2009 ENGINE

Engine Mechanical (QR25DE) - 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:

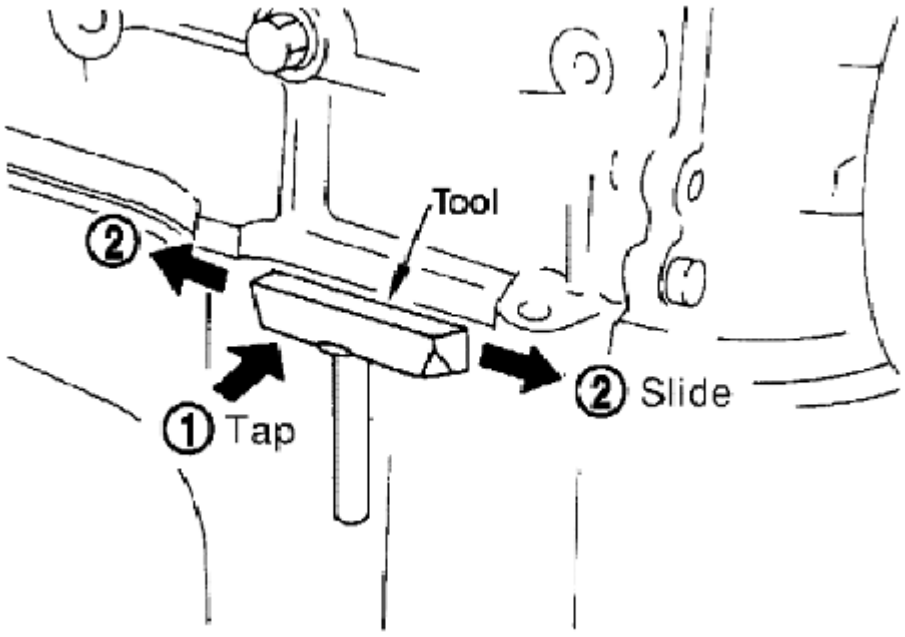
  Tool number: KV10112100 (BT-8653-A)

  - 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.

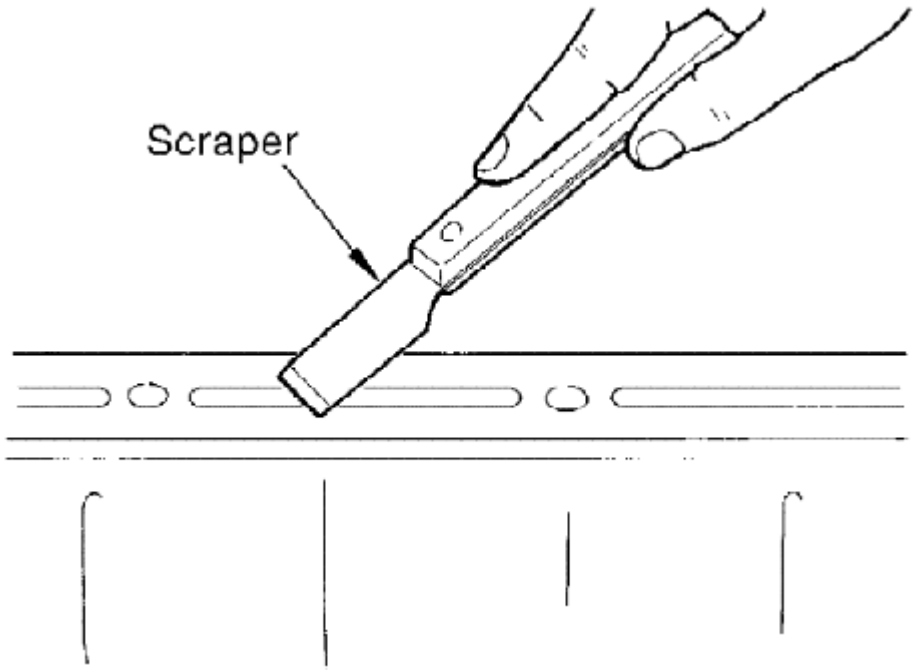


Fig. 2: Removing Old Liquid Gasket From Mating Surface Using Scraper
Courtesy of SUZUKI OF AMERICA CORP.

   - 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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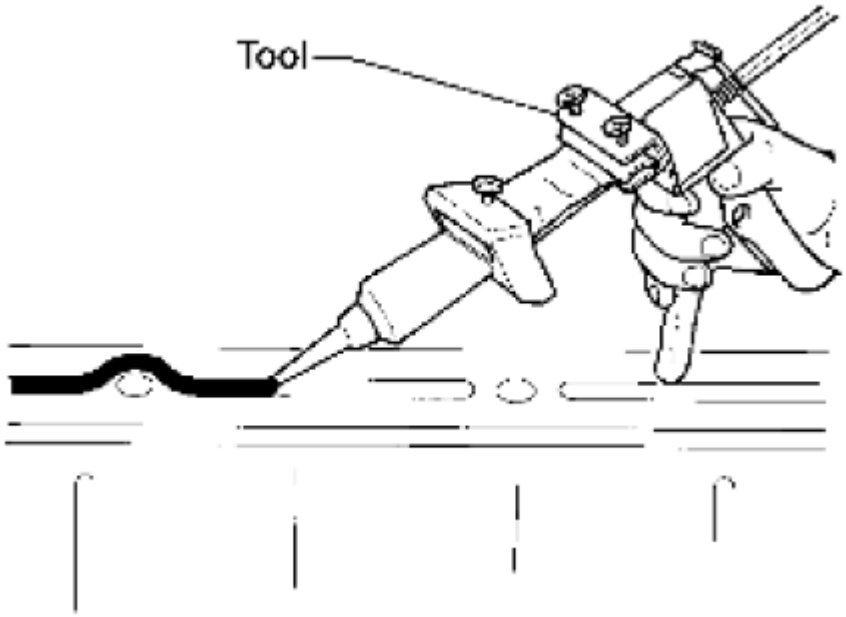


Fig. 3: Attaching Liquid Gasket Tube To Tool
Courtesy of SUZUKI OF AMERICA CORP.

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.

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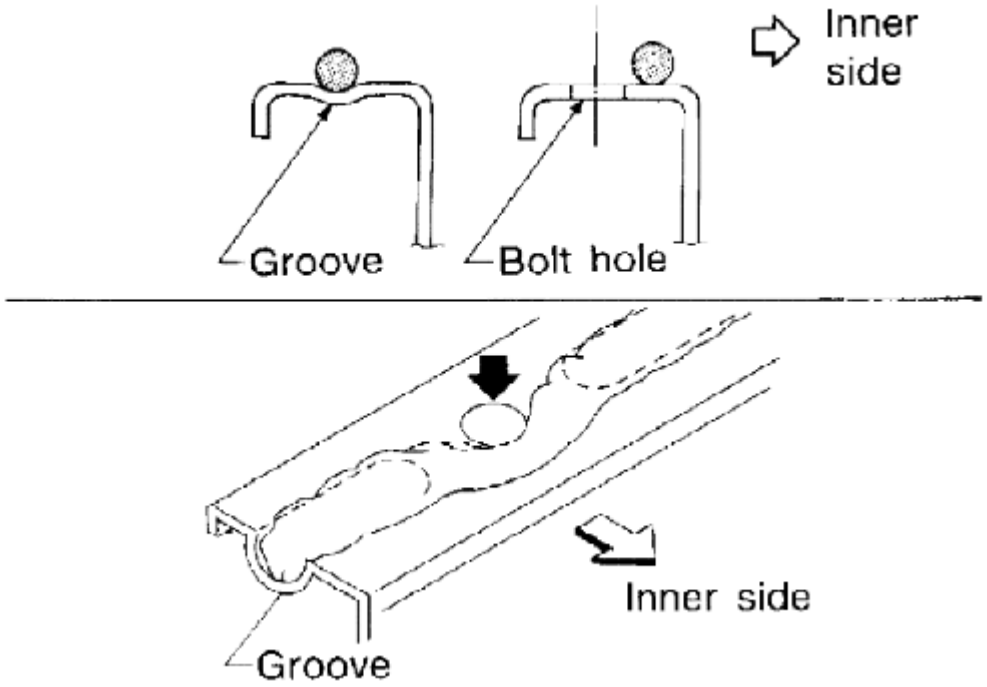


Fig. 4: Identifying Groove For Applying Liquid Gasket
Courtesy of SUZUKI OF AMERICA CORP.

- 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.

