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## **GENERAL INFORMATION**

### **Description**

The 6.8 liter engine consists of four basic modules that can be repaired individually. Remove only those components required to repair the module.

The induction module consists of an upper and lower intake manifold (9424).

Each aluminum cylinder head module utilizes a single overhead camshaft (6250) to operate the two-valves-per-cylinder design. Individual ignition coils (12029) are used for each spark plug (12405).

The cylinder block module is a cast iron, 90-degree V-10 cylinder block (6010).

The basic engine components consist of the following:

- Two overhead camshafts.
- Engine dynamic balance shaft.
- Two valves per cylinder.
- Aluminum cylinder heads (6049).
- Cast iron, 90-degree V-10 cylinder block.
- Two-piece aluminum intake manifold system.

### **Engine Identification**

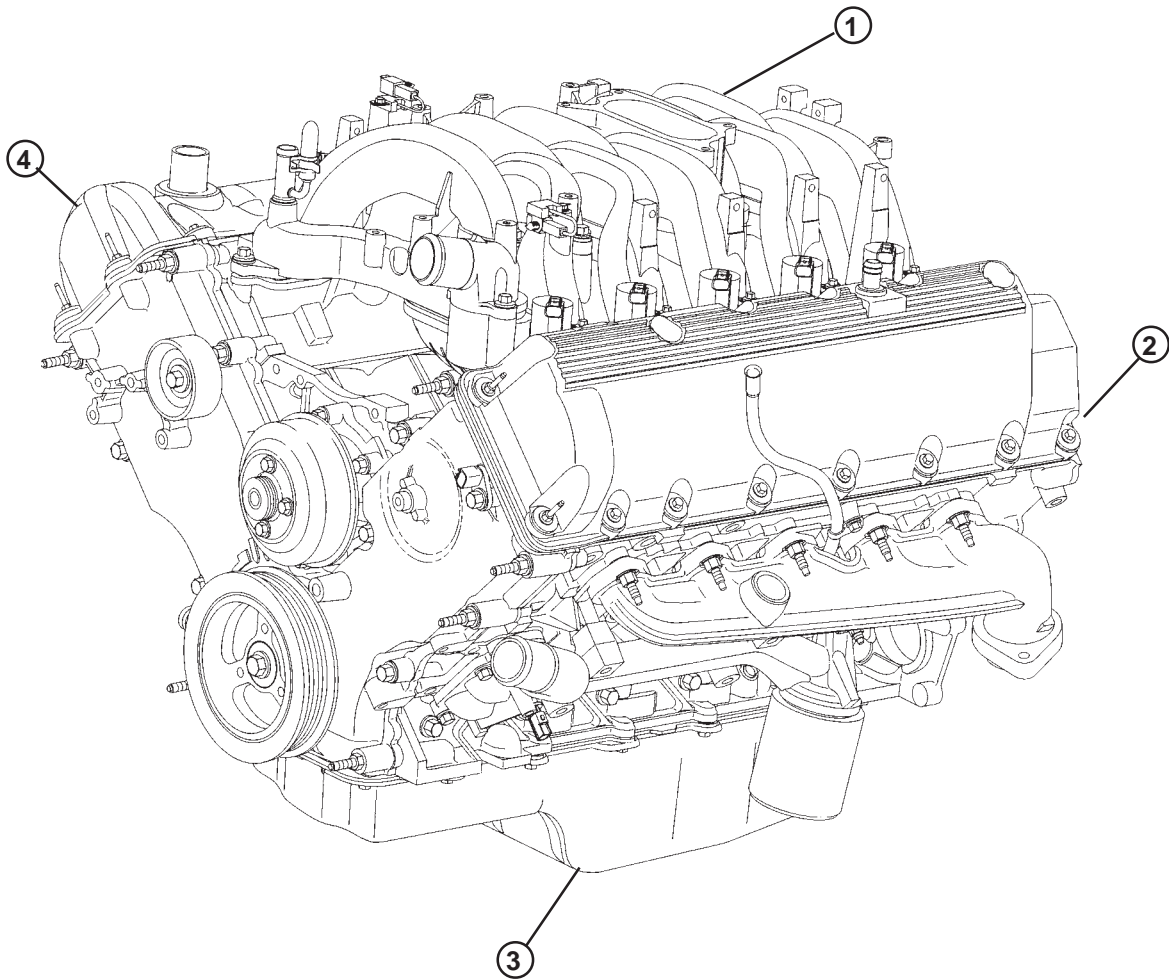
It is important the engine codes and the calibration number be used when ordering parts or making inquiries about the engine.

### **Engine Code Information**

The engine code information label, located on the valve cover, contains the following:

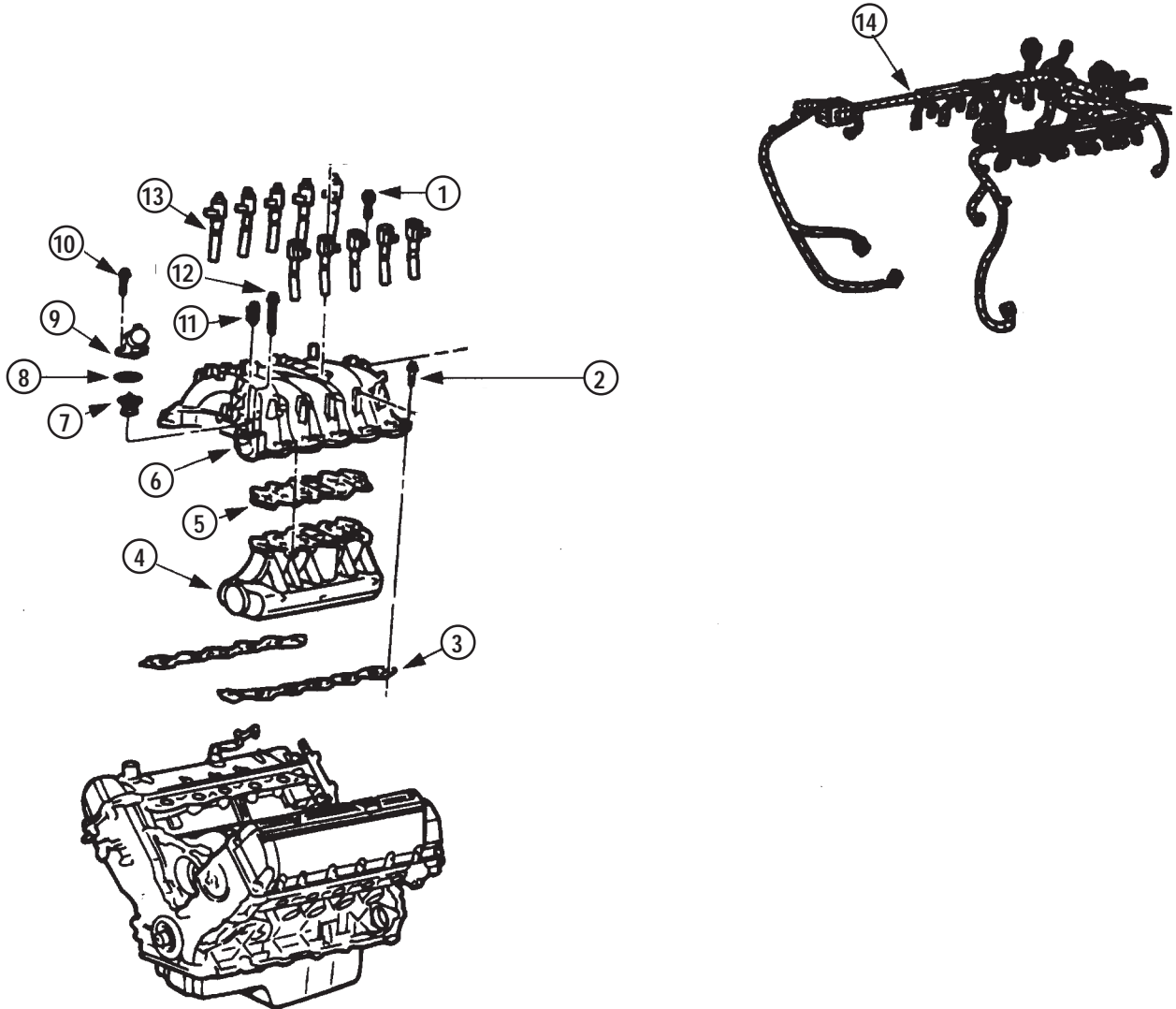
- Engine build date.
- Engine code.

Module View



Item	Part Number	Description
1	-	Induction Module
2	-	Cylinder Head Module (LH)
3	-	Cylinder Block Module
4	-	Cylinder Head Module (RH)

Engine Intake Components



DA0443-A

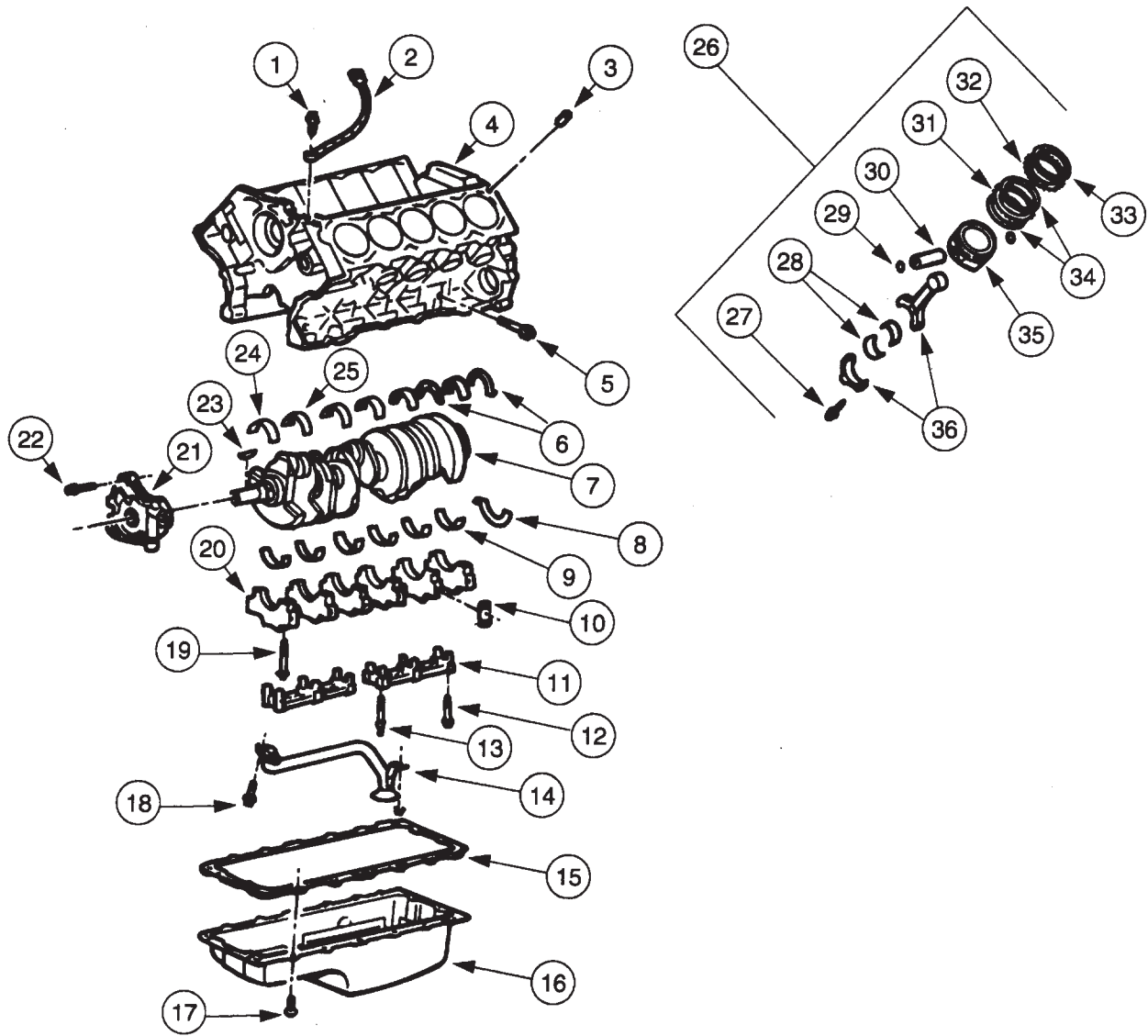
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**WSG-1068 ENGINE**

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<b>Item</b>	<b>Part Number</b>	<b>Description</b>
1	N606500	Bolt (10 Req'd)
2	N806156	Bolt (11 Req'd)
3	9439	Intake Manifold Gasket
4	9424	Intake Manifold
5	9461	Intake Manifold Gasket
6	9424	Intake Manifold (Upper)
7	9575	Water Thermostat
8	N806807	O-Ring Seal
9	8494	Water Outlet Connection
10	N806178	Bolt (3 Req'd)
11	10884	Water Temperature Indicator Sender Unit
12	N806178	Bolt (2 Req'd)
13	12A366	Ignition Coil and Boot (10 Req'd)
14	12B637	Ignition Harness

Low End Components



DA0442-A

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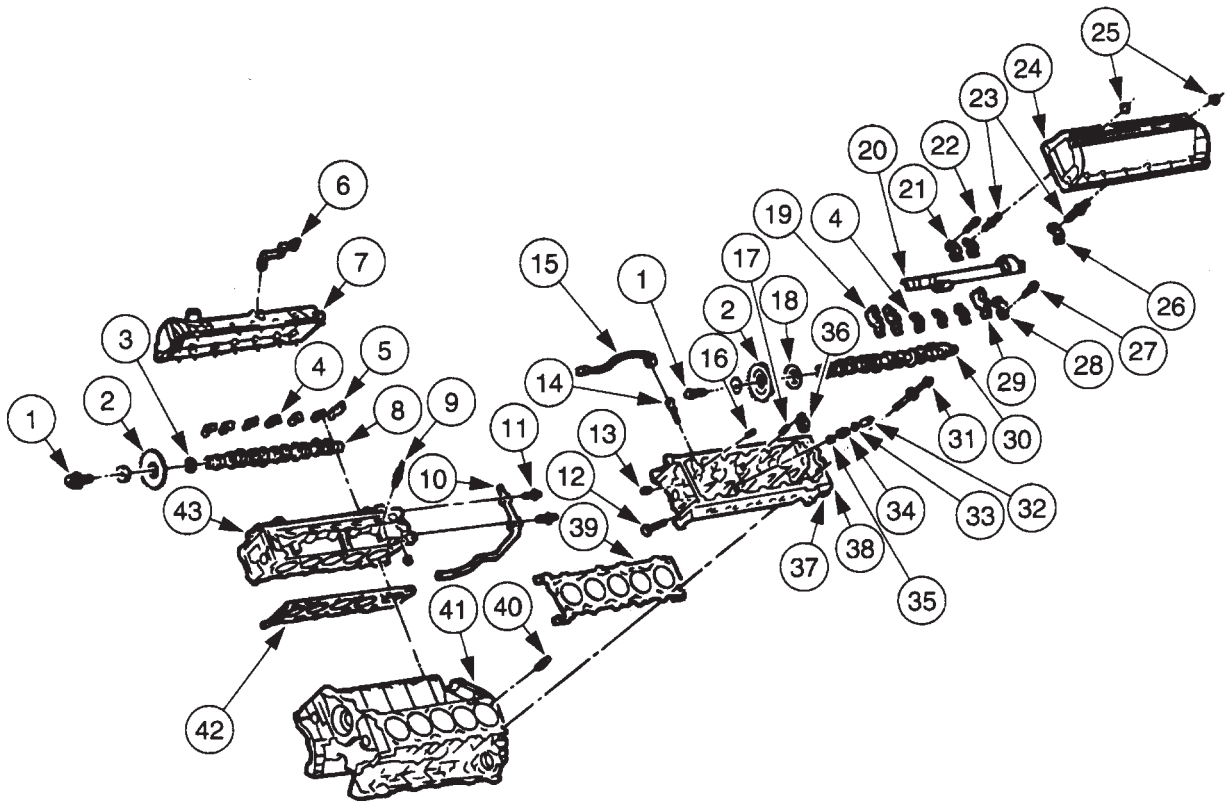
**WSG-1068 ENGINE**

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<b>Item</b>	<b>Part Number</b>	<b>Description</b>
1	W500225	Bolt
2	12A699	Knock Sensor
3	N806459	Dowel (4 Req'd)
4	6010	Cylinder Block
5	6345	Crankshaft Main Bearing Cap Stud
6	6334	Crankshaft Thrust Washer (Upper) (2 Req'd)
7	6303	Crankshaft
8	6K302	Crankshaft Thrust Washer (Lower)
9	6333	Crankshaft Main Bearing (Lower)
10	6A346	Dowel
11	6F098	Support
12	N811025	Bolt
13	N811026	Stud
14	6622	Oil Pump Screen Cover and Tube
15	6710	Oil Pan Gasket
16	6675	Oil Pan
17	W701605	Bolt
18	N806155	Bolt

<b>Item</b>	<b>Part Number</b>	<b>Description</b>
19	6345	Crankshaft Main Bearing Cap Stud
20	6325	Crankshaft Main Bearing Cap
21	6600	Oil Pump
22	N806183	Bolt
23	N806201	Key
24	6W337	Crankshaft Upper Main Bearing Shell
25	6333	Crankshaft Main Bearing (Upper)
26	6100	Piston/Connecting Rod Assy.
27	6214	Connecting Rod Bolt
28	6211	Connecting Rod Bearing
29	6140	Piston Pin Retainer
30	6135	Piston Pin
31	6161	Piston Ring, Spacer Oil Control
32	6152	Compression Ring (Lower)
33	6150	Compression Ring (Upper)
34	6159	Piston Ring, Segment Oil Control
35	6108	Piston
36	6200	Connecting Rod

