2010 ENGINE

Engine Mechanical (VQ40DE) - Equator

PRECAUTIONS

PRECAUTION FOR DRAIN ENGINE COOLANT

Drain engine coolant when engine is cooled.

PRECAUTION FOR DISCONNECTING FUEL PIPING

- Before starting work, make sure no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

PRECAUTION FOR REMOVAL AND DISASSEMBLY

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

PRECAUTION FOR INSPECTION, REPAIR AND REPLACEMENT

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

PRECAUTION FOR ASSEMBLY AND INSTALLATION

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.

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- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gasses for leakage.

PARTS REQUIRING ANGLE TIGHTENING

- For the final tightening of the following engine parts use Tool:

  Tool number: KV10112100 (BT-8653-A)

  - Cylinder head bolts
  - Lower cylinder block bolts
  - Connecting rod cap bolts
  - Crankshaft pulley bolt (No angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

PRECAUTION FOR LIQUID GASKET

REMOVAL OF LIQUID GASKET SEALING

- After removing nuts and bolts, separate the mating surface and remove old liquid gasket sealing using Tool.

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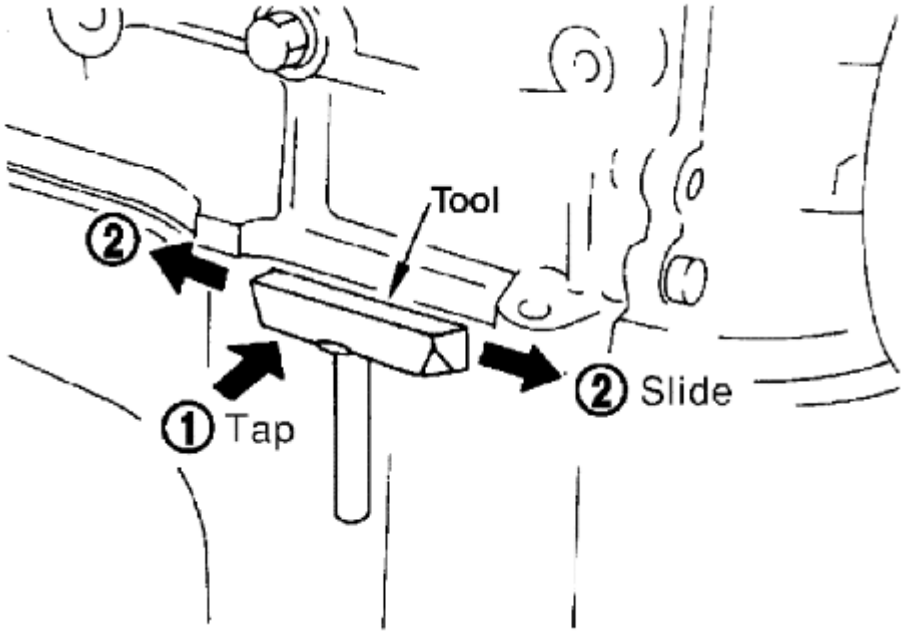


Fig. 1: Removing Old Liquid Gasket Sealing Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10111100 (J-37228)

CAUTION: Be careful not to damage the mating surfaces.

- Tap seal cutter to insert it (1), and then slide it by tapping on the side (2) as shown.
- In areas where Tool is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

CAUTION: If for some unavoidable reason tool such as screwdriver is used, be careful not to damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

1. Remove the old liquid gasket adhering to the gasket application surface and the mating surface using suitable tool.

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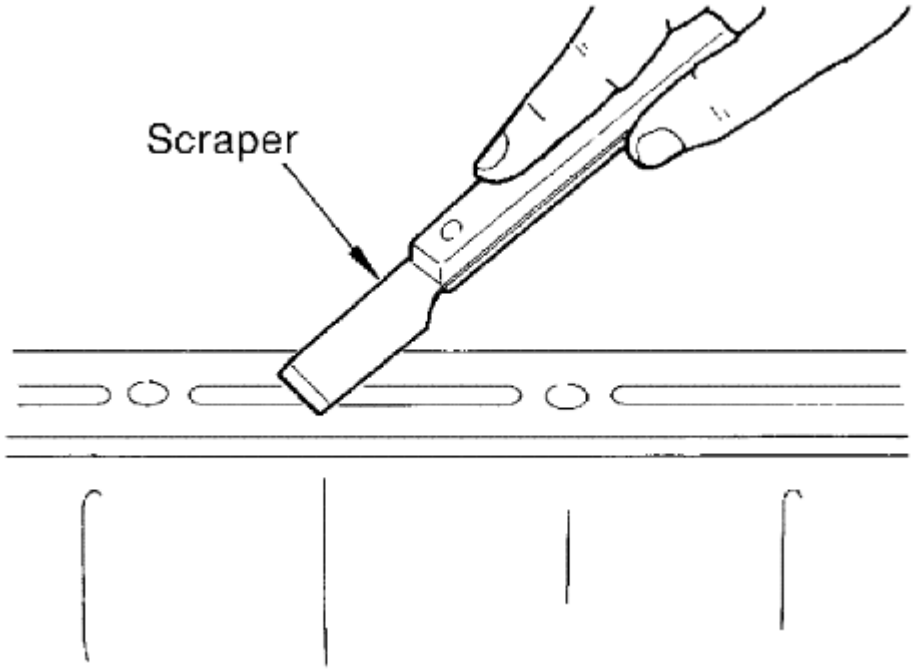
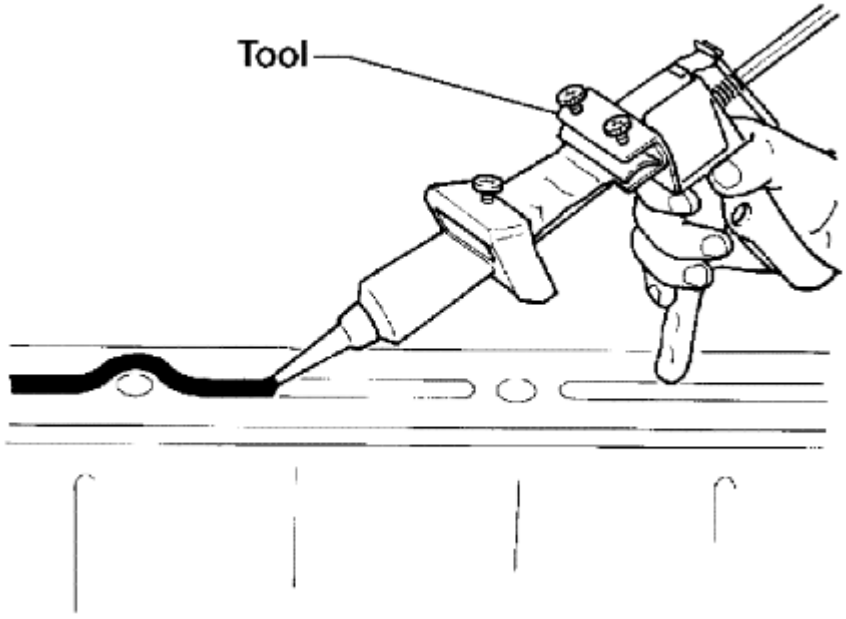


Fig. 2: Removing Liquid Gasket Adhering To Gasket Application Surface And Mating Surface Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

- Remove liquid gasket completely from the groove of the gasket application surface, bolts, and bolt holes.

2. Thoroughly clean the mating surfaces and remove adhering moisture, grease and foreign materials.
3. Attach liquid gasket tube to the Tool.



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Fig. 3: Attaching Liquid Gasket Tube To Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
   - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.

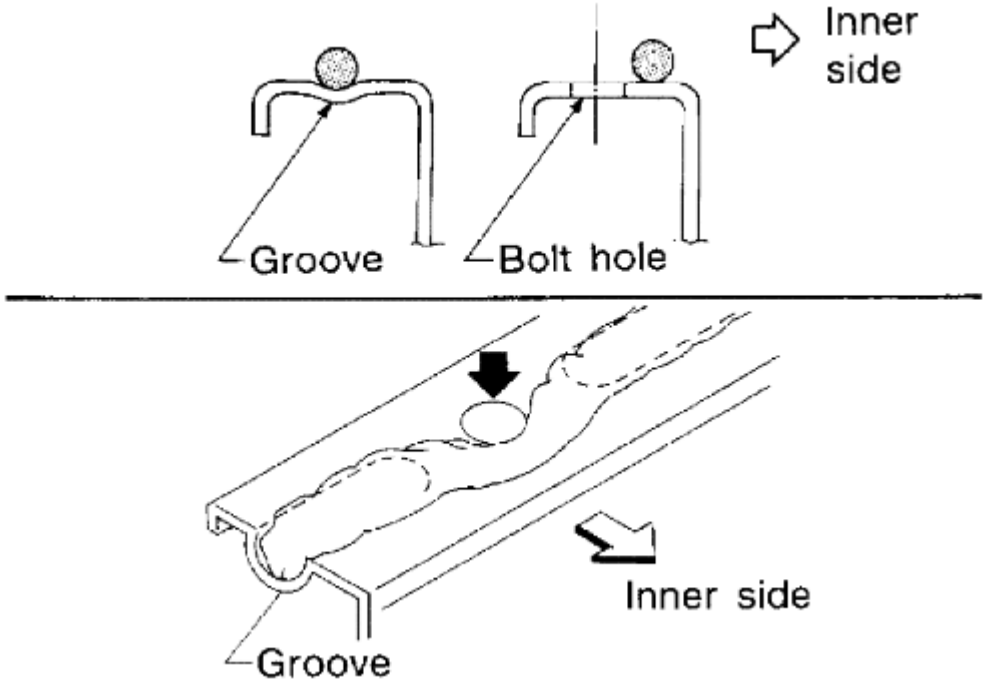


Fig. 4: Applying Liquid Gasket Without Breaks To Specified Location
Courtesy of SUZUKI OF AMERICA CORP.

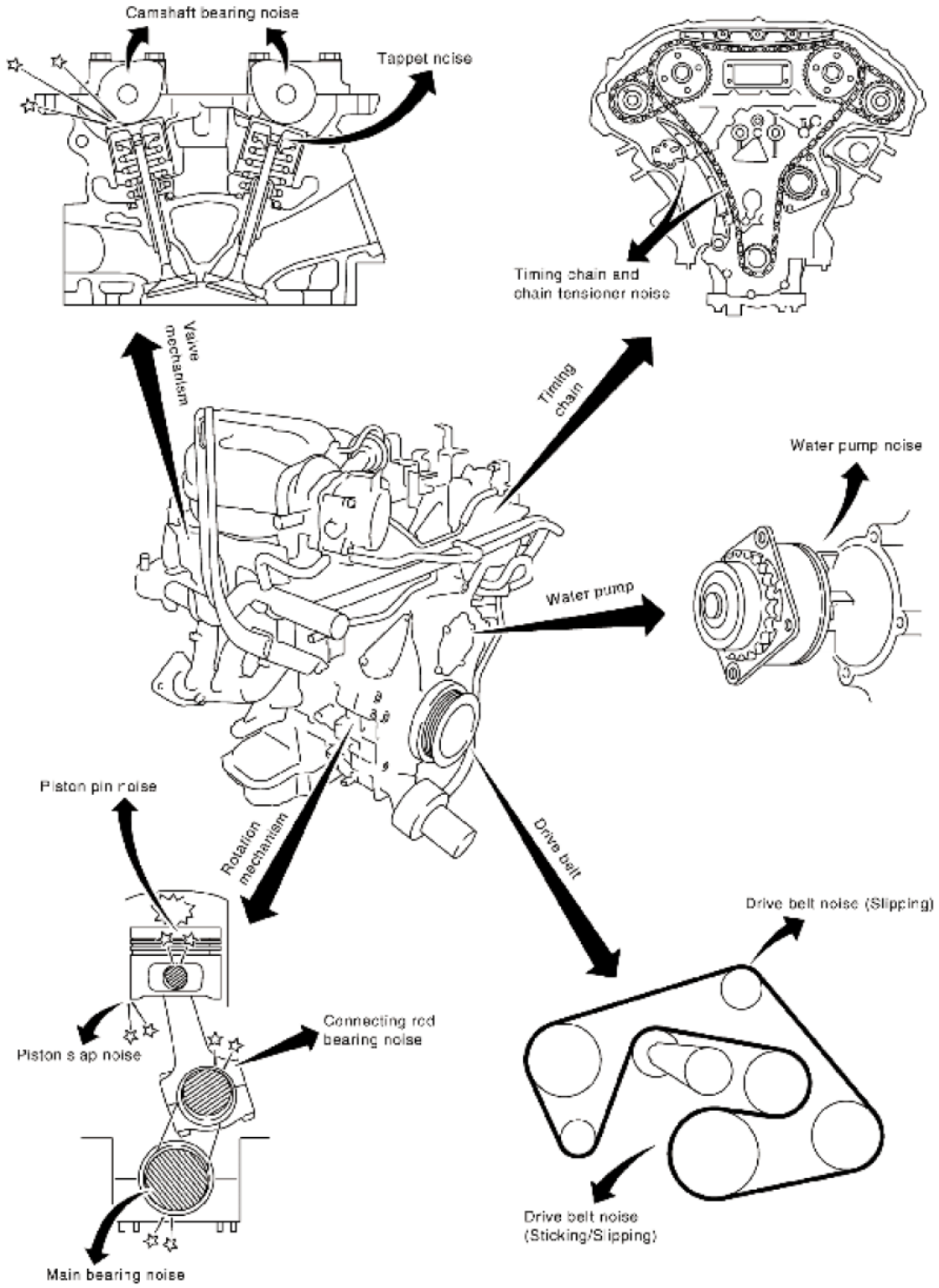
- As for bolt holes, normally apply the liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten nuts or bolts after the installation.
- Wait 30 minutes or more after installation, before refilling the engine with engine oil and engine coolant.

CAUTION: If there are specific instructions in this manual, observe them.

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DIAGNOSTIC INFORMATION AND PROCEDURES

NVH TROUBLESHOOTING - ENGINE NOISE



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Fig. 5: NVH Troubleshooting Chart (Engine Noise)
Courtesy of SUZUKI OF AMERICA CORP.

NVH TROUBLESHOOTING

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

NVH TROUBLESHOOTING CHART

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	-	A	B	-	Tappet noise	Valve clearance	**Camshaft Valve Clearance**
	Rattle	C	A	-	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal oil clearance	**CAMSHAFT: REMOVAL AND INSTALLATION**
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	-	A	-	B	B	-	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**
	Slap or rap	A	-	-	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**
									Connecting rod	

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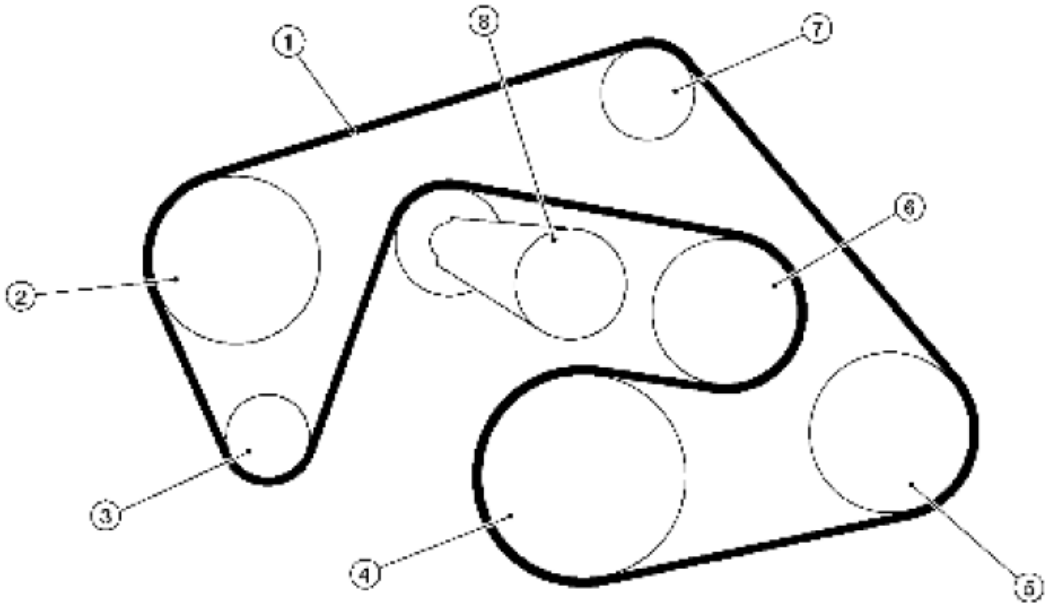
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	bushing oil clearance Connecting rod bearing oil clearance	**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**
	Knock	A	B	-	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**
Front of engine Timing chain case	Tapping or ticking	A	A	-	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	**TIMING CHAIN: REMOVAL AND INSTALLATION**
Front of engine	Squeaking or fizzing	A	B	-	B	-	C	Drive belts (Sticking or slipping)	Drive belts deflection	**Checking Drive Belts**
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	-	B	A	B	Water pump noise	Water pump operation	**WATER PUMP: REMOVAL AND INSTALLATION**
	Rattle	-	-	A	-	-	-	VTC	VTC lock pin clearance	**TIMING CHAIN: REMOVAL AND INSTALLATION**

A: Closely related B: Related C: Sometimes related -: Not related

REPAIR INSTRUCTIONS

DRIVE BELTS: EXPLODED VIEW

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1.	Drive belt	2.	Power steering oil pump pulley	3.	Generator pulley
4.	Crankshaft pulley	5.	A/C compressor	6.	Cooling fan pulley
7.	Idler pulley	8.	Drive belt tensioner		

Fig. 6: Exploded View Of Drive Belt (VQ40DE)
Courtesy of SUZUKI OF AMERICA CORP.

CHECKING DRIVE BELTS

WARNING: Be sure to perform when the engine is stopped.

1. Remove air duct and resonator assembly when inspecting drive belt. Refer to **AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**
2. Make sure that the auto tensioner indicator is within the allowable working range (A) as shown.

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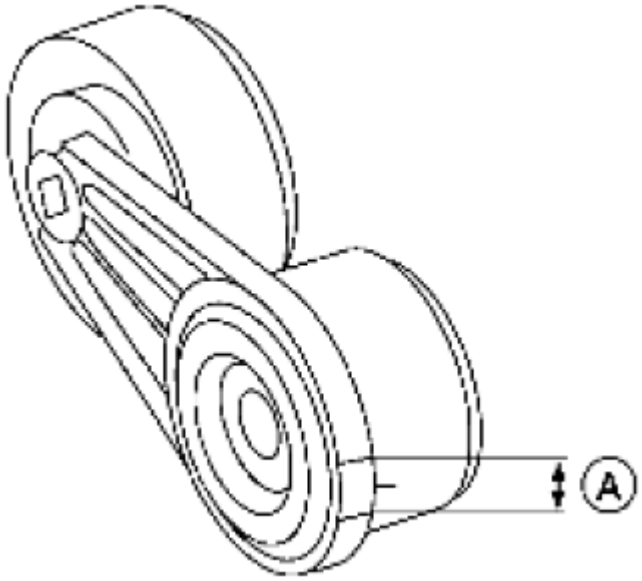


Fig. 7: Identifying Auto Tensioner Indicator Allowable Working Range
Courtesy of SUZUKI OF AMERICA CORP.

3. Visually check entire belt for wear, damage or cracks.
4. If the indicator is out of allowable working range or drive belt is damaged, replace the drive belt. Refer to **DRIVE BELTS: REMOVAL AND INSTALLATION**

DRIVE BELTS: ADJUSTMENT

There is no manual drive belt tension adjustment. The drive belt tension is automatically adjusted by the drive belt auto tensioner.

DRIVE BELTS: REMOVAL AND INSTALLATION

REMOVAL

1. Remove the engine room cover. Refer to **ENGINE ROOM COVER: REMOVAL AND INSTALLATION**
2. Remove air duct and resonator assembly. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].
3. Rotate the drive belt auto tensioner in the direction of arrow (loosening direction of tensioner) as shown, using suitable tool.

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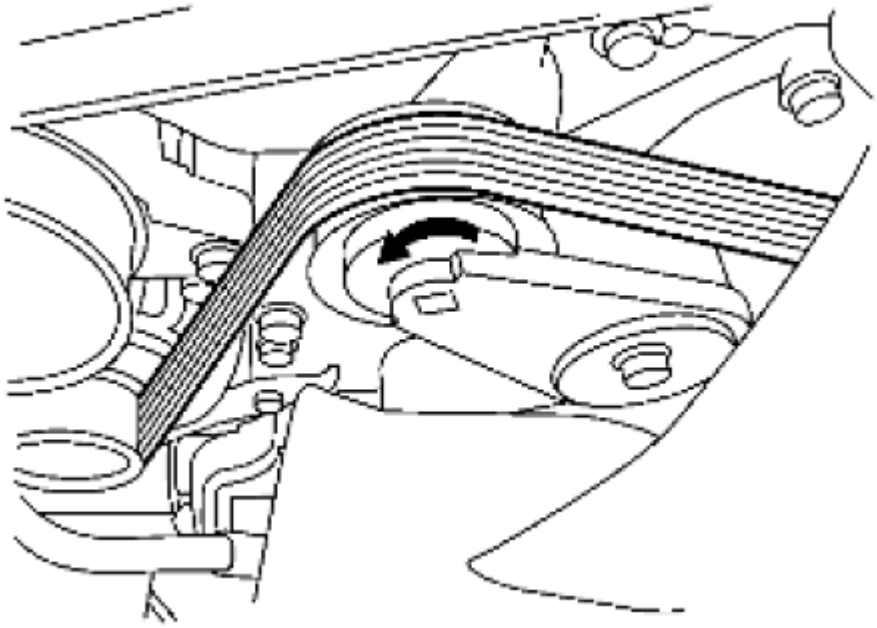


Fig. 8: Rotating Drive Belt Auto Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Avoid placing hand in a location where pinching may occur if the tool accidentally comes off.

4. Remove the drive belt.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION: Make sure belt is securely installed around all pulleys.

DRIVE BELT AUTO TENSIONER AND IDLER PULLEY: REMOVAL AND INSTALLATION

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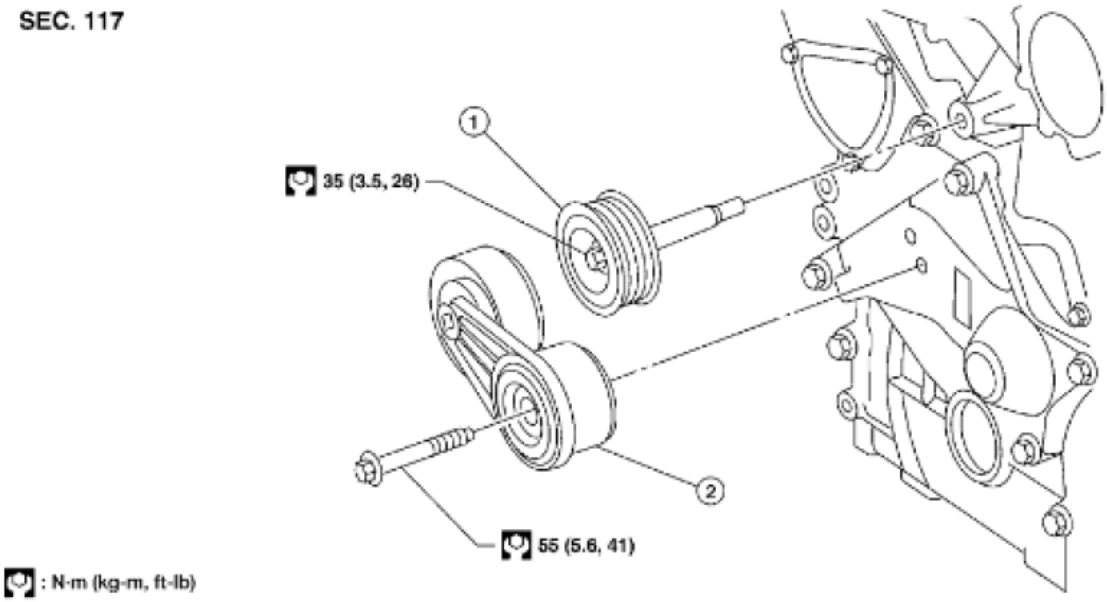


Fig. 9: Identifying Drive Belt Auto Tensioner And Idler Pulley
Courtesy of SUZUKI OF AMERICA CORP.

REMOVAL

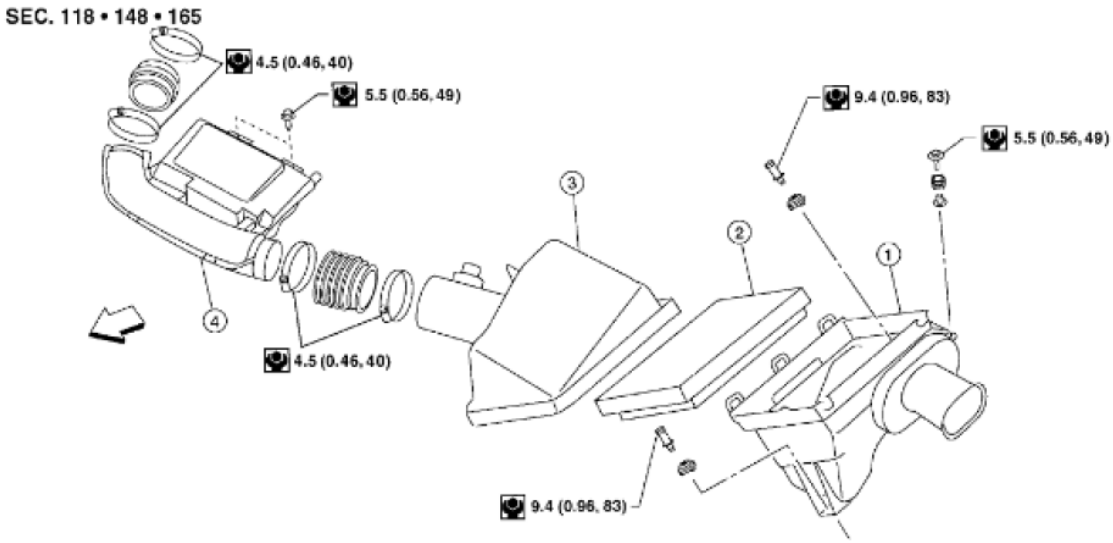
1. Remove the engine room cover. Refer to **ENGINE ROOM COVER: REMOVAL AND INSTALLATION**
2. Remove air duct and resonator assembly. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].
3. Remove drive belt. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
4. Remove auto tensioner and idler pulley using power tool.

INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER FILTER: EXPLODED VIEW

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1. Air cleaner case (lower)	2. Air cleaner filter	3. Air cleaner case (upper)
4. Air duct and resonator	: Front	

Fig. 10: Exploded View Of Air Cleaner (VQ40DE)
Courtesy of SUZUKI OF AMERICA CORP.

AIR CLEANER FILTER: REMOVAL AND INSTALLATION

REMOVAL

1. Unhook clips, and lift air cleaner case (upper).
2. Remove air cleaner filter.

INSTALLATION

Installation is in the reverse order of removal.

CAMSHAFT VALVE CLEARANCE

INSPECTION

NOTE: Perform the following inspection after removal, installation or replacement of camshaft or valve-related parts, or if there are unusual engine conditions due to changes in valve clearance over time (starting, idling, and/or noise).

1. Remove the engine room cover. Refer to [**ENGINE ROOM COVER: REMOVAL AND INSTALLATION**].
2. Remove the air cleaner and air duct assembly. Refer to [**AIR CLEANER AND AIR DUCT: EXPLODED VIEW**].
3. Remove rocker covers (RH and LH banks). Refer to [**ROCKER COVER: REMOVAL AND INSTALLATION**].

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4. Measure the valve clearance as follows:
    a. Set No. 1 cylinder at TDC of its compression stroke.
        - Rotate crankshaft pulley clockwise to align timing mark (A) (grooved line without color) with timing indicator (B).

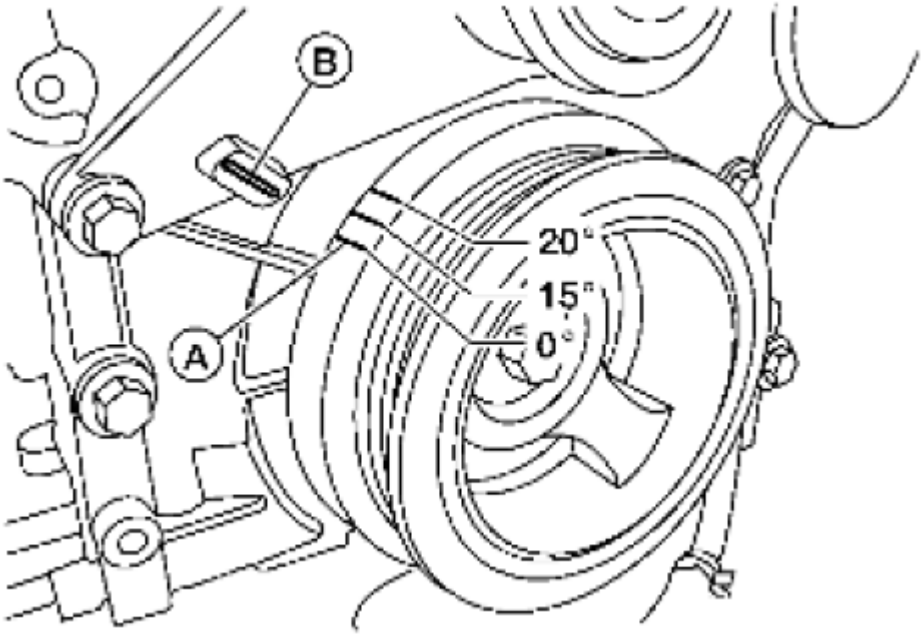


Fig. 11: Aligning Timing Mark With Timing Indicator
Courtesy of SUZUKI OF AMERICA CORP.

        - Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of RH bank) are located as shown.

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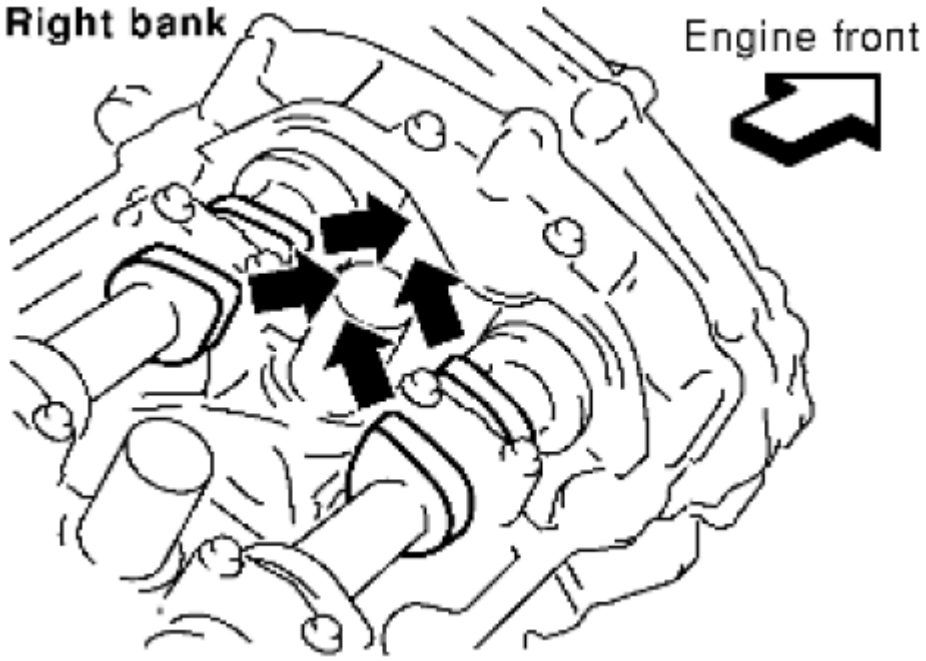


Fig. 12: Identifying Intake And Exhaust Cam Noses On No. 1 Cylinder
Courtesy of SUZUKI OF AMERICA CORP.

- If not, rotate crankshaft one revolution (360°) and align as shown.

b. Use feeler gauge, measure the clearance between valve lifter and camshaft.

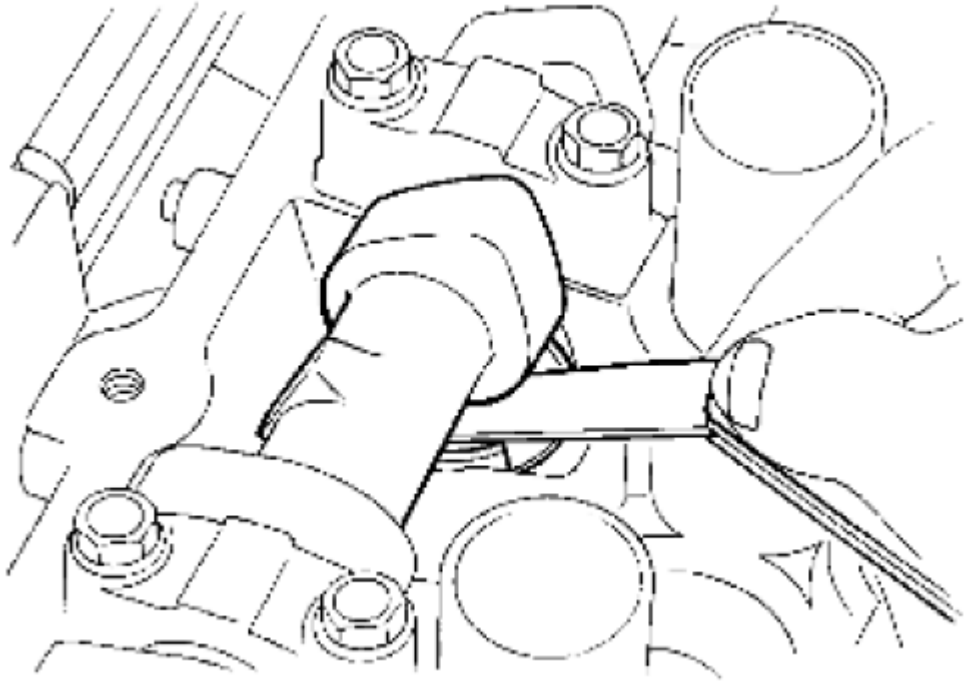


Fig. 13: Measuring Clearance Between Valve Lifter And Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

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Valve clearance:

VALVE CLEARANCE SPECIFICATION

		Unit: mm (in)
	Cold	**Hot (1) (reference data)**
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)
(1) Approximately 80 °C (176 °F)		

- Measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the illustration) with feeler gauge.

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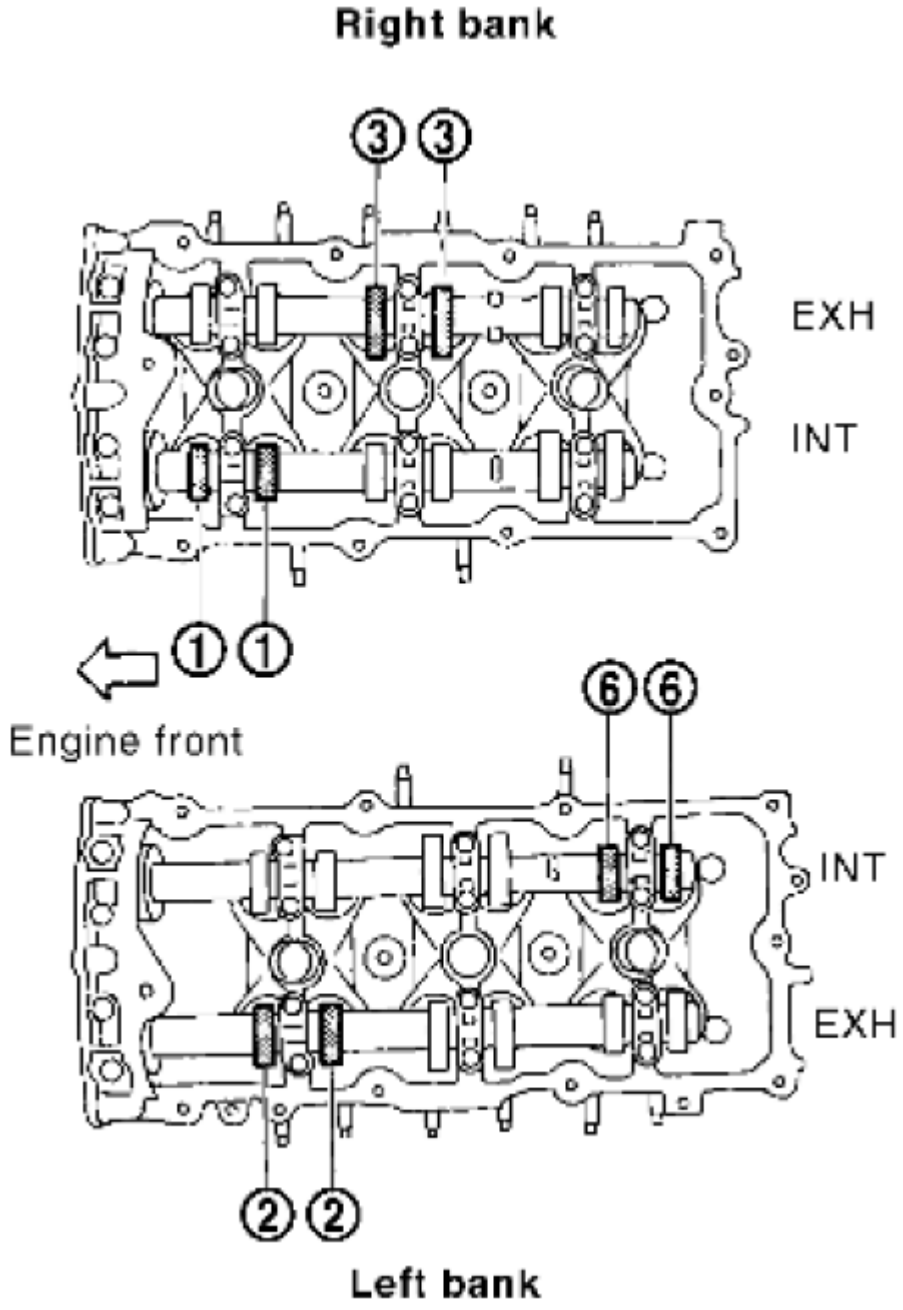


Fig. 14: Identifying Valve Clearances At Locations Marked
Courtesy of SUZUKI OF AMERICA CORP.

- No. 1 cylinder at compression TDC

CYLINDER REFERENCE

Measuring position (RH bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 1 cylinder at compression TDC	EXH		x	
	INT	x		
Measuring position (LH bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.

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No. 1 cylinder at compression TDC	INT			x
	EXH	x		

c. Rotate crankshaft by 240° clockwise (when viewed from engine front) to align No. 3 cylinder at TDC of its compression stroke.

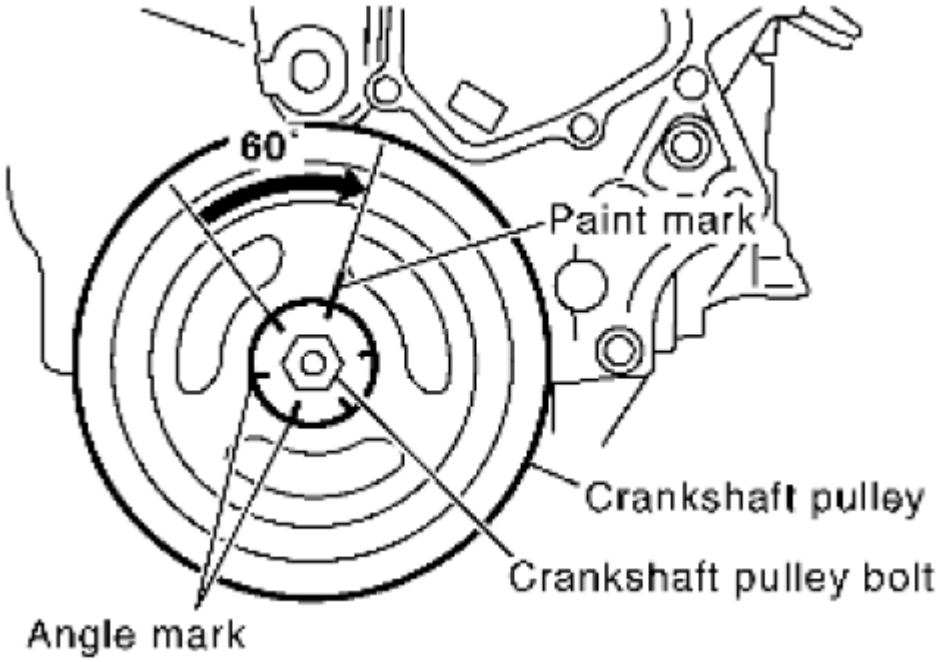


Fig. 15: Aligning No. 3 Cylinder At TDC Of Compression Stroke
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Crankshaft pulley bolt flange has a stamped line every 60°. They can be used as a guide to rotation angle.

- Measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the illustration) with feeler gauge.

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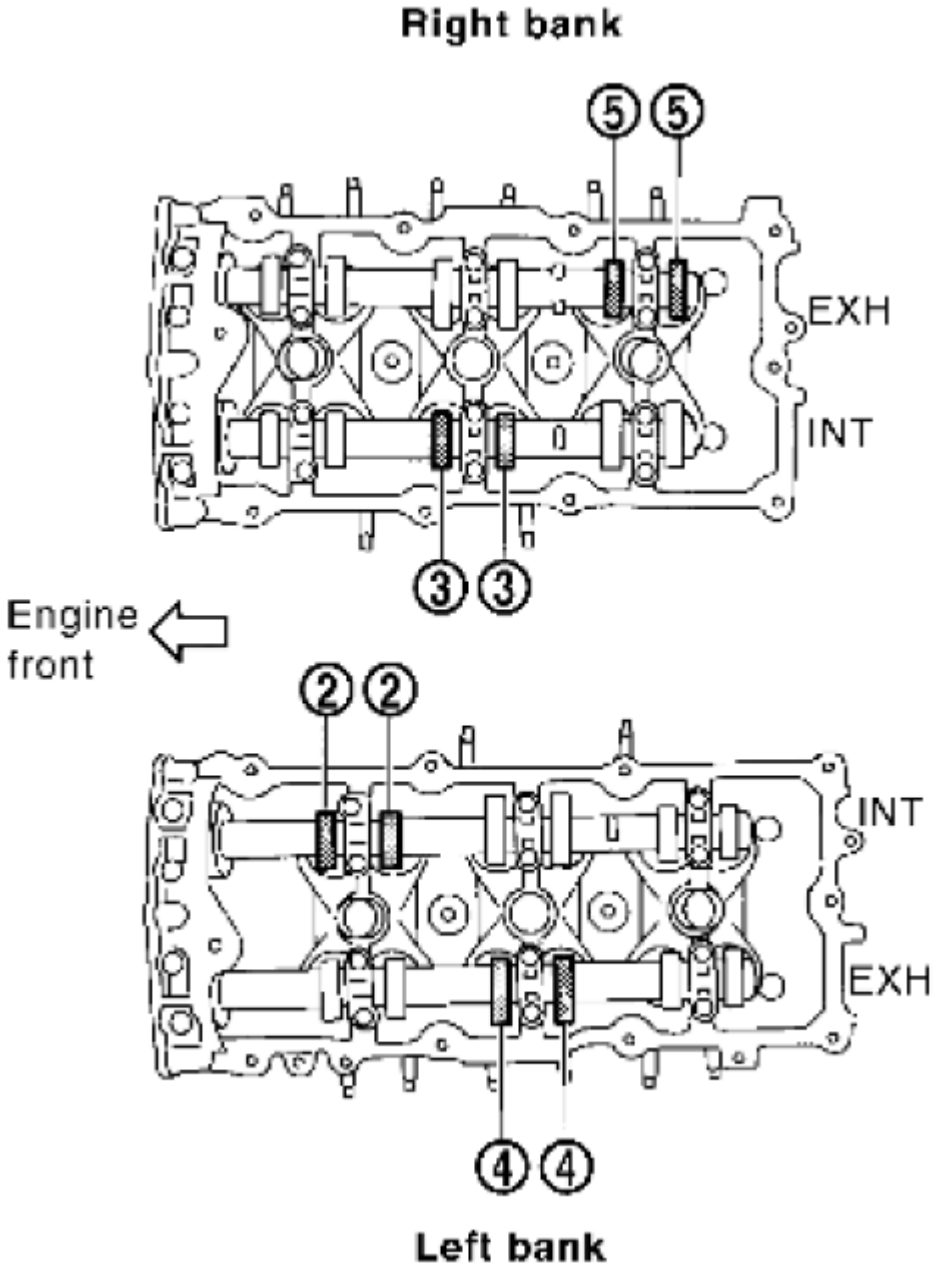


Fig. 16: Measuring Valve Clearances At Locations Marked
Courtesy of SUZUKI OF AMERICA CORP.

- No. 3 cylinder at compression TDC

CYLINDER SPECIFICATION

Measuring position (RH bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 3 cylinder at compression TDC	EXH			x
	INT		x	
Measuring position (LH bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
	INT	x		

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No. 3 cylinder at compression TDC	EXH		x	

d. Rotate crankshaft by 240° clockwise (when viewed from engine front) to align No. 5 cylinder at TDC of compression stroke.

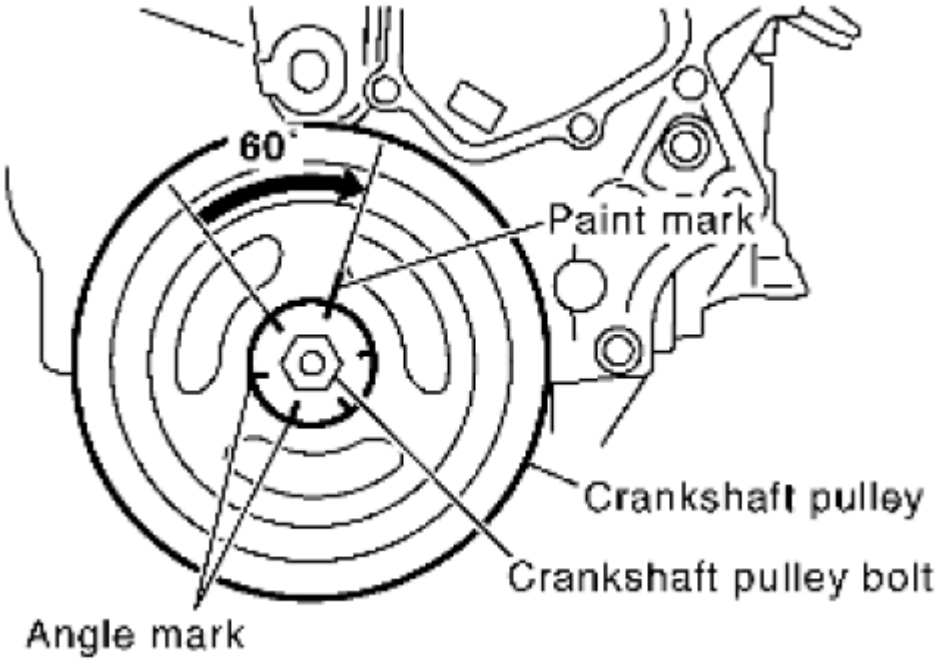


Fig. 17: Aligning No. 5 Cylinder At TDC Of Compression Stroke
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the illustration) with feeler gauge.

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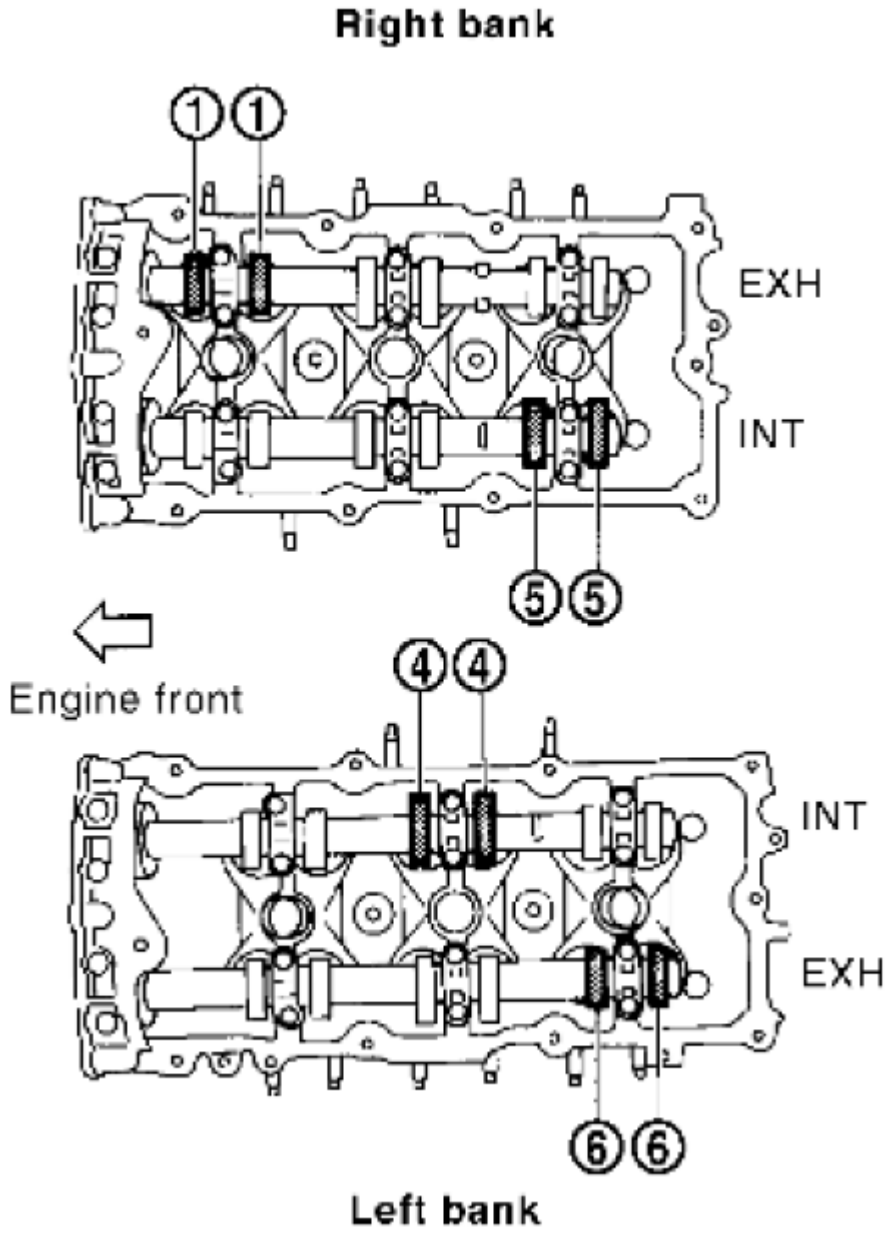


Fig. 18: Measuring Valve Clearances At Locations Marked
Courtesy of SUZUKI OF AMERICA CORP.

- No. 5 cylinder at compression TDC

CYLINDER SPECIFICATION

Measuring position (RH bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 5 cylinder at compression TDC	EXH	x		
	INT			x
Measuring position (LH bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 5 cylinder at compression TDC	INT		x	

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	EXH			x

5. For the measured value out of the standard, perform adjustment.

ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.

1. Measure the valve clearance.
2. Remove camshaft. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
3. Remove valve lifters at the locations that are out of the standard.
4. Measure the center thickness of removed valve lifters with micrometer.

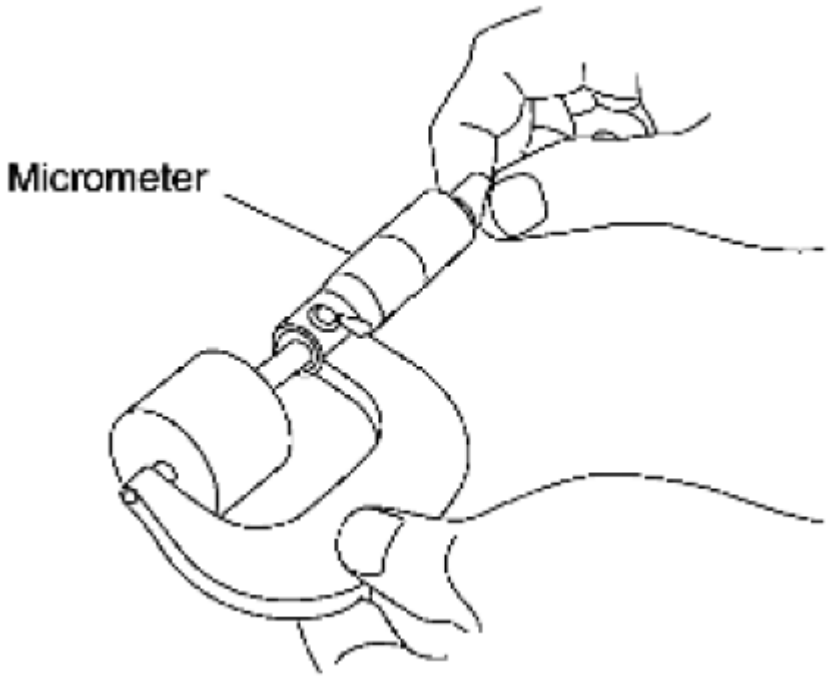


Fig. 19: Measuring Center Thickness Of Removed Valve Lifters With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

5. Use the equation below to calculate valve lifter thickness for replacement.

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t_1 = Removed valve lifter thickness

C_1 = Measured valve clearance

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C_2 = Standard valve clearance:

Intake: 0.30 mm (0.012 in)*

Exhaust: 0.33 mm (0.013 in)*

***: Approximately 20 °C (68 °F)**

- Thickness of new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder).

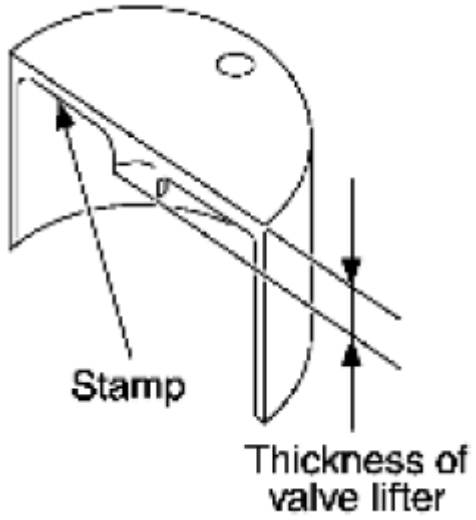


Fig. 20: Identifying Thickness Of Valve Lifter
Courtesy of SUZUKI OF AMERICA CORP.

Intake

THICKNESS CHART

Stamp mark	Thickness
788U	7.88 mm (0.3102 in)
790U	7.90 mm (0.3110 in)
.	.
.	.
840U	8.40 mm (0.3307 in)

Available thickness of valve lifter: 27 sizes with range 7.88 to 8.40 mm (0.3102 to 0.3307 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [**SERVICE DATA AND SPECIFICATIONS**].

Exhaust

THICKNESS CHART

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Stamp mark	Thickness
N788	7.88 mm (0.3102 in)
N790	7.90 mm (0.3110 in)
.	.
.	.
N836	8.36 mm (0.3291 in)

Available thickness of valve lifter: 25 sizes with range 7.88 to 8.36 mm (0.3102 to 0.3291 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [**SERVICE DATA AND SPECIFICATIONS**].

CAUTION: Install identification letter at the end and top, "U" and "N", at each of proper positions. (Be careful of mis-installation between intake and exhaust.)

6. Install selected valve lifter.
7. Install camshaft. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
8. Manually turn crankshaft pulley a few turns.
9. Make sure that the valve clearances for cold engine are within the specifications by referring to the specified values.
10. Installation of the remaining components is in the reverse order of removal.
11. Start the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly.
2. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: VQ40DE**]
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.

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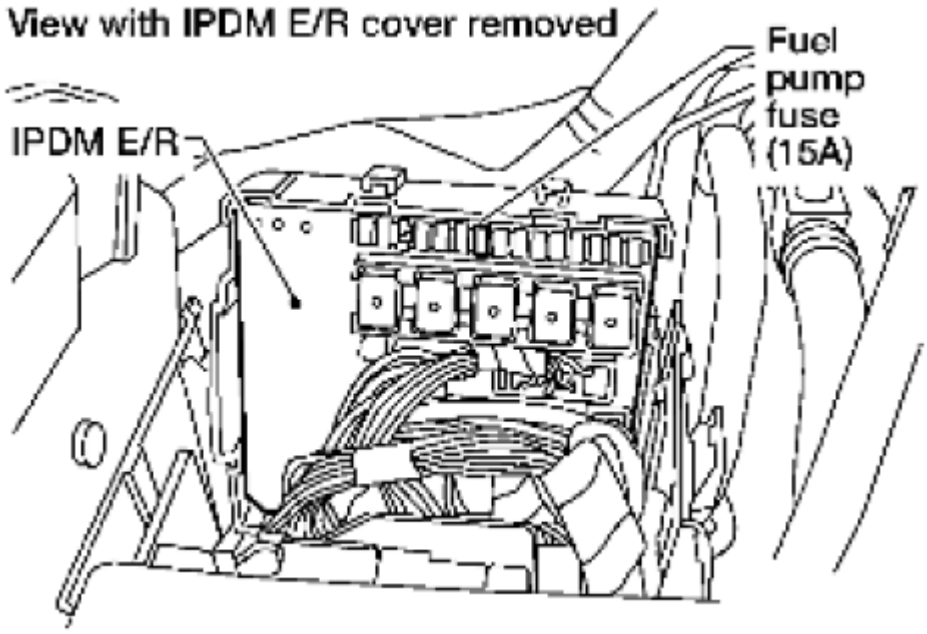


Fig. 21: Identifying Fuel Pump Fuse (15A)
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove intake manifold collector. Refer to [**INTAKE MANIFOLD COLLECTOR: REMOVAL AND INSTALLATION**].
5. Remove spark plug from each cylinder. Refer to [**SPARK PLUG: REMOVAL AND INSTALLATION**]
6. Connect engine tachometer (not required in use of SDT).
7. Install compression tester with adapter onto spark plug hole.

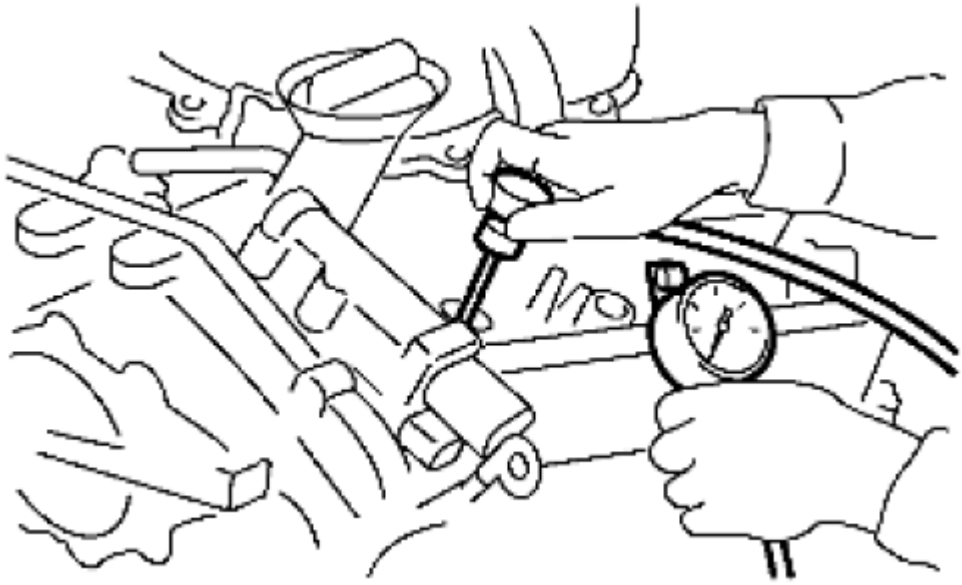


Fig. 22: Installing Compression Tester With Adapter Onto Spark Plug Hole

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Courtesy of SUZUKI OF AMERICA CORP.

- Use compression gauge whose pick up end inserted to spark plug hole is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.

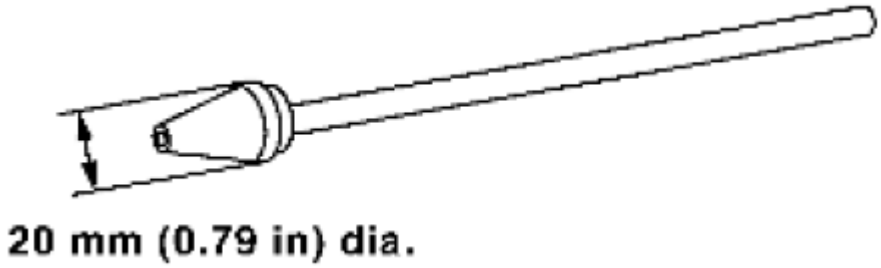


Fig. 23: Identifying Compression Gauge Diameter
Courtesy of SUZUKI OF AMERICA CORP.

8. Turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and engine RPM. Perform these steps to check each cylinder.

Compression pressure:

COMPRESSION PRESSURE CHART

		Unit: kPa (kg/cm^2 , psi) /RPM
Standard	**Minimum**	**Differential limit between cylinders**
1,275 (13.0, 185) / 300	981 (10.0, 142) / 300	98 (1.0, 14) / 300

CAUTION: Always use a fully charged battery to obtain specified engine speed.

- If the engine speed is out of the specified range, check the battery liquid for proper gravity. Check the engine speed again with normal battery gravity.
- If the compression pressure is below the minimum value, check the valve clearances and parts associated with the combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.
- If some cylinders have low compression pressure, pour a small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
- If the added engine oil improves the compression, piston rings may be worn out or damaged. Check the piston rings and replace if necessary.
- If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets may be leaking, or a valve in adjacent cylinders may be damaged. Inspect and repair as required.

9. Install the components in the reverse order of removal.

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10. Start the engine, and confirm that it runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it.

ENGINE ROOM COVER: REMOVAL AND INSTALLATION

CAUTION: Do not damage or scratch cover when installing or removing.

REMOVAL

1. Remove the engine room cover bolts using power tool.

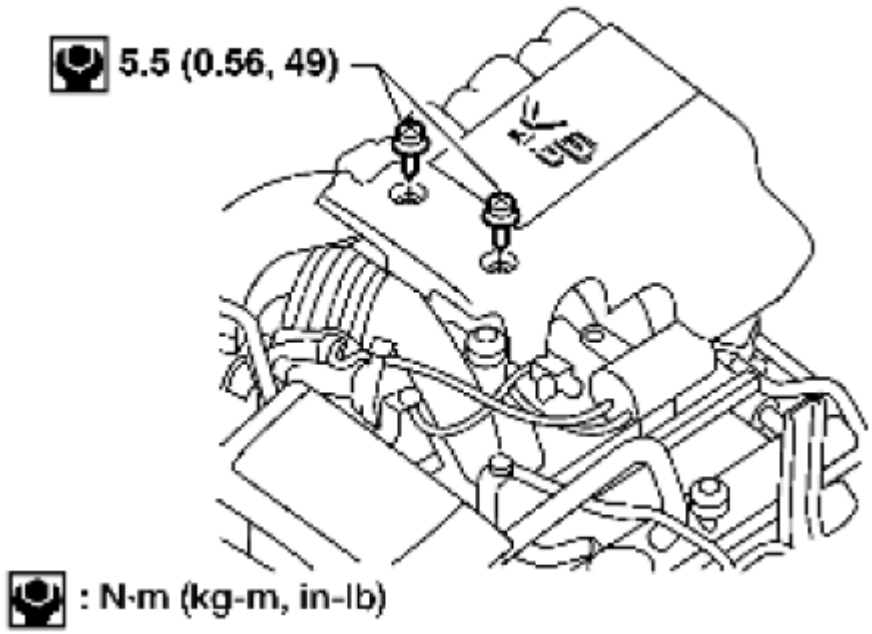


Fig. 24: Identifying Engine Room Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

2. Lift up on engine cover firmly to dislodge snap fit mounts.

INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT: EXPLODED VIEW

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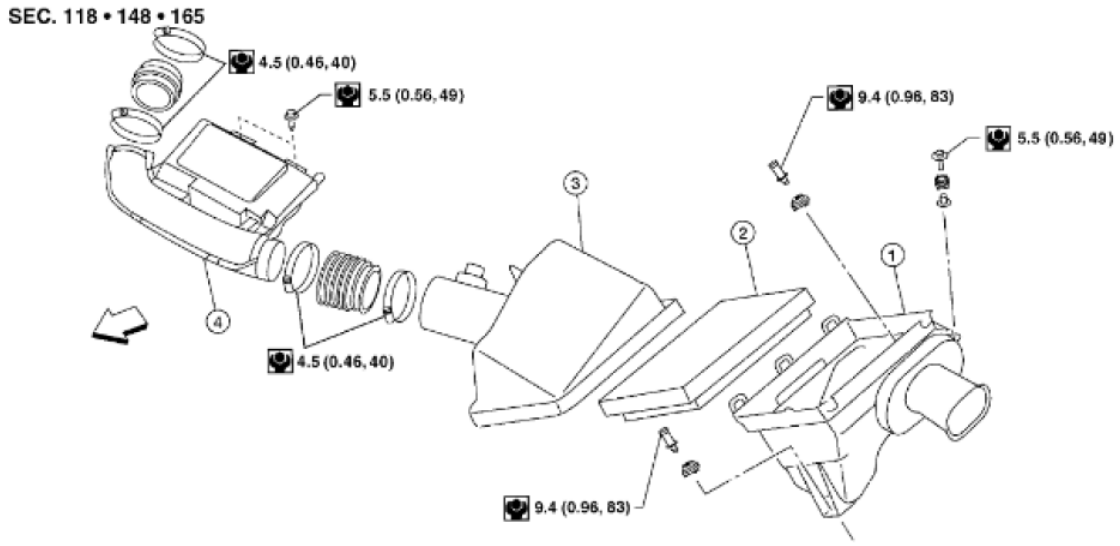


Fig. 25: Exploded View Of Air Cleaner And Air Duct With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION

CAUTION: Handle mass air flow sensor with care.

- **Do not shock it.**
- **Do not disassemble it.**
- **Do not touch its sensor.**

NOTE: Add marks as necessary for easier installation.

REMOVAL

1. Remove the engine room cover using power tool. Refer to [**ENGINE ROOM COVER: REMOVAL AND INSTALLATION**].
2. Disconnect the harness connector from air cleaner case (upper).
3. Remove the air duct and resonator assembly and air cleaner case (upper).
4. Remove air cleaner filter and air cleaner case (lower).

INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for cracks or tears.

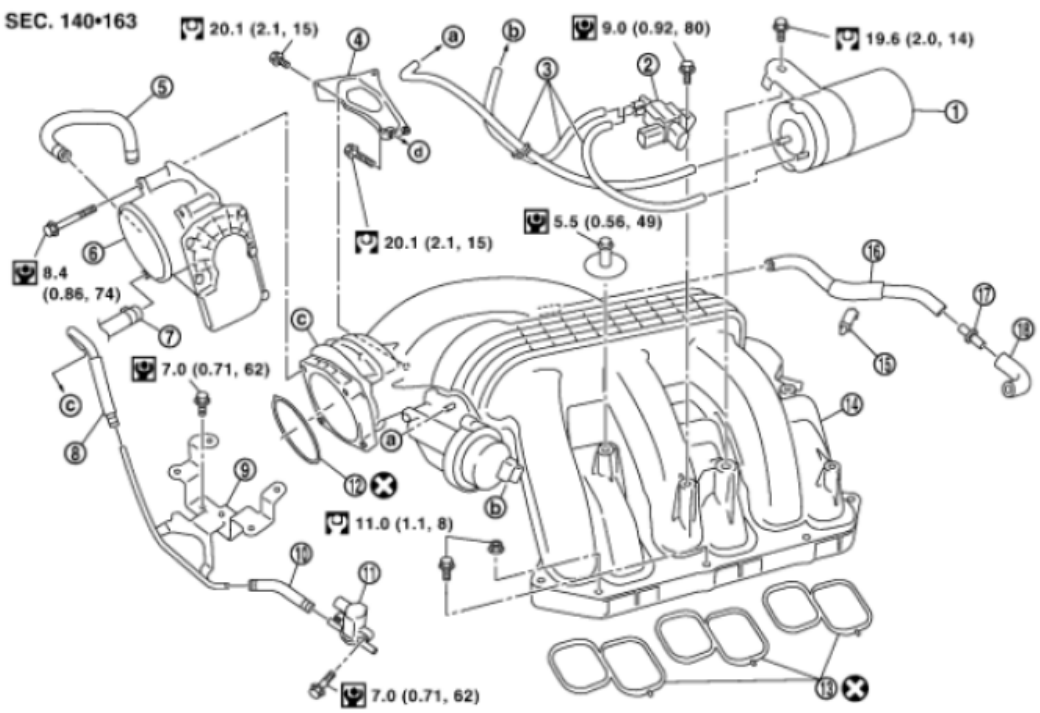
- If anything found, replace air duct and resonator assembly.

INSTALLATION

Installation is in the reverse order of removal.

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INTAKE MANIFOLD COLLECTOR: EXPLODED VIEW



1.	Vacuum tank	2.	VIAS control solenoid valve	3.	Vacuum hose
4.	Intake manifold collector support	5.	Water hose	6.	Electronic throttle control actuator
7.	Water hose	8.	EVAP hose	9.	Bracket
10.	EVAP hose	11.	EVAP canister purge volume control solenoid valve	12.	Gasket
13.	Gasket	14.	Intake manifold collector	15.	Clip
16.	PCV hose	17.	Connector	18.	PCV hose
a.	To intake manifold collector	b.	To power valve	c.	To throttle body
d.	To cylinder head (RH bank)				

Fig. 26: Exploded View Of Intake Manifold Collector
Courtesy of SUZUKI OF AMERICA CORP.

INTAKE MANIFOLD COLLECTOR: REMOVAL AND INSTALLATION

REMOVAL

1. Remove the engine undercover using power tool. Refer to **FRONT BUMPER: REMOVAL AND INSTALLATION**
2. Remove engine room cover using power tool. Refer to [**ENGINE ROOM COVER: REMOVAL AND INSTALLATION**].

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3. Remove air cleaner case (upper) and air duct and resonator assembly. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].
4. Remove electronic throttle control actuator as follows:
   a. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to [**CHANGING ENGINE COOLANT**]

      WARNING: To avoid the danger of being scalded, never drain engine coolant when engine is hot.

      CAUTION:
      - **Perform when engine is cold.**
      - **Do not spill engine coolant on drive belt.**

   b. Disconnect water hoses from electronic throttle control actuator.
      - When engine coolant is not drained from radiator, attach plug to water hoses to prevent engine coolant leakage.
   c. Disconnect harness connector.
   d. Loosen bolts in reverse order as shown.

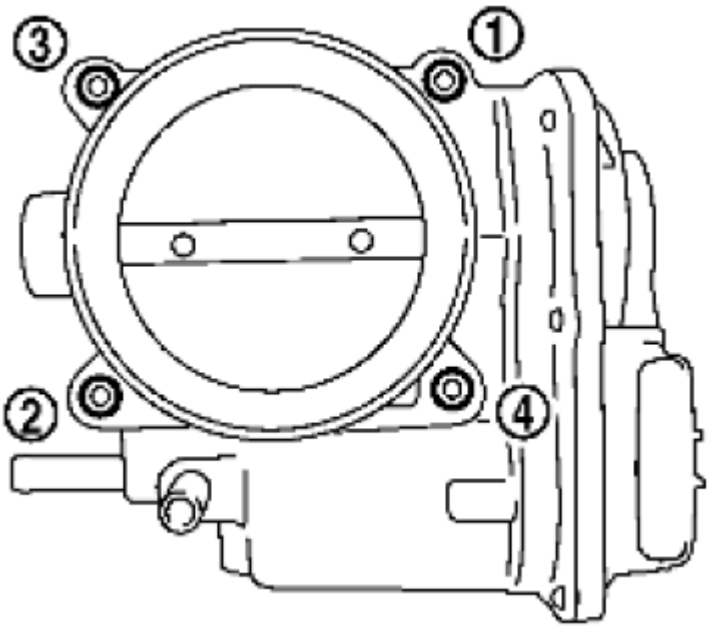


Fig. 27: Identifying Electronic Throttle Control Actuator Bolts Loosen Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Handle carefully to avoid any shock to electronic throttle control actuator.**
- **Do not disassemble.**

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5. Remove the following parts:
   - Vacuum hose (to brake booster)
   - PCV hose
6. Loosen bolts in reverse order as shown to remove intake manifold collector support.

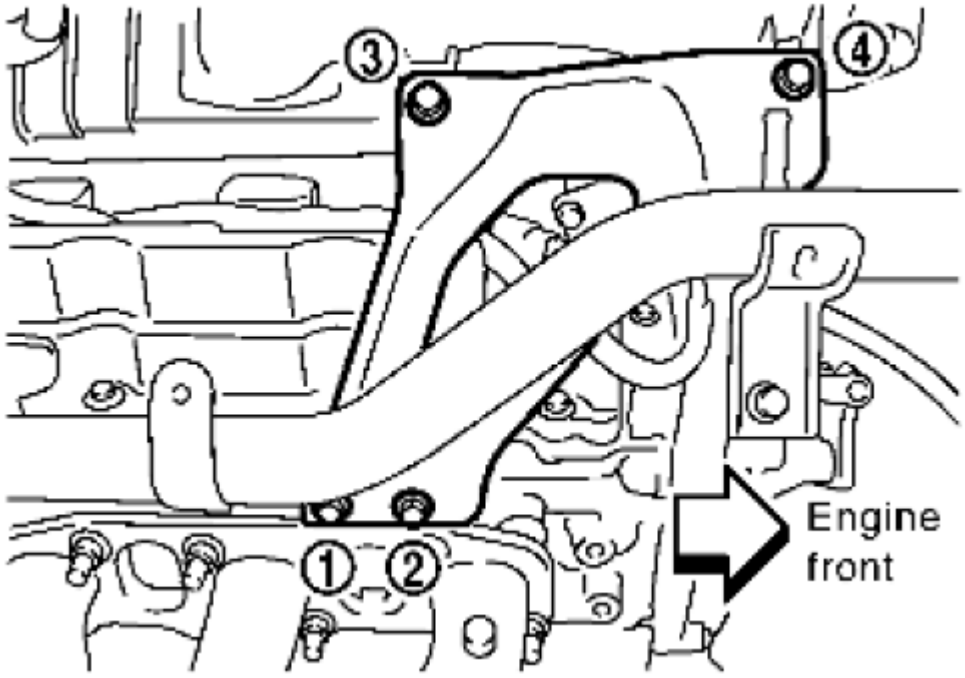


Fig. 28: Identifying Intake Manifold Collector Support Bolts Loosen Sequence
Courtesy of SUZUKI OF AMERICA CORP.

7. Disconnect EVAP hoses and harness connector from EVAP canister purge volume control solenoid valve.
8. Remove EVAP canister purge volume control solenoid valve.
9. Remove VIAS control solenoid valve and vacuum tank.
   - Add mating marks as necessary for easier installation.
10. Loosen nuts and bolts in reverse order as shown with power tool, and remove intake manifold collector.

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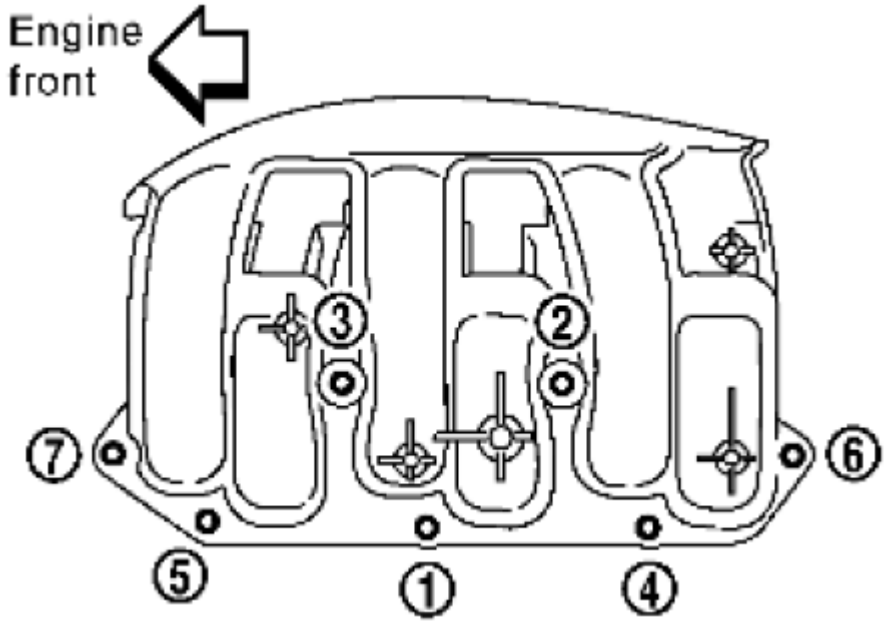


Fig. 29: Identifying Intake Manifold Collector Bolts Loosen Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Cover engine openings to avoid entry of foreign materials.

INSTALLATION

Installation is in the reverse order of removal. Note the following:

Intake Manifold Collector

- If stud bolts were removed from intake manifold, install them and tighten to the specified torque.
- Tighten nuts and bolts in numerical order as shown.

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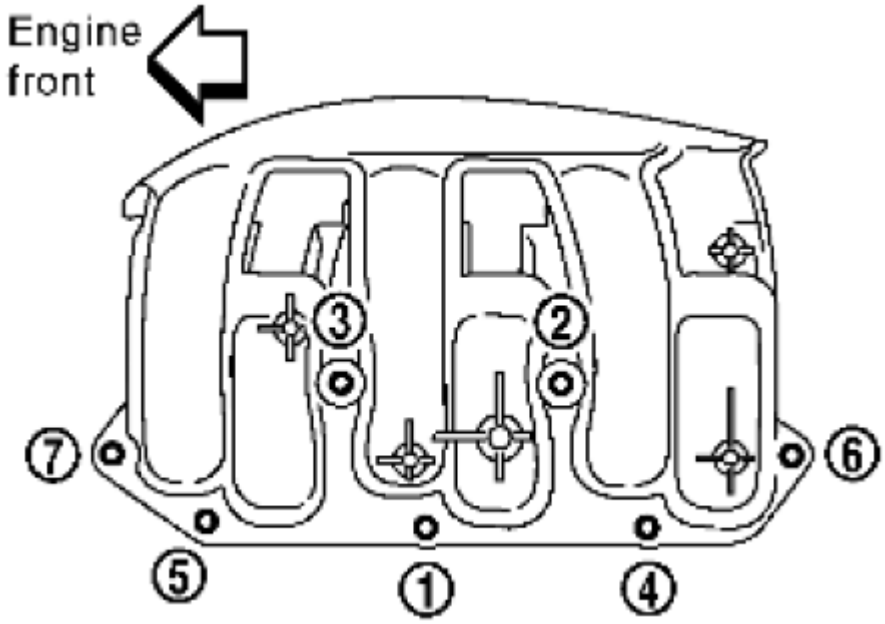


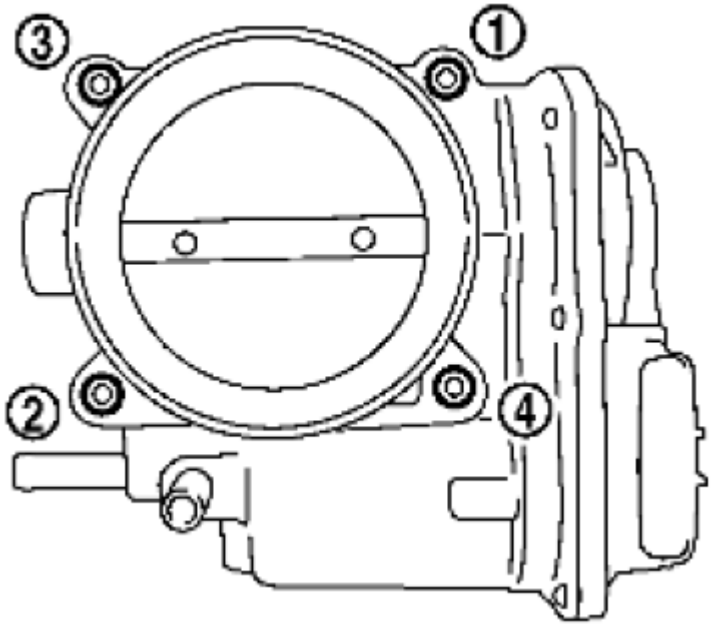
Fig. 30: Identifying Intake Manifold Nuts And Bolts Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

Intake manifold collector bolts and nuts: 11.0 N.m (1.1 kg-m, 8 ft-lb)

Stud bolts: 6.9 N.m (7.0 kg-m, 61 in-lb)

Electronic Throttle Control Actuator

- Tighten bolts in numerical order as shown.

