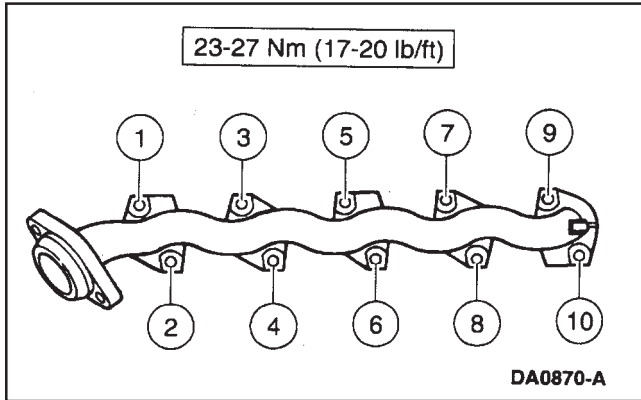
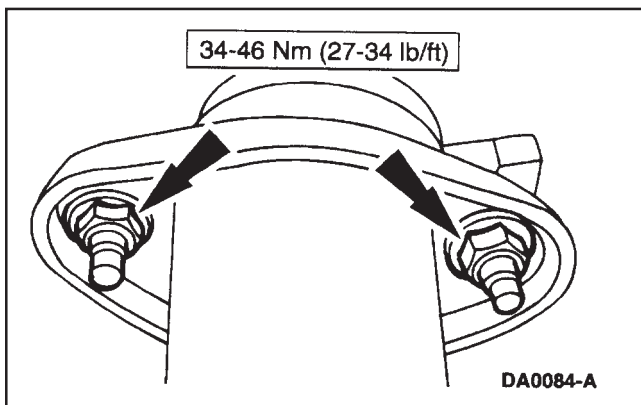


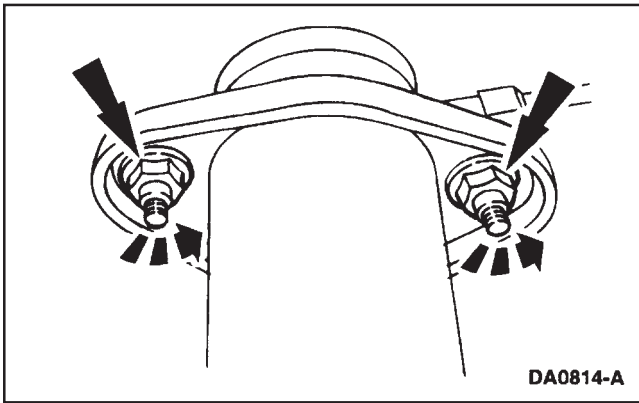
Exhaust Manifold - RH - Installation



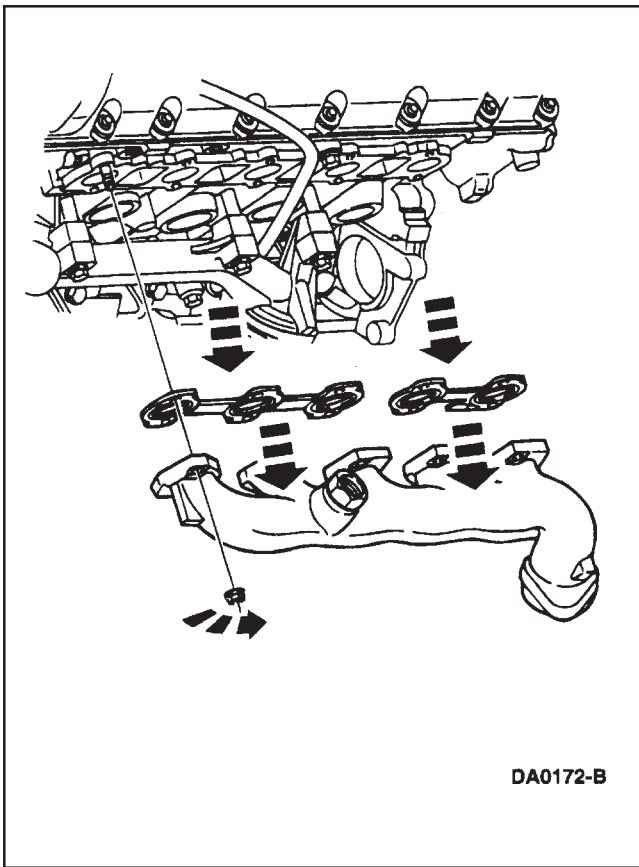
1. Follow the removal procedure in reverse order.



Exhaust Manifold – LH - Removal

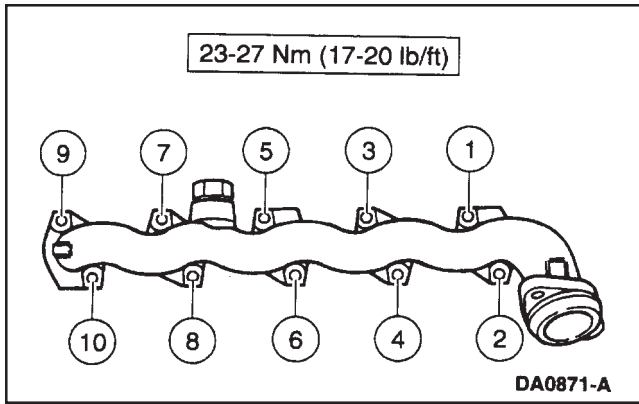


1. Remove the nuts from the exhaust pipe and remove pipe.

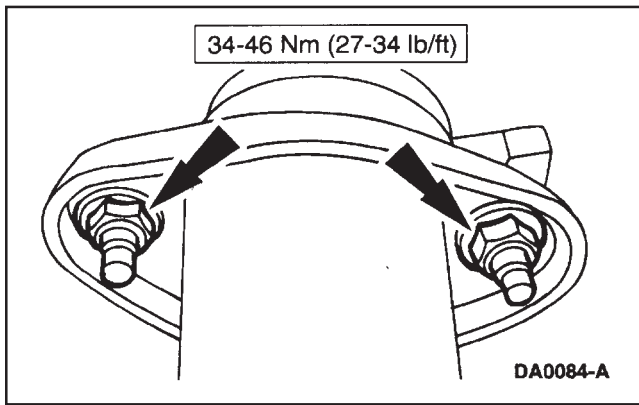


2. Remove the exhaust manifold nuts and the exhaust manifold (9430). Discard the exhaust manifold gaskets (9448).
3. Clean and inspect the exhaust manifold; refer to Section 01.

Exhaust Manifold – LH - Installation




1. Follow the removal procedure in reverse order.

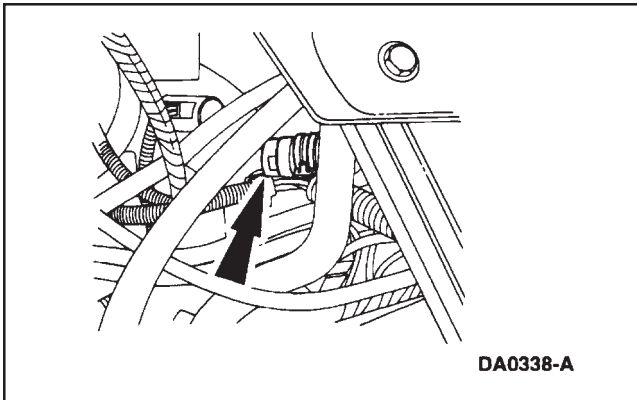


Cylinder Head - Removal

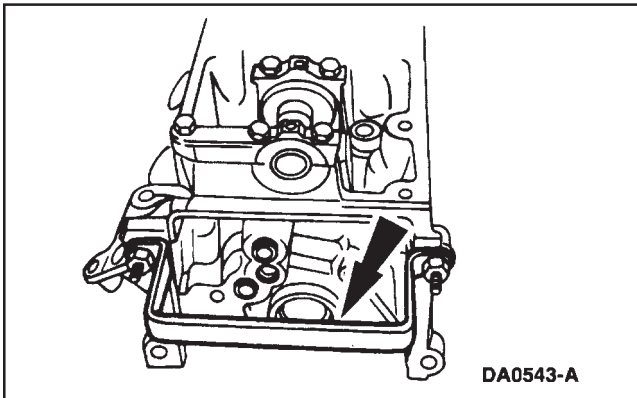
Special Tool(s)	
<p>ST1668-A</p>	Lifting Handles 303-572 (T97T-6000-A)

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

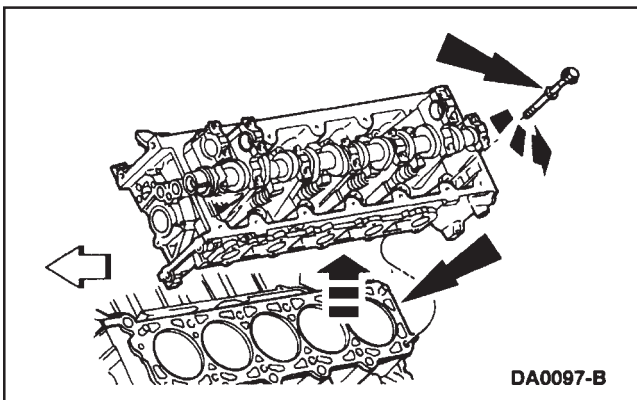
1.  **WARNING: DO NOT SMOKE OR CARRY LIGHTED TOBACCO OR OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENTS. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND CAN BE IGNITED, RESULTING IN POSSIBLE PERSONAL INJURY.**




2. Remove the intake manifold (9424); refer to Intake Manifold – Variable Resonance Induction System (VRIS) in this section.
3. Remove the timing chains (6268); refer to Timing Drive Components in this section.
4. Compress and slide the hose clamp back and remove the evaporation water hose (18472) if so equipped.



5. Install the Lifting Handles.



6.  **CAUTION: These bolts must be replaced with new bolts. They are tighten-to-yield designed and cannot be reused.**

Remove the bolts and the cylinder head (6049).

- Discard the head gasket (6051), the cylinder head bolts (6049) and clean the engine block surface.
- The LH is shown. The RH is similar.

7. **NOTE:** Sealant must be removed and area cleaned with solvent.

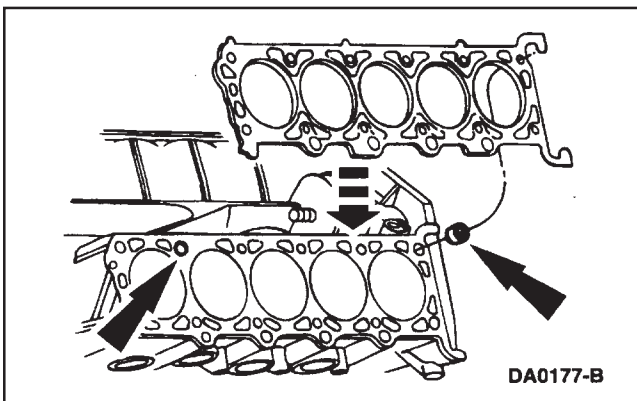
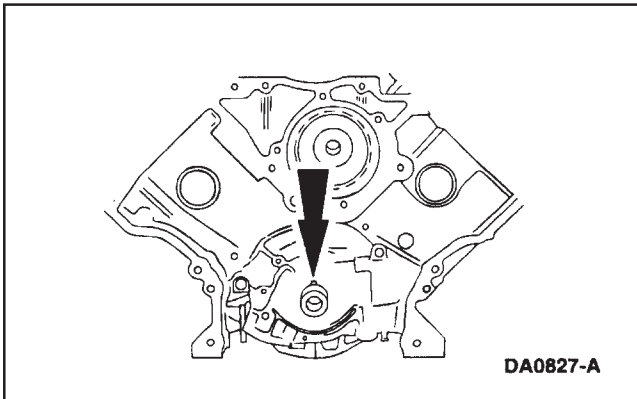
⚠ CAUTION: Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.

- 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.

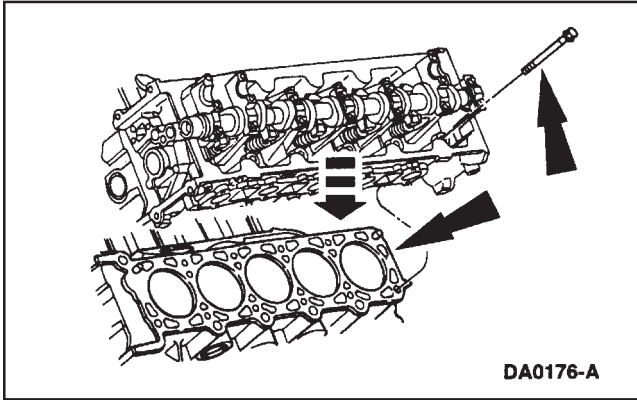
Cylinder Head - Installation



1. Rotate the crankshaft (6303) to position the keyway at 12 o'clock.

2. **NOTE:** Do not turn the crankshaft until otherwise instructed.

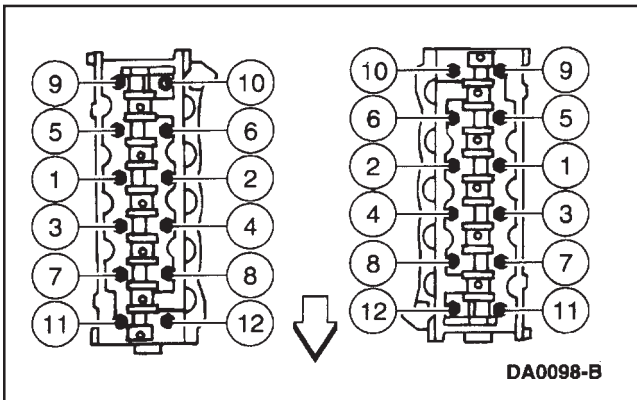
Install the head gasket over the dowel pins.



3. **NOTE:** Head bolts are torque to yield and must be replaced whenever cylinder head is removed.

Install the cylinder head on the head gasket and loosely install new bolts.

- The LH is shown; the RH is similar.

