

2012-13 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.

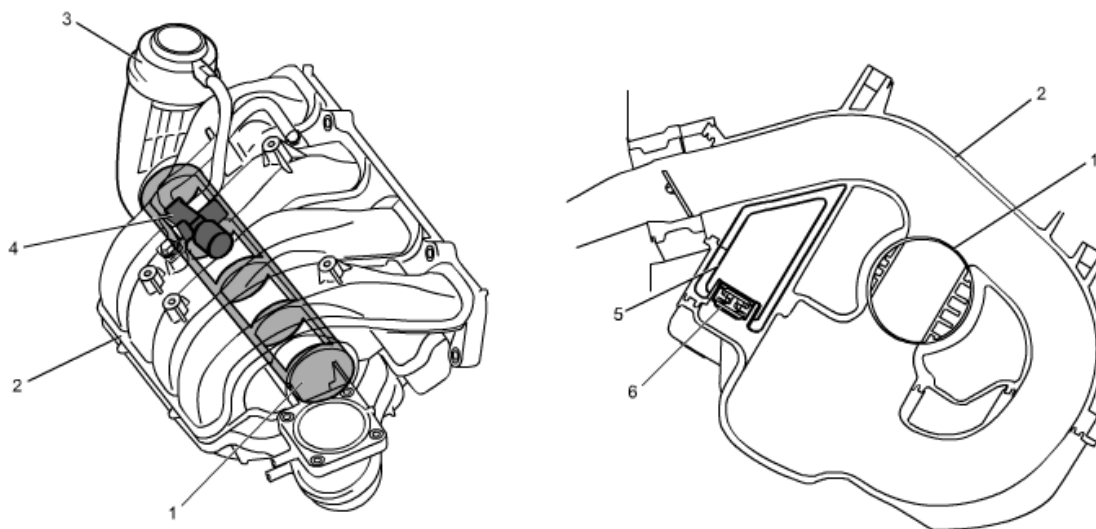


Fig. 1: Identifying Intake Manifold Components
Courtesy of SUZUKI OF AMERICA CORP.

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.

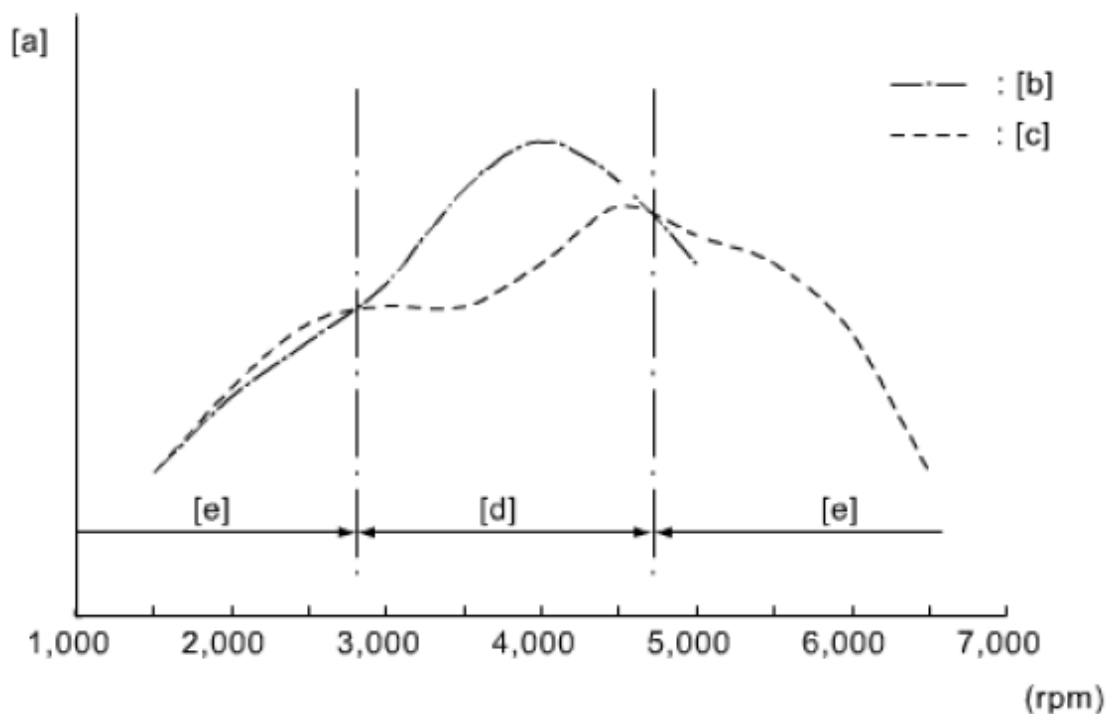
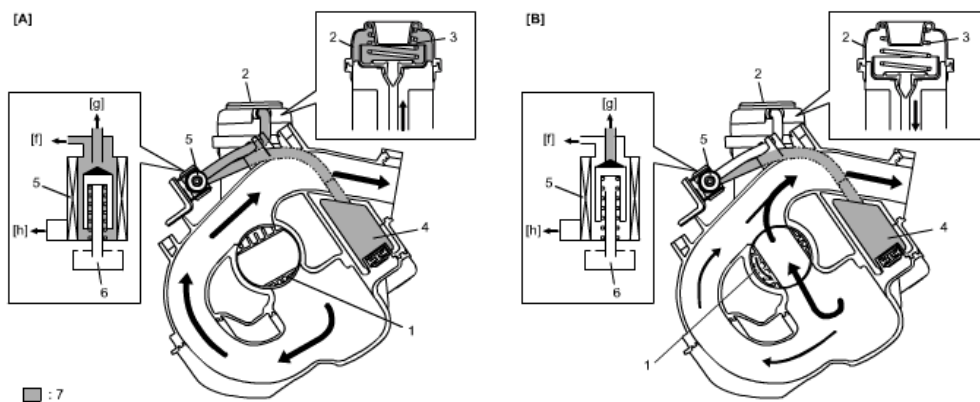


Fig. 2: Intake Manifold Tuning Graph
Courtesy of SUZUKI OF AMERICA CORP.



[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 BETWEEN VALVE OPERATION AND INTAKE PIPE LENGTH

	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)

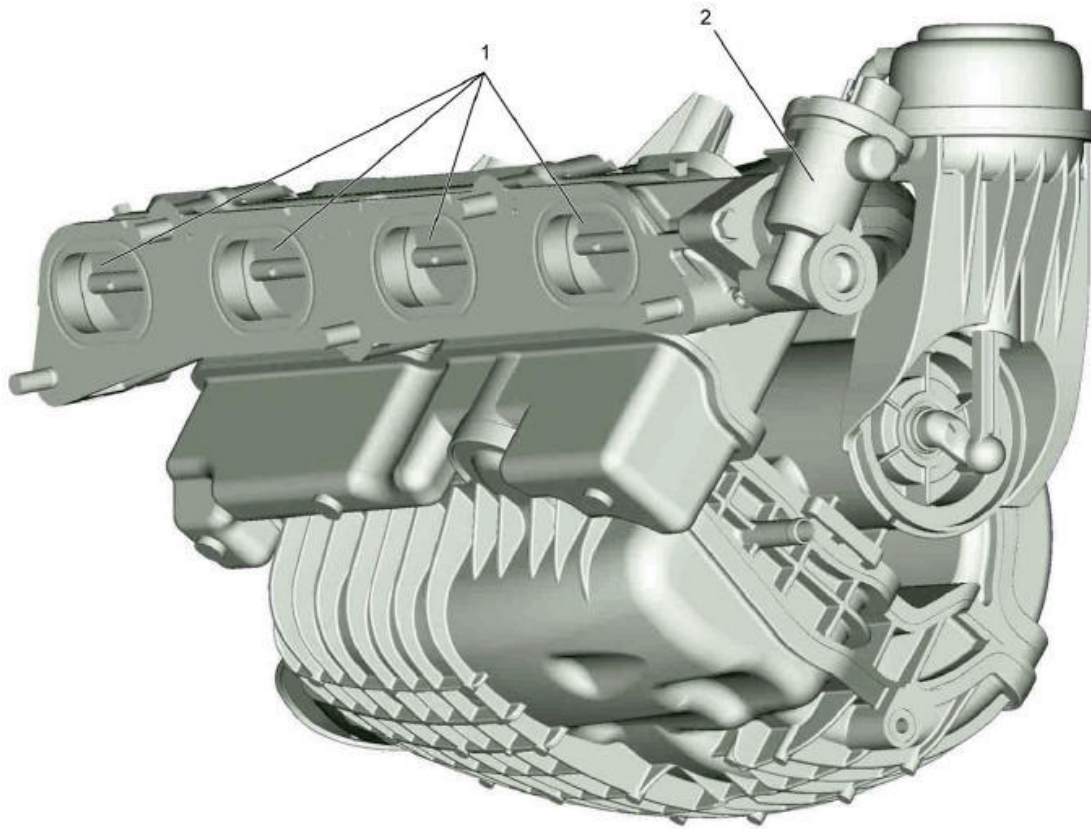


Fig. 4: Identifying IMRC Valve And IMRC Valve Actuator
Courtesy of SUZUKI OF AMERICA CORP.

- 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**

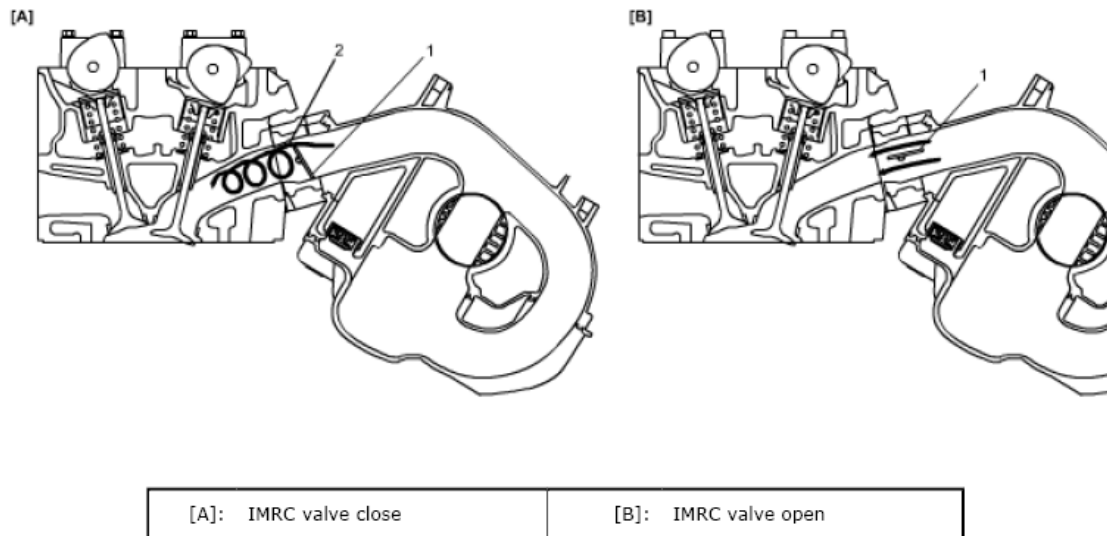


Fig. 5: Identifying IMRC Valve Close And IMRC Valve Open
Courtesy of SUZUKI OF AMERICA CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

COMPRESSION CHECK

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

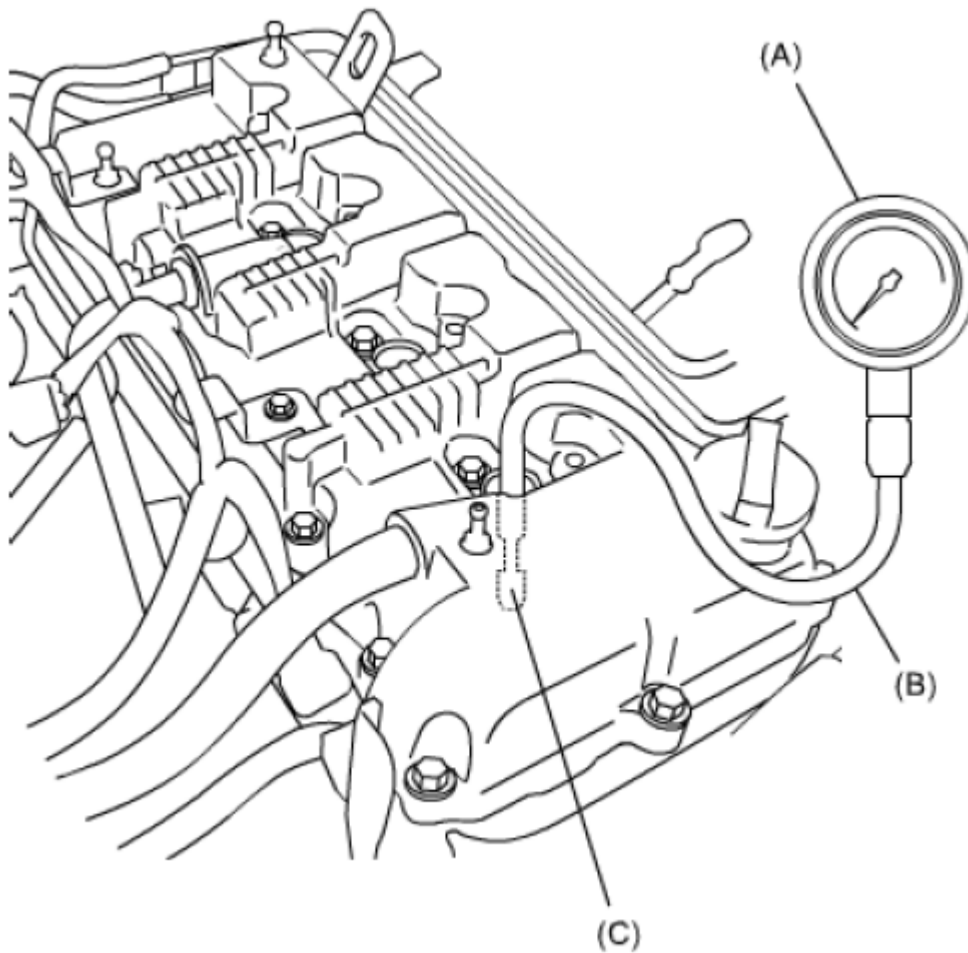


Fig. 6: Installing Special Tools Into Spark Plug Hole
Courtesy of SUZUKI OF AMERICA CORP.

8. For A/T model, depress accelerator pedal all the way to fully open throttle.

For 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 at least 200 rpm with fully charged battery, and read the highest pressure on compression gauge.

NOTE:

- 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/cm² , 203 psi)

Limit: 1, 100 kPa (11.2 kgf/cm² , 160 psi)

Max. difference between any two cylinders: 100 kPa (1.02 kgf/cm² , 14.5 psi)

10. Carry out Steps 7) through 9) on each cylinder.
11. Install spark plugs and ignition coil assemblies. Refer to **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 A/T model, place select lever in "P" and apply parking brake.

For 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.

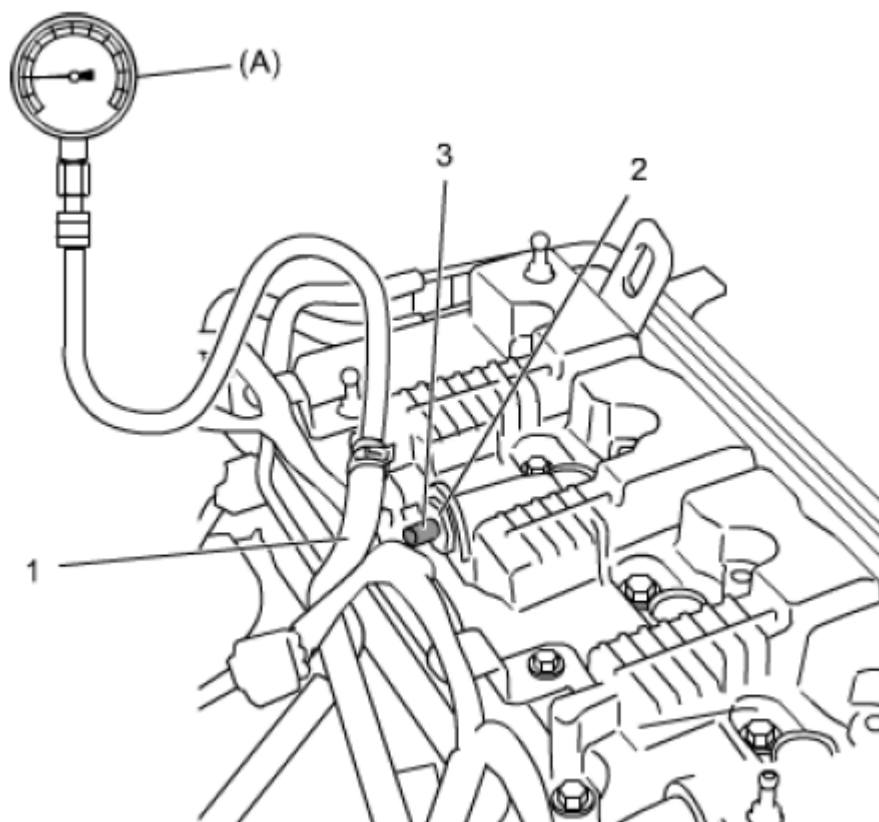


Fig. 7: Connecting Special Tool To PCV Hose
Courtesy of SUZUKI OF AMERICA CORP.

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

Vacuum specification (at sea level)

Standard: -65 kPa (-0.66 kgf/cm² , -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. Refer to **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.

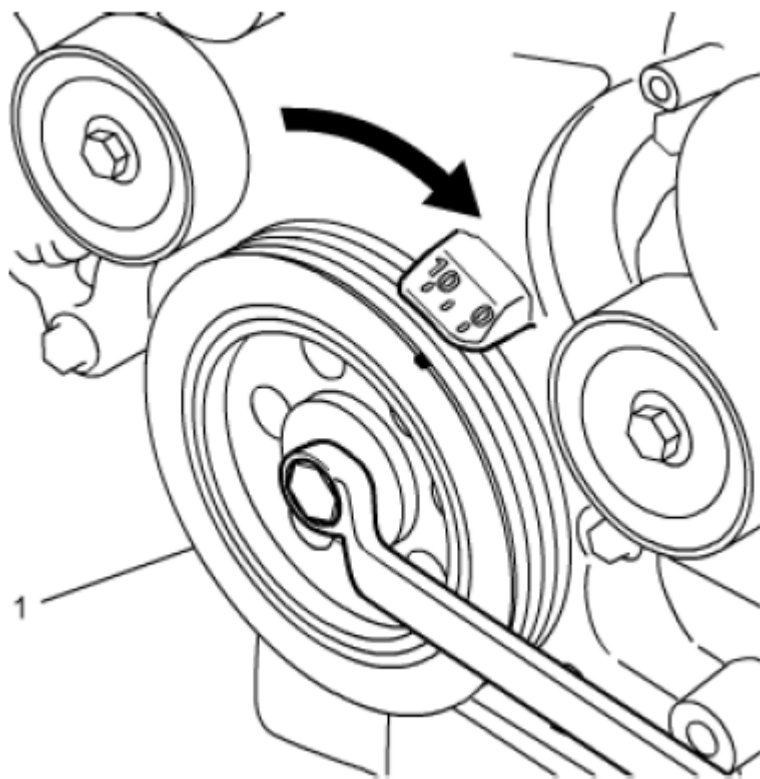


Fig. 8: Turning Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

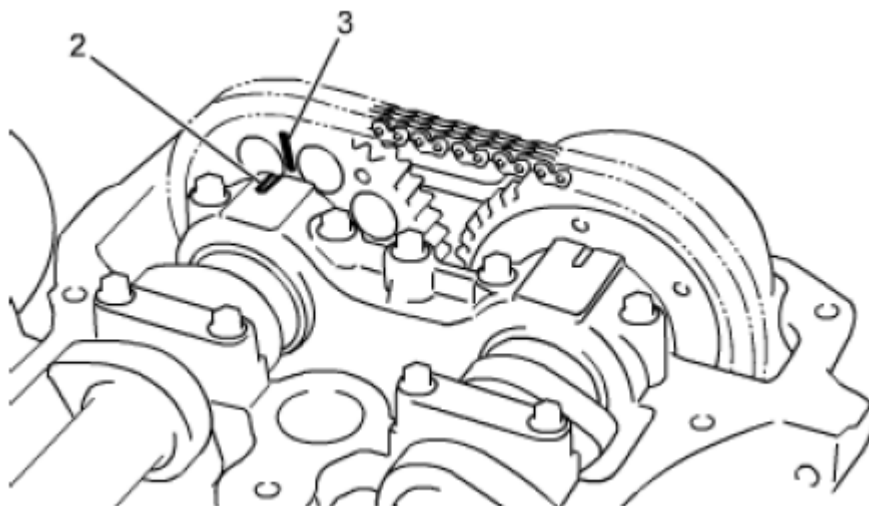


Fig. 9: Aligning Timing Mark On Exhaust Camshaft Timing Sprocket With Match Mark On Camshaft Housing 1
Courtesy of SUZUKI OF AMERICA CORP.

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.

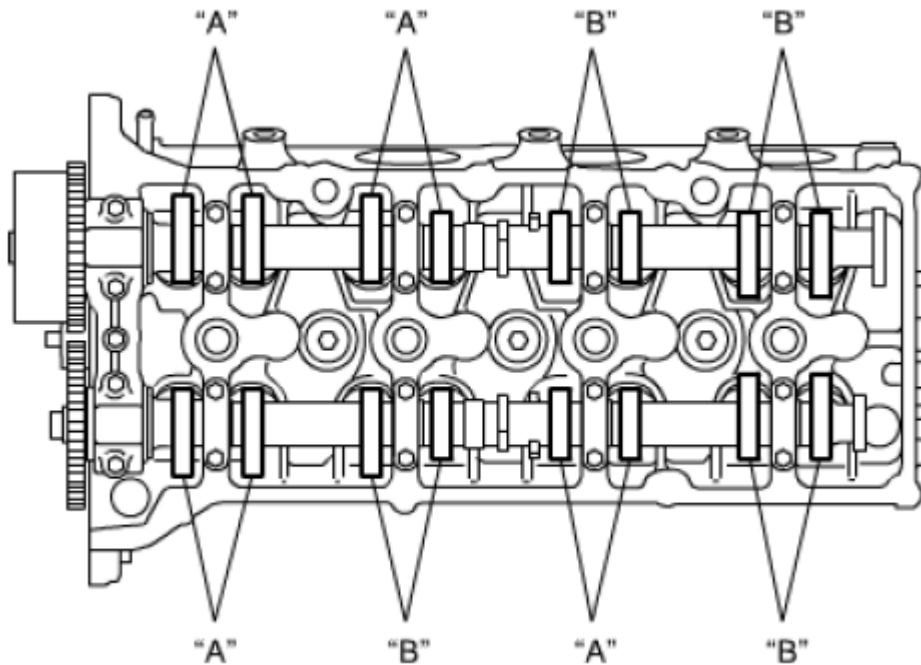


Fig. 10: Identifying Valve Clearances Of Indicated Valves (A And B)
Courtesy of SUZUKI OF AMERICA CORP.

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. Refer to **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

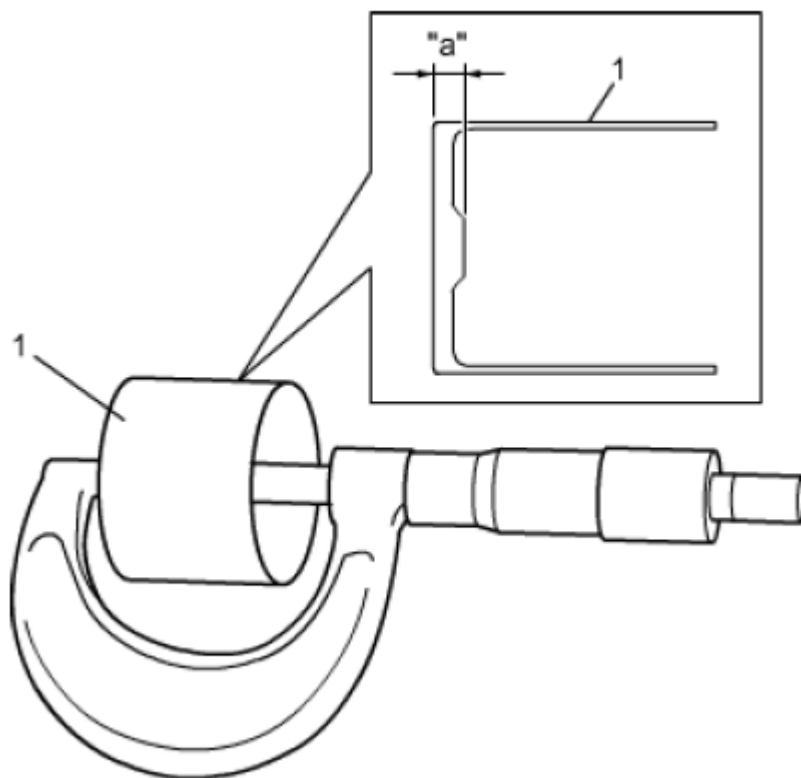


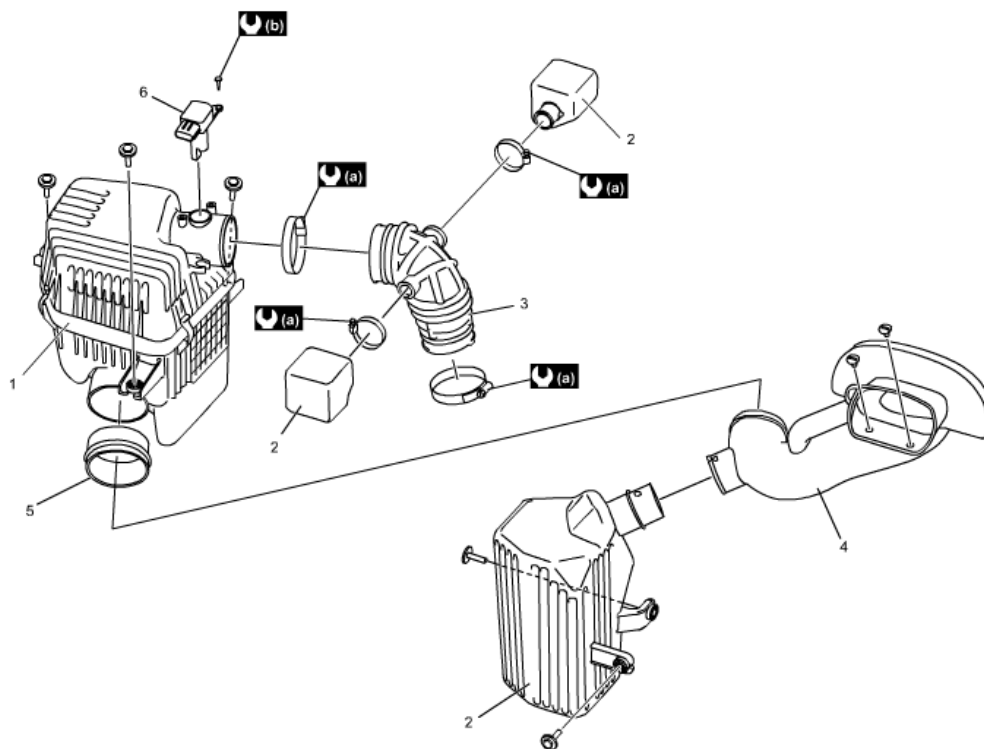
Fig. 11: Measuring Valve Clearance
Courtesy of SUZUKI OF AMERICA CORP.

- c. Select new tappet closest to calculated value from available size as a spare part.
3. Install tappets and camshafts. Refer to **Camshaft and Tappet Removal and Installation**.

4. Recheck valve clearance.

REPAIR INSTRUCTIONS

AIR CLEANER COMPONENTS



1. Air cleaner assembly	4. Air cleaner suction pipe	(a): 2.0 Nm (0.20 kgf-m, 1.5 lbf-ft)
2. Resonator	5. Suction pipe joint	(b): 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
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).

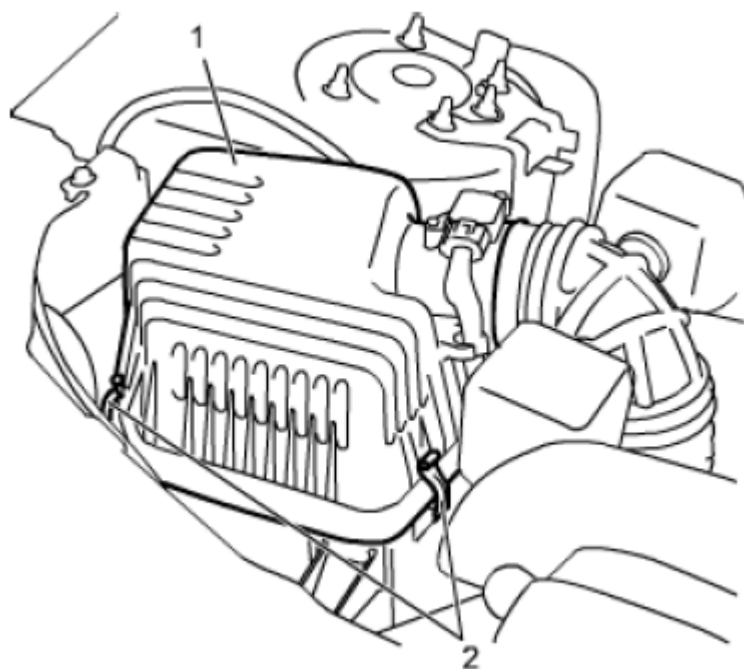


Fig. 13: Identifying Air Cleaner Case And Clamps
Courtesy of SUZUKI OF AMERICA CORP.

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.

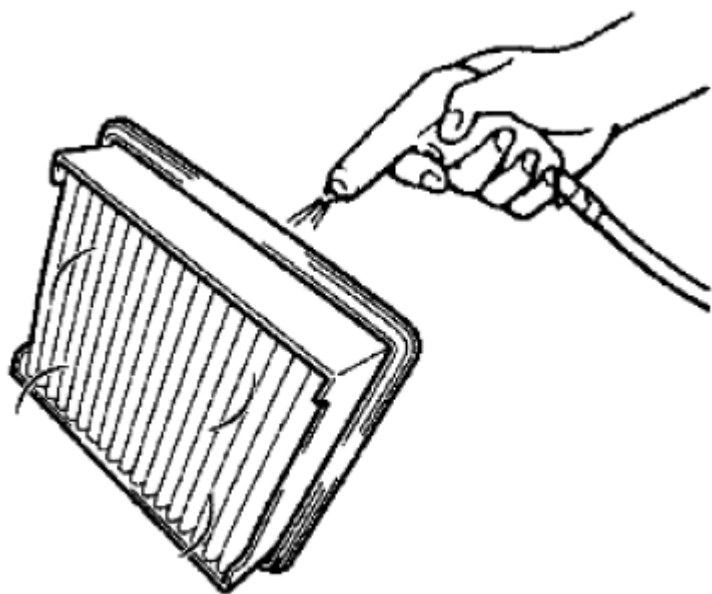


Fig. 14: Blowing Dust With Compressed Air From Air Outlet Side Of Filter
Courtesy of SUZUKI OF AMERICA CORP.

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).

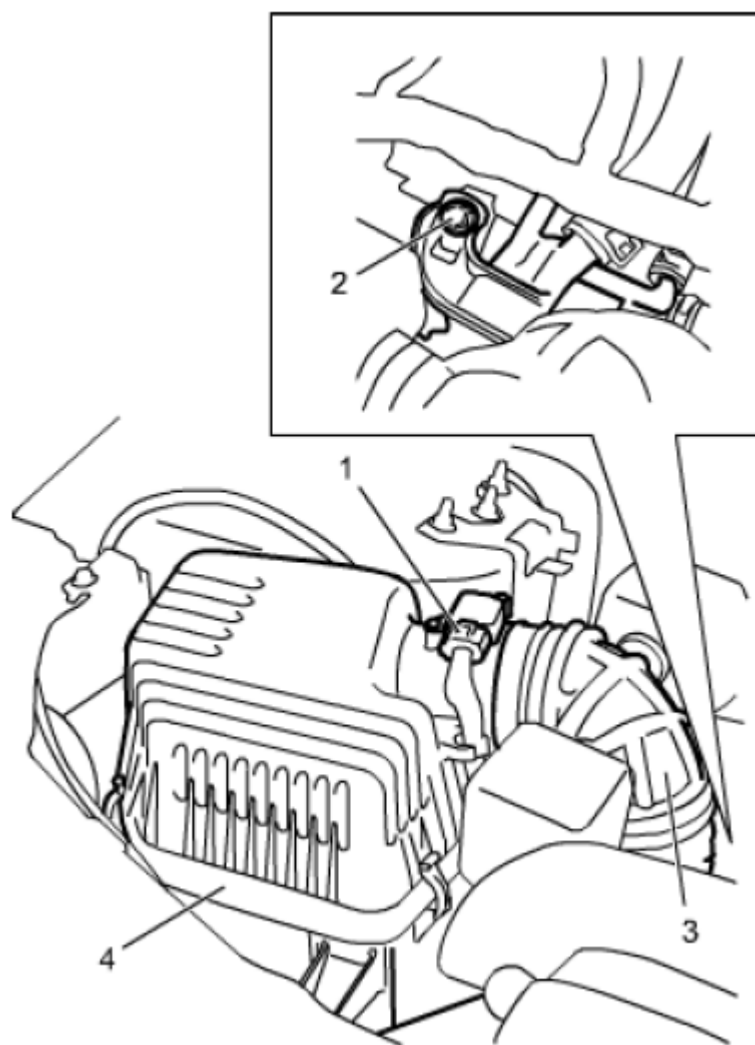
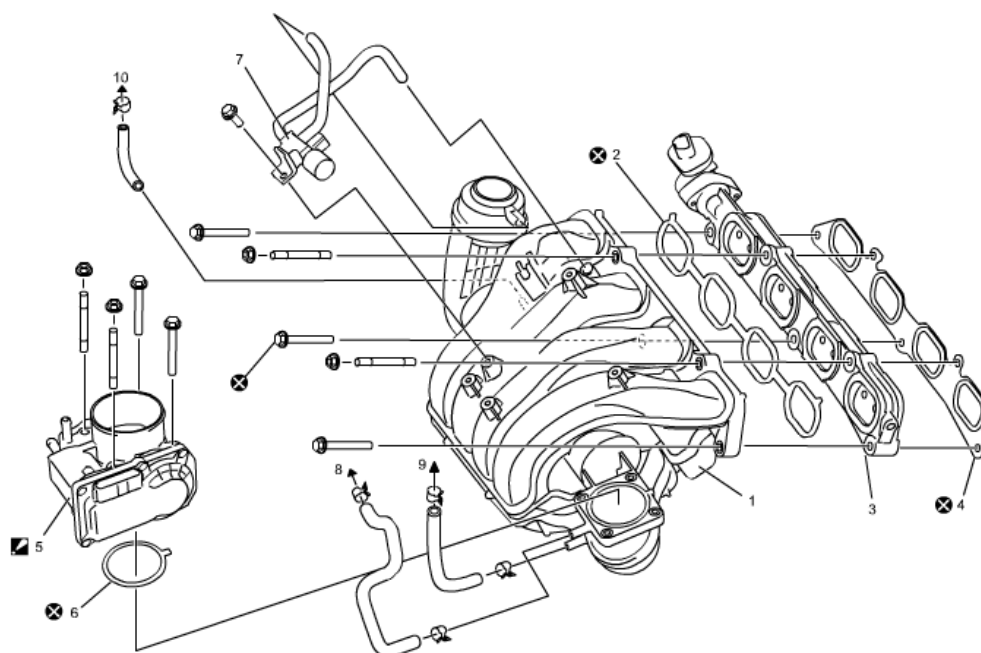


Fig. 15: Identifying Water Bypass Pipe Bolt, Air Cleaner Outlet Hose And Air Cleaner Assembly
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reverse removal procedure for installation.

THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS



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

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

NOTE: The throttle body will lose its original performance if it is disassembled.
Do not try to disassemble the throttle body.

Removal

1. Disconnect negative (-) cable from battery.
2. Drain coolant. Refer to COOLING SYSTEM DRAINING.
3. Remove water bypass pipe bolt (2).
4. Remove air cleaner outlet hose (1).

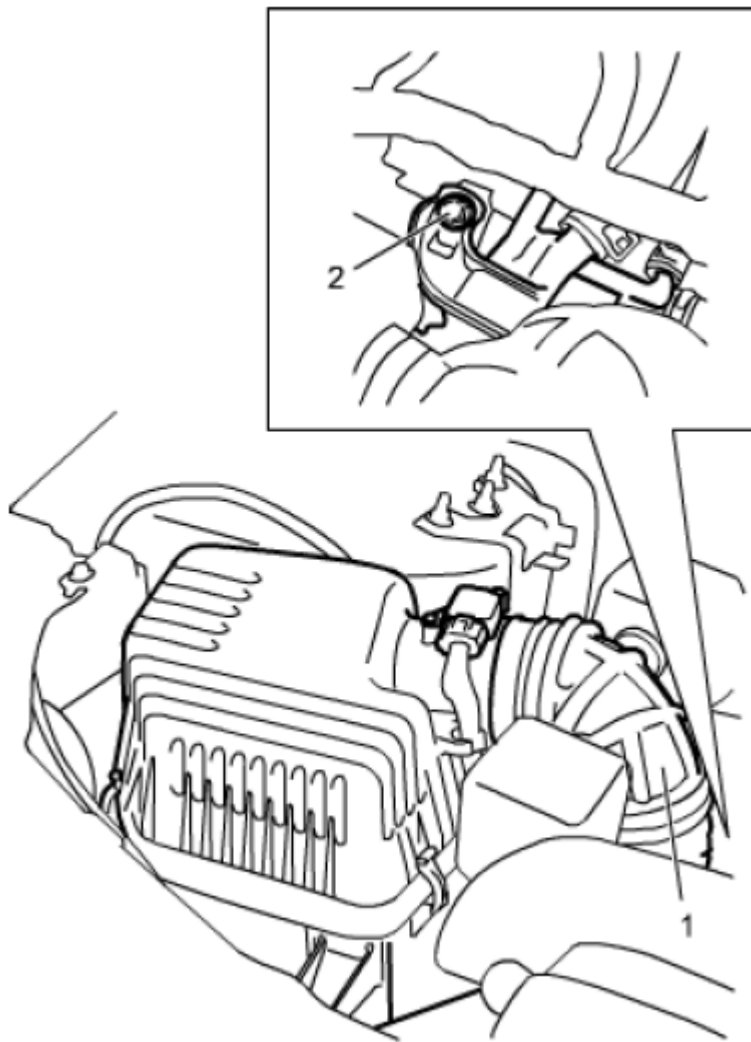


Fig. 17: Identifying Water Bypass Pipe Bolt And Air Cleaner Outlet Hose
Courtesy of SUZUKI OF AMERICA CORP.

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

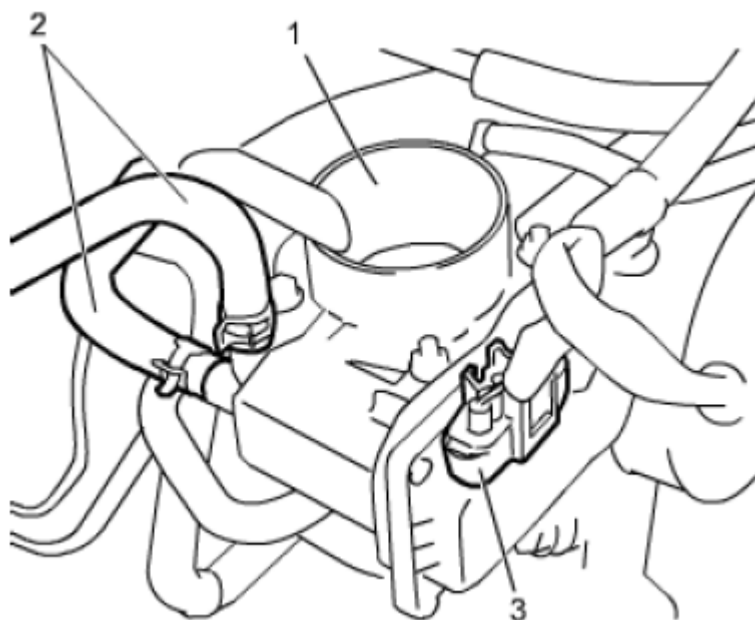


Fig. 18: Identifying Engine Coolant Hoses, Connector And Throttle Body Assembly
Courtesy of SUZUKI OF AMERICA CORP.

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.

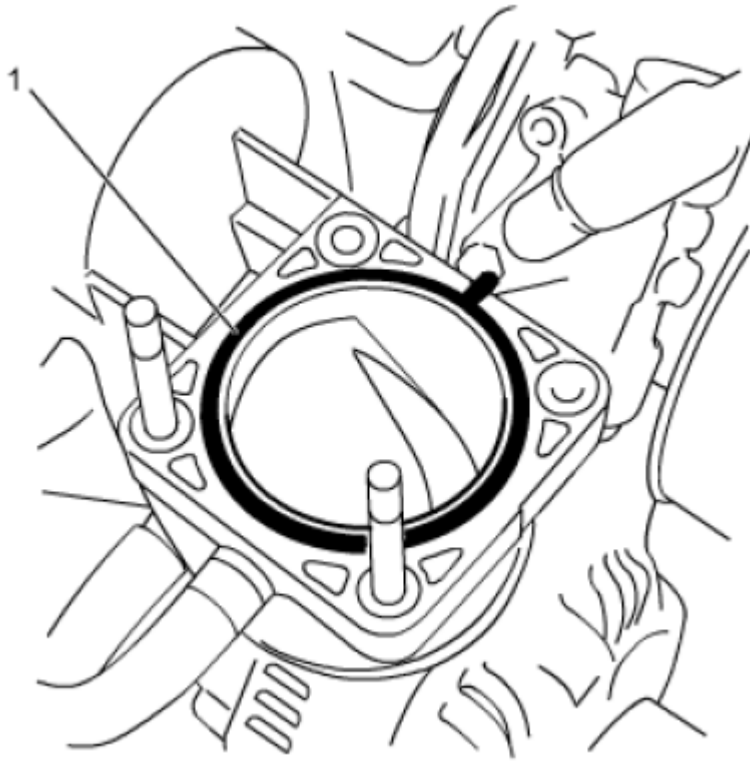


Fig. 19: Identifying Throttle Body Gasket To Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

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

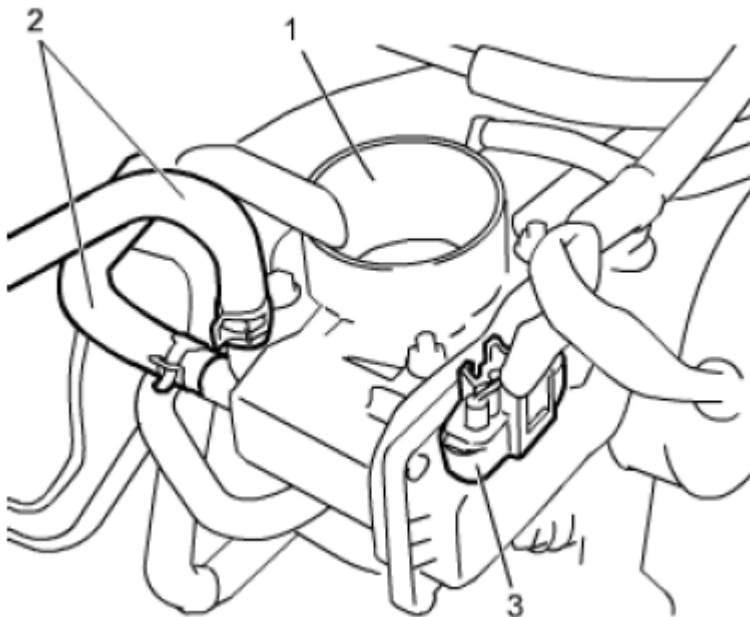


Fig. 20: Identifying Connector, Coolant Hoses And Throttle Body Assembly

Courtesy of SUZUKI OF AMERICA CORP.

4. Install air cleaner outlet hose. Refer to **Air Cleaner Assembly Removal and Installation.**
5. Refill cooling system. Refer to **COOLING SYSTEM REFILLING** .
6. Connect negative (-) cable to battery.
7. Check for coolant leaks. Refer to **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. Refer to **Air Cleaner Filter Removal and Installation.**
4. Remove throttle body assembly. Refer to **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 (A/T model): Refer to **OIL COOLER HOSE AND PIPE COMPONENTS** .
 - Engine harness clamps
 - Brake vacuum pipe. Refer to **BRAKE BOOSTER COMPONENTS** .

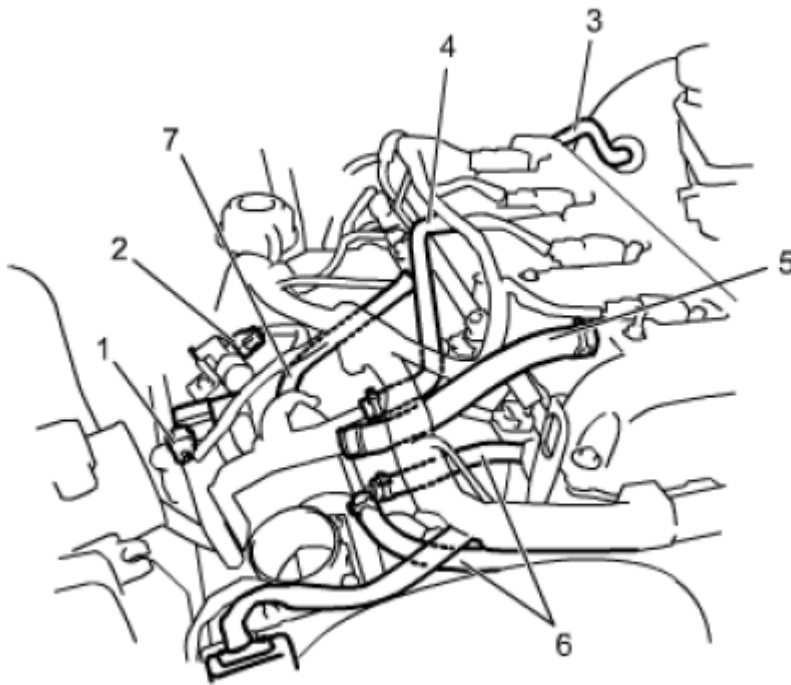


Fig. 21: Identifying Intake Manifold Components
 Courtesy of SUZUKI OF AMERICA CORP.

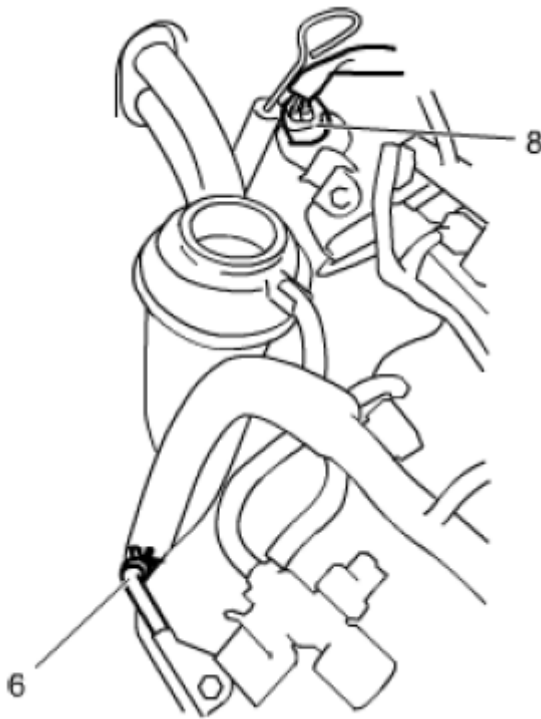


Fig. 22: Identifying IMRC Valve Actuator Connector And Engine Coolant Hoses
 Courtesy of SUZUKI OF AMERICA CORP.

