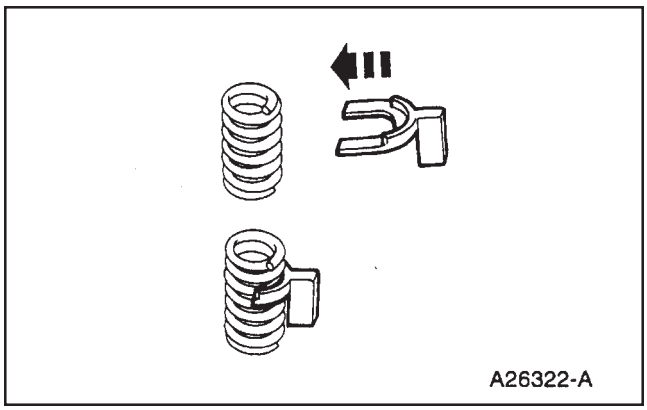
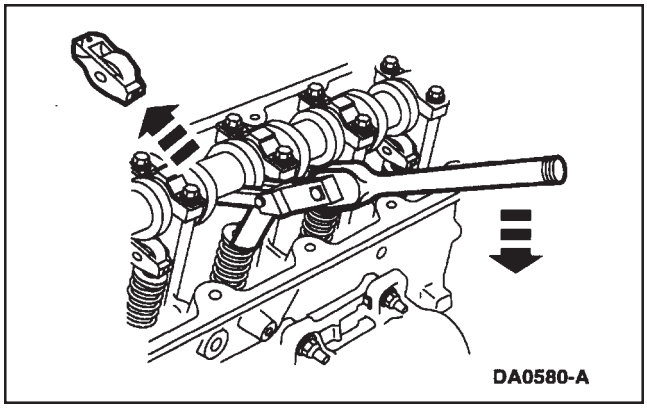


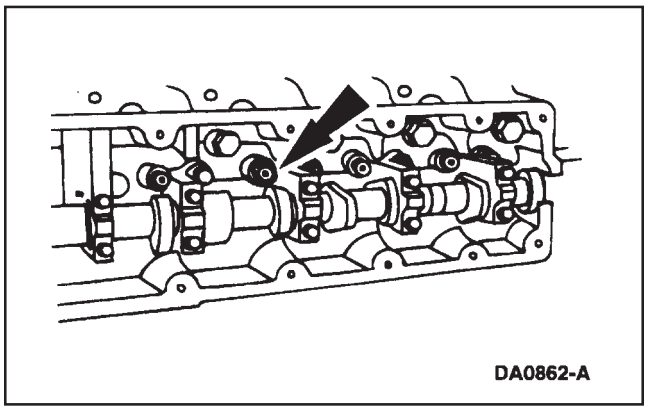
2. **⚠ CAUTION: Do not remove the camshaft before removing the roller followers.**

   ⚠ CAUTION: Place the cylinder head on a cardboard or wood surface to prevent damage to the joint face.

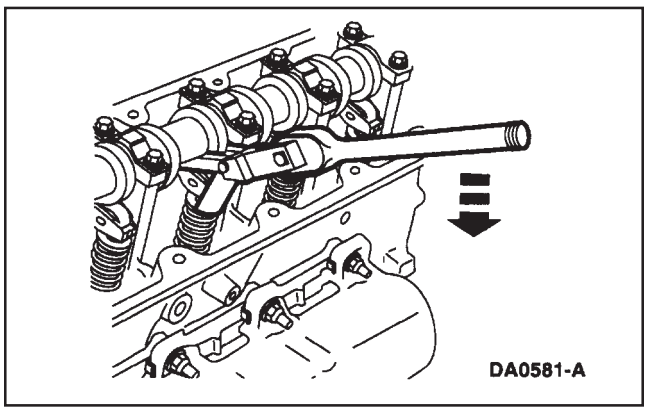
   Install the Valve Spring Spacer between the valve spring coils to prevent valve stem seal damage.



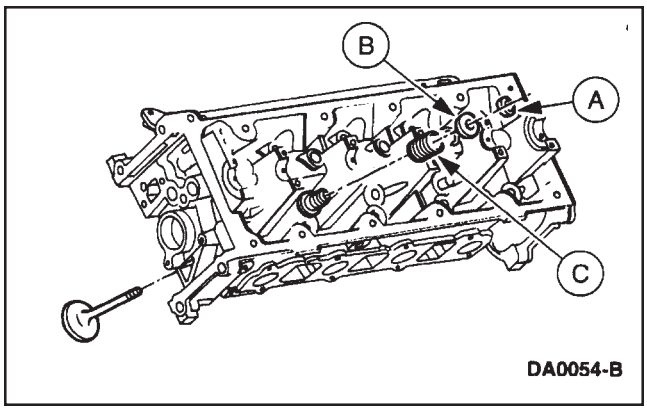
3. Use the Valve Spring Compressor to compress the valve springs (6513), and remove the roller followers.



4. Remove the hydraulic lash adjusters.



5. Use the Valve Spring Compressor to compress the valve springs.

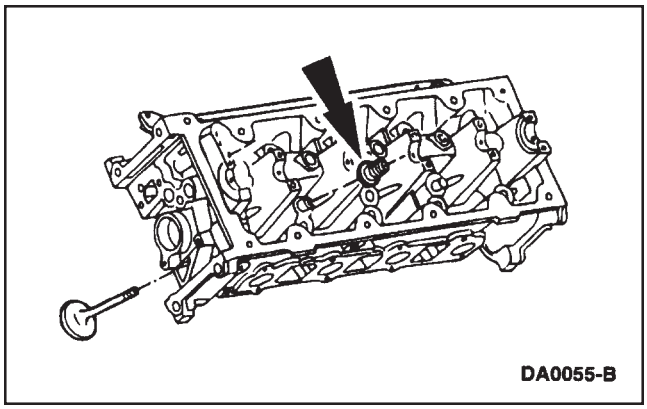


6. **CAUTION: Keep the valves and the valve spring retainer keys (6518) in order so they can be installed in the same positions.**

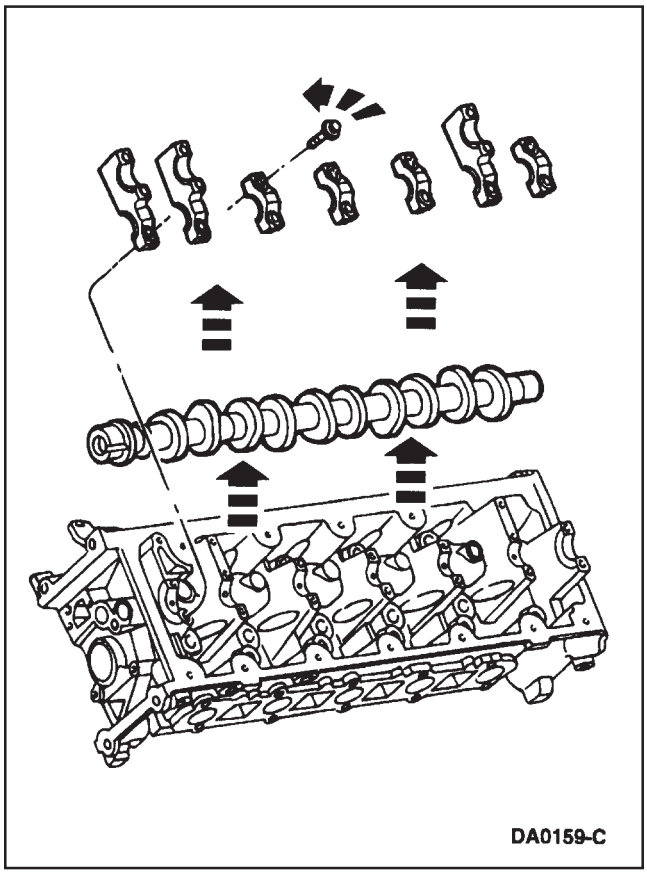
   NOTE: The 8-cylinder is shown. The 10-cylinder is similar.

   NOTE: Shown without camshaft for clarity.

   Remove the (A) valve spring retainer keys, the (B) valve spring retainers (6514), the (C) valve springs, and the valves.



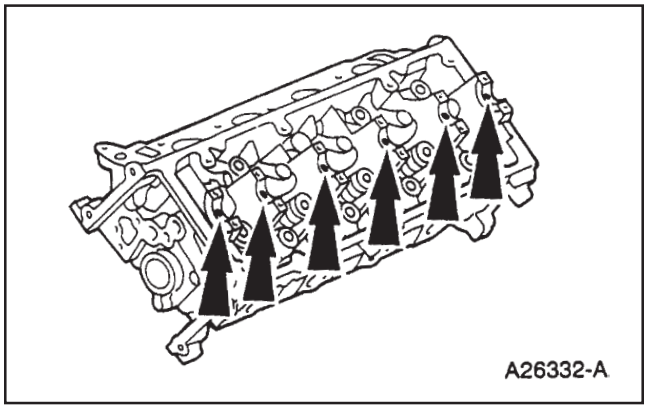
7. Remove the valve stem seals (6571).

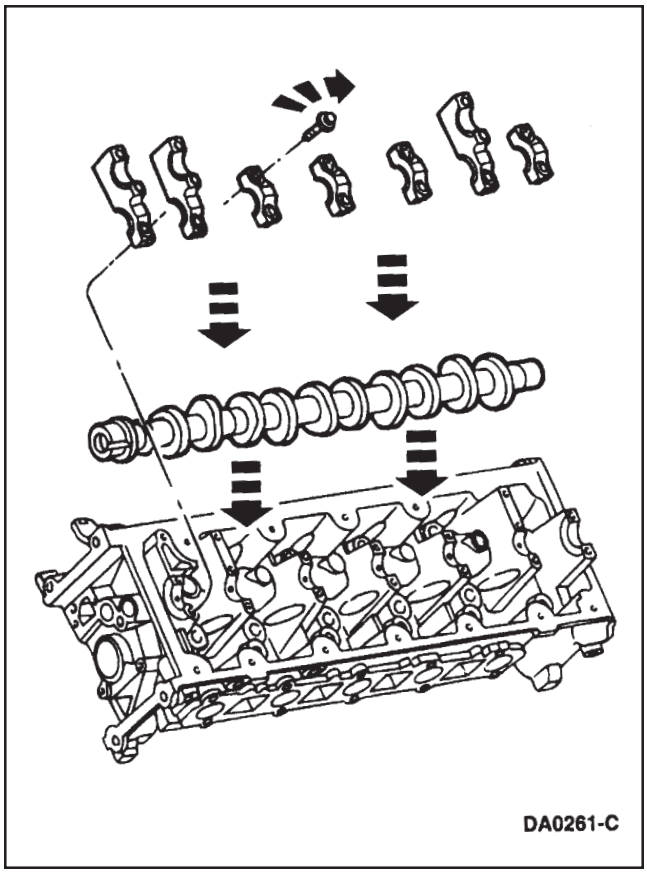


8. **CAUTION: The caps must be marked for installation in their original location or damage to the engine may occur.**

   Remove the bolts, the bearing caps and the camshaft.

Cylinder Head - Assembly





1. **CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.**

   - Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

NOTE: Sealant must be removed and area cleaned with solvent if above instructions are not followed.

   - Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

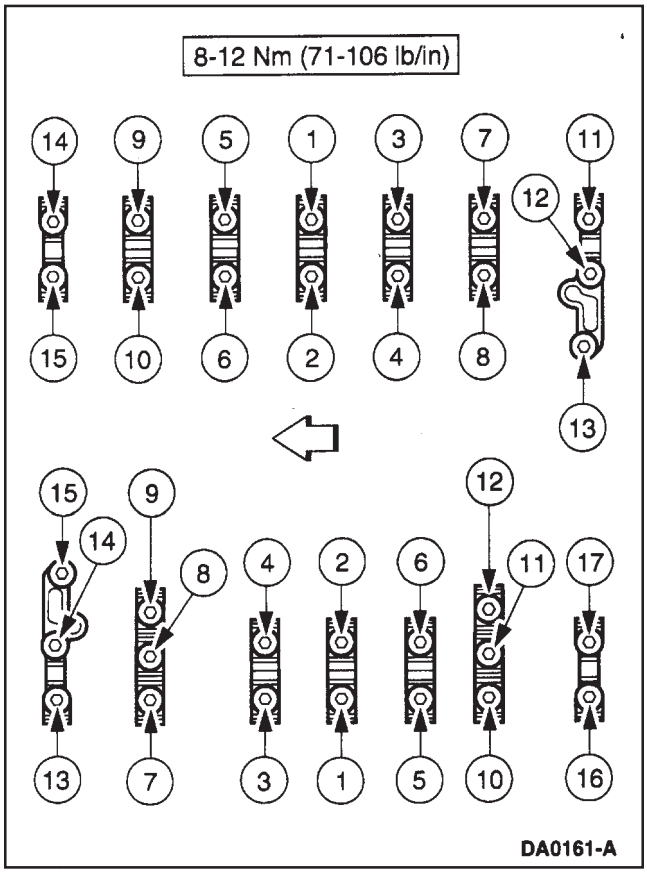
2. Lubricate the camshaft journals.

   - Use Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-C.

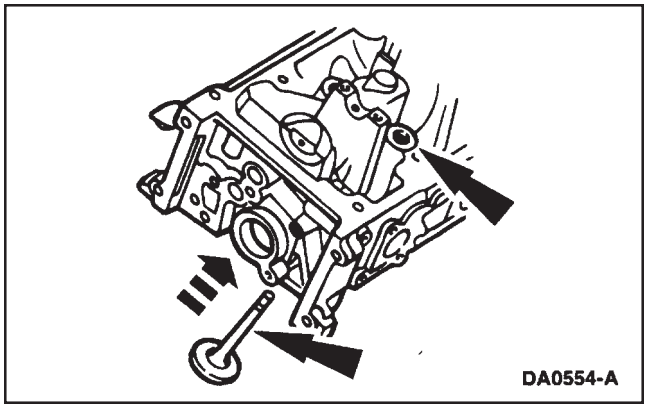
3. Install the camshaft and the camshaft bearing caps in their original location and the bolts.

   - Lubricate and position the camshaft bearing caps.

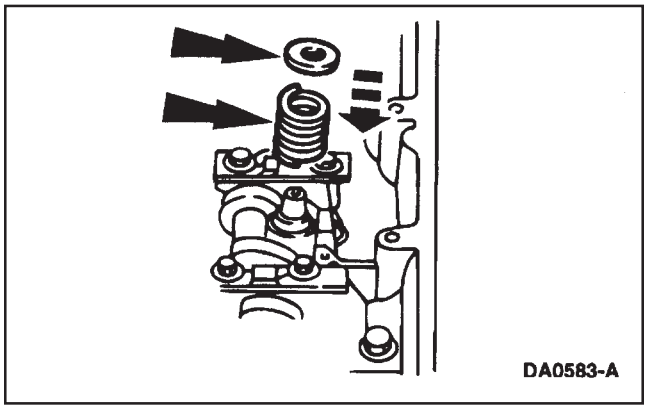
     – Use Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-G.



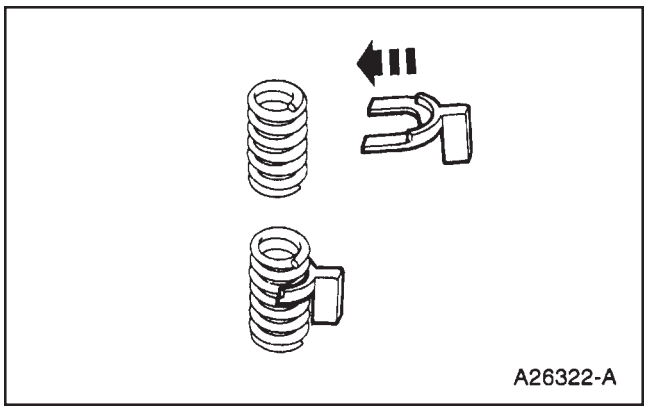
4. Tighten the bolts in the sequence shown.