DIAGNOSTIC INFORMATION AND PROCEDURES

NVH TROUBLESHOOTING - ENGINE NOISE

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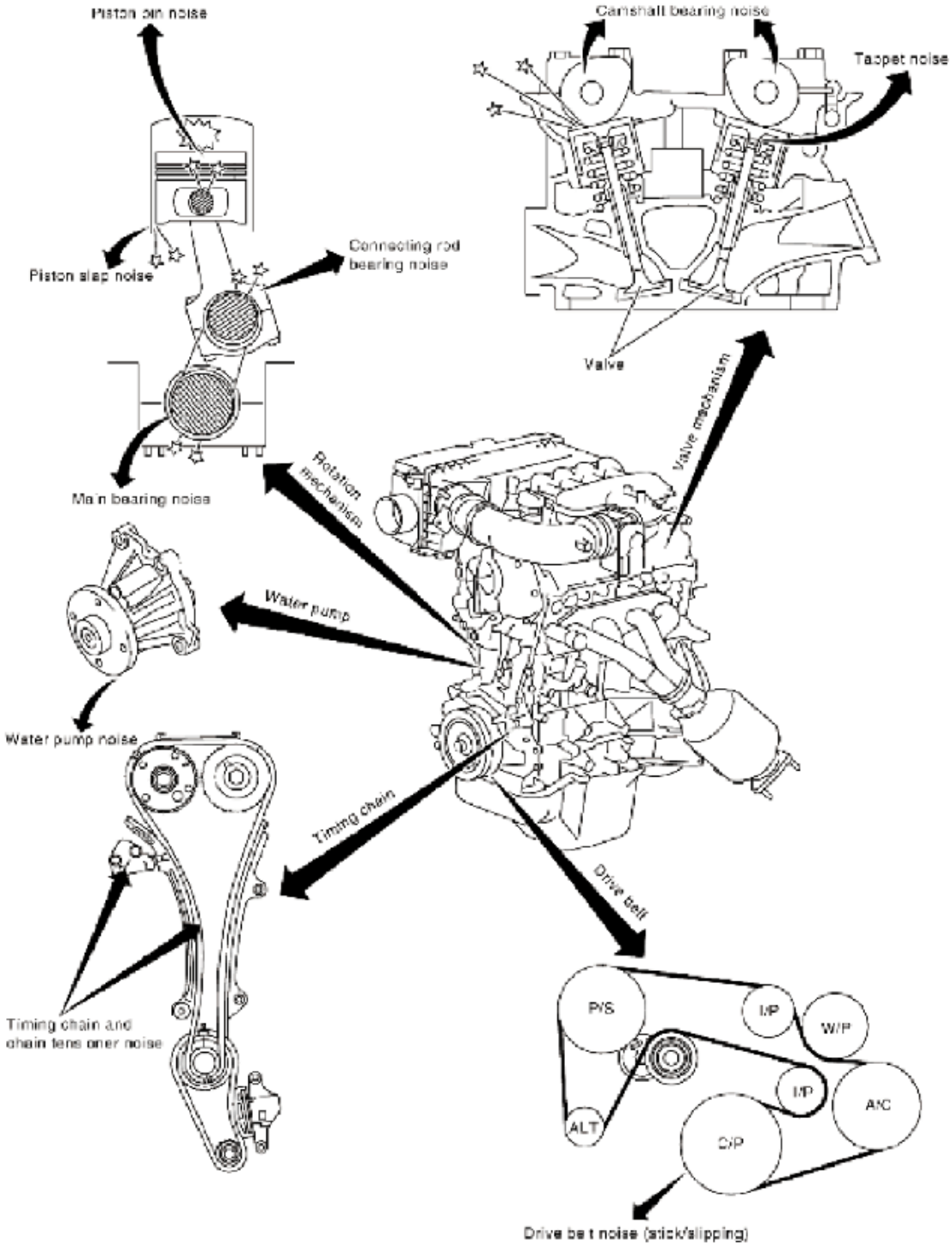


Fig. 5: Identifying Engine Noise Occurring Components
Courtesy of SUZUKI OF AMERICA CORP.

NVH TROUBLESHOOTING

1. Locate the area where noise occurs.

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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
		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
	Rattle	C	A	-	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout
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
	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
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance

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	Knock	A	B	-	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout
Front of engine Front cover	Tapping or ticking	A	A	-	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation
Front of engine	Squeaking or fizzing	A	B	-	B	-	B	Drive belt (Sticking or slipping)	Drive belt deflection
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation
	Squall Creak	A	B	-	B	A	B	Water pump noise	Water pump operation
A: Closely related B: Related C: Sometimes related -: Not related									

REPAIR INSTRUCTIONS

DRIVE BELTS: EXPLODED VIEW

Refer to [**DRIVE BELT EXPLODED VIEW [QR25DE]**].

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.
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

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belt auto tensioner.

DRIVE BELTS: REMOVAL AND INSTALLATION

REMOVAL

1. Install Tool on auto tensioner pulley bolt and move in the direction of arrow (loosening direction of tensioner).

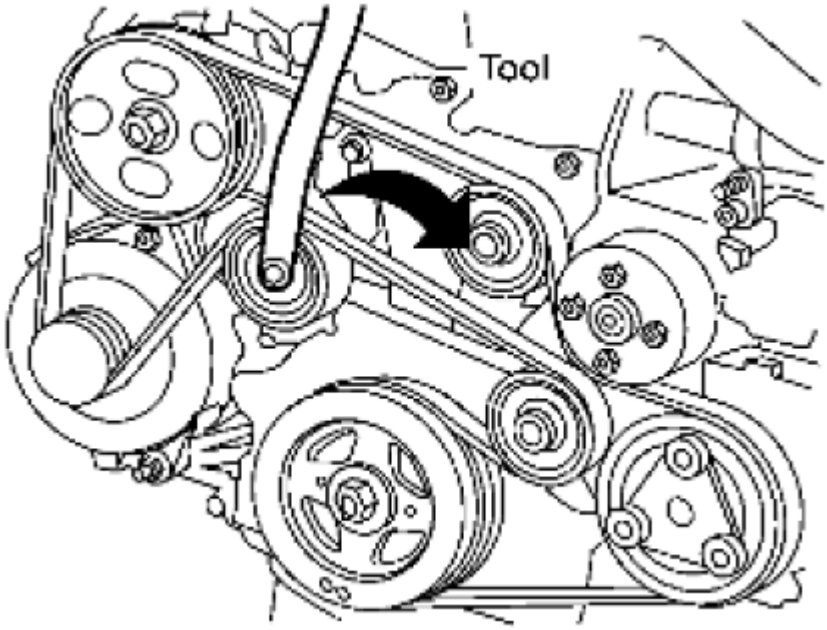


Fig. 6: Moving Tool On Auto Tensioner Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: - (J-46535)

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

CAUTION:
- **Do not loosen the auto-tensioner pulley bolt. (Do not turn it counterclockwise.) If turned counterclockwise, the complete auto-tensioner must be replaced as a unit, including pulley.**

2. Remove drive belt.

INSTALLATION

Installation is in the reverse order of removal.

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WARNING:

- **Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.**

CAUTION:

- **Do not loosen the auto-tensioner pulley bolt. (Do not turn it counterclockwise.) If turned counterclockwise, the complete auto-tensioner must be replaced as a unit, including pulley.**
- **Confirm belts are completely set on the pulleys.**
- **Check that there is no engine oil or engine coolant on the drive belt or pulley grooves.**

NOTE:

- **Turn crankshaft pulley clockwise several times to equalize tension between each pulley.**
- **Confirm tension of drive belt indicator (fixed side) is within the allowable working range.**

DRIVE BELT AUTO TENSIONER AND IDLER PULLEY: REMOVAL AND INSTALLATION

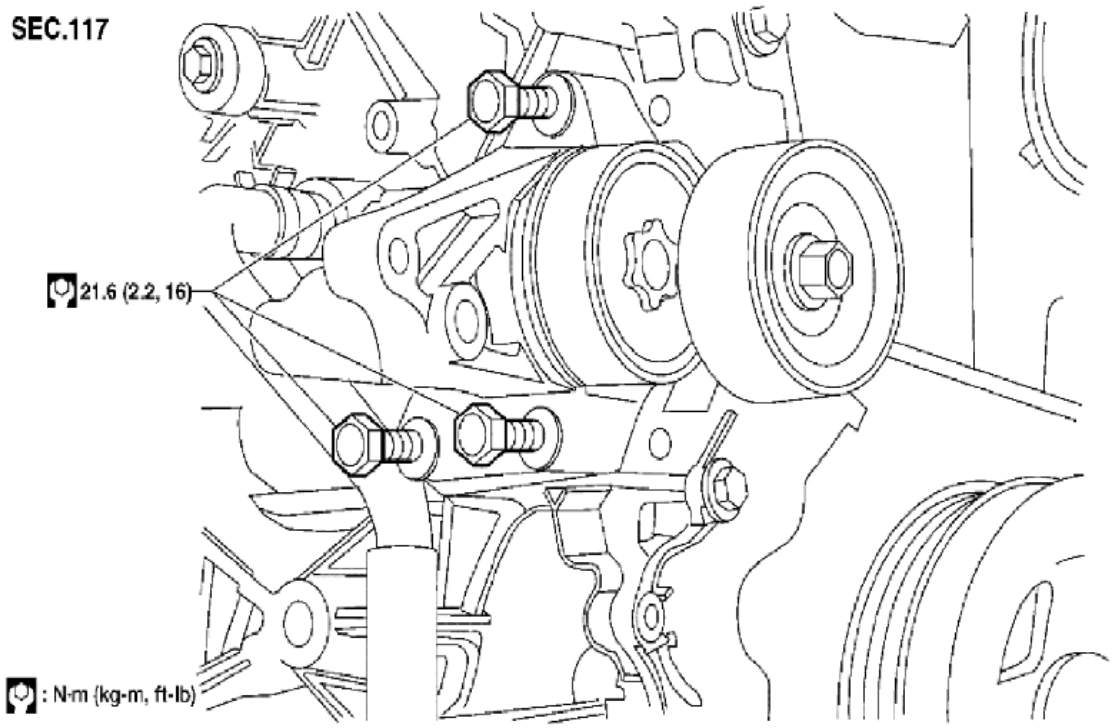


Fig. 7: Identifying Drive Belt Auto Tensioner And Idler Pulley Bolts Torque Specifications
Courtesy of SUZUKI OF AMERICA CORP.

REMOVAL

1. Remove air cleaner and air duct. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].

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2. Remove drive belt. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
3. Remove the power steering oil pump and position aside. Refer to [**POWER STEERING OIL PUMP: REMOVAL AND INSTALLATION**]
4. Remove generator. Refer to [**GENERATOR: REMOVAL AND INSTALLATION - QR25DE MODELS**]
5. Remove drive belt auto-tensioner.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION: If there is damage greater than peeled paint, replace drive belt auto-tensioner.

