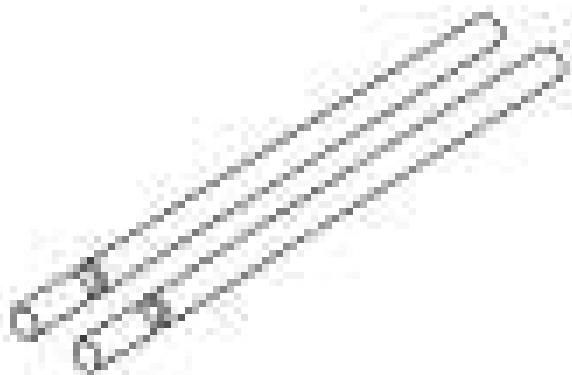


# ASSEMBLY

## ENGINE

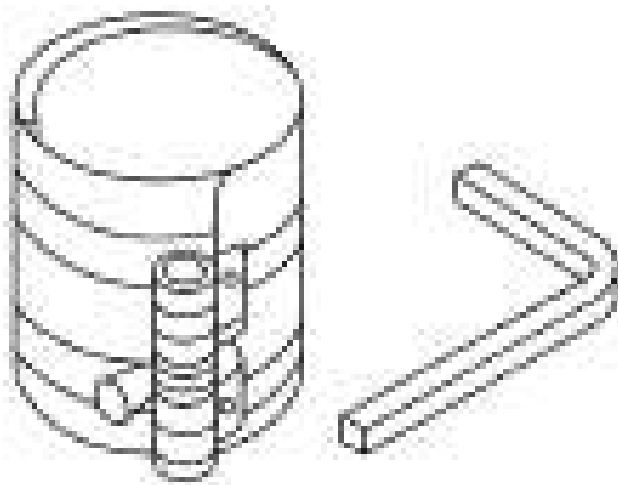
### Special Tool(s)

#### SPECIAL TOOL CHART



**ST2806-A**

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



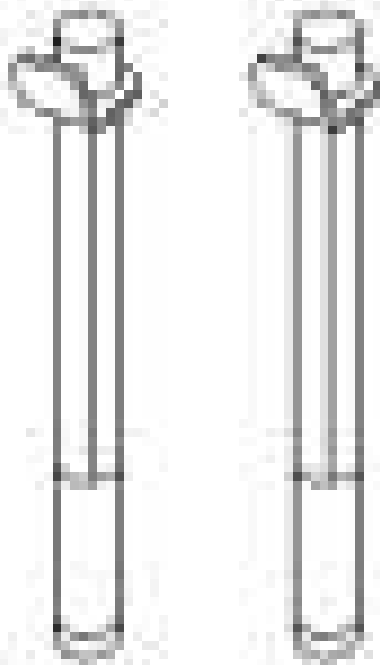
**ST1376-A**

Compressor, Piston Ring  
303-D032 (D81L-6002-C) or equivalent



ST2804-A

Compressor, Valve Spring  
303-1039



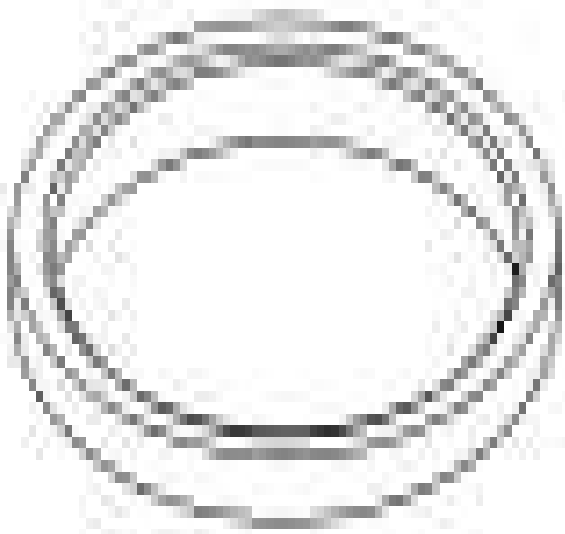
ST1337-A

Installer, Connecting Rod  
303-442 (T93P-6136-A)



**ST2197-A**

Installer, Crankshaft Front Seal  
303-635



**ST1482-A**

Installer, Crankshaft Rear Oil Slinger  
303-517 (T95P-6701-CH)



**ST1479-A**

Installer, Crankshaft Rear Seal  
303-516 (T95P-6701-EH)



**ST1480-A**

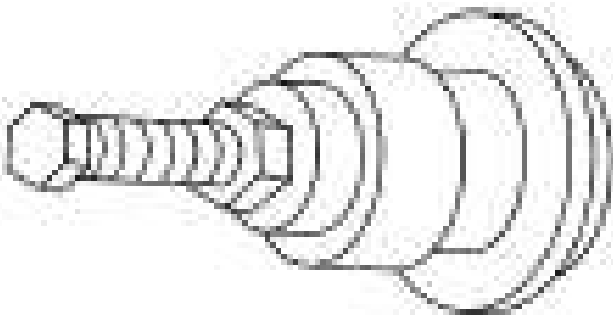
Installer, Crankshaft Rear Seal  
303-518 (T95P-6701-DH)

Installer, Crankshaft Vibration Damper

303-102 (T74P-6316-B)



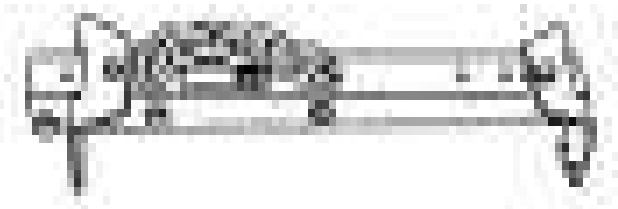
ST2428-A



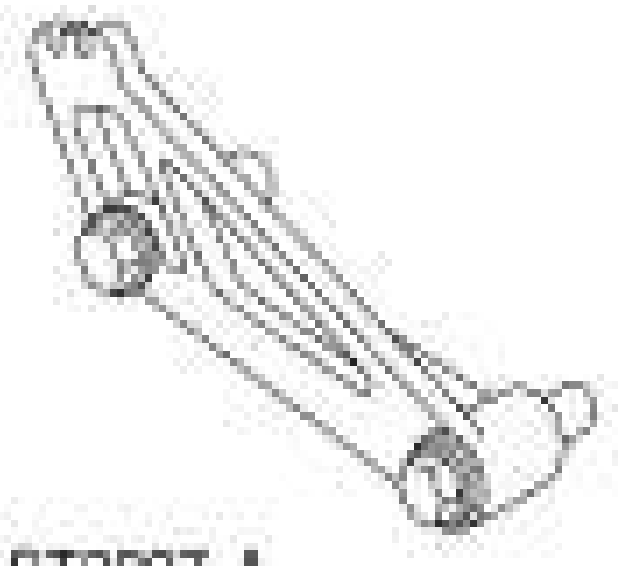
ST1328-A

Installer, Front Cover Seal  
303-335 (T88T-6701-A)

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



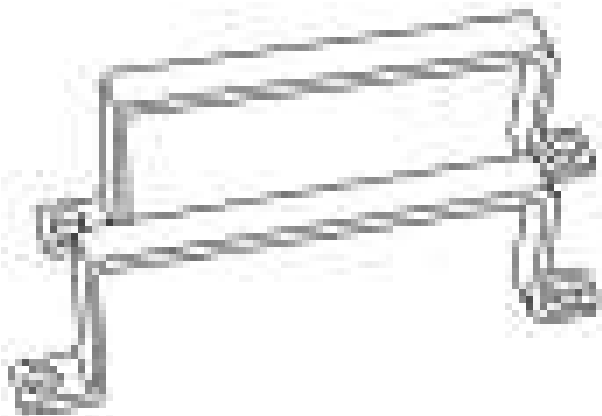
ST1377-A



ST2807-A

Locking Tool, Cam Phaser  
303-1046

Remover/Installer, Cylinder Head  
303-572 (T97T-6000-A)



**ST1658-A**

**General Equipment**

**GENERAL EQUIPMENT**

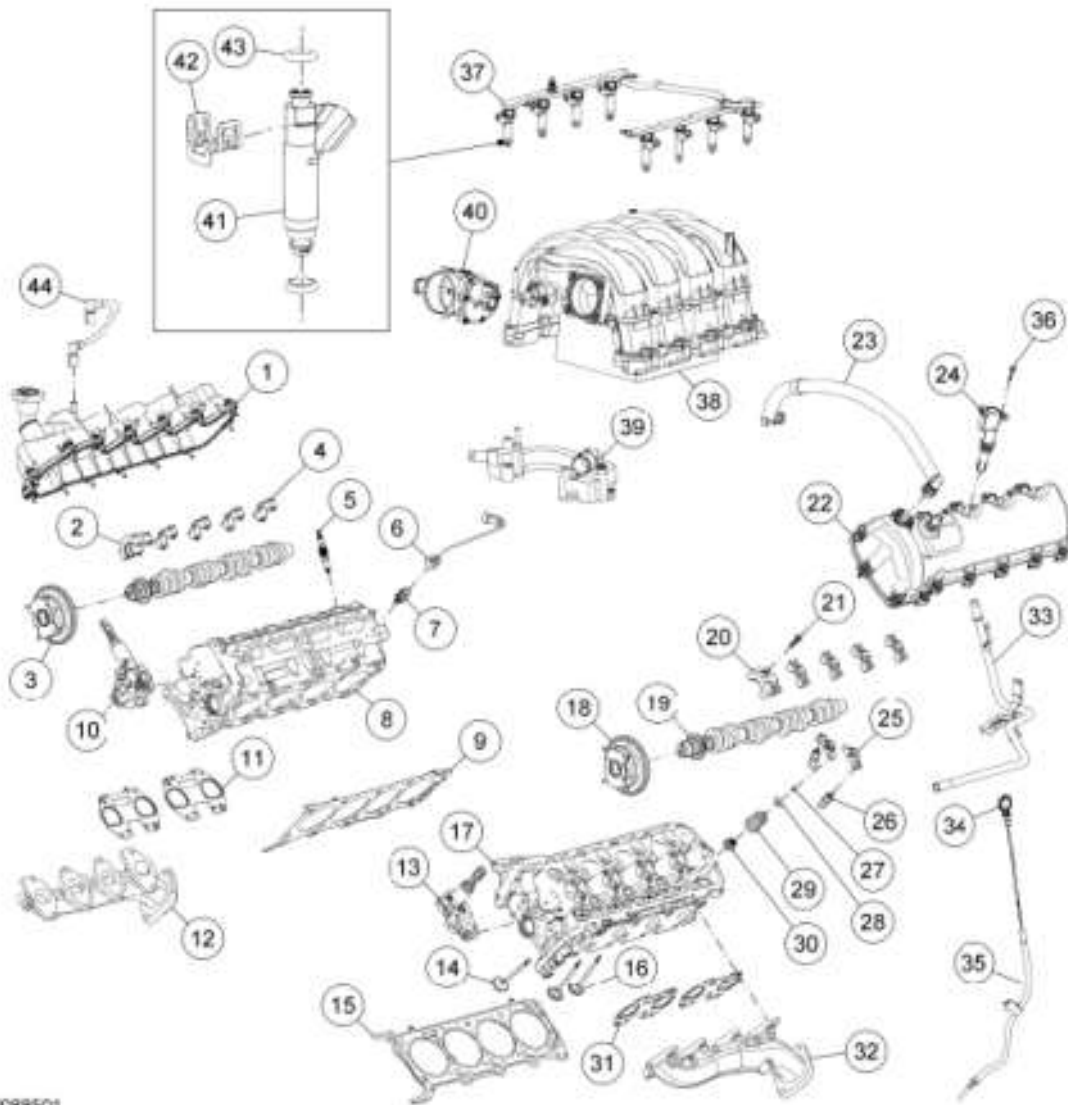
Hydraulic Chain Tensioner Retaining Clip 1L3Z-6P250-AA

**Material**

**MATERIAL SPECIFICATIONS**

Item	Specification
Gasket Maker TA-16	WSK-M2G348-A5
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® Premium Gold Engine Coolant with Bittering Agent (US); Motorcraft® Premium Gold Engine Coolant (Canada) VC-7-B (US); CVC-7-A (Canada); or equivalent (yellow color)	WSS-M97B51-A1
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
Silicone Gasket Remover ZC-30	-