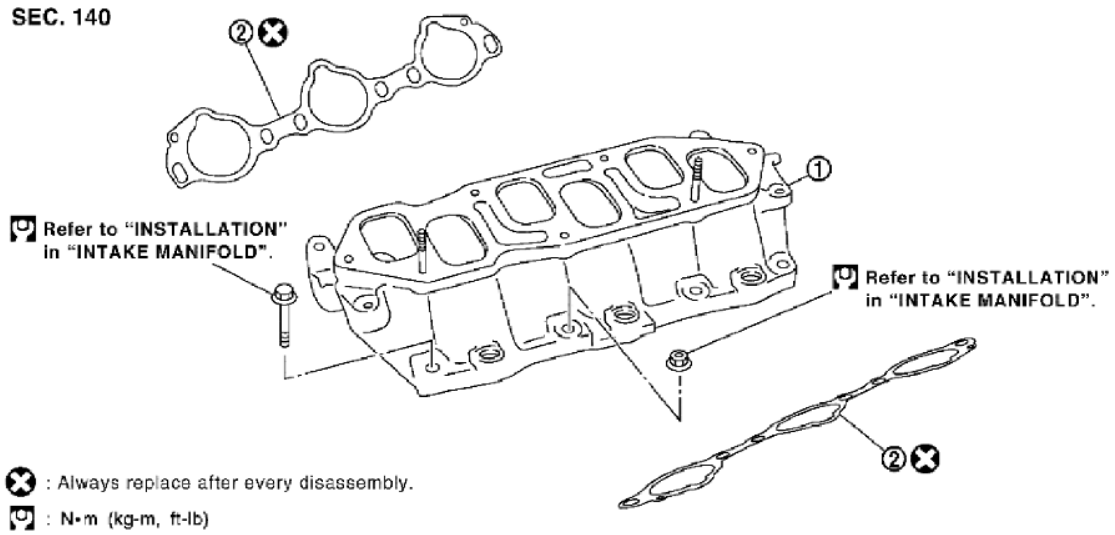


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Fig. 31: Identifying Electronic Throttle Control Actuator Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

- Perform the "Throttle Valve Closed Position Learning" when harness connector of electronic throttle control actuator is disconnected. Refer to [**THROTTLE VALVE CLOSED POSITION LEARNING**]
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when electronic throttle control actuator is replaced. Refer to [**IDLE AIR VOLUME LEARNING**]

INTAKE MANIFOLD: EXPLODED VIEW



1. Intake manifold	2. Gasket	

Fig. 32: Exploded View Of Intake Manifold Components With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

INTAKE MANIFOLD: REMOVAL AND INSTALLATION

REMOVAL

1. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: VQ40DE**]
2. Remove intake manifold collector. Refer to [**INTAKE MANIFOLD COLLECTOR: REMOVAL AND INSTALLATION**].
3. Remove fuel tube and fuel injector assembly. Refer to [**FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [VQ40DE]**]
4. Loosen nuts and bolts with power tool in reverse order as shown to remove intake manifold.

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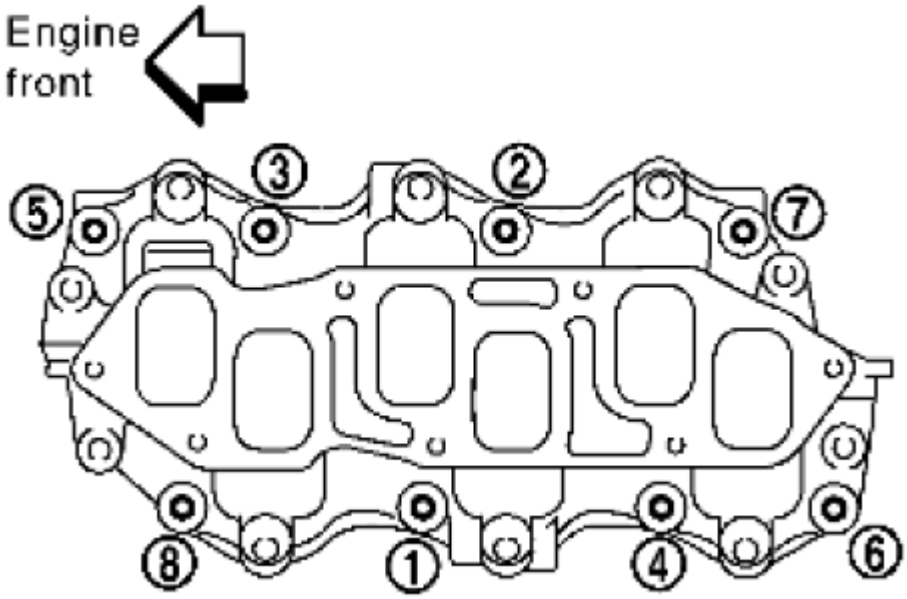


Fig. 33: Identifying Intake Manifold Nuts And Bolts Remove Sequence
Courtesy of SUZUKI OF AMERICA CORP.

5. Remove gaskets.

CAUTION: Cover engine openings to avoid entry of foreign materials.

INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of the intake manifold mating surface with straightedge and feeler gauge.

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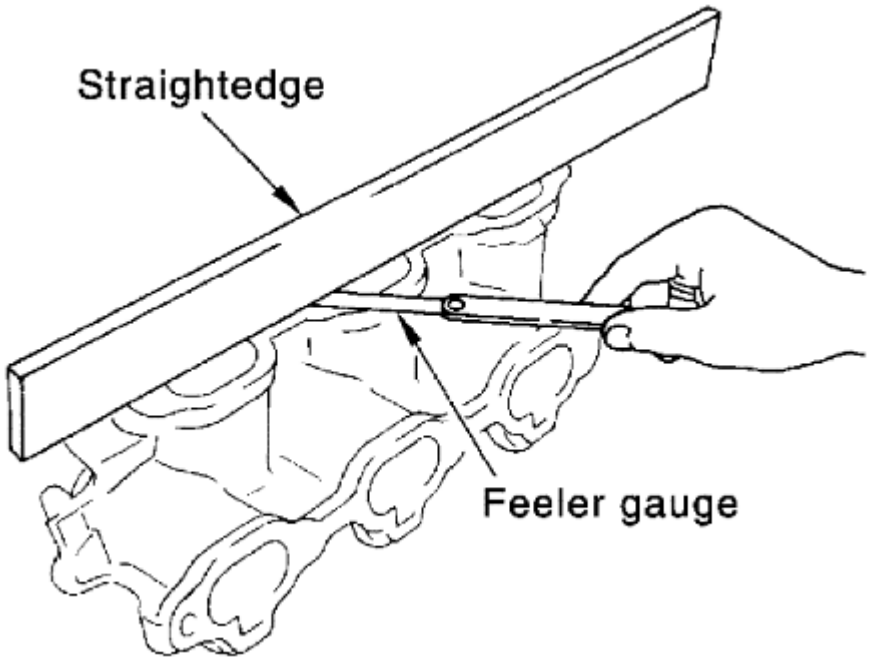


Fig. 34: Checking Surface Distortion Of Intake Manifold Mating Surface With Straightedge And Feeler Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace intake manifold.

INSTALLATION

Installation is in the reverse order of removal. Note the following:

Intake Manifold

- If stud bolts were removed from cylinder head, install them and tighten to the specified torque.

  Intake manifold studs: 11.0 N.m (1.1kg-m, 8 ft-lb)

- Tighten all nuts and bolts to the specified torque in two or more steps in numerical order as shown.

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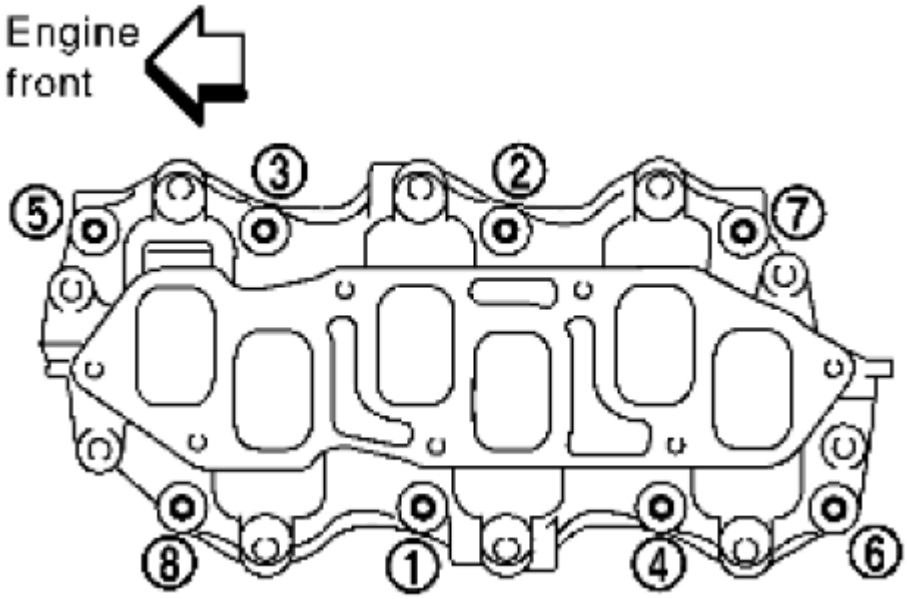


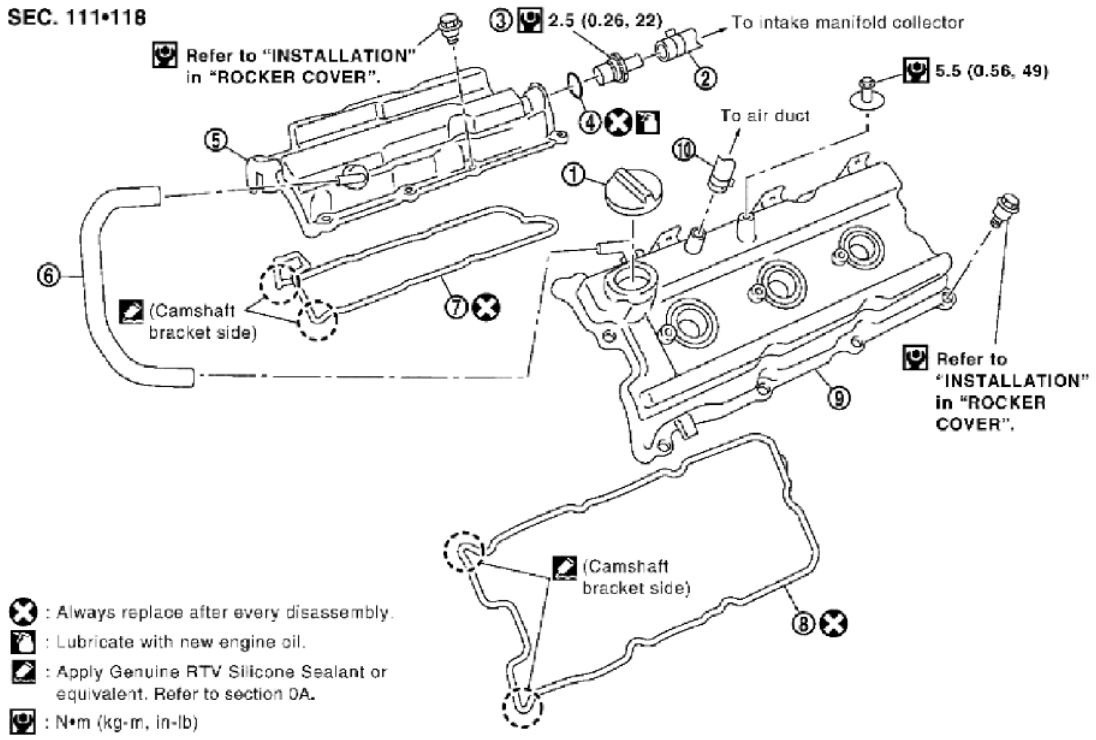
Fig. 35: Identifying Intake Manifold Nuts And Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

Intake manifold bolt and nuts 1st step: 7.4 N.m (0.75 kg-m, 65 in-lb)

2nd step and after: 29.0 N.m (3.0 kg-m, 21 ft-lb)

ROCKER COVER: EXPLODED VIEW

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1.	Oil filler cap	2.	PCV hose	3.	PCV valve
4.	O-ring	5.	Rocker cover (RH)	6.	PCV hose
7.	Rocker cover gasket (RH)	8.	Rocker cover gasket (LH)	9.	Rocker cover (LH)
10.	PCV hose				

Fig. 36: Exploded View Of Rocker Cover Components With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

ROCKER COVER: REMOVAL AND INSTALLATION

REMOVAL (LH)

1. Remove the engine room cover using power tool. Refer to [**ENGINE ROOM COVER: REMOVAL AND INSTALLATION**].
2. Remove air duct and resonator assembly. Refer to **Air Cleaner and Air Duct: Exploded View**
3. Separate engine harness removing their brackets from rocker covers.
4. Remove harness bracket from cylinder head, if necessary.
5. Disconnect and remove the intake valve timing control solenoid valve (LH bank). Refer to **Front Timing Chain Case: Exploded View**
6. Remove ignition coils. Refer to [**IGNITION COIL: REMOVAL AND INSTALLATION**]
7. Remove PCV hoses from rocker covers.
8. Remove oil filler cap from rocker cover (LH), if necessary.
9. Remove the rocker cover bolts using power tool in reverse order as shown.

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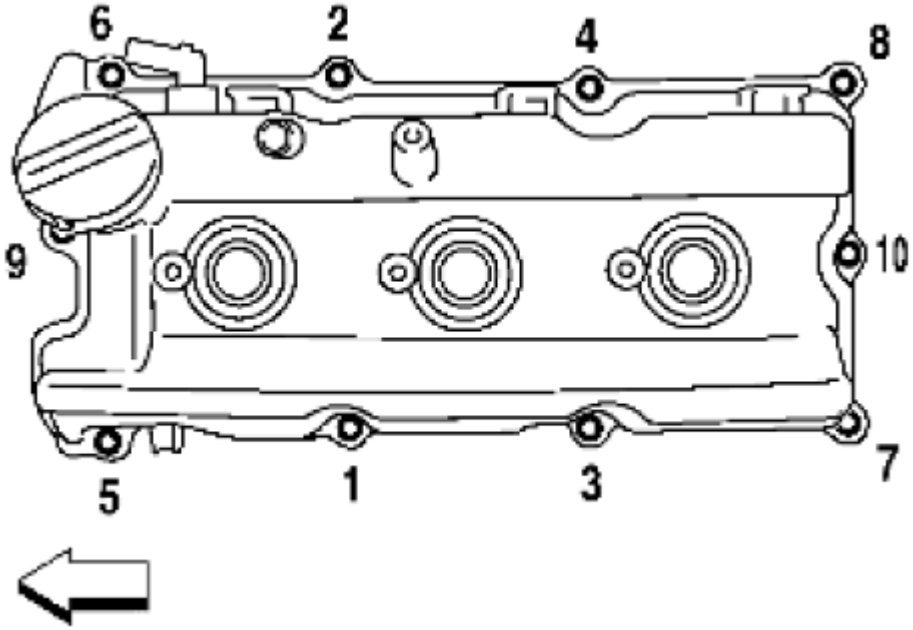


Fig. 37: Identifying Rocker Cover Bolts Remove Sequence
Courtesy of SUZUKI OF AMERICA CORP.

- <==: Front

10. Remove rocker cover gaskets from rocker covers.
11. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

CAUTION: Do not scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION (LH)

1. Apply liquid gasket using Tool to joint of rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

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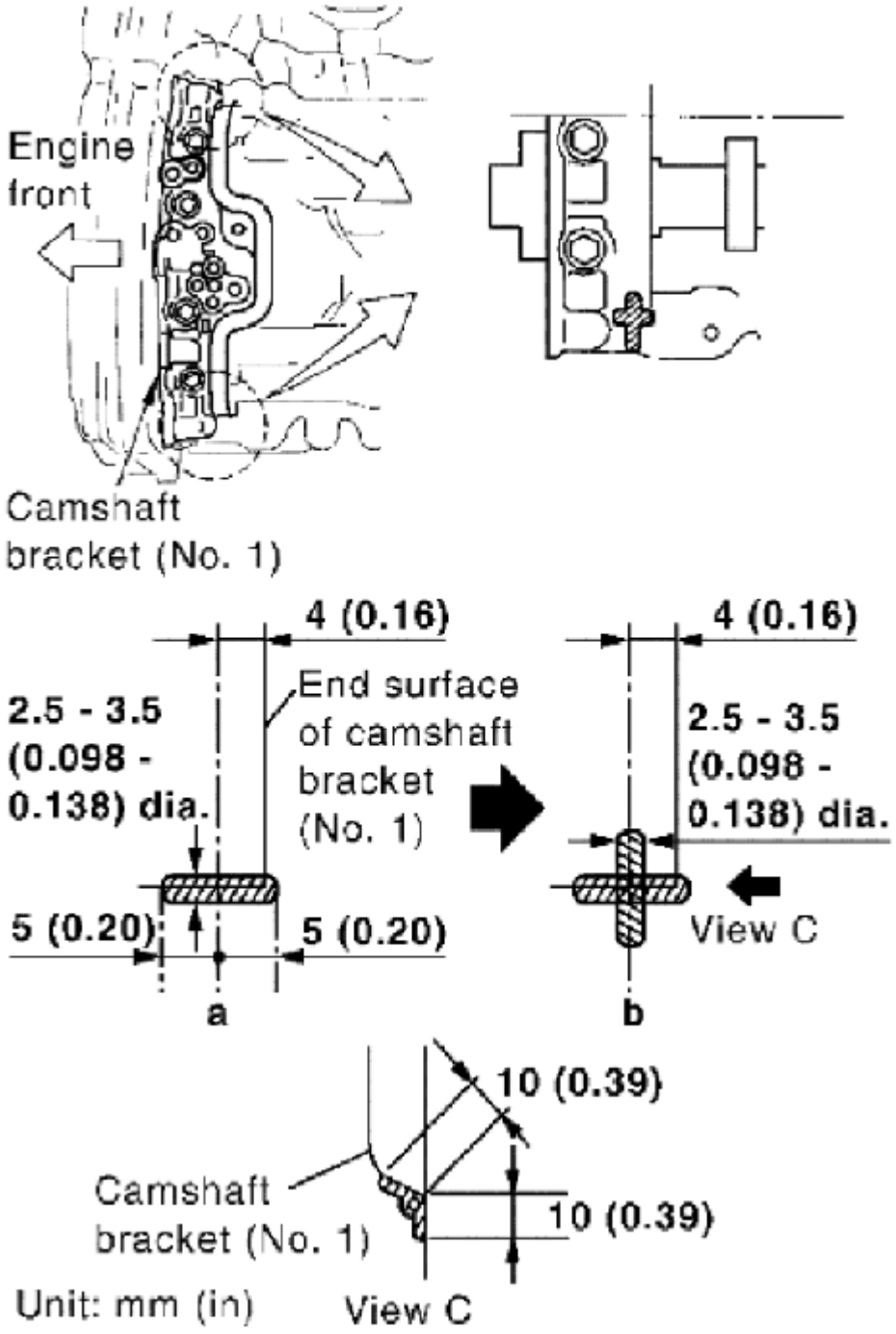


Fig. 38: Applying Liquid Gasket Using Tool To Joint Of Rocker Cover, Cylinder Head And Camshaft Bracket
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

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NOTE: The figure shows an example of LH side [zoomed in shows camshaft bracket (No. 1)].

a. Apply liquid gasket to joint part of camshaft bracket (a) (No. 1) and cylinder head.
b. Apply liquid gasket (b) 90° to figure (a).

2. Install new rocker cover gasket to rocker cover.
3. Install rocker cover.
   - Check to be sure rocker cover gasket is not dropped from installation groove of rocker cover.
4. Tighten the rocker cover bolts in two steps in numerical order as shown.

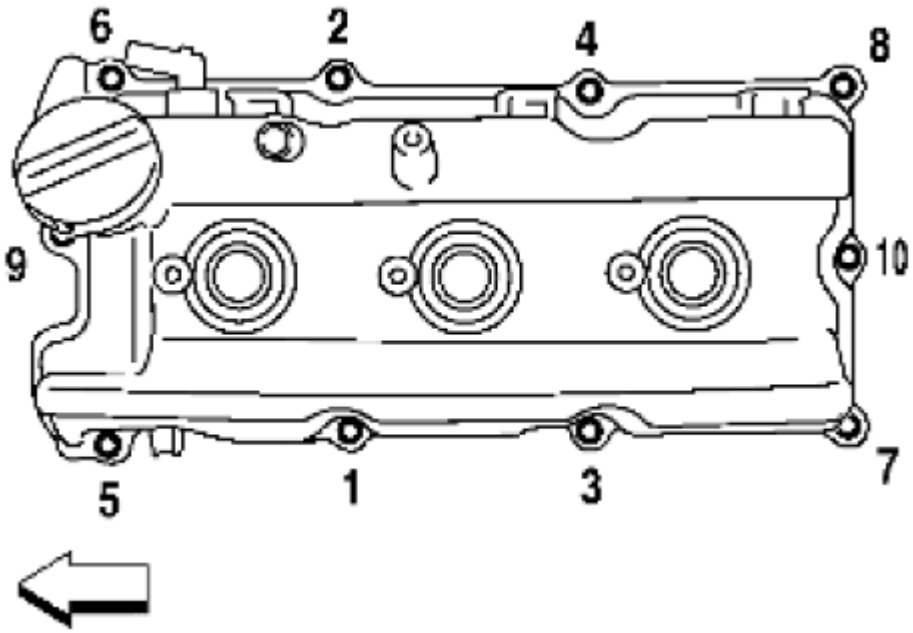


Fig. 39: Identifying Rocker Cover Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

- <==: Front

1st step: 1.96 N.m (0.20 kg-m, 17 in-lb)

2nd step: 8.33 N.m (0.85 kg-m, 74 in-lb)

5. Install oil filler cap to rocker cover (LH), if removed.
6. Install PCV hose.
   - Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
   - When installing, be careful not to twist or come in contact with other parts.
7. Installation of the remaining components is in the reverse order of removal.

REMOVAL (RH)

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1. Remove intake manifold collector. Refer to [**INTAKE MANIFOLD COLLECTOR: REMOVAL AND INSTALLATION**].

CAUTION: Perform this step when engine is cold.

2. Separate engine harness removing their brackets from rocker covers.
3. Remove harness bracket from cylinder head (RH). Refer to [**CYLINDER HEAD: REMOVAL AND INSTALLATION**].
4. Disconnect and remove the intake valve timing control solenoid valve (RH bank). Refer to **Front Timing Chain Case: Exploded View**
5. Remove the ignition coils. Refer to [**IGNITION COIL: REMOVAL AND INSTALLATION**]
6. Remove the PCV hoses from rocker cover.
7. Remove the PCV valve and O-ring from rocker cover (RH), if necessary.
8. Remove the rocker cover bolts using power tool in reverse order as shown.

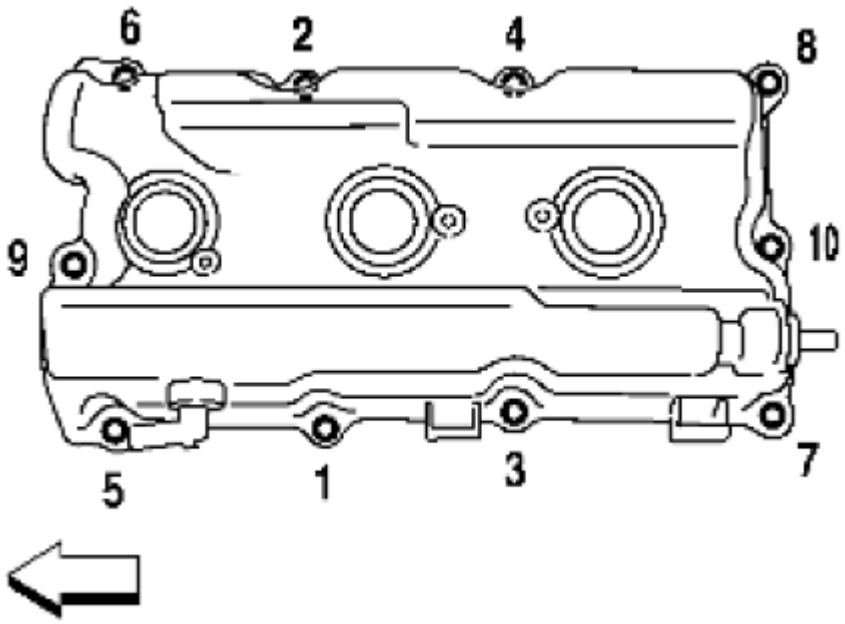


Fig. 40: Identifying Rocker Cover Bolts Remove Sequence
Courtesy of SUZUKI OF AMERICA CORP.

- <==: Front

9. Remove rocker cover gaskets from rocker covers.
10. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

CAUTION: Do not scratch or damage the mating surface when cleaning off old liquid gasket.

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INSTALLATION (RH)

1. Apply liquid gasket using Tool to joint part among rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

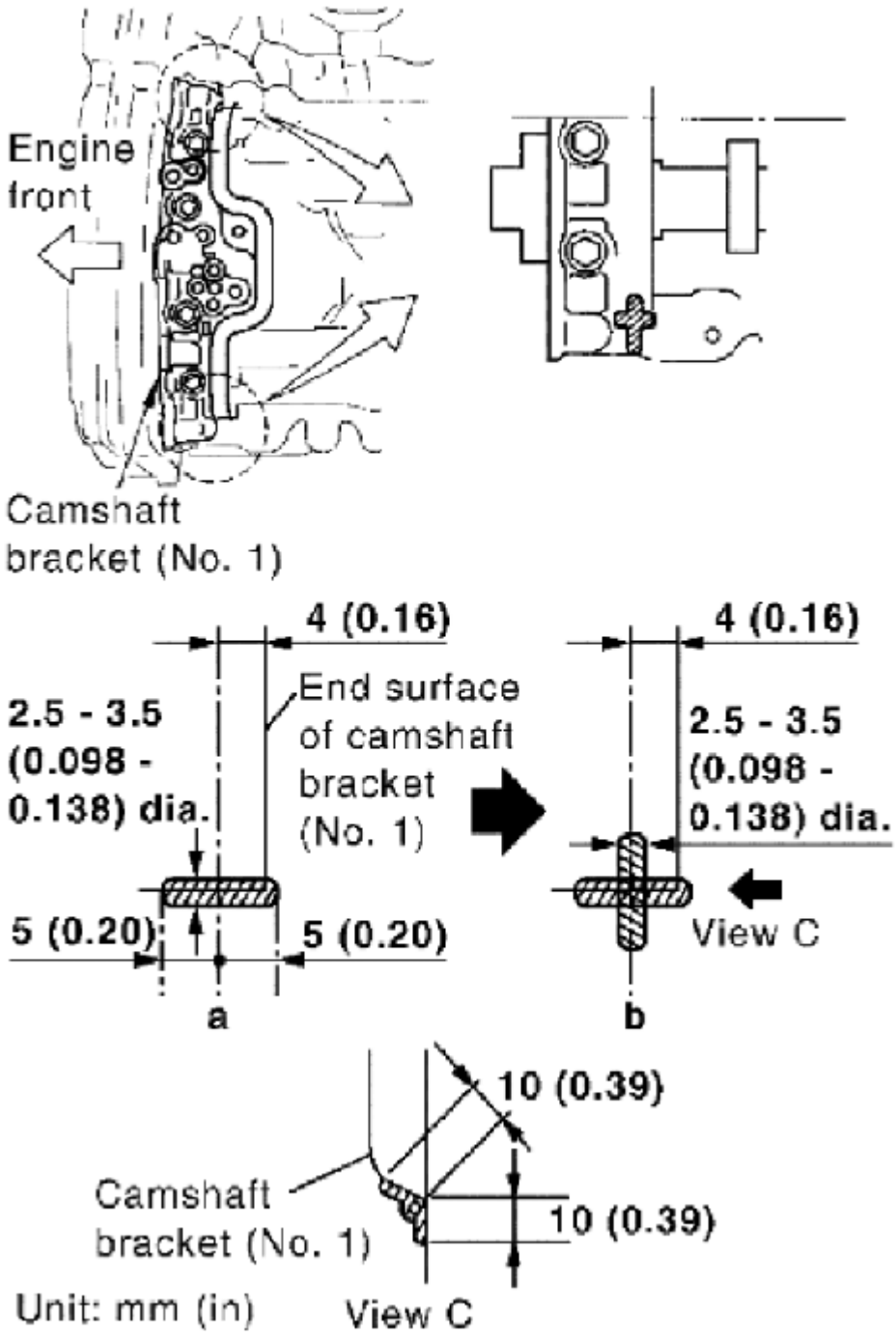


Fig. 41: Applying Liquid Gasket Using Tool To Joint Part Among Rocker Cover, Cylinder Head And Camshaft Bracket
Courtesy of SUZUKI OF AMERICA CORP.

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Tool number: WS39930000 (-)

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

NOTE: The figure shows an example of LH side [zoomed in shows camshaft bracket (No. 1)].

a. Apply liquid gasket to joint part of camshaft bracket (a) (No. 1) and cylinder head.
b. Apply liquid gasket (b) to the figure (a) squarely.

2. Install new rocker cover gasket to rocker cover.
3. Install rocker cover.
   - Check to be sure rocker cover gasket is not dropped from installation groove of rocker cover.
4. Tighten the rocker cover bolts in two steps in numerical order as shown.

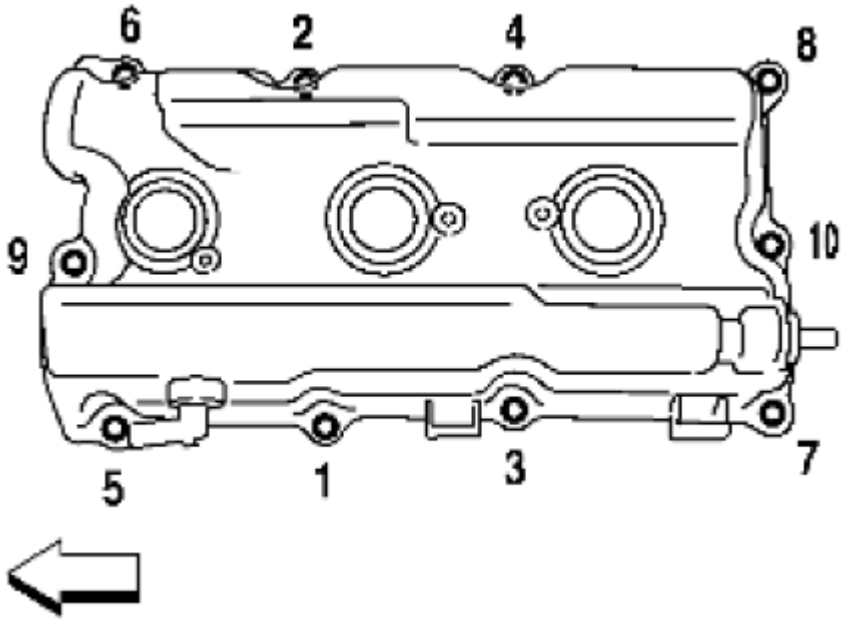


Fig. 42: Identifying Rocker Cover Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

- <==: Front

1st step: 1.96 N.m (0.20 kg-m, 17 in-lb)

2nd step: 8.33 N.m (0.85 kg-m, 74 in-lb)

5. Install new O-ring and PCV valve to rocker cover (RH), if removed.
6. Install PCV hose.
   - Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.

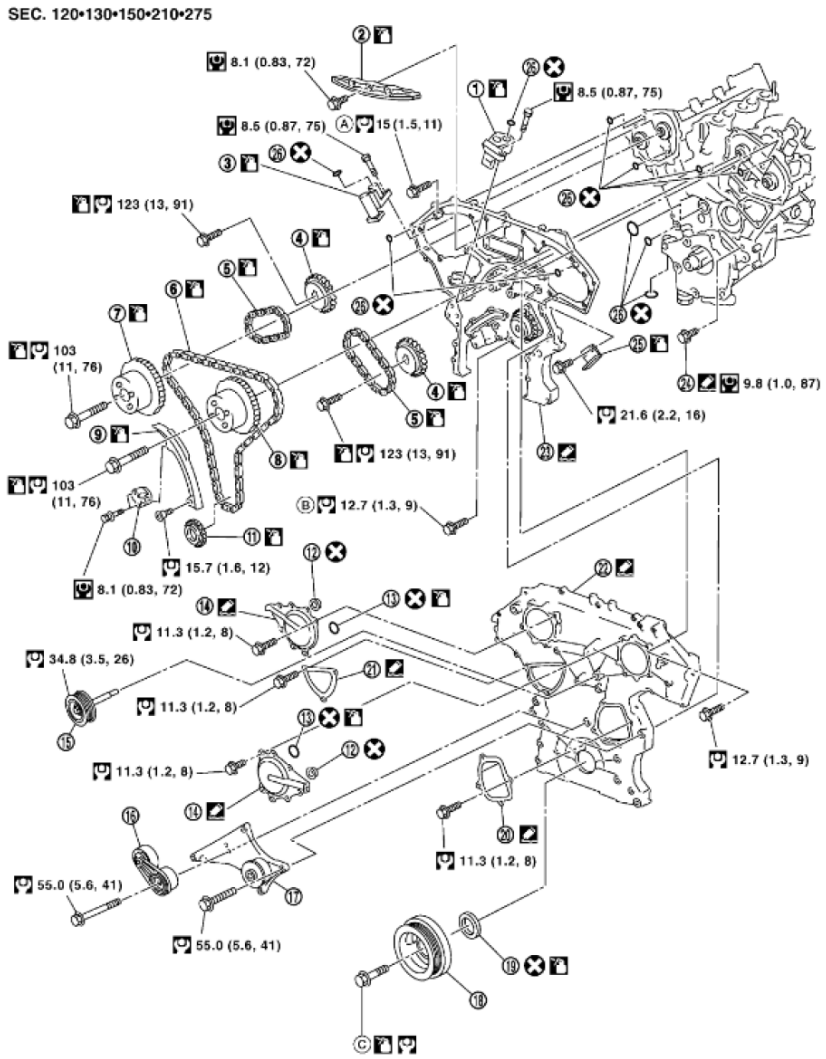
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- When installing, be careful not to twist or come in contact with other parts.

7. Installation of the remaining components is in the reverse order of removal.

FRONT TIMING CHAIN CASE: EXPLODED VIEW

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1. Timing chain tensioner (secondary) (LH)	2. Internal chain guide	3. Timing chain tensioner (secondary) (RH)
4. Camshaft sprocket (EXH)	5. Timing chain (secondary)	6. Timing chain (primary)
7. Camshaft sprocket (INT)	8. Camshaft sprocket (INT)	9. Slack guide
10. Timing chain tensioner (primary)	11. Crankshaft sprocket	12. Collared O-ring
13. O-ring	14. Intake valve timing control cover	15. Idler pulley
16. Drive belt auto tensioner	17. Cooling fan bracket	18. Crankshaft pulley
19. Front oil seal	20. Water pump cover	21. Chain tensioner cover
22. Front timing chain case	23. Rear timing chain case	24. Water drain plug (front)
25. Tension guide	26. O-ring	A. Refer to ☞
B. Refer to ☞	C. Refer to ☞	

Fig. 43: Exploded View Of Front Timing Chain Case With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

FRONT TIMING CHAIN CASE: REMOVAL AND INSTALLATION

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REMOVAL

1. Remove engine room cover using power tool. Refer to [**ENGINE ROOM COVER: REMOVAL AND INSTALLATION**].
2. Drain engine oil. Refer to [**CHANGING ENGINE OIL**]

CAUTION:
- **Perform this step when engine is cold.**
- **Do not spill engine oil on drive belts.**

3. Drain engine coolant from radiator. Refer to [**CHANGING ENGINE COOLANT**]

CAUTION:
- **Perform this step when engine is cold.**
- **Do not spill engine coolant on drive belts.**

4. Remove radiator cooling fan assembly. Refer to [**ENGINE COOLING FAN: REMOVAL AND INSTALLATION (MOTOR DRIVEN TYPE)**]
5. Separate engine harnesses removing their brackets from front timing chain case.
6. Remove EVAP canister purge volume control solenoid valve, if necessary.
7. Remove drive belts. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
8. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [**POWER STEERING OIL PUMP: REMOVAL AND INSTALLATION**]
9. Remove power steering oil pump bracket. Refer to [**POWER STEERING OIL PUMP: COMPONENT**]
10. Remove generator. Refer to [**GENERATOR: REMOVAL AND INSTALLATION - VQ40DE MODELS**]
11. Remove water bypass hose and water hose clamp.
12. Remove cooling fan (crankshaft driven type) and fan bracket. Refer to **ENGINE COOLING FAN: REMOVAL AND INSTALLATION (CRANKSHAFT DRIVEN TYPE)**
13. Remove water hose at oil cooler.
14. Remove oil cooler water bypass pipe from front timing chain case. Refer to **OIL COOLER: EXPLODED VIEW**
15. Remove right and left intake valve timing control covers.
    - Loosen bolts in reverse order as shown.

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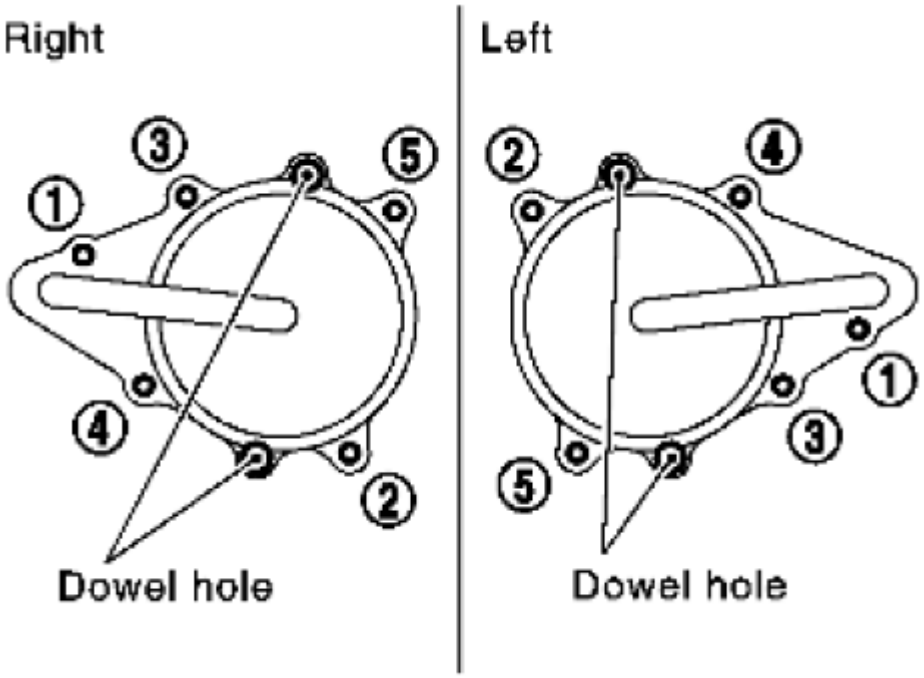


Fig. 44: Identifying Right And Left Intake Valve Timing Control Covers
Courtesy of SUZUKI OF AMERICA CORP.

- Cut liquid gasket for removal using Tool.

  Tool number: KV10111100 (J-37228)

  CAUTION: Shaft is internally jointed with camshaft sprocket (INT) center hole. When removing, keep it horizontal until it is completely disconnected.

16. Remove collared O-rings from front timing chain case (left and right side).

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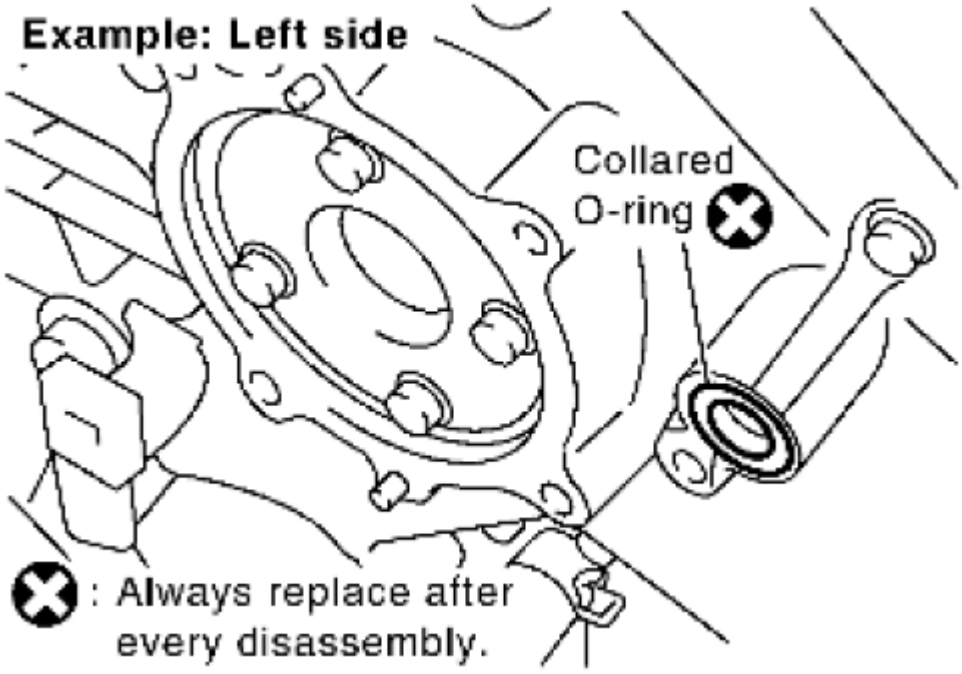


Fig. 45: Identifying Collared O-Rings From Front Timing Chain Case (Left And Right Side)
Courtesy of SUZUKI OF AMERICA CORP.

17. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

NOTE: When timing chain is not removed/installed, this step is not required.

a. Rotate crankshaft pulley clockwise to align timing mark (A) (grooved line without color) with timing indicator (B).

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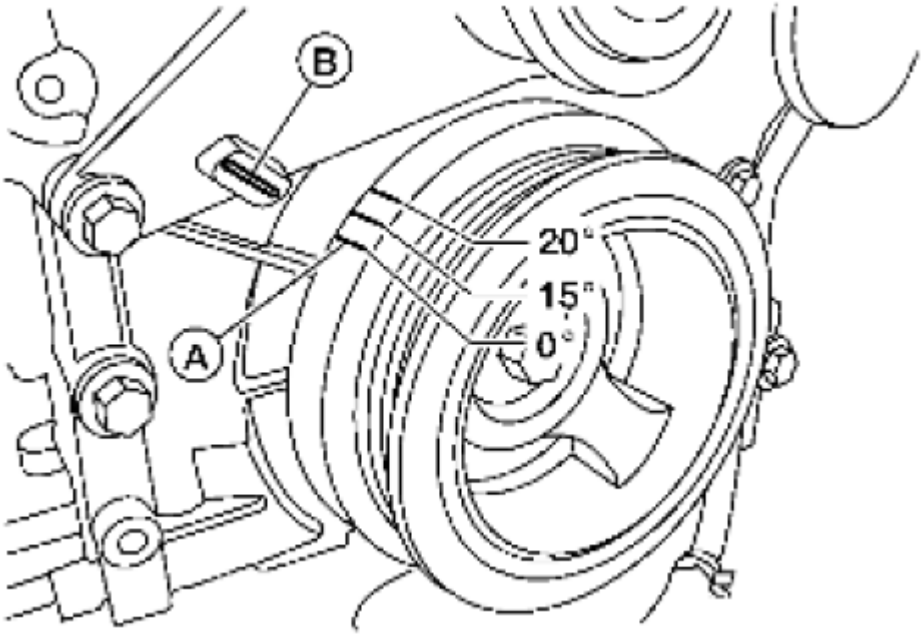


Fig. 46: Aligning Timing Mark With Timing Indicator
Courtesy of SUZUKI OF AMERICA CORP.

b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown.

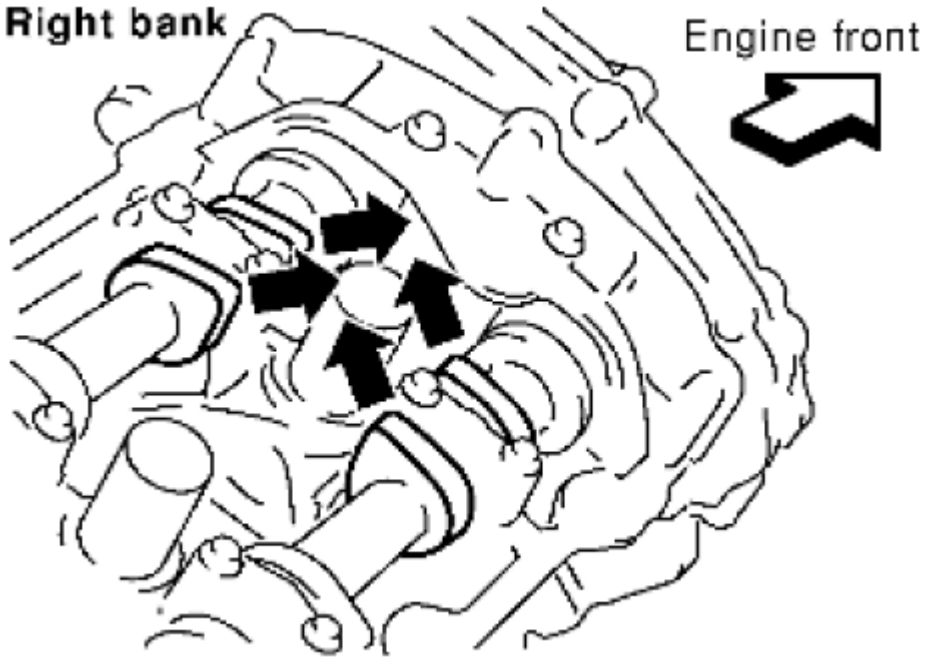


Fig. 47: Locating Intake And Exhaust Cam Noses On No. 1 Cylinder
Courtesy of SUZUKI OF AMERICA CORP.

- If not, turn crankshaft one revolution (360°) and align as shown.

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NOTE: **When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to [TIMING CHAIN: REMOVAL AND INSTALLATION].**

18. Remove A/C compressor bolts and temporarily secure A/C compressor aside. Refer to **COMPRESSOR: REMOVAL AND INSTALLATION**
19. Remove crankshaft pulley as follows:
    a. Remove starter motor and set Tool. Refer to [**STARTER MOTOR: REMOVAL AND INSTALLATION (VQ40DE)**]

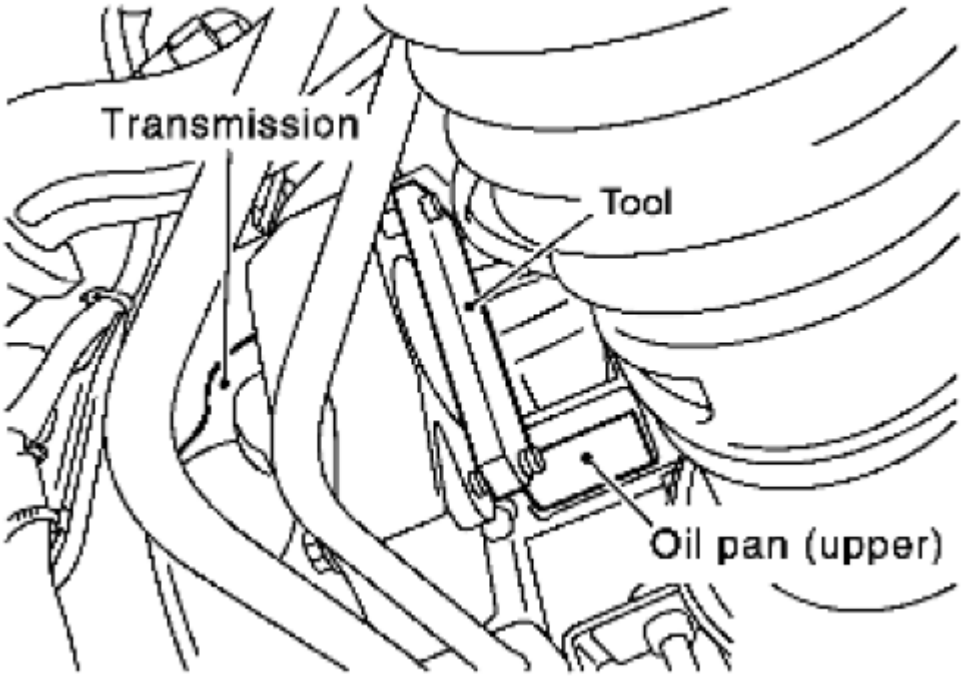


Fig. 48: Identifying Transmission And Oil Pan
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: - (J-48761)

    b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

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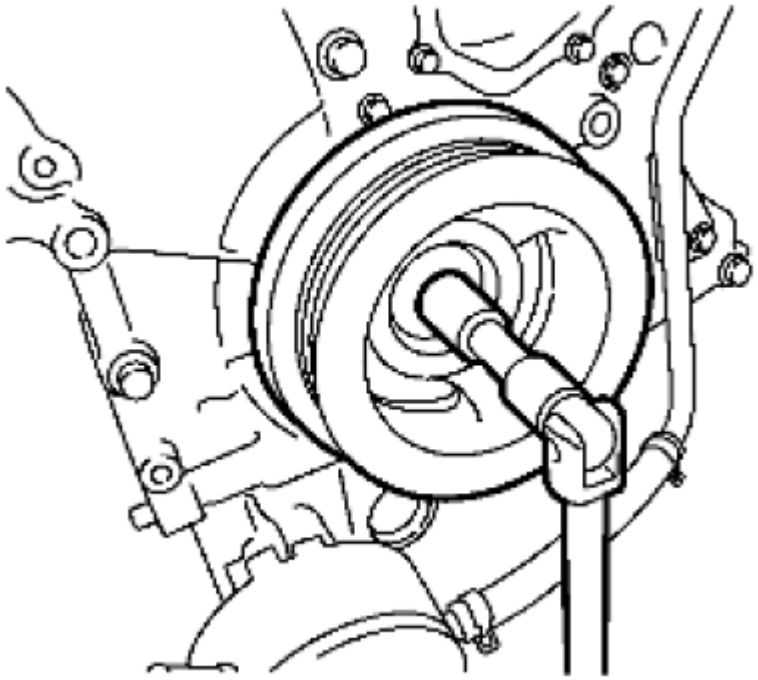


Fig. 49: Loosening Crankshaft Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not remove crankshaft pulley bolt. Keep loosened crankshaft pulley bolt in place to protect the crankshaft pulley from dropping.

c. Pull crankshaft pulley with both hands to remove it.

20. Loosen two bolts in front of oil pan (upper) in reverse order as shown.

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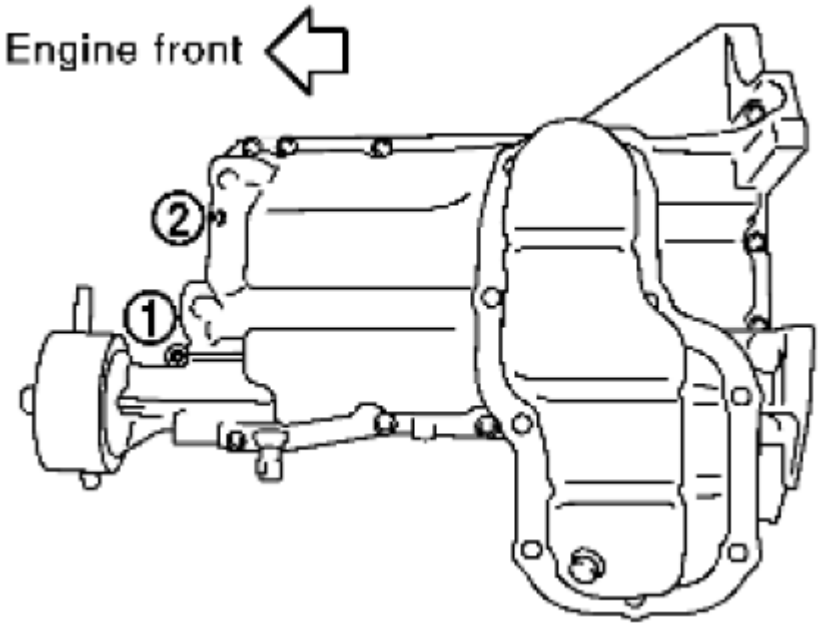


Fig. 50: Identifying Oil Pan Bolts Loosen Sequence
Courtesy of SUZUKI OF AMERICA CORP.

21. Remove front timing chain case as follows:
    a. Loosen bolts with power tool in reverse order as shown.

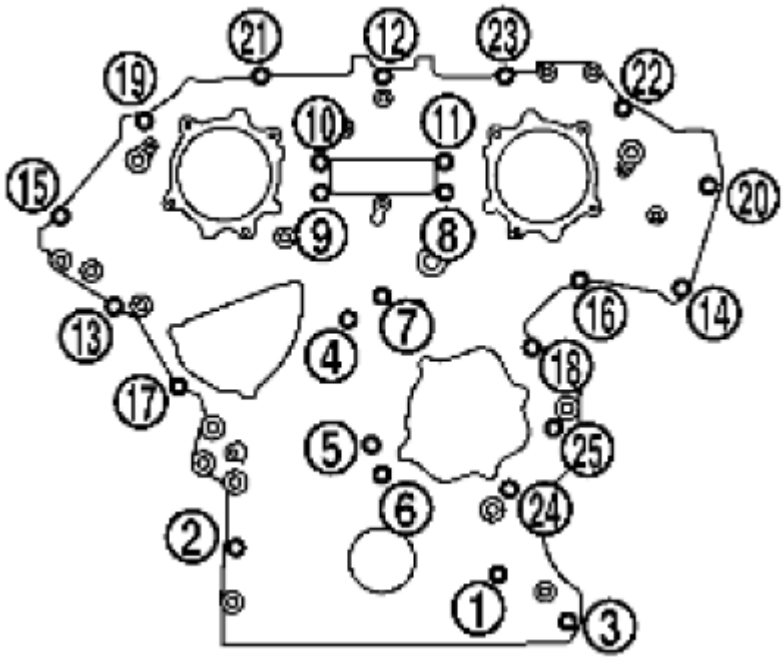


Fig. 51: Identifying Front Timing Chain Case Bolts Loosen Sequence
Courtesy of SUZUKI OF AMERICA CORP.

    b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).

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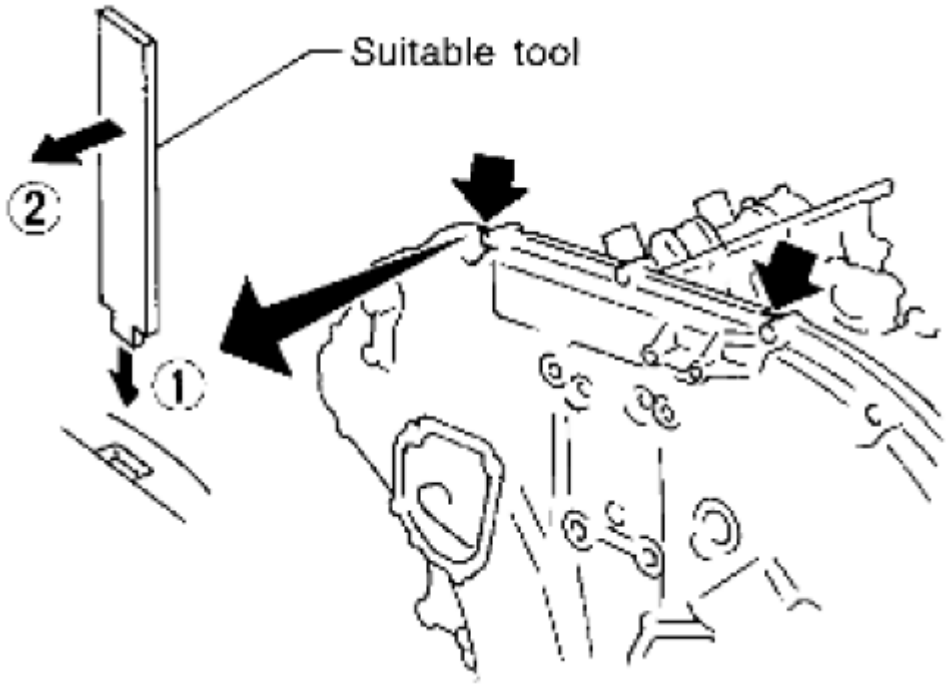


Fig. 52: Inserting Suitable Tool Into Notch At Top Of Front Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

c. Pry off case by moving tool as shown (2).
   - Cut liquid gasket for removal using Tool.

   Tool number: KV10111100 (J-37228)

CAUTION:
- **Do not use screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not twist, bend, or warp under a load.**

22. Remove O-rings from rear timing chain case.

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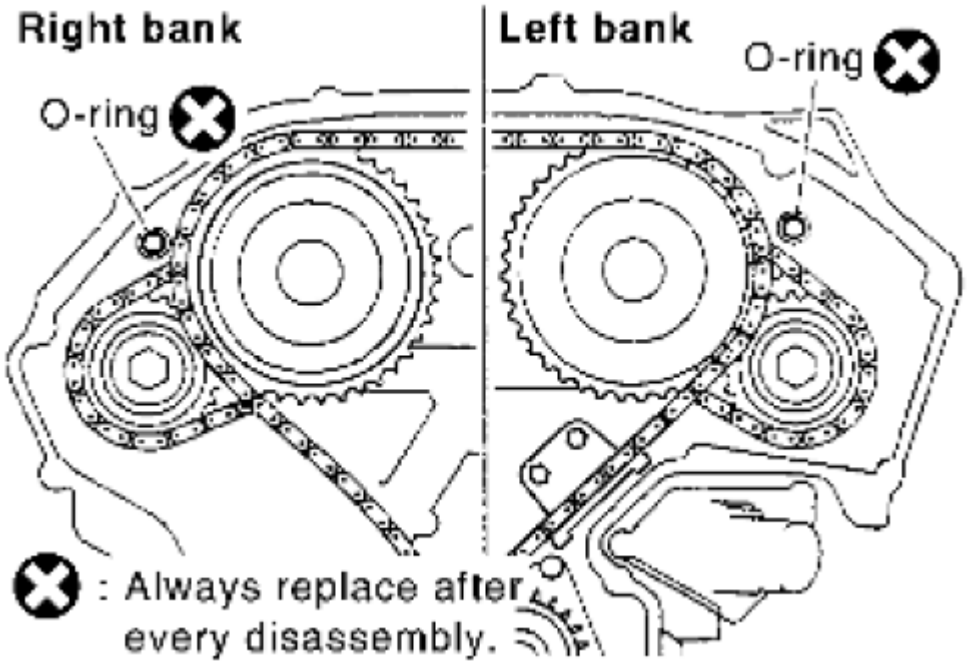


Fig. 53: Removing O-rings From Rear Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

23. Remove water pump cover and chain tensioner cover from front timing chain case, if necessary.
    - Cut liquid gasket for removal using Tool.

    Tool number: KV10111100 (J-37228)

24. Remove front oil seal from front timing chain case using suitable tool.

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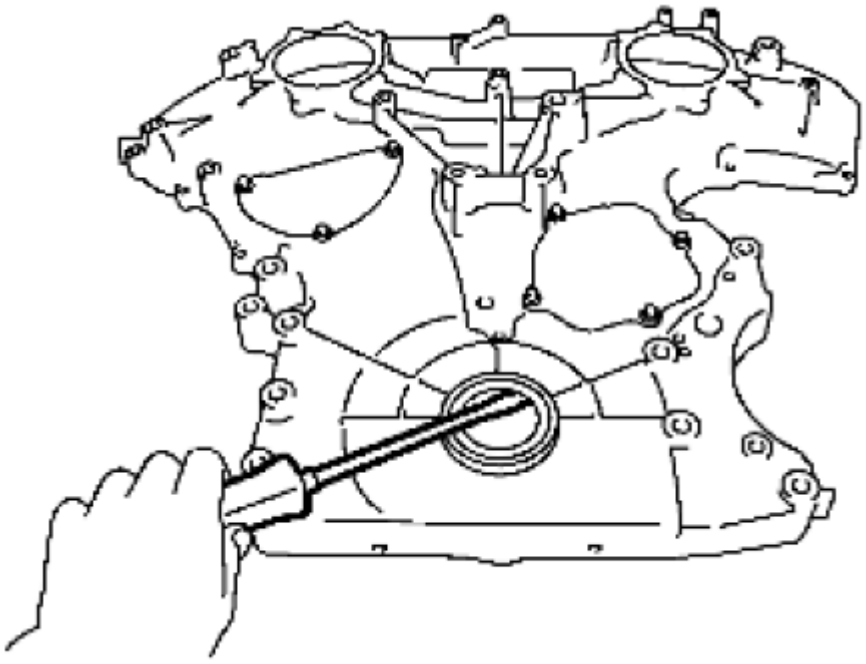


Fig. 54: Removing Front Oil Seal From Front Timing Chain Case Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Be careful not to damage front timing chain case.

25. Remove idler pulley, if necessary. Refer to **Front Timing Chain Case: Exploded View**
26. Use a scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

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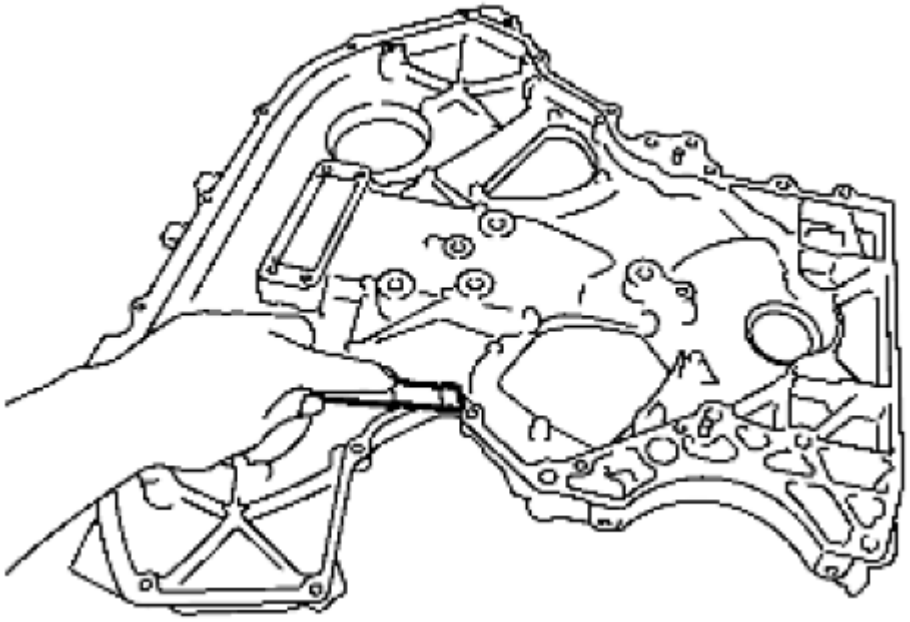


Fig. 55: Removing Traces Of Old Liquid Gasket From Front And Rear Timing Chain Cases
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Be careful not to allow gasket fragments to enter oil pan.

- Remove old liquid gasket from bolt hole and thread.

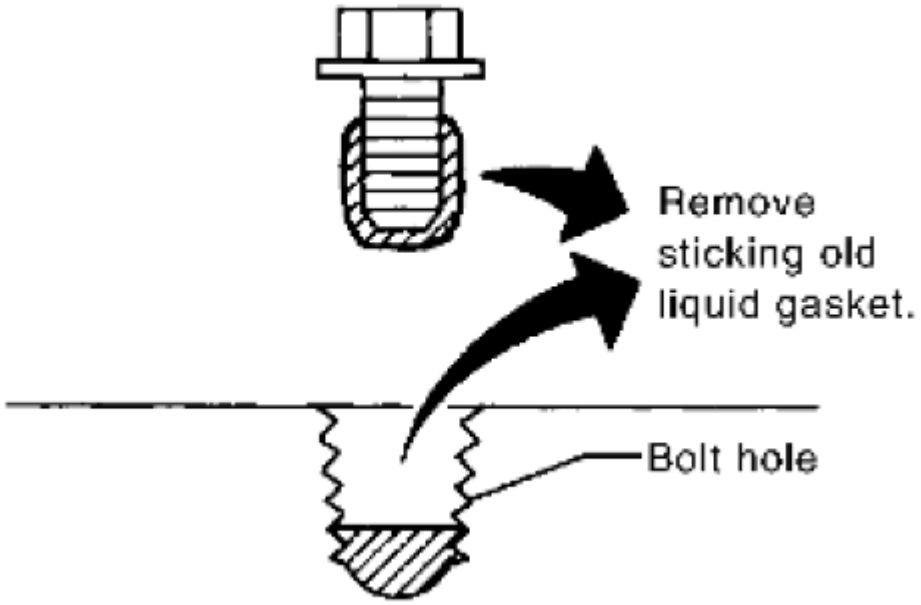


Fig. 56: Removing Old Liquid Gasket From Bolt Hole And Thread
Courtesy of SUZUKI OF AMERICA CORP.

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27. Use a scraper to remove all traces of old liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.

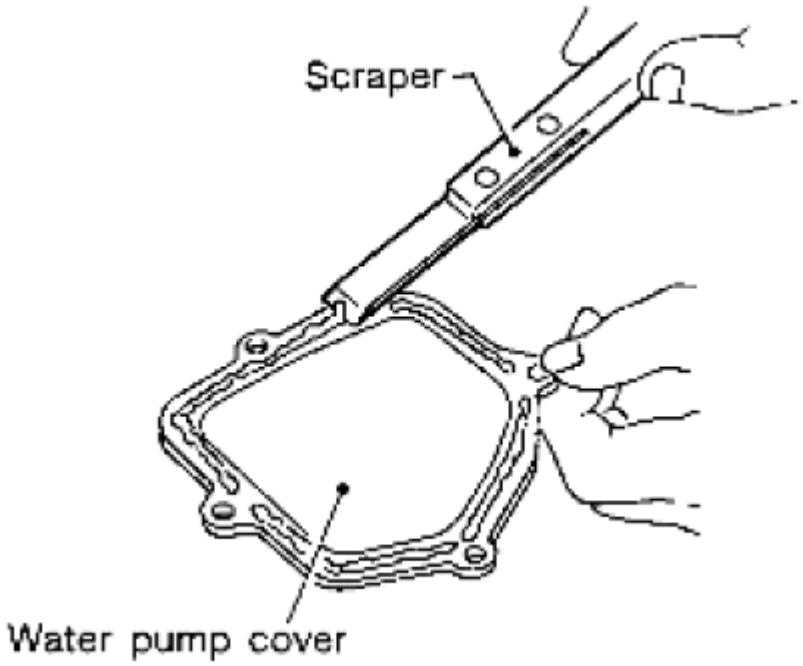


Fig. 57: Removing Traces Of Liquid Gasket From Water Pump Cover
Courtesy of SUZUKI OF AMERICA CORP.

INSTALLATION

1. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.

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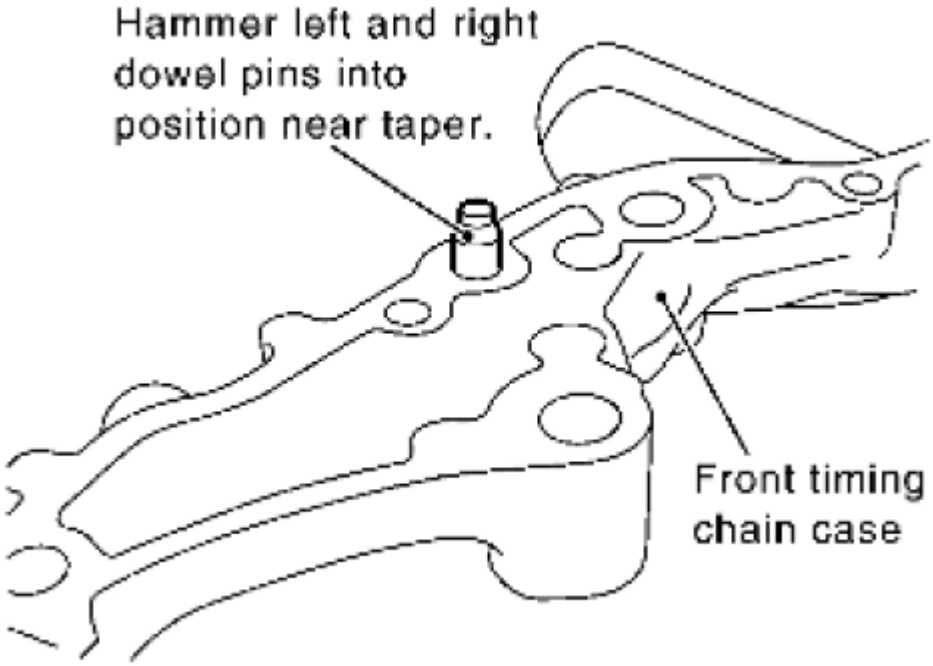


Fig. 58: Identifying Hammer Dowel Pins Into Front Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

2. Install new front oil seal on the front timing chain case.
   - Apply new engine oil to both oil seal lip and dust seal lip.
   - Install it so that each seal lip is oriented as shown.

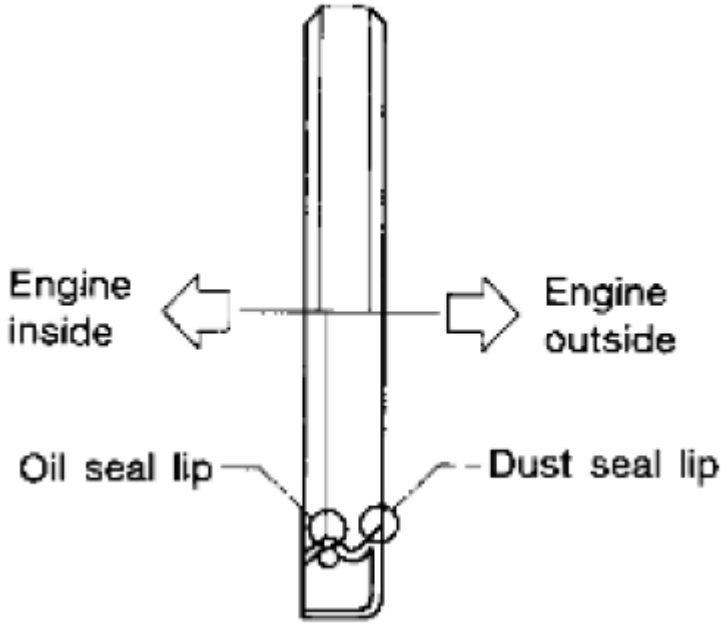


Fig. 59: Installing Front Oil Seal On Front Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

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- Press-fit oil seal until it becomes flush with front timing chain case end face using suitable drift [outer diameter: 60 mm (2.36 in)].

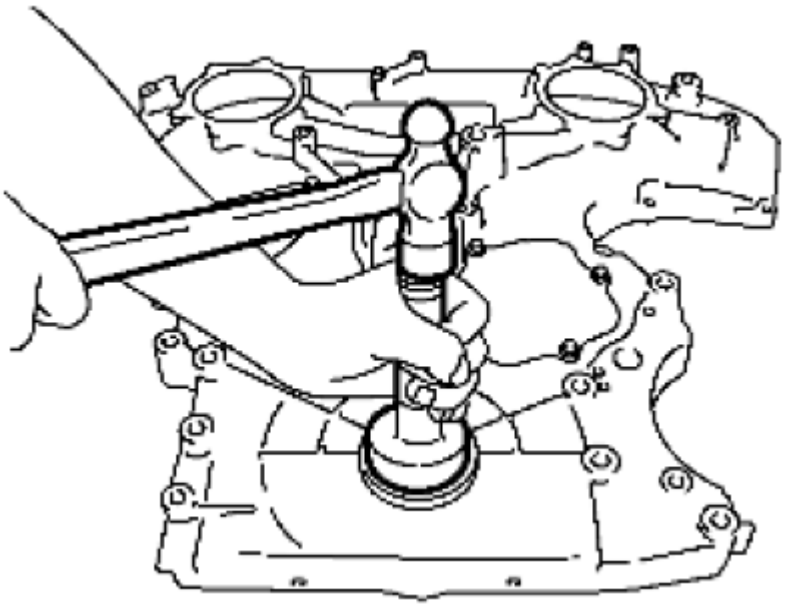
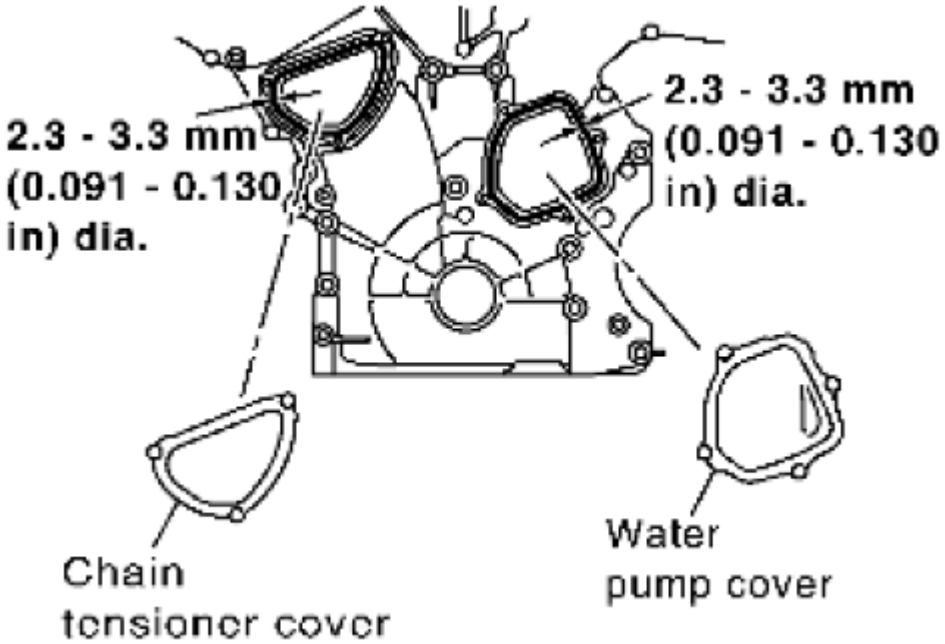


Fig. 60: Pressing Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

- Make sure the garter spring is in position and seal lip is not inverted.

3. Install water pump cover and chain tensioner cover to front timing chain case, if removed.
   - Apply a continuous bead of liquid gasket using Tool to front timing chain case as shown.



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Fig. 61: Identifying Water Pump Cover And Chain Tensioner Cover
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

4. Install idler pulley, if removed.
5. Install front timing chain case as follows:
   a. Apply a continuous bead of liquid gasket using Tool to front timing chain case back side as shown.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

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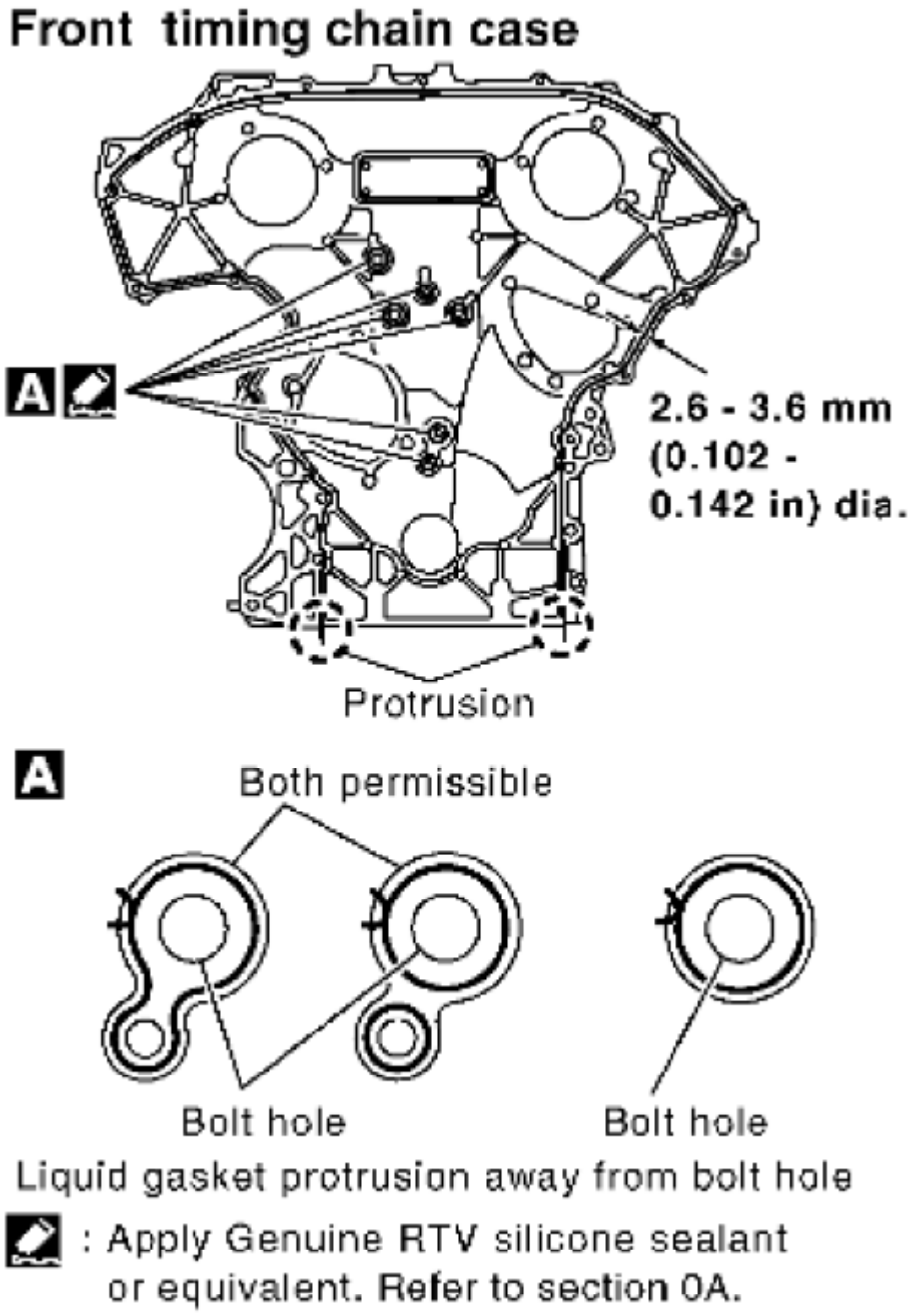


Fig. 62: Identifying Front Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

b. Install new O-rings on rear timing chain case.

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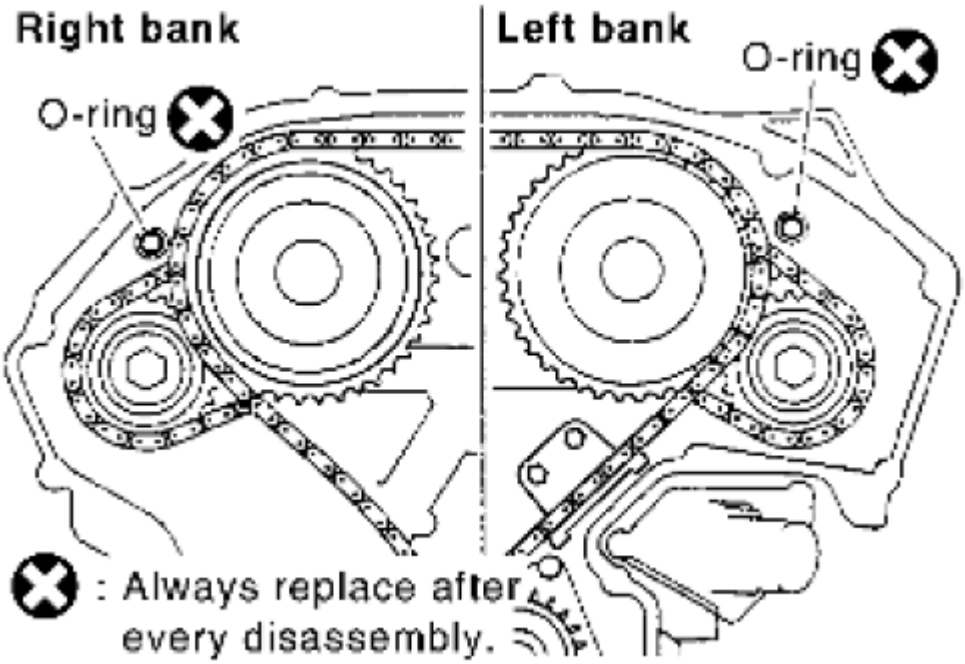


Fig. 63: Identifying O-Rings On Rear Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

c. Assemble front timing chain case as follows:
   i. Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.

