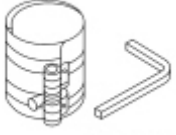



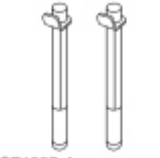
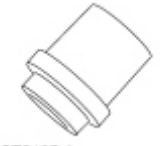




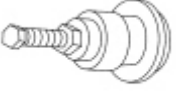





Engine

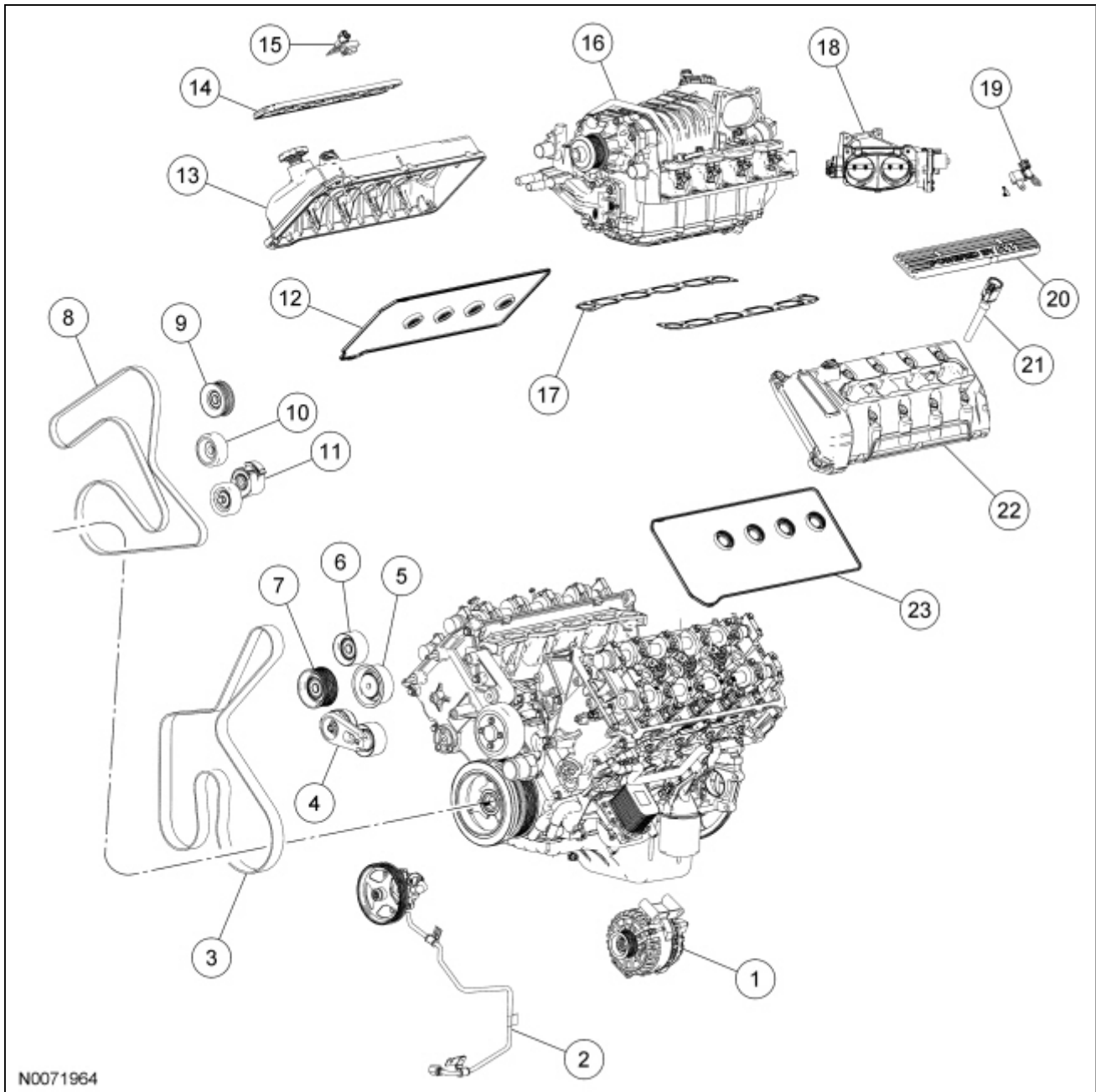
Special Tool(s)

 <p>ST1376-A</p>	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
 <p>ST1718-A</p>	Compressor, Valve Spring 303-452 (T93P-6565-AR)
 <p>ST1341-A</p>	Heavy Duty Floor Crane 014-00071 or equivalent
 <p>ST1335-A</p>	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 <p>ST1337-A</p>	Installer, Connecting Rod 303-442 (T93P-6136-A)
 <p>ST2197-A</p>	Installer, Crankshaft Front Oil Seal 303-635
 <p>ST1482-A</p>	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 <p>ST1479-A</p>	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)

 <p>ST1480-A</p>	<p>Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)</p>
 <p>ST1287-A</p>	<p>Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)</p>
 <p>ST1328-A</p>	<p>Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)</p>
 <p>ST1602-A</p>	<p>Lifting Bracket, Engine 303-D089 (D93P-6001-A3) or equivalent</p>
 <p>ST1603-A</p>	<p>Lifting Bracket, Engine (2 required) 303-D087 (D93P-6001-A1) or equivalent</p>
 <p>ST1438-A</p>	<p>Strap Wrench 303-D055 (D85L-6000-A) or equivalent</p>

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT or equivalent	WSS-M2C931-B
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Silicone Gasket Remover ZC-30	—

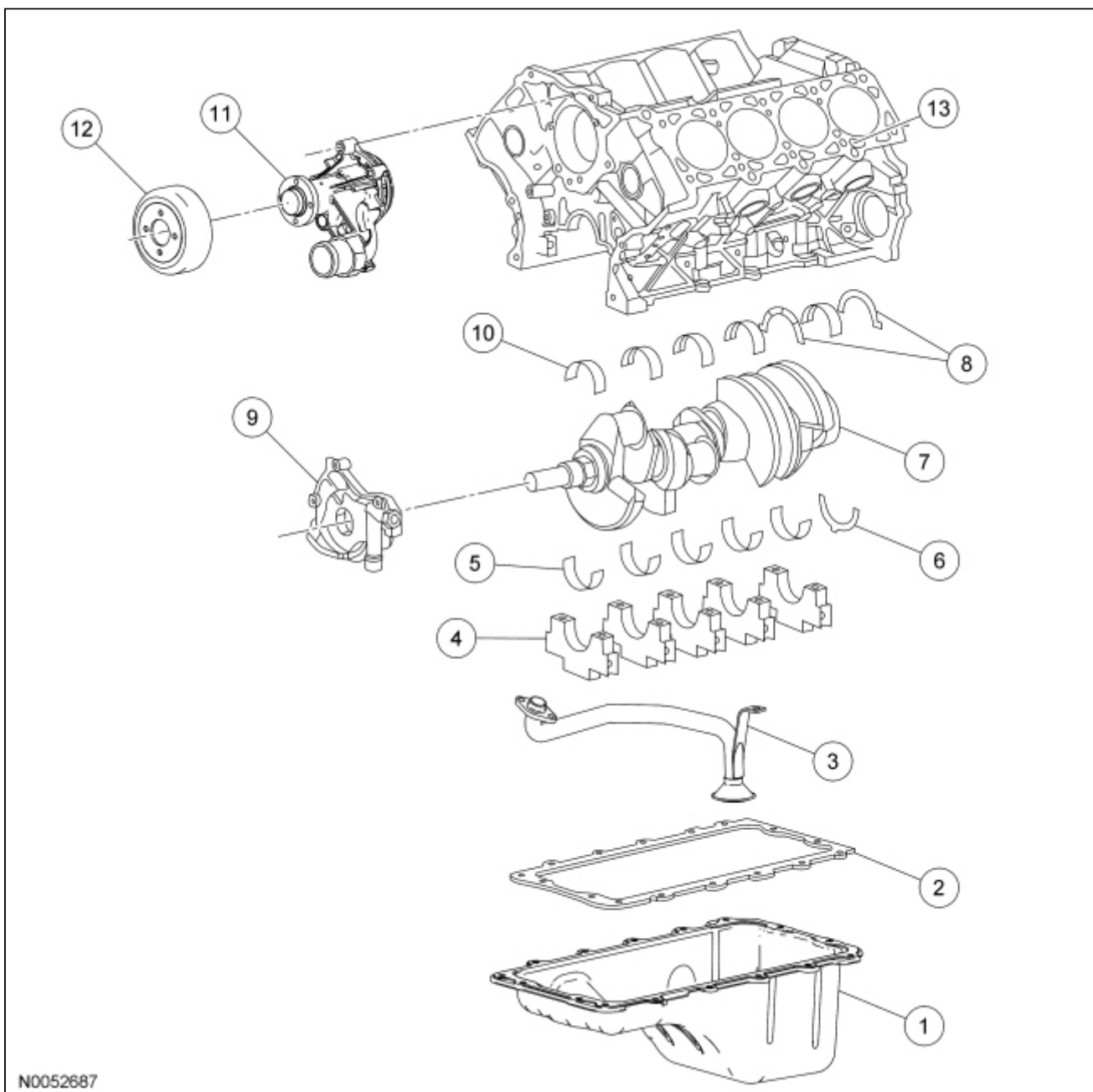


N0071964

Item	Part Number	Description
1	10300	Generator
2	3A696	Power steering pump
3	8620	Supercharger (SC) drive belt
4	6B209	SC drive belt tensioner
5	19A216	SC drive belt heavy load idler pulley
6	19A216	SC drive belt smooth idler pulley
7	6C348	SC drive belt grooved idler pulley
8	8620	Engine accessory drive belt
9	19A216	Engine accessory drive belt grooved idler pulley
10	19A216	Engine accessory drive belt smooth idler pulley
11	6B209	Engine accessory drive belt tensioner
12	6584	RH valve cover gasket
13	6582	RH valve cover
14	6P067	RH ignition coil-on-plug cover

15	18801	RH radio interference capacitor
16	9H487	Intake manifold assembly
17	9439	Intake manifold assembly gasket (2 required)
18	9E822	Throttle Body (TB) assembly
19	18801	LH radio interference capacitor
20	6P067	LH ignition coil-on-plug cover
21	12A366	Ignition coil-on-plug (8 required)
22	6A505	LH valve cover
23	6584	LH valve cover gasket

Lower End Components and Coolant Pump

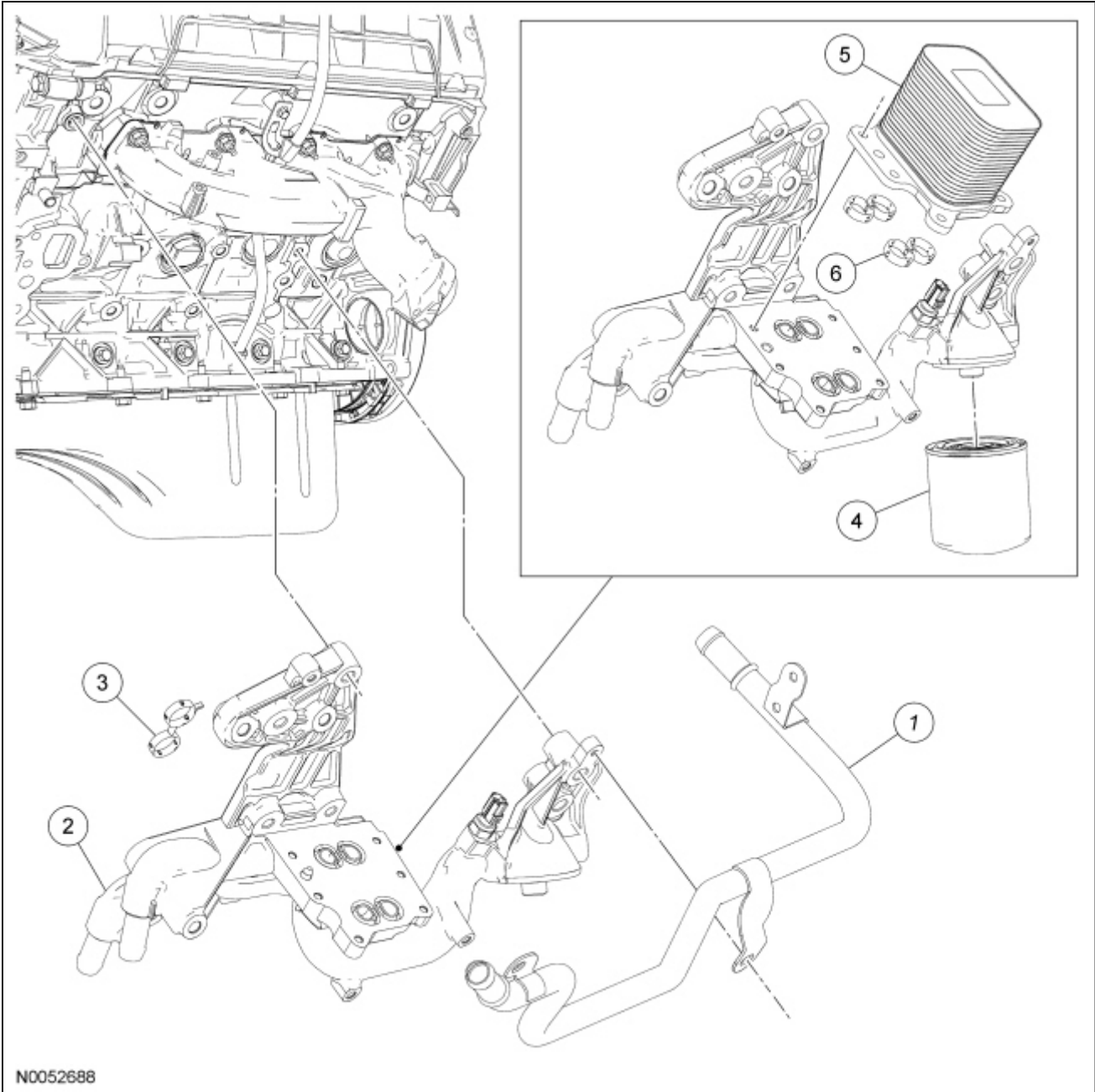


N0052687

Item	Part Number	Description

1	6675	Oil pan
2	6710	Oil pan gasket
3	6622	Oil pump screen and pickup tube
4	6325	Main bearing cap
5	6A338	Crankshaft lower main bearing (5 required)
6	6K302	Crankshaft lower thrust washer
7	6303	Crankshaft
8	6A341	Crankshaft upper thrust washers (2 required)
9	6621	Oil pump
10	6333	Crankshaft upper main bearing (5 required)
11	8501	Coolant pump
12	8A528	Coolant pump pulley
13	6010	Cylinder block

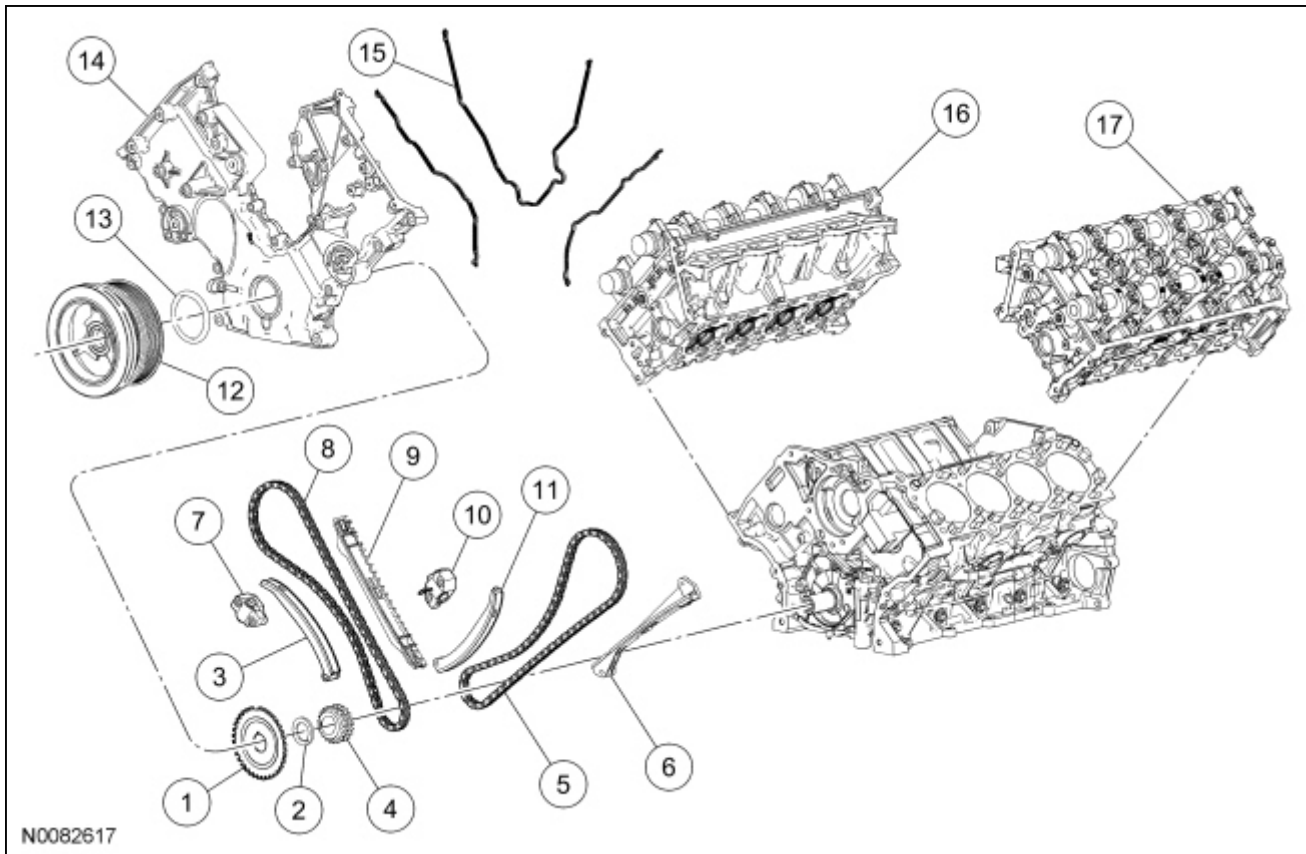
Oil Filter Adapter Assembly



N0052688

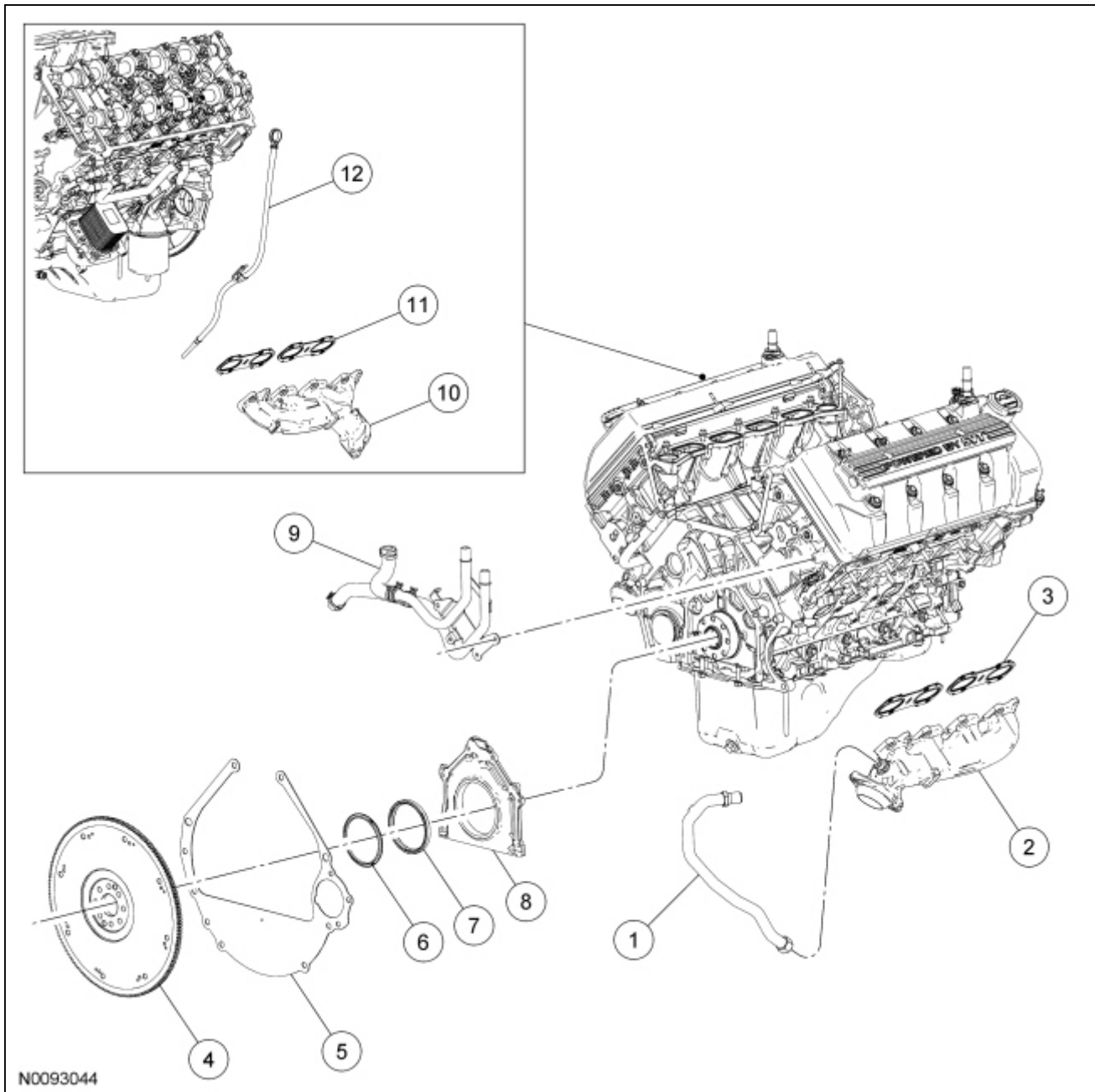
Item	Part Number	Description
1	18663	Coolant tube assembly
2	6884	Oil filter adapter
3	6A636	Oil filter adapter gasket
4	6714	Engine oil filter
5	6A642	Oil cooler
6	6N818	Oil cooler gasket (4 required)

