

# INSTALLATION

## ENGINE

### Special Tool(s)

#### SPECIAL TOOL DESCRIPTION CHART



**ST1586-A**

Installer, Power Steering Pump Pulley  
211-185 (T91P-3A733-A)



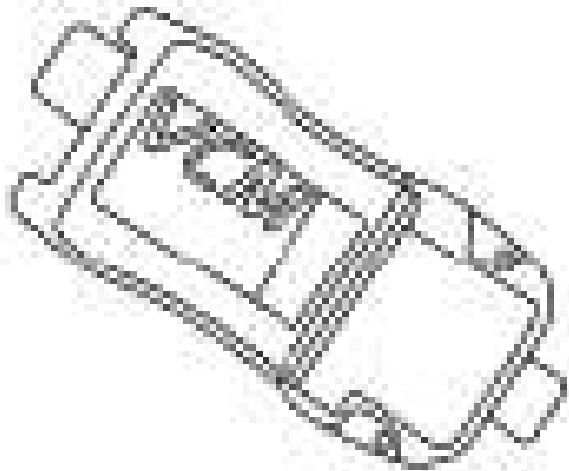
**ST1377-A**

Lifting Bracket, Engine  
303-F047 (014-00073) or equivalent

Support Brackets, Engine  
303-1507 or equivalent



ST3110-A



ST2834-A

Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

**Material**

**MATERIAL SPECIFICATIONS**

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Threadlock 262 TA-26	WSK-M2G351-A6

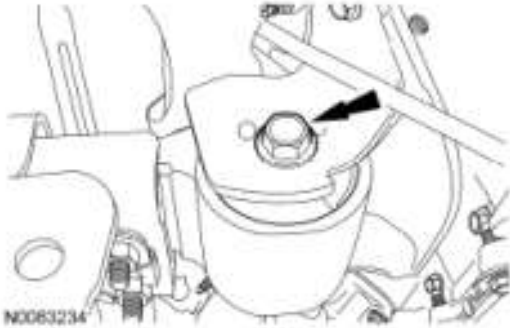
1. Using a suitable floor crane, position the engine assembly into the vehicle.

**NOTE:** Only use hand tools when tightening the engine support insulator through bolt or the engine support insulator may be damaged.

2.

Apply threadlock to the bolt threads and install the LH engine support insulator bolt.

- Tighten to 350 Nm (258 lb-ft).



**Fig. 442: Locating Engine Support Insulator Bolt**  
Courtesy of FORD MOTOR CO.

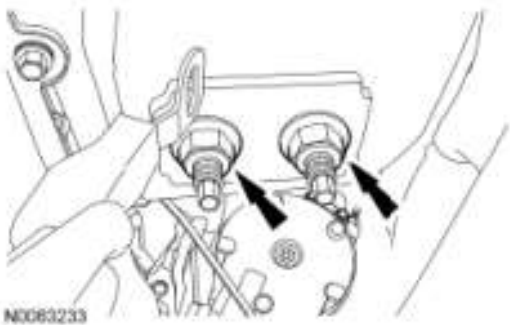
**NOTE:** Only use hand tools when tightening the engine support insulator nuts or the engine support insulator may be damaged.

3.

**NOTE:** Make sure the RH engine support insulator mating surfaces and the washer mating surface are free of foreign material and corrosion before installation. Install a new washer.

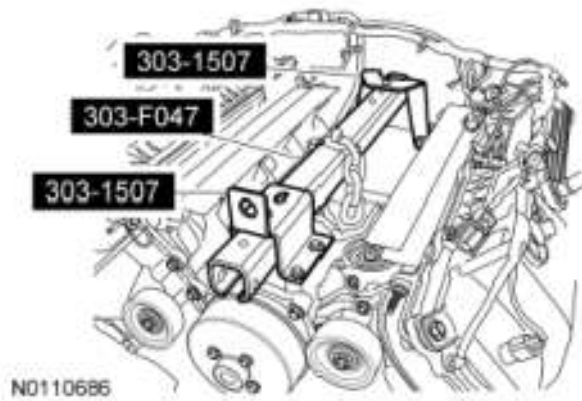
Apply threadlock to the stud threads and install the RH engine support insulator washer and nuts.

- Tighten to 250 Nm (184 lb-ft).



**Fig. 443: Locating RH Engine Support Insulator Nuts**  
Courtesy of FORD MOTOR CO.

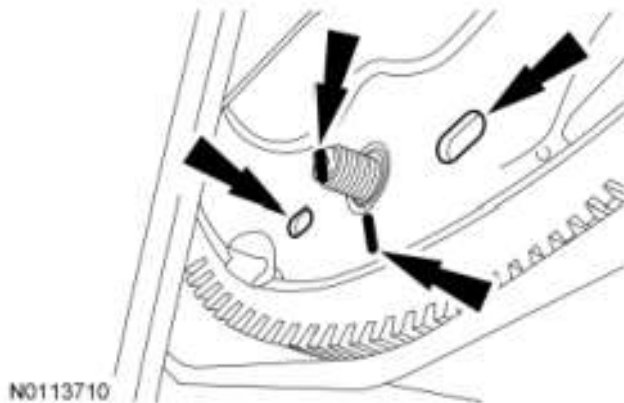
4. Remove the Engine Lifting Bracket and Engine Support Brackets.



**Fig. 444: Identifying Engine Lifting Bracket And Engine Support Brackets**  
 Courtesy of FORD MOTOR CO.

5. **NOTE:** The torque converter must be installed in it's original orientation to the flexplate or engine damage may occur.

Check that the flexplate is positioned so that the 2 slotted holes are shown at the 6 o'clock position and the index marks are aligned.

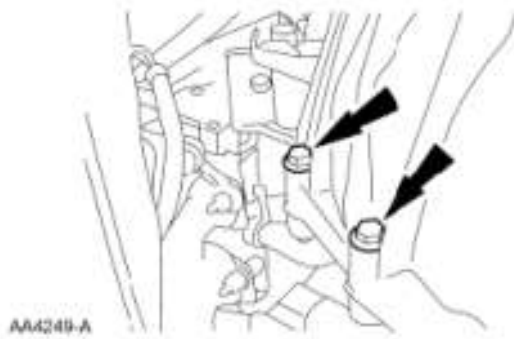


**Fig. 445: Checking Flexplate Slotted Holes At 6 O'Clock Position And Index Marks Are Aligned**  
 Courtesy of FORD MOTOR CO.

6. **NOTE:** The upper 2 transmission-to-engine bolts will be installed later.

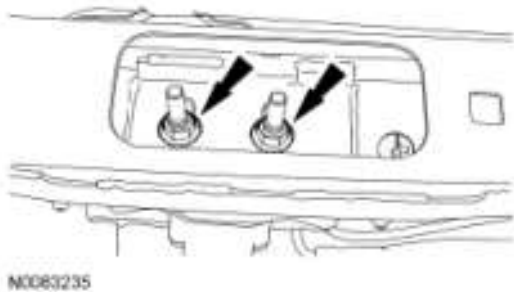
Install the lower 5 transmission-to-engine bolts.

- Tighten to 48 Nm (35 lb-ft).



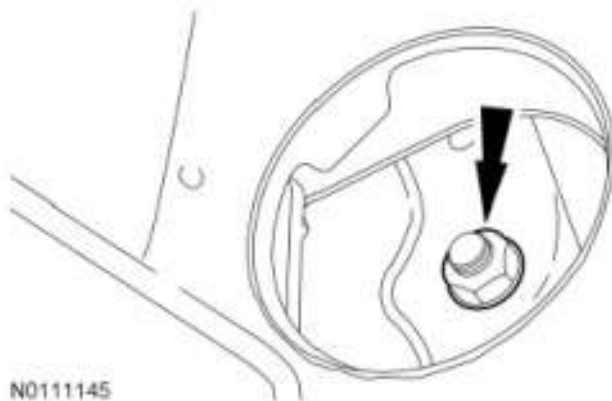
**Fig. 446: Locating Lower Transmission-To-Engine Bolts**  
Courtesy of FORD MOTOR CO.

7. Tighten the 2 transmission insulator and retainer nuts.
  - Tighten to 90 Nm (66 lb-ft).



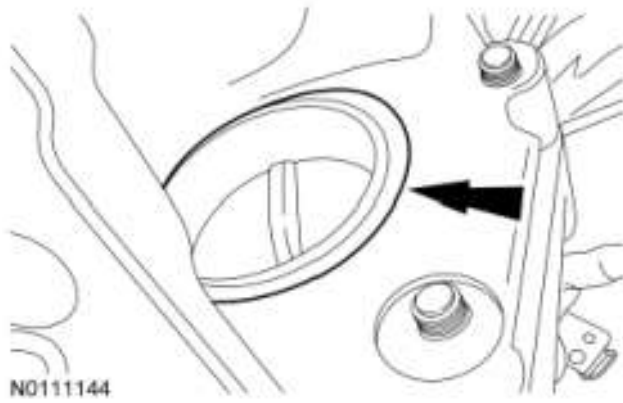
**Fig. 447: Locating Transmission Insulator And Retainer Nuts**  
Courtesy of FORD MOTOR CO.

8. Install 4 new torque converter-to-flexplate nuts.
  - Tighten to 36 Nm (27 lb-ft).



**Fig. 448: Locating Torque Converter-To-Flexplate Nuts**  
Courtesy of FORD MOTOR CO.

9. Install the cylinder block opening cover.



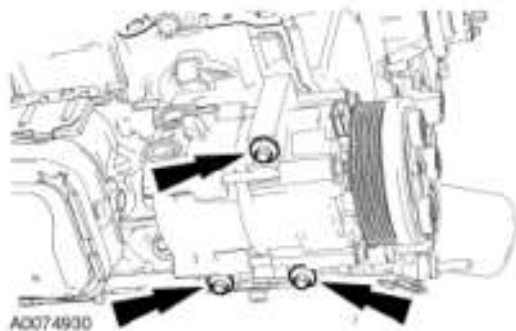
**Fig. 449: Locating Cylinder Block Opening Cover**  
 Courtesy of FORD MOTOR CO.

10. Install the flexplate inspection cover and the 2 bolts.
  - Tighten to 34 Nm (25 lb-ft).



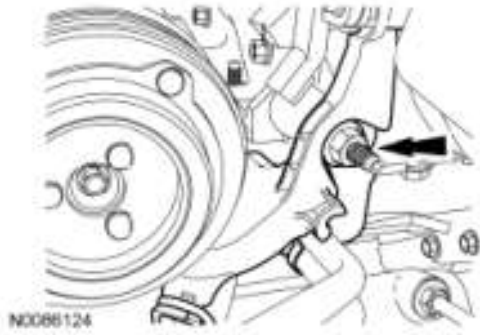
**Fig. 450: Locating Flexplate Inspection Cover And Bolts**  
 Courtesy of FORD MOTOR CO.

11. Position the A/C compressor and install the 3 bolts.
  - Tighten to 25 Nm (18 lb-ft).



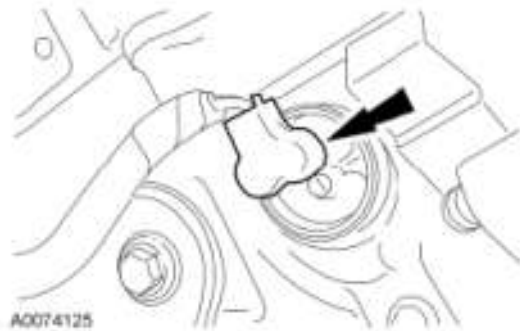
**Fig. 451: Locating A/C Compressor Bolts**  
 Courtesy of FORD MOTOR CO.

12. Position the transmission cooler tube support bracket, the starter wiring harness support bracket and install the nut.
  - Tighten to 10 Nm (89 lb-in).



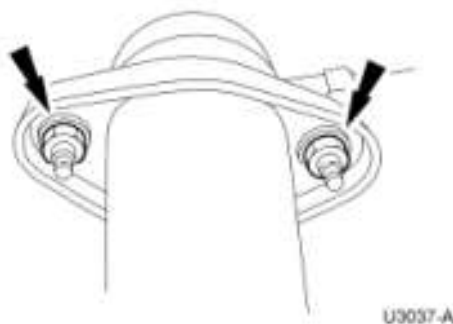
**Fig. 452: Locating Transmission Cooler Tube Support Bracket And Nut**  
Courtesy of FORD MOTOR CO.