**Engine - Upper End**



M0088501

**Fig. 435: Exploded View Of Engine - Upper End**  
 Courtesy of FORD MOTOR CO.

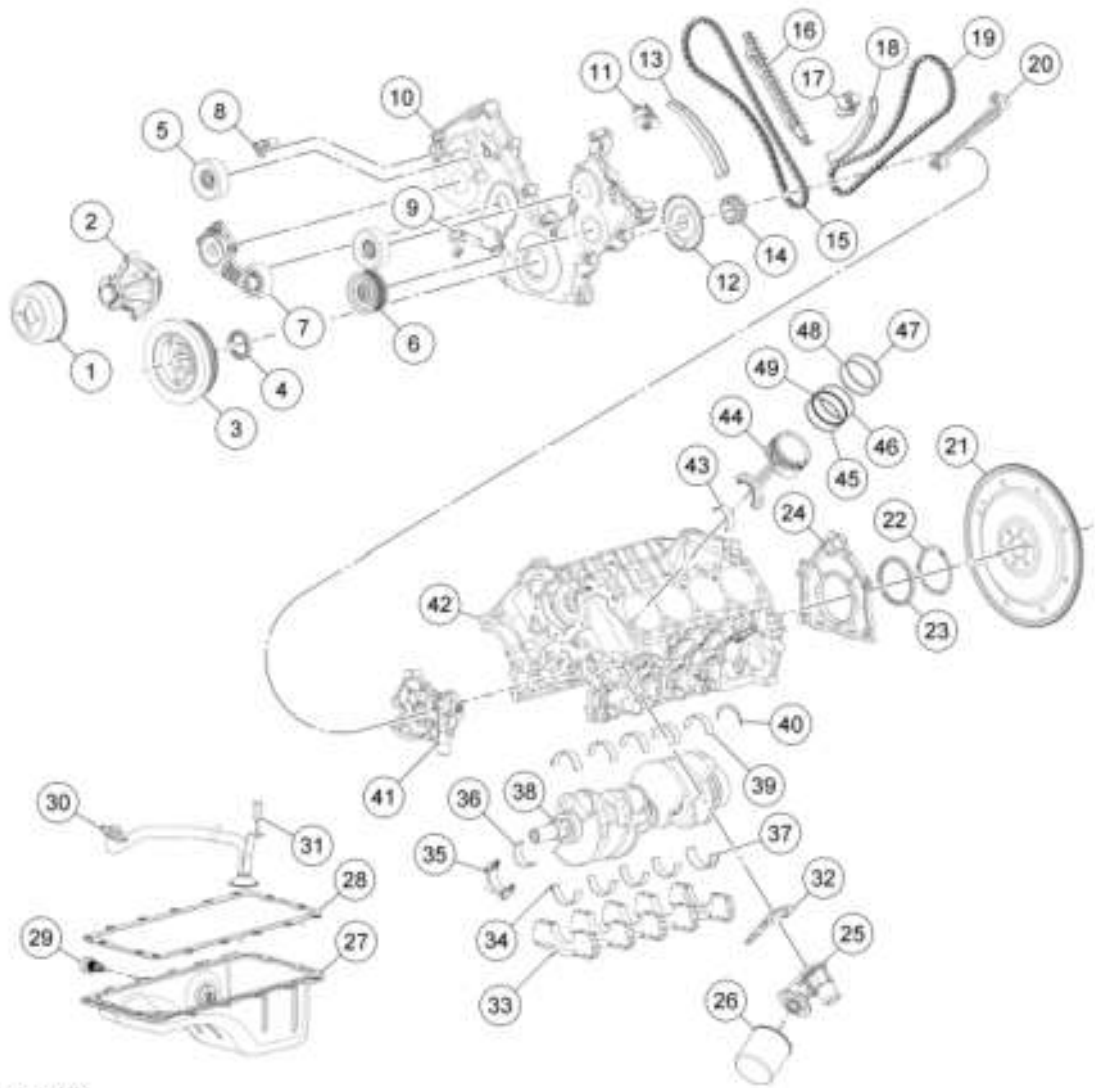
**ITEM DESCRIPTION**

Item	Part Number	Description
1	6582	RH valve cover
2	6B284	RH camshaft thrust bearing cap
3	6C524	RH camshaft phaser sprocket
4	6B280	Camshaft bearing cap (8 required)
5	12405	Spark plug (8 required)
6	14B485	Cylinder Head Temperature (CHT) sensor jumper harness
7	6G004	<b>CHT</b> sensor
8	6049	RH cylinder head
9	6051	RH cylinder head gasket
10	6C261	RH Variable Camshaft Timing (VCT) oil control solenoid assembly
11	9Y431	Exhaust manifold gasket (2 required)
12	9430	Exhaust manifold - RH



13	6C261	LH VCT oil control solenoid assembly
14	6505	Exhaust valve (8 required)
15	6083	LH cylinder head gasket
16	6507	Intake valve (16 required)
17	6050	LH cylinder head
18	6C524	LH camshaft phaser sprocket
19	6C255	LH camshaft
20	6B284	LH camshaft thrust bearing cap
21	N807834	Camshaft bearing cap bolt (20 required)
22	6A505	LH valve cover
23	6K817	PCV tube
24	12A366	Ignition coil (8 required)
25	6529	Roller follower (24 required)
26	6C501	Hydraulic lash adjuster (24 required)
27	6518	Valve spring retainer key (48 required)
28	6514	Valve spring retainer (24 required)
29	6513	Valve spring (24 required)
30	6A517	Valve stem seal (24 required)
31	9Y431	Exhaust manifold gasket (2 required)
32	9431	LH exhaust manifold
33	18B402	Coolant tube
34	6750	Oil level indicator
35	6K873	Oil level indicator tube
36	W706175	Ignition coil bolt (8 required)
37	9F792	Fuel rail assembly
38	9424	Intake manifold assembly
39	8C369	Engine coolant crossover
40	9F991	Electronic throttle body
41	9F860	Fuel injector (8 required)
42	9C995	Fuel injector clip (8 required)
43	9F798	O-ring seal (16 required)
44	6758	PCV breather hose

#### Engine - Lower End



NO106662

**Fig. 436: Exploded View Of Engine - Lower End**  
 Courtesy of FORD MOTOR CO.

**ITEM DESCRIPTION**

Item	Part Number	Description
1	8A528	Coolant pump pulley
2	8501	Coolant pump
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal
5	19A216	Accessory drive belt idler pulley (2 required)
6	6C348	Accessory drive belt idler pulley
7	6B209	Accessory drive belt tensioner
8	6B288	Camshaft Position (CMP) sensor (2 required)
9	6C315	Crankshaft Position (CKP) sensor
10	6C086	Engine front cover
11	6L266	RH timing chain tensioner
12	12A227	Ignition pulse wheel

13	6K255	RH tensioner arm
14	6306	Crankshaft sprocket
15	6268	RH timing chain
16	6M256	RH timing chain guide
17	6M269	LH timing chain tensioner
18	6M274	LH tensioner arm
19	6268	LH timing chain
20	6B274	LH timing chain guide
21	6375	Flexplate
22	6310	Crankshaft oil slinger
23	6701	Crankshaft rear seal
24	6K318	Crankshaft rear seal retainer plate
25	6881	Oil filter adapter
26	6714	Oil filter
27	6675	Oil pan
28	6710	Oil pan gasket
29	12A648	Engine Oil Temperature (EOT) sensor
30	6622	Oil pump screen and pickup tube
31	N806180	Oil pump screen and pickup tube spacer
32	6A636	Oil filter adapter gasket
33	6325	Crankshaft main bearing cap (5 required)
34	6A338	Lower crankshaft bearing (4 required)
35	6210	Connecting rod cap (8 required)
36	6211	Connecting rod lower bearing (8 required)
37	6K302	Lower crankshaft thrust washer
38	6303	Crankshaft
30	6333	Upper crankshaft bearing (5 required)
40	6A341	Upper crankshaft thrust washer
41	6621	Oil pump
42	6010	Cylinder block
43	6211	Connecting rod upper bearing (8 required)
44	6110	Piston (8 required)
45	6159	Outer oil control ring (8 required)
46	6159	Outer oil control ring (8 required)
47	6150	Upper compression ring (8 required)
48	6152	Lower compression ring (8 required)
49	6161	Inner oil control ring (8 required)

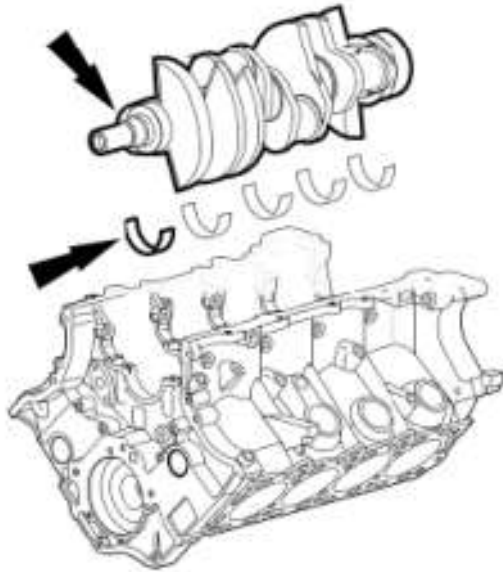
**NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

1.

Install the crankshaft main bearings.

- Install the crankshaft upper main bearings into the cylinder block.

- Install the crankshaft lower main bearings into the bearing caps.
  - Make sure all oil passages are aligned.
  - Lubricate all main bearings with clean engine oil.
2. Lubricate the crankshaft bearing journals with clean engine oil. Install the crankshaft onto the upper crankshaft main bearings.

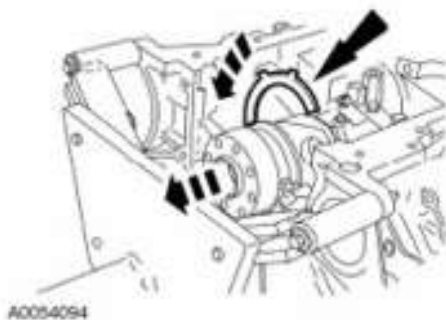


A0054093

**Fig. 437: Locating Crankshaft And Upper Crankshaft Main Bearings**  
Courtesy of FORD MOTOR CO.

- NOTE:** The oil groove on the thrust washer must face toward the rear of the engine (against the crankshaft thrust surface).
- 3.

Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 5 main boss.

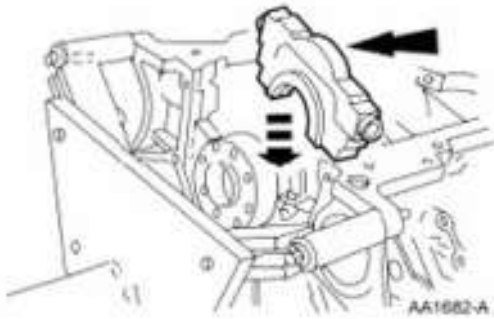


A0054094

**Fig. 438: Locating Crankshaft Upper Thrust Washer**  
Courtesy of FORD MOTOR CO.

- NOTE:** Rotate the jackscrews into the main bearing caps enough to provide clearance to the cylinder block prior to installing the bearing caps.

4. Install the thrust washer on the rear (No. 5) main bearing cap and install the rear (No. 5) main bearing cap.

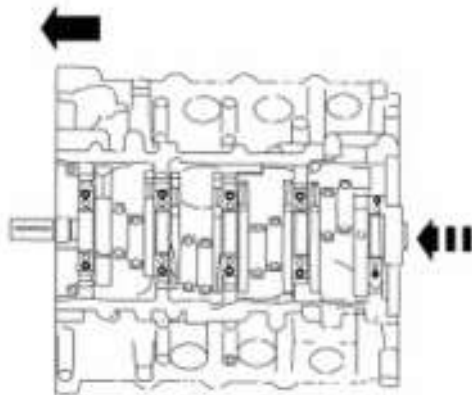


**Fig. 439: Installing Rear Main Bearing Cap**  
Courtesy of FORD MOTOR CO.

- NOTE:** Make sure the stud bolt is installed in the same position from which it was removed.
- 5.

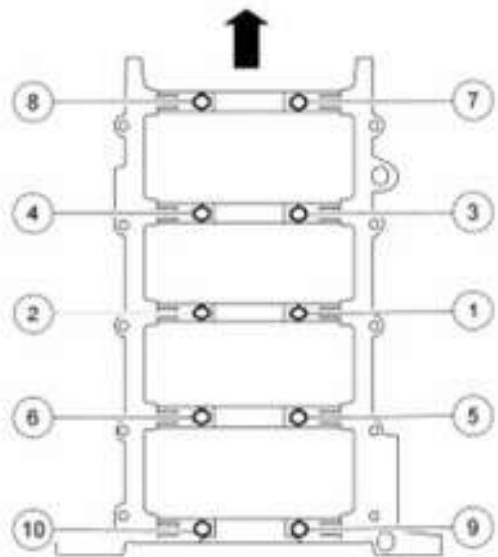
Install the crankshaft lower main bearings into the main bearing caps and lubricate them with clean engine oil. Locate the main bearing cap on the cylinder block and, keeping the cap as square as possible, alternately draw the cap down evenly using the 9 cap bolts and the stud bolt.

