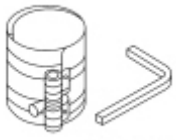
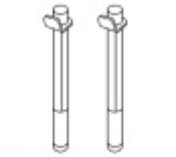
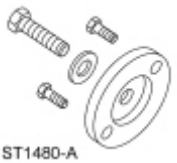
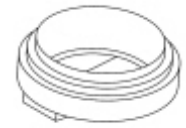
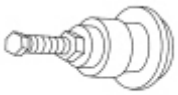
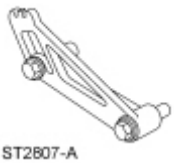
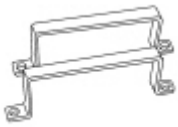
Engine

Special Tool(s)

 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 Oil Seal 303-635
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST2428-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-EH)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073) or equivalent
 ST2807-A	Locking Tool, Camshaft Phaser 303-1046
 ST1668-A	Remover/Installer, Cylinder Head 303-572 (T97T-6000-A)

General Equipment

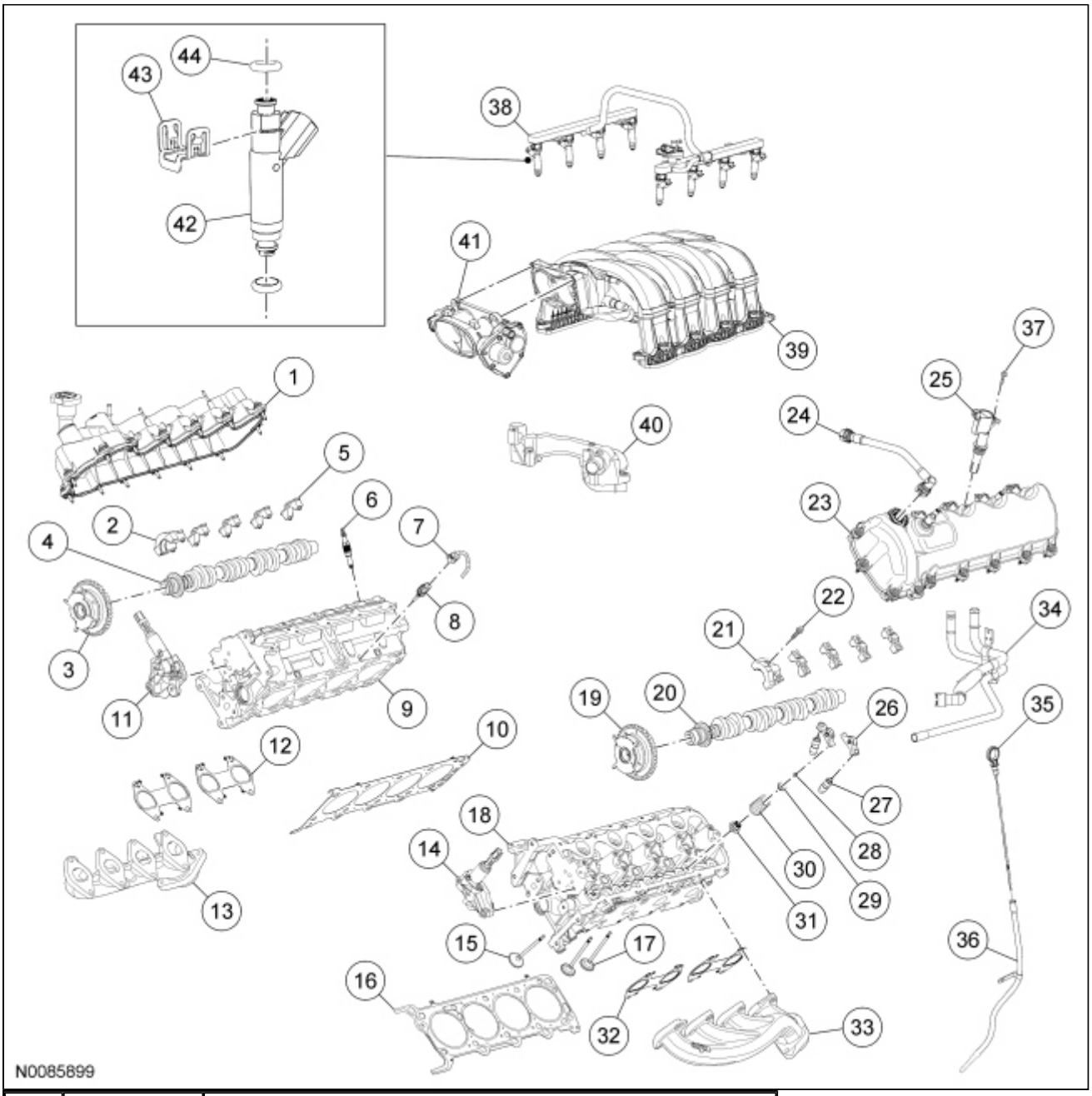
Hydraulic Chain Tensioner Retaining Clip 1L3Z-6P250-AA

Material

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	

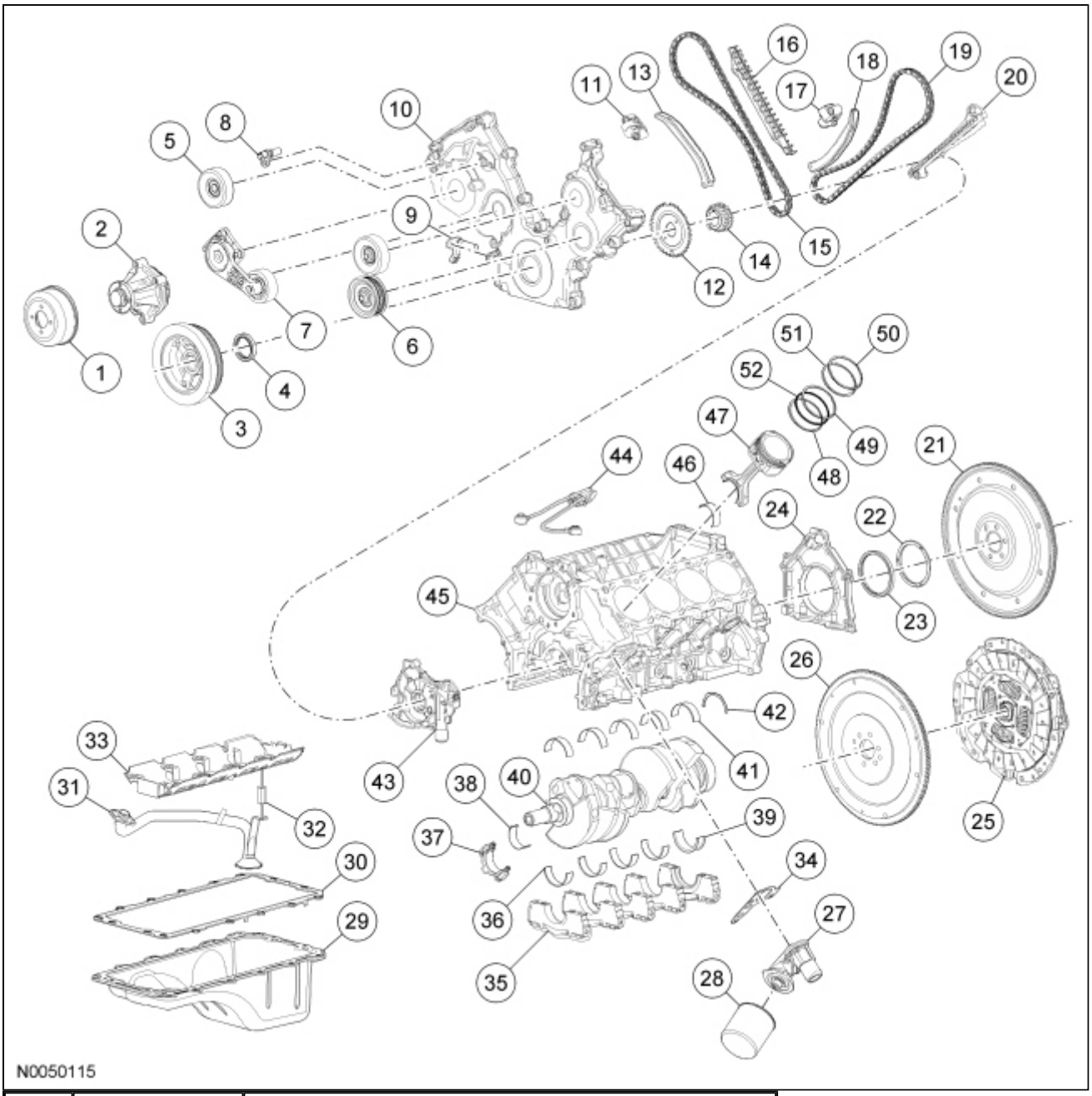
Engine — Upper End



Item	Part Number	Description
1	6582	RH valve cover
2	6B284	RH camshaft thrust bearing cap
3	6C524	RH camshaft phaser sprocket
4	6250	RH camshaft
5	6B280	Camshaft bearing cap (8 required)
6	12405	Spark plug (8 required)
7	14B102	Cylinder Head Temperature (CHT) sensor jumper harness
8	6G004	CHT sensor

9	6049	RH cylinder head
10	6051	RH cylinder head gasket
11	6C260	RH Variable Camshaft Timing (VCT) oil control solenoid assembly
12	9Y431	Exhaust manifold gasket (2 required)
13	9430	Exhaust manifold — RH
14	6C261	LH VCT oil control solenoid assembly
15	6505	Exhaust valve (8 required)
16	6083	LH cylinder head gasket
17	6507	Intake valve (16 required)
18	6050	LH cylinder head
19	6C524	LH camshaft phaser sprocket
20	6C255	LH camshaft
21	6B284	LH camshaft thrust bearing cap
22	N807834	Camshaft bearing cap bolt (20 required)
23	6A505	LH valve cover
24	6K817	PCV tube
25	12A366	Ignition coil (8 required)
26	6529	Roller follower (24 required)
27	6C501	Hydraulic lash adjuster (24 required)
28	6518	Valve spring retainer key (48 required)
29	6514	Valve spring retainer (24 required)
30	6513	Valve spring (24 required)
31	6A517	Valve stem seal (24 required)
32	9Y431	Exhaust manifold gasket (2 required)
33	9431	LH exhaust manifold
34	18B402	Coolant tube
35	6750	Oil level indicator
36	6K873	Oil level indicator tube
37	W706175	Ignition coil bolt (8 required)
38	9F792	Fuel rail assembly
39	9424	Intake manifold assembly
40	8C369	Engine coolant crossover
41	9F991	Electronic throttle body
42	9F860	Fuel injector (8 required)
43	9C995	Fuel injector clip (8 required)
44	9F798	O-ring seal (16 required)

Engine — Lower End

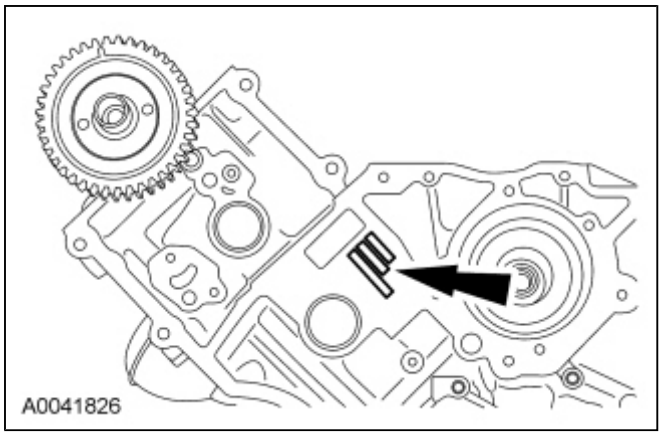


Item	Part Number	Description
1	8A528	Coolant pump pulley
2	8501	Coolant pump
3	6316	Crankshaft pulley
4	6700	Crankshaft front oil seal
5	12A216	Accessory drive belt idler pulley (2 required)
6	6C348	Accessory drive belt idler pulley
7	6B209	Accessory drive belt tensioner
8	6B288	Camshaft Position (CMP) 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

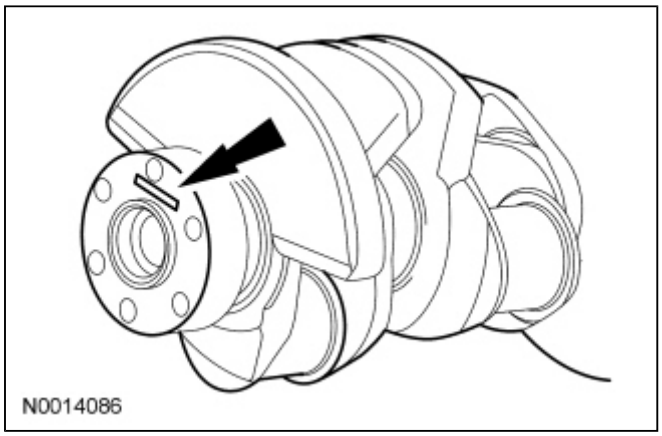
15	6268	RH timing chain
16	6M256	RH timing chain guide
17	6M269	LH timing chain tensioner
18	6M274	LH tensioner arm
19	6268	LH timing chain
20	6B274	LH timing chain guide
21	6375	Flexplate
22	6701	Crankshaft oil slinger
23	6310	Crankshaft rear seal
24	6K318	Crankshaft rear seal retainer plate
25	7B546	Pressure plate
26	6375	Flywheel
27	6881	Oil filter adapter
28	6714	Oil filter
29	6675	Oil pan
30	6710	Oil pan gasket
31	6622	Oil pump screen and pickup tube
32	N806180	Oil pump screen and pickup tube spacer
33	6687	Windage tray
34	6A636	Oil filter adapter gasket
35	6325	Crankshaft main bearing cap (5 required)
36	6A338	Lower crankshaft bearing (4 required)
37	6210	Connecting rod cap (8 required)
38	6211	Connecting rod lower bearing (8 required)
39	6K302	Lower crankshaft thrust washer
40	6303	Crankshaft
41	6333	Upper crankshaft bearing (5 required)
42	6A341	Upper crankshaft thrust washer
43	6621	Oil pump
44	12A699	Knock Sensor (KS)
45	6010	Cylinder block
46	6211	Connecting rod upper bearing (8 required)
47	6110	Piston (8 required)
48	6159	Outer oil control ring (8 required)
49	6159	Outer oil control ring (8 required)
50	6150	Upper compression ring (8 required)
51	6152	Lower compression ring (8 required)
52	6161	Inner oil control ring (8 required)

All vehicles

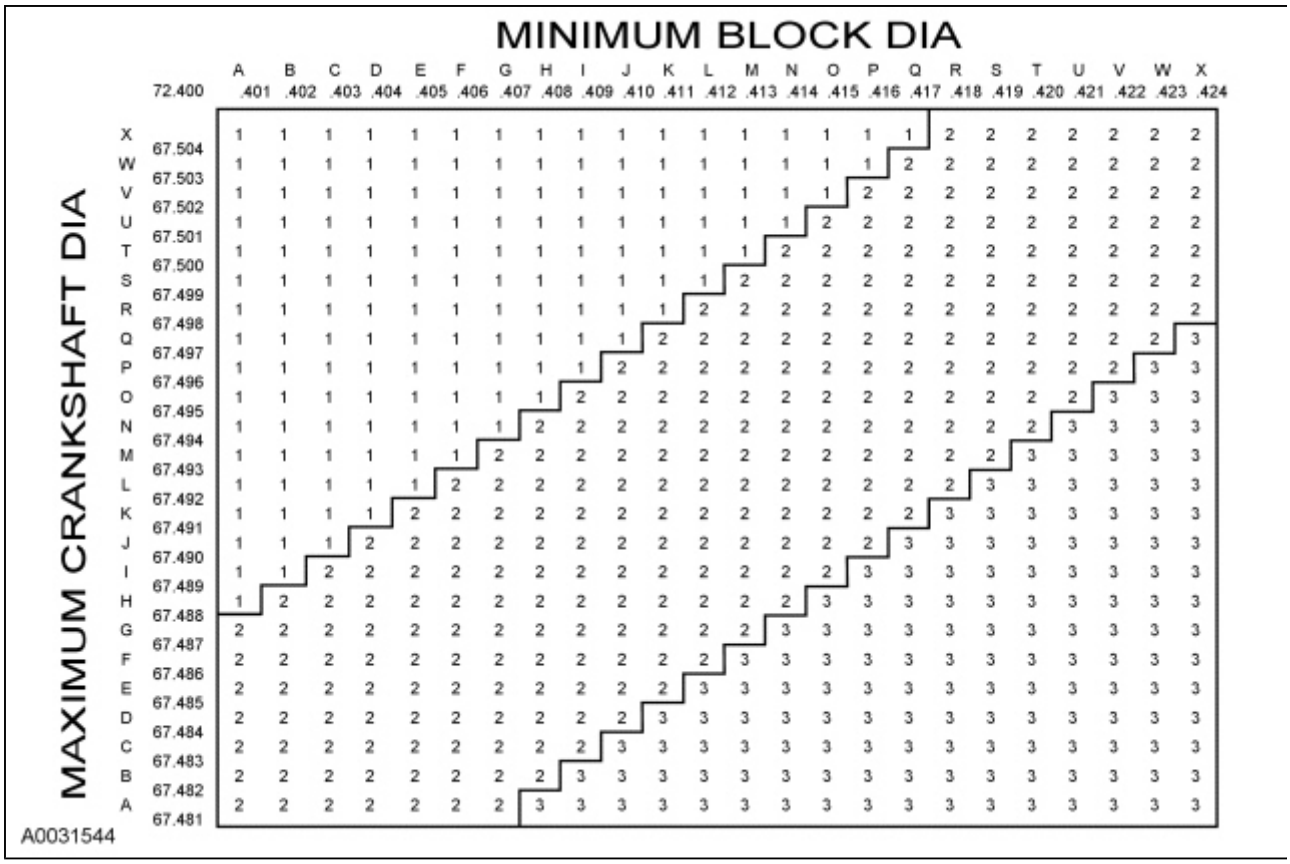
1. Record the main bearing code found on the front of the engine block.