AIR CLEANER FILTER: REMOVAL AND INSTALLATION

Refer to [**AIR CLEANER REMOVAL AND INSTALLATION [QR25DE]**].

CAMSHAFT VALVE CLEARANCE

INSPECTION

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 or noise).

1. Remove rocker cover. Refer to [**ROCKER COVER: REMOVAL AND INSTALLATION [QR25DE]**].
2. Remove engine undercover.
3. Remove radiator shroud (lower). Refer to [**RADIATOR: EXPLODED VIEW**]
4. Measure the valve clearance as follows:
    a. Set No. 1 cylinder at TDC of its compression stroke.
        - Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.

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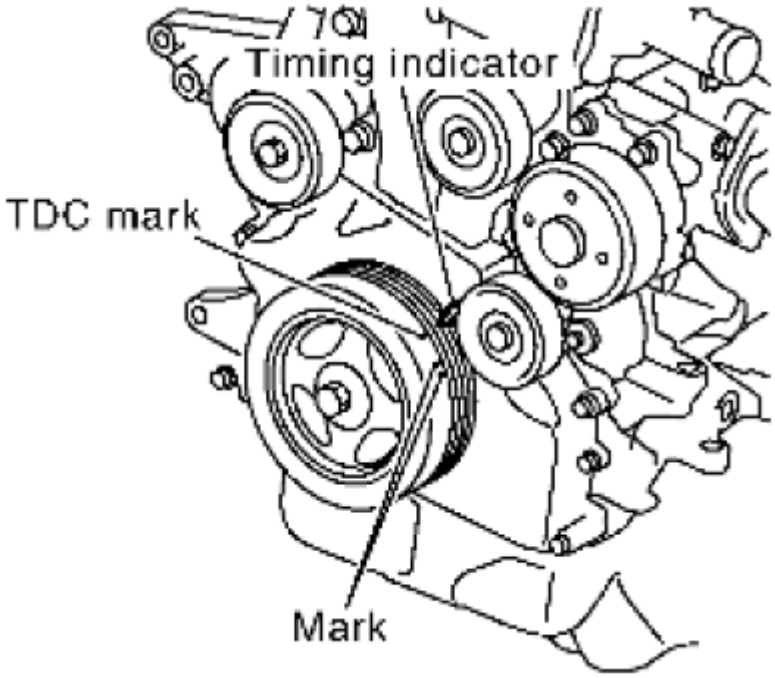


Fig. 8: Aligning TDC Mark To Timing Indicator On Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

- Make sure that intake and exhaust cam noses of No. 1 cylinder are located as shown.

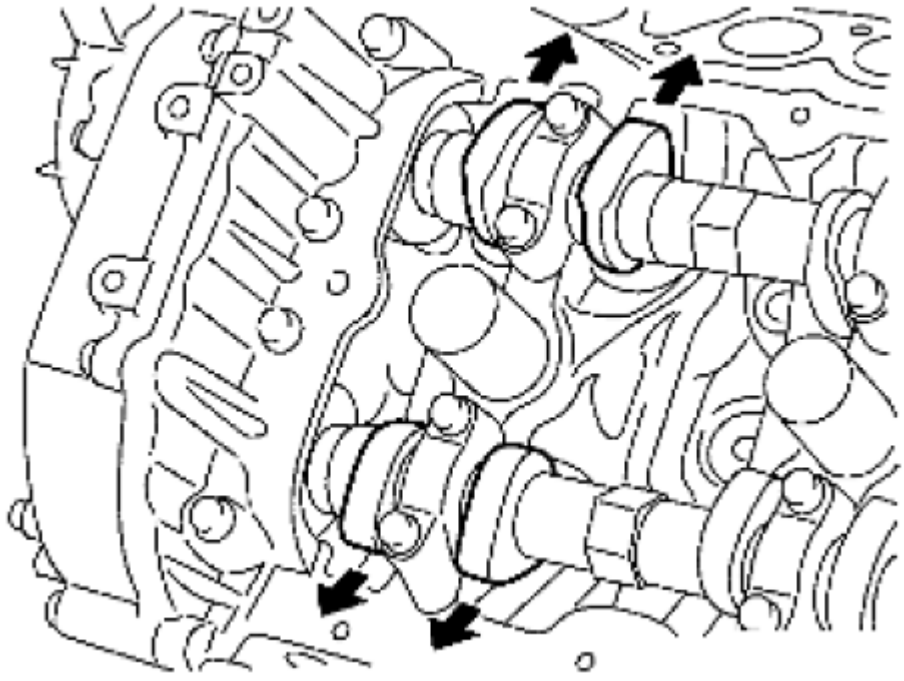


Fig. 9: Locating Intake And Exhaust Cam Noses Of No. 1 Cylinder
Courtesy of SUZUKI OF AMERICA CORP.

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

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

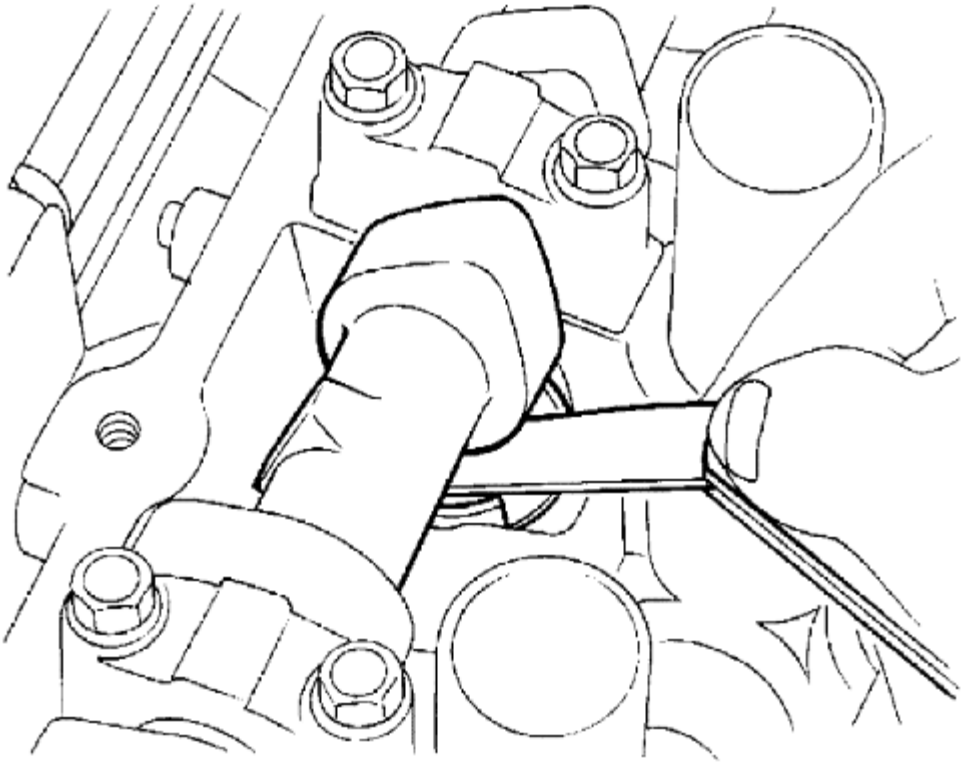


Fig. 10: Measuring Clearance Between Valve Lifter And Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

Valve clearance:

VALVE CLEARANCE SPECIFICATIONS

		Unit: mm (in)
	Cold	**Hot (1) (reference data)**
Intake	0.24 - 0.32 (0.009 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	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 with black arrow shown) with feeler gauge.

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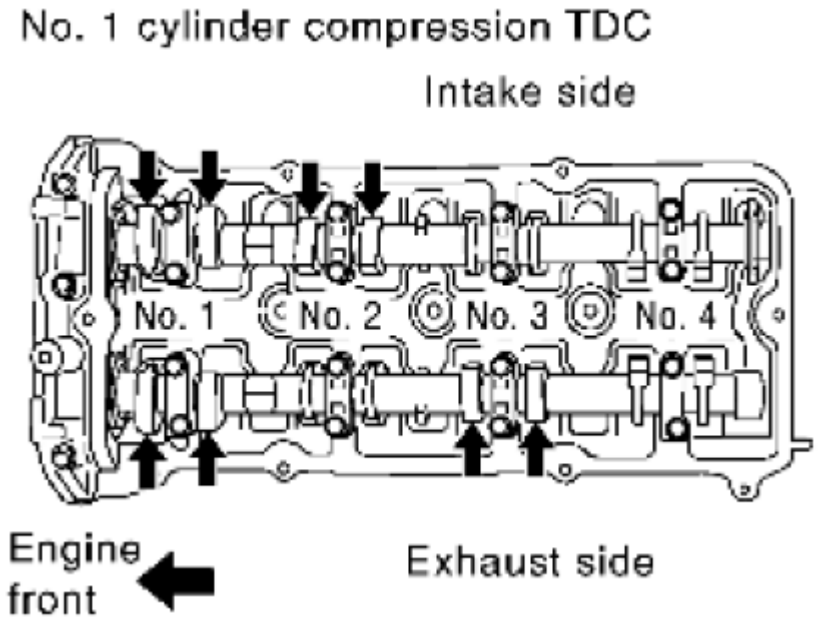


Fig. 11: Valve Clearances Measuring Position
Courtesy of SUZUKI OF AMERICA CORP.

- No. 1 cylinder compression TDC

VALVE CLEARANCES REFERENCE CHART

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 1 cylinder at compression TDC	INT	x	x		
	EXH	x		x	

c. Rotate crankshaft one revolution (360°) and align TDC mark to timing indicator on front cover.