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

from cylinder head.

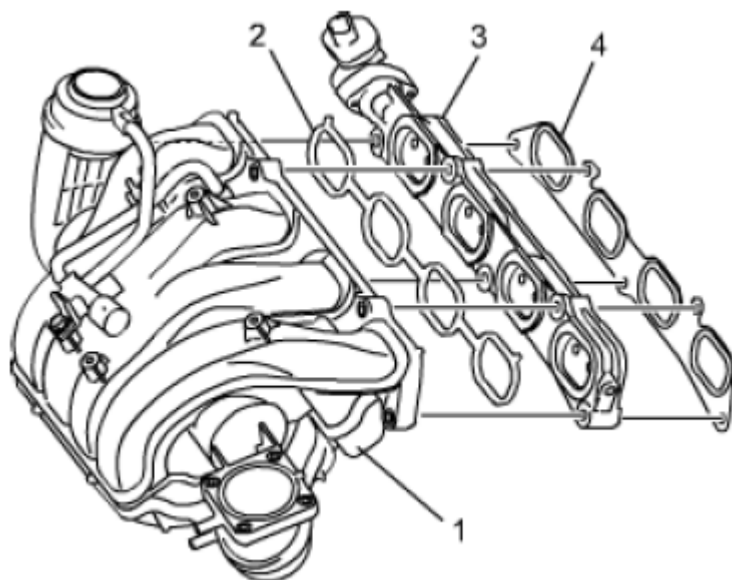


Fig. 23: Identifying Intake Manifold, Intake Manifold Gasket, IMRC Valve And IMRC Valve Gasket

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.

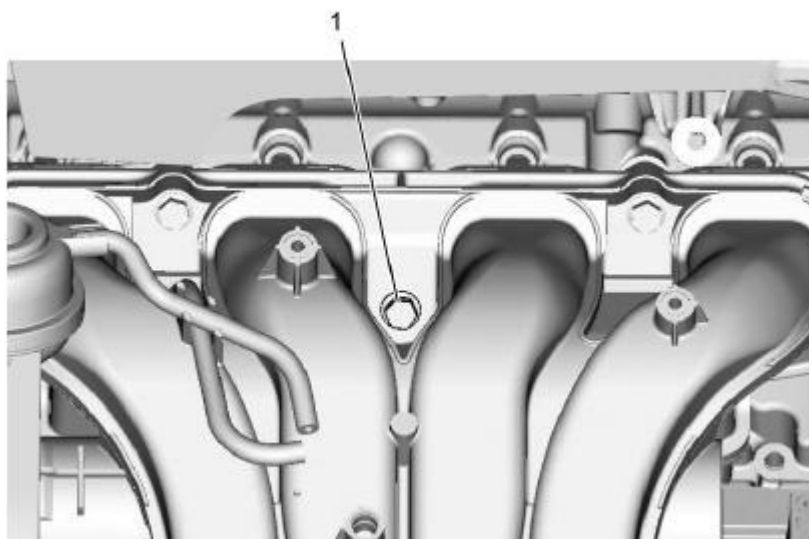


Fig. 24: Identifying Intake Manifold Bolt

Courtesy of SUZUKI OF AMERICA CORP.

- Use new gaskets
- Refill cooling system. Refer to **COOLING SYSTEM REFILLING** .
- Check for coolant leaks. Refer to **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).

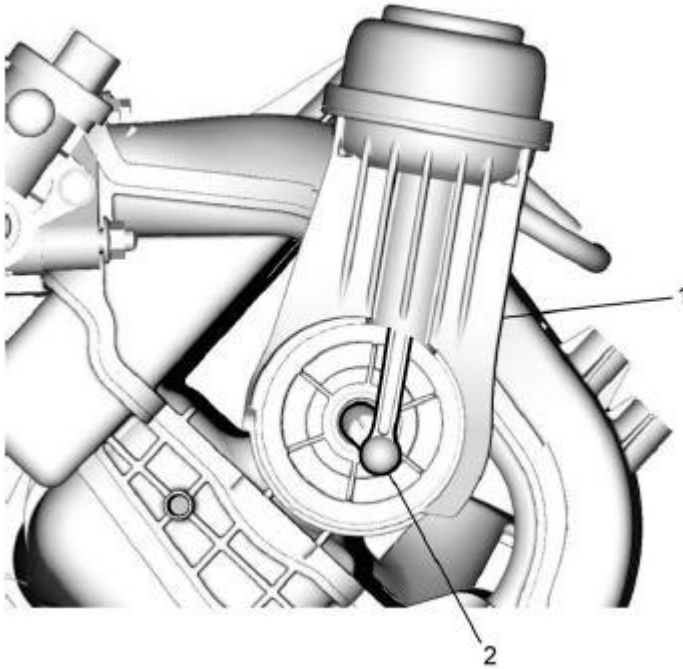


Fig. 25: Checking IMT Valve Actuator At Fully Open Position
Courtesy of SUZUKI OF AMERICA CORP.

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

NOTE: If too high a vacuum is applied, the IMT valve actuator may be damaged.
Do not exceed a vacuum of standard value.

Special Tool

(A): 09917-47011

Actuation vacuum specification

Standard value: -33 kpa (-0.3 kgf/cm² , -4.79 psi, -0.33 bar)

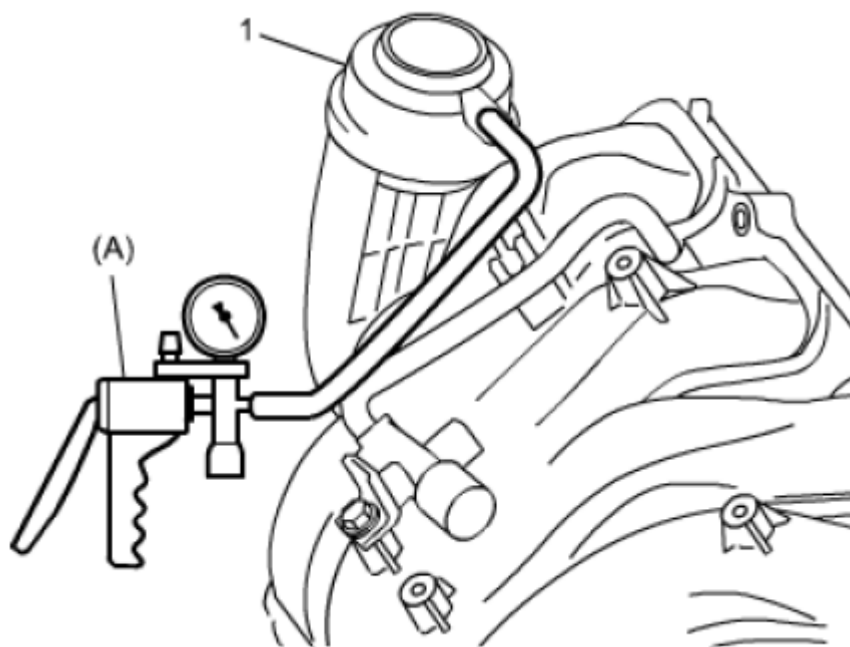


Fig. 26: Connecting Special Tool To IMT Valve Actuator And Vacuum
Courtesy of SUZUKI OF AMERICA CORP.

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

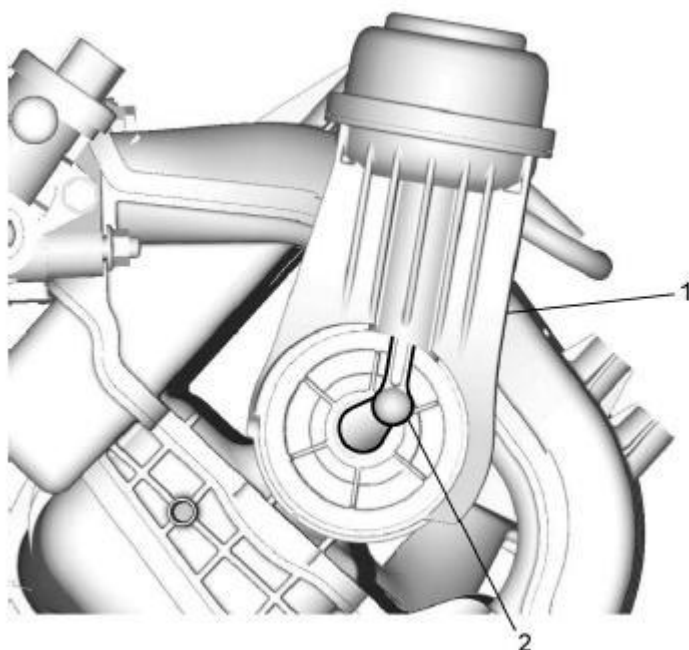


Fig. 27: Checking IMT Valve Actuator Sets Valve To Fully Closed Position
Courtesy of SUZUKI OF AMERICA CORP.

- 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 . Refer to **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

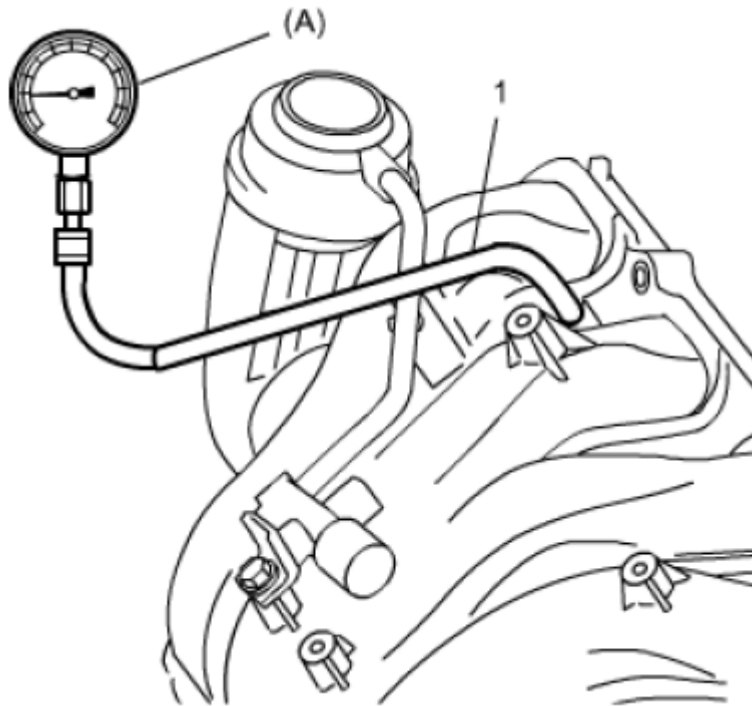


Fig. 28: Connecting Special Tool To Vacuum Hose
Courtesy of SUZUKI OF AMERICA CORP.

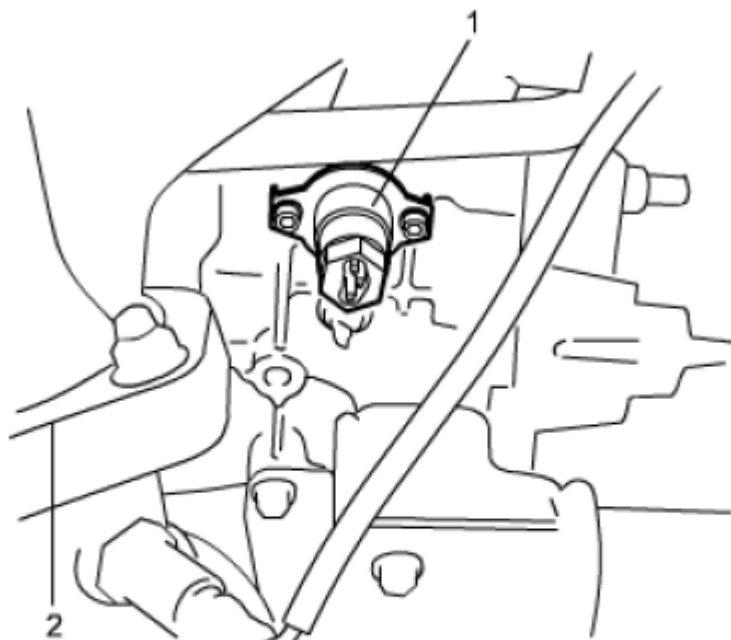
2. Run engine at specified idle speed and check that engine vacuum is standard value . Refer to **Engine Vacuum Check**.
3. Stop engine and check that engine vacuum is held for longer than one minute.

If any abnormality is found, replace intake manifold assembly . Refer to **Intake Manifold Removal and Installation**.

CYLINDER BLOCK HEATER REMOVAL AND INSTALLATION (IF EQUIPPED)

Removal

1. Disconnect negative (-) cable from battery.
2. Drain coolant. Refer to **COOLING SYSTEM DRAINING**.
3. Remove exhaust manifold cover.



2. Exhaust manifold

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

4. Remove engine block heater (1).

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 kgf-m, 8.5 lbf-ft)

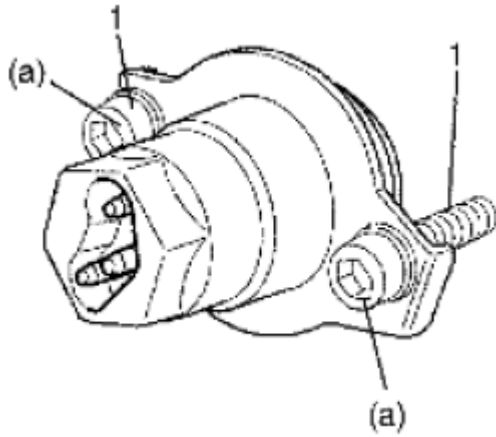


Fig. 30: Identifying Cylinder Block Heater Bolt
Courtesy of SUZUKI OF AMERICA CORP.

- Refill coolant. Refer to **COOLING SYSTEM REFILLING** .
- Check for coolant leaks. Refer to **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 . Refer to **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 . Refer to **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 . Refer to **Cylinder Block Heater Removal and Installation (If Equipped)**.

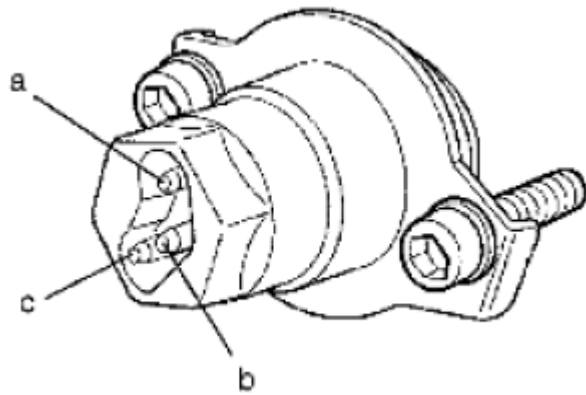
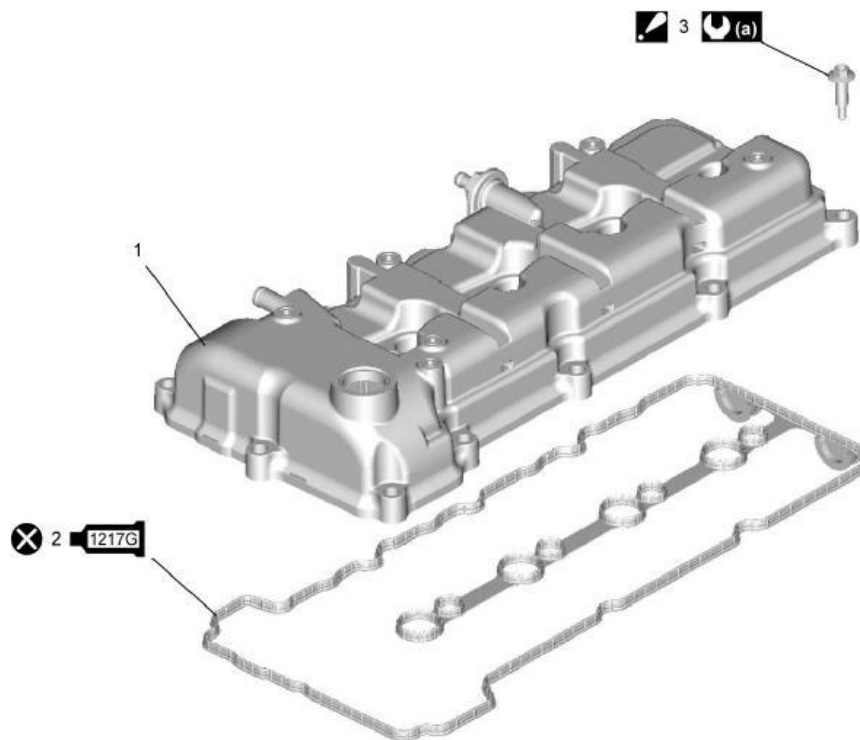


Fig. 31: Checking Continuity Between Terminal B And Engine Block Heater Body
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD COVER COMPONENTS





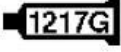

1. Cylinder head cover	 3. Cylinder head cover bolt : For tightening order, refer to Cylinder Head Cover Removal and Installation .	 : Do not reuse.
 2. Cylinder head cover gasket : Apply sealant 99000-31260 referring to Cylinder Head Cover Removal and Installation .	 (a) : 3.0 N·m → 5.0 N·m → 7.5 N·m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

Fig. 32: Identifying Cylinder Head Cover Components
 Courtesy of SUZUKI OF AMERICA CORP.

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 . Refer to **IGNITION COIL ASSEMBLY REMOVAL AND INSTALLATION** .
4. Disconnect PCV valve hose (1) and breather hose (2).
5. Detach engine harness clamps.

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

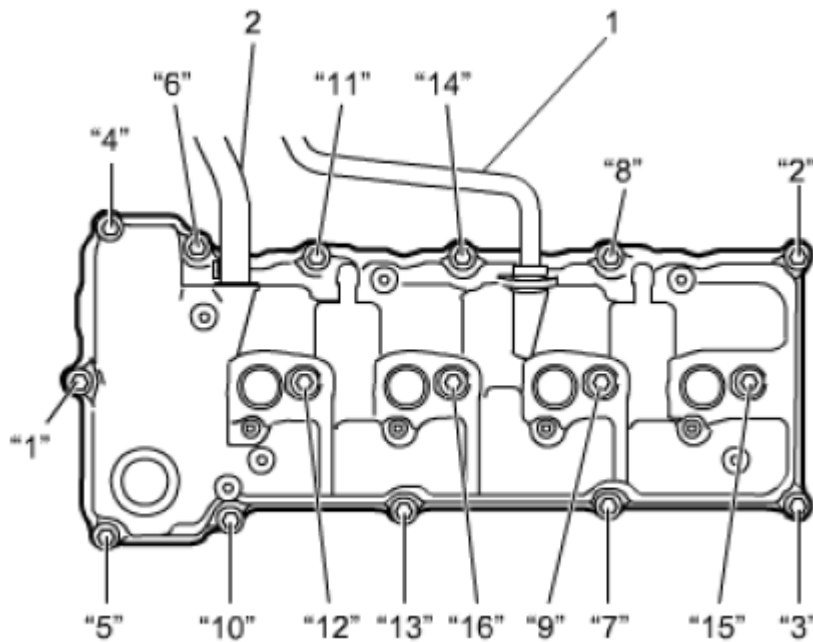


Fig. 33: Identifying Cylinder Head Cover Bolts Loosening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

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

Installation

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

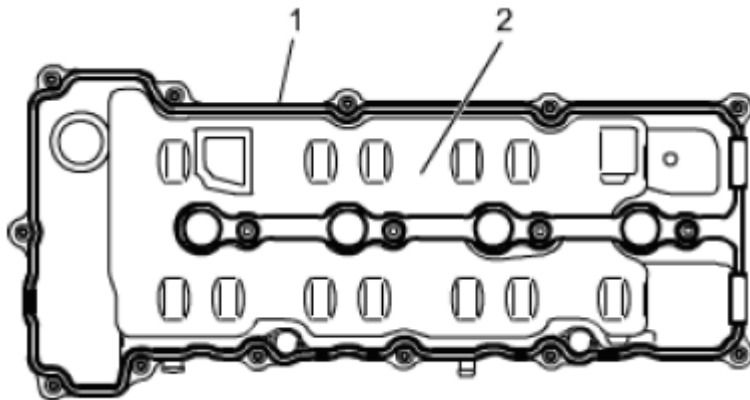


Fig. 34: Identifying Cylinder Head Cover Gasket And Cylinder Head Cover
Courtesy of SUZUKI OF AMERICA CORP.

2. 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)

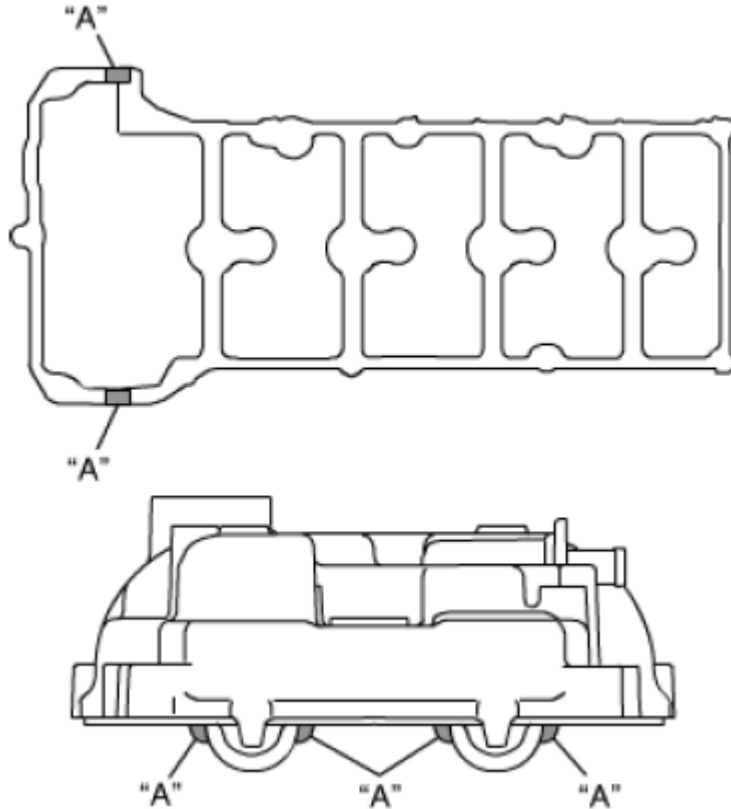


Fig. 35: Identifying Sealing Surfaces On Cylinder Head And Cover
Courtesy of SUZUKI OF AMERICA CORP.

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. 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.

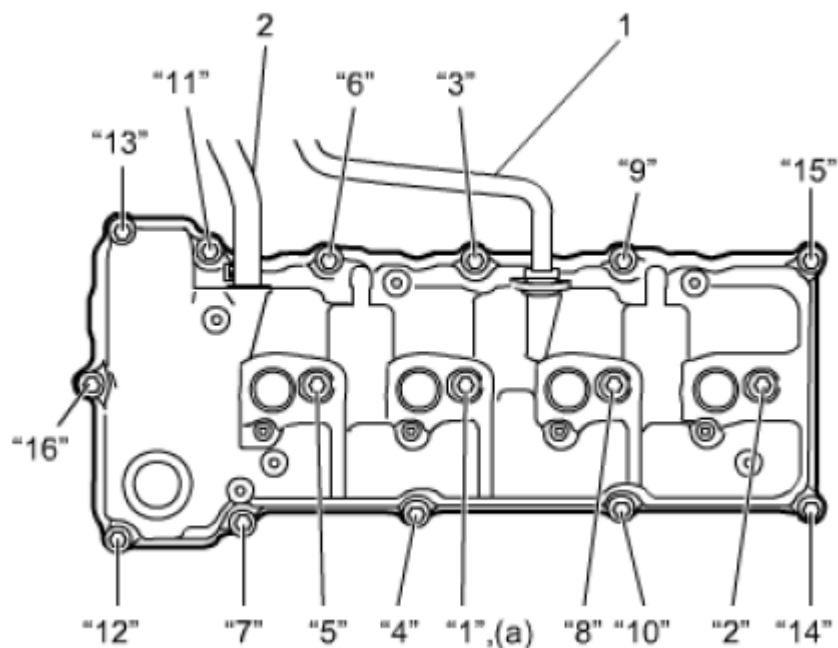
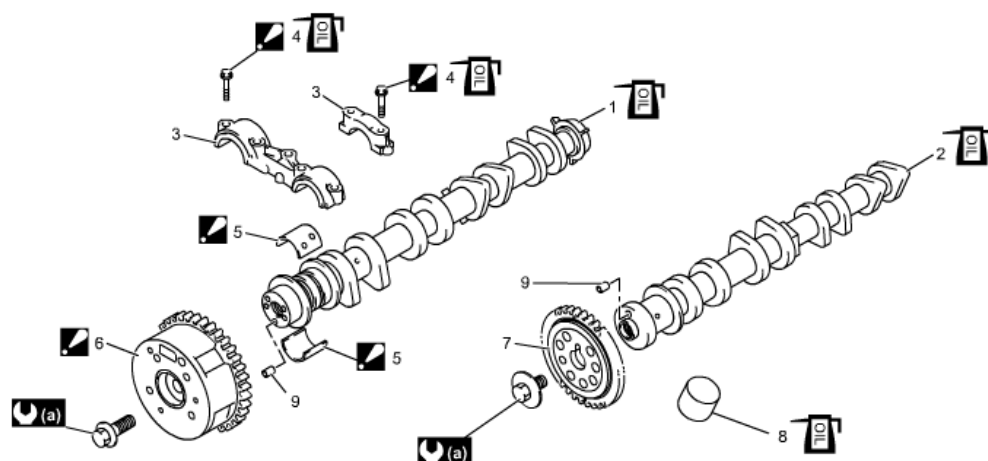


Fig. 36: Identifying Cylinder Head Cover Bolts Tightening Sequence
 Courtesy of SUZUKI OF AMERICA CORP.

6. Install ignition coil assemblies. Refer to **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 <u>Camshaft and Tappet Removal and Installation.</u> : To distinguish upper and lower, refer to <u>Camshaft and Tappet Removal and Installation.</u>	9. Dowel pin
 2. Exhaust camshaft : Apply engine oil to sliding surface.	 6. CMP actuator : Do not disassemble.	 (a): 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 <u>Camshaft and Tappet Removal and Installation.</u>	 8. Tappet : Apply engine oil to sliding surface.	

Fig. 37: Identifying Camshaft And Tappet Components
Courtesy of SUZUKI OF AMERICA CORP.

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. Refer to **Cylinder Head Cover Removal and Installation.**
2. Remove accessory drive belt. Refer to **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.

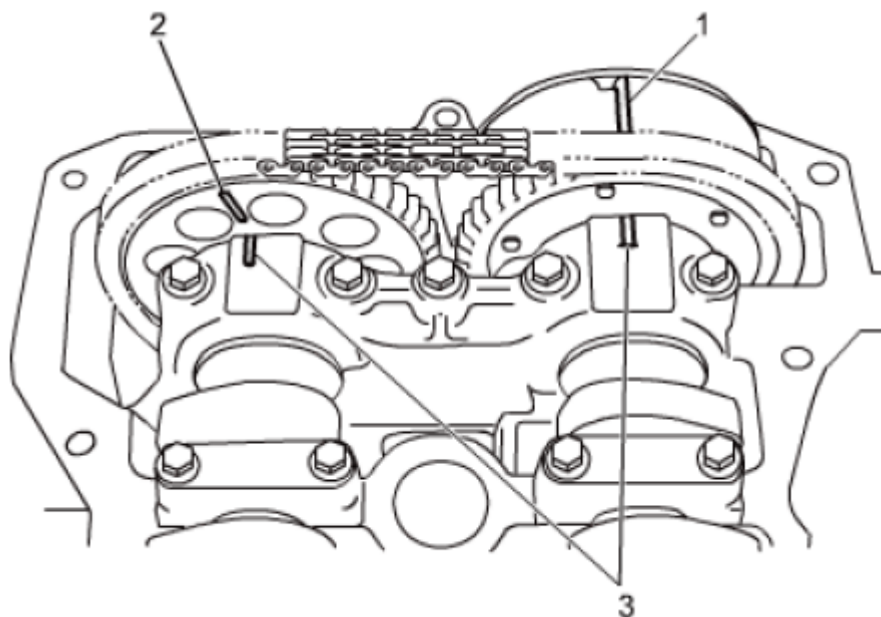


Fig. 38: Identifying Timing Mark On CMP Actuator Exhaust And Camshaft Timing Sprocket

Courtesy of SUZUKI OF AMERICA CORP.

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

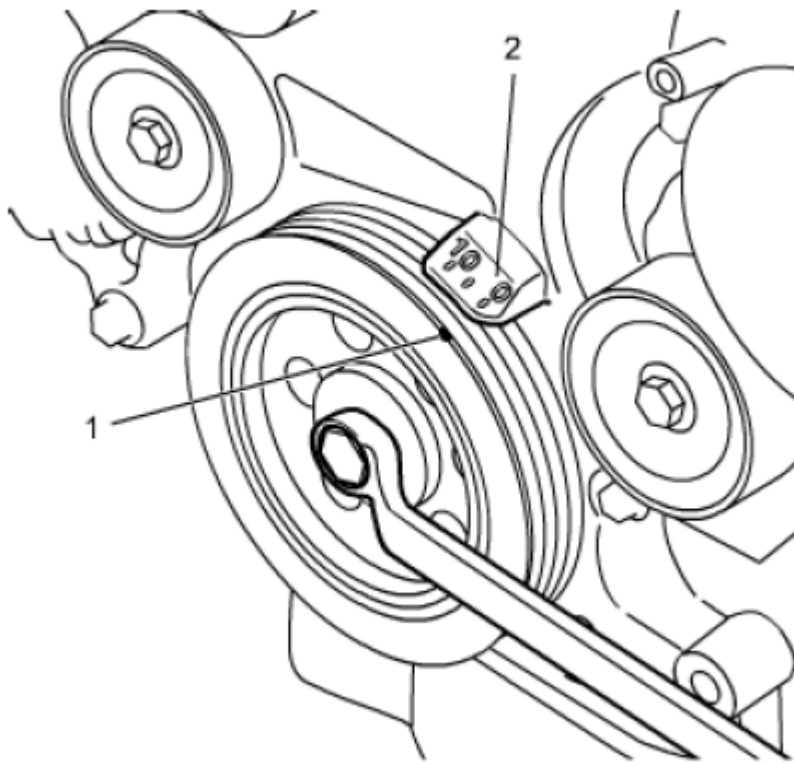


Fig. 39: Aligning Notch On Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

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

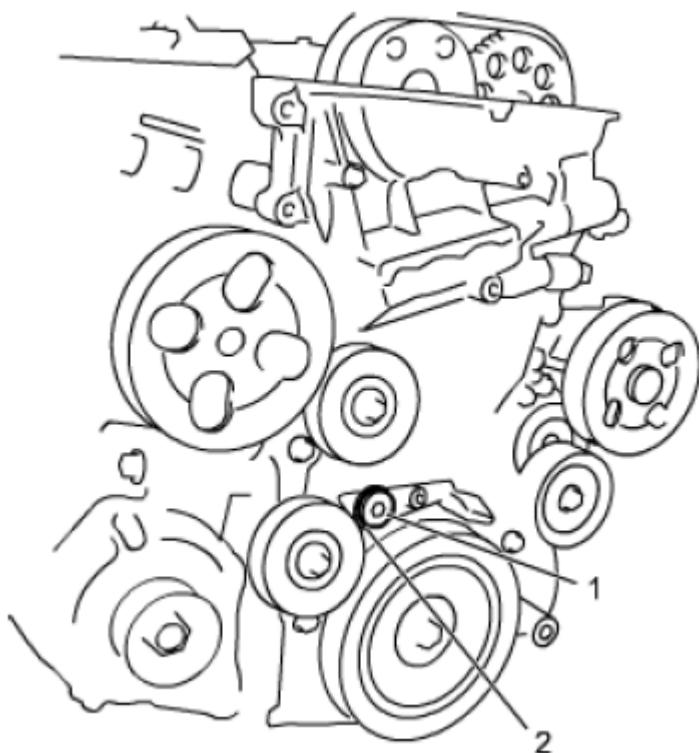


Fig. 40: Identifying Timing Chain Cover Plug And Gasket
Courtesy of SUZUKI OF AMERICA CORP.

- 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): 09917-16710

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

NOTE: • Use the following bolt for special tool fixing bolt.

Special tool fixing bolt

Bolt size: M6

Pitch: 1.0 mm (0.039 in.)

Length "a": 15.0 mm (0.0590 in.)

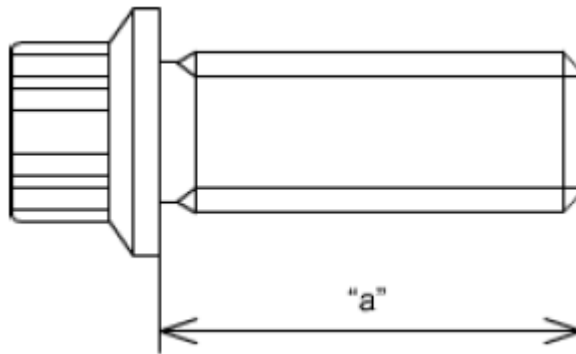


Fig. 41: Identifying Special Tool Fixing Bolt Dimension
Courtesy of SUZUKI OF AMERICA CORP.

- Do not turn crankshaft after timing chain is fixed with special tool.

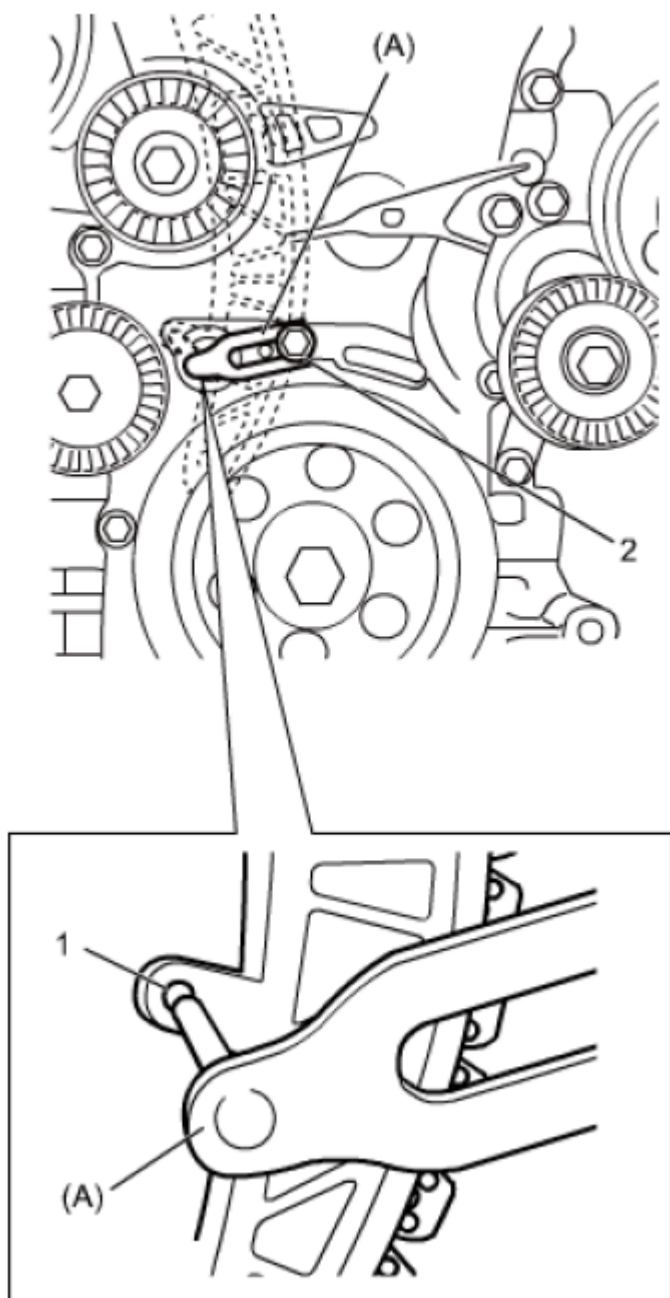


Fig. 42: Identifying Timing Chain Links
Courtesy of SUZUKI OF AMERICA CORP.

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.

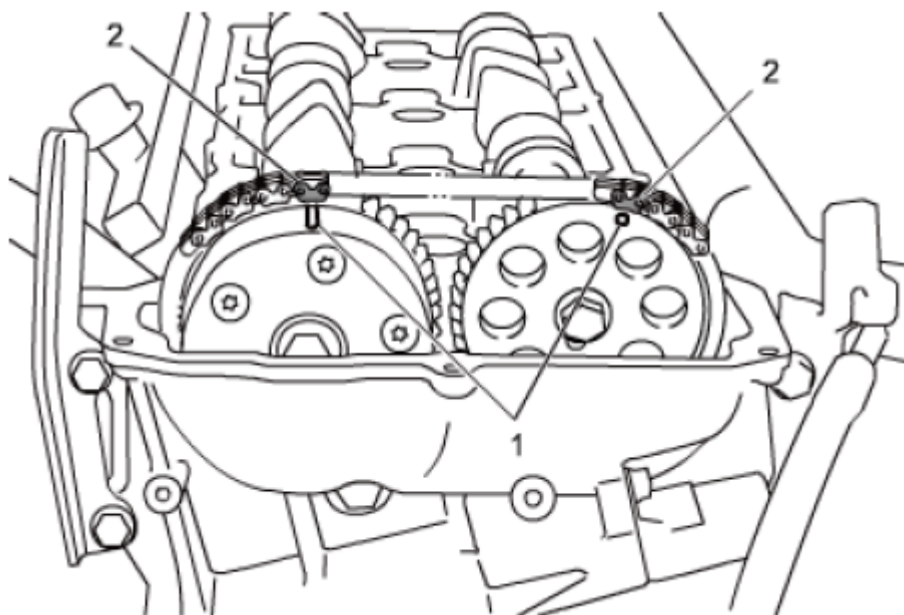


Fig. 43: Identifying Exhaust Camshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

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).

NOTE:

- 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.

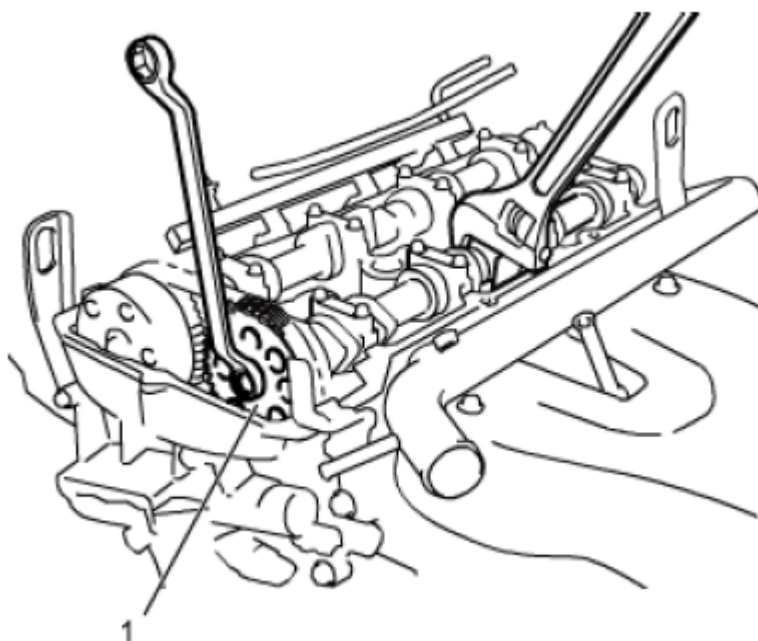


Fig. 44: Loosening Exhaust Camshaft Timing Sprocket Bolt
 Courtesy of SUZUKI OF AMERICA CORP.

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

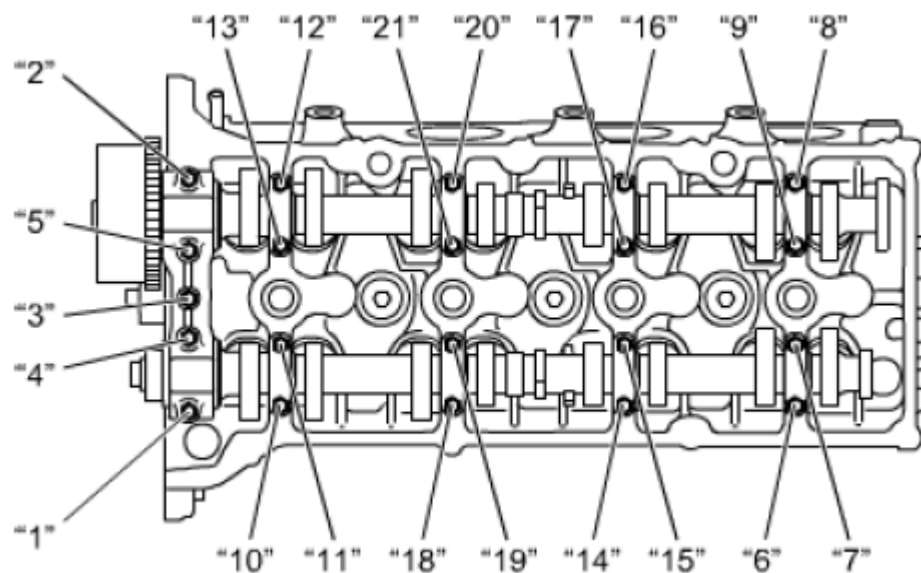


Fig. 45: Identifying Camshaft Housing Bolts In Numerical Order
 Courtesy of SUZUKI OF AMERICA CORP.

9. Remove intake camshaft and exhaust camshaft.

NOTE: Be careful not to drop timing chain into timing chain cover.

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).

NOTE: The CMP actuator will lose its original performance if it is disassembled. Do not try to disassemble and repair the CMP actuator. If any faulty condition is found, replace the CMP actuator with a new one.

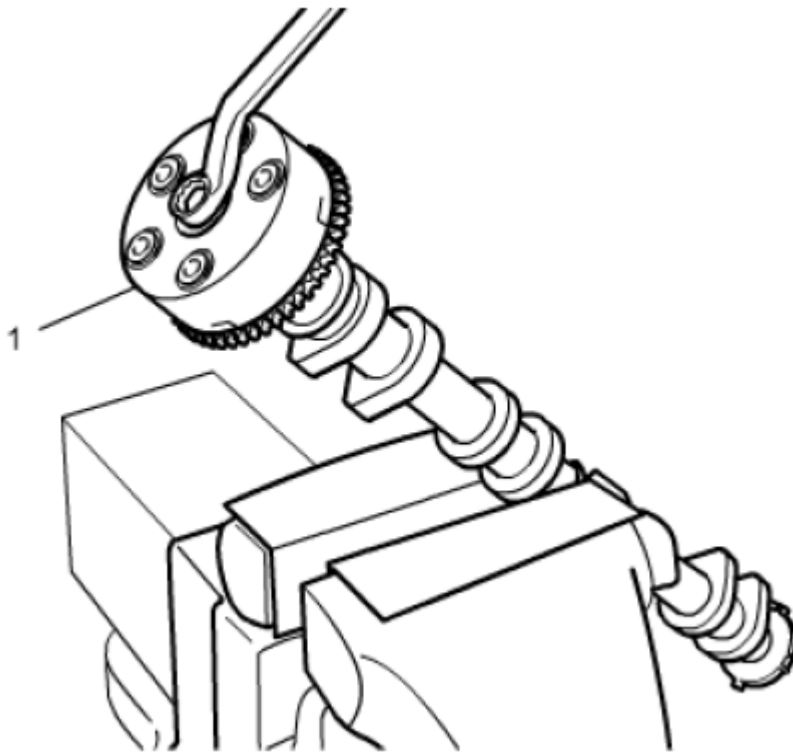


Fig. 46: Loosening CMP Actuator Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 44.5 lbf-ft)

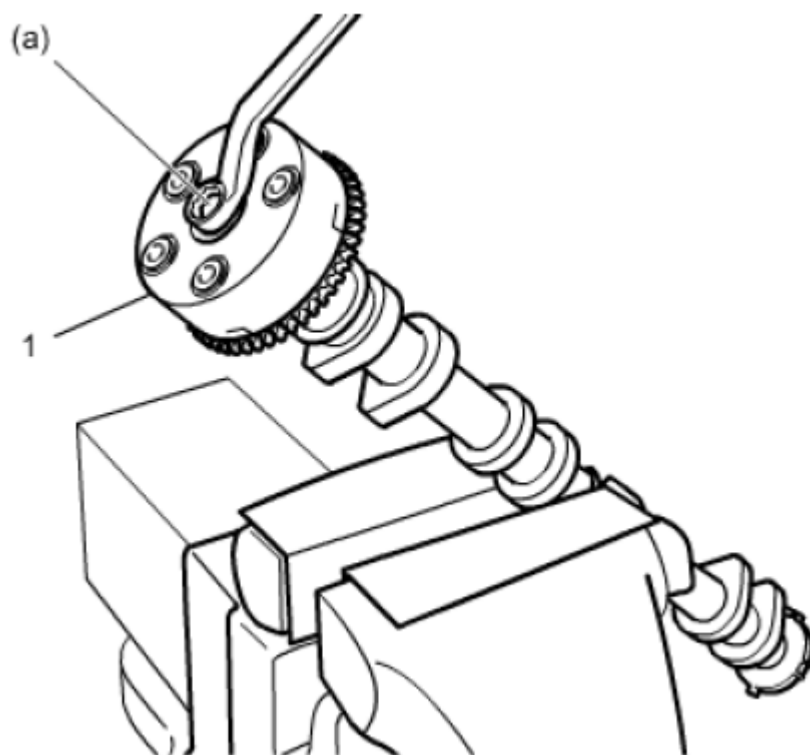


Fig. 47: Installing CMP Actuator To Intake Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

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

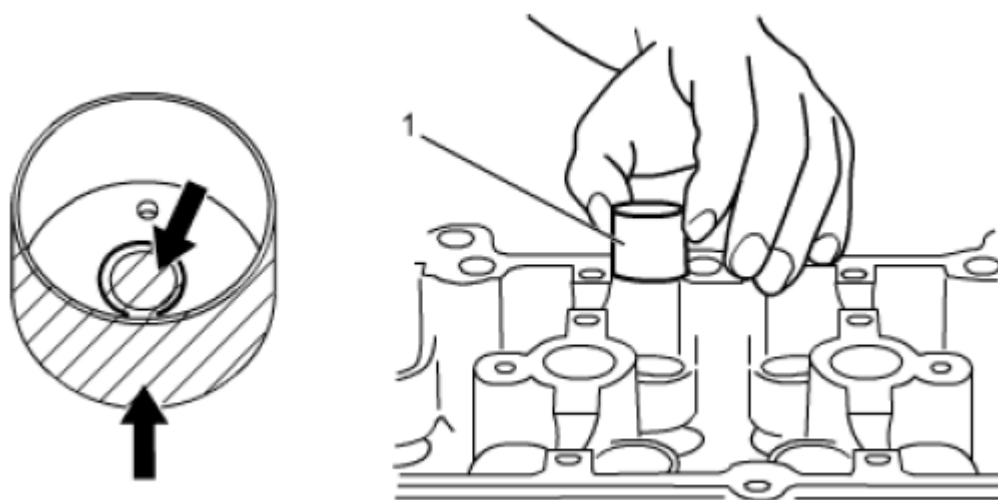


Fig. 48: Installing Tappets To Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

3. Install camshaft bearings according to the following procedure.

NOTE: The camshaft upper bearing (1) is different in shape from the camshaft

lower bearing (2). If these bearings are installed in the wrong (reverse) positions, the VVT system will have operational problems and/or the camshaft could seize up. Be sure to install the bearings in the specified positions.