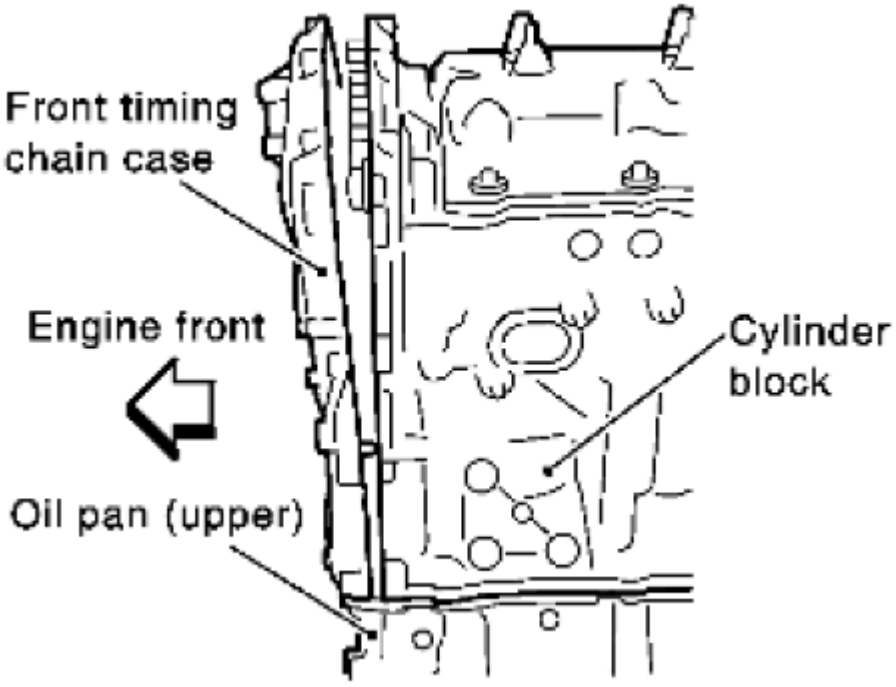


Fig. 64: Identifying Front Timing Chain Case And Cylinder Block

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Courtesy of SUZUKI OF AMERICA CORP.

ii. Since front timing chain case is offset for difference of bolt holes, tighten bolts temporarily while holding front timing chain case from front and top as shown.

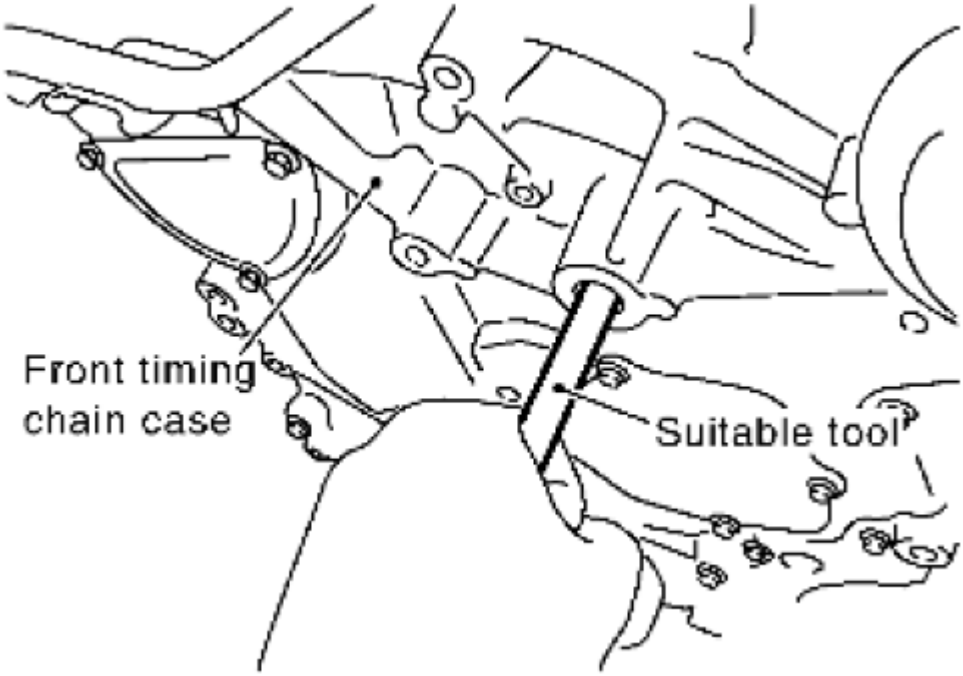


Fig. 65: Identifying Front Timing Chain Case
Courtesy of SUZUKI OF AMERICA CORP.

iii. Same as the previous step, insert dowel pin while holding front timing chain case from front and top completely.

d. Tighten bolts to the specified torque in numerical order as shown.

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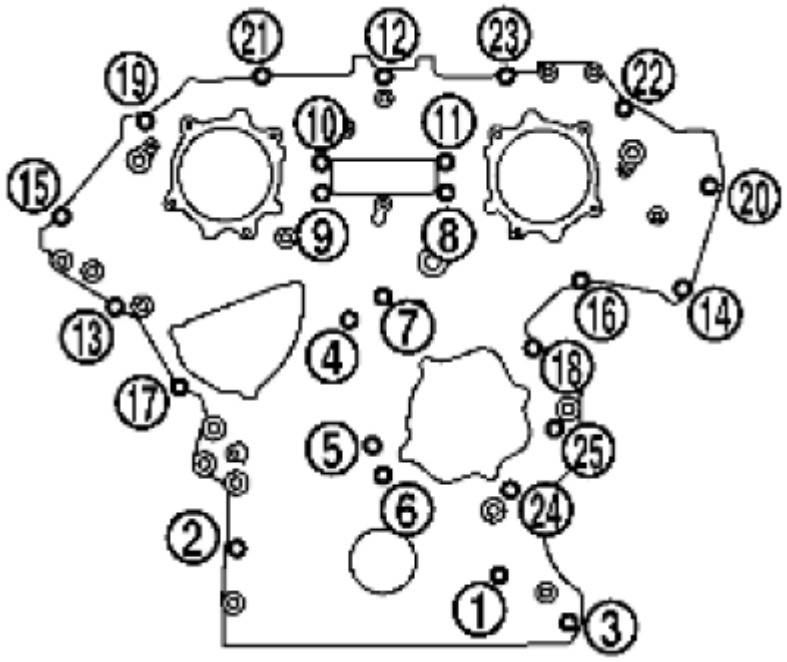


Fig. 66: Identifying Front Timing Chain Case Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

e. After all bolts are tightened, retighten them to the specified torque in numerical order as shown.
   - There are four type of bolts.

   Bolt position Bolt diameter

   1 - 5: 10 mm (0.39 in)

   6 - 25: 6 mm (0.24 in)

   Bolt position Tightening specification

   1 - 5: 55.0 N.m (5.6 kg-m, 41 ft-lb)

   6 - 25: 12.7 N.m (1.3 kg-m, 9 ft-lb)

6. Install two bolts in front of oil pan (upper) in numerical order as shown.

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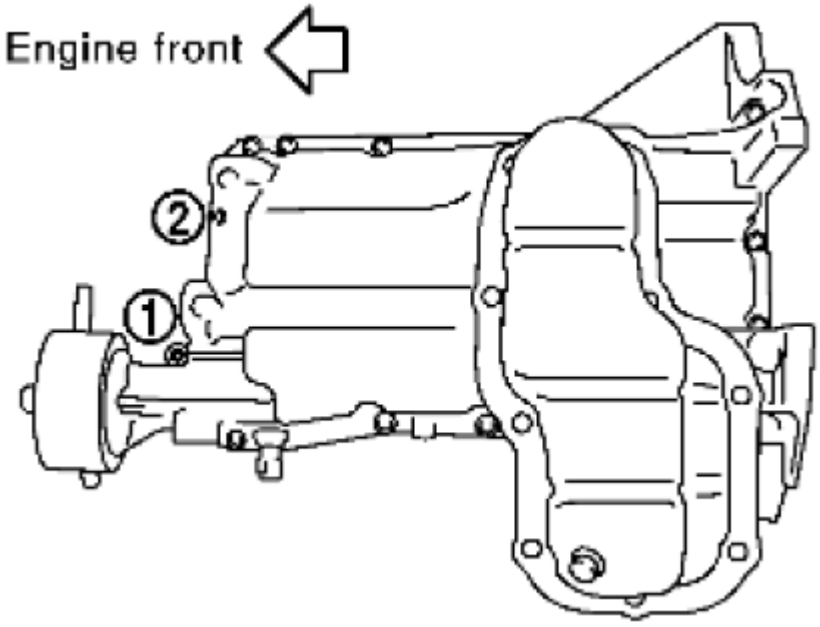
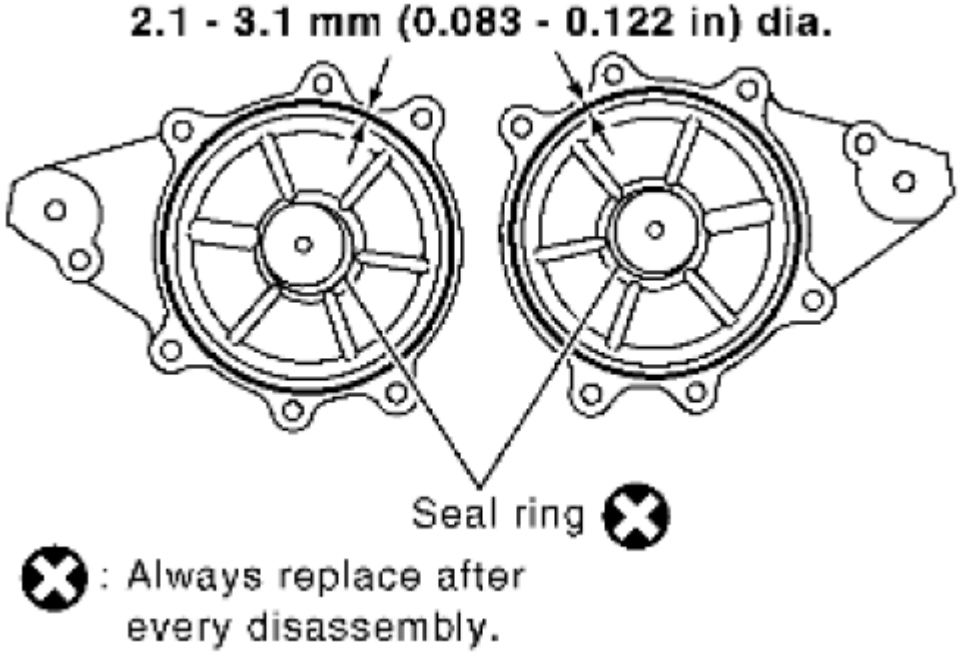


Fig. 67: Identifying Oil Pan Bolts Install Sequence
Courtesy of SUZUKI OF AMERICA CORP.

Front oil pan bolt torque: 22.0 N.m (2.2 kg-m, 16 ft-lb)

7. Install right and left intake valve timing control covers as follows:
   a. Install new seal rings in shaft grooves.
   b. Apply a continuous bead of liquid gasket using Tool to intake valve timing control covers as shown.



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Fig. 68: Identifying Intake Valve Timing Control Covers
Courtesy of SUZUKI OF AMERICA CORP.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

Tool number: WS39930000 (-)

c. Install new collared O-rings in front timing chain case oil hole (left and right sides).

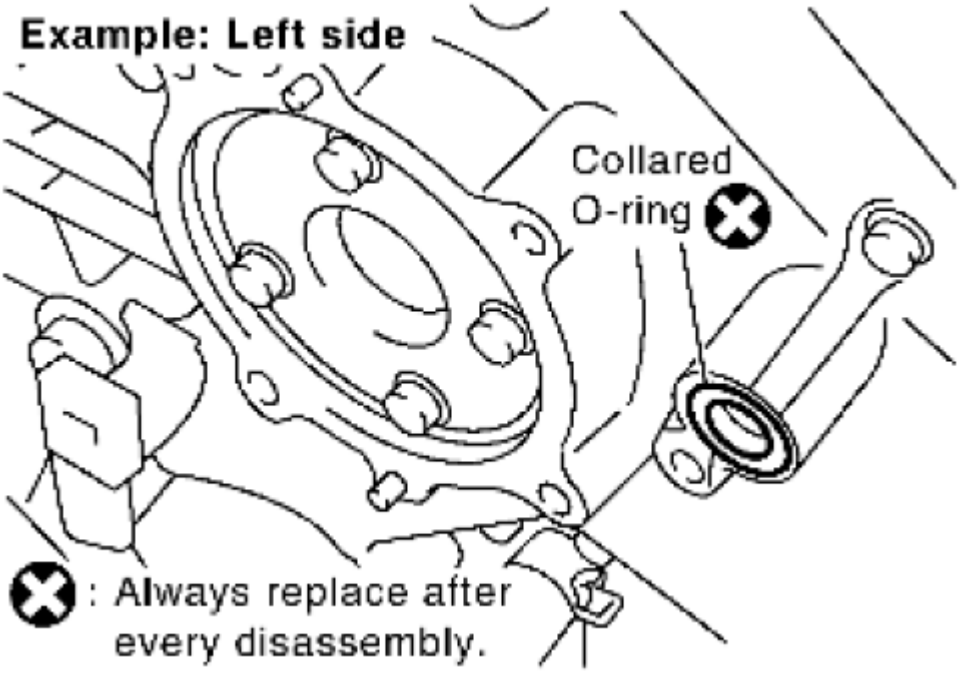


Fig. 69: Identifying O-Rings In Front Timing Chain Case Oil Hole
Courtesy of SUZUKI OF AMERICA CORP.

d. Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.
e. Tighten bolts in numerical order as shown.

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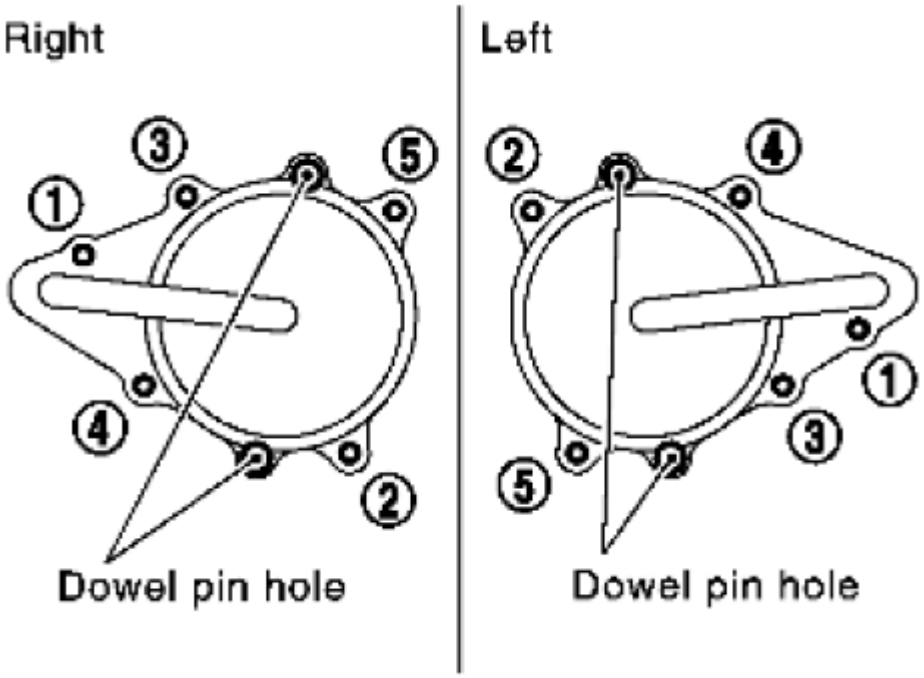


Fig. 70: Identifying Dowel Pin Hole Location And Bolt Tightening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

8. Install crankshaft pulley as follows:
    a. Install crankshaft pulley, taking care not to damage front oil seal.
        - When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).
    b. Tighten crankshaft pulley bolt in two steps.

        Step 1: 44.1 N.m (4.5 kg-m, 33 ft-lb)

        Step 2: 84° - 90° degrees clockwise

    c. Remove Tool.

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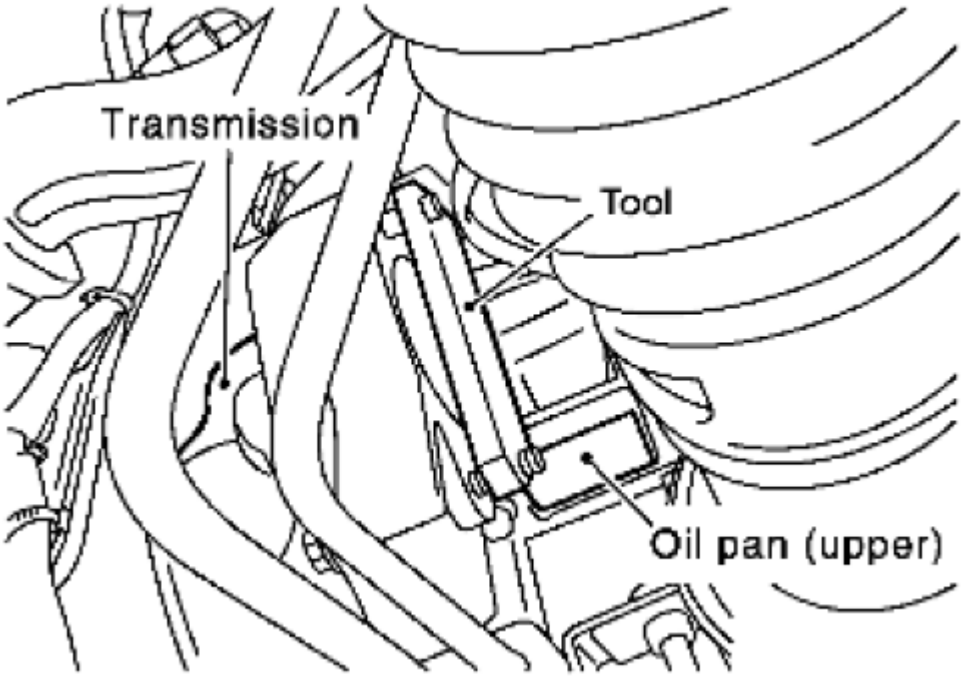


Fig. 71: Identifying Oil Pan And Transmission
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: - (J-48761)

9. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
10. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- Before starting the engine, check oil/fluid levels including engine coolant and engine oil. If the levels are lower than required quantity, fill to the specified level. Refer to [**RECOMMENDED FLUIDS AND LUBRICANTS**]
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to the fuel piping, check for fuel leakage at the connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE: If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids

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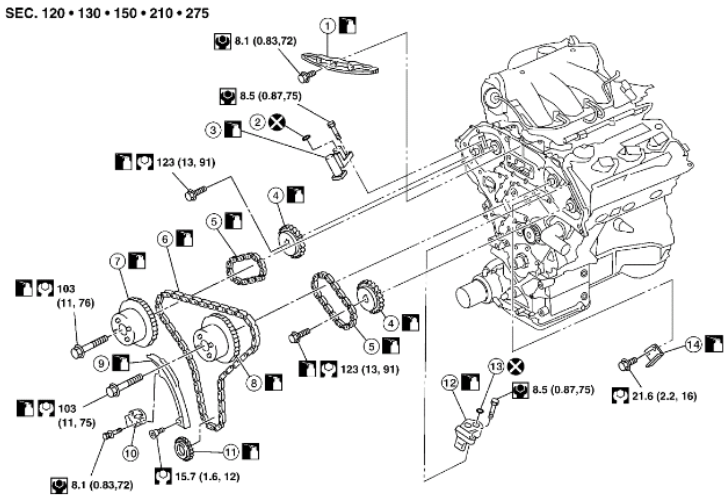
including engine oil and engine coolant.

- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level if necessary.
- Summary of the inspection items:

ITEM SPECIFICATION

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluids(1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gas	-	Leakage	-
(1) Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.			

TIMING CHAIN: EXPLODED VIEW



Expand image

1.	Internal chain guide	2.	O-ring	3.	Timing chain tensioner (secondary) (RH)
4.	Camshaft sprocket (EXH)	5.	Timing chain (secondary)	6.	Timing chain (primary)
7.	Camshaft sprocket RH (INT)	8.	Camshaft sprocket LH (INT)	9.	Slack guide
10.	Timing chain tensioner (primary)	11.	Crankshaft sprocket	12.	Timing chain tensioner (secondary) (LH)
13.	O-ring	14.	Tension guide		

Fig. 72: Exploded View Of Timing Chain Components
Courtesy of SUZUKI OF AMERICA CORP.

TIMING CHAIN: REMOVAL AND INSTALLATION

CAUTION:

- **After removing timing chains, do not turn the crankshaft and**

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camshaft separately, or the valves will strike the pistons.

- **When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets, camshaft brackets, and crankshaft pulley.**

REMOVAL

1. Remove front timing chain case. Refer to **FRONT TIMING CHAIN CASE: REMOVAL AND INSTALLATION**
2. Remove timing chain tensioner (primary) as follows:
   a. Loosen clip of timing chain tensioner (primary), and release plunger stopper (1).

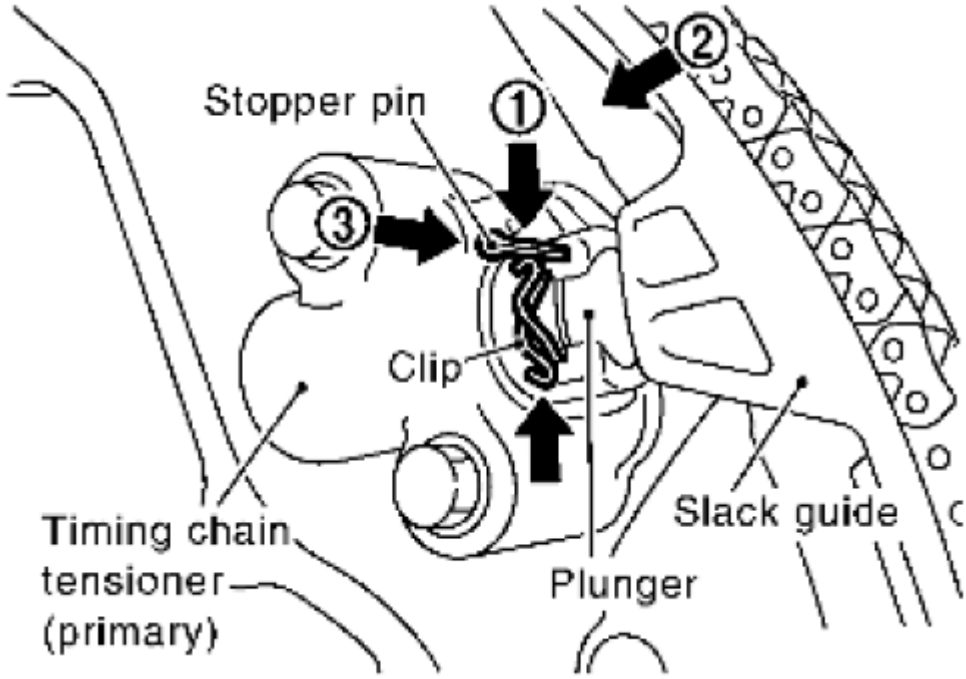


Fig. 73: Locating Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

   b. Insert plunger into tensioner body by pressing slack guide (2).
   c. Keep slack guide pressed and hold plunger in by pushing stopper pin through the tensioner body hole and plunger groove (3).
   d. Remove bolts and remove timing chain tensioner (primary).
3. Remove internal chain guide, tension guide and slack guide.

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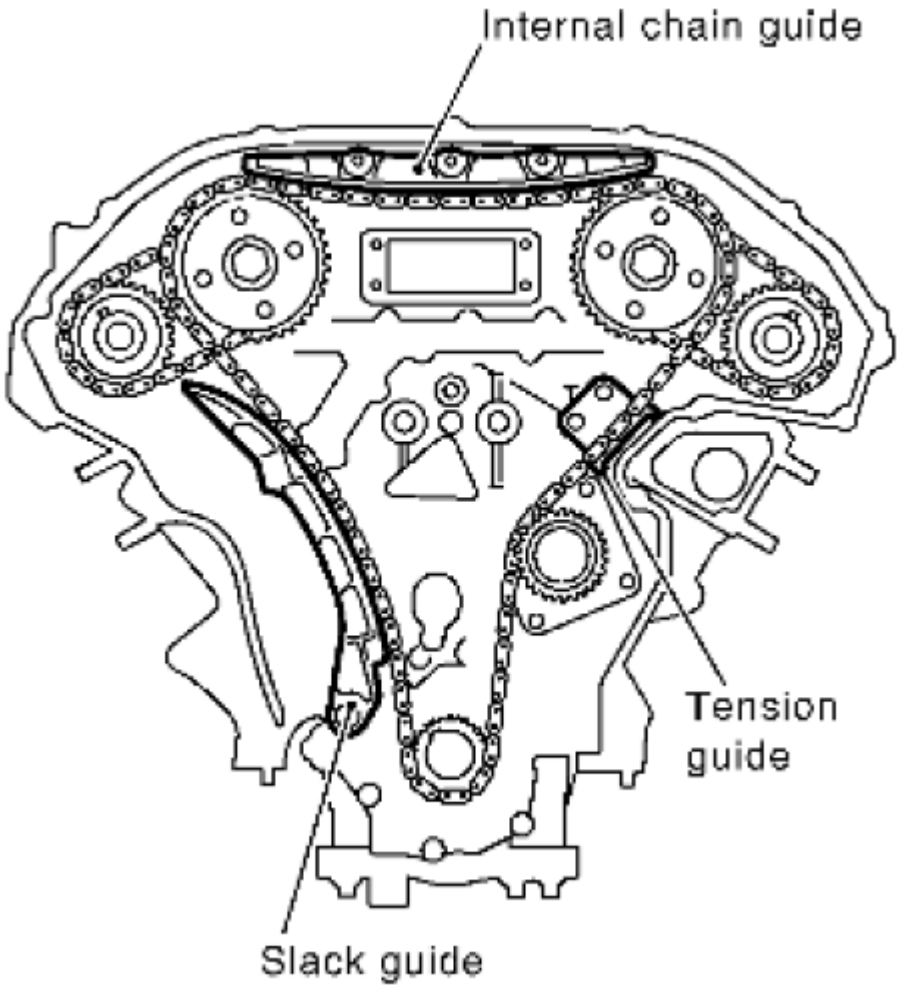


Fig. 74: Removing Internal Chain Guide, Tension Guide And Slack Guide
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Tension guide can be removed after removing timing chain (primary).

4. Remove timing chain (primary) and crankshaft sprocket.

CAUTION: After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.

5. Remove crankshaft sprocket, if necessary.
6. Remove timing chain (secondary) and camshaft sprockets as follows:
   a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).

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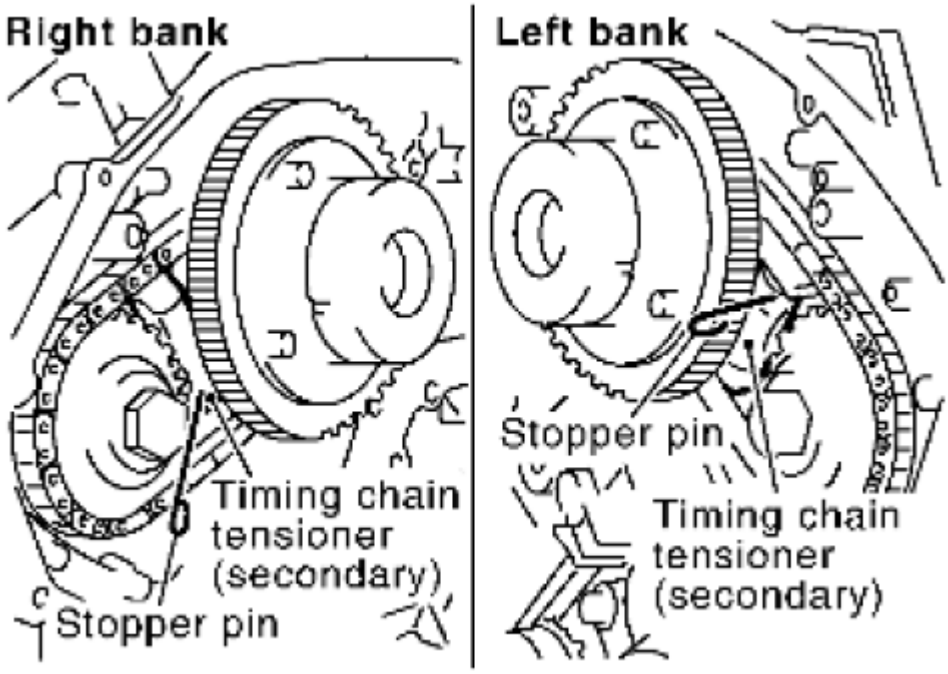


Fig. 75: Identifying Right/Left Timing Chain Tensioners
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.**
- **For removal of timing chain tensioner (secondary), refer to CAMSHAFT: REMOVAL AND INSTALLATION. [Removing camshaft bracket (No. 1) is required.]**

b. Remove camshaft sprocket (INT and EXH) bolts.

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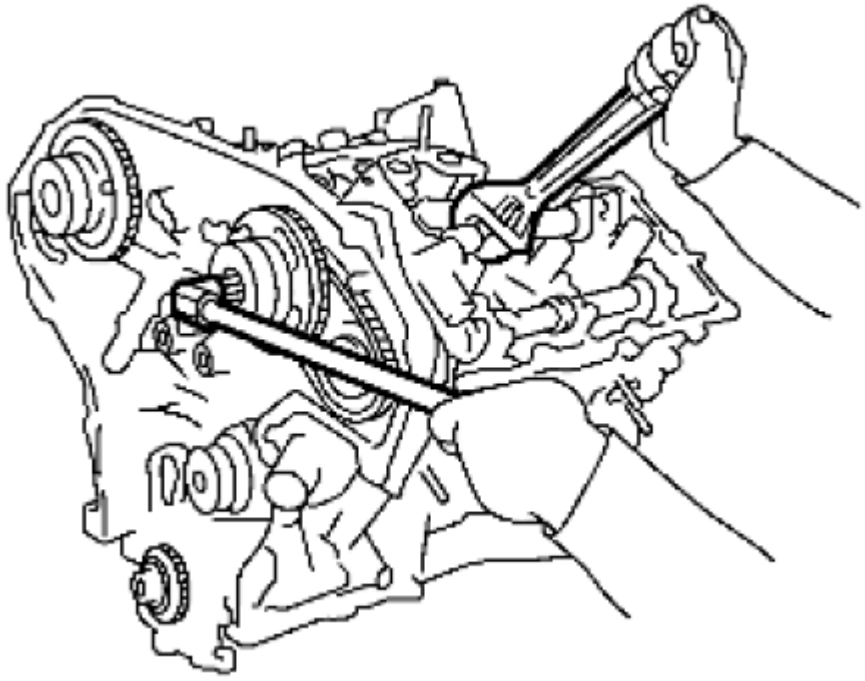


Fig. 76: Removing Camshaft Sprocket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

- Secure the hexagonal portion of camshaft using wrench to loosen bolts.

CAUTION: Do not loosen bolts by securing anything other than the camshaft hexagonal portion.

c. Remove timing chain (secondary) together with camshaft sprockets.
   - Turn camshaft slightly to secure slackness of timing chain on timing chain tensioner (secondary) side.
   - Insert 0.5 mm (0.020 in)-thick metal or resin plate between timing chain and timing chain tensioner plunger (guide). Remove timing chain (secondary) together with camshaft sprockets with timing chain loose from guide groove.

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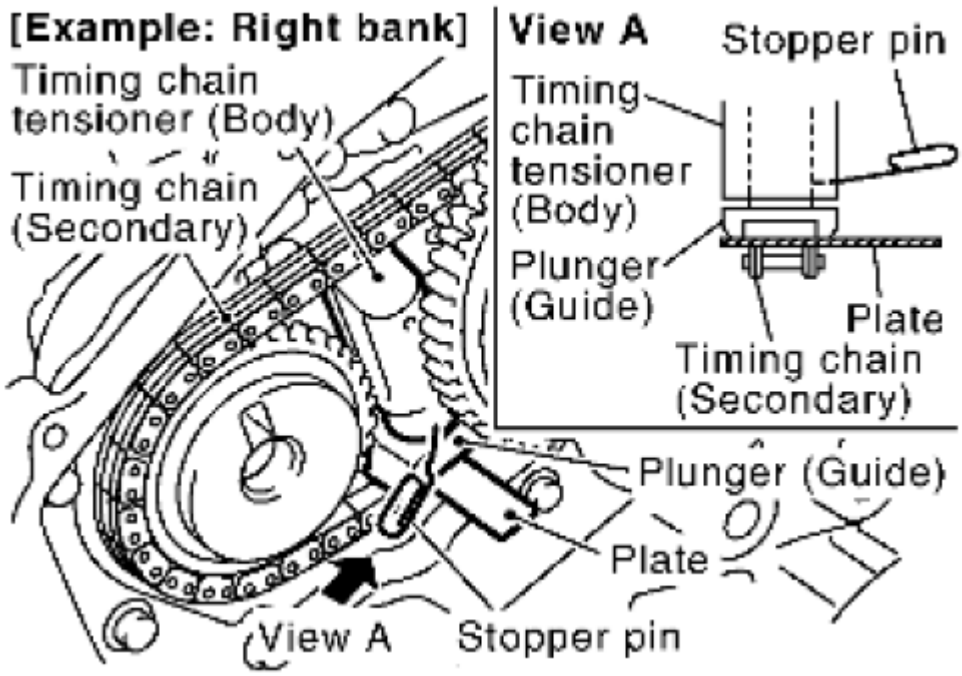


Fig. 77: Identifying Timing Chain Tensioner And Plunger
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Be careful of plunger coming off when removing timing chain (secondary).

NOTE: Camshaft sprocket (INT) is a one piece integrated design sprockets for timing chain (primary) and for timing chain (secondary).

- When handling camshaft sprocket (INT), be careful of the following:

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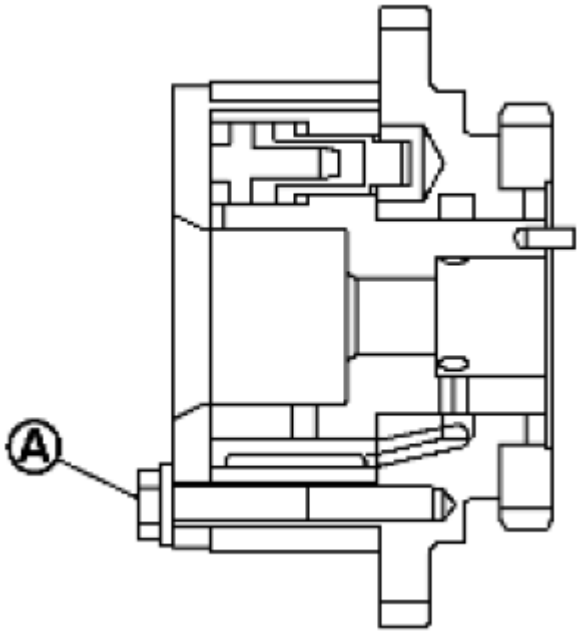


Fig. 78: Identifying Camshaft Sprocket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Handle carefully to avoid any shock to camshaft sprocket.**
- **Do not disassemble. (Do not loosen bolts (A) as shown).**

7. Remove timing chain tensioners (secondary) from cylinder head if necessary.
   a. Remove camshaft brackets (No. 1). Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
   b. Remove timing chain tensioners (secondary) with stopper pin attached.

INSPECTION AFTER REMOVAL

Check for cracks and any excessive wear at link plates. Replace chain if necessary.

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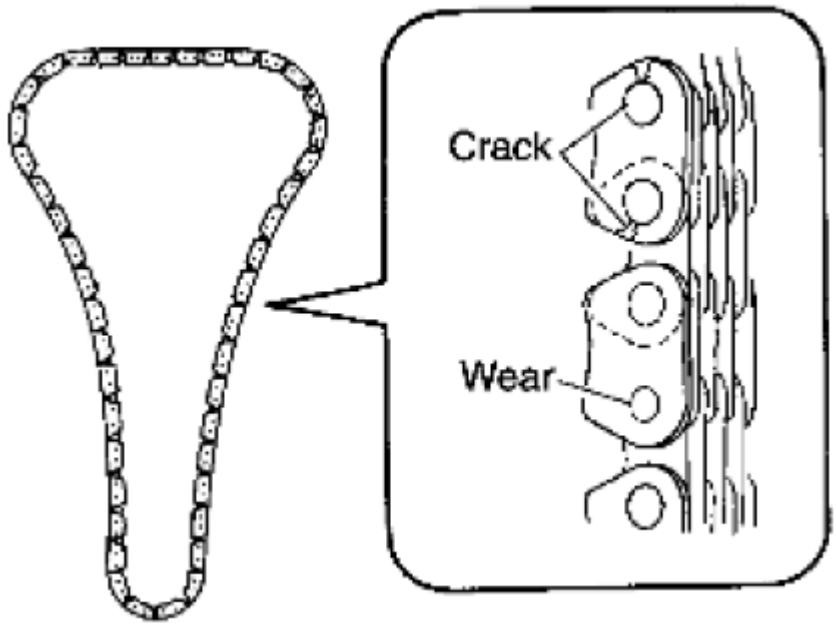
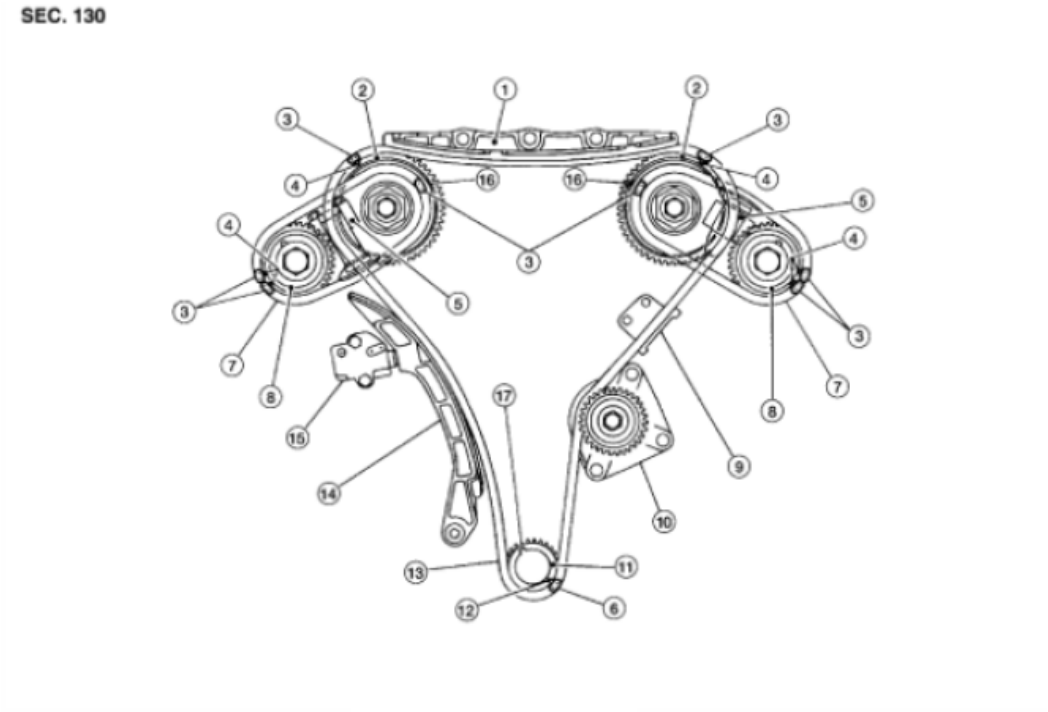


Fig. 79: Checking Link Plates
Courtesy of SUZUKI OF AMERICA CORP.

- In the same way as for the LH bank, inspect the timing chain and associated parts on the RH bank.

INSTALLATION

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1.	Internal chain guide	2.	Camshaft sprocket (intake)	3.	Mating mark (blue link)
4.	Mating mark (punched)	5.	Secondary timing chain tensioner	6.	Mating mark (copper link)
7.	Secondary timing chain	8.	Camshaft sprocket (exhaust)	9.	Tensioner guide
10.	Water pump	11.	Crankshaft sprocket	12.	Mating mark (notched)
13.	Primary timing chain	14.	Slack guide	15.	Primary timing chain tensioner
16.	Mating mark (back side)	17.	Crankshaft key		

Fig. 80: Identifying Timing Chain Components
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The figure above shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.

1. Install timing chain tensioners (secondary) to cylinder head if removed.
   a. Install timing chain tensioners (secondary) with stopper pin attached and new O-ring.
   b. Install camshaft brackets (No. 1). Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
2. Make sure that dowel pin hole, dowel pin of camshaft and crankshaft key are located as shown. (No. 1 cylinder at compression TDC)

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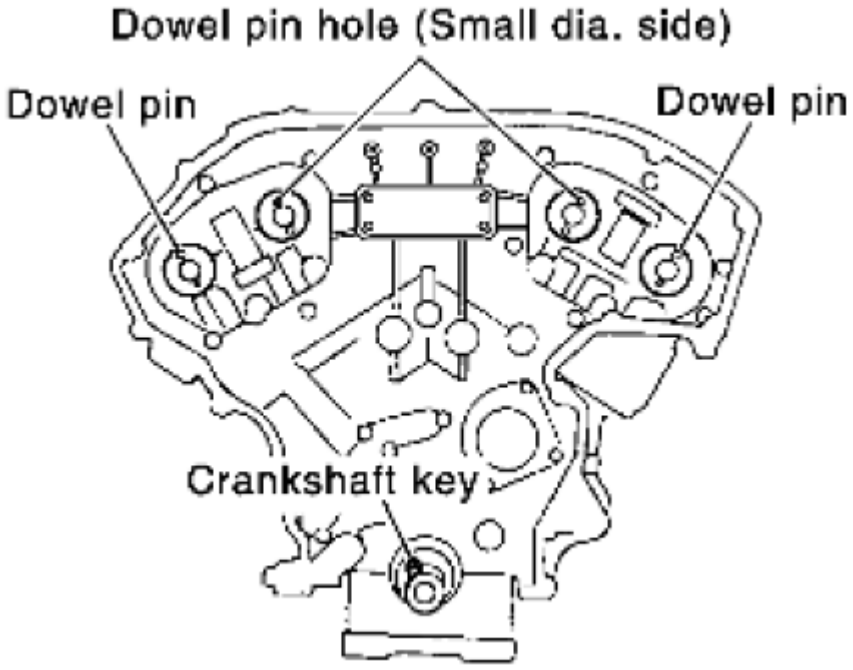


Fig. 81: Identifying Dowel Pin And Crankshaft Key
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Though camshaft does not stop at the position as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.

Camshaft dowel pin hole (intake side)

: At cylinder head upper face side in each bank.

Camshaft dowel pin (exhaust side)

: At cylinder head upper face side in each bank.

Crankshaft key

: At cylinder head side of right bank.

CAUTION: Hole on small dia. side must be used for intake side dowel pin hole. Do not misidentify (ignore big dia. side).

3. Install timing chains (secondary) and camshaft sprockets as follows:

CAUTION: Mating marks between timing chain and sprockets slip easily. Confirm all mating mark positions repeatedly during the installation

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process.

a. Push plunger of timing chain tensioner (secondary) and keep it pressed in with stopper pin.

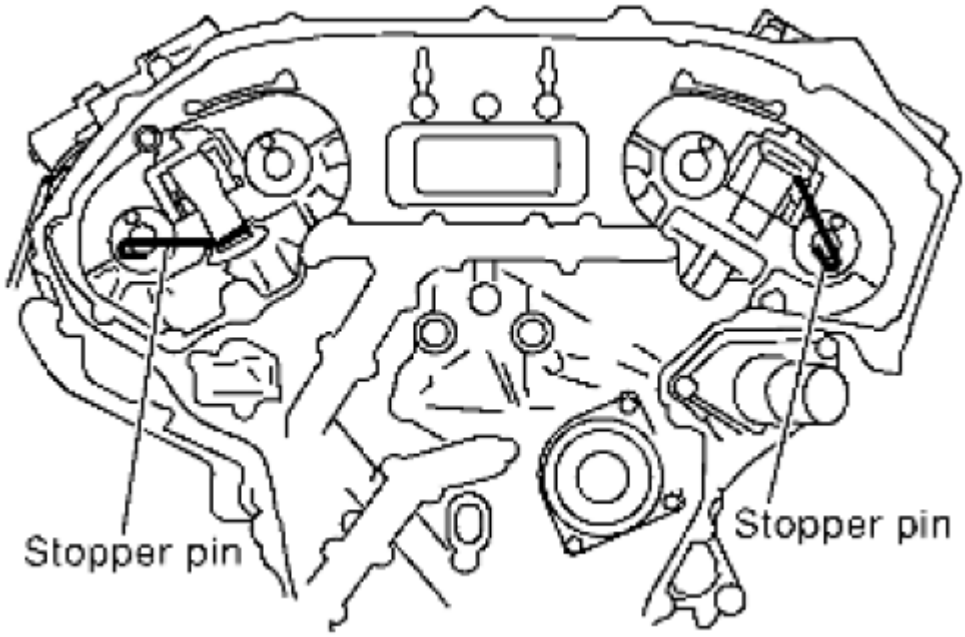


Fig. 82: Identifying Stopper Pin Location
Courtesy of SUZUKI OF AMERICA CORP.

b. Install timing chains (secondary) (8) and camshaft sprockets [INT (1) and EXH (9)].

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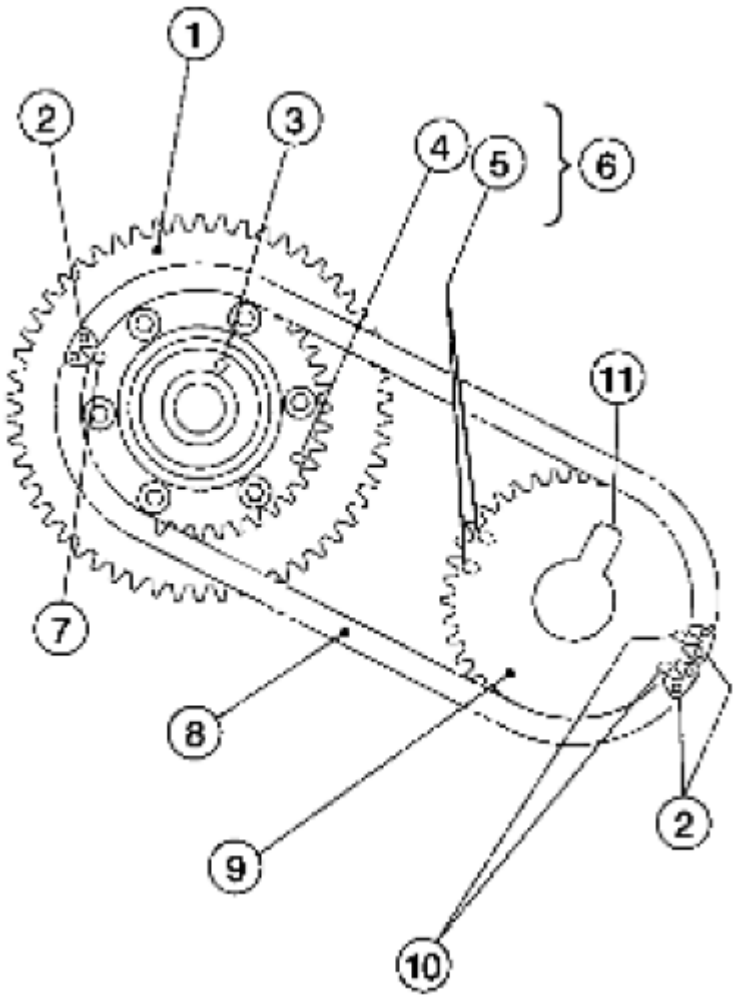


Fig. 83: Identifying Timing Chains And Camshaft Sprockets
Courtesy of SUZUKI OF AMERICA CORP.

- Left bank mating marks (6)
- Align the timing chain mating marks (secondary) (2) (blue color link) with the ones on camshaft sprockets (INT and EXH) (4), (5), (7) and (10) (punched), and install them.

NOTE:

- **Mating marks for camshaft sprocket (INT) are on the back side of camshaft sprocket (secondary).**
- **There are two types of mating marks, circle (7), (10) and oval (4), (5) types. They should be used for the right and left banks, respectively.**

  Right bank: Use circle type (7) and (10).

  Left bank: Use oval type (4) and (5).

- Align dowel pin (3) and pin hole on camshafts with the groove (11) and dowel pin on

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sprockets, and install them.

- On the intake side, align pin hole on the small diameter side of the camshaft front end with dowel pin (3) on the back side of camshaft sprocket, and install them.
- On the exhaust side, align dowel pin on camshaft front end with pin groove (11) on camshaft sprocket, and install them.
- In case that positions of each mating mark and each dowel pin do not fit on mating parts, make fine adjustment to the position holding the hexagonal portion on camshaft with wrench or equivalent.
- Bolts for camshaft sprockets must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of dowel pins.
- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the top of sprocket teeth and its extended line in advance with paint.

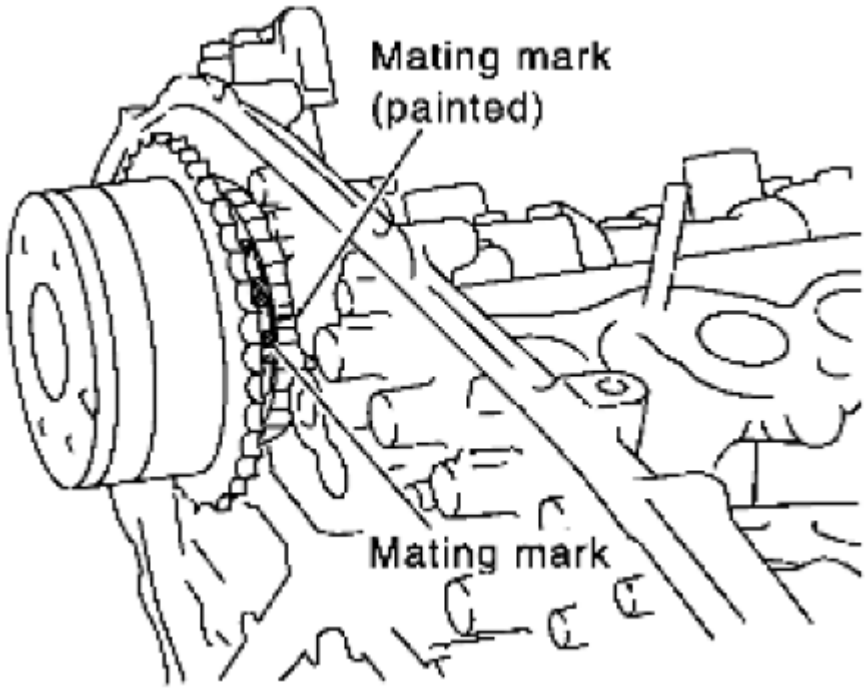


Fig. 84: Identifying Mating Mark On Top Of Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

c. After confirming the mating marks are aligned, tighten camshaft sprocket bolts.

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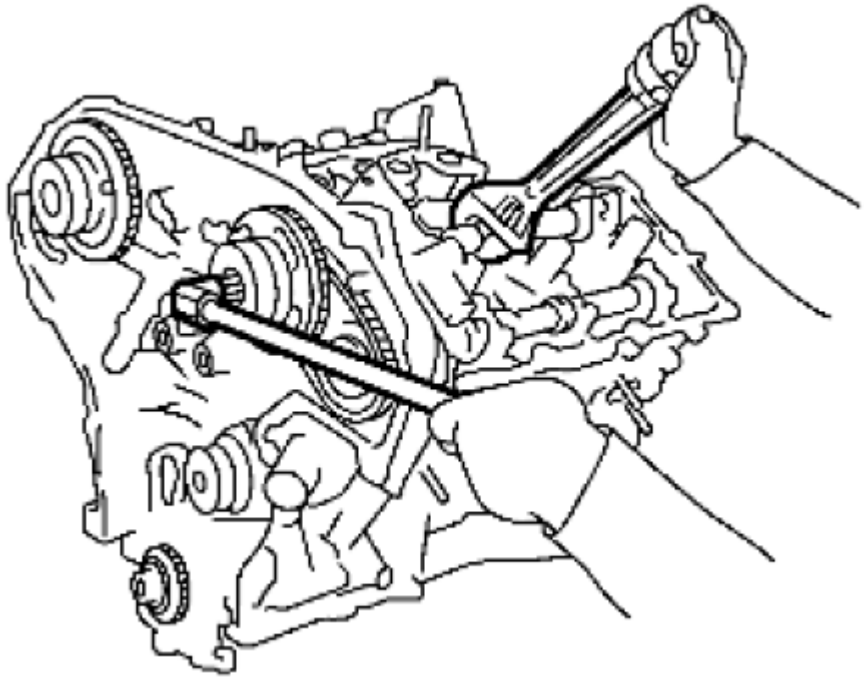


Fig. 85: Tightening Camshaft Sprocket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

- Secure camshaft using wrench at the hexagonal portion to tighten bolts.

d. Pull stopper pins out from timing chain tensioners (secondary).

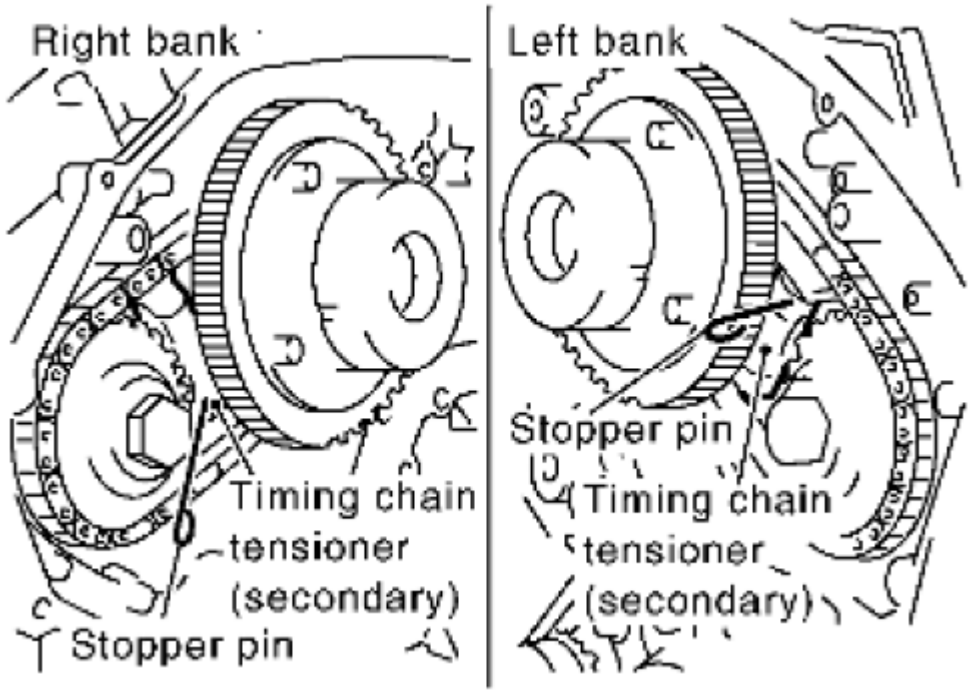


Fig. 86: Pulling Stopper Pins Out From Timing Chain Tensioners

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Courtesy of SUZUKI OF AMERICA CORP.

4. Install tension guide.
5. Install timing chain (primary) as follows:
   a. Install crankshaft sprocket.

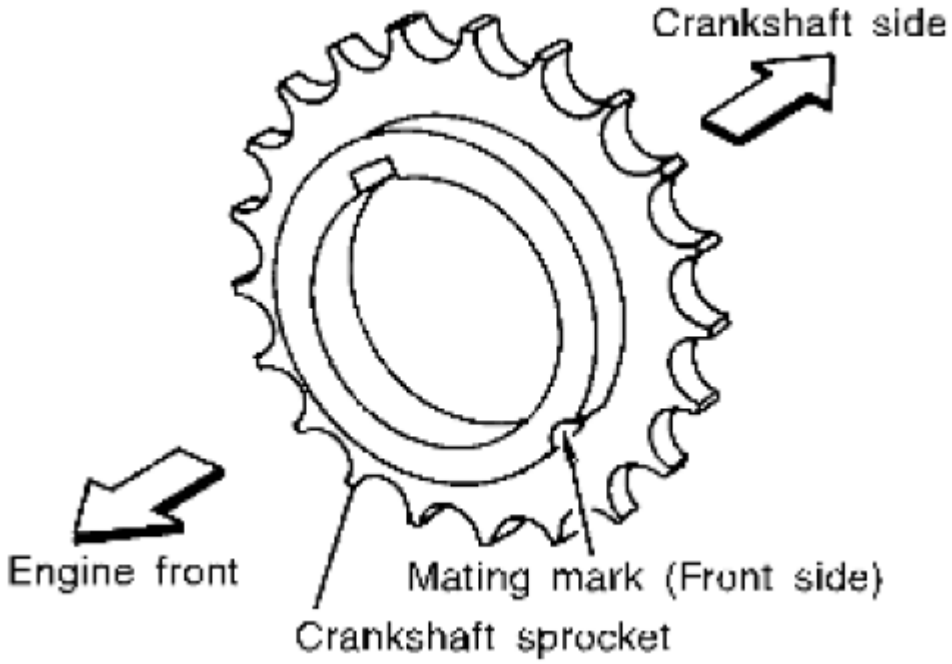


Fig. 87: Installing Crankshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

- Make sure the mating marks on crankshaft sprocket face the front of engine.

   b. Install the primary timing chain.

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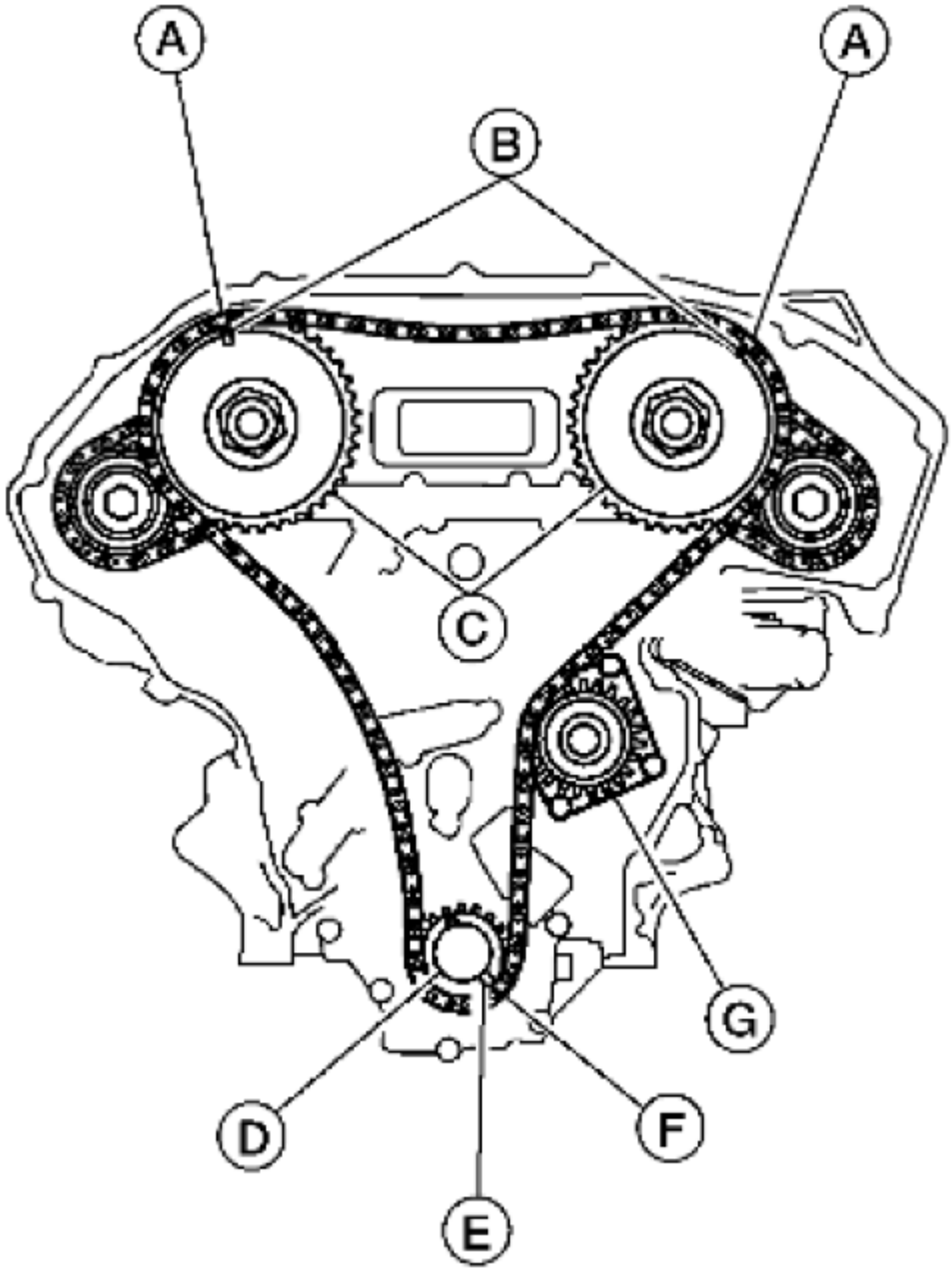


Fig. 88: Identifying Primary Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

- Water pump (G).
- Install primary timing chain so the mating mark punched (B) on camshaft sprocket is aligned with the blue link (A) on the timing chain, while the mating mark notched (E) on the crankshaft sprocket (D) is aligned with the copper link (F) on the timing chain, as shown.
- When it is difficult to align mating marks (A) with (B) and (E) with (F) of the primary timing chain with each sprocket, gradually turn the camshaft using a wrench on the hexagonal portion to align it with the mating marks.
- During alignment, be careful to prevent dislocation of mating mark alignments of the

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secondary timing chains.

6. Install internal chain guide, slack guide and timing chain tensioner (primary).

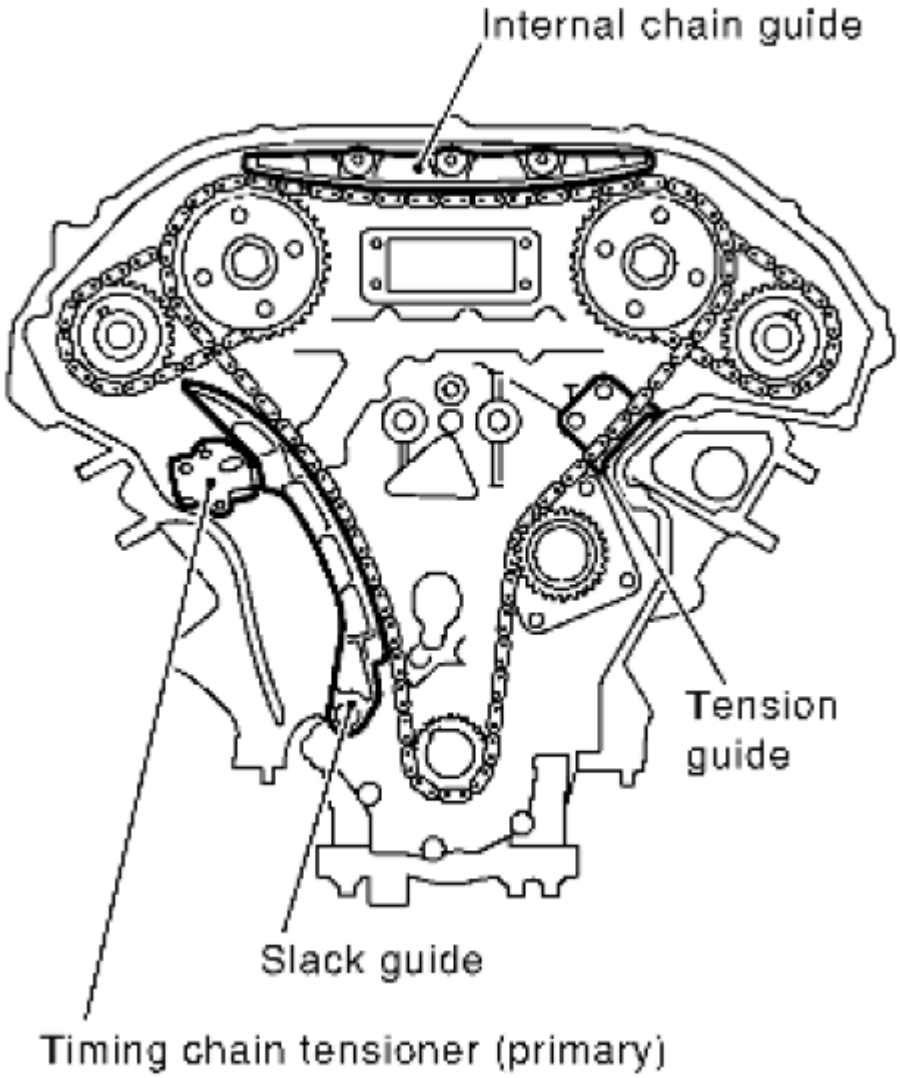


Fig. 89: Identifying Internal Chain Guide, Slack Guide And Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not overtighten slack guide bolts. It is normal for a gap to exist under the bolt seats when bolts are tightened to specification.

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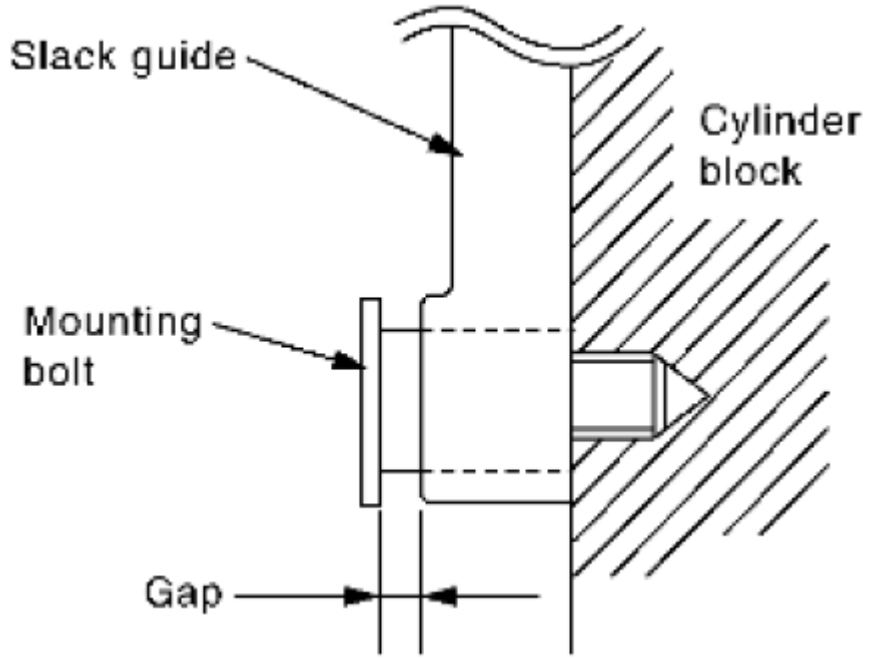


Fig. 90: Identifying Slack Guide, Mounting Bolt And Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

- When installing timing chain tensioner (primary), push in plunger and keep it pressed in with stopper pin.
- Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner (primary).
- After installation, pull out stopper pin.

7. Make sure again that the mating marks on camshaft sprockets and timing chain have not slipped out of alignment.
8. Install front timing chain case. Refer to **Front Timing Chain Case: Removal and Installation**

INSPECTION AFTER INSTALLATION

- Before starting the engine, check oil/fluid levels including engine coolant and engine oil. If the levels are lower than required quantity, fill to the specified level. Refer to [**RECOMMENDED FLUIDS AND LUBRICANTS**]
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to the fuel piping, check for fuel leakage at the connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE: If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after

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hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level if necessary.
- Summary of the inspection items:

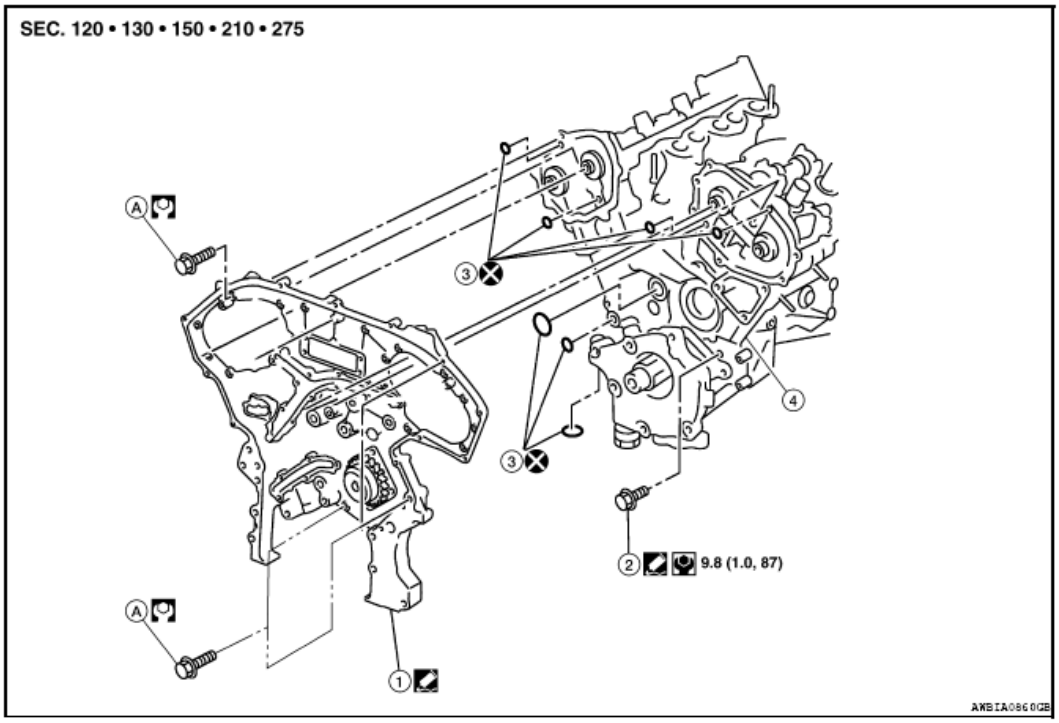
ITEM SPECIFICATION

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluids(1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gas	-	Leakage	-
(1) Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.			

REAR TIMING CHAIN CASE: EXPLODED VIEW

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Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Rear timing chain case
2. Water drain plug (front)
3. O-rings
4. Cylinder block
A. Refer to installation

Fig. 91: Exploded View Camshaft Components With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

REAR TIMING CHAIN CASE: REMOVAL AND INSTALLATION

REMOVAL

1. Remove oil pan (lower) and (upper). Refer to **OIL PAN AND OIL STRAINER: REMOVAL AND INSTALLATION** .
2. Remove front timing chain case. Refer to **Front Timing Chain Case: Removal and Installation**.
3. Remove timing chains and related components. Refer to **Timing Chain: Removal and Installation**.
4. Remove water pump, if necessary. Refer to **WATER PUMP: EXPLODED VIEW** .
5. Remove rear timing chain case as follows:
   a. Loosen and remove bolts using power tool in reverse order as shown in illustration.
   b. Cut liquid gasket using Tool and remove rear timing chain case.

Tool number : KV10111100 (J-37228)

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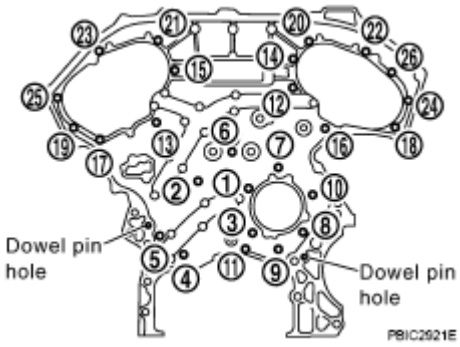


Fig. 92: Identifying Rear Timing Chain Case Bolts Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Do not remove plate metal cover of oil passage.**
- **After removal, handle rear timing chain case carefully so it does not twist, bend, or warp under a load.**

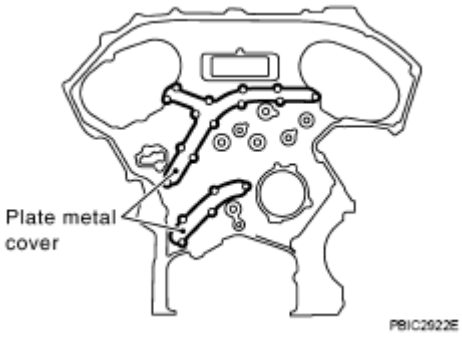


Fig. 93: Identifying Plate Metal Cover
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove O-rings from cylinder head and camshaft bracket (No. 1).

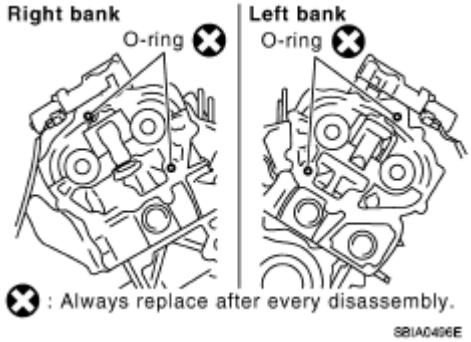


Fig. 94: Identifying O-Rings
Courtesy of SUZUKI OF AMERICA CORP.

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7. Remove O-rings from cylinder block.

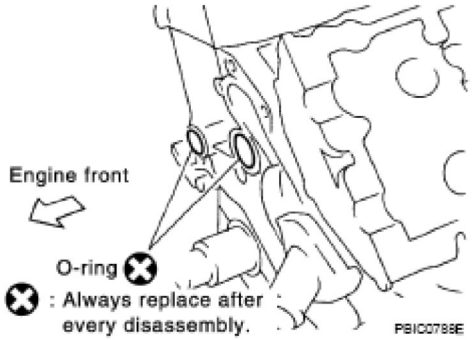


Fig. 95: Identifying Cylinder Block O-Ring
Courtesy of SUZUKI OF AMERICA CORP.

8. Use scraper to remove all traces of old liquid gasket from rear timing chain case, and opposite mating surfaces.

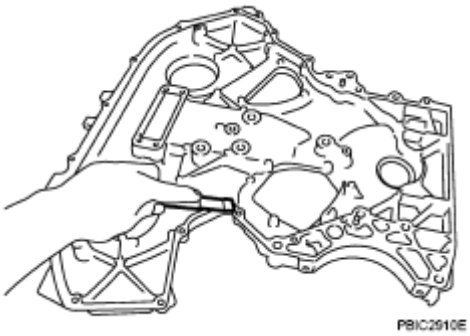


Fig. 96: Removing Old Liquid Gasket Using Scraper
Courtesy of SUZUKI OF AMERICA CORP.

- Remove old liquid gasket from bolt hole and thread.

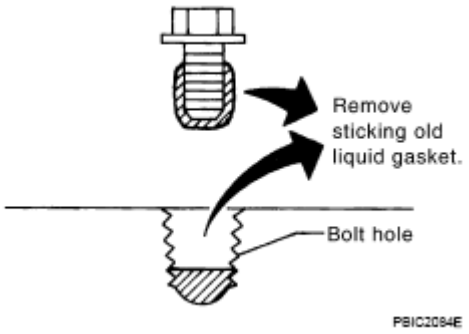


Fig. 97: Identifying Bolt Hole And Thread
Courtesy of SUZUKI OF AMERICA CORP.

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INSTALLATION

1. Install rear timing chain case as follows:
   a. Install new O-rings onto cylinder block.

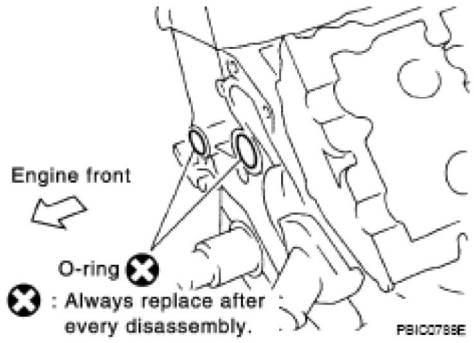


Fig. 98: Identifying Cylinder Block O-Ring
Courtesy of SUZUKI OF AMERICA CORP.

   b. Install new O-rings to cylinder head and camshaft bracket (No. 1).

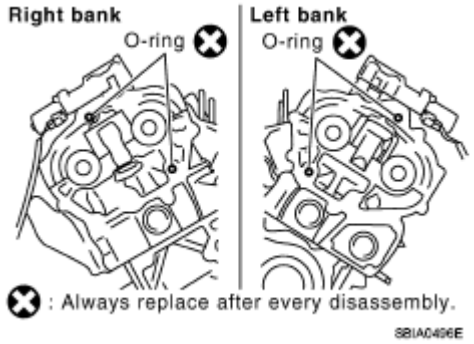


Fig. 99: Identifying O-Rings
Courtesy of SUZUKI OF AMERICA CORP.

   c. Apply liquid gasket using Tool to rear timing chain case back side as shown in illustration.

Tool number : WS39930000 (-)

Use Genuine RTV Silicone Sealant or equivalent. Refer to RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS .

CAUTION:
- **For "A", completely wipe off liquid gasket covering the area shown in illustration.**
- **Apply liquid gasket on installation position of water pump and cylinder head very completely.**

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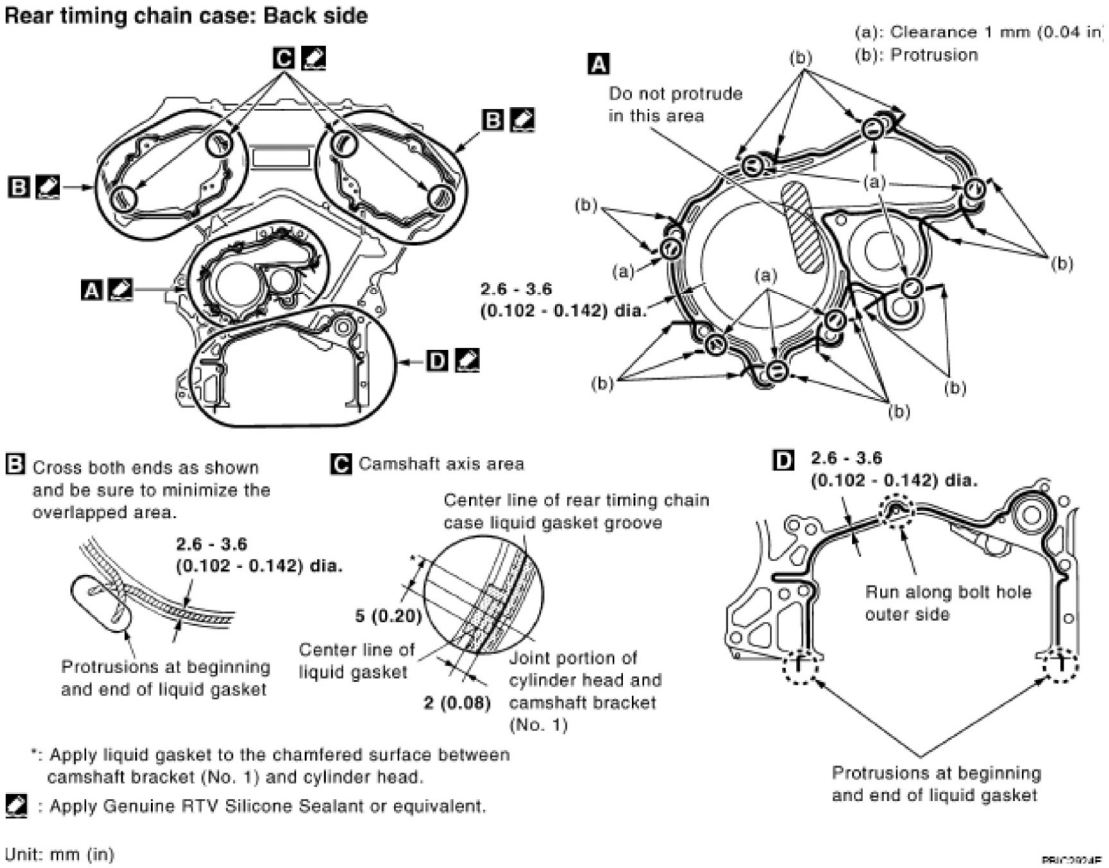


Fig. 100: Identifying Liquid Gasket Applying Area
Courtesy of SUZUKI OF AMERICA CORP.

d. Align rear timing chain case with dowel pins (right and left) on cylinder block and install rear timing chain case.
   - Make sure O-rings stay in place during installation to cylinder block, cylinder head and camshaft bracket (No. 1).

e. Tighten bolts in numerical order as shown in illustration.
   - There are two type of bolts with different torque specifications. Refer to the following for installing bolts.

Bolt length Bolt position Torque specification

20 mm (0.79 in) 1, 2, 3, 6, 7, 8, 9, 10 : 12.7 N.m (1.3 kg-m, 9 ft-lb)

16 mm (0.63 in) 4, 5, 11 : 12.7 N.m (1.3 kg-m, 9 ft-lb)

16 mm (0.63 in) 12 through 26 : 15.0 N.m (1.5 kg-m, 11 ft-lb)

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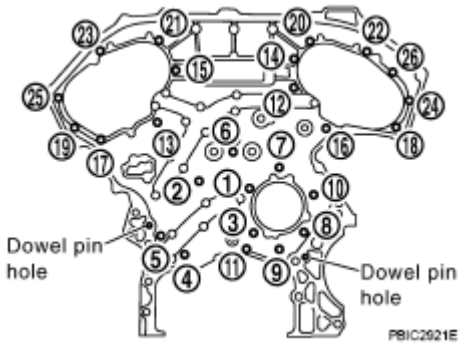


Fig. 101: Identifying Dowel Pin Hole And Bolts Sequence
Courtesy of SUZUKI OF AMERICA CORP.

f. After all bolts are tightened, retighten them to the specified torque in numerical order as shown in illustration.
   - If liquid gasket protrudes, wipe it off immediately.

g. After installing rear timing chain case, check the surface height difference between following parts on oil pan (upper) mounting surface.