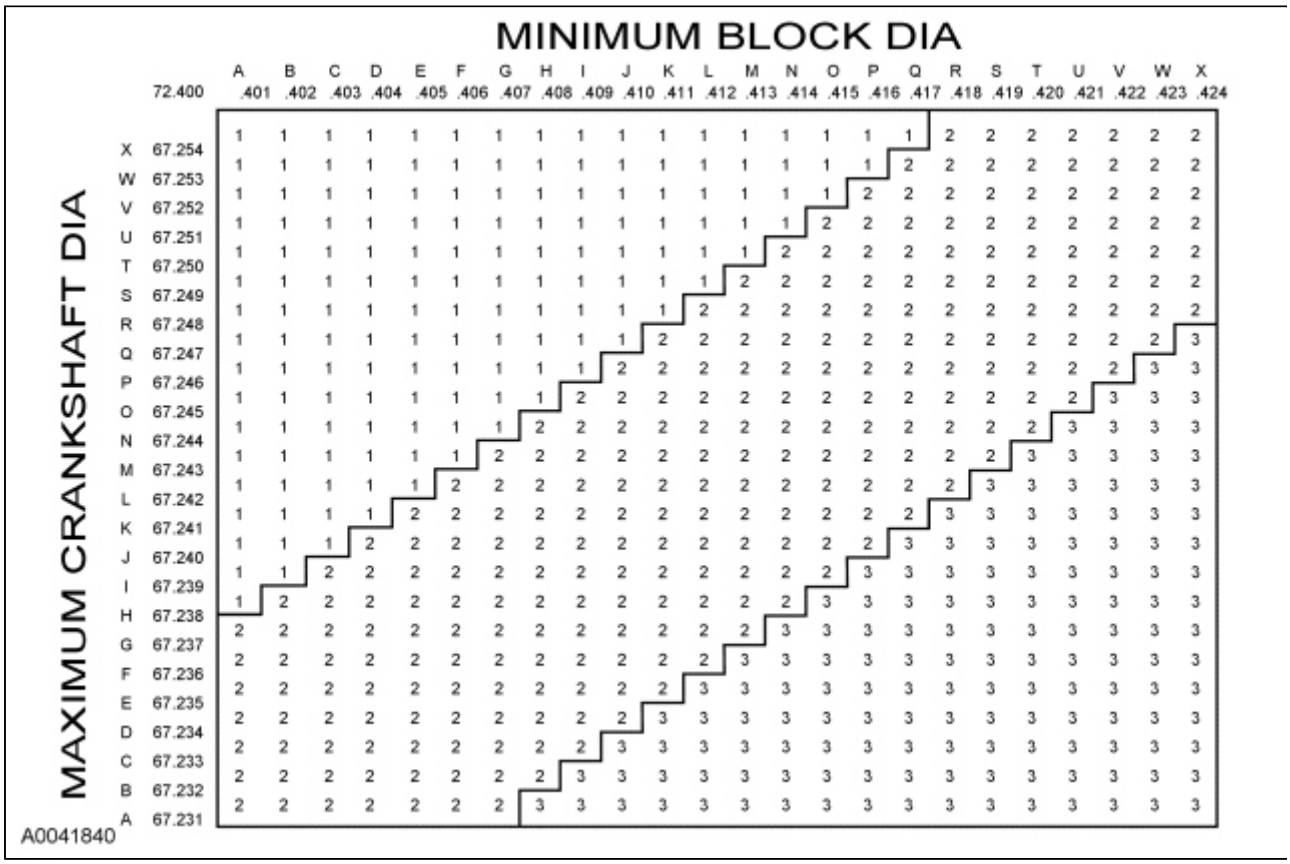
2. Record the main bearing code found on the back of the crankshaft.



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 No. 1 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.



4. 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.

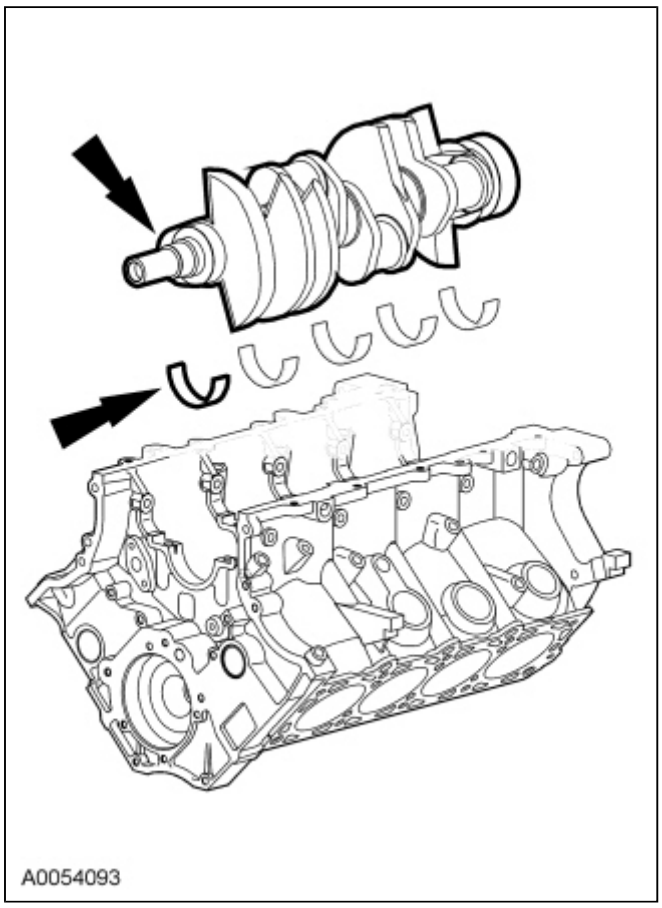


5. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

   Install the crankshaft main bearings.

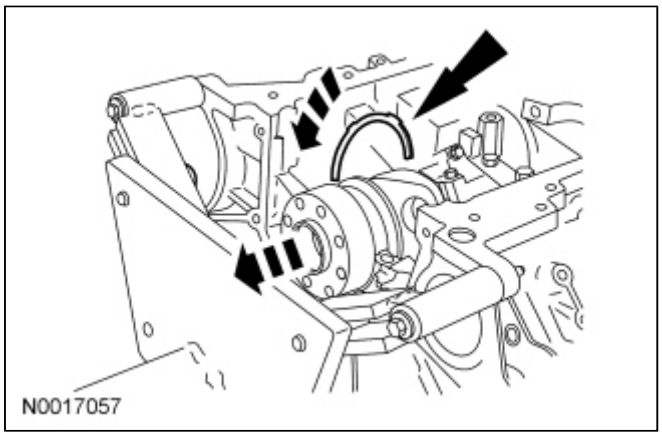
- Install the crankshaft upper main bearings into the cylinder block.
- Install the crankshaft lower main bearings into the bearing caps.
- Make sure all oil passages are aligned.
- Lubricate all main bearings with clean engine oil.

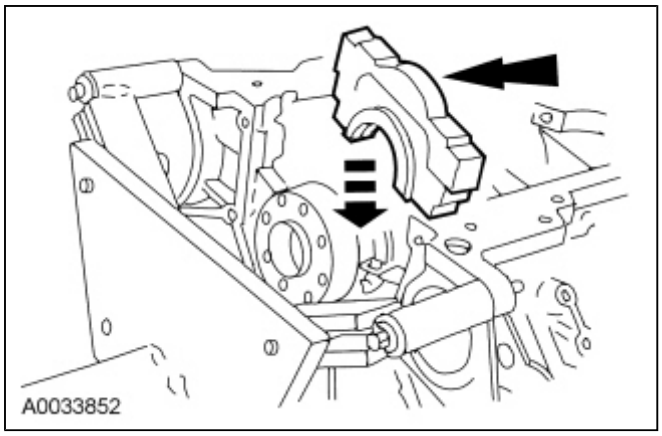
6. Lubricate the crankshaft bearing journals with clean engine oil. Install the crankshaft onto the upper crankshaft main bearings.



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

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

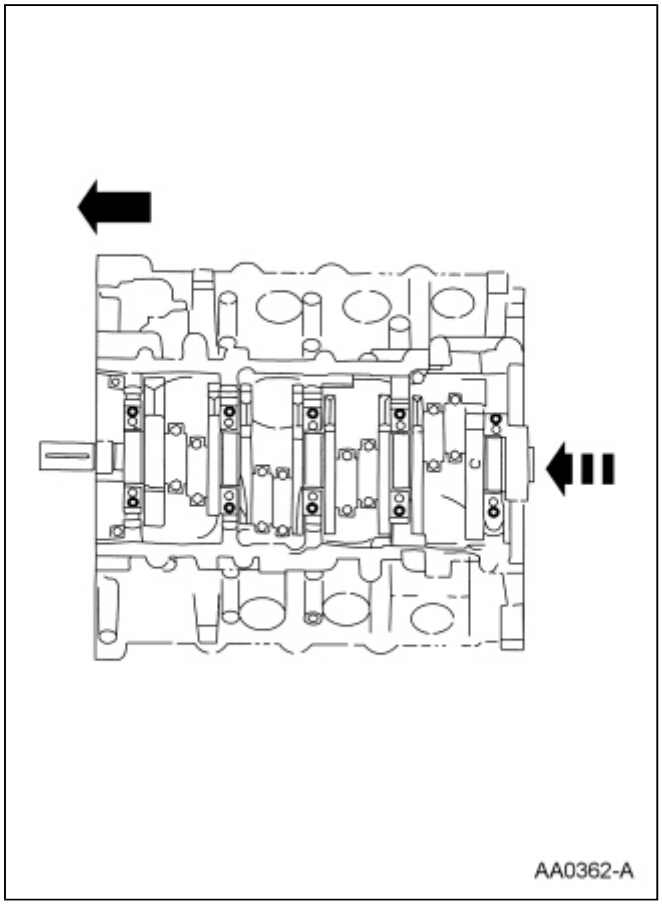




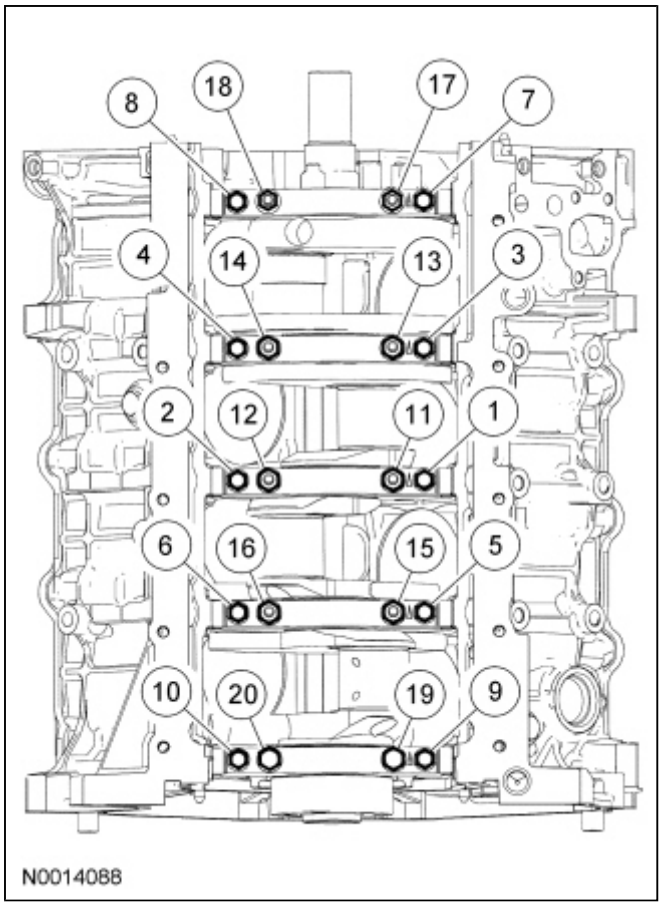
8. Install the rear (No. 5) main bearing cap.

9. 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.

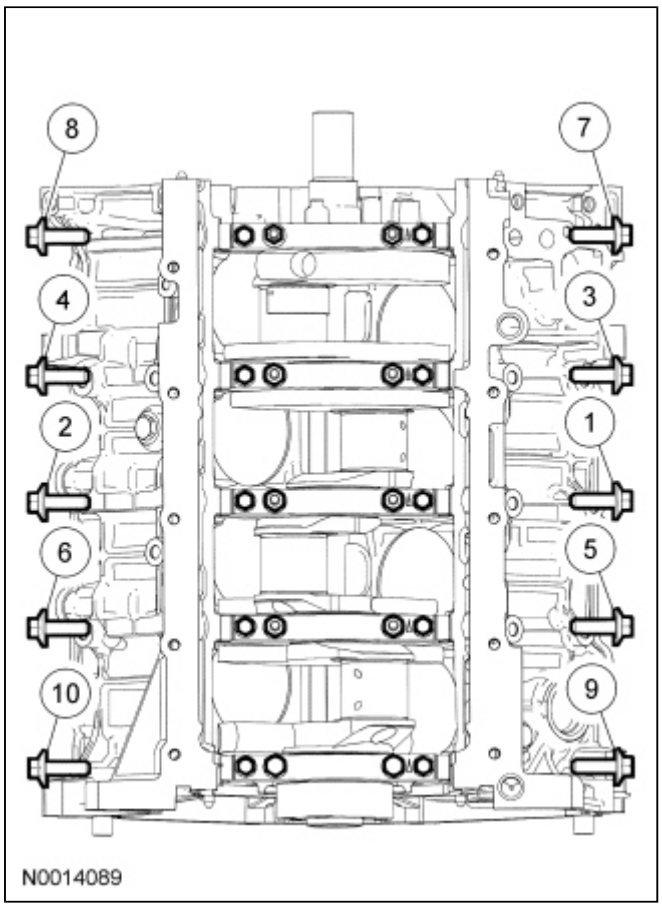
10. Push the crankshaft forward to seat the crankshaft thrust washer. Hold the crankshaft in the forward position.



11. Install the vertical main bearing cap fasteners and tighten in the sequence shown, in 4 stages.
    - Stage 1: Tighten fasteners 1 through 20 to 10 Nm (89 lb-in).
    - Stage 2: Tighten fasteners 1 through 10 to 25 Nm (18 lb-ft).
    - Stage 3: Tighten fasteners 11 through 20 to 40 Nm (30 lb-ft).
    - Stage 4: Tighten fasteners 1 through 20 an additional 90 degrees.



12. Install the cross-mounted main bearing cap fasteners and tighten in the sequence shown, in 2 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



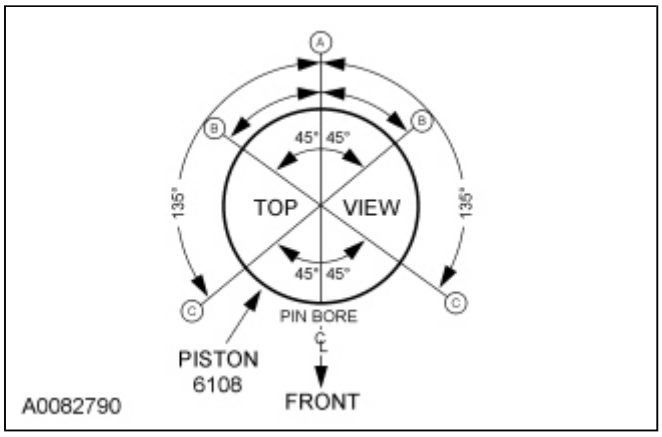
13. Check the crankshaft end play. For additional information, refer to Section 303-00 .

14. Check that crankshaft torque-to-turn does not exceed 6 Nm (53 lb-in).

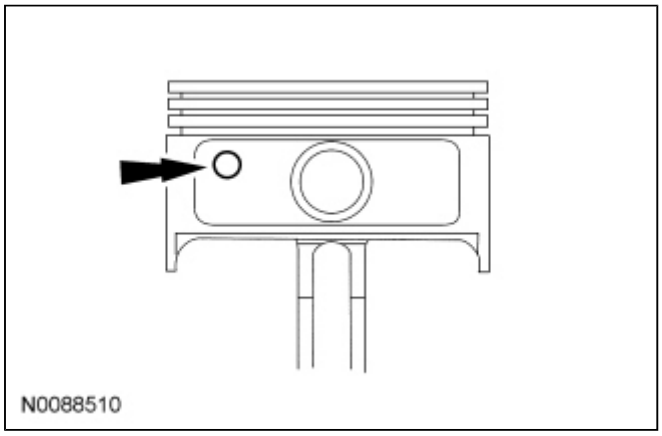
15. Check the piston-to-cylinder block and piston ring clearances. For additional information, refer to Section 303-00 .

16. Assemble the pistons. For additional information, refer to Piston in this section.

17. Make sure the ring gaps (oil spacer-A, oil ring-B, compression ring-C) are correctly spaced around the circumference of the piston.



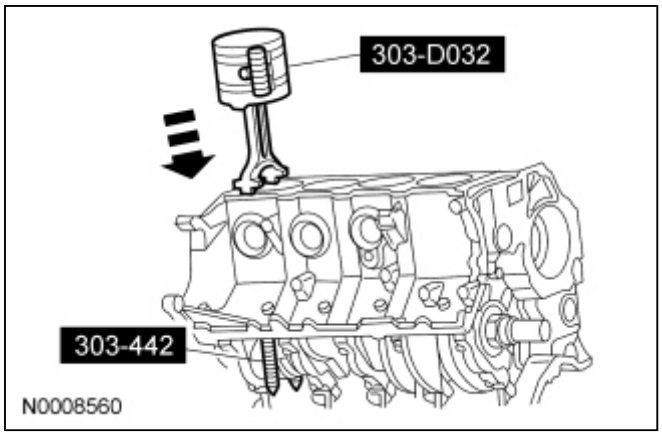
18. Make sure the dimple in the piston faces the front of the engine.



19. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.**

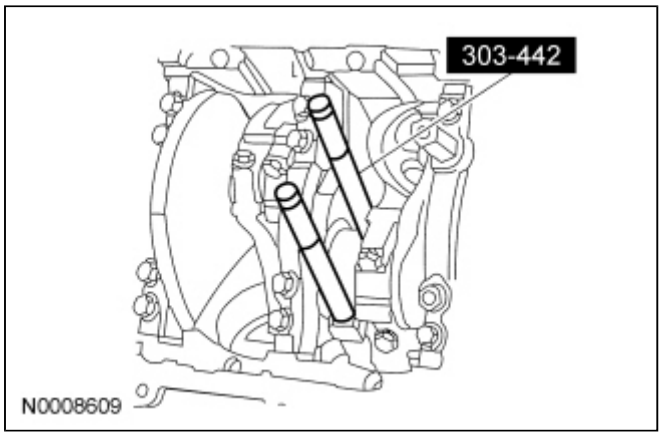
    NOTE: The following piston installation steps are for all 8 connecting rods, rod bearings and pistons. Only 1 connecting rod, rod bearing and piston is shown.

    Use the Piston Ring Compressor and the Connecting Rod Installers 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.



20. ***NOTICE:*** **Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.**

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



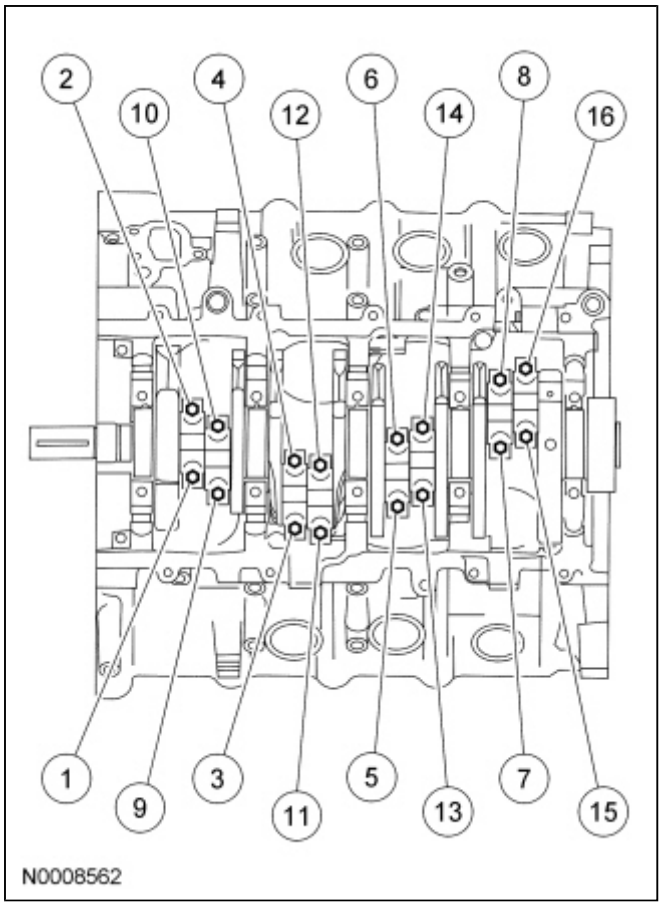
21. ***NOTICE:*** **The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

    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.

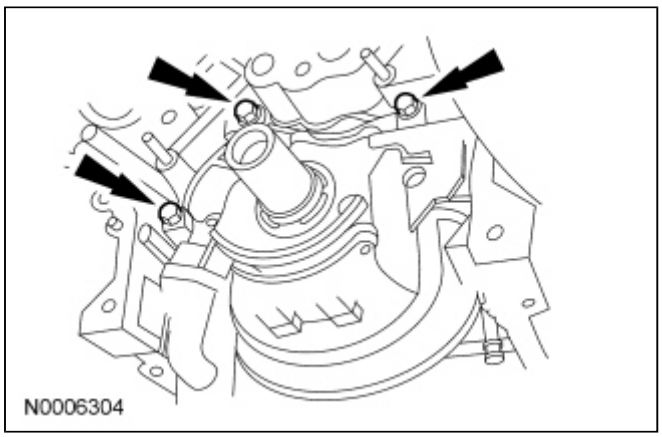
    Position the lower bearing and connecting rod and install the new bolts loosely.

22. **NOTE:** Main bearing caps are removed for clarity.

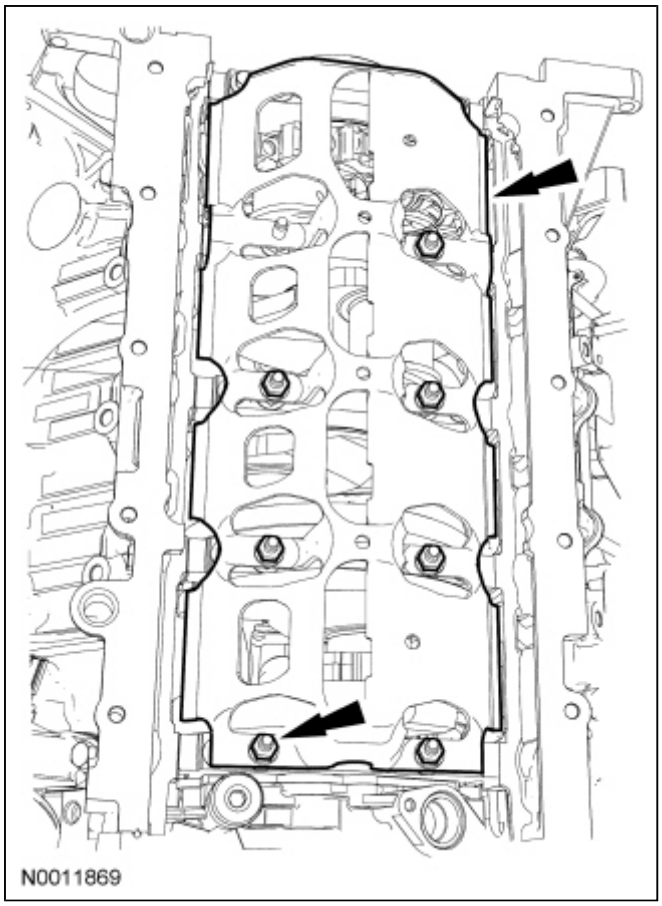
    Tighten the bolts in 2 stages, in the sequence shown.
    - Stage 1: Tighten to 43 Nm (32 lb-ft).
    - Stage 2: Tighten an additional 105 degrees.



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



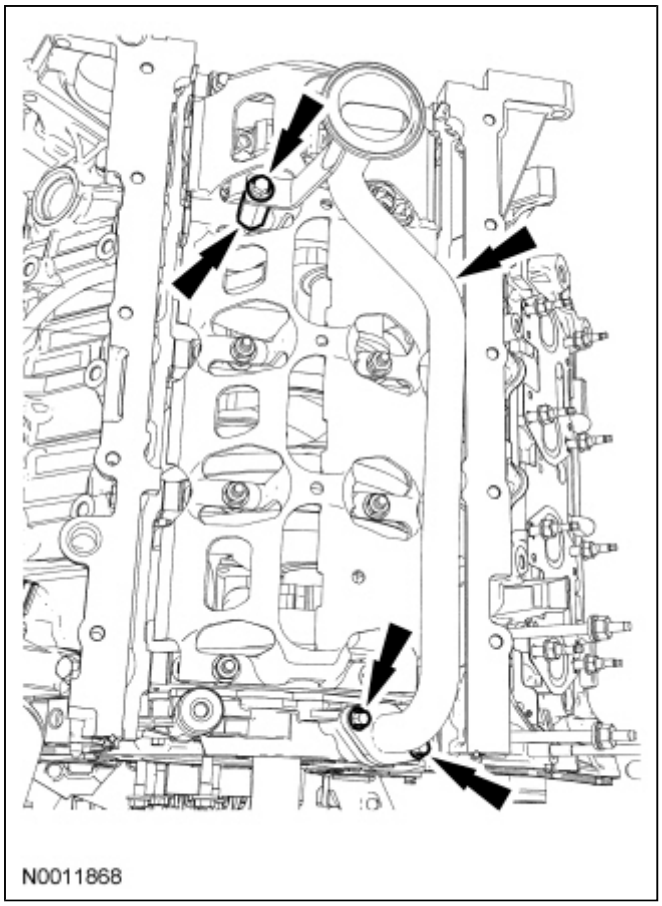
24. Install the windage tray and the 7 nuts.
    - Tighten to 25 Nm (18 lb-ft).



25. ***NOTICE:*** **Make sure the O-ring seal is in place and not damaged. A missing or damaged O-ring seal 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 seal. Lubricate the O-ring seal with clean engine oil prior to installation.

    Install the spacer, oil pump screen and pickup tube and the 3 bolts.
    - Tighten the spacer and the oil pump screen and pickup tube-to-spacer bolt to 25 Nm (18 lb-ft).
    - Tighten the oil pump screen and pickup tube-to-oil pump bolts to 10 Nm (89 lb-in).



26. ***NOTICE:*** **Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow these instructions may result in engine damage.**

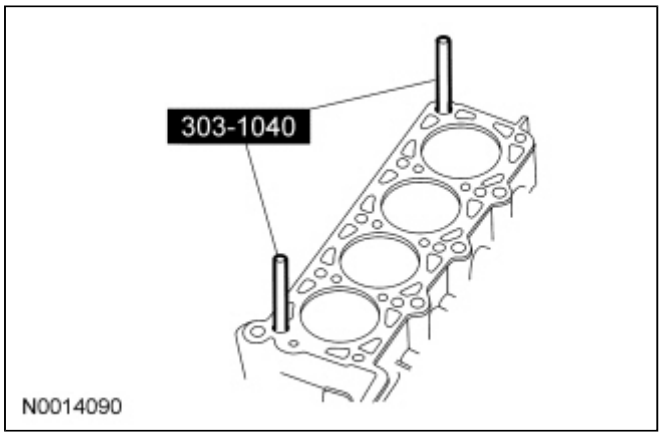
    NOTICE: **The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry. Failure to follow these instructions may result in future oil leakage.**

    NOTICE: **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.

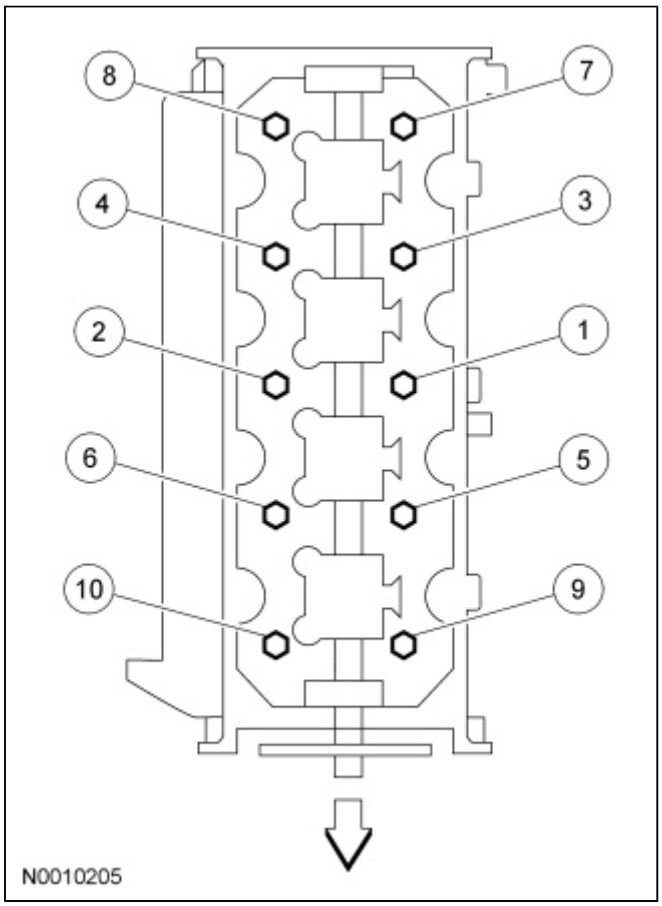
    Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the 20 cylinder head bolts loosely.



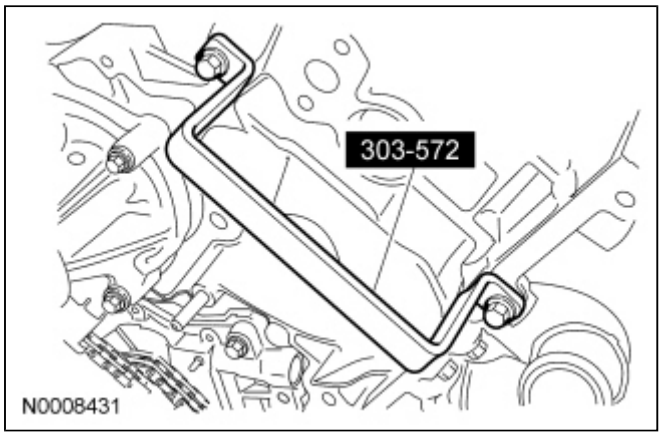
27. **NOTE:** LH shown, RH similar.

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

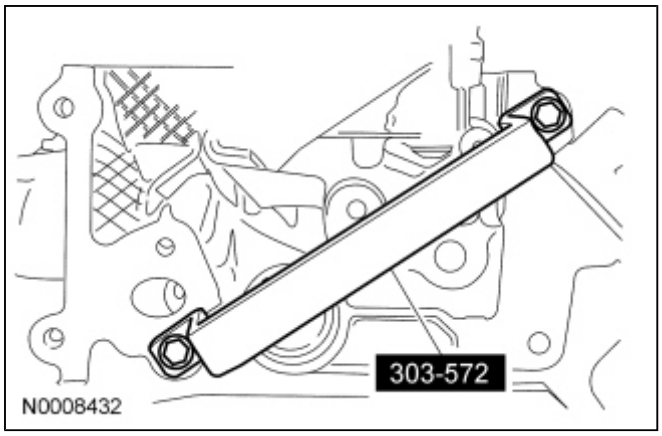
- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Tighten an additional 90 degrees.



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

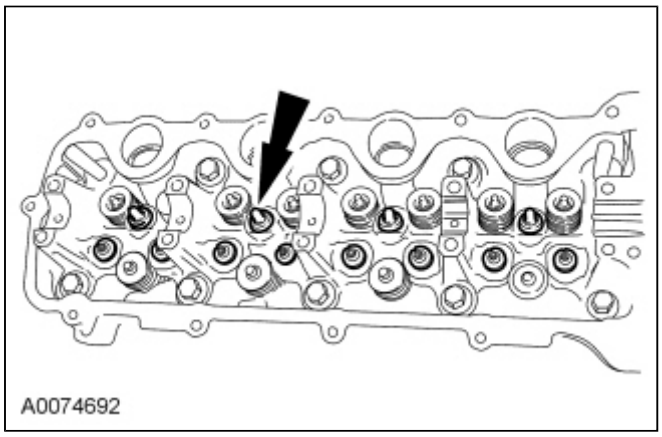


29. Remove the Cylinder Head Remover/Installer from the RH cylinder head.



30. **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.



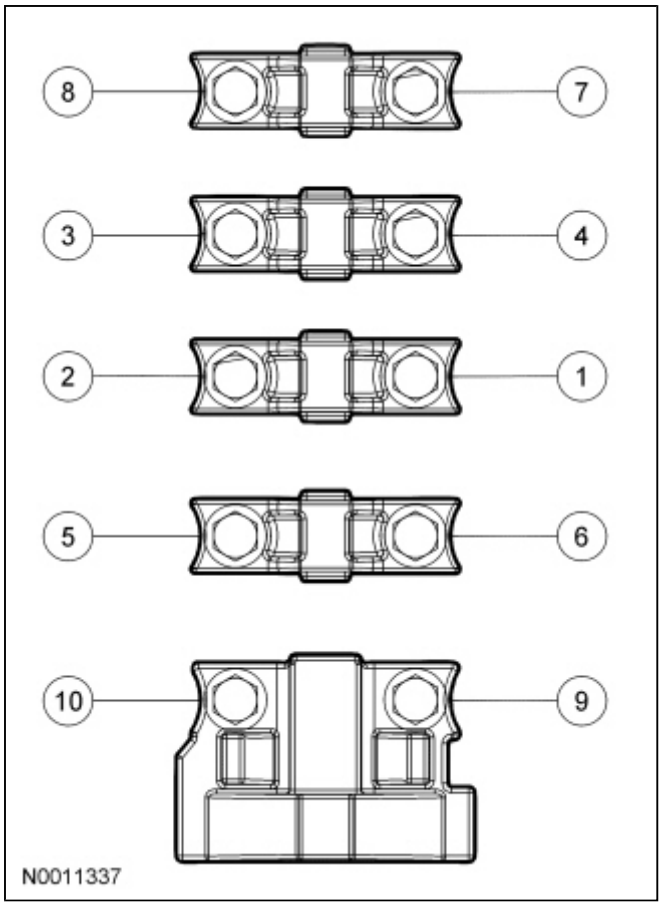
31. **NOTE:** Lubricate the camshaft and camshaft journals with clean engine oil prior to installation.

    Install the LH and RH camshafts.

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

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

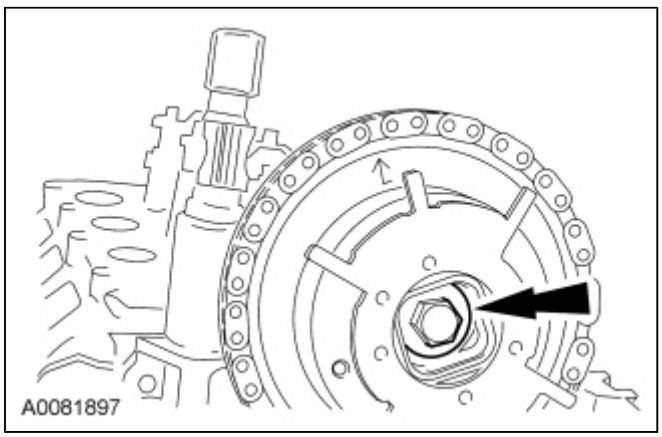
    Install the LH and RH camshaft bearing caps in their original locations.
    - Position the front camshaft bearing cap.
    - Position the remaining camshaft bearing caps.
    - Install the bolts loosely.
    - Tighten to 10 Nm (89 lb-in) in the sequence shown.