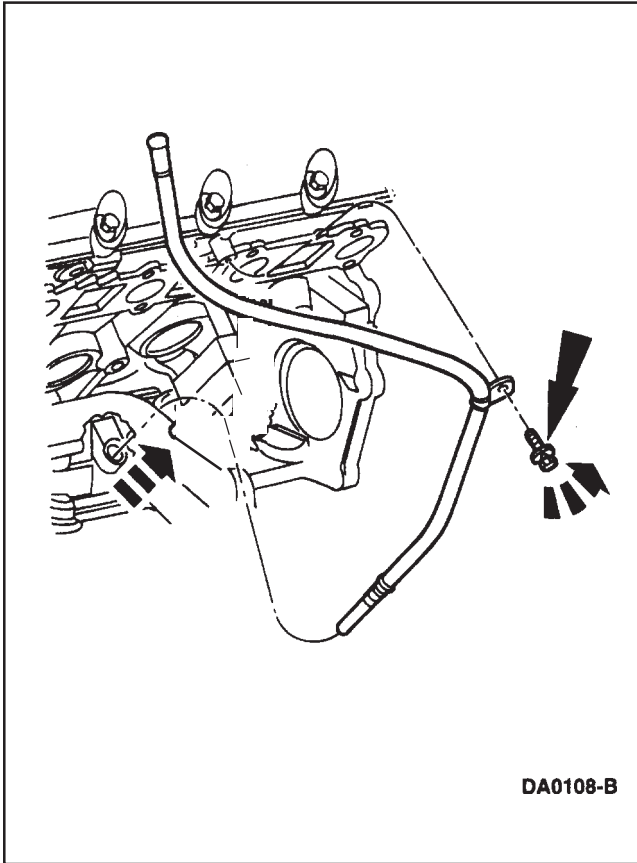


4. **NOTE:** Be sure to tighten the bolts in three stages.

- 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.

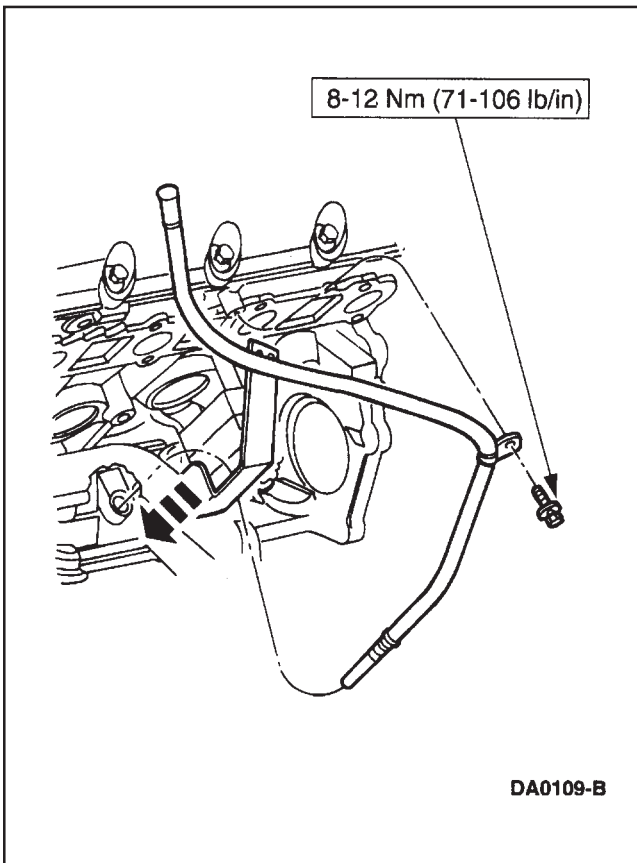
5. Install the timing chains; refer to Drive Components in this section.
6. Install the intake manifold; refer to Intake Manifold – Variable Resonance Induction System (VRIS) in this section.

Oil Level Indicator Tube - Removal



1. Remove the bolt and remove the oil level indicator tube (6754).
2. Inspect the oil level indicator tube for damage.

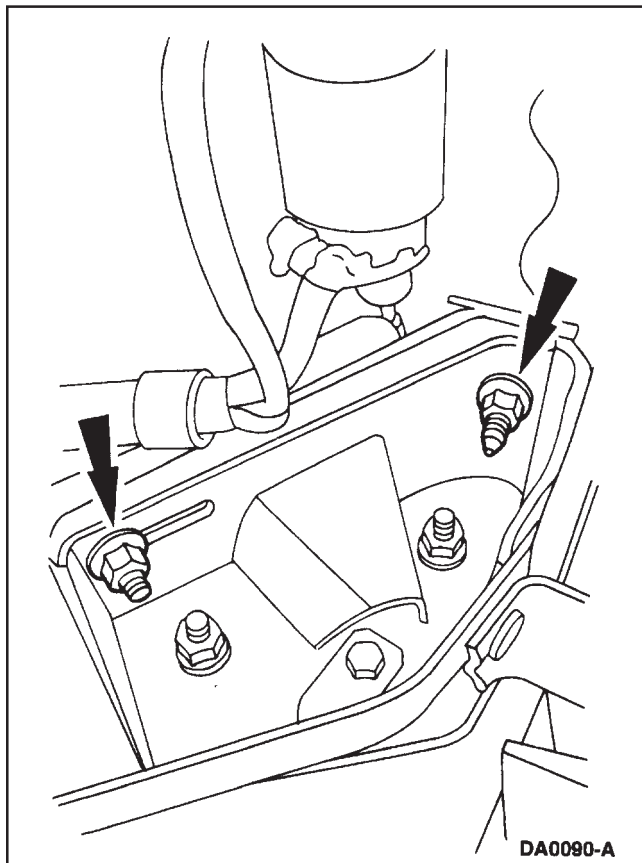
Oil Level Indicator Tube - Installation

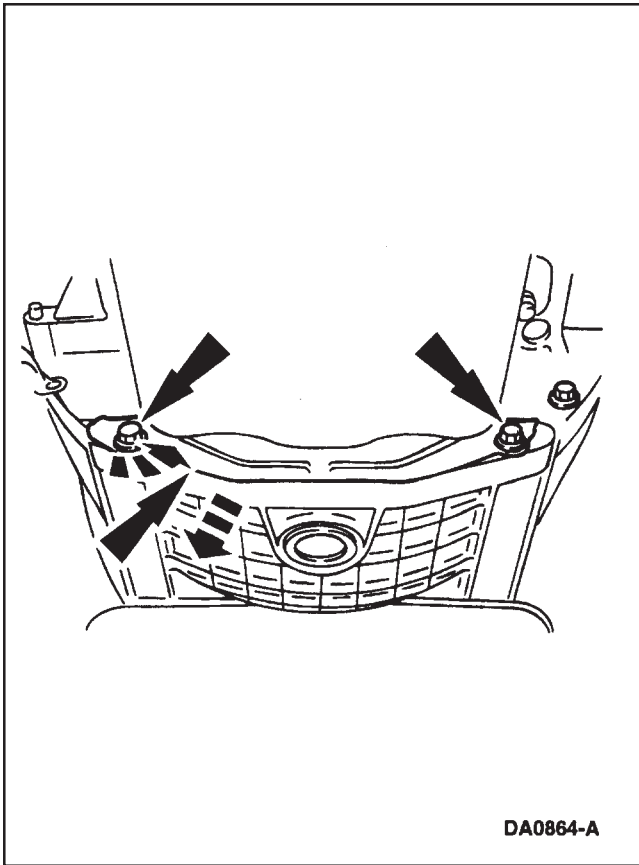


1. Follow the removal procedure in reverse order.
2. Replace and lubricate the O-rings with Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-G.
3. Replace oil level indicator (oil dipstick).

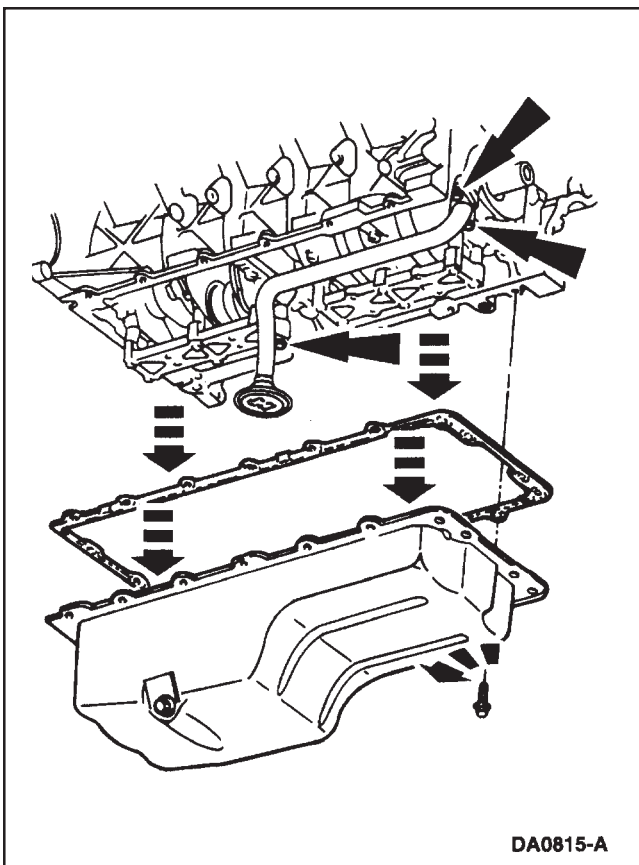
Oil Pan - Removal

1. Disconnect the battery ground cable (14301).
2. Partially drain the radiator (8005) and disconnect the upper radiator hose (8260) at the radiator.
3. Drain the engine oil and remove the oil bypass filter (6714).
4. Remove the nuts retaining the front engine support insulator (6038) to the front engine support bracket (6028). The RH is shown, the LH is typical.

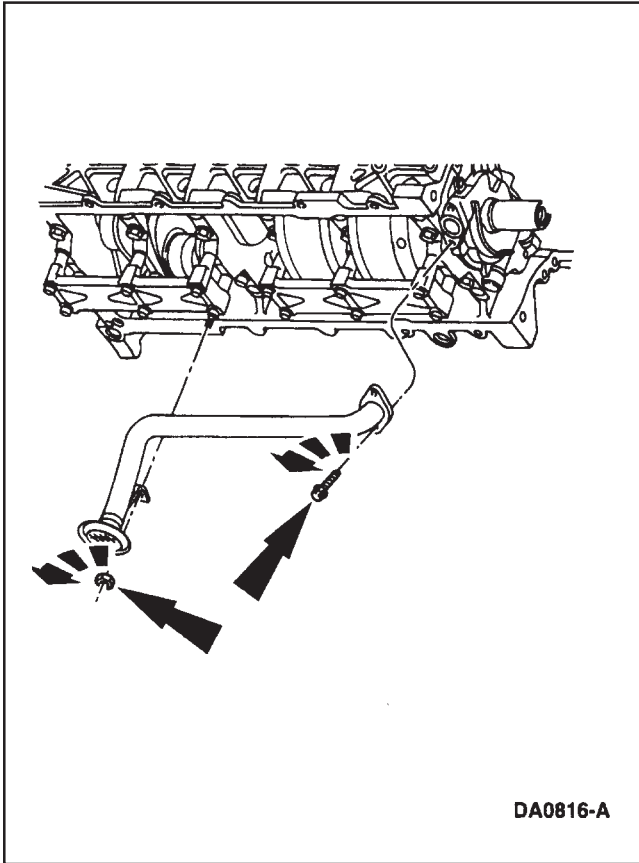




5. Remove the flywheel inspection plate.

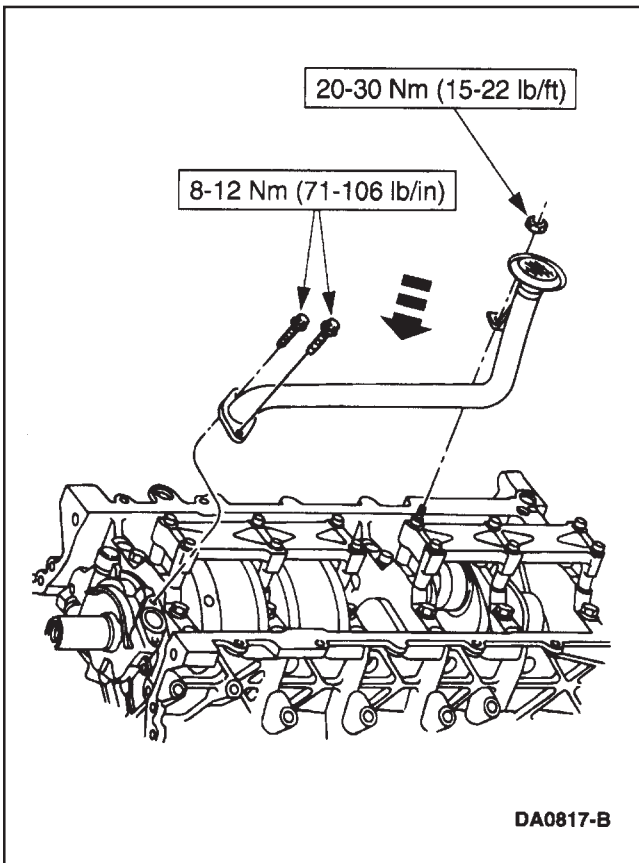


6. Remove the bolts and partially lower the oil pan (6675).



7. Remove the two bolts and the nut retaining the oil pump screen cover and tube (6622) and let them drop into the oil pan.
8. Remove the oil pan and oil pan gasket (6710) from the rear of the engine.
9. Clean the mating surfaces and thoroughly clean the oil pan.

Oil Pan - Installation

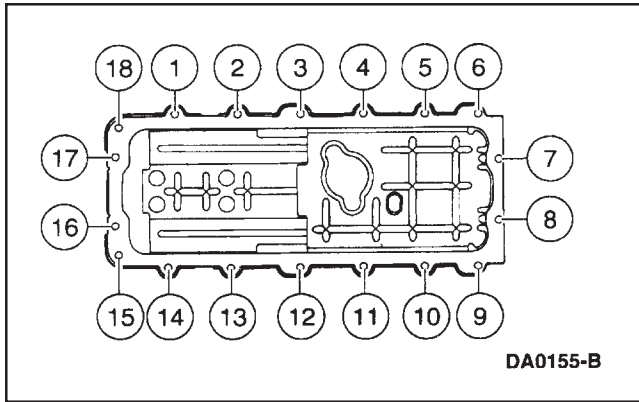


1. Install the oil pump screen cover and tube.
2. **CAUTION:** Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.

- 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.