Timing Drive Components and Cylinder Heads



Item	Part Number	Description
1	12A227	Crankshaft sensor ring
2	6378	Crankshaft washer
3	6K255	RH timing chain tensioner arm
4	6306	Crankshaft timing sprocket
5	6268	LH primary timing chain
6	6B274	LH primary timing chain guide
7	6L266	RH primary timing chain tensioner
8	6268	RH primary timing chain
9	6M256	RH primary timing chain guide
10	6L266	LH primary timing chain tensioner
11	6M274	LH timing chain tensioner arm
12	6316	Crankshaft pulley
13	6700	Crankshaft front seal
14	6C086	Engine front cover
15	6D081	Engine front cover gasket
16	6F093	RH cylinder head assembly
17	6M099	LH cylinder head assembly

Flywheel and Exhaust Manifolds



N0093044

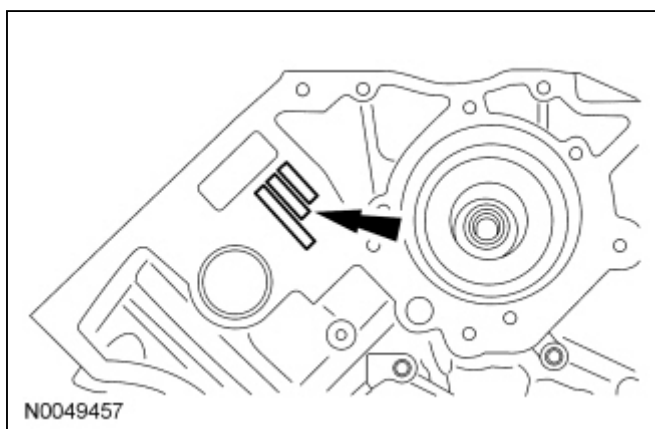
Item	Part Number	Description
1	9D477	EGR tube
2	9428	RH exhaust manifold
3	9Y431	RH exhaust manifold gasket (2 required)
4	6375	Flywheel
5	6A373	Engine-to-transmission spacer plate
6	6310	Crankshaft oil slinger
7	6701	Crankshaft rear seal
8	6K318	Crankshaft rear seal retainer plate
9	18C553	Coolant tube assembly
10	9431	LH exhaust manifold
11	9Y431	LH exhaust manifold gasket (2 required)
12	6754	Oil level indicator tube assembly

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

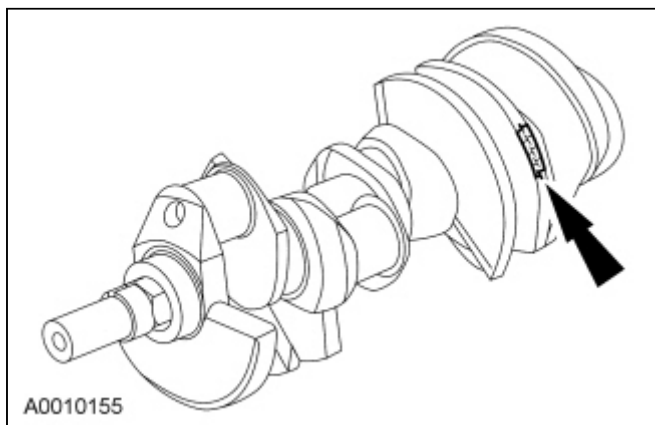
passages or the oil pan, can cause engine failure.

NOTE: During engine assembly it may become necessary to check bearing clearances and end play. For additional information, refer to [Section 303-00](#).

1. Record the first character code information on the cylinder block.



2. Note the first character on the No. 7 crankshaft counterweight.



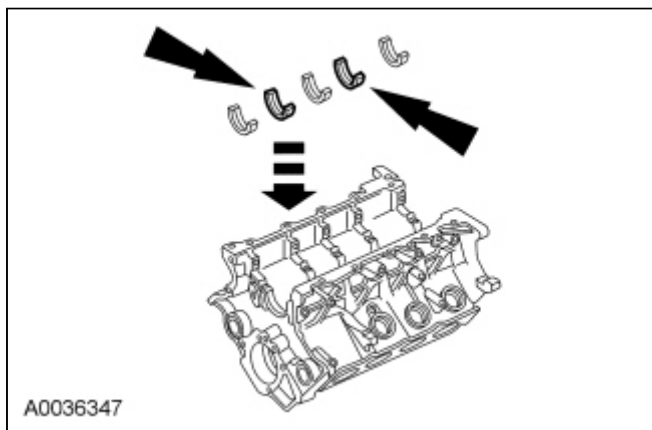
3. Using the data recorded in the previous 2 steps, cross-reference using the chart to obtain bearing grade.

		MINIMUM BLOCK DIA																							
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
72.400		.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424
MAXIMUM CRANKSHAFT DIA	X 67.504	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	W 67.503	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	V 67.502	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	U 67.501	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	T 67.500	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	S 67.499	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	R 67.498	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	Q 67.497	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	P 67.496	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	O 67.495	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	N 67.494	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	M 67.493	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	L 67.492	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	K 67.491	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	J 67.490	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	I 67.489	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	H 67.488	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	G 67.487	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	F 67.486	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	E 67.485	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
D 67.484	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
C 67.483	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
B 67.482	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
A 67.481	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	

A0031544

- 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.

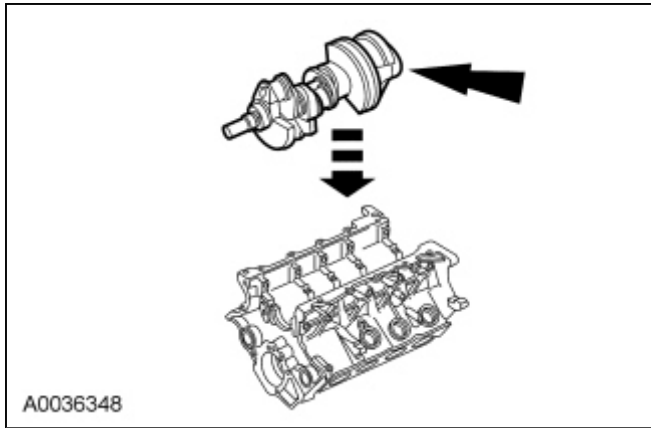
Lubricate the upper crankshaft main bearings with clean engine oil and install into the cylinder block.



- NOTE:** Do not install the upper thrust bearings until the crankshaft is installed.

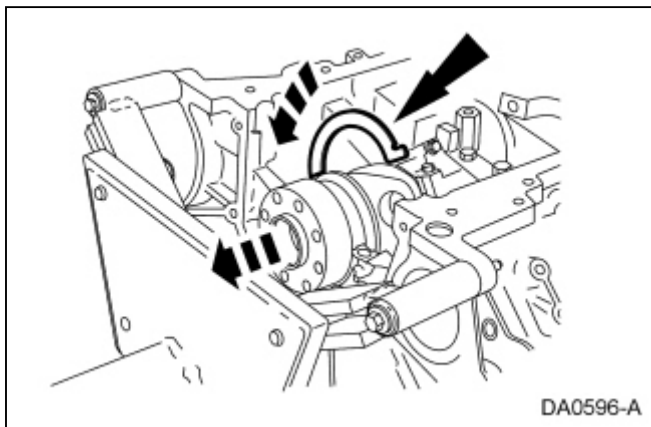
NOTE: Lubricate the thrust surfaces of the crankshaft with clean engine oil.

Install the crankshaft onto the upper main bearings.



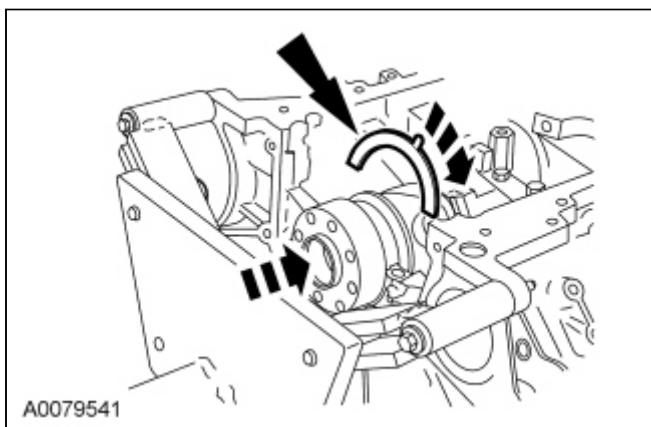
6. **NOTE:** Make sure the side of the thrust washer, with three 5-mm wide oil grooves, faces the crankshaft thrust surface.

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



7. **NOTE:** Make sure the side of the thrust washer, with three 5-mm wide oil grooves, faces the crankshaft thrust surface.

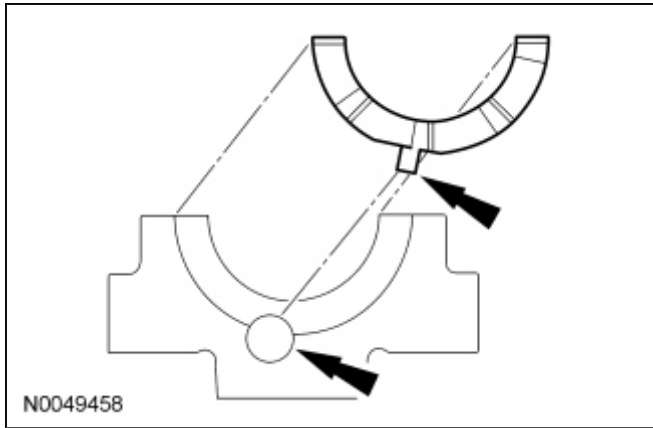
Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 5 main boss.



8. **NOTE:** Make sure the side of the thrust washer, with three 5-mm wide oil grooves, faces the crankshaft thrust surface.

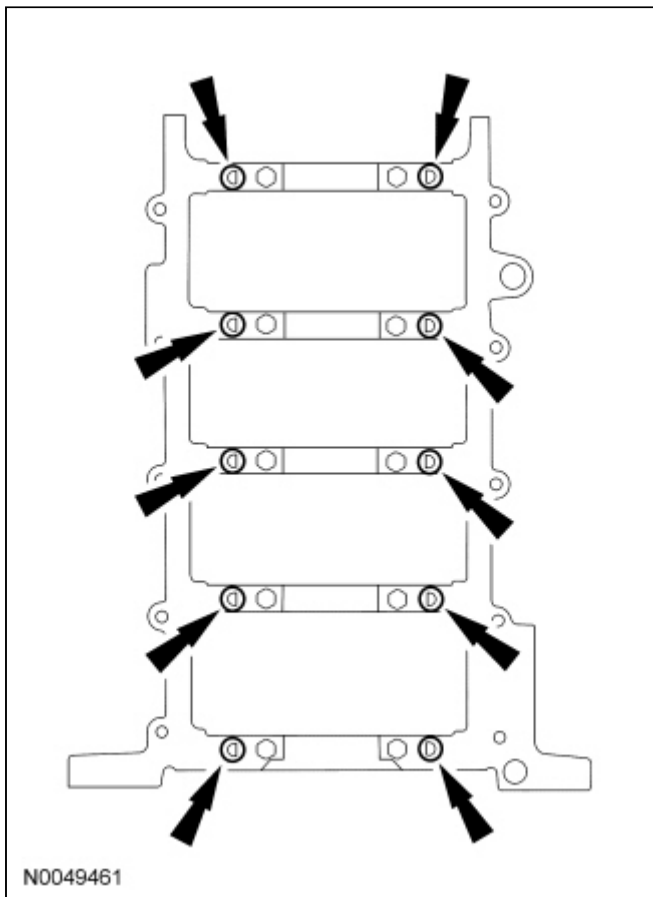
NOTE: To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

Install the lower crankshaft thrust washer to the back side of the No. 5 main bearing cap, with the tab aligned with the cutout in the main bearing cap.

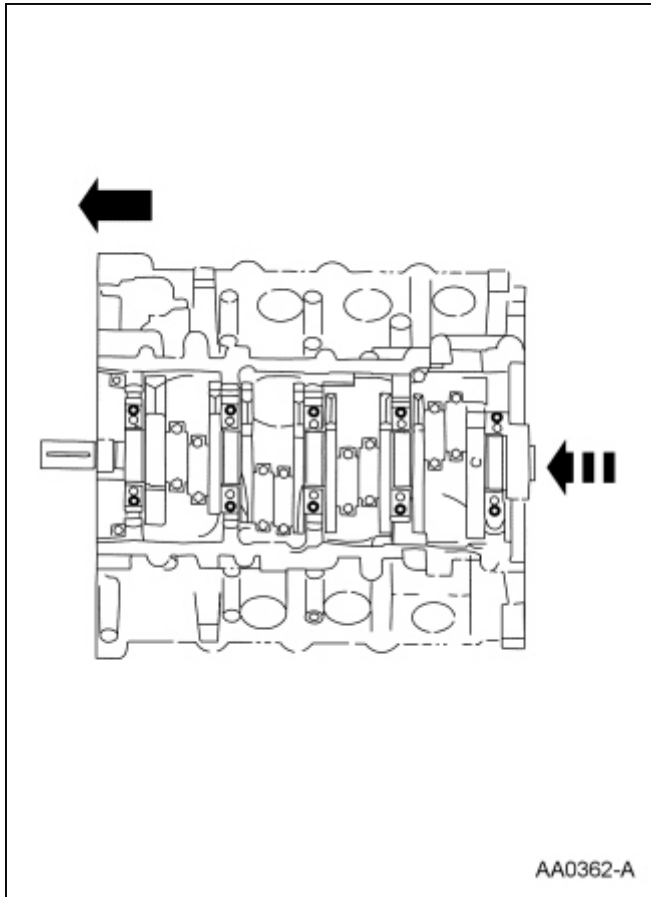


9. Lubricate the crankshaft lower main bearings and install them into the main bearing caps. Locate the main bearing caps on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the new cap fasteners.
10. **NOTE:** Crankshaft not shown for clarity.

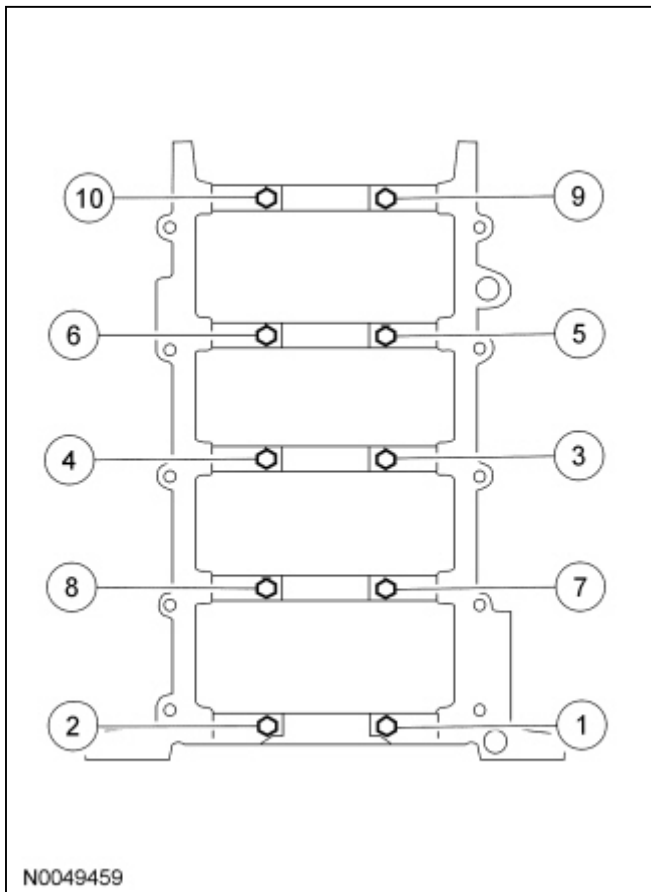
Install the main bearing cap dowel pins so the flat sides face the crankshaft.



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



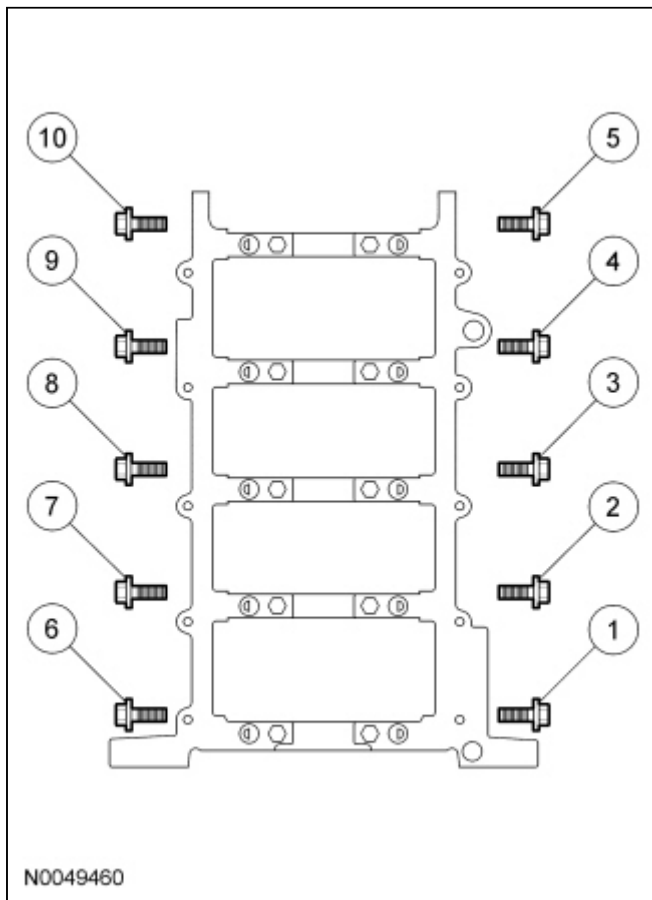
12. Tighten the vertical main bearing cap fasteners in the sequence shown, in 3 stages.
- Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten to 40 Nm (30 lb-ft).
 - Stage 3: Tighten an additional 90 degrees.



13. **NOTE:** Crankshaft not shown for clarity.

Install the new side bolts and tighten them in the sequence shown, in 2 stages.

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



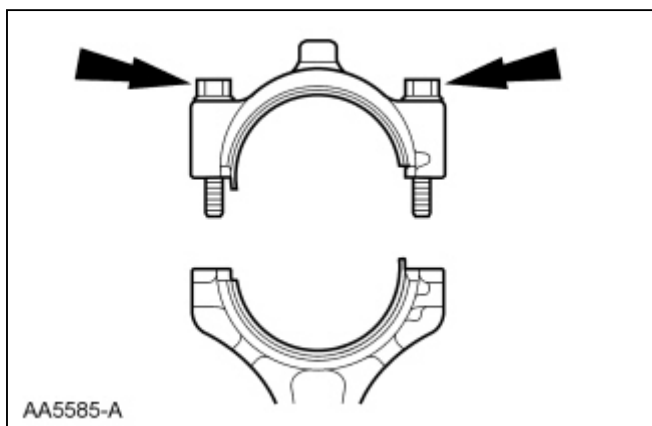
14. Check that crankshaft torque-to-turn does not exceed 6 Nm (53 lb-in).

15. Check the crankshaft end play. For additional information, refer to [Section 303-00](#).

16. **NOTE:** Verify correct orientation of connecting rod and rod cap.

Prepare the connecting rod and cap.

- Insert the bolts in the rod cap.
- Insert the upper and lower rod bearings into the rod and cap.



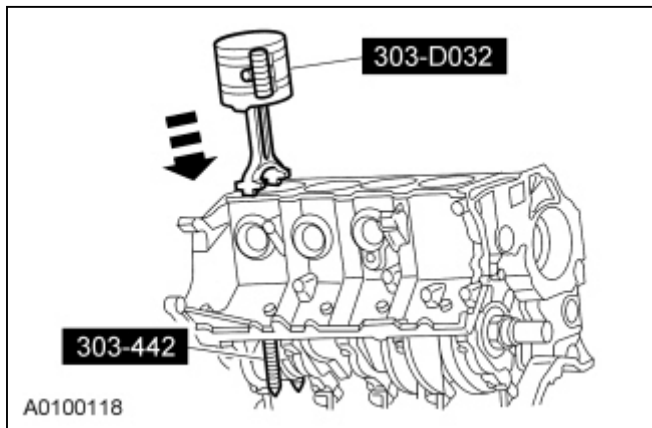
17. **NOTE:** Do not scratch the cylinder walls or crankshaft journals with the connecting rod.

NOTE: The next 3 steps are for all 8 connecting rods, rod caps and pistons. Only 1 connecting rod, rod cap and piston is shown.

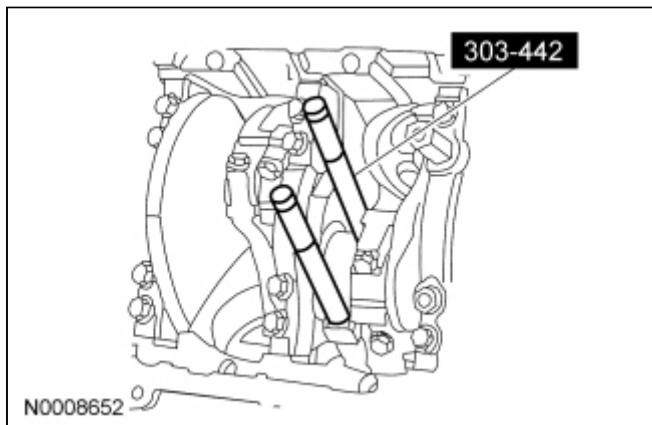
NOTE: Make sure the identification marks on the piston and connecting rod face toward the front of the engine.

