SECTION 6A1

ENGINE MECHANICAL—1.6 LITER L4 VIN CODE 6 (RPO L01)

CAUTION: This vehicle is 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 proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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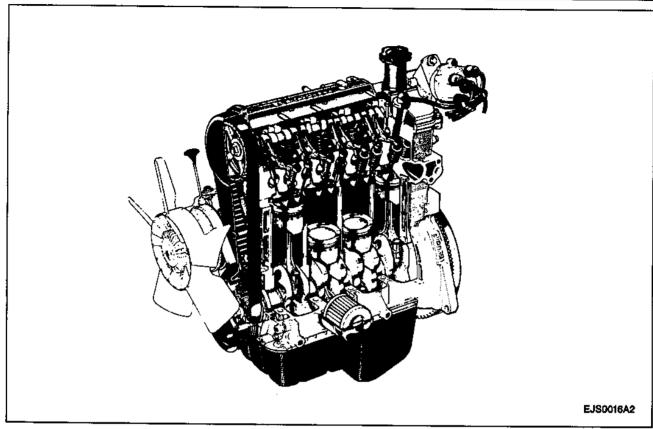


Figure 1—Engine Construction

GENERAL DESCRIPTION

ENGINE CONSTRUCTION

Figure 1

The engine is a four cylinder in-line, four stroke gasoline unit with a single overhead cam (SOHC) valve mechanism arranged for "V"-type valve configuration.

The SOHC is mounted over the cylinder head and is driven by the crankshaft through the timing belt. In this configuration, there are no push rods provided in the valve train system (Figure 1).

Cylinder Head and Valve Train

Figure 2

The cylinder head is made of a cast aluminum alloy and has four in-line combustion chambers. Each combustion chamber has two intake valves and two exhaust valves.

A fuel injector is positioned near each set of intake valves. During each intake stroke of the engine, a fuel injector sprays or atomizes fuel into a fine mist. This mist mixes with air drawn in through the intake manifold as the piston reaches the bottom of the cylinder during the intake stroke (Figure 2).

The valve train is driven by a single overhead camshaft. The camshaft has sixteen cam lobes. Each cam lobe operates an intake or exhaust valve through a rocker arm. Valve lash can be adjusted by turning the adjusting screw on the rocker arm after loosening the locknut. This will increase or decrease clearance between rocker arm and valve stem.

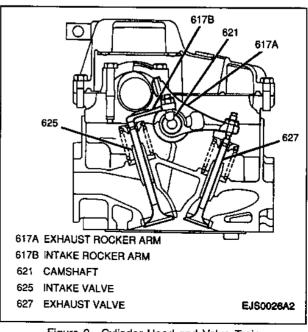


Figure 2-Cylinder Head and Valve Train

Cylinder Block

The cylinder block is made of cast aluminum alloy and has four cylinders arranged in-line. A cylindrical cast iron sleeve is installed in each cylinder. Engine coolant is circulated through water jackets which surround each sleeve keeping engine operating temperature constant.

Crankshaft and Main Bearings

A monoblock casting crankshaft is supported by five main bearings. It has an eight-piece type counter weight which is incorporated with the balance weight. Four crank pins on the crankshaft are positioned 180 degrees apart. The bearing caps incorporate bearing cap supports.

Pistons, Rings, Piston Pins, and Connecting Rods

Each piston is cast aluminum alloy and has two compression rings and one oil ring. The top compression ring is plated with hard chromium for improvement in abrasion resistance. The oil ring consists of two rails and one spacer.

The piston pin is offset 0.5 mm (0.02-inch) toward the thrust side. This allows a gradual change in thrust pressure against the cylinder wall as the piston travels through the bore. Piston pins are chromium steel and have a floating fit in the pistons and partially in the connecting rods. The connecting rods are made of forged steel and the rod bearings are of precession insert type.

ENGINE LUBRICATION

Figure 3

The oil pump is a trochoid type and is mounted on the crankshaft at the crankshaft pulley side. Oil is drawn up through the oil pump strainer and passed through the pump to the oil filter. The filtered oil flows in two paths in the cylinder block (Figure 3).

In one path, oil reaches the crankshaft journal bearings. Oil from the crankshaft journal bearings is supplied to the rod bearings by means of intersecting passages drilled in the crankshaft. Its then injected through a small hole in the connecting rod to lubricate the pistons, rings and cylinder walls.

In the second path, oil flows to the cylinder head and lubricates the rocker arms, valves, camshaft, etc., after passing through the internal oil passage of the rocker arm shafts.

A pressure relief valve is provided on the oil pump to relieve oil pressure should it become greater than 392 kPa (56.9 psi). As oil pressure is relieved, oil is diverted through the valve back to the engine oil pan.

ON-VEHICLE SERVICE

ENGINE MOUNTS

Engine mounts are the nonadjustable type and seldom require service. Broken or deteriorated mounts must be replaced immediately because of the added strain placed on the mounts and drive line components.

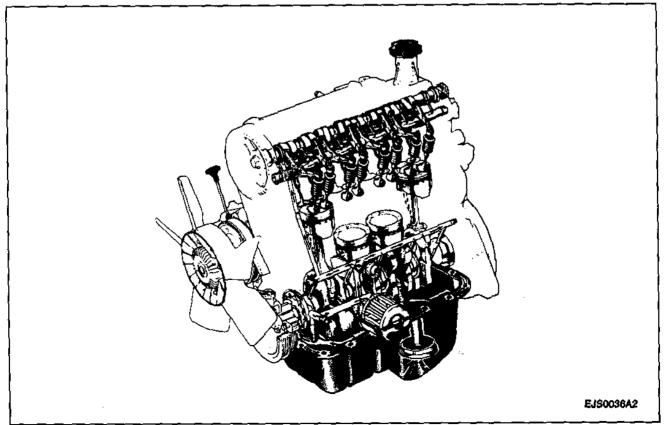


Figure 3-Engine Lubrication

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Checking Engine Mounts

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe mounts while raising engine. Replace any mount that exhibits:

- Hard rubber surfaces covered with heat check
- Rubber separated from a metal plate of the mount.
- Rubber split through center.

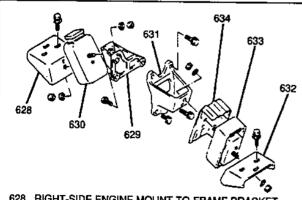
If there is movement between a metal plate of the mount and its attaching points, lower the engine on the mount and tighten the bolts or nuts securing the mount to the engine, frame or bracket.

Right-Side Engine Mount

Figure 4

Remove or Disconnect

- 1. Negative (-) battery cable.
- 2. Four bolts and reposition shroud to the rear.
- 3. Raise and suitably support vehicle. Refer to SECTION 0A.
- 4. Support engine using a suitable engine support
- 5. Four bolts and front skid plate from engine (if equipped).
- 6. Lead wires from starter motor to gain clearance for engine mount assembly removal. Refer to SECTION 6D2.
- 7. Three right-side engine mount-to-frame bracket bolts (Figure 4).
- 8. Three right-side engine mount-to-engine bracket bolts.
- 9. Raise engine slightly to provide clearance for engine mount assembly removal.



- 628 RIGHT-SIDE ENGINE MOUNT-TO-FRAME BRACKET
- 629 RIGHT-SIDE ENGINE MOUNT-TO-ENGINE BRACKET
- 630 RIGHT-SIDE ENGINE MOUNT
- 631 LEFT-SIDE ENGINE MOUNT-TO-ENGINE BRACKET
- 632 LEFT-SIDE ENGINE MOUNT-TO-FRAME BRACKET
- 633 LEFT-SIDE ENGINE MOUNT
- 634 LEFT-SIDE ENGINE MOUNT COVER

EJS0046A1

Figure 4—Engine Mounts

10. Right-side engine mount from vehicle.

Disassemble

- 1. Right-side engine mount-to-frame bracket from engine mount.
- 2. Right-side engine mount-to-engine bracket from engine mount.

Assemble

- 1. Right-side engine mount-to-engine bracket to engine mount.
- 2. Right-side engine mount-to-frame bracket to engine mount.

Install or Connect

- 1. Right-side engine mount to engine.
- 2. Three right-side engine mount-to-frame bracket bolts. Do not tighten fully.
- 3. Three right-side engine mount-to-engine bracket bolts.

|Q| Tighten

- Right-side engine mount-to-frame bracket bolts to 54 N·m (40 lb. ft.).
- · Right-side engine mount-to-engine bracket bolts to 54 N·m (40 lb. ft.).
- 4. Lead wires to starter motor. Refer to SECTION 6D2.
- Remove engine support stand.
- 6. Front skid plate to engine (if equipped); secure with four bolts.

ĮĐ

Tighten

- Front skid plate bolts to 54 N·m (40 lb. ft.).
- 7. Lower vehicle.
- 8. Shroud to radiator; secure with four bolts.

Tighten

- Shroud bolts to 10 N·m (89 lb. ft.).
- 9. Negative (-) battery cable.

Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

Left-Side Engine Mount

Figure 4

Remove or Disconnect

- 1. Negative (-) battery cable.
- 2. Four bolts and reposition shroud to the rear.
- 3. Raise and suitably support vehicle. Refer to SECTION 0A.

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- 4. Four bolts and front skid plate from engine (if equipped).
- 5. Exhaust pipe-to-bracket nut.
- 6. Two left-side engine mount-to-bracket bolts.
- 7. Lower vehicle.
- 8. Support engine using a floor jack.
- Two left-side engine mount-to-exhaust bracket bolts and exhaust bracket from vehicle.
- Three left-side engine mount-to-frame bracket bolts.
- 11. Raise engine slightly to provide clearance for left-side engine mount removal.
- 12. Left-side engine mount from vehicle.

Disassemble

- Left-side engine mount-to-frame bracket from engine mount.
- Left-side engine mount-to-engine bracket from engine mount.

Assemble

- Left-side engine mount-to-frame bracket to engine mount.
- Left-side engine mount-to-engine bracket to engine mount.

++ Install or Connect

- 1. Left-side engine mount to vehicle.
- 2. Three left-side engine mount-to-frame bracket bolts. Do not tighten fully.
- Exhaust bracket; secure with two engine mount-to-exhaust bracket bolts.

হি Tighten

- Engine mount-to-exhaust bracket bolts to 54 N.m (40 lb. ft.).
- Left-side engine mount-to-frame bracket bolts to 54 N.m (40 lb. ft.).
- 4. Raise and suitably support vehicle.
- 5. Two left-side engine mount-to-engine bolts. Do not tighten fully.
- One exhaust pipe-to-bracket nut.

(1) Tighten

- Left-side engine mount-to-engine bolts to 54 N·m (40 lb. ft.).
- Exhaust pipe-to-bracket nut to 50 N-m (37 lb. ft.).
- 7. Front skid plate to vehicle (if equipped); secure with four bolts.

(1) Tighten

- Front skid plate bolts to 54 N.m (40 lb. ft.).
- 8. Lower vehicle.
- 9. Shroud to radiator; secure with four bolts.

(1) Tighten

- Shroud bolts to 10 N·m (89 lb. in.).
- 10. Negative (-) battery cable.

2 Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

OIL LEVEL INDICATOR AND GUIDE TUBE

Figure 5

Remove or Disconnect

- 1. Oil level indicator from guide tube.
- One bolt and guide tube from cylinder block (Figure 5).
- 3. Guide tube seal from oil pump body.

+ Install or Connect

- 1. Coat new guide tube seal with new engine oil.
- 2. New guide tube seal to cylinder block.
- Guide tube to cylinder block; secure with one bolt.

হি Tighten

- Guide tube bolt to 14 N.m (10 lb. ft.).
- 4. Oil level indicator to guide tube.

OIL PRESSURE SWITCH

Remove or Disconnect

- 1. Negative (-) battery cable.
- Rubber boot and electrical connector from oil pressure switch.
- 3. Oil pressure switch from engine.

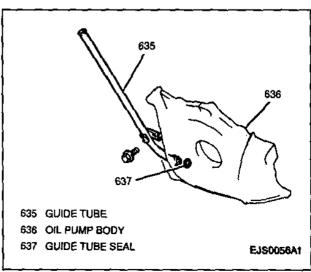


Figure 5-Oil Level Indication Guide Tube

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[Important

 For oil pressure switch diagnosis, refer to SECTION 8A.

++ Install or Connect

- Coat oil pressure switch threads with Loctite® pipe sealant (with Teflon®) GM P/N 1052080, or equivalent, to prevent leaks.
- 2. Oil pressure switch to engine.

হি Tighten

- Oil pressure switch to 14 N·m (10 lb. ft.).
- Electrical connector and rubber to oil pressure switch.
- 4. Negative (-) battery cable.

হ্ম Tighten

 Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

DISTRIBUTOR CASE

Figure 6

+→ Remove or Disconnect

- 1. Negative (-) battery cable.
- Distributor ground wires from distributor gear case.
- Distributor from distributor case. Refer to SECTION 6D4.
- 4. Three bolts and distributor case with O-ring from cylinder head (Figure 6).

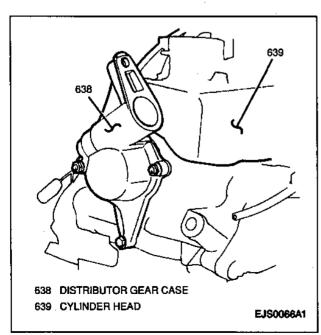


Figure 6-Distributor Case

? Important

 A small amount of oil may drain from the distributor case upon removal from the cylinder head. Place a suitable container underneath the distributor case or use a shop towel to catch and absorb oil.

++ Install or Connect

- 1. Lubricate a new O-ring with clean engine oil and install into distributor gear case.
- Apply RTV silicone rubber sealant GM P/N 12345739, or equivalent to the surface of the distributor case that mates with the rear of the rocker arm shaft.
- Distributor case to cylinder head; secure with three bolts.

হ্মি Tighten

- Distributor case bolts to 10 N·m (89 lb. in.).
- 4. Add approximately 30 cc (1.01 oz.) of engine oil into the distributor case after installation to the cylinder head.
- Distributor into distributor case. Refer to SECTION 6D4.
- 6. Distributor ground wires to distributor gear case.
- 7. Negative (-) battery cable.

হ্মি Tighten

 Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

AIR CLEANER (ACL) ELEMENT

Figures 7 and 8

←→ Remove or Disconnect

- 1. Loosen four ACL upper case screws (Figure 7).
- 2. ACL upper case from ACL lower case.

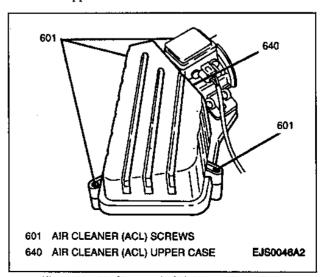


Figure 7—Air Cleaner (ACL) Upper Case Bolts

3. ACL element from ACL lower case.



Clean

 ACL element by blowing out dust with low pressure compressed air (Figure 8).

→+ Install or Connect

- 1. ACL element into lower case.
- 2. ACL upper case to ACL lower case.

Q Tighten

Four ACL upper case screws.

AIR INTAKE PIPE

Figure 9

Remove or Disconnect

- 1. Relieve cooling system pressure. Refer to SECTION 6B.
- 2. Idle air control (IAC) valve air intake hose from air intake pipe (Figure 9).
- 3. Positive crankcase ventilation (PCV) hose from air intake pipe (Figure 9).
- 4. Two coolant hoses from air intake pipe (Figure 9).
- 5. Loosen ACL-to-air intake pipe and air intake pipe-to-throttle body hose clamps.
- 6. Three bolts and air intake pipe from engine.

→+ Install or Connect

1. Air intake pipe to engine; secure with three bolts.

(1) Tighten

• Air intake pipe bolts to 15 N·m (11 lb. ft.).

Tighten

 ACL-to-air intake pipe and air intake pipe-to-throttle body hose clamps.

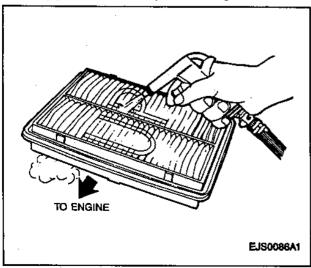


Figure 8—Cleaning Air Cleaner (ACL) Element

- 2. Two coolant hoses to air intake pipe (Figure 9).
- 3. PCV hose to air intake pipe (Figure 9).
- 4. IAC valve air intake hose to air intake pipe (Figure 9).
- Refill cooling system as necessary. Refer to SECTION 6B.

AIR CLEANER (ACL)

Remove or Disconnect

- 1. Negative (-) battery cable.
- Mass air flow (MAF) and intake air temperature (IAT) sensor electrical connectors.
- 3. Loosen ACL hose-to-MAF sensor hose clamp.
- 4. ACL hose from MAF sensor.
- 5. Three bolts and ACL from vehicle.

? Important

 If the ACL is being replaced as an assembly, the MAF sensor, IAT sensor ACL element must be transferred to the new ACL assembly.

→+ Install or Connect

1. ACL into vehicle; secure with three bolts.

(1) Tighten

- Air cleaner (ACL) mounting bolts to 10 N-m (89 lb. in.).
- 2. ACL hose to MAF sensor.

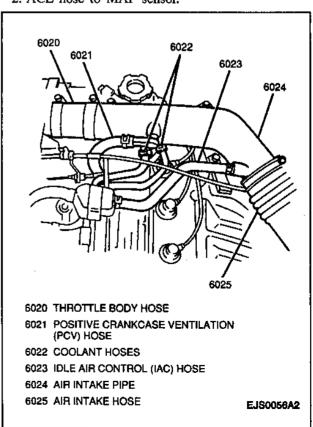


Figure 9--Air Intake Pipe

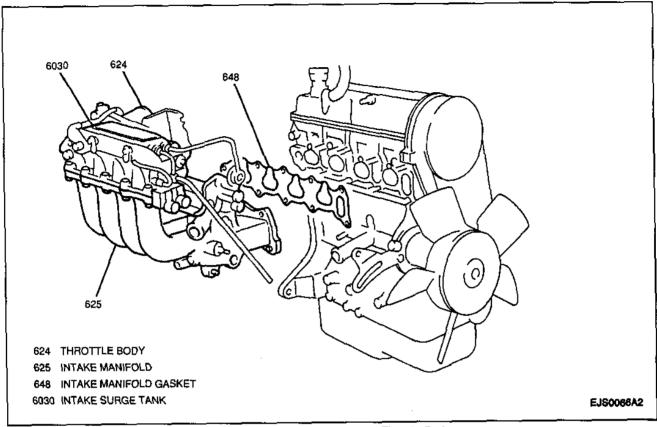


Figure 10-Intake Manifold and Throttle Body

2 Tighten

- Air cleaner (ACL) hose-to-MAF sensor hose clamp.
- Mass air flow (MAF) and intake air temperature (IAT) sensor electrical connectors.
- 4. Negative (-) battery cable.

(1) Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

INTAKE MANIFOLD AND THROTTLE BODY

Remove or Disconnect

Figures 10 through 15

- 1. Negative (-) battery cable.
- 2. Release fuel pressure. Refer to SECTION 6C.
- 3. Fuel filler cap to release fuel vapor pressure in fuel tank. After releasing pressure, replace cap.
- Air intake pipe from ACL intake hose and throttle hose. Refer to "Air Intake Pipe" earlier in this section.
- 5. Drain cooling system. Refer to SECTION 6B.
- Three bolts and throttle cover from intake manifold.
- Accelerator cable and kickdown cable (automatic transmission equipped vehicles) from throttle body bellcrank (Figure 11).

- 8. One bolt, one nut, one screw and accelerator cable bracket from throttle body (Figure 11).
- 9. The following electrical connectors:
 - · Throttle position (TP) sensor.
 - Idle air control (IAC) valve.
 - Engine coolant temperature (ECT) sensor (Figure 12).
 - ECT sensor sending unit (Figure 12).

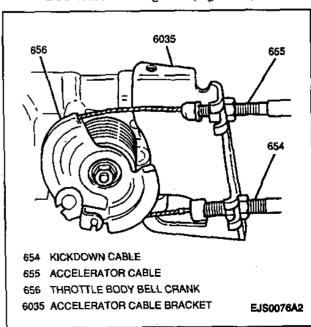


Figure 11-Accelerator Cable and Kickdown Cable

- A/C ECT switch (A/C equipped vehicles only) (Figure 12).
- Evaporative emission solenoid purge valve (Figure 12).
- Exhaust gas recirculation (EGR) temperature sensor.
- EGR solenoid vacuum valve (Figure 12).
- EGR by-pass valve.
- Fuel injectors (Figure 12).
- · Wiring harness from retaining clamps.
- Engine ground wire from intake surge tank (Figure 12).
- 10. The following vacuum hoses:
 - EVAP canister purge valve.
 - Vacuum modulator supply hose (automatic transmission equipped vehicles).
 - · Brake booster supply hose.
 - · EGR valve.
 - · EGR pressure transducer.
 - Intake manifold absolute pressure sensor hose from sensor.
- 11. Coolant hose from the IAC valve.
- 12. IAC air hose from the IAC valve.
- 13. Coolant hoses from the fast idle air valve below throttle body.
- 14. Fuel feed hose at fuel feed hose union (Figure 13).
- 15. Fuel return hose from fuel return line.
- 16. PCV hose from PCV valve.

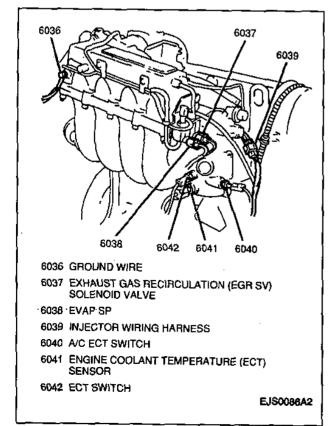


Figure 12-Intake Manifold Electrical Connections

- 17. Loosen upper radiator hose clamp at thermostat housing.
- 18. Upper radiator hose from thermostat housing.
- 19. Coolant bypass hose from intake manifold.
- 20. One bolt, one nut and generator adjusting arm bracket from intake manifold (Figure 14).
- 21. Two bolts and front intake manifold reinforcement bracket from intake manifold (Figure 15).
- 22. Two bolts and rear intake manifold reinforcement bracket from intake manifold (Figure 15).
- 23. Two bolts and lower intake manifold support bracket from intake manifold (Figure 15).
- 24. Eight nuts, three bolts, intake manifold with gasket, intake surge tank and throttle body from cylinder head.
- 25. PCV valve, EGR valve, ECT sensor, ECT sensor sending unit, A/C ECT switch (A/C equipped vehicles) and EGR temperature sensor from intake manifold if required.

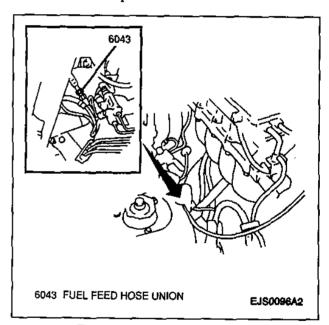


Figure 13-Fuel Feed Hose Union

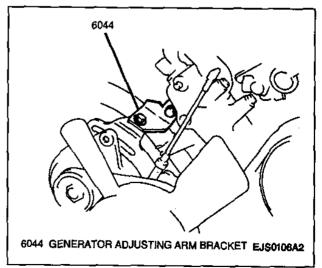
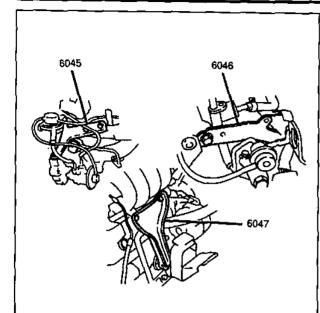


Figure 14-Generator Adjusting Arm Bracket



- 6045 REAR INTAKE MANIFOLD REINFORCEMENT BRACKET
- 6046 FRONT INTAKE MANIFOLD REINFORCEMENT BRACKET
- 6047 LOWER INTAKE MANIFOLD REINFORCEMENT
 BRACKET EJS011RA2

Figure 15-Intake Manifold Reinforcement Brackets

++ Install or Connect

- PCV valve, EGR valve, ECT sensor, ECT sensor sending unit, A/C ECT switch (A/C equipped vehicles) and EGR temperature sensor to intake manifold if required.
- New intake manifold gasket and intake manifold with intake surge tank and throttle body to cylinder head; secure with eight nuts, three bolts.

1 Tighten

- Intake manifold nuts and bolts to 23 N-m (17 lb. ft.).
- 3. Lower intake manifold support bracket to intake manifold; secure with two bolts (Figure 15).

(1) Tighten

- Lower intake manifold support bracket bolts to 50 N·m (37 lb. ft.).
- 4. Rear intake manifold reinforcement bracket to intake manifold; secure with two bolts (Figure 15).

(1) Tighten

- Rear intake manifold reinforcement bracket bolts to 50 N·m (37 lb. ft.).
- 5. Front intake manifold reinforcement bracket to intake manifold (Figure 15).

2 Tighten

- Front intake manifold reinforcement bracket bolts to 50 N·m (37 lb. ft.).
- 6. Generator adjusting arm bracket to intake manifold; secure with one bolt and one nut (Figure 14).

