

# **SERVICE REPAIR**

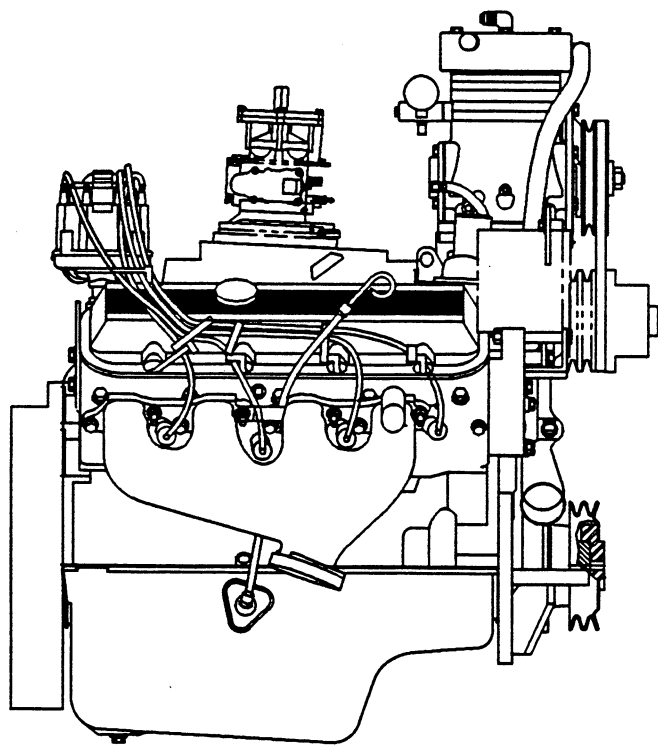
# **MANUAL**

Hyster E007 (H165XL, H190XL, H210XL, H230XL,  
H250XL, H280XL) Forklift

# ***HYSTER***

# GM ENGINES

6-LITRE V8-366



# ***HYSTER***

# SAFETY PRECAUTIONS

## MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure that all slings, chains or cables are correctly fastened and that the load being lifted is balanced. Make sure that the crane, cables and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand. Use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See “How To Put The Lift Truck On Blocks” in the OPERATING MANUAL or the PERIODIC MAINTENANCE section.
- Keep the unit and working area clean and in order.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure that all nuts, bolts, snap rings and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE sign to the controls of the unit when making repairs or if the unit needs repairs.
- Make sure you follow the DANGER, WARNING and CAUTION notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), and Diesel are flammable fuels. Make sure that you follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area has ventilation.

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This section is for the following models:

H8.00-12.00XL (H165-280XL)  
H13.00-16XL (H300-360XL),  
H10.00-12EC (H330XL-EC),  
H12.00XL-12EC (H360XL-EC)

**Thanks very much for your reading,  
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# GM 6.0 LITRE V8-366

## INTRODUCTION

This section has the description and the repair instructions for the GM 6.0 litre V8-366 engine. Checks and Adjustments, Troubleshooting procedures and Specifications are included in this section. This engine is normally used as an option for LPG fuel.

### **⚠ WARNING**

Disconnect the battery cables before doing any disassembly and repair of the engine or parts of the electrical system. Put a "DO NOT OPERATE" tag in the operator's area and on the battery connectors.

### **⚠ CAUTION**

The diodes and resistors in the electrical system can

be damaged if the following cautions are not followed:

- Do not disconnect the battery when the engine is running. The voltage surge can damage the diodes and resistors.
- Do not disconnect an electric wire before the engine is stopped and the switches are "OFF".
- Do not cause a short circuit by connection of the electric wires to the wrong terminals. Make sure a correct identification is made of the wire before it is connected.
- Make sure a battery is the correct voltage and polarity before it is connected.
- Do not check for current flow by making a spark because the electronic components can be damaged.