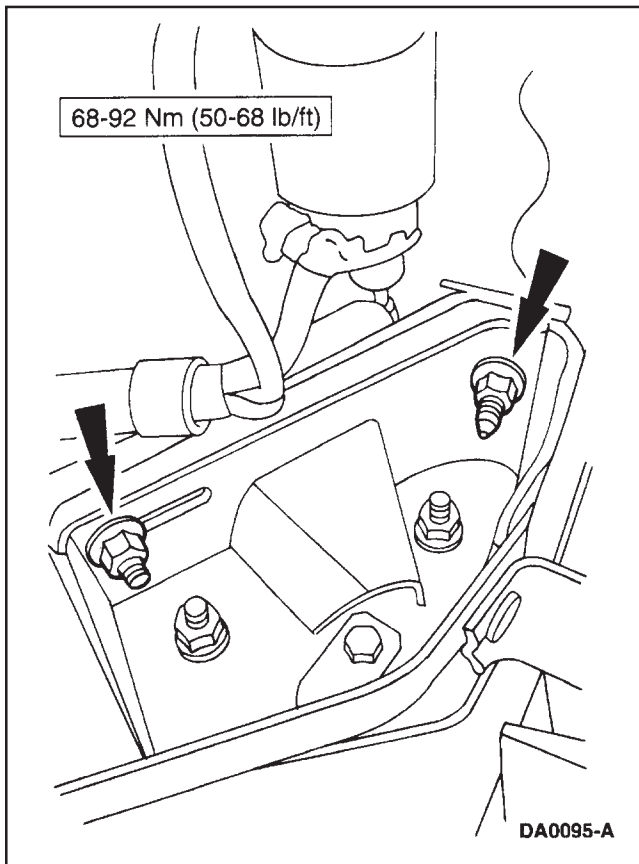
3. **NOTE:** Be sure to tighten the bolts in three stages.

Replace oil pan and bolts.

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.

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



5. Tighten the front engine support insulators.

6. Connect the battery ground cable.

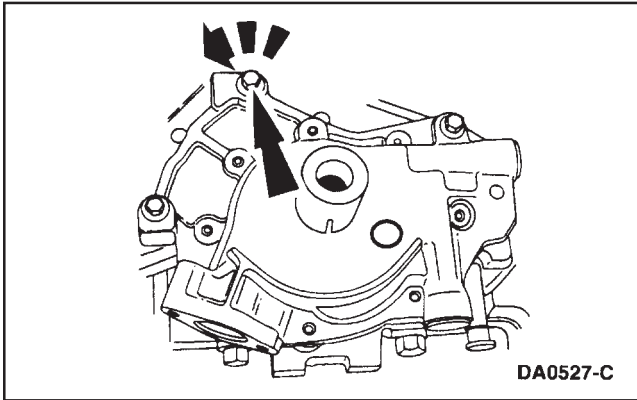
7. Fill the engine with oil.

- Use Motorcraft Engine Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

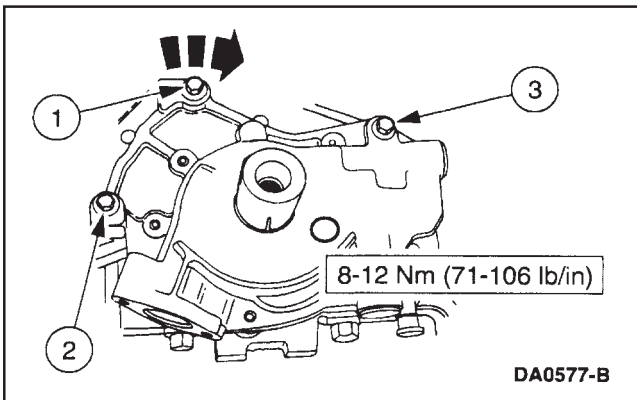
8. Fill the cooling system.

Oil Pump - Removal

1. Disconnect the battery ground cable (14301).
2. Remove the engine front cover (6019) and crankshaft sprockets (6306); refer to Engine Front Cover in this section.
3. Remove the oil pan (6675); refer to Oil Pan in this section.
4. Remove the oil pump (6600).
 - Remove the bolts.
 - Remove the oil pump



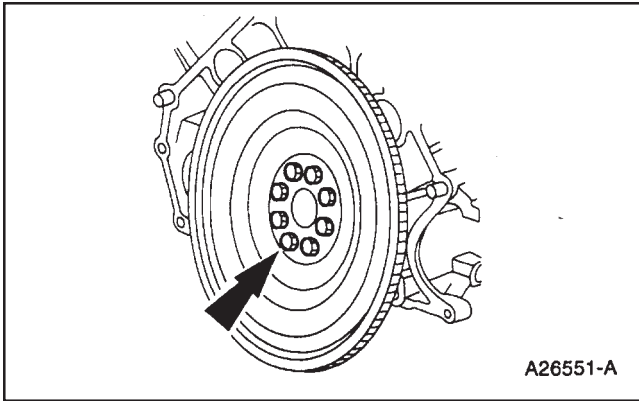
Oil Pump - Installation



1. Clean and inspect the mating surfaces.
2. Position the oil pump and loosely install the bolts. Tighten the bolts in the sequence shown.
3. Install the oil pan; refer to Oil Pan in this section.
4. Install the timing chain (6268); refer to Timing Drive Components in this section.
5. Connect the battery ground cable.

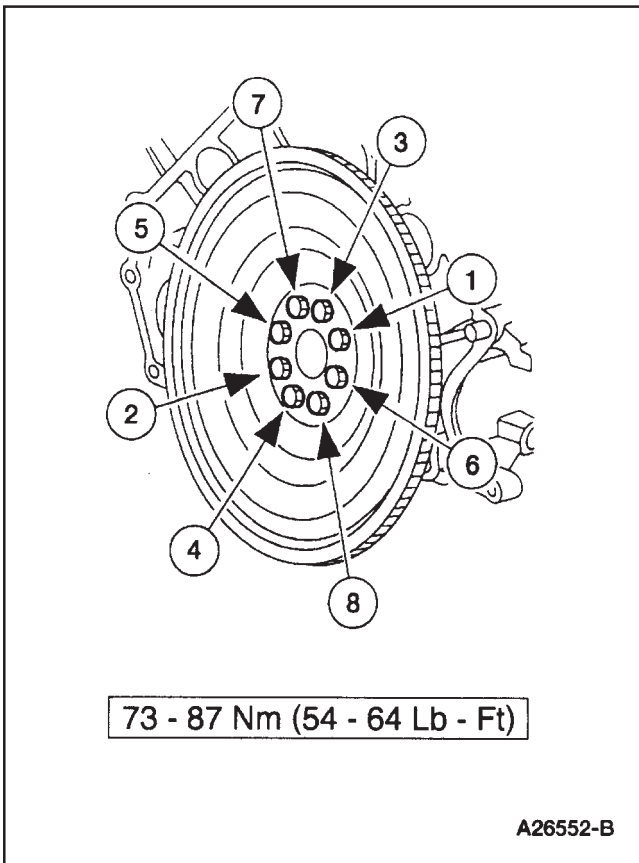
Flywheel - Removal

1. Disconnect the battery ground cable (14301).
2. Remove generator from bell housing.
3. Remove bell housing.
4. Remove the bolts and the flywheel (6375).



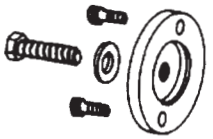
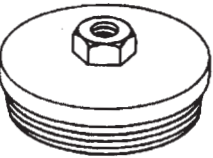

Flywheel - Installation

1. Follow the removal procedure in reverse order.






Crankshaft Rear Oil Seal - Removal

Special Tool(s)

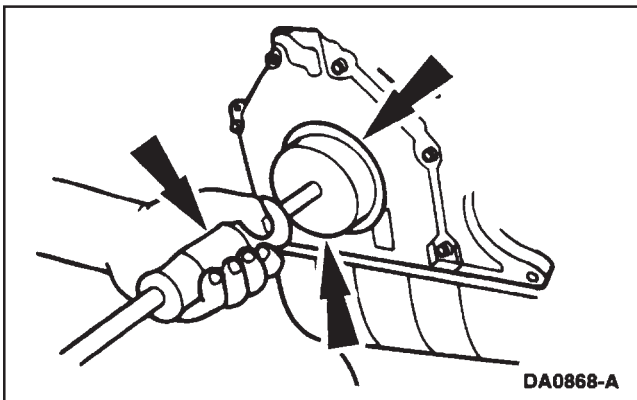
 <p>ST1480-A</p>	<p>Rear Crankshaft Seal Adapter 303-518 (T95P-6701-DH)</p>
 <p>ST1382-A</p>	<p>Rear Crankshaft Seal Remover 303-519 (T95P-6701-EH)</p>
 <p>ST1482-A</p>	<p>Rear Crankshaft Slinger Replacer 303-517 (T95P-6701-CH)</p>

Special Tool(s)

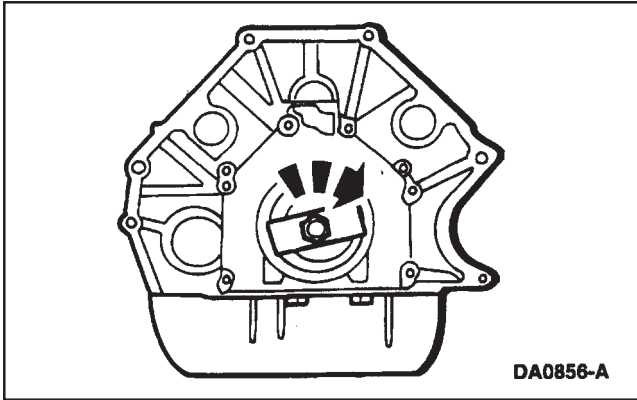
 <p>ST1479-A</p>	<p>Rear Crankshaft Seal Replacer 303-516 (T95P-6701-BH)</p>
 <p>ST1481-A</p>	<p>Rear Crankshaft Slinger Remover 303-514 (T95P-6701-AH)</p>
 <p>ST1185-A</p>	<p>Slide Hammer 100-001 (T50T-100-A)</p>


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

1. Disconnect the battery ground cable (14301).
2. Remove the flywheel (6375); refer to Flywheel in this section.
3. Use the Rear Crankshaft Slinger Remover and the Slide Hammer to remove the crankshaft oil slinger (6310).
4. Use the Rear Crankshaft Seal Remover and the Impact Slide Hammer to remove the crankshaft rear oil seal (6701).



Crankshaft Rear Oil Seal - Installation



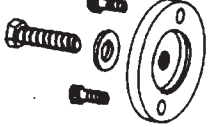
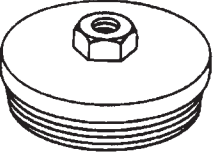

1.  **CAUTION:** Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.
 - Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

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



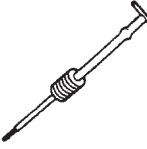
 - Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.
2. Using the Rear Crankshaft Seal Replacer and the Rear Crankshaft Seal Adapter, install the crankshaft rear oil seal.
3. With the Rear Crankshaft Seal Adapter still installed, use the Rear Crankshaft Slinger Replacer and the Rear Crankshaft Seal Replacer to install the rear main seal slinger.
4. Install the flywheel; refer to Flywheel in this section.
5. Connect the battery ground cable.

Crankshaft Rear Oil Seal (with retainer plate) - Removal

Special Tool(s)

 <p>ST1480-A</p>	<p>Rear Crankshaft Seal Adapter 303-518 (T95P-6701-DH)</p>
 <p>ST1382-A</p>	<p>Rear Crankshaft Seal Remover 303-519 (T95P-6701-EH)</p>
 <p>ST1479-A</p>	<p>Rear Crankshaft Seal Replacer 303-516 (T95P-6701-BH)</p>

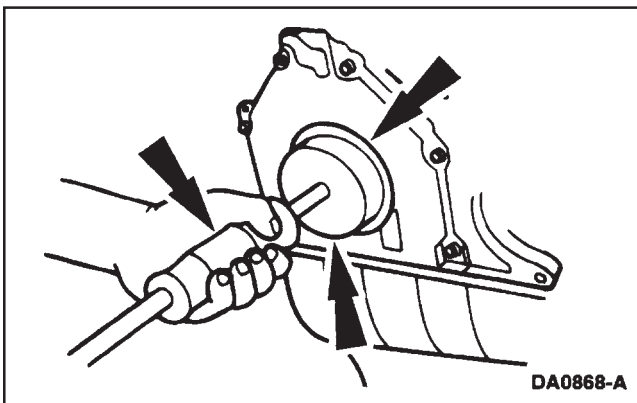
Special Tool(s)

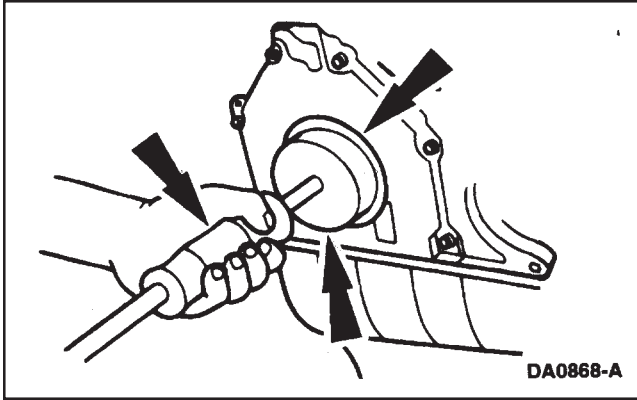
 <p>ST1481-A</p>	<p>Rear Crankshaft Slinger Remover 303-514 (T95P-6701-AH)</p>
 <p>ST1482-A</p>	<p>Rear Crankshaft Slinger Replacer 303-517 (T95P-6701-CH)</p>
 <p>ST1185-A</p>	<p>Slide Hammer 100-001 (T50T-100-A)</p>

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

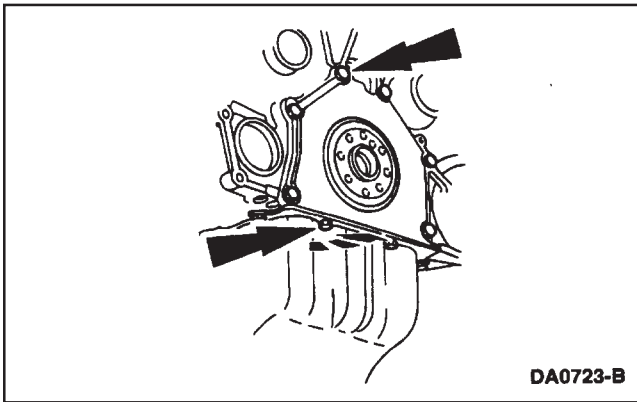
1. Disconnect the battery ground cable (14301).