Upper End Components



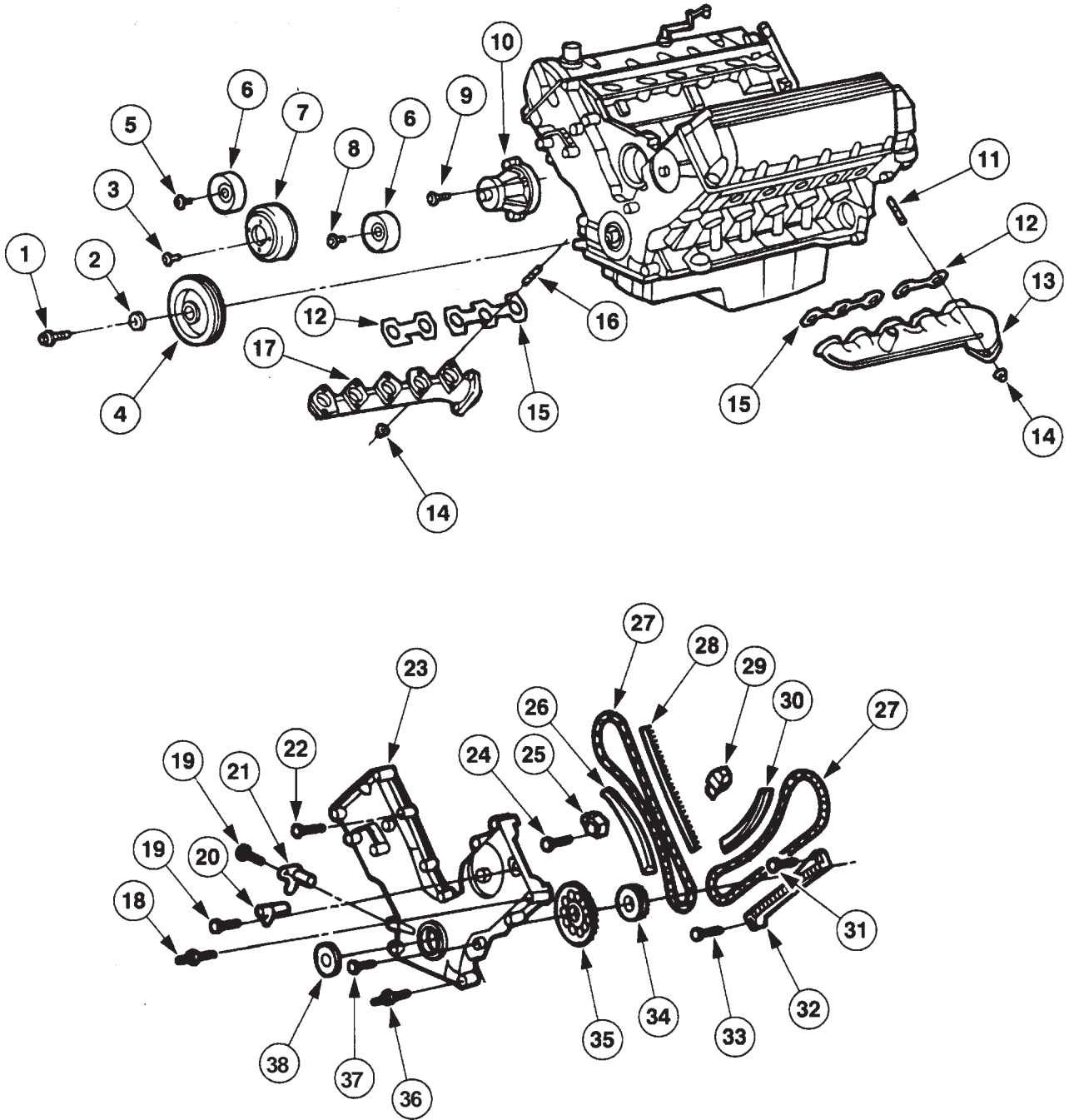
DA0444-B

**WSG-1068 ENGINE**

<b>Item</b>	<b>Part Number</b>	<b>Description</b>
1	N811085	Bolt
2	6256	Camshaft Sprocket
3	6265	Camshaft Sprocket Spacer
4	6C268	Camshaft Bearing Cap
5	6B284	Camshaft Bearing Cap
6	6C324	Crankcase Vent Connector and Hose
7	6582	Valve Cover
8	6250	Camshaft
9	12405	Spark Plug
10	18663	Heater Water Outlet Tube
11	N808897	Bolt (2 Req'd)
12	–	Valve (Part of 6049)
13	87838	Plug (6 Req'd)
14	6G004	Cylinder Head Temperature Sensor
15	14B102	Electrical Connector
16	6F087	Cylinder Head Oil Reservoir Restrictor
17	6500	Hydraulic Lash Adjuster
18	6A303	Balance Shaft Drive Gear
19	7C272	Balance Shaft Journal
20	6A305	Balance Shaft
21	6C267	Balance Shaft Journal Cap

<b>Item</b>	<b>Part Number</b>	<b>Description</b>
22	N808777	Bolt (4 Req'd)
23	N808775	Bolt
24	6582	Valve Cover
25	N805320	Nut (2 Req'd)
26	6C266	Balance Shaft Journal Cap (2 Req'd)
27	N807834	Fastener (26 Req'd)
28	6B280	Camshaft Bearing Cap
29	6C266	Balance Shaft Journal (2 Req'd)
30	6250	Camshaft
31	6065	Cylinder Head Stud
32	6518	Valve Spring Retainer Key
33	6514	Valve Spring Retainer
34	6513	Valve Spring
35	6571	Valve Stem Seal
36	6564	Rocker Arm
37	87836	Plug (2 Req'd)
38	6049	Cylinder Head
39	6051	Head Gasket
40	N806459	Dowel (4 Req'd)
41	6010	Cylinder Block
42	6051	Head Gasket
43	6049	Cylinder Head

Major Front End Components



AA2902-A

## WSG-1068 ENGINE

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Item	Part Number	Description
1	N806139	Damper Bolt
2	N806165	Washer
3	N806282	Bolt (4 Req'd)
4	6316	Front Crankshaft Damper
5	N806102	Bolt
6	12A216	Idler Pulley
7	8509	Water Pump Pulley
8	N808102	Bolt
9	–	Bolt (4 Req'd)
10	8501	Water Pump
11	811313	Stud (10 Req'd)
12	9448	Exhaust Manifold Gasket
13	9430	Exhaust Manifold
14	W701706	Bolt (10 Req'd)
15	9448	Exhaust Manifold Gasket
16	W701706	Stud (10 Req'd)
17	9430	Exhaust Manifold
18	N808140	Fastener (5 Req'd)
19	N806155	Bolt
20	6B288	Camshaft Position Sensor

Item	Part Number	Description
21	6C315	Crankshaft Position Sensor
22	N808142	Bolt (3 Req'd)
23	6019	Engine Front Cover
24	N606543	Bolt (4 Req'd)
25	6L266	Timing Chain Tensioner (RH)
26	6L253	Timing Chain Tensioner Arm (RH)
27	6268	Timing Chain/Belt (2 Req'd)
28	6K297	Timing Chain Guide (RH)
29	6L266	Timing Chain Tensioner (LH)
30	6L253	Timing Chain Tensioner Arm (LH)
31	N605892	Bolt (3 Req'd)
32	6K297	Timing Chain Guide (LH)
33	N606427	Bolt
34	6306	Crankshaft Sprocket
35	12A227	Crankshaft Sensor Ignition Pulse Ring
36		Fasteners (2 Req'd)
37	N806177	Bolt (5 Req'd)
38	6700	Crankshaft Front Seal


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## DIAGNOSIS AND TESTING

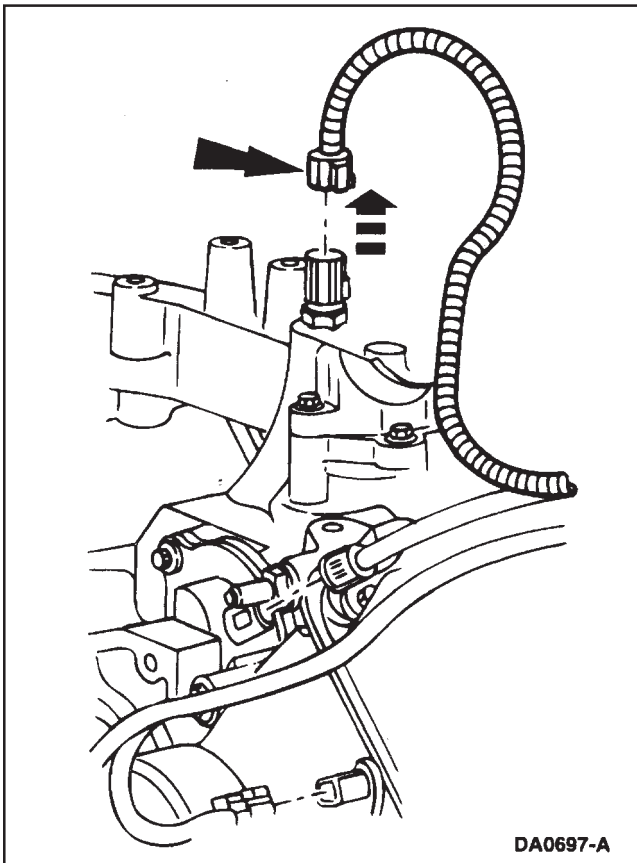
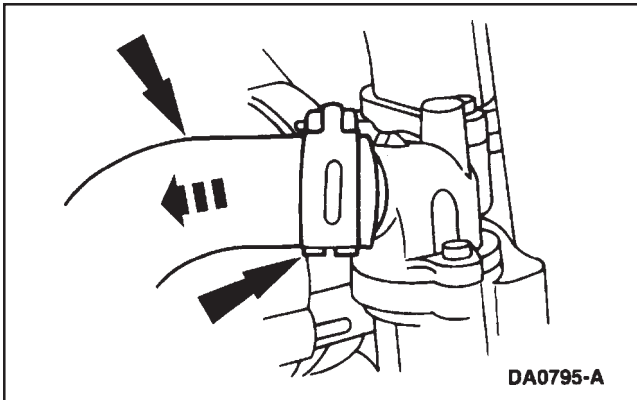
Refer to Section 01 for basic mechanical concerns.

ENGINE REPAIR

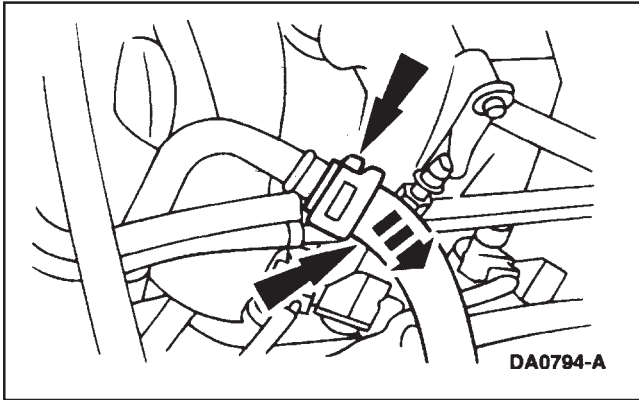
Intake Manifold – Variable Resonance Induction System (VRIS) - Removal

 **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.**

 **WARNING: FUEL IN THE FUEL SYSTEM REMAINS UNDER HIGH PRESSURE EVEN WHEN THE ENGINE IS NOT RUNNING.**



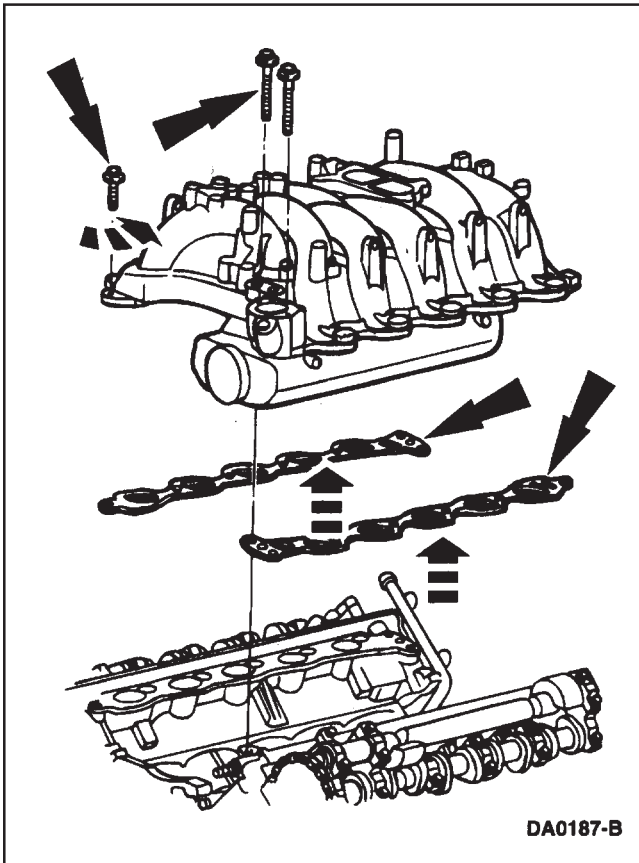
1. Disconnect the battery ground cable (14301).
2. Drain the coolant system.
3. Loosen and slide the hose clamp and disconnect the water outlet hose.
4. Remove the engine vacuum hoses.
5. Disconnect the water temperature indicator sender unit electrical connectors.
6. Disconnect and remove the ten ignition coils (12029); refer to Section 03.
7. Remove the drive belt (8620); refer to Section 05.
8. Remove the generator (GEN) (10300); refer to Section 06.



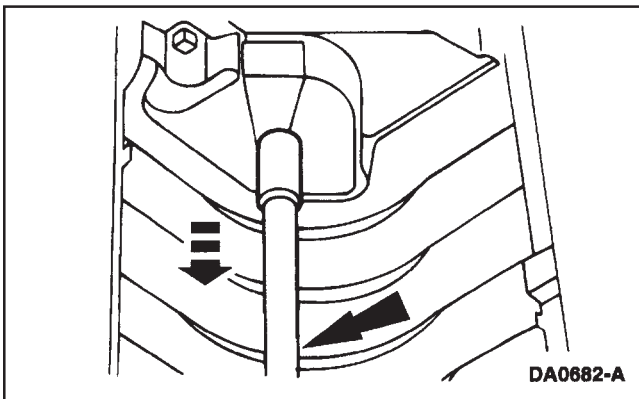
9. Disconnect the hose clamps and remove the heater water hose (18472).

10. Remove the water thermostat (8575).

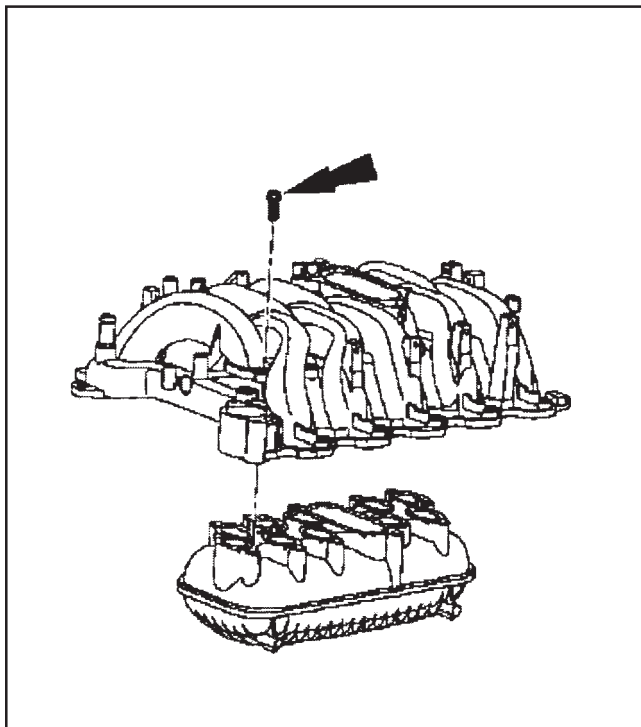
11. Remove the two studs retaining the heater water return tube.



12. Remove the bolts, the upper intake manifold and the intake manifold gasket (9439). Discard the intake manifold gaskets.



13. Pull back and remove the heater water return tube. Inspect the O-rings and replace if required.

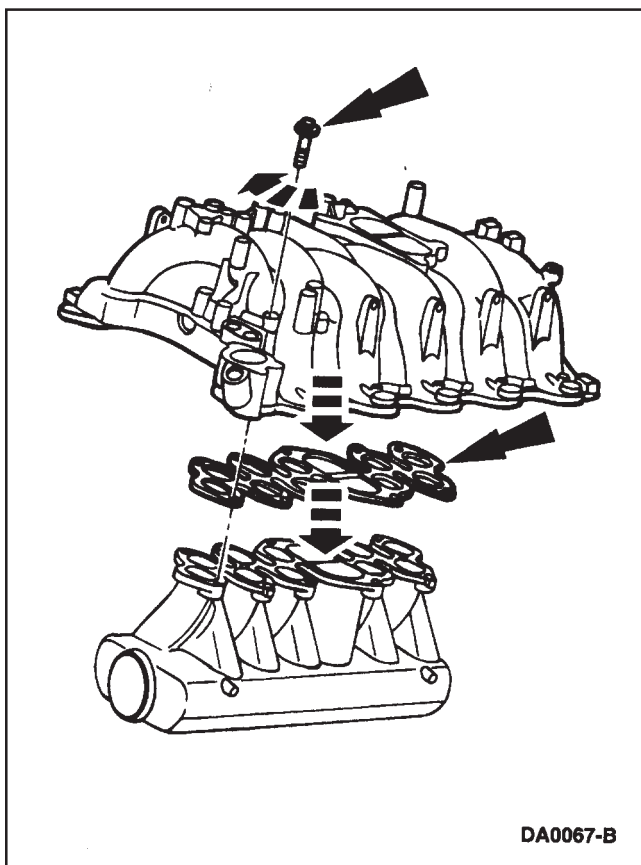


14. Separate the upper and lower intake manifolds (9424).

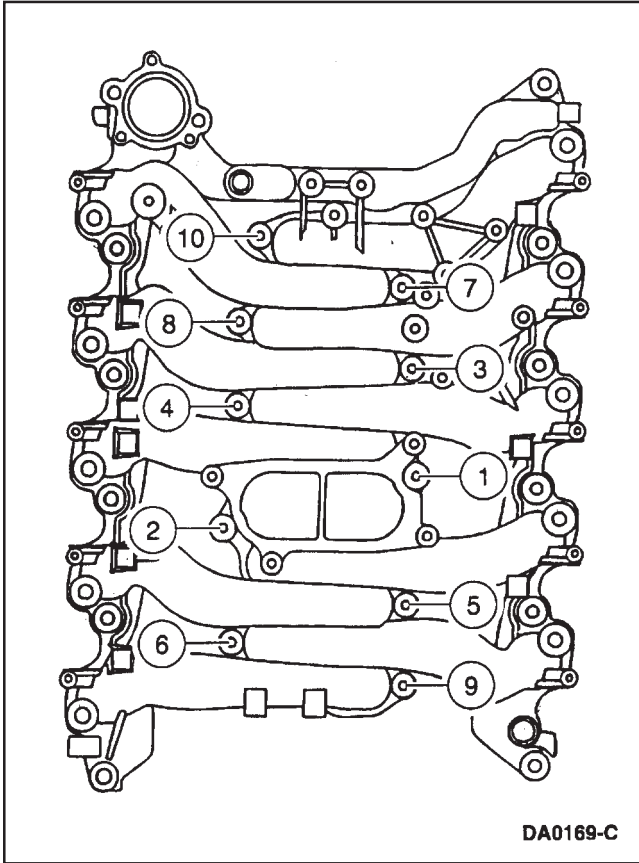
- Remove the ten bolts.
- Discard the intake manifold gasket.

15. Clean all mating surfaces.

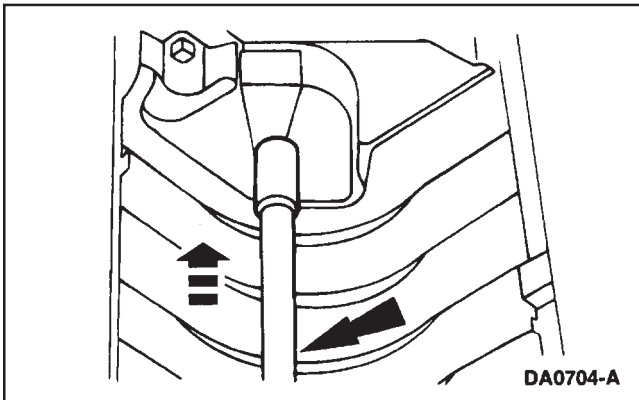
### Intake Manifold – Variable Resonance Induction System (VRIS) - Installation



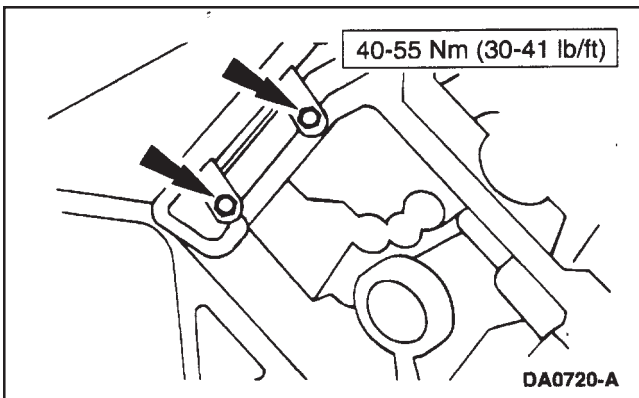
1. Position the lower intake manifold gasket (9461) and the upper intake manifold on the intake manifold and loosely install the ten bolts.