Using the Piston Ring Compressor and the Connecting Rod Installer, install the No. 1 and No. 6 piston and the connecting rod assemblies.

- Lubricate the piston and rings with clean engine oil.
- Lubricate the rod bearings with clean engine oil.
- Lubricate the cylinder bores with clean engine oil.



18. Seat the connecting rods on the crankshaft journals and remove the Connecting Rod Installer.

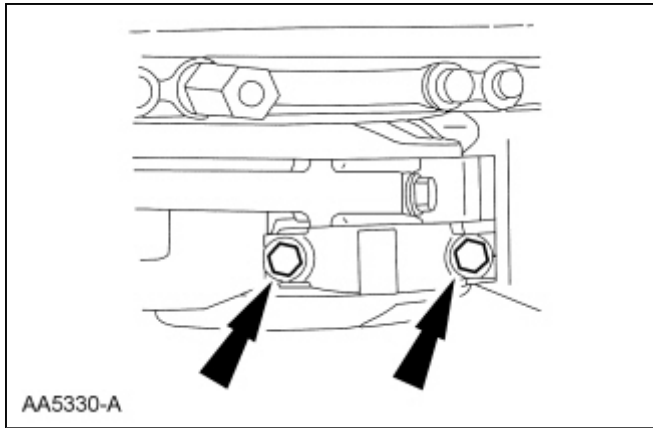


19. **NOTICE:** The rod cap installation must keep the same orientation as marked during disassembly or damage to the engine may occur.

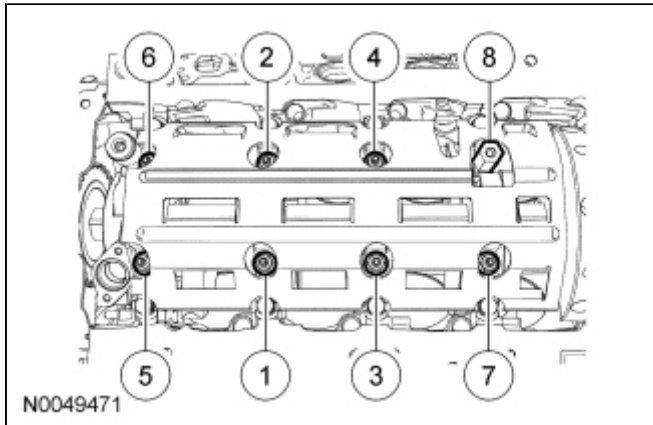
NOTE: Rotate the crankshaft after each connecting rod is installed and tightened, to check for assembly binding.

Install the rod bearing caps and tighten the bolts in 2 stages.

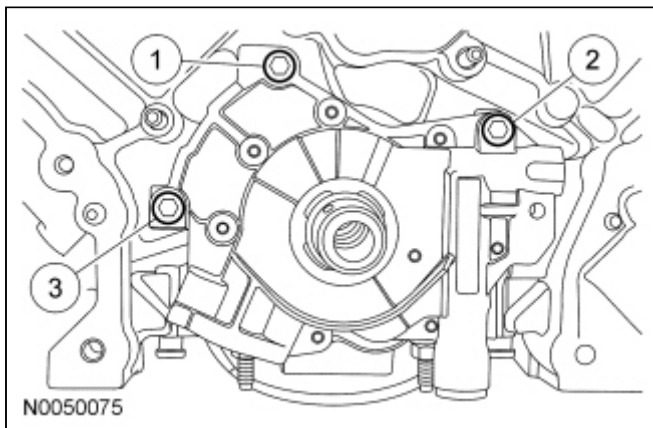
- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.



20. Install the piston assemblies 3 and 5, 4 and 7, 2 and 8, by turning the crankshaft 90 degrees and repeating the previous steps.
21. Install the windage tray, the 7 nuts and the spacer.
 - Tighten in the sequence shown to 25 Nm (18 lb-ft).



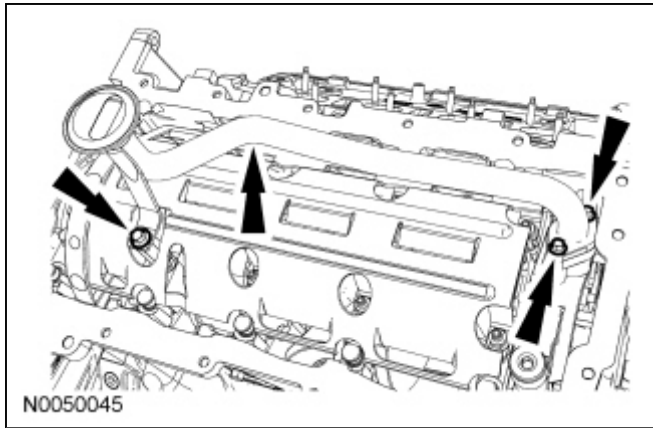
22. Install the oil pump and 3 bolts.
 - Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



23. **NOTE:** Install a new O-ring seal on the oil pump screen and pickup tube.

Install the oil pump screen and pickup tube and the 3 bolts.

- Tighten the 2 small bolts to 10 Nm (89 lb-in).
- Tighten the large bolt to 25 Nm (18 lb-ft).



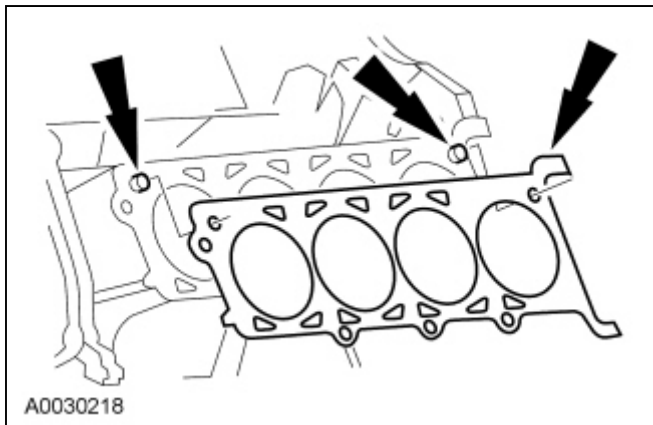
24. **NOTICE:** The gasket sealing surfaces on the cylinder head and the cylinder block must be clean. Failure to follow these instructions may result in engine damage. For additional information, refer to [Cylinder Head](#) in the Removal portion of this section.

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 engine damage.

NOTICE: The new gasket has a film coating which is crucial to the gasket's ability to seal correctly. Do not scratch the gasket.

NOTE: RH head gasket shown, LH head gasket similar.

Install the RH and LH head gasket over the dowel pins.



25. **NOTICE:** Cylinder head machining or milling is not authorized by the Ford Motor Company. Cylinder head flatness must be within 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area. Failure to follow these instructions may result in engine damage.

NOTICE: The gasket sealing surfaces on the cylinder head and the cylinder block must be clean. 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.

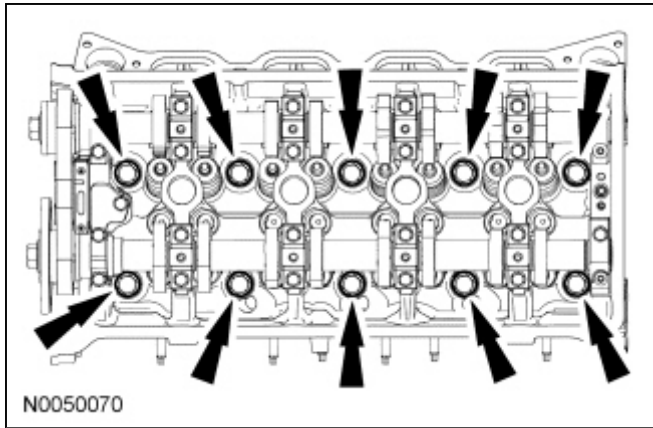
NOTICE: The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry. Failure to follow these instructions may result in engine damage.

NOTICE: Do not allow the dowels to scratch the sealing surface of the cylinder head during cylinder head installation. Failure to follow these instructions may result in engine damage.

NOTE: LH shown, RH similar.

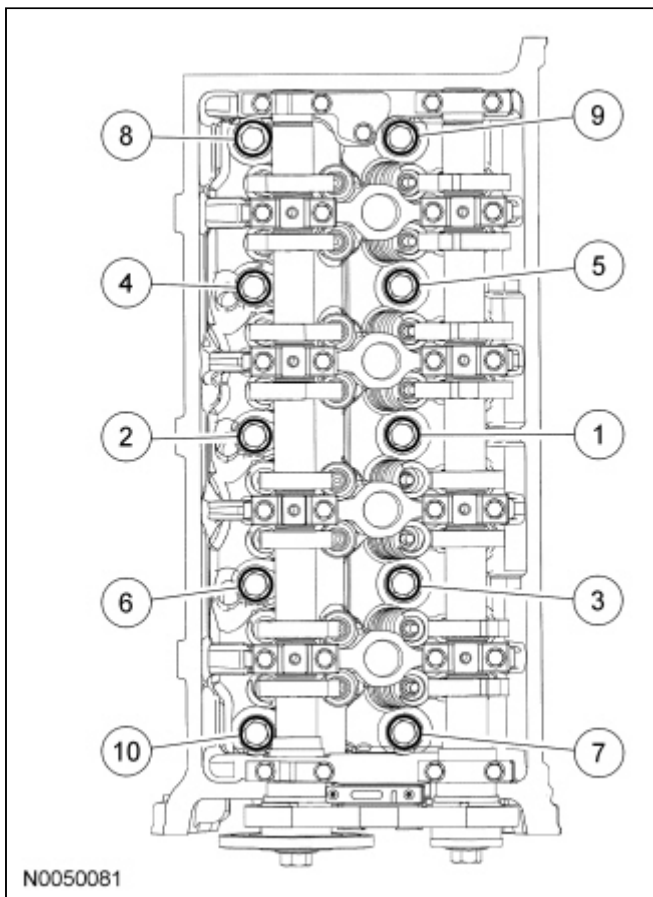
Install the RH and LH cylinder heads on the dowels and the head gaskets.

- Loosely install new bolts.



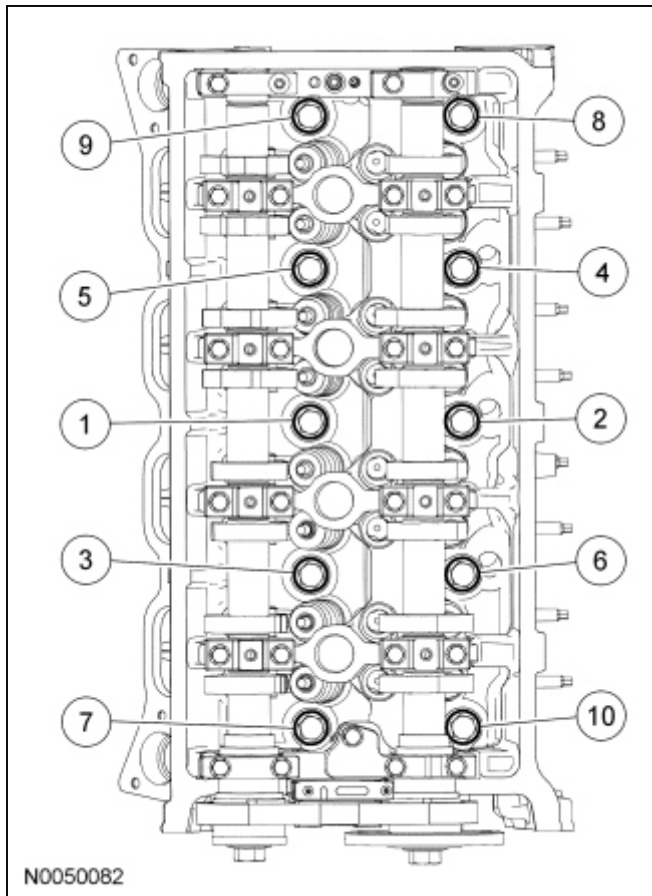
26. Tighten the new RH cylinder head bolts in 5 stages in the sequence shown.

- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 50 Nm (37 lb-ft).
- Stage 3: Tighten to 80 Nm (59 lb-ft).
- Stage 4: Tighten an additional 90 degrees.
- Stage 5: Tighten an additional 90 degrees.



27. Tighten the new LH cylinder head bolts in 5 stages in the sequence shown.

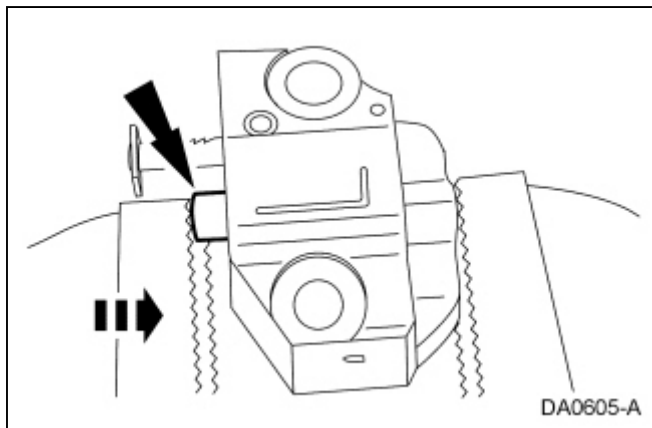
- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 50 Nm (37 lb-ft).
- Stage 3: Tighten to 80 Nm (59 lb-ft).
- Stage 4: Tighten an additional 90 degrees.
- Stage 5: Tighten an additional 90 degrees.



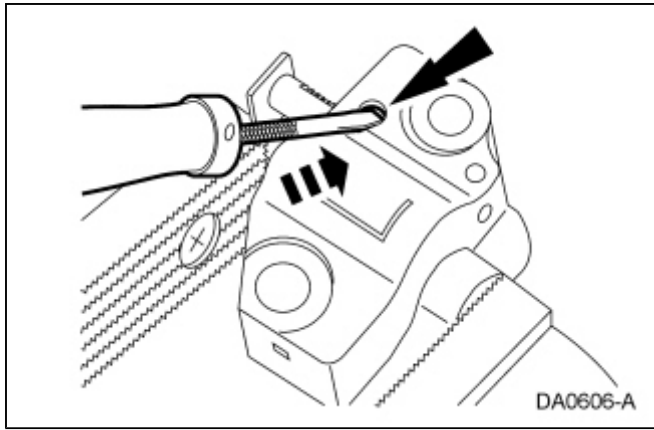
28. **NOTICE:** Do not compress the ratchet assembly. This will damage the ratchet assembly.

NOTE: LH shown, RH similar.

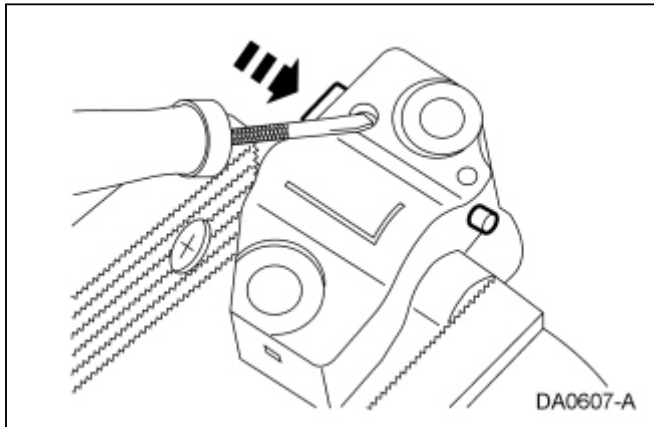
Compress each tensioner plunger, using an edge of a vise.



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

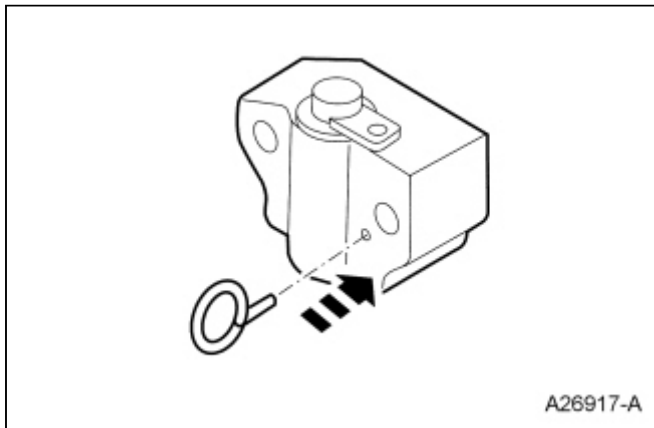


30. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.

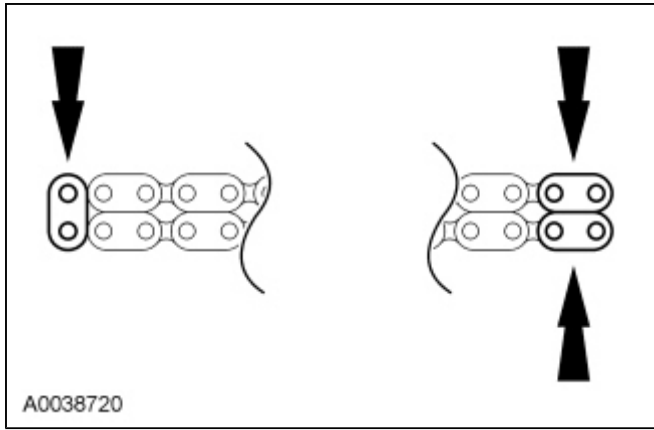


31. Install a suitable pin into the hole of each tensioner housing to hold the ratchet assembly and plunger in place during installation.

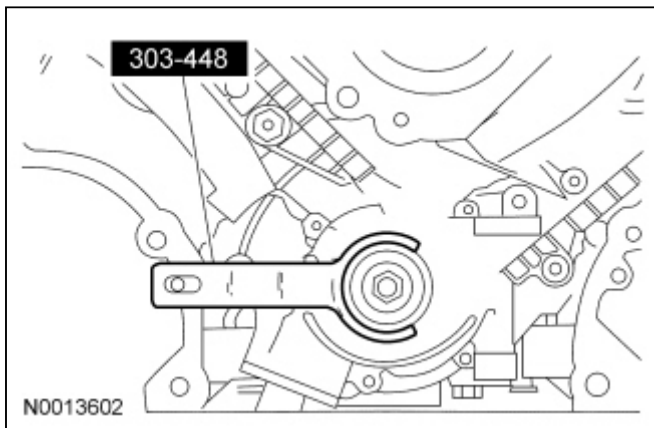
- Remove the tensioner from the vise.



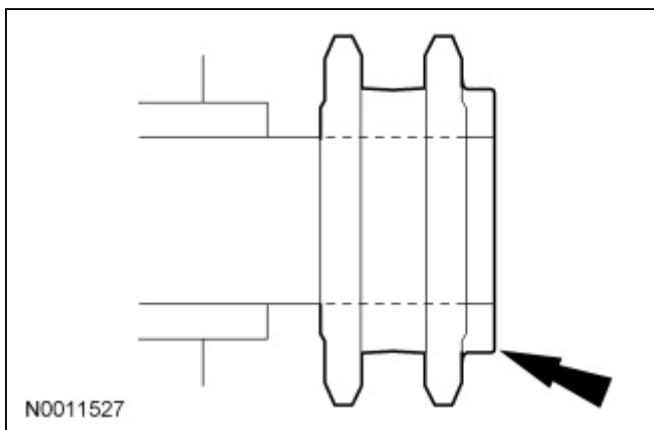
32. If the colored links are not visible, mark one link on one end and 2 links on the other end, and use as timing marks.



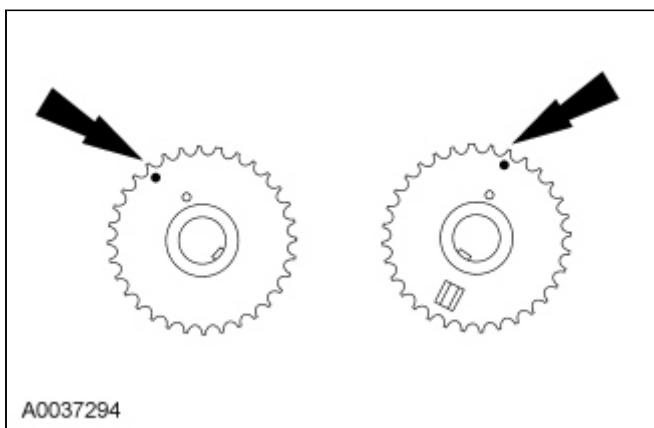
33. Using the Crankshaft Holding Tool, position the crankshaft.



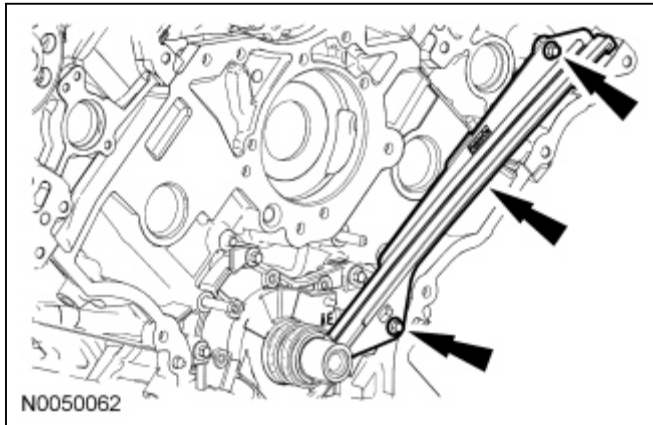
34. Install the crankshaft sprocket with the flange facing forward.



