

**2011 ENGINE****Engine Mechanical - Grand Vitara****GENERAL DESCRIPTION****ENGINE CONSTRUCTION DESCRIPTION**

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 and has 16 valves (4 valves/one cylinder). The intake camshaft and exhaust camshaft are mounted over the cylinder head; They are driven by crankshaft through timing chain, and no push rod is provided in the valve train system.

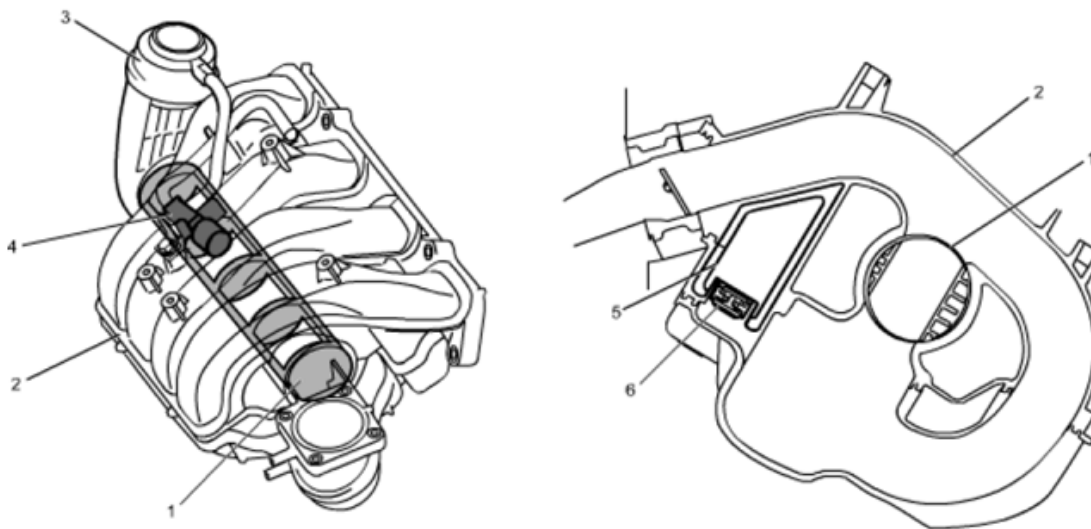
**IMT (INTAKE MANIFOLD TUNING) SYSTEM DESCRIPTION**

The IMT (Intake manifold tuning) system consists of the following items.

- IMT valve (1) included in the intake manifold (2)
- IMT valve actuator (3) fixed on the intake manifold
- IMT vacuum solenoid valve (4)
- Vacuum tank (5)

The vacuum tank contains the one way check valve (6) to maintain negative pressure constantly regardless of variation in the intake manifold pressure.

There fore, the vacuum tank, supplies the IMT vacuum solenoid valve actuator with stable negative pressure in the whole of engine speed ranges.



**Fig. 1: Identifying Intake Manifold Components**  
Courtesy of SUZUKI OF AMERICA CORP.

The IMT system varies effective length of the intake pipe by opening and closing the IMT valve (1) in order to improve air volumetric efficiency.

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

When the IMT valve is totally closed [A]:

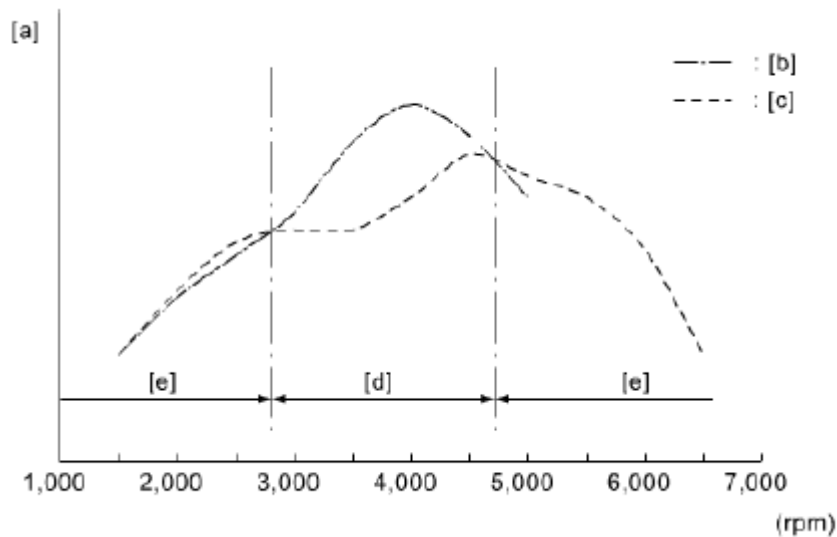
The effective intake pipe length is longer. The engine torque in the low engine speed range and the high engine speed range drops, however it is improved in the middle engine speed range.

When the IMT valve is fully open [B]:

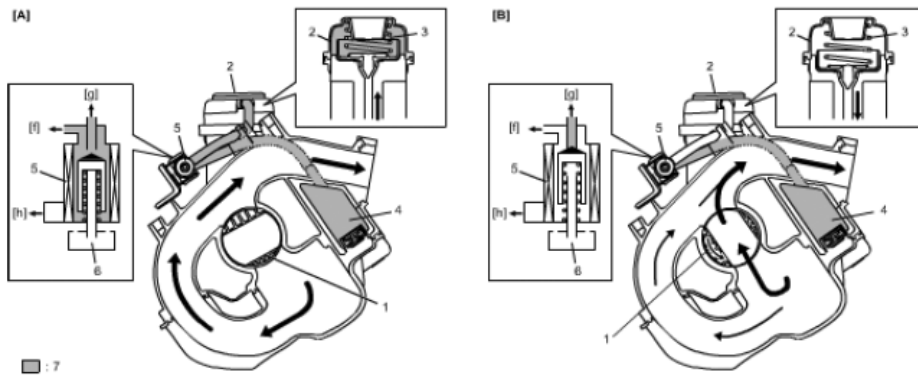
The effective intake pipe length is shorter. The engine torque in the low engine speed range and the high engine speed range are improved, however it drops in the middle engine speed range.

The IMT system utilizes above-mentioned characteristic of the engine torque. The IMT valve is closed in the middle engine speed range, and opened in the low engine speed range and the high engine speed range.

In this way, the engine torque is improved in the whole of engine speed range.



**Fig. 2: Intake Manifold Tuning Graph**  
Courtesy of SUZUKI OF AMERICA CORP.



[a]: Engine torque	[f]: To IMT vacuum solenoid valve	4. Vacuum tank
[b]: Characteristic of long intake pipe	[g]: To vacuum tank	5. IMT vacuum solenoid valve
[c]: Characteristic of short intake pipe	[h]: To ECM	6. Relief port
[d]: Range of long intake pipe	2. IMT valve actuator	7. Vacuum
[e]: Range of short intake pipe	3. Return spring	

**Fig. 3: Intake Manifold Function Diagram**  
 Courtesy of SUZUKI OF AMERICA CORP.

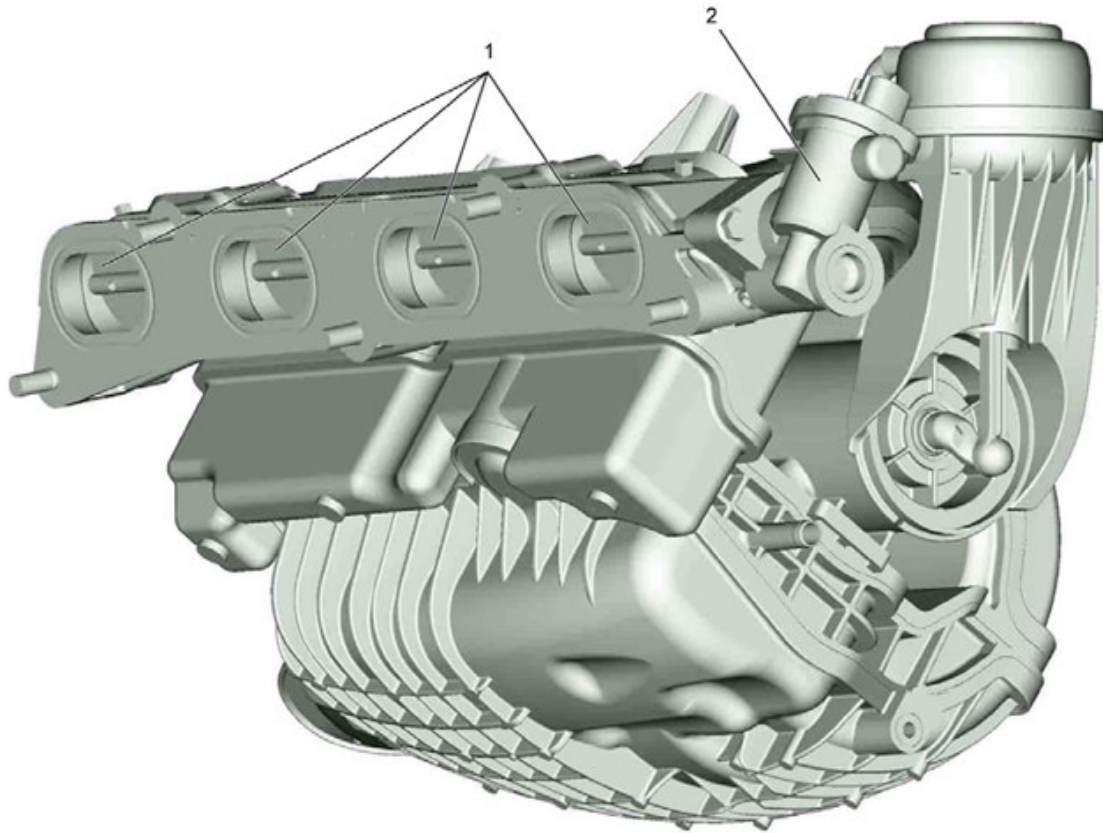
**Cross-reference table between valve operation and intake pipe length**

**SOLENOID VALVE SPECIFICATION**

	Long intake pipe	Short intake pipe
IMT vacuum solenoid valve	ON	OFF
	Open	Closed
IMT valve	Closed	Open
Effective intake pipe length (only in intake manifold)	420 mm (16.5 in.) at 43 mm (1.7 in.) diameter equivalent path	270 mm (10.6 in.) at 45 mm (1.8 in.) diameter equivalent path

**IMRC (INTAKE MANIFOLD RUNNER CONTROL) SYSTEM DESCRIPTION**

- The IMRC (Intake Manifold Runner Control) system reduces fuel consumption and exhaust emission by producing the tumble air flow which makes A/F leaner when the engine is idling at low temperature.
- The tumble air flow is generated by opening/closing the IMRC valve located between the intake manifold and the cylinder head.
- The IMRC system consists of the following items.
  - IMRC valve (1)
  - IMRC valve actuator (2) (including in the IMRC valve motor and the IMRC valve position sensor)

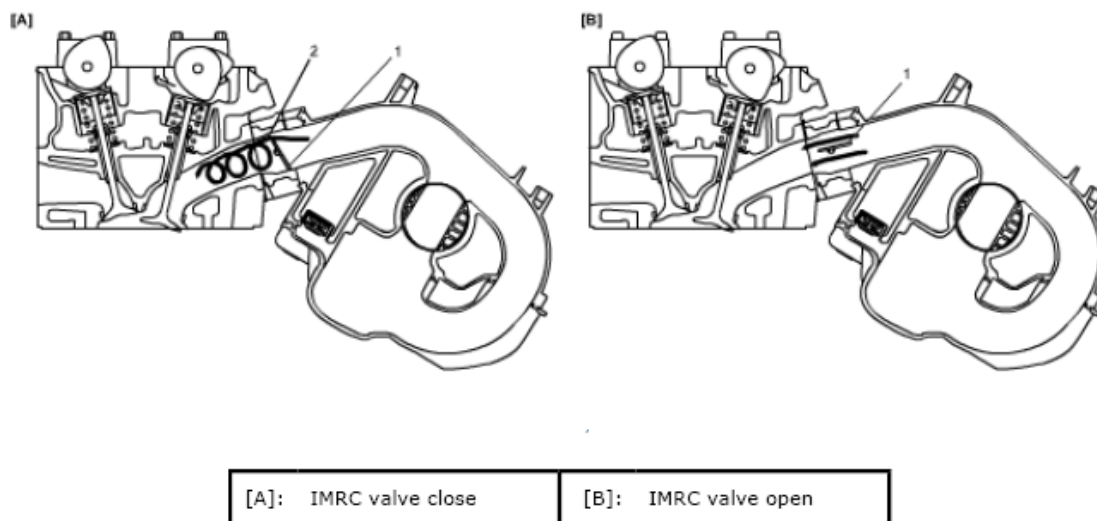


**Fig. 4: Identifying Intake Manifold Runner Control Component Location**  
 Courtesy of SUZUKI OF AMERICA CORP.

- The ECM drives the IMRC valve motor which is included in the IMRC valve actuator according to a vehicle speed, an engine speed, a coolant temperature and an accelerator pedal position.
- When the IMRC valve (1) driving conditions are met, the ECM sends "closing" signal to the IMRC valve motor. The IMRC valve motor closes the IMRC valve to create the tumble air flow (2).
- When the IMRC valve driving conditions are not met, The ECM sends "opening" signal to the IMRC valve motor. The IMRC valve motor opens the IMRC valve.
- The ECM detects an IMRC valve position by a non-contact type IMRC valve position sensor.

#### **IMRC valve closing condition**

- **Vehicle speed: Stop**
- **Engine speed: Idling speed**
- **Engine coolant temperature: Low**
- **Accelerator position: Fully released**



**Fig. 5: Identifying IMRC Valve Close And IMRC Valve Open**  
 Courtesy of SUZUKI OF AMERICA CORP.

## DIAGNOSTIC INFORMATION AND PROCEDURES

### COMPRESSION CHECK

1. Warm up engine to normal operating temperature.
2. Stop engine after warm-up.
3. For 4 A/T model, place select lever in "P" and apply parking brake.

For 5 M/T model, place gear shift lever in "Neutral" and apply parking brake.

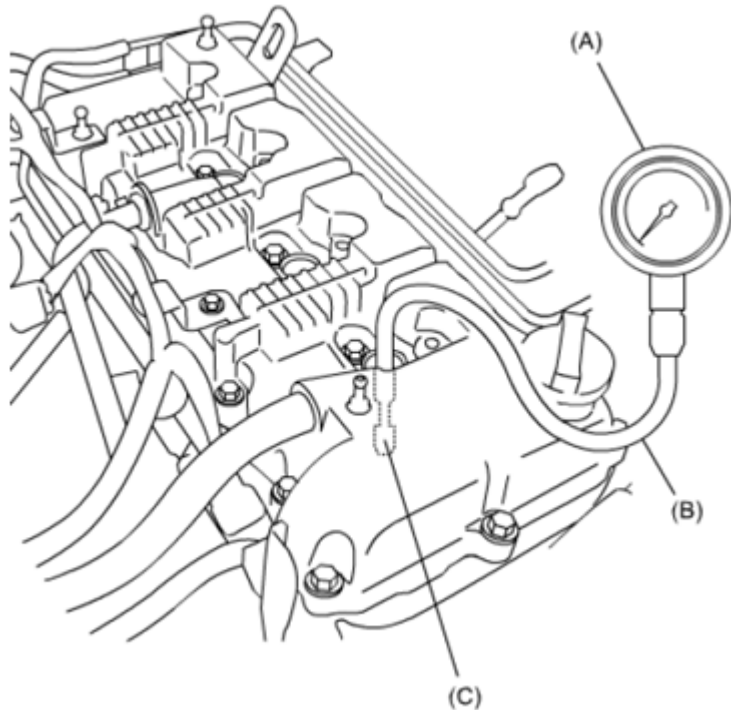
4. Remove engine cover.
5. Remove all ignition coils and spark plugs. See **SPARK PLUG REMOVAL AND INSTALLATION**.
6. Disconnect all fuel injector connectors.
7. Install special tools into spark plug hole.

#### Special Tool

**(A): 09915-64512**

**(B): 09915-64530**

**(C): 09915-67010**



**Fig. 6: Installing Special Tools Into Spark Plug Hole**  
 Courtesy of SUZUKI OF AMERICA CORP.

8. Depress accelerator pedal all the way to fully open throttle.

**NOTE:** For 5 M/T model, disengage clutch to lighten starting load on engine, and depress accelerator pedal all the way to fully open throttle.

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

**NOTE:**

- For measuring compression pressure, crank engine at least 200 RPM by using fully charged battery.
- If measured compression pressure is lower than limit value, check installation condition of special tool.
- If the measured compression pressure of particular cylinder is lower than limit, add a bit of engine oil into the cylinder through the spark plug hole, and then repeat the compression check.
  - If the compression pressure increases after adding engine oil, there is possibility of the following cause.
    - The pressure leakage is caused by worn piston rings or worn cylinder.
  - If the compression pressure does not increase significantly, there is possibility of the following causes.
    - Incorrect valve timing.

- The pressure leakage is at the valves and the valve seats.
- The pressure leakage is at the cylinder head gasket.

### Compression pressure

**Standard: 1, 400 kPa (14.3 kgf/cm<sup>2</sup> , 203 psi)**

**Limit: 1, 100 kPa (11.2 kgf/cm<sup>2</sup> , 160 psi)**

**Max. difference between any two cylinders: 100 kPa (1.02 kgf/cm<sup>2</sup> , 14.5 psi)**

10. Carry out Steps 7) through 9) on each cylinder.
11. Install spark plugs and ignition coil assemblies. See SPARK PLUG REMOVAL AND INSTALLATION .
12. Connect fuel injector connectors.
13. Install engine cover.

### ENGINE VACUUM CHECK

1. Warm up engine to normal operating temperature.
2. For 4 A/T model, place select lever in "P" and apply parking brake.

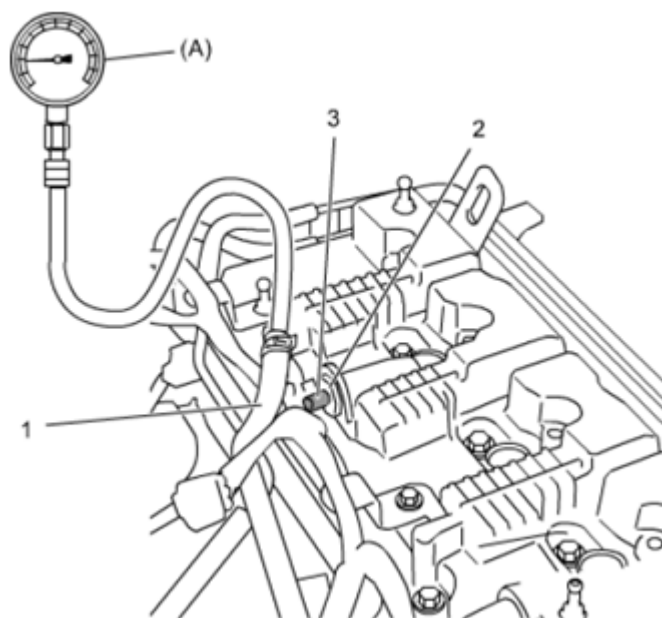
For 5 M/T model, place gear shift lever in "Neutral" and apply parking brake.

3. Remove engine cover.
4. Remove PCV hose (1) from PCV valve (2).
5. Connect special tool to PCV hose (1).

#### Special Tool

**(A): 09915-67311**

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



**Fig. 7: Connecting Special Tool To PCV Hose**  
 Courtesy of SUZUKI OF AMERICA CORP.

7. Start engine and turn off all electric loads.
8. Read vacuum gauge at specified idle speed. See **IDLE SPEED AND IAC THROTTLE VALVE OPENING INSPECTION** .

#### **Vacuum specification (at sea level)**

**Standard: -65 kPa (-0.66kgf/cm<sup>2</sup> , -9.43 psi, -0.65 bar) or less at specified idle speed**

9. After checking, disconnect special tool from PCV valve.
10. Peel off tape from PCV hose.
11. Connect PCV hose to PCV valve.
12. Install engine cover.

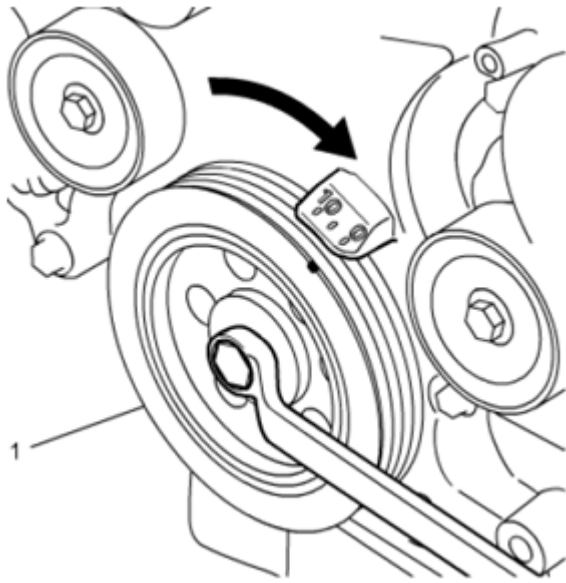
#### **VALVE CLEARANCE INSPECTION AND ADJUSTMENT**

**NOTE:** For identification of each cylinder, refer to **PRECAUTIONS FOR IDENTIFICATION OF CYLINDER** .

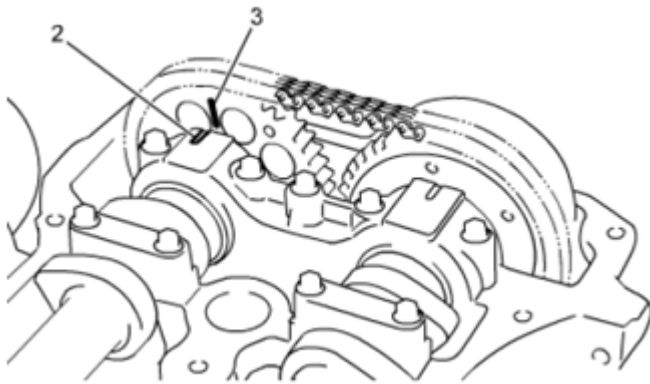
#### **Inspection**

1. Disconnect negative (-) cable from battery.
2. Remove cylinder head cover. See **CYLINDER HEAD COVER REMOVAL AND INSTALLATION**.
3. Remove engine under cover.
4. Align timing mark (3) on exhaust camshaft timing sprocket with match mark (2) on camshaft housing No.

1, by turning crankshaft pulley (1) clockwise with 19 mm wrench.

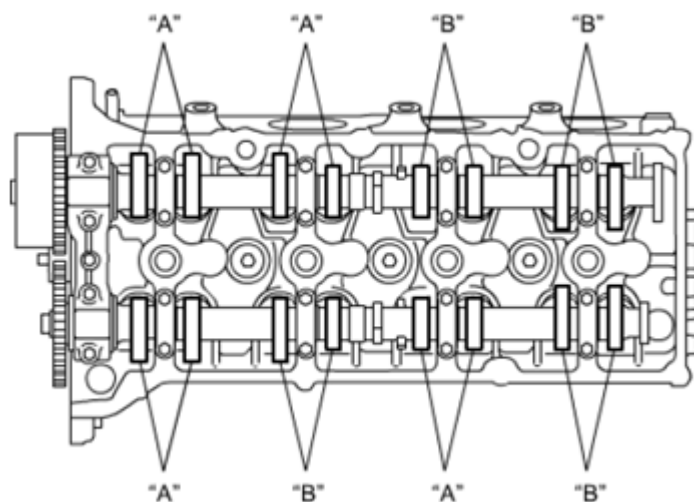


**Fig. 8: Turning Crankshaft Pulley**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 9: Aligning Timing Mark On Exhaust Camshaft Timing Sprocket With Match Mark On Camshaft Housing 1**  
Courtesy of SUZUKI OF AMERICA CORP.

5. Measure valve clearances with thickness gauge according to the following procedures.
  - a. Measure valve clearances of indicated valves "A" in figure.
  - b. Turn crankshaft pulley 360° clockwise with 19 mm wrench.
  - c. Measure valve clearances of indicated valves "B" in figure.



**Fig. 10: Identifying Valve Clearances Of Indicated Valves (A And B)**  
 Courtesy of SUZUKI OF AMERICA CORP.

If valve clearance is out of specification, record valve clearance and adjust it to specification.

### Valve clearance specification

When cold (ECT: 15 - 25 °C (59 - 77 °F)):

- Intake: 0.16 - 0.24 mm (0.0063 - 0.0094 in.)
- Exhaust: 0.31 - 0.39 mm (0.0123 - 0.0153 in.)

### Adjustment

1. Remove tappet to be replaced. See **CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION**.
2. Select proper size of tappet as follows.
  - a. Using a micrometer, measure the thickness of the removed tappet (1).
  - b. Calculate the thickness of new tappet by formula below.

**NOTE:** If the number at second places of decimal point A is odd number, use (A - 0.01) tappet.

Intake side:

$$A = B + C - 0.20 \text{ mm (0.0079 in.)}$$

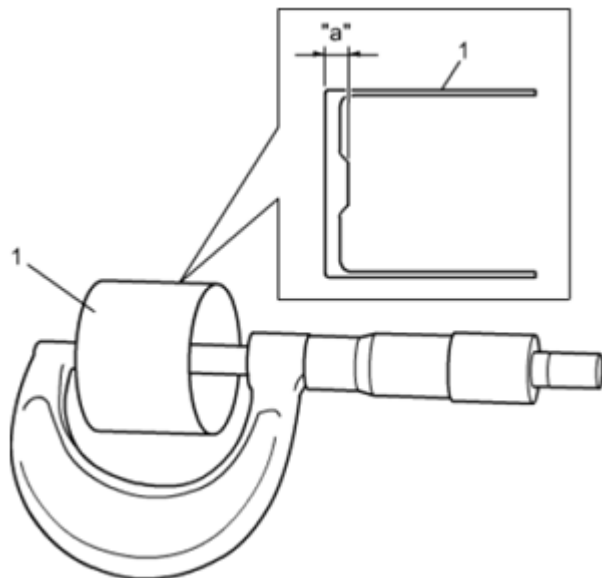
Exhaust side:

$$A = B + C - 0.35 \text{ mm (0.0138 in.)}$$

A: Thickness "a" of new tappet

B: Thickness "a" of removed tappet

C: Measured valve clearance

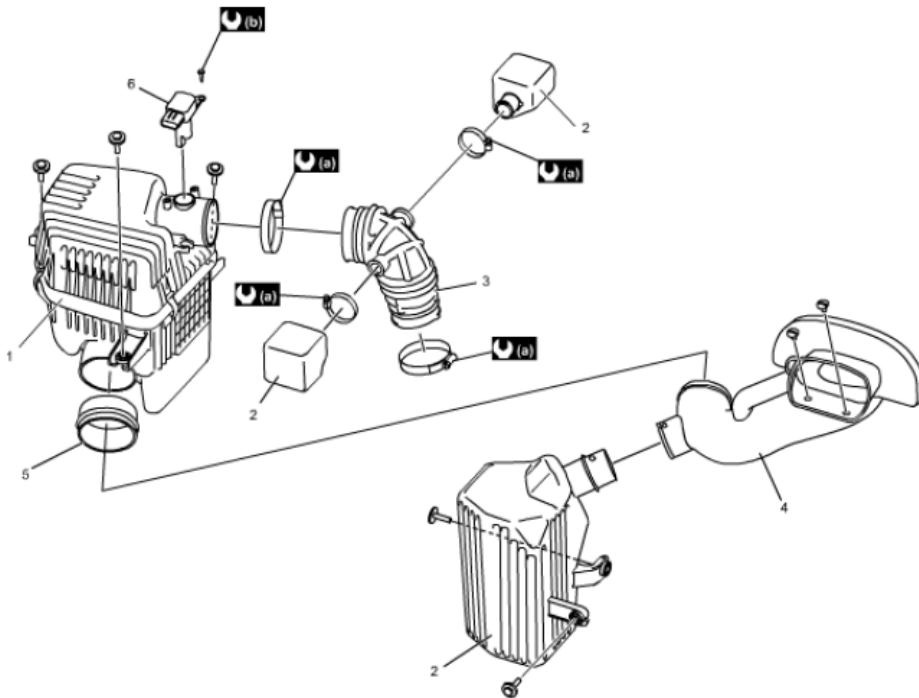


**Fig. 11: Measuring Valve Clearance**  
Courtesy of SUZUKI OF AMERICA CORP.

- c. Select new tappet closest to calculated value from available size as a spare part.
3. Install tappets and camshafts. See **CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION.**
4. Recheck valve clearance.

## REPAIR INSTRUCTIONS

### AIR CLEANER COMPONENTS



1. Air cleaner assembly	4. Air cleaner suction pipe	: 2.0 Nm (0.20 kgf-m, 1.5 lbf-ft)
2. Resonator	5. Suction pipe joint	: 1.2 Nm (0.12 kgf-m, 1.0 lbf-ft)
3. Air cleaner outlet hose	6. MAF and IAT sensor	

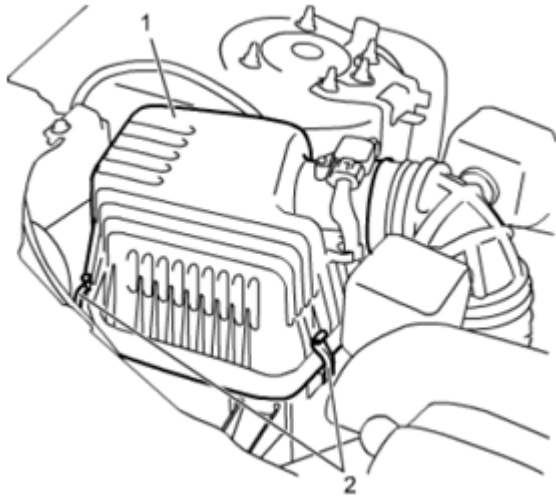
**Fig. 12: Identifying Air Cleaner Components With Torque Specifications**  
 Courtesy of SUZUKI OF AMERICA CORP.

**AIR CLEANER FILTER REMOVAL AND INSTALLATION**

**Reference: AIR CLEANER COMPONENTS**

**Removal**

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



**Fig. 13: Identifying Air Cleaner Case And Clamps**  
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove air cleaner filter from case.

#### **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**

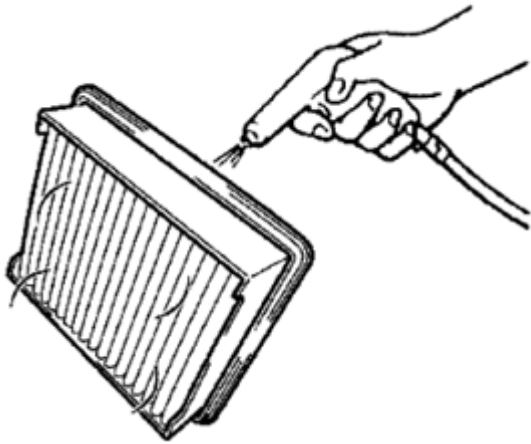
#### **Inspection**

Check air cleaner filter for dirt.

Replace excessively dirty filter.

#### **Cleaning**

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



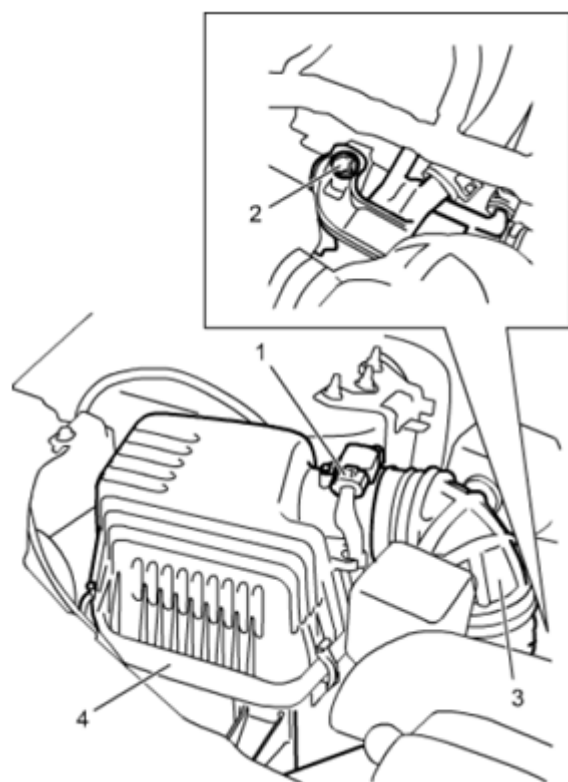
**Fig. 14: Blowing Dust With Compressed Air From Air Outlet Side Of Filter**  
Courtesy of SUZUKI OF AMERICA CORP.

## AIR CLEANER ASSEMBLY REMOVAL AND INSTALLATION

**Reference: AIR CLEANER COMPONENTS**

### Removal

1. Disconnect negative (-) cable from battery.
2. Disconnect MAF and IAT sensor connector (1).
3. Remove water bypass pipe bolt (2).
4. Remove air cleaner outlet hose (3).
5. Remove air cleaner assembly (4).

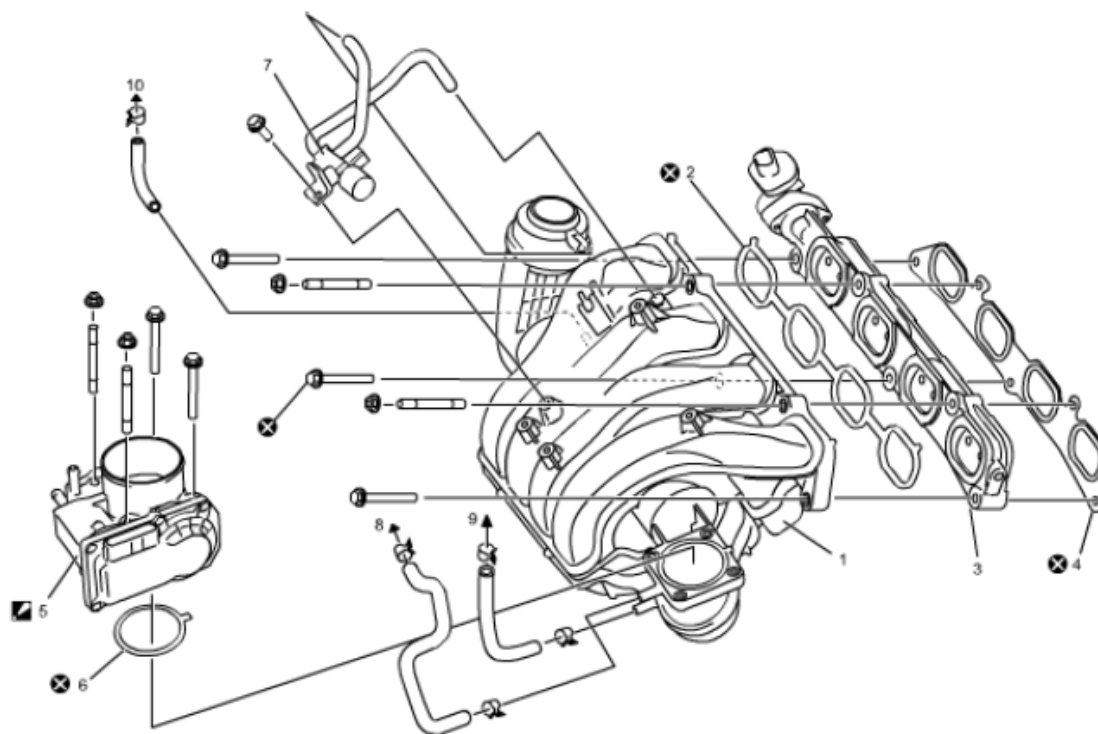




**Fig. 15: Identifying Water Bypass Pipe Bolt, Air Cleaner Outlet Hose And Air Cleaner Assembly**  
Courtesy of SUZUKI OF AMERICA CORP.

**Installation**

Reverse removal procedure for installation.

**THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS**



1. Intake manifold	7. IMT vacuum solenoid valve
2. Intake manifold gasket	8. To EVAP canister purge valve
3. IMRC valve	9. To PCV valve
4. IMRC valve gasket	10. To brake booster
 5. Throttle body : Do not disassemble.	 : Do not reuse.
6. Throttle body gasket	

**Fig. 16: Identifying Throttle Body And Intake Manifold Components**  
 Courtesy of SUZUKI OF AMERICA CORP.

### THROTTLE BODY ASSEMBLY REMOVAL AND INSTALLATION

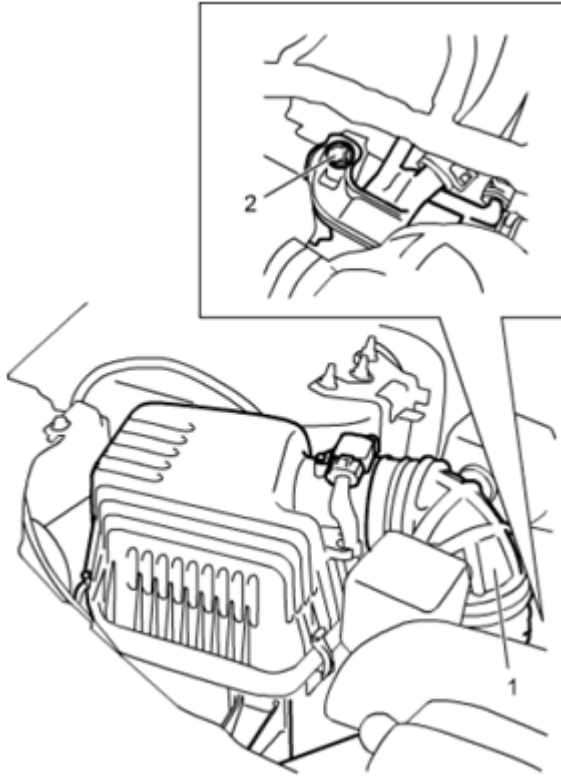
**Reference:** THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS

**CAUTION:** Never disassemble throttle body. Disassembly will spoil its original performance. If faulty condition is found, replace it with new one as an assembly.

#### Removal

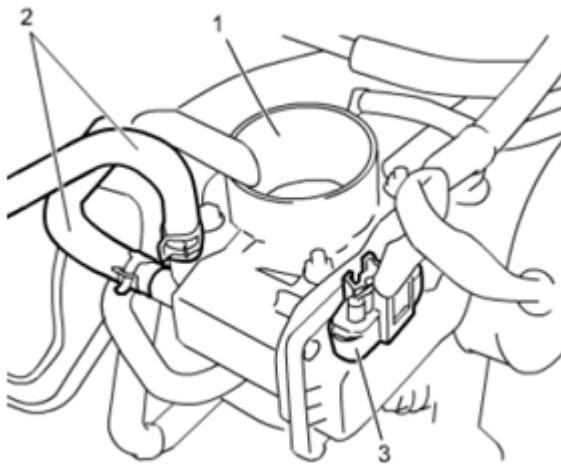
1. Disconnect negative (-) cable from battery.

2. Drain coolant. See **COOLING SYSTEM DRAINING** .
3. Remove water bypass pipe bolt (2).
4. Remove air cleaner outlet hose (1).



**Fig. 17: Identifying Water Bypass Pipe Bolt And Air Cleaner Outlet Hose**  
 Courtesy of SUZUKI OF AMERICA CORP.

5. Disconnect engine coolant hoses (2) and connector (3) from throttle body assembly (1).



**Fig. 18: Identifying Engine Coolant Hoses, Connector And Throttle Body Assembly**

Courtesy of SUZUKI OF AMERICA CORP.

6. Remove throttle body assembly and its gasket from intake manifold.

**Installation**

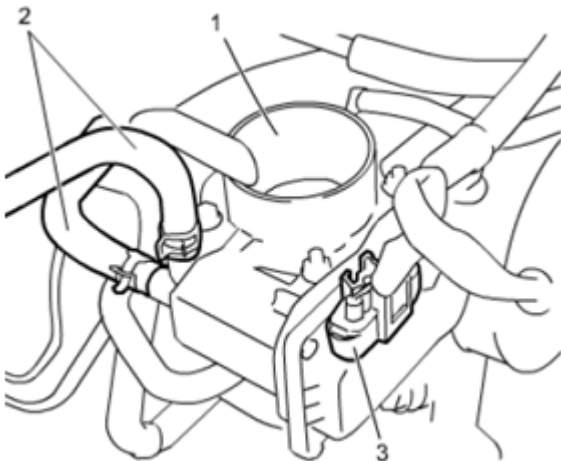
**Reference:** THROTTLE BODY CLEANING

1. Clean mating surfaces and install new throttle body gasket (1) to intake manifold.



**Fig. 19: Identifying Throttle Body Gasket To Intake Manifold**  
Courtesy of SUZUKI OF AMERICA CORP.

2. Install throttle body assembly (1) to intake manifold.
3. Connect connector (3) and coolant hoses (2) to throttle body assembly (1).



**Fig. 20: Identifying Connector, Coolant Hoses And Throttle Body Assembly**

**Courtesy of SUZUKI OF AMERICA CORP.**

4. Install air cleaner outlet hose. See **AIR CLEANER ASSEMBLY REMOVAL AND INSTALLATION**.
5. Refill cooling system. See **COOLING SYSTEM REFILLING** .
6. Connect negative (-) cable to battery.
7. Check for coolant leaks. See **ENGINE COOLING SYSTEM INSPECTION** .

**THROTTLE BODY CLEANING**

**Reference:** **THROTTLE BODY ASSEMBLY REMOVAL AND INSTALLATION**

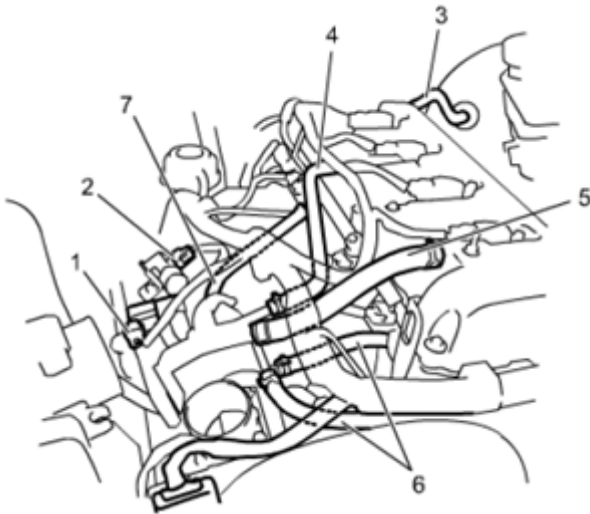
Clean throttle body assembly according to "Throttle Valve Visual Check" under **THROTTLE BODY ASSEMBLY ON-VEHICLE INSPECTION** .

**INTAKE MANIFOLD REMOVAL AND INSTALLATION**

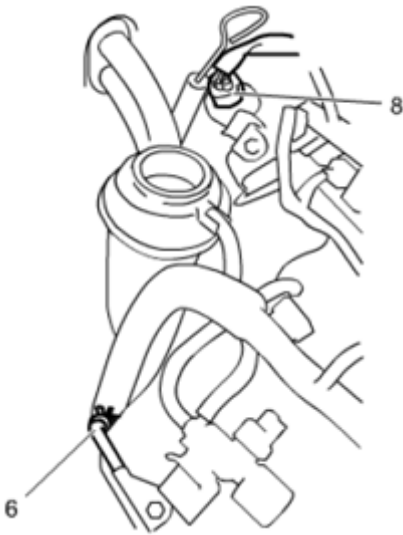
**Reference:** **THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS**

**Removal**

1. Disconnect negative (-) cable from battery.
2. Remove engine cover.
3. Remove air cleaner outlet hose and air cleaner upper case. See **AIR CLEANER FILTER REMOVAL AND INSTALLATION**.
4. Remove throttle body assembly. See **THROTTLE BODY ASSEMBLY REMOVAL AND INSTALLATION**.
5. Disconnect the following connectors and hoses.
  - EVAP canister purge valve connector (1)
  - IMT vacuum solenoid valve connector (2)
  - Brake booster hose (3)
  - PCV valve hose (4)
  - Breather hose (5)
  - Engine coolant hoses (6)
  - Purge hose (7)
  - IMRC valve actuator connector (8)
  - A/T oil filler tube (4 A/T model): See **OIL COOLER HOSE AND PIPE COMPONENTS** .
  - Engine harness clamps
  - Brake vacuum pipe. See **BRAKE BOOSTER COMPONENTS** .