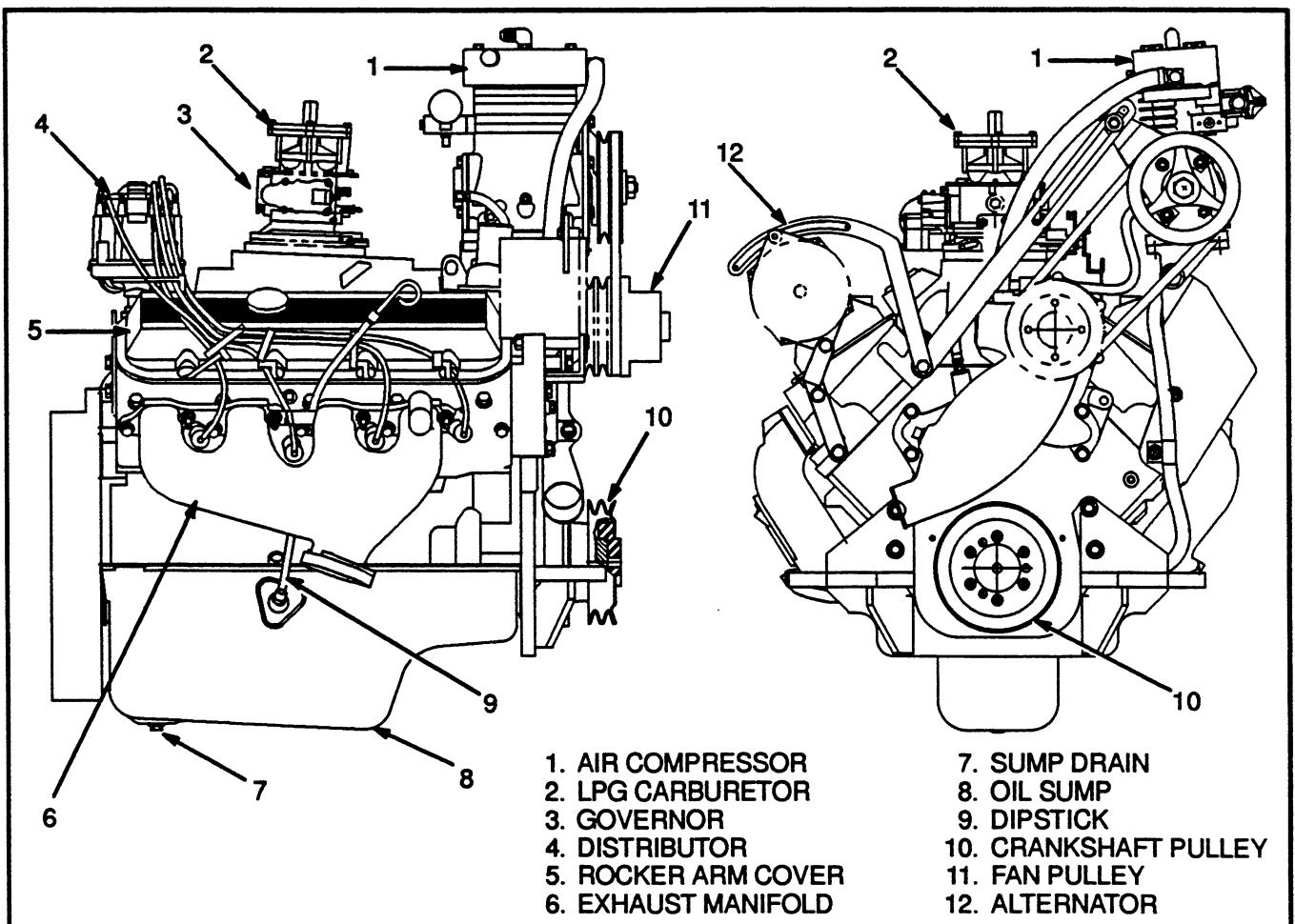


FIGURE 1. GM V8 ENGINE

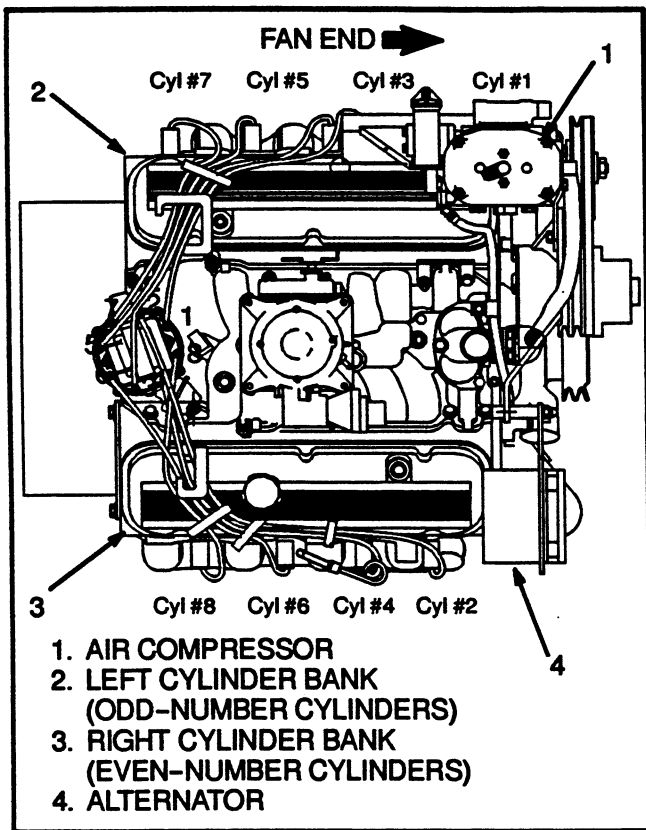


FIGURE 2. GM V8 6-LITRE ENGINE  
(TOP VIEW)

## DESCRIPTION

The arrangement of the cylinders is in a "V" shape. The cylinder block is made of cast iron. The engine has four main bearings.

The cylinder head is cast iron and has an intake valve and an exhaust valve for each cylinder. The valve mechanism is actuated by push rods and rocker arms from the camshaft.

The camshaft has five bearings. The camshaft is driven by a chain from the crankshaft. Hydraulic valve lifters are used to actuate the push rods and valves. The rocker arms for the valves are on a ball pivot.

The crankshaft has five bearings. The bearing caps are machined with the cylinder block to maintain the correct alignment and clearances. Each bearing cap is fastened to the cylinder block with four capscrews. The number five bearing at the flywheel end of the cylinder block is the thrust bearing. The connecting rod journals (two rods per journal) are 90 degrees apart.

The pistons are made of cast aluminum alloy and have three compression rings and one oil control ring.

The engine uses an LPG fuel system.

## ENGINE, REMOVAL AND INSTALLATION

The Removal and Installation procedures for the engine is in the section for **THE FRAME, 100 SRM 436** for each model of lift truck. See the section **THREE-SPEED TRANSMISSION (HYSTER T-50), 1300 SRM 518** to separate the transmission from the engine.

## CYLINDER HEAD

### Removal And Disassembly

**NOTE:** Remove and disassemble the parts as necessary for maintenance and repair.

1. Drain the cooling system.
2. Disconnect and remove the coolant hose from the housing for the thermostat.
3. Remove the air cleaner and distributor. Remove the drive belt(s) and remove the bracket for the fan mount from the cylinder heads.
4. Remove the air compressor.
5. Disconnect the spark plug wires. Remove the dipstick tube.
6. Remove the intake manifold. See FIGURE 3.
7. Remove the exhaust manifold. See FIGURE 4.