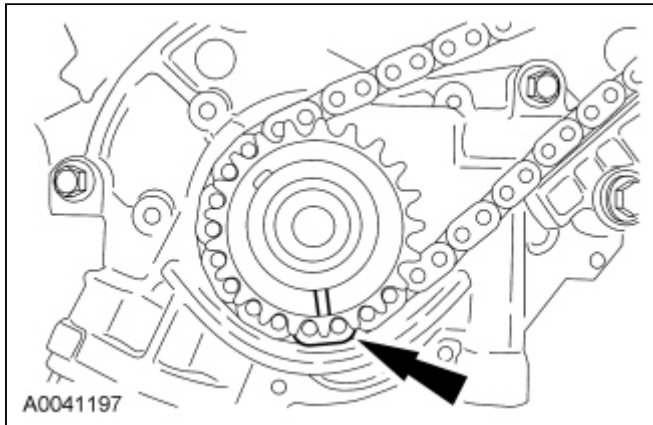
35. Position the camshaft sprocket timing marks as shown.



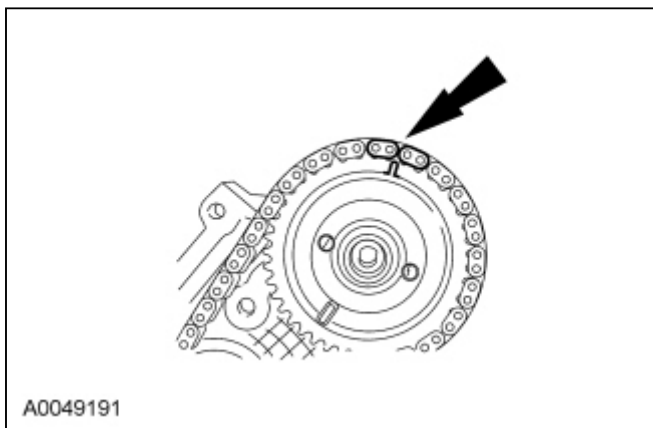
36. Install the LH primary timing chain guide and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).



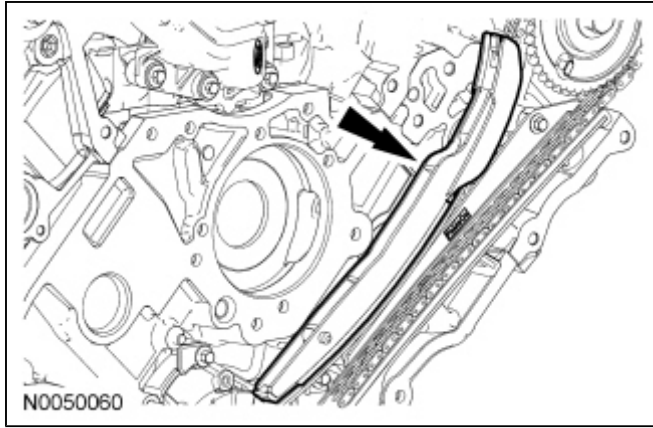
37. Position the LH (inner) timing chain onto the crankshaft sprocket, aligning the one colored link on the timing chain with the slot on the crankshaft sprocket.



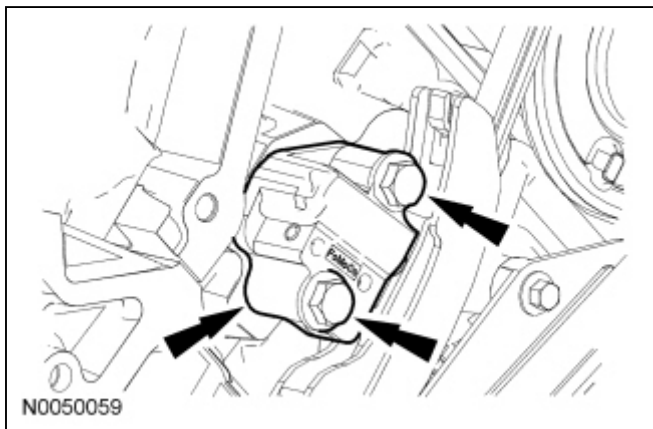
38. Install the LH timing chain on the camshaft sprocket, aligning the 2 colored links with the timing mark on the sprocket.



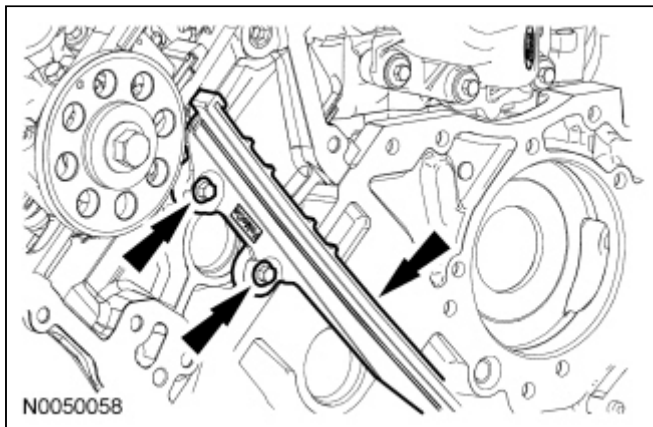
39. Install the LH primary timing chain tensioner arm.



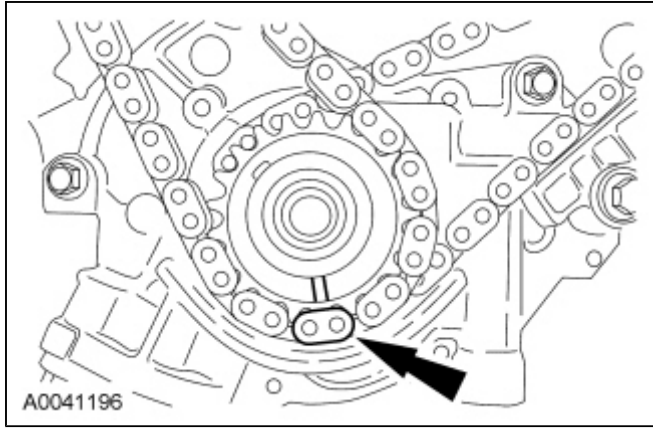
40. Install the LH primary timing chain tensioner and the 2 bolts.
- Tighten to 25 Nm (18 lb-ft).
 - Remove the pin from the tensioner.



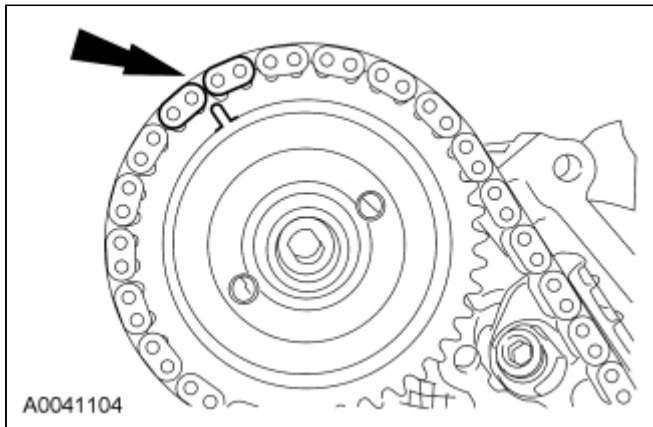
41. Install the RH primary timing chain guide and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).



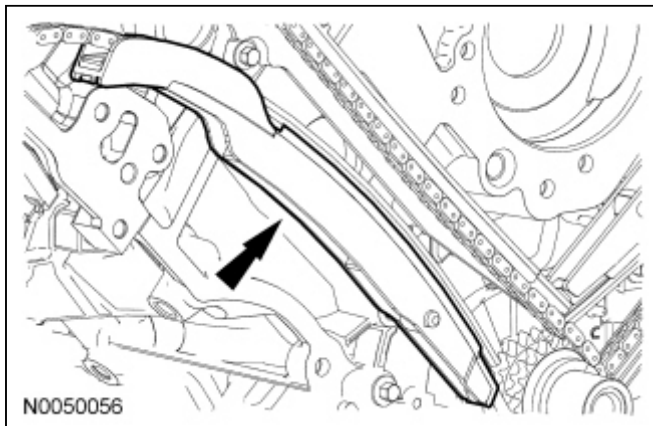
42. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the colored link with the timing marks on the sprocket.



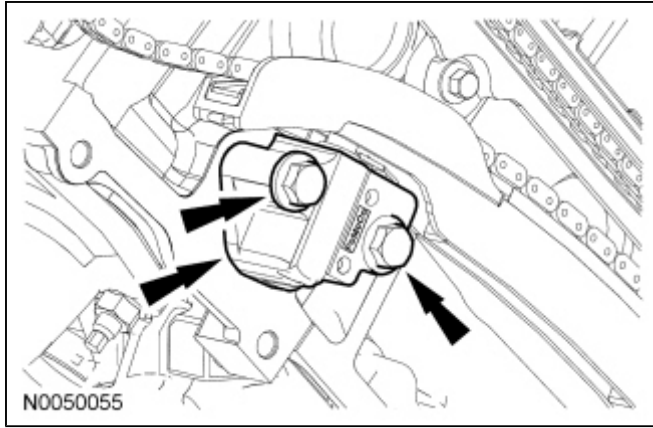
43. Install the RH timing chain on the camshaft sprocket, aligning the 2 colored links with the timing mark on the sprocket.



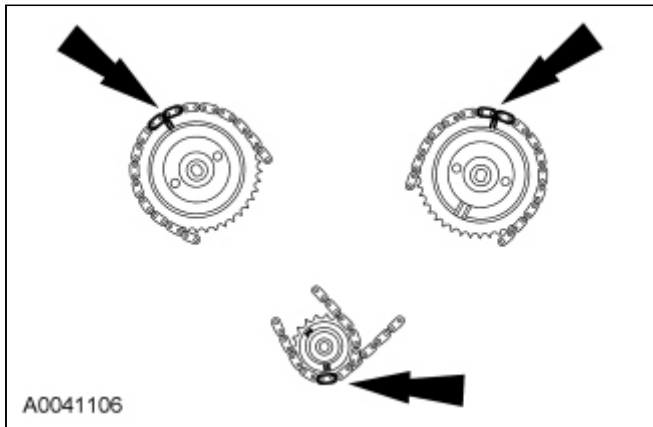
44. Install the RH primary timing chain tensioner arm.



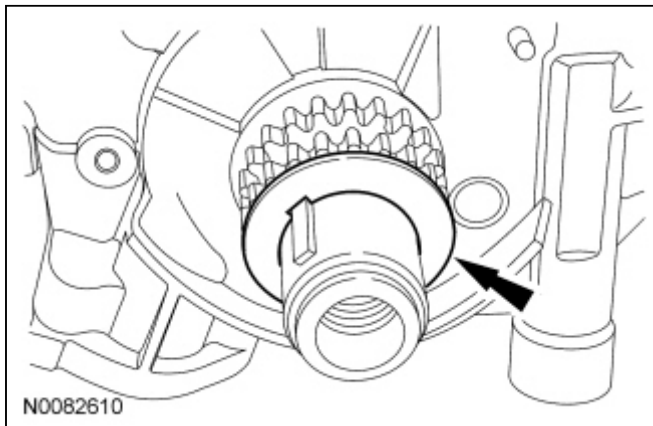
45. Install the RH primary timing chain tensioner and the 2 bolts.
- Tighten to 25 Nm (18 lb-ft).
 - Remove the pin from the tensioner.



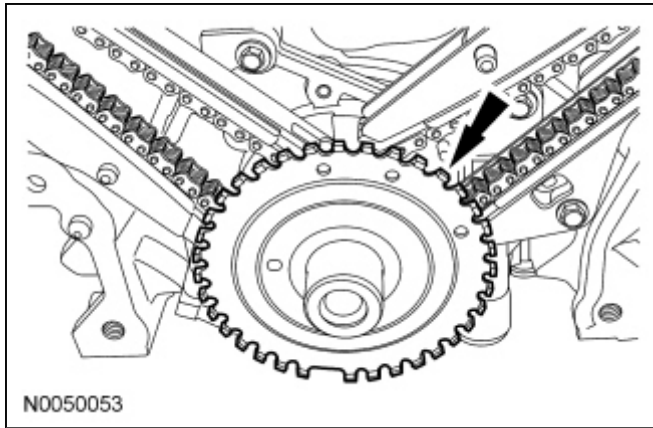
46. As a post-check, verify correct alignment of all timing marks. Make sure that the colored links are lined up with the marks on the crankshaft sprocket and the camshaft sprockets.



47. Install the crankshaft washer.

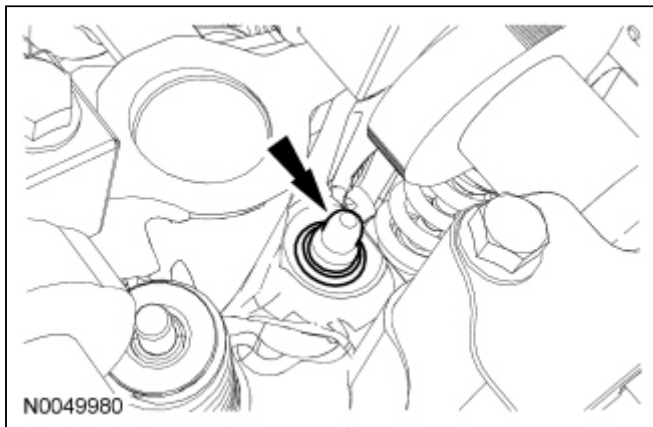


48. Install the crankshaft sensor ring.



49. **NOTICE:** If the components are to be reinstalled, they must be installed in their original positions or damage to the engine may occur.

Install the hydraulic lash adjusters.



50. Using the Valve Spring Compressor, compress the valve spring and install the roller follower.



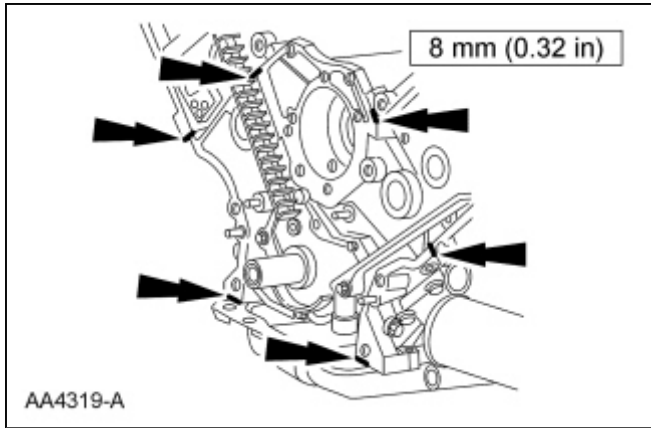
51. Repeat the previous step to install all the roller followers.
52. **NOTE:** RH shown, LH similar.

Install the 8 spark plugs.

- Tighten to 18 Nm (159 lb-in).

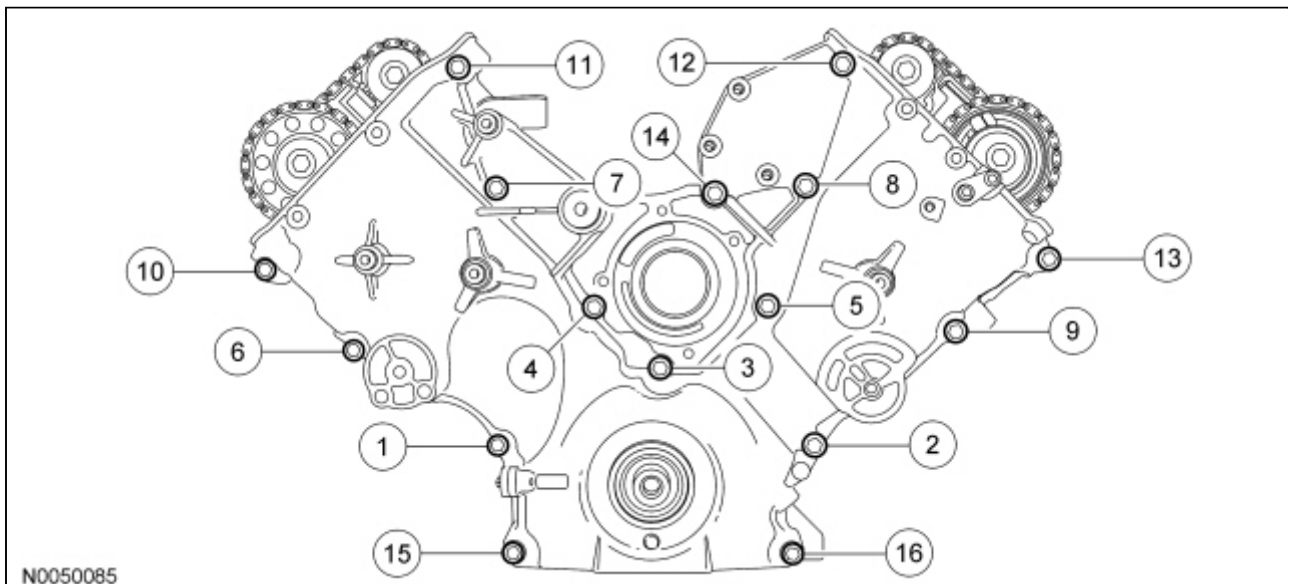
53. **NOTE:** If the engine front cover is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness or 4 minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.



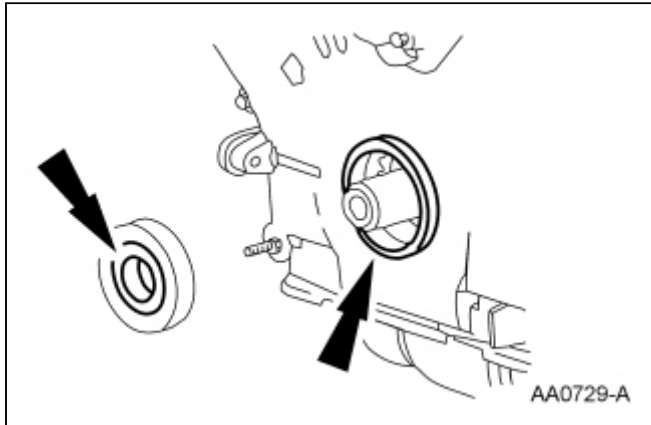
54. Using new gaskets, install the engine front cover and the 16 bolts. Tighten the bolts in the sequence shown:

- Bolts 1 through 14 to 25 Nm (18 lb-ft).
- Bolts 15 and 16 to 50 Nm (37 lb-ft).

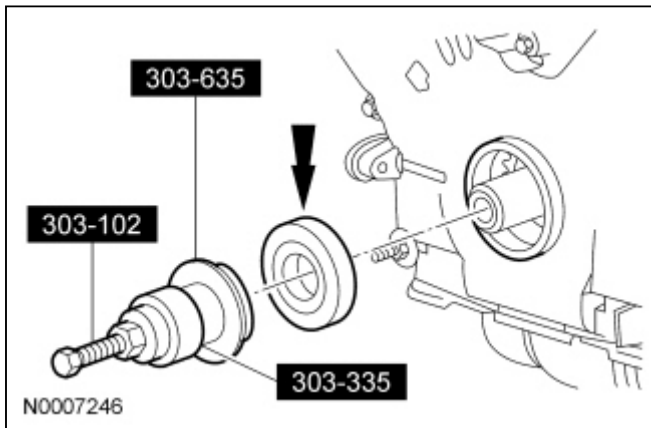


Item	Part Number	Description
1	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
2	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
3	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
4	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
5	N806177	Bolt, hex head pilot, M8 x 1.25 x 53
6	N806177	Bolt, hex head pilot, M8 x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

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

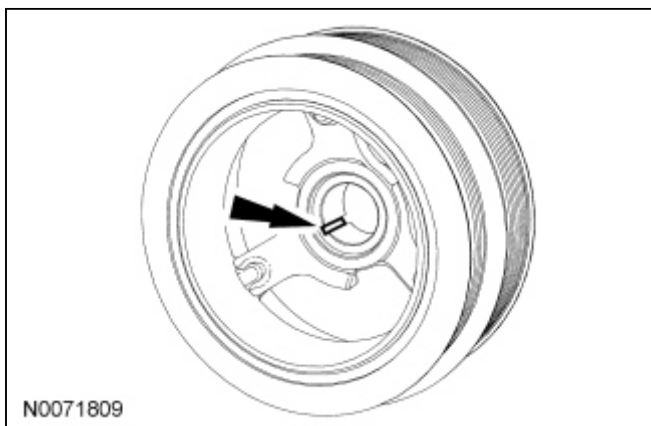


56. Using the Crankshaft Vibration Damper Installer, Front Cover Oil Seal Installer and the Crankshaft Front Oil Seal Installer, install the crankshaft front seal.

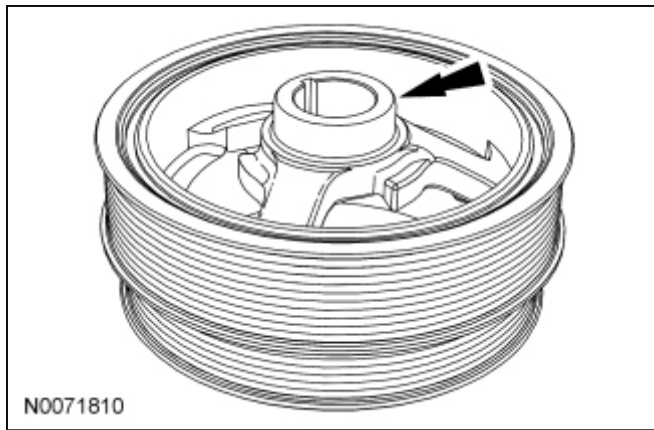


57. **NOTE:** If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

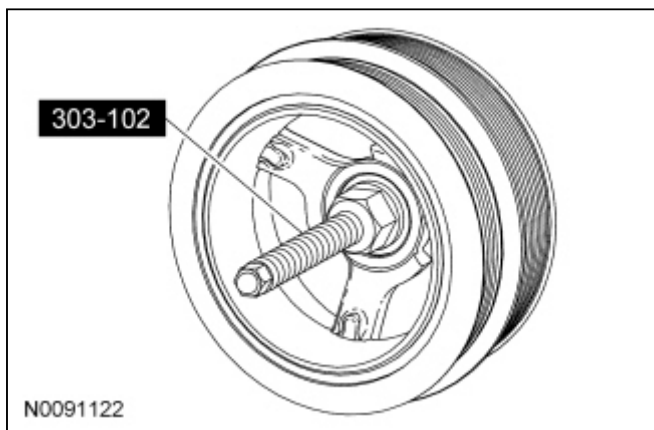
Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



58. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.