13. Install the starter. For additional information, refer to **STARTING SYSTEM -- F150**.
14. If equipped, connect the block heater electrical connector.



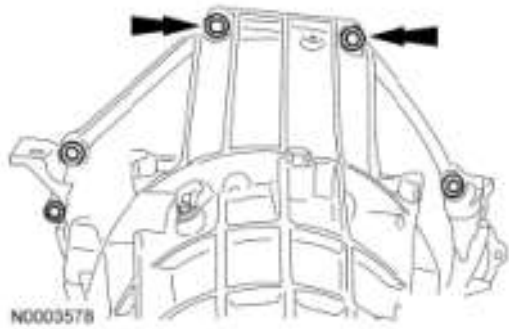
**Fig. 453: Locating Block Heater Electrical Connector**  
Courtesy of FORD MOTOR CO.

15. Install the 4 exhaust Y-pipe flange nuts (2 RH and 2 LH).
  - Tighten to 40 Nm (30 lb-ft).



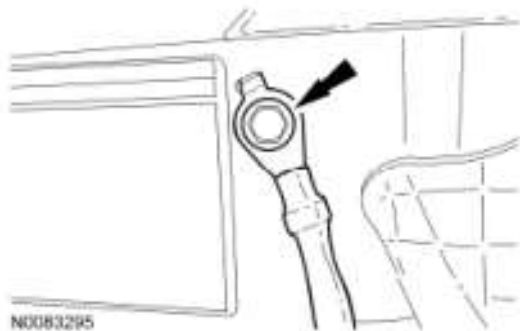
**Fig. 454: Locating Exhaust Y-Pipe Flange Nuts**  
Courtesy of FORD MOTOR CO.

16. Position the fuel and Evaporative Emission (EVAP) tube support bracket and install the upper 2 transmission-to-engine bolts.
  - Tighten to 48 Nm (35 lb-ft).



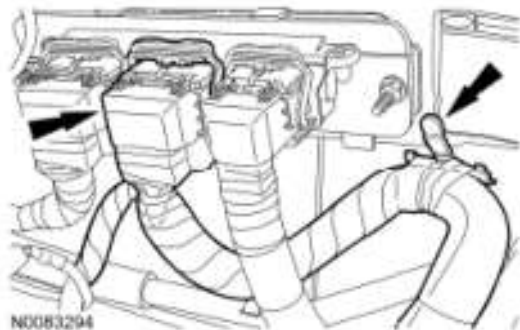
**Fig. 455: Locating Upper Transmission-To-Engine Bolts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 456: Locating Ground Strap And Bolt**  
Courtesy of FORD MOTOR CO.

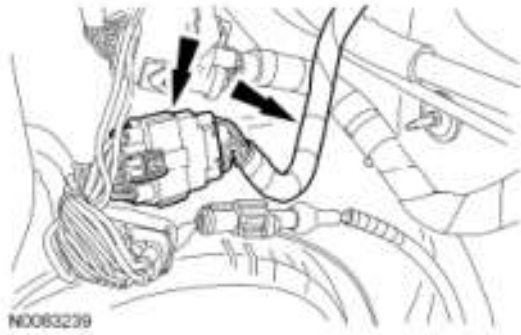
18. Connect the PCM electrical connector and the engine wiring harness retainer.



**Fig. 457: Locating PCM Electrical Connector And Engine Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

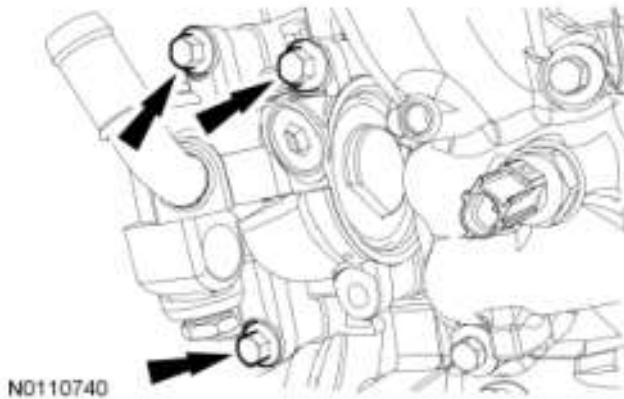
19. Connect the engine harness electrical connector and wiring harness retainer.





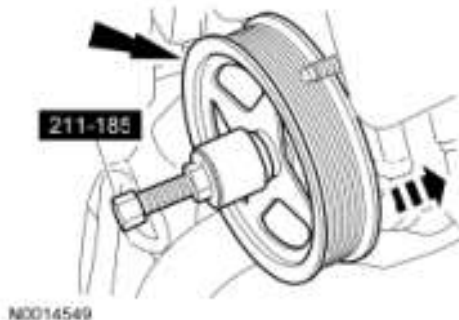
**Fig. 458: Locating Engine Harness Electrical Connector And Wiring Harness Retainer**  
 Courtesy of FORD MOTOR CO.

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



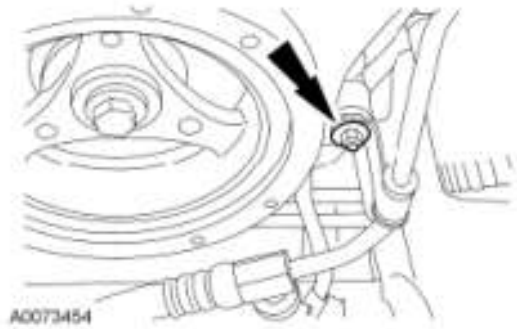
**Fig. 459: Locating Power Steering Pump Bolts**  
 Courtesy of FORD MOTOR CO.

21. Using the Power Steering Pump Pulley Installer, install the power steering pump pulley.



**Fig. 460: Installing Power Steering Pump Pulley**  
 Courtesy of FORD MOTOR CO.

22. Position the Power Steering Pressure (PSP) hose support bracket and install the nut.
  - Tighten to 10 Nm (89 lb-in).

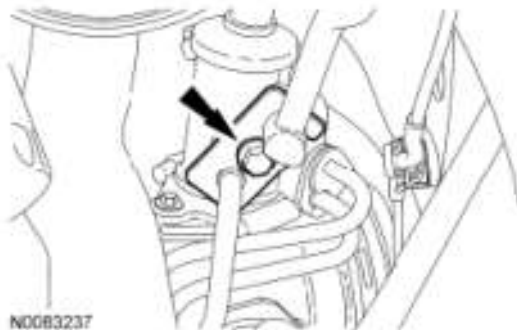


**Fig. 461: Locating Power Steering Pressure Hose Support Bracket Nut**  
Courtesy of FORD MOTOR CO.

23. **NOTE:** While servicing the power steering system, care should be taken to prevent the entry of foreign material or failure of the power steering components may result.

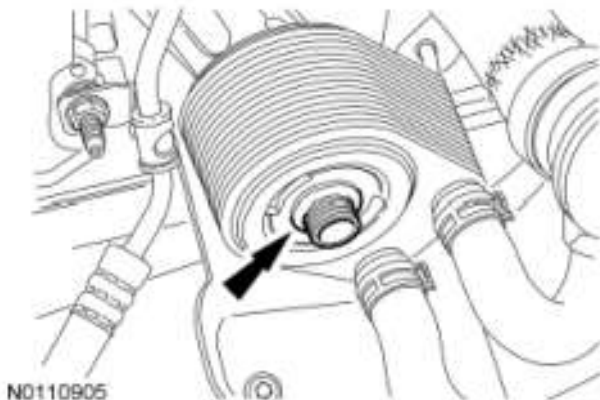
Position the power steering fluid tubes and install the bolt.

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



**Fig. 462: Locating Power Steering Fluid Tubes And Bolt**  
Courtesy of FORD MOTOR CO.

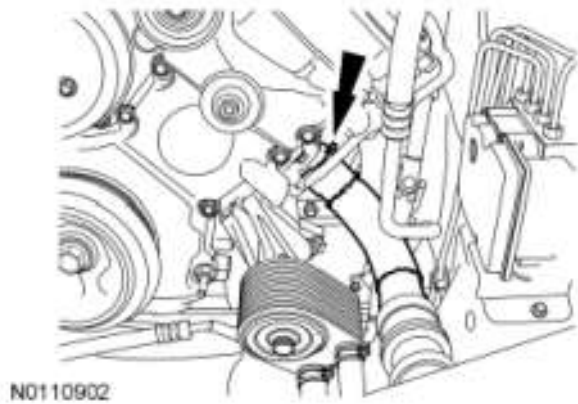
24. Position the oil cooler and install the threaded shaft.
- Tighten to 58 Nm (43 lb-ft).



**Fig. 463: Locating Oil Cooler And Threaded Shaft**

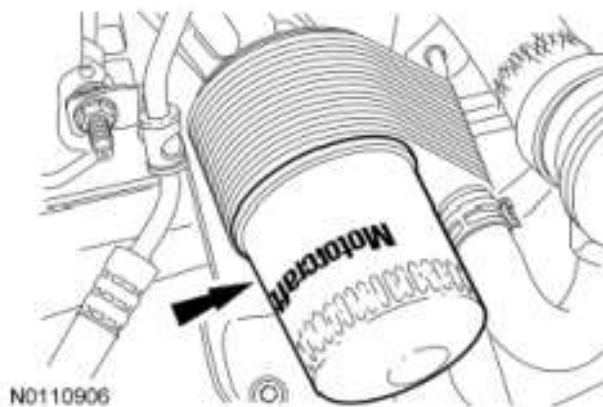
Courtesy of FORD MOTOR CO.

25. Connect the lower radiator hose to the oil filter adapter.



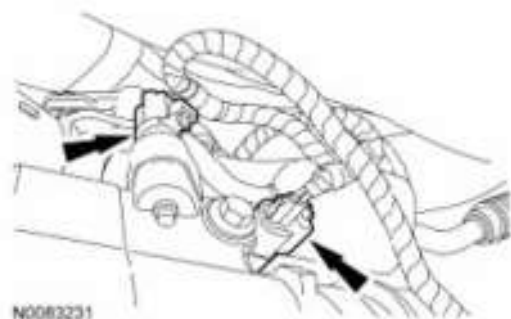
**Fig. 464: Locating Lower Radiator Hose And Oil Filter Adapter**  
Courtesy of FORD MOTOR CO.

26. Install a new oil filter in 2 stages.
- Stage 1: Tighten to 5 Nm (44 lb-in).
  - Stage 2: Tighten an additional 180 degrees.



**Fig. 465: Locating Oil Filter**  
Courtesy of FORD MOTOR CO.

27. Connect the A/C compressor electrical connector and the wiring harness retainer.



**Fig. 466: Locating A/C Compressor Electrical Connector And Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

28. Position the accessory drive belt onto the accessory drive pulleys.
29. Position the Power Distribution Box (PDB) and wiring harness onto the engine.
30. Install the cooling module. For additional information, refer to **ENGINE COOLING -- F150** .

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

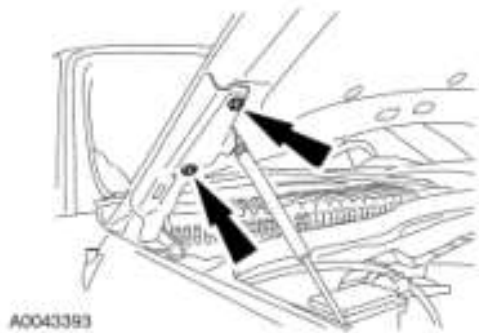
31.

Install the intake manifold. For additional information, refer to **INTAKE MANIFOLD**.

32. **NOTE:** Align the index marks made during hood removal.

Position the hood and install the 4 bolts.

