















ASSEMBLY

ENGINE

Special Tools

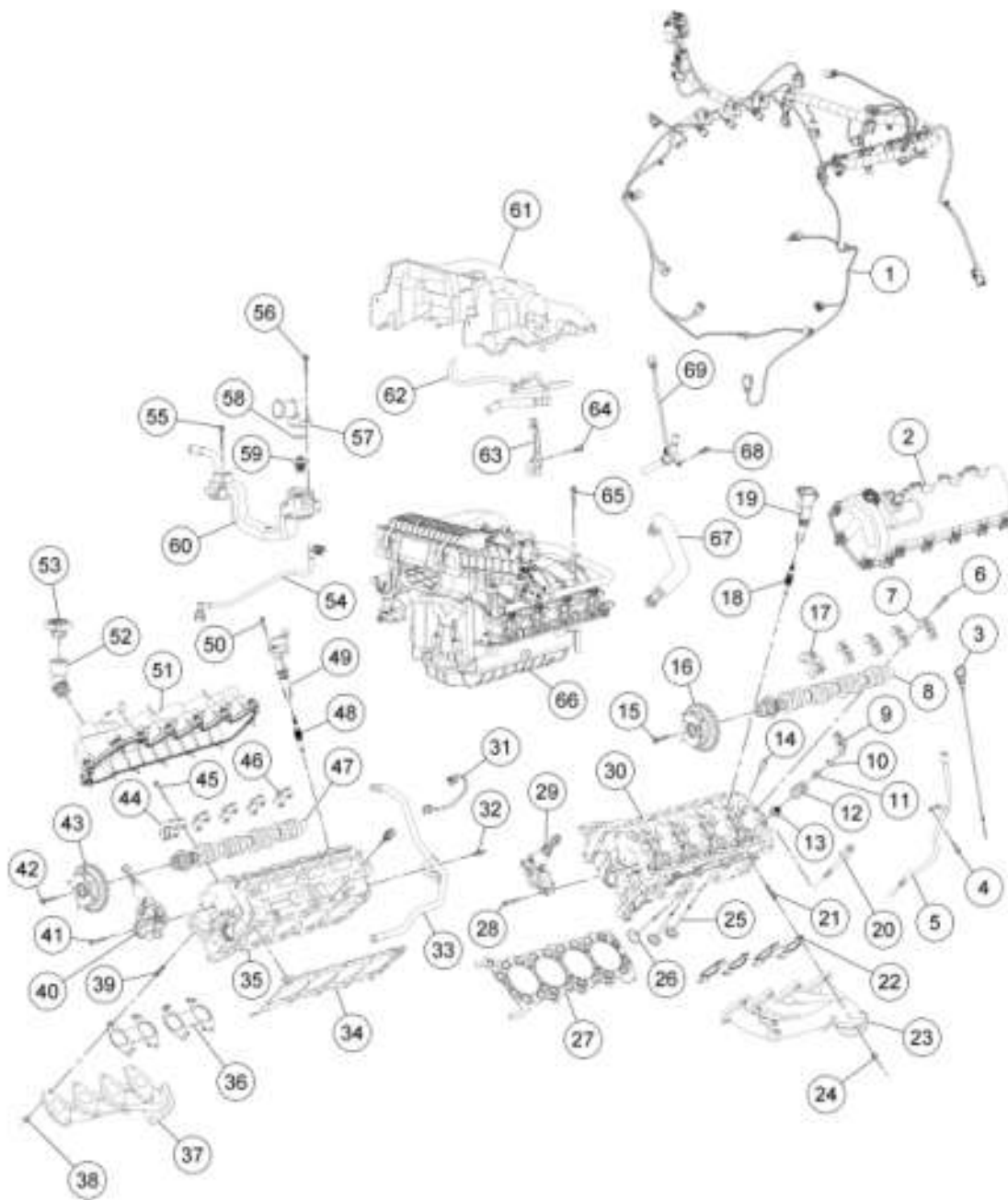
Illustration	Tool Name	Tool Number
 ST1668-A	Remover/Installer, Cylinder Head	303-572 (T97T-6000-A)
 ST1337-A	Installer, Connecting Rod	303-442 (T93P-6136-A)
 ST2804-A	Compressor, Valve Spring	303-1039
 ST2428-A	Installer, Crankshaft Vibration Damper	303-102 (T74P-6316-B)
 ST2197-A	Installer, Crankshaft Front Seal	303-635
 ST1328-A	Installer, Front Cover Seal	303-335 (T88T-6701-A)
 ST1376-A	Compressor, Piston Ring	303-D032 (D81L-6002-C) or equivalent
	Installer, Crankshaft Rear Seal	303-518 (T95P-6701-DH)

 <p>ST1480-A</p>		
 <p>ST1482-A</p>	Installer, Crankshaft Oil Slinger	303-517 (T95P-6701-CH)
 <p>ST1479-A</p>	Installer, Crankshaft Rear Seal	303-516 (T95P-6701-EH)
 <p>ST1335-A</p>	Holding Tool, Crankshaft	303-448 (T93P-6303-A)
 <p>ST2805-A</p>	Alignment Pins, Cylinder Head	303-1040 (SR-015486)
 <p>ST1377-A</p>	Modular Engine Lift Bracket	303-F047 (014-00073) or equivalent
 <p>ST2837-A</p>	Locking Tool, Camshaft Phaser Sprocket	303-1046

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-
Silicone Gasket Remover ZC-30	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
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
Motorcraft Premium Gold Engine Coolant with Bittering Agent (US only) VC-7-B (US); CVC-7-A (Canada); or equivalent (yellow color)	WSS-M97B51-A1
Threadlock 262 TA-26	WSK-M2G351-A6
Hydraulic Chain Tensioner Retaining Clip 1L3Z-6P250-AA	-



N0005739

Fig. 435: Identifying Engine - Upper End
 Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	12B637	Engine wiring harness
2	6A505	Valve cover - LH
3	6750	Oil level indicator
4	N605892	Oil level indicator tube bolt
5	6K873	Oil level indicator tube
6	N807834	Camshaft bearing cap bolt (10 required)

7	6B280	Camshaft bearing cap (4 required)
8	6C255	Camshaft - LH
9	6529	Roller follower (24 required)
10	6518	Valve spring retainer key (48 required)
11	6514	Valve spring retainer (24 required)
12	6513	Valve spring (24 required)
13	6A517	Valve stem seal (24 required)
14	6C501	Hydraulic lash adjuster (24 required)
15	6279	Camshaft phaser sprocket bolt - LH
16	6A257	Camshaft phaser sprocket - LH
17	6B284	Camshaft bearing cap
18	12405	Spark plug (4 required)
19	12A366	Ignition coil (4 required)
20	6065	Cylinder head bolt (20 required)
21	W707747	Exhaust manifold stud (8 required)
22	9Y431	Exhaust manifold gasket (2 required)
23	9431	Exhaust manifold - LH
24	W701706	Exhaust manifold nut (8 required)
25	6507	Intake valve (16 required)
26	6505	Exhaust valve (8 required)
27	6083	Cylinder head gasket - LH
28	W701520	Variable camshaft timing (VCT) oil control solenoid assembly bolt (2 required)
29	6C261	VCT oil control solenoid assembly
30	6050	Cylinder head - LH
31	14B102	Cylinder head temperature (CHT) sensor jumper harness
32	W701571	Heater outlet tube stud bolt
33	18663	Heater outlet tube
34	6051	Cylinder head gasket - RH
35	6049	Cylinder head - RH
36	9Y431	Exhaust manifold gasket (2 required)
37	9430	Exhaust manifold - RH
38	W701706	Exhaust manifold nut (8 required)
39	W707747	Exhaust manifold stud (8 required)
40	6C260	VCT oil control solenoid assembly
41	W701520	VCT oil control solenoid assembly bolt (2 required)
42	6279	Camshaft phaser sprocket bolt - RH
43	6A257	Camshaft phaser sprocket - RH
44	6B284	Camshaft bearing cap
45	N807834	Camshaft bearing cap bolt (10 required)
46	6B280	Camshaft bearing cap (4 required)
47	6251	Camshaft - RH

48	12405	Spark plug (4 required)
49	12A366	Ignition coil (4 required)
50	W706175	Ignition coil bolt (8 required)
51	6582	Valve cover - RH
52	6765	Oil fill adapter
53	6766	Oil fill adapter cap
54	6758	Crankcase ventilation tube
55	W503282	Coolant crossover tube bolt (3 required)
56	W503279	Thermostat housing bolt (2 required)
57	8594	Thermostat housing
58	N806807	Thermostat O-ring seal
59	8575	Thermostat
60	8C369	Coolant crossover tube
61	6N041	Intake manifold dust cover
62	9A474	Intake manifold vacuum harness
63	9S440	Intake manifold vacuum harness support bracket
64	N811050	Intake manifold vacuum harness support bracket bolt
65	W709775	Intake manifold bolt (10 required)
66	9Y451	Intake manifold assembly
67	6K817	Positive crankcase ventilation (PCV) tube
68	W500204	PCV heater element assembly bolt (2 required)
69	9F624	PCV heater element assembly

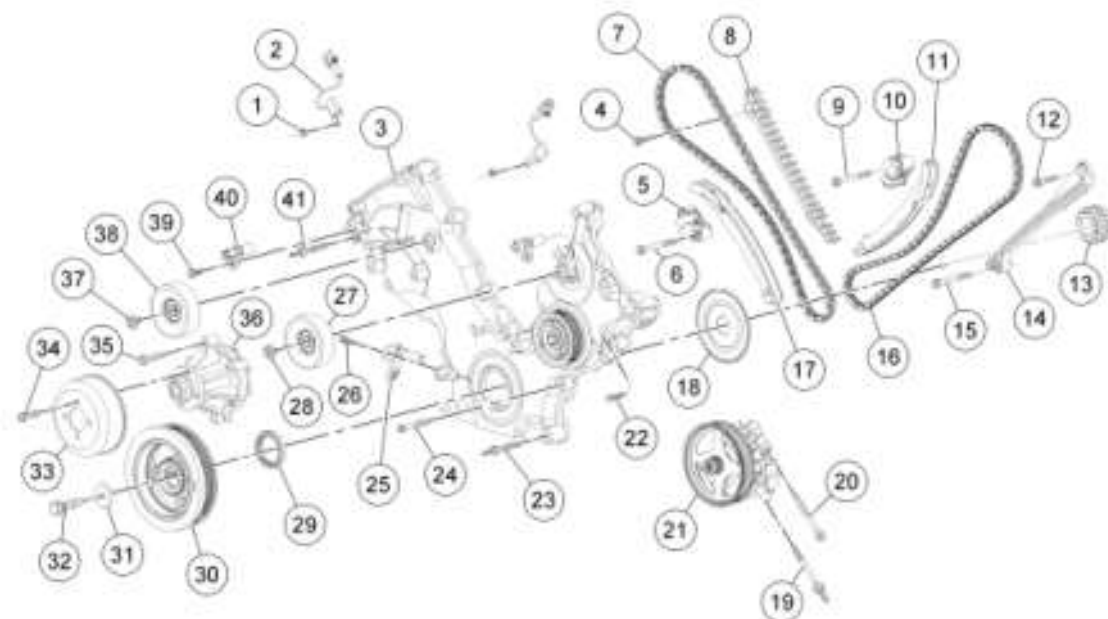
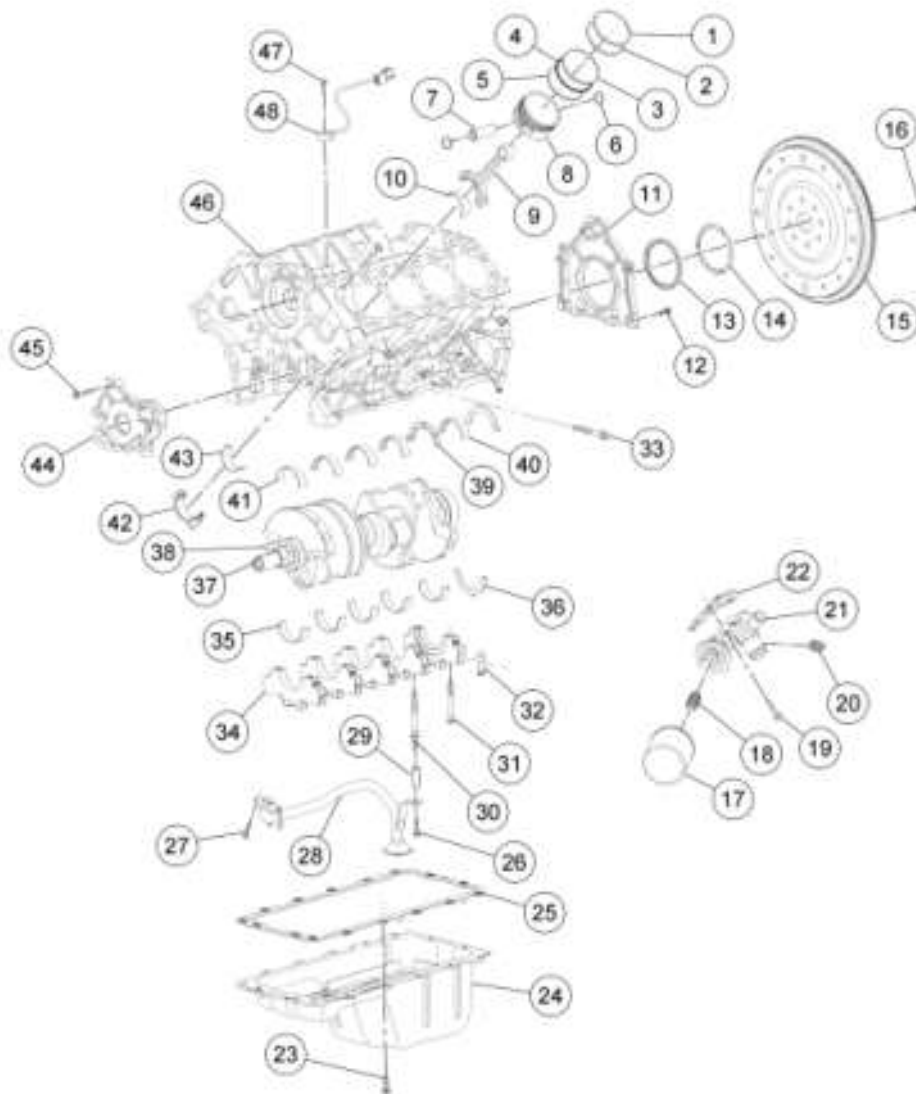