Remove the flywheel (6375); refer to Flywheel in this section.
2. Use the Rear Crankshaft Slinger Remover and the Impact Slide Hammer to remove the crankshaft oil slinger (6310).



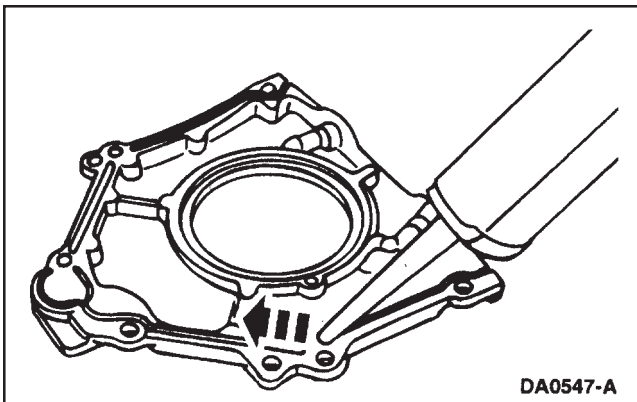


3. Use the Rear Crankshaft Seal Remover and the Impact Slide Hammer to remove the crankshaft rear oil seal (6701).



4. Remove the oil pan; refer to Oil Pan in this section.
5. Remove the crankcase bolts and the crankshaft rear oil seal retainer plate.

Crankshaft Rear Oil Seal (with retainer plate) - Installation

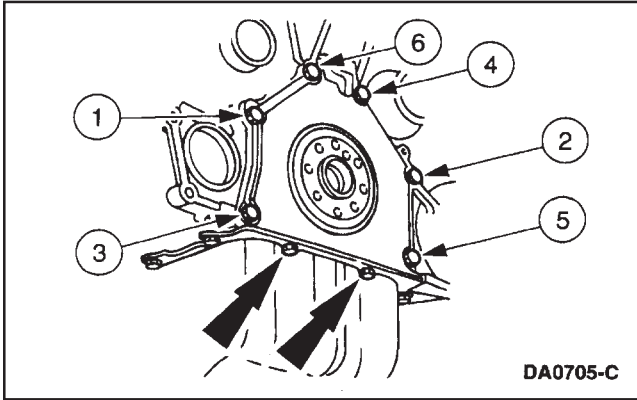


1. **CAUTION:** Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.

- 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.

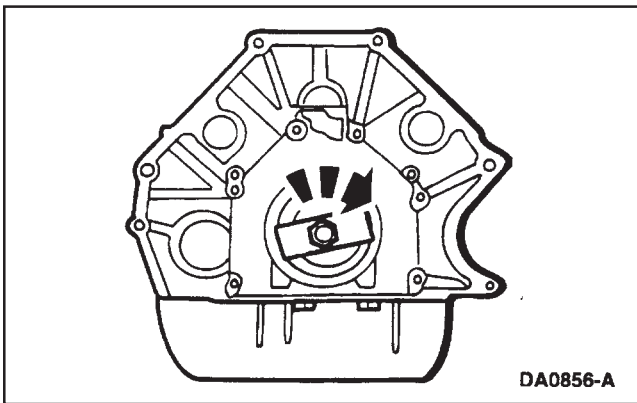
- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.
2. Apply a bead of silicone around the rear oil seal retainer sealing surface.
 - Use Silicone Gasket and Sealant F6AZ-19562-A or equivalent meeting Ford specification WSE-M4G323-A6.



3. **NOTE:** If the rear main oil seal is still in place and being reinstalled, be sure the lip is not folded over or wrinkled during the retainer plate installation. The seal lip must start squarely on the crankshaft journal.

Position the crankshaft rear oil seal and retainer (6K301), install the bolts. Then install the oil pan and the two bolts. Tighten in two stages.


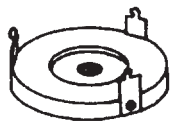
- Stage 1: Tighten retainer plate bolts to 8-12 Nm (71-107 lb/in).
- Stage 2: Tighten oil pan bolts to 14-20 Nm 10-15 lb/ft) then tighten an additional 90°.



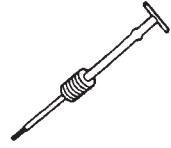
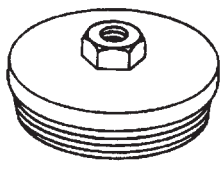
4. Use the Rear Crankshaft Seal Replacer and Rear Crankshaft Seal Adapter to install the crankshaft rear oil seal.
5. With the Rear Crankshaft Seal Adapter still installed, use the Rear Crankshaft Slinger Replacer and Rear Crankshaft Seal Replacer to install the crankshaft oil slinger.
6. Install the flywheel; refer to Flywheel in this section.
7. Connect the battery ground cable.

Engine - Removal

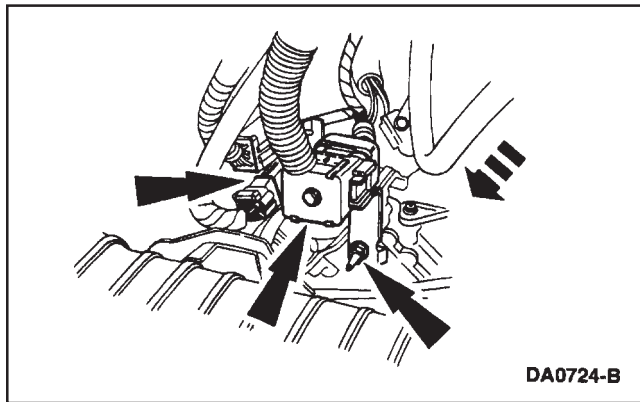
Special Tool(s)

 <p>ST1377-A</p>	<p>Modular Lifting Bar 303-F047 (014-00073) or Equivalent</p>
 <p>ST1481-A</p>	<p>Rear Crankshaft Slinger Remover T95P-6701-AA</p>

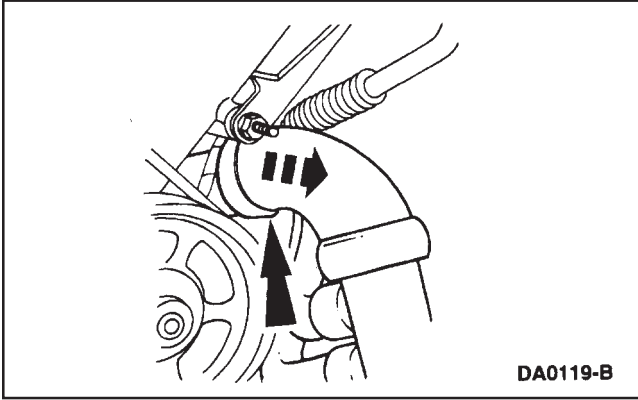
Special Tool(s)

 <p>ST1185-A</p>	<p>Impact Slide Hammer 100-001 (T50T-100-A)</p>
 <p>ST1382-A</p>	<p>Rear Crankshaft Seal Remover 303-519 (T95P-6701-EH)</p>

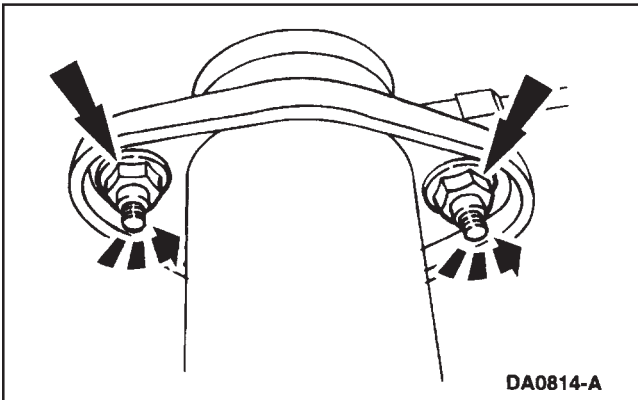
Special Service Tools called for by the procedures can be obtained by calling:
1-800-ROTUNDA (1-800-768-8632).



1. Disconnect the battery ground cable (14301).
2. Remove the intake manifold (9424); refer to Intake Manifold – Variable Resonance Induction System (VRIS) in this section.
3. Remove the radiator upper and lower radiator supports (16138).
4. Remove the radiator (8005), fan shroud (8146) and engine cooling fan.
5. Remove the drive belt (8620); refer to Section 05.

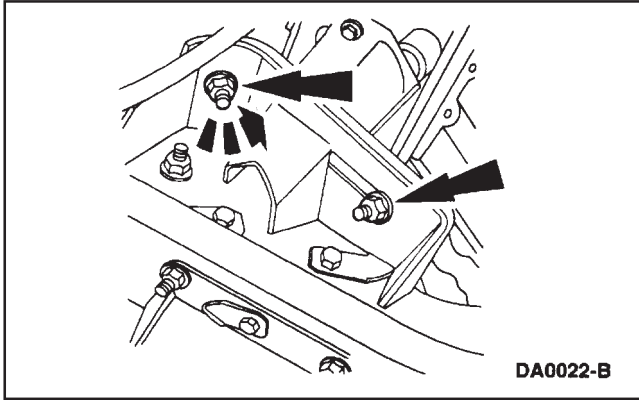


6. At the oil cooler water inlet, disconnect and set aside the lower radiator hose (8286).
7. Disconnect the engine harness.

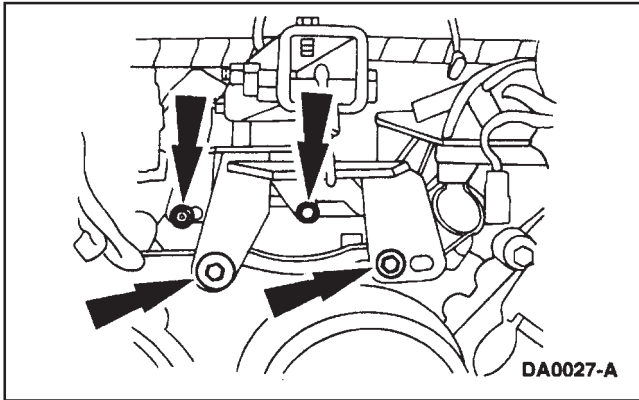


8. Remove exhaust pipe nuts.

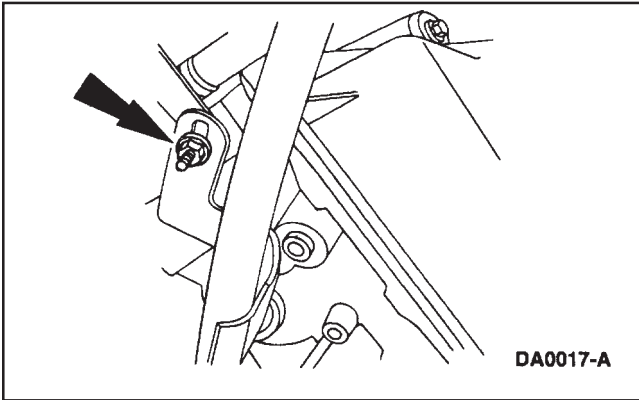
9. Drain engine oil and remove the oil bypass filter (6714).
10. Remove the starter motor (11002); refer to Section 07.



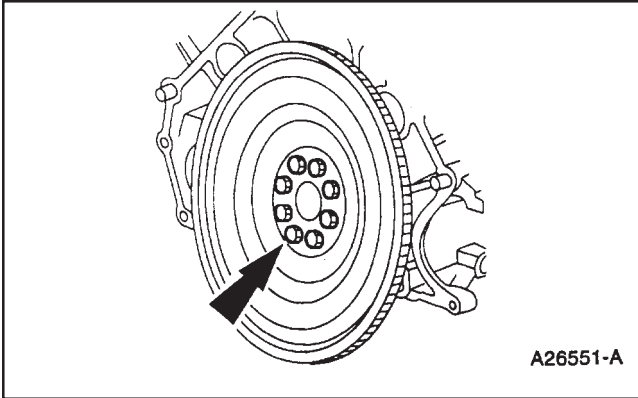
11. Remove the engine support insulator nuts.



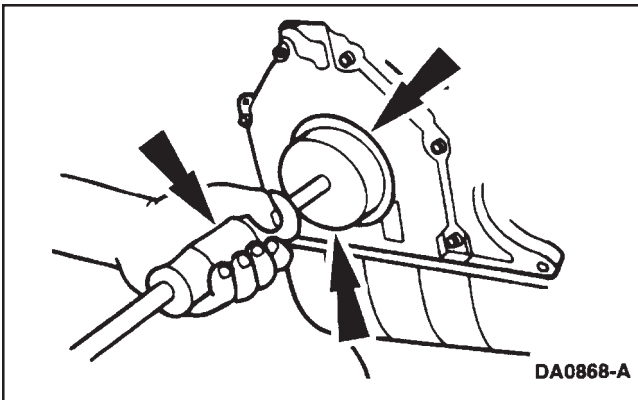
12. Install the Modular Lifting Bar.