6. Push the crankshaft forward to seat the crankshaft thrust washer. Hold the crankshaft in the forward position.



**Fig. 440: Pushing Crankshaft Forward**  
Courtesy of FORD MOTOR CO.

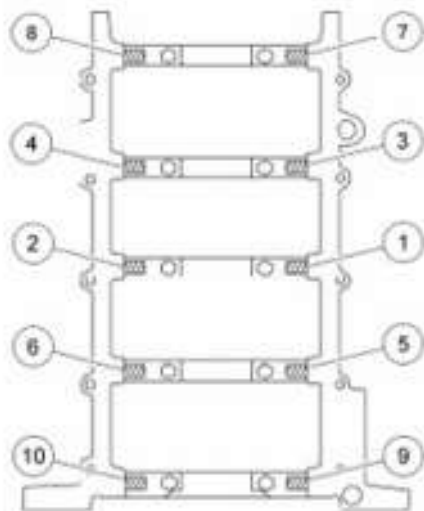
7. Tighten the 9 vertical main bearing cap bolts and the stud bolt in the sequence shown in illustration, in 2 stages.
  - Stage 1: Tighten to 40 Nm (30 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



N0013765

**Fig. 441: Identifying Main Bearing Cap Bolts In Sequence**  
 Courtesy of FORD MOTOR CO.

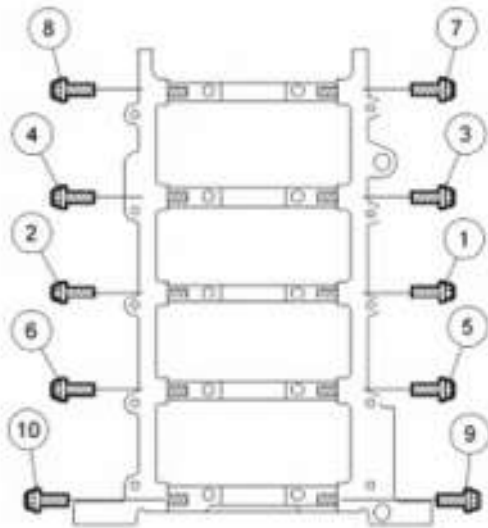
8. Tighten the 10 jackscrews against the cylinder block in the sequence shown in illustration in 2 stages.
  - Stage 1: Tighten to 5 Nm (44 lb-in).
  - Stage 2: Tighten to 10 Nm (89 lb-in).



N0015132

**Fig. 442: Identifying Jackscrews In Sequence**  
 Courtesy of FORD MOTOR CO.

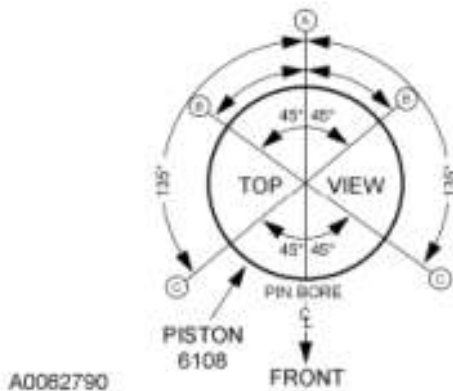
9. Install the 10 side bolts and tighten them in the sequence shown in illustration.
  - Tighten to 21 Nm (15 lb-ft).



N0015131

**Fig. 443: Identifying Side Bolts In Sequence**  
Courtesy of FORD MOTOR CO.

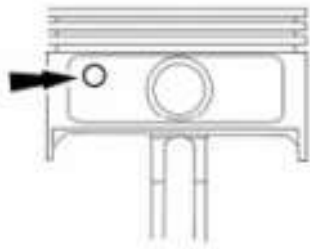
10. Check the crankshaft end play. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
11. Check that crankshaft torque-to-turn does not exceed 6 Nm (53 lb-in).
12. Check the piston-to-cylinder block and piston ring clearances. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .
13. Assemble the pistons. For additional information, refer to **PISTON**.
14. Make sure the ring gaps (oil spacer-A, oil ring-B and compression ring-C) are correctly spaced around the circumference of the piston.



A0082790

**Fig. 444: Identifying Piston Ring Gap Direction**  
Courtesy of FORD MOTOR CO.

15. Make sure the dimple in the piston faces the front of the engine.



N0086510

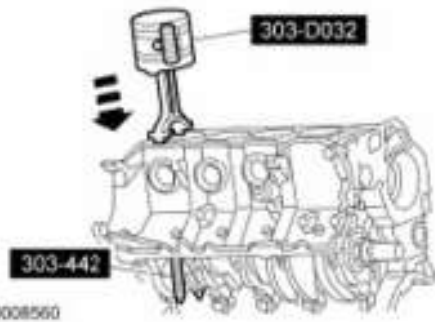
**Fig. 445: Locating Dimple In Piston Faces**  
 Courtesy of FORD MOTOR CO.

16. **NOTE:** Install the piston and connecting rod assemblies carefully, or the cylinder walls or crankshaft journals may be damaged.

**NOTE:** The following piston installation steps are for all 8 connecting rods, rod bearings and pistons. Only one connecting rod, rod bearing and piston shown in illustration.

Use the Connecting Rod Installers and the Piston Ring Compressor to install the connecting rod with the upper connecting rod bearing in place.

- Lubricate the piston and ring with clean engine oil.
- Lubricate the rod bearings with clean engine oil.



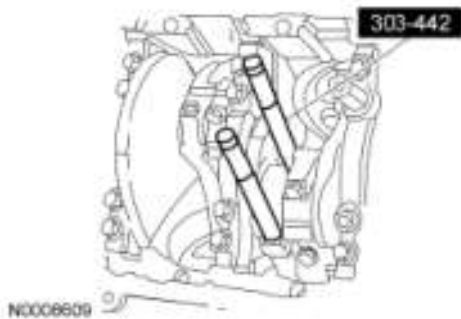
N0008560

**Fig. 446: Installing Connecting Rod With Upper Connecting Rod Bearing**  
 Courtesy of FORD MOTOR CO.

17. **NOTE:** Remove the Connecting Rod Installers carefully, or the crankshaft journals may be damaged.

Once the connecting rod is seated on the crankshaft journal, remove the Connecting Rod Installers.





**Fig. 447: Identifying Connecting Rod Installers (303-442)**  
 Courtesy of FORD MOTOR CO.

18. **NOTE:** The rod cap installation must keep the same orientation as marked during disassembly, or the engine may be damaged.

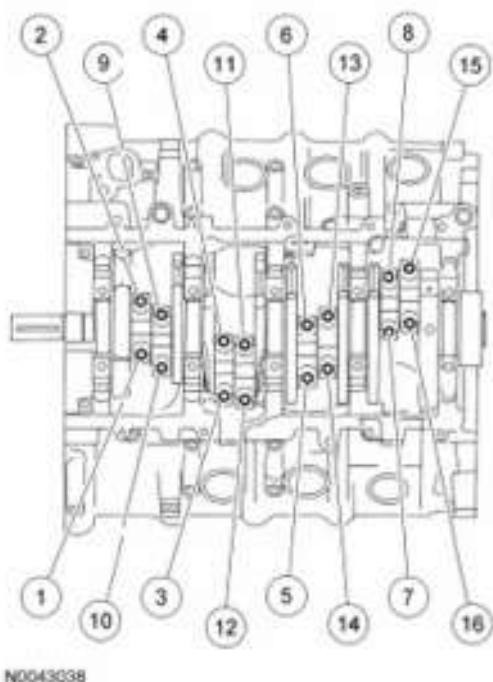
**NOTE:** The connecting rod caps are of the "cracked" design and must mate with the connecting rod ends. Excessive bearing clearance will result if not mated correctly.

Position the lower bearing and connecting rod and install the new bolts loosely.

19. **NOTE:** Main bearing caps removed from art for clarity.

Tighten the 16 bolts in 3 stages, in the sequence shown in illustration.

- Stage 1: Tighten to 23 Nm (17 lb-ft).
- Stage 2: Tighten to 43 Nm (32 lb-ft).
- Stage 3: Tighten an additional 105 degrees.



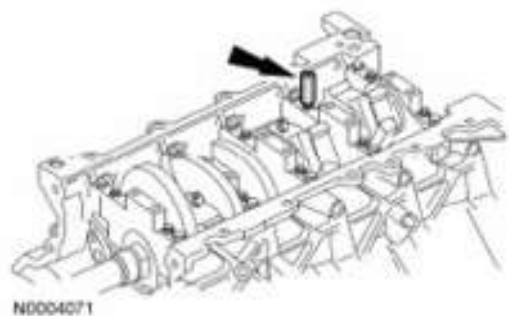
**Fig. 448: Identifying Main Bearing Caps Bolts In Sequence**  
Courtesy of FORD MOTOR CO.

20. Position the oil pump and install the 3 bolts.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 449: Locating Oil Pump And Bolts**  
Courtesy of FORD MOTOR CO.

21. Install the pickup tube spacer.
  - Tighten to 25 Nm (18 lb-ft).



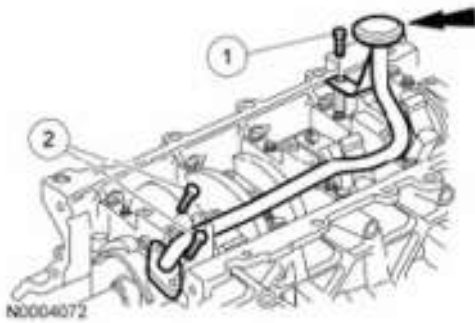
**Fig. 450: Locating Pickup Tube Spacer**  
Courtesy of FORD MOTOR CO.

- NOTE:** Make sure the O-ring is in place and not damaged. A missing or damaged O-ring may cause foam in the lubrication system, low oil pressure and severe engine damage.
- 22.

**NOTE:** Clean and inspect the mating surfaces and install a new O-ring. Lubricate the O-ring with clean engine oil.

Position the oil pump screen and pickup tube and install the 3 bolts.

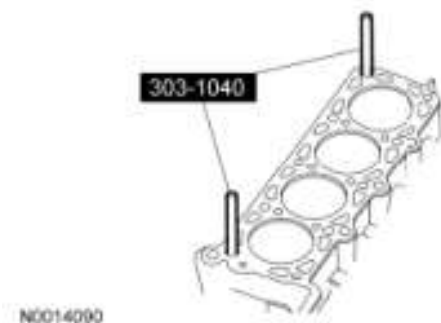
1. Tighten to 25 Nm (18 lb-ft).
2. Tighten to 10 Nm (89 lb-in).



**Fig. 451: Locating Oil Pump Screen**  
 Courtesy of FORD MOTOR CO.

23. **NOTE:** Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore, or the engine may be damaged.
- 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.

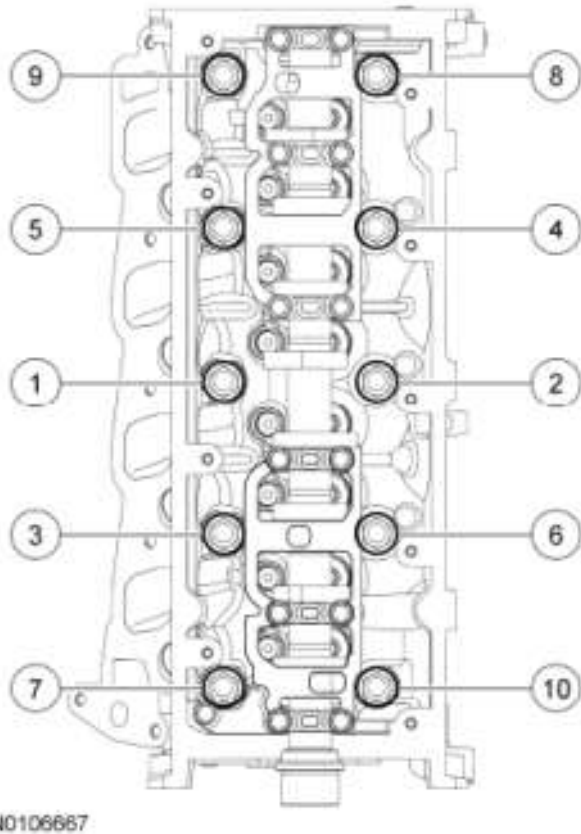
Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the 20 new cylinder head bolts loosely.