Fig. 436: Identifying Engine - Front End
 Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	N804758	Radio ignition interference capacitor nut
2	18801	Radio ignition interference capacitor
3	6C086	Engine front cover
4	W503282	Timing chain guide bolt- RH (2 required)
5	6L266	Timing chain tensioner - RH
6	N606543	Timing chain tensioner bolt - RH (2 required)
7	6268	Timing chain - RH
8	6M256	Timing chain guide - RH
9	N606543	Timing chain tensioner bolt - LH (2 required)
10	6M269	Timing chain tensioner - LH
11	6M274	Tensioner arm - LH
12	N605892	Timing chain guide upper bolt - LH
13	6306	Crankshaft sprocket
14	6B274	Timing chain guide - LH
15	N606527	Timing chain guide lower bolt - LH
16	6268	Timing chain - LH
17	6K255	Tensioner arm - RH
18	12A227	Ignition pulse wheel
19	W707225	Power steering pump stud bolt
20	W706447	Power steering pump bolt (2 required)
21	3A696	Power steering pump assembly
22	W706605	Engine front cover bolt
23	N808529	Engine front cover stud bolt (2 required)
24	N806177	Engine front cover bolt (9 required)
25	6C315	Crankshaft position (CKP) sensor
26	N806155	CKP sensor bolt
27	12A216	Accessory drive belt idler pulley
28	N808102	Accessory drive belt idler pulley bolt
29	6700	Crankshaft front seal
30	6316	Crankshaft pulley
31	N806165	Crankshaft pulley washer
32	W701512	Crankshaft pulley bolt
33	8A528	Coolant pump pulley
34	N806282	Coolant pump pulley bolt (4 required)
35	N806177	Coolant pump bolt (4 required)
36	8501	Coolant pump

37	N808102	Accessory drive belt idler pulley bolt
38	12A216	Accessory drive belt idler pulley
39	N806155	Camshaft position (CMP) sensor bolt (2 required)
40	6B288	CMP sensor (2 required)
41	W709573	Engine front cover stud bolt (3 required)



N0052376

Fig. 437: Identifying Engine - Lower End
 Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6150	Upper compression ring (8 required)
2	6152	Lower compression ring (8 required)
3	6159	Outer oil control ring (8 required)
4	6161	Inner oil control ring (8 required)
5	6159	Outer oil control ring (8 required)

6	6140	Piston pin retainer (16 required)
7	6135	Piston pin (8 required)
8	6110	Piston (8 required)
9	6200	Connecting rod assembly (8 required)
10	6211	Connecting rod bearing (8 required)
11	6K318	Crankshaft rear seal retainer plate
12	N806155	Crankshaft rear seal retainer plate bolt (6 required)
13	6310	Crankshaft rear seal
14	6701	Crankshaft oil slinger
15	6375	Flexplate
16	N806168	Flexplate bolt (8 required)
17	6714	Oil filter
18	6890	Oil filter threaded adapter
19	N806156	Oil filter adapter bolt (4 required)
20	9278	Engine oil pressure (EOP) sensor
21	6881	Oil filter adapter
22	6A636	Oil filter adapter gasket
23	W701605	Oil pan bolt (16 required)
24	6675	Oil pan
25	6710	Oil pan gasket
26	N605904	Oil pump screen and pickup tube bolt
27	N806155	Oil pump screen and pickup tube bolt (2 required)
28	6622	Oil pump screen and pickup tube
29	N806180	Oil pump screen and pickup tube spacer
30	6K258	Crankshaft main bearing cap stud
31	6345	Crankshaft main bearing cap bolt (9 required)
32	6A346	Crankshaft main bearing dowel (10 required)
33	6C357	Crankshaft main bearing cap bolt (10 required)
34	6325	Crankshaft main bearing cap (5 required)
35	6A338	Crankshaft bearing - Lower (5 required)
36	6K302	Crankshaft thrust washer - Lower
37	6303	Crankshaft
38	N806201	Crankshaft key
39	6A341	Crankshaft thrust washer - Upper (2 required)
40	6333	Crankshaft bearing - Upper
41	6333	Crankshaft bearing - Upper (4 required)
42	6210	Connecting rod cap (8 required)
43	6211	Connecting rod bearing (8 required)

44	6621	Oil pump
45	N806183	Oil pump bolt (3 required)
46	6010	Cylinder block
47	W500225	Knock sensor (KS) bolt (2 required)
48	12A699	KS (2 required)

All vehicles

1. Record the main bearing code found on the front of the engine block.

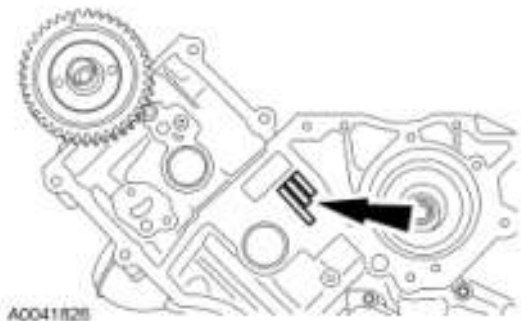


Fig. 438: Identifying Main Bearing Code Found On Front Of Engine Block
 Courtesy of FORD MOTOR CO.

2. Record the main bearing code found on the back of the crankshaft.

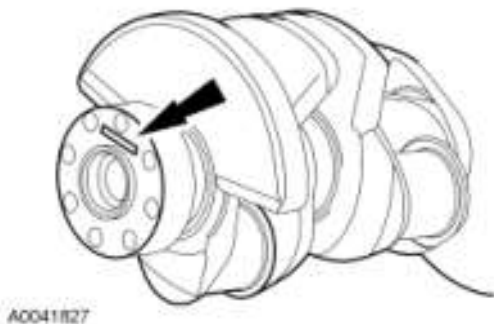


Fig. 439: Identifying Main Bearing Code - Found On Back Of Crankshaft
 Courtesy of FORD MOTOR CO.

3. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings, determine the required bearing grade for each main bearing.
 - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
 - Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the 2 intersect. This is the required bearing grade for the number one crankshaft main bearing.
 - As an example, if the engine block code letter is "F" and the crankshaft code letter is "D," the correct bearing grade for this main bearing is a "2."
 - Repeat this process for the remaining 4 main bearings.

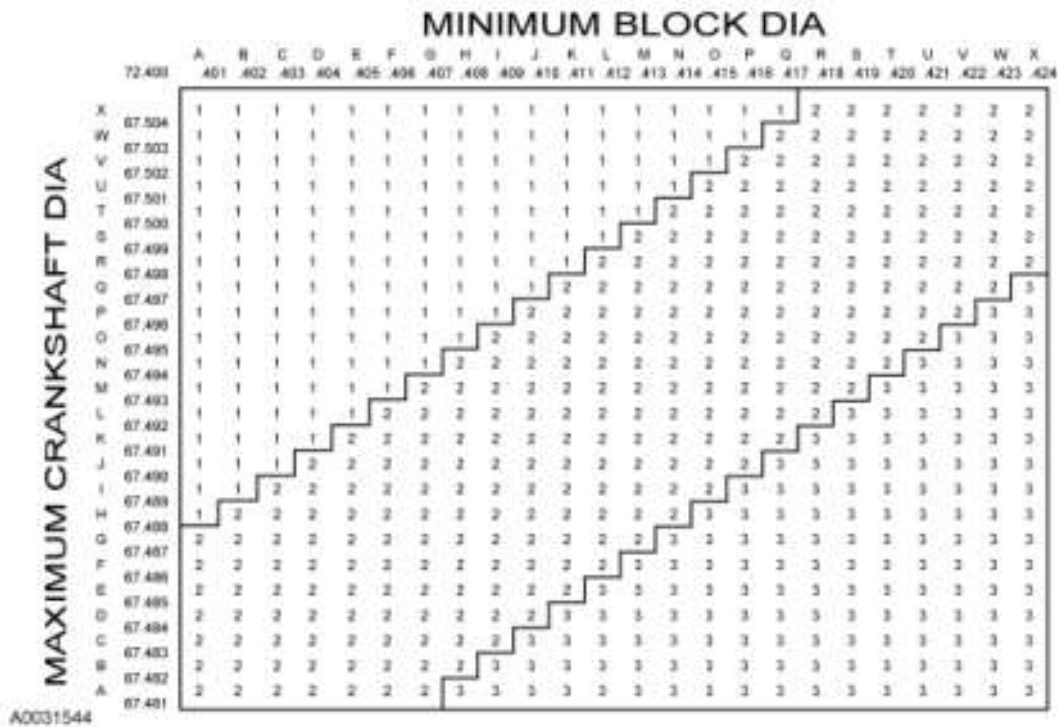


Fig. 440: Bearing Select Fit Chart (Standard Bearings)
 Courtesy of FORD MOTOR CO.

- If oversize bearings are being used, use the procedure in the previous step and the Bearing Select Fit Chart, Oversize Bearings to determine the required bearing grade for each main bearing.

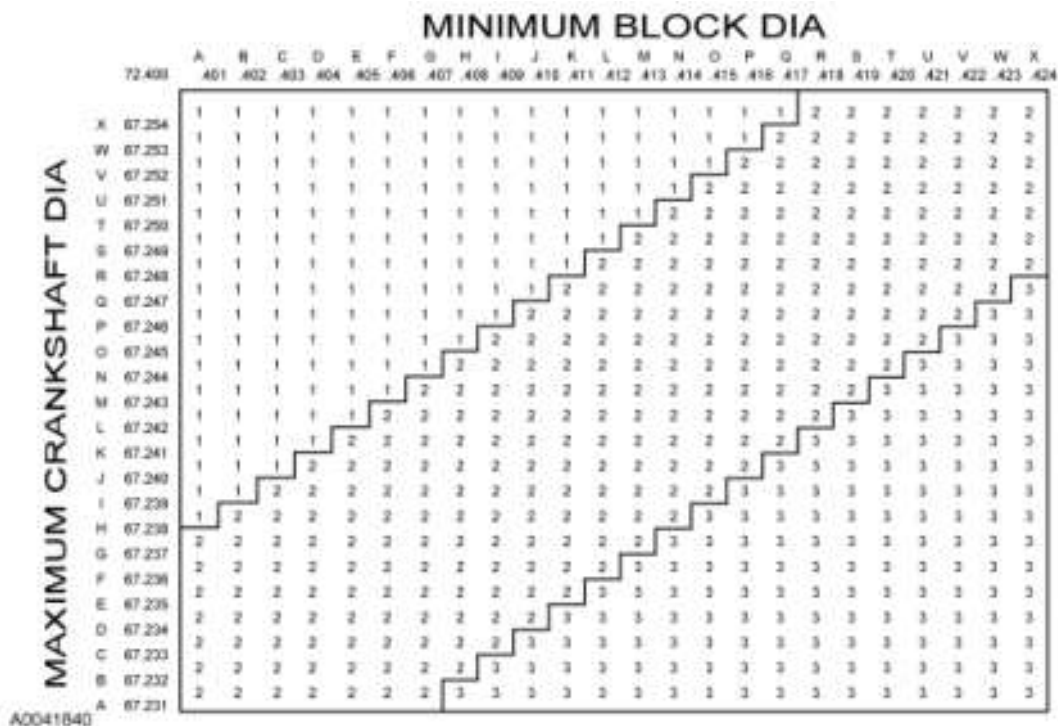


Fig. 441: Bearing Select Fit Chart (Oversize Bearings)
 Courtesy of FORD MOTOR CO.

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.

5. Install the crankshaft upper main bearings into the cylinder block and lubricate them with clean engine oil.

NOTE: The upper thrust washers are shown for location purposes only. Do not install the upper thrust washers until the crankshaft is installed. Refer to the following 2 steps.

