

**SECTION 6A6****6.5L DIESEL  
RPO L49, VIN P  
RPO L56, VIN S  
RPO L65, VIN F**

**CAUTION:** On vehicles equipped with Supplemental Inflatable Restraint (SIR), refer to **CAUTIONS** in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow **CAUTIONS** could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

**NOTICE:** Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.
- Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

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## **GENERAL DESCRIPTION**

The 6.5L diesel engine is a 90-degree V8 type, with indirect type combustion chambers. There are three versions of the 6.5L engine used for C/K models. Two of the engines are turbocharged (L56, VIN S and L65, VIN F) and one is naturally aspirated (L49, VIN P).

The crankshaft is supported by five precision insert main bearings, with crankshaft thrust taken at the number three (center) main bearing.

The camshaft is supported by five plain-type bearings and is chain driven. Motion from the camshaft is transmitted to the overhead valves by roller type hydraulic lifters, pushrods, and shaft mounted rocker arms. The valve guides are integral to the cylinder head.

The connecting rods are forged steel with precision insert type crankpin bearings. The piston pins are held in place by retaining rings.

For a disassembled view of the 6.5L engine, refer to figures 1 through 4.

For engine identification information, refer to SECTION 0A.

For bench repair of the 6.5L diesel engine, refer to the Light Duty Truck Unit Repair Manual.

For information about the turbocharger, refer to SECTION 6J.

## **ENGINE LUBRICATION**

A lubrication schematic is shown in figure 5.

The gear-type oil pump is driven from the drive gear. The drive gear is driven by the camshaft. Oil is drawn into the pump through a pickup screen and pipe.

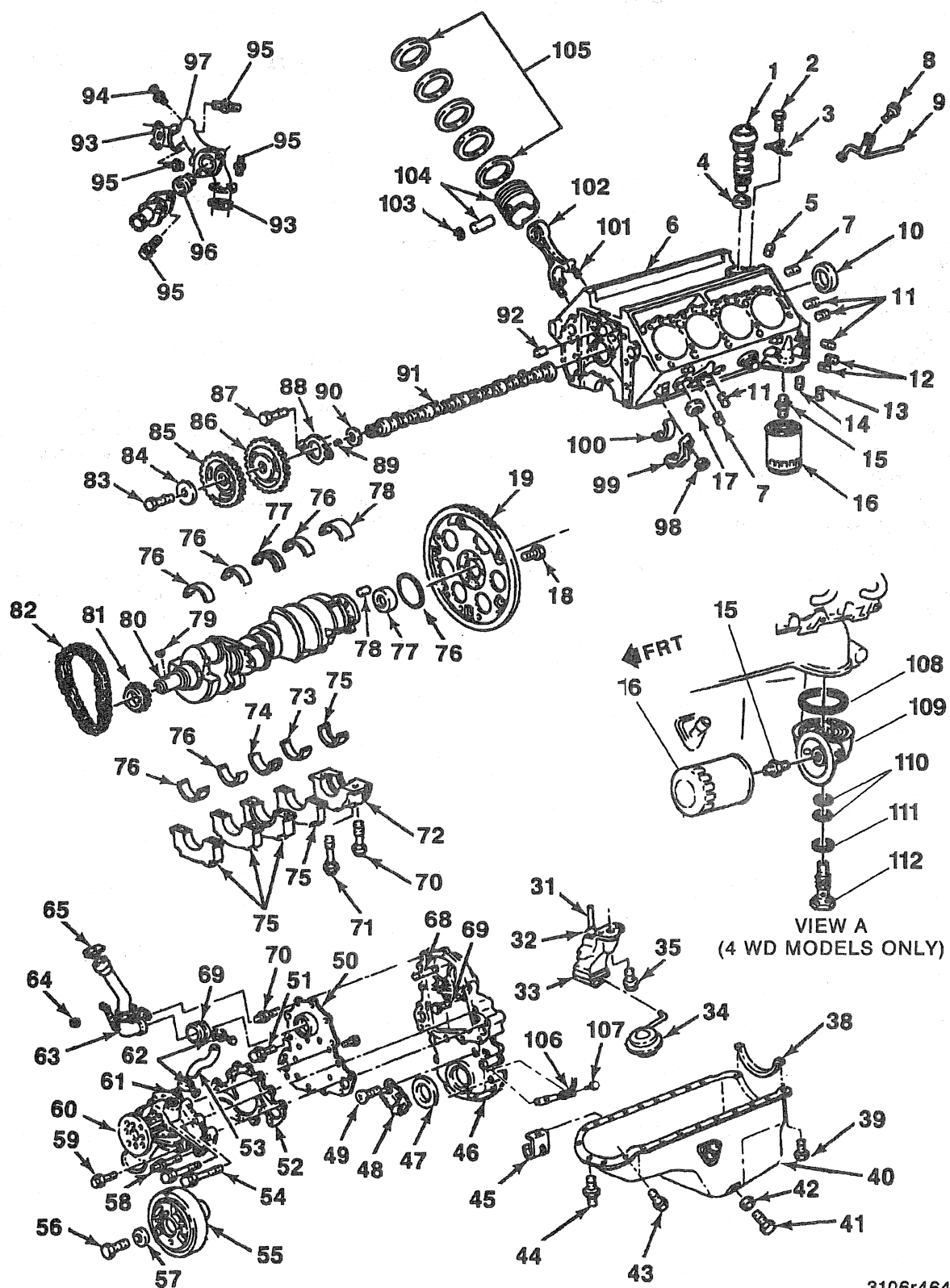
Pressurized oil is routed to the oil cooler located either inside of the radiator or in front of the radiator. A bypass valve is provided to protect the oil cooler from high oil pressures on cold start up. Oil flows from the cooler to a full-flow oil filter.

Oil flows from the oil filter to the oil galleries, providing pressurized lubrication to various components, including the turbocharger.

The hydraulic valve lifters receive oil from the oil galleries. Oil flows from the hydraulic lifters through hollow pushrods to the rocker arms. Oil from the heads drains back to the crankcase through oil drain holes.

The pistons, piston rings, cylinder walls, and connecting rod small end bearings are lubricated by oil splash.

The turbocharger is supplied oil from the right side lifter gallery through a braided steel line to the top of the center housing. The oil returns to the crankcase by a drain tube that goes from the turbocharger center housing to the lower right hand side of the engine block.



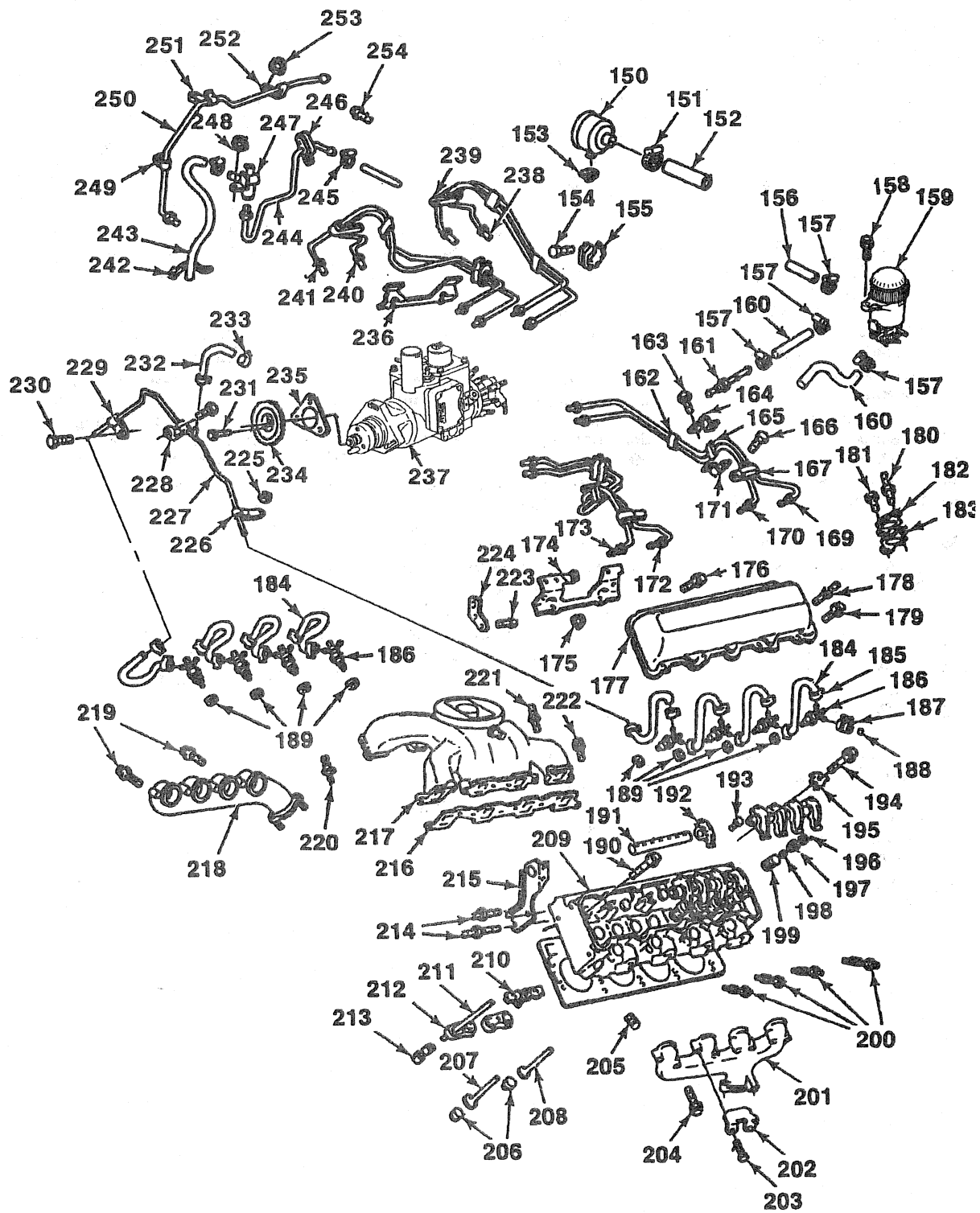
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Figure 1—Cylinder Block and Components

- |                                |  |  |
|--------------------------------|--|--|
| 1. Oil Pump Drive              | 51. Bolt                                   | 84. Camshaft Washer                          |
| 2. Bolt                        | 52. Coolant Plate Gasket                   | 85. Fuel Injection Drive Gear                |
| 3. Oil Pump Drive Clamp        | 53. Thermostat By-Pass Hose                | 86. Camshaft Sprocket                        |
| 4. Oil Pump Drive Gasket       | 54. Coolant Pump and Plate Bolt            | 87. Camshaft Bolt                            |
| 5. Oil Pressure Sensor Plug    | 55. Torsional Damper                       | 88. Camshaft Thrust Bearing                  |
| 6. Block                       | 56. Torsional Damper Bolt                  | 89. Camshaft Sprocket Key                    |
| 7. Plug                        | 57. Torsional Damper Bolt Washer           | 90. Camshaft Sprocket Spacer Ring            |
| 8. Bolt                        | 58. Coolant Pump Stud                      | 91. Camshaft                                 |
| 9. Fuel Drain Tube             | 59. Coolant Pump Bolt                      | 92. Oil Galley Hole Plug                     |
| 10. Rear Camshaft Bearing Plug | 60. Coolant Pump                           | 93. Coolant Crossover Gasket                 |
| 11. Plug                       | 61. Thermostat By-Pass Nipple              | 94. Glow Plug Inhibit Switch                 |
| 12. Oil Cooler Line Plug       | 62. Clamp                                  | 95. Coolant Crossover Stud                   |
| 13. Oil Cooler Plug            | 63. Oil Fill Tube                          | 96. Thermostat                               |
| 14. Main Galley Hole Plug      | 64. Nut                                    | 97. Coolant Crossover and Thermostat Housing |
| 15. Oil Filter Connector       | 65. Oil Filler Cap                         | 98. Connecting Rod Nut                       |
| 16. Oil Filter (PF35)          | 66. Oil Separator Grommet                  | 99. Connecting Rod Bearing Cap               |
| 17. Coolant Jacket Plug        | 67. Coolant Pump and Plate Stud            | 100. Connecting Rod Bearing                  |
| 18. Flywheel Bolt              | 68. Fuel Injection Pump Stud               | 101. Connecting Rod Bolt                     |
| 19. Flywheel                   | 69. Bolt                                   | 102. Connecting Rod                          |
| 31. Oil Pump Shaft             | 70. Crankshaft Bearing Cap Bolt (Outboard) | 103. Piston Pin Retainer                     |
| 32. Retainer                   | 71. Crankshaft Bearing Cap Bolt (Inboard)  | 104. Piston and Pin                          |
| 33. Oil Pump                   | 72. Crankshaft Bearing Cap                 | 105. Rings                                   |
| 34. Oil Pump Screen            | 73. Crankshaft Bearings                    | 106. Crankshaft Sensor                       |
| 35. Oil Pump and Screen Bolt   | 74. Crankshaft Bearing (Thrust)            | 107. Bolt                                    |
| 36. Clutch Housing (W/JF9)     | 75. Crankshaft Bearing (Rear)              | 108. Oil Filter Adapter Seal                 |
| 37. Clutch Housing Bolt        | 76. Crankshaft Rear Oil Seal (One Piece)   | 109. Oil Filter Adapter                      |
| 38. Rear Oil Pan Seal          | 77. Clutch Pilot Bearing                   | 110. Oil Filter Adapter O – Ring Seals       |
| 39. Bolt                       | 78. Flywheel Dowel Pin                     | 111. Oil Filter Adapter Gasket               |
| 40. Oil Pan                    | 79. Crankshaft Sprocket Key                | 112. Oil Filter Adapter Bolt                 |
| 41. Oil Pan Drain Plug         | 80. Crankshaft                             | 63 N·m (47 Lbs. Ft.)                         |
| 42. Oil Pan Drain Plug Gasket  | 81. Crankshaft Sprocket                    |  |
| 43. Oil Pan Bolt               | 82. Camshaft Timing Chain                  |  |
| 44. Oil Pan Stud               | 83. Camshaft Bolt                          |  |
| 45. Oil Cooler Pipe Stud       |  |  |
| 46. Front Crankcase Cover      |  |  |
| 47. Crankcase Front Oil Seal   |  |  |
| 48. Timing Pointer             |  |  |
| 49. Timing Pointer Screw       |  |  |
| 50. Coolant Pump Backing Plate |  |  |

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Figure 2—Cylinder Block and Components -Legend



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Figure 3—Cylinder Head, Manifolds, and Components

- |   |   |                               |
|---|---|-------------------------------|
| 150. Crankcase Depression Regulator Valve (CDR) | 196. Valve Stem Key                             | 240. Fuel Injection Pipe (#4) |
| 151. Clamp                                      | 197. Exhaust Valve Rotator                      | 241. Fuel Injection Pipe (#2) |
| 152. Hose (CDR)                                 | 198. Exhaust Valve Seal                         | 242. Plastic Retainer         |
| 153. Grommet (CDR)                              | 199. Valve Spring                               | 243. Fuel Evaporation Hose    |
| 154. Fuel Injection Clamp Bolt                  | 200. Glow Plugs                                 | 244. Water Drain Hose         |
| 155. Fuel Injection Pipe Clamp                  | 201. Exhaust Manifold L.H.                      | 245. Clamp                    |
| 156. Fuel Filter Inlet Hose                     | 202. Dipstick Tube Shield                       | 246. Water Drain Pipe Insert  |
| 157. Clamp                                      | 203. Exhaust Manifold Bolt                      | 247. Water Drain Valve        |
| 158. Fuel Filter Bolt                           | 204. Exhaust Manifold Bolt                      | 248. Nut                      |
| 159. Fuel Filter Assembly                       | 205. Coolant Temperature Switch Hole Plug       | 249. Fuel Inlet Pipe Clip     |
| 160. Fuel Filter Outlet Hose                    | 206. Prechamber                                 | 250. Fuel Filter Inlet Tubing |
| 161. Fuel Filter Outlet Tubing                  | 207. Intake Valve                               | 251. Fuel Pipe Clip           |
| 162. Fuel Injection Pipe Insert                 | 208. Exhaust Valve                              | 252. Fuel Pipe Clip           |
| 163. Bolt                                       | 209. Cylinder Head                              | 253. Nut                      |
| 164. Fuel Injection Pipe Clip                   | 210. Hydraulic Valve Lifter Guide Clamp (Upper) | 254. Bolt                     |
| 165. Fuel Injection Pipe Insert                 | 211. Push Rod                                   |                               |
| 166. Bolt                                       | 212. Hydraulic Valve Lifter Guide Plate (Upper) |                               |
| 167. Fuel Injection Pipe Clip                   | 213. Valve Lifter                               |                               |
| 169. Fuel Injection Pipe (#7)                   | 214. Engine Lifting Studs                       |                               |
| 170. Fuel Injection Pipe (#5)                   | 215. Front Engine Lifting Bracket               |                               |
| 171. Fuel Injection Pipe Clip                   | 216. Intake Manifold Gasket                     |                               |
| 172. Fuel Injection Pipe (#3)                   | 217. Intake Manifold                            |                               |
| 173. Fuel Injection Pipe (#1)                   | 218. Exhaust Manifold R.H.                      |                               |
| 174. Fuel Injection Pipe L.H. Bracket           | 219. Exhaust Manifold Bolts                     |                               |
| 175. Nut  | 220. Cold Advance Temperature Switch            |                               |
| 176. Rocker Cover Bolt                          | 221. Intake Manifold Stud                       |                               |
| 177. Rocker Arm Cover L.H.                      | 222. Intake Manifold Bolt                       |                               |
| 178. Rocker Arm Cover Stud                      | 223. Rear Engine Lift Bracket Bolt              |                               |
| 179. Rocker Arm Cover Bolt                      | 224. Rear Engine Lift Bracket                   |                               |
| 180. Coolant Crossover Stud                     | 225. Fuel Drain Back Pipe Clip Nut              |                               |
| 181. Cylinder Head Coolant Jacket Cover Bolt    | 226. Fuel Drain Back Pipe Clip                  |                               |
| 182. Cylinder Head Coolant Jacket Cover         | 227. Fuel Drain Back Pipe                       |                               |
| 183. Cylinder Head Coolant Jacket Gasket        | 228. Fuel Drain Back Pipe Clip                  |                               |
| 184. Fuel Drain Back Hose                       | 229. Fuel Drain Back Pipe Clip                  |                               |
| 185. Clamp                                      | 230. Bolt                                       |                               |
| 186. Injection Nozzle                           | 231. Fuel Injection Pump Driven Gear            |                               |
| 187. Clamp                                      | 232. Fuel Drain Back Hose                       |                               |
| 188. Fuel Injector Nozzle Cap                   | 233. Clamp                                      |                               |
| 189. Injection Nozzle Gaskets                   | 234. Fuel Injection Pump Driven Gear            |                               |
| 190. Cylinder Head Bolt                         | 235. Fuel Injection Pump Gasket                 |                               |
| 191. Rocker Arm Shaft                           | 236. Fuel Injection Pipe Bracket L.H.           |                               |
| 192. Rocker Arm                                 | 237. Fuel Injection Pump                        |                               |
| 193. Rocker Arm Retainer                        | 238. Fuel Injection Pipe (#8)                   |                               |
| 194. Rocker Arm Shaft Bolt                      | 239. Fuel Injection Pipe (#6)                   |                               |
| 195. Rocker Arm Shaft Retainer                  |   |                               |