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

    NOTE: LH shown, RH similar.

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

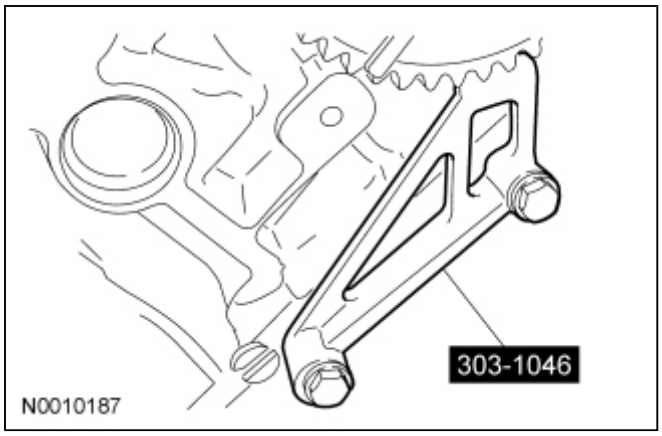


34. ***NOTICE:*** **Damage to the camshaft phaser sprocket assembly will occur if mishandled or used as a lifting or leveraging device.**

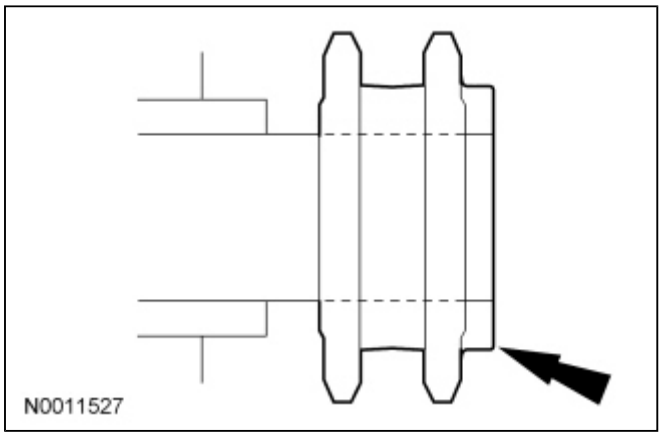
    NOTICE: **Only use hand tools to remove the camshaft phaser sprocket assembly or damage may occur to the camshaft or camshaft phaser unit.**

    NOTE: LH shown, RH similar.

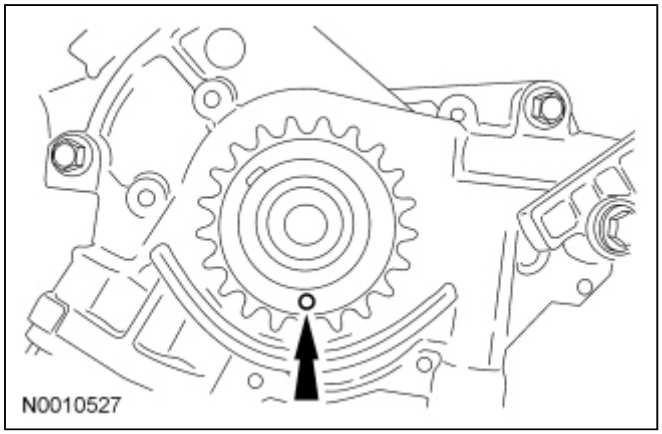
    Using the Camshaft Phaser Locking Tool, tighten the LH and RH camshaft phaser sprocket bolts in 2 stages.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



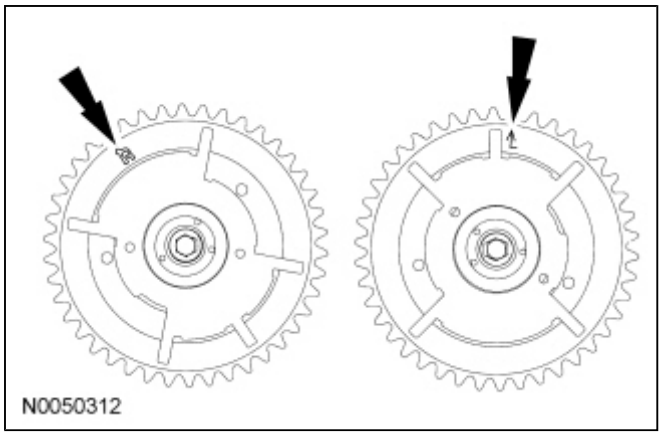
35. Install the crankshaft sprocket, making sure the flange faces forward.



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



37. 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.

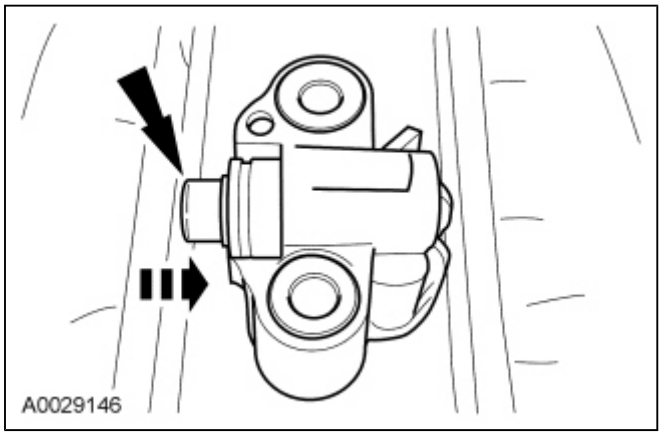


38. ***NOTICE:*** **If one or both of the tensioner mounting bolts are loosened or removed, the tensioner-sealing bead must be inspected for seal integrity. If cracks, tears, separation from the tensioner body or permanent compression of the seal bead is observed, install a new tensioner or engine damage may occur.**

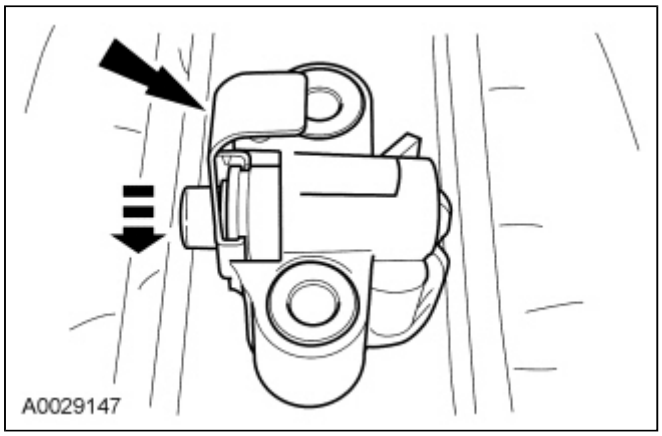
    Inspect the RH and LH timing chain tensioners.
    - Install new tensioners as necessary.

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

    Compress the tensioner plunger, using a vise.

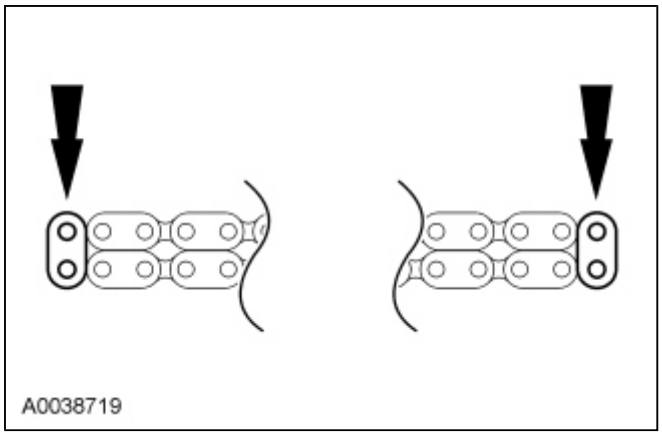


40. Install a retaining clip on the tensioner to hold the plunger in during installation.

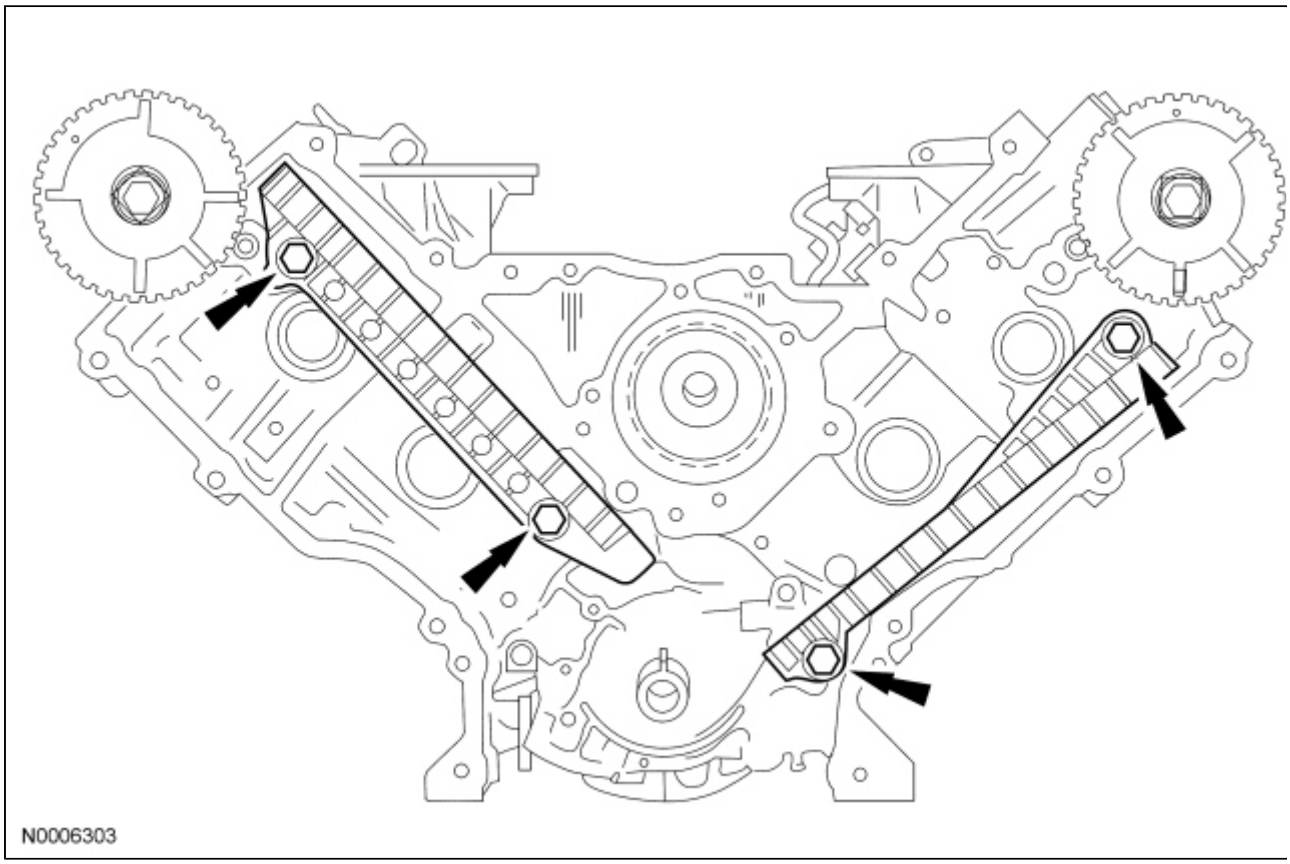


41. Remove the tensioner from the vise.

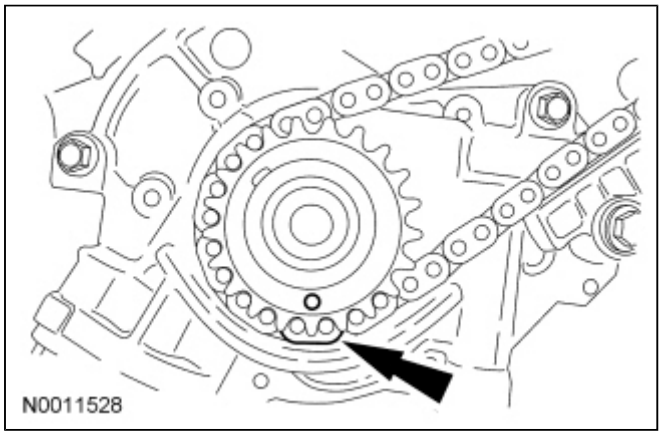
42. If the colored links are not visible, mark one link on one end and one link on the other end and use as timing marks.



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

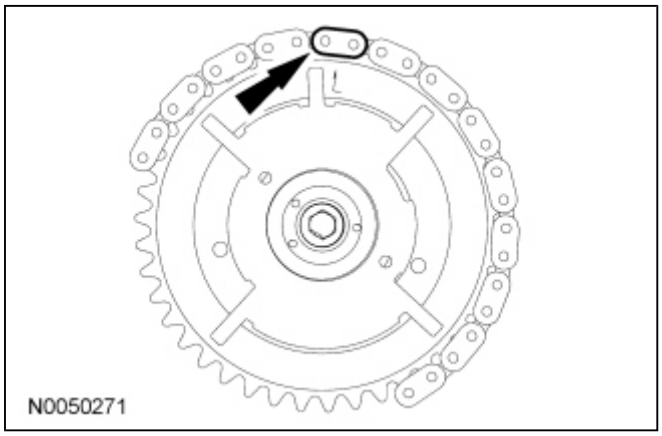


44. Position the lower end of the LH (inner) timing chain on the crankshaft sprocket, aligning the timing mark on the outer flange of the crankshaft sprocket with the single colored (marked) link on the chain.



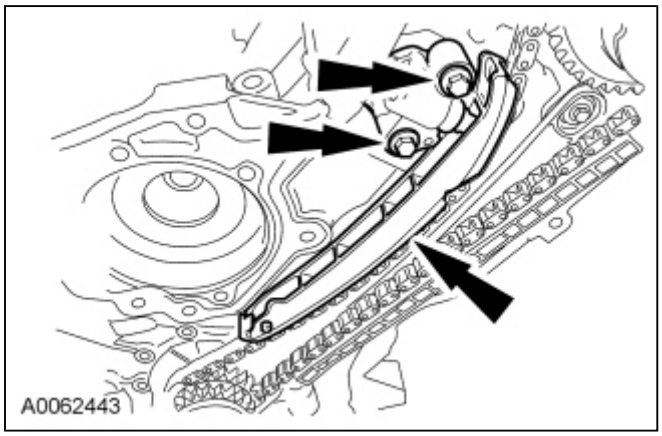
45. **NOTE:** Make sure the upper half of the timing chain is below the tensioner arm dowel.

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

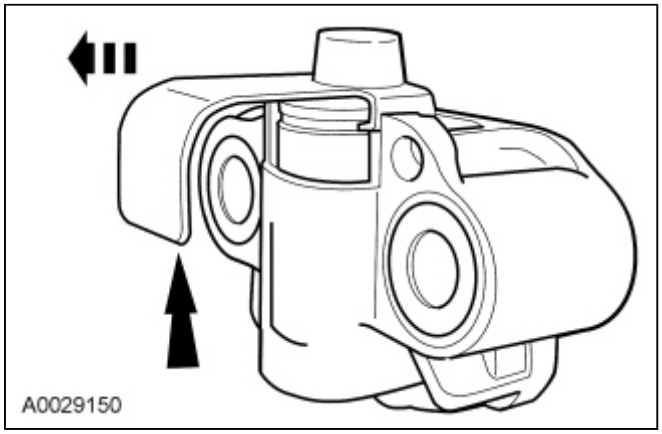


46. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

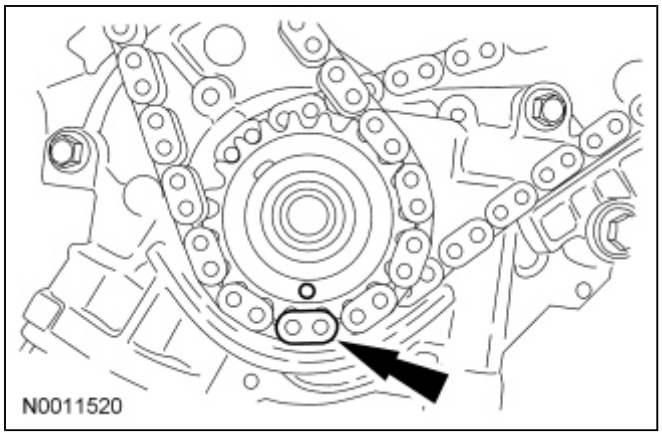
    Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner and 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).



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



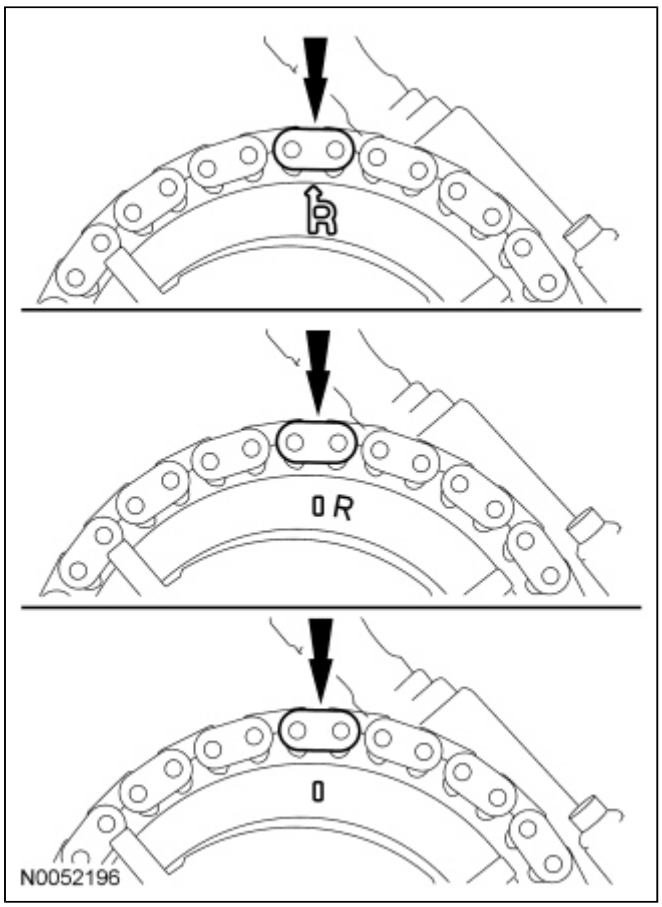
48. Position the lower end of the RH (outer) timing chain on the crankshaft sprocket, aligning the timing mark on the sprocket with the single colored (marked) chain link.