Standard

Rear timing chain case to lower cylinder block:

-0.24 to 0.14 mm (-0.0094 to 0.0055 in)

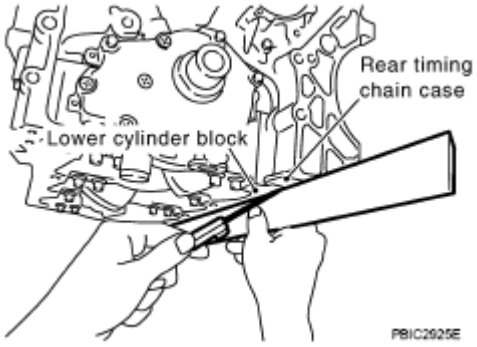


Fig. 102: Checking Surface Height Difference Between Parts On Oil Pan (Upper) Mounting Surface
Courtesy of SUZUKI OF AMERICA CORP.

- If not within the standard, repeat the installation procedure.

2. Install water pump with new O-rings, if removed. Refer to **WATER PUMP: REMOVAL AND INSTALLATION** .
3. Install timing chains and related components. Refer to **Timing Chain: Removal and Installation**.
4. Install front timing chain case. Refer to **Front Timing Chain Case: Removal and Installation**.
5. Install oil pan (upper) and (lower). Refer to **OIL PAN AND OIL STRAINER: REMOVAL AND INSTALLATION** .

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INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to **RECOMMENDED FLUIDS AND LUBRICANTS** .
- Run engine to check for unusual noise and vibration.

NOTE: If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

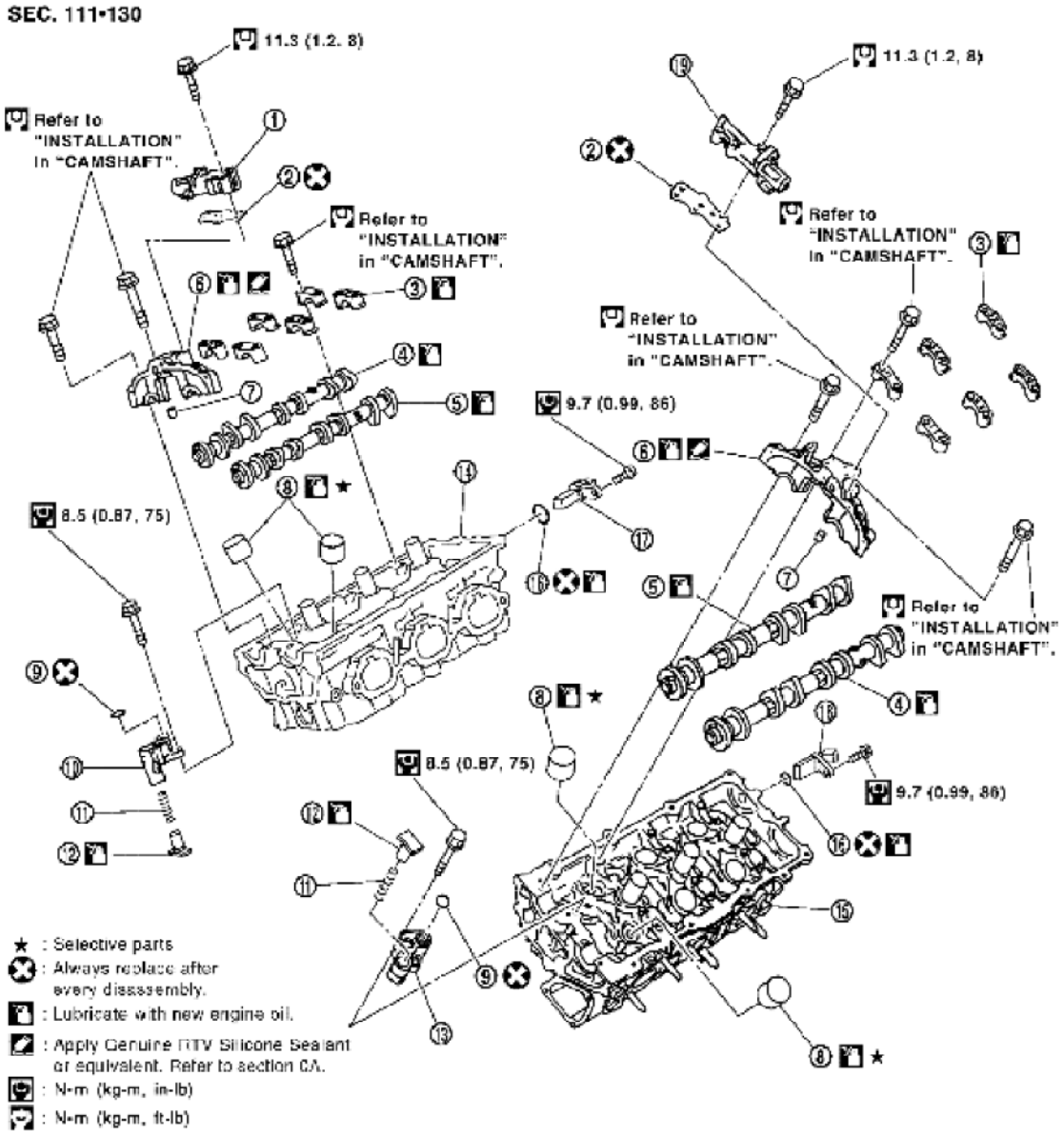
Summary of the inspection items:

INSPECTION ITEMS CHART

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid (1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
(1) Transmission fluid, power steering fluid, brake fluid, etc.			

CAMSHAFT: EXPLODED VIEW

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1.	Intake valve timing control solenoid valve (RH bank)	2.	Gasket	3.	Camshaft bracket (No. 2 to 4)
4.	Camshaft (EXH)	5.	Camshaft (INT)	6.	Camshaft bracket (No. 1)
7.	Dowel pin	8.	Valve lifter	9.	O-ring
10.	Timing chain tensioner (secondary) (RH bank)	11.	Spring	12.	Plunger
13.	Timing chain tensioner (secondary) (LH bank)	14.	Cylinder head (RH bank)	15.	Cylinder head (LH bank)
16.	O-ring	17.	Camshaft position sensor (PHASE) (RH bank)	18.	Camshaft position sensor (PHASE) (LH bank)
19.	Intake valve timing control solenoid valve (LH bank)				

Fig. 103: Exploded View Camshaft Components With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

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CAMSHAFT: REMOVAL AND INSTALLATION

REMOVAL

1. Release the fuel pressure (LH only). Refer to **FUEL PRESSURE CHECK: VQ40DE**
2. Disconnect the battery negative terminal.
3. Remove front wheels and tires.
4. Remove front fender protectors. Refer to **FRONT FENDER PROTECTOR: REMOVAL AND INSTALLATION**
5. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [**TIMING CHAIN: REMOVAL AND INSTALLATION**].
6. Remove camshaft position sensor (PHASE) (right and left banks) from cylinder head back side.

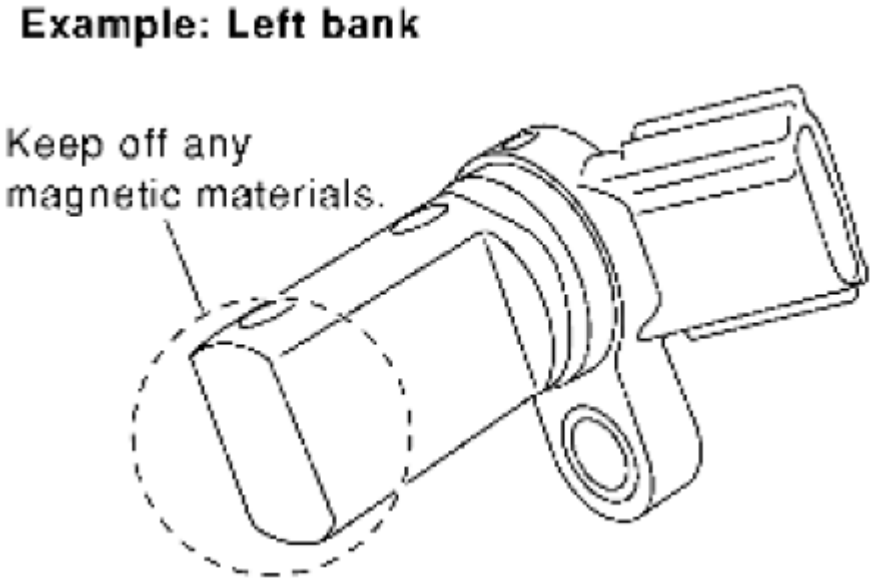


Fig. 104: Identifying Camshaft Position Sensor (Phase)
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Handle carefully to avoid dropping and shocks.**
- **Do not disassemble.**
- **Do not allow metal powder to adhere to magnetic part at sensor tip.**
- **Do not place sensors in a location where they are exposed to magnetism.**

7. Remove IVT control solenoid valves.

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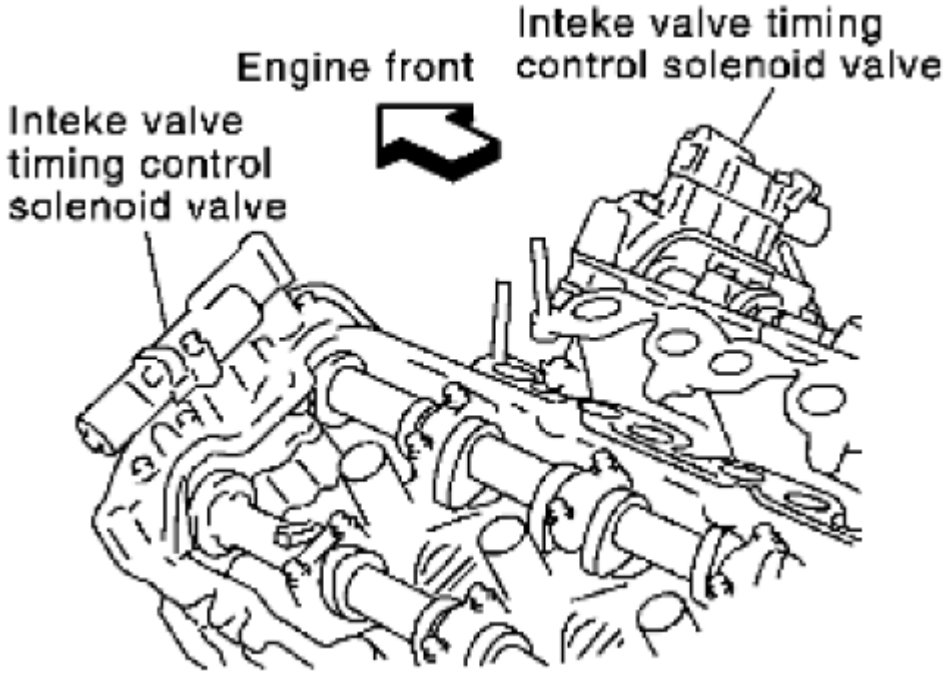


Fig. 105: Removing IVT Control Solenoid Valves
Courtesy of SUZUKI OF AMERICA CORP.

- Discard IVT control solenoid valve gaskets and use new gaskets for installation.

8. Remove camshaft brackets.
   - Mark camshafts, camshaft brackets and bolts so they are placed in the same position and direction for installation.
   - Equally loosen camshaft bracket bolts in several steps in reverse order as shown.

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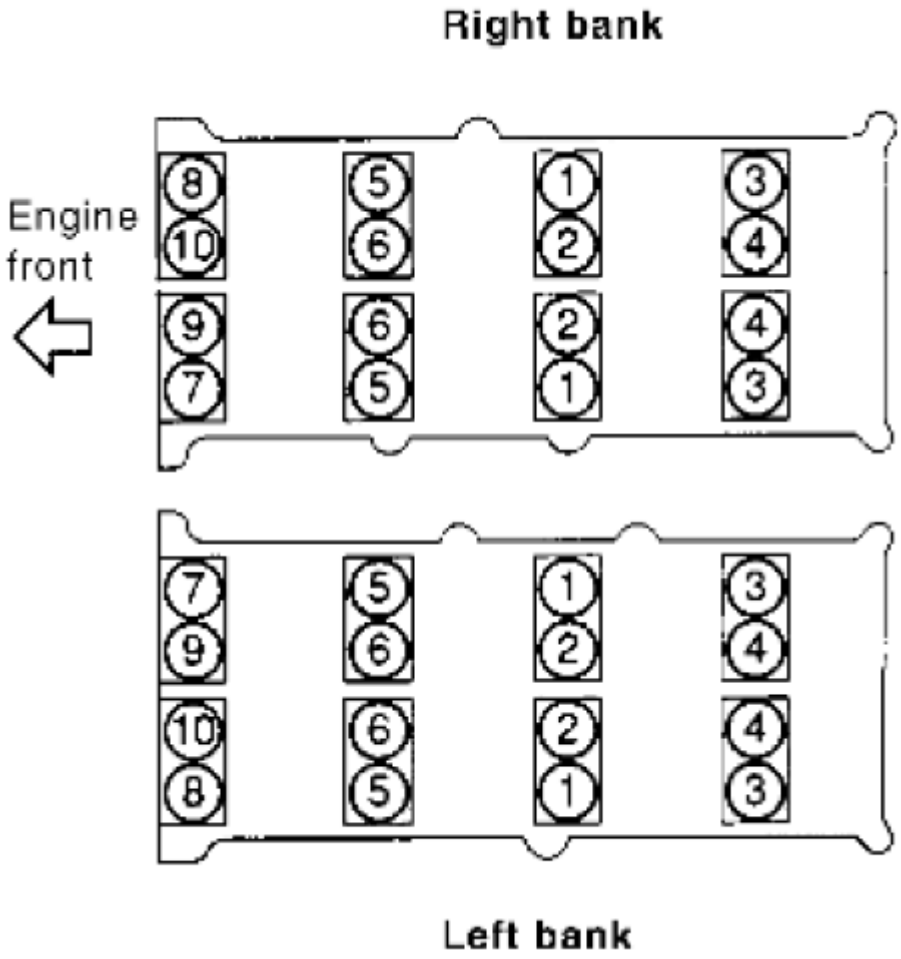


Fig. 106: Identifying Camshaft Bracket Bolts Loosen Sequence
Courtesy of SUZUKI OF AMERICA CORP.

9. Remove camshafts.
10. Remove valve lifters.
    - Identify installation positions, and store them without mixing them up.
11. Remove timing chain tensioner (secondary) from cylinder head.

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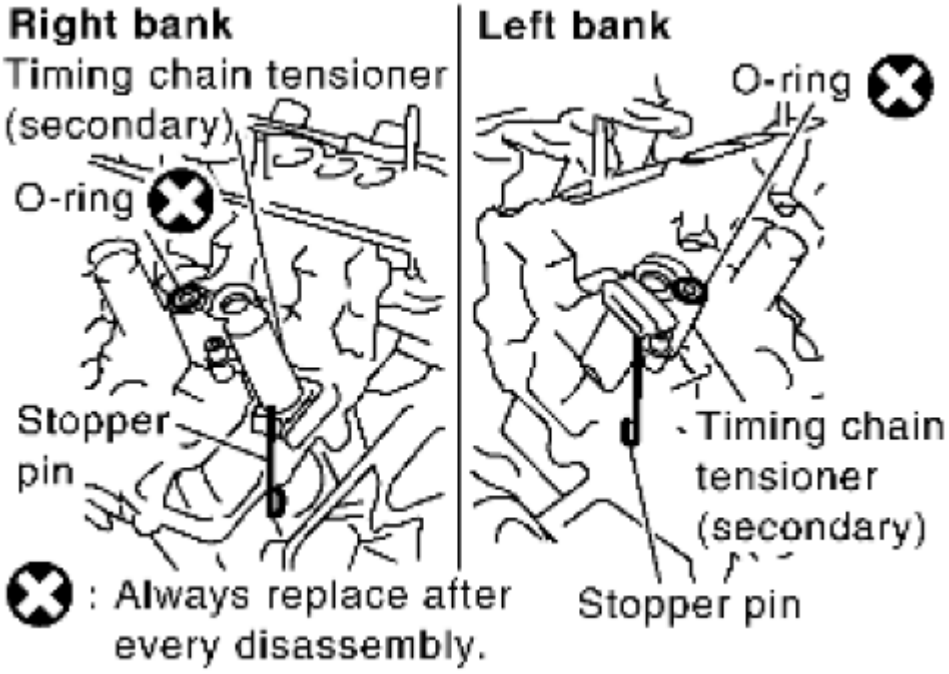


Fig. 107: Identifying Timing Chain Tensioner From Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

- Remove timing chain tensioner (secondary) with its stopper pin attached.

NOTE: Stopper pin was attached when timing chain (secondary) was removed.

INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V-block on precise flat table, and support No. 2 and 4 journal of camshaft.

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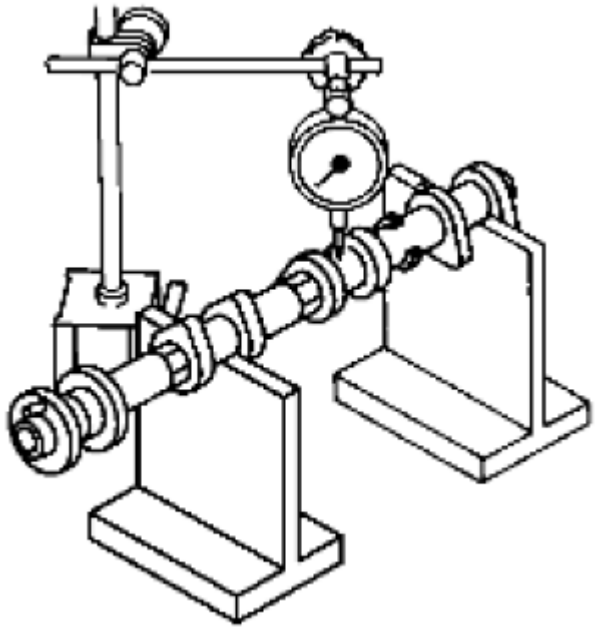


Fig. 108: Supporting No. 2 And 4 Journal Of Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not support journal No. 1 (on the side of camshaft sprocket) because it has a different diameter from the other three locations.

2. Set dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on dial indicator. (Total indicator reading)

   Standard: Less than 0.02 mm (0.0008 in)

   Limit: 0.05 mm (0.0020 in)

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

1. Measure the camshaft cam height with micrometer.

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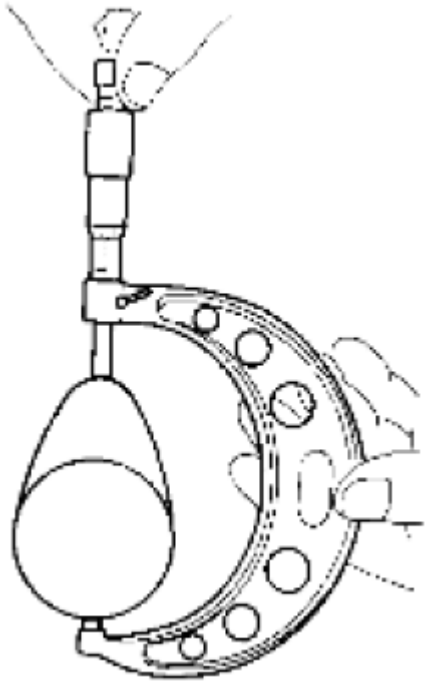


Fig. 109: Measuring Camshaft Cam Height With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

Intake: 45.465 - 45.655 mm (1.7900 - 1.7974 in)

Exhaust: 45.075 - 45.265 mm (1.7746 - 1.7821 in)

Limit:

Intake: 45.265 mm (1.7821 in)

Exhaust: 44.875 mm (1.7667 in)

2. If wear exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

- Measure the outer diameter of camshaft journal with micrometer.

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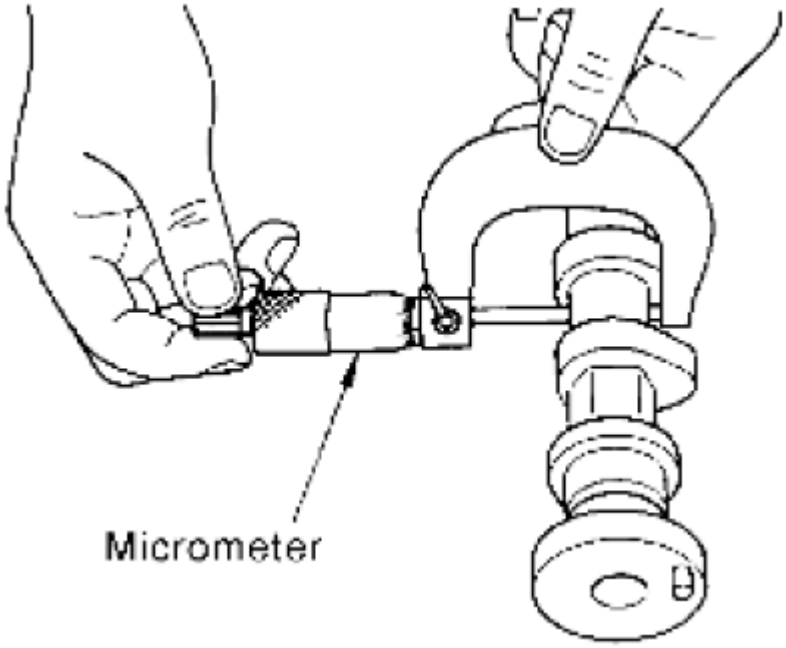


Fig. 110: Measuring Outer Diameter Of Camshaft Journal With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

No. 1: 25.935 - 25.955 mm (1.0211 - 1.0218 in)

No. 2, 3, 4: 23.445 - 23.465 mm (0.9230 - 0.9238 in)

CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolt with the specified torque.
- Measure the inner diameter "A" of camshaft bracket with bore gauge.

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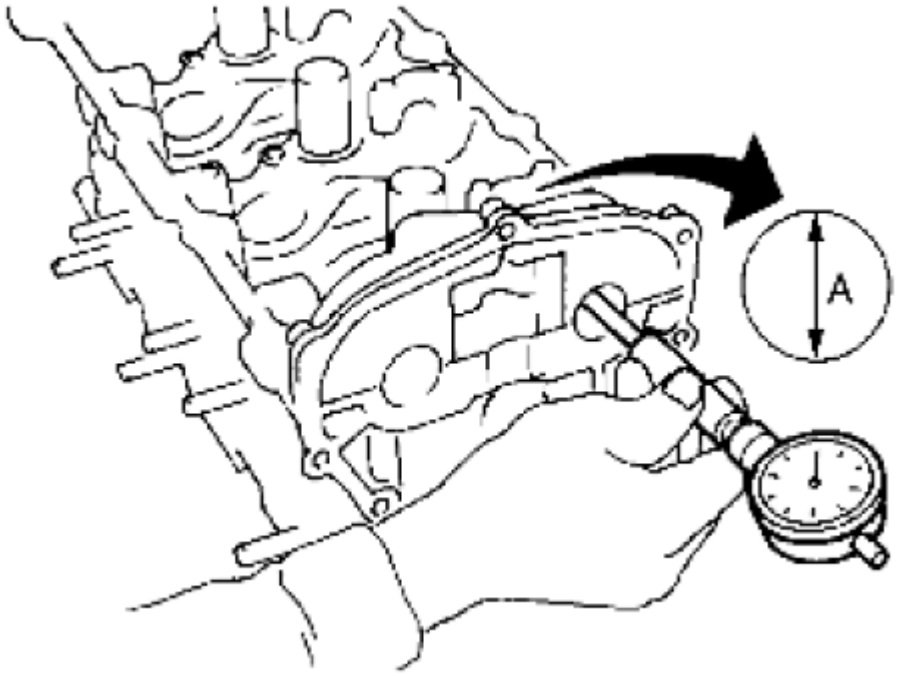


Fig. 111: Measuring Inner Diameter "A" Of Camshaft Bracket With Bore Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

No. 1: 26.000 - 26.021 mm (1.0236 - 1.0244 in)

No. 2, 3, 4: 23.500 - 23.521 mm (0.9252 - 0.9260 in)

CAMSHAFT JOURNAL OIL CLEARANCE

- (Oil clearance) = (Camshaft bracket inner diameter) - (Camshaft journal diameter).

  Standard:

  No. 1: 0.045 - 0.086 mm (0.0018 - 0.0034 in)

  No. 2, 3, 4: 0.035 - 0.076 mm (0.0014 - 0.0030 in)

  Limit: 0.15 mm (0.0059 in)

- If the calculated value exceeds the limit, replace either or both camshaft and cylinder head.

NOTE: **Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.**

Camshaft End Play

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- Install dial indicator in thrust direction on front end of camshaft. Measure the end play of dial indicator when camshaft is moved forward/backward (in direction to axis).

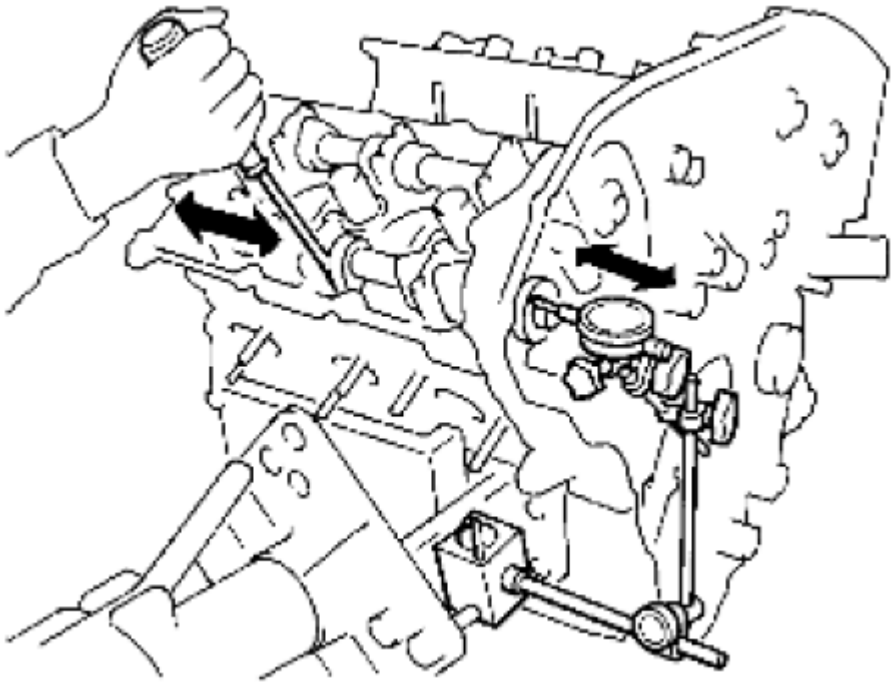


Fig. 112: Measuring End Play Of Dial Indicator
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 0.115 - 0.188 mm (0.0045 - 0.0074 in)

Limit: 0.24 mm (0.0094 in)

- Measure the following parts if out of the limit.

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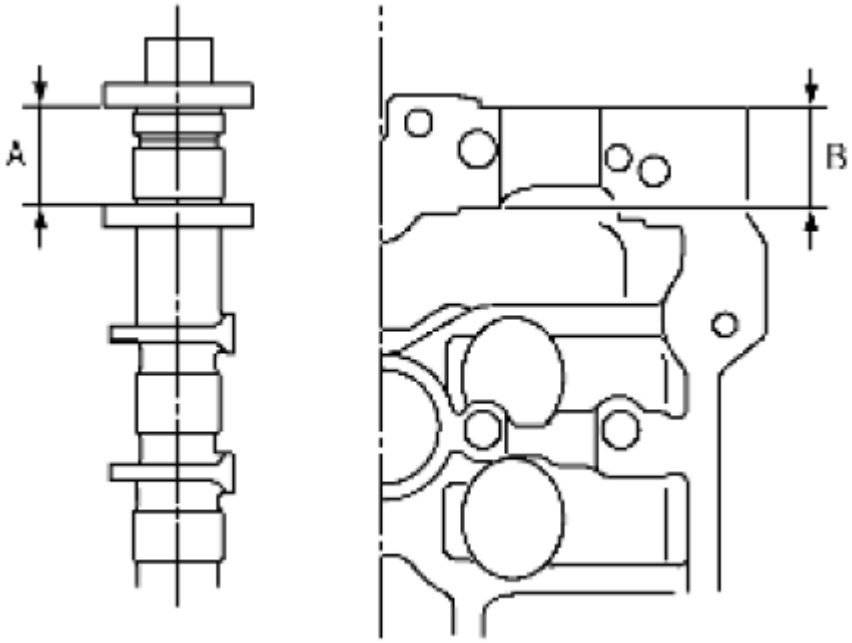


Fig. 113: Identifying Camshaft Journal Dimension
Courtesy of SUZUKI OF AMERICA CORP.

- Dimension "A" for camshaft No. 1 journal

  Standard: 27.500 - 27.548 mm (1.0827 - 1.0846 in)

- Dimension "B" for cylinder head No. 1 journal bearing

  Standard: 27.360 - 27.385 mm (1.0772 - 1.0781 in)

- Following the standards above, replace camshaft and/or cylinder head.

Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 4 journal of camshaft.

   CAUTION: Do not support journal No. 1 (on the side of camshaft sprocket) because it has a different diameter from the other three locations.

2. Measure the camshaft sprocket runout with dial indicator. (Total indicator reading)

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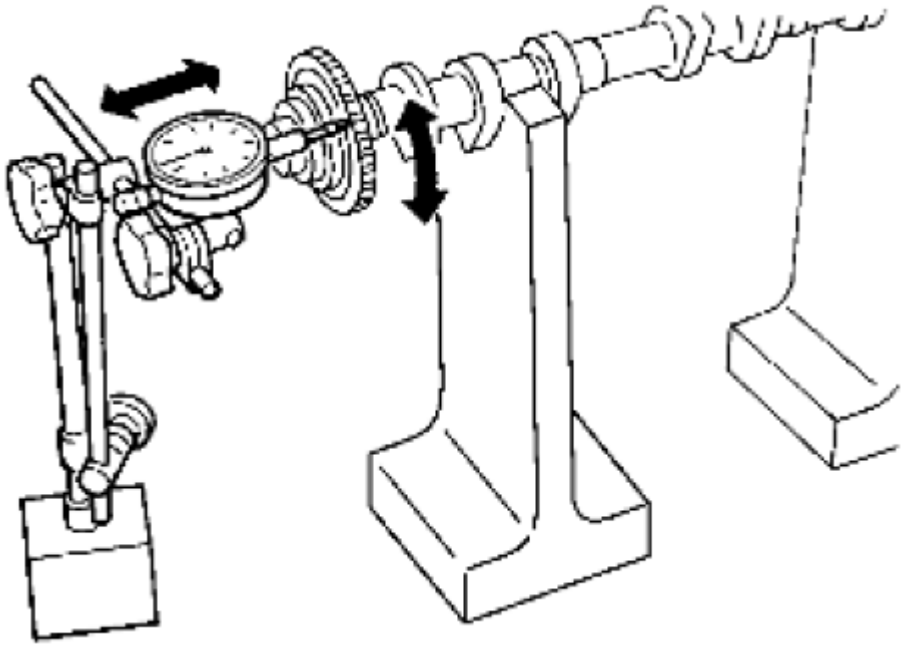


Fig. 114: Measuring Camshaft Sprocket Runout With Dial Indicator
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.

Valve Lifter

Check if surface of valve lifter has any wear or cracks.

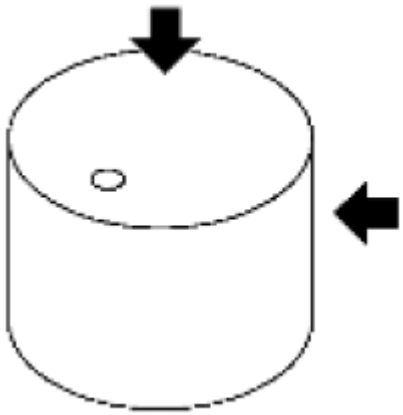


Fig. 115: Checking Surface Of Valve Lifter Or Cracks
Courtesy of SUZUKI OF AMERICA CORP.

- If anything above is found, replace valve lifter. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

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Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter at 1/2 height of valve lifter with micrometer since valve lifter is in barrel shape.

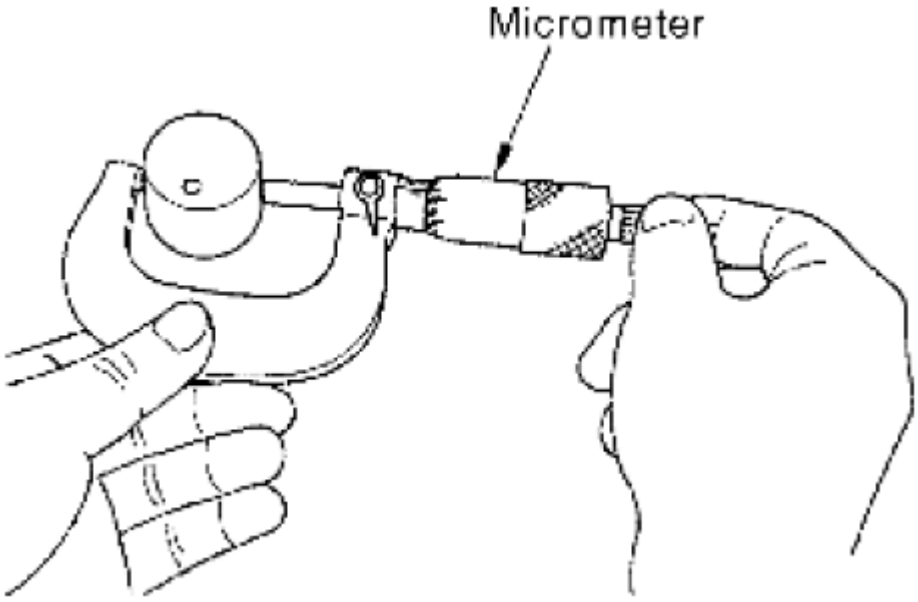


Fig. 116: Measuring Outer Diameter At 1/2 Height Of Valve Lifter With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard (Intake and exhaust)

: 33.977 - 33.987 mm (1.3377 - 1.3381 in)

VALVE LIFTER HOLE DIAMETER

- Measure the inner diameter of valve lifter hole of cylinder head with inside micrometer.

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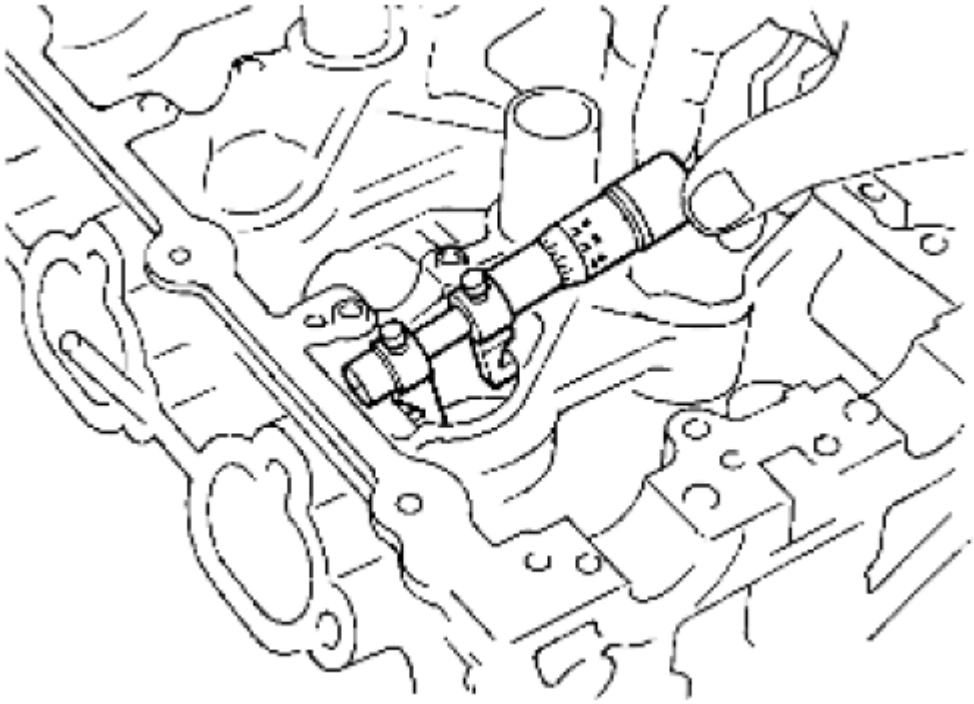


Fig. 117: Measuring Inner Diameter Of Valve Lifter Hole Of Cylinder Head With Inside Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard (Intake and exhaust)

: 34.000 - 34.016 mm (1.3386 - 1.3392 in)

VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) - (Valve lifter outer diameter), Refer to [**CAMSHAFT VALVE CLEARANCE**].

  Standard (Intake and exhaust)

  : 0.013 - 0.039 mm (0.0005 - 0.0015 in)

- If the calculated value is out of the standard, referring to each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSTALLATION

1. Install timing chain tensioners (secondary) on both sides of cylinder head.

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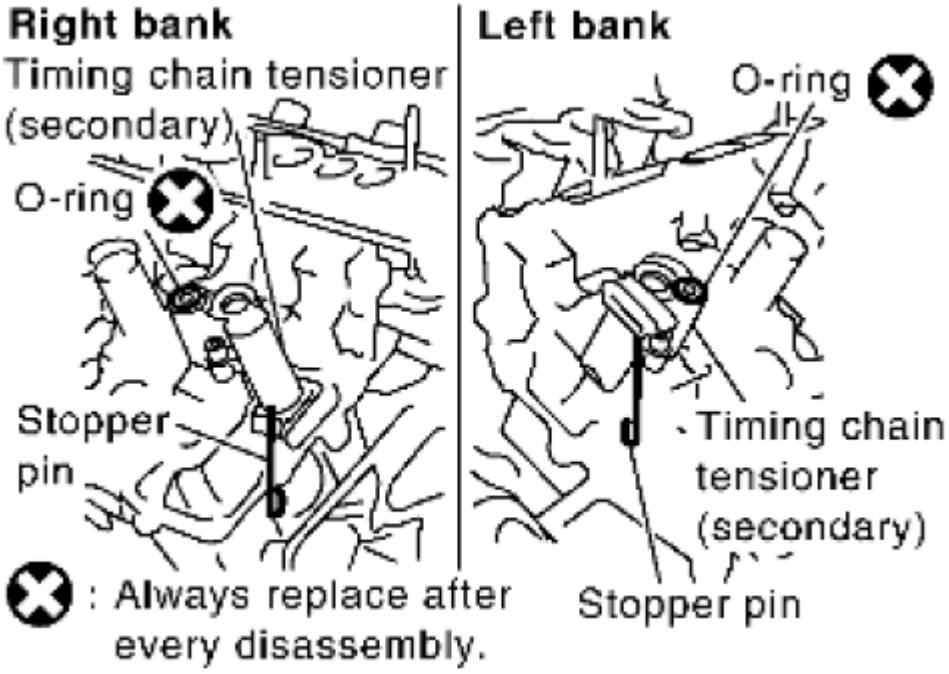


Fig. 118: Installing Timing Chain Tensioners On Both Sides Of Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

- Install timing chain tensioner with its stopper pin attached.
- Install timing chain tensioner with sliding part facing downward on right-side cylinder head, and with sliding part facing upward on left-side cylinder head.
- Install new O-rings as shown.

2. Install valve lifters.
   - Install it in the original position.
3. Install camshafts.
   - Install camshaft with dowel pin attached to its front end face on the exhaust side.

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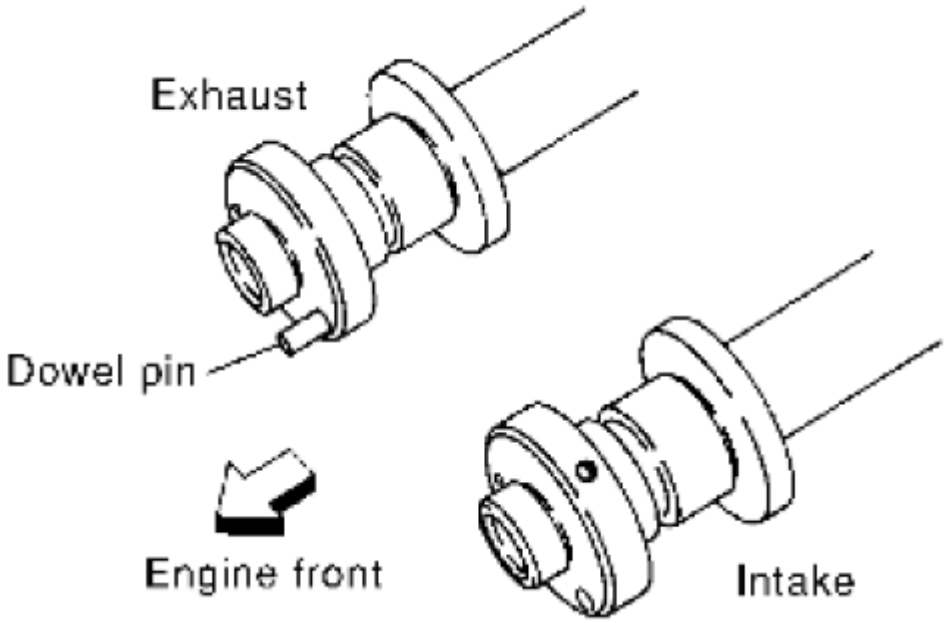


Fig. 119: Installing Camshaft With Dowel Pin
Courtesy of SUZUKI OF AMERICA CORP.

- Follow your identification marks made during removal, or follow the identification marks that are present on new camshafts for proper placement and direction.

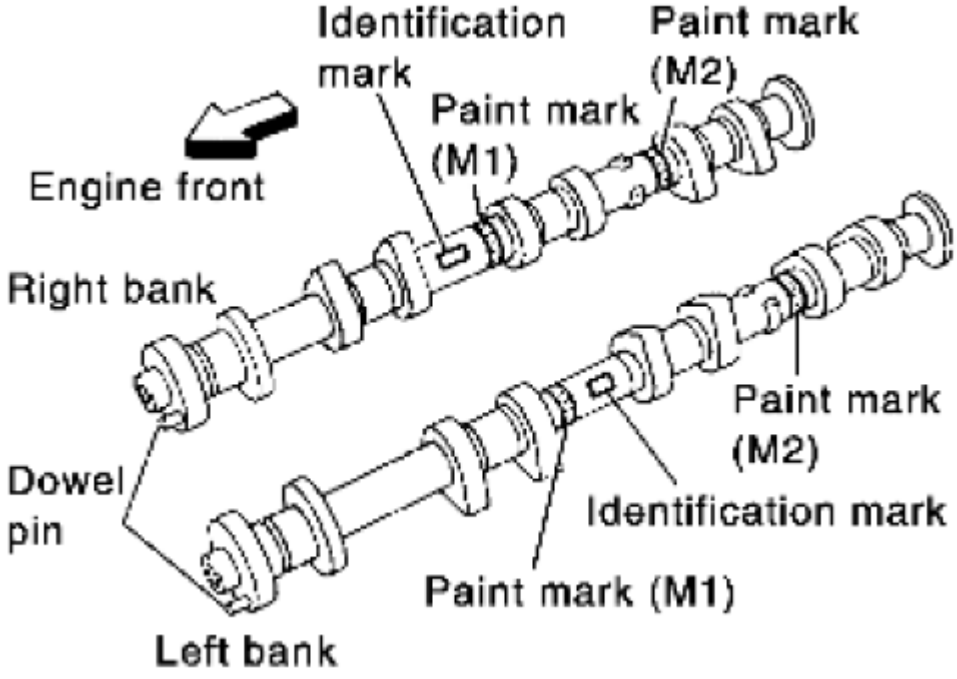


Fig. 120: Identifying Identification Marks On Camshafts
Courtesy of SUZUKI OF AMERICA CORP.

PAINT MARKS REFERENCE

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Bank	INT/EXH	Dowel pin	Paint marks		Identification mark
			M1	M2	
RH	INT	No	Green	No	RE
	EXH	Yes	No	White	RE
LH	INT	No	Green	No	LH
	EXH	Yes	No	White	LH

- Install camshaft so that dowel pin hole and dowel pin on front end face are positioned as shown. (No. 1 cylinder TDC on its compression stroke)

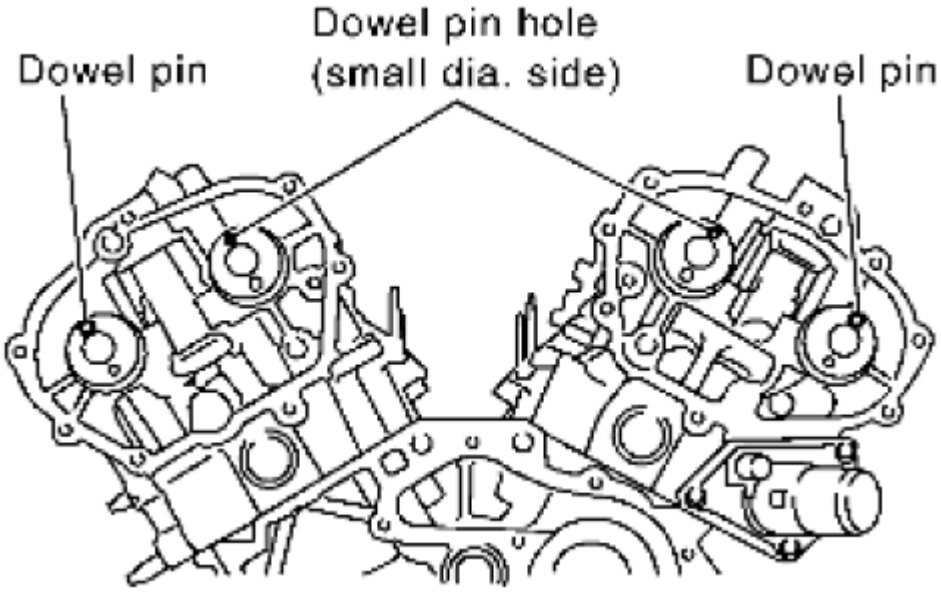


Fig. 121: Identifying Dowel Pin Hole And Dowel Pin Location
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Large and small pin holes are located on front end face of camshaft (INT), at intervals of 180°. Face small dia. side pin hole upward (in cylinder head upper face direction).**
- **Though camshaft does not stop at the portion as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction as shown.**

4. Install camshaft brackets.

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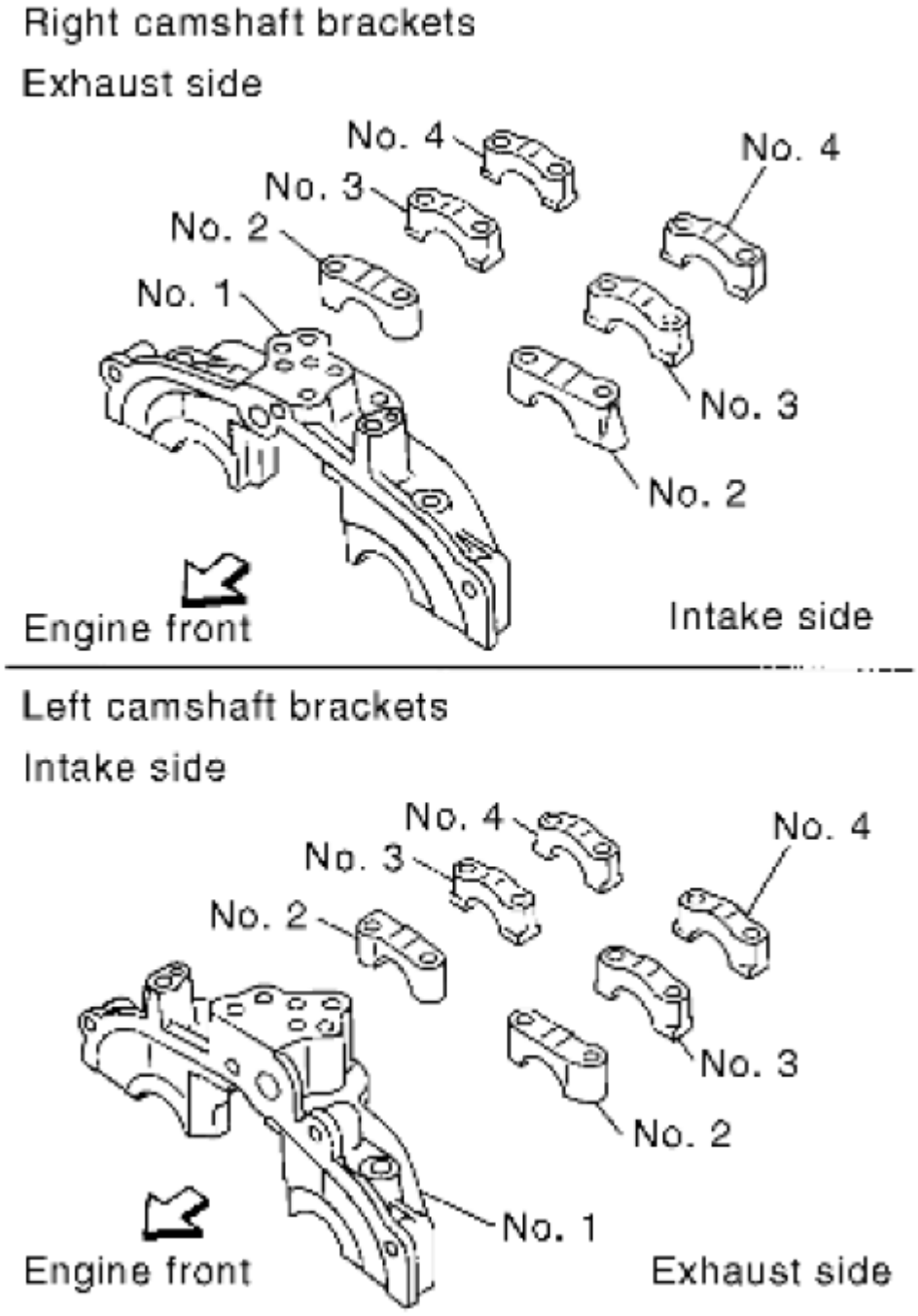


Fig. 122: Identifying Camshaft Brackets Components
Courtesy of SUZUKI OF AMERICA CORP.

- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Install camshaft bracket in original position and direction as shown.
- Install camshaft brackets (No. 2 to 4) aligning the stamp marks as shown.

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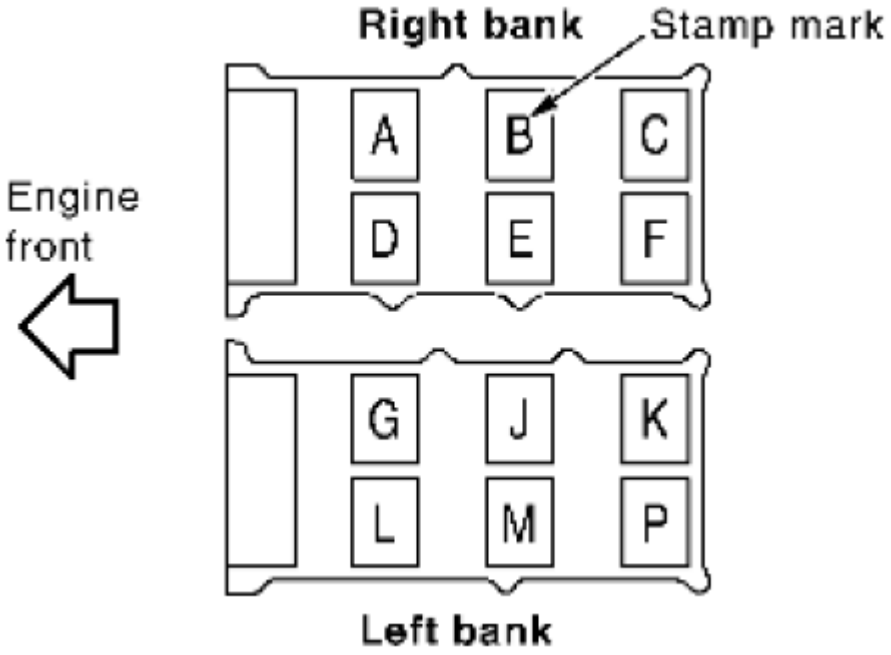


Fig. 123: Aligning Stamp Marks On Camshaft Brackets
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: There are no identification marks indicating left and right for camshaft bracket (No. 1).

- Apply liquid gasket to mating surface of camshaft bracket (No. 1) as shown on right and left banks.

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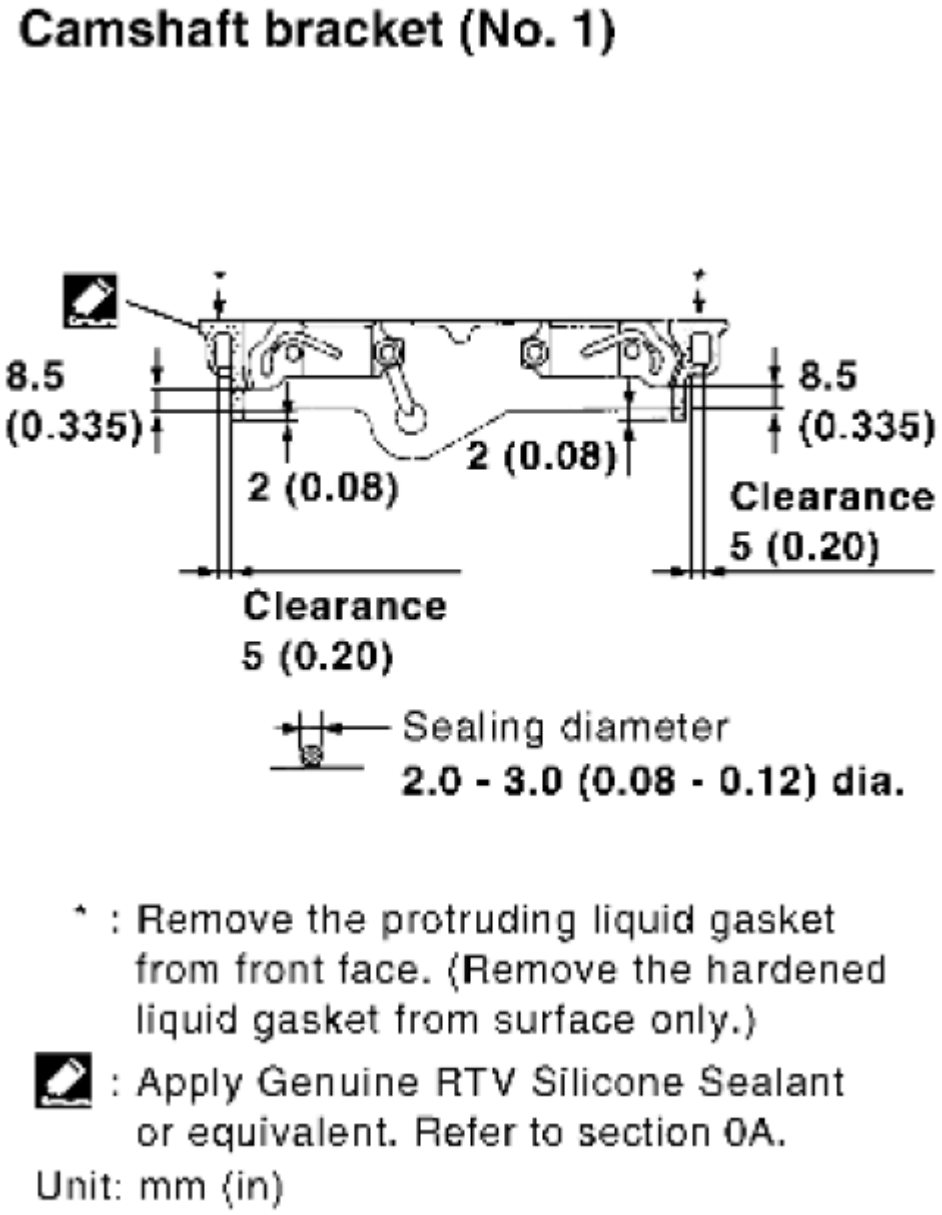


Fig. 124: Applying Liquid Gasket To Mating Surface Of Camshaft Bracket (No. 1)
Courtesy of SUZUKI OF AMERICA CORP.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

5. Tighten camshaft bracket bolts in the following steps, in numerical order as shown.

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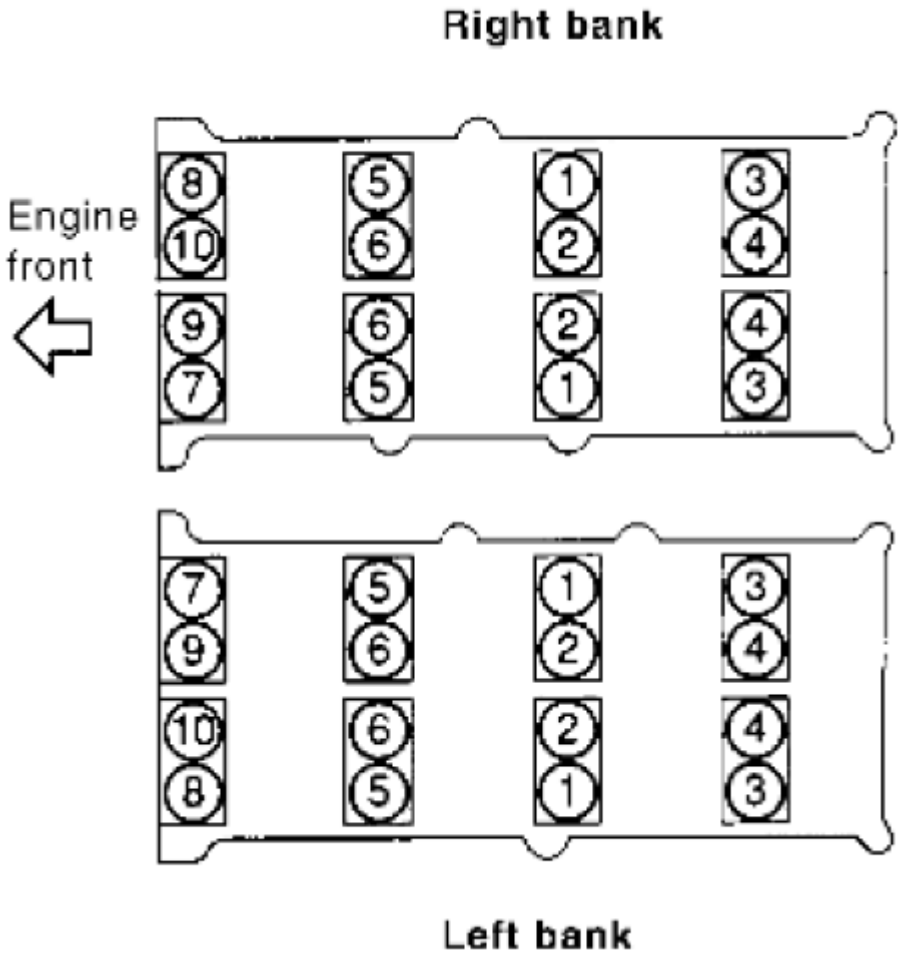


Fig. 125: Tightening Camshaft Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

Camshaft bracket bolts

Step 1 (bolts 7 - 10): 1.96 N.m (0.2 kg-m, 17 in-lb)

Step 2 (bolts 1 - 6): 1.96 N.m (0.2 kg-m, 17 in-lb)

Step 3: 5.88 N.m (0.6 kg-m, 52 in-lb)

Step 4: 10.4 N.m (1.1 kg-m, 92 in-lb)

6. Measure the difference in levels between front end faces of camshaft bracket (No. 1) and cylinder head.

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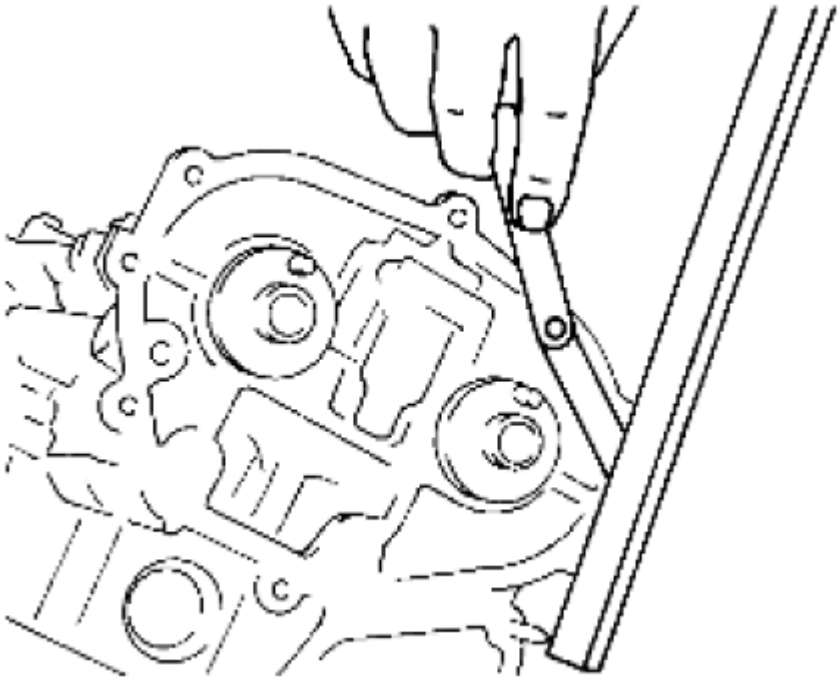


Fig. 126: Measuring Difference In Levels Between Front End Faces Of Camshaft Bracket And Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

Standard: -0.14 to 0.14 mm (-0.0055 to 0.0055 in)

- Measure two positions (both intake and exhaust side) for a single bank.
- If the measured value is out of the standard, re-install camshaft bracket (No. 1).

7. Check and adjust the valve clearance. Refer to [**CAMSHAFT VALVE CLEARANCE**].
8. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:

- **Perform this inspection only when DTC P0011 or P0021 are detected in "DTC check" of SDT and it is directed according to inspection procedure. Refer to [P0011, P0021 IVT CONTROL].**
- **Check when engine is cold so as to prevent burns from any splashing engine oil.**

1. Check the engine oil level. Refer to [**ENGINE OIL: INSPECTION**]
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
   a. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: VQ40DE**]

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b. Disconnect ignition coil and injector harness connectors.

3. Remove intake valve timing control solenoid valve. Refer to [**FRONT TIMING CHAIN CASE: REMOVAL AND INSTALLATION**].
4. Crank the engine, and then make sure that engine oil comes out from camshaft bracket (No. 1) oil hole. End cranking after checking.

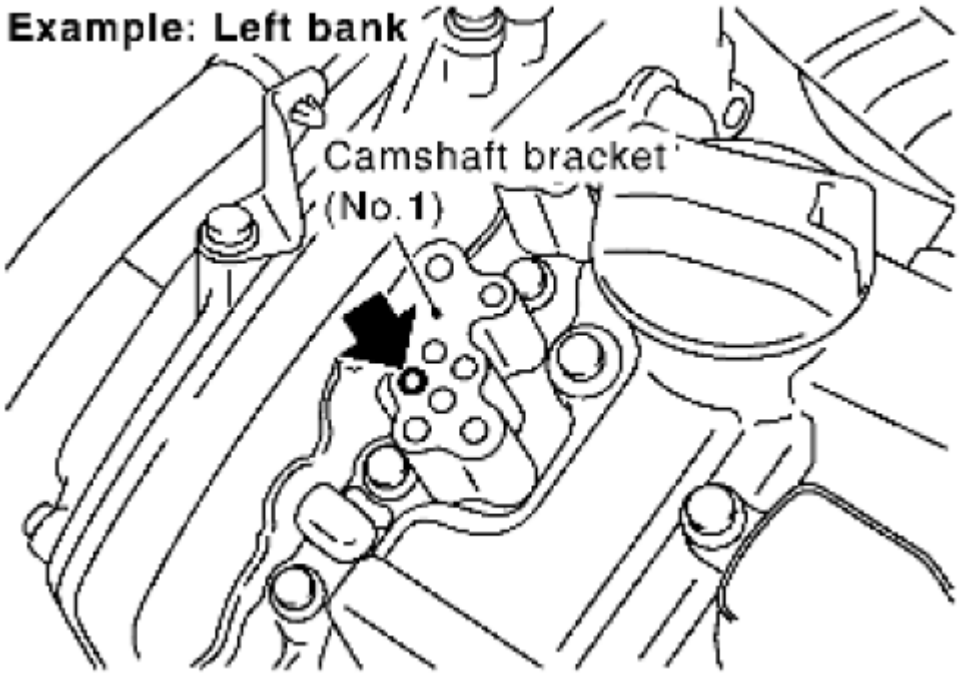


Fig. 127: Locating Camshaft Bracket (No. 1) Oil Hole
Courtesy of SUZUKI OF AMERICA CORP.

WARNING:

- **Be careful not to touch rotating parts (drive belts, idler pulley, and crankshaft pulley, etc.).**

CAUTION:

- **Engine oil may squirt from intake valve timing control solenoid valve installation hole during cranking. Use a shop cloth to prevent the engine oil from spilling on components and the vehicle.**
- **Do not allow engine oil to get on rubber components such as drive belt or engine mount insulators. Immediately wipe off any splashed engine oil.**

- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from camshaft bracket (No. 1) oil hole. Refer to [**LUBRICATION CIRCUIT**], [**LUBRICATION SYSTEM: SYSTEM CHART**].

5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.

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- Clean oil groove if necessary. Refer to [**LUBRICATION CIRCUIT**], [**LUBRICATION SYSTEM: SYSTEM CHART**].

6. After inspection, installation of the remaining components is in the reverse order of removal.

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [**RECOMMENDED FLUIDS AND LUBRICANTS**]
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE: If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

ITEM SPECIFICATION

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid(1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
(1) Transmission fluid, power steering fluid, brake fluid, etc.			

VALVE OIL SEAL: REMOVAL AND INSTALLATION

REMOVAL

1. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.

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2. Remove camshaft relating to valve oil seal to be removed. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
3. Remove valve lifters. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
4. Remove valve collet, valve spring retainer and valve spring using Tool.

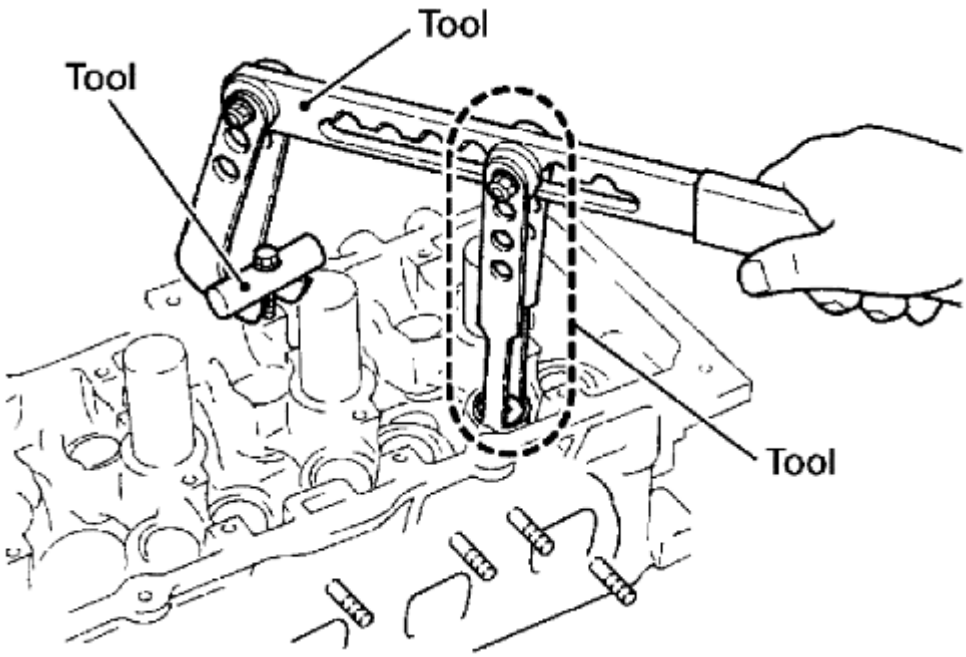


Fig. 128: Removing Valve Collet, Valve Spring Retainer And Valve Spring Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: When working, take care not to damage valve lifter holes.

Tool numbers: KV10116200 (J-26336 -B)

: KV10115900 (J-26336 -20)

: KV10109220 (-)

- Compress valve spring using Tool attachment, adapter. Remove valve collet with magnet hand.

5. Remove valve oil seal using Tool.

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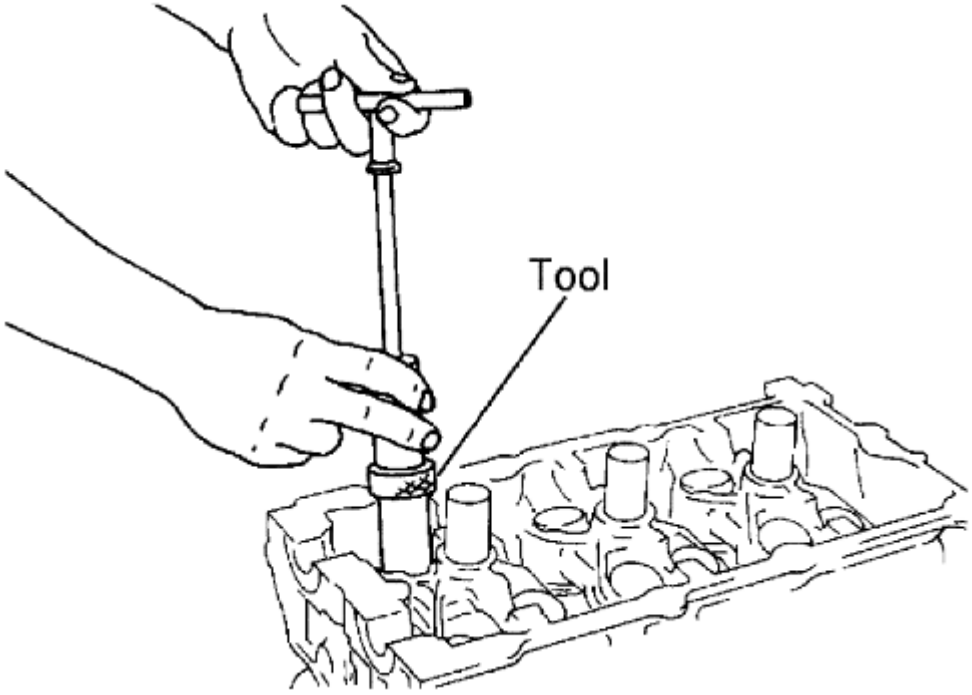


Fig. 129: Removing Valve Oil Seal Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10107902 (J-38959)

INSTALLATION

1. Apply new engine oil to new valve oil seal joint surface and seal lip.
2. Press in valve oil seal to specified height (H) using Tool.

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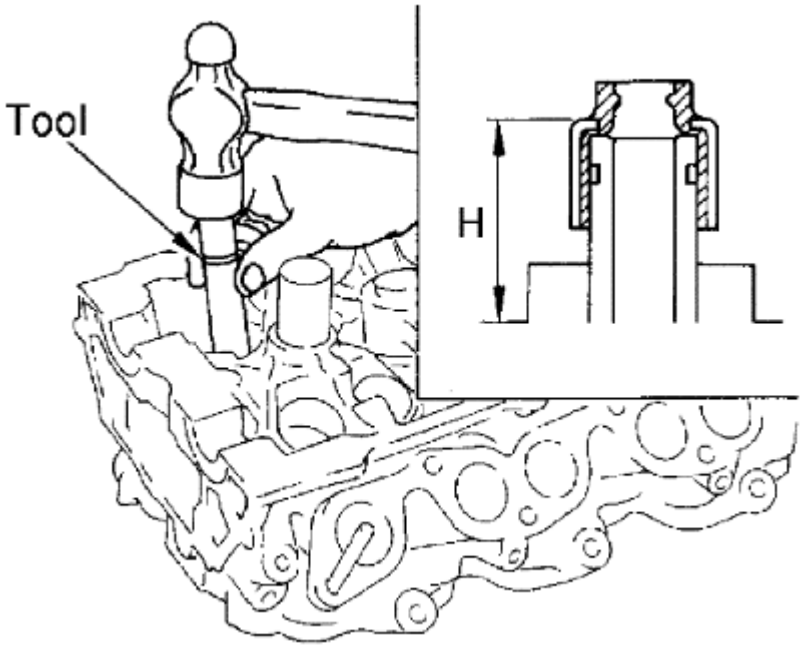


Fig. 130: Pressing Valve Oil Seal To Specified Height (H) Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: - (J-39386)

NOTE: Dimension (H): height measured before valve spring seat installation.

Intake and exhaust: 14.3 - 14.9 mm (0.563 - 0.587 in)

3. Installation of the remaining components is in the reverse order of removal.

FRONT OIL SEAL: REMOVAL AND INSTALLATION

REMOVAL

1. Remove engine undercover using power tools. Refer **FRONT BUMPER: REMOVAL AND INSTALLATION**
2. Remove drive belts. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
3. Remove engine cooling fan assembly. Refer to [**ENGINE COOLING FAN: REMOVAL AND INSTALLATION (CRANKSHAFT DRIVEN TYPE)**]
4. Remove crankshaft pulley. Refer to [**TIMING CHAIN: REMOVAL AND INSTALLATION**].
5. Remove front oil seal using suitable tool.

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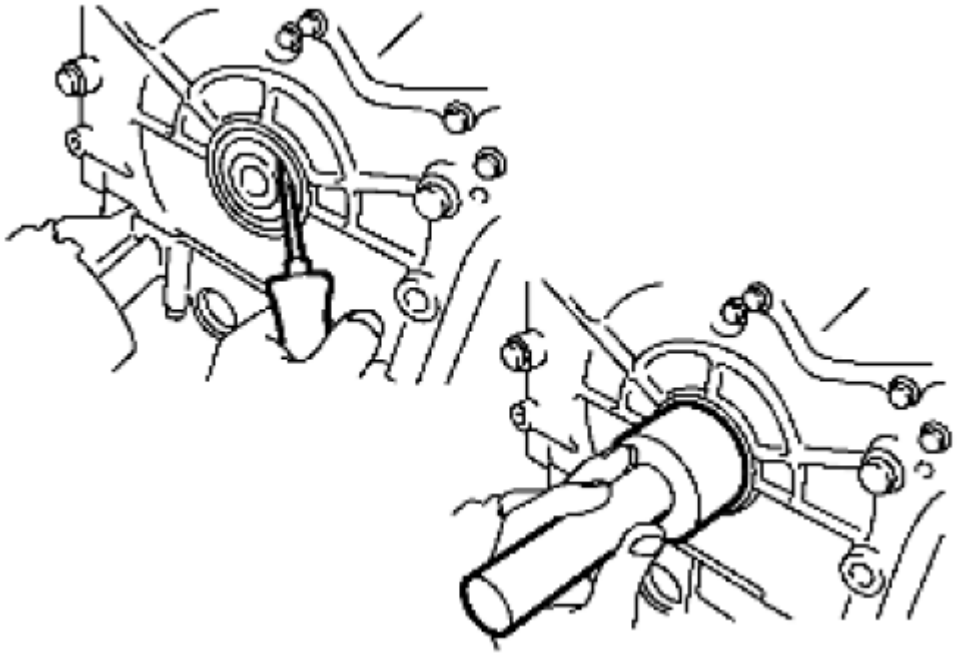


Fig. 131: Removing Front Oil Seal Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Be careful not to damage front timing chain case and crankshaft.

INSTALLATION

1. Apply new engine oil to both oil seal lip and dust seal lip of new front oil seal.
2. Install front oil seal.
    - Install front oil seal so that each seal lip is oriented as shown.

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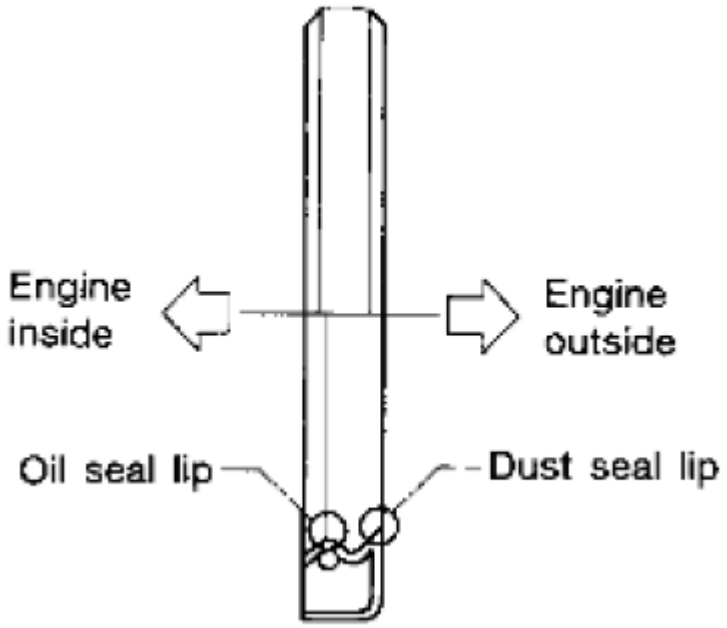


Fig. 132: Installing Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

- Press-fit until the height of front oil seal is level with the mounting surface using suitable tool.

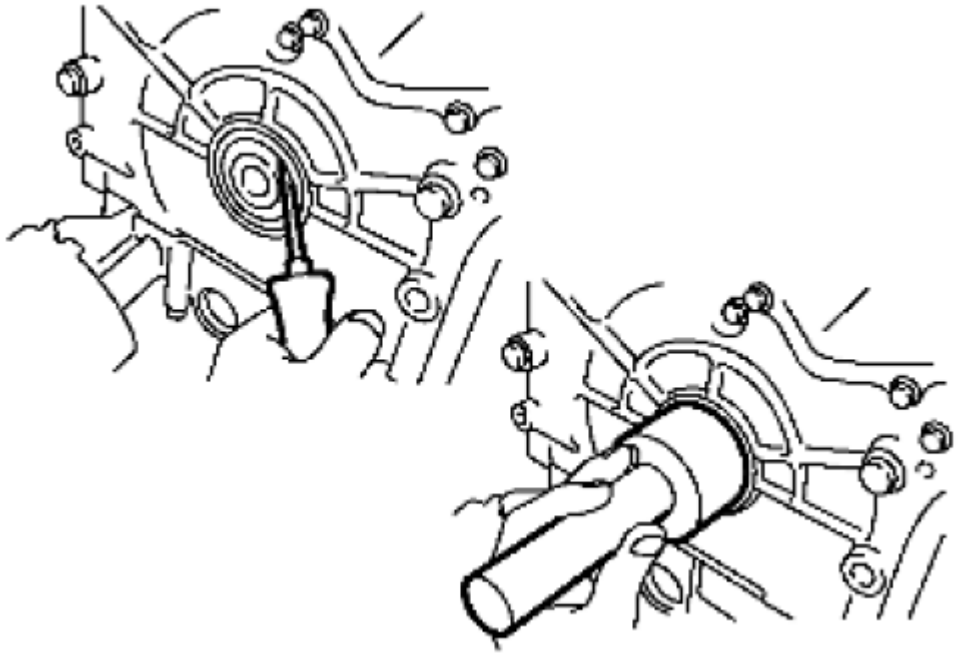


Fig. 133: Pressing Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

  - Suitable drift: outer diameter 60 mm (2.36 in), inner diameter 50 mm (1.97 in).

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CAUTION:

- **Be careful not to damage front timing chain case and crankshaft.**
- **Press-fit straight and avoid causing burrs or tilting oil seal.**

3. Installation is in the reverse order of removal after this step.

REAR OIL SEAL: REMOVAL AND INSTALLATION

REMOVAL

1. Remove transmission assembly. Refer to [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE (FOR 2WD MODELS)**] (2WD M/T models), [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE (FOR 4WD MODELS)**] (4WD M/T models), [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FOR VQ40DE 2WD MODELS**] (2WD A/T models), [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FOR VQ40DE 4WD MODELS**] (4WD A/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to [**CLUTCH DISC, CLUTCH COVER: EXPLODED VIEW [6M/T]**]
3. Remove drive plate (A/T models) or flywheel (M/T models). Refer to [**ENGINE UNIT: EXPLODED VIEW**].
4. Remove rear oil seal with a suitable tool.

