

2002 ENGINES

Tracker - 2.5L V6

ENGINE IDENTIFICATION

ENGINE IDENTIFICATION CODES

Application	VIN
Tracker	4

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

Hydraulic lifters are used; no valve adjustments are required.

TROUBLE SHOOTING

NOTE: To trouble shoot engine mechanical components, see ENGINE MECHANICAL in BASIC TROUBLE SHOOTING article in GENERAL INFORMATION.

REMOVAL & INSTALLATION

WARNING: Vehicle is equipped with Supplemental Inflatable Restraint (SIR) system. When servicing vehicle, use care to avoid accidental air bag deployment. SIR system-related components are located in various locations throughout interior and exterior of vehicle, depending on application. Do not use electrical test equipment on or near these circuits. If necessary, deactivate SIR system before servicing components. See AIR BAG SAFETY PRECAUTIONS and DISABLING & ACTIVATING AIR BAG SYSTEM in AIR BAG RESTRAINT SYSTEMS article in RESTRAINTS.

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

NOTE: For repair procedures not covered in this article, see ENGINE OVERHAUL PROCEDURES article in GENERAL INFORMATION.

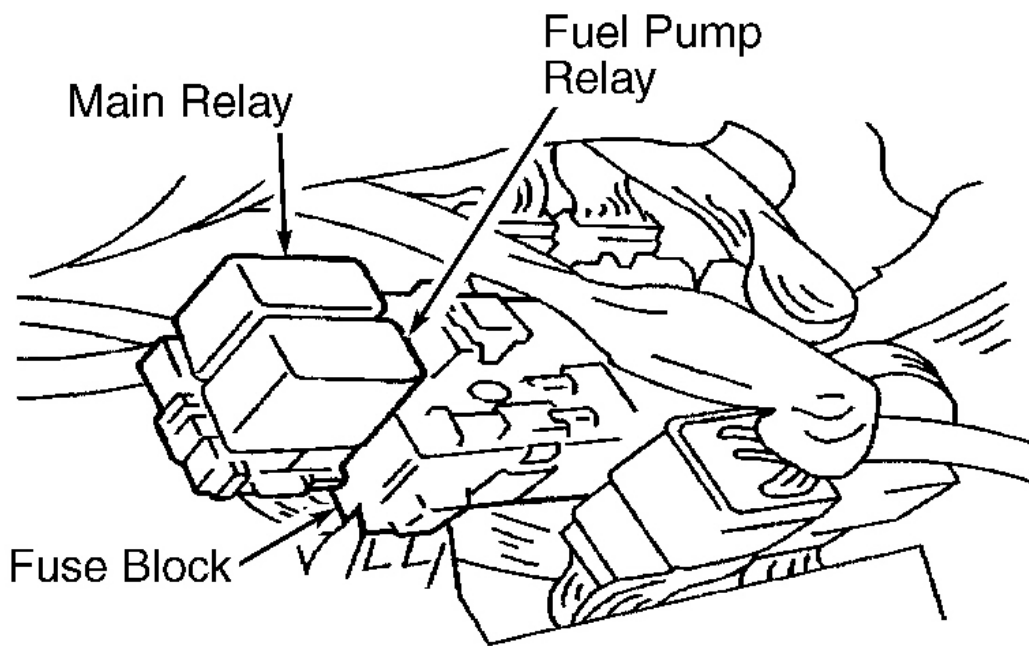
NOTE: For reassembly reference, label electrical connectors, vacuum hoses and fuel lines before removal. Place mating marks on engine hood and other major assemblies before removal.

FUEL PRESSURE RELIEF PROCEDURE

CAUTION: Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

NOTE: Do not perform this test for more than 2 minutes in order to prevent damaging the catalytic converter.

1. Loosen the fuel filler cap in order to relieve any fuel tank pressure.
2. Remove the fuel pump relay from the junction box. See **Fig. 1**.
3. Crank the engine.
4. Allow the engine to start and stall.
5. Crank the engine for an additional 3 seconds to ensure the relief of any remaining fuel pressure.
6. Disconnect the negative battery cable in order to avoid repressurizing the fuel system.
7. Install the fuel pump relay to the junction box.
8. Tighten the fuel filler cap.



G00026174

Fig. 1: Removing Fuel Pump Relay
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE

NOTE: **Tools Required:**

- J-36854 Heavy Duty Automotive Engine Stand
- J-35271 Flywheel Holder

Removal

1. Relieve fuel pressure. See **FUEL PRESSURE RELIEF PROCEDURE**.
2. Disconnect negative battery cables.
3. Remove the hood from vehicle.
4. Raise and support vehicle.
5. Remove front skid plate from vehicle, if equipped.
6. Drain engine oil.
7. Drain engine cooling system.
8. Remove automatic transmission fluid cooler lines from the radiator. Cap open lines to prevent leakage.

9. Lower vehicle.
10. Remove the radiator. See **RADIATOR**.
11. Disconnect accelerator cable. See **Fig. 2**.
12. Disconnect the A/T throttle cable.

NOTE: **The vehicle should be supported on a hoist prior to removing the strut tower brace. This will facilitate removal and installation of the brace.**

13. Remove the 6 bolts and the strut tower brace.
14. Remove the 4 screws and the surge tank cover.
15. Disconnect the Intake Air Temperature (IAT) sensor connector.
16. Remove the 4 nuts from the Surge Tank Pipe.
17. Remove the Air Cleaner Upper Case, Intake Air Hose, Intake Air Pipe, and Surge Tank Pipe as an assembly.
18. Remove the one bolt and the engine oil level indicator and tube.
19. Remove the one bolt and the transmission fluid level indicator and tube.
20. Remove the ignition coil covers.
21. Disconnect the injector wire connector.
22. Disconnect the brake booster vacuum hose.
23. Disconnect the following electrical connectors:
 - The Camshaft Position Sensor (CMP).
 - The 6 ignition coils.
 - The Throttle Position (TP) sensor.
 - The Mass Air Flow (MAF) sensor.
 - The Idle Air Control (IAC) valve.
 - The ground wires from the surge tank.
24. Remove the clamp bracket.
25. Disconnect the following electrical connectors:
 - EVAP canister purge valve.
 - Exhaust Gas Recirculation (EGR) valve.
 - Oxygen sensor.
 - Coolant temperature sensor.
 - Generator wires.
 - Starter wires.
 - Oil pressure switch wire.
 - Power steering pressure switch wire.
 - Ground wire from the generator bracket.
26. Remove clamp brackets.
27. Disconnect the following hoses:

- Heater hose from the heater water pipe.
- Heater hose from the water outlet cap.
- EVAP canister hose from the canister pipe.

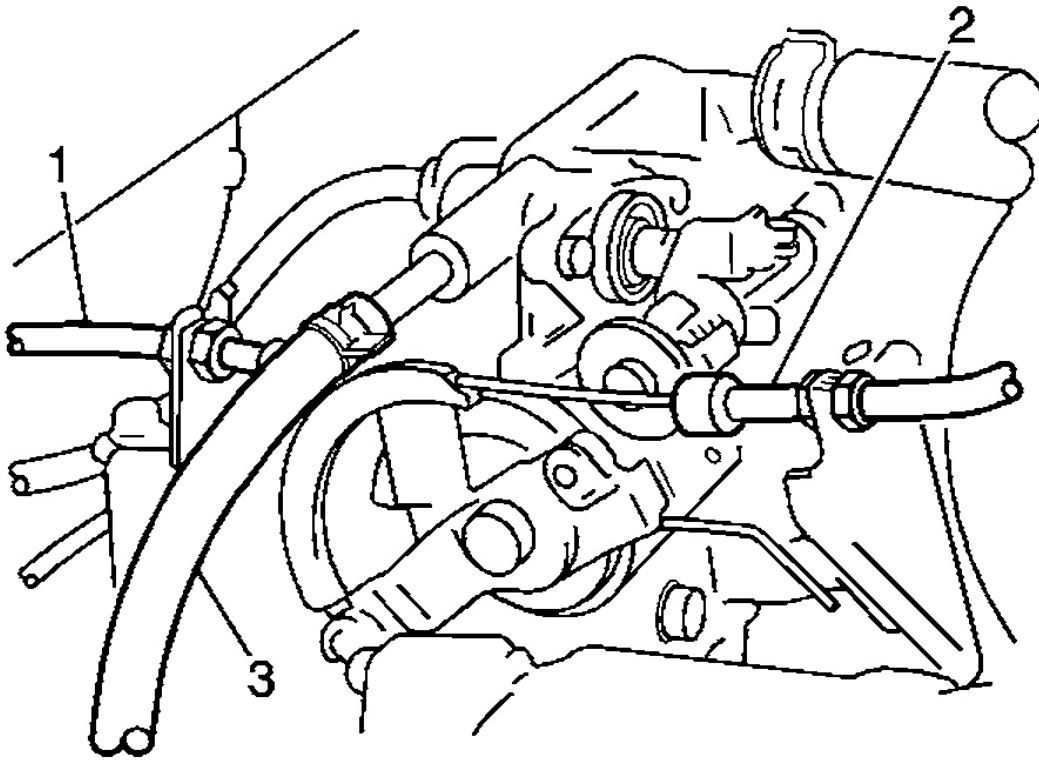
28. Remove the Idle Air Control (IAC) valve.
29. Remove the EVAP canister purge valve.
30. Disconnect the fuel feed hose from the fuel feed pipe.
31. Disconnect the fuel return hose from the fuel return pipe.
32. Remove the EVAP canister.
33. Remove the 3 bolts and the power steering pump from it's bracket, and position aside.

NOTE: **Do not discharge the A/C system nor remove the refrigerant lines from the compressor.**

34. Remove the 3 bolts and the A/C compressor, if equipped, from it's bracket, and position aside.
35. Remove the 4 bolts and the A/C compressor bracket, if equipped.
36. Remove the lower steering shaft assembly.
37. Raise the vehicle.
38. On vehicles with 4WD, remove the front axle housing. See appropriate **DIFFERENTIALS & AXLE SHAFTS - TRACKER** article.
39. Remove the front exhaust pipe.
40. Remove the exhaust manifold bracket from the transmission.
41. Remove the transmission fluid hose clamps from the engine mounting bracket.
42. Remove the flywheel cover.
43. Remove the torque converter bolts on automatic transmission equipped vehicles. Use a screwdriver in order to lock the flywheel.
44. Remove the 2 bolts and the starter motor.
45. Lower the vehicle.
46. Support the transmission.
47. Remove the 4 bolts and 2 nuts that fasten the transmission to the cylinder block.
48. Install the engine hoist to the engine.
49. Remove the 2 nuts from the top side of the engine mounts.

NOTE: **Before lifting the engine, ensure that all of the hoses, pipes, electrical wires and cables are disconnected from the engine, and positioned aside.**

50. Remove the engine assembly from the vehicle by sliding the assembly toward the front side of the engine compartment. Carefully lift the engine assembly from the vehicle verifying clearance on all sides.



G00286622

Fig. 2: Removing & Installing Accelerator Cable
Courtesy of GENERAL MOTORS CORP.

Installation

1. Install the engine hoist.
2. Remove the engine assembly from the Heavy Duty Automotive Engine Stand (J-36854).

NOTE: Apply the proper amount of the sealant to the fastener when assembling this component. Excessive use of the sealant can prohibit the component from being assembled properly or allow the fastener to loosen. A component or fastener that is not assembled properly can loosen or fall off leading to extensive engine damage.

3. Align the flywheel-to-crankshaft marks and install the flywheel.
4. Apply threadlocker GM P/N 12345493, or the equivalent, to the flywheel retaining bolt threads.
5. Install the flywheel retaining bolts to the crankshaft. Use the Flywheel Holder (J-35271) to lock the flywheel. Cross tighten the 8 flywheel retaining bolts. See **TORQUE SPECIFICATIONS**.
6. Install the engine assembly. Lower the engine into the front of the engine compartment. While ensuring

clearance on all sides, slide the assembly rearward.

7. Install the engine mount nuts. Tighten the engine mount nuts. See **TORQUE SPECIFICATIONS**.
8. Remove the engine hoist.
9. Install the 4 bolts and 2 nuts that fasten the transmission to the cylinder block. Tighten the bolts and nuts.
10. Raise the vehicle.
11. Install the torque converter bolts. Use a screwdriver in order to lock the flywheel. Tighten the torque converter bolts. See **TORQUE SPECIFICATIONS**.
12. Install the flywheel cover.
13. Install the starting motor.
14. Install the transmission fluid hose clamps to the engine mounting bracket.
15. Install the exhaust manifold bracket to the transmission.
16. Install the front exhaust pipe.
17. Install the front axle housing (on 4WD models only).
18. Install the lower steering shaft assembly.
19. Install the 4 bolts and the A/C compressor bracket, if equipped. Tighten the compressor bracket bolts. See **TORQUE SPECIFICATIONS**.
20. Install the A/C compressor, if equipped. Secure with the 3 bolts. Tighten the compressor mounting bolts.
21. Install the power steering pump to its bracket. Secure with the 3 bolts. Tighten the power steering pump mounting bolts. See **TORQUE SPECIFICATIONS**.
22. Install the power steering pump drive belt.
23. Install the EVAP canister.
24. Connect the fuel return hose to the fuel return pipe.
25. Connect the fuel feed hose to the fuel feed pipe.
26. Install the EVAP canister purge valve.
27. Install the Idle Air Control (IAC) valve.
28. Connect the following hoses:
 - The EVAP canister hose to the canister pipe.
 - The heater hose to the water outlet cap.
 - The heater hose to the heater water pipe.
29. Connect the following electrical connectors:
 - The EVAP canister purge valve.
 - The Exhaust Gas Recirculation (EGR) valve.
 - The oxygen sensor.
 - The coolant temperature sensor.
 - The generator wires.
 - The starter wires.
 - The oil pressure switch wire.
 - The power steering pressure switch wire.

- The ground wire to the generator bracket.
30. Install the clamp brackets.
 31. Connect the following electrical connectors:
 - The Camshaft Position Sensor (CMP).
 - The 6 ignition coils.
 - The Throttle Position (TP) sensor.
 - The Mass Airflow (MAF) sensor.
 - The Idle Air Control (IAC) valve.
 - The ground wires to the surge tank.
 32. Install the clamp bracket.
 33. Connect the injector wire connector.
 34. Connect the brake booster vacuum hose.
 35. Install the engine oil level indicator and tube. Secure with the bolt. Tighten the oil level indicator tube bolt. See **TORQUE SPECIFICATIONS**.
 36. Install the transmission fluid level indicator and tube. Secure with the one bolt. Tighten the transmission fluid level indicator tube bolt. See **TORQUE SPECIFICATIONS**.
 37. Install the ignition coil covers.
 38. Install the Air Cleaner Upper Case, the Intake Air Hose, the Intake Air Pipe and the Surge Tank Pipe as an assembly to the throttle body and intake manifold.
 39. Install the 4 nuts to the surge tank pipe. Tighten the surge tank pipe nuts. See **TORQUE SPECIFICATIONS**.
 40. Connect the Intake Air Temperature (IAT) sensor connector.
 41. Install the surge tank cover.
 42. Install the strut tower brace. Secure with the 6 bolts. Tighten the strut tower brace bolts. See **TORQUE SPECIFICATIONS**.
 43. Connect the A/T throttle cable.
 44. Connect the accelerator cable.
 45. Install the radiator.
 46. Install the upper radiator hose.
 47. Install the automatic transmission fluid cooler lines to the radiator.
 48. Install the lower radiator hose.
 49. Install the front skid plate to the vehicle, if equipped. Secure the front skid plate with the 4 bolts. Tighten the front skid plate bolts. See **TORQUE SPECIFICATIONS**.
 50. Install the engine oil drain plug with a NEW gasket. Tighten the engine oil drain plug. See **TORQUE SPECIFICATIONS**.
 51. Fill the crankcase with engine oil.
 52. Fill the cooling system.
 53. Fill the automatic transmission fluid as necessary.
 54. Connect the negative battery cable.

55. Run the engine and inspect for the following:

- Engine oil leaks.
- Transmission fluid leaks.
- Engine coolant leaks.
- Fuel leaks.

INTAKE MANIFOLD

Removal

1. Partially drain cooling system and relieve fuel pressure. Disconnect the water hoses from the throttle body.
2. Disconnect the injector wire coupler.
3. Disconnect the following electrical connectors:
 - The Throttle Position (TP) sensor.
 - The Mass Airflow (MAF) sensor.
 - The Idle Air Control (IAC) valve.
4. Disconnect the ground terminal from the intake collector.
5. Remove the clamp bracket from the intake collector.
6. Disconnect the following electrical connectors:
 - The Manifold Differential Pressure (MDP) sensor.
 - The EVAP canister purge valve.
 - The Exhaust Gas Recirculation (EGR) valve.
7. Disconnect the following hoses:
 - The PVC hose from the cylinder head cover.
 - The breather hose from the throttle body.
 - The EVAP canister purge valve hose.
 - The water hose.
 - The heater hoses.
8. Remove the EGR pipe.
9. Disconnect the following hoses:
 - The heater hose.
 - The EVAP canister hose.
 - The fuel feed hose.
 - The fuel return hose.
 - The tank pressure control solenoid valve hose.
10. Disconnect the hose from the Idle Air Control (IAC) valve.
11. Remove the Idle Air Control (IAC) valve.
12. Remove the 4 nuts and 2 bolts on the intake collector.

13. Remove the intake manifold rear crossover pipe and throttle body from the intake manifold as an assembly.
14. If necessary, remove the 2 nuts and bolts and remove the throttle body from the intake manifold rear crossover pipe.
15. Remove the 8 bolts and 4 nuts on the intake manifold.
16. Remove the intake manifold.

Installation

1. Install the NEW intake manifold gaskets onto the cylinder heads.
2. Install the intake manifold. Secure the intake manifold with the 8 bolts and 4 nuts. Tighten the bolts and nuts. See **TORQUE SPECIFICATIONS**.
3. Install the NEW throttle body gasket to the intake collector.
4. Install the throttle body to the intake collector. Secure the throttle body with the 2 bolts and 2 nuts. Tighten the nuts and bolts. See **TORQUE SPECIFICATIONS** table.
5. Install the intake collector and the throttle body as an assembly to the intake manifold with a NEW gasket. Secure with the 4 nuts and 2 bolts. Tighten the nuts and bolts. See **TORQUE SPECIFICATIONS**.
6. Install the Idle Air Control (IAC) valve with a NEW gasket.
7. Connect the following hoses:
 - The heater hose.
 - The EVAP canister hose.
 - The fuel feed hose.
 - The fuel return hose.
 - The tank pressure control solenoid valve hose.
8. Install the Exhaust Gas Recirculation (EGR) pipe.
9. Connect the following hose:
 - The PCV hose to the cylinder head cover.
 - The breather hose to the throttle body.
 - The EVAP canister purge valve hose.
 - The water hose.
 - The heater hoses.
10. Connect the following electrical connectors:
 - The Manifold Differential Pressure (MDP) sensor.
 - The EVAP canister purge valve.
 - The exhaust gas recirculation (EGR) valve.
11. Install the clamp bracket to the intake collector.
12. Install the ground terminal to intake collector.
13. Connect the following electrical connectors:
 - The Throttle Position (TP) sensor.

- The Mass Airflow (MAF) sensor.
 - The Idle Air Control (IAC) valve.
14. Connect the injector wire coupler.
 15. Connect the water hoses to the throttle body.

EXHAUST MANIFOLD

Removal (Left)

1. Remove exhaust manifold cover bolts and the cover.
2. Remove exhaust manifold reinforcement bracket.
3. Remove nuts and bolts from exhaust manifold.
4. Remove exhaust manifold and gasket.

Removal (Right)

1. Disconnect the EGR pipe from the exhaust manifold.
2. Remove the exhaust manifold cover bolts and the cover.
3. Remove the exhaust manifold reinforcement bracket.
4. Remove the nuts and bolts from the exhaust manifold.
5. Remove the exhaust manifold with the gasket.

Installation (Left)

NOTE: When installing a new exhaust system component, always use new gaskets and seals.

1. Install exhaust manifold with a new gasket. Tighten the manifold nuts and bolts. See **TORQUE SPECIFICATIONS**.
2. Install the exhaust manifold reinforcement bracket to the exhaust manifold and engine block. Tighten the engine mount-to-exhaust bracket bolt and the exhaust bracket-to-exhaust manifold nut. See **TORQUE SPECIFICATIONS**.
3. Install the exhaust manifold cover and the cover bolts. Tighten the exhaust manifold heat shield bolts. See **TORQUE SPECIFICATIONS**.

Installation (Right)

NOTE: When installing a new exhaust system component, always use new gaskets and seals.

1. Install the exhaust manifold with a new gasket. Tighten the manifold bolts and nuts. See **TORQUE SPECIFICATIONS**.
2. Install the exhaust manifold reinforcement bracket following to the exhaust manifold and engine block. Tighten the engine mount-to-exhaust bracket bolt and the exhaust bracket-to-exhaust manifold nut. See

TORQUE SPECIFICATIONS.

3. Install the exhaust manifold cover and the cover bolts. Tighten the lower manifold heat shield bolts. See **TORQUE SPECIFICATIONS.**
4. Connect the EGR pipe to the exhaust manifold.

VALVE COVERS

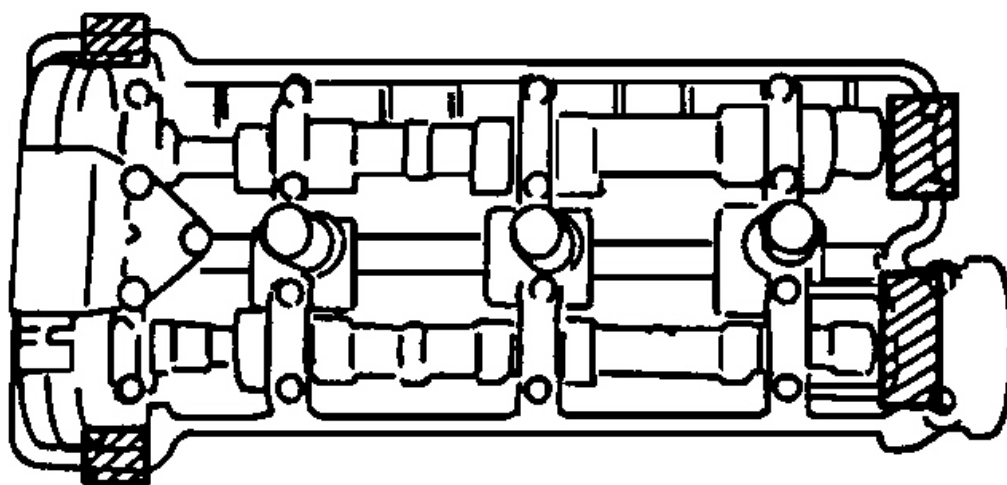
NOTE: Valve cover may also be referred to as camshaft cover.

Removal (Left & Right)

1. Remove ignition coil cover.
2. Remove ignition coils.
3. Remove the 4 nuts on the valve cover.
4. Remove valve cover.
5. Remove valve cover gasket.