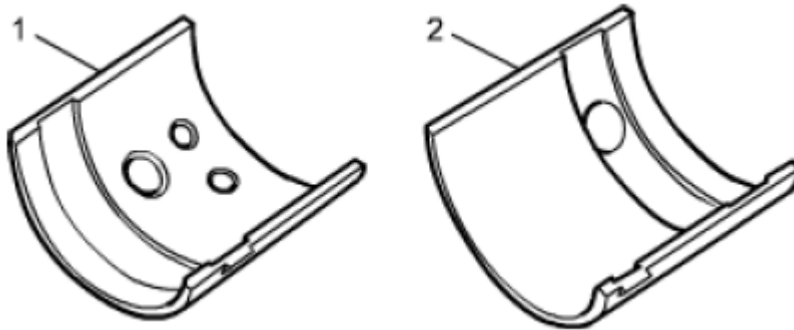


Fig. 49: Identifying Upper And Lower Bearing
Courtesy of SUZUKI OF AMERICA CORP.

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

NOTE: If oil is present between the bearing's outside surface and the camshaft housing/cylinder head surface, the bearing could heat up to very high temperature, resulting in seizure. Be sure to thoroughly wipe off any trace of oil that is present between the bearing's outside surface (5) and the camshaft housing/cylinder head surface.

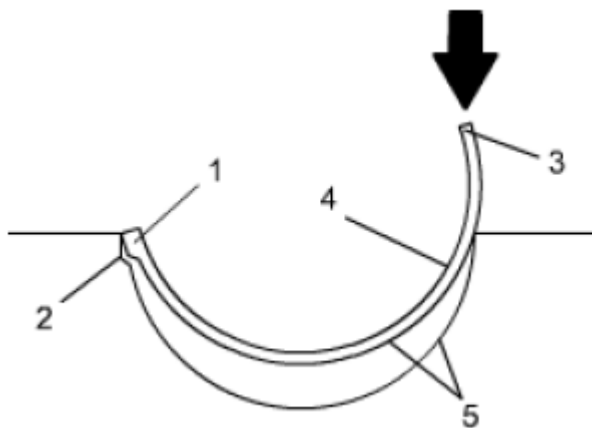


Fig. 50: Pressing Camshaft Bearing End In Cylinder Head And Camshaft Housing
Courtesy of SUZUKI OF AMERICA CORP.

- 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 section, 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.

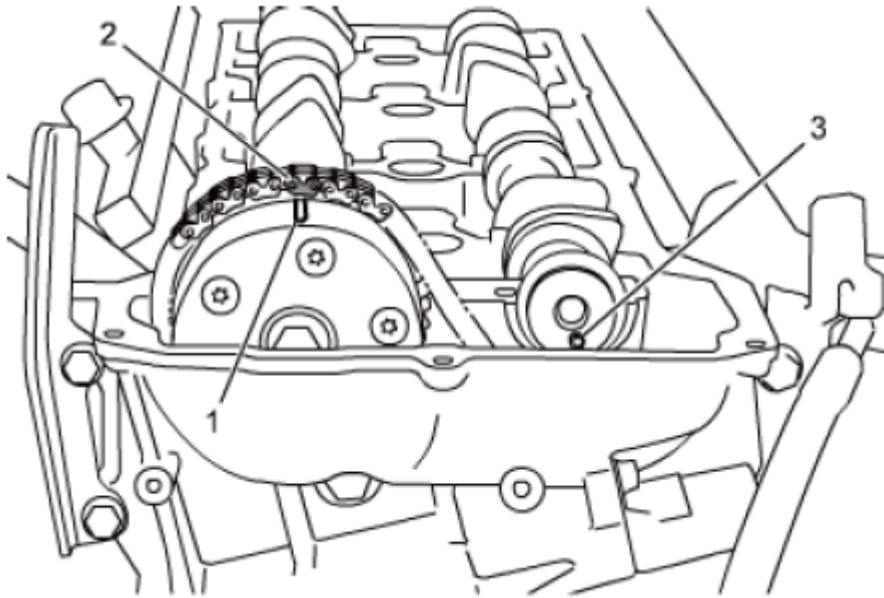
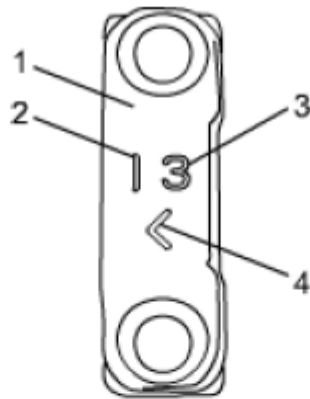


Fig. 51: Identifying Timing Mark On CMP Actuator And Intake Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 8.5 lbf-ft)

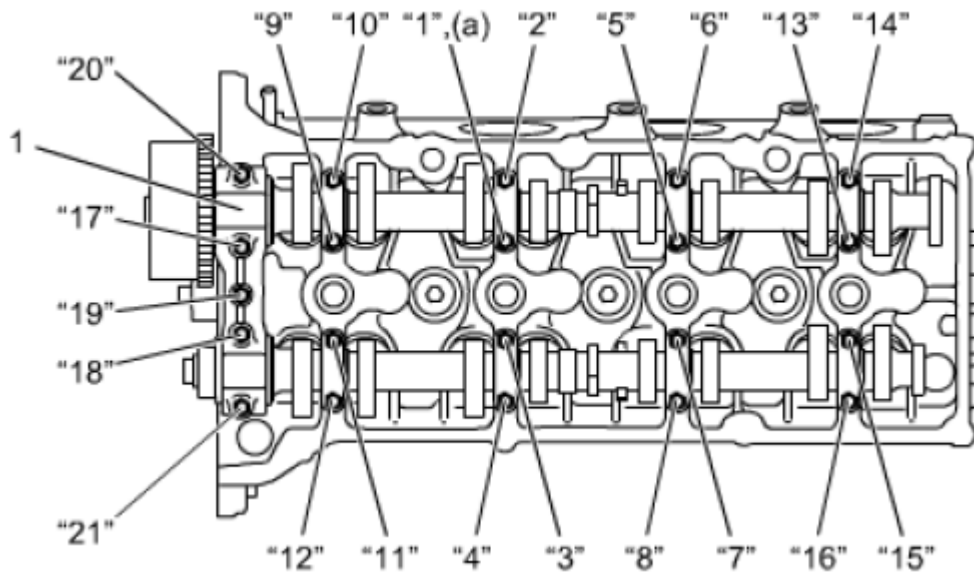


Fig. 53: Identifying Camshaft Housing Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

7. Install dowel pin to exhaust camshaft.

NOTE: 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 section, 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.

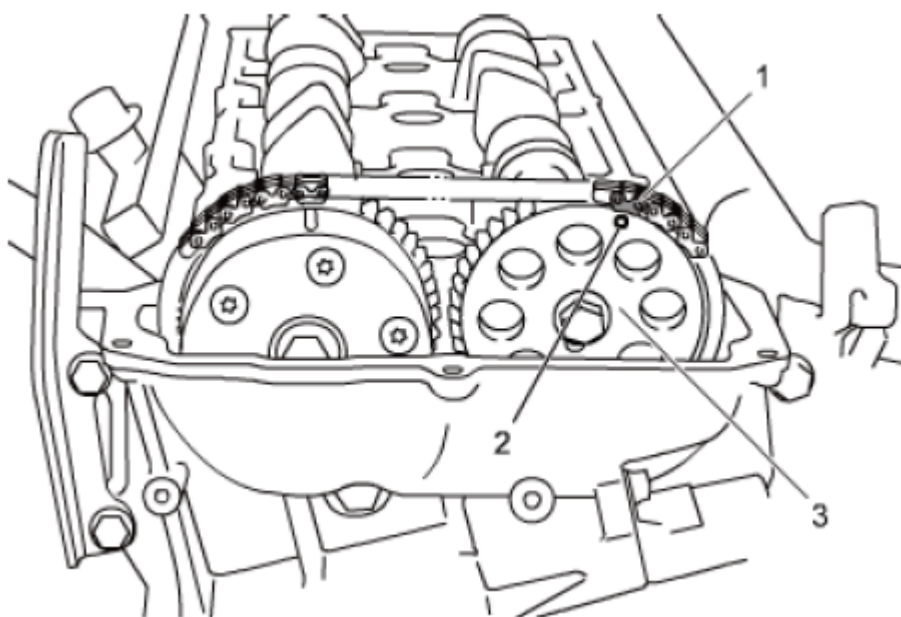


Fig. 54: Identifying Exhaust Camshaft Timing Sprocket And Exhaust Camshaft
 Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 44.5 lbf-ft)

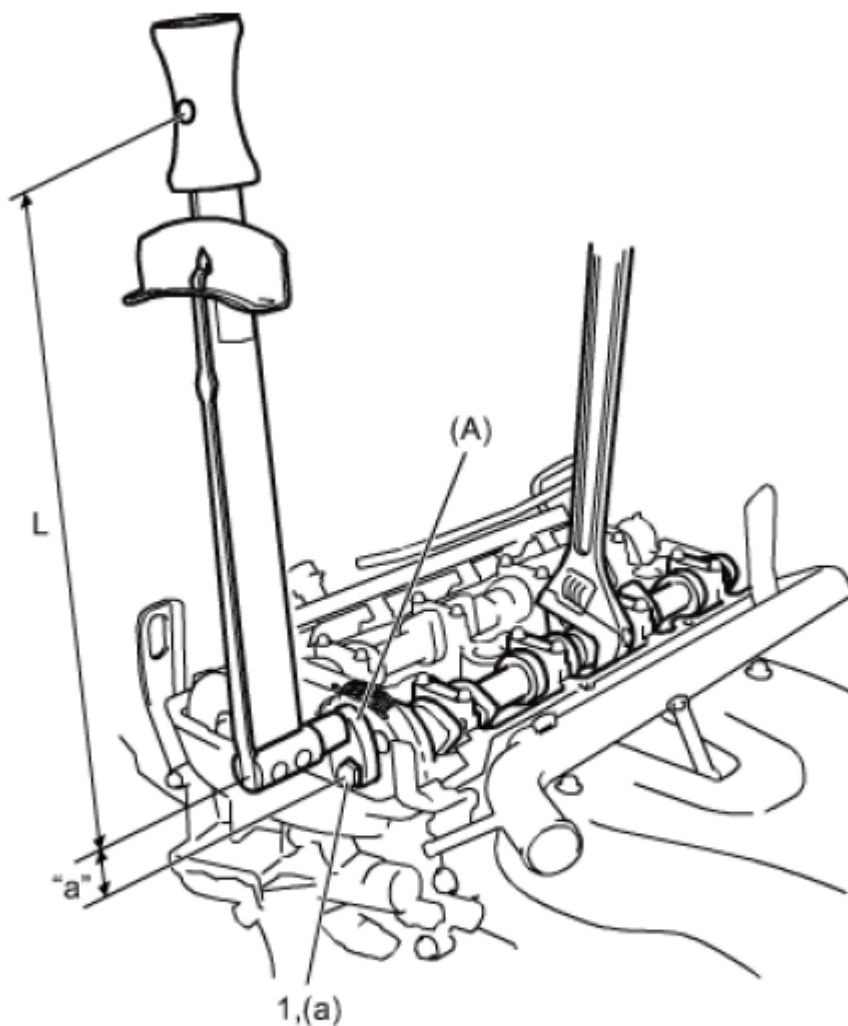
NOTE: If the bolt is tightened using the extension special tool until the torque wrench reads the specified torque, the bolt will actually be tightened to a torque much more than the specified torque. This could cause damage to the related components.
 Use the formula shown below to determine the correct reading of the torque wrench for its length. Then tighten the bolt until the torque wrench indicates the value thus determined.

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.

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

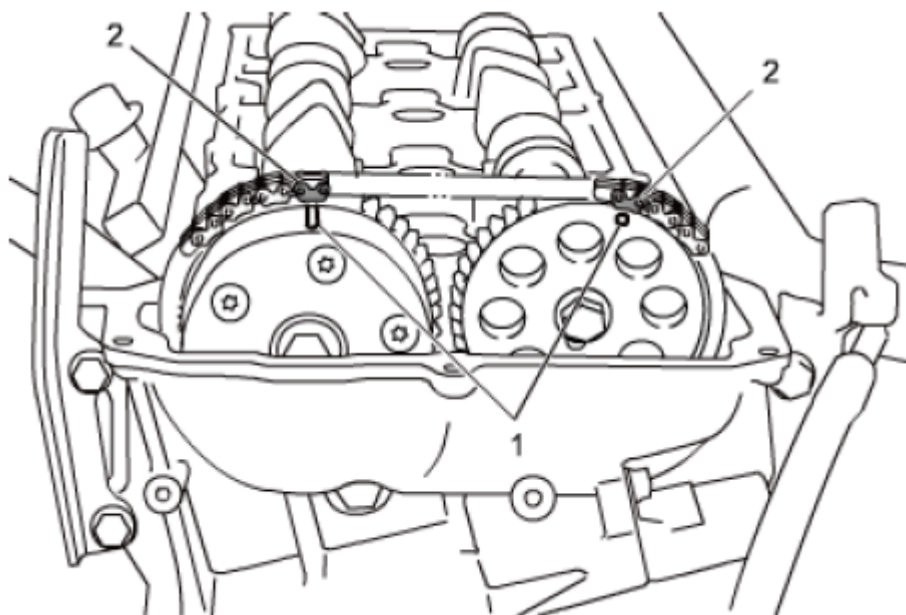


Fig. 56: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 20.0 lbf-ft)

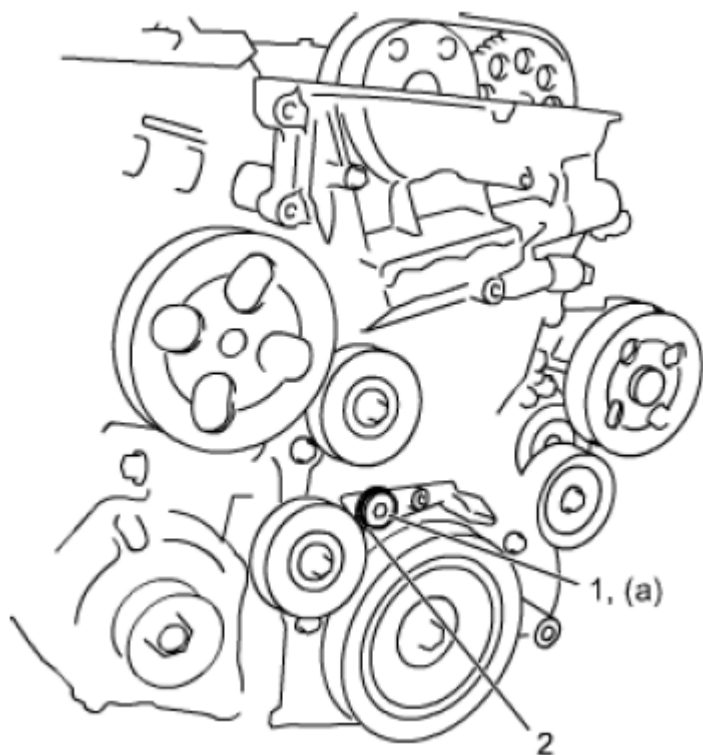


Fig. 57: Identifying Timing Chain Cover Plug And Gasket
Courtesy of SUZUKI OF AMERICA CORP.

13. Check that camshaft and timing chain are installed properly as follows.
 - a. 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.

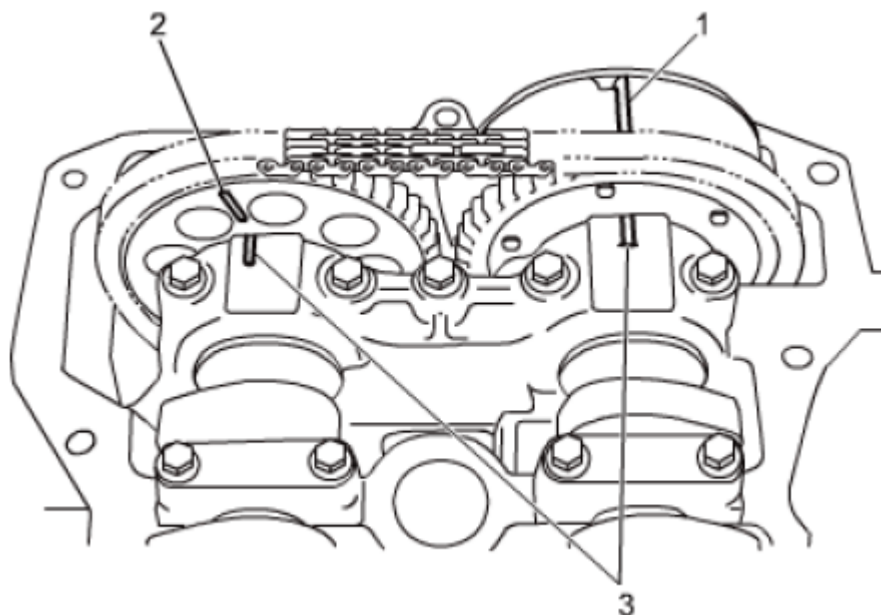


Fig. 58: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

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

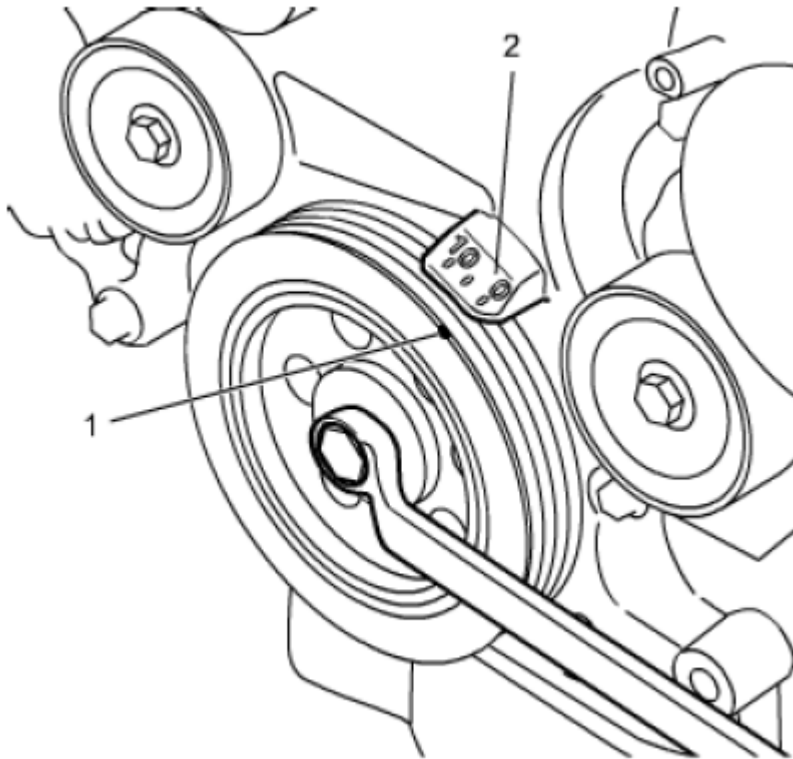


Fig. 59: Identifying Notch On Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

- 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. Refer to Valve Clearance Inspection and Adjustment.
15. Install cylinder head cover. Refer to 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.)

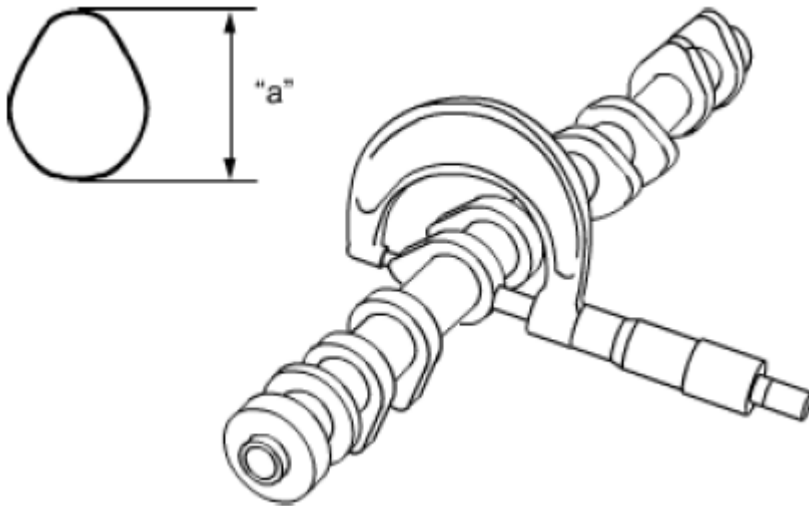


Fig. 60: Measuring Cam Height

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.

Camshaft runout limit

0.015 mm (0.00050 in.)

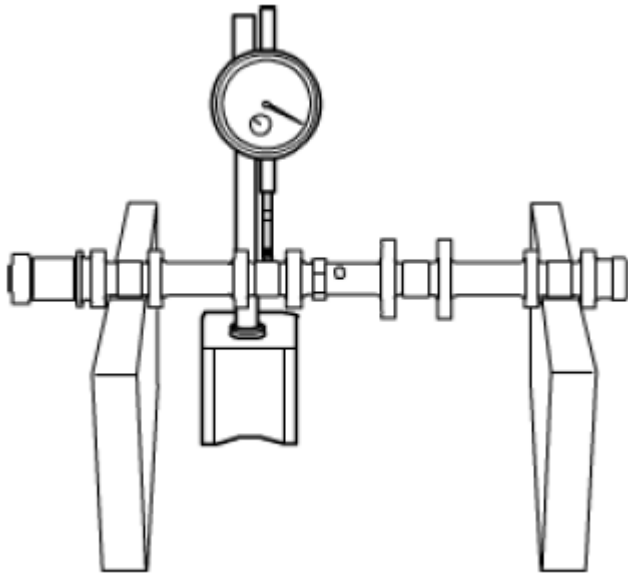


Fig. 61: Checking Camshaft Runout
Courtesy of SUZUKI OF AMERICA CORP.

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.

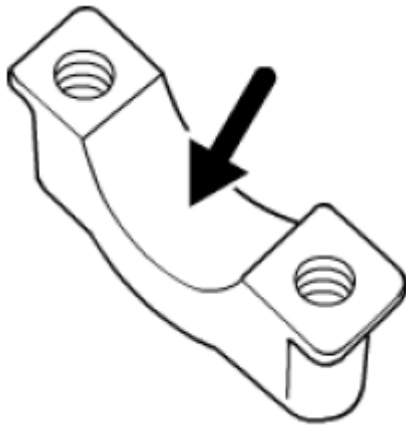


Fig. 62: Identifying Camshaft Journal
Courtesy of SUZUKI OF AMERICA CORP.

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*** .

NOTE: 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.)

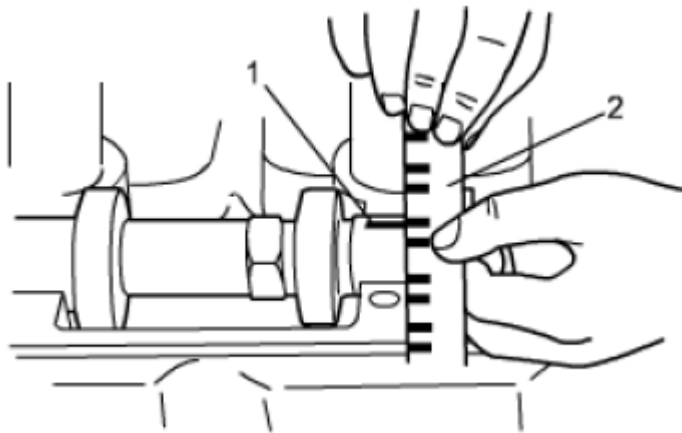


Fig. 63: Measuring Gauging Plastic Width At Widest Point
Courtesy of SUZUKI OF AMERICA CORP.

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

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

Item	
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.)

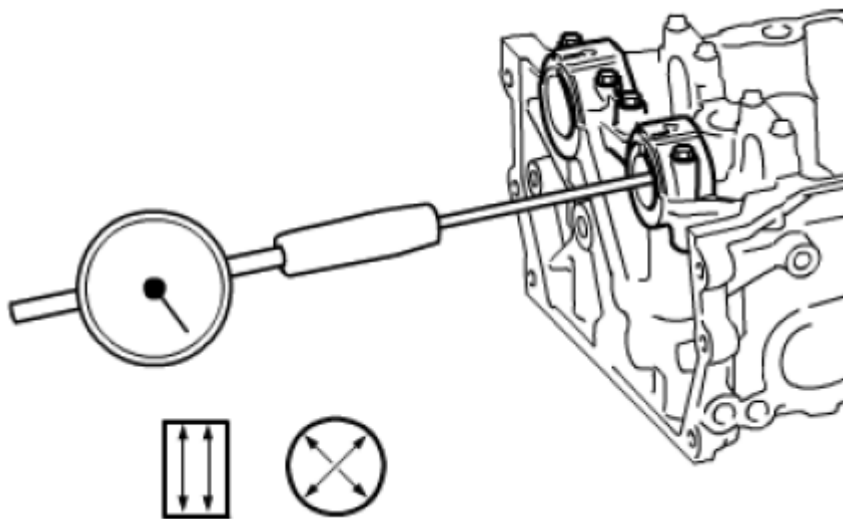


Fig. 64: Measuring Camshaft Housing Outside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

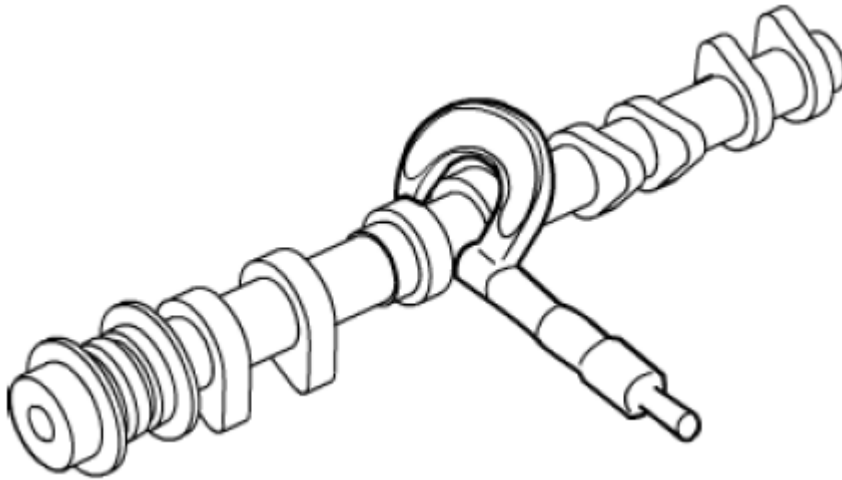


Fig. 65: Measuring Camshaft Housing Inside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

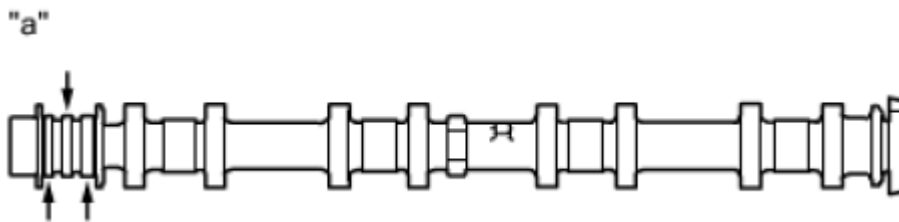


Fig. 66: Identifying Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

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.)

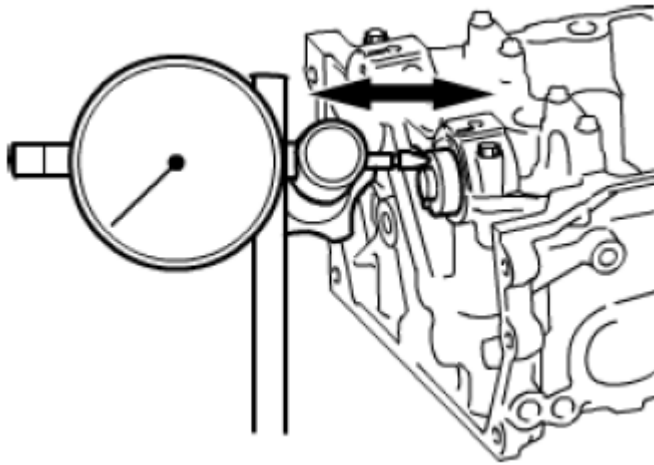


Fig. 67: Measuring Intake And Exhaust Camshaft Housing Thrust Clearance With Dial Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Wear of Tappet

Check tappet for pitting, scratches, or damage.

If any defective condition is found, replace tappet.

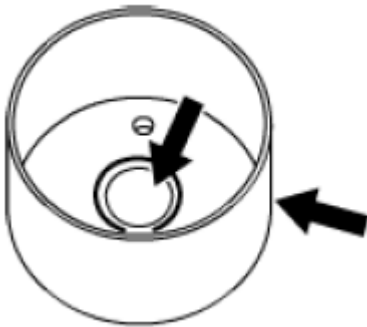


Fig. 68: Locating Cylinder Head Tappet For Pitting, Scratches Or Damage
Courtesy of SUZUKI OF AMERICA CORP.

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.)

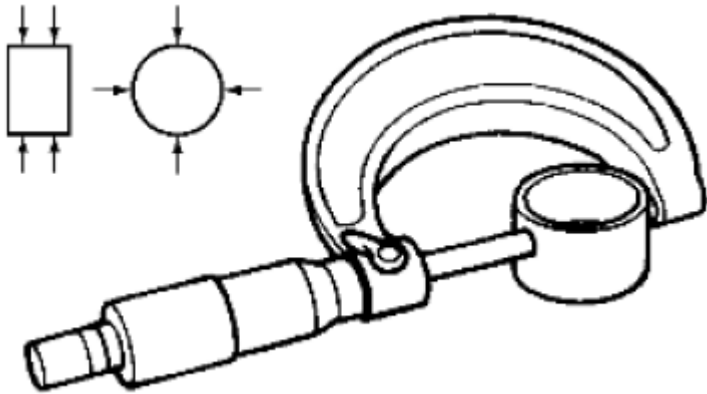


Fig. 69: Measuring Cylinder Head Tappet Outside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

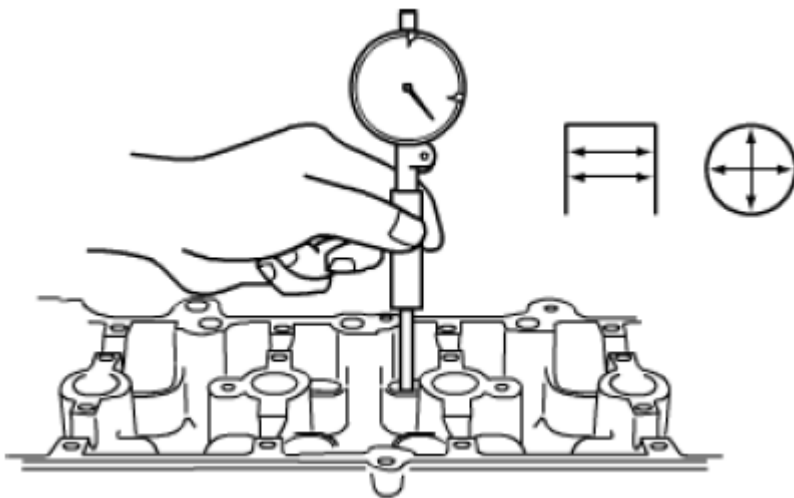


Fig. 70: Measuring Tappet Bore Of Cylinder Head Inside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

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.

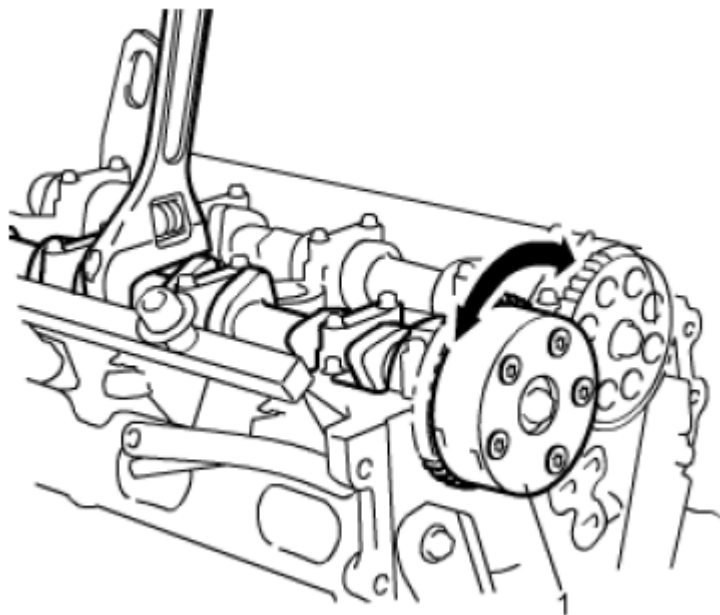
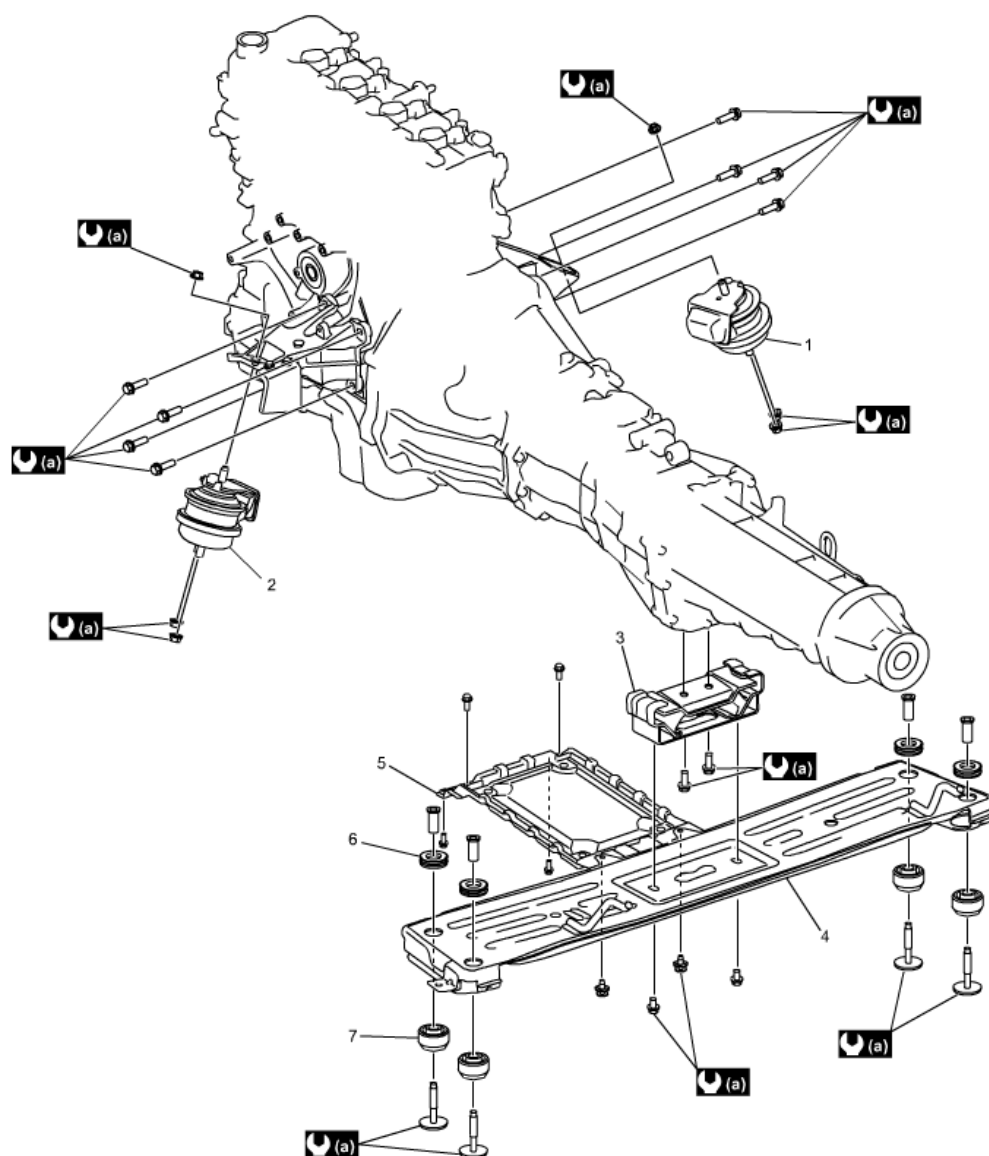


Fig. 71: Checking CMP Actuator For Wear Or Damage
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE MOUNTING 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	 : 55 N·m (5.6 kgf-m, 40.5 lbf-ft)

Fig. 72: Identifying Engine Mountings Components
 Courtesy of SUZUKI OF AMERICA CORP.

ENGINE ASSEMBLY REMOVAL AND INSTALLATION

Removal

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

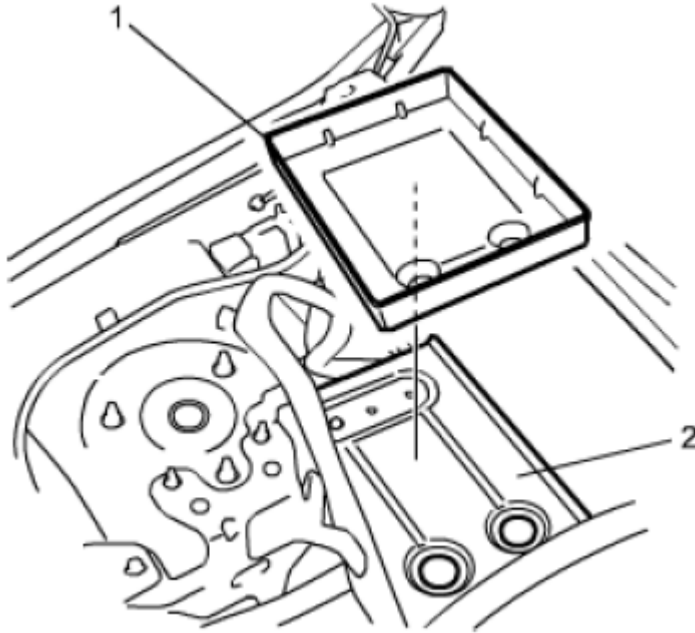


Fig. 73: Identifying Battery Tray And Battery Bracket
Courtesy of SUZUKI OF AMERICA CORP.

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

10. Remove front bumper. Refer to **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)

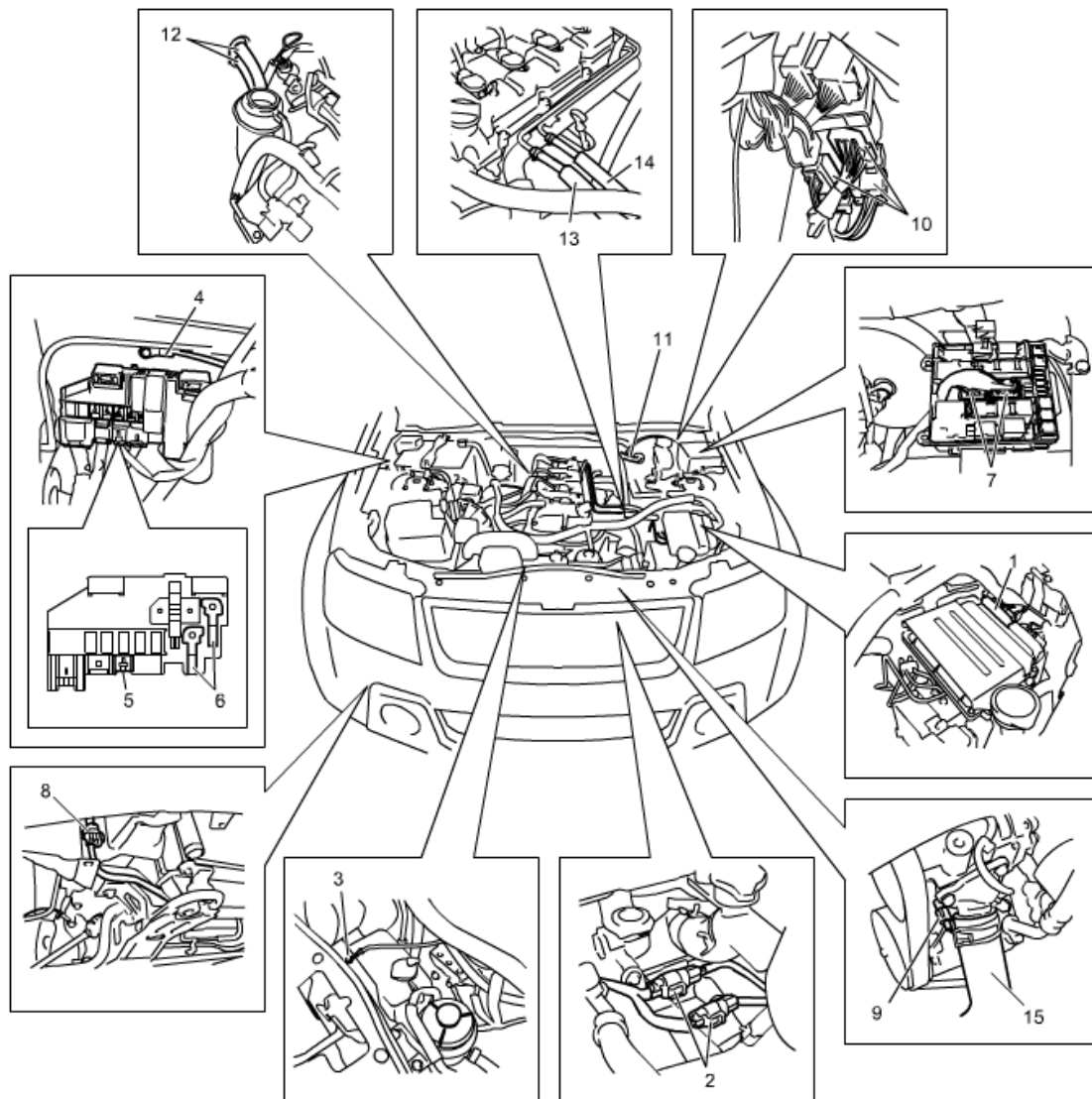


Fig. 74: Identifying Engine Assembly Related Components
 Courtesy of SUZUKI OF AMERICA CORP.

13. Remove engine harness clamps
14. With hose connected, remove A/C compressor from its bracket. Refer to **MAGNET CLUTCH COMPONENTS**.

NOTE: The A/C compressor may be damaged if it hits against or interferes with other parts.
 Suspend the removed A/C compressor in a place where no damage will be caused during removal and installation of the engine assembly.

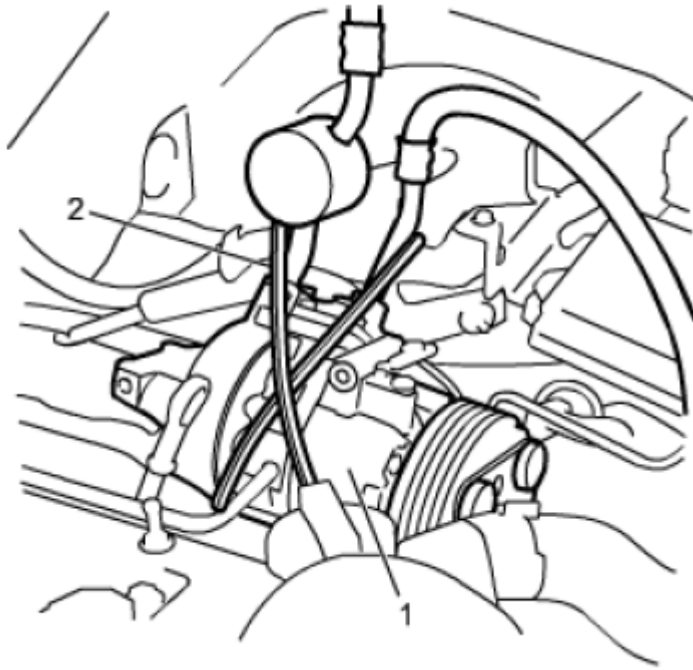


Fig. 75: Identifying A/C Compressor And Hose
Courtesy of SUZUKI OF AMERICA CORP.

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

NOTE: The A/C condenser may be damaged if it hits against or interferes with other parts.
Suspend the removed A/C condenser in a place where no damage will be caused during removal and installation of the engine assembly.

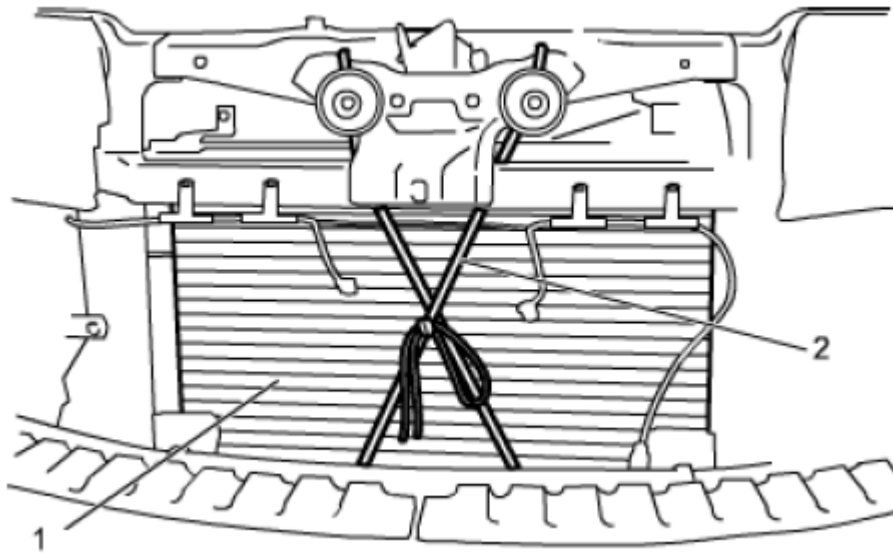


Fig. 76: Identifying A/C Condenser Assembly Of Radiator
Courtesy of SUZUKI OF AMERICA CORP.

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.

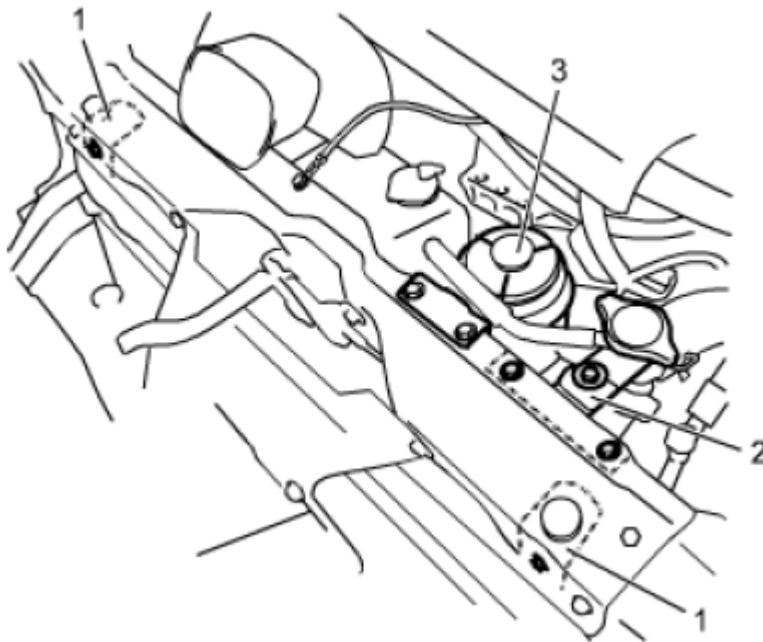


Fig. 77: Identifying P/S Fluid Reservoir, Radiator Support Bracket And Filler Neck Bracket
Courtesy of SUZUKI OF AMERICA CORP.

