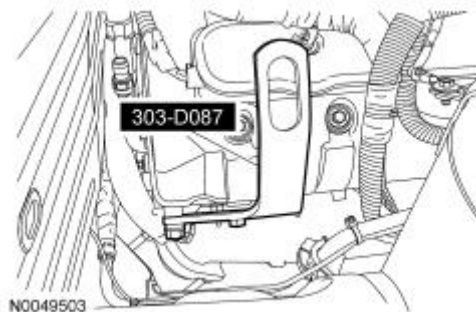
23. Remove the 8 pin-type retainers and the upper radiator sight shield.



24. Install the Engine Lifting Bracket.



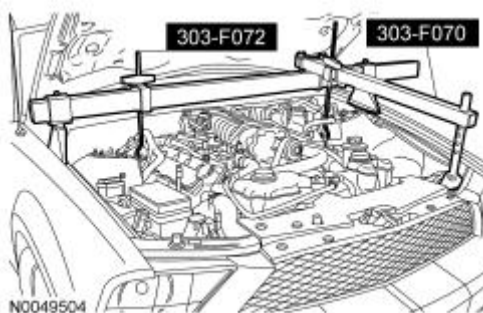
25. Install the Engine Lifting Bracket.



26. **NOTE:** The heavy duty Engine Support Bar (303-F070) must be used with the draw screws from the light duty Engine Support Bar (303-F072). This will provide enough clearance between the SC and the Engine Support Bar, and enough clearance between the draw screw and the vehicle hood.

Install the Engine Support Bars.

- Remove the LH and RH engine support insulator nuts.
- Using the Engine Support Bars, raise the engine.



27. Remove the 3 bolts and lower the underbody shield.



28. Remove the nut and disconnect the B+ wire terminal from the generator.

29. Disconnect the generator electrical connector.

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

31. Remove the nut and the wire harness retainer bracket from the oil pan stud bolt.

32. Remove the 3 bolts and the generator.

33. If equipped, disconnect the coolant hose from the oil filter adapter.

34. **NOTICE:** If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to Section 303-00.

Remove the 6 bolts and the oil cooler or oil cooler thermostat.

- Discard the gaskets.
- Inspect the oil cooler.

35. Drain the engine oil.

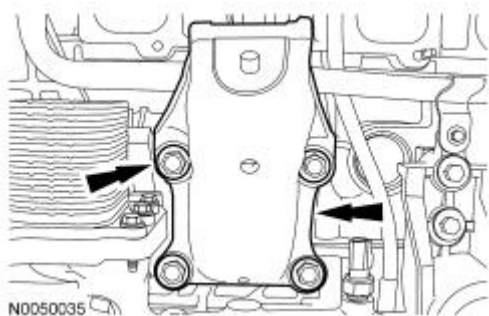
- Tighten the drain plug to 26 Nm (19 lb-ft).

36. Remove and discard the engine oil filter.

37. Remove the 3 coolant tube assembly bolts.

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

39. Remove the 4 bolts and the LH engine mount bracket.



40. Remove the 8 bolts and the oil filter adapter.

- Discard the gasket.

41. Remove the oil pan-to-engine front cover bolt and the 3 oil pan-to-engine front cover stud bolts.



42. Remove the 4 bolts and the coolant pump.

- Discard the gasket.

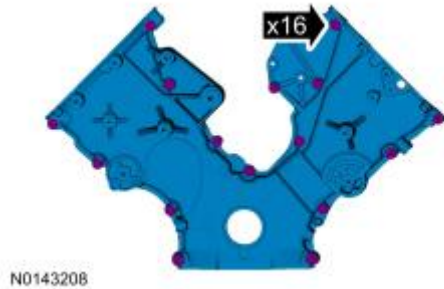
43. Remove the 16 bolts and the engine front cover.

- Remove and discard the engine front cover gaskets.

- **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.

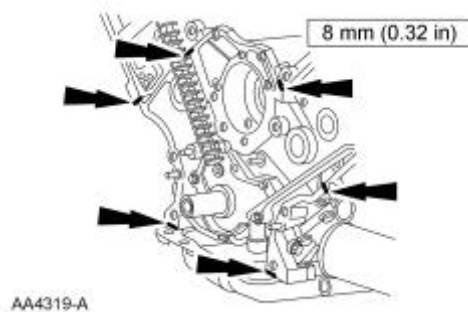


## Installation

### All vehicles

1. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 4 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 4 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