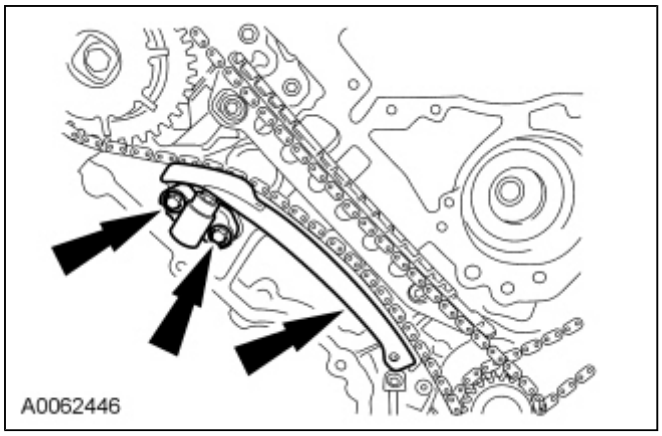
49. **NOTE:** The camshaft phaser and sprocket will be stamped with one of the illustrated timing marks for the RH camshaft.

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

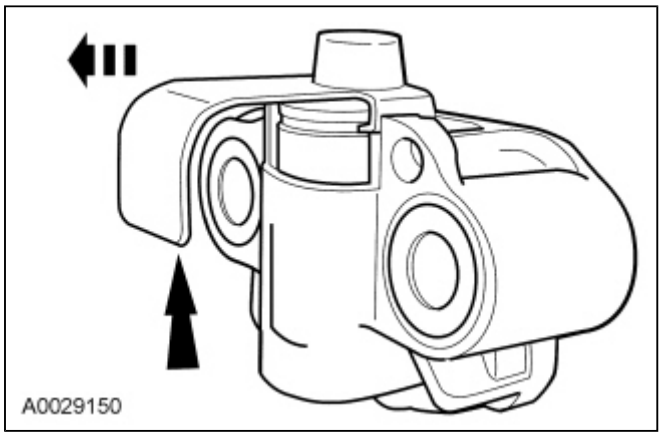
    Position the RH timing chain on the camshaft sprocket. Make sure the camshaft sprocket timing mark is aligned with the colored (marked) chain link.



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

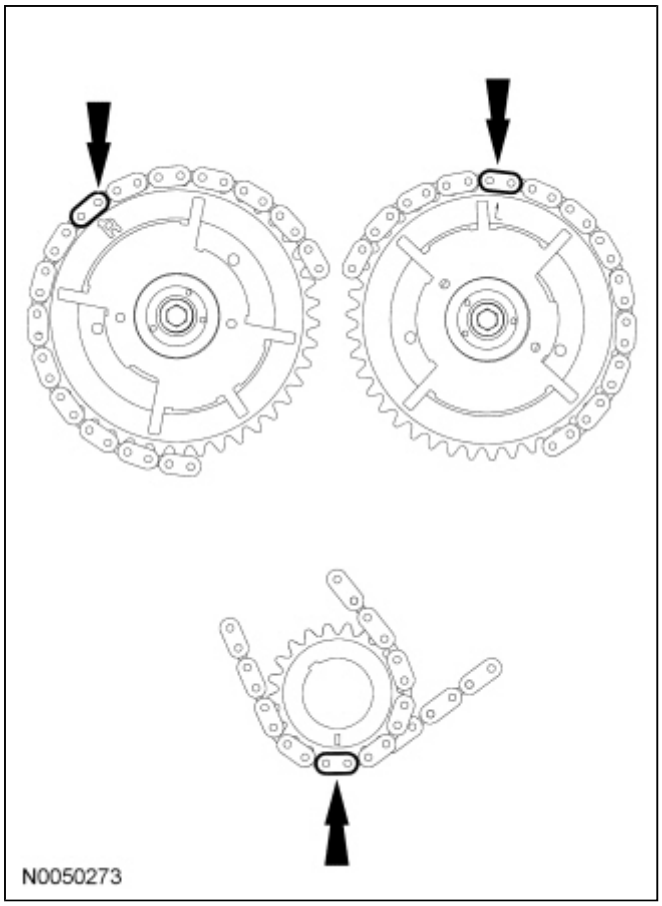


51. Remove the retaining clip from the RH timing chain tensioner.

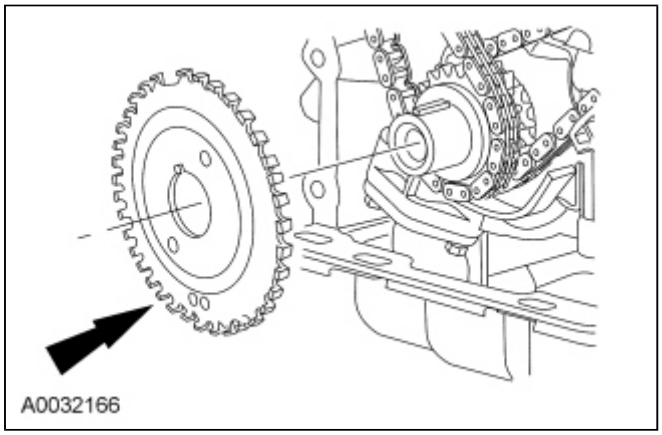


52. **NOTE:** The RH and LH camshaft phaser sprockets are similar. Refer to the single timing mark to identify the RH camshaft phaser sprocket and the L timing mark to identify the LH camshaft phaser sprocket.

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



53. Install the crankshaft sensor ring on the crankshaft.



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

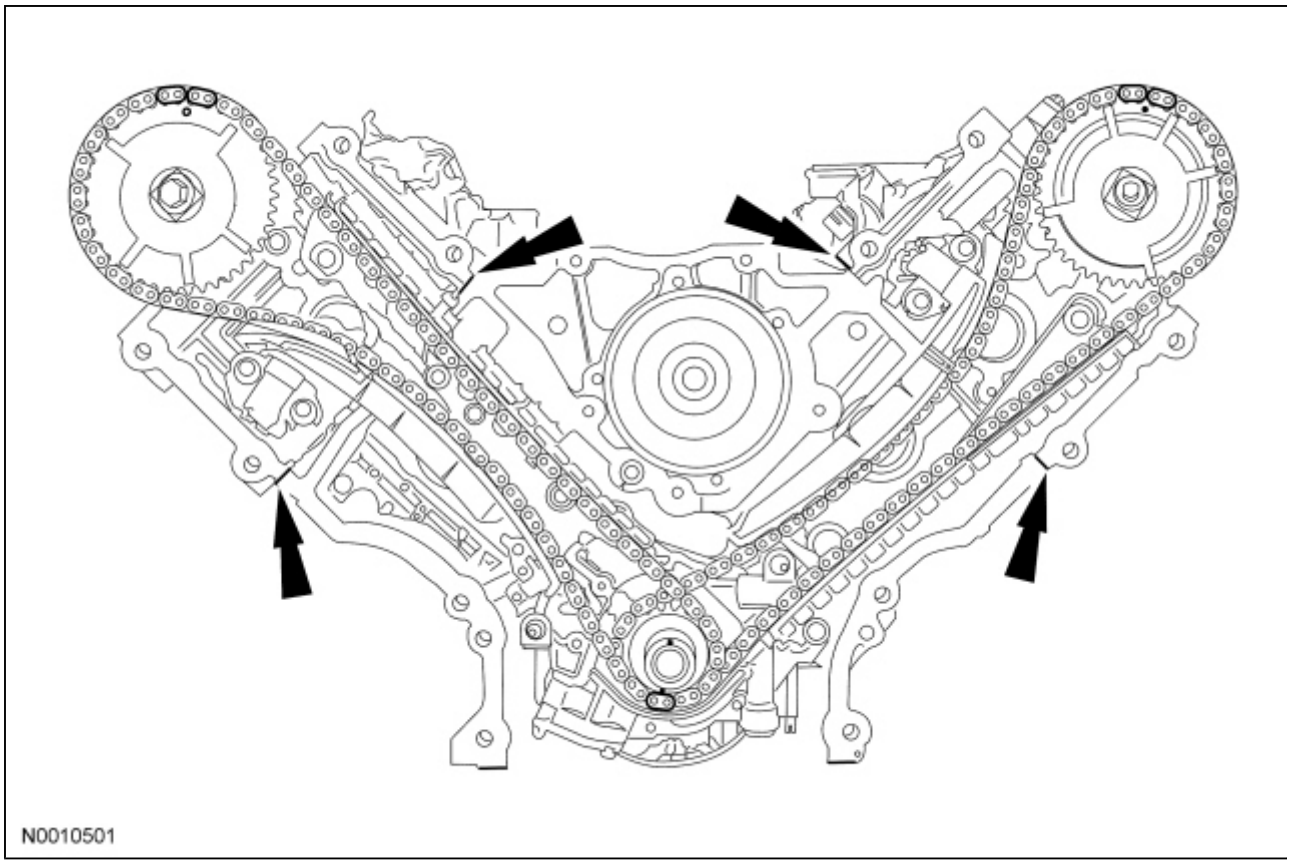
    Using the Valve Spring Compressor, install all of the camshaft roller followers.

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

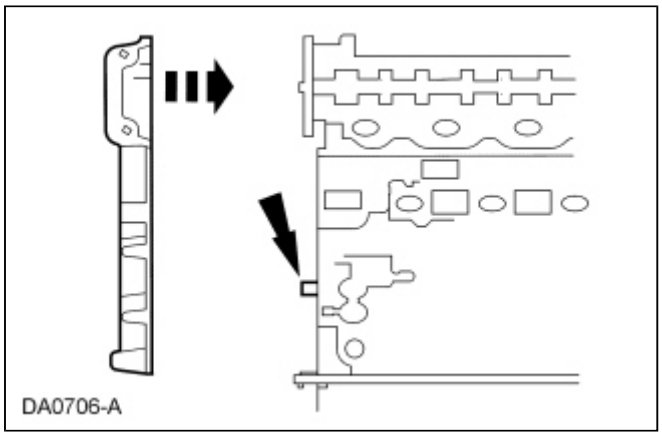
    NOTE: If the engine front cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

    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.



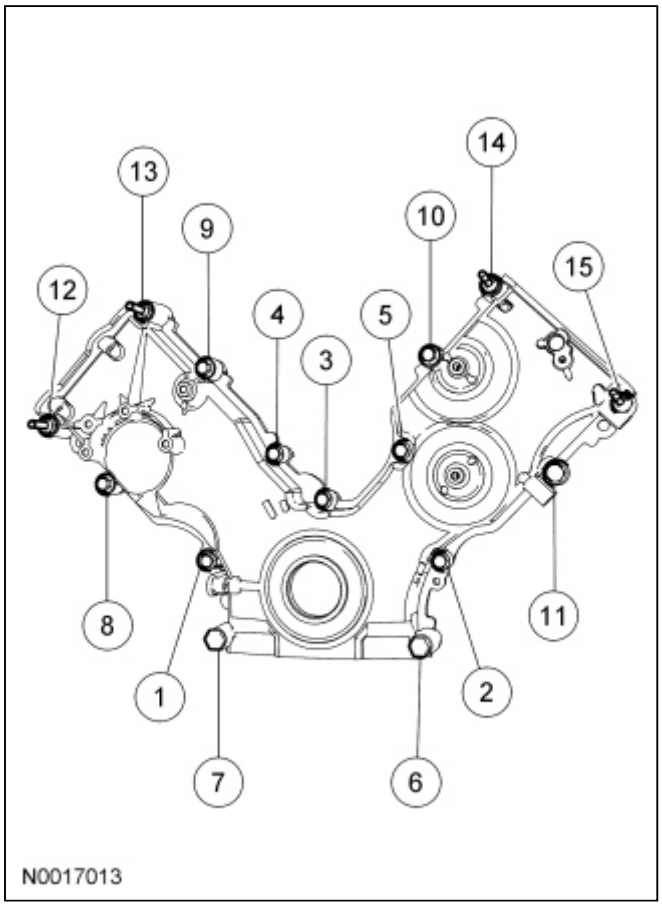
56. Install a new engine front cover gasket on the engine front cover. Position the engine front cover onto the dowels. Install the 15 fasteners finger-tight.



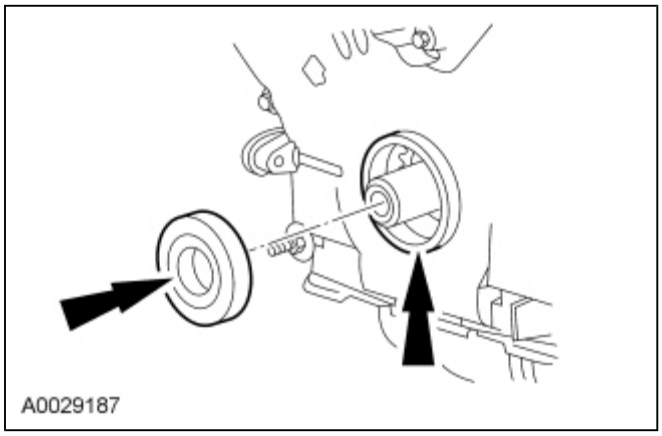
57. Tighten the 15 engine front cover fasteners in the sequence shown to 25 Nm (18 lb-ft).

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	N808586	Stud and Washer, Hex Head Pilot, M8 x 1.25 - M6 x 1 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

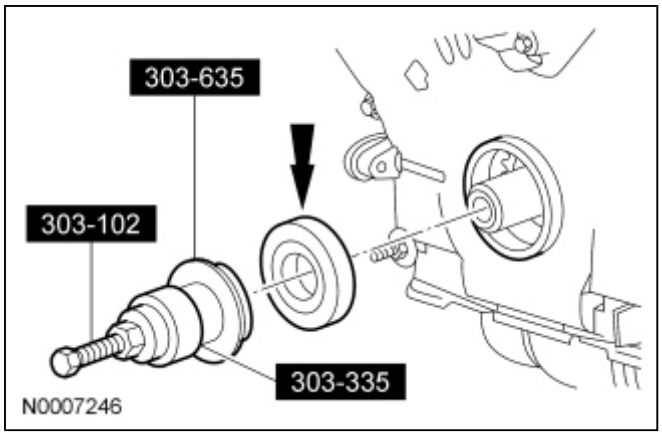
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
12	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1
13	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806300	Stud, Hex Shoulder Pilot, M8 x 1.25 x 1.25 x 91.1



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

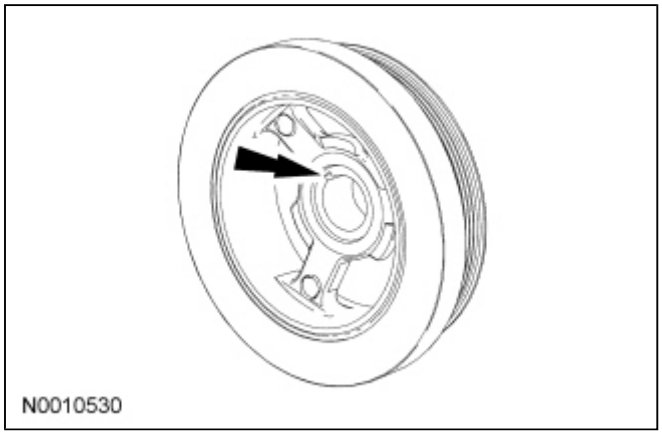


59. Using the Crankshaft Vibration Damper Installer, Crankshaft Front Oil Seal Installer and the Front Cover Oil Seal Installer, install the crankshaft front oil seal into the engine front cover.

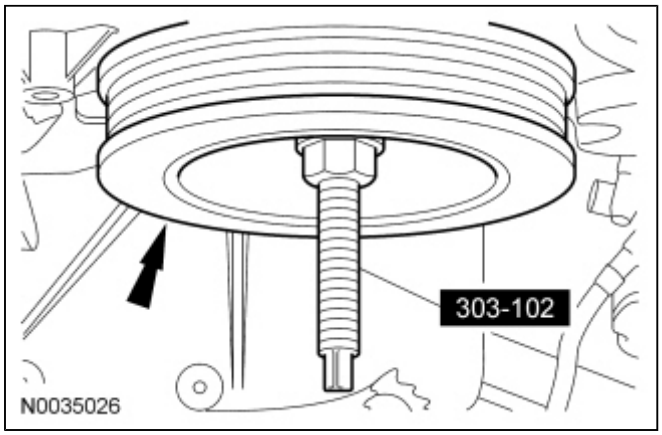


60. **NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

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



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

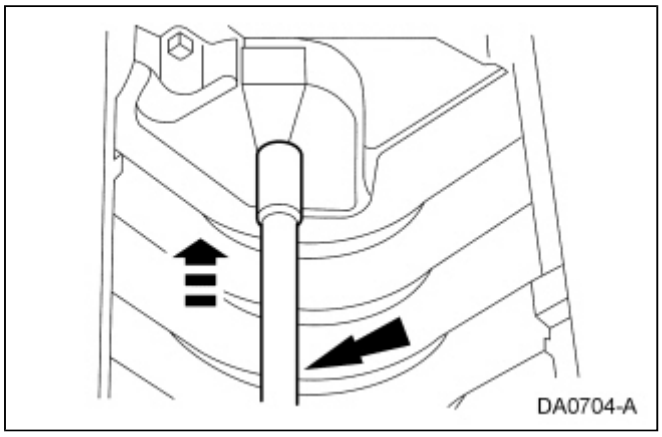


62. Using a new crankshaft pulley bolt, install the bolt and washer and tighten the bolt in 4 stages.
    - Stage 1: Tighten to 90 Nm (66 lb-ft).
    - Stage 2: Loosen 360 degrees.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

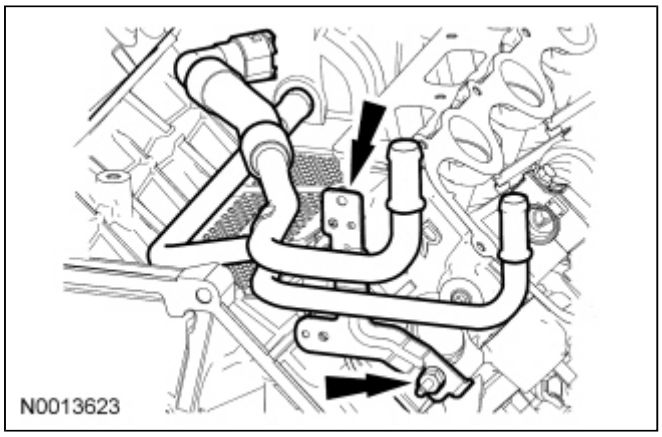
63. **NOTE:** Do not reuse the O-ring seals.