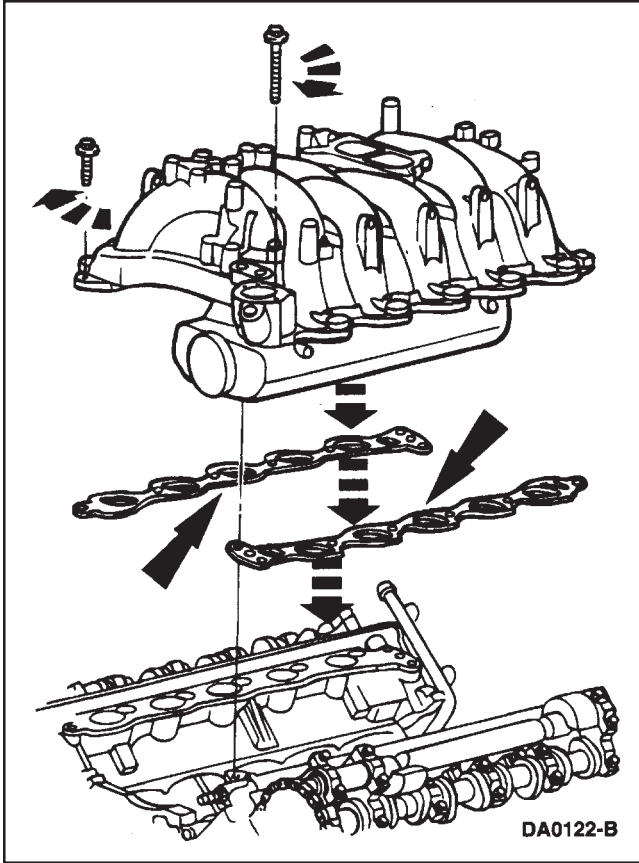
2. **NOTE:** Tighten the bolts in two stages.  
Tighten the bolts in the sequence shown.
  - Stage 1: Tighten to 2 Nm (18 lb/in).
  - Stage 2: Tighten to 8-12 Nm (71-106 lb/in).



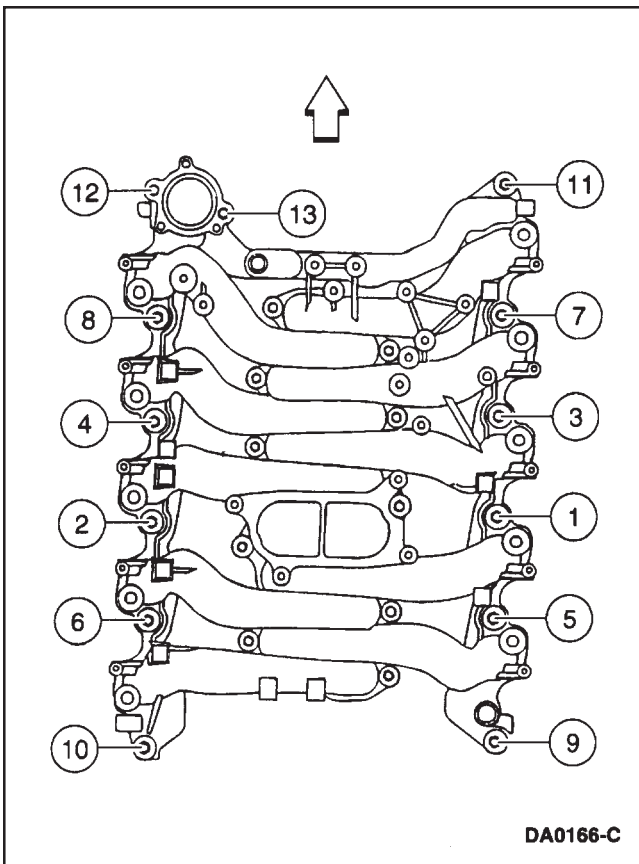
3. Position the water return tube as shown.



4. Install the heater water return tube studs.



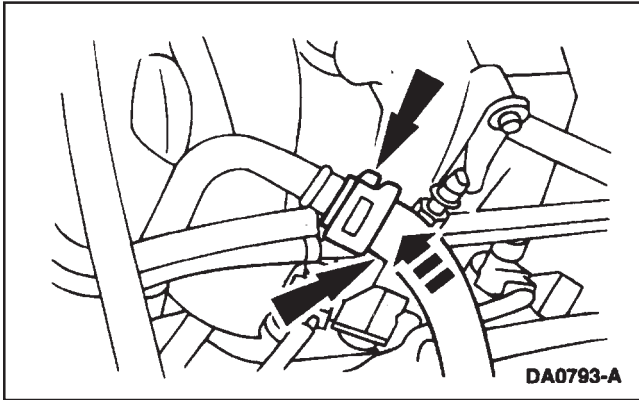
5. Install the upper intake manifold.
  - Position the upper intake manifold gaskets and the intake manifold, and loosely install the bolts.



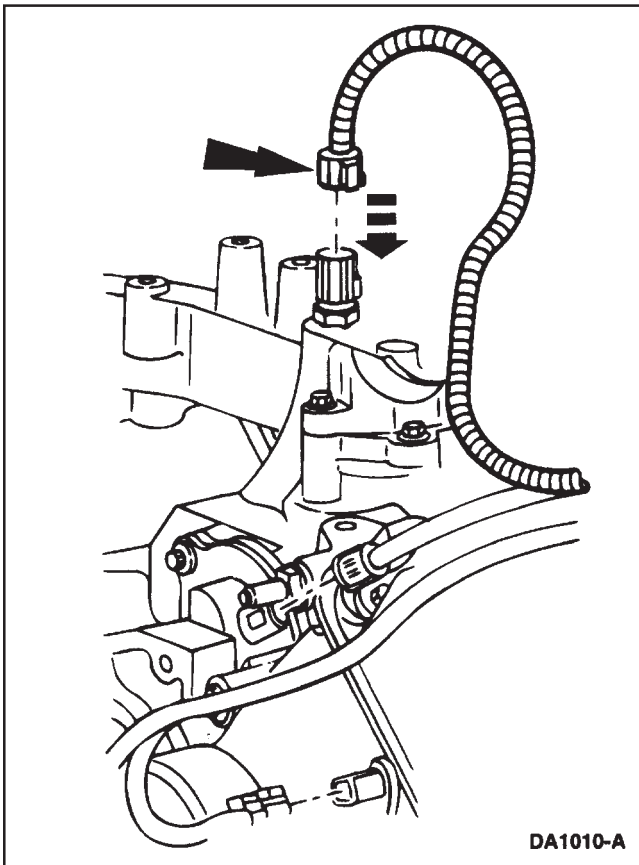
6. Install the thermostat, gasket and the thermostat housing and loosely install the bolts.
7. **NOTE:** Be sure to tighten the bolts in two stages.
 

Tighten the bolts in the sequence shown.

  - Stage 1: Tighten to 2 Nm (18 lb/in).
  - Stage 2: Tighten to 20-30 Nm (15-22 lb/ft).



8. Install the heater water hose and position the clamp.

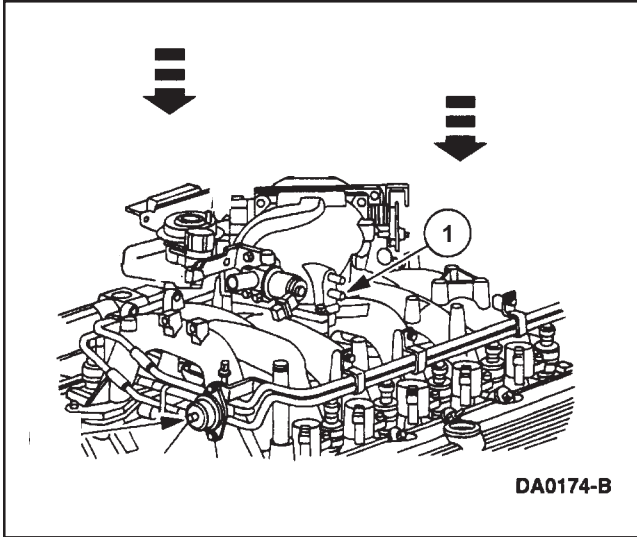


9. Connect the water temperature indicator sending unit electrical connector.

10. Install the generator.

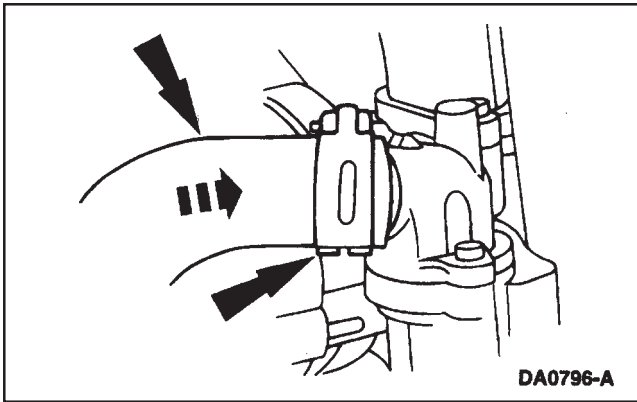
11. Install the drive belt

12. Install the ignition coils.



13. Connect the engine vacuum hoses.

- Vacuum source.



14. Connect the engine water outlet hose and position the hose clamp.

15. Install the air cleaner outlet tube (9B659).

16. Fill the cooling system; refer to Section 05.

17. Install the engine cover.

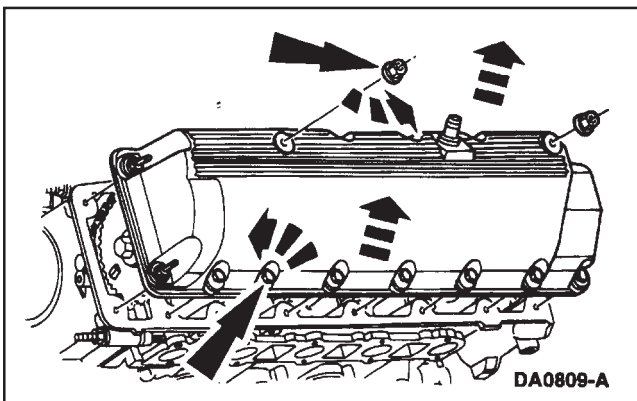
18. Connect the battery ground cable.

### Valve Cover – Left - Removal

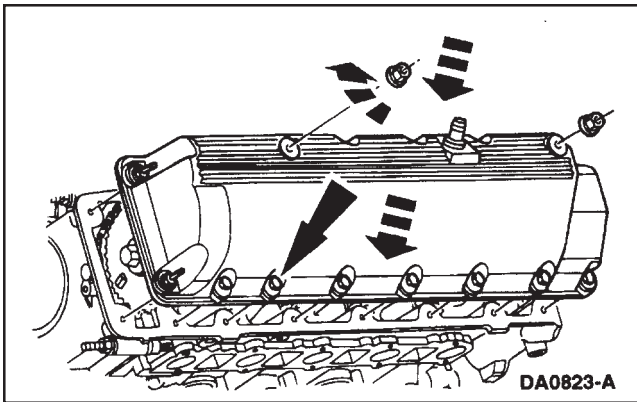
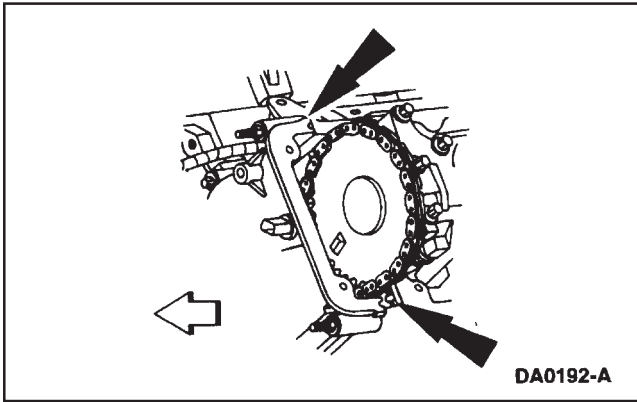
1. **NOTE:** The bolts are a part of the valve cover (6582) and are not to be removed.

Fully loosen the valve cover.

- Remove the two nuts and the sixteen bolts, and remove the valve cover and the valve cover gasket (6584).



Valve Cover – Left - Installation

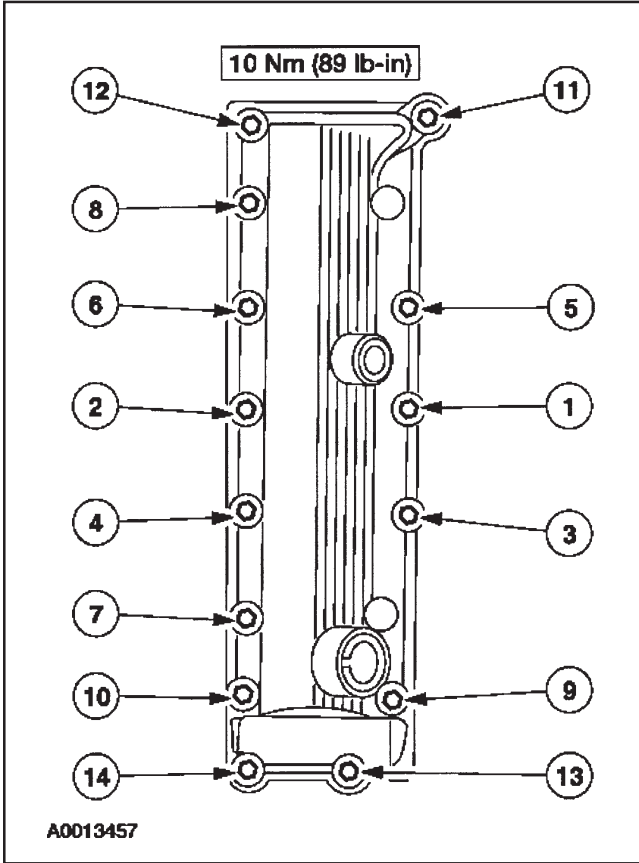


1. **⚠ CAUTION:** Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.

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

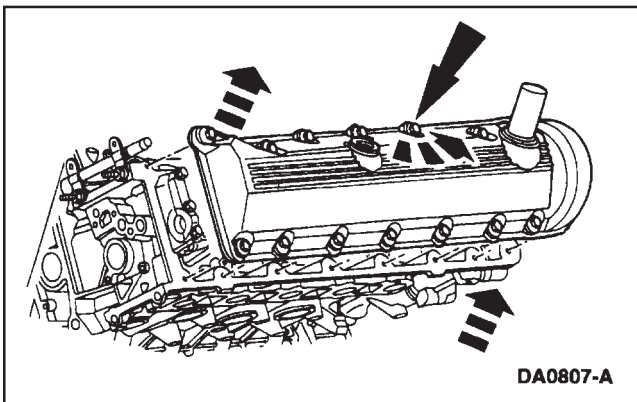
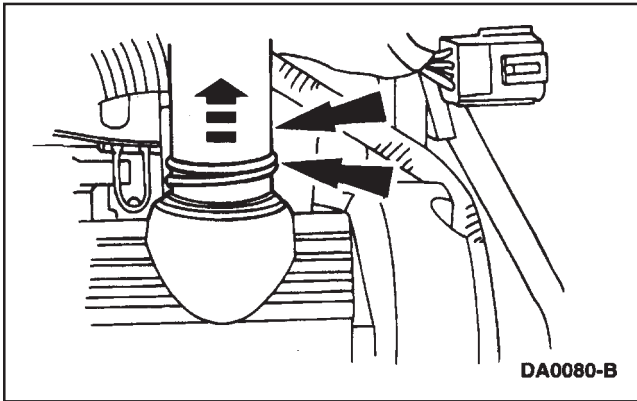
**NOTE:** Sealant must be removed and area cleaned with solvent if above instructions are not followed.


- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.
2. Apply silicone in two places where the engine front cover (6019) meets the cylinder head.
    - Use Silicone Gasket and Sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.
  3. Position the valve cover and the valve cover gasket on the cylinder head and loosely install the bolts and nuts.



4. Tighten the nuts and bolts in the sequence shown.

### Valve Cover – Right - Removal




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

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

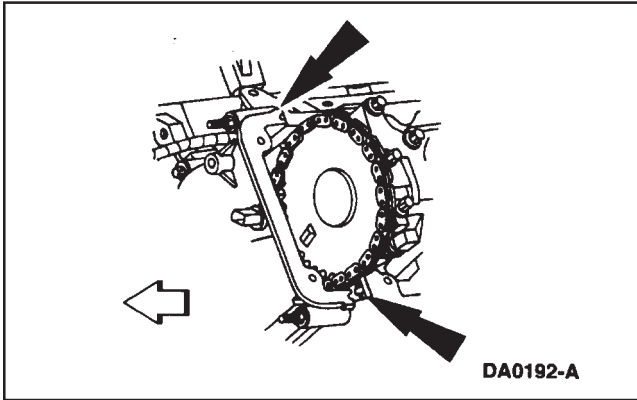
### Valve Cover – Right - Installation

1. Remove the PCV valve.

 **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.**

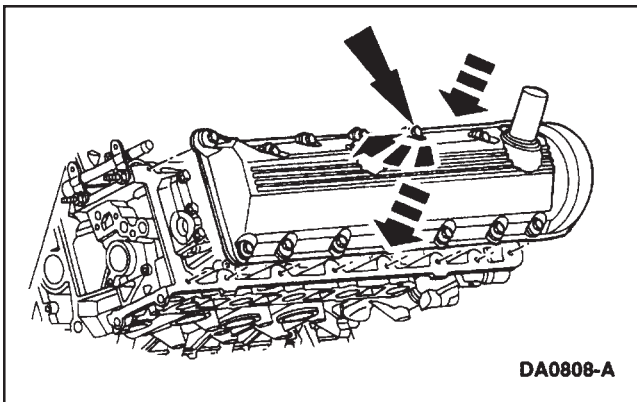
- Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

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

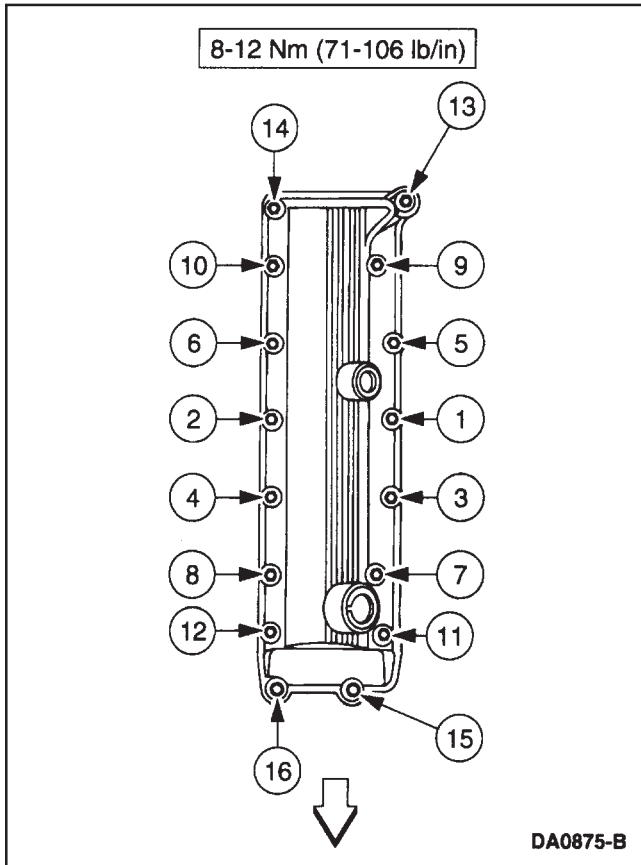


- Use metal surface cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B292-A.