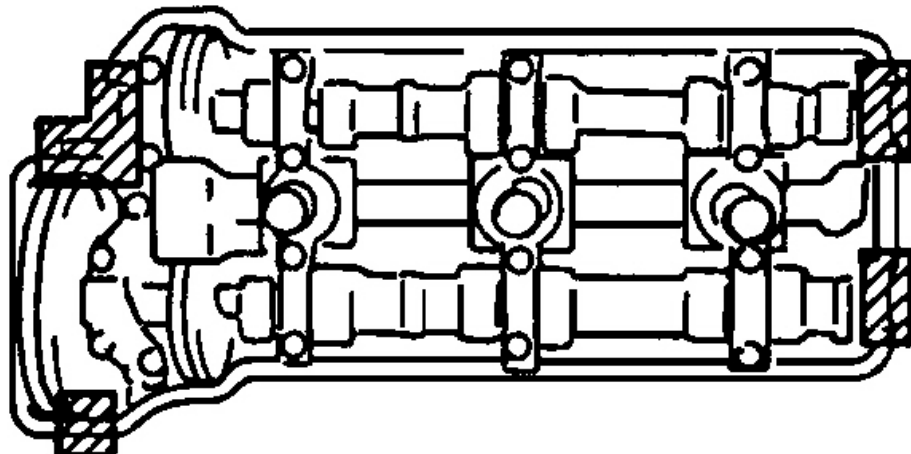
Installation (Left & Right)

1. Clean sealing surfaces on valve cover and cylinder head.
2. Apply GM P/N 12346240 or equivalent to the cylinder head at the points indicated. See **Fig. 3.**
3. Install the NEW valve cover gasket to the valve cover.
4. Install the NEW cylinder head side seals to the cylinder head.
5. Install the valve cover to the cylinder head.
6. Using NEW seal washers, tighten the 4 nuts on the valve cover. See **TORQUE SPECIFICATIONS.**
7. Install the ignition coils.
8. Install the ignition coil cover.



LEFT SIDE (NO. 1) CYLINDER

▨ : Area To Apply Sealant "A"



RIGHT SIDE (NO. 2) CYLINDER

▨ : Area To Apply Sealant "A"

G00010493

Fig. 3: Applying Valve Cover Sealant

Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD

Removal (Left & Right)

1. Remove the camshafts.
2. Remove the lifters.
3. Remove the exhaust manifold.
4. Remove the water crossover pipe.
5. Remove the hex bolt.
6. Remove the cylinder head bolts in the proper order. See **Fig. 39**.
7. Remove the cylinder heads.
8. Clean the cylinder head mating surface.
9. Clean the cylinder block mating surface.
10. Clean the cylinder head bolt threads and bolts. Replace any stretched or damaged bolts.
11. Clean the cylinder block bolt holes of all debris, threadlocker, sealant etc. Installing a bolt to a blocked bolt hole will cause incorrect torque and may cause cylinder head/block damage.

Cleaning & Inspection

1. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion and blow-by.
2. If the gasket has failed, determine the cause. Gasket failure may be caused by the following:
 - Improper installation.
 - Loose or warped cylinder head.
 - Warped cylinder block surface.
 - Missing, off location or not fully seated dowel pins.
 - Corrosion in the seal area around the coolant passages.
 - Chips or debris in the cylinder head bolt holes.
 - Bolt holes in the cylinder block not drilled or tapped deep enough.
 - Incorrect cylinder head bolt torque.
 - Incorrect cylinder head bolt length.
3. Inspect the cylinder head gasket surface:
 - Replace the cylinder head if the area between the valve seats is cracked.
 - Replace the cylinder head if corrosion has been found inside a .375" (4 mm) band around each combustion chamber.

NOTE: **Do not use a wire brush on any gasket sealing surface. Do not attempt to weld the cylinder head, replace it.**

4. Clean the cylinder head. Remove all varnish, soot and carbon to the bare metal.

5. Clean the valve guides.
6. Inspect the valve guides for wear.
7. Inspect the valve seats for excessive wear and hot spots.
8. Inspect the valve seating surfaces.
9. Clean the threaded holes. Use a nylon bristle brush.
10. Clean the remains of the sealer from the plug holes.
11. Replace all suspect bolts.
12. Inspect the cylinder head for cracks. Check between the valve seats and in the exhaust ports.
13. Inspect the cylinder head deck for corrosion, sand inclusions and blow holes.
14. Inspect all the threaded holes for damage. Threads may be reconditioned with thread inserts.
15. Inspect the intake, the exhaust and the cylinder head deck sealing surfaces.
16. Inspect the cylinder head deck surface for flatness. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.
17. Inspect the cylinder head intake surface for flatness. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.
18. Inspect the cylinder head exhaust surface for flatness. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.
19. If the warpage is greater than the maximum in any measurement, replace the cylinder head.
20. Measure the free length of each valve spring using a Vernier caliper. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
21. If the free length of any valve spring is not within specification, replace the valve spring.
22. Measure the tension of the valve spring at the specified installed height using a spring tester. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
23. If the installed tension of any valve spring is not within specifications, replace the valve spring.
24. Measure the valve spring squareness deviation using a steel square. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
25. If the deviation of any valve spring is greater than the specified maximum, replace the valve spring.
26. Inspect the valve spring seating surface of the valve spring seats for wear or gouging. Replace as required.
27. Temporarily install the valves into the cylinder head.
28. Measure valve runout. Inspect valve face-to-valve seat contact pattern by performing the following:
 - Apply a light coating of Prussian blue to the entire valve face. Seat the valve but do not rotate it. The Prussian blue traces transferred to the valve seat are an indication of concentricity of the valve seat.
 - Clean all traces of Prussian blue.
 - Apply a light coating of Prussian blue to the valve seat and repeat the check. The traces of Prussian blue transferred to the valve face indicates valve face concentricity.
 - Recondition the valve seat and/or replace the valves as necessary.

Installation

1. Install the knockpin to the cylinder block if removed.
2. Apply sealant to the cylinder head gasket as shown.
3. Install the cylinder head gasket to the block with the 86FA mark facing up.
4. Install the cylinder head to the block.

NOTE: **The cylinder head bolts must be tightened in 2 stages, loosened, and then retightened in 3 stages in order to ensure against compression and coolant leaks.**

5. Apply clean engine oil to the bolt threads and install the cylinder head bolts.
6. Tighten the cylinder head bolts. See **TORQUE SPECIFICATIONS**.
7. Install the water crossover pipe.
8. Install the lifters.
9. Install the camshafts.

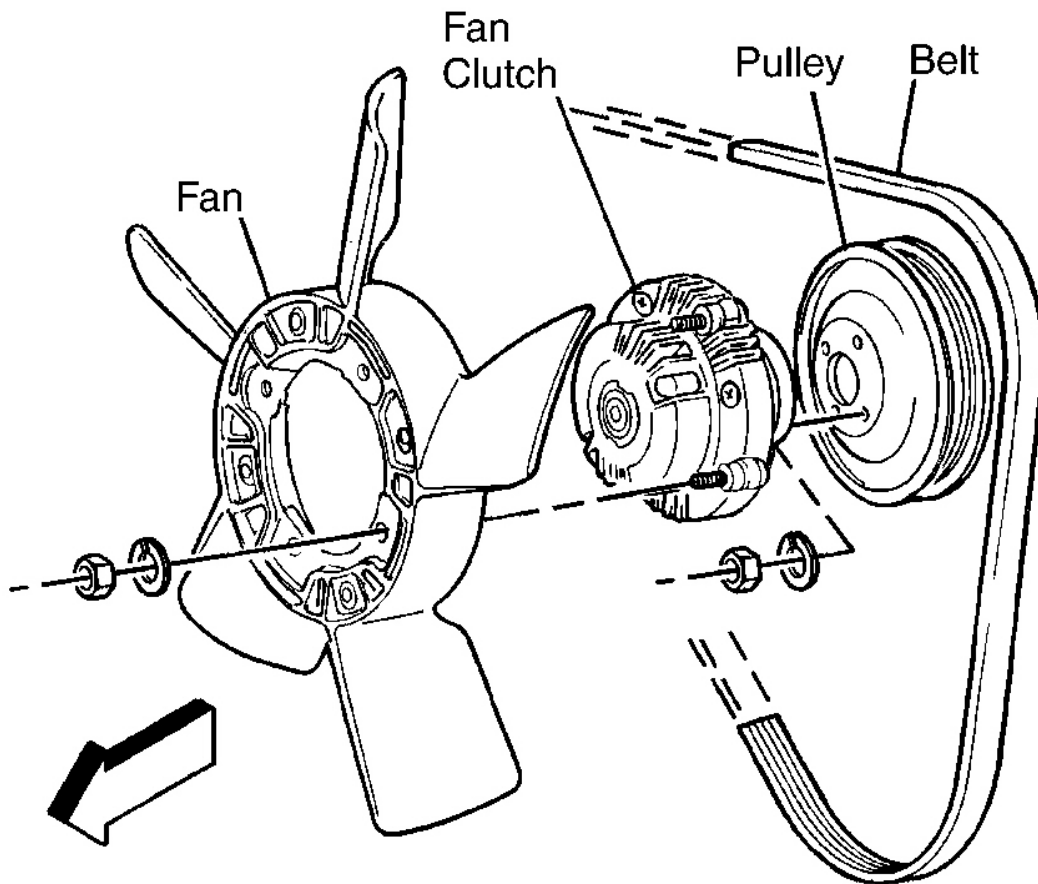
TIMING CHAIN COVER & FRONT OIL SEAL

Removal

1. Drain the engine oil.
2. Remove the throttle body and intake manifold.
3. Remove the left and right cylinder head covers.
4. Remove the water pump drive belt. See **Fig. 4**.
5. Remove the water pump pulley.
6. Remove the 3 bolts and the thermostat cap.
7. Remove the 3 bolts from the power steering pump bracket and remove bracket.
8. Remove the crankshaft balancer.
9. Remove the lower oil pan.
10. Remove the upper oil pan.
11. Disconnect the Crankshaft Position (CKP) sensor.
12. Remove the bolt and the (CKP) sensor.
13. Remove the bolts and the front cover.
14. Remove engine crankshaft balancer.

NOTE: **To protect the crankshaft from damage, wrap the tip of the screwdriver with tape.**

15. Carefully pry out the crankshaft front oil seal using a screwdriver.



G00286620

Fig. 4: Identifying Coolant Fan & Pulley
Courtesy of GENERAL MOTORS CORP.

Installation

1. Lubricate the new crankshaft front oil seal with Chassis Grease GM P/N 1051344 or equivalent.

NOTE: Tap the oil seal in until its surface is flush with the crankshaft front oil seal retainer edge.

2. Using a hammer and an appropriate driver, lightly tap the crankshaft front oil seal into place.
3. Install the crankshaft balancer.
4. Clean the sealing surfaces on the front cover, the crankcase, the cylinder block and the cylinder heads.
5. Apply GM P/N 12346240 or equivalent to the front cover. See **Fig. 5**.
6. Apply engine oil to the oil seal lip and the water pump "O" ring.

7. Install the front cover and secure with the bolts. Tighten the bolts. See **TORQUE SPECIFICATIONS**.
8. Apply engine oil to the "O" ring of the Crankshaft Position (CKP) sensor.
9. Install the CKP sensor. Secure with the bolt. Tighten the bolt. See **TORQUE SPECIFICATIONS**.
10. Install the upper oil pan.
11. Install the lower oil pan.
12. Install the crankshaft balancer.
13. Install the power steering pump bracket. Secure with the 3 bolts. Tighten the bolts. See **TORQUE SPECIFICATIONS**.
14. Install the thermostat cap.
15. Install the water pump pulley.
16. Install the left and right cylinder head covers.
17. Install the intake manifold and throttle body.

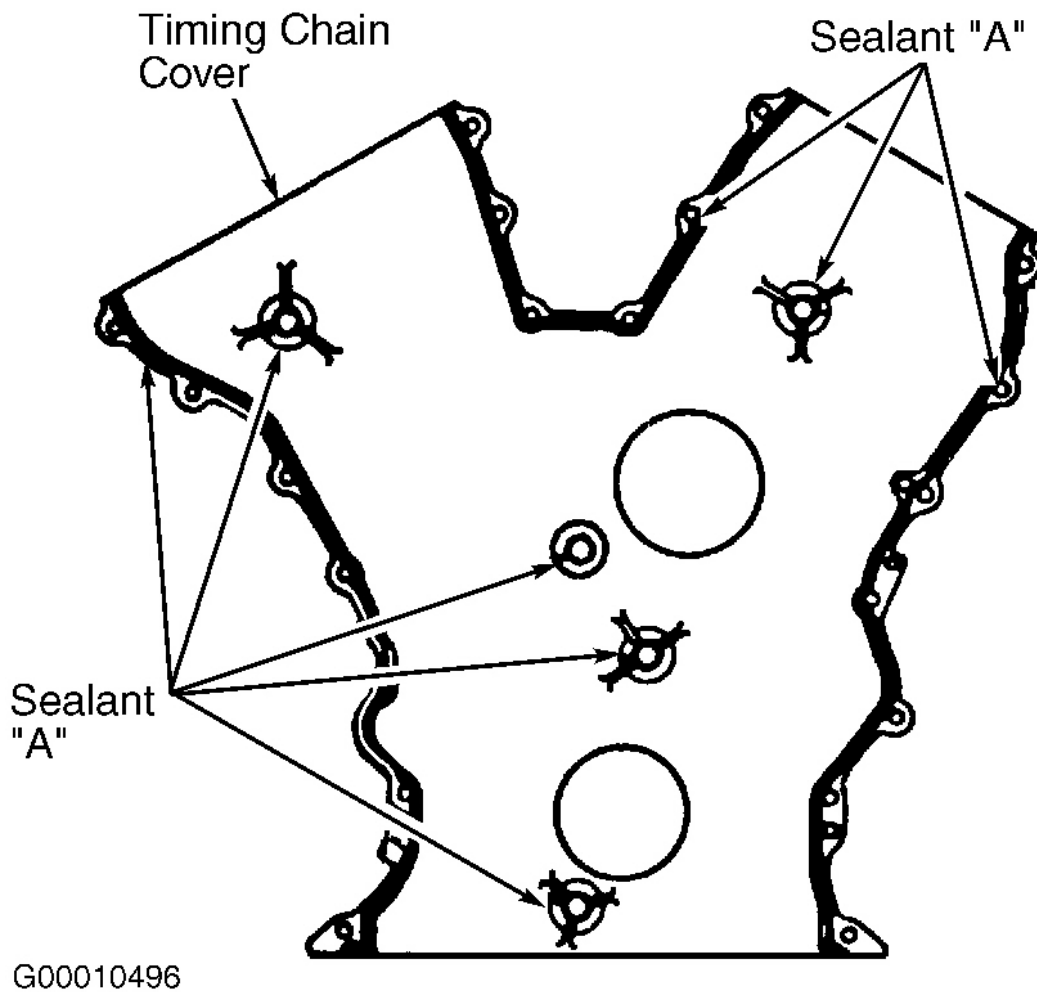


Fig. 5: Applying Timing Chain Cover Sealant
Courtesy of SUZUKI OF AMERICA CORP.

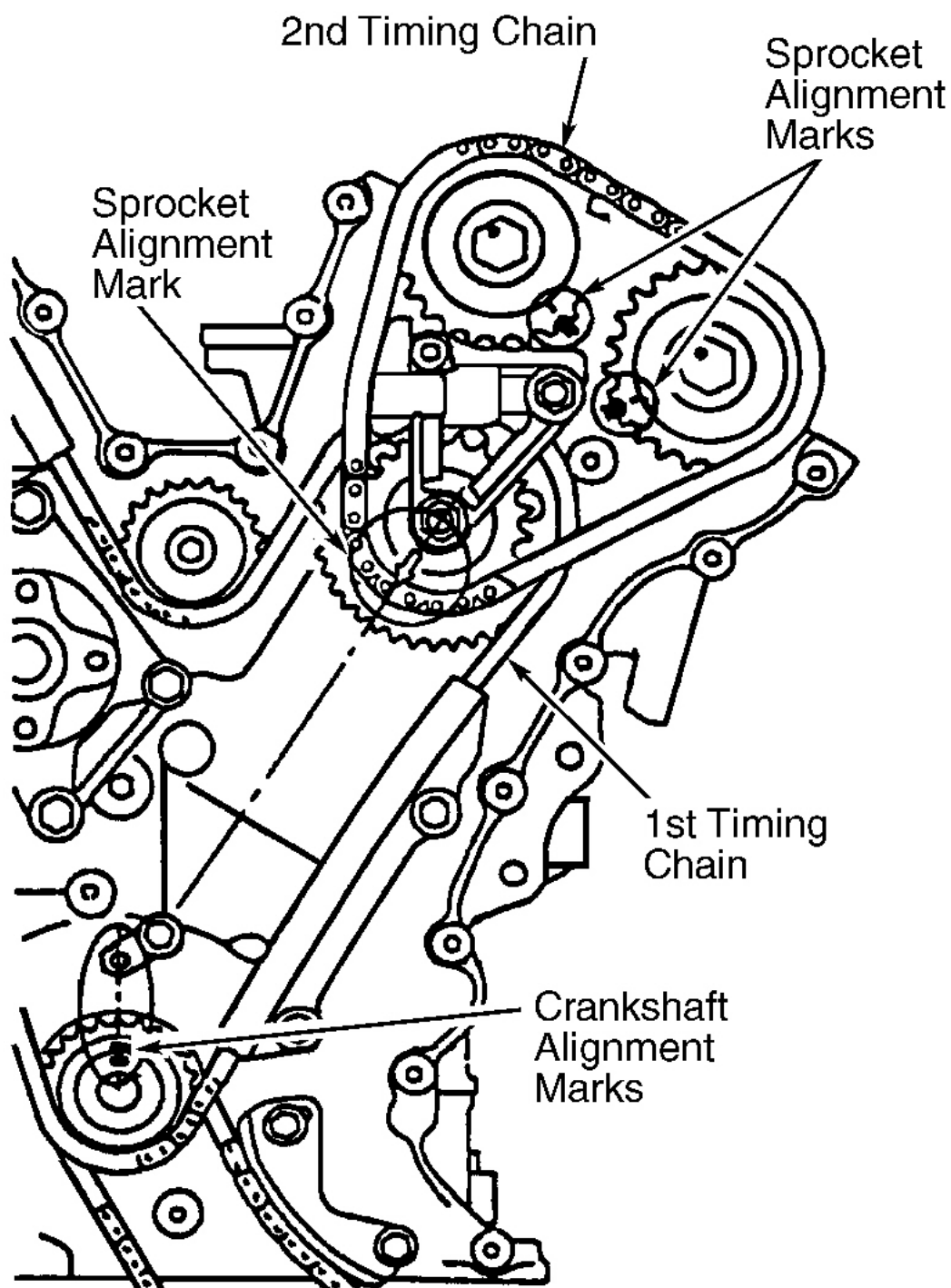
LEFT (NO. 1) BANK 2ND TIMING CHAIN & CHAIN TENSIONER

Removal

1. Remove the engine front cover.
2. Remove the spark plugs.

NOTE: The timing marks must be correctly aligned before disassembly in order to correctly install the timing chains. Avoid turning the camshafts and the crankshaft once the timing chain is removed. Valve and piston damage may occur.

3. Rotate the crankshaft so that the following conditions are met:
 - The keyway on the crankshaft is properly positioned.
 - The arrow on the idler sprocket is pointing to the crankshaft.
 - The marks on the sprockets match up with the marks on the cylinder head. See **Fig. 6**.
4. Remove the 3 bolt and the upper chain guide.
5. Remove the one nut and 2 bolts from the timing chain tensioner.
6. Remove the timing chain tensioner. It may be necessary to slacken the timing chain by turning the intake camshaft counterclockwise a little while pushing back on the tensioner pad. See **Fig. 7**.
7. Hold the camshafts with a wrench and remove the camshaft sprocket bolts.
8. Remove the camshaft sprockets and timing chain.
9. Remove the 2 bolts and the side chain guide.



G00010497

Fig. 6: Aligning Marks For Left Bank 2nd Timing Chain

Courtesy of SUZUKI OF AMERICA CORP.

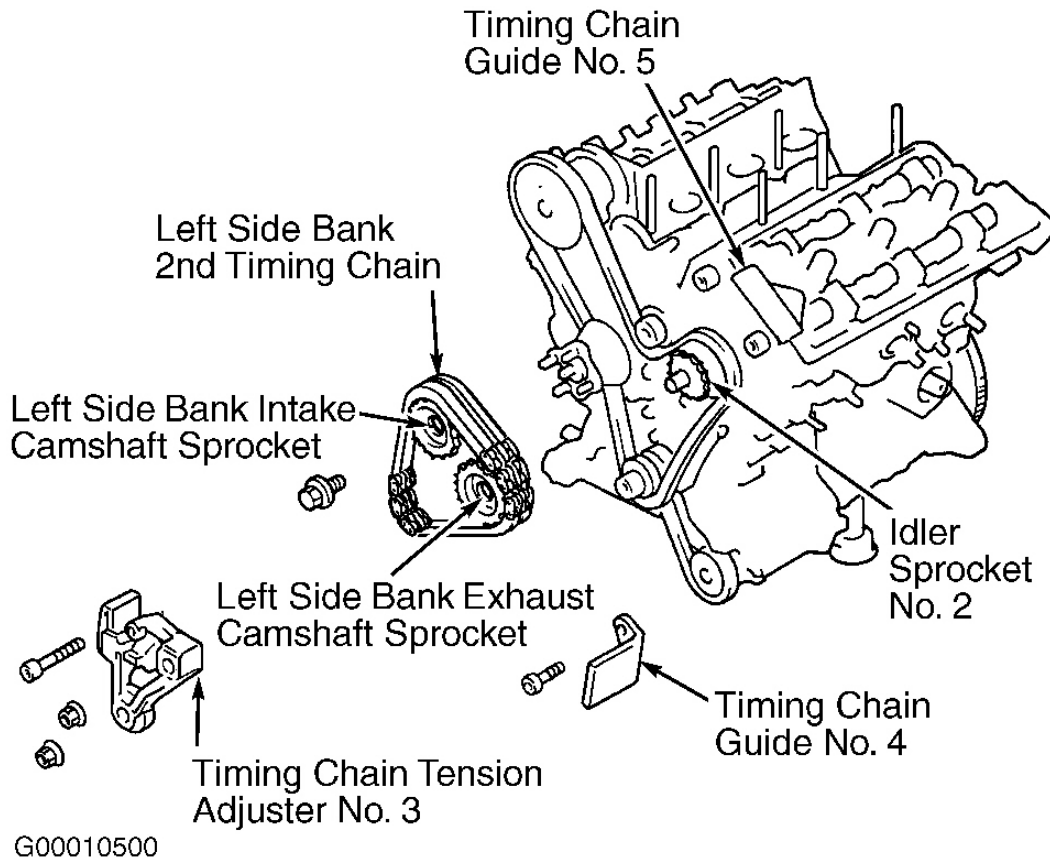


Fig. 7: Removing Left Bank 2nd Timing Chain
 Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Verify the keyway on the crankshaft is properly positioned.
2. Verify the timing mark on the idler sprocket is properly positioned.
3. Install the side chain guide. Secure with the 2 bolts. Tighten the bolts. See **TORQUE SPECIFICATIONS**.
4. Verify that the knock-pin of the intake camshaft and knock-pin of the exhaust camshaft are aligned with the match marks on the cylinder head. See **Fig. 8**
5. Install timing chain to idler sprocket by aligning Yellow link of the timing chain with the mark on the idler sprocket. See **Fig. 9**.
6. Install the sprockets to the camshafts by aligning the Silver links with the mark on the intake sprocket and the exhaust sprocket.
7. Secure the sprocket with the bolts while holding the camshafts with a wrench. Tighten the 2 bolts. See

TORQUE SPECIFICATIONS.

8. With the latch of the tensioner adjuster returned and the plunger pushed back into the body, insert a retainer (paper clip or similar tool) into the set hole. After inserting the pin, make sure the plunger will not come out.
9. Install the timing chain tensioner. Secure with the bolt. Tighten the bolt. See **TORQUE SPECIFICATIONS.**
10. Install tensioner nut. Tighten the nut. See **TORQUE SPECIFICATIONS.**
11. Remove the retainer from the tensioner.
12. Install the upper chain guide. Secure with the 3 bolts. Tighten the bolts. See **TORQUE SPECIFICATIONS.**
13. Turn the crankshaft 2 revolutions clockwise.
14. Align the keyway on the crankshaft with the oil jet.
15. Verify that all the other timing marks are properly aligned.
16. Apply engine oil to the following:
 - The timing chains.
 - The tensioner.
 - The guides.
 - The sprockets.
17. Install the spark plugs.
18. Install the engine front cover.