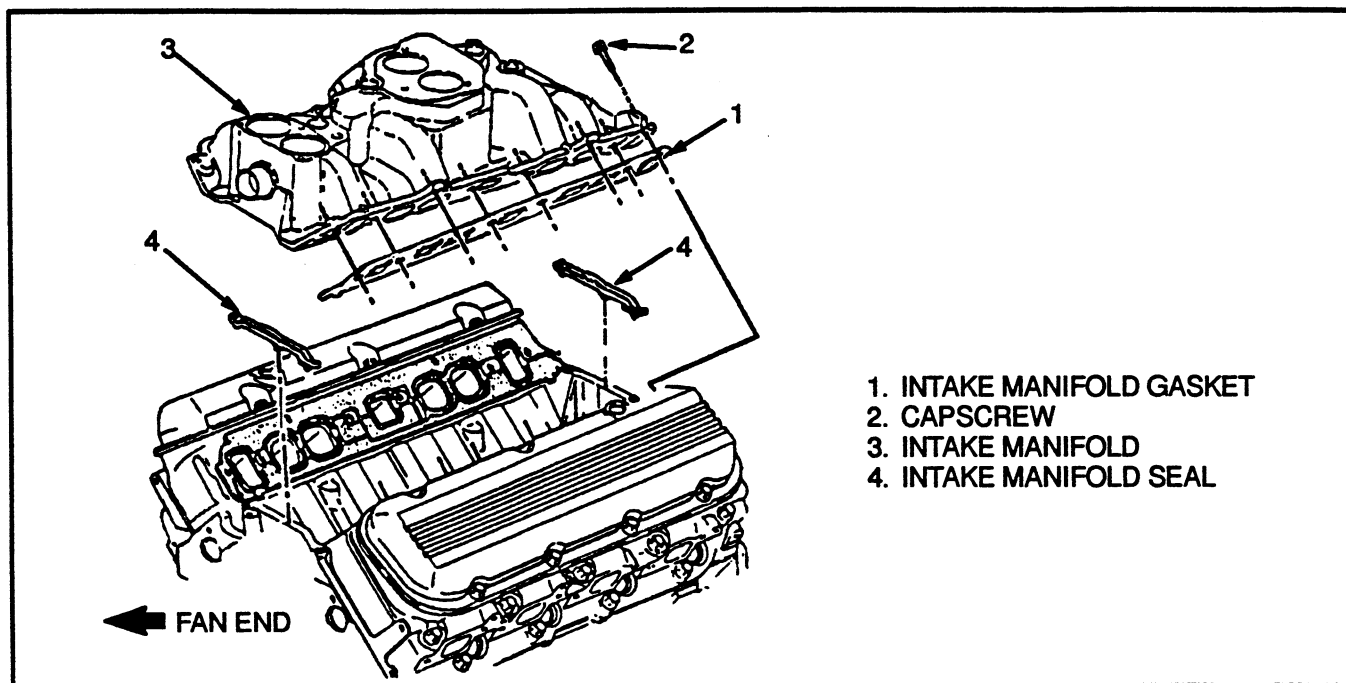


FIGURE 3. INTAKE MANIFOLD

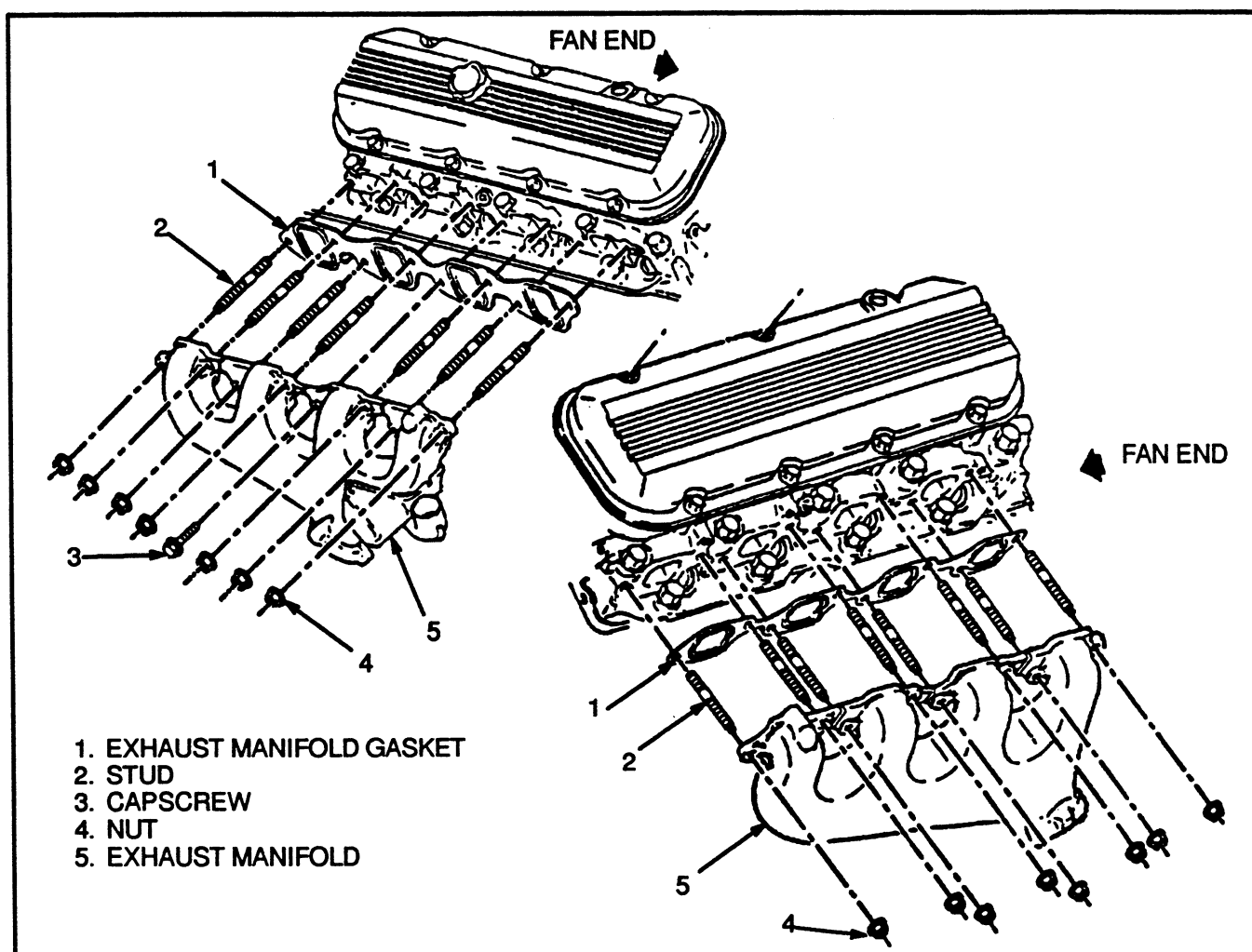


FIGURE 4. EXHAUST MANIFOLD

8. Remove the rocker arm covers. See FIGURE 5.

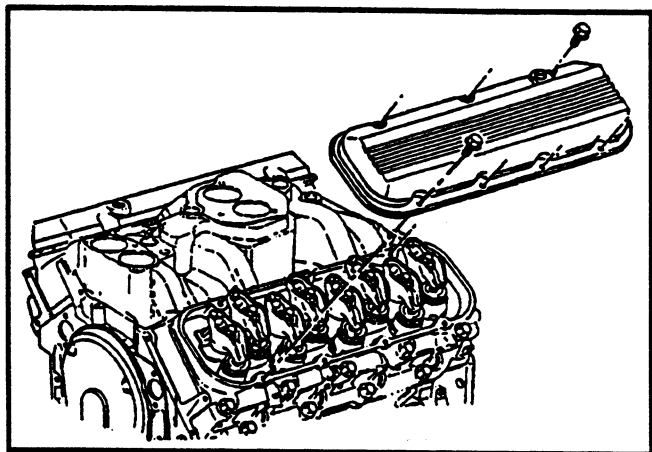


FIGURE 5. REMOVE THE ROCKER ARM COVER

**NOTE:** The exhaust push rods are longer than the intake push rods.

Many service personnel make an organizer rack to make sure the valve train components are installed in their original locations. An organizer rack can be made from a 50 mm x 200 mm (2 x 8 in) piece of wood as shown in FIGURE 6.