**Fig. 452: Identifying Cylinder Head Alignment Pins (303-1040)**  
 Courtesy of FORD MOTOR CO.

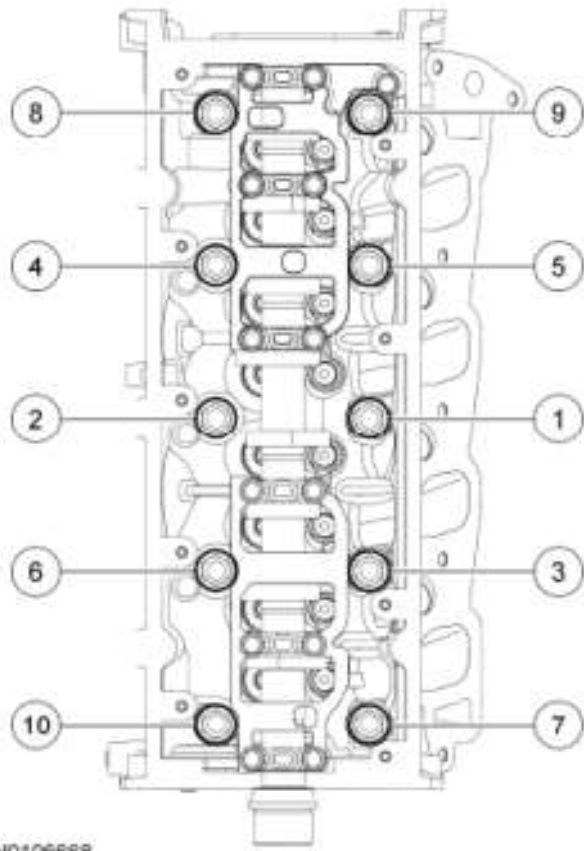
24. Tighten the 10 new LH cylinder head bolts in 6 stages, in the sequence shown in illustration.
- Stage 1: Tighten to 40 Nm (30 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.
  - Stage 3: Loosen all 10 bolts a minimum of 1 full turn (360 degrees).
  - Stage 4: Tighten to 40 Nm (30 lb-ft).
  - Stage 5: Tighten an additional 90 degrees.

- Stage 6: Tighten an additional 90 degrees.



**Fig. 453: Identifying LH Cylinder Head Bolts In Sequence**  
Courtesy of FORD MOTOR CO.

25. Tighten the 10 new RH cylinder head bolts in 6 stages, in the sequence shown in illustration.
- Stage 1: Tighten to 40 Nm (30 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.
  - Stage 3: Loosen all 10 bolts a minimum of 1 full turn (360 degrees).
  - Stage 4: Tighten to 40 Nm (30 lb-ft).
  - Stage 5: Tighten an additional 90 degrees.
  - Stage 6: Tighten an additional 90 degrees.



N010668

**Fig. 454: Identifying RH Cylinder Head Bolts In Sequence**  
 Courtesy of FORD MOTOR CO.

26. Remove the Cylinder Head Remover/Installer from the LH cylinder head.



N0008431

**Fig. 455: Identifying Cylinder Head Remover/Installer (303-572)**  
 Courtesy of FORD MOTOR CO.

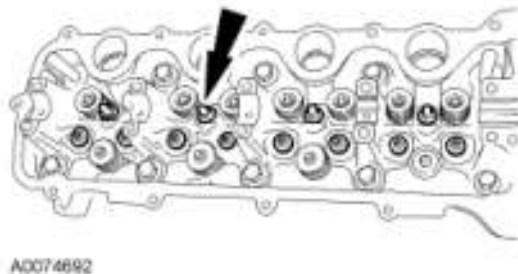
27. Remove the Cylinder Head Remover/Installer from the RH cylinder head.



**Fig. 456: Identifying Cylinder Head Remover/Installer (303-572)**  
 Courtesy of FORD MOTOR CO.

28. **NOTE:** Lubricate the hydraulic lash adjusters with clean engine oil prior to installation.

Install the hydraulic lash adjusters into the RH and LH cylinder heads.



**Fig. 457: Locating Hydraulic Lash Adjusters**  
 Courtesy of FORD MOTOR CO.

29. **NOTE:** Lubricate the camshaft and camshaft journals with clean engine oil prior to installation.

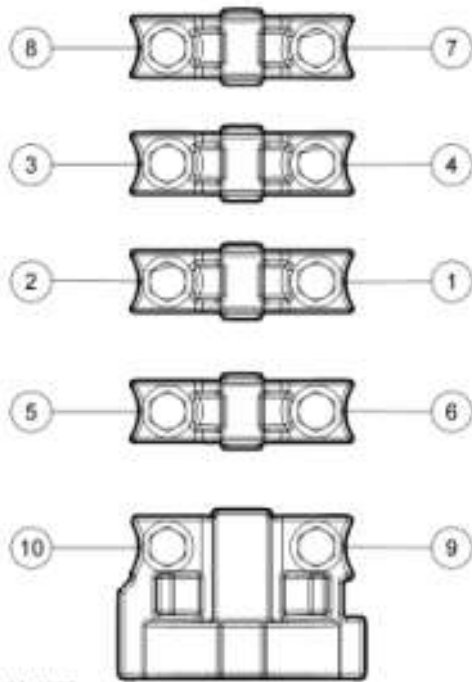
Install the LH and RH camshafts.

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

**NOTE:** Lubricate the camshaft bearing caps with clean engine oil.

Install the LH and RH camshaft bearing caps in their original locations.

- Position the front camshaft bearing cap.
- Position the remaining camshaft bearing caps.
- Install the 20 bolts loosely.
- Tighten to 10 Nm (89 lb-in) in the sequence shown in illustration.



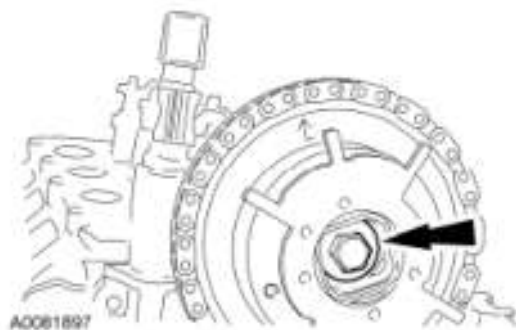
N0011337

**Fig. 458: Identifying Camshaft Bearing Cap Bolt In Sequence**  
 Courtesy of FORD MOTOR CO.

31. **NOTE:** Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

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

Position the camshaft phaser sprockets and install 2 new camshaft phaser bolts finger-tight.



**Fig. 459: Locating Camshaft Phaser And Sprocket Bolt**  
 Courtesy of FORD MOTOR CO.

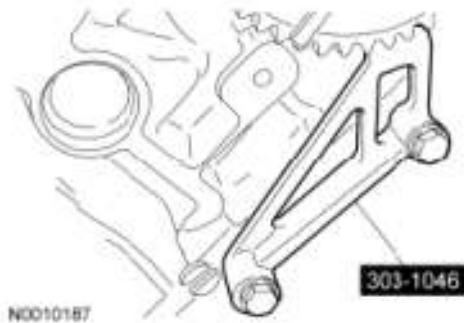
32. **NOTE:** Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

**NOTE:** Only use hand tools to install the camshaft phaser sprocket assembly or damage may occur to the camshaft or camshaft phaser unit.

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

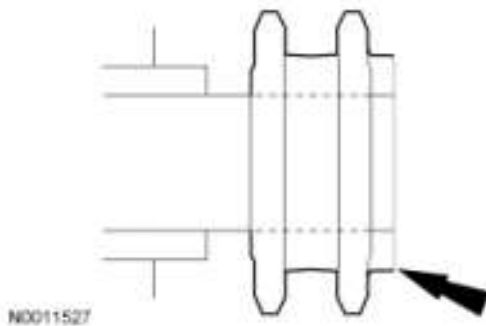
Using the Cam Phaser Locking Tool, tighten the LH and RH camshaft phaser sprocket bolts in 2 stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.



**Fig. 460: Identifying Cam Phaser Locking Tool (303-1046)**  
Courtesy of FORD MOTOR CO.

33. Install the crankshaft sprocket, making sure the flange faces forward.



**Fig. 461: Locating Crankshaft Sprocket**  
Courtesy of FORD MOTOR CO.

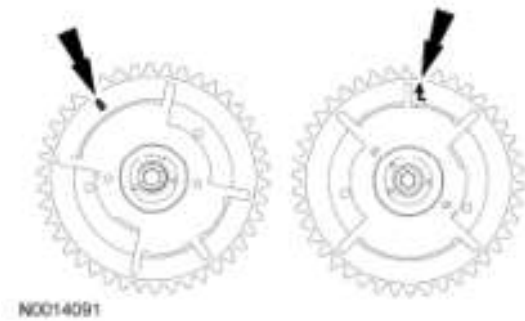
34. Rotate the crankshaft to position the crankshaft sprocket timing mark in the 6 o'clock position.



**Fig. 462: Locating Crankshaft Sprocket Timing Mark**  
Courtesy of FORD MOTOR CO.



35. Rotate the camshaft sprockets to position the RH camshaft sprocket timing mark in the 11 o'clock position and the LH camshaft sprocket timing mark in the 12 o'clock position.



**Fig. 463: Locating Camshaft Sprocket Timing Mark**  
Courtesy of FORD MOTOR CO.

- NOTE:** If one or both tensioner mounting bolts are loosened or removed, the tensioner-sealing bead must be inspected for seal integrity. Any cracks, tears, cuts or separation from the tensioner body, or permanent compression of the seal bead, will require installation of a new tensioner. Failure to follow this instruction may result in damage to the engine.

36.

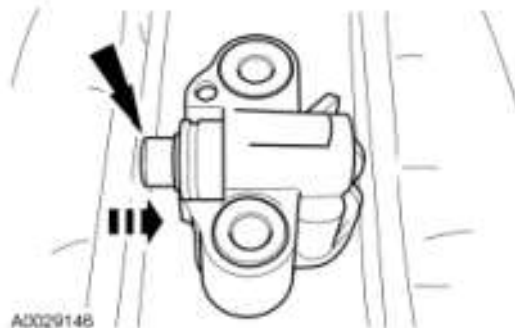
Inspect the RH and LH timing chain tensioners.

- Install new tensioners as necessary.

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

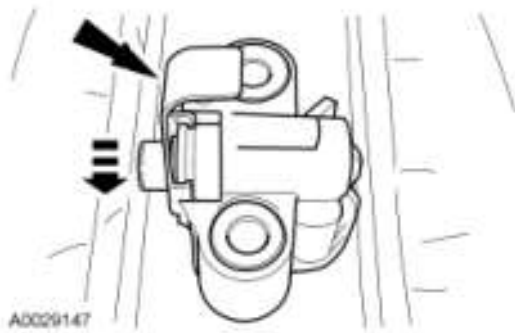
37.

Compress the tensioner plunger, using a vise.



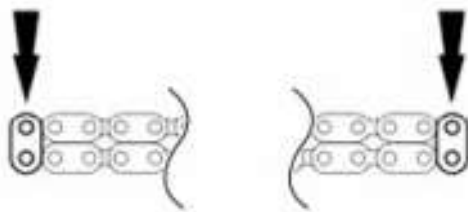
**Fig. 464: Compressing Tensioner Plunger**  
Courtesy of FORD MOTOR CO.

38. Install a Hydraulic Chain Tensioner Retaining Clip on the tensioner to hold the plunger in during installation.



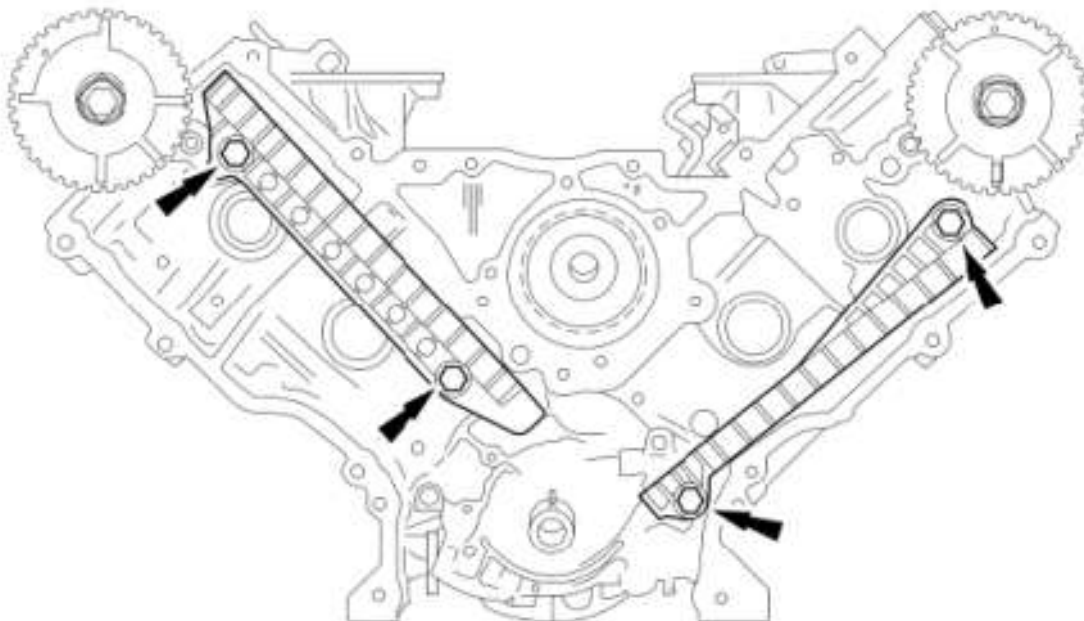
**Fig. 465: Locating Retaining Clip**  
 Courtesy of FORD MOTOR CO.