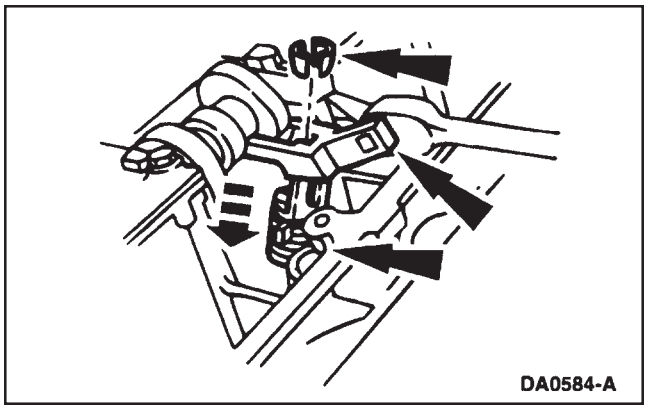
5. Install the valves in the valve guides located in the cylinder block (6010).



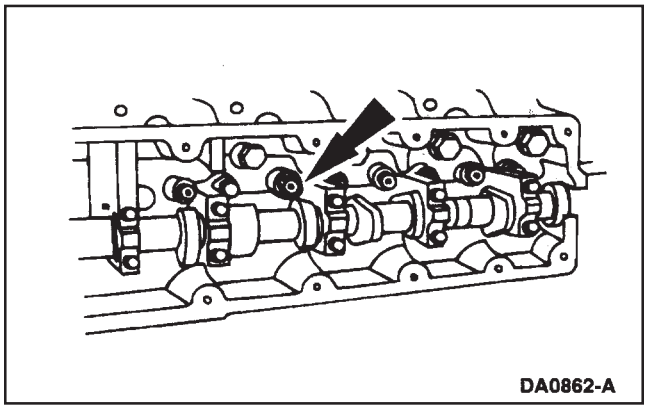
6. Install the valve spring and the valve spring retainer onto the valve.



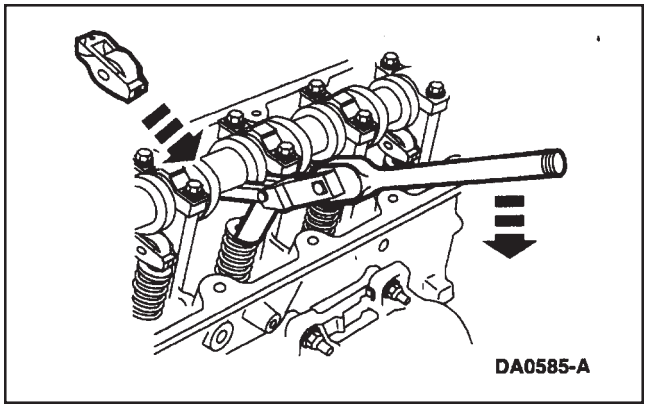
7. Install the valve spring spacer between the valve spring coils to prevent valve stem seal damage.



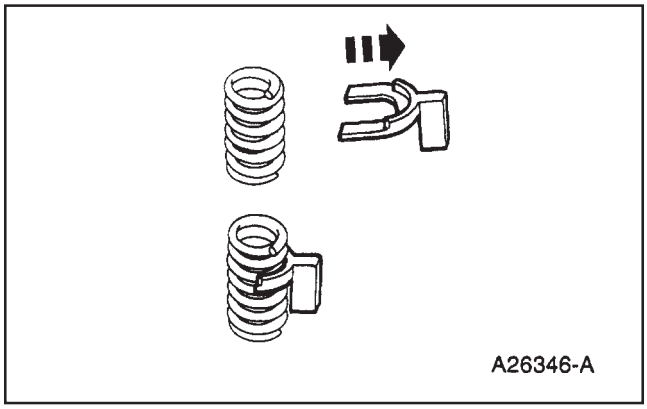
8. Use the Valve Spring Compressor to compress the valve spring, and install the valve spring retainer keys.



9. Install the hydraulic lash adjusters.



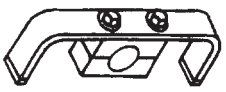
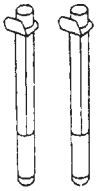
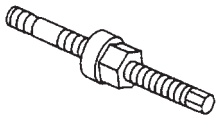
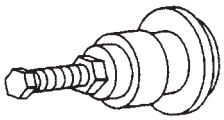
10. Install the roller followers.



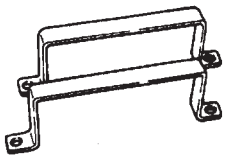
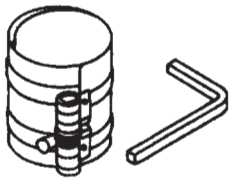
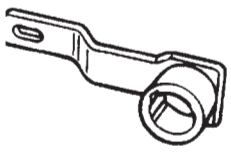
11. Remove the Valve Spring Spacer.

Engine - Assembly

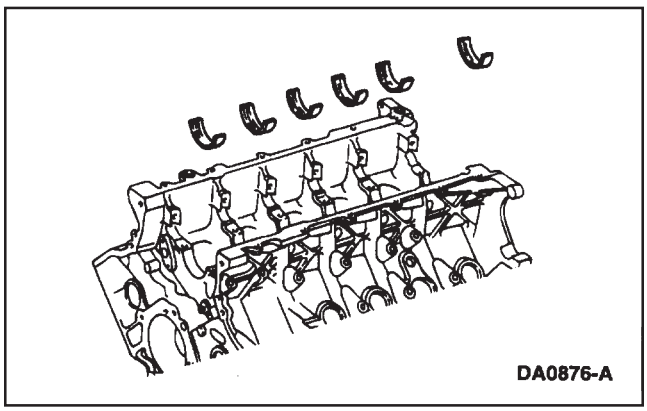
Special Tool(s)

	Camshaft Holding Tool 303-557 (T96T-6256-B) (2 Req'd)
 ST1337-A	Connecting Rod Guide Tool 303-442 (T93P-6136-A)
 ST1287-A	Crankshaft Damper Replacer 303-102 (T74P-6316-B)
 ST1328-A	Crankshaft Seal Replacer/Aligner 303-335 (T88T-6701-A)

Special Tool(s)

 ST1668-A	Lifting Handles (2 Sets Required) 303-572 (T97T-6000-A)
	Piston Ring Compressor 303-D032 (D81L-6002-C) or Equivalent
 ST1335-A	Crankshaft Holding Tool 303-448 (T93P-6303-A)

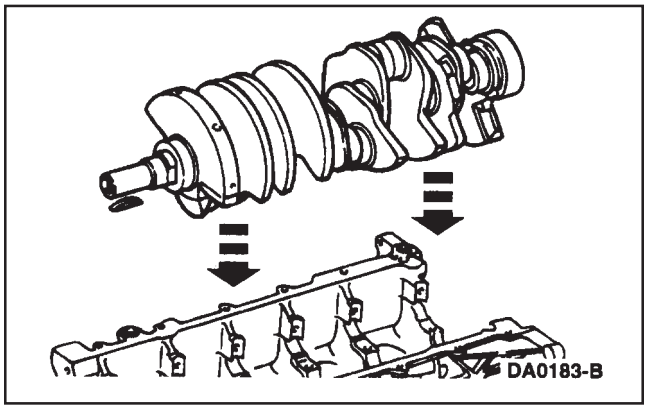
Special Service Tools called for by the procedures can be obtained by calling:
1-800-ROTUNDA (1-800-768-8632).


DA0876-A

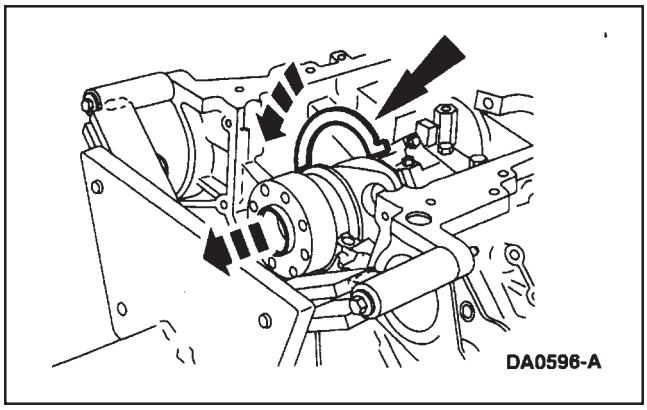
1. **NOTE:** Before assembling the cylinder block (6010), all seating surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

   Lubricate and install the crankshaft upper main bearings into the cylinder block.

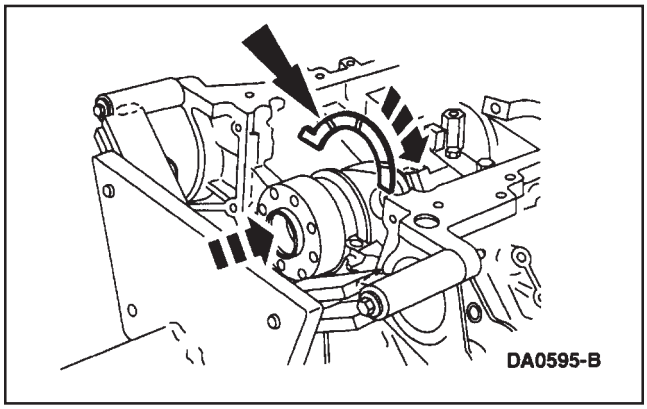
   - Use Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-G.



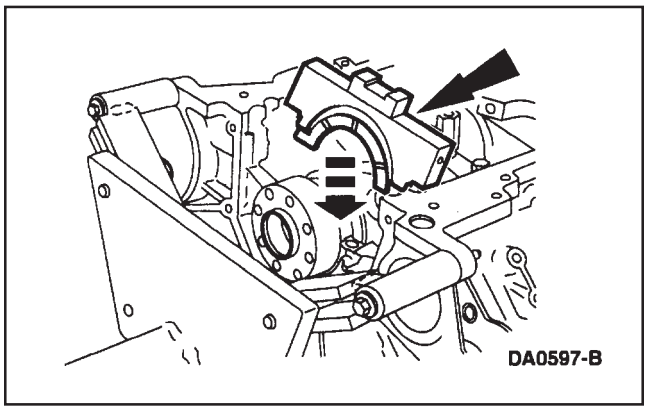
2. Install the crankshaft (6303) into the cylinder block and onto the upper crankshaft main bearings (6333).



3. Push the crankshaft rearward and install the rear lower crankshaft thrust washer (6334) at the back of the No. 6 main boss.

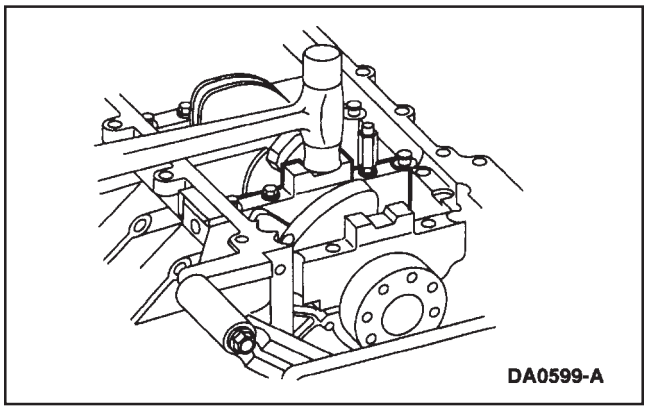


4. Push the crankshaft forward and install the front lower crankshaft thrust washer at the front of the No. 6 main boss.

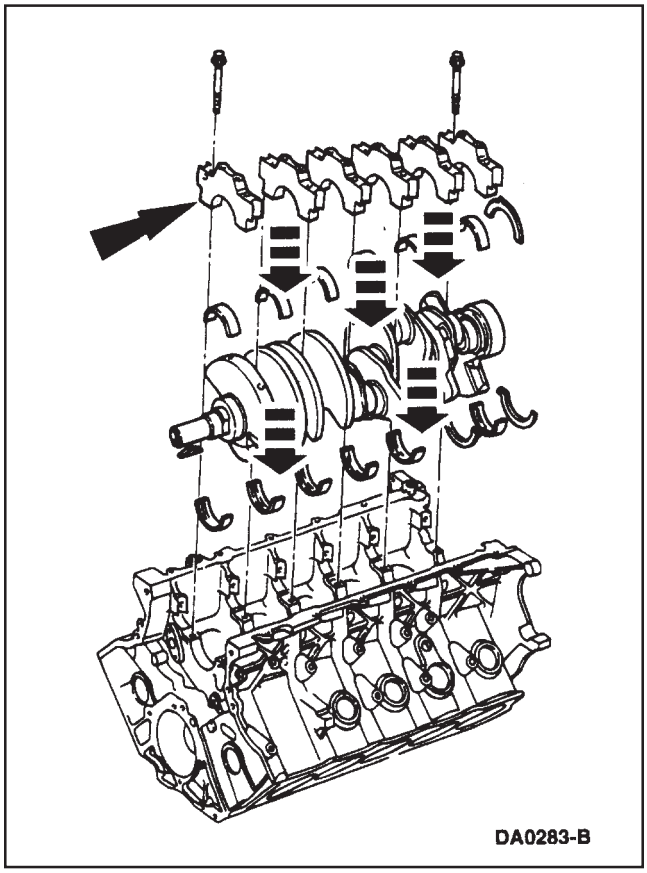


5. **NOTE:** To aid in assembly, apply petroleum jelly to the back of the crankshaft thrust washer.

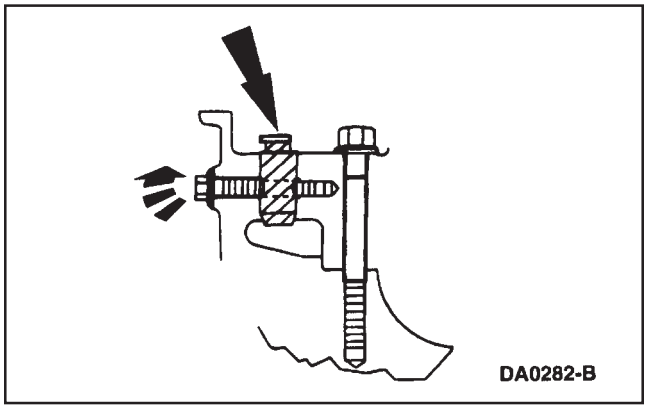
   Install the upper crankshaft thrust washer to the back side of the No. 6 main bearing cap, with oil grooves facing the crankshaft surface, and install the No. 6 rear main bearing cap.



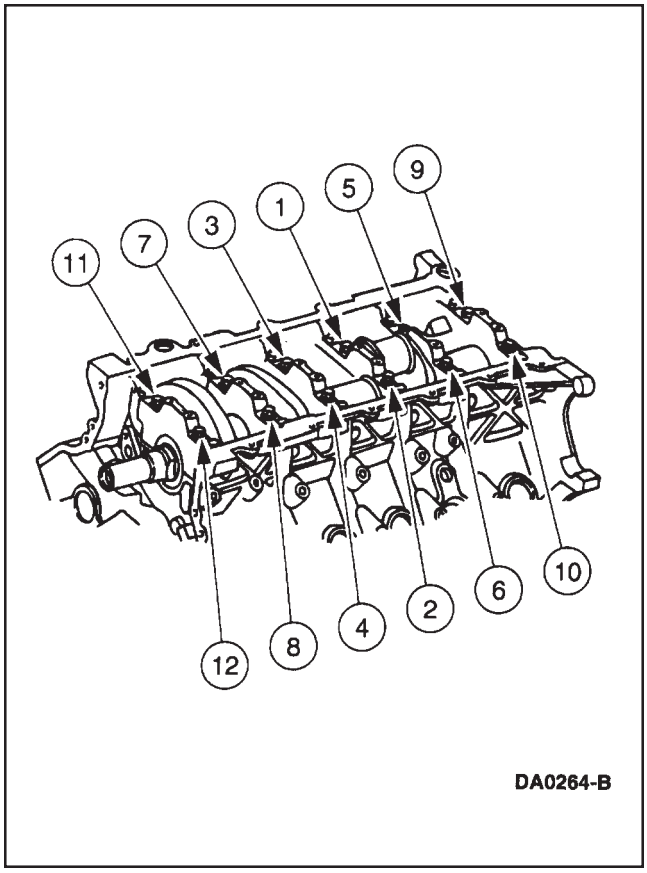
6. Install the No. 1 through No. 5 crankshaft lower main bearings into the main bearing caps. Locate the main bearing caps on the cylinder block and tap into place using a plastic or dead-blow hammer.