2. Apply silicone in two places where the engine front cover (6019) meets the cylinder head (6049).



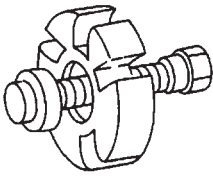
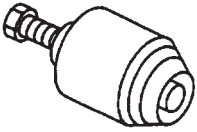
3. Position the valve cover on the cylinder head and loosely install the bolts.



4. Tighten the bolts in the sequence shown.
5. Reinstall the PCV valve.

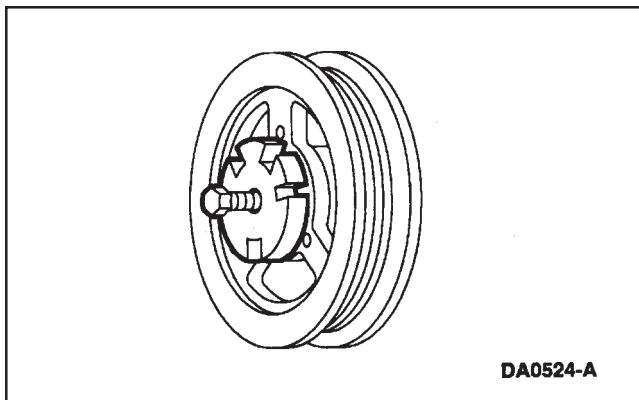
### Crankshaft Pulley - Removal

#### Special Tool(s)

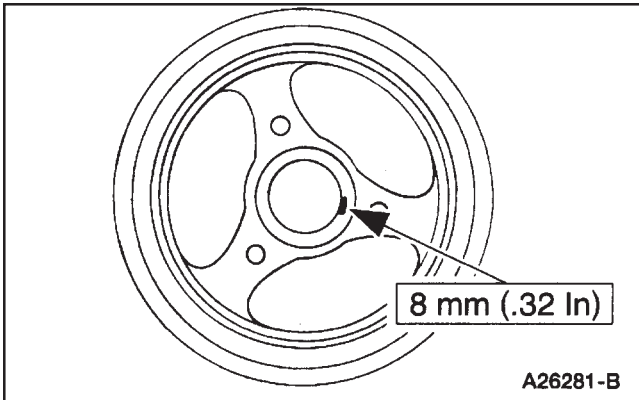
 ST1288-A	Crankshaft Damper Remover 303-009 (T58P-6316-D)
 ST1288-A	Front Cover Seal Remover 303-107 (T74P-6700-A)

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

1. Remove the engine cooling fan and fan shroud (8146).
2. Remove the drive belt (8620).
3. Remove the crankshaft pulley bolt (6A340).
4. Using the Crankshaft Damper Remover, remove the crankshaft pulley (6312).



**Crankshaft Pulley - Installation**

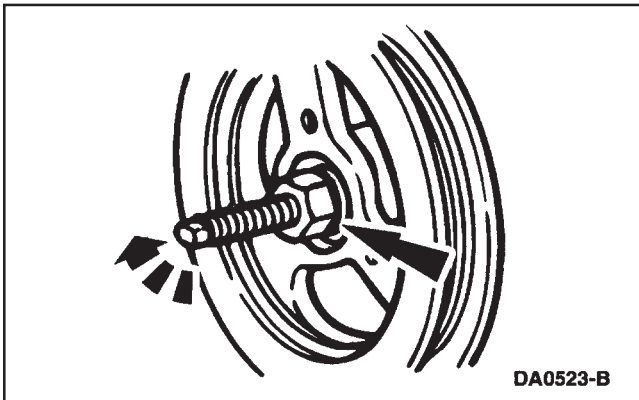


**⚠ CAUTION:** Mating parts must make contact to each other within 4 minutes and connecting bolts must be torqued within 15 minutes after applying sealant. Failure to follow this procedure can cause future oil leakage.

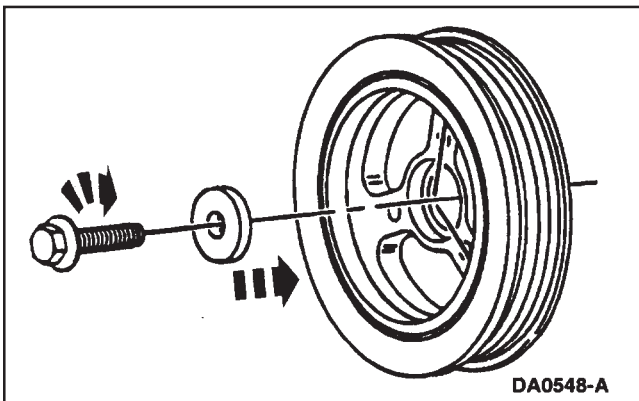
- Use silicone gasket and sealant F6AZ-19562-AA or equivalent meeting Ford specification WSE-M4G323-A6.

**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.



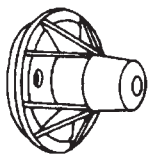
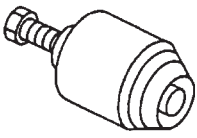
1. Use the Crankshaft Damper Replacer to install the crankshaft pulley.



2. Tighten the crankshaft pulley bolt 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 85-95 degrees.

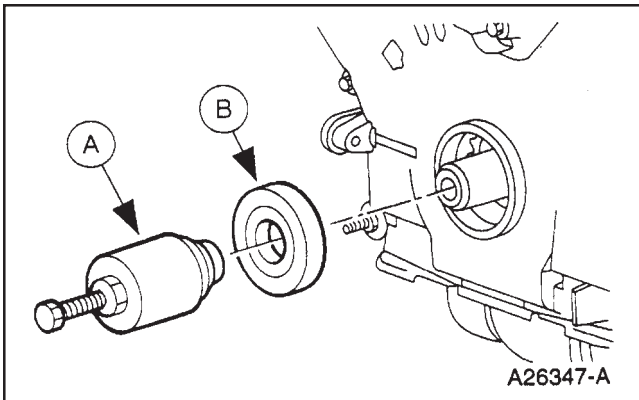
### Crankshaft Front Oil Seal - Removal

#### Special Tool(s)

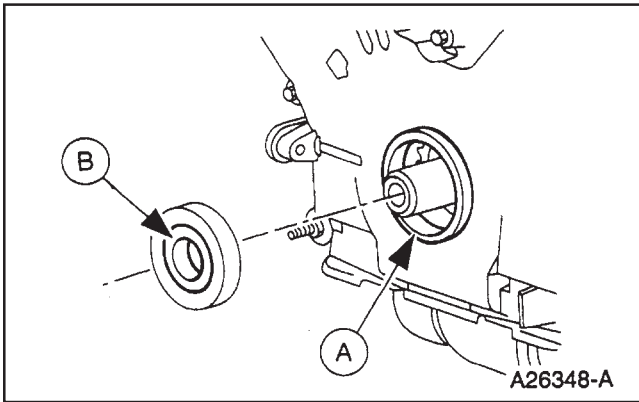
 ST1506-A	Crankshaft Rear Seal Replacer T88T-6701-B1
 ST1288-A	Front Cover Seal Remover 303-107 (T74P-6700-A)

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

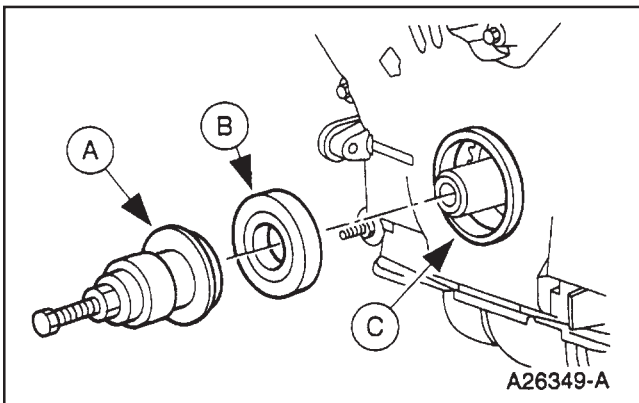
1. Remove the crankshaft pulley (6312); refer to this section.
2. Using the (a) Front Cover Seal Remover, remove the (B) crankshaft front seal (6700).



### Crankshaft Front Oil Seal - Installation




1. Lubricate the (A) engine front cover (6019) and the (B) crankshaft front seal inner lip.
  - Use Super Premium SAE 5W30 Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.



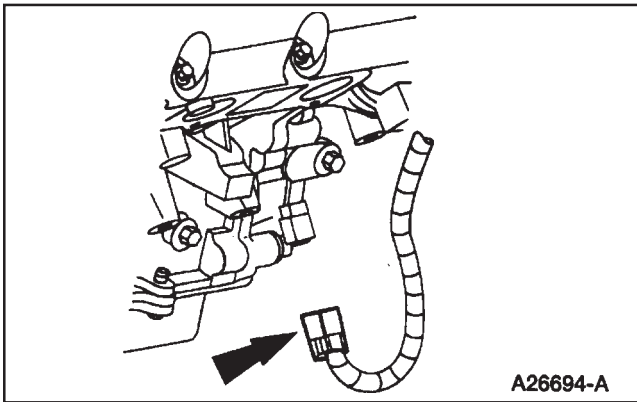
2. Use the (A) Crankshaft Seal Replacer to install the (B) crankshaft front seal into the (C) engine front cover.
3. Install crankshaft pulley; refer to Crankshaft Pulley in this section.

## Front Engine Cover - Removal

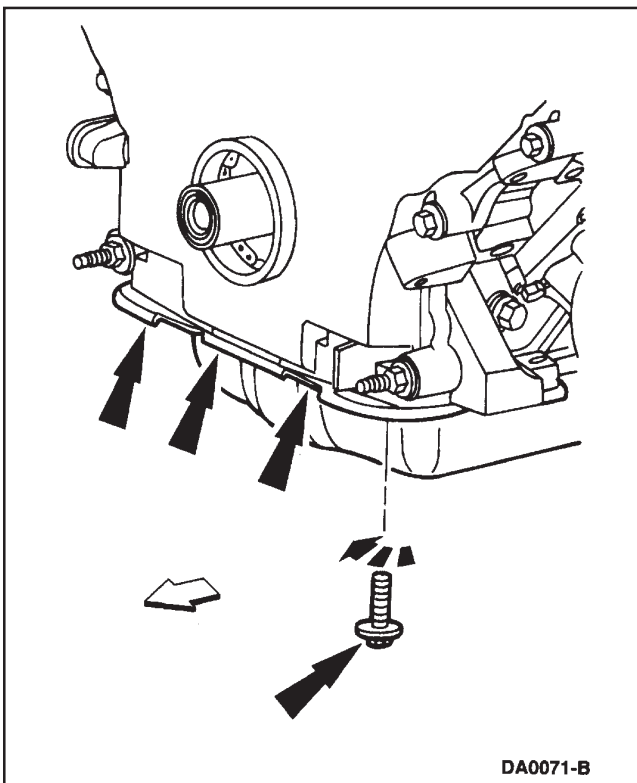
1.  **WARNING: DO NOT SMOKE OR CARRY LIGHTED TOBACCO OR OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENTS. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND CAN BE IGNITED, RESULTING IN POSSIBLE PERSONAL INJURY.**

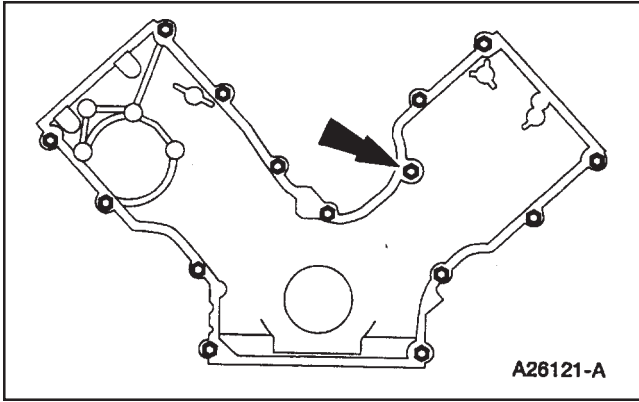
Disconnect the battery ground cable (14301).

2. Remove the valve covers (6582); refer to Valve Cover in this section.
3. Remove the radiator (8005).
4. Disconnect the camshaft position sensor (CMP sensor) (6B288).
5. Remove the drive belt (8620).
6. Disconnect the crankshaft position (CKP) sensor electrical connector.
7. Remove the drain plug and drain the engine oil.
8. Remove the crankshaft front seal (6700); refer to Crankshaft Front Oil Seal in this section.

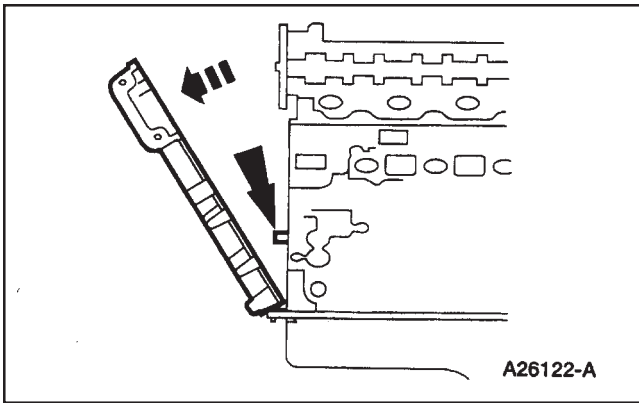


9. Remove the bolts from the front of the oil pan that hold the front cover.



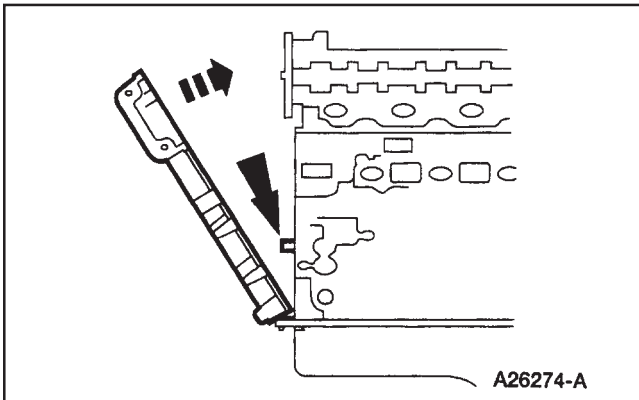


10. Remove the engine front cover fasteners.



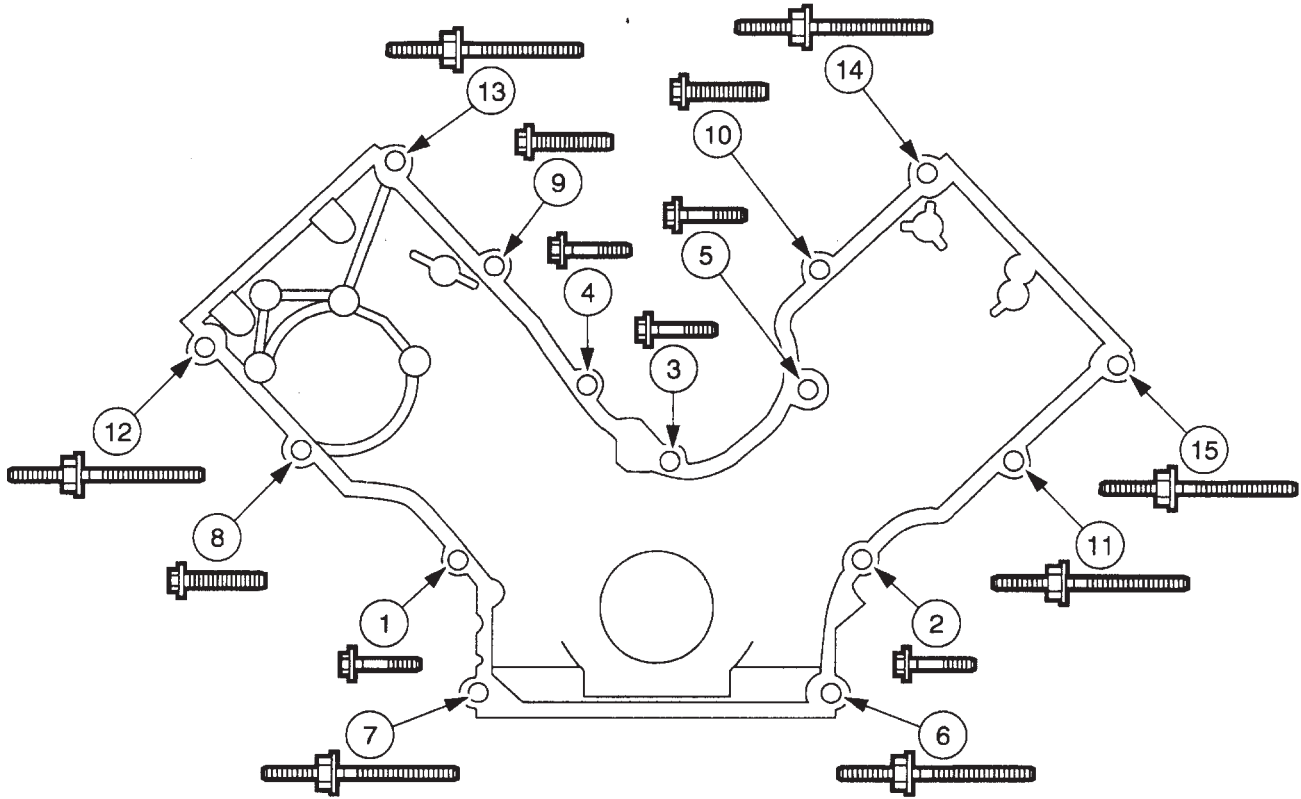
11. Remove the engine front cover (6019) from the front cover to cylinder block dowels (6C002).

### Front Engine Cover - Installation



1. Install a new engine front cover gasket (6020) on the engine front cover, then position the engine front cover on the front cover to cylinder block dowels.