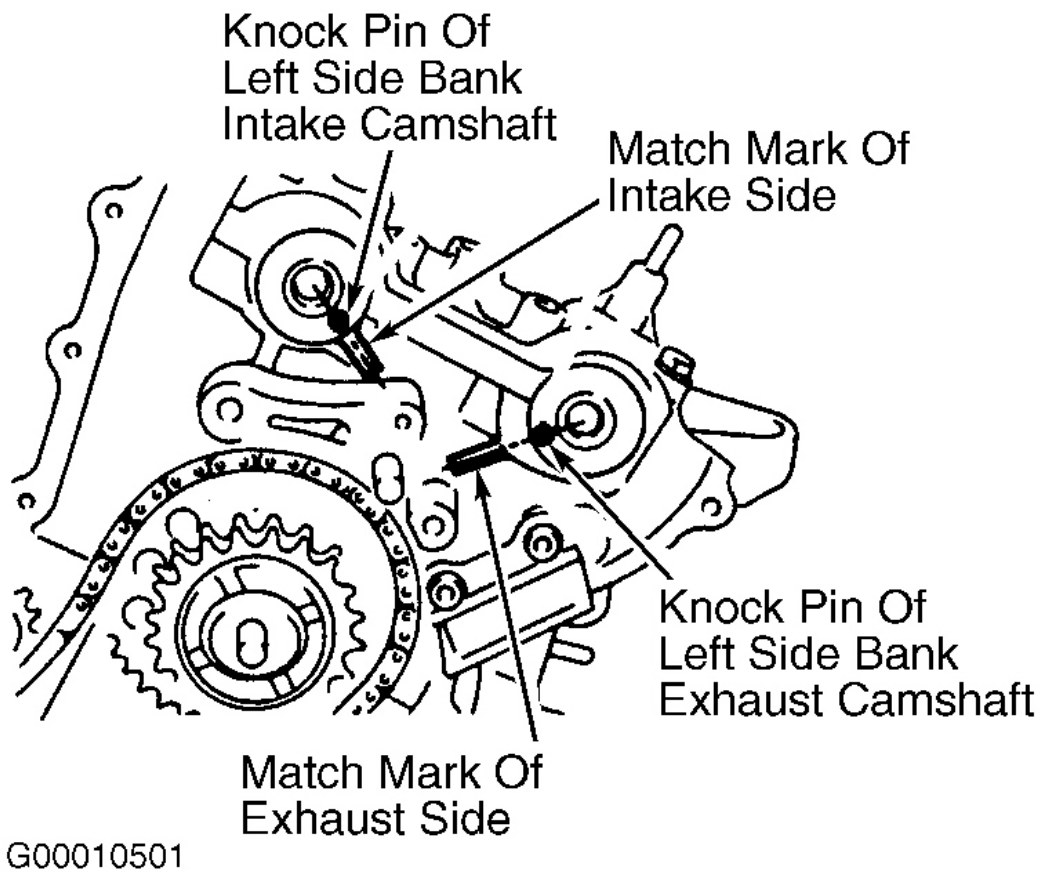
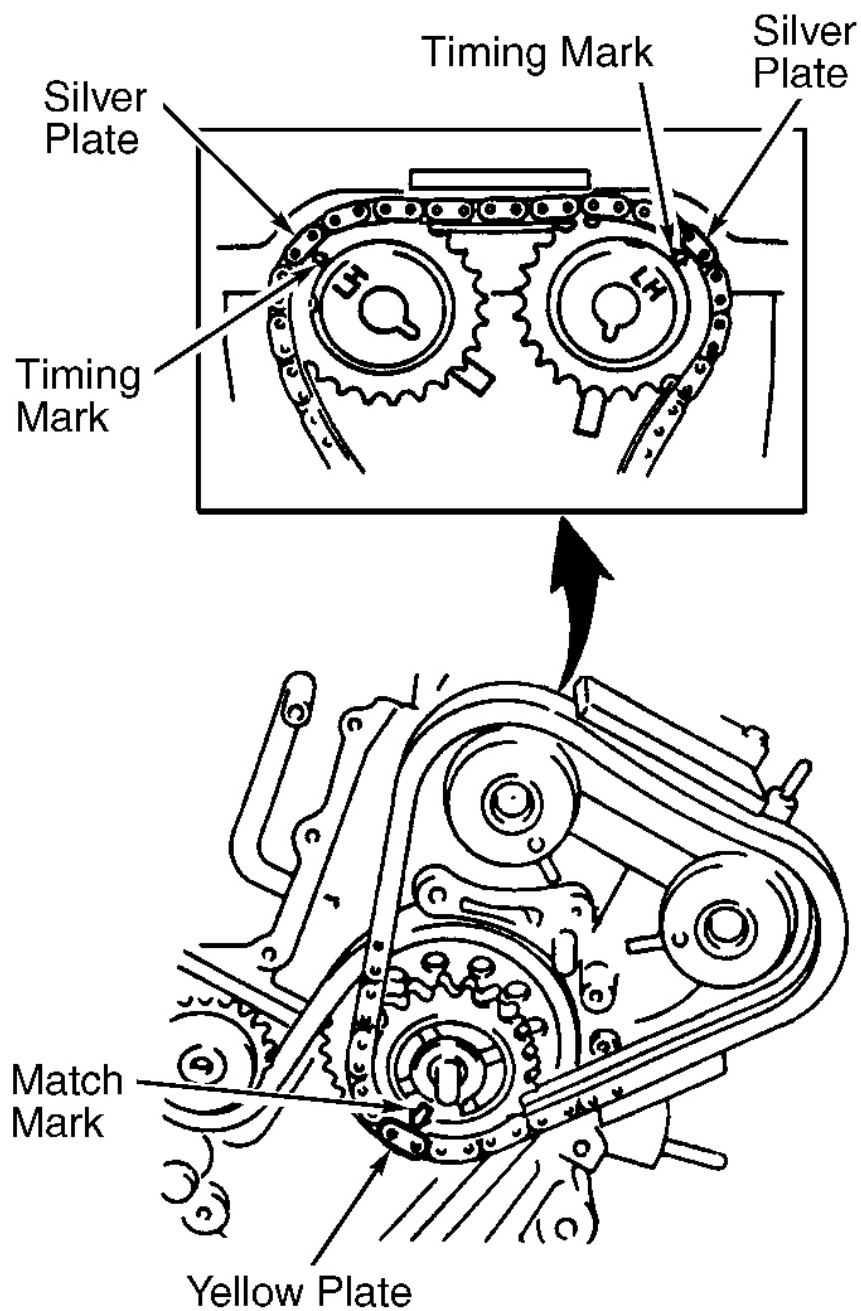


Fig. 8: Aligning Left Bank Camshaft Knock Pins
Courtesy of SUZUKI OF AMERICA CORP.



G00010498

Fig. 9: Locating Left Bank Camshaft Timing Chain Marks
 Courtesy of SUZUKI OF AMERICA CORP.

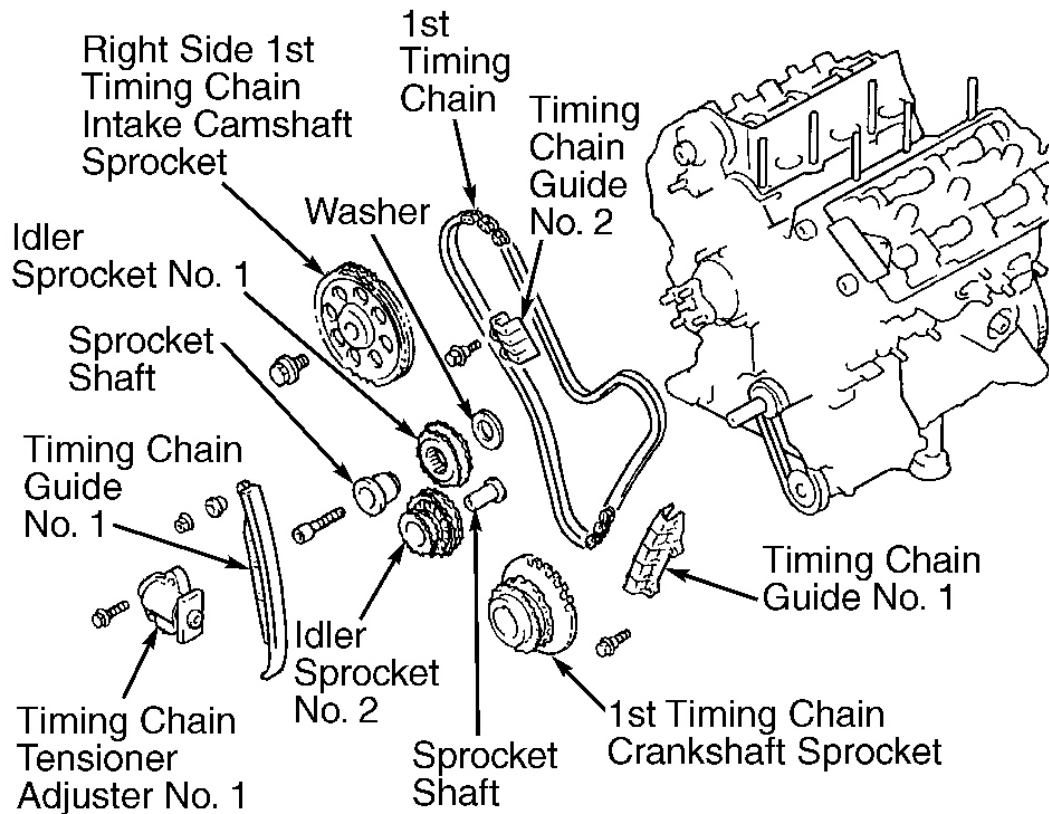
1ST TIMING CHAIN & CHAIN TENSIONER

Removal

1. Remove the engine front cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**.
2. Remove the spark plugs.

NOTE: **The timing marks must be correctly aligned before disassembly in order to correctly install the timing chains. Avoid turning the camshafts and the crankshaft once the timing chain is removed. Valve and piston damage may occur.**

3. Rotate the crankshaft so that timing marks are aligned.
4. Remove the secondary timing chain.
5. Remove the timing chain guides.
6. Remove the timing chain tensioner adjuster.
7. Remove the idler sprocket and the primary timing chain.
8. Remove the idler sprocket and the sprocket shaft.
9. Remove the timing chain tensioner.
10. Remove the right primary timing chain camshaft sprocket bolt while holding the right intake camshaft with a wrench.
11. Remove the right primary sprocket from the intake camshaft.
12. Remove the primary timing chain crankshaft sprocket. See **Fig. 10**.



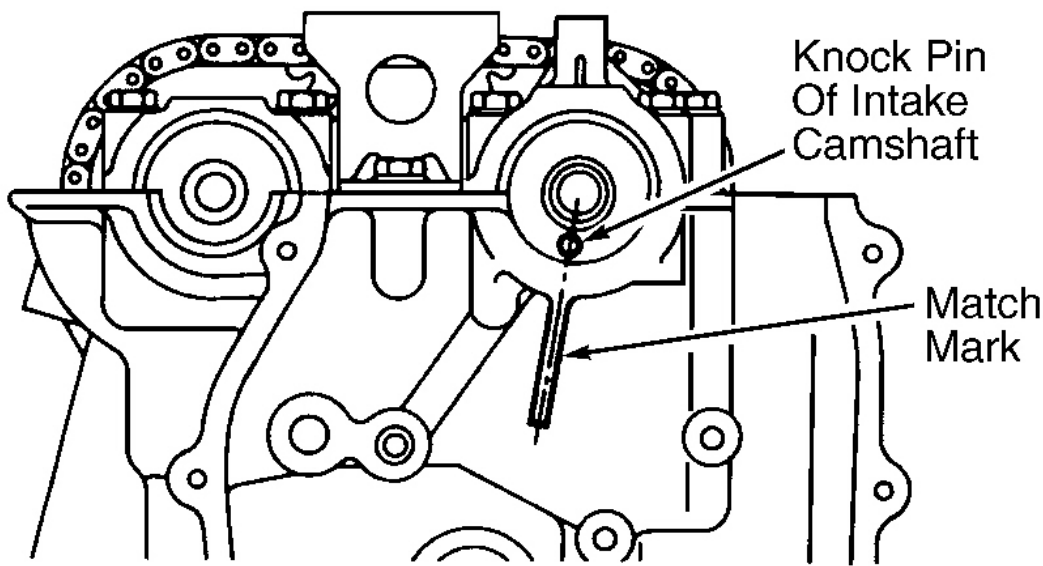
G00010499

Fig. 10: Exploded View Of Right Bank Timing Chain Components
 Courtesy of SUZUKI OF AMERICA CORP.

Installation

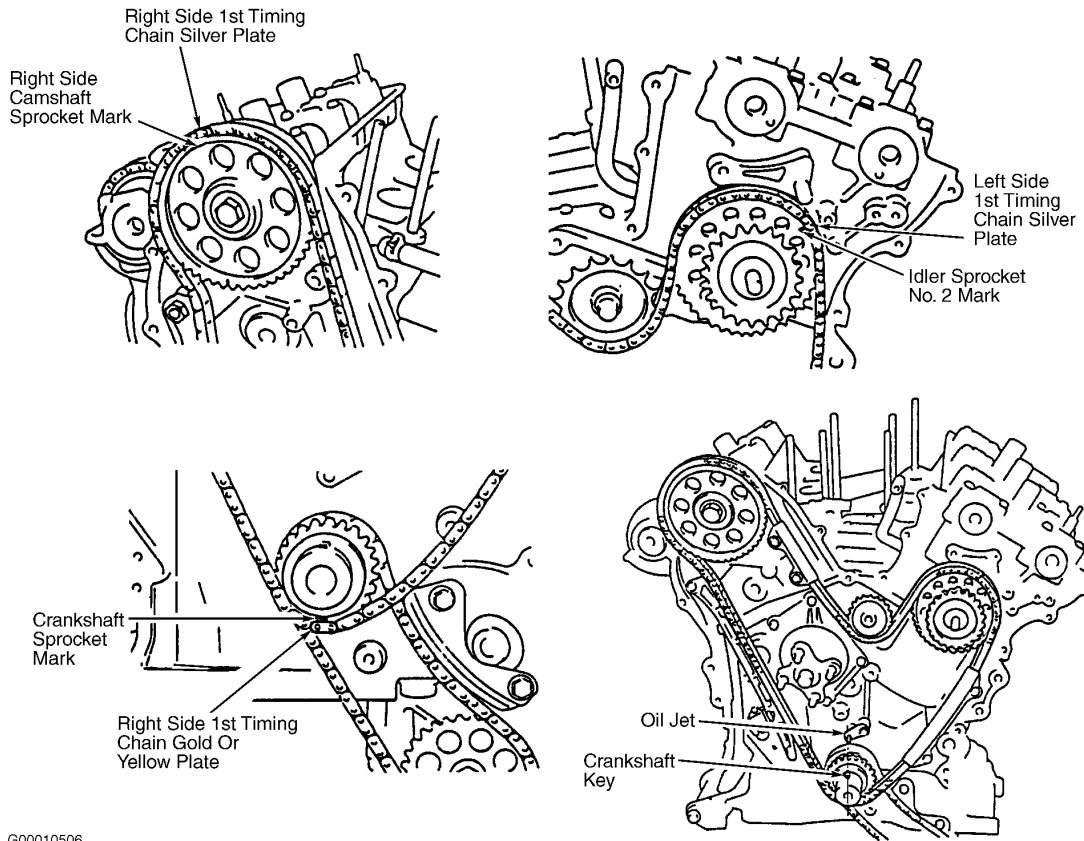
1. Verify the keyway on the crankshaft is positioned properly.
2. Install the crankshaft sprocket to the crankshaft.
3. Verify that the knock-pin on the right intake camshaft is aligned with the match mark. See **Fig. 11**.
4. Install the right primary sprocket to the intake camshaft with the RH mark facing forward.
5. Secure the sprocket with the bolt while holding the intake camshaft with a wrench. Tighten the bolt. See **TORQUE SPECIFICATIONS**.
6. Install the timing chain tensioner. Secure with the nut. Tighten the nut. See **TORQUE SPECIFICATIONS**.
7. Install the primary timing chain to the primary right intake sprocket by aligning the right Silver link on the chain with the mark on the sprocket.
8. Apply oil to the inside of the idler sprocket and install the sprocket by aligning the left Silver link with the mark on the idler sprocket.

9. Install the primary timing chain to the crankshaft sprocket by aligning the Yellow link on the chain with the mark on the sprocket.
10. Apply oil to the bearing of the idler sprocket.
11. Install the primary timing chain to the idler sprocket and secure the sprocket to the engine block with the bolt. Tighten the bolt. See **TORQUE SPECIFICATIONS**.
12. With the latch of the tensioner adjuster returned and the plunger pushed back into the body, insert a retainer (paper clip or similar tool) into the set hole. After inserting the pin, make sure the plunger will not come out.
13. Install the tensioner adjuster to the engine block and tensioner. Secure with the 2 bolts. Tighten the bolt. See **TORQUE SPECIFICATIONS**.
14. Remove the retainer from the tensioner.
15. Install the timing chain guides. Tighten the bolts. See **TORQUE SPECIFICATIONS**.
16. Verify that each timing mark is aligned properly. See **Fig. 12**.
17. Install the left secondary timing chain and tensioner.
18. Install the engine front cover.
19. Install the spark plugs.



G00010502

Fig. 11: Aligning Right Bank Intake Camshaft
Courtesy of SUZUKI OF AMERICA CORP.



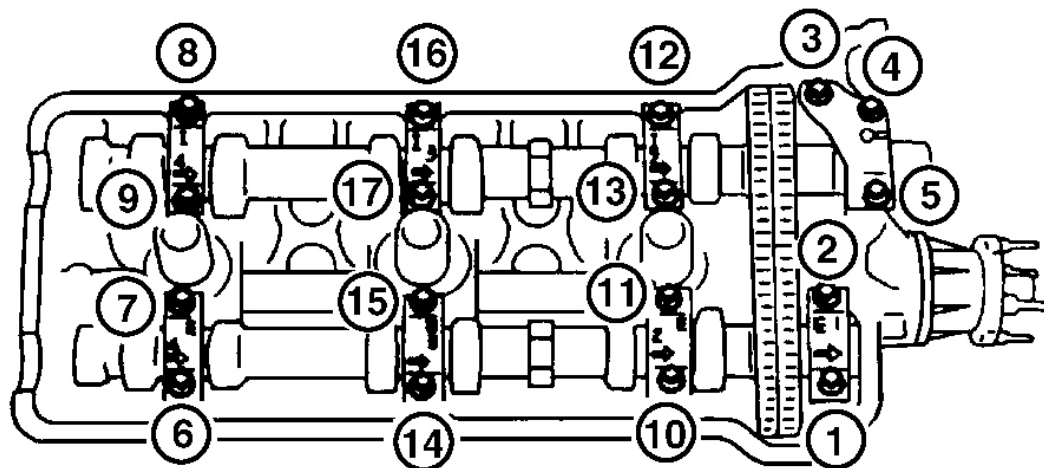
G00010506

Fig. 12: Aligning Marks On Right 1st Timing Chain
 Courtesy of SUZUKI OF AMERICA CORP.

RIGHT (NO. 2) BANK 2ND TIMING CHAIN & CHAIN TENSIONER

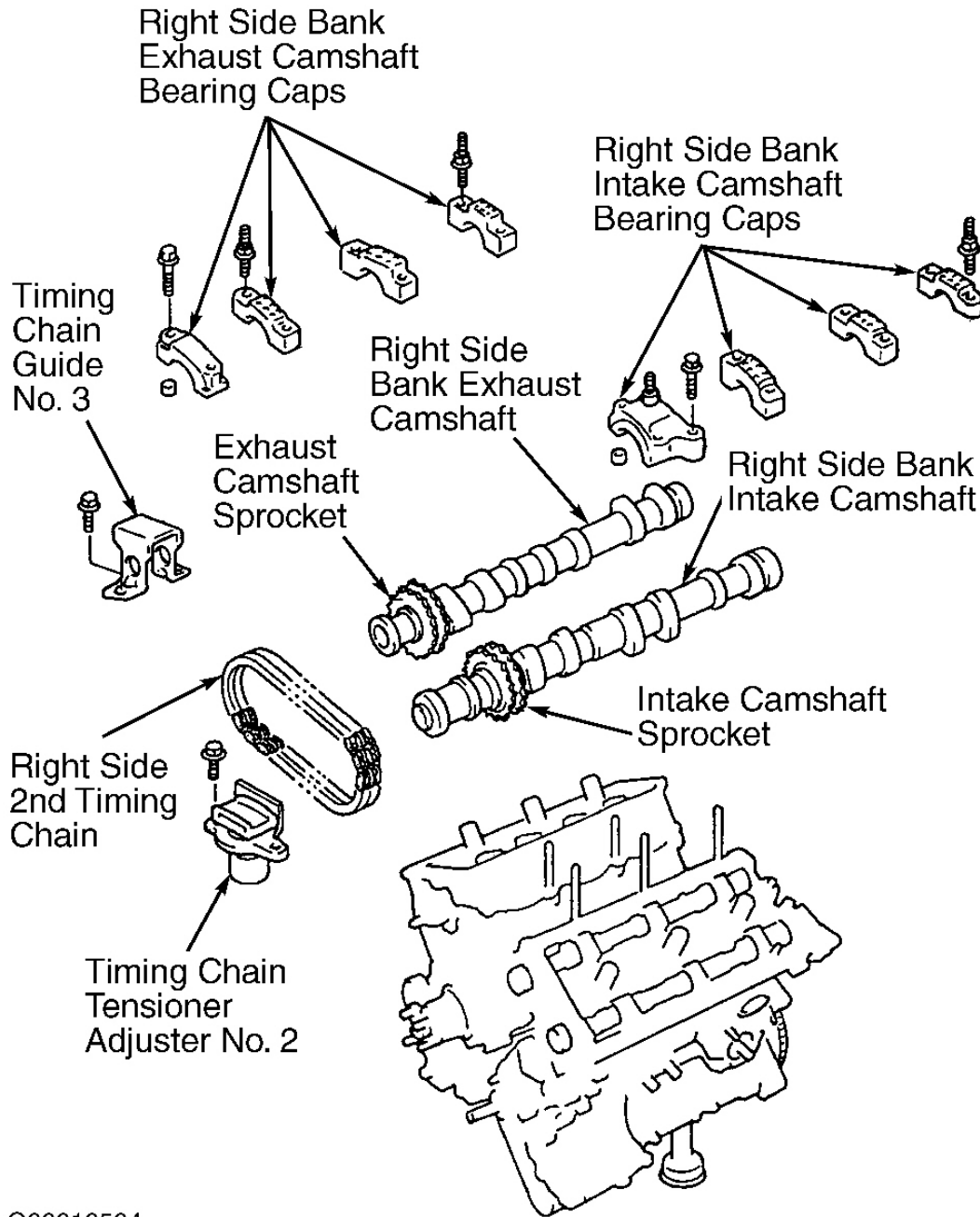
Removal

1. Remove the engine front cover.
2. Remove the left secondary timing chain.
3. Remove the primary timing chain.
4. Remove the 2 bolts and the timing chain guide.
5. Remove the camshaft bearing cap bolts in the proper sequence. See **Fig. 13**.
6. Remove the camshaft bearing caps.
7. Remove the camshafts and secondary timing chain as a set.
8. Remove the 2 bolts and the timing chain tensioner. See **Fig. 14**.



G00010508

Fig. 13: Right Camshaft Bearing Cap Bolt Removal Sequence
 Courtesy of SUZUKI OF AMERICA CORP.



G00010504

Fig. 14: Exploded View Of Right Timing Chain & Camshafts
 Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Verify that the keyway on the crankshaft is positioned properly.

