2007 ENGINE

Engine Mechanical - SX4

GENERAL DESCRIPTIONS

ENGINE CONSTRUCTION

The engine is water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its DOHC (Double over head camshaft) valve mechanism arranged for "V" type valve configuration consisting of 16 valves (4 valves/one cylinder). The double overhead camshaft is mounted over the cylinder head; it is driven from crankshaft through timing chains, and no push rods are provided in the valve train system.

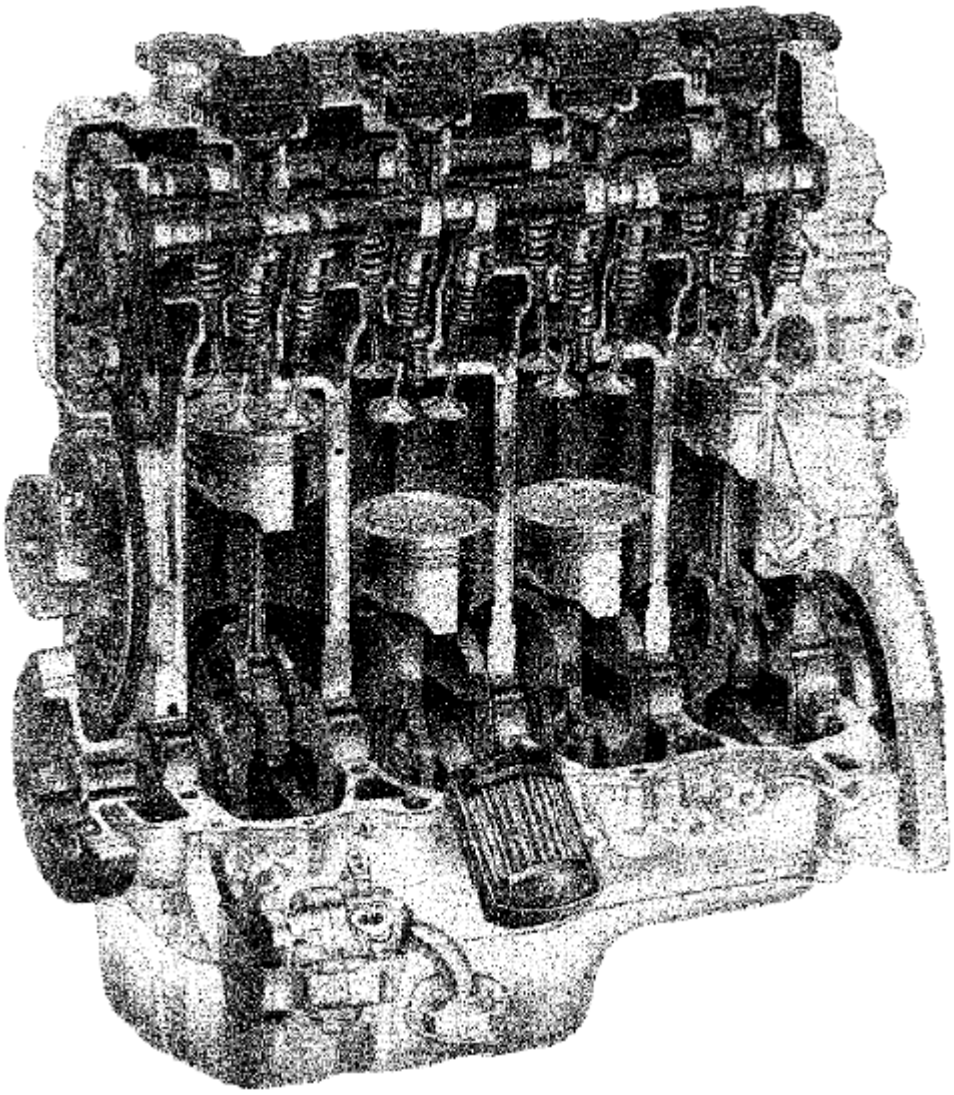
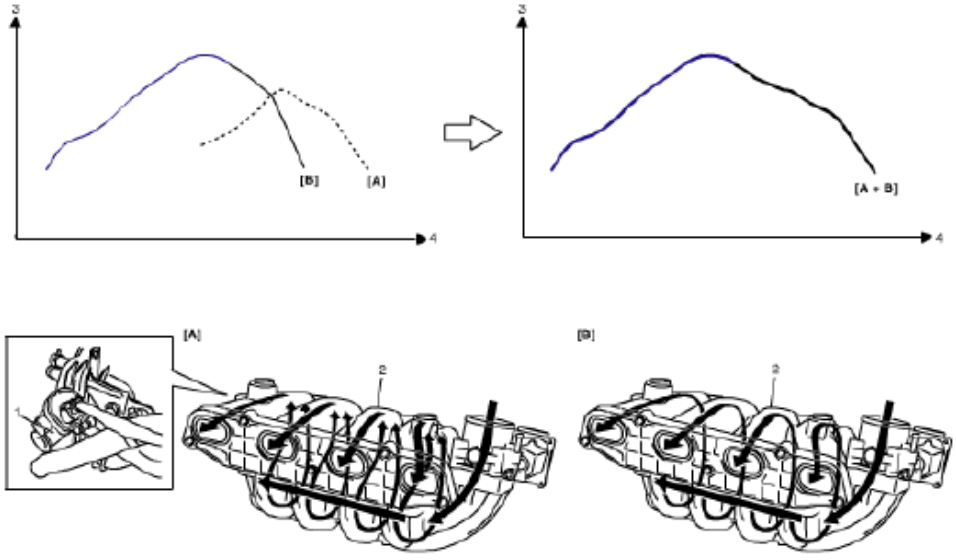


Fig. 1: Identifying Engine
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IMT (INTAKE MANIFOLD TUNING) SYSTEM



[A]: IMT valve open	1. IMT valve actuator	3. Engine torque
[B]: IMT valve closed	2. Intake manifold	4. Engine speed

Fig. 2: Identifying View Of IMT System
Courtesy of SUZUKI OF AMERICA CORP.

IMT (Intake manifold tuning) system varies effective length of intake pipe by opening and closing IMT valve in order to improve air volumetric efficiency.

As intake valve in cylinder head is opened and closed repeatedly, intake air pulsation always exists. If intake valve is opened when air pressure is momentarily maximum, intake air volumetric efficiency is increased. This momentary maximum air pressure depends on effective intake pipe length.

When IMT valve is fully open [A]:

The effective intake pipe length is shorter. Engine torque between middle and high engine speed ranges is improved, whilst it drops between low and middle engine speed ranges.

When IMT valve is totally closed [B]:

The effective intake pipe length is longer. Engine torque between middle and high engine speed ranges drops, while it is improved between low and middle ranges.

IMT system utilizes this characteristic of engine. IMT valve is closed between low and middle engine speed ranges, and opened between middle and high engine speed ranges.

In this way, engine torque is improved in whole engine speed ranges.

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DIAGNOSTIC INFORMATION AND PROCEDURES

COMPRESSION CHECK

Check compression pressure on all 4 cylinders as follows:

1. Warm up engine.
2. Stop engine after warming up.

NOTE: After warming up engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

3. Remove ignition coils and all spark plugs, referring to **REMOVAL** .
4. Disconnect fuel injector wire harness at the connector.
5. Install special tool (Compression gauge) into spark plug hole.

Special Tool

A. **09915-64512**
B. **09915-64530**
C. **09915-67010**

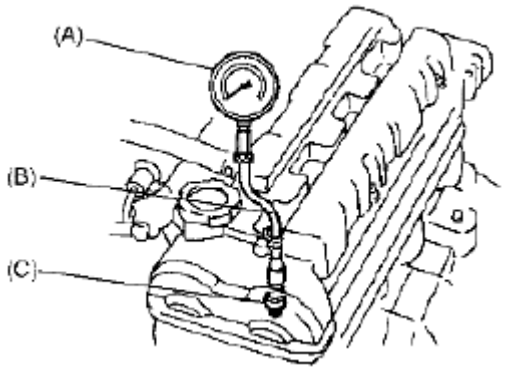


Fig. 3: Installing Special Tool (Compression Gauge) Into Spark Plug Hole
Courtesy of SUZUKI OF AMERICA CORP.

6. Disengage clutch (to lighten starting load on engine) for M/T vehicle, and depress accelerator pedal all the way to make throttle fully open.

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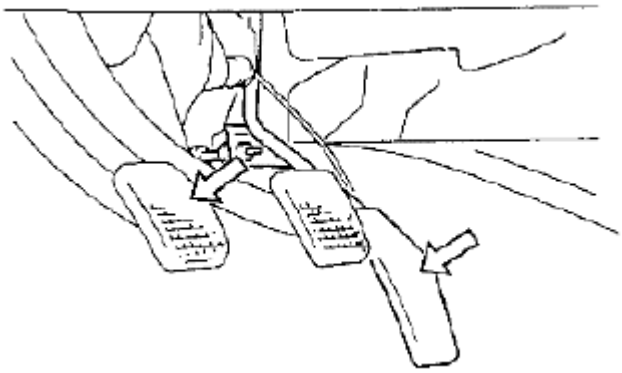


Fig. 4: Depressing Accelerator Pedal
Courtesy of SUZUKI OF AMERICA CORP.

7. Crank engine with fully charged battery, and read the highest pressure on compression gauge.

NOTE:
- **For measuring compression pressure, crank engine at least 250 r/min by using fully charged battery.**
- **If measured compression pressure is lower than limit value, check installation condition of special tool.**

Compression pressure

Standard: 1400 kPa (14.0 kgf/cm^2 , 199.0 psi)

Limit: 1100 kPa (11.0 kgf/cm^2 , 158.0 psi)

Max. difference between any two cylinders: 100 kPa (1.0 kgf/cm^2 , 14.2 psi)

8. Carry out Steps 5 through 7 on each cylinder to obtain 4 readings.
9. After checking, install spark plugs and ignition coils, referring to **INSTALLATION** .
10. Connect injector wire harness at connector.
11. Install air cleaner assembly, referring to **INSTALLATION**.

ENGINE VACUUM CHECK

The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows:

1. Warm up engine to normal operating temperature.

NOTE: **After warming up engine, be sure to place transaxle gear shift lever in "Neutral" (Shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.**

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2. Stop engine and turn off the all electric switches.
3. Remove air cleaner assembly, referring to **REMOVAL**.
4. Remove hose (1) from PCV valve (2).

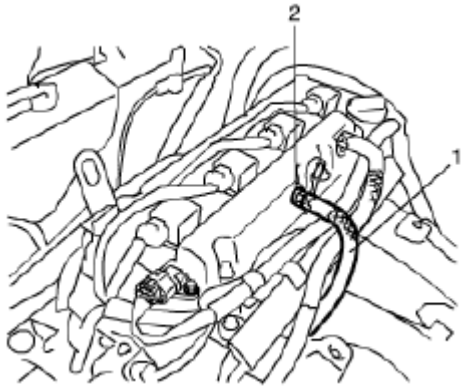


Fig. 5: Identifying PCV Valve Hose
Courtesy of SUZUKI OF AMERICA CORP.

5. Connect special tool (Vacuum gauge) to PCV hose (1).

   Special Tool

   (A): 09915-67311

6. Blind PCV valve (2) using tape (3) or the like.

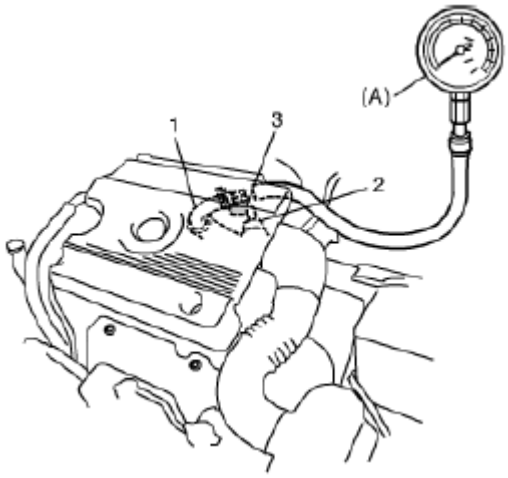


Fig. 6: Connecting Special Tool (Vacuum Gauge) To PCV Hose
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7. Install air cleaner assembly, referring to **INSTALLATION**.
8. Run engine at specified idle speed and read vacuum gauge. Vacuum should be within specification.

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Vacuum specification (at sea level)

59 - 73 kPa (45 - 55 cmHg, 17.7 - 21.6 in.Hg) at specified idle speed

9. After checking, remove air cleaner assembly.
10. Disconnect special tool (Vacuum gauge) from PCV valve.
11. Detach blind cap from PCV valve.
12. Connect PCV hose to PCV valve.
13. Install air cleaner assembly.

VALVE LASH (CLEARANCE) INSPECTION

1. Remove negative (-) cable at battery.
2. Remove cylinder head cover, referring to **REMOVAL**.
3. Using 17 mm wrench, turn crankshaft pulley (1) clockwise until index (2) of cylinder block and index (3) of crankshaft pulley (1) are aligned.

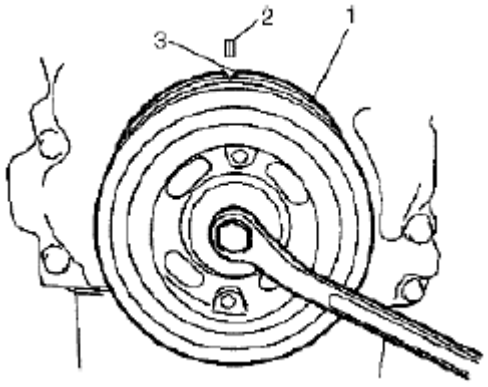
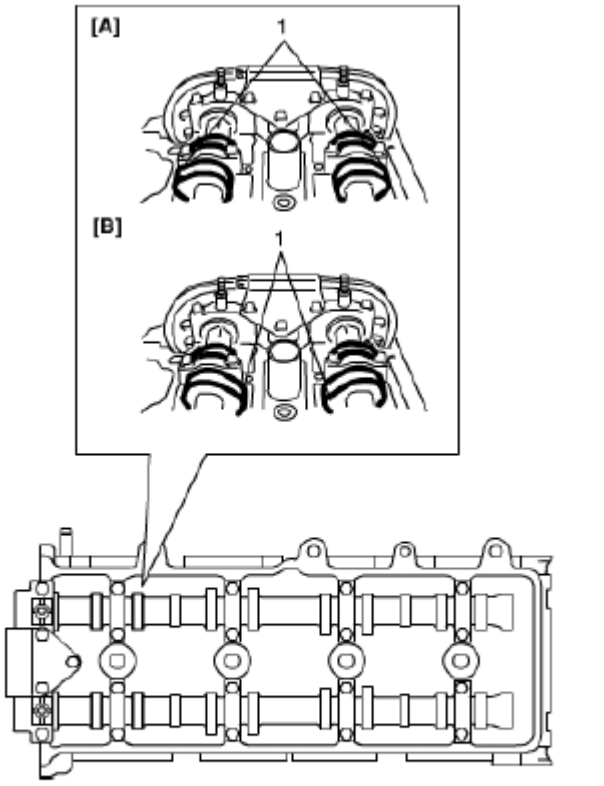


Fig. 7: Turning Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

4. Check whether cam position (1) of No.1 cylinder is at the specified position [A] as shown in **Fig. 8**. If cam position is [B], locate cam position to [A] by turning crankshaft one rotation.

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[A]:	TDC in compression for No.1 cylinder
[B]:	TDC in exhaust for No.1 cylinder

Fig. 8: Checking Cam Position
Courtesy of SUZUKI OF AMERICA CORP.

5. Check valve lashes with thickness gauge (1) according to the following procedure.
   a. Check valve lashes of cylinder No.1.
   b. Turn crankshaft pulley by 180° clockwise.
   c. Check valve lashes of cylinder No.3.
   d. In the same manner as b and c, check valve lashes of cylinder No.4 then cylinder No.2.

If valve lash is out of specification, record valve lash and adjust it to specification by replacing shim.

Valve clearance specification

VALVE CLEARANCE SPECIFICATION

When cold (Coolant temperature is 15 - 25°C (59 - 77°F))	When hot (Coolant temperature is 60 - 68°C (140 - 154°F))	
Intake	0.18 - 0.22 mm (0.007 - 0.009 in.)	0.21 - 0.27 mm (0.008 - 0.011 in.)
		0.30 - 0.36 mm (0.012

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Exhaust	0.28 - 0.32 mm (0.011 - 0.013 in.)	- 0.014 in.)

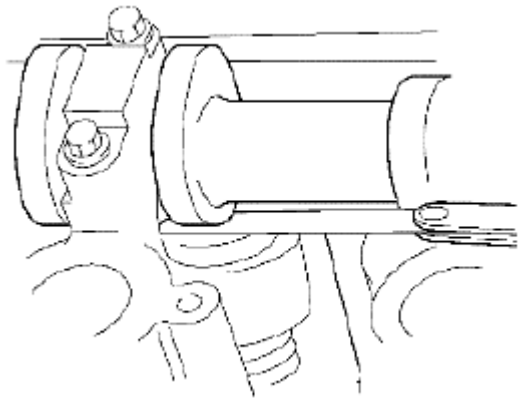


Fig. 9: Checking Valve Lashes With Thickness Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Shim Replacement

1. Close the valve whose shim (2) is to be replaced by turning crankshaft, then turn tappet (3) till its cut section (1) faces inside.

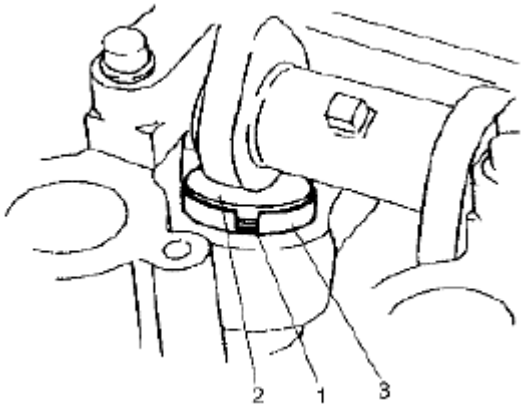


Fig. 10: Identifying Valve Shim & Tappet
Courtesy of SUZUKI OF AMERICA CORP.

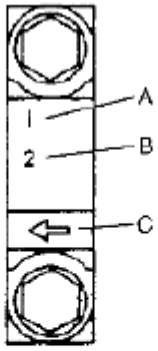
2. Lift down the valve by turning crankshaft to 360°.
3. Hold tappet at that position using special tool as follows.
   a. Remove its housing bolts.
   b. Check housing No. and select special tool corresponding to housing No., referring to **SPECIAL TOOL SELECTION TABLE**.

SPECIAL TOOL SELECTION TABLE

No. on camshaft housing	Embossed mark on special tool
I2, I3, I4, I5	IN

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E2, E3, E4, E5	EX



A:	I: Intake side or E: Exhaust side
B:	Position from timing chain side
C:	Pointing to timing chain side

Fig. 11: Identifying Bearing Cap Mark
Courtesy of SUZUKI OF AMERICA CORP.

c. Hold down the tappet so as not to contact the shim by installing special tool on camshaft housing with housing bolt (1) tighten housing bolts by hand.

Special Tool

(A): 09916-66510

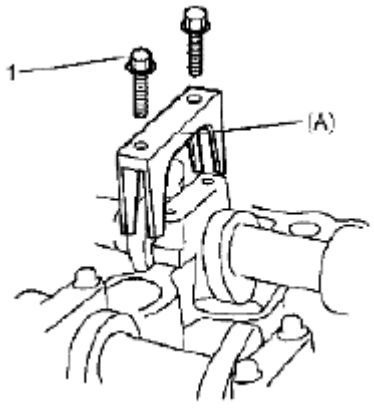
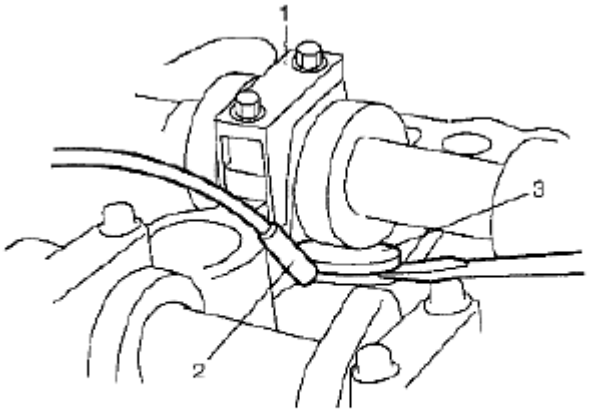


Fig. 12: Identifying Camshaft Housing Bolt
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4. Turn camshaft by approximately 90° clockwise and remove shim (3).

WARNING: Never put in the hand between camshaft and tappet.

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1. Special tool	2. Magnet

Fig. 13: Removing Shim
Courtesy of SUZUKI OF AMERICA CORP.

5. Using a micrometer (2), measure the thickness of the removed shim (1), and determine replacement shim by calculating the thickness of new shim with the following formula and **SHIM THICKNESS SPECIFICATION TABLE**.

   Shim thickness specification

   Intake side:

   A = B + C - 0.20 mm (0.008 in.)

   Exhaust side:

   A = B + C - 0.30 mm (0.012 in.)

   A. **Thickness of new shim**
   B. **Thickness of removed shim**
   C. **Measured valve clearance**

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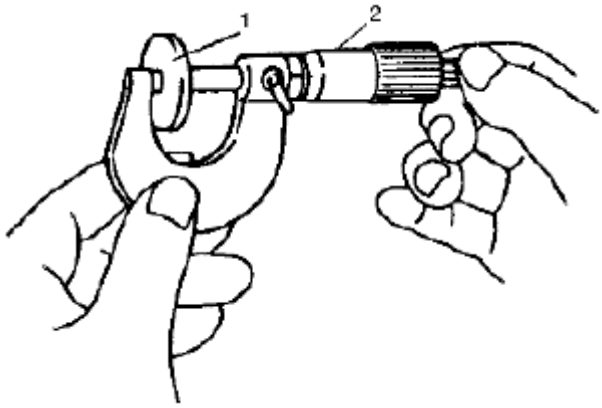


Fig. 14: Measuring Shim Thickness Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

For example of intake side:

When thickness of removed shim is 2.40 mm (0.094 in.), and measured valve clearance is 0.45 mm (0.018 in.).

A = 2.40 mm (0.094 in.) + 0.45 mm (0.018 in.) - 0.20 mm (0.008 in.) = 2.65 mm (0.104 in.)

Calculated thickness of new shim = 2.65 mm (0.104 in.)

6. Select new shim No. (1) with a thickness as close as possible to calculated value.

Available new shims No .

SHIM THICKNESS SPECIFICATION TABLE

Thickness mm (in.)	Shim No.	Thickness mm (in.)	Shim No.
2.175 (0.0856)	218	2.600 (0.1024)	260
2.200 (0.0866)	220	2.625 (0.1033)	263
2.225 (0.0876)	223	2.650 (0.1043)	265
2.250 (0.0886)	225	2.675 (0.1053)	268
2.275 (0.0896)	228	2.700 (0.1063)	270
2.300 (0.0906)	230	2.725 (0.1073)	273
2.325 (0.0915)	233	2.750 (0.1083)	275
2.350 (0.0925)	235	2.775 (0.1093)	278
2.375 (0.0935)	238	2.800 (0.1102)	280
2.400 (0.0945)	240	2.825 (0.1112)	283
2.425 (0.0955)	243	2.850 (0.1122)	285
2.450 (0.0965)	245	2.875 (0.1132)	288
2.475 (0.0974)	248	2.900 (0.1142)	290
2.500 (0.0984)	250	2.925 (0.1152)	293
2.525 (0.0994)	253	2.950 (0.1161)	295

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2.550 (0.1004)	255	2.975 (0.1171)	298
2.575 (0.1014)	258	3.000 (0.1181)	300

7. Install new shim facing shim No. side with tappet.

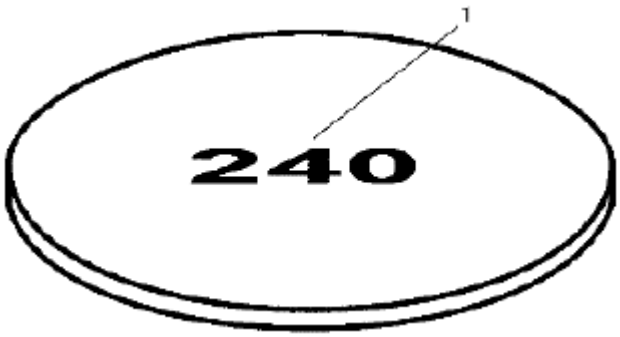
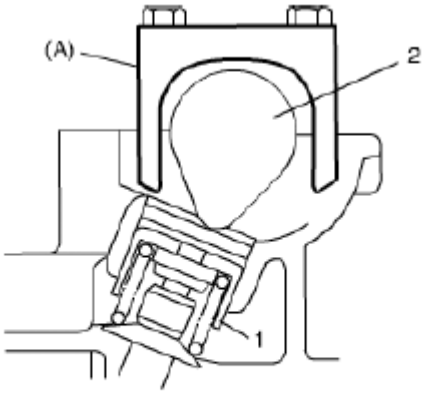


Fig. 15: Identifying Shim Number
Courtesy of SUZUKI OF AMERICA CORP.

8. Lift valve by turning crankshaft counterclockwise (in opposite direction against above Step 4) and remove special tool.

Special Tool

(A): 09916-66510



1. Tappet	2. Camshaft

Fig. 16: Identifying Tappet & Camshaft
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9. Install camshaft housing (1) and tighten bolts to specified torque.

Tightening torque

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Camshaft housing bolt a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

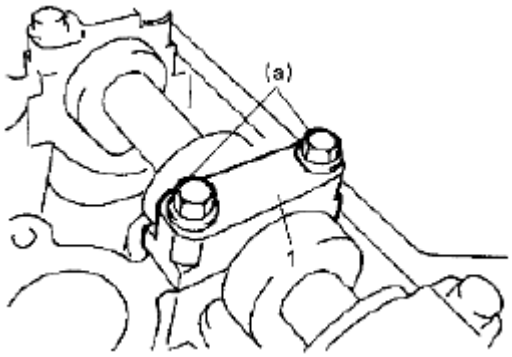
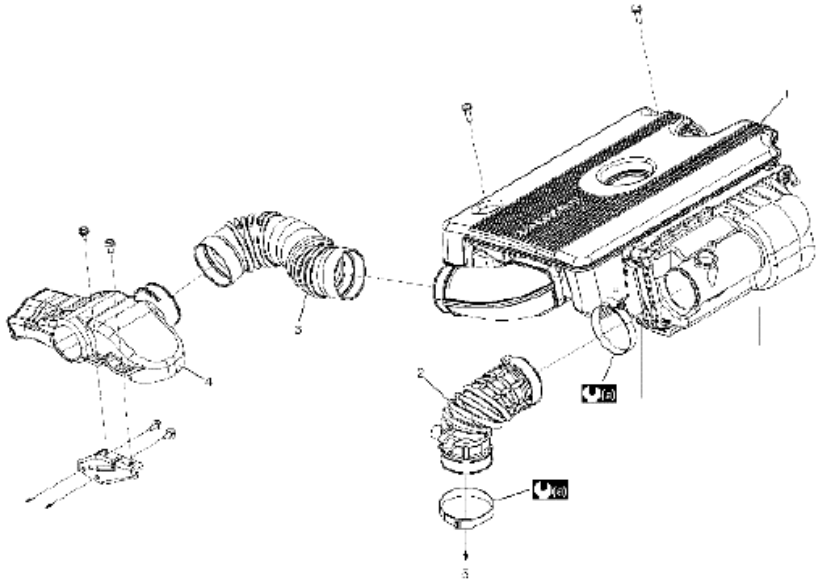


Fig. 17: Identifying Camshaft Housing Bolts
Courtesy of SUZUKI OF AMERICA CORP.

10. Turn crankshaft pulley more than 4 rotations.
11. Check valve clearance again.
12. After checking and adjusting all valves, install cylinder head cover, referring to **INSTALLATION**.

REPAIR INSTRUCTIONS

AIR CLEANER COMPONENTS



1. Air cleaner assembly	3. Air cleaner inlet hose	5. To electric throttle body
2. Air cleaner outlet hose	4. Air cleaner suction pipe	(a): 3 N·m (0.3 kgf-m, 2.5 lb-ft)

Fig. 18: Identifying Air Cleaner Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

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AIR CLEANER ASSEMBLY REMOVAL AND INSTALLATION

Reference: **AIR CLEANER COMPONENTS**

Removal

1. Remove air cleaner inlet hose (2) and outlet hose.
2. Disconnect MAF sensor connector (3).
3. Remove air cleaner case (1).

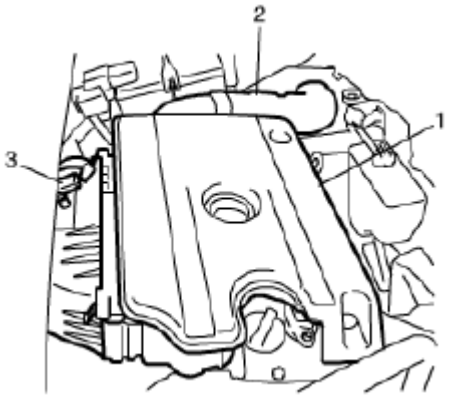


Fig. 19: Identifying MAF Sensor Connector & Air Cleaner Case
Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Install air cleaner case (1).
2. Connect MAF sensor connector (3), and tighten hose clamp to specified torque.

   Tightening torque

   Air cleaner outlet hose clamp: 3 N.m (0.3 kg-m, 2.5 lb-ft)

3. Install air cleaner inlet hose (2) and outlet hose.

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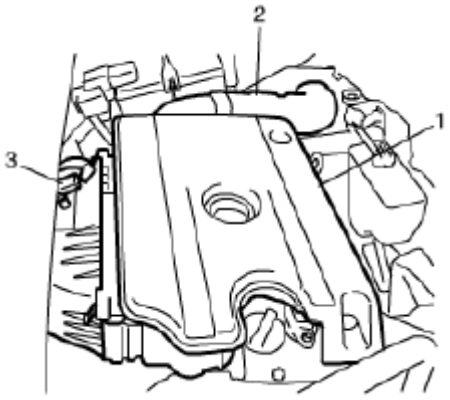


Fig. 20: Identifying Air Cleaner Inlet Hose, Outlet Hose & MAF Sensor Connector
Courtesy of SUZUKI OF AMERICA CORP.

AIR CLEANER FILTER REMOVAL AND INSTALLATION

Removal

1. Open air cleaner case (1) by unhooking its clamps (2).
2. Remove air cleaner filter.

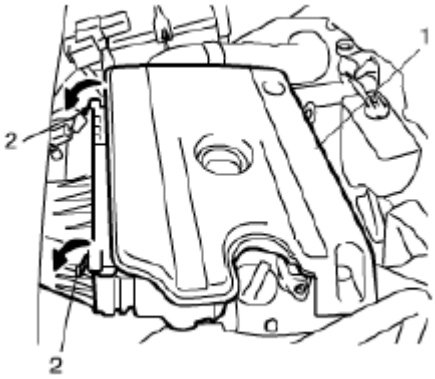


Fig. 21: Identifying Air Cleaner Case & Clamps
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reference: **AIR CLEANER FILTER INSPECTION AND CLEANING**

Reverse removal procedure for installation.

AIR CLEANER FILTER INSPECTION AND CLEANING

Reference: **AIR CLEANER FILTER REMOVAL AND INSTALLATION**

Inspection

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Check air cleaner filter for dirt.

Cleaning

Blow off dust by compressed air from air outlet side of element.

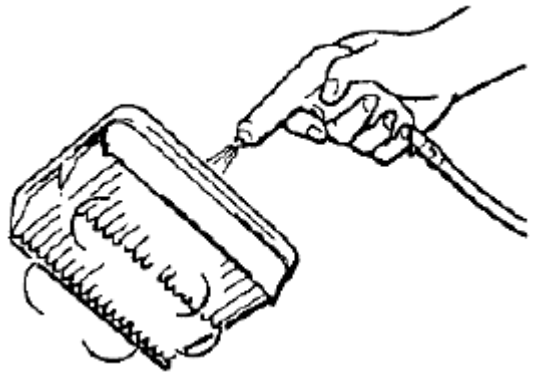
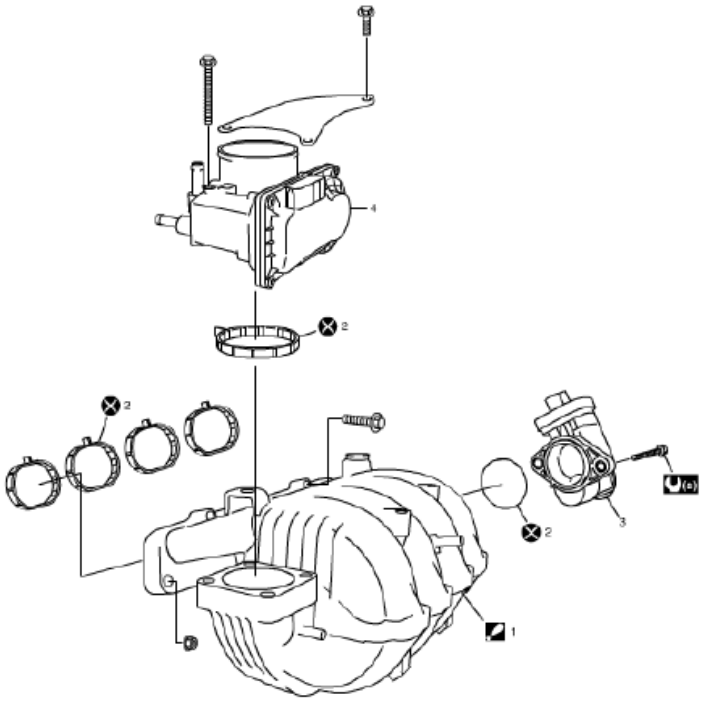


Fig. 22: Blowing Off Dust By Compressed Air From Air Outlet Side Of Element
Courtesy of SUZUKI OF AMERICA CORP.