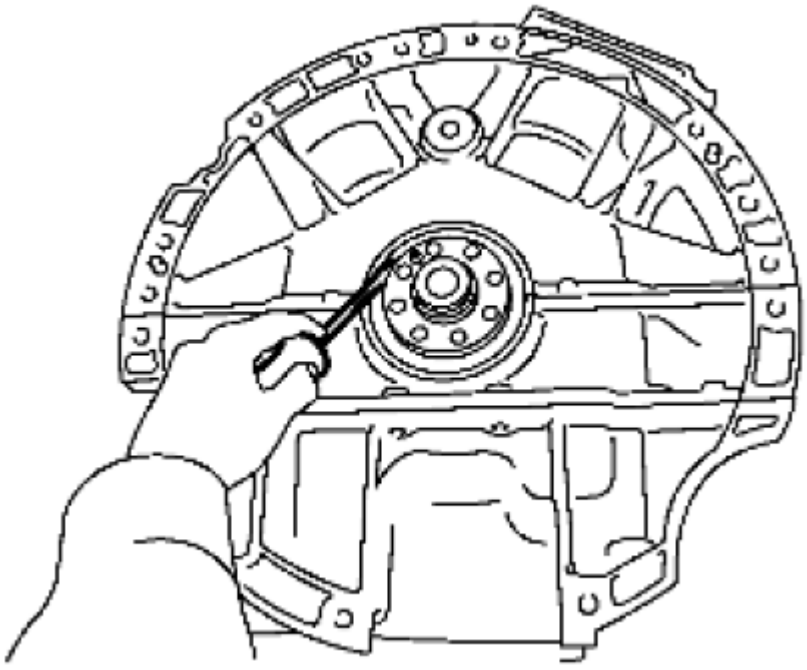


Fig. 134: Removing Rear Oil Seal With Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

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CAUTION: Be careful not to damage crankshaft and cylinder block.

INSTALLATION

1. Apply new engine oil to new rear oil seal joint surface and seal lip.
2. Install rear oil seal so that each seal lip is oriented as shown.

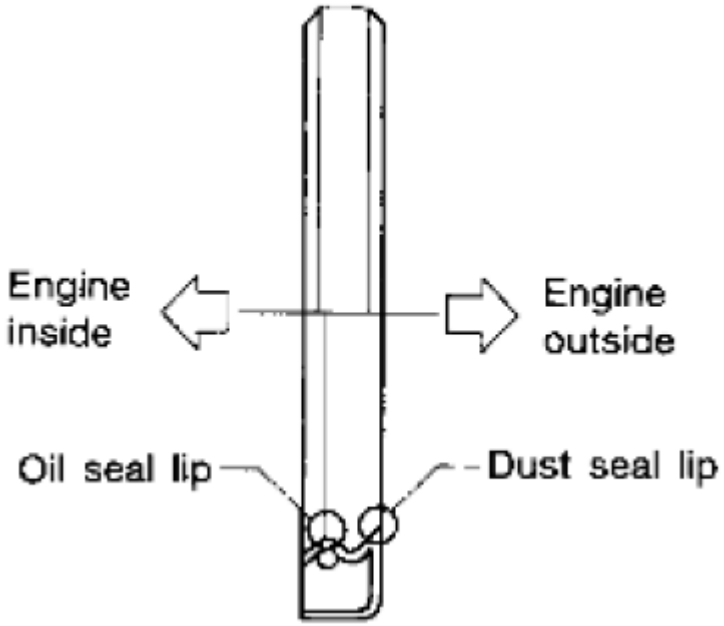


Fig. 135: Installing Rear Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

- Install new rear oil seal using Tool.

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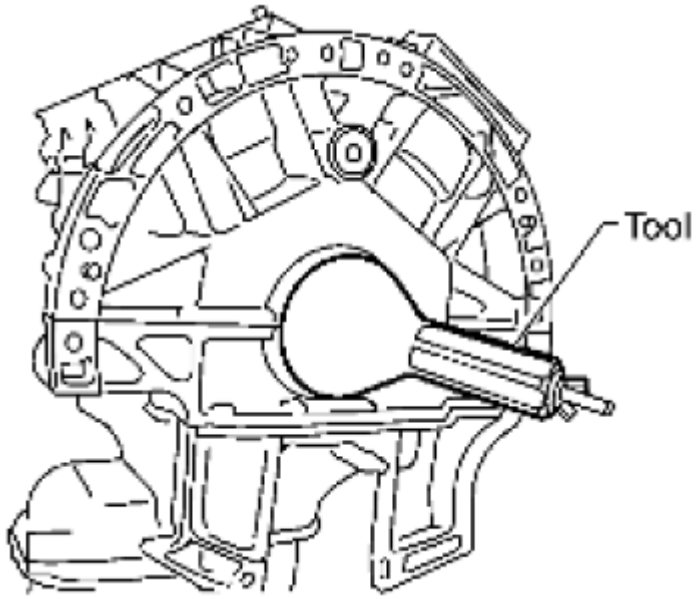


Fig. 136: Installing Rear Oil Seal Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV991J0120 (J-47128)

CAUTION:
- **Be careful not to damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Do not touch grease applied onto oil seal lip.**

- Press in rear oil seal to the position as shown.

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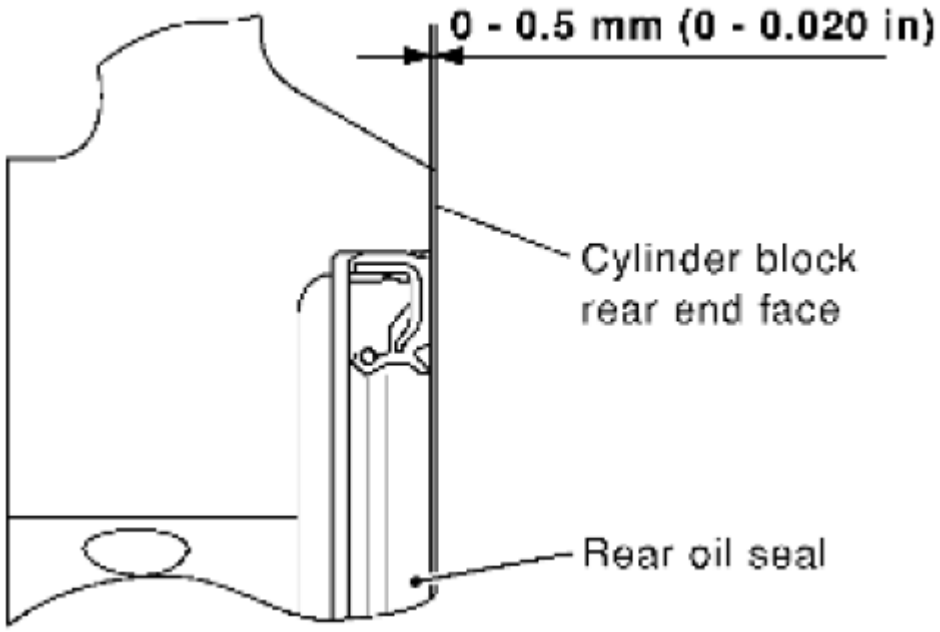


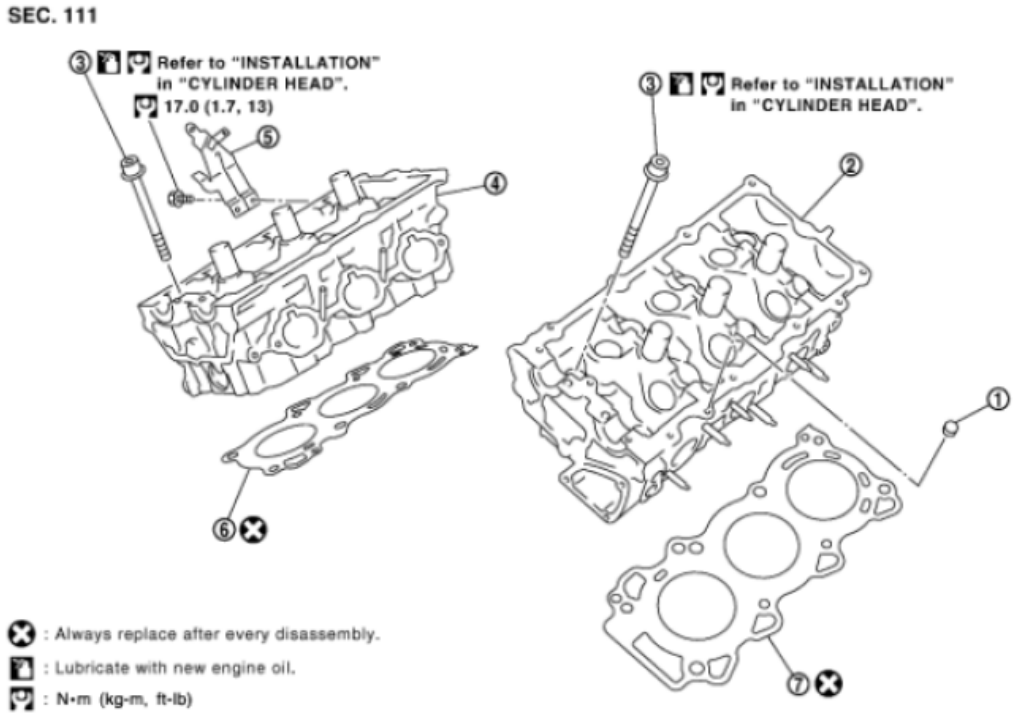
Fig. 137: Pressing Rear Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

3. Installation of the remaining components is in the reverse order of removal.

CAUTION:
- **When replacing an engine or transmission you must make sure the dowels are installed correctly during reassembly.**
- **Improper alignment caused by missing dowels may cause vibration, oil leaks or breakage of drivetrain components.**

CYLINDER HEAD: EXPLODED VIEW (1)

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1. Rubber plug	2. Cylinder head (left bank)	3. Cylinder head bolt
4. Cylinder head (right bank)	5. Harness bracket	6. Cylinder head gasket (right bank)
7. Cylinder head gasket (left bank)		

Fig. 138: Exploded View Of Cylinder Head Components
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD: REMOVAL AND INSTALLATION

REMOVAL

1. Remove camshaft. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
2. Remove intake manifold. Refer to [**INTAKE MANIFOLD: REMOVAL AND INSTALLATION**].
3. Remove exhaust manifold. Refer to [**EXHAUST MANIFOLD AND THREE WAY CATALYST: REMOVAL AND INSTALLATION [VQ40DE]**]
4. Remove water inlet and thermostat assembly. Refer to [**WATER INLET AND THERMOSTAT ASSEMBLY: REMOVAL AND INSTALLATION**]
5. Remove water outlet, water pipe and heater pipe. Refer to [**WATER OUTLET AND WATER PIPING: REMOVAL AND INSTALLATION**]
6. Remove cylinder head bolts in reverse order as shown using suitable tool and power tool to remove cylinder heads (right and left banks).

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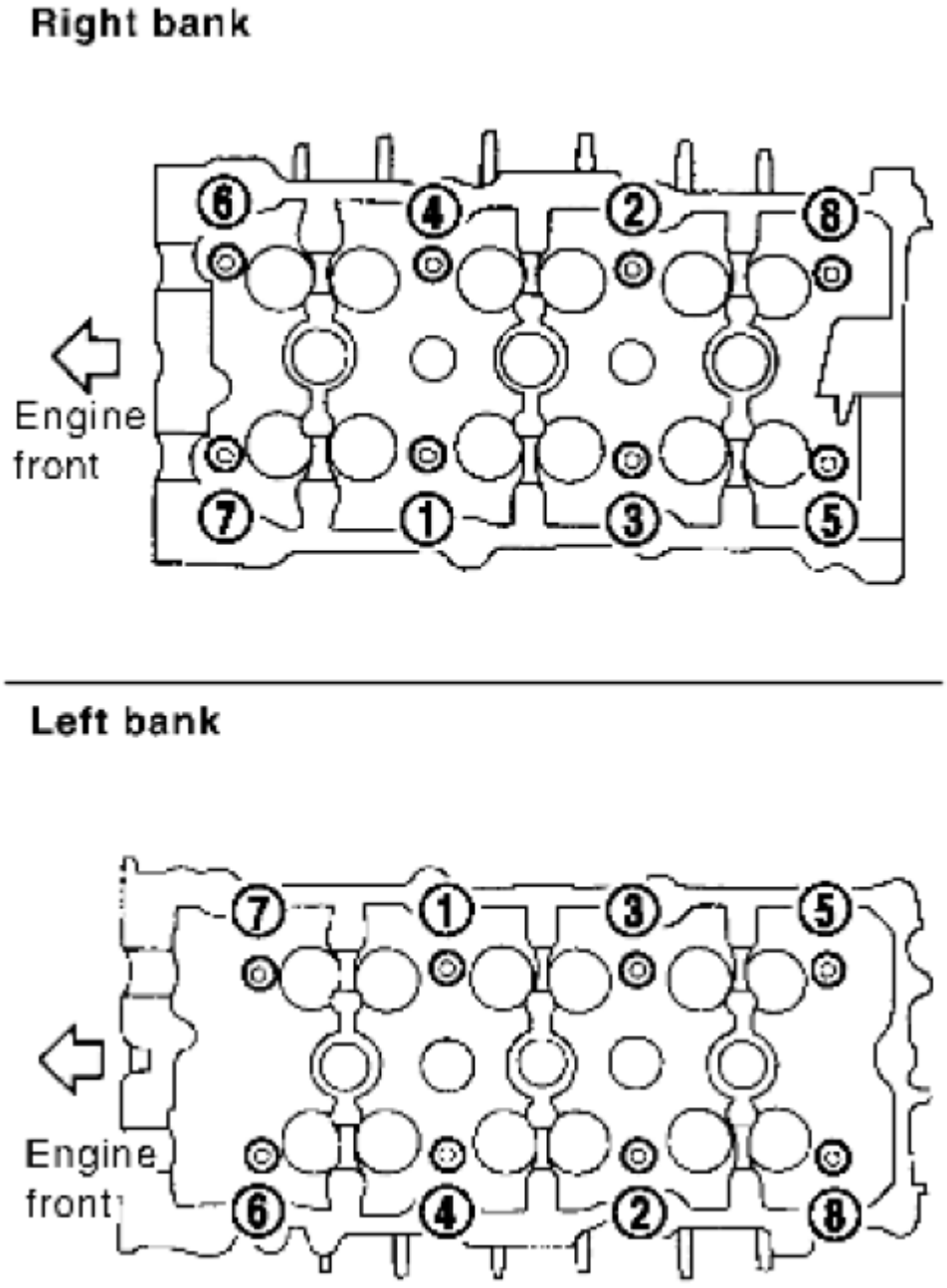


Fig. 139: Identifying Cylinder Head Bolts Remove Sequence
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove cylinder head gaskets.

INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between (d_1) and (d_2) exceeds the limit, replace the bolt with a new one.

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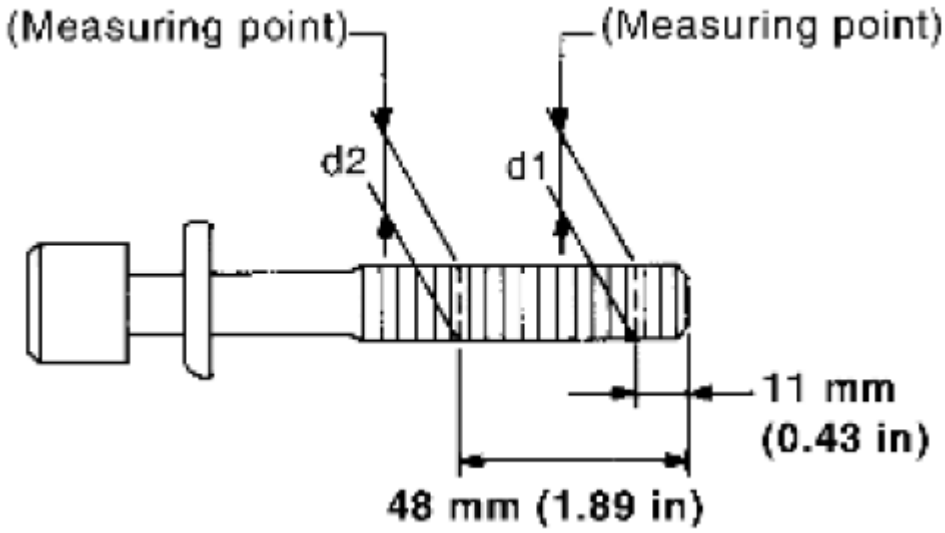


Fig. 140: Identifying Cylinder Head Bolts Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Limit [(d_1) - (d_2)]: 0.11 mm (0.0043 in)

- If reduction of outer diameter appears in a position other than (d_2), use it as (d_2) point.

Cylinder Head Distortion

NOTE: When performing this inspection, cylinder block distortion should be also checked. Refer to [ENGINE UNIT: INSPECTION AFTER DISASSEMBLY].

1. Using suitable tool, wipe off oil, scale, gasket, sealant and carbon deposits from surface of cylinder head.

CAUTION: Do not allow gasket fragments to enter engine oil or engine coolant passages.

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

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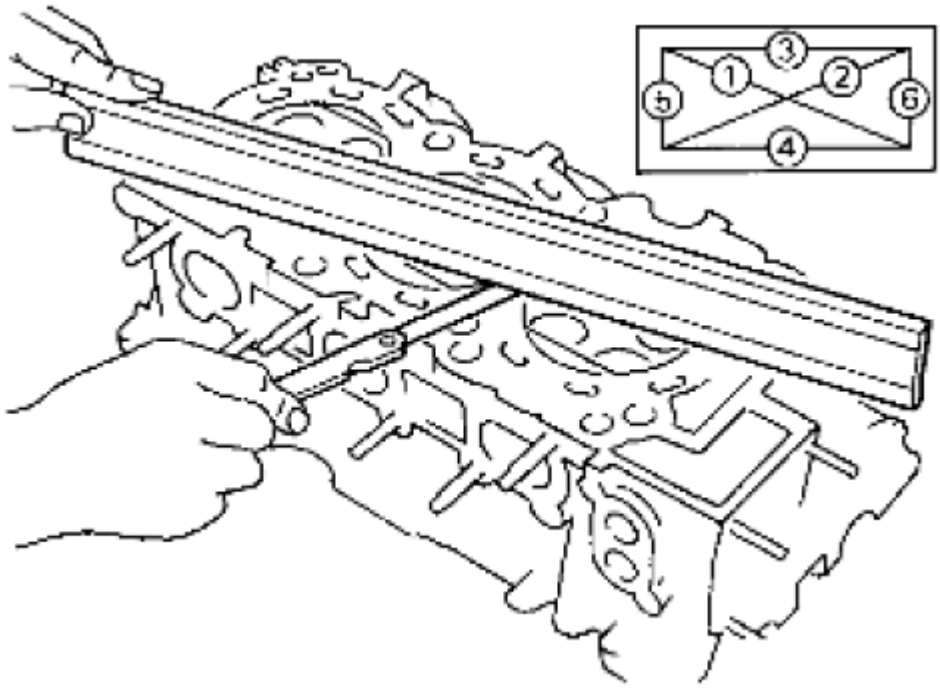


Fig. 141: Checking Bottom Surface Of Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.

INSTALLATION

1. Install new cylinder head gasket.
2. Turn crankshaft until No. 1 piston is set at TDC.

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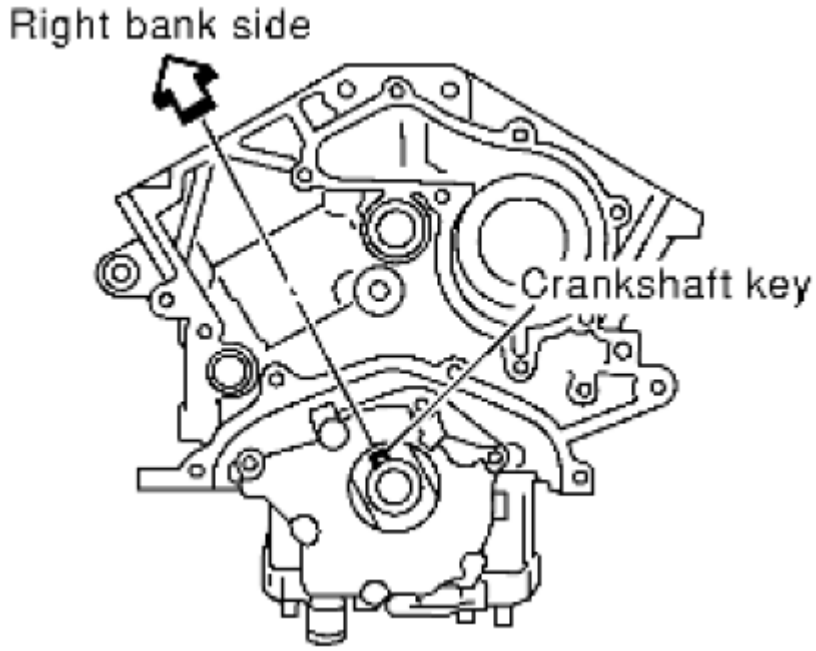


Fig. 142: Identifying Crankshaft Key Location
Courtesy of SUZUKI OF AMERICA CORP.

- Crankshaft key should line up with the right bank cylinder center line as shown.

3. Install cylinder head follow the steps below to tighten cylinder head bolts in numerical order as shown.

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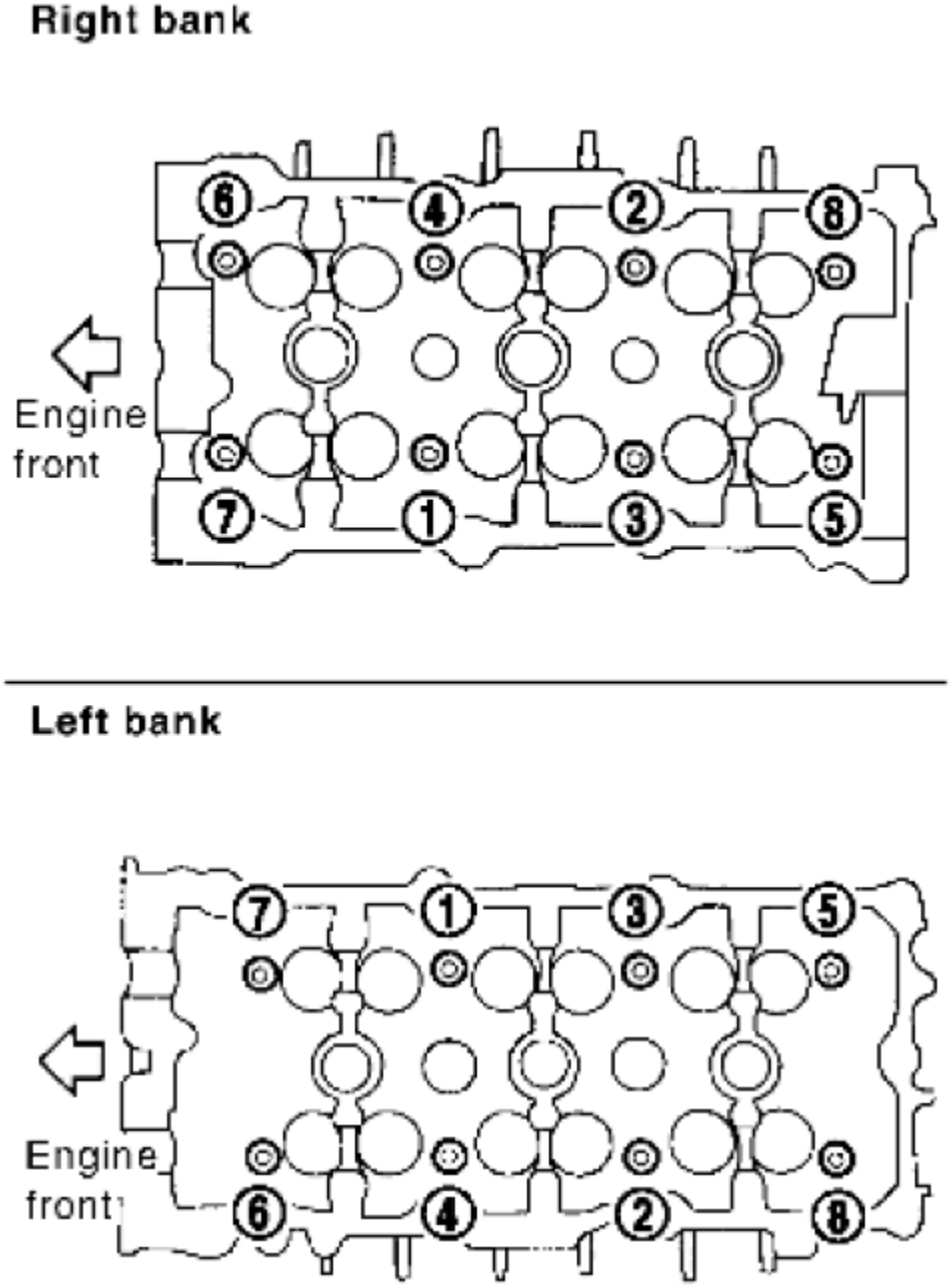


Fig. 143: Identifying Cylinder Head Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: If cylinder head bolts re-used, check their outer diameters before installation. Refer to [CYLINDER HEAD: REMOVAL AND INSTALLATION] (Cylinder Head Bolts Outer Diameter).

Step a: 98 N.m (10 kg-m, 72 ft-lb)

Step b: Loosen to 0 N.m in the reverse order of tightening.

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Step c: 39.2 N.m (4.0 kg-m, 29 ft-lb)

Measure the tightening angle using Tool.

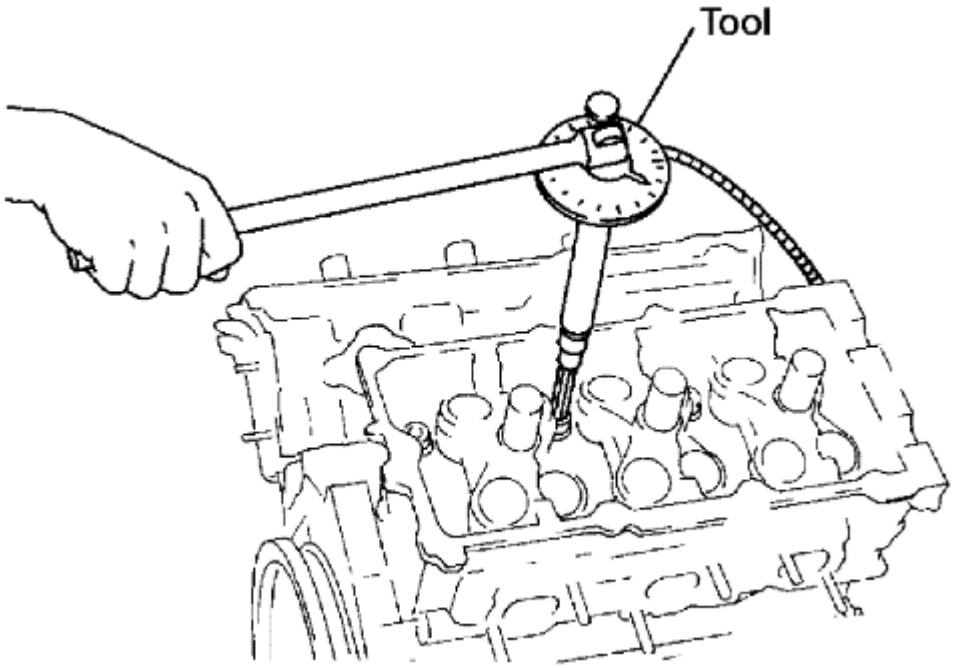


Fig. 144: Measuring Tightening Angle Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10112100 (BT-8653 -A)

Step d: 90° clockwise

Step e: 90° clockwise

4. After installing cylinder head, measure distance between front end faces of cylinder block and cylinder head (left and right banks).

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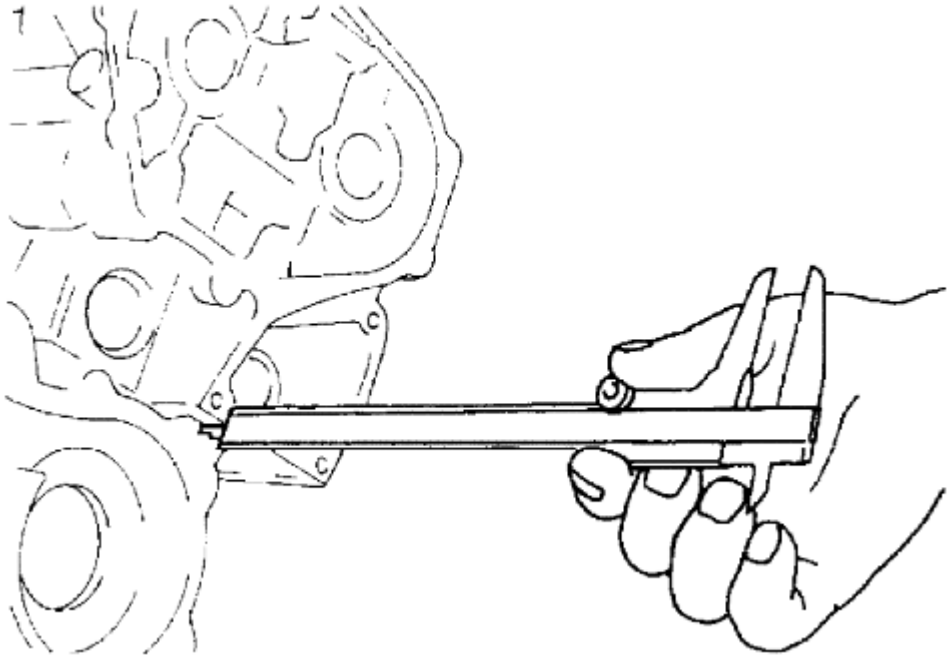


Fig. 145: Measuring Distance Between Front End Faces Of Cylinder Block And Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 14.1 - 14.9 mm (0.555 - 0.587 in)

- If the measured value is out of the standard, re-install cylinder head.

5. Installation of the remaining parts is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- Before starting the engine, check oil/fluid levels including engine coolant and engine oil. If the levels are lower than required quantity, fill to the specified level. Refer to [**RECOMMENDED FLUIDS AND LUBRICANTS**]
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to the fuel piping, check for fuel leakage at the connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE: If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids including engine oil and engine coolant.

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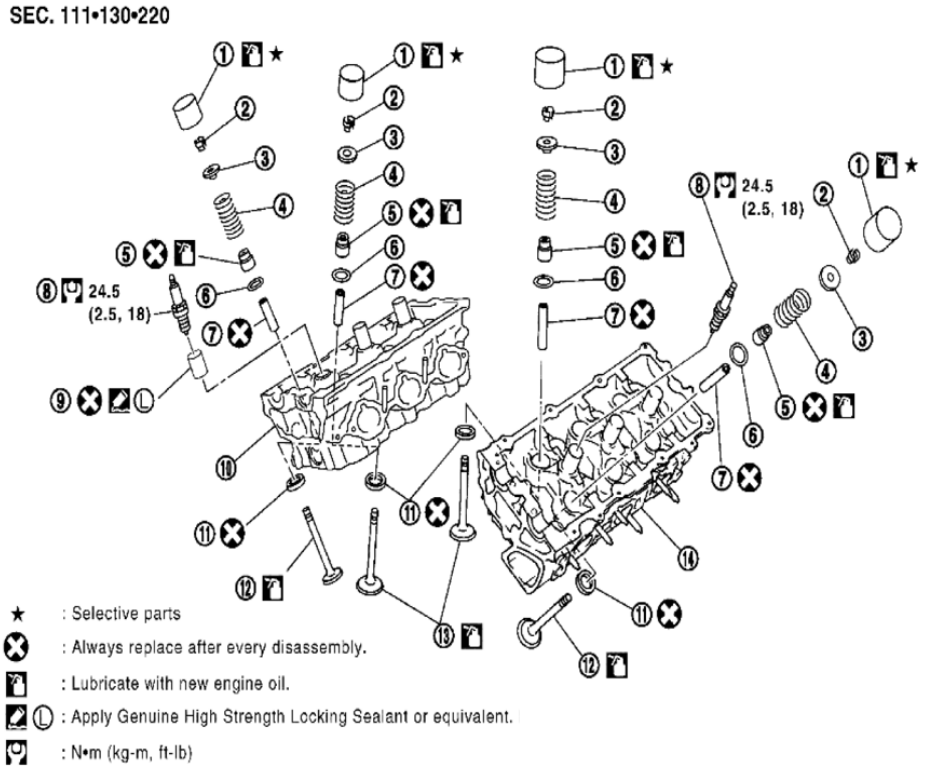
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level if necessary.
- Summary of the inspection items:

ITEM SPECIFICATION

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluids(1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gas	-	Leakage	-
(1) Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.			

CYLINDER HEAD: EXPLODED VIEW (2)

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1.	Valve lifter	2.	Valve collet	3.	Valve spring retainer
4.	Valve spring	5.	Valve oil seal	6.	Valve spring seat
7.	Valve guide	8.	Spark plug	9.	Spark plug tube
10.	Cylinder head (right bank)	11.	Valve seat	12.	Valve (EXH)
13.	Valve (INT)	14.	Cylinder head (left bank)		

Fig. 146: Exploded View Of Cylinder Head Components
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD: DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

1. Remove spark plug.
2. Remove valve lifter.
    - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.

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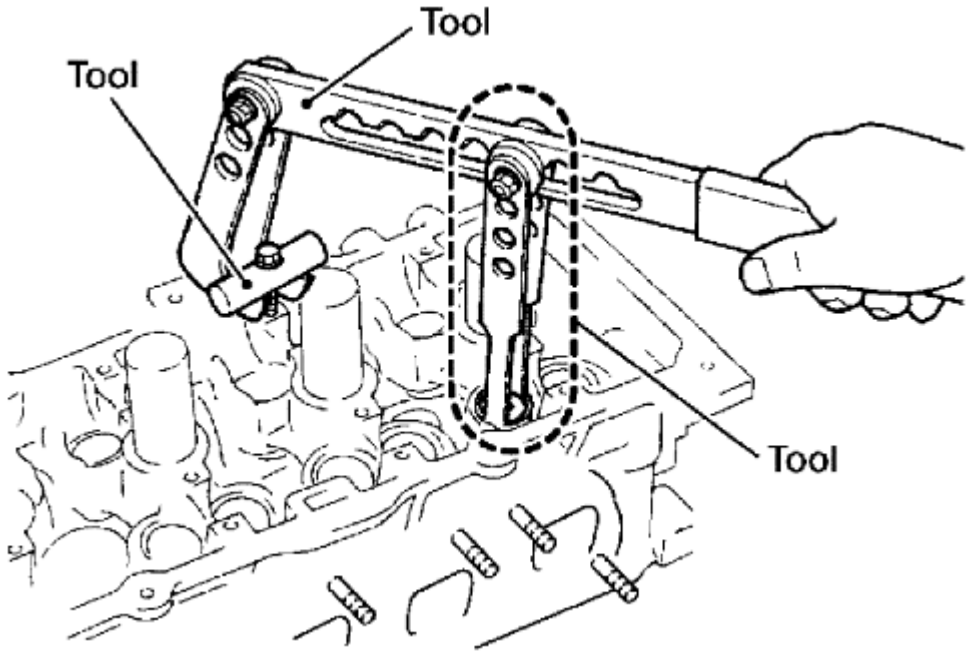


Fig. 147: Removing Valve Collet
Courtesy of SUZUKI OF AMERICA CORP.

- Compress valve spring and remove valve collet with magnet hand using Tool.

CAUTION: When working, take care not to damage valve lifter holes.

Tool numbers: KV10109220 (-)

: KV10116200 (J-26336-B)

: KV10115900 (J-26336-20)

4. Remove valve spring retainer, valve spring and valve spring seat.
5. Push valve stem to combustion chamber side, and remove valve.
   - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seals using Tool.

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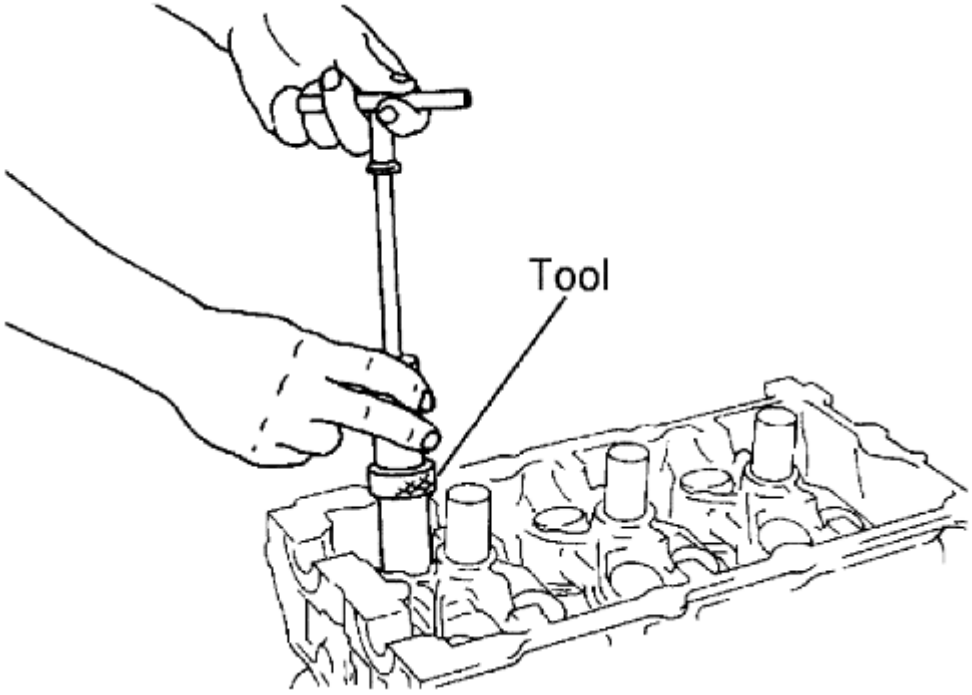


Fig. 148: Removing Valve Oil Seals Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10107902 (J-38959)

7. If valve seat must be replaced, refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
8. If valve guide must be replaced, refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
9. Remove spark plug tube, as necessary.
    - Using pair of pliers, pull spark plug tube out of cylinder head.

CAUTION:
- **Take care not to damage cylinder head.**
- **Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.**

ASSEMBLY

1. When valve guide is removed, install it. Refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
2. When valve seat is removed, install it. Refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
3. Install valve oil seals using Tool.

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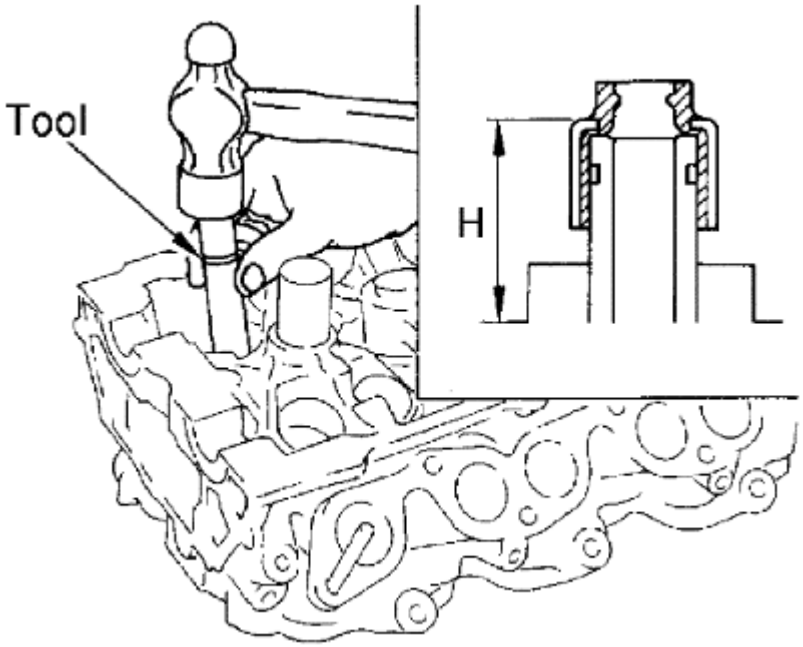


Fig. 149: Installing Valve Oil Seals Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: - (J-39386)

Height (H) (Without valve spring seat installed) Intake and exhaust: 14.3 - 14.9 mm (0.563 - 0.587 in)

4. Install valve spring seat.
5. Install valves.
    - Install it in the original position.

NOTE: Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type).

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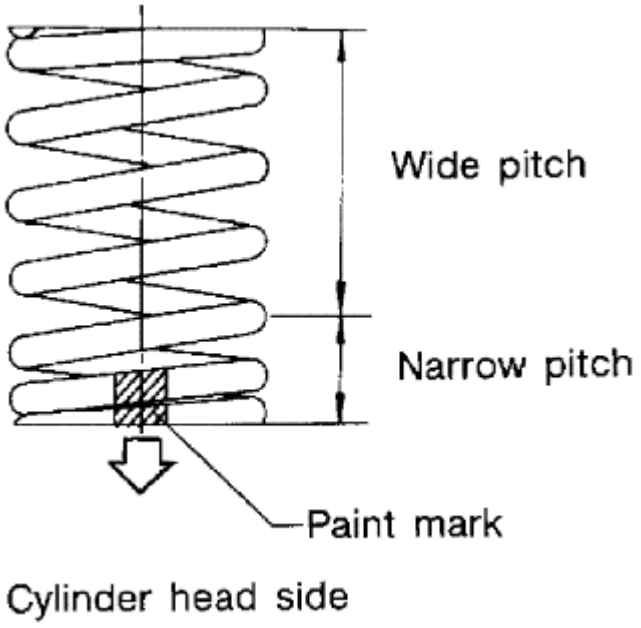


Fig. 150: Installing Valve Spring (Uneven Pitch Type)
Courtesy of SUZUKI OF AMERICA CORP.

- Install narrow pitch end (paint mark) to cylinder head side (valve spring seat side).

7. Install valve spring retainer.
8. Install valve collet.

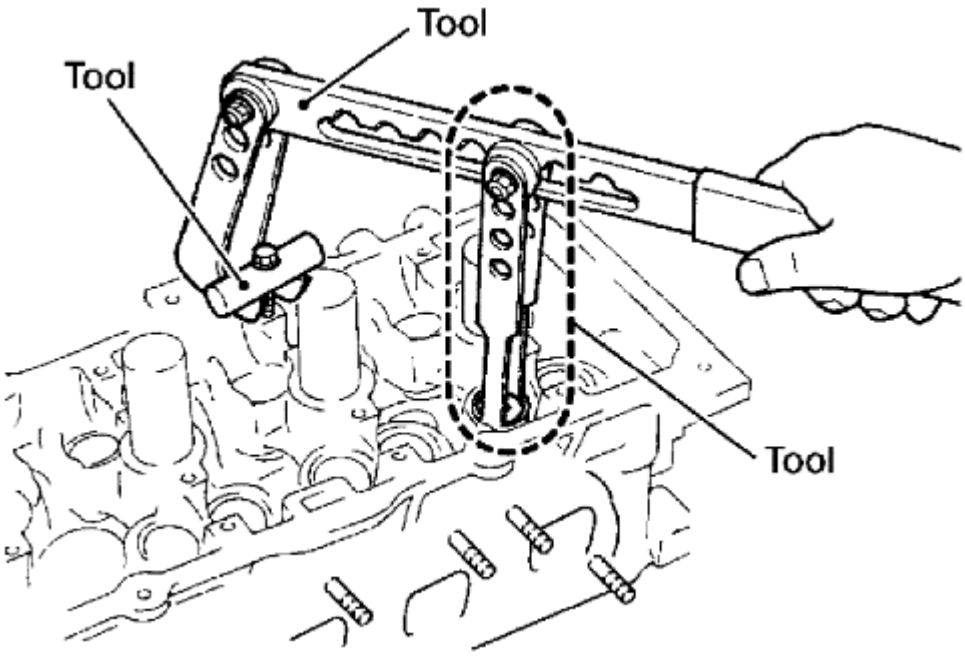


Fig. 151: Installing Valve Collet
Courtesy of SUZUKI OF AMERICA CORP.

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- Compress valve spring using Tool, attachment and adapter using Tool. Install valve collet with magnet hand.

  Tool numbers: KV10109220 (-)

  : KV10116200 (J-26336-B)

  : KV10115900 (J-26336-20)

  CAUTION: When working, take care not to damage valve lifter holes or valve stems.

- Tap valve stem edge lightly with plastic hammer after installation to check its installed condition.

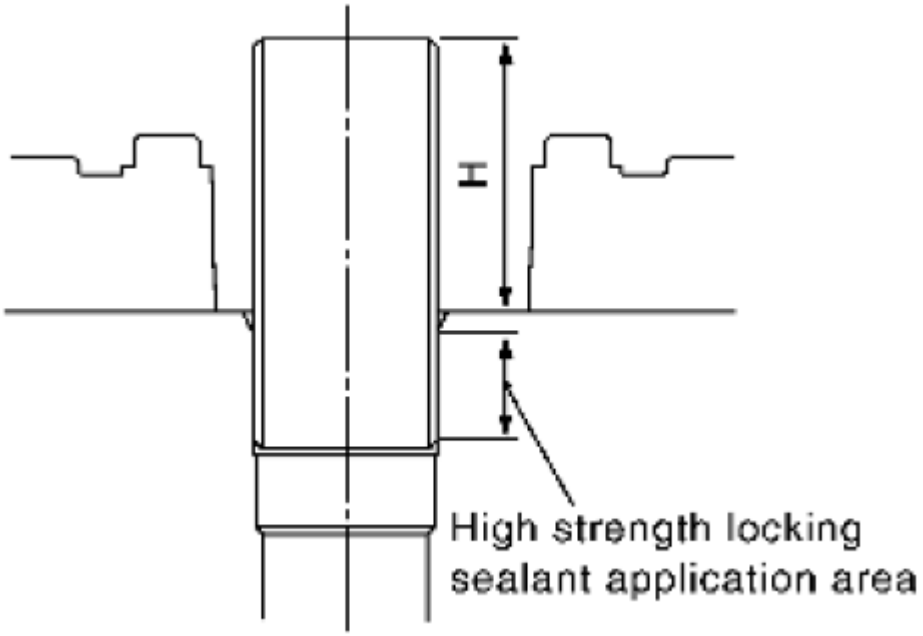
9. Install valve lifter.
   - Install it in the original position.
10. Install spark plug tube.
    - Press-fit spark plug tube as follows:

    a. Remove old liquid gasket adhering to cylinder head mounting hole.

    b. Apply sealant to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.

       Use Genuine High Strength Locking Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

    c. Press-fit spark plug tube so that its height (H) is as specified using suitable drift.



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Fig. 152: Pressing Spark Plug Tube Height
Courtesy of SUZUKI OF AMERICA CORP.

Standard press-fit height (H): 38.1 - 39.1 mm (1.500 - 1.539 in)

CAUTION:
- **When press-fitting, take care not to deform spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.**

11. Install spark plug.

CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY

VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [**SERVICE DATA AND SPECIFICATIONS**].
- If dimensions are out of the standard, replace valve and check the valve seat contact.

VALVE GUIDE CLEARANCE

Valve Stem Diameter

Measure the diameter of valve stem with micrometer.

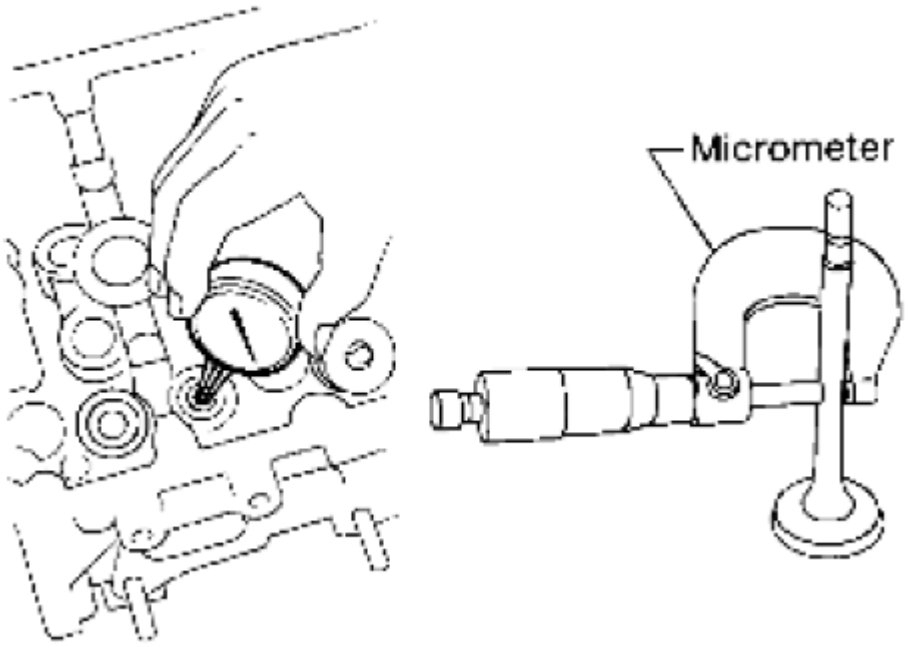


Fig. 153: Measuring Diameter Of Valve Stem With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

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Standard

Intake: 5.965 - 5.980 mm (0.2348 - 0.2354 in)

Exhaust: 5.955 - 5.970 mm (0.2344 - 0.2350 in)

Valve Guide Inner Diameter

Measure the inner diameter of valve guide with inside micrometer.

Standard

Intake and Exhaust: 6.000 - 6.018 mm (0.2362 - 0.2369 in)

Valve Guide Clearance

(Valve guide clearance) = (Valve guide inner diameter) - (Valve stem diameter).

Valve guide clearance: Standard

Intake: 0.020 - 0.053 mm (0.0008 - 0.0021 in)

Exhaust: 0.030 - 0.063 mm (0.0012 - 0.0025 in)

Limit

Intake: 0.08 mm (0.003 in)

Exhaust: 0.09 mm (0.004 in)

- If the calculated value exceeds the limit, replace valve and/or valve guide.

VALVE GUIDE REPLACEMENT

When valve guide is removed, replace with oversized [0.2 mm (0.008 in)] valve guide.

1. To remove valve guide, heat cylinder head to 110° to 130 °C (230° to 266 °F) by soaking in heated oil.

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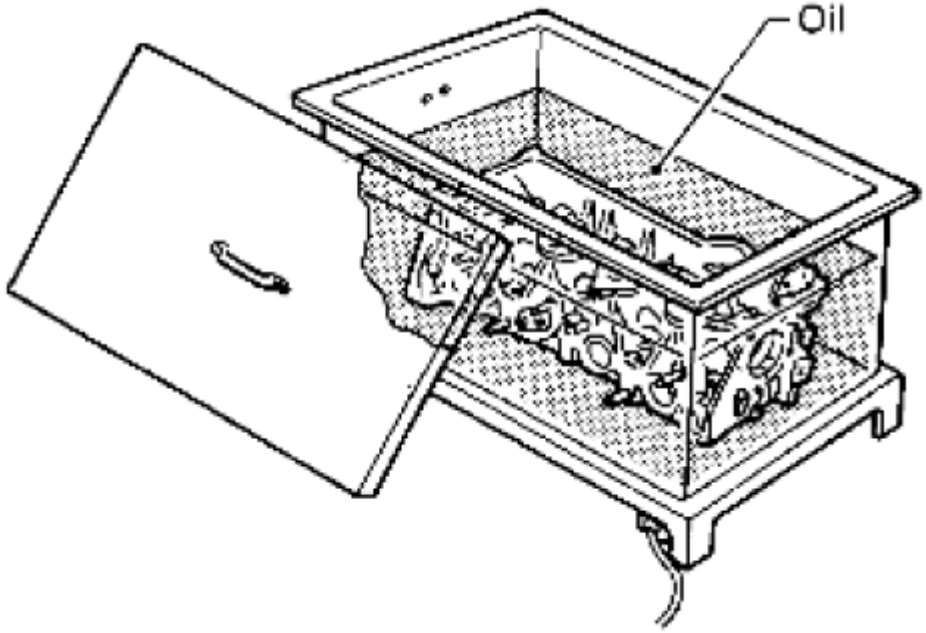


Fig. 154: Heating Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.

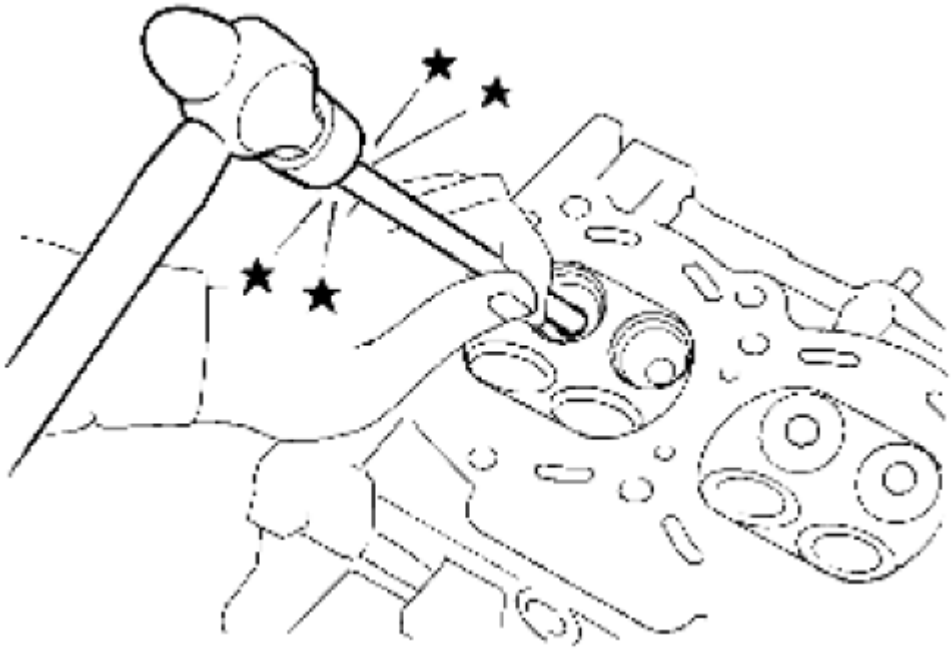


Fig. 155: Pressing Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

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WARNING: Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.

3. Ream cylinder head valve guide hole using suitable tool.

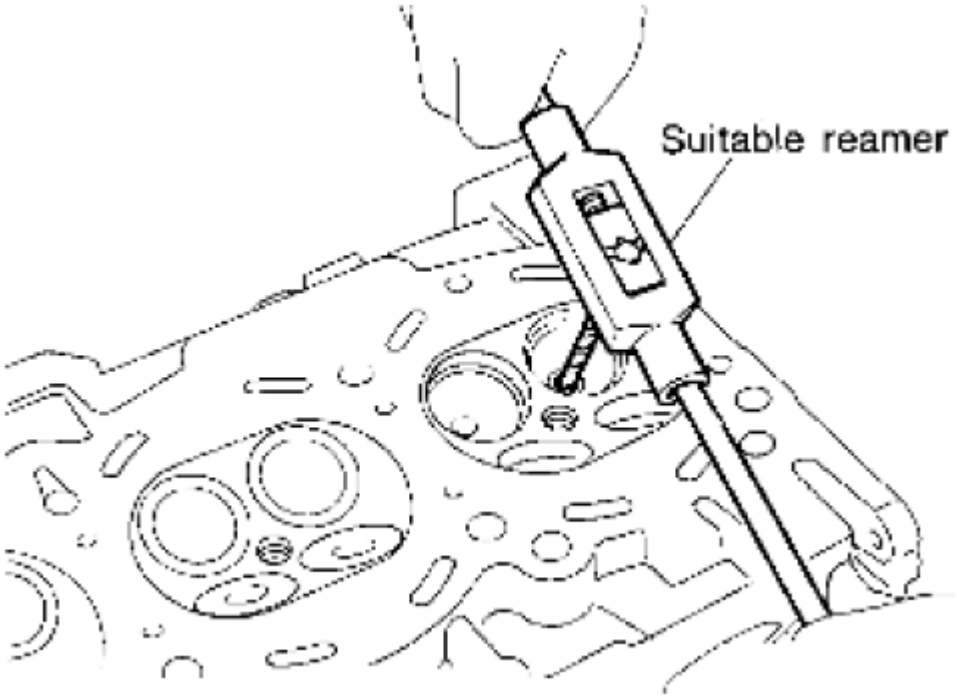


Fig. 156: Reaming Cylinder Head Valve Guide Hole Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

Valve guide hole diameter (for service parts):

Intake and exhaust: 10.175 - 10.196 mm (0.4006 - 0.4014 in)

4. Heat cylinder head to 110° to 130 °C (230° to 266 °F) by soaking in heated oil.

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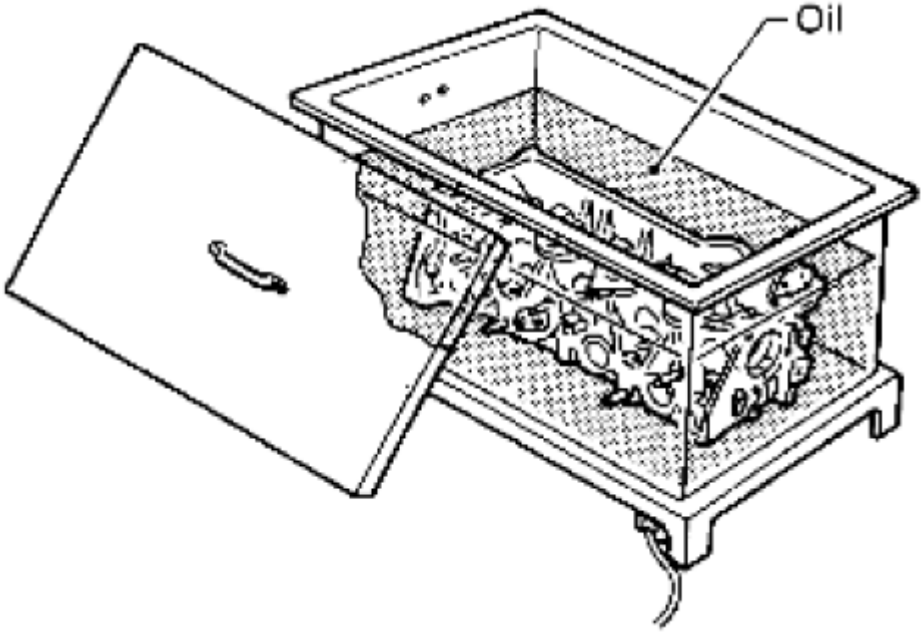


Fig. 157: Heating Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

5. Press valve guide from camshaft side to the dimensions as shown using suitable tool.

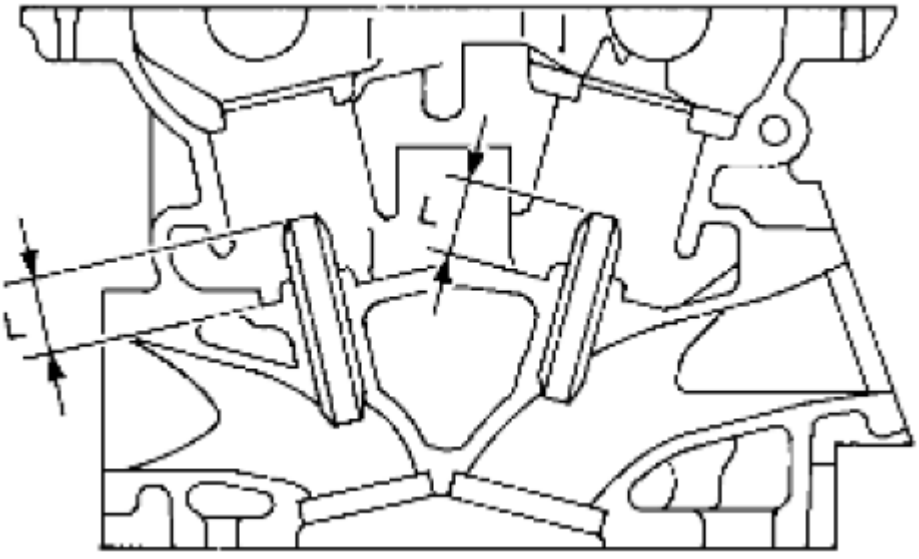


Fig. 158: Pressing Valve Guide From Camshaft Side
Courtesy of SUZUKI OF AMERICA CORP.

Projection "L"

Intake and exhaust: 12.6 - 12.8 mm (0.496 - 0.504 in)

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WARNING: Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.

6. Apply reamer finish to valve guide using suitable tool.

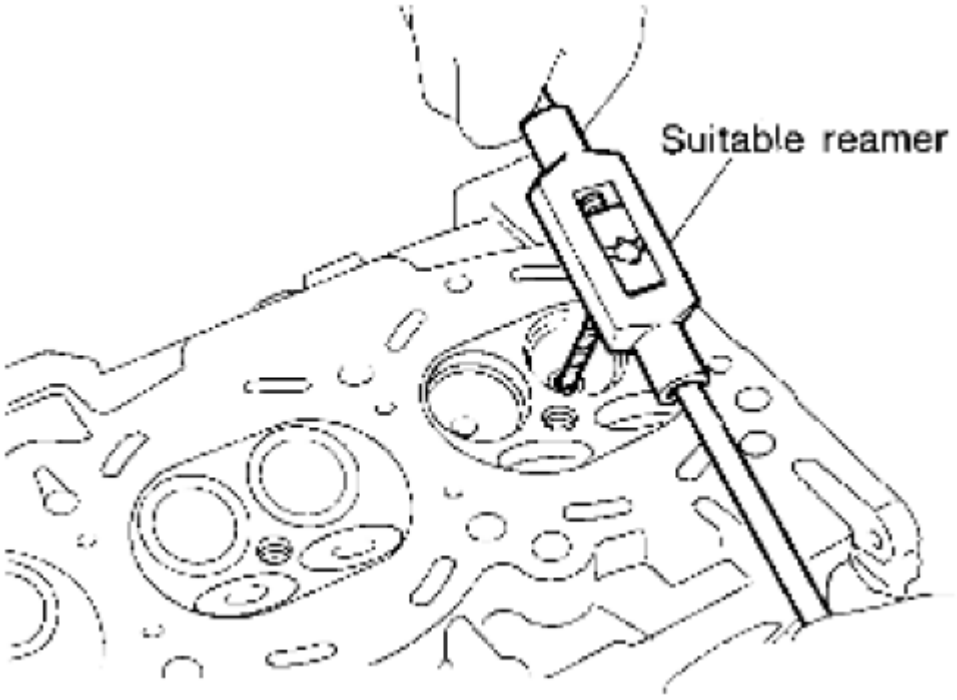


Fig. 159: Applying Reamer Finish To Valve Guide Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

Intake and exhaust: 6.000 - 6.018 mm (0.2362 - 0.2369 in)

VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.

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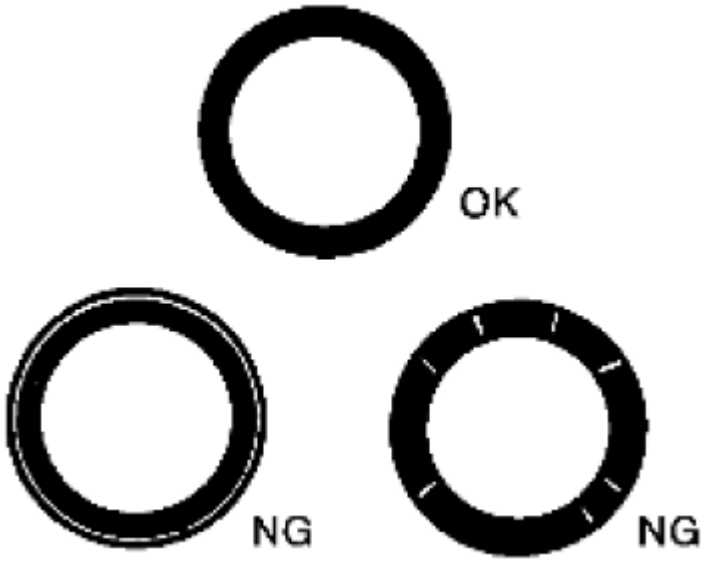


Fig. 160: Identifying Valve Guides And Valves
Courtesy of SUZUKI OF AMERICA CORP.

- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace valve seat.

VALVE SEAT REPLACEMENT

When valve seat is removed, replace with oversized [0.5 mm (0.020 in)] valve seat.

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

CAUTION: Prevent to scratch cylinder head by excessive boring.

2. Ream cylinder head recess diameter for service valve seat.

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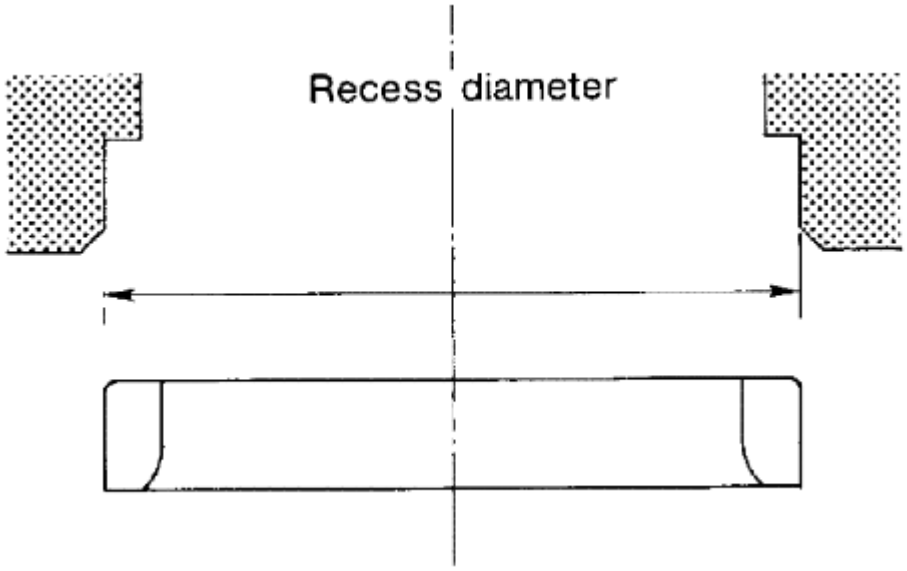


Fig. 161: Reaming Cylinder Head Recess Diameter For Service Valve Seat
Courtesy of SUZUKI OF AMERICA CORP.

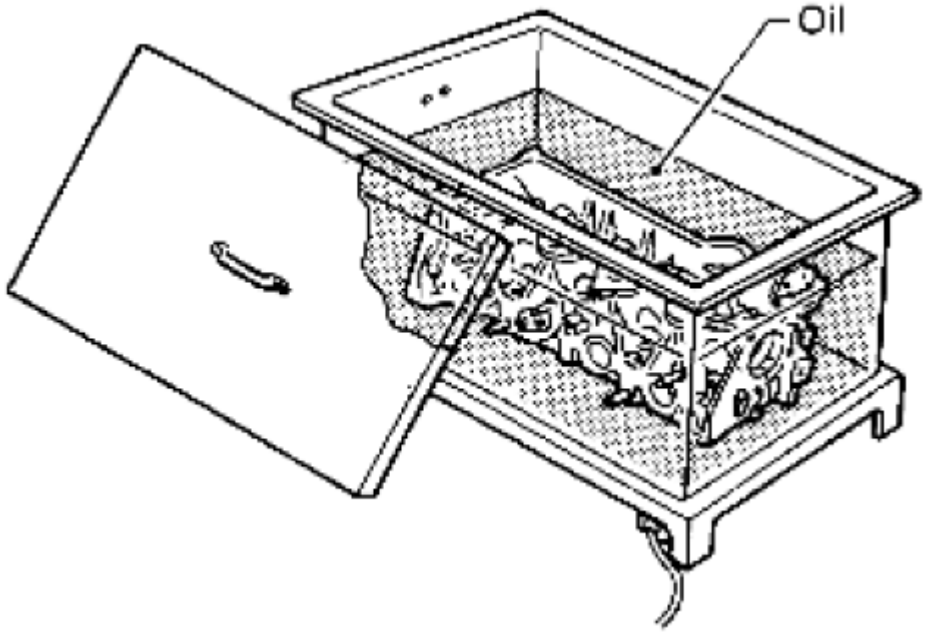
Oversize [0.5 mm (0.020 in)]

Intake: 38.500 - 38.516 mm (1.5157 - 1.5164 in)

Exhaust: 32.700 - 32.716 mm (1.2874 - 1.2880 in)

- Be sure to ream in circles concentric to valve guide center. This will enable valve to fit correctly.

3. Heat cylinder head to 110° to 130 °C (230° to 266 °F) by soaking in heated oil.



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Fig. 162: Heating Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

WARNING:
- **Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.**

CAUTION:
- **Avoid directly touching cold valve seats.**

5. Finish seat to the specified dimensions using suitable tool. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

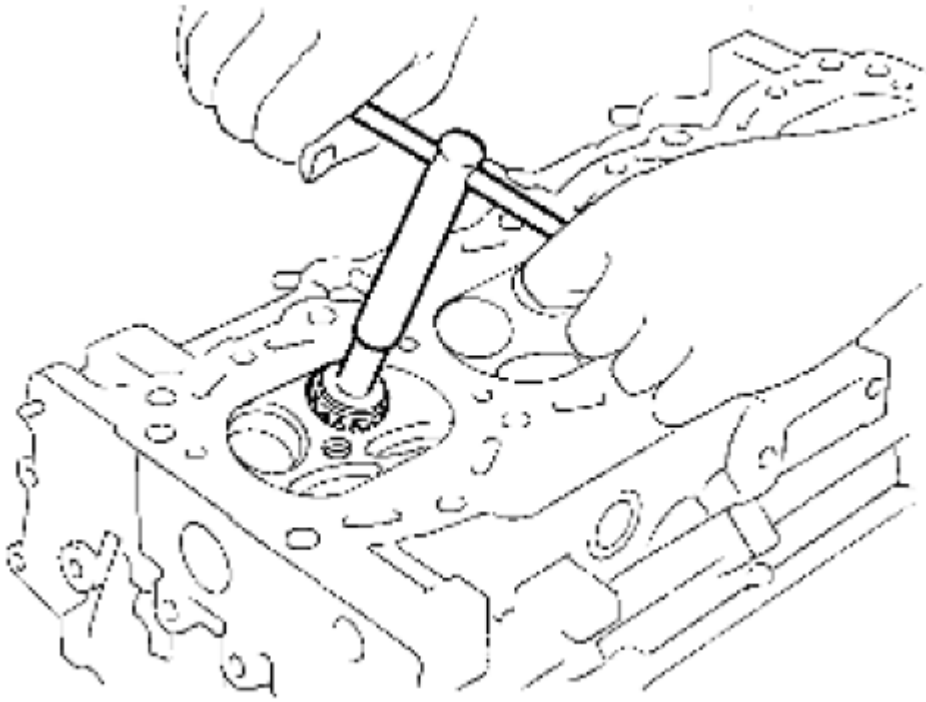


Fig. 163: Fitting Valve Seat Into Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: When using valve seat cutter, firmly grip cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with cutter or cutting many different times may result in staged valve seat.

6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact.

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VALVE SPRING SQUARENESS

- Set try square along the side of valve spring and rotate spring. Measure the maximum clearance between the top face of spring and try square.

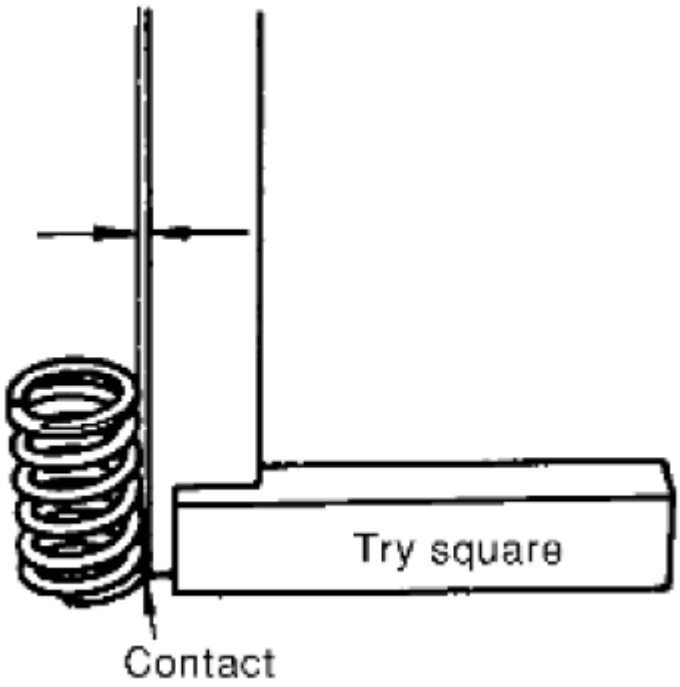


Fig. 164: Measuring Maximum Clearance Between Top Face Of Spring And Try Square
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 2.1 mm (0.083 in)

- If it exceeds the limit, replace valve spring.

VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure at the specified spring height.

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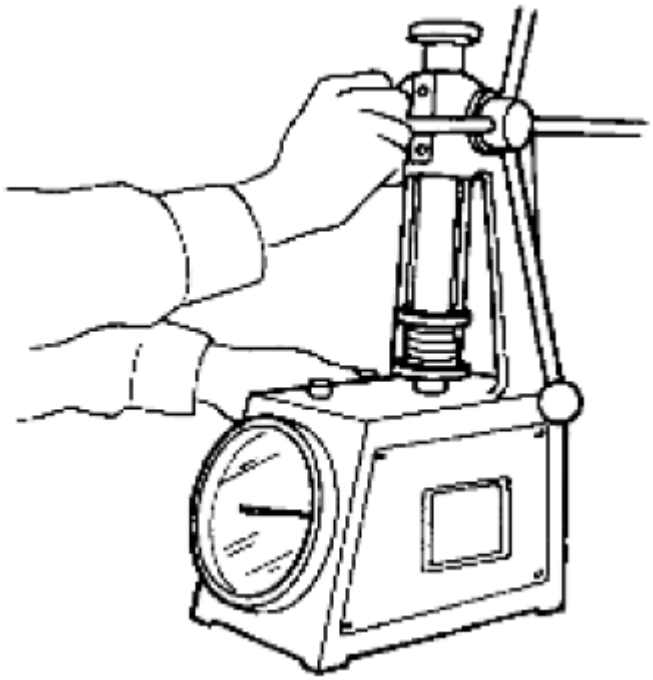


Fig. 165: Checking Valve Spring Pressure At Specified Spring Height
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

Intake and exhaust

Free height: 47.07 mm (1.8531 in)

Installation height: 37.00 mm (1.4567 in)

Installation load: 166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)

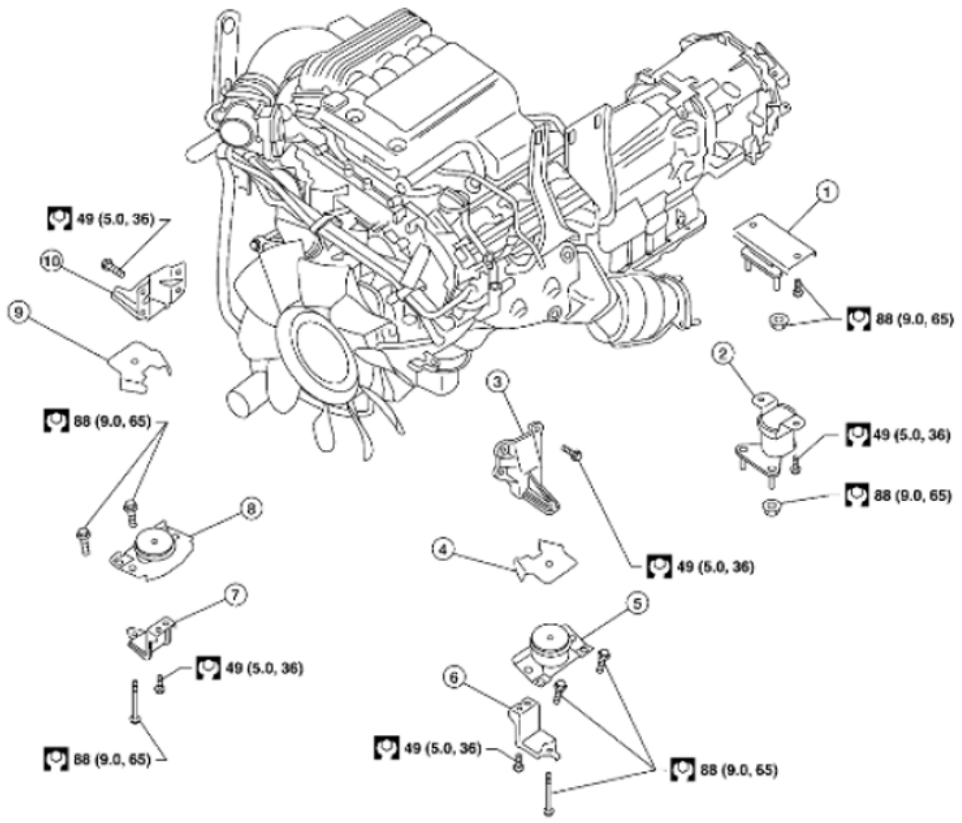
Height during valve open: 27.20 mm (1.0709 in)

Load with valve open: 373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb)

- If the installation load or load with valve open is out of the standard, replace valve spring.

ENGINE ASSEMBLY: EXPLODED VIEW

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1. Rear engine mounting insulator 4WD	2. Rear engine mounting insulator 2WD	3. LH engine mounting bracket (upper)
4. LH heat shield plate	5. LH engine mounting insulator	6. LH engine mounting bracket (lower)
7. RH engine mounting bracket (lower)	8. RH engine mounting insulator	9. RH heat shield plate
10. RH engine mounting bracket (upper)		

Fig. 166: Exploded View Of Engine Assembly With Torque Specification
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE ASSEMBLY: REMOVAL AND INSTALLATION

WARNING:

- **Situate vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.**

CAUTION:

- **Always be careful to work safely, avoid forceful or uninstructed operations.**

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- **Do not start working until exhaust system and engine coolant are cooled sufficiently.**
- **If items or work required are not covered by the engine article, follow the procedures in the applicable articles.**
- **Always use the support point specified for lifting.**
- **Use either 2-point lift type or separate type lift. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to [LIFTING POINT].**

REMOVAL

Preparation

1. Remove front and rear engine under covers, if equipped. Refer to **FRONT BUMPER: REMOVAL AND INSTALLATION**
2. Drain engine oil.
3. Remove engine oil filter.
4. Drain engine coolant. Refer to [**CHANGING ENGINE COOLANT**]
5. Partially drain A/T fluid. Refer to [**CHANGING THE A/T FLUID (ATF)**]
6. Remove the front wheels and tires.
7. Remove the front fender protectors. Refer to **FRONT FENDER PROTECTOR: REMOVAL AND INSTALLATION**
8. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: VQ40DE**]
9. Remove the engine hood. Refer to [**HOOD ASSEMBLY: REMOVAL AND INSTALLATION**]
10. Disconnect the battery negative terminal.
11. Remove engine room cover using power tools. Refer to **ENGINE ROOM COVER: REMOVAL AND INSTALLATION**
12. Remove the air duct and air cleaner case assembly. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].
13. Disconnect vacuum hose between vehicle and engine and set it aside.
14. Remove the radiator assembly and hoses. Refer to [**RADIATOR: REMOVAL AND INSTALLATION**]
15. Remove the drive belts. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
16. Remove the engine cooling fan. Refer to [**ENGINE COOLING FAN: REMOVAL AND INSTALLATION (CRANKSHAFT DRIVEN TYPE)**]
17. Disconnect the engine room harness from the engine side and set it aside.
18. Disconnect the engine harness grounds.
19. Disconnect the reservoir tank for power steering from engine and move it aside.

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20. Disconnect power steering oil pump from engine. Move it from its location and secure with a rope. Refer to [**POWER STEERING OIL PUMP: REMOVAL AND INSTALLATION**]
21. Remove the A/C compressor bolts and set aside. Refer to [**COMPRESSOR: REMOVAL AND INSTALLATION**]
22. Disconnect brake booster vacuum line.
23. Disconnect EVAP line.
24. Disconnect the fuel hose at the engine side connection. Refer to [**FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [VQ40DE]**]
25. Disconnect the heater hoses at cowl, and install plugs to avoid leakage of engine coolant.
26. Remove the A/T oil level indicator and indicator tube.
27. Remove front final drive assembly (4WD models). Refer to [**FRONT FINAL DRIVE ASSEMBLY: REMOVAL AND INSTALLATION**]
28. Remove three way catalyst. Refer to [**EXHAUST MANIFOLD AND THREE WAY CATALYST: REMOVAL AND INSTALLATION [VQ40DE]**]
29. Install engine slingers into left bank and right bank.