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



**Fig. 467: Locating Hood Supports Bolts**  
Courtesy of FORD MOTOR CO.

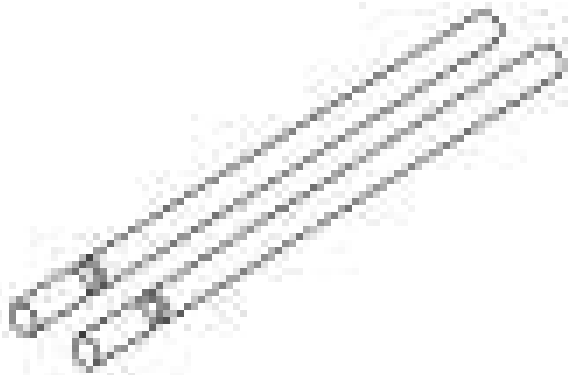
33. Fill the crankcase with clean engine oil.
34. Evacuate and charge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS -- F150** .
35. Fill and bleed the power steering system. For additional information, refer to **STEERING SYSTEM - F150** .
36. If the engine was disassembled, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

## CYLINDER HEAD

### Special Tool(s)

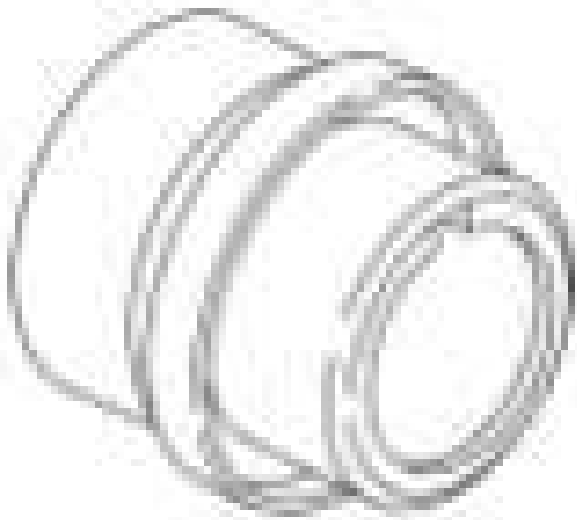
### SPECIAL TOOL DESCRIPTION CHART

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Alignment Pins, Cylinder Head  
303-1040 (SR-015486)

**ST2606-A**



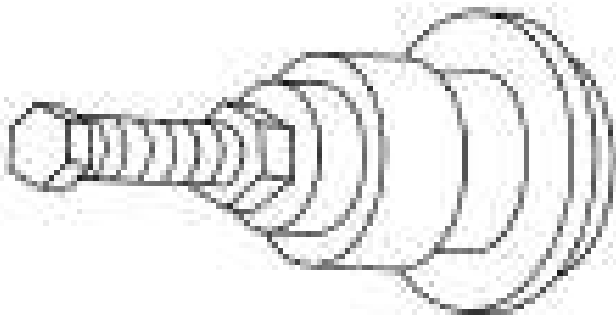
Installer, Crankshaft Front Oil Seal  
303-335-2

**ST3111-A**

Installer, Crankshaft Vibration Damper  
303-1508



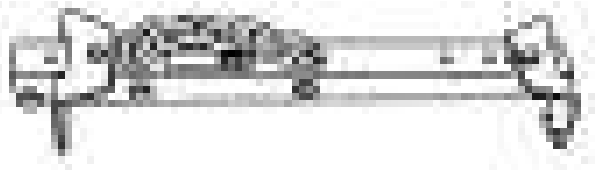
ST2428-A



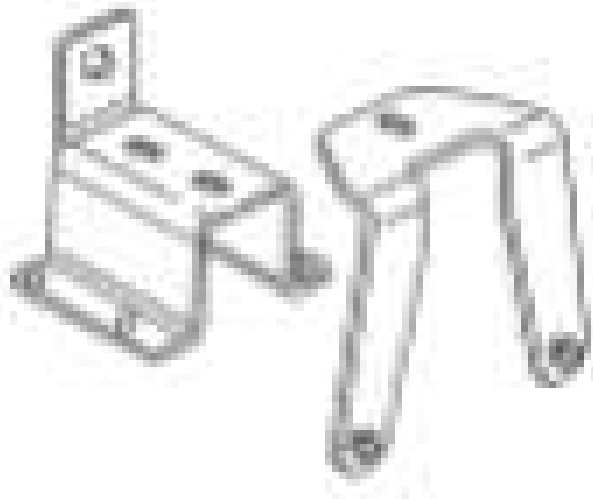
ST1328-A

Installer, Front Cover Oil Seal  
303-335-1

Lifting Bracket, Engine  
303-F047 (014-00073) or equivalent



**ST1377-A**



**ST3110-A**

Support Brackets, Engine  
303-1507 or equivalent

**Material**

**MATERIAL SPECIFICATIONS**

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Motorcraft® Silicone Gasket Remover	-

ZC-30	
Threadlock 262 TA-26	WSK-M2G351-A6

## All cylinder heads

1. Position the crankshaft keyway at the 11 o'clock position.

**NOTE:** Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow this instruction may result in engine damage.

- 2.

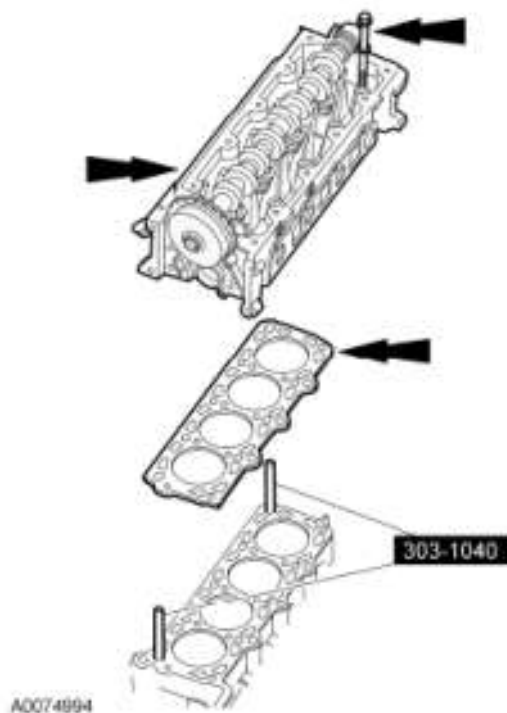
**NOTE:** The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry.

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

**NOTE:** Do not turn the crankshaft until instructed to do so.

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

Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the 20 cylinder head bolts loosely.



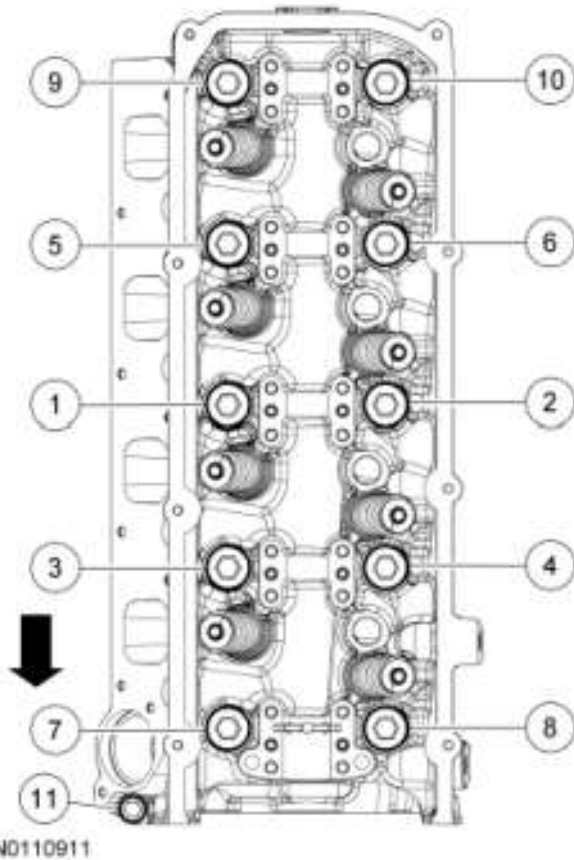
**Fig. 468: Locating Cylinder Head Alignment Pins, Cylinder Head Gaskets And Cylinder Head**  
Courtesy of FORD MOTOR CO.

LH cylinder head



3. Tighten the 11 bolts in 6 stages, in the sequence shown in illustration.

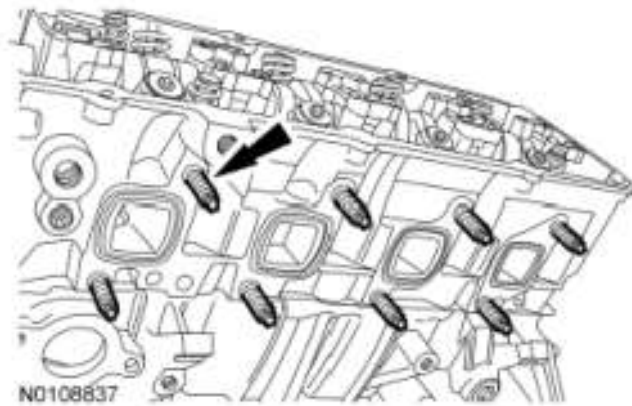
- Stage 1: Tighten the M12 fasteners to 25 Nm (18 lb-ft).
- Stage 2: Tighten the M12 fasteners to 60 Nm (44 lb-ft).
- Stage 3: Tighten the M12 fasteners an additional 90 degrees.
- Stage 4: Tighten the M12 fasteners an additional 90 degrees.
- Stage 5: Tighten the M8 fastener to 20 Nm (177 lb-in).
- Stage 6: Tighten the M8 fastener an additional 45 degrees.



**Fig. 469: Identifying LH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

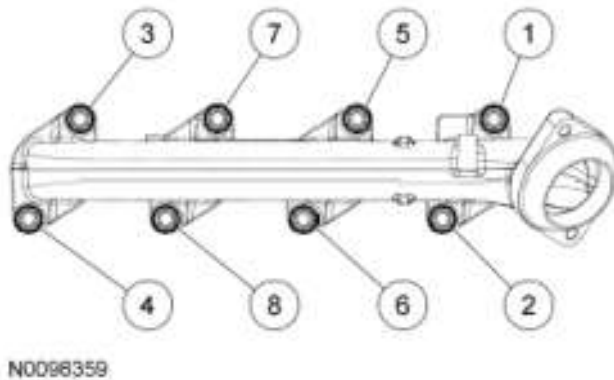
4. Install 8 new exhaust manifold-to-cylinder head studs.

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



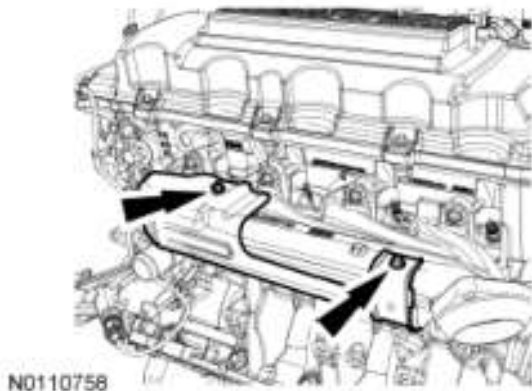
**Fig. 470: Locating Exhaust Manifold-To-Cylinder Head Studs**  
 Courtesy of FORD MOTOR CO.

5. Using new exhaust manifold nuts, position the LH exhaust manifold and install the 8 nuts in 2 stages in the sequence shown in illustration.
  - Stage 1: Tighten to 25 Nm (18 lb-ft).
  - Stage 2: Tighten to 32 Nm (24 lb-ft).



**Fig. 471: Identifying Exhaust Manifold Nuts Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

6. Position the LH exhaust manifold heat shield and install the 2 bolts.
  - Tighten to 12 Nm (106 lb-in).

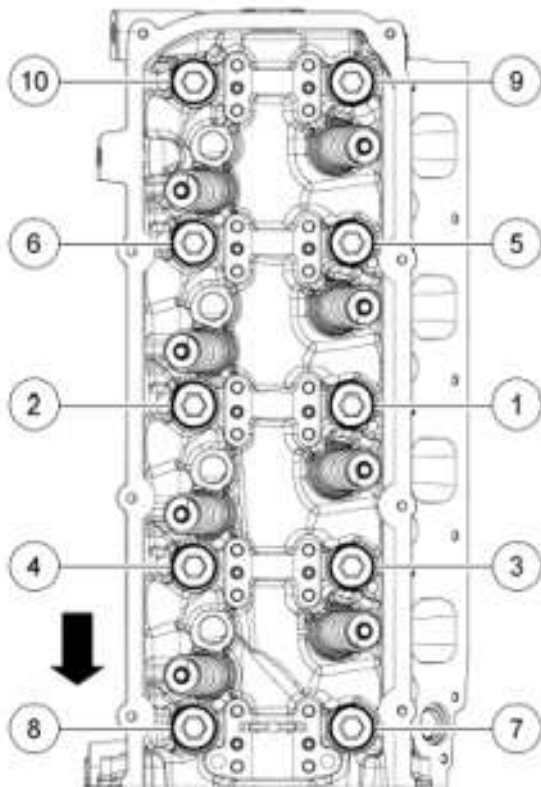


**Fig. 472: Locating LH Exhaust Manifold Heat Shield And Bolts**

Courtesy of FORD MOTOR CO.