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

Slide the coolant tube forward with the new O-ring seals into the cylinder block.



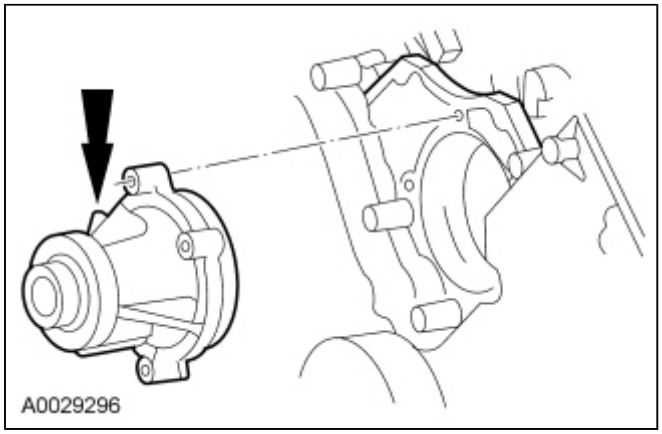
64. Install the coolant tube stud bolt.
    - Tighten to 10 Nm (89 lb-in).



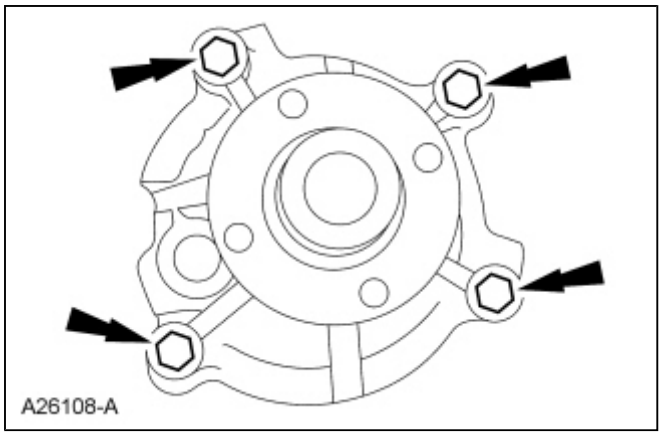
65. ***NOTICE:*** **Do not rotate the coolant pump housing once the coolant pump housing has been positioned in the cylinder block. Damage to the O-ring seal will occur.**

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

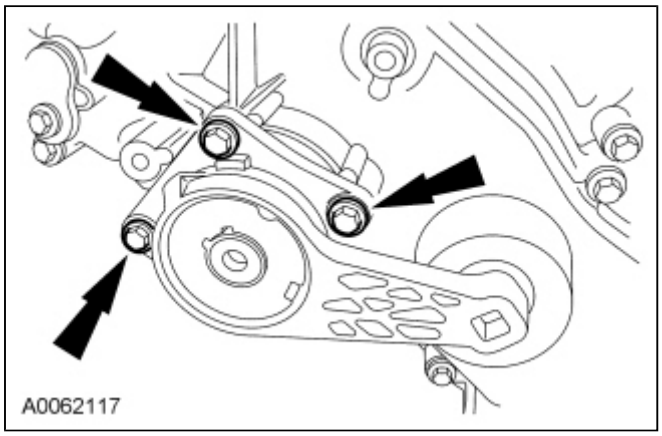
    Position the coolant pump and install the 4 bolts loosely.



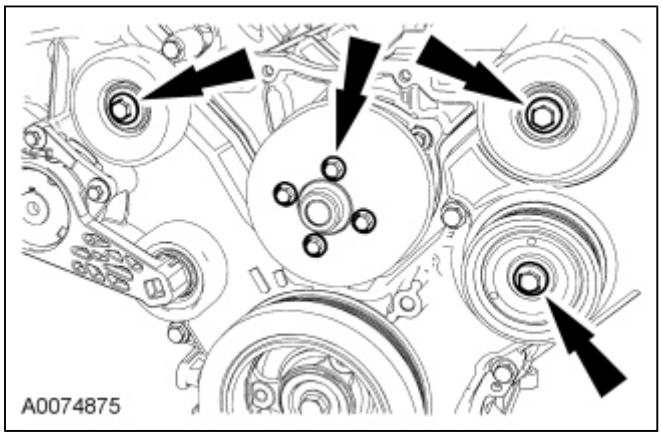
66. Tighten the 4 coolant pump bolts.
    - Tighten to 25 Nm (18 lb-ft).



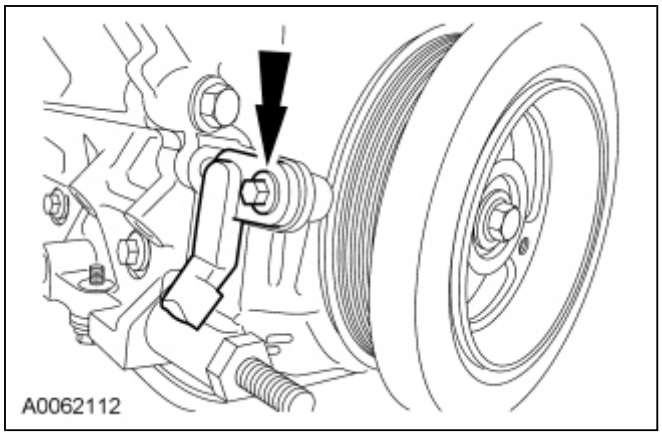
67. Position the accessory drive belt tensioner and install the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).



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

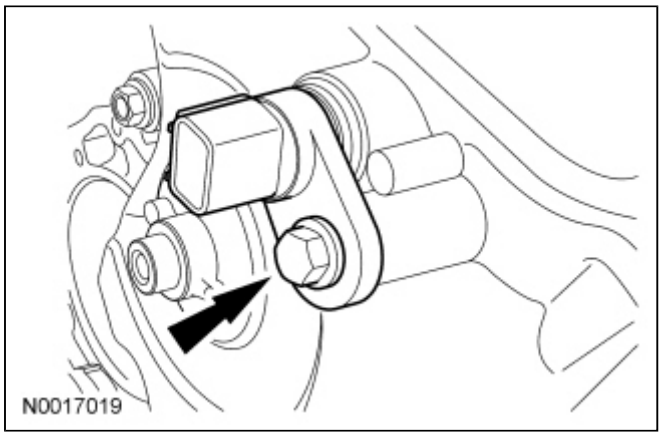


69. Install the Crankshaft Position (CKP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).



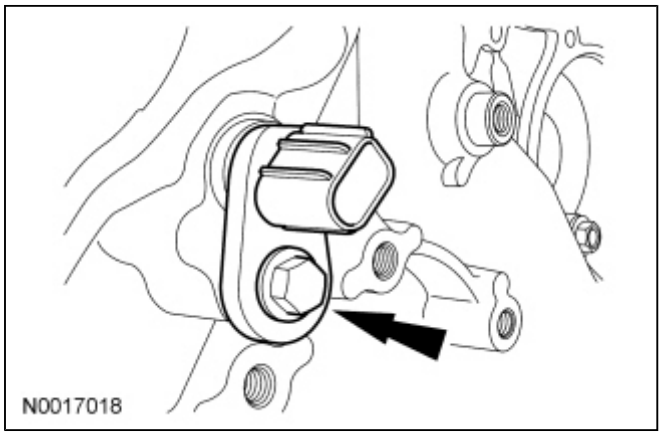
70. **NOTE:** Lubricate the new O-ring seal with clean engine oil prior to installation.

    Install the LH Camshaft Position (CMP) sensor and the bolt.
    - Tighten to 10 Nm (89 lb-in).

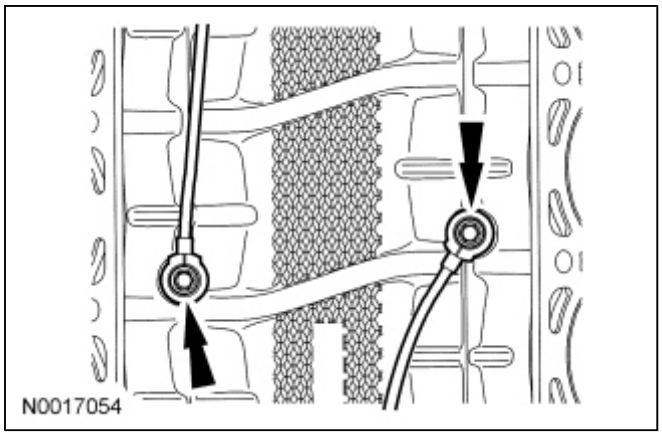


71. **NOTE:** Lubricate the new O-ring seal with clean engine oil prior to installation.

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



72. Install the Knock Sensor (KS) and the bolts.
    - Tighten to 20 Nm (177 lb-in).

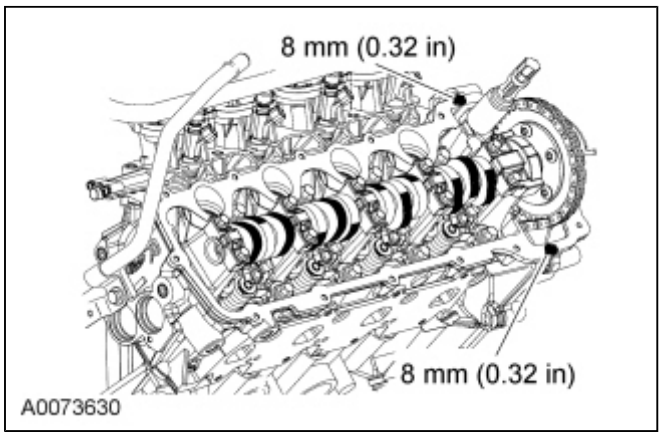


73. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

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

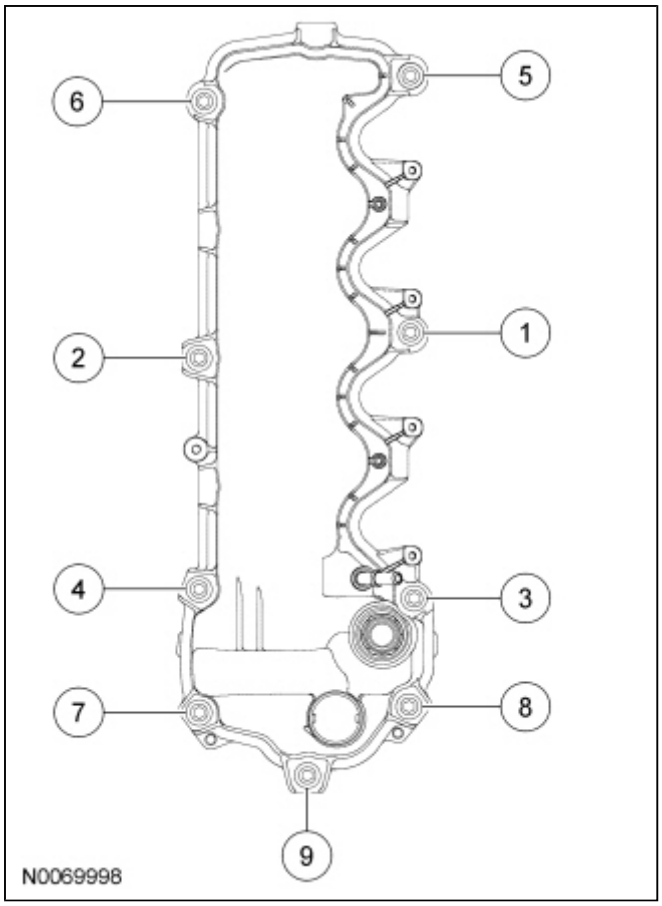
74. **NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

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



75. ***NOTICE:*** **When installing the valve cover, make sure to avoid damaging the Variable Camshaft Timing (VCT) solenoid.**

    Position the RH valve cover and gasket on the cylinder head and tighten the 9 bolts in the sequence shown.
    - Tighten to 10 Nm (89 lb-in).

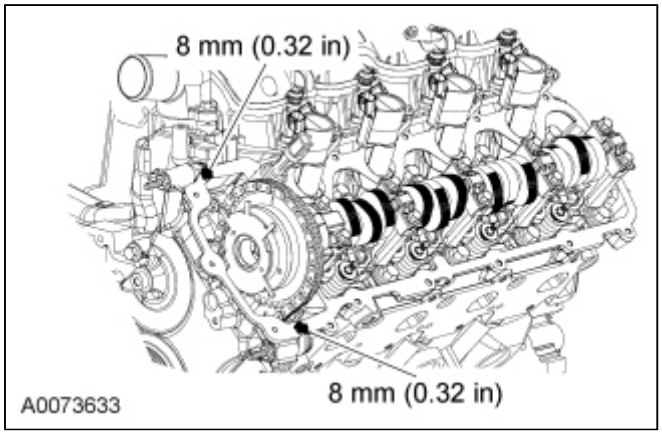


76. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

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

77. **NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

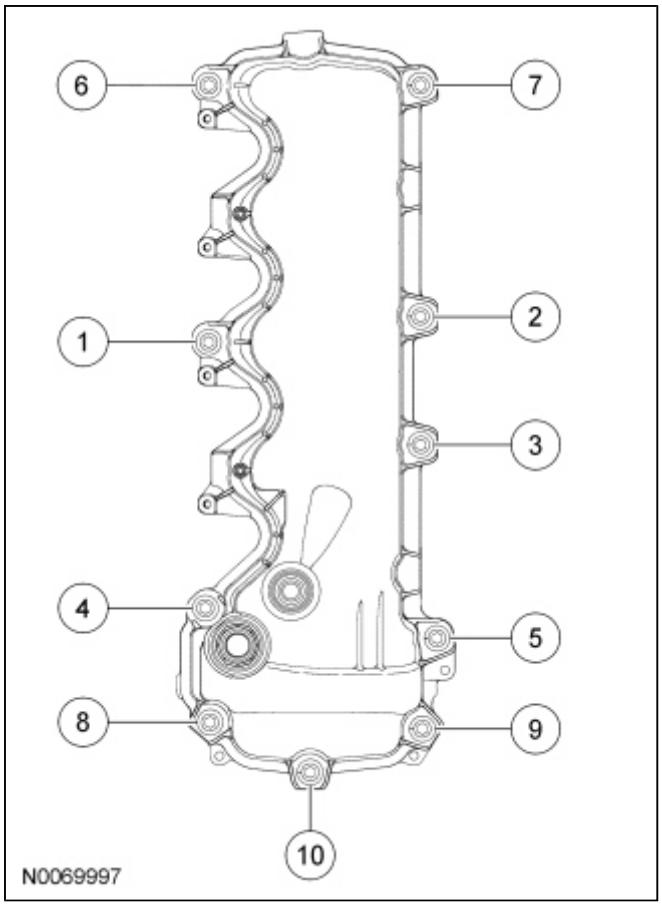
    Apply silicone gasket and sealant in 2 places where the engine front cover meets the cylinder head.



78. ***NOTICE:*** **When installing the valve cover, make sure to avoid damaging the Variable Camshaft Timing (VCT) solenoid.**

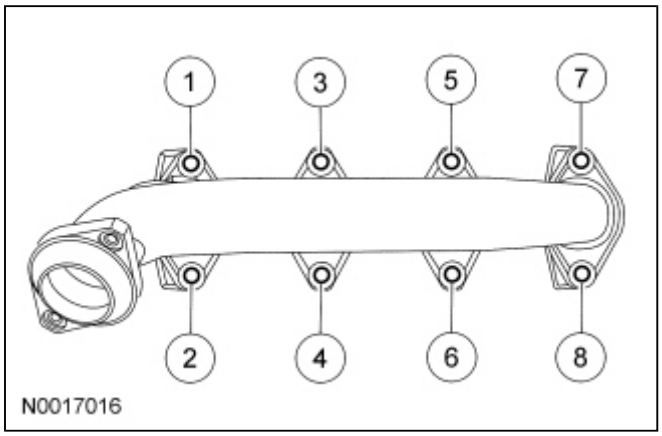
    Position the LH valve cover and gasket on the cylinder head and tighten the 10 bolts in the sequence shown.