13. Remove the engine from the equipment.

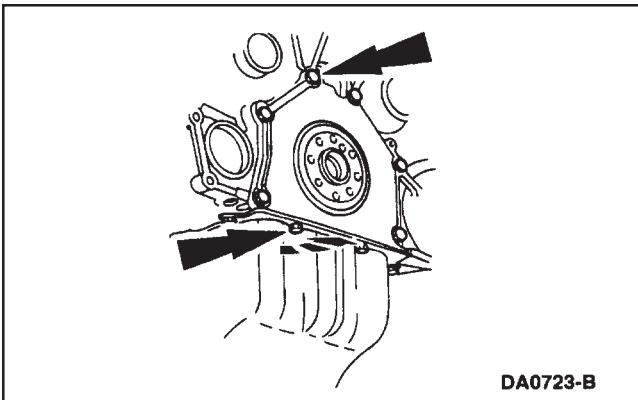


14. Remove the bolts, and remove the flywheel.



15. Use the Rear Crankshaft Slinger Remover and the Impact Slide Hammer to remove the crankshaft oil slinger (6310).

16. Use the Rear Crankshaft Seal Remover and the Impact Slide Hammer to remove the crankshaft rear oil seal (6701).



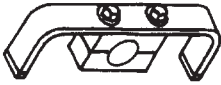

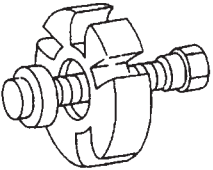
17. Remove the bolts and remove the crankshaft rear oil seal retainer plate.

18. Mount the engine on an engine stand.

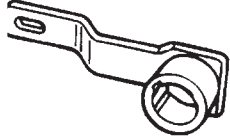
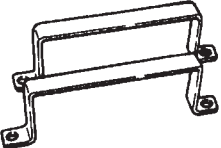

19. Remove the Modular Lifting Bar.

Engine - Disassembly

Special Tool(s)

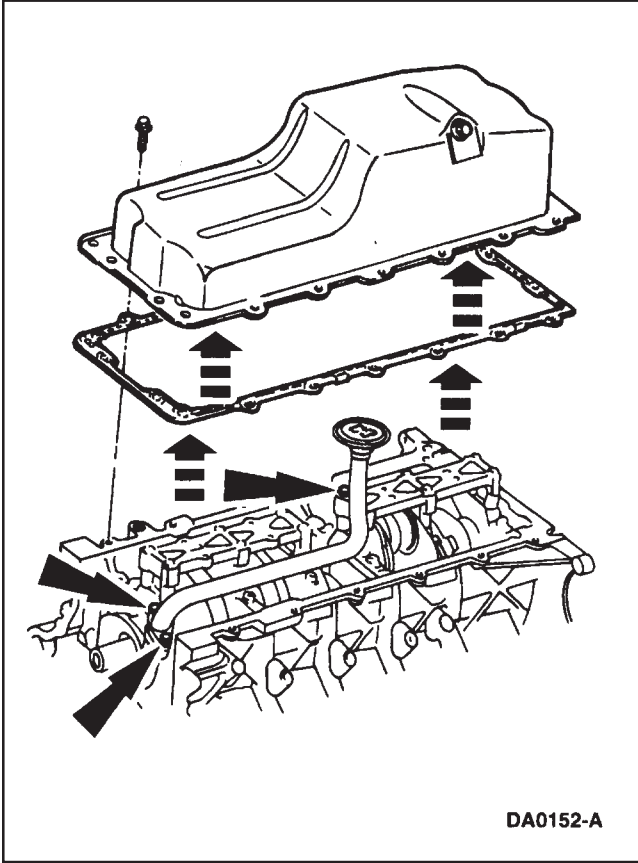
	<p>Camshaft Holding Tool (2 Required) 303-557 (T96T-6256-B)</p>
 <p>ST1337-A</p>	<p>Connecting Rod Guide Tool 303-442 (T93P-6136-A)</p>
 <p>ST1286-A</p>	<p>Crankshaft Damper Remover 303-009 (T58P-6316-D)</p>

Special Tool(s)

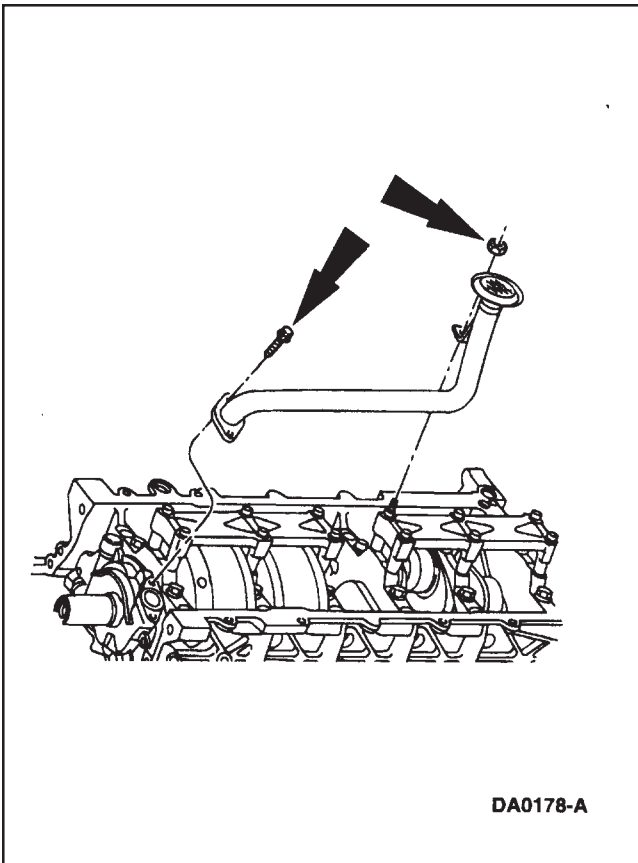
 <p>ST1335-A</p>	<p>Crankshaft Holding Tool 303-448 (T93P-6303-A)</p>
 <p>ST1668-A</p>	<p>Lifting Handles (2 Sets Required) 303-572 (T97T-6000-A)</p>
 <p>ST1730-A</p>	<p>Front Cover Seal Remover 303-107 (T74P-6700-A)</p>

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

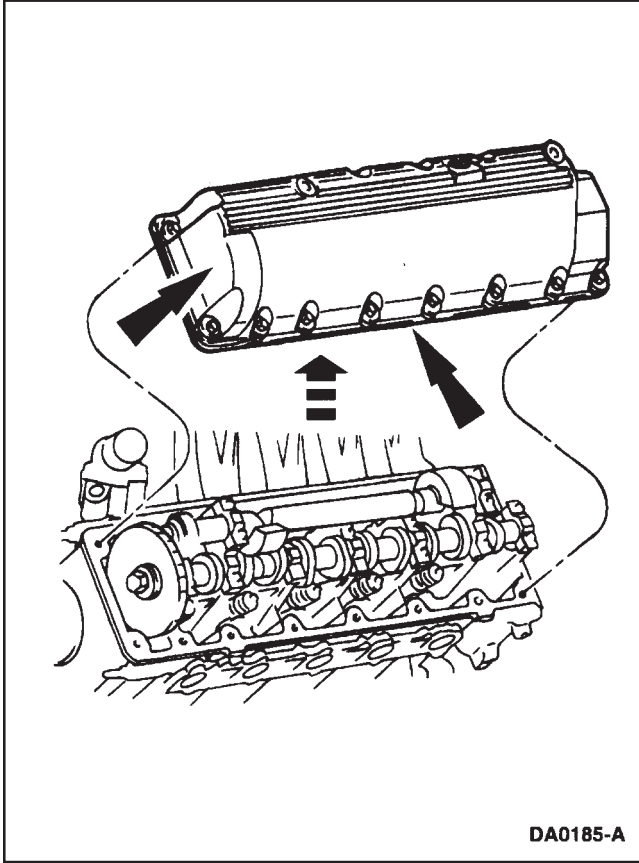
1. With the engine on the engine stand, remove the engine wiring harness.



2. Remove the bolts, the oil pan (6675), and the oil pan gasket (6710).



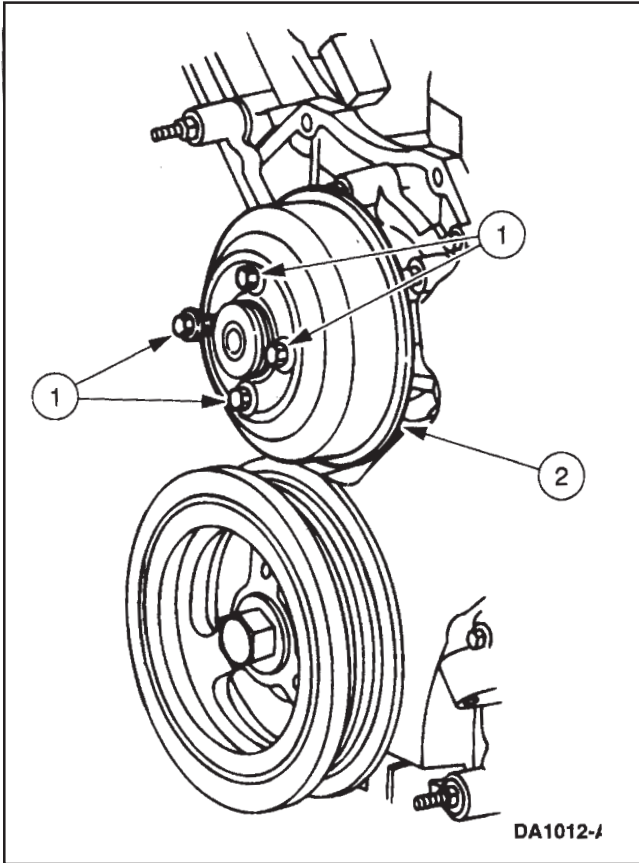
3. Remove the two bolts and nut retaining the oil pump screen cover and tube (6622) and remove the oil pump screen cover and tube.



4. **NOTE:** The bolts are a part of the valve cover (6582) and are not to be removed.

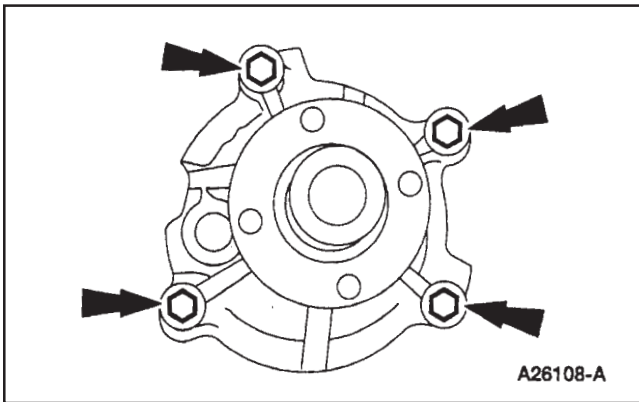
LH is shown; RH is similar.

- Fully loosen the sixteen bolts, and remove the valve cover gasket (6584).

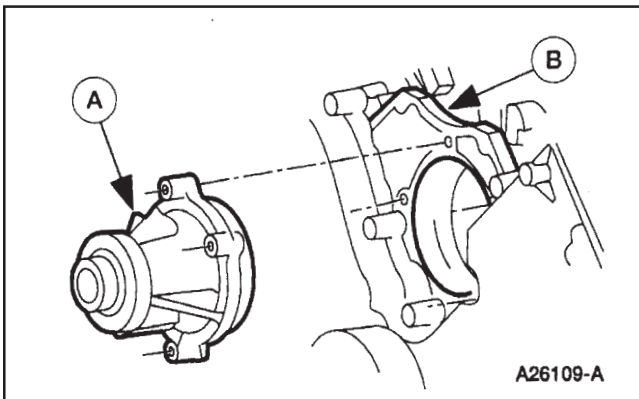


5. Remove the drive belt.
6. Remove the water pump pulley (8509).

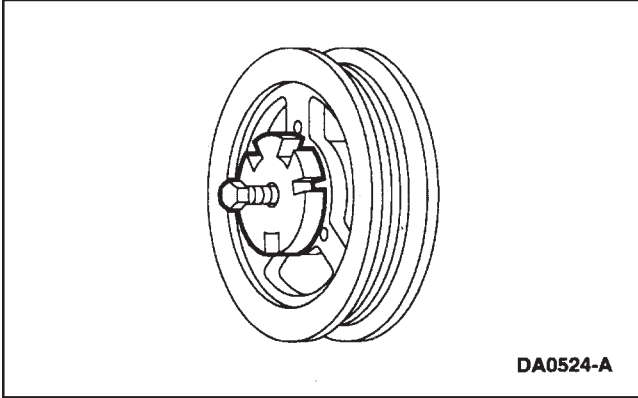
1. Remove the four bolts.
2. Remove the water pump pulley.



7. Remove the four bolts from the water pump.

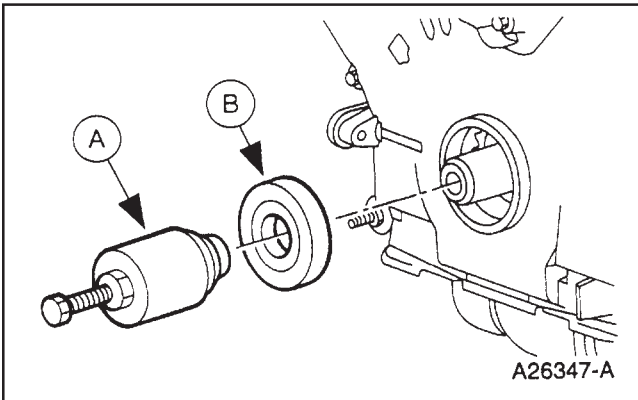


8. Remove the (A) water pump (8501) from the (B) cylinder block (6010).

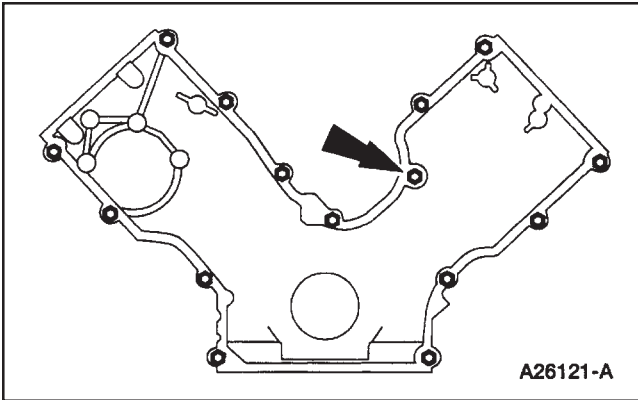


9. Remove the crankshaft pulley bolt (6A340).

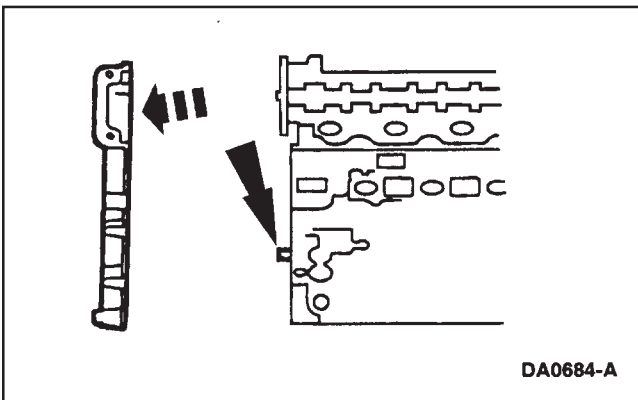
Use the Crankshaft Damper Remover to remove the crankshaft pulley (6312).