ELECTRIC THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS

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1. Intake manifold : Never disassemble intake manifold. Disassembly will spoil its original performance. If faulty condition is found, replace it with new one.	4. Electric throttle body assembly
2. O-ring	(a): 6 N·m (0.6 kgf-m, 4.5 lb-ft)
3. IMT valve actuator	: Do not reuse.

Fig. 23: Identifying Electric Throttle Body & Intake Manifold Components (With Torque Specifications) Courtesy of SUZUKI OF AMERICA CORP.

ELECTRIC THROTTLE BODY ON-VEHICLE INSPECTION

Check electric throttle body assembly, referring to "Throttle Valve Operation Check" and "Electric Throttle Body Assembly Operation Check" under **ELECTRIC THROTTLE BODY ASSEMBLY ON-VEHICLE INSPECTION** .

ELECTRIC THROTTLE BODY ASSEMBLY REMOVAL AND INSTALLATION

Reference: **ELECTRIC THROTTLE BODY ON-VEHICLE INSPECTION**

Reference: **ELECTRIC THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS**

Reference: **ELECTRIC THROTTLE BODY CLEANING**

Removal

1. Disconnect negative (-) cable at battery.

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2. Drain coolant.
3. Remove air cleaner assembly, referring to **REMOVAL**.
4. Disconnect engine coolant hoses (1) from electric throttle body assembly (2).
5. Disconnect connector (3) from electric throttle body assembly.
6. Remove stiffener (4).

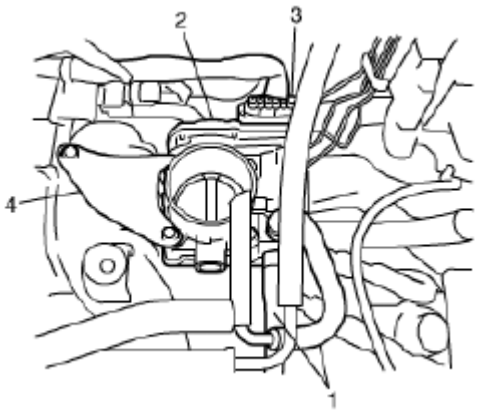


Fig. 24: Identifying Stiffener, Connector & Engine Coolant Hoses
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove electric throttle body assembly from intake manifold.

Installation

1. Clean mating surfaces, and install new throttle body gasket to intake manifold.
2. Install electric throttle body assembly (2) with stiffener (4) to intake manifold.
3. Connect connector (3) to electric throttle body assembly securely.
4. Connect engine coolant hoses (1) to electric throttle body assembly (2).

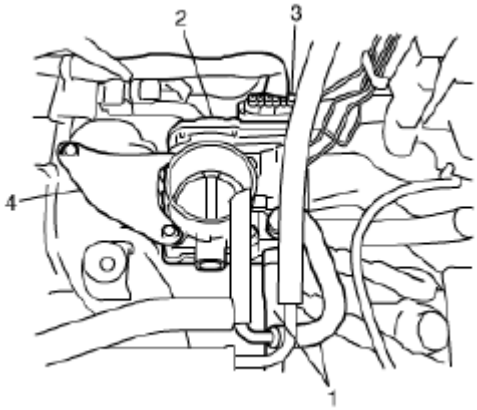


Fig. 25: Identifying Electric Throttle Body Assembly With Stiffener & Engine Coolant Hoses
Courtesy of SUZUKI OF AMERICA CORP.

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5. Install air cleaner assembly, referring to **INSTALLATION**.
6. Refill coolant, referring to **COOLING SYSTEM FLUSH AND REFILL** .
7. Connect negative (-) cable at battery.
8. Perform calibration of electric throttle body assembly, referring to **ELECTRIC THROTTLE BODY SYSTEM CALIBRATION** if replaced.

ELECTRIC THROTTLE BODY CLEANING

Clean electric throttle body assembly referring to "Throttle Valve Operation Check" under **ELECTRIC THROTTLE BODY ASSEMBLY ON-VEHICLE INSPECTION** .

INTAKE MANIFOLD REMOVAL AND INSTALLATION

Reference: **ELECTRIC THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS**

CAUTION: Never disassemble intake manifold. Disassembly will spoil its original performance. If faulty condition is found, replace it with new one.

Removal

1. Disconnect negative (-) cable at battery.
2. Drain cooling.
3. Remove electric throttle body assembly, referring to **REMOVAL**.
4. Disconnect the following electric lead wires:
   - IMT connector (1)
5. Disconnect the following hoses:
   - Brake booster hose (2) from intake manifold
   - PCV hose (3) from PCV valve
   - Vacuum hose (4) from EVAP canister purge valve
   - Breather hose from intake manifold
6. Remove harness brackets (5) from intake manifold.

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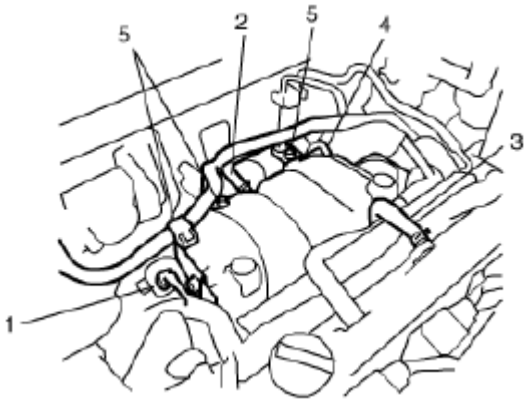


Fig. 26: Identifying Vacuum Hose, Brake Booster Hose & PCV Hose
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove intake manifold and O-ring from cylinder head.

Installation

Reverse removal procedure for installation noting the followings.

- Use new intake manifold O-ring.
- Install intake manifold bolts (2) and nuts (1) as shown in **Fig. 27**.

  Apply thread lock cement to intake manifold bolt.

  "A": Thread lock cement 99000-32110Thread Lock Cement Super 1322 ()

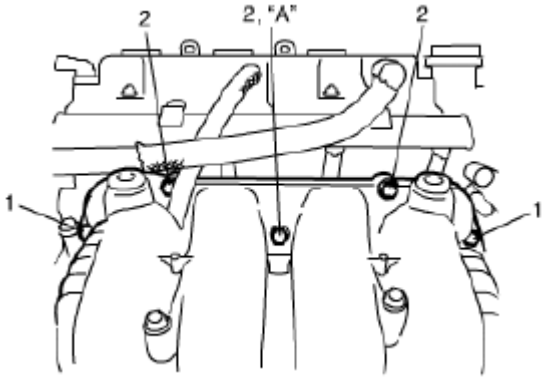


Fig. 27: Identifying Intake Manifold Bolts & Nuts
Courtesy of SUZUKI OF AMERICA CORP.

- Check to ensure that all removed parts are back in place.

  Reinstall any necessary parts which have not been reinstalled.

- Refill cooling system, referring to **COOLING SYSTEM FLUSH AND REFILL** .

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- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

IMT VALVE ACTUATOR REMOVAL AND INSTALLATION

Reference: **ELECTRIC THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS**

Removal

1. Disconnect negative (-) cable at battery.
2. Disconnect IMT valve actuator connector.
3. Remove IMT valve actuator (1) and O-ring (2) from intake manifold (3).

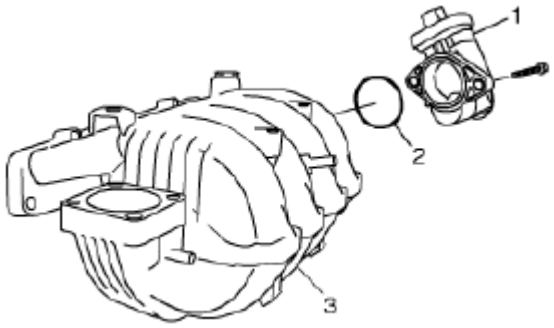


Fig. 28: Identifying IMT Valve Actuator & O-Ring
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reverse removal procedure noting the followings.

- Use new O-ring (1).
- Tighten IMT valve actuator bolt (2) to specified torque.

Tightening torque

IMT valve actuator bolt a: 6 N.m (0.6 kg-m, 4.5 lb-ft)

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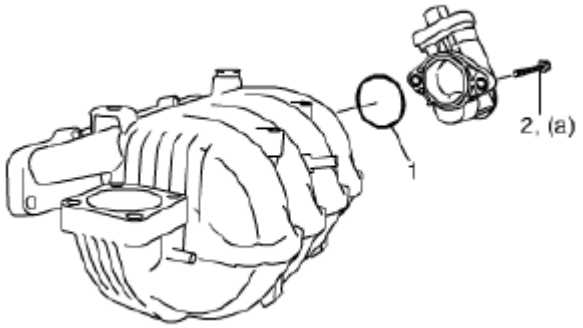
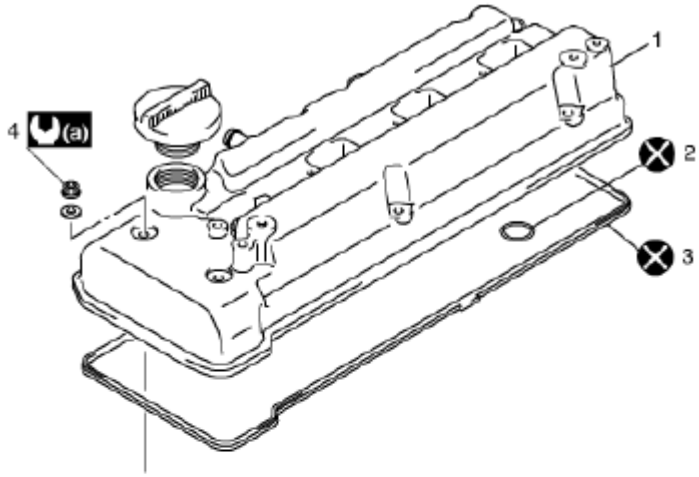


Fig. 29: Identifying IMT Valve Actuator Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD COVER COMPONENTS



1.	Cylinder head cover
2.	O-ring
3.	Cylinder head cover gasket
4.	Cylinder head cover nut
(a):	Tighten 11 N·m (1.1 kgf-m, 8.0 lb-ft) by specified procedure.
:	Do not reuse.

Fig. 30: Identifying Cylinder Head Cover Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD COVER REMOVAL AND INSTALLATION

Reference: **CYLINDER HEAD COVER COMPONENTS**

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Removal

1. Disconnect negative (-) cable at battery.
2. Remove ignition coils referring to **REMOVAL** .
3. Remove oil level gauge (1).
4. Disconnect CMP sensor connector (2) and then remove CMP sensor (7) from cylinder head cover.
5. Disconnect breather hose (3) and PCV hose (4) from cylinder head cover (5).
6. Remove harness bracket (6) from cylinder head cover (5).

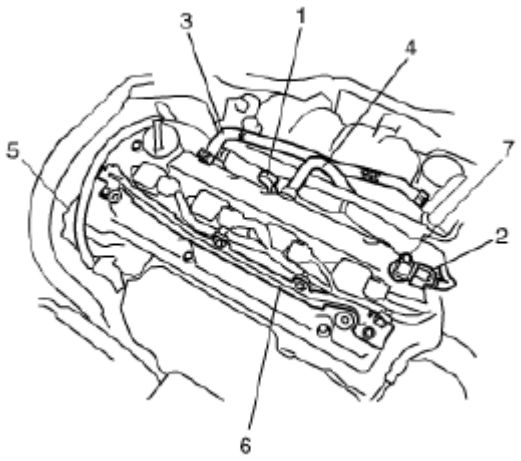


Fig. 31: Identifying Oil Level Gauge Breather Hose & PCV Hose
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove PCV valve from cylinder head cover.
8. Remove cylinder head cover nuts in such order as indicated in **Fig. 32**.

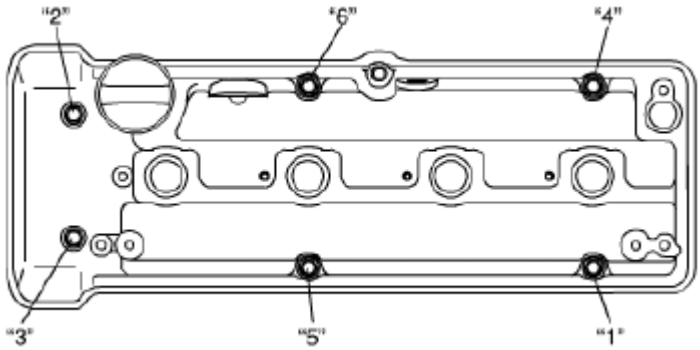


Fig. 32: Identifying Sequence Of Cylinder Head Cover Nuts
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove cylinder head cover from cylinder head.
10. Remove cylinder head side seals from cylinder head.

Installation

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1. Install PCV valve to cylinder head cover, referring to **INSTALLATION** .
2. Remove oil, old sealant and dust from sealing surfaces on cylinder head and cover.
3. Install new cylinder head side seals (1) to cylinder head.
4. Apply sealant "A" to cylinder head sealing surface area as shown in **Fig. 33**.

"A": Water tight sealant 99000-31250SUZUKI Bond No.1207F

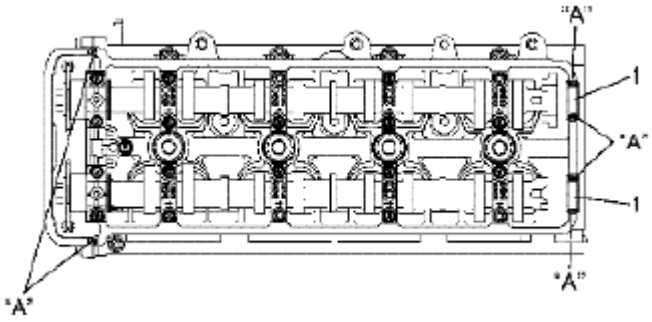


Fig. 33: Identifying Cylinder Head Side Seals
Courtesy of SUZUKI OF AMERICA CORP.

5. Apply engine oil to new O-rings.
6. Install new O-rings (3) and new cylinder head cover gasket (2) to cylinder head cover (1).

NOTE: Be sure to check each of these parts for deterioration or any damage before installation and replace if found defective.

7. Install cylinder head cover to cylinder head.

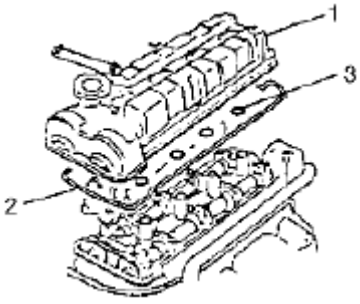


Fig. 34: Identifying Cylinder Head Cover Gasket & O-Rings
Courtesy of SUZUKI OF AMERICA CORP.

8. Tighten cylinder head cover nuts in such order as indicated in **Fig. 35** a little at a time till they are tightened to specified torque.
   - Use new seal washers.

Tightening torque

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Cylinder head cover nut a: Tighten 11 N.m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure

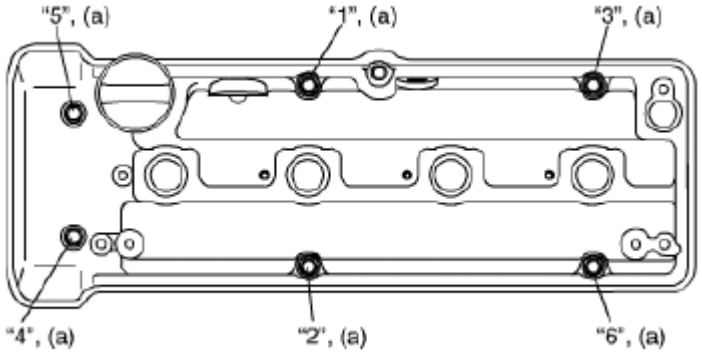


Fig. 35: Identifying Tightening Sequence Of Cylinder Head Cover Nuts
Courtesy of SUZUKI OF AMERICA CORP.

9. Install oil level gauge (1).
10. Install CMP sensor (5) to cylinder head cover, referring to **INSTALLATION** .
11. Connect CMP sensor connector (4).
12. Connect breather hose (2) and PCV hose (3) to cylinder head cover.
13. Install harness bracket (6) to cylinder head cover.

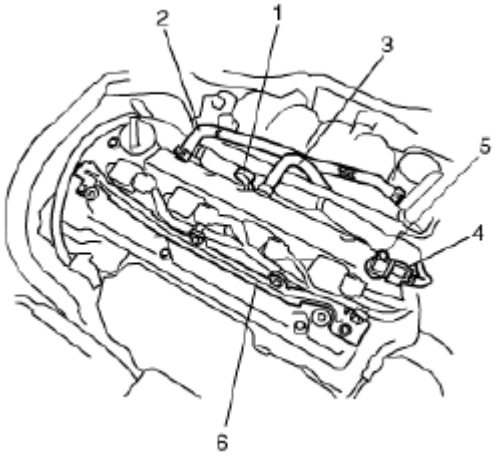
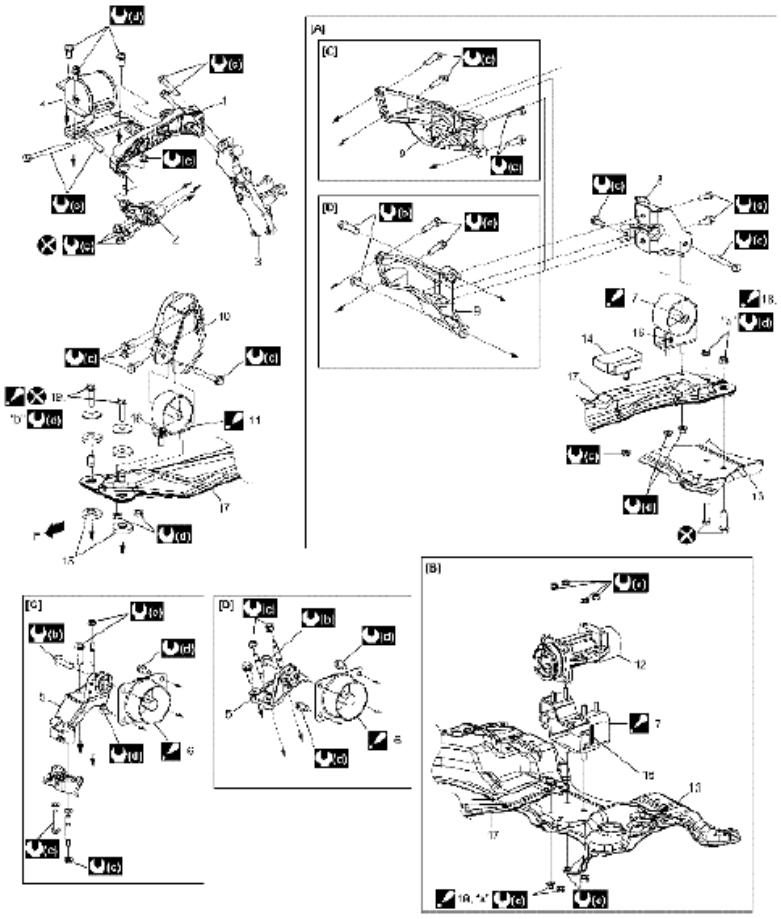


Fig. 36: Identifying CMP Sensor Connector & PCV Hose
Courtesy of SUZUKI OF AMERICA CORP.

14. Install ignition coils, referring to **INSTALLATION** .
15. Install air cleaner case, referring to **INSTALLATION**.
16. Connect negative (-) cable at battery.

ENGINE MOUNTINGS COMPONENTS

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[A]: 2WD model	6. Engine left mounting :Be sure to direct paint mark to forward.	16. Yellow mark
[B]: 4WD model	7. Engine rear mounting :Be sure to direct paint mark to forward.	17. Mounting member
[C]: M/T model	8. Engine rear mounting No.1 bracket	18. Mounting member nut Tighten order: "a"→"b"
[D]: A/T model	9. Engine rear mounting No.2 bracket	19. Mounting member bolt Tighten order: "a"→"b"
F: Vehicle forward	10. Engine front mounting bracket	(a): 25 N·m (2.5 kgf-m, 18.0 lb-ft)
1. Engine right mounting No.1 bracket	11. Engine front mounting :Be sure to direct yellow mark to forward.	(b): 93 N·m (9.3 kgf-m, 67.5 lb-ft)
2. Engine right mounting No.2 bracket	12. Transfer	(c): 55 N·m (5.5 kgf-m, 40.0 lb-ft)
3. Generator bracket	13. Suspension frame	(d): 65 N·m (6.5 kgf-m, 47.0 lb-ft)
4. Engine right mounting	14. Dynamic damper	: Do not reuse.
5. Engine left mounting bracket	15. Mounting member cushion	

Fig. 37: Identifying Engine Mountings Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE ASSEMBLY REMOVAL AND INSTALLATION

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Reference: **ENGINE MOUNTINGS COMPONENTS**

Removal

1. Relieve fuel pressure according to **FUEL PRESSURE RELIEF PROCEDURE** .
2. Disconnect negative and positive cables at battery.
3. Disconnect ECM connectors.
4. Remove battery and battery tray with ECM.
5. Remove right and left side engine under covers.
6. Remove water pump and generator drive belt, referring to **REMOVAL** .
7. Drain engine oil.
8. Drain transaxle oil.
9. Drain transfer oil (4WD model).
10. Drain coolant.
11. Remove air cleaner assembly, referring to **REMOVAL**.
12. With hose connected, detach A/C compressor from its bracket, referring to **REMOVAL** .

CAUTION: Suspend removed A/C compressor at a place where no damage will be caused during removal and installation of engine assembly.

13. Remove condenser cooling fan from radiator, referring to **CONDENSER COOLING FAN REMOVAL AND INSTALLATION** .
14. Drain P/S fluid.
15. Disconnect P/S fluid reservoir hose (1) and then remove P/S fluid reservoir (2) from bracket.



Fig. 38: Identifying P/S Fluid Reservoir Hose & Bracket
Courtesy of SUZUKI OF AMERICA CORP.

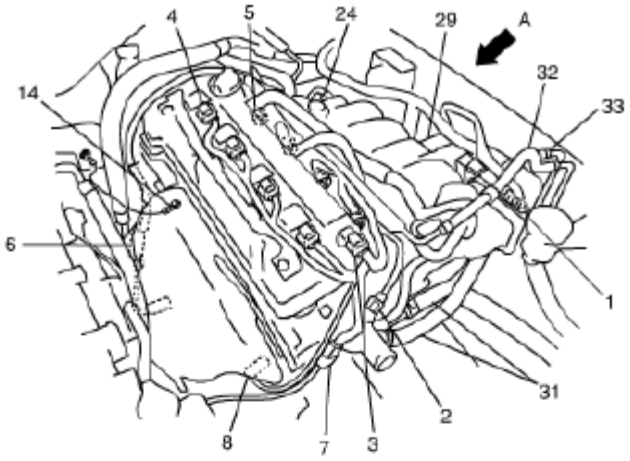
16. Disconnect the following electric wires/connectors and each clamps.

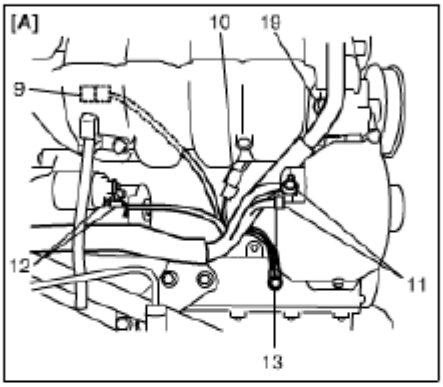
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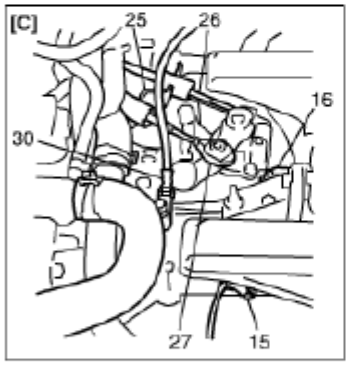
- Electric throttle body (1)
- ECT sensor (2)
- CMP sensor (3)
- Ignition coil assembly (4)
- Injector (5)
- HO2S (6)
- A/F sensor (7)
- Engine oil pressure switch (8)
- CKP sensor (9)
- Knock sensor (10)
- Generator (11)
- Starting motor (12)
- Ground terminal (13) from cylinder block
- Ground terminal (14) from exhaust manifold
- Battery ground cable (15) from transaxle
- Back-up light switch (16) (M/T model)
- Torque sensor (17) (electric P/S model)
- P/S motor (18) (electric P/S model)
- P/S pump (19) (hydraulic P/S model)
- Output shaft speed sensor (VSS) (20) (A/T model)
- Solenoid valve (21) (A/T model)
- Transmission range sensor (22) (A/T model)
- Input shaft speed sensor (23) (A/T model)
- IMT sensor (24)

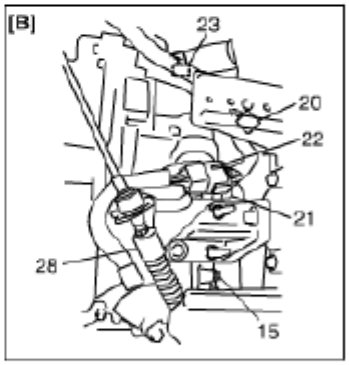
17. Disconnect the following cables, and remove control cable bracket (25)
    - Gear select control cable (26) (M/T model)
    - Gear shift control cable (27) (M/T model)
    - A/T select cable with select cable bracket (28) (A/T model)
18. Disconnect the following hoses.
    - Brake booster hose (29) from intake manifold
    - Radiator inlet and outlet hoses from radiator
    - Heater inlet and outlet hoses (31) from heater core
    - Fuel feed hose (32) from fuel feed pipe
    - Purge hose (33) from purge valve
    - Clutch hose (30) from transaxle (M/T model)
    - A/T fluid cooler hoses (A/T model)

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[A]:	View A
[B]:	A/T model
[C]:	M/T model

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Fig. 39: Identifying Cables, Control Cable Bracket, Electric Wires/Connectors & Clamps
Courtesy of SUZUKI OF AMERICA CORP.

19. Disconnect right and left drive shaft joints from differential gear, referring to **REMOVAL** .
20. Remove exhaust center pipe, referring to **EXHAUST SYSTEM COMPONENTS** .
21. Disconnect propeller shaft from transfer, referring to **REMOVAL** (4WD model).
22. Disconnect steering lower shaft from pinion shaft, referring to **REMOVAL** .
23. Fix radiator to body with rope in order to avoid the radiator fall off when front lower cross member lowered.
24. Fix transaxle to suspension frame with rope in order to avoid the engine assembly inclines when engine assembly lowered.

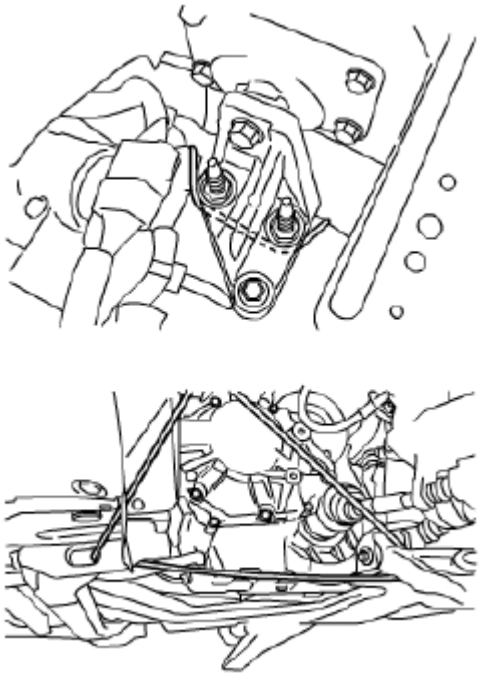


Fig. 40: Identifying Steering Lower Shaft & Pinion Shaft
Courtesy of SUZUKI OF AMERICA CORP.

25. Support front suspension frame and front lower cross member using jack at hatched parts (1) indicated in **Fig. 41**.

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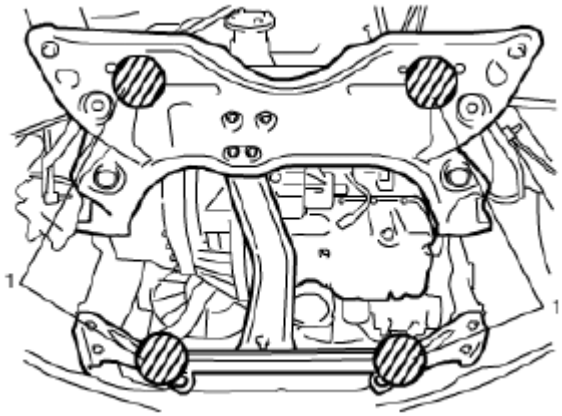


Fig. 41: Supporting Front Suspension Frame & Front Lower Cross Member
Courtesy of SUZUKI OF AMERICA CORP.

26. Remove engine right mounting (1), engine right mounting No.1 bracket (2) and engine left mounting bracket bolt and nuts (3).



Fig. 42: Identifying Engine Left Mounting Bracket Bolt & Nuts
Courtesy of SUZUKI OF AMERICA CORP.

27. Remove suspension frame mounting bolts (1) and front lower cross member bolts (2).

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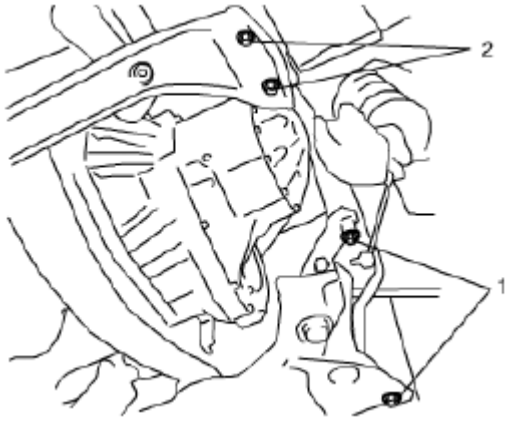


Fig. 43: Identifying Suspension Frame Mounting & Front Lower Cross Member Bolts
Courtesy of SUZUKI OF AMERICA CORP.

28. Lower engine with transaxle, front suspension frame, front lower cross member, transfer (4WD model) and steering gear case.

CAUTION: Before lowering engine, in order to avoid damage to A/C compressor, make clearance by rising it.

29. Disconnect steering gear case from suspension frame, referring to **STEERING GEAR CASE ASSEMBLY COMPONENTS** , if necessary.
30. Disconnect transfer.
31. Disconnect transaxle from engine.
32. Remove clutch cover and clutch disk, referring to **REMOVAL** , if necessary (M/T model).

Installation

1. Install clutch cover and clutch disk, referring to **INSTALLATION** , if necessary (M/T model).
2. Connect transaxle to engine, referring to **MANUAL TRANSAXLE UNIT DISMOUNTING AND REMOUNTING** or **AUTOMATIC TRANSAXLE UNIT DISMOUNTING AND REMOUNTING** , if removed.
3. Connect transfer to suspension frame, referring to **TRANSFER DISMOUNTING AND REMOUNTING** , if removed (4WD model).
4. Connect steering gear case to suspension frame, referring to **STEERING GEAR CASE ASSEMBLY COMPONENTS** , if removed.
5. Lift engine with transaxle, front suspension frame, front lower cross member, transfer (4WD model) and steering gear case into engine compartment with jack.

CAUTION: Before lifting engine, in order to avoid damage to A/C compressor, make clearance by rising it.

6. Tighten suspension frame mounting bolts and front lower cross member bolts, and then tighten bolts to

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specified torque.

Tightening torque

Suspension frame mounting bolt a: 150 N.m (15.0 kg-m, 108.5 lb-ft)

Front lower cross member bolt b: 55 N.m (5.5 kg-m, 40.0 lb-ft)

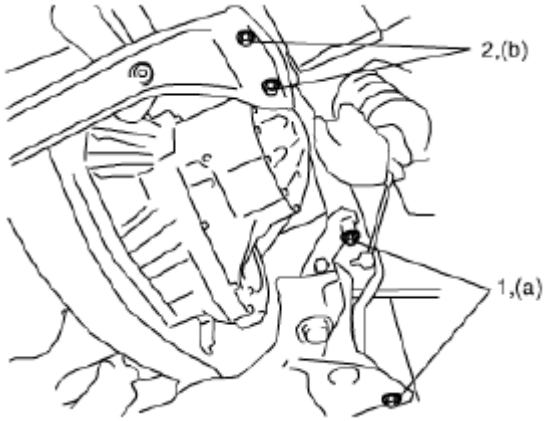


Fig. 44: Identifying Suspension Frame Mounting & Front Lower Cross Member Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Install engine right mounting, engine right mounting No.1 bracket and engine left mounting bracket, and then tighten bolts and nuts to specified torque referring to **ENGINE MOUNTINGS COMPONENTS**.
8. Remove jack.
9. Connect steering lower shaft to pinion shaft, referring to **INSTALLATION** .
10. Connect propeller shaft, referring to **INSTALLATION** (4WD model).
11. Install exhaust center pipe, referring to **EXHAUST SYSTEM COMPONENTS** .
12. Connect right and left drive shaft joints to differential gear, referring to **INSTALLATION** .
13. Reverse disconnected hoses, cables and electric wires for connection noting the following.

Tighten bolts and nuts to specified torque.