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

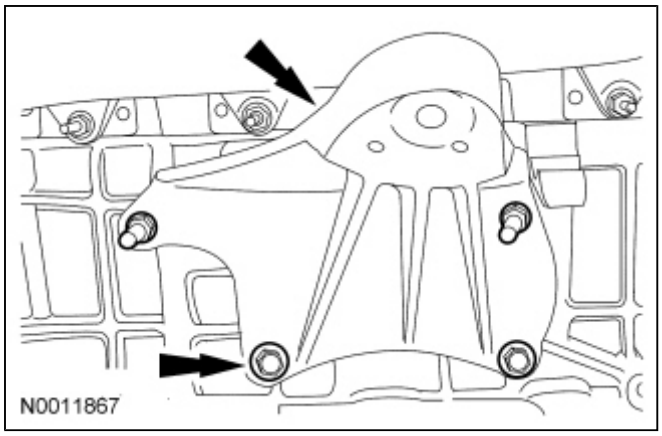


79. Install 8 new RH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

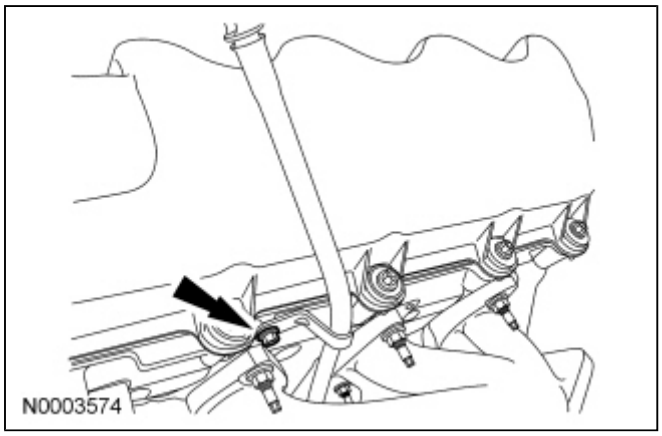
80. Position a new gasket, the RH exhaust manifold and tighten the 8 new nuts in the sequence shown.
    - Tighten to 25 Nm (18 lb-ft).



81. Install the RH motor mount bracket, 2 bolts and 2 stud bolts.
    - Tighten to 55 Nm (41 lb-ft).

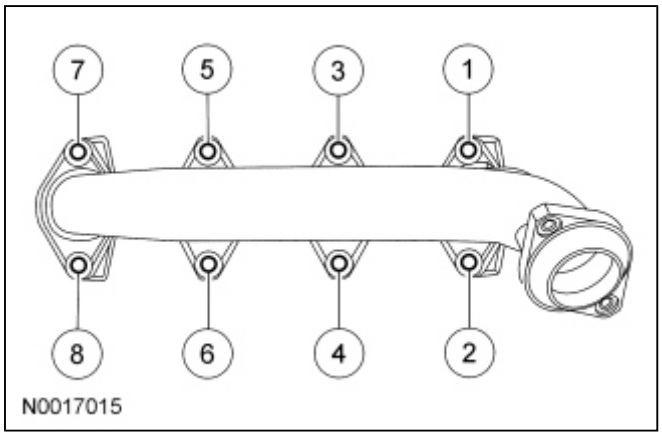


82. Install the oil level indicator tube and the bolt.
    - Install a new O-ring seal and lubricate the O-ring seal with clean engine oil prior to installation.
    - Tighten to 10 Nm (89 lb-in).

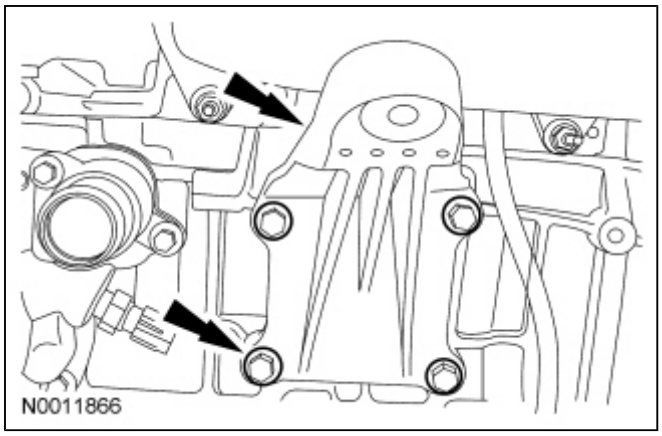


83. Install 8 new LH exhaust manifold studs.
    - Tighten to 12 Nm (106 lb-in).

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



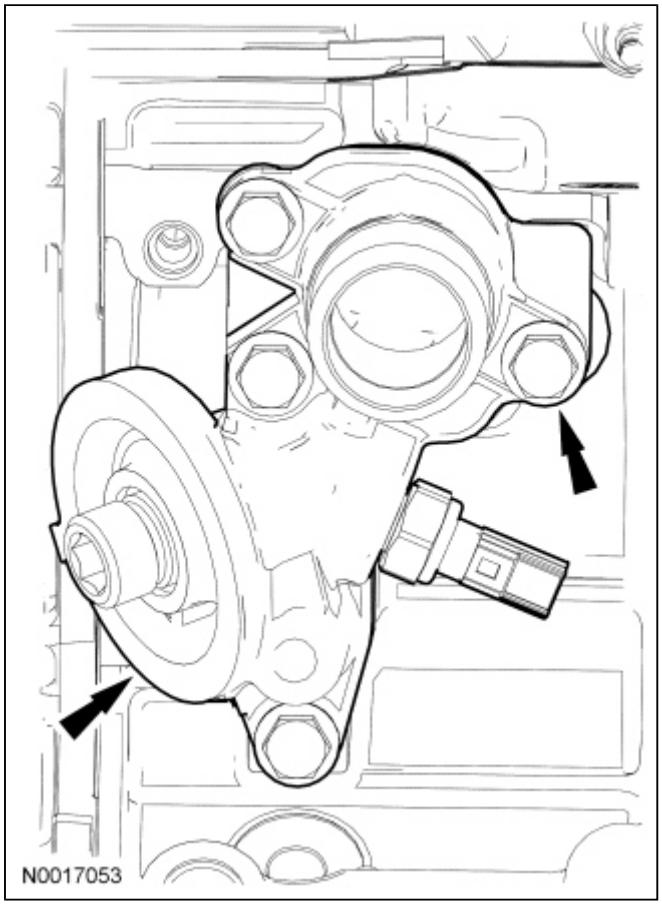
85. Install the LH motor mount bracket and 4 bolts.
    - Tighten to 55 Nm (41 lb-ft).



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

    NOTE: Clean and inspect the mating surfaces and install new gaskets.

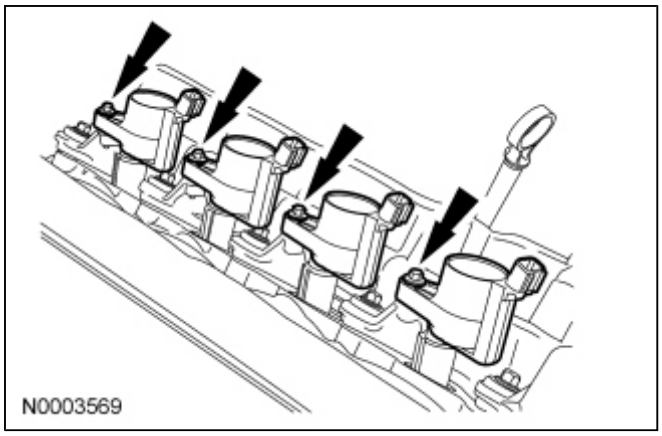
    Position the oil filter adapter and install the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).



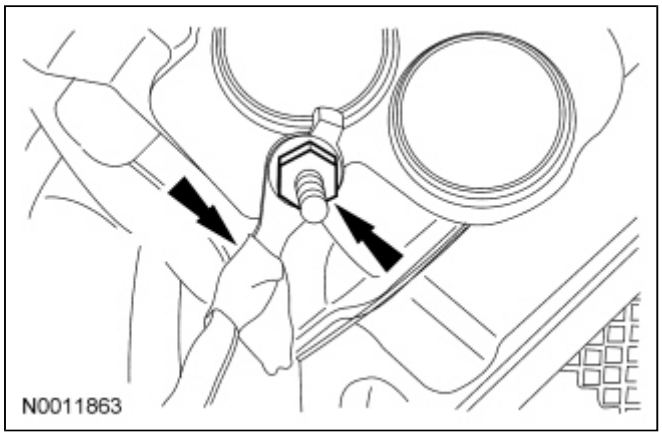
87. Install a new oil filter.

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

    Install the 8 ignition coils and the 8 bolts.
    - Tighten to 6 Nm (53 lb-in).

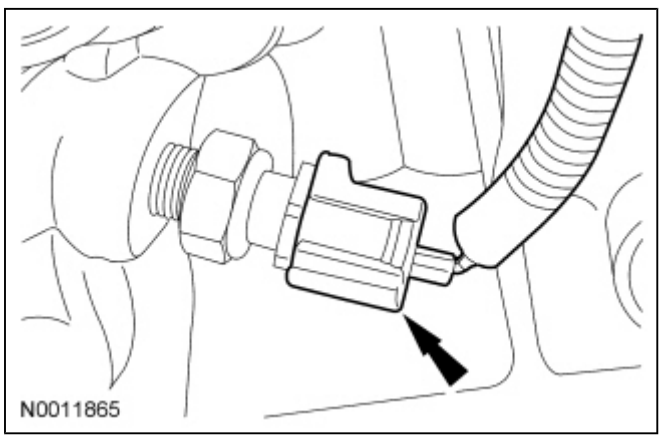


89. Install the ground strap and nut to the stud bolt.
    - Tighten to 10 Nm (89 lb-in).

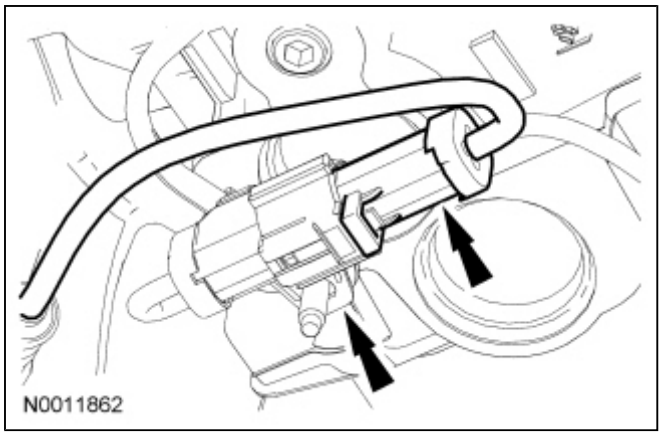


90. Position the engine wiring harness on the engine.

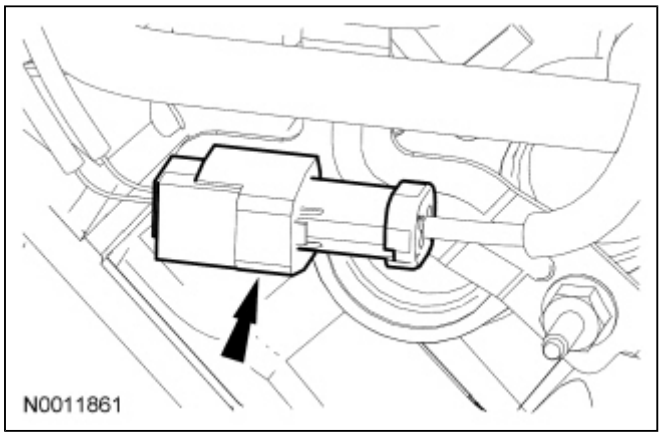
91. Connect the Engine Oil Pressure (EOP) switch electrical connector.



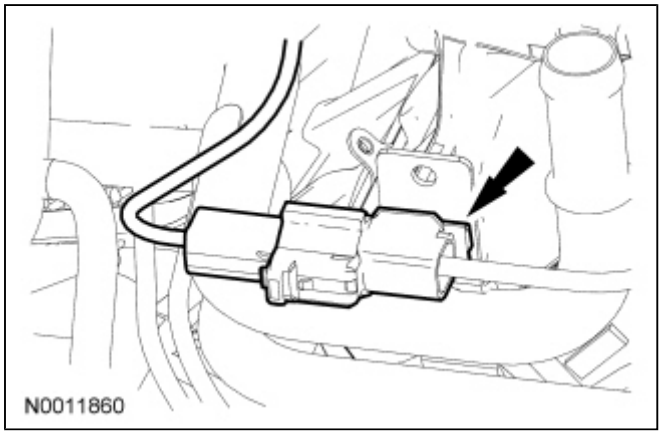
92. Attach the engine wiring harness retainer to the stud bolt.
    - Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.



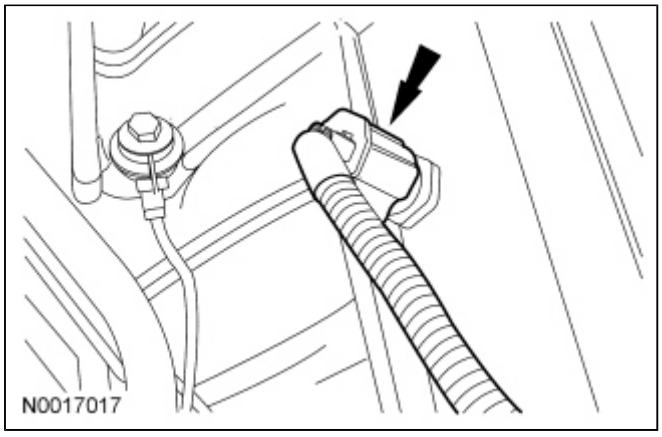
93. Connect the KS electrical connector and pin-type retainer.



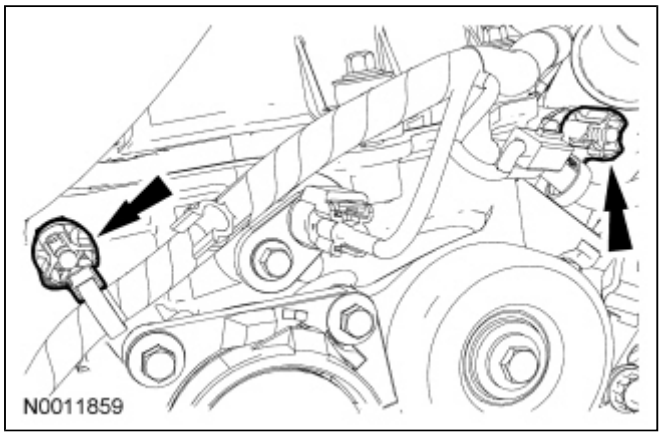
94. Attach the CHT sensor jumper harness electrical connector pin-type retainer.



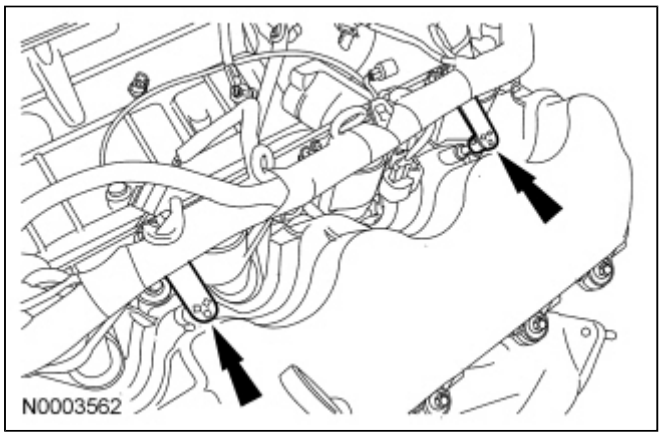
95. Connect the CHT sensor electrical connector.



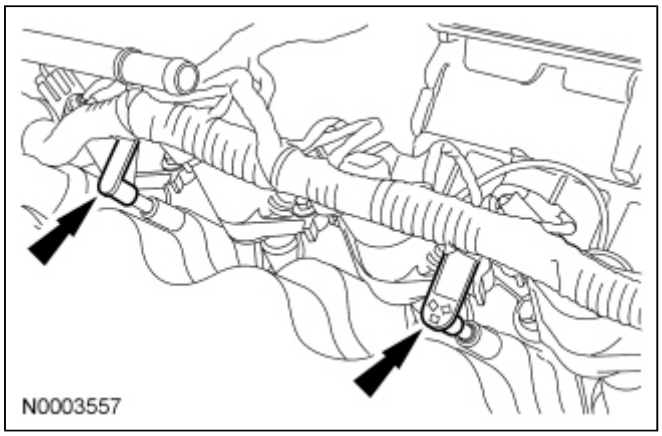
96. Detach the engine wiring harness pin-type retainers.



97. Connect the 2 engine wiring harness retainers to the LH valve cover studs.

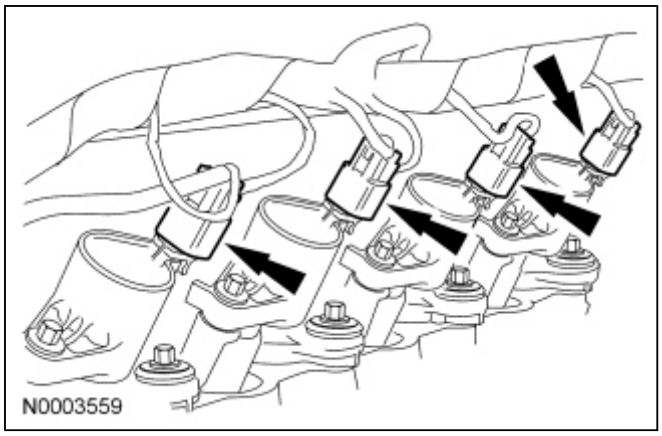


98. Connect the 2 engine wiring harness retainers to the RH valve cover studs.

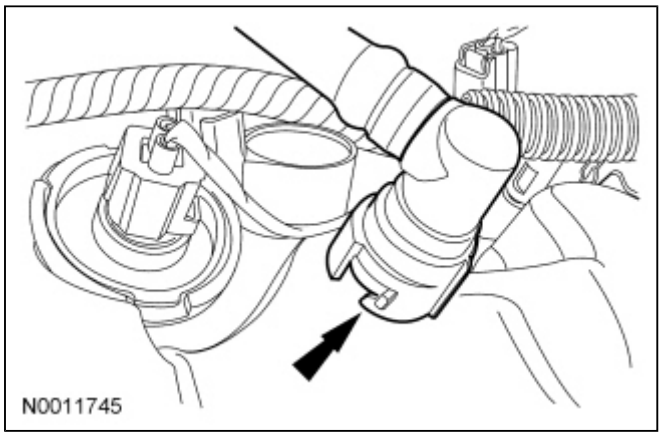


99. **NOTE:** RH shown, LH similar.