# WSG-1068 ENGINE



DA0568-A

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

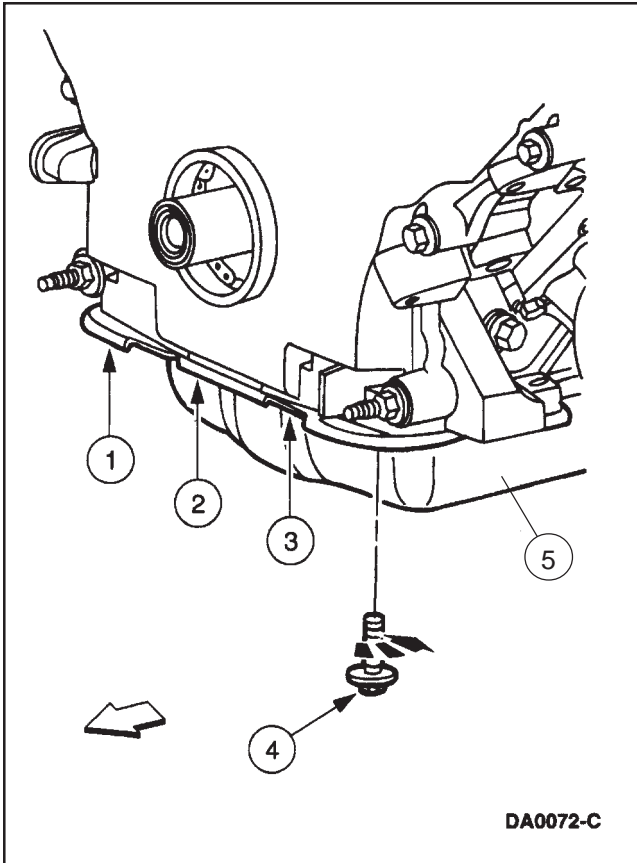
Item	Part Number	Description
9	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
10	N808142	Screw and Washer, Hex Pilot, M10 x 1.5 x 57.5
11	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6
12	N808140	Stud and Washer, Hex-Head Pilot, M10 x 1.5 x M8 x 1.25 x 109.6
13	N808140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

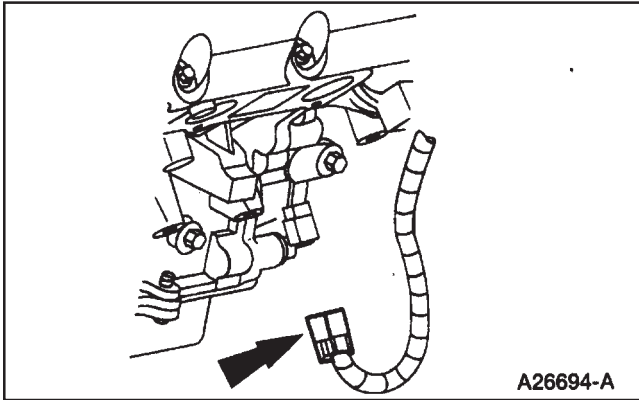
2. Tighten the fasteners in two stages following the sequence shown.

- 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).

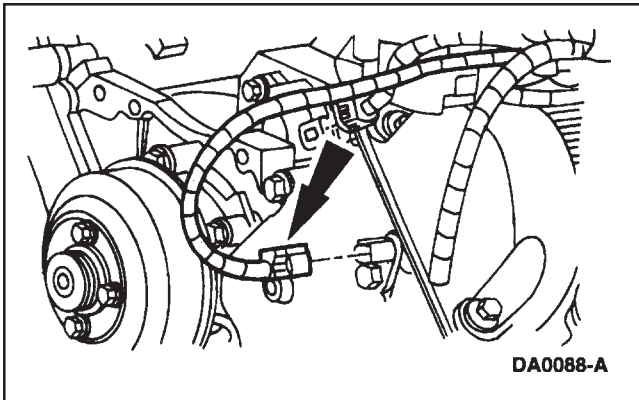
3. **NOTE:** Be sure to tighten the bolts through the front of the oil pan (5) in two stages.

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





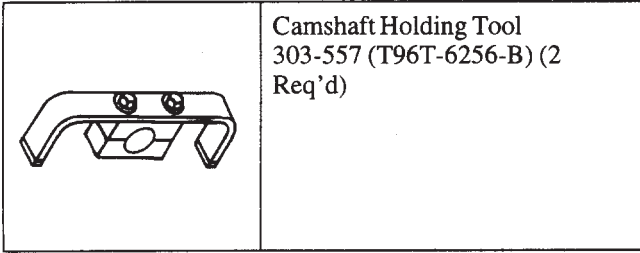
4. Connect the CKP sensor electrical connector.
5. Install the water pump pulley.



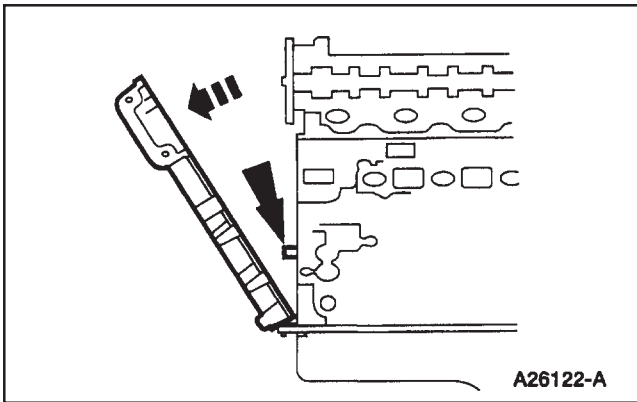
6. Connect the CMP electrical connector.
7. Install a new crankshaft front seal and the crankshaft pulley (6312); refer to Crankshaft Pulley in this section.
8. Install the drive belt (8620).
9. Install the valve covers; refer to Valve Cover in this section.
10. Fill the engine (6007) with oil.
  - Use engine oil meeting Ford specification D9AZ-19579A.

### Timing Drive Components - Removal

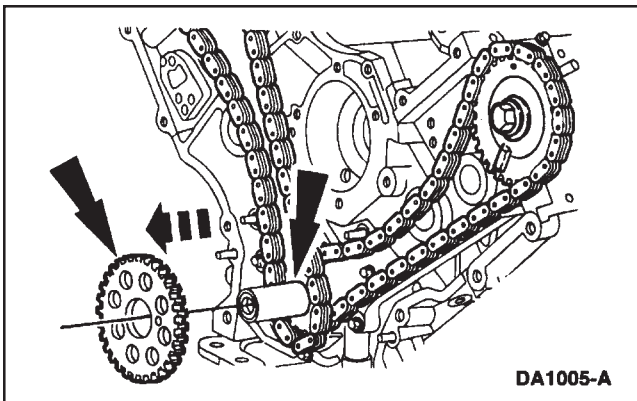
#### Special Tool(s)



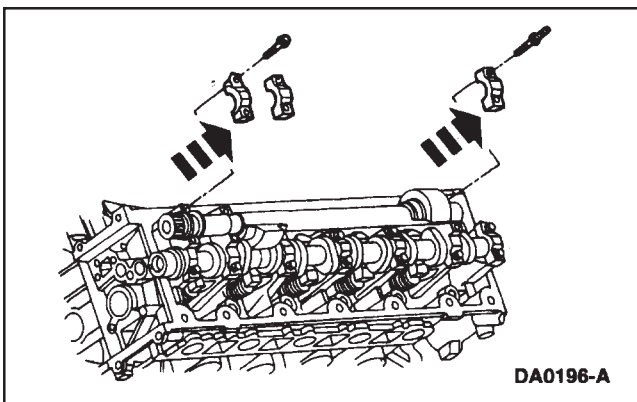
Special Service Tools called for by the procedures can be obtained by calling:  
1-800-ROTUNDA (1-800-768-8632).



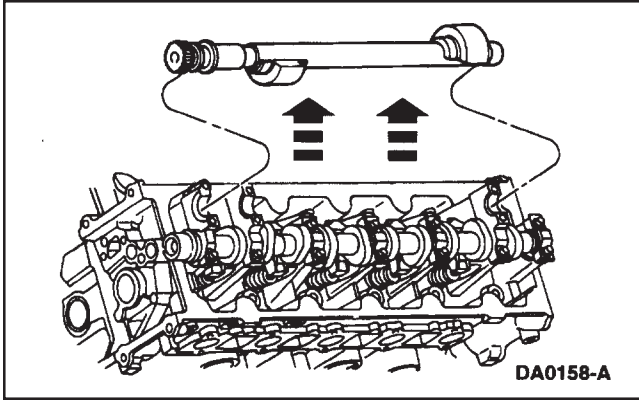
1. Remove the engine front cover (6019); refer to Engine Front Cover in this section.



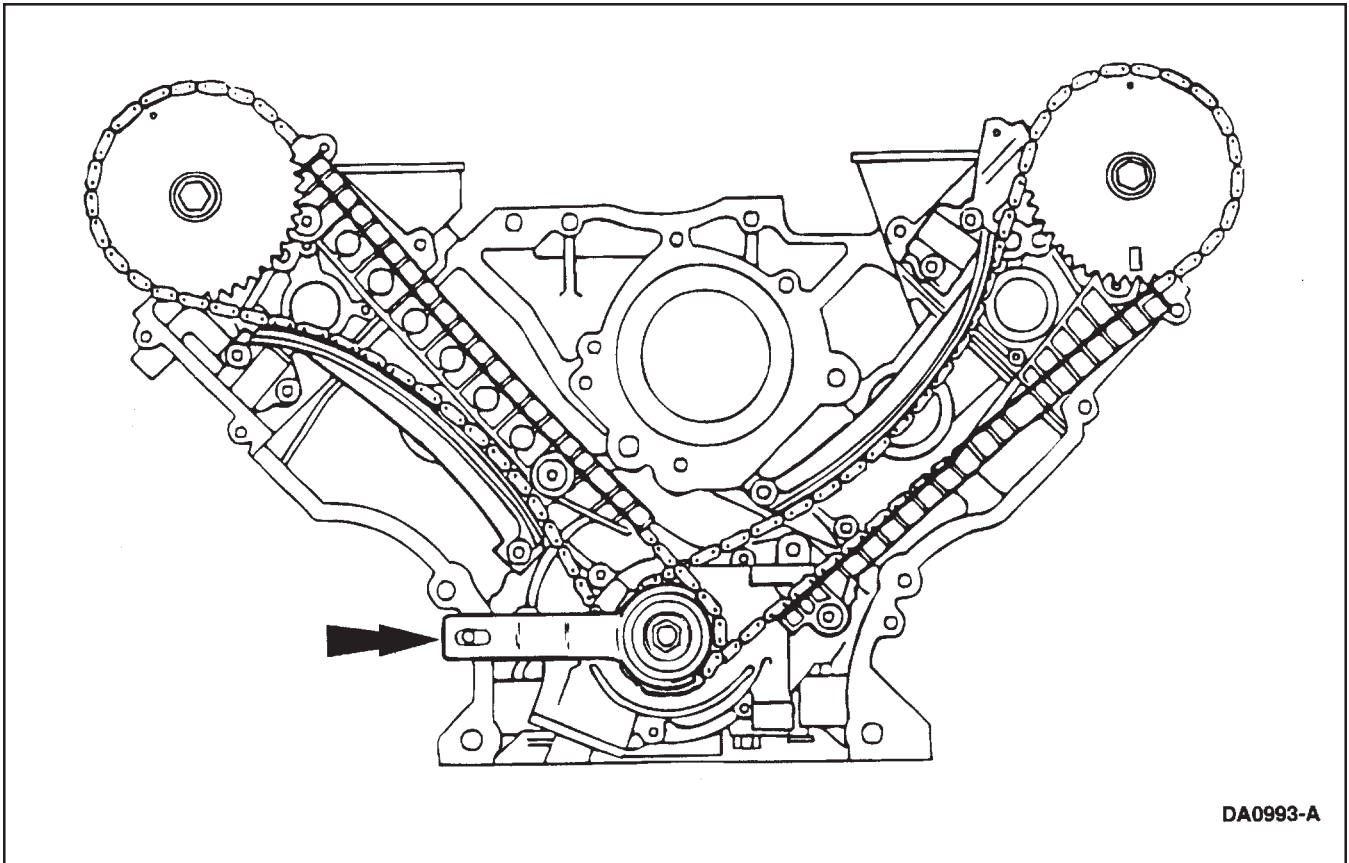
2. Remove the crankshaft sensor ring from the crankshaft (6303).



3. Remove the six bolts and remove the balance shaft bearing caps.

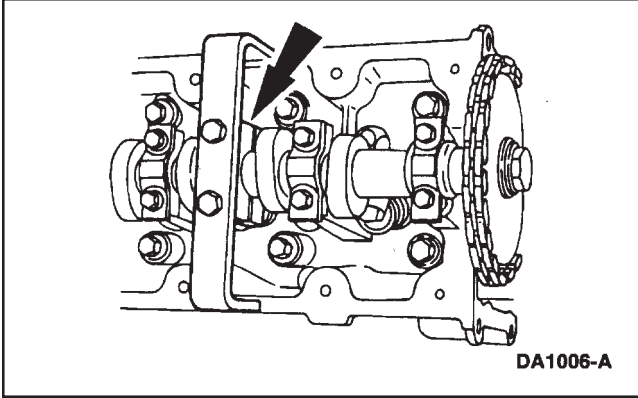


4. Remove the balance shaft.

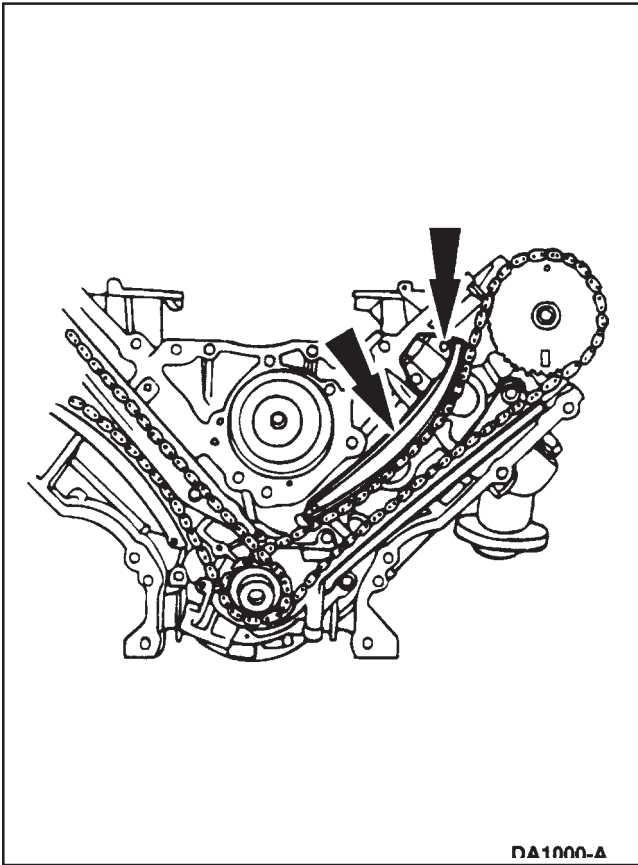


5. **CAUTION:** Unless otherwise instructed, at no time when the timing chains (6268) are removed and the cylinder heads (6049) are installed may the crankshaft or camshaft (6250) be rotated. Severe piston (6108) and valve damage could occur.

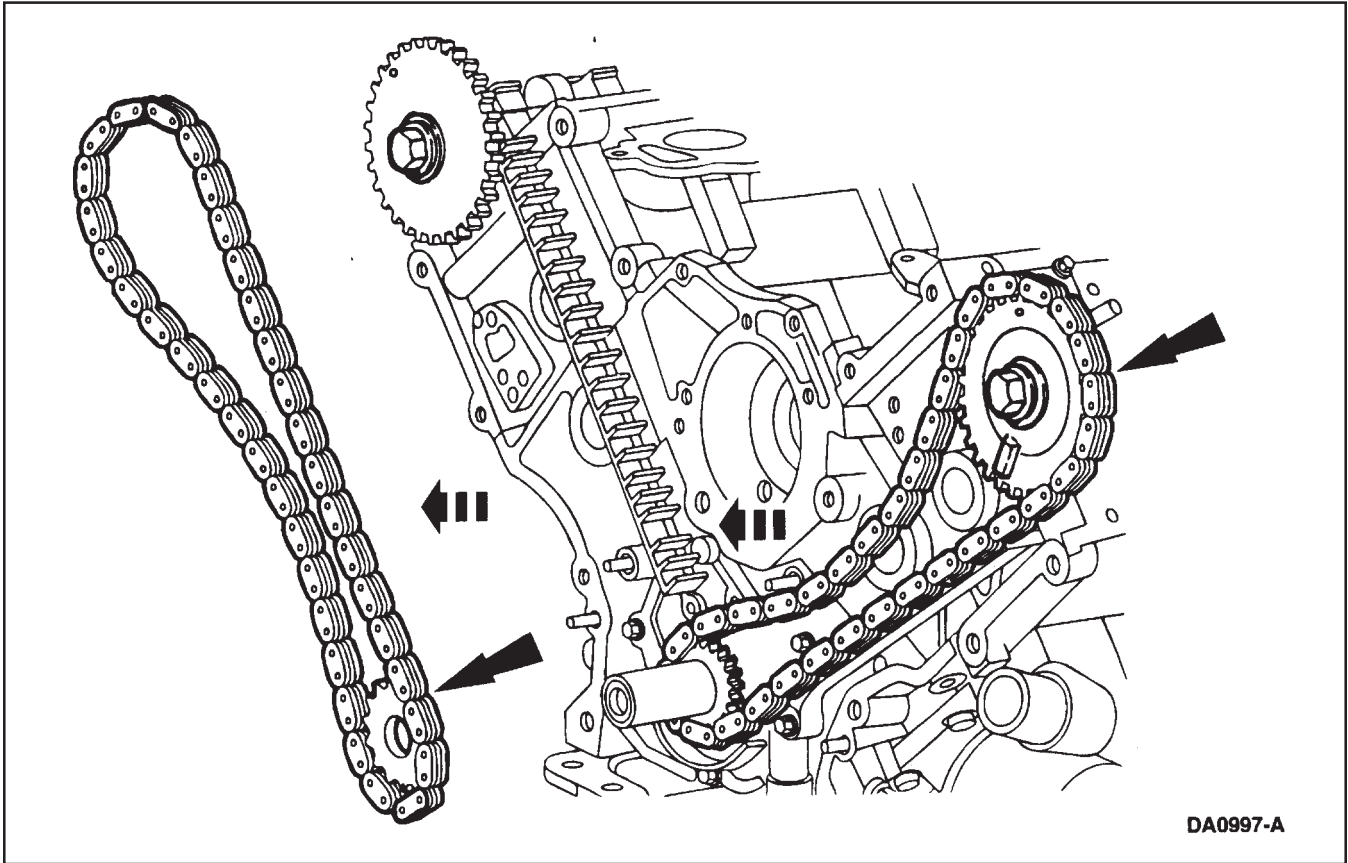
Use the Crankshaft Holding Tool to position the crankshaft as shown.