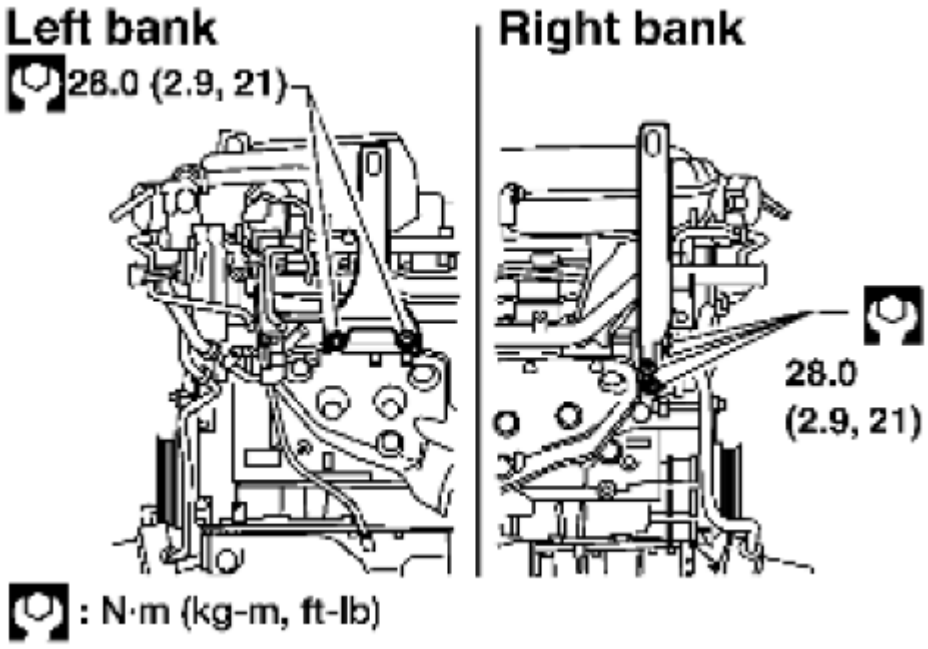


Fig. 167: Installing Engine Slingers Into Left Bank And Right Bank
Courtesy of SUZUKI OF AMERICA CORP.

Engine slinger torque: 28.0 N.m (2.9 kg-m, 21 ft-lb)

30. Remove front frame crossmember.
31. Remove transmission. Refer to [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE (FOR 2WD MODELS)**] (2WD M/T models) [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE (FOR 4WD MODELS)**] (4WD M/T models), [**TRANSMISSION ASSEMBLY: REMOVAL AND**

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INSTALLATION FOR VQ40DE 2WD MODELS] (2WD A/T models), [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FOR VQ40DE 4WD MODELS**] (4WD A/T models).

32. Lift with hoist and secure the engine in position.
33. Remove engine assembly from vehicle, avoiding interference with vehicle body.

CAUTION:
- **Before and during this lifting, always check if any harnesses are left connected.**

34. Remove the parts that may restrict installation of engine to engine stand.

NOTE: **The procedure is described assuming that you use a engine holding the surface, to which transmission is installed.**

a. Remove clutch cover and clutch disc (M/T models). Refer to **CLUTCH DISC, CLUTCH COVER: REMOVAL AND INSTALLATION [6M/T]**
b. Remove flywheel (M/T models) or drive plate (A/T models).
   - Holding crankshaft pulley bolts, lock crankshaft to remove flywheel or drive plate bolts.
   - Loosen bolts diagonally.

CAUTION:
- **Be careful not to damage drive plate. Especially avoid deforming and damaging of signal plate teeth (circumference position).**

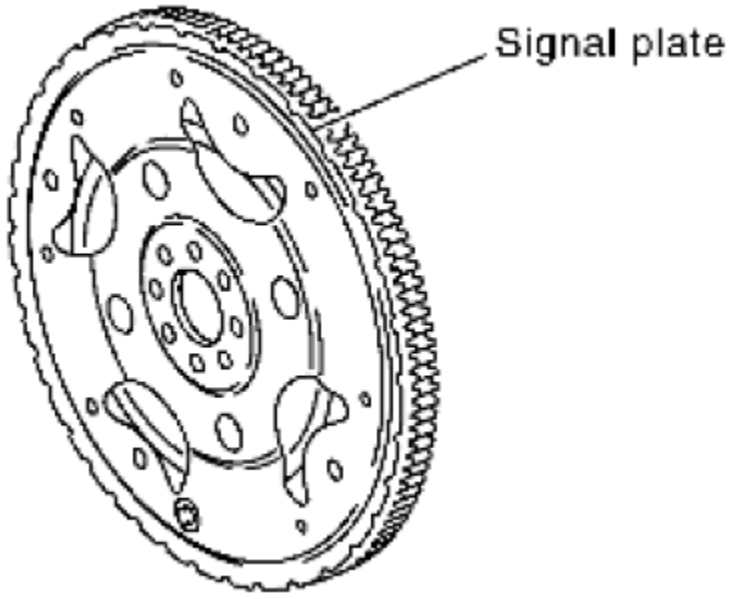


Fig. 168: Identifying Signal Plate Teeth
Courtesy of SUZUKI OF AMERICA CORP.

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- **Place the drive plate with signal plate surface facing other than downward.**
- **Keep magnetic materials away from signal plate.**

CAUTION: Use an engine stand that has a load capacity [approximately 240kg (529 lb) or more] large enough for supporting the engine weight.

- **If the load capacity of the stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning the stand.**
  - **Remove fuel tube and fuel injector assembly. Refer to [FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [VQ40DE]].**
  - **Remove intake manifold. Refer to [INTAKE MANIFOLD: REMOVAL AND INSTALLATION].**
  - **Remove rocker cover. Refer to [ROCKER COVER: REMOVAL AND INSTALLATION].**
  - **Other removable brackets.**

CAUTION: Before removing the hanging chains, make sure the engine stand is stable and there is no risk of overturning.

35. Remove generator. Refer to [**GENERATOR: REMOVAL AND INSTALLATION - VQ40DE MODELS**]
36. Remove engine mounting insulator bracket (upper) with power tool.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

- **When replacing an engine or transmission you must make sure the dowels are installed correctly during reassembly.**
- **Improper alignment caused by missing dowels may cause vibration, oil leaks or breakage of drivetrain components.**

INSPECTION AFTER INSTALLATION

- Before starting the engine, check oil/fluid levels including engine coolant and engine oil. If the levels are lower than required quantity, fill to the specified level. Refer to [**RECOMMENDED FLUIDS AND LUBRICANTS**]
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to the fuel piping, check for

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fuel leakage at the connection points.

- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE: If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

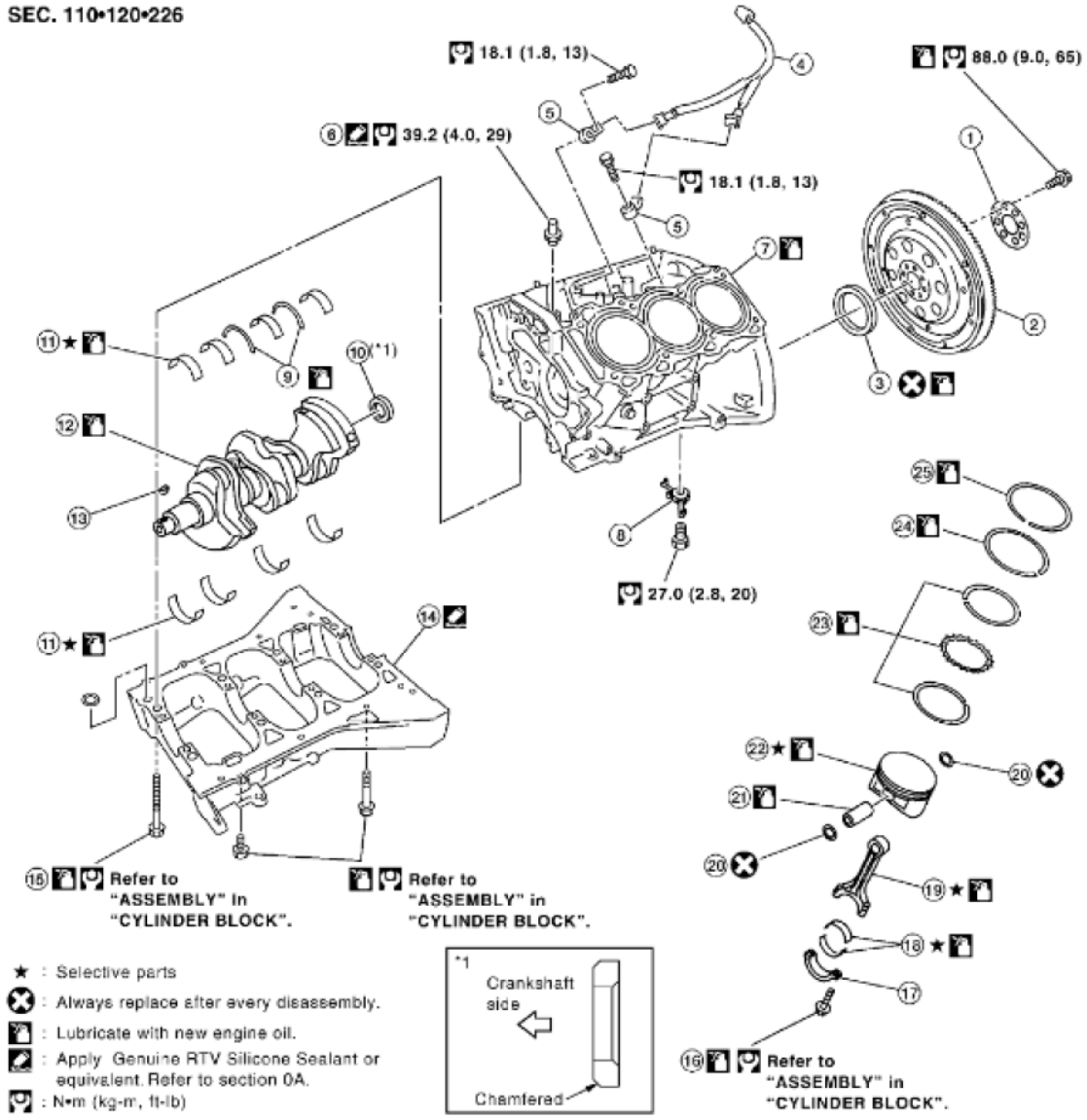
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level if necessary.
- Summary of the inspection items:

ITEM SPECIFICATION

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluids(1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gas	-	Leakage	-
(1) Transmission fluid, power steering fluid, brake fluid, etc.			

ENGINE UNIT: EXPLODED VIEW

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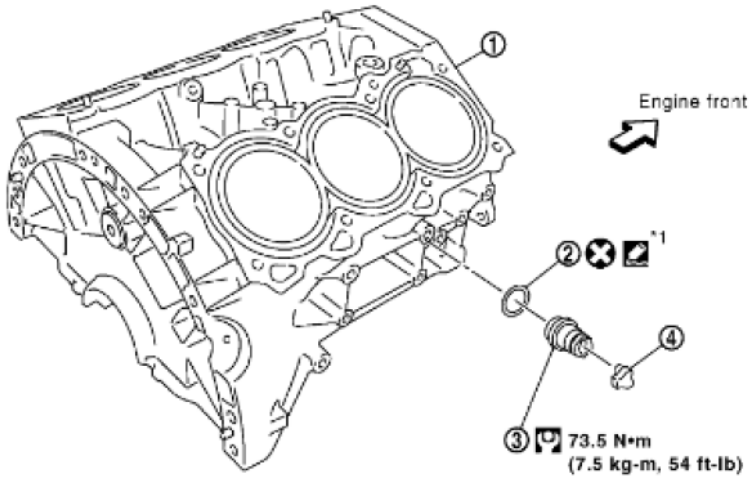


1. Reinforcement plate	2. Drive plate (A/T models), Flywheel (M/T models)	3. Rear oil seal
4. Sub harness	5. Knock sensor	6. Water connector
7. Cylinder block	8. Oil jet	9. Thrust bearing
10. Pilot converter (A/T models)	11. Main bearing	12. Crankshaft
13. Crankshaft key	14. Lower cylinder block	15. Lower cylinder block bolt
16. Connecting rod bolt	17. Connecting rod bearing cap	18. Connecting rod bearing
19. Connecting rod	20. Snap ring	21. Piston pin
22. Piston	23. Oil ring	24. Second ring
25. Top ring		

Fig. 169: Exploded View Engine Unit With Torque Specification (1 Of 2)
Courtesy of SUZUKI OF AMERICA CORP.

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For Canada
SEC. 110



- Install cylinder block heater with heater part downward as shown in the figure.
- Remove liquid gasket completely after removing cylinder block heater.

: Apply Anaerobic Liquid Gasket or equivalent. Refer to section 0A.
*1 Sealing point : Front and reverse side.
: Always replace after every disassembly.

1. Cylinder block	2. Gasket	3. Cylinder block heater
4. Connector protector cap		

Fig. 170: Exploded View Engine Unit With Torque Specification (2 Of 2)
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE UNIT: DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

NOTE: Explained here is how to disassemble with engine stand supporting transmission surface. When using different type of engine stand, some steps may be different.

1. Remove the engine and the transmission assembly from the vehicle, and separate the transmission assembly from the engine. Refer to [**ENGINE ASSEMBLY: REMOVAL AND INSTALLATION**].
2. Remove both exhaust manifolds. Refer to **EXHAUST MANIFOLD: REMOVAL AND INSTALLATION [VQ40DE]**
3. Remove pilot converter (A/T models) using Tool as necessary.

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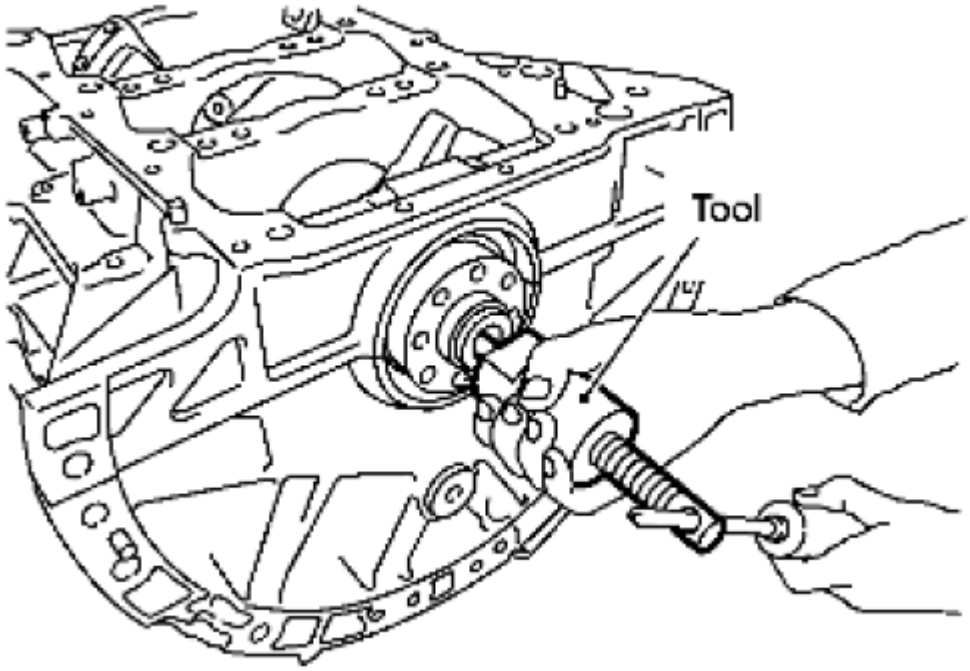


Fig. 171: Removing Pilot Converter (A/T Models)
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: ST16610001 (J-23907)

4. Lift engine, and mount to engine stand.

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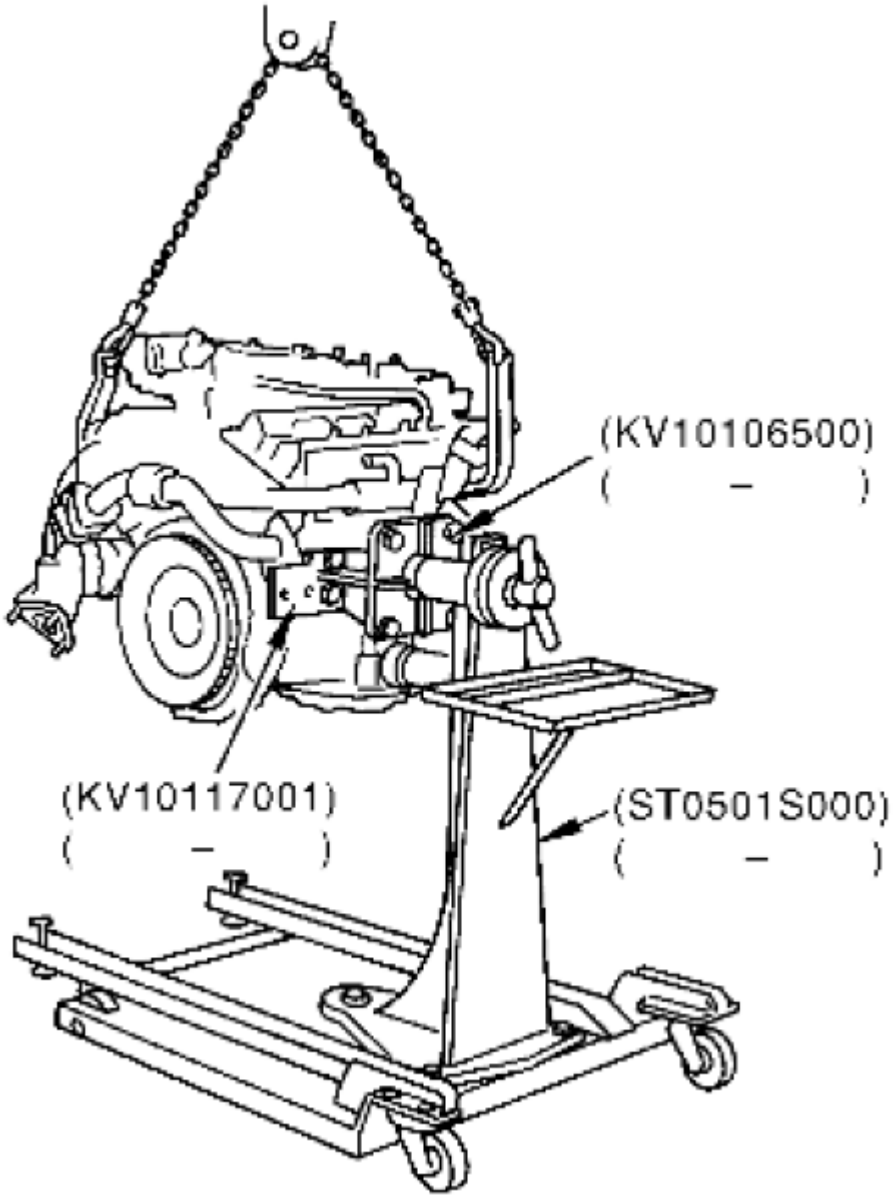


Fig. 172: Lifting Engine And Mount To Engine Stand
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Before removing the hanging chains, make sure engine stand is stable and there is no risk of overturning.

- A widely use engine stand can be used.

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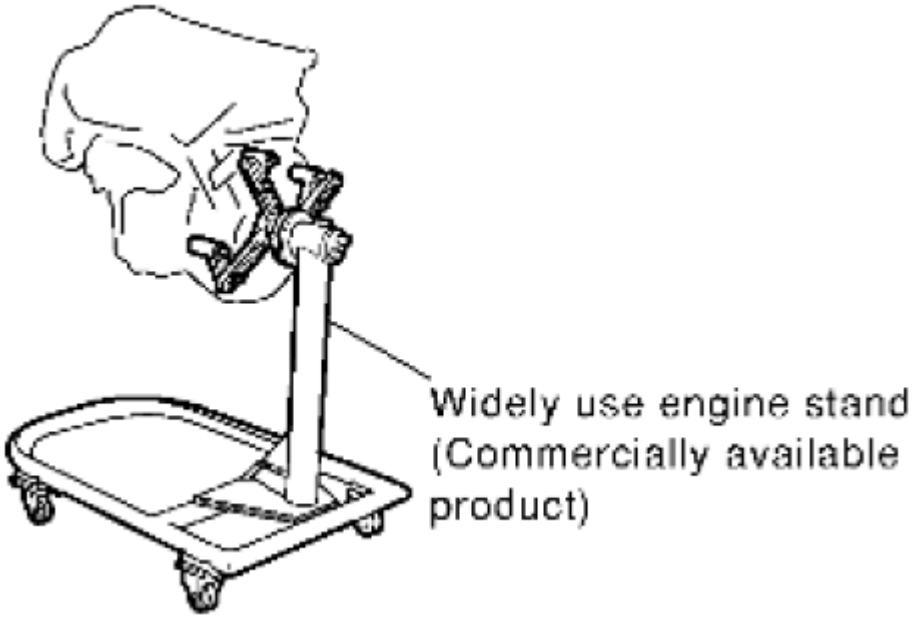


Fig. 173: Identifying Engine Stand
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Use engine stand that has a load capacity [approximately 220 kg (441 lb) or more] large enough for supporting the engine weight.

5. Drain engine oil. Refer to [**CHANGING ENGINE OIL**]
6. Drain engine coolant by removing the cylinder block drain plugs (A), (B), (C) and (D) from cylinder block as shown.

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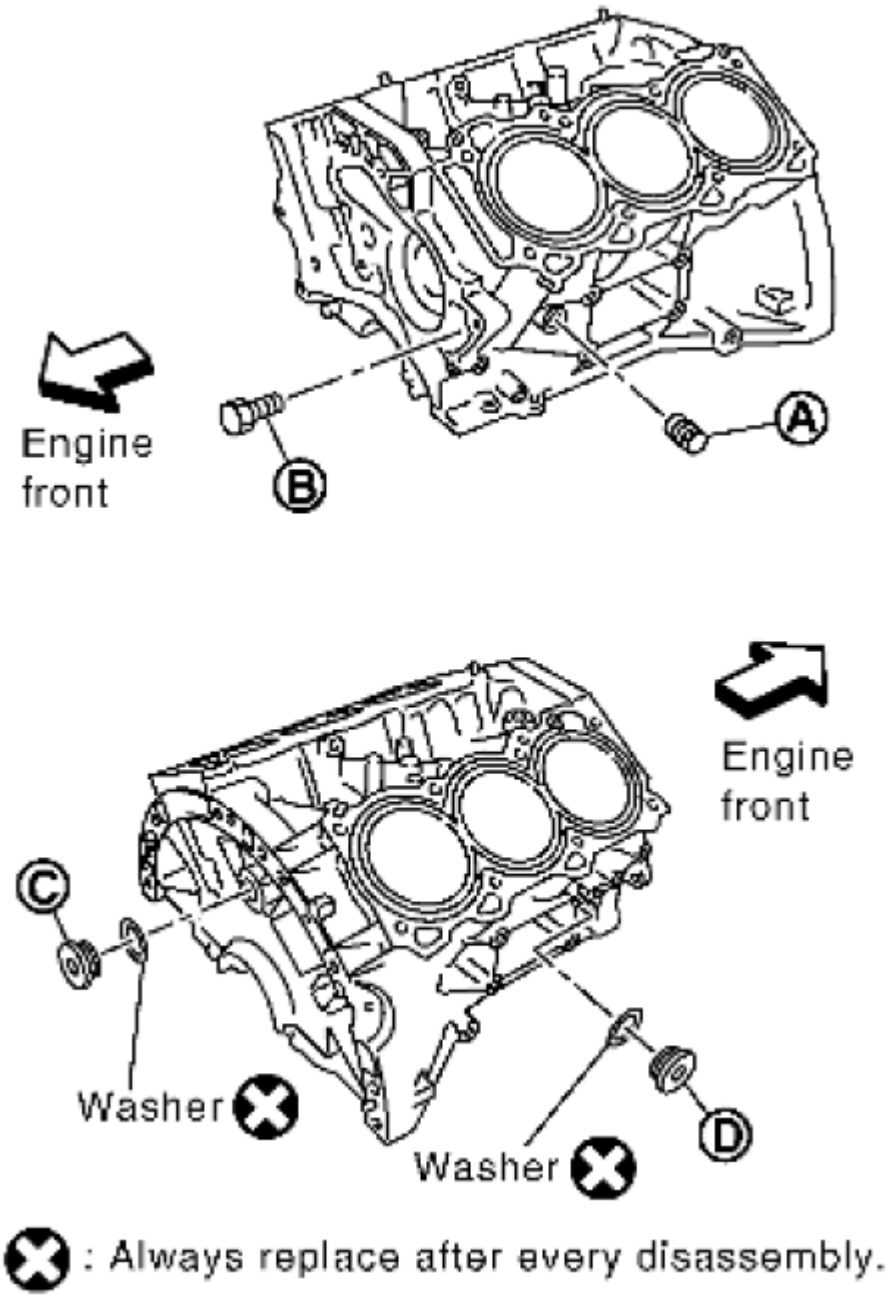


Fig. 174: Identifying Cylinder Block Drain Plugs And Washer
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: For Canada, (D) is not plug but block heater.

7. Remove cylinder head. Refer to [**CYLINDER HEAD: REMOVAL AND INSTALLATION**].
8. Remove sub harness, and remove knock sensors.

CAUTION: Carefully handle sensor avoiding shocks.

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9. Remove piston and connecting rod assembly as follows:
   - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].

CAUTION: Be careful not to drop connecting rod bearing, and to scratch the surface.

10. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
11. Remove connecting rod bearing cap.
12. Push piston and connecting rod assembly out to the cylinder head side using suitable tool.

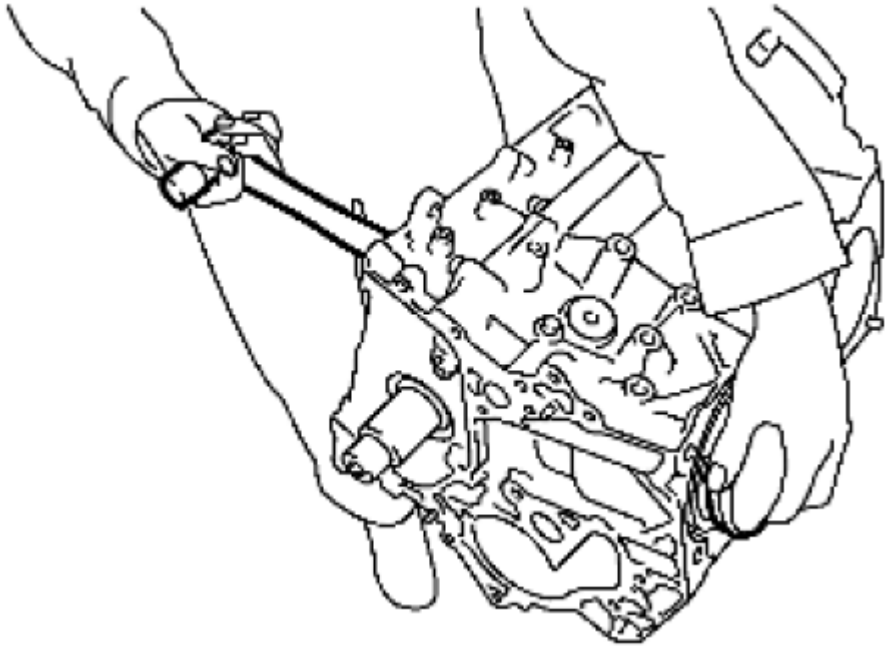


Fig. 175: Pushing Piston And Connecting Rod Assembly
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.

13. Remove connecting rod bearings from connecting rod and connecting rod bearing cap.

CAUTION: Identify installation position, and store them without mixing them up.

14. Remove piston rings from piston.
    - Before removing piston rings, check the piston ring side clearance. Refer to [**ENGINE UNIT:**

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INSPECTION AFTER DISASSEMBLY].

- Remove piston rings using piston ring expander or suitable tool.

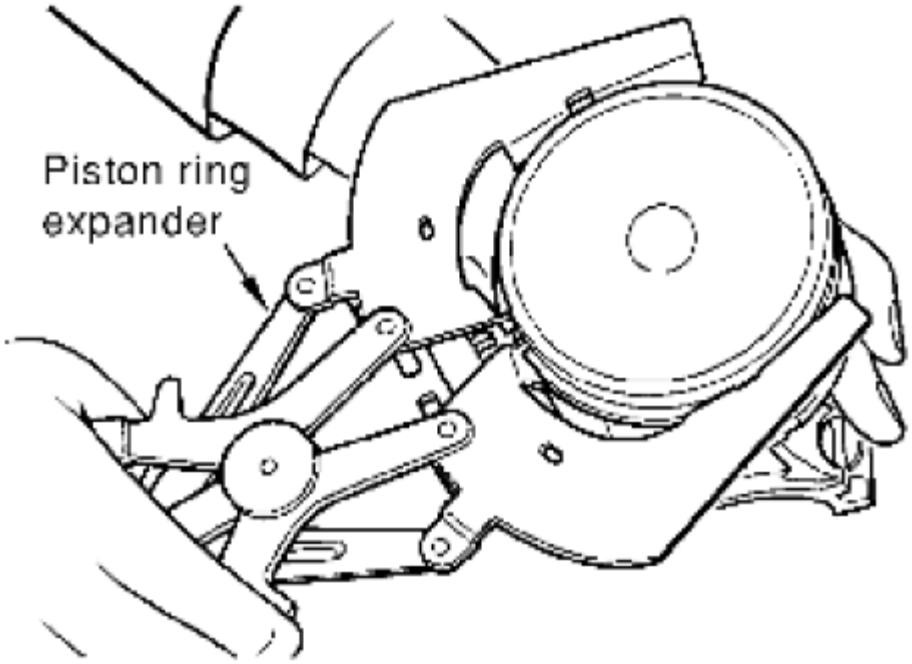


Fig. 176: Removing Piston Rings Using Piston Ring Expander Or Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **When removing piston rings, be careful not to damage piston.**
- **Be careful not to damage piston rings by expanding them excessively.**

15. Remove piston from connecting rod as follows:
    a. Remove snap ring using snap ring pliers.

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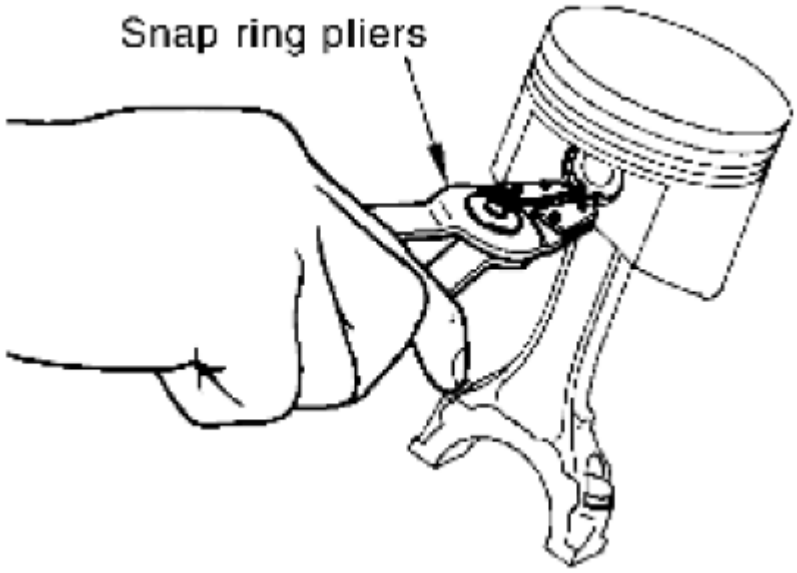


Fig. 177: Removing Snap Ring Using Snap Ring Pliers
Courtesy of SUZUKI OF AMERICA CORP.

b. Heat piston to 60° to 70 °C (140° to 158 °F) with industrial use drier or equivalent.

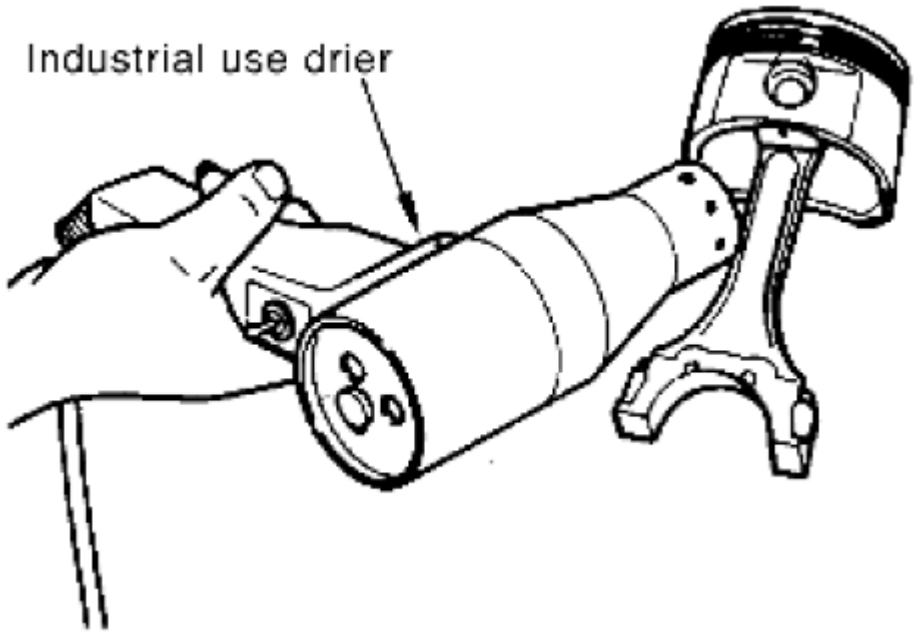


Fig. 178: Heating Piston
Courtesy of SUZUKI OF AMERICA CORP.

c. Push out piston pin with stick of outer diameter approximately 20 mm (0.79 in).

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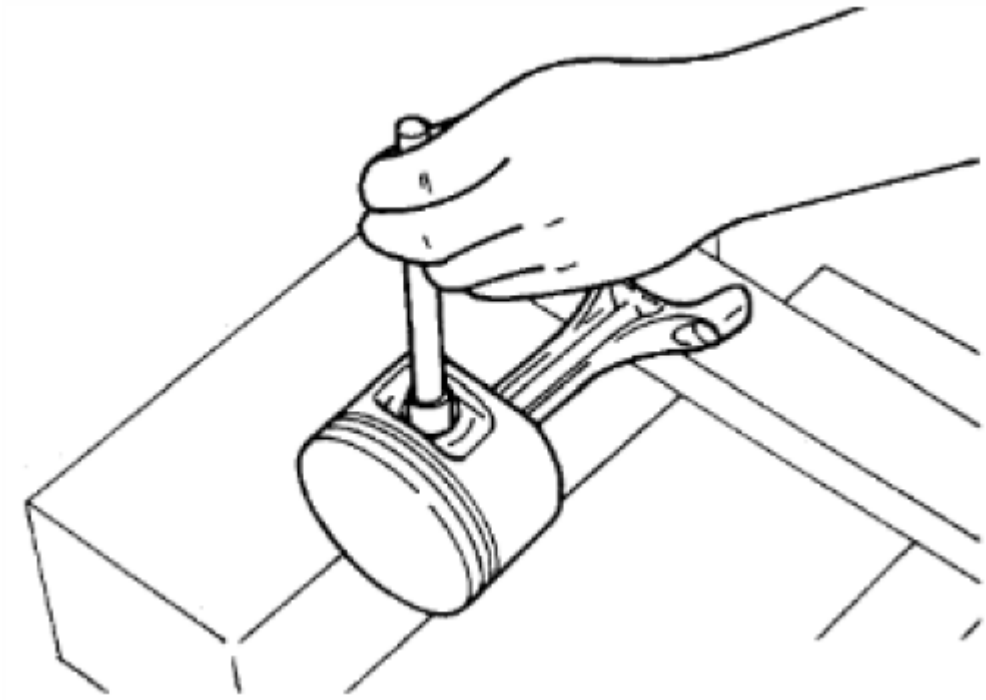


Fig. 179: Pushing Piston Pin
Courtesy of SUZUKI OF AMERICA CORP.

16. Remove lower cylinder block bolts.
    - Before loosening lower cylinder block bolts, measure the crankshaft end play. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
    - Loosen lower cylinder block bolts in reverse order as shown in several different steps.

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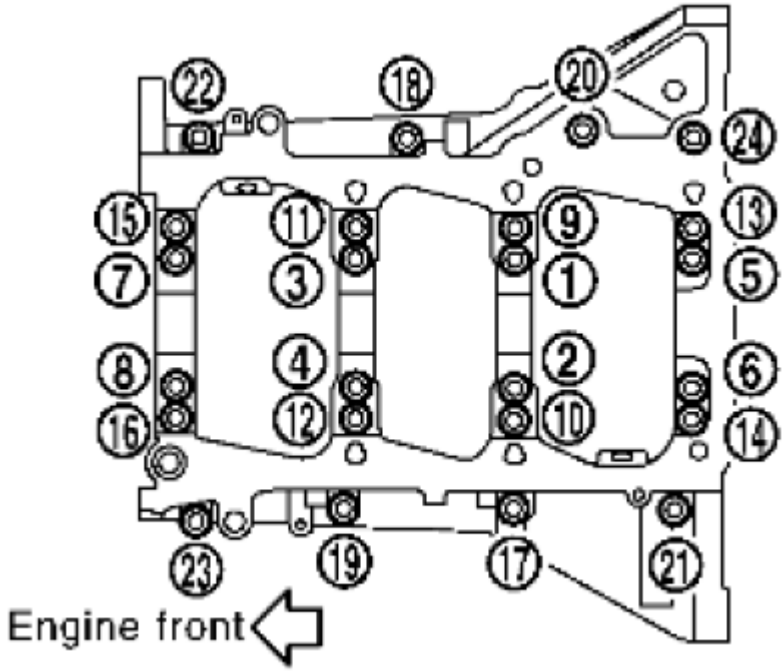


Fig. 180: Identifying Lower Cylinder Block Bolts
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Use TORX socket (size E14) for bolts No. 1 to 16 (M10 bolt).

17. Remove lower cylinder block.
    - Cut liquid gasket for removal. Refer to [**PRECAUTION FOR LIQUID GASKET**].

    Tool number: KV10111100 (J-37228)

    CAUTION: Be careful not to damage the mounting surfaces.

18. Remove crankshaft.
19. Pull rear oil seal out from rear end of crankshaft.

    NOTE: When replacing rear oil seal without removing lower cylinder block, use a suitable tool to pull the rear oil seal installed between crankshaft and cylinder block out.

    CAUTION: Be careful not to damage crankshaft and cylinder block.

20. Remove main bearings and thrust bearings from cylinder block and lower cylinder block.

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CAUTION:

- **Do not drop main bearing, or scratch the surface.**
- **Identify installation positions, and store them without mixing them up.**

21. Remove oil jet.

ASSEMBLY

1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

WARNING: Use a goggles to protect your eyes.

2. Install each plug to cylinder block as shown.

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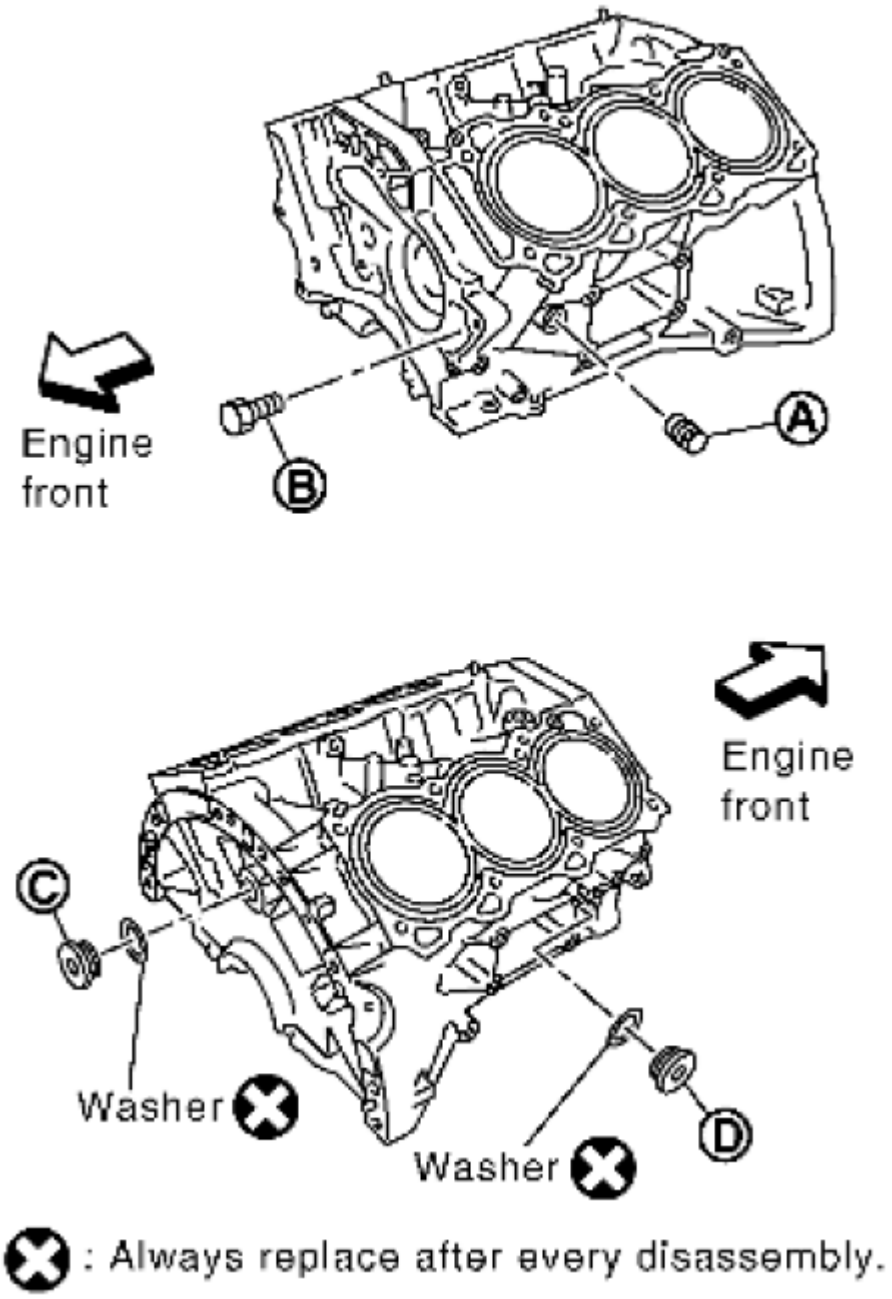


Fig. 181: Identifying Drain Plugs And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

- Apply sealant to the thread of water drain plugs (A) and (B).

  Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

- Apply sealant to the thread of plug (C).

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Use Genuine High Strength Thread Locking Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

- Apply sealant to the threads of plug (D).

Use Anaerobic Liquid Gasket or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

NOTE: For Canada, (D) is not plug but block heater. Refer to [ENGINE UNIT: DISASSEMBLY AND ASSEMBLY].

- Replace washers with new one.
- Tighten each plug as specified below.

Block Plug and Block Heater Installation

TIGHTENING TORQUE SPECIFICATION

Part		Washer	Tightening Torque
A		No	19.6 N.m (2.0 kg-m, 14 ft-lb)
B	Reuse	No	9.8 N.m (1.0 kg-m, 87 in-lb)
	New		6.0 N.m (0.61 kg-m, 53 in-lb)
C		Yes	116 N.m (11.8 kg-m, 85 ft-lb)
D	Plug	Yes	62 N.m (6.3 kg-m, 46 ft-lb)
	Block heater		73.5 N.m (7.5 kg-m, 54 ft-lb)

3. Install oil jet.
   - Insert oil jet dowel pin into cylinder block dowel pin hole, and tighten bolts.

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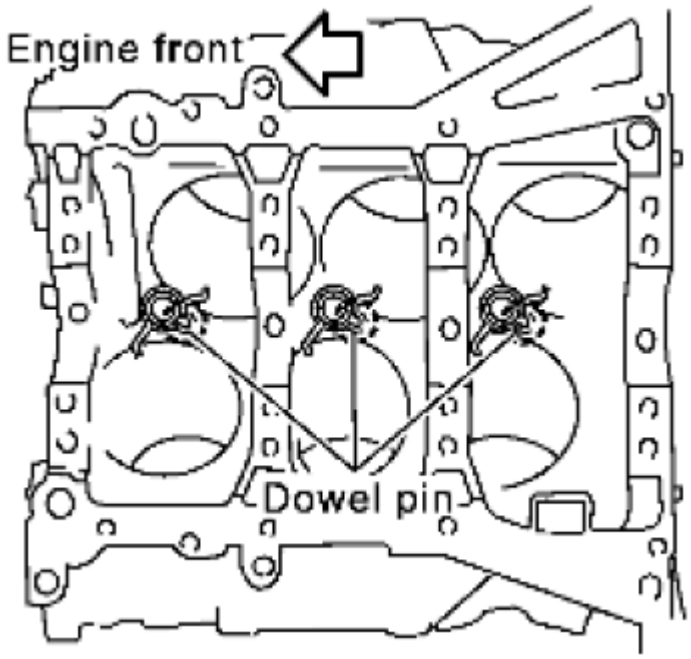


Fig. 182: Inserting Oil Jet Dowel Pin Into Cylinder Block Dowel Pin Hole
Courtesy of SUZUKI OF AMERICA CORP.

4. Install main bearings and thrust bearings as follows:
   a. Remove dust, dirt, and engine oil on bearing mating surfaces of cylinder block and main bearing caps.
   b. Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block.

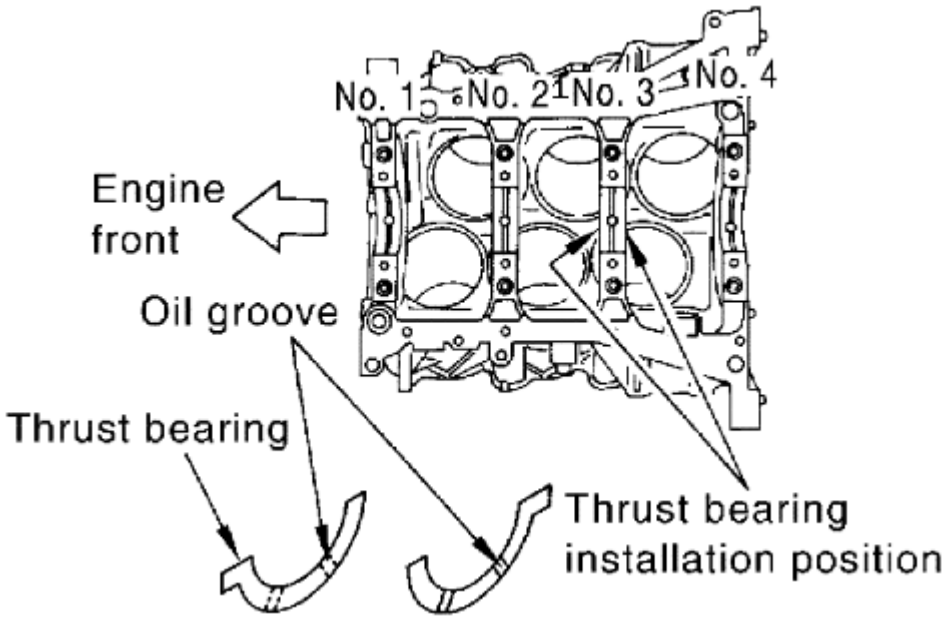


Fig. 183: Identifying Thrust Bearing
Courtesy of SUZUKI OF AMERICA CORP.

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- Install thrust bearings with the oil groove facing crankshaft arm (outside).
- Install thrust bearing with a projection on one end on cylinder block, Align projection with mating notch.

c. Install main bearings paying attention to the direction.

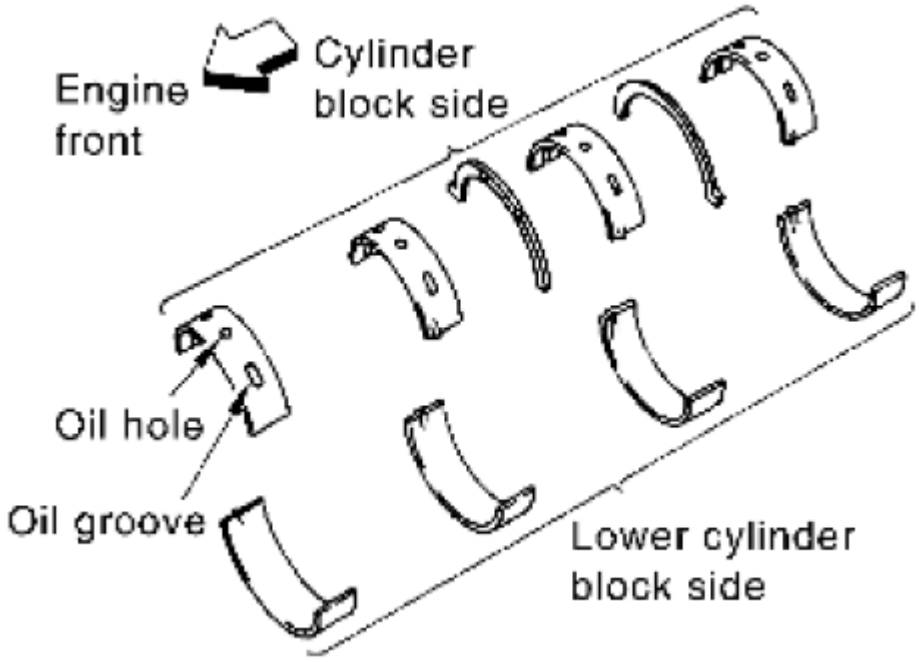


Fig. 184: Identifying Main Bearings Oil Hole And Oil Groves
Courtesy of SUZUKI OF AMERICA CORP.

- Main bearing with oil hole and groove goes on cylinder block. The one without them goes on lower cylinder block.
- Before installing main bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing stopper protrusion to cutout of cylinder block and lower cylinder block.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.

5. Install crankshaft to cylinder block.
   - While turning crankshaft by hand, check that it turns smoothly.
6. Inspect the outer diameter of lower cylinder block bolt. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
7. Install lower cylinder block as follows:

NOTE: Lower cylinder block cannot be replaced as a single part, because it is machined together with cylinder block.

a. Apply a continuous bead of liquid gasket using Tool to lower cylinder block as shown.

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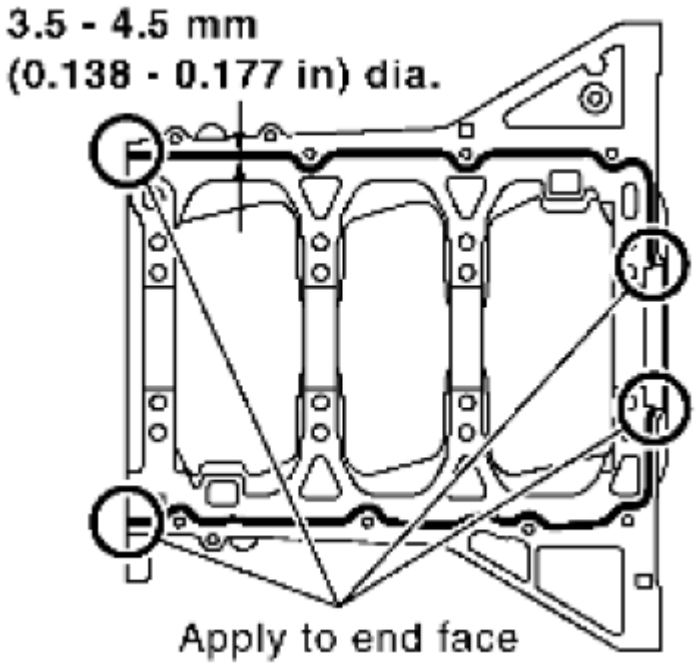


Fig. 185: Applying Continuous Bead Of Liquid Gasket Using Tool To Lower Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

Use Genuine RTV Silicone Sealant or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**].

CAUTION: After liquid gasket is applied, rear oil seal installation must be finished within 5 minutes. Therefore, the following procedure must be performed quickly.

b. Tighten lower cylinder block as follows:
   i. Apply new engine oil to threads and seat surfaces of the bolts.
   ii. Tighten M8 bolts in numerical order as shown from No. 17 to 24.

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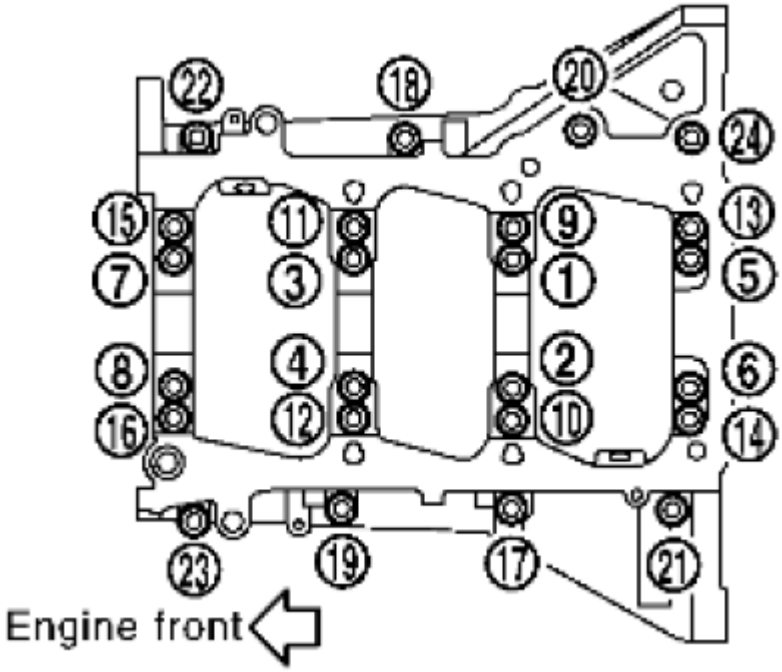


Fig. 186: Identifying Lower Cylinder Block Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

Bolts 17 - 24: 22.1 N.m (2.3 kg-m, 16 ft-lb)

CAUTION: Wipe off completely any protruding liquid gasket on rear oil seal installation surface.

NOTE: There are more processes to complete the tightening bolts. However stop procedure here to install rear oil seal.

c. Install rear oil seal. Refer to [**REAR OIL SEAL: REMOVAL AND INSTALLATION**].
d. Restart tightening of lower cylinder block bolts as follows:
    i. Tighten M10 bolts in numerical order as shown from No. 1 to 16.

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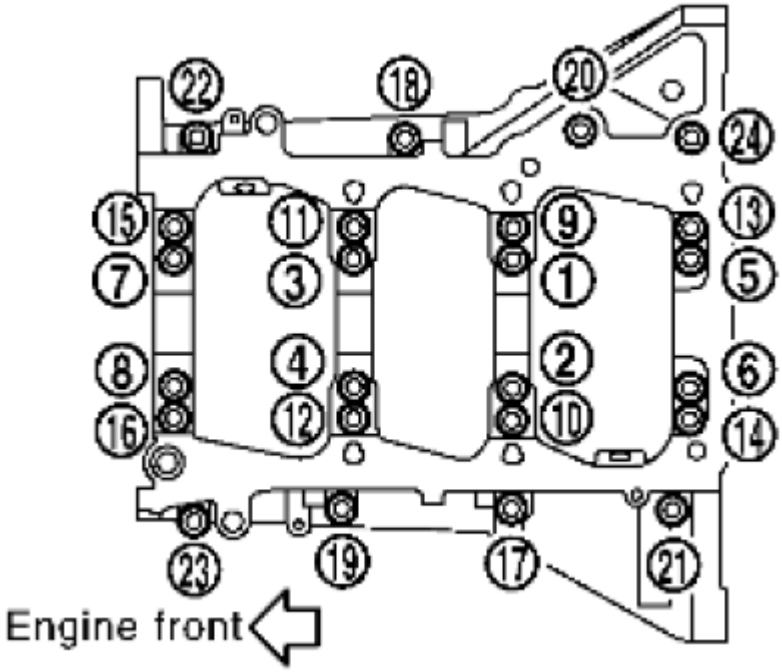


Fig. 187: Identifying Lower Cylinder Block Bolts Tighten Sequence
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Use TORX socket (size E14) for bolts No. 1 to 16 (M10 bolt).

Bolts 1 - 16: 35.3 N.m (3.6 kg-m, 26 ft-lb)

ii. Turn M10 bolts 90° clockwise in numerical order from No. 1 to 16 using Tool.

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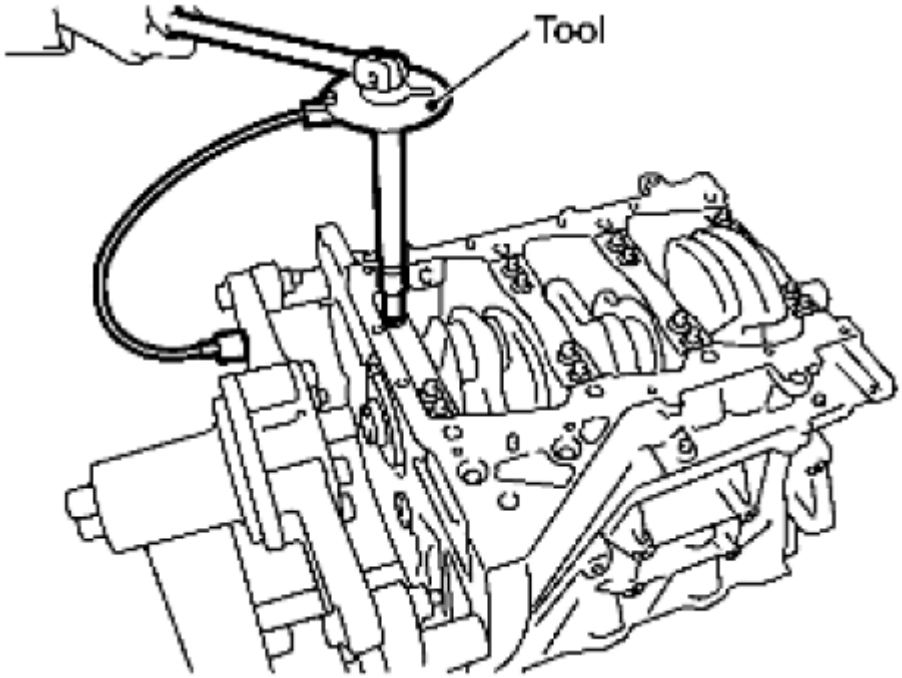


Fig. 188: Turning Crankshaft Bolts
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10112100 (BT-8653-A)

CAUTION: Use angle wrench Tool to check tightening angle. Do not make judgement by visual inspection.

- After installing the bolts, make sure that crankshaft can be rotated smoothly by hand.
- Wipe off completely any protruding liquid gasket on front side of the engine.
- Check the crankshaft end play. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].

8. Inspect the outer diameter of connecting rod bolt. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
9. Install piston to connecting rod as follows:
   a. Install new snap ring to the groove of piston rear side using suitable tool.
      - Insert it fully into groove to install.
   b. Install piston to connecting rod.
      - Using industrial use drier or similar tool, heat piston until piston pin can be pushed in by hand without excess force [approx. 60° to 70 °C (140° to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.
      - Assemble so that the front mark on the piston head and the cylinder number on connecting rod are positioned as shown.

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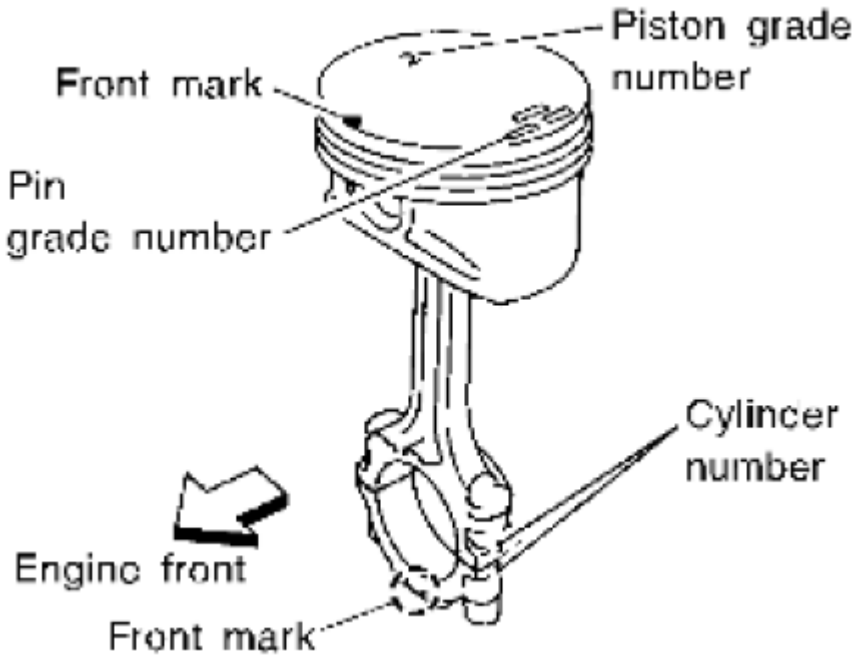
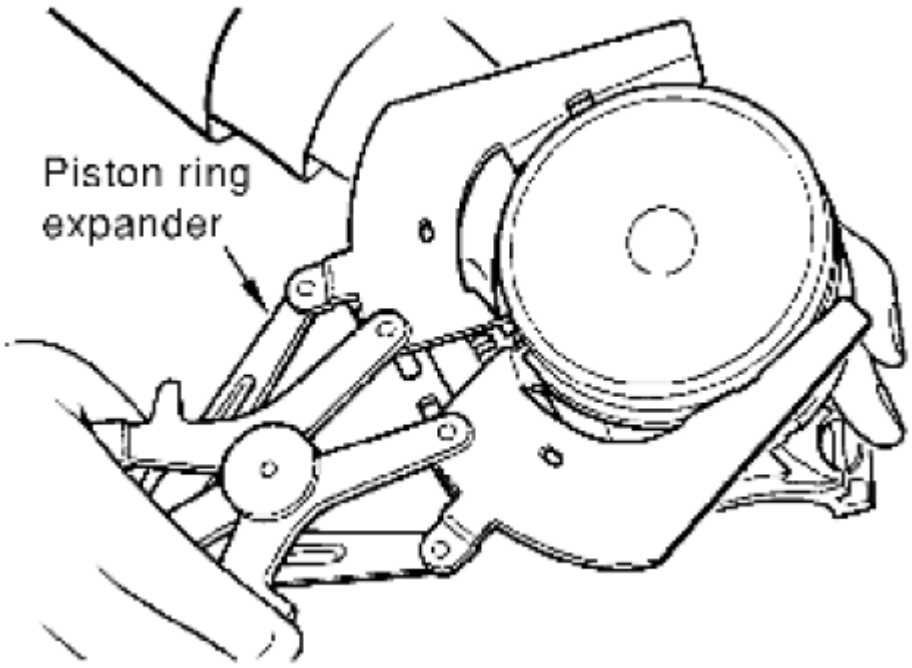


Fig. 189: Identifying Piston Grade Number, Cylinder Number And Pin Grade Number
Courtesy of SUZUKI OF AMERICA CORP.

c. Install new snap ring to the groove of the piston front side.
   - Insert it fully into groove to install.
   - After installing, make sure that connecting rod moves smoothly.

10. Install piston rings using piston ring expander or suitable tool.



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Fig. 190: Installing Piston Rings Using Piston Ring Expander Or Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **When installing piston rings, be careful not to damage piston.**
- **Be careful not to damage piston rings by expending them excessively.**

- If there is stamped mark on ring, mount it with marked side up.

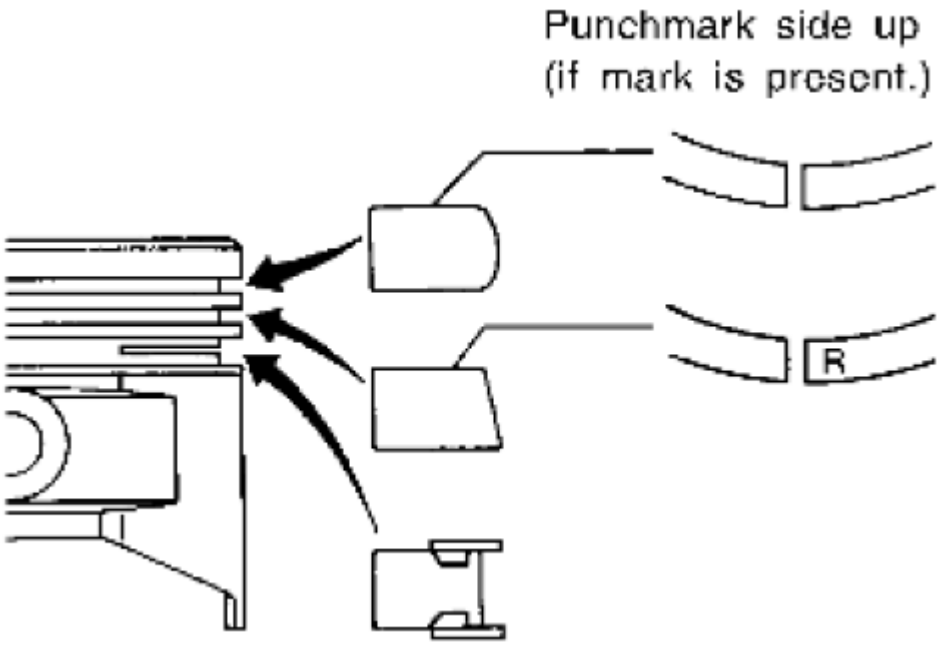


Fig. 191: Identifying Stamped Mark On Ring
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: **If there is no stamp on ring, no specific orientation is required for installation.**
Stamped mark:
Top ring: -
Second ring: R

- Position each ring with the gap as shown referring to the piston front mark.

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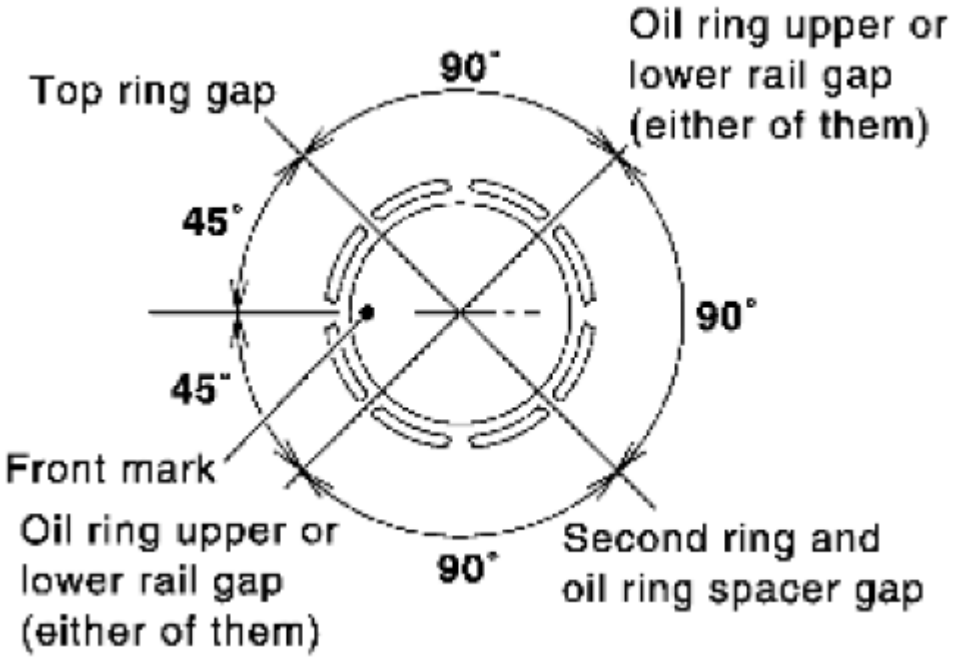
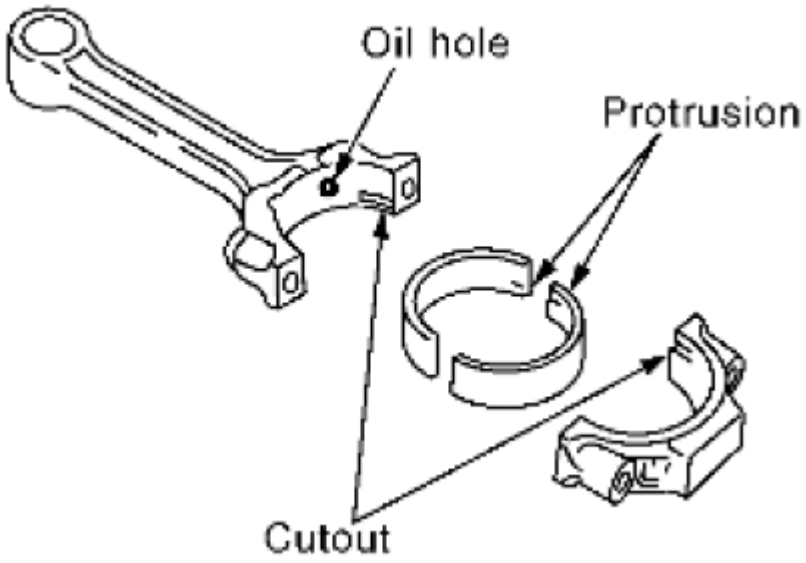


Fig. 192: Positioning Ring With Gap
Courtesy of SUZUKI OF AMERICA CORP.

- Check the piston ring side clearance. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].

11. Install connecting rod bearings to connecting rod and connecting rod bearing cap.
    - Before installing connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
    - When installing, align connecting rod bearing stopper protrusion with cutout of connecting rods and connecting rod bearing caps to install.



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Fig. 193: Identifying Connecting Rods And Connecting Rod Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

- Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.

12. Install piston and connecting rod assembly to crankshaft.
13. Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
14. Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin journal.
15. Match the cylinder position with the cylinder number on connecting rod to install.

NOTE: Be sure that front mark on piston head is facing front of engine.

16. Install piston with the front mark on the piston head facing the front of engine using Tool.

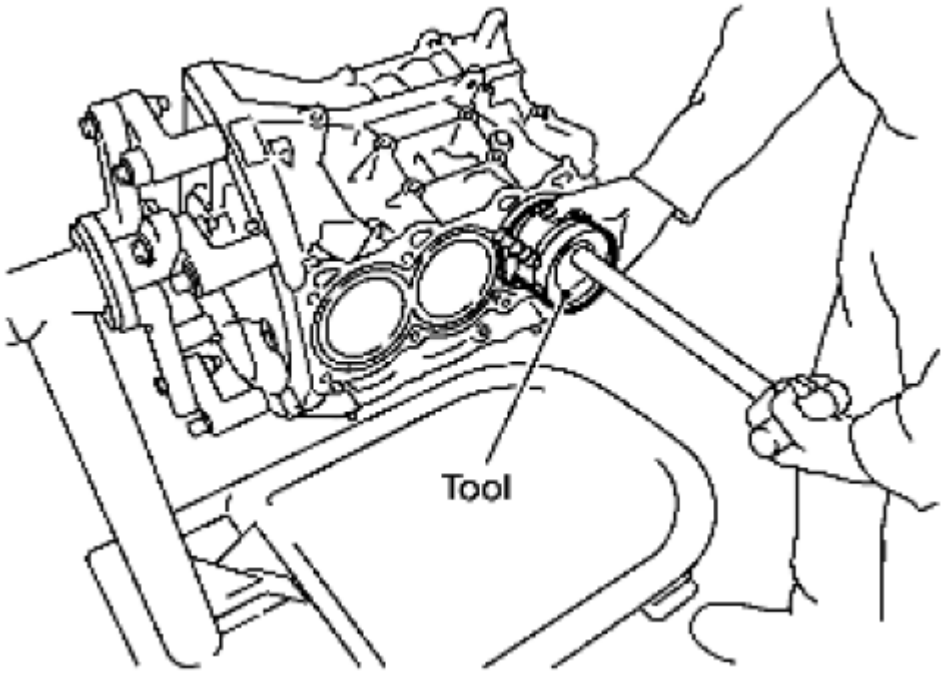


Fig. 194: Installing Piston With Front Mark On Piston Head
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: EM03470000 (J-8037)

CAUTION: Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.

17. Install connecting rod bearing cap.
    - Match the stamped cylinder number marks on connecting rod with those on connecting rod bearing cap to install.

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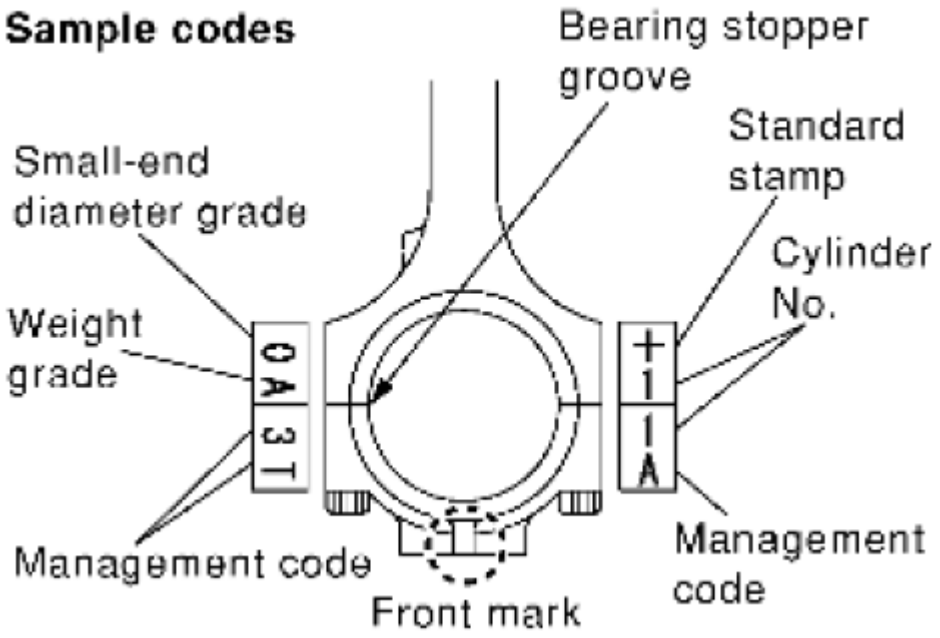


Fig. 195: Matching Stamped Cylinder Number Marks On Connecting Rod
Courtesy of SUZUKI OF AMERICA CORP.

- Be sure that front mark on connecting rod bearing cap is facing front of engine.

18. Tighten connecting rod bolts as follows:
    a. Apply engine oil to the threads and seats of connecting rod bolts.
    b. Tighten connecting rod bolts.

       Connecting rod bolt: 19.6 N.m (2.0 kg-m, 14 ft-lb)

    c. Then tighten all connecting rod bolts 90° clockwise.

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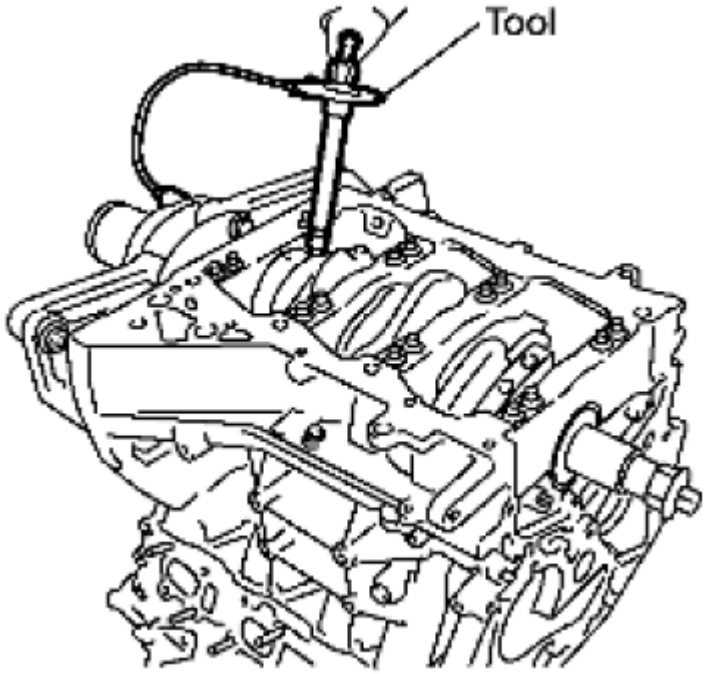


Fig. 196: Tightening Connecting Rod Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Always use Tool. Avoid tightening based on visual check alone.

Tool number: KV10112100 (BT-8653-A)

- After tightening connecting rod bolts, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].

19. Install pilot converter.

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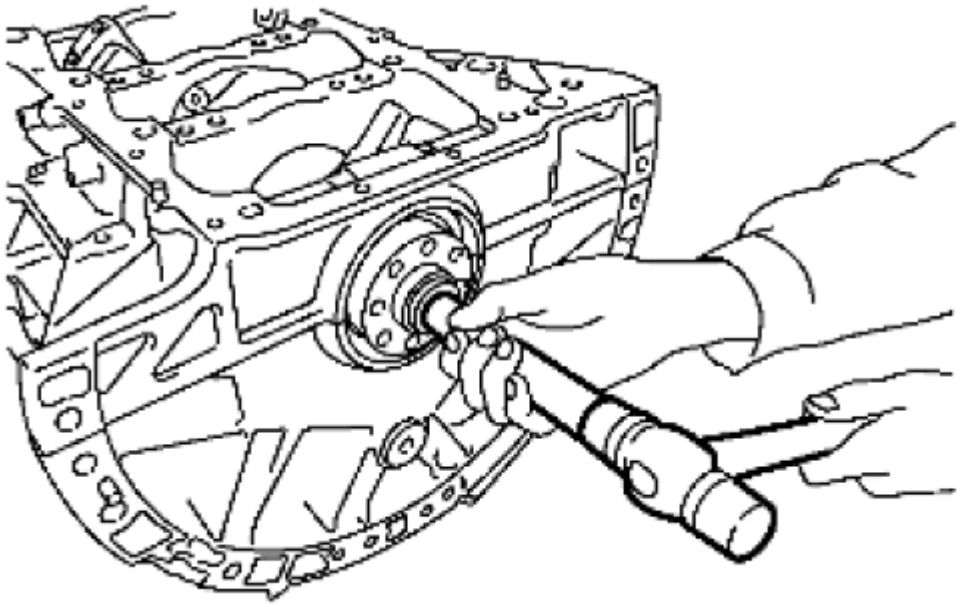


Fig. 197: Installing Pilot Converter
Courtesy of SUZUKI OF AMERICA CORP.

- With drift of the following outer diameter, press-fit as far as it will go.

  Pilot converter: Approx. 33 mm (1.30 in)

- Press-fit pilot converter with its chamfer facing crankshaft as shown.

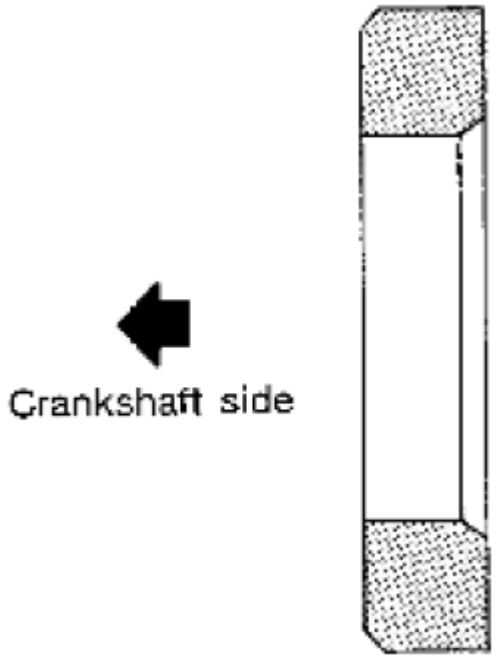


Fig. 198: Pressing Pilot Converter With Chamfer Facing Crankshaft

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Courtesy of SUZUKI OF AMERICA CORP.