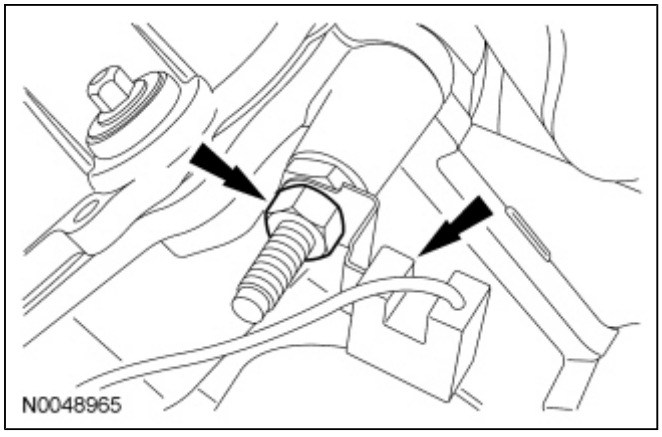
    Connect the 4 RH and 4 LH ignition coil electrical connectors.



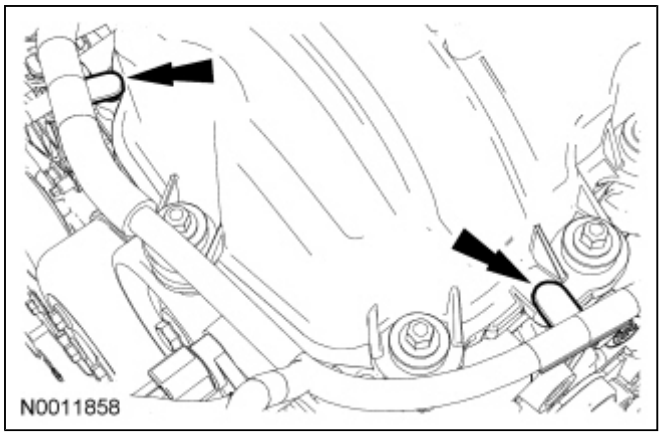
100. Connect the PCV tubes from the RH and LH valve covers.



101. Install the RH radio ignition interference capacitor and nut.
    - Tighten to 25 Nm (18 lb-ft).

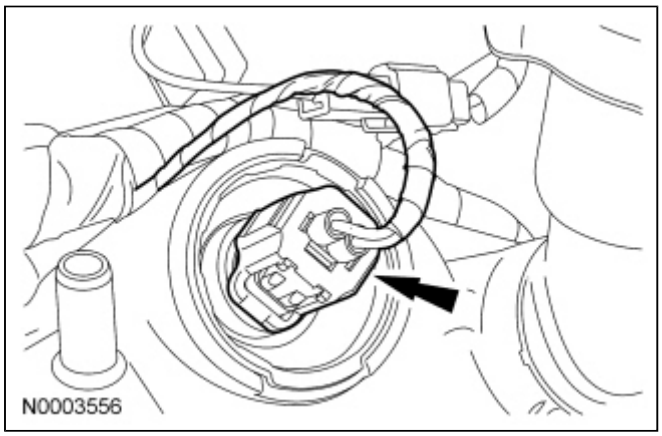


102. Attach the engine wiring harness pin-type retainers.



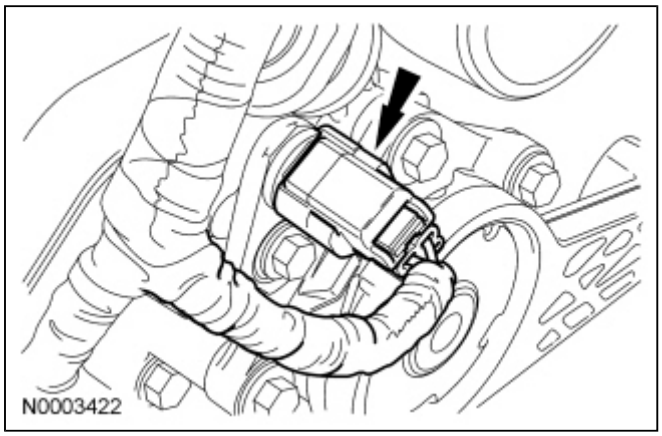
103. **NOTE:** RH shown, LH similar.

Connect the RH and LH Variable Camshaft Timing (VCT) solenoid electrical connectors.

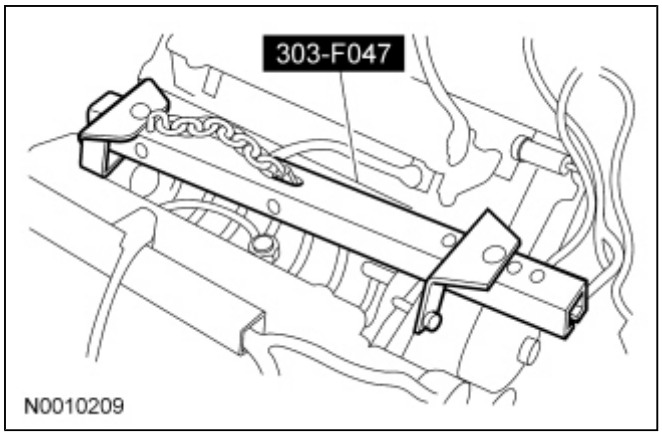


104. **NOTE:** RH shown, LH similar.

Connect the RH and LH CMP sensor electrical connectors.



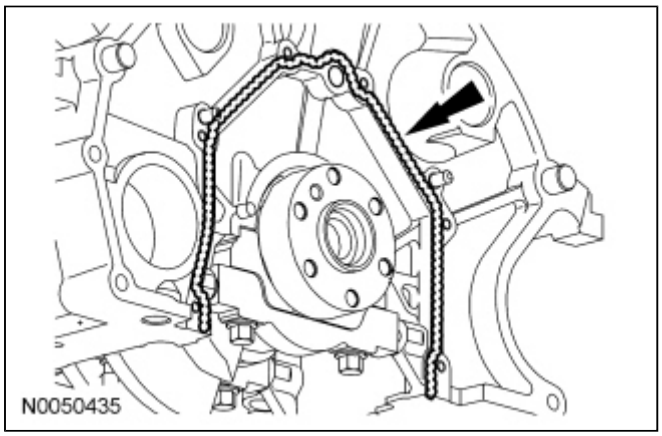
105. Install the Engine Lifting Bracket.



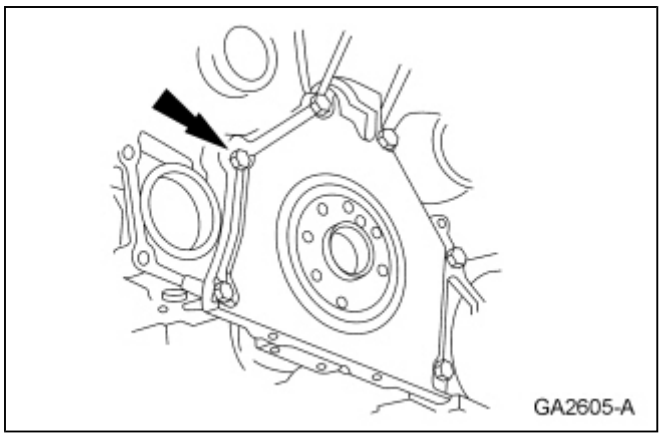
106. Using a suitable floor crane, remove the engine from the engine stand.

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

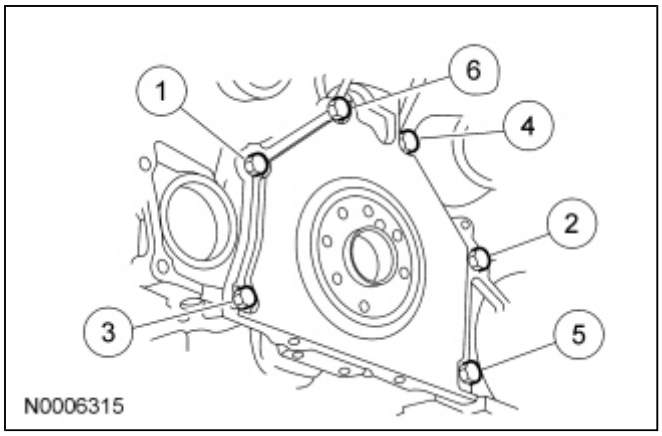
Apply a bead of gasket maker to the rear crankshaft seal retainer mating surface on the engine block.



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



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

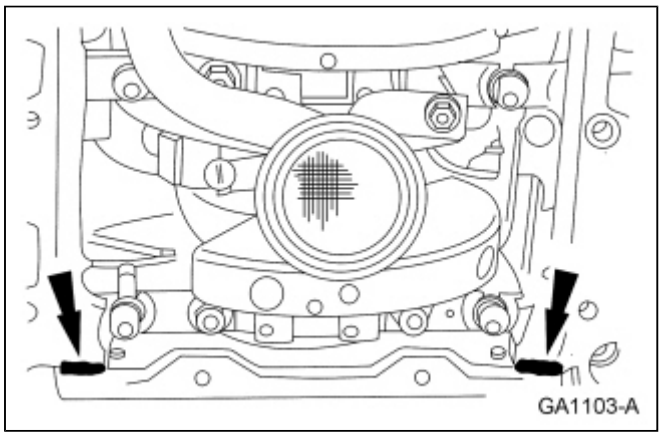


110. ***NOTICE:*** **Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

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.

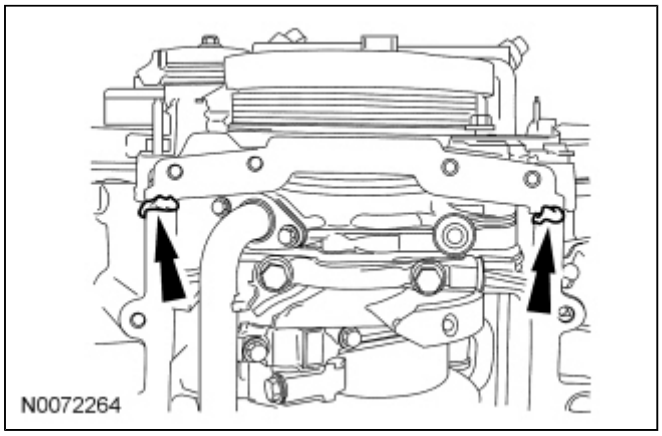
111. **NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

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

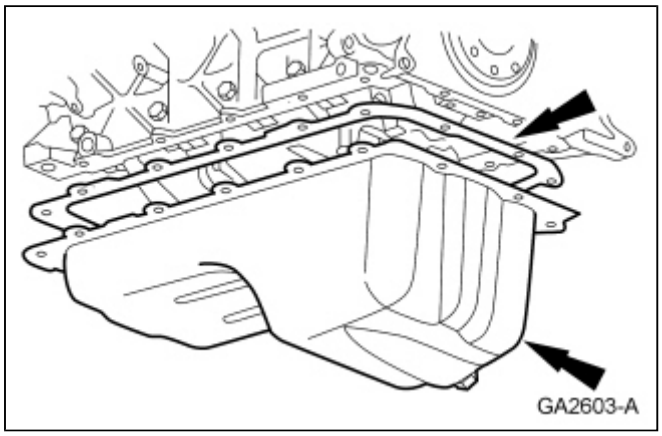


112. **NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

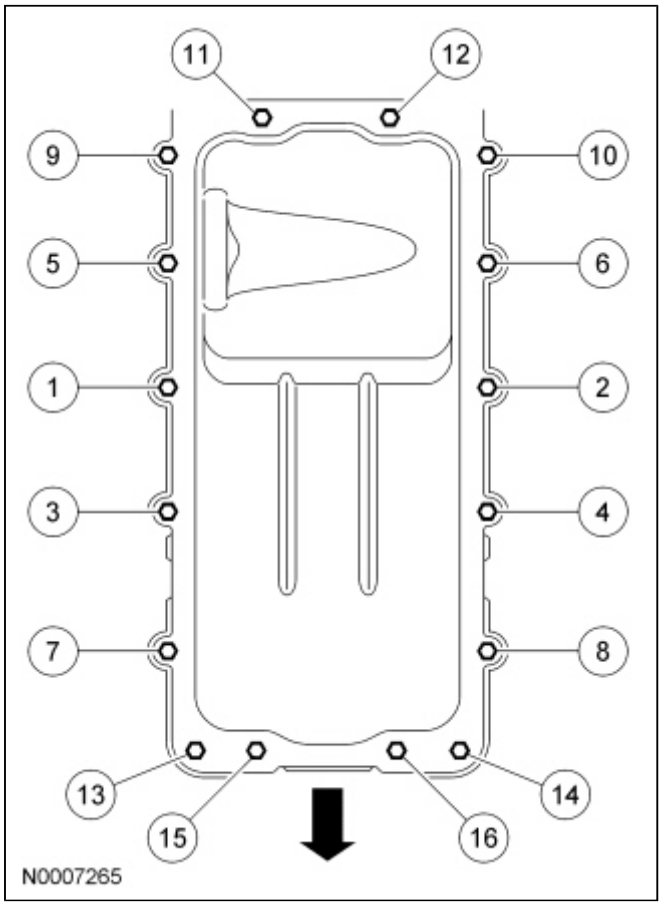
Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing surface.



113. Install the new oil pan gasket and the oil pan and loosely install the 16 bolts.

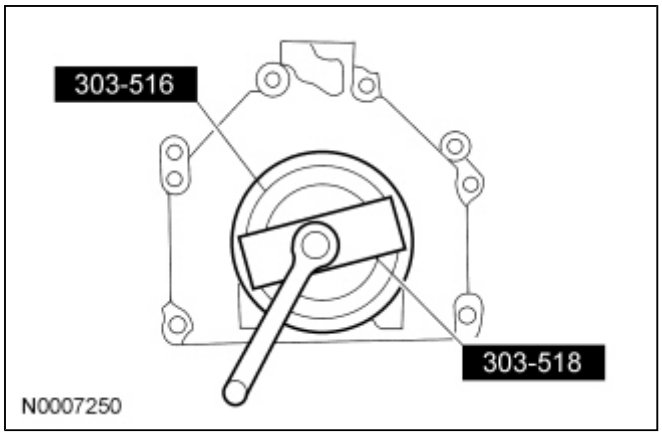


114. Tighten the 16 bolts in 3 stages, in the sequence shown.
    - Stage 1: Tighten to 2 Nm (18 lb-in).
    - Stage 2: Tighten to 20 Nm (177 lb-in).
    - Stage 3: Tighten an additional 60 degrees.

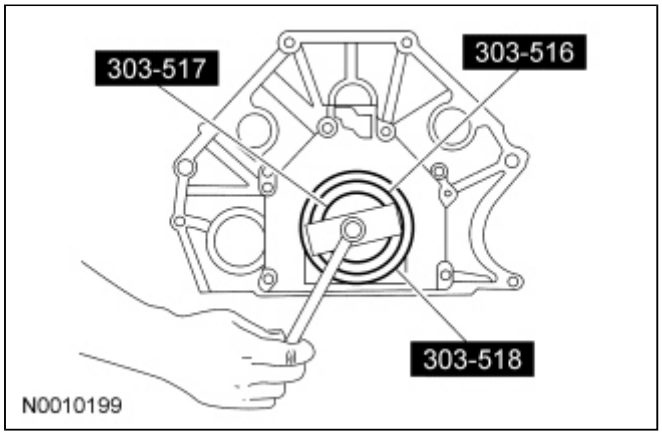


115. **NOTE:** Lubricate the inner lip of the crankshaft rear seal with clean engine oil.

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

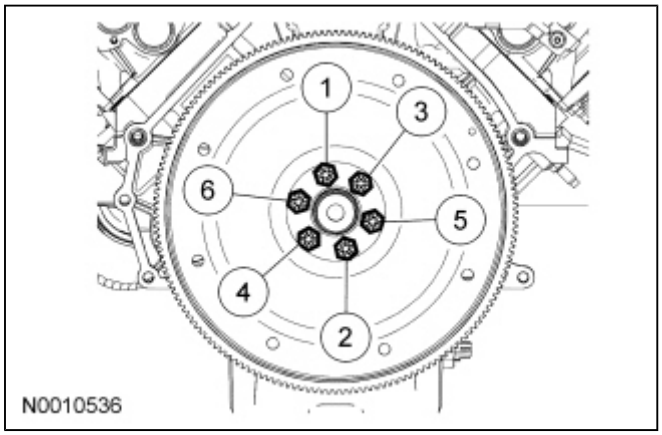


116. Using the Crankshaft Rear Oil Slinger Installer and the Crankshaft Rear Oil Seal Installers, install a new crankshaft rear oil slinger.



Vehicles with automatic transmission

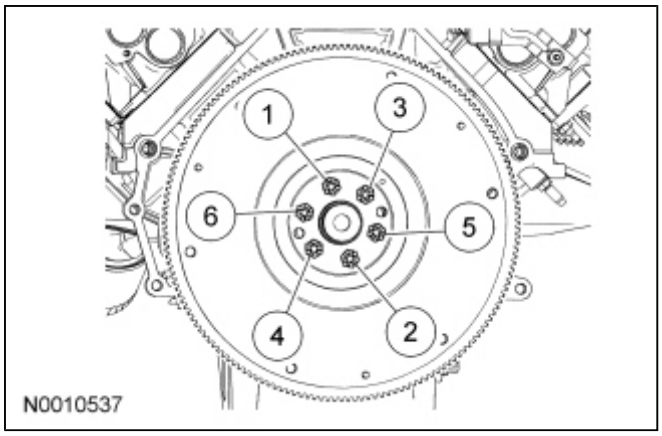
117. Install the flexplate and the 6 bolts in the sequence shown.
    - Tighten to 80 Nm (59 lb-ft).



Vehicles with manual transmission

118. Position the flywheel on the crankshaft pilot and start the 6 flywheel bolts.

119. Tighten the flywheel bolts evenly in the sequence shown to fully seat the flywheel on the crankshaft pilot.
    - Tighten to 80 Nm (59 lb-ft).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