6. Install the Camshaft Holding Tools on the camshafts.

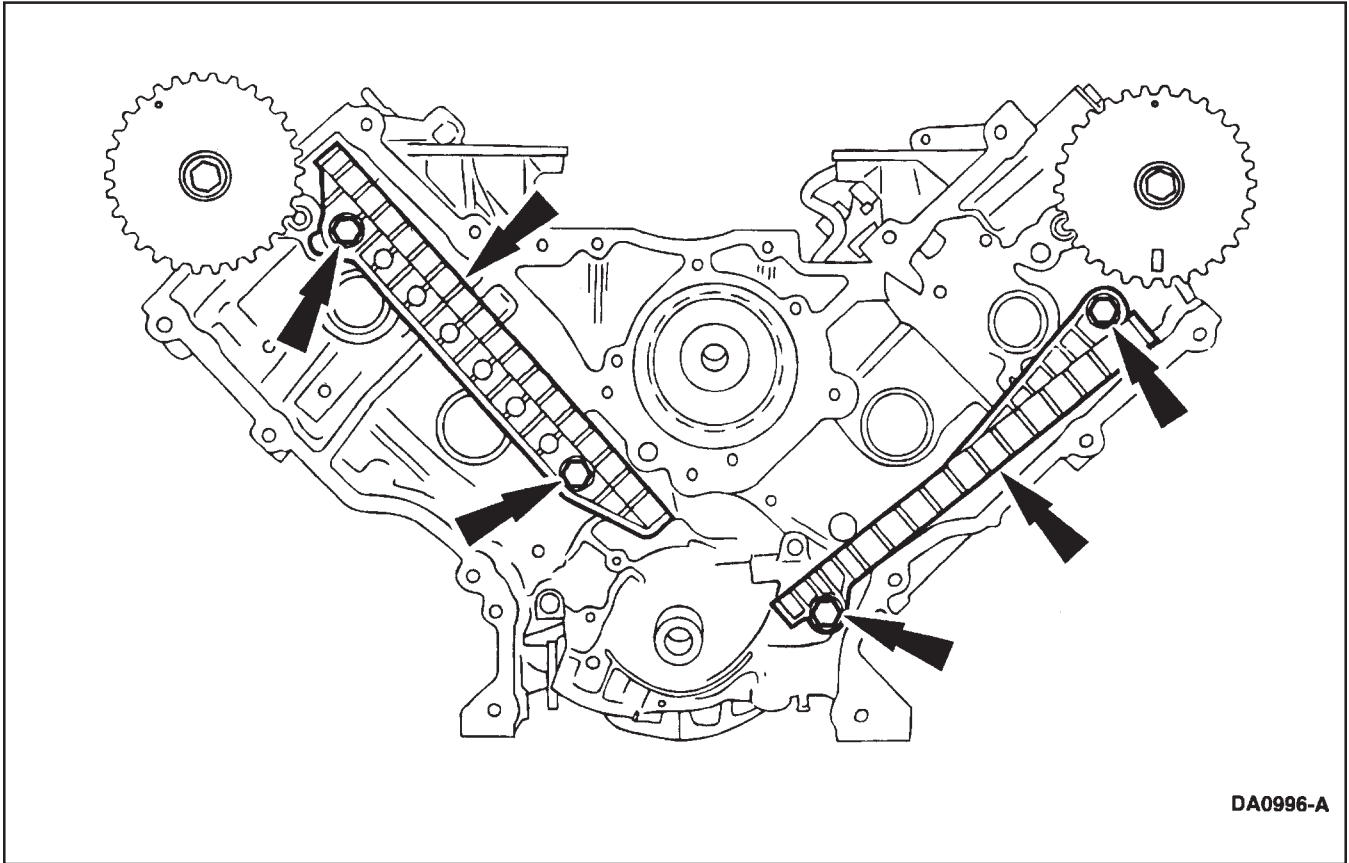


7. Remove the bolts and the timing chain tensioners (6L266). Remove the timing chain tensioner arms (6L253) from the dowel pins.




8. Remove the LH and RH timing chain and the crankshaft sprockets (6306).

  1. Remove the RH timing chain from the camshaft sprocket (6256).
  2. Remove the RH timing chain and outer crankshaft sprocket from the crankshaft.
  3. Repeat for the LH timing chain and crankshaft sprocket.



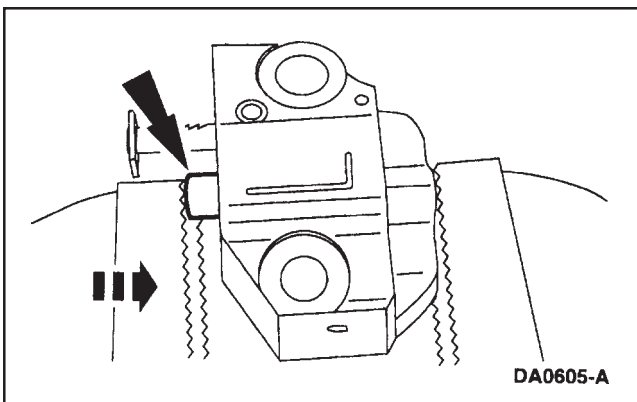
9. Remove the timing chain guides (6K297).
  - Remove the bolts.
  - Remove the timing chain guides.

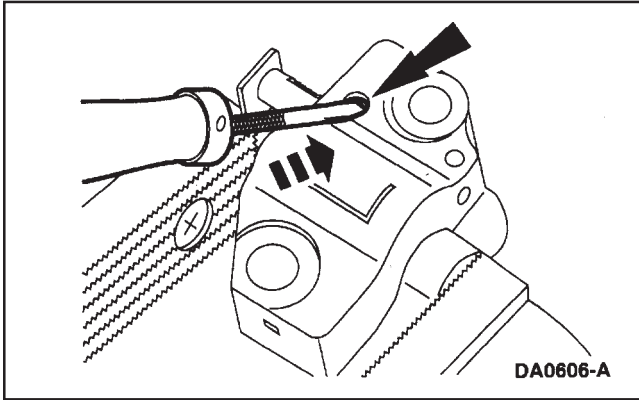
### Timing Drive Components - Installation

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

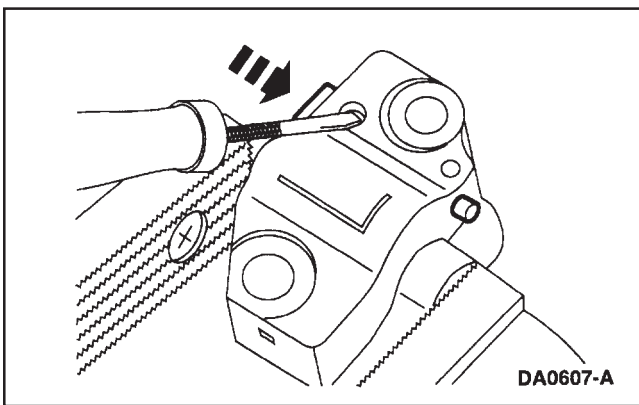
 **CAUTION: Do not compress the ratchet assembly. This will damage the ratchet assembly.**

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

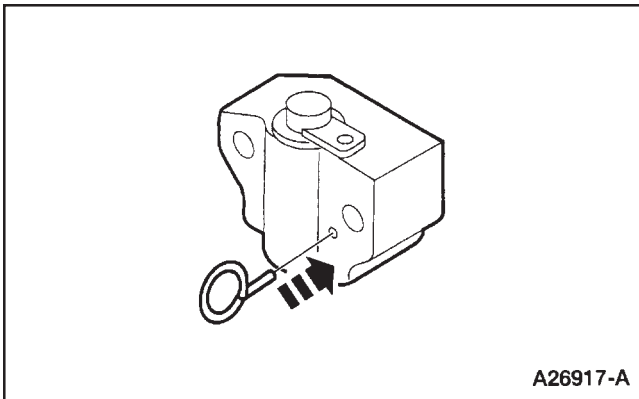




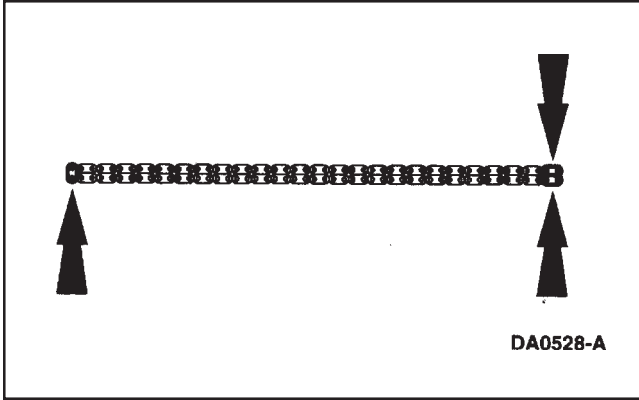
2. Using a small screwdriver or pick, push back and hold the ratchet mechanism.



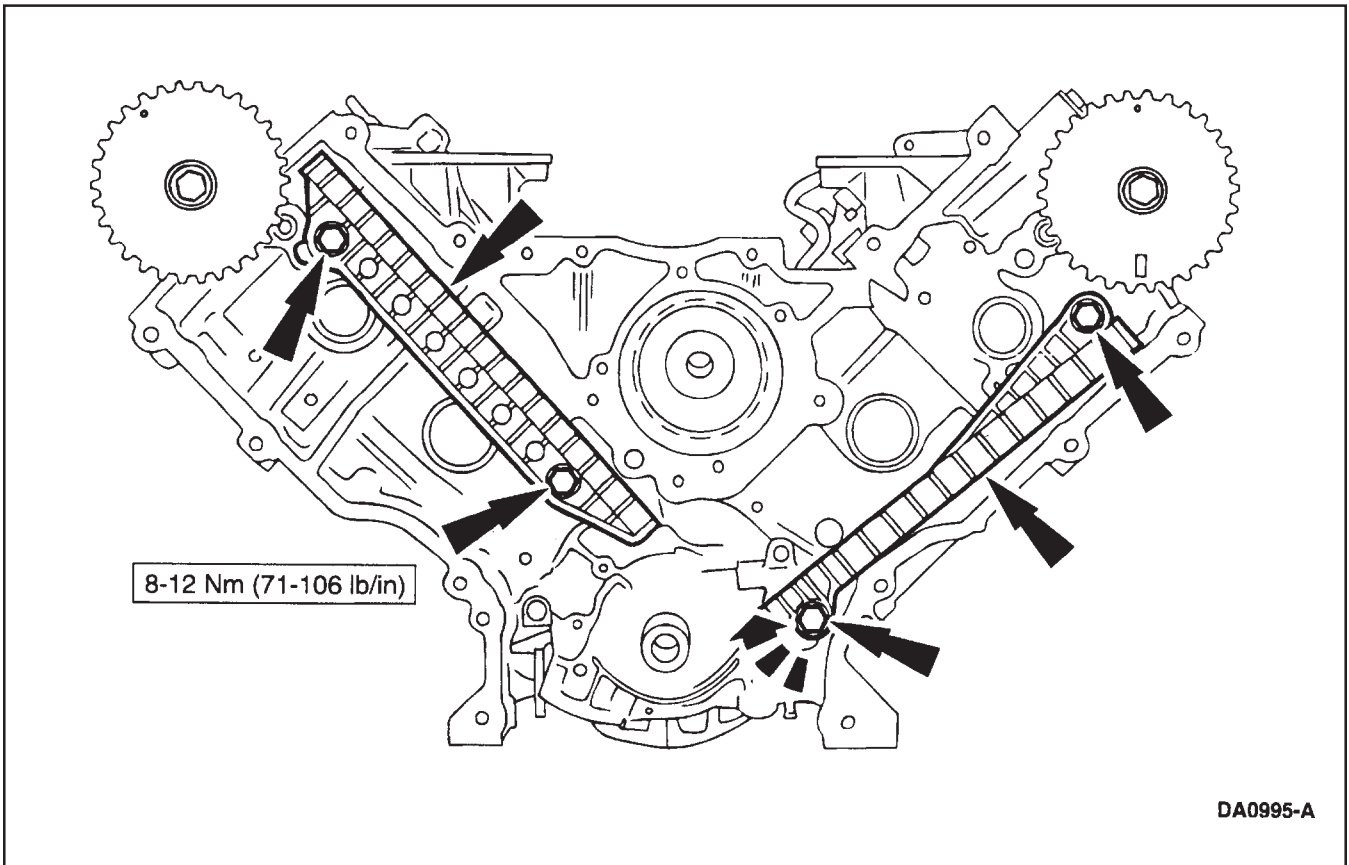
3. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.



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

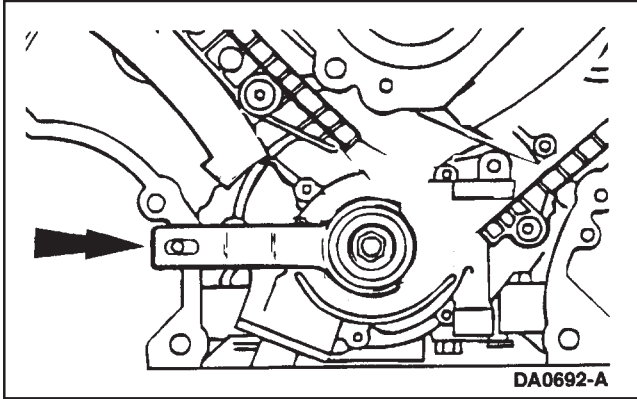


5. If copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

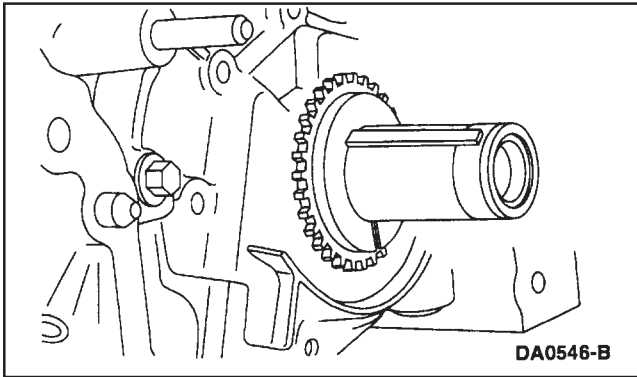


6. Install the timing chain guides.

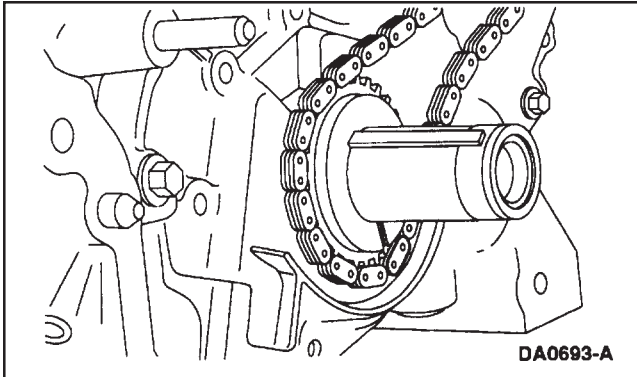
7. Remove the Crankshaft Holding Tool



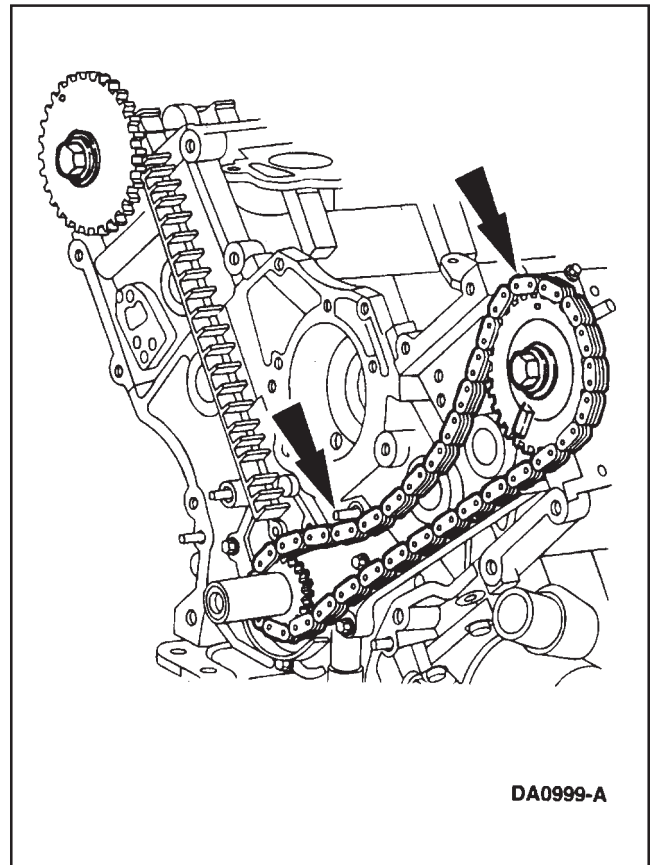
8. Install the inner crankshaft sprocket with the long hub facing outward.

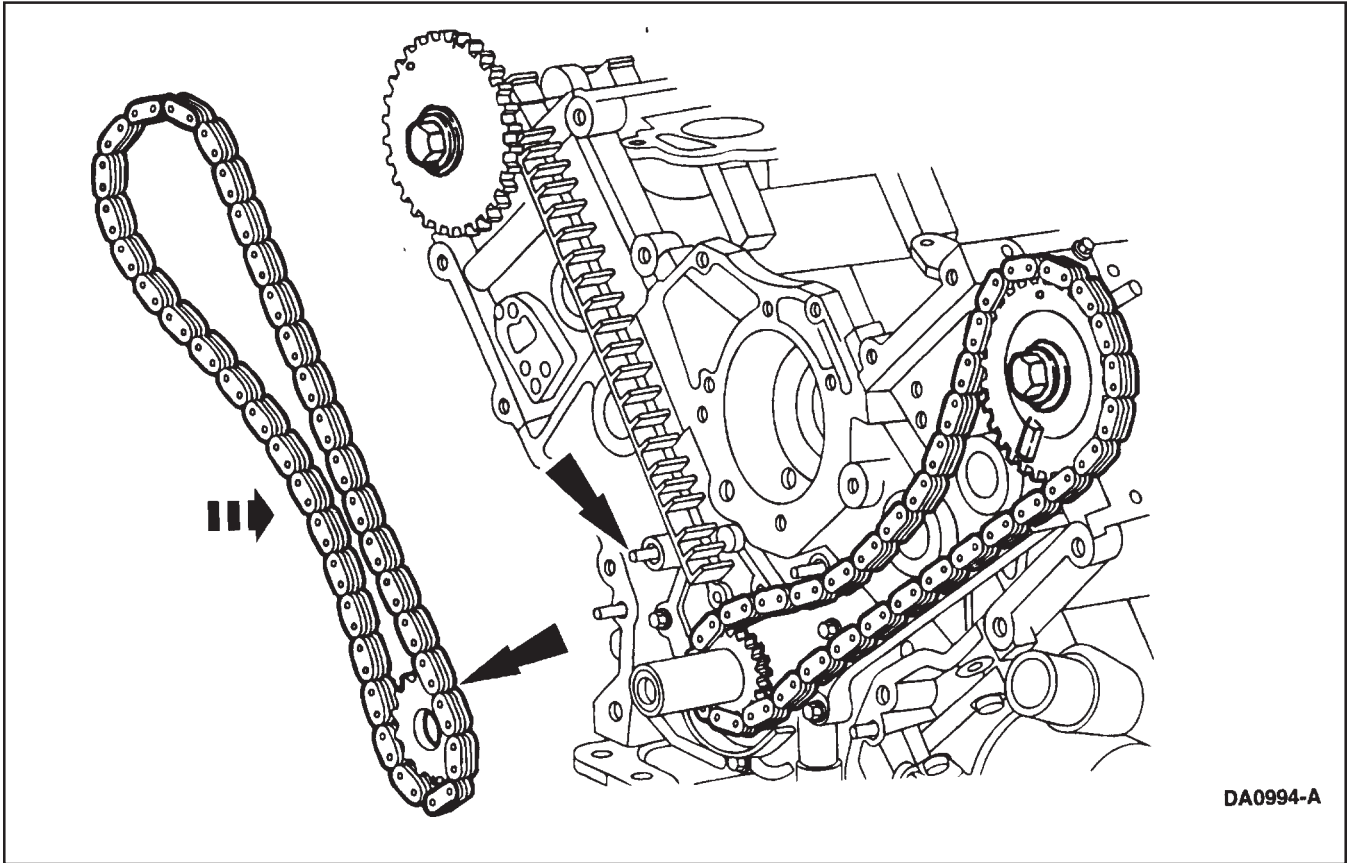


9. Install the inner timing chain on the crankshaft sprocket with the timing marks aligned.



10. **NOTE:** Be sure the upper half of the timing chain is below the tensioner





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

**NOTE:** Be sure the chain link and crankshaft sprocket timing marks are aligned.

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

Install the outer crankshaft sprocket and timing chain/belt with the long hub of the crankshaft sprocket facing inward.