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Figure 4—Cylinder Head, Manifolds, and Components - Legend

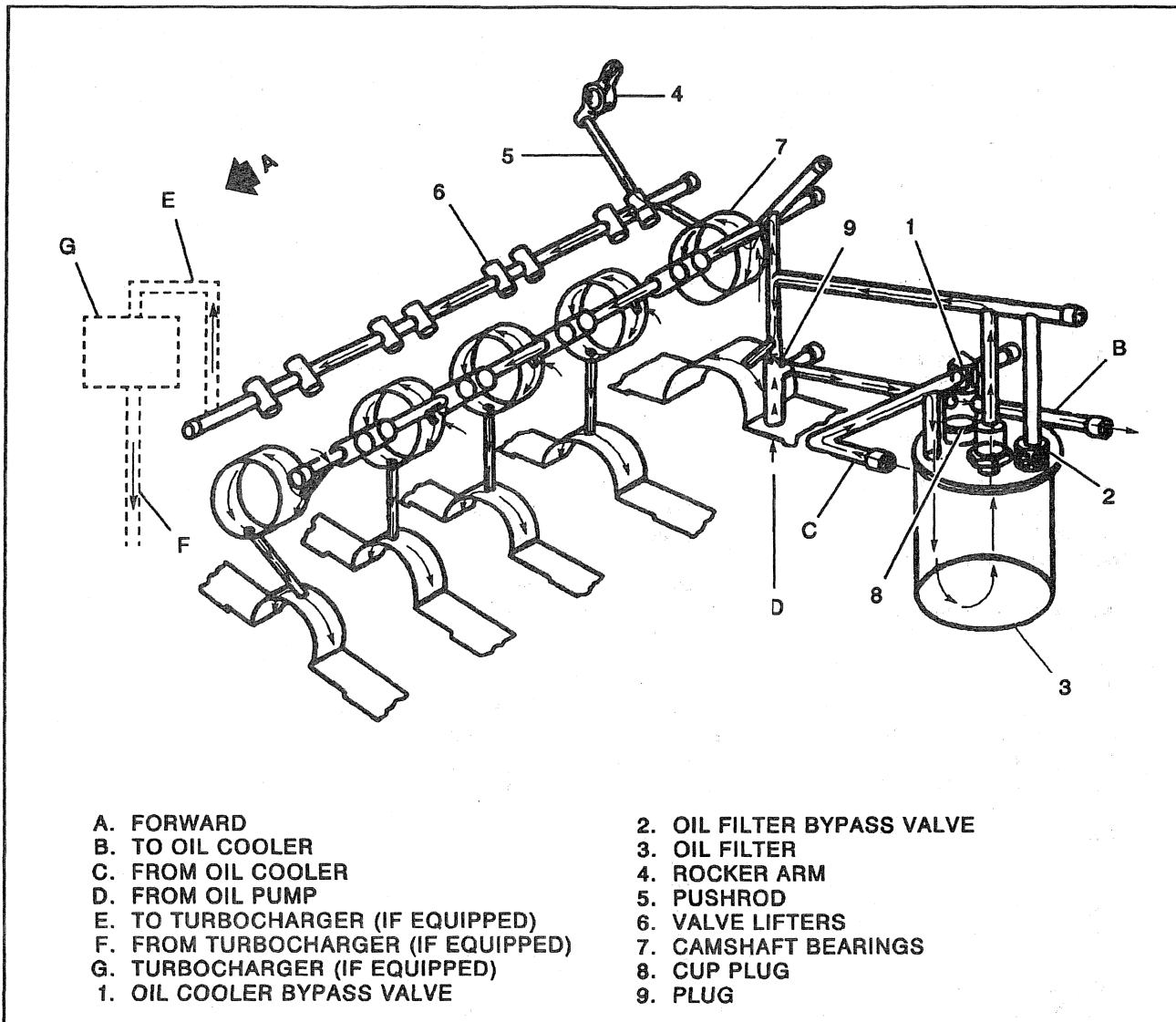


Figure 5—Lubrication Diagram

## ON-VEHICLE SERVICE

### INTAKE MANIFOLD REPLACEMENT

#### Remove or Disconnect (Figure 6 and 7)

Tool Required:

J 29664 Manifold Cover Set

1. Negative battery cables. Refer to SECTION 0A.
2. Air cleaner.
3. Fuel filter. Refer to SECTION 6C.
4. Generator rear bracket.
5. EGR/Boost solenoids with bracket from the intake manifold studs.
6. CDR hose at the manifold.
7. EGR and crankcase ventilation hoses.
8. Fuel line bracket and ground straps.
9. Intake manifold bolts and fuel line clips.
10. Intake manifold and gasket.

#### Important

- If any further service work is to be done, cover the intake ports with tool J 29664-1.

#### Clean

- Gasket surfaces on intake manifold and cylinder heads.

#### Install or Connect (Figure 6 and 7)

#### Remove or Disconnect

- Tool J 29664-1 from the intake ports.
- 1. New gaskets.




**Important**

- Be sure to use the correct gasket. The gaskets for light duty emissions models have openings for the EGR, the gaskets for heavy duty emissions models do not.
2. Intake manifold.
  3. Intake manifold bolts/studs and fuel line clips. There are 4 bolts, numbers 9, 11, 13, and 15 exposed to the crankcase, and should be sealed with teflon sealer.


**Tighten**

- Intake manifold bolts to 42 N.m (31 lbs. ft.). Use the tightening sequence shown in figure 8.
4. Tool J 29664-2 from the mouth of the intake manifold.
  5. Fuel line bracket and ground straps.
  6. EGR and crankcase ventilation hoses.
  7. CDR hose.
  8. EGR/Boost solenoids with bracket.
  9. Generator rear bracket.
  10. Fuel filter. Refer to SECTION 6C.
  11. Air cleaner.
  12. Negative battery cable(s). Refer to SECTION 0A.

## EXHAUST MANIFOLD REPLACEMENT

### LEFT SIDE MANIFOLD


**Remove or Disconnect (Figure 9)**

1. Negative battery cable(s). Refer to SECTION 0A.
  - Raise the vehicle and support with safety stands.
2. Engine oil cooler line clip and bracket.
3. Exhaust pipe from the manifold.
4. Exhaust manifold bolts.
5. Exhaust manifold from under the vehicle.

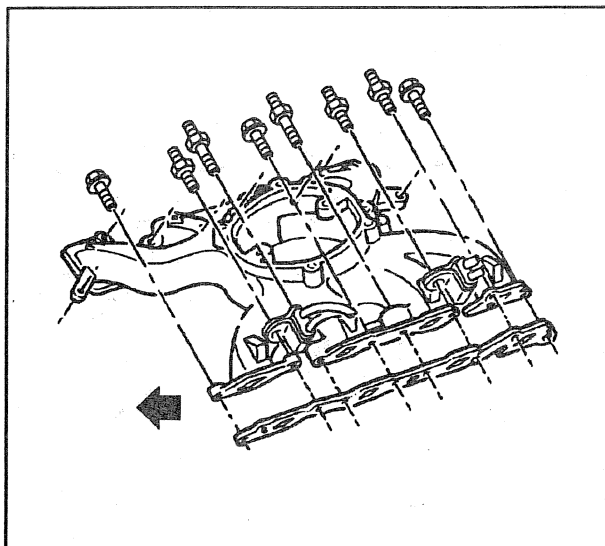


Figure 6—Intake Manifold Left Side

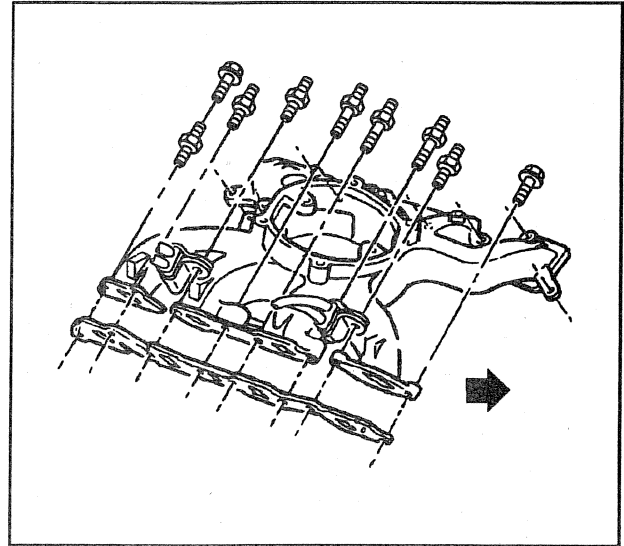


Figure 7—Intake Manifold Right Side


**Clean**

- Sealing surfaces on exhaust manifold and cylinder head.
- Threads on manifold bolts.


**Install or Connect (Figure 9)**

1. Exhaust manifold from under the vehicle.
2. Exhaust manifold bolts.


**Tighten**

- Bolts to 35 N.m (26 lbs. ft.).
3. Exhaust pipe to the manifold.
    - Lower the vehicle.
  4. Engine oil cooler line and bracket.
  5. Negative battery cable(s).

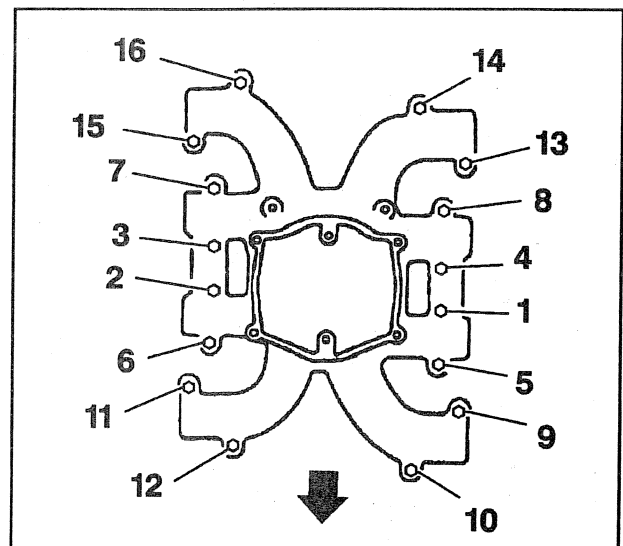


Figure 8—Intake Manifold Torque Sequence

### RIGHT SIDE MANIFOLD

#### Remove or Disconnect (Figures 10 or 11)

1. Negative battery cables. Refer to SECTION 0A.
  - Raise the vehicle and support with safety stands.
2. Exhaust pipe from the manifold.
3. Glow plug wires using tool J 39083.
  - Lower the vehicle.
4. Turbocharger assembly (if used). Refer to SECTION 6J.
5. Exhaust manifold bolts.
6. Glow plug wires and shields.
7. Exhaust manifold.

#### Clean

- Sealing surfaces on the exhaust manifold and cylinder head.
- Threads on the exhaust manifold bolts.

#### Install or Connect (Figures 10 or 11)

1. Exhaust manifold and bolts.

#### Tighten

- Bolts to 35 N·m (26 lbs. ft.)
2. Glow plug wires and shield.
  3. Turbocharger assembly if equipped. Refer to SECTION 6J.
    - Raise the vehicle and support with safety stands.
  4. Glow plug wires using tool J 39083.
  5. Exhaust pipe to the manifold.
    - Lower the vehicle.
  6. Negative battery cables.

## ROCKER ARM COVER REPLACEMENT

#### Remove or Disconnect

1. Intake manifold. Refer to "Intake Manifold Replacement."
2. Fuel injection lines. Refer to SECTION 6C2. (Injection lines for #5 and #7 cylinders do not have to be removed for right side rocker arm cover replacement).
3. CDR valve (right side cover).
4. Dipstick tube (left side cover).
5. Fuel return line clip at the cover stud.
6. Wiring harness at the rear of the cover from the clips and move aside.
7. Rocker arm cover bolts.

**NOTICE:** Do not pry on the rocker arm cover. Damage to sealing surfaces may result. Use a block of wood against the side of rocker cover and strike with a hammer in a side-ways direction to shear RTV sealant.

8. Rocker arm cover.

#### Clean

- RTV from the rocker arm cover and cylinder head. All loose RTV or pieces that will cause installation interference must be removed.
- Oil and grease from the sealing surfaces on the rocker arm cover and cylinder head. Use a suitable solvent.

#### Inspect

- Rocker arm cover sealing flanges for distortion. Replace as necessary.

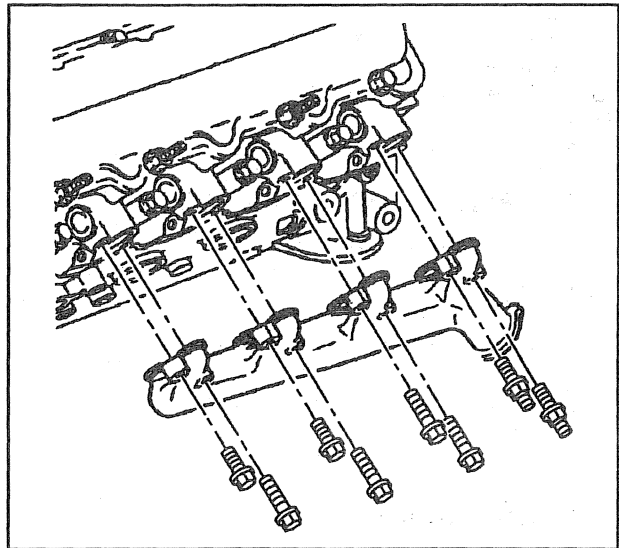


Figure 9—Exhaust Manifold Left Side

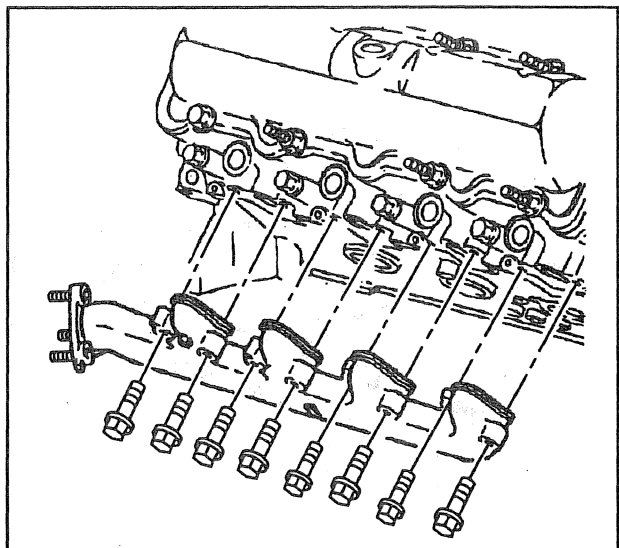


Figure 10—Exhaust Manifold Right Side (L49)

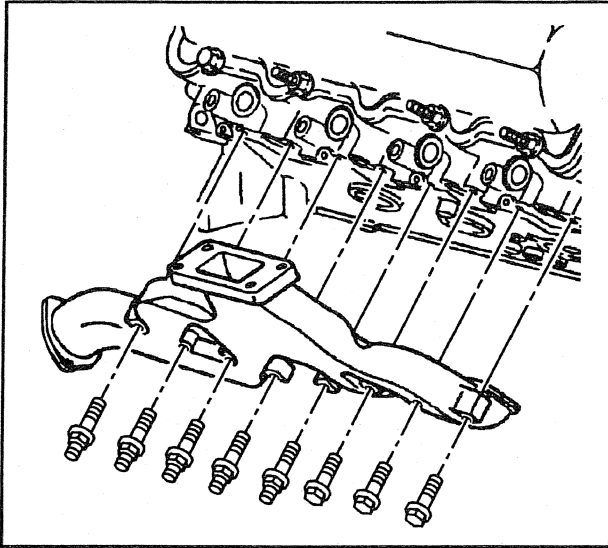


Figure 11—Exhaust Manifold Right Side (L56,L65)

→← Install or Connect (Figure 12)

**NOTICE:** Do not allow RTV sealant to enter the rocker arm cover bolt holes. This may cause a "hydraulic lock" condition when the bolts are tightened, damaging the cylinder head casting.

- Apply a 5-mm (3/16-inch) bead of RTV sealant (GM P/N 12345739) to the rocker arm covers, inboard of the bolt holes. Refer to figure 12. The sealer must be wet to the touch when the bolts are tightened.

1. Rocker arm cover.
2. Rocker arm cover bolts.

⊞ Tighten

- Bolts to 22 N.m (16 lbs. ft.).