(1) Tighten

- Generator adjusting arm bracket nut and bolt to 50 N·m (37 lb. ft.).
- 7. Coolant bypass hose to intake manifold.
- 8. Upper radiator hose to thermostat housing.

(1) Tighten

- Upper radiator hose clamp at thermostat housing.
- 9. PCV hose to PCV valve.
- 10. Fuel return hose.
- 11. Fuel feed hose at fuel feed hose union (Figure 13).
- Coolant hoses to the fast idle air valve below throttle body.
- 13. IAC air hose to the IAC valve.
- 14. Coolant hose to the IAC valve.
- 15. The following vacuum hoses:
 - EGR pressure transducer.
 - · EGR valve.
 - · Brake booster supply hose.
 - Vacuum modulator supply hose (automatic transmission equipped vehicles).
 - EVAP canister purge valve.
 - Intake manifold absolute pressure sensor hose to sensor.
- 16. The following electrical connectors:
 - Engine ground wire to intake surge tank (Figure 12).
 - Wiring harness to retaining clamps.
 - Fuel injectors (Figure 12).
 - EGR solenoid vacuum valve (Figure 12).
 - EGR by-pass valve.
 - Exhaust gas recirculation (EGR) temperature sensor.
 - Evaporative emission solenoid purge valve (Figure 12).
 - A/C ECT switch (A/C equipped vehicles only) (Figure 12).
 - ECT sensor sending unit (Figure 12).
 - Engine coolant temperature (ECT) sensor (Figure 12).
 - Idle air control (IAC) valve.
 - Throttle position (TP) sensor.
- 17. Accelerator cable bracket to throttle body; secure with one screw, one bolt and one nut (Figure 11).

E Tighten

- Throttle body nut and bolt to 23 N.m (17 lb. ft.).
- 18. Accelerator cable and kickdown cable (automatic transmission equipped vehicles) to throttle body belicrank (Figure 11).



Adjust

- · Accelerator cable as necessary. Refer to SECTION 6C.
- Kickdown cable (automatic transmission) equipped vehicles) as necessary. Refer to SECTION 7A.
- 19. Throttle cover to intake manifold: secure with three bolts.



Tighten

- Throttle cover bolts to 15 N·m (11 lb. ft.).
- 20. Refill cooling system as necessary. Refer to SECTION 6B.
- 21. Air intake pipe to throttle body hose and ACL intake hose. Refer to "Air Intake Pipe" earlier in this section.
- 22. Negative (-) battery cable.

Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

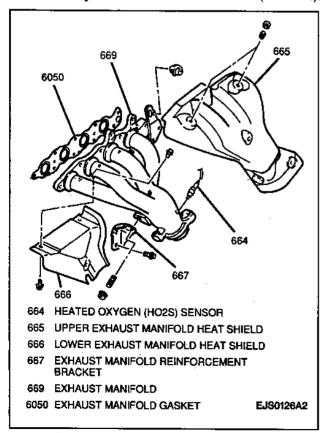


Figure 16—Exhaust Manifold Components

EXHAUST MANIFOLD

Figures 16 through 20

CAUTION: To avoid the danger of being burned, do not service exhaust system while it is still hot. Service should be performed only after the system has had sufficient time to cool down.

Remove or Disconnect

- 1. Negative (-) battery cable.
- 2. Heated oxygen sensor (HO2S1) electrical connector.

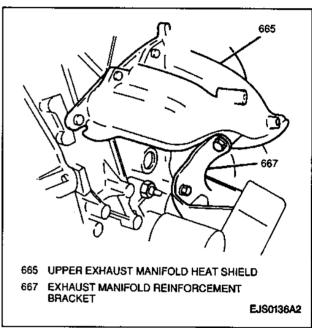


Figure 17—Exhaust Manifold Reinforcement Bracket

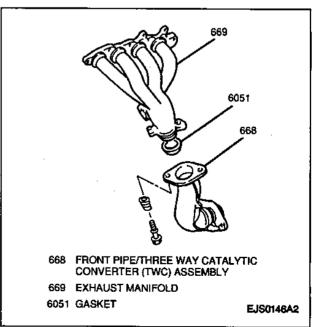


Figure 18—Front Pipe/Three Way Catalytic Converter (TWC) Assembly at Exhaust Manifold

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- Air intake pipe from ACL intake hose and throttle hose. Refer to "Air Intake Pipe" earlier in this section.
- Three bolts and air intake pipe bracket from cylinder head.
- 5. Two nuts, three bolts and upper exhaust manifold heat shield from exhaust manifold (Figure 16).
- Raise and suitably support vehicle. Refer to SECTION 0A.
- 7. Two bolts, one nut and exhaust manifold reinforcement bracket from exhaust manifold and engine mount (Figure 17).
- 8. Three bolts and front pipe/three way catalytic converter (TWC) assembly, with gasket, from exhaust manifold (Figure 19).
- 9. Lower vehicle.

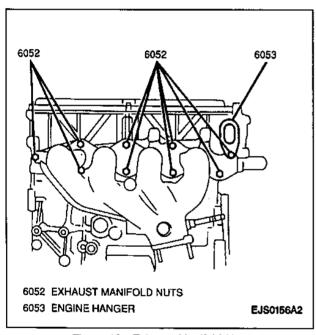


Figure 19-Exhaust Manifold Nuts

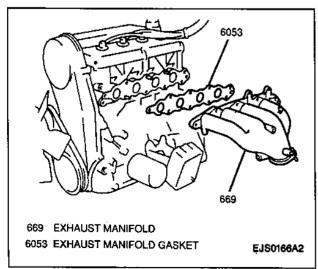


Figure 20-Removing Exhaust Manifold and Gasket

- Nine nuts and exhaust manifold with gasket and engine hanger from cylinder head (Figures 19 and 20).
- 11. Two bolts and lower exhaust manifold heat shield from exhaust manifold (Figure 16).
- 12. Heated oxygen (HO2S1) sensor from exhaust manifold.

→+ Install or Connect

1. HO2S1 sensor into exhaust manifold.

(Tighten

- HO2S1 sensor to 43 N·m (32 lb. ft.).
- 2. New exhaust manifold gasket and exhaust manifold with engine hanger to cylinder head; secure with nine nuts (Figures 19 and 20).

1 Tighten

- Exhaust manifold nuts to 23 N·m (17 lb. ft.).
- 3. Raise and suitably support vehicle. Refer to SECTION 0A.
- 4. Front pipe/TWC assembly with new gasket to exhaust manifold; secure with three bolts (Figure 18).

হ্মি Tighten

- Exhaust manifold-to-front pipe/TWC assembly to 50 N·m (37 lb, ft,).
- 5. Lower exhaust manifold heat shield to exhaust manifold; secure with two bolts (Figure 16).

(1) Tighten

- Lower exhaust manifold heat shield bolts to 10 N·m (89 lb. in.).
- Exhaust manifold bracket to exhaust manifold and engine mount; secure with one nut and two bolts (Figure 17).

হ্ম Tighten

- Engine mount-to-exhaust bracket bolts to 54 N·m (40 lb. ft.).
- Exhaust bracket-to-exhaust manifold nut to 50 N·m (37 lb. ft.).
- 7. Lower vehicle.
- 8. Upper exhaust manifold heat shield to exhaust manifold; secure with two nuts and three bolts (Figure 16).

1 Tighten

- Upper exhaust manifold heat shield nuts and bolts to 10 N·m (89 lb. in.).
- Air intake pipe bracket to cylinder head; secure with three bolts,

() Tighten

- Air intake pipe bracket bolts to 10 N.m (89 lb. ft.).
- Air intake pipe to throttle body hose and ACL intake hose. Refer to "Air Intake Pipe" earlier in this section.
- Heated oxygen sensor (HO2S1) electrical connector.
- 12. Negative (-) battery cable.

1 Tighten

 Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

CYLINDER HEAD COVER

Figures 11, 21 and 22

Remove or Disconnect

- 1. Negative (-) battery cable.
- Air intake pipe from ACL intake hose and throttle hose. Refer to "Air Intake Pipe" earlier in this section.
- 3. Three bolts and air intake pipe bracket from cylinder head.
- 4. Three bolts and throttle cover from intake manifold.
- Accelerator cable and kickdown cable (automatic transmission equipped vehicles) from throttle body bellcrank (Figure 11).
- One bolt, one nut, one screw and accelerator cable bracket from throttle body (Figure 11).
- 7. Positive crankcase ventilation (PCV) valve hose and PCV valve from cylinder head cover.
- 8. Secondary (spark plug) wires from spark plugs and cylinder head cover.

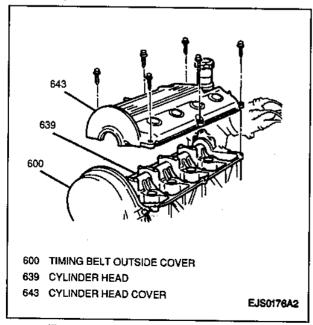


Figure 21—Removing Cylinder Head Cover

- 9. Six bolts and cylinder head cover from cylinder head (Figure 21).
- Cylinder head cover gasket and four O-rings from cylinder head.

Clean

 Sealing surfaces on cylinder head and cylinder head cover.

Important

 A new cylinder head cover gasket and O-rings MUST be used whenever cylinder head cover removal and installation is performed. Ensure that new gasket and O-rings are correctly positioned during cylinder head cover installation.

++ Install or Connect

- 1. New cylinder head cover gasket and four O-rings to cylinder head cover (Figure 22).
- 2. Cylinder head cover to cylinder head; secure with six bolts (Figure 21).

Tighten

- Cylinder head cover bolts to 10 N·m (89 lb. in.).
- Secondary (spark plug) wires to cylinder head cover and spark plugs.
- Positive crankcase ventilation (PCV) valve and PCV valve hose to cylinder head cover.
- 5. Accelerator cable bracket to throttle body; secure with one screw, one bolt and one nut (Figure 11).

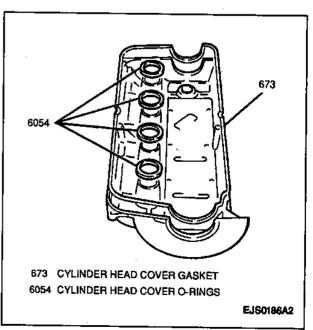


Figure 22—Cylinder Head Cover Gasket and O-Ring Installation

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2 Tighten

- Throttle body nut and bolt to 23 N.m (17 lb, ft.).
- 6. Accelerator cable and kickdown cable (automatic transmission equipped vehicles) to throttle body bellcrank (Figure 11).

P

Adjust

- Accelerator cable as necessary. Refer to SECTION 6C.
- Kickdown cable (automatic transmission equipped vehicles) as necessary. Refer to SECTION 7A.
- Throttle cover to intake manifold; secure with three bolts.

(1) Tighten

- Throttle cover bolts to 15 N·m (11 lb. ft.).
- Air intake pipe bracket to cylinder head; secure with three bolts.

হি Tighten

- Air intake pipe bracket bolts to 15 N.m. (11 lb. ft.).
- Air intake pipe to throttle body hose and ACL intake hose. Refer to "Air Intake Pipe" earlier in this section.
- 10. Negative (-) battery cable.

(1) Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

VALVE LASH

Valve lash is the gap between the rocker arm adjusting screw and the valve stem when the valve is closed. Valve lash can be adjusted with a cold engine (coolant temperature 25°C {77°F}) or a hot engine (coolant temperature 68°C {154°F}) (Figure 22).

Valve Lash Specifications

- Intake valve cold valve lash is 0.13 to 0.17 mm (0.005 to 0.007-inch).
- Intake valve hot valve lash is 0.17 to 0.21 mm (0.007 to 0.008-inch).
- Exhaust valve cold valve lash is 0.13 to 0.17 mm (0.005 to 0.007-inch).
- Exhaust valve hot valve lash is 0.17 to 0.21 mm (0.007 to 0.008-inch).

Measurement and Adjustment Procedures Figures 23, 24 and 25

- 1. Disconnect negative (-) battery cable.
- 2. Remove cylinder head cover. Refer to "Cylinder Head Cover" earlier in this section.

- Turn the crankshaft pulley clockwise until "V" mark (in white paint) on pulley is aligned with the "0" (zero) calibrated on timing belt cover (Figure 23).
- 4. Remove the distributor cap and check if rotor is positioned as shown (Figure 24). This position indicates No.1 piston is at TDC of compression stroke and valves to be adjusted are closed. If rotor is out of place, turn crankshaft pulley clockwise one revolution (360 degrees).
- 5. Using a feeler gage, measure the valve lash at valves (1), (2), (5) and (7) (Figure 25).

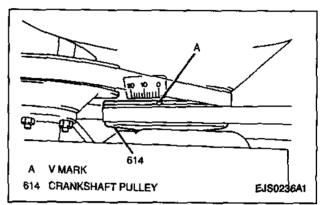


Figure 23—Timing Mark Alignment For Valve Lash Adjustment

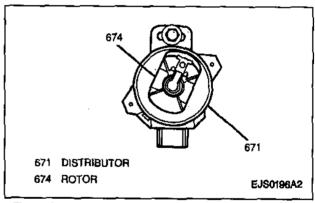


Figure 24-Rotor Positioning For Valve Lash Adjustment

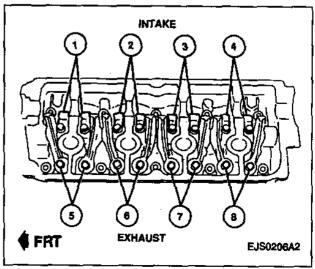


Figure 25-Valve Identification

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6. If valve lash is out of specification, adjust it by loosening the adjusting screw locknut and turning the adjusting screw. After adjustment, hold the screw in position and tighten the locknut to specification.

- Adjusting screw locknut to 17 N m (13 lb. ft.).
- 7. Rotate crankshaft one revolution (360 degrees) clockwise and check valve lash at valves (3), (4), (6) and (8) (Figure 25).
- 8. If valve lash is out of specification, adjust it by loosening the adjusting screw locknut and turning the adjusting screw. After adjustment, hold the screw in position and tighten the locknut to specification.

Tighten

 Adjusting screw locknut to 17 N·m (13 lb. ft.). 9. Install the distributor cap on distributor.

- Tighten
- 10. Install the cylinder head cover. Refer to "Cylinder Head Cover" earlier in this section.
- 11. Connect the negative battery cable.

Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N m (11 lb. ft.).

TIMING BELT AND TENSIONER

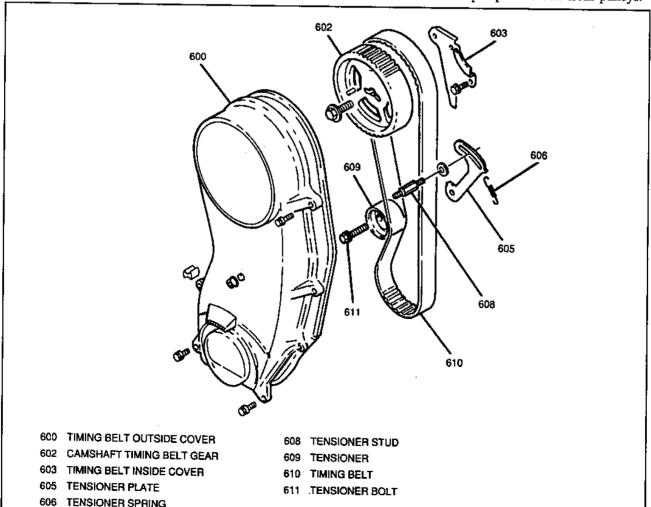
Figures 26 through 29

Remove or Disconnect

- 1. Negative (-) battery cable.
- 2. Loosen upper and lower A/C compressor mounting bolts (if equipped).
- 3. Loosen upper and lower power steering pump mount bolts.
- 4. A/C compressor (if equipped) and/or power steering drive belt from pulleys.
- 5. Loosen upper and lower generator mounting bolts.

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6. Generator/coolant pump drive belt from pulleys.



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- 7. Four nuts, cooling fan and coolant pump pulley from coolant pump.
- Raise and suitably support vehicle. Refer to SECTION 0A.
- 9. Four bolts and front skid plate from undercarriage (if equipped).
- 10. Two lower radiator shroud bolts.
- 11. Lower vehicle.
- Two bolts from A/C suction line brackets at right side of radiator core support (if equipped) and carefully reposition suction line for radiator shroud removal access.
- Two upper radiator shroud bolts and radiator shroud from radiator.

? Important

 If radiator shroud is difficult to remove, drain the cooling system and disconnect the upper radiator hose from the radiator to gain access.

? Important

- It is not necessary to remove the crankshaft pulley center bolt when removing the crankshaft pulley.
- 14. Five bolts and crankshaft pulley from crankshaft (Figure 27).
- 15. Oil pressure sending unit wire conduit from timing belt cover.
- 16. Eight bolts, one nut and timing belt cover from engine.

[mportant

• There are two sets of timing marks which must be aligned to ensure correct engine timing upon timing belt installation. A notch in the camshaft timing belt gear designated as "E" must be aligned with the notch in the cylinder head cover (Figure 28). A punch mark on the crankshaft timing belt gear should then align with the arrow in the oil pump

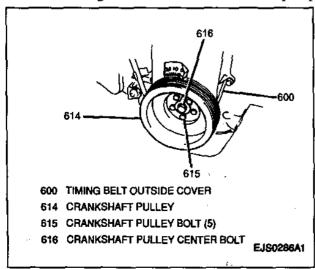


Figure 27—Crankshaft Pulley

- casting (Figure 28). Make sure to align both sets of marks prior to timing belt removal to ensure correct timing belt installation and engine timing.
- 17. Align the timing marks on the cylinder head cover and carnshaft timing belt gear. This should also align the timing marks on the oil pump casting and crankshaft timing belt gear (Figure 28).
- 18. Loosen the timing belt tensioner bolt (Figure 29).
- 19. Timing belt tensioner spring from timing belt tensioner plate (Figure 29).
- Timing belt from camshaft and crankshaft timing belt gears.
- 21. One stud, one bolt, timing belt tensioner and tensioner plate from engine.

NOTICE: Do not turn the crankshaft and camshaft independently of one another once the timing belt has been removed. If the crankshaft or camshaft is turned independently, interference between the pistons and valves may occur causing component damage.

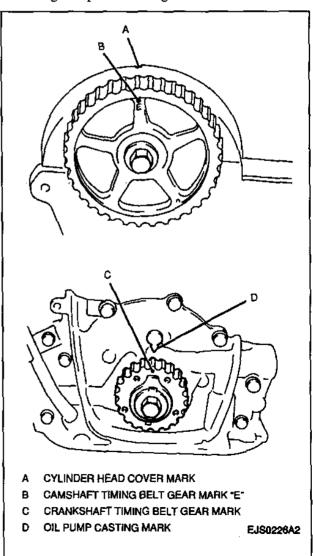


Figure 28—Camshaft and Crankshaft Timing Belt Gear Timing Marks

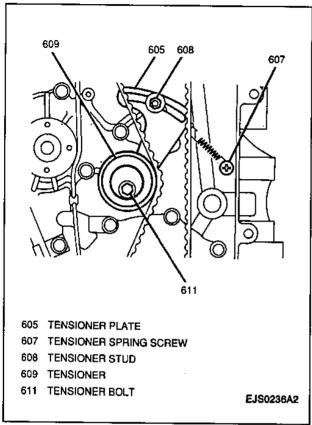


Figure 29—Tensioner Assembly

Inspect

- Timing belt for wear or cracking; replace if necessary.
- Tensioner for smooth operation; replace if necessary.

→+ Install or Connect

 Timing belt tensioner plate and tensioner to engine; secure with timing belt tensioner stud and bolt.

[Important

 Do not tighten the timing belt tensioner stud and bolt to specification until the timing belt is properly installed. Install the timing belt tensioner stud and bolt finger tight only.

NOTICE: When installing a new or used timing belt, the directional arrows on the timing belt must be matched with the rotation of the crankshaft. If this precaution is not observed, excessive wear and timing belt failure may occur.

- Push the timing belt tensioner plate up for timing belt installation.
- Timing belt onto camshaft and crankshaft timing belt gears.

[Inspect

- Timing marks on the cylinder head cover and camshaft timing belt gear for alignment as well as the timing marks on the oil pump casting and crankshaft timing belt gear. If these two sets of timing marks are not properly aligned, remove the timing belt and align both sets of marks as previously outlined in this procedure (Figure 28).
- 4. Timing belt tensioner spring to timing belt tensioner plate (Figure 29).

Important

 Rotate the crankshaft two complete revolutions to remove any slack from the timing belt and to properly seat the timing belt. When all slack has been removed from the timing belt, inspect both sets of timing marks to ensure that they are aligned respectively (Figure 28).

Tighten

- Timing belt tensioner stud to 10 N·m (89 lb. in.).
- Timing belt tensioner bolt to 25 N·m (18 lb. ft.).
- 5. Timing belt cover to engine; secure with one nut and eight bolts.

(1) Tighten

- Timing belt cover nut and bolts to 10 N·m (89 lb. in.).
- Oil pressure sending unit wire conduit to timing belt cover.
- 7. Crankshaft pulley to crankshaft; secure with five bolts (Figure 27).

Q Tighten

- Crankshaft pulley bolts to 16 N·m (12 lb. ft.).
- 8. Radiator shroud to radiator; secure with two bolts.

(1) Tighten

- Upper shroud bolts to 10 N·m (89 lb. in.).
- Carefully reposition A/C suction line and brackets to right side of radiator core support (if equipped); secure with two bolts.

হি Tighten

- A/C suction line bracket bolts to 10 N·m (89 lb. in.).
- Raise and suitably support vehicle. Refer to SECTION 0A.
- 11. Two lower radiator shroud bolts.

(1) Tighten

• Lower shroud bolts to 10 N·m (89 lb. in.).

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 Front skid plate to undercarriage (if equipped); secure with four bolts.

2

Tighten

- Front skid plate bolts to 54 N·m (40 lb. ft.).
- 13. Lower vehicle.
- 14. Coolant pump pulley and cooling fan to coolant pump; secure with four nuts.

হি Tighten

- Coolant fan nuts to 11 N.m (97 lb. in.).
- 15. Generator/coolant pump drive belt to pulleys.
- 16. A/C compressor (if equipped) and/or power steering drive belt to pulleys.



Adjust

 Generator/coolant pump drive belt. Refer to SECTION 6D.

- A/C compressor (if equipped) and/or power steering drive belt. Refer to SECTION 1B and/or SECTION 3B.
- 17. Negative (-) battery cable.

(1) Tighten

 Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

ROCKER ARMS AND ROCKER ARM SHAFT

Figures 30 through 47

++

Remove or Disconnect

Tool Required:

J 1840 Camshaft Sprocket Spanner Wrench

- 1. Negative (-) battery cable.
- 2. Three screws, two clips and front grille from radiator core support.
- 3. Two bolts and hood latch from header panel.

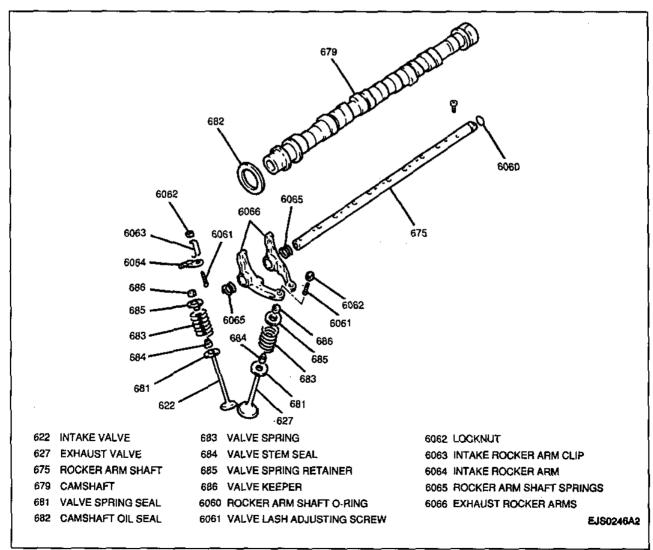


Figure 30-Rocker Arms, Rocker Arm Shaft and Carnshaft

- 4. Two electrical connectors from horn.
- 5. Twelve bolts and header panel from vehicle (Figure 31).
- 6. Radiator from radiator core support. Refer to SECTION 6B.
- 7. Timing belt from engine. Refer to "Timing Belt and Tensioner" earlier in this section.
- 8. One bolt and camshaft timing belt gear from camshaft using a J 41840 to hold the camshaft timing belt gear stationary (Figure 32).
- Cylinder head cover from cylinder head. Refer to "Cylinder Head Cover" earlier in this section.
- Distributor from distributor case. Refer to SECTION 6D4.

? Important

- A small amount of oil may drain from the distributor case upon removal from the cylinder head. Place a suitable container underneath the distributor case or use a shop towel to catch and absorb oil.
- 11. Three bolts and distributor case from cylinder head (Figure 33).
- 12. Loosen all valve adjusting screw locknuts (Figure 34).
- 13. Loosen all valve adjusting screws until all rocker arms move freely (Figure 34).