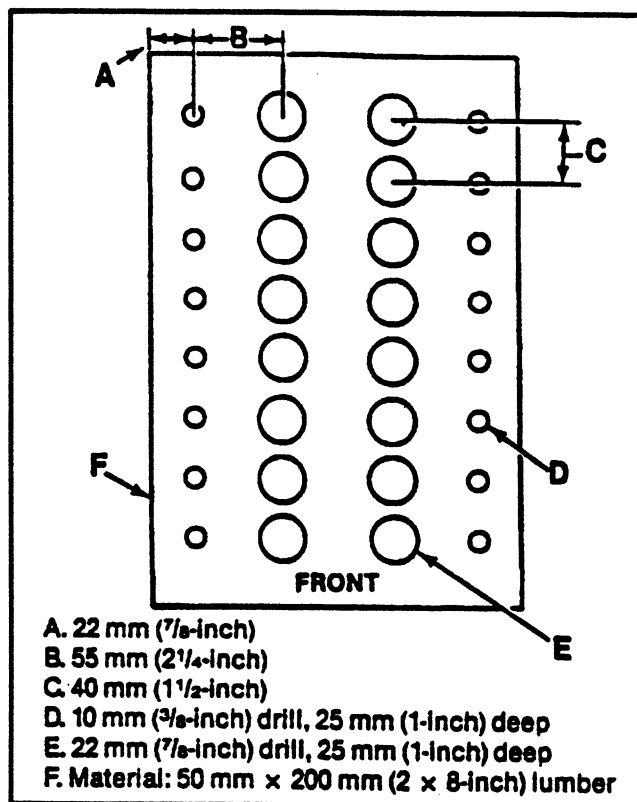


FIGURE 6. ORGANIZER RACK FOR VALVE TRAIN COMPONENTS

1. CAPSCREW
2. BALL
3. ROCKER ARM
4. PUSH ROD
5. HYDRAULIC LIFTER
6. CYLINDER HEAD
7. PUSH ROD GUIDE

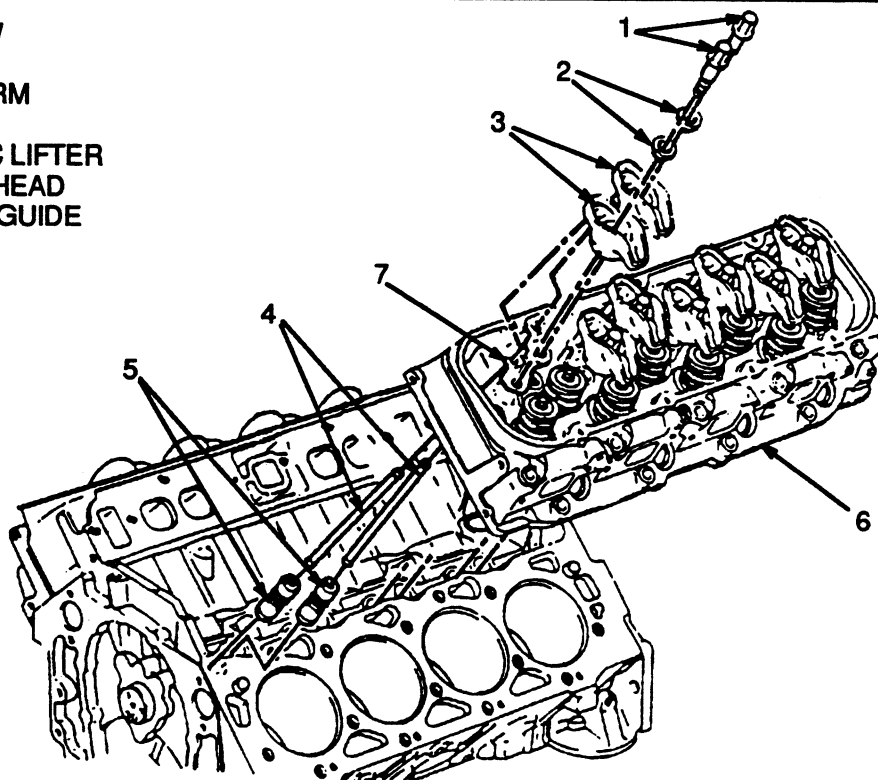


FIGURE 7. REMOVE THE VALVE TRAIN COMPONENTS AND CYLINDER HEAD

9. Disassemble the valve train. See FIGURE 7. Remove the capscrews, balls and the rocker arms. Remove the rocker arms. Keep the parts for each rocker arm assembly together. Mark the assemblies so that they can be installed in their original positions.

10. Remove the capscrews that hold the cylinder head to the block. Loosen the capscrews in the reverse order of the tightening sequence shown in FIGURE 15. Remove the cylinder head and the gasket.

11. Use a valve spring compressor to remove the valves and springs. Put the valves and springs in a rack so that they can be installed in their original positions.

12. Remove the hydraulic lifters from the cylinder block. Use a magnet to raise the hydraulic lifter in the cylinder block so that it can be removed. Make sure that the hydraulic lifters can be installed in the same place from which they were removed.

**NOTE:** Some hydraulic lifters can be difficult to remove because of varnish deposits. A tool (J 9290-01) is available to remove a hydraulic lifter. See FIGURE 8.

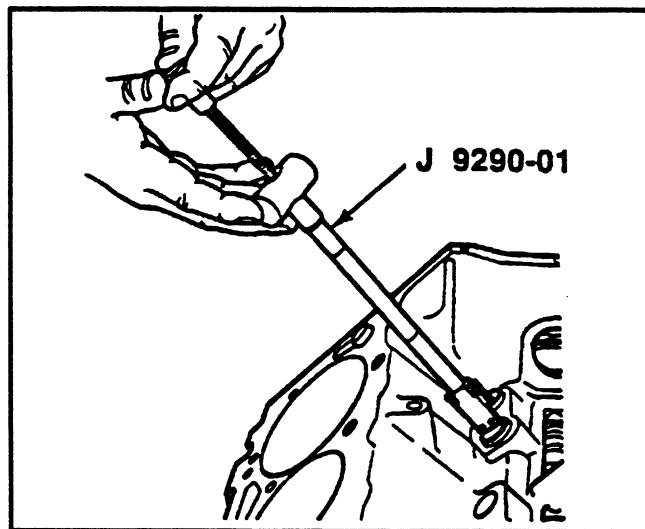


FIGURE 8. REMOVAL TOOL FOR HYDRAULIC LIFTER

### Cleaning And Inspection

1. Clean the carbon from the valve ports and combustion chambers in the cylinder head.
2. Clean the carbon and oil from the valves, push rods, and rocker arms.
3. Clean the valve guides.

4. Clean the surfaces of the cylinder head where the gaskets fit.

5. Inspect the cylinder head for cracks in the ports, combustion chambers, and external surfaces.

6. Inspect the valves for burned or damaged areas in the seat surfaces. Inspect for cracks and damaged or worn valve stems.

### Repairs, Valve Guides and Seats

Measure the clearance between the valve stem and the guide as shown in FIGURE 9. The maximum clearance for the intake valves is 0.094 mm (0.0037 in). The maximum clearance for the exhaust valves is 0.124 mm (0.0049 in). If the clearance is more than the maximum amount, oversize valves must be installed. Use a reamer of the correct size when installing oversize valves. Use normal service procedures when grinding the valve seats. See the specifications in this section for dimensions.

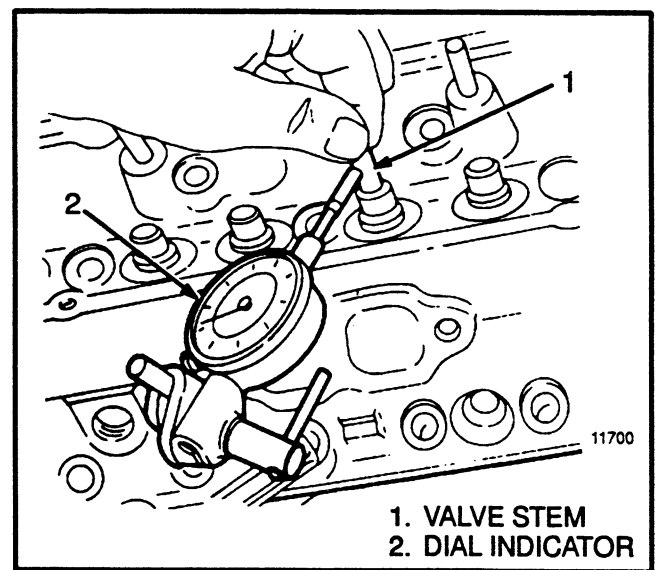


FIGURE 9. VALVE STEM CLEARANCE

### Repairs, Valves

**NOTE:** Before any work is performed on the valve faces and seats, make sure the clearance of the valve stems in their valve guides is within specifications. See Repairs, Valve Guides and Seats in this section.

A correction for minimum wear and damage to the valve and seat can be done by a process called "lapping". When the valve seats are "lapped," keep the valve faces and seats within the specifications. Make sure all of the lapping compound is removed from the valve and valve seat when the process is completed.

Replace a valve if any of the following conditions are present:

- The valve stem is worn below specifications.
- The valve stem is bent.
- The valve face is warped.
- Any part of the valve is cracked.
- Any wear or damage to the valve face cannot be removed by resurfacing and still meet the specifications shown in FIGURE 10.