### RH cylinder head

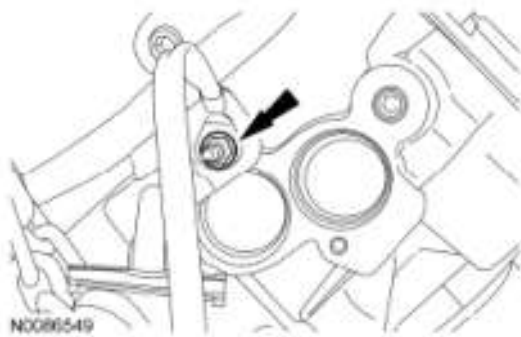
7. Tighten the 10 bolts in 4 stages, in the sequence shown in illustration.
  - Stage 1: Tighten the M12 fasteners to 25 Nm (18 lb-ft).
  - Stage 2: Tighten the M12 fasteners to 60 Nm (44 lb-ft).
  - Stage 3: Tighten the M12 fasteners an additional 90 degrees.
  - Stage 4: Tighten the M12 fasteners an additional 90 degrees.



N0098351

**Fig. 473: Identifying RH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

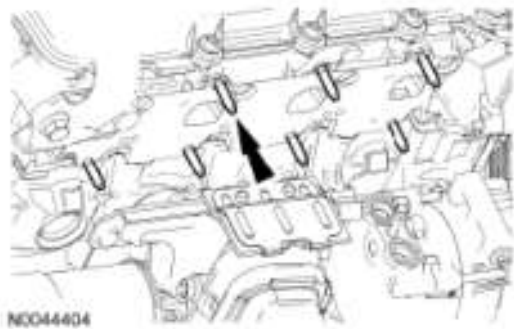
8. Position the ground strap and install the nut.
  - Tighten to 10 Nm (89 lb-in).



N0086549

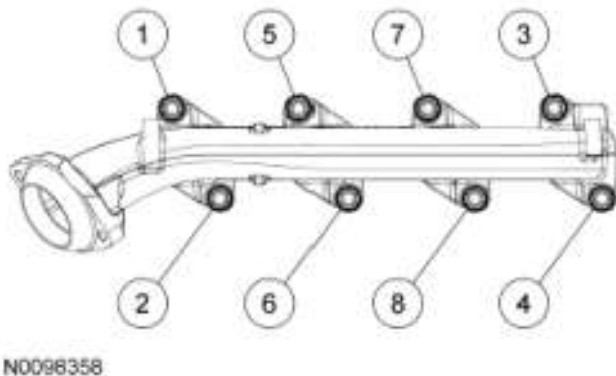
**Fig. 474: Locating Nut And Ground Strap**  
Courtesy of FORD MOTOR CO.

9. Install 8 new exhaust manifold-to-cylinder head studs.
  - Tighten to 12 Nm (106 lb-in).



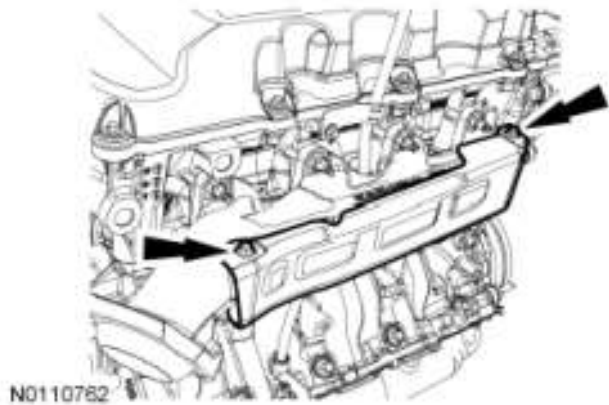
**Fig. 475: Locating Exhaust Manifold-To-Cylinder Head Studs**  
Courtesy of FORD MOTOR CO.

10. Using new exhaust manifold nuts, position the LH exhaust manifold and install the 8 nuts in 2 stages in the sequence shown in illustration.
  - Stage 1: Tighten to 25 Nm (18 lb-ft).
  - Stage 2: Tighten to 32 Nm (24 lb-ft).



**Fig. 476: Identifying Exhaust Manifold Nuts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

11. Position the RH exhaust manifold heat shield and install the 2 bolts.
  - Tighten to 12 Nm (106 lb-in).

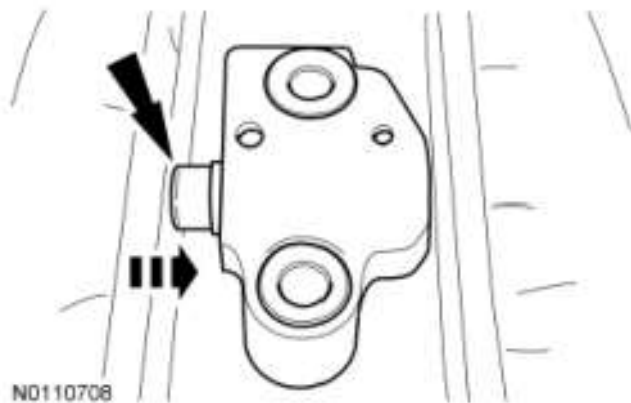


**Fig. 477: Locating RH Exhaust Manifold Heat Shield Bolts**  
 Courtesy of FORD MOTOR CO.

All cylinder heads

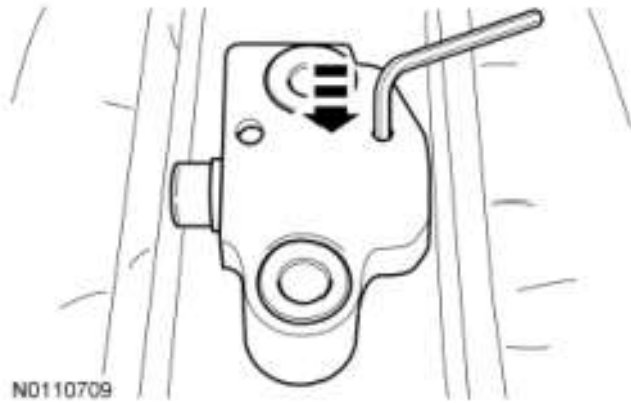
12. **NOTE:** Timing chain procedures must be followed exactly or damage to valves and pistons will result.

Compress the tensioner plunger, using a vise.



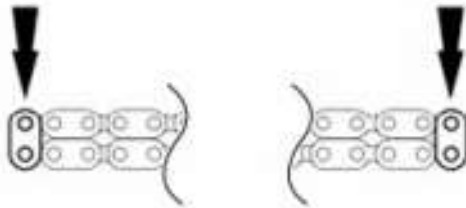
**Fig. 478: Compressing Tensioner Plunger Using Vise**  
 Courtesy of FORD MOTOR CO.

13. Install a retaining clip into the tensioner to hold the plunger in during installation.



**Fig. 479: Installing Retaining Clip Into Tensioner To Hold Plunger In During Installation**  
 Courtesy of FORD MOTOR CO.

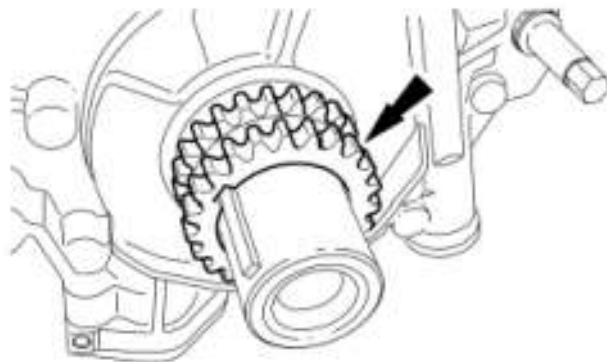
14. Remove the tensioner from the vise.
15. If the copper links are not visible, mark 2 links on one end, and use as timing marks.



A0038719

**Fig. 480: Locating Timing Chain Copper Links**  
 Courtesy of FORD MOTOR CO.

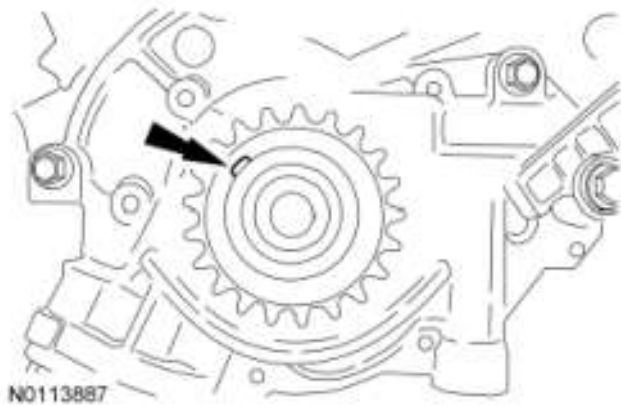
16. Install the crankshaft sprocket.



N0108824

**Fig. 481: Locating Crankshaft Sprocket**  
 Courtesy of FORD MOTOR CO.

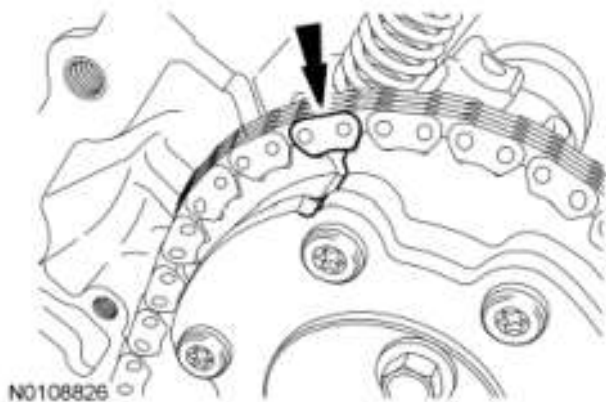
17. Position the crankshaft keyway at the 11 o'clock position.



**Fig. 482: Positioning Crankshaft Keyway At 11 O'Clock Position**  
 Courtesy of FORD MOTOR CO.

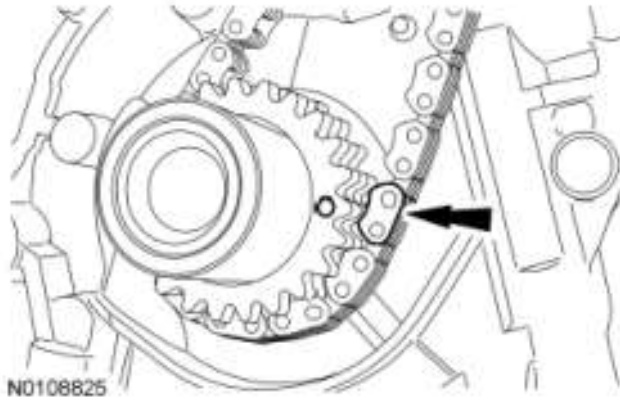
18. **NOTE: Make sure the upper half of the timing chain is below the tensioner arm dowel and above the chain guide pin.**

Position the upper end of the LH (inner) timing chain on the LH camshaft phaser and sprocket, aligning the timing mark on the outer flange of the camshaft phaser and sprocket with the single blue (marked) link on the chain.



**Fig. 483: Aligning Timing Mark On Outer Flange Of Camshaft Phaser And Sprocket With Single Blue (Marked) Link On Chain**  
 Courtesy of FORD MOTOR CO.

19. Position the lower end of the LH (inner) timing chain on the crankshaft sprocket, aligning the timing mark on the outer flange of the crankshaft sprocket with the single blue (marked) link on the chain.