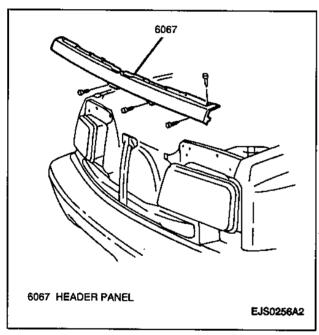


Figure 31—Header Panel

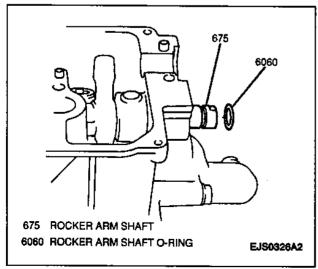


Figure 32-Holding Camshaft Timing Gear Stationary

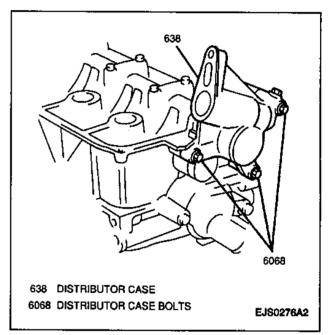


Figure 33—Distributor Case Bolts

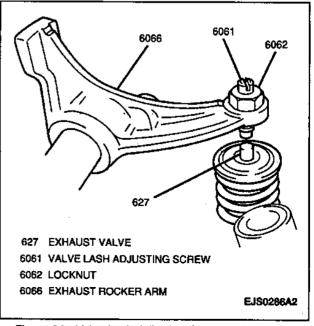


Figure 34—Valve Lash Adjusting Screw and Locknuts

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NOTICE: Always remove the camshaft carrier bolts gradually in the order shown in Figure 35 in order to relieve tension on the camshaft. If the camshaft carrier bolts are removed at random, damage to the camshaft may occur.

- 14. Twelve bolts, camshaft carrier caps, camshaft seal and camshaft from cylinder head.
- 15. Rocker arm shaft plug from cylinder head (Figure 36).
- 16. Two bolts and timing belt inside cover from cylinder head (Figure 36).
- 17. All intake rocker arms with clips from rocker arm shaft.
- 18. Six rocker arm shaft bolts from cylinder head (Figure 37).

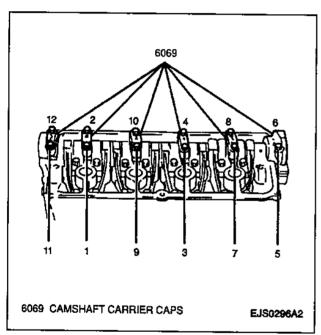


Figure 35—Camshaft Carrier Cap Bolt Removal

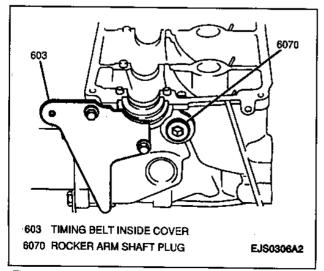


Figure 36—Rocker Arm Shaft Plug and Timing Belt Inside Cover

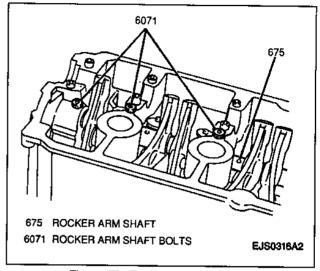


Figure 37-Rocker Arm Shaft Bolts

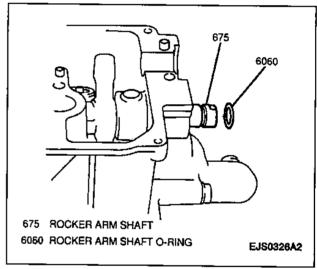


Figure 38-Rocker Arm Shaft O-Ring

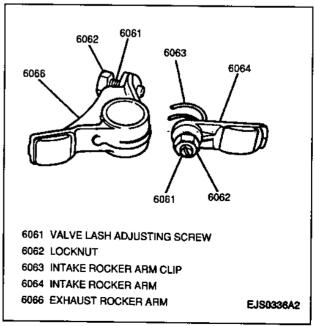


Figure 39—Exhaust and Intake Rocker Arms

- Push rocker arm shaft back through the rear of the cylinder head until the end of the rocker arm shaft appears.
- 20. One O-ring from rear of rocker arm shaft (Figure 38).
- 21. Exhaust rocker arms, rocker arm springs and rocker arm shaft by pulling the rocker arm shaft through the front of the cylinder head.

Clean

 All camshaft and rocker arm components thoroughly will clean solvent.

[Inspect

- Rocker arms for excessive wear or damage (Figure 39). Pay particular attention to the rocker arm adjusting screw tips and cam riding surfaces. If excessive wear or damage exists, replace rocker arms as necessary.
- 2. Camshaft, camshaft carrier and carrier caps for excessive wear or damage. Replace as necessary.

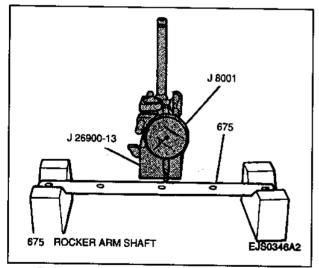


Figure 40-Measuring Rocker Arm Shaft Runout

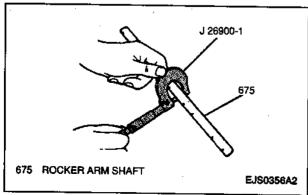


Figure 41-Measuring Rocker Arm Shaft Outside Diameter

1

Measure

Tools Required:

- J 8001 Dial Indicator
- J 26900-13 Magnetic Base
- J 26900-1 Outside Micrometer
- Rocker arm shaft runout using a J 8001 with a J 26900-13 (Figure 40). Place the rocker arm shaft between two V-blocks and rotate slowly while measuring runout. Maximum rocker arm shaft runout is 0.20 mm (0.008-inch). If rocker arm shaft runout exceeds 0.20 mm (0.008-inch), replace the rocker arm shaft.
- Rocker arm-to-rocker arm shaft clearance using J 26900-1 and telescopic micrometer. Measure the outside diameter of the rocker arm shaft using the J 26900-1 and the inside diameter of the rocker arms using a telescopic micrometer (Figure 41).

Standard Rocker arm shaft outside diameter: 15.969 to 15.984 mm (0.6287 to 0.6293-inch).

Standard rocker arm shaft inside diameter: 15.985 to 16.005 mm (0.629 to 0.630-inch).

Subtract the outside diameter measurement of the rocker arm shaft from the inside diameter measurement of the rocker arms to determine rocker arm-to-rocker arm shaft clearance.

Standard rocker arm-to-rocker arm shaft clearance: 0.0011 to 0.036 mm (0.0001 to 0.0014-inch).

Maximum rocker arm-to-rocker arm shaft clearance: 0.09 mm (0.0035-inch).

If rocker arm inside diameter, rocker arm shaft outside diameter or rocker arm-to-rocker arm shaft clearance exceed specification, Replace the rocker arms and/or rocker arm shaft as necessary.

3. Camshaft journal runout using a J 8001 with a J 26900-13 (Figure 42). Place the camshaft between two V-blocks and rotate slowly while measuring journal runout. Maximum camshaft journal runout is 0.10 mm (0.0039-inch). If camshaft journal runout exceeds 0.10 mm (0.0039-inch), replace the camshaft.

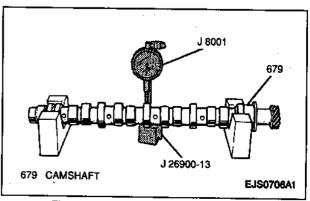


Figure 42—Measuring Camshaft Runout

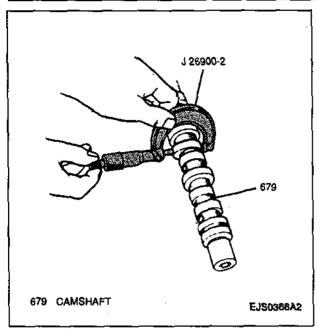


Figure 43-Measuring Camshaft Lobe Height

4. Camshaft lobe height using a J 26900-1 (Figure 43).

Standard intake camshaft lobe height: 36.171 to 36.331 mm (1.4241 to 1.4303-inch).

Minimum intake camshaft lobe height: 36.071 mm (1.4202-inch).

Standard exhaust camshaft lobe height: 36,356 to 36,516 mm (1,4314 to 1,4376-inch).

Minimum exhaust camshaft lobe height: 36.256 mm (1.4275-inch).

If any intake or exhaust camshaft lobe is below minimum lobe height, replace the camshaft.

5. Camshaft journal clearance using plastic-type gaging material. Place one piece of plastic-type gaging material the full width of a journal on each camshaft journal parallel to the camshaft. Install the camshaft into the camshaft carrier in the

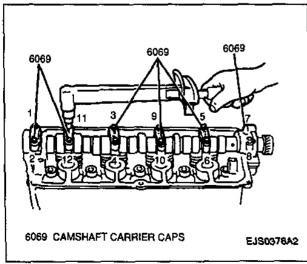


Figure 44—Camshaft Center Cap Bolt Tightening Sequence

cylinder head. Install the camshaft carrier caps and tighten the carrier cap bolts gradually in the order shown in Figure 44.

(1) Tighten

• Camshaft carrier cap bolts to 10 N·m (89 lb. in.).

| Important

 DO NOT rotate the camshaft with plastic-type gaging material installed.

Čarefully remove the camshaft carrier caps without disturbing the plastic-type gaging material. Measure each piece of plastic-type gaging material at its widest point using the gaging scale provided on the plastic-type gaging material packaging.

Standard camshaft journal clearance: 0.040 to

0.082 mm (0.0016 to 0.0032-inch).

Maximum camshaft journal clearance: 0.12 mm (0.0047-inch).

If camshaft journal clearance exceeds 0.12 mm (0.0047-inch), install the camshaft carrier caps onto the camshaft carrier and tighten the carrier cap bolts to specification. Measure the camshaft journal bore inside diameter using a telescopic micrometer. Then, measure the camshaft journal outside diameter using the J 26900-1.

Standard camshaft journal bore inside diameter: 28.000 to 28.021 mm (1.1024 to 1.1031-inch).

Standard camshaft journal outside diameter: 27.939 to 27.960 mm (1.1000 to 1.1008-inch).

If the camshaft journal outside diameter is farther out of specification than the camshaft journal bore inside diameter, replace the camshaft. If the camshaft journal bore inside diameter is farther out of specification than the camshaft journal outside diameter, replace the cylinder head.

→+ Install or Connect

Tool Required:

J 41840 Camshaft Sprocket Spanner Wrench

- I. Apply clean engine oil to all rocker arm components to ensure ease of assembly.
- Rocker arm shaft by pushing the rocker arm shaft through the front of the cylinder head. Slide the exhaust rocker arms and rocker arm springs as the rocker arm shaft is being installed.
- Push rocker arm shaft back through the rear of the cylinder head until the end of the rocker arm shaft appears.
- 4. New O-ring onto rear of rocker arm shaft (Figure 38).

9 Important

• Rotate the rocker arm shaft so that the flat machined surface is horizontal and facing down parallel with the cylinder head mating surface (Figure 45).

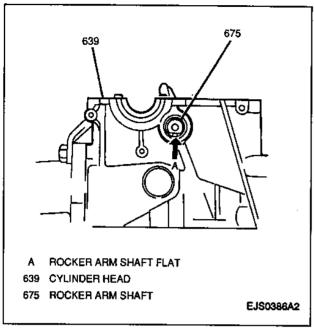


Figure 45-Rocker Arm Shaft Installation Position

5. Six rocker arm shaft bolts into cylinder head (Figure 37).

Tighten

- Rocker arm shaft bolts to 10 N·m (89 lb. in.).
- Fill rocker arm shaft bolt holes with clean engine oil.
- 7. All intake rocker arms with clips onto rocker arm shaft.

? Important

- The camshaft carrier caps are embossed with numbers and arrows to ensure correct assembly. The number one "1" camshaft carrier cap must be installed at the front of the cylinder head with the remaining carrier caps following in numerical order. The directional arrows must always point toward the front of the cylinder head.
- Apply a liberal amount of clean engine oil to camshaft.
- 9. Apply RTV silicone rubber sealant GM P/N 12345739, or equivalent to the bottom of the number six "6" camshaft carrier cap.
- 10. Camshaft and camshaft carrier caps onto cylinder head; secure with twelve bolts.

NOTICE: Always tighten the camshaft carrier cap bolts gradually in the order shown in Figure 44. If the camshaft carrier cap bolts are tightened at random, damage to the camshaft may occur.

(Tighten

• Camshaft carrier cap bolts to 10 N·m (89 lb. in.).

- 11. Apply engine oil to the new camshaft seal lip.
- 12. New camshaft seal into cylinder head until camshaft seal is flush with camshaft carrier surface.
- 13. Timing belt inside cover to cylinder head; secure with two bolts (Figure 36).

হ্ম Tighten

- Timing belt inside cover bolts to 10 N·m (89 lb. in.).
- 14. Rocker arm shaft plug into cylinder head (Figure 36).

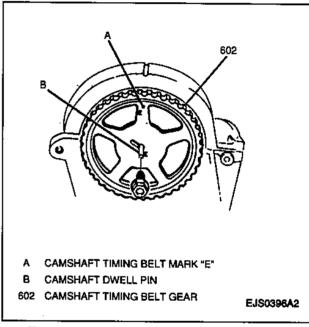


Figure 46—Camshaft Timing Belt Gear Installation

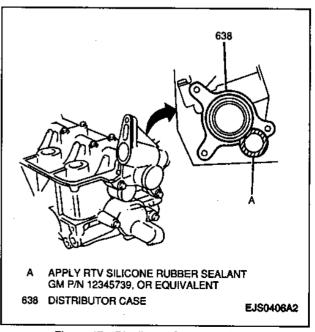


Figure 47—Distributor Case Installation

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(1) Tighten

· Rocker arm shaft plug to 33 N·m (24 lb. ft.).

[Important

- During camshaft timing belt gear installation, align the camshaft dwell pin with the slot in the camshaft timing belt gear designated as "E" (Figure 46).
- 15. Camshaft timing belt gear onto camshaft using a J 41840 to hold the camshaft timing belt gear stationary; secure with one bolt (Figure 32).

(1) Tighten

- Camshaft timing belt gear bolt to 60 N·m (44 lb. ft.).
- 16. Timing belt to engine. Refer to "Timing Belt and Tensioner" earlier in this section.
- 17. Apply RTV silicone rubber sealant GM P/N 12345739, or equivalent to the surface of the distributor case that mates with the rear of the rocker arm shaft (Figure 47).
- Distributor case to cylinder head; secure with three bolts.

(1) Tighten

- Distributor case bolts to 10 N·m (89 lb. in.).
- 19. Distributor into distributor case. Refer to SECTION 6D4.

🔊 Adjust

- Valve lash. Refer to "Valve Lash" earlier in this section.
- 20. Cylinder head cover onto cylinder head. Refer to "Cylinder Head Cover" earlier in this section.
- 21. Radiator into radiator core support. Refer to SECTION 6B.
- 22. Header panel to vehicle; secure with twelve bolts (Figure 31).

Tighten

- · Header panel bolts to 10 N·m (89 lb. in.).
- 23. Two electrical connectors to horn.
- 24. Hood latch to header panel; secure with two bolts.

হি Tighten

- Hood latch bolts to 10 N·m (89 lb. in.).
- Three screws, two clips and front grille to radiator core support.
- 26. Negative (-) battery cable.

(1) Tighten

 Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

CAMSHAFT, VALVES AND CYLINDER HEAD

Figures 11 through 22, 27, 28, 29, 32 through 36, 44, and 46 through 50

Remove or Disconnect

Tool Required:

- J 41840 Camshaft Sprocket Spanner Wiench
- 1. Negative (-) battery cable.
- 2. Release fuel pressure. Refer to SECTION 6C.
- 3. Fuel filler cap to release fuel vapor pressure in fuel tank. After releasing pressure, replace cap.
- 4. Drain cooling system. Refer to SECTION 6B.
- Air intake pipe from ACL intake hose and throttle hose. Refer to "Air Intake Pipe" earlier in this section.
- Three bolts and throttle cover from intake manifold.
- Accelerator cable and kickdown cable (automatic transmission equipped vehicles) from throttle body bellcrank (Figure 11).
- 8. One bolt, one nut, one screw and accelerator cable bracket from throttle body (Figure 11).
- 9. The following electrical connectors:
 - · Throttle position (TP) sensor.
 - Idle air control (IAC) valve.
 - Engine coolant temperature (ECT) sensor (Figure 12).
 - ECT sending unit (Figure 12).
 - A/C ECT switch (A/C equipped vehicles only) (Figure 12).
 - Evaporative emissions solenoid purge (EVAP SP) valve (Figure 12).
 - Exhaust gas recirculation (EGR) temperature sensor.
 - EGR solenoid vacuum valve (Figure 12).
 - · EGR by-pass valve.
 - Fuel injectors (Figure 12).
 - Engine ground wire from intake surge tank.
- 10. The following vacuum hoses:
 - EVAP SP valve.
 - Vacuum modulator supply hose (automatic transmission equipped vehicles).
 - · Brake booster supply hose.
 - EGR valve.
 - EGR valve modulator.
 - Intake manifold absolute pressure sensor hose.
- 11. Coolant hose from IAC valve.
- 12. IAC hose from IAC valve.
- 13. Coolant hoses from the fast idle air valve below throttle body.
- 14. Fuel feed hose at fuel feed hose union (Figure 13).
- 15. Fuel return hose from fuel return line.
- PCV hose from PCV valve.

- 17. Loosen upper radiator hose clamp at thermostat housing.
- 18. Upper radiator hose from thermostat housing.
- 19. Coolant bypass hose from intake manifold.
- 20. One bolt, one nut and generator adjusting arm bracket from intake manifold (Figure 14).
- 21. Two bolts and front intake manifold reinforcement bracket from intake manifold (Figure 15).
- 22. Two bolts and rear intake manifold reinforcement bracket from intake manifold (Figure 15).
- 23. Two bolts and lower intake manifold support bracket from intake manifold (Figure 15).
- 24. Eight nuts, three bolts, intake manifold with gasket, intake surge tank and throttle body from cylinder head.
- 25. Two nuts, three bolts and upper exhaust manifold heat shield from exhaust manifold (Figure 16).
- 26. Raise and suitably support vehicle. Refer to SECTION 0A.
- 27. Two bolts, one nut and exhaust manifold reinforcement bracket from exhaust manifold and engine mount (Figure 17).
- Two bolts and lower exhaust manifold heat shield from exhaust manifold (Figure 16).
- 29. Three bolts and front pipe/three way catalytic converter (TWC) assembly with gasket from exhaust manifold (Figure 18).
- 30. Lower vehicle.
- 31. Nine nuts and exhaust manifold with gasket and engine hanger from cylinder head (Figures 19 and 20).
- 32. Loosen upper and lower A/C compressor mounting bolts (if equipped).
- Loosen upper and lower power steering pump mount bolts.
- 34. A/C compressor (if equipped) and/or power steering drive belt from pulleys.
- 35. Loosen upper and lower generator mounting bolts.
- 36. Generator/coolant pump drive belt from pulleys.
- 37. Four nuts, cooling fan and coolant pump pulley from coolant pump.
- Raise and suitably support vehicle. Refer to SECTION 0A.
- 39. Four bolts and front skid plate from undercarriage (if equipped).
- 40. Two lower radiator shroud bolts.
- 41. Lower vehicle.
- 42. Two bolts from A/C suction line brackets at right side of radiator core support (if equipped) and carefully reposition suction line for radiator shroud removal access.
- 43. Two upper radiator shroud bolts and radiator shroud from radiator.

? Important

 If radiator shroud is difficult to remove, drain the cooling system and disconnect the upper radiator hose from the radiator to gain access.

!mportant

- It is not necessary to remove the crankshaft pulley center bolt when removing the crankshaft pulley.
- 44. Five bolts and crankshaft pulley from crankshaft (Figure 27).
- 45. Oil pressure sending unit wire conduit from timing belt cover.
- 46. Eight bolts, one nut and timing belt cover from engine.

| Important

- There are two sets of timing marks which must be aligned to ensure correct engine timing upon timing belt installation (Figure 28). A notch in the camshaft timing belt gear designated as "E" must be aligned with the notch in the cylinder head cover. A punch mark on the crankshaft timing belt gear should then align with the arrow in the oil pump casting. Make sure to align both sets of marks prior to timing belt removal to ensure correct timing belt installation and engine timing.
- 47. Align the timing marks on the cylinder head cover and camshaft timing belt gear. This should also align the timing marks on the oil pump casting and crankshaft timing belt gear (Figure 28).
- 48. Loosen the timing belt tensioner bolt (Figure 29).
- 49. Timing belt tensioner spring from timing belt tensioner plate (Figure 29).
- 50. Timing belt from camshaft and crankshaft timing belt gears.
- 51. One bolt and camshaft timing belt gear from camshaft using a J 41840 to hold the camshaft timing belt gear stationary (Figure 32).
- 52. Two bolts and inside timing belt cover from cylinder head (Figure 36).
- 53. Two bolts and A/C mounting bracket with compressor from cylinder head.
- 54. Distributor from distributor case. Refer to SECTION 6D4.
- 55. Six bolts and cylinder head cover from cylinder head (Figure 21).
- 56. Cylinder head cover gasket and O-rings from cylinder head cover.

§ Important

- A small amount of oil may drain from the distributor case upon removal from the cylinder head. Place a suitable container underneath the distributor case or use a shop towel to catch and absorb oil.
- 57. Three bolts and distributor case from cylinder head (Figure 33).
- 58. Loosen all valve adjusting screw locknuts (Figure 34).

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59. Loosen all valve adjusting screws until all rocker arms move freely (Figure 34).

NOTICE: Always loosen the camshaft carrier bolts gradually in the order shown in Figure 35 in order to relieve tension on the camshaft. If the camshaft carrier bolts are removed at random, damage to the camshaft may occur.

60. Twelve bolts, camshaft carrier caps, camshaft seal and camshaft from cylinder head.

[Important

- Loosen the cylinder head bolts gradually in the sequence shown in Figure 56 to prevent cylinder head distortion.
- 61. Ten bolts, cylinder head and cylinder head gasket from cylinder block (Figure 48).



 Mating surfaces of cylinder head, cylinder block, intake manifold, exhaust manifold, and distributor gear case of all gasket or sealant materials.

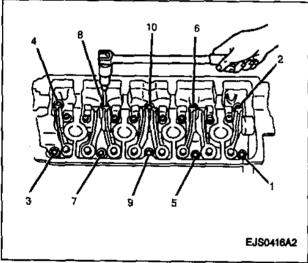


Figure 48—Cylinder Head Bolt Loosening Sequence

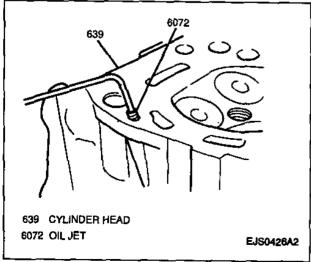


Figure 49-Tighten Oil Jet

2. All bolt threads and bolts.

[*

Inspect

- For cylinder head inspection procedures, refer to "Cylinder Head and Valve Off-Vehicle Service" later in this section.
- 2. Oil jet in cylinder head for any obstructions and ensure that the oil jet is tightened to its torque specification (Figure 49).

(1) Tighten

• Oil jet to 5 N·m (44 lb. in.).

++

Install or Connect

Tool Required:

J 41840 Camshaft Sprocket Spanner Wrench

- Apply clean engine oil to the threaded portion of all cylinder head bolts.
- New cylinder head gasket and cylinder head with distributor case onto cylinder block; secure with ten bolts (Figure 50).

(1) Tighten

- Cylinder head bolts in three separate steps using the sequence shown in Figure 50 for each step.
 - a. 35 N·m (26 lb. ft.).
 - b. 55 N·m (41 lb. ft.).
 - c. 70 N·m (52 lb. ft.).
- Apply a liberal amount of clean engine oil to camshaft.
- Apply RTV silicone rubber sealant GM P/N 12345739, or equivalent to the bottom of the number six "6" camshaft carrier cap.
- 5. Camshaft and camshaft carrier caps onto cylinder head; secure with twelve bolts (Figure 44).

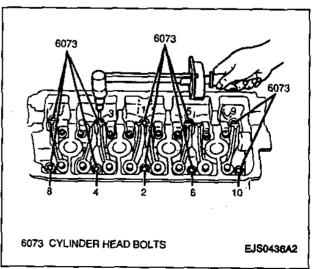


Figure 50-Cylinder Head Bolt Tightening Sequence

NOTICE: Always tighten the camshaft carrier cap bolts gradually in the order shown in Figure 44. If the camshaft carrier cap bolts are tightened at random, damage to the camshaft may occur.

(Tighten

- Camshaft carrier cap bolts to 10 N.m (89 lb. in.).
- 6. Apply engine oil to the new camshaft seal lip.
- New camshaft seal into cylinder head until camshaft seal is flush with camshaft carrier surface.

Adjust

- Valve lash. Refer to "Valve Lash" earlier in this section.
- Apply RTV silicone rubber sealant GM P/N 12345739, or equivalent to the surface of the distributor case that mates with the rear of the rocker arm shaft (Figure 47).
- 9. Distributor case to cylinder head; secure with three bolts (Figure 47).