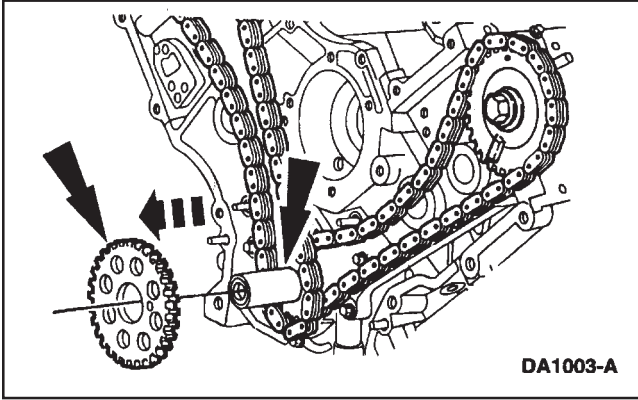
10. Use the (A) Front Cover Seal Remover to remove the (B) crankshaft front seal (6700).



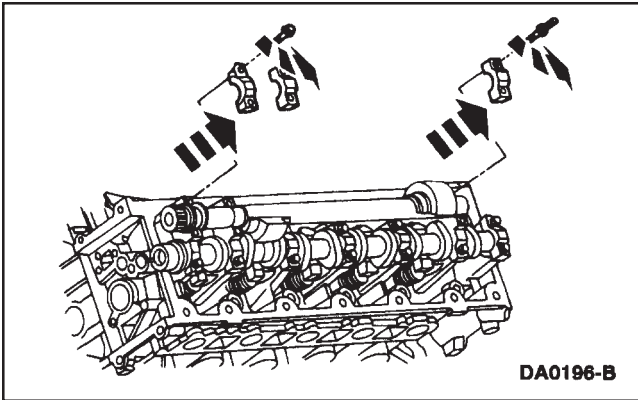
11. Remove the engine front cover fasteners.



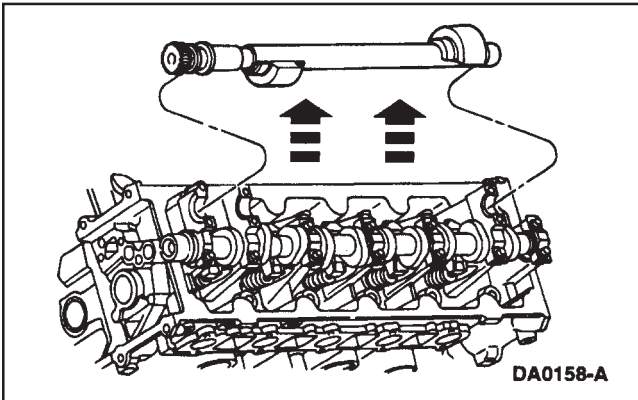
12. Remove the engine front cover (6019) from the front cover to cylinder block dowels (6C002).



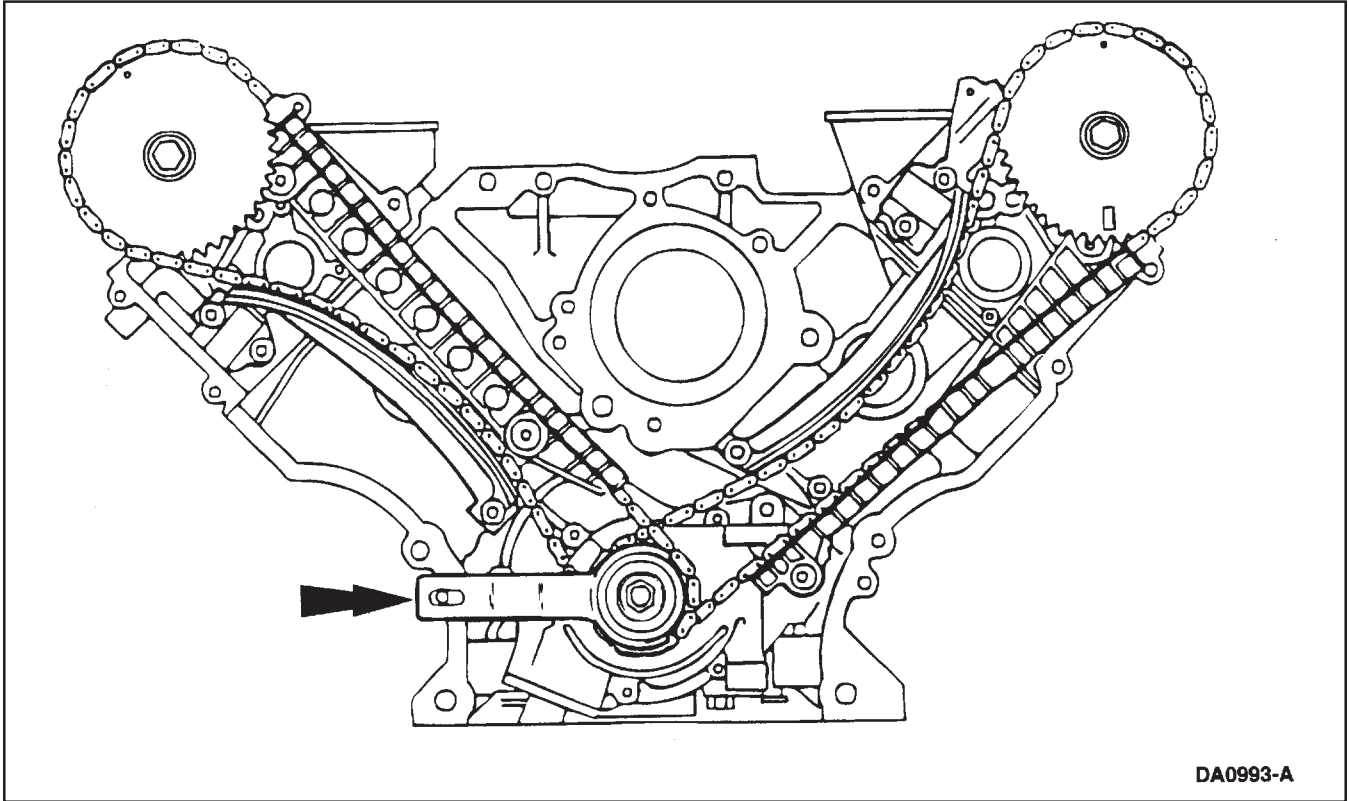
13. Remove the crankshaft sensor ring from the crankshaft (6303).



14. Remove the balancing shaft bearing caps.

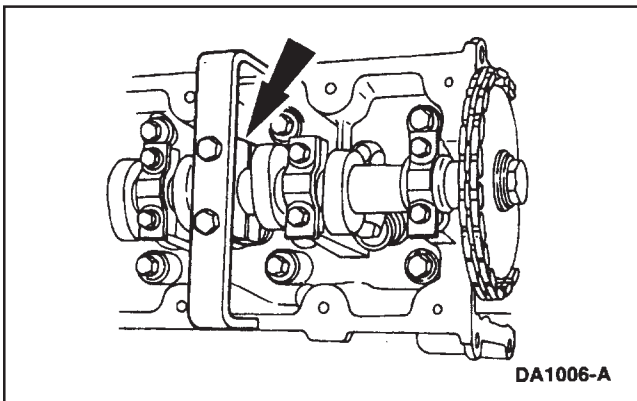


15. Remove balancing shaft.

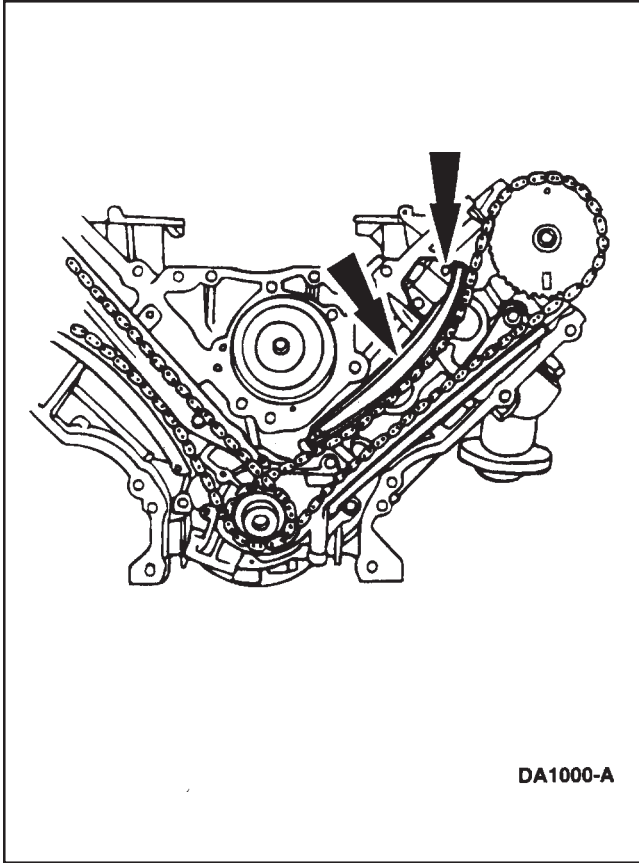


16. **⚠ CAUTION:** Unless otherwise instructed, at no time when the timing chains (6268) are removed and the cylinder heads (6049) are installed is the crankshaft or camshaft (6250) to be rotated. Severe piston (6108) and valve damage will occur.

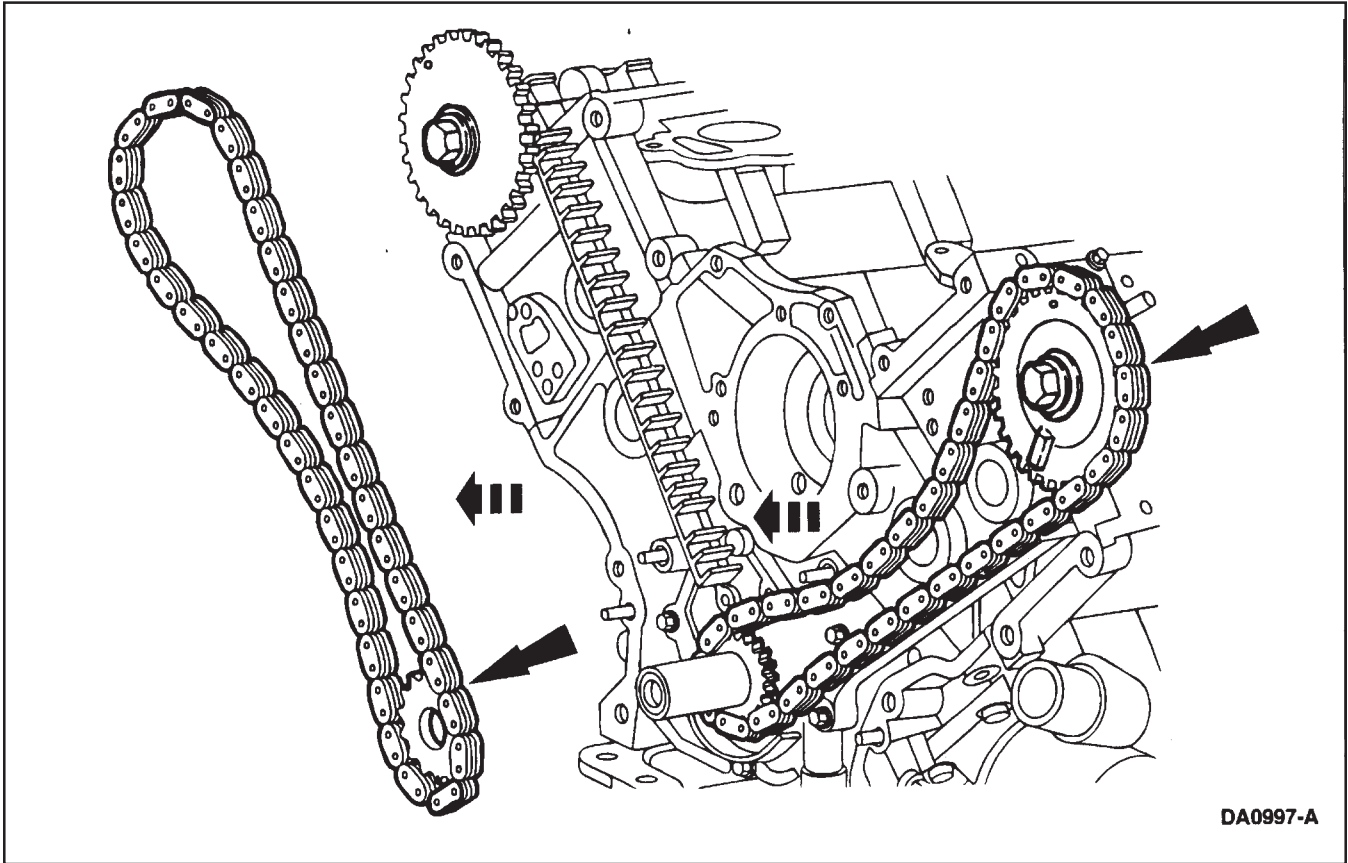
Position the crankshaft with the Crankshaft Holding Tool as shown.