23. Remove stabilizer bar joints from stabilizer bar. Refer to **FRONT SUSPENSION FRAME, STABILIZER BAR AND/OR BUSHING 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. Refer to **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).

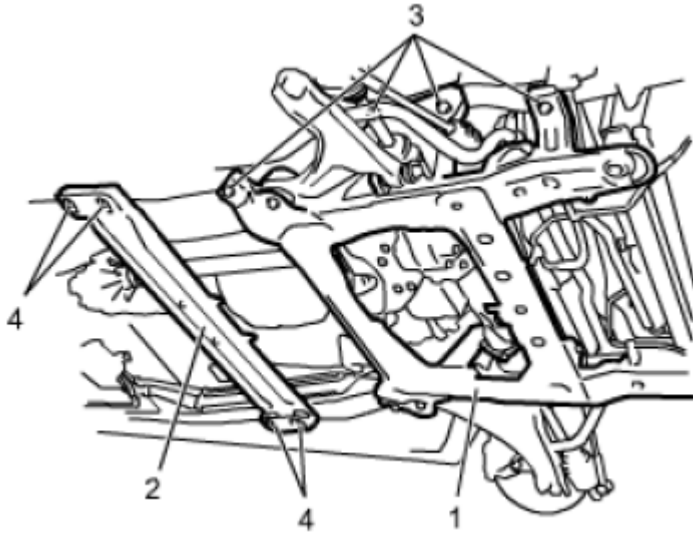


Fig. 78: Identifying Front Suspension Frame Bolts And Support Front Suspension Frame
Courtesy of SUZUKI OF AMERICA CORP.

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: The A/C compressor may be damaged if there is not adequate clearance when the engine is lowered.
Before lowering the engine, move the A/C compressor to vehicle body side to ensure that there is adequate clearance when the engine is lowered.

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.

31. Disconnect transmission if necessary.
 - M/T model: Refer to **MANUAL TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING**.
 - A/T model: Refer to **AUTOMATIC TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING**.
32. For A/T model, remove oil cooler pipe if necessary. Refer to **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 M/T model, remove clutch cover and clutch disc if necessary. Refer to **CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION .**
36. For M/T model, remove flywheel if necessary. Refer to **Flywheel/Drive Plate Removal and Installation.**

For A/T model, remove drive plate if necessary. Refer to **Flywheel/Drive Plate Removal and Installation.**

Installation

1. For M/T model, install flywheel if removed. Refer to **Flywheel/Drive Plate Removal and Installation.**

For A/T model, install drive plate if removed. Refer to **Flywheel/Drive Plate Removal and Installation.**

2. For M/T model, install clutch cover and clutch disc if removed. Refer to **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 kgf-m, 8.5 lbf-ft)

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

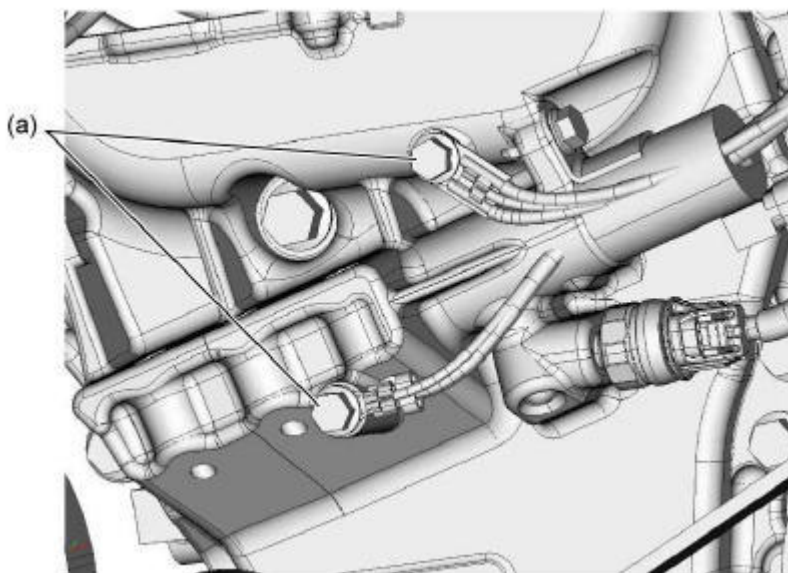


Fig. 79: Identifying Engine Harness Ground Bolts (M6)

Courtesy of SUZUKI OF AMERICA CORP.

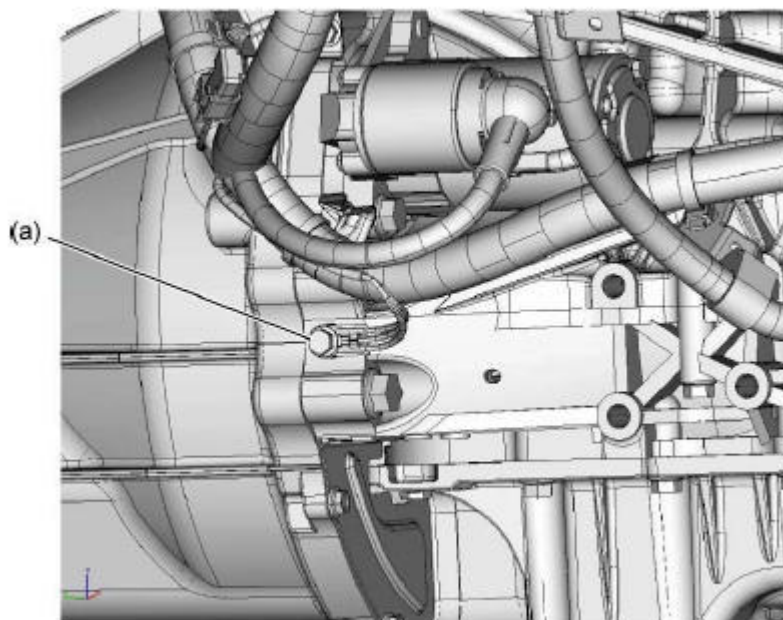


Fig. 80: Identifying Engine Harness Ground Bolt (M6)
Courtesy of SUZUKI OF AMERICA CORP.

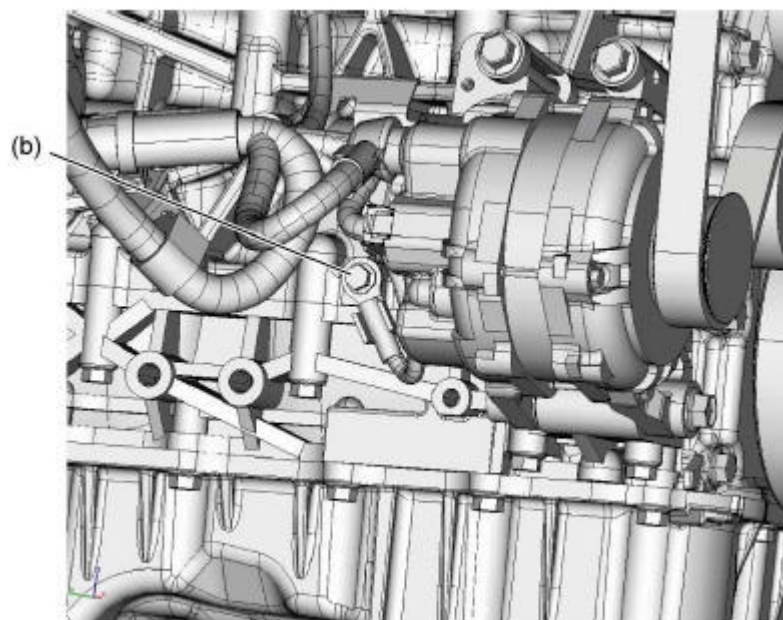


Fig. 81: Identifying Engine Harness Ground Bolt (M8)
Courtesy of SUZUKI OF AMERICA CORP.

4. Connect transmission to engine if removed.
 - For M/T model: Refer to **MANUAL TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING** .

- For A/T model: Refer to **AUTOMATIC TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING**.

5. Lift engine assembly with transmission and transfer (4WD model) into engine compartment using jack.

NOTE: The A/C compressor may be damaged if there is not adequate clearance when the engine is raised.
Before raising the engine, move the A/C compressor to vehicle body side to ensure that there is adequate clearance when the engine is raised.

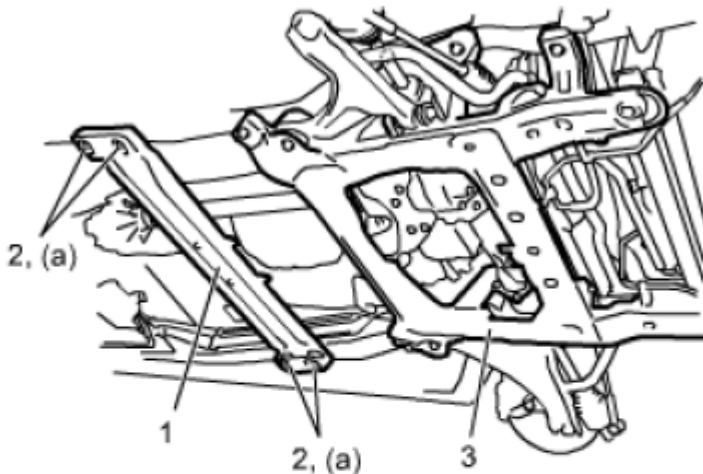
NOTE: Lift engine assembly, transmission, transfer (4WD model), front suspension frame, drive shafts (4WD model), radiator, P/S gear case and engine rear mounting member all together.

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

Tightening torque

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

7. Tighten front suspension frame bolts to specified torque. Refer to **FRONT SUSPENSION FRAME, STABILIZER BAR AND/OR BUSHING COMPONENTS**.



1. Engine rear mounting member

3. Front suspension frame

Fig. 82: Identifying Engine Rear Mounting Member And Front Suspension Frame
Courtesy of SUZUKI OF AMERICA CORP.

8. Install steering lower shaft assembly to P/S gear case assembly. Refer to **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. Refer to **FRONT SUSPENSION FRAME, STABILIZER BAR AND/OR BUSHING 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. Refer to **A/C CONDENSER ASSEMBLY REMOVAL AND INSTALLATION** .
14. Install rear propeller shaft. Refer to **PROPELLER SHAFT REMOVAL AND INSTALLATION** .
15. Install exhaust pipe No. 2. Refer to **EXHAUST SYSTEM COMPONENTS** .
16. For M/T model, install transmission shift control lever to transmission. Refer to **TRANSMISSION SHIFT CONTROL LEVER REMOVAL AND INSTALLATION** .
17. For M/T model, connect clutch fluid hose and clutch fluid pipe joint. Refer to **CLUTCH FLUID PIPE REMOVAL AND INSTALLATION** .
18. For A/T model, connect A/T select cable to A/T. Refer to **SELECT CABLE COMPONENTS** .
19. Install A/C compressor to engine assembly. Refer to **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 kgf-m, 18.5 lbf-ft)

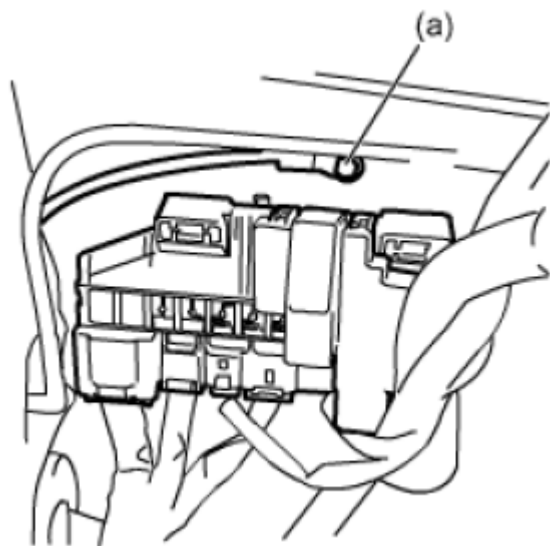
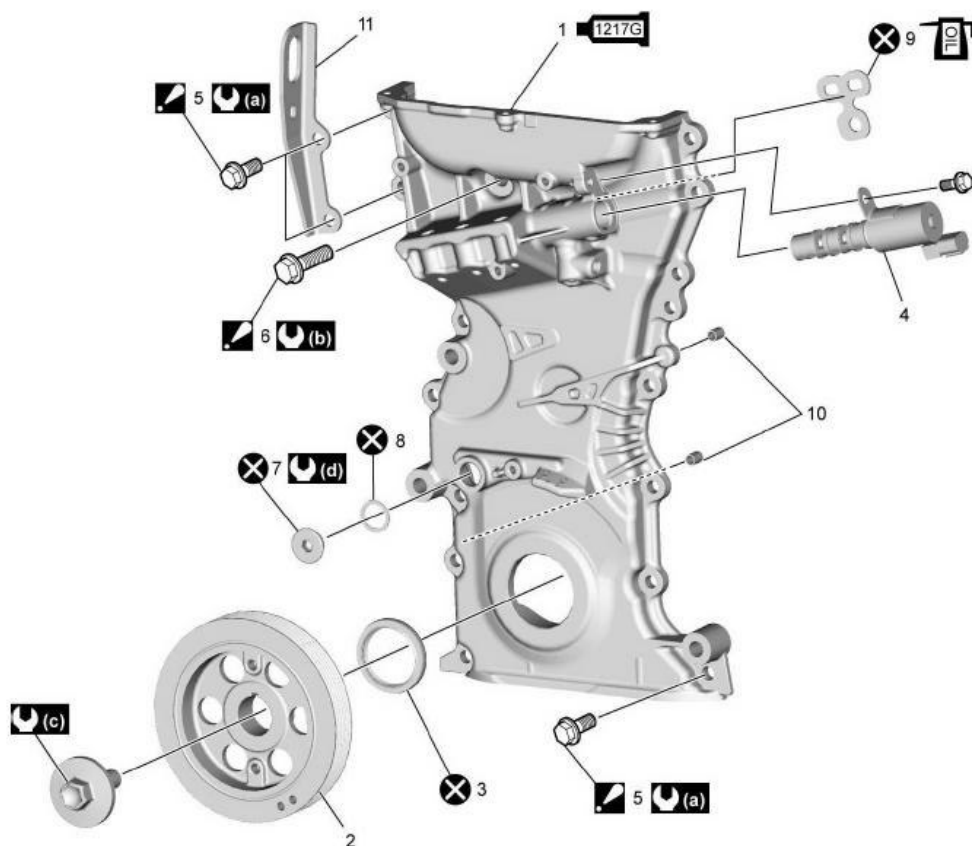


Fig. 83: Identifying Battery Ground Terminal Bolt
Courtesy of SUZUKI OF AMERICA CORP.

23. Install front bumper and radiator grille. Refer to **FRONT BUMPER COMPONENTS** .
24. Install accessory drive belt. Refer to **ACCESSORY DRIVE BELT REMOVAL AND INSTALLATION** .
25. Install air cleaner assembly and air cleaner outlet hose. Refer to **Air Cleaner Assembly Removal and Installation**.
26. Install air cleaner suction pipe. Refer to **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: Refer to **ENGINE OIL AND FILTER CHANGE** .
 - Manual transmission oil (M/T model): Refer to **MANUAL TRANSMISSION OIL CHANGE** .
 - A/T fluid (A/T model): Refer to **A/T FLUID CHANGE** .
 - P/S fluid: Refer to **P/S FLUID CHANGE** .
 - Transfer oil (4WD model):
 - Motor shift type: Refer to **TRANSFER OIL CHANGE** .
 - Non-shift type: Refer to **TRANSFER OIL CHANGE** .
 - Front differential oil (4WD model): Refer to **FRONT DIFFERENTIAL OIL CHANGE** .
30. Install front tires.
31. Install engine cover.
32. Install battery tray and battery bracket.
33. Install battery. Refer to **BATTERY REMOVAL AND INSTALLATION** .
34. Refill cooling system with coolant. Refer to **COOLING SYSTEM REFILLING** .
35. Check any leakage of coolant, oil, fuel and exhaust.
 - Fuel leak: Refer to **FUEL LEAKAGE CHECK PROCEDURE** .
 - Coolant leak: Refer to **ENGINE COOLING SYSTEM INSPECTION** .

TIMING CHAIN COVER COMPONENTS



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

Fig. 84: Identifying Timing Chain Cover Components
Courtesy of SUZUKI OF AMERICA CORP.

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

NOTE: If the crankshaft pulley bolt is loosened and tightened without crankshaft locked using the special tool, the timing chain, sprocket and their related parts may receive undue forces, which could cause damage to these components. When loosening and tightening the crankshaft pulley bolt, be sure to use the special tool, which should be securely installed to the crankshaft pulley using a bolt of the following specifications:

Bolt size: M8

Pitch: 1.25 mm (0.049 in.)

Length: 25 mm (0.98 in.)

Strength: 7T

Removal

1. Remove engine assembly from vehicle. Refer to Engine Assembly Removal and Installation.
2. Remove crankshaft pulley bolt.

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

Special Tool

(A): 09917-68221

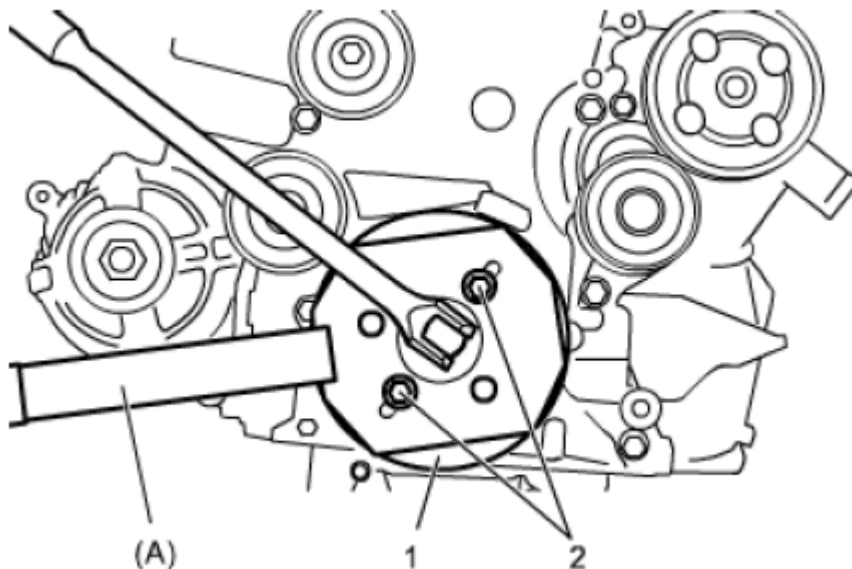


Fig. 85: Removing Crankshaft Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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

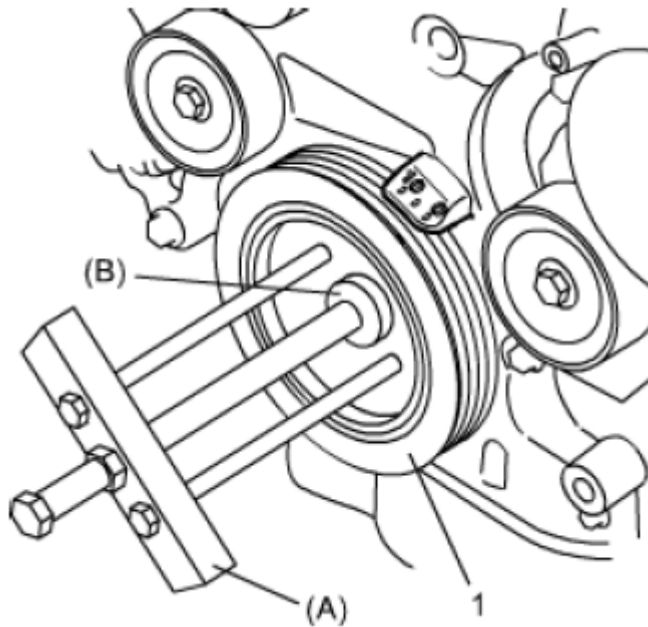


Fig. 86: Removing Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove cylinder head cover. Refer to **Cylinder Head Cover Removal and Installation.**
5. Remove oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION** .
6. Remove tensioner pulley and idler pulley. Refer to **TENSIONER AND IDLER PULLEY REMOVAL AND INSTALLATION** .
7. Remove timing chain cover by loosening timing chain cover bolts in numerical order ("1" - "17") evenly and gradually.

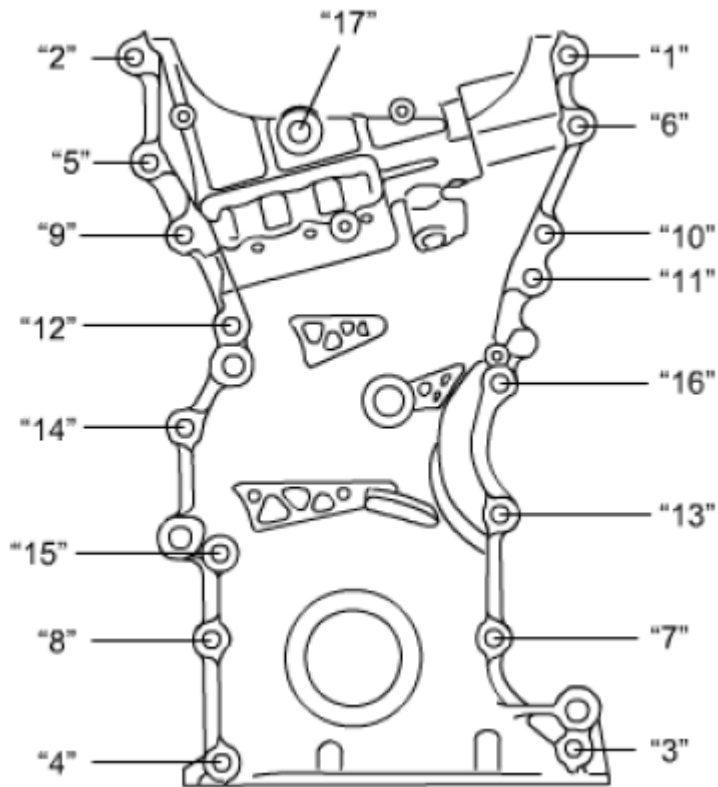


Fig. 87: Identifying Timing Chain Cover Bolts Loosening Sequence
 Courtesy of SUZUKI OF AMERICA CORP.

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

Installation

Reference: TIMING CHAIN COVER INSPECTION

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

Remove oil, old sealant and dust from mating surface.

2. 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

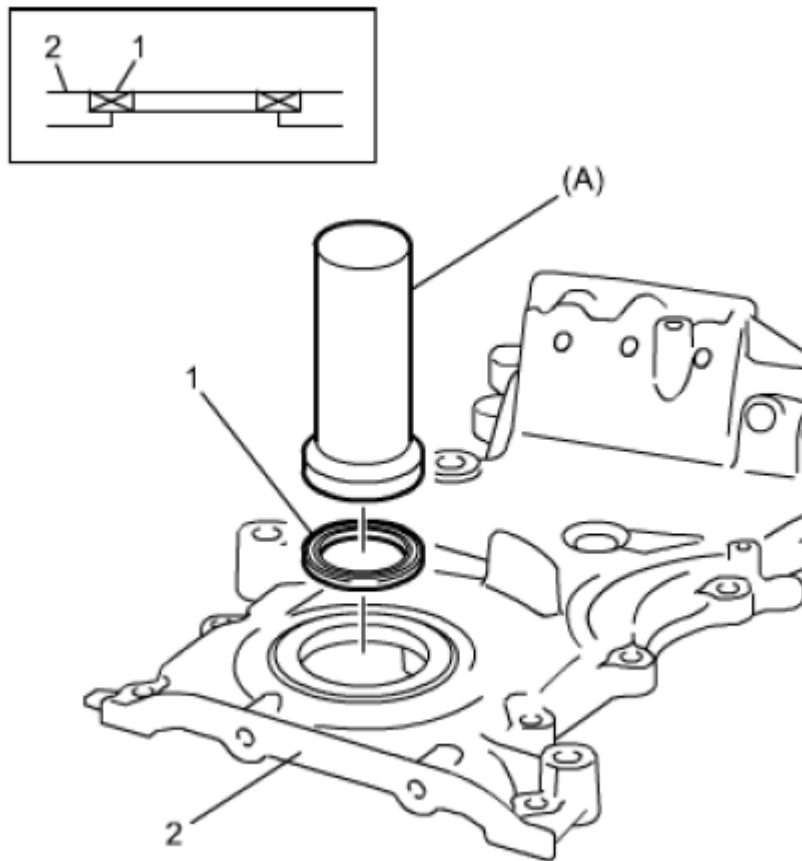


Fig. 88: Installing Oil Seal

Courtesy of SUZUKI OF AMERICA CORP.

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

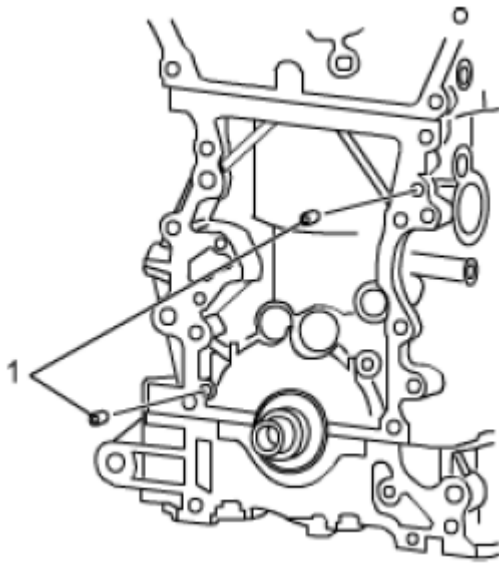


Fig. 89: Identifying Dowel Pins Of Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

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.)

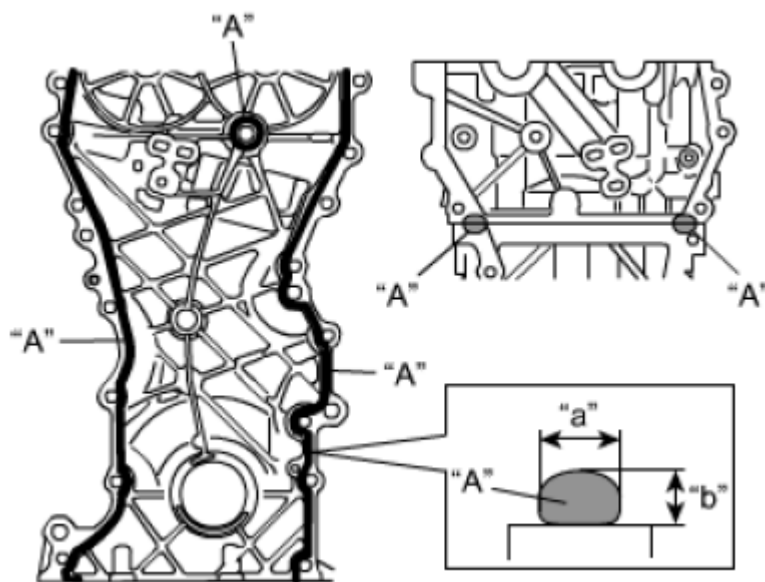


Fig. 90: Applying Sealant To Mating Surface Of Cylinder, Cylinder Head And Timing Chain Cover

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 kgf-m, 18.5 lbf-ft)

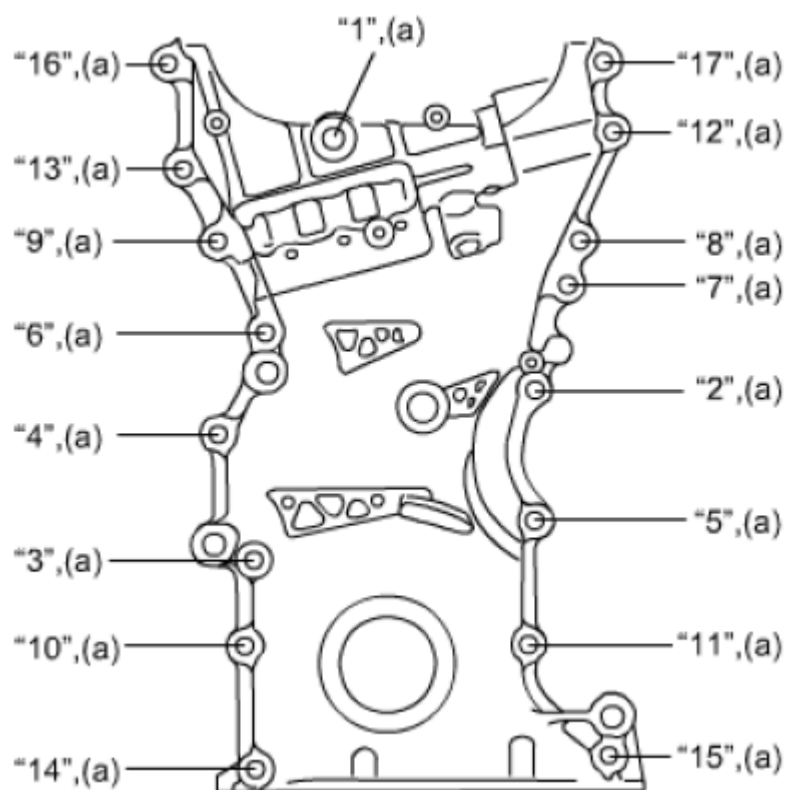


Fig. 91: Identifying Timing Chain Cover Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

6. Install tensioner pulley and idler pulley. Refer to TENSIONER AND IDLER PULLEY REMOVAL AND INSTALLATION.
7. Install cylinder head cover. Refer to Cylinder Head Cover Removal and Installation.
8. Install oil pan. Refer to 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.

Special Tool

(A): 09917-68221

Tightening torque

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

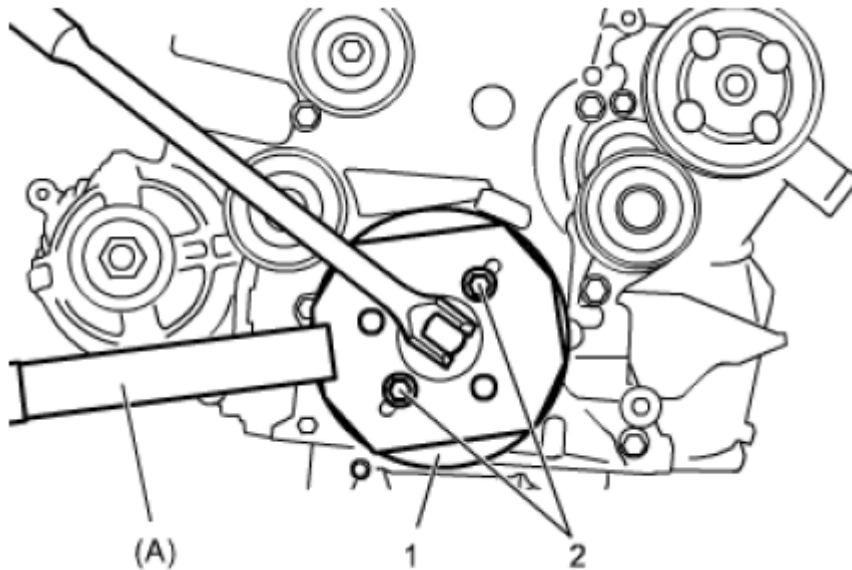


Fig. 92: Installing Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

10. Install engine assembly to vehicle. Refer to **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.

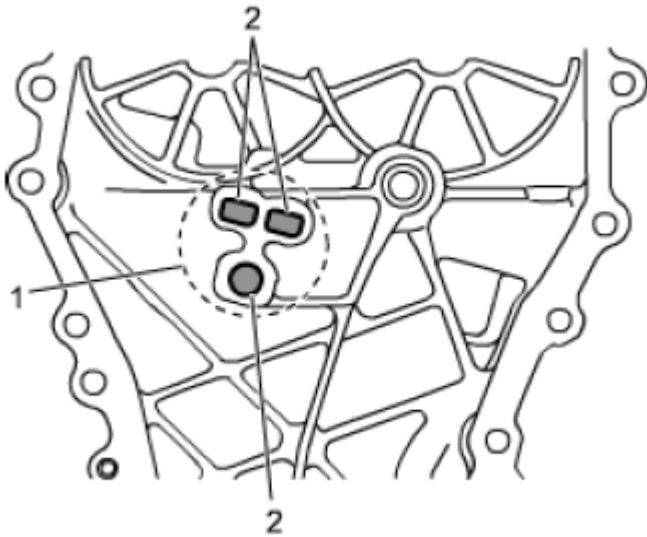


Fig. 93: Identifying Oil Passage, Driving CMP Actuator And Strainer
Courtesy of SUZUKI OF AMERICA CORP.

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).

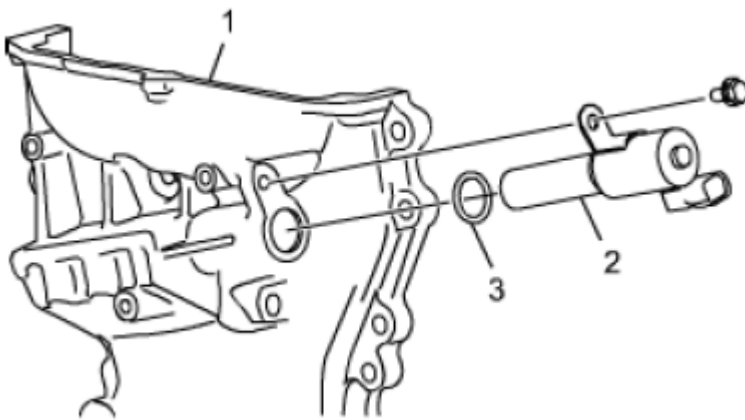


Fig. 94: Identifying OCV, O-ring And Timing Chain Cover
Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 8.5 lbf-ft)

FLYWHEEL/DRIVE PLATE REMOVAL AND INSTALLATION**Removal**

1. Remove transmission assembly.
 - M/T model: Refer to **MANUAL TRANSMISSION ASSEMBLY DISMOUNTING AND REMOUNTING**.
 - A/T model: Refer to **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

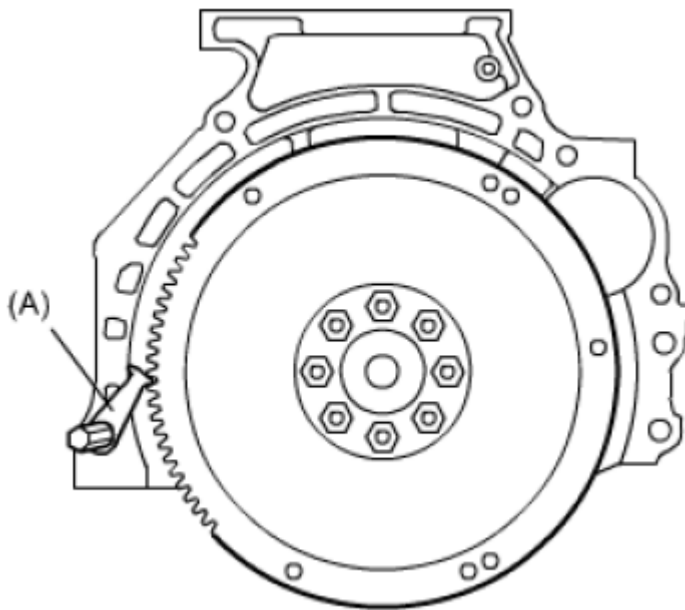


Fig. 95: Wedging Special Tool In Ring Gear Teeth To Lock Flywheel Or Drive Plate
Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 52.0 lbf-ft)

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

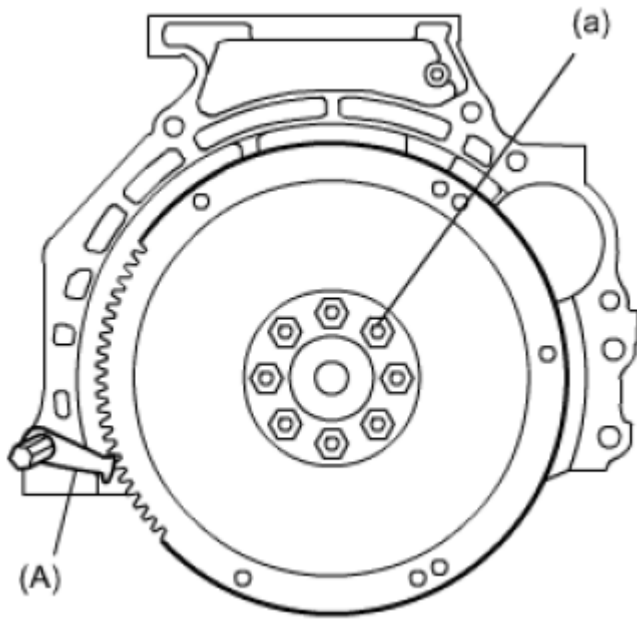
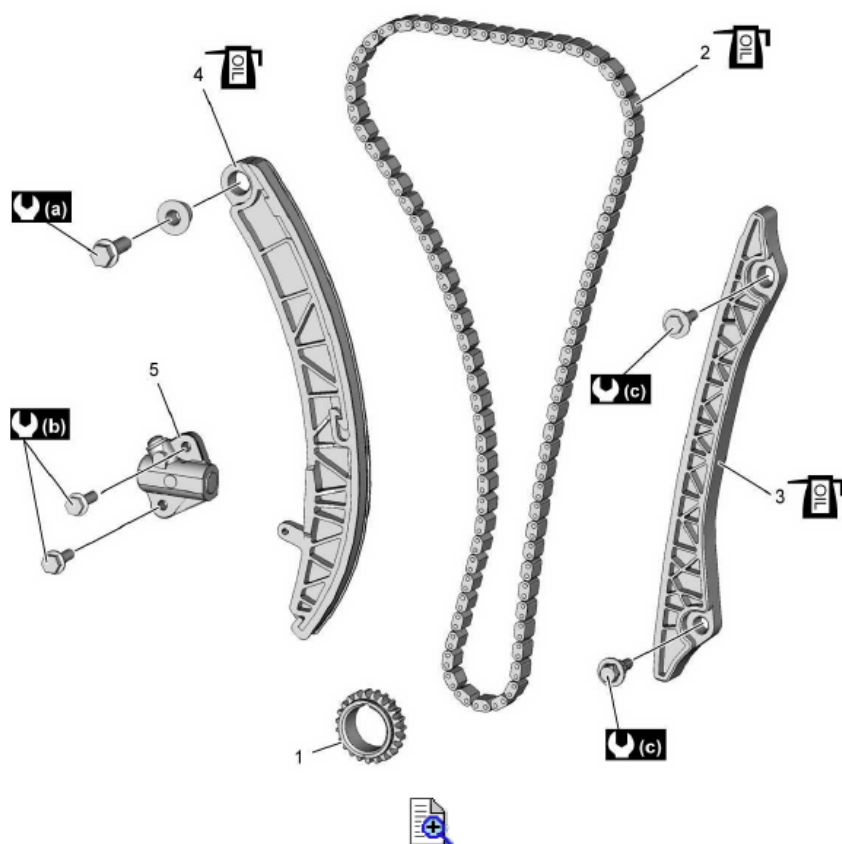


Fig. 96: Identifying Flywheel And Drive Plate Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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

Courtesy of SUZUKI OF AMERICA CORP.

TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION

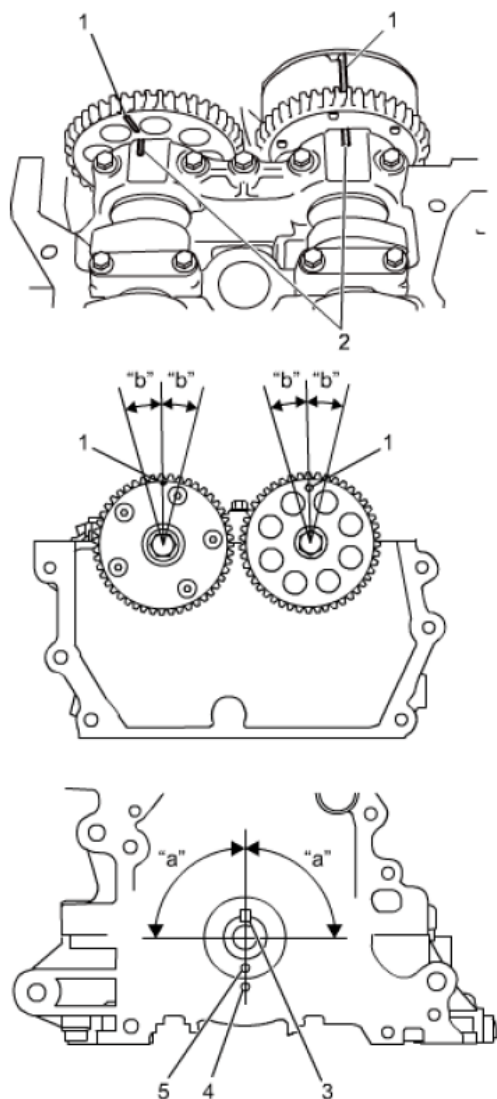
Reference: TIMING CHAIN AND CHAIN TENSIONER COMPONENTS

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

Removal

NOTE: After the timing chain has been removed, independently turning the camshaft or crankshaft beyond the allowable angle ranges shown in figure will cause

interference between pistons and valves or between the valves themselves, which will cause damage to these parts and/or related parts. Avoid turning the camshafts or crankshaft beyond the angle ranges shown in figure.



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

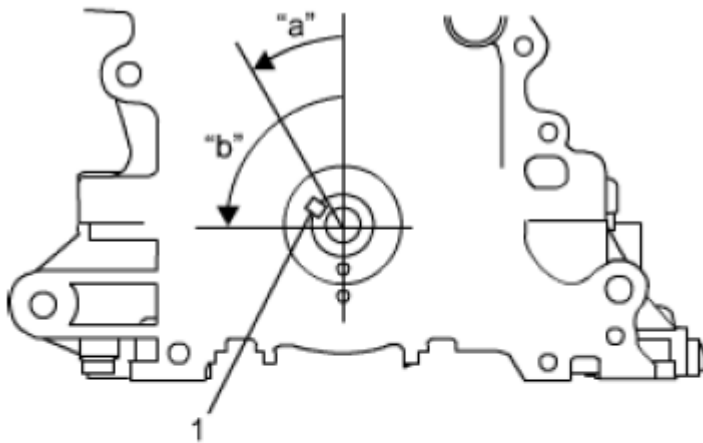
"a": 90°

"b": 15°

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. Refer to **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.

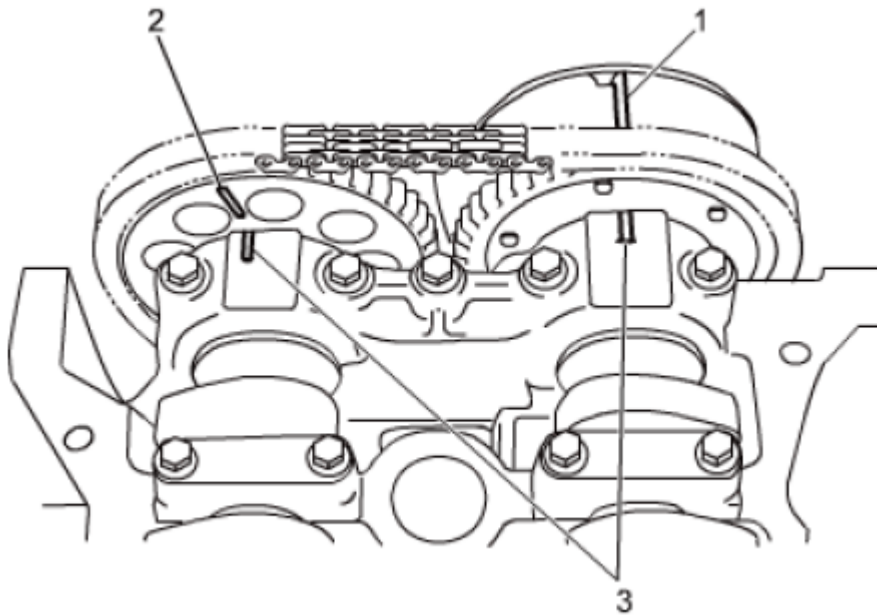


Fig. 100: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprocket

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).

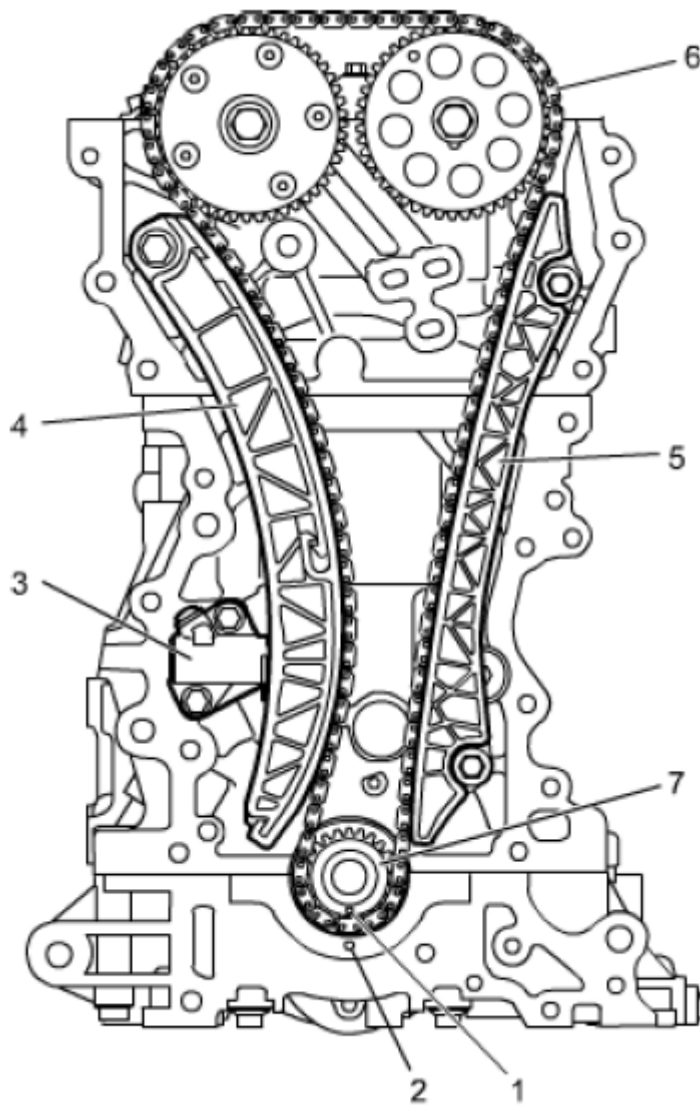


Fig. 101: Identifying Timing Chain Tensioner Adjuster, Timing Chain Tensioner, Timing Chain Guide, Timing Chain And Crankshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

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.