2. Apply oil to the secondary right timing chain tensioner.
3. Install the timing chain tensioner and secure with the 2 bolts. Tighten the bolts. See **TORQUE SPECIFICATIONS**.
4. Apply oil to the camshafts lobes and journals.
5. Install the right timing chain to the camshaft sprockets by aligning the Silver or Yellow links with the marks on the camshaft sprockets. See **Fig. 15**.
6. Install the camshaft bearing cap pins.
7. Install the camshafts with the timing chain to the cylinder head.
8. Apply oil to the camshaft bearing cap bolts.

NOTE: **Cylinder head and camshaft damage may result if the bearing caps are incorrectly installed.**

9. Install the camshaft bearing caps. The caps are marked intake or exhaust, position away from the timing chain, and direction toward the timing chain. See **Fig. 16**.
10. Tighten the camshaft bearing caps. See **TORQUE SPECIFICATIONS**. See **Fig. 16** and **Fig. 20**.
11. Install the right secondary timing chain guide. Secure with the 2 bolts. Tighten the bolts. See **TORQUE SPECIFICATIONS**.
12. Install the primary timing chain.
13. Install the left secondary timing chain.
14. Install the engine front cover.

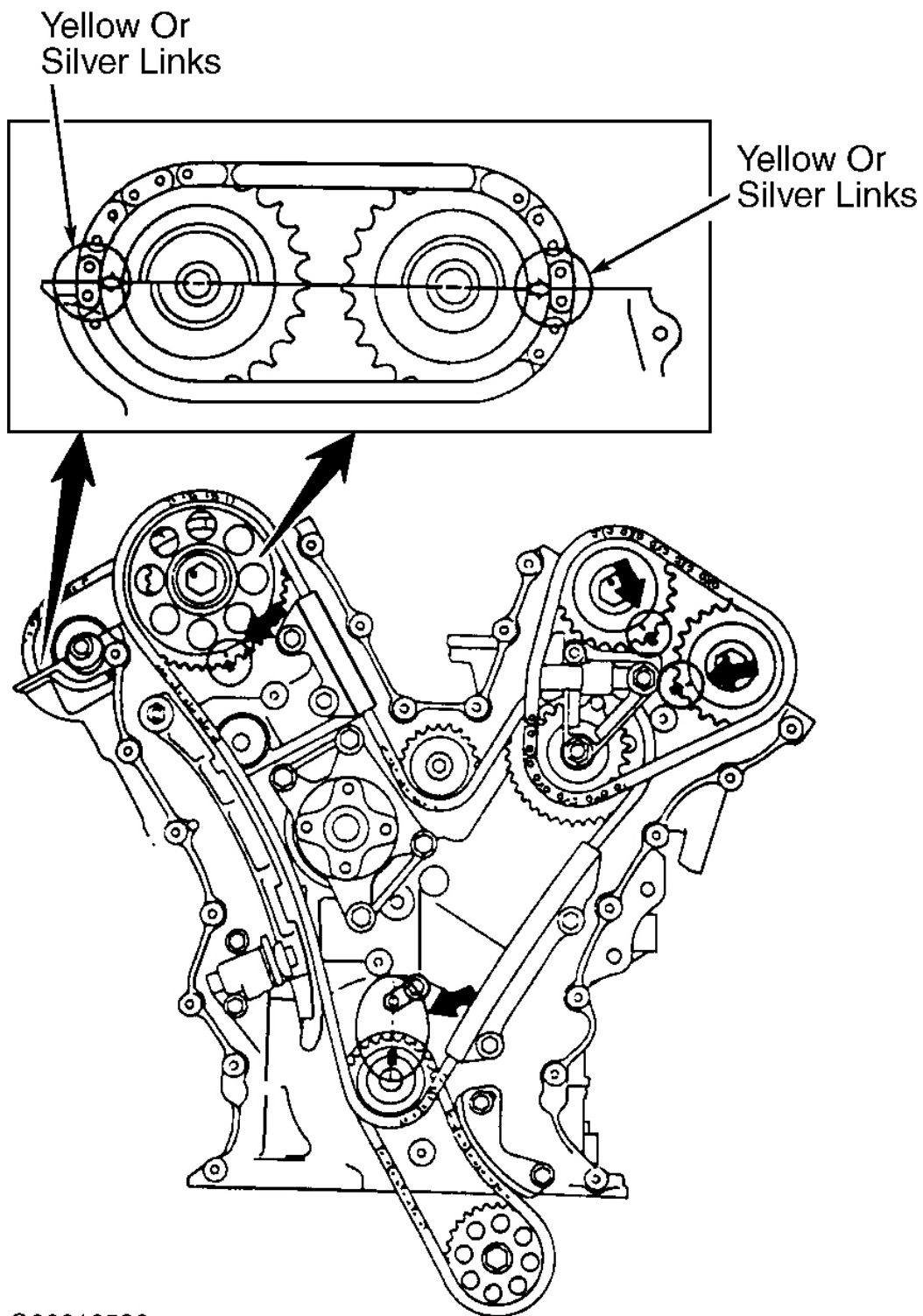


Fig. 15: Aligning Right Bank Timing Chain & Camshaft Sprockets Marks
Courtesy of SUZUKI OF AMERICA CORP.

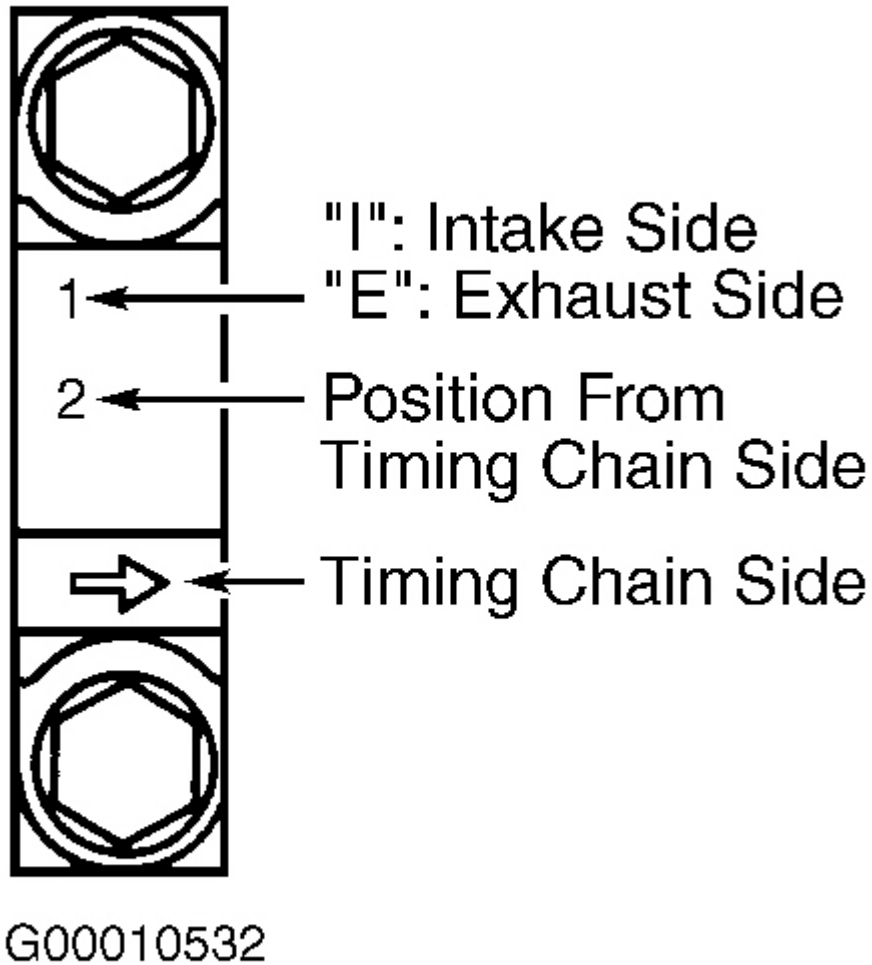


Fig. 16: Installing Right Camshaft Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

CAMSHAFT

Removal (Left Exhaust)

1. Remove the Camshaft Position (CMP) sensor.
2. Loosen the camshaft bearing caps in sequence.

3. Remove the camshaft bearing caps.
4. Remove the camshaft.

Removal (Left Intake)

1. Loosen the camshaft bearing caps in sequence.
2. Remove the camshaft bearing caps. See **Fig. 17**.
3. Remove the camshafts.

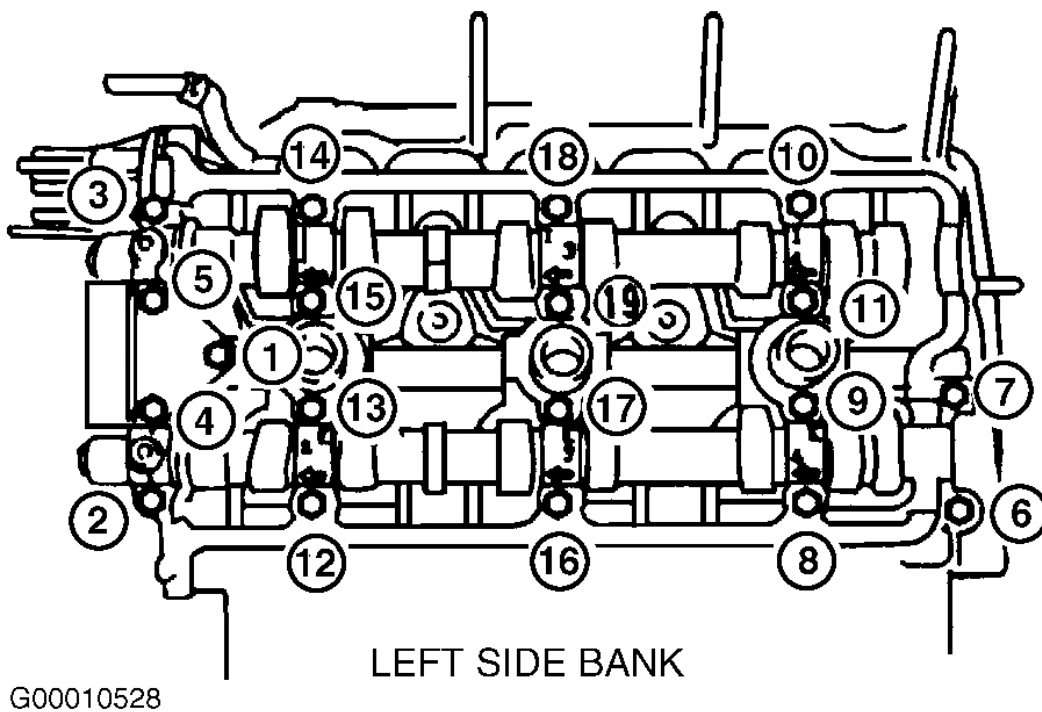
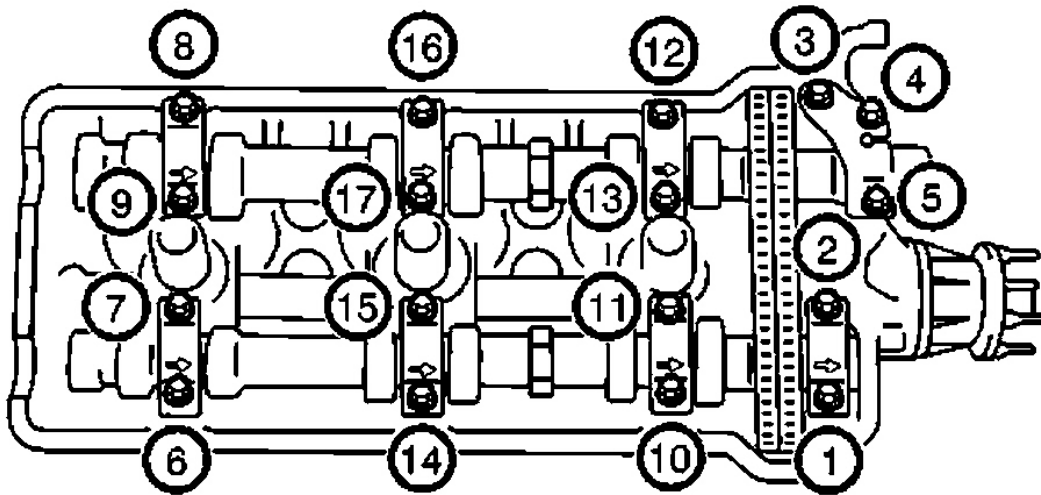


Fig. 17: Left Camshafts Bearing Cap Bolt Removal Sequence
 Courtesy of SUZUKI OF AMERICA CORP.

Removal (Right Exhaust)

1. Remove the camshaft bearing cap bolts in the proper sequence. See **Fig. 18**.
2. Remove the camshaft bearing caps.
3. Remove the camshafts and secondary drive chain as a set.



G00286615

Fig. 18: Right Camshafts Bearing Cap Bolt Removal Procedure
 Courtesy of GENERAL MOTORS CORP.

Removal (Right Intake)

1. Remove the camshaft bearing cap bolts in the proper sequence.
2. Remove the camshaft bearing caps.
3. Remove the camshafts and secondary drive chain as a set.

Inspection

NOTE: The following tools are required:

- J-26900-2 Micrometer
- J-8001 Dial Indicator Set
- J-26900-13 Magnetic Indicator Base

1. Measure the camshaft lobe height using the J-26900-2. Replace the camshaft if any lobe is below the minimum. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
2. Place the camshaft onto V-blocks. Measure the camshaft runout using the J-8001 with the J-26900-13. Replace the camshaft if the runout exceeds specifications. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
3. Inspect the camshaft bearing caps for wear, cracks and scoring.
4. Inspect the camshaft bearing journals in the cylinder head for wear, cracks and scoring.
5. If excessive wear or scoring is present, or if the cylinder head is cracked, replace the cylinder head, with

bearing caps.

6. Clean the journals of the camshaft and the cylinder head.
7. Do not install the valve lifters.
8. Install the camshafts. The rear end of the exhaust camshaft is slotted to mate with the camshaft position sensor.

NOTE: **Do not turn the camshafts while the plastic gauge is installed.**

9. Place a piece of plastic gauge across the full width of each camshaft journal.

NOTE: **Cylinder head and camshaft damage may result if the bearing caps are incorrectly installed. The oil clearance measurement will also be incorrect.**

10. Install the camshaft bearing caps. The caps are marked intake or exhaust, position away from the timing chain, and direction toward the timing chain.
11. Use 3 progressive steps to tighten the camshaft bearing cap bolts in sequence. See **TORQUE SPECIFICATIONS**.
12. Remove the camshaft bearing caps.
13. Measure the plastic gauge at it's widest point. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
14. If the clearance is greater than the maximum perform the following:
 - Remove the camshaft.
 - Measure the camshaft journal outside diameter with the J-26900-2. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
 - Install the camshaft bearing caps and torque to 97 INCH lbs (11 N.m).
 - Measure the camshaft journal inside (bore) diameter. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
15. Replace the component, camshaft or cylinder head with caps, that has the greatest difference from specification.

Installation (Left Exhaust)

1. Verify that the keyway on the crankshaft is properly positioned.
2. Apply engine oil to the camshaft journals and lobes.
3. Install the camshaft aligning the guide pin with the mark on the cylinder head. The exhaust camshaft rear end is slotted to mate with the camshaft position sensor.
4. Install the dowel pins to the cylinder head.
5. Apply a bead of GM P/N 12346240, Canadian P/N 10953493 or equivalent to the exhaust camshaft end housing sealing surface.

NOTE: **Cylinder head and camshaft damage may result if the bearing caps are incorrectly installed.**

6. Install the camshaft bearing caps. The caps are marked intake or exhaust, position away from the timing chain, and direction toward the timing chain.
7. Apply oil to the camshaft bearing cap bolts.

NOTE: Both camshafts need to be installed and tightened together. See **Fig. 19**.

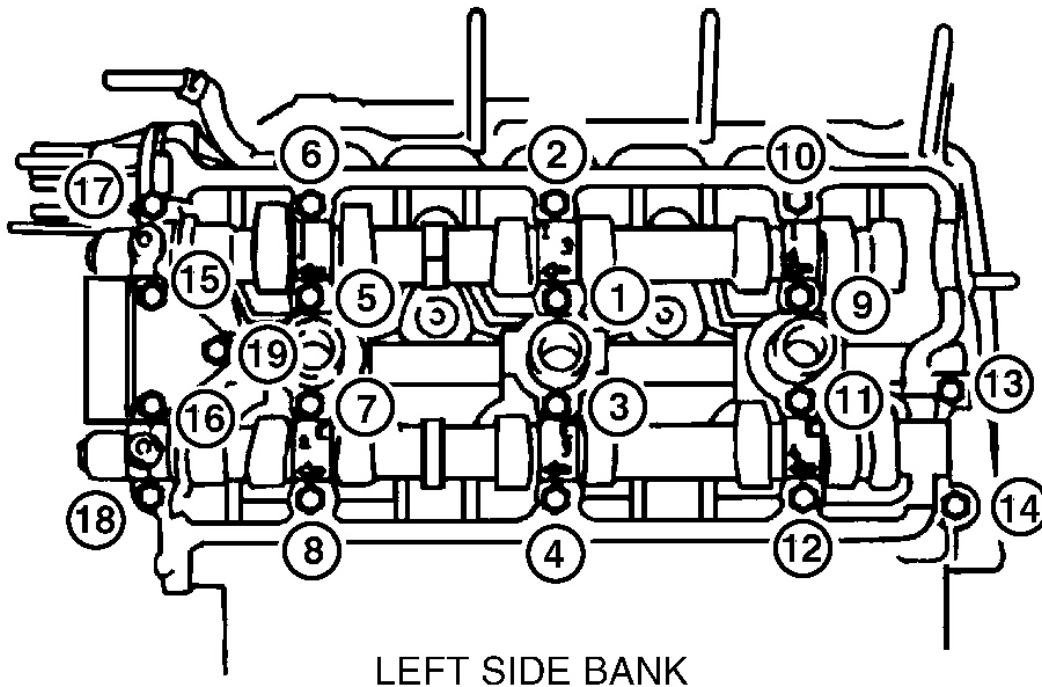
8. Tighten the camshaft bearing caps in sequence. See **Fig. 19**. Tighten to specification. See **TORQUE SPECIFICATIONS**.
9. Install Camshaft Position (CMP) sensor.

Installation (Left Intake)

1. Verify the keyway on the crankshaft is properly positioned.
2. Apply engine oil to the camshaft journals and lobes.
3. Install the camshaft aligning the guide pin with the mark on the cylinder head.
4. Install the dowel pins to the cylinder head.

NOTE: Cylinder head and camshaft damage may result if the bearing caps are incorrectly installed.

5. Install the camshaft bearing caps. The caps are marked intake or exhaust, position away from the timing chain, and direction toward the timing chain.
6. Apply oil to the camshaft bearing cap bolts.
7. Tighten the camshaft bearing caps. See **Fig. 19**. See **TORQUE SPECIFICATIONS**.



G00010520

Fig. 19: Left Camshaft Bearing Cap Tightening Sequence
 Courtesy of SUZUKI OF AMERICA CORP.

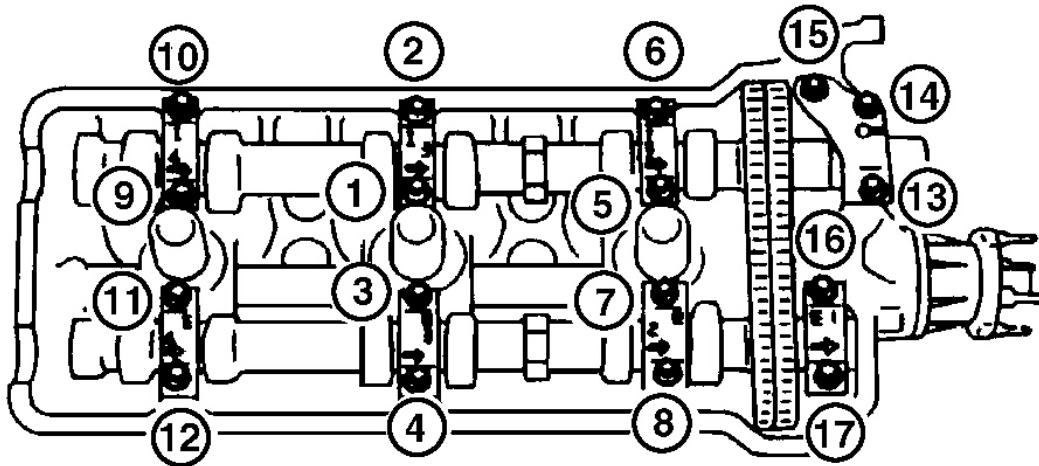
Installation (Right Exhaust)

1. Verify that the keyway on the crankshaft is properly positioned.
2. Apply oil to the camshaft lobes and journals.
3. Install the right timing chain to the camshaft sprockets by aligning the Silver or Yellow links with the marks on the camshaft sprockets.
4. Install the camshafts with the timing chain to the cylinder head.
5. Install the dowel pins to the cylinder head.
6. Apply oil to the camshaft bearing cap bolts.

NOTE: **Cylinder head and camshaft damage may result if the bearing caps are incorrectly installed.**

7. Install the camshaft bearing caps. The caps are marked intake or exhaust, position away from the timing chain, and direction toward the timing chain. See **Fig. 22**.
8. Tighten the camshaft bearing caps. See **Fig. 20**. See **TORQUE SPECIFICATIONS**.
9. Install the right secondary timing chain guide. Secure with the 2 bolts. See **TORQUE SPECIFICATIONS**.

10. Install the right sprocket and primary timing chain.
11. Install the left secondary timing chain.
12. Install the engine front cover.



G00010512

Fig. 20: Right Camshaft Bearing Cap Tightening Sequence
 Courtesy of SUZUKI OF AMERICA CORP.

Installation (Right Intake)

1. Verify that the keyway on the crankshaft is properly positioned.
2. Apply oil to the camshaft lobes and journals.
3. Install the right timing chain to the camshaft sprockets by aligning the silver or yellow links with the marks on the camshaft sprockets.
4. Install the camshafts with the timing chain to the cylinder head.
5. Install the dowel pins to the cylinder head.
6. Apply oil to the camshaft bearing cap bolts.

NOTE: **Cylinder head and camshaft damage may result if the bearing caps are incorrectly installed.**

7. Install the camshaft bearing caps. The caps are marked intake or exhaust, position away from the timing chain, and direction toward the timing chain.
8. Tighten the camshaft bearing caps. See **Fig. 19**.
9. Install the right secondary timing chain guide. Secure with the 2 bolts. See **TORQUE SPECIFICATIONS**.

10. Install the right sprocket and primary timing chain.
11. Install the left secondary timing chain.
12. Install the engine front cover.

VALVE LIFTER

NOTE: Store the valve lifters so that they can be installed in the same bore from which they were removed. Do not disassemble the valve lifter. Do not apply force to the body (valve side) of the valve lifter, this will force oil to leak out of the valve lifter. Store the valve lifters submerged in clean engine oil camshaft side down until installation. Store the valve lifters camshaft side up if left in air until installation. Do not store in air with the camshaft side down or on the valve lifter side.

Removal (Left & Right)

1. Disconnect the negative battery cable. Remove the engine front cover.
2. Remove the spark plugs.
3. Remove the left secondary timing chain. Remove the camshafts.
4. To remove the lifters:
 - Store the valve lifters so that they can be installed in the same bore from which they were removed.
 - Do not disassemble the valve lifter.
 - Do not apply force to the body (valve side) of the valve lifter, this will force oil to leak out of the valve lifter.
 - Store the valve lifters submerged in clean engine oil camshaft side down until installation.
 - Store the valve lifters camshaft side up if left in air until installation.
 - Do not store in air with the camshaft side down or on the valve lifter side.
5. Remove the lifters. See **Fig. 21**.