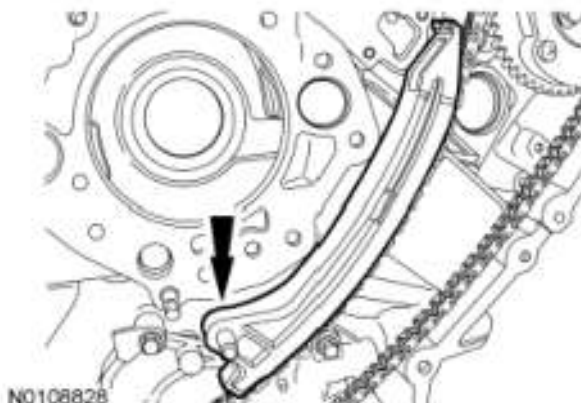
**Fig. 484: Aligning Timing Mark On Outer Flange Of Crankshaft Sprocket With Single Blue (Marked) Link On Chain**  
Courtesy of FORD MOTOR CO.

20. Position the LH timing chain guide and install the bolt in 2 stages.
- Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten an additional 45 degrees.



**Fig. 485: Locating Bolt And LH Timing Chain Guide**  
Courtesy of FORD MOTOR CO.

21. Install the LH timing chain tensioner arm.

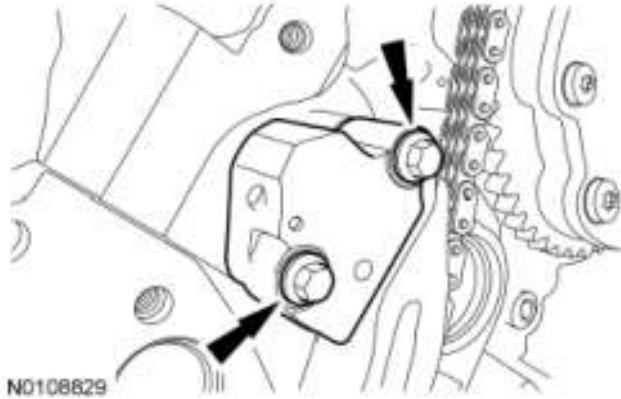


**Fig. 486: Locating LH Timing Chain Tensioner Arm**



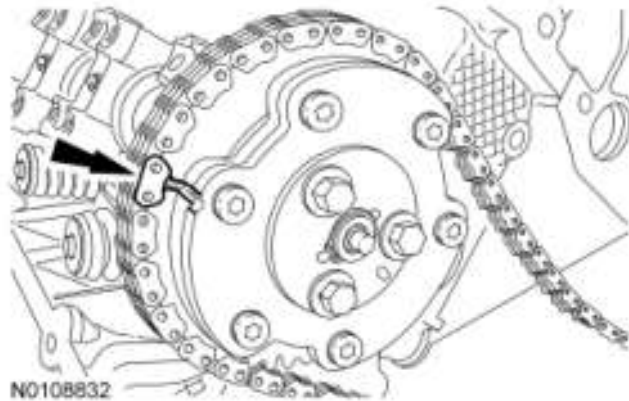
Courtesy of FORD MOTOR CO.

22. Position the LH timing chain tensioner and install the 2 bolts in 2 stages.
  - Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten an additional 45 degrees.



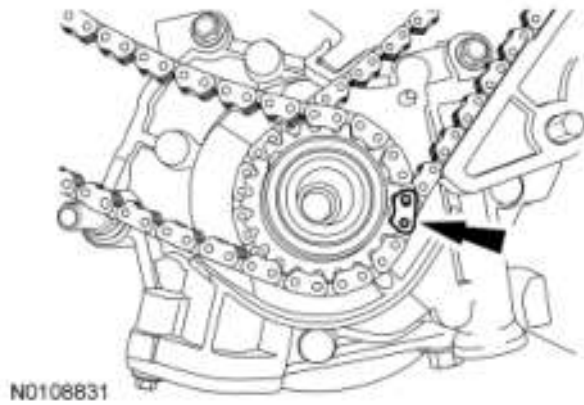
**Fig. 487: Locating LH Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

23. Remove the retaining clip from the LH timing chain tensioner.
24. Position the upper end of the RH (outer) timing chain on the RH camshaft phaser and sprocket, aligning the timing mark on the outer flange of the camshaft phaser and sprocket with the single blue (marked) link on the chain.



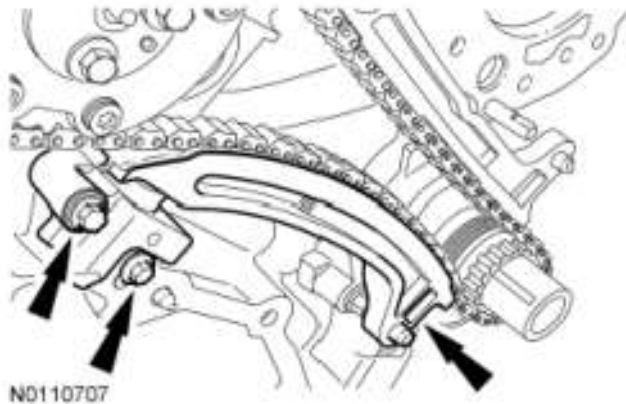
**Fig. 488: Aligning Timing Mark On Outer Flange Of Camshaft Phaser And Sprocket With Single Blue (Marked) Link On Chain**  
Courtesy of FORD MOTOR CO.

25. Position the lower end of the RH (outer) timing chain on the crankshaft sprocket, aligning the timing mark on the sprocket with the single blue (marked) chain link.



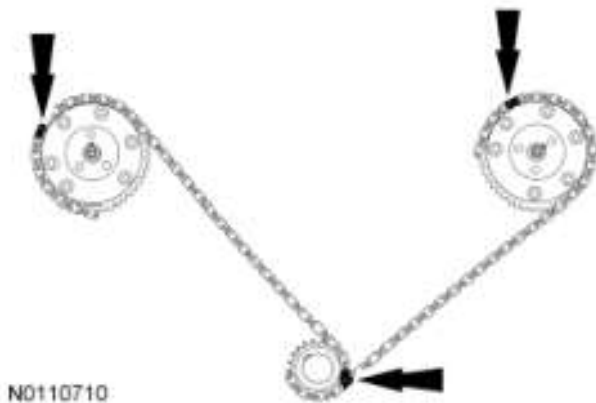
**Fig. 489: Aligning Timing Mark On Sprocket With Single Blue (Marked) Chain Link**  
 Courtesy of FORD MOTOR CO.

26. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner and install the 2 bolts in 2 stages.
  - Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten an additional 45 degrees.



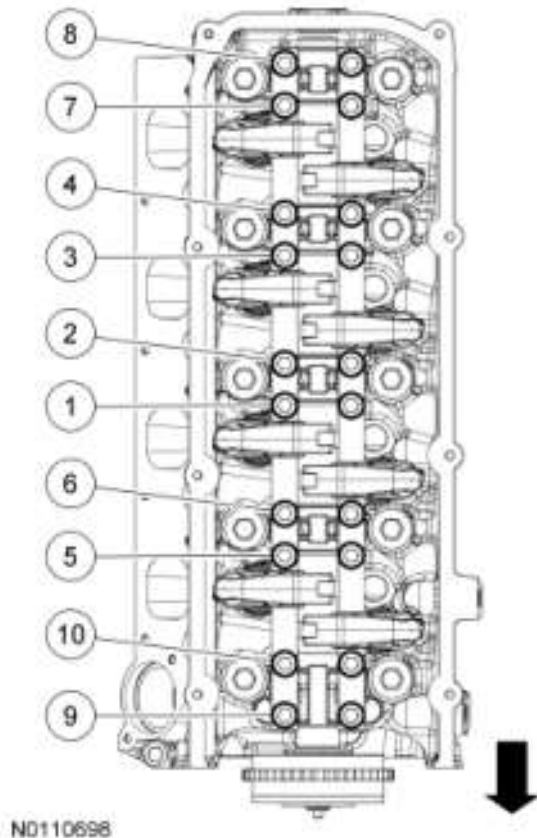
**Fig. 490: Locating Bolts, RH Timing Chain Tensioner And Tensioner Arm**  
 Courtesy of FORD MOTOR CO.

27. Remove the retaining clip from the RH timing chain tensioner.
28. As a post-check, verify correct alignment of all timing marks.



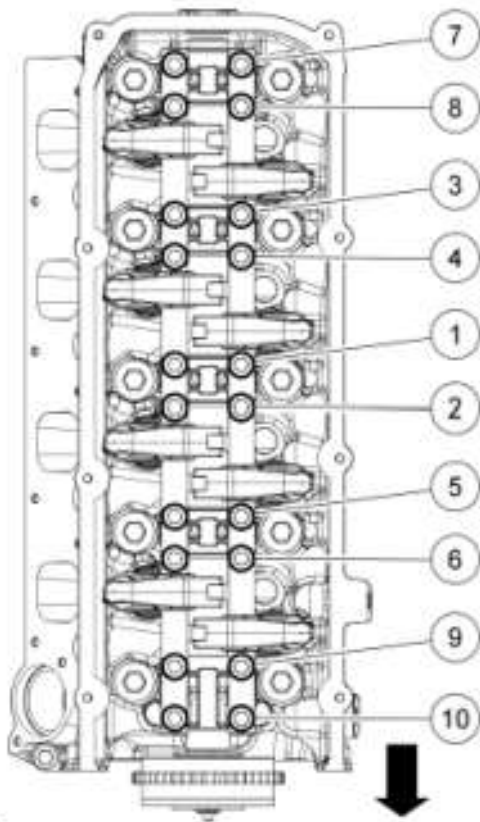
**Fig. 491: Inspecting Correct Alignment Of All Timing Marks**  
Courtesy of FORD MOTOR CO.

29. Rotate the engine clockwise until the No. 1 cylinder intake valve is open.
30. Position the LH intake rocker arm shaft assembly and install the bolts finger-tight.
31. Tighten the 10 LH intake rocker arm shaft assembly bolts in the sequence shown in illustration, in 3 stages.
  - Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten to 20 Nm (177 lb-in).
  - Stage 3: Tighten an additional 60 degrees.



**Fig. 492: Identifying LH Intake Rocker Arm Shaft Assembly Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

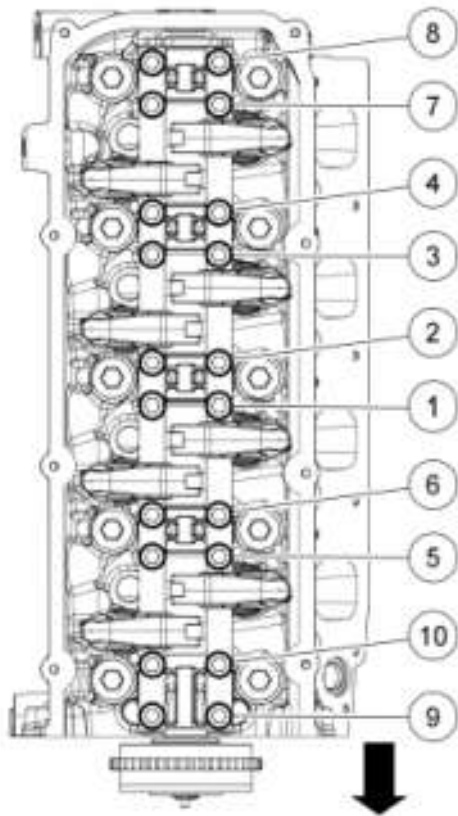
32. Rotate the engine clockwise until the No. 1 cylinder exhaust valve is open.
33. Position the LH exhaust rocker arm shaft assembly and install the bolts finger-tight.
34. Tighten the 10 LH exhaust rocker arm shaft assembly bolts in the sequence shown in illustration, in 3 stages.
  - Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten to 20 Nm (177 lb-in).
  - Stage 3: Tighten an additional 60 degrees.