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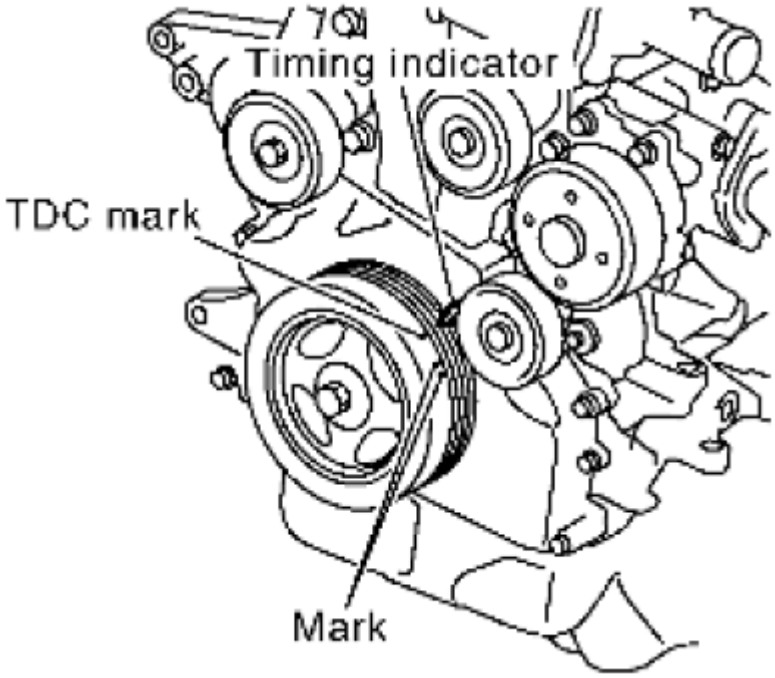


Fig. 12: Aligning TDC Mark To Timing Indicator On Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

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

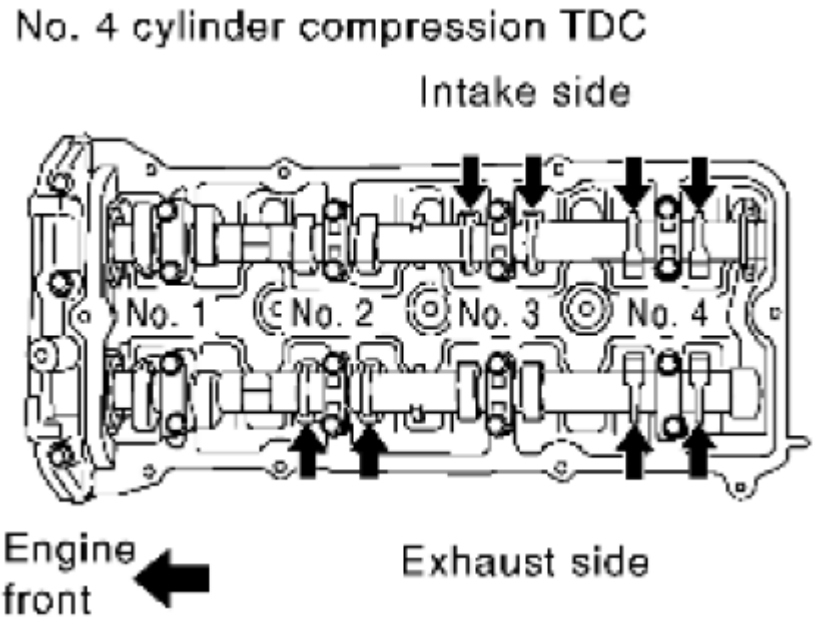


Fig. 13: Valve Clearance Measuring Position
Courtesy of SUZUKI OF AMERICA CORP.

- No. 4 cylinder compression TDC

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VALVE CLEARANCES REFERENCE CHART

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	INT			x	x
	EXH		x		x

5. If out of 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 the removed valve lifters with a micrometer.

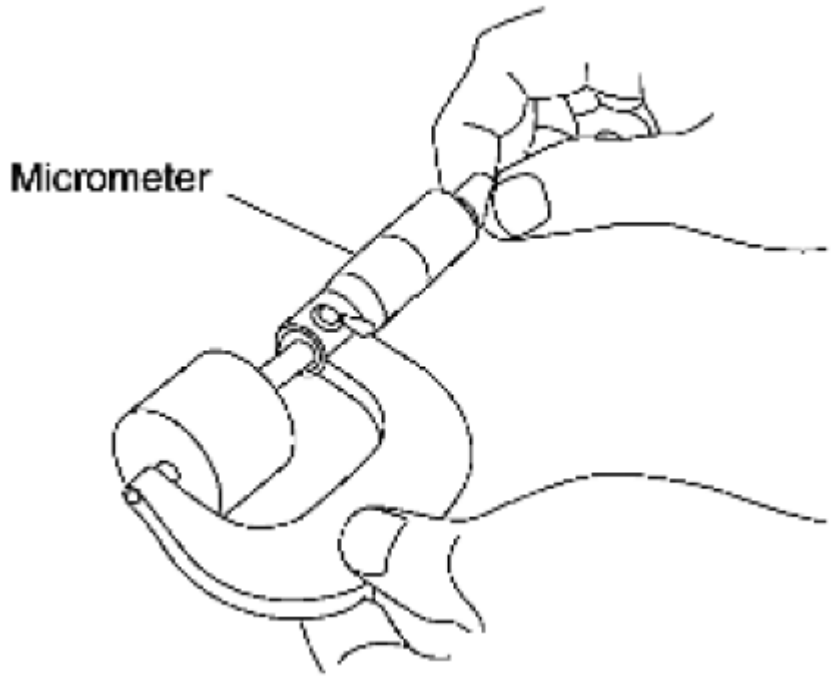


Fig. 14: Measuring Center Thickness Of Valve Lifter
Courtesy of SUZUKI OF AMERICA CORP.

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

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t_1 = Removed valve lifter thickness

C_1 = Measured valve clearance

C_2 = Standard valve clearance:

Intake: 0.28 mm (0.011 in)

Exhaust: 0.30 mm (0.012 in)

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

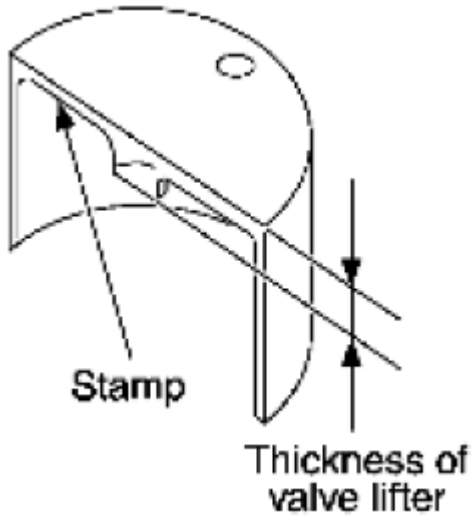


Fig. 15: Identifying Valve Lifter Thickness
Courtesy of SUZUKI OF AMERICA CORP.

Stamp mark "696" indicates 6.96 mm (0.2740 in) in thickness.

NOTE: Available thickness of valve lifter: 26 sizes range 6.96 to 7.46 mm (0.2740 to 0.2937 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [SERVICE DATA AND SPECIFICATIONS].

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

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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: QR25DE**]
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.

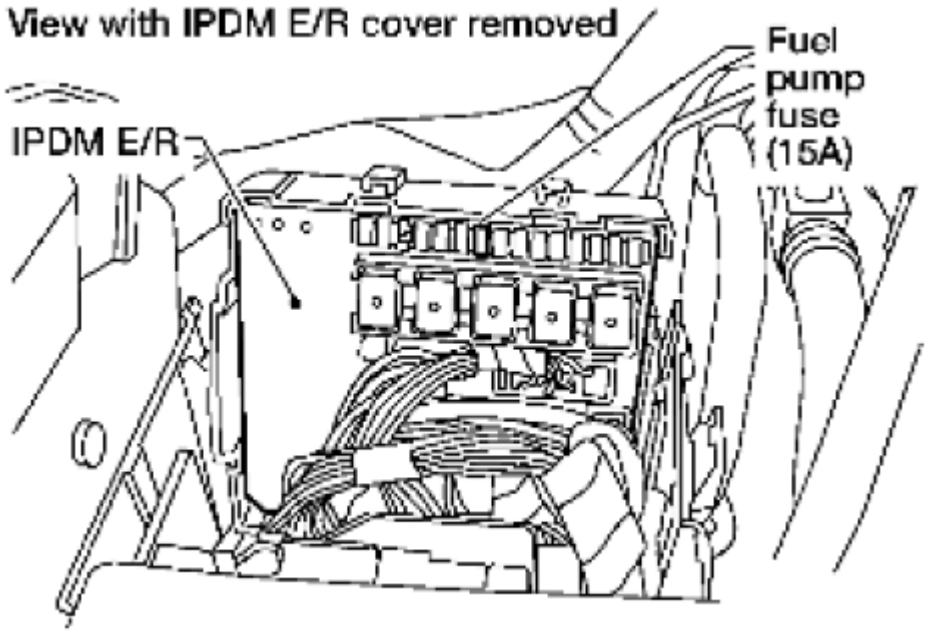


Fig. 16: Identifying Fuel Pump Fuse And IPDM E/R
Courtesy of SUZUKI OF AMERICA CORP.

4. Remove spark plug from each cylinder. Refer to [**SPARK PLUG: REMOVAL AND INSTALLATION**]
5. Connect engine tachometer (not required in use of SDT).
6. Install compression tester with an adapter into spark plug hole.