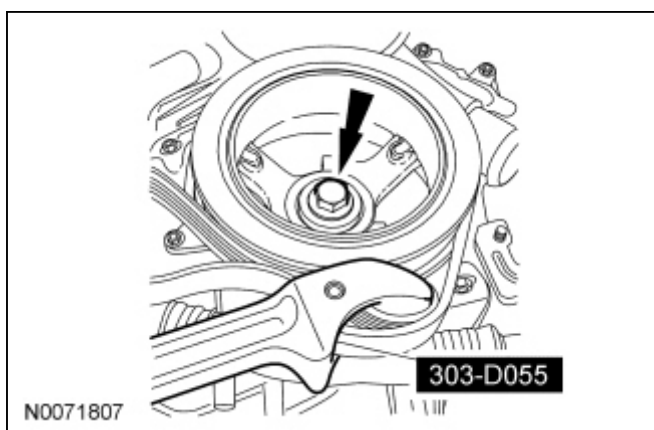


59. Using the Crankshaft Vibration Damper Installer, install the crankshaft pulley.



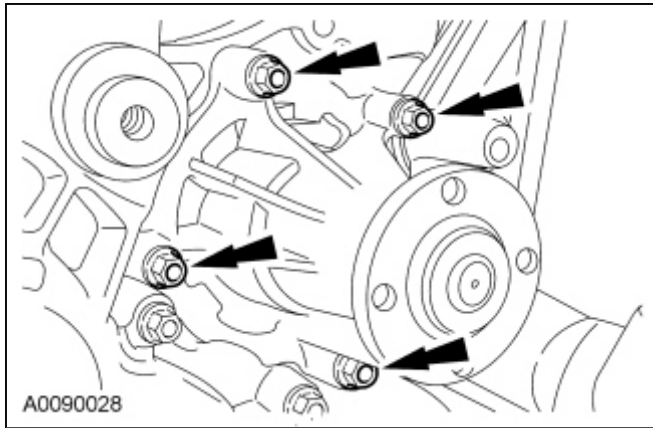
60. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:

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

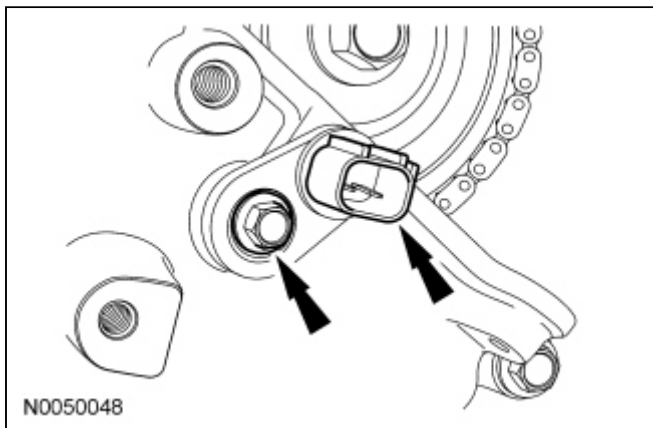


61. Install the coolant pump and the 4 bolts.

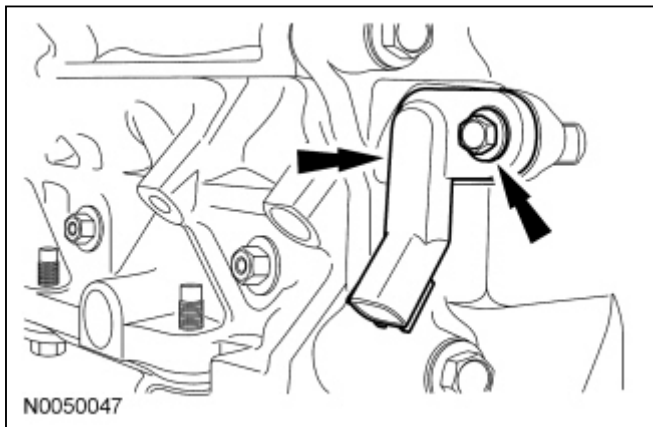
- Tighten to 25 Nm (18 lb-ft).



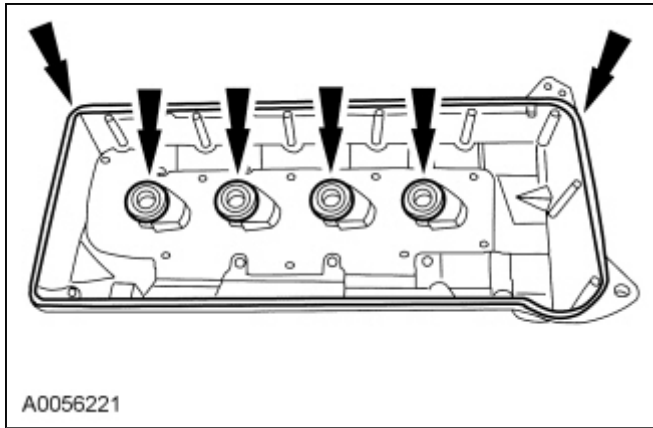
62. Install the Camshaft Position (CMP) sensor and the bolt.
- Tighten to 10 Nm (89 lb-in).



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



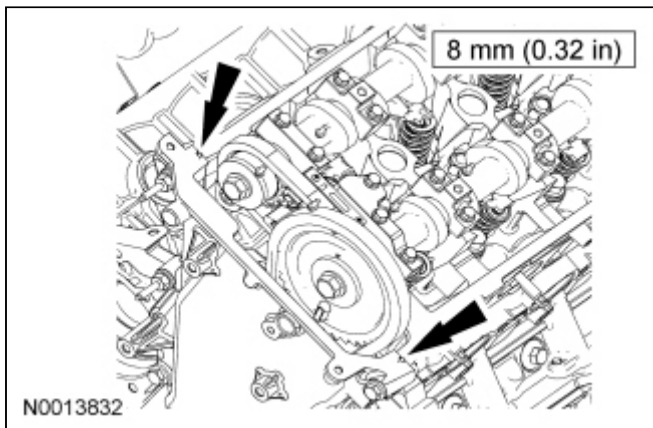
64. Install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



65. **NOTE:** If the valve covers are not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. 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: LH shown, RH similar.

Apply silicone gasket and sealant to the engine front cover-to-cylinder block joints.

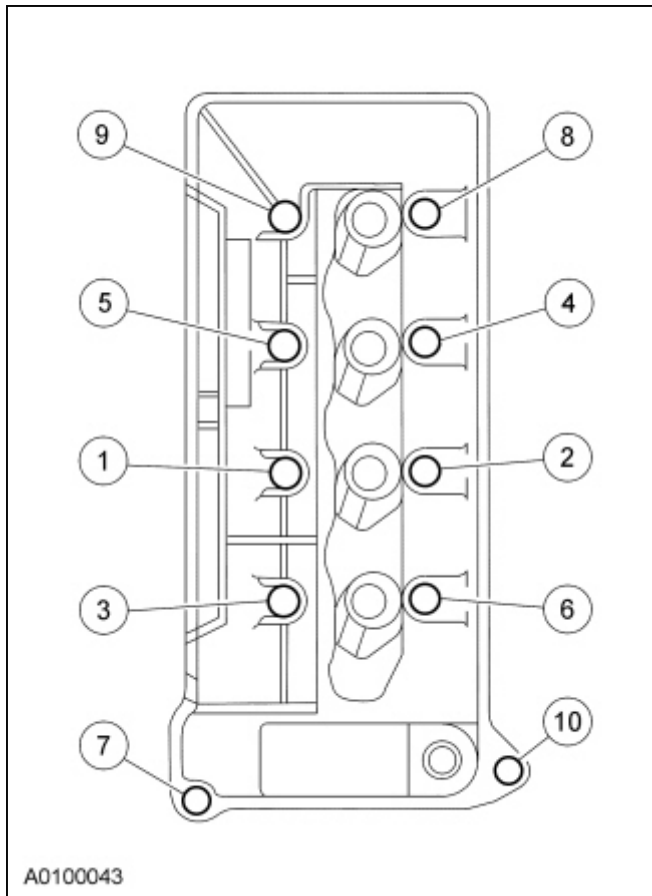


66. **NOTE:** If the valve covers are not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

NOTE: RH shown, LH similar.

Install the valve covers, bolts and stud bolts.

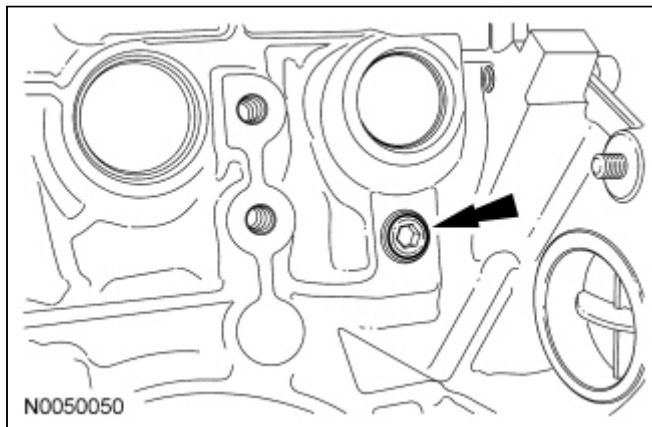
- Tighten in the sequence shown to 10 Nm (89 lb-in).



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

Install the LH and RH block drain plugs.

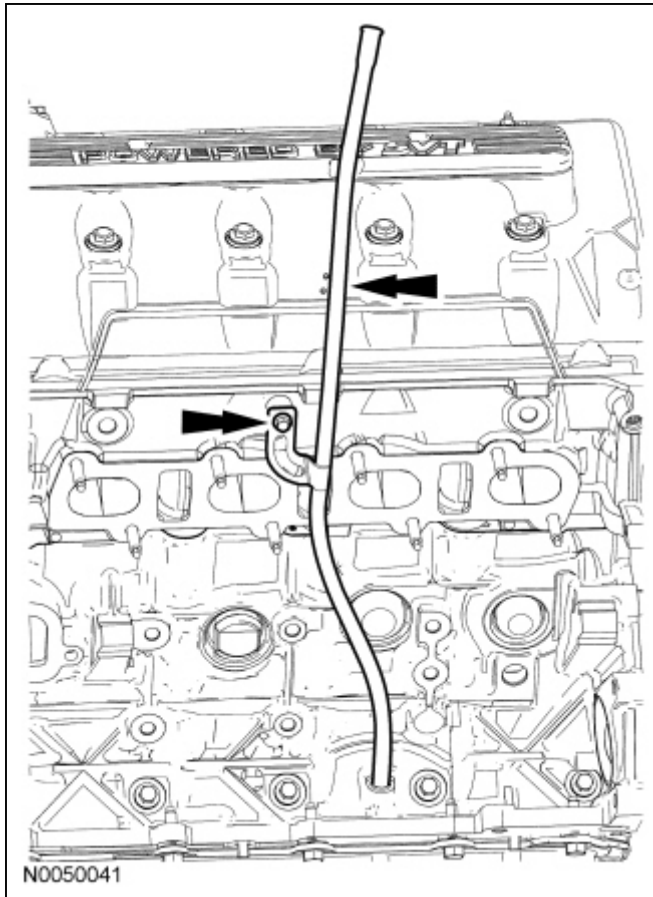
- Tighten to 14 Nm (124 lb-in).



68. **NOTE:** Lubricate the new oil level indicator tube O-ring seal with clean engine oil prior to installation.

Using a new O-ring seal, install the oil level indicator tube, bolt and oil level indicator.

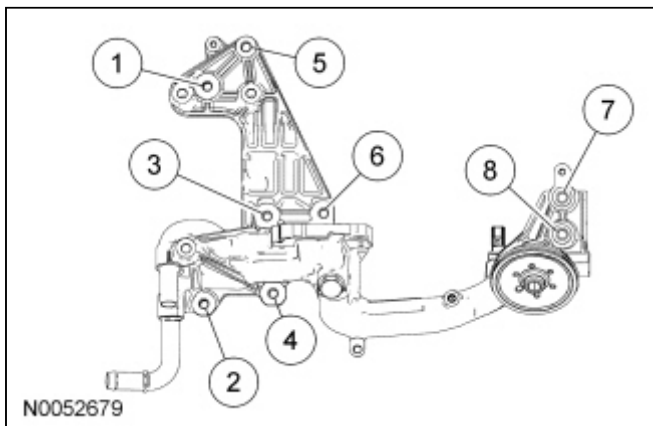
- Tighten to 10 Nm (89 lb-in).



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

Using a new gasket, install the oil filter adapter and the 8 bolts.

- Tighten in the sequence shown:
 - Bolts 1 through 6 to 25 Nm (18 lb-ft).
 - Bolts 7 and 8 to 50 Nm (37 lb-ft).

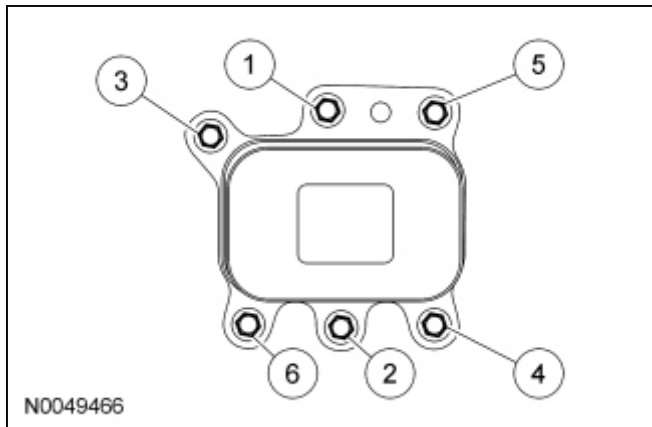


70. **NOTICE:** A new cooler must be installed or severe damage to the engine can occur.

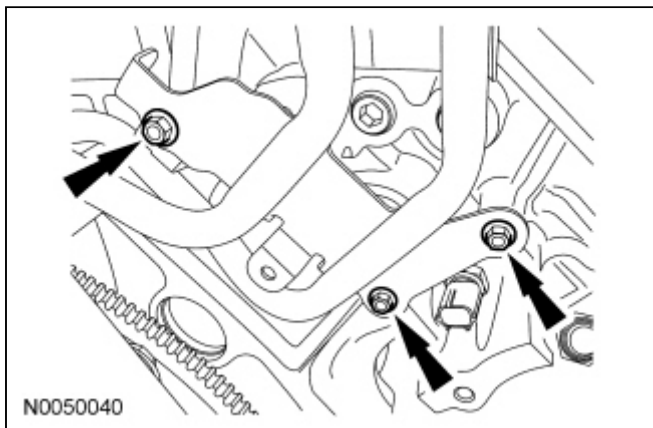
NOTE: Clean and inspect the sealing surfaces with metal surface prep. Follow the directions on the packaging.

Using new gaskets, install a new oil cooler and the 6 bolts.

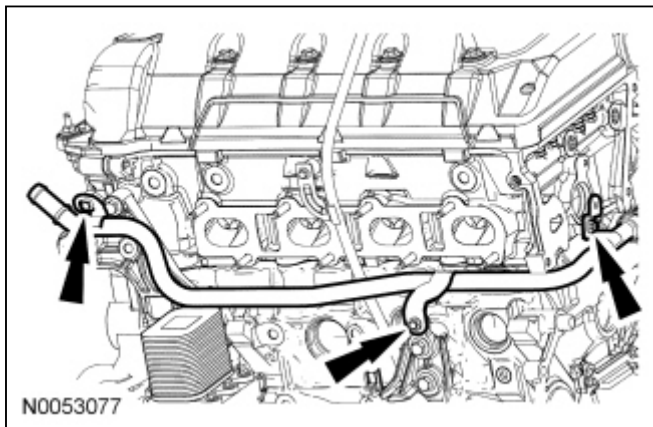
- Tighten in the sequence shown to 10 Nm (89 lb-in).



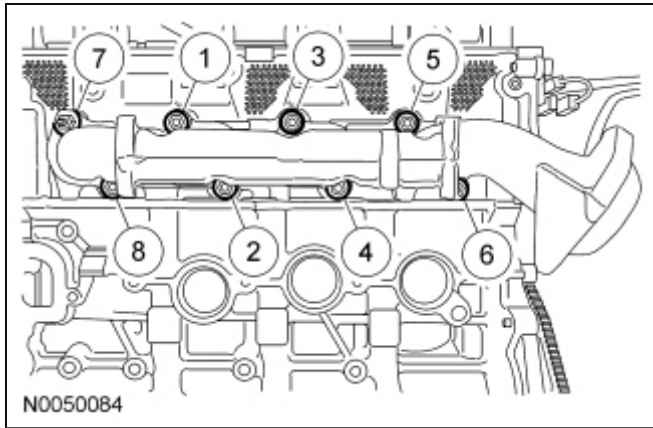
71. Install the coolant tube assembly and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



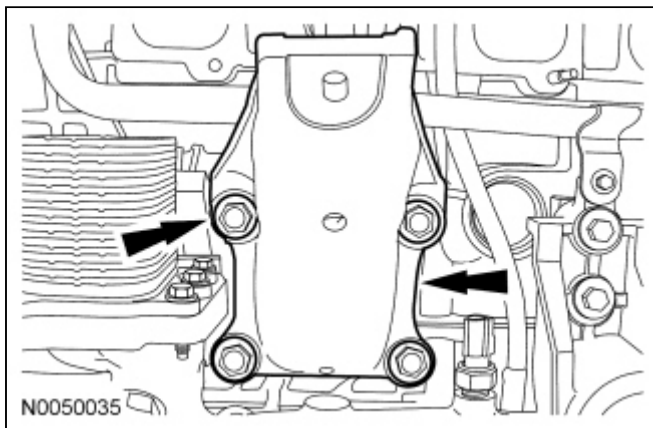
72. Install the 3 coolant tube assembly bolts.
- Tighten to 10 Nm (89 lb-in).



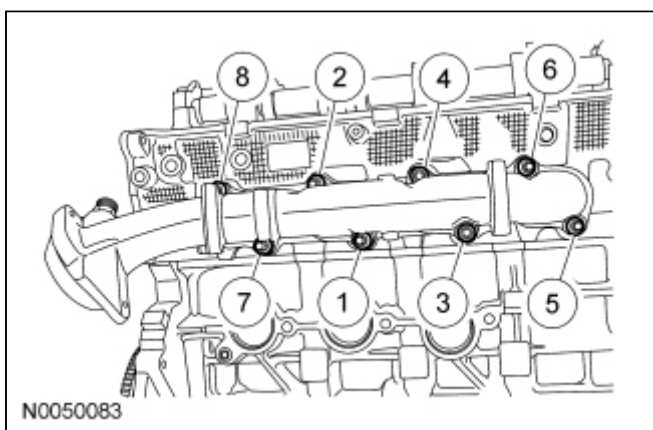
73. Install 8 new LH exhaust manifold studs.
- Tighten to 12 Nm (106 lb-in).
74. Install new gaskets, the LH exhaust manifold and 8 new nuts.
- Tighten in the sequence shown to 20 Nm (177 lb-in).



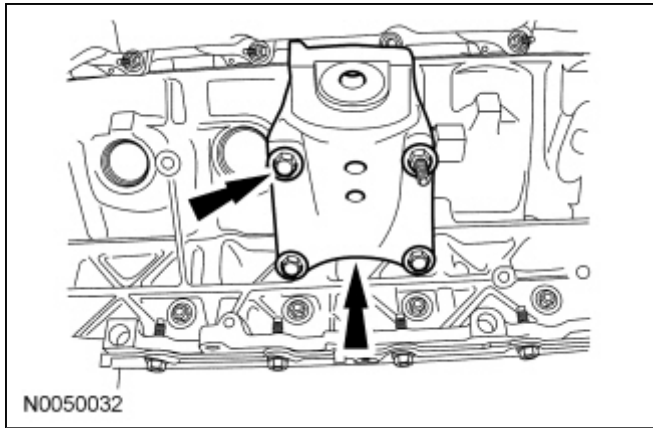
75. Install the LH engine support insulator bracket and the 4 bolts.
- Tighten to 63 Nm (46 lb-ft).



76. Install 8 new RH exhaust manifold studs.
- Tighten to 12 Nm (106 lb-in).
77. Install new gaskets, the RH exhaust manifold and 8 new nuts.
- Tighten in the sequence shown to 20 Nm (177 lb-in).