39. Remove the tensioner from the vise.
40. If the copper links are not visible, mark one link on one end and one link on the other end and use as timing marks.



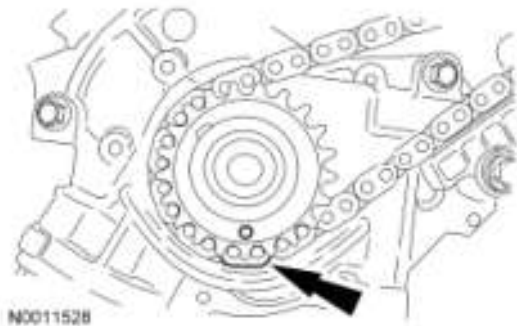
**Fig. 466: Locating Timing Chain Colored Links**  
 Courtesy of FORD MOTOR CO.

41. Install the LH and RH timing chain guides and the 4 bolts.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 467: Locating Timing Chain Guides And Bolts**  
Courtesy of FORD MOTOR CO.

42. 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 copper (marked) link on the chain.



**Fig. 468: Aligning Timing Mark On Outer Flange Of Crankshaft Sprocket With Single Colored (Marked) Link On Chain**  
Courtesy of FORD MOTOR CO.

- NOTE:** Make sure the upper half of the timing chain is below the tensioner arm dowel.
- 43.

Position the LH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is aligned with the copper (marked) chain link.

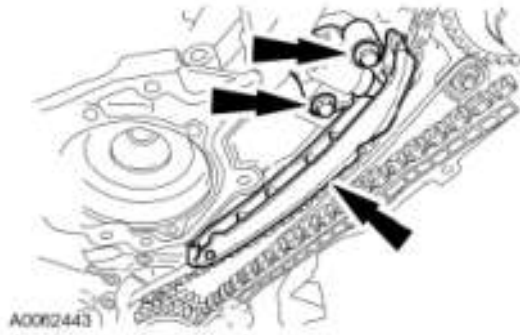


**Fig. 469: Locating Camshaft Sprocket Timing Mark With Copper Link**  
Courtesy of FORD MOTOR CO.

- NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.
- 44.

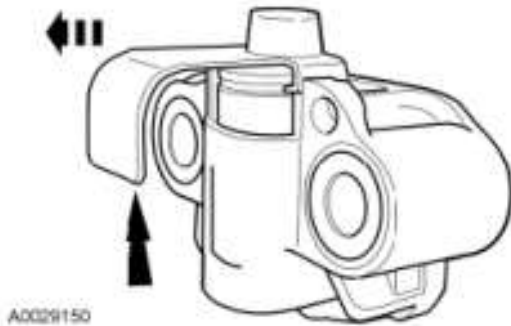
Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner and the 2 bolts.

- Tighten to 25 Nm (18 lb-ft).



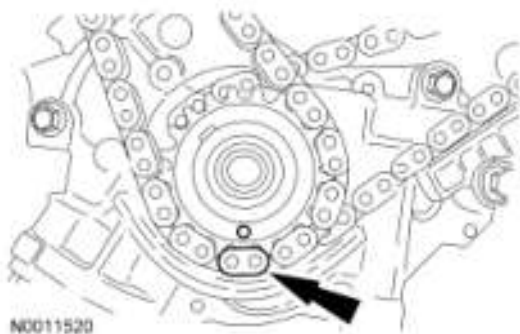
**Fig. 470: Locating Bolts And LH Timing Chain Tensioner**  
 Courtesy of FORD MOTOR CO.

45. Remove the Hydraulic Chain Tensioner Retaining Clip from the LH timing chain tensioner.



**Fig. 471: Locating Retaining Clip**  
 Courtesy of FORD MOTOR CO.

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

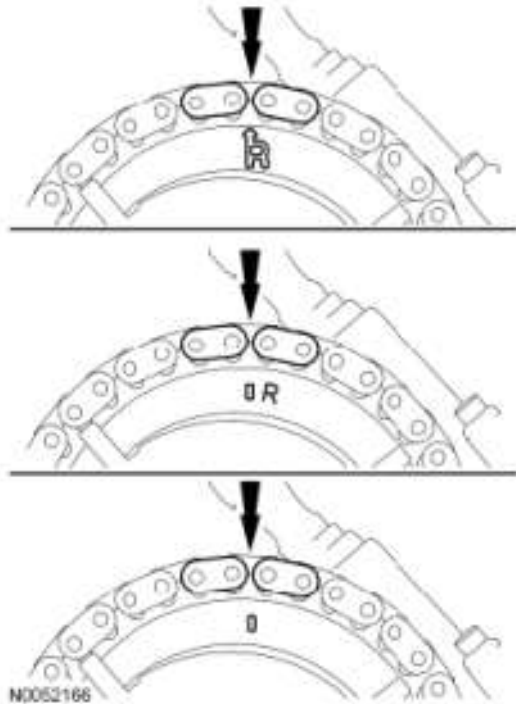


**Fig. 472: Aligning Timing Mark On Sprocket With Single Colored (Marked) Chain Link**  
 Courtesy of FORD MOTOR CO.

47. **NOTE:** The lower half of the timing chain must be positioned above the tensioner arm dowel.

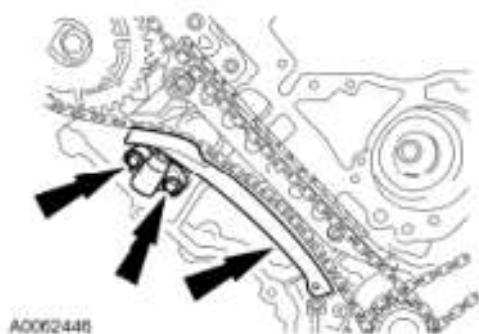
- NOTE:** The camshaft phaser and sprocket will be stamped with one of the illustrated timing marks for the RH camshaft.

Position the RH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is aligned with the copper (marked) chain link.



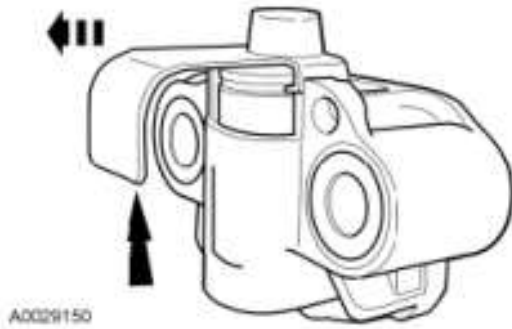
**Fig. 473: Locating Timing Marks**  
Courtesy of FORD MOTOR CO.

48. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner and the 2 bolts.
  - Tighten to 25 Nm (18 lb-ft).



**Fig. 474: Locating RH Timing Chain Tensioner And Bolts**  
Courtesy of FORD MOTOR CO.

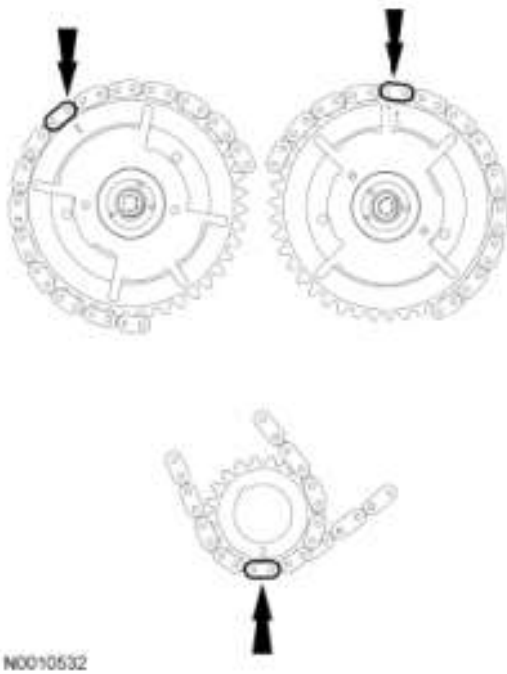
49. Remove the Hydraulic Chain Tensioner Retaining Clip from the RH timing chain tensioner.



**Fig. 475: Locating Retaining Clip**  
 Courtesy of FORD MOTOR CO.

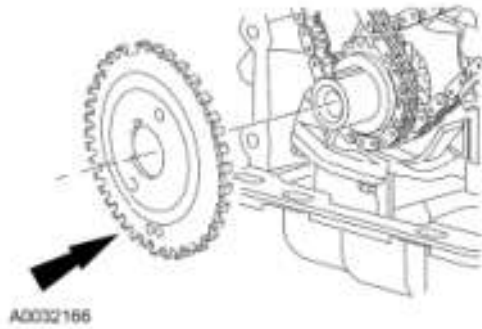
50. **NOTE:** The RH and LH camshaft phaser sprockets are similar. Refer to the single timing mark to identify the RH camshaft phaser sprocket and the L timing mark to identify the LH camshaft phaser sprocket.

As a post-check, verify correct alignment of all timing marks. Make sure the timing marks on the sprockets correspond to the above note.



**Fig. 476: Locating Timing Marks**  
 Courtesy of FORD MOTOR CO.

51. Install the crankshaft sensor ring on the crankshaft.



**Fig. 477: Locating Crankshaft Sensor Ring**  
 Courtesy of FORD MOTOR CO.

52. **NOTE:** Lubricate the roller followers with clean engine oil prior to installation.

Using the Valve Spring Compressor, install all of the camshaft roller followers.



**Fig. 478: Identifying Valve Spring Compressor (303-1039)**  
 Courtesy of FORD MOTOR CO.

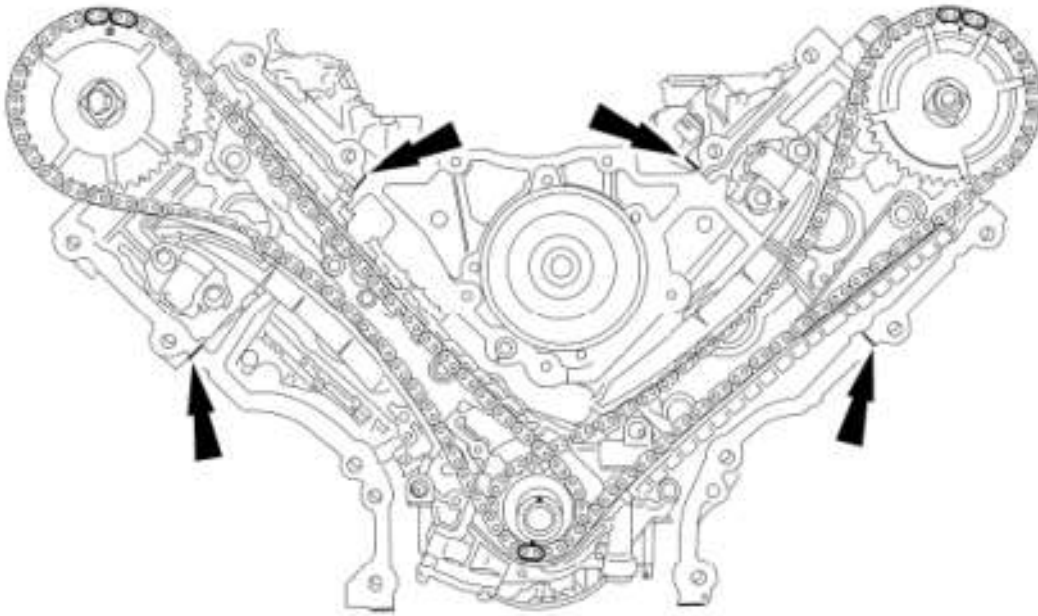
53. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

- NOTE:** If the engine front cover is not secured within 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.

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

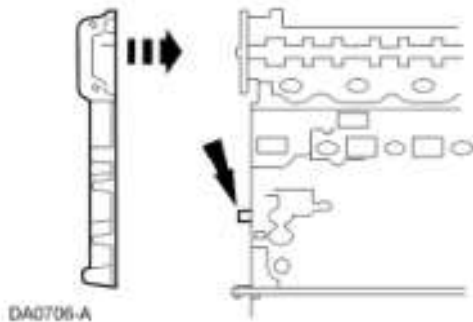
Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface at the locations shown in illustration.



N0010501

**Fig. 479: Locating Silicone Gasket And Sealant Area**  
Courtesy of FORD MOTOR CO.

54. Install a new engine front cover gasket on the engine front cover. Position the engine front cover onto the dowels. Install the 9 bolts and 6 stud bolts finger-tight.