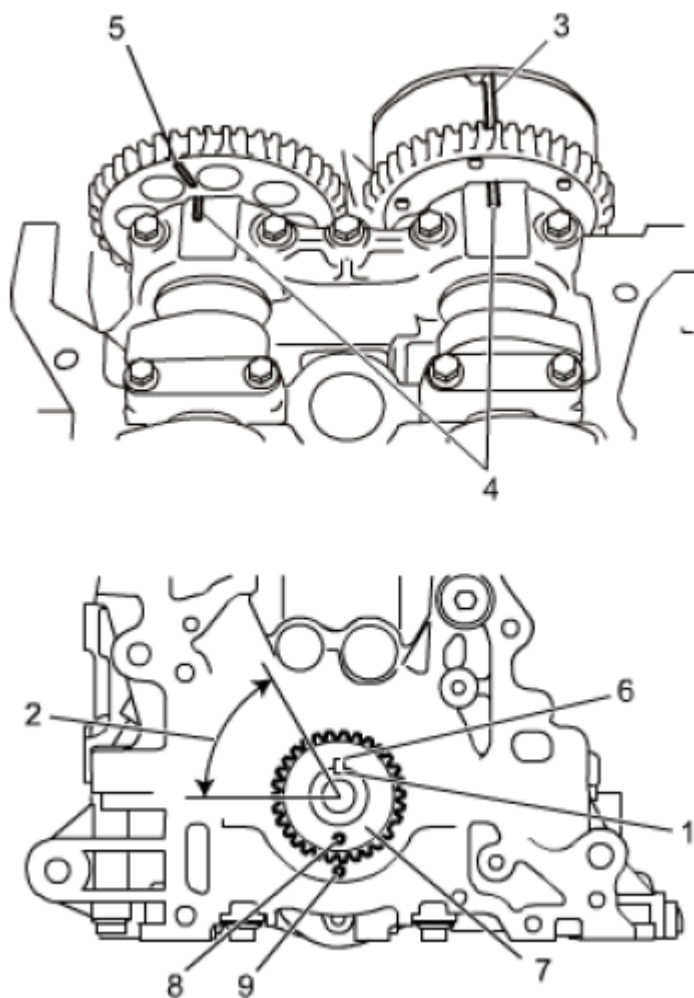


Fig. 102: Aligning Timing Mark On Crankshaft Timing Sprocket With Match Mark On Lower Crank Case
Courtesy of SUZUKI OF AMERICA CORP.

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

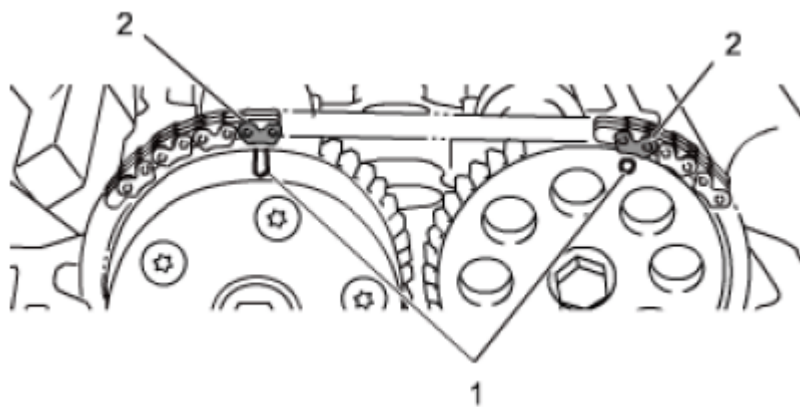


Fig. 103: Identifying Timing Marks On CMP Actuator And Exhaust Camshaft Timing Sprockets
 Courtesy of SUZUKI OF AMERICA CORP.

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

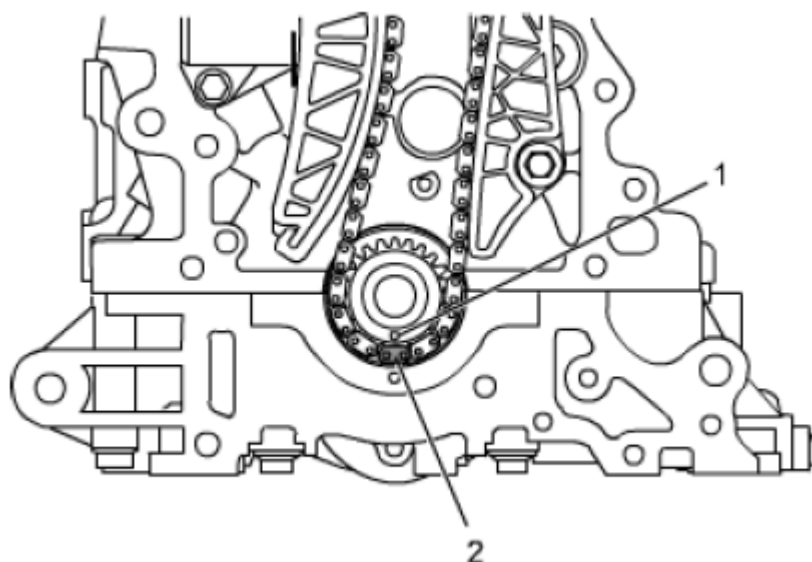


Fig. 104: Identifying Timing Mark On Crankshaft Timing Sprocket
 Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-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 kgf-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.

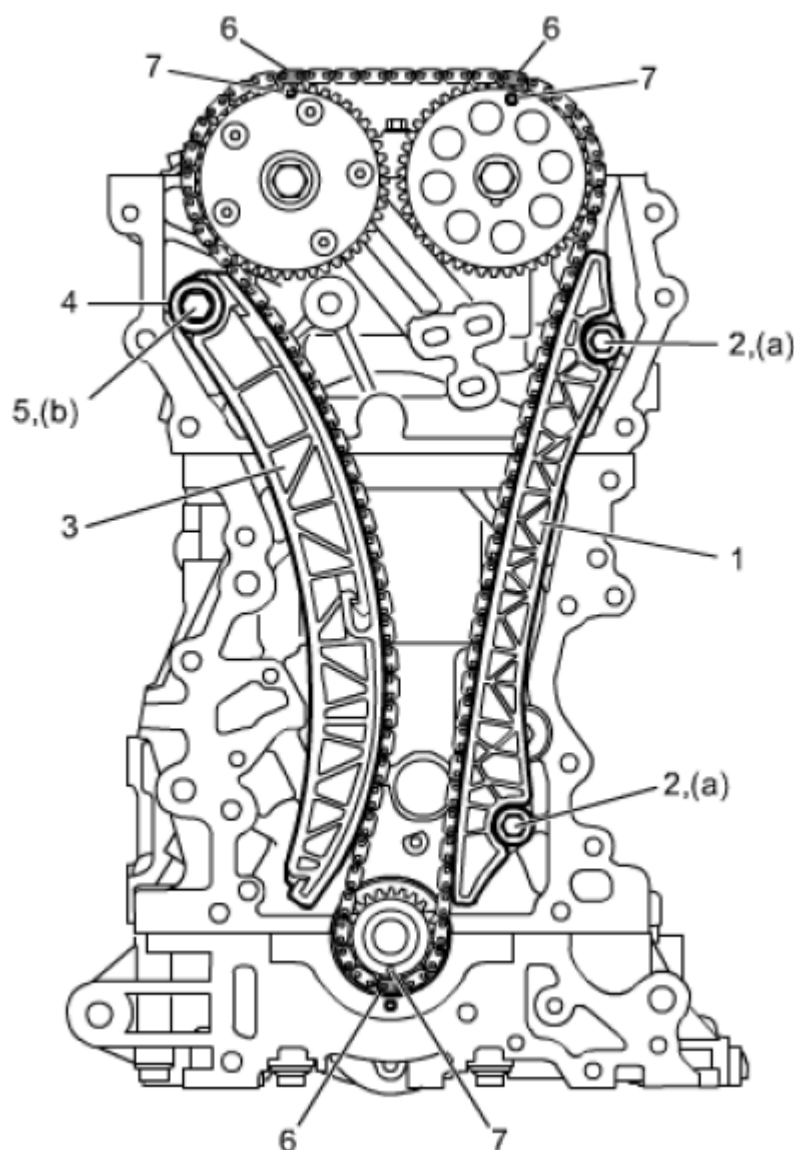


Fig. 105: Identifying Spacer, Timing Chain Tensioner And Timing Chain Tensioner Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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.

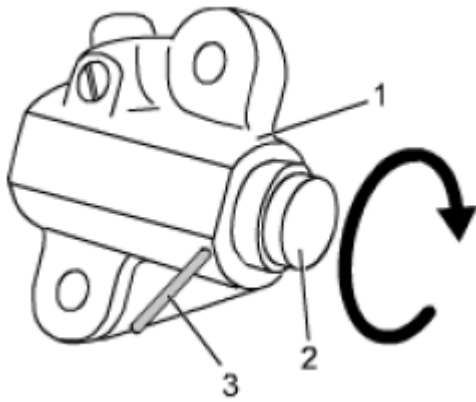


Fig. 106: Screwing Plunger Of Timing Chain Tensioner Adjuster Clockwise
Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-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.**

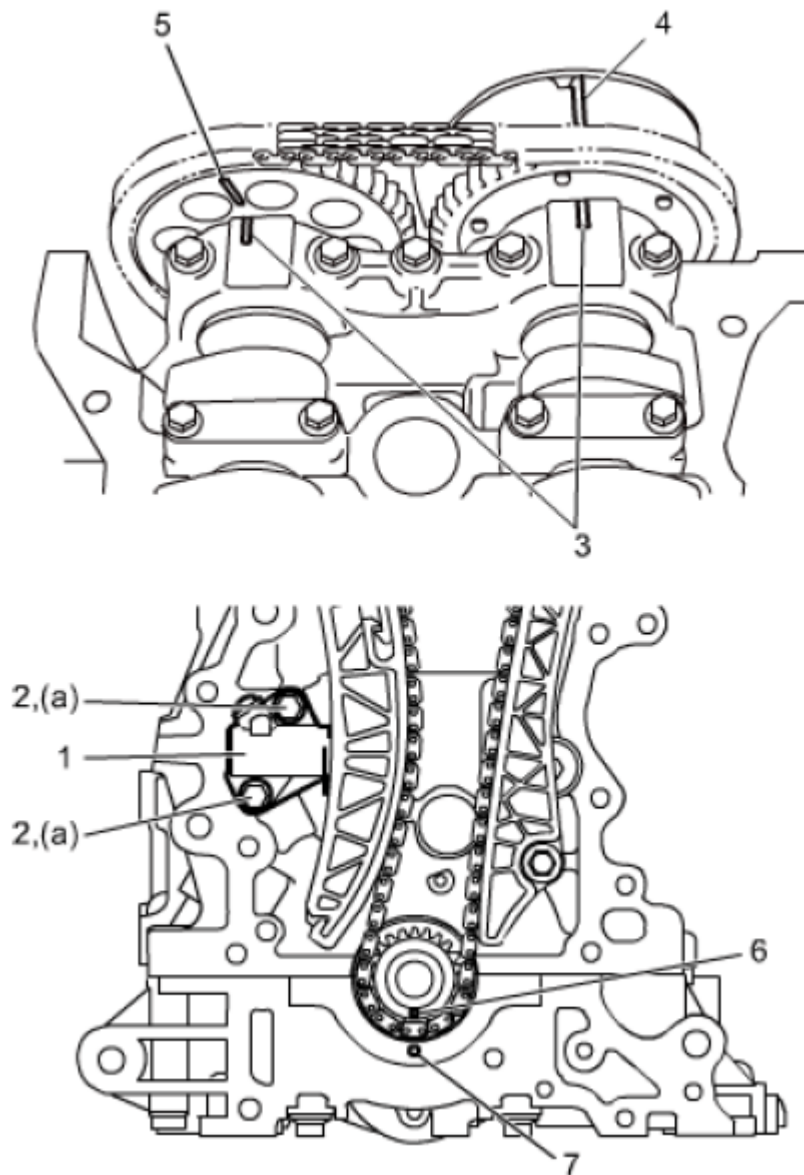


Fig. 107: Identifying Timing Marks On CMP Actuator, Exhaust Camshaft Timing Sprocket And Crankshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

16. Install timing chain cover. Refer to **Timing Chain Cover Removal and Installation**.
17. Install cylinder head cover. Refer to **Cylinder Head Cover Removal and Installation**.
18. Install oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION**.
19. Install engine assembly. Refer to **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.

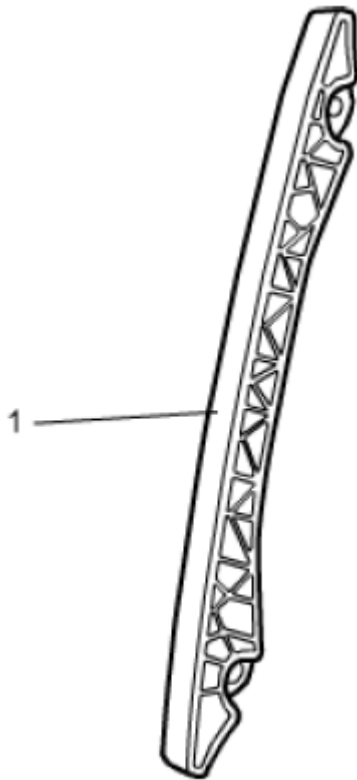


Fig. 108: Identifying Timing Chain Guide
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain Tensioner

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

If abnormality is found, replace timing chain tensioner.

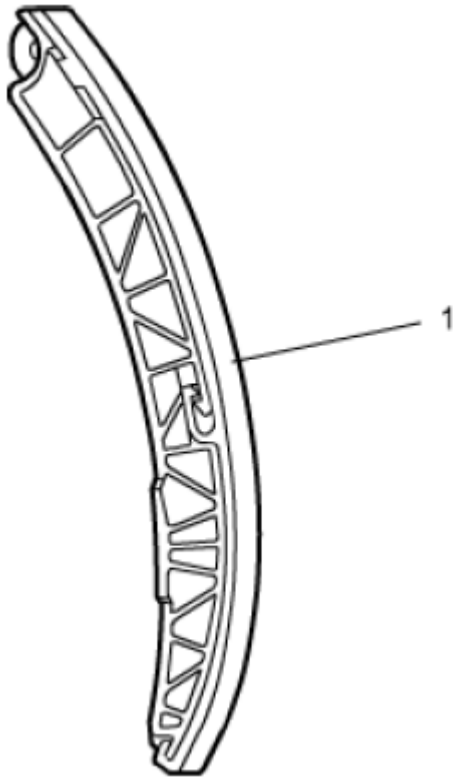


Fig. 109: Identifying Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft Timing Sprocket

Check sprocket teeth for wear or damage.

If abnormality is found, replace crankshaft timing sprocket.

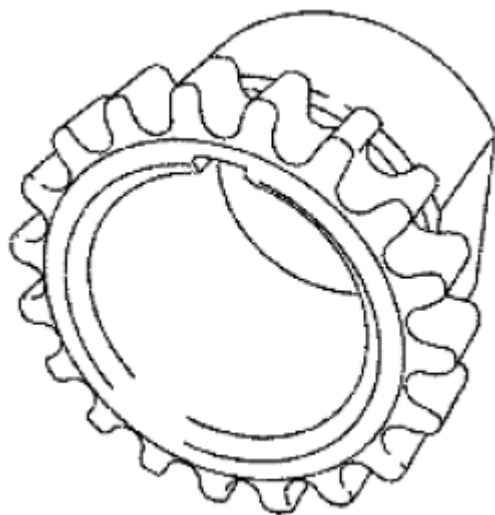


Fig. 110: Identifying Crankshaft Timing Sprocket

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.

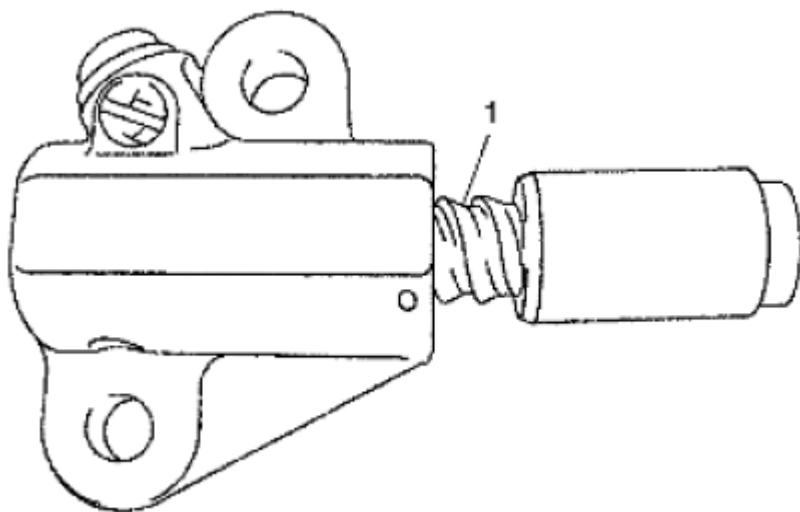
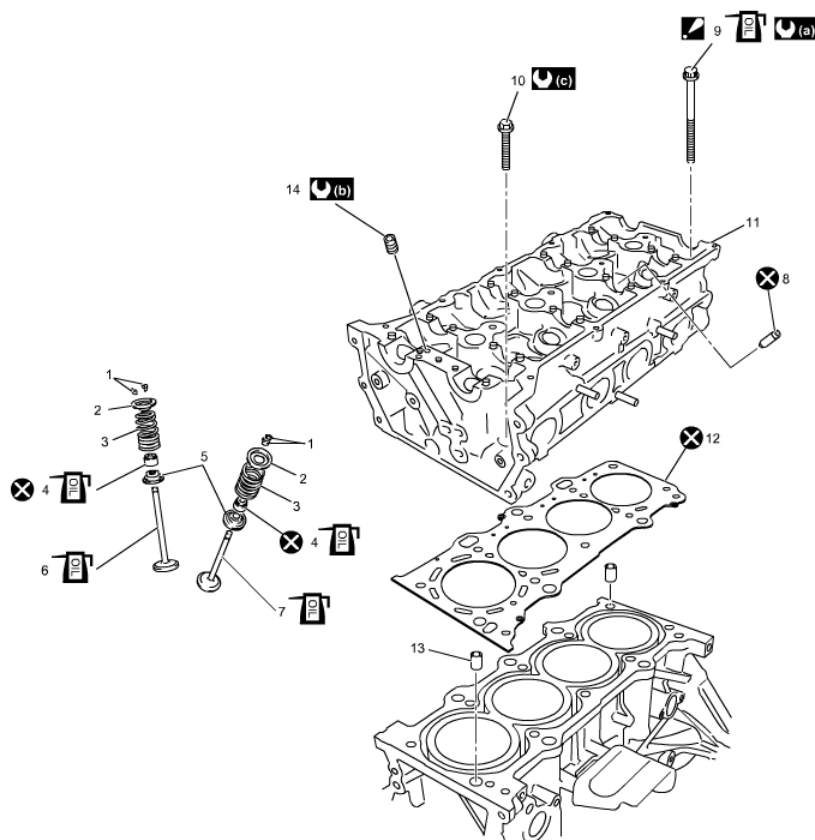


Fig. 112: Identifying Timing Chain Tensioner Adjuster Tooth Surface

Courtesy of SUZUKI OF AMERICA CORP.

VALVE AND CYLINDER HEAD COMPONENTS



1. Valve cotters	7. Exhaust valve: Apply engine oil to sliding surface.	13. Dowel pin
2. Valve spring retainer	8. Valve guide	14. Venturi plug
3. Valve spring	9. Cylinder head No.1 bolt : Check cylinder head bolt No.1 for deformation to reuse. : : Apply engine oil to bolt thread. : For tightening order, refer to <u>Valve and Cylinder Head Removal and Installation.</u>	(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°)
4. Valve stem seal : Apply engine oil to valve stem seal lip.	10. Cylinder head No.2 bolt	(b) : 3.5 N·m (0.36 kgf- m, 2.5 lbf-ft)
5. Valve spring seat	11. Cylinder head	(c) : 25 N·m (2.5 kgf- m, 18.5 lbf-ft)
6. Intake valve : Apply engine oil to sliding surface.	12. Cylinder head gasket	: Do not reuse.

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

VALVE AND CYLINDER HEAD REMOVAL AND INSTALLATION

Reference: VALVE AND CYLINDER HEAD COMPONENTS**Removal**

1. Remove timing chain. Refer to **Timing Chain and Chain Tensioner Removal and Installation**.
2. Remove spark plugs. Refer to **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: The CMP actuator will lose its original performance if it is disassembled. Do not try to disassemble and repair the CMP actuator. If any faulty condition is found, replace the CMP actuator with a new one.

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.

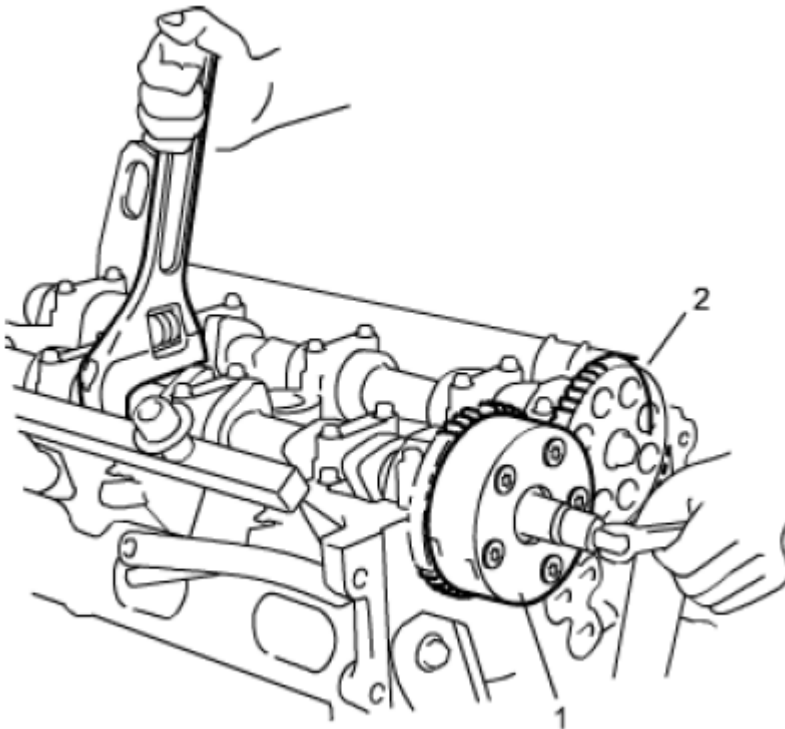


Fig. 114: Removing CMP Actuator And Exhaust Camshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove intake camshaft and exhaust camshaft. Refer to **Camshaft and Tappet Removal and Installation**.

5. Remove camshaft bearings.
6. Remove water outlet pipe from cylinder head. Refer to **COOLING SYSTEM COMPONENTS** .
7. Remove heater outlet pipe bolt (1) from cylinder head (2).

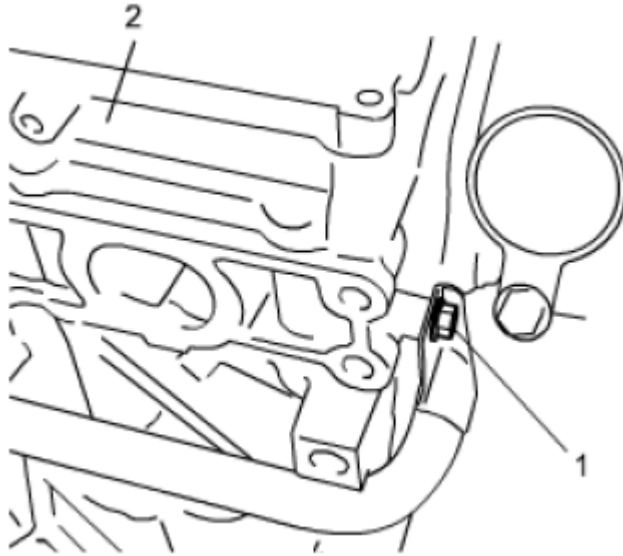


Fig. 115: Identifying Heater Outlet Pipe Bolt And Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove cylinder head No. 2 bolt (1).
9. Loosen cylinder head No. 1 bolts in numerical order ("1" - "10") evenly and gradually.

NOTE: Use 12-point socket wrench to cylinder head No. 1 bolts (2).

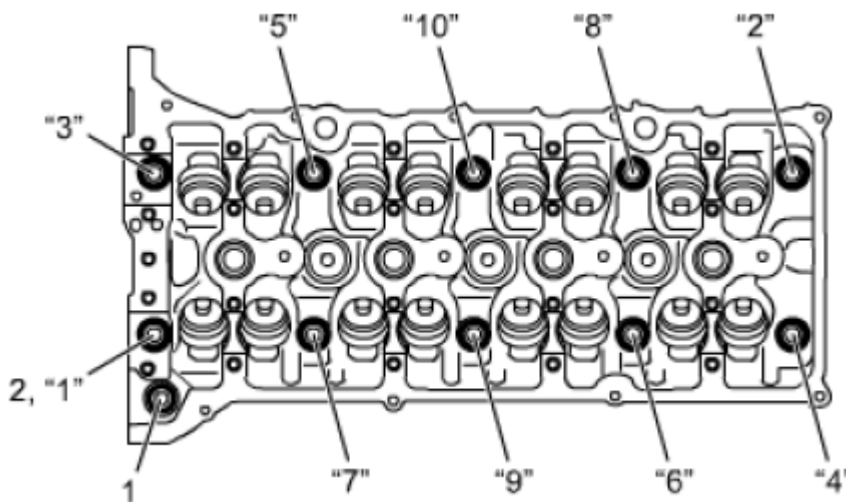


Fig. 116: Identifying Cylinder Head Bolts Loosening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove cylinder head with its gasket, intake manifold and exhaust manifold from cylinder block.
11. Remove the following components cylinder head if necessary.
 - Intake manifold: Refer to **Intake Manifold Removal and Installation**.
 - Exhaust manifold: Refer to **EXHAUST MANIFOLD REMOVAL AND INSTALLATION** .
 - Fuel injector: Refer to **FUEL INJECTOR REMOVAL AND INSTALLATION** .
 - Water outlet cap: Refer to **COOLING SYSTEM COMPONENTS** .
 - Oil venture plug: Refer to **Valve and Cylinder Head Disassembly and Reassembly**.

Installation

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

Reference: **CYLINDER HEAD INSPECTION**

Reference: **CYLINDER HEAD NO. 1 BOLT INSPECTION**

NOTE: Using cylinder head No. 1 bolts that are deformed exceeding the service limit could lead to engine problems.
When cylinder head No. 1 bolts are reused, make sure that they are not deformed exceeding the service limit referring to **CYLINDER HEAD NO. 1 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.

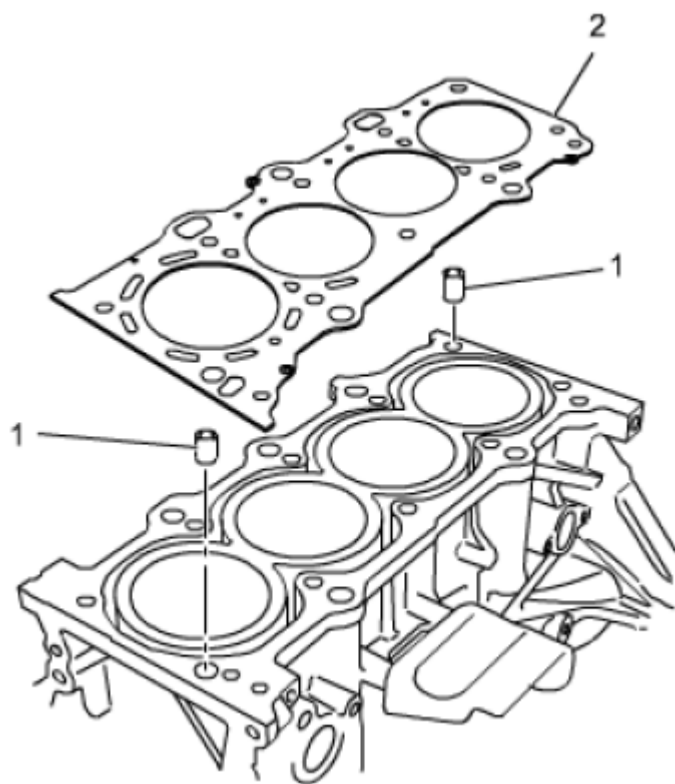


Fig. 117: Identifying Cylinder Head Gasket And Dowel Pins
Courtesy of SUZUKI OF AMERICA CORP.

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.

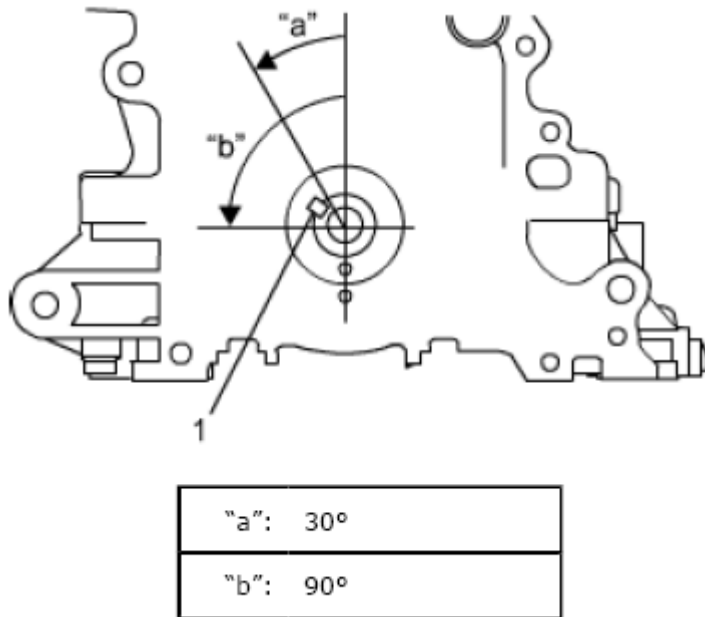


Fig. 118: Identifying Crankshaft And Position Key Turning Angle
 Courtesy of SUZUKI OF AMERICA CORP.

- a. Install cylinder head to cylinder block.
- b. Apply engine oil to cylinder head No. 1 bolts threads.
- c. Tighten cylinder head No. 1 bolts (1) 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 No. 1 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 No. 1* 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°)

- g. Tighten cylinder head No. 2 bolt (2) to specified torque.

Tightening torque

Cylinder head No. 2 bolt (b): 25 N.m (2.5 kgf-m, 18.5 lbf-ft)

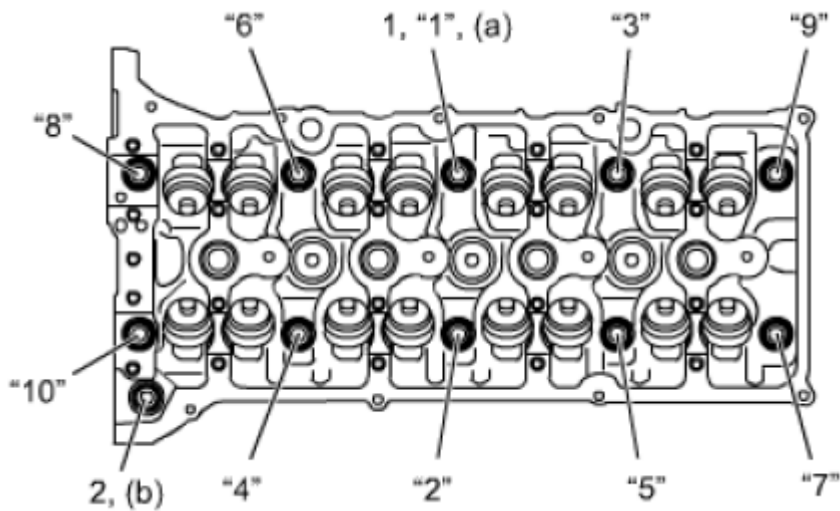


Fig. 119: Identifying Cylinder Head Bolt Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

5. Install intake camshaft and exhaust camshaft. Refer to Camshaft and Tappet Removal and Installation.
6. Install timing chain. Refer to Timing Chain and Chain Tensioner Removal and Installation.
7. Install timing chain cover. Refer to Timing Chain Cover Removal and Installation.
8. Install cylinder head cover. Refer to Cylinder Head Cover Removal and Installation.
9. Install oil pan. Refer to OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION.
10. Install water outlet cap if removed. Refer to COOLING SYSTEM COMPONENTS.
11. Install heater outlet pipe bolt to cylinder head. Refer to COOLING SYSTEM COMPONENTS.
12. Install water outlet pipe to cylinder head. Refer to COOLING SYSTEM COMPONENTS.

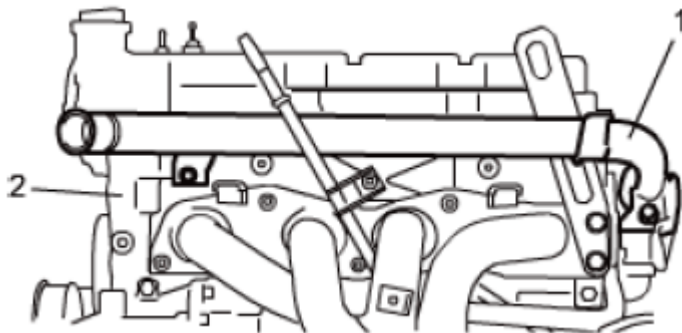


Fig. 120: Identifying Water Outlet Pipe Of Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

13. Install spark plugs. Refer to SPARK PLUG REMOVAL AND INSTALLATION.
14. Install exhaust manifold if removed. Refer to EXHAUST MANIFOLD REMOVAL AND INSTALLATION.

15. Install intake manifold if removed. Refer to Intake Manifold Removal and Installation.
16. Install fuel injectors if removed. Refer to FUEL INJECTOR REMOVAL AND INSTALLATION.
17. Install engine assembly. Refer to 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).

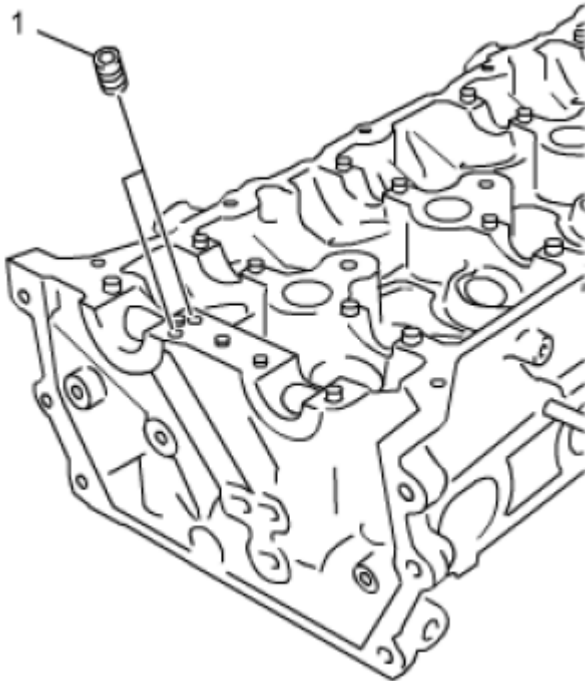


Fig. 121: Identifying Oil Venturi Plugs
Courtesy of SUZUKI OF AMERICA CORP.

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).

NOTE: **Damaging the wall surface of the tappet fitting hole could result in engine problems.**
 Prevent the special tool from touching the tappet sliding surface in the cylinder head.

Special Tool

(A): 09916-14510

(B): 09916-14522

(C): 09916-84511

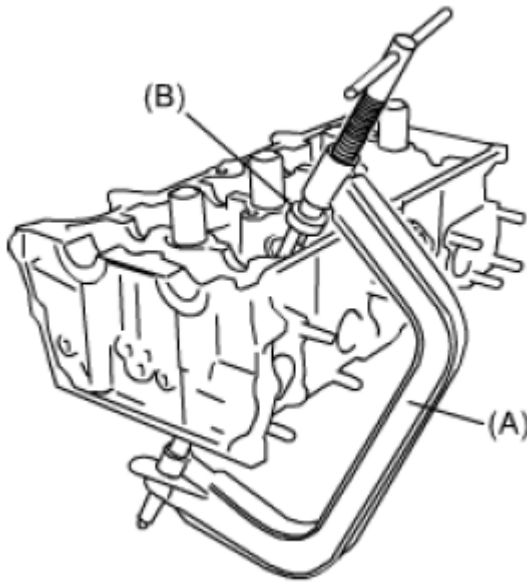


Fig. 122: Compressing Valve Spring
Courtesy of SUZUKI OF AMERICA CORP.

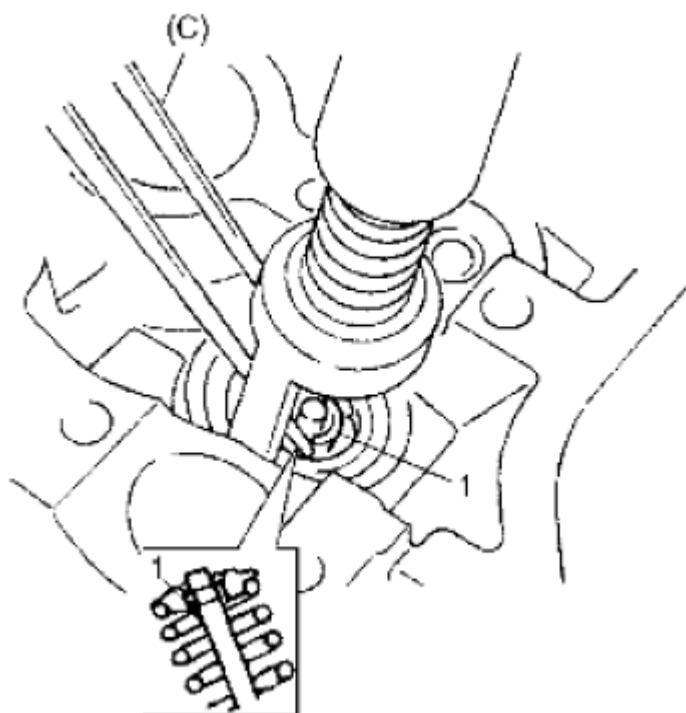


Fig. 123: Removing Valve Cotters
Courtesy of SUZUKI OF AMERICA CORP.

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).

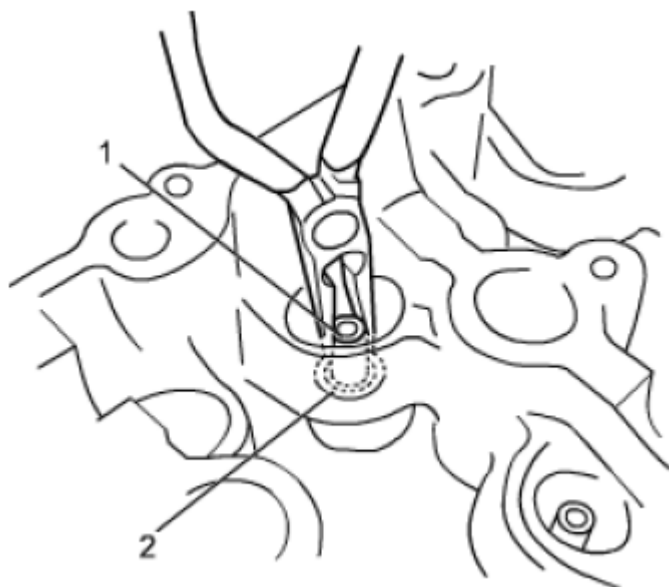


Fig. 124: Removing Valve Stem Seal And Valve Spring Seat
Courtesy of SUZUKI OF AMERICA CORP.

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

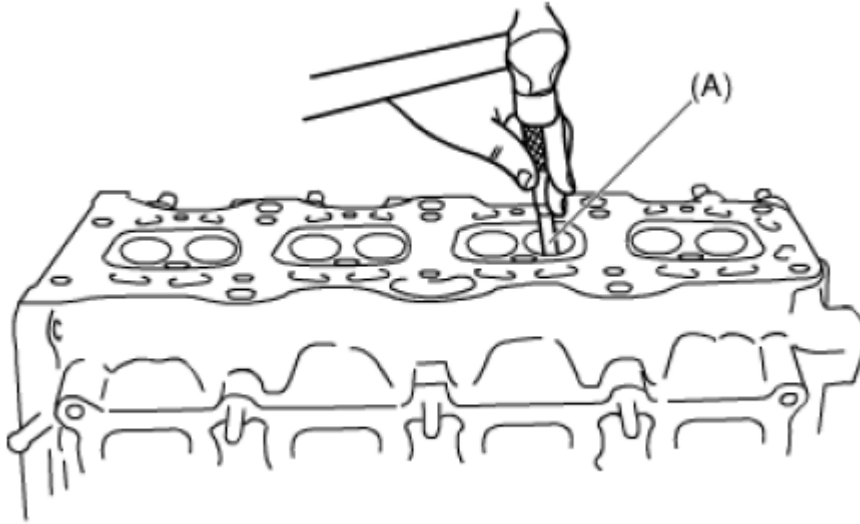


Fig. 125: Removing Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

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.

NOTE: The engine could be damaged if shavings remain inside the valve guide hole after reaming it.
Be sure to thoroughly remove shavings from the reamed hole.

Special Tool

(A): 09916-37320

(B): 09916-34542

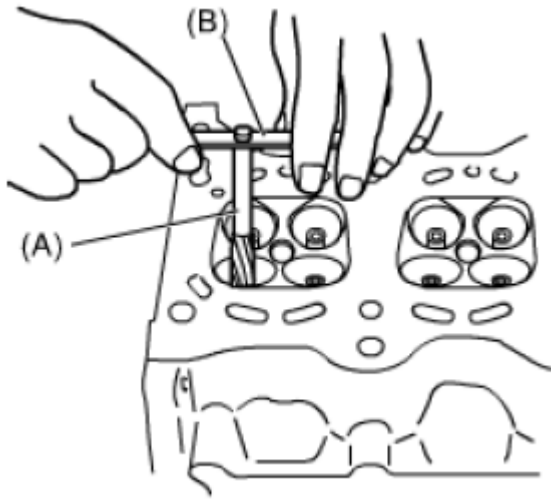


Fig. 126: Installing Valve Guide Into Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

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.

NOTE:

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.

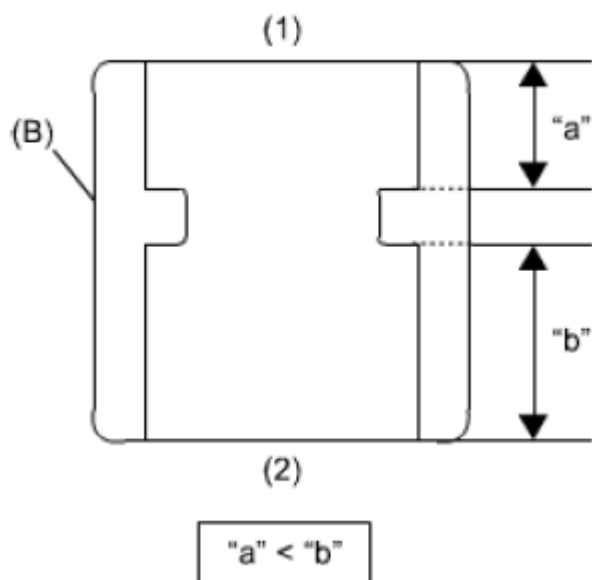


Fig. 127: Identifying Valve Guide Dimension
Courtesy of SUZUKI OF AMERICA CORP.

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.)

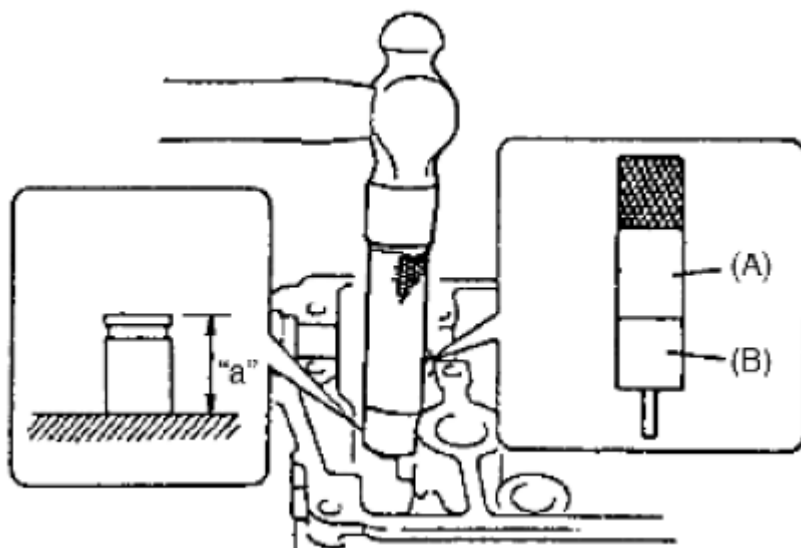


Fig. 128: Installing Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

3. Ream valve guide bore with special tool.

NOTE: The engine could be damaged if shavings remain inside the valve guide hole after reaming it.
Be sure to thoroughly remove shavings from the reamed hole.

Special Tool

(A): 09916-34550

(B): 09916-34542

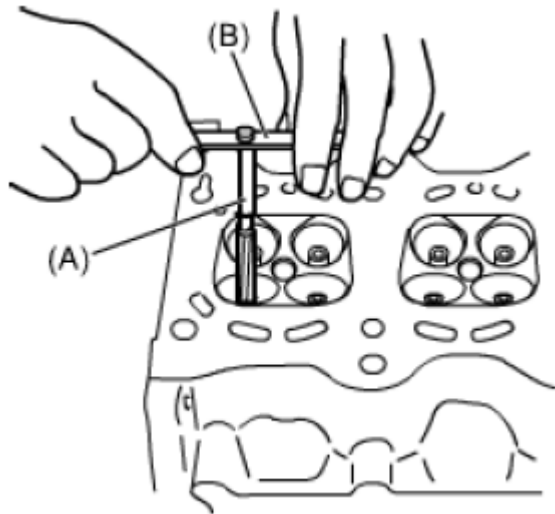


Fig. 129: Reaming Valve Guide Bore With Special Tool
Courtesy of SUZUKI OF AMERICA CORP.

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.

NOTE: If the valve stem seal is installed by striking the special tool with a hammer or other similar tool, the valve stem seal may be damaged, causing oil to get down past the seal.
Be sure to push the special tool only by hand to force the valve stem seal into position.

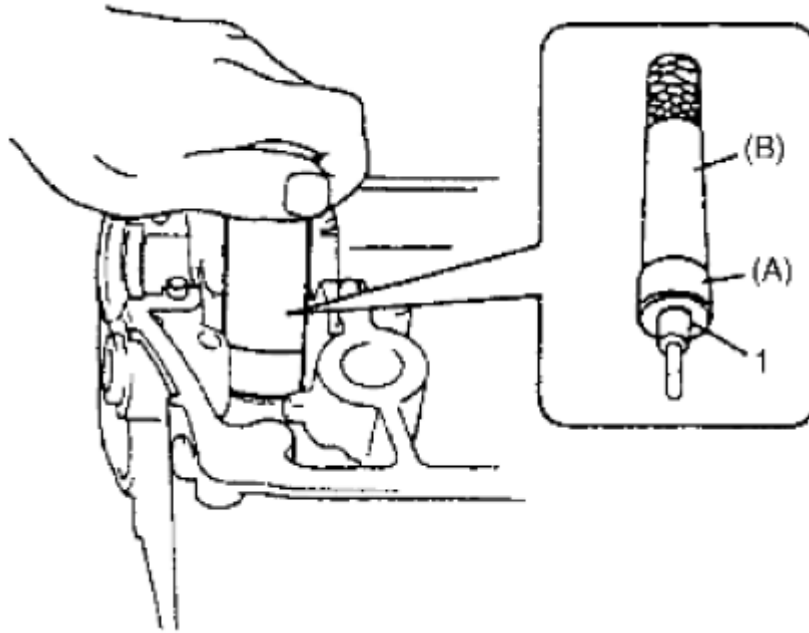
Special Tool**(A): 09917-98221****(B): 09916-58210**

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.