Tightening torque

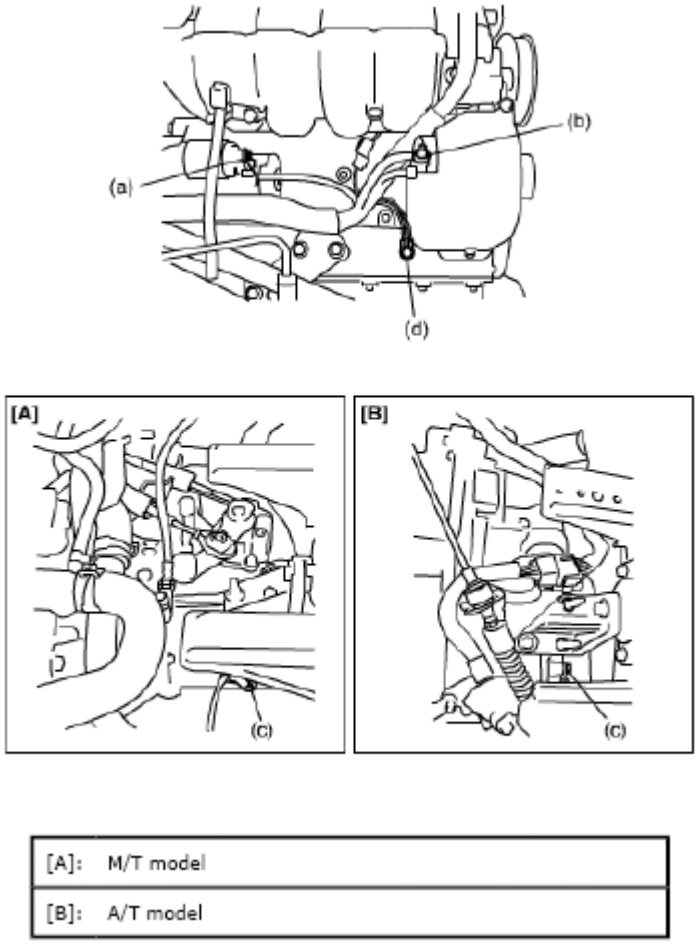
Starting motor terminal nut a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

Generator terminal nut b: 5 N.m (0.5 kg-m, 4.0 lb-ft)

Battery ground bolt c: 25 N.m (2.5 kg-m, 18.0 lb-ft)

Ground terminal bolt d: 11 N.m (1.1 kg-m, 8.0 lb-ft)

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[A]:	M/T model
[B]:	A/T model

Fig. 45: Identifying Hoses, Cables & Electric Wires Connection
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14. Connect P/S fluid reservoir hose (1) and then install P/S fluid reservoir (2) to bracket.

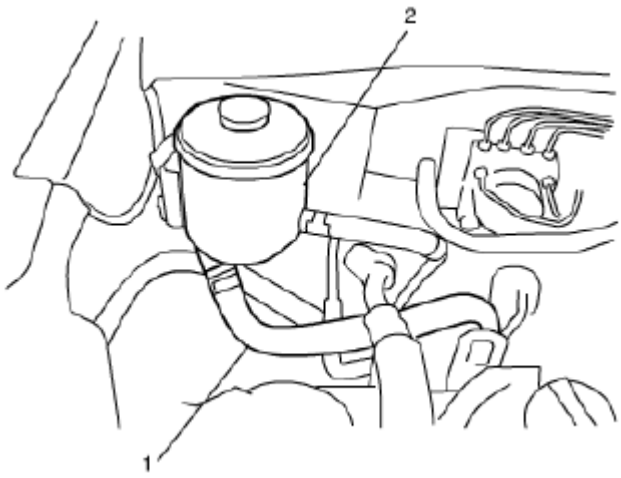


Fig. 46: Identifying P/S Fluid Reservoir Hose

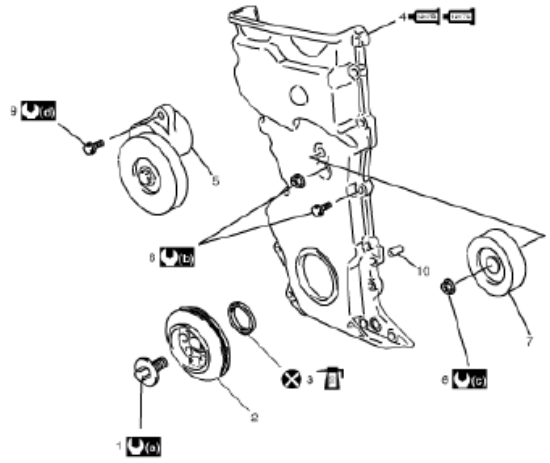
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15. Refill P/S fluid, referring to **P/S FLUID CHANGE** .
16. Install condenser cooling fan to radiator, referring to **INSTALLATION** .
17. Install A/C compressor to its bracket (if removed), referring to **INSTALLATION** .
18. Install air cleaner assembly, referring to **INSTALLATION**.
19. Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
20. Refill coolant, referring to **COOLING SYSTEM FLUSH AND REFILL** .
21. Refill transfer oil, referring to **TRANSFER OIL CHANGE** (4WD model).
22. Refill transaxle oil, referring to **MANUAL TRANSAXLE OIL CHANGE** or **A/T FLUID CHANGE** .
23. Refill engine oil, referring to **ENGINE OIL AND FILTER CHANGE** .
24. Install water pump and generator drive belt, referring to **INSTALLATION** .
25. Install right and left side engine under covers.
26. Install battery and battery tray with ECM.
27. Connect ECM connectors.
28. Connect negative and positive cable at battery.
29. Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

TIMING CHAIN COVER COMPONENTS

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1. Crankshaft pulley bolt	6. Timing chain cover bolt and nut	(a):	150 N·m (15.0 kgf-m, 108.5 lb-ft)
2. Crankshaft pulley	7. Idler pulley	(b):	11 N·m (1.1 kgf-m, 8.0 lb-ft)
3. Oil seal : Apply engine oil to oil seal lip.	8. Idler pulley nut	(c):	42 N·m (4.2 kgf-m, 30.5 lb-ft)
1207B 1217G 4. Timing chain cover : See "A" : See "B"	9. Generator belt tensioner bolt	(d):	25 N·m (2.5 kgf-m, 18.0 lb-ft)
5. Generator belt tensioner	10. Pin	:	Do not reuse.
"A": Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head.			
"B": Apply sealant 99000-31260 to the mating surface of timing chain cover referring to the figure of Step 3) of "Installation" under *Timing Chain Cover Removal and Installation*.			

Fig. 47: Identifying Timing Chain Cover Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

TIMING CHAIN COVER REMOVAL AND INSTALLATION

Reference: **TIMING CHAIN COVER COMPONENTS**

Removal

1. Remove engine assembly from vehicle referring to **REMOVAL**.
2. Remove oil pan, referring to **REMOVAL** .
3. Remove cylinder head cover, referring to **REMOVAL**.
4. Remove crankshaft pulley bolt.

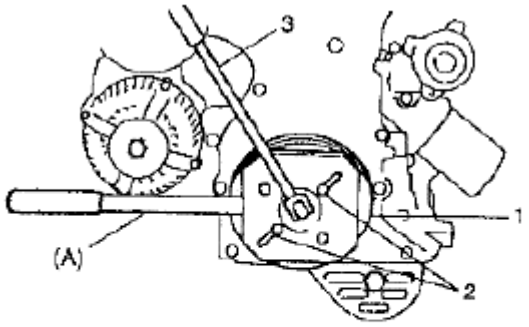
   To lock crankshaft pulley (1), use special tool (camshaft pulley holder) as shown in **Fig. 48**.

   Special Tool

   (A): 09917-68221

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NOTE: **Be sure to use the following bolts instead of pins in order to fix crankshaft pulley by special tool.**
Bolt size: M8, P1.25 L = 25 mm (0.98 in.)
Strength: 7T



2. Bolt	3. Wrench

Fig. 48: Locking Crankshaft Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove crankshaft pulley (1).

   To remove crankshaft pulley, use special tools (Steering wheel remover, Bearing puller attachment) with it as shown in **Fig. 49**.

   Special Tool

   A. **09944-36011**
   B. **09926-58010**

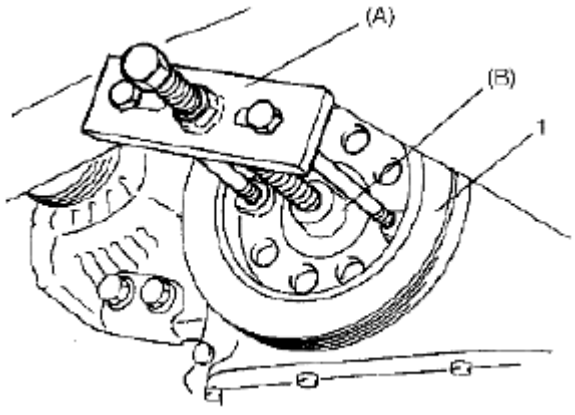


Fig. 49: Removing Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

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6. Remove idler pulley (1), water pump pulley (2) and belt tensioner (3).

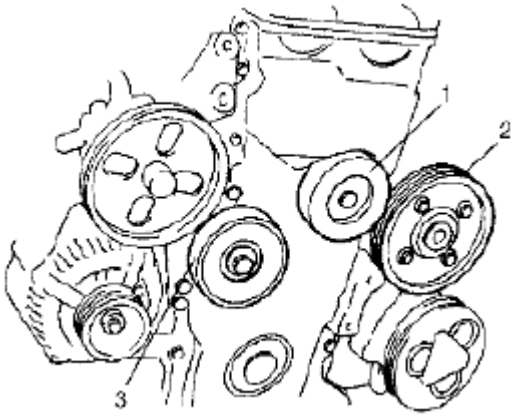


Fig. 50: Identifying Idler Pulley, Water Pump Pulley & Belt Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove timing chain cover bolts (2) and nut (1).
8. Remove timing chain cover (3).

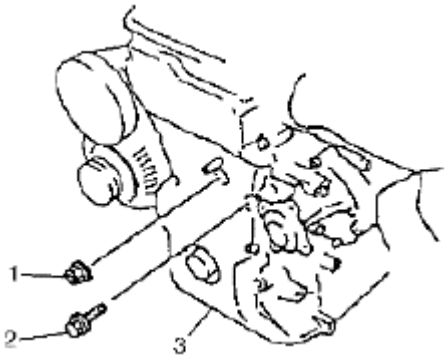


Fig. 51: Identifying Timing Chain Cover Bolts & Nut
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reference: **TIMING CHAIN COVER CLEANING AND INSPECTION**

1. Clean sealing surfaces on timing chain cover, cylinder block and cylinder head.

   Remove oil, old sealant and dust from sealing surface.

2. Install new oil seal (2) to timing chain cover using special tool, if removed.

NOTE: When installing new oil seal (2), drive it until its surface is flash with edge of timing chain cover (1).

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Special Tool

(A): 09913-75510

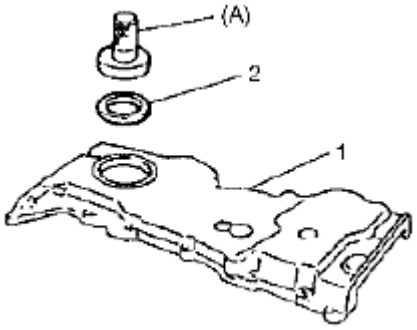


Fig. 52: Installing Timing Chain Cover Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

3. Apply sealant "A" and "B" to specific area as shown in **Fig. 53**.

"A": Sealant 99000-31260SUZUKI Bond No.1217G

"B": Water tight sealant 99000-31140SUZUKI Bond No.1207B

Sealant amount for timing chain cover

"a": 3 mm (0.12 in.)

"b": 2 mm (0.08 in.)

"c": 4 mm (0.16 in.)

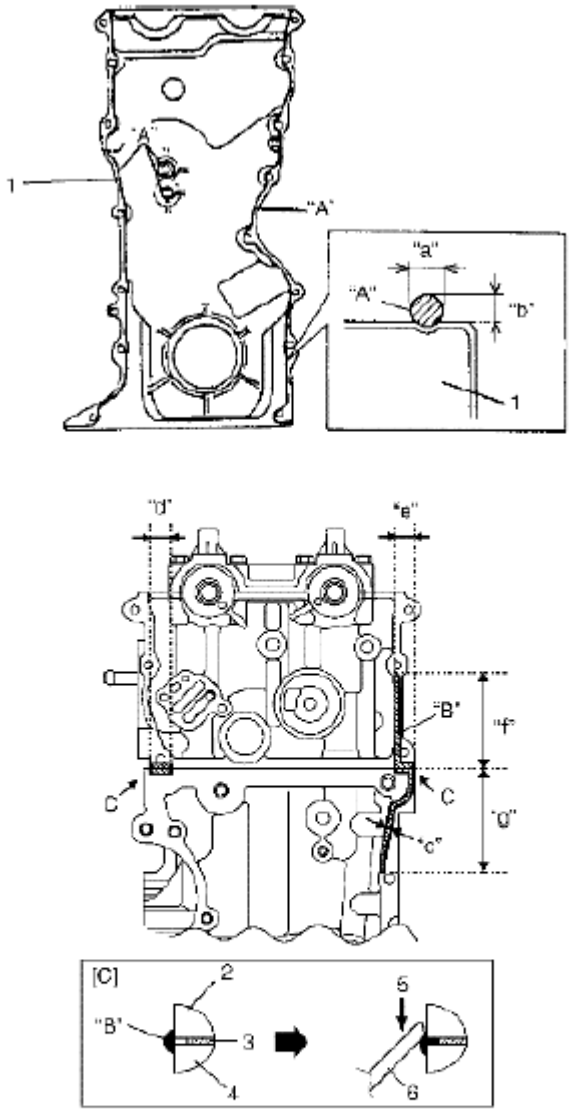
"d": 16 mm (0.63 in.)

"e": 14 mm (0.55 in.)

"f": 65 mm (2.56 in.)

"g": 73 mm (2.87 in.)

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1. Timing chain cover	5. Rub into
2. Cylinder head	6. Jig
3. Cylinder head gasket	[C]: View C
4. Cylinder block	

Fig. 53: Identifying Area For Applying Sealant
Courtesy of SUZUKI OF AMERICA CORP.

4. Apply engine oil to oil seal lip, then install timing chain cover (1). Tighten bolts and nut to specified torque.

NOTE: Before installing timing chain cover, check that pin is securely fitted.

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Tightening torque

Timing chain cover bolt and nut a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

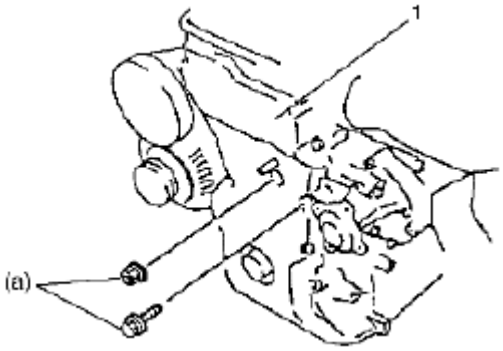


Fig. 54: Identifying Timing Chain Cover Bolts & Nut
Courtesy of SUZUKI OF AMERICA CORP.

5. Install belt idler pulley (1). Tighten nut to specified torque.

   Tightening torque

   Idler pulley nut a: 42 N.m (4.2 kg-m, 30.5 lb-ft)

6. Install belt tensioner (2). Tighten bolts to specified torque.

   Tightening torque

   Generator belt tensioner bolt b: 25 N.m (2.5 kg-m, 18.5 lb-ft)

7. Install water pump pulley (3).

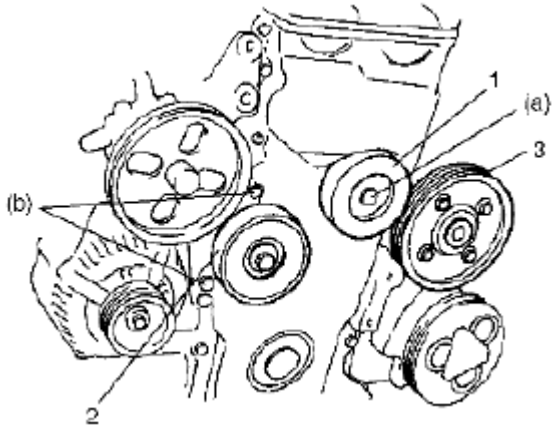


Fig. 55: Identifying Water Pump Pulley & Belt Tensioner Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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8. Install cylinder head cover, referring to **INSTALLATION**.
9. Install oil pan. Refer to **INSTALLATION** .
10. Install crankshaft pulley. To lock crankshaft pulley (1), use special tool (camshaft pulley holder) as shown in **Fig. 56**.

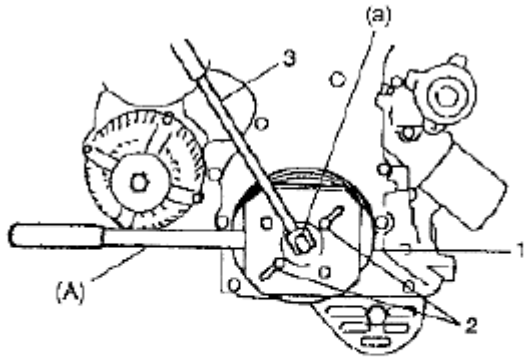
    Special Tool

    (A): 09917-68221

    NOTE: Be sure to use the following bolts instead of pins in order to fix crank pulley by special tool.
    Bolt size: M8, P1.25 L = 25 mm (0.98 in.)
    Strength: 7T

    Tightening torque

    Crankshaft pulley bolt a: 150 N.m (15.0 kg-m, 108.5 lb-ft)



2. Bolt	3. Wrench

Fig. 56: Locking Crankshaft Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

11. Install engine assembly to vehicle, referring to **INSTALLATION**.

TIMING CHAIN COVER CLEANING AND INSPECTION

Reference: **TIMING CHAIN COVER REMOVAL AND INSTALLATION**

Clean

Clean sealing surface on timing chain cover, crank case, cylinder block and cylinder head.

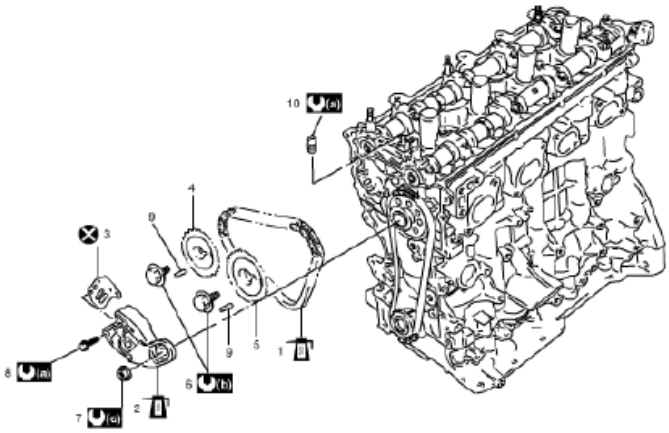
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Remove oil, old sealant, and dust from sealing surface.

Inspection

Check oil seal lip for fault or other damage. Replace as necessary.

2ND TIMING CHAIN AND CHAIN TENSIONER COMPONENTS



1. 2nd timing chain : Apply engine oil	6. Camshaft timing sprocket bolt	(a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)
2. Timing chain tensioner adjuster No.2 : Apply engine oil to sliding surface.	7. Timing chain tensioner adjuster No.2 nut	(b): 80 N·m (8.0 kgf-m, 58.0 lb-ft)
3. Tensioner adjuster No.2 gasket	8. Timing chain tensioner adjuster No.2 bolt	(c): 45 N·m (4.5 kgf-m, 32.5 lb-ft)
4. Intake camshaft timing sprocket	9. Knock pin	: Do not reuse.
5. Exhaust camshaft timing sprocket	10. Oil relief valve	

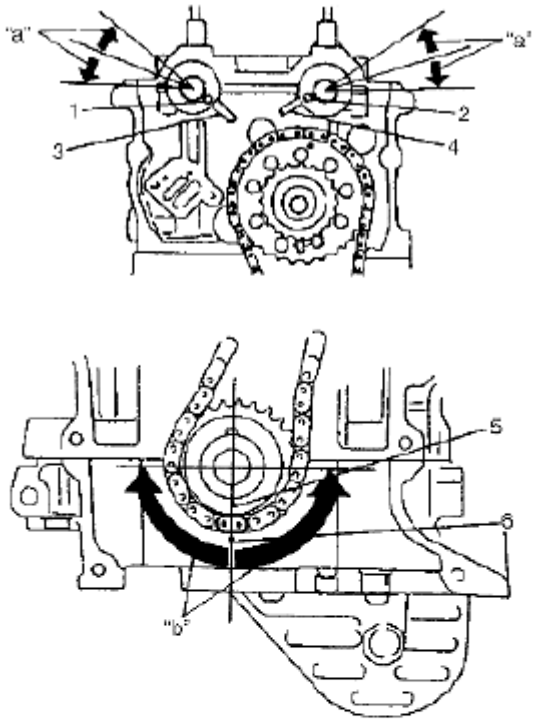
Fig. 57: Identifying 2nd Timing Chain & Chain Tensioner Components (With Torque Specifications) Courtesy of SUZUKI OF AMERICA CORP.

2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION

Reference: **2nd TIMING CHAIN AND CHAIN TENSIONER COMPONENTS**

CAUTION: After 2nd timing chain is removed, never turn intake camshaft, exhaust camshaft and crankshaft independently more than such an extent. If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

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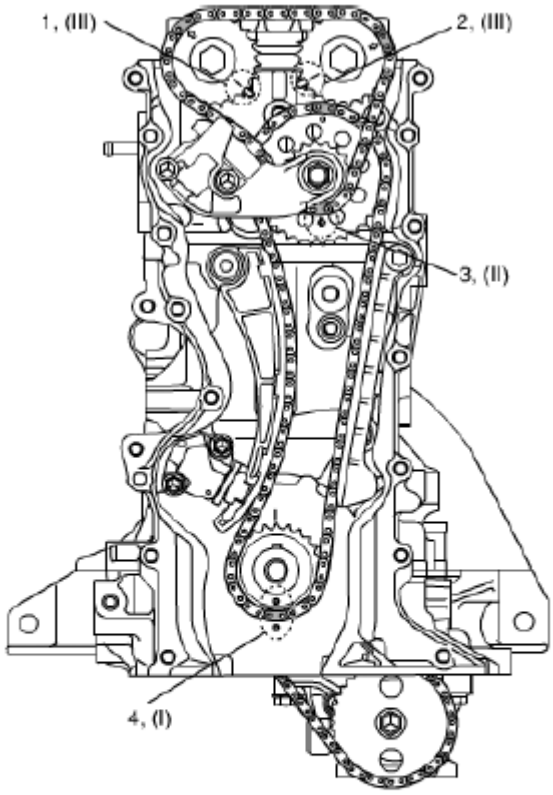
1.	Knock pin of intake camshaft
2.	Knock pin of exhaust camshaft
3.	Timing mark of intake side
4.	Timing mark of exhaust side
5.	Match mark on crank timing sprocket
6.	Timing mark on lower crankcase
"a":	Camshafts (IN & EX) allowable turning range..... Within 20° on both right and left
"b":	Crankshaft allowable turning range..... Within 90° on both right and left

Fig. 58: Identifying Timing Chain Rotation
Courtesy of SUZUKI OF AMERICA CORP.

Removal

1. Remove timing chain cover. Refer to **REMOVAL**.
2. Turn crankshaft clockwise to meet the following conditions.
   - Mark on crank sprocket match with mark on lower crankcase (I).
   - Arrow mark on idler sprocket points upward (II).
   - Marks on cam sprockets match with marks on cylinder head (III).

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1.	Timing marks of intake camshaft timing sprocket
2.	Timing marks of exhaust camshaft timing sprocket
3.	Arrow mark on idler sprocket
4.	Timing mark of crankshaft timing sprocket

Fig. 59: Identifying Timing Marks Of Intake Camshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove timing chain tensioner adjuster No.2 (1) and gasket. To remove them, slacken 2nd timing chain by turning intake camshaft counterclockwise a little while pushing back pad.

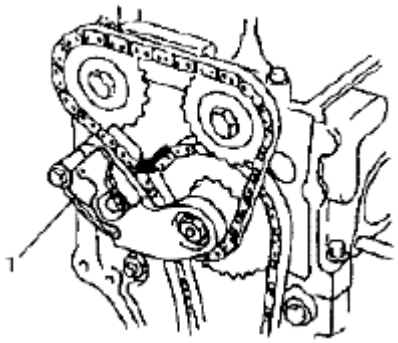


Fig. 60: Identifying Timing Chain Tensioner Adjuster No.2

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Courtesy of SUZUKI OF AMERICA CORP.

4. Remove intake and exhaust camshaft timing sprocket bolts (1). To remove them, fit a spanner (4) to hexagonal part (3) at the center of camshaft to hold it stationary.
5. Remove camshaft timing sprockets and 2nd timing chain (2).

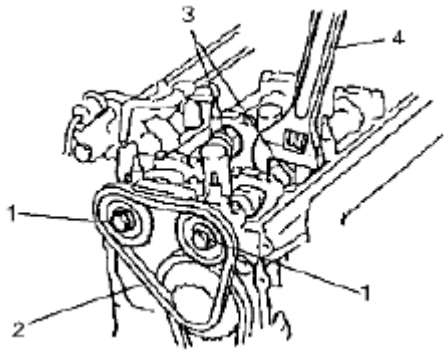


Fig. 61: Identifying Camshaft Timing Sprockets & 2nd Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reference: **2nd TIMING CHAIN AND CHAIN TENSIONER INSPECTION**

1. Check that match mark (1) on crank timing sprocket is in match with timing mark (2) on lower crankcase as shown in **Fig. 62**.

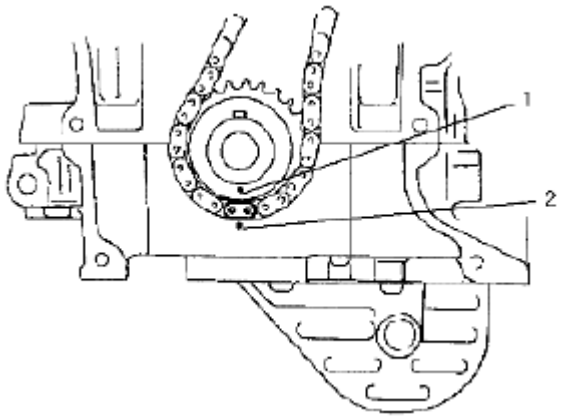
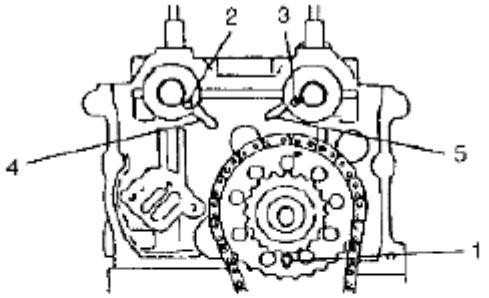


Fig. 62: Identifying Match Mark On Crank Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Check that arrow mark (1) on idler sprocket faces upward.
3. Check that knock pins of intake (2) and exhaust (3) camshafts are aligned with timing marks on cylinder head.

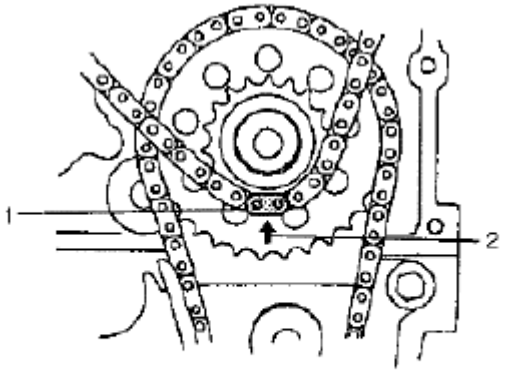
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4.	Timing mark of intake side
5.	Timing mark of exhaust side

Fig. 63: Identifying Arrow Mark On Idler Sprocket Faces
Courtesy of SUZUKI OF AMERICA CORP.

4. Install 2nd timing chain by aligning yellow plate (1) of 2nd timing chain and match marks on idler sprocket.



2.	Match mark of 2nd timing chain (Arrow mark)

Fig. 64: Identifying 2nd Timing Chain & Match Marks On Idler Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

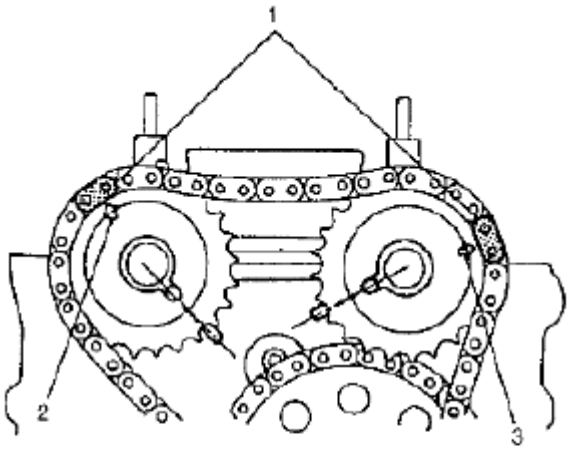
5. Install sprockets to intake and exhaust camshafts by aligning dark blue plate of 2nd timing chain, match marks on intake sprocket and exhaust sprocket respectively.

CAUTION: Do not turn more than allowable turning range.
If turned excessively, valve and piston may be damaged.

NOTE: As an arrow mark is provided on both sides, camshaft timing sprocket has

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no specific installation direction.



1.	Dark blue plate
2.	Arrow mark on intake camshaft timing sprocket
3.	Arrow mark on exhaust camshaft timing sprocket

Fig. 65: Identifying Arrow Mark On Intake & Exhaust Camshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

6. Tighten intake and exhaust camshaft timing sprocket bolts (1) to specified torque. To tighten it, fit a spanner (2) to hexagonal part (3) at the center of camshaft to hold it stationary.

   Tightening torque

   Camshaft timing sprocket bolt a: 80 N.m (8.0 kg-m, 57.5 lb-ft)

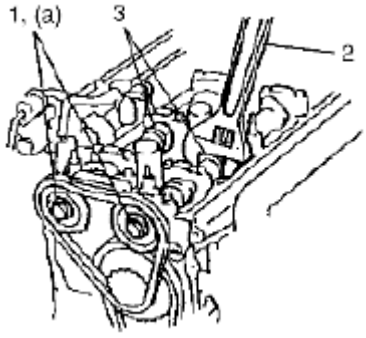


Fig. 66: Identifying Camshaft Timing Sprocket Bolt
Courtesy of SUZUKI OF AMERICA CORP.

7. Push back plunger (1) into tensioner body (2), and hold it at the position by inserting stopper (3) into

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body.

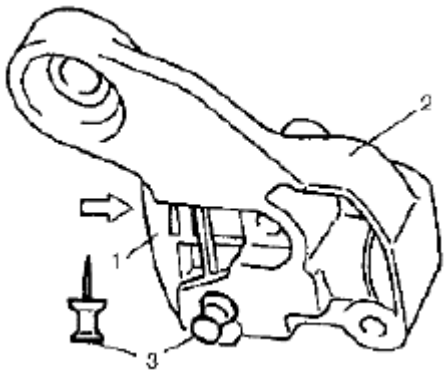


Fig. 67: Pushing Back Plunger Into Tensioner Body
Courtesy of SUZUKI OF AMERICA CORP.

8. Install timing chain tensioner adjuster No.2 (1) with new gasket.

   Tightening torque

   Timing chain tensioner adjuster No.2 bolt a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

   Timing chain tensioner adjuster No.2 nut b: 45 N.m (4.5 kg-m, 33.0 lb-ft)

9. Pull out stopper (2) from timing chain tensioner adjuster No.2.

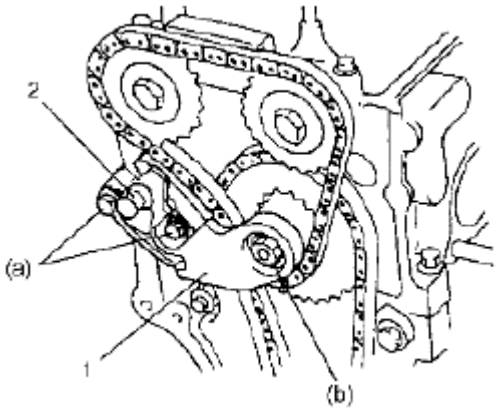
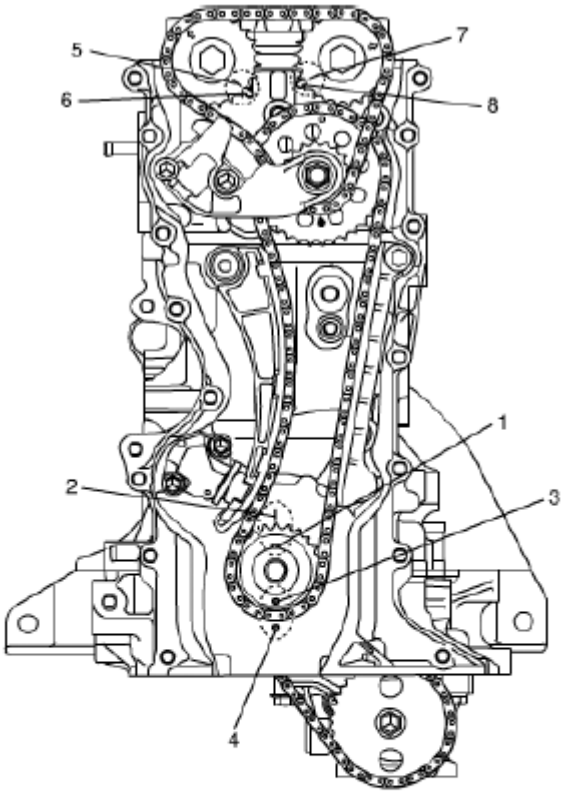


Fig. 68: Identifying Stopper
Courtesy of SUZUKI OF AMERICA CORP.

10. Turn crankshaft two rotations clockwise, and then align timing mark (1) on crankshaft and timing mark (2) on cylinder block as shown in **Fig. 69**.