হ্মি Tighten

· Distributor case bolts to 10 N·m (89 lb. in.).

Clean

 Sealing surfaces on cylinder head and cylinder head cover.

? Important

- A new cylinder head cover gasket and O-rings MUST be used whenever cylinder head cover removal and installation is performed. Ensure that new gasket and O-rings are correctly positioned during cylinder head cover installation (Figure 22).
- 10. New cylinder head cover gasket and four O-rings to cylinder head cover (Figure 22).
- 11. Cylinder head cover to cylinder head; secure with six bolts.

(Tighten

- Cylinder head cover bolts to 10 N·m (89 lb. in.).
- Distributor into distributor case. Refer to SECTION 6D4.
- 13. A/C mounting bracket with compressor to cylinder head; secure with two bolts.

হি Tighten

- A/C Mounting bracket bolts to 10 N.m (89 lb. in.).
- 14. Timing belt inside cover to cylinder head; secure with two bolts (Figure 36).

Tighten

• Timing belt inside cover bolts to 10 N.m (89 lb. in.).

? Important

- During camshaft timing belt gear installation, align the camshaft dwell pin with the slot in the camshaft timing belt gear designated as "E" (Figure 46).
- 15. Camshaft timing belt gear onto camshaft using a J 41840 to hold the camshaft timing belt gear stationary; secure with one bolt (Figure 32).

(2) Tighten

- Camshaft timing belt gear bolt to 60 N·m (44 lb. ft.).
- 16. Timing belt tensioner plate and tensioner to engine; secure with timing belt tensioner stud and bolt (Figure 29).

!mportant

 Do not tighten the timing belt tensioner stud and bolt to specification until the timing belt is properly installed. Install the timing belt tensioner stud and bolt finger tight only.

NOTICE: When installing a new or used timing belt, the directional arrows on the timing belt must be matched with the rotation of the crankshaft. If this precaution is not observed, excessive wear and timing belt failure may occur.

- 17. Push the timing belt tensioner plate up for timing belt installation.
- Timing belt onto camshaft and crankshaft timing belt gears.

Inspect .

- Timing marks on the cylinder head cover and camshaft timing belt gear for alignment as well as the timing marks on the oil pump casting and crankshaft timing belt gear (Figure 28). If these two sets of timing marks are not properly aligned, remove the timing belt and align both sets of marks as previously outlined in this procedure.
- 19. Timing belt tensioner spring to timing belt tensioner plate (Figure 28).

? Important

 Rotate the crankshaft two complete revolutions to remove any slack from the timing belt and to properly seat the timing belt. When all slack has been removed from the timing belt, inspect both sets of timing marks to ensure that they are aligned respectively.

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Tighten

- Timing belt tensioner stud to 10 N·m (89 lb. in.).
- Timing belt tensioner bolt to 25 N.m (18 lb. ft.).
- 20. Timing belt cover to engine; secure with one nut and eight bolts.

(1) Tighten

- Timing belt cover nut and bolts to 10 N-m (89 lb. in.).
- Oil pressure sending unit wire conduit to timing belt cover.
- 22. Crankshaft pulley to crankshaft; secure with five bolts (Figure 27).

Tighten

- Crankshaft pulley bolts to 16 N·m (12 lb. ft.).
- 23. Radiator shroud to radiator; secure with two bolts.

হ্মি Tighten

- Upper shroud bolts to 10 N·m (89 lb. in.).
- Carefully reposition A/C suction line and brackets to right side of radiator core support (if equipped); secure with two bolts.

হ্ম Tighten

- A/C suction line bracket bolts to 10 N.m (89 lb. in.).
- Raise and suitably support vehicle. Refer to SECTION 0A.
- 26. Two lower radiator shroud bolts.

Tighten

- Lower shroud bolts to 10 N·m (89 lb. in.).
- 27. Front skid plate to undercarriage (if equipped); secure with four bolts.

(Q) Tighten

- Front skid plate bolts to 54 N·m (40 lb. ft.).
- 28. Lower vehicle.
- Coolant pump pulley and cooling fan to coolant pump; secure with four nuts.

(1) Tighten

- · Coolant fan nuts to 11 N.m (97 lb. in.).
- 30. Generator/coolant pump drive belt to pulleys.
- 31. A/C compressor (if equipped) and/or power steering drive belt to pulleys.

🔑 Adjust

 Generator/coolant pump drive belt. Refer to SECTION 6D.

- A/C compressor (if equipped) and/or power steering drive belt. Refer to SECTION 1B and/or SECTION 3B.
- 32. New exhaust manifold gasket and exhaust manifold with engine hanger to cylinder head; secure with nine nuts (Figures 19 and 20).

হ্ম Tighten

- Tighten exhaust manifold nuts to 23 N·m (17 lb. ft.).
- 33. Raise and suitably support vehicle. Refer to SECTION 0A.
- 34. Front pipe/TWC assembly with new gasket to exhaust manifold; secure with three bolts (Figure 18).

Tighten

- Exhaust manifold-to-front pipe/TWC assembly to 50 N·m (37 lb. ft.).
- 35. Lower exhaust manifold heat shield to exhaust manifold; secure with two bolts (Figure 16).

হী Tighten

- Lower exhaust manifold heat shield bolts to 10 N-m (89 lb. in.).
- 36. Exhaust manifold bracket to exhaust manifold and engine mount; secure with one nut and two bolts (Figure 17).

1 Tighten

- Engine mount-to-exhaust bracket bolts to 54 N·m (40 lb. ft.).
- Exhaust bracket-to-exhaust manifold nut to 50 N·m (37 lb. ft.).
- 37. Lower vehicle.
- 38. Upper exhaust manifold heat shield to exhaust manifold; secure with two nuts and three bolts (Figure 16).

Q Tighten

- Upper exhaust manifold heat shield nuts and bolts to 10 N·m (89 lb. in.).
- Air intake pipe bracket to cylinder head; secure with three bolts.

1 Tighten

- Air intake pipe bracket bolts to 10 N·m (89 lb. in.).
- 40. New intake manifold gasket and intake manifold with intake surge tank and throttle body to cylinder head; secure with eight nuts, three bolts.

হ Tighten

• Intake manifold nuts and bolts to 23 N.m (17 lb. ft.).

41. Lower intake manifold support bracket to intake manifold; secure with two bolts (Figure 15).

1 Tighten

- Lower intake manifold support bracket bolts to 50 N·m (37 lb. ft.).
- Rear intake manifold reinforcement bracket to intake manifold; secure with two bolts (Figure 15).

1 Tighten

- Rear intake manifold reinforcement bracket bolts to 50 N·m (37 lb. ft.).
- 43. Front intake manifold reinforcement bracket to intake manifold (Figure 15).

Tighten

- Front intake manifold reinforcement bracket bolts to 50 N·m (37 lb. ft.).
- 44. Generator adjusting arm bracket to intake manifold; secure with one bolt and one nut (Figure 14).

Tighten

- Generator adjusting arm bracket nut and bolt to 50 N·m (37 lb. ft.).
- 45. Coolant bypass hose to intake manifold.
- 46. Upper radiator hose to thermostat housing.

₹ Tighten

- Upper radiator hose clamp at thermostat housing.
- 47. PCV hose to PCV valve.
- 48. Fuel return hose to fuel return line.
- 49. Fuel feed hose at fuel feed hose union (Figure 13).
- Coolant hoses to the fast idle air valve below throttle body.
- 51. IAC air hose to the IAC valve.
- 52. Coolant hose to the IAC valve.
- 53. The following vacuum hoses:
 - EGR valve modulator.
 - EGR valve.
 - · Brake booster supply hose.
 - Vacuum modulator supply hose (automatic transmission equipped vehicles).
 - EVAP SP Valve.
 - · Intake manifold absolute pressure sensor hose.

- 54. The following electrical connectors:
 - Engine ground wire to intake surge tank (Figure 12).
 - Fuel injectors (Figure 12).
 - · EGR solenoid vacuum valve.
 - EGR by-pass vacuum valve.
 - Exhaust gas recirculation (EGR) temperature sensor.
 - Evaporative emission solenoid purge (EVAP SP) valve (Figure 12).
 - A/C ECT switch (A/C equipped vehicles only) (Figure 12).
 - ECT sensor sending unit (Figure 12).
 - Engine coolant temperature (ECT) sensor (Figure 12).
 - · Idle air control (IAC) valve.
 - Throttle position (TP) sensor.
- 55. Accelerator cable bracket to throttle body; secure with one screw, one bolt and one nut (Figure 11).

1 Tighten

- Throttle body nut and bolt to 23 N-m (17 lb. ft.).
- Accelerator cable and kickdown cable (automatic transmission equipped vehicles) to throttle body bellcrank (Figure 11).

Adjust

- Accelerator cable as necessary. Refer to SECTION 6C.
- Kickdown cable (automatic transmission equipped vehicles) as necessary. Refer to SECTION 7A.
- 57. Throttle cover from intake manifold; secure with three bolts.

1 Tighten

- Throttle cover bolts to 15 N·m (11 lb. ft.).
- 58. Refill cooling system as necessary. Refer to SECTION 6B.
- 59. Air intake pipe to throttle body hose and ACL intake hose. Refer to "Air Intake Pipe" earlier in this section.
- 60. Negative (-) battery cable.

হ্ম Tighten

• Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 lb. ft.).

CYLINDER HEAD AND VALVE OFF VEHICLE SERVICE

Cylinder Head Disassembly Figures 51 through 54

++

Remove or Disconnect

Tools Required:

J 37979 Valve Spring Compressor Adaptor

J 8062 Valve Spring Compressor

J 37968 Valve Guide Seal Installer Kit

[] Important

- Keep all disassembled parts, except valve stem seals and valve guides (which must be replaced), in order by cylinder so they can be installed in their original position.
- Rocker arm shaft from cylinder head. Refer to "Rocker Arms and Rocker Arm Shaft" earlier in this section.
- Valve keepers from valves using a J 8062 with a J 37979 to compress the valve springs (Figures 51 and 52).

Important

- Do not reuse valve stem seals once disassembled. Be sure to use new seals when reassembling.
- 3. Valve spring retainers, valve springs, and valves from combustion chamber side of cylinder head, valve spring seats and valve stem oil seals from top of cylinder head (Figure 53).
- 4. Valve guides from combustion chamber side of cylinder head using a J 37968 and hammer to drive to valve guide out of the cylinder head (Figure 54).

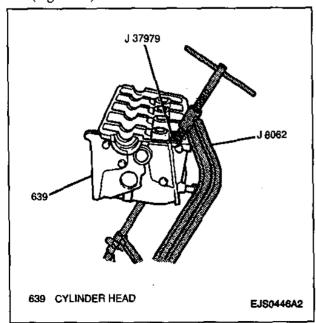


Figure 51—Compressing Valve Springs

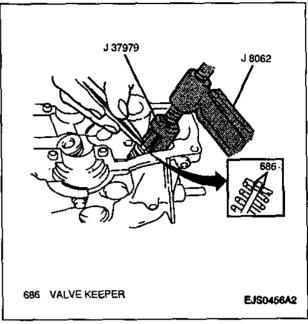


Figure 52-Removing Valve Keepers

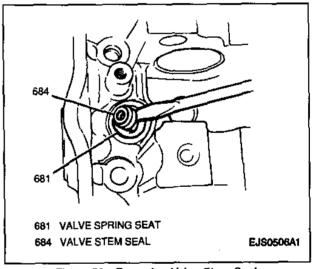


Figure 53—Removing Valve Stem Seals

Ý lm

Important

- Do not reuse valve guides once disassembled.
 Be sure to use new valve guides when reassembling.
- Repeat procedure for remaining valve assemblies as required.

Cylinder Head Assembly

Figures 51, 52 and 55

§ Important

 Be sure that all cylinder head parts are reinstalled in the same cylinder they were removed from.

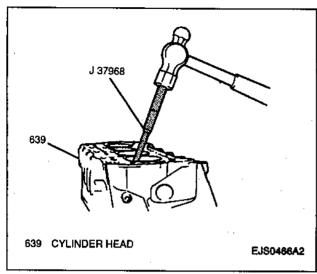


Figure 54--Removing Valve Guides

++

Install or Connect

Tools Required:

J 37968 Valve Guide Seal Installer Kit

J 8062 Valve Spring Compressor

J 37979 Valve Spring Compressor Adaptor

- 1. New valve guides to cylinder head. Refer to "Valve Guide Installation" later in this section.
- 2. Valve spring seat to cylinder head.
- 3. New valve stem seals to valve guides. After applying clean engine oil to the valve stem seal and spindle of the J 37968, fit the valve stem seal onto the spindle, then install the valve stem seal onto the valve guide by pushing down on the J 37968 by hand. After installing, check to be sure that valve stem seals are properly fitted to valve guides.

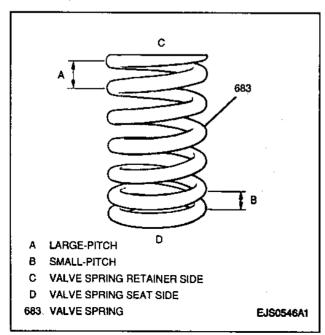


Figure 55-Valve Spring

NOTICE: When installing, never tap or hit the J 37968 with a hammer when installing valve seals. Install oil seals to guides by pushing the J 37968 by hand only. Tapping or hitting tool may cause damage to the valve seals.

- Valves into valve guides. Before installing valves into valve guides, apply clean engine oil to oil seals, valve guide bores and valve stems.
- 5. Valve springs and valve spring retainers. Each valve spring has large-pitch end (top) and small-pitch end (bottom) (Figure 55). Be sure to position valve spring in place with its small-pitch end facing the bottom (valve spring seat side).
- Compress each valve spring using a J 8062 with a J 37979 and fit two valve keepers into groove provided on each valve stem (Figures 51 and 52).
- 7. Remove the J 8062 and J 37979.
- Rocker arm shaft into cylinder head. Refer to "Rocker Arms and Rocker Arm Shaft" earlier in this section.

Valves

Figures 56 and 57



Inspect

- 1. Each valve for wear, burn or distortion at its face and stem. Replace as necessary.
- Valve stem end face for pitting and wear. If pitting or wear is found, valve stem end may be resurfaced. Replace valve if chamfer area is excessively worn.

1

Measure

Tools Required:

J 8001 Dial Indicator Set

J 26900-1 Outside Micrometer

J 26900-13 Magnetic Base

1. Thickness of all valve heads using a steel scale (Figure 56). The standard valve thickness is 0.8 to 1.2 mm (0.03 to 0.047-inch). If the intake valve

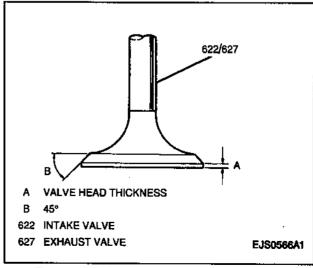


Figure 56-Valve Head Thickness Measurement

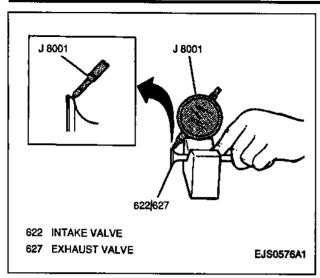


Figure 57—Measuring Valve Radial Runout

thickness is less than 0.6 mm (0.024-inch), replace the intake valve. If the exhaust valve thickness is less than 0.7 mm (0.027-inch), replace the exhaust valve.

 Each valve for radial runout using a J 8001 with a J 26900-13 and "V" block (Figure 57). To measure runout, rotate valve slowly. If measured runout exceeds limit of 0.08 mm (0.003-inch), replace valve.

Seating Contact Width

Figure 58

Produce a contact pattern on each valve by the following procedure:

- 1. Apply a uniform coat of a smooth coloring compound to the valve seat. There are many compounds available for this purpose. The manufacturer's instructions should be carefully followed to get the proper results.
- Using a valve lapper, produce a contact pattern on each valve by rotating valve while gently tapping each valve head to the valve seat.

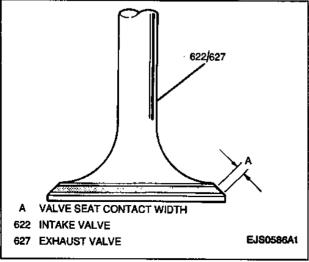


Figure 58-Valve Seating Contact Pattern Width

The pattern produced on the seating face of each valve must be a continuous ring without any break. The width of the pattern must be within 1.1 to 1.3 mm (0.0433 to 0.0512-inch) for both intake and exhaust valves (Figure 58).

Valve Seat Repair

Figure 59

A valve seat not producing a uniform contact with its valve or showing seating contact that is not within the specified width, must be repaired by regrinding finish, or by lapping the valve with lapping compound.

The valve seats for both the intake and exhaust valves are machined to two different angles. For both intake and exhaust valves, the seat contact surface is cut to a 45 degree angle. The area above the contact surface (closest to the combustion chamber) is cut to a 15 degree angle (Figure 58).

1. Using a 45 degree valve seat cutter, descale and clean up the seat with one or two turns.

NOTICE: Cut only the minimum amount from the seat as necessary. This prevents the possibility of valve stem becoming too close to the camshaft lobe.

- Inspect seat contact width. Refer to "Seating Contact Width" earlier in this section. If seat is pitted or burned, additional seat conditioning with a 45 degree valve seat cutter is required.
- If contact area is too wide, use a 15 degree valve seat cutter to narrow the valve seat. If contact area is too narrow, use the 45 degree valve seat cutter to widen.
- 4. After desired seat width is achieved, lap valve on seat in two steps, first with a course lapping compound applied to its face and then with a fine compound, each time using a valve lapper.

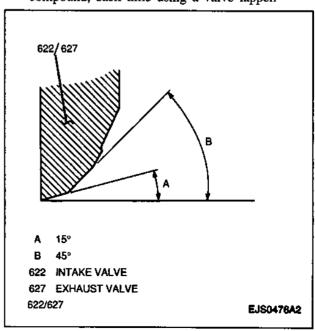


Figure 59-Valve Head Cutting Angles

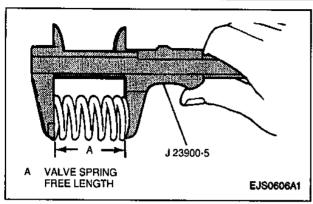


Figure 60-Measuring Valve Spring Free Length

Valve Springs

Figures 60 and 61



Inspect

 Valve springs for evidence of weakness or distortion. Replace as necessary.



Measure

Tools Required:

J 26900-5 Vernier Caliper J 22738-2 Valve Spring Tester

- 1. Each valve spring free length using a J 26900-5 (Figure 60). Standard free length is 36.83 mm (1.4500-inches). If valve spring free length is less than 35.67 mm (1.4043-inches), replace the valve spring.
- 2. Using a J 22738-2, measure valve spring preload. Standard preload is 10.7 to 12.5 kg at 31.5 mm (23.6 to 27.5 lbs. at 1.24-inches).
- 3. Valve spring squareness, using a square and surface plate, to check each valve spring for squareness in terms of clearance between end of valve spring and square. Valve springs with a side clearance larger than 2.0 mm (0.079-inch) must be replaced (Figure 61).

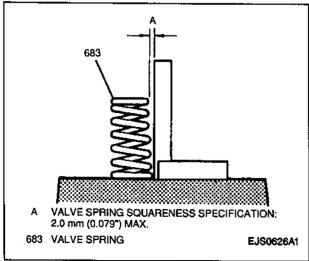


Figure 61—Measuring Valve Spring Squareness

Cylinder Head

Figures 62, 63 and 64



Inspect

NOTICE: Do not use any sharp edged tools to scrape off carbon. Be careful not to scuff or nick the sealing surfaces when cleaning. This could lead to leakage and reduced power output.

- Clean cylinder head with solvent and air dry thoroughly. Remove all carbon from combustion chambers.
- 2. Cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface.
- 3. Flatness of cylinder head gasket surface. Using a straightedge and feeler gage, check surface at a total of six locations (Figure 62). If distortion exceeds the 0.05 mm (0.002-inch) limit at any location, resurfacing of the head is necessary. If

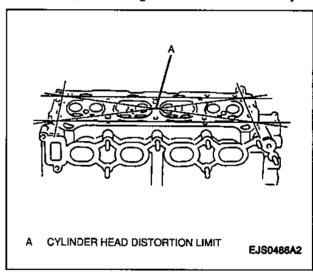


Figure 62—Cylinder Head Distortion Measurement Locations

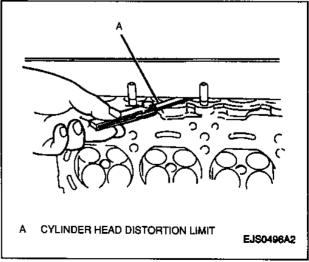


Figure 63---Measuring Intake Manifold Seating Surface Distortion

- distortion cannot be brought within limits, replace cylinder head. Leakage of combustion gases from this gasket joint is often due to a warped gasket surface; such leakage results in reduced power output.
- 4. Distortion of manifold seating faces. Using a straightedge and a feeler gage, check seating faces of intake and exhaust manifolds on cylinder head (Figures 63 and 64). Distortion limit is 0.10 mm (0.004-inch). If distortion cannot be brought within limit by resurfacing, replace cylinder head.

Valve Guide Clearance

Figure 65



Measure

Tools Required: J 26900-1 Outside Micrometer J 26900-14 Small Hose Gages

- 1. Valve stem outside diameter using a J 26900-1 and record the measurement (Figure 65). The standard outside diameters for valve stems are 5.465 to 5.480 mm (0.2152 to 0.2157-inch) for intake valves and 5.440 to 5.455 mm (0.2142 to 0.2148-inch) for exhaust valves. Measure the diameter at more than one place along the length of the valve stem. Record measurement.
- 2. Valve guide inside diameter using a J 26900-14 (Figure 65). Record the measurement. The standard inside diameter of valve guides is 5.500 to 5.512 mm (0.2166 to 0.2170-inch) for intake and exhaust valve guides. Measure the diameter at more than one place along the length of the valve guide. Record measurement.
- Valve stem-to-valve guide clearance by subtracting the valve stem outside diameter measurement from the valve guide inside diameter measurement. Standard clearances are 0.020 to

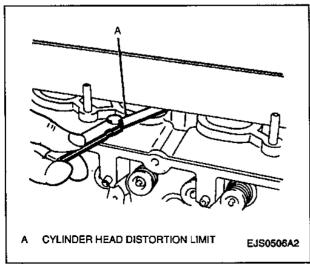


Figure 64—Measuring Exhaust Manifold Seating Surface Distortion

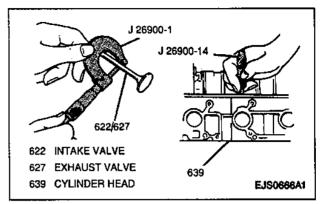


Figure 65-Measuring Valve and Valve Guide

0.047 mm (0.0008 to 0.0018-inch) for the intake valves and 0.045 to 0.072 mm (0.0018 to 0.0028-inch) for the exhaust valves. If the intake valve guide clearance exceeds 0.07 mm (0.0027-inch), replace the intake valve and valve guide. If the exhaust valve guide clearance exceeds 0.09 mm (0.0035-inch), replace the exhaust valve and valve guide.

Valve Guide Installation

Figures 66, 67 and 68

++ Install or Connect

Tools Required: J 37972 Reamer

J 37971 Reamer

J 37968 Valve Guide Seal Installer Kit

 Before installing valve guide to cylinder head, ream guide hole with a J 37972 to remove burrs (Figure 66).

? Important

- Do not reuse old valve guide once disassembled. Install a new valve guide.
- Intake and exhaust valve guides are identical.

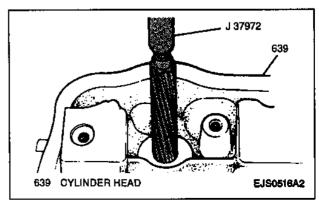


Figure 66—Reaming Valve Guide Bore

- 2. Valve guide to cylinder head using a J 37968. Drive in new valve guide until J 37968 contacts cylinder head. After installing, make sure the valve guide protrudes from cylinder head by 11.5 mm (0.45-inch) (Figure 67).
- 3. Ream valve guide with a J 37971 (Figure 68). After reaming, clean bore.

Camshaft

Figures 42, 43, 44,

Measure

Tools Required:

J 8001 Dial Indicator Set J 26900-13 Magnetic Base

J 26900-2 Outside Micrometer

1. Camshaft journal runout using a J 8001 with a J 26900-13 (Figure 42). Place the camshaft between two V-blocks and rotate slowly while measuring journal runout. Maximum camshaft journal runout is 0.10 mm (0.0039-inch). If camshaft journal runout exceeds 0.10 mm (0.0039-inch), replace the camshaft.