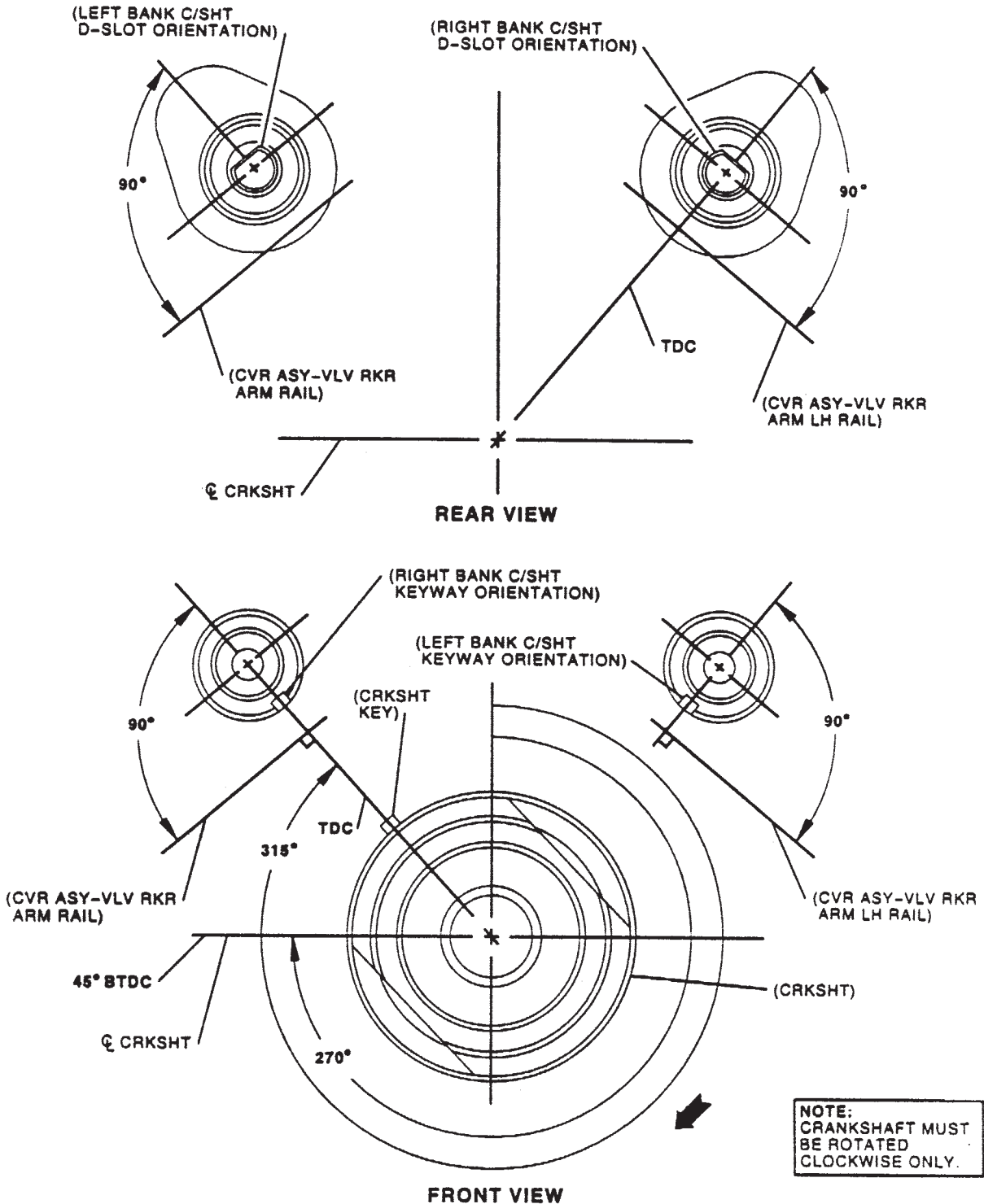
12. Position the timing chain on the camshaft sprocket. Make sure the two copper-colored links align with the camshaft sprocket timing mark.
13. Check for proper alignment of all timing marks.

Camshaft Assembly Timing Mark Alignment

**NOTE:**  
CAMSHAFT D-SLOT MUST MAINTAIN A 90° CLOCKED POSITION RELATIVE TO CAM COVER RAIL (AS SHOWN). USE APPROPRIATE TOOL.

CRANKSHAFT KEYWAY MUST BE CLOCKED @ 315° (TDC) AFTER INSTALLATION OF CYLINDER HEAD ASY (AS SHOWN) AND PRIOR TO INSTALLTION OF TIMING CHAIN ASY TO PREVENT PISTON CROWN AND VALVE DAMAGE.

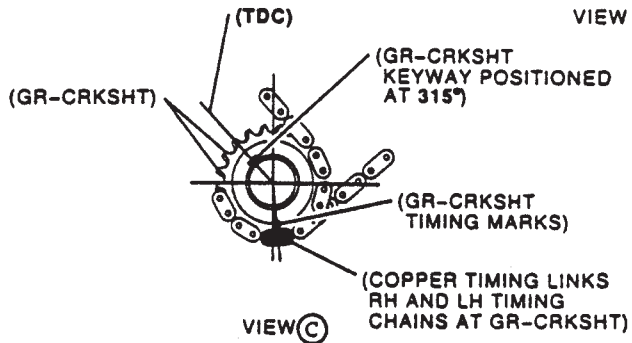
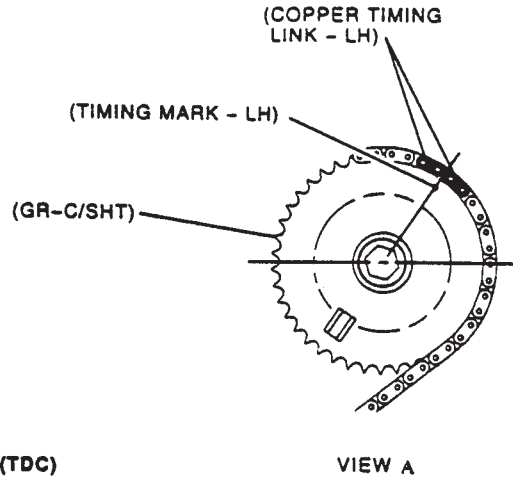
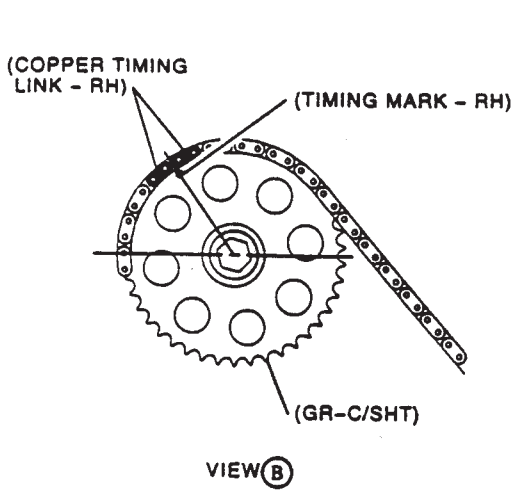
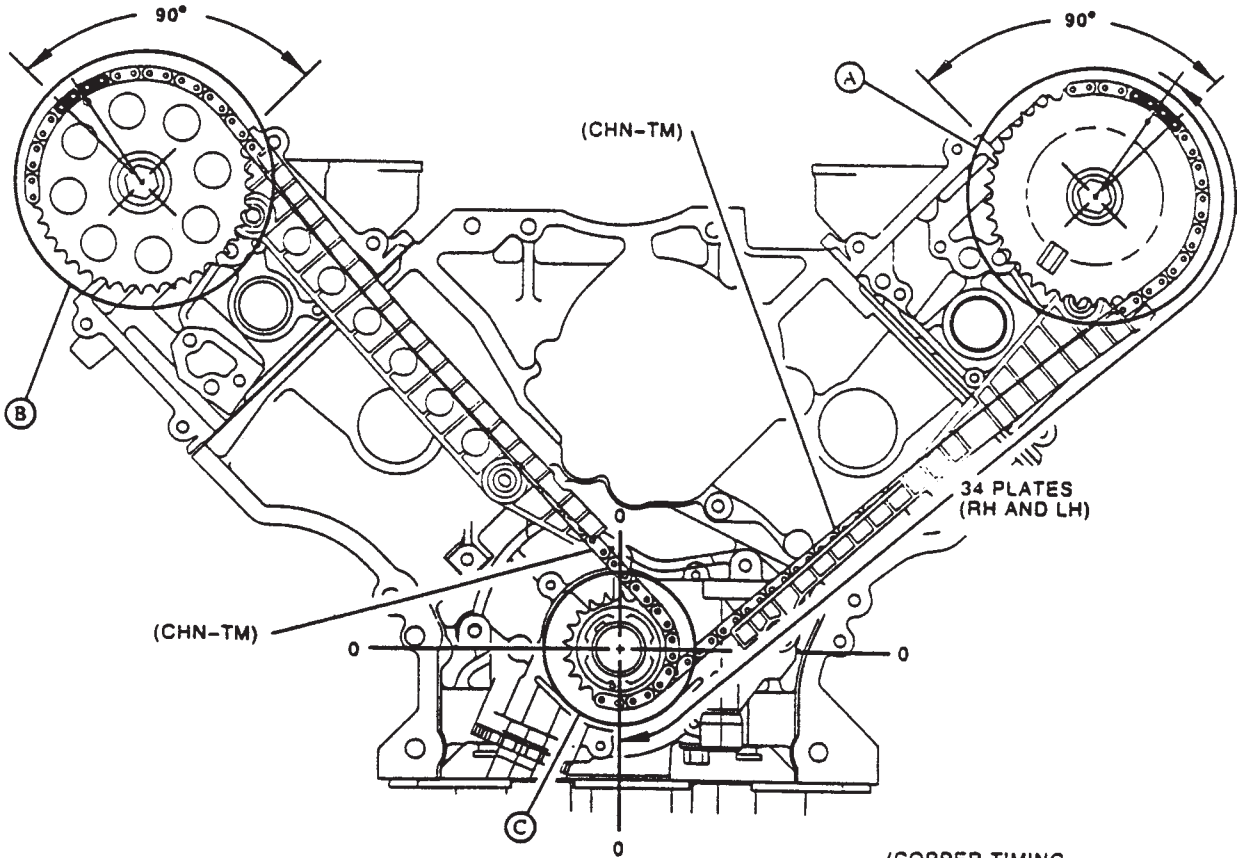
**NOTE:**  
ROTATE CRANKSHAFT TO TDC AFTER INSTALLATION OF CYLINDER HEAD ASSEMBLY TO CYLINDER BLOCK ASSEMBLY AS SHOWN.



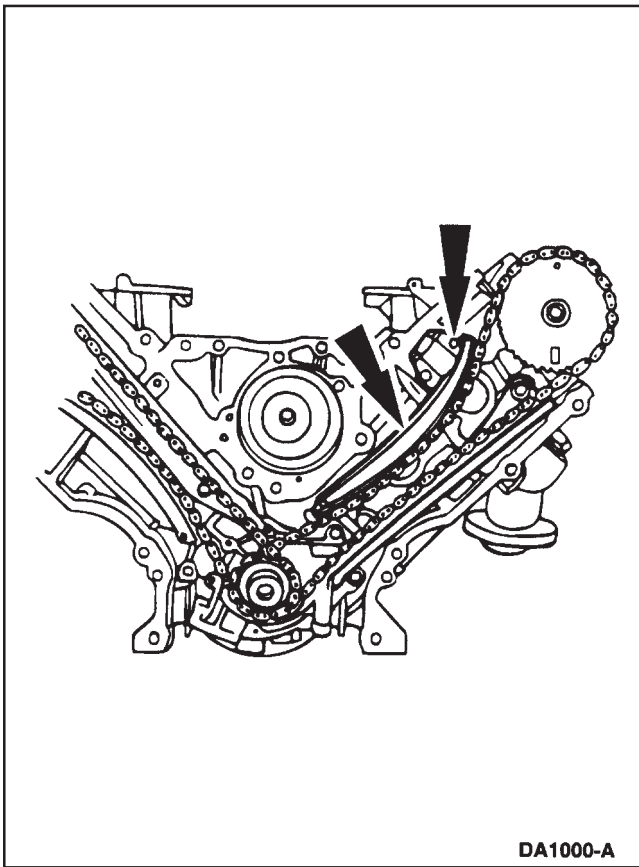
**NOTE:**  
CRANKSHAFT MUST BE ROTATED CLOCKWISE ONLY.

FPP04061

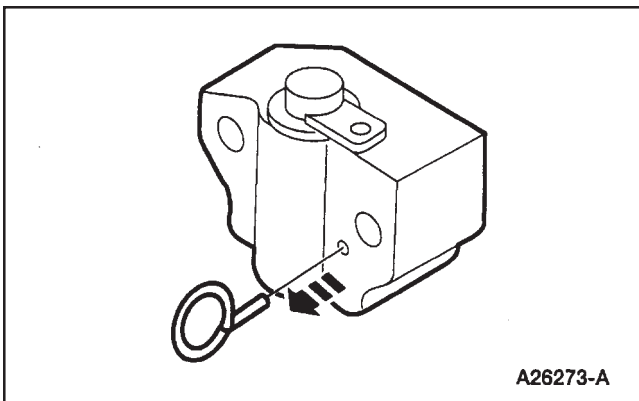
Timing Chains, Camshaft Gears and Crankshaft Gears Alignment



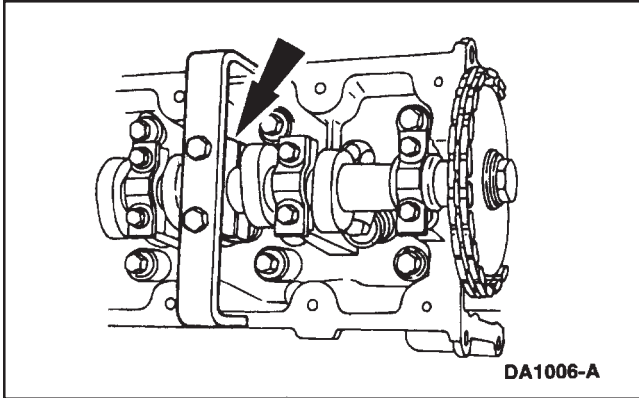
FPP04062



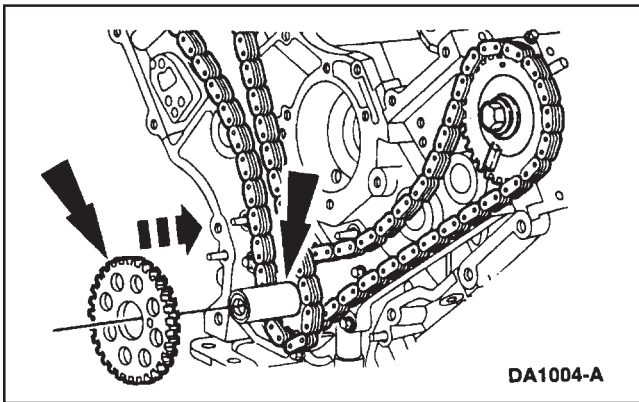
14. Position the LH and RH timing chain tensioner arms on the dowel pins. Position the timing chain tensioners and install the bolts.



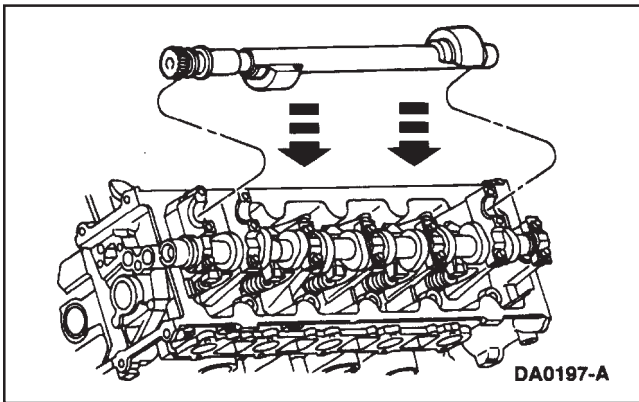
15. Remove the retaining pins from the RH and LH timing chain tensioners.



16. Remove the Camshaft Holding Tools from the camshafts.



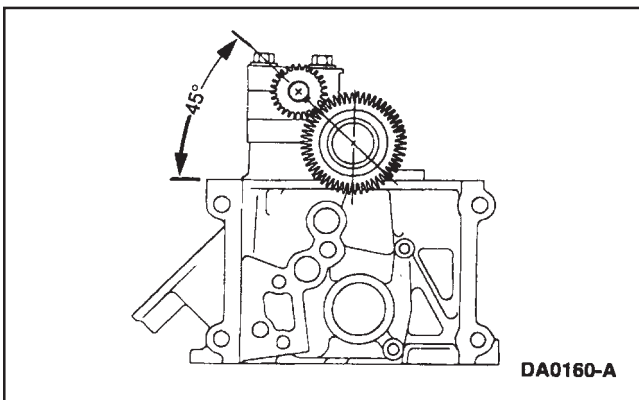
17. Install the crankshaft sensor ring on the crankshaft.



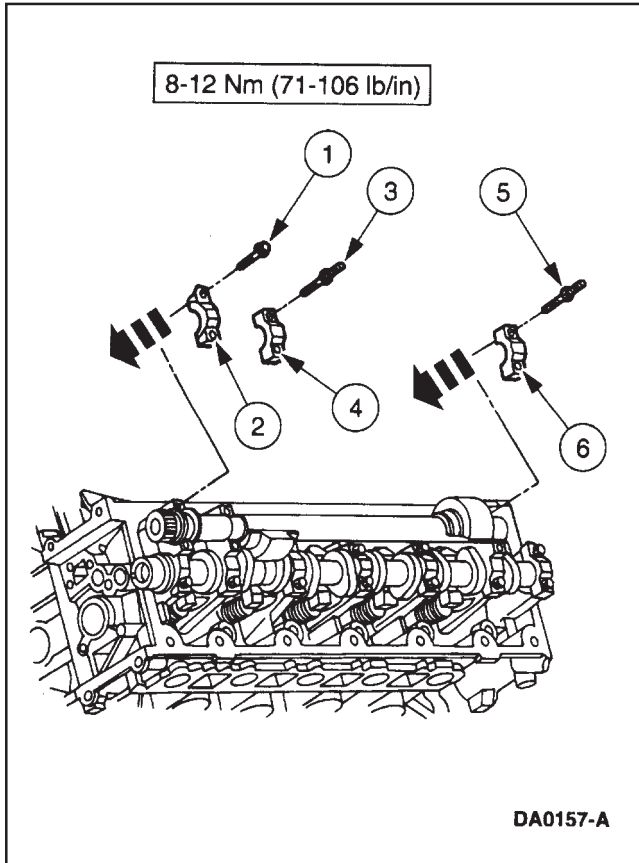
18. Lubricate the balance shaft journals with engine oil.