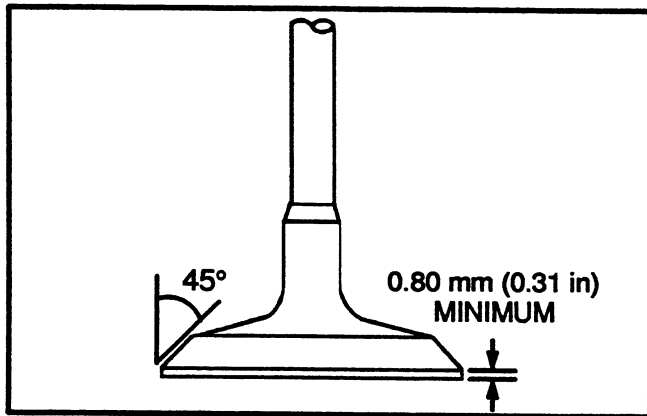


FIGURE 10. VALVE HEAD MEASUREMENTS

## Repairs, Valve Seats

**NOTE:** Before any work is done on the valve faces and seats, make sure the clearance of the valve stems in their valve guides is within specifications. See Repairs, Valve Guides and Seats in this section.

A correction for minimum wear and damage to the valve and seat can be done by a process called "lapping". When the valve seats are "lapped," keep the valve faces and seats within the specifications. Make sure all of the lapping compound is removed from the valve and valve seat when the process is completed.

## CAUTION

The exhaust valve seats in these cylinder heads are induction hardened. Removal of too much valve seat material damages the valve seats and requires replacement of the cylinder head.

Damaged valve seats can be resurfaced with a tool that is designed to repair valve seats. There are many different types of equipment for repairing valve seats. Follow the instructions of the manufacturer of the equipment that you are using.

The valve seats are ground at three different angles: 30°, 46°, and 60°. This method makes a valve seat that is the correct width and produces the correct contact line between the valve and valve seat. The specifications for the valve seats are shown in the ENGINE SPECIFICATIONS in this section and in FIGURE 11.

- If the contact line is too high, it can be made lower by using a 30° stone.
- If the contact line is too low, it can be raised using the 46° stone.
- If the seat is too narrow, it can be made wider using a 46° stone.
- If the seat is too wide, it can be made narrower using a 60° stone.

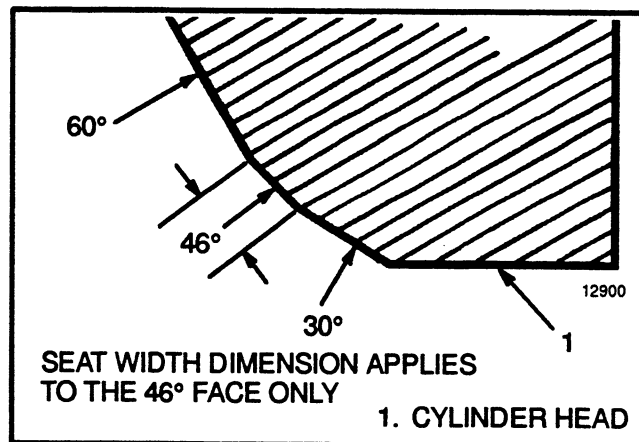


FIGURE 11. VALVE SEAT SPECIFICATIONS FOR INLET AND EXHAUST VALVES

The correct dimensions for the valve seat widths and valve/valve seat overlap are shown in FIGURE 12. The valve seat widths are the dimensions of the 46° face only. The valve/valve seat overlap is the distance from the edge of the seat to the outside edge of the valve.

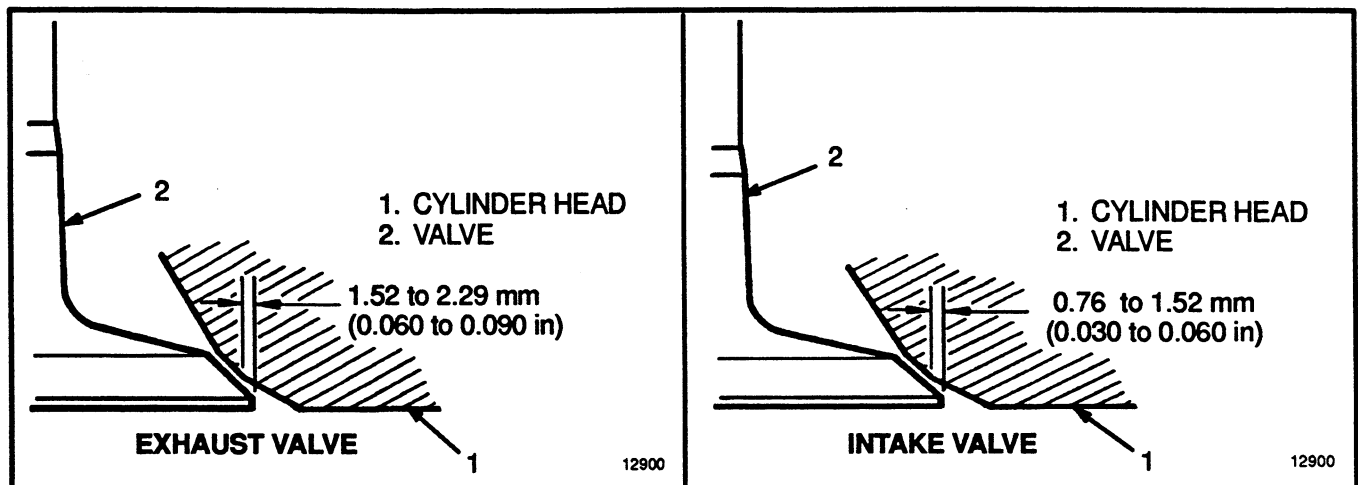


FIGURE 12. VALVE SEAT WIDTHS

### Valve Springs (See FIGURE 13.)

Measure the length of the valve springs. The correct length is 51.6 mm (2.03 in).

#### **⚠ WARNING**

Be careful when testing the valve springs. These springs can come loose with enough force to cause an injury. Always use equipment that was designed to test springs. Always wear eye and face protection while testing valve springs.

Use a special tool to check the tension of the valve springs. Compress the spring to the correct height and check the tension. For the correct specifications, see FIGURE 13. Replace valve springs that are not within specifications.

### Assembly And Installation

1. Install each valve in the correct port. Lubricate the valve stem with engine oil. Install the rotator and oil seal on the valve. Install the spring and cap. Using a spring compressor, compress the assembly and install the retainers. Measure the height of the valve spring as shown in FIGURE 13. and FIGURE 14. Measure from the spring seat to the top of the spring. Install shims under the rotator to get the correct height shown in FIGURE 13. The installed height of the valve spring must not be less than the minimum height.

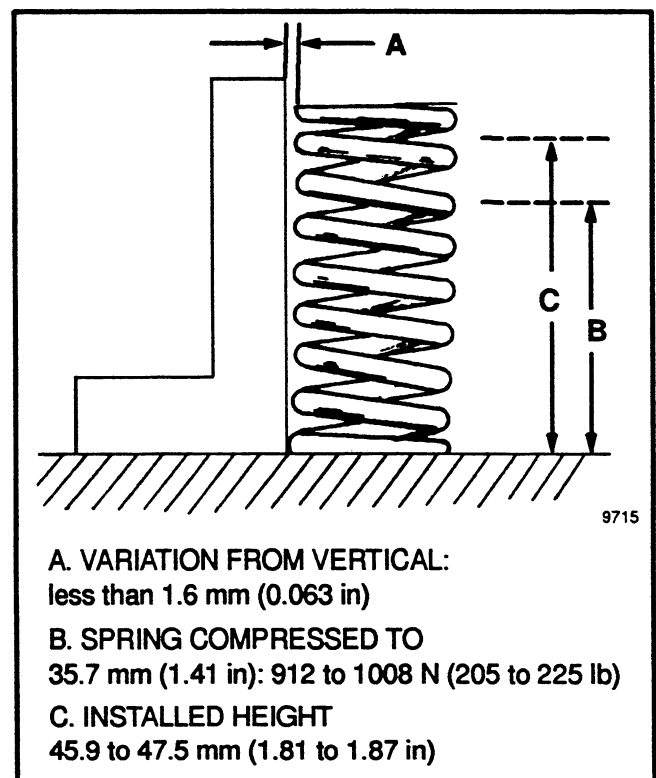


FIGURE 13. VALVE SPRING SPECIFICATIONS

2. Clean the surface of the cylinder head and the top of the cylinder block. Make sure the threads in the block are clean.