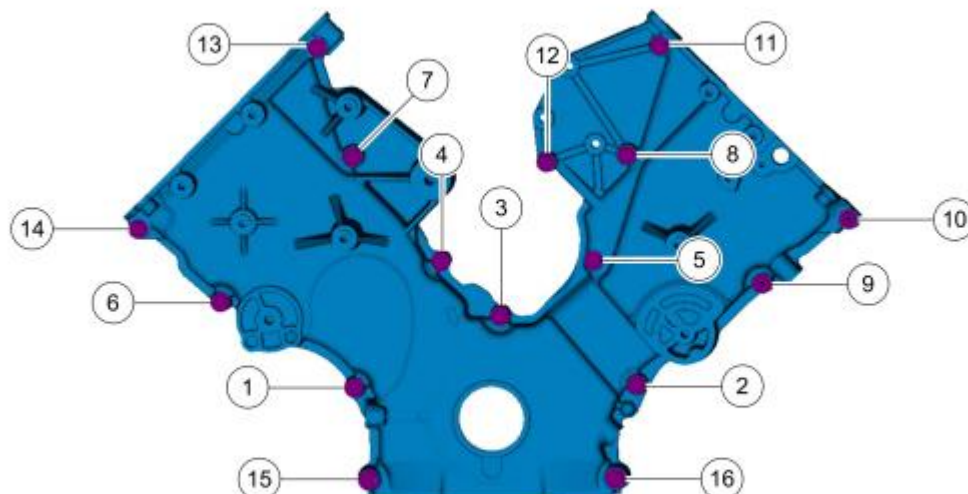
Apply a bead of Motorcraft® High Performance Engine RTV Silicone to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.



2. **NOTE:** Make sure that the engine front cover gaskets are in place on the engine front cover before installation.

Using new gaskets, position the engine front cover onto the dowels and install the 16 bolts. Tighten the bolts in the sequence shown in 2 stages.

- Stage 1: Tighten bolts 1 through 14 to 25 Nm (18 lb-ft).
- Stage 2: Tighten bolts 15 and 16 to 48 Nm (35 lb-ft).



N0143209

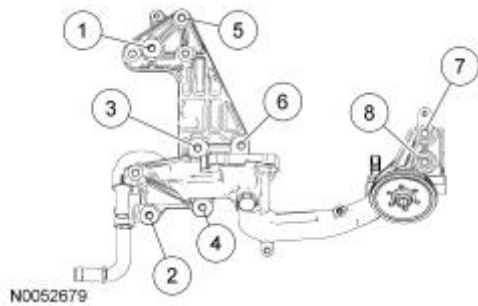
Item	Part Number	Description
1	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
2	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
3	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
4	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
5	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
6	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
7	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
8	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
9	N808586	Stud bolt, hex head pilot, M8 x 1.25 x 50
10	N808586	Stud bolt, hex head pilot, M8 x 1.25 x 50
11	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
12	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
13	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
14	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
15	N606063	Bolt, hex flange head pilot, M10 x 1.50 x 55
16	N606063	Bolt, hex flange head pilot, M10 x 1.50 x 55

3. Install the oil pan-to-engine front cover bolt and the 3 oil pan-to-engine front cover stud bolts.
- Tighten to 25 Nm (18 lb-ft).
4. Using a new gasket, install the coolant pump and the 4 bolts.
- Tighten to 25 Nm (18 lb-ft).

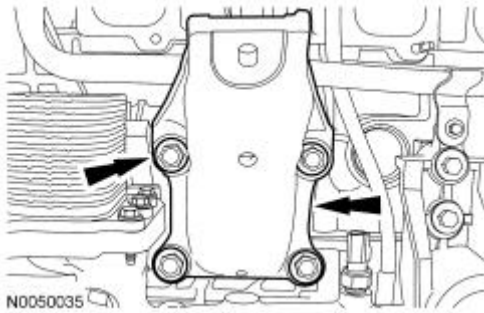
5. **NOTE:** Clean and inspect the sealing surfaces with metal surface prep. Follow the directions on the packaging.

Using a new gasket, install the oil filter adapter and the 8 bolts. Tighten in the sequence shown in 2 stages.

- Stage 1: Tighten bolts 1 through 6 to 25 Nm (18 lb-ft).
- Stage 2: Tighten bolts 7 and 8 to 48 Nm (35 lb-ft).



6. Install the LH engine mount bracket and the 4 bolts
- Tighten to 55 Nm (41 lb-in).



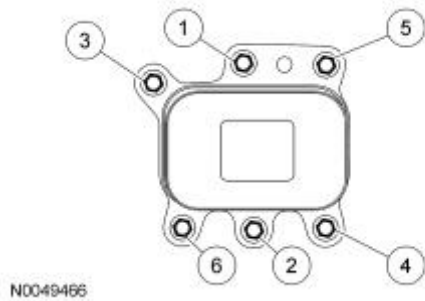
7. Connect the EOP switch electrical connector and the 2 wiring harness pin-type retainers.
8. Install the 3 coolant tube assembly bolts.
- Tighten to 10 Nm (89 lb-in).
9. Install a new engine oil filter in the following sequence.
1. Lubricate the oil filter gasket with clean engine oil and tighten until the seal makes contact.
10. Using an oil filter strap wrench, tighten the filter an additional 270 degrees.

11. **NOTE:** Clean the sealing surfaces with metal surface prep. Follow the directions on the packaging. Inspect the mating surfaces.

**NOTE:** Oil cooler shown, oil cooler thermostat similar.

Using new gaskets, install the oil cooler or oil cooler thermostat and the 6 bolts. Tighten in the sequence shown in 2 stages.