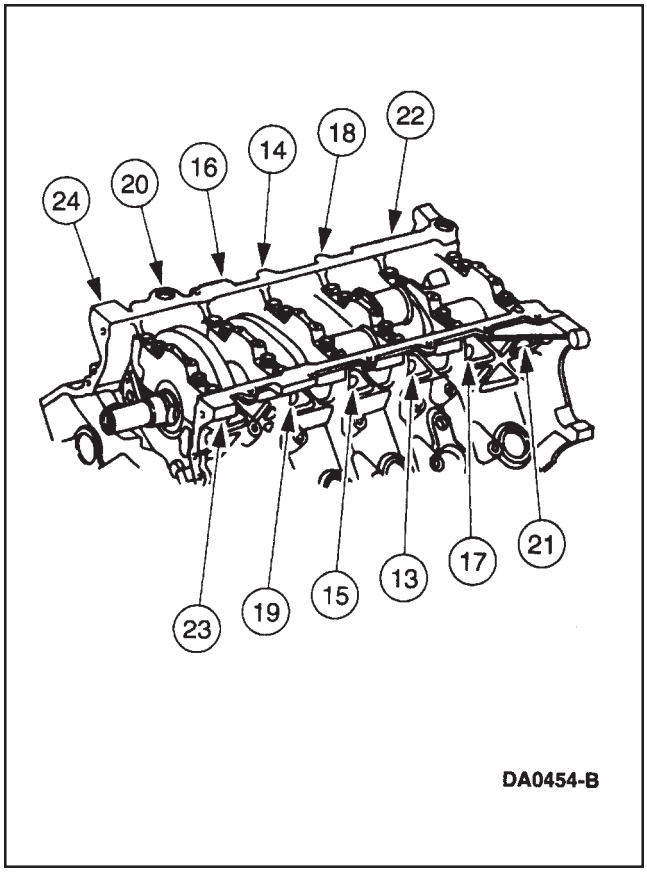
7. Install new main cap bearing bolts.



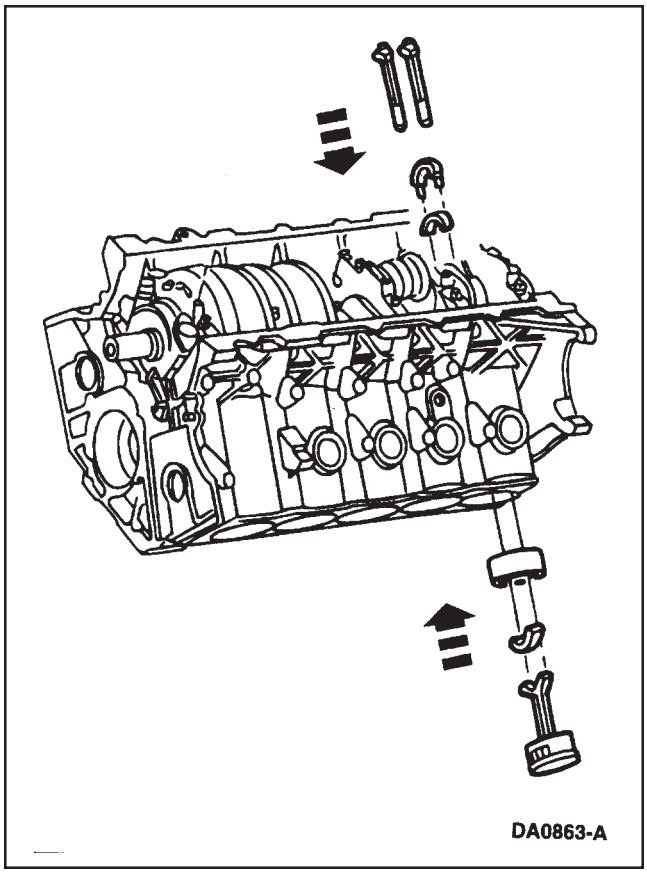
8. Install the ten dowel pins so that the flat sides face the crankshaft. Install the cross-mounted bolts.



9. Tighten fasteners 1 through 12 in two stages in the sequence shown.
   - Stage 1: Tighten to 37-43 Nm (22-32 lb/ft).
   - Stage 2: Tighten an additional 85 degrees to 95 degrees.



10. Tighten fasteners 13 through 24 in two stages in the sequence shown.
    - Stage 1: Tighten to 27-33 Nm (20-26 lb/ft).
    - Stage 2: Tighten an additional 85 degrees to 95 degrees.



11. Use the Connecting Rod Guide Tool and Piston Ring Compressor to install the piston and connecting rod assembly.

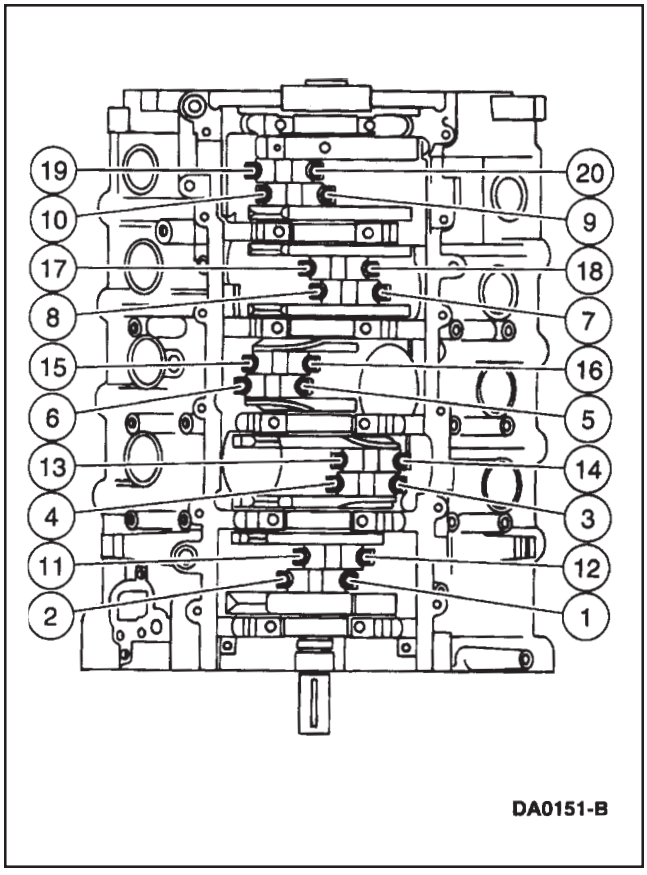
12. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod (6200).**

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

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

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

    Install the connecting rod bearings, position the connecting rod cap and loosely install the two new bolts.

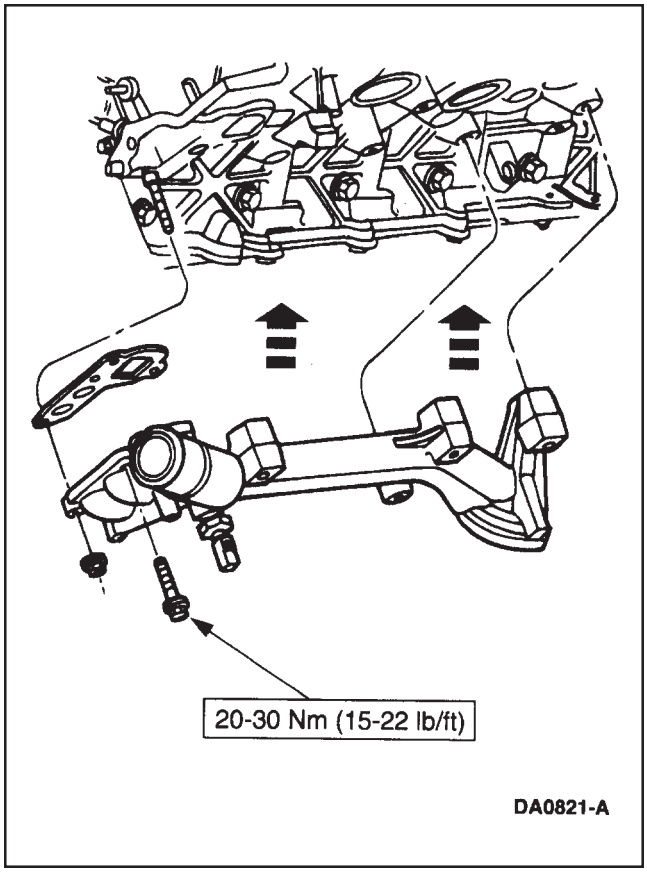


14. **NOTE:** Be sure to tighten the bolts in two stages.

    Tighten the connecting rod bolts in the sequence shown.

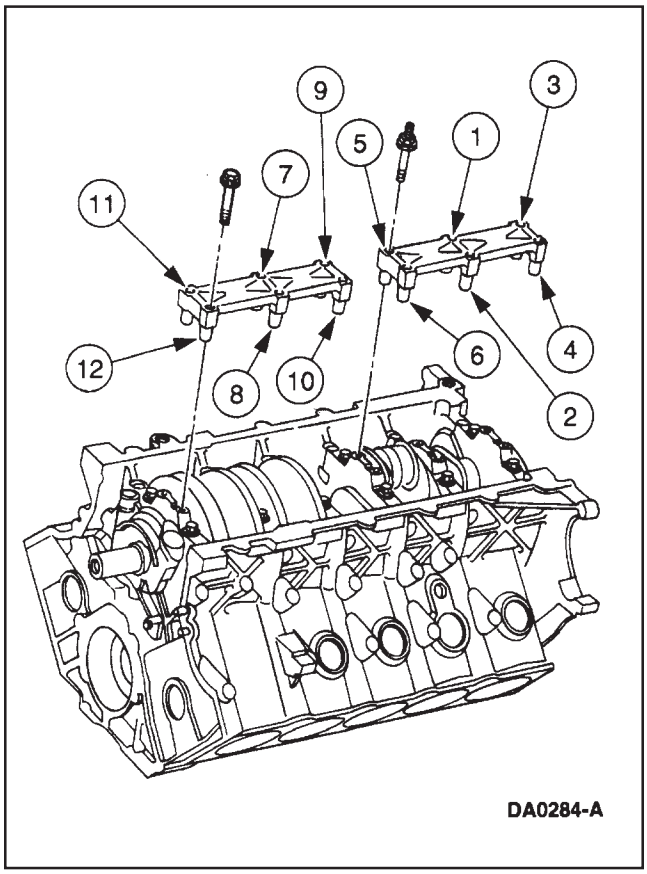
    - Stage 1: Tighten to 40-45 Nm (30-33 lb/ft).
    - Stage 2: Tighten an additional 90 degrees to 120 degrees.

15. Rotate the crankshaft and repeat the procedure to position each connecting rod at bottom dead center until all bolts are tightened to specification.

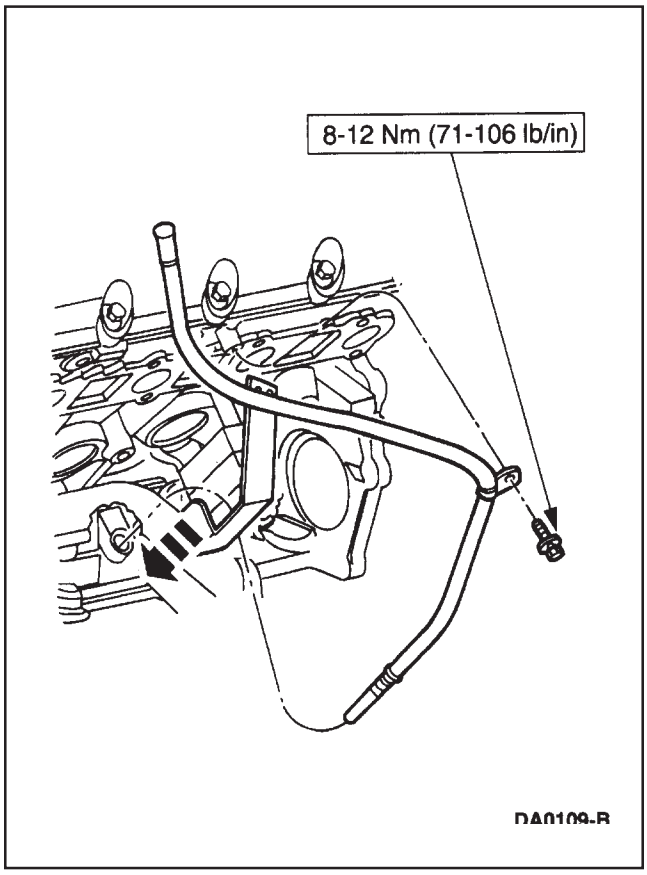


16. Install the oil filter adapter (6881).

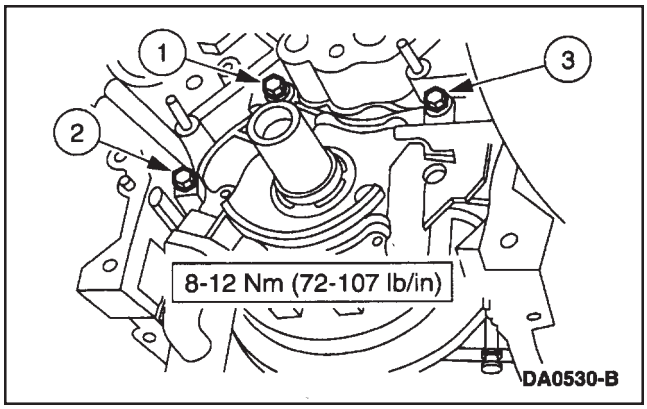
17. Install the front engine support insulators (6038).



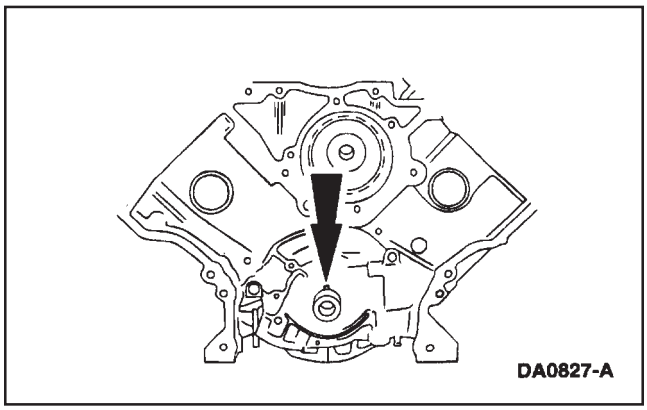
18. Install the lower crankshaft bearing supports and tighten fasteners in the sequence shown.