NOTE: **Damaging the wall surface of the tappet fitting hole could result in engine problems.**
Prevent the special tool from touching the tappet sliding surface in the cylinder head.

Special Tool**(A): 09916-14510****(B): 09916-14522**

(C): 09916-84511

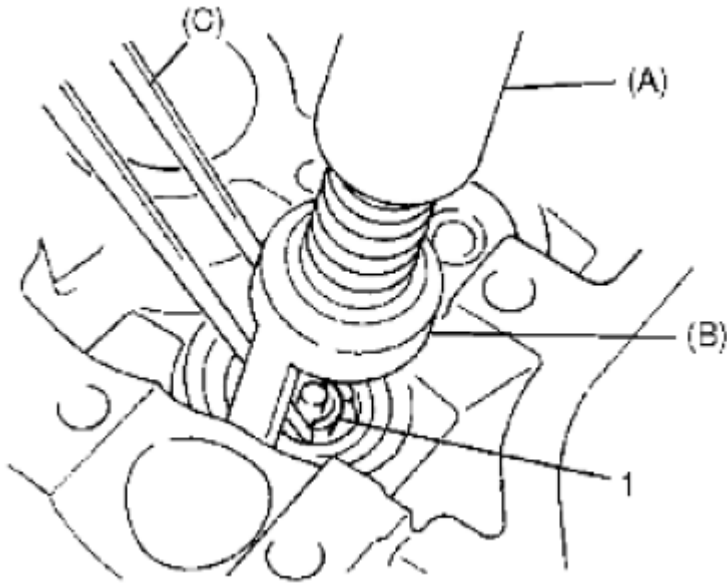


Fig. 131: Compressing Valve Spring And Valve Cotters
Courtesy of SUZUKI OF AMERICA CORP.

10. Install venturi plugs (1).

Tightening torque

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

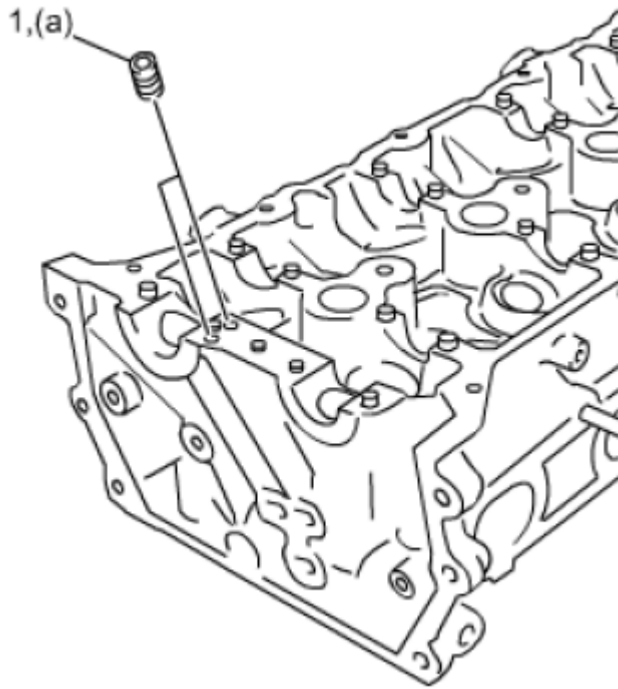


Fig. 132: Installing Venturi Plugs
Courtesy of SUZUKI OF AMERICA CORP.

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 Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

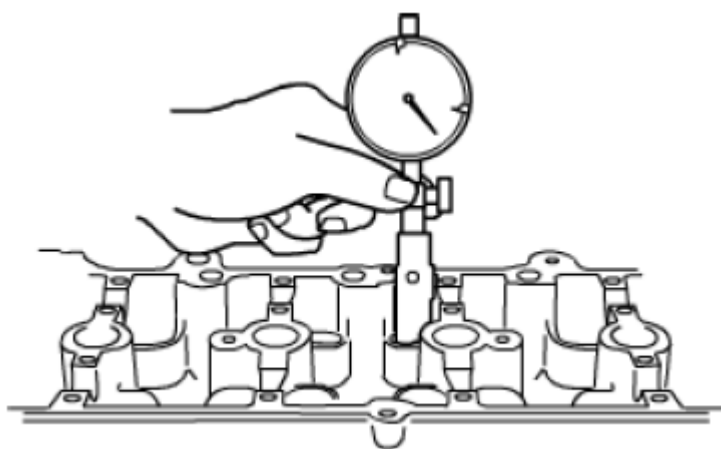


Fig. 134: Checking Valve Stem Inside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

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.)

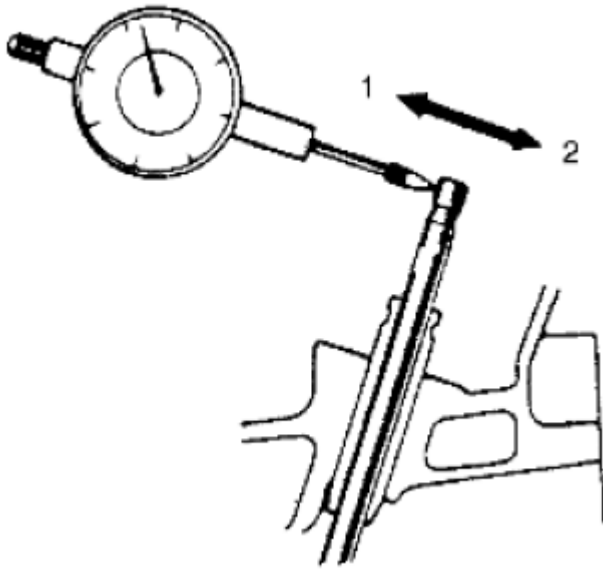


Fig. 135: Checking Valve Stem End Deflection With Dial Gauge
Courtesy of SUZUKI OF AMERICA CORP.

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".

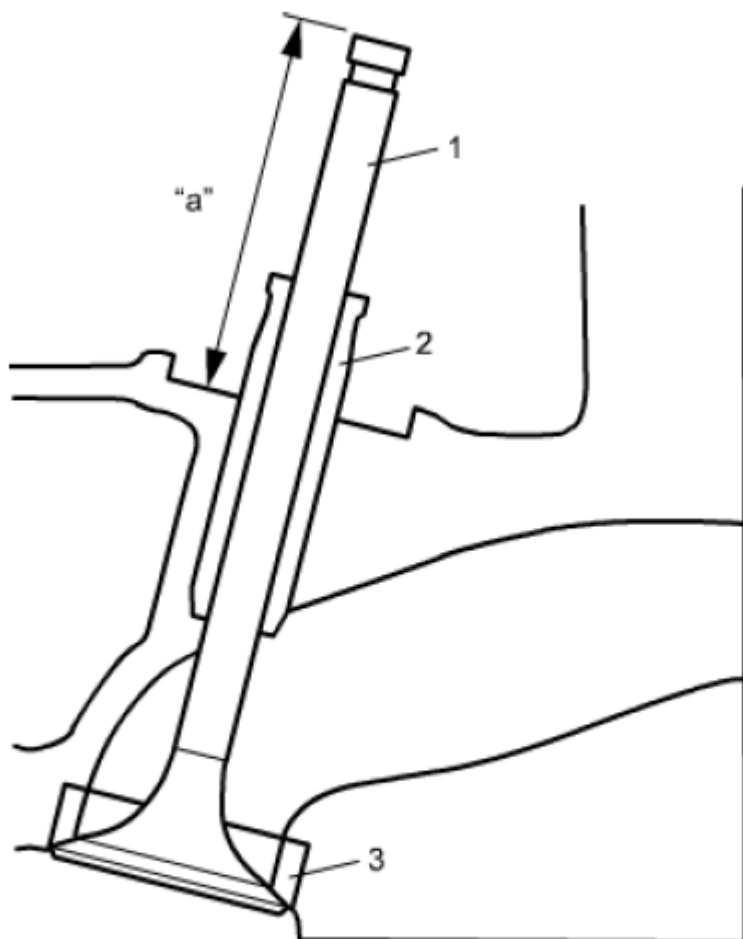
If measured length is out of standard value, replace valve.

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.

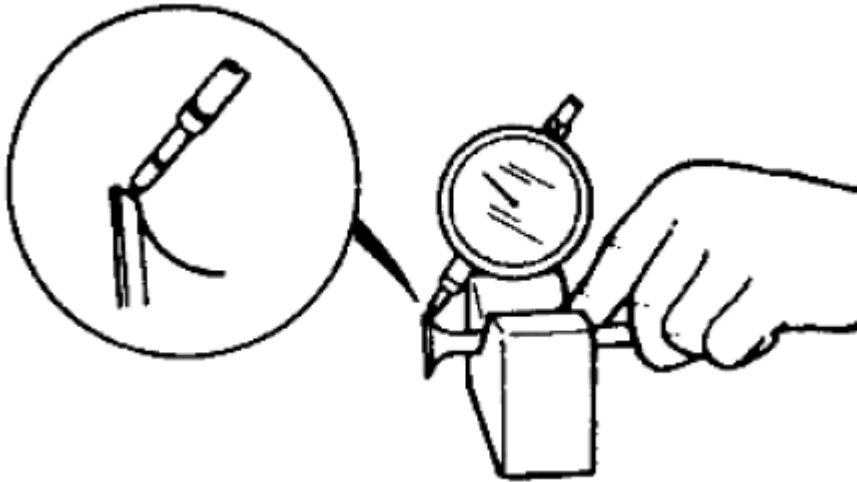
Valve head radial runout**Standard****IN: 0.000 - 0.045 mm (0.0000 - 0.0017 in.)****EX: 0.000 - 0.030 mm (0.0000 - 0.0011 in.)****Limit****IN: 0.090 mm (0.0035 in.)****EX: 0.060 mm (0.0023 in.)**

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.)**

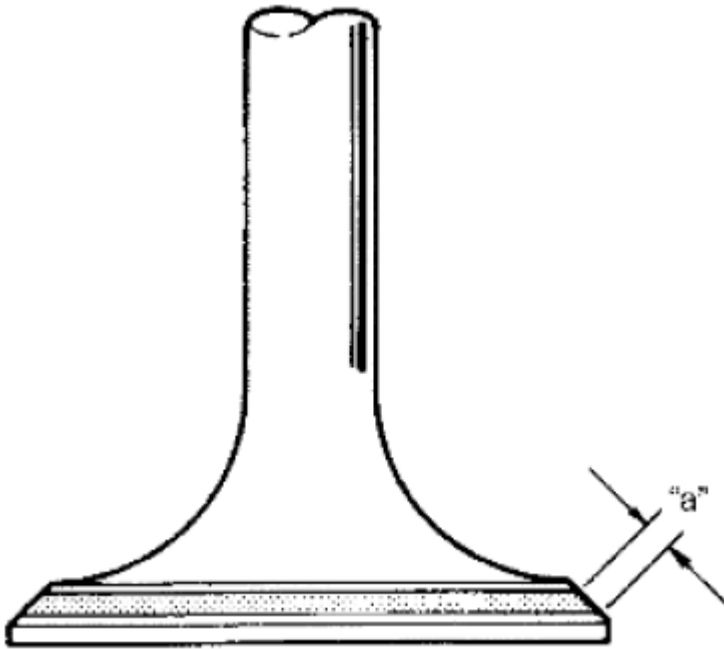


Fig. 138: Identifying Valve Width
Courtesy of SUZUKI OF AMERICA CORP.

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.)

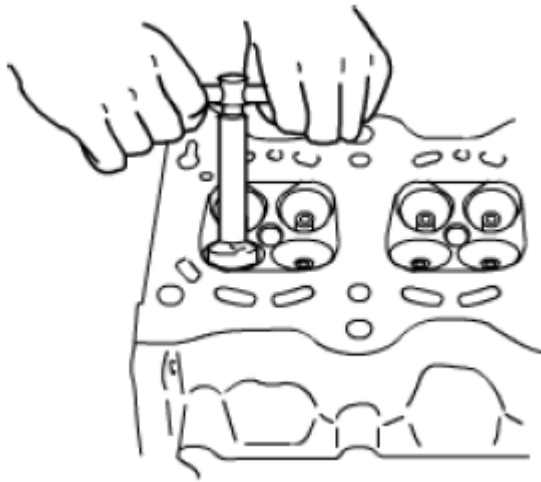
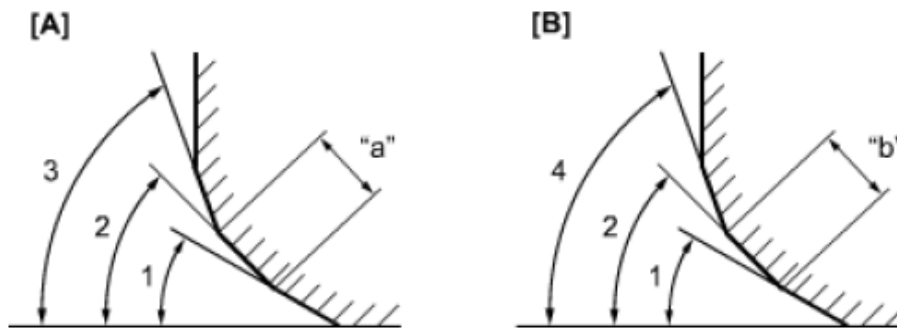


Fig. 139: Seating Valve Seat Using Valve Seat Cutters
 Courtesy of SUZUKI OF AMERICA CORP.



[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.

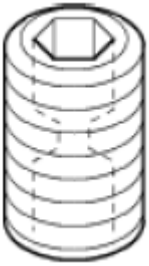


Fig. 141: Identifying Venturi Plug
Courtesy of SUZUKI OF AMERICA CORP.

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.)

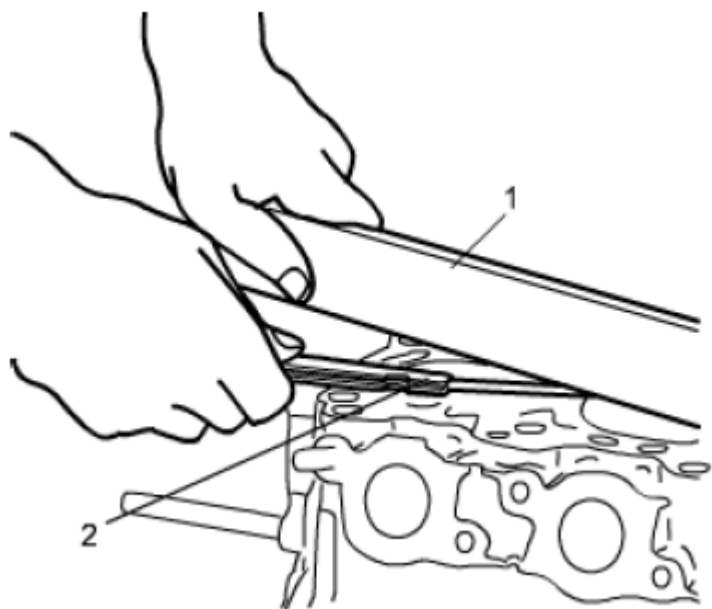


Fig. 142: Checking Cylinder Head Flatness Surface
Courtesy of SUZUKI OF AMERICA CORP.

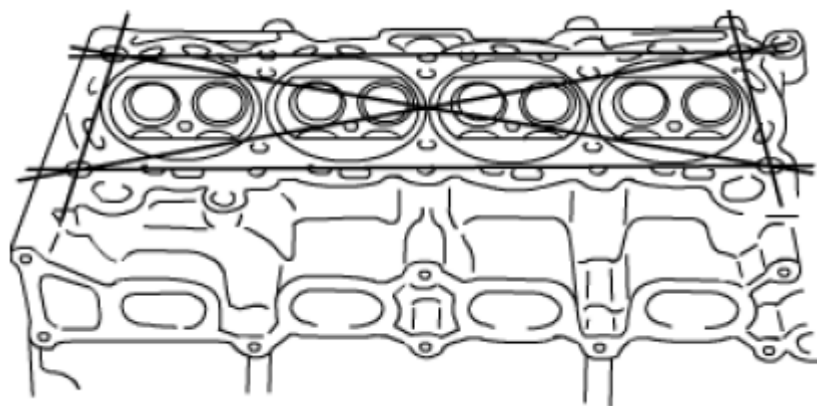


Fig. 143: Identifying Cylinder Head Surface
Courtesy of SUZUKI OF AMERICA CORP.

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.)

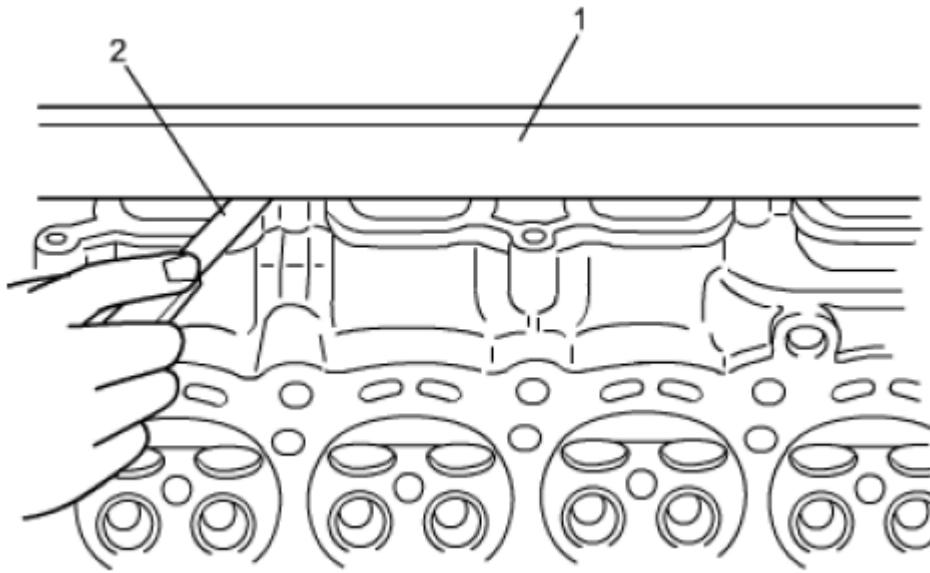


Fig. 144: Checking Flatness Of Manifold Seating Surface
 Courtesy of SUZUKI OF AMERICA CORP.

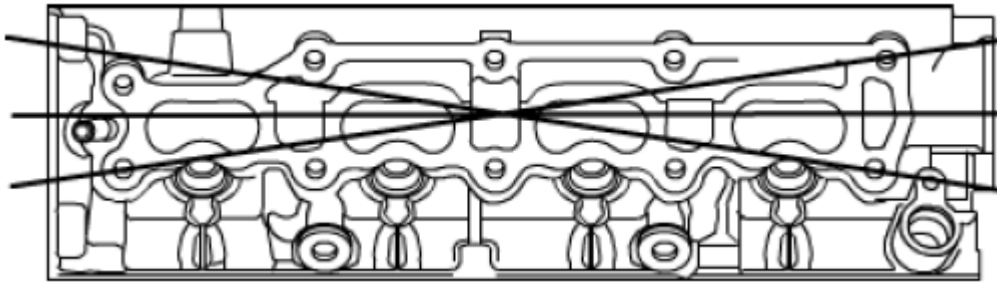


Fig. 145: Identifying Cylinder Head Surface
 Courtesy of SUZUKI OF AMERICA CORP.

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 No. 1 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 No. 1 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 No. 1 bolt with new bolt.

Cylinder head No. 1 bolt diameter measurement points

"a": 95.0 mm (3.74 in.)

"b": 130.0 mm (5.12 in.)

Cylinder head No. 1 bolt diameter difference (deformation)

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

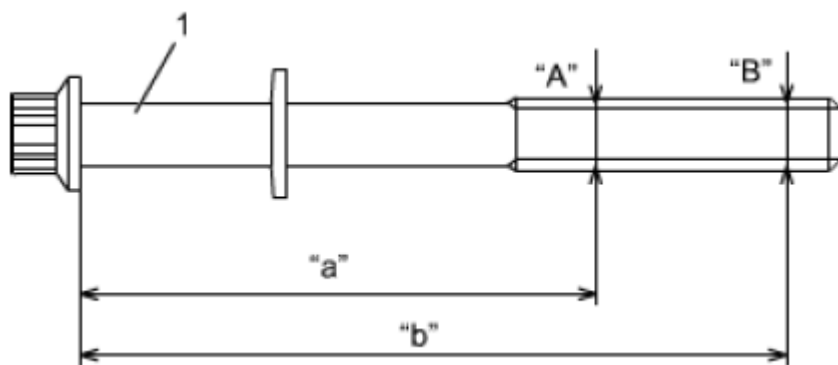
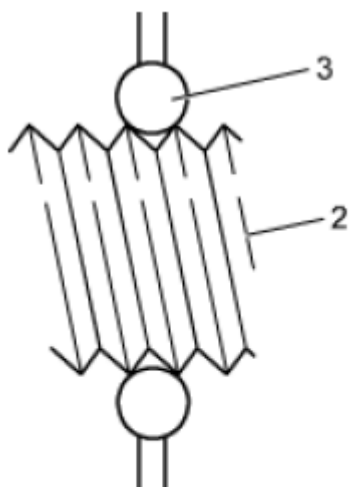


Fig. 146: Identifying Cylinder Head Bolt Dimension
Courtesy of SUZUKI OF AMERICA CORP.



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)

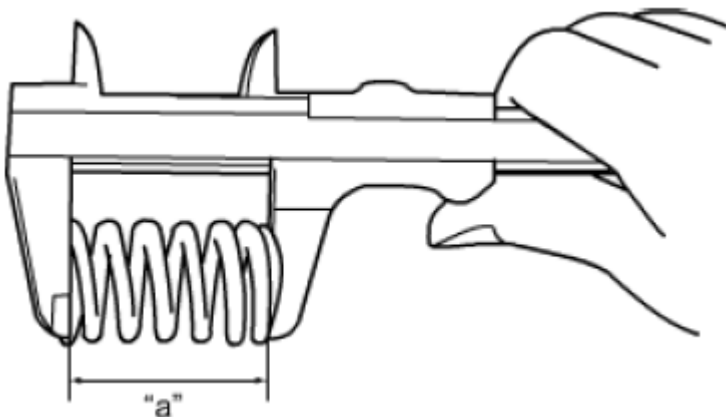


Fig. 148: Measuring Valve Spring Free Length
Courtesy of SUZUKI OF AMERICA CORP.

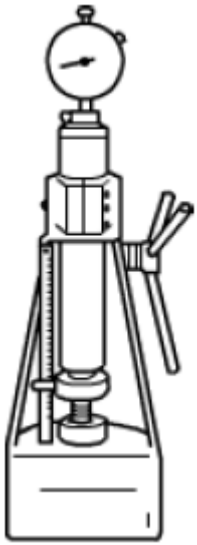


Fig. 149: Compressing Valve Spring
Courtesy of SUZUKI OF AMERICA CORP.

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.)

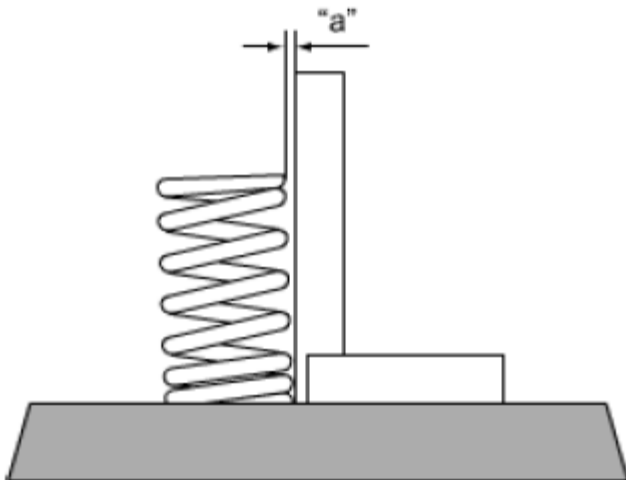
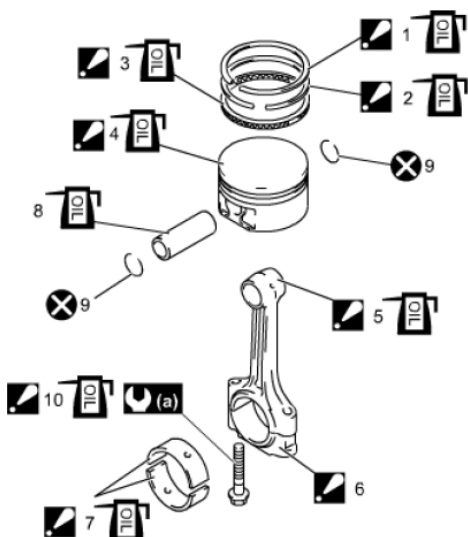


Fig. 150: Checking Spring Squareness
Courtesy of SUZUKI OF AMERICA CORP.

PISTON, PISTON RING AND CONNECTING ROD COMPONENTS















 <p>1. 1st ring : For assembling, refer to Piston, Piston Ring and Connecting Rod Disassembly and Reassembly. : 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 Piston, Piston Ring and Connecting Rod Disassembly and Reassembly. : 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 Piston, Piston Ring and Connecting Rod Removal and Installation.</p>
 <p>3. Oil ring : For assembling, refer to Piston, Piston Ring and Connecting Rod Disassembly and Reassembly. : Apply engine oil to sliding surface.</p>	 <p>7. Connecting rod bearing : For applying engine oil, refer to Piston, Piston Ring and Connecting Rod Removal and Installation.</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 Piston, Piston Ring and Connecting Rod Removal and Installation. : 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
Courtesy of SUZUKI OF AMERICA CORP.

PISTON, PISTON RING AND CONNECTING ROD REMOVAL AND INSTALLATION

NOTE: If any of the parts listed below is reinstalled into a position different from the original position, engine problems could occur.
If these parts are to be reused, keep them in numerical order so that they may be reinstalled in their original positions.

- Connecting rods
- Connecting rod bearings
- Connecting rod bearing caps
- Pistons

Removal

Reference: PISTON, PISTON RING AND CONNECTING ROD COMPONENTS

1. Remove engine assembly from vehicle. Refer to Engine Assembly Removal and Installation.
2. Remove cylinder head. Refer to Valve and Cylinder Head Removal and Installation.
3. Remove oil pump. Refer to 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 BEARING INSPECTION

NOTE: The engine will seize up if it is operated when the parts listed below are not properly lubricated.
Be sure to lubricate all the friction surfaces of these parts with engine oil before installing them.

- Crankshaft pins
- Connecting rod bearings
- Pistons
- Piston rings
- Cylinder walls

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

NOTE: If oil is present between the bearing's outside surface and the connecting rod surface, the bearing could heat up to very high temperature, resulting in seizure.
Be sure to thoroughly wipe off any trace of oil that is present between the bearing's outside surface and the connecting rod surface.

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.

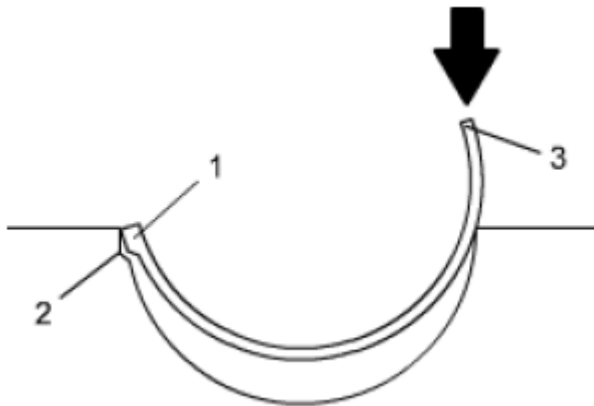
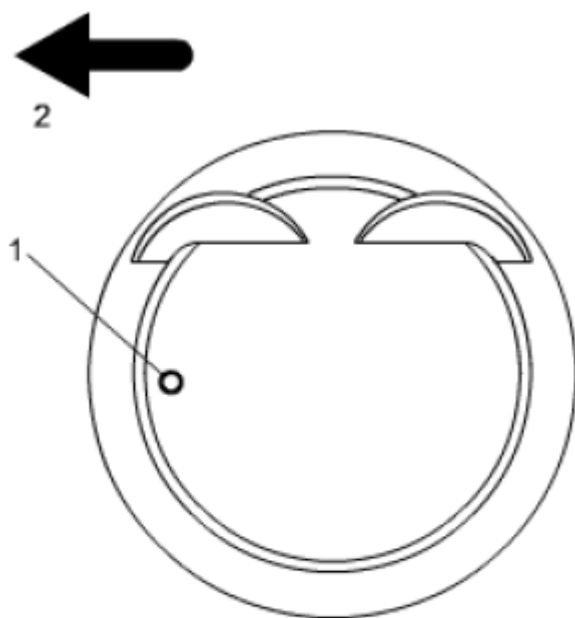


Fig. 152: Pressing Bearing End
Courtesy of SUZUKI OF AMERICA CORP.

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



2: Crankshaft pulley side

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

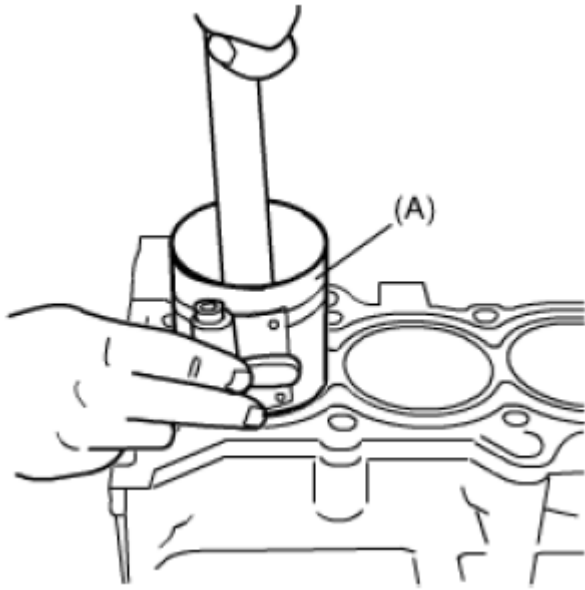


Fig. 154: Installing Piston And Connecting Rod Assembly Into Cylinder Bore
Courtesy of SUZUKI OF AMERICA CORP.

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

NOTE: Using connecting rod bolts that are deformed exceeding the service limit could lead to engine problems.
Before installing connecting rod bearing cap, make sure that connecting rod bolts are not deformed exceeding the service limit referring to **"CONNECTING ROD BOLT DEFORMATION"** under *Piston Pin and Connecting Rod Inspection*.

NOTE: Tighten connecting rod bearing cap bolt (3) gradually.

- Point arrow mark (2) on connecting rod bearing cap (1) to crankshaft pulley side.
- 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°)

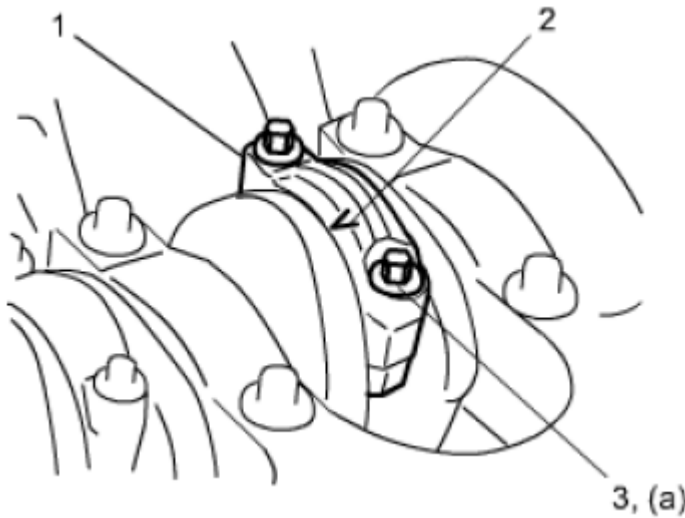


Fig. 155: Identifying Arrow Mark On Connecting Rod Bearing Cap And Crankshaft Pulley Side

Courtesy of SUZUKI OF AMERICA CORP.

6. Install oil pump. Refer to **OIL PUMP ASSEMBLY REMOVAL AND INSTALLATION** .
7. Install cylinder head. Refer to **Valve and Cylinder Head Removal and Installation**.
8. Install engine assembly. Refer to **Engine Assembly Removal and Installation**.

PISTON, PISTON RING AND CONNECTING ROD DISASSEMBLY AND REASSEMBLY

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

NOTE: Using the parts removed from a piston for another piston may lead to engine problems.
If the following parts are to be reused, be sure to use them only in the original combination.

- Piston
- Piston pin
- Piston rings
- Connecting rod
- Connecting rod bearings
- 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.

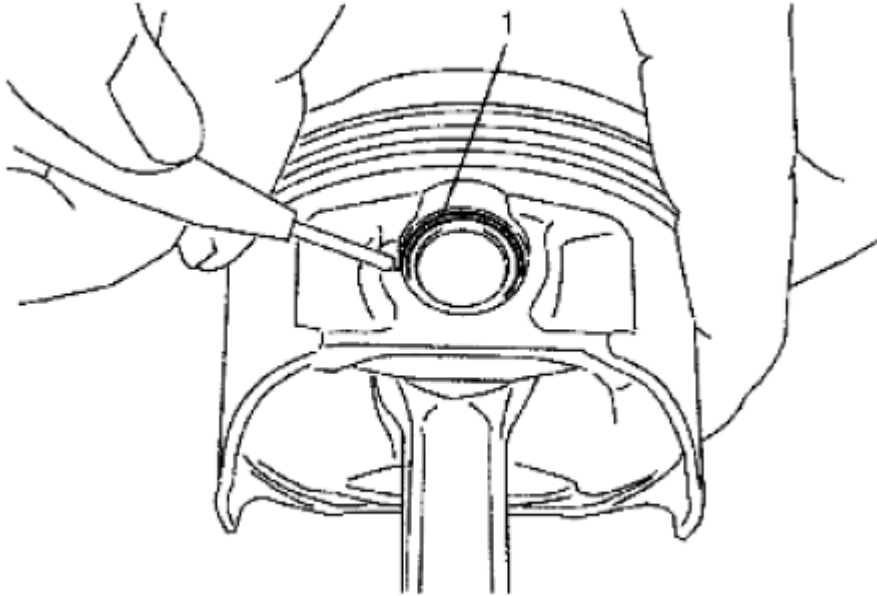


Fig. 156: Removing Piston Pin Circlips
Courtesy of SUZUKI OF AMERICA CORP.

- b. Take out piston pin.

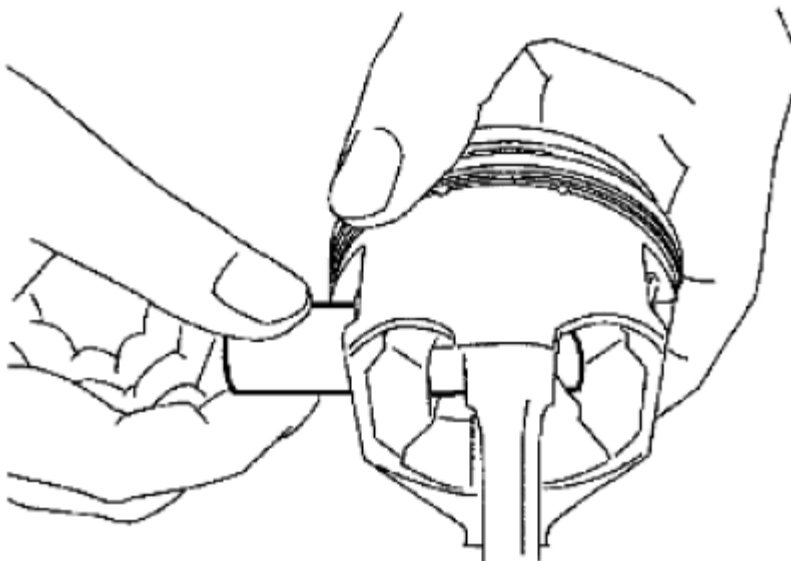


Fig. 157: Taking Out Piston Pin
Courtesy of SUZUKI OF AMERICA CORP.

Reassembly

Reference: CYLINDER, PISTON AND PISTON RING INSPECTION

Reference: PISTON PIN AND CONNECTING ROD INSPECTION

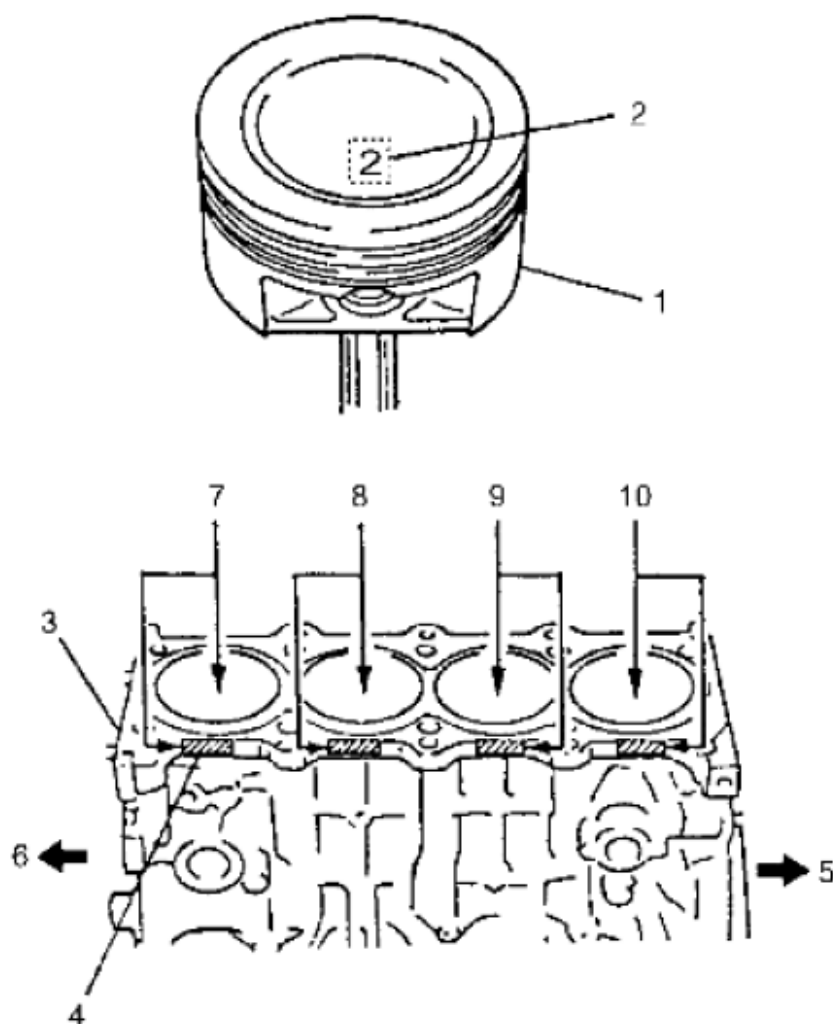
Reference: CRANKSHAFT PIN AND CONNECTING ROD BEARING INSPECTION

NOTE: The engine will seize up if it is operated when the parts listed below are not properly lubricated.
Be sure to lubricate all the friction surfaces of these parts with engine oil before installing them.

- Piston pin hole
- Piston pin
- Connecting rod small-end bore

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. Apply engine oil to piston pin, piston pin hole and connecting rod small-end bore.
2. 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

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

3. Remove carbon deposit from piston head and ring grooves using a suitable tool.
4. 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).

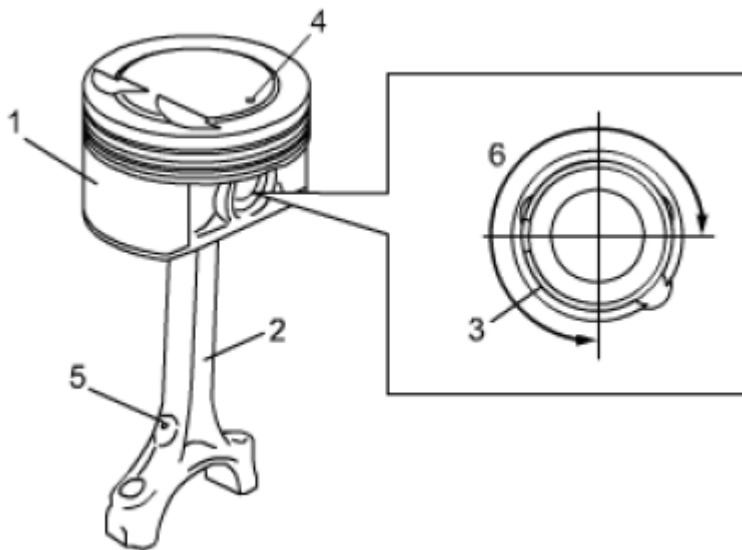


Fig. 159: Installing Piston Pin Circlips
Courtesy of SUZUKI OF AMERICA CORP.

5. 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.

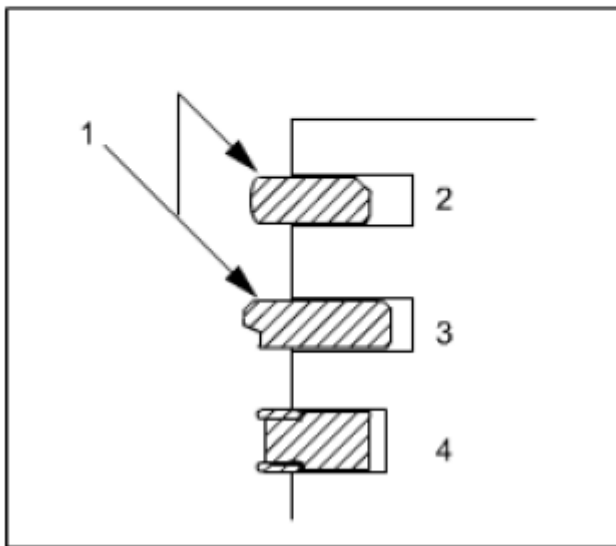
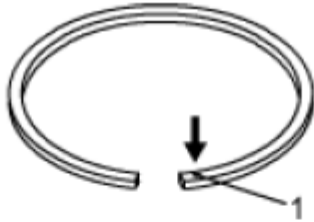
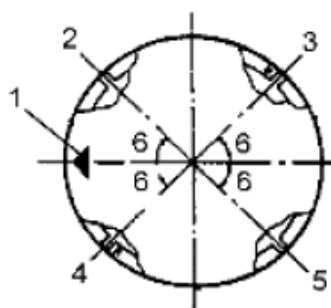


Fig. 160: Identifying Ring Thickness
Courtesy of SUZUKI OF AMERICA CORP.

6. 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 or abnormality is found on cylinder inside wall, 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.

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 SPECIFICATION**

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.)

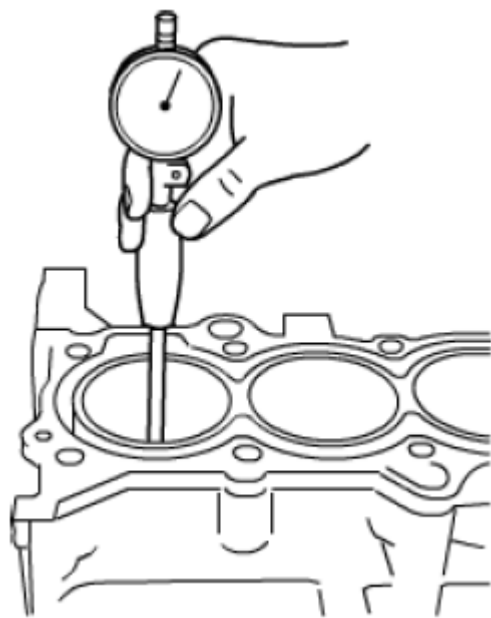
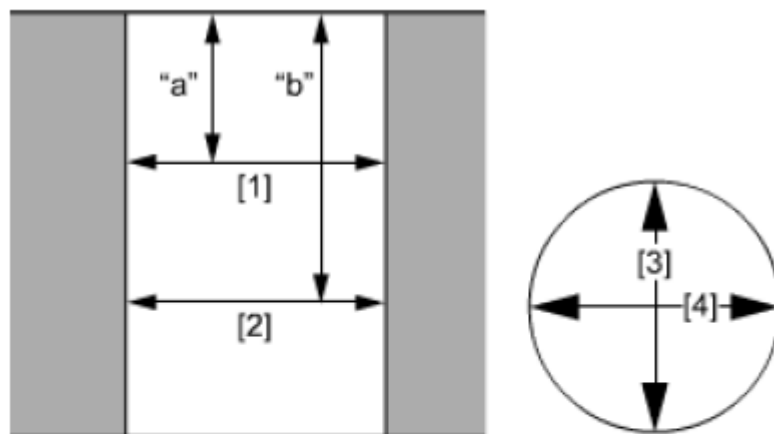
Cylinder bore diameter**Limit: 92.050 mm (3.6240 in.)****Cylinder bore roundness ([3] - [4])****Limit: 0.020 mm (0.00078 in.)****Cylinder bore taper ([1] - [2])****Limit: 0.013 mm (0.00051 in.)**

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.

PISTON DIAMETER STANDARD SIZE SPECIFICATION

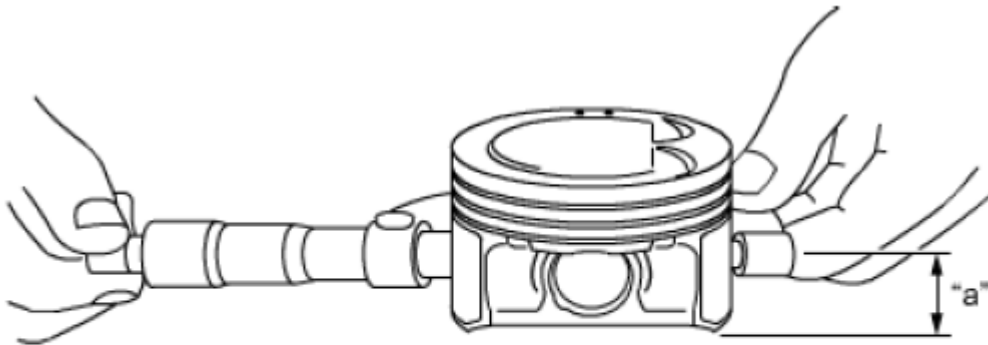
Stamped number on piston	1	91.990 - 92.020 mm (3.6217 - 3.6228 in.)
	2	91.980 - 92.010 mm (3.6213 - 3.6224 in.)