20. Install knock sensors.

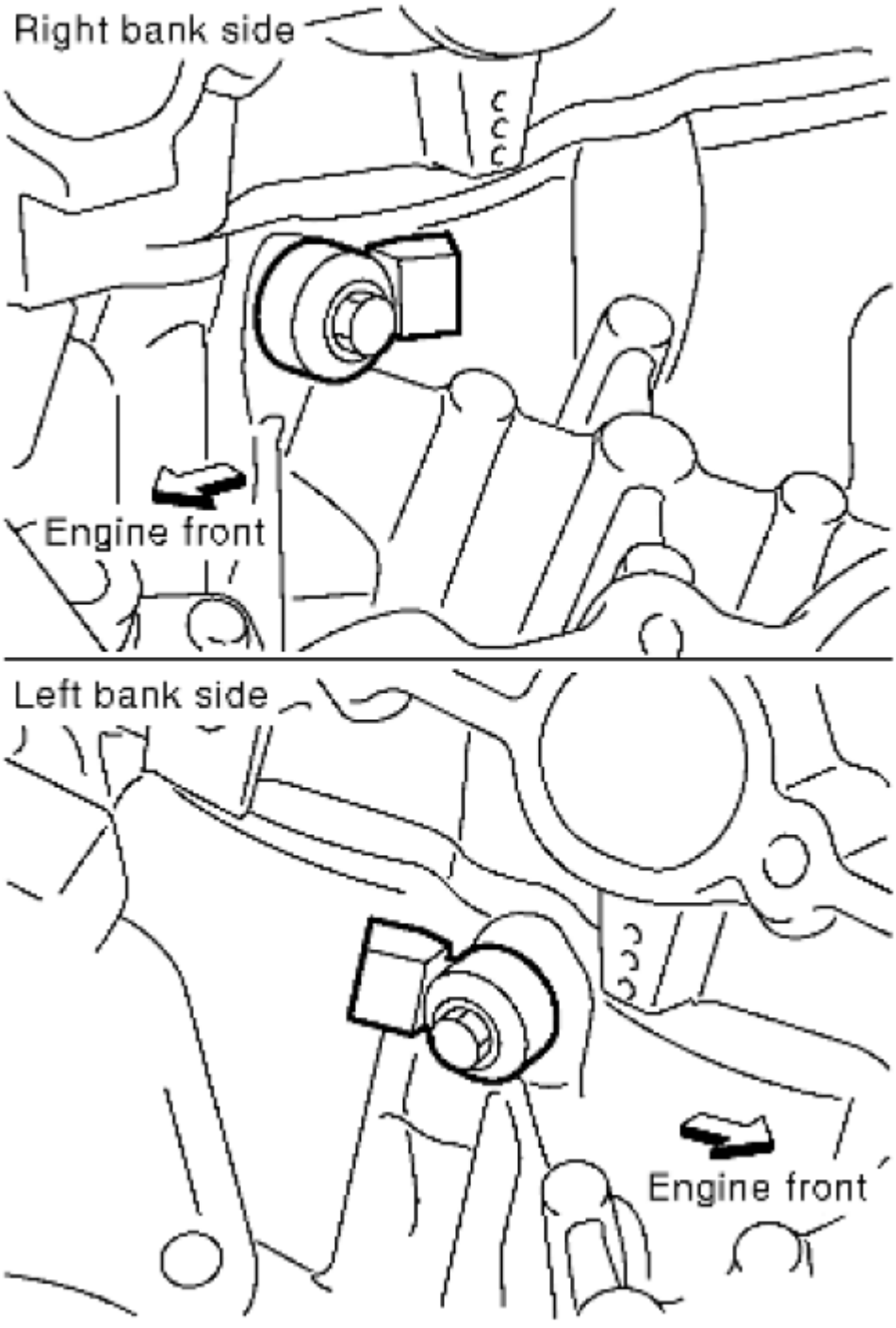


Fig. 199: Installing Knock Sensors
Courtesy of SUZUKI OF AMERICA CORP.

- Install knock sensor so that connector faces rear of engine.

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- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

CAUTION:

- **Do not tighten bolts while holding connector.**
- **If any impact by dropping is applied to knock sensor, replace it with new one.**

NOTE:

- **Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.**
- **Make sure that knock sensor does not interfere with other parts.**

21. Assemble in the reverse order of disassembly after this step.

Drive plate (A/T models)

- Install drive plate and reinforcement plate as shown.

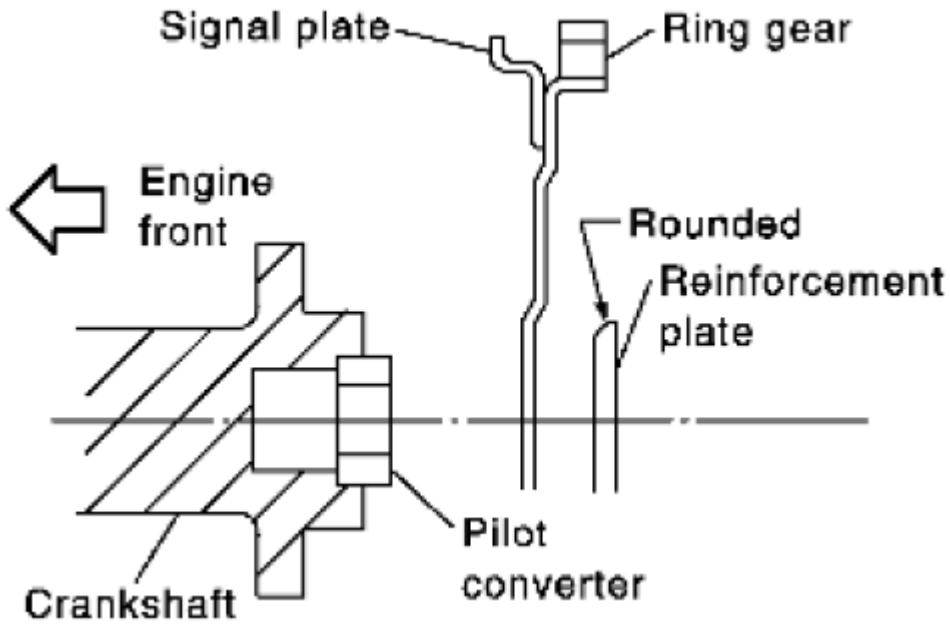


Fig. 200: Installing Drive Plate And Reinforcement Plate
Courtesy of SUZUKI OF AMERICA CORP.

- Holding ring gear using Tool.

Tool number: - (J-48761)

- Tighten bolts crosswise over several times.

ENGINE UNIT: INSPECTION AFTER DISASSEMBLY

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CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with dial indicator.

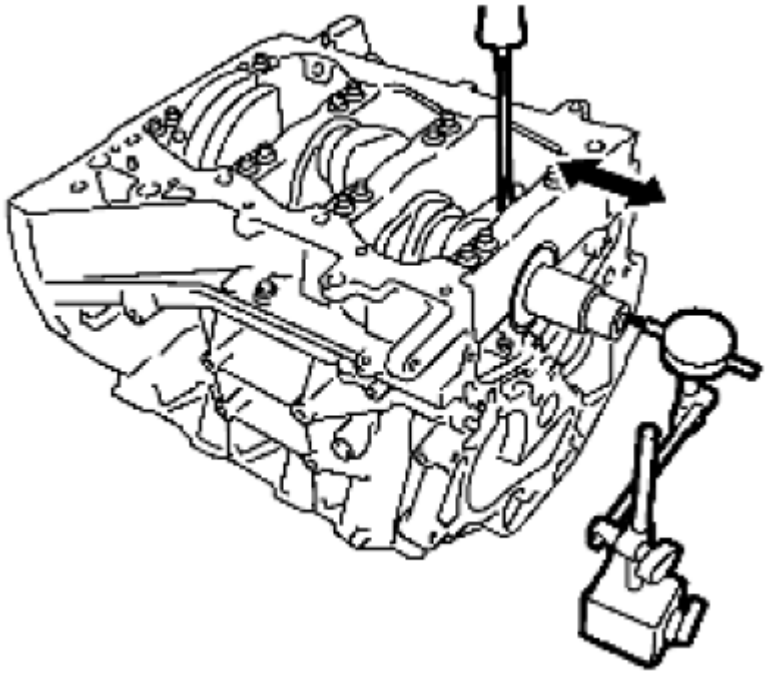


Fig. 201: Measuring Clearance Between Thrust Bearings And Crankshaft Arm
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 0.10 - 0.25 mm (0.0039 - 0.0098 in)

Limit: 0.30 mm (0.0118 in)

- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with feeler gauge.

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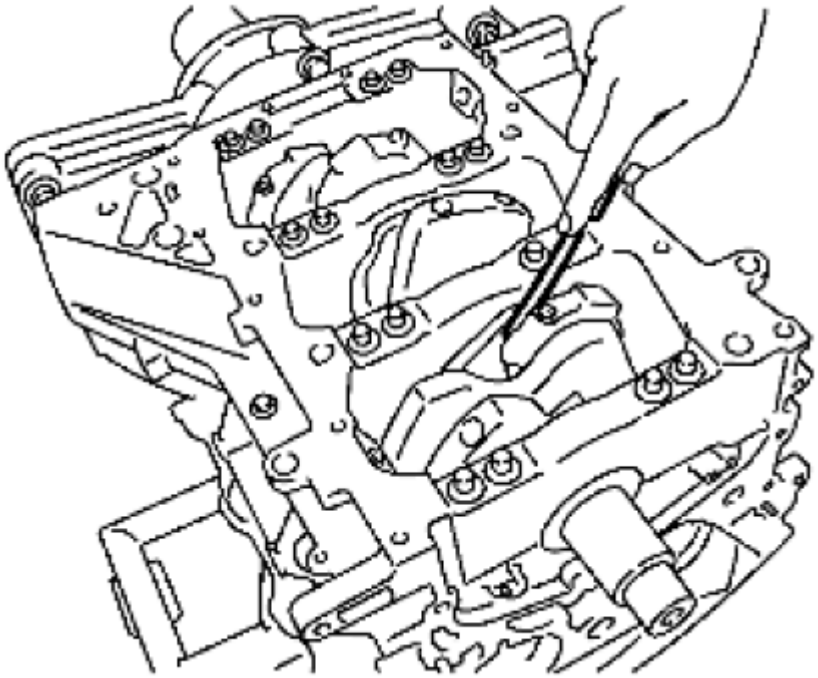


Fig. 202: Measuring Side Clearance Between Connecting Rod And Crankshaft Arm With Feeler Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit: 0.40 mm (0.0157 in)

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

PISTON TO PISTON PIN CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with inside micrometer.

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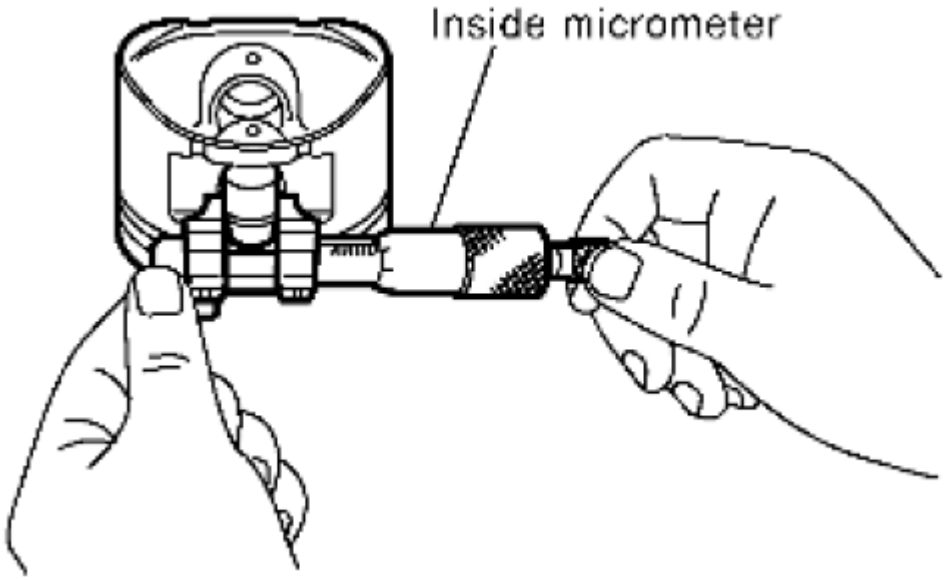


Fig. 203: Measuring Inner Diameter Of Piston Pin Hole With Inside Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 21.993 - 22.005 mm (0.8659 - 0.8663 in)

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

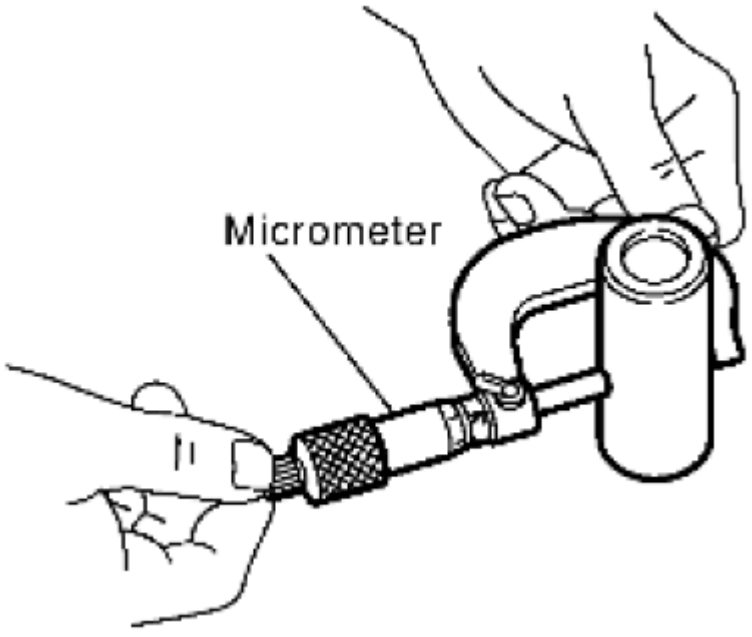


Fig. 204: Measuring Outer Diameter Of Piston Pin With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

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Standard: 21.989 - 22.001 mm (0.8657 - 0.8662 in)

Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) - (Piston pin outer diameter)

Standard: 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If the calculated value is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, refer to [**HOW TO SELECT PISTON AND BEARING**].

NOTE:

- **Piston is available together with piston pin as assembly.**
- **Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no piston pin grades can be selected. (Only "0" grade is available.)**

PISTON RING SIDE CLEARANCE

- Measure side clearance of piston ring and piston ring groove with feeler gauge.

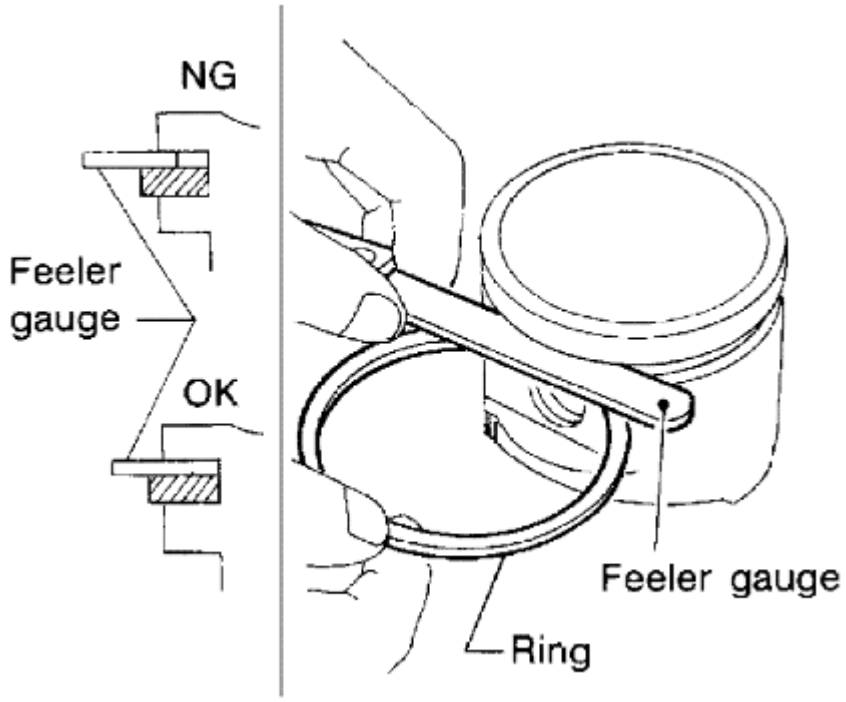


Fig. 205: Measuring Side Clearance Of Piston Ring And Piston Ring Groove
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

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Top ring: 0.045 - 0.080 mm (0.0018 - 0.0031 in)

2nd ring: 0.030 - 0.070 mm (0.0012 - 0.0028 in)

Oil ring: 0.065 - 0.135 mm (0.0026 - 0.0053 in)

Limit:

Top ring: 0.11 mm (0.0043 in)

2nd ring: 0.10 mm (0.0039 in)

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.

PISTON RING END GAP

- Make sure that the cylinder bore inner diameter is within the specification. Follow the "Cylinder Bore Inner Diameter" procedure.

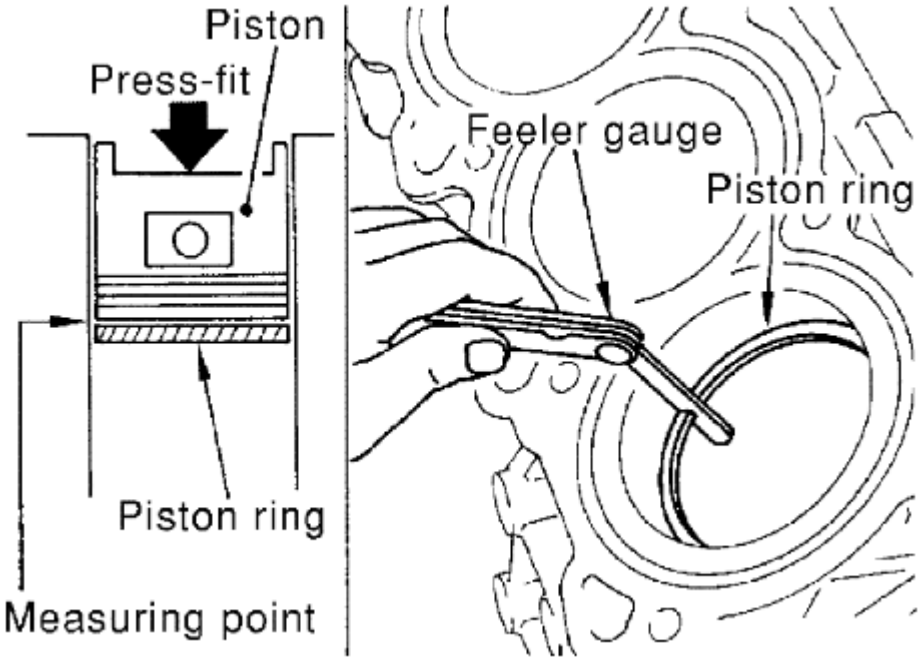


Fig. 206: Pressing Piston Ring
Courtesy of SUZUKI OF AMERICA CORP.

- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure the piston ring end gap with feeler gauge.

Standard:

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Top ring: 0.23 - 0.33 mm (0.0091 - 0.0130 in)

2nd ring: 0.33 - 0.48 mm (0.0130 - 0.0189 in)

Oil ring: 0.20 - 0.50 mm (0.0079 - 0.0197 in)

Limit:

Top ring: 0.56 mm (0.0220 in)

2nd ring: 0.68 mm (0.0268 in)

Oil ring: 0.85 mm (0.0335 in)

- If the measured value exceeds the limit, replace piston ring, and measure again.

CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner.

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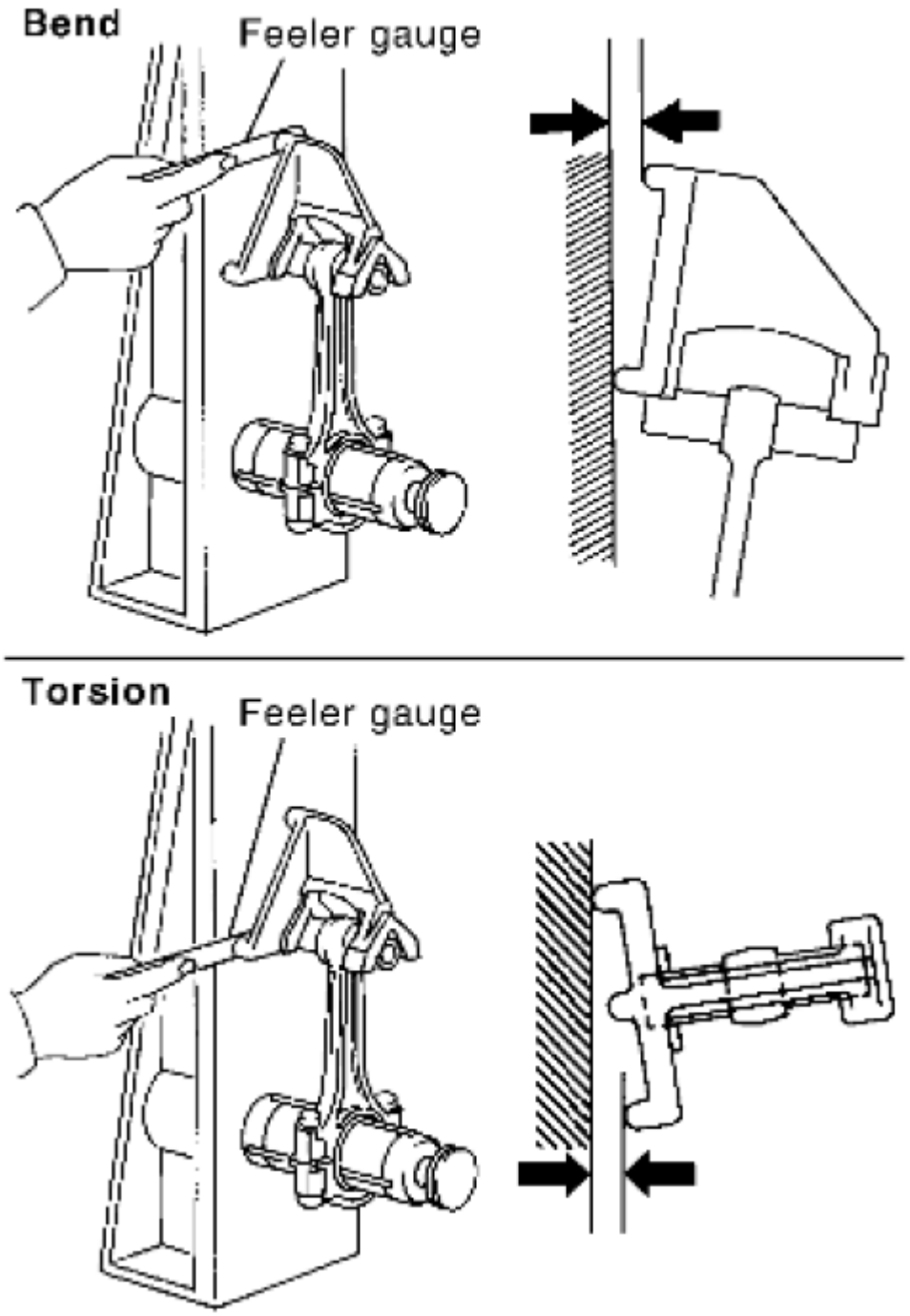


Fig. 207: Checking Connecting Rod Aligner
Courtesy of SUZUKI OF AMERICA CORP.

Bend:

Limit: 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

Torsion:

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Limit: 0.30 mm (0.0118 in) per 100 mm (3.94 in) length

- If it exceeds the limit, replace connecting rod assembly.

CONNECTING ROD DIAMETER (BIG END)

- Install connecting rod bearing cap without installing connecting rod bearing, and tightening connecting rod bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

Example

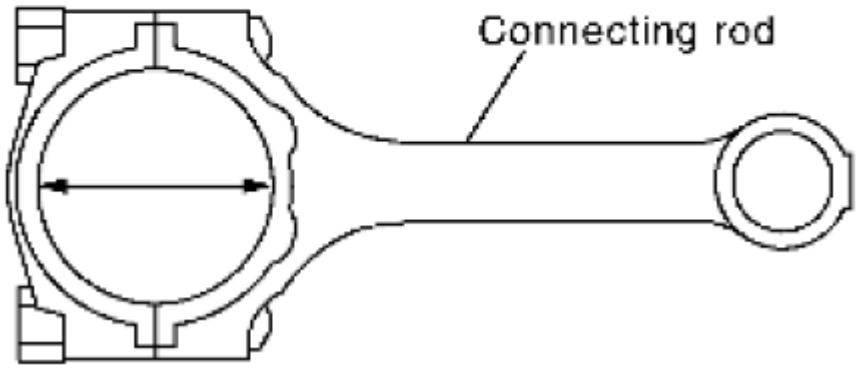


Fig. 208: Identifying Connecting Rod Diameter (Big End)
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the inner diameter of connecting rod big end with inside micrometer.

Standard: 57.000 - 57.013 mm (2.2441 - 2.2446 in)

- If out of the standard, replace connecting rod assembly.

CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Connecting Rod Bushing Inside Diameter (Small End)

Measure inside diameter of connecting rod bushing using suitable tool.

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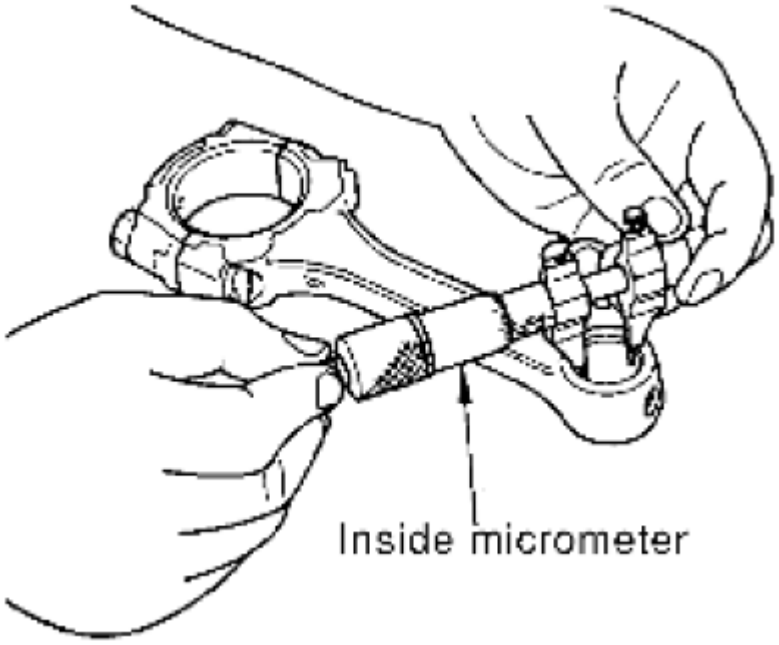


Fig. 209: Measuring Inside Diameter Of Connecting Rod Bushing Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 22.000 - 22.012 mm (0.8661 - 0.8666 in)

Piston Pin Diameter

Measure diameter of piston pin using suitable tool.

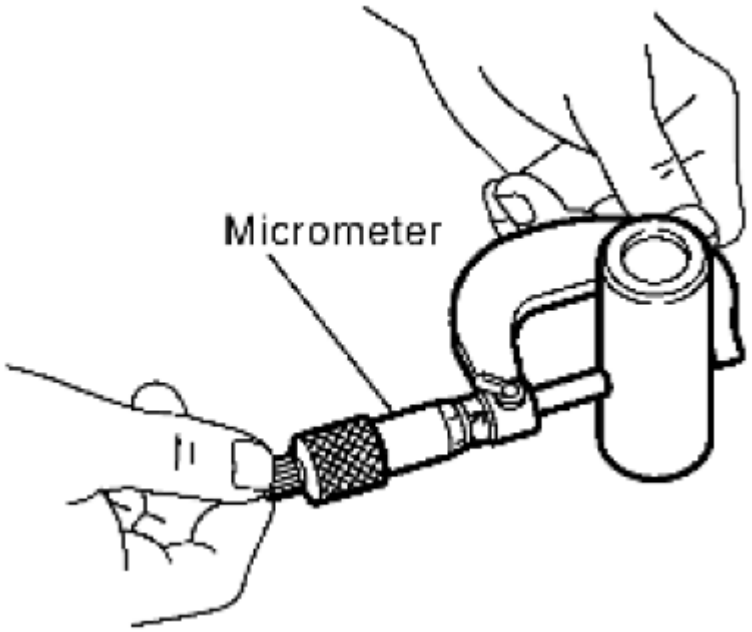


Fig. 210: Measuring Diameter Of Piston Pin Using Suitable Tool

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Courtesy of SUZUKI OF AMERICA CORP.

Standard: 21.989 - 22.001 mm (0.8657 - 0.8662 in)

Connecting Rod Bushing Oil Clearance (Small End)

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) - (Piston pin outer diameter)

Standard: 0.005 - 0.017 mm (0.0002 - 0.0007 in)

Limit: 0.030 mm (0.0012 in)

- If the calculated value exceeds the limit, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to [**HOW TO SELECT PISTON AND BEARING**].
- If replacing connecting rod assembly, follow the "CONNECTING ROD BEARING OIL CLEARANCE" procedure to select the connecting rod bearing.

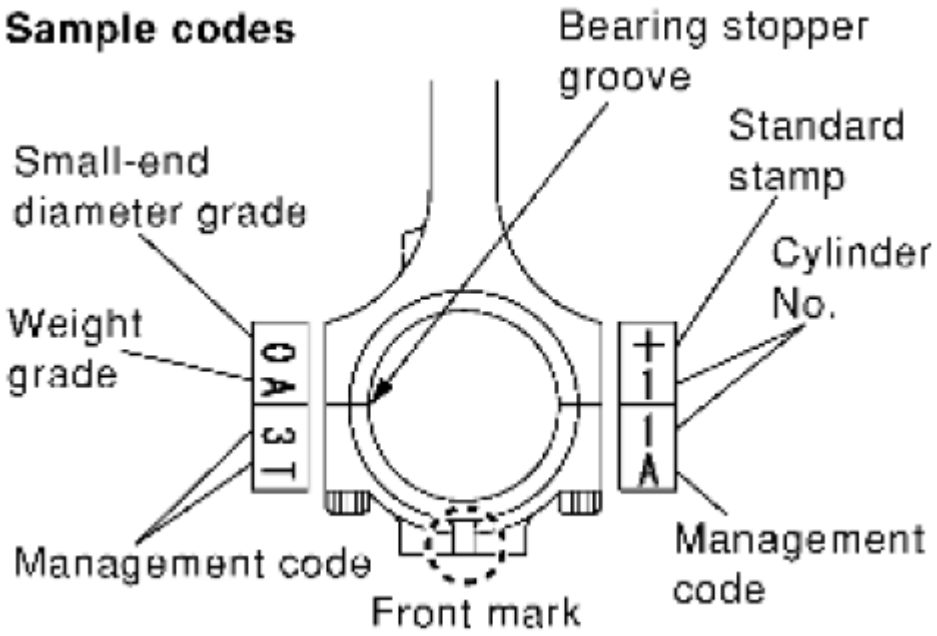


Fig. 211: Identifying Bearing Stopper Grove, Standard Stamp And Weight Guide
Courtesy of SUZUKI OF AMERICA CORP.

Factory installed parts grading:

- Only grade "0".

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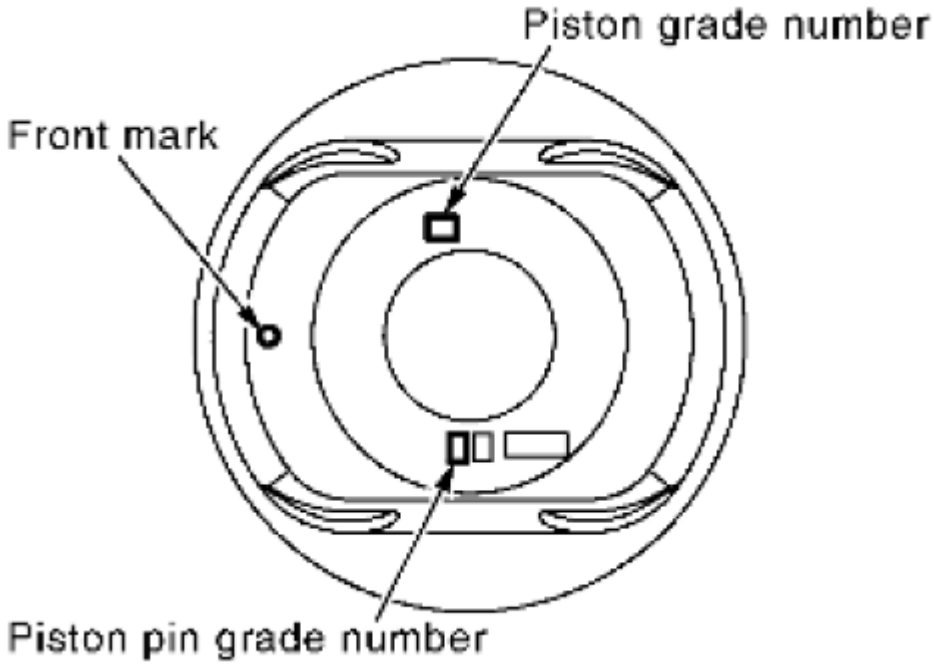


Fig. 212: Identifying Piston Grade Number And Piston Pin Grade Number
Courtesy of SUZUKI OF AMERICA CORP.

UNIT GRADE REFERENCE

		Unit: mm (in)
Grade	0	1
Connecting rod bushing inner diameter (1)	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22. 005 (0.8661 - 0.8663)
Piston pin outer diameter	21.989 - 21.995 (0.8657- 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)
(1) After installing in connecting rod		

CYLINDER BLOCK DISTORTION

- Remove any oil, scale, gasket, sealant and carbon deposits from the cylinder block surface.

CAUTION: Do not allow any debris to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with straightedge and feeler gauge.

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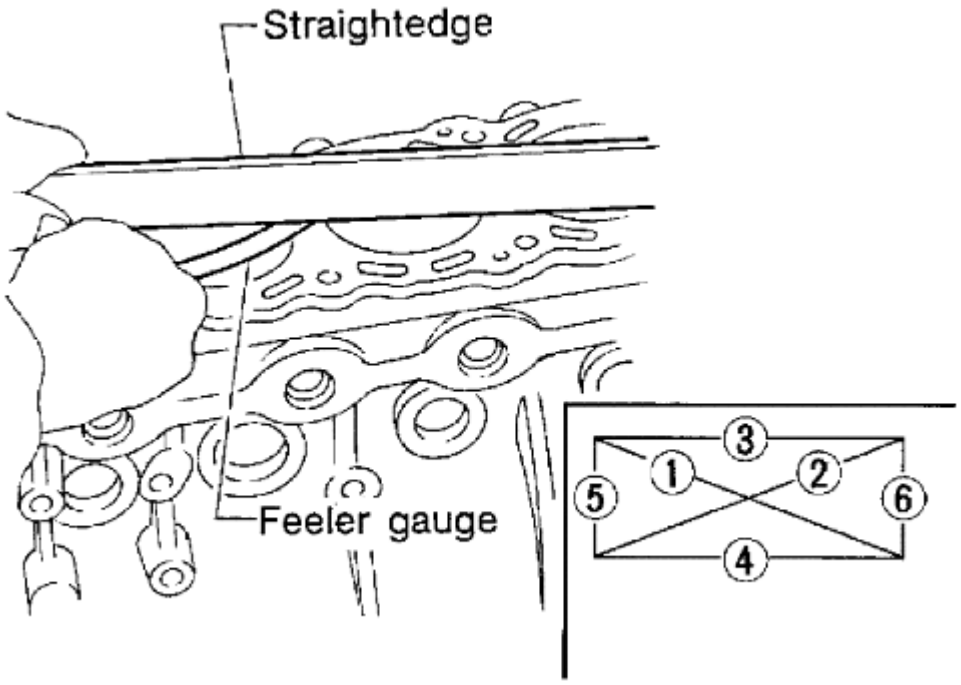


Fig. 213: Measuring Distortion On Cylinder Block Upper Face
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.

MAIN BEARING HOUSING INNER DIAMETER

- Install lower cylinder block without installing main bearings, and tighten lower cylinder block bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

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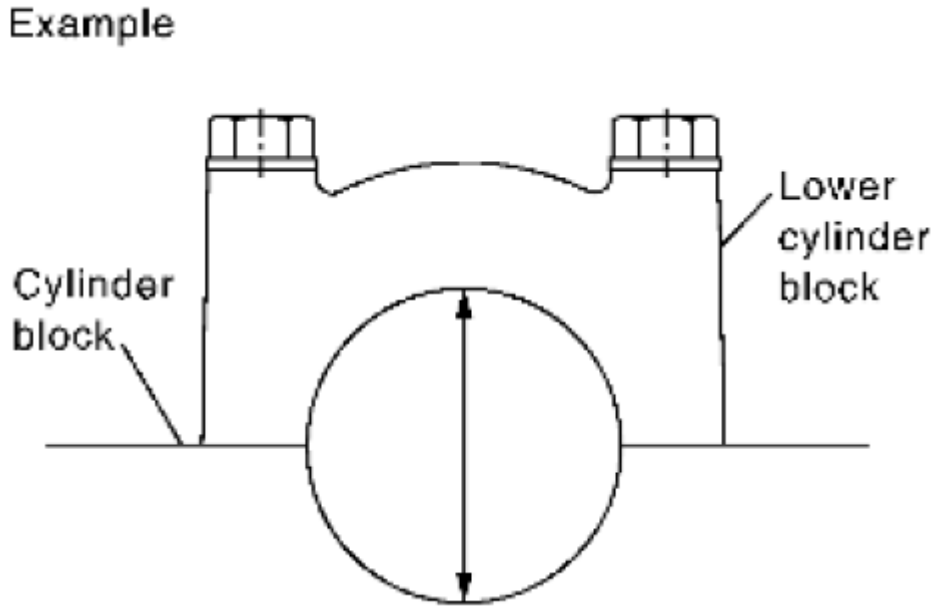


Fig. 214: Identifying Main Bearing Housing Inner Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the inner diameter of main bearing housing with bore gauge.

  Standard: 74.993 - 75.017 mm (2.9525 - 2.9534 in)

- If out of the standard, replace cylinder block and lower cylinder block as assembly.

  NOTE: Cylinder block cannot be replaced as a single part, because it is machined together with lower cylinder block.

PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using bore gauge, measure cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(X) and (Y) directions at (A), (B) and (C)] [(X) is in longitudinal direction of engine].

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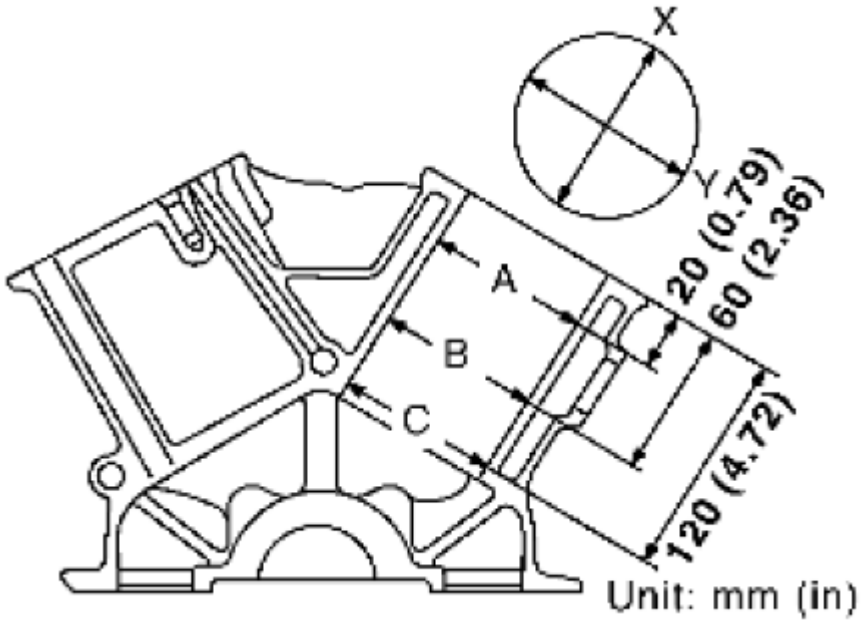


Fig. 215: Measuring Cylinder Bore For Wear, Out-Of-Round And Taper
Courtesy of SUZUKI OF AMERICA CORP.

Standard inner diameter:

95.500 - 95.530 mm (3.7598 - 3.7610 in)

Out-of-round [Difference between (X) and (Y)]:

0.015 mm (0.0006 in)

Taper limit [Difference between (A) and (C)]:

0.01 mm (0.0004 in)

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or re-bore the inner wall.

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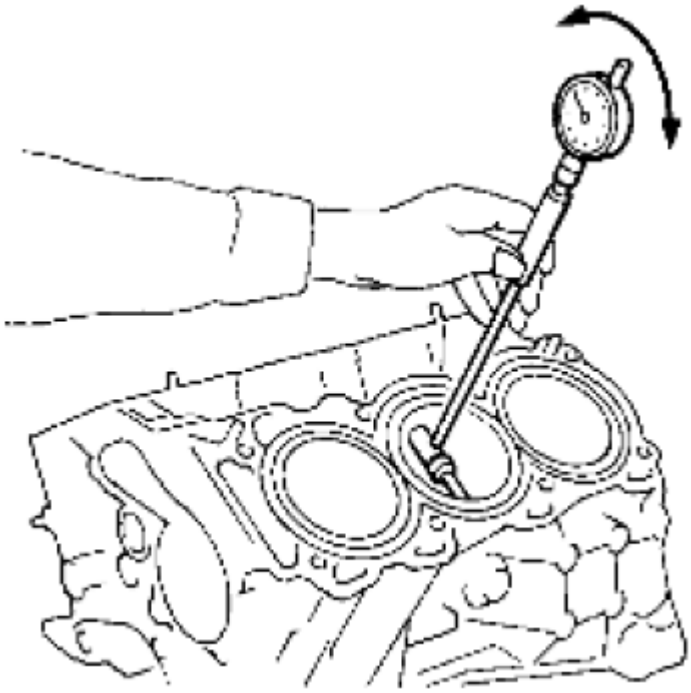


Fig. 216: Measuring Piston Inner Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with micrometer.

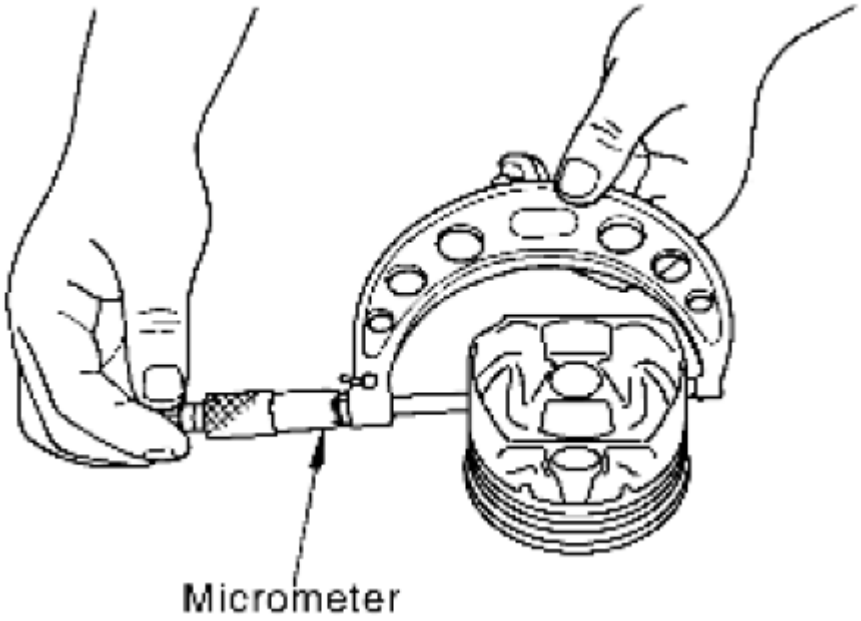


Fig. 217: Measuring Outer Diameter Of Piston Skirt With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

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Measure point

: Distance from the top 43.03 mm (1.6941 in)

Standard

: 95.480 - 95.510 mm (3.7590 - 3.7602 in)

Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (X), position (B)]. (Clearance) = (Cylinder bore inner diameter) - (Piston skirt diameter).

Standard: 0.010 - 0.030 mm (0.0004 - 0.0012 in)

Limit: 0.08 mm (0.0031 in)

- If the calculated value exceeds the limit, replace piston and piston pin assembly. Refer to [**HOW TO SELECT PISTON AND BEARING**].

Re-boring Cylinder Bore

1. Cylinder bore size is determined by adding piston to cylinder bore clearance to piston skirt diameter.

   Re-bored size calculation: D = A + B - C

   where,

   D: Bored diameter

   A: Piston skirt diameter as measured

   B: Piston to cylinder bore clearance (standard value)

   C: Honing allowance 0.02 mm (0.0008 in)

2. Install lower cylinder block, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

   NOTE:

   - **When any cylinder needs boring, all other cylinders must also be bored.**
   - **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**

4. Hone cylinders to obtain the specified piston to cylinder bore clearance.

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5. Measure the finished cylinder bore for out-of-round and taper.

NOTE: Measurement should be done after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with micrometer.

  Standard: 69.951 - 69.975 mm (2.7540 - 2.7549 in) dia.

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing.

CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with micrometer.

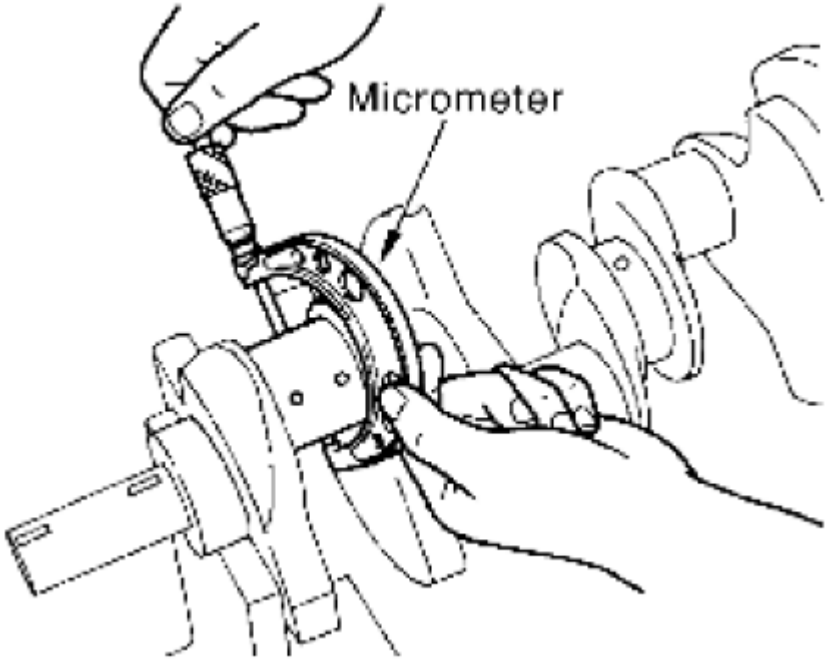


Fig. 218: Measuring Outer Diameter Of Crankshaft Pin Journal With Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 53.956 - 53.974 mm (2.1242 - 2.1250 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing.

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure the dimensions at four different points as shown on each main journal and pin journal with micrometer.

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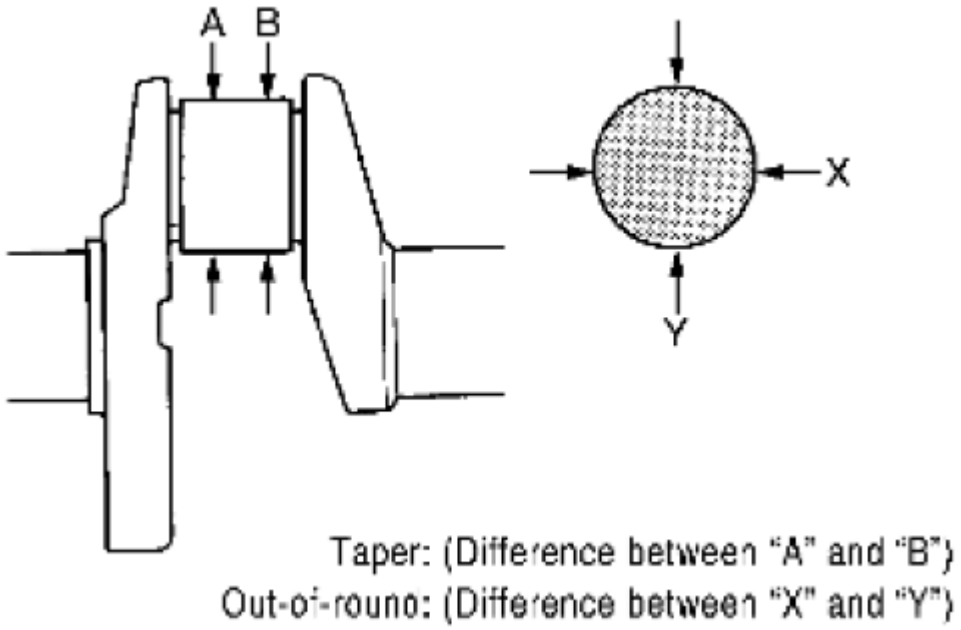


Fig. 219: Measuring Dimensions At Four Different Points
Courtesy of SUZUKI OF AMERICA CORP.

- Out-of-round is indicated by the difference in the dimensions between (X) and (Y) at (A) and (B).
- Taper is indicated by the difference in the dimensions between (A) and (B) at (X) and (Y).

Limit:

Out-of-round [Difference between (X) and (Y)]

: 0.002 mm (0.0001 in)

Taper [Difference between (A) and (B)]

: 0.002 mm (0.0001 in)

- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select the main bearing and/or connecting rod bearing.

CRANKSHAFT RUNOUT

- Place V-block on precise flat table, and support the journals on the both end of crankshaft.

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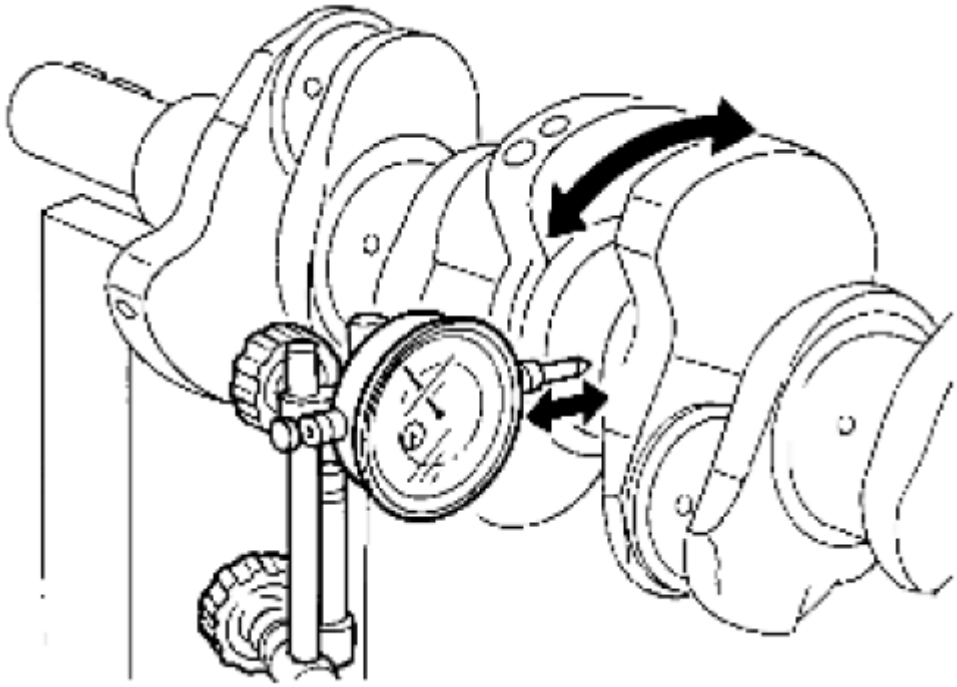


Fig. 220: Measuring Crankshaft Runout
Courtesy of SUZUKI OF AMERICA CORP.

- Place dial indicator straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on dial indicator. (Total indicator reading)

  Standard: Less than 0.05 mm (0.002 in)

  Limit: 0.10 mm (0.0039 in)

- If it exceeds the limit, replace crankshaft.

CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

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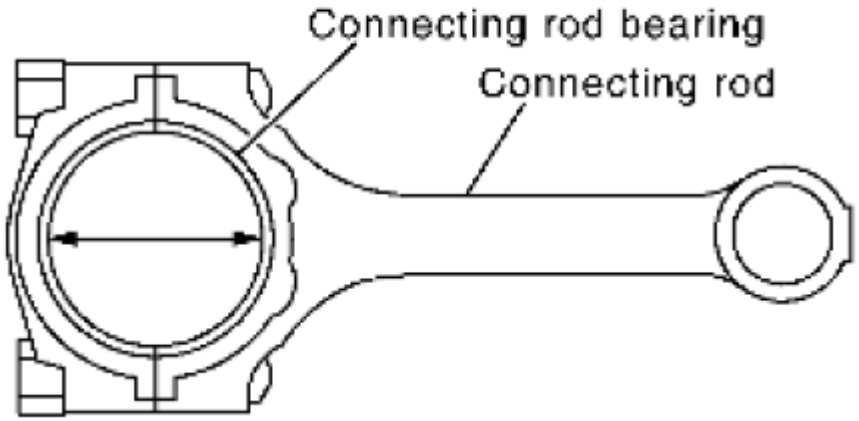


Fig. 221: Identifying Connecting Rod Bearings
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the inner diameter of connecting rod bearing with inside micrometer.

  (Bearing oil clearance) = (Connecting rod bearing inner diameter) - (Crankshaft pin journal diameter)

  Standard: 0.034 - 0.059 mm (0.0013 - 0.0023 in) (actual clearance)

  Limit: 0.070 mm (0.0028 in)

- If the calculated value exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to [**HOW TO SELECT PISTON AND BEARING**].

Method of Using Plastigage

- Remove oil and dust on crankshaft pin journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

  CAUTION: Do not rotate crankshaft.

- Remove connecting rod bearing cap and bearing, and using scale on plastigage bag, measure the plastigage width.

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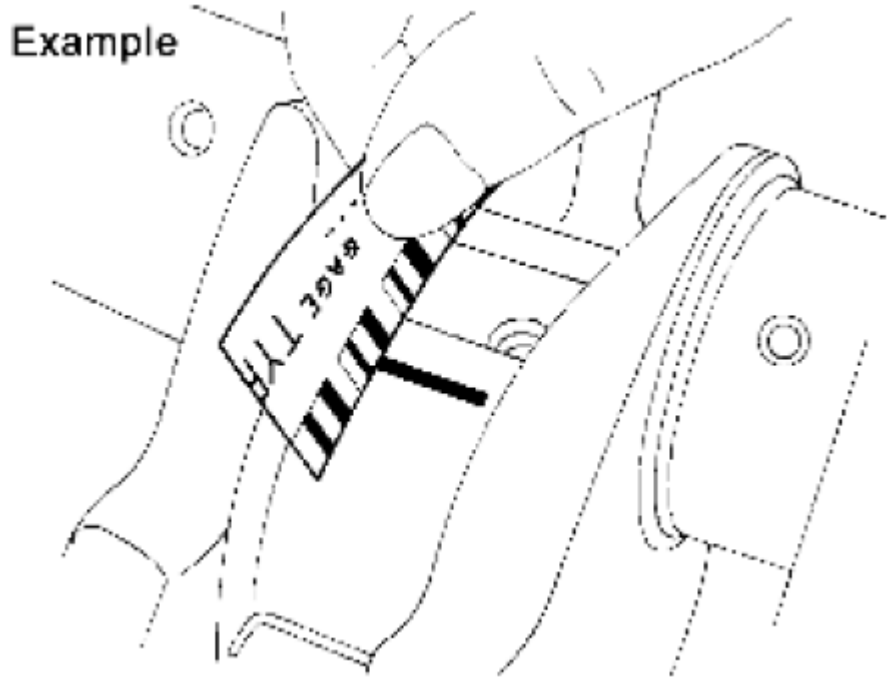


Fig. 222: Measuring Plastigage Width
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The procedure when the measured value exceeds the limit is same as that described in the "METHOD BY CALCULATION".

MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

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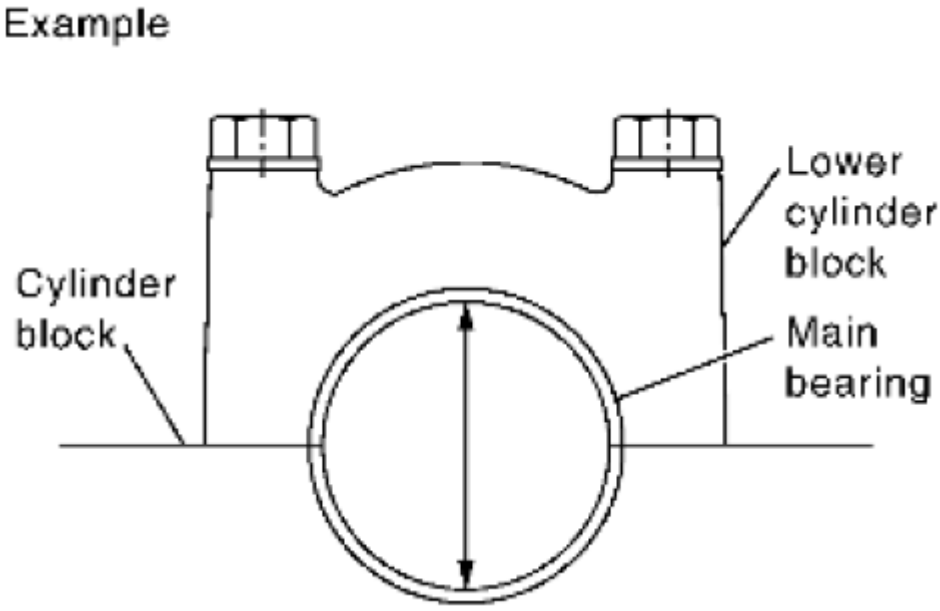


Fig. 223: Identifying Inner Diameter Of Main Bearing
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the inner diameter of main bearing with bore gauge.

  (Bearing clearance) = (Main bearing inner diameter) - (Crankshaft main journal diameter)

  Standard: 0.035 - 0.045 mm (0.0014 - 0.0018 in) (actual clearance)

  Limit: 0.065 mm (0.0026 in)

- If the calculated value exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [**HOW TO SELECT PISTON AND BEARING**].

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

CAUTION: Do not rotate crankshaft.

- Remove lower cylinder block and bearings, and using scale on plastigage bag, measure the plastigage width.

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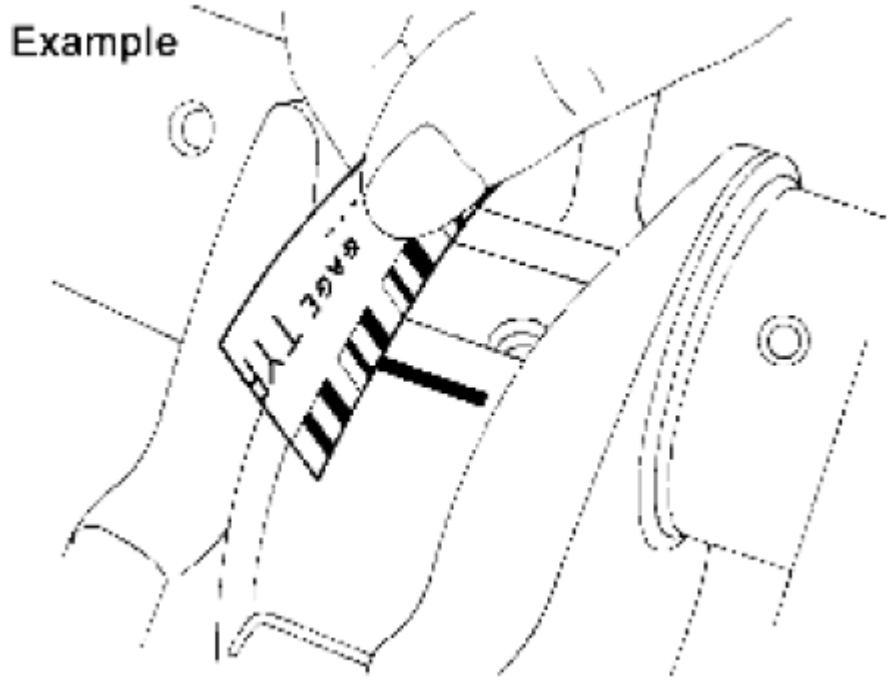


Fig. 224: Measuring Plastigage Width
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The procedure when the measured value exceeds the limit is same as that described in the "METHOD BY CALCULATION".

CRUSH HEIGHT OF MAIN BEARING

- When lower cylinder block is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

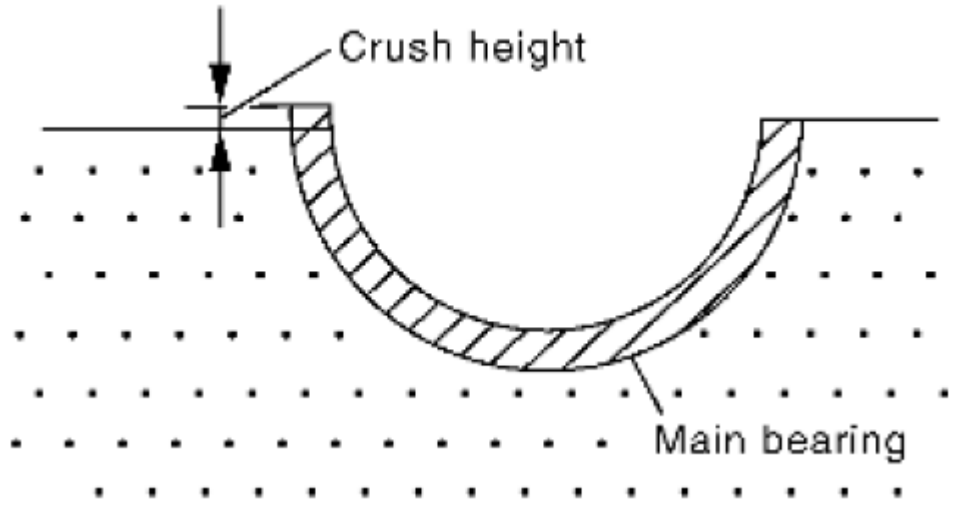


Fig. 225: Identifying Crush Height Of Main Bearing

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Courtesy of SUZUKI OF AMERICA CORP.

Standard: There must be crush height.

- If the standard is not met, replace main bearings.

CRUSH HEIGHT OF CONNECTING ROD BEARING

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.

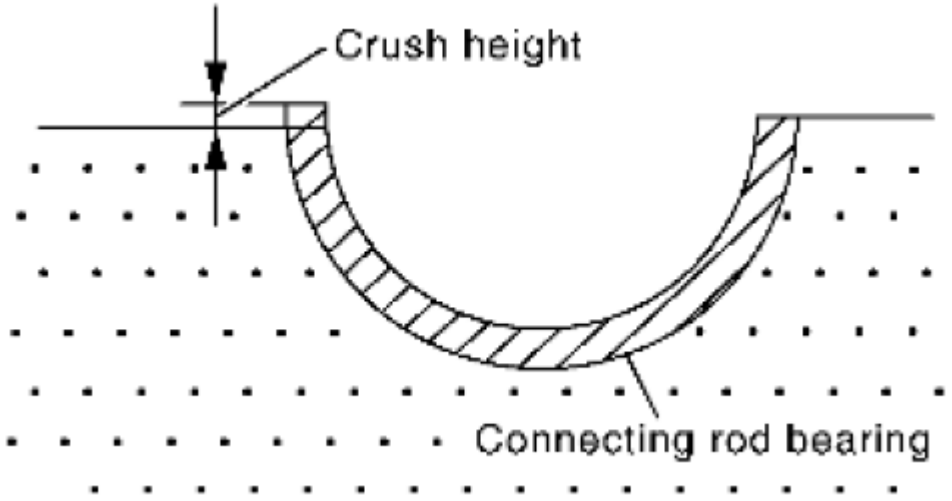


Fig. 226: Identifying Crush Height Of Connecting Rod Bearing
Courtesy of SUZUKI OF AMERICA CORP.

Standard: There must be crush height.

- If the standard is not met, replace connecting rod bearings.

LOWER CYLINDER BLOCK BOLT OUTER DIAMETER

- Measure the outer diameters [(d_1), (d_2)] at two positions as shown.

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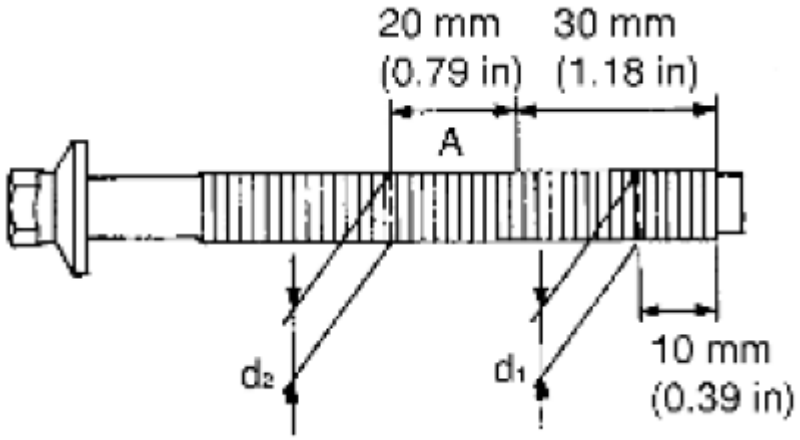


Fig. 227: Identifying Lower Cylinder Block Bolt Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- If reduction appears in (A) range, regard it as (d_2).

  Limit [(d_1) - (d_2)]: 0.11 mm (0.0051 in)

- If it exceeds the limit (large difference in dimensions), replace lower cylinder block bolt with new one.

CONNECTING ROD BOLT OUTER DIAMETER

- Measure the outer diameter (d) at position shown.

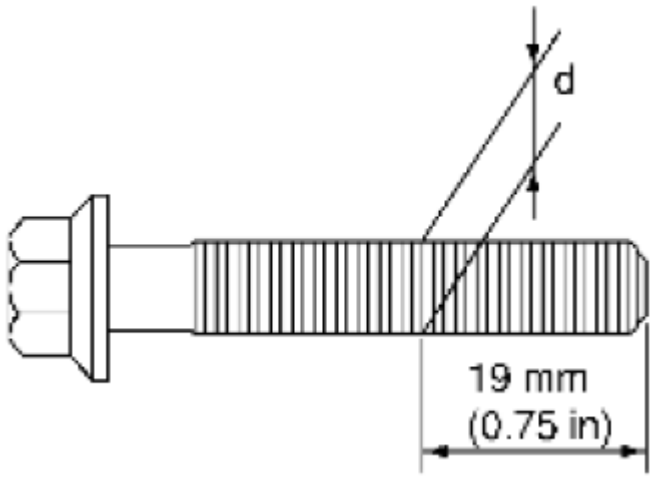


Fig. 228: Identifying Connecting Rod Bolt Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- If the reduction appears in a position other than (d), regard it as (d).

  Limit: 7.75 mm (0.3051 in)

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- When (d) exceeds the limit (when it becomes thinner), replace connecting rod bolt with new one.

FLYWHEEL RUNOUT (M/T)

NOTE:

- **This inspection is for double mass flywheel only.**
- **Do not disassemble the double mass flywheel.**

Flywheel Deflection

- Measure the deflection of the flywheel contact surface to the clutch with a dial gauge.

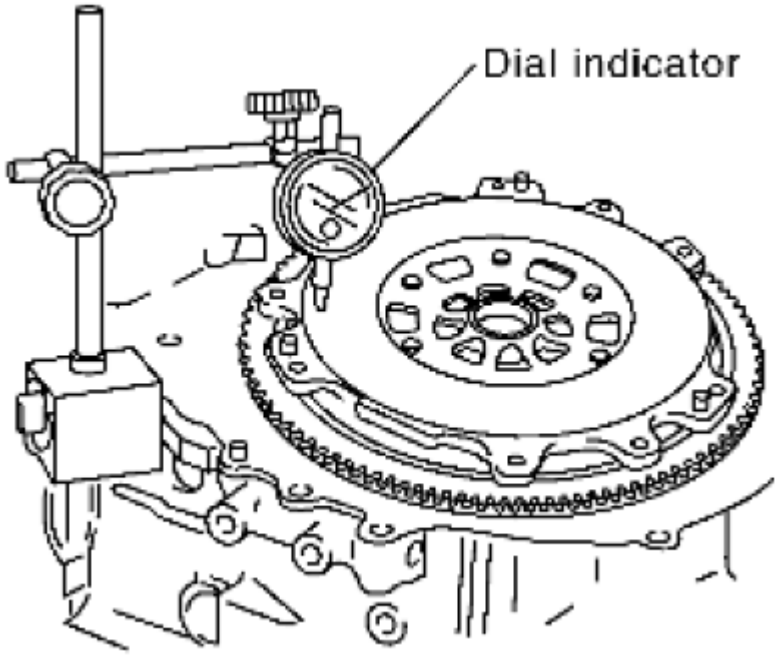


Fig. 229: Measuring Deflection Of Flywheel Contact Surface To Clutch With Dial Gauge
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the runout at 210 mm (8.27 in) diameter.

  Limit: 0.45 mm (0.0177 in) or less

- When measured value exceeds the limit, replace the flywheel with a new one.

MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

CAUTION: Do not disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

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- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

  Standard: 1.3 mm (0.051 in) or less

- If measured value is out of the standard, replace flywheel.

Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
   - Tighten bolt at a force of 9.8 N.m (1.0 kg-m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).

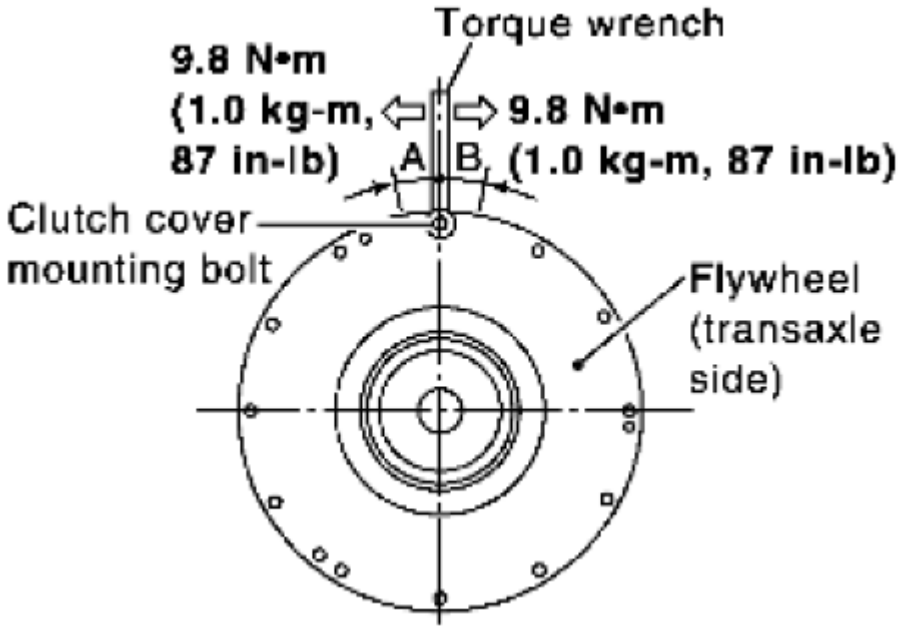


Fig. 230: Identifying Mating Mark On Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

3. Apply a force of 9.8 N.m (1.0 kg-m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure the dimensions of movement amounts (A) and (B) on circumference of flywheel on the transmission side.

   Standard: 44.3 mm (1.744 in) or less.

   - If measured value is out of the standard, replace flywheel.

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DRIVE PLATE (A/T MODELS)

- Check drive plate and signal plate for deformation or cracks.

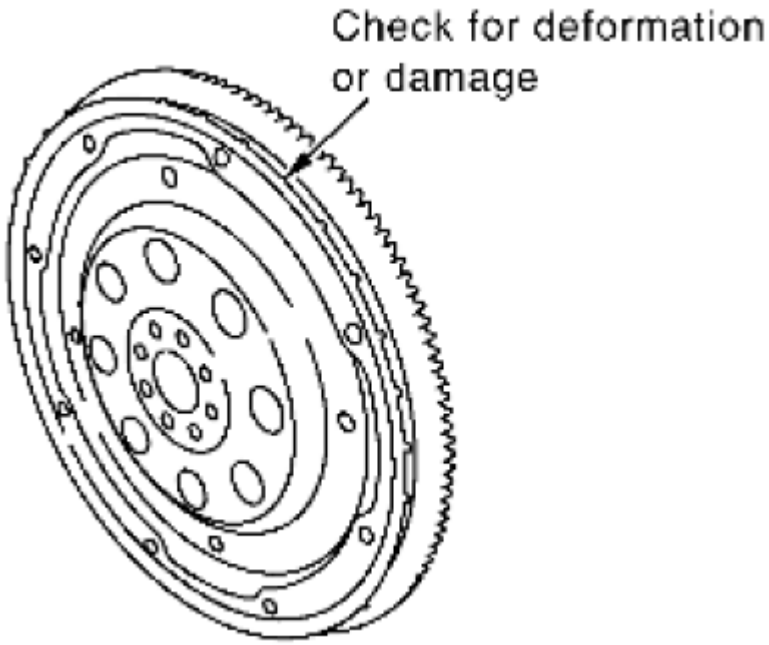


Fig. 231: Checking Drive Plate And Signal Plate For Deformation Or Cracks
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Do not disassemble drive plate.**
- **Do not place drive plate with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch it.**
- **Handle signal plate in a manner that prevents it from becoming magnetized.**

- If anything is found, replace drive plate.

OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, clean or replace oil jet.

OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.

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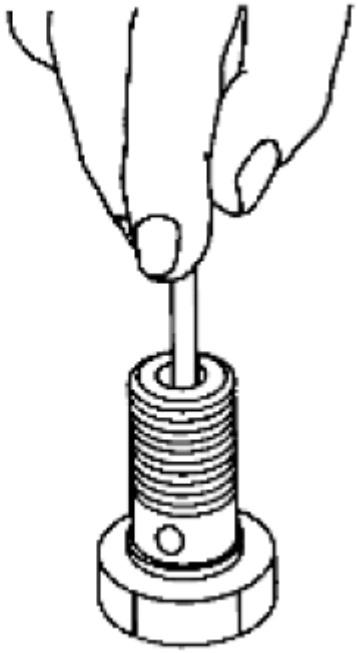


Fig. 232: Pressing Check Valve In Oil Jet Relief Valve
Courtesy of SUZUKI OF AMERICA CORP.

- If it is not satisfied, replace oil jet relief valve.

ENGINE UNIT: DOWEL PIN ALIGNMENT

REMOVAL

1. Use Tool to lock the drive plate (A/T models) or flywheel (M/T models) and match mark (A) the drive plate or flywheel before removing the bolts.

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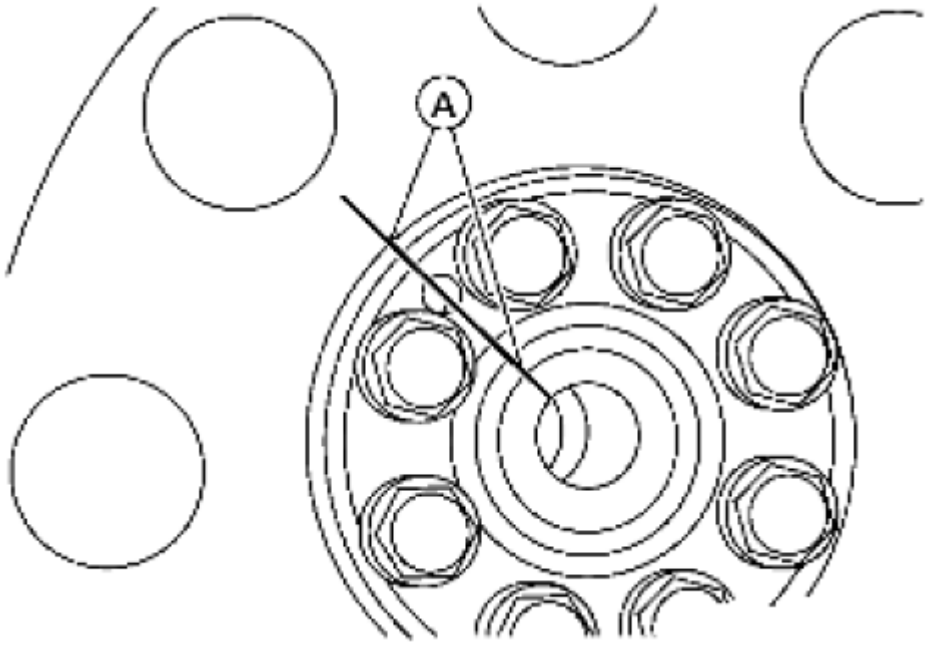


Fig. 233: Identifying Match Mark On Drive Plate
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: - (J-48761)

CAUTION: Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting Tool.

2. Remove drive plate (A/T models) or flywheel (M/T models).

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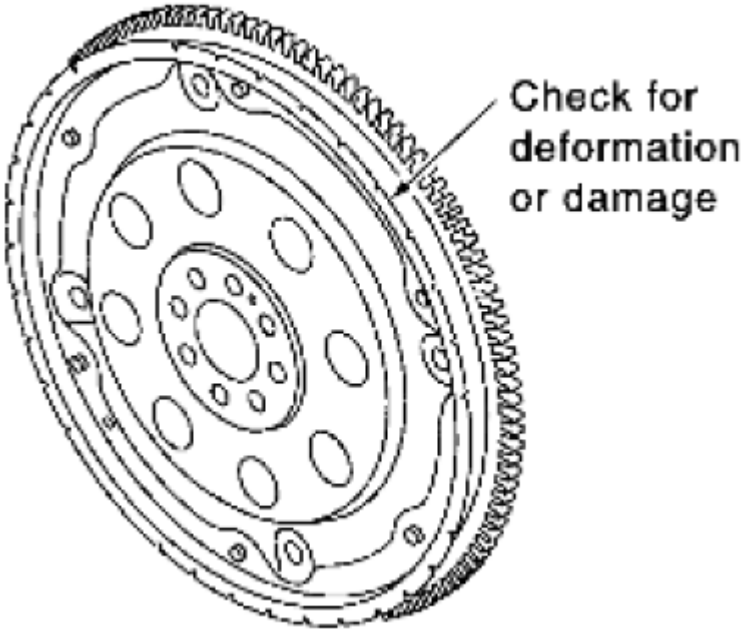


Fig. 234: Checking Drive Plate Deformation And Damage
Courtesy of SUZUKI OF AMERICA CORP.

- Loosen the drive plate or flywheel bolts in a diagonal order.

CAUTION:
- **Never place drive plate (A/T models) or flywheel (M/T models) with signal plate facing down.**
- **When handling the signal plate, take care not to damage or scratch it.**
- **Handle the signal plate in a manner that prevents it from becoming magnetized**

INSTALLATION (A/T models)

1. Installation is in the reverse order of removal.
   - When installing the drive plate to the crankshaft, use the match mark (A) as shown to correctly align the crankshaft side dowel pin to the drive plate side dowel pin hole.

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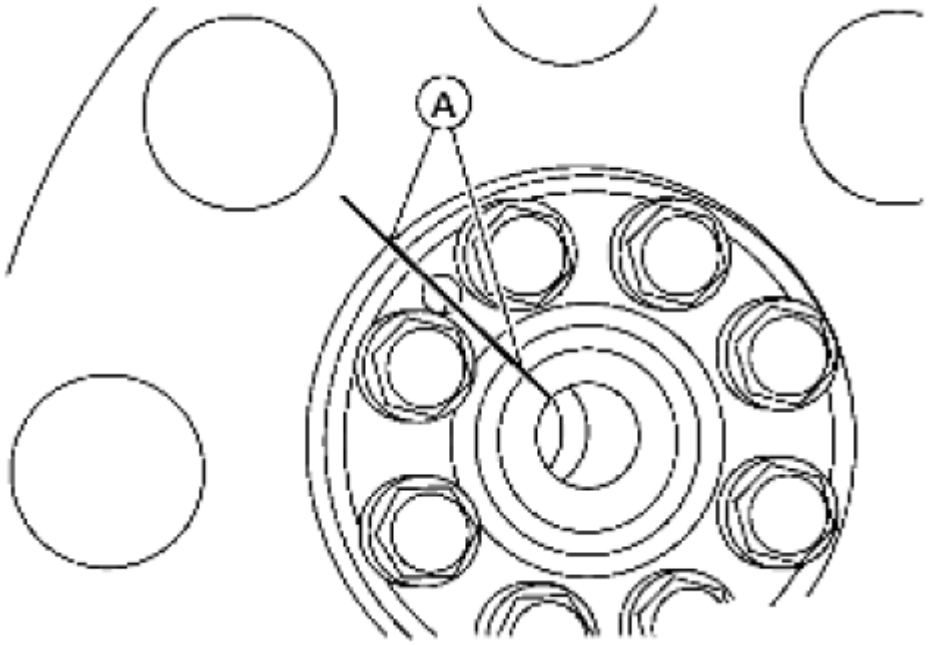


Fig. 235: Identifying Match Mark On Drive Plate
Courtesy of SUZUKI OF AMERICA CORP.

- Install the drive plate and the reinforcement plate in the direction as shown.

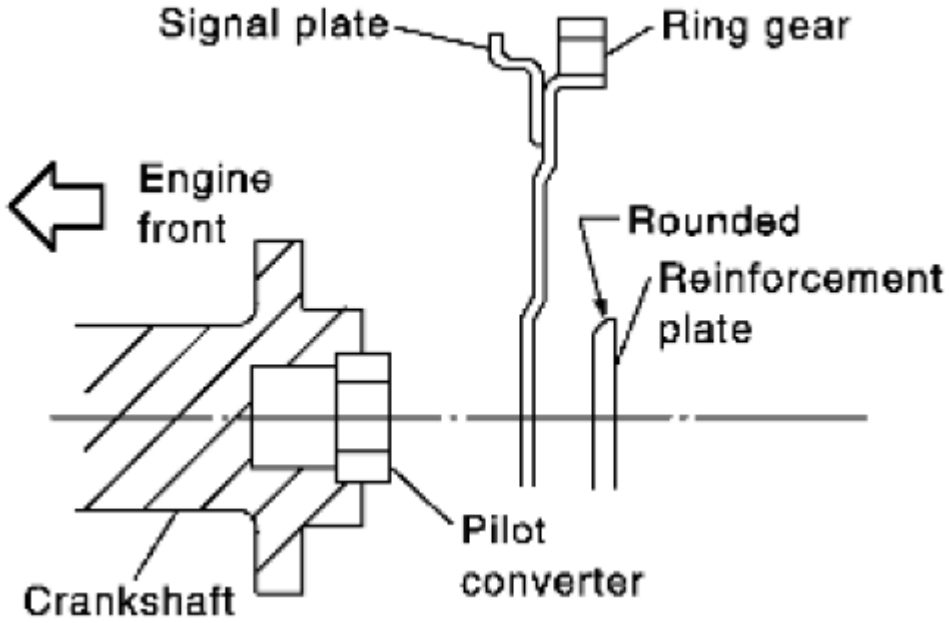


Fig. 236: Installing Drive Plate And Reinforcement Plate
Courtesy of SUZUKI OF AMERICA CORP.