N0110697

**Fig. 493: Identifying LH Exhaust Rocker Arm Shaft Assembly Bolts Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

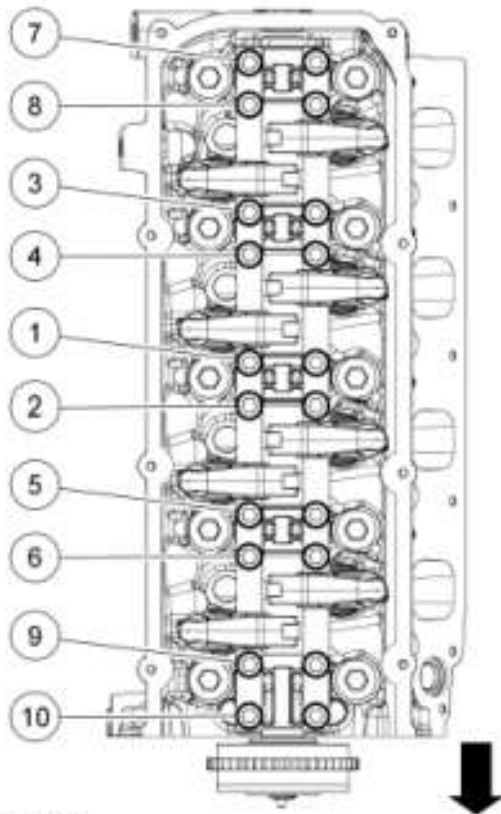
35. Rotate the engine clockwise until the No. 1 cylinder intake valve is closed.
36. Position the RH intake rocker arm shaft assembly and install the bolts finger-tight.
37. Tighten the 10 RH intake rocker arm shaft assembly bolts in the sequence shown in illustration, in 3 stages.
  - Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten to 20 Nm (177 lb-in).
  - Stage 3: Tighten an additional 60 degrees.



N0110890

**Fig. 494: Identifying RH Intake Rocker Arm Shaft Assembly Bolts Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

38. Rotate the engine clockwise until the No. 1 cylinder exhaust valve is closed.
39. Position the RH exhaust rocker arm shaft assembly and install the bolts finger-tight.
40. Tighten the 10 RH intake rocker arm shaft assembly bolts in the sequence shown in illustration, in 3 stages.
  - Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten to 20 Nm (177 lb-in).
  - Stage 3: Tighten an additional 60 degrees.



N0110696

**Fig. 495: Identifying RH Exhaust Rocker Arm Shaft Assembly Bolts Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

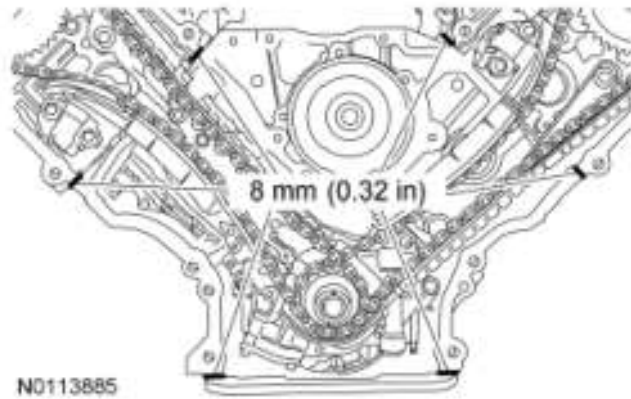
41.

**NOTE:** 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.

**NOTE:** If the engine front cover is not secured within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

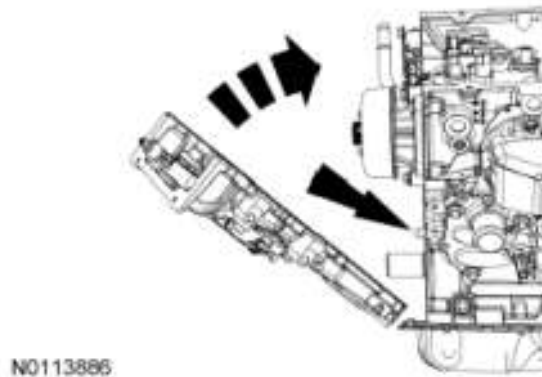
**NOTE:** Make sure that the engine front cover gasket is in place on the engine front cover before installation.

Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface, at the locations shown in illustration.



**Fig. 496: Identifying Apply Locations Of Silicone Gasket And Sealant Along Cylinder Head-To-Cylinder Block Surface And Oil Pan-To-Cylinder Block Surface**  
 Courtesy of FORD MOTOR CO.

42. Install new engine front cover gaskets on the engine front cover. Position the engine front cover onto the dowels. Install the fasteners finger-tight.



**Fig. 497: Installing Engine Front Cover Onto Dowels**  
 Courtesy of FORD MOTOR CO.

43. Tighten the 20 engine front cover fasteners in the sequence shown in illustration in 2 stages.

Stage 1: Tighten all fasteners to 10 Nm (89 lb-in).

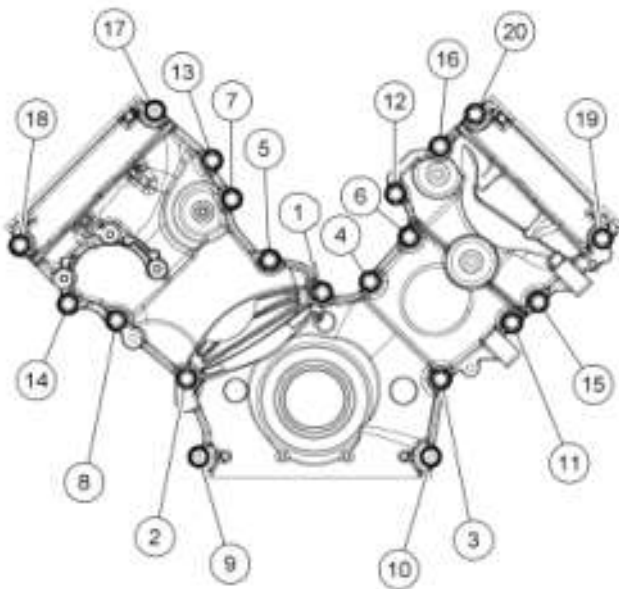
Stage 2: Tighten all fasteners to 20 Nm (177 lb-in).

Stage 3: Tighten all fasteners an additional 45 degrees.

**ITEM DESCRIPTION CHART**

Item	Part Number	Description
1	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
2	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
3	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
4	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
5	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
6	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33

7	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
8	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
9	W713462	Stud, Hex Head Pilot, M8 x 33 + M10 x 30
10	W713462	Stud, Hex Head Pilot, M8 x 33 + M10 x 30
11	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
12	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
13	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
14	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
15	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
16	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
17	W713461	Stud, Hex Head Pilot, M8 x 33 + M8 x 27
18	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
19	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33
20	W713261	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 33

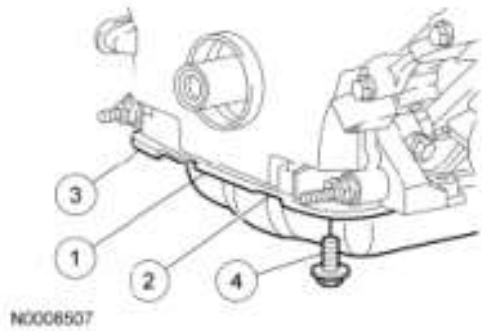


N0110684

**Fig. 498: Identifying Engine Front Cover Fasteners Tightening Sequence**  
**Courtesy of FORD MOTOR CO.**

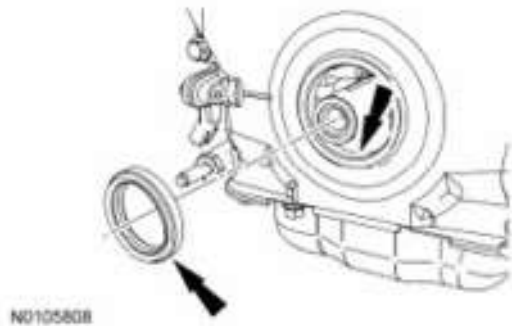
44. Loosely install the 4 bolts, then tighten in 2 stages, in the sequence shown in illustration.
- Stage 1: Tighten to 10 Nm (89 lb-in).
  - Stage 2: Tighten an additional 45 degrees.





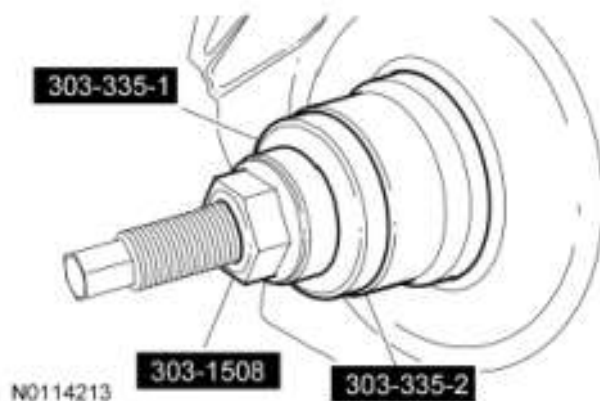
**Fig. 499: Identifying Tightening Sequence Of Oil Pan Front Bolts**  
 Courtesy of FORD MOTOR CO.

45. Lubricate the engine front cover and the crankshaft seal inner lip with clean engine oil.



**Fig. 500: Locating Engine Front Cover And Crankshaft Front Seal Inner Lip**  
 Courtesy of FORD MOTOR CO.

46. Using the Crankshaft Vibration Damper Installer, Front Cover Oil Seal Installer and the Crankshaft Front Oil Seal Installer, install a new crankshaft front seal into the engine front cover.



**Fig. 501: Installing Crankshaft Front Seal Into Engine Front Cover**  
 Courtesy of FORD MOTOR CO.

**NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with metal surface prep and silicone gasket remover. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

47.

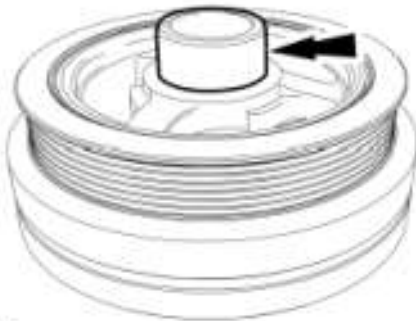
Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



N0113878

**Fig. 502: Locating Woodruff Key Slot In Crankshaft Pulley**  
Courtesy of FORD MOTOR CO.

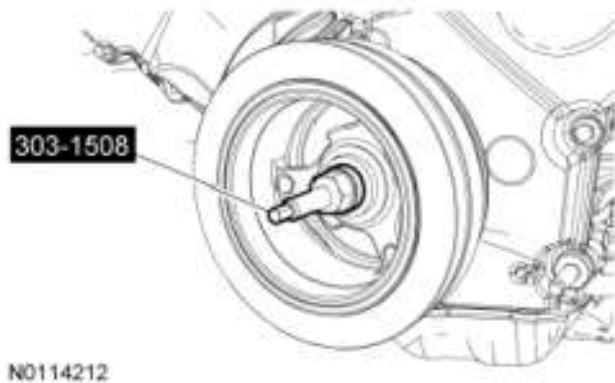
48. Lubricate the crankshaft pulley sealing area with clean engine oil prior to installation.



N0113877

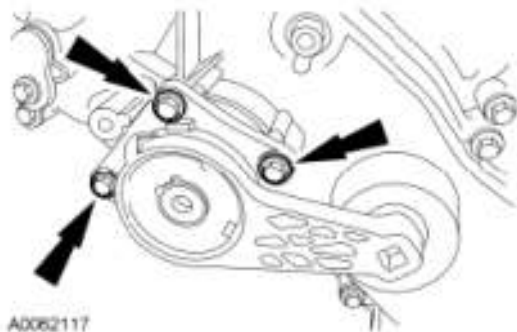
**Fig. 503: Locating Crankshaft Pulley Sealing Area**  
Courtesy of FORD MOTOR CO.

49. Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.