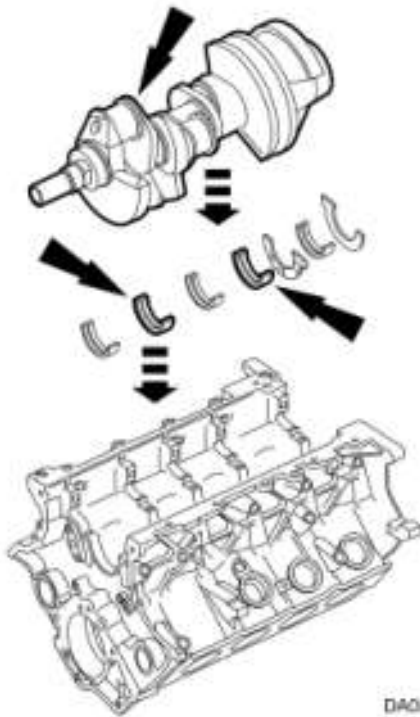


Fig. 442: Installing Crankshaft Onto Upper Crankshaft Main Bearings
Courtesy of FORD MOTOR CO.

6. Install the crankshaft onto the upper crankshaft main bearings.

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

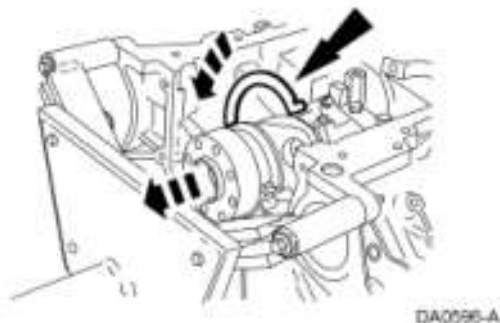


Fig. 443: Installing Rear Crankshaft Upper Thrust Washer

Courtesy of FORD MOTOR CO.

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

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



Fig. 444: Installing Front Crankshaft Upper Thrust Washer
Courtesy of FORD MOTOR CO.

8. Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 5 main boss.

NOTE: To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

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

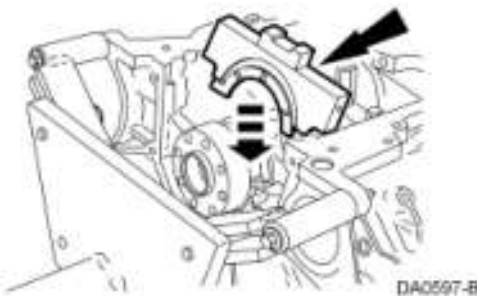


Fig. 445: Installing Lower Crankshaft Thrust Washer
Courtesy of FORD MOTOR CO.

9. Install the lower crankshaft thrust washer to the back side of the No. 5 main bearing cap, with oil grooves facing the crankshaft surface.
10. 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 cap fasteners.
11. Install the dowel pins so the flat sides face the crankshaft.

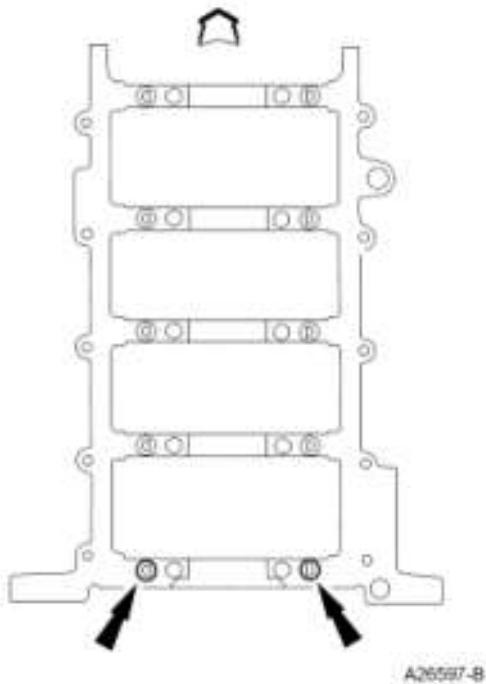


Fig. 446: Installing Dowel Pins
 Courtesy of FORD MOTOR CO.

12. Install the vertical main bearing cap fasteners and tighten in the sequence shown.
 - Tighten to 40 N.m (30 lb-ft).
 - Tighten an additional 90 degrees.

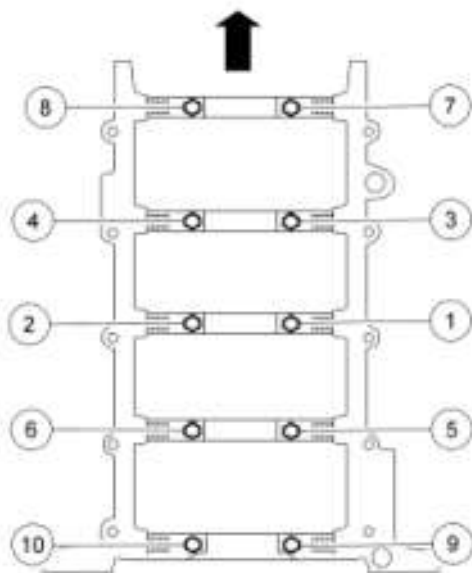
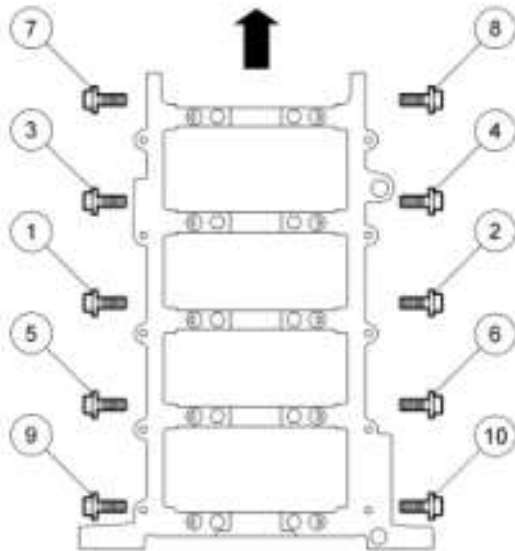


Fig. 447: Tightening Main Bearing Cap Fasteners In Sequence
 Courtesy of FORD MOTOR CO.

13. Install the side bolts and tighten them in the sequence shown.

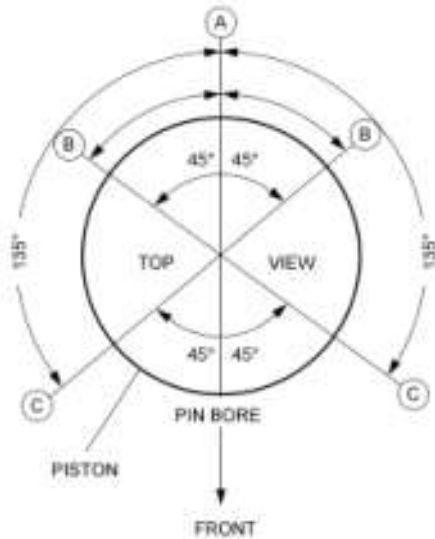
- Tighten to 30 N.m (22 lb-ft).
- Tighten an additional 90 degrees.



N0010201

Fig. 448: Tightening Side Bolts In Sequence
Courtesy of FORD MOTOR CO.

14. Check the piston-to-cylinder block and piston ring clearances. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.
15. Assemble the 8 pistons. For additional information, refer to **Piston** in this article.
16. Make sure the ring gaps (oil spacer-A, oil ring-B, compression ring-C) are correctly spaced around the circumference of the piston.



N0029312

Fig. 449: Identifying Piston Ring Gap Positioning
 Courtesy of FORD MOTOR CO.

CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.

NOTE: The following piston installation steps are for all 8 connecting rods, rod bearings and pistons. Only 1 connecting rod, rod bearing and piston is shown.

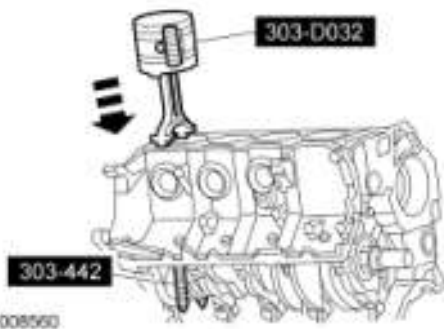


Fig. 450: Using Special Tools To Install Piston And Connecting Rod Assembly
 Courtesy of FORD MOTOR CO.

17. Use the special tools 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.

CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.

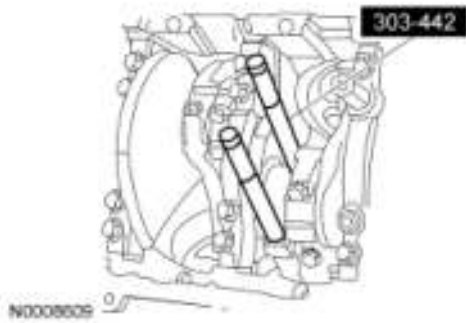


Fig. 451: Identifying Special Tool
 Courtesy of FORD MOTOR CO.

18. Once the connecting rod is seated on the crankshaft journal, remove the special tools.

CAUTION: The rod cap installation must keep the same orientation as marked during disassembly.

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.

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

NOTE: Main bearing caps are removed for clarity.

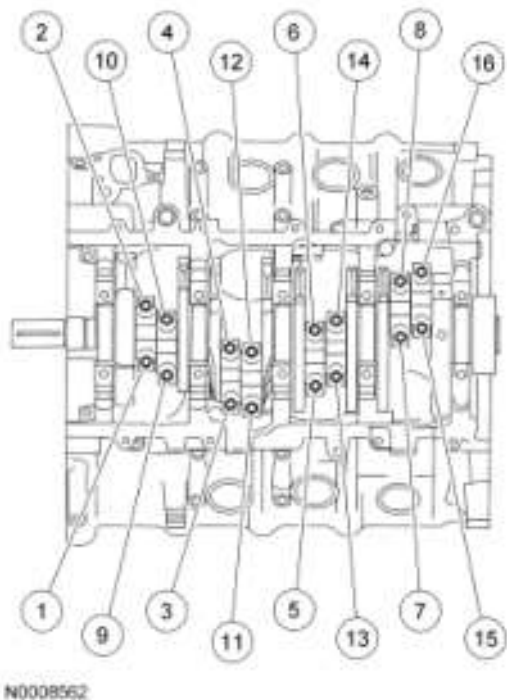


Fig. 452: Identifying Tighten Sequence Of Connecting Rod Bearing Caps
 Courtesy of FORD MOTOR CO.

20. Tighten the bolts in 2 stages, in the sequence shown.
- Stage 1: Tighten to 43 N.m (32 lb-ft).
 - Stage 2: Tighten an additional 105 degrees.
21. Position the oil pump and install the bolts.
- Tighten to 10 N.m (89 lb-in).



Fig. 453: Locating Oil Pump Bolts
Courtesy of FORD MOTOR CO.

22. Install the oil pump screen and pickup tube spacer.
- Tighten to 25 N.m (18 lb-ft).

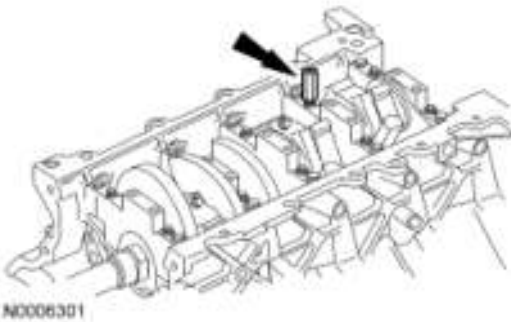


Fig. 454: Installing Oil Pump Screen And Pickup Tube Spacer
Courtesy of FORD MOTOR CO.

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

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

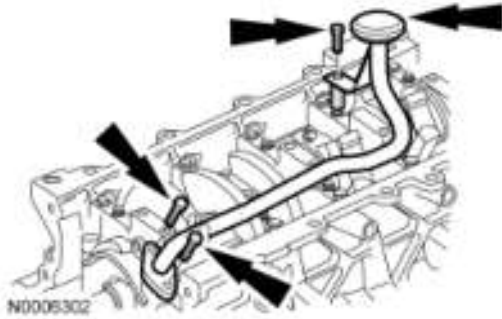


Fig. 455: Positioning Oil Pump Screen, Pickup Tube And Installing Bolts
 Courtesy of FORD MOTOR CO.

23. Position the oil pump screen and pickup tube and install the bolts.
 - Tighten the oil pump screen and pickup tube-to-oil pump bolts to 10 N.m (89 lb-in).
 - Tighten the oil pump screen and pickup tube-to-spacer bolt to 25 N.m (18 lb-ft).
24. Position the crankshaft with the special tool, then remove the tool.

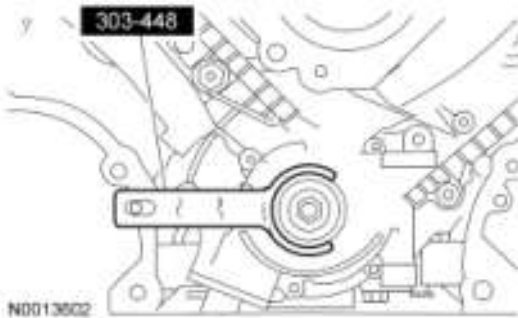


Fig. 456: Positioning Crankshaft With Special Tool
 Courtesy of FORD MOTOR CO.

CAUTION: Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore.

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

CAUTION: The cylinder head bolts must be discarded and new bolts installed. They are tighten-to-yield designed and cannot be reused.

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

NOTE: LH shown, RH similar.