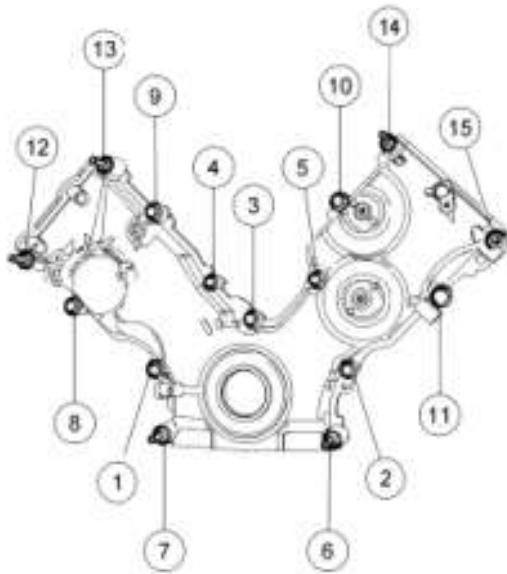


DA0706-A

**Fig. 480: Installing Engine Front Cover**  
Courtesy of FORD MOTOR CO.

55. Tighten the 9 bolts and the 6 stud bolts in the sequence shown in illustration to 25 Nm (18 lb-ft).





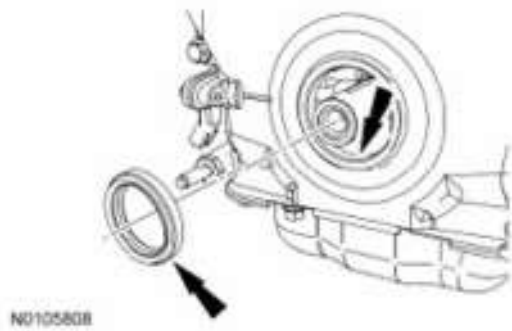
N0089343

**Fig. 481: Identifying Engine Front Cover Fasteners In Sequence**  
 Courtesy of FORD MOTOR CO.

**ITEM DESCRIPTION**

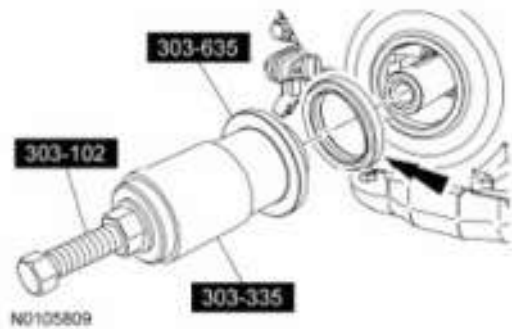
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shoulder Pilot, M8 x 1.25 x 50 - M6 x 1 x 10
7	N806586	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 86.35
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N808294	Bolt, Hex Head Pilot, M8 x 1.25 x 53
12	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1
13	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1

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



**Fig. 482: Locating Engine Front Cover And Crankshaft Seal Inner Lip**  
 Courtesy of FORD MOTOR CO.

57. Using the Crankshaft Front Seal Installer, the Front Cover Seal Installer and the Crankshaft Vibration Damper Installer, install the crankshaft front seal into the engine front cover.



**Fig. 483: Identifying Crankshaft Vibration Damper Installer, Front Cover Seal Installer And Crankshaft Front Seal Installer**  
 Courtesy of FORD MOTOR CO.

**NOTE:** If not secured within 4 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 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

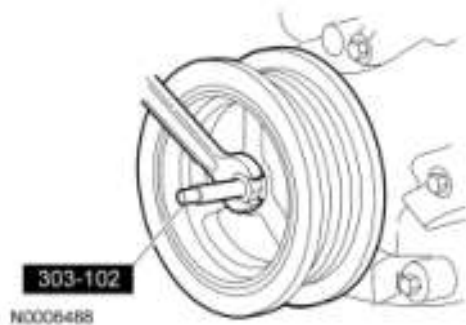
- 58.

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



**Fig. 484: Locating Woodruff Key Slot**  
 Courtesy of FORD MOTOR CO.

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



**Fig. 485: Identifying Crankshaft Vibration Damper Installer**  
Courtesy of FORD MOTOR CO.

60. Using a new crankshaft pulley bolt, install the bolt and washer and tighten the bolt in 4 stages.

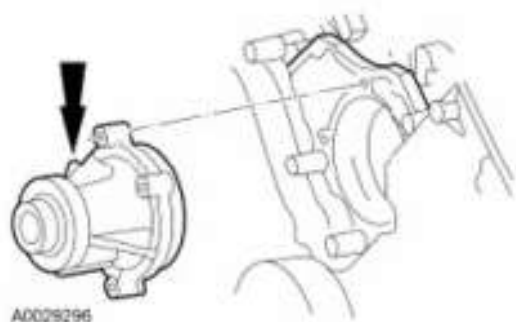
- Stage 1: Tighten to 120 Nm (66 lb-ft).
- Stage 2: Loosen 360 degrees.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.

**NOTE:** Do not rotate the coolant pump housing once the coolant pump has been positioned in the cylinder block. Damage to the O-ring seal will occur.

61.

**NOTE:** Lubricate the new O-ring seal using clean engine coolant and install the O-ring seal onto the coolant pump.

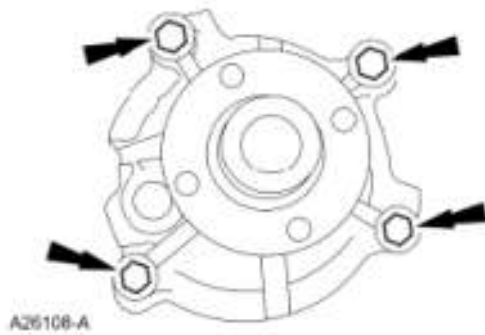
Position the coolant pump and install the 4 bolts loosely.



**Fig. 486: Locating Coolant Pump**  
Courtesy of FORD MOTOR CO.

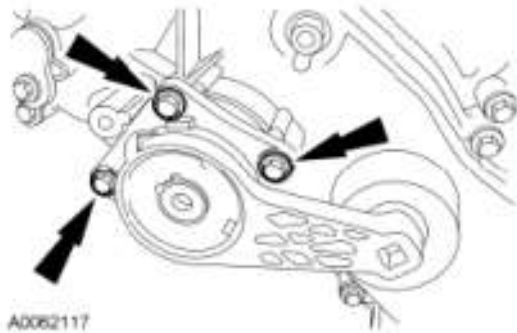
62. Tighten the 4 coolant pump bolts.

- Tighten to 25 Nm (18 lb-ft).



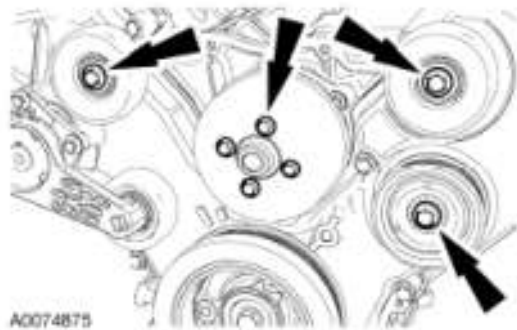
**Fig. 487: Locating Coolant Pump Bolts**  
 Courtesy of FORD MOTOR CO.

63. Position the accessory drive belt tensioner and install the 3 bolts.
- Tighten to 25 Nm (18 lb-ft).



**Fig. 488: Locating Accessory Drive Belt Tensioner Bolts**  
 Courtesy of FORD MOTOR CO.

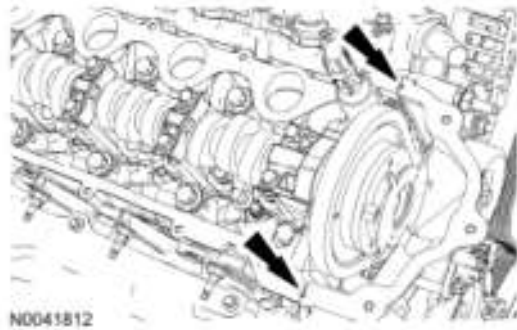
64. Install the 3 accessory drive belt idler pulleys, the coolant pump pulley and the 7 bolts.
- Tighten to 25 Nm (18 lb-ft).



**Fig. 489: Locating Bolts And Coolant Pump Pulley**  
 Courtesy of FORD MOTOR CO.

**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 RH cylinder head.

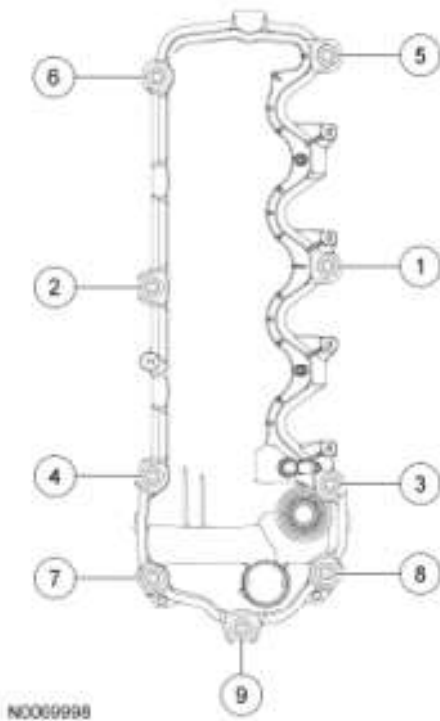


**Fig. 490: Locating Silicone Gasket And Sealant Applying Area**  
Courtesy of FORD MOTOR CO.

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

Position the RH valve cover and gasket on the cylinder head and tighten the 9 bolts in the sequence shown in illustration.

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



**Fig. 491: Identifying RH Valve Cover Bolts In Sequence**  
Courtesy of FORD MOTOR CO.

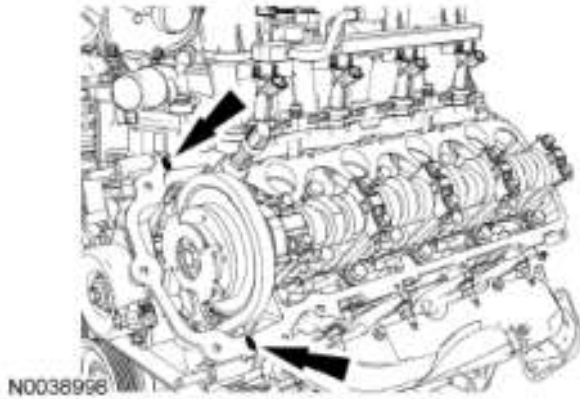
**NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket

67.

remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

67.

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



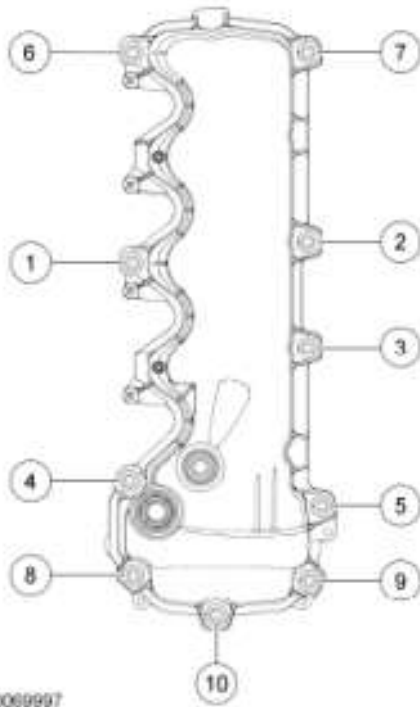
**Fig. 492: Locating Silicone Gasket And Sealant Applying Area**  
Courtesy of FORD MOTOR CO.

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

68.

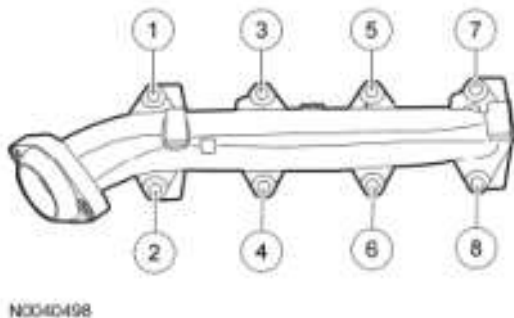
Position the LH valve cover and gasket on the cylinder head and tighten the 10 bolts in the sequence shown in illustration.

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



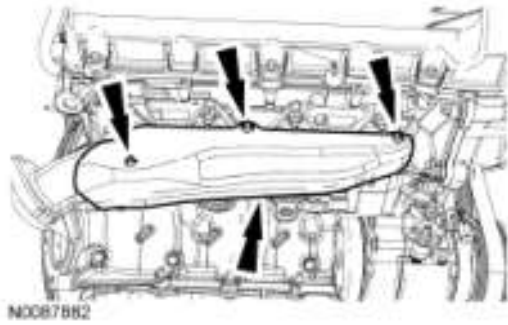
**Fig. 493: Identifying LH Valve Cover Bolt In Sequence**  
 Courtesy of FORD MOTOR CO.

69. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
70. Install 8 new RH exhaust manifold studs.
  - Tighten to 12 Nm (106 lb-in).
71. Position 2 new gaskets, the RH exhaust manifold and tighten the 8 new nuts in the sequence shown in illustration.
  - Tighten to 25 Nm (18 lb-ft).