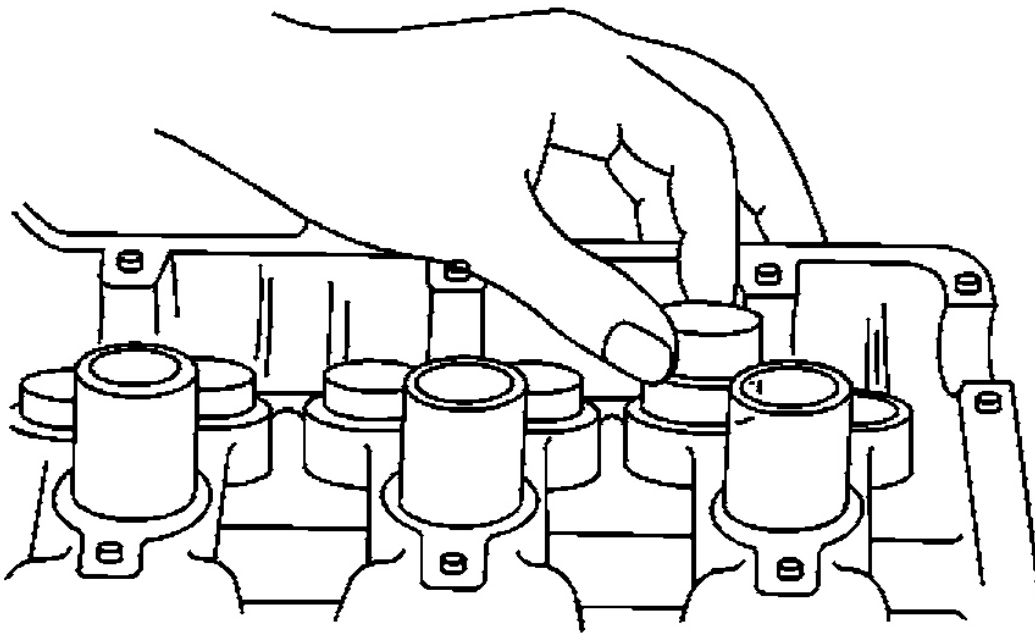
Installation (Left & Right)

1. Pour engine oil into the oil feed hole in the valve lifter bore in order to flush any debris from the gallery and to prelube the bore.

NOTE:

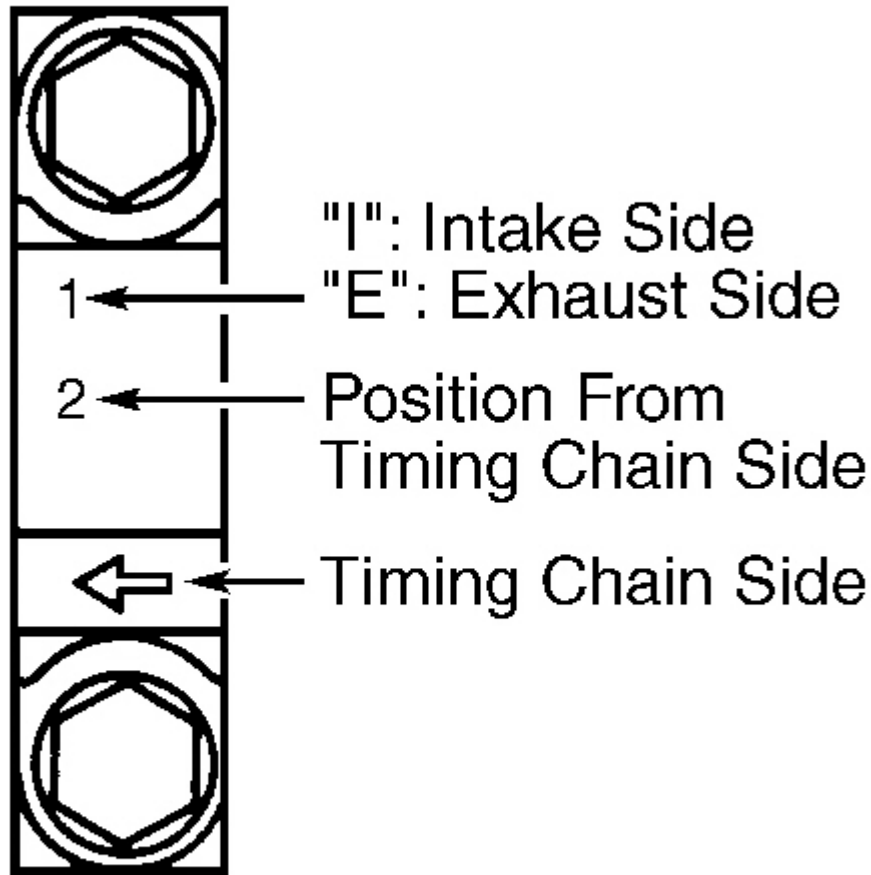
- Do not turn the camshafts or start the engine (valves should not be operated) for approximately 30 minutes after replacing the valve lifters and camshafts.
- Allow approximately 30 minutes for the valves to settle in place. Operating the valves before this time may cause valve or piston damage.
- The valve(s) may make a tapping/ticking sound after replacement if air is trapped in the valve lifter. Run the engine at 2000 RPM until the air is purged from the lifter.

- If the tapping/ticking does not stop, locate the defective lifter with a stethoscope and replace. Or, remove the cylinder head cover with the engine stopped and push the lifter down by hand with a force less than 44 lbs (20 kg) when the camshaft is on the base circle. If clearance exists between the camshaft and the lifter, the lifter is defective and should be replaced.
2. Apply engine oil to the valve lifter and install the valve lifters in the same bore from which they were removed. See **Fig. 21**.



G00286617

Fig. 21: Removing & Installing Valve Lifters
Courtesy of GENERAL MOTORS CORP.



G00010524

Fig. 22: Installing Left Camshaft Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

CRANKSHAFT REAR OIL SEAL

Removal

1. Mark the flywheel-to-crankshaft position.
2. Remove the flywheel from the crankshaft.

NOTE: To protect the crankshaft from damage, wrap the tip of the screwdriver with tape.

3. Carefully pry out the crankshaft rear oil seal using a screwdriver.

Installation

NOTE: **The following tool is required: J-41172 Oil Seal Installer.**

1. Apply GM P/N 1051344 Chassis Grease to the new crankshaft rear oil seal lip.

NOTE: **The J-41172 will install the seal to the correct installed depth. Other sealer installers may not seat the seal properly and oil leakage may result.**

2. Position the new seal in place over the end of the crankshaft.
3. Lightly tap the crankshaft rear oil seal into place using a hammer and the Oil Seal Installer (J-41172).
4. Install the flywheel.

RADIATOR

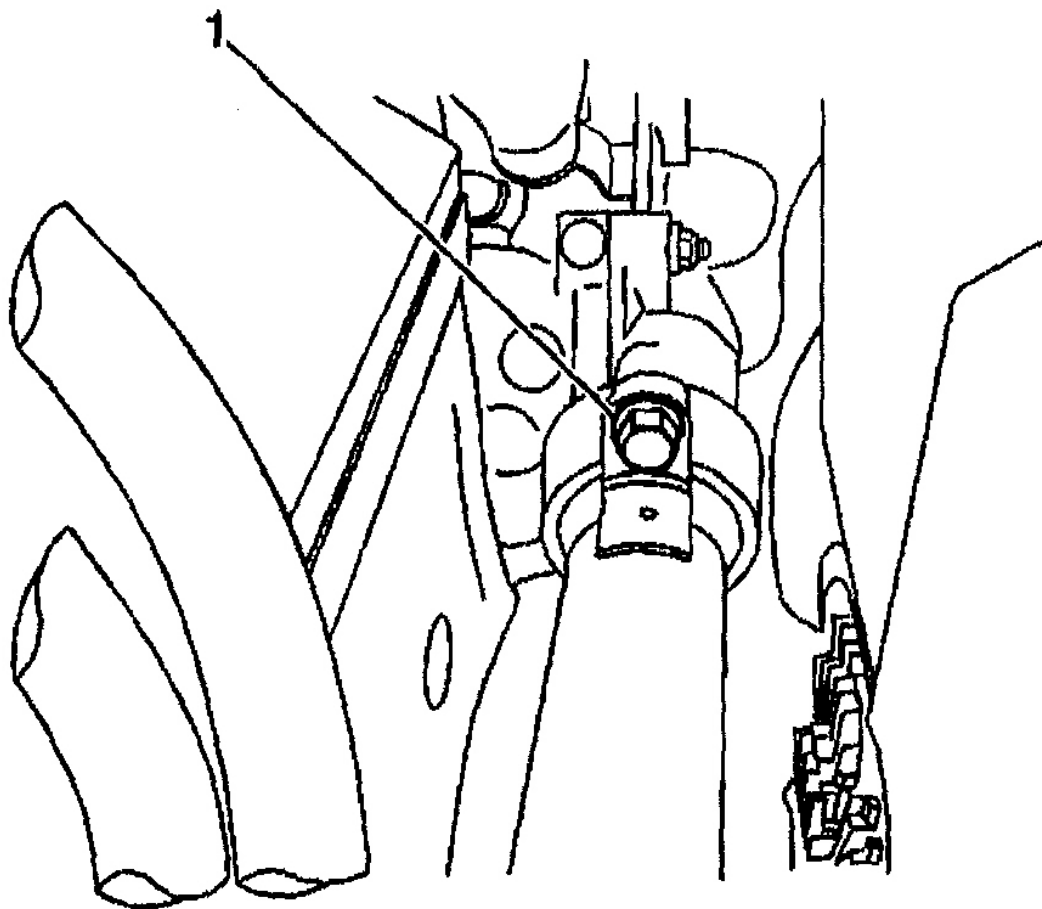
1. Disconnect the negative battery cable.
2. Remove the radiator cap.
3. Raise and properly support the vehicle.
4. Remove the lower radiator shroud clips.
5. Open the drain plug.
6. Drain the cooling system.
7. Close the drain plug.
8. Remove the transmission oil cooler lines from the bottom of the radiator (automatic transmission only). Cap the open lines to prevent leakage.
9. Remove the lower radiator hose.
10. Lower the vehicle then remove the radiator overflow hose.
11. Remove the upper radiator hose.
12. Remove the 2 upper radiator shroud clips.
13. Remove the bolts from each side of the radiator.

NOTE: **Do not damage the radiator or the fan during removal.**

14. Lean the fan shroud toward the engine and lift the radiator up and out of the vehicle.

THERMOSTAT REPLACEMENT**Removal Procedure**

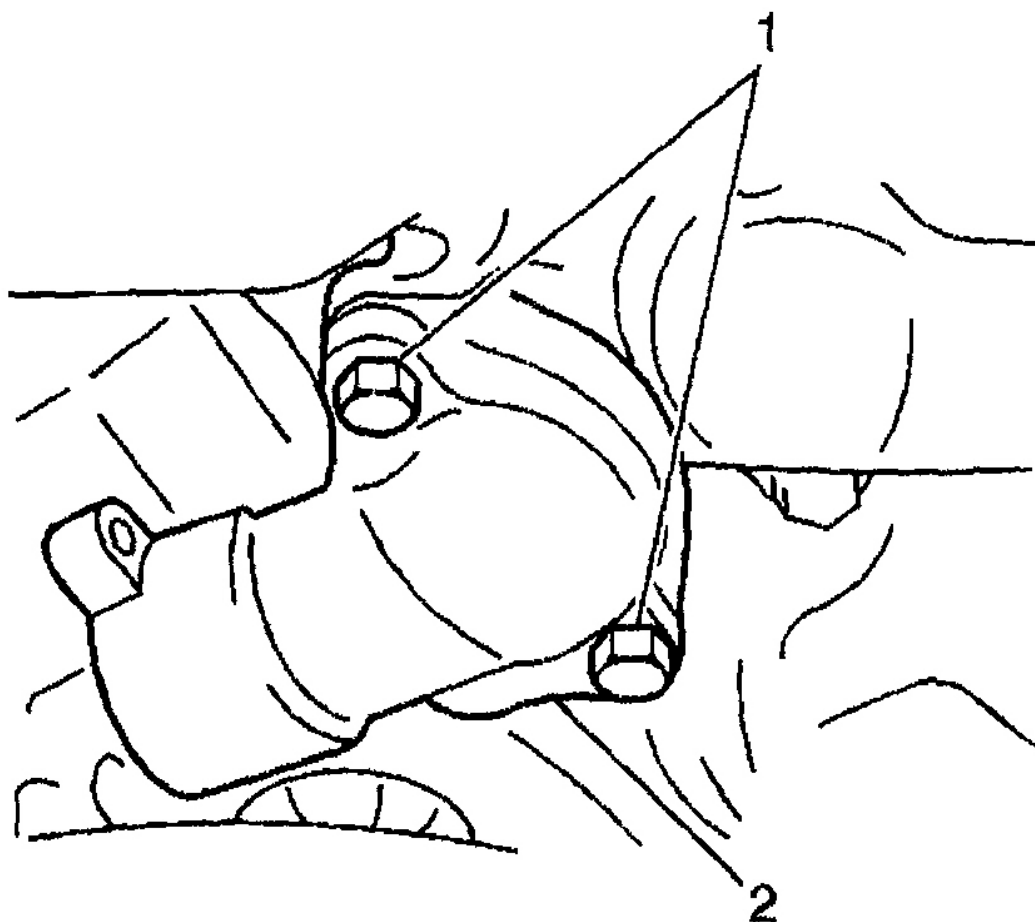
1. Drain the engine coolant.
2. Remove the lower radiator pipe bolt (1).



G01470681

Fig. 23: Lower Radiator Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the thermostat cap bolts (1), cap (2) and the thermostat.



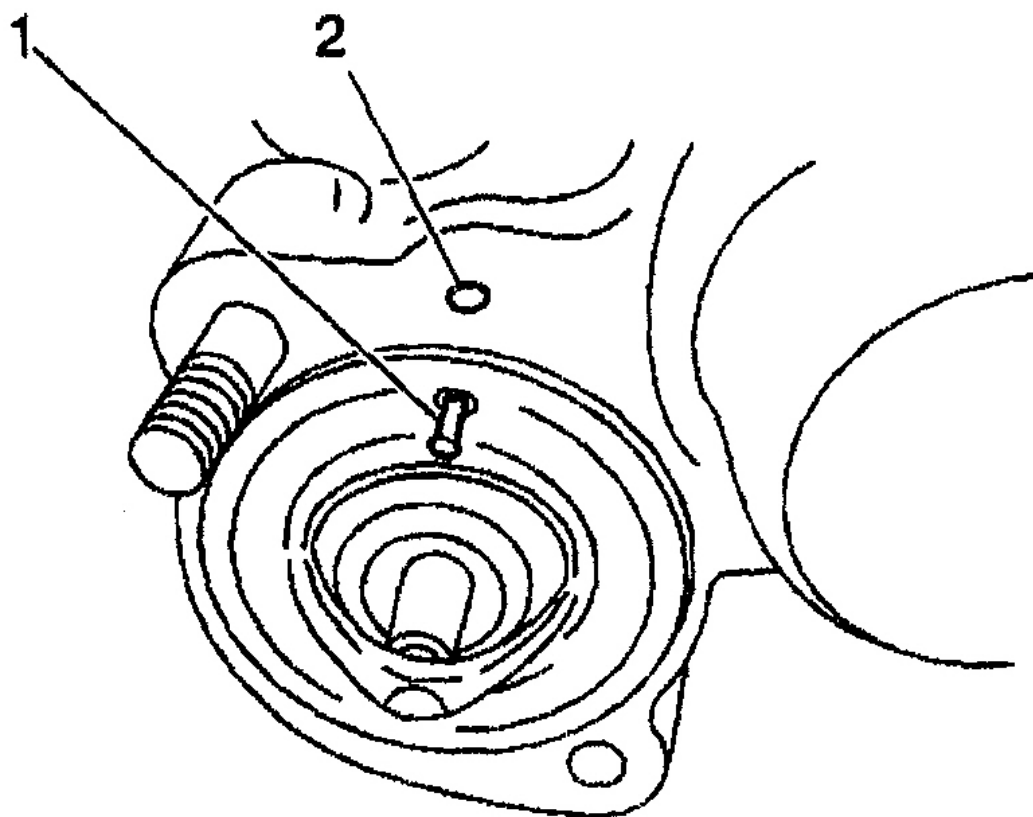
G01470682

Fig. 24: Thermostat Cap Bolts, Cap & Thermostat
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

IMPORTANT: Align the thermostat air bleed valve (1) to the recession on the thermostat case (2).

1. Position the new thermostat and O-ring on the thermostat case.



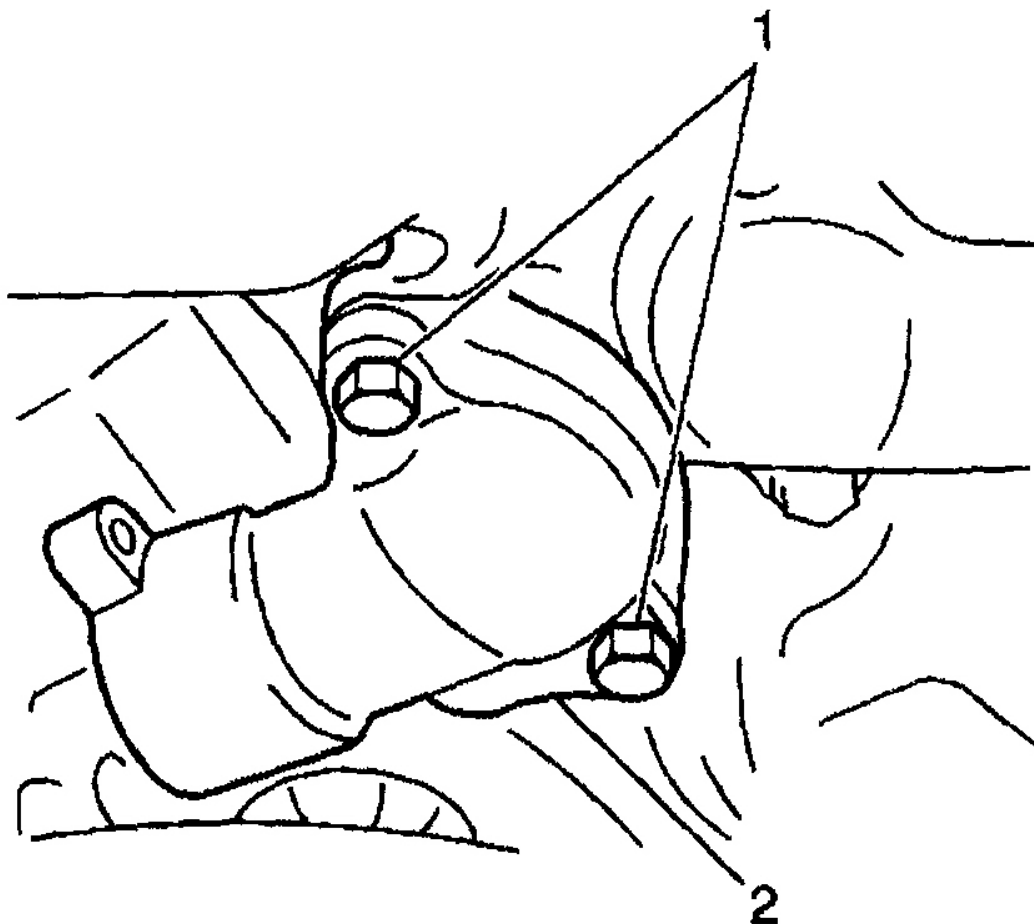
G01470683

Fig. 25: Positioning New Thermostat & O-Ring On Thermostat Case
Courtesy of GENERAL MOTORS CORP.

2. Secure the thermostat housing cap (2) with two bolts (1).

Tighten

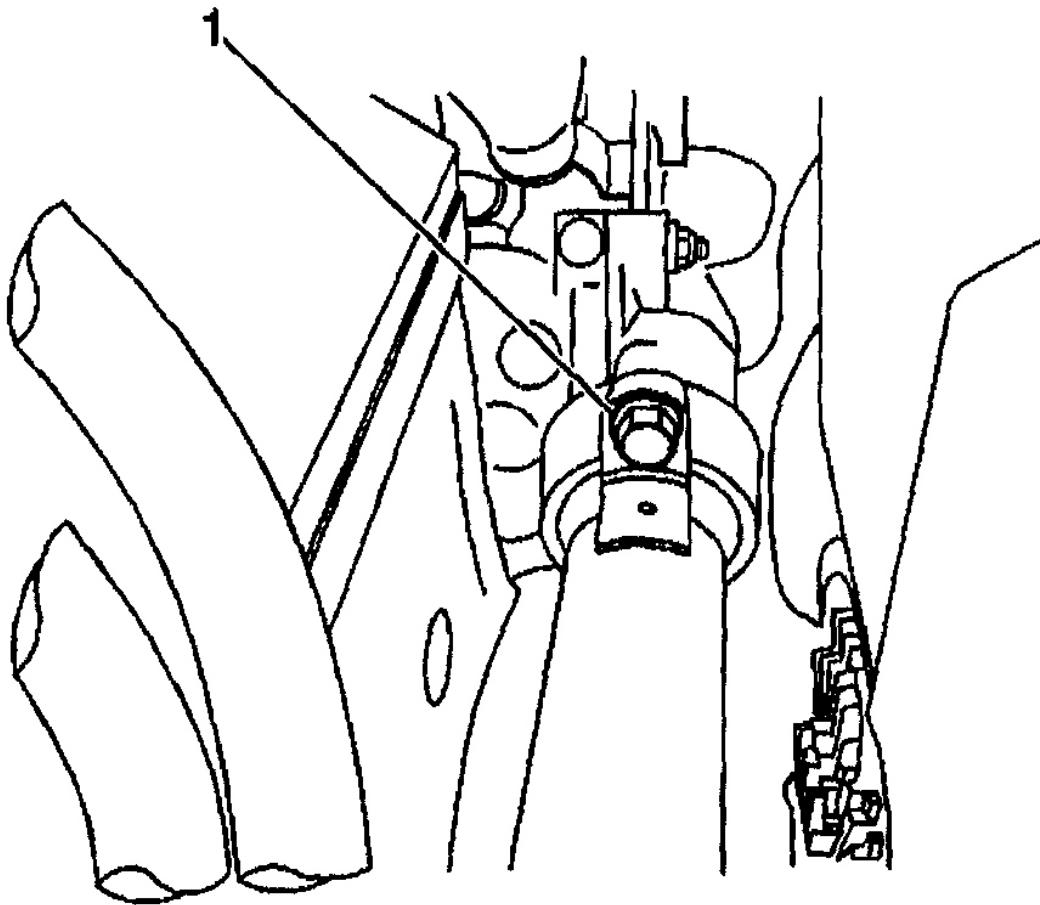
Tighten the thermostat housing bolts to 16 N.m (12 lb ft).



G01470684

Fig. 26: Installing Thermostat Housing Cap With Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the lower radiator pipe bolt.
4. Fill the radiator with an approved coolant.