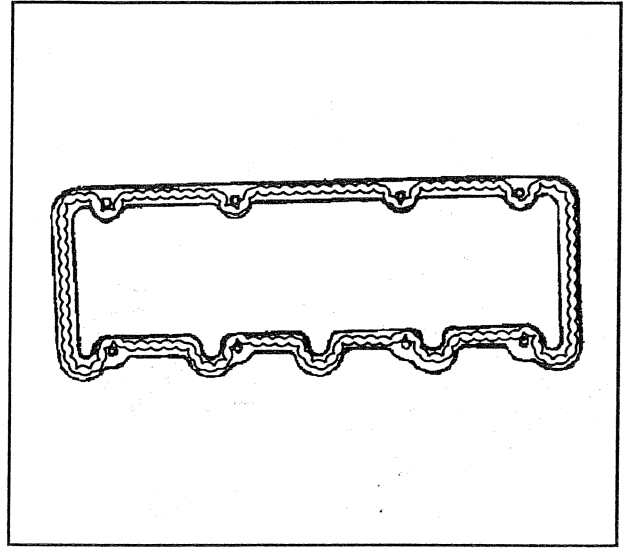


Figure 12—Applying Sealant to the Rocker Arm Cover

3. Wiring harness.
4. Fuel return clips.
5. Dipstick tube (left side cover).
6. CDR valve (right side cover).
7. Intake manifold. Refer to "Intake Manifold Replacement."
8. Fuel injection lines. Refer to SECTION 6C2.

## ROCKER ARM SHAFT, ROCKER ARMS, AND PUSHROD REPLACEMENT

→← Remove or Disconnect (Figure 13 and 14)

1. Rocker arm cover. Refer to "Rocker Arm Cover Replacement."
2. Rocker arm shaft bolts.

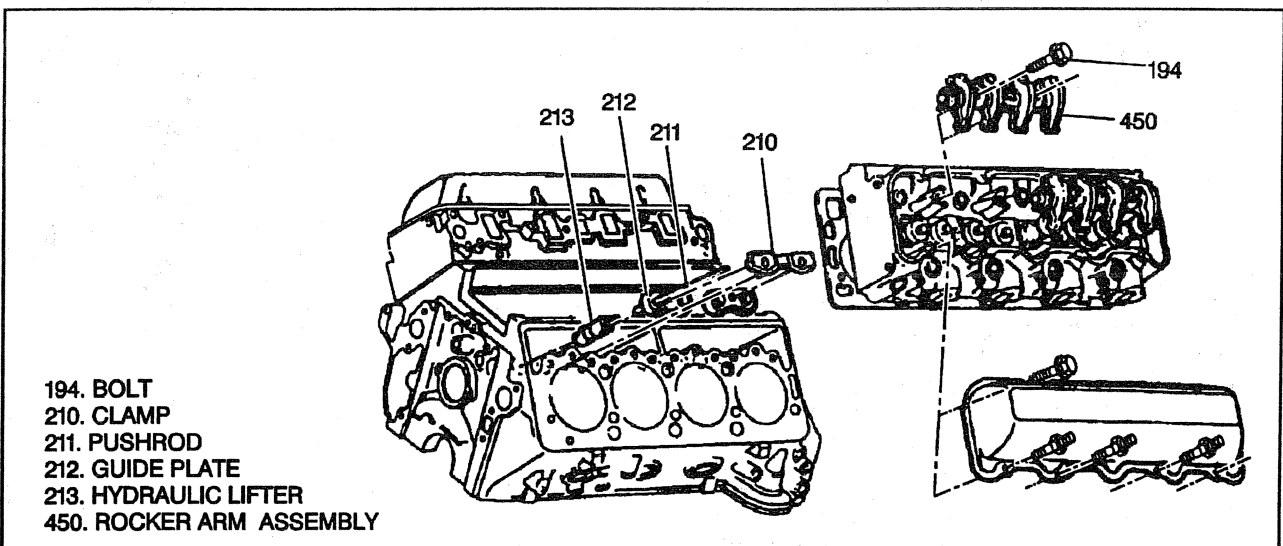
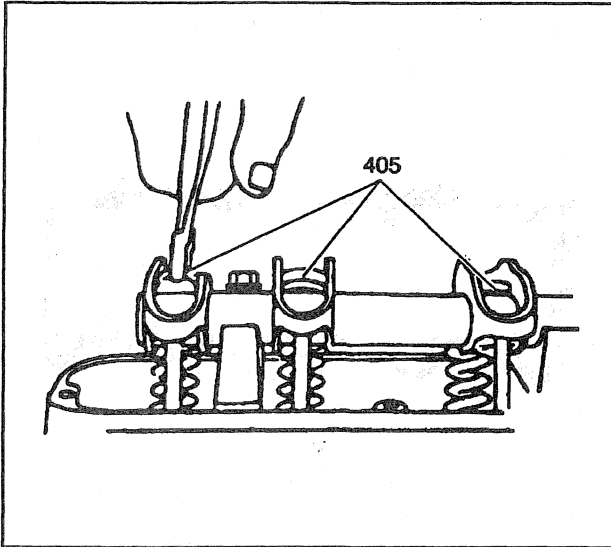


Figure 13—Valve Train Components



**Figure 14—Removing the Rocker Arm Retainers**

**NOTICE:** Store and mark all valve train components in an exact order so they may be reassembled in the same position from which they were removed.

3. Rocker arm shaft with rocker arms.
4. Pushrods.

**! Important**

- The pushrods must be installed in the original direction at assembly. This is because the pushrods have a different degree of hardness at each end. A paint stripe identifies the upper end of the pushrod. If the paint stripe is not visible, mark the pushrods on the upper end as they are removed.

5. Rocker arms, if required.

- A. Insert a screwdriver into the rocker arm shaft bore and break off the end of the nylon rocker arm retainers.
- B. Remove the rocker arm retainers with pliers.
- C. Slide the rocker arms from the shaft.

**🔍 Inspect**

- Rocker arms and shafts at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.
- Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.
- Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.
- Ends of the pushrods for scoring or roughness.
- Hydraulic lifter guide plates and clamps for damage.
- Oil passages in the pushrods for obstructions. Pushrod oil passages must be clean.

**↔ Install or Connect (Figure 15)**

**NOTICE:** All valve train components must be reassembled in the exact order and position from which they were removed.

1. Rocker arms to the rocker arm shaft. One type of rocker arm is used at all locations.

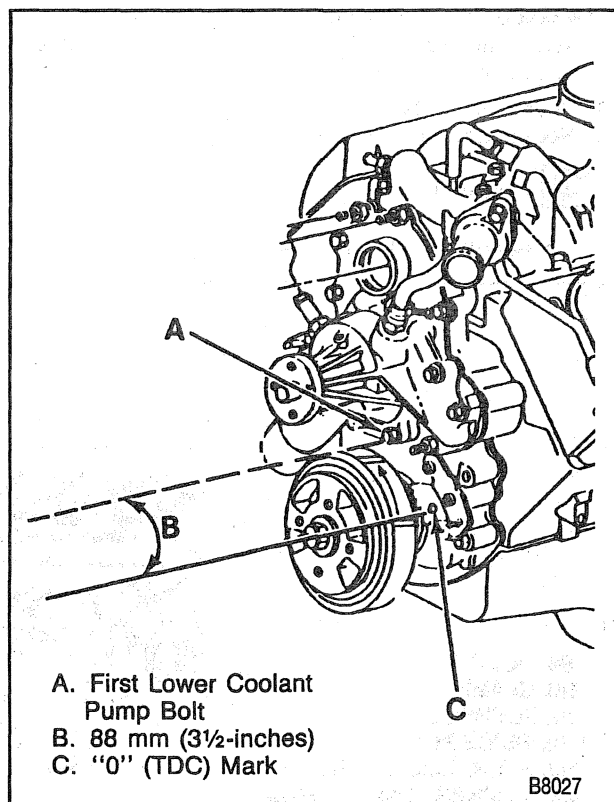
**! Important**

- Lubricate the rocker arms with engine oil before installing.
2. Rocker arm retainers.
    - Center the rocker arms on the corresponding holes in the rocker arm shaft.
    - Install new retainers. Use a drift at least 13 mm (1/2 inch) in diameter.

**NOTICE:** The pushrods must be installed with the marked or painted end up. Failure to do so may result in damage or premature wear.

3. Pushrods, with the painted or marked end up.
4. Rocker arm shaft assembly. Make sure the ball ends of the pushrods seat in the rocker arms.

**NOTICE:** Improper installation of the rocker arm shaft bolts may cause rocker arm shaft breakage and/or piston to valve contact.



**Figure 15—Aligning the Timing Mark**

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5. Rocker arm shaft bolts.

- A. Rotate the engine until the mark on the torsional damper aligns with the "O" mark on the timing tab.
- B. Rotate the engine to the left 88 mm (3 1/2 inch), measured at the torsional damper. This measurement can be estimated by aligning the torsional damper mark with the first lower coolant pump bolt (figure 15). This procedure will position the engine so no pistons are close to the valves.
- C. Install the bolts finger tight.



**Tighten**

- Bolts alternately to 55 N·m (40 lbs. ft.). Rotate engine by hand to ensure free movement of the valve train.

6. Rocker arm cover. Refer to "Rocker Arm Cover Replacement."

## HYDRAULIC LIFTER REPLACEMENT



**Remove or Disconnect (Figure 13)**

1. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."
2. Rocker arm shaft with rocker arms and pushrods. Refer to "Rocker Arm Shaft, Rocker Arm, and Pushrod Replacement."



**Important**

- Rocker arm assemblies and pushrods must be marked for proper assembly.
3. Clamps.
  4. Guide plates. Use mechanical fingers, if necessary.
  5. Hydraulic lifters, through the access hole in the cylinder head. Use a stick magnet. Place the lifters in an organizer rack. The lifters must be installed in the same bores from which they were removed.



**Inspect**

- Hydraulic lifter body for scuffing and scoring. Replace the lifter if present.
- Roller for looseness and excessive play. Check for missing or broken needle bearings. Replace if necessary.
- Roller surface for pits and roughness. If present, the mating camshaft lobe should also be checked. If the lobe is pitted or rough, replace the camshaft and lifter.

### HYDRAULIC LIFTER REPAIR

- Refer to SECTION 6A7 in the Light Duty Truck Unit Repair Manual.



**Important**

- Some engines will have both standard and 0.010 inch oversize hydraulic lifters. The oversize lifter will have a "10" etched on the side. The block will

be stamped "O.S." on the cast pad adjacent to the lifter bore and on the top rail of the cylinder case above the lifter bore.



**Install or Connect (Figure 13)**

**NOTICE: New hydraulic lifters must be primed before installation. Damage to the lifters may result if dry when the engine is started.**

1. Hydraulic lifters to the engine. Fabricate an installation tool from mechanic's wire.



**Important**

- Prime new hydraulic lifters before installation by working the lifter plunger while submerged in clean kerosene or diesel fuel.
- Coat the lifter roller and bearings with lubricant (GM P/N 1052365) or equivalent.
- Lifters MUST be installed in their original locations.

2. Guide plates.
3. Clamps.



**Tighten**

- Clamp bolt to 26 N·m (18 lbs. ft.).



**Important**

- After all clamps are installed, turn the crankshaft by hand two full revolutions, to ensure free movement of the lifters in the guide plates. If the engine will not turn over by hand, one or more of the lifters may be binding in the guide plate.
4. Rocker arm shaft with rocker arms and pushrods in their original locations. Refer to "Rocker Arm Shaft, Rocker Arm, and Pushrod Replacement." Hardened ends of the pushrods must face up.
  5. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."

## VALVE STEM SEAL AND VALVE SPRING REPLACEMENT



**Remove or Disconnect (Figures 16 and 17)**

**Tools Required:**

- J 26999-10 Air Line Adapter
- J 26999-30 Air Line Adapter (K models with quad front shocks)
- J 38606 Valve Spring Compressor

1. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."
2. Rocker arm shaft with rocker arms. Refer to "Rocker Arm Shaft, Rocker Arms, and Pushrod Replacement." Mark the assemblies so they can be returned to their original locations.
3. Glow plugs.
4. Valve keepers.

- A. Rotate the engine until the piston for the cylinder being serviced is at TDC.
- B. Install tool J 26999-10 (C and K models) or tool J 26999-30 (K models with quad front shocks) into the glow plug hole.
- C. Apply compressed air to hold the valves in place. If the compressed air is removed the valves can drop into the cylinder.
- D. Use tool J 38606 to compress the valve spring (figure 17). If the spring will not compress, tap on the tool lightly with a mallet to break the cap or rotator loose from the valve keepers.

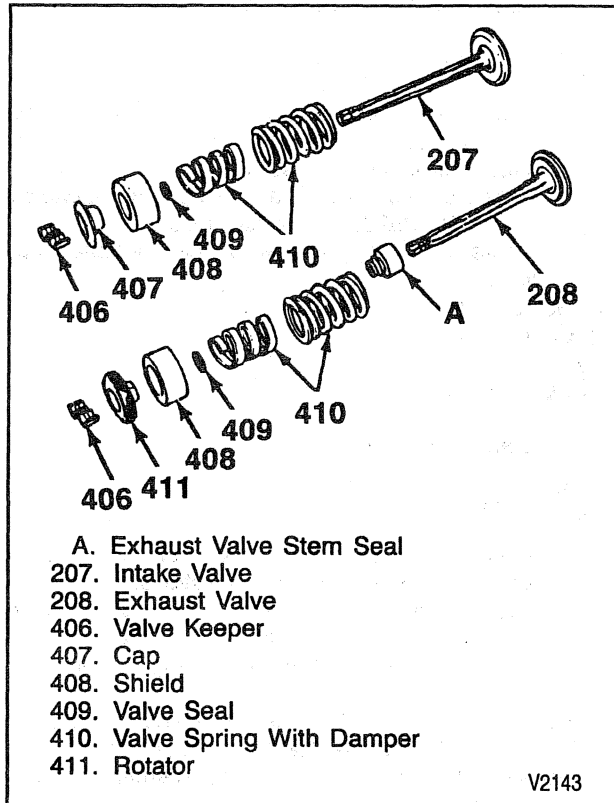


Figure 16—Valves and Components

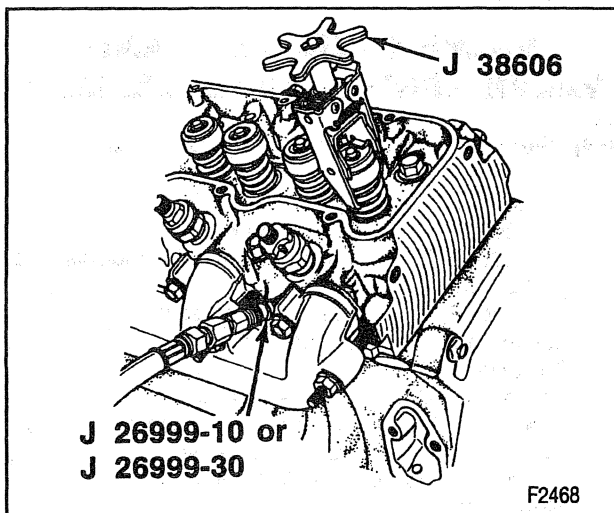


Figure 17—Compressing the Valve Spring

- E. Remove the valve keepers.
- F. Carefully release spring tension. Remove tool J 38606.

5. Cap or rotator, shield, and valve spring with damper.
6. Valve seals.

## Install or Connect (Figures 16 and 17)

**NOTICE:** Air pressure should remain applied to the cylinder for installation.

1. New valve seals.
2. Valve spring with damper, shield, and cap or rotator.
3. Valve keepers.
  - A. Install the valve keepers. Use grease to hold them in place.
  - B. Carefully release spring pressure. Make sure the valve keepers stay in place.
  - C. Remove tool J 38606 and tool J 26999-10 or tool J 29666-30.
4. Glow plugs.
5. Rocker arm shaft with rocker arms. Refer to "Rocker Arm Shaft, Rocker Arms and Pushrod Replacement."
6. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."

## CYLINDER HEAD REPLACEMENT

### Remove or Disconnect

Tool Required:

J 39083 Glow Plug Connector Remover/Installer

1. Intake manifold. Refer to "Intake Manifold Replacement."
2. Injection lines. Refer to SECTION 6C2.
3. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."
4. Drain the cooling system.
  - Raise the vehicle and support with safety stands.
5. Exhaust pipe from the manifold.
  - Lower the vehicle.
6. Components as follows for right cylinder head.
  - Air conditioning compressor with bracket and lay aside.
  - Vacuum pump (if equipped) with bracket and lay aside.
  - Ground strap at the cowl.
  - Turbocharger. Refer to SECTION 6J.
7. Components as follows for left cylinder head:
  - Power steering pump and lay aside.
  - Generator and rear bracket and lay it aside.
  - Left side engine accessory bracket.
  - Wiring harness at the clips and move aside.
  - Glow plug relay.
  - Dipstick tube.
8. Wire from the coolant sensor at the cylinder head.

9. Glow plug wires. Use tool J 39083 to disconnect the glow plug connectors from the glow plugs on the right hand cylinder head if equipped with turbo-charger. The connector cannot be reached with the hand. **Do not pull on the glow plug harness wire.**
10. Rocker arm assemblies and pushrods. Refer to "Rocker Arm Shaft, Rocker Arms, and Pushrod Replacement."

### ! Important

- Rocker arm assemblies and pushrods must be marked for proper assembly.

11. Radiator, bypass, and heater hoses.
12. Ground straps.
13. Coolant crossover pipe/thermostat housing assembly.
14. Exhaust manifold.
15. Cylinder head bolts. Rear bolt in left cylinder head may have to remain in the head during removal.
16. Cylinder head.

## CLEANING AND INSPECTION

### 🧼 Clean

- Carbon deposits from combustion chambers.
- All traces of old head gasket from cylinder head and block. Use of a motorized wire brush is not recommended.
- Cylinder head bolt threads using a wire brush.
- Metal chips and dirt from the threads in the block.

### 🔍 Inspect

- Cylinder head for cracks between the intake and exhaust ports. Use the magnaflux or dye method if available.
- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.
- Block for missing or damaged dowel pins or dowel pins in the wrong location.