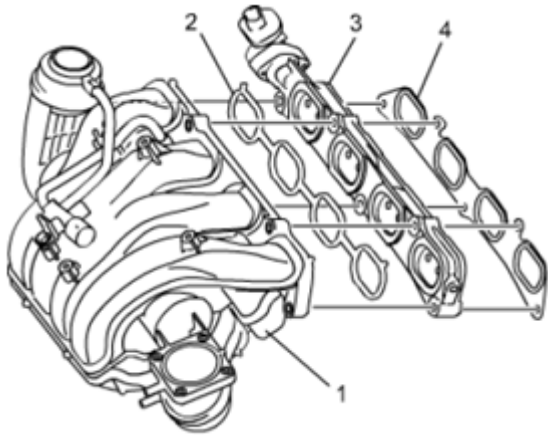


**Fig. 21: Identifying Intake Manifold Components**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 22: Identifying IMRC Valve Actuator Connector And Engine Coolant Hoses**  
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove intake manifold (1), intake manifold gasket (2), IMRC valve (3) and IMRC valve gasket (4) from cylinder head.



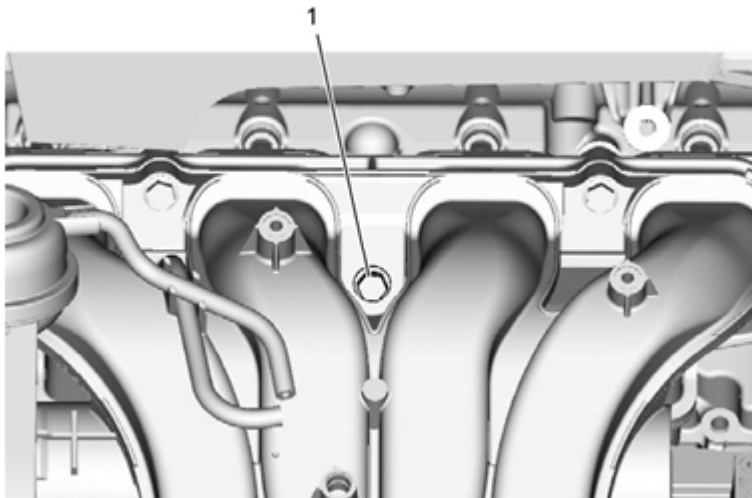
**Fig. 23: Identifying Intake Manifold, Intake Manifold Gasket, IMRC Valve And IMRC Valve Gasket**

Courtesy of SUZUKI OF AMERICA CORP.

### Installation

Reverse removal procedure for installation noting the following.

- Use new Intake manifold bolt for position (1) in figure, because it is not reusable.

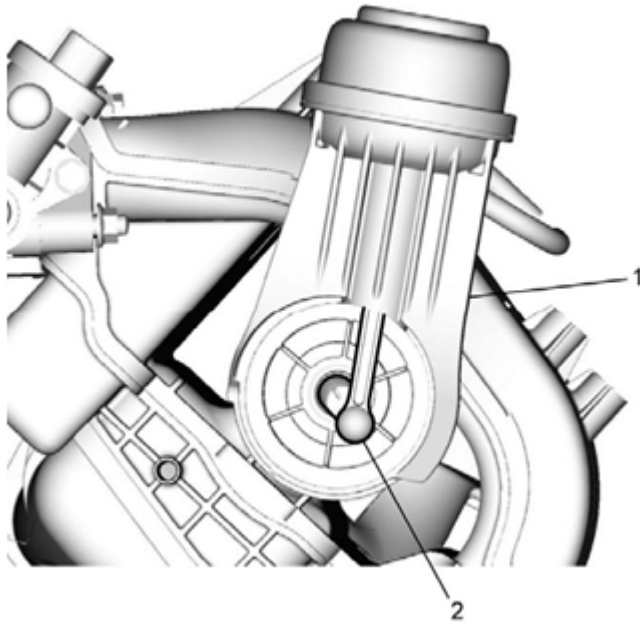


**Fig. 24: Identifying Intake Manifold Bolt**  
Courtesy of SUZUKI OF AMERICA CORP.

- Use New gaskets
- Refill cooling system. See **COOLING SYSTEM REFILLING** .
- Check for coolant leaks. See **ENGINE COOLING SYSTEM INSPECTION** .

### IMT VALVE ACTUATOR INSPECTION

1. When the engine is not running, make sure the IMT valve actuator (1) is at fully open position (2).



**Fig. 25: Identifying IMT Valve Actuator**  
Courtesy of SUZUKI OF AMERICA CORP.

2. Check IMT valve actuator (1) according to the following procedure.
  - a. Connect special tool to IMT valve actuator (1) and then vacuum it.

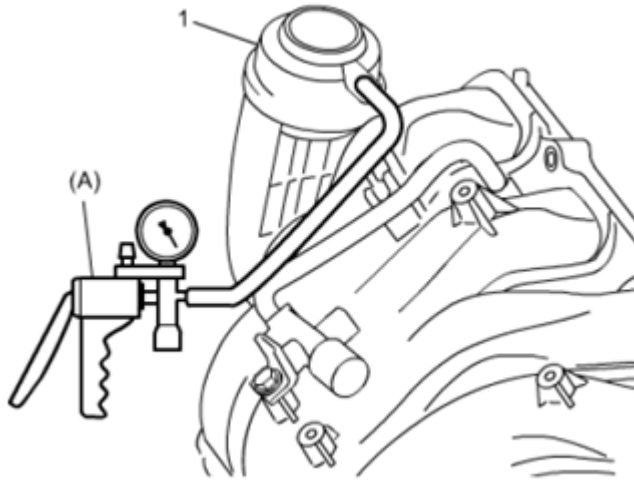
**CAUTION: Never apply excessive vacuum more than standard value.**

**Special Tool**

**(A): 09917-47011**

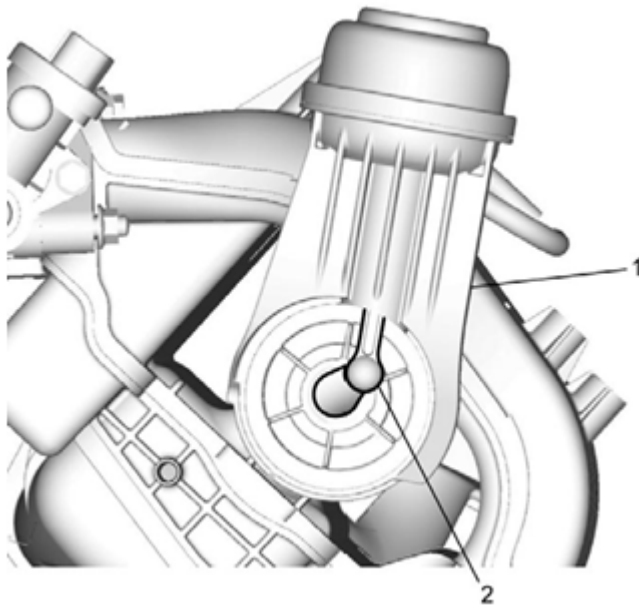
**Actuation vacuum specification**

**Standard value: -33 kPa (-0.3 kgf/cm<sup>2</sup> , -4.79 psi, -0.33 bar)**



**Fig. 26: Connecting Special Tool To IMT Valve Actuator And Vacuum**  
 Courtesy of SUZUKI OF AMERICA CORP.

- b. Check that IMT valve actuator sets valve to fully closed position, and keeps fully closed.



**Fig. 27: Checking IMT Valve Actuator Sets Valve To Fully Closed Position**  
 Courtesy of SUZUKI OF AMERICA CORP.

- c. With actuating valve to fully opened and closed positions several times, check that IMT valve actuator moves smoothly and properly.

If any abnormality is found, replace intake manifold assembly. See **INTAKE MANIFOLD REMOVAL AND INSTALLATION**.

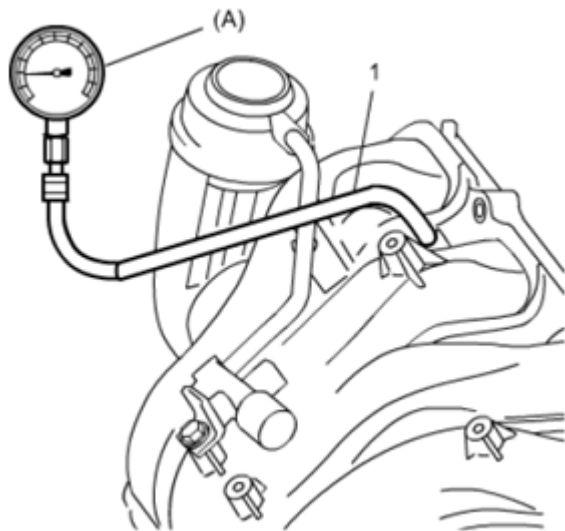
#### VACUUM TANK AND ONE-WAY CHECK VALVE INSPECTION

Check vacuum tank and one-way check valve according to the following procedure.

1. Disconnect vacuum hose (1) from IMT vacuum solenoid valve and connect special tool to vacuum hose (1).

### Special Tool

(A): 09915-67311



**Fig. 28: Inspecting Vacuum Tank And One-Way Check Valve**  
Courtesy of SUZUKI OF AMERICA CORP.

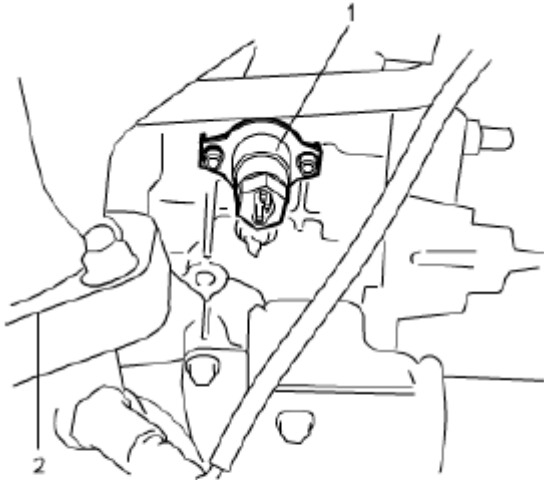
2. Run engine at specified idle speed and check that engine vacuum is standard value. See **ENGINE VACUUM CHECK**.
3. Stop engine and check that engine vacuum is held for longer than one minute.

If any abnormality is found, replace intake manifold assembly. See **INTAKE MANIFOLD REMOVAL AND INSTALLATION**.

## CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED)

### Removal

1. Disconnect negative (-) cable from battery.
2. Drain coolant. See **COOLING SYSTEM DRAINING**.
3. Remove exhaust manifold cover.
4. Remove engine block heater (1).



2. Exhaust manifold

**Fig. 29: Identifying Engine Block Heater**  
 Courtesy of SUZUKI OF AMERICA CORP.

### Installation

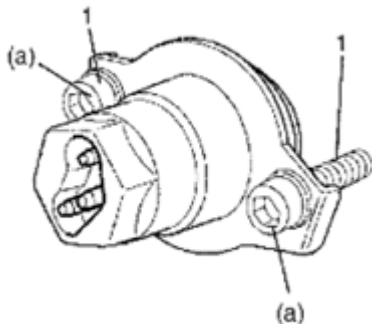
#### **Reference: CYLINDER BLOCK HEATER INSPECTION (IF EQUIPPED)**

Reverse removal procedure for installation noting the following.

- Use new cylinder block heater bolts.
- Tighten cylinder block heater bolts (1) to specified torque.

### Tightening torque

**Cylinder block heater bolt (a): 11 N.m (1.1 kg-m, 8.5 lbf-ft)**



**Fig. 30: Identifying Cylinder Block Heater Bolt**

Courtesy of SUZUKI OF AMERICA CORP.

- Refill coolant. See COOLING SYSTEM REFILLING .
- Check for coolant leaks. See ENGINE COOLING SYSTEM INSPECTION .

### CYLINDER BLOCK HEATER INSPECTION (IF EQUIPPED)

*Reference:* CYLINDER HEAD COVER REMOVAL AND INSTALLATION

- Check continuity between terminals "a" and "c".

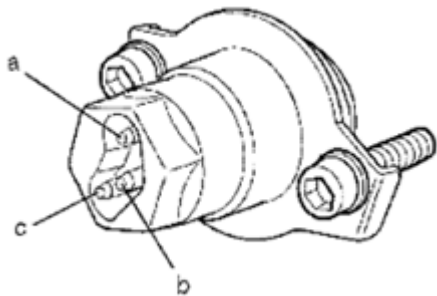
If there is no continuity, replace cylinder block heater. See CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED).

- Check that there is no continuity between terminal "a" and "b".

If there is continuity, replace engine block heater. See CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED).

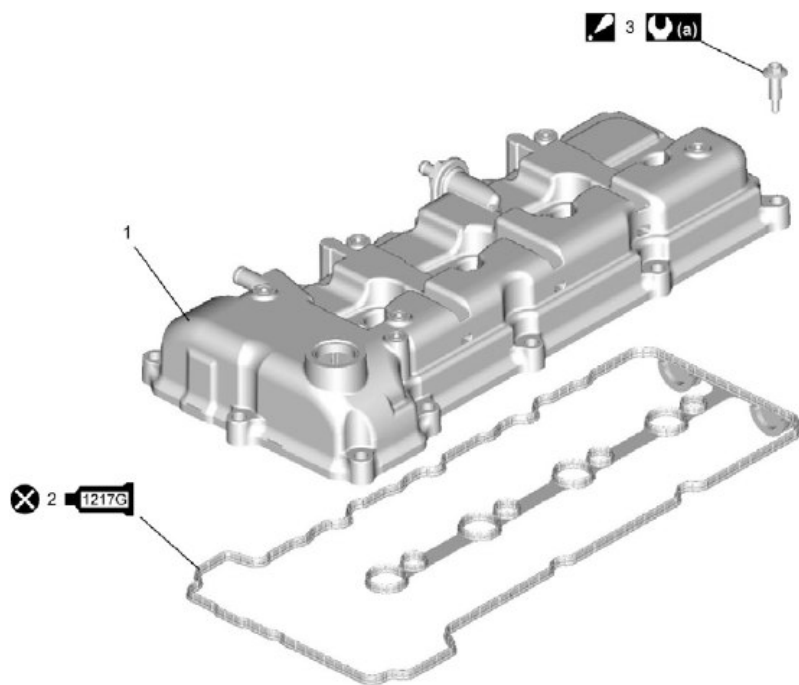
- Check continuity between terminal "b" and engine block heater body.



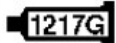

If there is no continuity, replace engine block heater. See CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED).



**Fig. 31: Checking Continuity Between Terminal B And Engine Block Heater Body**  
Courtesy of SUZUKI OF AMERICA CORP.

### CYLINDER HEAD COVER COMPONENTS



<p>1. Cylinder head cover</p>	<p> 3. Cylinder head cover bolt : For tightening order, refer to <a href="#">Cylinder Head Cover Removal and Installation:J24B.</a></p>	<p> : Do not reuse.</p>
<p> 2. Cylinder head cover gasket : Apply sealant 99000-31260 referring to <a href="#">Cylinder Head Cover Removal and Installation:J24B.</a></p>	<p> : 3.0 N·m → 5.0 N·m → 7.5 N·m (0.31 kgf-m → 0.51 kgf-m → 0.76 kgf-m, 2.5 lbf-ft → 4.0 lbf-ft → 5.5 lbf-ft)</p>	

**Fig. 32: Identifying Cylinder Head Cover Components With Torque Specifications**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Tightening Order/Removal and Installation figure callout references:**

**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**

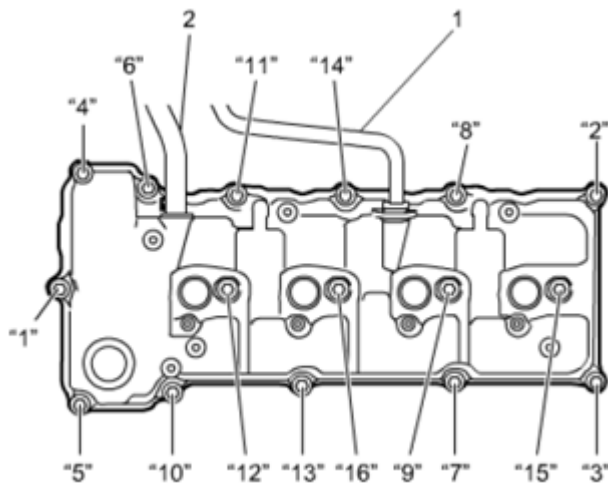
**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**

**Reference: CYLINDER HEAD COVER COMPONENTS**

**Removal**

1. Disconnect negative (-) cable from battery.
2. Remove engine cover.
3. Remove ignition coil assemblies from cylinder head cover. See **IGNITION COIL ASSEMBLY REMOVAL AND INSTALLATION** .
4. Disconnect PCV valve hose (1) and breather hose (2).
5. Detach engine harness clamps.

- Loosen cylinder head cover bolts in numerical order ("1" - "16") evenly and gradually.

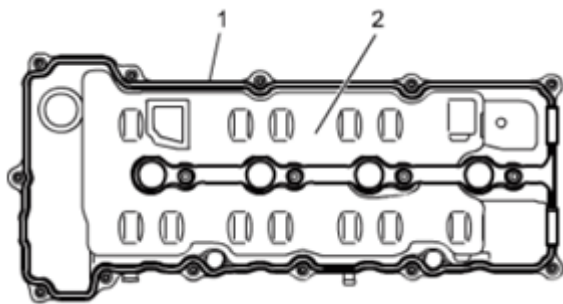


**Fig. 33: Identifying Cylinder Head Cover Bolts Loosen Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

- Remove cylinder head cover with its gasket.
- Remove PCV valve if necessary.

**Installation**

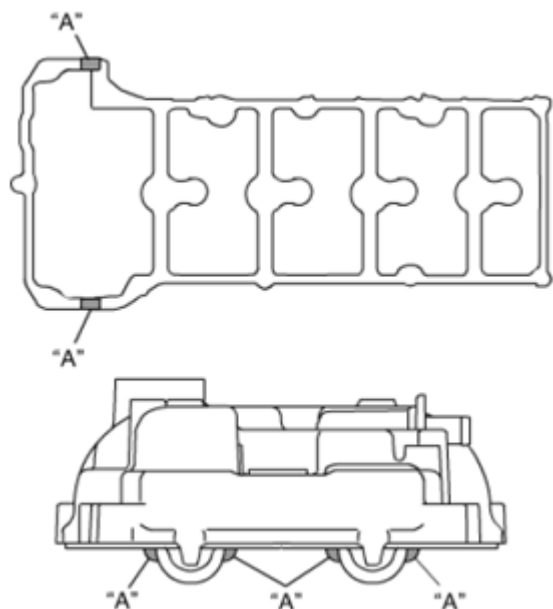
- Install new cylinder head cover gasket (1) to cylinder head cover (2) as shown in figure.



**Fig. 34: Identifying Cylinder Head Cover Gasket And Cylinder Head Cover**  
 Courtesy of SUZUKI OF AMERICA CORP.

- Remove oil, old sealant, and dust from sealing surfaces on cylinder head and cover. After cleaning, apply sealant "A" to the designated area in figure.

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



**Fig. 35: Identifying Sealing Surfaces On Cylinder Head And Cover**  
 Courtesy of SUZUKI OF AMERICA CORP.

3. Install cylinder head cover to cylinder head.

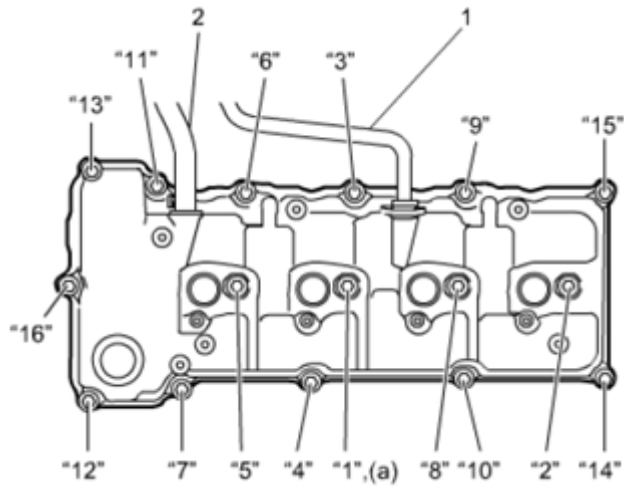
**NOTE:** When installing cylinder head cover, use care so that cylinder head cover gasket does not get out of place or fall off.

4. Tighten cylinder head cover bolts according to the following procedure.
  - a. Tighten cylinder head cover bolts to 3.0 N.m (0.31 kgf-m, 2.5 lbf-ft) in numerical order ("1" - "16") evenly and gradually.
  - b. In the same manner as Step a), retighten them to 5.0 N.m (0.51 kgf-m, 4.0 lbf-ft).
  - c. In the same manner as Step a), retighten them to 7.5 N.m (0.76 kgf-m, 5.5 lbf-ft).

#### Tightening torque

**Cylinder head cover bolt\* (a): 3.0 N.m --> 5.0 N.m --> 7.5 N.m (0.31 kgf-m --> 0.51 kgf-m --> 0.76 kgf-m, 2.5 lbf-ft --> 4.0 lbf-ft --> 5.5 lbf-ft)**

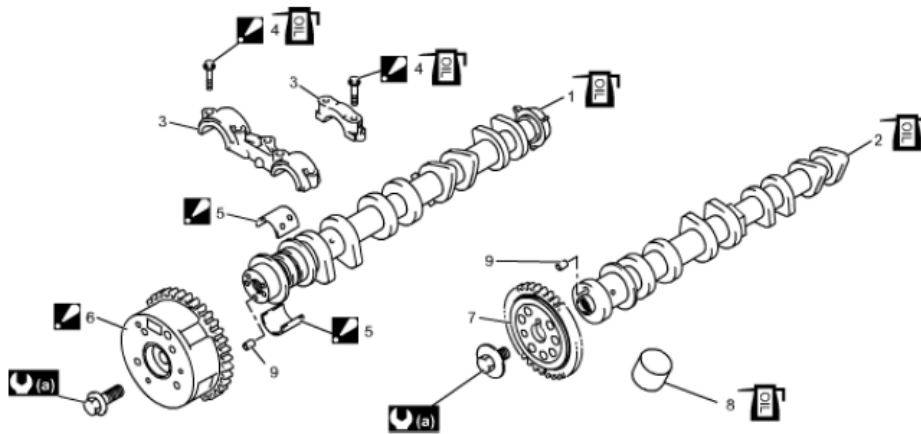
5. Connect PCV valve hose (1) to PCV valve and breather hose (2) to cylinder head cover.











**Fig. 36: Identifying Cylinder Head Cover Bolts Tightening Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

6. Install ignition coil assemblies. See **IGNITION COIL ASSEMBLY REMOVAL AND INSTALLATION** .
7. Install engine cover.
8. Connect negative (-) cable to battery.

#### CAMSHAFT AND TAPPET COMPONENTS



 1. Intake camshaft : Apply engine oil to sliding surface.	 5. Camshaft bearing : For applying engine oil, refer to <a href="#">Camshaft and Tappet Removal and Installation:J24B</a> . : To distinguish upper and lower, refer to <a href="#">Camshaft and Tappet Removal and Installation:J24B</a> .	9. Dowel pin
 2. Exhaust camshaft : Apply engine oil to sliding surface.	 6. CMP actuator : Do not disassemble.	 60 N·m (6.1 kgf-m, 44.5 lbf-ft)
3. Camshaft housing	7. Exhaust camshaft timing sprocket	
  4. Camshaft housing bolt : Apply engine oil to bolt thread and seat. : For tightening order, refer to <a href="#">Camshaft and Tappet Removal and Installation:J24B</a> .	 8. Tappet : Apply engine oil to sliding surface.	

**Fig. 37: Identifying Camshaft And Tappet Components With Torque Specifications**  
Courtesy of SUZUKI OF AMERICA CORP.

Tightening Order/Removal and Installation figure callout references:

**CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION**

**CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION**

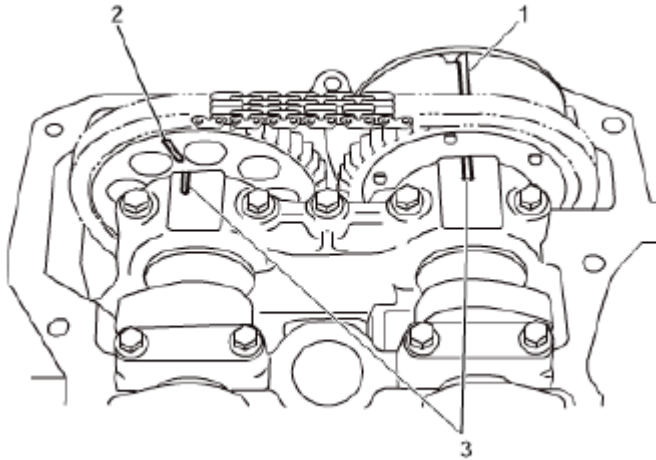
**Reference: CAMSHAFT AND TAPPET COMPONENTS**

**NOTE: For identification of each cylinder, refer to PRECAUTIONS FOR IDENTIFICATION OF CYLINDER .**

**Removal**

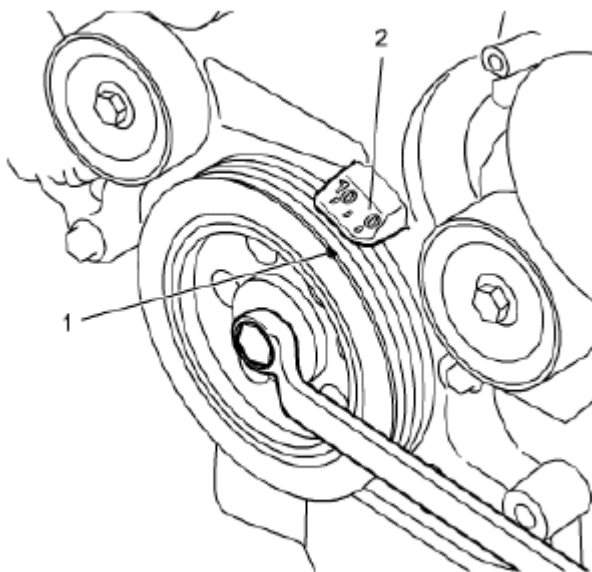
1. Remove cylinder head cover. See **CYLINDER HEAD COVER REMOVAL AND INSTALLATION**.

2. Remove accessory drive belt. See **ACCESSORY DRIVE BELT REMOVAL AND INSTALLATION**.
3. Turn crankshaft clockwise with 19 mm wrench, and position piston No. 1 at TDC on the compression stroke according to the following procedure.
  - a. Align the timing mark (1) on the CMP actuator and the timing mark (2) on the exhaust camshaft timing sprocket with the match marks (3) on the camshaft housing No. 1.



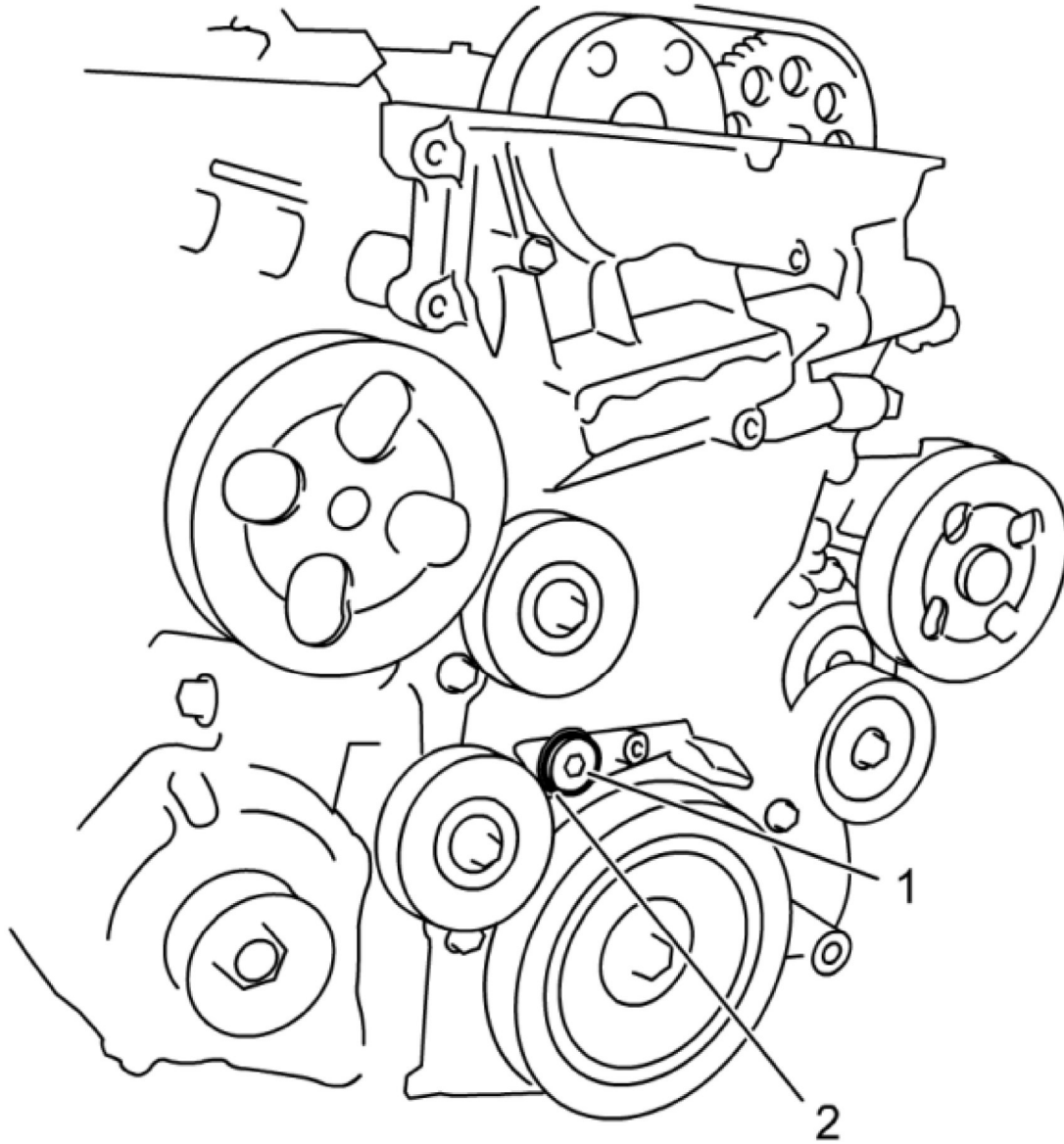
**Fig. 38: Identifying Timing Mark On CMP Actuator Exhaust And Camshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

- b. Align notch (1) on the crankshaft pulley with "0" (2) on the timing chain cover.



**Fig. 39: Aligning Notch On Crankshaft Pulley**  
 Courtesy of SUZUKI OF AMERICA CORP.

4. Fix timing chain tensioner according to the following procedure.
  - a. Remove timing chain cover plug (1) and gasket (2).



**Fig. 40: Identifying Timing Chain Cover Plug And Gasket**  
Courtesy of SUZUKI OF AMERICA CORP.

- b. Insert fore-end of special tool into timing chain tensioner hole (1) from timing chain cover plug hole.

**NOTE:** Make sure that special tool is inserted in timing chain tensioner hole, with mirrors or the like.

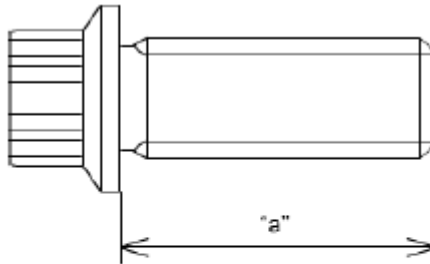
#### Special Tool

**(A): 09917-16510**

- c. Fix special tool by tightening bolt (2) to 8 N.m (0.82 kgf-m, 6.0 lbf-ft).

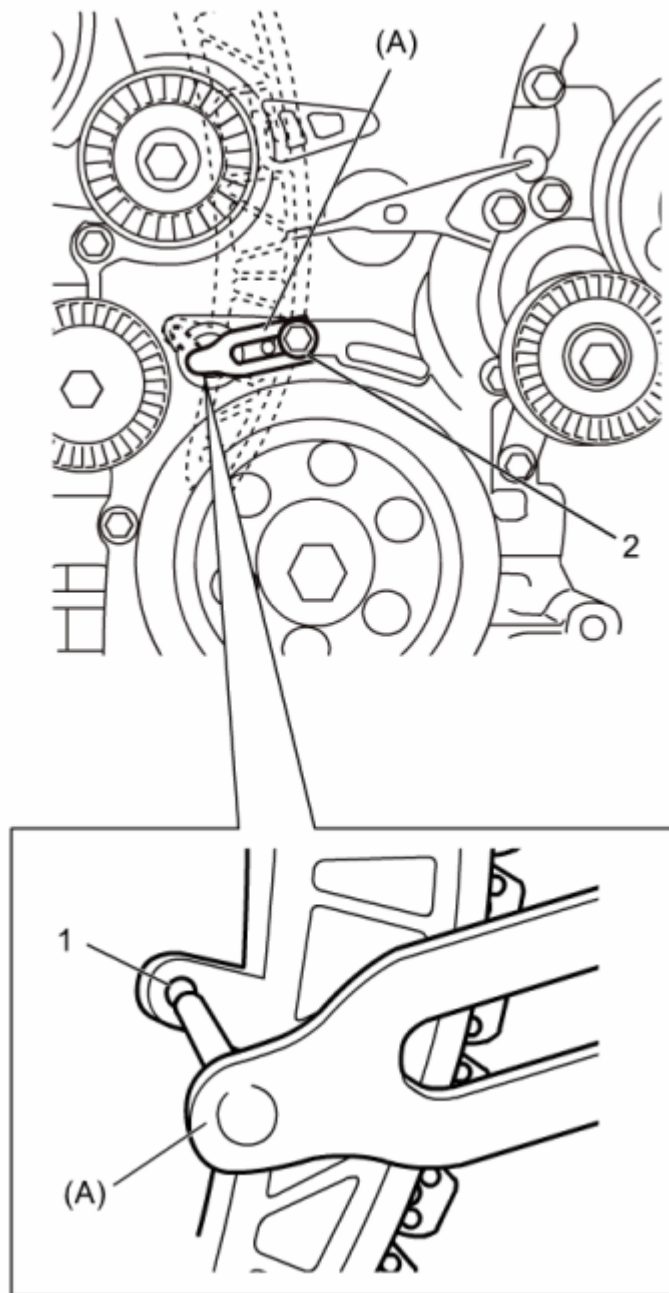
**CAUTION:**

- Failure to observe the following cautions result in engine damage or incorrect installing of timing chain.
- Use bolt (2) of M6 size and 1.00 mm (0.039 in.) pitch.
- Be sure to tighten bolt (2) to 8 N.m (0.82 kgf-m, 6.0 lbf-ft). If bolt becomes loose, plunger of timing chain tensioner adjuster may extend, making it difficult to reinstall timing chain properly.
- Do not turn crankshaft after timing chain is fixed with special tool.



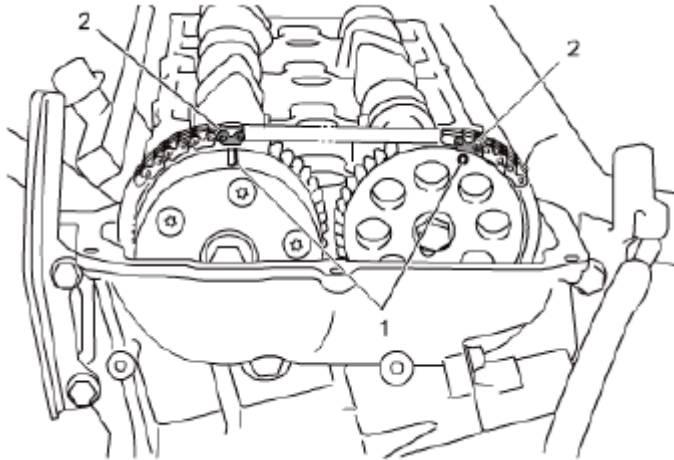
"a": 15 mm (0.59 in)

**Fig. 41: Identifying Bolt Dimension**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 42: Identifying Timing Chain Links**  
Courtesy of SUZUKI OF AMERICA CORP.

5. Apply a dab of paint to two timing chain links (2) which meet timing marks (1) on CMP actuator and exhaust camshaft timing sprocket.

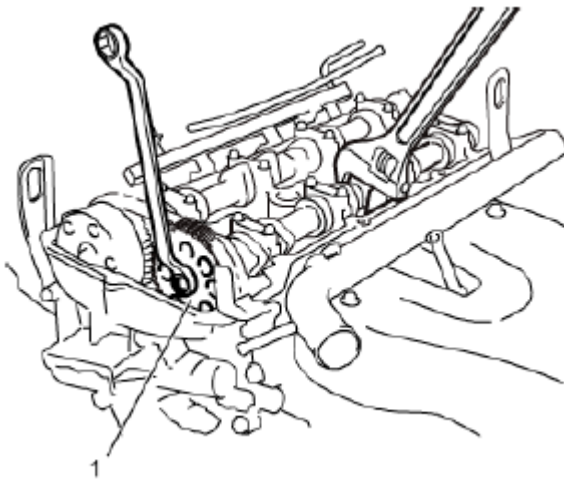


**Fig. 43: Identifying Exhaust Camshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

6. Remove exhaust camshaft timing sprocket according to the following procedure.
  - a. Hold hexagonal section of exhaust camshaft using wrench or the like.
  - b. Loosen exhaust camshaft timing sprocket bolt and remove exhaust camshaft timing sprocket (1).

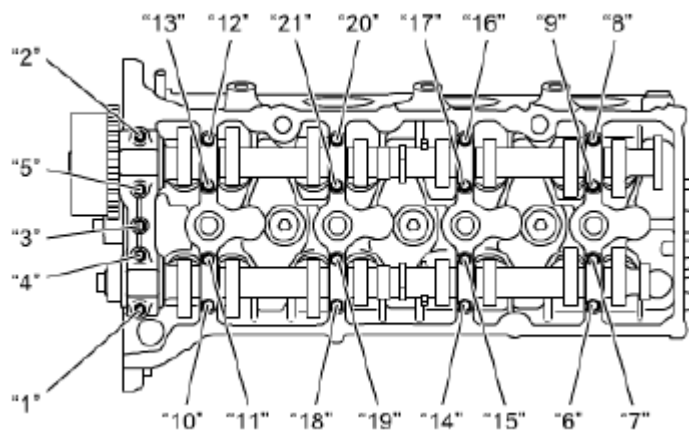
**CAUTION:**

- Be careful not to drop dowel pin into the space between timing chain cover and cylinder block.
- It is not needed to remove CMP actuator at this procedure.



**Fig. 44: Identifying Exhaust Camshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

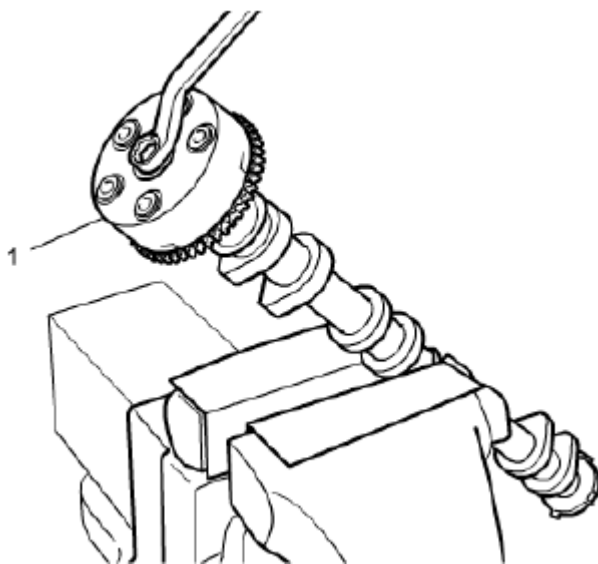
7. Remove dowel pin from exhaust camshaft.
8. Loosen camshaft housing bolts in numerical order ("1" - "21") evenly and gradually.



**Fig. 45: Identifying Dowel Pin From Exhaust Camshaft**  
 Courtesy of SUZUKI OF AMERICA CORP.

9. Remove intake camshaft and exhaust camshaft.
10. Remove camshaft bearings and tappets as necessary.
11. Remove CMP actuator from intake camshaft according to the following procedure if necessary.
  - a. Hold hexagonal section of intake camshaft using vice.
  - b. Loosen CMP actuator bolt and remove CMP actuator (1).

**CAUTION: Do not disassemble CMP actuator.**



**Fig. 46: Identifying CMP Actuator Bolt And CMP Actuator**  
 Courtesy of SUZUKI OF AMERICA CORP.

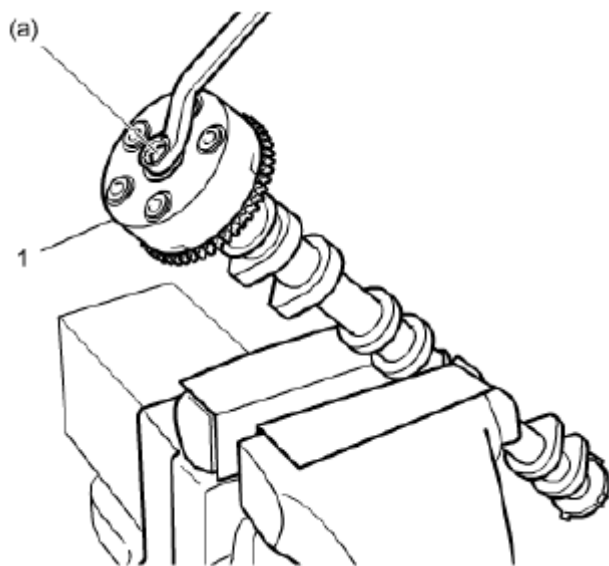
**Installation**

**Reference: CAMSHAFT AND TAPPET INSPECTION**

1. Install CMP actuator (1) to intake camshaft.

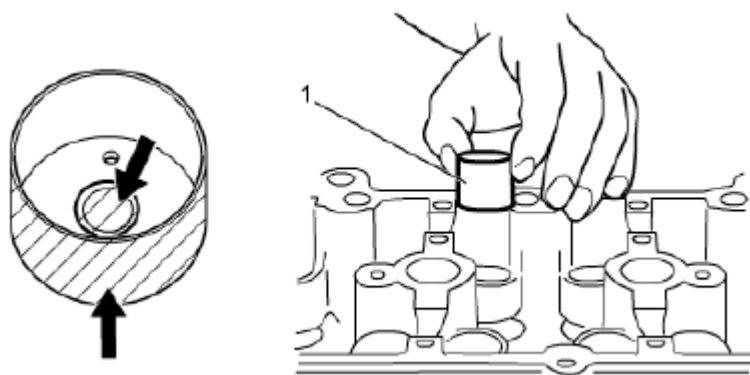
**Tightening torque**

**CMP actuator bolt (a): 60 N.m (6.1 kg-m, 44.5 lbf-ft)**



**Fig. 47: Identifying CMP Actuator To Intake Camshaft**  
 Courtesy of SUZUKI OF AMERICA CORP.

2. Apply engine oil to contact surface of tappets (arrow), and then Install tappets (1) to cylinder head.

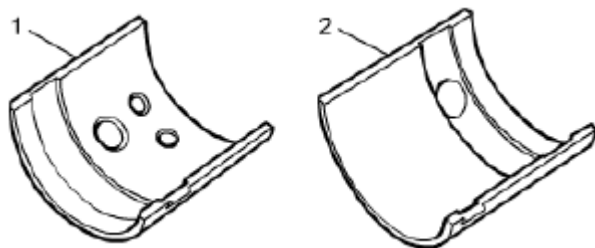


**Fig. 48: Identifying Tappets To Cylinder Head**  
 Courtesy of SUZUKI OF AMERICA CORP.

3. Install camshaft bearings according to the following procedure.

**CAUTION: Camshaft upper bearing half (1) is different in shape from lower**

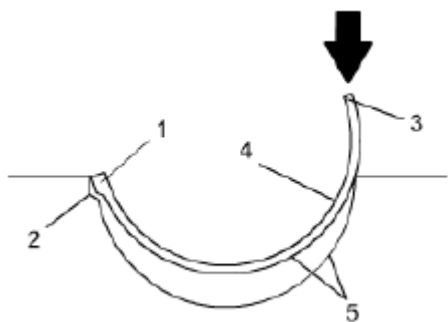
**bearing half (2). Distinguish upper and lower bearing halves certainly when installing.**



**Fig. 49: Identifying Upper Bearing Half And Lower Bearing Half**  
Courtesy of SUZUKI OF AMERICA CORP.

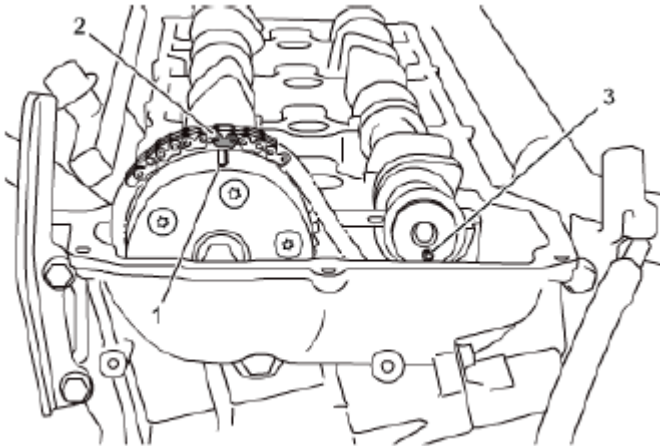
- a. Fit tab (1) of camshaft bearing to groove (2) of cylinder head or camshaft housing.
- b. Press camshaft bearing end (3) until it fully seats in cylinder head or camshaft housing.
- c. Apply engine oil to sliding surface (4) of camshaft bearing halves.