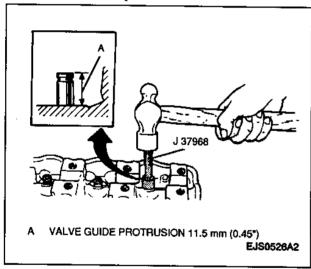


Figure 67-Valve Guide Installation

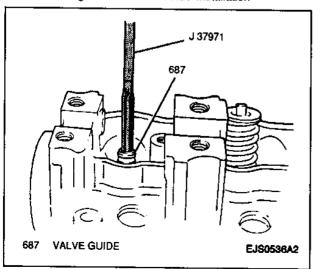


Figure 68—Reaming Valve Guide

- 2. Camshaft lobe height using a J 26900-1 (Figure 43). Standard intake camshaft lobe height: 36.171 to 36.331 mm (1.4241 to 1.4303-inch). Minimum intake camshaft lobe height: 36.071 mm (1.4202-inch). Standard exhaust camshaft lobe height: 36.356 to 36.516 mm (1.4314 to 1.4376-inch). Minimum exhaust camshaft lobe height: 36.256 mm (1.4275-inch). If any intake or exhaust camshaft lobe is below minimum lobe height, replace the camshaft.
- 3. Camshaft journal clearance using plastic-type gaging material. Place one piece of plastic-type gaging material the full width of a journal on each camshaft journal parallel to the camshaft. Install the camshaft into the camshaft carrier in the cylinder head. Install the camshaft carrier caps and tighten the carrier cap bolts gradually in the order shown in Figure 44.

(Tighten

 Camshaft carrier cap bolts to 10 N·m (89 lb. in.).

!mportant

 DO NOT rotate the camshaft with plastic-type gaging material installed.

Carefully remove the camshaft carrier caps without disturbing the plastic-type gaging material. Measure each piece of plastic-type gaging material at its widest point using the gaging scale provided on the plastic-type gaging material packaging.

Standard camshaft journal clearance: 0.040 to 0.082 mm (0.0016 to 0.0032-inch).

Maximum camshaft journal clearance: 0.12 mm (0.0047-inch).

If camshaft journal clearance exceeds 0.12 mm (0.0047-inch), install the camshaft carrier caps onto the camshaft carrier and tighten the carrier cap bolts to specification. Measure the camshaft journal bore inside diameter using a telescopic micrometer. Then, measure the camshaft journal outside diameter using the J 26900-1.

Standard camshaft journal bore inside diameter: 28.000 to 28.021 mm (1.1024 to 1.1031-inch).

Standard camshaft journal outside diameter: 27.939 to 27.960 mm (1.1000 to 1.1008-inch).

If the camshaft journal outside diameter is farther out of specification than the camshaft journal bore inside diameter, replace the camshaft. If the camshaft journal bore inside diameter is farther out of specification than the camshaft journal outside diameter, replace the cylinder head.

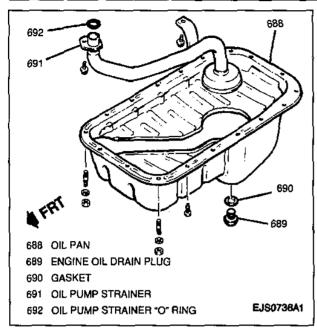


Figure 69-Engine Oil Pan and Oil Pump Strainer

ENGINE OIL PAN AND OIL PUMP STRAINER

Figures 69 through 73

++

Remove or Disconnect

- Raise and suitably support vehicle. Refer to SECTION 0A.
- 2. Four bolts and front skid plate from vehicle (if equipped).
- Front differential assembly from chassis (four-wheel drive model vehicles). Refer to SECTION 4C.
- Crankshaft position sensor bolt and remove crankshaft position sensor.
- 5. Place a drain pan beneath engine oil pan to catch escaping oil.
- 6. Engine oil drain plug and gasket allowing engine oil to drain (Figure 70).
- 7. Transmission left side support bracket, two bolts (4-speed automatic transmission models).

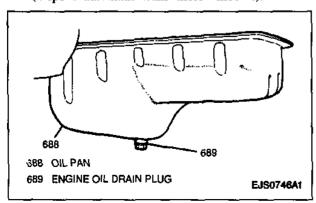


Figure 70-Engine Oil Pan Drain Plug

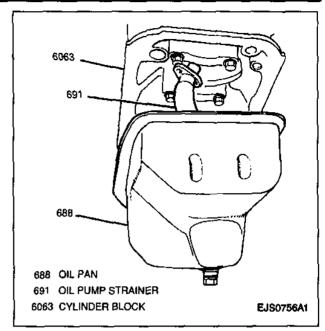


Figure 71-Engine Oil Pan and Oil Pump Strainer Removal

- 8. Clutch housing lower plate (manual transmission equipped vehicles, refer to SECTION 7B) or torque converter housing lower plate (automatic transmission equipped vehicles, refer to SECTION 7A).
- 9. Sixteen bolts, two nuts and engine oil pan from cylinder block (Figure 71).
- Two bolts and oil pump strainer from cylinder block.



Clean

- Inside of engine oil pan and oil pump strainer screen.
- 2. Mating surfaces of engine oil pan and cylinder block.

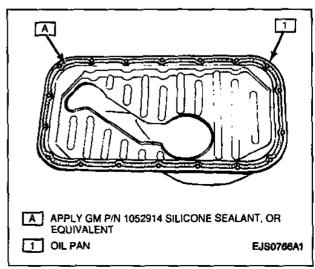


Figure 72-Engine Oil Pan Gasket Application

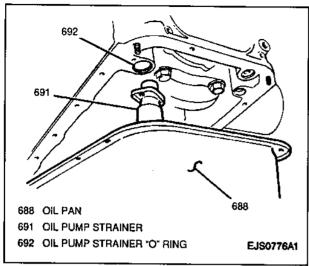


Figure 73-Installing Oil Pump Strainer and Engine Oil Pan

→← Install or Connect

- 1. Apply silicone sealant GM P/N 1052914, or equivalent, to the engine oil pan mating surface in a continuous bead (Figure 72).
- 2. Oil pump strainer to cylinder block; secure with two bolts (Figure 73).

Tighten

- Oil pump strainer bolts to 11 N·m (97 lb. in.).
- Engine oil pan to cylinder block; secure with sixteen bolts and two nuts.

(2) Tighten

- Engine oil pan nuts and bolts to 11 N·m (97 lb. in.).
- Clutch housing lower plate (manual transmission equipped vehicles, refer to SECTION 7B) or torque converter housing lower plate (automatic transmission equipped vehicles, refer to SECTION 7A).
- 5. Transmission left side support bracket, two bolts (4 spd. automatic transmission models).
- 6. Engine oil drain plug and gasket.

হ্ম Tighten

- Engine oil drain plug to 35 N.m (26 lb. ft.).
- 7. Crankshaft position sensor.
- 8. Front differential assembly to chassis (four-wheel drive model vehicles). Refer to SECTION 4C.
- Front skid plate (if equipped); secure with four bolts.

Tighten

- Front skid plate bolts to 55 N·m (40 lb. ft.).
- 10. Lower vehicle.
- 11. Refill engine oil to specifications. Refer to SECTION 0B.

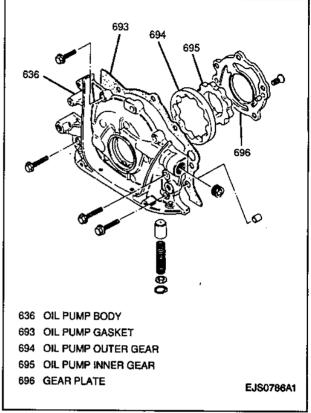


Figure 74-Oil Pump

Inspect

• Upon completion of installation, check oil pressure. Refer to SECTION 6.

OIL PUMP

Figures 70 through 81

←→ Remove or Disconnect

Tool Required: J 35271 Flywheel Holder

- Discharge and recover refrigerant (if equipped). Refer to SECTION 1B.
- 2. Raise and suitably support vehicle. Refer to SECTION 0A.
- Four bolts and front skid plate from vehicle (if equipped).
- Front differential assembly from chassis (four-wheel drive model vehicles). Refer to SECTION 4C.
- 5. Place a drain pan beneath engine oil pan to catch escaping oil.
- Engine oil drain plug and gasket allowing engine oil to drain (Figure 70).
- Clutch housing lower plate (manual transmission equipped vehicles, refer to SECTION 7B) or torque converter housing lower plate (automatic transmission equipped vehicles, refer to SECTION 7A).

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- 8. Sixteen bolts and two nuts and engine oil pan from cylinder block (Figure 71).
- 9. Two bolts and oil pump strainer from cylinder block.
- 10. Lower vehicle.
- 11. A/C drive belt, compressor and bracket (if equipped). Refer to SECTION 1B.
- 12. Timing belt outside cover, timing belt and tensioner. Refer to "Timing Belt and Tensioner" earlier in this section.
- 13. Oil level indicator from guide tube.
- 14. One bolt and guide tube with O-ring from oil pump.
- 15. Lock crankshaft using a J 35271 on the flywheel (Figure 75).
- 16. Crankshaft timing belt gear bolt (Figure 76).
- 17. Crankshaft timing belt gear.

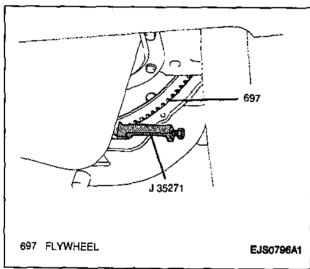


Figure 75-Locking Flywheel

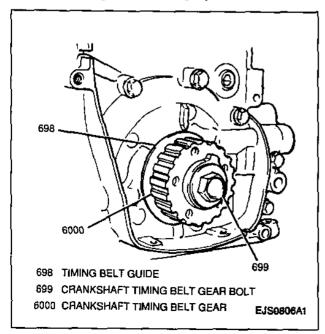


Figure 76—Crankshaft Timing Belt Gear Bolts

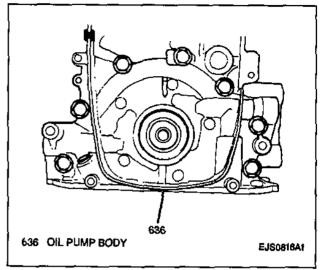


Figure 77-Oil Pump Bolts

 Seven bolts and oil pump assembly, gasket, rubber oil pump-to-coolant pump seals and two guide pins from cylinder block (Figure 77).



Clean

 Cylinder block, oil pump and oil pan mating surfaces.

++

Install or Connect

Tool Required:

J 34853 Crankshaft Oil Seal Guide

- 1. Apply a thin coat of oil to J 34853.
- 2. Oil seal to crankshaft using a J 34853 (Figure 78).
- Two guide pins and oil pump assembly using J 34853 (Figures 79 and 80); secure with seven bolts.

হি Tighten

• Oil pump bolts to 11 N·m (97 lb. in.).

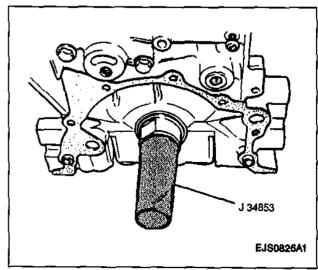


Figure 78-Oil Seal Installation With J 34853

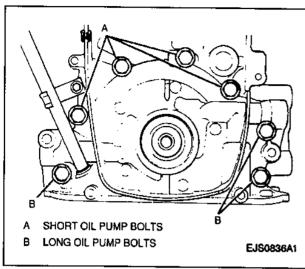


Figure 79—Oil Pump Bolt Locations

[Inspect

- Ensure the oil seal lip is not upturned, then remove the J 34853.
- 4. Raise and suitably support vehicle. Refer to SECTION 0A.
- 5. Apply gasket paste GM P/N 1050026, or equivalent, to the engine oil pan mating surface in a continuous bead (Figure 72).
- 6. Oil pump strainer to engine oil pan.
- 7. Oil pump strainer to cylinder block; secure with one oil pump strainer bolt and one oil pump strainer bracket bolt (Figure 73).

হ্ম Tighten

- Oil pump strainer bolt and oil pump strainer bracket bolt to 11 N.m (97 lb. in.).
- 8. Engine oil pan to cylinder block; secure with sixteen bolts and two nuts.

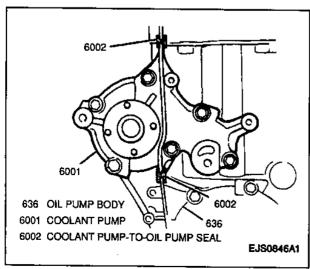


Figure 80-Rubber Oil Pump-To-Coolant Pump Seals

1 Tighten

- Engine oil pan nuts and bolts to 11 N·m (97 lb. in.).
- 9. Engine oil drain plug and gasket to engine oil pan.

হ্মি Tighten

- Engine oil drain plug to 35 N·m (26 lb. ft.).
- Clutch housing lower plate (manual transmission equipped vehicles, refer to SECTION 7B) or torque converter housing lower plate (automatic transmission equipped vehicles, refer to SECTION 7A).
- 11. Front differential assembly to chassis (four-wheel drive model vehicles). Refer to SECTION 4C.
- Front skid plate (if equipped); secure with four bolts.

(1) Tighten

- Front skid plate bolts to 54 N·m (40 lb. ft.).
- 13. Lower vehicle.
- 14. Crankshaft timing belt gear; secure with one bolt.

(1) Tighten

- Crankshaft timing belt gear bolt to 110 N·m (81 lb. ft.).
- 15. Guide tube with new O-ring and oil level indicator to cylinder block; secure with one bolt.

₹ Tighten

- Guide tube bolt to 14 N.m (10 lb. ft.).
- 16. Timing belt outside cover, timing belt and tensioner. Refer to "Timing Belt and Tensioner" earlier in this section.
- 17. A/C drive belt, compressor and bracket (if equipped). Refer to SECTION 1D.
- 18. Refill engine oil to specifications. Refer to SECTION 0B.
- 19. Evacuate and charge A/C system (if equipped). Refer to SECTION 1B,

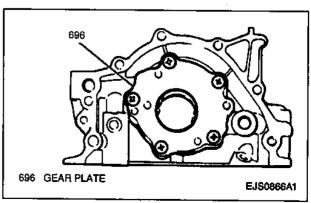


Figure 81-Gear Plate

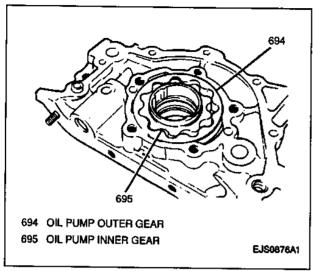


Figure 82-Oil Pump Outer and Inner Gears

20. After completing installation, start engine and check for normal oil pressure (refer to SECTION 6).

Oil Pump Overhaul Figures 81 through 84

⇔

Disassemble

- Five screws and gear plate from oil pump body (Figure 81).
- 2. Outer and inner oil pump gears from oil pump body (Figure 82).

Inspect

 Oil pump outer and inner gears, gear plate and oil pump body for excessive wear or damage.

Measure

- Radial clearance between oil pump outer gear and oil pump body using a feeler gage (Figure 83). If clearance exceeds 0.310 mm (0.0122-inch), replace oil pump outer gear and/or oil pump body as necessary.
- Side clearance between the oil pump gears and a straightedge using a feeler gage (Figure 84). If clearance exceeds 0.15 mm (0.0059-inch), replace the gears as necessary.

Assemble

- 1. Apply a thin coat of new engine oil to oil pump inner and outer gears, oil seal lip, and inside surface of oil pump body and gear plate.
- 2. Oil pump outer and inner gears to oil pump body.
- Gear plate to oil pump body; secure with five screws.

| Important

 Be sure that the oil pump gears operate smoothly after installation of the gear plate.

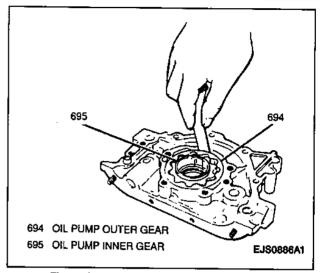


Figure 83—Radial Clearance Measurement

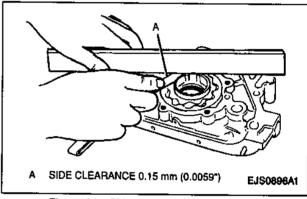


Figure 84—Side Clearance Measurement

PISTONS, PISTON RINGS, CYLINDERS AND CONNECTING RODS

Figures 86 through 89

Remove or Disconnect

- Cylinder head from the cylinder block. Refer to "Camshaft, Valves and Cylinder Head" earlier in this section.
- Engine oil pan and oil pump strainer. Refer to "Engine Oil Pan and Oil Pump Strainer" earlier in this section.
- 3. Mark cylinder number on each piston, connecting rod and connecting rod bearing cap.
- 4. Eight nuts and connecting rod bearing caps.
- Slide hose piece over connecting rod studs to prevent damage to the cylinder when piston and connecting rod are removed (Figure 86).

Clean

- Carbon from top of cylinder bore.
- 6. Piston and connecting rod from cylinder bore by pushing out through the top of the cylinder bore.

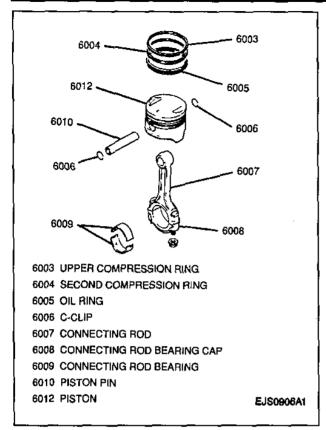


Figure 85-Piston Assembly

→← install or Connect

Tool Required: J 8037 Piston Ring Compressor

- 1. Apply light coat of clean engine oil to pistons, rings, cylinder walls, connecting rod bearings and crank pins.
- 2. Guide hoses over the connecting rod bolts to prevent damage to bearing journal and connecting rod bolt threads when installing connecting rods (Figure 87).
- 3. Piston and connecting rod into cylinder bore using a J 8037, ensuring arrow mark on top of the piston points to crankshaft pulley end (Figures 88 and 89). Use a hammer handle to tap piston head and install piston into cylinder bore, keeping J 8037 pressed securely against the top of the cylinder block until all piston rings have entered cylinder bore.
- 4. Remove hose pieces from connecting rod bolts.
- 5. Connecting rod bearing cap to connecting rod; secure with two nuts.

| Important

 Be sure to point arrow mark on cap toward the crankshaft pulley side.

হ্ম Tighten

 Connecting rod bearing cap nuts to 35 N·m (26 lb. ft.).

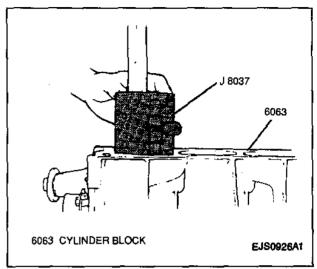


Figure 86--Installing Piston

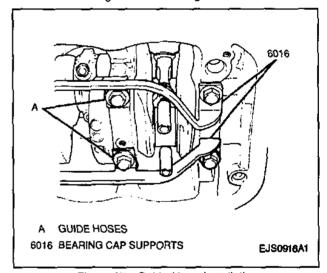


Figure 87—Guide Hose Installation

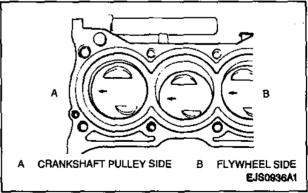


Figure 88-Piston Arrow Mark-To-Cylinder Block Orientation

- 6. Engine oil pan and oil pump strainer. Refer to "Engine Oil Pan and Oil Pump Strainer" earlier in this section.
- Cylinder head to the cylinder block. Refer to "Camshaft, Valves and Cylinder Head" earlier in this section.

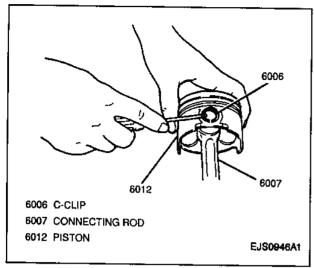


Figure 89—Removing Piston Pin C-Clip

Pistons

Figures 90 through 100

₽

Disassemble

- 1. Using a piston ring expander, remove two compression rings and oil ring from piston.
- 2. Two C-clips from piston pin ends (Figure 89).
- 3. Push piston pin out (Figure 90).



Clean

Tool Required:

J 3936-03 Piston Ring Groove Cleaner

Carbon from ring grooves using a J 3936-03.
 Remove remainder of carbon from piston head using suitable tools.



Measure

Tools Required:

- J J26900-3 Outside Micrometer
- J J8087 Cylinder Bore Gage
- 1. Piston diameter using a J 26900-3 at the piston grading position located 15 mm (0.59-inch) from the piston skirt end and in the direction perpendicular to the piston pin (Figure 91). Record measurement.
- 2. Cylinder bore inside diameter using a J 8087 (Figure 92). Cylinder bore diameter limit is 75.15 mm (2.9586-inches).
- 3. Piston oil clearance by subtracting the piston outside diameter from the cylinder bore inside diameter. If the piston oil clearance is not 0.02 to 0.04 mm (0.0008 to 0.0015-inch) in any cylinder, replace all four pistons. If necessary, rebore all three cylinders or replace the cylinder block.

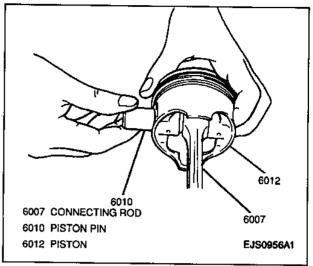


Figure 90-Removing Piston Pin

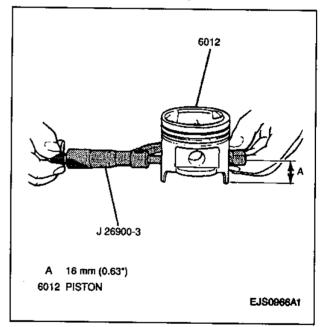


Figure 91-Measuring Piston Diameter

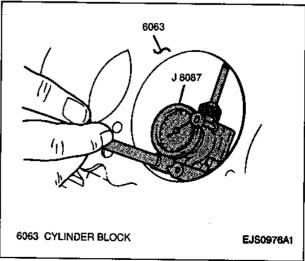


Figure 92—Measuring Cylinder Bore

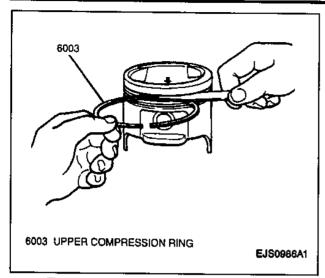


Figure 93—Piston Ring Groove Measurement

- There are three sizes of piston available; one standard and two oversize:
 - Standard piston diameter specification: 74.970 to 74.990 mm (2.9516 to 2.9523-inches).
 - 0.25 mm (0.0098-inch) oversized piston diameter specification: 75,220 to 75.230 mm (2.9614 to 2.9618-inches).
 - 0.50 mm (0.0196-inch) oversized piston diameter specification: 75.470 to 75.480 mm (2.9712 to 2.9716-inches).
- 4. Piston ring groove clearance by fitting a new piston ring into the piston groove and measuring the clearance between the ring and ring land using an appropriate feeler gage (Figure 93). Before measurement can be made, the piston grooves must be clean, dry, and free of carbon.
 - Piston upper compression ring groove clearance specification: 0.03-0.07 mm (0.0012-0.0027-inch).
 - Piston lower compression ring groove clearance specification: 0.02-0.06 mm (0.0008-0.0023-inch).

If ring groove clearance is not within specification, the piston must be replaced.

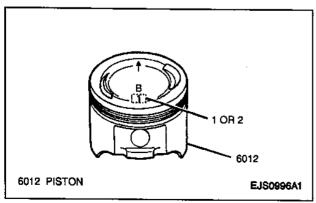


Figure 94—Piston Diameter Identification

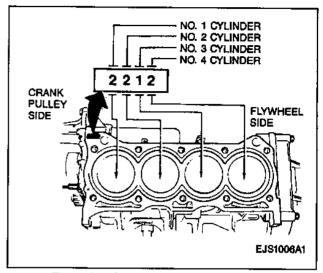


Figure 95—Cylinder Diameter Identification

茶

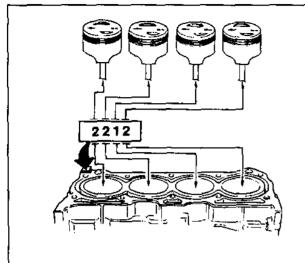
Assemble

!mportant

- Two sizes of pistons are available as standard size replacement parts ensuring proper piston-to-cylinder clearance.
- When installing a standard size piston, make sure to match each piston with a cylinder as follows:
- A. Each piston has a stamped number 1 or 2. These numbers represent the outer diameter of the piston (Figure 94).
- B. There are also stamped numbers 1 or 2 on the cylinder block (Figure 95). The first number indicates the inner diameter of the No. 1 cylinder, the second number, the No. 2 cylinder, the third number, the No. 3 cylinder, and the fourth number, the No. 4 cylinder.
- C. The stamped numbers on the pistons must correspond with the numbers stamped on the cylinder block for the stamped piston and cylinder number diameter specifications (Figure 96).
- 1. Connecting rod to piston by applying engine oil to piston pin holes, piston and the connecting rod. Fit connecting rod to piston (Figure 97).
- 2. Piston pin to piston assembly; secure with two C-clips.
- 3. Oil ring to piston head.
- 4. Compression rings to piston head using a piston ring expander.

? Important

• The compression rings have an "R", "RN", or "T" identification mark stamped on one side. When installing these rings to the piston, direct marked side of each ring toward the top of the piston (Figure 98).