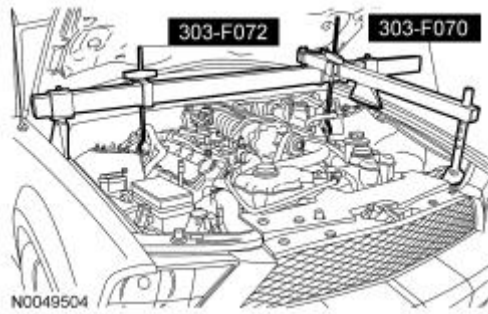
- Stage 1: Tighten to 9 Nm (80 lb-in).
- Stage 2: Tighten an additional 90 degrees.



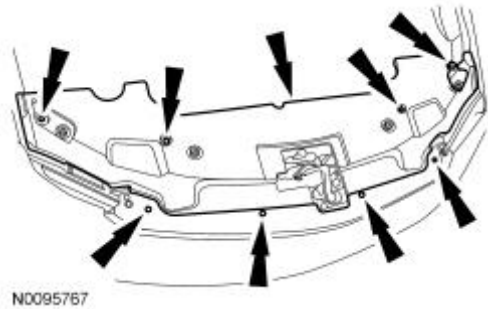
11. If equipped, connect the coolant hose to the oil filter adapter.
12. Install the generator and the 3 bolts.
- Tighten to 48 Nm (35 lb-ft).
13. Install the 2 wire harness retainer brackets on the 2 oil pan stud bolts and install the 2 nuts.
- Tighten to 10 Nm (89 lb-in).
14. Attach the wiring harness retainer to the oil pan stud bolt.
15. Connect the generator electrical connector.
16. Connect the B+ wire terminal to the generator and install the nut.
- Tighten to 8 Nm (71 lb-in).
17. Position the underbody shield and install the 3 bolts.
- Tighten to 9 Nm (80 lb-in).



18. Using the Engine Support Bars, lower the engine onto the engine support insulators.



19. Install the upper radiator sight shield and the 8 pin-type retainers.



20. **NOTICE:** Do not tighten the engine support insulator nuts until the full weight of the engine is on the engine insulator or damage to the engine insulator may occur.

Install the LH and RH engine support insulator nuts.

- Tighten to 63 Nm (46 lb-ft).

21. Connect the CKP sensor electrical connector.

22. Install the lower radiator hose assembly to the coolant pump, radiator, oil filter adapter (if equipped) and the coolant tube assembly (located above the generator).

23. Connect the coolant hoses to the CAC.

24. Connect the 2 upper radiator hoses to the intake manifold.

25. Connect the 2 coolant vent hoses to the intake manifold.

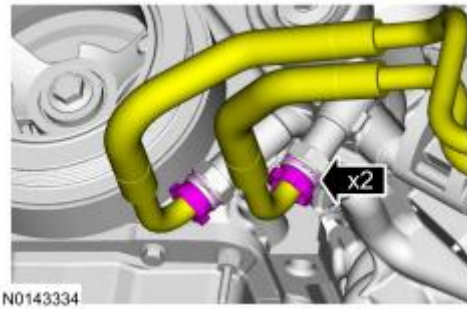
26. Install the crankshaft front seal. Refer to Crankshaft Front Seal.

27. Install the 3 SC drive belt idler pulleys, SC drive belt and the SC drive belt tensioner. Refer to Section 303-05.

28. Install the RH and LH valve covers. Refer to Valve Cover — RH and Valve Cover — LH.

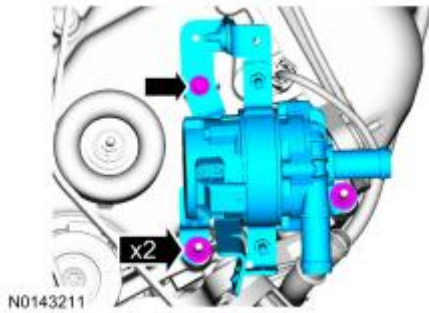
## Vehicle equipped with the cooling package

29. Connect the 2 oil hoses to the oil filter adapter and install the 2 retaining clips.

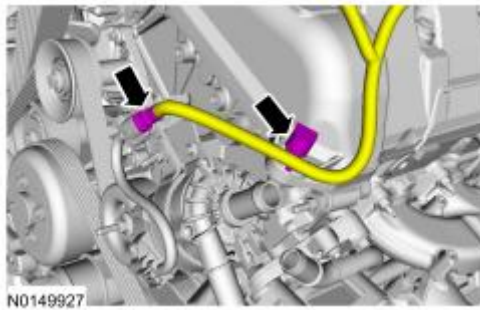


## All vehicles

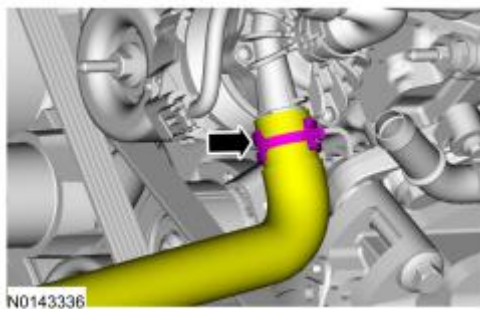
30. Install the SC coolant pump, bolt and the 2 nuts.
- Tighten the bolt to 10 Nm (89 lb-in).
  - Tighten the nuts to 11 Nm (97 lb-in).