    At this time, check timing marks (3, 5 and 7) of sprockets are in match with timing marks (4, 6 and 8) of cylinder head, cylinder block and lower crank case.

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3.	Timing mark on crank timing sprocket
4.	Timing mark on lower crankcase
5.	Timing mark on intake camshaft timing sprocket
6.	Timing mark of intake camshaft timing sprocket
7.	Timing mark on exhaust camshaft timing sprocket
8.	Timing mark of exhaust camshaft timing sprocket

Fig. 69: Identifying Camshaft & Crankshaft Timing Mark
Courtesy of SUZUKI OF AMERICA CORP.

11. Apply oil to timing chains, tensioner, tensioner adjusters, sprockets and guides.
12. Install timing chain cover. Refer to **INSTALLATION**.
13. Install cylinder head cover. Refer to **INSTALLATION**.
14. Install oil pan. Refer to **INSTALLATION** .
15. Install engine assembly to vehicle, referring to **INSTALLATION**.

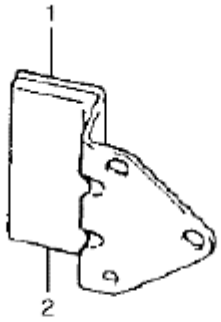
2ND TIMING CHAIN AND CHAIN TENSIONER INSPECTION

Reference: **2nd TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**

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Timing Chain Guide No.2

Check shoe (2) for wear or damage.



1. Timing chain guide No.2

Fig. 70: Identifying Timing Chain Guide No. 2
Courtesy of SUZUKI OF AMERICA CORP.

Camshaft Sprocket

Check teeth of sprocket for wear or damage.

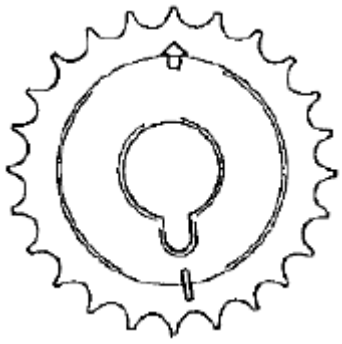


Fig. 71: Identifying Camshaft Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain

Check timing chain for wear or damage.



Fig. 72: Identifying Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

Tensioner Adjuster No.2

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Check shoe (1) for wear or damage and latch functions properly.

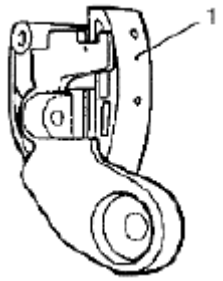
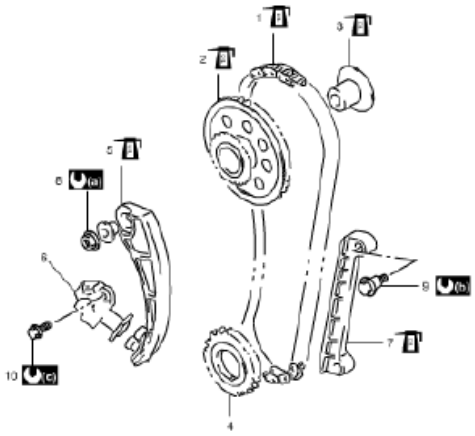


Fig. 73: Identifying Tensioner Adjuster No. 2 Shoe
Courtesy of SUZUKI OF AMERICA CORP.

1ST TIMING CHAIN AND CHAIN TENSIONER COMPONENTS



1. 1st timing chain	6. Timing chain tensioner adjuster No.1	(a): 25 N·m (2.5 kgf-m, 18.0 lb-ft)
2. Idler sprocket	7. Timing chain guide No.1	(b): 9 N·m (0.9 kgf-m, 6.5 lb-ft)
3. Idler sprocket shaft	8. Timing chain tensioner nut	(c): 11 N·m (1.1 kgf-m, 8.0 lb-ft)
4. Crankshaft timing sprocket	9. Timing chain guide No.1 bolt	: Apply engine oil to sliding surface.
5. Timing chain tensioner	10. Timing chain tensioner adjuster No.1 bolt	

Fig. 74: Identifying 1st Timing Chain & Chain Tensioner Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

1ST TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION

Reference: **1st TIMING CHAIN AND CHAIN TENSIONER COMPONENTS**

CAUTION: After timing chain is removed, never turn crankshaft and camshafts

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independently more than its allowable turning range described referring to 2nd TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION.
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

Removal

1. Remove 2nd timing chain. Refer to **REMOVAL** for removal.
2. Remove timing chain guide No.1 (1).
3. Remove timing chain tensioner adjuster No.1 (2).
4. Remove timing chain tensioner (3).
5. Remove idler sprocket (6) and 1st timing chain (5).
6. Remove crankshaft timing sprocket (4).

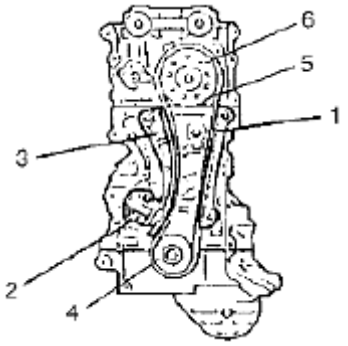


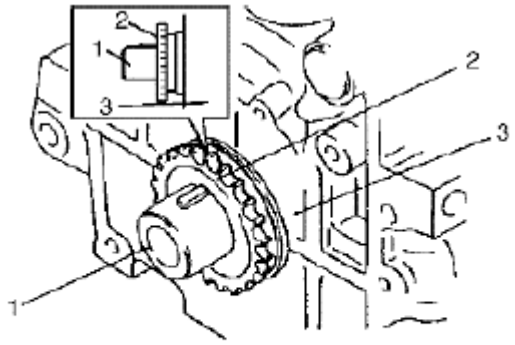
Fig. 75: Identifying Crankshaft Timing Sprocket & Timing Chain Guide No.1
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reference: **1st TIMING CHAIN AND CHAIN TENSIONER INSPECTION**

1. Install crankshaft timing sprocket (2).

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1. Crankshaft	3. Cylinder block

Fig. 76: Identifying Crankshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Check that match mark (1) on crankshaft timing sprocket is in match with timing mark (2) on lower crankcase.

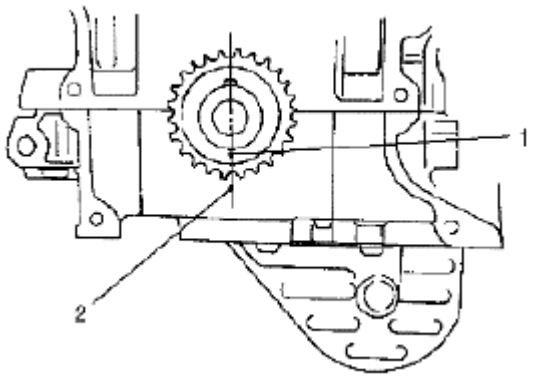


Fig. 77: Identifying Crankshaft Timing Sprocket Timing Mark
Courtesy of SUZUKI OF AMERICA CORP.

3. Apply engine oil to idler sprocket shaft and bush of idler sprocket (1).
4. Install idler sprocket and idler sprocket shaft.
5. Install 1st timing chain by aligning dark blue plate (4) of 1st timing chain (3) and match mark (2) on idler sprocket (1).

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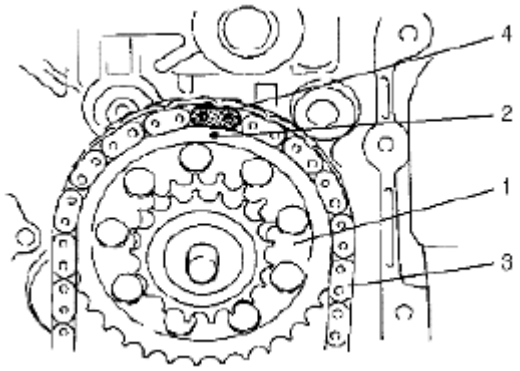


Fig. 78: Aligning Dark Blue Plate Of 1st Timing Chain & Match Mark On Idler Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

6. Bring gold plate (4) of 1st timing chain (3) into match with match mark (2) on crankshaft timing sprocket (1).

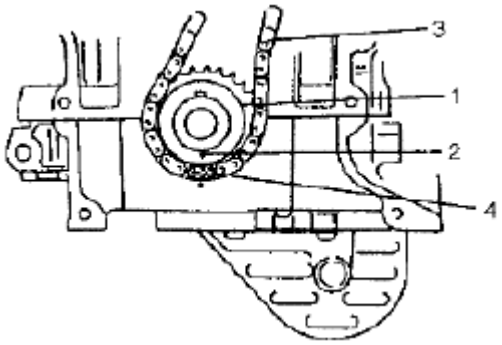


Fig. 79: Identifying Gold Plate Of 1st Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

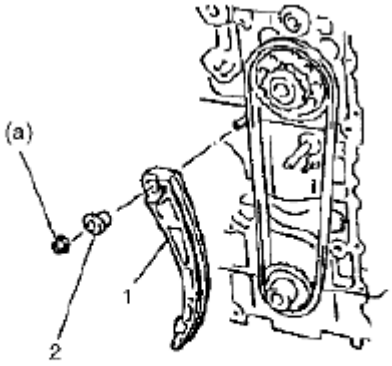
7. Apply engine oil to sliding surface of timing chain tensioner (1) and then install it as shown in **Fig. 80**.

   Tighten tensioner nut to specified torque.

   Tightening torque

   Timing chain tensioner nut a: 25 N.m (2.5 kg-m, 18.0 lb-ft)

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2. Spacer

Fig. 80: Identifying Timing Chain Tensioner & Spacer
Courtesy of SUZUKI OF AMERICA CORP.

8. With latch of tensioner adjuster No.1 returned and plunger (1) pushed back into body, insert stopper (4) into latch (2) and body (3).

   After inserting it, check to make sure that plunger will not come out.

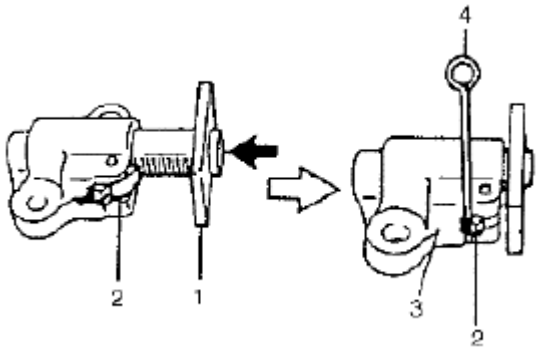


Fig. 81: Inserting Stopper Into Latch & Body
Courtesy of SUZUKI OF AMERICA CORP.

9. Install timing chain tensioner adjuster No.1 (1).

   Tightening torque

   Timing chain tensioner adjuster No.1 bolt a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

10. Pull out stopper (2) from timing chain tensioner adjuster No.1.

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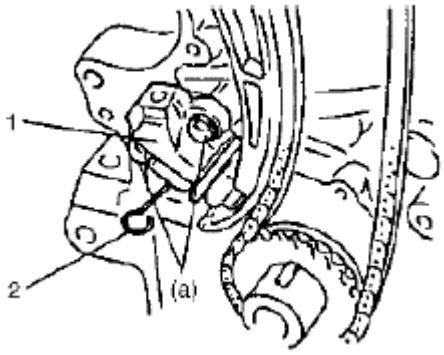


Fig. 82: Identifying Timing Chain Tensioner Adjuster No.1 & Stopper
Courtesy of SUZUKI OF AMERICA CORP.

11. Apply engine oil to sliding surface of timing chain guide No.1 (1) and then install it.

    Tighten guide bolts to specified torque.

    Tightening torque

    Timing chain guide No.1 bolt a: 9 N.m (0.9 kg-m, 6.5 lb-ft)

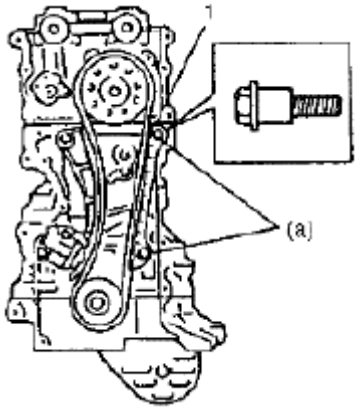
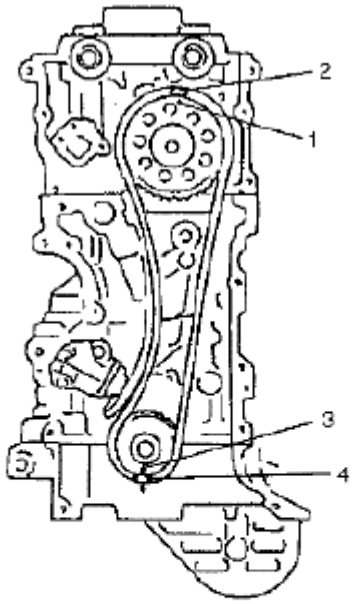


Fig. 83: Identifying Timing Chain Guide No.1 Bolts
Courtesy of SUZUKI OF AMERICA CORP.

12. Check that dark blue and gold plates of 1st timing chain are in match with match marks on sprockets respectively.

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1.	Match mark on idler sprocket
2.	Dark blue plate
3.	Match mark on crankshaft timing sprocket
4.	Gold plate

Fig. 84: Identifying Match Mark On Idler Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

13. Install 2nd timing chain. Refer to **INSTALLATION**.
14. Install timing chain cover. Refer to **INSTALLATION**.
15. Install cylinder head cover. Refer to **INSTALLATION**.
16. Install oil pan. Refer to **INSTALLATION** .
17. Install engine assembly to vehicle, referring to **INSTALLATION**.

1ST TIMING CHAIN AND CHAIN TENSIONER INSPECTION

Reference: **1st TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**

Timing Chain Guide No.1

Check shoe for wear or damage.

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1. Timing chain guide No.1

Fig. 85: Identifying Timing Chain Guide No.1
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain Tensioner

Check shoe (1) for wear or damage.

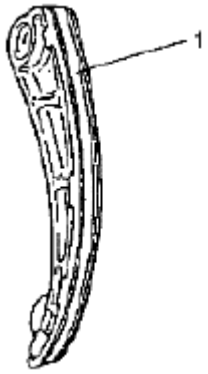


Fig. 86: Identifying Timing Chain Tensioner Shoe
Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft Timing Sprocket

Check teeth of sprocket for wear or damage.

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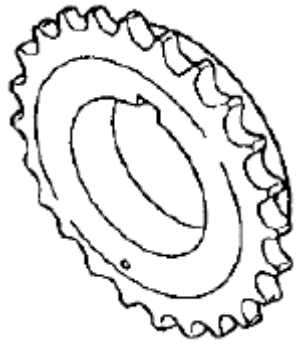


Fig. 87: Identifying Crankshaft Timing Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

Idler Sprocket

Check teeth and bush (1) of sprocket for wear or damage.

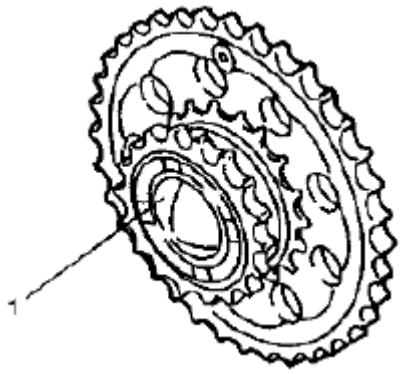


Fig. 88: Identifying Idler Sprocket Teeth & Bush
Courtesy of SUZUKI OF AMERICA CORP.

1st Timing Chain

Check timing chain for wear or damage.

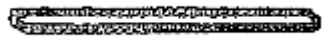


Fig. 89: Identifying 1st Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain Tensioner Adjuster No.1

Check that latch (1) and tooth surface (2) are free from damage and latch functions properly.

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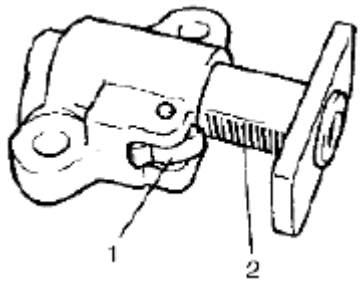
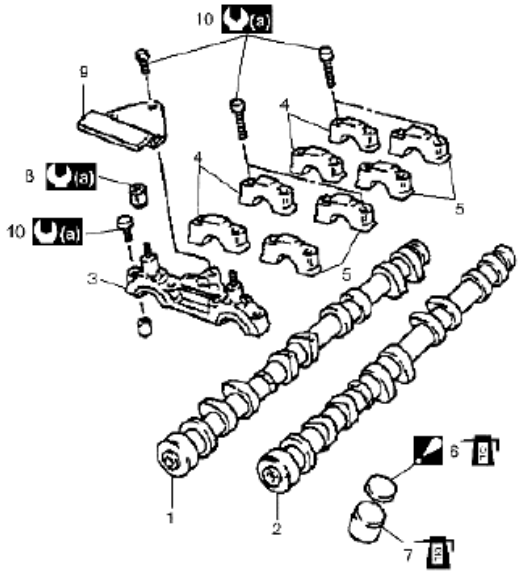


Fig. 90: Identifying Timing Chain Tensioner Adjuster No.1 Latch & Tooth Surface
Courtesy of SUZUKI OF AMERICA CORP.

CAMSHAFTS, TAPPET AND SHIM COMPONENTS



1. Intake camshaft	5. Exhaust camshaft housing	9. Timing chain guide No.2
2. Exhaust camshaft	6. Shim : Direct shim No. side toward tappet.	10. Camshaft housing bolt
3. Camshaft housing	7. Tappet	(a): Tighten 11 N·m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure.
4. Intake camshaft housing	8. Oil relief valve	OIL: Apply engine oil to sliding surface of each part.

Fig. 91: Identifying Camshafts, Tappet & Shim Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

CAMSHAFTS, TAPPET AND SHIM REMOVAL AND INSTALLATION

Reference: **CAMSHAFTS, TAPPET AND SHIM COMPONENTS**

CAUTION:

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- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust.**

  Keep them always clean.

Removal

1. Remove 2nd timing chain. Refer to **REMOVAL**.
2. Loosen camshaft housing bolts in such order as indicated in **Fig. 92** and remove them.

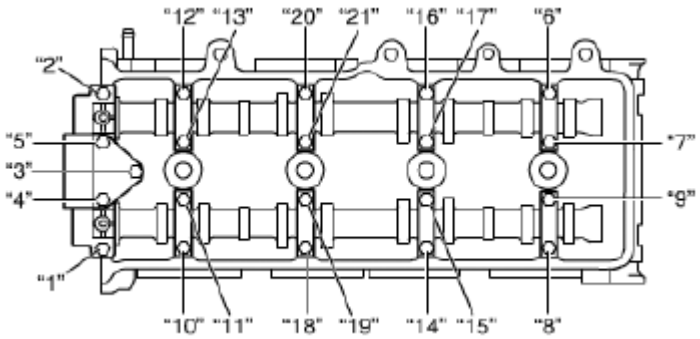


Fig. 92: Identifying Camshaft Housing Bolts Sequence
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove camshaft housings.
4. Remove camshafts.
5. Remove tappets with shims.

Installation

Reference: **CAMSHAFT, TAPPET AND SHIM INSPECTION**

1. Apply engine oil around tappet (1) and shim, and then install tappets with shims to cylinder head.

NOTE: When installing shim, make sure to direct shim No. side toward tappet.

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Fig. 93: Identifying Tappet & Shim
Courtesy of SUZUKI OF AMERICA CORP.

2. Match mark (1) on crank timing sprocket and mating surface of cylinder block (3) and lower crankcase (2).

   At this time, make sure that arrow mark (4) on idler sprocket (5) at the position.

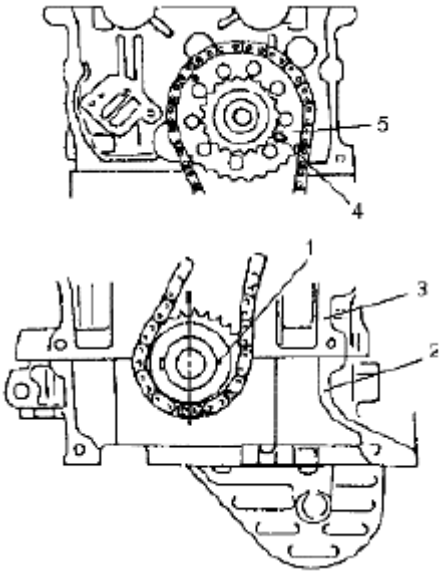
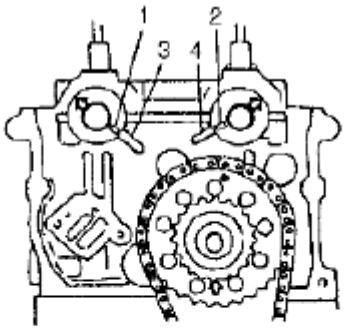


Fig. 94: Identifying Match Mark On Crank Timing Sprocket & Mating Surface Of Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

3. Install camshafts.

   Apply oil to sliding surface of each camshaft and camshaft journal then install them by aligning match marks on cylinder head and camshafts as shown in **Fig. 95**.

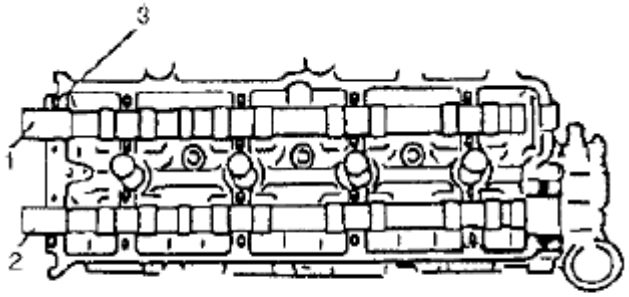
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1.	Knock pin of intake camshaft
2.	Knock pin of exhaust camshaft
3.	Match mark of intake camshaft
4.	Match mark of exhaust camshaft

Fig. 95: Identifying Knock Pin Of Intake & Exhaust Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

4. Install camshaft housing pins (3).



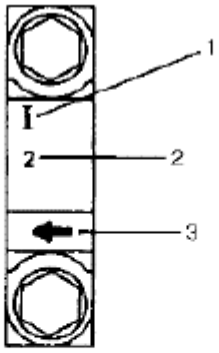
1.	Intake camshaft	2.	Exhaust camshaft

Fig. 96: Identifying Camshaft Housing Pins
Courtesy of SUZUKI OF AMERICA CORP.

5. Check position of camshaft housings.

   Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housings as indicated by these marks.

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1.	I: Intake side or E: Exhaust side
2.	Position from timing chain side
3.	Pointing to timing chain side

Fig. 97: Identifying Bearing Cap Mark
Courtesy of SUZUKI OF AMERICA CORP.

6. After applying oil to housing bolts, tighten them temporarily first. Then tighten them by following numerical order in **Fig. 98**.

   Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

   Tightening torque

   Camshaft housing bolt a: Tighten 11 N.m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure

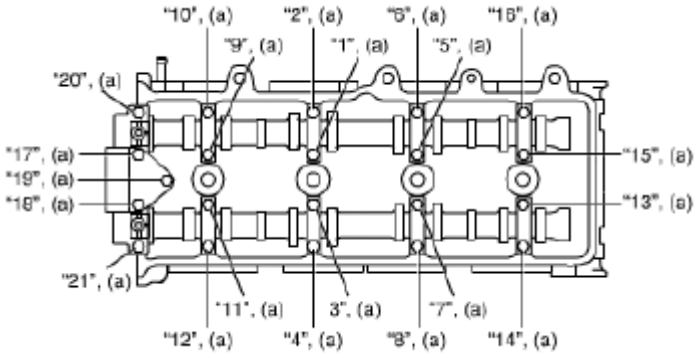


Fig. 98: Identifying Tightening Sequence Of Camshaft Housing Bolt
Courtesy of SUZUKI OF AMERICA CORP.

7. Turn crankshaft clockwise then align crankshaft timing sprocket key (1) with timing mark (2).

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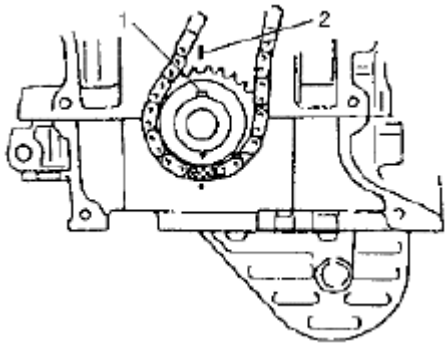


Fig. 99: Identifying Crankshaft Timing Sprocket Key With Timing Mark
Courtesy of SUZUKI OF AMERICA CORP.

8. Install 2nd timing chain. Refer to **INSTALLATION**.
9. Install timing chain cover. Refer to **INSTALLATION**.
10. Install cylinder head cover. Refer to **INSTALLATION**.
11. Install oil pan. Refer to **INSTALLATION** .
12. Install engine assembly to vehicle, referring to **INSTALLATION**.
13. Check valve lashes, referring to **VALVE LASH (CLEARANCE) INSPECTION**.

CAMSHAFT, TAPPET AND SHIM INSPECTION

Reference: **CAMSHAFTS, TAPPET AND SHIM REMOVAL AND INSTALLATION**

Cam Wear

Using a micrometer, measure cam height. If measured height is below its limit, replace camshaft.

Cam height "a"

CAM HEIGHT SPECIFICATION

Cam height	Standard	Limit
Intake cam	45.669 - 45.829 mm (1.798 - 1.8043 in.)	45.550 mm (1.793 in.)
Exhaust cam	45.550 - 45.710 mm (1.7933 - 1.7996 in.)	45.430 mm (1.789 in.)

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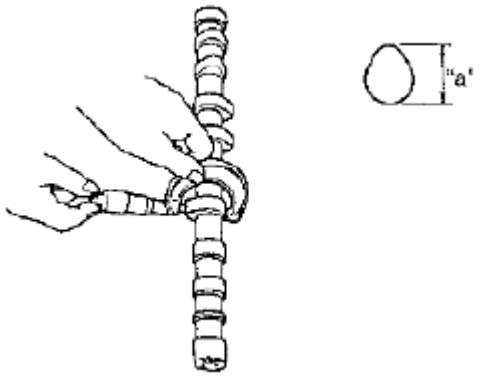


Fig. 100: Measuring Cam Height Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Camshaft Runout

Set camshaft between two "V" blocks, and measure its runout by using a dial gauge.

If measured runout exceeds the specified limit, replace camshaft.

Runout limit

0.03 mm (0.0012 in.)

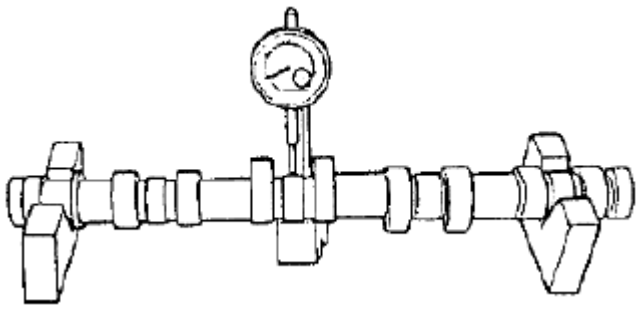


Fig. 101: Measuring Camshaft Runout Using Dial Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Camshaft Journal Wear

Check camshaft journals and camshaft housings for pitting, scratches, wear or damage.

If any malcondition is found, replace camshaft or cylinder head with housing. Never replace cylinder head without replacing housings.

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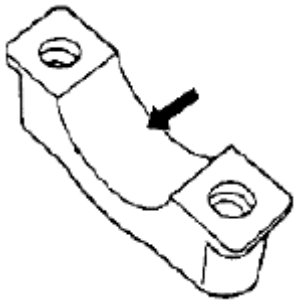


Fig. 102: Identifying Bearing Cap
Courtesy of SUZUKI OF AMERICA CORP.

Check clearance by using gauging plastic. Checking procedure is as follows.

1. Clean housings and camshaft journals.
2. Make sure that all tappets with shims are removed and install camshafts to cylinder head.
3. Place a piece of gauging plastic to full width of journal of camshaft (parallel to camshaft).
4. Install camshaft housing.
5. Tighten camshaft housing bolts in such order as indicated in **Fig. 103** a little at a time till they are tightened to specified torque.

NOTE: Do not rotate camshaft while gauging plastic is installed.

Tightening torque

Camshaft housing bolt a: Tighten 11 N.m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure

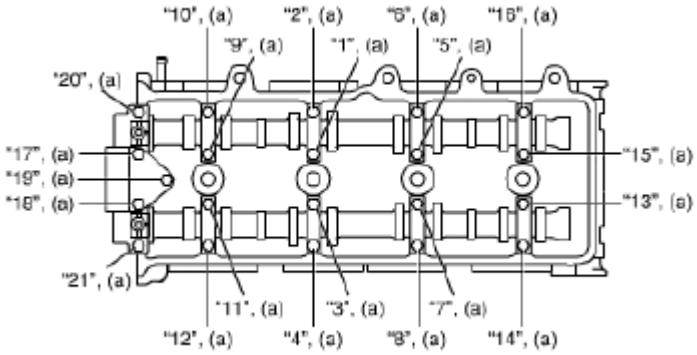


Fig. 103: Identifying Camshaft Housing Bolt Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove housing, and using scale (2) on gauging plastic envelop (1), measure gauging plastic width at its widest point.

Journal clearance

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JOURNAL CLEARANCE SPECIFICATION

Standard	Limit
0.020 - 0.074 mm (0.0008 - 0.0029 in.)	0.12 mm (0.0047 in.)

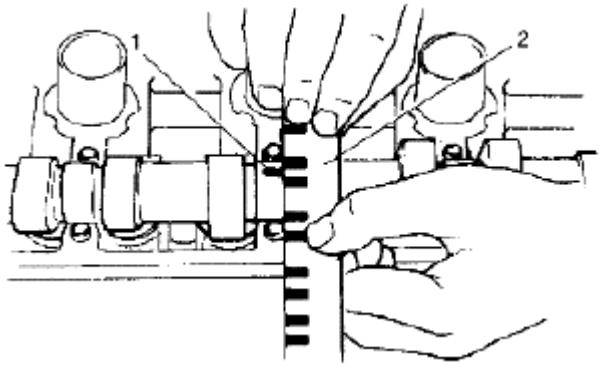


Fig. 104: Measuring Plastic Gauge Width
Courtesy of SUZUKI OF AMERICA CORP.

If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Camshaft journal

CAMSHAFT JOURNAL SPECIFICATION

Item	Standard
Camshaft journal bore diameter. (IN & EX) [A]	26.000 - 26.033 mm (1.0236 - 1.0249 in.)
Camshaft journal O.D. (IN & EX) [B]	25.959 - 25.980 mm (1.0221 - 1.0228 in.)

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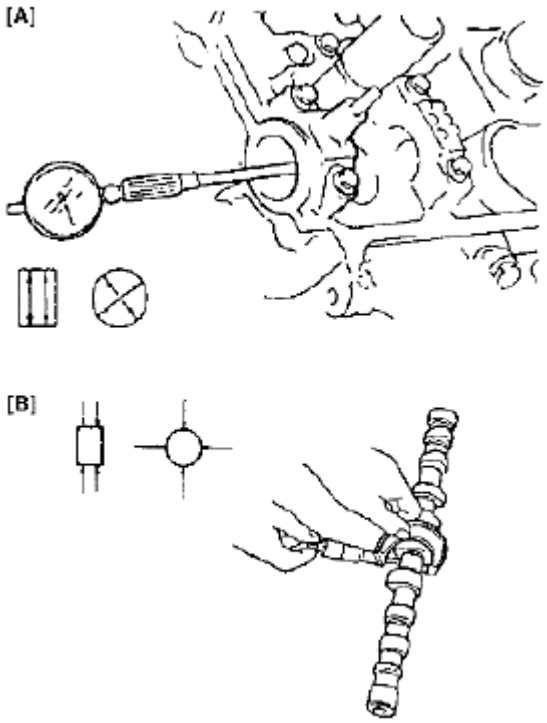


Fig. 105: Measuring Journal (Housing) Bore & Outside Diameter Of Camshaft Journal
Courtesy of SUZUKI OF AMERICA CORP.

Wear of Tappet and Shim

Check tappet and shim for pitting, scratches, or damage.

If any malcondition is found, replace.

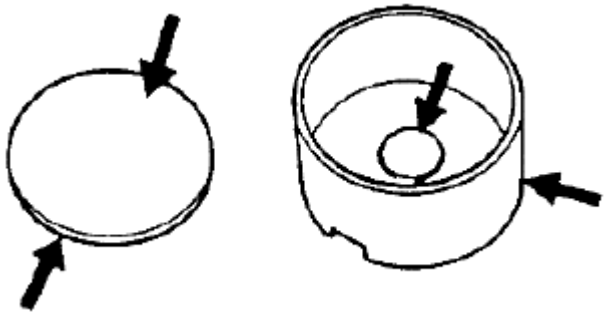


Fig. 106: Inspecting Cylinder Head Bore
Courtesy of SUZUKI OF AMERICA CORP.

Measure cylinder head bore and tappet outside diameter to determine cylinder head-to-tappet clearance. If clearance exceeds limit, replace tappet or cylinder head.

Cylinder head bore and tappet outside diameter

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CYLINDER HEAD BORE AND TAPPET OUTSIDE DIAMETER

Item	Standard	Limit
Tappet outside diameter [A]	32.456 - 32.472 mm (1.2778 - 1.2784 in.)	-
Cylinder head bore [B]	32.500 - 32.525 mm (1.2795 - 1.2805 in.)	-
Cylinder head to tappet clearance	0.028 - 0.069 mm (0.0011 - 0.0027 in.)	0.15 mm (0.0059 in.)