	PISTON		PISTON		CYLINDER	
NUMBER AT THE TOP OUTSIDE DIAMETER (MARK)				PISTON-TO- CYLINDER CLEARANCE		
1	74.98–74.99 mm (2.9520–2.9524")	1	75.01–75.02 mm (2.9531–2.9535°)	0.02-0.04 mm (0.0008- 0.0015")		
2	74,97–74.98 mm (2.9516–2.9520°)	2	75.00-75.01 mm (2.9528-2.9531")	0.02-0.04 mm (0.0008- 0.0015")		
EJS1016A1						

Figure 96---Cytinder-To-Piston Orientation

- The upper compression ring differs from the lower compression ring in thickness, shape, and color of cylinder wall contact surface (Figure 98). When installing the oil ring, install the spacer first and then the two rails,
- Offset the end gap of each ring as shown in Figure 99.

Piston Rings

Figure 100



- Piston ring end gap by inserting each piston ring into cylinder bore, positioning ring at a point 120 mm (4.72-inches) from the top. Use the top of a piston to push ring in squarely. Measure ring end gap with a feeler gage (Figure 100). The cylinder bore top must be free of carbon before inserting the piston ring.
 - Piston upper compression ring end gap specification is 0.20 to 0.35 mm (0.0079 to 0.0137-inch).

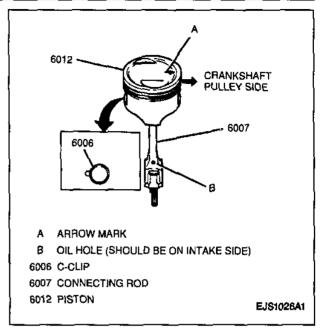


Figure 97—Piston-To-Connecting Rod Orientation

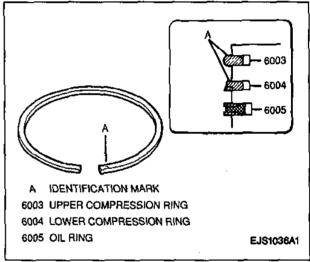


Figure 98--Piston Ring Installation

- Piston lower compression ring end gap specification is 0.20 to 0.35 mm (0.0079 to 0.0137-inch).
- Piston oil ring end gap specification is 0.20 to 0.70 mm (0.0079 to 0.0275-inch).

Piston Pins

Figure 101



 Piston pin should fit into piston bore easily at normal room temperature.

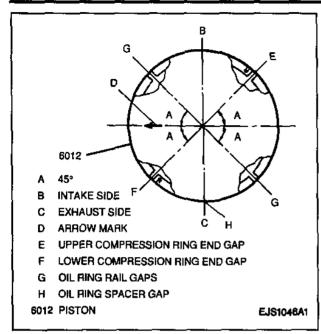


Figure 99-Piston Ring End Gap Positioning

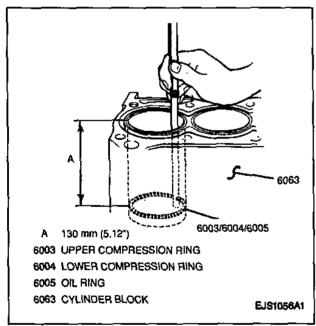


Figure 100 Measuring Piston Ring End Gap

Measure

Tool Required:
J 26900-1 Outside Micrometer

1. Connecting rod bore inside diameter using a telescoping micrometer. Record measurement. Standard connecting rod bore inside diameter is 19.003 to 19.011 mm (0.7482 to 0.7486-inch). If the connecting rod bore is out of specification, replace the connecting rod.

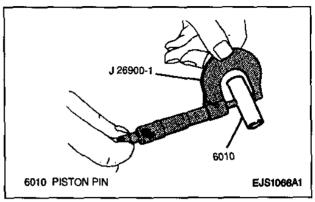


Figure 101-Measuring Piston Pin Diameter

- 2. Piston pin diameter using a J 26900-1 (Figure 101). Record measurement. Standard piston pin diameter is 18.995 to 19.000 mm (0.7479 to 0.7480-inch). If the piston pin diameter is out of specification, replace the piston pin.
- 3. Subtract piston pin diameter from connecting rod bore inside diameter to obtain piston pin clearance. Piston pin clearance specification is 0.003 to 0.016 (0.0001 to 0.0006-inch). If the piston pin clearance exceeds 0.05 mm (0.002-inch), replace the connecting rod and/or piston pin.

Cylinders

Figure 102

Inspect

 Cylinder walls for scratches, gouges, roughness, or ridges which indicate excessive wear.

NOTICE: If cylinder bore is very rough, deeply scratched or ridged, rebore cylinder and use oversize piston. If reboring of any cylinder is needed, it will be necessary to rebore all four cylinders to the same next oversize.

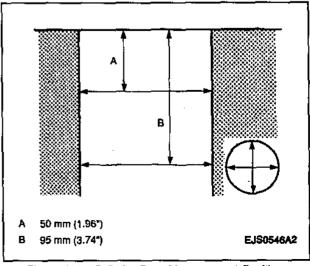


Figure 102—Cylinder Bore Measurement Positions

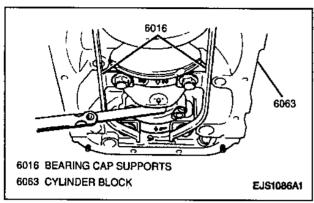


Figure 103-Connecting Rod Side Clearance



Measure

Tool Required: J 8087 Cylinder Bore Gage

- Cylinder bore in thrust and axial directions at two points, 50 mm and 95 mm (1.96-inches and 3.74-inches) from top of cylinder using J 8087 (Figure 102). If the cylinder bore exceeds 75.15 mm (2.9586-inches), the cylinders must be rebored and an oversize piston installed.
- Take the difference between the thrust and axial measurements of the upper position and the thrust and axial measurements of the lower position. This is the taper measurement.
- Take the difference between the thrust and axial measurements at each of the positions. This is the out-of-round measurement.
- If the taper and/or the out-of-round measurement exceeds the maximum specification of 0.10 mm (0.0039-inch), the cylinder must be rebored.

Connecting Rods

Figure 103



Measure

- 1. Connecting rod side clearance using a feeler gage with connecting rod fitted and connected to crankshaft (Figure 103). Connecting rod side clearance specification is 0.10 to 0.20 mm (0.0039 to 0.0078-inch). If the side clearance exceeds 0.35 mm (0.0137-inch), the connecting rod must be replaced.
- Connecting rod alignment by mounting connecting rod on an aligner and measuring for bow and twist of the connecting rod. If the connecting rod bow is more than 0.05 mm (0.0020-inch) and/or twist is more than 0.10 mm (0.0039-inch), the connecting rod must be replaced.

Crankshaft and Connecting Rod Bearings Figures 105, 106 and 107



Inspect

1. Crankshaft for uneven wear or damage. If crankshaft is damaged, it must be replaced.

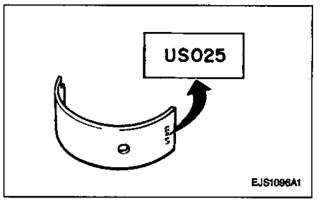


Figure 104—0.25 mm (0.0098-inch) Undersize Connecting Rod Bearing

- 2. Connecting rod bearings for signs of fusion, pitting, burn or flaking and observe contact pattern. Any connecting rod bearing found in defective condition must be replaced.
- Two kinds of connecting rod bearings are available: Standard size and a 0.25 mm (0.0098-inch) undersize bearing. To distinguish them, the undersize bearing has the stamped number "US025" on its backside (Figure 104). The standard size bearing has no stamped number.



Measure

Tool Required: J 26900-2 Outside Micrometer

- Crankshaft diameter and out-of-round measurement using a J 26900-2.
 - Crankshaft standard size diameter specification is 43.982 to 44.000 mm (1.7316 to 1.7322-inches).
 - 0.25 mm (0.0098-inch) undersize crankshaft diameter specification is 43,732 to 43,750 mm (1.7218 to 1.7224-inches).
 - Crankshaft out-of-round specification is a maximum of 0.01 mm (0.0004-inch).

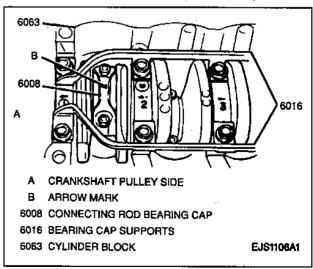


Figure 105-Installing Connecting Rod Bearing

If the crankshaft is out of specification, the crankshaft must be replaced as necessary or ground to the undersize diameter specification and the connecting rod bearing replaced with the undersized bearings.

👺 Clean

- · Connecting rod bearing and crankshaft.
- 2. Connecting rod bearing clearance.
 - A. Install connecting rod bearing in connecting rod and connecting bearing cap.
 - B. Place a piece of plastic-type gaging material the full width of the connecting rod bearing (parallel to crankshaft), avoiding the oil passage hole.
 - C. Install the connecting rod bearing cap to the connecting rod with the arrow mark on the cap facing toward the crankshaft pulley (Figure 105).

NOTICE: Apply clean engine oil to the connecting rod bolts prior to installation and never turn the crankshaft with the plastic-type gaging material installed.

(Tighten

- Connecting rod bearing cap bolts to 35 N·m (26 lb. ft.).
- D. Remove the connecting rod bearing cap from the connecting rod and, using a scale on the plastic-type gaging material envelope, measure the connecting rod bearing clearance at the widest point of the plastic-type gaging material (Figure 106). Connecting rod bearing clearance specification: 0.020-0.050 mm (0.0008-0.0019-inch) with a limit of 0.080 mm (0.0031-inch). If connecting rod bearing clearance is greater than 0.080 mm (0.0031-inch) use a new standard size bearing and remeasure clearance. If clearance still cannot be brought into specification, the

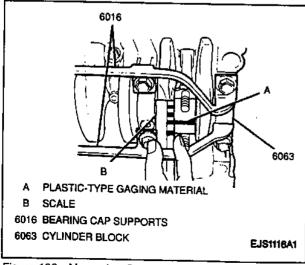


Figure 106-Measuring Connecting Rod Bearing Clearance

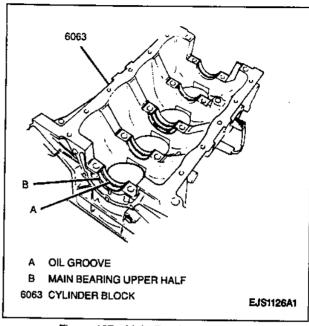


Figure 107-Main Bearing Upper Half

crankshaft must be ground to the undersize diameter specification and undersized bearing used in place of the standard size connecting rod bearing.

MAIN BEARINGS

Figures 108 and 109

←→ Remove or Disconnect

- 1. Engine oil pan and oil pump strainer from cylinder block. Refer to "Engine Oil Pan and Oil Pump Strainer" earlier in this section.
- Ten bolts and bearing cap supports, main bearing caps and main bearing lower half.
- 3. Main bearing upper half.

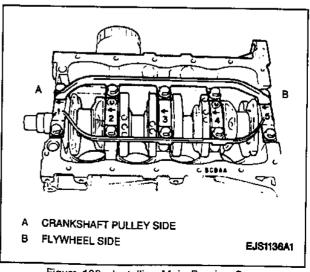


Figure 108-Installing Main Bearing Caps

Inspect

· Main bearings for pitting, scratches, wear or damage. If any of these conditions are found, replace both upper and lower halves of main bearings.

Important

· Any time main bearings must be replaced, both the upper and lower half should be replaced as a set. Never replace only one half.

+ Install or Connect

Important

- The main bearing upper half has an oil groove. Install with oil groove to cylinder (Figure 107).
- 1. Main bearing upper half.
- 2. Bearing cap supports and main bearing caps to cylinder block. Install each cap in ascending order of numbers 1, 2, 3, 4 and 5 starting from the crankshaft pulley side and going to the flywheel side. Make sure all arrow marks point toward crankshaft pulley side (Figure 108).

Tighten

Main bearing cap bolts to 54 N·m (40 lb. ft.).

Important

- Gradual and uniform tightening is important for main bearing cap bolts.
- After tightening main bearing bolts, check to be sure that crankshaft rotates smoothly when turned by hand.
- 3. Oil pump strainer and engine oil pan to cylinder block. Refer to "Engine Oil Pan and Oil Pump Strainer" earlier in this section.

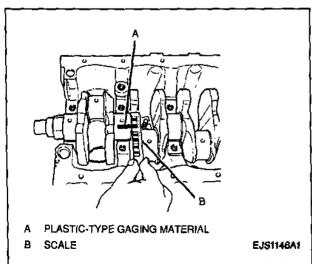


Figure 109-Measuring Main Bearing Clearance

Main Bearing Clearance Figures 109 and 110

- 1. Remove main bearing caps.
- 2. Clean main bearings and main journals.
- 3. Place a piece of plastic-type gaging material across the full width of main bearing (parallel to crankshaft) on the journal while avoiding the oil hole.
- 4. Install main bearing caps and bearing cap supports to cylinder block. Install each cap in ascending order of numbers 1, 2, 3, 4 and 5 starting from the crankshaft pulley end and going to the flywheel end. Make sure all arrow marks point toward crankshaft pulley end (Figure 108).

Tighten

• Main bearing cap bolts to 54 N.m (40 lb. ft.).

NOTICE: Do not rotate crankshaft while plastic-type gaging material is installed.

Important

- · Main bearing caps MUST be torqued to specification in order to obtain accurate measurement.
- 5. Remove main bearing cap and, using scale on plastic-type gaging material envelope, measure plastic-type gaging material width at its widest point (Figure 109). If clearance exceeds specification, replace main bearing. Standard main bearing clearance is 0.02 to 0.04 mm (0.0008 to 0.0016-inch). If clearance exceeds 0.06 mm (0.0023-inch), replace main bearing. Always replace both upper and lower bearing halves as a set.

important

· A new standard main bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal and use a 0.25 mm (0.0098-inch) undersize bearing. For procedures on main bearing selection, refer to "Selection of Main Bearings" later in this section. After selecting new main bearing, recheck clearance as described above.

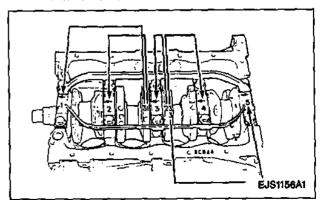


Figure 110-Stamped Numerals on Crankshaft Web of No. 2 and No. 3 Cylinders

SELECTION OF MAIN BEARINGS

Standard Bearings

Figures 111 through 114

New standard main bearings should be installed in cases where main bearing is damaged or main bearing clearance is out of specification. Select new main bearings according to the following procedure.

- 1. Inspect the journal diameter by noting the five stamped numerals on crank web of No. 2 and No. 3 cylinders (Figure 110). The three numerals ("1", "2" and "3") represent the following journal diameters:
 - Stamped numeral "1" represents journal diameter of 51.994 to 52.000 mm (2.0470 to 2.0472-inches).
 - Stamped numeral "2" represents journal diameter of 51.988 to 51.994 mm (2.0468 to 2.0470-inches).
 - Stamped numeral "3" represents journal diameter of 51.982 to 51.988 mm (2.0465 to 2.0468-inches). These journal diameter indicators correspond to the main bearing caps numbers "1", "2", "3", "4" and "5" respectively.
- 2. Inspect the main bearing cap bore diameter without main bearing. A five letter code is stamped on the mating surface on the cylinder block (Figure 111). This code consists of a combination of three letters, "A", "B" or "C" and represents the main bearing cap bore

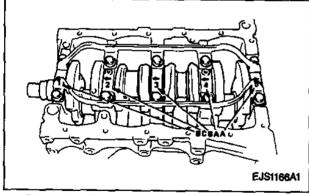


Figure 111-Stamped Letters on the Cylinder Block

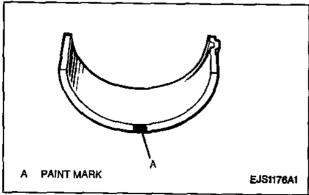


Figure 112-Standard Main Bearing Paint Mark

diameters (without main bearing installed) of bearing caps "1", "2", "3", "4" and "5" respectively.

- "A" represents a main bearing cap bore diameter of 56.000 to 56.006 mm (2.2047 to 2.2050-inches).
- "B" represents a main bearing cap bore diameter of 56.006 to 56.012 mm (2.2050 to 2.2052-inches).
- "C" represents a main bearing cap bore diameter of 56.012 to 56.018 mm (2.2052 to 2.2054-inches).
- 3. There are five sizes of standard bearings. To distinguish them, there is a paint mark on the center edge (Figure 112). Each color indicates the thickness at the center of the bearing.
 - "Green" represents a main bearing thickness of 1.996 to 2.000 mm (0.0786 to 0.0787-inch).
 - "Black" represents a main bearing thickness of 1.999 to 2.003 mm (0.0787 to 0.0788-inch).
 - Colorless (no paint) represents a main bearing thickness of 2.002 to 2.006 mm (0.0788 to 0.0789-inch).
 - "Yellow" represents a main bearing thickness of 2.005 to 2.009 mm (0.0789 to 0.0790-inch).
 - "Blue" represents a main bearing thickness of 2.008 to 2.012 mm (0.0790 to 0.0791-inch).
- 4. From the numbers stamped on the crank web of No. 2 and No. 3 cylinders and the letters stamped on the mating surface of the cylinder block, determine new standard bearing to be installed on the journal by referring to the "Standard Bearing Table" (Figure 113). For example if the number stamped on the mating surface is "1" and the letter stamped on the mating surface is "B", install the new standard main bearing with "Black" to its journal.

	-	NUMERAL STAMPED ON CRANK WEB (JOURNAL DIAMETER)		
<u> </u>		1	2	3
LETTER	Α	GREEN	BLACK	COLORLESS
STAMPED ON MATING	В	BLACK	COLORLESS	YELLOW
SURFACE	С	COLORLESS	YELLOW	BLUE
	NEW STANDARD BEARING TO BE INSTALLED			NG TO BE

T5474

Figure 113-Standard Bearing Table

- 5. Inspect bearing clearance with new standard bearing installed. Refer to "Main Standard Bearing Clearance" earlier in this section for procedure. If the clearance still exceeds the limit, use the next thicker bearing and recheck the clearance.
- 6. When replacing the crankshaft or the cylinder block for any reason, select new standard bearings to be installed by referring to the numbers stamped on the (new) crankshaft and the letters stamped on the mating surface of the (new) cylinder block.

Undersize Bearings

Figures 115 and 116

Tool Required:

J 26900-3 Outside Micrometer

A 0.025 mm (0.0098-inch) undersize bearings is available through GM SPO. To distinguish between them, each bearing has paint marks on one side (Figure 114). Each color indicates the following thickness at the center of the bearing:

- A. "Green" & "Red" represent bearing thickness of 2.121 to 2.125 mm (0.0835 to 0.0836-inch).
- B. "Black" & "Red" represent bearing thickness of 2.124 to 2.128 mm (0.0836 to 0.0837-inch).
- C. "Red" represents bearing thickness of 2.127 to 2.131 mm (0.0837 to 0.0838-inch).
- D. "Yellow" & "Red" represent bearing thickness of 2.130 to 2.134 mm (0.0838 to 0.0839-inch).
- E. "Blue" & "Red" represent bearing thickness of 2.133 to 2.137 mm (0.0839 to 0.0840-inch).

 If 0.25 mm (0.0098-inch) undersized bearings are to be used, regrind the crankshaft journal as follows:
- 1. Regrind the crankshaft journal to a finished diameter of 51.732-51.750 mm (2.0367-2.0373-inches).
- 2. Using a J 26900-3, measure the reground journal diameter. The measurement must be taken in two directions, perpendicular to each other, in order to check for an out of round condition.
- 3. Using journal diameter measured in step 2 and the letters stamped on mating surface of cylinder block, select undersize bearing to be installed by referring to the "Undersize Bearing Table" (Figure 115).
- 4. Inspect bearing clearance with new undersize bearing installed. Refer to "Main Bearing Clearance" earlier in this section.

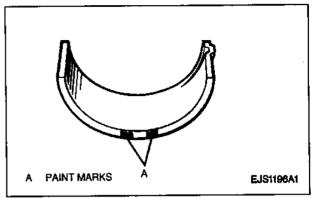


Figure 114-Undersize Bearing Paint Marks

FLYWHEEL

Figure 116

Remove or Disconnect

- 1. Transmission from cylinder block. Refer to SECTION 7A (automatic transmission equipped vehicles) or SECTION 7B (manual transmission equipped vehicles).
- 2. Clutch from flywheel (manual transmission equipped vehicles). Refer to SECTION 7C.

inspect

- If the ring gear is damaged, cracked or worn, replace the flywheel.
- If the surface contacting the clutch disc is damaged or excessively worn, replace the flywheel (manual transmission equipped vehicles).



Tools Required:
J 8001 Dial Indicator Set
J 26900-13 Magnetic Base

<u> </u>		MEASURED JOURNAL DIAMETER		
		51.744-51.750 mm (2.0371-2.0373")	51.738-51.744 mm (2.0369-2.0371'')	51.732-51.738 mm (2.0367-2.0369")
LETTERS STAMPED ON	Α	GREEN & RED	BLACK & RED	RED ONLY
MATING SURFACE OF	В	BLACK & RED	RED ONLY	YELLOW & RED
CYLINDER BLOCK	С	RED ONLY	YELLOW & RED	BLUE & RED
		UNDERSIZE BEARING TO BE INSTALLED.		

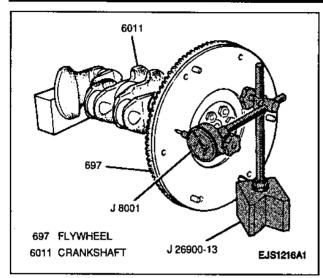


Figure 116—Measuring Flywheel Face Runout

Flywheel for face runout using a J 8001 with a J 26900-13. If the runout exceeds 0.2 mm (0.0078-inch), replace the flywheel (Figure 116).

- 3. Mark the flywheel-to-engine position.
- 4. Six flywheel retaining bolts and flywheel from crankshaft.
- 5. Nylon clutch pilot bushing from crankshaft.



Clean

* Grease and dirt from flywheel outer surfaces using suitable solvent.

++

Install or Connect

- Flywheel to crankshaft, aligning the flywheel-to-engine marks.
- 7. Apply Loctite® 414 GM P/N 12345493, or equivalent, to the flywheel retaining bolt threads.

NOTICE: Do not apply an excessive amount of sealant to the flywheel retaining bolt threads. Applying too much sealant will result in the sealant overflowing the bolt seat. This could cause the bolt to break loose during vehicle operation.

8. Flywheel retaining bolts to flywheel.



Tighten

- Flywheel retaining bolts to 78 N-m (58 lb. ft.).
- Clutch to flywheel (manual transmission equipped vehicles). Refer to SECTION 7C.
- Transmission to engine. Refer to SECTION 7A (manual transmission equipped vehicles) or SECTION 7B (automatic transmission equipped vehicles).

Flywheel Balancing (Automatic Transmission Equipped Vehicles)

Flywheel and torque converter imbalance can be corrected using the following procedure.

- 1. Change the position of the torque converter-to-flywheel 120° at a time to cancel out engine and torque converter unbalance. Recheck in each position for vibration improvements.
- If the unbalanced condition still exists, leave the torque converter-to-flywheel in the best balanced position. Install longer flywheel-to-torque converter bolts, adding and removing washers until the best balance is achieved.

NOTICE: Be sure that the bolts are not bottoming in the holes. If a bolt bottoms the cover could be dented, causing internal clutch facing damage. Always rotate the torque converter by hand after adding washers to check for clearance.



Inspect

- 1. For missing or loose torque converter-to-flywheel bolts. Replace or tighten as necessary.
- 2. Torque converter for damage or missing balance weights. If the torque converter is damaged or balance weights are missing, replace the converter.

REAR MAIN SEAL

Figure 117

++

Remove or Disconnect

- 1. Transmission from vehicle. Refer to SECTION 7A (automatic transmission equipped vehicles) or to SECTION 7B (manual transmission equipped vehicles).
- Pressure plate assembly and clutch disc (manual transmission equipped vehicles only). Refer to SECTION 7C.
- 3. Mark the flywheel-to-engine position.
- Six flywheel retaining bolts and flywheel from crankshaft.
- 5. Rear main seal (Figure 117).

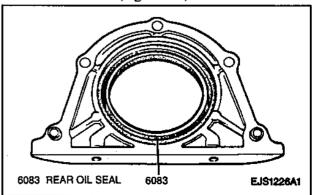


Figure 117—Rear Main Seal

6A1-52 ENGINE MECHANICAL - 1.6 LITER L4 VIN CODE 6 (RPO L01)

++ Install or Connect

- 1. New rear main seal.
- 2. Apply Loctite® 414 GM P/N 12345493, or equivalent, to the flywheel retaining bolt threads.

NOTICE: Do not apply an excessive amount of sealant to the flywheel retaining bolt threads. Applying too much sealant will result in the sealant overflowing the bolt seat. This could cause the bolt to break loose during vehicle operation.

3. Flywheel; secure with six flywheel retaining bolts.

Tighten

• Flywheel retaining bolts to 78 N·m (58 lb. ft.).