78. Install the RH engine support insulator bracket, the stud bolt, and the 3 bolts.
- Tighten to 63 Nm (46 lb-ft).

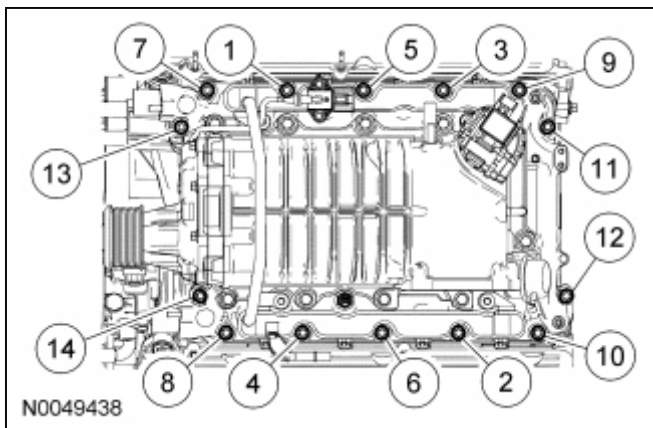


79. **NOTICE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

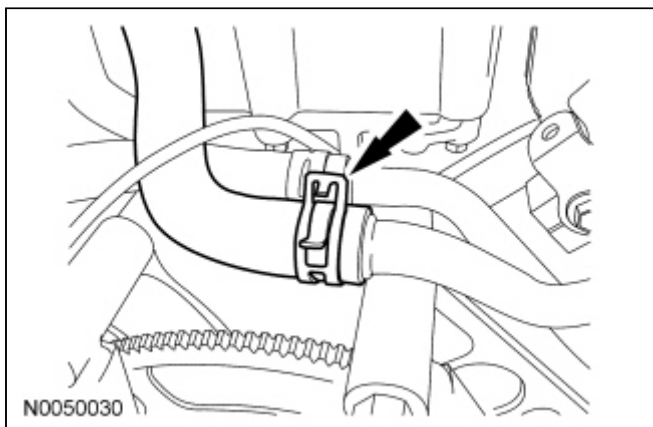
NOTE: Clean and inspect the sealing surfaces with metal surface prep. Follow the directions on the packaging.

Using new intake manifold gaskets, install the intake manifold and the 14 bolts.

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



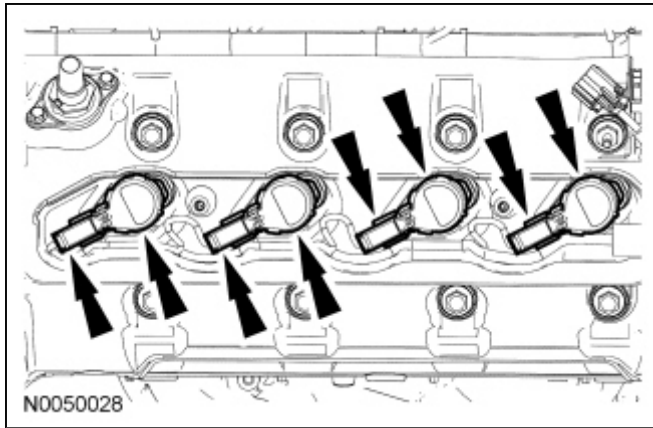
80. Connect the intake manifold-to-coolant tube assembly hose.



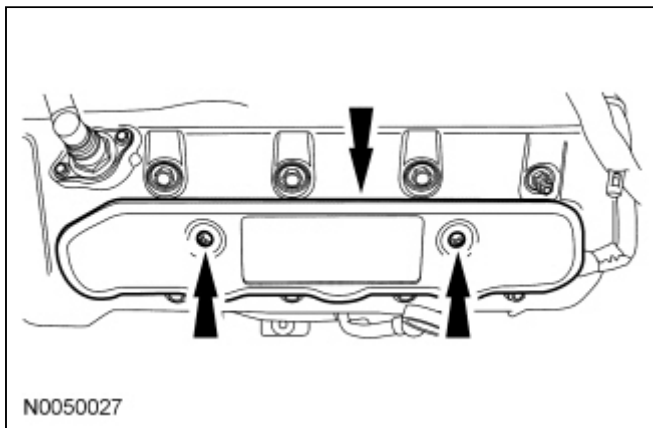
81. Position the wiring harness assembly onto the engine.
82. **NOTE:** Apply a light film of brake dielectric grease to the inside of the coil boots before installation.

Install the 4 LH coil-on-plugs.

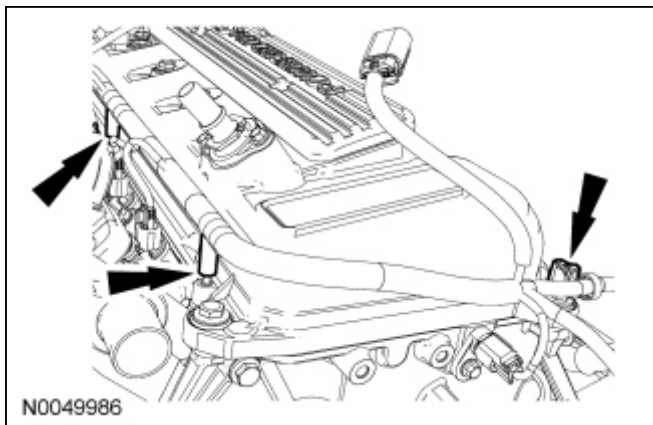
- Connect the 4 LH coil-on-plug electrical connectors.



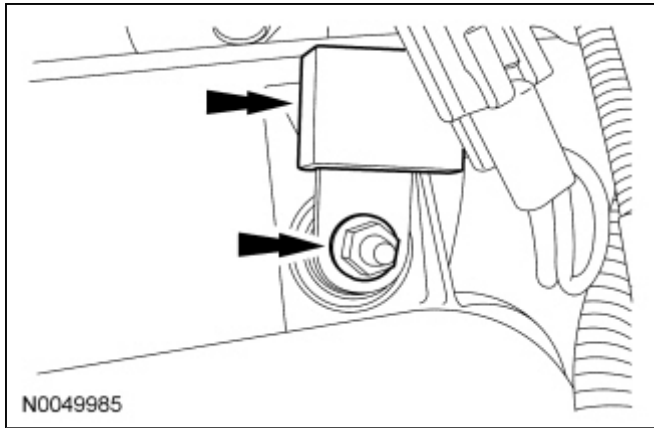
83. Install the LH coil-on-plug cover and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).



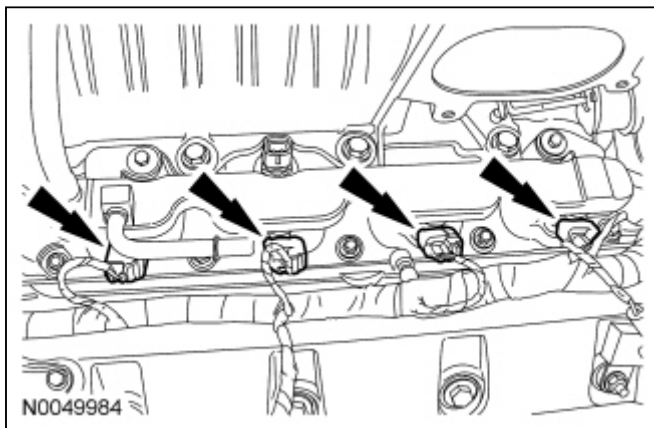
84. Attach the wiring harness retainers to the LH valve cover stud bolts.



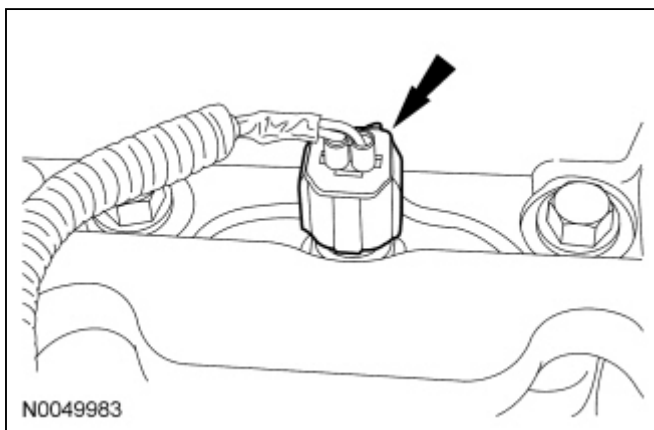
85. Install the LH radio interference capacitor and the nut.
- Tighten to 10 Nm (89 lb-in).



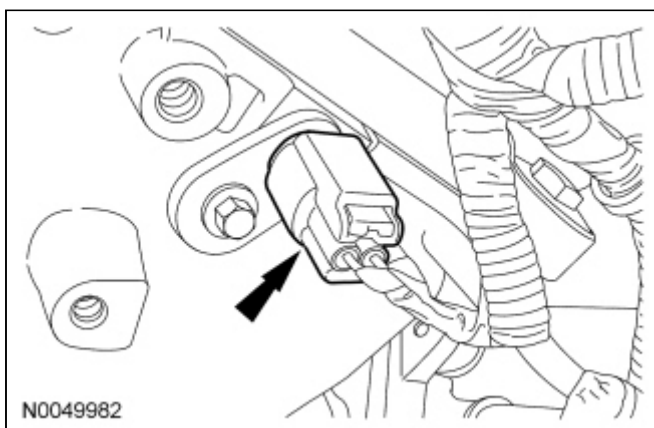
86. Connect the 4 LH fuel injector electrical connectors.



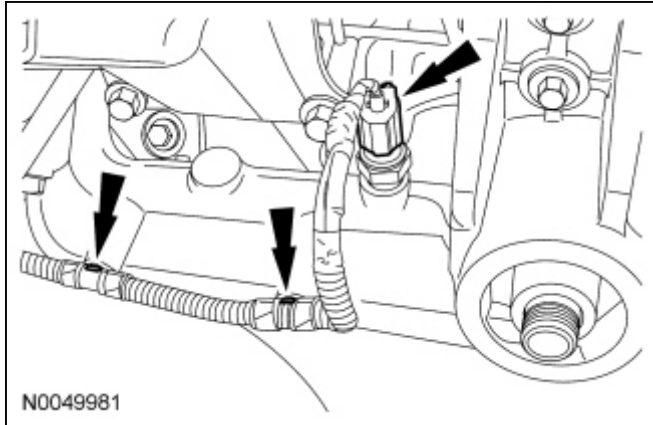
87. Connect the Intake Air Temperature 2 (IAT2) sensor electrical connector.



88. Connect the CMP sensor electrical connector.



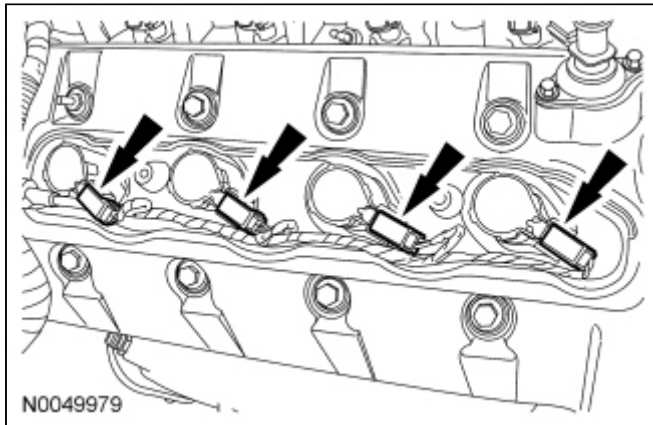
89. Connect the Engine Oil Pressure (EOP) switch electrical connector and the 2 wiring harness pin-type retainers.



90. **NOTE:** Apply a light film of brake dielectric grease to the inside of the coil boots before installation.

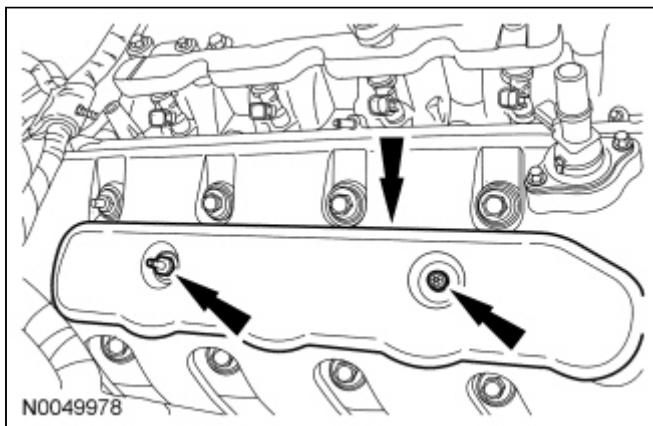
Install the 4 RH coil-on-plugs.

- Connect the 4 RH coil-on-plug electrical connectors.

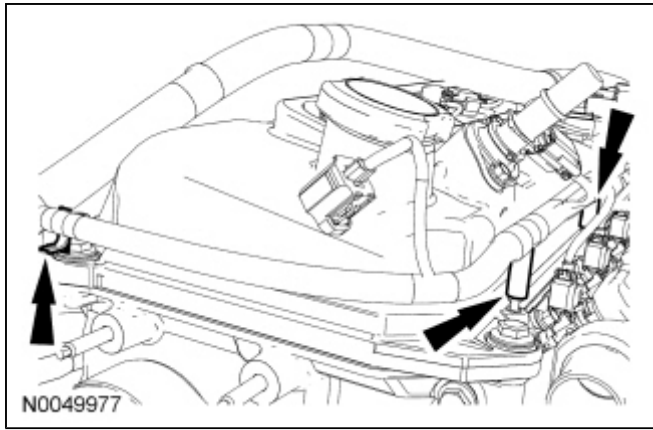


91. Install the RH coil-on-plug cover, bolt and stud bolt.

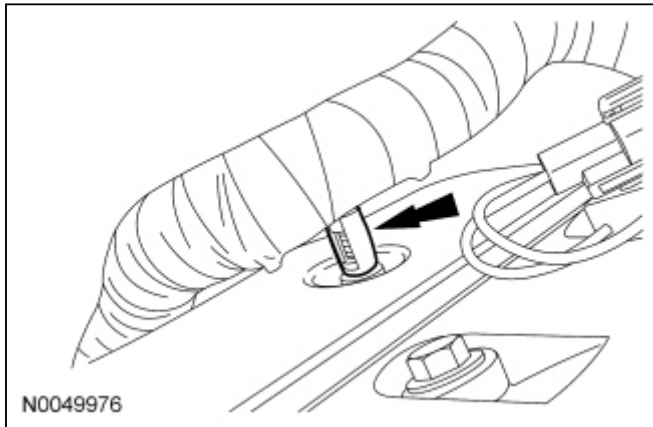
- Tighten to 10 Nm (89 lb-in).



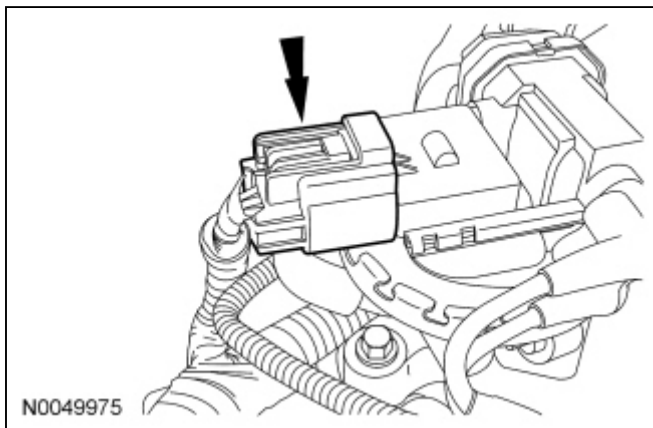
92. Attach the wiring harness retainers to the RH valve cover stud bolts.



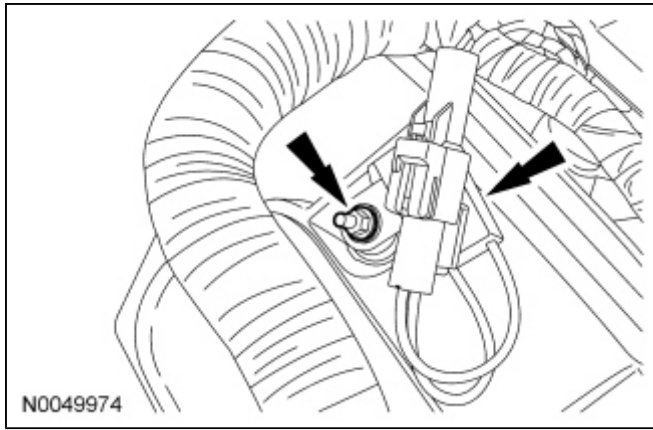
93. Attach the wiring harness to the RH coil-on-plug cover stud bolt.



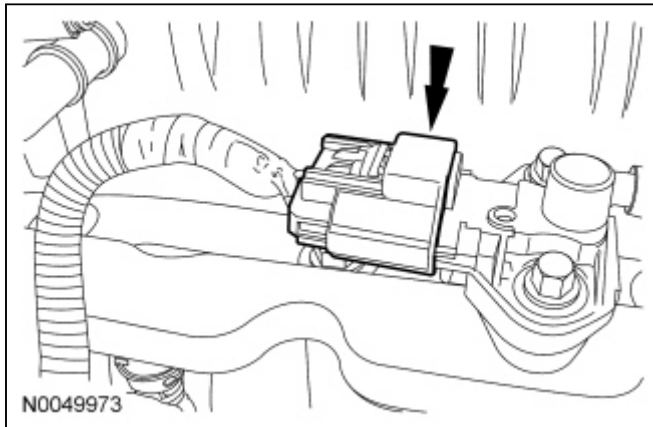
94. Connect the EGR valve electrical connector.



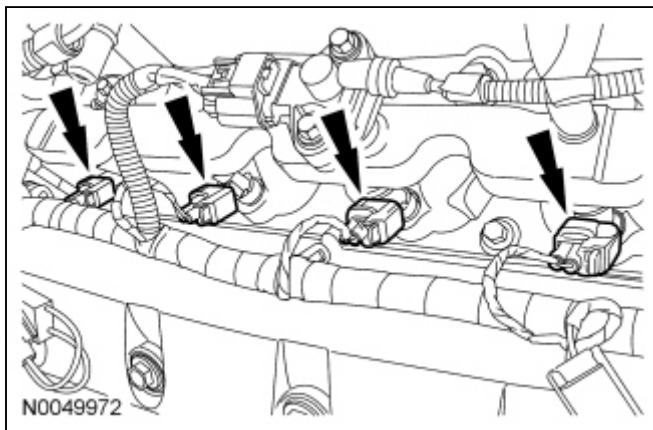
95. Install the RH radio interference capacitor and the nut.
• Tighten to 10 Nm (89 lb-in).



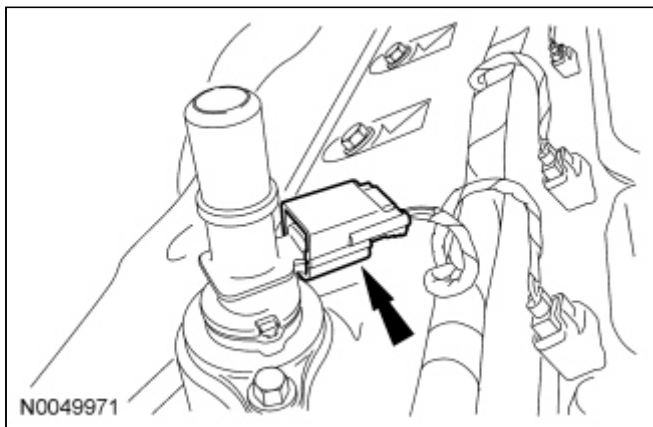
96. Connect the fuel rail pressure and temperature sensor electrical connector.



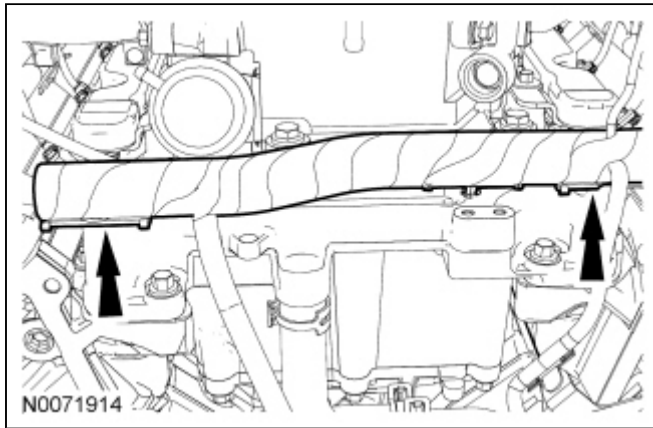
97. Connect the 4 RH fuel injector electrical connectors.



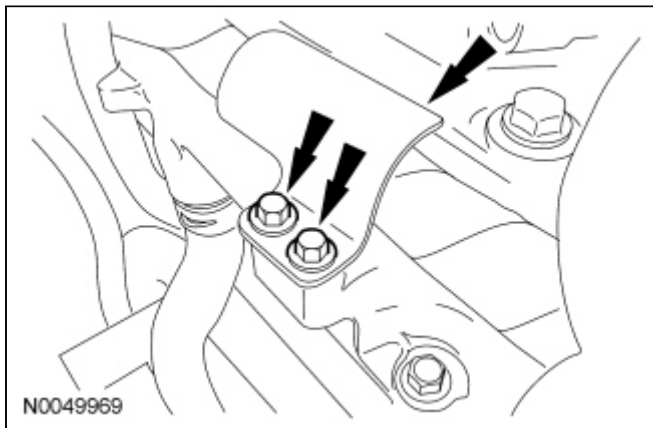
98. Connect the PCV valve electrical connector.



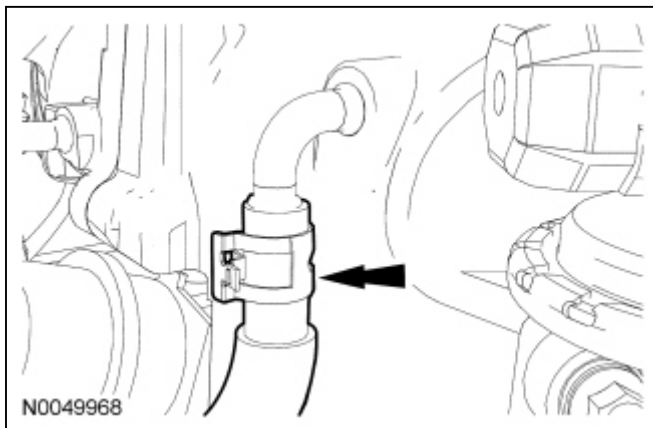
99. Attach the 2 wiring harness pin-type retainers.