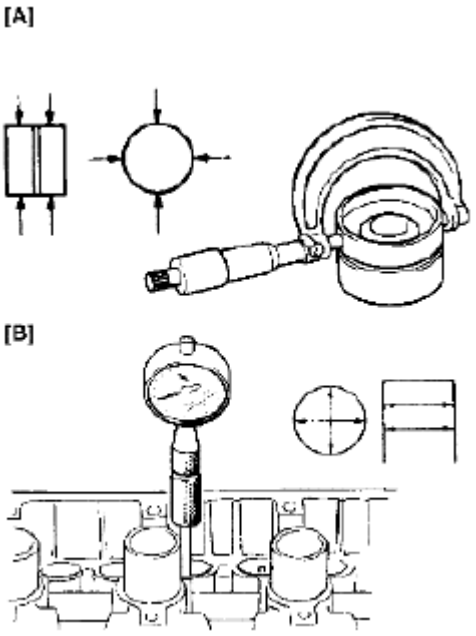


Fig. 107: Identifying Tappet Outside Diameter & Cylinder Head Bore
Courtesy of SUZUKI OF AMERICA CORP.

Oil Relief Valve

Check oil relief valve for clogging and ball for being stuck.

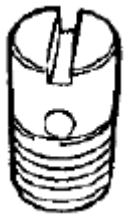
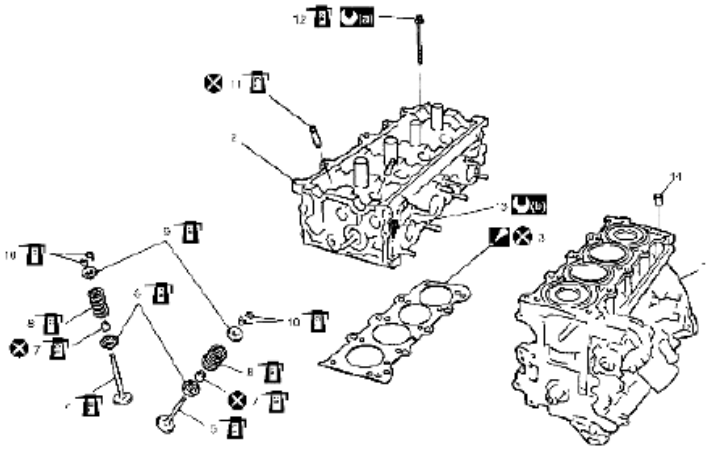


Fig. 108: Identifying Oil Relief Valve
Courtesy of SUZUKI OF AMERICA CORP.

VALVES AND CYLINDER HEAD COMPONENTS

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1. Cylinder block	7. Valve stem seal	13. Cylinder head bolt (M6) : Be sure to tighten cylinder head bolt (M6) after securing cylinder head bolt (M10).
2. Cylinder head	8. Valve spring	14. Knock pin
3. Cylinder head gasket : Identification number provided on gasket comes to crankshaft pully side, facing up.	9. Valve spring retainer	(a): Tighten 52 N·m (5.2 kgf-m, 38.0 lb-ft), 82 N·m (8.2 kgf-m, 59.5 lb-ft), 0 N·m (0 kgf-m, 0 lb-ft), 52 N·m (5.2 kgf-m, 38.0 lb-ft) and 103 N·m (10.3 kgf-m, 74.5 lb-ft) by the specified procedure.
4. Intake valve	10. Valve cotter	(b): 11 N·m (1.1 kgf-m, 8.0 lb-ft)
5. Exhaust valve	11. Valve guide	: Do not reuse.
6. Valve spring seat	12. Cylinder head bolt (M10)	: Apply engine oil to sliding surface of each part.

Fig. 109: Identifying Valves & Cylinder Head Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

VALVES AND CYLINDER HEAD REMOVAL AND INSTALLATION

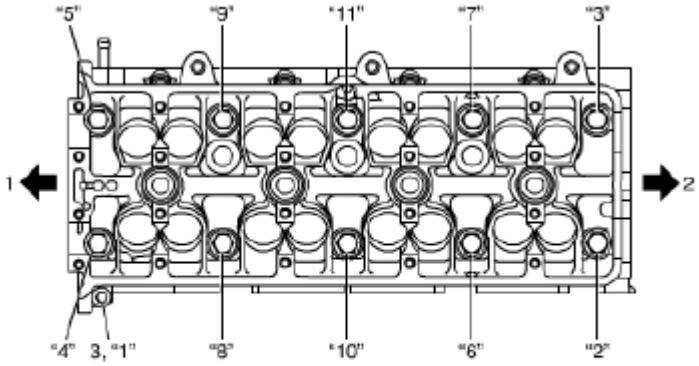
Reference: **VALVES AND CYLINDER HEAD COMPONENTS**

Removal

1. Remove camshafts, tappets and shims. Refer to **REMOVAL**.
2. Loosen cylinder head bolts in such order as numbered in **Fig. 110** and remove them.

NOTE: Don't forget to remove cylinder head bolt (M6) (3).

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1. Crankshaft pulley side	2. Flywheel side

Fig. 110: Identifying Cylinder Head Bolt Sequence
Courtesy of SUZUKI OF AMERICA CORP.

3. Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
4. Remove cylinder head with intake manifold, exhaust manifold and water outlet cap. Use lifting device, if necessary.

Installation

Reference: **VALVES AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY**

1. Match mark (1) on crank timing sprocket and mating surface (2) of cylinder block and lower crankcase.

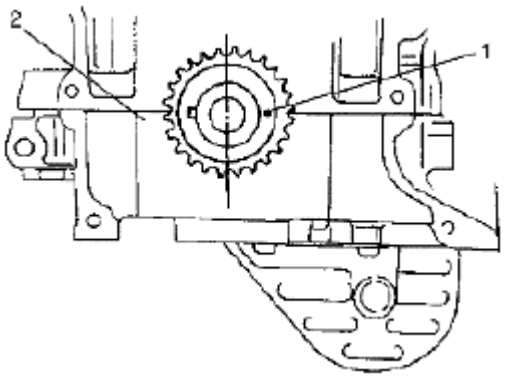
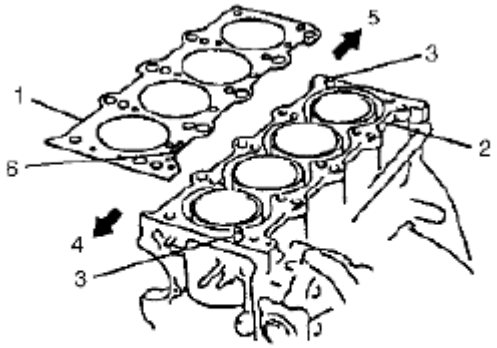


Fig. 111: Identifying Match Mark On Crank Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

2. Clean mating surface of cylinder head and cylinder block (2). Remove oil, old gasket and dust from mating surface.
3. Install knock pins (3) to cylinder block.

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4. Install new cylinder head gasket (1) to cylinder block. Identification number (6) provided on gasket comes to crankshaft pulley side (4), facing up (toward cylinder head side).



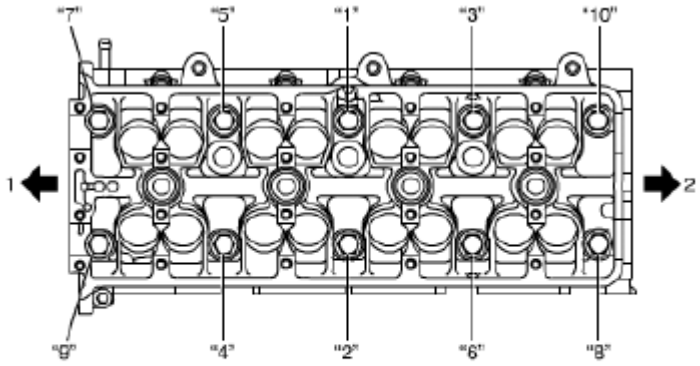
5.	Flywheel side

Fig. 112: Identifying Cylinder Head Gasket
Courtesy of SUZUKI OF AMERICA CORP.

5. Install cylinder head to cylinder block.

   Apply engine oil to cylinder head bolts and tighten them gradually as follows.

   a. Tighten cylinder head bolts (M10) to 52 N.m (5.2 kgf-m, 38.0 lb-ft) according to numerical order in **Fig. 113**.
   b. In the same manner as in step a), retighten cylinder head bolts (M10) to 82 N.m (8.2 kgf-m, 59.5 lb-ft).

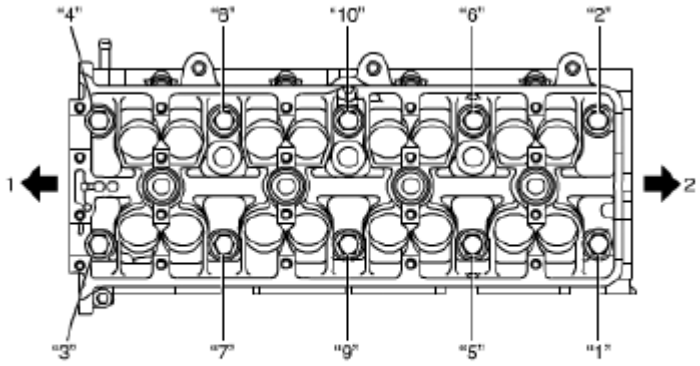


1.	Crankshaft pulley side	2.	Flywheel side

Fig. 113: Identifying Tightening Sequence Of Cylinder Head Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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c. Loosen cylinder head bolts (M10) until tightening torque is reduced to 0 according to numerical order in **Fig. 114**.



1. Crankshaft pulley side	2. Flywheel side

Fig. 114: Identifying Loosening Sequence Of Cylinder Head Bolt
Courtesy of SUZUKI OF AMERICA CORP.

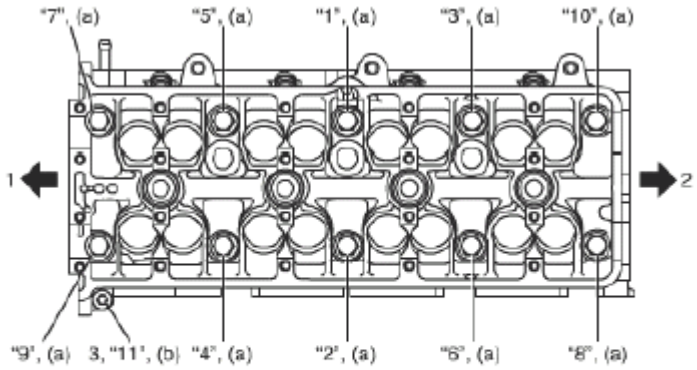
d. Tighten cylinder head bolts (M10) to 52 N.m (5.2 kgf-m, 38.0 lb-ft) according to numerical order in **Fig. 115**.
e. In the same manner as in step b), retighten cylinder head bolts (M10) to 103 N.m (10.3 kgf-m, 74.5 lb-ft).
f. Tighten cylinder head bolt (M6) to specified torque.

Tightening torque

Cylinder head bolt (M10) a: Tighten 52 N.m (5.2 kgf-m, 38.0 lb-ft), 82 N.m (8.2 kgf-m, 59.5 lb-ft), 0 N.m (0 kgf-m, 0 lb-ft), 52 N.m (5.2 kgf-m, 38.0 lb-ft) and 103 N.m (10.3 kgf-m, 74.5 lb-ft) by the specified procedure

Cylinder head bolt (M6) b: 11 N.m (1.1 kg-m, 8.0 lb-ft)

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1. Crankshaft pulley side	2. Flywheel side

Fig. 115: Identifying Tightening Sequence Of Cylinder Head Bolt
Courtesy of SUZUKI OF AMERICA CORP.

6. Install camshafts, tappets and shims. Refer to **INSTALLATION**.
7. Install 1st timing chain. Refer to **INSTALLATION**.
8. Install 2nd timing chain. Refer to **INSTALLATION**.
9. Install timing chain cover. Refer to **INSTALLATION**.
10. Check intake and exhaust valve lashes by referring to **VALVE LASH (CLEARANCE) INSPECTION**.
11. Install cylinder head cover by referring to **INSTALLATION**.
12. Install oil pan by referring to **INSTALLATION** .
13. Install engine assembly to vehicle by referring to **INSTALLATION**.

VALVES AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY

Reference: **VALVES AND CYLINDER HEAD REMOVAL AND INSTALLATION**

Disassembly

1. When servicing cylinder head, remove intake manifold, injectors, exhaust manifold and water outlet cap from cylinder head.
2. Using special tools, compress valve springs and then remove valve cotters (1) also by using special tool.

Special Tool

A. **09916-14510**
B. **09916-16510**
C. **09919-28610**
D. **09916-84511**

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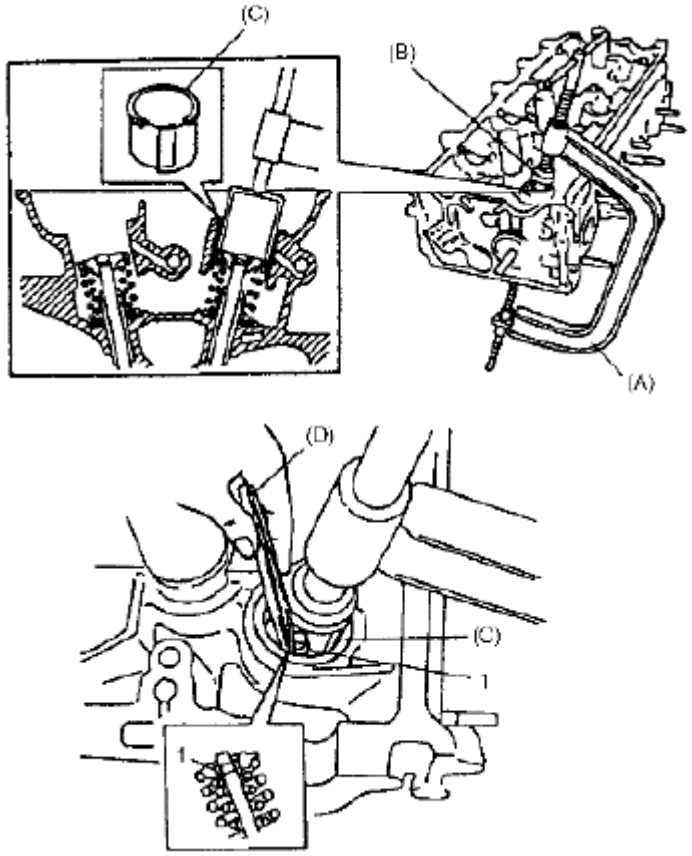
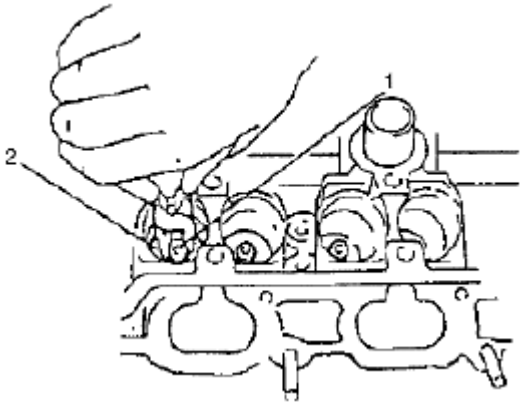


Fig. 116: Compressing Valve Springs
Courtesy of SUZUKI OF AMERICA CORP.

3. Release special tool, and remove spring retainers and valve springs.
4. Remove valve from combustion chamber side.
5. Remove valve stem seal (1) from valve guide, and then valve spring seat (2).

NOTE: Do not reuse seal once disassembled. Be sure to use new seal when assembling.



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Fig. 117: Removing Valve Stem Seal From Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

6. Using special tool (Valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

   Special Tool

   (A): 09916-46020

   NOTE: Do not reuse valve guide once disassembled. Be sure to use new valve guide (oversize) when assembling.

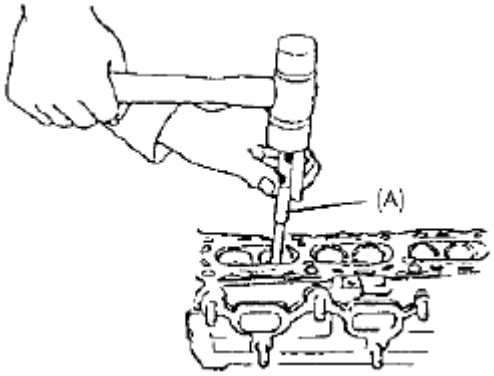


Fig. 118: Driving Valve Guide Out From Combustion Chamber Side To Valve Spring Side
Courtesy of SUZUKI OF AMERICA CORP.

7. Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original positions.

Reassembly

Reference: **VALVES AND VALVE GUIDES INSPECTION**

1. Before installing valve guide into cylinder head, ream guide hole with special tool (11 mm reamer) so as to remove burrs and make it truly round.

   Special Tool

   A. **09916-34542**
   B. **09916-38210**

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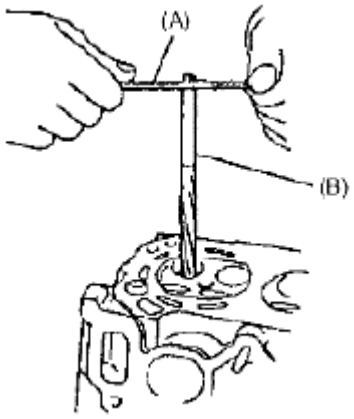


Fig. 119: Reaming Guide Hole With Special Tool
Courtesy of SUZUKI OF AMERICA CORP.

2. Install valve guide to cylinder head.

   Heat cylinder head uniformly at a temperature of 80 to 100°C (176 to 212°F) so that head will not be distorted, and drive new valve guide into hole with special tools.

   Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.

   After installing, make sure that valve guide protrudes by specified value from cylinder head.

   Special Tool

   A. **09916-57350**
   B. **09916-57340**

   NOTE:
   - **Do not reuse valve guide once disassembled. Install new valve guide (Oversize).**
   - **Intake and exhaust valve guides are identical.**

   Valve guide oversize

   0.03 mm (0.0012 in.)

   Valve guide protrusion "a"

   In: 14.5 mm (0.57 in.)

   Ex: 13.5 mm (0.53 in.)

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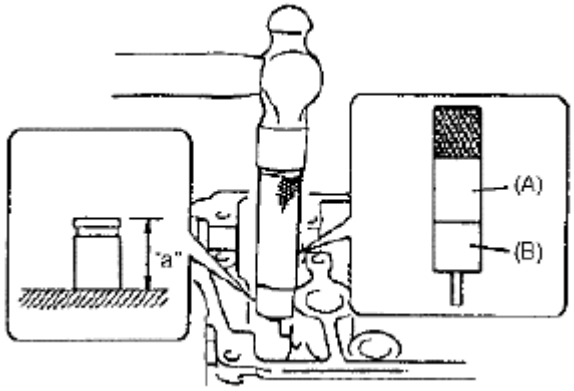


Fig. 120: Installing Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

3. Ream valve guide bore with special tool (6.0 mm reamer). After reaming, clean bore.

   Special Tool

   A. **09916-34542**
   B. **09916-37810**

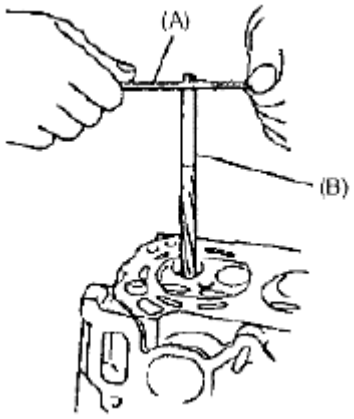


Fig. 121: Reaming Guide Hole With Special Tool
Courtesy of SUZUKI OF AMERICA CORP.

4. Install valve spring seat to cylinder head.
5. Install new valve stem seal (1) to valve guide.

   After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.

   After installing, check to be sure that seal is properly fixed to valve guide.

   Special Tool

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A. **09917-98221**
B. **09916-57350**

NOTE:

- **Do not reuse seal once disassembled. Be sure to install new seal.**
- **When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.**

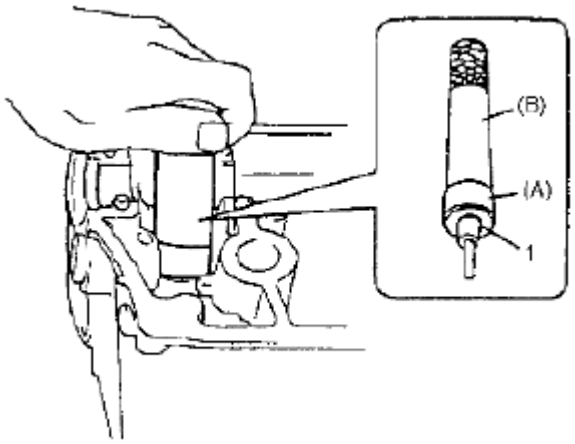


Fig. 122: Installing Valve Stem Seal
Courtesy of SUZUKI OF AMERICA CORP.

6. Install valve to valve guide.

   Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore, and valve stem.

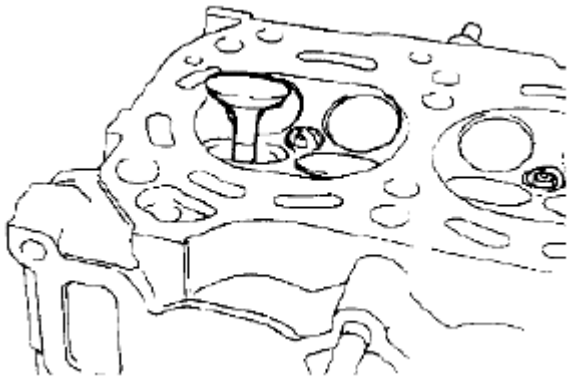


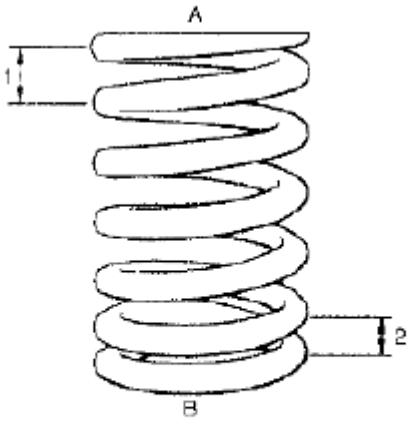
Fig. 123: Installing Valve To Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

7. Install valve spring and spring retainer.

   Each valve spring has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to

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position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).



A: Valve spring retainer side	B: Valve spring seat side

Fig. 124: Identifying Valve Spring & Spring Retainer
Courtesy of SUZUKI OF AMERICA CORP.

8. Using special tool (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

Special Tool

A. **09916-14510**
B. **09916-16510**
C. **09919-28610**
D. **09916-84511**

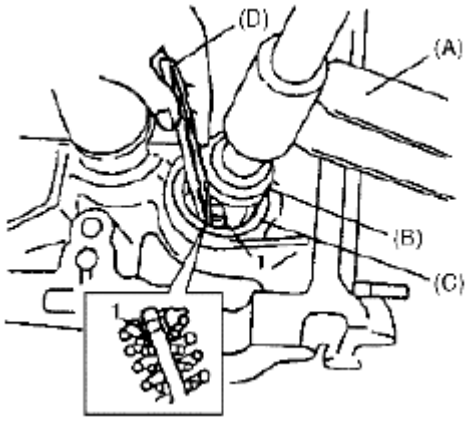


Fig. 125: Compressing Valve Spring & Fit Two Valve Cotters Into Groove In Valve Stem
Courtesy of SUZUKI OF AMERICA CORP.

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9. Install intake manifold by referring to **INSTALLATION**.
10. Install exhaust manifold by referring to **INSTALLATION** .
11. Install injectors by referring to **INSTALLATION** .

VALVES AND VALVE GUIDES INSPECTION

Reference: **VALVES AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY**

Valve Guide

Valve stem-to-guide clearance

Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance.

Be sure to take reading at more than one place along the length of each stem and guide.

If clearance exceeds limit, replace valve and valve guide.

Valve stem and valve guide specification

VALVE STEM AND VALVE GUIDE SPECIFICATION

Item		Standard	Limit
Valve stem diameter [A]	In	5.965 - 5.980 mm (0.2348 - 0.2354 in.)	-
	Ex	5.940 - 5.955 mm (0.2339 - 0.2344 in.)	-
Valve guide bore [B]	In & Ex	6.000 - 6.012 mm (0.2362 - 0.2366 in.)	-
Stem-to-guide clearance	In	0.020 - 0.047 mm (0.0008 - 0.0018 in.)	0.070 mm (0.0028 in.)
	Ex	0.045 - 0.072 mm (0.0017 - 0.0028 in.)	0.090 mm (0.0035 in.)

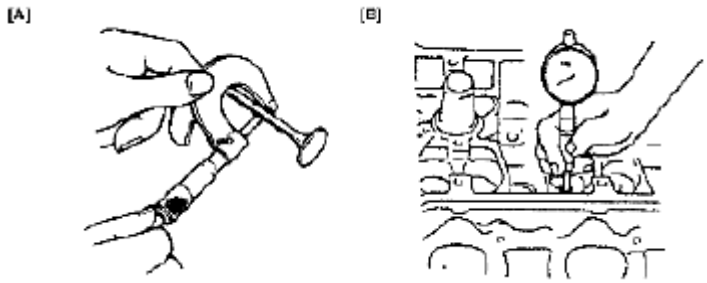


Fig. 126: Checking Valve Stem-To-Guide Clearance
Courtesy of SUZUKI OF AMERICA CORP.

Valve stem end deflection

If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.

Move stem end in directions (1) and (2) to measure end deflection.

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If deflection exceeds its limit, replace valve stem and valve guide.

Valve stem end deflection limit

In: 0.14 mm (0.005 in.)

Ex: 0.18 mm (0.007 in.)

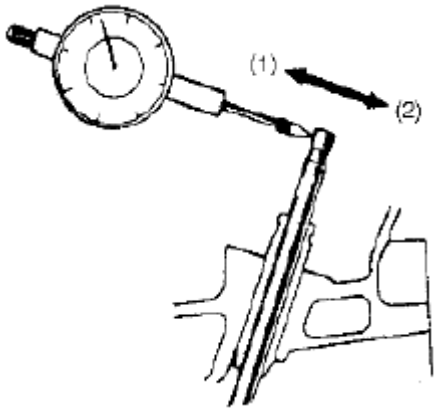


Fig. 127: Measuring Valve Stem End Deflection
Courtesy of SUZUKI OF AMERICA CORP.

Valve

Visual inspection

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem end, as necessary, replace it.
- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not too much to grind off its chamber. When it is worn out too much that its chamber is gone, replace valve.

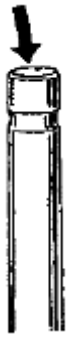


Fig. 128: Locating Valve Stem End Face
Courtesy of SUZUKI OF AMERICA CORP.

Valve head thickness

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Measure thickness "a" of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness "a"

Intake

Standard: 1.25 - 1.55 mm (0.049 - 0.061 in.)

Limit: 0.9 mm (0.035 in.)

Exhaust

Standard: 1.45 - 1.75 mm (0.057 - 0.069 in.)

Limit: 1.1 mm (0.04 in.)

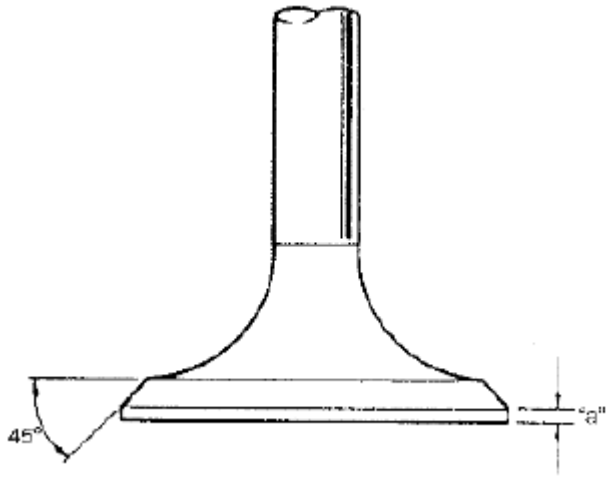


Fig. 129: Measuring Thickness Of Valve Head
Courtesy of SUZUKI OF AMERICA CORP.

Valve head radial runout

Check each valve for radial runout with a dial gauge and "V" block. To check runout, rotate valve slowly. If runout exceeds its limit, replace valve.

Valve head radial runout

Limit: 0.08 mm (0.003 in.)

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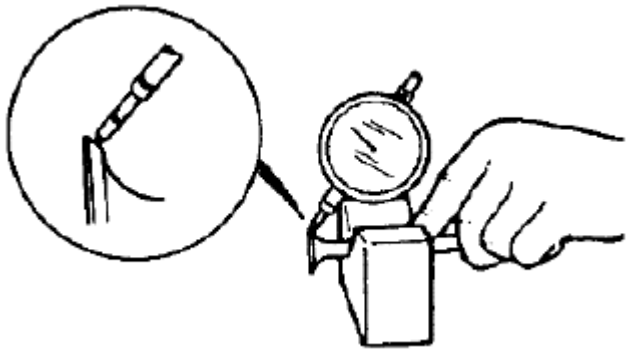


Fig. 130: Checking Valve Head Radial Runout
Courtesy of SUZUKI OF AMERICA CORP.

Seating contact width

Create contact pattern on each valve in the usual manner, i.e., by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.

Pattern produced on seating face of valve must be a continuous ring without any break, and the width of pattern must be within specified range.

Standard seating width "a" revealed by contact pattern on valve face

Intake and Exhaust: 1.0 - 1.4 mm (0.0389 - 0.0551 in.)

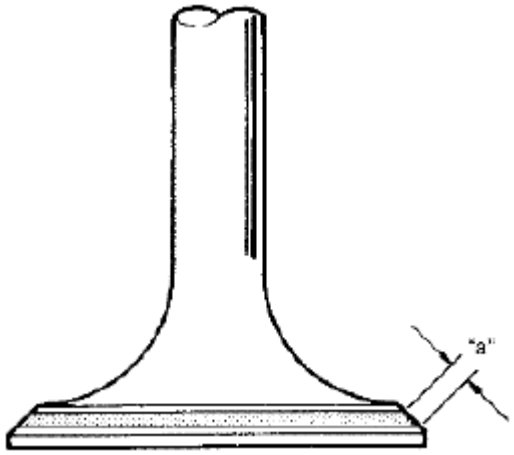


Fig. 131: Checking Seating Contact Width Of Valve Face
Courtesy of SUZUKI OF AMERICA CORP.

Valve seat repair

A valve seat not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

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1. **Exhaust valve seat:**

   Use valve seat cutters (1) to make two cuts as shown in **Fig. 132**. Two cutters must be used: the first for making 15° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

   Seat width for exhaust valve seat

   "a": 1.0 - 1.4 mm (0.0389 - 0.0551 in.)

2. **Intake valve seat:**

   Use valve seat cutters (1) to make three cuts as shown in **Fig. 132**. Three cutters must be used: the 1st for making 25° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

   Seat width for intake valve seat

   "b": 1.0 - 1.4 mm (0.0389 - 0.0551 in.)

3. **Valve lapping:**

   Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.

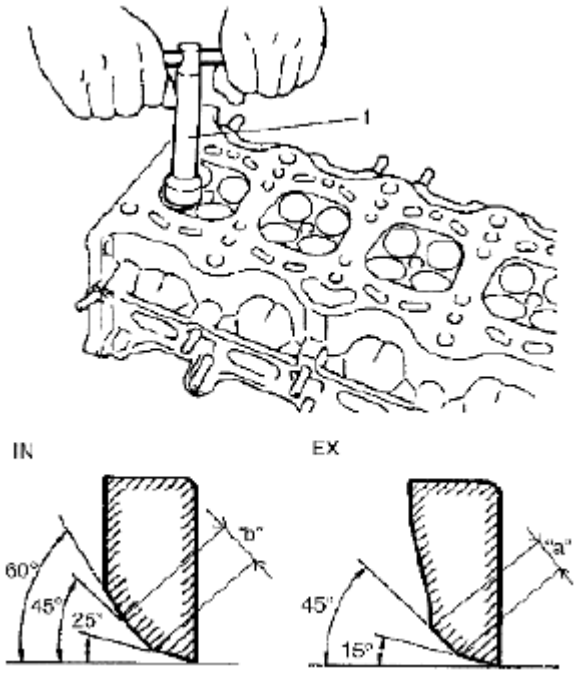


Fig. 132: Identifying Valve Seat Cutter
Courtesy of SUZUKI OF AMERICA CORP.

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CYLINDER HEAD INSPECTION

Reference: **CYLINDER HEAD COVER REMOVAL AND INSTALLATION**

- Remove all carbon deposits from combustion chambers.

NOTE: Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.

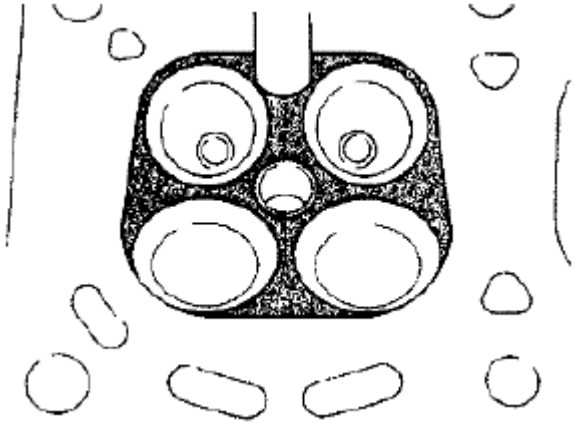


Fig. 133: Removing Carbon Deposits From Combustion Chambers
Courtesy of SUZUKI OF AMERICA CORP.

- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface. Using a straightedge and thickness gauge, check flatness of gasketed surface at a total of 6 locations. If distortion limit is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head. Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

  Distortion for cylinder head surface on piston side

  Limit: 0.03 mm (0.001 in.)