**CAUTION: Do not apply engine oil between bearing halves (5) and camshaft housing or cylinder head (5).**



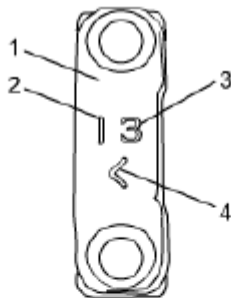
**Fig. 50: Pressing Camshaft Bearing End In Cylinder Head And Camshaft Housing**  
Courtesy of SUZUKI OF AMERICA CORP.

4. Apply engine oil to sliding surfaces of camshafts, and then install camshafts to cylinder head according to the following procedure.
  - a. Align the timing chain link (2), which is painted in removal procedure under this information, with timing mark (1) on CMP actuator and install intake camshaft.
  - b. Install exhaust camshaft and position dowel pin hole (3) of exhaust camshaft downward.



**Fig. 51: Identifying Timing Mark On CMP Actuator And Intake Camshaft**  
 Courtesy of SUZUKI OF AMERICA CORP.

5. Install camshaft housings (1) to proper places distinguished by character (2), number (3) and arrow direction (4) on each camshaft housing.



2.	I: For intake camshaft E: For exhaust camshaft
3.	Position from timing chain side
4.	Point arrowhead to timing chain side

**Fig. 52: Identifying Camshaft Housings**  
 Courtesy of SUZUKI OF AMERICA CORP.

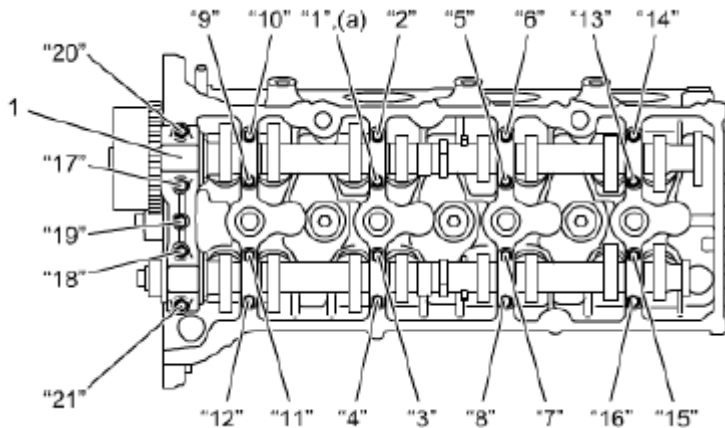
6. Tighten camshaft housing bolts according to the following procedure.
  - a. Apply engine oil to bolt thread and seat of camshaft housing bolts.
  - b. Install camshaft housing No. 1 (1).

Install camshaft housing bolts, and tighten them by hand.

- c. Tighten camshaft housing bolts in numerical order ("1" - "21") evenly and gradually.

**Tightening torque**

**Camshaft housing bolt\*: 11 N.m (1.1 kg-m, 8.5 lbf-ft)**

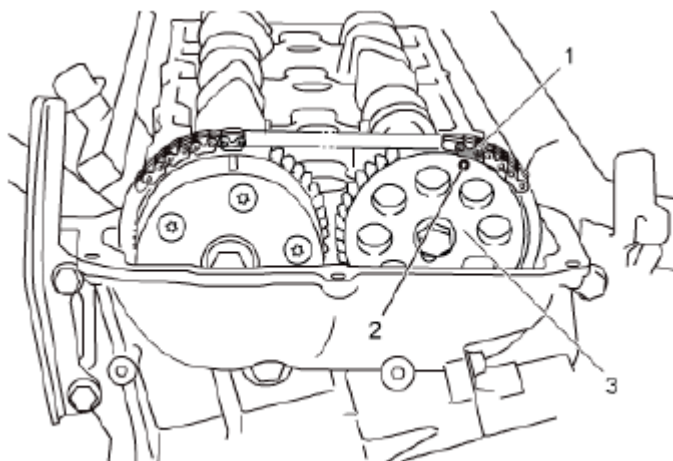


**Fig. 53: Identifying Camshaft Housing Bolts Tighten Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

- 7. Install dowel pin to exhaust camshaft.

**CAUTION: Be careful not to drop dowel pin into the space between timing chain cover and cylinder block.**

- 8. Install exhaust camshaft timing sprocket (3) to exhaust camshaft according to the following procedure.
  - a. Align timing chain link (1), which is painted in "removal" under this information, with timing mark (2) on exhaust camshaft timing sprocket (3), and loop timing chain up over exhaust camshaft timing sprocket.
  - b. Install exhaust camshaft timing sprocket (3) with timing chain to the exhaust camshaft.



**Fig. 54: Identifying Exhaust Camshaft Timing Sprocket And Exhaust Camshaft**  
**Courtesy of SUZUKI OF AMERICA CORP.**

9. Tighten exhaust camshaft timing sprocket bolt (1) using special tool.

**Special Tool**

**(A): 09911-05120**

**Tightening torque**

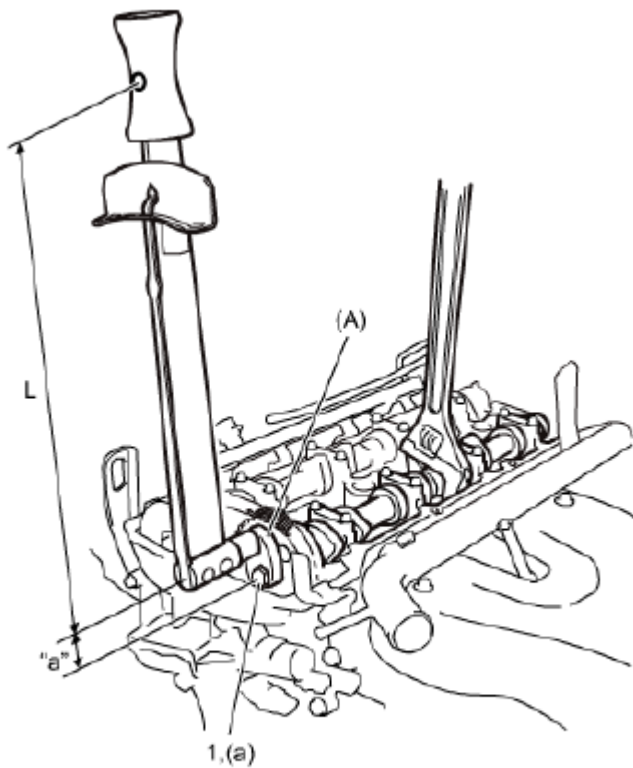
**Exhaust camshaft timing sprocket bolt (a): 60 N.m (6.1 kg-m, 44.5 lbf-ft)**

**CAUTION:** In case of using extension special tool combined with torque wrench, reading value of torque wrench is smaller than actual value. When using extension special tool, reading value should be calculated according to formula below.

**Formula for reading value of torque wrench .**

$$M = T \times L / (L + "a")$$

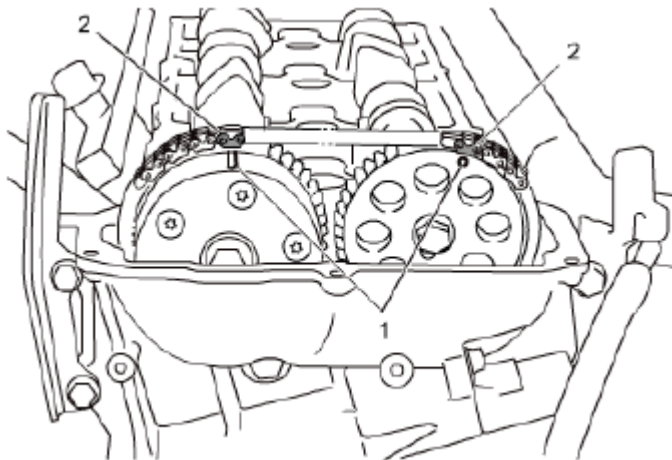
- **M:** Reading value using extension special tool
- **T:** Specified torque
- **L:** Torque wrench length
- **"a":** Dimension of special tool



"a": 20 mm (0.79 in.)

**Fig. 55: Tightening Exhaust Camshaft Timing Sprocket Bolt**  
 Courtesy of SUZUKI OF AMERICA CORP.

- Confirm that painted timing chain links (1) are aligned with timing marks (2) on CMP actuator and exhaust camshaft timing sprocket.

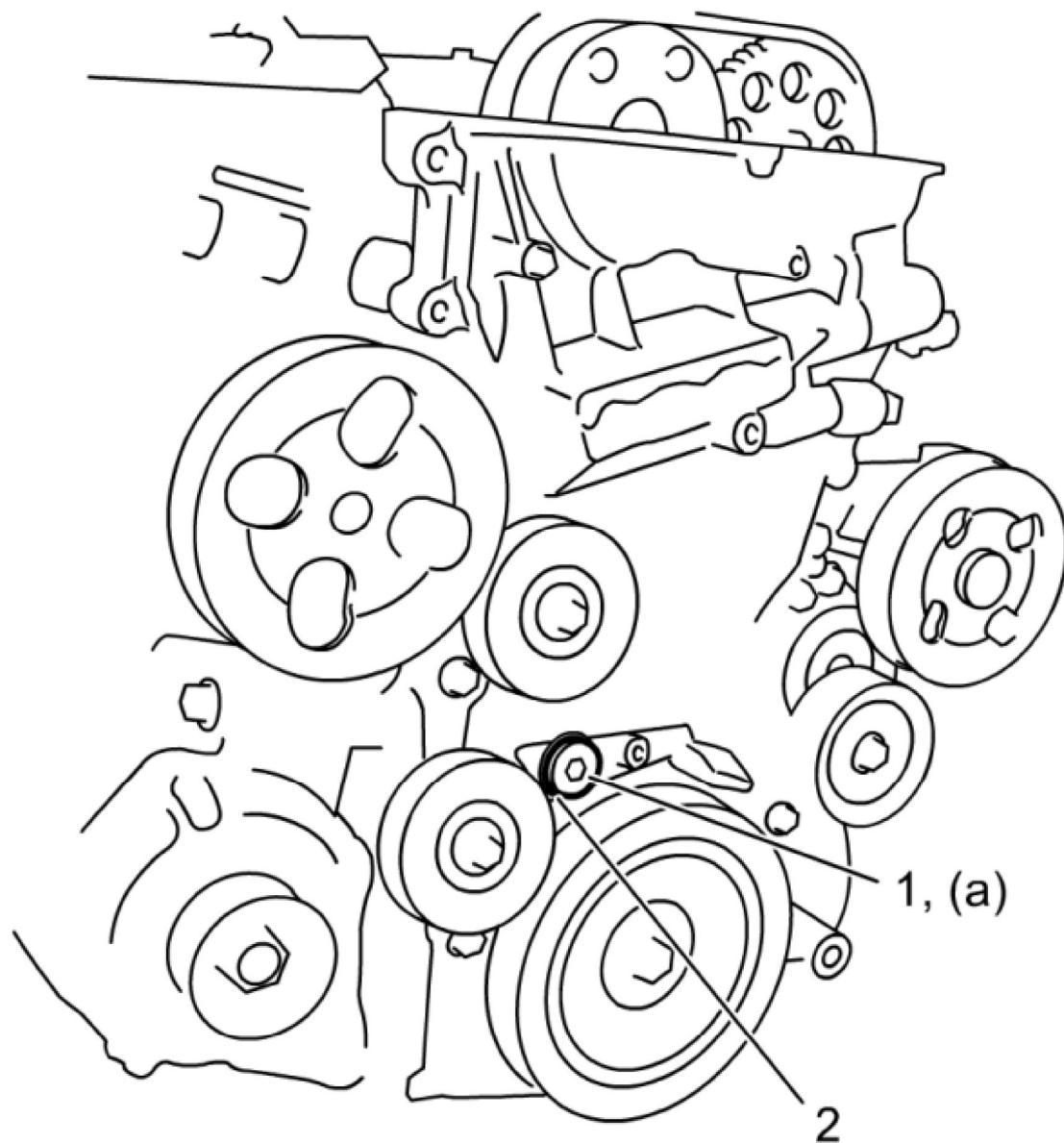


**Fig. 56: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

11. Remove special tool from timing chain cover.
12. Install timing chain cover plug (1) with new gasket (2), and tighten it to specified torque.

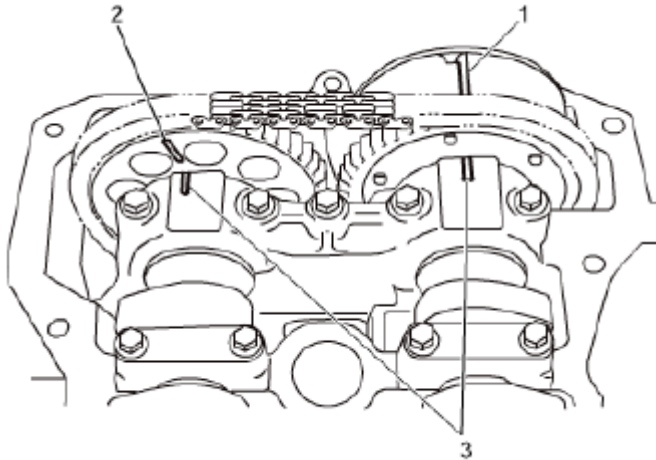
### Tightening torque

**Timing chain cover plug (a): 27 N.m (2.8 kg-m, 20.0 lbf-ft)**



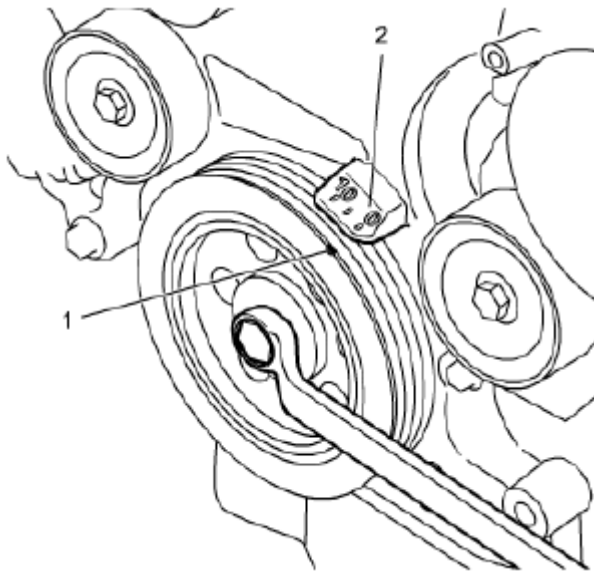
**Fig. 57: Identifying Timing Chain Cover Plug And Gasket**  
Courtesy of SUZUKI OF AMERICA CORP.

13. Check that camshaft and timing chain are installed properly as follows.
  - a. Check that timing mark (1) on CMP actuator and timing mark (2) on exhaust camshaft timing sprocket are aligned with match marks (3) on camshaft housing No. 1.



**Fig. 58: Identifying Timing Mark On CMP Actuator And Timing Mark**  
 Courtesy of SUZUKI OF AMERICA CORP.

- b. Check that notch (1) on crankshaft pulley is aligned with "0" (2) on timing chain cover.



**Fig. 59: Identifying Notch On Crankshaft Pulley**  
 Courtesy of SUZUKI OF AMERICA CORP.

- c. Turn crankshaft clockwise twice and repeat Step a) and b).

**NOTE:**

- Be sure to turn crankshaft fully twice. If it is once, timing marks on CMP actuator and exhaust camshaft timing sprockets do not meet match marks on camshaft housing No. 1.
- After turning crankshaft twice, the painted timing chain links are not aligned with the timing marks on the CMP actuator and the exhaust timing sprocket, but it is normal.

14. Check valve clearance. See VALVE CLEARANCE INSPECTION AND ADJUSTMENT.
15. Install cylinder head cover. See CYLINDER HEAD COVER REMOVAL AND INSTALLATION.

## CAMSHAFT AND TAPPET INSPECTION

**Reference:** CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION

### Cam Height

Using a micrometer, measure cam height "a". If measured height is out of standard values, replace camshaft.

### Cam Height (IN)

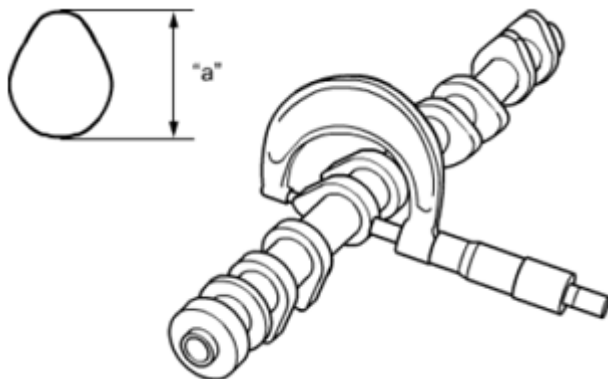
**Standard:** 47.023 - 47.183 mm (1.8513 - 1.8576 in.)

**Limit:** 46.890 mm (1.8461 in.)

### Cam Height (EX)

**Standard:** 46.543 - 46.703 mm (1.8324 - 1.8387 in.)

**Limit:** 46.420 mm (1.8276 in.)



**Fig. 60: Measuring Cam Height**

Courtesy of SUZUKI OF AMERICA CORP.

### Camshaft Runout

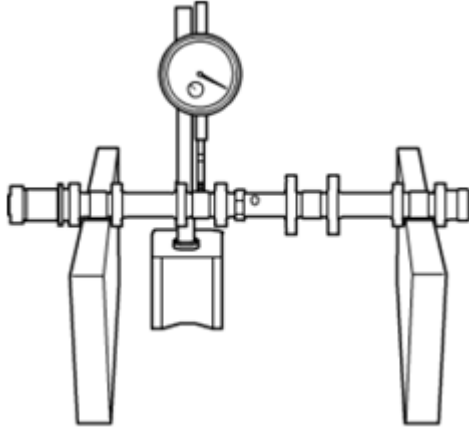
Set camshaft between two "V" blocks and measure its runout using a dial gauge.

If measured camshaft runout exceeds limit, replace camshaft.

**CAUTION: Do not attempt to fix camshaft runout for reuse.**

### Camshaft runout limit

0.015 mm (0.00050 in.)



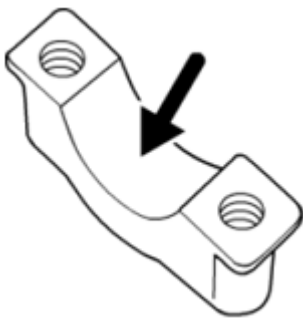
**Fig. 61: Checking Camshaft Runout**  
Courtesy of SUZUKI OF AMERICA CORP.

### Camshaft Journal

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

If any defective is found, replace camshaft or cylinder head with camshaft housings.

**CAUTION: Do not attempt to fix malcondition of camshaft journal and camshaft housing for reuse.**



**Fig. 62: Identifying Camshaft Journal**  
Courtesy of SUZUKI OF AMERICA CORP.

### Camshaft Journal Clearance

1. Clean camshaft housings and camshaft journals.
2. Remove all tappets.
3. Install camshafts and lower bearing half to cylinder head.

4. Place a piece of gauging plastic to full width of camshaft journal (parallel to camshaft).
5. Install camshaft housing referring to steps 2) to 5) in "Installation" under **CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION.**

**CAUTION: Do not rotate camshaft while gauging plastic is installed.**

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

**Camshaft journal clearance (intake side of camshaft housing No. 1)**

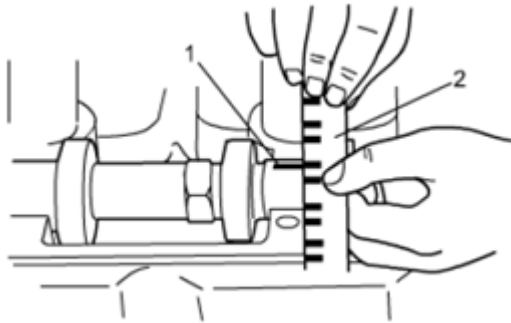
**Standard: 0.020 - 0.072 mm (0.00079 - 0.00244 in.)**

**Limit: 0.10 mm (0.0039 in.)**

**Camshaft journal clearance (except intake side of camshaft housing No. 1)**

**Standard: 0.020 - 0.062 mm (0.00079 - 0.0024 in.)**

**Limit: 0.095 mm (0.00374 in.)**



**Fig. 63: Measuring Gauging Plastic Width At Widest Point**  
**Courtesy of SUZUKI OF AMERICA CORP.**

If measured camshaft journal clearance exceeds limit, recheck camshaft journal clearance according to the following procedure.

- a. Install camshaft upper bearing half and camshaft housings without camshafts to cylinder head.
- b. Tighten camshaft housing bolts referring to Step 6) in "Installation" under **CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION.**
- c. For intake camshaft journal No. 1, measure journal outside diameter at positions shown in figure. If measured diameter is out of standard values, replace camshaft and recheck camshaft journal clearance.

If measured diameter is within standard values, replace camshaft bearings and recheck camshaft

journal clearance.

- d. For all other camshaft journals, measure camshaft journal outside diameters and camshaft housing inside diameters.

If measured diameters are out of standard values, replace corresponding camshaft or cylinder head and camshaft housings.

**Camshaft journal outside diameter**

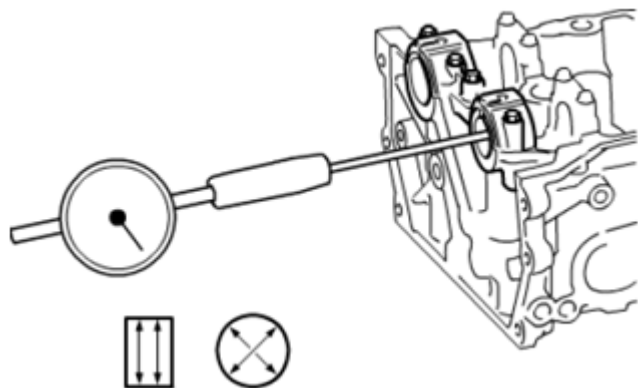
**CAMSHAFT JOURNAL OUTSIDE DIAMETER SPECIFICATIONS**

Item	Standard
Intake camshaft journal No. 1 "a"	28.959 - 28.980 mm (1.1402 - 1.1409 in.)
Exhaust camshaft journal No. 1	26.959 - 26.980 mm (1.0614 - 1.0622 in.)
Others	25.959 - 25.980 mm (1.0220 - 1.0228 in.)

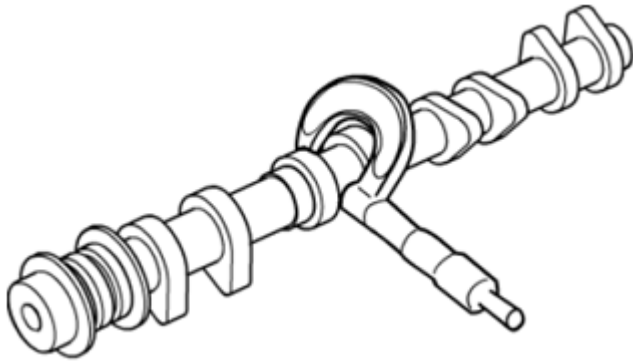
**Camshaft housing inside diameter**

**CAMSHAFT HOUSING INSIDE DIAMETER SPECIFICATIONS**

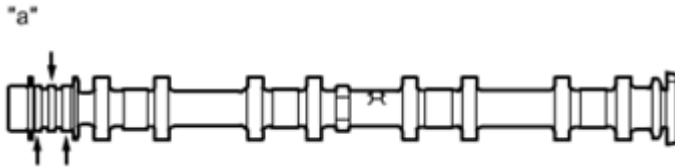
Item	Standard
Camshaft housing No. 1 (intake)	32.000 - 32.025 mm (1.2599 - 1.2608 in.)
Camshaft housing No. 1 (exhaust)	27.000 - 27.021 mm (1.0630 - 1.0638 in.)
Others	26.000 - 26.021 mm (1.0237 - 1.0244 in.)



**Fig. 64: Measuring Camshaft Housing Outside Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 65: Measuring Camshaft Housing Inside Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 66: Identifying Camshaft**  
 Courtesy of SUZUKI OF AMERICA CORP.

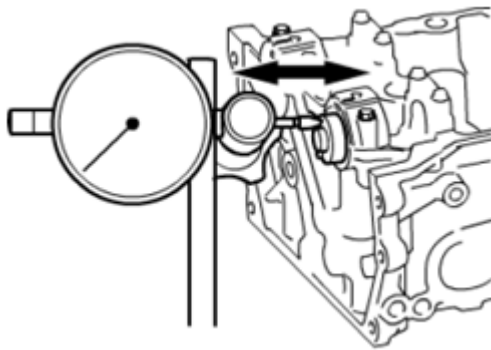
7. Install intake and exhaust camshaft without tappet, and then measure intake and exhaust camshaft housing thrust clearance using a dial gauge.

If measured clearance exceeds limit, replace camshaft or cylinder head and camshaft housings.

#### Camshaft housing thrust clearance

**Standard: 0.10 - 0.35 mm (0.0040 - 0.0137 in.)**

**Limit: 0.50 mm (0.020 in.)**

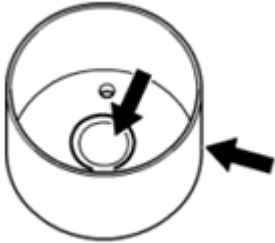


**Fig. 67: Measuring Intake And Exhaust Camshaft Housing Thrust Clearance With Dial Gauge**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Wear of Tappet**

Check tappet for pitting, scratches, or damage.

If any defective condition is found, replace tappet.



**Fig. 68: Locating Cylinder Head Tappet For Pitting, Scratches, Or Damage**  
Courtesy of SUZUKI OF AMERICA CORP.

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

**Cylinder head to tappet clearance**

**Standard: 0.025 - 0.066 mm (0.0010 - 0.0025 in.)**

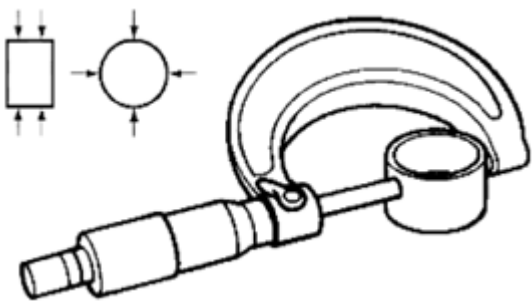
**Limit: 0.10 mm (0.0039 in.)**

**Tappet outside diameter**

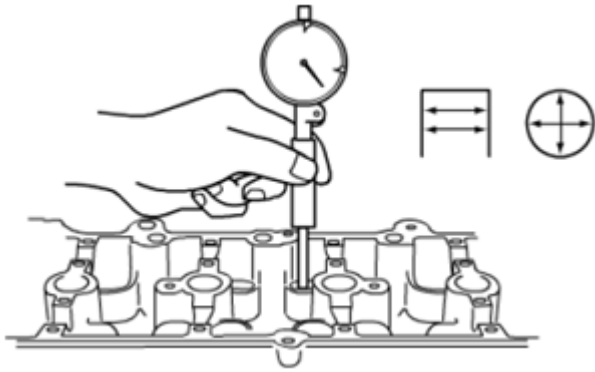
**Standard: 32.459 - 32.475 mm (1.2780 - 1.2785 in.)**

**Cylinder head tappet bore**

**Standard: 32.500 - 32.525 mm (1.2796 - 1.2805 in.)**



**Fig. 69: Measuring Cylinder Head Tappet Outside Diameter**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 70: Measuring Tappet Bore Of Cylinder Head Inside Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.

### Exhaust Camshaft Timing Sprocket

Check exhaust camshaft timing sprocket for wear and damage.

If any defective condition is found, replace exhaust camshaft timing sprocket.

### CMP actuator

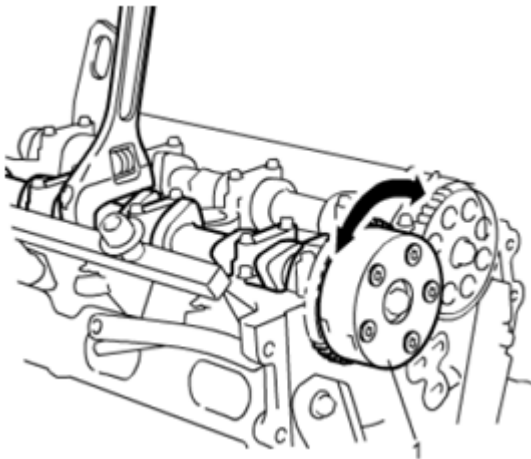
- Check CMP actuator for wear or damage.

If any defective condition is found, replace CMP actuator.

- Install CMP actuator to intake camshaft and hold hexagonal section of intake camshaft stationary using wrench or the like.

Check that CMP actuator (1) cannot be turned by hand.

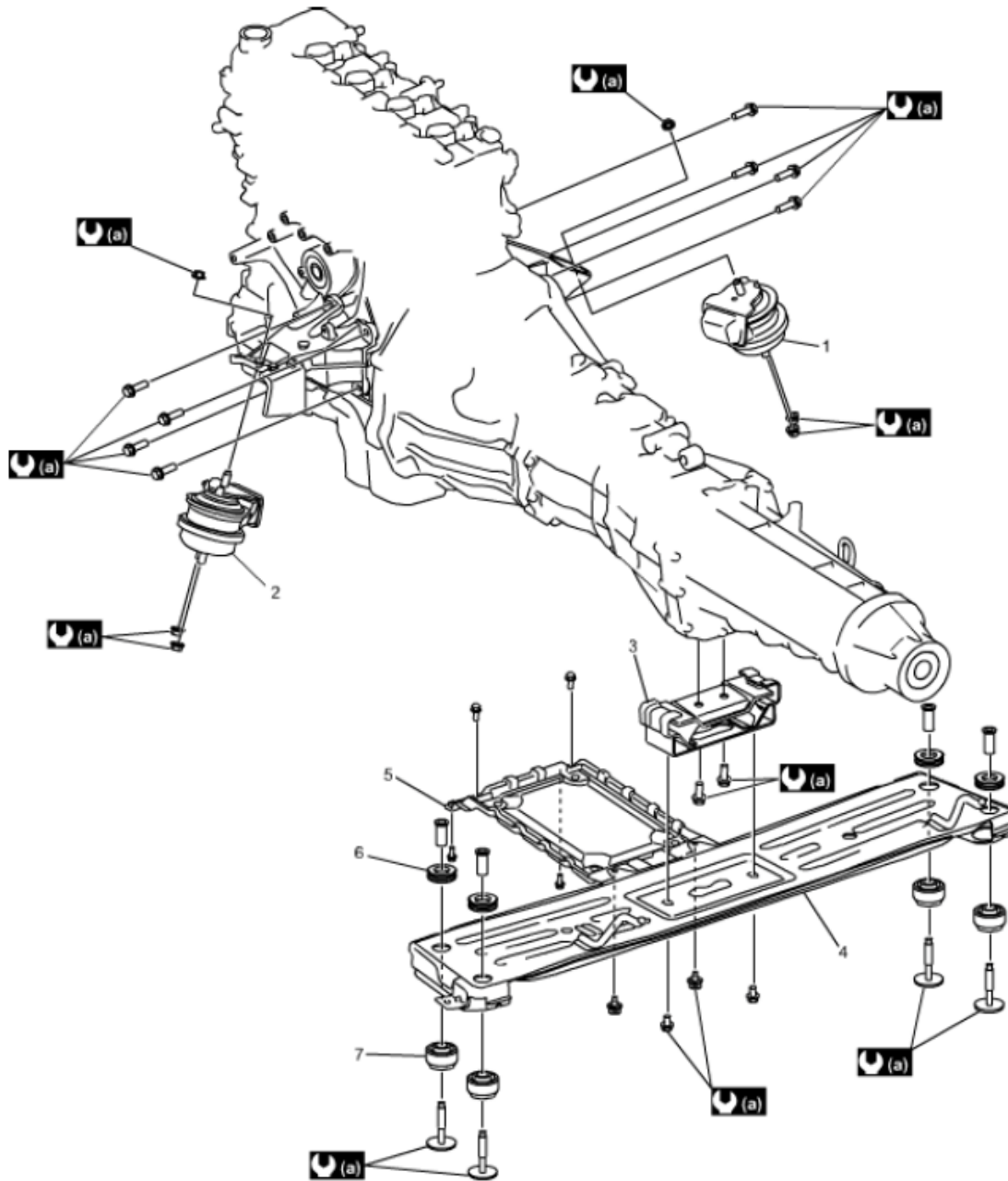
If it can be turned by hand, replace CMP actuator.



**Fig. 71: Checking CMP Actuator For Wear Or Damage**

Courtesy of SUZUKI OF AMERICA CORP.

ENGINE MOUNTINGS COMPONENTS



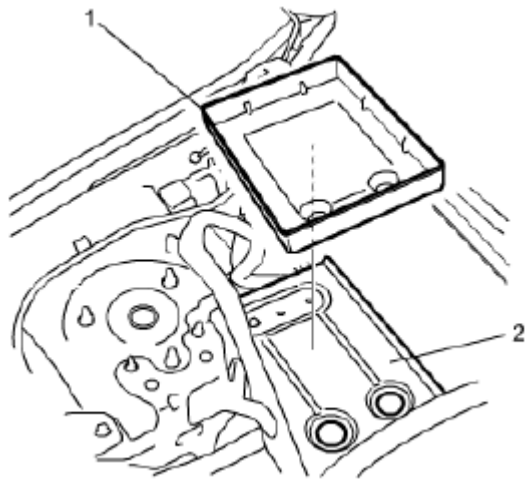
1. Engine right mounting	5. Engine splash cover
2. Engine left mounting	6. Mounting member upper cushion
3. Engine rear mounting	7. Mounting member lower cushion
4. Engine rear mounting member	(a) : 55 N·m (5.6 kgf-m, 40.5 lbf-ft)

**Fig. 72: Identifying Engine Mountings Components With Torque Specifications**  
 Courtesy of SUZUKI OF AMERICA CORP.

## ENGINE ASSEMBLY REMOVAL AND INSTALLATION

### Removal

1. Relieve fuel pressure. See **FUEL PRESSURE RELIEF PROCEDURE** .
2. Remove battery. See **BATTERY REMOVAL AND INSTALLATION** .
3. Remove battery tray (1) and battery bracket (2).

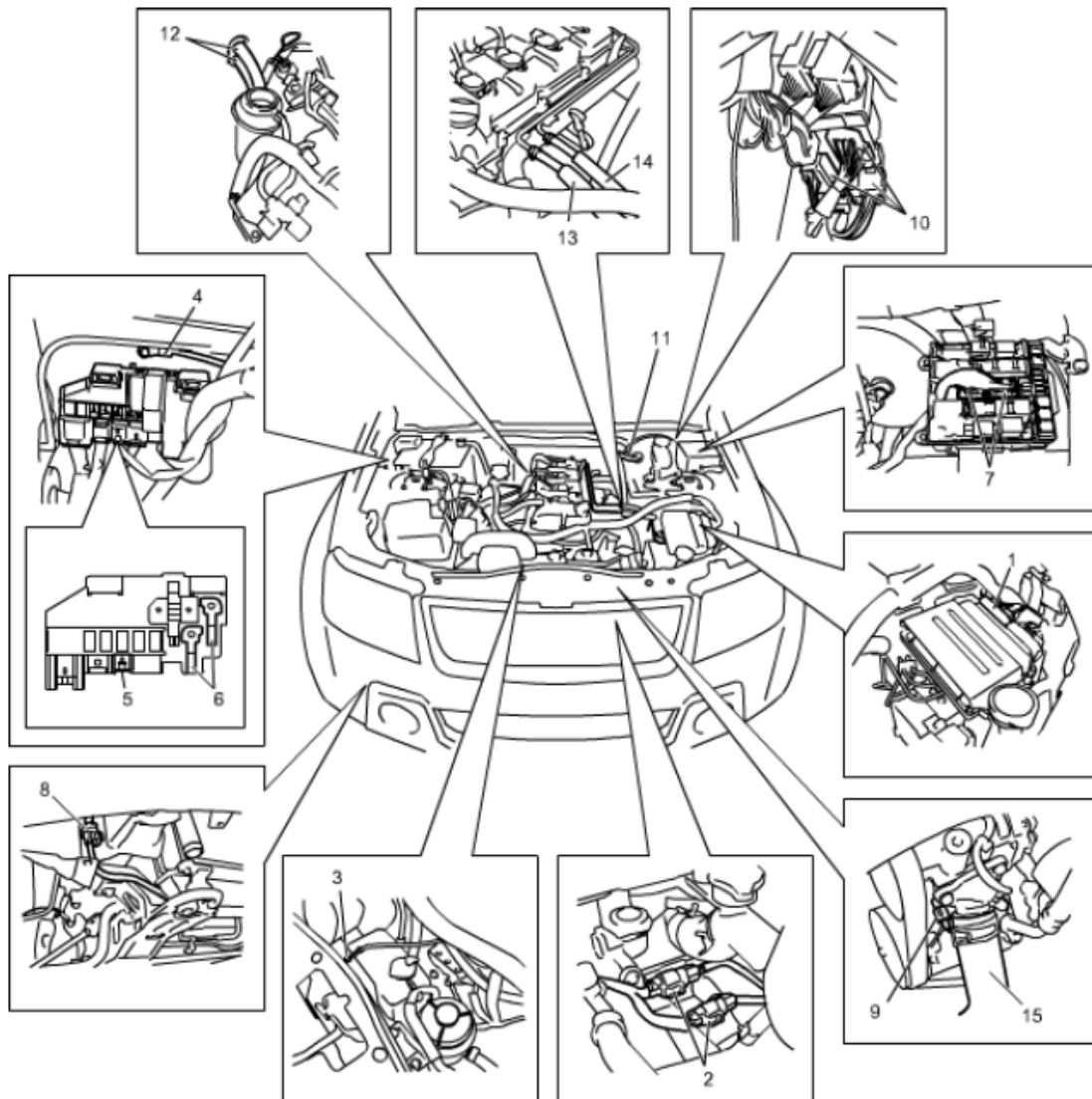


**Fig. 73: Identifying Battery Tray And Battery Bracket**  
 Courtesy of SUZUKI OF AMERICA CORP.

4. Remove engine cover.
5. Drain the following oils and fluids if necessary.
  - Engine oil: See **ENGINE OIL AND FILTER CHANGE** .
  - Manual transmission oil (5M/T model): See **MANUAL TRANSMISSION OIL CHANGE** .
  - A/T fluid (4 A/T model): **A/T FLUID CHANGE** .
  - P/S fluid: See **P/S FLUID CHANGE** .
  - Transfer oil (4WD model):
    - Motor shift type: See **TRANSFER OIL CHANGE** .
    - Non-shift type: See **TRANSFER OIL CHANGE** .
  - Front differential oil (4WD model): See **FRONT DIFFERENTIAL OIL CHANGE** .
6. Drain coolant. See **COOLING SYSTEM DRAINING** .
7. Remove air cleaner suction pipe. See **AIR CLEANER COMPONENTS**.
8. Remove air cleaner assembly and air cleaner outlet hose. See **AIR CLEANER ASSEMBLY REMOVAL AND INSTALLATION**.
9. Remove accessory drive belt. See **ACCESSORY DRIVE BELT REMOVAL AND**

**INSTALLATION** .

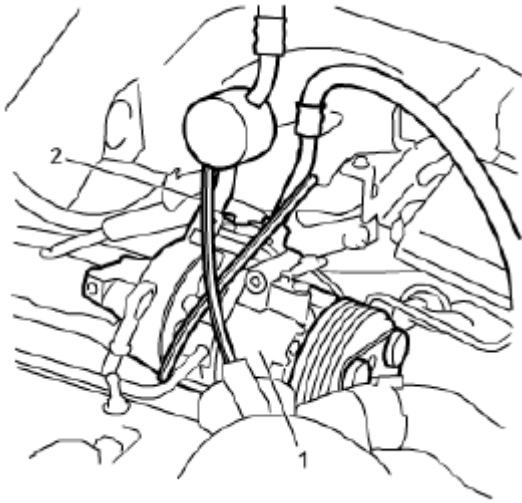
10. Remove front bumper. See **FRONT BUMPER COMPONENTS** .
11. Disconnect the following electric wires and connectors.
  - ECM connector (1)
  - Radiator cooling fan motor connector (2)
  - Ground cable (3) and (4)
  - Connector (5) and terminal (6) in fuse box No. 1
  - Connectors (7) in fuse box No. 2
  - Front height sensor connector (8)
  - A/C compressor magnet clutch connector (9)
  - Engine harness connector (10)
12. Disconnect the following hoses.
  - Brake booster hose (11)
  - Heater inlet and outlet hoses (12)
  - Fuel hose (13)
  - EVAP canister purge hose (14)
  - Radiator lower hose (15)



**Fig. 74: Identifying Brake Booster Hose, Fuel Hose And Radiator Lower Hose Location**  
 Courtesy of SUZUKI OF AMERICA CORP.

13. Remove engine harness clamps
14. With hose connected, remove A/C compressor from its bracket. See **COMPRESSOR ASSEMBLY REMOVAL AND INSTALLATION** .