### 📏 Measure

- Cylinder head warpage. If warped more than 0.15 mm (0.006 inch) longitudinally or 0.08 mm (0.003 inch) transversely, replace the cylinder head. Resurfacing is not recommended.
- Pre-chamber installed depth. The pre-chamber should be flush to a maximum of 0.05 mm (0.002 inch) protrusion.
  - Make the measurement at two or more points on the pre-chamber where the prechamber seats on the head gasket shield and sealing ring.
  - Measure the difference between the flat of the pre-chamber and the flat surface of the cylinder head.
  - The pre-chamber must not protrude out of the cylinder head more than 0.05 mm (0.002 inch).
  - The pre-chamber must not be recessed into the cylinder head.

## CYLINDER HEAD REPAIR

- Refer to the Light Duty Truck Unit Repair Manual for cylinder head repair.

### ↔ Install or Connect (Figure 18)

1. Head gasket to block over dowel pins.

### ! Important

- The block gasket surfaces must be clean.
  - **DO NOT** use a sealer on the head gasket. The head gasket is manufactured with the proper amount of sealant "printed" on its surface. Additional sealer may cause leakage or malfunction. In addition, some sealers may attack the sealant already on the head gasket.
2. Rear cylinder head bolt to the cylinder head (left cylinder head). Apply sealant to the bolt as described in step 4. Due to clearances, the bolt must be installed at this time.
  3. Cylinder head. Make sure the gasket surfaces are clean. Guide the head carefully into place over the dowel pins.
  4. Cylinder head bolts.
    - A. Make sure the bolt threads are clean.
    - B. Apply sealant (GM P/N 9985283) or equivalent to the bolt threads and under the bolt heads.

### 🔩 Tighten

- Cylinder head bolts, as follows:
  - A. Using the sequence shown in figure 18, tighten all bolts to 25 N.m (20 lbs. ft.).
  - B. In sequence, tighten all bolts to 65 N.m (50 lbs. ft.).
  - C. Repeat step B, tighten all bolts to 65 N.m (50 lbs. ft.).
  - D. In sequence, tighten all bolts an additional 90 to 100 degrees (1/4 + turn).
- 5. Coolant crossover pipe/thermostat assembly. Use new gaskets.

### 🔩 Tighten

- Bolts to 42 N.m (31 lbs. ft.).
6. Ground strap.
  7. Radiator, bypass, and heater hoses.

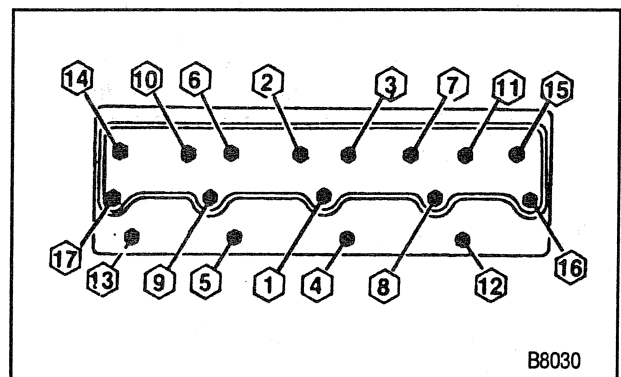


Figure 18—Head Bolt Tightening Sequence

8. Pushrods and rocker arm assemblies, in their original locations, refer to "Rocker Arm Shaft, Rocker Arms, and Pushrod Replacement." Hardened ends of the pushrods must face up.
9. Glow plug wires. Use tool J 39083 to connect the glow plug connectors to the glow plugs.
10. Wire from the coolant sensor at the cylinder head.
11. Components as follows for right cylinder head.
  - Air conditioning compressor with bracket.
  - Ground strap at the cowl.
  - Turbocharger. Refer to SECTION 6J.
12. Components as follows for left cylinder head:
  - Power steering pump.
  - Generator and rear bracket.
  - Left side engine accessory bracket.
  - Wiring harness at the clips.
  - Glow plug relay.
  - Dipstick tube.
- Raise the vehicle and support with safety stands.
13. Exhaust pipe to the manifold.
  - Lower the vehicle.
14. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."
15. Injection lines. Refer to SECTION 6C2.
16. Intake manifold. Refer to "Intake Manifold Replacement."
  - Fill the cooling system with the proper quantity and grade of coolant.

## OIL PUMP DRIVE REPLACEMENT

**NOTICE:** Do not run the engine without the oil pump drive in place. This will cause extensive engine damage.

### Remove or Disconnect (Figure 19)

1. Negative battery cables. Refer to SECTION 0A.
2. Air cleaner.
3. Fuel filter from the intake manifold.
4. Move the wiring harness aside.
5. Bolt and clamp.
6. Oil pump drive.
7. Gasket.

### Install or Connect (Figure 19)

1. New gasket to the oil pump drive.
2. Oil pump drive to the engine. Index the drive with the camshaft gear and oil pump drive shaft. Make sure the drive seats fully.
3. Clamp and bolt.

### Tighten

- Bolt to 42 N·m (31 lbs. ft.).
4. Wiring harness.
  5. Fuel filter.
  6. Air cleaner.
  7. Negative battery cables.

## TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

### Remove or Disconnect (Figures 20 and 21)

Tool Required:

J 39046 Torsional Damper Puller

1. Negative battery cables. Refer to SECTION 0A.
2. Accessory drive belt.
3. Bolts and crankshaft pulley.
4. Torsional damper bolt and washer.
5. Torsional damper. Use tool J 39046 (figure 20).
6. Front crankshaft seal. Pry out with a screwdriver.

### Install or Connect (Figure 21)

Tool Required:

J 22102 Seal Installer

1. New front crankshaft seal. Use tool J 22102 (figure 21). Lubricate the seal lips with engine oil.
- Apply engine oil to the crankshaft stub.

### Inspect

- Torsional damper sealing surface for grooving or roughness. Replace if necessary.
2. Torsional damper. Tap into place with a mallet. Make sure the key is in place. Make sure the damper is all the way on the crankshaft.
  3. Torsional damper bolt and washer.

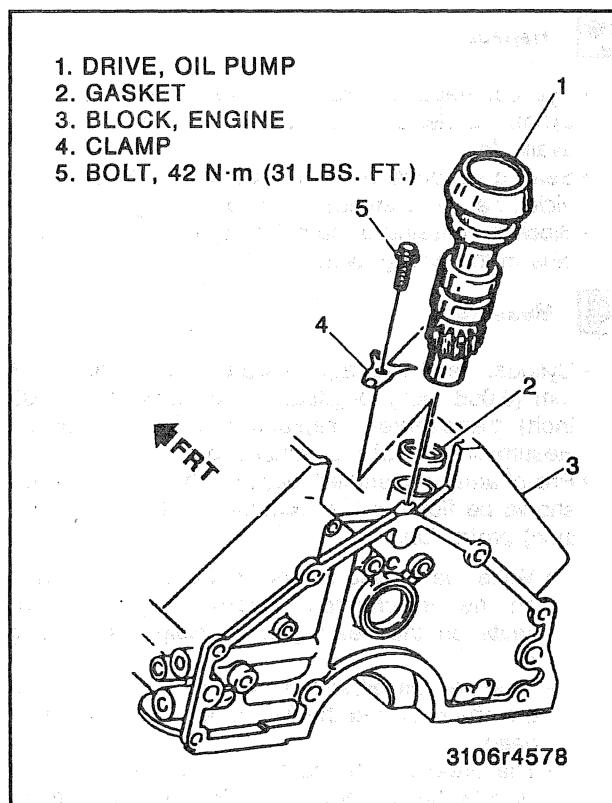


Figure 19—Oil Pump Drive





### Tighten

- Bolt to 270 N.m (200 lbs. ft.).
4. Crankshaft pulley and bolts.



### Tighten

- Bolts to 40 N.m (30 lbs. ft.).
5. Accessory drive belt.  
6. Negative battery cables.

## FRONT COVER REPLACEMENT



### Remove or Disconnect (Figures 22 and 23)

**NOTICE:** If the timing chain, timing gears, front cover, crankshaft position sensor, crankshaft or other component(s) affecting timing are replaced, it will be necessary to reprogram TDC Offset into the PCM. Refer to the appropriate Driveability, Emissions and Electrical Diagnosis Manual. (L49 VIN P, L56 VIN S, L65 VIN F only)

1. Drain the cooling system.
2. Coolant pump. Refer to SECTION 6B.
  - Rotate the engine until the timing marks on the pump gear and camshaft gear are aligned (figure 23).
3. Torsional damper. Refer to "Torsional Damper and Front Crankshaft Seal Replacement."
4. Crankshaft position sensor.
5. Four front cover to oil pan bolts.
6. Two fuel return line clips.
7. Injection pump gear.
8. Injection pump retaining nuts at the front cover.
9. Front cover bolts.
10. Front cover from the injection pump and engine.
11. Front crankshaft seal. Pry out with a screwdriver.



### Clean

- RTV from oil pan sealing surface.
- Sealing surfaces on front cover.

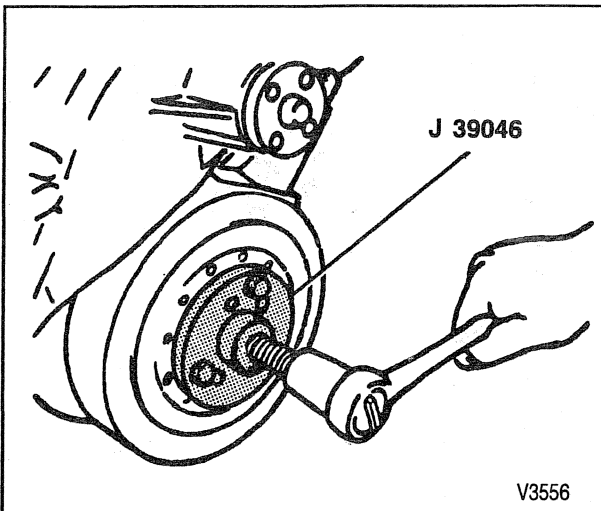


Figure 20—Removing the Torsional Damper

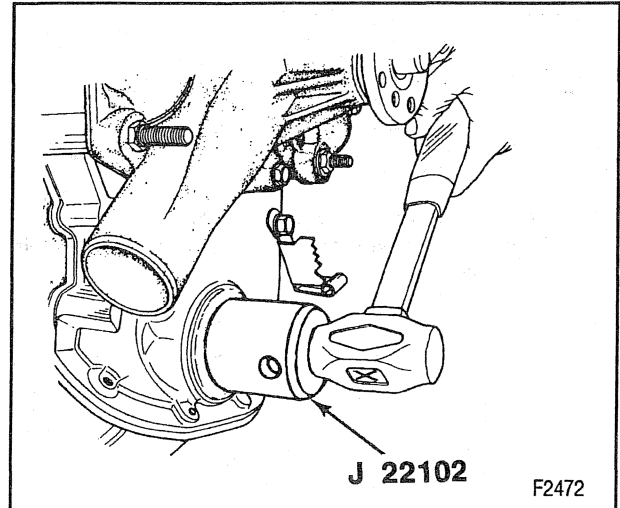


Figure 21—Installing the Front Crankshaft Seal



### Inspect

- Front cover for cracks or damage to sealing surfaces.



### Install or Connect (Figures 21, 22 and 23)

#### Tool Required:

#### J 22102 Seal Installer

1. New front crankshaft seal to the front cover. Use tool J 22102 (figure 21)
  - Apply a 2-mm (3/32-inch) bead of anaerobic sealant (GM P/N 1052357) or equivalent to the front cover sealing area shown in (figure 22).
  - Apply a 5-mm (3/16-inch) bead of RTV sealant to the front cover sealing surface that mates against the oil pan.
2. Front cover to the engine. Install the attaching bolts and the injection pump studs.



### Tighten

- Front cover to block bolts to 45 N.m (33 lbs. ft.).
  - Oil pan to front cover bolts to 10 N.m (89 lbs. in.).
3. Injection pump nuts.



### Tighten

- Nuts to 42 N.m (31 lbs. ft.).
4. Injection pump gear and bolts. Align the timing marks.



### Tighten

- Injection pump gear bolts to 23 N.m (17 lbs. ft.).



### Measure

- Clearance between injection pump gear and baffle (figure 23). It is necessary to maintain a minimum of 1.0 mm (0.040 inch) between the gear and baffle or noise may result.

5. Fuel return line clip screws.
6. Crankshaft position sensor.
7. Torsional damper. Refer to "Torsional Damper and Front Crankshaft Seal Replacement."
8. Coolant pump. Refer to SECTION 6B.
9. Fill the cooling system with the proper quantity and grade of coolant.
10. Reset the injection pump timing. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual GMT/95-CK-2.

## TIMING CHAIN AND SPROCKET REPLACEMENT



Remove or Disconnect (Figure 24)

**NOTICE:** If the timing chain, timing gears, front cover, crankshaft position sensor, crankshaft or other components(s) affecting timing are replaced, it will be necessary to reprogram TDC Offset into the PCM. Refer to the appropriate Driveability, Emissions and Electrical Diagnosis Manual. (L49 VIN P, L56 VIN S, L65 VIN F only)

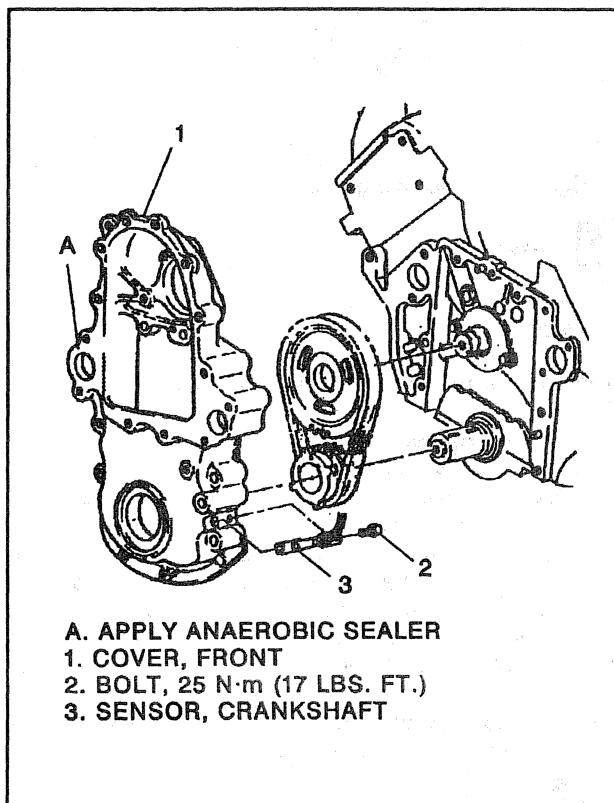
1. Front cover. Refer to "Front Cover Replacement."



Measure

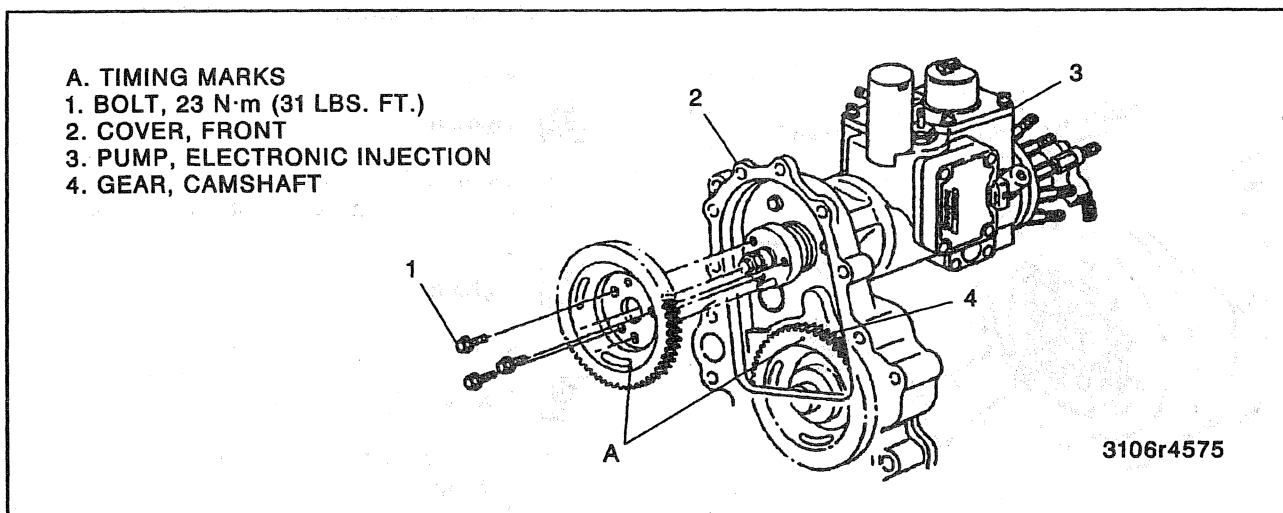
- Timing chain free play as follows:

- A. Mount a dial indicator to the front of the block.
  - B. Position the dial indicator so the plunger contacts the timing chain between the two gears.
  - C. Pull the chain outward (parallel to the front face of the block) the maximum amount with finger pressure on the inside of the chain.
  - D. Set the dial indicator to zero.
  - E. Move the chain inward (parallel to the front face of the block) the maximum amount with finger pressure on the outside of the chain.
  - F. Note the total indicator travel. With used parts, the deflection must not exceed 20.3 mm (0.8 inch). If the deflection exceeds this limit, the sprockets and timing chain must be inspected for wear and replaced as necessary. With new parts the maximum deflection must not exceed 12.7 mm (0.5 inch).
2. Injection pump gear.
  3. Camshaft gear.
- Align the timing marks (figure 24).
4. Camshaft sprocket with timing chain.
  5. Crankshaft sprocket.



- A. APPLY ANAEROBIC SEALER
1. COVER, FRONT
  2. BOLT, 25 N·m (17 LBS. FT.)
  3. SENSOR, CRANKSHAFT

Figure 22—Front Cover and Components



- A. TIMING MARKS
1. BOLT, 23 N·m (31 LBS. FT.)
  2. COVER, FRONT
  3. PUMP, ELECTRONIC INJECTION
  4. GEAR, CAMSHAFT

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Figure 23—Injection Pump Gear and Timing Marks

## Install or Connect (Figure 24)

1. Crankshaft sprocket.
2. Camshaft sprocket with timing chain.

### Important

- Align the timing marks (figure 24).
3. Camshaft gear, bolt, and washer.