**Fig. 494: Identifying Exhaust Manifold Nuts In Sequence**  
 Courtesy of FORD MOTOR CO.

72. Position the RH heat shield and install the 3 bolts.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 495: Locating RH Heat Shield And Bolts**  
 Courtesy of FORD MOTOR CO.

73. **NOTE:** Clean the engine support insulator bracket-to-cylinder block mating surfaces of any dirt or foreign material prior to installation.

Position the RH engine support insulator bracket and the RH engine support insulator as an assembly and install the 3 bolts.

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



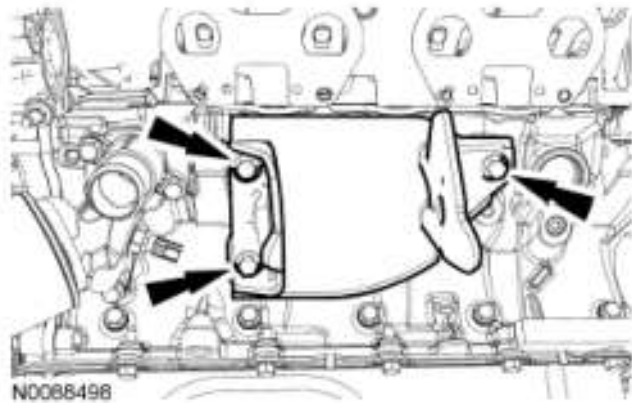
**Fig. 496: Locating Engine Support Insulator Bolts**  
 Courtesy of FORD MOTOR CO.

74. **NOTE:** Clean the engine support insulator bracket-to-cylinder block mating surfaces of any dirt or foreign material prior to installation.

Position the LH engine support insulator bracket and install the 3 bolts.

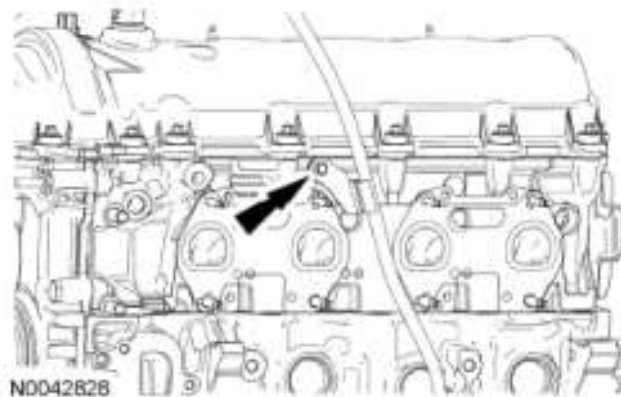
- Tighten to 63 Nm (46 lb-ft).





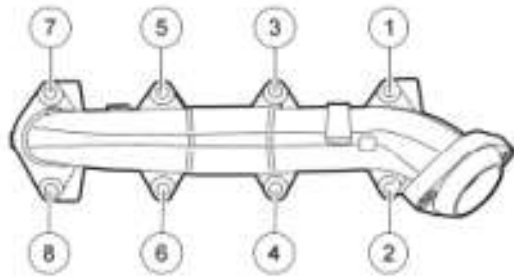
**Fig. 497: Locating LH Engine Support Insulator Bracket And Bolts**  
 Courtesy of FORD MOTOR CO.

75. Position the oil level indicator tube and install the bolt.
  - Install a new O-ring seal and lubricate the O-ring seal with clean engine oil prior to installation.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 498: Locating Bolt And Oil Level Indicator Tube**  
 Courtesy of FORD MOTOR CO.

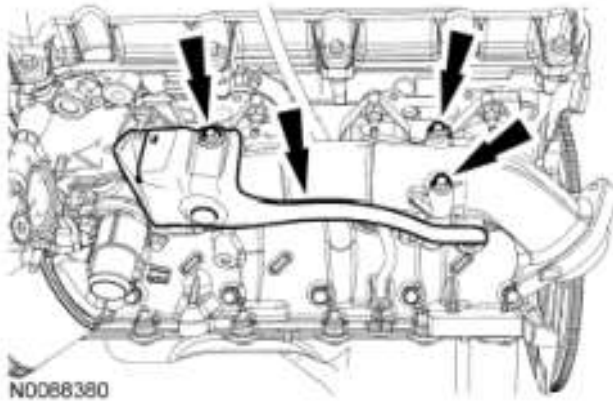
76. Clean and inspect the LH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
77. Install 8 new LH exhaust manifold studs.
  - Tighten to 12 Nm (106 lb-in).
78. Position 2 new gaskets, the LH exhaust manifold and tighten the 8 new nuts in the sequence shown in illustration.
  - Tighten to 25 Nm (18 lb-ft).



N0040497

**Fig. 499: Identifying Exhaust Manifold Nuts In Sequence**  
 Courtesy of FORD MOTOR CO.

79. Position the LH exhaust manifold heat shield and install the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



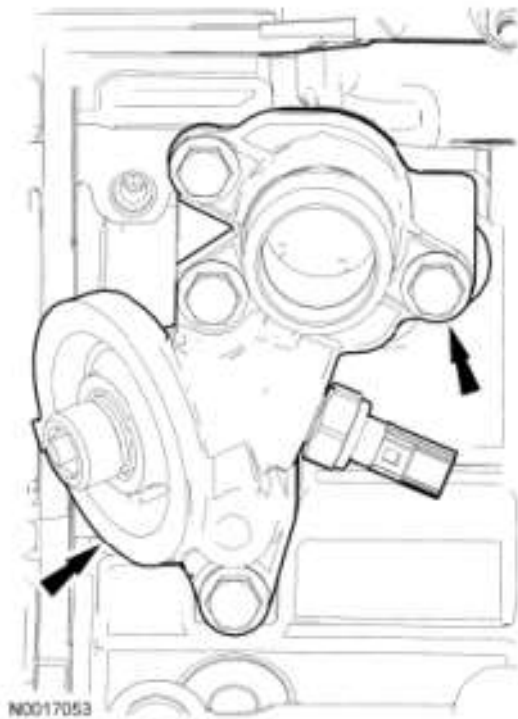
N0088380

**Fig. 500: Locating Exhaust Manifold Heat Shield And Bolts**  
 Courtesy of FORD MOTOR CO.

**NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These may cause scratches and gouges resulting in leak paths. Use a plastic scraper to clean the sealing surfaces.

- 80.
- Clean the oil filter adapter sealing surfaces using silicone gasket remover, metal surface prep and a plastic scraping tool. Follow the directions on the packaging.

81. Position the oil filter adapter and install the 4 bolts.
- Tighten to 25 Nm (18 lb-ft).



**Fig. 501: Locating Oil Filter Adapter And Bolt**  
 Courtesy of FORD MOTOR CO.

82. **NOTE:** Lubricate the oil filter gasket with clean engine oil.

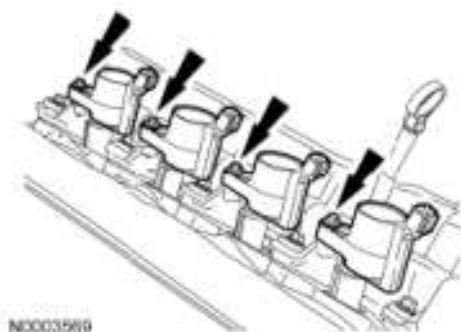
Install a new oil filter.

- Tighten the oil filter until the gasket makes contact, then use an oil filter strap wrench to tighten the filter an additional 270 degrees.

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

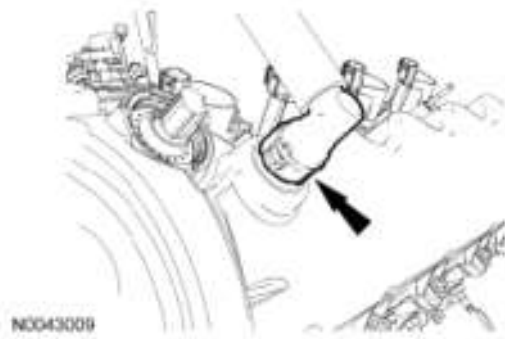
Install the 8 ignition coils and the 8 bolts.

- Tighten to 6 Nm (53 lb-in).



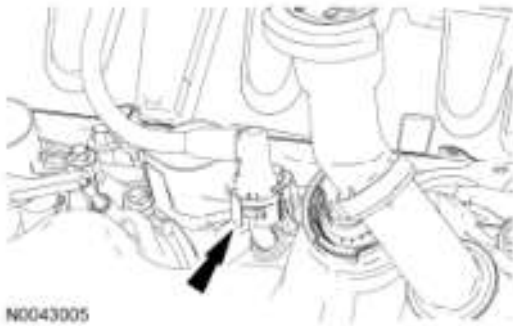
**Fig. 502: Locating Ignition Coils And Bolts**  
 Courtesy of FORD MOTOR CO.

84. Connect the PCV hose to the LH valve cover.



**Fig. 503: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

85. Connect the breather tube to the RH valve cover.



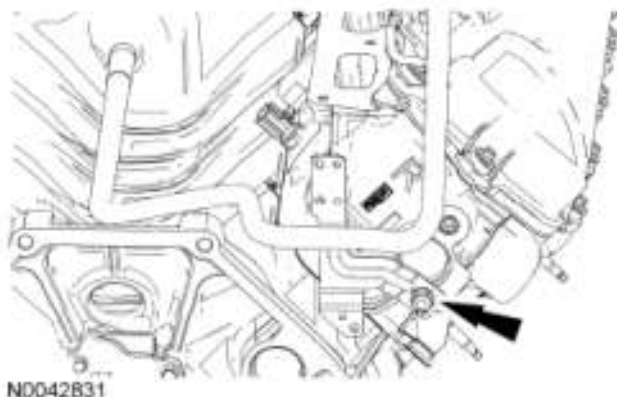
**Fig. 504: Locating Breather Tube**  
Courtesy of FORD MOTOR CO.

**NOTE:** Install 2 new O-ring seals and lubricate the O-ring seals with clean engine coolant.

86.

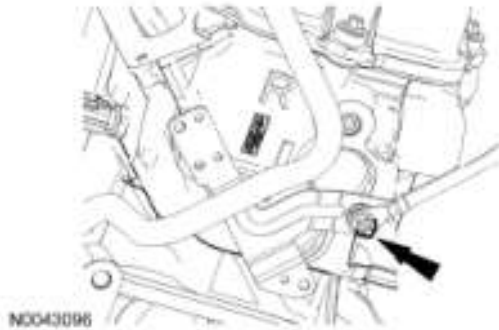
Position the heater supply tube and the hoses as an assembly and install the stud bolt.

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



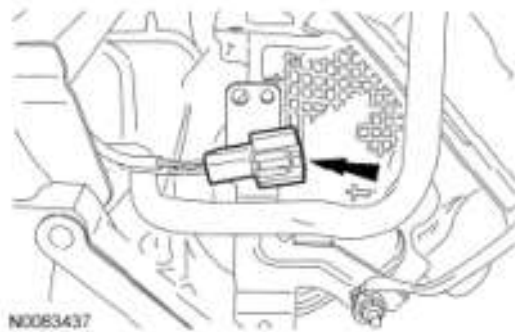
**Fig. 505: Locating Stud Bolt And Heater Supply Tube**  
Courtesy of FORD MOTOR CO.

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



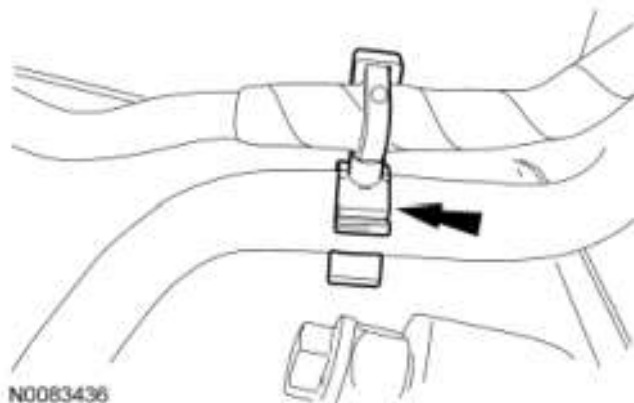
**Fig. 506: Locating Ground Strap Nut**  
Courtesy of FORD MOTOR CO.

88. Attach the Knock Sensor (KS) electrical connector to the heater coolant tube.



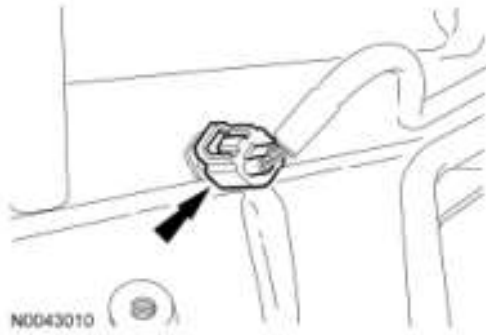
**Fig. 507: Locating Knock Sensor (KS) Electrical Connector**  
Courtesy of FORD MOTOR CO.