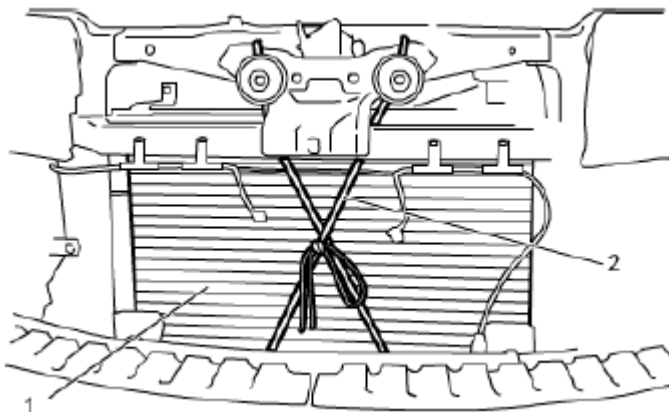
**CAUTION:** Suspend removed A/C compressor (1) with rope (2) or the like, at a place where no damage will be caused during removal and installation of engine assembly.



**Fig. 75: Identifying A/C Compressor And Rope**  
 Courtesy of SUZUKI OF AMERICA CORP.

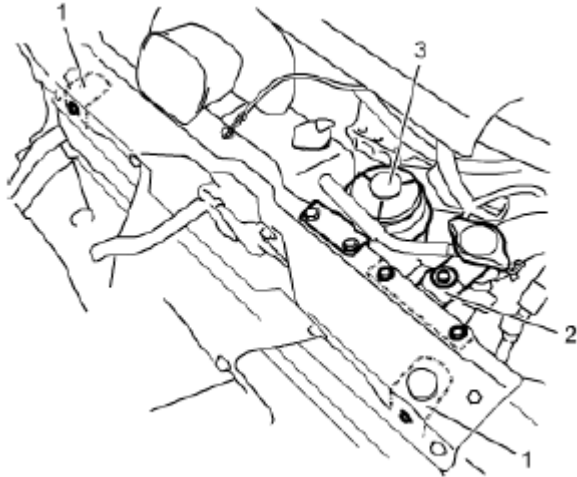
15. For 5 M/T model, disconnect clutch fluid hose from clutch fluid pipe joint. See CLUTCH FLUID PIPE REMOVAL AND INSTALLATION .
16. For 4 A/T model, disconnect A/T select cable from A/T. See SELECT CABLE COMPONENTS .
17. For 5 M/T model, remove transmission shift control lever from transmission. See TRANSMISSION SHIFT CONTROL LEVER REMOVAL AND INSTALLATION .
18. Remove exhaust pipe No. 2. See EXHAUST SYSTEM COMPONENTS .
19. Remove rear propeller shaft. See PROPELLER SHAFT REMOVAL AND INSTALLATION .
20. With hose connected, remove A/C condenser assembly from radiator. See A/C CONDENSER ASSEMBLY REMOVAL AND INSTALLATION .

**CAUTION:** Suspend removed A/C condenser (1) with rope (2) or the like, at a place where no damage will be caused during removal and installation of engine assembly.



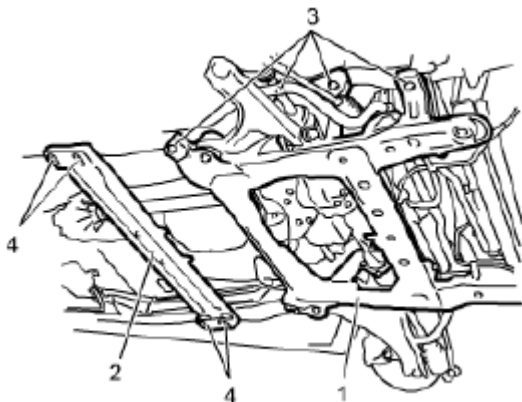
**Fig. 76: Identifying A/C Condenser And Rope**  
 Courtesy of SUZUKI OF AMERICA CORP.

21. Remove radiator with radiator support bracket (1) and filler neck bracket (2) from vehicle body.
22. With hose connected, remove P/S fluid reservoir (3) from vehicle body.



**Fig. 77: Identifying Radiator Support Bracket And Filler Neck Bracket**  
 Courtesy of SUZUKI OF AMERICA CORP.

23. Remove stabilizer bar joints from stabilizer bar. See **FRONT SUSPENSION FRAME, STABILIZER BAR AND/OR BUSHINGS COMPONENTS** .
24. Remove tie-rod ends, front drive shafts (4WD model) and ball joints from steering knuckles referring to Step 1) through 9) in "Removal" under **SUSPENSION CONTROL ARM REMOVAL AND INSTALLATION** .
25. Remove steering lower shaft assembly from P/S gear case assembly. See **STEERING LOWER SHAFT ASSEMBLY REMOVAL AND INSTALLATION** .
26. Support front suspension frame (1) and engine rear mounting member (2) using jack.
27. Remove front suspension frame bolts (3).
28. Remove engine rear mounting member bolts (4).



**Fig. 78: Identifying Front Suspension Frame Bolts And Support Front Suspension Frame**  
 Courtesy of SUZUKI OF AMERICA CORP.

29. Before lowering engine, make sure that all hoses, electric wires and cables are disconnected from engine.
30. Lower engine assembly with transmission and transfer (4WD model) from engine compartment.

**NOTE:**

- Lower engine assembly, transmission, transfer (4WD model), front suspension frame, drive shafts (4WD model), radiator, P/S gear case and engine rear mounting member all together.
- Before lowering engine assembly, make clearance by raising A/C compressor and A/C condenser in order to avoid damage to them.

31. Disconnect transmission if necessary.
  - 5 M/T model: See MANUAL TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING .
  - 4 A/T model: See AUTOMATIC TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING .
32. For 4 A/T model, remove oil cooler pipe if necessary. See OIL COOLER HOSE AND PIPE REMOVAL AND INSTALLATION .
33. Remove engine harness from engine assembly if necessary.
34. Remove engine mounting from engine front mounting bracket if necessary.
35. For 5 M/T model, remove clutch cover and clutch disc if necessary. See CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION .
36. For 5 M/T model, remove flywheel if necessary. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.

For 4 A/T model, remove drive plate if necessary. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.

**Installation**

1. For 5 M/T model, install flywheel if removed. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.

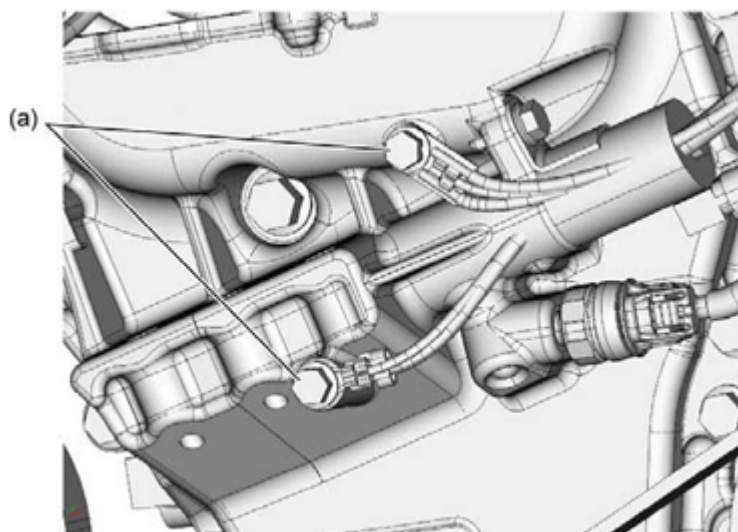
For 4 A/T model, install drive plate if removed. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.

2. For 5 M/T model, install clutch cover and clutch disc if removed. See CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION .
3. Install engine harness to engine assembly if removed.
  - Tighten engine harness ground bolts with engine harness ground cables to specified torque.

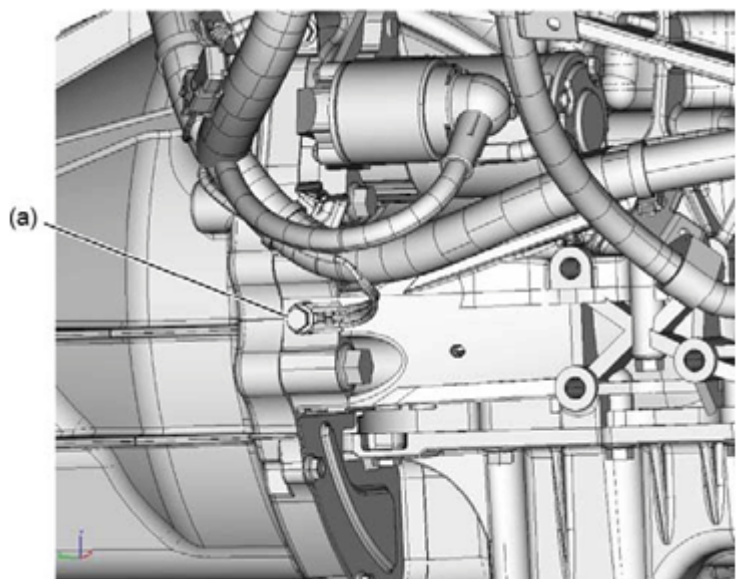
**Tightening torque**

**Engine harness ground bolt (M6) (a): 11 N.m (1.1 kg-m, 8.5 lbf-ft)**

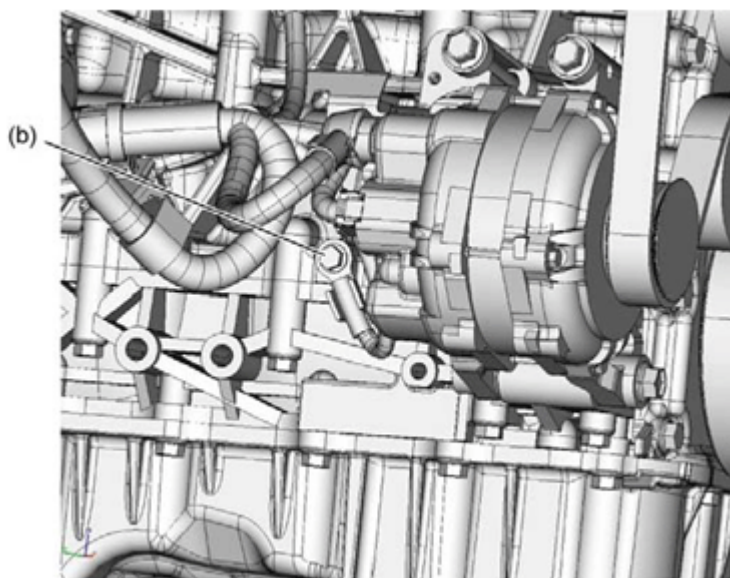
**Engine harness ground bolt (M8) (b): 25 N.m (2.5 kg-m, 18.5 lbf-ft)**



**Fig. 79: Identifying Engine Harness Ground Bolt**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 80: Identifying Engine Harness Ground Bolt**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 81: Identifying Engine Rear Mounting Member And Front Suspension Frame**  
 Courtesy of SUZUKI OF AMERICA CORP.

4. Connect transmission to engine if removed.
  - For 5 M/T model: See MANUAL TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING .
  - For 4 A/T model: See AUTOMATIC TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING .
5. Lift engine assembly with transmission and transfer (4WD model) into engine compartment using jack.

**NOTE:**

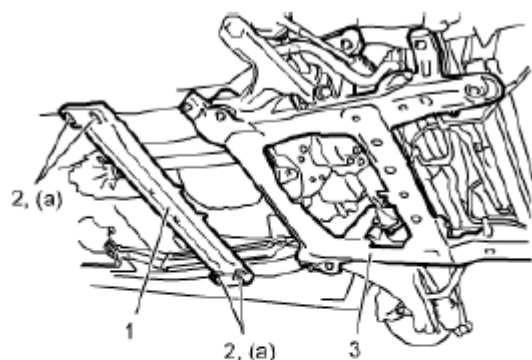
- Lift engine assembly, transmission, transfer (4WD model), front suspension frame, drive shafts (4WD model), radiator, P/S gear case and engine rear mounting member all together.
- Before lifting engine assembly, make clearance by raising A/C compressor and A/C condenser in order to avoid damage to them.

6. Tighten engine rear mounting member bolts (2) to specified torque.

**Tightening torque**

**Engine rear mounting member bolt (a): 55 N.m (5.6 kg-m, 40.5 lbf-ft)**

7. Tighten front suspension frame bolts to specified torque. See FRONT SUSPENSION FRAME, STABILIZER BAR AND/OR BUSHINGS REMOVAL AND INSTALLATION .



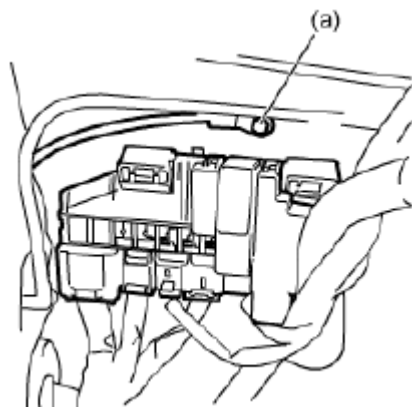
- |                                |
|--------------------------------|
| 1. Engine rear mounting member |
| 3. Front suspension frame      |

**Fig. 82: Identifying Front Suspension Frame Bolts**  
 Courtesy of SUZUKI OF AMERICA CORP.

8. Install steering lower shaft assembly to P/S gear case assembly. See **STEERING LOWER SHAFT ASSEMBLY REMOVAL AND INSTALLATION** .
9. Install tie-rod ends, front drive shafts (4WD model) and ball joints to steering knuckles referring to "Removal" under **SUSPENSION CONTROL ARM REMOVAL AND INSTALLATION** .
10. Install stabilizer bar joints to stabilizer bar. See **FRONT SUSPENSION FRAME, STABILIZER BAR AND/OR BUSHINGS COMPONENTS** .
11. Install P/S fluid reservoir to vehicle body.
12. Install radiator with radiator support bracket and filler neck bracket to vehicle body.
13. Install A/C condenser assembly to radiator. See **A/C CONDENSER ASSEMBLY REMOVAL AND INSTALLATION** .
14. Install rear propeller shaft. See **PROPELLER SHAFT REMOVAL AND INSTALLATION** .
15. Install exhaust pipe No. 2. See **EXHAUST SYSTEM COMPONENTS** .
16. For 5 M/T model, install transmission shift control lever to transmission. See **TRANSMISSION SHIFT CONTROL LEVER REMOVAL AND INSTALLATION** .
17. For 5 M/T model, connect clutch fluid hose and clutch fluid pipe joint. See **CLUTCH FLUID PIPE REMOVAL AND INSTALLATION** .
18. For 4 A/T model, connect A/T select cable to A/T. See **SELECT CABLE COMPONENTS** .
19. Install A/C compressor to engine assembly. See **COMPRESSOR ASSEMBLY REMOVAL AND INSTALLATION** .
20. Install engine harness clamps.
21. Install all other removed electric wires, connectors and hoses to original locations.
22. Connect battery ground cable to vehicle body.

**Tightening torque**

**Battery ground terminal bolt (a): 25 N.m (2.5 kg-m, 18.5 lbf-ft)**

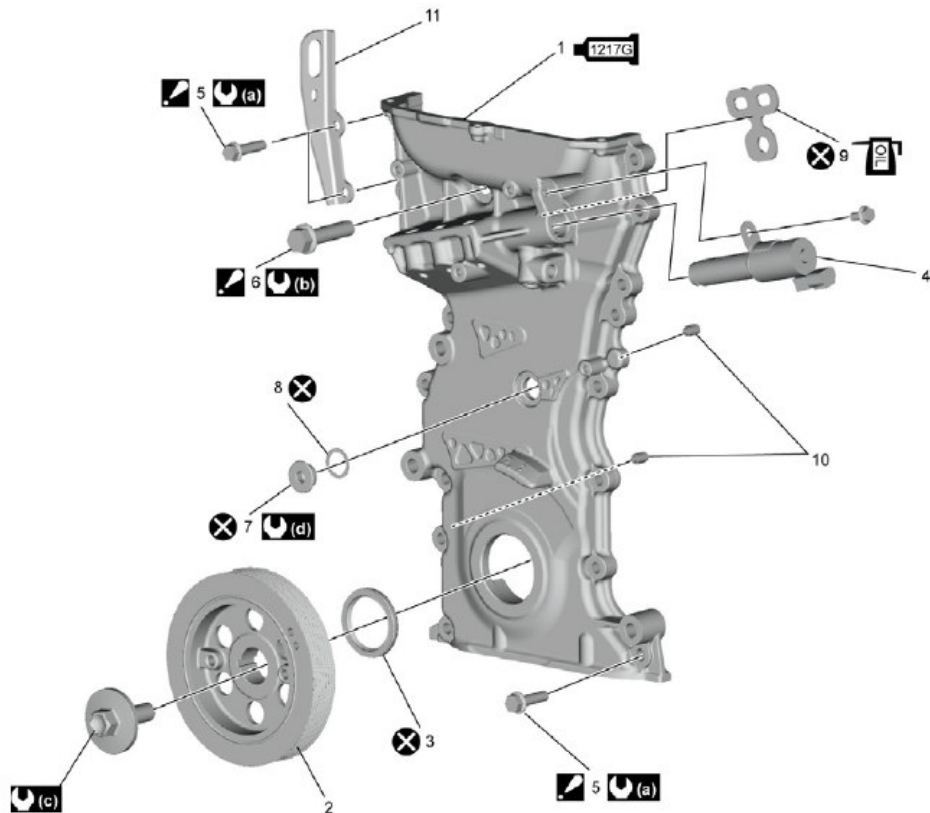


**Fig. 83: Connecting Battery Ground Cable To Vehicle Body**  
 Courtesy of SUZUKI OF AMERICA CORP.

23. Install front bumper and radiator grille. See **FRONT BUMPER COMPONENTS** .
24. Install accessory drive belt. See **ACCESSORY DRIVE BELT REMOVAL AND INSTALLATION** .
25. Install air cleaner assembly and air cleaner outlet hose. See **AIR CLEANER ASSEMBLY REMOVAL AND INSTALLATION** .
26. Install air cleaner suction pipe. See **AIR CLEANER COMPONENTS** .
27. Make sure that all electric wires, connectors and hoses are installed at original locations.
28. Make sure that all removed components are installed at original locations.
29. Fill all drained oils and fluids.
  - Engine oil: See **ENGINE OIL AND FILTER CHANGE** .
  - Manual transmission oil (5M/T model): See **MANUAL TRANSMISSION OIL CHANGE** .
  - A/T fluid (4 A/T model): **A/T FLUID CHANGE** .
  - P/S fluid: See **P/S FLUID CHANGE** .
  - Transfer oil (4WD model):
    - Motor shift type: See **TRANSFER OIL CHANGE** .
    - Non-shift type: See **TRANSFER OIL CHANGE** .
  - Front differential oil (4WD model): See **FRONT DIFFERENTIAL OIL CHANGE** .
30. Install front tires.
31. Install engine cover.
32. Install battery tray and battery bracket.
33. Install battery. See **BATTERY REMOVAL AND INSTALLATION** .
34. Refill cooling system with coolant. See **COOLING SYSTEM REFILLING** .
35. Check any leakage of coolant, oil, fuel and exhaust.
  - Fuel leak: See **FUEL LEAKAGE CHECK PROCEDURE** .

- Coolant leak: See **ENGINE COOLING SYSTEM INSPECTION** .

**TIMING CHAIN COVER COMPONENTS**



<b>1217G</b>	1. Timing chain cover : Apply sealant 99000-31260 referring to <a href="#">Timing Chain Cover Removal and Installation:J24B</a> .	7. Timing chain cover plug	<b>(b)</b> : 55 N·m (5.6 kgf-m, 40.5 lbf-ft)
	2. Crankshaft pulley	8. Timing chain cover plug gasket	<b>(c)</b> : 150 N·m (15.3 kgf-m, 111.0 lbf-ft)
	3. Oil seal	9. Gasket	<b>(d)</b> : 27 N·m (2.8 kgf-m, 20.0 lbf-ft)
	4. Oil control valve	10. Dowel pin	<b>X</b> : Do not reuse.
<b>!</b>	5. Timing chain cover bolt (M8) : For tightening order, refer to <a href="#">Timing Chain Cover Removal and Installation:J24B</a> .	11. Engine hook	<b>Oil</b> : Apply engine oil.
<b>!</b>	6. Timing chain cover bolt (M10) : For tightening order, refer to <a href="#">Timing Chain Cover Removal and Installation:J24B</a> .		<b>(a)</b> : 25 N·m (2.5 kgf-m, 18.5 lbf-ft)

**Fig. 84: Identifying Timing Chain Cover Components With Torque Specifications**  
Courtesy of SUZUKI OF AMERICA CORP.

**Tightening Order/Removal and Installation figure callout references:**

**TIMING CHAIN COVER REMOVAL AND INSTALLATION**

**TIMING CHAIN COVER REMOVAL AND INSTALLATION**

*Reference:* **TIMING CHAIN COVER COMPONENTS**

- CAUTION:**
- 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 engine assembly from vehicle. See **ENGINE ASSEMBLY REMOVAL AND INSTALLATION**.
2. Remove crankshaft pulley bolt.

To lock crankshaft pulley (1), use special tool as shown in figure.

- CAUTION:**
- Use special tool to avoid applying unnecessary load to timing chain, sprockets and any other related parts.
  - Use specified bolts (2) to install special tool to crankshaft pulley. Bolt size: M8

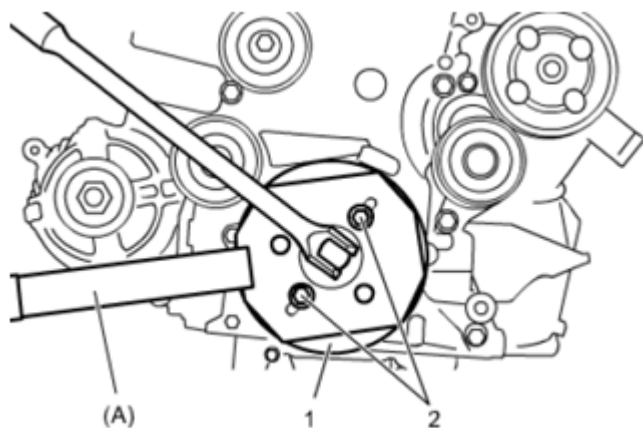
**Pitch: 1.25 mm**

**Length: 25 mm (0.98 in.)**

**Strength: 7T**

**Special Tool**

**(A): 09917-68221**



**Fig. 85: Installing Crankshaft Pulley**  
Courtesy of SUZUKI OF AMERICA CORP.

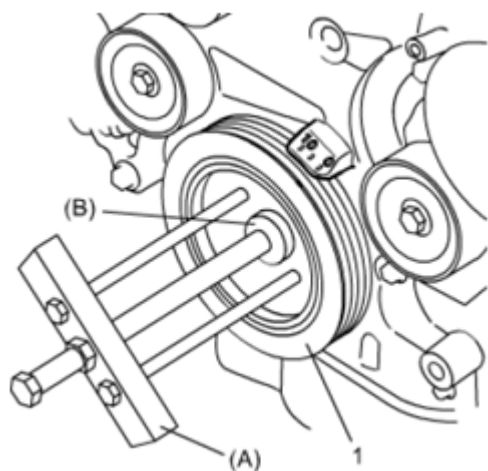
3. Remove crankshaft pulley (1).

If it is hard to remove, use special tools as shown in figure.

#### Special Tool

(A): 09944-36011

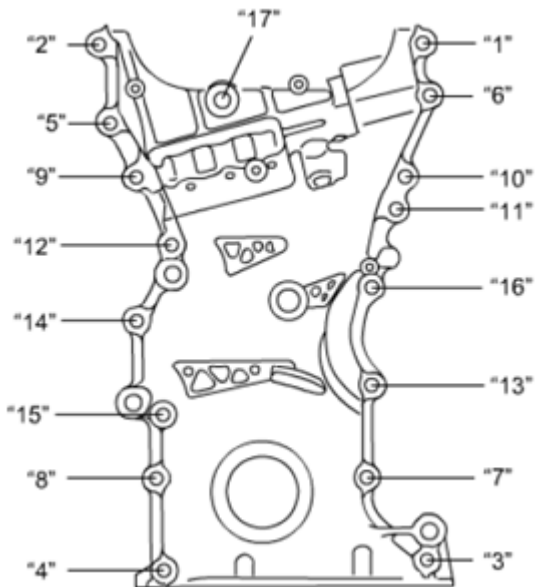
(B): 09926-58010



**Fig. 86: Removing Crankshaft Pulley**  
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove cylinder head cover. See **CYLINDER HEAD COVER REMOVAL AND INSTALLATION**.
5. Remove oil pan. See **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION**.
6. Remove tensioner pulley and idler pulley. See **TENSIONER AND IDLER PULLEY REMOVAL AND INSTALLATION**.

- Remove timing chain cover by loosening timing chain cover bolts in numerical order ("1" - "17") evenly and gradually.



**Fig. 87: Identifying Timing Chain Cover Bolts Loosen Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

- Remove crankshaft oil seal from timing chain cover using flat-head screwdriver or the like, if necessary.
- Remove oil seal from timing chain cover if necessary.

#### Installation

#### **Reference:** TIMING CHAIN COVER INSPECTION

- Clean mating surface of timing chain cover, cylinder block and cylinder head.

Remove oil, old sealant and dust from mating surface.

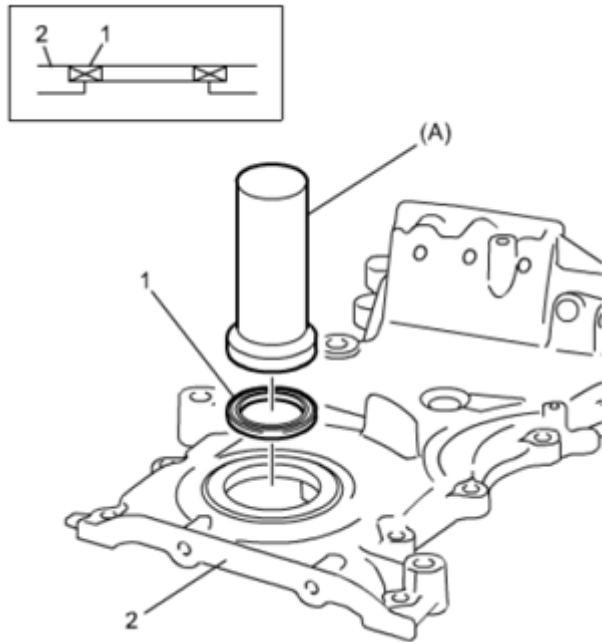
- Check oil seal (1) for any damage.

If abnormality is found, replace oil seal.

**NOTE:** When installing new oil seal, press it into timing chain cover (2) using special tool as shown in figure.

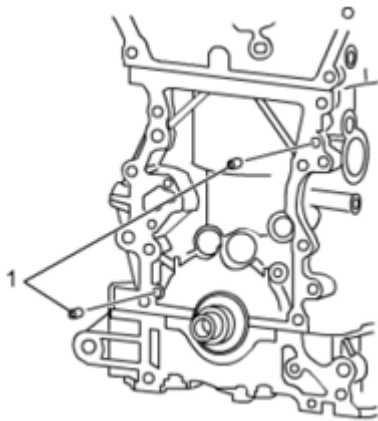
#### Special Tool

(A): 09913-75510



**Fig. 88: Installing Oil Seal**  
 Courtesy of SUZUKI OF AMERICA CORP.

3. Install dowel pins (1) to cylinder block.



**Fig. 89: Identifying Dowel Pins To Cylinder Block**  
 Courtesy of SUZUKI OF AMERICA CORP.

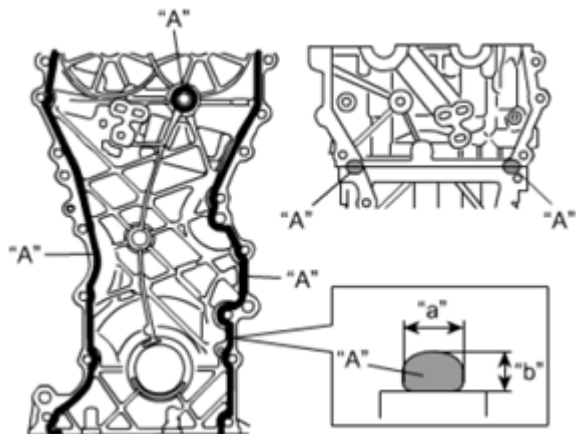
4. Apply sealant "A" to mating surface of cylinder, cylinder head and timing chain cover as shown in figure.

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

**Sealant bead size for timing chain cover**

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

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



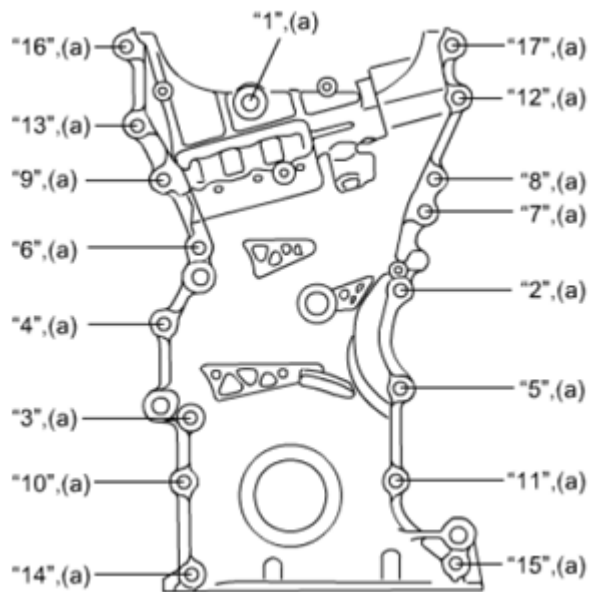
**Fig. 90: Applying Sealant To Mating Surface Of Cylinder, Cylinder Head And Timing Chain Cover**  
 Courtesy of SUZUKI OF AMERICA CORP.

5. Apply engine oil to oil seal lip, then install timing chain cover (1). Tighten timing chain cover bolts to specified torque in numerical order ("1" - "17") evenly and gradually.

**NOTE:** Before installing timing chain cover, check that dowel pins are securely fitted.

**Tightening torque**

Timing chain cover bolt\* (a): 25 N.m (2.5 kg-m, 18.5 lbf-ft)



**Fig. 91: Installing Timing Chain Cover**  
 Courtesy of SUZUKI OF AMERICA CORP.

6. Install tensioner pulley and idler pulley. See **TENSIONER AND IDLER PULLEY REMOVAL AND INSTALLATION** .
7. Install cylinder head cover. See **CYLINDER HEAD COVER REMOVAL AND INSTALLATION**.
8. Install oil pan. See **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION** .
9. Install crankshaft pulley (1) and tighten crankshaft pulley bolt to specified torque. To lock crankshaft pulley, use special tool as shown in figure.

**CAUTION:**

- Use special tool to avoid being applying unnecessary load to timing chain, sprockets and any other related parts.
- Use specified bolts (2) to install special tool to crankshaft pulley.

**Bolt size: M8**

**Pitch: 1.25 mm**

**Length: 25 mm (0.98 in.)**

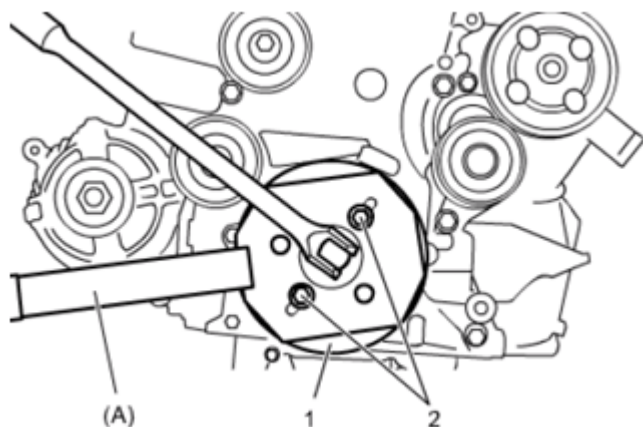
**Strength: 7T**

**Special Tool**

**(A): 09917-68221**

**Tightening torque**

**Crankshaft pulley bolt (a): 150 N.m (15.3 kg-m, 111.0 lbf-ft)**



**Fig. 92: Tightening Crankshaft Pulley Bolt**  
**Courtesy of SUZUKI OF AMERICA CORP.**

10. Install engine assembly to vehicle. See **ENGINE ASSEMBLY REMOVAL AND INSTALLATION**.

## TIMING CHAIN COVER INSPECTION

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

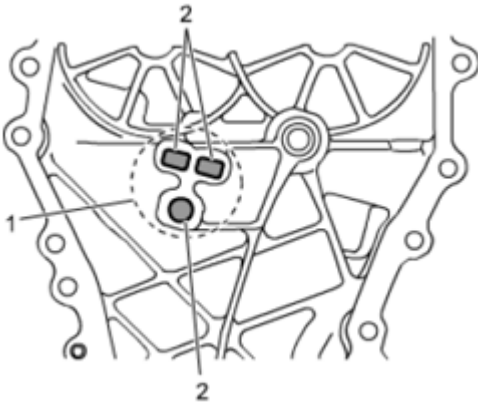
### Oil Seal

Check oil seal lip for any damage. If abnormality is found, replace oil seal.

### Timing Chain Cover

Inspect oil passage (1) for driving CMP actuator and strainer (2).

If clog or foreign matter exists, clean strainer.



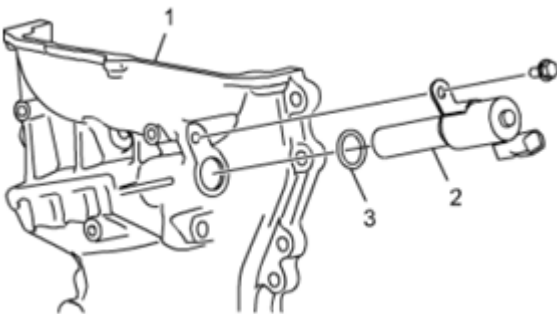
**Fig. 93: Identifying Oil Passage, Driving CMP Actuator And Strainer**  
Courtesy of SUZUKI OF AMERICA CORP.

## OCV (OIL CONTROL VALVE) REMOVAL AND INSTALLATION

**Reference:** TIMING CHAIN COVER COMPONENTS

### Removal

Remove OCV (2) and O-ring (3) from timing chain cover (1).



**Fig. 94: Identifying OCV, O-ring And Timing Chain Cover**

Courtesy of SUZUKI OF AMERICA CORP.

### Installation

Reverse removal procedure noting the following.

- Install new O-ring.
- Tighten OCV bolt to specified torque.

### Tightening torque

**OCV bolt: 11 N.m (1.1 kg-m, 8.5 lbf-ft)**

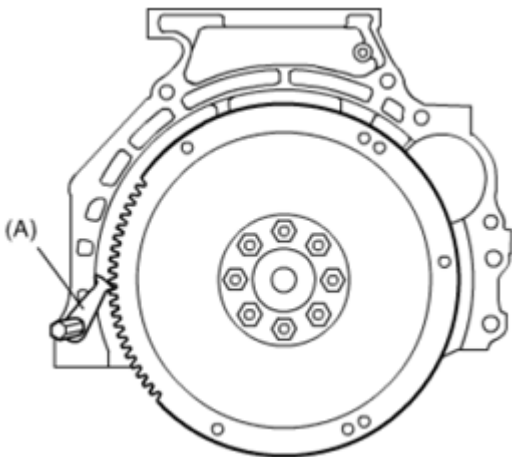
## FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION

### Removal

1. Remove transmission assembly.
  - 5 M/T model: See MANUAL TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING .
  - 4 A/T model: See AUTOMATIC TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING .
2. Wedge a special tool in ring gear teeth to lock flywheel or drive plate as shown in figure.

### Special Tool

(A): 09924-17811



**Fig. 95: Identifying Transmission Assembly**  
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove flywheel or drive plate from engine assembly.

## Installation

Reverse removal procedure noting the following.

- Install new drive plate bolts or flywheel bolts.
- Wedge a special tool in ring gear teeth to lock flywheel or drive plate as shown in figure.

### Special Tool

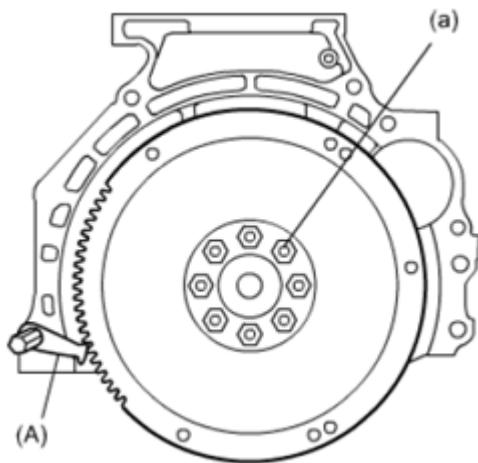
(A): 09924-17811

- Tighten flywheel bolts or drive plate bolts to specified torque.

### Tightening torque

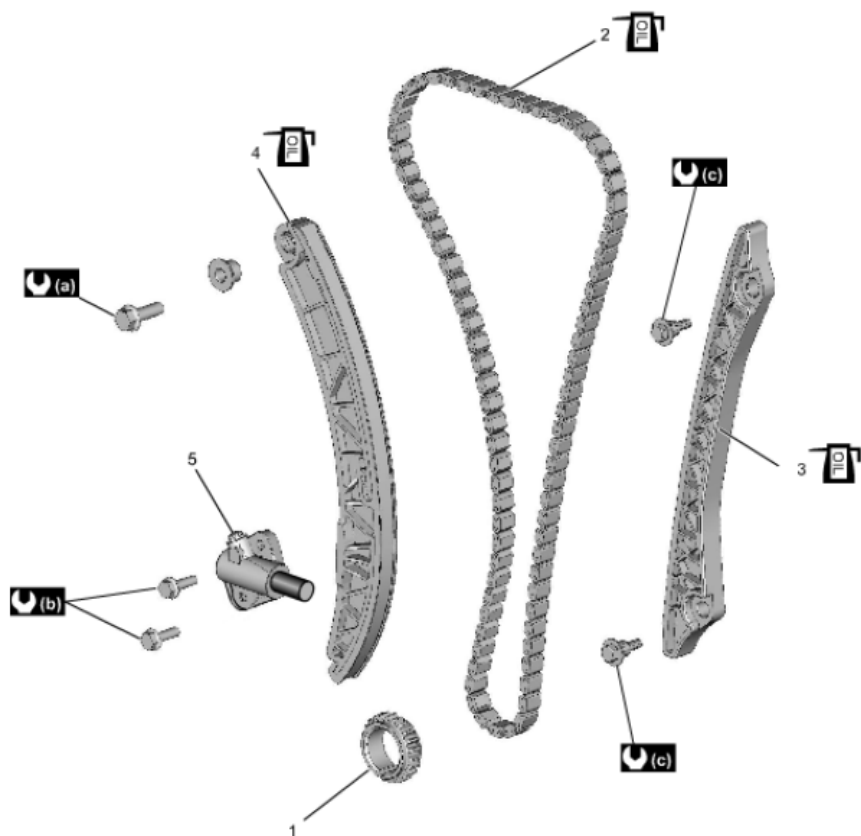
Flywheel bolt (a): 70 N.m (7.1 kg-m, 52.0 lbf-ft)

Drive plate bolt (a): 70 N.m (7.1 kg-m, 52.0 lbf-ft)



**Fig. 96: Identifying Flywheel Bolts Tighten Sequence**  
Courtesy of SUZUKI OF AMERICA CORP.

## TIMING CHAIN AND CHAIN TENSIONER COMPONENTS



1. Crankshaft timing sprocket	4. Timing chain tensioner	: 11 N·m (1.1 kgf-m, 8.5 lbf-ft)
2. Timing chain	5. Timing chain tensioner adjuster	: 9 N·m (0.92 kgf-m, 7.0 lbf-ft)
3. Timing chain guide	: 25 N·m (2.5 kgf-m, 18.5 lbf-ft)	: Apply engine oil to sliding surface.

**Fig. 97: Identifying Timing Chain And Chain Tensioner Components With Torque Specifications**  
 Courtesy of SUZUKI OF AMERICA CORP.

**TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**

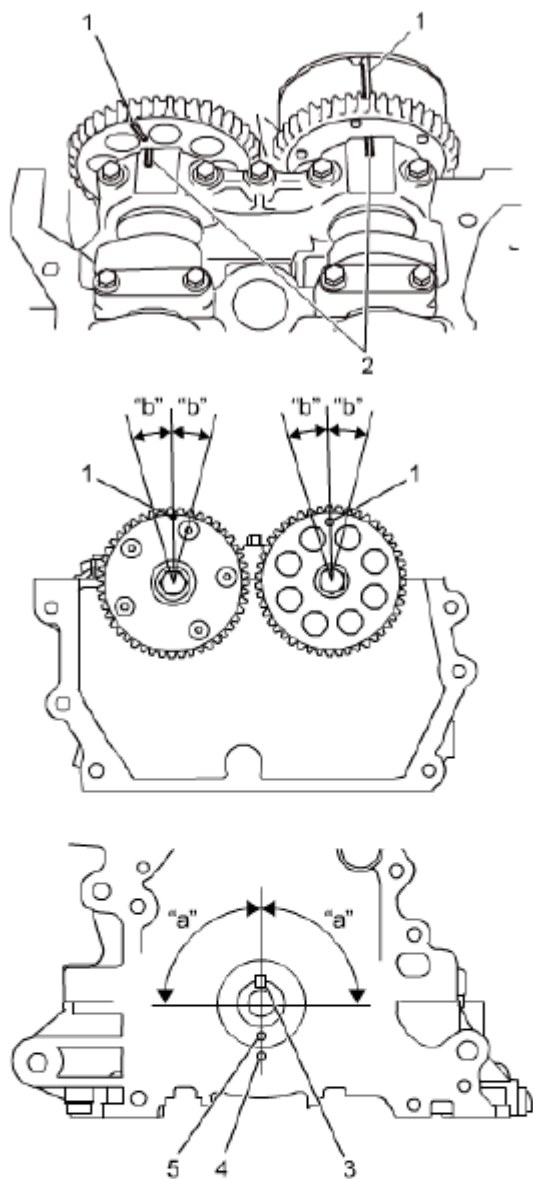
**Reference:** TIMING CHAIN AND CHAIN TENSIONER COMPONENTS

**NOTE:** For identification of each cylinder, refer to PRECAUTIONS FOR IDENTIFICATION OF CYLINDER .

**Removal**

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

**independently more than specified range ("a" and "b") as shown in figure. If either of those shafts is turned, interference may occur between pistons and valves and valves themselves, and parts related to piston and valves may be damaged.**

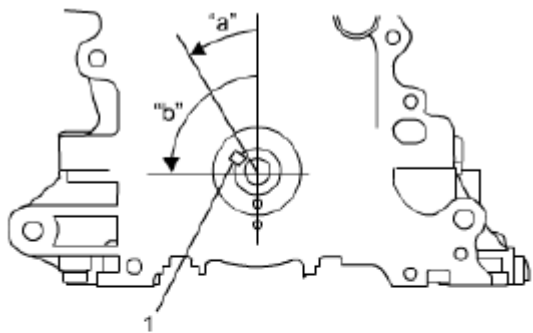


1. Timing marks on camshaft timing sprockets
2. Match marks on camshaft housing No.1
3. Key
4. Match mark on lower crank case
5. Timing mark on crankshaft timing sprocket
"a": 90°

**Fig. 98: Identifying Timing Chain And Chain Tensioner Components**

Courtesy of SUZUKI OF AMERICA CORP.

**NOTE:** If it is necessary to rotate the camshaft after removing timing chain, turn crankshaft counterclockwise and position key (1) within specified range (30 - 90°) as shown in figure before rotating camshaft.