### Tighten

- Bolt to 100 N.m (75 lbs. ft.).
4. Injection pump gear and bolts.

### Important

- Align the timing marks (figure 24).

### Tighten

- Bolts to 23 N.m (17 lbs. ft.).
5. Front cover. Refer to "Front Cover Replacement."

### Adjust

- Injection pump timing. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual GMT/95-CK-2.

## CAMSHAFT REPLACEMENT

### Remove or Disconnect (Figure 24)

**NOTICE:** If the timing chain, timing gears, front cover, crankshaft position sensor, crankshaft or other component(s) affecting timing are replaced, it will be necessary to reprogram TDC Offset into the PCM. Refer to the appropriate Driveability, Emissions and Electrical Diagnosis Manual. (L49 VIN P, L56 VIN S, L65 VIN F only)

1. Negative battery cables. Refer to SECTION 0A.
  - Drain the cooling system.
2. Radiator, shrouds, and fan.
3. Air conditioning condenser mounting bolts (if equipped). Lift the condenser with the aid of an assistant.
4. Grille and parking lamp assembly.
5. Hood latch and brace assembly.
6. Oil pump drive. Refer to "Oil Pump Drive Replacement."
7. Power steering pump, generator, and air conditioning compressor and position aside.
8. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."
9. Rocker arm assemblies and pushrods. Refer to "Rocker Arm Shaft, Rocker Arms, and Pushrod Replacement."

### Important

- Rocker arm assemblies and pushrods must be marked for proper assembly.

10. Hydraulic lifters. Refer to "Hydraulic Lifter Replacement." Place the lifters in an organizer rack. The lifters must be installed in the same bore from which they were removed.
11. Front cover. Refer to "Front Cover Replacement."
12. Timing chain and camshaft sprocket. Refer to "Timing Chain and Sprocket Replacement."
13. Front engine mounting through bolts.

**NOTICE:** When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Raise the engine and block in position.
14. Bolts and thrust plate.
  15. Camshaft. Pull the camshaft from the block carefully to avoid damage to the camshaft bearings.
  16. Spacer (if necessary).

## CLEANING, INSPECTION, AND REPAIR

Clean, inspect, and repair or replace the camshaft and related components. Refer to the Light Duty Truck Unit Repair Manual.

The Light Duty Truck Unit Repair Manual also describes camshaft bearing replacement.

### Install or Connect (Figures 23 and 24)

- When a new camshaft is installed, replacement of all hydraulic lifters, engine oil, and oil filter is recommended.
1. Spacer, with the ID chamfer towards the camshaft.
  2. Camshaft.
    - A. Coat the camshaft lobes with camshaft and lifter Pre Lube (GM P/N 1052365) or equivalent.
    - B. Lubricate the camshaft bearing journals with engine oil.
    - C. Insert the camshaft carefully into the block to avoid damage to the camshaft bearings.
  3. Thrust plate and bolts.

### Tighten

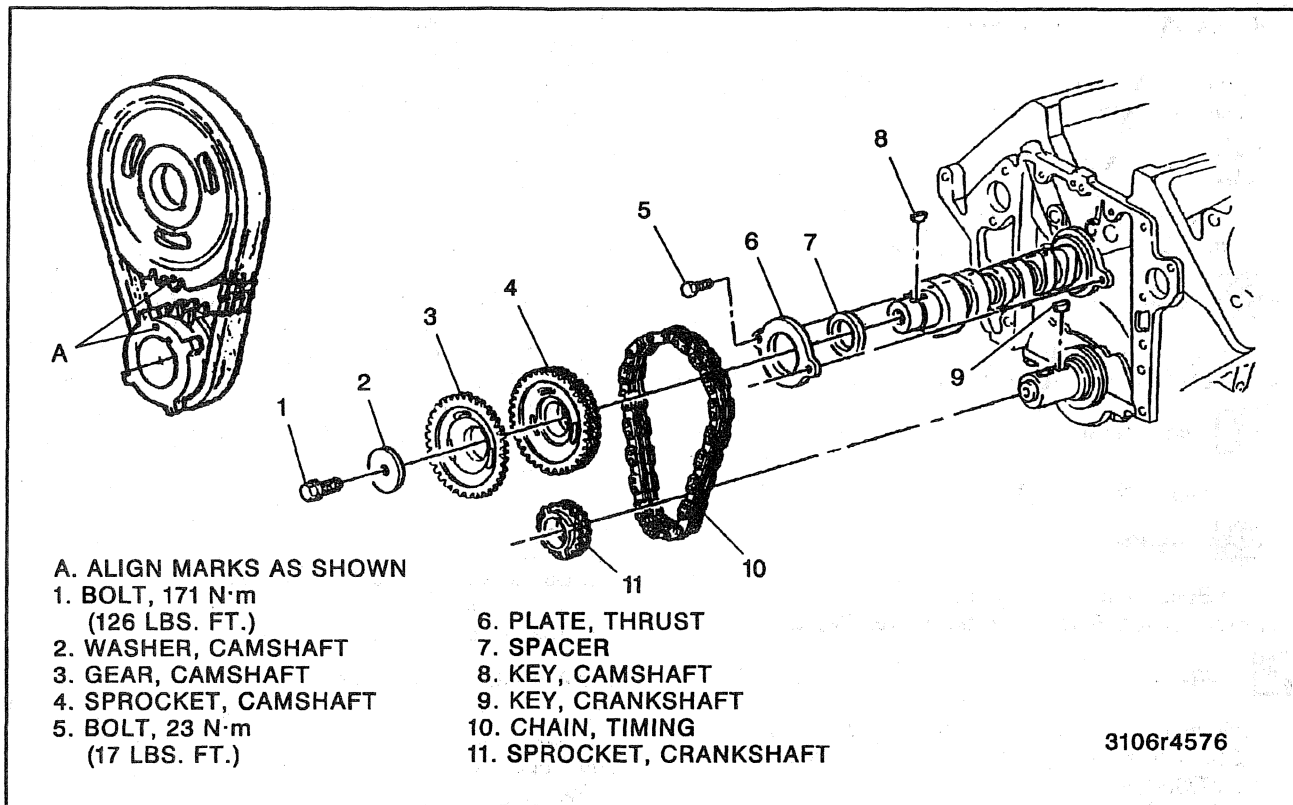
- Bolts to 23 N.m (17 lbs. ft.).
  - Lower the engine.
4. Engine mounting through-bolts and nuts.

### Tighten

- Bolts to 95 N.m (70 lbs. ft.) or nuts to 70 N.m (50 lbs. ft.).
5. Timing chain and sprockets. Refer to "Timing Chain and Sprocket Replacement."

### Important

- Align the timing marks (figure 24).
6. Fuel pump (lift pump).
  7. Front cover. Refer to "Front Cover Replacement."



**Figure 24—Camshaft and Components**

**NOTICE:** If the timing chain, timing gears, front cover, crankshaft position sensor, crankshaft or other component(s) affecting timing are replaced, it will be necessary to reprogram TDC Offset into the PCM. Refer to the appropriate Driveability, Emissions and Electrical Diagnosis Manual. (L49 VIN P, L56 VIN S, L65 VIN F only)

8. Hydraulic lifters. Refer to "Hydraulic Lifter Replacement." Used lifters must be installed in the same bore from which they were removed.
9. Rocker arm assemblies and pushrods, in their original locations. Refer to "Rocker Arm Shaft, Rocker Arms, and Pushrod Replacement." Hardened ends of the pushrods must face up.
10. Rocker arm covers. Refer to "Rocker Arm Cover Replacement."
11. Power steering pump, generator, and air conditioning compressor, as equipped.
12. Oil pump drive. Refer to "Oil Pump Drive Replacement."
13. Hood latch and brace assembly.
14. Air conditioning condenser (if equipped).
15. Grille and parking lamp assembly.
16. Fan, radiator, and radiator shrouds.
17. Negative battery cables.

- Fill the cooling system with the proper quantity and grade of coolant.

## **DIPSTICK TUBE REPLACEMENT**

### **↔ Remove or Disconnect (Figure 25)**

1. Negative battery cables. Refer to SECTION 0A.
2. Dipstick tube bracket, nut, and washer, at the exhaust manifold.
3. Dipstick tube.
4. O-ring seal from the dipstick tube.

### **→→ Install or Connect (Figure 25)**

1. New O-ring seal to the dipstick tube.
2. Dipstick tube to the engine.
3. Dipstick tube bracket nut and washer.
4. Negative battery cables.

## **OIL PAN REPLACEMENT**

### **↔ Remove or Disconnect (Figure 26)**

1. Negative battery cables. Refer to SECTION 0A.
  - Raise the vehicle and support with safety stands.
  - Drain the engine oil.
2. Flywheel cover.
3. Exhaust pipes from the manifold.
4. Front engine mounting through-bolts.

**NOTICE:** When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Raise the engine.
- 5. Oil pan bolts.
- 6. Oil pan.
- 7. Oil pan rear seal.



## Clean

- Old RTV from the oil pan and block.
- All oil and grease from the gasket surfaces.



## Install or Connect (Figure 26)

- Apply a 5-mm (3/16-inch) bead of RTV sealant (GM P/N 1052915) or equivalent to the oil pan sealing surface, inboard of the bolt holes (figure 26). The sealer must be wet to the touch when the oil pan is installed.
- 1. Oil pan rear seal.
- 2. Oil pan to the engine. Be sure to connect the oil dipstick.
- 3. Oil pan bolts.



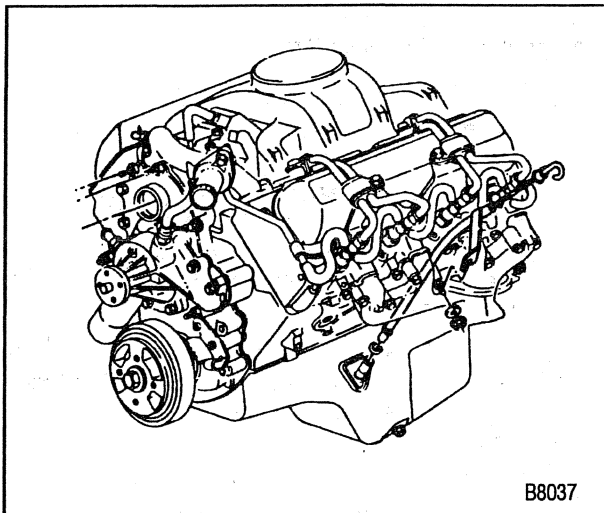
## Tighten

- All except rear two bolts to 10 N·m (89 lbs. in.).
- Rear two bolts to 23 N·m (17 lbs. ft.).
- Lower the engine.
- 4. Engine mounting through-bolt and nut.



## Tighten

- Bolt to 95 N·m (70 lbs. ft.) or nut to 70 N·m (50 lbs. ft.).
- 5. Exhaust pipes to manifolds.



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Figure 25—Oil Dipstick Tube

- 6. Flywheel cover.
- Lower the vehicle.
- 7. Proper quantity and grade of engine oil.
- 8. Negative battery cables.

## OIL PUMP REPLACEMENT



## Remove or Disconnect (Figure 26)

1. Oil pan. Refer to "Oil Pan Replacement."
2. Oil pump to main bearing cap bolt.
3. Oil pump and extension shaft.



## Inspect

- Oil pump pick up tube and screen for damage.
- Oil pump extension shaft bushing for cracks.

## OIL PUMP REPAIR

- The oil pump is serviced only as a unit.



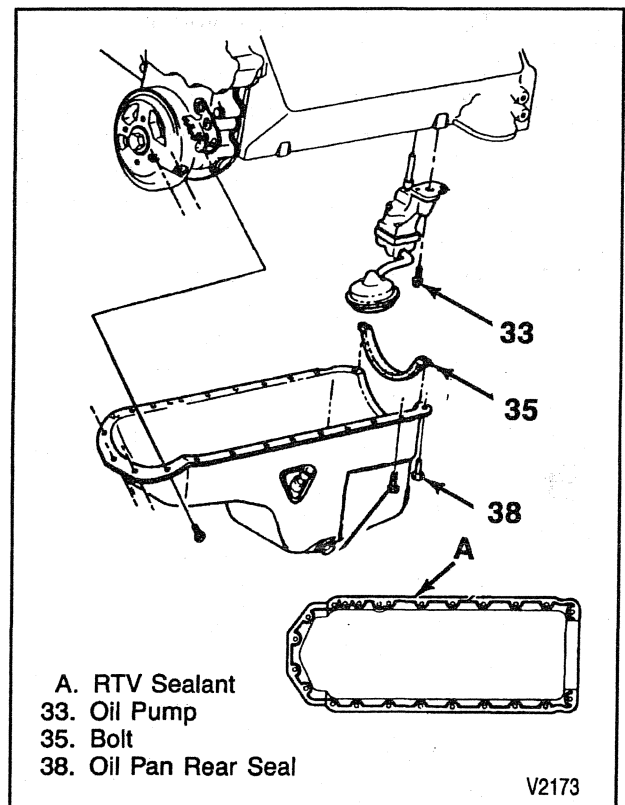
## Install or Connect (Figure 26)

1. Oil pump and extension shaft to the engine. Align the extension shaft hex with the drive hex on the oil pump drive. The oil pump should push easily into place.
2. Oil pump bolt.



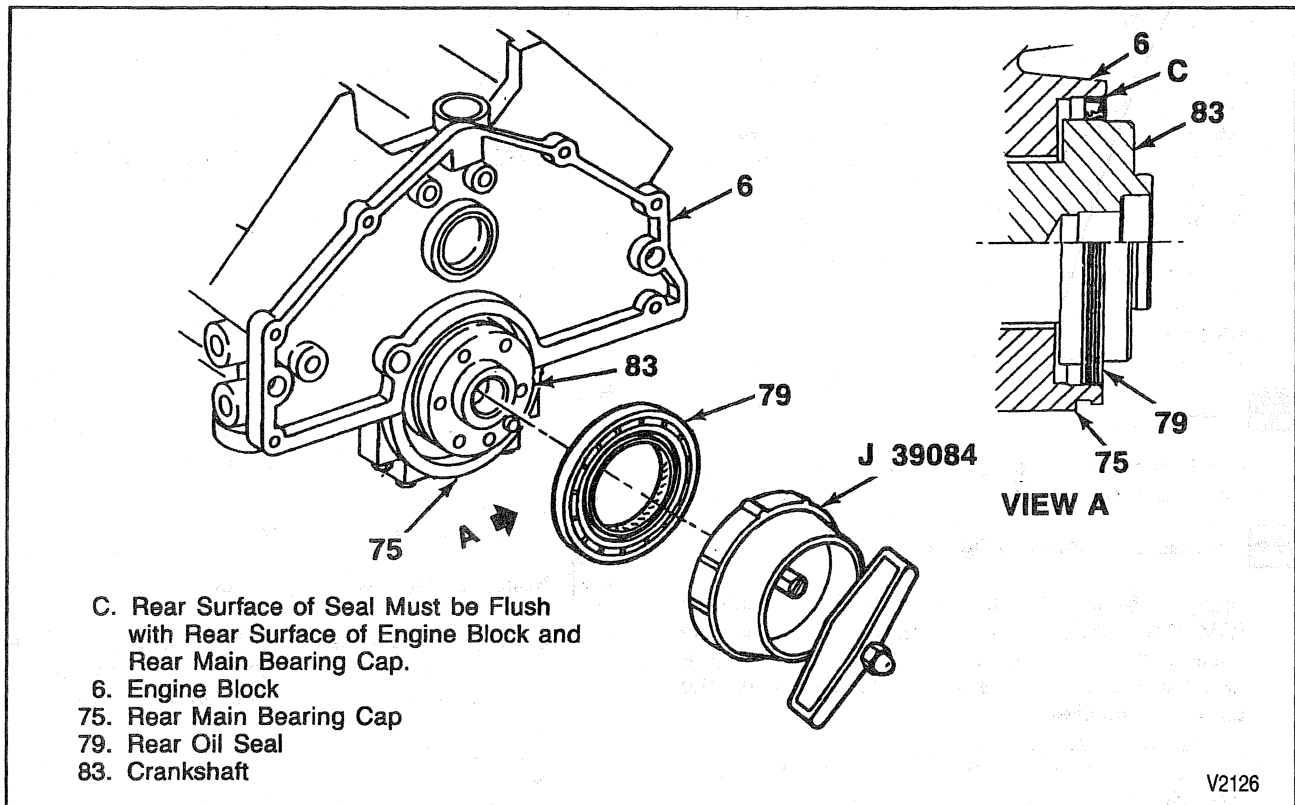
## Tighten

- Oil pump bolt to 90 N·m (65 lbs. ft.).
- 3. Oil pan. Refer to "Oil Pan Replacement."



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Figure 26—Oil Pan and Oil Pump



**Figure 27—Installing the Rear Main Seal**

## REAR CRANKSHAFT OIL SEAL REPLACEMENT

### Tools Required:

J 39084 Rear Main Seal Installer

Before a new seal is installed, the CDR and crankcase ventilation system should be thoroughly inspected and crankcase pressure should be checked. Refer to SECTION 6E2.

### ↔ Remove or Disconnect (Figure 27)

1. Transmission. Refer to SECTION 7.
2. Flywheel.
3. Oil seal using oil seal removal tool. Do not reuse old seal.



### Clean

- Clean the oil seal bore in the block thoroughly before installing a new oil seal.



### Inspect

- The rear portion of the crankshaft where the oil seal makes contact for wear due to the rubbing action of the oil seal or dirt buildup. Correct as necessary.



### Important

- The crankshaft surface must be clean and smooth to prevent damaging the seal lip when a new oil seal is installed.
- Because of rear crankshaft wear or grooving, the service seal will be positioned flush with the rear block face. The position of the new seal will be controlled by the installation tool J 39084. The reason for the positioning of the seal in a new location is to provide a new surface for the oil seal to ride on.