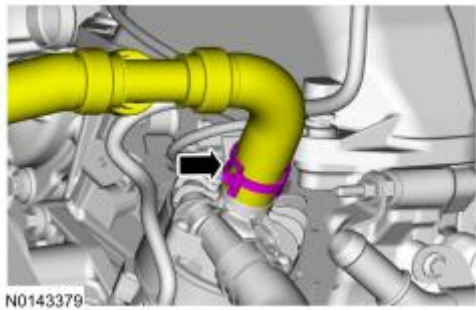
31. Connect the SC coolant pump electrical connector and wire retainer.



32. Connect the lower coolant hose to the SC coolant pump.



33. Connect the upper coolant hose to the SC coolant pump.

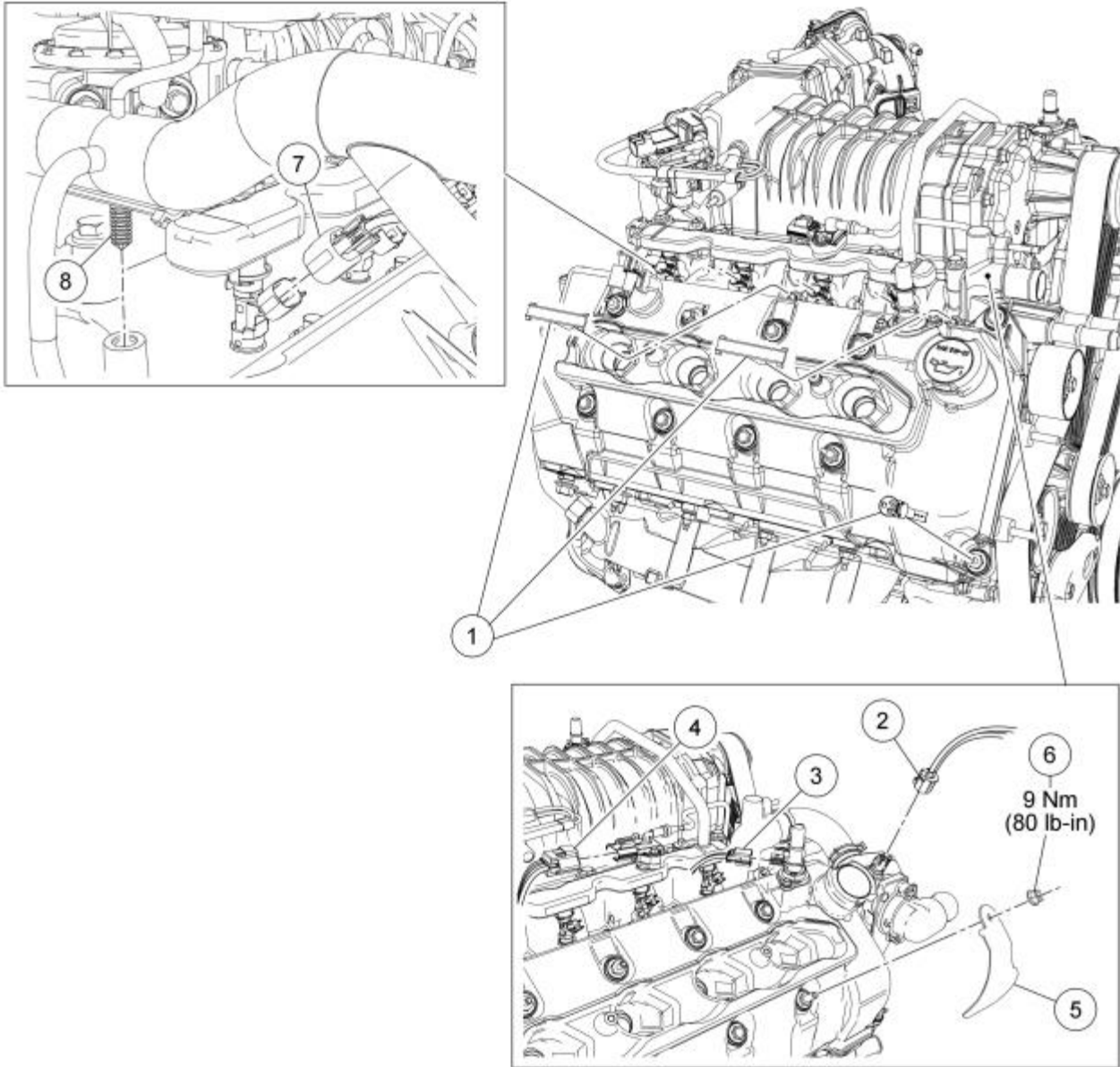


- 34. Install the coolant pump pulley and the 4 bolts.
- 35. Install the 2 accessory drive belt idler pulleys, the accessory drive belt tensioner and the accessory drive belt. Refer to Section 303-05.
- 36. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).
- 37. Install the thermostat housing. Refer to Section 303-03A.
- 38. Install the SC coolant degas bottle. Refer to Section 303-03B.
- 39. Install the engine coolant degas bottle. Refer to Section 303-03A.
- 40. Fill the engine with clean engine oil.
- 41. Fill and bleed the SC cooling system. Refer to Section 303-03B.
- 42. Fill and bleed the engine cooling system. Refer to Section 303-03A.
- 43. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