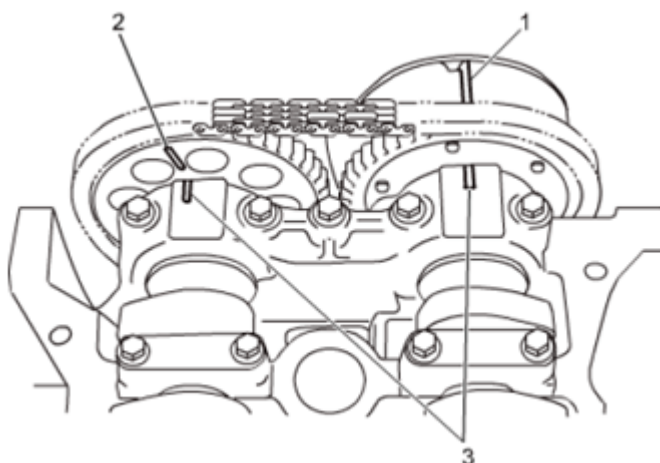


"a": 30°
"b": 90°
1. Key

**Fig. 99: Turning Crankshaft Counterclockwise And Position Key**

Courtesy of SUZUKI OF AMERICA CORP.

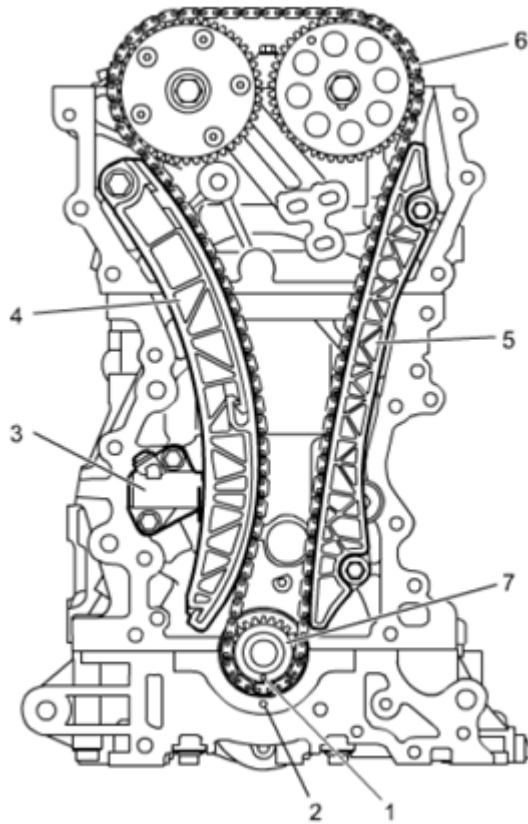
1. Remove timing chain cover. See **TIMING CHAIN COVER REMOVAL AND INSTALLATION**.
2. By turning crankshaft, align camshafts and crankshaft at specific position as follows.
  - a. Align timing marks on CMP actuator (1) and timing mark (2) on exhaust camshaft timing sprocket with match marks (3) on camshaft housing No. 1.



**Fig. 100: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprocket**

**Courtesy of SUZUKI OF AMERICA CORP.**

- b. Align timing mark (1) on crankshaft timing sprocket with match mark (2) on lower crank case.
3. Remove timing chain tensioner adjuster (3).
4. Remove timing chain tensioner (4).
5. Remove timing chain guide (5).
6. Remove timing chain (6) and crankshaft timing sprocket (7).

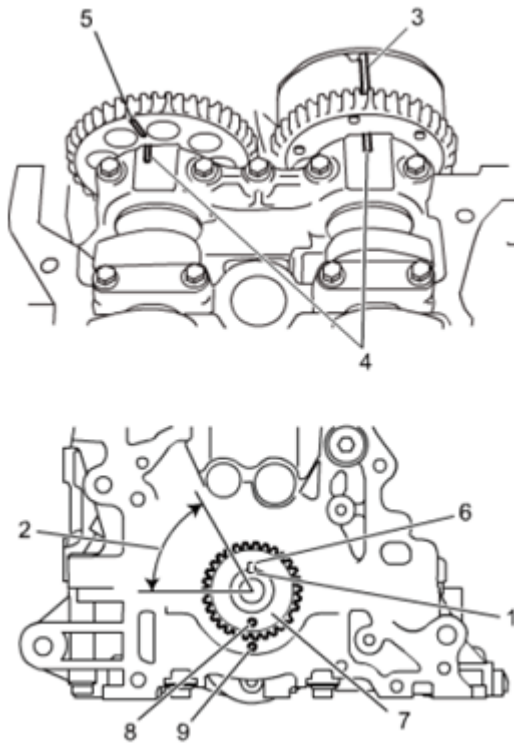


**Fig. 101: Identifying Timing Chain And Crankshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

### Installation

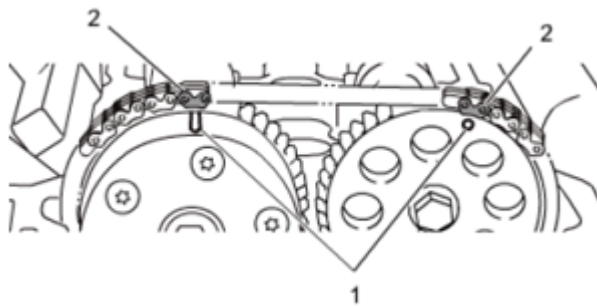
#### **Reference: TIMING CHAIN AND CHAIN TENSIONER INSPECTION**

1. Turn camshaft position key slot (1) within specified range (30 - 90°) (2) in counterclockwise direction from top as shown in figure.
2. Align timing mark (3) on CMP actuator with match marks (4) on camshaft housing No. 1.
3. Align timing mark (5) on exhaust camshaft timing sprocket with match marks (4) on camshaft housing No. 1.
4. Install key (6) to key slot (1) of crankshaft.
  - a. Align key slot of crankshaft timing sprocket (7) with key, and then Install crankshaft timing sprocket to crankshaft.
  - b. Align timing mark (8) on crankshaft timing sprocket with match mark (9) on lower crank case.



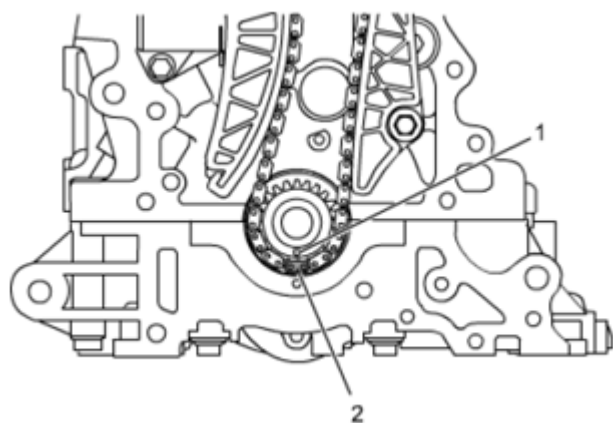
**Fig. 102: Aligning Timing Mark On Crankshaft Timing Sprocket**  
Courtesy of SUZUKI OF AMERICA CORP.

5. Install timing chain while aligning two blue plates (2) with timing marks (1) on CMP actuator and exhaust camshaft timing sprockets.



**Fig. 103: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprockets**  
Courtesy of SUZUKI OF AMERICA CORP.

6. Install timing chain while aligning blue plate (2) with timing mark (1) on crankshaft timing sprocket.



**Fig. 104: Identifying Timing Mark On Crankshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

7. Install timing chain guide (1) and tighten timing chain guide bolts (2) to specified torque.

#### **Tightening torque**

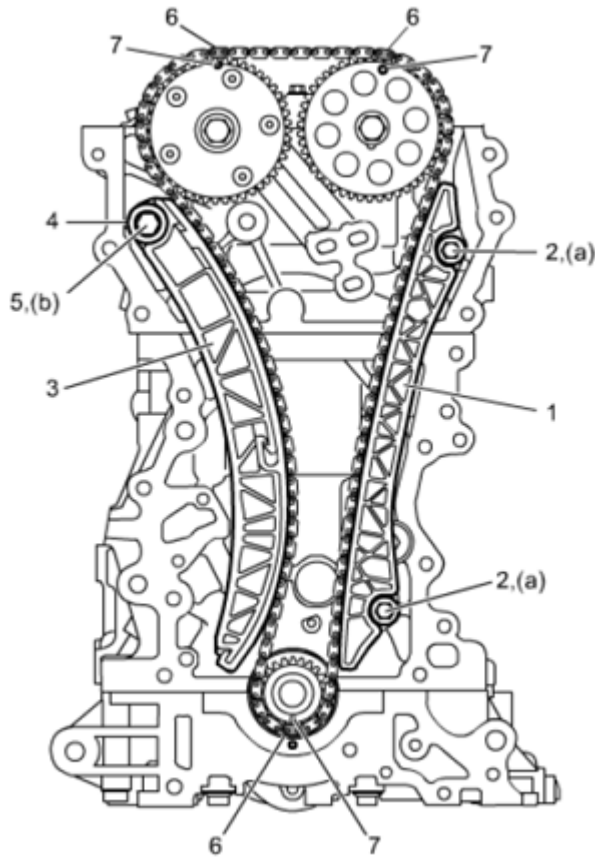
**Timing chain guide bolt (a): 9 N.m (0.92 kg-m, 7.0 lbf-ft)**

8. Apply engine oil to sliding surface of timing chain guide.
9. Attach spacer (4) to timing chain tensioner (3).
10. Install timing chain tensioner (3) and tighten timing chain tensioner bolt (5) to specified torque.

#### **Tightening torque**

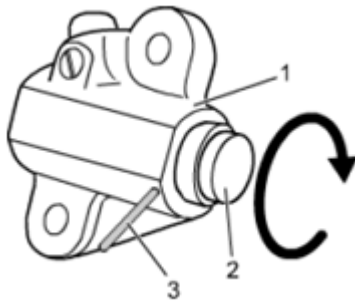
**Timing chain tensioner bolt (b): 25 N.m (2.5 kg-m, 18.5 lbf-ft)**

11. Apply engine oil to sliding surface of timing chain tensioner.
12. Make sure that all blue plated (6) are aligned with timing marks (7) on corresponding timing sprockets.



**Fig. 105: Identifying Timing Chain Tensioner And Timing Chain Tensioner Bolt**  
 Courtesy of SUZUKI OF AMERICA CORP.

13. Screw in plunger (2) of timing chain tensioner adjuster (1) clockwise and install a retainer (3) (1.4 mm-diameter wire or the like) to hold plunger in place.



**Fig. 106: Identifying Plunger, Timing Chain Tensioner Adjuster And Retainer**  
 Courtesy of SUZUKI OF AMERICA CORP.

14. Install timing chain tensioner adjuster (1) with a retainer.

Tighten timing chain tensioner adjuster bolts (2) to specified torque, and then remove a retainer from timing chain tensioner adjuster.

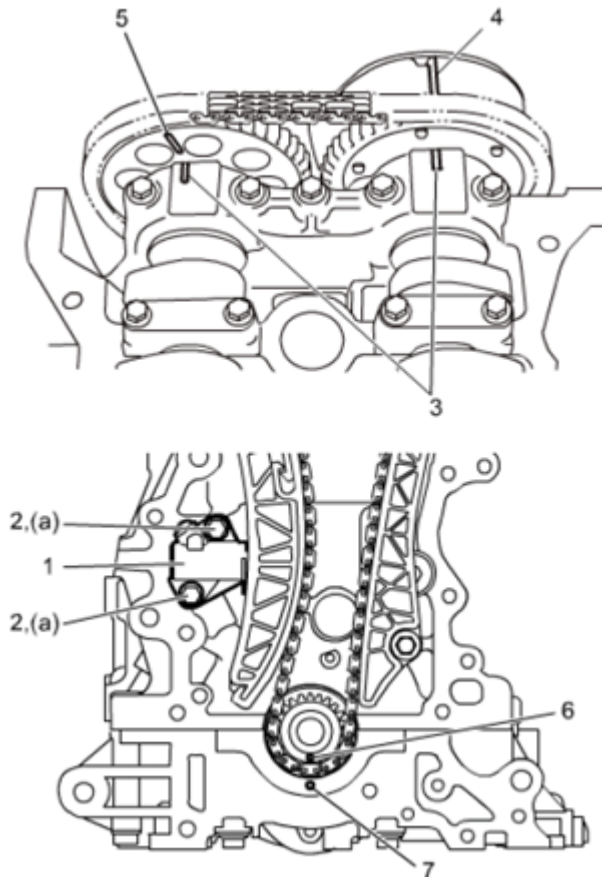
## Tightening torque

### Timing chain tensioner adjuster bolt (a): 11 N.m (1.1 kg-m, 8.5 lbf-ft)

15. Apply engine oil to timing chain, and then turn crankshaft clockwise fully twice, and make sure the following items.
- Timing mark (4) on CMP actuator is aligned with match mark (3) on camshaft housing No. 1.
  - Timing mark (5) on exhaust camshaft timing sprocket is aligned with match mark (3) on camshaft housing No. 1.
  - Timing mark (6) on crankshaft timing sprocket is aligned with match mark (7) on lower crank case.

#### NOTE:

- **Be sure to turn crankshaft fully twice. If it is once, timing marks on CMP actuator and exhaust camshaft timing sprocket do not meet match marks on camshaft housing No. 1.**
- **After turning crankshaft twice, the discrimination links of timing chain are not aligned with the timing marks on the CMP actuator and the exhaust timing sprocket, but it is normal.**



**Fig. 107: Identifying Timing Mark On CMP Actuator**  
**Courtesy of SUZUKI OF AMERICA CORP.**

16. Install timing chain cover. See **TIMING CHAIN COVER REMOVAL AND INSTALLATION.**
17. Install cylinder head cover. See **CYLINDER HEAD COVER REMOVAL AND INSTALLATION.**
18. Install oil pan. See **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION .**
19. Install engine assembly. See **ENGINE ASSEMBLY REMOVAL AND INSTALLATION.**

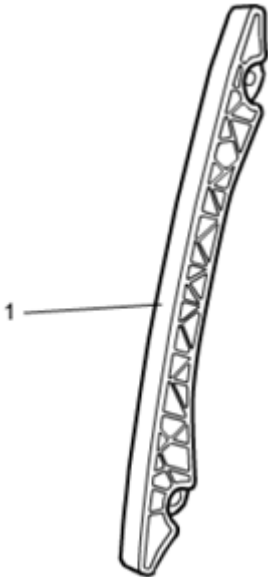
## TIMING CHAIN AND CHAIN TENSIONER INSPECTION

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

### Timing Chain Guide

Check sliding surface of timing chain guide (1) for wear or damage.

If abnormality is found, replace timing chain guide.

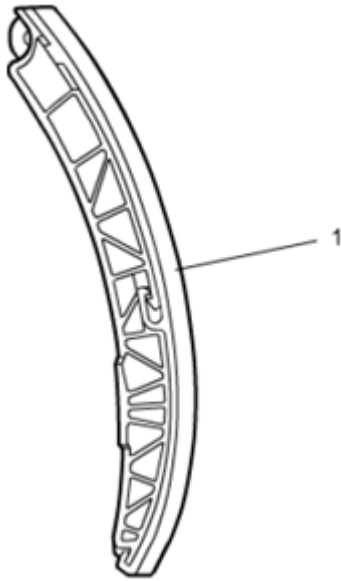


**Fig. 108: Identifying Timing Chain Guide**  
Courtesy of SUZUKI OF AMERICA CORP.

### Timing Chain Tensioner

Check sliding surface of timing chain tensioner (1) for wear or damage.

If abnormality is found, replace timing chain tensioner.

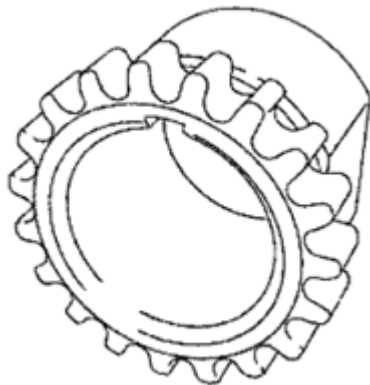


**Fig. 109: Identifying Timing Chain Tensioner**  
Courtesy of SUZUKI OF AMERICA CORP.

#### **Crankshaft Timing Sprocket**

Check sprocket teeth for wear or damage.

If abnormality is found, replace crankshaft timing sprocket.

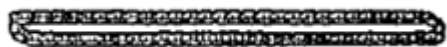


**Fig. 110: Identifying Crankshaft Timing Sprocket**  
Courtesy of SUZUKI OF AMERICA CORP.

#### **Timing Chain**

Check timing chain for wear or damage.

If abnormality is found, replace timing chain.

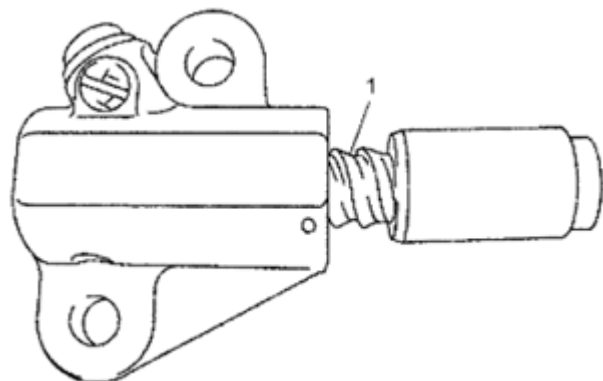


**Fig. 111: Identifying Timing Chain**  
Courtesy of SUZUKI OF AMERICA CORP.

**Timing Chain Tensioner Adjuster**

Check that tooth surface (1) are free from damage.

If abnormality is found, replace timing chain tensioner adjuster.

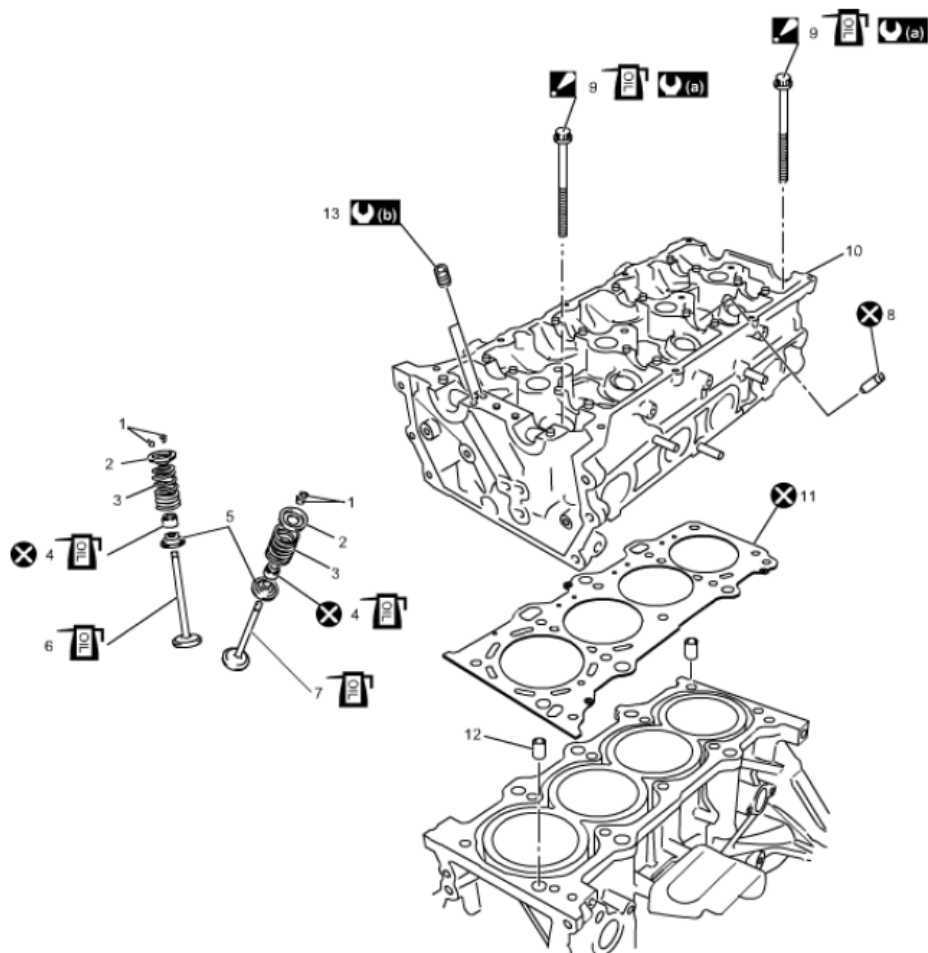


**Fig. 112: Identifying Timing Chain Tensioner Adjuster**  
Courtesy of SUZUKI OF AMERICA CORP.

**VALVE AND CYLINDER HEAD COMPONENTS**

# 2011 Suzuki Grand Vitara

## 2011 ENGINE Engine Mechanical - Grand Vitara



1. Valve cotters	7. Exhaust valve: Apply engine oil to sliding surface.	13. Venturi plug
2. Valve spring retainer	8. Valve guide	: 20 N·m → 40 N·m → +60° → +80° (2.0 kgf·m → 4.1 kgf·m → +60° → +80°, 15.0 lbf·ft → 29.5 lbf·ft → +60° → +80°)
3. Valve spring	9. Cylinder head bolt : Check cylinder head bolt for deformation to reuse. <a href="#">Cylinder Head Bolt Inspection:J24B</a> : Apply engine oil to bolt thread. : For tightening order, refer to <a href="#">Valve and Cylinder Head Removal and Installation:J24B</a> .	: 3.5 N·m (0.36 kgf·m, 2.5 lbf·ft)
4. Valve stem seal : Apply engine oil to valve stem seal lip.	10. Cylinder head	: Do not reuse.
5. Valve spring seat	11. Cylinder head gasket	
6. Intake valve : Apply engine oil to sliding surface.	12. Dowel pin	

**Fig. 113: Identifying Valve And Cylinder Head Components With Torque Specifications**  
 Courtesy of SUZUKI OF AMERICA CORP.

Tightening Order figure callout reference:

**VALVE AND CYLINDER HEAD REMOVAL AND INSTALLATION**

**VALVE AND CYLINDER HEAD REMOVAL AND INSTALLATION**

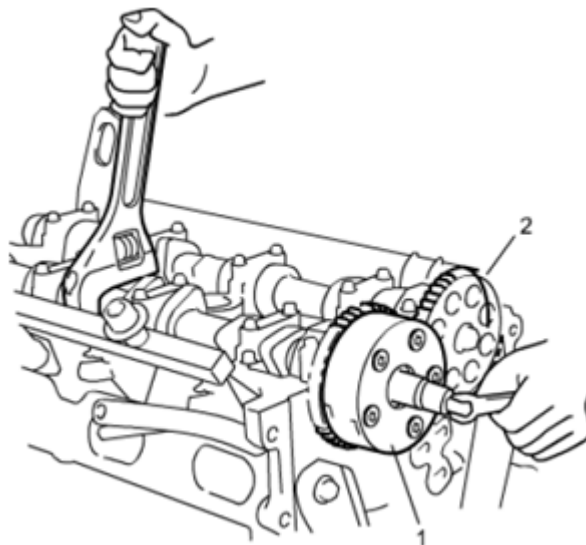
**Reference: VALVE AND CYLINDER HEAD COMPONENTS**

**Removal**

1. Remove timing chain. See **TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**.
2. Remove spark plugs. See **SPARK PLUG REMOVAL AND INSTALLATION**.
3. Remove CMP actuator and exhaust camshaft timing sprocket according to the following procedure.
  - a. Hold hexagonal section of camshaft stationary using wrench or the like.
  - b. Loosen bolts and remove CMP actuator (1) and exhaust camshaft timing sprocket (2).

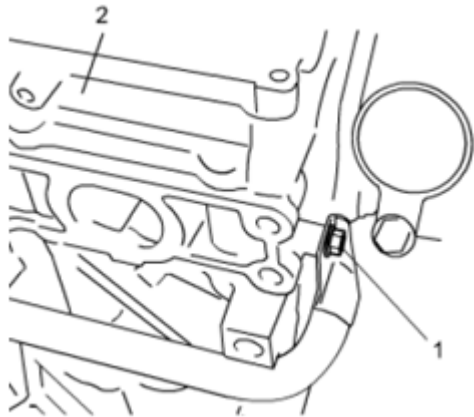
**NOTE:**

- Do not hold CMP actuator to loosen bolt. Doing so may result in damaged lock pin.
- Do not use impact wrench to loosen bolt.
- Do not disassemble CMP actuator (1).



**Fig. 114: Identifying CMP Actuator And Exhaust Camshaft Timing Sprocket**  
 Courtesy of SUZUKI OF AMERICA CORP.

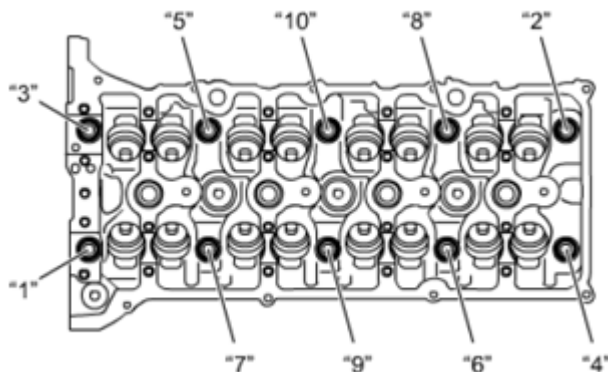
4. Remove intake camshaft and exhaust camshaft. See CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION.
5. Remove camshaft bearings.
6. Remove water outlet pipe from cylinder head. See COOLING SYSTEM COMPONENTS.
7. Remove heater outlet pipe bolt (1) from cylinder head (2).



**Fig. 115: Identifying Heater Outlet Pipe Bolt And Cylinder Head**  
 Courtesy of SUZUKI OF AMERICA CORP.

8. Loosen cylinder head bolts in numerical order ("1" - "10") evenly and gradually.

**NOTE: Use 12-point socket wrench to cylinder head bolts.**



**Fig. 116: Identifying Cylinder Head Bolts Loosen Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

9. Remove cylinder head with its gasket, intake manifold and exhaust manifold from cylinder block.
10. Remove the following components cylinder head if necessary.
  - Intake manifold: See INTAKE MANIFOLD REMOVAL AND INSTALLATION.
  - Exhaust manifold: See EXHAUST MANIFOLD REMOVAL AND INSTALLATION (J24B).
  - Fuel injector: See FUEL INJECTOR REMOVAL AND INSTALLATION.

- Water outlet cap: See COOLING SYSTEM COMPONENTS .
- Oil venture plug: See VALVE AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY.

### Installation

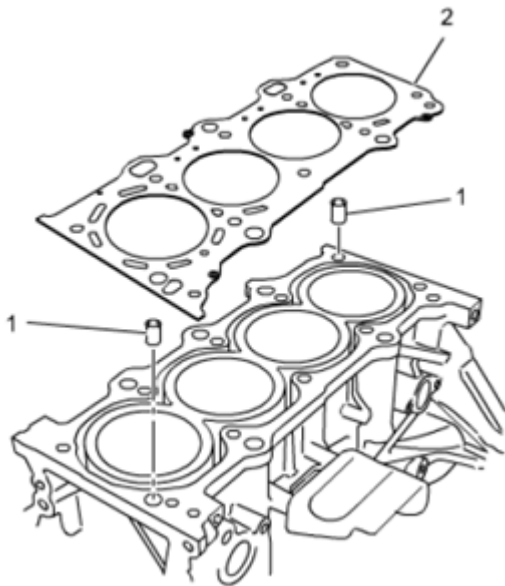
**Reference:** VALVE AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY

**Reference:** CYLINDER HEAD INSPECTION

**Reference:** CYLINDER HEAD BOLT INSPECTION

**CAUTION:** If cylinder head bolts are reused, check them for deformation referring to CYLINDER HEAD BOLT INSPECTION.

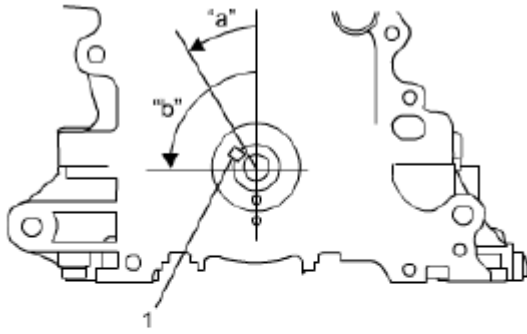
1. Clean mating surface of cylinder head and cylinder block. Remove oil, old gasket and dust from mating surface.
2. Install dowel pins (1) to cylinder block.
3. Install new cylinder head gasket (2) to cylinder block.



**Fig. 117: Identifying Cylinder Head Gasket And Cylinder Block**  
Courtesy of SUZUKI OF AMERICA CORP.

4. Install cylinder head to cylinder block as follows.

**NOTE:** Before installing cylinder head to cylinder block, turn crankshaft and position key (1) within specified range (30 - 90°) in counterclockwise direction from top as shown in figure.



"a": 30°
"b": 90°

**Fig. 118: Turning Crankshaft And Position Key**  
 Courtesy of SUZUKI OF AMERICA CORP.

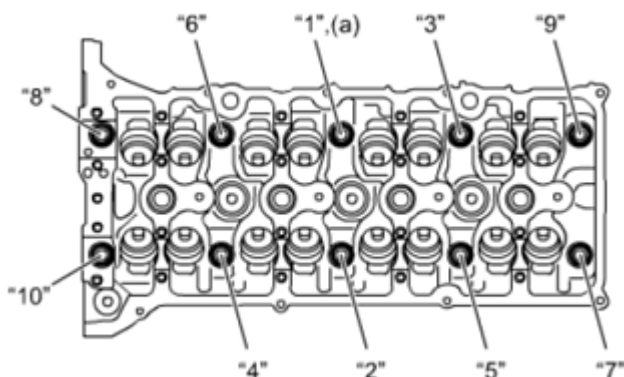
- a. Install cylinder head to cylinder block.
- b. Apply engine oil to cylinder head bolts threads.
- c. Tighten cylinder head bolts to 20 N.m (2.0 kgf-m, 15.0 lbf-ft) in numerical order ("1" - "10") evenly and gradually.

**NOTE: Use 12-point socket wrench to cylinder head bolts.**

- d. In the same manner as in Step c), retighten them to 40 N.m (4.1 kgf-m, 29.5 lbf-ft).
- e. In the same manner as Step c), retighten them to 60°.
- f. In the same manner as Step c), retighten them to 80°.

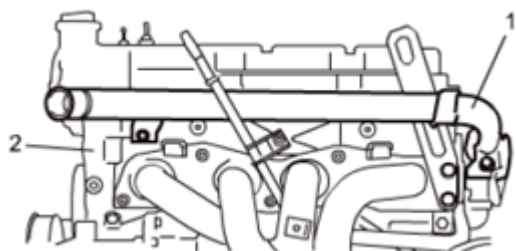
#### Tightening torque

Cylinder head bolt \* (a): 20 N.m --> 40 N.m --> +60° --> +80° (2.0 kgf-m --> 4.1 kgf-m --> +60° --> +80°, 15.0 lbf-ft --> 29.5 lbf-ft --> +60° --> +80°)



**Fig. 119: Identifying Cylinder Head Bolt Tighten Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

5. Install intake camshaft and exhaust camshaft. See CAMSHAFT AND TAPPET REMOVAL AND INSTALLATION.
6. Install timing chain. See TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION.
7. Install timing chain cover. See TIMING CHAIN COVER REMOVAL AND INSTALLATION.
8. Install cylinder head cover. See CYLINDER HEAD COVER REMOVAL AND INSTALLATION.
9. Install oil pan. See OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION.
10. Install water outlet cap if removed. See COOLING SYSTEM COMPONENTS.
11. Install heater outlet pipe bolt to cylinder head. See COOLING SYSTEM COMPONENTS.
12. Install water outlet pipe to cylinder head. See COOLING SYSTEM COMPONENTS.



**Fig. 120: Identifying Water Outlet Pipe To Cylinder Head**  
 Courtesy of SUZUKI OF AMERICA CORP.

13. Install spark plugs. See SPARK PLUG REMOVAL AND INSTALLATION.
14. Install exhaust manifold if removed. See EXHAUST MANIFOLD REMOVAL AND INSTALLATION (J24B).
15. Install intake manifold if removed. See INTAKE MANIFOLD REMOVAL AND INSTALLATION.
16. Install fuel injectors if removed. See FUEL INJECTOR REMOVAL AND INSTALLATION.
17. Install engine assembly. See ENGINE ASSEMBLY REMOVAL AND INSTALLATION.

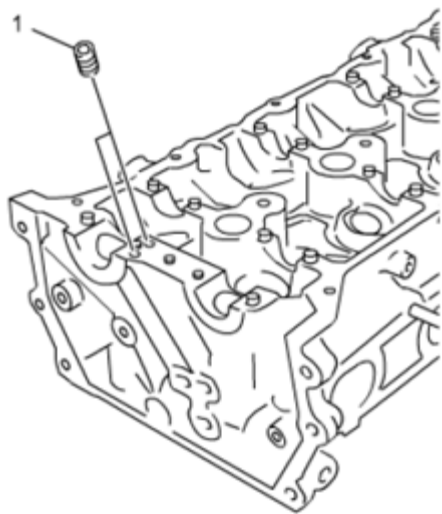
## VALVE AND CYLINDER HEAD DISASSEMBLY AND REASSEMBLY

**Disassembly****Reference:** VALVE AND CYLINDER HEAD REMOVAL AND INSTALLATION

**NOTE:** If following parts are removed, keep them in order. They must go back in the position from which they were removed.

- Valve cotter
- Valve spring retainer
- Valve spring
- Valve spring seat
- Intake valve
- Exhaust valve
- Tappet

1. Remove oil venturi plugs (1).



**Fig. 121: Identifying Oil Venturi Plugs**  
Courtesy of SUZUKI OF AMERICA CORP.

2. Remove tappets from cylinder head.
3. Using special tools (A) and (B), compress valve spring and then remove valve cotters (1) also by using special tool (C).

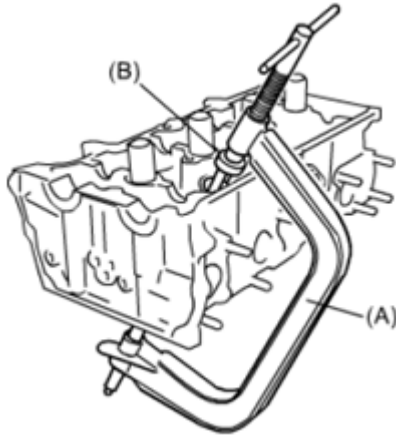
**CAUTION:** When compressing the valve spring, be careful not to damage in inside surface of tappet installing hole.

**Special Tool**

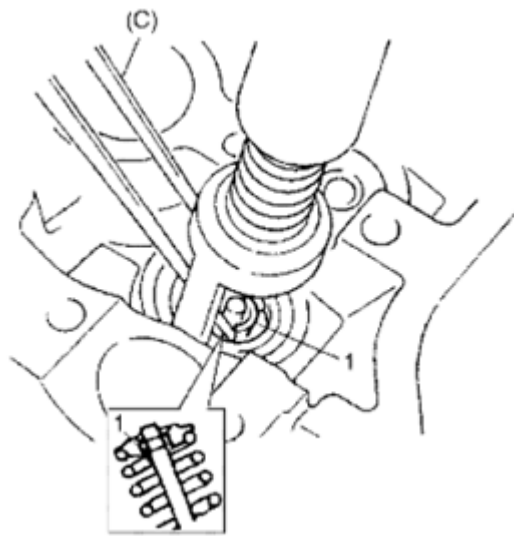
(A): 09916-14510

(B): 09916-14522

(C): 09916-84511



**Fig. 122: Compressing Valve Spring And Valve Cotters**  
 Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 123: Removing Valve Cotters**  
 Courtesy of SUZUKI OF AMERICA CORP.

4. Release special tools (A) and (B), and remove spring retainer and valve spring.
5. Remove valve from combustion chamber side.
6. Remove valve stem seal (1) and valve spring seat (2).



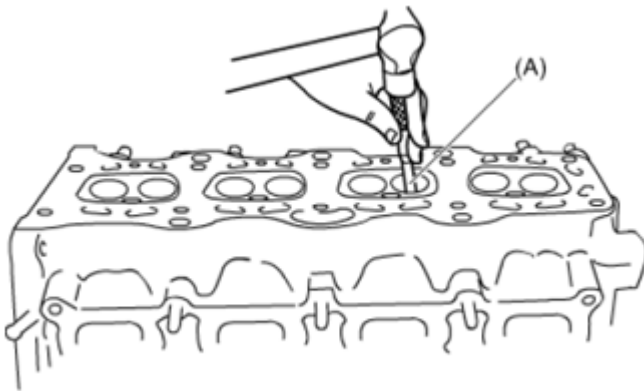
**Fig. 124: Removing Valve Stem Seal**  
Courtesy of SUZUKI OF AMERICA CORP.

7. Using special tool, drive out valve guide from combustion chamber side to valve spring side.

**NOTE:** Heat cylinder head to remove valve guide, if necessary.

Special Tool

(A): 09916-44910



**Fig. 125: Removing Valve Guide**  
Courtesy of SUZUKI OF AMERICA CORP.

Reassembly

**Reference:** VALVE AND VALVE GUIDE INSPECTION

**Reference:** CYLINDER HEAD INSPECTION

**Reference:** VALVE SPRING INSPECTION

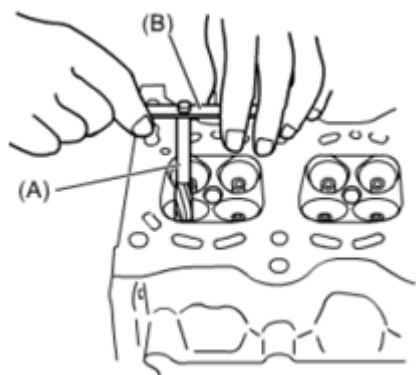
1. Before installing valve guide into cylinder head, ream guide hole with special tool (10.5 mm reamer) so as to remove burrs and make it truly round.

**CAUTION: Clean away shavings from reamed hole.**

### Special Tool

**(A): 09916-37320**

**(B): 09916-34542**



**Fig. 126: Installing Valve Guide Into Cylinder Head**  
Courtesy of SUZUKI OF AMERICA CORP.

2. Using special tools, install valve guide to cylinder head as follows.

### Special Tool

**(A): 09916-58210**

**(B): 09916-56510**

### NOTE:

- **Never reuse valve guide.**
- **Install new oversized valve guide.**
- **Intake and exhaust valve guides are identical.**

- a. Heat cylinder head uniformly to a temperature of 80 to 100 °C (176 to 212 °F) so that it will not be distorted, and drive new valve guide into guide hole with special tools.
- b. Drive in new valve guide until special tool contacts cylinder head.

After installation, make sure that valve guide protrudes by specified dimension "a" from cylinder

head.

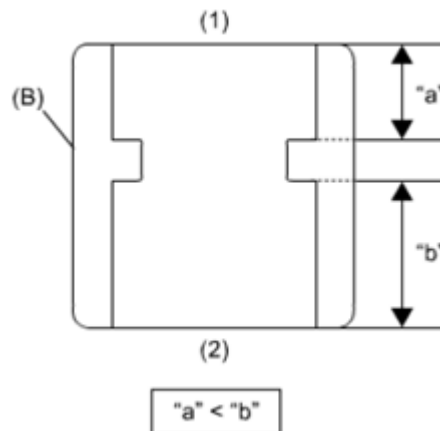
**CAUTION:** For installing intake valve guide and exhaust valve guide, the same special tool (B) is used, but its application direction is different. Use it in proper direction.

- For intake valve guide

The side (2) should be directed to valve guide.

- For exhaust valve guide

The side (1) should be directed to valve guide.

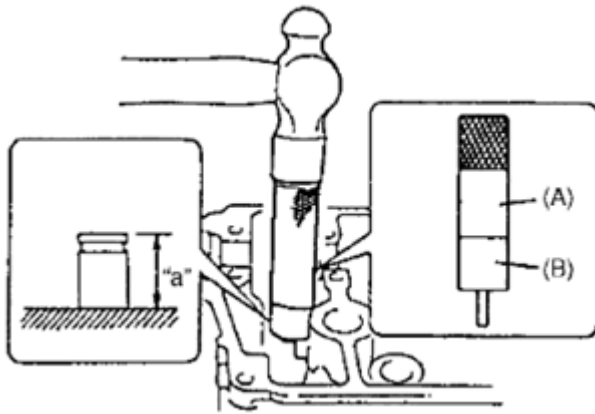


**Fig. 127: Identifying Valve Guide Dimension**  
Courtesy of SUZUKI OF AMERICA CORP.

Valve guide protrusion "a"

IN: 16.3 - 16.7 mm (0.642 - 0.657 in.)

EX: 12.3 - 12.7 mm (0.485 - 0.500 in.)



**Fig. 128: Installing Valve Guide**  
Courtesy of SUZUKI OF AMERICA CORP.

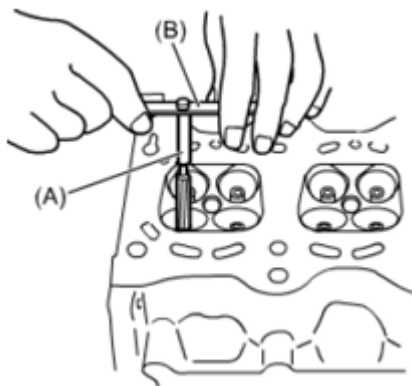
3. Ream valve guide bore with special tool.

**CAUTION:** Clean away shavings from reamed hole.

#### Special Tool

(A): 09916-34550

(B): 09916-34542



**Fig. 129: Reaming Valve Guide Bore 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 valve stem seal and spindle of special tool (A), fit valve stem seal to spindle, and then install valve stem seal to valve guide pushing special tool by hand.

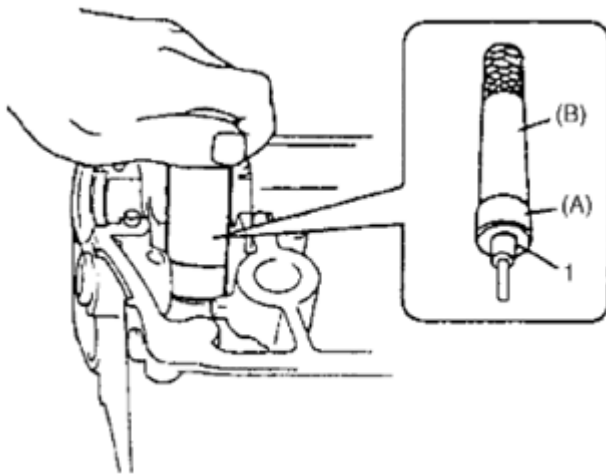
After installation, check that valve stem seal is properly fixed to valve guide.

**CAUTION:** When installing, never tap or hit special tool with a hammer or else. Install seal to guide only pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.

### Special Tool

(A): 09917-98221

(B): 09916-58210



**Fig. 130: Installing Valve Spring Seat To Cylinder Head**  
Courtesy of SUZUKI OF AMERICA CORP.

6. Apply engine oil to valve stem seal, valve guide bore and valve stem.
7. Install valve to valve guide.
8. Install valve spring and valve spring retainer.

**NOTE:** Valve spring does not have specific direction for installation.

9. Using special tools, compress valve spring and fit two valve cotters (1) into groove in valve stem.

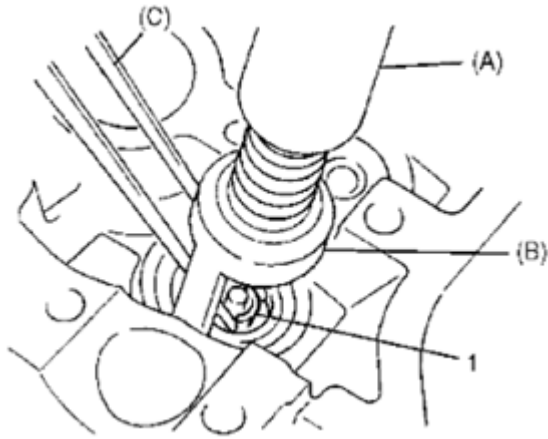
**CAUTION:** When compressing the valve spring, be careful not to damage inside surface of tappet installing hole.