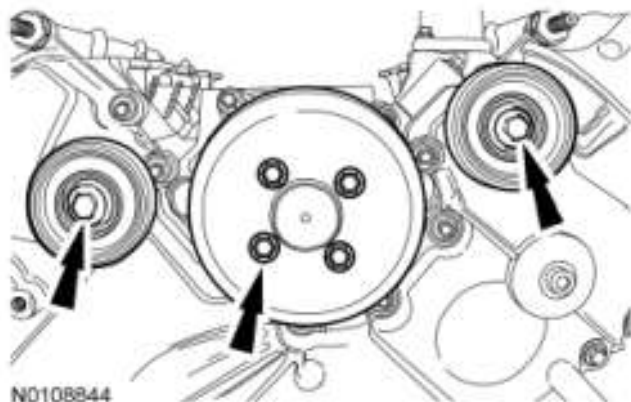
**Fig. 504: Installing Crankshaft Pulley Using Crankshaft Vibration Damper Installer**  
 Courtesy of FORD MOTOR CO.

50. Tighten the new crankshaft pulley bolt in 2 stages.
  - Stage 1: Tighten to 175 Nm (129 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.
51. Install the accessory drive belt tensioner and the 3 bolts.
  - Tighten to 25 Nm (18 lb-ft).



**Fig. 505: Locating Accessory Drive Belt Tensioner Bolts**  
 Courtesy of FORD MOTOR CO.

52. Install the 2 accessory drive idler pulleys, the coolant pump pulley and the 6 bolts.
  - Tighten to 25 Nm (18 lb-ft).



**Fig. 506: Locating Bolts, Coolant Pump Pulley And Accessory Drive Belt Idler Pulleys**

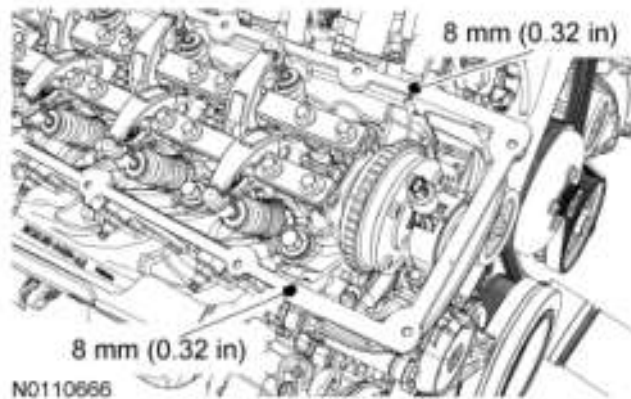
Courtesy of FORD MOTOR CO.

53. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean 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 valve cover mating surface with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

54. **NOTE:** If not secured within 4 minutes, the 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 silicone gasket and sealant in 2 places where the engine front cover meets the cylinder head.

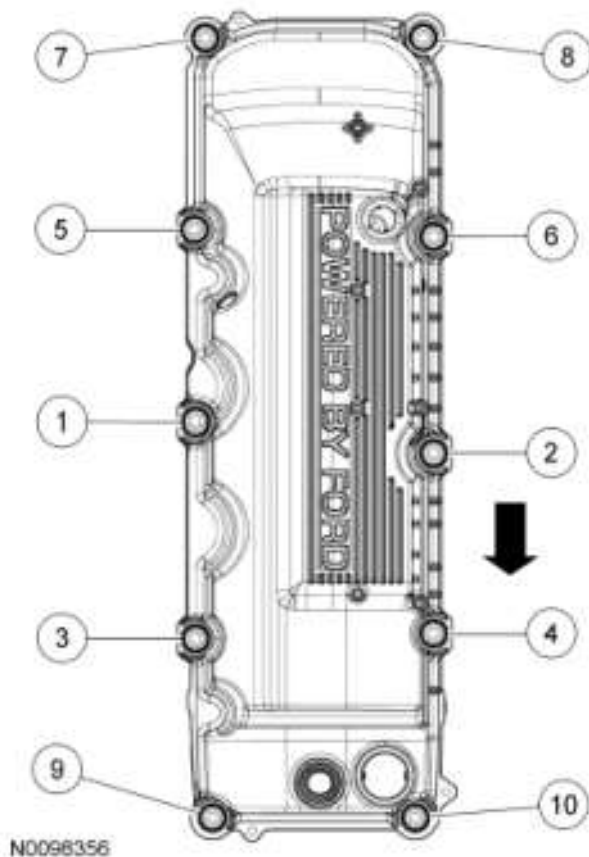


**Fig. 507: Identifying Apply Locations Of Silicone Gasket And Sealant Where Engine Front Cover Meets Cylinder Head**  
Courtesy of FORD MOTOR CO.

55. **NOTE:** Install the valve cover carefully, or the Variable Camshaft Timing (VCT) solenoid may be damaged.

Position the RH valve cover and new gasket on the cylinder head and tighten the 10 fasteners in the sequence shown in illustration.

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



**Fig. 508: Identifying RH Valve Cover Fasteners Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

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

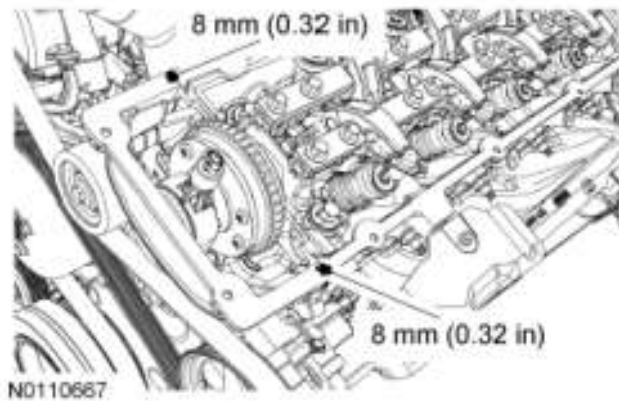
56.

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

**NOTE:** If not secured within 4 minutes, the 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.

57.

Apply silicone gasket and sealant in 2 places where the engine front cover meets the cylinder head.

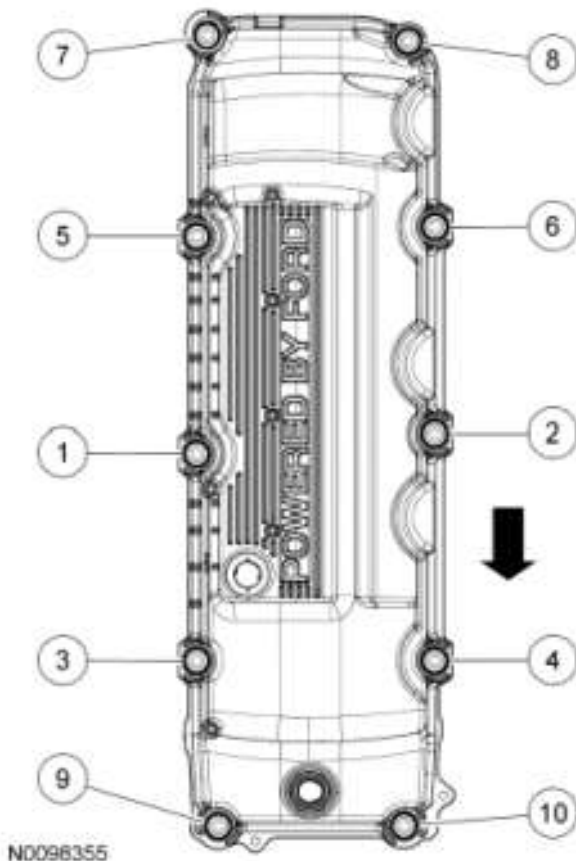


**Fig. 509: Identifying Apply Locations Of Silicone Gasket And Sealant Where Engine Front Cover Meets Cylinder Head**  
 Courtesy of FORD MOTOR CO.

58. **NOTE:** Install the valve cover carefully, or the Variable Camshaft Timing (VCT) solenoid may be damaged.

Position the LH valve cover and new gasket on the cylinder head and tighten the 10 fasteners in the sequence shown in illustration.

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

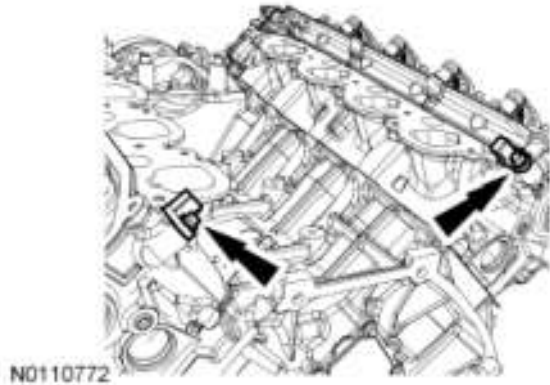


**Fig. 510: Identifying LH Valve Cover Fasteners Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

59. **NOTE:** Lubricate the O-ring seals with clean engine oil prior to installation.

Install the LH and RH Camshaft Position (CMP) sensors and the 2 bolts.

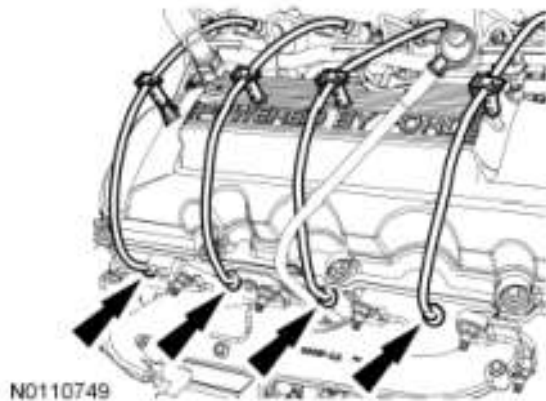
- Tighten to 10 Nm (89 lb-in).



**Fig. 511: Locating Bolts And CMP Sensors**  
Courtesy of FORD MOTOR CO.

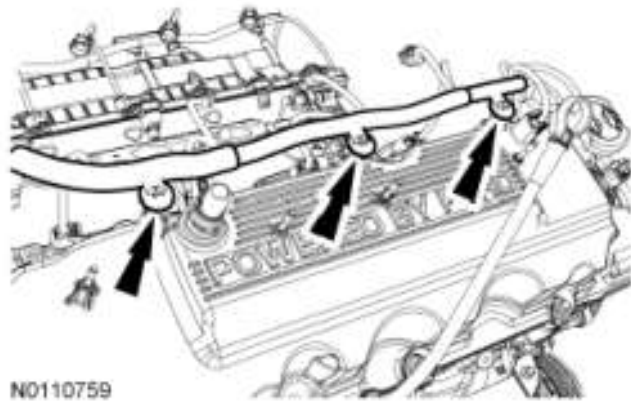
60. **NOTE:** RH shown in illustration, LH similar.

Connect the 8 ignition wires to the valve cover retainers and the lower spark plugs.



**Fig. 512: Locating Ignition Wires Of Valve Cover Retainers And Lower Spark Plugs**  
Courtesy of FORD MOTOR CO.

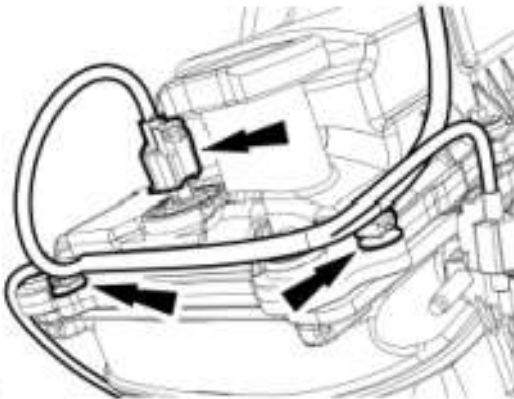
61. Position the wiring harness onto the engine assembly.
62. Connect the 3 engine wiring harness position retainers to the RH valve cover.



N0110759

**Fig. 513: Locating Engine Wiring Harness Position Retainers On RH Valve Cover**  
 Courtesy of FORD MOTOR CO.

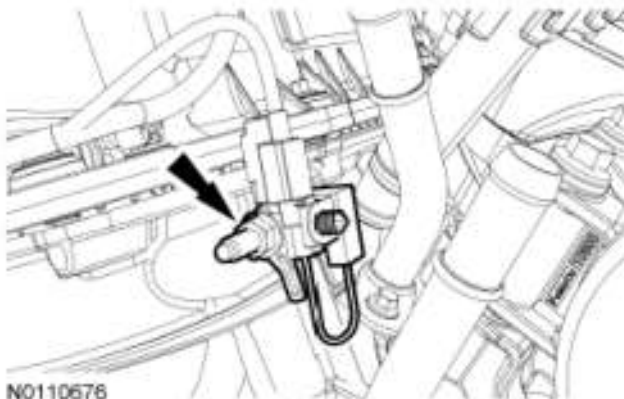
63. Connect the RH VCT electrical connector and the 2 wiring harness retainers.