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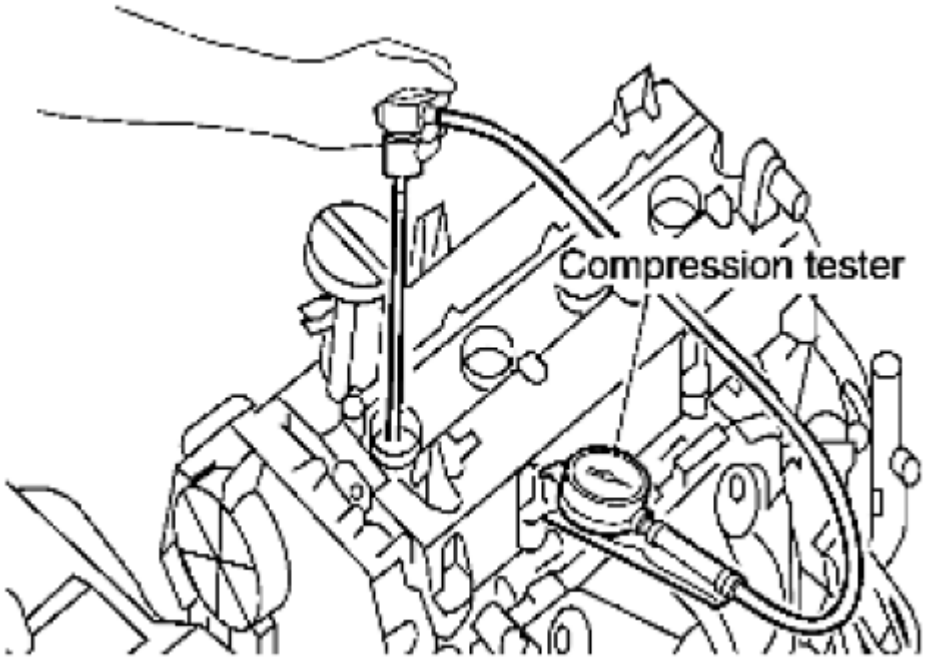


Fig. 17: Installing Compression Tester With An Adapter Into Spark Plug Hole
Courtesy of SUZUKI OF AMERICA CORP.

- Use the adapter 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.

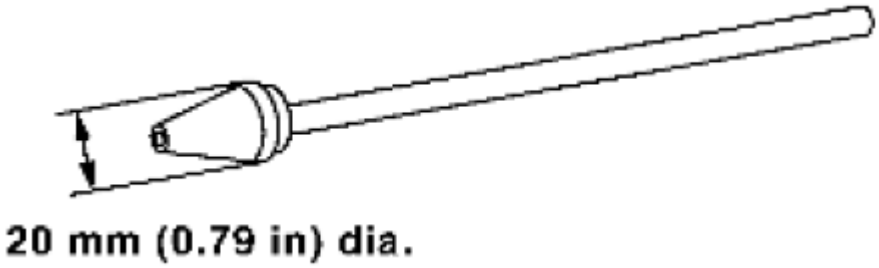


Fig. 18: Identifying Adapter Diameter
Courtesy of SUZUKI OF AMERICA CORP.

7. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and the engine RPM. Perform these steps to check each cylinder.

Compression pressure:

COMPRESSION PRESSURE SPECIFICATIONS

Unit: kPa (kg/cm^2 , psi) /rpm		
Standard	**Minimum**	**Differential limit between cylinders**
1,304 (13.3, 189) / 250	1,108 (11.3, 161) / 250	100 (1.0, 14) / 250

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

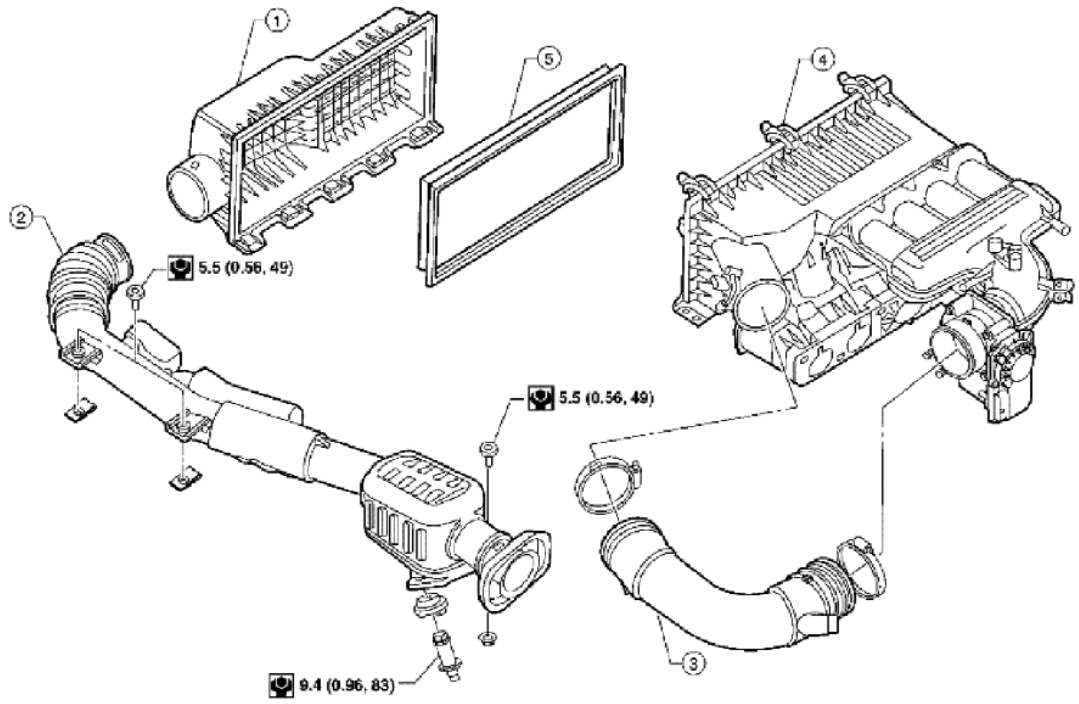
- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.
- If some cylinders have low compression pressure, pour 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 piston rings and replace if necessary.
- If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace 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 gasket is leaking. In such a case, replace cylinder head gasket.

8. After inspection is completed, install removed parts.
9. Start engine, and make sure that engine runs smoothly.
10. Perform trouble diagnosis. If DTC appears, erase it.

AIR CLEANER AND AIR DUCT: EXPLODED VIEW

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SEC. 140



: N·m (kg-m, in-lb)

1. Air cleaner case	2. Air duct and resonator assembly	3. Air duct
4. Intake manifold	5. Air cleaner filter	

Fig. 19: Exploded View Of Air Cleaner And Air Duct
Courtesy of SUZUKI OF AMERICA CORP.

AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION

NOTE: Add mating marks as necessary for easier installation.

REMOVAL

1. Remove the breather hose from the air duct.
2. Loosen the air duct clamps and remove the air duct.
3. Remove the air duct and resonator assembly bolts and remove air duct and resonator assembly.
   - Remove resonator in fender lifting left fender protector, as necessary.
4. Remove air cleaner case.

INSPECTION AFTER REMOVAL

Inspect air duct and air duct and resonator assembly for cracks or tears.

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- Replace air duct and air duct and resonator assembly, if necessary.

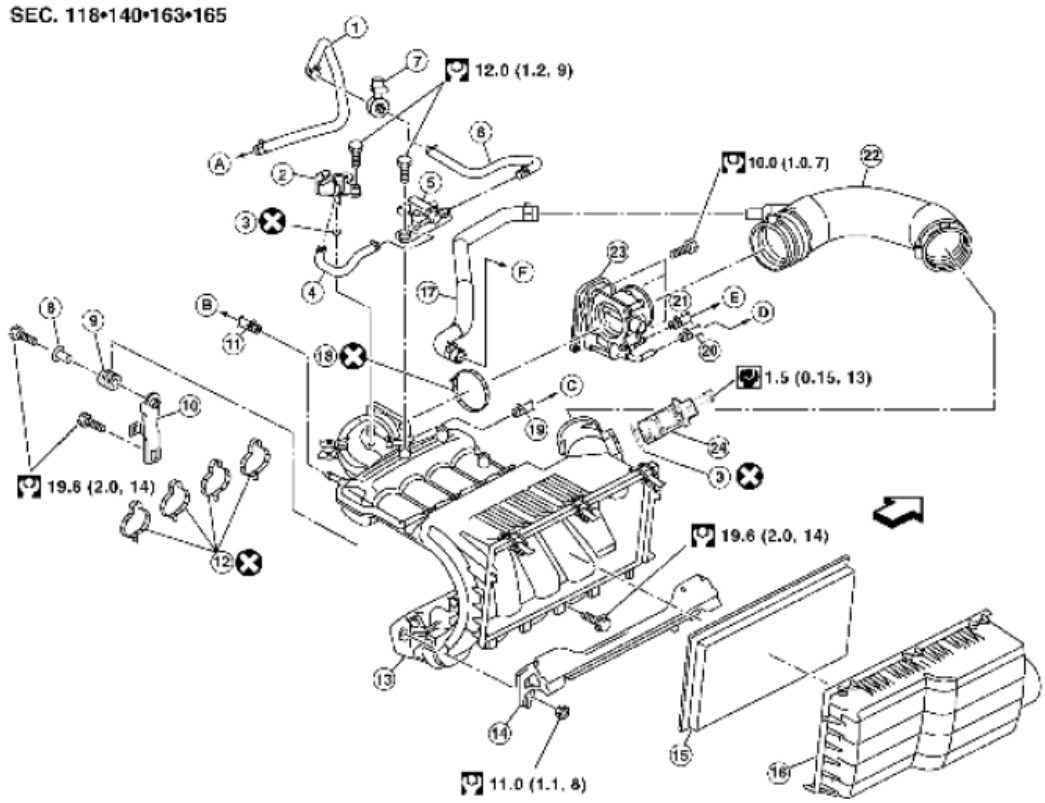
INSTALLATION

Installation is in the reverse order of removal.