### Special Tool

(A): 09916-14510

(B): 09916-14522

(C): 09916-84511

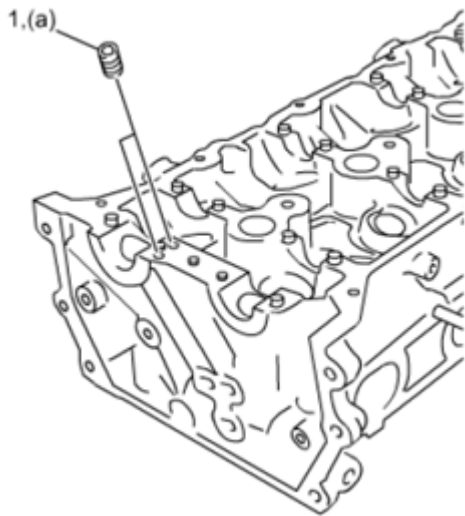


**Fig. 131: Compressing Valve Spring And Valve Cotters**  
Courtesy of SUZUKI OF AMERICA CORP.

10. Install venturi plugs (1).

**Tightening torque**

**Venturi plug (a): 3.5 N.m (0.36 kg-m, 2.5 lbf-ft)**



**Fig. 132: Installing Venturi Plugs**  
Courtesy of SUZUKI OF AMERICA CORP.

**VALVE AND VALVE GUIDE INSPECTION**

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

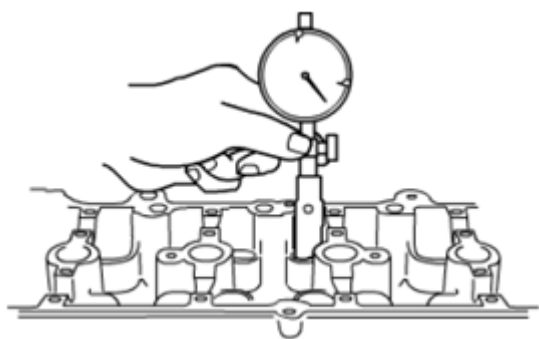
**Valve Guide**

**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 outside diameter****IN: 5.465 - 5.480 mm (0.2152 - 0.2157 in.)****EX: 5.440 - 5.455 mm (0.2142 - 0.2147 in.)****Valve guide inside diameter****IN & EX: 5.500 - 5.512 mm (0.2166 - 0.2170 in.)****Stem-to-guide clearance****Standard****IN: 0.020 - 0.047 mm (0.0008 - 0.0018 in.)****EX: 0.045 - 0.072 mm (0.0018 - 0.0028 in.)****Limit****IN: 0.070 mm (0.0027 in.)****EX: 0.090 mm (0.0035 in.)**

**Fig. 133: Checking Valve Stem Inside Diameter**  
**Courtesy of SUZUKI OF AMERICA CORP.**



**Fig. 134: Checking Valve Stem Outside Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Valve stem end deflection

Check valve stem end deflection using a dial gauge.

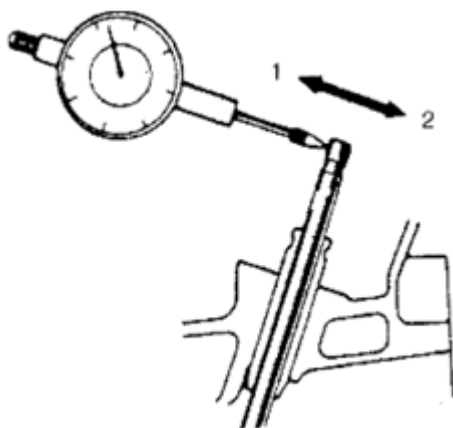
Move stem end in directions (1) and (2) to measure end deflection.

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

#### Valve stem end deflection limit

**In: 0.14 mm (0.0055 in.)**

**Ex: 0.18 mm (0.0070 in.)**



**Fig. 135: Checking Valve Stem End Deflection With Dial Gauge**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Valve

##### Visual inspection

- Remove all carbon deposits from all valves (1).

- Check each valve for wear, burn or distortion at its face and stem end.

Replace it if necessary.

- Measure valve protrusion length "a".

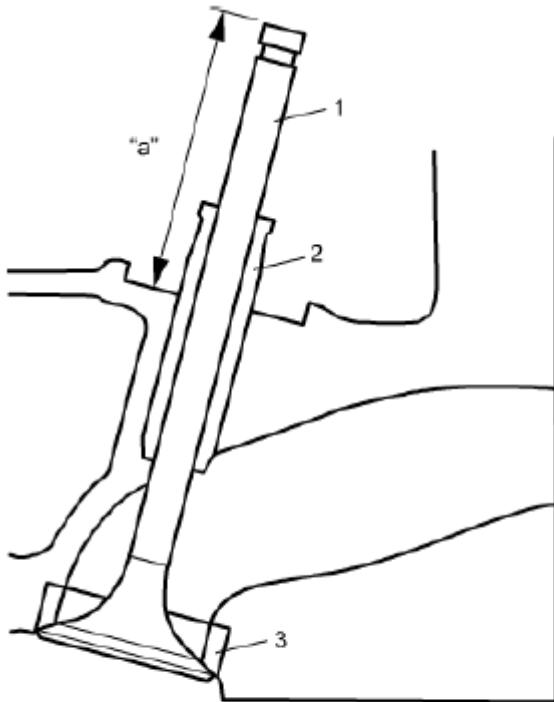
If measured length is out of standard value, replace valve.

### Valve protrusion length "a"

#### Standard

**IN: 44.00 - 44.60 mm (1.733 - 1.755 in.)**

**EX: 42.85 - 43.45 mm (1.687 - 1.710 in.)**



2. Valve guide

3. Valve seat

**Fig. 136: Identifying Valve Protrusion Length**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Valve head radial runout

Check each valve for radial runout using a dial gauge and "V" block.

To check runout, rotate valve slowly.

If runout exceeds its limit, replace valve.

### Valve head radial runout

#### Standard

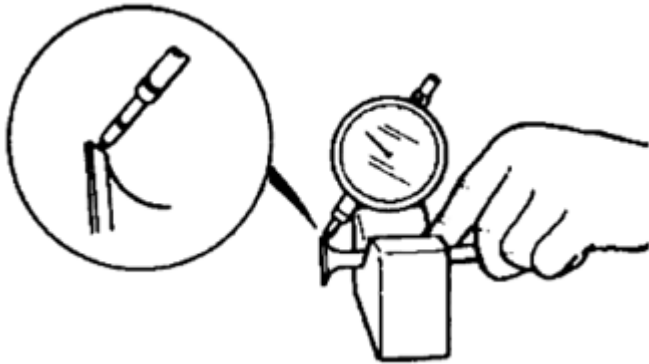
**IN: 0.000 - 0.045 mm (0.0000 - 0.0017 in.)**

**EX: 0.000 - 0.030 mm (0.0000 - 0.0011 in.)**

#### Limit

**IN: 0.090 mm (0.0035 in.)**

**EX: 0.060 mm (0.0023 in.)**



**Fig. 137: Checking Valve Head Radial Runout**  
Courtesy of SUZUKI OF AMERICA CORP.

#### Seating contact width

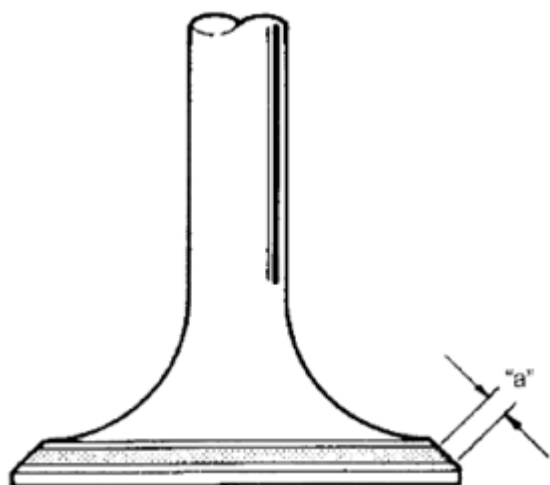
Create contact pattern on each valve in the usual manner, i.e., by giving uniform coat of marking compound to valve seat and by rotating tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.

Pattern produced on seating surface 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

**IN: 1.05 - 1.35 mm (0.0414 - 0.531 in.)**

**EX: 1.12 - 1.42 mm (0.0441 - 0.0559 in.)**



**Fig. 138: Identifying Valve Width**  
 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.

#### 1. Intake valve seat:

Use valve seat cutters to make three cuts as illustrated in figure. Three cutters must be used: the 1st for making 22° 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

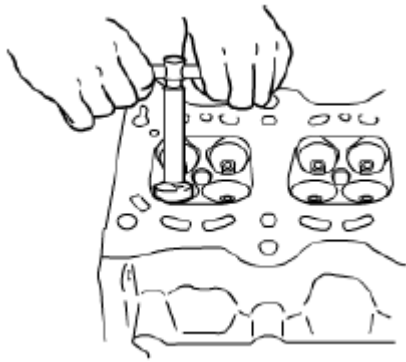
"a": 1.05 - 1.35 mm (0.0414 - 0.0531 in.)

#### 2. Exhaust valve seat:

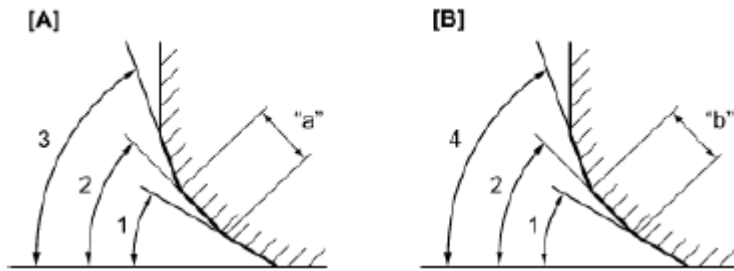
Use valve seat cutters to make three cuts as illustrated in the figure. Three cutters must be used: the 1st for making 22° angle, the 2nd for making 65° angle, and 3rd for making 45° angle. The 3rd cut must be made to produce desired seat width.

#### Seat width for exhaust valve seat

"b": 1.12 - 1.42 mm (0.0441 - 0.559 in.)



**Fig. 139: Seating Valve Seat Using Valve Seat Cutters**  
 Courtesy of SUZUKI OF AMERICA CORP.



[A]: Intake	1. 22°	3. 60°
[B]: Exhaust	2. 45°	4. 65°

**Fig. 140: Identifying Intake And Exhaust Angle**  
 Courtesy of SUZUKI OF AMERICA CORP.

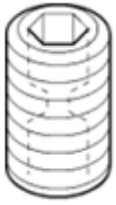
### 3. Valve lapping:

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.

#### Venturi Plug Inspection

Check that venturi plug passage is not clogged.

If venturi plug passage is clogged, clean or replace venturi plug.



**Fig. 141: Identifying Venturi Plug**  
Courtesy of SUZUKI OF AMERICA CORP.

## CYLINDER HEAD INSPECTION

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

### Combustion Chamber

- Remove all carbon deposits from all 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 removing carbon deposits. The same applies to valves and valve seats, too.

- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface.

### Cylinder Head Flatness

Using a straightedge (1) and thickness gauge (2), check flatness of gasket surface at a total of 6 locations.

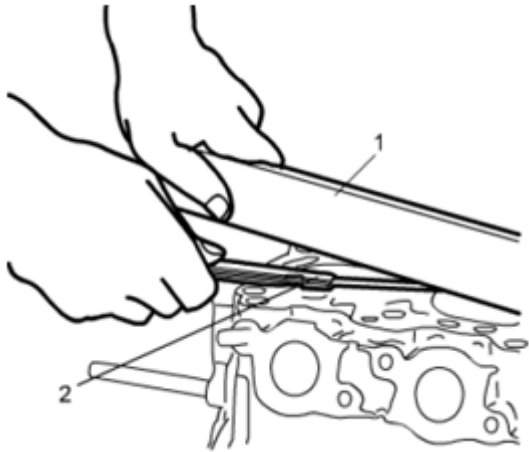
If any measure value exceeds its limit, correct gasket surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasket surface against paper to grind off high spots.

If it is impossible to correct cylinder head distortion, replace cylinder head.

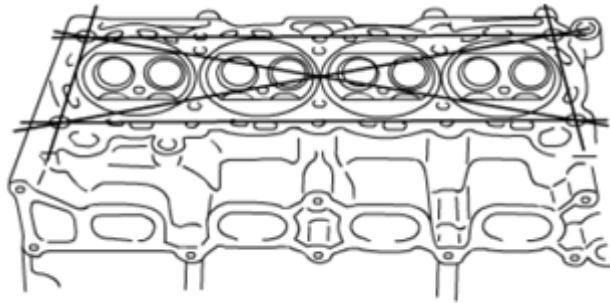
**NOTE:** Distorted mating surface of cylinder head and cylinder head gasket causes combustion gas leakage, overheating and reduced power output.

### Distortion of mating surface of cylinder head and cylinder head gasket

**Limit: 0.03 mm (0.0011 in.)**



**Fig. 142: Checking Cylinder Head Flatness Surface**  
 Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 143: Identifying Cylinder Head Surface**  
 Courtesy of SUZUKI OF AMERICA CORP.

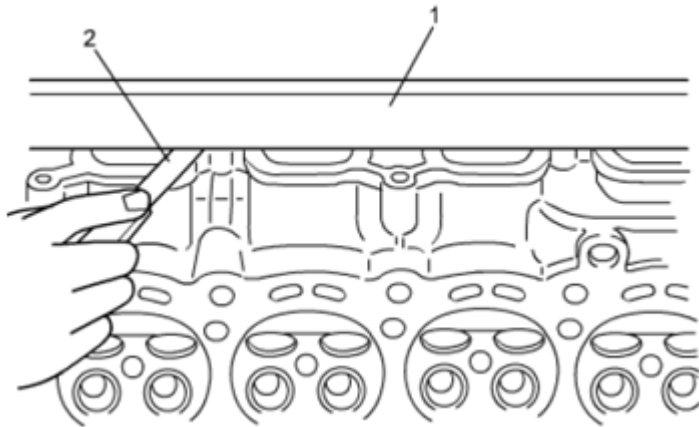
#### Manifold Seating Surface Flatness

Using straightedge (1) and thickness gauge (2), check flatness of manifold seating surface.

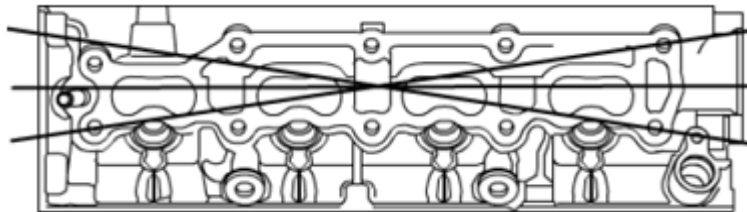
If measured value exceeds its limit, correct seating surface or replace cylinder head.

#### Distortion of seating face of intake manifold and exhaust manifold on cylinder head

**Limit: 0.05 mm (0.0019 in.)**



**Fig. 144: Checking Flatness Of Manifold Seating Surface**  
Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 145: Identifying Cylinder Head Surface**  
Courtesy of SUZUKI OF AMERICA CORP.

#### CYLINDER HEAD NO. 1 BOLT INSPECTION

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

**NOTE:** If they are reused, check thread diameter of cylinder head bolt (1) for deformation as follows and replace it with new one if thread diameter difference exceeds its limit.

Measure each thread diameter of cylinder head bolt "A" at "a" and "B" at "b" using micrometer (3).

Then calculate difference in diameters (A - B).

If it exceeds limit, replace cylinder head bolt with new bolt.

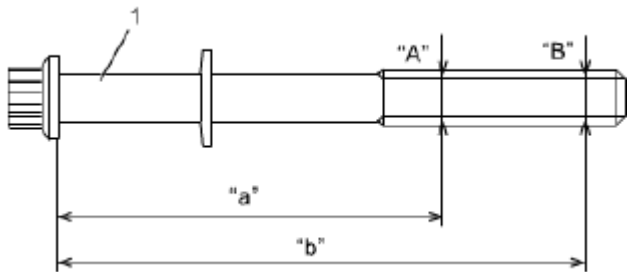
#### Cylinder head bolt diameter measurement points

"a": 95.0 mm (3.74 in.)

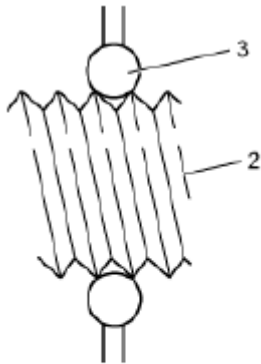
"b": 130.0 mm (5.12 in.)

#### Cylinder head bolt diameter difference (deformation)

Limit (A - B): 0.25 mm (0.0098 in.)



**Fig. 146: Identifying Cylinder Head Bolt Dimension**  
Courtesy of SUZUKI OF AMERICA CORP.



2. Thread

**Fig. 147: Identifying Cylinder Head Bolt Thread**  
Courtesy of SUZUKI OF AMERICA CORP.

## VALVE SPRING INSPECTION

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

### Valve Spring Free Length and Preload

- Check each valve springs for breakage or weakening.
- Measure valve spring free length and preload.

If measured value is less than limit, replace valve spring.

**NOTE:** 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 "a"**

**Standard: 51.34 mm (2.021 in.)**

**Limit: 50.34 mm (1.981 in.)**

**Valve spring preload when compressed to 41 mm (1.61 in.)**

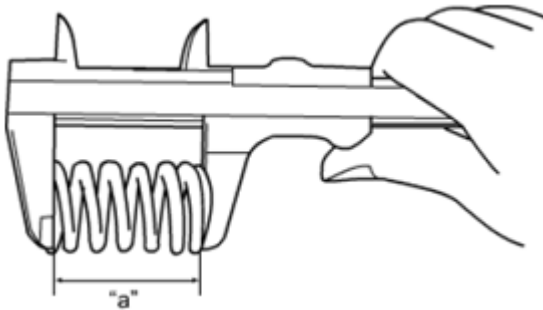
**Standard: 170 - 196 N (17.4 kgf - 19.9 kgf, 38.3 lbf - 44.0 lbf)**

**Limit: 165 N (16.9 kgf, 37.1 lbf)**

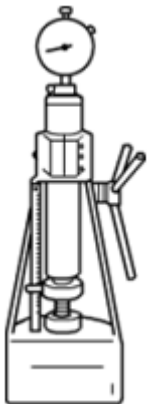
**Valve spring preload when compressed to 31.2 mm (1.23 in.)**

**Standard: 379 - 437 N (38.7 - 44.5 kgf, 85.2 - 98.2 lbf)**

**Limit: 375 N (38.3 kgf, 84.3 lbf)**



**Fig. 148: Measuring Valve Spring Free Length**  
Courtesy of SUZUKI OF AMERICA CORP.



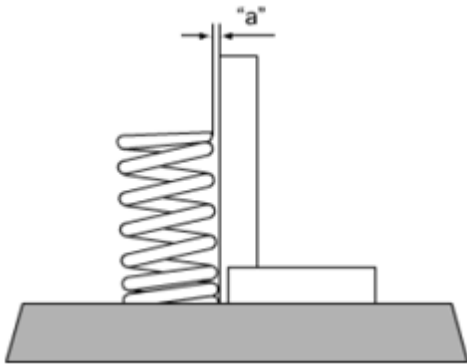
**Fig. 149: Compressing Valve Spring**  
Courtesy of SUZUKI OF AMERICA CORP.

**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.

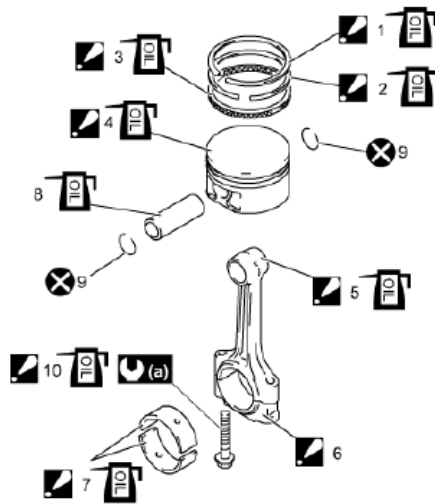
**Valve spring squareness**













**Limit: 2.2 mm (0.086 in.)**



**Fig. 150: Checking Spring Squareness**  
Courtesy of SUZUKI OF AMERICA CORP.

**PISTON, PISTON RING AND CONNECTING ROD COMPONENTS**



 <p>1. 1st ring : For assembling, refer to <a href="#">Piston, Piston Ring and Connecting Rod Disassembly and Reassembly:J24B</a>. : Apply engine oil to sliding surface.</p>	 <p>5. Connecting rod : Do not apply engine oil to mating surface between connecting rod bearing and connecting rod. : Apply engine oil to sliding surface.</p>	<p>9. Piston pin circlip</p>
 <p>2. 2nd ring : For assembling, refer to <a href="#">Piston, Piston Ring and Connecting Rod Disassembly and Reassembly:J24B</a>. : Apply engine oil to sliding surface.</p>	 <p>6. Connecting rod bearing cap : To install connecting rod cap, direct arrow on it to crank pulley. : Do not apply engine oil to mating surface between connecting rod bearing and connecting rod cap.</p>	 <p>10. Connecting rod bearing cap bolt : Check connecting rod bearing cap bolt for deformation to reuse.  : Apply engine oil to bolt thread and seat. : For tightening order, refer to <a href="#">Piston, Piston Ring and Connecting Rod Removal and Installation:J24B</a>.</p>
 <p>3. Oil ring : For assembling, refer to <a href="#">Piston, Piston Ring and Connecting Rod Disassembly and Reassembly:J24B</a>. : Apply engine oil to sliding surface.</p>	 <p>7. Connecting rod bearing : For applying engine oil, refer to <a href="#">Piston, Piston Ring and Connecting Rod Removal and Installation:J24B</a>.</p>	 <p>(a). 15 N·m → +45° → +45° (1.5 kgf·m → +45° → +45°, 11.0 lbf·ft → +45° → +45°)</p>
 <p>4. Piston : For assembling, refer to <a href="#">Piston, Piston Ring and Connecting Rod Removal and Installation:J24B</a>. : Apply engine oil to sliding surface.</p>	 <p>8. Piston pin : Apply engine oil to sliding surface.</p>	 <p>: Do not reuse.</p>

**Fig. 151: Identifying Piston, Piston Ring And Connecting Rod Components With Torque Specifications**  
Courtesy of SUZUKI OF AMERICA CORP.

**Tightening Order/Removal and Installation figure callout references:**

**PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION****PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION**

**CAUTION:** Keep the following parts in order. They must go back in the position from which they were removed.

- **Connecting rod**
- **Connecting rod bearing**
- **Connecting rod bearing cap**
- **Piston**

**Removal**

**Reference:** PISTON, PISTON RING AND CONNECTING ROD COMPONENTS

1. Remove engine assembly from vehicle. See ENGINE ASSEMBLY REMOVAL AND INSTALLATION.
2. Remove cylinder head. See VALVE AND CYLINDER HEAD REMOVAL AND INSTALLATION.
3. Remove oil pump. See OIL PUMP ASSEMBLY REMOVAL AND INSTALLATION.
4. Mark cylinder number on all pistons, connecting rods and connecting rod bearing caps using silver pencil or quick drying paint.
5. Remove connecting rod bearing caps.
6. Remove carbon deposits from tops of cylinder bores before removing pistons from cylinder.
7. Push piston and connecting rod assembly out through the top of cylinder bore.
8. Remove connecting rod bearings from connecting rod and connecting rod bearing cap, if necessary.

**Installation**

**Reference:** PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY

**Reference:** CRANKSHAFT PIN AND CONNECTING ROD BEARINGS INSPECTION

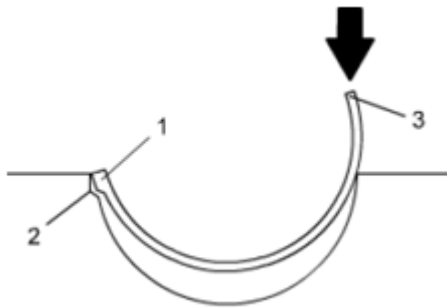
- CAUTION:**
- **Apply engine oil to the following parts.**
    - **Crankshaft pin**
    - **Connecting rod bearing**
    - **Piston**
    - **Piston ring**
    - **Cylinder wall**
  - **Install the following parts in the position from which they were removed.**
    - **Connecting rod**

- Connecting rod bearing
- Connecting rod bearing cap
- Piston

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

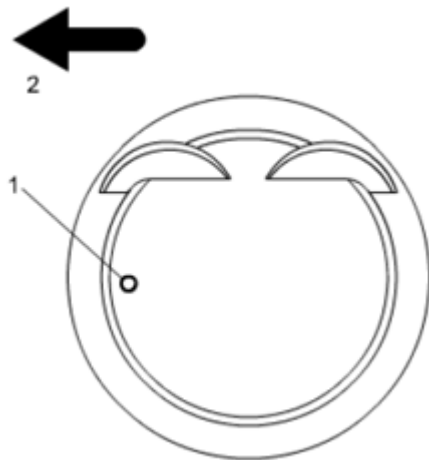
**NOTE:** Do not apply engine oil between connecting rod and bearing, between connecting rod bearing cap and bearing.

2. Install connecting rod bearing to connecting rod bearing cap and connecting rod as follows.
- a. Fit tab (1) of connecting rod bearing to groove (2) of connecting rod or bearing cap.
  - b. Press bearing end (3) until it fully seats in connecting rod and bearing cap.



**Fig. 152: Pressing Bearing End**  
Courtesy of SUZUKI OF AMERICA CORP.

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



**Fig. 153: Identifying Point Front Mark On Piston Head To Crankshaft Pulley Side**  
Courtesy of SUZUKI OF AMERICA CORP.

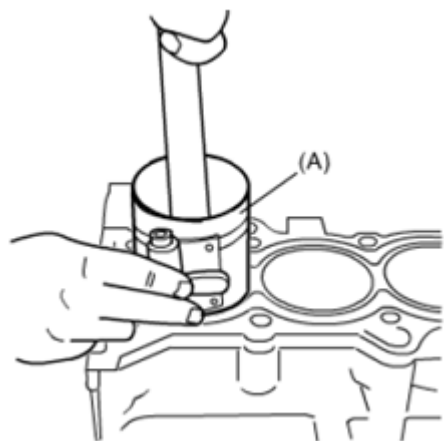
4. Install piston and connecting rod assembly into cylinder bore. Use special tool to compress rings.

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 in cylinder bore.

### Special Tool

(A): 09916-77310



**Fig. 154: Installing Piston And Connecting Rod Assembly Into Cylinder Bore**  
Courtesy of SUZUKI OF AMERICA CORP.

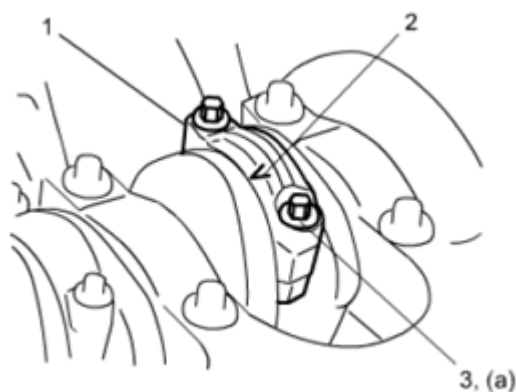
5. Install connecting rod bearing cap (1) as follows.

### NOTE:

- Before installing connecting rod bearing cap, check connecting rod bearing cap bolts for deformation. Refer to "CONNECTING ROD BOLT DEFORMATION" under PISTON PINS AND CONNECTING RODS INSPECTION.
- Tighten connecting rod bearing cap bolt (3) gradually.
  - a. Point arrow mark (2) on connecting rod bearing cap (1) to crankshaft pulley side.
  - b. Apply engine oil to bolt thread and seat of connecting rod bearing cap bolt.
  - c. Tighten all connecting rod bearing cap bolt to 15 N.m (1.5 kgf-m, 11.0 lbf-ft) evenly and gradually.
  - d. In the same manner as Step c), retighten them to 45°.
  - e. In the same manner as Step c), retighten them to 45°.

### Tightening torque

Connecting rod bolt\* (a): 15 N.m --> +45° --> +45° (1.5 kgf-m --> +45° --> +45°, 11.0 lbf-ft --> +45° --> +45°)



**Fig. 155: Identifying Connecting Rod Bearing Cap And Crankshaft Pulley Side**  
 Courtesy of SUZUKI OF AMERICA CORP.

6. Install oil pump. See OIL PUMP ASSEMBLY REMOVAL AND INSTALLATION .
7. Install cylinder head. See VALVE AND CYLINDER HEAD REMOVAL AND INSTALLATION.
8. Install engine assembly. See ENGINE ASSEMBLY REMOVAL AND INSTALLATION.

#### PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY

**Reference:** PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION

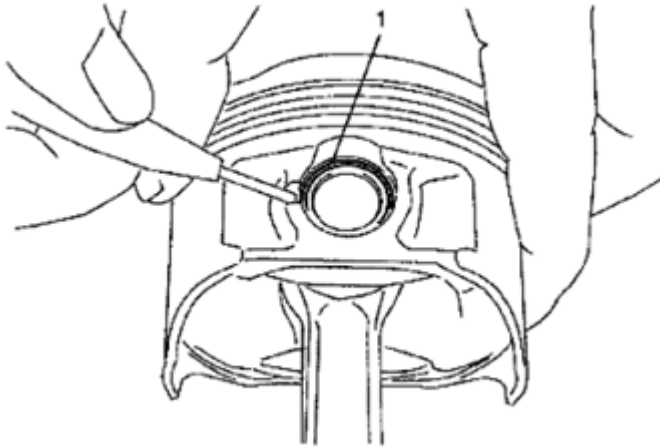
**CAUTION:** Keep the following parts as a group for each cylinder. They must be reassembled in the position from which they were removed.

- Piston
- Piston pin
- Piston ring
- Connecting rod
- Connecting rod bearing
- Connecting rod bearing cap

**NOTE:** For identification of each cylinder, refer to PRECAUTIONS FOR IDENTIFICATION OF CYLINDER .

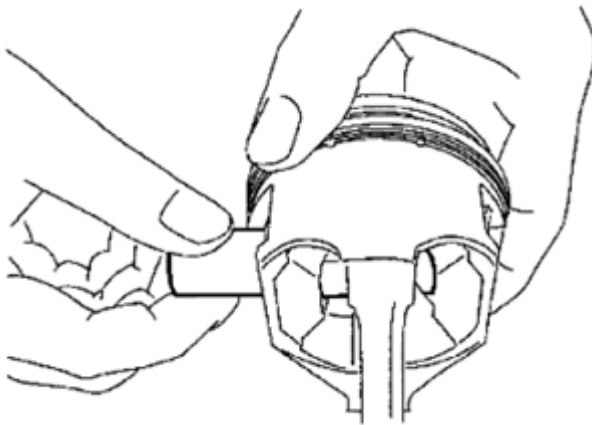
#### Disassembly

1. Using piston ring expander, remove 1st and 2nd rings and oil ring from piston.
2. Remove piston pin from connecting rod as follows.
  - a. Remove piston pin circlips (1), as shown.



**Fig. 156: Removing Piston Pin Circlips**  
Courtesy of SUZUKI OF AMERICA CORP.

- b. Take out piston pin.



**Fig. 157: Taking Piston Pin**  
Courtesy of SUZUKI OF AMERICA CORP.

**Reassembly**

**Reference:** CYLINDER, PISTON AND PISTON RING INSPECTION

**Reference:** PISTON PINS AND CONNECTING RODS INSPECTION

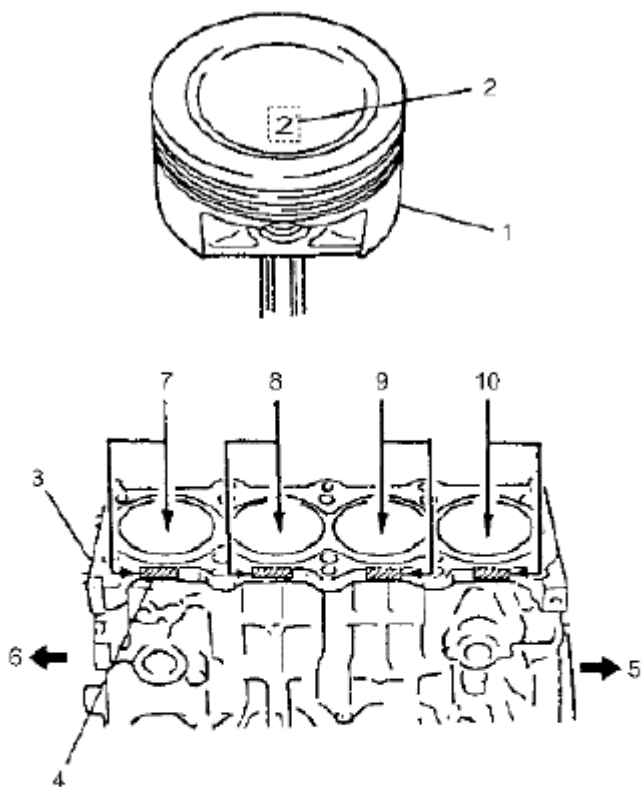
**Reference:** CRANKSHAFT PIN AND CONNECTING ROD BEARINGS INSPECTION

- CAUTION:**
- **Apply engine oil to the following parts.**
    - **Piston pin hole**
    - **Piston pin**
    - **Connecting rod small-end bore**

- **Reassemble the following parts in the position from which they were removed.**
  - **Piston**
  - **Piston pin**
  - **Piston ring**
  - **Connecting rod**
  - **Connecting rod bearing**
  - **Connecting rod bearing cap**

**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.

1. To replace piston, select proper piston according the following procedure
  - a. Check stamped number (2) on piston (1) as shown in figure.
  - b. Check stamped number or painted color (4) on cylinder block (3) as shown in figure.



5. Transmission side	8. Cylinder No.2
6. Crank shaft pulley side	9. Cylinder No.3
7. Cylinder No.1	10. Cylinder No.4

**Fig. 158: Identifying Stamped Number On Piston**  
 Courtesy of SUZUKI OF AMERICA CORP.

- c. Stamped number on piston and stamped number or painted color on cylinder block correspond with each other.

Select proper piston referring the following table.

**Piston selection table**

**PISTON STAMPED NUMBER REFERENCE**

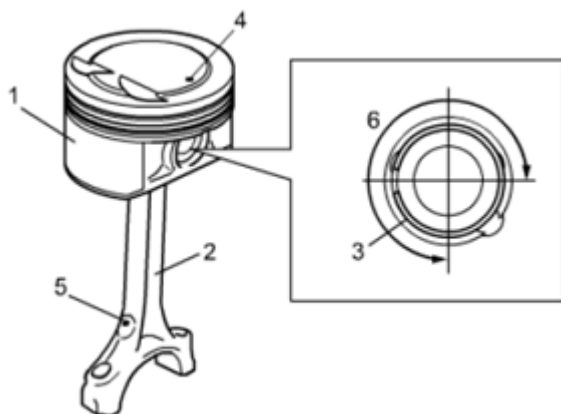
	Stamped number or painted color on cylinder block	
	1 or Red	2 or Blue
Stamped number on piston	1	2

2. Remove carbon deposit from piston head and ring grooves using a suitable tool.
3. Assemble piston pin, piston (1) and connecting rod (2) as follows.
  - a. Apply engine oil to piston pin, piston pin hole in piston and connecting rod.
  - b. Fit connecting rod to piston.

**NOTE:** Be sure to position front mark (4) on piston and oil hole (5) of connecting rod (2) at specified position as shown in figure.

- c. Insert piston pin to piston and connecting rod.
- d. Install new piston pin circlips (3).

**NOTE:** Install so that circlip end gap comes within the range indicated by arrow (6).

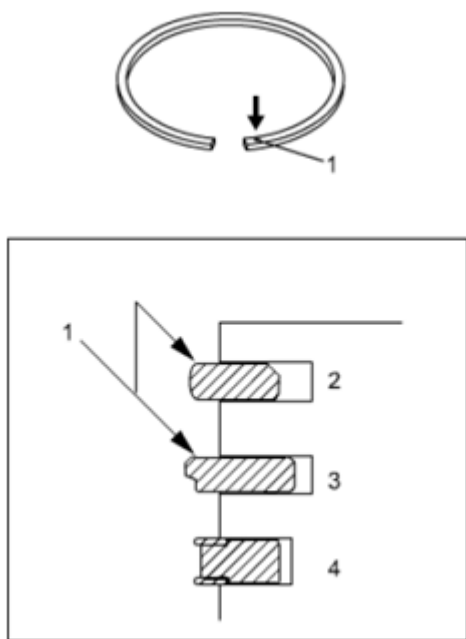


**Fig. 159: Installing Piston Pin Circlips**  
Courtesy of SUZUKI OF AMERICA CORP.

4. Install piston rings to piston noting the following.
  - As indicated in figure, 1st and 2nd rings have direct discrimination mark (1) respectively. When installing these piston rings to piston, direct discrimination mark side of each ring toward top of piston.
  - 1st ring (2) differs from 2nd ring (3) in thickness, shape and color of surface contacting cylinder wall.

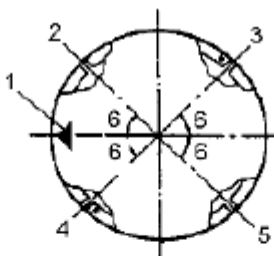
Distinguish 1st ring from 2nd ring referring to the figure.

- When installing oil ring (4), install spacer first and then install two rails.



**Fig. 160: Identifying Ring Thickness**  
 Courtesy of SUZUKI OF AMERICA CORP.

5. After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.



1. Front mark	4. 2nd ring end gap and oil ring spacer gap
2. Oil ring upper rail gap	5. Oil ring lower rail gap
3. 1st ring end gap	6. 45°

**Fig. 161: Identifying Oil Rings Gaps**  
 Courtesy of SUZUKI OF AMERICA CORP.

**CYLINDER, PISTON AND PISTON RING INSPECTION**

**Reference: PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY****Cylinder****Visual inspection**

Check cylinder walls for scratches, roughness or ridges which indicate excessive wear.

If cylinder wall is too rough, deeply scratched, ridged, replace cylinder block, piston rings and/or pistons.

**Cylinder bore diameter, taper and out-of-round**

Using cylinder gauge, measure cylinder bore in thrust and axial directions.

If any of the following conditions is noted, replace cylinder block.

- Cylinder bore exceeds limit.
- Difference of measurements at two positions ([1] and [2]) exceeds taper limit.
- Difference between thrust [4] and axial [3] measurements exceeds roundness limit.

**CAUTION: If abnormality is found on cylinder inside wall, replace cylinder block.**

**NOTE:** There are two sizes for cylinder bore, to keep clearance between piston and cylinder properly.  
To distinguish standard value, refer to PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY.

**Cylinder bore diameter****Standard****CYLINDER BLOCK DIAMETER REFERENCE**

Stamped number or painted color on cylinder block	1 or Red	92.0101 - 92.0200 mm (3.62245 - 3.62283 in.)
	2 or Blue	92.0000 - 92.0100 mm (3.62205 - 3.62244 in.)

**Cylinder bore diameter**

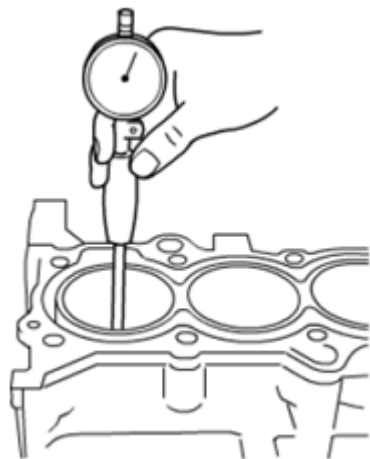
**Limit: 92.050 mm (3.6240 in.)**

**Cylinder bore roundness ([3] - [4])**

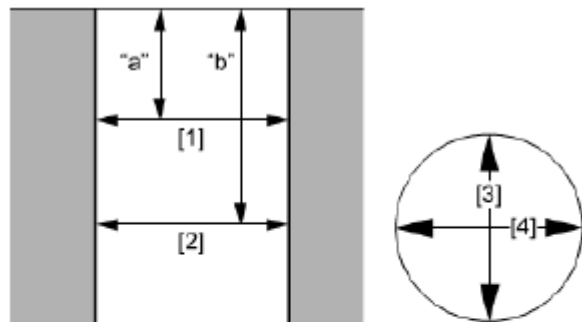
**Limit: 0.020 mm (0.00078 in.)**

**Cylinder bore taper ([1] - [2])**

**Limit: 0.013 mm (0.00051 in.)**



**Fig. 162: Measuring Cylinder Bore Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.



"a":	50 mm (1.97 in.)
"b":	100 mm (3.94 in.)

**Fig. 163: Identifying Cylinder Dimension**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Piston**

**NOTE:** Two sizes of piston are available as standard size spare part so as to ensure proper piston-to-cylinder clearance.

**Visual inspection**

Inspect piston for cracks or other damages.

If abnormality is found, replace piston.

**Piston diameter**

As indicated in figure, piston diameter should be measured at specified position "a" 11.4 mm (0.449 in) from piston skirt end in the direction perpendicular to piston pin.

If measured diameter is less than its limit, replace piston.

**New piston diameter standard size**

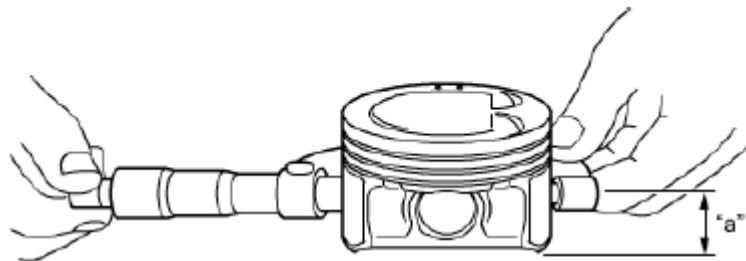
**PISTON STAMPED NUMBER REFERENCE**

Stamped number on piston	1	91.990 - 92.020 mm (3.6217 - 3.6228 in.)
	2	91.980 - 92.010 mm (3.6213 - 3.6224 in.)

**Piston diameter limit size**

**PISTON STAMPED NUMBER REFERENCE**

Stamped number on piston	1	91.940 mm (3.6197 in.)
	2	91.930 mm (3.6193 in.)



"a": 11.4 mm (0.449 in.)

**Fig. 164: Identifying Piston Diameter Limit Size**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Piston clearance**

Measure cylinder bore diameter and piston diameter to find their difference called is piston clearance.

Piston clearance should be within its standard value.

If it is out of its limit, replace piston.

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

### Piston clearance

**Limit: 0.12 mm (0.0047 in.)**

### Ring groove clearance

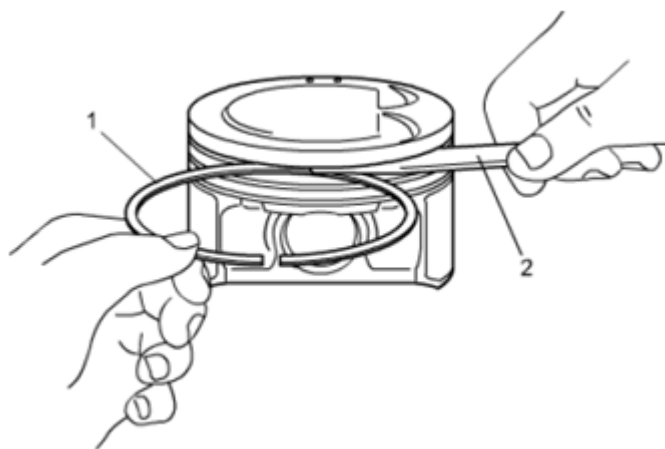
1. Before checking, piston grooves must be clean, dry and free from carbon deposits.
2. Fit new piston ring (1) into piston groove.
3. Measure clearance between ring and ring land using thickness gauge (2).