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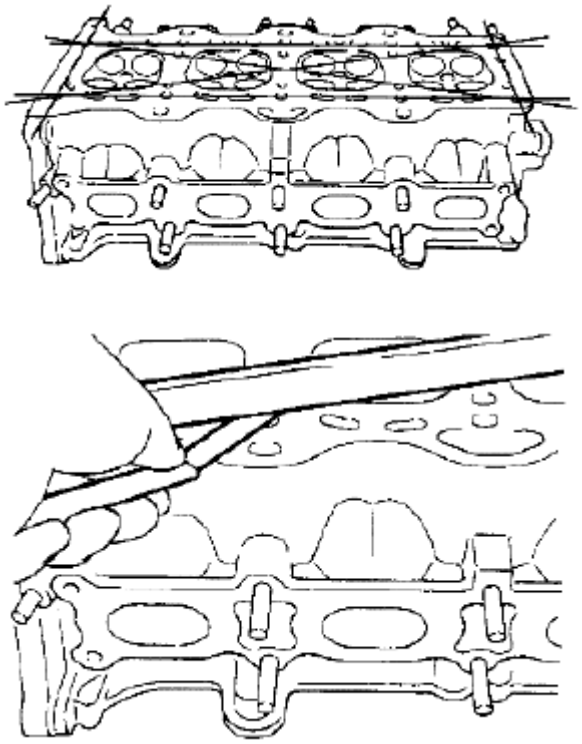


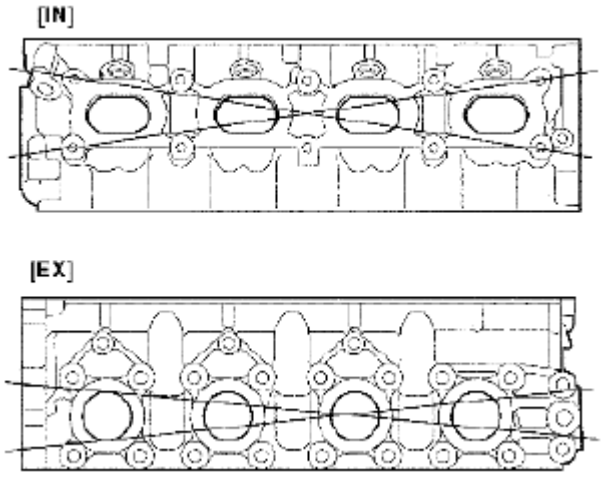
Fig. 134: Checking Distortion For Cylinder Head Surface On Piston Side
Courtesy of SUZUKI OF AMERICA CORP.

- Distortion of manifold seating faces:

  Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

  Distortion for cylinder head surface on intake and exhaust manifold

  Limit: 0.05 mm (0.002 in.)



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Fig. 135: Checking Distortion Of Manifold Seating Faces
Courtesy of SUZUKI OF AMERICA CORP.

VALVE SPRING INSPECTION

Reference: **VALVES AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY**

Valve Spring Free Length and Preload

Referring to data, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Valve spring free length

Standard: 51.13 mm (2.013 in.)

Limit: 50.13 mm (1.974 in.)

Valve spring preload

Standard: 209 - 241 N (20.9 - 24.1 kgf) for 37.60 mm (46.1 - 53.1 lb/1.480 in.)

Limit: 208 N (20.8 kgf) for 37.60 mm (45.9 lb/1.480 in.)

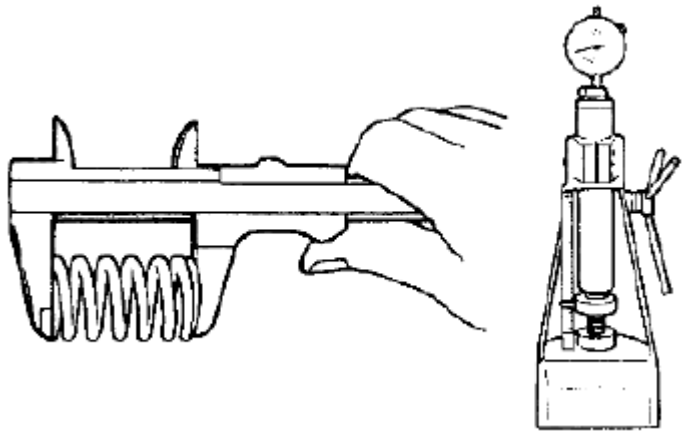


Fig. 136: Checking Valve Spring Free Length
Courtesy of SUZUKI OF AMERICA CORP.

Spring Squareness

Use a square and surface plate to check each spring for squareness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit must be replaced.

Valve spring squareness

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Limit: 2.2 mm (0.087 in.)

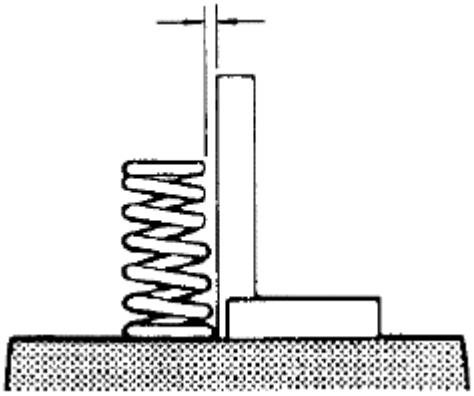
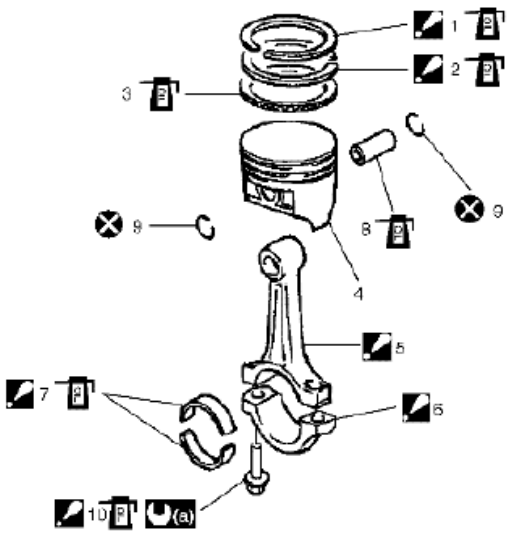


Fig. 137: Checking Valve Spring Squareness
Courtesy of SUZUKI OF AMERICA CORP.

PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS COMPONENTS

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1. Top ring : "R" mark provided on piston ring comes to facing up.	8. Piston pin
2. 2nd ring : "R" mark provided on piston ring comes to facing up.	9. Piston pin circlip
3. Oil ring	10. Connecting rod bolt : Check connecting rod bolt, plastic deformation tightening bolt, for deformation when reuse it due to plastic deformation tightening referring to "Connecting rod bolt" under *Pistons, Piston Rings, Connecting Rods and Cylinders Inspection and Cleaning* if it is reused.
4. Piston	(a): Tighten 15 N·m (1.5 kgf-m, 11.0 lb-ft) 45° and 45° by the specified procedure.
5. Connecting rod : See "C"	: Apply engine oil to sliding surface of each part.
6. Connecting rod bearing cap : See "A"	: Do not reuse.
7. Connecting rod bearing : See "B"	
"A": Point arrow mark on cap to crankshaft pulley side. Do not apply engine oil to inner surface of bearing cap.	
"B": Do not apply engine oil between connecting rod big end and bearing, between cap and bearing.	
"C": Apply engine oil to sliding surface except inner surface of connecting rod big end. Oil hole comes on intake side.	

Fig. 138: Identifying Pistons, Piston Rings, Connecting Rods & Cylinders Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS REMOVAL AND INSTALLATION

Reference: **PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS COMPONENTS**

Removal

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1. Remove oil pump with oil pump strainer. Refer to **REMOVAL** .
2. Remove cylinder head. Refer to **REMOVAL**.
3. Mark cylinder number on all pistons, connecting rods and connecting rod caps.
4. Remove connecting rod bearing caps.
5. Clean carbon from top of cylinder bore before removing piston from cylinder.
6. Push piston and connecting rod assembly out through the top of cylinder bore.

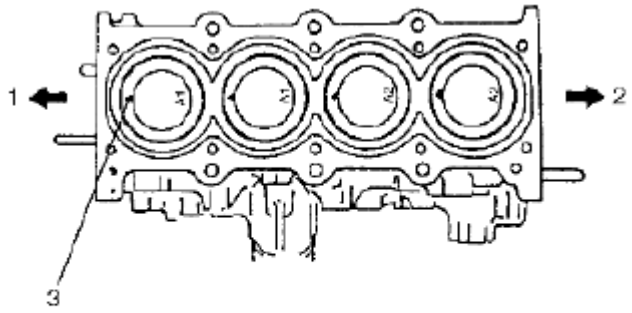
Installation

Reference: **PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS DISASSEMBLY AND REASSEMBLY**

1. Apply engine oil to pistons, piston rings, cylinder walls, connecting rod bearings and crank pins.

   NOTE: Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

2. When installing piston and connecting rod assembly into cylinder bore, point front mark (3) on piston head to crankshaft pulley side (1).



2. Flywheel side

Fig. 139: Identifying Front Mark Point On Piston Head
Courtesy of SUZUKI OF AMERICA CORP.

3. Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft.

   Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

   Special Tool

   (A): 09916-77310

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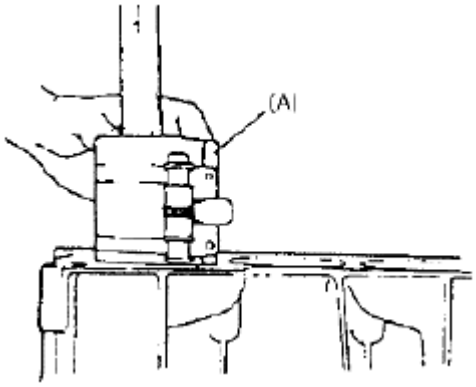


Fig. 140: Installing Piston Into Bore
Courtesy of SUZUKI OF AMERICA CORP.

4. Install connecting rod bearing cap (1) as follows.

NOTE: If connecting rod bolt is reused, make sure to check connecting rod bolt for deformation referring to "Connecting Rod Bolt Deformation (Plastic Deformation Tightening Bolt)" under PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS INSPECTION AND CLEANING.

a. Point arrow mark (2) on cap to crankshaft pulley side.
b. Apply engine oil to new connecting rod bolts (3).
c. Tighten all connecting rod bolts to 15 N.m (1.5 kgf-m, 11.0 lb-ft).
d. Retighten them by turning through 45°.
e. Repeat step d once again.

Tightening torque

Connecting rod bolt a: Tighten 15 N.m (1.5 kgf-m, 11.0 lb-ft), 45° and 45° by the specified procedure

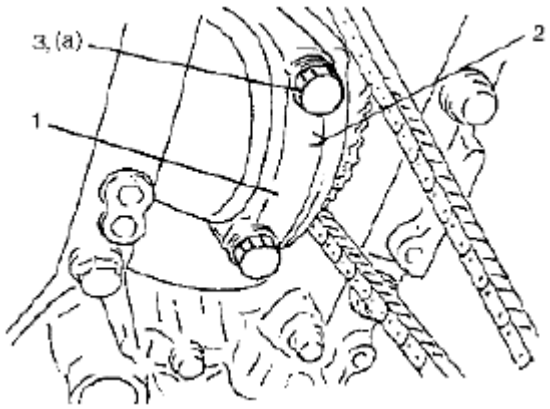


Fig. 141: Identifying Connecting Rod Bolt

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Courtesy of SUZUKI OF AMERICA CORP.

5. Install cylinder head. Refer to **INSTALLATION**.
6. Install oil pan. Refer to **INSTALLATION** .
7. Install camshafts and tappets and shims. Refer to **INSTALLATION**.
8. Install 1st timing chain. Refer to **INSTALLATION**.
9. Install 2nd timing chain. Refer to **INSTALLATION**.
10. Install timing chain cover. Refer to **INSTALLATION**.
11. Check intake and exhaust valve lashes by referring to **VALVE LASH (CLEARANCE) INSPECTION**.
12. Install cylinder head cover by referring to **INSTALLATION**.
13. Install engine assembly to vehicle by referring to **INSTALLATION**.

PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS DISASSEMBLY AND REASSEMBLY

Reference: **PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS REMOVAL AND INSTALLATION**

Disassembly

1. Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
2. Remove piston pin from connecting rod.
   - Ease out piston pin circlips (1).

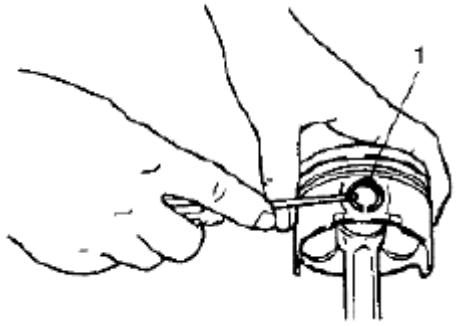


Fig. 142: Removing Compression Rings & Oil Ring From Piston
Courtesy of SUZUKI OF AMERICA CORP.

   - Force piston pin out.

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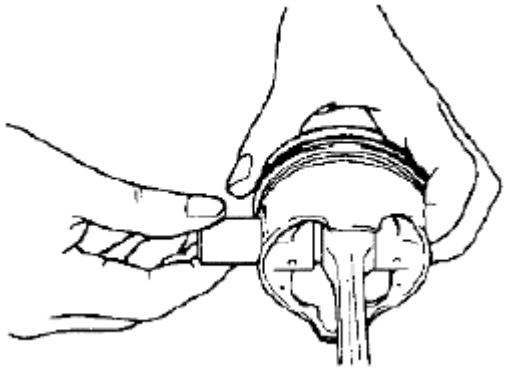


Fig. 143: Removing Piston Pin
Courtesy of SUZUKI OF AMERICA CORP.

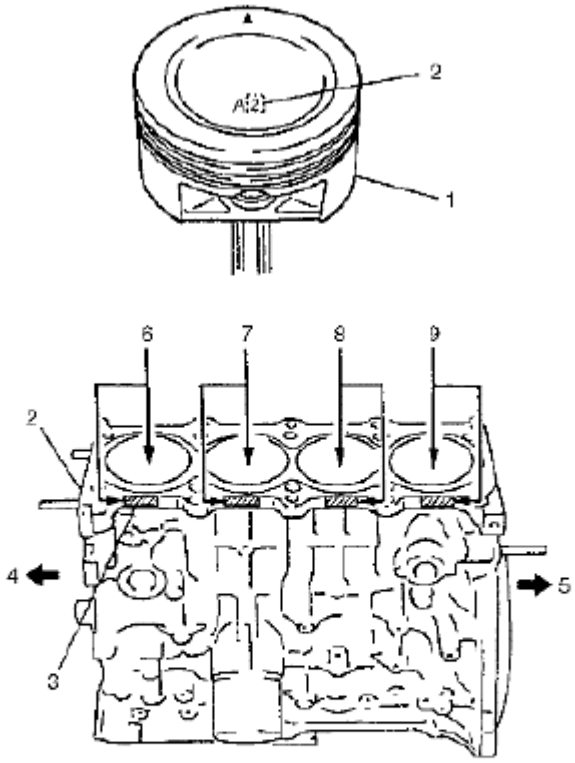
Reassembly

Reference: **PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS INSPECTION AND CLEANING**

NOTE: Two sizes of piston are available as standard size spare part so as to ensure proper piston-to-cylinder clearance. When installing a standard size piston, make sure to match piston with cylinder as follows.

1. Each piston (1) has stamped number (2) as shown in **Fig. 144**. It represents outer diameter of piston.
2. There are also painted color (3) of red or blue on cylinder block (2).

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4. Crank shaft pulley side	7. No.2 cylinder
5. Flywheel side	8. No.3 cylinder
6. No.1 cylinder	9. No.4 cylinder

Fig. 144: Identifying Piston Stamped Number
Courtesy of SUZUKI OF AMERICA CORP.

3. Stamped number on piston and painted color (or stamped number) on cylinder block should correspond. That is, install number "2" stamped piston to cylinder which is identified with blue painted (or "2" stamped) and a number "1" piston to cylinder with red painted (or "1" stamped).

   Also, a letter "A" or "B" is stamped on piston head but ordinarily it is not necessary to discriminate each piston by this letter.

   Piston outer diameter and cylinder bore diameter specification

PISTON OUTER DIAMETER AND CYLINDER BORE DIAMETER SPECIFICATION

Piston		Cylinder	
Number	Outer diameter	Paint (Number)	Bore diameter
1	83.9800 - 83.9900 mm (3.3063 - 3.3066 in.)	Red (1)	84.0101 - 84.0200 mm (3.3075 - 3.3078 in.)

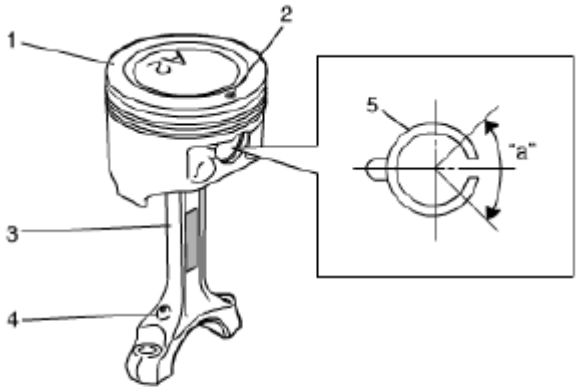
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2	83.9700 - 83.9799 mm (3.3059 - 3.3062 in.)	Blue (2)	84.0000 - 84.0100 mm (3.3071 - 3.3074 in.)

4. Install piston pin to piston (1) and connecting rod (3):

   After applying engine oil to piston pin, piston pin holes in piston and inner surface of connecting rod small end, fit connecting rod to piston as shown in **Fig. 145** and insert piston pin to piston and connecting rod, and install piston pin circlips.

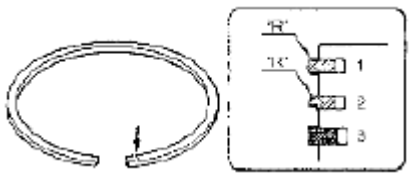
   NOTE:
   - **Oil hole (4) comes on intake side.**
   - **Circlip (5) should be installed so that circlip end gap comes within such range as indicated by arrow.**



"a": 90°	4. Oil hole
2. Front mark	

Fig. 145: Identifying Piston Stamped Number & Oil Hole
Courtesy of SUZUKI OF AMERICA CORP.

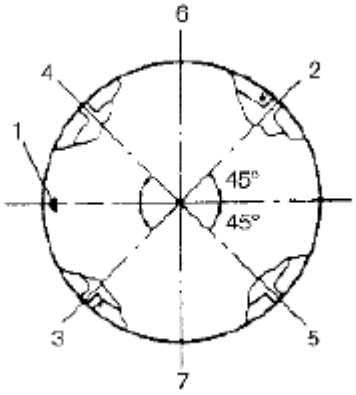
5. Install piston rings to piston:
   - As indicated in **Fig. 146**, 1st and 2nd rings have "R" mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
   - 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall. Distinguish 1st ring from 2nd ring by referring to **Fig. 146**.
   - When installing oil ring (3), install spacer first and then two rails.



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Fig. 146: Identifying Piston Rings Installing Mark
Courtesy of SUZUKI OF AMERICA CORP.

6. After installing three rings (1st, 2nd and oil rings), distribute their end gaps.



1.	Front mark
2.	1st ring end gap
3.	2nd ring end gap and oil ring spacer gap
4.	Oil ring upper rail gap
5.	Oil ring lower rail gap
6.	Intake side
7.	Exhaust side

Fig. 147: Identifying Piston Ring End Gap
Courtesy of SUZUKI OF AMERICA CORP.

PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS INSPECTION AND CLEANING

Reference: **PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS DISASSEMBLY AND REASSEMBLY**

Inspection

Cylinder

- Inspect cylinder walls for scratches, roughness, or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched, or ridged, rebore cylinder and use over size piston.
- Using a cylinder gauge, measure cylinder bore in thrust and axial directions at two positions as shown in **Fig. 148**. If any of following conditions is noted, rebore cylinder.

1. Cylinder bore diameter exceeds limit.

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2. Difference of measurements at two positions exceeds taper limit.
3. Difference between thrust and axial measurements exceeds out-of-round limit.

Cylinder bore diameter

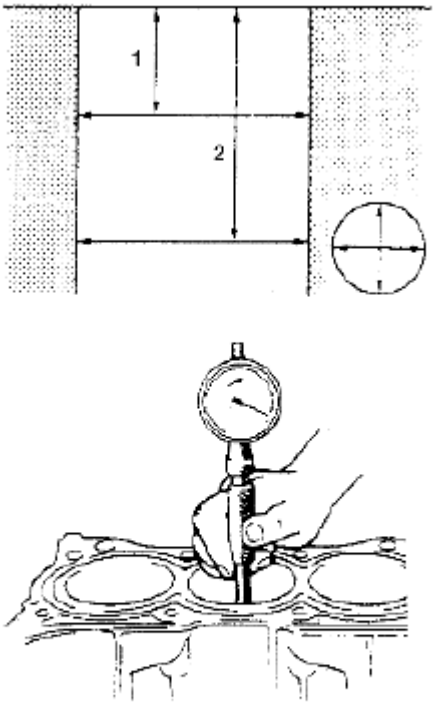
Standard: 84.000 - 84.020 mm (3.3070 - 3.3078 in.)

Limit: 84.050 mm (3.3090 in.)

Taper and out-of-round

Limit: 0.10 mm (0.004 in.)

NOTE: If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.



1. 50 mm (1.96 in.)	2. 95 mm (3.74 in.)

Fig. 148: Measuring Cylinder Bore Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Pistons

- Inspect piston for faults, cracks or other damages.

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Damaged or faulty piston should be replaced.

- Piston diameter:

  As indicated in **Fig. 149**, piston diameter should be measured at a position 26.5 mm (1.04 in.) ("a") from piston skirt end in the direction perpendicular to piston pin.

  Piston diameter

  PISTON DIAMETER

Standard	83.9700 - 83.9900 mm (3.3059 - 3.3067 in.)
Oversize: 0.50 mm (0.0196 in.)	84.4700 - 84.4900 mm (3.3256 - 3.3264 in.)

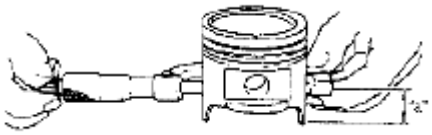


Fig. 149: Measuring Piston Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- Piston clearance:

  Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as follows. If it is out of specification, rebore cylinder and use oversize piston.

  Piston clearance

  0.02 - 0.04 mm (0.0008 - 0.0015 in.)

  NOTE: Cylinder bore diameters used here are measured in thrust direction at two positions.

- Ring groove clearance:

  Before checking, piston grooves must be clean, dry and free of carbon.

  Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2).

  If clearance is out of specification, replace piston.

  Ring groove clearance

  RING GROOVE CLEARANCE SPECIFICATION

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Item	Standard	Limit
Top ring	0.03 - 0.07 mm (0.0120 - 0.0027 in.)	0.12 mm (0.0047 in.)
2nd ring	0.02 - 0.06 mm (0.0008 - 0.0023 in.)	0.1 mm (0.0039 in.)
Oil ring	0.06 - 0.15 mm (0.0024 - 0.0059 in.)	-

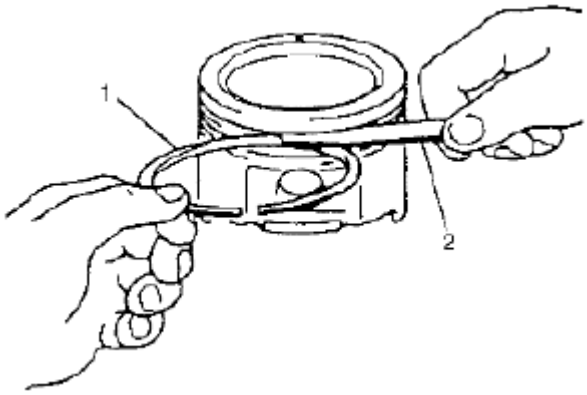


Fig. 150: Checking Ring Groove Clearance
Courtesy of SUZUKI OF AMERICA CORP.

Piston pin

- Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod or piston.
- Piston pin clearance: Check piston pin clearance in small end.

  Replace connecting rod if its small end is badly worn or damaged or if measured clearance exceeds limit.

  Piston pin clearance in small end

  Standard: 0.003 - 0.014 mm (0.0001 - 0.0005 in.)

  Piston pin clearance in piston

  Standard: 0.006 - 0.017 mm (0.00024 - 0.00067 in.)

  Small-end bore [A]

  21.003 - 21.011 mm (0.8269 - 0.8272 in.)

  Piston pin diameter [B]

  20.997 - 21.000 mm (0.8267 - 0.8268 in.)

  Piston bore

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21.006 - 21.014 mm (0.8270 - 0.8273 in.)

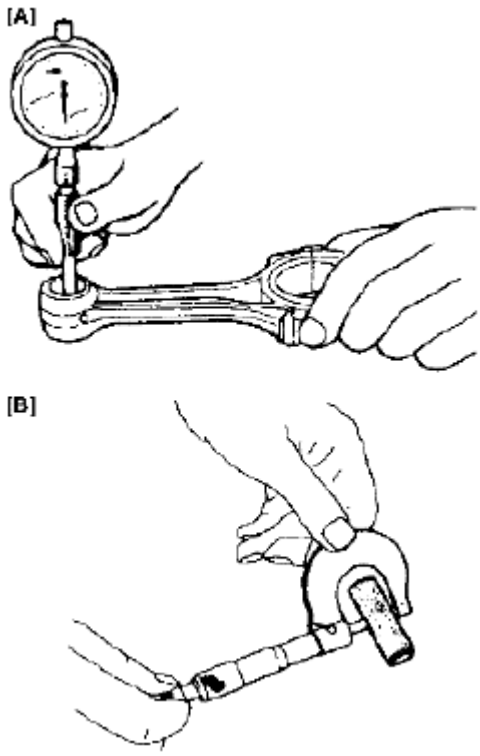


Fig. 151: Checking Piston Pin Clearance In Small End
Courtesy of SUZUKI OF AMERICA CORP.

Piston rings

To measure end gap, insert piston ring (2) into cylinder bore and then measure the gap by using thickness gauge (1). If measured gap is out of specification, replace ring.

NOTE: Clean carbon and any other dirt from top of cylinder bore before inserting piston ring.

Piston ring end gap

PISTON RING END GAP SPECIFICATION

Item	Standard	Limit
Top ring	0.20 - 0.33 mm (0.0079 - 0.0129 in.)	0.7 mm (0.0276 in.)
2nd ring	0.33 - 0.48 mm (0.0129 - 0.0188 in.)	0.7 mm (0.0276 in.)
Oil ring	0.20 - 0.50 mm (0.0079 - 0.0196 in.)	1.8 mm (0.0709 in.)

Piston rings end gap

"a": 120 mm (4.72 in.)

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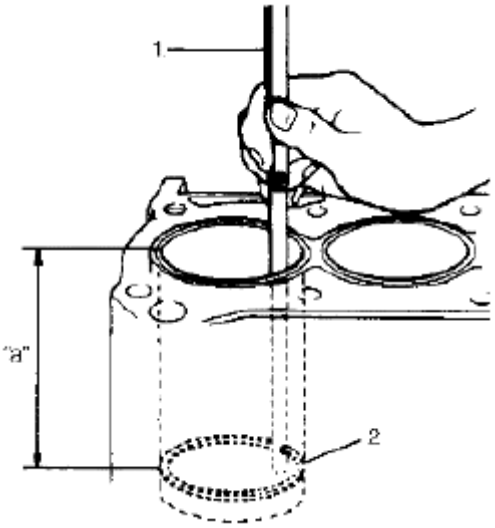


Fig. 152: Checking Piston Rings End Gap
Courtesy of SUZUKI OF AMERICA CORP.

Connecting rod

- Big-end side clearance:

  Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

  Big-end side clearance

  BIG-END SIDE CLEARANCE SPECIFICATION

Standard	Limit
0.25 - 0.40 mm (0.0099 - 0.0150 in.)	0.45 mm (0.0177 in.)

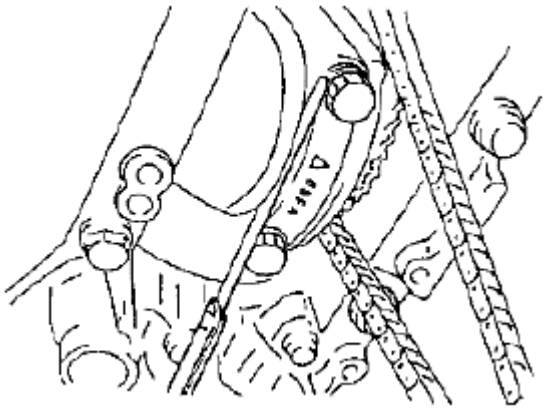


Fig. 153: Checking Big-End Of Connecting Rod For Side Clearance
Courtesy of SUZUKI OF AMERICA CORP.

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- Connecting rod alignment:

  Mount connecting rod on aligner to check it for bow and twist. If limit is exceeded, replace it.

  Limit on bow

  0.05 mm (0.0020 in.)

  Limit on twist

  0.10 mm (0.0039 in.)

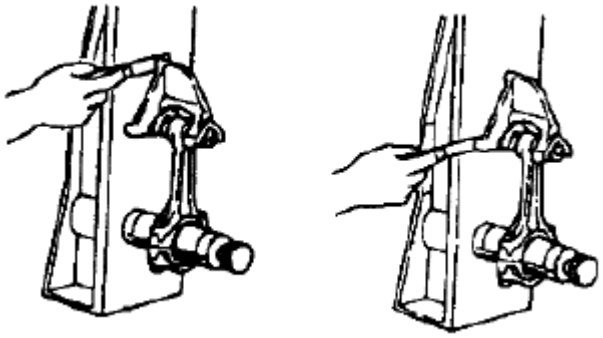


Fig. 154: Checking Connecting Rod Alignment
Courtesy of SUZUKI OF AMERICA CORP.

Crank pin and connecting rod bearings

- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged, or out-of round or taper is out of limit, replace crankshaft or regrind crank pin.

  Connecting rod bearing and crank pin

  CONNECTING ROD BEARING AND CRANK PIN SPECIFICATION

Item	Standard
Crank pin diameter	49.982 - 50.000 mm (1.9768 - 1.9685 in.)

  Out-of-round

  "A"-"B"

  Taper

  "a"-"b"

  Out-of-round and taper limits

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0.01 mm (0.0004 in.)

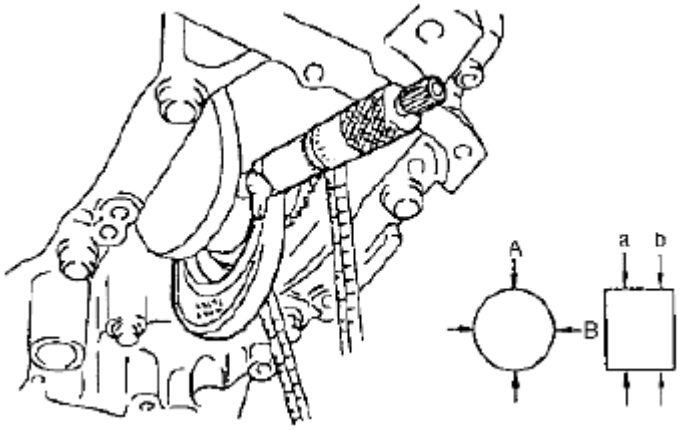


Fig. 155: Measuring Crank Pin For Out-Of-Round Or Taper With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

- **Connecting rod bearing general information:**

  Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

  Two kinds of connecting rod bearings are available; standard size bearing and 0.25 mm (0.0098 in.) undersize bearing. For identification of undersize bearing, it is painted red (1) at the position as indicated in **Fig. 156**, undersize bearing thickness is 1.605 - 1.615 mm (0.0632 - 0.0635 in.) at the center of it.

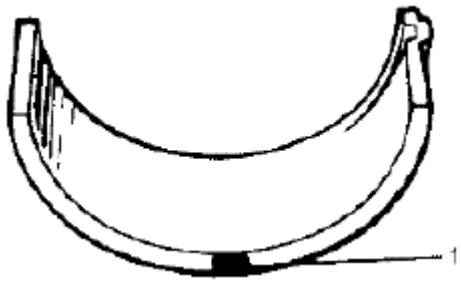


Fig. 156: Identifying Connecting Rod Bearing
Courtesy of SUZUKI OF AMERICA CORP.

- **Connecting rod bearing clearance:**
  a. Before checking bearing clearance, clean bearing and crank pin.
  b. Install bearing in connecting rod and bearing cap.
  c. Place a piece of gauging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.

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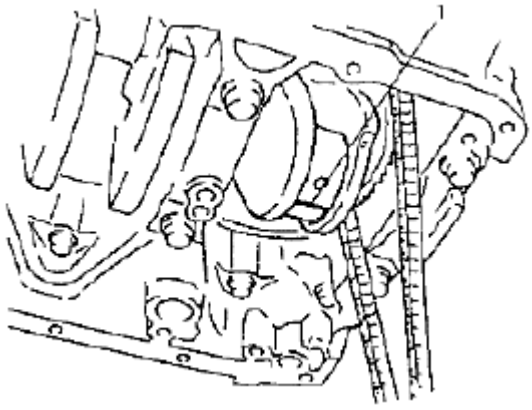


Fig. 157: Placing Piece Of Gauging Plastic
Courtesy of SUZUKI OF AMERICA CORP.

d. Install connecting rod bearing cap (1) as follows.
   i. Point arrow mark (2) on cap to crankshaft pulley side.
   ii. Apply engine oil to connecting rod bolts (3).
   iii. Tighten all connecting rod bolts to 15 N.m (1.5 kgf-m, 11.0 lb-ft).
   iv. Retighten them by turning through 45°.
   v. Repeat step d once again.