G01470685

Fig. 27: Lower Radiator Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

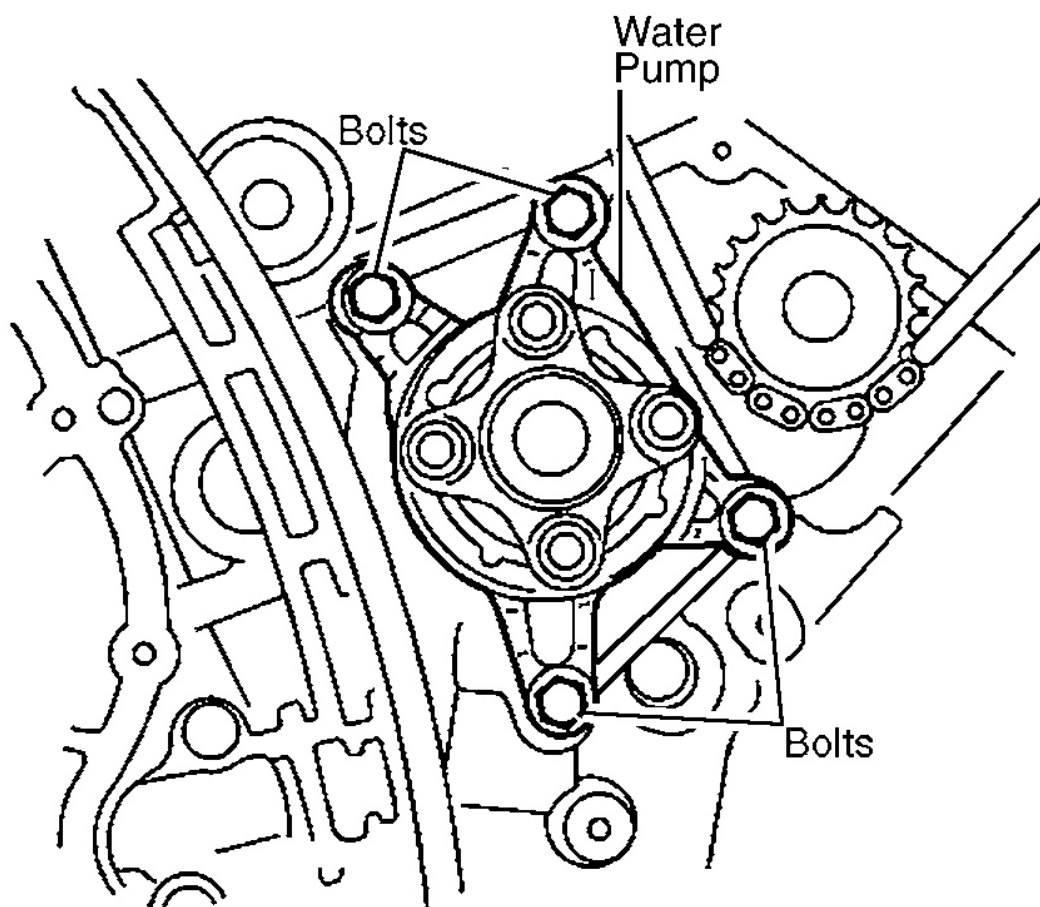
WATER PUMP

Removal

Remove the negative battery cable. Drain the engine oil. Drain the engine coolant. Remove the engine front cover. See **TIMING CHAIN COVER & FRONT OIL SEAL**. Remove the water pump bolts and the water pump. See **Fig. 28**.

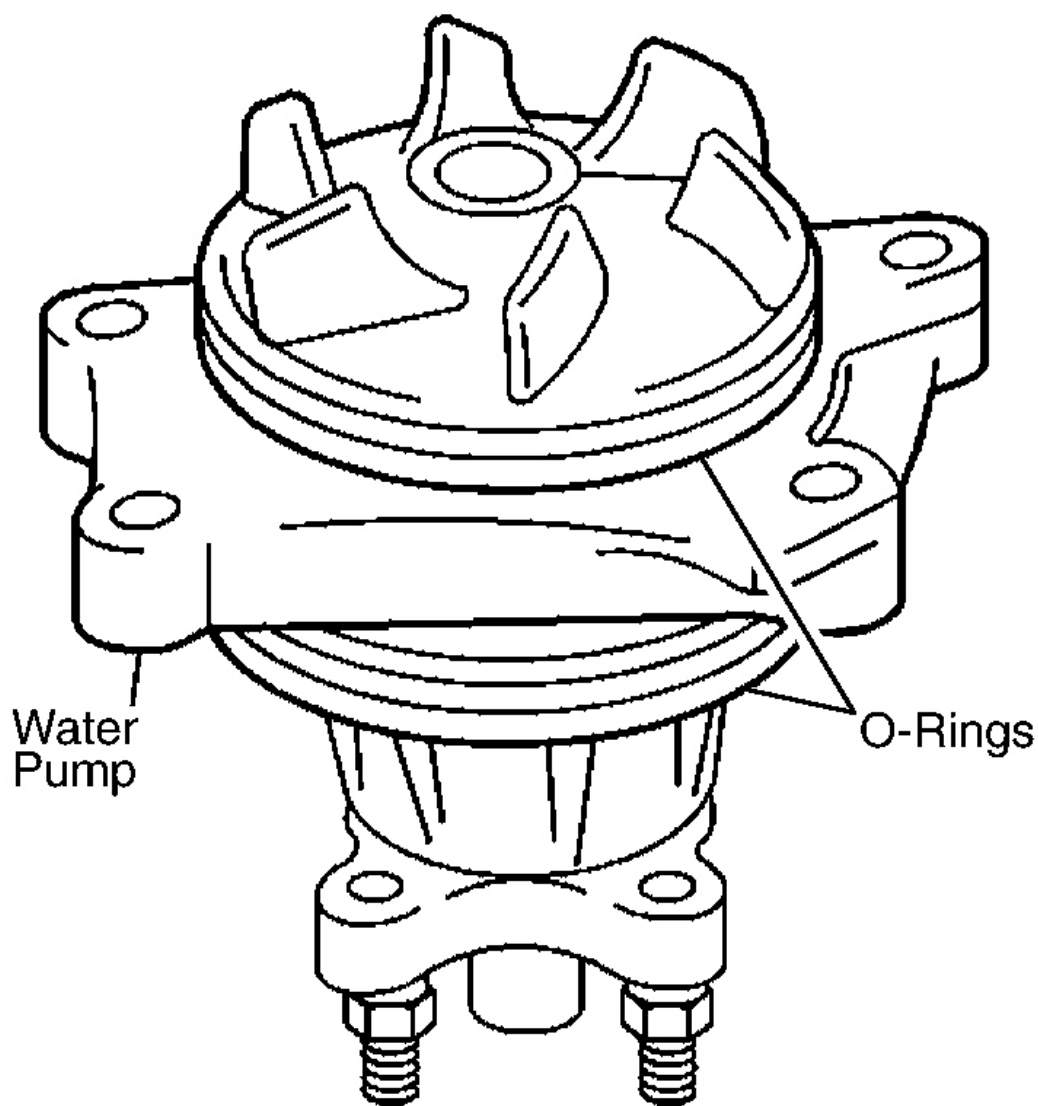
Installation

Install NEW "O" rings to the water pump. See **Fig. 29**. Insert the water pump to the cylinder block. Tighten the bolts to 20 ft. lbs. (27 N.m). Refill the engine coolant. Refill the engine oil. Connect the negative battery cable. Check the systems for leaks.



G00286618

Fig. 28: Identifying Water Pump Bolts
Courtesy of GENERAL MOTORS CORP.



G00286619

Fig. 29: Replacing Water Pump "O" Rings
Courtesy of GENERAL MOTORS CORP.

OIL PAN

Removal (Lower)

1. Drain the engine oil.
2. Remove the 2 nuts and 8 bolts from the lower oil pan. See **Fig. 30**.

3. Separate the lower oil pan from the upper oil pan.

Removal (Upper)

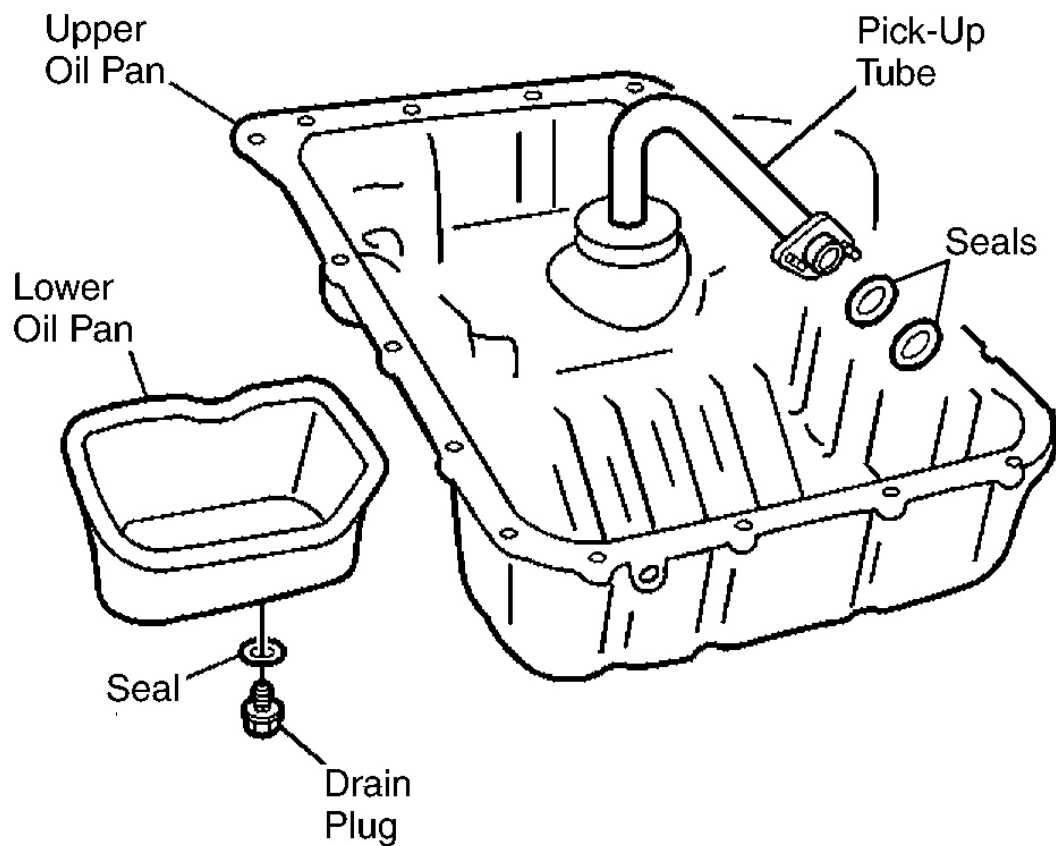
1. Remove the lower oil pan.
2. Remove the 2 bolts and the oil strainer bracket.
3. Remove the radiator outlet pipe from the upper oil pan.
4. Remove the upper oil pan bolts and lower the oil pan.
5. Remove the 2 bolts that secure the oil pump pipe to the oil.
6. Remove the upper oil pan and oil strainer together.

Installation (Upper)

1. Install a NEW "O" ring to the lower crankcase.
2. Install NEW "O" rings to the oil pump pipe.
3. Apply sealant to the upper oil pan.
4. Place the upper oil pan with the oil pump pipe and screen assembly beneath the crankcase.
5. Install the oil pump pipe and screen assembly and secure with the 2 bolts.
6. Install the upper oil pan to the crankcase and secure with the bolts. Tighten the bolts to 97 INCH. lbs. (11 N.m). See **Fig. 31**.
7. Install the bracket to the oil strainer. Tighten the bolts to 97 INCH lbs. (11 N.m)
8. Attach the radiator outlet pipe to the upper oil pan.

Installation (Lower)

1. Apply a bead of sealant to the lower oil pan.
2. Install the lower oil pan to the upper oil pan and secure with the 2 nuts and 8 bolts. See **TORQUE SPECIFICATIONS**.
3. Install the drain plug to the oil pan. See **TORQUE SPECIFICATIONS**.
4. Fill the engine with oil.



G00286621

Fig. 30: Identifying Oil Pan Components
Courtesy of GENERAL MOTORS CORP.

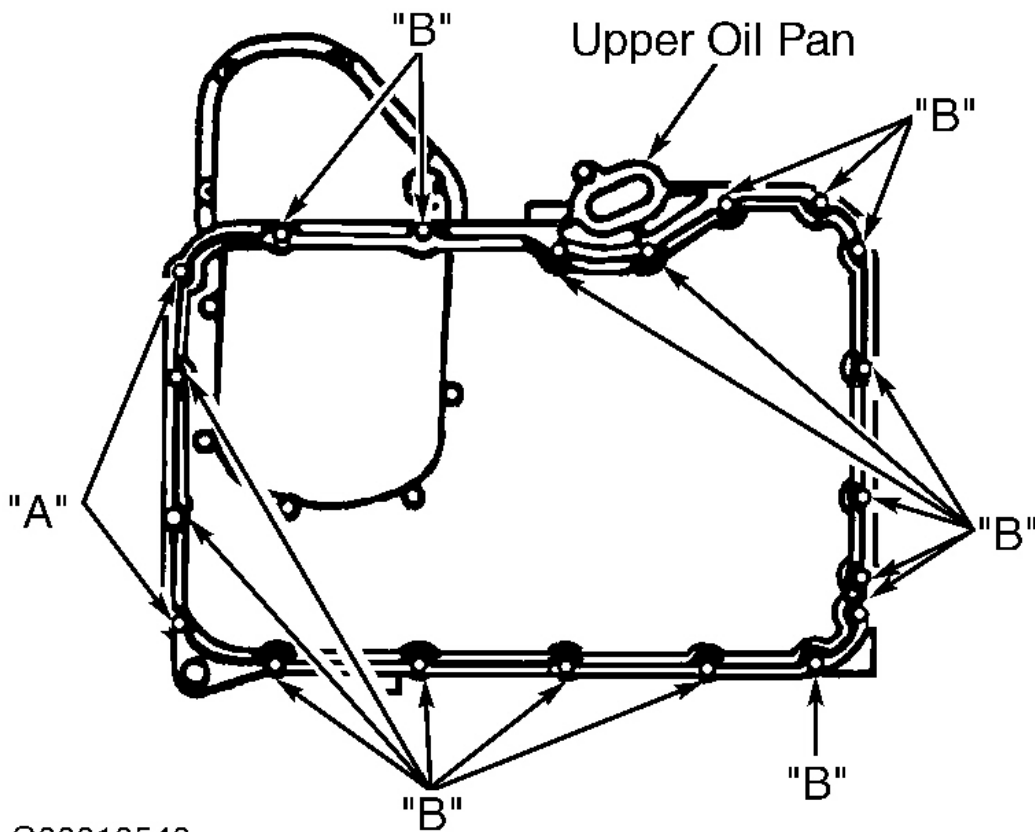


Fig. 31: Installing Upper Oil Pan
Courtesy of SUZUKI OF AMERICA CORP.

OVERHAUL

NOTE: For repair procedures not covered in this article, see **ENGINE OVERHAUL PROCEDURES** article in **GENERAL INFORMATION**.

CYLINDER HEAD

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

NOTE: The following tools are required:

- **J-8062 Valve Spring Compressor**
- **J-37979 Valve Spring Compressor Adaptor**
- **J-36017 Valve Guide Seal Remover**

Disassembly

NOTE: Keep the valve train components together and identified in order for proper installation in their original position.

1. Compress the valve spring using the Valve Spring Compressor (J-8062) and the Valve Spring Compressor Adaptor (J-37979).
2. Remove the valve keepers using a magnet or small screwdriver.
3. Slowly release the Valve Spring Compressor (J-8062) from the valve spring assembly.
4. Remove the retainer and the inner and the outer valve springs. Both the inner and outer valve spring have a top, large-pitch, and bottom, small-pitch, end. The small-pitch end is installed toward the valve spring seat.

NOTE: Do not damage the valve guide. Remove any burrs that have formed at the key groove by chamfering the valve stem with an oil stone or a file.

5. Remove the valve seal using the Valve Guide Seal (J-36017).
6. Remove the spring seat.
7. Remove the valve.
8. Remove the remaining valve springs and valves.

Cleaning & Inspection

1. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion and blow-by.
2. If the gasket has failed, determine the cause. Gasket failure may be caused by the following:
 - Improper installation.
 - Loose or warped cylinder head.
 - Warped cylinder block surface.
 - Missing, off location or not fully dowel pins.
 - Corrosion in the seal area around the coolant passages.
 - Chips or debris in the cylinder block not drilled or tapped deep enough.
 - Incorrect cylinder head bolt torque.
 - Incorrect cylinder head bolt length.
3. Inspect the cylinder head gasket surface:
 - Cylinder head may be reused if corrosion is found only outside a .375 in (44 mm) band around each combustion chamber.

- Replace the cylinder head if the area between the valve seats is cracked.
- Replace the cylinder head if corrosion has been found inside a .375 in (44 mm) band around each combustion chamber.

NOTE: **Do not use a wire brush on any gasket sealing surface. Do not attempt to weld the cylinder head, replace it.**

4. Clean the cylinder head. Remove all varnish, soot and carbon to the bare metal.
5. Clean the valve guides.
6. Inspect the valve guides for wear.
7. Inspect the valve seats for excessive wear and hot spots.
8. Inspect the valve seating surfaces.
9. Clean the threaded holes. Use a nylon bristle brush.
10. Clean the remains of the sealer from the plug holes.
11. Replace all suspect bolts.
12. Inspect the cylinder head for cracks. Check between the valve seats and in the exhaust ports.
13. Inspect the cylinder head deck for corrosion, sand inclusions and blow holes.
14. Inspect all the threaded holes for damage. Threads may be reconditioned with thread inserts.
15. Inspect the intake, the exhaust and the cylinder head deck sealing surfaces.
16. Inspect the cylinder head deck surface for flatness. See **CYLINDER HEAD**.
17. Inspect the cylinder head intake surface for flatness. See **CYLINDER HEAD**.
18. Inspect the cylinder head exhaust surface for flatness. See **CYLINDER HEAD**.
19. If the warpage is greater than the maximum in any of the above measurements, replace the cylinder head.
20. Measure the free length of each valve spring using a Vernier caliper. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
21. If the free length of any valve spring is not within specifications, replace the valve spring.
22. Measure the tension of the valve spring at the specified installed height using a spring tester. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
23. If the installed tension of any valve spring is not within specifications, replace the valve spring.
24. Measure the valve spring squareness deviation using a steel square. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
25. If the deviation of any valve spring is greater than the specified maximum, replace the valve spring.
26. Inspect the valve spring seating surface of the valve spring seats for wear or gouging. Replace as required.
27. Temporarily install the valves into the cylinder head.
28. Measure valve runout, valve face-to-valve seat contact pattern, by performing the following:
 - Apply a light coating of Prussian blue to the entire valve face. Seat the valve but do not rotate it. The Prussian blue traces transferred to the valve seat are an indication of concentricity of the valve seat.
 - Clean all traces of Prussian blue.

- Apply a light coating of Prussian blue to the valve seat and repeat the check. The traces of Prussian blue transferred to the valve face indicates valve face concentricity.
- Recondition the valve seat and/or replace the valves as necessary.

Reassembly

CAUTION: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

NOTE: The following tools are required:

- **J-8062 Valve Spring Compressor**
- **J-37979 Valve Spring Compressor Adaptor**
- **J-38232 Valve Guide Seal Installer**

1. Install the spring seat to the cylinder head.
2. Install the new valve seals using the Valve Guide Seal Installer (J-38232). Fully seat the seals on the valve guides.
3. Apply engine oil to the valve stem. Install the valve.

NOTE: Both the inner and outer valve springs have a top, large-pitch, and bottom, small-pitch end. Install the small-pitch end toward the valve spring seat.

4. Install the springs.
5. Install the retainer.
6. Compress the valve spring using the J-8062 and the J-37979.
7. Install the valve keepers.
8. Slowly release the J-8062 from the valve spring assembly.
9. Lightly tap the valve stem tip with a plastic faced hammer and inspect for proper valve keeper seating.

Valve Springs

Check valve springs for damage. Using a square and flat surface plate, check spring squareness. Using valve spring tester, check valve spring pre-load pressure. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS. Replace any weak or out-of-square springs.

Valve Stem Oil Seals

NOTE: Do not reuse old valve stem oil seals.

Place new lubricated stem seal on valve guide. Using Valve Stem Seal Installer (J-38232), press oil seal onto valve guide using hand pressure only. When installer bottoms on head, seal is properly positioned. DO NOT twist seals during installation. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.

Valve Guides

NOTE: The following tools are required:

- J-37968 Valve Guide Seal/Installer Kit.
- J-37972 11 mm Reamer.
- J-43842 Valve Guide Installer.
- J-38342 (6 mm) Reamer.

1. Tap out the valve guide from the combustion chamber side of the cylinder head using a hammer and the Valve Guide Seal/Installer Kit (J-37968).

NOTE: Clean the valve guides before reaming. Packing of chips or carbon may result in the reamer jamming into the valve guide or broken reamer flutes.

2. Ream the valve guide bore with a 11 mm reamer (J-37972).
3. Gradually heat the cylinder head to 176-212°F (80-100°C).

NOTE: Intake and exhaust valve guides are identical. The new valve guide is 0.0012 in (0.03 mm) oversize. Intake and exhaust valve guides should protrude 0.53 in (13.5 mm) above the cylinder head surface.

4. Tap the new (oversize) valve guide into the cylinder head from the camshaft side using the J-37968, the J-43842 and a hammer.
5. Install the valve guide to the specified protrusion. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS. The J-43842 should bottom out on the cylinder head when the specified protrusion height is reached.
6. Ream the new valve guide with the J-38342.

Valve Seat

NOTE: Proper reconditioning of the valve seats is very important. Because the valve guide serves to support and center the valve grinder, it is essential that the valve guide is cleaned properly. If the valve guide requires reaming, this must be done first.

1. Use the following as a general guideline when reconditioning the cylinder head:
 - Ream the valve guide bores first and then recondition the valve seats.

- Inspect the valve seats for excessive wear and burned spots. Valve seats may be reconditioned by grinding. If grinding results in the new seat being too wide, it may be narrowed by using a 20 degree or 70 degree stone. The 20 degree stone will lower the seat and the 70 degree stone will raise the seat.
 - The valves must seat perfectly for the engine to deliver optimum power and performance.
 - Cooling the valve heads is another important factor. Good contact between each valve and its seat in the cylinder head is necessary to ensure that the heat in the valve head is properly carried away.
 - Regardless of what type of equipment is used, it is essential that the valve guide bores are free from carbon or dirt to ensure the proper centering of the pilot in the guide.
 - The valve seats should be concentric to within .031 in (.05 mm) total indicator reading.
 - Replace any valve that is not in serviceable condition.
 - Several different types of equipment are available for reconditioning valves and valve seats. Use the manufacturers recommendations to obtain proper results.
2. Grind the exhaust valve seat first with a 15 degree stone, and then with a 45 degree stone. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
 3. Grind the intake valve seat first with a 15 degree stone, then with a 60 degree stone and then with a 45 degree. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
 4. Lap the valves and seats with a coarse compound and then with a fine compound.
 5. Clean all traces of the grinding compound from the valve components before final assembly.

Valves

NOTE: Excessive valve stem to guide clearance may cause a noisy valve train, premature valve stem oil seal wear, component damage, and/or excessive oil consumption. Insufficient valve stem to guide clearance will result in noisy or sticking valves. Valves that are too tight may disturb engine smoothness or lead to component damage.

1. Inspect for excessive valve stem to guide clearance.

NOTE: Do not scratch the valve stem with the wire brush.

2. Clean the valves of carbon, oil and varnish. Carbon can be removed with a wire brush, varnish can be removed by soaking in Parts Immersion Solvent GM P/N 12345368 or equivalent.
3. Clean the deposits from the valve face.
4. Inspect the valve face for the following:
 - Worn or no margin.
 - Pitting.
 - Burnt or eroded areas.
 - Grooving.
 - Deposits.
5. If any of the above conditions exist, replace the valve.

6. Clean the valve guides with a rifle brush and a suitable solvent.
7. Inspect the valves for the following:
 - Burnt or eroded areas.
 - A worn margin.
 - A bent stem.
 - A worn or scored stem.
 - A worn or chipped valve keeper groove.
 - A worn stem end.
 - A bent valve head.
8. If the valves are worn or damaged, replace the valve.
9. Burrs and minor scratches on the valve stem may be removed with an oil stone.
10. The valve stem end may be reconditioned by grinding. Follow the grinder manufacturer's instructions.
11. If the valve face had pieces broken off, inspect the corresponding piston and cylinder head area for damage.
12. The valves may be lightly lapped to the valve seats.