3. Install the cylinder head gasket with the bead facing up. Do not use a sealant. Install the cylinder head, making sure the cylinder head is aligned with the pins in the block.

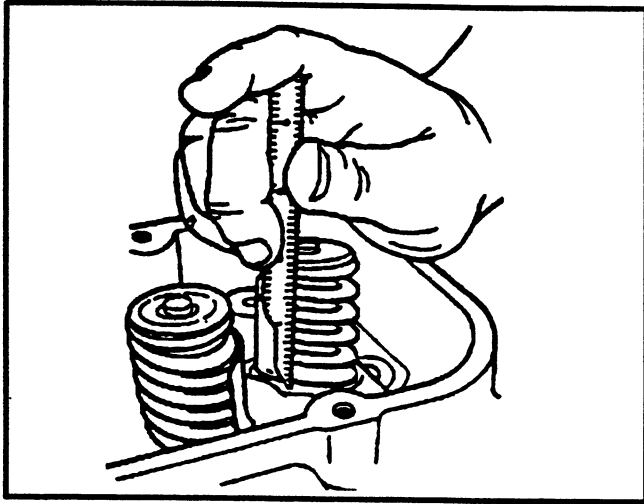


FIGURE 14. MEASURE THE VALVE SPRINGS

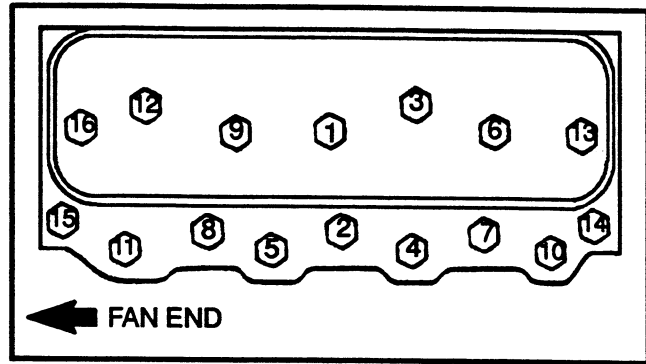


FIGURE 15. TIGHTENING SEQUENCE, CYLINDER HEAD

4. Use a sealant on the threads of the capscrews for the cylinder head. Tighten the capscrews in three steps to 40 Nm (30 lbf ft), 80 Nm (60 lbf ft) and finally to 115 Nm (85 lbf ft). Use the sequence shown in FIGURE 15.

5. See FIGURE 16. Install the intake manifold seals to the block. Install the intake manifold gaskets on the cylinder heads. Apply a 5 mm (0.2 in) spot of RTV sealant (part number 280472) to the front and rear of the block in four places. Install the intake manifold. Tighten the capscrews to 40 Nm (30 lbf ft) in the sequence shown in FIGURE 17.