Tightening torque

Connecting rod bolt a: Tighten 15 N.m (1.5 kgf-m, 11.0 lb-ft), 45° and 45° by the specified procedure

NOTE: Do not turn crankshaft with gauging plastic installed.

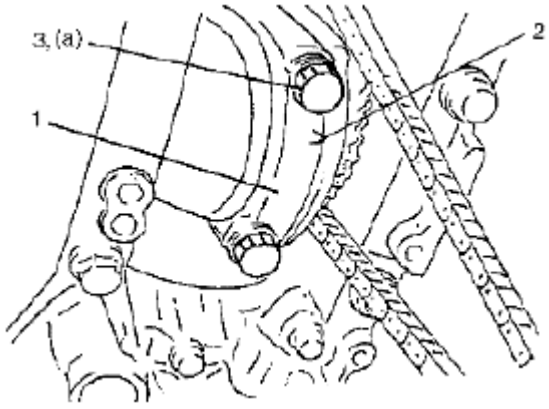


Fig. 158: Identifying Connecting Rod Bolt
Courtesy of SUZUKI OF AMERICA CORP.

e. Remove connecting rod bearing cap, and using a scale (2) on gauging plastic envelope, measure

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gauging plastic (1) width at the widest point (clearance).

If clearance exceeds its limit, select connecting rod bearing by referring to **PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS INSPECTION AND CLEANING** below mentioned item.

After selecting new bearing, recheck clearance.

Bearing clearance

BEARING CLEARANCE SPECIFICATION

Standard	Limit
0.045 - 0.063 mm (0.0018 - 0.0025 in.)	0.08 mm (0.0031 in.)

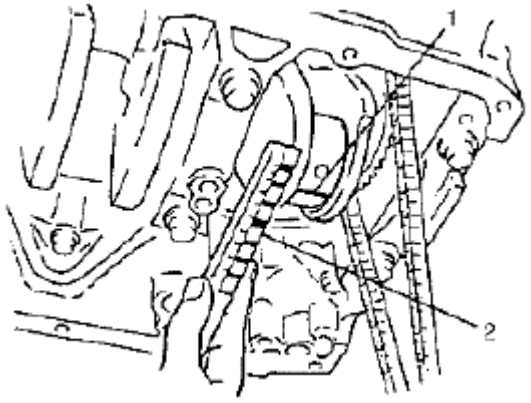


Fig. 159: Removing Connecting Rod Bearing Cap
Courtesy of SUZUKI OF AMERICA CORP.

f. If clearance can not be brought to within its limit even by using a new standard size bearing, replace crankshaft or regrind crankpin to undersize as follows.
   - Install 0.25 mm undersize bearing to connecting rod big end.
   - Measure bore diameter of connecting rod big end.
   - Regrind crankpin to the following finished diameter.

     Finished crankpin diameter = Measured big end bore diameter (including undersize bearing) - 0.054 mm (0.0021 in.)

   - Confirm that bearing clearance is within the standard value.

NOTE: **After checking the connecting rod bearing clearance, make sure to check for "Connecting rod bolt" under PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS INSPECTION AND CLEANING.**

- **Selection of connecting rod bearings:**

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NOTE:

- **If bearing is in malcondition or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.**
- **When replacing crankshaft or connecting rod and its bearing due to any reason, select new standard bearings to be installed by referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No. 3 cylinder.**

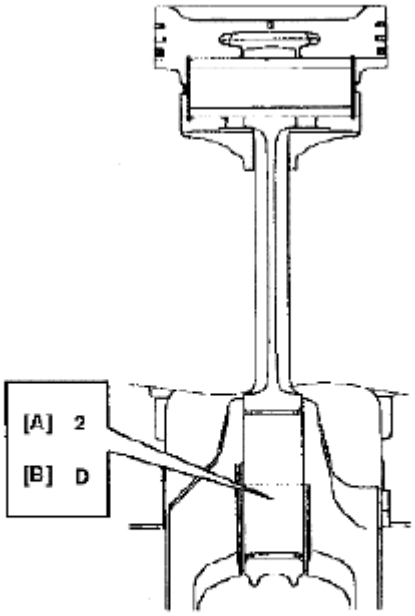
a. Check stamped numbers on connecting rod and its cap as shown in **Fig. 160**.

Three kinds of numbers ("1", "2" and "3") represent the following connecting rod big end inside diameters. For example, stamped number "1" indicates that corresponding connecting rod big-end inside diameter is 53.0000 - 53.0060 mm (2.0867 - 2.0868 in.).

Connecting rod big-end inside diameter

CONNECTING ROD BIG-END INSIDE DIAMETER

Stamped numbers	Connecting rod big-end inside diameter
1	53.0000 - 53.0060 mm (2.0867 - 2.0868 in.)
2	53.0061 - 53.0120 mm (2.0869 - 2.0870 in.)
3	53.0121 - 53.0180 mm (2.0871 - 2.0873 in.)



[A]:	Connecting rod big-end inside diameter number
[B]:	Weight indication mark (It is not necessary in servicing)

Fig. 160: Identifying Stamped Numbers On Connecting Rod

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Courtesy of SUZUKI OF AMERICA CORP.

b. Next, check crank pin diameter. On crank web of No. 3 cylinder, four alphabets are stamped as shown in **Fig. 161**.

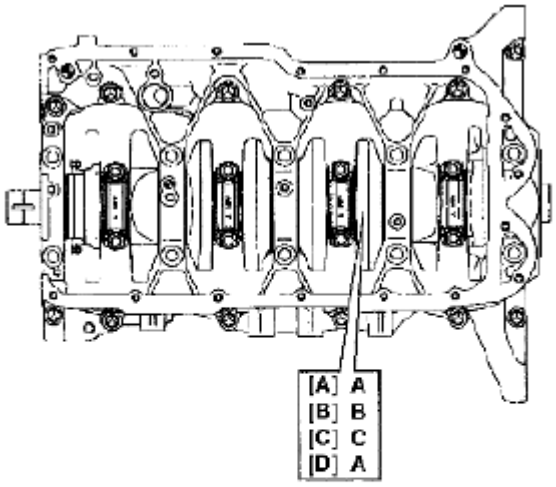
Three kinds of alphabet ("A", "B" and "C") represent the following crank pin diameter respectively.

For example, stamped "A" indicates that corresponding crank pin diameter is 49.9940 - 50.0000 mm (1.9683 - 1.9685 in.).

Crank pin diameter

CRANK PIN DIAMETER

Stamped alphabet	Crank pin diameter (without bearing)
A	49.9940 - 50.0000 mm (1.9683 - 1.9685 in.)
B	49.9880 - 49.9939 mm (1.9681 - 1.9682 in.)
C	49.9820 - 49.9879 mm (1.9677 - 1.9680 in.)



[A]:	Crankshaft pin diameter for No.1 cylinder
[B]:	Crankshaft pin diameter for No.2 cylinder
[C]:	Crankshaft pin diameter for No.3 cylinder
[D]:	Crankshaft pin diameter for No.4 cylinder

Fig. 161: Identifying Crank Pin Diameter Location
Courtesy of SUZUKI OF AMERICA CORP.

c. There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in **Fig. 162**.

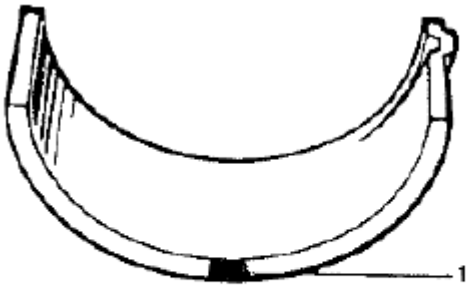
Each color indicated the following thickness at the center of bearing.

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Standard size of connecting rod bearing thickness

STANDARD SIZE OF CONNECTING ROD BEARING THICKNESS SPECIFICATION

Color painted	Bearing thickness
Green	1.482 - 1.485 mm (0.05835 - 0.05846 in.)
Black	1.485 - 1.488 mm (0.05847 - 0.05858 in.)
Colorless	1.488 - 1.491 mm (0.05859 - 0.05870 in.)
Yellow	1.491 - 1.494 mm (0.05871 - 0.05881 in.)
Blue	1.494 - 1.497 mm (0.05882 - 0.05893 in.)



1. Paint

Fig. 162: Identifying Paint Mark For Connecting Rod Bearing Thickness
Courtesy of SUZUKI OF AMERICA CORP.

d. From number stamped on connecting rod and its cap and alphabet stamped on crank web No. 3 cylinder, determine new standard bearing to be installed to connecting rod big-end inside, by referring to **SPECIFICATIONS OF STANDARD CONNECTING ROD BEARING SIZE TABLE**. For example, if number stamped on connecting rod and its cap is "1" and alphabet stamped on crank web No. 3 cylinder is "B", install a new standard bearing painted in "Black" to its connecting rod big-end inside.

Specifications of new standard connecting rod bearing size

SPECIFICATIONS OF STANDARD CONNECTING ROD BEARING SIZE TABLE

	Number stamped on connecting rod and its cap (Connecting rod big end inside diameter)			
1	2	3		
Alphabet stamped on crank web of No. 3 cylinder (Crank pin diameter)	A	Green	Black	Colorless
	B	Black	Colorless	Yellow
	C	Colorless	Yellow	Blue

e. Check bearing clearance with newly selected standard bearing by referring to **CRANK PIN AND CONNECTING ROD BEARINGS**.

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If clearance still exceeds its limit, use next thicker bearing and recheck clearance.

- **Connecting rod bolt**

  Measure each thread diameter of connecting rod bolts (1) at "A" on 28.5 mm (1.12 in.) from bolt mounting surface and "B" on 42.0 mm (1.65 in.) from bolt mounting surface by using a micrometer (2).

  Calculate difference in diameters ("A"-"B"). If it exceeds limit, replace connecting rod.

  Connecting rod bolt measurement points

  "a": 28.5 mm (1.12 in.)

  "b": 42.0 mm (1.65 in.)

  Connecting rod bolt diameter difference

  limit ("A"-"B"): 0.1 mm (0.004 in.)

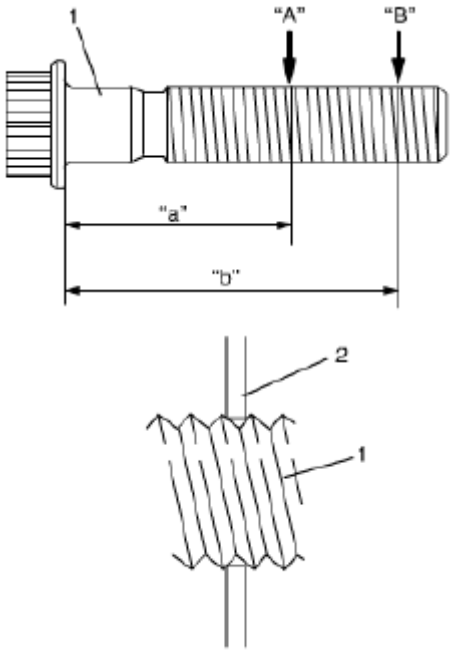


Fig. 163: Measuring Thread Diameter Of Connecting Rod Bolts Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Cleaning

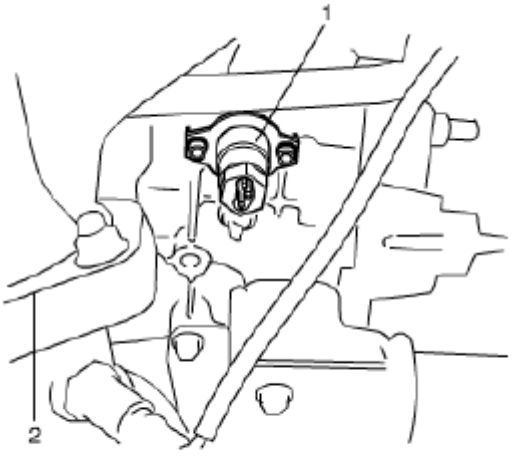
Clean carbon from piston head and ring grooves, using a suitable tool.

CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED)

Removal

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1. Disconnect negative (-) cable at battery.
2. Drain engine coolant.
3. Remove exhaust manifold cover.
4. Remove engine block heater (1).



2. Exhaust manifold

Fig. 164: Identifying Engine Block Heater
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reference: **CYLINDER BLOCK HEATER INSPECTION (IF EQUIPPED)**

Reverse removal procedure for installation, noting the following.

- Install cylinder block heater (1) in the direction as shown in **Fig. 165**.

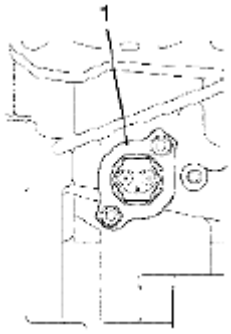


Fig. 165: Identifying Cylinder Block Heater
Courtesy of SUZUKI OF AMERICA CORP.

- Tighten cylinder block heater mounting bolt (1) to specified torque.

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Tightening torque

Cylinder block heater mounting bolt a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

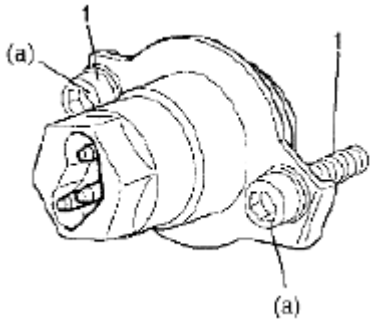


Fig. 166: Identifying Cylinder Block Heater Mounting Bolt
Courtesy of SUZUKI OF AMERICA CORP.

- Refill coolant by referring to **COOLING SYSTEM FLUSH AND REFILL** .
- Finally, start engine and check for engine coolant leaks and exhaust gas leakage.

CYLINDER BLOCK HEATER INSPECTION (IF EQUIPPED)

Reference: **CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED)**

- Check continuity between terminals "a" and "c". If there is no continuity, replace it.
- Check that there is no continuity between terminals "a" or "b" and "c". If there is continuity, replace it.
- Check continuity between terminal "c" and cylinder block heater body. If there is no continuity, replace it.

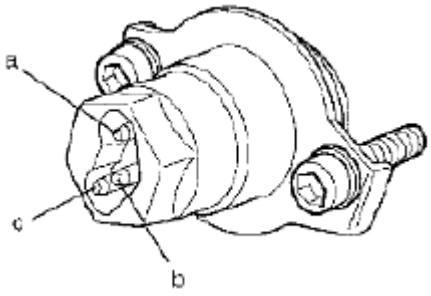
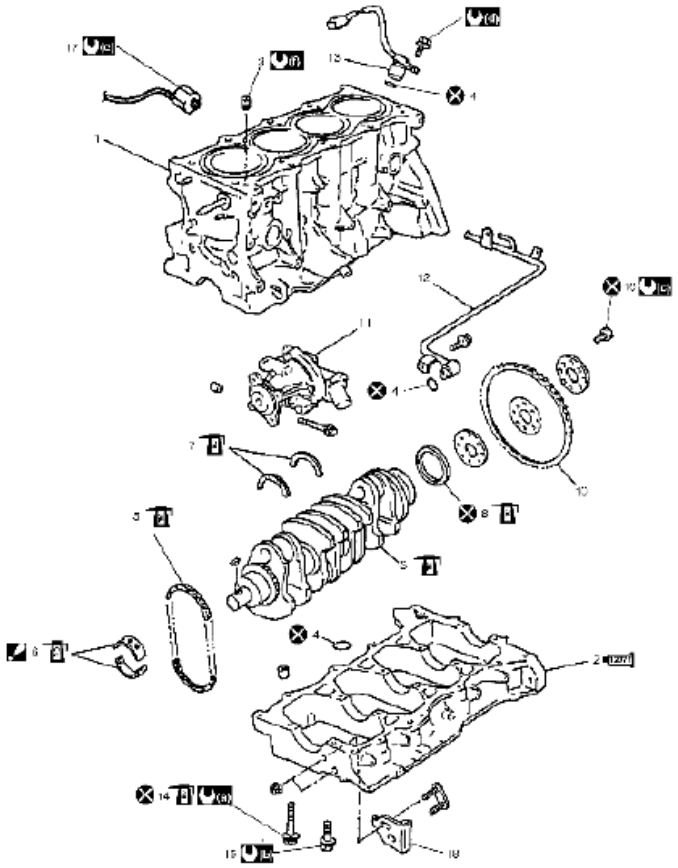


Fig. 167: Checking Continuity Between Terminal
Courtesy of SUZUKI OF AMERICA CORP.

MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS

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1. Cylinder block	10. Flywheel	(a): Tighten 40 N·m (4.0 kgf-m, 29.0 lb-ft), 0 N·m (0 kgf-m, 0 lb-ft), 40 N·m (4.0 kgf-m, 29.0 lb-ft) and 58 N·m (5.8 kgf-m, 42.0 lb-ft) by the specified procedure.
1207F 2. Lower crankcase : Apply sealant 99000-31250 to mating surface.	11. Water pump	(b): Tighten 26 N·m (2.6 kgf-m, 19.0 lb-ft) by the specified procedure.
3. Crankshaft	12. Heater outlet pipe	(c): 70 N·m (7.0 kgf-m, 51.0 lb-ft)
4. O-ring	13. CKP sensor	(d): 11 N·m (1.1 kgf-m, 8.0 lb-ft)
5. Oil pump chain	14. Crankcase bolt (10 mm thread diameter)	(e): 22 N·m (2.2 kgf-m, 16.0 lb-ft)
6. Main bearing : Do not apply engine oil between cylinder block and bearing, between lower crankcase and bearing. Upper half of bearing has an oil groove.	15. Crankcase bolt (8 mm thread diameter)	(f): 3 N·m (0.3 kgf-m, 2.5 lb-ft)
7. Thrust bearing	16. Flywheel or drive plate bolt	: Do not reuse.
8. Rear oil seal	17. Knock sensor	OIL : Apply engine oil to inside / sliding surface.
9. Check valve	18. Oil pump chain guide	

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Fig. 168: Identifying Main Bearings, Crankshaft & Cylinder Block Components (With Torque Specifications)
Courtesy of SUZUKI OF AMERICA CORP.

MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION

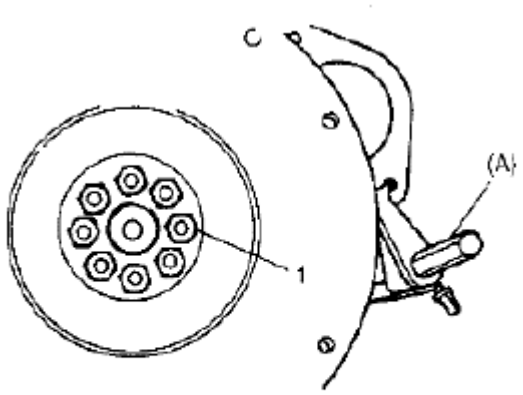
Reference: **MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**

Removal

1. Remove engine assembly from vehicle. Refer to **REMOVAL**.
2. Remove flywheel (drive plate for A/T) by using special tool.

   Special Tool

   (A): 09924-17811



1. Flywheel bolt

Fig. 169: Identifying Flywheel Bolt
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove pistons and connecting rods by referring to **REMOVAL**.
4. Remove CKP sensor (1).

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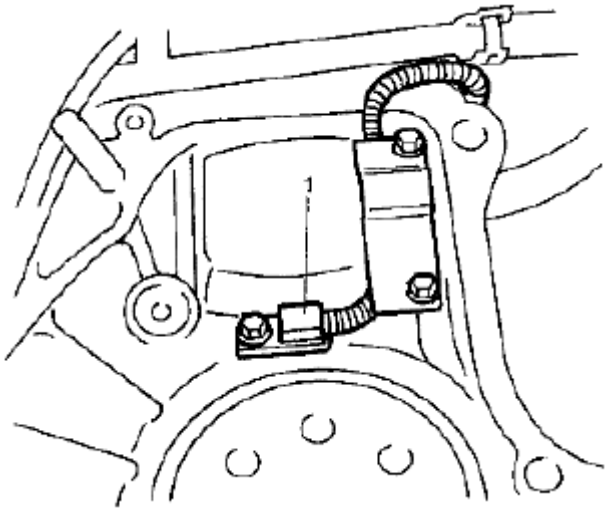


Fig. 170: Identifying CKP Sensor
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove water pump (1) and heater outlet pipe (3).
6. Remove engine front mounting brackets (2).

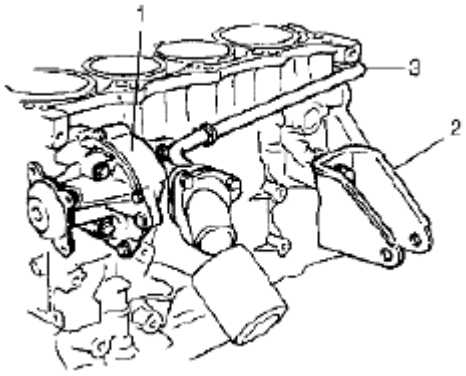
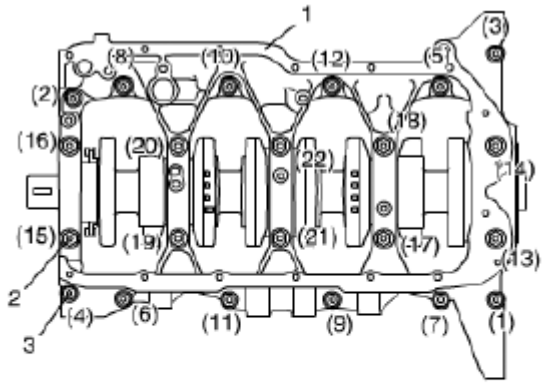


Fig. 171: Identifying Engine Front Mounting Brackets
Courtesy of SUZUKI OF AMERICA CORP.

7. Loosen crankcase bolts, in sequence shown in **Fig. 172** and remove them.

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1.	Lower crankcase
2.	Crankcase bolts (10 mm thread diameter)
3.	Crankcase bolts (8 mm thread diameter)

Fig. 172: Identifying Loosening Sequence Of Crankcase Bolts
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove crankshaft from cylinder block.

Installation

Reference: **MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK INSPECTION**

NOTE:

- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, crankcase (bearings caps), connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb combination and try to see that each part goes back to where it came from, when installing.**
- **Clean mating surface of cylinder block and lower crankcase, remove oil, old sealant and dust from mating surface.**

1. Fit main bearings to cylinder block (1).

   One of two halves of main bearing (4) has oil groove (3).

   Install this half with oil groove to cylinder block and another half without oil groove to lower crankcase.

   Make sure that two halves are painted in the same color.

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2. Install new O-ring (2) to cylinder block.
3. Install knock pins (5) to cylinder block.

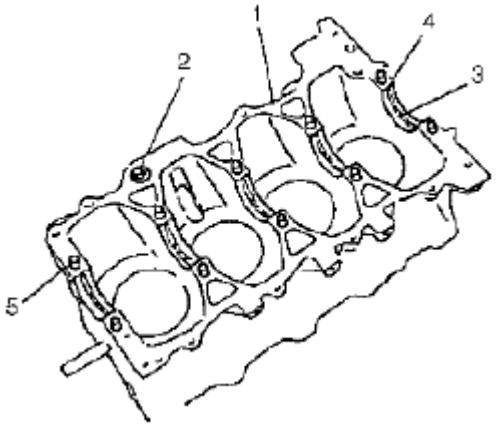


Fig. 173: Identifying Main Bearing Oil Groove
Courtesy of SUZUKI OF AMERICA CORP.

4. Fit thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
5. Put crankshaft (1) with oil pump chain to cylinder block.

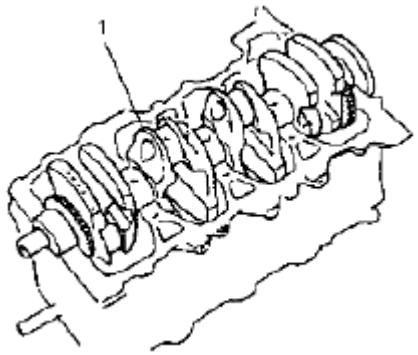


Fig. 174: Identifying Thrust Bearings
Courtesy of SUZUKI OF AMERICA CORP.

6. Apply sealant "A" to lower crankcase (1) mating surface area as shown in **Fig. 175**.

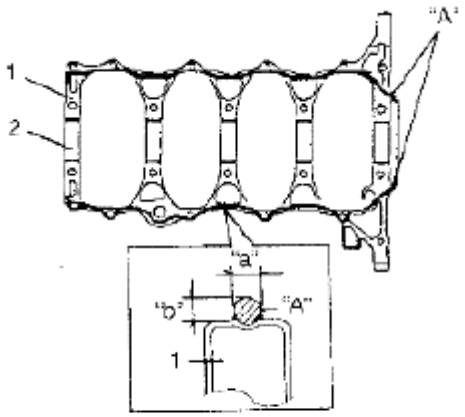
"A": Water tight sealant 99000-31250SUZUKI Bond No.1207F ()

Sealant amount for lower crankcase

Width "a": 3 mm (0.12 in.)

Height "b": 2 mm (0.08 in.)

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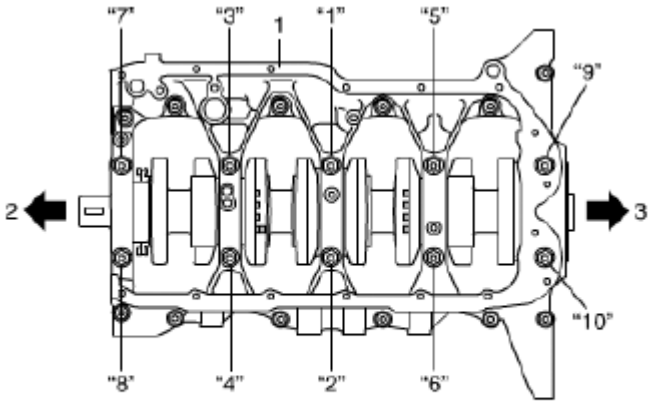
2.	Bearing

Fig. 175: Identifying Area For Applying Sealant
Courtesy of SUZUKI OF AMERICA CORP.

7. Install lower crankcase (1) to cylinder block.

   Apply engine oil to all crankcase bolts ((1) - (10)) and tighten them gradually as follows.

   a. Tighten bolts ((1) - (10)) to 40 N.m (4.0 kgf-m, 29.0 lb-ft) according to numerical order in **Fig. 176**.

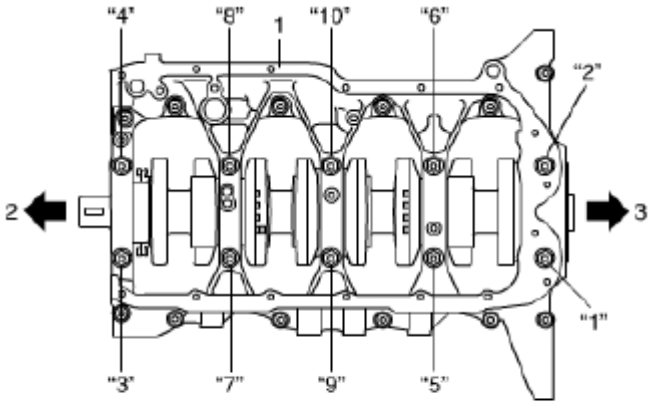


2.	Crankshaft pulley side	3.	Flywheel side

Fig. 176: Identifying Tightening Sequence Of Crankcase Bolts
Courtesy of SUZUKI OF AMERICA CORP.

   b. Loosen bolts ((1) - (10)) until tightening torque is reduced to 0 according to numerical order in **Fig. 177**.

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2. Crankshaft pulley side	3. Flywheel side

Fig. 177: Identifying Loosening Sequence Of Crankcase Bolts
Courtesy of SUZUKI OF AMERICA CORP.

c. Tighten bolts ((1) - (10)) to 40 N.m (4.0 kgf-m, 29.0 lb-ft) according to numerical order in **Fig. 178**.
d. In the same manner as in step c), retighten bolts ((1) - (10)) to 58 N.m (5.8 kgf-m, 42.0 lb-ft).
e. Tighten bolts ((11) - (22)) to specified torque according to numerical order in **Fig. 178**.

Tightening torque

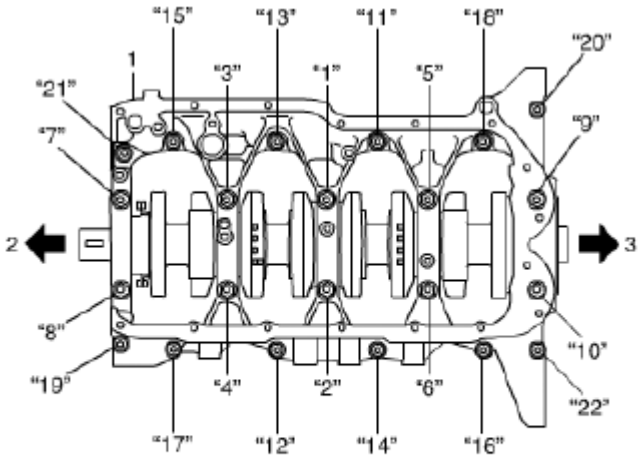
Crankcase bolt with 10 mm thread diameter ((1) - (10)): Tighten 40 N.m (4.0 kgf-m, 29.0 lb-ft), 0 N.m (0 kgf-m, 0 lb-ft), 40 N.m (4.0 kgf-m, 29.0 lb-ft), 58 N.m (5.8 kgf-m, 42.0 lb-ft) by the specified procedure

Crankcase bolt with 8 mm thread diameter ((11) - (22)): Tighten 26 N.m (2.6 kgf-m, 19.0 lb-ft) by the specified procedure

NOTE:

- **After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.**
- **Use new crankcase bolt (10 mm thread diameter).**

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2. Crankshaft pulley side	3. Flywheel side

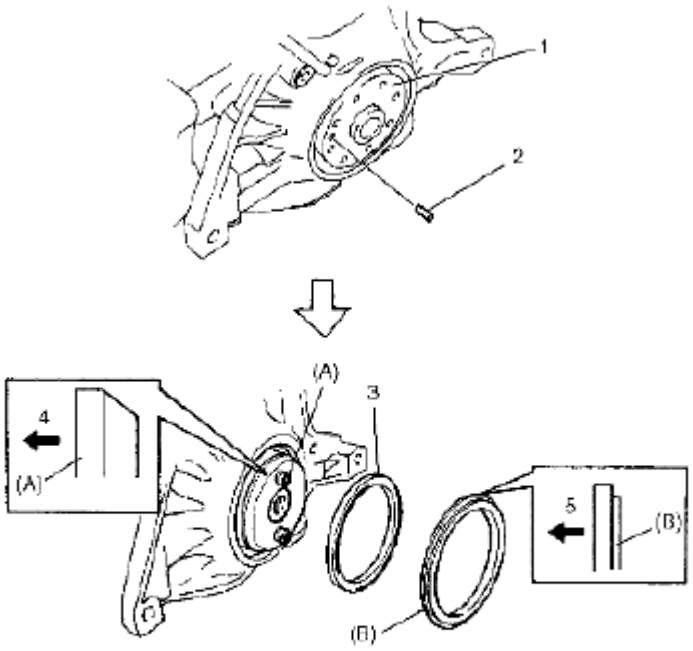
Fig. 178: Identifying Tightening Sequence Of Crankcase Bolts
Courtesy of SUZUKI OF AMERICA CORP.

8. Pull out dowel pin (2) from crankshaft (1) and then install rear oil seal (3) until it becomes flush with cylinder block surface using special tools and plastic hammer.

   Special Tool

   A. **09911-97710**
   B. **09911-97811**
9. Install dowel pin (2).

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4. Crankshaft side	5. Oil seal side

Fig. 179: Installing Dowel Pin
Courtesy of SUZUKI OF AMERICA CORP.

10. Install CKP sensor (1) and fix its wire harness with bracket.

    Tightening torque

    CKP sensor bolt a: 11 N.m (1.1 kg-m, 8.0 lb-ft)

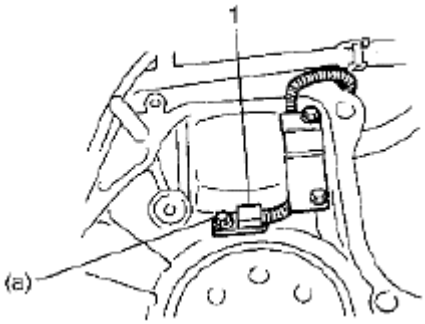


Fig. 180: Identifying CKP Sensor & Bolt
Courtesy of SUZUKI OF AMERICA CORP.

11. Install flywheel (drive plate for A/T).

    Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts (1) to specified

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torque.

NOTE: Use new flywheel or drive plate bolt.

Special Tool

(A): 09924-17811

Tightening torque

Flywheel or drive plate bolt a: 70 N.m (7.0 kg-m, 51.0 lb-ft)

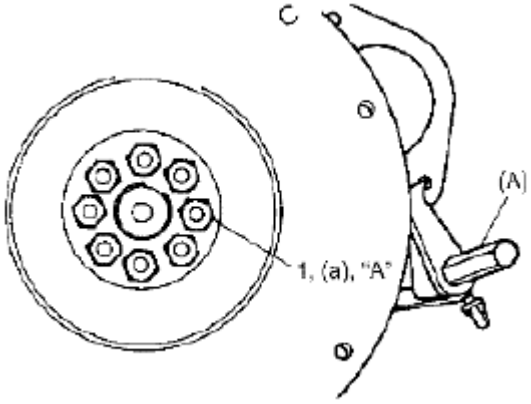


Fig. 181: Identifying Flywheel Or Drive Plate Bolts
Courtesy of SUZUKI OF AMERICA CORP.

12. Install engine front mounting brackets (1). Tighten bracket bolts to specified torque.

    Tightening torque

    Engine front mounting bracket bolt a: 55 N.m (5.5 kg-m, 40.0 lb-ft)

13. Install water pump (2) and heater outlet pipe (3). Refer to **INSTALLATION** .



Fig. 182: Identifying Water Pump & Heater Outlet Pipe

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Courtesy of SUZUKI OF AMERICA CORP.