17. Install the Camshaft Holding Tools on the camshafts (2).

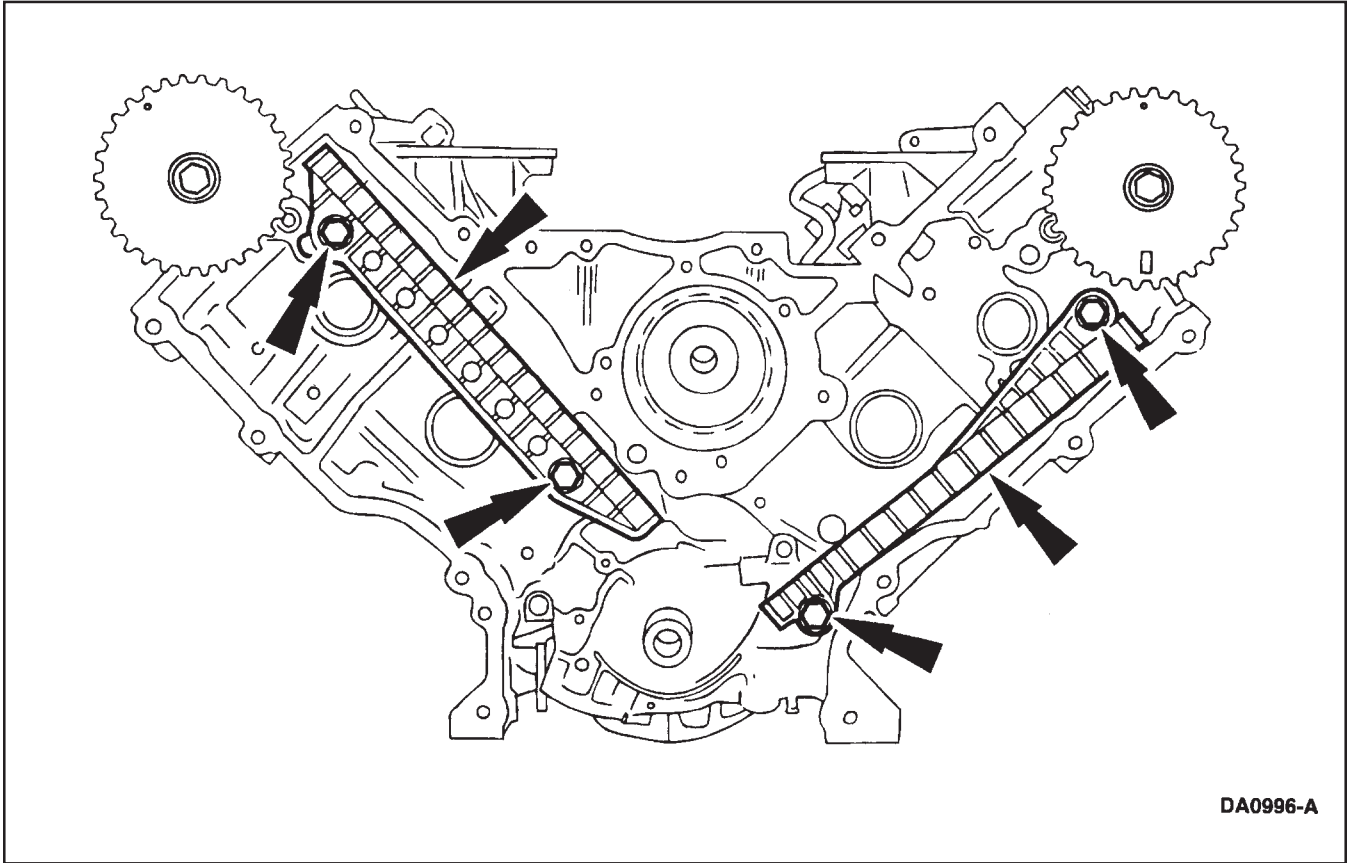


18. Remove the bolts and the timing chain tensioners (6L266). Remove the timing chain tensioner arms (6L253) from the dowel pins.



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

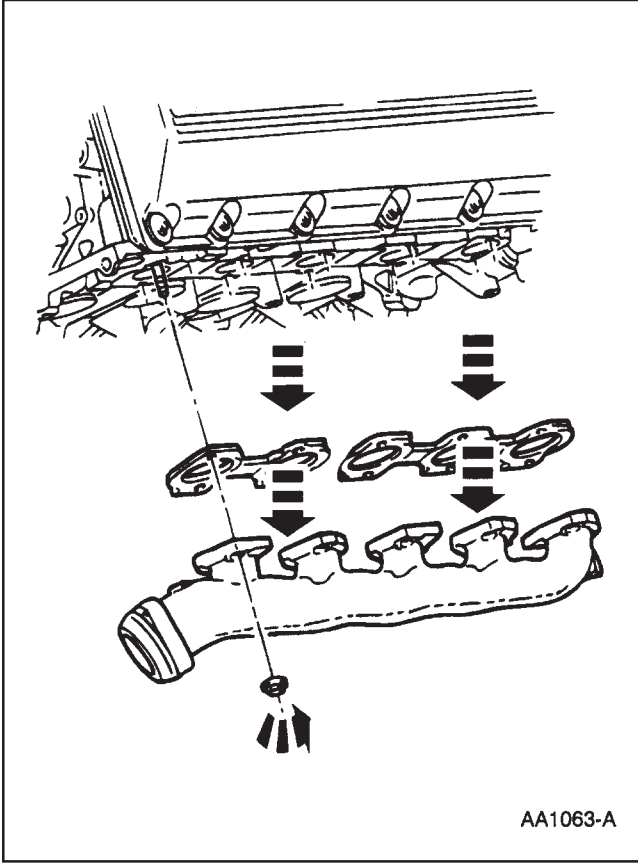
- Remove the Crankshaft Holding Tool.
- Remove the RH timing chain from the camshaft sprocket (6256).
- Remove the RH timing chain and outer crankshaft sprocket from the crankshaft.
- Repeat for the LH timing chain and crankshaft sprocket.



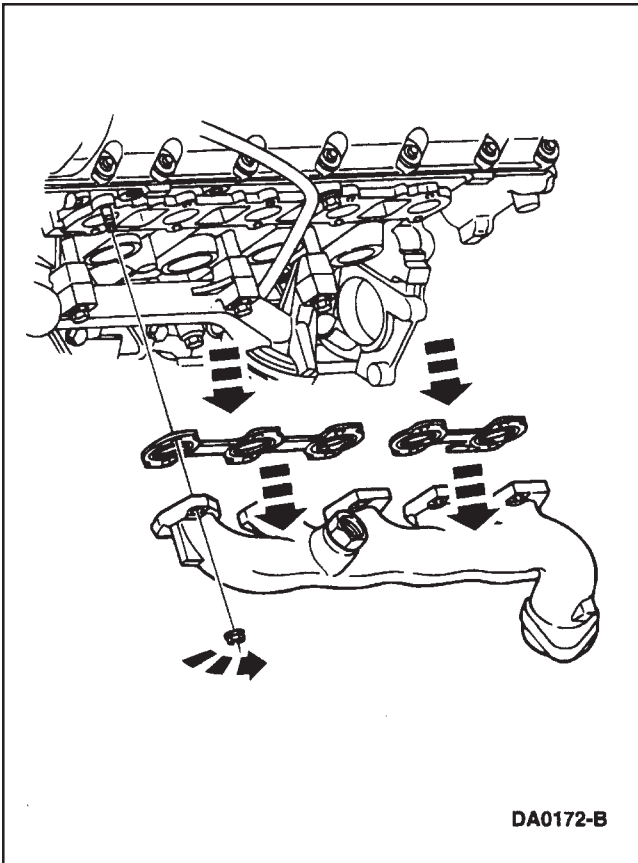
DA0996-A

20. Remove the timing chain guides (6K297).

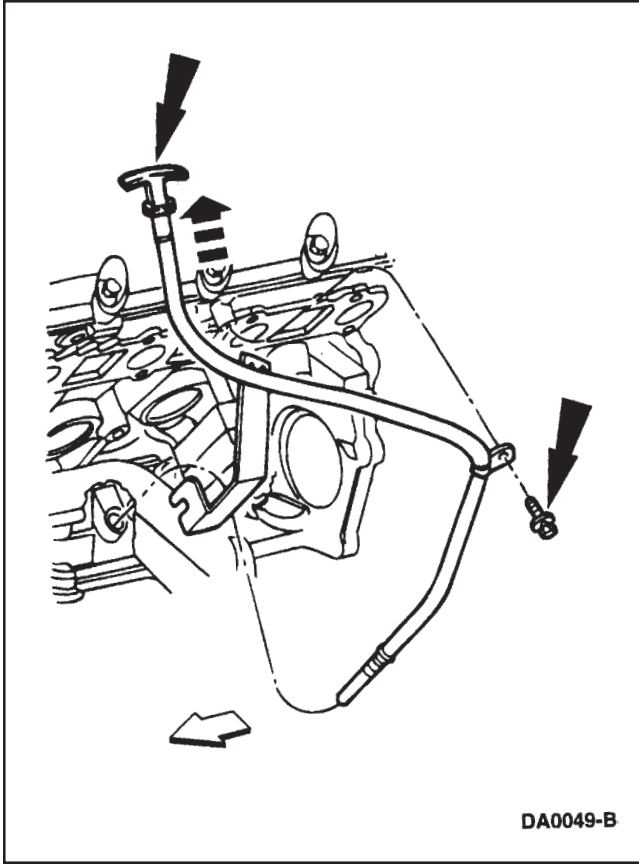
- Remove the bolts.
- Remove the timing chain guides.



21. Remove the ten nuts and the RH exhaust manifold (9430) and exhaust manifold gasket (9448). Discard the exhaust manifold gasket.

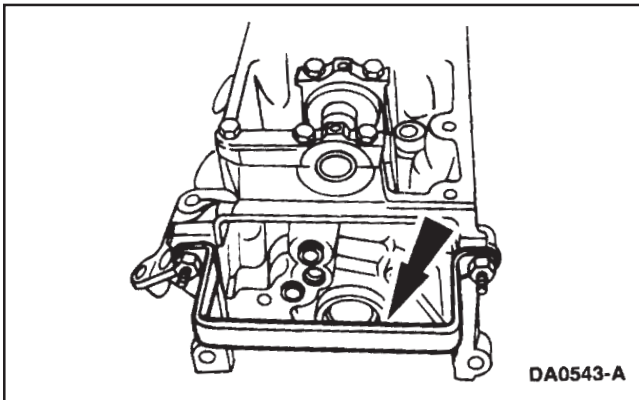


22. Remove the ten nuts, the LH exhaust manifold and the exhaust manifold gaskets. Discard the exhaust manifold gasket.



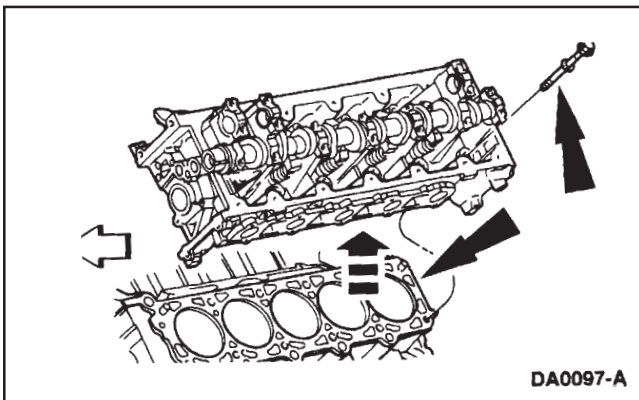
DA0049-B

23. Remove the oil level dipstick, the bolt and the oil level indicator tube (6754).



DA0543-A

24. Install the Lifting Handles on both ends of the cylinder head.



DA0097-A

25. **⚠ CAUTION: These bolts must be replaced with new bolts. They are tighten-to-yield designed and cannot be reused.**

Remove the bolts, cylinder head, and head gasket.

- Discard the head gasket (6051), cylinder head bolts and clean the engine block surface.
- LH is shown; RH is similar.

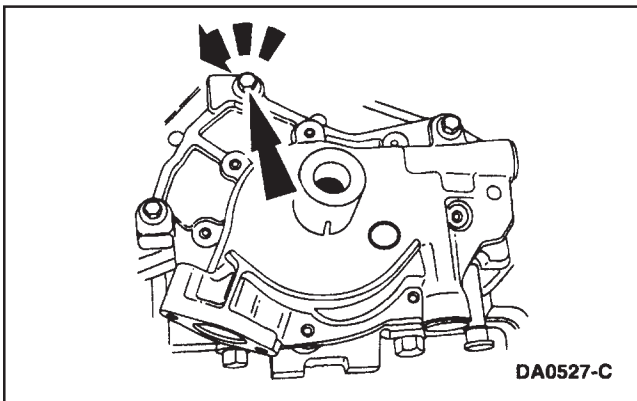
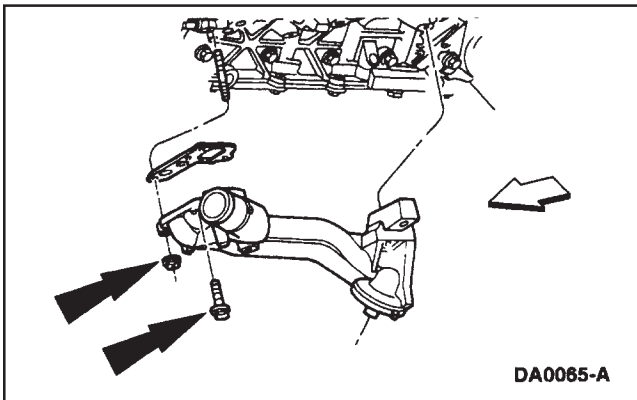
26. Use silicone gasket and sealant F6AZ-19562-AA equivalent meeting Ford specification WSE-M4G323-A6.