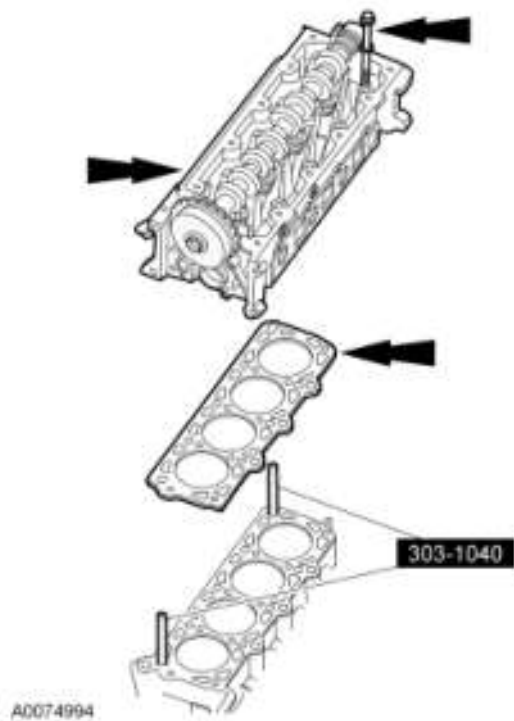
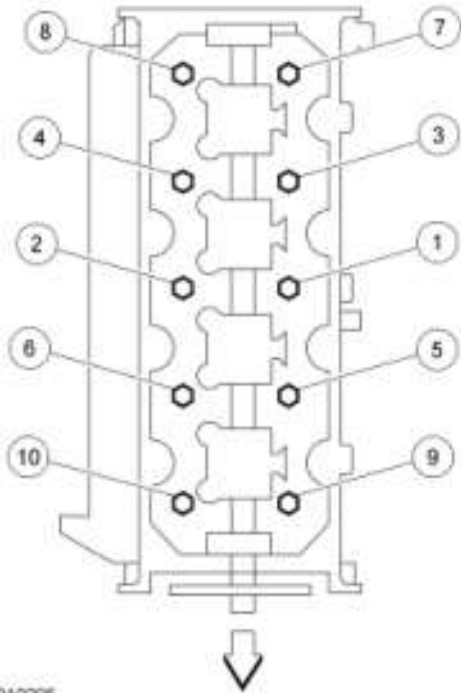


Fig. 457: Locating Cylinder Head And Gaskets Using Special Tool
Courtesy of FORD MOTOR CO.

25. Using the special tools, position the cylinder head gaskets and cylinder heads over the dowels and install the cylinder head bolts loosely.
26. Tighten the bolts in 3 stages, in the sequence shown.

RH shown, LH similar.

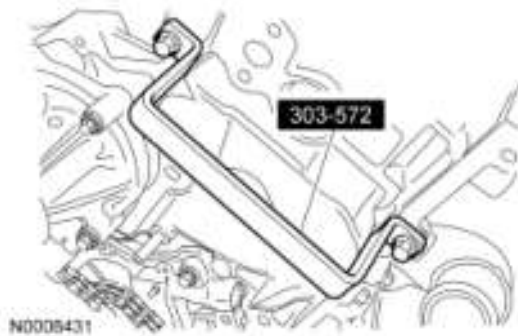
- Stage 1: Tighten to 40 N.m (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Tighten an additional 90 degrees.



N0010205

Fig. 458: Tightening Bolts In Sequence
 Courtesy of FORD MOTOR CO.

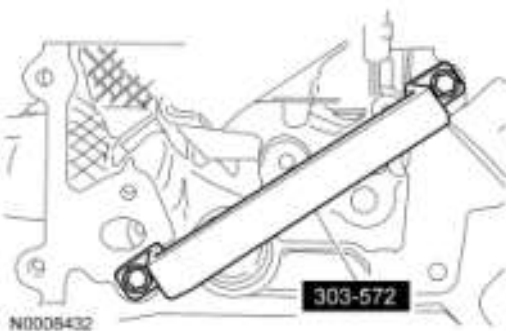
27. Remove the special tool from the LH cylinder head.



N0008431

Fig. 459: Identifying Special Tool Onto Cylinder Head
 Courtesy of FORD MOTOR CO.

28. Remove the special tool from the RH cylinder head.

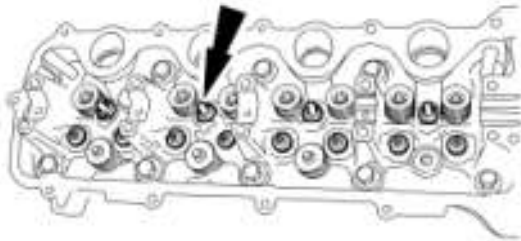


N0008432

Fig. 460: Identifying Special Tool On Cylinder Head

Courtesy of FORD MOTOR CO.

29. Install the hydraulic lash adjusters into the RH and LH cylinder heads.
- Lubricate the hydraulic lash adjusters with clean engine oil prior to installation.

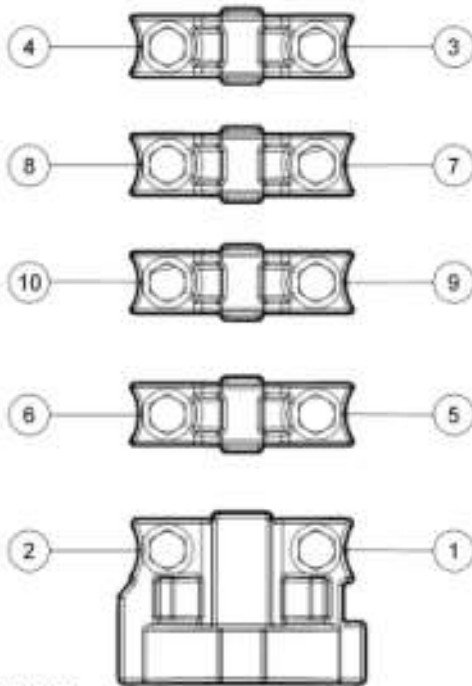


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Fig. 461: Identifying Hydraulic Lash Adjusters
Courtesy of FORD MOTOR CO.

30. Install the LH and RH camshafts.
- Lubricate the camshaft and camshaft journals with clean engine oil prior to installation.

NOTE: LH shown, RH similar.



N0010190

Fig. 462: Identifying Camshaft Bearing Caps Loosening/Tightening Sequence
Courtesy of FORD MOTOR CO.

31. Install the LH and RH camshaft bearing caps in their original locations.
- Lubricate the camshaft bearing caps with clean engine oil.
 - Position the front camshaft bearing cap.

- Position the remaining camshaft bearing caps.
- Install the bolts loosely.
- Tighten to 10 N.m (89 lb-in) in the sequence shown.

CAUTION: Damage to the variable camshaft timing (VCT) phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

NOTE: LH shown, RH similar.



Fig. 463: Identifying Camshaft Phaser And Sprocket Assembly Bolt
 Courtesy of FORD MOTOR CO.

32. Install the VCT phaser sprockets and new VCT phaser bolts finger tight.

CAUTION: Damage to the variable camshaft timing (VCT) phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.

CAUTION: Only use hand tools to remove the variable camshaft timing (VCT) phaser sprocket assembly or damage may occur to the camshaft or VCT phaser sprocket.

NOTE: LH shown, RH similar.

33. Using the special tool, tighten the LH and RH VCT phaser sprocket bolts in 2 stages.
- Stage 1: Tighten to 40 N.m (30 lb-ft).
 - Stage 2: Tighten an additional 90 degrees.

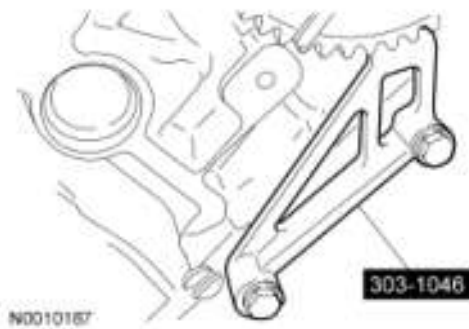


Fig. 464: Identifying Special Sprocket Phase Tool
 Courtesy of FORD MOTOR CO.

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

CAUTION: Prior to installation, inspect the tensioner-sealing bead for seal integrity. If cracks, tears, separation from the tensioner body or permanent compression of the seal bead is observed, install a new tensioner. Failure to follow these instructions may result in engine damage.

34. Compress the tensioner plunger, using a vise.

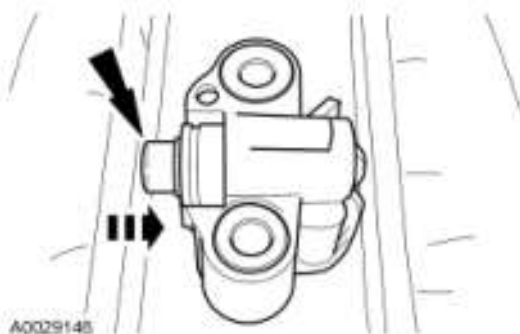


Fig. 465: Compressing Tensioner Plunger
 Courtesy of FORD MOTOR CO.

35. Install a retaining clip on the tensioner to hold the plunger in during installation.

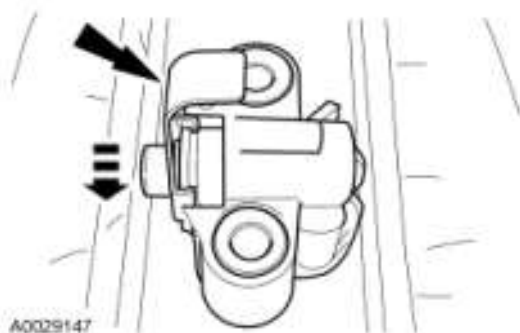
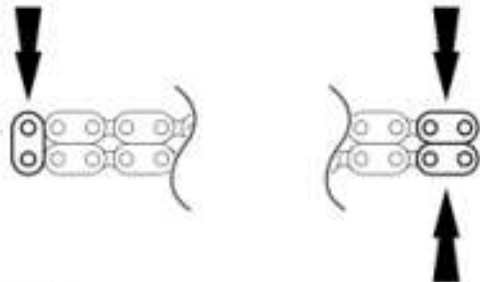


Fig. 466: Identifying Retaining Clip on Tensioner

Courtesy of FORD MOTOR CO.

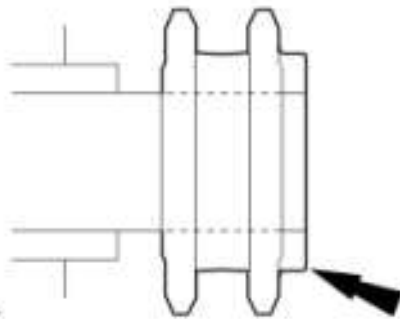
36. Remove the tensioner from the vise.
37. If the copper links are not visible, mark 2 links on one end and 1 link on the other end, and use as timing marks.



A0038720

Fig. 467: Locating Timing Chain Marks
Courtesy of FORD MOTOR CO.

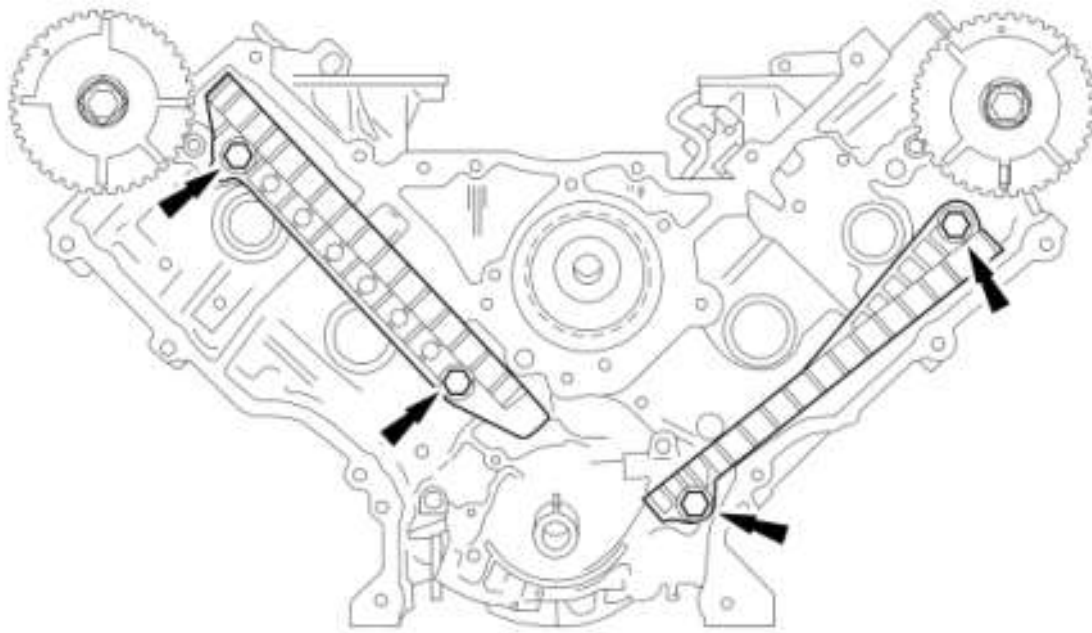
38. Install the crankshaft sprocket, making sure the flange faces forward.



N0011527

Fig. 468: Identifying Crankshaft Sprocket
Courtesy of FORD MOTOR CO.