14. Install pistons and connecting rods. Refer to **INSTALLATION**.
15. Install oil pump. Refer to **INSTALLATION** .
16. Install cylinder head assembly to cylinder. Refer to **INSTALLATION**.
17. Install camshafts and tappets and shims. Refer to **INSTALLATION**.
18. Check intake and exhaust valve lashes by referring to **VALVE LASH (CLEARANCE) INSPECTION**.
19. Install, timing chain sprockets, timing chains, timing chain tensioner, tensioner adjusters, timing chain guides, timing chain cover, crankshaft pulley, water pump pulley. Refer to **INSTALLATION**, **INSTALLATION** and **INSTALLATION**.
20. Install cylinder head cover referring to **INSTALLATION**.
21. Install oil pump strainer and oil pan by referring to **INSTALLATION** .
22. Install clutch cover and clutch disc to flywheel (for M/T vehicle). For clutch installation, refer to **INSTALLATION** .
23. Install engine assembly to vehicle. Refer to **INSTALLATION**.

MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK INSPECTION

Reference: **MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION**

Crankshaft

Crankshaft runout

Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

Limit on runout

0.06 mm (0.0023 in.)



Fig. 183: Measuring Runout At Center Journal
Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft thrust play

Measure this play with crankshaft set in cylinder block in the normal manner, that is, with thrust bearing and lower crankcase installed. Tighten crankcase bolts by referring to **MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION**.

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Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Crankshaft Thrust Play

Standard: 0.10 - 0.35 mm (0.0039 - 0.0137 in.)

Limit: 0.42 mm (0.0149 in.)

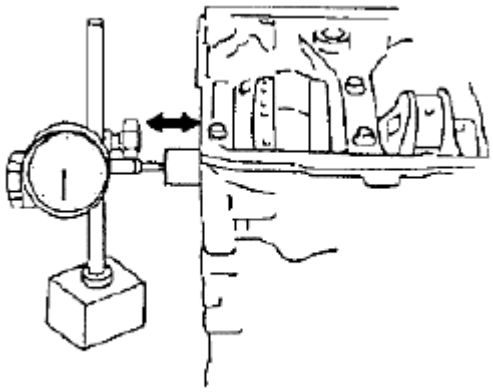
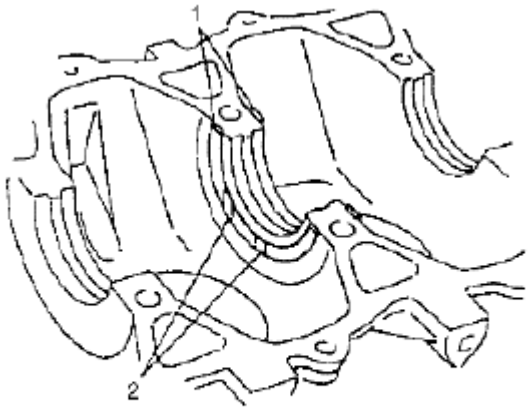


Fig. 184: Measuring Crankshaft Thrust Play
Courtesy of SUZUKI OF AMERICA CORP.

Thickness of crankshaft thrust bearing

THICKNESS OF CRANKSHAFT THRUST BEARING SPECIFICATION

Standard	2.425 - 2.475 mm (0.09796 - 0.09992 in.)
Oversize: 0.125 mm (0.0049 in.)	2.488 - 2.538 mm (0.09548 - 0.09744 in.)



1. Thrust bearing	2. Oil groove

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Fig. 185: Identifying Thrust Bearing & Oil Groove
Courtesy of SUZUKI OF AMERICA CORP.

Out-of-round and taper (uneven wear) of journals

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense exceeds its limit, regrind or replace crankshaft.

Limit on out-of-round and taper

0.01 mm (0.0004 in.)

Out-of-round

"A"-"B"

Taper

"a"-"b"

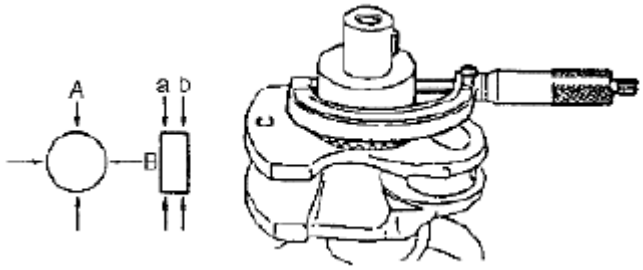


Fig. 186: Measuring Out-Of-Round & Taper (Uneven Wear) Of Journals
Courtesy of SUZUKI OF AMERICA CORP.

Main Bearings

Main bearings general information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and standard size has 5 kinds of bearings differing in tolerance.
- Upper half of bearing (1) has oil groove (2) as shown in **Fig. 187**.

  Install this half with oil groove to cylinder block.

- Lower half of bearing does not have oil groove.

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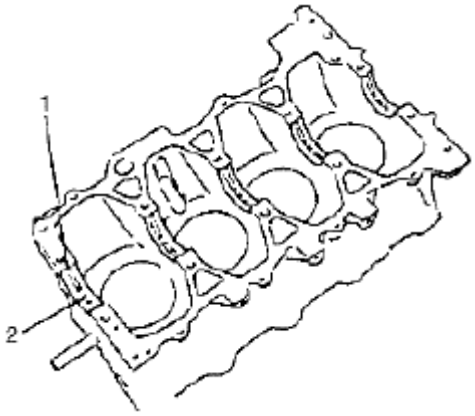


Fig. 187: Identifying Upper Half Of Bearing & Oil Groove
Courtesy of SUZUKI OF AMERICA CORP.

Main bearings inspection

Check bearings for pitting, scratches, wear or damage.

If any malcondition is found, replace both upper and lower halves. Never replace either half without replacing the other half.

Main bearing clearance

Check clearance by using gauging plastic according to the following procedure.

1. Remove lower crankcase.
2. Clean bearings and main journals.
3. Place a piece of gauging plastic (1) to full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.

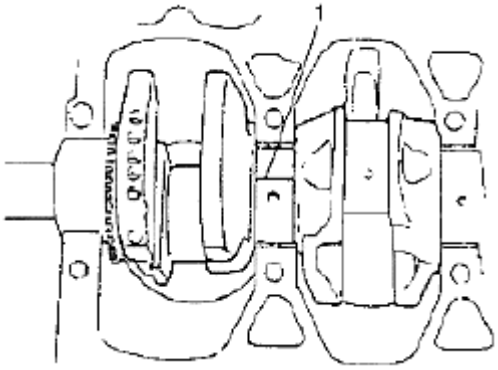


Fig. 188: Placing Piece Of Gauging Plastic
Courtesy of SUZUKI OF AMERICA CORP.

4. Install lower crankcase to cylinder block by referring to **INSTALLATION**.

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NOTE: Do not rotate crankshaft while gauging plastic is installed.

5. Remove lower crankcase and using scale (2) on gauging plastic envelop (1), measure gauging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit. A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.

   After selecting new bearing, recheck clearance.

   Main bearing clearance

   Standard: 0.020 - 0.038 mm (0.00079 - 0.00149 in.)

   Limit: 0.063 mm (0.0024 in.)

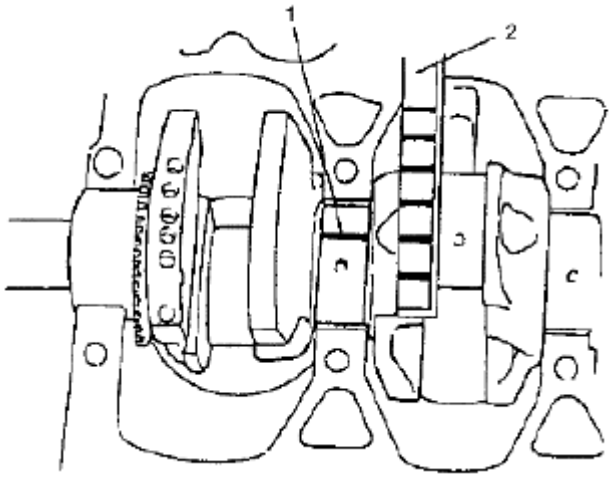


Fig. 189: Removing Lower Crankcase & Using Scale
Courtesy of SUZUKI OF AMERICA CORP.

Selection of main bearings STANDARD BEARING:

- Bearing is in malcondition.
- Bearing clearance is out of specification.
- Crankshaft or cylinder block is replaced.

1. First check journal diameter. As shown in **Fig. 190**, crank web No.2 has stamped numbers.

   Six kinds of numbers ("4" through "9") represent the following journal diameters.

   Journal diameter

JOURNAL DIAMETER AND STAMPED NUMBERS

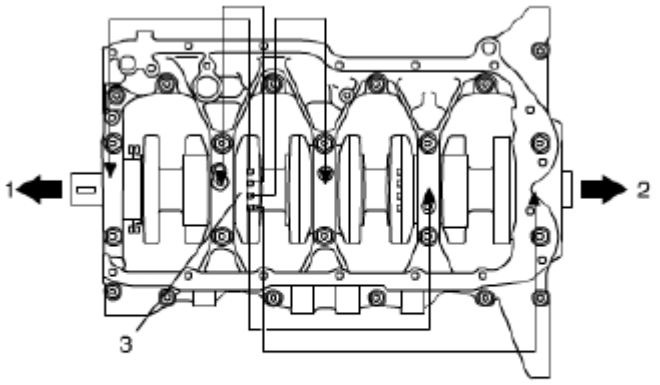
Stamped numbers	Journal diameter

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4	58.0030 - 58.0060 mm (2.28358 - 2.28369 in.)
5	58.0000 - 58.0029 mm (2.28346 - 2.28357 in.)
6	57.9970 - 57.9999 mm (2.28334 - 2.28345 in.)
7	57.9940 - 57.9969 mm (2.28323 - 2.28333 in.)
8	57.9910 - 57.9939 mm (2.28311 - 2.28322 in.)
9	57.9880 - 57.9909 mm (2.28299 - 2.28310 in.)

Stamped numbers on crank web No.2 (3) represent journal diameters marked with an arrow in **Fig. 190** respectively.

For example, stamped number "5" indicates that corresponding journal diameter is 58.0000 - 58.0029 mm (2.28346 - 2.28357 in.).



1. Crankshaft pulley side	2. Flywheel side

Fig. 190: Identifying Stamped Numbers On Crank Web
Courtesy of SUZUKI OF AMERICA CORP.

2. Next, check journal bore diameter. On lower crankcase five alphabets are stamped as shown in **Fig. 191**.

   Three kinds of alphabets ("A", "B" and "C") represent the following journal bore diameters.

   Journal bore diameter

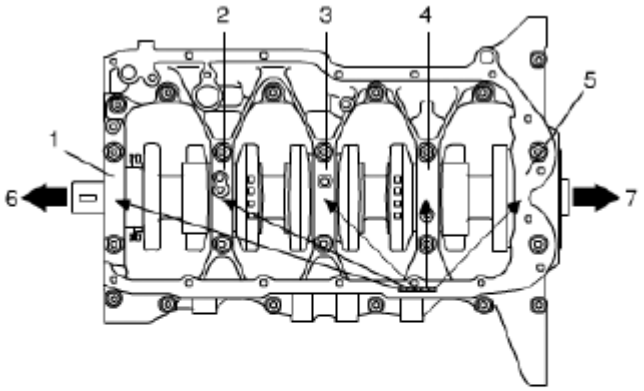
   JOURNAL BORE DIAMETER AND STAMPED ALPHABET

Stamped alphabet	Journal bore diameter
A	61.9940 - 62.0000 mm (2.44070 - 2.44094 in.)
B	62.0001 - 62.0060 mm (2.44095 - 2.44117 in.)
C	62.0061 - 62.0120 mm (2.44118 - 2.44141 in.)

   Stamped alphabets on lower crankcase represent journal diameter marked with an arrow in figure respectively. For example, stamped alphabet "A" at No.2 journal indicates that (journal) bore diameter of

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No.2 journal is 61.9940 - 62.0000 mm (2.44070 - 2.44094 in.).



1. No.1 journal	5. No.5 journal
2. No.2 journal	6. Crankshaft pulley side
3. No.3 journal	7. Flywheel side
4. No.4 journal	

Fig. 191: Identifying Stamped Alphabets On Lower Crankcase
Courtesy of SUZUKI OF AMERICA CORP.

3. There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted (1) in the following colors at the position as indicated in **Fig. 192**.

   Each color indicates the following thickness at the center of bearing.

   Standard size main bearing thickness

STANDARD SIZE MAIN BEARING THICKNESS SPECIFICATION

Color painted	Bearing thickness
Green	1.9910 - 1.9940 mm (0.07839 - 0.07850 in.)
Black	1.9940 - 1.9970 mm (0.07851 - 0.07862 in.)
Colorless (no painted)	1.9970 - 2.0000 mm (0.07863 - 0.07874 in.)
Yellow	2.0000 - 2.0030 mm (0.07874 - 0.07885 in.)
Blue	2.0030 - 2.0060 mm (0.07886 - 0.07897 in.)

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Fig. 192: Identifying Paint Mark For Standard Size Main Bearing Thickness
Courtesy of SUZUKI OF AMERICA CORP.

4. From number stamped on crank web No.2 and alphabets stamped on lower crankcase, determine new standard bearing to be installed to journal by referring to **MAIN BEARING CROSS-REFERENCE TABLE**.

   For example, if number stamped on crank web No.2 is "5" and alphabet stamped on lower crankcase is "A", install new standard bearings painted in "Green" to cylinder block side journal and "Black" to lower crankcase side journal.

   NOTE: The meaning of "Upper" and "Lower" described in MAIN BEARING CROSS-REFERENCE TABLE.

   - **Upper: It is instruction of main bearing installed in cylinder block side journal.**
   - **Lower: It is instruction of main bearing installed in lower crankcase side journal.**

   Main bearing cross-reference table (new standard bearing)

   MAIN BEARING CROSS-REFERENCE TABLE

Standard number on crank web No.2							
4	**5**	**6**	**7**	**8**	**9**		
Standard alphabet on lower crankcase	A	Green	Upper: Green Lower: Black	Black	Upper: Black Lower: Colorless	Colorless	Upper: Colorless Lower: Yellow
	B	Black	Upper: Black Lower: Colorless	Colorless	Upper: Colorless Lower: Yellow	Yellow	Upper: Yellow Lower: Blue
	C	Colorless	Upper: Colorless Lower: Yellow	Yellow	Upper: Yellow Lower: Blue	Blue	Blue

5. Check main bearing clearance with newly selected standard bearing referring to **MAIN BEARING CLEARANCE**. If clearance still exceeds its limit, use next thicker bearing and recheck clearance.

UNDERSIZE BEARING (0.25 mm):

- 0.25 mm undersize bearing is available, in five kinds varying in thickness.

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To distinguish them, each bearing is painted (1) in the following colors at such position as indicated in **Fig. 193**. Each color represents the following thickness at the center of bearing.

Undersize main bearing thickness

UNDERSIZE MAIN BEARING THICKNESS SPECIFICATION

Color painted	Bearing thickness
Green & Red	2.1160 - 2.1190 mm (0.08331 - 0.08342 in.)
Black & Red	2.1190 - 2.1220 mm (0.08343 - 0.08354 in.)
Red only	2.1220 - 2.1250 mm (0.08355 - 0.08366 in.)
Yellow & Red	2.1250 - 2.1280 mm (0.08367 - 0.08377 in.)
Blue & Red	2.1280 - 2.1310 mm (0.08378 - 0.08389 in.)

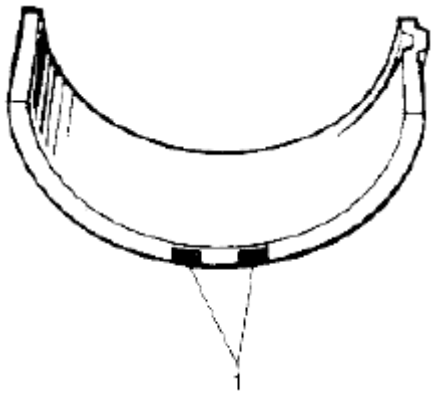


Fig. 193: Identifying Paint Mark For Undersize Main Bearing Thickness
Courtesy of SUZUKI OF AMERICA CORP.

- If necessary, regrind crankshaft journal and select under-size bearing to use with it as follows.
  a. Regrind journal to the following finished diameter.

     Finished journal diameter

     57.7380 - 57.7560 mm (2.27315 - 2.27385 in.)

  b. Using micrometer, measure reground journal diameter.

     Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.

  c. Using journal diameter measured and alphabets stamped on lower crankcase, select an undersize bearing by referring to **UNDERSIZE BEARING SPECIFICATION TABLE** .

     Check bearing clearance with newly selected undersize bearing.

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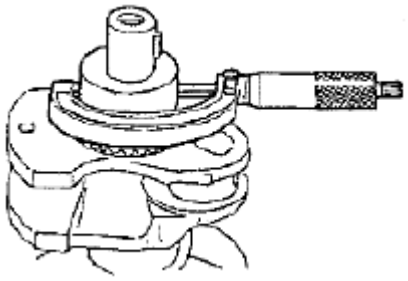


Fig. 194: Measuring Reground Journal Diameter Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Undersize bearing specification

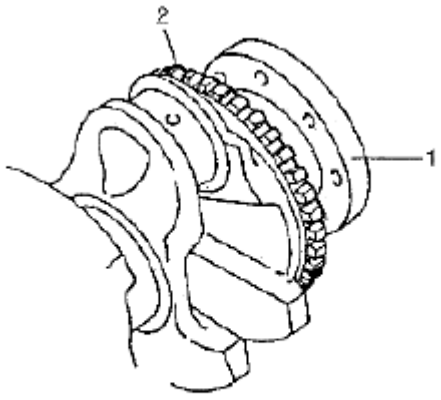
UNDERSIZE BEARING SPECIFICATION TABLE

		Measured journal diameter		
57.7500 - 57.7560 mm (2.27362 - 2.27385 in.)	**57.7440 - 57.7499 mm (2.27338 - 2.27361 in.)**	**57.7380 - 57.7439 mm (2.27315 - 2.27337 in.)**		
Alphabets stamped on lower crankcase	A	Green & Red	Black & Red	Red only
	B	Black & Red	Red only	Yellow & Red
	C	Red only	Yellow & Red	Blue & Red

Crankshaft Position Sensor Plate

Check teeth of plate for damage.

If any damage is found, replace crankshaft (1).



2. Crankshaft position sensor plate

Fig. 195: Identifying Crankshaft Position Sensor Plate

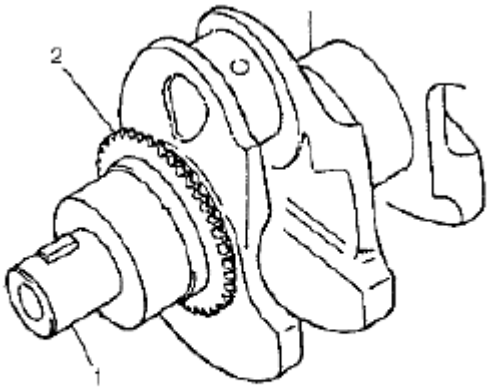
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Courtesy of SUZUKI OF AMERICA CORP.

Oil Pump Sprocket

Check teeth of sprocket for wear or damage.

If any damage or wear is found, replace crankshaft (1).



2. Oil pump sprocket

Fig. 196: Identifying Oil Pump Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pump Chain

Check oil pump chain for wear or damage.



Fig. 197: Identifying Oil Pump Chain
Courtesy of SUZUKI OF AMERICA CORP.

Flywheel

- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.
- Check flywheel for face runout with a dial gauge.

  If runout exceeds its limit, replace flywheel.

  Limit on runout

  0.2 mm (0.0078 in.)

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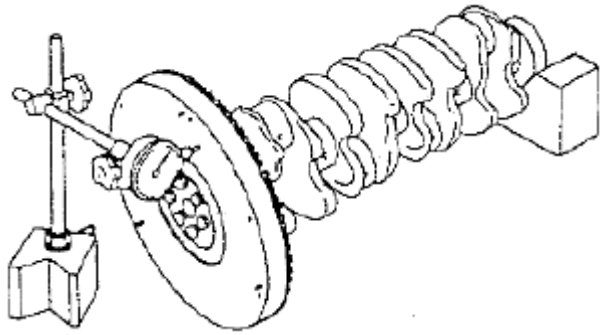


Fig. 198: Checking Flywheel Face Runout
Courtesy of SUZUKI OF AMERICA CORP.

Cylinder Block

- Distortion of gasketed surface.
- Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct It.

Flatness Limit

0.06 mm (0.0024 in.)

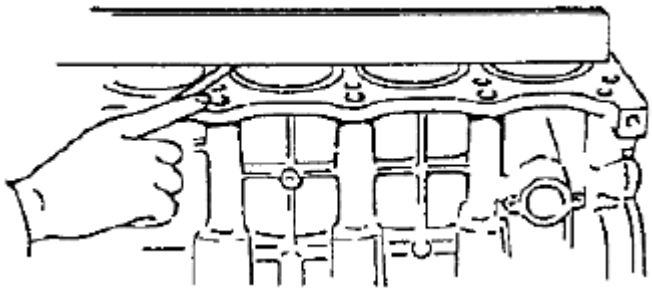


Fig. 199: Checking Gasket Surface For Distortion
Courtesy of SUZUKI OF AMERICA CORP.

Honing or reboring cylinders

1. When any cylinder needs reboring, all other cylinders must also be rebored at the same time.

   Oversize piston specification

   OVERSIZE PISTON SPECIFICATION

Size	Piston diameter
STD	83.970 - 83.990 mm (3.3059 - 3.3067 in.)
O/S 0.50	84.470 - 84.490 mm (3.3256 - 3.3264 in.)

2. Using micrometer, measure piston diameter.

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3. Calculate cylinder bore diameter to be rebored as follows.

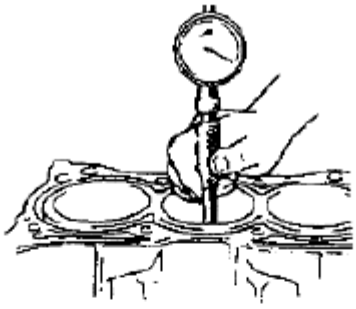
   D = A + B - C

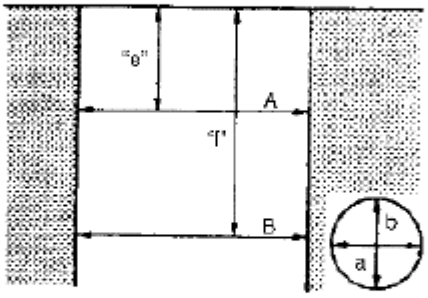
   D: Cylinder bore diameter to be rebored.

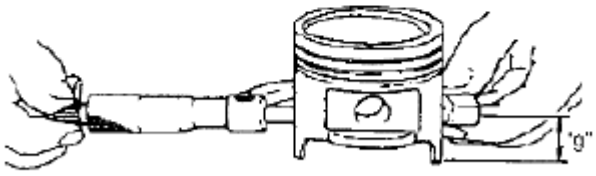
   A. Piston diameter as measured.
   B. Piston clearance = 0.02 - 0.04 mm (0.0008 - 0.0015 in.)
   C. Allowance for honing = 0.02 mm (0.0008 in.)
4. Rebore and hone cylinder to calculated dimension.

   NOTE: Before reboring, install lower crankcase and tighten to specification to avoid distortion of bearing bores.

5. Measure piston clearance after honing.







"e": 50 mm (1.96 in.)	"g": 26.5 mm (1.04 in.)
"f": 95 mm (3.74 in.)	

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Fig. 200: Measuring Piston Clearance After Honing
Courtesy of SUZUKI OF AMERICA CORP.

Check Valve

Check valve for clogging and ball for being stuck.



Fig. 201: Checking Valve For Clogging & Ball
Courtesy of SUZUKI OF AMERICA CORP.

SPECIFICATIONS

TIGHTENING TORQUE SPECIFICATIONS

TIGHTENING TORQUE SPECIFICATIONS

Fastening part	Tightening torque			Note
	N.m	kgf-m	lb-ft	
Camshaft housing bolt	11	1.1	8.0	-
Air cleaner outlet hose clamp	3	0.3	2.5	-
IMT valve actuator bolt	6	0.6	4.5	-
Cylinder head cover nut	Tighten 11 N.m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure			-
Suspension frame mounting bolt	150	15.0	108.5	-
Front lower cross member bolt	55	5.5	40.0	-
Starting motor terminal nut	11	1.1	8.0	-
Generator terminal nut	5	0.5	4.0	-
Battery ground bolt	25	2.5	18.0	-
Ground terminal bolt	11	1.1	8.0	-
Timing chain cover bolt and nut	11	1.1	8.0	-
Idler pulley nut	42	4.2	30.5	-
Generator belt tensioner bolt	25	2.5	18.5	-
Crankshaft pulley bolt	150	15.0	108.5	-
Camshaft timing sprocket				

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bolt	80	8.0	57.5	-
Timing chain tensioner adjuster No.2 bolt	11	1.1	8.0	-
Timing chain tensioner adjuster No.2 nut	45	4.5	33.0	-
Timing chain tensioner nut	25	2.5	18.0	-
Timing chain tensioner adjuster No.1 bolt	11	1.1	8.0	-
Timing chain guide No.1 bolt	9	0.9	6.5	-
Camshaft housing bolt	Tighten 11 N.m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure			-
Cylinder head bolt (M10)	Tighten 52 N.m (5.2 kgf-m, 38.0 lb-ft), 82 N.m (8.2 kgf-m, 59.5 lb-ft), 0 N.m (0 kgf-m, 0 lb-ft), 52 N.m (5.2 kgf-m, 38.0 lb-ft) and 103 N.m (10.3 kgf-m, 74.5 lb-ft) by the specified procedure			-
Cylinder head bolt (M6)	11	1.1	8.0	-
Connecting rod bolt	Tighten 15 N.m (1.5 kgf-m, 11.0 lb-ft), 45° and 45° by the specified procedure			-
Cylinder block heater mounting bolt	11	1.1	8.0	-
Crankcase bolt with 10 mm thread diameter ((1) - (10))	Tighten 40 N.m (4.0 kgf-m, 29.0 lb-ft), 0 N.m (0 kgf-m, 0 lb-ft), 40 N.m (4.0 kgf-m, 29.0 lb-ft), 58 N.m (5.8 kgf-m, 42.0 lb-ft) by the specified procedure			-
Crankcase bolt with 8 mm thread diameter ((11) - (22))	Tighten 26 N.m (2.6 kgf-m, 19.0 lb-ft) by the specified procedure			-
CKP sensor bolt	11	1.1	8.0	-
Flywheel or drive plate bolt	70	7.0	51.0	-
Engine front mounting bracket bolt	55	5.5	40.0	-

NOTE: **The specified tightening torque is also described in the following: AIR CLEANER COMPONENTS, ELECTRIC THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS, CYLINDER HEAD COVER COMPONENTS, ENGINE MOUNTINGS COMPONENTS, TIMING CHAIN COVER COMPONENTS, 2nd TIMING CHAIN AND CHAIN TENSIONER COMPONENTS, 1st TIMING CHAIN AND CHAIN TENSIONER COMPONENTS, CAMSHAFTS, TAPPET AND SHIM COMPONENTS, VALVES AND CYLINDER HEAD COMPONENTS, PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS COMPONENTS and MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**

Reference:

For the tightening torque of fastener not specified in this article, refer to **FASTENERS INFORMATION** .

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SPECIAL TOOLS AND EQUIPMENT

RECOMMENDED SERVICE MATERIAL

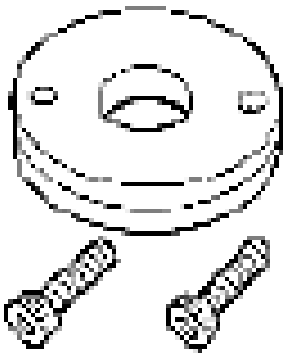
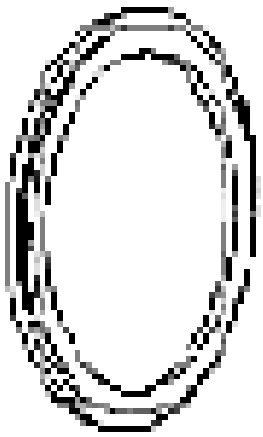
RECOMMENDED SERVICE MATERIAL

Material	SUZUKI recommended product or Specification		Note
Sealant	SUZUKI Bond No.1217G	P/No.: 99000-31260	-
Thread lock cement	Thread Lock Cement Super 1322	P/No.: 99000-32110	-
Water tight sealant	SUZUKI Bond No.1207B	P/No.: 99000-31140	-
	SUZUKI Bond No.1207F	P/No.: 99000-31250	-

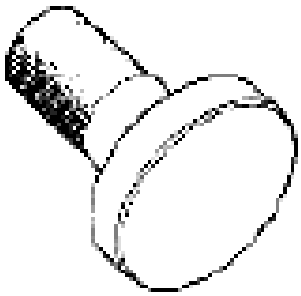
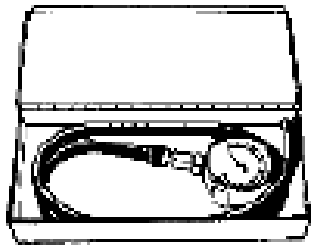
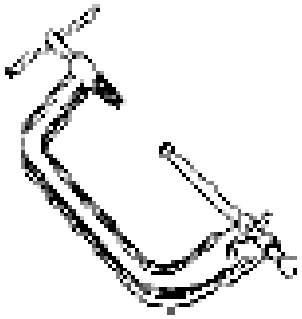
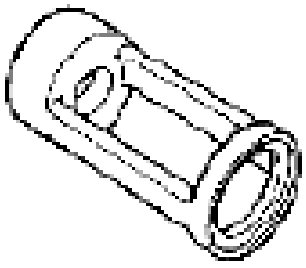
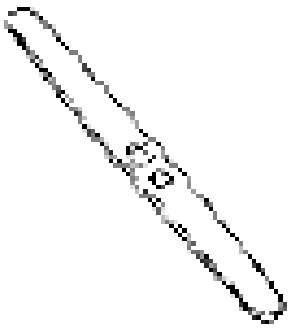
NOTE: **Required service material is also described in the following: TIMING CHAIN COVER COMPONENTS, 2nd TIMING CHAIN AND CHAIN TENSIONER COMPONENTS, 1st TIMING CHAIN AND CHAIN TENSIONER COMPONENTS, CAMSHAFTS, TAPPET AND SHIM COMPONENTS, VALVES AND CYLINDER HEAD COMPONENTS, PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS COMPONENTS and MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**

SPECIAL TOOL

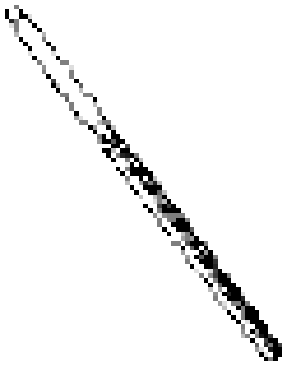
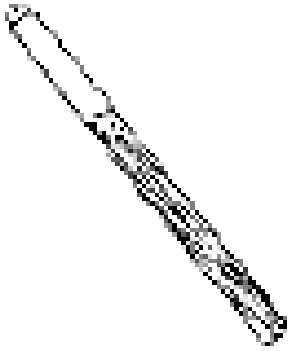
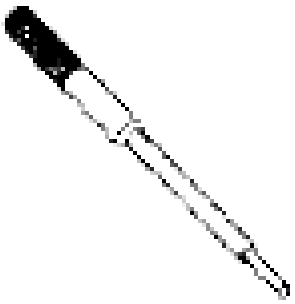
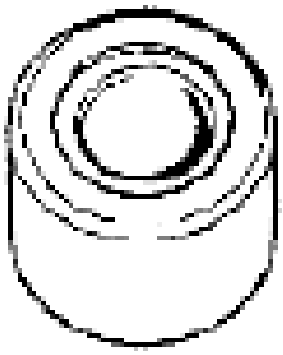
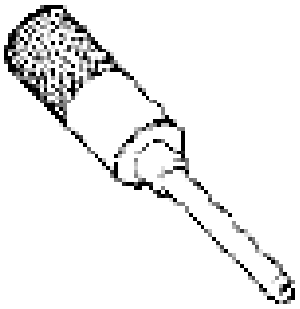
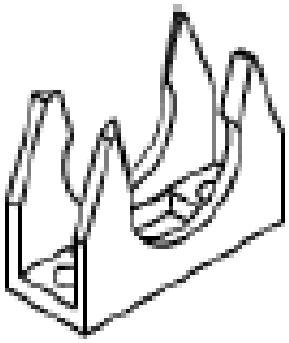
SPECIAL TOOL

09911-97710 Oil seal guide 	09911-97811 Oil seal installer 
09913-75510 Bearing installer	09915-64512 Compression gauge

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09915-64530 Compression gauge hose 	09915-67010 Compression gauge attachment (C) 
09915-67311 Vacuum gauge 	09916-14510 Valve lifter 
09916-16510 Valve lifter attachment 	09916-34542 Reamer handle 
09916-37810 Valve guide reamer (6 mm)	09916-38210 Valve guide reamer (11 mm)

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09916-46020 Valve guide remover 	09916-57340 Valve guide installer attachment 
09916-57350 Valve guide installer handle (6 mm) 	09916-66510 Tappet holder 
09916-77310 Piston ring compressor (50-125 mm) 09917-68221 Camshaft pulley holder 09919-28610 Protector sle	09916-84511 Forceps 09917-98221 Valve guide stem attachment 09924-17811

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