19. Install the oil level indicator tube (6754).

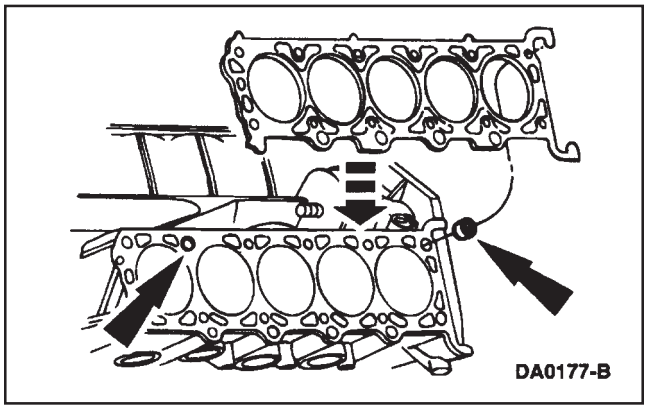


20. Position the oil pump (6600) and install the bolts loosely. Tighten the bolts in the sequence shown.



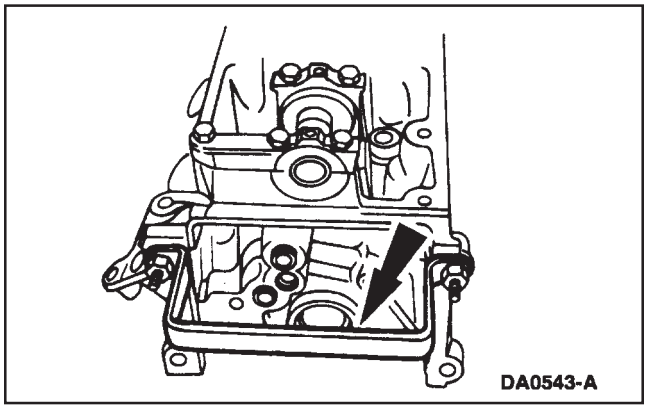
21. Rotate the crankshaft to position the keyway at 12 o'clock.

    NOTE: After crankshaft has been positioned, do not turn the crankshaft until instructed to do so.

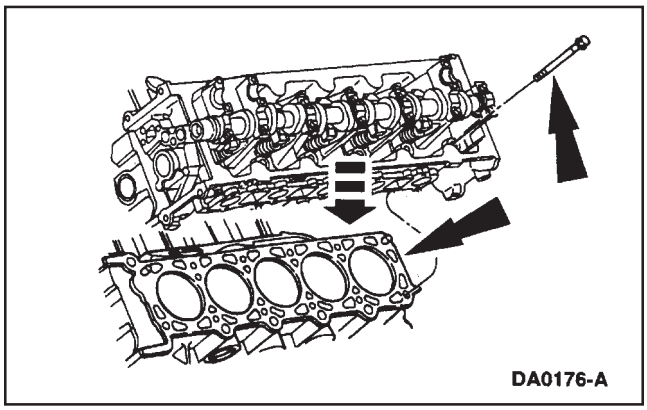


22. Install the head gasket (6051) over the dowel pins.

23. Install the Camshaft Holding Tools.

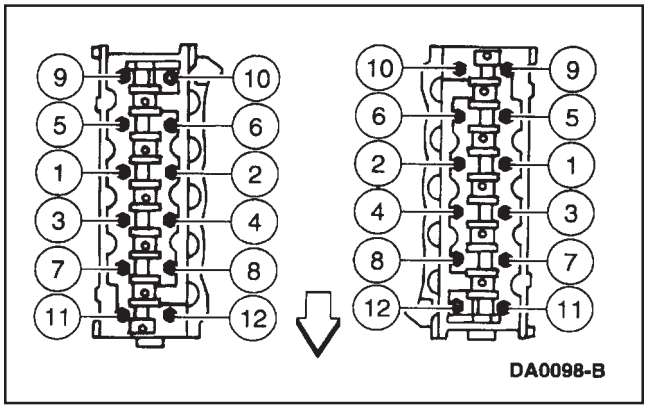


24. Install the Lifting Handles.



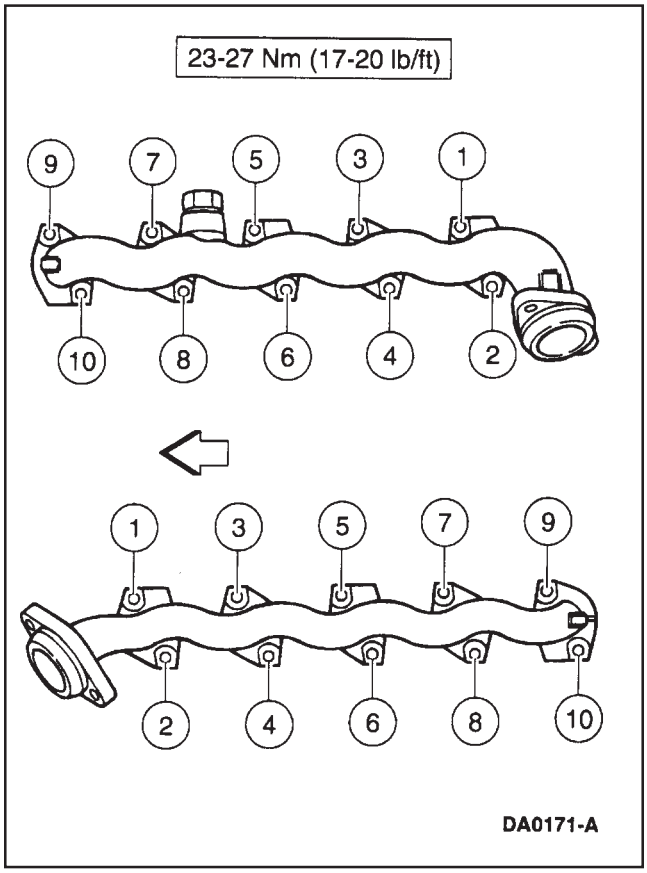
25. Install the cylinder head (6049) on the head gasket and loosely install new bolts.

    • The LH is shown; the RH is similar.

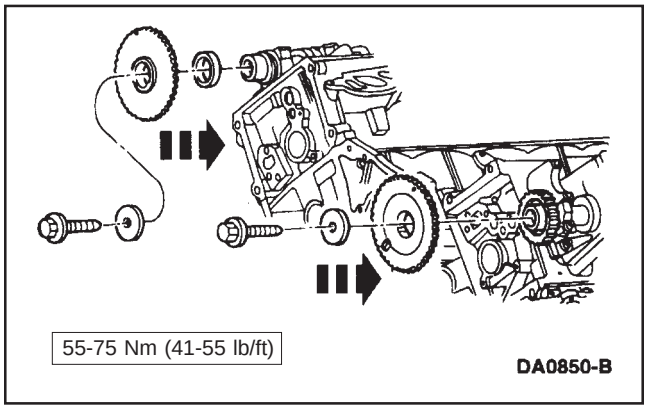


26. **NOTE:** Be sure to tighten the new bolts in three stages.

    - Stage 1: Tighten to 37-43 Nm (27-32 lb/ft).
    - Stage 2: Tighten an additional 85 degrees to 95 degrees.
    - Stage 3: Tighten an additional 85 degrees to 95 degrees.

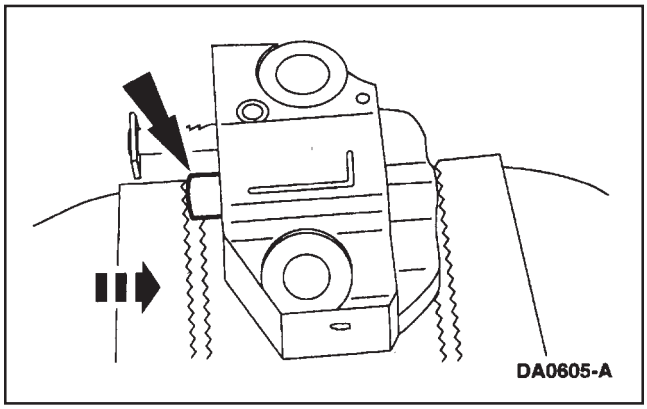


27. Install the left and right exhaust manifold gaskets (9448) and exhaust manifolds (9430). Loosely install the nuts. Tighten the nuts in the sequence shown.



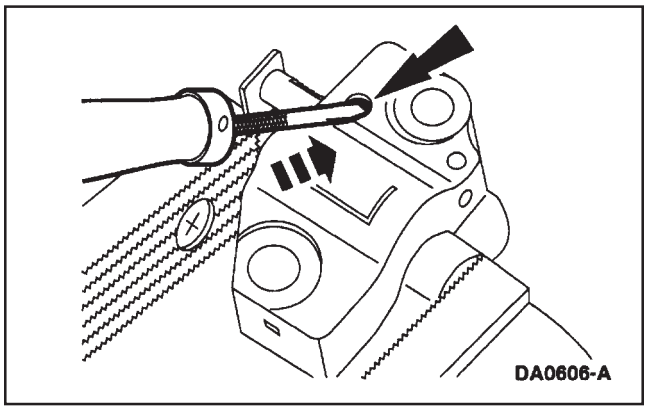
28. ⚠ **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons (6108) will result.**

    If removed, install the left and right camshaft sprockets (6256).

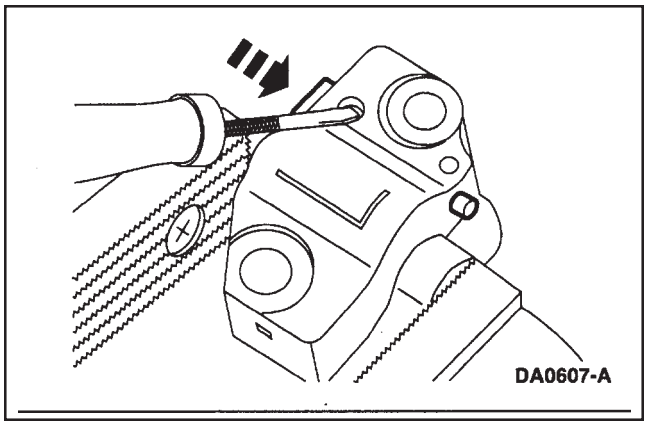


29. ⚠ **CAUTION: Do not compress the ratchet assembly. This will damage the ratchet assembly.**

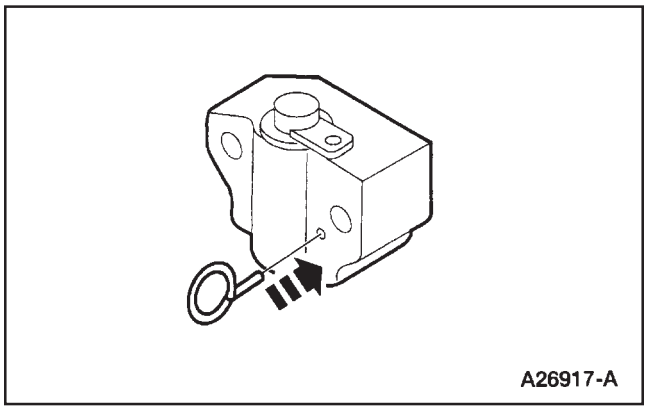
    Compress the tensioner plunger, using an edge of a vise.



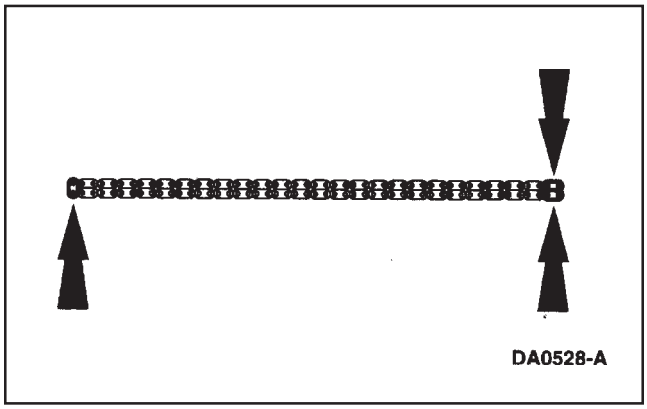
30. Using a small screwdriver or pick, push back and hold the ratchet mechanism.



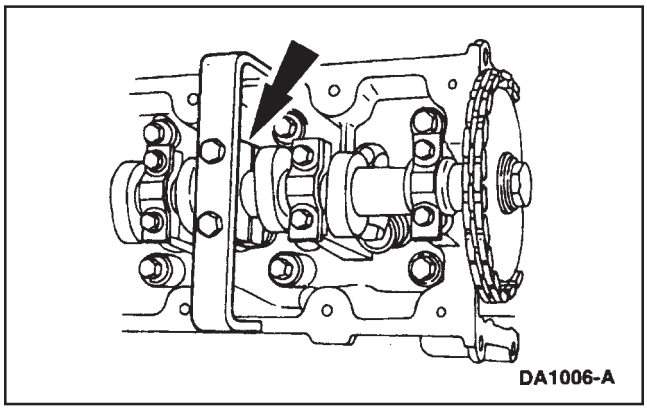
31. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



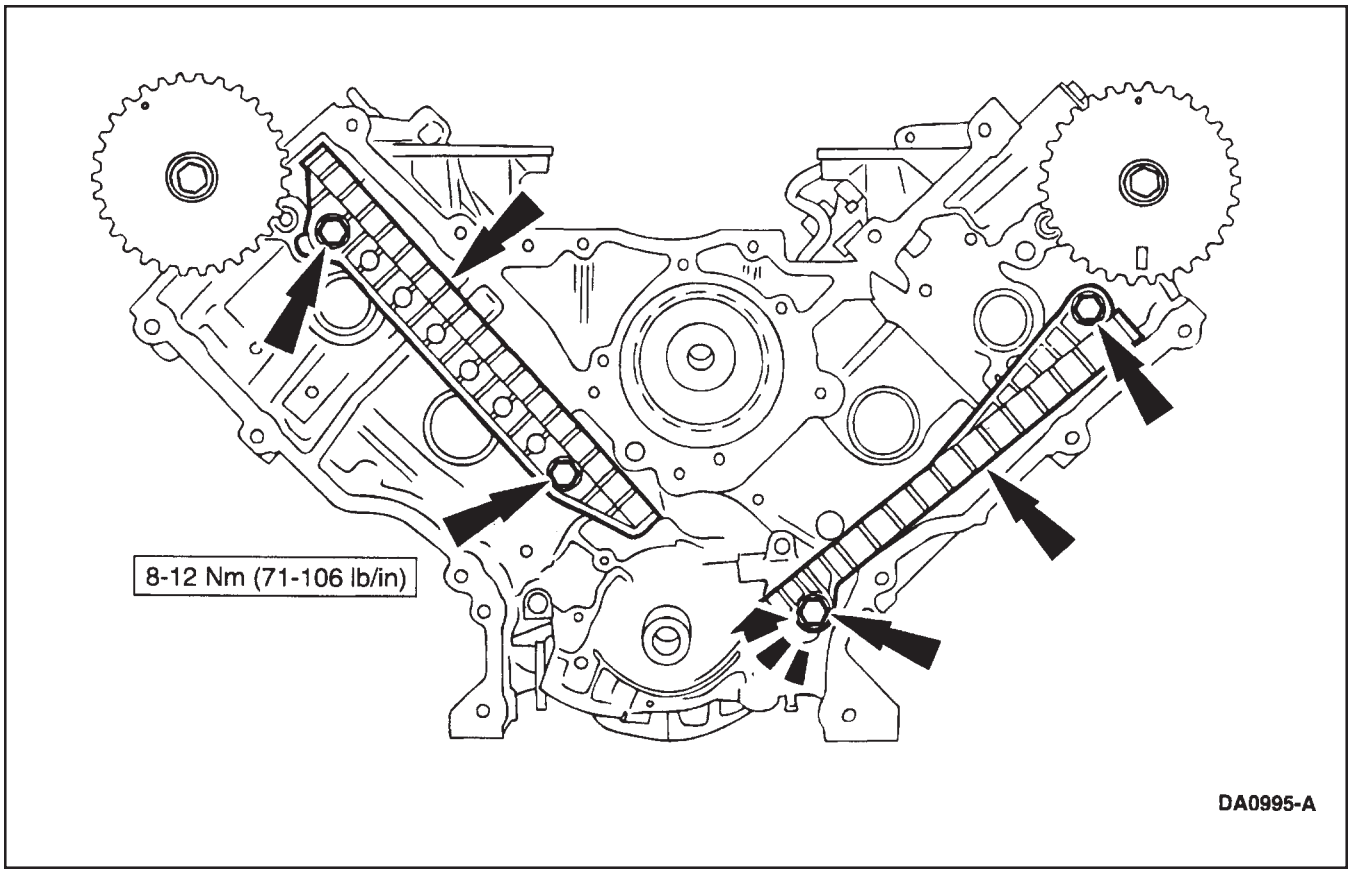
32. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and plunger in during installation.