89. Position the Cylinder Head Temperature (CHT) sensor wiring and attach the wiring retainer to the heater coolant tube.



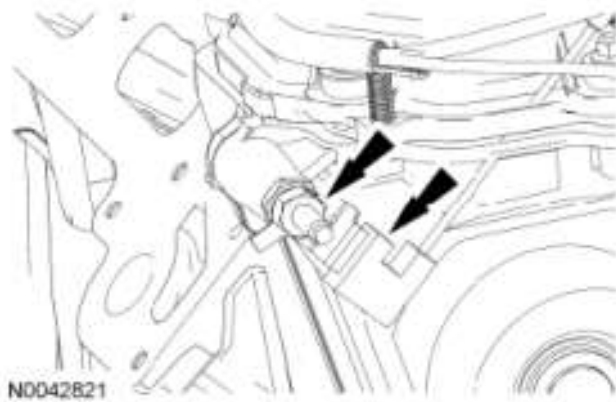
**Fig. 508: Locating CHT Sensor Jumper Wire Retainer**  
Courtesy of FORD MOTOR CO.

90. Connect the CHT sensor electrical connector.



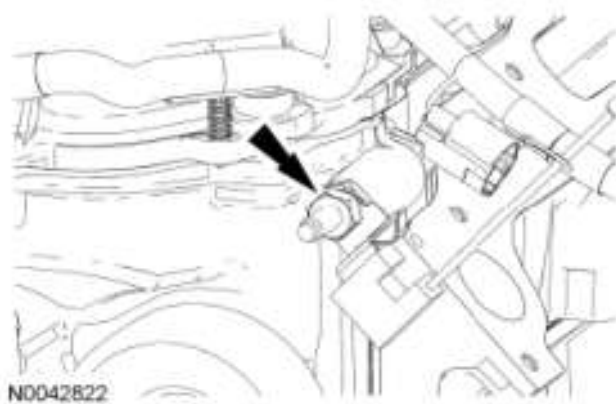
**Fig. 509: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

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



**Fig. 510: Locating LH Radio Interference Capacitor And Nut**  
Courtesy of FORD MOTOR CO.

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



**Fig. 511: Locating RH Radio Interference Capacitor And Nut**  
Courtesy of FORD MOTOR CO.

93. Install the Engine Lifting Bracket.



**Fig. 512: Identifying Engine Lifting Bracket (303-F047)**  
Courtesy of FORD MOTOR CO.

94. Using a suitable floor crane, remove the engine from the engine stand.

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

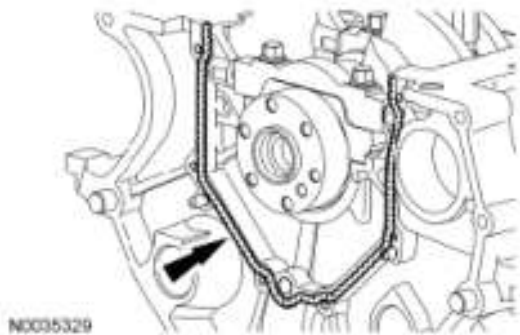
95.

Inspect the crankshaft rear seal retainer plate. Clean the mating surface for the rear seal retainer plate with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

**NOTE:** The crankshaft rear seal retainer plate does not have a sealant groove. Gasket maker must be applied to the crankshaft rear seal retainer plate mating surface on the engine block.

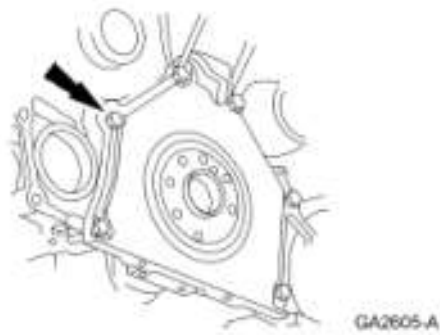
96.

Apply a bead of gasket maker to the crankshaft rear seal retainer mating surface on the engine block.



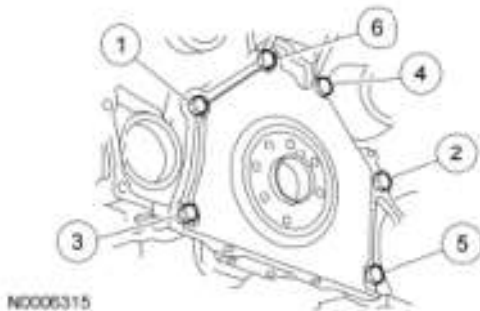
**Fig. 513: Applying Bead Of Gasket Maker To Rear Crankshaft Seal Retainer Mating Surface On Engine Block**  
Courtesy of FORD MOTOR CO.

97. Install the crankshaft rear seal retainer plate and loosely install the 6 bolts.



**Fig. 514: Locating Crankshaft Rear Seal Retainer Plate And Bolts**  
 Courtesy of FORD MOTOR CO.

98. Tighten the 6 bolts in the sequence shown in illustration.
- Tighten to 10 Nm (89 lb-in).



**Fig. 515: Identifying Crankshaft Rear Seal Retainer Plate Bolts In Sequence**  
 Courtesy of FORD MOTOR CO.

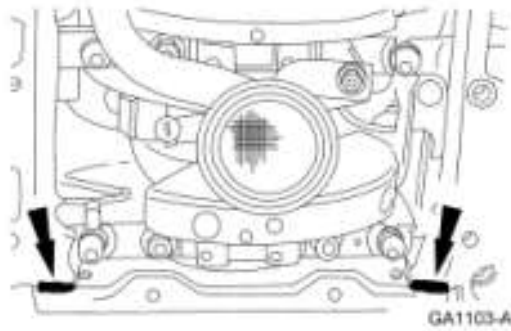
**NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

99. Inspect the oil pan. Clean the mating surface for the oil pan 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.

100. Apply silicone gasket and sealant at the crankshaft rear seal retainer plate-to-cylinder block sealing surface.



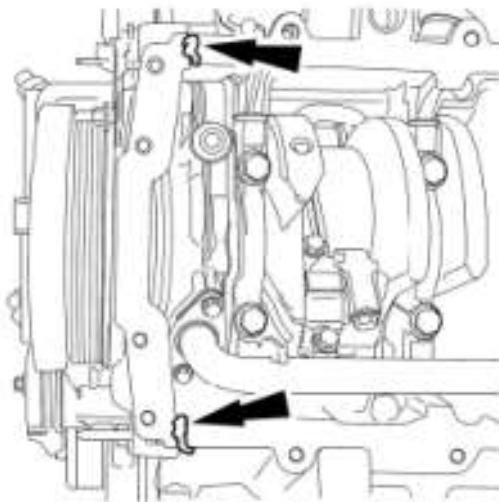


**Fig. 516: Locating Silicone Gasket And Sealant Area**  
 Courtesy of FORD MOTOR CO.

**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.

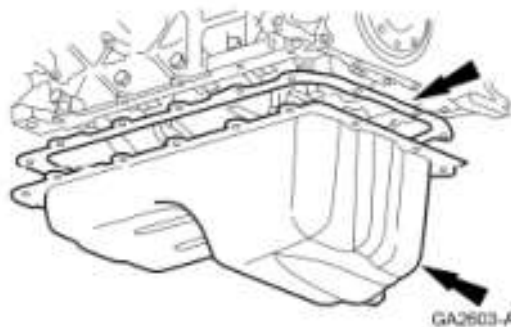
101.

Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.



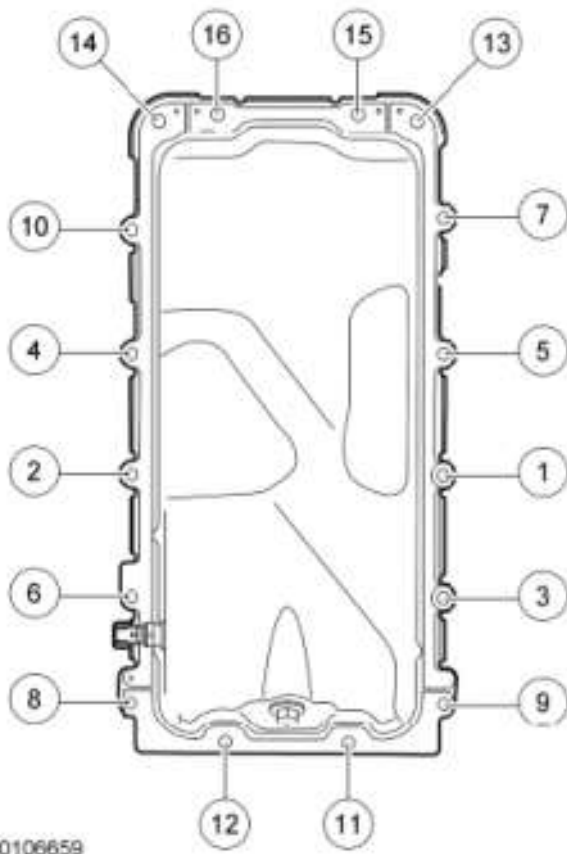
**Fig. 517: Locating Silicone Gasket And Sealant Area**  
 Courtesy of FORD MOTOR CO.

102. Install the oil pan gasket and the oil pan and loosely install the 16 bolts.



**Fig. 518: Locating Oil Pan Gasket And Oil Pan**  
Courtesy of FORD MOTOR CO.

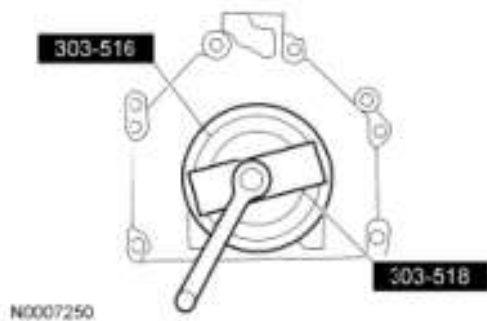
103. Tighten the 16 bolts in 3 stages, in the sequence shown in illustration.
- Stage 1: Tighten to 2 Nm (18 lb-in).
  - Stage 2: Tighten to 20 Nm (177 lb-in).
  - Stage 3: Tighten an additional 60 degrees.



**Fig. 519: Identifying Oil Pan Bolts In Sequence**  
Courtesy of FORD MOTOR CO.

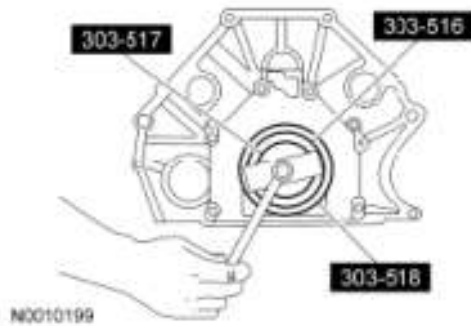
104. **NOTE:** Lubricate the inner lip of the crankshaft rear seal with clean engine oil.

Using the 2 Crankshaft Rear Seal Installers, install a new crankshaft rear seal.



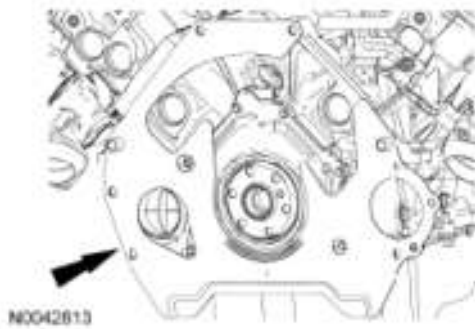
**Fig. 520: Identifying Crankshaft Rear Seal Installers**  
Courtesy of FORD MOTOR CO.

105. Using the 2 Crankshaft Rear Seal Installers and the Crankshaft Rear Oil Slinger Installer, install the crankshaft rear oil slinger.



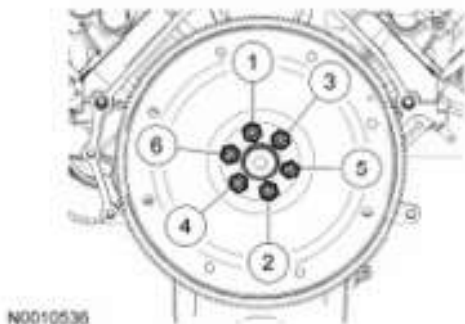
**Fig. 521: Identifying Crankshaft Rear Seal Installers And Crankshaft Rear Oil Slinger Installer**  
Courtesy of FORD MOTOR CO.

106. Install the spacer plate.



**Fig. 522: Locating Spacer Plate**  
Courtesy of FORD MOTOR CO.

107. Position the flexplate and install the bolts in the sequence shown in illustration.
- Tighten to 80 Nm (59 lb-ft).



**Fig. 523: Identifying Flexplate Bolt In Sequence**  
Courtesy of FORD MOTOR CO.