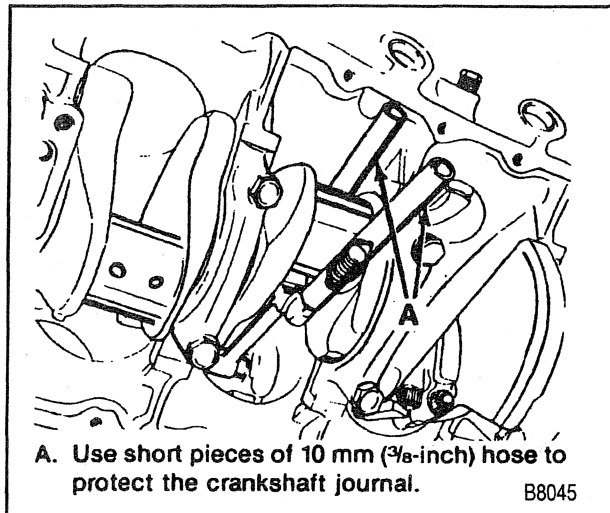
### Install or Connect (Figure 27)



### Important

- Coat the crankshaft surface with engine oil, and lightly coat the lip of the new oil seal with engine oil or grease before installing the new oil seal. Do not scratch or nick the sealing edge of the oil seal.

1. The oil seal, with the spring cavity towards the engine, onto the crankshaft.
2. Using tool J 39084, drive the seal in until the tool bottoms against the block and rear main bearing cap.
3. Flywheel.
4. Transmission. Refer to SECTION 7.



**Figure 28—Replacing the Connecting Rod and Piston**

## CONNECTING ROD AND PISTON REPLACEMENT

### Remove or Disconnect (Figure 28)

1. Cylinder head. Refer to "Cylinder Head Replacement."
2. Oil pan. Refer to "Oil Pan Replacement."
3. Oil pump. Refer to "Oil Pump Replacement."
4. Ridge or deposits from the upper end of the cylinder bores.
  - A. Turn the crankshaft until the piston is at BDC.
  - B. Place a cloth on top of the piston.
  - C. Perform the cutting operation with a ridge reamer.
  - D. Turn the crankshaft until the piston is at TDC.
  - E. Remove the cloth and cuttings.
5. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
6. Connecting rod and piston.
  - A. Attach two short pieces of 10-mm (3/8-inch) hose to the connecting rod bolts (figure 28). This will protect the crankshaft journal during removal.
  - B. Push the connecting rod and piston out of the bore.
7. Connecting rod bearings. Place the bearings in a rack, if they are to be reused, so they can be returned to their original locations.

### CLEANING, INSPECTION, AND REPAIR

Clean, inspect, and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the Light Duty Truck Unit Repair Manual.

The Light Duty Truck Unit Repair Manual contains information on:

- Connecting rod and piston.
- Piston rings.
- Connecting rod and crankpin.
- Cylinder bores.

### Install or Connect (Figures 27 through 31)

Tool Required:

J 8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder. Install new pistons in the cylinders for which they were fitted. Install used pistons in the cylinder from which they were removed.

1. Connecting rod bearings.
  - A. Make sure that the bearings are the proper size.
  - B. Install the bearings in the connecting rod and connecting rod cap.
  - C. Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
  - A. With the connecting rod cap removed, install two short pieces of 10-mm (3/8-inch) hose onto the connecting rod studs (figure 28).
  - B. Locate the piston ring end gaps as shown in figure 29. Lubricate the piston and rings with engine oil.
  - C. Without disturbing the ring end gap location, install tool J 8037 over the piston (figure 30).
  - D. The piston must be installed so that the depression in the piston crown is toward the outside of the engine. The connecting rod bearing tang slots must be opposite the camshaft.
  - E. Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 30). At the same time, from beneath the vehicle, guide the connecting rod to the crankpin with the pieces of hose. Hold the ring compressor against the block until all rings have entered the cylinder bore.
  - F. Remove the hoses from the connecting rod bolts.

### Measure

- Connecting rod bearing clearance. Refer to the Light Duty Truck Unit Repair Manual.

3. Connecting rod cap and bearing.
4. Connecting rod cap nuts.

### Tighten

- Connecting rod cap nuts to 65 N.m (48 lbs. ft.).

### Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 30). The correct clearance is 0.17-0.63 mm (0.0067-0.0248 inch).

5. Oil pump (if removed). Refer to "Oil Pump Replacement."
6. Oil pan and cylinder head. Refer to "Oil Pan Replacement" and "Cylinder Head Replacement."

## MAIN BEARING REPLACEMENT

### Remove or Disconnect (Figure 32)

Tool Required:

J 8080 Main Bearing Remover/Installer

1. Glow plugs.
2. Oil pan. Refer to "Oil Pan Replacement."
3. Oil pump. Refer to "Oil Pump Replacement."
4. Main bearing caps.
  - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Rear crankshaft oil seal if necessary. Refer to "Rear Crankshaft Oil Seal Replacement."
7. Upper main bearing inserts.
  - A. Insert tool J 8080 into the crankshaft oil hole (figure 32).
  - B. Rotate the crankshaft to "turn" the bearing insert out of the block.

### CLEANING, INSPECTION, AND REPAIR

Clean, inspect, and repair or replace the components as required. Refer to the Light Duty Truck Unit Repair Manual. The Light Duty Truck Unit Repair Manual contains information on:

- Crankshaft.
- Main and connecting rod bearings.

### Install or Connect (Figures 32 and 33)

Tool Required:

J 8080 Main Bearing Remover/Installer

1. Upper main bearing inserts.
  - A. Insert tool J 8080 into a crankshaft main bearing oil hole (figure 32).
  - B. Apply engine oil to inserts of the proper size.
  - C. Insert the plain end (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
  - D. Rotate the crankshaft to "roll" the insert into the block.
  - E. Remove tool J 8080.
2. Lower main bearing inserts to the main bearing caps.
  - A. Make sure the inserts are of the proper size.
  - B. Apply engine oil to the inserts.



### Measure

- Main bearing clearance. Refer to the Light Duty Truck Unit Repair Manual. If the engine is in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.
3. Rear crankshaft oil seal (if necessary). Refer to "Rear Crankshaft Oil Seal Replacement."

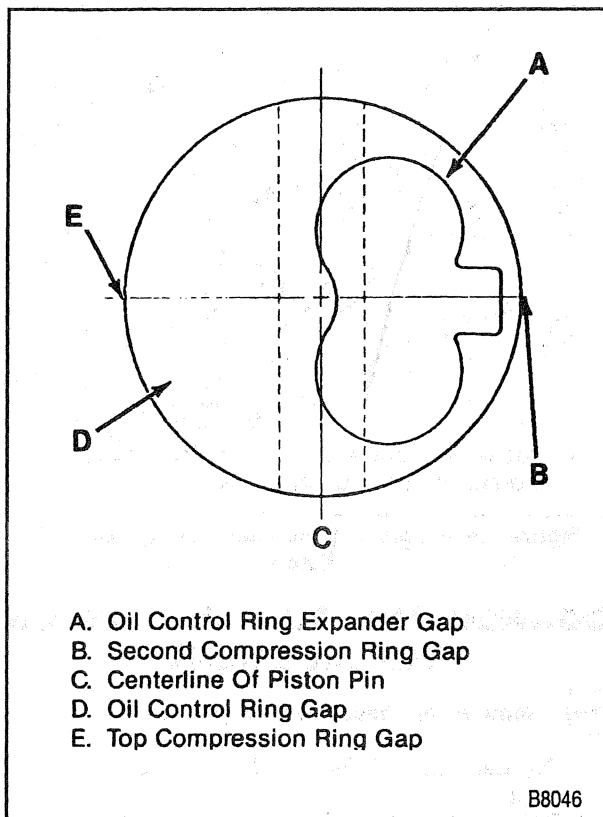


Figure 29—Ring Gap Location

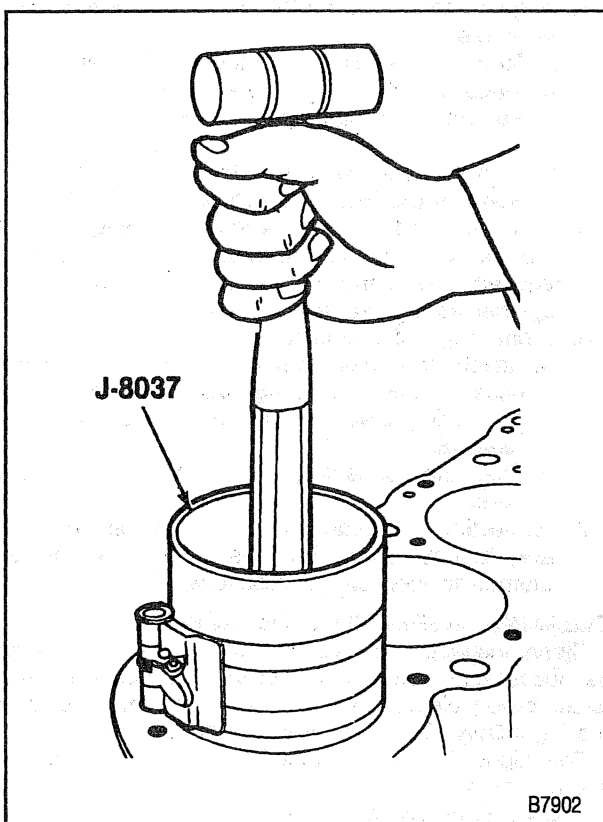


Figure 30—Installing the Piston and Connecting Rod



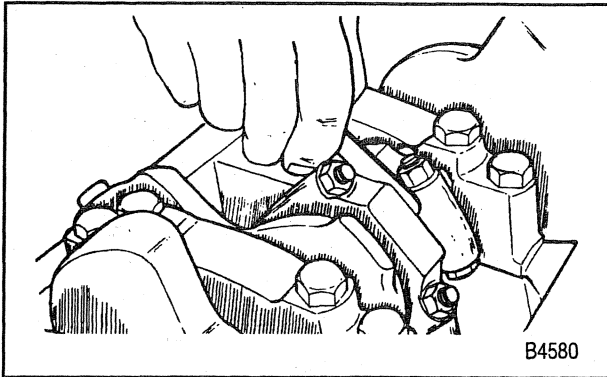


Figure 31—Checking Connecting Rod Side Clearance

**NOTICE:** The main bearing caps are to be tapped into place with a brass or leather mallet before the attaching bolts are installed. Do not use the attaching bolts to pull the main bearing caps into their seats, as this may damage the bearing cap and/or block.

4. Number 5 (rear) main bearing cap.

- Apply a thin film of anaerobic sealant (GM P/N 1052756) or equivalent to the bearing cap. Keep the sealant off the seal and bearing. Do not put sealant in the bearing cap oil relief slot.
- Apply a light coat of engine oil to the crankshaft surface that will contact the seal.
- Apply engine oil to the main bearing cap bolt threads.
- Tap the main bearing cap into place with a brass or leather mallet. Then install the bolts.



**Tighten**

- Bolts to specifications, in the following sequence:

- Inner bolts: 150 N·m (110 lbs. ft.).
- Outer bolts: 135 N·m (100 lbs. ft.).
- Re-tighten all bolts in the same sequence.

5. Numbers 1, 2, and 4, main bearing caps and bolts.



**Tighten**

- Bolts to specifications. Refer to step 4.

6. Number 3 (center) main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (124 lbs. in.).



**Measure**

- Crankshaft end play, as follows:

- Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
- Tighten the rear main bearing cap bolts to specifications. Refer to step 4.

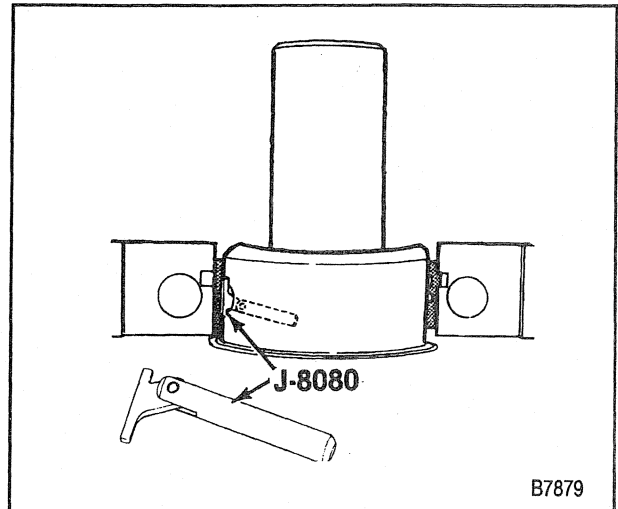


Figure 32—Removing the Main Bearings

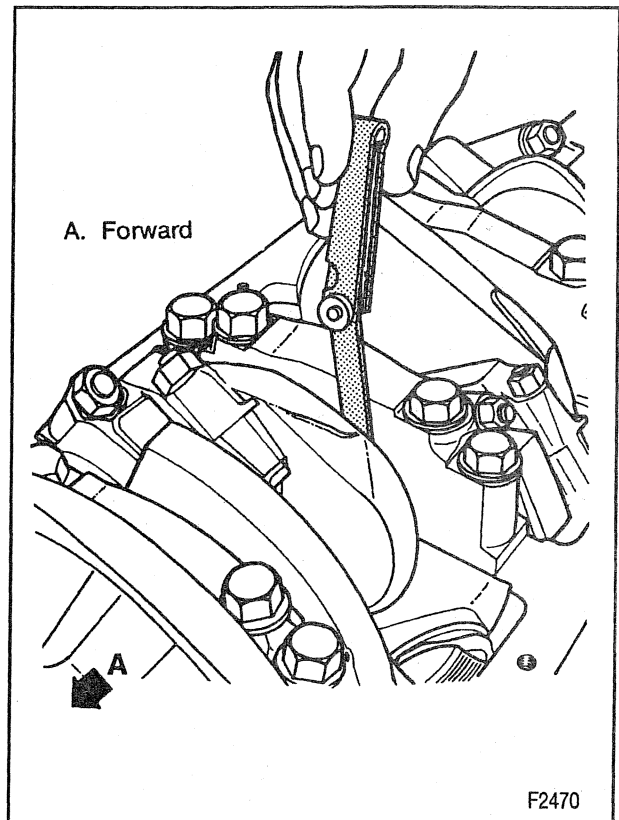


Figure 33—Measuring Crankshaft End Play

- With the crankshaft forced forward, measure at the front end of the number 3 main bearing with a feeler gage (figure 33). The proper clearance is 0.10-0.25 mm (0.0039-0.0098 inch).

- Oil pump. Refer to "Oil Pump Replacement."
- Oil pan. Refer to "Oil Pan Replacement."
- Glow plugs.

## OIL FILTER AND OIL COOLER BYPASS VALVE REPLACEMENT

### Remove or Disconnect (Figure 34)

1. Oil filter.
2. Oil filter bypass valve. Using a screwdriver.
3. Oil cooler bypass valve.
  - A. Center punch the cup plug leaving 3.2 mm (1/8 inch) hole.
  - B. Install a 4.8 mm (3/16 inch) sheet metal screw into hole in cup plug.
  - C. Using two heel bars, take out cup plug.
  - D. Using a slide hammer remove oil cooler bypass valve.

### Clean

- Recess in the block.

### Install or Connect (Figure 34)

1. Oil cooler bypass valve, using a socket to drive the bypass valve into the bore until seated on the shoulder in the bore.
2. Cup plug for oil cooler bypass valve. (This plug has an orifice hole that prevents an air lock from occurring and blocking oil flow).
3. Oil filter bypass valve.
  - Use a socket to drive valve into bore until it seats against shoulder in bore.
4. Oil filter.

## ENGINE MOUNTINGS

**NOTICE:** Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

### INSPECTING ENGINE MOUNTINGS

#### Front Engine Mountings

**NOTICE:** When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if any of the following conditions exist:
  - Hard rubber surface covered with heat check cracks.

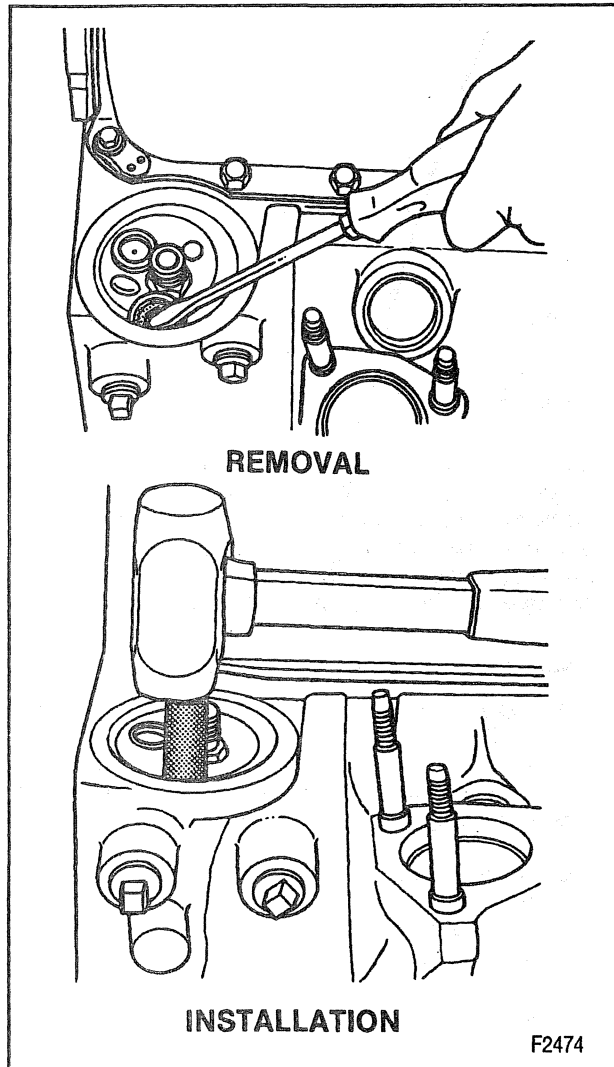


Figure 34—Replacing the Oil Filter Bypass Valve

- Rubber cushion separated from the metal plate of the mounting.
  - Rubber cushion split through the center.
3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

#### Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if either of the following conditions exist:
  - Rubber cushion separated from the metal plate of the mounting.
  - Mounting bottomed out (tailshaft can be moved up but not down).
3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

## FRONT ENGINE MOUNTING REPLACEMENT

### Remove or Disconnect (Figures 35, 36, and 37)

1. Upper fan shroud.
  - Raise the vehicle and support with safety stands.
2. Engine mounting through-bolts on both sides.