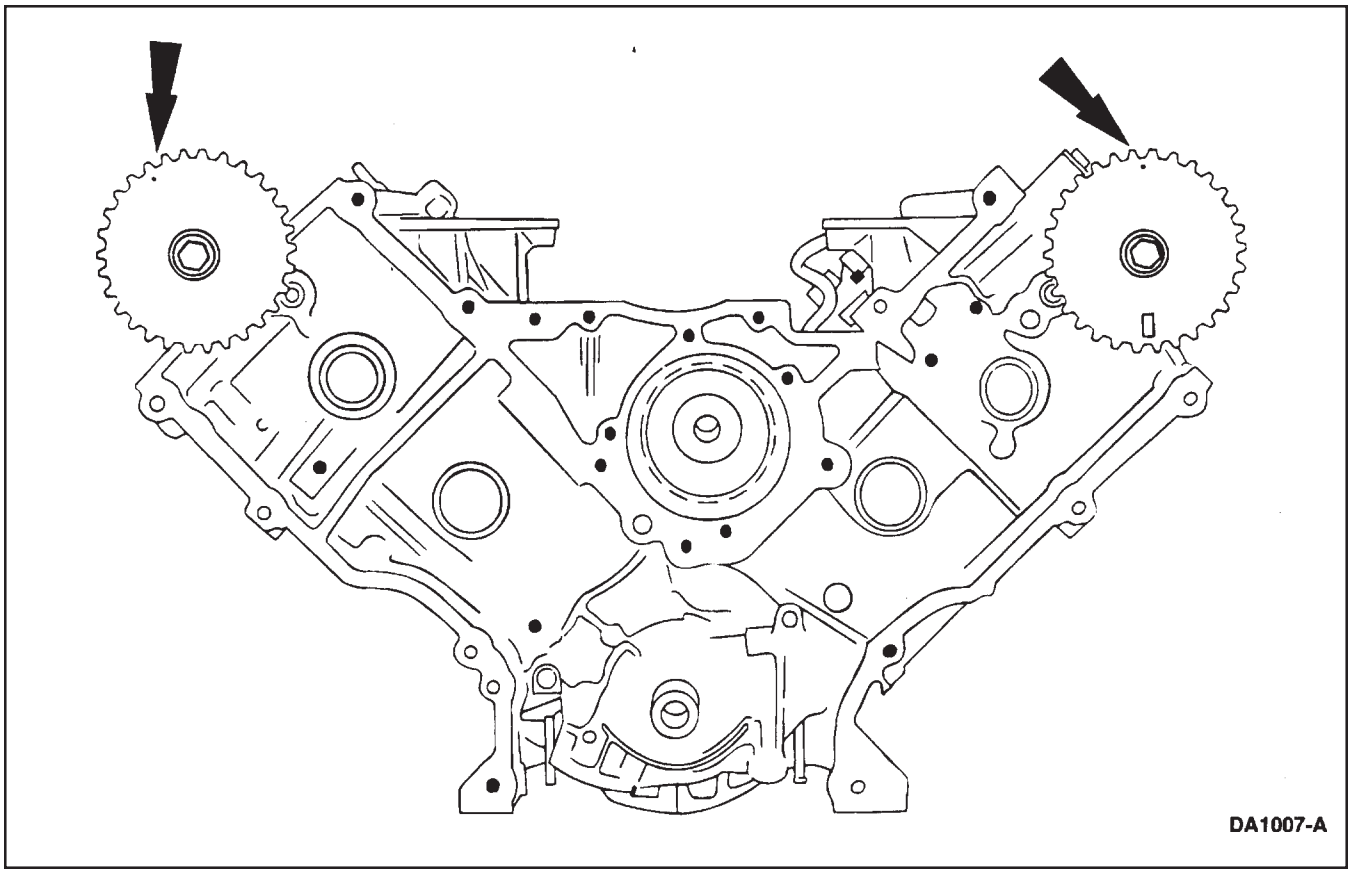
33. If the copper links are not visible, mark two links on one end and one link on the other end to use as timing marks.



34. Loosen the Camshaft Holding Tools on both camshafts (6250).

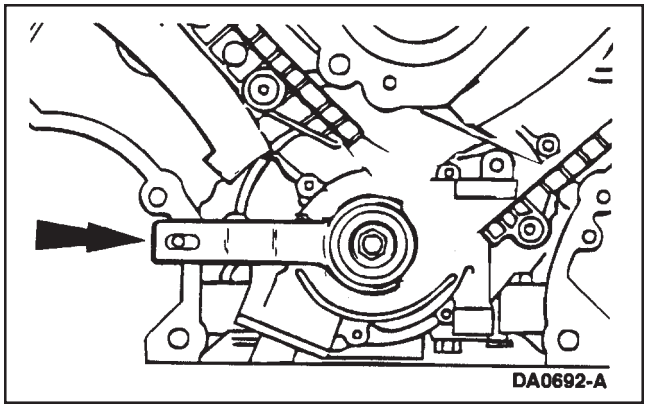


35. Install the timing chain guides (6K297).



36. Rotate the LH camshaft sprocket until the timing mark is approximately at 12 o'clock.

    Rotate the RH camshaft until the timing mark is approximately at 11 o'clock. Tighten the Camshaft Holding Tools to maintain camshaft pre-positioning.

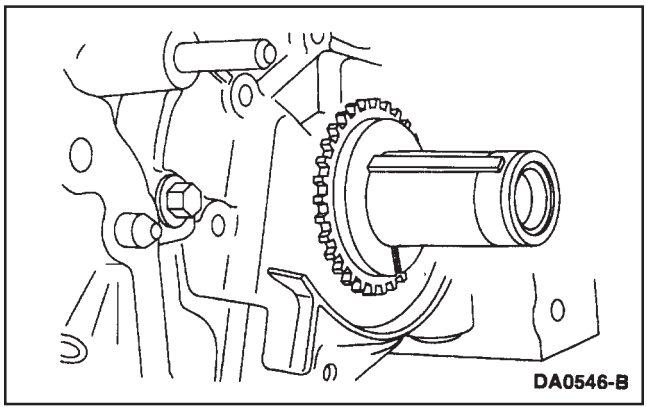


37. **⚠ CAUTION: Unless otherwise instructed, at no time when the timing chains (6268) are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.**

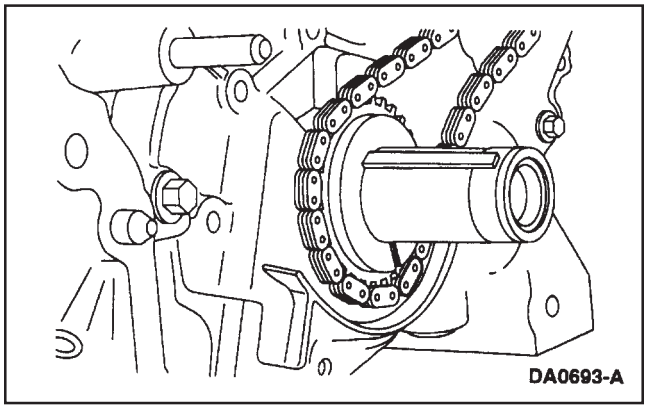
    ⚠ CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past the position shown or severe piston or valve damage can occur.

    Position the crankshaft with the Crankshaft Holding Tool.

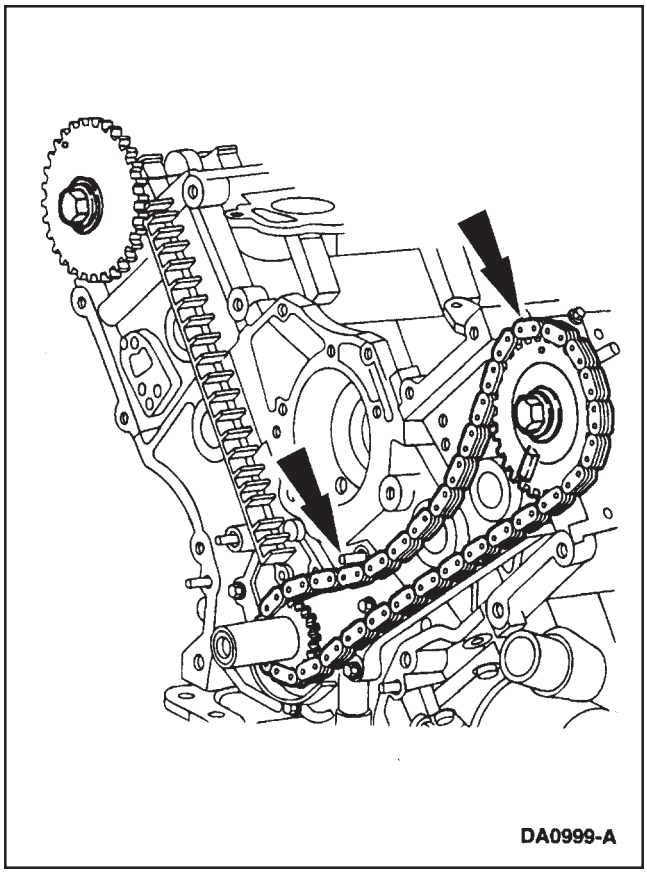
38. Remove the Crankshaft Holding Tool.



39. Position the inner crankshaft sprocket (6306) with the long hub facing outward.



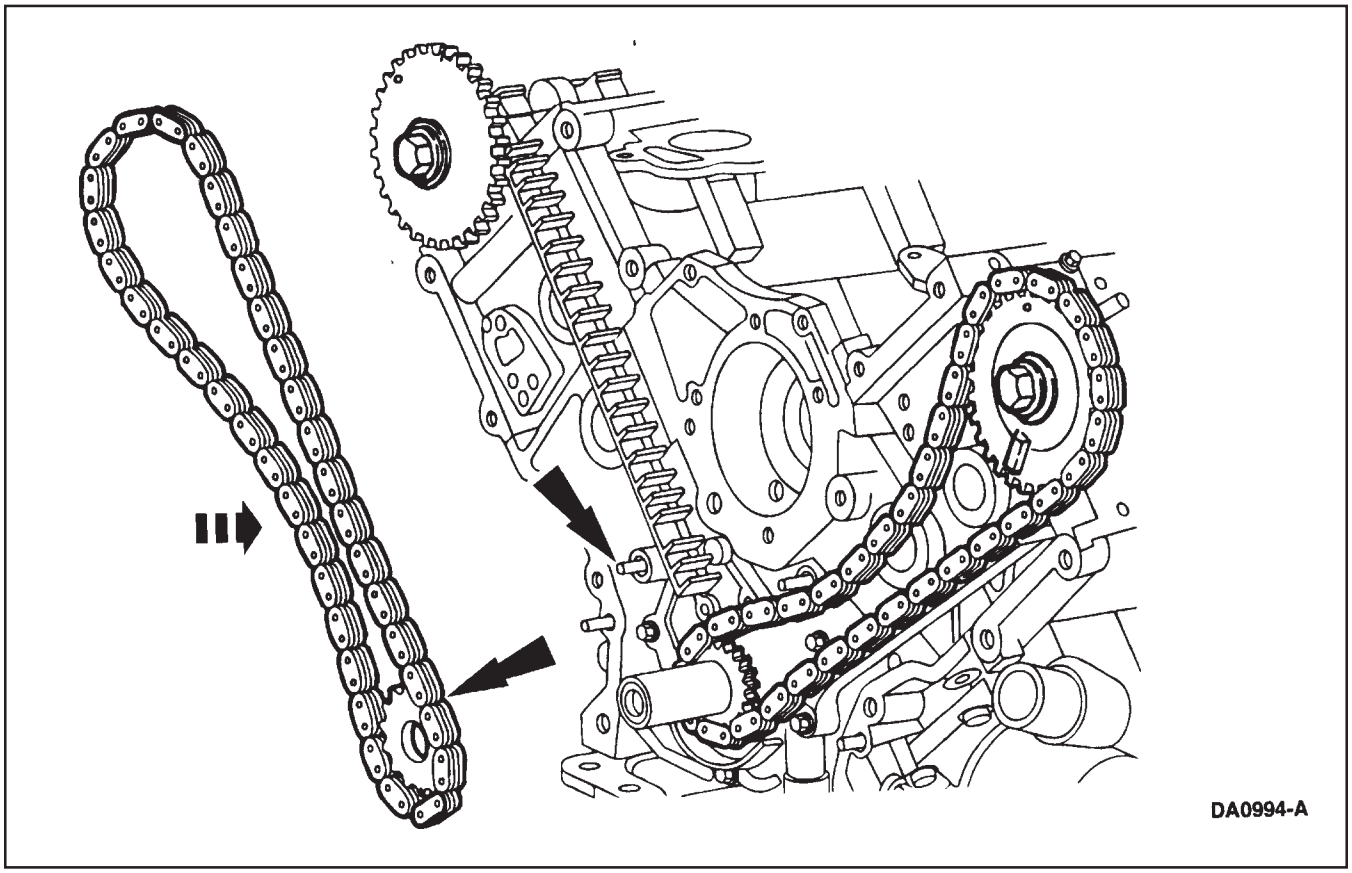
40. Install the LH timing chain/belt onto the crankshaft sprocket, aligning the one copper link on the timing chain with the slot on the crankshaft sprocket.



41. **NOTE:** Make sure the upper half of the timing chain is below the tensioner guide dowel. If necessary, use the Camshaft Holding Tool to adjust.

    NOTE: If necessary, adjust the camshaft sprocket slightly to obtain timing mark alignment.

    Position the timing chain on the camshaft sprocket with the two copper chain links and the camshaft sprocket timing mark aligned.



42. **CAUTION: The camshaft sprocket can jump time if the Camshaft Holding Tool is not secured.**

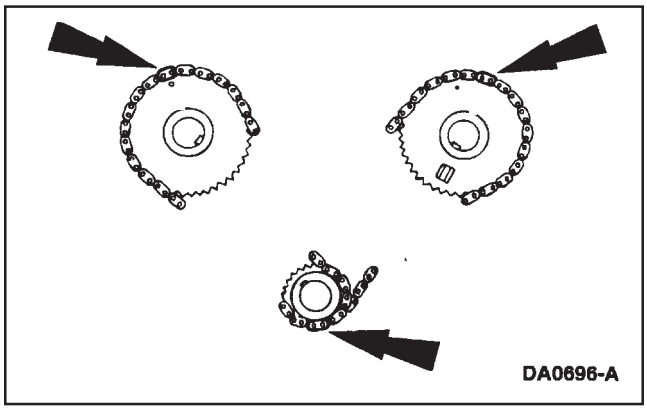
    NOTE: Be sure the copper chain link and the crankshaft sprocket timing mark are aligned.

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

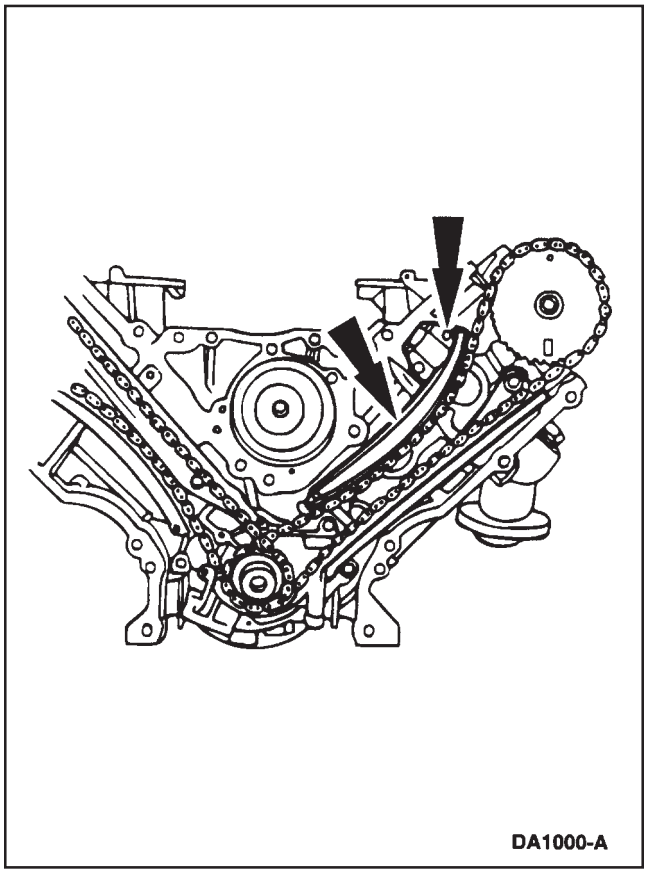
    Position the outer camshaft sprocket and the RH timing chain with the long hub of the camshaft sprocket facing inward.