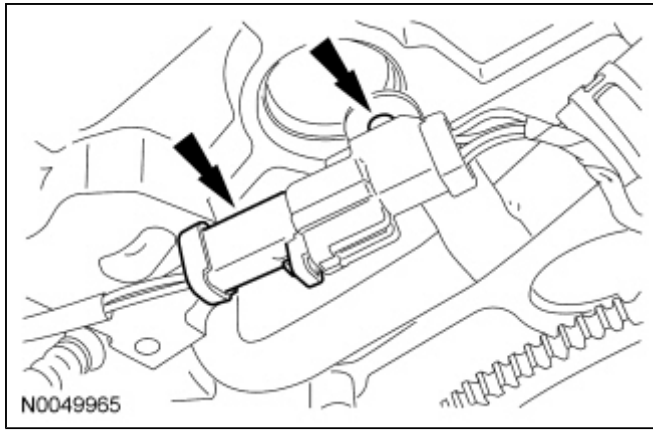
100. Install the wiring harness retaining bracket and the 2 bolts.
• Tighten to 10 Nm (89 lb-in).



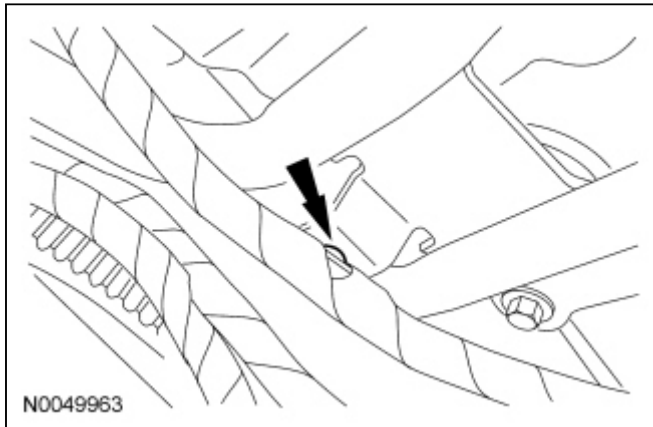
101. Connect the bubbler tube from the Supercharger (SC).



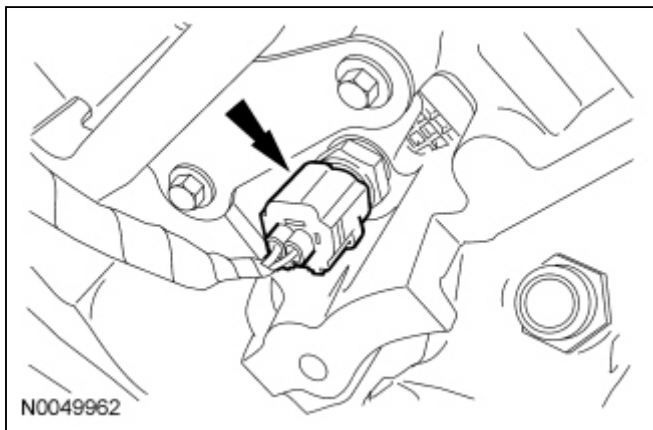
102. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector and pin-type retainer.



103. Attach the 2 wiring harness pin-type retainers (1 shown) to the coolant tube assembly bracket.

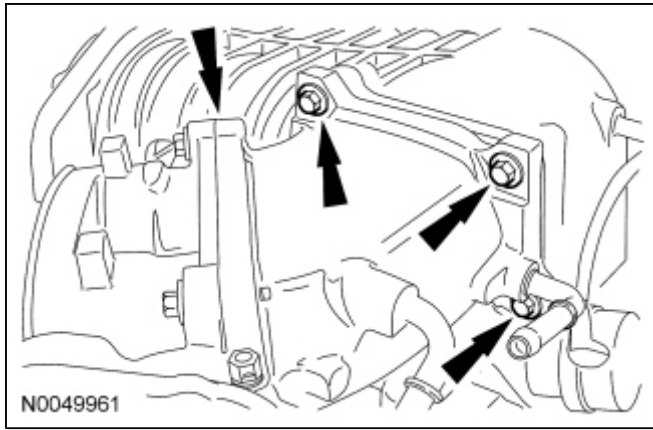


104. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.

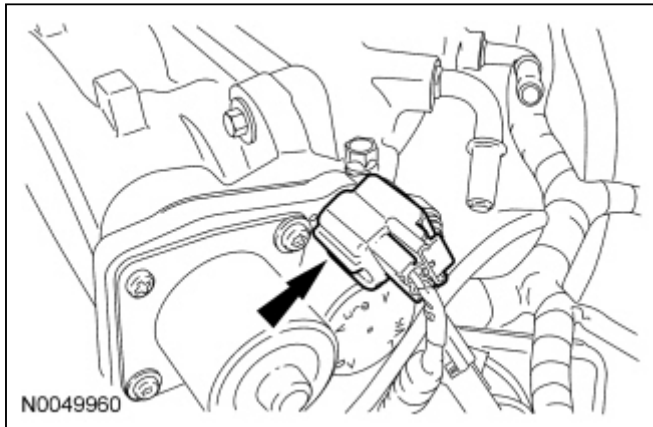


105. Install a new gasket, the Throttle Body (TB) and spacer assembly and the 4 bolts.

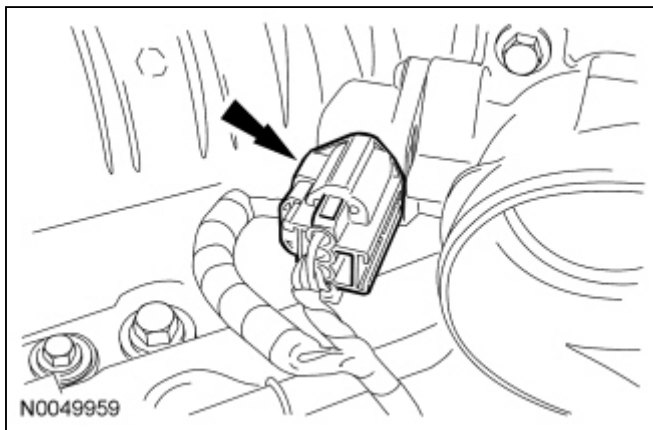
- Tighten to 10 Nm (89 lb-in).



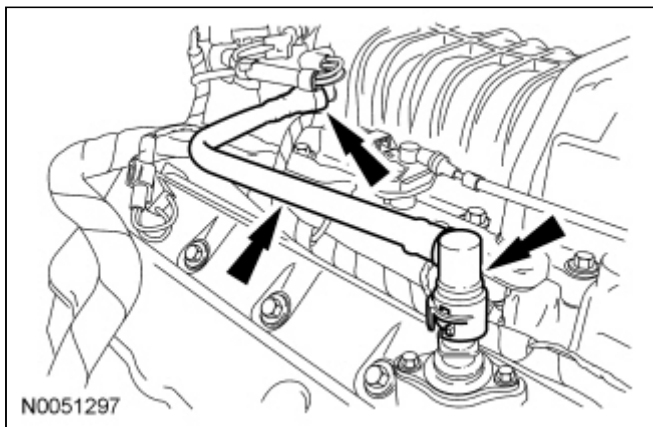
106. Connect the electronic throttle control electrical connector.



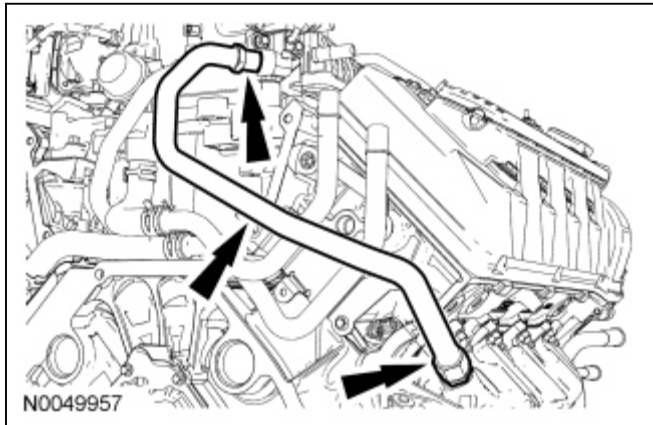
107. Connect the Throttle Position (TP) sensor electrical connector.



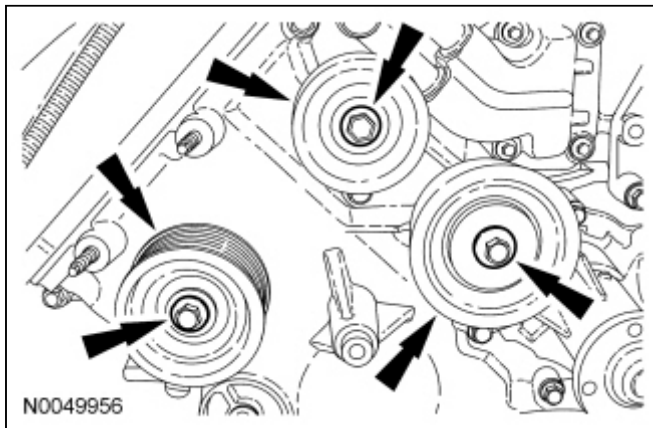
108. Install and connect the crankcase ventilation tube.



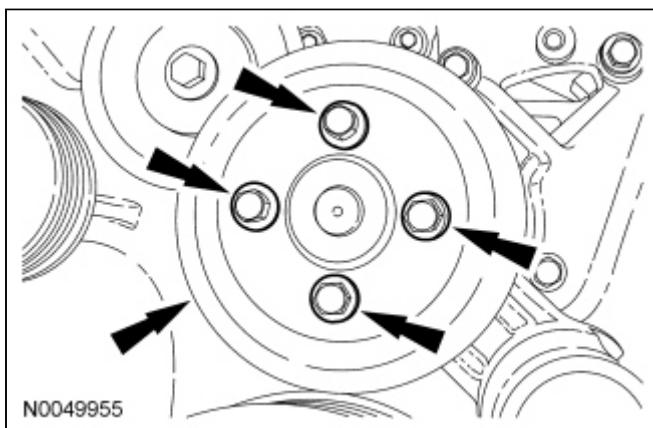
109. Install the EGR tube.
- Tighten to 40 Nm (30 lb-ft).



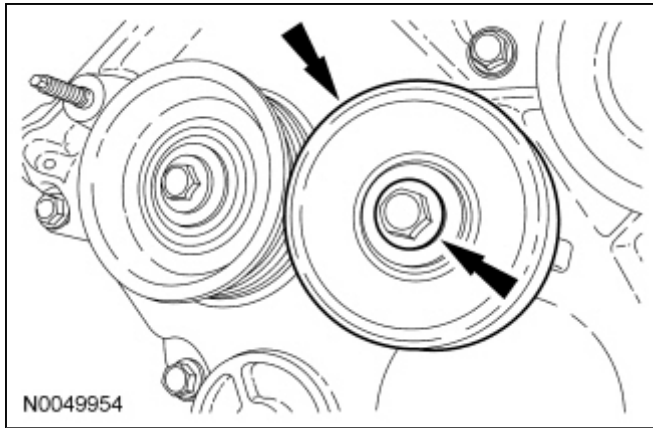
110. Install the 3 **SC** drive belt idler pulleys and the 3 bolts.
- Tighten the heavy load idler pulley (closest to centerline of engine) to 48 Nm (35 lb-ft).
 - Tighten the smooth idler pulley and the grooved idler pulley to 25 Nm (18 lb-ft).



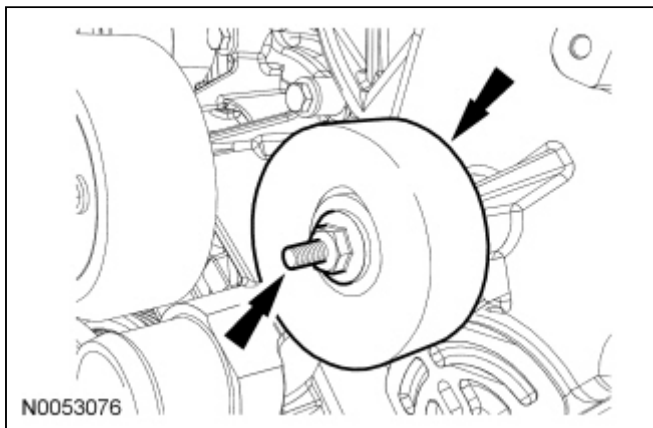
111. Install the coolant pump pulley and install the 4 bolts hand-tight.



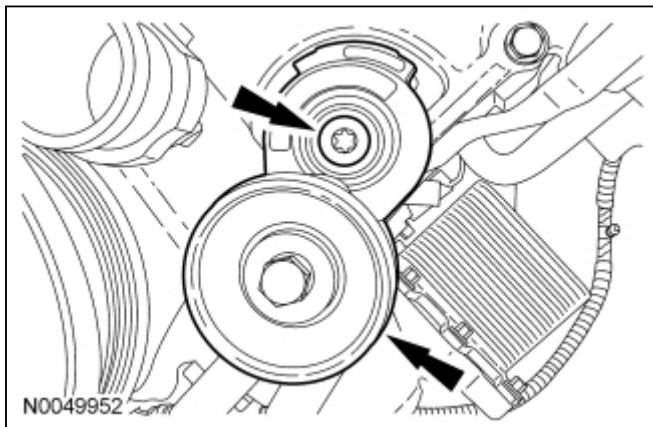
112. Install the accessory drive belt idler pulley (grooved) and the bolt.
- Tighten to 25 Nm (18 lb-ft).



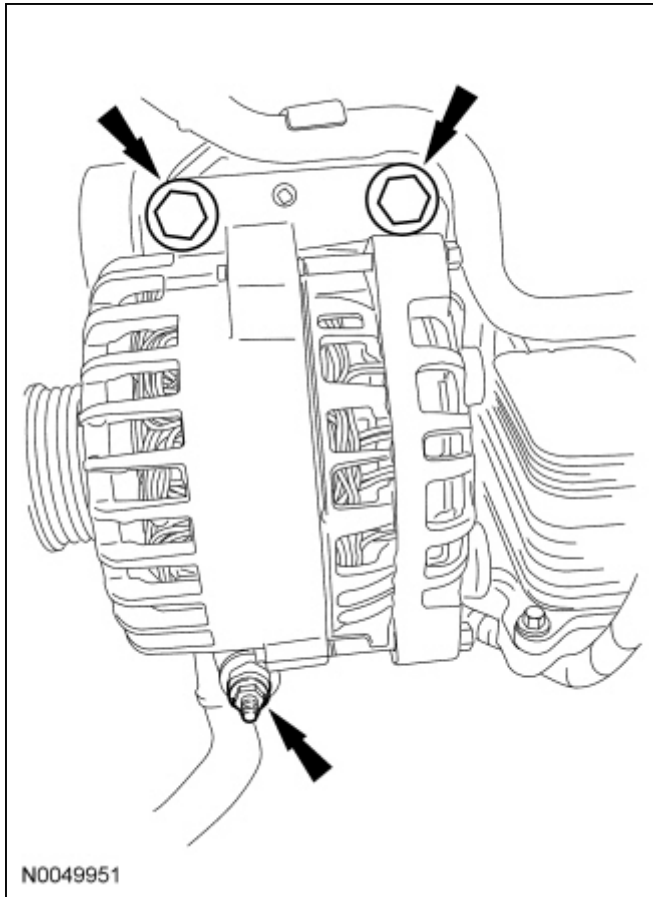
113. Install the accessory drive belt idler pulley (smooth) and the stud bolt.
- Tighten to 25 Nm (18 lb-ft).



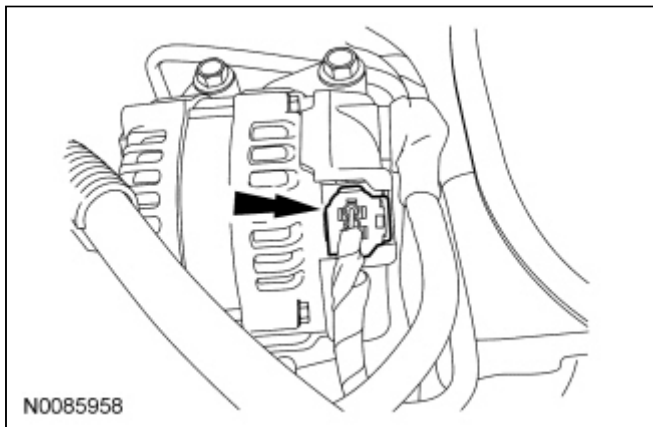
114. Install the accessory drive belt tensioner and the bolt.
- Tighten to 25 Nm (18 lb-ft).



115. Install the generator, 2 bolts and the stud bolt.
- Tighten to 50 Nm (37 lb-ft).

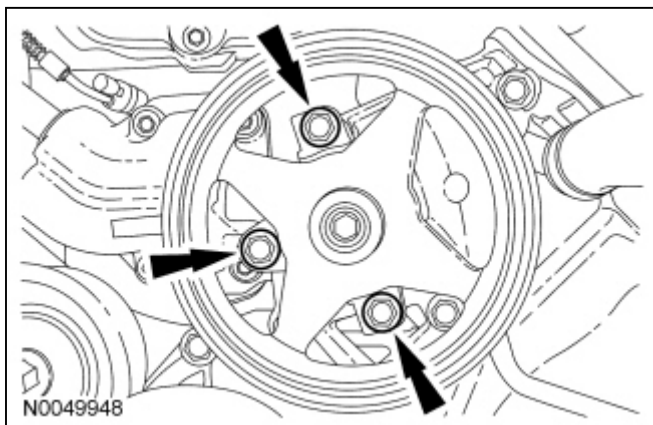


116. Connect the generator electrical connector.

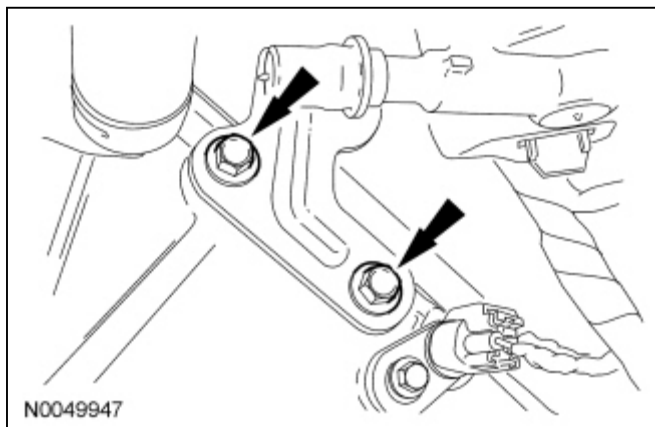


117. Install the power steering pump and reservoir assembly and the 3 bolts.

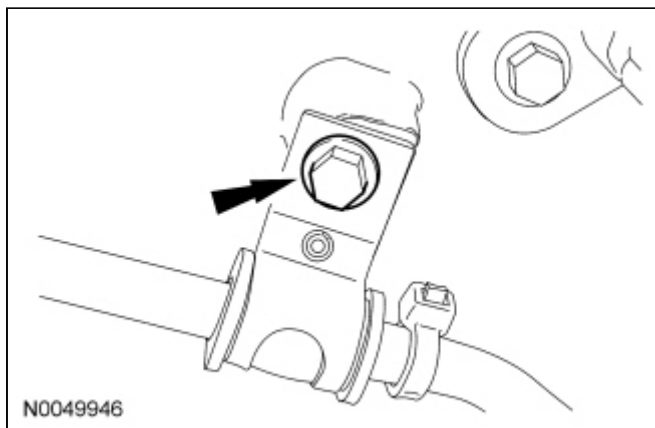
- Tighten to 25 Nm (18 lb-ft).



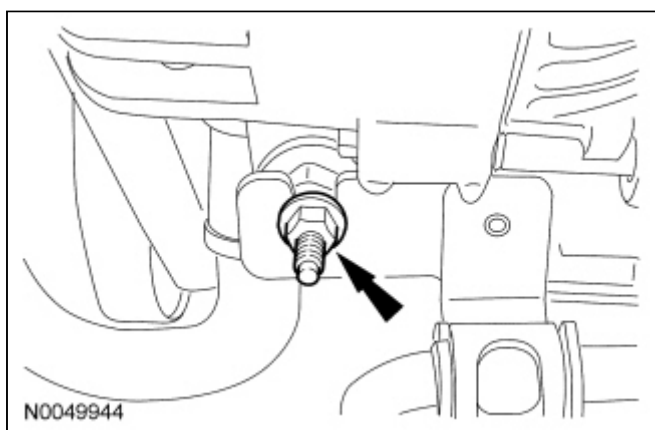
118. Install the power steering reservoir bracket bolts.
- Tighten to 25 Nm (18 lb-ft).



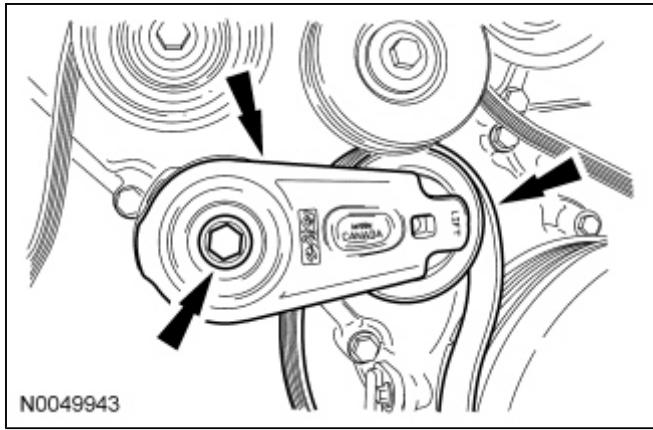
119. Install the power steering tube bracket bolt.
- Tighten to 10 Nm (89 lb-in).