Valve Cover — RH

Material		
Item		Specification
Motorcraft® High Performance Engine RTV Silicone TA-357		WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A		—
Motorcraft® Silicone Gasket Remover ZC-30		—

RH Valve Cover (View 1 of 2)

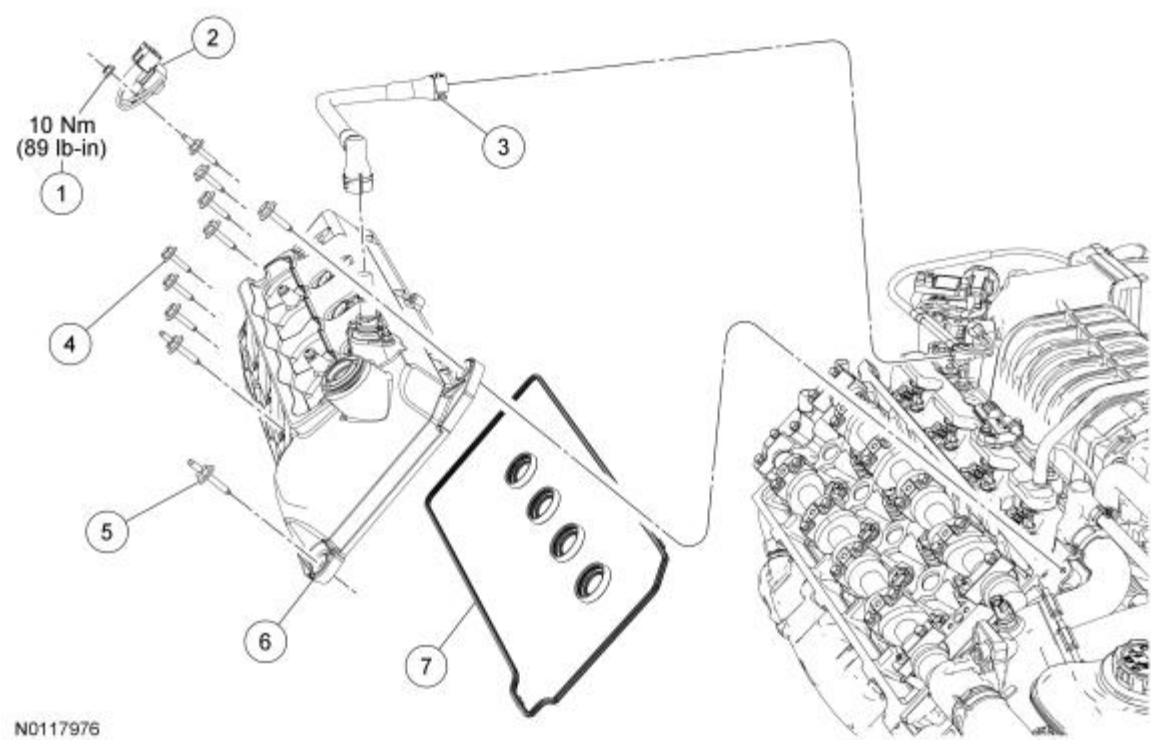


N0117977

Item	Part Number	Description
1	—	Wiring harness retainers (3 required) (part of 12B637)
2	14A464	Engine Coolant Temperature (ECT) sensor electrical connector (part of 12B637)
3	14A464	PCV valve electrical connector (part of 12B637)
4	14A464	Fuel rail pressure and temperature sensor electrical connector (part of 12B637)
5	19C789	A/C tube support bracket
6	W520111	A/C tube support bracket nut
7	14A464	RH fuel injector electrical connector (4 required) (part of 12B637)
8	—	Wiring harness retainer (part of 12B637)



RH Valve Cover (View 2 of 2)



Item	Part Number	Description
1	W520111	RH radio interference capacitor nut
2	18801	RH radio interference capacitor
3	64817	Crankcase ventilation hose
4	W708441	RH valve cover bolt (7 required)
5	W708442	RH valve cover stud bolt (3 required)
6	6582	RH valve cover assembly
7	6584	RH valve cover gaskets

Removal

1. Remove the battery and tray. Refer to Section 414-01.
2. Remove the RH ignition coils. Refer to Section 303-07C.
3. Remove the crankcase ventilation tube. Refer to Section 310-00.
4. Disconnect the PCV valve electrical connector.
5. Remove the nut and the RH radio interference capacitor.
6. Disconnect the 4 RH fuel injector electrical connectors.
7. Disconnect the fuel rail pressure and temperature sensor electrical connector.
8. Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.
9. Detach the 3 wiring harness retainers from the RH valve cover studs.
10. Detach the wiring harness pin-type retainer from the rear of the intake manifold.
11. Remove the nut and the A/C tube support bracket.

12. Remove the 7 bolts, 3 stud bolts and RH valve cover.

- Remove and discard the gaskets.

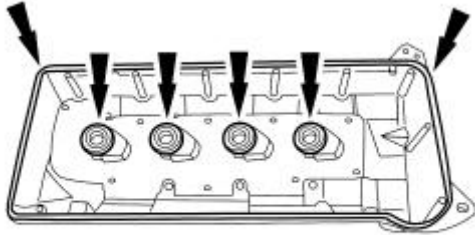
- **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

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

- Inspect the mating surfaces.