43. **NOTE:** If necessary, adjust the camshaft sprocket slightly to obtain timing mark alignment.

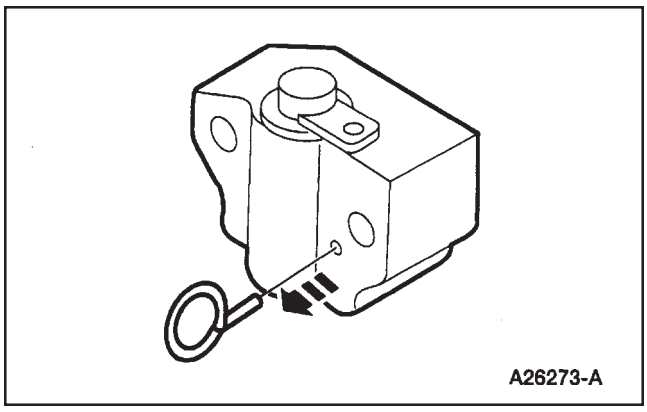
    Position the RH timing chain on the camshaft sprocket. Make sure the two copper-colored links align with the camshaft sprocket timing mark.



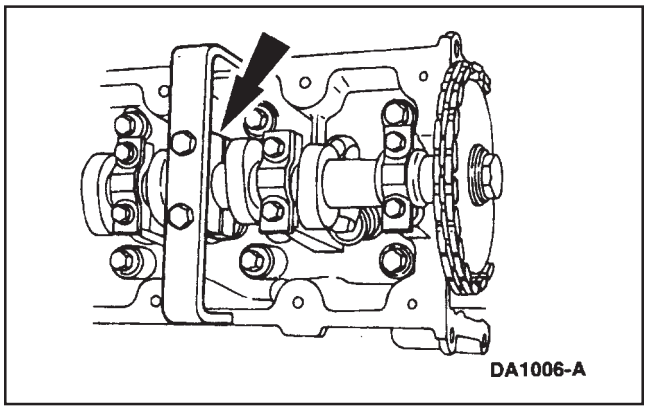
44. As a post-check, verify timing mark alignment.



45. Position the LH and RH timing chain tensioner arm (6L253) on the dowel pins. Position the timing chain tensioners (6L266), and install the bolts.



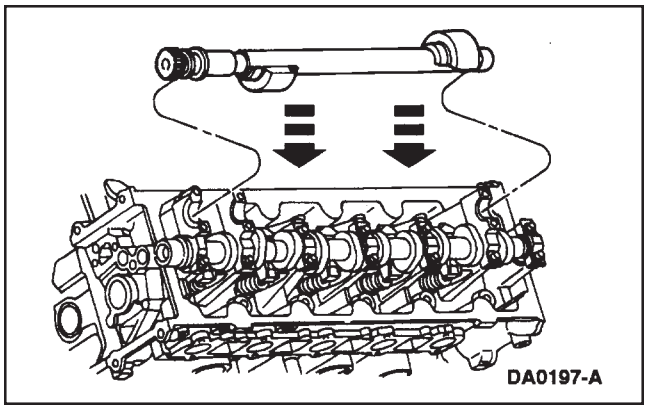
46. Remove both the RH and LH retaining pins from the timing chain tensioner assembly.



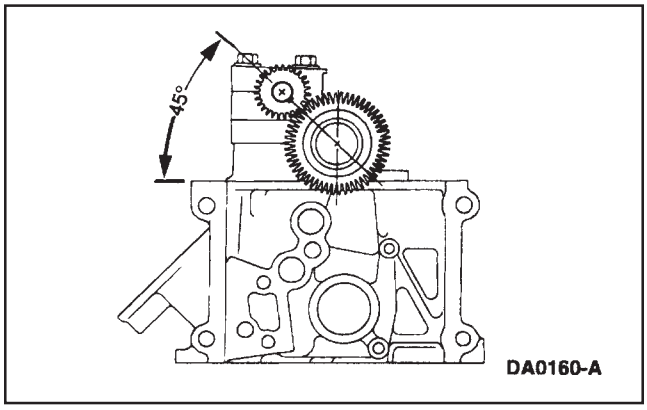
47. Remove the Camshaft Holding Tools from the camshafts.

48. Lubricate the balance shaft journals with engine oil.

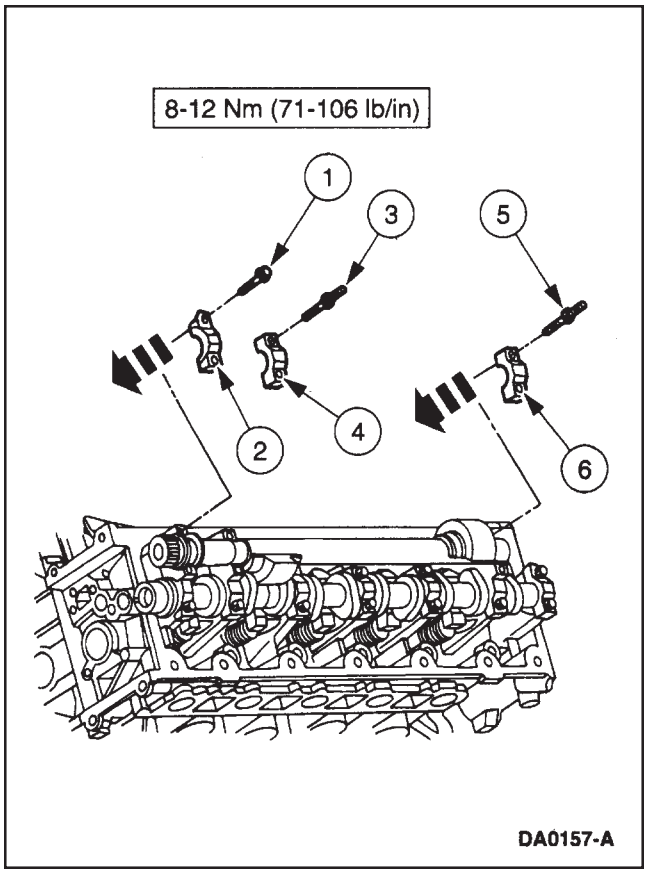
    - Use Super Premium SAE 5W30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.



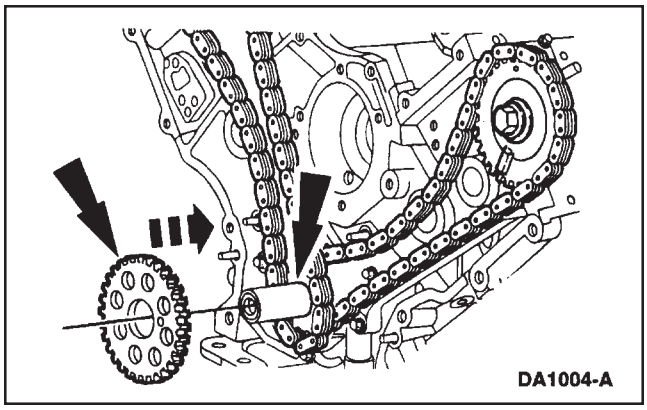
49. Position the balance shaft on the journals.



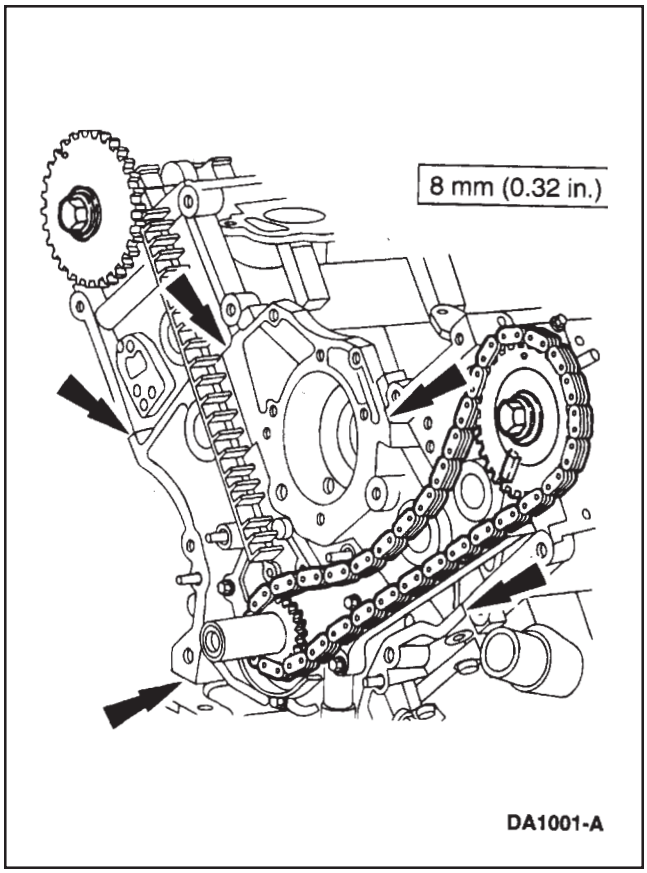
50. Align the balance shaft timing marks as shown.



51. Lubricate the balance shaft journals with engine oil.
    - Use Super Premium SAE 5W30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.
52. Install the bearing caps and the bolts. Tighten the bolts in the sequence shown.



53. Position the crankshaft sensor ring.



54. **CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.**

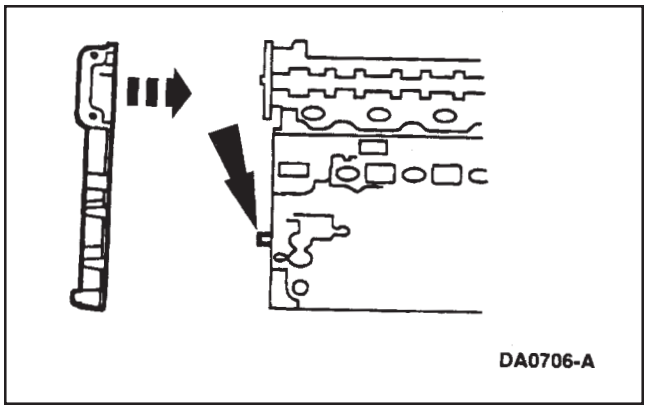
- Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

NOTE: Sealant must be removed and area cleaned with solvent if above instructions are not followed.

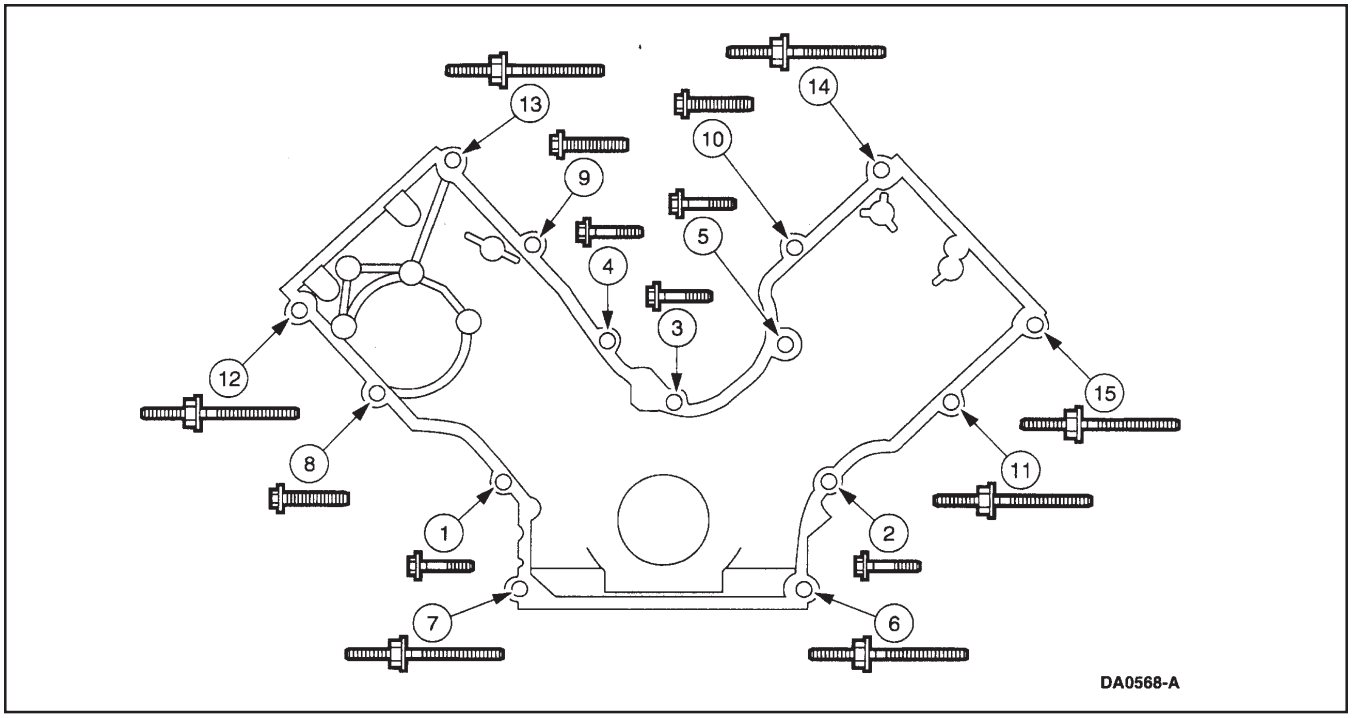
- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

NOTE: The RH timing chain is removed for clarity.

- Apply a bead of silicone along the cylinder head-to-block surface and the oil pan-to-cylinder block surface as specified.



55. Install a new engine front cover gasket (6020) onto the engine front cover (6019), then position the engine front cover on the front cover to cylinder block dowel (6C002).



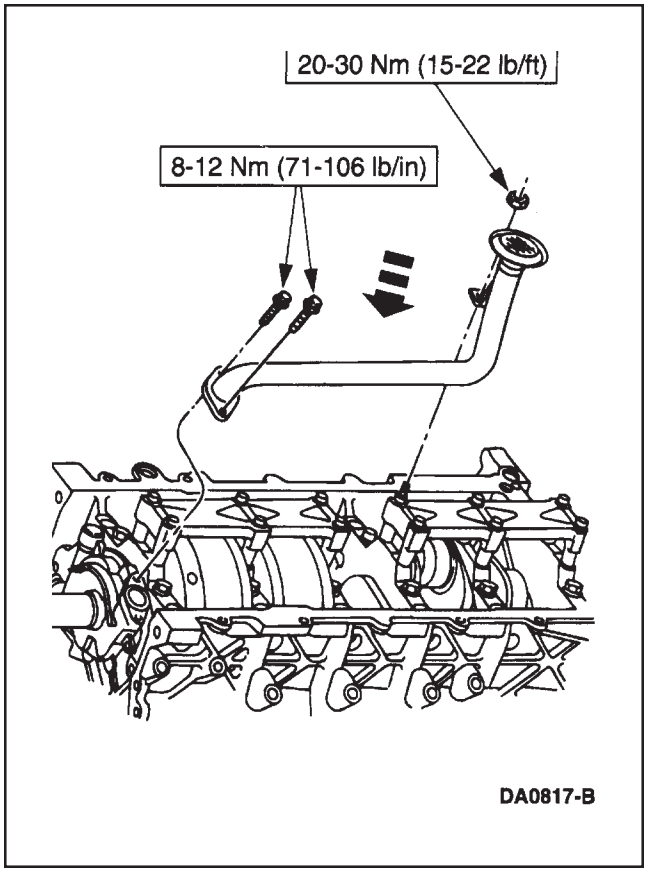
56. Loosely install the fasteners.