**NOTICE:** When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Raise the engine and block into position.
3. Lower control arm at pivot point. Refer to SECTION 3C.
  4. Engine mounting to frame bolts.
  5. Engine mounting.

### Install or Connect (Figure 35, 36, and 37)

1. Engine mounting to the frame.
2. Engine mounting to frame bolts and nuts.

#### Tighten

- Nuts to 48 N·m (36 lbs. ft.)
  - Lower the engine.
3. Engine mounting through-bolts.

#### Tighten

- Through-bolts to 95 N·m (70 lbs. ft.) or nuts to 70 N·m (50 lbs. ft.).
4. Lower control arm. Refer to SECTION 3C.
  5. Upper fan shroud.

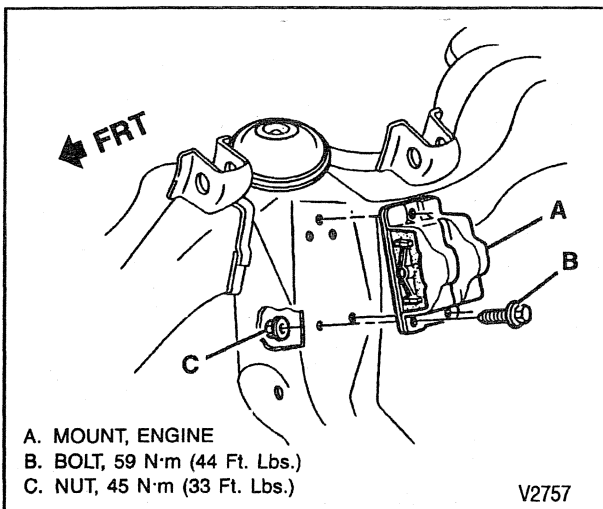


Figure 35—Front Engine Mounting (2WD Models)

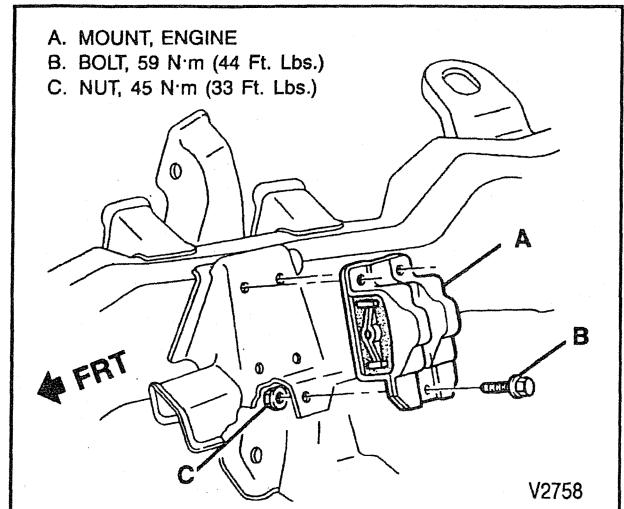


Figure 36—Front Engine Mounting (4WD Models)

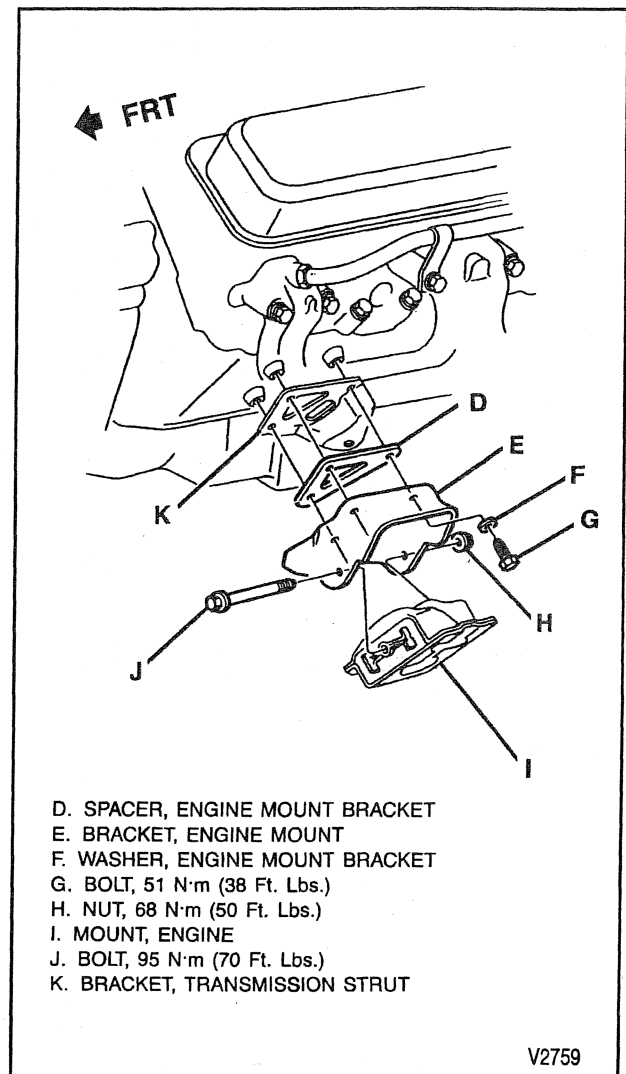


Figure 37—Front Engine Mounting Brackets (2WD and 4WD Models)

## REAR MOUNTING REPLACEMENT

 Remove or Disconnect (Figure 38 or 39)

**NOTICE:** When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, resulting in a damaged oil pickup unit.

- Support the rear of the engine to relieve the weight on the rear mountings.
- 1. Mounting to crossmember nut(s) and washer(s).
- 2. Mounting to transmission bolts and washers.
- Raise the rear of the engine only enough to allow removal of the mounting.
- 3. Mounting.


 Install or Connect (Figure 38 or 39)

- 1. Mounting.
- Lower the rear of the engine.
- 2. Mounting to transmission bolts and washers.

 Tighten

- Fasteners to specifications. Refer to legends on figures 38 and 39.

## ENGINE REPLACEMENT

 Remove or Disconnect

Tool Required:

J 29664 Manifold Cover Set

1. Negative battery cables. Refer to SECTION 0A.
  - Raise the vehicle and support with safety stands.
2. Flywheel cover.
3. Flywheel to torque converter bolts.
4. Exhaust pipes at the manifolds.
5. Starter.
6. Bell housing bolts.
7. Engine mounting through-bolts.
8. Block heater wire.
9. Wiring harness, transmission cooler lines, and front battery cable clamp at the oil pan.
10. Fuel return lines at the engine.
11. Oil cooler lines at the engine.
- Lower the vehicle.
12. Hood. Refer to SECTION 2B.
  - Drain the cooling system.
13. Air cleaner. Cover the mouth of the intake manifold with tool J 29664.
14. Generator wires and clips.
15. Wiring at the injector pump.
16. Wiring from the rocker arm clips, including the glow plug wires.
17. EGR/Boost solenoids, glow plug controller, and temperature solenoid. Move the harness aside.
18. Left or right side ground strap.
19. Upper fan shroud.

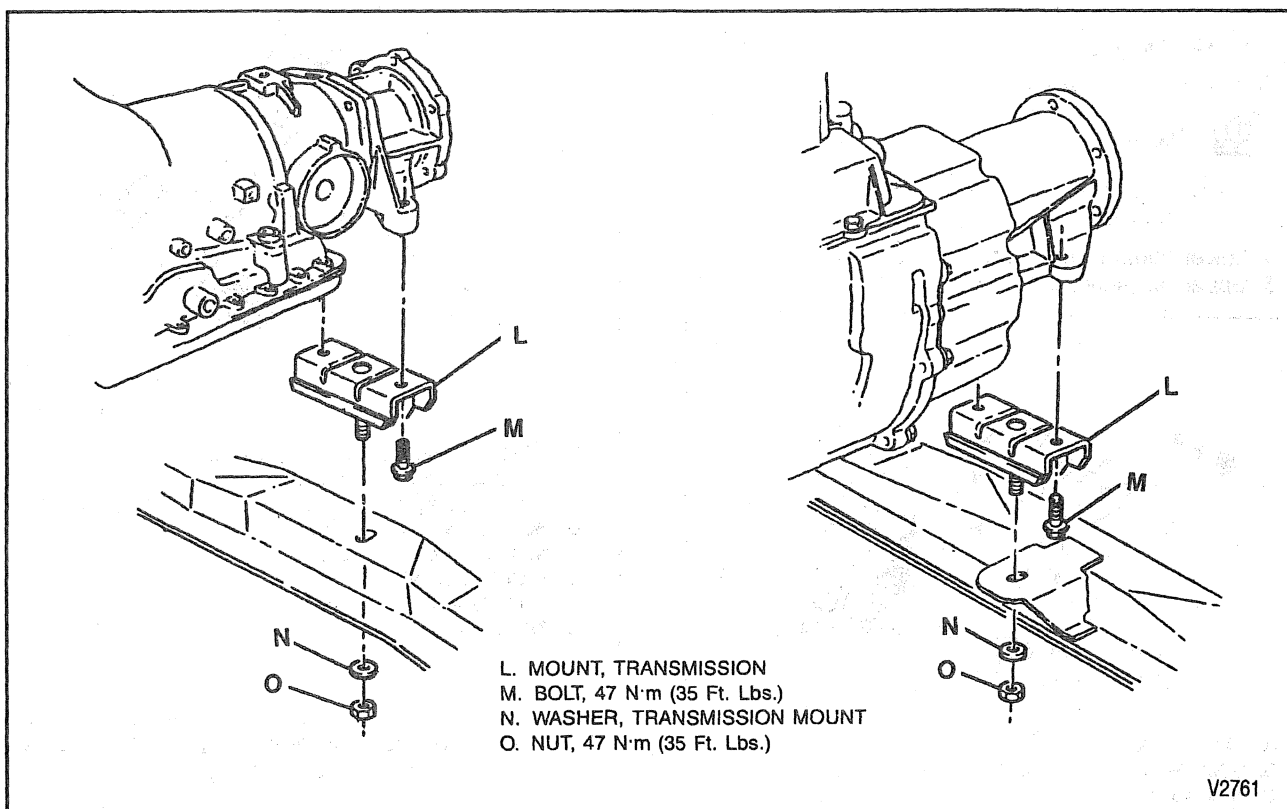
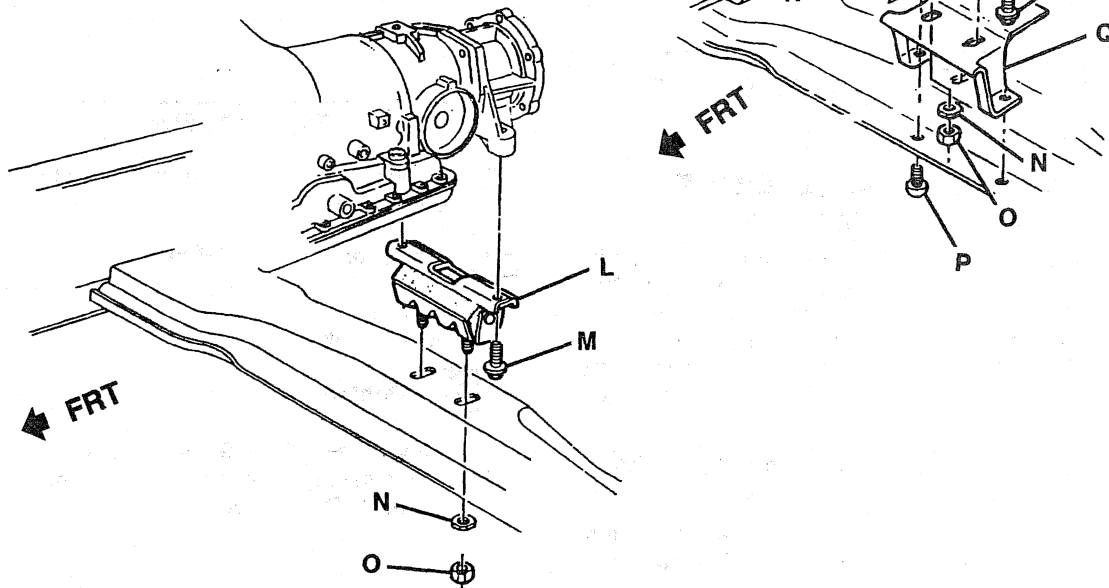


Figure 38—Rear Mounting (2WD Models)

- L. MOUNT, TRANSMISSION  
M. BOLT, 47 N·m (35 Ft. Lbs.)  
N. WASHER, TRANSMISSION MOUNT  
O. NUT, 47 N·m (35 Ft. Lbs.)  
P. BOLT, TRANSMISSION MOUNT BRACKET  
Q. BRACKET, TRANSMISSION MOUNT  
R. NUT, 35 N·m (26 Ft. Lbs.)



V2762

Figure 39—Rear Mounting (2WD with 15,000 GVW and 4WD Models)

20. Fan.
21. Power steering pump and reservoir and lay aside.
22. Heater hose at the engine.
23. Radiator.
- Support the transmission with a jack.
24. Engine.

#### Install or Connect

1. Engine to the vehicle.
2. Radiator.
3. Heater hose.
4. Power steering pump and reservoir.
5. Fan.
6. Upper fan shroud.
7. Left or right ground strap.
8. EGR/Boost solenoids and glow plug controller.
9. Wiring at the rocker arm clips.
10. Injection pump wires.
11. Generator wires and clips.
12. Air cleaner.
13. Hood. Refer to SECTION 2B.
- Raise the vehicle and support with safety stands.

14. Fuel return and oil cooler lines at engine.
15. Wiring harness, transmission cooler lines, and front battery cable clamp at the oil pan.
16. Block heater wire.
17. Engine mounting through-bolts.

#### Tighten

- Through mount bolt to 95 N·m (70 lbs. ft.) or nut to 70 N·m (52 lbs. ft.).
- 18. Bell housing bolts.
- 19. Starter.
- 20. Exhaust pipes.
- 21. Flywheel to torque converter bolts (automatic transmission).
- 22. Flywheel cover.
- Lower the vehicle.
- 23. Negative battery cables.
- Fill the cooling system with the proper quantity and grade of coolant.
- Be sure crankcase has proper quantity and grade of oil.

## FLYWHEEL REPLACEMENT

### MANUAL AND AUTOMATIC TRANSMISSIONS

#### Remove or Disconnect (Figure 40)

1. Transmission, flywheel housing, and clutch (if equipped). Refer to SECTION 7.
2. Flywheel bolts.
3. Flywheel.

#### Clean

- Mating surfaces of crankshaft and flywheel. Remove any burrs.

#### Inspect

- Flywheel for burring, scoring, warping, and wear. Replace the flywheel if necessary. Do not machine the flywheel.
- Flywheel ring gear for worn or broken teeth.

## FLYWHEEL RING GEAR REPLACEMENT

1. Use a torch to heat the gear around the entire circumference on the engine side of the gear. Then drive the gear off the flywheel using care not to damage the flywheel. On vehicles equipped with a dual mass flywheel, be sure to keep heat away from the dual mass flywheel springs and plastic spring retainers.

**NOTICE:** *Never heat the ring gear to red hot as this will change the metal hardness.*

2. Uniformly heat the flywheel gear to a temperature that will expand the gear to permit installation. Temperature must not exceed 278° C (500° F).

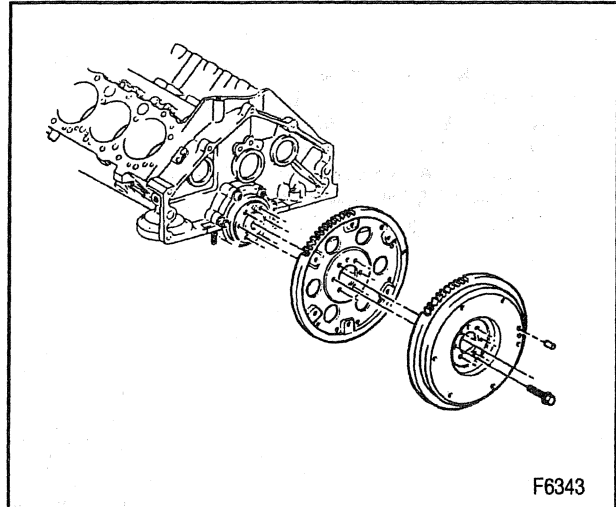


Figure 40—Flywheel

3. As soon as the gear has been heated, install on the flywheel.

#### Install or Connect (Figure 40)

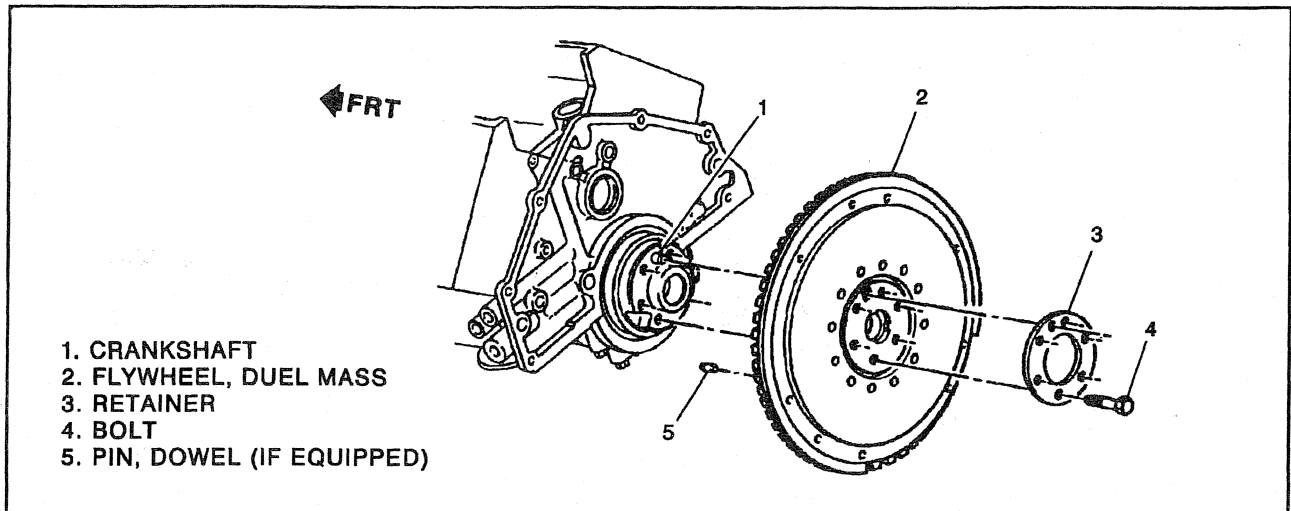
1. Flywheel.
2. Flywheel bolts.