## Installation

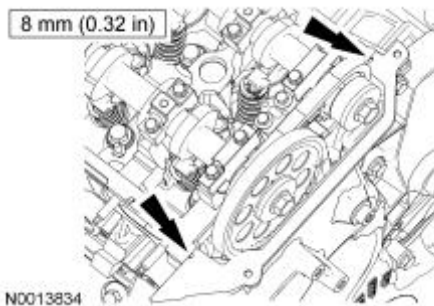
1. Install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



A0056221

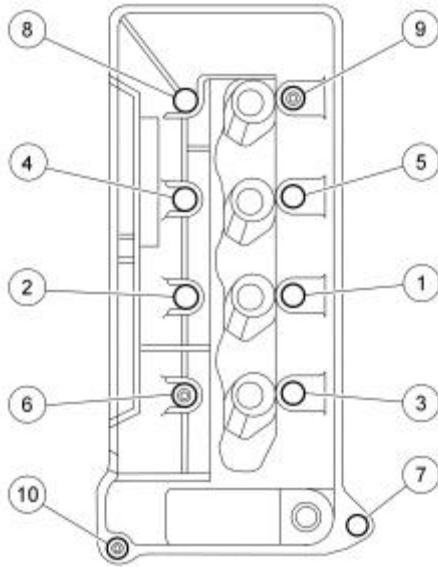
2. **NOTE:** If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a bead of Motorcraft® High Performance Engine RTV Silicone in 2 places where the engine front cover meets the cylinder head.



N0013834

3. Install the RH valve cover, the 7 bolts and 3 stud bolts. Tighten in the sequence shown.
  - Tighten to 10 Nm (89 lb-in).