If clearance is out of limit, replace piston.

### Ring groove clearance

#### OIL RING SPECIFICATION

	Standard	Limit
1st ring	0.24 - 0.28 mm (0.0095 - 0.0110 in.)	0.13 mm (0.0052 in.)
2nd ring	0.03 - 0.07 mm (0.0012 - 0.0027 in.)	0.11 mm (0.0433 in.)
Oil ring	0.04 - 0.18 mm (0.0016 - 0.0070 in.)	-



**Fig. 165: Identifying Ring Groove Clearance**  
Courtesy of SUZUKI OF AMERICA CORP.

### Piston Ring

#### Piston ring end gap

To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap using thickness gauge (2).

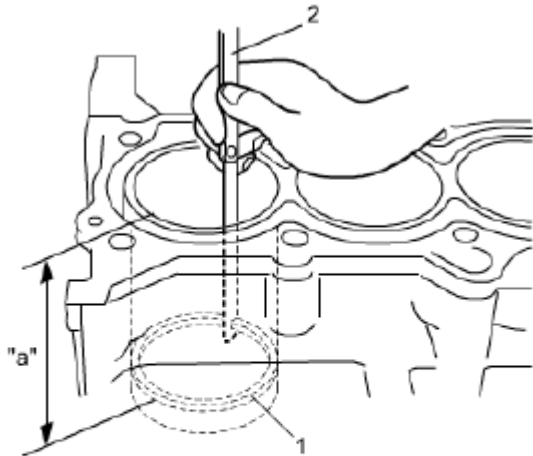
If measured gap exceeds limit, replace piston ring.

**NOTE:** Remove carbon deposit from and clean top of cylinder bore before inserting piston ring.

**Piston ring end gap**

**ITEM STANDARD CHART**

Item	Standard	Limit
1st ring	0.20 - 0.33 mm (0.0079 - 0.0129 in.)	0.7 mm (0.0275 in.)
2nd ring	0.32 - 0.48 mm (0.0126 - 0.0188 in.)	0.7 mm (0.0275 in.)
Oil ring	0.20 - 0.50 mm (0.0079 - 0.0196 in.)	1.8 mm (0.0708 in.)



"a". 120 mm (4.724 in.)

**Fig. 166: Measuring End Gap Using Thickness Gauge**  
 Courtesy of SUZUKI OF AMERICA CORP.

**PISTON PINS AND CONNECTING RODS INSPECTION**

**Reference:** PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY

**Piston Pin**

**Visual inspection**

Check piston pin, connecting rod small-end bore and piston pin hole in piston for wear or damage, paying particular attention to condition of small-end bore bush.

If piston pin, connecting rod small-end bore or piston pin hole in piston is badly worn or damaged, replace

piston pin, connecting rod and/or piston.

**Piston pin clearance**

Check piston pin clearance in connecting rod small-end and piston. Replace connecting rod and/or piston if its small-end is badly worn or damaged or if measured clearance exceeds limit.

**Piston pin clearance in connecting rod small-end**

**Standard: 0.003 - 0.017 mm (0.0002 - 0.0006 in.)**

**Limit: 0.040 mm (0.0015 in.)**

**Piston pin clearance in piston**

**Standard: 0.010 - 0.016 mm (0.00040 - 0.00062 in.)**

**Limit: 0.05 mm (0.0019 in.)**

**Small-end bore**

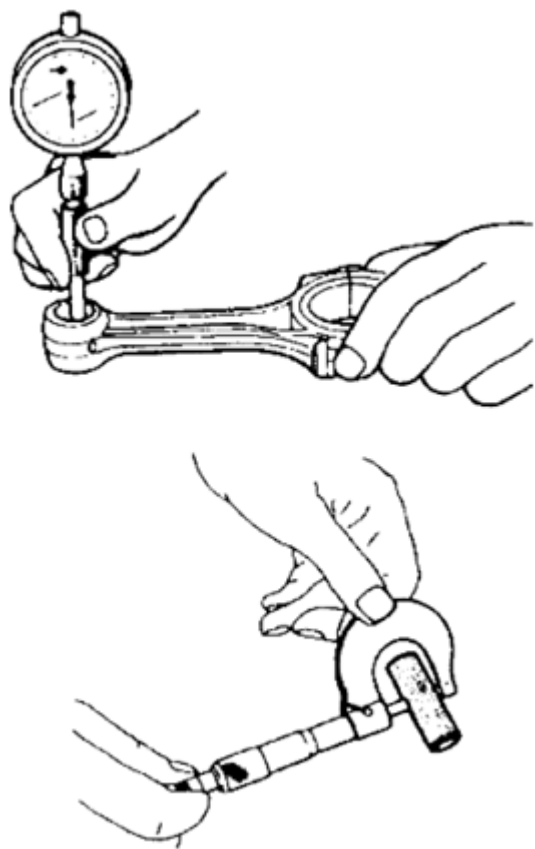
**21.003 - 21.011 mm (0.82689 - 0.83720 in.)**

**Piston pin outside diameter**

**20.994 - 21.000 mm (0.82654 - 0.82677 in.)**

**Diameter of piston pin hole in piston**

**21.007 - 21.013 mm (0.82705 - 0.82728 in.)**



**Fig. 167: Measuring Piston Pin Clearance**  
Courtesy of SUZUKI OF AMERICA CORP.

### Connecting Rod

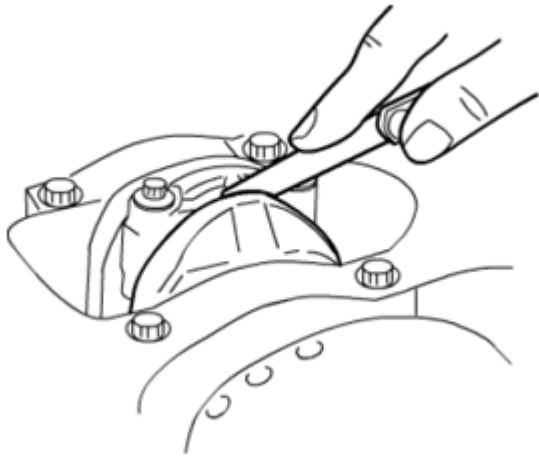
#### Big-end side clearance

Check big-end side clearance of connecting rod, with rod fitted and connected to its crankshaft pin in the normal manner.

If measured clearance is out of its standard value, replace connecting rod.

#### Big-end side clearance

**Standard: 0.25 - 0.40 mm (0.0099 - 0.0157 in.)**



**Fig. 168: Checking Big-end Side Clearance**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Connecting rod alignment

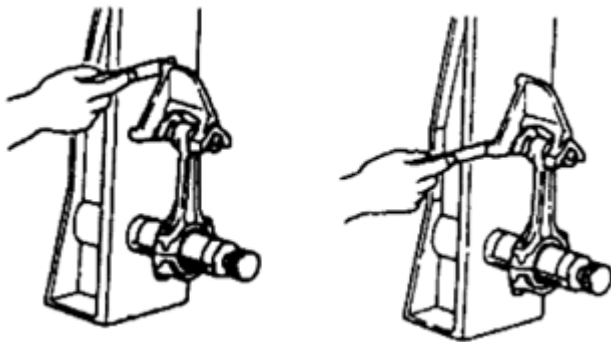
Mount connecting rod on aligner to check for bow and twist.

If measured value exceeds the limit, replace it.

#### Connecting rod alignment

**Limit on bow: 0.05 mm (0.0019 in.)**

**Limit on twist: 0.10 mm (0.0039 in.)**



**Fig. 169: Checking Connecting Rod Alignment**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Connecting rod bolt deformation

Measure each thread, diameter of connecting rod bolt (1) "A" at "a" and "B" at "b" using a micrometer (3).

Calculate difference in diameters ("A" - "B").

If it exceeds limit, replace connecting rod (1).

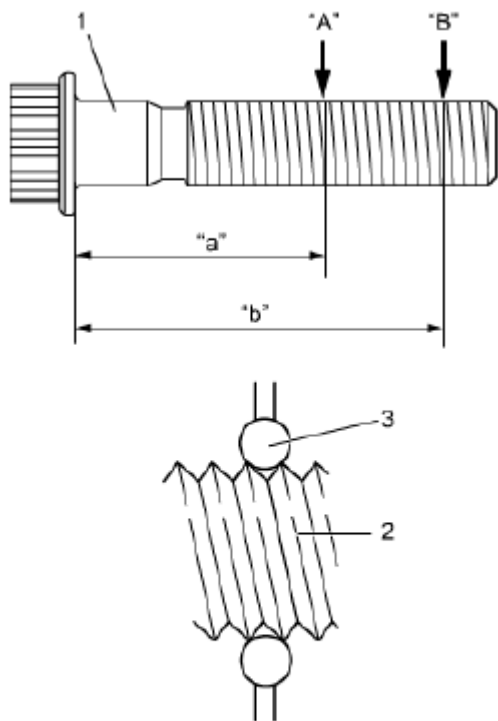
### Connecting rod bolt measurement points

"a": 28.5 mm (1.12 in.)

"b": 42.0 mm (1.65 in.)

### Connecting rod bolt diameter difference

Limit ("A" - "B"): 0.05 mm (0.0019 in.)



2. Thread

**Fig. 170: Identifying Connecting Rod Bolt Dimension**

Courtesy of SUZUKI OF AMERICA CORP.

## CRANKSHAFT PIN AND CONNECTING ROD BEARINGS INSPECTION

**Reference:** PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY

**NOTE:** For identification of each cylinder, refer to PRECAUTIONS FOR IDENTIFICATION OF CYLINDER.

### Crankshaft Pin Diameter

- Using micrometer, measure crankshaft pin diameter at several points and calculate taper and out-of-round conditions.

If calculated taper and/or out-of-round is out of their service limit, replace crankshaft or regrind crankshaft pin to undersize and use undersize bearing.

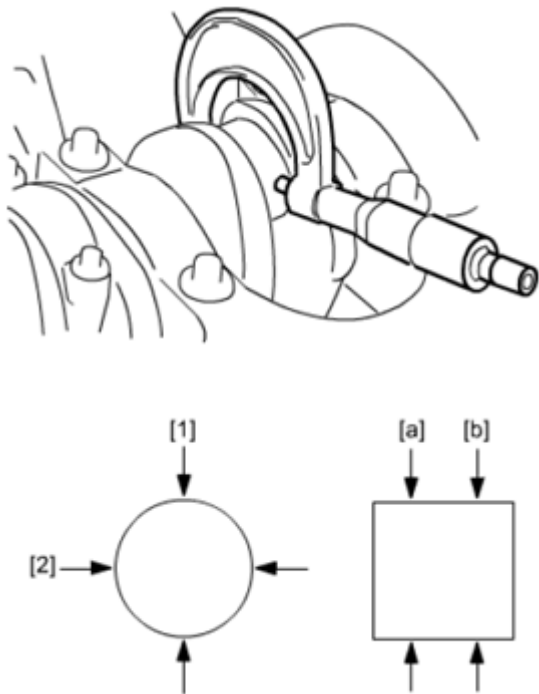
**CAUTION: If crankshaft pin is reground, new undersize bearings must be installed and bearing clearance must be checked.**

### Crankshaft pin diameter

Standard: 49.982 - 50.000 mm (1.96780 - 1.96850 in)

Crankshaft pin taper ([a] -[b]) and out-of-round ([1] -[2])

Limit: 0.01 mm (0.0003 in.)



**Fig. 171: Checking Crankshaft Pin Diameter**  
Courtesy of SUZUKI OF AMERICA CORP.

### Connecting Rod Bearing General Information

- Service connecting rod bearings are available in five standard sizes and 0.25 mm (0.0098 in) undersize bearing. The difference of those sizes is thickness.

- Specified colors for identification of sizes are painted at specified location (1) as shown in figure.

### BEARING THICKNESS CHART

	Painted color	Bearing thickness
Standard size	Blue	1.494 - 1.497 mm (0.05882 - 0.05893 in.)
	Yellow	1.491 - 1.494 mm (0.05871 - 0.05881 in.)
	Colorless	1.488 - 1.491 mm (0.05859 - 0.05870 in.)
	Black	1.485 - 1.488 mm (0.05847 - 0.05858 in.)
	Green	1.482 - 1.485 mm (0.05835 - 0.05846 in.)
0.25 mm (0.0098 in) undersize	Red	1.605 - 1.615 mm (0.06319 - 0.06358 in.)



**Fig. 172: Identifying Connecting Rod Bearing**  
Courtesy of SUZUKI OF AMERICA CORP.

#### Connecting Rod Bearing Visual Inspection

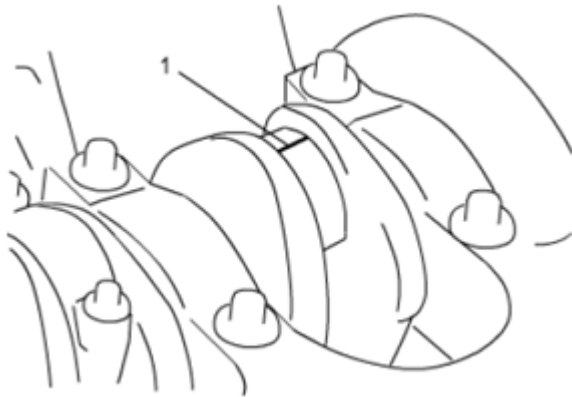
Check bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. If abnormality is found, replace connecting rod bearings.

#### Connecting Rod Bearing Clearance

**CAUTION: Do not rotate crankshaft while gauging plastic is installed.**

**NOTE: After checking connecting rod bearing clearance, check connecting rod bolt for deformation referring to "CONNECTING ROD BOLT DEFORMATION" under PISTON PINS AND CONNECTING RODS INSPECTION.**

- Clean connecting rod bearings and crankshaft pin.
- Place a piece of gauging plastic (1) to full width of crankshaft pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



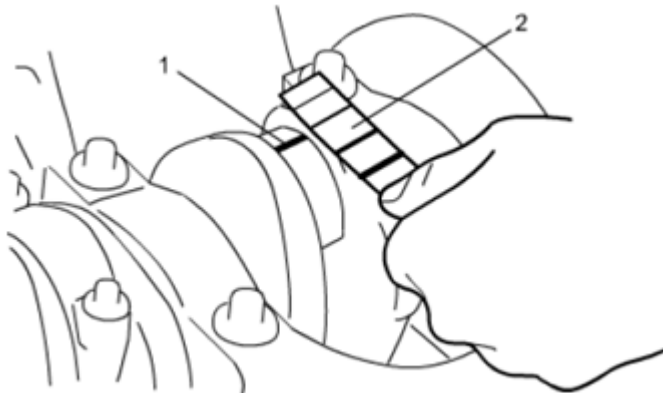
**Fig. 173: Identifying Piece Of Gauging Plastic**  
Courtesy of SUZUKI OF AMERICA CORP.

3. Install connecting rod bearings and its cap. See **PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION**.
4. After three minutes elapsed, remove cap and using a scale (2) on gauging plastic envelope, measure gauging plastic (1) width at the widest point.

#### Connecting rod bearing clearance

**Standard: 0.045 - 0.063 mm (0.0018 - 0.0024 in.)**

**Limit: 0.065 mm (0.0025 in.)**



**Fig. 174: Measuring Gauging Plastic Width At Widest Point**  
Courtesy of SUZUKI OF AMERICA CORP.

If measured oil clearance is less than standard value or more than service limit, replace connecting rod bearings with new ones referring to **SELECTION OF CONNECTING ROD BEARINGS**, and recheck oil clearance. Depending on measured oil clearance with new bearing, select other bearings according to the following procedures, and recheck oil clearance.

- More than standard:

Replace bearings with one size thicker or regrind crank shaft pin to under size and use 0.25 mm (0.0098 in) undersize bearings.

- Less than standard:

Replace bearings with one size thinner or regrind crank shaft pin to under size and use 0.25 mm (0.0098 in) undersize bearings.

**Selection of Connecting Rod Bearings**

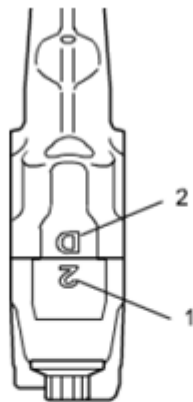
**Standard size**

1. Check connecting rod big-end inside diameter according to the following procedures.
  - There is stamped number (any of "1", "2" or "3") on each connecting rod and it cap as shown in figure.
  - That number represent connecting rod big-end inside diameter as follows.

**Connecting rod big-end inside diameter**

**CONNECTING ROD BIG-END INSIDE DIAMETER CHART**

Stamped number	Connecting rod big-end inside diameter
1	53.0000 - 53.0060 mm (2.08662 - 2.08685 in.)
2	53.0061 - 53.0120 mm (2.08686 - 2.08708 in.)
3	53.0121 - 53.0180 mm (2.08710 - 2.08732 in.)



1. Connecting rod big-end inside diameter number
2. Weight indication mark

**Fig. 175: Identifying Connecting Rod Bearings**  
 Courtesy of SUZUKI OF AMERICA CORP.

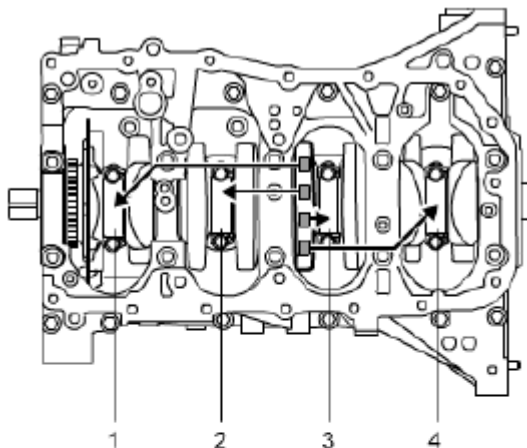
2. Check crankshaft pin diameter according to the following procedures.

- There are four stamped alphabets (any of "A", "B" or "C") on crank web No. 5 as shown in figure.
- Those alphabets represent crankshaft pin diameter as follows.

**Crankshaft pin diameter**

**CRANKSHAFT PIN DIAMETER CHART**

Stamped alphabet	Crankshaft pin diameter
A	49.9940 - 50.0000 mm (1.96827 - 1.96850 in.)
B	49.9880 - 49.9939 mm (1.96804 - 1.96826 in.)
C	49.9820 - 49.9879 mm (1.96780 - 1.96802 in.)



1. Crankshaft pin No.1
2. Crankshaft pin No.2
3. Crankshaft pin No.3
4. Crankshaft pin No.4

**Fig. 176: Identifying Crankshaft Pin No. 1**  
 Courtesy of SUZUKI OF AMERICA CORP.

3. From numbers stamped on connecting rods and its caps and alphabets stamped on crank web No. 5, determine new standard bearings to be installed to connecting rod big-end from the following table.

**Connecting rod bearing cross-reference selection table**

**CONNECTING ROD STAMPED NUMBER REFERENCE**

--	--

		Stamped number for connecting rod big-end inside diameter		
		1 or A	2 or B	3 or C
Stamped alphabet for Crankshaft pin outside diameter	A	Green	Black	Colorless
	B	Black	Colorless	Yellow
	C	Colorless	Yellow	Blue

**Undersize**

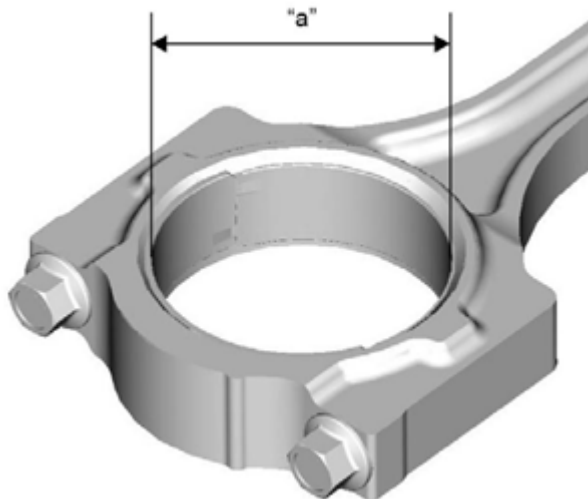
1. Determine target diameter of crankshaft pin for regrinding according to the following procedure.
  - a. Assemble connecting rod, connecting rod cap and undersize bearings (0.25 mm), referring to step 2) to 5) of "Installation" under **PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION**.
  - b. Using bore gauge, measure connecting rod bearing inside diameter "a".
  - c. Calculate target diameter according to formula below.

**Formula for target diameter of crankshaft pin**

$$A = B - 0.054 \text{ mm (0.0021 in.)}$$

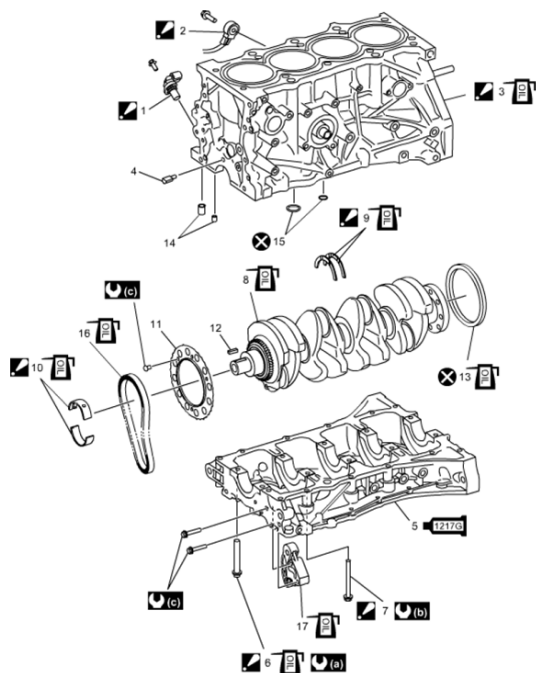
**A: Target diameter of crankshaft pin B: Measured connecting rod bearing inside diameter "a" .**

2. Grind crankshaft pin to target diameter.
3. Check connecting rod bearing oil clearance. See **CONNECTING ROD BEARING CLEARANCE**.



**Fig. 177: Measuring Connecting Rod Bearing Inside Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.

**MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**



1. CKP sensor : For removal and installation, refer to <a href="#">CKP (Crankshaft Position) Sensor Removal and Installation:J24B</a> .	8. Crankshaft : Apply engine oil to sliding surface	15. O-ring
2. Knock sensor : For removal and installation, refer to <a href="#">Knock Sensor Removal and Installation:J24B</a> .	9. Thrust bearing : Install thrust bearing with oil grooves facing out.: Apply engine oil to sliding surface.	16. Oil pump chain : Apply engine oil to sliding surface.
3. Cylinder block : Do not apply engine oil to main bearing seating face. : Apply engine oil to sliding surface	10. Main bearing : For applying engine oil, refer to <a href="#">Main Bearings, Crankshaft and Cylinder Block Removal and Installation:J24B</a> .	17. Oil pump chain adjuster : Apply engine oil to sliding surface.
4. Timing chain oil jet	11. Sensor plate	(a) : 50 N·m → 0 N·m → 20 N·m → 35 N·m → +40° → +40° (5.1 kgf·m → 0 kgf·m → 2.0 kgf·m → 3.6 kgf·m → +40° → +40°, 37.0 lbf·ft → 0 lbf·ft → 15.0 lbf·ft → 26.0 lbf·ft → +40° → +40°)
1217G 5. Lower crank case : Apply sealant 99000-31260 referring to <a href="#">Main Bearings, Crankshaft and Cylinder Block Removal and Installation:J24B</a> .	12. Crankshaft timing sprocket key	(b) : 25 N·m (2.5 kgf·m, 18.5 lbf·ft)
6. Crank case bolt No.1 : Check crank case bolt No.1 for deformation to reuse.  : Apply engine oil to bolt thread and seat.: For tightening order, refer to <a href="#">Main Bearings, Crankshaft and Cylinder Block Removal and Installation:J24B</a> .	13. Rear oil seal : Apply engine oil to oil seal lip.	(c) : 11 N·m (1.1 kgf·m, 8.5 lbf·ft)
7. Crank case bolt No.2 : For tightening order, refer to <a href="#">Main Bearings, Crankshaft and Cylinder Block Removal and Installation:J24B</a> .	14. Dowel pin	: Do not reuse.

**Fig. 178: Identifying Main Bearing, Crankshaft And Cylinder Block Components With Torque Specifications**

Courtesy of SUZUKI OF AMERICA CORP.

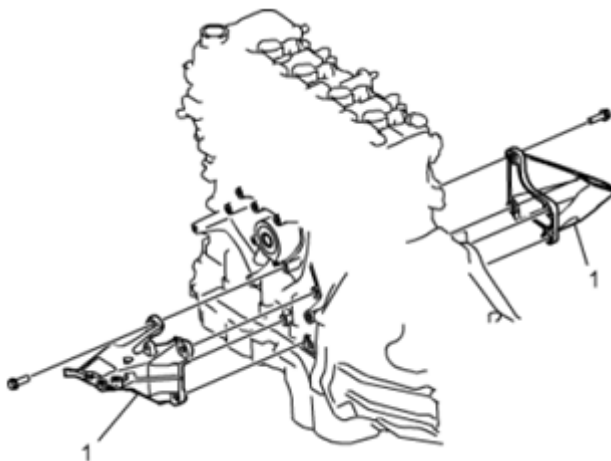
**Tightening Order/Removal and Installation figure callout references:**

1) CKP (CRANKSHAFT POSITION) SENSOR REMOVAL AND INSTALLATION2) KNOCK SENSOR REMOVAL AND INSTALLATION5), 6), 7), 10) MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION**MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION***Reference:* MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**CAUTION:** Keep the following parts in order. They must go back in the position from which they were removed.

- Main bearing
- Thrust bearing

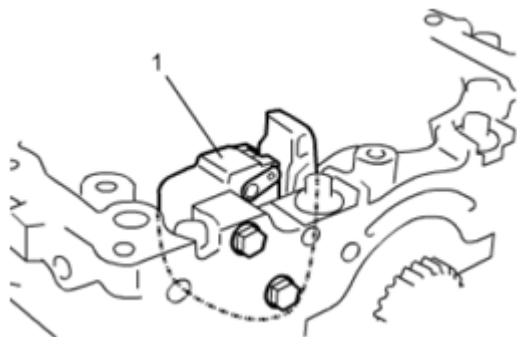
**NOTE:** For identification of each cylinder, refer to PRECAUTIONS FOR IDENTIFICATION OF CYLINDER .**Removal**

1. Remove engine assembly. See ENGINE ASSEMBLY REMOVAL AND INSTALLATION.
2. Remove flywheel for 5 M/T model or drive plate for 4 A/T model. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.
3. Remove generator. See GENERATOR REMOVAL AND INSTALLATION .
4. Remove water pump. See WATER PUMP REMOVAL AND INSTALLATION .
5. Remove P/S pump. See P/S PUMP REMOVAL AND INSTALLATION .
6. Remove engine front mounting brackets (1).

**Fig. 179: Identifying Engine Front Mounting Brackets**

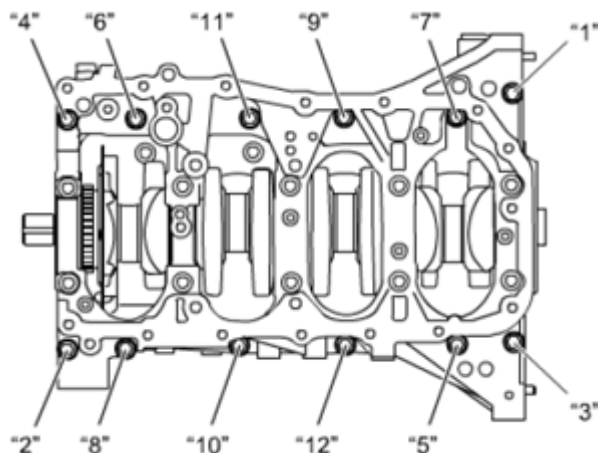
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove piston and connecting rod. See **PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION.**
8. Remove oil pump chain adjuster (1) from lower crank case.



**Fig. 180: Identifying Oil Pump Chain Adjuster And Lower Crank Case**  
Courtesy of SUZUKI OF AMERICA CORP.

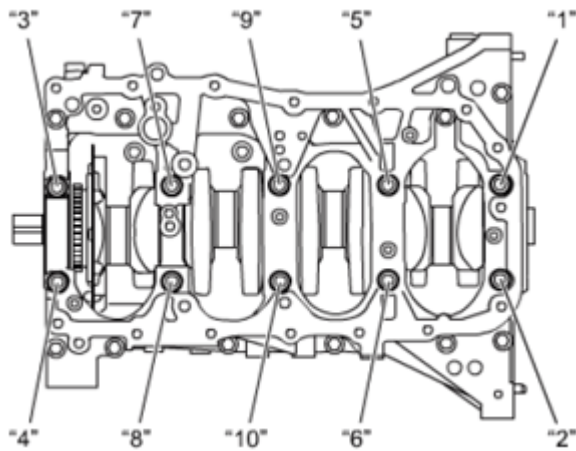
9. Remove CKP sensor. See **CKP (CRANKSHAFT POSITION) SENSOR REMOVAL AND INSTALLATION .**
10. Loosen crank case bolt No. 2s in numerical order ("1" - "12") evenly and gradually.



**Fig. 181: Identifying Crank Case Bolt Loosen Sequence**  
Courtesy of SUZUKI OF AMERICA CORP.

11. Loosen crank case bolt No. 1s in numerical order ("1" - "10") evenly and gradually, and then remove lower crank case and rear oil seal.

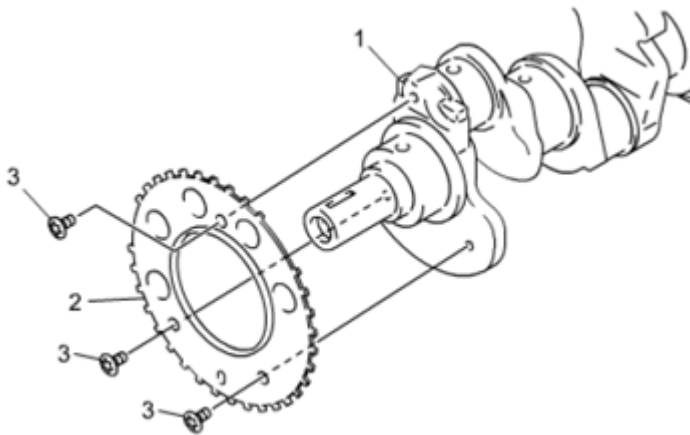
**NOTE: Use 12-point socket wrench to crank case bolt No. 1s.**



**Fig. 182: Crank Case Bolt Loosen Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

12. Remove crankshaft and oil pump chain from cylinder block.
13. Remove sensor plate (2) from crankshaft (1), if necessary.

**NOTE:** Use T-30 security TORX® to loosen sensor plate screws (3).



**Fig. 183: Identifying Sensor Plate And Crankshaft**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### Installation

**Reference:** CRANKSHAFT INSPECTION

**Reference:** MAIN BEARINGS INSPECTION

**Reference:** SENSOR PLATE INSPECTION

**Reference:** FLYWHEEL/DRIVE PLATE INSPECTION

**Reference:** CYLINDER BLOCK INSPECTION

**Reference:** OIL PUMP DRIVE SPROCKET INSPECTION

**Reference:** OIL PUMP CHAIN AND OIL PUMP CHAIN ADJUSTER INSPECTION

**CAUTION:**

- Apply engine oil to the following parts.
  - Crankshaft journal
  - Main bearing
  - Thrust bearing
  - Oil pump chain adjuster
- Do not apply engine oil to the following spots.
  - Contact surfaces between main bearing and cylinder block
  - Contact surfaces between main bearing and lower crank case
  - Contact surfaces between connecting rod bearing and connecting rod
  - Contact surfaces between connecting rod bearing and connecting rod cap
- Install the following parts in the position from which they were removed.
  - Main bearing
  - Thrust bearing

1. Install sensor plate (1) according to the following procedure.
  - a. Attach spring pin (2) to crankshaft (3).

**NOTE:** Use spring pin which is genuine SUZUKI part (09205-05006).

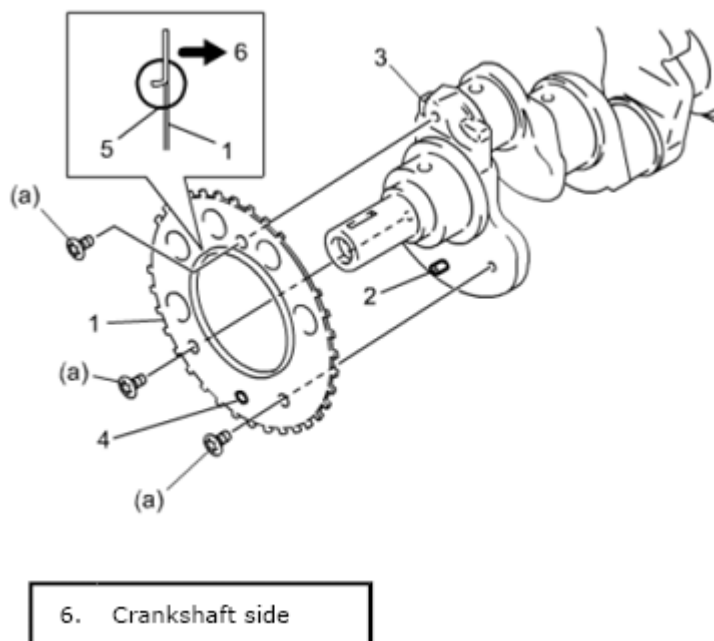
- b. Install sensor plate to crankshaft.

**CAUTION:**

- Align spring pin hole (4) on sensor plate with spring pin on crankshaft.
- Inside edge (5) of sensor plate is bent. Install sensor plate properly.

**Tightening torque**

Sensor plate screw (a): 11 N.m (1.1 kg-m, 8.5 lbf-ft)



**Fig. 184: Aligning Spring Pin Hole On Sensor Plate**  
 Courtesy of SUZUKI OF AMERICA CORP.

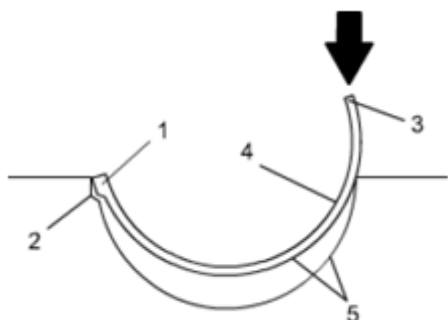
- c. Detach spring pin from crankshaft.
2. Install main bearings to cylinder block and lower crankcase according to the following procedure.

**NOTE:**

- Install main bearing halves with oil groove to cylinder block.
- Install other main bearing halves to lower crankcase.

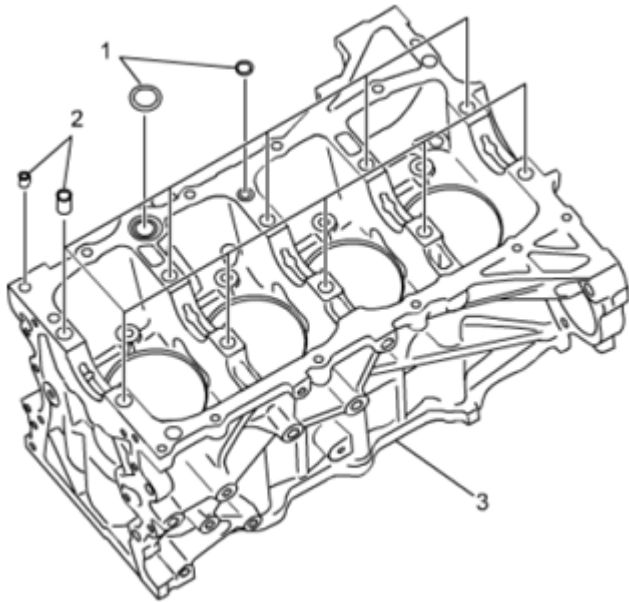
- a. Fit the tab (1) on each bearing into recess (2) in cylinder block or lower crank case.
- b. Press bearing end (3) until it fully seat in cylinder block or lower crankcase.
- c. Apply engine oil to sliding surface (4) of main bearing halves.

**CAUTION: Do not apply engine oil between bearing halves (5) and cylinder block or lower crank case (5).**



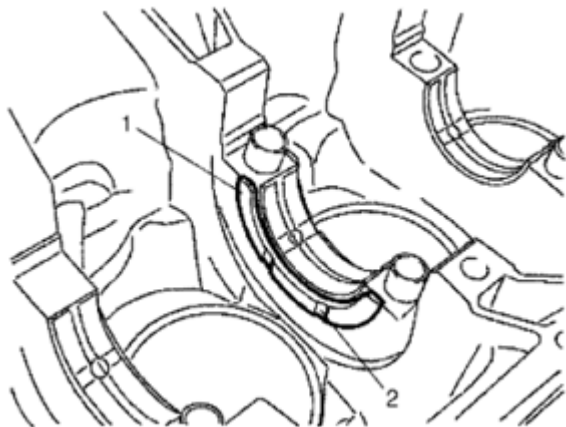
**Fig. 185: Pressing Bearing End**  
 Courtesy of SUZUKI OF AMERICA CORP.

3. Install new O-rings (1) to cylinder block (3).
4. Install dowel pins (2) to cylinder block (3).



**Fig. 186: Identifying Dowel Pins, Cylinder Block And O-ring**  
 Courtesy of SUZUKI OF AMERICA CORP.

5. Apply engine oil to thrust bearings (1) and install them to cylinder block journal No. 3, with oil grooves (2) facing outward.



**Fig. 187: Identifying Thrust Bearings**  
 Courtesy of SUZUKI OF AMERICA CORP.

6. Apply engine oil to sliding surface of main bearings and crankshaft.

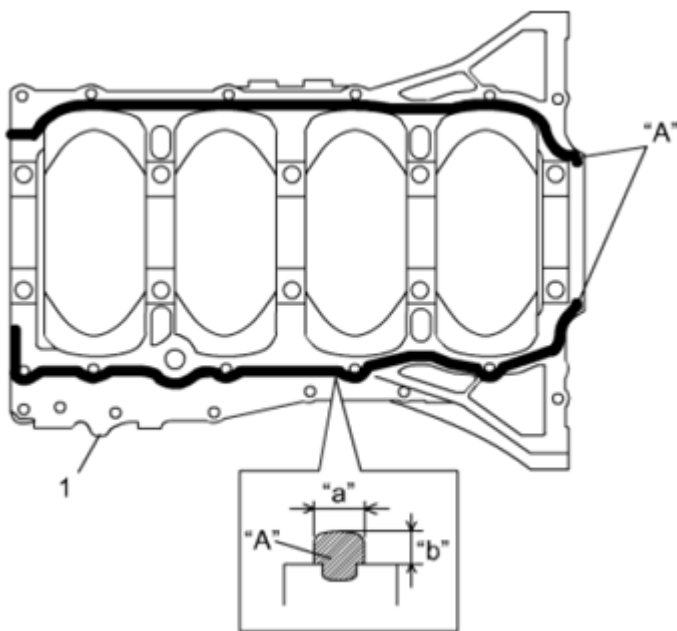
7. Install crankshaft to cylinder block, with oil pump chain installed to oil pump drive sprocket on crankshaft.
8. Apply sealant to mating surface of lower crankcase (1) as shown in figure.

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

**Sealant bead size for lower crankcase**

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

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



**Fig. 188: Applying Sealant To Mating Surface Of Lower Crankcase**  
Courtesy of SUZUKI OF AMERICA CORP.

9. Install lower crank case to cylinder block and tighten crank case bolt No. 1s according to the following procedure.

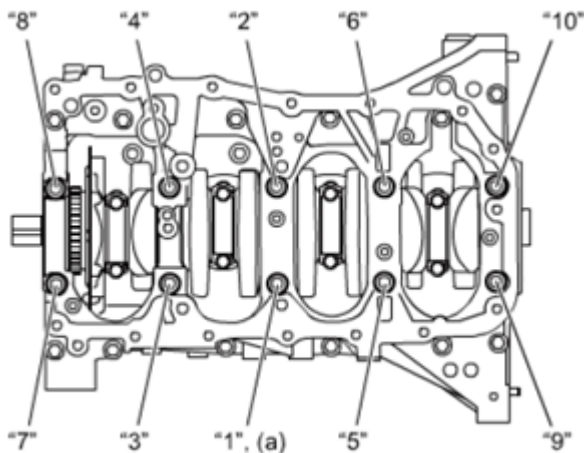
**NOTE:**

- If crank case bolt No. 1s are reused, check them for deformation referring to "CRANK CASE BOLT NO. 1 INSPECTION" under MAIN BEARINGS INSPECTION.
- Use 12-point socket wrench to crank case bolt No. 1s.
  - a. Apply engine oil to bolt threads and seats of crank case bolt No. 1 and tighten bolt to 50 N.m (5.1 kgf-m, 37.0 lbf-ft) in numerical order ("1" - "10") evenly and gradually.
  - b. Loosen all bolts in reverse numerical order until loosening torque becomes 0.
  - c. In the same manner as Step a), retighten them to 20 N.m (2.0 kgf-m, 15.0 lbf-ft).

- d. In the same manner as Step a), retighten them to 35 N.m (3.6 kgf-m, 26.0 lbf-ft).
- e. In the same manner as Step a), retighten them to 40°.
- f. In the same manner as Step a), retighten them to 40°.

**Tightening torque**

**Crank case bolt No. 1\* (a): 50 N.m --> 0 N.m --> 20 N.m --> 35 N.m --> 40° --> 40° (5.1 kgf-m --> 0 kgf-m --> 2.0 kgf-m --> 3.6 kgf-m --> 40° --> 40°, 37.0 lbf-ft --> 0 lbf-ft --> 15.0 lbf-ft --> 26.0 lbf-ft --> 40° --> 40°)**

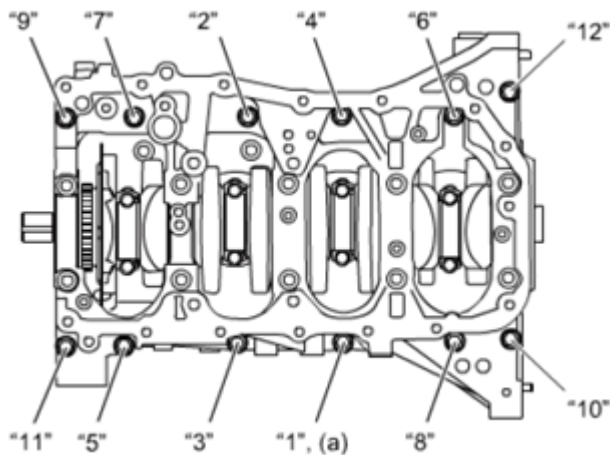


**Fig. 189: Identifying Crank Case Bolt Tighten Sequence**  
 Courtesy of SUZUKI OF AMERICA CORP.

- 10. Tighten crank case bolt No. 2s in numerical order ("1" - "12") evenly and gradually.

**Tightening torque**

**Crank case bolt No. 2\* (a): 25 N.m (2.5 kg-m, 18.5 lbf-ft)**



**Fig. 190: Identifying Crank Case Bolt Tighten Sequence**

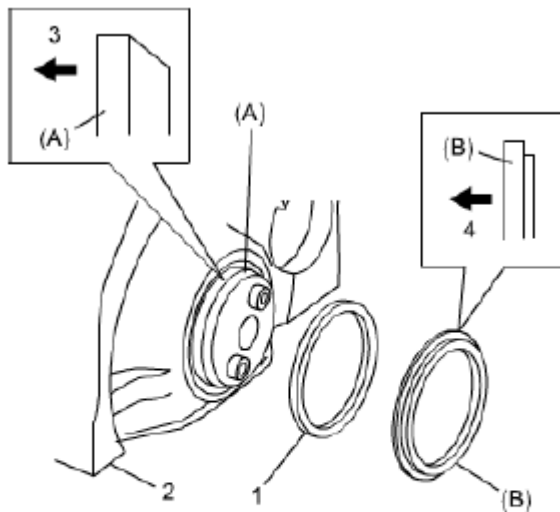
Courtesy of SUZUKI OF AMERICA CORP.