- Align marks. Attach each joint. Tighten clamps firmly.
- Install air duct and resonator assembly to air cleaner case by aligning "LOCK-UNLOCK" upward.

INTAKE MANIFOLD: EXPLODED VIEW

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1.	Vacuum hose	2.	Vacuum hose adapter	3.	O–ring
4.	Vacuum hose	5.	EVAP canister purge volume control solenoid valve	6.	Vacuum hose
7.	Service port	8.	Collar	9.	Grommet
10.	Intake manifold support	11.	Vacuum hose	12.	Gasket
13.	Intake manifold	14.	Fuel tube protector	15.	Air cleaner filter
16.	Air cleaner case	17.	PCV hose	18.	Gasket
19.	PCV hose	20.	Water hose	21.	Water hose
22.	Air duct	23.	Electric throttle control actuator	24.	Mass air flow sensor
A.	To vacuum pipe (EVAP canister)	B.	To brake booster	C.	To PCV valve
D.	To heater outlet	E.	To heater pipe	F.	To rocker cover
⇦ :	Engine front				

Fig. 20: Exploded View Of Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

INTAKE MANIFOLD: REMOVAL AND INSTALLATION

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CAUTION: Do not remove or disassemble parts unless instructed as shown.

REMOVAL

1. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: QR25DE**]
2. Remove air cleaner case, air cleaner filter and air duct and resonator assembly.
3. Disconnect water hoses from electric throttle control actuator, and pinch water hoses near electric throttle control actuator to prevent engine coolant spilling.

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

4. Remove mass air flow sensor from intake manifold.

CAUTION: Handle the mass air flow sensor with care:
- **Do not shock it.**
- **Do not disassemble it.**
- **Do not touch the internal sensor.**

5. Remove quick connector cap, and disconnect quick connector at the engine side. Refer to **FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [QR25DE]** .

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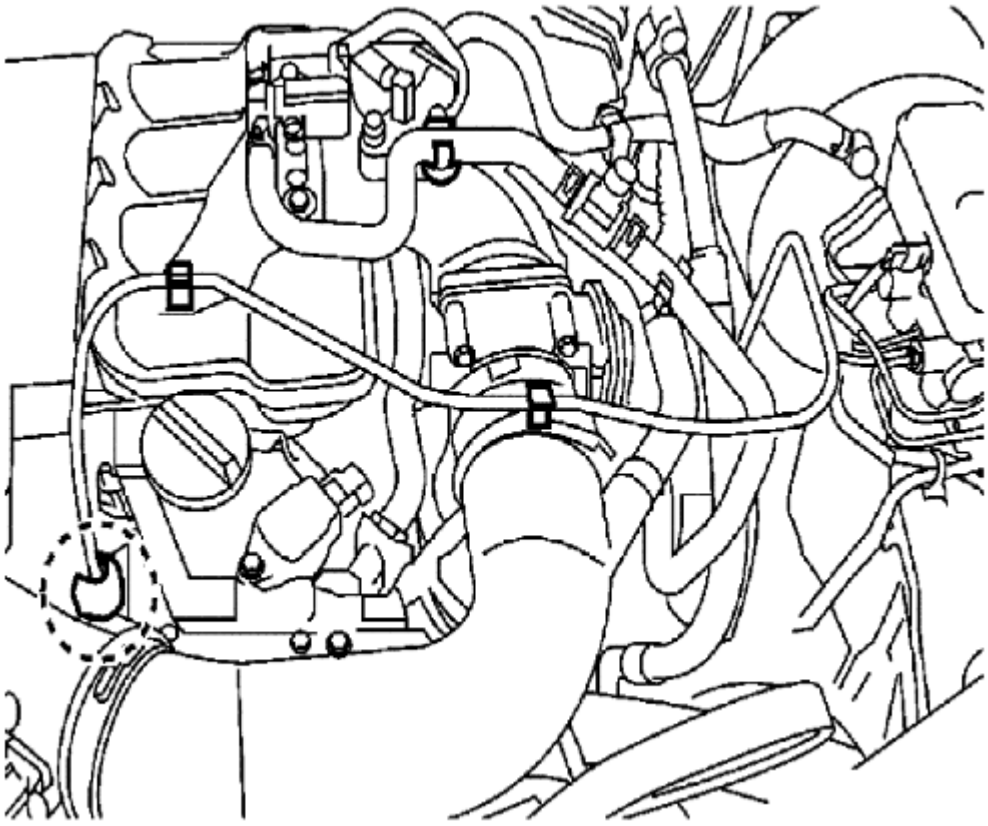


Fig. 21: Identifying Quick Connector
Courtesy of SUZUKI OF AMERICA CORP.

6. Remove electric throttle control actuator as follows:
   a. Disconnect harness connector.
   b. Loosen bolts in reverse order as shown, and remove electric throttle control actuator and gasket.

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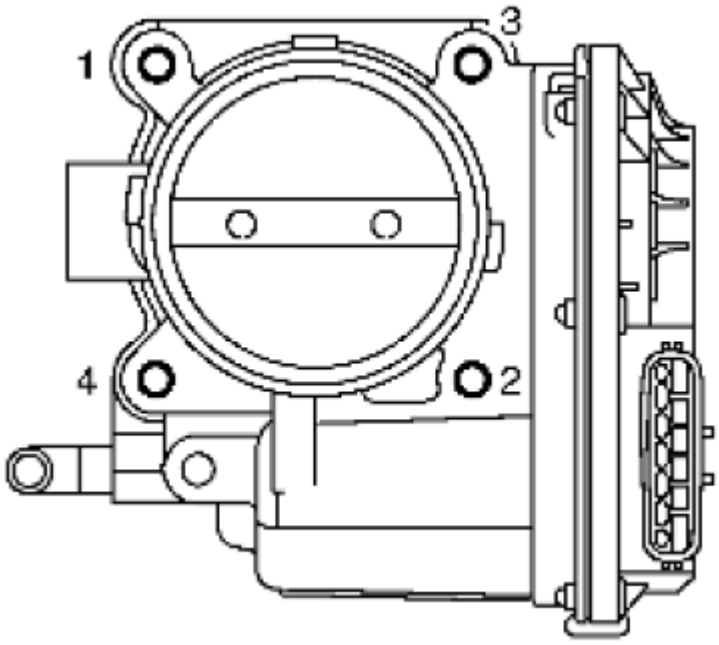


Fig. 22: Tightening Order Of Electric Throttle Control Actuator Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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

7. Disconnect harness, vacuum hoses and PCV hoses from intake manifold, and move them aside.
8. Remove intake manifold support.
9. Loosen nuts and bolts in reverse order as shown, and remove intake manifold, fuel tube protector and gasket.

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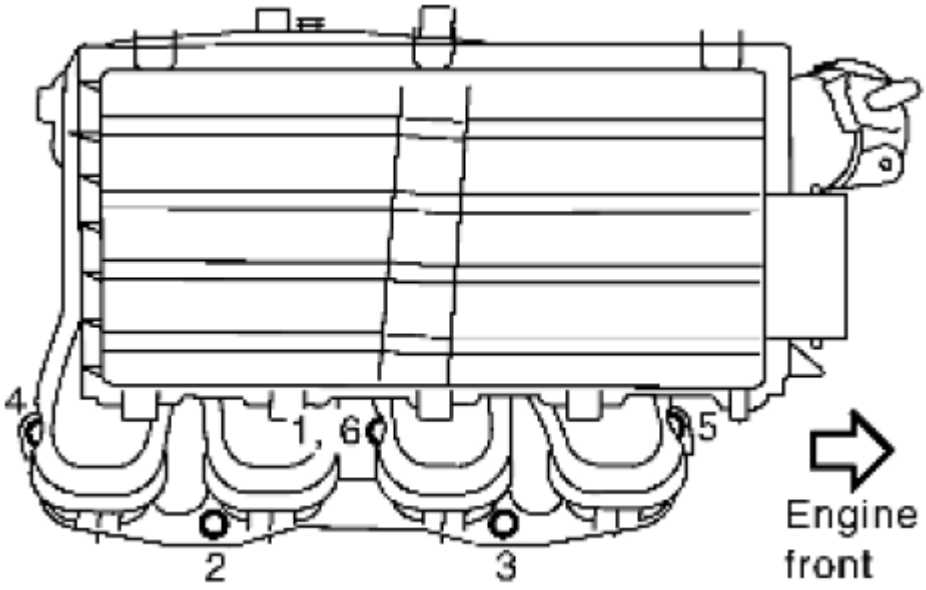


Fig. 23: Tightening Order Of Intake Manifold Nuts And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Cover engine openings to avoid entry of foreign materials.**
- **Do not disassemble intake manifold.**

NOTE: Disregard No. 6 when loosening.

10. Remove EVAP canister purge volume control solenoid valve and vacuum hose adapter from intake manifold, if necessary.
11. Disconnect sub-harness from fuel injector. Refer to **FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [QR25DE]** .
12. Remove fuel tube and fuel injector assembly from intake manifold. Refer to **FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [QR25DE]** .

INSTALLATION

Installation in the reverse order of removal.

Intake Manifold and Fuel Tube Protector

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

  Intake manifold bolts: 9.4 N.m (0.96 kg-m, 83 in-lb)

- Tighten in numerical order as shown.