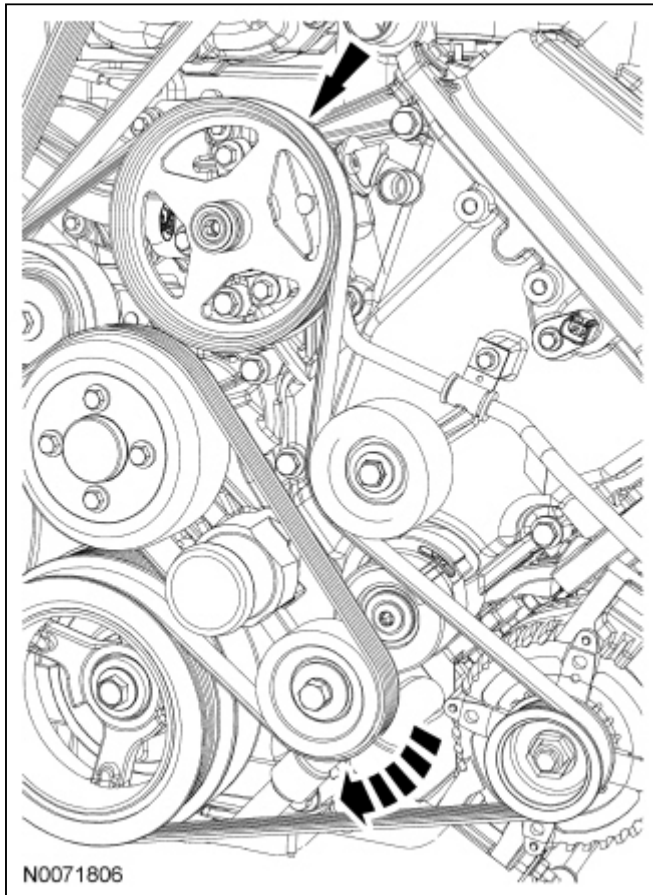
120. Install the power steering tube bracket nut.
- Tighten to 10 Nm (89 lb-in).



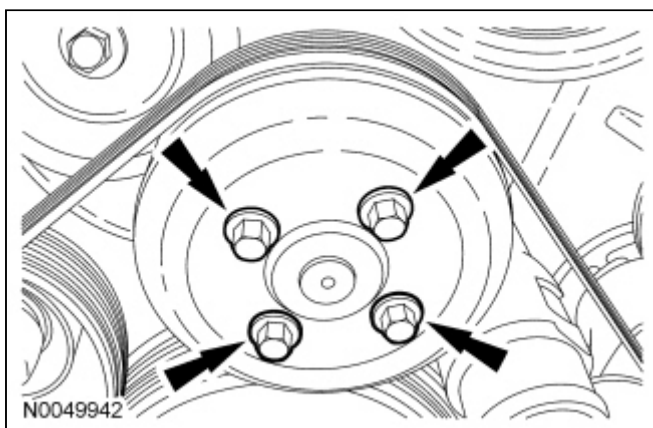
121. Position the **SC** drive belt and install the **SC** drive belt tensioner and bolt.
- Tighten to 48 Nm (35 lb-ft).



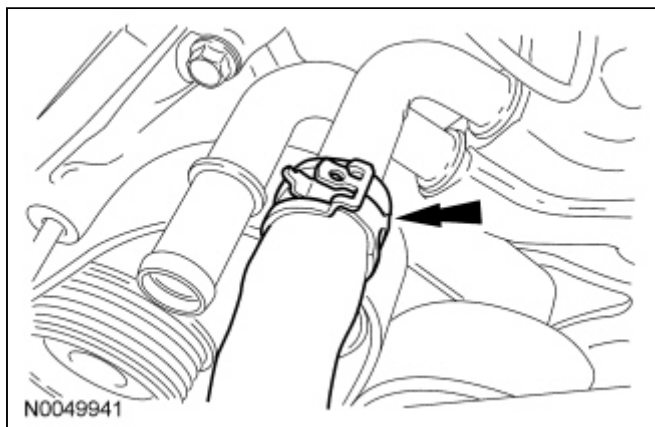
122. Rotate the accessory drive belt tensioner clockwise and install the accessory drive belt.



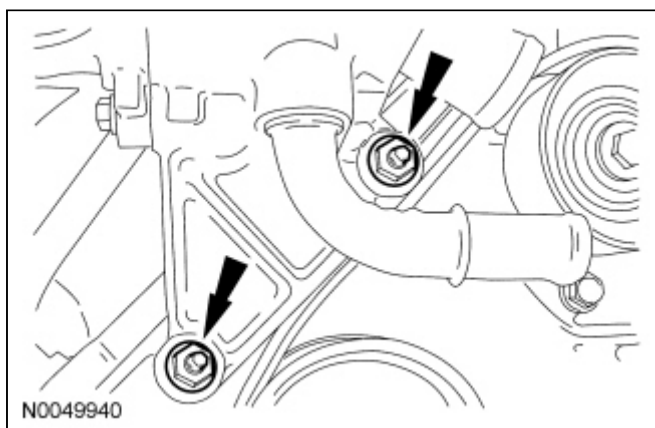
123. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).



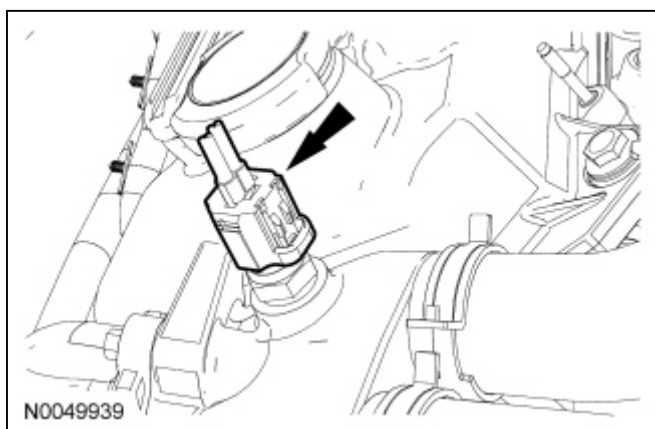
124. Connect the coolant hose from the Charge Air Cooler (CAC).



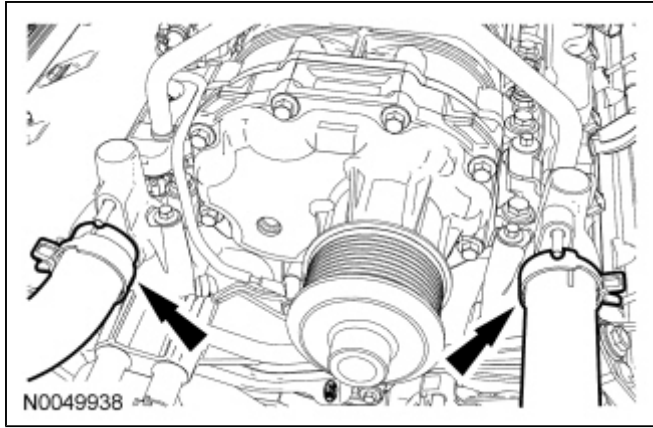
125. Install the thermostat housing assembly and the 2 nuts.
• Tighten to 25 Nm (18 lb-ft).



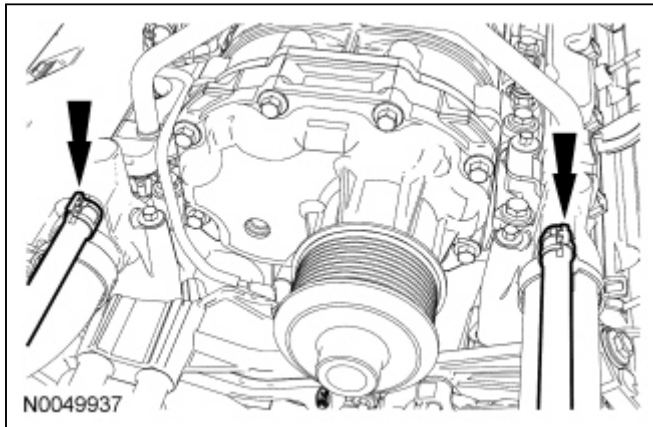
126. Connect the Engine Coolant Temperature (ECT) sensor electrical connector.



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

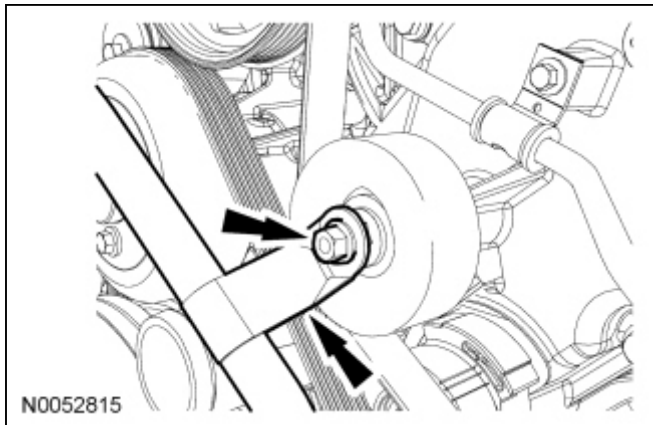


128. Connect the 2 coolant vent hoses to the intake manifold.

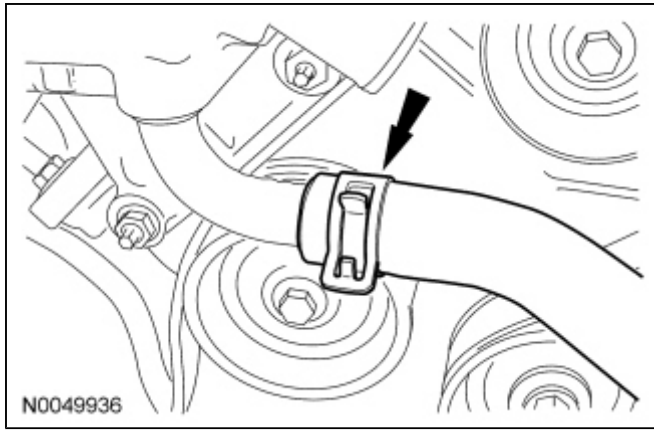


129. Install the coolant tube bracket nut.

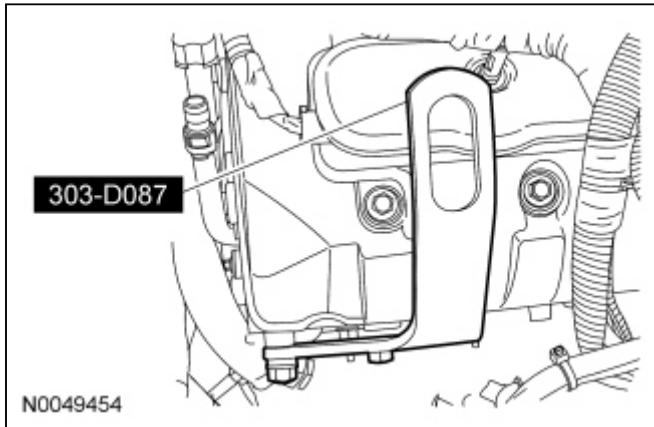
- Tighten to 9 Nm (80 lb-in).



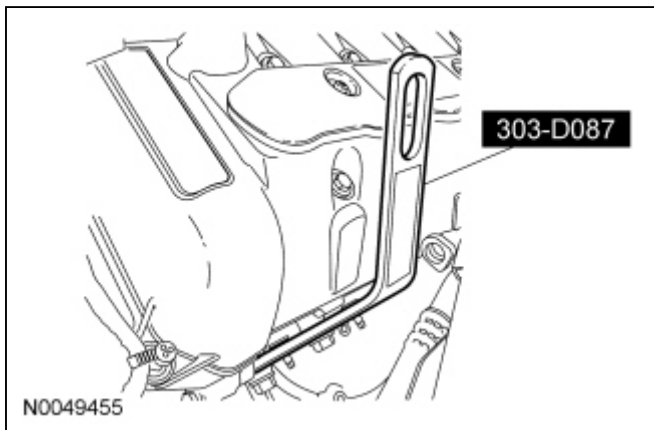
130. Connect the coolant hose to the thermostat housing.



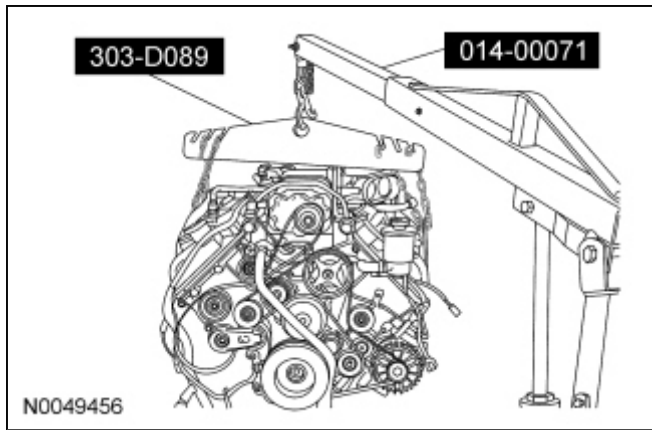
131. Install the Engine Lifting Bracket.



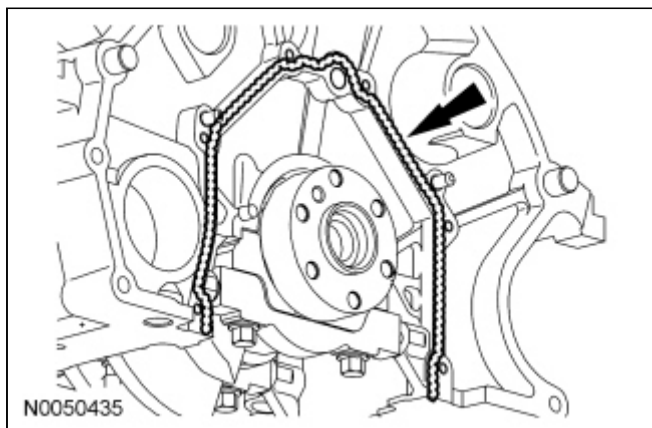
132. Install the Engine Lifting Bracket.



133. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, remove the engine from the work stand.



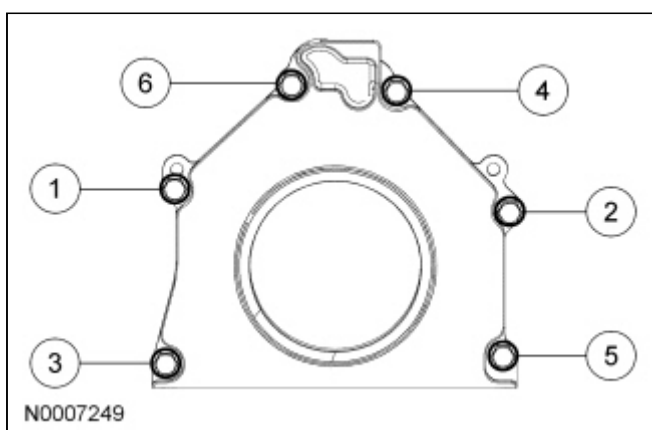
134. Apply a 4 mm (0.15 in) bead of silicone gasket and sealant to the rear crankshaft seal retainer mating surface on the engine block.



135. **NOTICE:** 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.

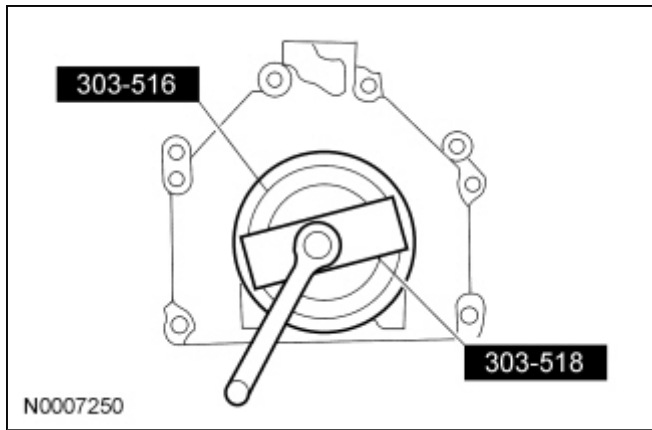
Install the crankshaft rear seal retainer plate and the 6 bolts.

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

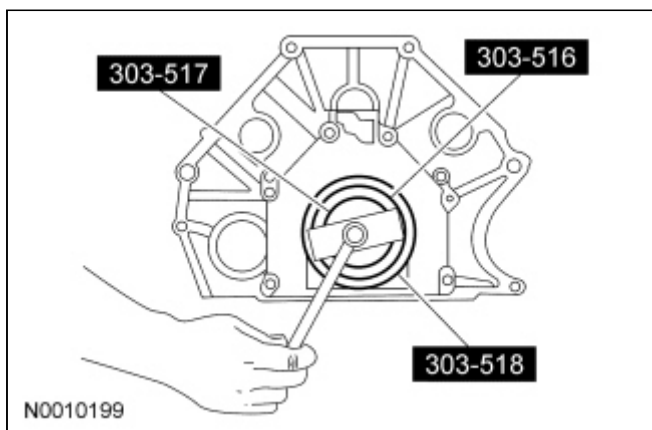


136. **NOTE:** Lubricate the inner lip of the crankshaft rear seal with clean engine oil.

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



137. Using the Crankshaft Rear Oil Seal Installers and the Crankshaft Rear Oil Slinger Installer, install the crankshaft rear seal.

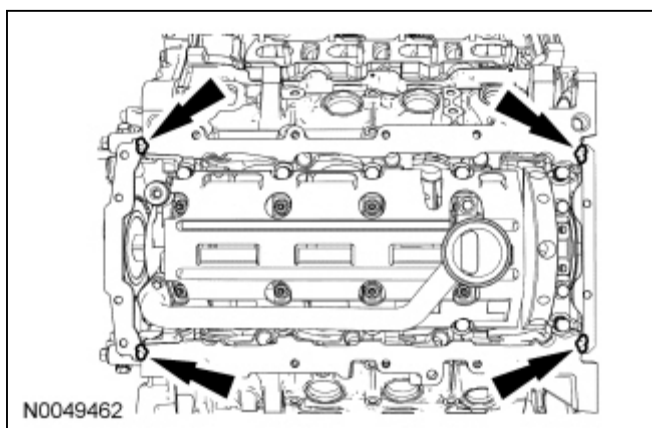


138. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

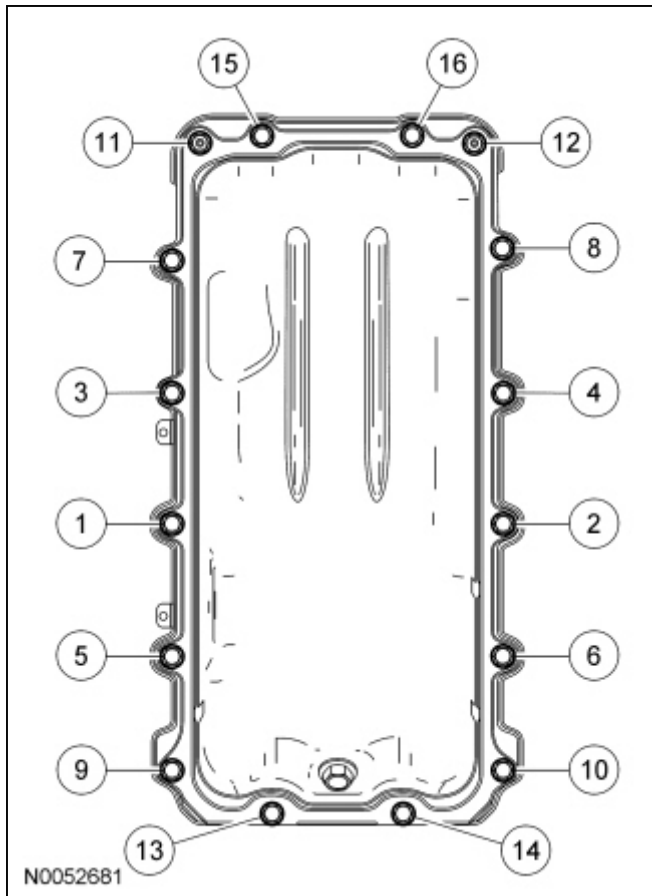
Inspect the oil pan. Clean the mating surface for the oil pan with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

139. **NOTICE:** 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.

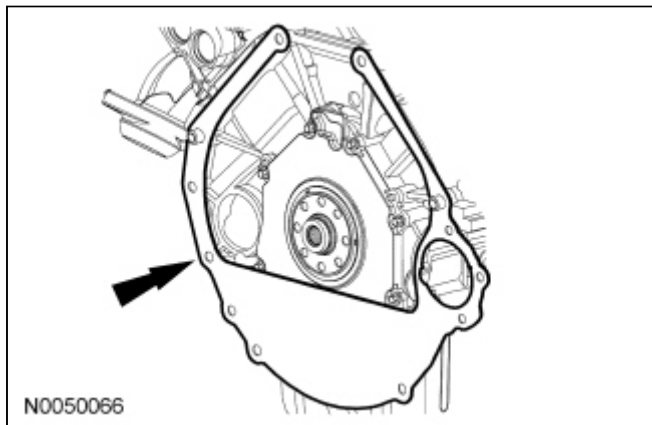
Apply silicone gasket and sealant at the engine front cover-to-cylinder block sealing joints and the crankshaft rear seal retainer plate-to-cylinder block sealing joints.



140. Using a new gasket, install the oil pan, 14 bolts and 2 stud bolts.
- Tighten in the sequence shown to 25 Nm (18 lb-ft).



141. Install the engine/transmission spacer plate.



142. Position the flywheel on the crankshaft pilot and start the 8 flywheel bolts.

143. 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).