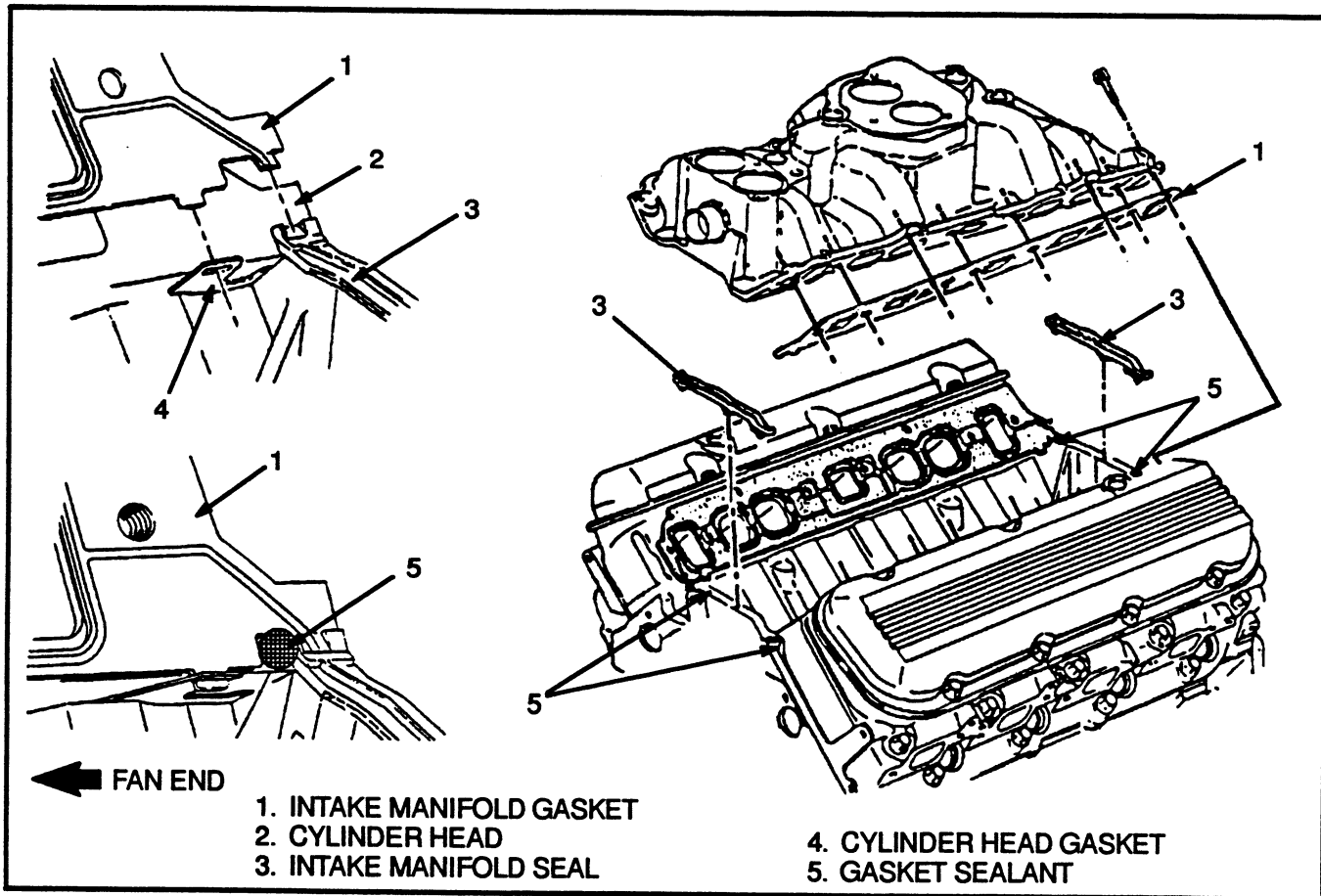


FIGURE 16. SEALANT LOCATIONS, INTAKE MANIFOLD

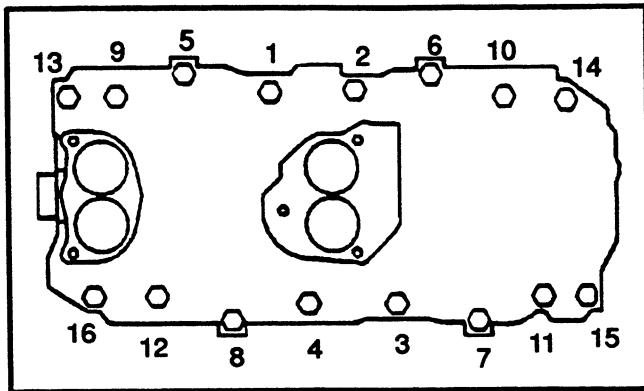


FIGURE 17. TIGHTENING SEQUENCE, INLET MANIFOLD

6. Install the push rods, making sure they are in the seat of the valve lifter.

**NOTE:** The push rods for the exhaust valves are longer than the push rods for the intake valves.

7. Lubricate the rocker arms and rocker arm balls with a molybdenum grease. Install the push rod guides, rocker arms, balls, and capscrews. Tighten the capscrews to 54 Nm (40 lb<sub>f</sub> ft).

8. Use a new gaskets and install the valve covers. Tighten the capscrews to 8 Nm (70 lb<sub>f</sub> in).

9. Install the exhaust manifold gaskets and the manifolds. Tighten the capscrews to 54 Nm (40 lb<sub>f</sub> ft) and the nuts to 30 Nm (22 lb<sub>f</sub> ft). Install the spark plug shields and tighten the nuts to 20 Nm (15 lb<sub>f</sub> ft).

10. Install the coolant hose to the housing for the thermostat. Fill the coolant system with coolant. See PERIODIC MAINTENANCE, 8000 SRM 433.

## CYLINDER BLOCK, CLEANING AND INSPECTION

After the engine is disassembled, clean the cylinder block in solvent. Make sure all of the oil passages are clean. Remove the gaskets from the surface of the block.

Inspect the bores for the pistons for wear or damage. Measure the bores and check the dimensions shown in Specifications. Repair the cylinder block as necessary.

**NOTE:** It is important that the piston bores are prepared correctly before new piston rings are installed. Incorrect preparation can cause the parts to wear quickly.

## PISTON BORE PREPARATION

Use a hone in the piston bores when installing new rings. Use the hone as follows:

1. Use a hone with a 280 grit stone. Make sure the stone is clean and will not damage the bore.
2. Move the hone quickly (approximately 60 times per minute) up and down in the bore. Make sure the hone makes a cross pattern of 45 to 60 degrees. Use the hone until the entire length of the bore has this pattern.
3. After using the hone, clean the cylinder block with hot water and detergent. Make sure all metal particles are removed from the block. Dry the bores and lubricate them with engine oil.

## LUBRICATION SYSTEM

### Oil Pump, Removal and Disassembly (See FIGURE 18.)

1. Remove the oil sump.
2. Remove the capscrew at the mount for the pump. Remove the oil pump, shaft and retainer.
3. Remove the cover for the oil pump. Put marks on the gear teeth to show their correct location during assembly.
4. Do not remove the tube and screen assembly unless it is damaged. The tube and screen must be replaced as an assembly.

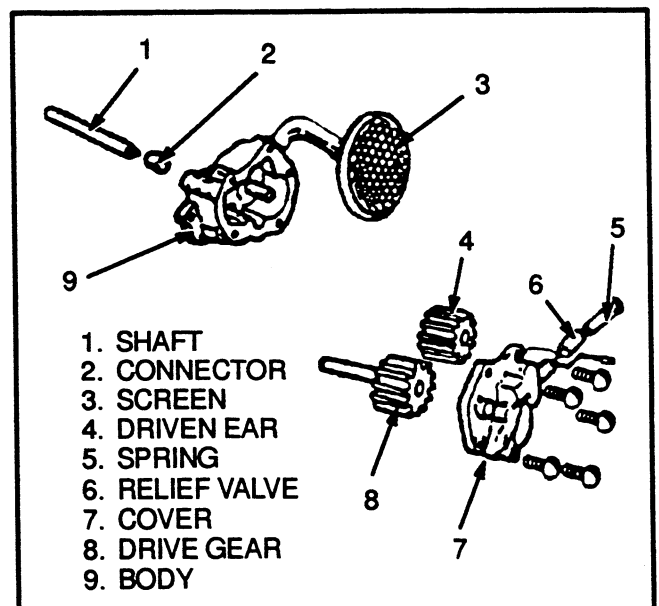


FIGURE 18. OIL PUMP

## Cleaning and Inspection

### **⚠ WARNING**

Compressed air can move particles so that they cause injury to the user or to other personnel. Make sure that the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent injury to the eyes.

Clean the parts of the oil pump in solvent and dry with compressed air. Inspect the gears, shaft and body of the pump for wear or damage. If any of the parts are worn or damaged the oil pump must be replaced. Separate parts are not available.

### **Oil Pump, Assembly and Installation (See FIGURE 18.)**

1. Use a sealant when replacement of the tube and screen assembly is necessary. Do not damage the tube during installation. Make sure that the surface of the screen assembly is parallel to the bottom surface of the cylinder block.

2. Install the gears in the body of the pump. Make sure to align the identification marks. Install the cover for the oil pump and tighten the capscrews to 12 Nm (106 lbf in). Turn the shaft for the oil pump and check for smooth operation.

3. Install the oil pump assembly to the engine. Make sure the shaft is aligned with the slot in the distributor shaft. Tighten the capscrew at the mount to 85 Nm (63 lbf ft).

### **Oil Sump, Installation (See FIGURE 19.)**

1. Apply an RTV sealant to the surfaces of the engine block as shown in FIGURE 19.

2. Install the gasket and the oil sump making sure the gasket stays in position.

3. Tighten the capscrews for the oil sump to 22 Nm (16 lbf ft).

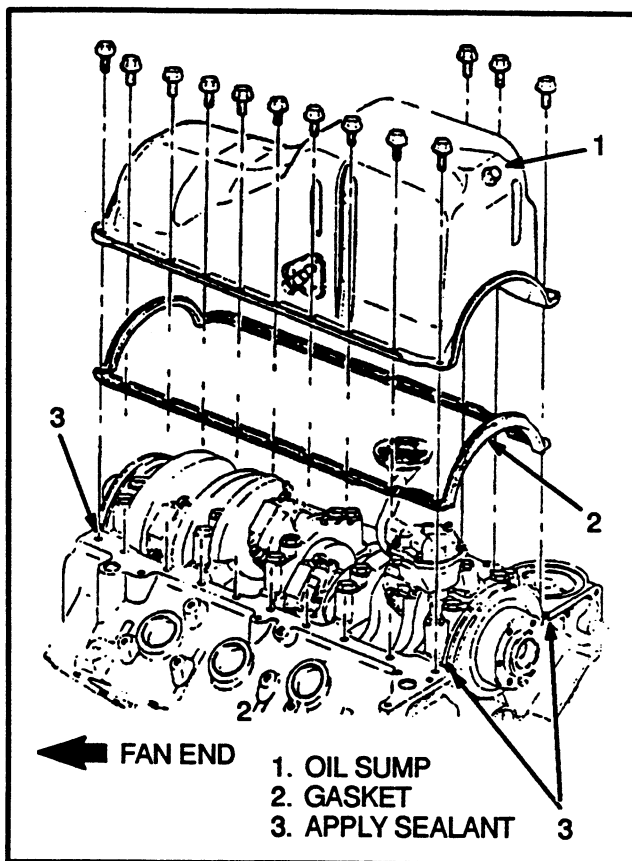


FIGURE 19. OIL SUMP

## **TIMING COVER, TIMING SPROCKETS, CAMSHAFT AND VALVE LIFTERS**

### **Timing Cover, Removal (See FIGURE 21.)**

1. Remove the fan assembly and belts.
2. Remove the crankshaft pulley and vibration damper. Use a tool that pulls on the center of the vibration damper. Do not pull on the outside diameter of the vibration damper. (See FIGURE 20.)