- Tighten the drive plate bolts in a diagonal pattern in two steps. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**].

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INSTALLATION (M/T models)

1. Installation is in the reverse order of removal after the following.
   - Be sure the dowel pin is installed in the crankshaft.
   - When installing the flywheel (3) to the crankshaft (2), be sure to correctly align crankshaft side dowel pin (1) to the flywheel side dowel pin hole (A) as shown.

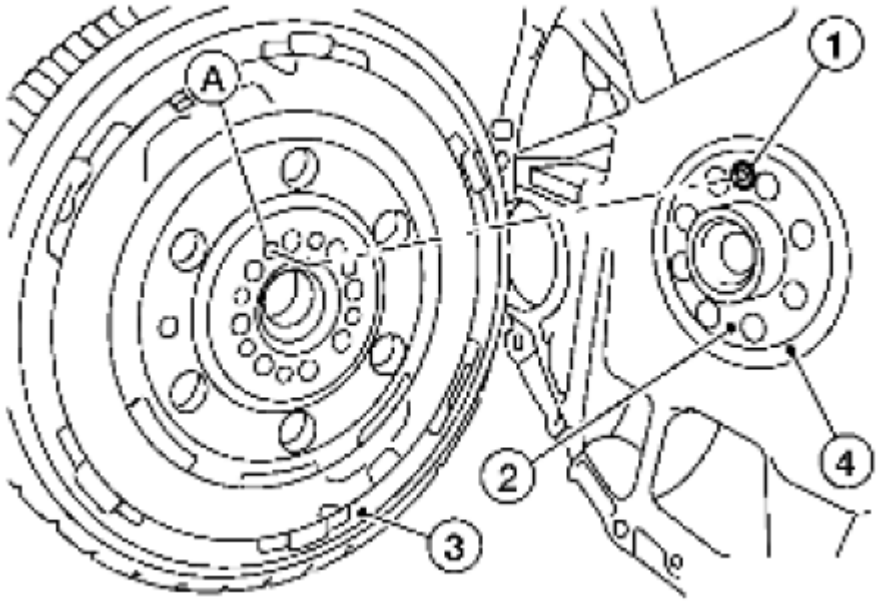


Fig. 237: Aligning Crankshaft Side Dowel Pin To Flywheel Side Dowel Pin Hole
Courtesy of SUZUKI OF AMERICA CORP.

     - Oil seal (4)
   - There is a locator mark (B) on the clutch cover side of the flywheel (4). Refer to this for ease of installation.

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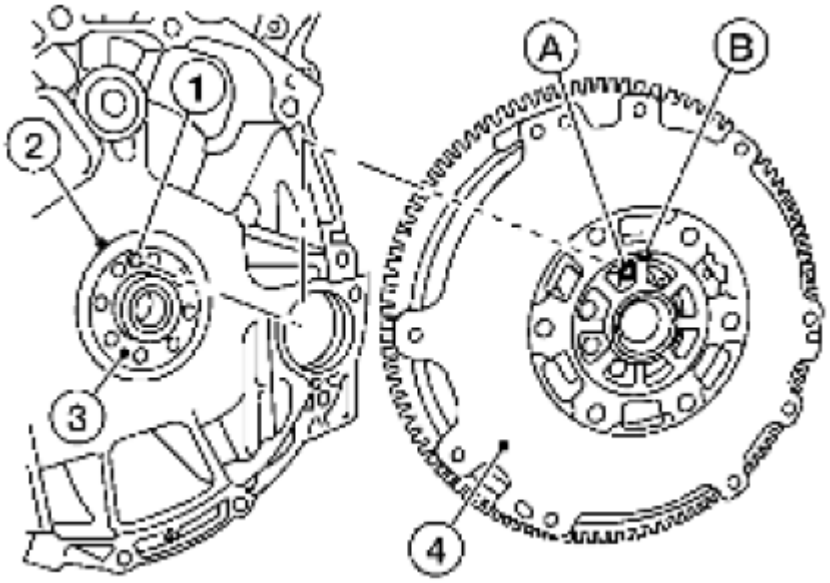


Fig. 238: Identifying Locator Mark On Clutch Cover Side
Courtesy of SUZUKI OF AMERICA CORP.

- Crankshaft dowel pin (1)
- Oil seal (2)
- Crankshaft (3)
- Flywheel (4)
- Dowel pin hole (A)
- Dowel pin locator mark (B)

- Tighten the flywheel bolts in a diagonal pattern in two steps. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**].

HOW TO SELECT PISTON AND BEARING

DESCRIPTION

ITEM SPECIFICATION

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block	Piston and piston pin assembly (Piston is	Piston grade (piston skirt	Piston grade = cylinder bore grade

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and piston	available together with piston pin as assembly.)	diameter)	(inner diameter of bore)
Between piston and connecting rod(1)	-	-	-
(1) For the service parts, the grade for fitting cannot be selected between piston pin and connecting rod. (Only (0) grade is available.) The information at the shipment from the plant is described as a reference.			

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, follow the applicable procedures.

HOW TO SELECT PISTON

When New Cylinder Block is Used

Check the cylinder bore grade [(1), (2), or (3)] on rear side of cylinder block, and select piston of the same grade.

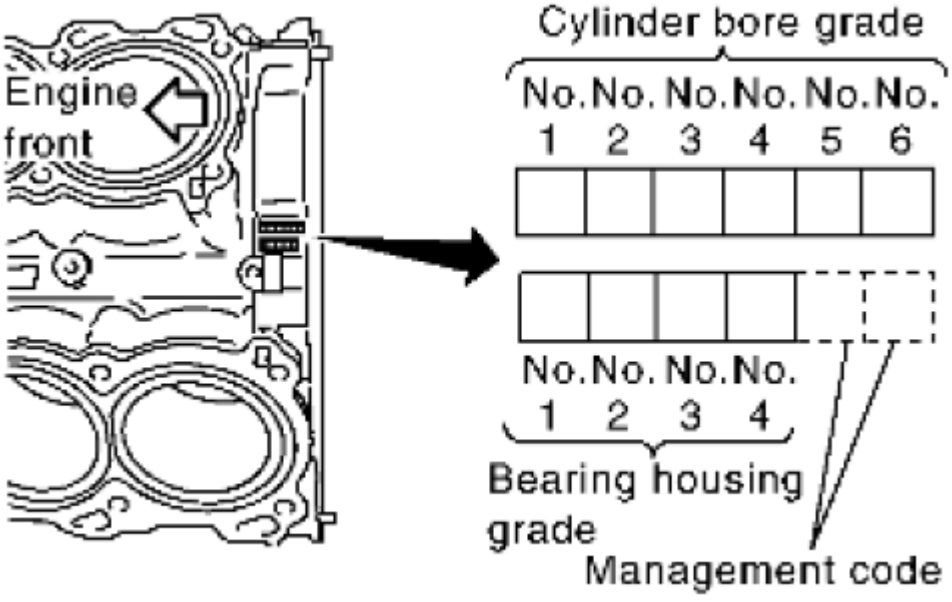


Fig. 239: Identifying Cylinder Bore Grade And Bearing Housing Grade
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Piston is available with piston pin as a set for the service part. (Only (0) grade piston pin is available.)

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When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".

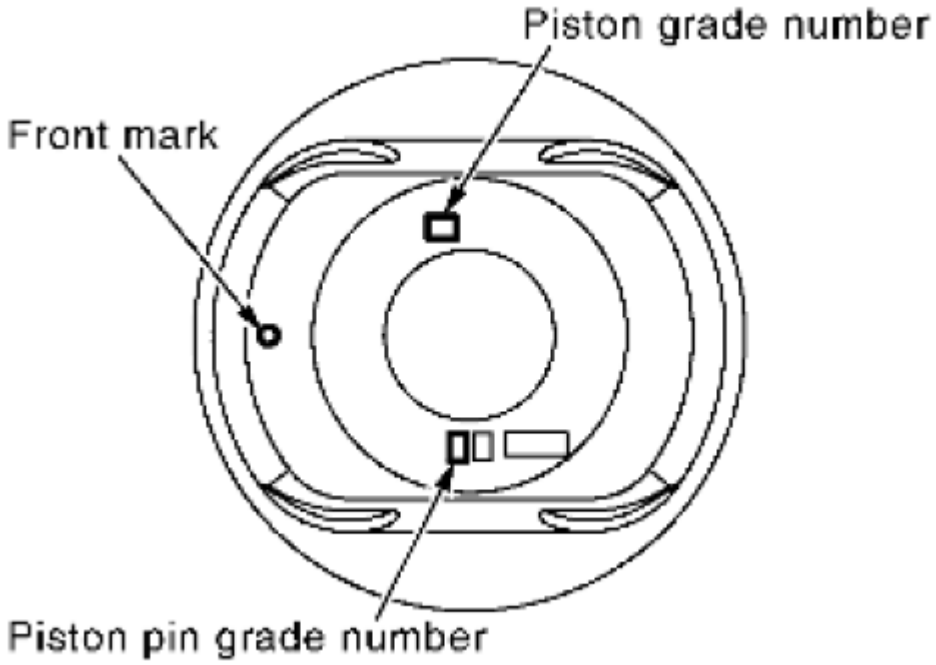


Fig. 240: Identifying Piston Grade Number And Piston Pin Grade Number
Courtesy of SUZUKI OF AMERICA CORP.

3. Select piston of the same grade.

Piston Selection Table

PISTON GRADE REFERENCE

			Unit: mm (in)
Grade	**1**	**2 (or no mark)**	**3**
Cylinder bore inner diameter	95.500 - 95.510 (3.7598 - 3.7602)	95.510 - 95.520 (3.7602 - 3.7606)	95.520 - 95.530 (3.7606 - 3.7610)
Piston skirt diameter	95.480 - 95.490 (3.7590 - 3.7594)	95.490 - 95.500 (3.7594 - 3.7598)	95.500 - 95.510 (3.7598 - 3.7602)

NOTE:

- **Piston is available together with piston pin as assembly.**
- **Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no piston pin grades can be selected. (Only (0) grade is available.)**

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- **No second grade mark is available on piston.**

HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

Check pin journal grade [(0), (1), or (2)] on front of crankshaft, and select connecting rod bearing of the same grade.

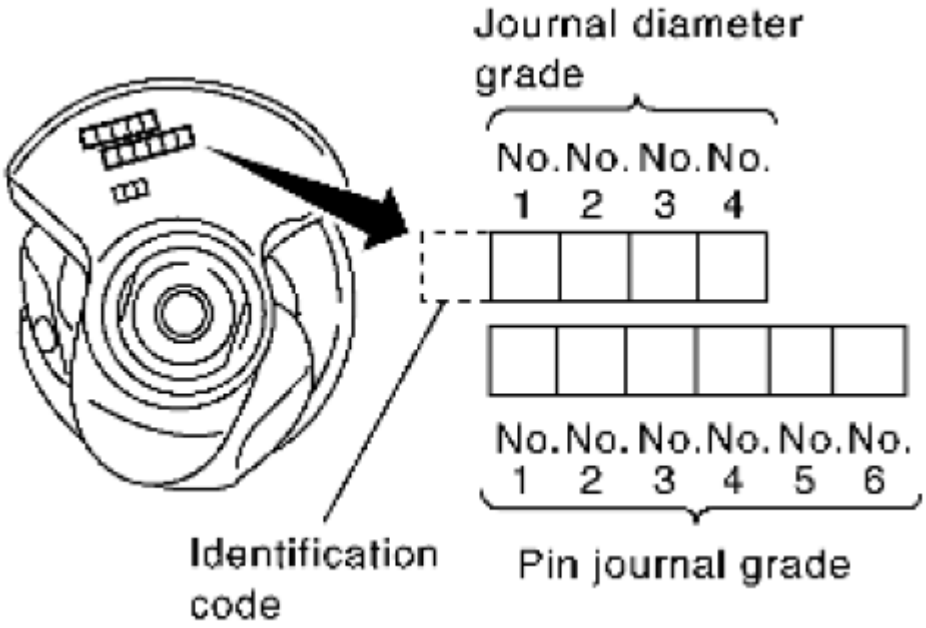


Fig. 241: Checking Pin Journal Grade On Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: There is no grading for connecting rod big end diameter.

When Crankshaft and Connecting Rod are Reused

1. Measure the connecting rod big end diameter. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
2. Make sure that the connecting rod big end diameter is within the standard value.
3. Measure the crankshaft pin journal diameter. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
4. Determine the grade of crankshaft pin journal grade by corresponding to the measured dimension in "Crankshaft pin journal diameter" column of "Connecting Rod Bearing Selection Table".
5. Select connecting rod bearing of the same grade.

Connecting Rod Bearing Selection Table

CONNECTING ROD BIG END DIAMETER CHART

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	Unit: mm (in)
Connecting rod big end diameter	57.000 - 57.013 (2.2441 - 2.2446)

CONNECTING ROD BEARING SELECTION CHART

				Unit: mm (in)
Crankshaft		**Connecting rod bearing**		
Crankshaft pin journal diameter	**Grade (Mark)**	**Dimension (Bearing thickness range)**	**Bearing grade No.**	**Color**
53.968 - 53.974 (2.1247 - 2.1250)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
53.962 - 53.968 (2.1245 - 2.1247)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
53.956 - 53.962 (2.1242 - 2.1245)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

Undersize Bearings Usage Guide

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

CAUTION: In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].

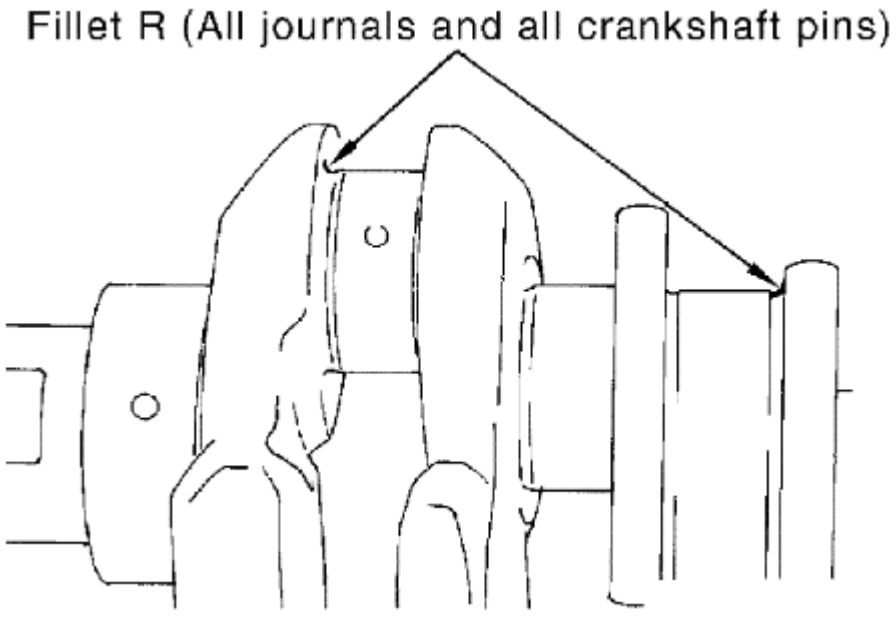


Fig. 242: Identifying Crankshaft Pins And Journals
Courtesy of SUZUKI OF AMERICA CORP.

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Bearing undersize table

THICKNESS CHART

Unit: mm (in)	
Size	**Thickness**
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used

1. "Main Bearing Selection Table" rows correspond to bearing housing grade on rear left side of cylinder block.

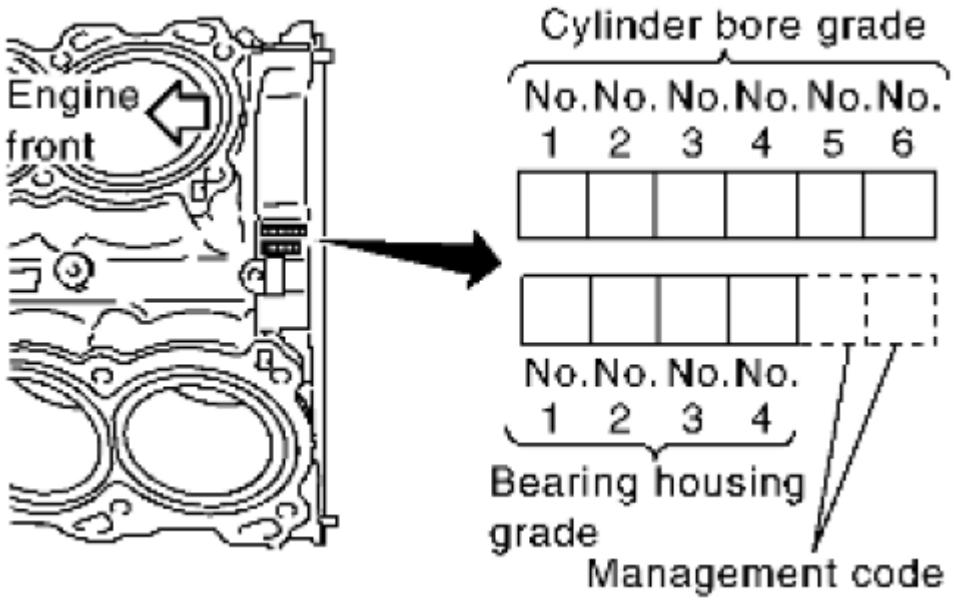


Fig. 243: Identifying Bearing Housing Grade And Cylinder Bore Grade
Courtesy of SUZUKI OF AMERICA CORP.

2. "Main Bearing Selection Table" columns correspond to journal diameter grade on front side of crankshaft.

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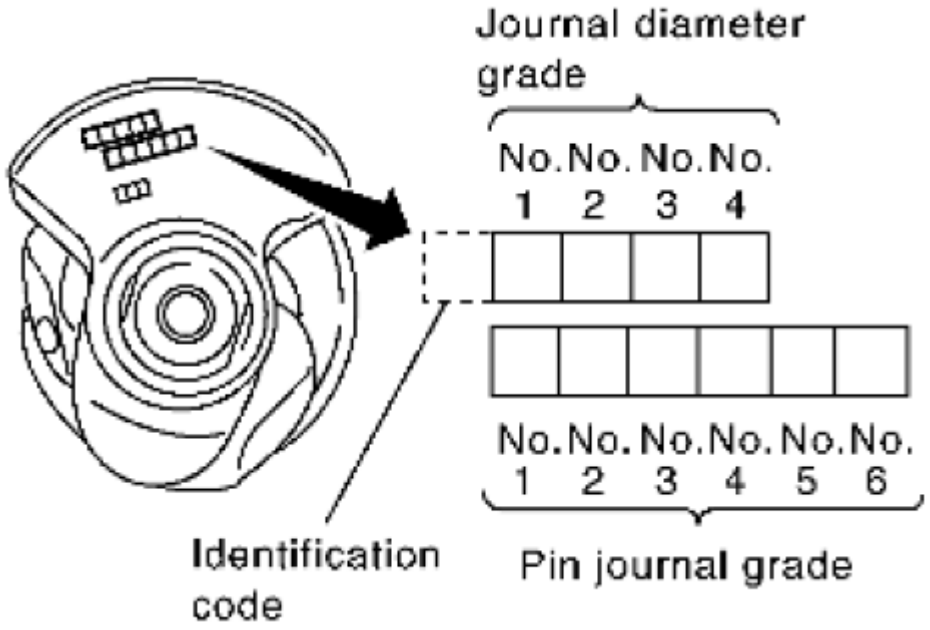


Fig. 244: Identifying Pin Journal Grade And Journal Diameter Grade
Courtesy of SUZUKI OF AMERICA CORP.

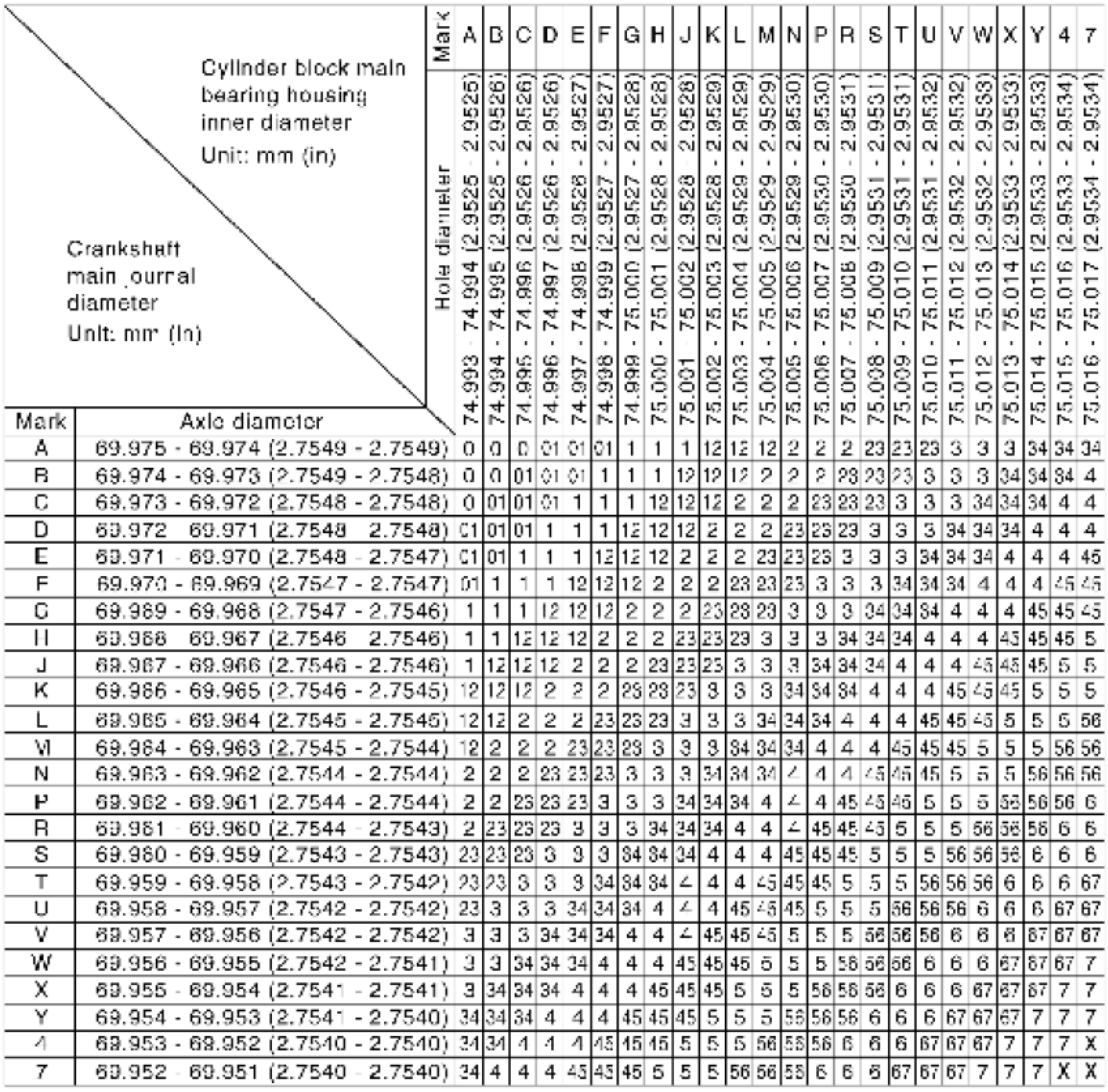
3. Select main bearing grade at the point where selected row and column meet in "Main Bearing Selection Table".

When Cylinder Block and Crankshaft are Reused

1. Measure cylinder block main bearing housing inner diameter and crankshaft main journal diameter. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**] and [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
2. Correspond the measured dimension in "Cylinder block main bearing housing inner diameter" row of "Main Bearing Selection Table".
3. Correspond the measured dimension in "Crankshaft main journal diameter" column of "Main Bearing Selection Table".
4. Select main bearing grade at the point where selected row and column meet in following selection table.

Main Bearing Selection Table

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Mark	Axle diameter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
	Hole diameter	74.994 (2.9525) - 74.995 (2.9525)	74.995 (2.9525) - 74.996 (2.9526)	74.996 (2.9526) - 74.997 (2.9526)	74.997 (2.9526) - 74.998 (2.9526)	74.998 (2.9526) - 74.999 (2.9527)	74.999 (2.9527) - 75.000 (2.9527)	75.000 (2.9527) - 75.001 (2.9528)	75.001 (2.9528) - 75.002 (2.9528)	75.002 (2.9528) - 75.003 (2.9528)	75.003 (2.9528) - 75.004 (2.9529)	75.004 (2.9529) - 75.005 (2.9529)	75.005 (2.9529) - 75.006 (2.9529)	75.006 (2.9529) - 75.007 (2.9530)	75.007 (2.9530) - 75.008 (2.9530)	75.008 (2.9530) - 75.009 (2.9531)	75.009 (2.9531) - 75.010 (2.9531)	75.010 (2.9531) - 75.011 (2.9531)	75.011 (2.9531) - 75.012 (2.9532)	75.012 (2.9532) - 75.013 (2.9532)	75.013 (2.9532) - 75.014 (2.9533)	75.014 (2.9533) - 75.015 (2.9533)	75.015 (2.9533) - 75.016 (2.9533)	75.016 (2.9533) - 75.017 (2.9534)
A	69.975 - 69.974 (2.7549 - 2.7549)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
B	69.974 - 69.973 (2.7549 - 2.7548)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
C	69.973 - 69.972 (2.7548 - 2.7548)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
D	69.972 - 69.971 (2.7548 - 2.7548)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
E	69.971 - 69.970 (2.7548 - 2.7547)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
F	69.970 - 69.969 (2.7547 - 2.7547)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
G	69.969 - 69.968 (2.7547 - 2.7546)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
H	69.968 - 69.967 (2.7546 - 2.7546)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
J	69.967 - 69.966 (2.7546 - 2.7546)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
K	69.966 - 69.965 (2.7546 - 2.7545)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
L	69.965 - 69.964 (2.7545 - 2.7545)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
M	69.964 - 69.963 (2.7545 - 2.7544)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
N	69.963 - 69.962 (2.7544 - 2.7544)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
P	69.962 - 69.961 (2.7544 - 2.7544)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
R	69.961 - 69.960 (2.7544 - 2.7543)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
S	69.960 - 69.959 (2.7543 - 2.7543)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
T	69.959 - 69.958 (2.7543 - 2.7542)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
U	69.958 - 69.957 (2.7542 - 2.7542)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
V	69.957 - 69.956 (2.7542 - 2.7542)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
W	69.956 - 69.955 (2.7542 - 2.7541)	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
X	69.955 - 69.954 (2.7541 - 2.7541)	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
Y	69.954 - 69.953 (2.7541 - 2.7540)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
4	69.953 - 69.952 (2.7540 - 2.7540)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	X
7	69.952 - 69.951 (2.7540 - 2.7540)	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	X	X

Fig. 245: Main Bearing Selection Chart
Courtesy of SUZUKI OF AMERICA CORP.

Main Bearing Grade Table (All Journals)

THICKNESS CHART

Grade number	Thickness Unit: mm (in)	Width Unit: mm (in)	Identification color	Remarks
0	2.500 - 2.503 (0.0984 - 0.0985)		Black	
1	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
2	2.506 - 2.509 (0.0987 - 0.0988)		Green	
3	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	Grade is the same for upper and

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4		2.512 - 2.515 (0.0989 - 0.0990)	19.9 - 20.1 (0.783 - 0.791)	Blue	lower bearings.
5		2.515 - 2.518 (0.0990 - 0.0991)		Pink	
6		2.518 - 2.521 (0.0991 - 0.0993)		Purple	
7		2.521 - 2.524 (0.0993 - 0.0994)		White	
01	UPR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	Grade is different for upper and lower bearings.
	LWR	2.500 - 2.503 (0.0984 - 0.0985)		Black	
12	UPR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
	LWR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
23	UPR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
	LWR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
34	UPR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
	LWR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
45	UPR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
	LWR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
56	UPR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
	LWR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
67	UPR	2.521 - 2.524 (0.0993 - 0.0994)		White	
	LWR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	

Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use underside (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

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CAUTION: In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].

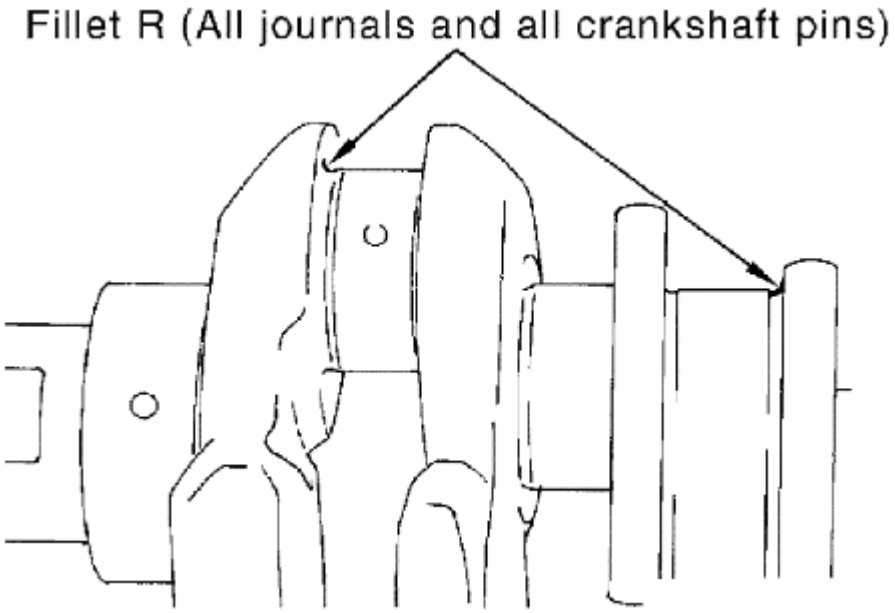


Fig. 246: Identifying Crankshaft Pins And Journal
Courtesy of SUZUKI OF AMERICA CORP.

Bearing undersize table

THICKNESS CHART

	Unit: mm (in)
Size	**Thickness**
US 0.25 (0.0098)	2.633 - 2.641 (0.1037 - 0.1040)

SPECIFICATIONS

SERVICE DATA AND SPECIFICATIONS

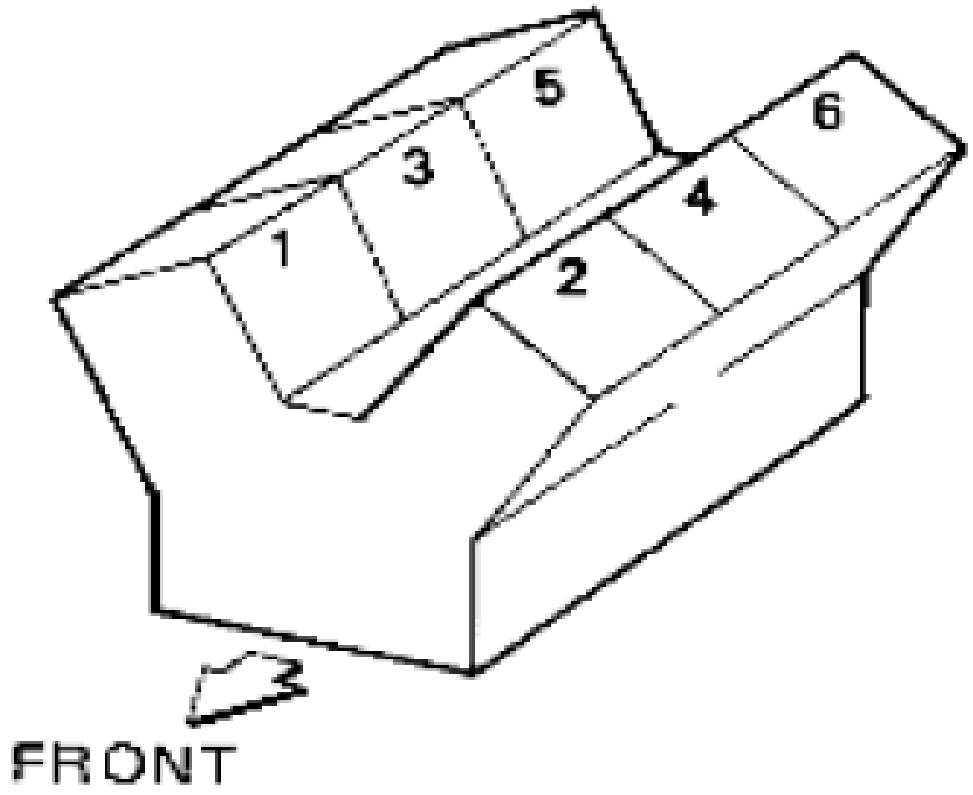
Standard and Limit

GENERAL SPECIFICATIONS

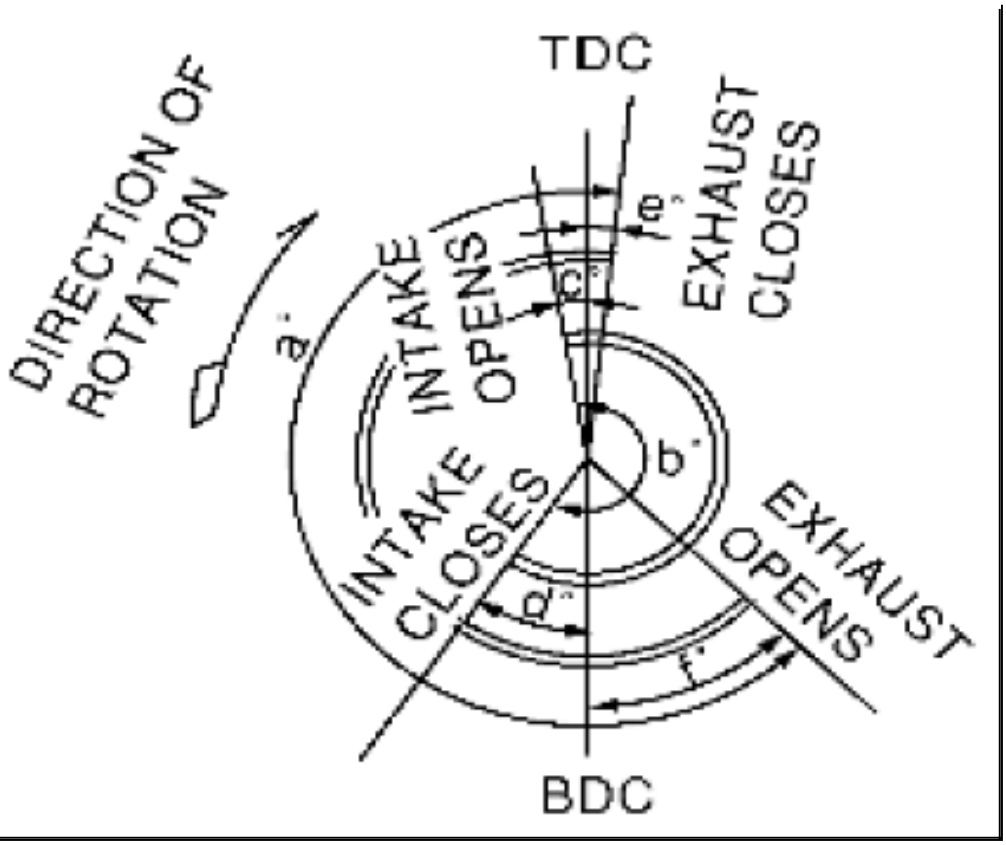
GENERAL SPECIFICATIONS

Cylinder arrangement	V-6
Displacement cm^3 (cu in)	3,954 (241.30)
Bore and stroke mm (in)	95.5 x 92.0 (3.76 x 3.622)
Valve arrangement	DOHC
Firing order	1-2-3-4-5-6

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Number of piston rings	Compression		2
	Oil		1
Number of main bearings			4
Compression ratio			9.7
Compression pressure kPa (kg/cm^2 , psi)/300 RPM	Standard		1,275 (13.0, 185)
	Minimum		981 (10.0, 142)
	Differential limit between cylinders		98 (1.0, 14)
Cylinder number			
Valve timing (Intake valve timing control - "OFF")			

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UNIT DEGREE REFERENCE

					Unit: degree
a	b	c	d	e	f
244	240	-4	64	6	58

DRIVE BELT

DRIVE BELT REFERENCE

Tension of drive belts	Auto adjustment by auto tensioner

INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

ITEM CHART

		Unit: mm (in)
Items		**Limit**
Surface distortion	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

SPARK PLUG

SPARK PLUG SPECIFICATION

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Application	United States and Canada	Mexico
Make	NGK	
Standard type	DILFR5A-11	PLFR5A-11
Gap (nominal)	1.1 mm (0.043 in)	

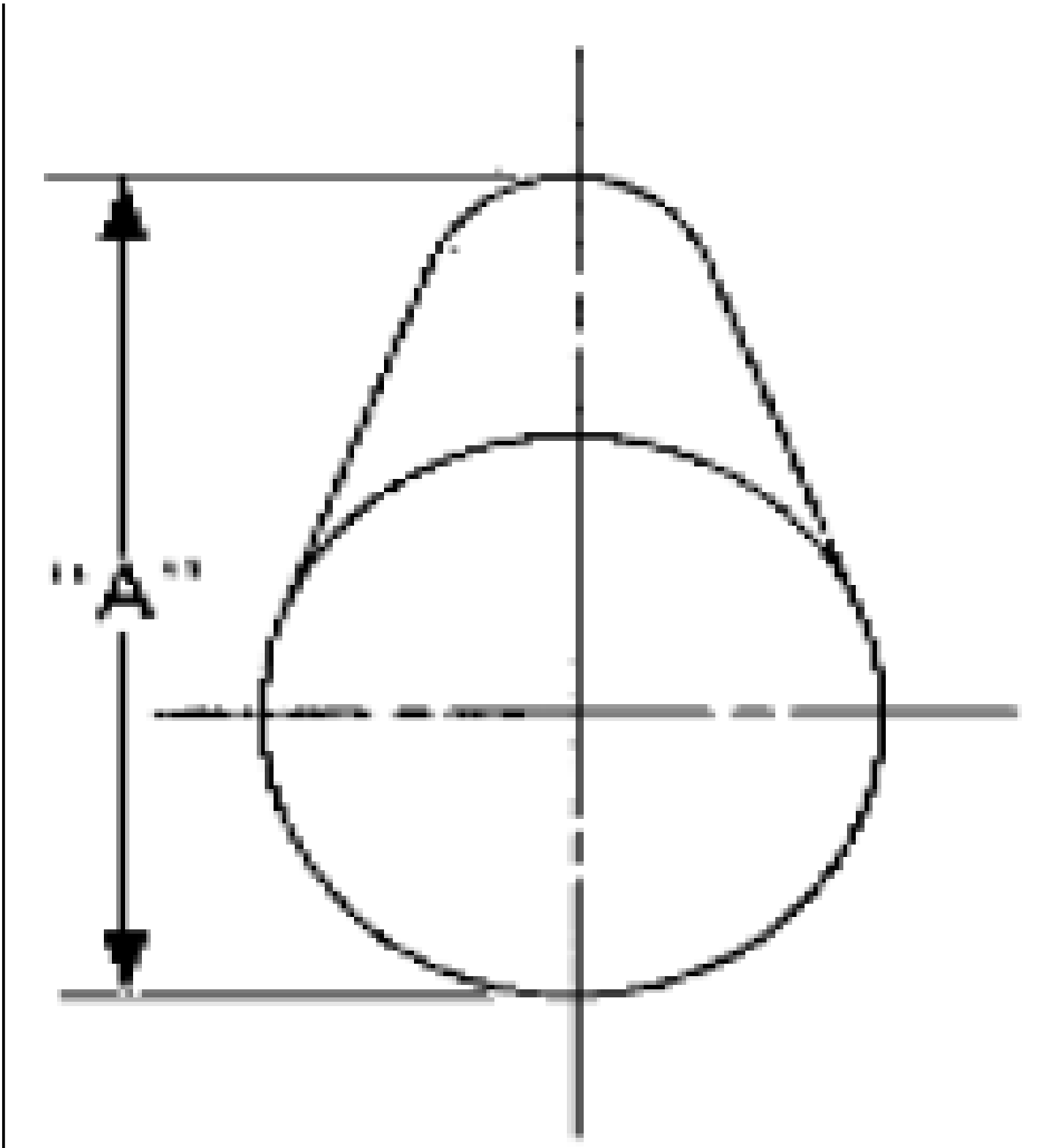
CAMSHAFT AND CAMSHAFT BEARING

CAMSHAFT AND CAMSHAFT BEARING CHART

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)	
Camshaft journal length	No. 1	27.500 - 27.548 (1.0827 - 1.0846)	-
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	-
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	-
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	-
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	-
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft cam height (A)	Intake	45.465 - 45.655 (1.7900 - 1.7974)	45.265 (1.7821)
	Exhaust	45.075 - 45.265 (1.7746 - 1.7821)	44.875 (1.7667)
Camshaft runout [TIR(1)]		Less than 0.02 (0.0008)	0.05 (0.002)
Camshaft sprocket runout [TIR*2]		-	0.15 (0.0059)

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(1) Total indicator reading

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Valve Seal

ITEM SPECIFICATION

	Unit: mm (in)
Items	**Standard**
Valve seal installed height (H)	14.3 - 14.9 (0.563 - 0.587)

Valve Lifter

ITEM SPECIFICATION

	Unit: mm (in)
Items	**Standard**
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.013 - 0.039 (0.0005 - 0.0015)

Valve Clearance

ITEM SPECIFICATION

		Unit: mm (in)
Items	**Cold**	**Hot(1) (reference data)**
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)
(1) Approximately 80 °C (176 °F)		

Available Valve Lifter

VQ40DE

THICKNESS CHART

		Unit: mm (in)
Identification (stamped) mark		**Thickness**
Intake	**Exhaust**	
788U	N788	7.88 (0.3102)
790U	N790	7.90 (0.3110)
792U	N792	7.92 (0.3118)
794U	N794	7.94 (0.3126)
796U	N796	7.96 (0.3134)
798U	N798	7.98 (0.3142)
800U	N800	8.00 (0.3150)
802U	N802	8.02 (0.3157)
804U	N804	8.04 (0.3165)
806U	N806	8.06 (0.3173)

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808U	N808	8.08 (0.3181)
810U	N810	8.10 (0.3189)
812U	N812	8.12 (0.3197)
814U	N814	8.14 (0.3205)
816U	N816	8.16 (0.3213)
818U	N818	8.18 (0.3220)
820U	N820	8.20 (0.3228)
822U	N822	8.22 (0.3236)
824U	N824	8.24 (0.3244)
826U	N826	8.26 (0.3252)
828U	N828	8.28 (0.3260)
830U	N830	8.30 (0.3268)
832U	N832	8.32 (0.3276)
834U	N834	8.34 (0.3283)
836U	N836	8.36 (0.3291)
838U	-	8.38 (0.3299)
840U	-	8.40 (0.3307)



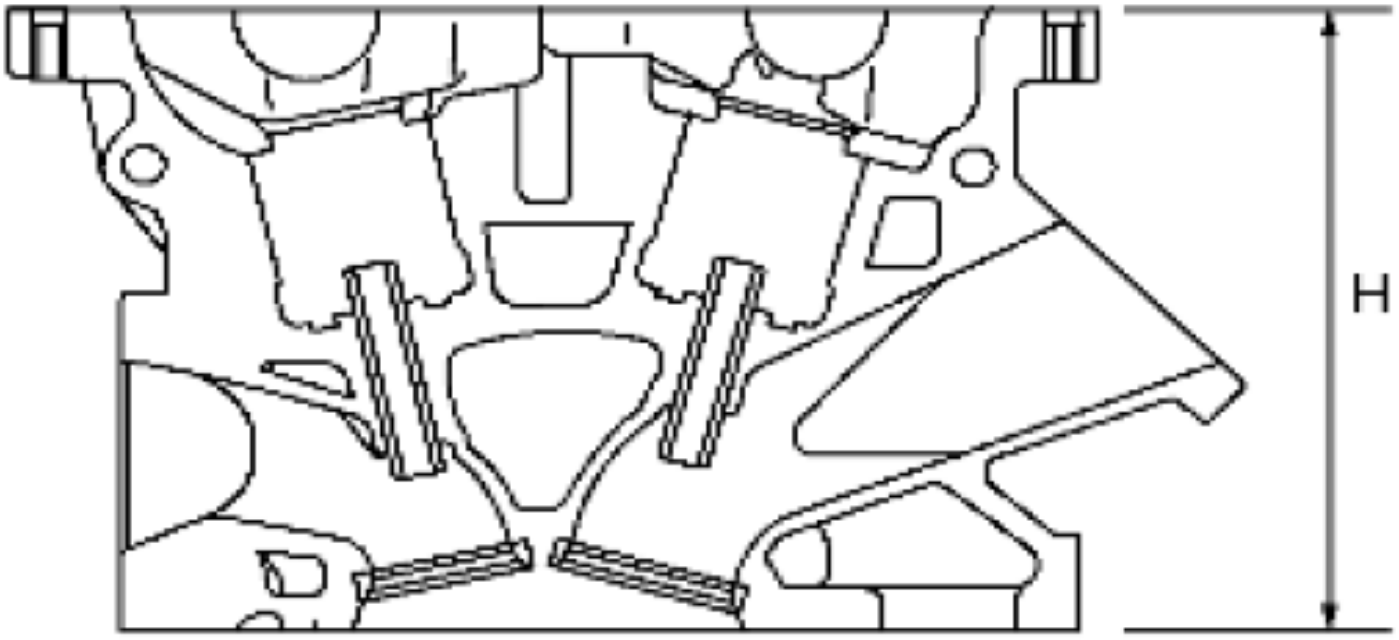
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CYLINDER HEAD

ITEM SPECIFICATION

Unit: mm (in)

Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height (H)	126.3 - 126.5 (4.972 - 4.980)	-
Cylinder head No. 1 camshaft journal bearing length	27.360 - 27.385 (1.0772 - 1.0781)	-

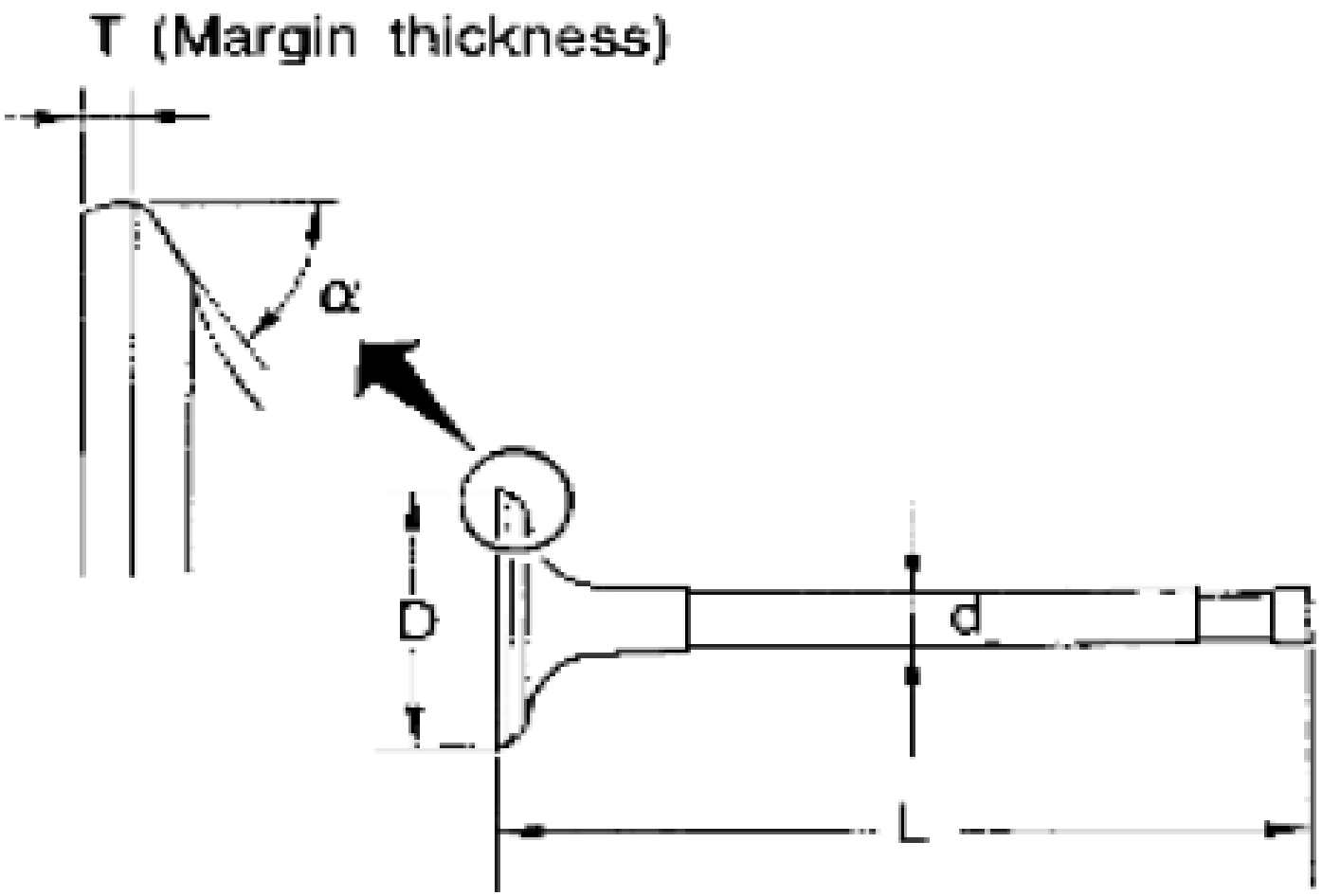


Valve Dimensions

VALVE HEAD DIAMETER CHART

Unit: mm (in)

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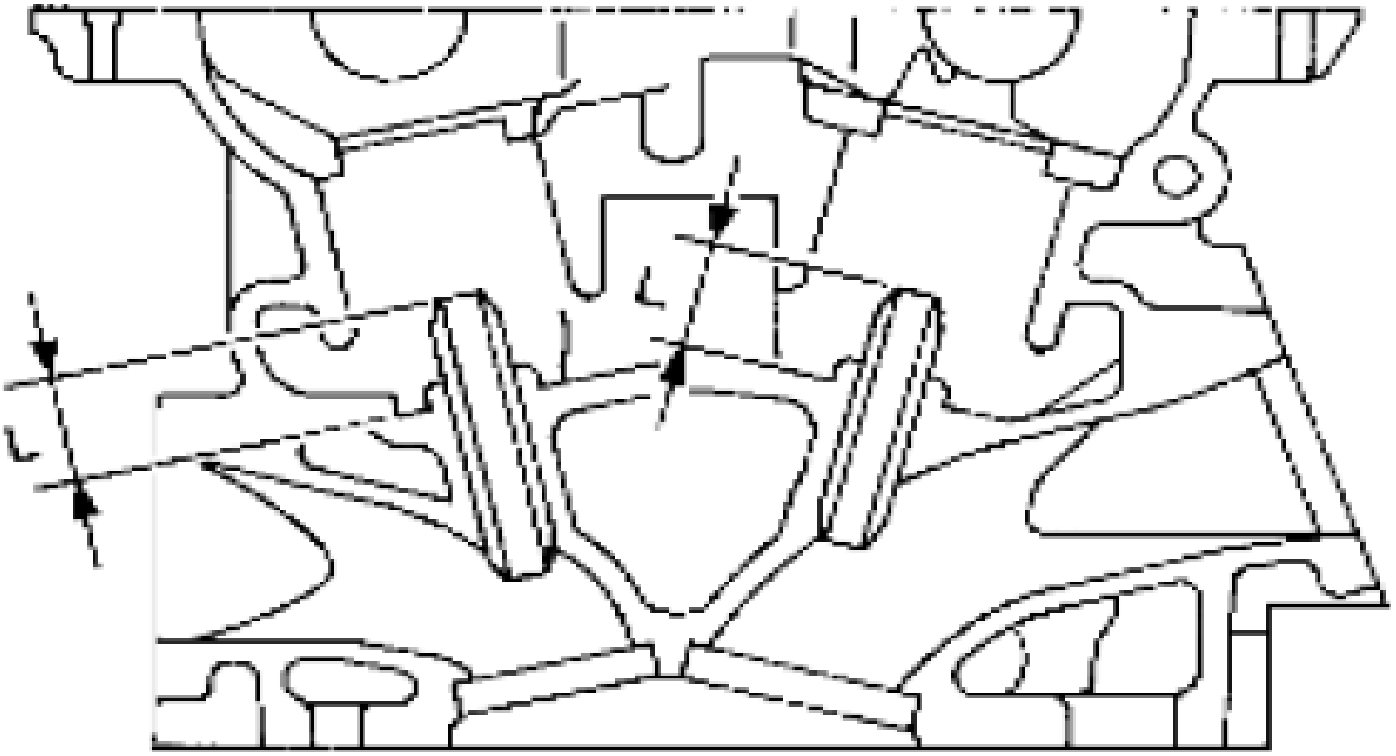
Valve head diameter (D)	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length (L)	Intake	96.46 (3.7976)
	Exhaust	93.99 (3.7004)
Valve stem diameter (d)	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle a	Intake	45°15' - 45°45'
	Exhaust	
Valve margin (T)	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)

Valve Guide

VALVE GUIDE SPECIFICATION

	Unit: mm (in)

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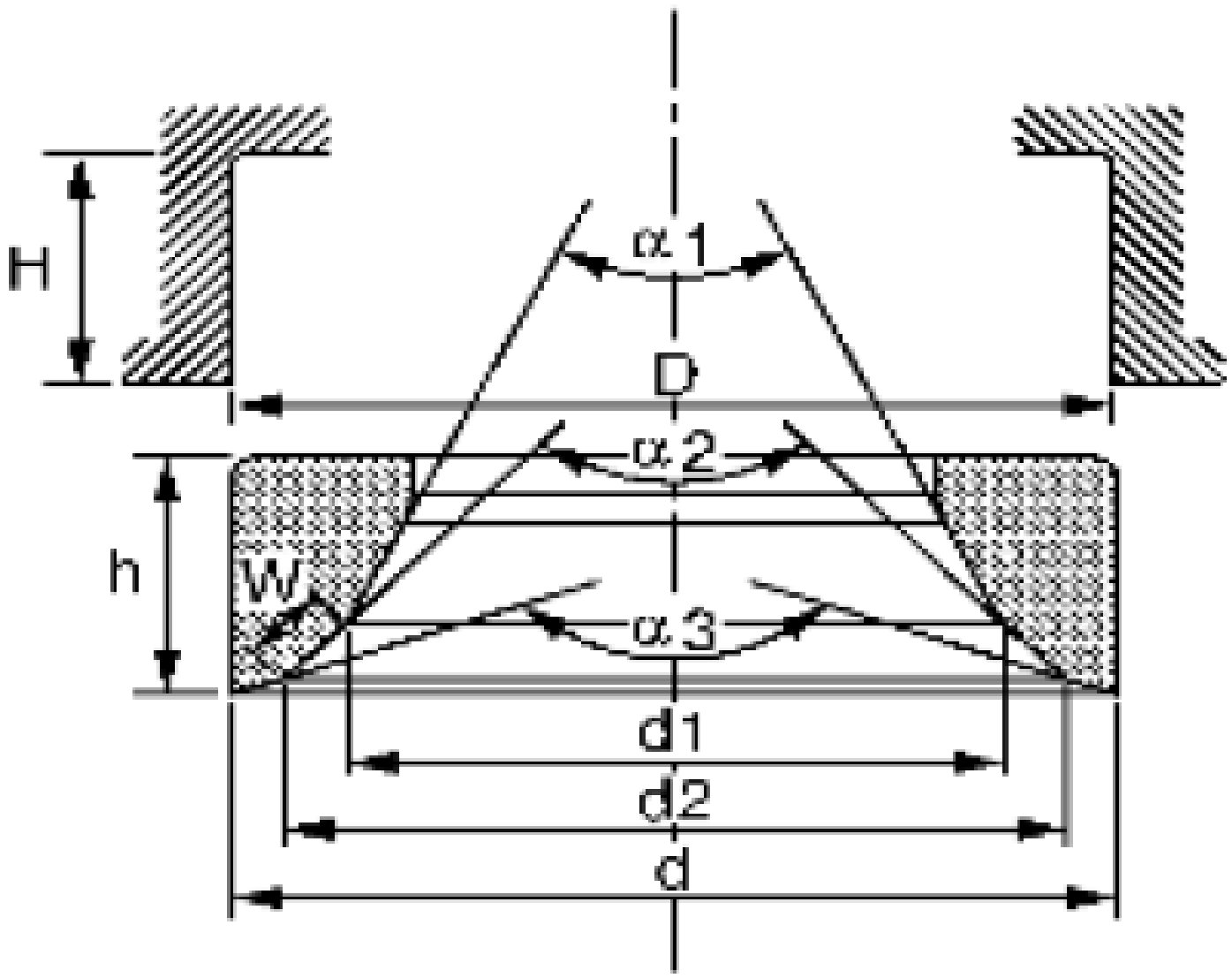
Items		Standard	0.2 (0.008) oversize (Service)
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length "L"		12.6 - 12.8 (0.496 - 0.504)	

Valve Seat

VALVE SEAT REFERENCE

Unit: mm (in)

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Items		Standard	Oversize [0.5 (0.020)] (Service)
Cylinder head seat recess diameter (D)	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat outer diameter (d)	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter (d1)(1)	Intake	35 (1.38)	
	Exhaust	28.7 (1.130)	
	Intake	36.3 - 36.8 (1.429 - 1.449)	

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Diameter (d2)(2)	Exhaust	30.3 - 30.8 (1.193 - 1.213)	
Angle a1)	Intake	60°	
	Exhaust	60°	
Angle a2)	Intake	88°45' - 90°15'	
	Exhaust	88°45' - 90°15'	
Angle a3)	Intake	120°	
	Exhaust	120°	
Contacting width (W)(3)	Intake	1.0 - 1.4 (0.039-0.055)	
	Exhaust	1.2 - 1.6 (0.047-0.063)	
Height (h)	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)		6.0 (0.236)	

(1) Diameter made by intersection point of conic angles a1) and (a2)

(2) Diameter made by intersection point of conic angles a2) and (a3)

(3) Machining data

Valve Spring

VALVE SPRING SPECIFICATION

Free height mm (in)		47.07 (1.8531)
Pressure N (kg, lb) at height mm (in)	Installation	166 - 188 (16.9 - 19.2, 37 - 42) at 37.00 (1.4567)
	Valve open	373 - 421 (38.0 - 42.9, 84 - 95) at 27.20 (1.0709)
Squareness mm (in)	Limit	2.1 (0.083)

Spark Plug Tube

ITEM CHART

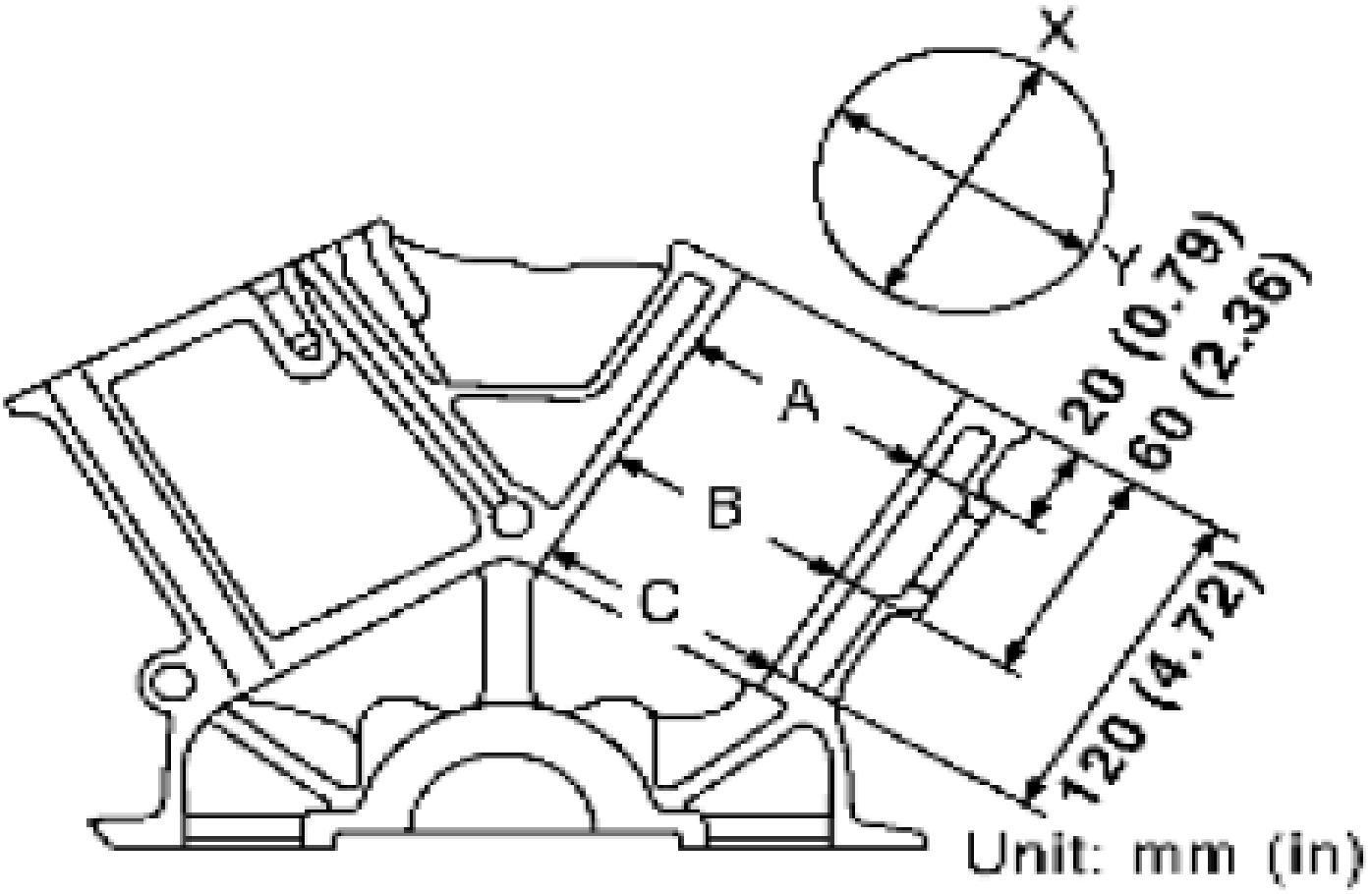
	Unit: mm (in)
Items	**Standard**
Spark plug tube press-fit height (H)	38.1 - 39.1 (1.500 - 1.539)

CYLINDER BLOCK

CYLINDER BLOCK SPECIFICATION

Unit: mm (in)

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Surface flatness		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Main bearing housing inner diameter		Standard		74.993 - 75.017 (2.9525 - 2.9534)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
Out-of-round [Difference between (X) and (Y)]		Limit		0.015 (0.0006)
Taper [Difference between (A) and (C)]				0.01 (0.0004)
			Grade No. A	74.993 - 74.994 (2.9525 - 2.9525)
			Grade No. B	74.994 - 74.995 (2.9525 - 2.9526)
			Grade No. C	74.995 - 74.996 (2.9526 - 2.9526)
			Grade No. D	74.996 - 74.997 (2.9526 - 2.9526)
			Grade No. E	74.997 - 74.998 (2.9526 - 2.9527)
			Grade No. F	74.998 - 74.999 (2.9527 - 2.9527)
			Grade No. G	74.999 - 75.000 (2.9527 - 2.9528)
			Grade No. H	75.000 - 75.001 (2.9528 - 2.9528)
			Grade No. J	75.001 - 75.002 (2.9528 - 2.9528)
			Grade No. K	75.002 - 75.003 (2.9528 - 2.9529)

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Main bearing housing inner diameter (Without bearing)		Grade No. L	75.003 - 75.004 (2.9529 - 2.9529)
		Grade No. M	75.004 - 75.005 (2.9529 - 2.9529)
		Grade No. N	75.005 - 75.006 (2.9529 - 2.9530)
		Grade No. P	75.006 - 75.007 (2.9530 - 2.9530)
		Grade No. R	75.007 - 75.008 (2.9530 - 2.9531)
		Grade No. S	75.008 - 75.009 (2.9530 - 2.9531)
		Grade No. T	75.009 - 75.010 (2.9531 - 2.9531)
		Grade No. U	75.010 - 75.011 (2.9531 - 2.9532)
		Grade No. V	75.011 - 75.012 (2.9532 - 2.9532)
		Grade No. W	75.012 - 75.013 (2.9532 - 2.9533)
		Grade No. X	75.013 - 75.014 (2.9533 - 2.9533)
		Grade No. Y	75.014 - 75.015 (2.9533 - 2.9533)
		Grade No. 4	75.015 - 75.016 (2.9533 - 2.9534)
		Grade No. 7	75.016 - 75.017 (2.9534 - 2.9534)
Difference in inner diameter between cylinders	Standard		Less than 0.03 (0.0012)

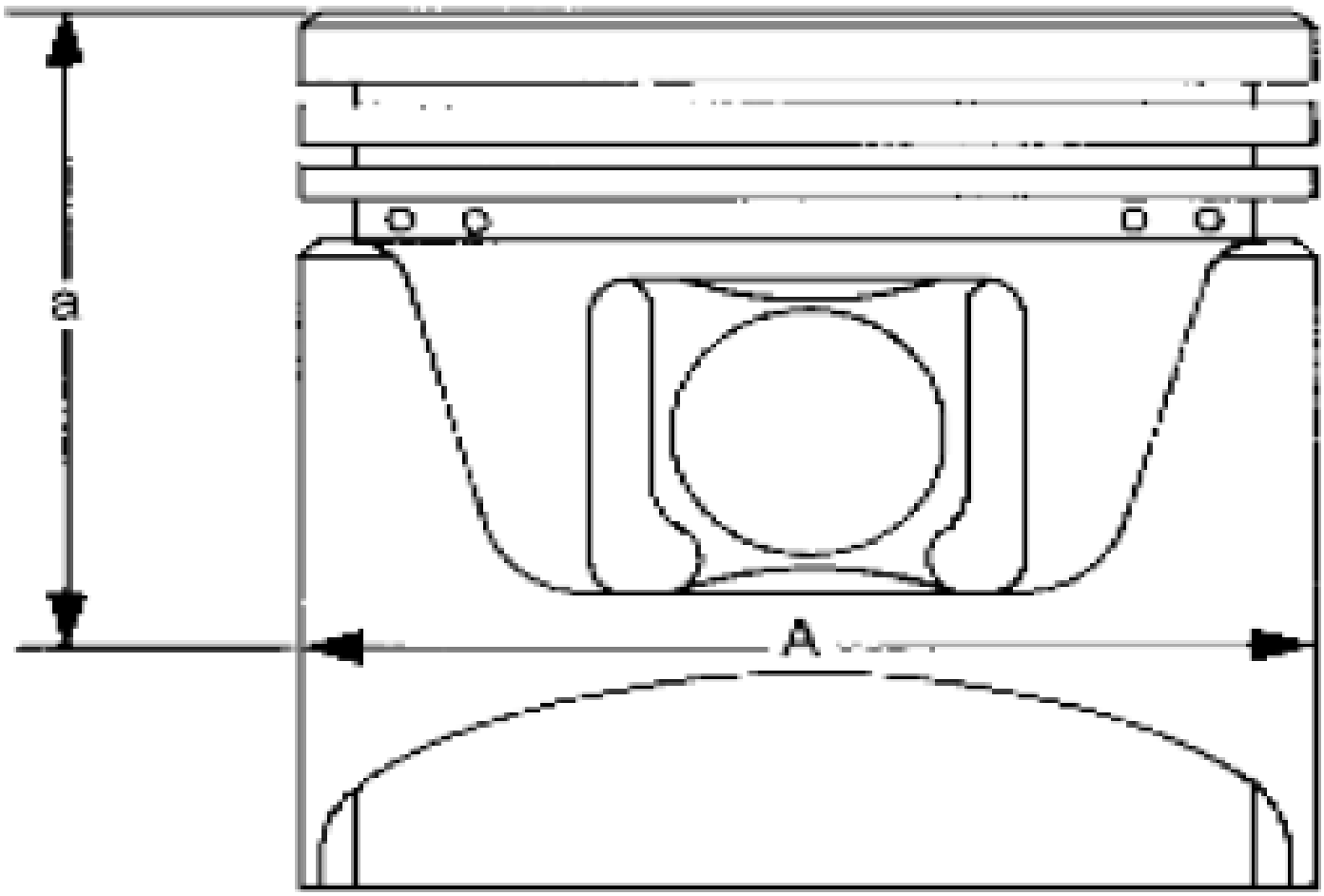
PISTON, PISTON RING AND PISTON PIN

Available Piston

PISTON SPECIFICATION

Unit: mm (in)

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Items		Standard	-
Piston skirt diameter (A)	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)	-
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)	-
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)	-
Items		Standard	Limit
(a) dimension		43.03 (1.6941)	-
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	-
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	-
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)	0.08 (0.0031)

Piston Ring

PISTON RING SPECIFICATION

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	-

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End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.56 (0.0220)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.68 (0.0268)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.85 (0.0335)

Piston Pin

ITEM SPECIFICATION

Unit: mm (in)

Items		Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	-
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	-
Piston to piston pin oil clearance		0.002 - 0.006 (0.0001 - 0.0002)	-
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

Always check with the Parts Department for the latest parts information on Grade.

CONNECTING ROD

ITEM SPECIFICATION

Unit: mm (in)

Items		Standard	Limit
Center distance		165.82 - 165.92 (6.5283 - 6.5323)	-
Bend [per 100 (3.94)]		-	0.15 (0.0059)
Torsion [per 100 (3.94)]		-	0.30 (0.0118)
Connecting rod bushing inner diameter(1)	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)	-
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)	-
Connecting rod big end diameter (Without bearing)		57.000 - 57.013 (2.2441 - 2.2446)	-
Side clearance		0.20 - 0.35 (0.0079 - 0.0138)	40 (0.0157)

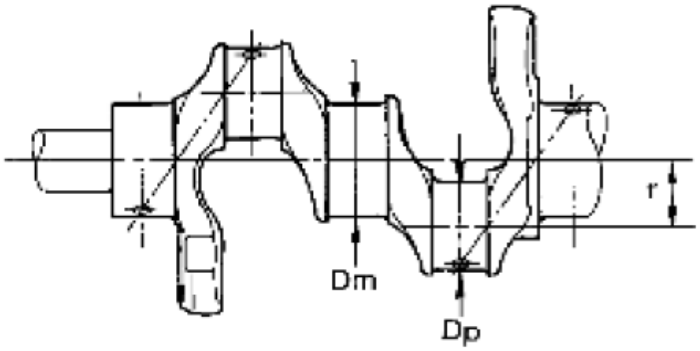
(1) After installing in connecting rod

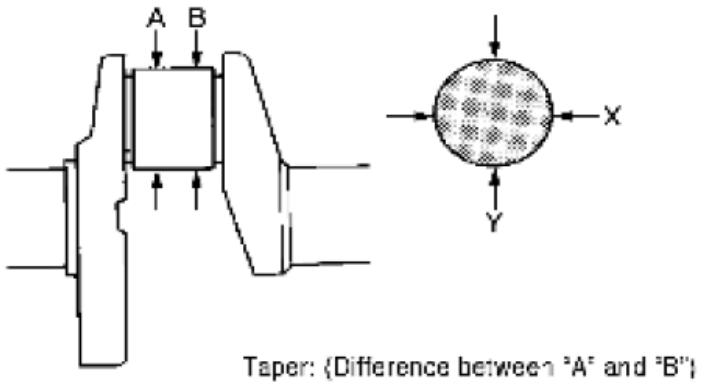
CRANKSHAFT

CRANKSHAFT SPECIFICATION

Unit: mm (in

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Taper: (Difference between "A" and "B")
Out-of-round: (Difference between "X" and "Y")

Main journal diameter. (Dm) grade	Standard	Grade No. A	69.975 - 69.974 (2.7549 - 2.7549)
		Grade No. B	69.974 - 69.973 (2.7549 - 2.7548)
		Grade No. C	69.973 - 69.972 (2.7548 - 2.7548)
		Grade No. D	69.972 - 69.971 (2.7548 - 2.7548)
		Grade No. E	69.971 - 69.970 (2.7548 - 2.7547)
		Grade No. F	69.970 - 69.969 (2.7547 - 2.7547)
		Grade No. G	69.969 - 69.968 (2.7547 - 2.7546)
		Grade No. H	69.968 - 69.967 (2.7546 - 2.7546)
		Grade No. J	69.967 - 69.966 (2.7546 - 2.7546)
		Grade No. K	69.966 - 69.965 (2.7546 - 2.7545)
		Grade No. L	69.965 - 69.964 (2.7545 - 2.7545)
		Grade No. M	69.964 - 69.963 (2.7545 - 2.7544)
		Grade No. N	69.963 - 69.962 (2.7544 - 2.7544)
		Grade No. P	69.962 - 69.961 (2.7544 - 2.7544)
		Grade No. R	69.961 - 69.960 (2.7544 - 2.7543)
		Grade No. S	69.960 - 69.959 (2.7543 - 2.7543)
		Grade No. T	69.959 - 69.958 (2.7543 - 2.7542)
		Grade No. U	69.958 - 69.957 (2.7542 - 2.7542)
		Grade No. V	69.957 - 69.956 (2.7542 - 2.7542)
		Grade No. W	69.956 - 69.955 (2.7542 - 2.7541)
		Grade No. X	69.955 - 69.954 (2.7541 - 2.7541)
		Grade No. Y	69.954 - 69.953 (2.7541 - 2.7540)
		Grade No. 4	69.953 - 69.952 (2.7540 - 2.7540)
		Grade No. 7	69.952 - 69.951 (2.7540 - 2.7540)
Pin journal diameter. (Dp) grade	Standard	Grade No. 0	53.968 - 53.974 (2.1247 - 2.1250)
		Grade No. 1	53.962 - 53.968 (2.1245 - 2.1247)
		Grade No. 2	53.956 - 53.962 (2.1242 - 2.1245)
Center distance (r)			45.96 - 46.04 (1.8094 - 1.8126)
Taper [Difference between (A) and (B)]	Limit		0.002 (0.0001)
Out-of-round [Difference between (X) and (Y)]	Limit		0.002 (0.0001)
	Standard		Less than 0.05 (0.002)

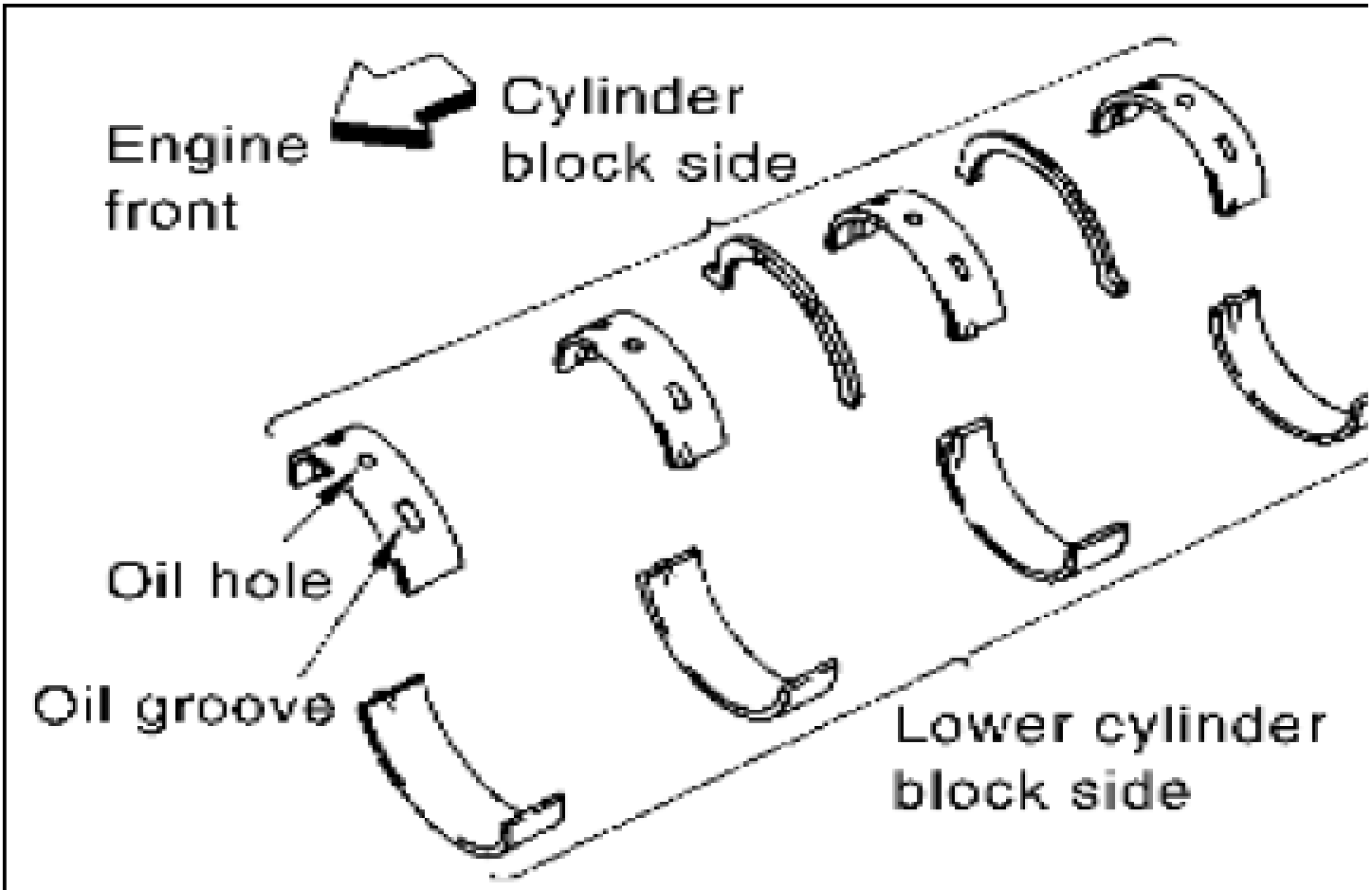
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Crankshaft runout [TIR(1)]	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)

(1) Total indicator reading

MAIN BEARING

MAIN BEARING SPECIFICATION



Grade number	UPR/LWR	Thickness mm (in)	Width mm (in)	Identification color	Remark
0	-	2.500 - 2.503 (0.0984 - 0.0985)		Black	
1	-	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
2	-	2.506 - 2.509 (0.0987 - 0.0988)		Green	
3	-	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	Grade is the s
4	-	2.512 - 2.515		Blue	for upper and

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		(0.0989 - 0.0990)			lower bearing
5	-	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
6	-	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
7	-	2.521 - 2.524 (0.0993 - 0.0994)		White	
01	UPR	2.503 - 2.506 (0.0985 - 0.0987)	19.9 - 20.1 (0.783 - 0.791)	Brown	Grade is diffe for upper and lower bearing
	LWR	2.500 - 2.503 (0.0984 - 0.0985)		Black	
12	UPR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
	LWR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
23	UPR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
	LWR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
34	UPR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
	LWR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
45	UPR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
	LWR	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
56	UPR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
	LWR	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
67	UPR	2.521 - 2.524 (0.0993 - 0.0994)		White	
	LWR	2.518 - 2.521 (0.0991 - 0.0993)		Purple	

Undersize

THICKNESS CHART

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.633 - 2.641 (0.1037 - 0.1040)	Grind so that bearing clearance is the specified value.

Main Bearing Oil Clearance

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ITEM SPECIFICATION

		Unit: mm (in)
Items	**Standard**	**Limit**
Main bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018) (1)	0.065 (0.0026)
(1) Actual clearance		

CONNECTING ROD BEARING

THICKNESS CHART

Grade number	Thickness mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

Undersize

THICKNESS CHART

		Unit: mm (in)
Items	**Thickness**	**Crank pin journal diameter**
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

Connecting Rod Bearing Oil Clearance

ITEM SPECIFICATION

		Unit: mm (in)
Items	**Standard**	**Limit**
Connecting rod bearing oil clearance	0.034 - 0.059 (0.0013 - 0.0023) (1)	0.070 (0.0028)
(1) Actual clearance		

SPECIAL TOOLS AND EQUIPMENT

SPECIAL SERVICE TOOL

Refer to [**SPECIAL SERVICE TOOL**].

COMMERCIAL SERVICE TOOL

Refer to [**COMMERCIAL SERVICE TOOL**].

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