CYLINDER BLOCK ASSEMBLY

Piston, Connecting Rod, & Bearing Installation

NOTE: The following tool is required: J-8037 Ring Compressor.

NOTE: Install pieces of hose over the threads of the rod bolts. This is to prevent damage to the bearing journal, the cylinder walls, or the rod bolt threads when removing the connecting rod. Remove the hose after the connecting rod is in place.

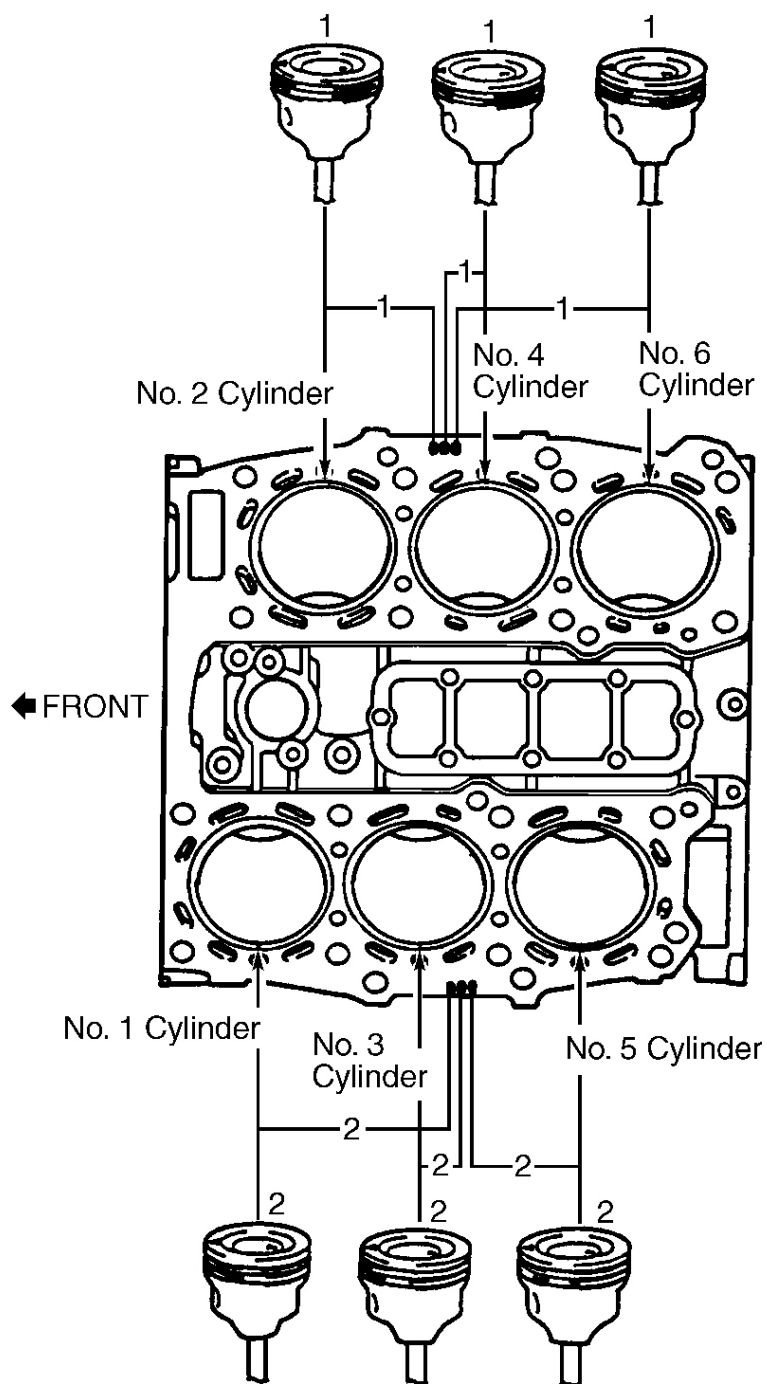
1. Lubricate the following components with engine oil:
 - The Pistons
 - The Rings
 - The Cylinder Walls
 - The Connecting Rod Bearings
 - The Crankshaft Journals
2. Ensure that the piston ring end gaps are staggered equally around the piston. See **Fig. 33**.
3. Install the piston so that the mark on the top of the piston faces the front of the engine.
4. Install the upper connecting rod bearing to the connecting rod.
5. Install a J-8037 over the piston, ensuring it sits firmly against the cylinder block until all of the piston rings have entered the cylinder bore.

NOTE: Guide the lower connecting rod end carefully to avoid damaging the crankshaft journal. See **Fig. 32**.

2002 Chevrolet Tracker

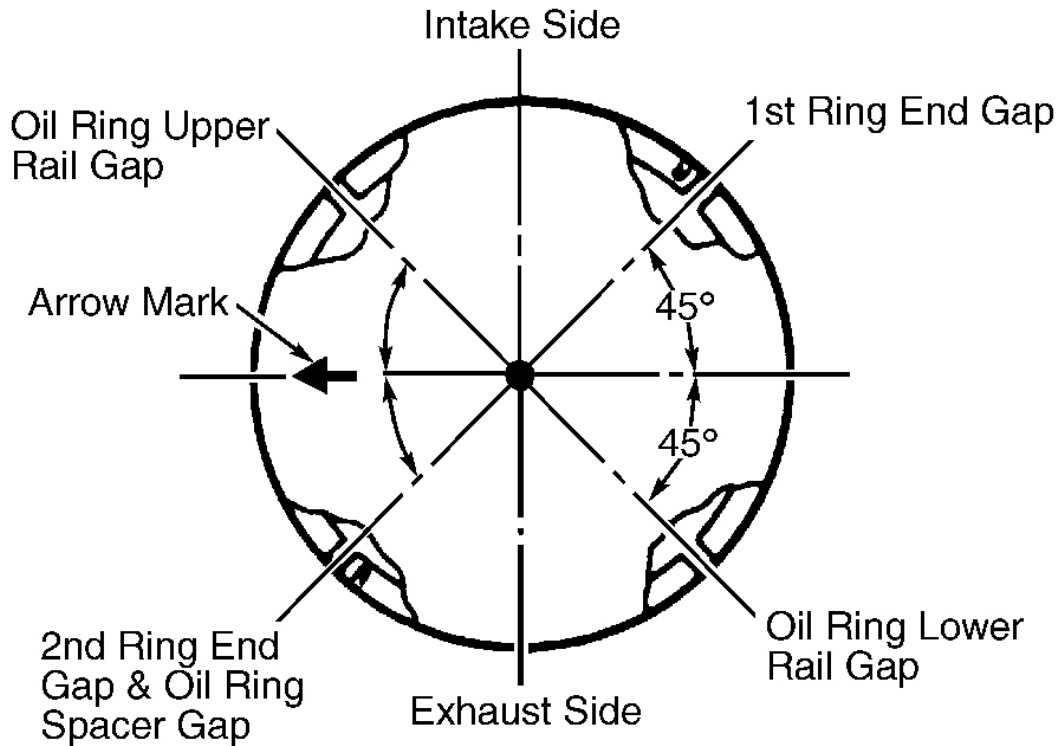
2002 ENGINES Tracker - 2.5L V6

6. Install the piston assembly into its matching cylinder bore.
7. Guide the connecting rod into place on the crankshaft.
8. Gently tap the piston into its cylinder bore with a hammer handle.
9. Install the lower connecting rod bearing to the connecting rod cap.
10. Install the connecting rod cap to its matching connecting rod with the arrow pointing towards the front of the engine. Secure with 2 connecting rod cap nuts. See **TORQUE SPECIFICATIONS**.
11. Pry the connecting rod back and forth in order to inspect for binding.



G00010556

Fig. 32: Locating Stamped Numbers On Cylinder Block & Pistons
 Courtesy of SUZUKI OF AMERICA CORP.



G00010516

Fig. 33: Positioning Piston Rings
 Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft & Main Bearings Removal

1. Remove the 8 mm bolts.
2. Remove the 10 mm bolts in the proper sequence.

NOTE: Do not gouge the sealing surfaces of the 2 halves of the cylinder block during disassembly.

3. Carefully pry the lower crankcase apart from the cylinder block using a screwdriver.
4. Carefully remove the lower crankcase with the lower bearing inserts.

NOTE: Remove the crankshaft carefully in order to avoid damaging the crankshaft journals, the rod, the main bearing inserts, or the connecting rods.

5. Remove the crankshaft from the cylinder block.
6. Remove the bearing inserts from the block.

Crankshaft & Main Bearings Installation

NOTE: The upper main bearings have an oil groove and oil holes, the lower bearings do not have oil grooves or oil holes.

1. Install the upper main bearings into the cylinder block and lubricate with engine oil.
2. Install the lower main bearings into the lower crankcase and lubricate with engine oil.

NOTE: Install the upper thrust bearing washers with the oil groove facing outward.

3. Install the 2 upper thrust bearing washers into the cylinder block and lubricate with engine oil.
4. Carefully place the crankshaft on to the main bearings in the cylinder block.
5. Thoroughly clean and remove any oil residue from the cylinder block mating surfaces.

NOTE: Avoid applying an excessive amount of sealant to the surface.

6. Apply a continuous bead of GM P/N 12345997 or equivalent sealant to the cylinder block mating rails.
7. Carefully place the lower crankcase assembly on to the cylinder block.
8. Gently tap the lower crankcase into place with a suitable tool.

NOTE: Gradual and uniform tightening is important for the lower crankcase bolts.

9. Install the long 8 mm bolt finger tight.
10. Install the 8 mm bolts finger tight.
11. Install the 10 mm bolts finger tight.
12. Progressively tighten the 10 mm main bearing cap bolts using 2 steps in the sequence shown. See **TORQUE SPECIFICATIONS**.

Undersize Main Bearing Selection

1. If new standard bearings do not produce the correct oil clearance, regrind the crankshaft to a finished diameter of 2.5485-2.5492 in. (64.732-64.750 mm) and install .0098 in (.25 mm) undersized bearings. Undersized bearings are available in 5 sizes/tolerances, differing in thickness in the center of the bearing.
2. Undersized bearings are distinguished from standard size bearings by a double paint mark. See **COLOR CODE FOR UNDERSIZE BEARINGS**.

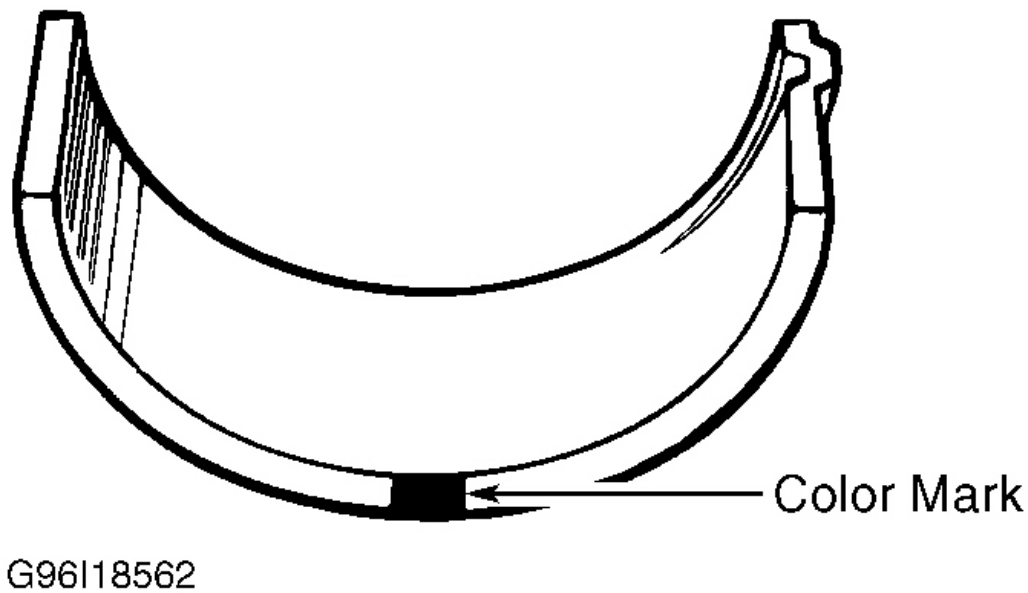


Fig. 34: Identifying Standard & Undersize Bearing Color Marks
 Courtesy of SUZUKI OF AMERICA CORP.

3. Measure the reground crankshaft journals for out-of-round. The maximum out-of-round is .0004 in (.01 mm).
4. Measure the reground crankshaft journals for taper. The maximum taper is .0004 in (.01 mm).
5. Measure the reground crankshaft journals for size.
6. Using the intersection of the measured journal size and the letters on the lower crankcase select the correct sized bearing from the table. Measure the oil clearance. If the oil clearance is incorrect, install the next thicker bearing and recheck the oil clearance.

COLOR CODE FOR UNDERSIZE BEARINGS

Paint Color	Bearing Thickness - In. (mm)
Green & Red	.1031-.1032 (2.619-2.621)
Black & Red	.1032-.1033 (2.621-2.625)
Red Only	.1033-.1034 (2.624-2.628)
Yellow & Red	.1034-.1035 (2.627-2.631)
Blue & Red	.1035-.1036 (2.630-2.634)
Pink & Red	.1037-.1038 (2.633-2.637)

UNDERSIZE JOURNAL BEARING APPLICATION

Letters Stamped On Lower	2.5489-2.5492 " (64.742- 64.750 mm) Diameter	2.5487-2.5489" (64.737- 64.742 mm) Diameter	2.5485-2.5487" (64.732- 64.737 mm) Diameter
-----------------------------	---	--	--

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Crankcase	Bearing Color	Bearing Color	Bearing Color
A	Green & Black	Black & Red	Red
B	Black & Red	Red	Yellow & Red
C	Red	Yellow & Red	Blue & Red

Thrust Bearing

The crankshaft thrust bearing is available in standard and oversize. Standard thrust bearing thickness .984 in (2.500 mm). Oversize thrust bearing thickness is .1009 in (2.563 mm). If the end play exceeds the maximum replace the thrust bearing with a new standard size thrust bearing. If the end play still exceeds the maximum replace the thrust bearing with a new oversize thrust bearing.

Cylinder Block Cleaning & Inspection

NOTE: The following tool is required: J-8087 Cylinder Bore Gage

1. Clean the sealing material from the gasket mating surfaces.
2. Boil the engine block in caustic solution.
3. Flush the engine block with clean water or stream.
4. Clean the oil passages.
5. Clean the coolant passages.
6. Clean the blind holes.
7. Spray the cylinder bores and the machined surfaces with engine oil.
8. Inspect the threaded holes. Clean the threaded holes with a rifle brush.
9. Measure the deck surface for flatness using a straightedge and a feeler gage. Carefully machine minor irregularities. Replace the block if warpage exceeds .0024 in (.06 mm).
10. Inspect the lower crankcase rail for nicks. Inspect the front cover attaching area for nicks. Use a flat mill file to remove any nicks.
11. Inspect the cylinder block for any cracks.
12. Visually inspect the cylinder bores for excessive wear or excessive ridging.
13. Measure the cylinder bore taper, out-of-round and size using the Cylinder Bore Gage (J-8087):
 - The maximum cylinder taper is .004 in (.10 mm)
 - Maximum cylinder out-of-round is .004 in (.10 mm)
 - Maximum cylinder bore diameter is 3.3090 in (84.050 mm)
14. Measure the pistons. Pistons are available in 2 standard and 2 oversizes.
 - A. Standard size piston diameter:
 - 3.3059-3.3062 in (83.970-83.980 mm)
 - 3.3063-3.3067 in (83.980-83.990 mm)
 - B. .0098 in (.25 mm) oversize piston diameter:
 - 3.3157-3.3156 in (84.220-84.240 mm)
 - C. .0196 in (.50 mm) oversize piston diameter:

- 3.3256-3.32634 in (84.470-84.490 mm)

15. Subtract the piston diameter from the cylinder bore diameter. The piston-to-cylinder bore clearance should be .0008-.0015 in (.02-.04 mm) for each piston cylinder.

NOTE: **If the bore is worn beyond the limits, rebore all 6 cylinders and fit with oversized pistons. Select the smallest available oversize piston.**

16. Leave sufficient material to allow honing when fitting the piston.

17. Calculate the cylinder bore diameter to be rebored. $D = A + B - C$ when:

- D = The cylinder bore diameter to be rebored.
- A = The measured piston diameter.
- B = The piston clearance: .0008-.0015 in (.02-.04 mm).
- C = The allowance for honing: .0008 in (.02 mm).

18. Install the lower crankcase and torque to specifications before boring or honing. This will avoid distortion of the cylinder block.

19. Bore and hone the cylinders to the calculated dimension.

20. Measure the piston clearance after the honing is completed.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

The oil pump is of a trochoid type, and is mounted under the crankshaft. Oil is drawn up through the oil pump strainer and passed through the pump the oil filter. The filtered oil flows into 3 paths in the cylinder block. In one path, the oil reaches the crankshaft journal bearings. Oil from the crankshaft journal bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft, and then injected from the big end of the connecting rod to lubricate the piston, rings, and cylinder wall. In other paths oil goes up to the cylinder heads and lubricates valves and camshafts after passing through the internal oilway of camshafts. An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure exceeds about 61.1 psi (430 kPa).

Crankcase Capacity

1. Install the oil filter.
2. Install the oil pan drain plug bolt. Tighten the oil pan drain bolt. See **TORQUE SPECIFICATIONS**.
3. Lower the vehicle.
4. Fill the engine with oil to the appropriate mark.

NOTE: **Oil capacity with oil and filter change is 3.9 quarts (3.7 liters). Oil capacity with oil change only is 3.7 quarts (3.5 liters).**

5. Start the engine and check for leaks.

Oil Pressure

1. Remove the oil pressure switch from the engine block.
2. Install a pressure gage in place of the oil pressure switch.
3. Start the engine and run at idle until normal operating temperature is reached.
4. Raise the engine speed to 4000 RPM and measure the oil pressure. Normal oil pressure is 47-61 psi (330-430 kPa) at 4000 RPM.
5. Stop the engine.
6. Remove the pressure gage.
7. Install the oil pressure switch. Tighten the oil pressure switch. See **TORQUE SPECIFICATIONS**.
8. Run the engine and inspect for oil leaks from the oil pressure switch.

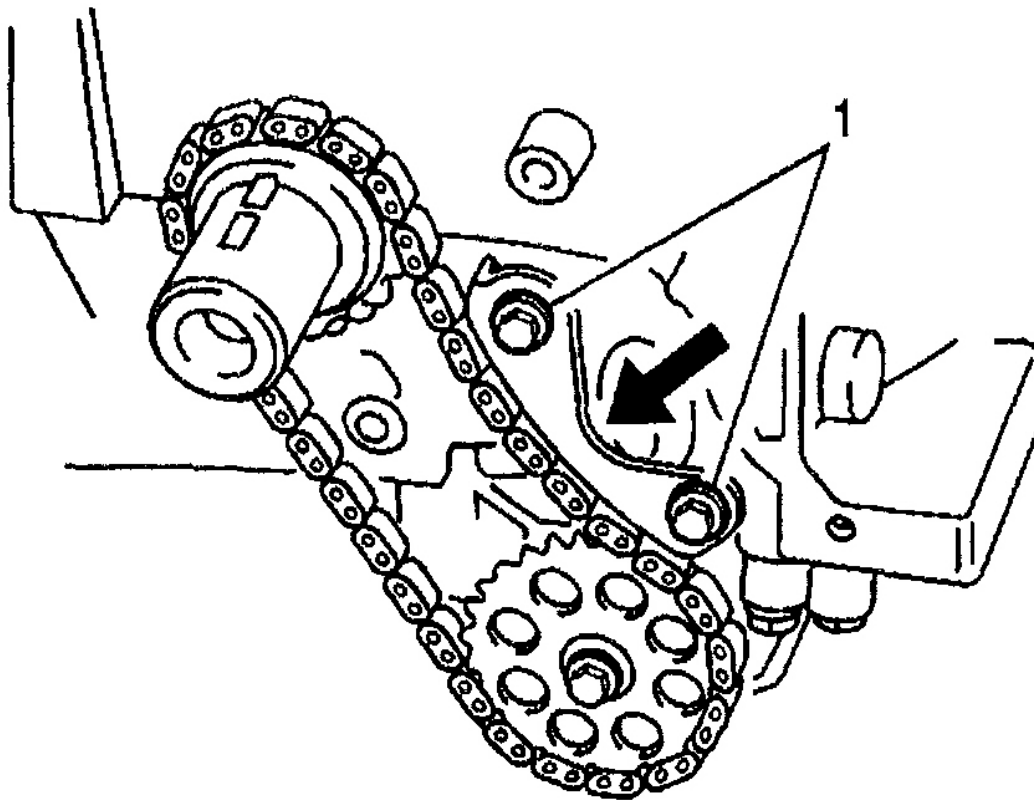
OIL PUMP

NOTE: Do not remove the oil pump sprocket or sprocket bolt.

NOTE: If the oil pump is found to be damaged or worn excessively replace the oil pump as an assembly.

Removal

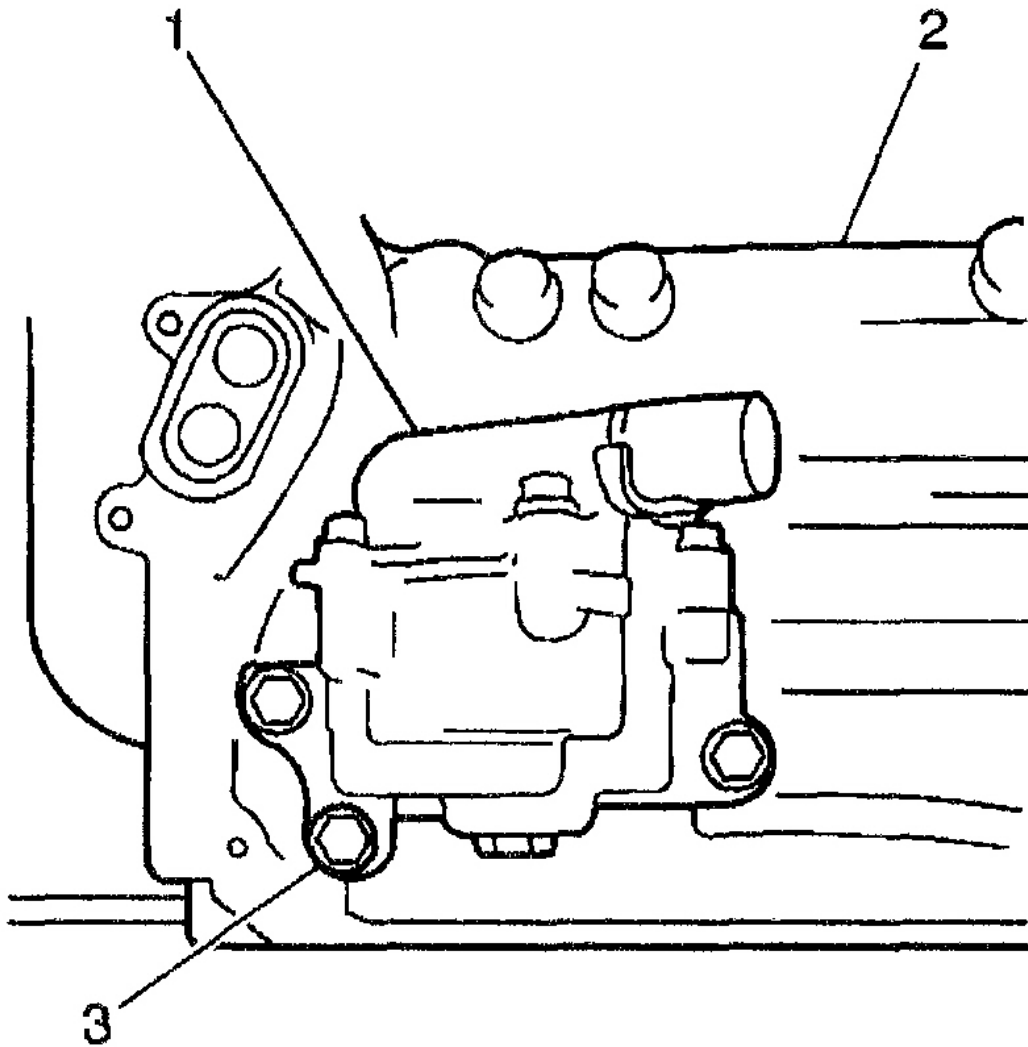
1. Remove the front engine cover. Refer to **TIMING CHAIN COVER & FRONT OIL SEAL**.
2. Remove the lower oil pan. Refer to **REMOVAL (LOWER)**.
3. Remove the upper oil pan. Refer to **REMOVAL (UPPER)**.
4. Loosen the 2 bolts (1) that secure the oil pump chain guide.