#### Tighten

- Flywheel bolts to 90 N·m (65 lbs. ft.).
3. Transmission, flywheel housing, and clutch (if equipped). Refer to SECTION 7.

## DIAGNOSIS OF DUAL MASS FLYWHEEL

PROBLEM	POSSIBLE CAUSE	CORRECTION
Clutch Noisy	Dual mass flywheel springs or spring retainers broken.	Replace dual mass flywheel.
Clutch Slips After the Pedal is Fully Released	Dual mass flywheel internal components worn, loose or saturated with oil.	Replace dual mass flywheel.
Clutch Does Not Disengage Completely	Dual mass flywheel bent or broken.	Replace dual mass flywheel.
Clutch Vibrates	<ol style="list-style-type: none"> <li>1. Dual mass flywheel attaching bolts loose.</li> <li>2. Dual mass flywheel central bearing worn or broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Re-tighten bolts.</li> <li>2. Replace dual mass flywheel.</li> </ol>
Transmission Rattles when Clutch Engaged with Transmission in Neutral and Engine at Idle	<ol style="list-style-type: none"> <li>1. Transmission internal damage.</li> <li>2. Dual mass flywheel central bearing worn or broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to SECTION 7.</li> <li>2. Replace dual mass flywheel.</li> </ol>



Figure—41 Dual Mass Flywheel

## DUAL MASS FLYWHEEL REPLACEMENT (MANUAL TRANSMISSION ONLY WITH L65, VIN F)

### Remove or Disconnect (Figure 41)

1. Transmission assembly. Refer to SECTION 7B.
2. Clutch and clutch housing. Refer to SECTION 7C.
3. Bolts and washers.
4. Retainer plate.
5. Flywheel.
6. Dowel pin (if equipped).

### Install or Connect (Figure 41)

- Position flywheel on crankshaft flange. Then coat the threads of the flywheel attaching bolts with sealant.
- 1. Dowel pin (if equipped).
- 2. Retainer plate.
- 3. Washers and bolts.

### Tighten

- Bolts to 60 N.m (45 lbs. ft.).
- Position clutch on the flywheel.
- 4. Clutch and clutch housing. Refer to SECTION 7C.
- 5. Transmission assembly. Refer to SECTION 7B.

## DUAL MASS FLYWHEEL REPAIR

### Disassemble (Figure 42)

- Remove the transmission. Refer to SECTION 7B.
- 1. Attaching bolts that hold the secondary flywheel to the primary flywheel assembly.

**NOTICE:** Use care to ensure that the secondary flywheel does not fall off the vehicle.

2. Using a screwdriver or similar object, pry around the outer edge of the secondary flywheel to remove it from the mounting pilot.

### Inspect

- Flywheel for cracks or heat checks.
- Flywheel for scored or worn surfaces.
- Ring gear for worn, chipped, or cracked teeth. Replace ring gear if any teeth are damaged.

### Measure

- The thickness of the secondary flywheel. Replace the secondary flywheel if the thickness is below 1.016 mm (0.040 inch).

**NOTICE:** The 5.5-mm (0.217-inch) step on the secondary flywheel must be maintained to ensure proper attachment and function of the clutch assembly. If 1.0 mm (0.0394 inch) is removed from the friction surface, 1.0 mm (0.0394 inch) must be removed from the secondary flywheel mounting surface.

### Clean

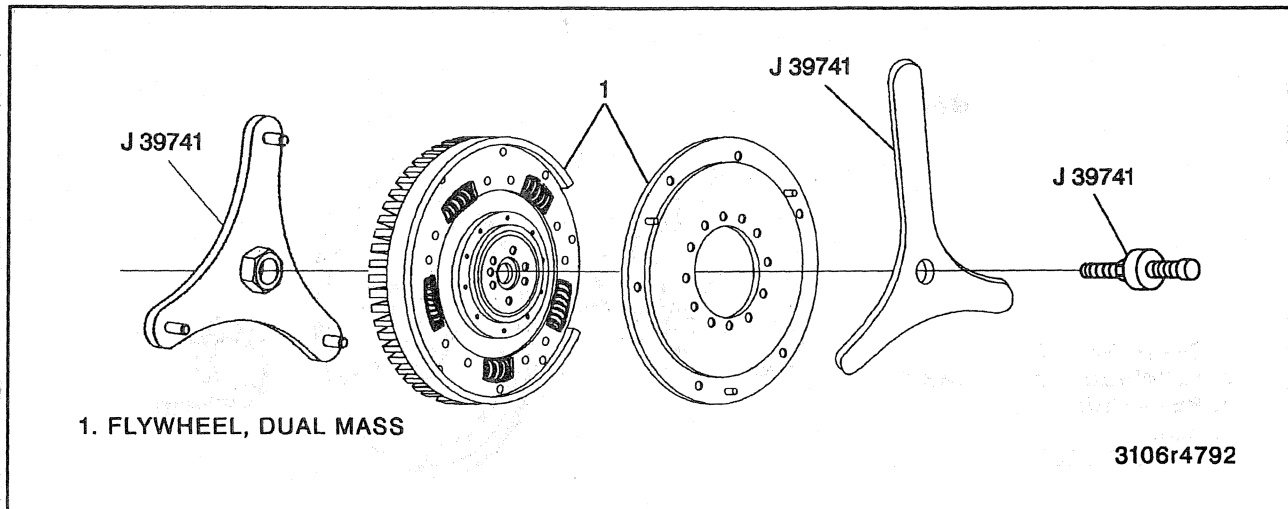
- Clutch friction surface with a suitable commercial alcohol base solvent. Be sure that the surfaces are free from any oil film.

### Assemble (Figure 42)

Tool Required:

J 39741 Dual Mass Flywheel Assembly Fixture

- Position secondary flywheel onto its mounting pilot on the primary flywheel assembly.
- 1. Align the secondary flywheel attaching bolt holes with threaded holes in the hub.
- 2. Compress primary and secondary flywheel assembly using tool J 39741 (figure 42).



**Figure—42 Dual Mass Flywheel Assembly**

3. New secondary flywheel attaching bolts that contain thread lock (3M Scotch grip) and install bolts.

4. Clutch pressure plate and friction disc.
5. Clutch assembly to transmission. Refer to SECTION 7B.



**Tighten**

- Bolts to 17 N·m (12 lbs. ft.) alternating across from each other.

## THREAD REPAIR

Damaged threads may be reconditioned by drilling out, rethreading, and installing a suitable thread insert.

**Tools Required:**

General purpose thread repair kits are available commercially.

**CAUTION: Wear safety glasses to avoid eye damage.**

1. Determine size, pitch, and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to required depth.



**Important**

- Refer to the kit manufacturer's instructions regarding the size of drill and tap to be used.

2. Drill out damaged thread. Clean out chips.

3. Tap hole. Lubricate tap with light engine oil. Clean the thread.



**Important**

- Avoid build-up of chips. Back out the tap every few turns and remove chips.

4. Thread the thread insert onto the mandrel of the installer (figure 43). Engage the tang of the insert onto the end of the mandrel.
5. Lubricate the insert with light engine oil (except when installing in aluminum) and install.

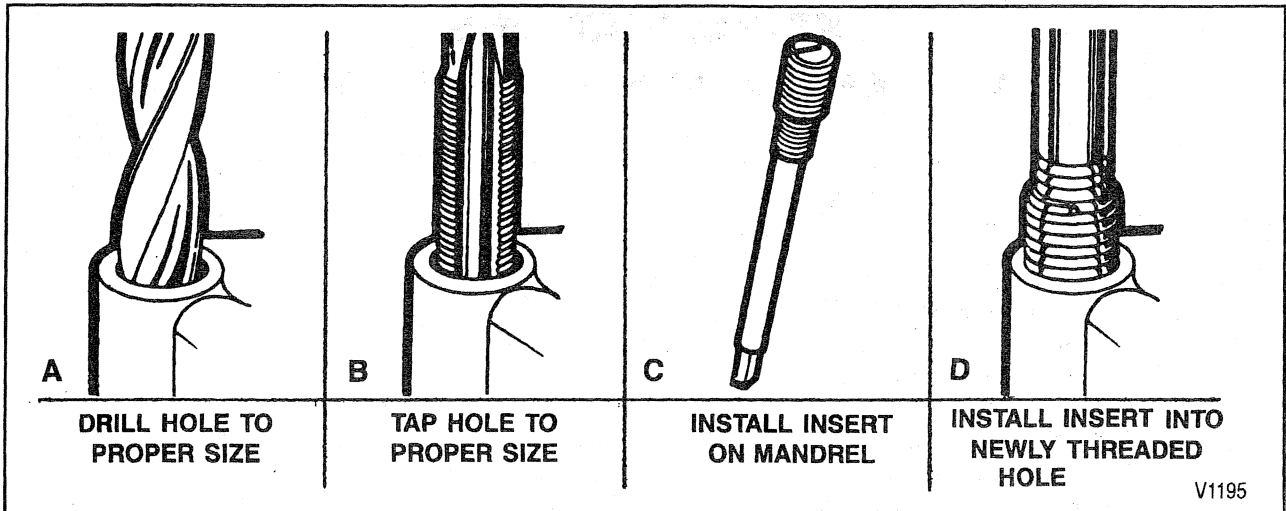


**Important**

- When correctly installed, the insert should be flush to one turn below the surface.

6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.





**Figure 43—Repairing Thread Holes**

## **SPECIFICATIONS**

### **FASTENER TIGHTENING SPECIFICATIONS**

Item	N-m	Lbs. Ft.	Lbs. In.
Bell Housing Bolts.....	40	30	—
Block Drain Plugs.....	22	16	—
Camshaft Gear Bolt .....	171	126	—
Camshaft Thrust Plate .....	23	17	—
Connecting Rod Cap Nuts.....	65	48	—
Coolant Crossover/Thermostat Housing Bolts .....	42	31	—
Crankshaft Pulley Bolts.....	40	30	—
Cylinder Head Bolts—Refer to Procedure .....	—	—	—
Dual Mass Flywheel.....	60	45	—
Exhaust Manifold Bolts .....	35	26	—
Flywheel Bolts .....	90	66	—
Front Cover to Block Bolts .....	45	33	—
Glow Plugs .....	14	—	124
Hydraulic Lifter Guide Plate Clamp Bolts .....	26	19	—
Intake Manifold Bolts.....	42	31	—
Injection Lines .....	33	24	—
Injection Nozzles .....	80	59	—
Injection Pump Gear Bolts.....	23	17	—
Injection Pump Nuts.....	42	31	—
Oil Filter Adapter Bolt .....	65	47	—
Main Bearing Cap Bolts—Inner.....	150	111	—
Outer .....	135	100	—
Oil Pan Bolts (all except rear two bolts).....	10	—	89
(rear two bolts) .....	23	17	—
Oil Pump Bolt.....	90	66	—
Oil Pan Drain Plug.....	27	20	—
Oil Pump Cover Screws .....	16	12	—
Oil Pump Drive Clamp Bolt .....	42	31	—
Rocker Arm Cover Bolts.....	22	16	—
Rocker Arm Shaft Bolts .....	55	41	—
Secondary Flywheel Bolt .....	17	12	—
Torsional Damper Bolt.....	270	200	—
Turbocharger to Exhaust Manifold Nuts.....	50	37	—

### **DUAL MASS FLYWHEEL SPECIFICATIONS**

Flywheel and Ring Gear Runout.....	0.76 mm (0.030 inch)
Flywheel and Ring Gear Concentricity.....	0.50 mm (0.020 inch)
Flywheel Friction Surface Maximum Stock Removal During Refacing.....	1.016 mm (0.040 inch)

T3154

## ENGINE SPECIFICATIONS

**All Specifications are in millimeters (mm) unless otherwise noted.**

GENERAL DATA:			
Displacement		6.5L	
RPO		L49, L56, L57, and L65	
Type		90-degree V8 Diesel	
Bore		103	
Stroke		97	
Compression Ratio		21.3:1	
Firing Order		1-8-7-2-6-5-4-3	
Oil Pressure		10 psi at idle (hot); 40-45 psi at 2000 RPM	
CYLINDER BORE: <sup>1</sup>			
Diameter		Refer to "Service Piston and Bore Specifications"	
Out Of Round		0.02 (Maximum)	
Taper (Thrust Side)		0.02 (Maximum)	
PISTON DIAMETER:		Refer to "Service Piston and Bore Specifications"	
Piston to Bore Clearance	Bohn Pistons	Bores 1 through 6	.094-0.120
		Bores 7 and 8	0.107-0.133
PISTON RING:			
Compression	Groove Clearance	Top	Keystone Type Ring
		2nd	0.039-0.079
	Gap <sup>2</sup>	Top	0.26-0.51
		2nd	0.75-1.00
Oil	Groove Clearance		0.040-0.090
	Gap		0.25-0.51
PISTON PIN:			
Diameter		30.9961-31.0039	
Clearance (Piston Pin to Piston Bore)		0.0101-0.0153	
Fit in Rod (Piston Pin to Rod Pin Bushing)		0.0081-0.0309	
CRANKSHAFT:			
Main Journal	Diameter	#1, #2, #3, #4	Refer to "Crankshaft Main Bearing Selection" Specifications
		#5	
	Taper		0.005 (Maximum)
	Out of Round		0.005 (Maximum)
Main Bearing Clearance		#1, #2, #3, #4	0.045-0.083
		#5	0.055-0.093
Crankshaft End Play		0.10-0.25	
Crankpin	Diameter		60.913-60.939
	Taper		0.005 (Maximum)
	Out-of-Round		0.005 (Maximum)
Rod Bearing Clearance (Select Fit)		0.045-0.100	
Rod Side Clearance		0.17-0.63	

<sup>1</sup>NOTE: Add 0.013mm to cylinder bore diameters to determine proper bore size for cylinders #7 and #8.






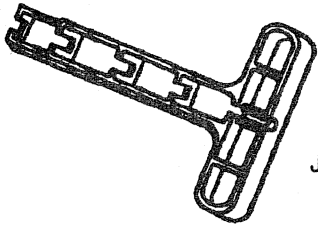
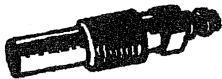



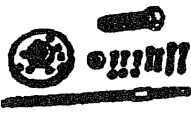
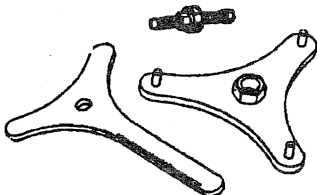
<sup>2</sup>NOTE: Ring end gap specifications are for new bores, worn bores will generate larger ring end gaps.

**ENGINE SPECIFICATIONS (CONT.)**

All Specifications are in millimeters (mm) unless otherwise noted.

<b>DISPLACEMENT</b>		6.5L
<b>CAMSHAFT:</b>		
Lobe Lift $\pm$ 0.05	Intake	7.133
	Exhaust	7.133
Journal Diameter	#1, #2, #3, #4	54.970-55.025
	#5	50.970-51.025
Journal Clearance #1, #2, #3, #4		0.025-0.118
Journal Clearance #5		0.020-0.113
Camshaft End Play		0.051-0.305
<b>VALVE SYSTEM:</b>		
Lifter		Hydraulic Roller
Rocker Arm Ratio		1.5:1
Valve Lash	Intake	Not Adjustable
	Exhaust	
Valve Protrusion (Negative because valve is recessed in head)	Intake	-.034
	Exhaust	-.048
Face Angle (Intake & Exhaust)		45°
Seat Angle (Intake & Exhaust)		46°
Seat Runout (Intake & Exhaust)		0.05
Seat Width	Intake	0.89-1.53
	Exhaust	1.57-2.36
Stem Clearance	Intake	0.026-0.069
	Exhaust	0.026-0.069
Valve Spring	Pressure Newtons @ mm	Closed 356 N @ 46.0 mm
		Open 1025 N @ 35.3 mm
	Installed Height	46
Timing Chain Free Play	New Chain	12.7 mm (0.500-inch)
	Used Chain	20.3 mm (0.800-inch)

**SPECIAL TOOLS**

- |    |   |            |     |  |         |
|----|---|------------|-----|--|---------|
| 1. |    | J 8037     | 7.  |   | J 29664 |
| 2. |    | J38606     | 8.  |   | J 8080  |
| 3. |    | J 26999-10 | 9.  |    | J 39083 |
| 4. |    | J 26999-30 | 10. |  | J 39084 |
| 5. |  | J 22102    | 11. |  | J 26999 |
| 6. |  | J 39046    | 12. |  | J 39741 |

1. RING COMPRESSOR
2. VALVE SPRING COMPRESSOR
3. AIR LINE ADAPTER
4. AIR LINE ADAPTER
5. SEAL INSTALLER
6. TORSIONAL DAMPER REMOVER
7. MANIFOLD COVER SET
8. MAIN BEARING REPLACER
9. GLOW PLOW CONNECTOR REMOVER AND INSTALLER
10. REAR CRANKSHAFT SEAL INSTALLER
11. COMPRESSION GAGE
12. DUAL MASS FLYWHEEL ASSEMBLY FIXTURE

## NOTES