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	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 1.5 x 103.1
7	N808529	Stud, Hex-Head Pilot, M10 x 1.5 x 1.5 x 103.1
8	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5

Item	Part Number	Description
9	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
10	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
11	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6
12	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6
13	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6
14	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6
15	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6

57. Tighten the fasteners in two stages; refer to the preceding illustration.

- Stage 1: Tighten fasteners 1 through 5 to 20-30 Nm (15-22 lb/ft).
- Stage 2: Tighten fasteners 6 through 15 to 40-55 Nm (30-41 lb/ft).



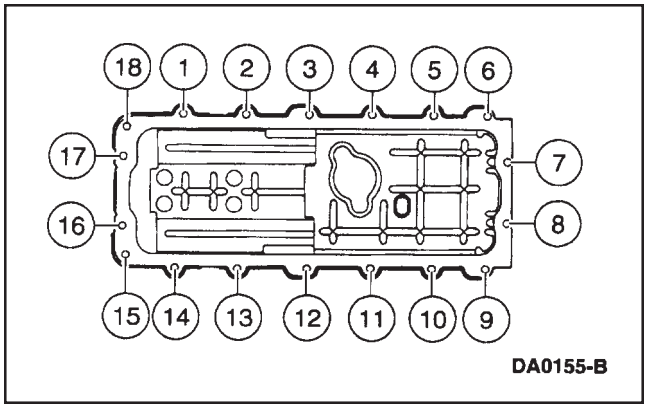
58. Position the oil pump screen cover and tube (6622) and install the bolts and nut.

59. **CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.**

    - Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

NOTE: Sealant must be removed and area cleaned with solvent if above instructions are not followed.

- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.
- Apply a bead of silicone where the rear crankshaft seal retainer plate and the front cover meets the cylinder block.
- Use Silicone Gasket and Sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

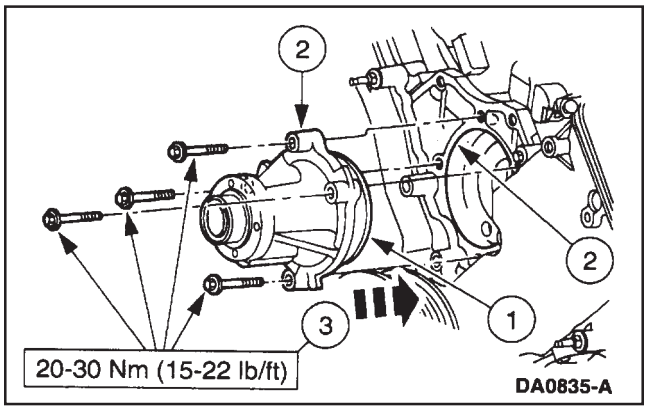


60. **NOTE:** Be sure to tighten the bolts in three stages.

    Install the oil pan (6675). Tighten the bolts in the sequence shown.

    - Stage 1: Tighten to 2 Nm (18 lb/in).
    - Stage 2: Tighten to 20 Nm (15 lb/ft).
    - Stage 3: Tighten an additional 60 degrees.

61. Install the oil drain plug. 11-16 Nm (98-143 lb/in).



62. **CAUTION: Do not rotate the water pump housing once the water pump (8501) has been positioned in the cylinder block. Damage to the O-ring seal will occur.**

    Install the water pump.

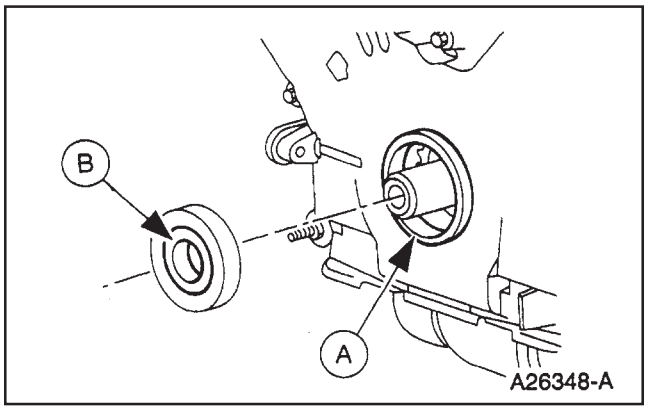
    1. Lubricate the new O-ring seal using Premium Cooling Fluid E2FZ-19549-AA or equivalent meeting Ford specification ESE-M97B44-A and install the O-ring seal onto the water pump.

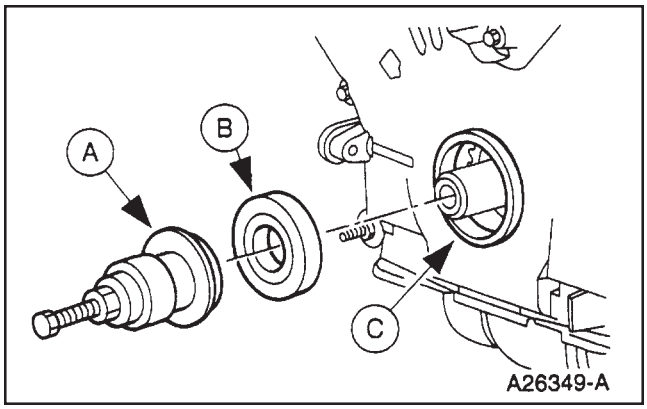
    2. Position the water pump into the cylinder block.

    3. Install the water pump retaining bolts.

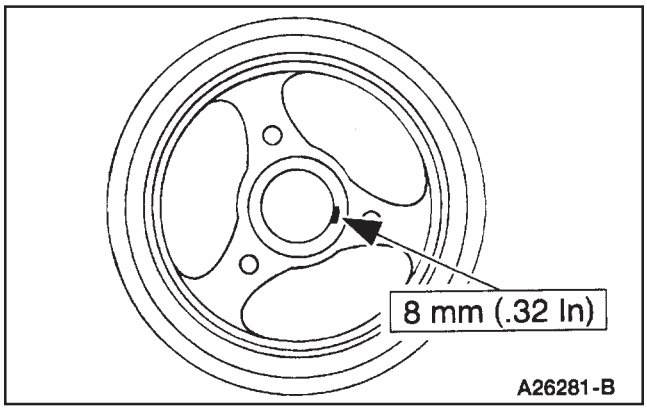
63. Lubricate the (A) engine front cover and the (B) front oil seal inner lip.

    - Use Super Premium SAE 5W30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.





64. Use the (A) Crankshaft Seal Replacer/Aligner to install the (B) crankshaft front seal (6700) into the (C) engine front cover.



65. **CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.**

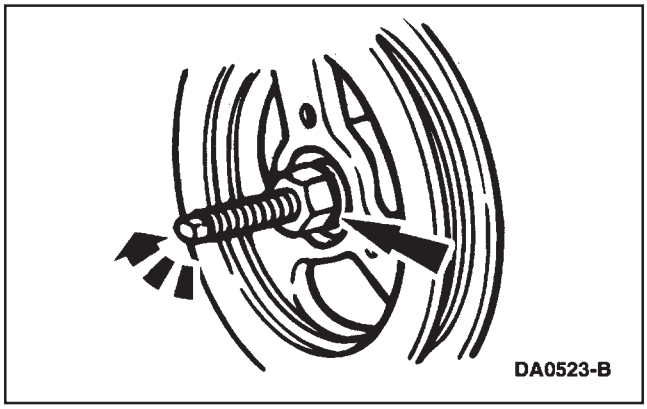
    - Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

NOTE: Sealant must be removed and area cleaned with solvent if above instructions are not followed.

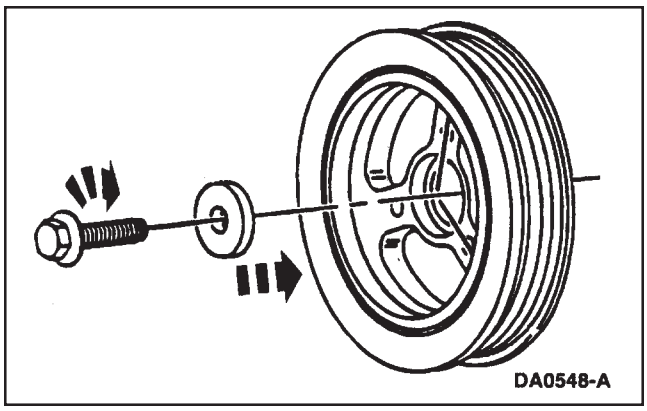
- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

Apply silicone to the Woodruff key slot on the crankshaft pulley (6312).

- Use Silicone Gasket and Sealant F6AZ-19562-A or equivalent meeting Ford specification WSE-M4G323-A6.



66. Use the Crankshaft Damper Replacer to install the crankshaft pulley.



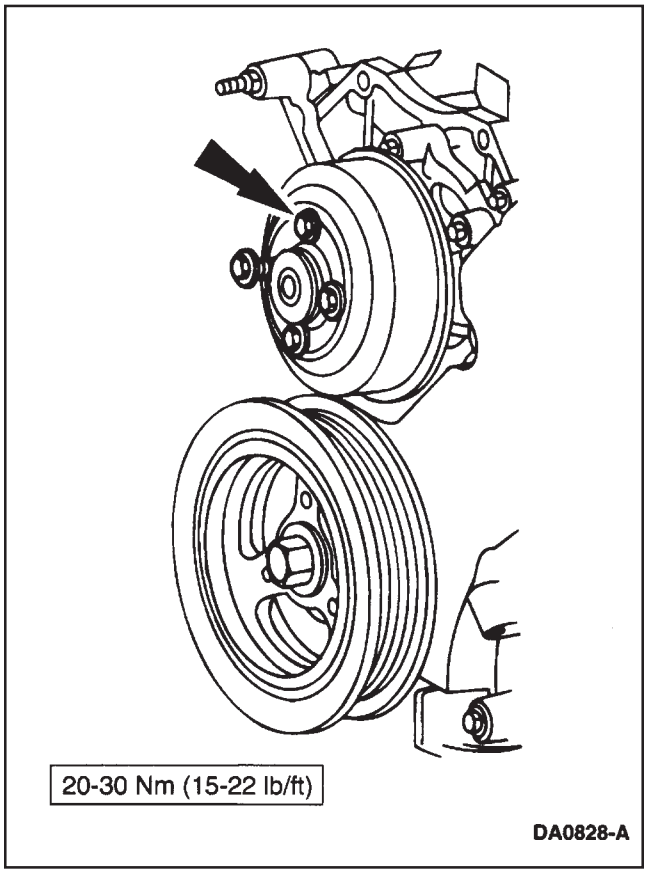
67. Tighten the crankshaft pulley bolt (6A340) in four stages.

    • Stage 1: Tighten to 90 Nm (66 lb/ft).

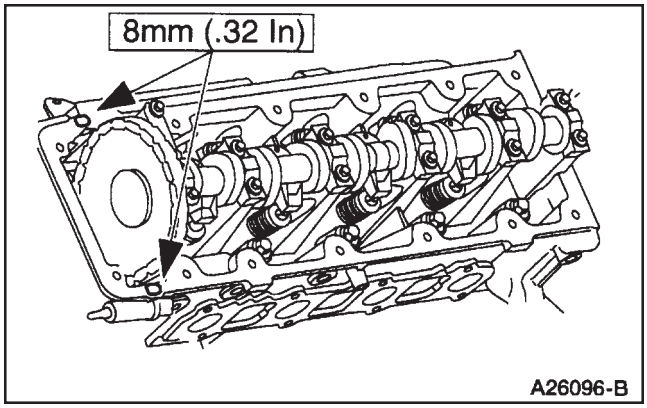
    • Stage 2: Loosen 360 degrees.

    • Stage 3: Tighten to 47-53 Nm (35-39 lb/ft).

    • Stage 4: Tighten an additional 85-90 degrees.



68. Position the water pump pulley (8509) on the water pump and install the bolts.



69. **CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.**

    - Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

NOTE: Sealant must be removed and area cleaned with solvent if above instructions are not followed.

- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

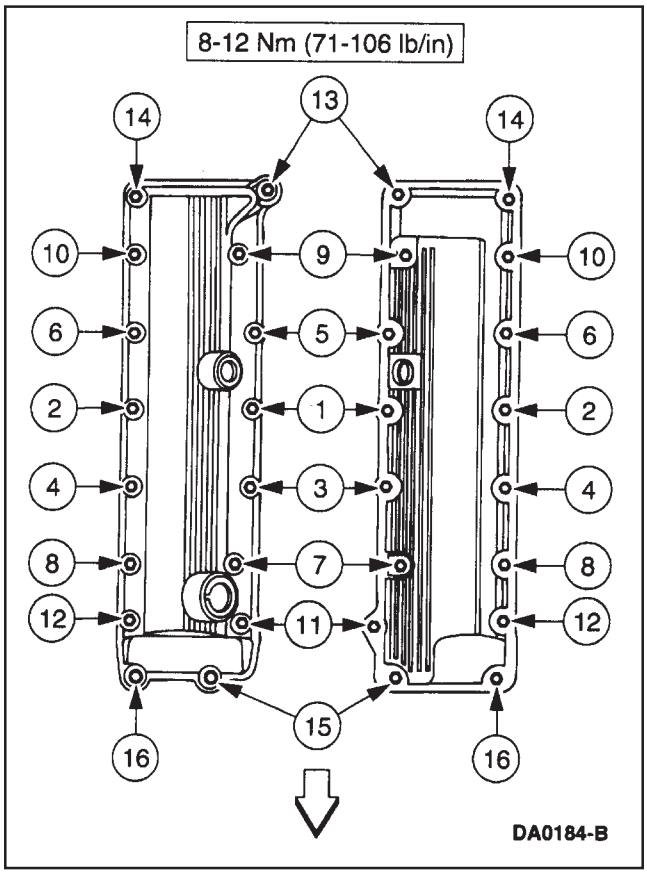
Apply silicone in two places where the engine front cover meets the cylinder head.

- Use Silicone Gasket and Sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

70. Position the valve covers (6582).

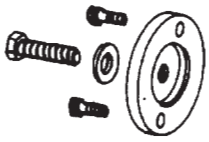
71. Tighten the bolts in the sequence shown.

72. Install the engine control wire harness.

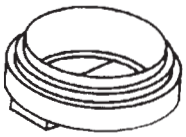


Engine - Installation

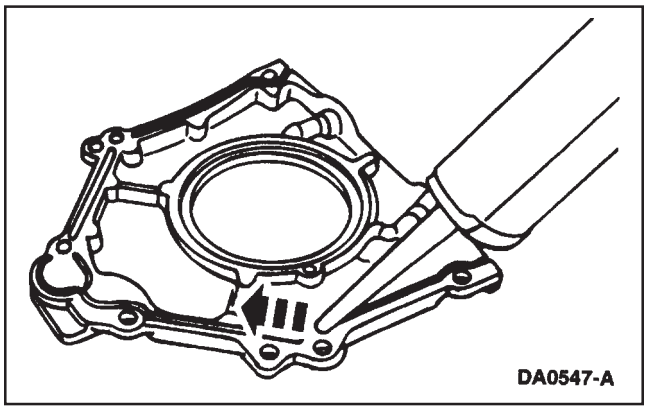
Special Tool(s)

 ST1377-A	Modular Lifting Bar 303-F047 (014-00073) or equivalent
 ST1480-A	Rear Crankshaft Seal Adapter 303-518 (T95P-6701-DH)

Special Tool(s)

 ST1479-A	Rear Crankshaft Seal Replacer 303-516 (T95P-6701-BH)
 ST1482-A	Rear Crankshaft Slinger Replacer 303-517 (T95P-6701-CH)

Special Service Tools called for by the procedures can be obtained by calling:
1-800-ROTUNDA (1-800-768-8632).