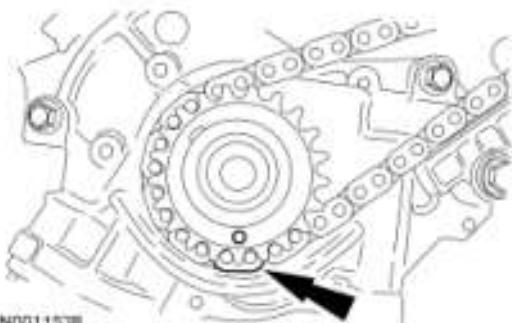
39. Install the 4 bolts and the LH and RH timing chain guides.
 - Tighten to 10 N.m (89 lb-in).



N0006303

Fig. 469: Identifying Timing Chain Guides
 Courtesy of FORD MOTOR CO.

40. 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.



N0011528

Fig. 470: Aligning Crankshaft Sprocket Timing Mark And LH Timing Chain Link
 Courtesy of FORD MOTOR CO.

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

41. Position the timing chain on the camshaft sprocket with the camshaft sprocket timing mark positioned between the 2 copper (marked) chain links.

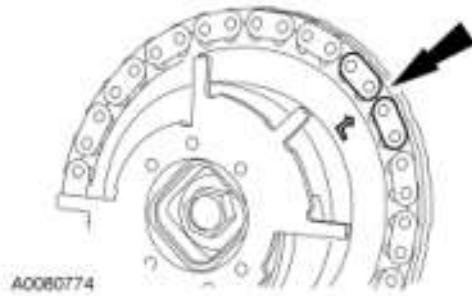


Fig. 471: Identifying Copper Links Of Timing Chain On VCT Phaser Sprocket
 Courtesy of FORD MOTOR CO.

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

42. Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner and bolts.
 - Tighten to 25 N.m (18 lb-ft).

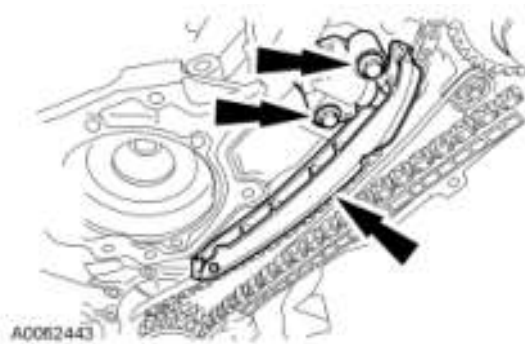


Fig. 472: Identifying LH Timing Chain Tensioner & Tensioner Arm
 Courtesy of FORD MOTOR CO.

43. Remove the retaining clip from the LH timing chain tensioner.

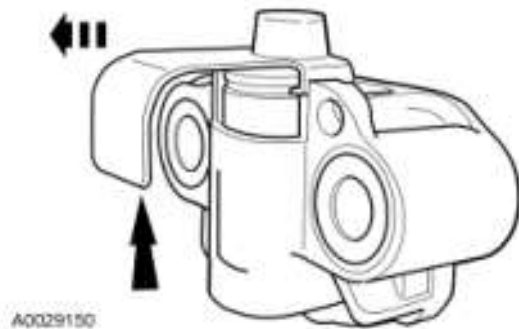


Fig. 473: Identifying Retaining Clip And Timing Chain Tensioner
 Courtesy of FORD MOTOR CO.

44. 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.

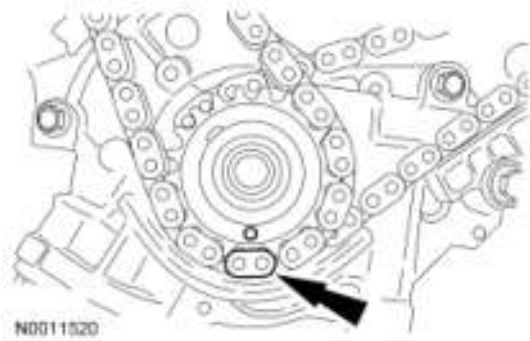


Fig. 474: Aligning Crankshaft Sprocket Timing Mark And RH Timing Chain Link
 Courtesy of FORD MOTOR CO.

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.

45. Position the RH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is positioned between the 2 copper (marked) chain links.

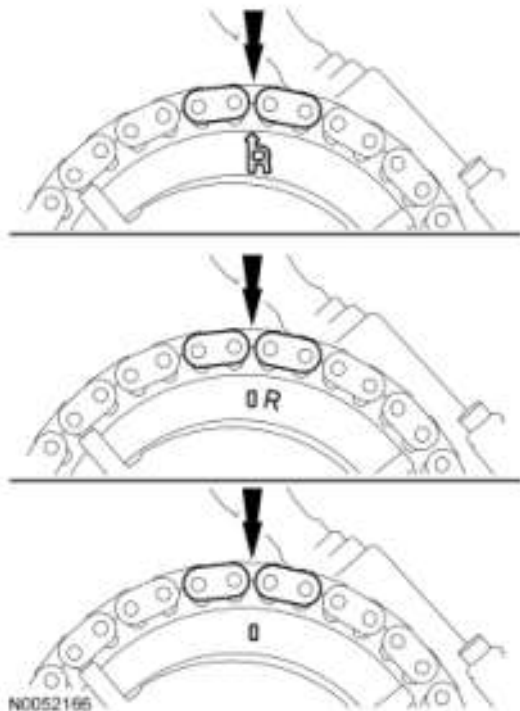


Fig. 475: Positioning RH Timing Chain On Camshaft Sprocket
 Courtesy of FORD MOTOR CO.

46. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner and bolts.
 - Tighten to 25 N.m (18 lb-ft).



Fig. 476: Identifying RH Timing Chain Tensioner, Tensioner Arm And Bolts
 Courtesy of FORD MOTOR CO.

47. Remove the retaining clip from the RH timing chain tensioner.

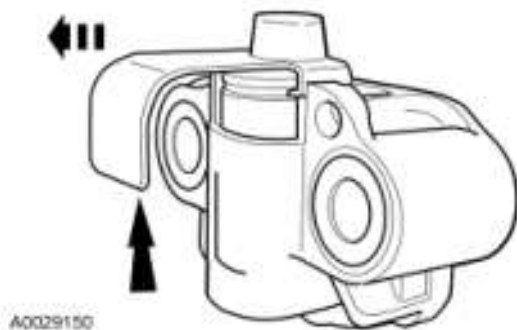


Fig. 477: Identifying Retaining Clip And Timing Chain Tensioner
 Courtesy of FORD MOTOR CO.

48. As a post-check, verify correct alignment of all timing marks.

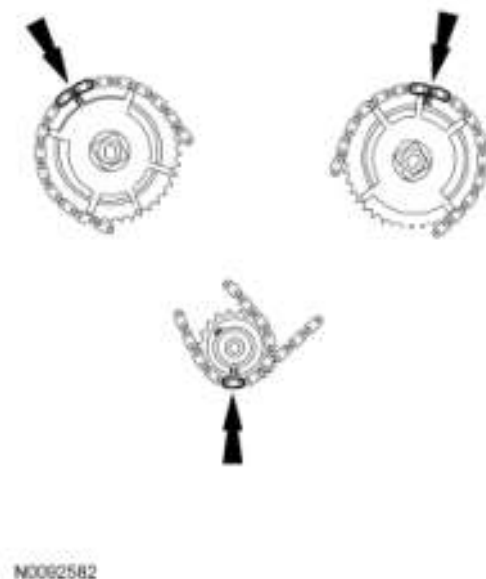


Fig. 478: Locating Timing Marks
 Courtesy of FORD MOTOR CO.

49. Install the crankshaft sensor ring on the crankshaft.

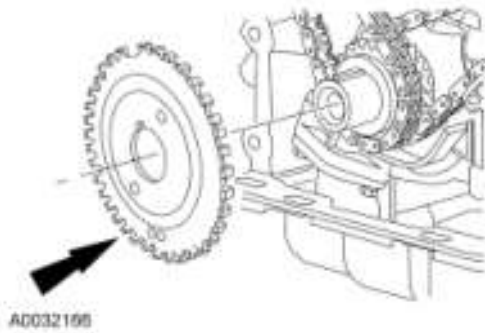


Fig. 479: Locating Crankshaft Sensor Ring At Crankshaft
 Courtesy of FORD MOTOR CO.

CAUTION: If the components are to be reinstalled, they must be installed in the same positions. Failure to follow these instructions may result in engine damage.

50. Using the special tool, install all of the camshaft roller followers.
- Lubricate the camshaft roller followers with clean engine oil prior to installation.



Fig. 480: Compressing Spring Using Special Tool (303-1039)
 Courtesy of FORD MOTOR CO.

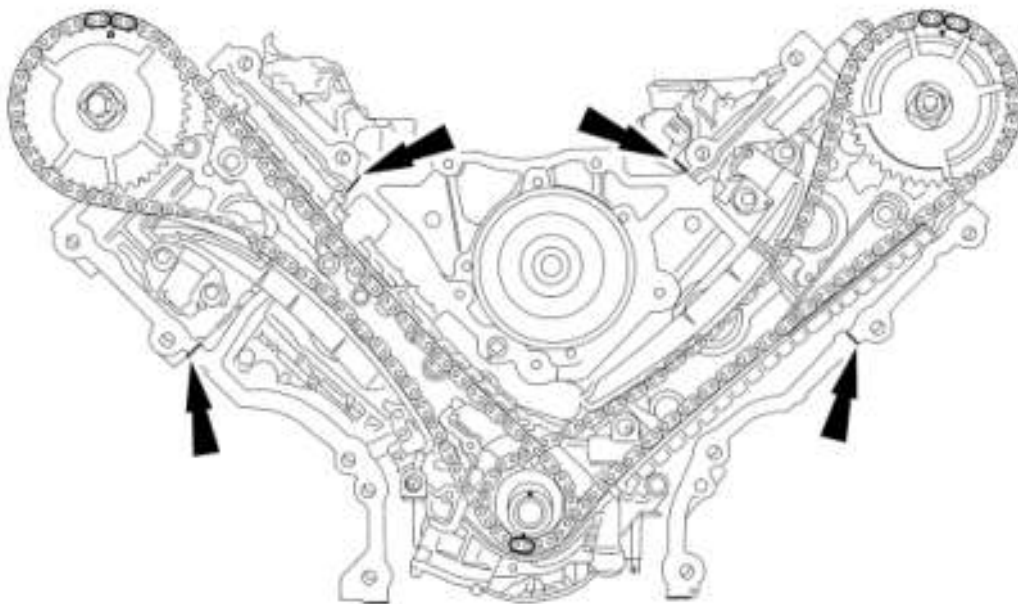
CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

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. 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.

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

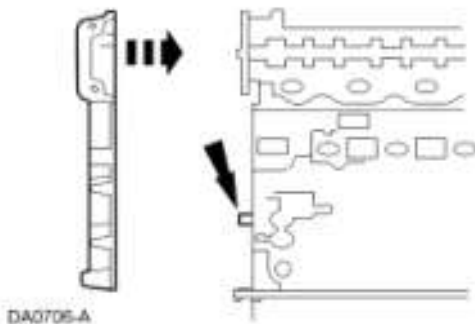
51. Apply a bead of silicone gasket and sealant along the cylinder head-to-cylinder block surface at the locations shown.



N0010501

Fig. 481: Applying Bead Of Silicone Gasket And Sealant
Courtesy of FORD MOTOR CO.

52. Install a new engine front cover gasket on the engine front cover. Position the engine front cover onto the dowels. Install the fasteners finger-tight.



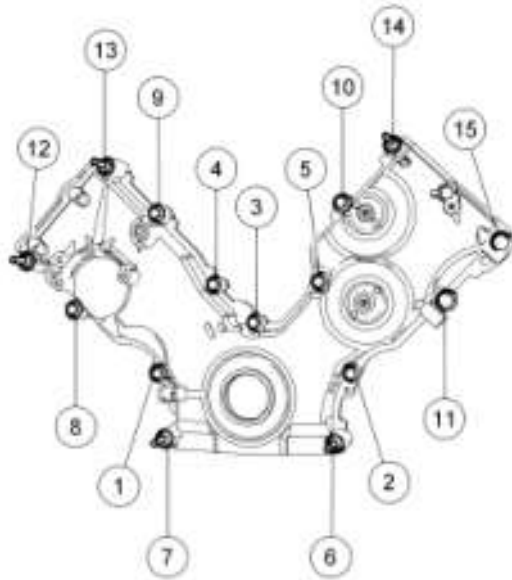
DA0705-A

Fig. 482: Installing Engine Front Cover Gasket
Courtesy of FORD MOTOR CO.

53. Tighten the engine front cover fasteners in the sequence shown in 2 stages.

Stage 1: Tighten fasteners 1 through 15 to 25 Nm (18 lb-ft).

Stage 2: Tighten fasteners 6 and 7 to 48 Nm (35 lb-ft).



N0010206

Fig. 483: Tightening Engine Front Cover In Sequence
 Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
4	N806177	Bolt, Hex Flange Head Pilot,

		M8 x 1.25 x 50
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
6	N808529	Stud, Hex Head Pilot, M10 x 1.5 x 1.5 x 103
7	N808529	Stud, Hex Head Pilot, M10 x 1.5 x 1.5 x 103
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 50
12	W709573	Stud and Washer, Hex Head Pilot, M8 x 1.25 x 1.25 x 94
13	W709573	Stud and Washer, Hex Head Pilot, M8 x 1.25 x 1.25 x 94
		Stud and Washer, Hex Head

14	W709573	Pilot, M8 x 1.25 x 1.25 x 94
15	W706605	Bolt, Hex Head Pilot, M8 x 1.25 x 56

NOTE: Lubricate the new O-ring seal with clean engine oil prior to installation.