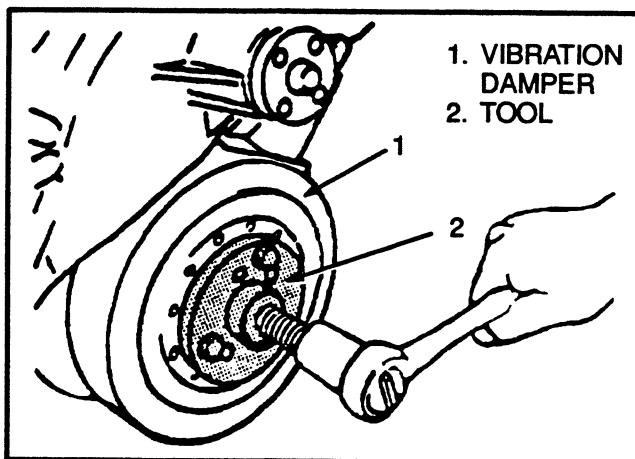


FIGURE 20. VIBRATION DAMPER



3. Remove the capscrews for the timing cover. Remove the timing cover. If the gasket is not damaged, it can be used again.

4. Carefully remove the oil seal from the cover.

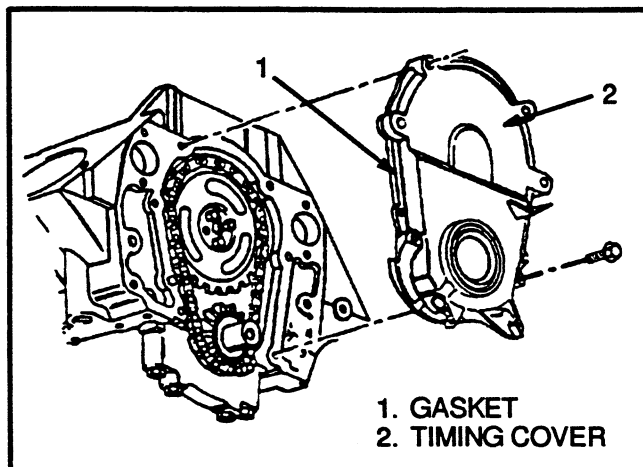


FIGURE 21. TIMING COVER

### Timing Cover, Installation

1. Install a new oil seal in the timing cover. See FIGURE 22. Make sure the open side of the seal is toward the inside of the cover.

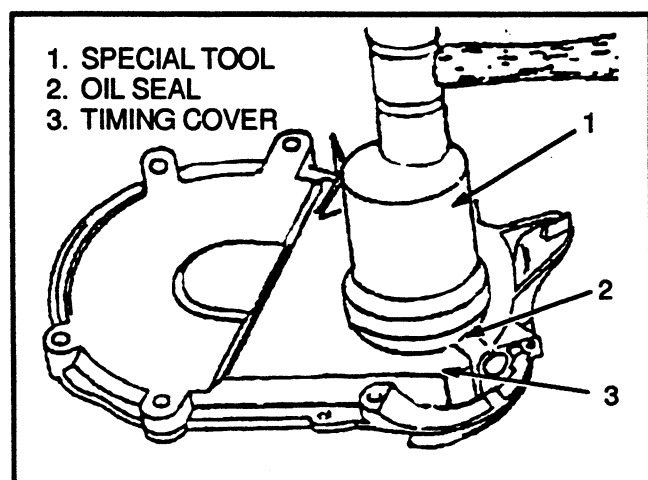


FIGURE 22. TIMING COVER

2. Use an RTV sealant where the timing cover meets the oil sump. See FIGURE 23. Install the gasket and the cover. Tighten the capscrews for the cover to 12 Nm (9 lb<sub>f</sub> ft).

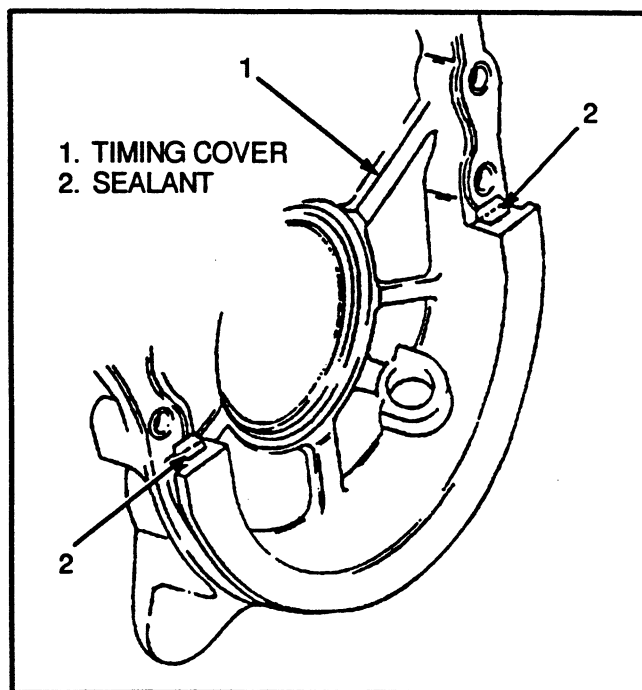


FIGURE 23. TIMING COVER

3. Lubricate the lips of the seal with clean engine oil before the vibration dampener is installed. Use a special tool to pull the vibration dampener onto the crankshaft. Install the stud into the threaded hole in the crankshaft. See FIGURE 24. Remove the tool and install the washer and capscrew. Make sure the "F" on the washer faces out. Tighten the capscrew for the damper to 149 Nm (110 lb<sub>f</sub> ft).

4. Install the crankshaft pulley, belts, and fan assembly.

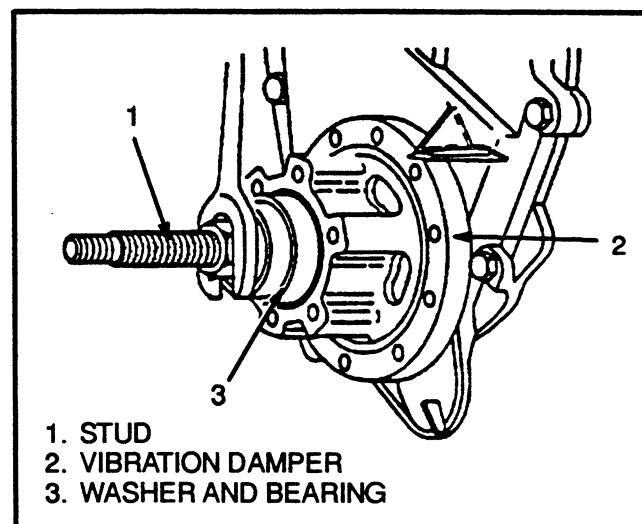


FIGURE 24. INSTALL THE VIBRATION DAMPER