DA0547-A

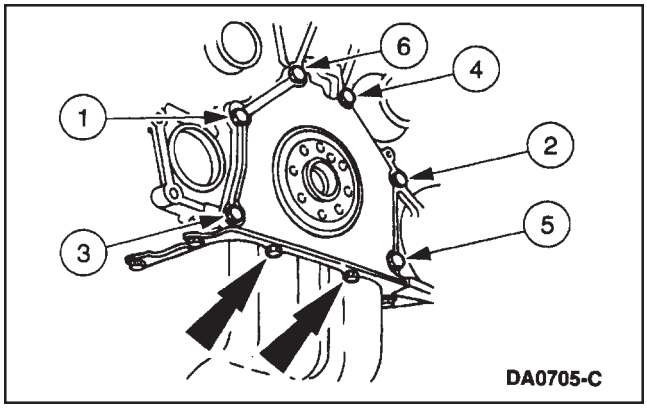
1. Attach the Modular Lifting Bar.
2. Remove the engine from the engine stand.
3. **CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.**

   - Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

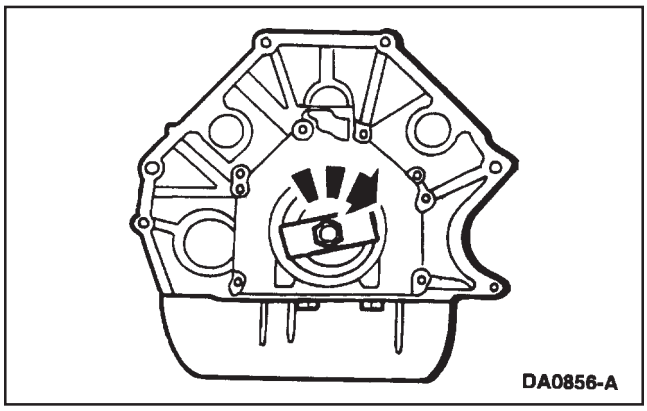
NOTE: Sealant must be removed and area cleaned with solvent if above instructions are not followed.

   - Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

4. Apply a bead of silicone around the rear oil seal retainer sealing surface.

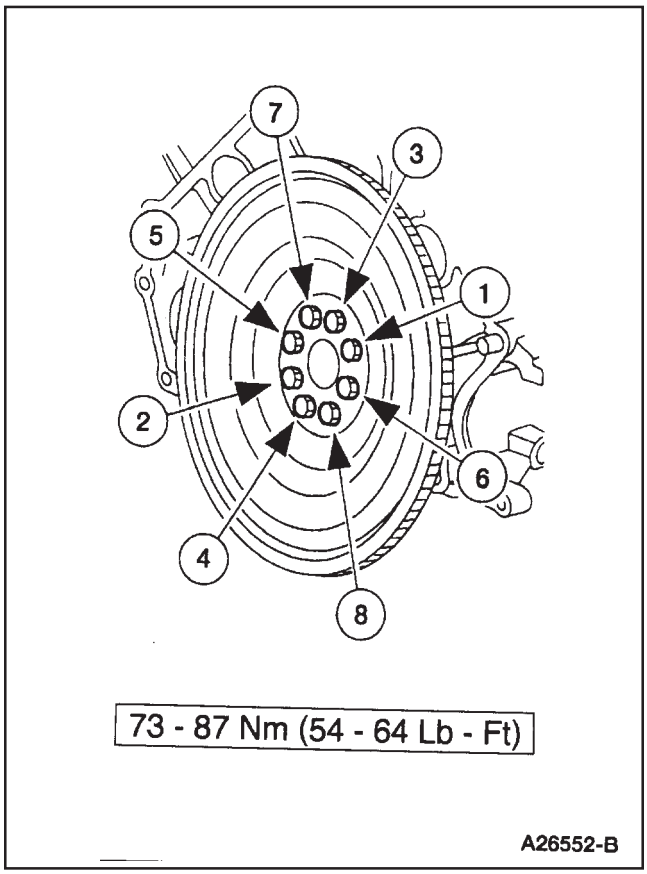


5. Install the retainer plate. Tighten the bolts to 8-12 Nm (71-107 lb/in).



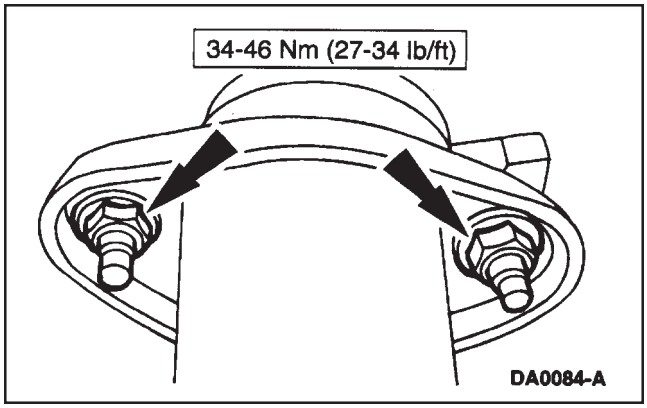
6. Use the Rear Crankshaft Seal Replacer and Rear Crankshaft Seal Adapter to install the crankshaft rear oil seal (6701).

7. With the Rear Crankshaft Seal Adapter still installed, use the Rear Crankshaft Slinger Replacer to install the crankshaft oil slinger.



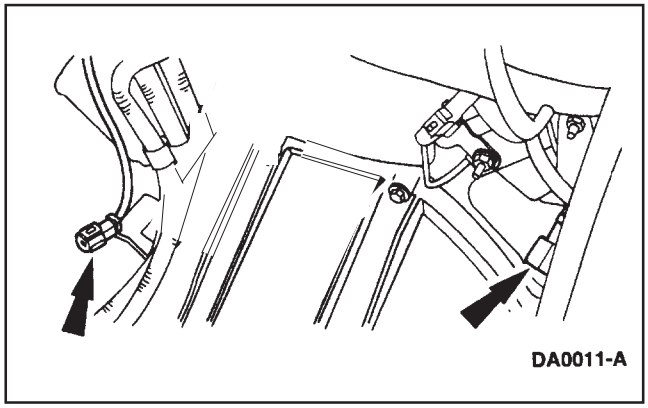
8. Install the flywheel (6375).

9. Install the starter motor (11002).



10. Connect the left and right exhaust pipes and install and tighten the nuts.

    NOTE: Apply a light coat of anti-sieze compound F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the threads of the exhaust manifold studs.



11. Connect the LH and RH heated exhaust gas oxygen sensor connector if equipped.
12. Install the intake manifold (9424); refer to Intake Manifold – Variable Resonance Induction System (VRIS) in this section.
13. Install vacuum hoses.
14. Install the drive belt (8620).
15. Install the upper and lower radiator supports (16138).
16. Install the radiator (8005).
17. Install the engine air cleaner (ACL) (9600) and the air cleaner outlet tube (9B659).
18. Fill all fluids to the proper levels.
19. Connect the battery ground cable (14301).
20. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.

SPECIFICATIONS

Torque Specifications

Description	Nm	Lb/Ft	Lb/In
Bolt Hex Flanged (Front of Engine)	20-30	15-22	–
Camshaft Bearing Cap Bolts	8-12	–	71-106
Camshaft Sprocket Bolts	55-75	41-55	–
CKP/CID Bolt	8-12	–	71-106
Coil Pack Bracket Bolts	20-30	15-22	–
Connecting Rod Bolts	(1)(2)	(1)(2)	(1)(2)
Crankshaft Pulley Bolt	(1)	(1)	(1)
Engine Support Insulator Bolts	80	59	–
Engine Support Insulator Nuts	90	66	–
Exhaust Manifold Nuts	23-27	17-20	–
Exhaust System to Exhaust Manifold Nuts	34-46	27-34	–
Flywheel Bolts	73-87	54-64	–
Front Engine Support Insulator	68-92	50-68	–
Head Bolts (LH) (RH) (1)	(1)(2)	(1)(2)	(1)(2)
Heater Water Return Tube Studs	40-55	30-41	–
Idler Pulley Bolt	20-30	15-22	–
Jack Screws	(1)	(1)	(1)
Lower Crankshaft Bearing Bolts and Stud Bolts	20-30	15-22	–
Lower Power Steering Bolts	20-30	15-20	–
Main Bearing Cap Bolts	(1)(2)	(1)(2)	(1)(2)
Main Cap Side Bolts	(1)(2)	(1)(2)	(1)(2)
Motor Mount Pivot Bolt	68-92	50-68	–
Motor Mount to Engine Bolts	52-71	38-52	–
Oil Cooler to Adapter	55-60	–	41-44
Oil Filter	14-17	–	125-151.6
Oil Filter Adapter Assembly Bolts	20-30	15-22	–
Oil Level Indicator Bracket Nut	20-30	15-22	–
Oil Level Indicator Tube Bolt	8-12	–	71-106
Oil Pan Bolts	(1)	(1)	(1)
Oil Pan Drain Plug	11-16	-	98-143
Oil Pump Bolts	8-12	–	71-107
Oil Pump Screen Cover and Tube Bolts	8-12	–	71-106
Oil Pump Screen and Cover Assembly Spacer	20-30	15-22	–
Oil Pump Screen Cover and Tube Nut	20-30	15-22	–
Power Steering Pump Bolts	20-30	15-22	–
Rear Oil Seal Bolts	8-12	–	71-106
Screw and Washer (Front of Engine)	40-55	29-40	–
Stud and Washer (Front of Engine)	40-55	29-40	–
Timing Chain Guide Bolts	8-12	–	71-106
Torque Converter Nuts	34-46	25-34	–

(Continued)

Torque Specifications (Continued)

Description	Nm	Lb/Ft	Lb/In
Flywheel Housing to Engine Bolts	41-54	30-40	–
Upper Intake Manifold Bolts	(1)	(1)	(1)
Upper Intake Manifold to Cylinder Head Bolts	(1)	(1)	(1)
Upper Power Steering Bolts	20-30	15-20	–
Valve Cover Bolts	8-12	–	71-106
Water Pump Bolts	20-30	15-22	–
Water Pump Pulley Bolts	20-30	15-22	–

(1) Refer to this section for tightening procedure and sequence.

(2) Torque to yield bolts must be discarded and replaced with new bolts.

General Specifications

Item	Specification
Displacement (CID)	6.8L (415)
No. Cylinder	10
Bore/Stroke	90.215/105.8 mm
Fire Order	1-6-5-10-2-7-3-8-4-9
Oil Capacity	6.0 qts.
(With oil filter – 6.5)	6.5 qts.
Oil Pressure 93.33°C (200°F) at Cylinder Block	18 psi @ 650 rpm 100 psi @ 4,000 rpm
Cylinder Head/Valve Train	
Combustion Chamber Volume	52.6 - 51.6 cc
Valve Seat Width – Intake	2.1-1.9 mm
Valve Seat Width – Exhaust	2.1-1.9 mm
Valve Seat Angle	45.00-44.50 degrees
Valve Seat Runout (T.I.R.)	0.025 mm
Valve Arrangement (Front to Rear)	
Valve Stem Guide Clearance: Intake	0.069-0.020 mm
Exhaust	0.095-0-045 mm
Valve Head Diameter: Intake	44.63-44.37 mm
Exhaust	34.12-33.88 mm
Valve Face Runout (Limit)	0.05 mm
Valve Face Angle	45.75-45.25 degrees
Valve Stem Diameter: Intake	6.995-6.975 mm
Exhaust	6.970-6.949 mm
Valve Stem Diameter (List Oversizes): Intake	N/A
Exhaust	N/A
Valve Spring Compression Pressure: Intake (N @ Spec. Length)	667.3 N @ 28.02 mm
Exhaust (N @ Spec. Length)	667.3 N @ 28.02 mm

(Continued)

General Specifications (Continued)

Item	Specification
Valve Spring Free Length: Intake	50.2 mm
Exhaust	50.2 mm
Valve Spring Installed Pressure N @ Spec. Length: Intake	289.1 N @ 40.01 mm
Exhaust	289.1 N @ 40.01 mm
Valve Springs Installed Pressure N @ Spec. Length – Service Limit: Intake	274.6 mm @ 40.01 mm
Exhaust	274.6 mm @ 40.01 mm
Valve Springs – Out of Square Limit: Intake	2.5 degrees
Exhaust	2.5 degrees
Valve Guide Inside Diameter	7.044-7.015 mm
Camshaft	
Lobe Lift: Intake	6.58077 mm
Exhaust	6.58551 mm
Lobe Lift – Allowable Lift Loss	0
Valve Lift @ Zero Lash: Intake	12.00 mm
Exhaust	12.00 mm
Camshaft End Play	0.25-0.188 mm
End Play Service Limit	0.025-0.188 mm
Journal to Bearing Clearance	0.076-0.025 mm
Clearance Service Limit	–
Journal Diameters	26.962-26.936 mm
Journal Inside Diameter (Cap Assembled)	27.012-26.987 mm
Camshaft Runout: Full Indicator Measurement on all journals when supported on front and rear journals Engine	0.09 mm (5 Places)
Cylinder Bore Diameter: Grade 1	90.200-90.210 mm
Grade 2	90.210-90.220 mm
Grade 3	90.220-90.230 mm
Piston	
Piston Diameter (Grade 2) at Right Angle to Pin Bore	90.180 ± 0.005 mm
Piston to Bore Clearance	(-0.005) to +0.025 mm
Pin Bore Diameter (Piston)	22.008-22.014 mm
Pin Diameter	22.0005-22.0030 mm
Clearance (Neg. or Pos.)	0.01395-0.005 mm
Pin Bore Diameter (Rod)	22.012-22.024 mm
Clearance	0.009-0.0235 mm
Ring Groove Width: Top	1.503-1.505 mm
Intermediate	1.502-1.504 mm

General Specifications (Continued)

Item	Specification
Oil Control	3.030-3.050 mm
Piston Ring Gap: Top	0.13-0.28 mm
Intermediate	0.25-0.40 mm
Oil Control	0.15-0.65 mm
Crankshaft	
Main Bearing Journal Diameter	27-482-67.504
Maximum Out-of-Round	0.0075 mm Between Cross Sections
Maximum Taper (Straightness)	0.004 mm
Runout: FIM of center journals when located on front and rear journal	TBD
Clearance – Crankshaft Journal to Main Bearing Clearance	0.048-0.024 mm
Connecting Rod Journal Diameter	53.003-52.983 mm
Maximum Out-of-Round	0.0075 mm Between Cross Sections
Maximum Taper	0.004 mm
Crankshaft End Play	0.075-0.377
Connecting Rod	
Big End Journal Inside Diameter with Assembled Liners	53.049-53.027 mm
Rod Bearing to Journal Clearance	0.064-0.026 mm
Pin Bore Diameter (Rod)	22.024-22.012 mm
Balance Shaft System	
Balance Shaft Journal Diameter	26.962-26.936 mm
Clearance – Balance Shaft Journal to Cylinder Head	0.076-0.025 mm
Cylinder Head B/S Journal Diameter	27.012-26.987 mm
Gear Backlash	0.0076-0.1295 mm
Balance Shaft End Play	0.04-0.18 mm
Rod Length (Centerline Bore-to-Bore)	169.1 mm
Alignment: Bore-to-Bore Max. Twist	± 0.05 mm
Bore-to-Bore Max. Bend	± 0.038 mm
Side Play (As Assembled to Crank): Standard Play	0.410 + 0.26 mm
Max Play	0.670 mm

(Continued)

General Specifications (Continued)

Item	Specification
Sealant and Lubricants	
Silicone Gasket and Sealant F6AZ-19562-AA (in Canada CXC-8-B) (in Oregon F5FZ-19549-CC)	ESE-M97B44-A
Super Premium Engine Oil SAE 5W30	D9AZ-19579A
Petroleum Jelly	WSD-M1C226-A
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Anti-seize Compound F6AZ-9L494-AA	ESE-M12A4-A