G01470220

Fig. 35: Loosening Bolts Securing Oil Pump Chain Guide
Courtesy of GENERAL MOTORS CORP.

5. Remove the 3 bolts and the oil pump (1).



G01470221

Fig. 36: Bolts & Oil Pump

Courtesy of GENERAL MOTORS CORP.

Disassembly

1. Remove the 5 bolts and separate the oil pump halves.
2. Remove the retainer, the spring and the relief valve.
3. Apply light air pressure to the oil jet. Inspect the oil jet for damage or clogging.
4. Remove and inspect the relief valve. Coat the relief valve with oil and check that it falls smoothly into the valve hole by it's own weight.

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Cleaning & Inspection

NOTE: If the oil pump is found to be damaged or excessively worn replace the oil pump as an assembly.

1. Inspect the following for excessive wear or damage:
 - The oil pump outer gear.
 - The oil pump inner gear.
 - The oil pump cover.
 - The oil pump body.
2. Measure the radial clearance between the oil pump outer gear and the oil pump body using a feeler gage. Replace the oil pump if the clearance exceeds .0043 in (.15 mm).
3. Measure the side clearance between the oil pump gears and a straightedge using a feeler gage. Replace the oil pump if the clearance exceeds .0043 in (.11 mm).
4. Measure the free length of the oil pressure relief spring. Replace the spring if the free length is less than 2.5 in (63.5 mm).
5. Measure the oil pressure relief spring tension. Replace the spring if the tension is less than 62 lbs at 2.05 in (86.0 Newtons at 52 mm).

OIL PUMP SPECIFICATIONS

Application	Specification
Rotor	
Radial Clearance	.0059" (.150 mm)
Side Clearance	.0043" (.109 mm)
Relief Spring	
Free Length	2.5" (63.5 mm)
Spring Preload	19 lbs. @ 2.05" (8.6 kg. @ 52.07 mm)

Reassembly

1. Lubricate the following with clean engine oil:
 - The oil pump inner gear.
 - The oil pump outer gear.
 - The inside surface of the oil pump body.
2. Install the oil pump outer and inner gears to the oil pump body.

NOTE: Fill oil pump cavities with petroleum jelly prior to installation. This will ensure that there is oil pressure immediately on start-up and will prevent engine damage.

3. Fill the oil pump with petroleum jelly to prime the oil pump.

4. Install the relief valve, the spring and retainer. See **TORQUE SPECIFICATIONS**.
5. Install the oil pump cover to the oil pump body. Secure the cover with 5 bolts. See **TORQUE SPECIFICATIONS**.

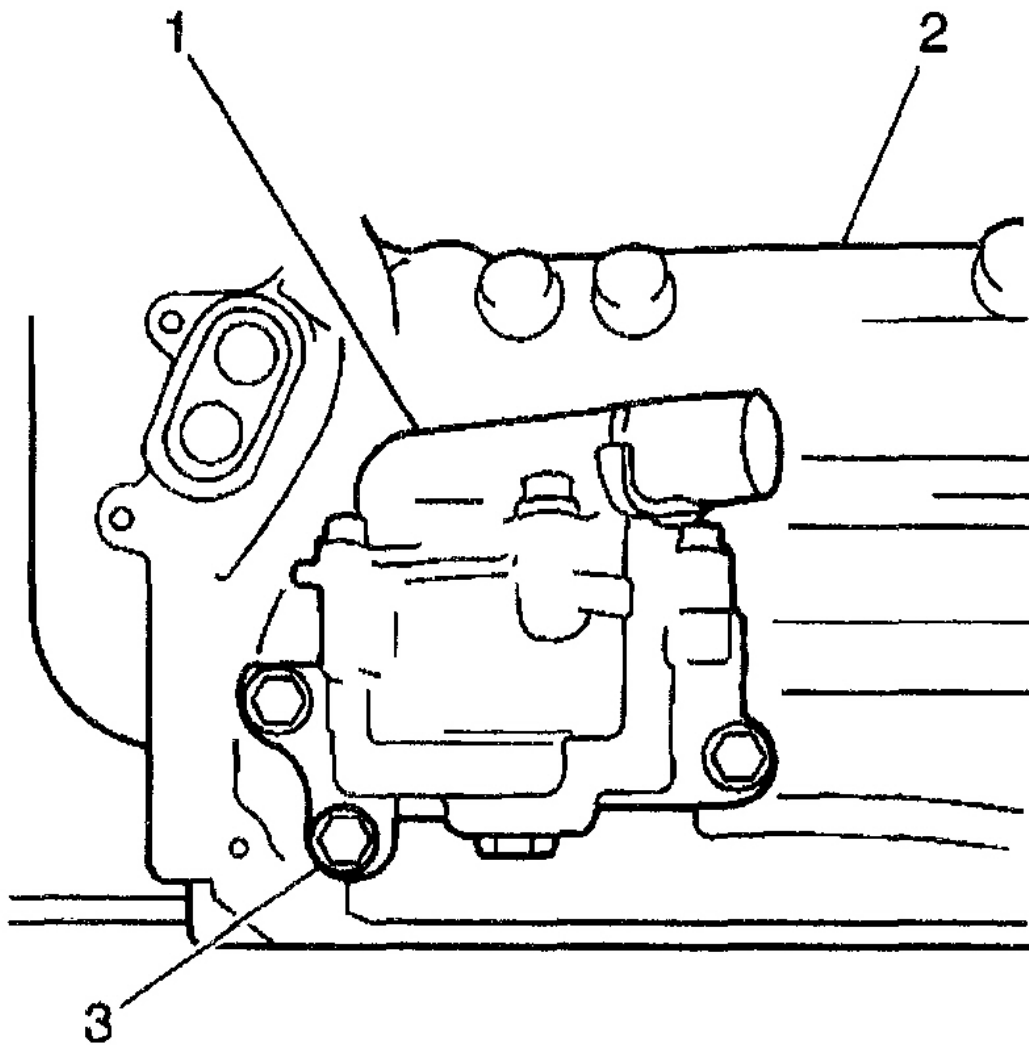
Installation

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

1. Install the oil pump with the chain on the sprocket and secure with the 3 bolts verifying the long bolt (3) is in the proper location.

Tighten

Tighten the bolts to 27 N.m (19.5 lb ft).



G01470222

Fig. 37: Bolts & Oil Pump

Courtesy of GENERAL MOTORS CORP.

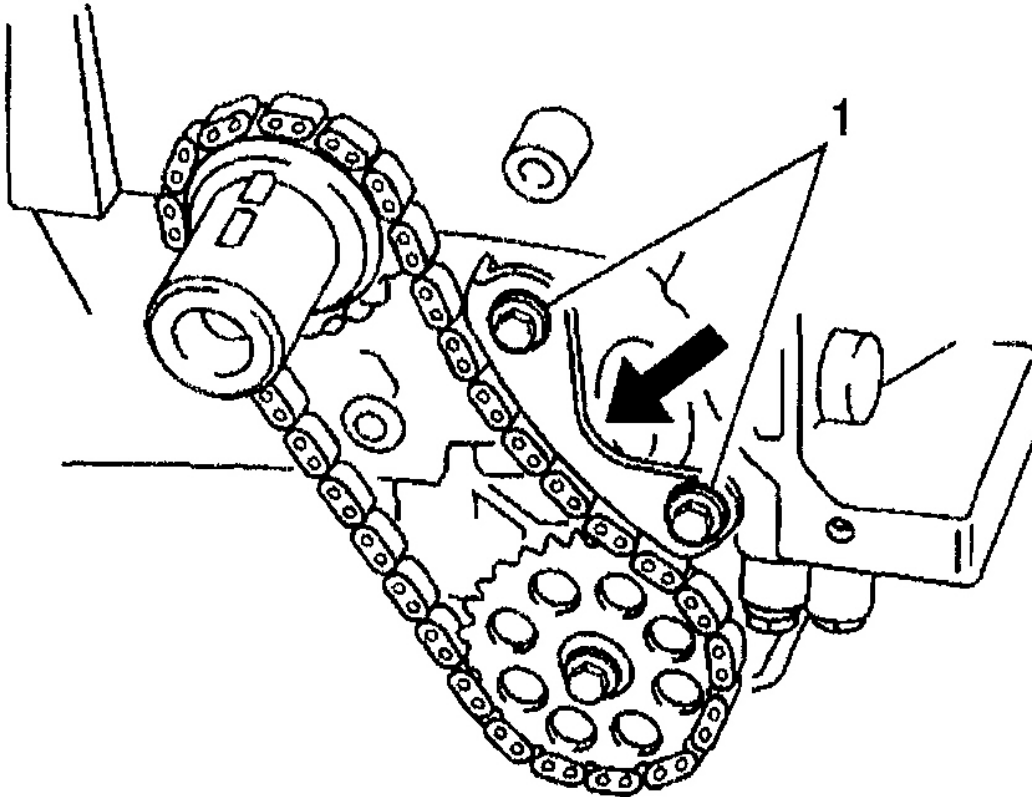
2. Push the center of the oil pump chain guide with a force of 0.5-0.6 N (0.11-0.13 lb) and secure the guide with the 2 bolts (1).

Tighten

Tighten the 2 bolts to 11 N.m (7.5 lb ft).

3. Install the front engine cover. Refer to **TIMING CHAIN COVER & FRONT OIL SEAL**.
4. Install the upper oil pan. Refer to **REMOVAL (UPPER)**.

5. Install the lower oil pan. Refer to **REMOVAL (LOWER)**.



G01470223

Fig. 38: Tightening Bolts Securing Oil Pump Chain Guide
Courtesy of GENERAL MOTORS CORP.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Air Conditioner (A/C) Compressor Bracket Mounting Bolts	40 (55)
Air Conditioner (A/C) Compressor Mounting Bolts	17 (23)
Camshaft Position Sensor Bolt	11 (15)
Camshaft Timing Sprocket Bolts	58 (80)
Connecting Rod Bearing Cap Nuts	33 (45)
Crankshaft Pulley Bolt	109 (150)
Cylinder Head Bolts ⁽¹⁾	

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

First Step	39 (53)
Second Step	61 (84)
Third Step	Loosen to 0
Fourth Step	39 (53)
Fifth Step	61 (84)
Sixth Step (Final Torque)	76 (105)
Accessory Drive Belt Tensioner Bolts	19 (25)
Engine Cooling Fan Nuts	18 (25)
Engine Ground Wire Bolts	11 (15)
Engine Mount Nuts	37 (50)
Engine Oil Drain Plug	26 (35)
Exhaust Manifold-to-Bracket Bolts	37 (50)
Exhaust Manifold-to-Cylinder Head Nuts	22 (30)
Flywheel Retaining Bolts (Automatic Transmission)	51 (70)
Fuel Rail Banjo Fitting	22 (30)
Generator Mounting Bolts and Nuts	17 (23)
Heated Oxygen (HO2S1 and HO2S2) Sensor	33 (45)
Intake Manifold Bolts and Nuts	17 (23)
Lower Crankcase Bolts	
First Step	14 (19)
Second Step (Final Torque)	20 (27)
Main Bearing Cap Bolts	
First Step	31 (42)
Second Step (Final Torque)	42 (58)
Negative Battery Cable	11 (15)
Oil Pressure Switch	11 (14)
Oil Pump Bolts	20 (27)
Power Steering Pump Bolts	19 (25)
Spark Plugs	18 (25)
Strut Tower Brace	37 (50)
Timing Chain Tensioner Nuts (Left Camshaft)	33 (45)
Timing Chain Tensioner Shoe Nut (Primary)	20 (27)
Torque Converter Bolts	65 (47)
Transmission to Engine Mounting Bolts	58 (80)
Water Pump Bolts	20 (27)
INCH Lbs. (N.m)	
Camshaft Bearing Cap Bolts ⁽²⁾⁽³⁾	106 (12)
Crankshaft Position Sensor Bolt	53 (6)
Cylinder Head Cover Bolts	93 (10.5)
Cylinder Head M6 Bolt	97 (11)
Engine Oil Pan Nuts and Bolts	97 (11)

2002 Chevrolet Tracker

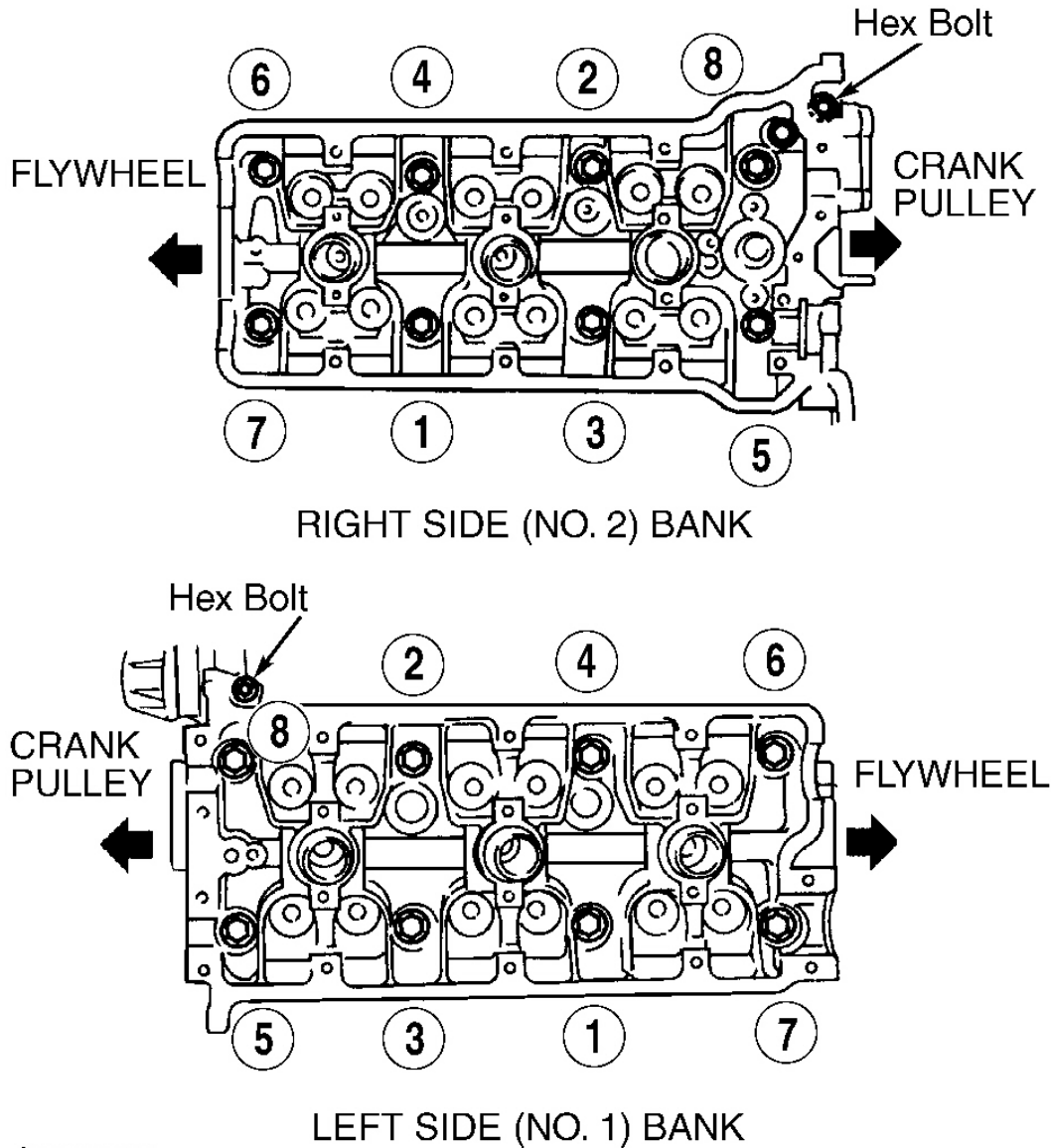
2002 ENGINES Tracker - 2.5L V6

Exhaust Manifold Heat Shield Bolts	89 (10)
Generator Terminal Nut	71 (8)
Ignition Coil Bolts	89 (10)
Oil Pump Case Bolts	106 (12)
Oil Pump Strainer Bolts	97 (11)
Starter Bolts	97 (11)
Throttle Body Bolts and Nuts	106 (12)
Timing Chain Cover Nuts and Bolts	97 (11)
Timing Chain Guide Bolts (Primary)	79 (9)
Timing Chain Tensioner Bolts (Left Camshaft)	106 (12)
Timing Chain Tensioner Bolts (Right Camshaft)	97 (11)
Timing Chain Tensioner Bolts (Primary)	97 (11)

(1) Tighten in sequence. See **Fig. 39**.

(2) Tighten in sequence. See **Fig. 20**.

(3) Tighten in sequence. See **Fig. 19**.



G00010492

Fig. 39: Cylinder Head Bolt Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	Specification

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Displacement	153 Cu. In. (2.5L)
Bore	3.31" (84 mm)
Stroke	2.95" (75.0 mm)
Compression Ratio	9.5:1
Fuel System	SFI

CRANKSHAFT, MAIN BEARINGS & CONNECTING ROD BEARINGS SPECIFICATIONS**CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS**

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0044-.0122 (.112-.310)
Limit	.0149 (.378)
Runout (Center Journal)	.0023 (.058)
Thrust Bearing	
Standard	.0984 (2.500)
Oversize	.1009 (2.563)
Main Bearings	
Journal Diameter	
Size Mark "1"	2.5588-2.5590 (64.994-65.999)
Size Mark "2"	2.5586-2.5588 (64.988-64.994)
Size Mark "3"	2.5583-2.5586 (64.981-64.988)
Journal Out-Of-Round	.0004 (.010)
Journal Taper	.0004 (.010)
Oil Clearance	
Standard	.0008-.0016 (.020-.040)
Limit	.0023 (.058)
Bearing Cap Bore Diameter	
"A"	2.7559-2.7561 (69.999-70.005)
"B"	2.7561-2.7563 (70.005-70.010)
"C"	2.7563-2.7566 (70.010-70.018)
Connecting Rod Bearings	
Journal Diameter	
Standard	1.9678-1.9685 (49.982-49.999)
Undersize	1.9580-1.9586 (49.733-49.748)
Journal Out-Of-Round	.0004 (.010)

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Journal Taper	.0004 (.010)
Oil Clearance	
Standard	.0010-.0022 (.025-.056)
Limit	.0031 (.079)

CONNECTING RODS SPECIFICATIONS**CONNECTING RODS**

Application	In. (mm)
Bore Diameter	
Pin Bore	.8269-.8272 (21.003-21.011)
Maximum Bend	.0020 (.050)
Maximum Twist	.0039 (.099)
Side Play	
Standard	.0099-.0157 (.251-.399)
Limit	.0177 (.450)

PISTONS, PISTON PINS & PISTON RINGS SPECIFICATIONS**PISTONS, PINS & RINGS**

Application	In. (mm)
Pistons	
Clearance	.0008-.0015 (.020-.038)
Diameter	3.3063-3.3067 (83.980-83.990)
Pins	
Diameter	.8266-.8268 (20.996-21.000)
Piston Fit	Slip
Rod Fit	Slip
Rings	
No. 1	
End Gap	
Standard	.0079-.0137 (.200-.348)
Limit	.0276 (.701)
Side Clearance	.0012-.0027 (.030-.069)
No. 2	
End Gap	
Standard	.0138-.0196 (.351-.498)
Limit	.0276 (.701)
Side Clearance	.0008-.0023 (.020-.058)
No. 3 (Oil)	
End Gap	
Standard	.0079-.0275 (.201-.699)

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Limit

.0709 (1.801)

CYLINDER BLOCK SPECIFICATIONS**CYLINDER BLOCK**

Application	In. (mm)
Cylinder Bore	
Diameter ⁽¹⁾	
Size Mark "1"	3.3075-3.3078 (84.010-84.018)
Size Mark "2"	3.3071-3.3074 (84.000-84.008)
Maximum Limit	3.3090 (84.049)
Maximum Taper	.004 (.10)
Maximum Out-Of-Round	.004 (.10)
Maximum Deck Warpage	.0024 (.061)
(1) Cylinder bore diameter determined by number stamped on block head surface.	

ENGINE VALVES & VALVE SPRINGS SPECIFICATIONS**VALVES & VALVE SPRINGS**

Application	In. (mm)
Intake Valves	
Face Angle	45 Degrees
Head Thickness	
Standard	.039 (.99)
Limit	.023 (.58)
Face Width	.0433-.0512 (1.099-1.300)
Stem Diameter	.2348-.2354 (5.964-5.979)
Exhaust Valves	
Face Angle	45 Degrees
Head Thickness	
Standard	.047 (1.19)
Limit	.027 (.69)
Face Width	.0433-.0512 (1.099-1.300)
Stem Diameter	.2339-.2344 (5.941-5.954)
Valve Springs	
Free Length	
Inner Standard	1.4204 (36.078)
Inner Service Limit	1.3780 (35.001)
Outer Standard	1.5921 (40.439)
Outer Service Limit	1.5441 (39.220)
Out-Of-Square	

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Inner	(1)
Outer	(1)
Side Clearance	
Inner	.063 (1.63)
Outer	.070 (1.77)
Lbs. @ In. (kg @ mm)	
Pressure	
Inner Standard	15.2-17.4 @ 1.08 (6.9-7.9 @ 27.43)
Inner Service Limit	13 @ 1.08 (5.9 @ 27.43)
Outer Standard	33.9-39.2 @ 1.25 (15.4-17.8 @ 31.75)
Outer Service Limit	30 @ 1.25 (13.3 @ 31.75)
(1) Information is not available from manufacturer.	

CYLINDER HEAD SPECIFICATIONS**CYLINDER HEAD**

Application	In. (mm)
Maximum Warpage	
Head-To-Block	.002 (.05)
Manifold-To-Block	.004 (.10)
Valve Seats	
Seat Angle	45 Degrees
Seat Width	.0433-.0512 (1.099-1.300)
Valve Guides	
Valve Guide I.D.	.2362-.2367 (5.999-6.012)
Valve Guide Installed Height	.53 (13.5)
Valve Stem-To-Guide Oil Clearance	
Intake Valve	
Standard	.0008-.0018 (.020-.046)
Limit	.0027 (.069)
Exhaust Valve	
Standard	.0018-.0028 (.046-.071)
Limit	.0035 (.089)

CAMSHAFT SPECIFICATIONS**CAMSHAFT**

Application	In. (mm)
Bore Diameter	1.0236-1.0249 (25.999-26.032)

2002 Chevrolet Tracker

2002 ENGINES Tracker - 2.5L V6

Journal Diameter	1.0220-1.0228 (25.959-25.979)
Journal Runout	.0039 (.099)
Lobe Height	
Intake	
Standard	1.5530-1.5593 (39.446-39.606)
Limit	1.5512 (39.400)
Exhaust	
Standard	1.5523-1.5586 (39.428-39.588)
Limit	1.5512 (39.400)
Oil Clearance	
Standard	.0008-.0029 (.020-.074)
Limit	.0047 (.119)