N0110750

**Fig. 514: Locating RH VCT System Oil Control Solenoid Electrical Connector And Wiring Harness Retainers**  
 Courtesy of FORD MOTOR CO.

64. Position the radio ignition interference capacitor and install the nut.
  - Tighten to 25 Nm (18 lb-ft).

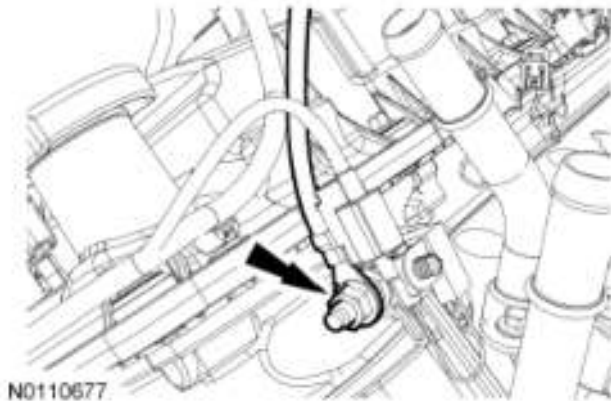


N0110676

**Fig. 515: Locating Radio Interference Capacitor Nut**  
 Courtesy of FORD MOTOR CO.



65. Position the ground strap and install the nut.
- Tighten to 25 Nm (18 lb-ft).



**Fig. 516: Locating Wiring Harness Ground Cable Nut**  
Courtesy of FORD MOTOR CO.

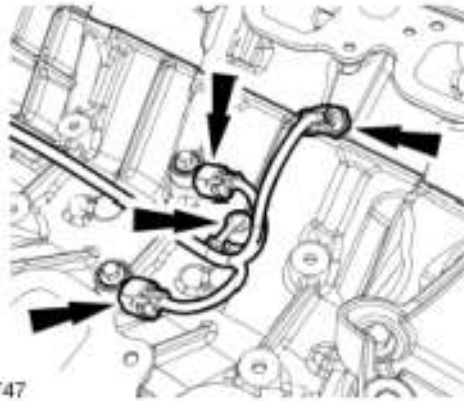
66. **NOTE:** Lubricate the O-ring seals with clean engine oil prior to installation.

Connect the LH and RH **CMP** sensor electrical connectors.



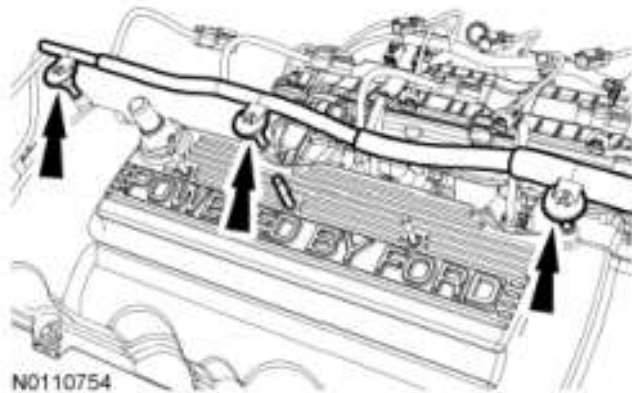
**Fig. 517: Locating LH And RH Camshaft Position Electrical Connectors**  
Courtesy of FORD MOTOR CO.

67. Connect the wiring harness retainer and the Knock Sensor (KS) and Cylinder Head Temperature (CHT) sensor electrical connectors.



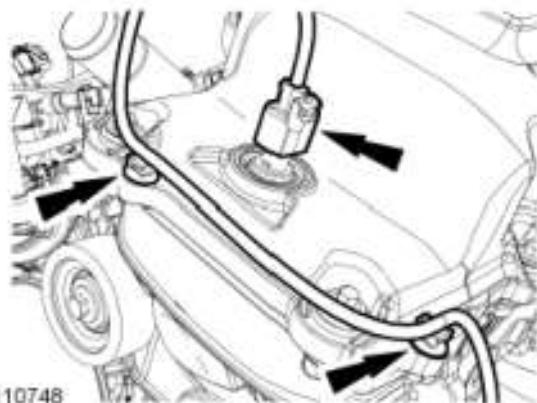
**Fig. 518: Locating Wiring Harness Retainer, Knock Sensor And Cylinder Head Temperature Sensor Electrical Connectors**  
 Courtesy of FORD MOTOR CO.

68. Connect the 3 engine wiring harness position retainers to the LH valve cover.



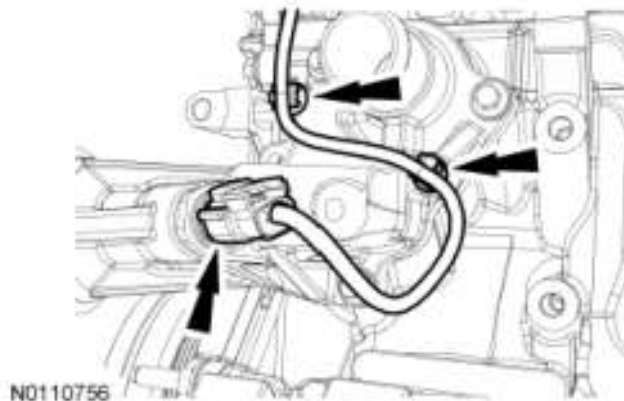
**Fig. 519: Locating Engine Wiring Harness Position Retainers On LH Valve Cover**  
 Courtesy of FORD MOTOR CO.

69. Connect the LH VCT system oil control solenoid electrical connector and the 2 wiring harness retainers.



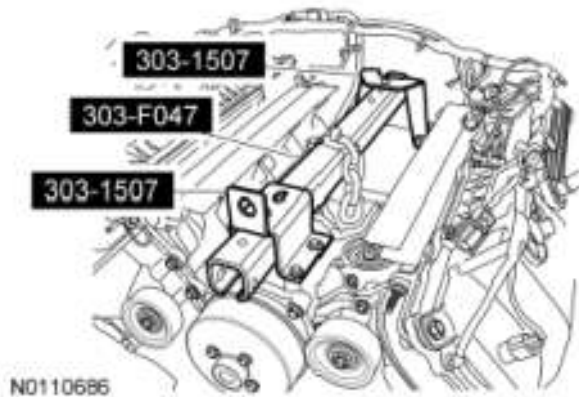
**Fig. 520: Locating LH Variable Camshaft Timing System Oil Control Solenoid Electrical Connector And Wiring Harness Retainers**  
 Courtesy of FORD MOTOR CO.

70. Connect the Engine Oil Pressure (EOP) switch electrical connector.



**Fig. 521: Locating Engine Oil Pressure Switch Electrical Connector And Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

71. Install the Engine Lifting Bracket and Engine Support Brackets.



**Fig. 522: Identifying Engine Lifting Bracket And Engine Support Brackets**  
Courtesy of FORD MOTOR CO.

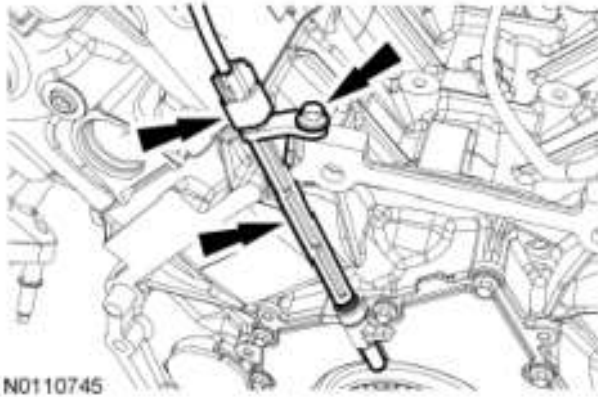
72. Using a floor crane, remove the engine from the engine stand.

**NOTE:** The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.

- 73.

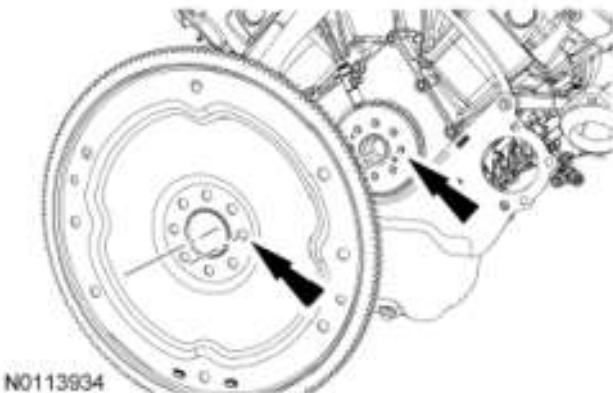
Position the Crankshaft Position (CKP) sensor, install the bolt and connect the electrical connector.

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



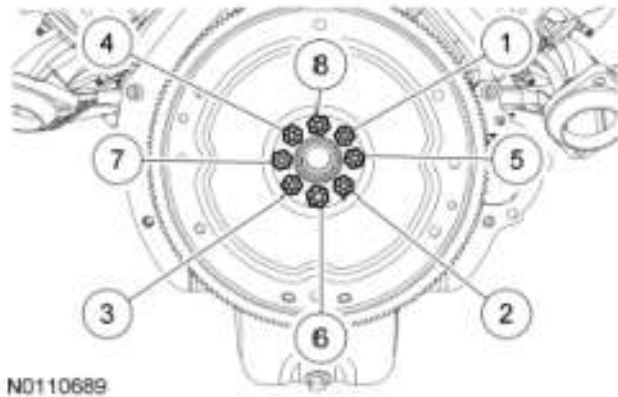
**Fig. 523: Locating Electrical Connector, Bolt And Crankshaft Position Sensor**  
**Courtesy of FORD MOTOR CO.**

74. With the offset hole on the crankshaft ignition pulse ring aligned with the offset hole on the flexplate, position the flexplate and install 8 new bolts finger-tight.



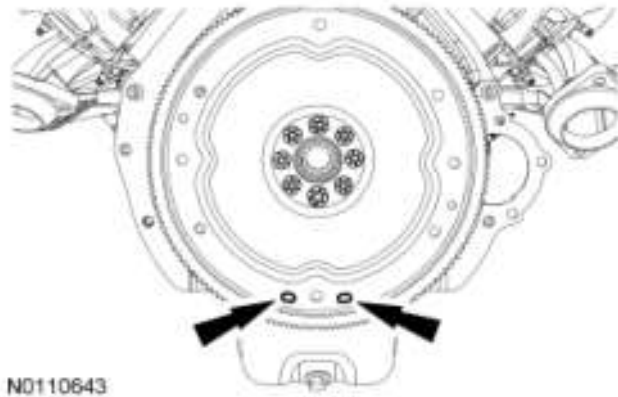
**Fig. 524: Aligning With Offset Hole On Crankshaft Ignition Pulse Ring With Offset Hole On Flexplate**  
**Courtesy of FORD MOTOR CO.**

75. Tighten the 8 new bolts in 6 stages.
- Stage 1: Tighten fasteners 1 through 4 in sequence to 20 Nm (177 lb-in).
  - Stage 2: Tighten fasteners 1 through 4 in sequence to 35 Nm (26 lb-in).
  - Stage 3: Tighten fasteners 1 through 4 sequence an additional 60 degrees.
  - Stage 4: Tighten fasteners 5 through 8 in sequence to 20 Nm (177 lb-in).
  - Stage 5: Tighten fasteners 5 through 8 in sequence to 35 Nm (26 lb-in).
  - Stage 6: Tighten fasteners 5 through 8 in sequence an additional 60 degrees.



**Fig. 525: Identifying Flexplate Bolts Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

76. Rotate the engine clockwise until the 2 slotted holes on the flexplate are at the 6 o'clock position as shown in illustration prior to engine installation.



**Fig. 526: Positioning Flexplate Slotted Holes Are At 6 O'Clock**  
 Courtesy of FORD MOTOR CO.

77. Install the engine. For additional information, refer to ENGINE.