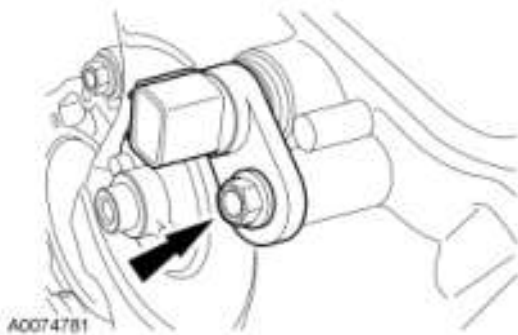


Fig. 484: Locating Bolt And LH CMP Sensor
Courtesy of FORD MOTOR CO.

54. Install the LH camshaft position (CMP) sensor and the bolt.
- Tighten to 10 N.m (89 lb-in).

NOTE: Lubricate the new O-ring seal with clean engine oil prior to installation.

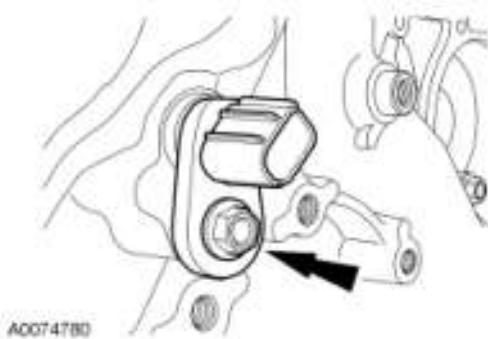


Fig. 485: Locating Camshaft (CMP) Sensor Bolt
Courtesy of FORD MOTOR CO.

55. Install the RH CMP sensor and the bolt.
- Tighten to 10 N.m (89 lb-in).

CAUTION: 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.

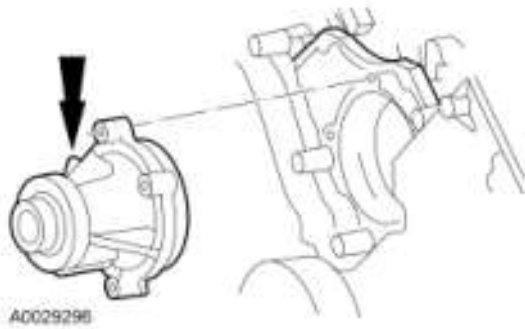


Fig. 486: Identifying Coolant Pump
 Courtesy of FORD MOTOR CO.

56. Position the coolant pump and install the bolts loosely.
 - Lubricate the new O-ring seal using clean engine coolant and install the O-ring seal onto the coolant pump.
57. Tighten the 4 coolant pump bolts.
 - Tighten to 25 N.m (18 lb-ft).

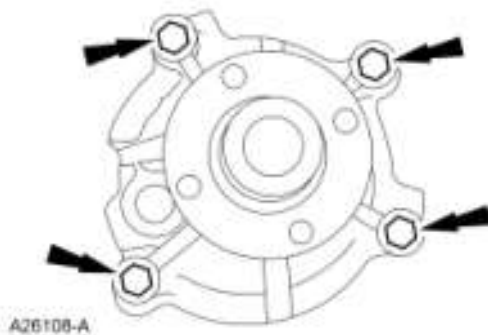


Fig. 487: Tightening Coolant Pump Bolts
 Courtesy of FORD MOTOR CO.

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

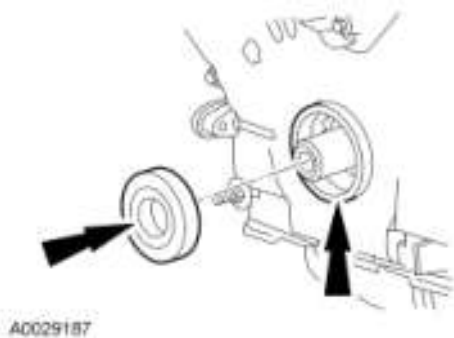


Fig. 488: Locating Crankshaft Front Seal
 Courtesy of FORD MOTOR CO.

59. Using the special tools, install a new crankshaft seal into the engine front cover.

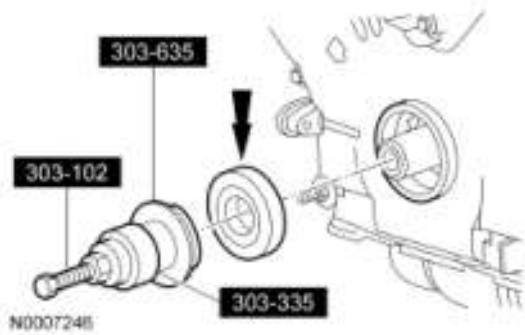


Fig. 489: Installing Crankshaft Front Seal Using Special Tools
 Courtesy of FORD MOTOR CO.

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. 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.

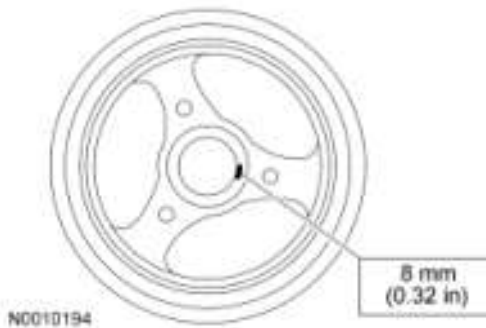


Fig. 490: Applying Silicone Gasket And Sealant To Woodruff Key Slot On Crankshaft Pulley
 Courtesy of FORD MOTOR CO.

60. Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.
61. Use the special tool to install the crankshaft pulley.



Fig. 491: Using Special Tool To Install Crankshaft Pulley
 Courtesy of FORD MOTOR CO.

62. Tighten the new crankshaft pulley bolt in 4 stages.
 - Stage 1: Tighten to 90 N.m (66 lb-ft).

- Stage 2: Loosen 360 degrees.
- Stage 3: Tighten to 50 N.m (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.

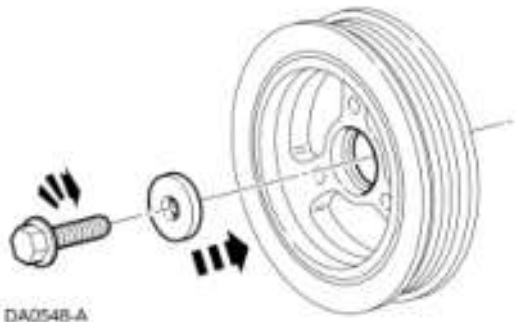


Fig. 492: Tightening Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

63. Position the crankshaft position (CKP) sensor and the bolt.
 - Install the new O-ring seal and lubricate the new O-ring seal with clean engine oil prior to installation.
 - Tighten to 10 N.m (89 lb-in).

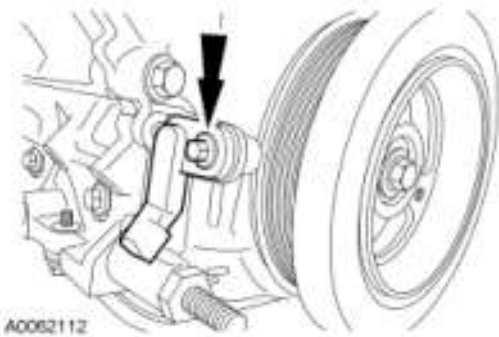


Fig. 493: Locating Crankshaft Position (CKP) Sensor Bolt
Courtesy of FORD MOTOR CO.

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

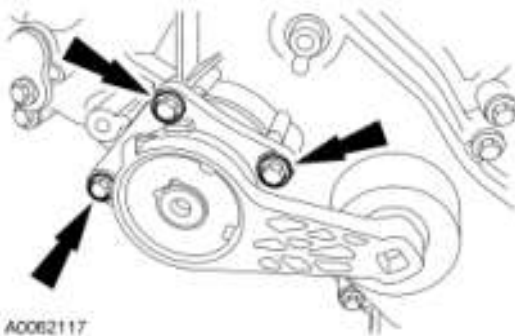


Fig. 494: Identifying Accessory Drive Belt Tensioner Bolts
Courtesy of FORD MOTOR CO.

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

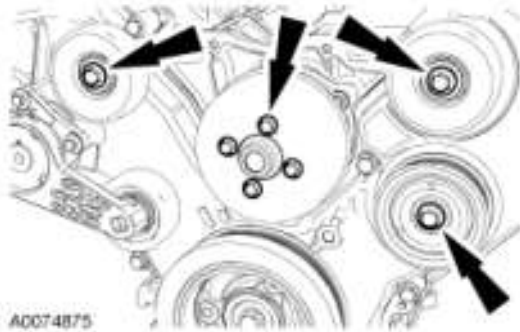


Fig. 495: Locating Coolant Pump Pulley And Accessory Drive Belt Idler Pulley Bolts
Courtesy of FORD MOTOR CO.

CAUTION: 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: Clean and inspect the mating surfaces, and install new gaskets.

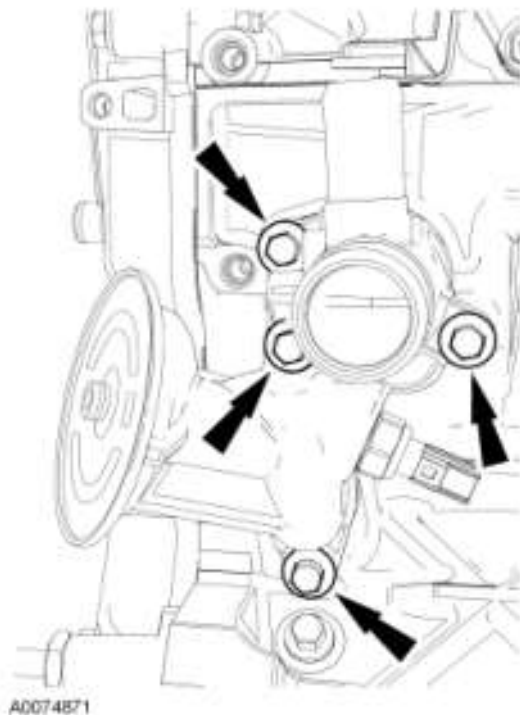


Fig. 496: Installing Oil Filter Adapter
Courtesy of FORD MOTOR CO.

66. Position the oil filter adapter and install the 4 bolts.
- Tighten to 25 N.m (18 lb-ft).
67. Install 8 new LH exhaust manifold-to-cylinder head studs.

- Tighten to 12 Nm (9 lb-ft).

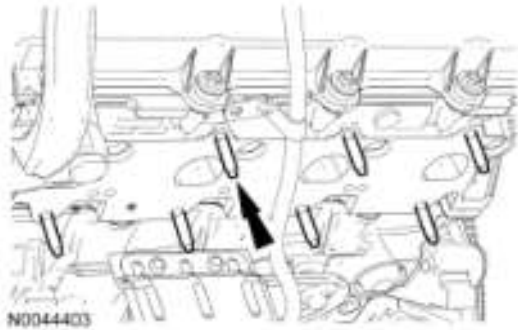


Fig. 497: Locating LH Exhaust Manifold-To-Cylinder Head Studs
 Courtesy of FORD MOTOR CO.

68. Position a new gasket, the LH exhaust manifold and tighten the 8 new nuts in the sequence shown.
- Tighten to 25 N.m (18 lb-ft).

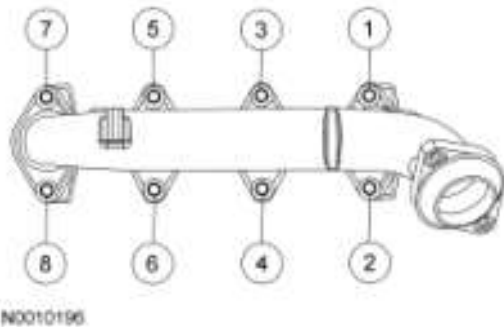


Fig. 498: Identifying Tightening Sequence Of LH Exhaust Manifold Nuts
 Courtesy of FORD MOTOR CO.

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

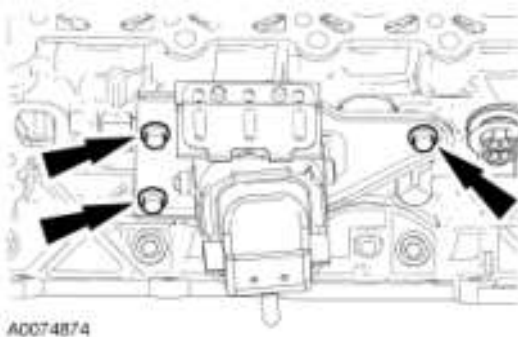


Fig. 499: Installing LH Engine Support Insulator Bolts
 Courtesy of FORD MOTOR CO.

69. Install the LH engine support insulator and the 3 bolts.
- Apply threadlock to the bolt threads prior to installation.
 - Tighten to 63 N.m (46 lb-ft).