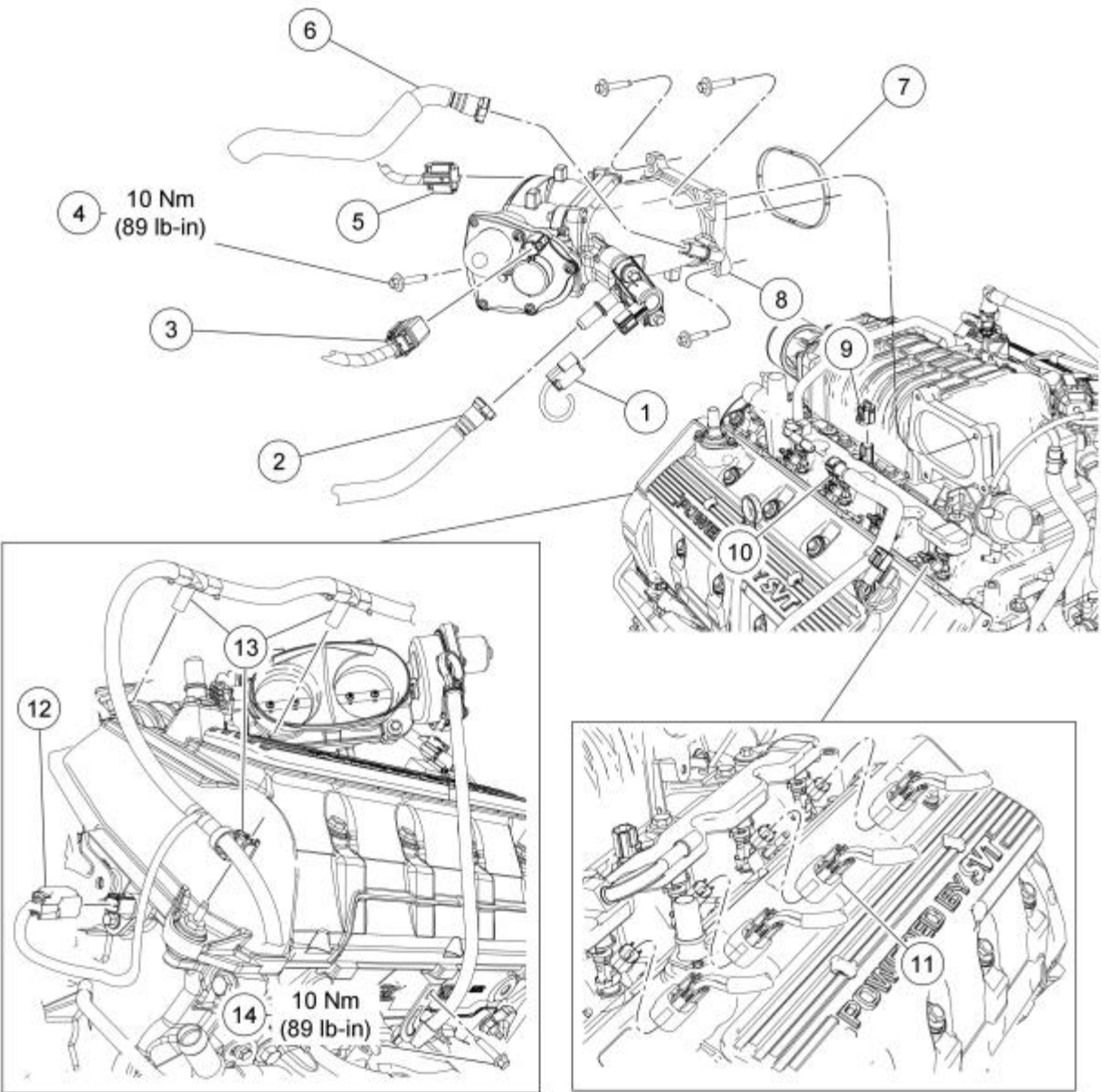
N0117975

4. Install the A/C tube support bracket and nut.
    - Tighten to 9 Nm (80 lb-in).
  5. Attach the wiring harness pin-type retainer to the rear of the intake manifold.
  6. Attach the 3 wiring harness retainers to the RH valve cover studs.
  7. Connect the ECT sensor electrical connector.
  8. Connect the fuel rail pressure and temperature sensor electrical connector.
  9. Connect the 4 RH fuel injector electrical connectors.
  10. Install the RH radio interference capacitor and the nut.
    - Tighten to 10 Nm (89 lb-in).
  11. Connect the PCV valve electrical connector.
  12. Install the crankcase ventilation tube. Refer to Section 310-00.
  13. Install the RH ignition coils. Refer to Section 303-07C.
  14. Install the battery and tray. Refer to Section 414-01.
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Valve Cover — LH

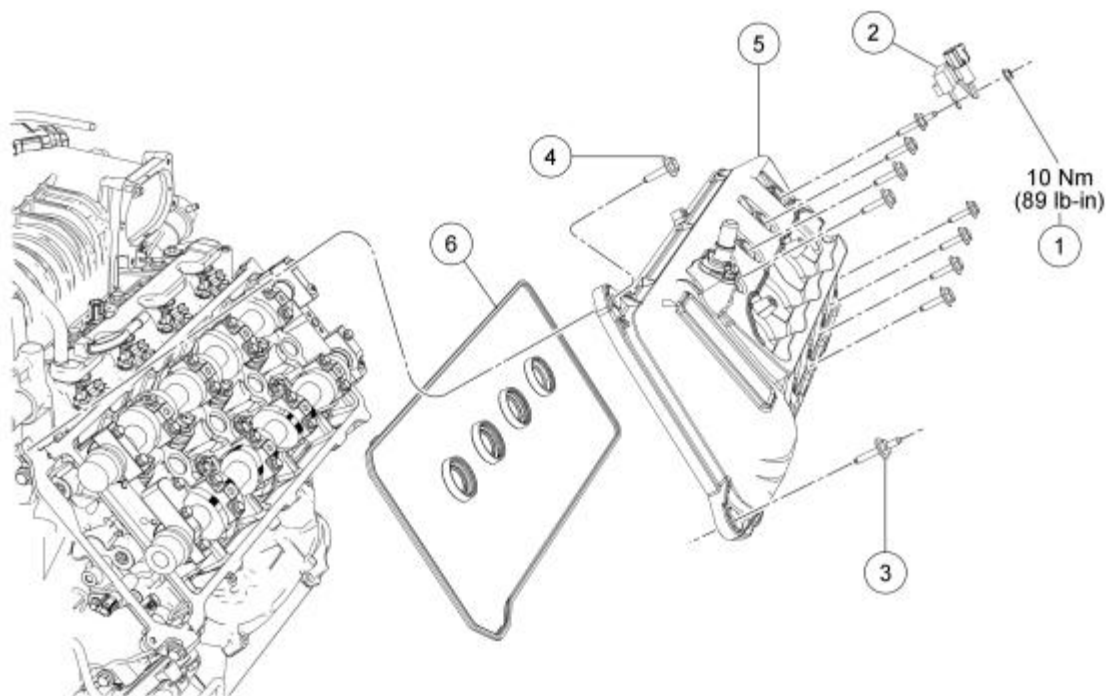
Material		
Item	Specification	
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6	
Motorcraft® Metal Surface Prep ZC-31-A	—	
Motorcraft® Silicone Gasket Remover ZC-30	—	

LH Valve Cover (View 1 of 2)



Item	Part Number	Description
1	14A464	Evaporative Emission (EVAP) canister purge valve electrical connector (part of 12B637)
2	9G271	EVAP canister purge valve vapor tube-to-Throttle Body (TB) spacer quick connect coupling
3	14A464	Electronic throttle control electrical connector (part of 12B637)
4	N806154	TB spacer bolt (4 required)
5	14A464	Throttle Position (TP) sensor electrical connector (part of 12B637)
6	2B432	Brake booster-to- TB spacer quick connect coupling
7	9L437	TB spacer-to-Supercharger (SC) gasket
8	9E822	TB spacer assembly
9	14A464	Intake Air Temperature 2 (IAT2) sensor electrical connector (part of 12B637)
10	9J280	Fuel supply tube-to-fuel rail quick connect coupling
11	14A464	LH fuel injector electrical connector (4 required) (part of 12B637)
12	14A464	Camshaft Position (CMP) sensor electrical connector (part of 12B637)
13	—	Wiring harness retainers (3 required) (part of 12B637)
14	N806155	Oil level indicator tube bolt