PISTON DIAMETER LIMIT SIZE SPECIFICATION

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: Checking 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

	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.)	-

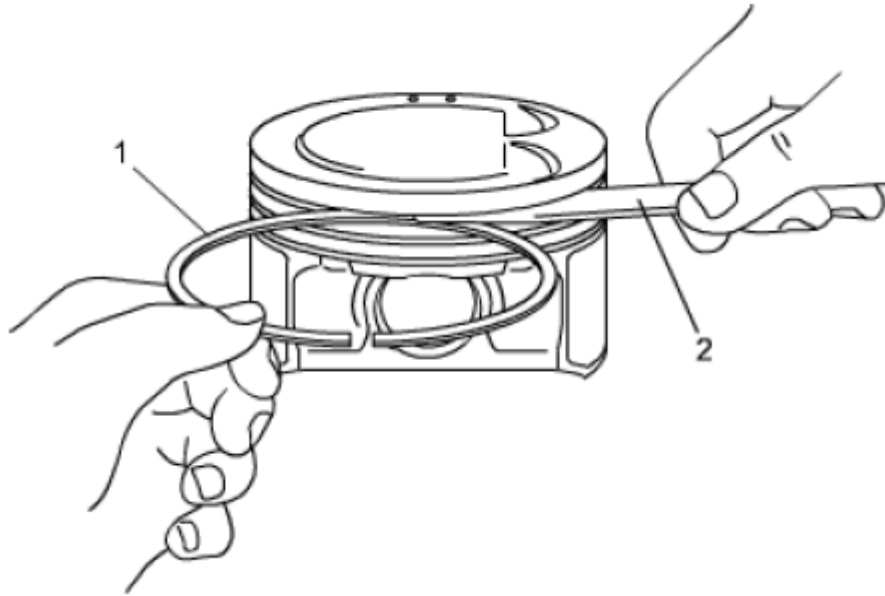


Fig. 165: Measuring Clearance Between Ring And Ring Land Using Thickness Gauge
 Courtesy of SUZUKI OF AMERICA CORP.

Piston Ring

Piston ring end gap

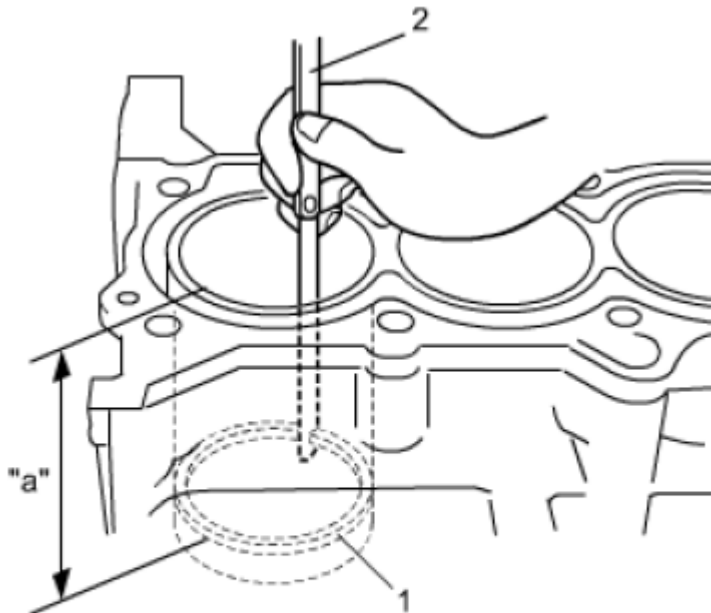
To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap using thickness gauge (2).

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 SPECIFICATION

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 Piston Ring End Gap Using Thickness Gauge
Courtesy of SUZUKI OF AMERICA CORP.

PISTON PIN AND CONNECTING ROD 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.)

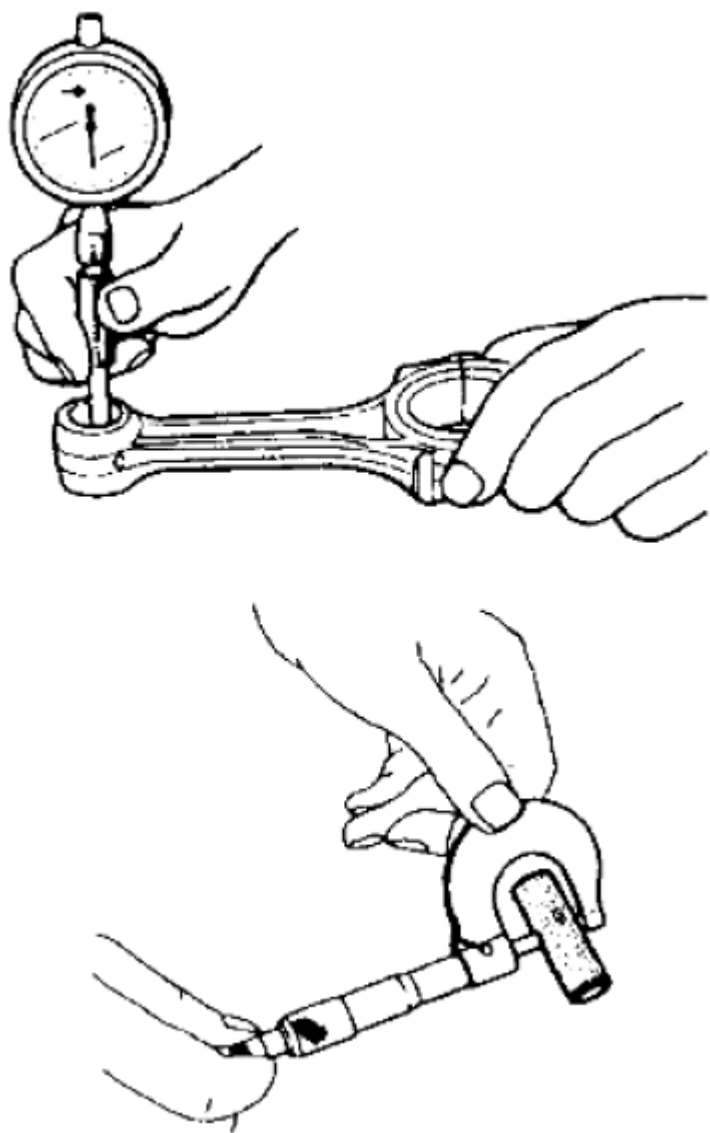


Fig. 167: Measuring Piston Pin Clearance
Courtesy of SUZUKI OF AMERICA CORP.

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.)

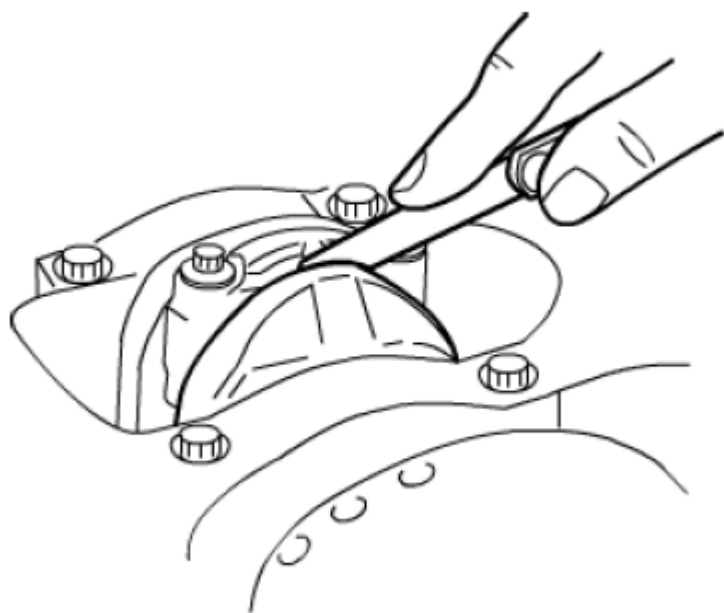


Fig. 168: Checking Big-End Side Clearance Of Connecting Rod
Courtesy of SUZUKI OF AMERICA CORP.

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.)

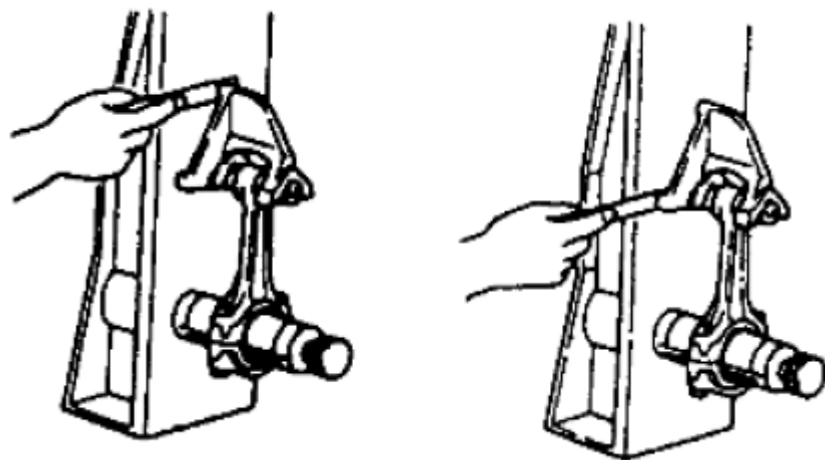


Fig. 169: Checking Connecting Rod Alignment

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 connected rod (1).

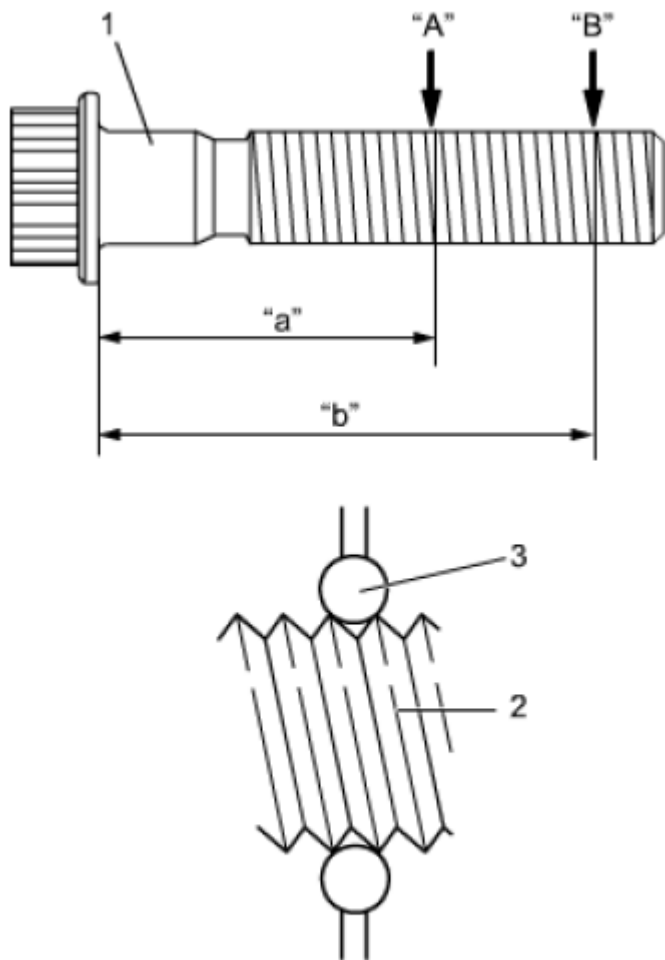
Connecting rod bolt measurement points

"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 BEARING 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.

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.)

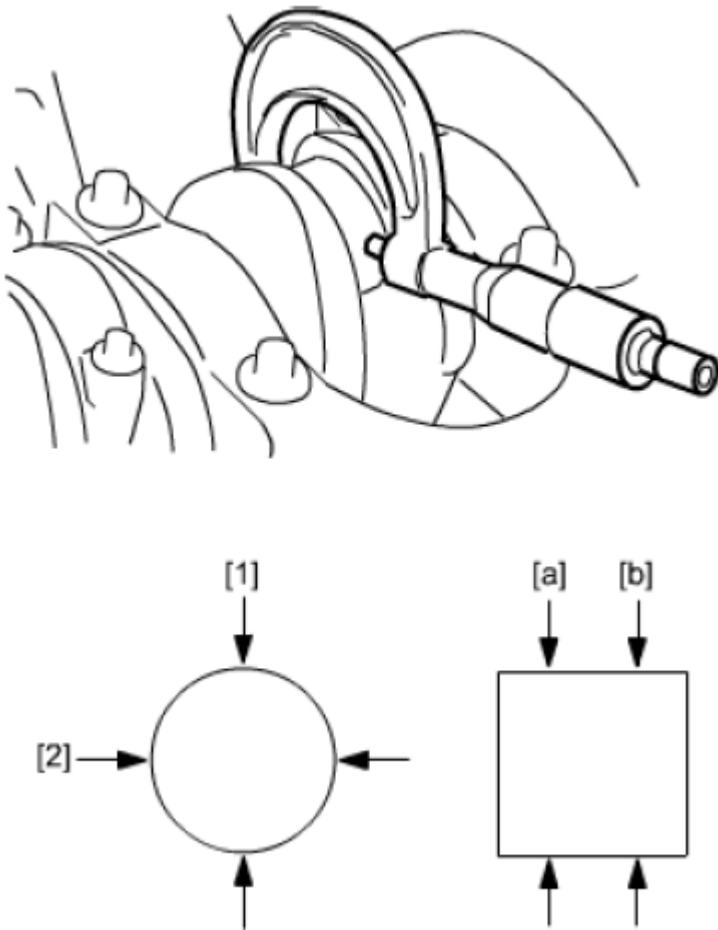


Fig. 171: Checking Crankshaft Pin Diameter
Courtesy of SUZUKI OF AMERICA CORP.

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.

	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 Specified Colors For Identification On 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

NOTE: Using connecting rod bolts that are deformed exceeding the service limit could lead to engine problems.
 After checking connecting rod bearing clearance, make sure that connecting rod bolts are not deformed exceeding the service limit referring to **"CONNECTING ROD BOLT DEFORMATION"** under *Piston Pin and Connecting Rod Inspection* .

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

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

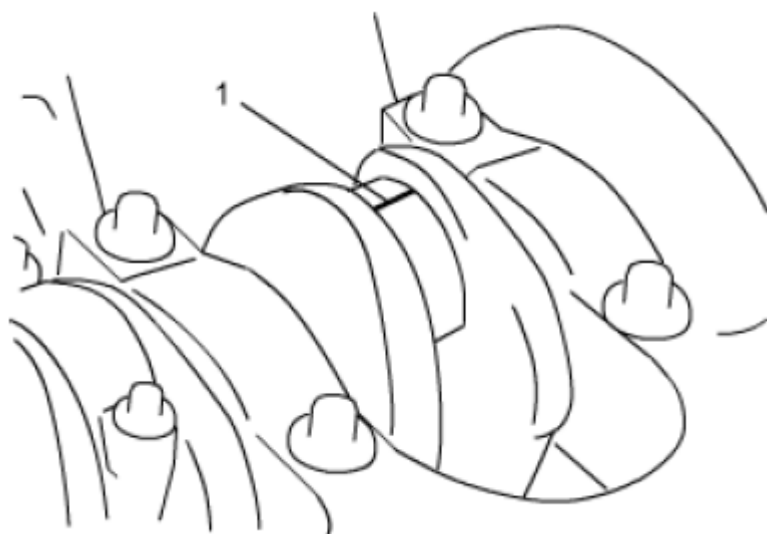


Fig. 173: Placing Piece Of Gauging Plastic To Full Width Of Crankshaft Pin
Courtesy of SUZUKI OF AMERICA CORP.

3. Install connecting rod bearings and its cap. Refer to **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.)

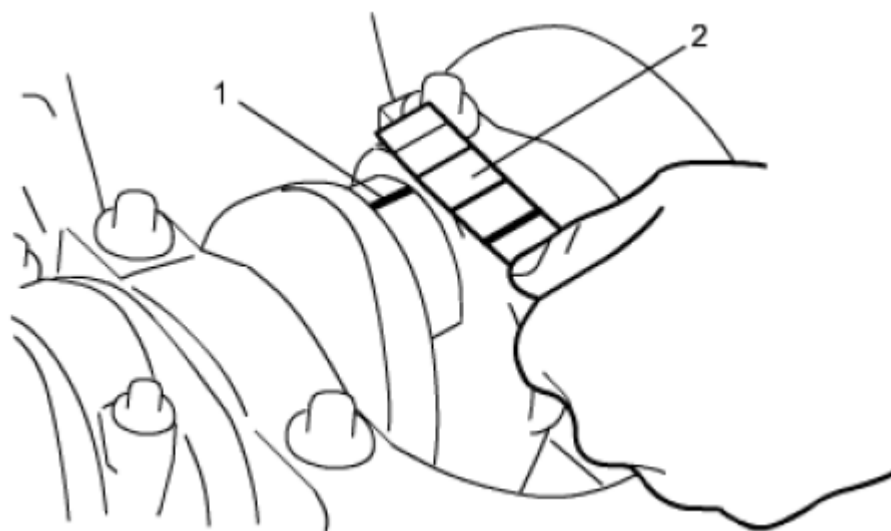


Fig. 174: Measuring Gauging Plastic Width At Widest Point
Courtesy of SUZUKI OF AMERICA CORP.

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.

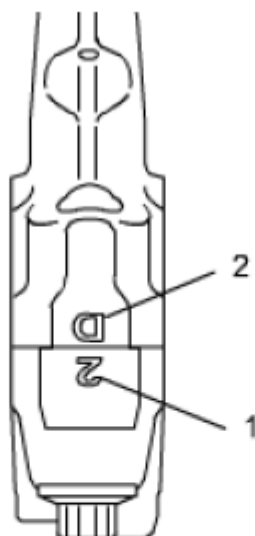
Selection of Connecting Rod Bearings

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

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

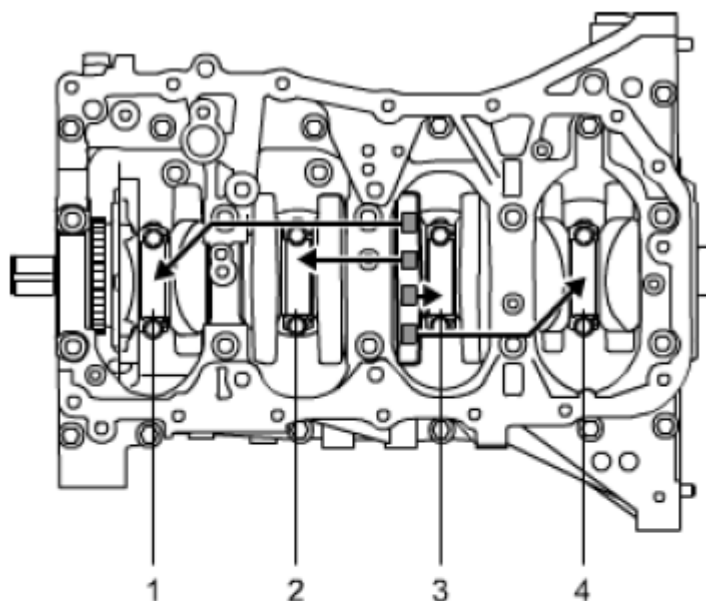
Fig. 175: Identifying Connecting Rod Big-End Inside Diameter Number And Weight Indication Mark

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

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 Numbers
 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

		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. Refer to **Connecting Rod Bearing Clearance.**

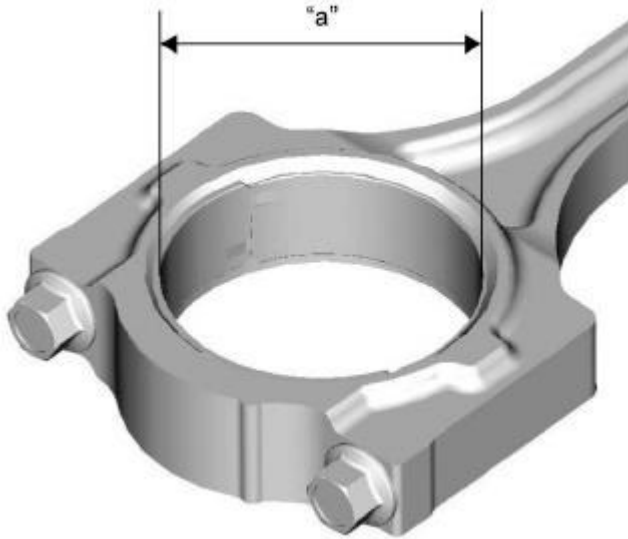


Fig. 177: Measuring Connecting Rod Bearing Inside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS

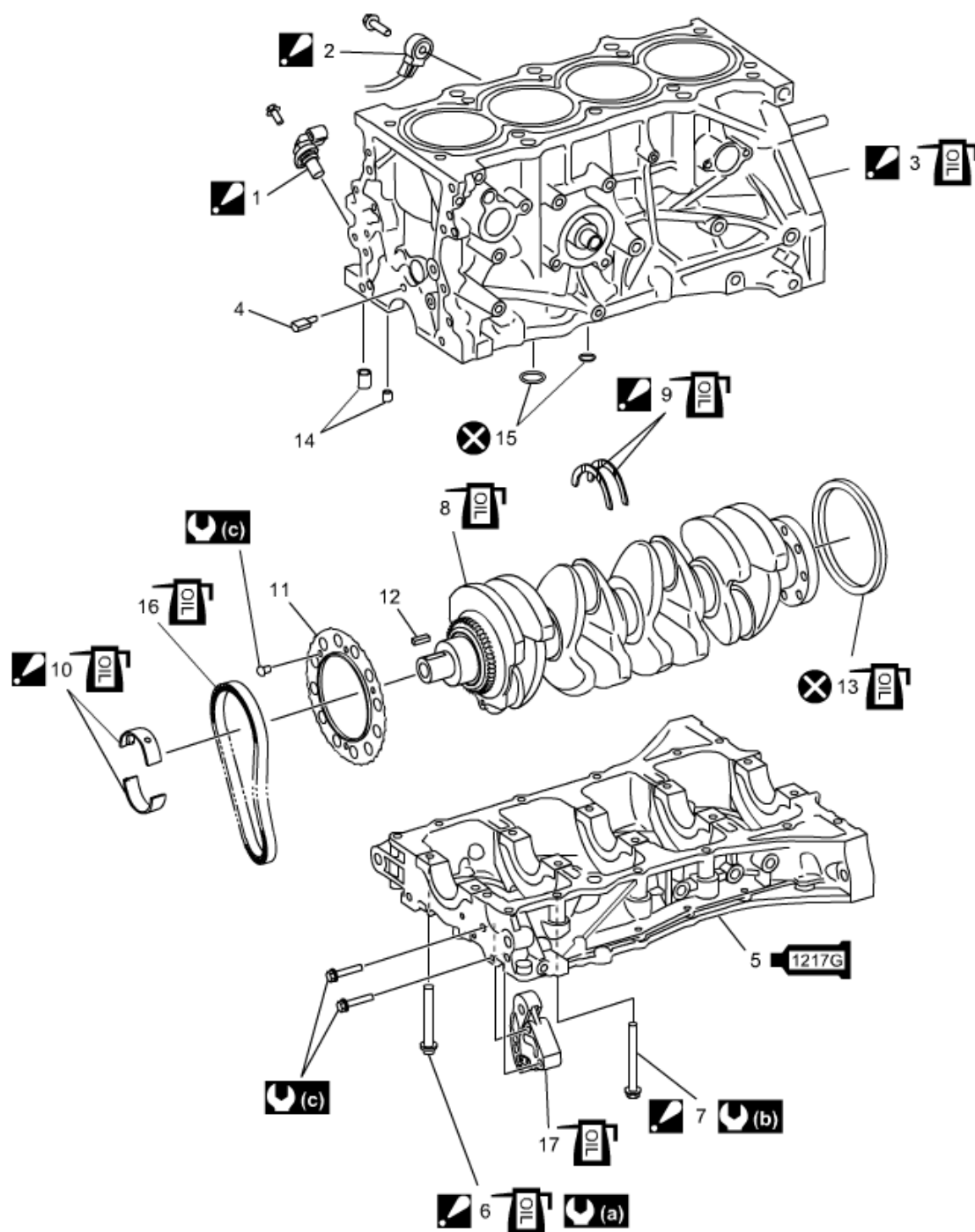


Fig. 178: Identifying Main Bearing, Crankshaft And Cylinder Block Components (1 Of 2)
 Courtesy of SUZUKI OF AMERICA CORP.













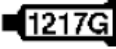








 1. CKP sensor : For removal and installation, refer to CKP (Crankshaft Position) Sensor Removal and Installation.	 8. Crankshaft : Apply engine oil to sliding surface	15. O-ring
 2. Knock sensor : For removal and installation, refer to Knock Sensor Removal and Installation.	  9. Thrust bearing : Install 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 Main Bearing, Crankshaft and Cylinder Block Removal and Installation.	 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 Main Bearing, Crankshaft and Cylinder Block Removal and Installation.	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 Main Bearing, Crankshaft and Cylinder Block Removal and Installation.	 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 Main Bearing, Crankshaft and Cylinder Block Removal and Installation.	14. Dowel pin	 : Do not reuse.

Fig. 179: Identifying Main Bearing, Crankshaft And Cylinder Block Components (2 Of 2)
 Courtesy of SUZUKI OF AMERICA CORP.

MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION

Reference: MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS

NOTE: If any of the parts listed below is reinstalled into a position different from the original position, engine problems could occur.
If these parts are to be reused, keep them in numerical order so that they may be reinstalled in their original positions.

- Main bearing
- Thrust bearing

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

Removal

1. Remove engine assembly. Refer to Engine Assembly Removal and Installation.
2. Remove flywheel for M/T model or drive plate for A/T model. Refer to Flywheel/Drive Plate Removal and Installation.
3. Remove generator. Refer to GENERATOR REMOVAL AND INSTALLATION .
4. Remove water pump. Refer to WATER PUMP REMOVAL AND INSTALLATION .
5. Remove P/S pump. Refer to P/S PUMP REMOVAL AND INSTALLATION .
6. Remove engine front mounting brackets (1).

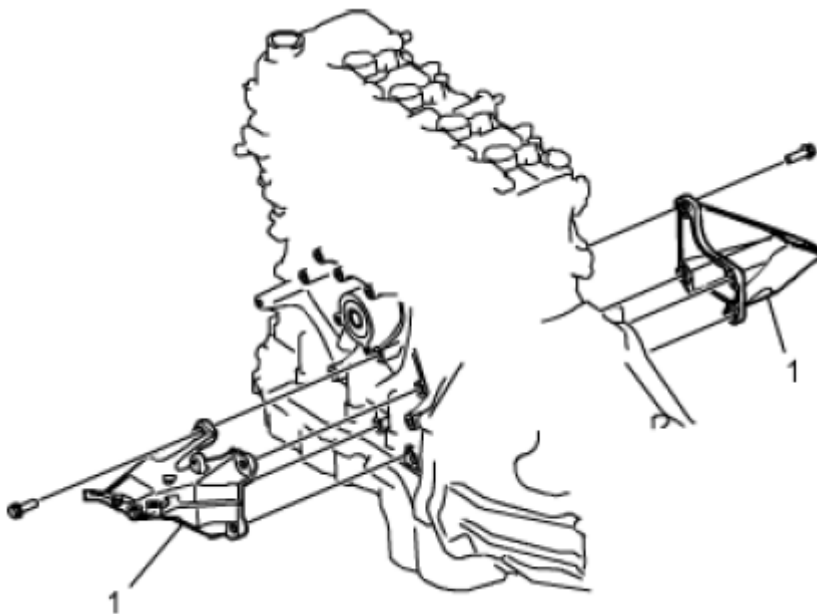


Fig. 180: Identifying Engine Front Mounting Brackets
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove piston and connecting rod. Refer to **Piston, Piston Ring and Connecting Rod Removal and Installation**.
8. Remove oil pump chain adjuster (1) from lower crank case.

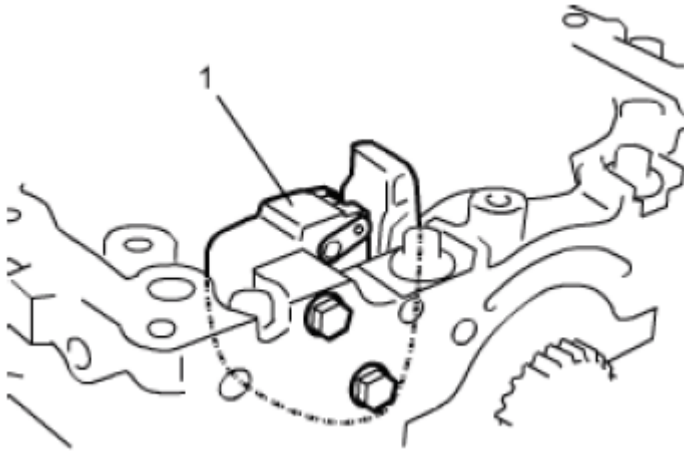


Fig. 181: Identifying Oil Pump Chain Adjuster
Courtesy of SUZUKI OF AMERICA CORP.

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

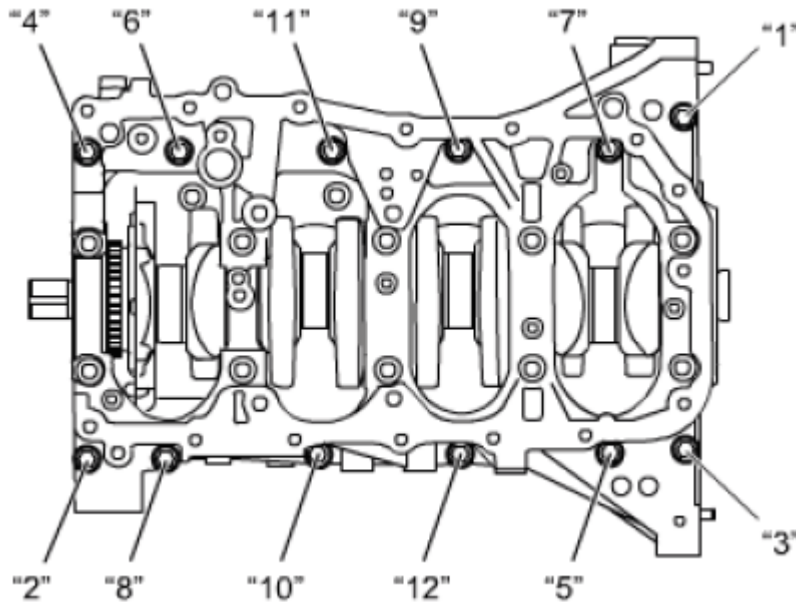


Fig. 182: Identifying Crank Case Bolt No. 2 Loosening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

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.

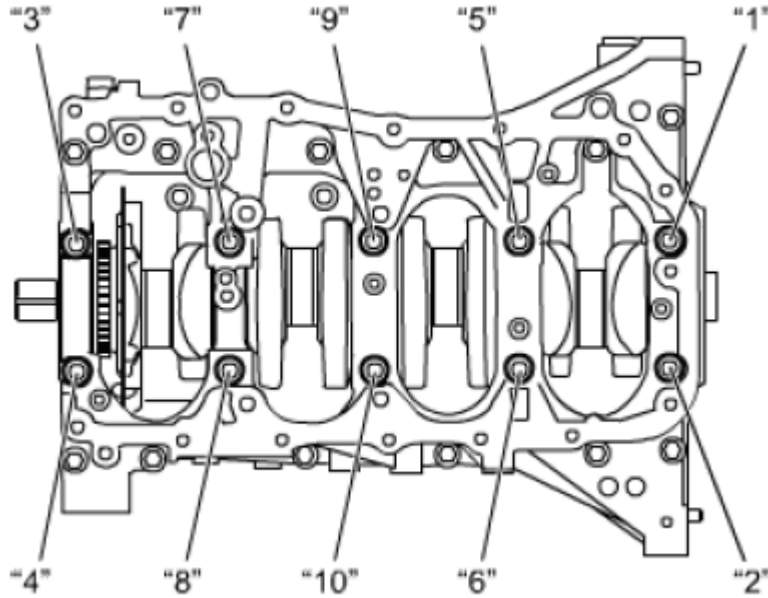


Fig. 183: Identifying Crank Case Bolt No. 1 Loosening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

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).

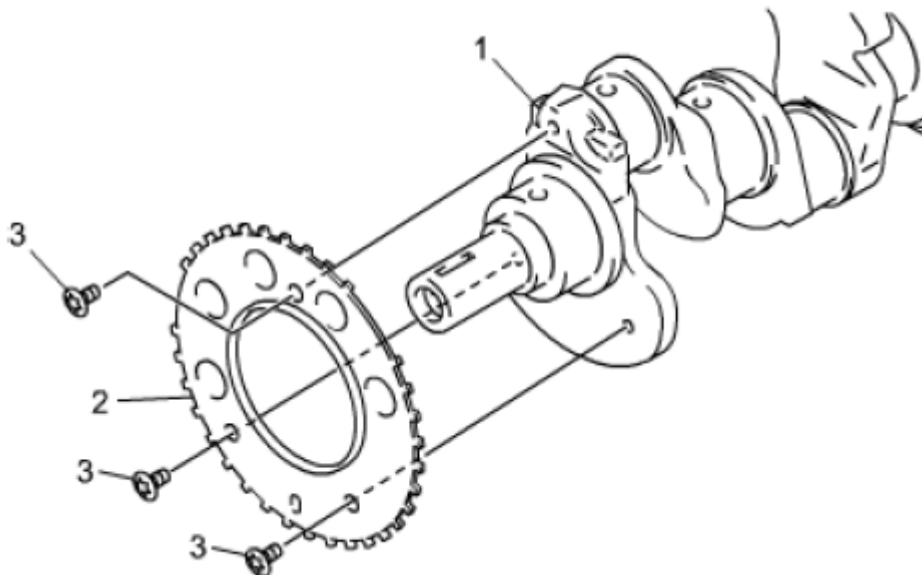


Fig. 184: Identifying Sensor Plate And Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reference: CRANKSHAFT INSPECTION

Reference: MAIN BEARING 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

NOTE:

- The engine will seize up if it is operated when the parts listed below are not properly lubricated.

Be sure to lubricate all the friction surfaces of these parts with engine oil before installing them.

- Crankshaft journal
- Main bearing
- Thrust bearing
- Oil pump chain guide
- If oil is present between the bearing's outside surface and the cylinder block/lower crank case surface, the bearing could heat up to very high temperature, resulting in seizure.

Be sure to thoroughly wipe off any trace of oil that is present between the bearing's outside surface and the cylinder block/lower crank case surface.

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, fitting pin into hole (4) and facing inside edge (5) outward as show in figure.

Tightening torque

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

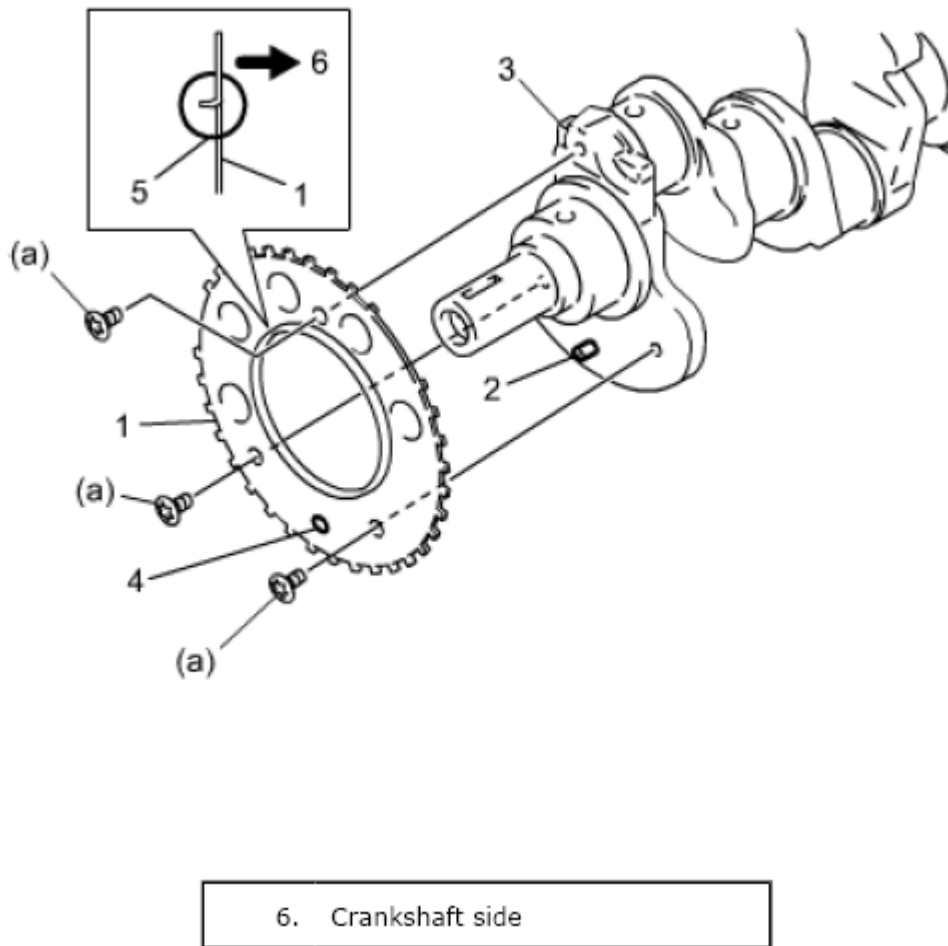


Fig. 185: Installing Sensor Plate To Crankshaft, Fitting Pin Into Hole And Facing Inside Edge Outward
 Courtesy of SUZUKI OF AMERICA CORP.

- 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.

NOTE:

If oil is present between the bearing's outside surface and the camshaft housing/cylinder head surface, the bearing could heat up to

very high temperature, resulting in seizure.
Be sure to thoroughly wipe off any trace of oil that is present
between the bearing's outside surface (5) and the camshaft
housing/cylinder head surface.

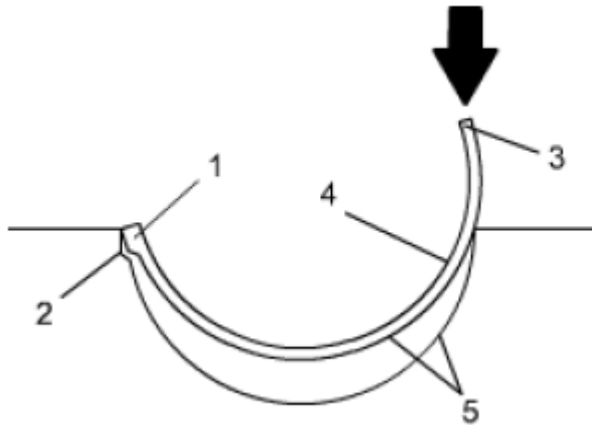


Fig. 186: Pressing Bearing End
Courtesy of SUZUKI OF AMERICA CORP.

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

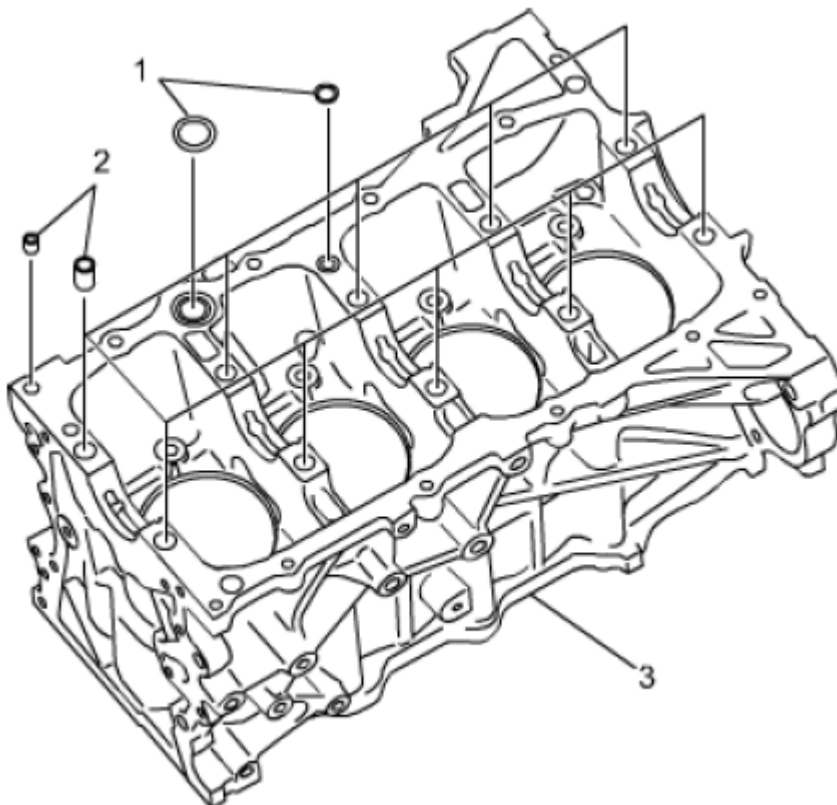


Fig. 187: Identifying Dowel Pins, Cylinder Block And O-ring
Courtesy of SUZUKI OF AMERICA CORP.

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

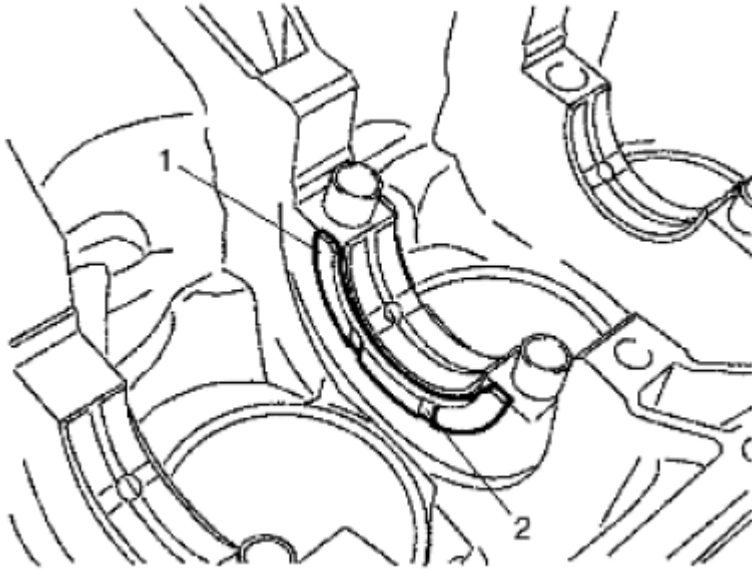


Fig. 188: Identifying Engine Oil Applying Area Into Thrust Bearings
Courtesy of SUZUKI OF AMERICA CORP.

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.)

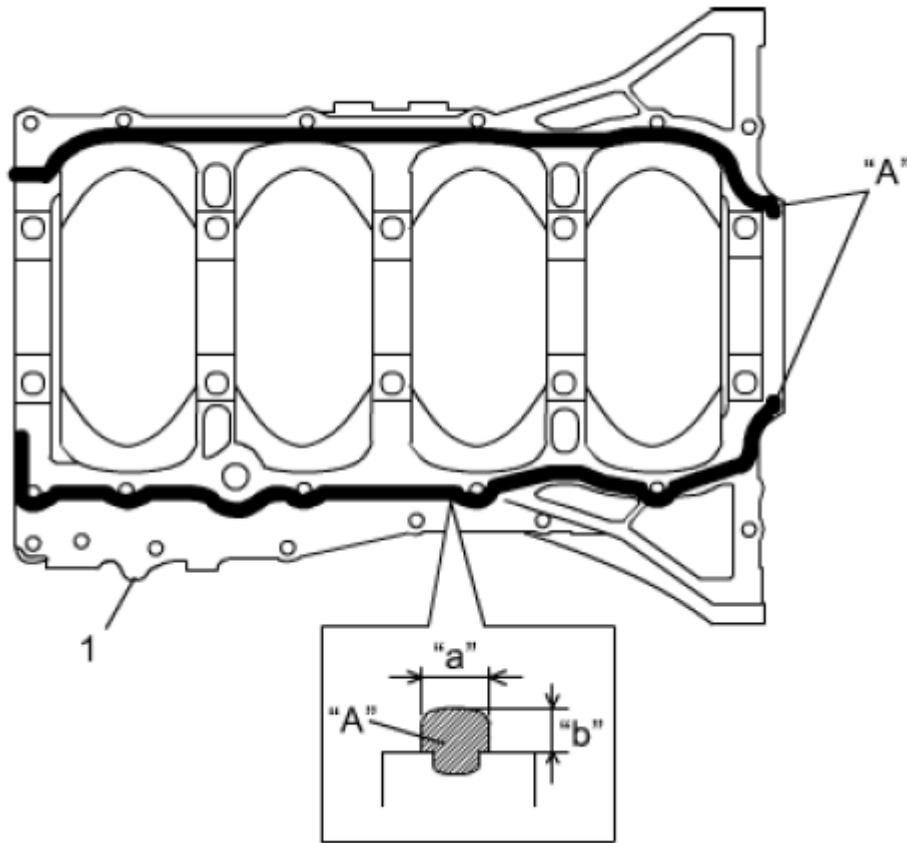


Fig. 189: Applying Sealant To Mating Surface Of Lower Crankcase
 Courtesy of SUZUKI OF AMERICA CORP.

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 Bearing Inspection*.
 - Use 12-point socket wrench to crank case bolt No. 1s.
- a. 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°)

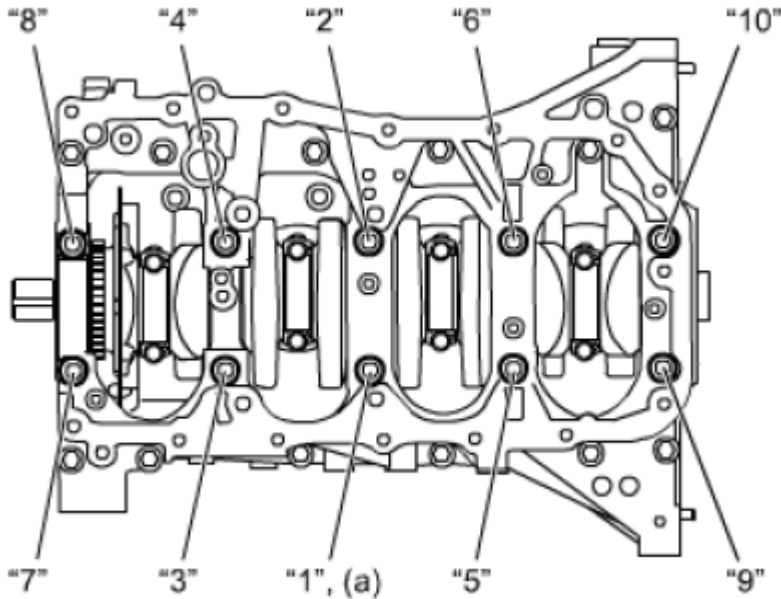


Fig. 190: Identifying Crank Case Bolt No. 1 Tightening Sequence
 Courtesy of SUZUKI OF AMERICA CORP.