70. Install 8 new RH exhaust manifold-to-cylinder head studs.
- Tighten to 12 Nm (9 lb-ft).

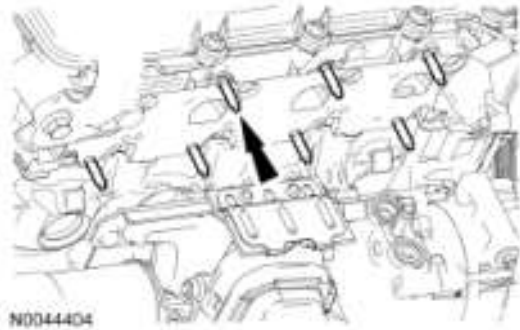


Fig. 500: Locating RH Exhaust Manifold-To-Cylinder Head Studs
Courtesy of FORD MOTOR CO.

71. Position a new gasket, the RH exhaust manifold and tighten the 8 new nuts in the sequence shown.
- Tighten to 25 N.m (18 lb-ft).

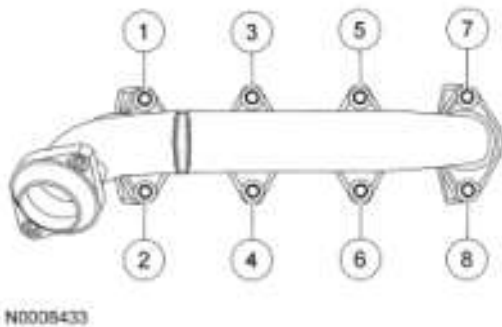


Fig. 501: Identifying Tightening Sequence Of RH Exhaust Manifold Bolts
Courtesy of FORD MOTOR CO.

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

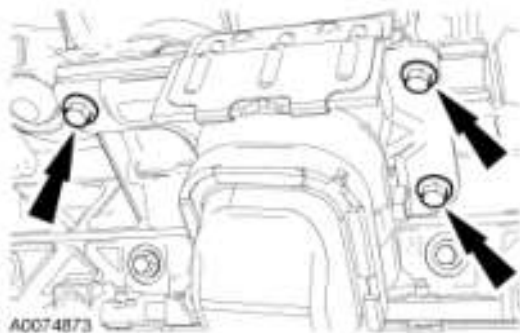


Fig. 502: Identifying RH Engine Support Insulator Bolts
Courtesy of FORD MOTOR CO.

72. Install the RH engine support insulator and the 3 bolts.
- Apply threadlock to the bolt threads prior to installation.

- Tighten to 63 N.m (46 lb-ft).

CAUTION: 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.

73. 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. 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.

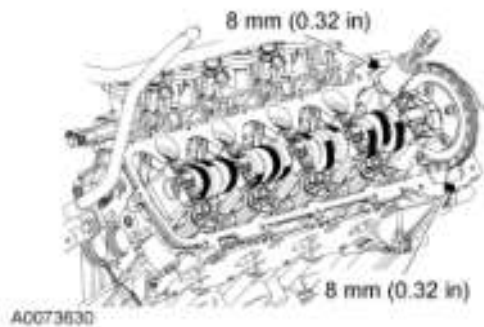
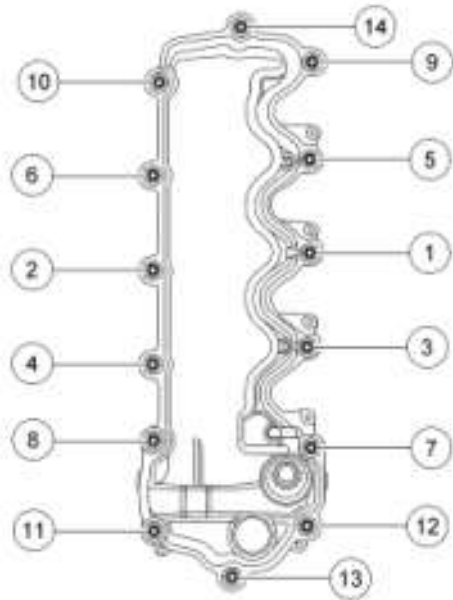


Fig. 503: Applying Bead Of Silicone Gasket And Sealant In 2 Places Where Engine Front Cover Meets Cylinder Head
Courtesy of FORD MOTOR CO.

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

Early build vehicles

CAUTION: When installing the valve cover, make sure to avoid damaging the VCT solenoid.



N0005317

Fig. 504: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

1. Position the RH valve cover and gasket on the cylinder head and tighten the fasteners in the sequence shown.
 - Tighten to 10 N.m (89 lb-in).

Late build vehicles

CAUTION: When installing the valve cover, make sure to avoid damaging the VCT solenoid.

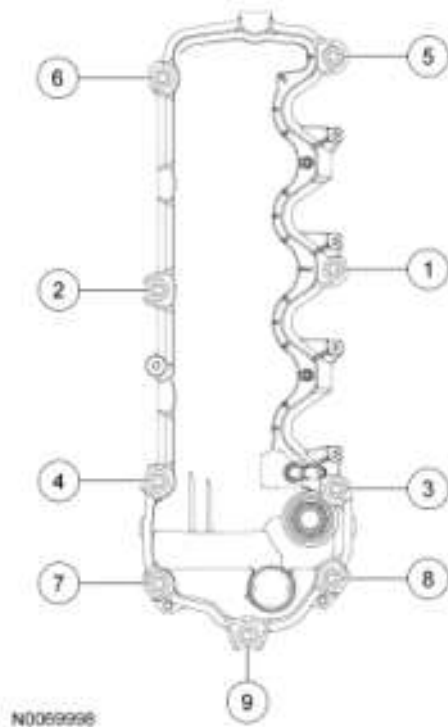


Fig. 505: Tightening RH Valve Cover In Sequence
Courtesy of FORD MOTOR CO.

1. Position the RH valve cover and gasket on the cylinder head and tighten the fasteners in the sequence shown.
 - Tighten to 10 Nm (89 lb-in).

All vehicles

CAUTION: 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.

1. 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. 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.**

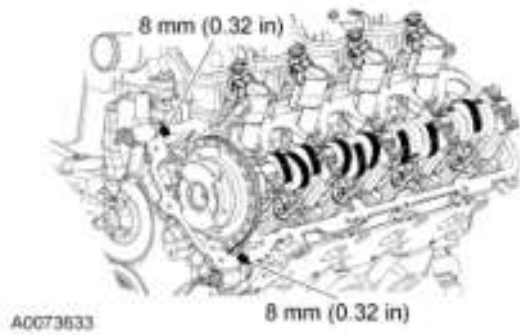
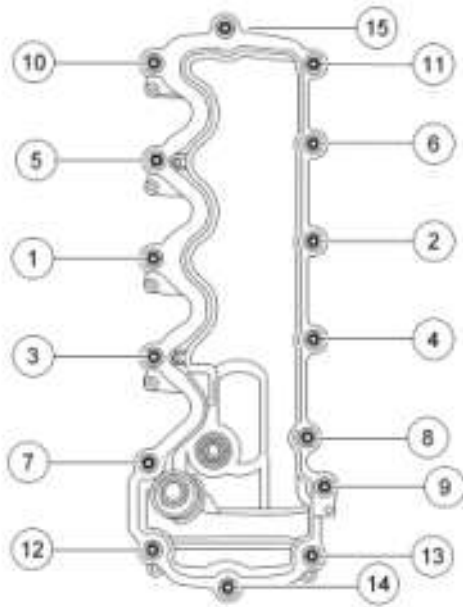


Fig. 506: Applying Bead Of Silicone Gasket And Sealant In 2 Places Where Engine Front Cover Meets Cylinder Head
 Courtesy of FORD MOTOR CO.

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

Early build vehicles

CAUTION: When installing the valve cover, make sure to avoid damaging the VCT solenoid.



N0005318

Fig. 507: Identifying Tighten Sequence Of Valve Cover Bolts
 Courtesy of FORD MOTOR CO.

1. Position the LH valve cover and gasket on the cylinder head and tighten the fasteners in the sequence shown.
 - Tighten to 10 N.m (89 lb-in).

Late build vehicles

CAUTION: When installing the valve cover, make sure to avoid damaging the VCT solenoid.

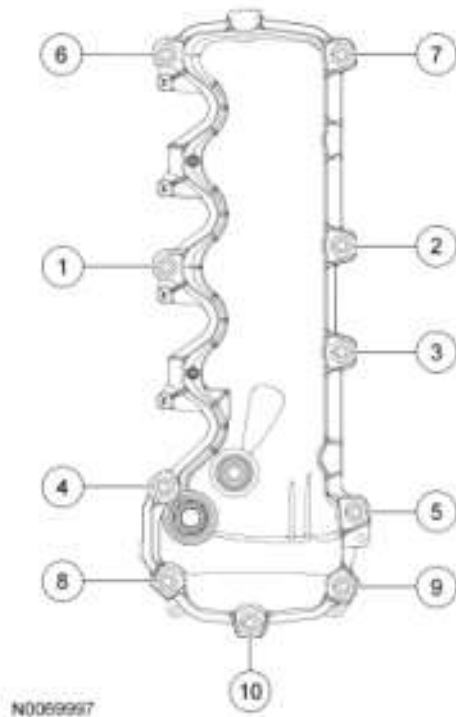


Fig. 508: Tightening LH Valve Cover In Sequence
Courtesy of FORD MOTOR CO.

1. Position the LH valve cover and gasket on the cylinder head and tighten the fasteners in the sequence shown.
 - Tighten to 10 Nm (89 lb-in).

All vehicles

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



Fig. 509: Installing Oil Level Indicator Tube
Courtesy of FORD MOTOR CO.

NOTE: Do not reuse the O-ring seals.

NOTE: Lubricate the O-ring seals with clean engine coolant prior to installation.

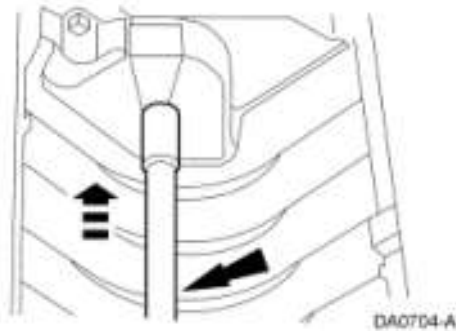


Fig. 510: Sliding Coolant Tube Forward With O-Ring Seals Into Cylinder Block
Courtesy of FORD MOTOR CO.

2. Slide the coolant tube forward with the new O-ring seals into the cylinder block.
3. Install the coolant tube stud bolt.
 - Tighten to 10 N.m (89 lb-in).

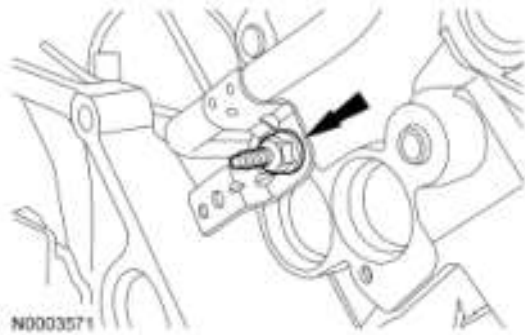


Fig. 511: Identifying Coolant Tube Stud Bolt
Courtesy of FORD MOTOR CO.

4. Install the 2 knock sensors (KS) and the bolts.
 - Tighten to 20 N.m (15 lb-ft).

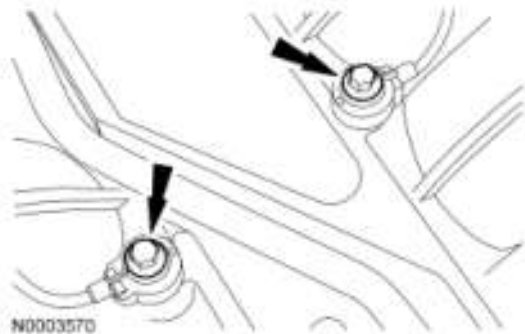


Fig. 512: Identifying Knock Sensors (KS)
Courtesy of FORD MOTOR CO.

5. Position the electrical harness on the engine assembly and connect the engine wiring harness retainers to the valve cover studs.
6. Connect the CKP sensor electrical connector.

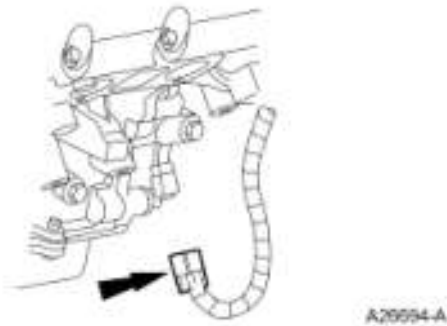


Fig. 513: Connecting CKP Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

7. Connect the 4 LH ignition coil electrical connectors.

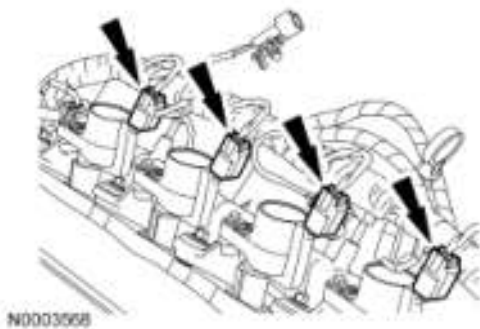


Fig. 514: Connecting LH Ignition Coil Electrical Connectors
Courtesy of FORD MOTOR CO.