11. Check that crankshaft rotates smoothly when turning it by hand.
12. Apply engine oil to new rear oil seal (1) and install it to cylinder block (2) using special tools.

### Special Tool

(A): 09911-97710

(B): 09911-97811



3. Crankshaft side

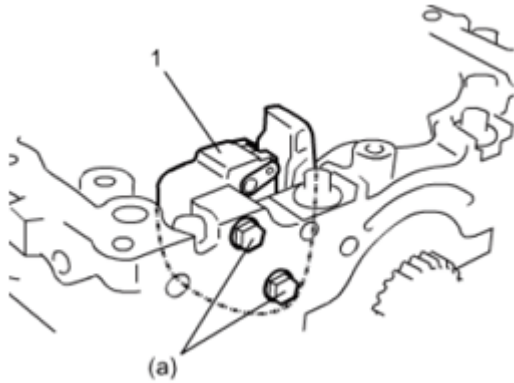
4. Oil seal side

**Fig. 191: Identifying Rear Oil Seal And Cylinder Block**  
Courtesy of SUZUKI OF AMERICA CORP.

13. Install pistons and connecting rods. See **PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION.**
14. Install oil pump chain adjuster (1).

### Tightening torque

Oil pump chain adjuster bolt (a): 11 N.m (1.1 kg-m, 8.5 lbf-ft)

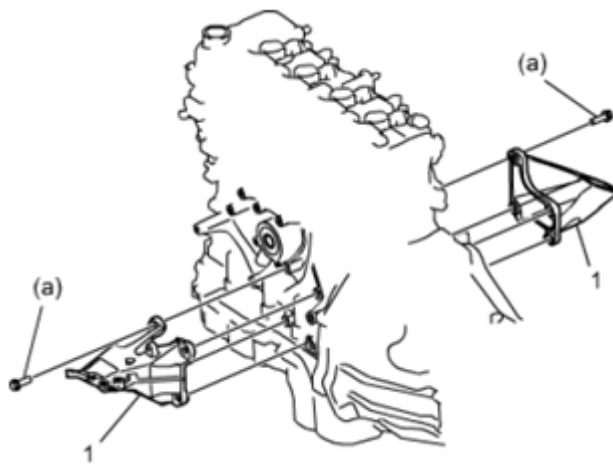


**Fig. 192: Identifying Oil Pump Chain Adjuster**  
Courtesy of SUZUKI OF AMERICA CORP.

15. Install CKP sensor. See **CKP (CRANKSHAFT POSITION) SENSOR REMOVAL AND INSTALLATION** .
16. Install flywheel for 5 M/T model, or drive plate for 4 A/T model. See **FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION** .
17. Install engine front mounting brackets (1).

#### **Tightening torque**

**Engine front mounting bracket bolt (a): 55 N.m (5.6 kg-m, 40.5 lbf-ft)**



**Fig. 193: Identifying Engine Front Mounting Brackets**  
Courtesy of SUZUKI OF AMERICA CORP.

18. Install P/S pump. See **P/S PUMP REMOVAL AND INSTALLATION** .
19. Install water pump. See **WATER PUMP REMOVAL AND INSTALLATION** .
20. Install generator. See **GENERATOR REMOVAL AND INSTALLATION** .
21. Install engine assembly. See **ENGINE ASSEMBLY REMOVAL AND INSTALLATION** .

## CRANKSHAFT INSPECTION

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

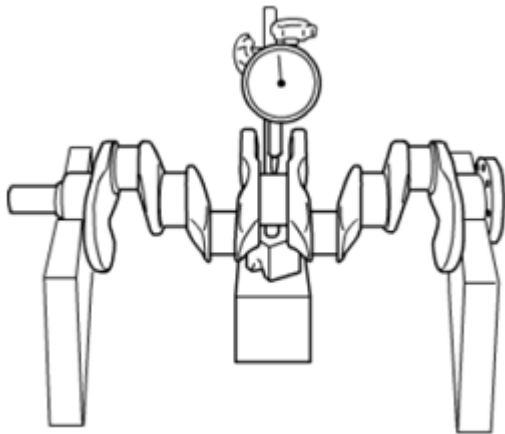
#### Crankshaft Runout

Using dial gauge, measure runout at center journal. Rotate crankshaft slowly.

If runout exceeds its limit, replace crankshaft.

#### Crankshaft runout

**Limit: 0.02 mm (0.0007 in.)**



**Fig. 194: Measuring Runout Center Journal**  
Courtesy of SUZUKI OF AMERICA CORP.

#### Crankshaft Thrust Play

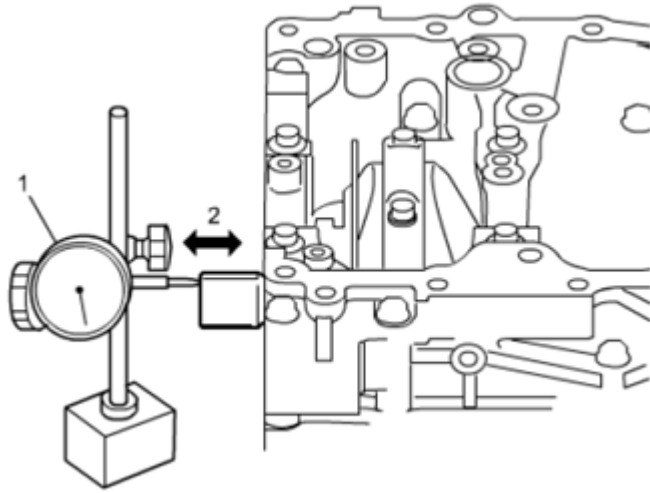
1. Assemble crankshaft, main bearings, thrust bearings and lower crank case. See MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION.
2. Using dial gauge (1), measure crankshaft thrust play (2) as shown in figure.

If measured thrust play is out of standard value, replace thrust bearing with new one (standard size or over size) to obtain standard thrust play.

Recheck crankshaft thrust play.

#### Crankshaft thrust play

**Standard: 0.10 - 0.35 mm (0.0040 - 0.0137 in.)**



**Fig. 195: Measuring Crankshaft Thrust Play**  
 Courtesy of SUZUKI OF AMERICA CORP.

#### **Thrust bearing thickness**

**Standard size: 2.470 - 2.520 mm (0.973 - 0.9921 in.)**

**Oversize (0.125 mm, 0.00492 in.): 2.533 - 2.583 mm (0.0998 - 0.1016 in.)**

#### **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 uneven wear exceeds its limit, regrind or replace crankshaft.

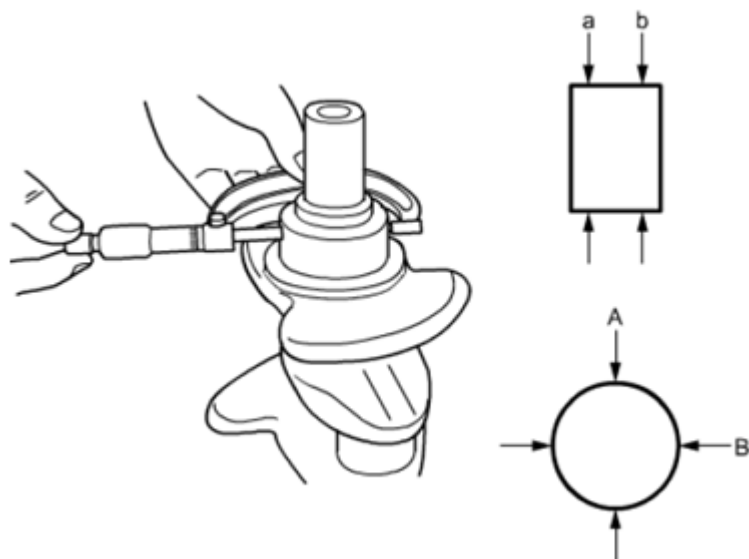
#### **Crankshaft journal outside diameter**

**Standard: 51.982- 52.000 mm (2.0466 - 2.0472 in)**

**Limit: 51.972 mm (2.0461 in.)**

#### **Crankshaft out-of-round (A - B) and taper (a - b)**

**Limit: 0.01 mm (0.0003 in.)**



**Fig. 196: Measuring Crankshaft Journal Outside Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.

## MAIN BEARINGS INSPECTION

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

### Visual Inspection

Check bearings for pitting, scratches, wear or damage.

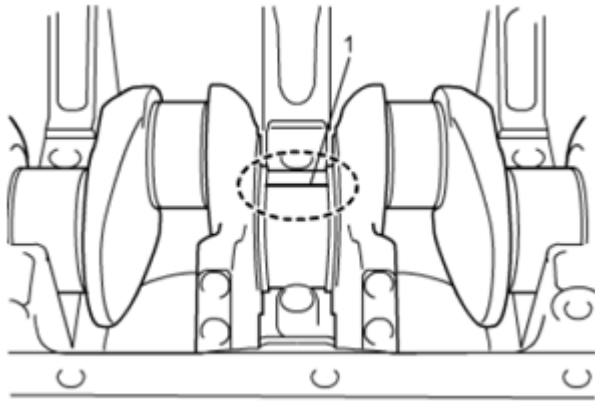
If any defective condition is found, replace both upper and lower halves. Never replace either half without replacing the other half.

### Main Bearing Clearance

**CAUTION:** Do not rotate crankshaft while gauging plastic is installed.

**NOTE:** After checking main bearing clearance, check crank case bolt No. 1 for deformation. See CRANK CASE BOLT NO. 1 INSPECTION.

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



**Fig. 197: Identifying Piece Of Gauging Plastic**  
Courtesy of SUZUKI OF AMERICA CORP.

4. Install lower crank case. See **MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION**.
5. After three minutes, remove lower crank case and using scale (2) on gauging plastic envelop (1), measure gauging plastic width at its widest point.

**NOTE:** If pair of crankshaft journal and cylinder block journal is in the following condition, different values are applied as standard.

- Stamped number for crankshaft journal diameter is "4", and stamped alphabet for cylinder block journal inside diameter is "A".

Standard: 0.019 - 0.031 mm (0.00075 - 0.00122 in.)

- Stamped number for crankshaft journal diameter is "9", and stamped alphabet for cylinder block journal inside diameter is "F".

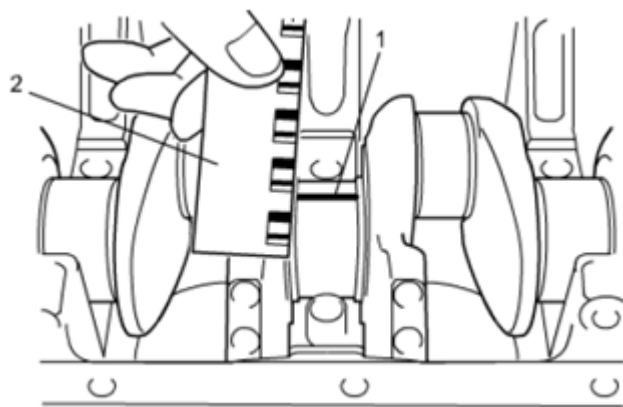
Standard: 0.025 - 0.037 mm (0.00098 - 0.00145 in.)

For more information about stamped number and stamped alphabet, refer to **SELECTION OF MAIN BEARINGS**.

**Main bearing clearance**

Standard: 0.022 - 0.034 mm (0.00087 - 0.00133 in.)

Limit: 0.050 mm (0.00196 in.)



**Fig. 198: Measuring Gauging Plastic Width At Widest Point**  
 Courtesy of SUZUKI OF AMERICA CORP.

If measured clearance is less than standard or more than service limit, replace main bearings with new ones referring to **SELECTION OF MAIN BEARINGS** and recheck main bearing clearance.

If measured clearance with new bearings is out of standard, select other bearings according to the following procedures and recheck main bearing clearance.

- More than standard:

Replace bearing with one size thicker or regrind crank shaft journal to undersize and use 0.25 mm undersize bearing (0.0098 in).

- Less than standard:

Replace bearing with one size thinner or regrind crank shaft journal to undersize and use 0.25 mm undersize bearing (0.0098 in).

### Selection of Main Bearings

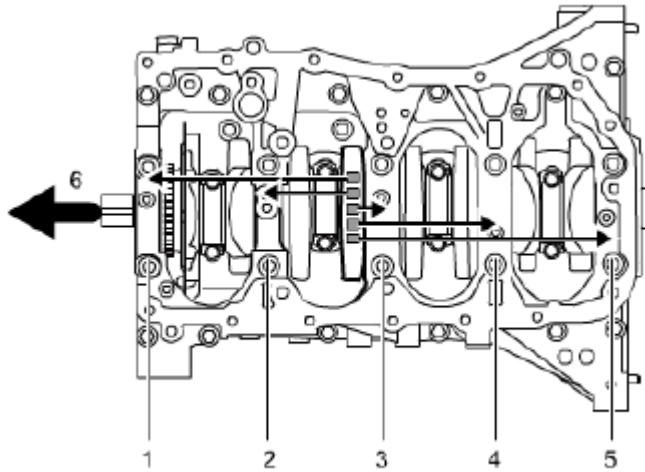
#### Standard size bearing

If engine is under one of the following conditions, select a new standard bearings as follows, and install it.

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

1. Check crankshaft journal diameter according to the following procedures.

- There are five stamped numbers (any of "4" through "9") on crank web No. 4 as shown in figure.
- Those numbers represent crankshaft journal diameter as follows.



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

**Fig. 199: Checking Crankshaft Journal**  
 Courtesy of SUZUKI OF AMERICA CORP.

- Determine crankshaft journal diameter for journals No. 1 through No. 5 using stamped numbers and following table.

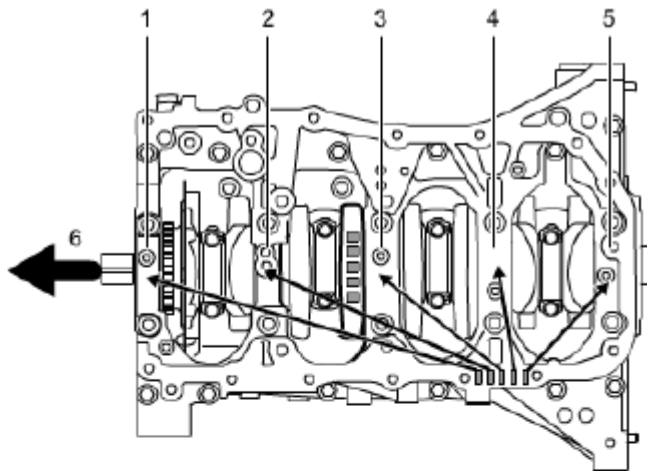
**Crankshaft journal diameter**

**CRANKSHAFT JOURNAL DIAMETER CHART**

Stamped numbers	Journal diameter
4	51.997 - 52.000 mm (2.04713 - 2.04724 in.)
5	51.994 - 51.997 mm (2.04701 - 2.04712 in.)
6	51.991 - 51.994 mm (2.04689 - 2.04700 in.)
7	51.988 - 51.991 mm (2.04678 - 2.04688 in.)
8	51.985 - 51.988 mm (2.04666 - 2.04677 in.)
9	51.982 - 51.985 mm (2.04654 - 2.04665 in.)

2. Check cylinder block journal inside diameter according to the following procedures.

- There are five stamped alphabets (any of "A" through "F") on Lower crank case as shown in figure.
- Those alphabets represent cylinder block journal inside diameter as follows.



1.	Cylinder block journal No.1
2.	Cylinder block journal No.2
3.	Cylinder block journal No.3
4.	Cylinder block journal No.4
5.	Cylinder block journal No.5
6.	Crankshaft pulley side

**Fig. 200: Identifying Cylinder Block Journal**  
 Courtesy of SUZUKI OF AMERICA CORP.

- Determine cylinder block journal inside diameter for journals No. 1 through No. 5 using stamped alphabets and following table.

**CRANKSHAFT JOURNAL DIAMETER CHART**

Stamped number	Cylinder block journal in side diameter
A	56.000 - 56.003 mm (2.20473 - 2.20484 in.)
B	56.003 - 56.006 mm (2.20485 - 2.20496 in.)
C	56.006 - 56.009 mm (2.20496 - 2.20507 in.)

D	56.009 - 56.012 mm (2.20508 - 2.20519 in.)
E	56.012 - 56.015 mm (2.20520 - 2.20531 in.)
F	56.015 - 56.018 mm (2.20532 - 2.20543 in.)

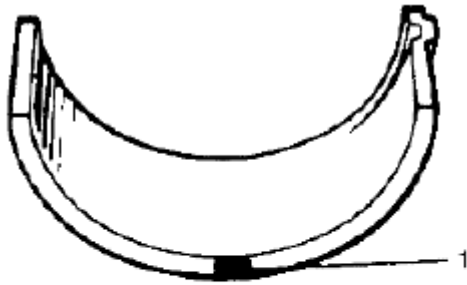
3. There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as shown in figure.

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

**Standard size crankshaft main bearing thickness**

**BEARING THICKNESS CHART**

Painted color	Bearing thickness
Blue	2.011 - 2.014 mm (0.07918 - 0.07929 in)
Yellow	2.008 - 2.011 mm (0.07906 - 0.07917 in)
Colorless	2.005 - 2.008 mm (0.07894 - 0.07905 in)
Black	2.002 - 2.005 mm (0.07882 - 0.07893 in)
Green	1.999 - 2.002 mm (0.07870 - 0.07881 in)



1. Paint

**Fig. 201: Identifying Crankshaft Main Bearing**  
 Courtesy of SUZUKI OF AMERICA CORP.

4. Select new standard crankshaft bearings using stamped numbers for crankshaft journal diameter, stamped alphabets for cylinder block journal inside diameter and following table.

**Main bearing cross - reference selection table (standard size)**

**MAIN BEARING CROSS REFERENCE**

	Stamped number on crank web No. 4					
	4	5	6	7	8	9

Stamped alphabets on lower crank case	A	Upper	Green	Green	Green	Black	Black	Colorless
		Lower	Green	Green	Black	Black	Colorless	Colorless
	B	Upper	Green	Green	Black	Black	Colorless	Colorless
		Lower	Green	Black	Black	Colorless	Colorless	Yellow
	C	Upper	Green	Black	Black	Colorless	Colorless	Yellow
		Lower	Black	Black	Colorless	Colorless	Yellow	Yellow
	D	Upper	Black	Black	Colorless	Colorless	Yellow	Yellow
		Lower	Black	Colorless	Colorless	Yellow	Yellow	Blue
	E	Upper	Black	Colorless	Colorless	Yellow	Yellow	Blue
		Lower	Colorless	Colorless	Yellow	Yellow	Blue	Blue
	F	Upper	Colorless	Colorless	Yellow	Yellow	Blue	Blue
		Lower	Colorless	Yellow	Yellow	Blue	Blue	Blue

**Undersize bearing (0.25 mm)**

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

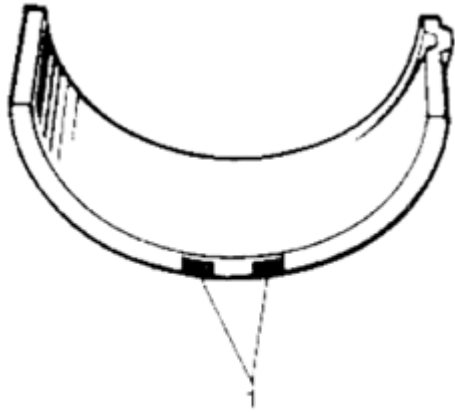
To distinguish them, each bearing is painted in the following colors at such position as indicated in figure.

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

**Undersize of crankshaft main bearing thickness**

**BEARING THICKNESS CHART**

Painted color	Bearing thickness
Red & Blue	2.136 - 2.139 mm (0.08410 - 0.08421 in.)
Red & Yellow	2.133 - 2.136 mm (0.08398 - 0.08409 in.)
Red	2.130 - 2.133 mm (0.08386 - 0.08397 in.)
Red & Black	2.127 - 2.130 mm (0.08374 - 0.08385 in.)
Red & Green	2.124 - 2.127 mm (0.08362 - 0.08374 in.)



1. Paint

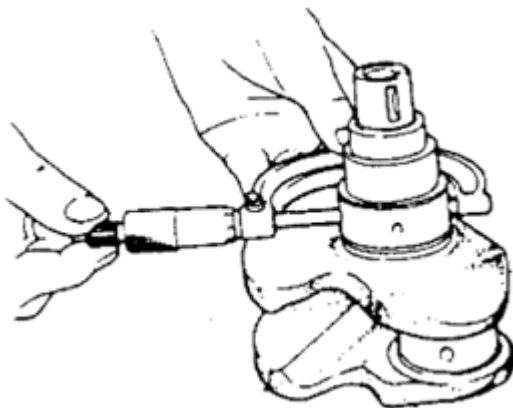
**Fig. 202: Identifying Crankshaft Main Bearing (Undersize Bearing)**  
 Courtesy of SUZUKI OF AMERICA CORP.

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

**Finished crankshaft journal diameter**

**52.232 - 52.250 mm (2.05638 - 2.05708 in.)**

- b. Using micrometer, measure reground journal diameter. See **CRANKSHAFT INSPECTION**
- c. Using measured journal diameter above and alphabets stamped on cylinder block, select an undersize bearing by referring to the following table.



**Fig. 203: Measuring Journal Diameter**  
 Courtesy of SUZUKI OF AMERICA CORP.

**Main bearing cross - reference table (under size)**

**MAIN BEARING CROSS REFERENCE**

		Measured journal diameter						
		52.2470 - 52.2499 (2.05697 - 2.05708 in.)	52.2440 - 52.2469 (2.05686 - 2.05696 in.)	52.2410 - 52.2439 (2.05674 - 2.05684 in.)	52.2380 - 52.2409 (2.05662 - 2.05672 in.)	52.2350 - 52.2379 (2.05650 - 2.05661 in.)	52.2320 - 52.2349 (2.05638 - 2.05649 in.)	
Stamped alphabet on lower crank case	A	Upper	Red & Green	Red & Green	Red & Green	Red & Black	Red & Black	Red
		Lower	Red & Green	Red & Green	Red & Black	Red & Black	Red	Red
	B	Upper	Red & Green	Red & Green	Red & Black	Red & Black	Red	Red
		Lower	Red & Green	Red & Black	Red & Black	Red	Red	Red & Yellow
	C	Upper	Red & Green	Red & Black	Red & Black	Red	Red	Red & Yellow
		Lower	Red & Black	Red & Black	Red	Red	Red & Yellow	Red & Yellow
	D	Upper	Red & Black	Red & Black	Red	Red	Red & Yellow	Red & Yellow
		Lower	Red & Black	Red	Red	Red & Yellow	Red & Yellow	Red & Blue
	E	Upper	Red & Black	Red	Red	Red & Yellow	Red & Yellow	Red & Blue
		Lower	Red	Red	Red & Yellow	Red & Yellow	Red & Blue	Red & Blue
	F	Upper	Red	Red	Red & Yellow	Red & Yellow	Red & Blue	Red & Blue
		Lower	Red	Red & Yellow	Red & Yellow	Red & Blue	Red & Blue	Red & Blue

- d. Install selected main bearings and measure bearing clearance. See **MAIN BEARING CLEARANCE**.

If measured clearance is more than standard, replace bearings with one size thicker and recheck bearing clearance.

If measured clearance is less than standard, replace bearings with one size thinner and recheck bearing clearance.

**Crank Case Bolt No. 1 Inspection**

Measure each thread diameter at specified points on crank case bolt No. 1 (1) using micrometer (2).

Calculate difference in diameters ("A" - "B").

If it exceeds limit, replace with new one.

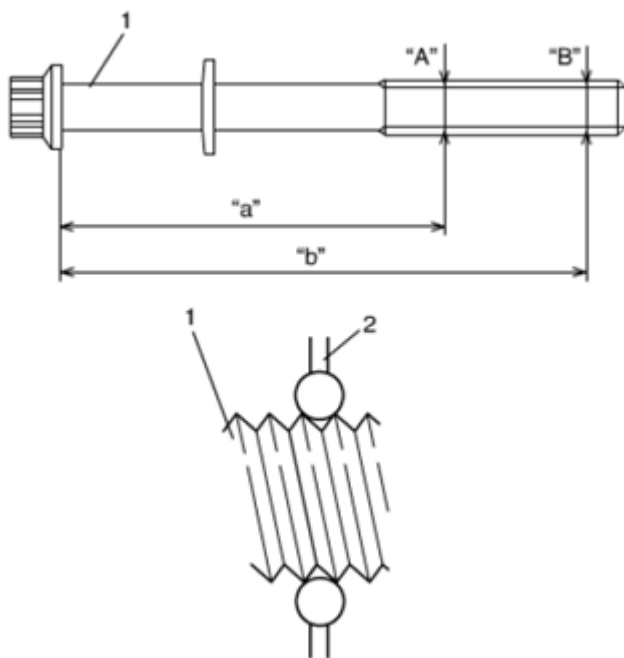
### Crank case bolt diameter measurement points

"a": 61.0 mm (2.40 in.)

"b": 98.0 mm (3.86 in.)

### Crank case cap bolt diameter difference

Limit ("A" - "B"): 0.013 mm (0.0051 in.)



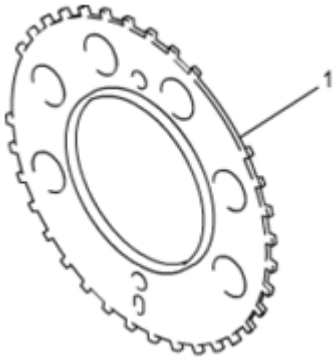
**Fig. 204: Identifying Crank Case Cap Bolt Dimension**  
 Courtesy of SUZUKI OF AMERICA CORP.

### SENSOR PLATE INSPECTION

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

Check sensor plate (1) for crack or damage.

If defective condition is found, replace it.

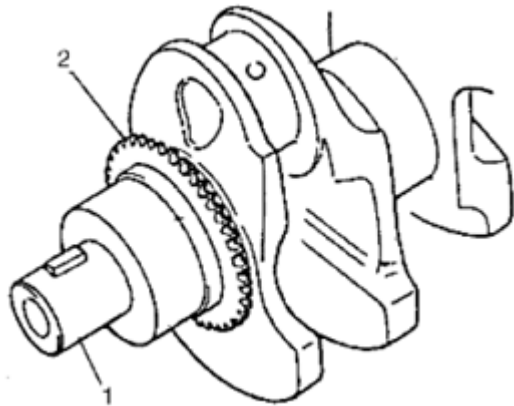


**Fig. 205: Identifying Sensor Plate**  
Courtesy of SUZUKI OF AMERICA CORP.

### OIL PUMP DRIVE SPROCKET INSPECTION

Check oil pump drive sprocket (2) for crack or any damage.

If defective condition is found, replace crankshaft (1).



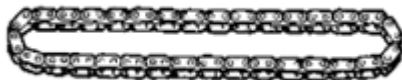
**Fig. 206: Identifying Oil Pump Drive Sprocket**  
Courtesy of SUZUKI OF AMERICA CORP.

### OIL PUMP CHAIN AND OIL PUMP CHAIN ADJUSTER INSPECTION

#### Oil Pump Chain

Check oil pump chain for wear or any damage.

If malcondition is found, replace oil pump chain.



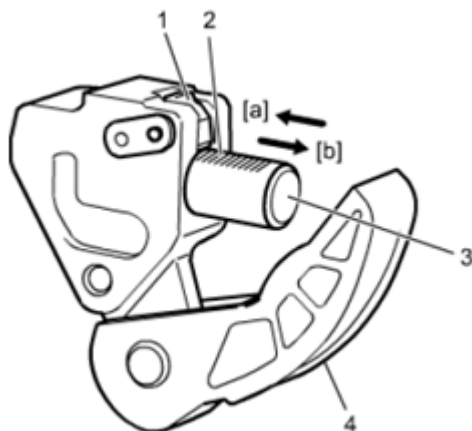
**Fig. 207: Identifying Oil Pump Chain**

Courtesy of SUZUKI OF AMERICA CORP.

### Oil Pump Chain Adjuster

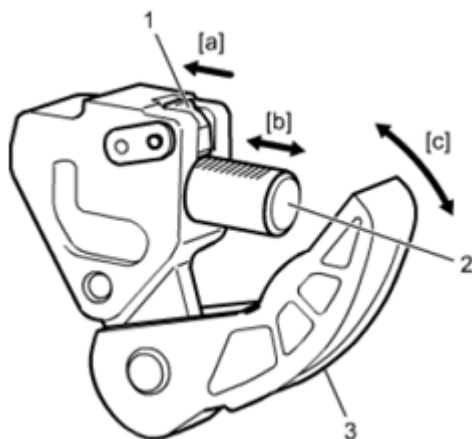
Check oil pump chain adjuster according to the following procedures.

- Check latch (1), teeth (2), plunger (3) or tensioner (4) for crack, wear or any damage.
- Check that plunger (3) moves in direction [b] and does not move in direction [a] when latch (1) engages with plunger teeth (2).



**Fig. 208: Identifying Oil Pump Chain Adjuster**  
Courtesy of SUZUKI OF AMERICA CORP.

- Check that plunger (2) moves in direction [b] freely and smoothly when latch (1) is raised up in direction [a].
- Check that tensioner (3) moves in direction [c] freely and smoothly.



**Fig. 209: Checking Plunger Direction**  
Courtesy of SUZUKI OF AMERICA CORP.

If defective condition is found, replace oil pump chain adjuster.

## FLYWHEEL/DRIVE PLATE INSPECTION

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

### Visual Inspection

- Check ring gear of flywheel for 5 M/T model or drive plate for 4 A/T model, for crack, wear or any damage.

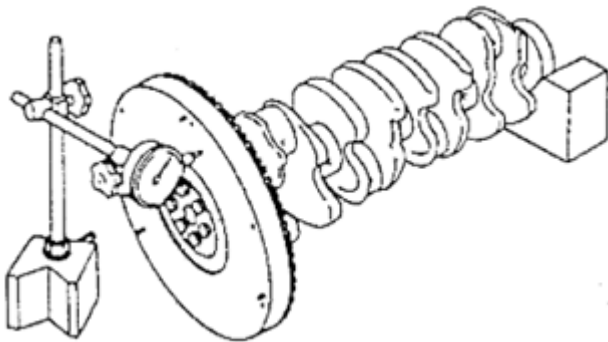
If defective condition is found, replace flywheel for 5 M/T model or drive plate for 4 A/T model. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.

### Flywheel/Drive Plate Face Runout

- Check flywheel for 5 M/T model or drive plate for 4 A/T model for runout using dial gauge and "V" blocks. If measured runout exceeds its limit, replace flywheel for 5 M/T model or drive plate for 4 A/T model. See FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION.

### Flywheel/drive plate face runout

**Limit: 0.2 mm (0.0078 in.)**



**Fig. 210: Checking Flywheel And Drive Plate Face Runout**  
Courtesy of SUZUKI OF AMERICA CORP.

## CYLINDER BLOCK INSPECTION

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

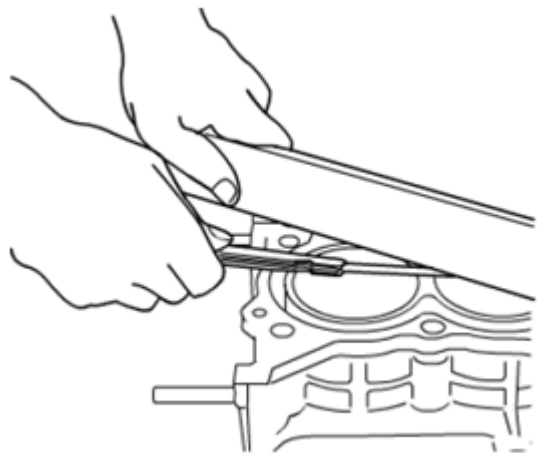
### Distortion of Gasket Surface

Using straightedge and thickness gauge, check gasket surface for distortion and, if flatness exceeds its limit, repair it.

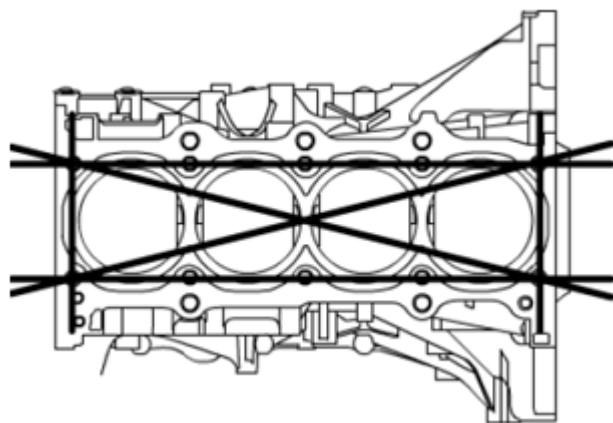
If repair is not possible, replace cylinder block.

**Cylinder block flatness**

**Limit: 0.03 mm (0.001 in.)**



**Fig. 211: Inspecting Cylinder Block**  
 Courtesy of SUZUKI OF AMERICA CORP.



**Fig. 212: Identifying Cylinder Block**  
 Courtesy of SUZUKI OF AMERICA CORP.

**SPECIFICATIONS**

**TIGHTENING TORQUE SPECIFICATIONS**

**CAUTION:** For fastener with \* (asterisk) below, be sure to tighten it according to specified procedure in "Repair Instructions".

**TIGHTENING TORQUE SPECIFICATIONS**

Fastening part	Tightening torque		
	N.m	kgf-m	lbf-ft

## 2011 Suzuki Grand Vitara

### 2011 ENGINE Engine Mechanical - Grand Vitara

Cylinder block heater bolt	11	1.1	8.5
Cylinder head cover bolt*	3.0 N.m --> 5.0 N.m --> 7.5 N.m (0.31 kgf-m --> 0.51 kgf-m --> 0.76 kgf-m, 2.5 lbf-ft --> 4.0 lbf-ft --> 5.5 lbf-ft)		
CMP actuator bolt	60	6.1	44.5
Camshaft housing bolt*	11	1.1	8.5
Exhaust camshaft timing sprocket bolt	60	6.1	44.5
Timing chain cover plug	27	2.8	20.0
Engine harness ground bolt (M6)	11	1.1	8.5
Engine harness ground bolt (M8)	25	2.5	18.5
Engine rear mounting member bolt	55	5.6	40.5
Battery ground terminal bolt	25	2.5	18.5
Timing chain cover bolt*	25	2.5	18.5
Crankshaft pulley bolt	150	15.3	111.0
OCV bolt	11	1.1	8.5
Flywheel bolt	70	7.1	52.0
Drive plate bolt	70	7.1	52.0
Timing chain guide bolt	9	0.92	7.0
Timing chain tensioner bolt	25	2.5	18.5
Timing chain tensioner adjuster bolt	11	1.1	8.5
Cylinder head bolt *	20 N.m --> 40 N.m --> +60° --> +80° (2.0 kgf-m --> 4.1 kgf-m --> +60° --> +80°, 15.0 lbf-ft --> 29.5 lbf-ft --> +60° --> +80°)		
Venturi plug	3.5	0.36	2.5
Connecting rod bolt*	15 N.m --> +45° --> +45° (1.5 kgf-m --> +45° --> +45°, 11.0 lbf-ft --> +45° --> +45°)		
Sensor plate screw	11	1.1	8.5
Crank case bolt No. 1*	50 N.m --> 0 N.m --> 20 N.m --> 35 N.m --> 40° --> 40° (5.1 kgf-m --> 0 kgf-m --> 2.0 kgf-m --> 3.6 kgf-m --> 40° --> 40°, 37.0 lbf-ft --> 0 lbf-ft --> 15.0 lbf-ft --> 26.0 lbf-ft --> 40° --> 40°)		
Crank case bolt No. 2*	25	2.5	18.5
Oil pump chain adjuster bolt	11	1.1	8.5
Engine front mounting bracket bolt	55	5.6	40.5

**NOTE:**     **The specified tightening torque is described in the following.**  
**AIR CLEANER COMPONENTS**

- CYLINDER HEAD COVER COMPONENTS**
- CAMSHAFT AND TAPPET COMPONENTS**
- ENGINE MOUNTINGS COMPONENTS**
- TIMING CHAIN COVER COMPONENTS**
- TIMING CHAIN AND CHAIN TENSIONER COMPONENTS**
- VALVE AND CYLINDER HEAD COMPONENTS**
- PISTON, PISTON RING AND CONNECTING ROD COMPONENTS**
- MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**

**Reference:**

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

**SPECIAL TOOLS AND EQUIPMENT**

**RECOMMENDED SERVICE MATERIAL**

**SPECIAL TOOLS REFERENCE**

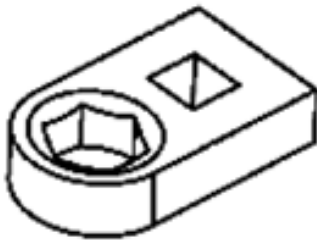
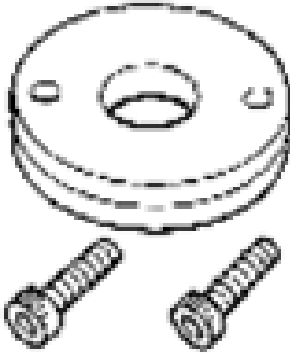
Material	SUZUKI recommended product or Specification	
Sealant	SUZUKI Bond No. 1217G	P/No.: 99000-31260

**NOTE:** Required service material is also described in the following.

- CYLINDER HEAD COVER COMPONENTS**
- CAMSHAFT AND TAPPET COMPONENTS**
- TIMING CHAIN COVER COMPONENTS**
- TIMING CHAIN AND CHAIN TENSIONER COMPONENTS**
- VALVE AND CYLINDER HEAD COMPONENTS**
- PISTON, PISTON RING AND CONNECTING ROD COMPONENTS**
- MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS**

**SPECIAL TOOL**

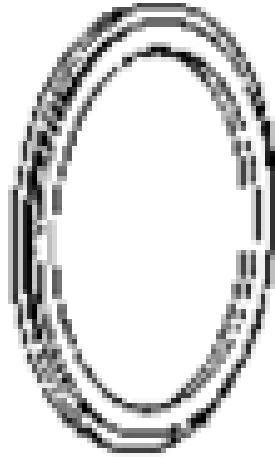
**SPECIAL TOOL REFERENCE**

<p>09911-05120 Box end wrench (14 mm)</p> 	<p>09911-97710 Oil seal guide</p> 

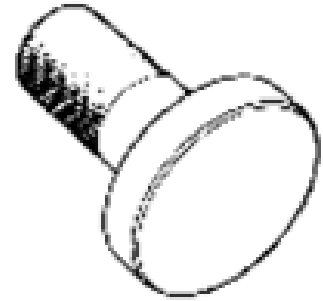
2011 Suzuki Grand Vitara

2011 ENGINE Engine Mechanical - Grand Vitara

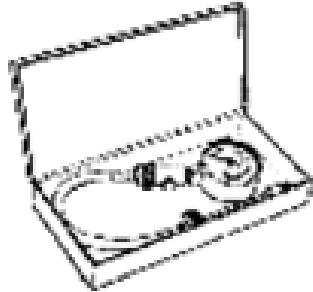
09911-97811  
Oil seal installer



09913-75510  
Bearing installer



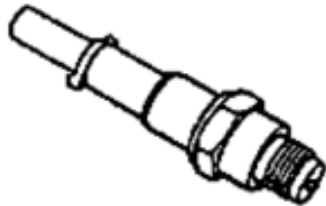
09915-64512  
Compression gauge



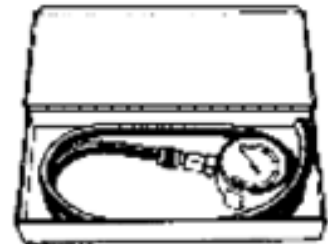
09915-64530  
Compression gauge  
hose



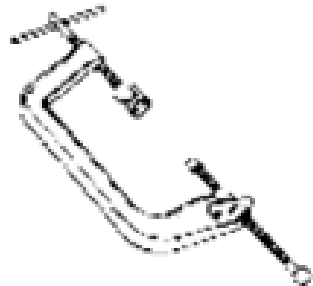
09915-67010  
Compression gauge  
attachment (C)



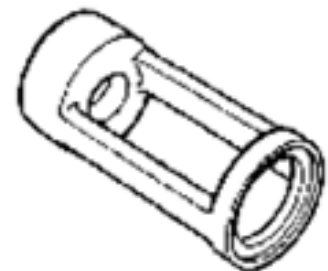
09915-67311  
Vacuum gauge



09916-14510  
Valve lifter



09916-14522  
Valve spring  
compressor attachment



# 2011 Suzuki Grand Vitara

## 2011 ENGINE Engine Mechanical - Grand Vitara

09916-34542  
Reamer handle



09916-34550  
Valve guide reamer  
(5.5 mm)



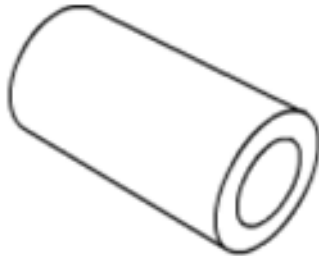
09916-37320  
Valve guide outer  
reamer (10.5 mm)



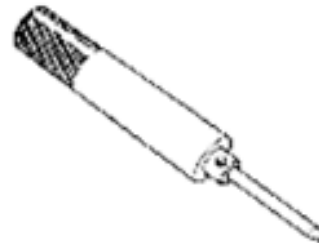
09916-44910  
Valve guide installer &  
remover



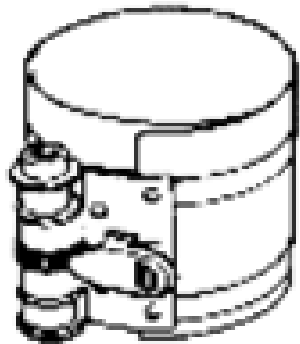
09916-56510  
Valve guide installer  
attachment



09916-58210  
Valve guide installer  
handle



09916-77310  
Piston ring compressor  
(50-125 mm)



09916-84511  
Forceps



09917-16510

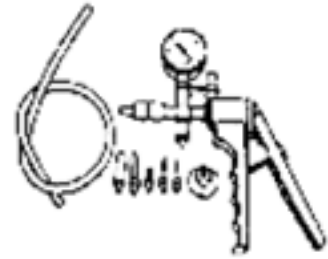
2011 Suzuki Grand Vitara

2011 ENGINE Engine Mechanical - Grand Vitara

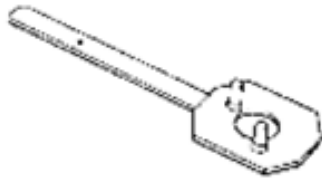
Timing chain tensioner holder



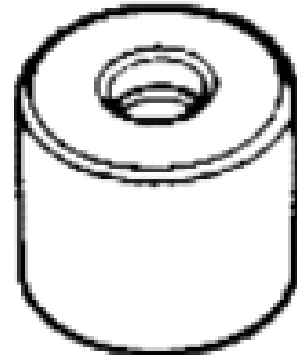
09917-47011  
Vacuum pump gauge



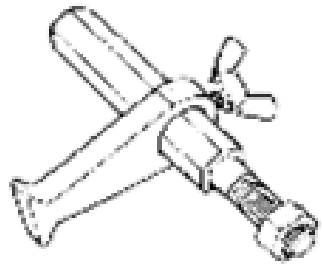
09917-68221  
Camshaft pulley holder



09917-98221  
Valve guide stem attachment



09924-17811  
Flywheel holder



09926-58010  
Bearing remover attachment



09944-36011  
Steering wheel remover