Important

- After the rear main seal housing bolts are tightened, the gasket may extend past the rear main seal housing. Trim the excess with a sharp knife so the gasket is flush with the cylinder block.
- Pressure plate assembly and clutch disc (manual transmission equipped vehicles only). Refer to SECTION 7C.
- 5. Transmission to vehicle. Refer to SECTION 7A (automatic transmission equipped vehicles) or to SECTION 7B (manual transmission equipped vehicles).

ENGINE ASSEMBLY

Figures 12, 13, 17 and 18



Remove or Disconnect

Tools Required:

- J 35271 Flywheel Holder
- J 36854 Heavy Duty Automotive Engine Stand
- 1. Discharge and recover refrigerant (if equipped with A/C). Refer to SECTION 1B.
- 2. Relieve fuel pressure. Refer to SECTION 6C.
- 3. Negative (-) battery cable.
- 4. Positive (+) battery cable.
- 5. Open fuel filler cap to relieve pressure in fuel tank. After relieving pressure, install cap.
- 6. Drain cooing system. Refer to SECTION 6B.
- 7. Two engine mount-to-exhaust bracket bolts, one exhaust bracket-to-exhaust manifold nut and exhaust bracket from vehicle (Figure 17).
- 8. Raise and suitably support vehicle. Refer to SECTION 0A.
- Four bolts and front skid plate from vehicle (if equipped).
- Place a drain pan or suitable container under engine oil pan.
- 11. Engine oil drain plug from engine oil pan and drain engine oil.

- 12. Clutch housing lower plate (manual transmission equipped vehicles, refer to SECTION 7B) or torque converter housing lower plate (automatic transmission equipped vehicles, refer to SECTION 7A).
- Two bolts and clutch cable from clutch release arm and bracket (manual transmission equipped vehicles).
- 14. Automatic transmission fluid hoses from clamps (automatic transmission equipped vehicles).
- 15. Clutch lower plate (manual transmission equipped vehicles).
- 16. Torque converter lower plate (automatic transmission equipped vehicles).
- 17. Torque converter bolts (automatic transmission equipped vehicles) using a J 35271 to lock drive plate.
- 18. Three nuts and front pipe/three way catalytic converter (TWC) from exhaust manifold (Figure 18).
- 19. Clutch cable from retaining straps (manual transmission equipped vehicles).
- 20. Support transmission and remove two bolts, separating from cylinder block. Refer to SECTION 7A automatic transmission equipped vehicles) or SECTION 7B (manual transmission equipped vehicles).
- 21. Starter motor. Refer to SECTION 6D2.
- 22. Engine mount lower nuts and washers.
- 23. Lower vehicle.
- 24. Upper coolant hose from radiator.
- 25. Air conditioner (A/C) compressor (if equipped). Refer to SECTION 1B.
- 26. Four bolts securing shroud to radiator and four fan clutch mounting nuts.
- 27. Shroud, fan clutch and cooling fan together.
- 28. Radiator assembly. Refer to section 6B.
- 29. Air intake pipe from engine. Refer to "Air Intake Pipe" earlier in this section.
- 30. Accelerator cable and automatic transmission kickdown cable (automatic transmission equipped vehicles) from throttle body.
- 31. Positive crankcase ventilation (PCV) valve, EGR valve, and EGR temperature sensor from intake manifold
- 32. Coolant hose from the IAC valve.
- 33. IAC air hose from IAC valve.
- 34. Fuel feed hose at fuel feed hose union (Figure 13).
- 35. Fuel return hose from fuel return line.
- 36. PCV hose from PCV valve.
- 37. Coolant hose from thermostat housing.
- 38. Coolant bypass and heater inlet hoses from intake manifold.
- 39. Lower coolant hose from radiator.
- 40. The following electrical connectors:
 - Main engine harness electrical connectors at bulkhead.
 - Throttle position (TP) sensor.

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- Idle air control (IAC) valve.
- Heated oxygen sensor (HO2S1).
- Engine coolant temperature (ECT) sensor (Figure 12).
- ECT sensor sending unit (Figure 12).
- A/C ECT switch (A/C equipped vehicles).
- · Wiring harness from retaining clamps.
- Injector wiring harness (Figure 12).
- · Generator.
- · Power steering pressure (PSP) switch.
- Exhaust gas recirculation temperature (EGRT) sensor.
- Exhaust gas recirculation solenoid vacuum valve (Figure 12).
- · Exhaust gas recirculation by-pass valve.
- 41. The following vacuum hoses:
 - Vacuum hose at sure tank, 3-way T connector.
 - · EGR pressure transducer.
 - · EGR valve.
 - · Brake booster supply hose.
 - Vacuum modulator supply hose (automatic transmission equipped vehicles).
 - · EVAP canister and hoses.
 - Intake manifold absolute pressure sensor hose from sensor.
- 42. Distributor from distributor case. Refer to SECTION 6D4.
- 43. Hood from vehicle. Refer to SECTION 10-5.
- 44. Install engine hoist to engine.
- 45. Engine mounting bracket-to-frame bolts.

? Important

- Before lifting engine, check to ensure all hoses, pipes, electric wires, and cables are disconnected from engine.
- 46. Engine assembly from vehicle by sliding assembly toward the front side of engine compartment; then, carefully lift engine assembly from vehicle verifying clearance on all sides.
- 47. Pressure plate assembly and clutch disc (manual transmission equipped vehicles only). Refer to SECTION 7C.
- 48. Six bolts and flywheel from crankshaft.
- 49. Engine assembly onto a J 36854 and disconnect engine hoist.

++ Install or Connect

- 1. Engine hoist and remove engine assembly from J 36854.
- Apply Loctite® 414 GM P/N 12345493, or equivalent, to the flywheel retaining bolt threads.

NOTICE: Do not apply an excessive amount of sealant to the flywheel retaining bolt threads. Applying too much sealant will result in the sealant overflowing the bolt seat. This could cause the bolt to break loose during vehicle operation.

3. Flywheel; secure with six flywheel retaining bolts.

(1) Tighten

- Flywheel retaining bolts to 78 N·m (58 lb. ft.).
- Pressure plate assembly and clutch disc (manual transmission equipped vehicles only). Refer to SECTION 7C.
- 5. Engine assembly, lowering into front of engine compartment while ensuring clearance on all sides, then slide assembly toward rear.
- 6. Engine mounting bracket-to-frame bolts.
 - A. Three right-side engine mount-to-engine bracket bolts.

হ্মি Tighten

- Right-side engine mount-to-engine bracket bolts to 54 N·m (40 lb. ft.).
- B. Two left-side engine mount-to-engine bolts. Do not tighten fully.

(1) Tighten

- Left-side engine mount-to-engine bolts to 54 N·m (40 lb. ft.).
- 7. Remove engine hoist.
- 8. Hood to vehicle. Refer to SECTION 10-5.
- 9. Distributor into distributor case. Refer to SECTION 6D4.
- 10. The following vacuum hoses:
 - EGR pressure transducer.
 - · EGR valve.
 - Brake booster supply hose.
 - Vacuum modulator supply hose (automatic transmission equipped vehicles).
 - EVAP canister purge valve.
 - Intake manifold absolute pressure sensor hose to sensor.
- 11. The following electrical connectors:
 - Throttle position (TP) sensor.
 - Idle air control (IAC) valve.
 - Heated oxygen sensor (HO2S1).
 - Engine coolant temperature (ECT) sensor (Figure 12).
 - ECT sensor sending unit (Figure 12).
 - A/C ECT switch (A/C equipped vehicles) (Figure 12).
 - · Wiring harness into retaining clamps.
 - Injector wiring harness (Figure 12).
 - Generator.
 - Power steering pressure (PSP) switch.
 - Exhaust gas recirculation temperature (EGRT) sensor.

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- Exhaust gas recirculation solenoid vacuum valve (Figure 12).
- Exhaust gas recirculation by-pass valve.
- 12. Lower coolant hose to radiator; secure with hose clamp.
- 13. Coolant bypass and heater inlet hoses to intake manifold; secure with hose clamps.
- 14. Coolant hose to thermostat housing.
- 15. PCV hose to PCV valve.
- 16. Fuel return hose to fuel return line.
- 17. Fuel feed hose at fuel feed hose union (Figure 13).
- 18. IAC air hose to IAC valve.
- 19. Coolant hose to the IAC valve.
- Positive crankcase ventilation (PCV) valve, EGR valve, and EGR temperature sensor to intake manifold.
- Accelerator cable and automatic transmission kickdown cable (automatic transmission equipped vehicles) to throttle body.
- 22. Air intake pipe to engine. Refer to "Air Intake Pipe" earlier in this section.
- 23. Fan clutch, cooling fan and shroud; secure with four fan clutch nuts and four shroud bolts.

হ্ম Tighten

- Fan clutch nuts to 11 N.m (97 lb. in.).
- Shroud bolts to 11 N·m (97 lb. in.).
- 24. Air conditioner (A/C) compressor (if equipped). Refer to SECTION 1B.
- 25. Upper coolant hose to radiator; secure with hose clamp.
- Raise and suitably support vehicle. Refer to SECTION 0A.
- 27. Engine mount lower nuts and washers.

হ্মি Tighten

- Engine mount lower nuts to 50 N·m (37 lb. ft.).
- 28. Starter motor. Refer to SECTION 6D2.
- Transmission to cylinder block. Refer to SECTION 7A (automatic transmission equipped vehicles) or SECTION 7B (manual transmission equipped vehicles).
- 30. Clutch cable to retaining straps (manual transmission equipped vehicles).
- 31. Front pipe/TWC to exhaust manifold; secure with three nuts (Figure 18).

Tighten

- Front pipe/TWC assembly-to-exhaust manifold nuts to 50 N·m (37 lb. ft.).
- 32. Torque converter bolts (automatic transmission equipped vehicles) using a J 35271 to lock drive plate.

Tighten

- Torque converter bolts to 54 N.m (40 lb. ft.).
- 33. Torque converter lower plate (automatic transmission equipped vehicles).
- 34. Clutch housing lower plate (manual transmission equipped vehicles).
- 35. Automatic transmission fluid hoses to clamps (automatic transmission equipped vehicles).
- Clutch cable to bracket and clutch release arm (manual transmission equipped vehicles). Refer to SECTION 7C.
- 37. Engine oil drain plug with new gasket.

(1) Tighten

- Engine oil drain plug to 35 N·m (26 lb. ft.).
- 38. Front skid plate (if equipped); secure with four bolts.

হ্ম Tighten

- Front skid plate bolts to 54 N·m (40 lb. ft.).
- 39. Lower vehicle.
- 40. Exhaust bracket into vehicle; secure with two engine mount-to-exhaust bracket bolts and one exhaust bracket-to-exhaust manifold nut (Figure 17).

રો Tighten

- Engine mount-to-exhaust bracket bolts to 54 N·m (40 lb. ft.).
- Exhaust bracket-to-exhaust manifold nut to 50 N·m (37 lb. ft.).
- 41. Refill cooling system as necessary. Refer to SECTION 6B.
- 42. Negative (-) and positive (+) battery cables.

(1) Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N·m (11 ft.lb.).
- Positive (+) battery cable-to-positive (+) battery terminal retainer to 15 N.m (11 ft.lb.).
- 43. Evacuate and charge A/C system (if equipped). Refer to SECTION 1B.

Cylinder Block Service

Figures 5, 32, 70 through 73, 77 through 81, 88 and 89

←→ Remove or Disconnect

- Cylinder head from cylinder block. Refer to "Camshaft, Valves and Cylinder Head" earlier in this section.
- 2. Three right-side engine mount-to-engine bracket bolts and right-side engine mount from engine.
- 3. Three left-side engine mount-to-engine bracket bolts and left-side engine mount from engine.

- 4. Generator mounting bolts, nuts and generator with generator/coolant pump drive belt from engine.
- 5. One bolt and guide tube from cylinder block (Figure 5).
- 6. Guide tube seal from oil pump body.
- One bolt and coolant inlet pipe from cylinder block.
- 8. Five bolts and coolant pump from cylinder block.
- 9. Oil pressure switch from cylinder block.
- 10. Generator mounting bracket.
- 11. Place a drain pan beneath engine oil pan to catch escaping oil.
- 12. Engine oil drain plug and gasket, allowing engine oil to drain (Figure 70).
- 13. Sixteen bolts, two nuts and engine oil pan from cylinder block (Figure 71).
- Two bolts and oil pump strainer from cylinder block.
- 15. Crankshaft timing gear bolt (Figure 32).
- 16. Crankshaft timing gear.
- 17. Seven bolts and oil pump assembly, gasket, rubber oil pump-to-coolant pump seals and two guide pins from cylinder block (Figure 77).
- 18. Decarbon top of cylinder bores.
- 19. Connecting rod bearing cap bolts, connecting rod bearing caps and connecting rod bearings.
- 20. Place a small piece of hose over threads of connecting rod to protect threads, journal, and cylinder bore during removal and installation.
- 21. Pistons and connecting rods from cylinder block through the top of cylinder bores.
- 22. Main bearing cap bolts, bearing cap supports, main bearing caps and main bearings.
- 23. Crankshaft from cylinder block.

Clean

- 1. Sealing material from mating surfaces.
- 2. Boil cylinder block in caustic solution and flush with clean water or steam.

NOTICE: Caustic cleaning solution destroys the bearing material. All bearings left in block must be replaced after cleaning with a caustic solution. Do not clean bearing material or aluminum parts with caustic solutions.

- 3. Engine oil passages.
- 4. All blind holes.
- 5. Spray or wipe cylinder bores and machined surfaces with clean engine oil.

10

Inspect

 Cylinder block for cracks in the cylinder walls, coolant jacket and main bearing webs, Replace if any cracks are found.



Measure

Tool Required: J 26900-3 Outside Micrometer

- Cylinder block-to-cylinder head gasket surface for distortion and flatness using a straightedge and a feeler gage. If specification is exceeded, correction is necessary. Minor irregularities can be carefully machined. Standard distortion is 0.03 mm (0.0012-inch). If distortion after any correction exceeds 0.06 mm (0.0024-inch), replace the cylinder block.
- When any one cylinder needs reboring, then all other cylinders must be rebored at the same time.
- Select oversize pistons according to the amount of cylinder wear.
 - Oversized piston of 0.25 has diameter of 75.220-75.230 mm (2.9614-2.9618-inch).
 - Oversized piston of 0.50 has diameter of 75.470-75.480 mm (2.9712-2.9716-inch).
- 2. Piston diameter using a J 26900-3.
- Calculate the cylinder bore diameter to be rebored.
 - D=A+B-C when:
 - D = Cylinder bore diameter to be rebored.
 - A = Piston diameter as measured.
 - --- B = Piston clearance = 0.02-0.04 mm (0.0008-0.0015-inch).
 - C = Allowance for honing = 0.02 mm (0.0008-inch).

NOTICE: Before reboring, install all main bearing caps and tighten to specification to avoid distortion of bearing bores.

- 3. Rebore and hone cylinders to calculated dimension.
- Piston clearance after honing is completed.

++

Install or Connect

Tools Required:
J 34853 Crankshaft Oil Seal Guide
J 8037 Piston Ring Compressor

NOTICE: To prevent damage to cylinder block or parts installed:

- All parts to be installed must be perfectly clean.
- Be sure to apply engine oil to the crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings, and cylinder bores.
- Journal bearings, bearing caps, connecting rod, rod bearings, rod bearing caps, pistons, and piston rings are in combination sets. Do not disturb the combinations and check to ensure that each part goes back to where it came from when installing.

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- Main bearings lower half to crankshaft: install the half with oil groove (upper half) to cylinder block.
- 2. Thrust bearings to cylinder block between No. 2 and No. 3 cylinders. Face the oil groove sides to counterweights.
- 3. Crankshaft to cylinder block.

[Important

- On each main bearing cap, the arrow mark and number are embossed. When installing each main bearing cap to the cylinder block, point the arrow mark toward the crankshaft pulley side and install each cap from crankshaft pulley end to flywheel in order "1", "2", "3", "4" and "5".
- 4. Five main bearing caps and two bearing cap supports; secure with ten main bearing cap bolts.

[Important

- Gradual and uniform tightening is important for main bearing cap bolts.
- After tightening main bearing bolts, check to be sure that crankshaft rotates smoothly when turned by hand.

(1) Tighten

- Main bearing cap bolts to 54 N m (40 lb. ft.).
- Apply light coat of clean engine oil to pistons, rings, cylinder walls, connecting rod bearings and crank pins.
- Guide hoses over the connecting rod bolts to prevent damage to bearing journal and connecting rod bolt threads when installing connecting rods (Figure 87).
- 7. Piston and connecting rod into cylinder bore using a J 8037, ensuring arrow mark on top of the piston points to crankshaft pulley end (Figures 88 and 89). Use a hammer handle to tap piston head and install piston into cylinder bore, keeping the J 8037 pressed securely against the top of the cylinder block until all piston rings have entered cylinder bore.
- 8. Remove hose pieces from connecting rod bolts.
- 9. Connecting rod bearing cap to connecting rod; secure with two nuts.

!mportant

 Be sure to point arrow mark on cap toward the crankshaft pulley side.

Tighten

- Connecting rod bearing cap nuts to 35 N·m (26 lb. ft.).
- 10. Rear main seal housing and new gasket to engine; secure with five rear main seal housing bolts. There are two different bolt lengths. Ensure correct placement.

হ্মি Tighten

 Rear main seal housing bolts to 12 N-m (106 lb. in.).

!mportant

- After the rear main seal housing bolts are tightened, the gasket may extend past the rear main seal housing. Trim the excess with a sharp knife so the gasket is flush with the cylinder block.
- 11. Apply a thin coat of oil to J 34853.
- 12. Oil seal to crankshaft using a J 34853 (Figure 78).
- 13. Two guide pins and oil pump assembly with new gasket and rubber oil pump-to-coolant pump seals to crankshaft using J 34853 (Figures 79 and 80); secure with seven bolts.

(1) Tighten

• Oil pump bolts to 11 N·m (97 lb. in.).

Inspect

- Ensure the oil seal lip is not upturned, then remove the J 34853.
- Edge of oil pump gasket. If it protrudes out into the engine oil pan mating surface, trim with a sharp knife, making edge smooth and flush with mating surface of the engine oil pan (Figure 81).
- 14. Apply gasket paste GM P/N 1050026, or equivalent, to the engine oil pan mating surface in a continuous bead (Figure 72).
- 15. Oil pump strainer to engine oil pan.
- 16. Oil pump strainer to cylinder block; secure with two bolts (Figure 73).

(1) Tighten

Oil pump strainer bolts to 11 N·m (97 lb. in.).
 Engine oil pan to cylinder block; secure with

17. Engine oil pan to cylinder block; secure with sixteen bolts and two nuts.

হ্ম Tighten

- Engine oil pan nuts and bolts to 11 N-m (97 lb. in.).
- 18. Engine oil pan drain plug and gasket to engine oil pan.

Tighten

- Engine oil drain plug to 35 N·m (26 lb. ft.).
- 19. New O-ring seal to coolant intake pipe.
- Coolant intake pipe to cylinder block; secure with one bolt.

(Tighten

• Coolant intake pipe bolt to 11 N·m (97 lb. in.).

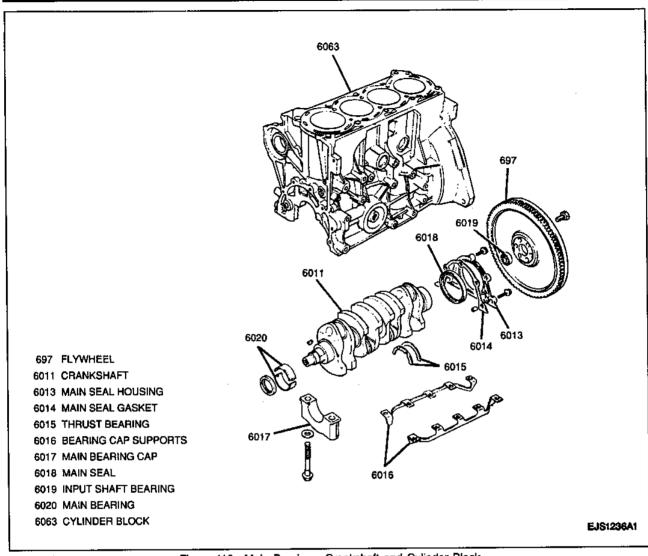


Figure 118-Main Bearings, Crankshaft and Cylinder Block

21. Coolant pump with new gasket to engine; secure with five bolts.

Tighten

- Coolant pump bolts to 12 N·m (106 lb. in.).
- 22. Rubber seals between coolant pump and oil pump and between coolant pump and cylinder head.
- 23. Engine oil level indicator tube with new O-ring to cylinder block; secure with mounting bolt. Do not tighten fully.

হ্ম Tighten

- Engine oil level indicator tube mounting bolt to 11 N·m (97 lb. in.).
- 24. Right-side engine mount to engine; secure with three right-side engine mount-to-engine bracket bolts.

(1) Tighten

• Right-side engine mount-to-engine bracket bolts to 55 N·m (40 lb. ft.).

25. Left-side engine mount to engine; secure with three left-side engine mount-to-engine bracket bolts.

1 Tighten

- Left-side engine mount-to-engine bolts to 55 N·m (40 lb. ft.).
- 26. Cylinder head onto cylinder block. Refer to "Camshaft, Valves and Cylinder head" earlier in this section.

CRANKSHAFT

Figures 27, 28, 29, 34, 70, 72, 75, 79 and 120 through 126

←→ Remove or Disconnect

- Engine assembly from vehicle. Refer to "Engine Assembly" earlier in this section.
- 2. Clutch from engine assembly (manual transmission equipped vehicles). Refer to SECTION 7C.

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- 3. Six bolts and flywheel from engine assembly.
- 4. Place a drain pan beneath engine oil pan to catch escaping oil.
- 5. Engine oil drain plug and gasket allowing engine oil to drain (Figure 70).
- 6. Five bolts and crankshaft pulley from crankshaft (Figure 27).

Important

- It is not necessary to remove the crankshaft pulley center bolt when removing the crankshaft pulley.
- 7. Eight bolts, one nut and timing belt outside cover from engine assembly.
- 8. Loosen tensioner stud and remove tensioner spring from tensioner plate and tensioner spring screw (Figure 29).
- 9. Sixteen bolts, two nuts and engine oil pan from cylinder block.
- 10. Two bolts and oil pump strainer from cylinder block,
- One bolt and crankshaft timing belt gear from crankshaft.
- 12. Oil level indicator from guide tube.
- 13. One bolt and guide tube with O-ring from cylinder block.
- 14. Seven bolts and oil pump assembly, gasket, rubber oil pump-to-coolant pump seals and two guide pins from cylinder block (Figure 79).
- 15. Mark the flywheel-to-engine position.
- 16. Six flywheel retaining bolts and flywheel from crankshaft.
- 17. Rear main seal.

| Important

- Main bearings, main bearing caps, connecting rod, connecting rod bearings, connecting rod bearing caps, pistons, and piston rings are in combination sets. Do not disturb the combinations and check to ensure that each part goes back to where it came from when installing.
- 18. Ten bolts, bearing cap supports and five main bearing caps with lower half of main bearings.
- 19. Thrust bearings from crankshaft (Figure 119).
- 20. Eight nuts and four connecting rod caps with lower half of connecting rod bearings.
- 21. Crankshaft from cylinder block.

Measure

Tools Required:

- J 8001 Dial Indicator Set
- J 26900-13 Magnetic Base
- J 26900-3 Outside Micrometer
- Crankshaft runout at center journal using a J 8001 and J 26900-13 (Figure 120). Rotate crankshaft slowly. If runout exceeds 0.06 mm (0.0023-inch.), replace the crankshaft.

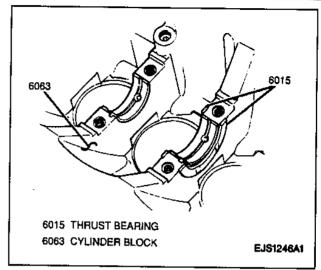


Figure 119—Thrust Bearing

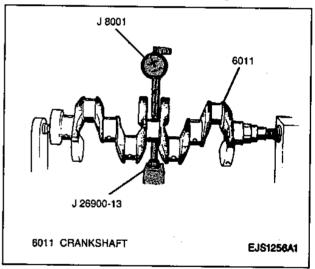


Figure 120-Measuring Crankshaft Runout

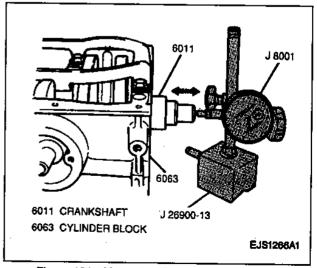


Figure 121—Measuring Crankshaft Thrust Play

 Crankshaft thrust play using the J 8001 and J 26900-13 (Figure 121). Crankshaft must be set in cylinder block with thrust bearing and main bearing caps installed. All bearing cap bolts must be tightened to specification prior to measurement.

Tighten

- Bearing cap bolts to 54 N-m (40 lb. ft.).