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 kgf-m, 18.5 lbf-ft)

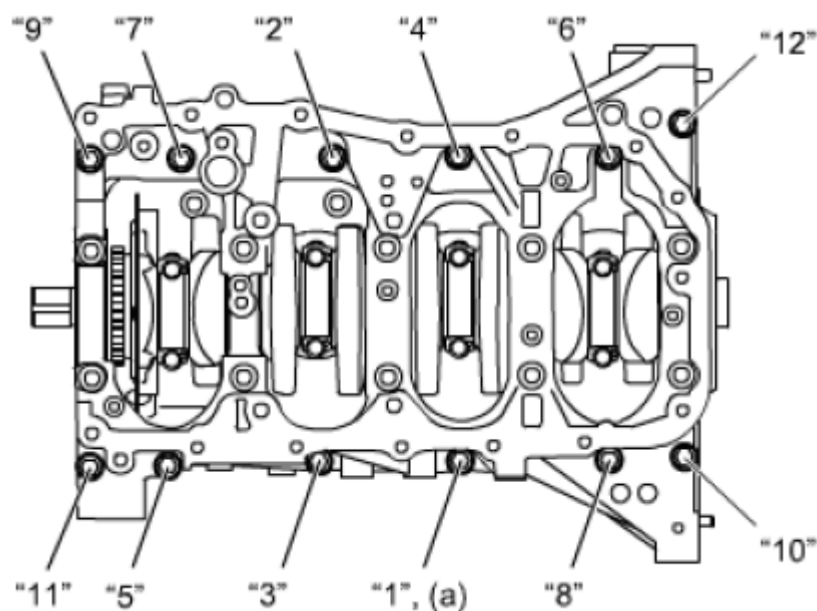


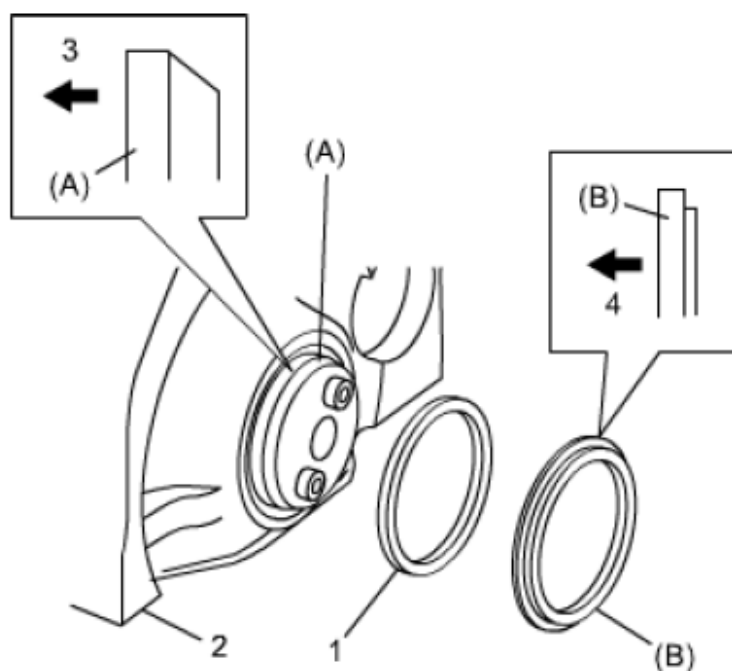
Fig. 191: Identifying Crank Case Bolt No. 2 Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

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. 192: Installing Cylinder Block Using Special Tools

Courtesy of SUZUKI OF AMERICA CORP.

13. Install pistons and connecting rods. Refer to **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 kgf-m, 8.5 lbf-ft)**

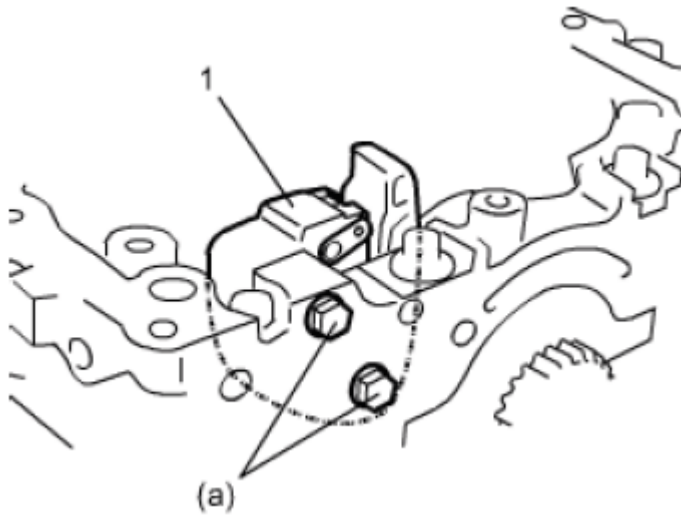


Fig. 193: Identifying Oil Pump Chain Adjuster And Bolt
Courtesy of SUZUKI OF AMERICA CORP.

15. Install CKP sensor. Refer to **CKP (CRANKSHAFT POSITION) SENSOR REMOVAL AND INSTALLATION**.
16. Install flywheel for M/T model, or drive plate for A/T model. Refer to **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 kgf-m, 40.5 lbf-ft)

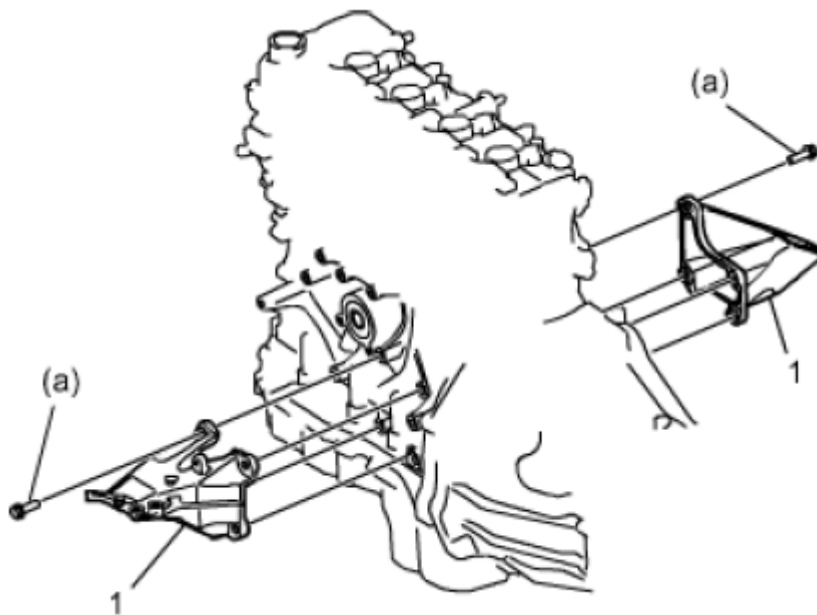


Fig. 194: Identifying Engine Front Mounting Brackets And Bolt

Courtesy of SUZUKI OF AMERICA CORP.

18. Install P/S pump. Refer to **P/S PUMP REMOVAL AND INSTALLATION** .
19. Install water pump. Refer to **WATER PUMP REMOVAL AND INSTALLATION** .
20. Install generator. Refer to **GENERATOR REMOVAL AND INSTALLATION** .
21. Install engine assembly. Refer to **Engine Assembly Removal and Installation**.

CRANKSHAFT INSPECTION

Reference: MAIN BEARING, 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.)

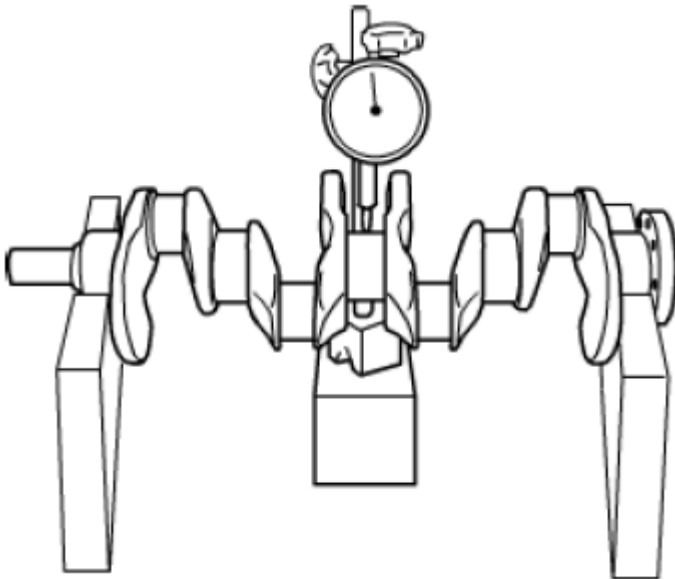


Fig. 195: Measuring Runout Center Journal
Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft Thrust Play

1. Assemble crankshaft, main bearings, thrust bearings and lower crank case. Refer to **Main Bearing, 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.)

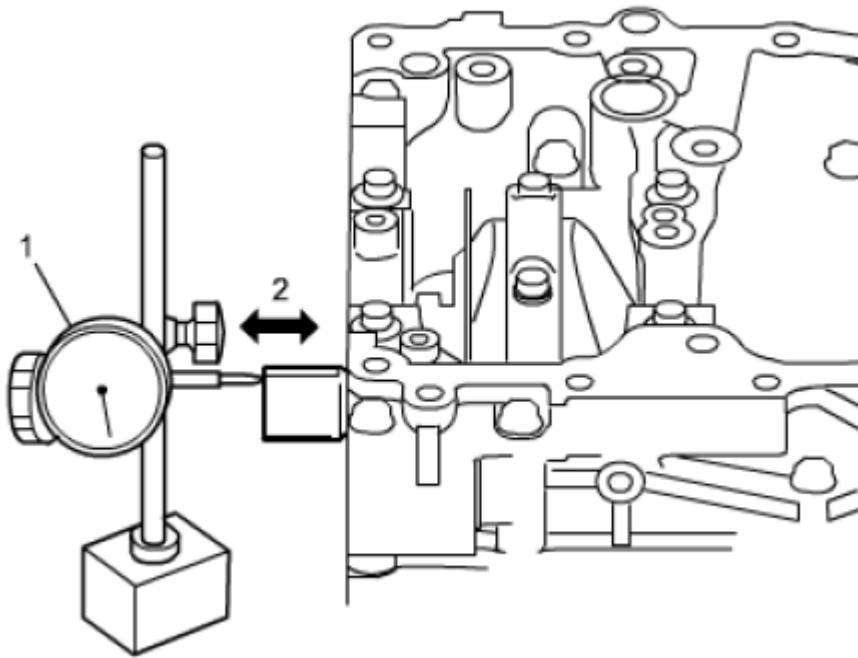


Fig. 196: Measuring Crankshaft Thrust Play
Courtesy of SUZUKI OF AMERICA CORP.

Thrust bearing thickness

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

Over size (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.)

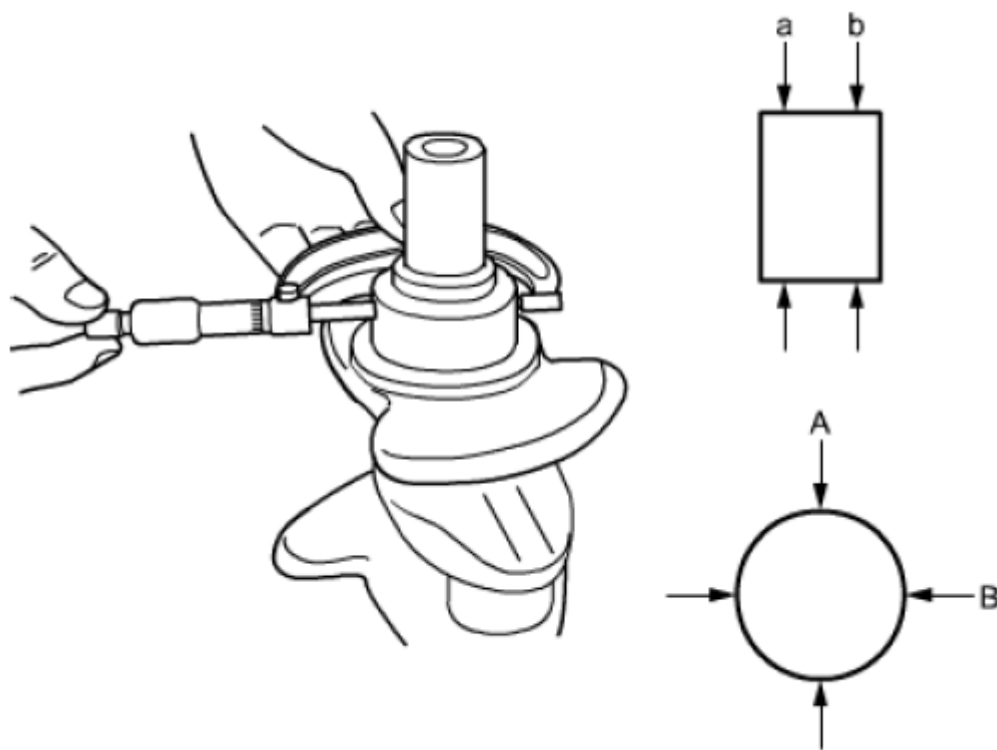


Fig. 197: Measuring Crankshaft Journal Outside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

MAIN BEARING INSPECTION

Reference: MAIN BEARING, 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

NOTE:

- Do not rotate crankshaft while gauging plastic is installed.
- After checking main bearing clearance, check crank case bolt No. 1 for deformation. Refer to 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.

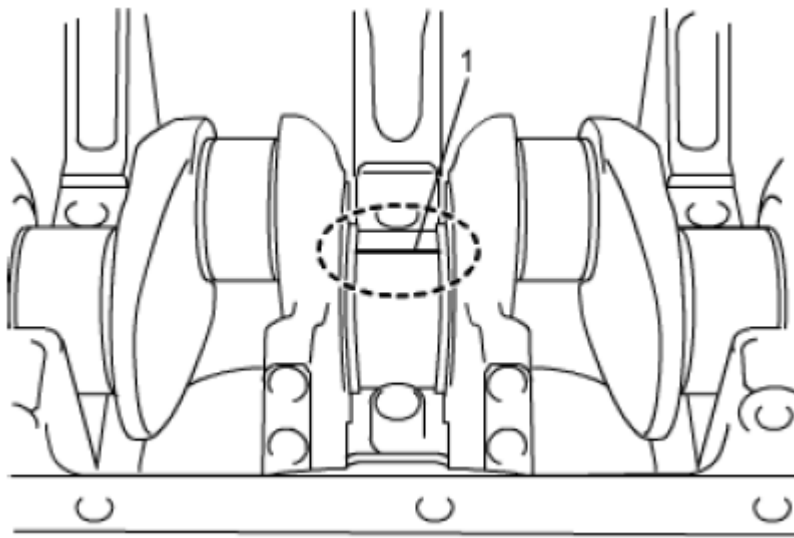


Fig. 198: Placing Piece Of Gauging Plastic Over Full Width Of Bearing (Parallel To Crankshaft) On Journal

Courtesy of SUZUKI OF AMERICA CORP.

4. Install lower crank case. Refer to **MAIN BEARING, 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.)

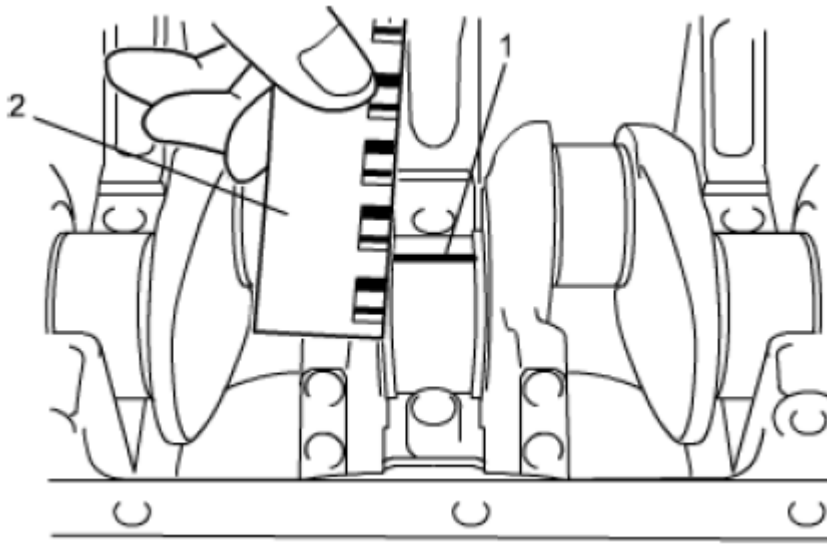


Fig. 199: Measuring Gauging Plastic Width At Widest Point
Courtesy of SUZUKI OF AMERICA CORP.

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

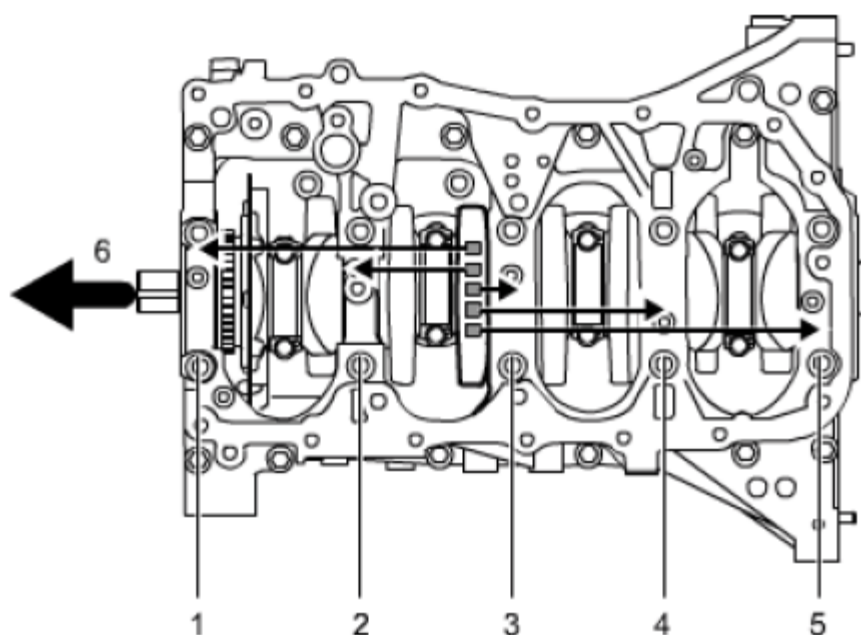
Standard size bearing

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. 200: Identifying Crankshaft Journal Numbers

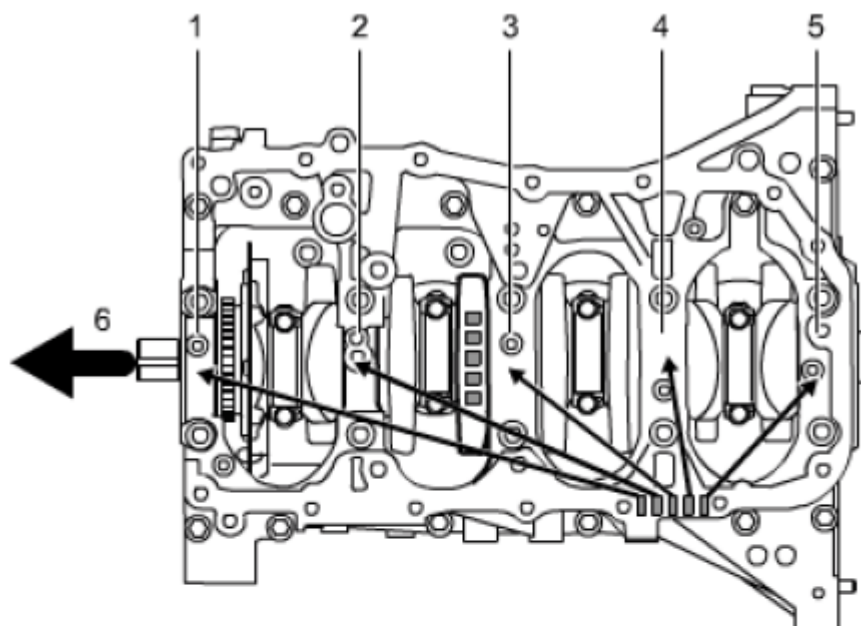
Courtesy of SUZUKI OF AMERICA CORP.

- Determine crankshaft journal diameter for journals No. 1 through No. 5 using stamped numbers and following table.

CRANKSHAFT JOURNAL DIAMETER

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. 201: Identifying Cylinder Block Journal Numbers

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.

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.)
	56.009 - 56.012 mm

D	(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

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. 202: Identifying Specified Colors For Identification On Connecting Rod 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 (STANDARD SIZE)

			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)

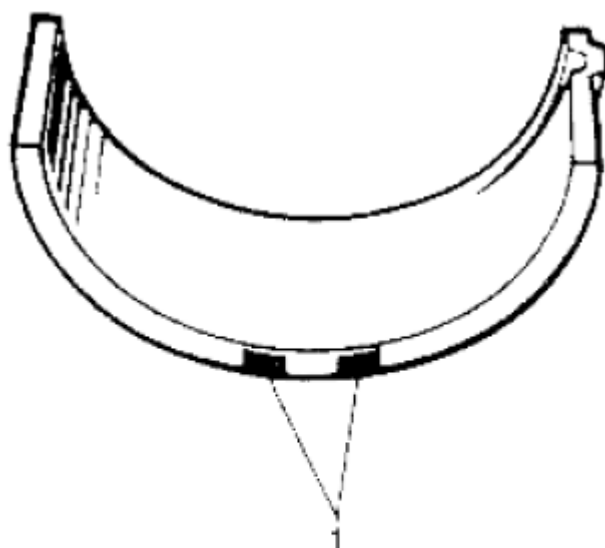
- 0.25 mm undersize bearing is available, in five kinds varying in thickness.

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

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. 203: Identifying Specified Colors For Identification On Connecting Rod 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

51.732 - 51.750 mm (2.03670 - 2.03740 in.)

- b. Using micrometer, measure reground journal diameter. Refer to **Crankshaft Inspection**.
 - c. Using measured journal diameter above and alphabets stamped on cylinder block, select an undersize bearing by referring to the following table.

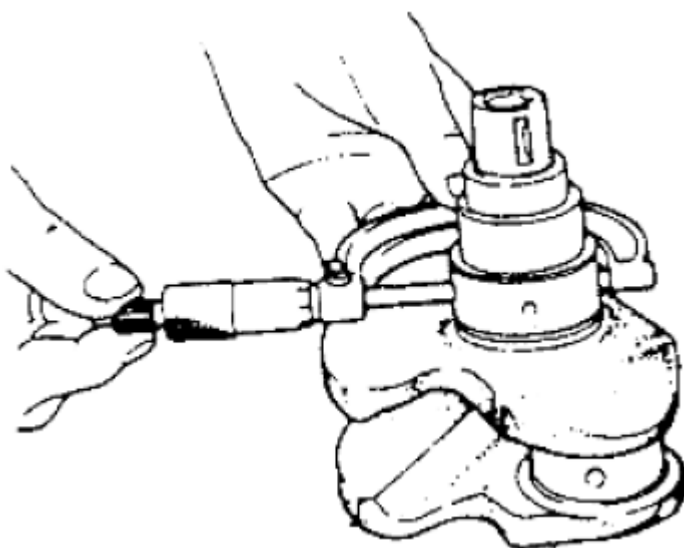


Fig. 204: Measuring Reground Journal Diameter
 Courtesy of SUZUKI OF AMERICA CORP.

MAIN BEARING CROSS - REFERENCE (UNDER SIZE)

			Measured journal diameter					
			51.7470 - 51.7499 mm (2.03728 - 2.03739 in.)	51.7440 - 51.7469 mm (2.03717 - 2.03727 in.)	51.7410 - 51.7439 mm (2.03705 - 2.03716 in.)	51.7380 - 51.7409 mm (2.03693 - 2.03704 in.)	51.7350 - 51.7379 mm (2.03681 - 2.03692 in.)	51.7320 - 51.7349 mm (2.03669 - 2.03680 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. Refer to **Main Bearing Inspection**.

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.)

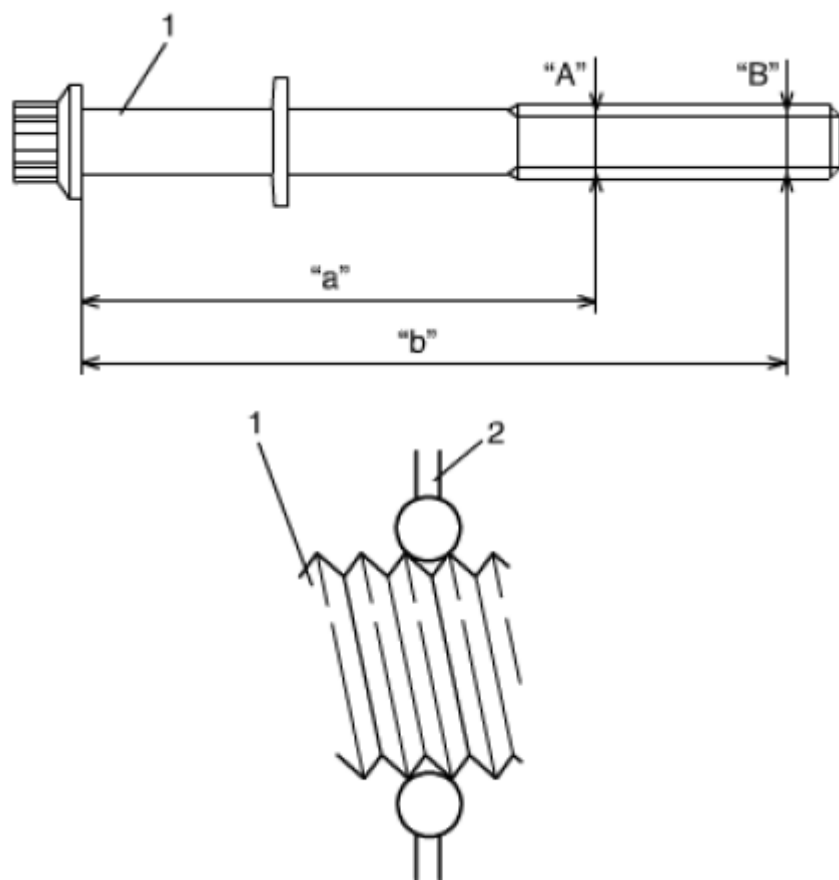


Fig. 205: Identifying Crank Case Cap Bolt Dimension
Courtesy of SUZUKI OF AMERICA CORP.

SENSOR PLATE INSPECTION

Reference: MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION

Check sensor plate (1) for crack or damage.

If defective condition is found, replace it.

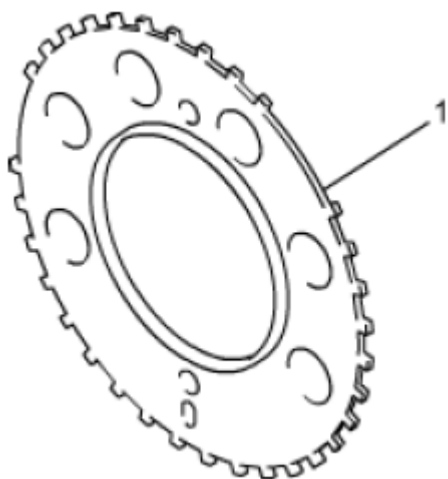


Fig. 206: Identifying Sensor Plate

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).

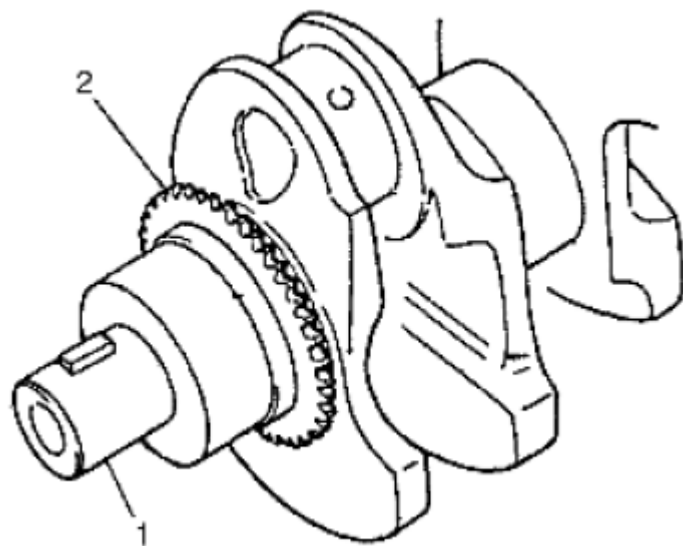


Fig. 207: Identifying Oil Pump Drive Sprocket

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 any abnormality is found, replace oil pump chain.



Fig. 208: 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).

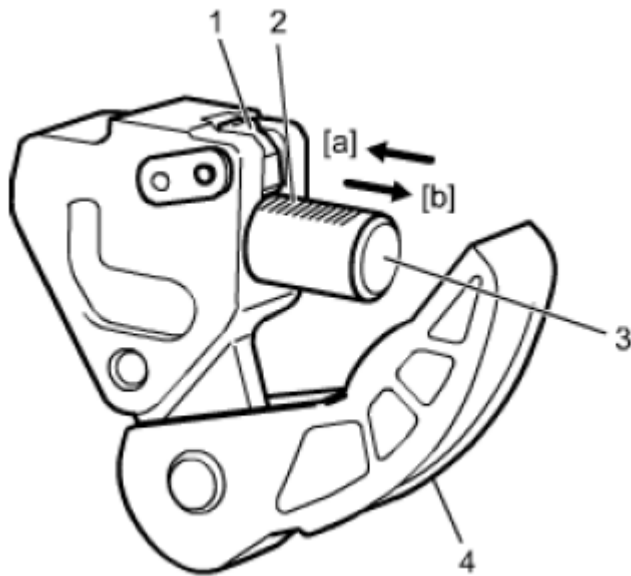


Fig. 209: Checking Latch, Teeth, Plunger Or Tensioner For Wear Or Any Damage
Courtesy of SUZUKI OF AMERICA CORP.

- 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.

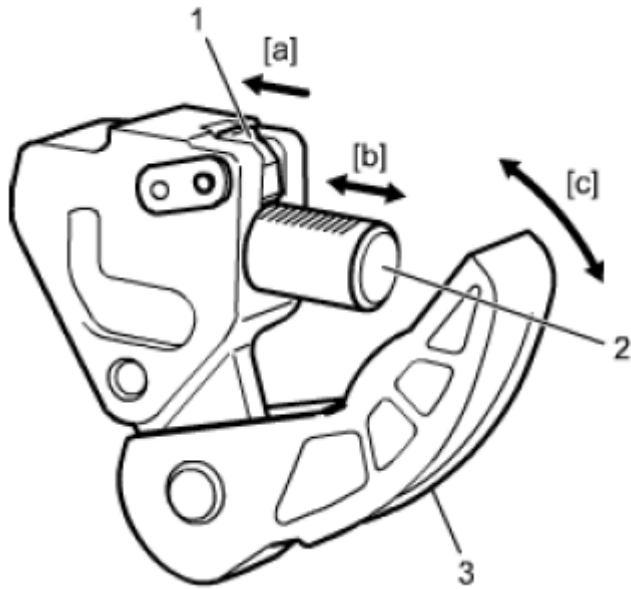


Fig. 210: Checking Plunger Moves In Direction
 Courtesy of SUZUKI OF AMERICA CORP.

If defective condition is found, replace oil pump chain adjuster.

FLYWHEEL/DRIVE PLATE INSPECTION

Reference: MAIN BEARING, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION

Visual Inspection

- Check ring gear of flywheel for M/T model or drive plate for A/T model, for crack, wear or any damage.

If defective condition is found, replace flywheel for M/T model or drive plate for A/T model. Refer to **Flywheel/Drive Plate Removal and Installation**.

Flywheel/Drive Plate Face Runout

- Check flywheel for M/T model or drive plate for A/T model for runout using dial gauge and "V" blocks. If measured runout exceeds its limit, replace flywheel for M/T model or drive plate for A/T model. Refer to **Flywheel/Drive Plate Removal and Installation**.

Flywheel/drive plate face runout

Limit: 0.2 mm (0.0078 in.)

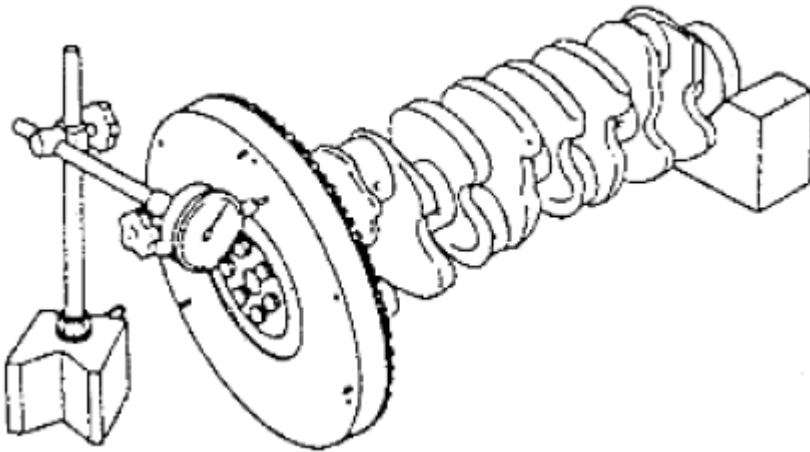


Fig. 211: Checking Flywheel And Drive Plate Face Runout
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER BLOCK INSPECTION

Reference: MAIN BEARING, 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.)

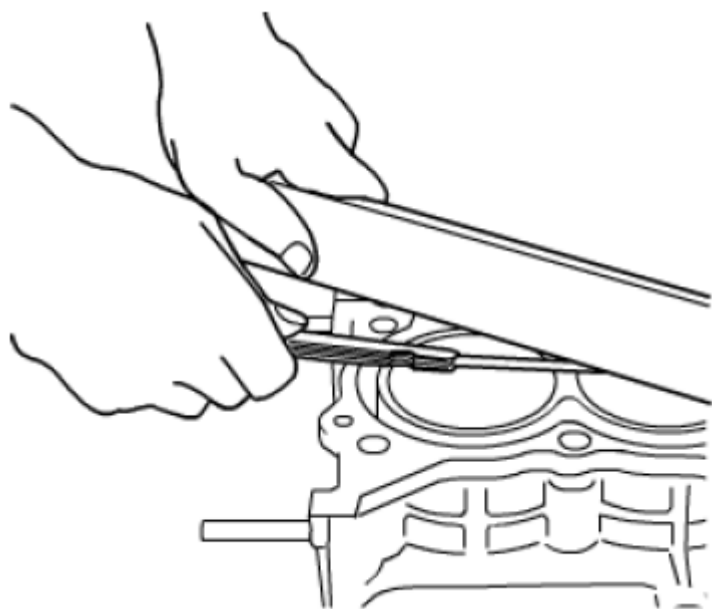


Fig. 212: Inspecting Cylinder Block Flatness
Courtesy of SUZUKI OF AMERICA CORP.

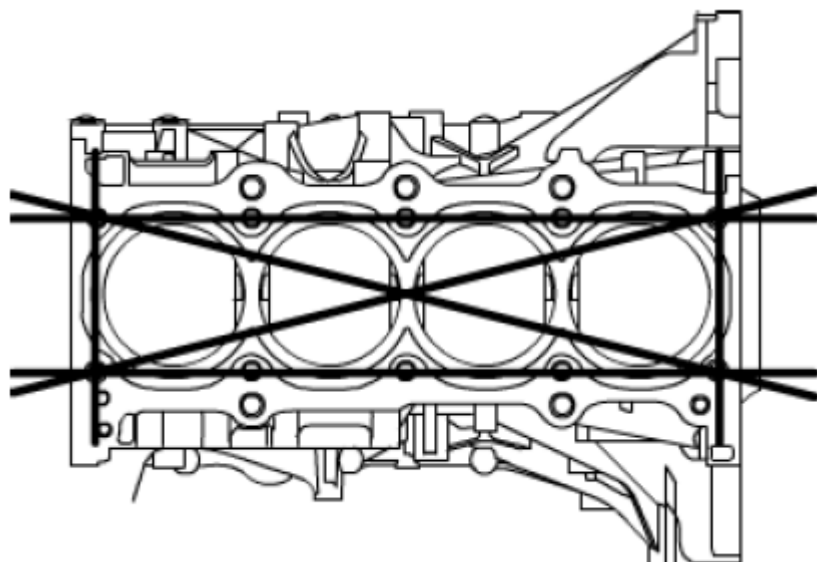


Fig. 213: Identifying Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

SPECIFICATIONS

TIGHTENING TORQUE SPECIFICATIONS

NOTE: For fastener(s) with * (asterisk) below, refer to the specified procedure in **"REPAIR INSTRUCTIONS"**.

2012 Suzuki Grand Vitara

2012-13 ENGINE Engine Mechanical - Grand Vitara

Fastening part	Tightening torque			Note
	N.m	kgf-m	lbf-ft	
Cylinder block heater bolt	11	1.1	8.5	Refer to <u>Cylinder Block Heater Removal and Installation (If Equipped)</u> .
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)			Refer to <u>Cylinder Head Cover Removal and Installation</u> .
CMP actuator bolt	60	6.1	44.5	Refer to <u>Camshaft and Tappet Removal and Installation</u> .
Camshaft housing bolt*	11	1.1	8.5	Refer to <u>Camshaft and Tappet Removal and Installation</u> .
Exhaust camshaft timing sprocket bolt	60	6.1	44.5	Refer to <u>Camshaft and Tappet Removal and Installation</u> .
Timing chain cover plug	27	2.8	20.0	Refer to <u>Camshaft and Tappet Removal and Installation</u> .
Engine harness ground bolt (M6)	11	1.1	8.5	Refer to <u>Engine Assembly Removal and Installation</u> .
Engine harness ground bolt (M8)	25	2.5	18.5	Refer to <u>Engine Assembly Removal and Installation</u> .
Engine rear mounting member bolt	55	5.6	40.5	Refer to <u>Engine Assembly Removal and Installation</u> .
Battery ground terminal bolt	25	2.5	18.5	Refer to <u>Engine Assembly Removal and Installation</u> .
Timing chain cover bolt*	25	2.5	18.5	Refer to <u>Timing Chain Cover Removal and Installation</u> .
Crankshaft pulley bolt	150	15.3	111.0	Refer to <u>Timing Chain Cover Removal and Installation</u> .
OCV bolt	11	1.1	8.5	Refer to <u>OCV (Oil Control Valve) Removal and Installation</u> .
Flywheel bolt	70	7.1	52.0	Refer to <u>Flywheel/Drive Plate Removal and Installation</u> .
Drive plate bolt	70	7.1	52.0	Refer to <u>Flywheel/Drive Plate Removal and Installation</u> .
Timing chain guide bolt	9	0.92	7.0	Refer to <u>Timing Chain and Chain Tensioner Removal and Installation</u> .
Timing chain	25	2.5	18.5	Refer to <u>Timing Chain and Chain Tensioner Removal</u> .

2012 Suzuki Grand Vitara

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tensioner bolt				<u>and Installation.</u>
Timing chain tensioner adjuster bolt	11	1.1	8.5	Refer to <u>Timing Chain and Chain Tensioner Removal and Installation.</u>
Cylinder head No. 1* 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°)			Refer to <u>Valve and Cylinder Head Removal and Installation.</u>
Cylinder head No. 2 bolt	25	2.5	18.5	Refer to <u>Valve and Cylinder Head Removal and Installation.</u>
Venturi plug	3.5	0.36	2.5	Refer to <u>Valve and Cylinder Head Disassembly and Reassembly.</u>
Connecting rod bolt*	15 N.m --> +45° --> +45° (1.5 kgf-m --> +45° --> +45°, 11.0 lbf-ft --> +45° --> +45°)			Refer to <u>Piston, Piston Ring and Connecting Rod Removal and Installation.</u>
Sensor plate screw	11	1.1	8.5	Refer to <u>Main Bearing, Crankshaft and Cylinder Block Removal and Installation.</u>
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°)			Refer to <u>Main Bearing, Crankshaft and Cylinder Block Removal and Installation.</u>
Crank case bolt No. 2*	25	2.5	18.5	Refer to <u>Main Bearing, Crankshaft and Cylinder Block Removal and Installation.</u>
Oil pump chain adjuster bolt	11	1.1	8.5	Refer to <u>Main Bearing, Crankshaft and Cylinder Block Removal and Installation.</u>
Engine front mounting bracket bolt	55	5.6	40.5	Refer to <u>Main Bearing, Crankshaft and Cylinder Block Removal and Installation.</u>

Reference:

For the tightening torques of fasteners not specified in this page, refer to:

AIR CLEANER COMPONENTS

CYLINDER HEAD COVER COMPONENTS

CAMSHAFT AND TAPPET COMPONENTS

ENGINE MOUNTING 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****FASTENER INFORMATION****SPECIAL TOOLS AND EQUIPMENT****RECOMMENDED SERVICE MATERIAL**

Material	SUZUKI recommended product or Specification		Note
Sealant	SUZUKI Bond No. 1217G	P/No.: 99000-31260	Refer to <u>Cylinder Head Cover Removal and Installation</u> , <u>Timing Chain Cover Removal and Installation</u> and <u>Main Bearing, Crankshaft and Cylinder Block Removal and Installation</u> .

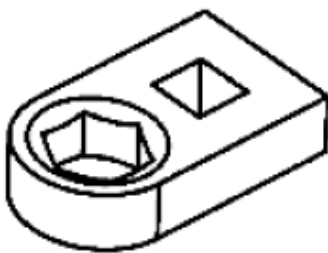
NOTE: Required service materials are also described in:

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**

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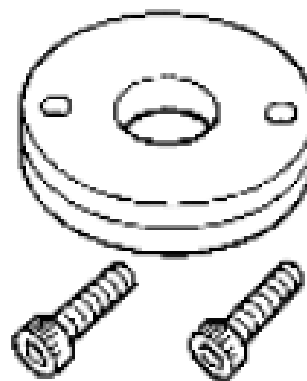
09911-05120

Box end wrench (14 mm)

Refer to **Camshaft and Tappet Removal and Installation.**

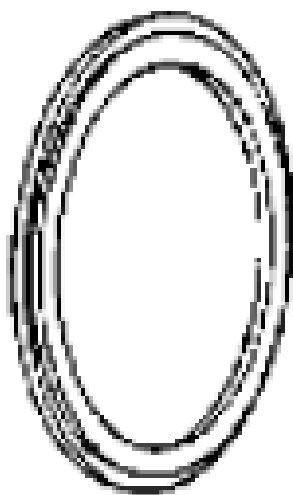
09911-97710

Oil seal guide

Refer to **Main Bearing, Crankshaft and Cylinder Block Removal and Installation.**

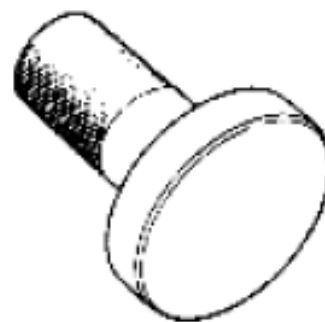
09911-97811

Oil seal installer

Refer to **Main Bearing, Crankshaft and Cylinder Block Removal and Installation.**

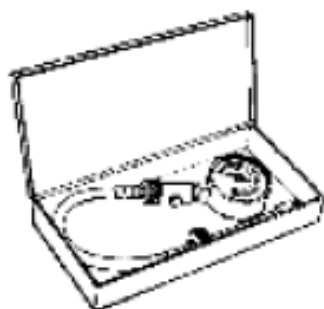
09913-75510

Bearing installer

Refer to **Timing Chain Cover Removal and Installation.**

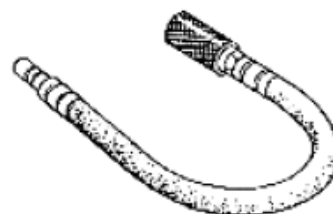
09915-64512

Compression gauge

Refer to **Compression Check.**

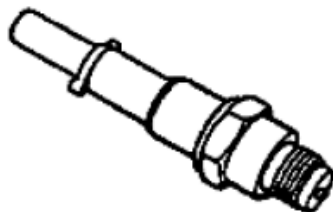
09915-64530

Compression gauge hose

Refer to **Compression Check.**

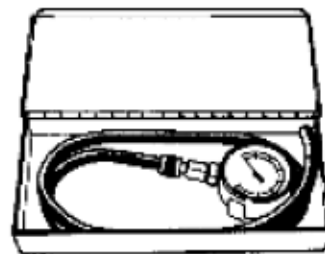
09915-67010

Compression gauge attachment (C)

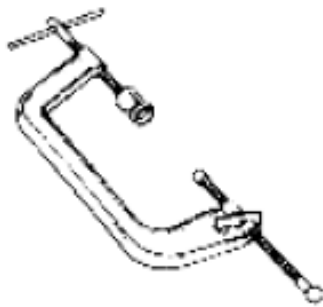
Refer to **Compression Check.**

09915-67311

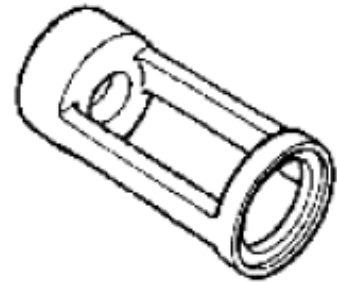
Vacuum gauge

Refer to **Engine Vacuum Check.**

09916-14510
Valve lifter
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



09916-14522
Valve spring
compressor attachment
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



09916-34542
Reamer handle
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



09916-34550
Valve guide reamer (5.5
mm)
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



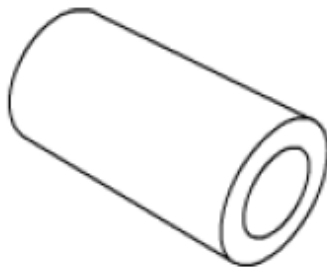
09916-37320
Valve guide outer
reamer (10.5 mm)
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



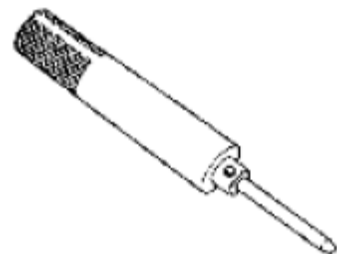
09916-44910
Valve guide
installer/remover
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



09916-56510
Valve guide installer
attachment
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



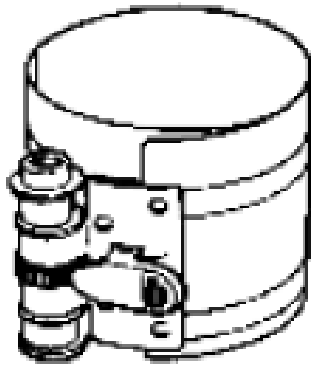
09916-58210
Valve guide installer
handle
Refer to **Valve and
Cylinder Head
Disassembly and
Reassembly.**



09916-77310
Piston ring compressor
(50 - 125 mm)

09916-84511
Forceps
Refer to **Valve and**

Refer to **Piston, Piston Ring and Connecting Rod Removal and Installation.**



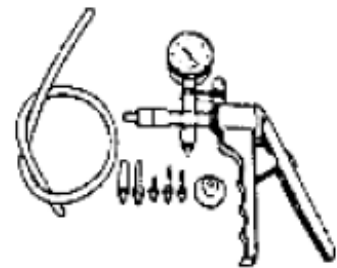
Cylinder Head Disassembly and Reassembly.



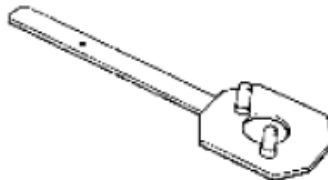
09917-16710
Timing chain tensioner holder
Refer to **Camshaft and Tappet Removal and Installation.**



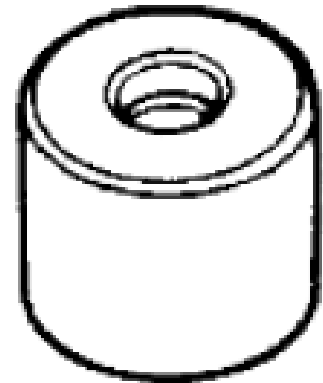
09917-47011
Vacuum pump gauge
Refer to **IMT Valve Actuator Inspection.**



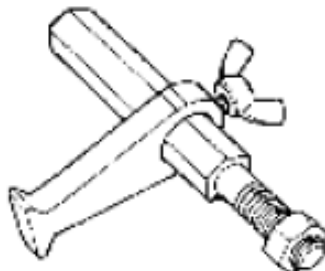
09917-68221
Camshaft pulley holder
Refer to **Timing Chain Cover Removal and Installation.**



09917-98221
Valve guide stem attachment
Refer to **Valve and Cylinder Head Disassembly and Reassembly.**



09924-17811
Flywheel holder
Refer to **Flywheel/Drive Plate Removal and Installation.**



09926-58010
Bearing remover attachment
Refer to **Timing Chain Cover Removal and Installation.**



09944-36011
Steering wheel remover
Refer to **Timing Chain**

**Cover Removal and
Installation.**