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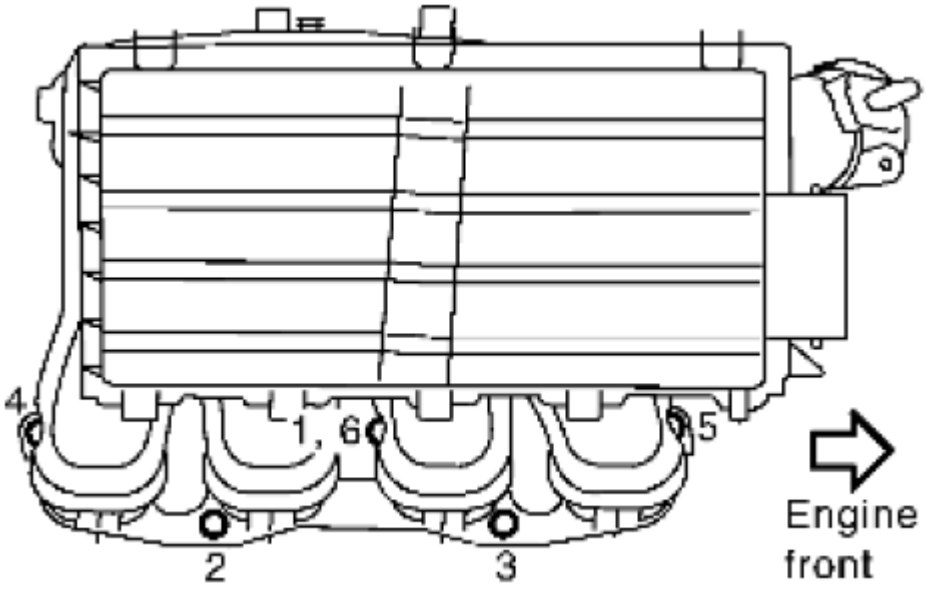


Fig. 24: Tightening Order Of Intake Manifold Nuts And Bolts
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: No. 6 means double tightening of bolt No. 1.

Use the following for locating bolts and nuts.

M8 x 38 mm (1.50 in) (Color green): No. 1, 6

M8 x 35 mm (1.38 in): No. 2, 3

Nut: No. 4, 5

Electric Throttle Control Actuator

- Tighten bolts equally and diagonally in several steps and in numerical order as shown.

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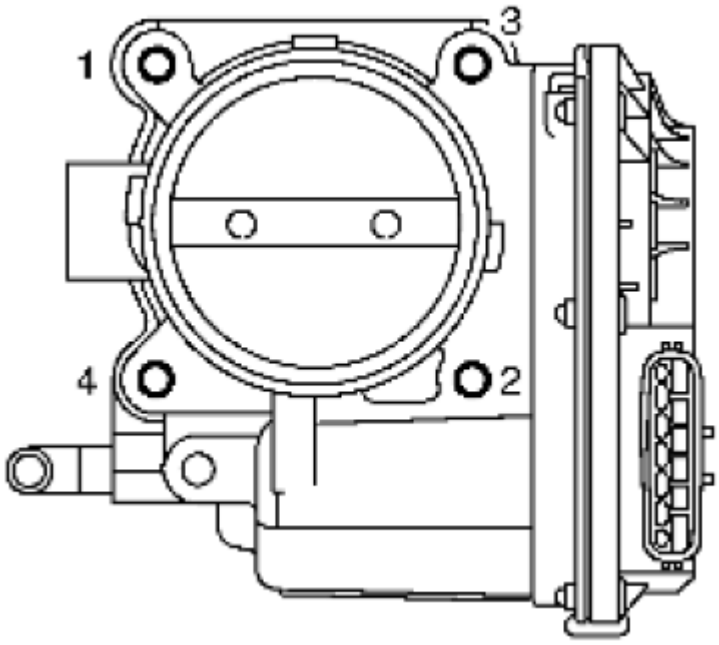


Fig. 25: Tightening Order Of Electric Throttle Control Actuator Bolts
Courtesy of SUZUKI OF AMERICA CORP.

- Perform the "Throttle Valve Closed Position Learning" when harness connector of electric throttle control actuator is disconnected. Refer to [**PROCEDURE AFTER REPLACING ECM**]
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when electric throttle control actuator is replaced. Refer to [**PROCEDURE AFTER REPLACING ECM**]

INSPECTION AFTER INSTALLATION

Make sure there are no fuel leaks at connections as follows:

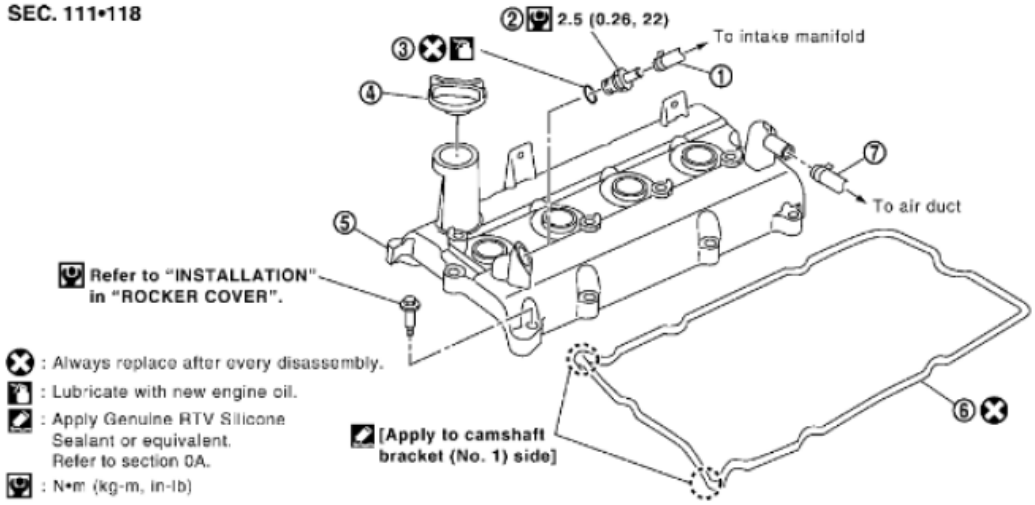
1. Apply fuel pressure to fuel lines by turning ignition switch ON (with the engine stopped). Then make sure there are no fuel leaks at connections.
2. Start the engine. With engine speed increased, make sure again there are no fuel leaks at connections.

WARNING: Do not touch the engine immediately after stopped as the engine becomes extremely hot.

NOTE: Use mirrors for checking on invisible points.

ROCKER COVER: EXPLODED VIEW

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Expand image

1. PCV hose	2. PCV valve	3. O-ring
4. Oil filler cap	5. Rocker cover	6. Rocker cover gasket
7. PCV hose		

Fig. 26: Exploded View Of Rocker Cover
Courtesy of SUZUKI OF AMERICA CORP.

ROCKER COVER: REMOVAL AND INSTALLATION [QR25DE]

REMOVAL

1. Remove intake manifold. Refer to **INTAKE MANIFOLD: REMOVAL AND INSTALLATION** .
2. Disconnect PCV hose from rocker cover.
3. Remove ignition coils.
4. Remove PCV valve and O-ring from rocker cover, if necessary.
5. Remove oil filler cap from rocker cover, if necessary.
6. Loosen bolts in reverse order as shown.

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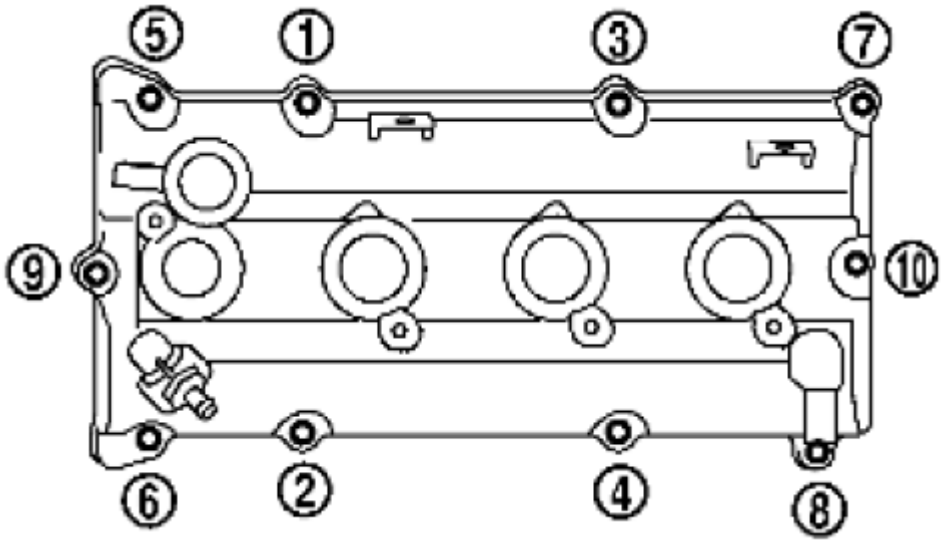


Fig. 27: Tightening Order Of Rocker Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove rocker cover gasket from rocker cover.
8. 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