## LH Valve Cover (View 2 of 2)



N0114716

Item	Part Number	Description
1	W520111	LH radio interference capacitor nut
2	18801	LH radio interference capacitor
3	W708442	LH valve cover stud bolt (2 required)
4	W708441	LH valve cover bolt (8 required)
5	6A505	LH valve cover
6	6584	LH valve cover gasket

## Removal

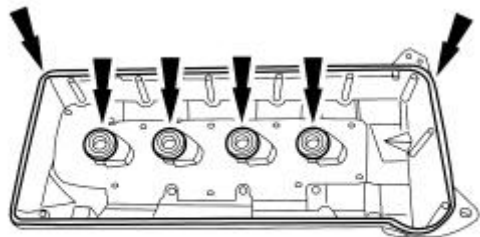
1. Release the fuel system pressure. Refer to Section 310-00.
2. Disconnect the battery ground cable. Refer to Section 414-01.
3. Remove the power brake booster. Refer to Section 206-07.
4. Remove the Air Cleaner (ACL) assembly and ACL outlet pipe. Refer to Section 303-12.
5. Remove the LH ignition coils. Refer to Section 303-07C.
6. Disconnect the Throttle Position (TP) sensor electrical connector.
7. Disconnect the electronic throttle control electrical connector.
8. Disconnect the brake booster vacuum hose from the Throttle Body (TB) spacer.
9. Disconnect the Evaporative Emission (EVAP) canister purge valve tube from the TB spacer. Refer to Section 310-00.
10. Disconnect the EVAP purge valve electrical connector.
11. Remove the 4 bolts and the TB and spacer assembly.
  - Discard the gasket.
12. Disconnect the 4 LH fuel injector electrical connectors.
13. Disconnect the fuel supply tube. Refer to Section 310-00.
14. Remove the nut and the LH radio interference capacitor.
15. Disconnect the Camshaft Position (CMP) sensor electrical connector.
16. Detach the 3 wiring harness retainers from the LH valve cover studs.
17. Remove the bolt and position the oil level indicator tube aside.
18. Remove the 8 bolts, 2 stud bolts and LH valve cover.
  - Remove and discard the gaskets.
  - **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.

## Installation

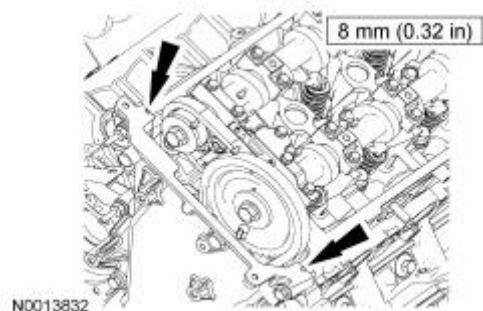
1. Install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



A0056221

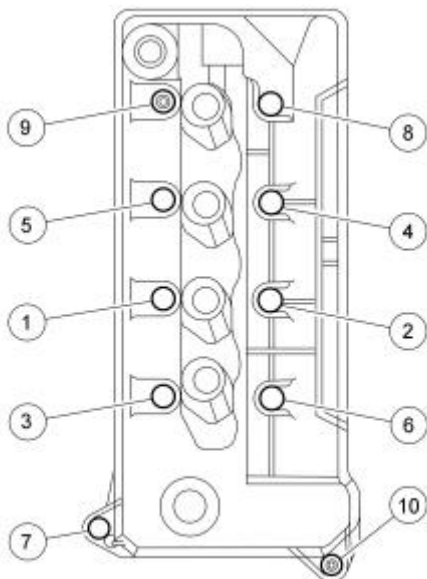
2. **NOTE:** If the valve cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a bead of Motorcraft® High Performance Engine RTV Silicone in 2 places where the engine front cover meets the cylinder head.



N0013832

3. Install the LH valve cover, the 8 bolts and 2 stud bolts. Tighten in the sequence shown.
  - Tighten to 10 Nm (89 lb-in).



N0117965

4. Position the oil level indicator tube and install the bolt.
  - Tighten to 10 Nm (89 lb-in).

5. Attach the 3 wiring harness retainers to the LH valve cover studs.
  6. Connect the CMP sensor electrical connector.
  7. Install the LH radio interference capacitor and nut.
    - Tighten to 10 Nm (89 lb-in).
  8. Connect the fuel supply tube. Refer to Section 310-00.
  9. Connect the 4 LH fuel injector electrical connectors.
  10. Using a new gasket, install the TB and spacer assembly and the 4 bolts.
    - Tighten to 10 Nm (89 lb-in).
  11. Connect the EVAP canister purge valve tube to the TB spacer. Refer to Section 310-00.
  12. Connect the EVAP purge valve electrical connector.
  13. Connect the brake booster vacuum hose to the TB spacer.
  14. Connect the electronic throttle control electrical connector.
  15. Connect the TP sensor electrical connector.
  16. Install the LH ignition coils. Refer to Section 303-07C.
  17. Install the ACL assembly and ACL outlet pipe. Refer to Section 303-12.
  18. Install the power brake booster. Refer to Section 206-07.
  19. Connect the battery ground cable. Refer to Section 414-01.
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