 Standard thrust play is 0.11 to 0.31 mm (0.0044 to 0.0122-inch). If thrust play exceeds 0.38 mm (0.0149-inch), replace thrust bearing with a new standard bearing or an 0.125 (0.0049-inch) oversize thrust bearing to obtain standard thrust play. Standard thrust bearing thickness is 2.500 mm (0.0984-inch). Thrust bearing oversize is 0.125 mm (0.0049-inch) for thrust bearing with a thickness of 2.563 mm (0.1009-inch).
- 3. Crankshaft journals for out-of-round and taper (uneven wear) using a J 26900-3 (Figure 122). A crankshaft journal is unevenly worn if there is a difference in diameter at a cross section or along its length (or both). If any journal is badly damaged or if amount of uneven wear exceeds 0.01 mm (0.0004-inch), regrind or replace crankshaft.

→+ Install or Connect

Tools Required:
J 34853 Crankshaft Oil Seal Guide
J 35271 Flywheel Holder

NOTICE: To prevent damage to cylinder block or parts installed:

- All parts to be installed must be perfectly clean.
- Be sure to apply engine oil to the crankshaft journals, main bearings, thrust bearings, connecting rod bearings, pistons, piston rings, and cylinder bores.
- Main bearings, main bearing caps, connecting rod, connecting rod bearings, connecting rod bearing caps, pistons, and piston rings are in combination sets. Do not disturb the combinations and check to ensure that each part goes back to where it came from when installing.
- 1. Main bearings upper half to crankshaft. For selection of correct main bearing, refer to "Main Bearings" earlier in this section.
- 2. Thrust bearings to cylinder block between No.2 and No.3 cylinders. Face the engine oil groove sides to counterweights (Figure 123).
- 3. Crankshaft to cylinder block.
- 4. Four connecting rod caps; secure with eight cap nuts.

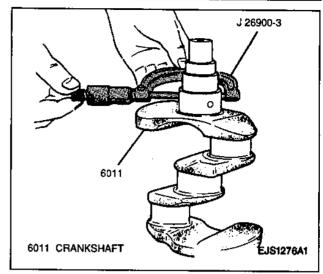


Figure 122-Measuring Crankshaft Journal Uneven Wear

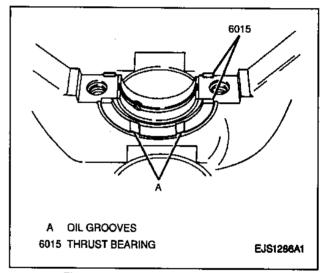


Figure 123--Thrust Bearing Installation

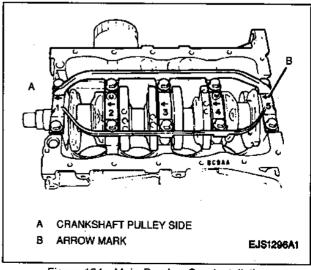


Figure 124-Main Bearing Cap Installation

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হ্মি Tighten

 Connecting rod bearing cap nuts to 35 N-m (26 lb. ft.).

Important

- On each main bearing cap, the arrow mark and number are embossed. When installing each main bearing cap to the cylinder block, point the arrow mark toward the crankshaft pulley side and install each cap from crankshaft pulley end to flywheel end in order "1", "2", "3", "4" and "5."
- 5. Five main bearing caps and two bearing cap supports; secure with ten main bearing bolts (Figure 124).

[Important

- Gradual and uniform tightening is important for main bearing cap bolts.
- After tightening main bearing bolts, check to be sure that crankshaft rotates smoothly when turned by hand.

Tighten

- Main bearing cap bolts to 54 N·m (40 lb. ft.).
- Rear main seal housing and new gasket to engine; secure with five rear main seal housing bolts. There are two different bolt lengths. Ensure correct placement.

হ্মি Tighten

• Rear main seal housing bolts to 12 N·m (106 lb. in.).

? Important

- After the rear main seal housing bolts are tightened, the gasket may extend past the rear main seal housing. Trim the excess with a sharp knife so the gasket is flush with the cylinder block (Figure 125).
- 7. Oil pump to cylinder block, using a J 34853 to install the oil seal over the crankshaft.

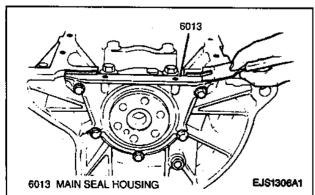


Figure 125-Trimming Gasket Edge

| Important

- During oil pump installation, ensure that oil seal lip is not turned out.
- 8. Remove the J 34853.
- 9. Oil pump mounting bolts to oil pump assembly.

(1) Tighten

- Oil pump mounting bolts to 11 N.m (97 lb. in.).
- 10. Rubber seals between oil pump and coolant pump.
- Edge of oil pump gasket might bulge out: if it does, cut bulge off with sharp knife, making edge smooth and flush with end faces of pump case and cylinder block.
- Guide tube with new O-ring to cylinder block. Apply light coat of oil to O-ring prior to installation.
- 12. Oil level indicator to guide tube.
- 13. Oil pump strainer and oil pump strainer seal to cylinder block; secure with oil pump strainer bolt first and then oil pump strainer bracket bolt.

Tighten

- Oil pump strainer bolt first and then oil pump strainer bracket bolt to 11 N·m (97 lb. in.).
- 14. Apply silicone sealant GM P/N 1052914, or equivalent, to the engine oil pan mating surface in a continuous bead (Figure 72).
- 15. Engine oil pan to cylinder block; secure with fourteen bolts and two nuts starting at the center and working outward.

(Tighten

- Engine oil pan bolts and nuts to 11 N-m (97 lb. in.).
- 16. Remove the cylinder head cover. Refer to "Cylinder Head Cover" earlier in this section.
- 17. Loosen all valve lash adjusting screws and locknuts to prevent damage to valves (Figure 34).
- 18. Timing belt guide and crankshaft timing belt gear. Install timing belt guide with concave side facing oil pump. Lock crankshaft with a J 35271. Secure with crankshaft timing belt gear bolt (Figure 75).

হি Tighten

- Crankshaft timing belt gear bolt to 110 N·m (81 lb. ft.).
- 19. Check that the timing mark on camshaft timing gear is aligned with "V" mark on cylinder head cover. If not, align the two marks by turning the camshaft.
- 20. Check that punch mark on crankshaft pulley is aligned with arrow mark on oil pump case. If not, align the two marks by turning crankshaft.
- Tensioner plate to timing belt tensioner. Insert tensioner plate lug into the timing belt tensioner hole.

22. Tensioner with tensioner plate to engine; secure with tensioner retaining bolt. Do not tighten fully.

[Important

- Make sure that the tensioner plate and tensioner move in the same direction when the tensioner plate is moved counterclockwise (Figure 29). If there is no associated movement between the tensioner plate and the tensioner, remove the tensioner and tensioner plate and reinsert the tensioner plate lock tab into the tensioner slot, then reinstall.
- 23. Remove the cylinder head cover. Refer to "Cylinder Head Cover" earlier in this section.
- 24. Loosen all valve lash adjusting screws and locknuts to prevent damage to valves (Figure 34).
- 25. Rotate the camshaft timing belt gear clockwise and align the camshaft timing gear timing mark with the "V" timing mark on the cylinder head cover (Figure 28).
- 26. Rotate the crankshaft clockwise and align the punch mark on the crankshaft timing belt gear with the arrow timing mark on the oil pump casting. This places the number four cylinder at TDC (Figure 28).
- 27. Timing belt, tensioner spring, and spring damper. With two sets of marks aligned and tensioner plate pushed up, install timing belt on two pulleys in such a way that drive side of belt is free from any slack. Then install the tensioner spring and spring damper. Hand tighten tensioner stud only.

| Important

- When installing timing belt, match arrow mark on timing belt with rotating direction of crankshaft.
- 28. To take up slack in timing belt, turn crankshaft two rotations clockwise after installing it. After making sure that belt is free from slack, tighten timing belt tensioner stud first and tensioner bolt.

🖋 Adjust

• Timing belt tension. Refer to "Timing Belt and Tensioner" earlier in this section.

(1) Tighten

- Tensioner stud to 11 N·m (97 lb. in.).
- Tensioner bolt to 27 N·m (20 lb. ft.).
- 29. Confirm again that both sets of timing marks are aligned properly.

!mportant

- Before installing timing belt cover, make sure that seal is between coolant pump and oil pump case.
- Timing belt cover; secure with eight bolts and one nut.

হ্মি Tighten

- Timing belt outside cover bolts and nut to 10 N·m (89 lb. in.).
- 31. Crankshaft pulley; secure with five crankshaft pulley bolts.

1 Tighten

• Crankshaft pulley bolts to 16 N·m (12 lb. ft.).

Adjust

- Valve lash. Refer to "Valve Lash" earlier in this section
- 32. Cylinder head cover with new gasket; secure with four nuts.

1 Tighten

• Cylinder head cover nuts to 5 N.m (44 lb. in.).

33. Engine to vehicle. Refer to "Engine Assembly" earlier in this section.

THREAD REPAIR

Figure 126

Damaged threads may be reconditioned by drilling out, rethreading and installing a suitable thread insert. General purpose thread repair kits are available commercially.

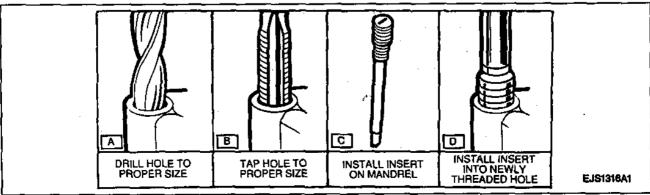


Figure 126-Repairing Threaded Holes

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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 the 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 (Figure 126A).



Clean

- Drilling chips out of hole.
- 3. Tap hole (Figure 126B). Lubricate tap with light engine oil (except when tapping into aluminum).

!mportant

- Avoid a buildup of chips. Back out the tap every few turns and remove chips.
- 4. Thread the insert onto the mandrel of the installer (Figure 126C). Engage the tang of the insert onto the end of the mandrel.
- 5. Lubricate the insert with light engine oil (except when installing into aluminum) and install the insert (Figure 126D).

!mportant

- When correctly installed, the insert should be flush to one turn below the surface.
- If the tang of the insert does not break off when backing out the installer, break the tang off with a drift punch.

SPECIFICATIONS

S	TENER TIGHTENING SPECIFICATIONS					
	Adjusting Screw Locknut	17	$N \cdot m$	(13	lb.	ft.)
	Air Cleaner (ACL) Mounting Bolts	. 10	N.m	(89 1	lb. i	in.)
	Air Conditioner (A/C) Compressor Flexible Hose Mounting Bolts	. 10	N.m	(89-1	lb. i	in.)
	Air Conditioner (A/C) Mounting Bracket Bolts	. 10	N _· m ((89-1	lb. i	in.)
	Air Intake Pipe Bolts	. 10	N⋅m ((89 1	lb. i	in.)
	Air Intake Pipe Bracket Bolts	15	N.m	(11	lb.	ft.)
	Bearing Cap Bolts	54	N₁m	(40	lb.	ft.)
	Camshaft Carrier Cap Bolts	. 10	N ₂ m ((89]	lb. i	in.)
	Camshaft Timing Belt Gear Bolt	60	N₊m	(44	lb.	ft.)
	Connecting Rod Bearing Cap Nuts	35	N.m	(26	lb.	ft.)
	Coolant Intake Pipe Bolt	11	N·m ((97.]	lb. i	in.)
	Coolant Pump Bolts	12 N	J.m (1	i06 I	lb. i	in.)
	Coolant Pump Pulley Nuts					
	Crankshaft Pulley Bolts	16	N⋅m	(12	lb.	ft.)
	Crankshaft Timing Belt Gear Bolt	110	N.m	(81	lb.	ft.)
	Cylinder Head Bolts First Pass	35	N.m	(26	lb.	ft.)
	Second Pass.	55	N⋅m	(41	lb.	ft.)
	Third Pass (Final Torque)	70	$N \cdot m$	(52	lb.	ft.)
	Cylinder Head Cover Bolts	10	N.m	(89.)	lb.	in.)
	Distributor Case Bolts					
	Engine Mount-to-Frame Bracket Bolts					
	Engine Mount-to-Engine Bracket Bolts	54	$N \cdot m$	(40	lb.	ft.)
	Engine Mount-to-Exhaust Bracket Bolts	54	N⋅m	(40	lb.	ft.)
	Engine Oil Drain Plug	35	N₁m	(26	lb.	ft.)
	Engine Oil Pan Nuts and Bolts	11	N.m	(97]	lb.	in.)
	Exhaust Manifold Nuts	23	$N \cdot m$	(17	lb.	ft.)
	Exhaust Manifold Heat Shield Bolts and Nuts					
	Exhaust Bracket-to-Exhaust Manifold Nut					
	Exhaust Manifold-to-Cylinder Head Bolts and Nuts	23	N.m	(17	lb.	ft.)
	Exhaust Manifold-to-Front Pipe/Three Way Catalytic Converter (TWC)					
	Assembly Bolts	50	N.m	(37	lb.	ft.)
	Exhaust Pipe-to-Bracket Nut	50	N.m	(37	lb.	ft.)
	Fan Clutch Nuts					
	Flywheel Retaining Bolts					
	Front Pipe/TWC Assembly-to-Exhaust Manifold Bolts	50	N∙m	(37	lb.	ft.)
	Front Pipe/TWC Assembly-to-Resonator/Center Pipe Nuts	35	N⋅m	(26	lb.	ft.)
	Front Skid Plate Bolts	54	N₊m	(40	ľЪ.	ft.)
	Generator Adjusting Arm Bracket Nut and Bolt					
	Generator Mounting Bolts and Nuts	23	N⋅m	(17	lb.	ft.)

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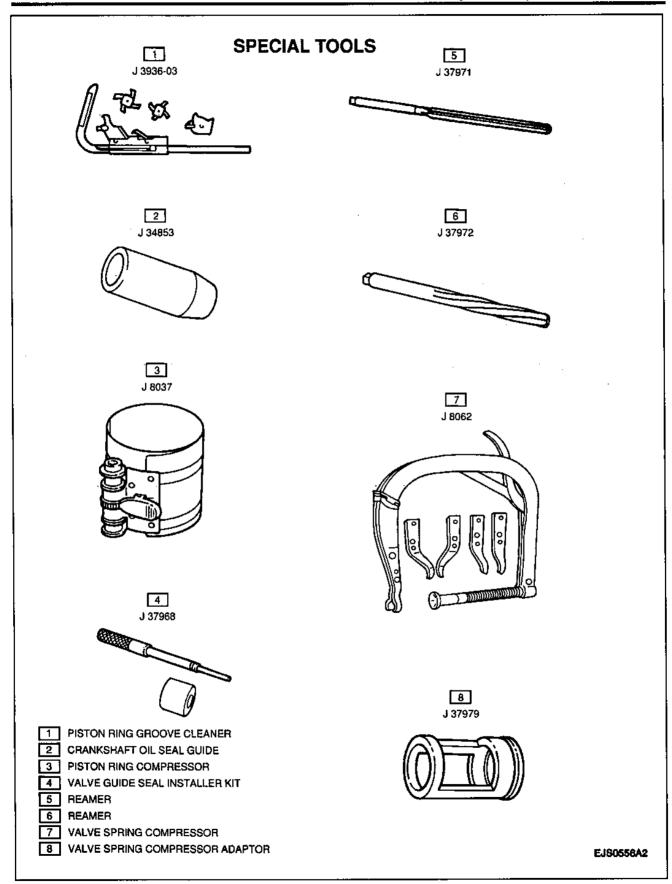
	1111 0 DO 1 OA 1-00
Guide Tube Bolt	14 N m (10 lk &)
Header Panel Bolts	10 N.m (80 lb in)
HOOU Later Boils	10 Nm (80 lb in)
intake Manifold Nuts and Bolts	23 Nm (17 lb ft)
make Manhold Support Bracket Bolts	50 Nm (37 lb ft)
Main Bearing Cap Boils	54 N m (40 lb 6)
Negative (-) Battery Cable-to-Negative (-) Battery Terminal Retain	ier 15 N.m (11 lb fr.)
OII Jet	5 N m (M lb in)
On Plessure Switch	
On rump bons	11 N m (07 lb in)
On rump strainer Bolt	11 Nm (07 lb in)
On Fump Strainer Bracket Bolt	11 N m (07 lb in)
neated Oxygen (nO231) Sensor	43 N m (32 lb ft)
rositive (+) Battery Cable-to-Positive (+) Battery Terminal Retained	er
Rocker Arm Shaft Bolts	10 N·m (89 lb. in.)
Shroud Bolts	10 N·m (89 lb. in.)
Rear Main Seal Housing Bolts	12 N·m (106 lb, in.)
Rocker Arm Shaft Plug	
minig beit cover Nul and Bolls	10 Nm (20 lb in)
Timing Belt Inside Cover Bolts	10 N·m (89 lb. ft.)
Timing Belt Tensioner Bolt	
Timing Belt Tensioner Stud	11 N.m (97 lb. in.)
Throttle Body Nuts and Bolts	
Throttle Cover Bolts	
Torque Converter Bolts	
ENGINE SPECIFICATIONS	
Camshaft	
Standard Camshaft Lobe Height Intake	36 151-36 331 mm (1 4241 1 4202 in)
Exhause	76 756 76 516 mm (1 1211 1 1276 :- \
Minimum Camshaft Lobe Height Intake	36.071 mm (1.4202 in)
DAHaust	36 256 mm (1 4275 in)
Camsnan Runout (Maximum)	0- 10 mm (0.0039 in)
Canishan Journal Outside Diameter Standard	27 939-27 960 mm (1 1000-1 1008 in)
Camshatt Johnnal Bore Inside Diameter Standard	20 00 20 021 /1 1024 1 1021 !
Camsnatt Journal-to-Journal Bore Clearance Standard	0.040-0.082 mm (0.0016-0.0032 in)
Maximum	
Connecting Rods and Bearings	
Connecting Red Side Cleanure St. 1	
Connecting Rod Side Clearance Standard	0.10-0.20 mm (0.0039-0.0078 in.)
MANIGUII LIMM	
Connecting Rod Bow Limit	
Connecting Rot Twist Limit	0.10 mm (0.0039 in.)
Crankshaft Diameter Out-of-Round and Taper Limit	
Standard	43.982-44.000 mm (1.7316-1.7322 m.)
0.25 mm (0.0098 in) Undersize	43./32-43./30 mm (1./218-1./224 m,)
Connecting Rod Bore Inside Diameter	19.003-19.011 mm (0./481-0./485 in.)
Limit	0.0008-0.019 in.)
	1500.0 mm (0,0031 m.)
Crankshaft	
Crankshaft Journal Taper or Out-of-Round	
Cranksnart Runout at Center Journal	0.06 mm (0.0023 in \
Crankshaft Thrust Play Standard	0.11-0.31 mm (0,0044-0.0122 in.)
waxinum	0.38 mm (0.01/0 in)
Thust bearing Thickness Standard	
0.125 mm (0.0049 in.) Oversize	2.5630 mm (0.1009 in.)
Cylinder Head	
Cylinder Head Gasket Surface Distortion (Standard)	0.03 mm (0.0012 in)
(Maximum),	0.06 mm (0.0024 in)
Cylinder Head Seating Distortion Intake and Exhaust Manifolds (M	Maximum)
	, and (old of mil)

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Cylinder Block	-
	75.15 (0.050/)
Cylinder Bore Limit Gasket Surface Distortion Specification Gasket Surface Distortion Limit	
Gasket Surface Distortion Limit	0.06 mm (0.0012 in.
Taper and Out-of-Round Limits	0.00 mm (0.0024 m.
Flywheel	•
Flywheel Face Runout	0.20 ***** (0.0070 :
Main Bearings	
Main Bearing Clearance Standard	0.020.0.040 mm (0.0000.0.0016 in
Undersize	0.020-0.040 mm (0.0006-0.0016 in
Limit	0.060 mm (0.0023 in
Standard Main Bearing Thickness Green	1 996-2 000 mm (0 0786-0 0787 in
Black	1 999-2 003 mm (0 0787-0 0788 in i
Colorless	
Yellow	2.005-2.009 mm (0.0789-0.0790 in
Blue	2.008-2.012 mm (0.0700-0.0701 in)
0.25 mm (0.0098 in.) Undersized Bearings Green & Red	2.121-2.125 mm (0.0835-0.0836 in
Black & Red	
Red	
reliow & Red	
Bille & Red	2 122 2 127 (0 0020 0 0040 1
Crankshaft Journal Diameter "1" Stamping	51.994-52.000 mm (2.0470-2.0472 in 1
Z Gtamping	1 988-1 994 mm (2 0468-2 0470 in)
Stamping	
(Undersized)	51.732-51.750 mm (2.0367-2.0373 in.
Main Bearing Cap Bore Diameter (Without Bearing)	· · · · · · · · · · · · · · · · · · ·
"A" Stamping	
B Stamping	
"C" Stamping	56.012-56.018 mm (2.2052-2,2054 in.)
Oil Pump	
Oil Pump Pressure Relief	
Oil Prime Original Relief	4.0 kg/cm, 400 kPa (56.9 psi)
Oil Pump Outer Rotor-to-Oil Pump Body Radial Clearance (M	aximum) 0.310 mm (0.0122 in.)
Oil Pump Housing-to-Oil Pump Gear Set (Side Clearance) (Ma	aximum) 0.15 mm (0.0059 in.)
Pistons	
Piston Pin Clearance Standard	0.002.0.014.40.0001.0.0004.1.
Maximum	0.0001-0,0000 in.)
Piston Pin Diameter.	
Piston Pin Offset	10.993-19,000 MIII (0.7479-0.7480 III.)
Piston-to-Cylinder Bore Clearance	0.02 0.04 mm (0.0000 0.0015 in)
Piston Diameter Standard	74 970-74 990 mm (2.0516 2.0522 in)
0.23 Hill (0.0098 in.) Oversize Piston	75 770-75 730 mm /7 0614 7 0610 to 1
0.50 mm (0.0197 in.) Oversize Piston	75 470-75 480 mm (2.9014-2.9016 in.
Piston Ring End Gap Top Ring (Standard)	0.20 0.25 mm (0.0070 0.0127 := 3
Top Ring (Maximum Limit)	0.7 (0.0079-0.0137 In.,
Lower Ring (Standard)	0.20-0.35 mm (0.0070 0.0127 in.)
Lower Ring (Maximum Limit)	0.7 mm (0.0075 in)
Oil Ring (Standard)	0.2-0.7 mm (0.0020 0.0275 in)
Oil Ring (Maximum Limit)	1.7 mm (0.0660 in)
Piston Ring Groove Clearance Upper Compression Ring	0.03-0.07 rpm (0.0012-0.0027 in)
Lower Compression Ring	
	(0.0000-0.0025 III.)
Rocker Arms	
Rocker Arm Clearance Standard	
Rocker Arm Inside Diameter	15 985-16 005 mm (0 620 0 620 in)
Rocker Arm Shaft Runout Limit	0.20 mm (0.008 in)
Rocker Arm Shaft Diameter	15.969-15.984 mm (0.6287-0.6293 in.)
	- (

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Valves
Valve Guide Inside Diameter
valve flead fillekliess fillake valves (Standard)
make valves (villiminim Limit)
\sim
-2414445 + 341465 + 3411111111111 + 3411111 + 341111111111
taive field Aligies for Kelmishing Area Above Seat Contact Surface 15 degrees
Sour Connact Surface
The boating contact which intake and expansion 11-13 mm (0.0422.0.0512 in)
Valve Stem Outside Diameter Intake Valves
MAISUNE VOLVES
raive stelli-to-valve unde Clearance Intake Valves (Ntandard) 1000-000-000-000-000-000-000-000-000-00
intake valves (viaximum Limit)
1045-0 077 mm (0.0018 0.0028 in)
Exhaust Valves (Maximum Limit)
Valve Spring Free Length Standard
Minimum Limit
Valve Spring Side Clearance (Maximum) 10.7-12.3 kg at 31.5 mm (23.6-27.5 lbs at 1.24 in.) 2.0 mm (0.079 in.)
Valve Lash
Cold Adjustment Coolant Temperature
110t Adjustment Coolant Temperature
111take varve Cold varve Lash
Exhaust valve Cold Valve Lash
make valve not valve Lash
Exhaust Valve Hot Valve Lash



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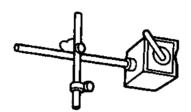
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J 26900-1 J 26900-2 J 26900-3

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J 26900-13

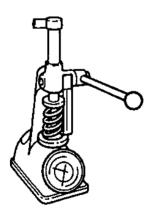


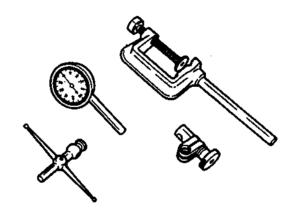


10 J 22738-2

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J 8001





- 9 OUTSIDE MICROMETER
- 10 VALVE SPRING TESTER
- 11 MAGNETIC BASE
- 12 DIAL INDICATOR SET

EJ\$0586A2

13 15 J 26900-5 J 36854 14 16 J 26900-14 J 35271 -C. (XXXXXXX) 13 VERNIER CALIPER 14 SMALL HOLE GAGES 15 HEAVY DUTY AUTOMOTIVE ENGINE STAND 16 FLYWHEEL HOLDER EJS0576A2