8. Install the LH radio ignition interference capacitor and the stud bolt.
 - Tighten to 10 N.m (89 lb-in).

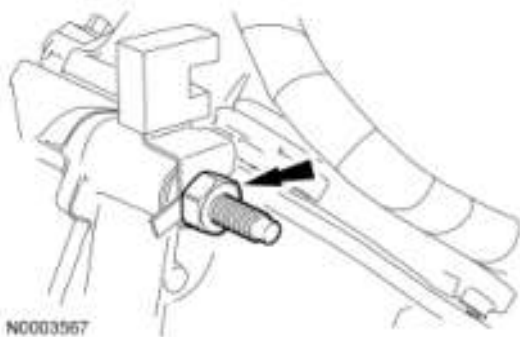


Fig. 515: Identifying LH Radio Ignition Interference Capacitor And Stud Bolt
Courtesy of FORD MOTOR CO.

9. Connect the cylinder head temperature (CHT) sensor electrical connector.

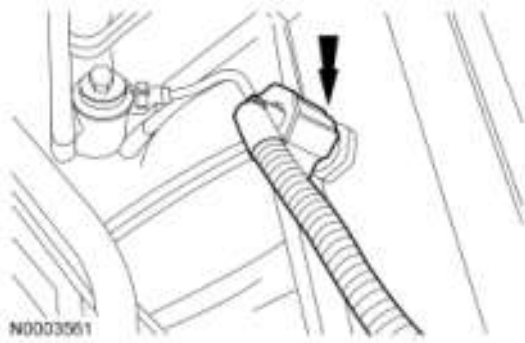


Fig. 516: Locating Cylinder Head Temperature (CHT) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

10. Connect the 4 RH ignition coil electrical connectors.



Fig. 517: Locating Ignition Coil Electrical Connectors
Courtesy of FORD MOTOR CO.

11. Connect the electrical connector retainer to the coolant tube.



Fig. 518: Locating Electrical Connector Retainer At Coolant Tube Support Bracket
Courtesy of FORD MOTOR CO.

12. Connect the 2 engine wiring harness retainers from the RH valve cover studs.

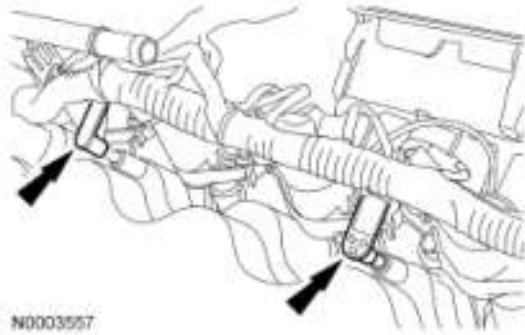


Fig. 519: Locating Engine Wiring Harness Retainers At RH Valve Cover
Courtesy of FORD MOTOR CO.

13. Connect the RH VCT solenoid electrical connector.

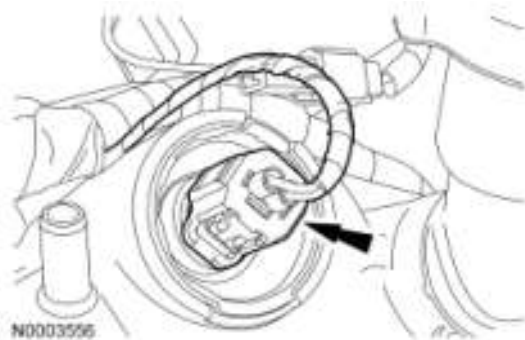


Fig. 520: Locating Camshaft Timing (VCT) Solenoid Electrical Connectors
Courtesy of FORD MOTOR CO.

14. Install the RH radio ignition interference capacitor and the stud bolt.
 - Tighten to 10 N.m (89 lb-in).



Fig. 521: Identifying RH Radio Ignition Interference Capacitor Stud Bolt
Courtesy of FORD MOTOR CO.

15. Connect the RH CMP sensor electrical connector.



Fig. 522: Identifying RH CMP Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

16. Install the special tool.

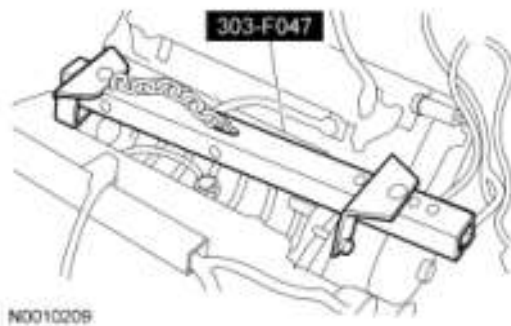


Fig. 523: Identifying Special Tool
Courtesy of FORD MOTOR CO.

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

CAUTION: 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.

18. 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: 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. 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.

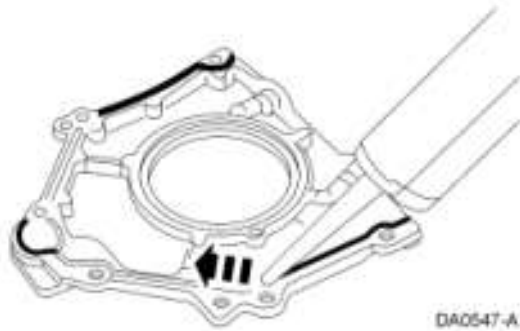


Fig. 524: Applying Bead Of Silicone Gasket And Sealant Around Crankshaft Rear Seal Retainer Sealing Surface
 Courtesy of FORD MOTOR CO.

19. Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the crankshaft rear seal retainer sealing surface.
20. Install the crankshaft rear seal retainer plate and loosely install the 6 bolts.

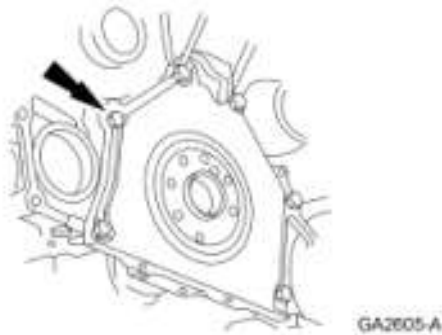


Fig. 525: Locating Crankshaft Rear Seal Retainer Plate Bolts
 Courtesy of FORD MOTOR CO.

21. Tighten the bolts in the sequence shown.
 - Tighten to 10 N.m (89 lb-in).

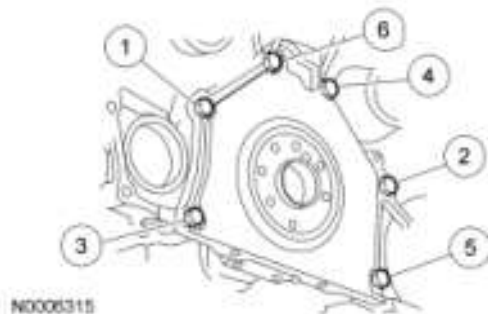


Fig. 526: Tightening Bolts In Sequence
 Courtesy of FORD MOTOR CO.

CAUTION: 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.

22. 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. 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.

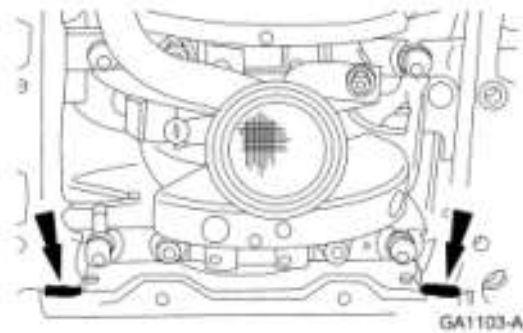
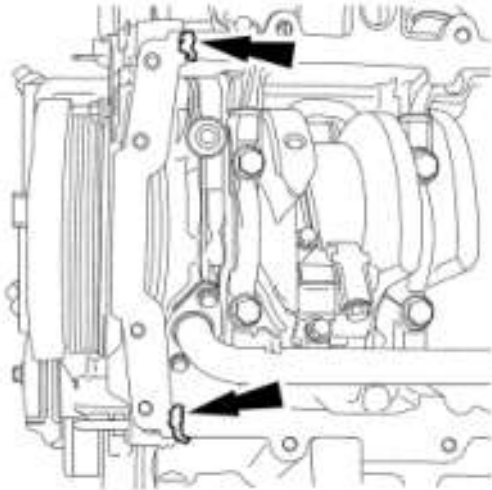


Fig. 527: Applying Silicone Gasket And Sealant
Courtesy of FORD MOTOR CO.

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

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. 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.



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Fig. 528: Applying Silicone Gasket And Sealant At Engine Front Cover-To-Cylinder Block Mating Surface
Courtesy of FORD MOTOR CO.

24. Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.
25. Install the oil pan gasket and the oil pan and loosely install the bolts.

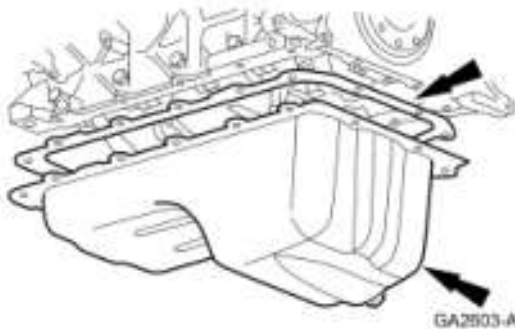


Fig. 529: Positioning New Oil Pan Gasket And Oil Pan
Courtesy of FORD MOTOR CO.

26. Tighten the bolts in 3 stages, in the sequence shown.
 - Stage 1: Tighten to 2 N.m (18 lb-in).
 - Stage 2: Tighten to 20 N.m (15 lb-ft).
 - Stage 3: Tighten an additional 60 degrees.

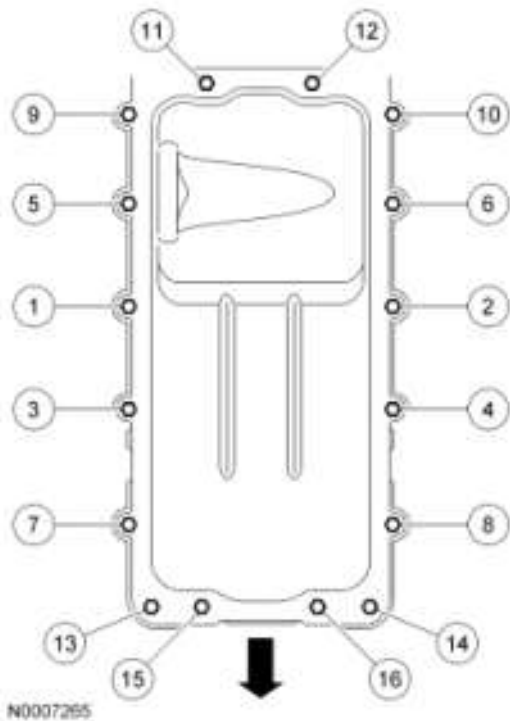


Fig. 530: Identifying Oil Pan Bolt Tightening Sequence
 Courtesy of FORD MOTOR CO.

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

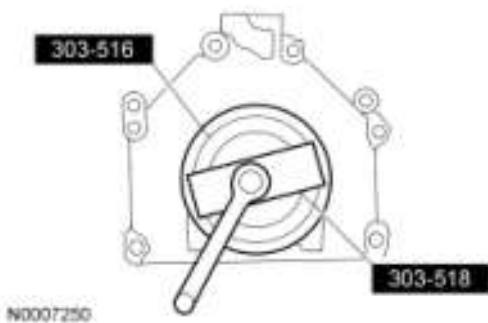


Fig. 531: Using Special Tools To Install New Crankshaft Rear Seal
 Courtesy of FORD MOTOR CO.

27. Using the special tools, install a new crankshaft rear seal.
28. Using the special tools, install a new crankshaft rear oil slinger.

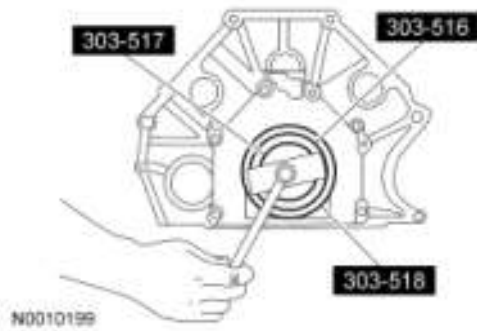
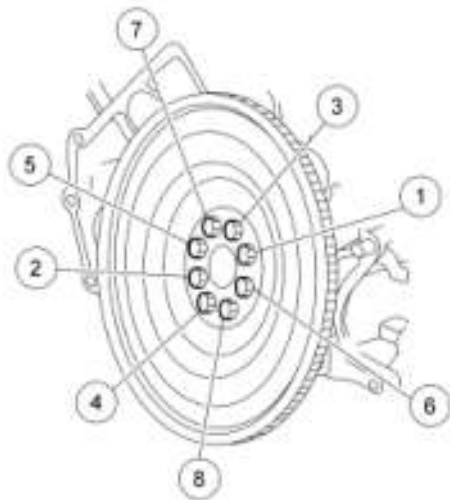


Fig. 532: Installing Crankshaft Rear Oil Slinger Using Special Tools
 Courtesy of FORD MOTOR CO.

29. Install the flexplate and the 8 bolts in the sequence shown.
- Tighten to 80 N.m (59 lb-ft).



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Fig. 533: Identifying Tightening Sequence For Flexplate Or Flywheel Bolts
 Courtesy of FORD MOTOR CO.