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

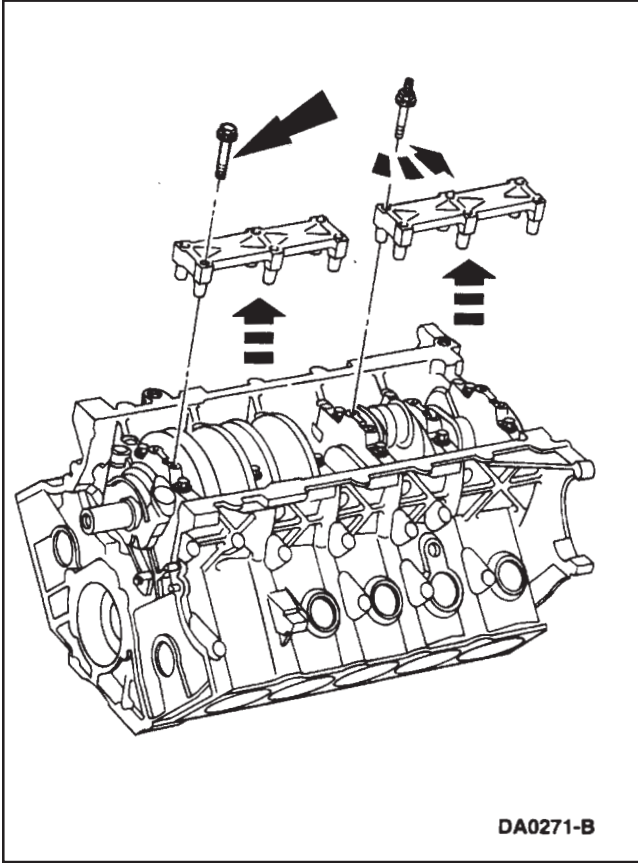
- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

27. Remove the bolts and remove the engine mounts.

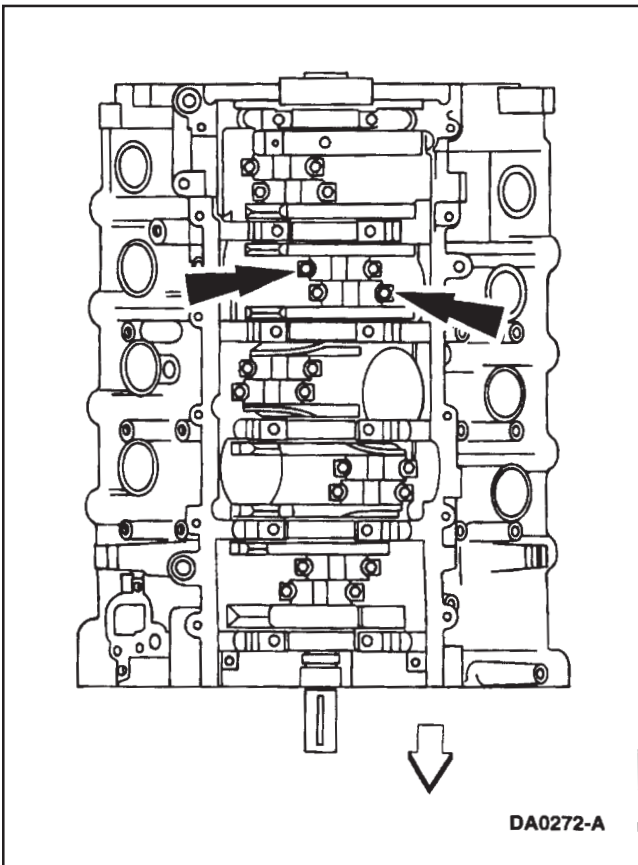
28. Remove the bolts and nut retaining the oil filter adapter (6881) to the cylinder block. Remove the oil filter adapter and clean the gasket surface.



29. Remove the bolts and the oil pump (6600).



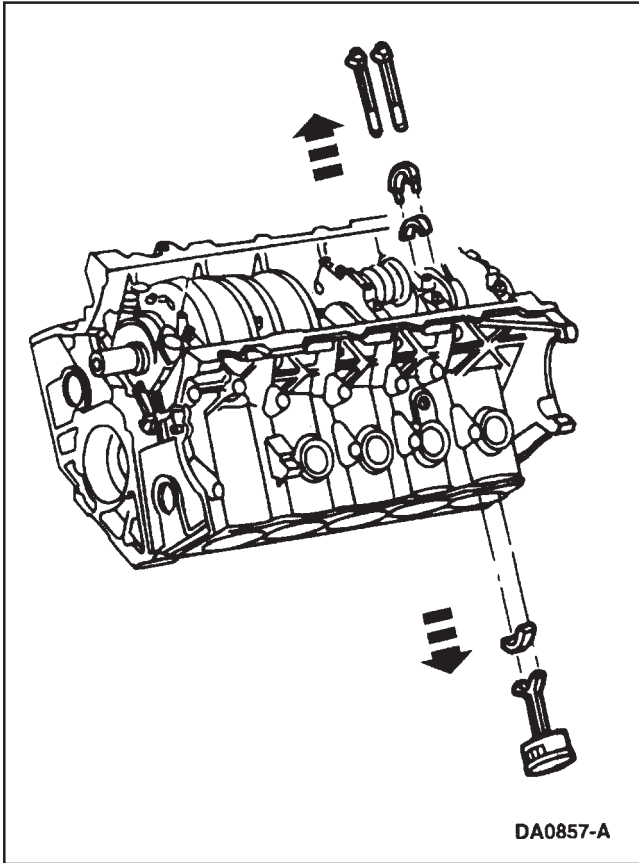
30. Remove the twelve bolts and the two lower crankshaft bearing supports.



31. **CAUTION:** Make sure connecting rods (6200) and rod caps are numbered, to keep in proper orientation.

Remove the bolts and the connecting rod caps.

- Rotate the crankshaft so that the connecting rod is at bottom dead center.
- Remove the bolts and discard them.

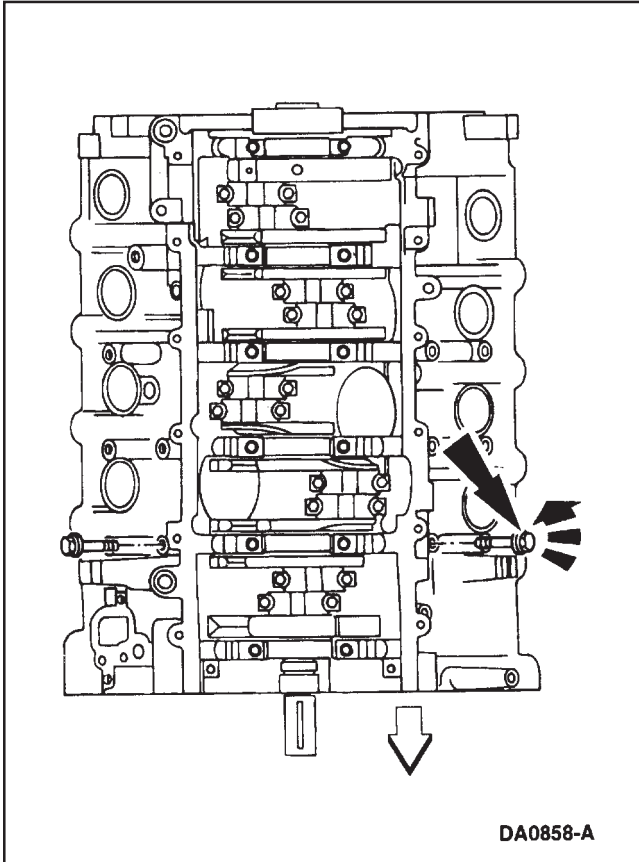


32. **CAUTION:** Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.

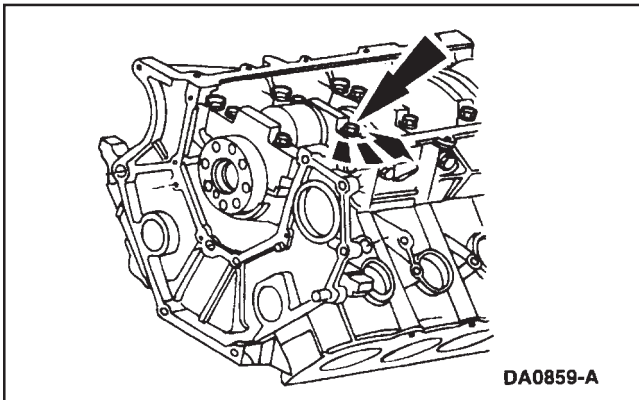
Remove the piston and rod assembly.

- Use the Connecting Rod Guide Tools to guide the piston and rod assembly out of the cylinder.

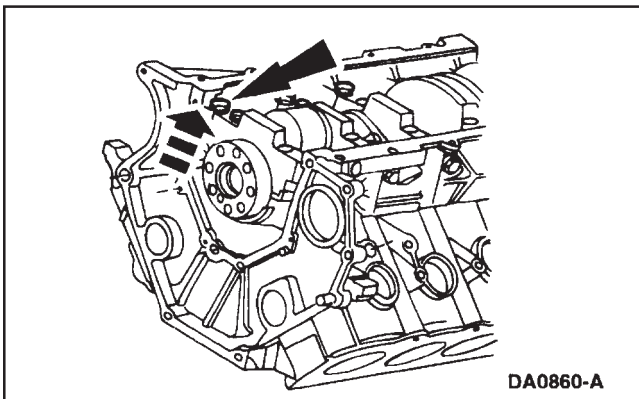
33. Repeat the previous steps until all ten piston and rod assemblies have been removed from the cylinder block.



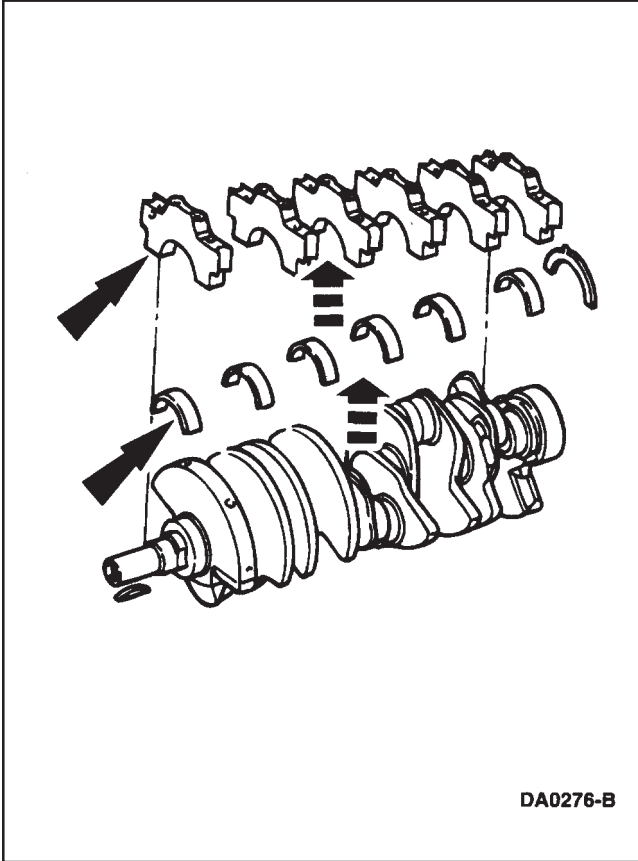
34. Remove and discard the twelve cross-mounted bolts.



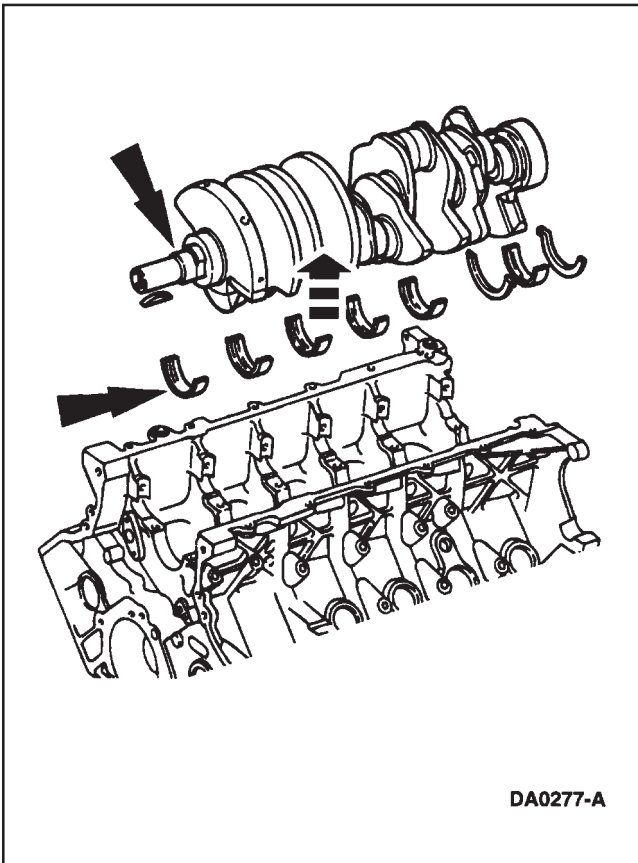
35. Remove the main bearing bolts and discard the bolts.



36. Remove the main bearing cap dowel pins.



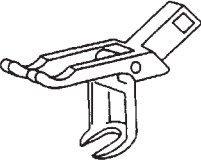
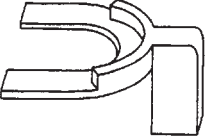

37. Remove the main bearing caps, the lower crankshaft main bearings (6333) and the thrust washer.



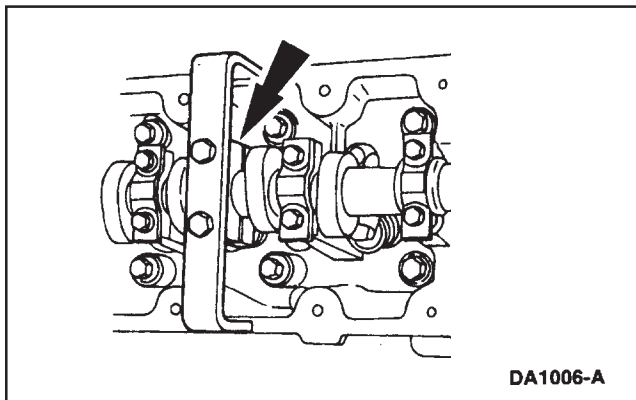
38. Remove the crankshaft and the crankshaft main bearings from the cylinder block.

Cylinder Head - Disassembly

Special Tool(s)

 <p>ST1330-A</p>	Valve Spring Compressor 303-381 (T91P-6565-A)
 <p>ST1331-A</p>	Valve Spring Spacer 303-382 (T91P-6565-AH)
 <p>ST1332-A</p>	Valve Stem Seal Replacer 303-383 (T91P-6571-A)

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



1. Remove the Camshaft Holding Tool from the camshaft (6250).