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

19. Position the balance shaft on the journals.



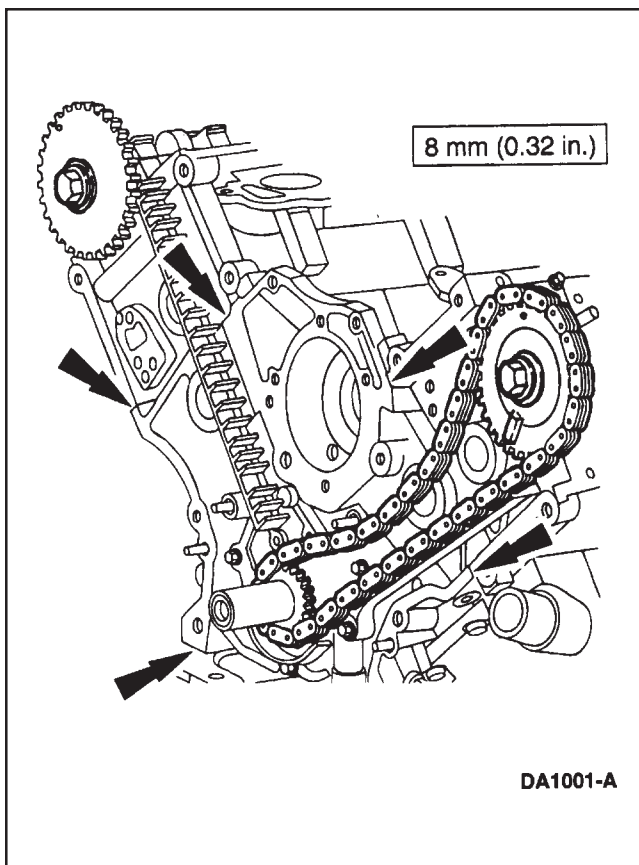
20. Align the balance shaft timing marks as shown.



21. Lubricate the bearing caps with engine oil.

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

22. Install the bearing caps, the bolts and tighten the bolts in the sequence shown.



23. **NOTE:** The timing chain is removed for clarity.

**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.

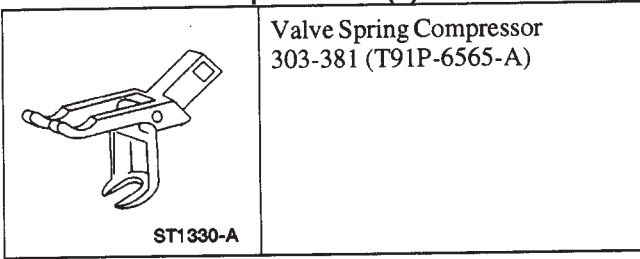
**NOTE:** Sealant must be removed and area cleaned with solvent if above instructions are not followed.

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

24. Install engine front cover; refer to Engine Front Cover in this section.

Camshaft - Removal

Special Tool(s)

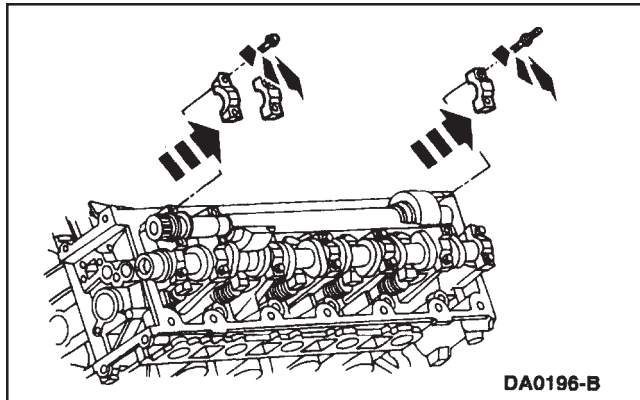


Special Service Tools called for by the procedures can be obtained by calling:  
1-800-ROTUNDA (1-800-768-8632).



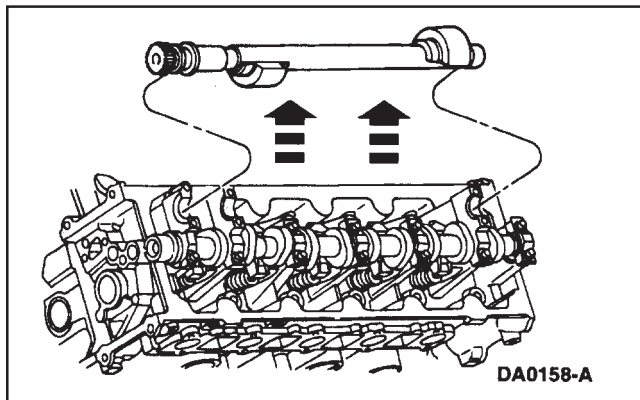
**WARNING: DO NOT SMOKE OR CARRY LIGHTED TOBACCO OR OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENTS. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND CAN BE IGNITED, RESULTING IN POSSIBLE PERSONAL INJURY.**

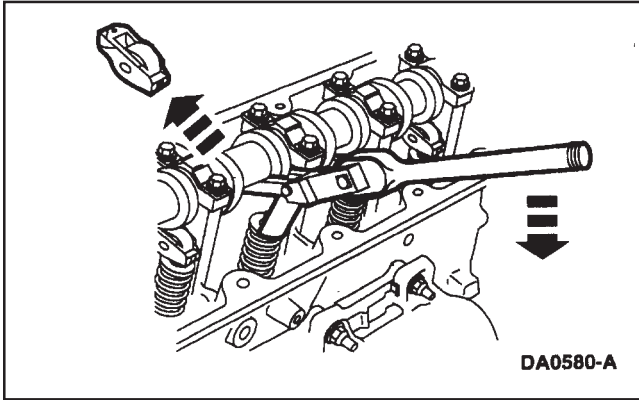
1. Disconnect the battery ground cable (14301).
2. Remove the intake manifold (9424); refer to Intake Manifold – Variable Resonance Induction System (VRIS) in this section.
3. Remove the timing chains (6268); refer to Timing Drive Components in this section.



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

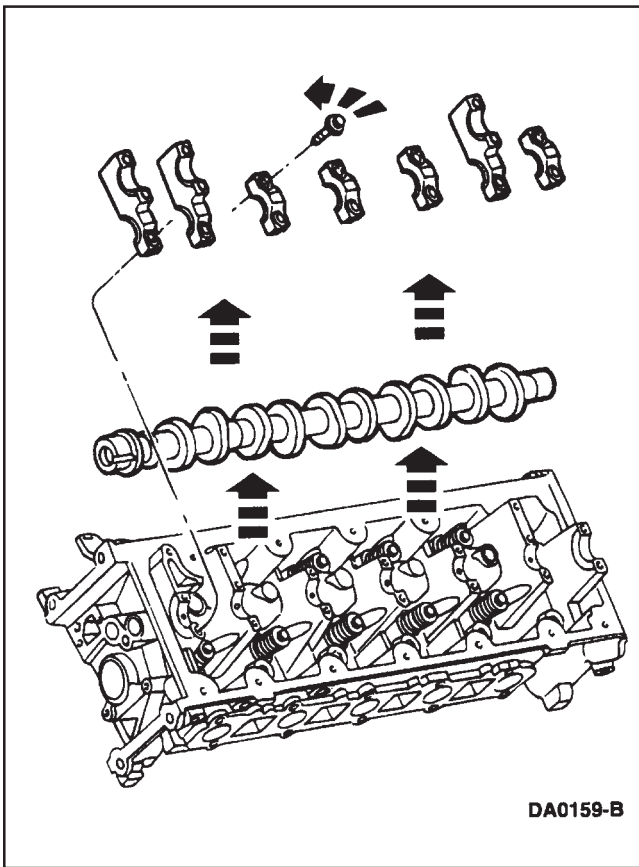
4. Remove the six bolts retaining the balance shaft bearing caps and remove the bearing caps.
5. Remove the balance shaft.





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

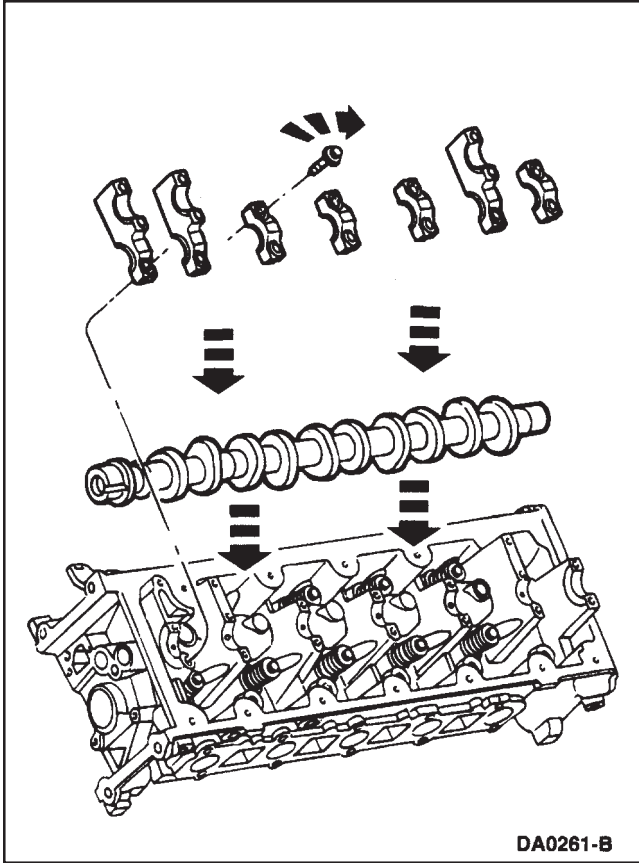
**CAUTION:** The caps must be marked for installation in their original location or damage to the engine may occur.



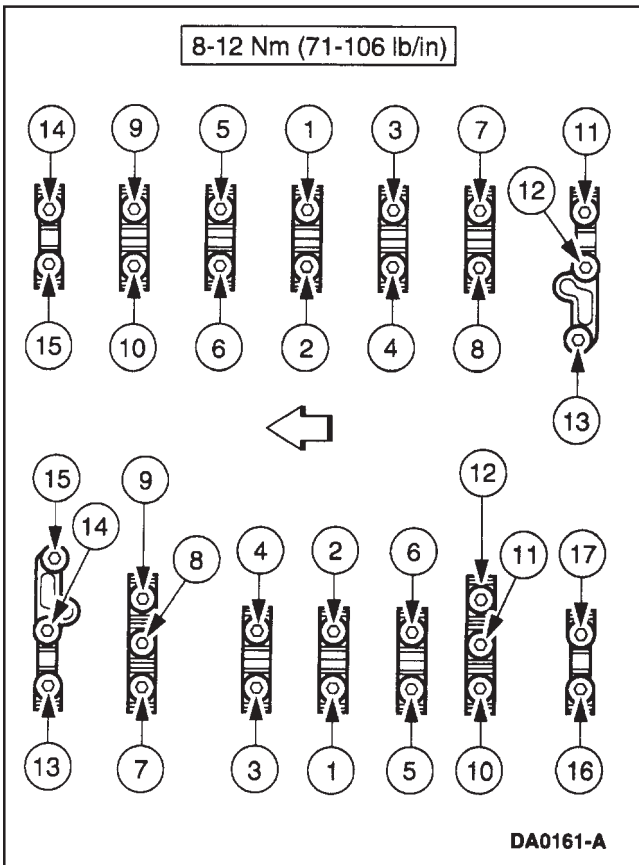
7. Remove the bolts, the camshaft bearing caps (6B280) and the camshaft (6250) from the cylinder block (6010).

### Camshaft - Installation

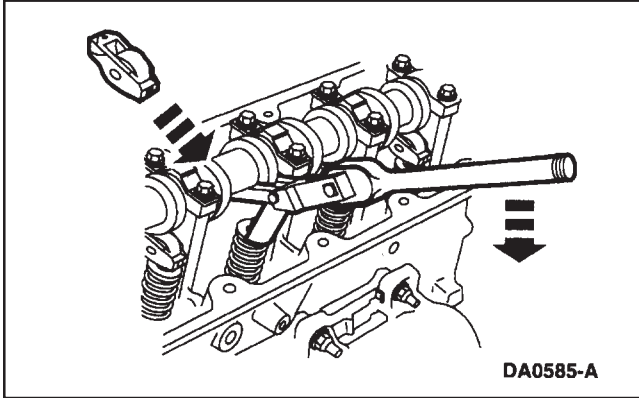
1. Lubricate the camshaft journals and bearing caps.
  - Use Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-G.



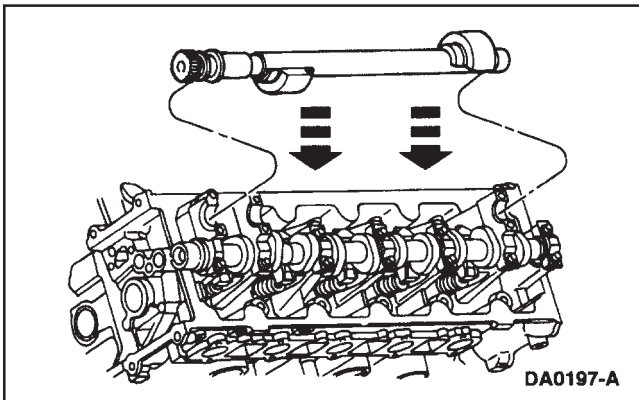
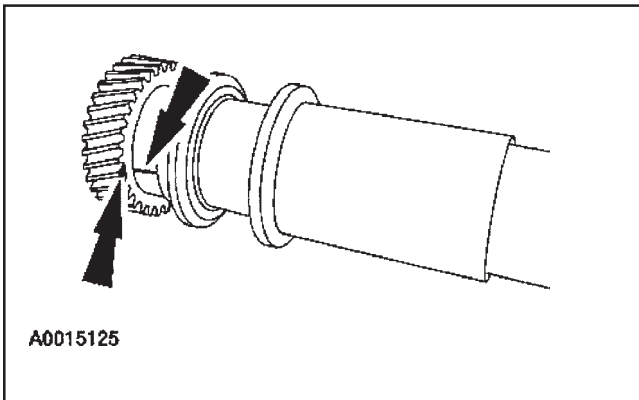
2. Install the bearing caps in their original locations and the bolts.



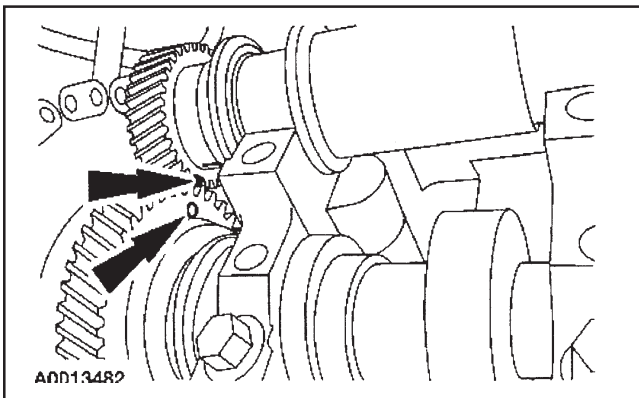
3. Tighten the bolts in the sequence shown.



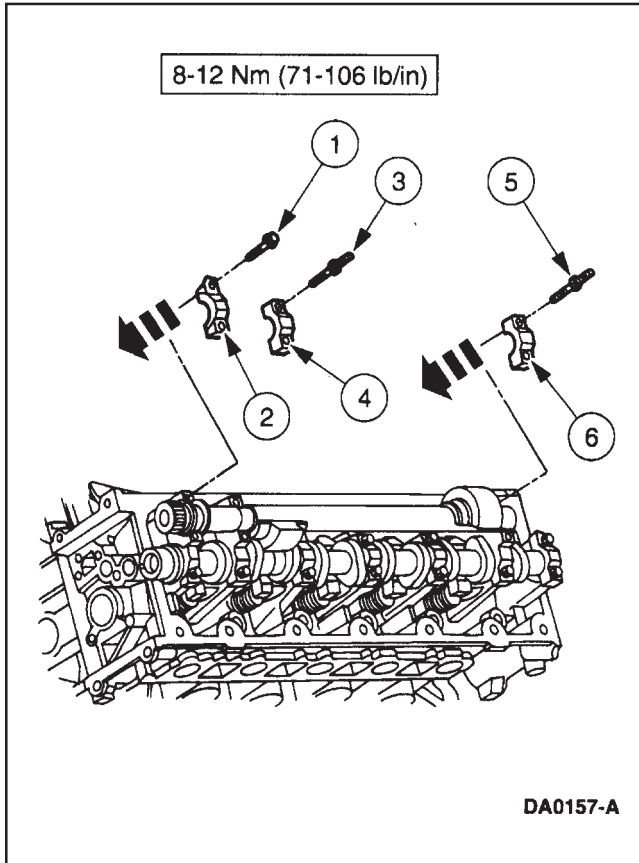
4. Use the Valve Spring Compressor to compress the valve springs and install the camshaft roller followers.
5. Lubricate the balance shaft journals with engine oil.
  - Use Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-G.



6. Using the index mark on the balance shaft, mark the corresponding teeth on the gear with chalk.
7. Position the balance shaft on the journals.

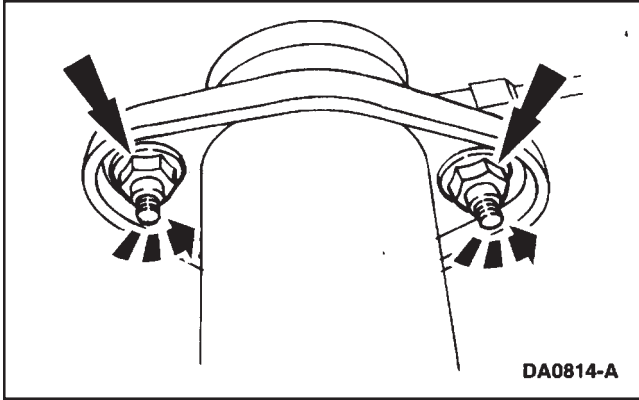


8. Align the balance shaft timing marks as shown. Align the chalk mark on the balance shaft with the camshaft timing mark as shown.

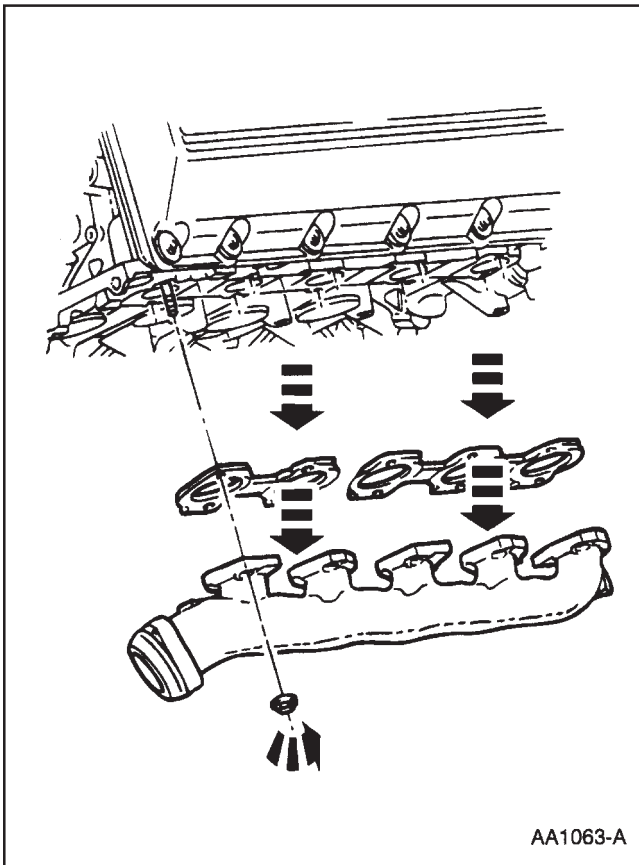


9. Lubricate the balance shaft journals with engine oil.
  - Use Super Premium SAE 5W30 Motor Oil D9AZ-19579-A or equivalent meeting Ford specification WSS-M2C153-G.
10. Position the bearing caps in their original locations and the bolts. Tighten the bolts in the sequence shown.
11. Install the intake manifold; refer to Intake Manifold – Variable Resonance Induction System (VRIS) in this section.
12. Install the timing chains; refer to Timing Drive Components in this section.

Exhaust Manifold – RH - Removal



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



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