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

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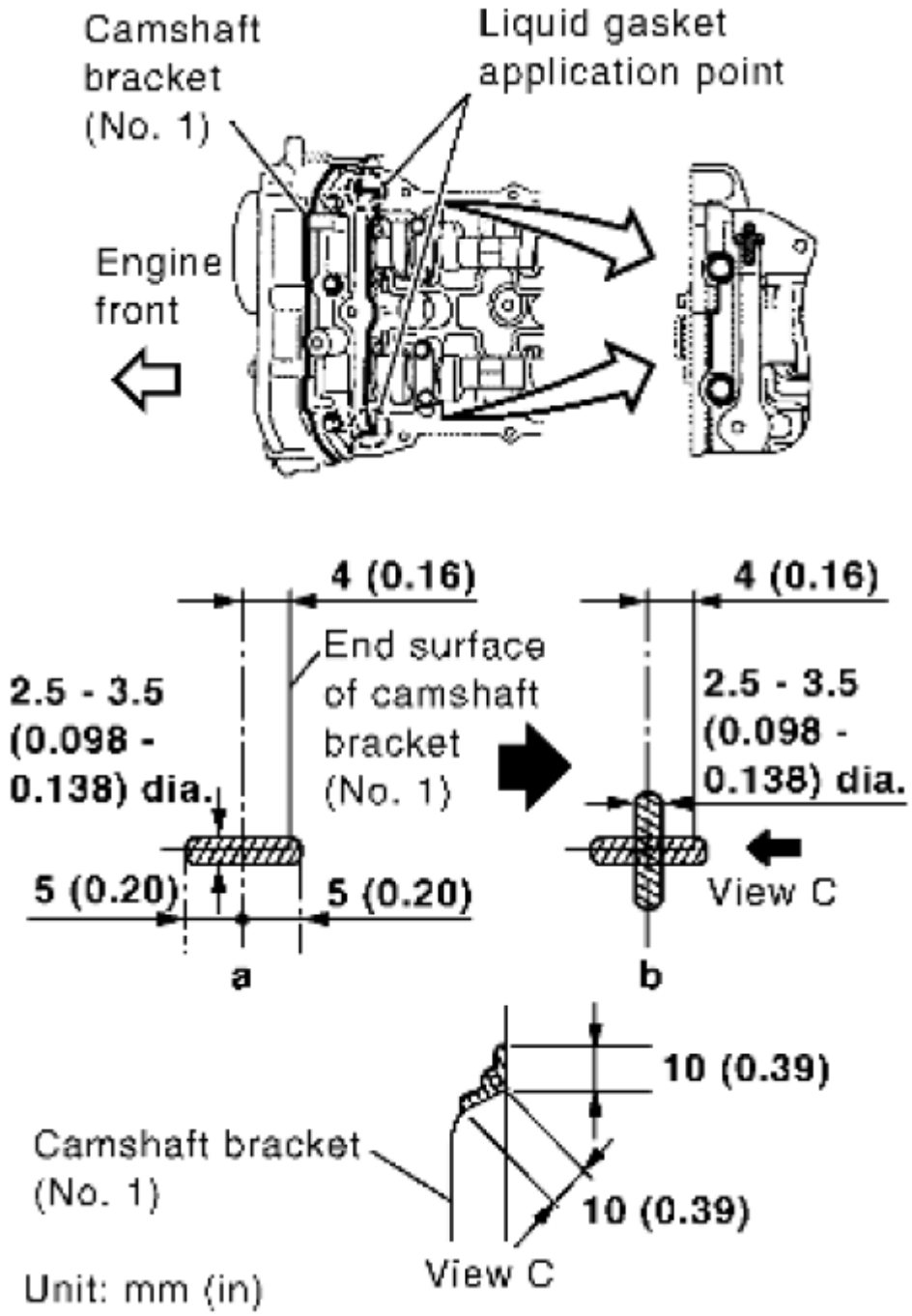


Fig. 28: Identifying Liquid Gasket Applying Specifications On Joint Of Rocker Cover, Cylinder Head And Camshaft Bracket (No. 1)
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

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

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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 bolts in two steps in numerical order as shown.

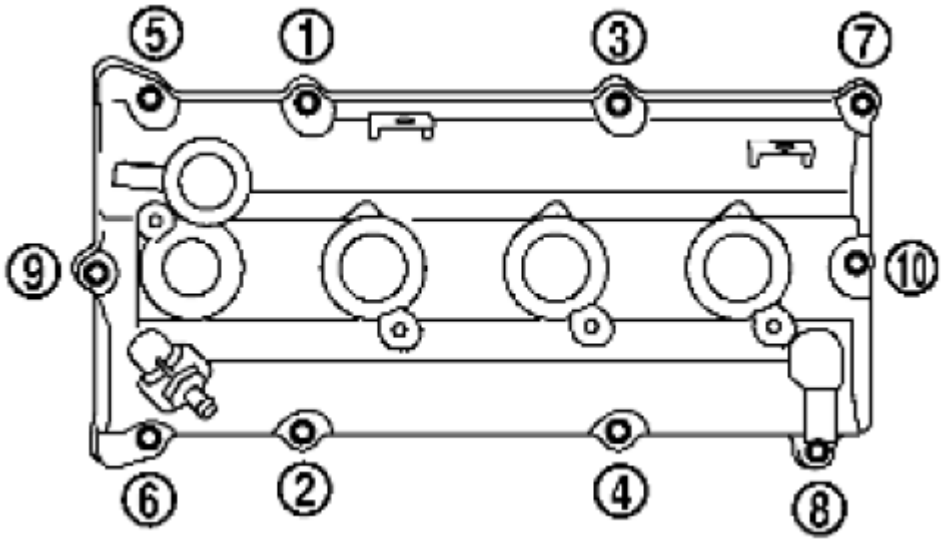


Fig. 29: Tightening Order Of Rocker Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

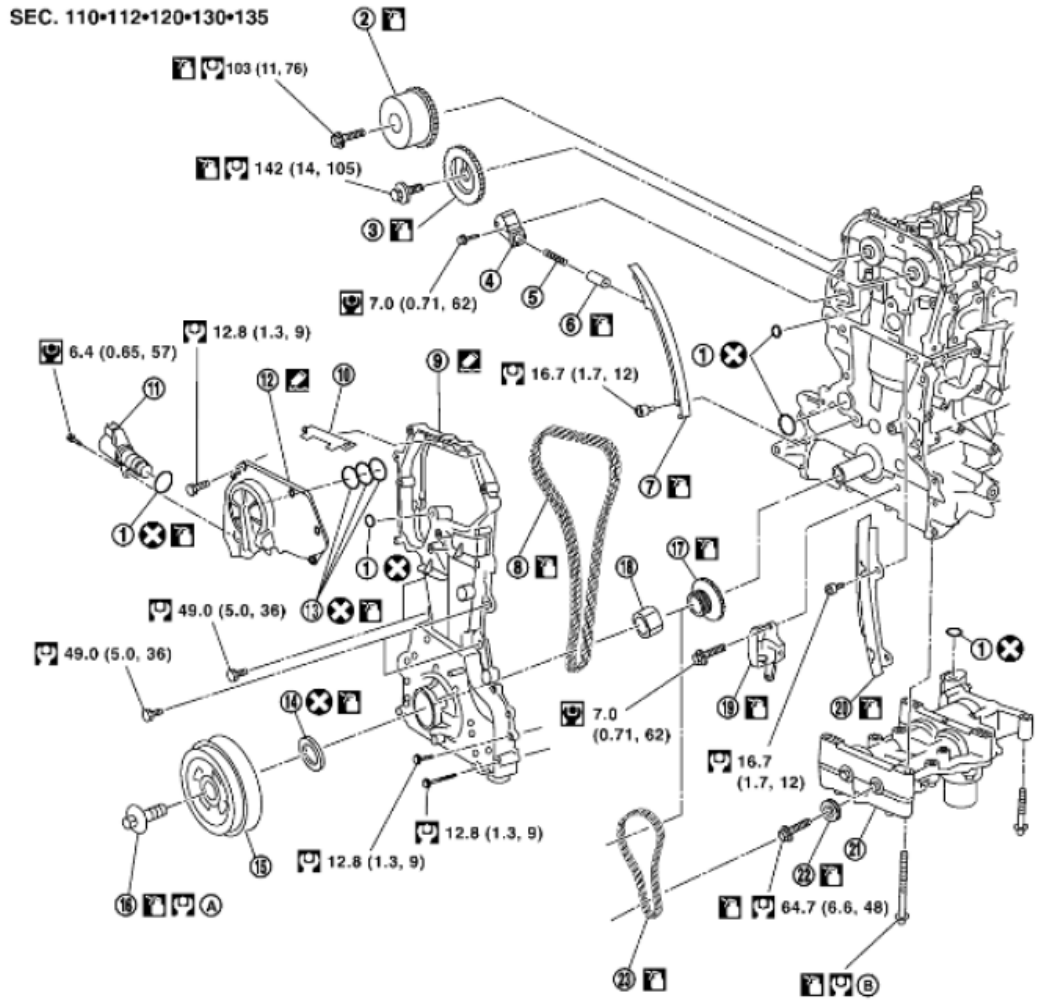
1st step: 2.0 N.m (0.2 kg-m, 18 in-lb)

2nd step: 8.3 N.m (0.85 kg-m, 73 in-lb)

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

TIMING CHAIN: EXPLODED VIEW

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1.	O-ring	2.	Camshaft sprocket (INT)	3.	Camshaft sprocket (EXH)
4.	Chain tensioner	5.	Spring	6.	Chain tensioner plunger
7.	Timing chain slack guide	8.	Timing chain	9.	Front cover
10.	Chain guide	11.	Intake valve timing control solenoid valve	12.	Intake valve timing control cover
13.	Oil ring	14.	Front oil seal	15.	Crankshaft pulley
16.	Crankshaft pulley bolt	17.	Crankshaft sprocket	18.	Spacer
19.	Balancer unit timing chain tensioner	20.	Timing chain tension guide	21.	Balancer unit
22.	Balancer unit sprocket	23.	Balancer unit timing chain	A.	Refer to [**Timing Chain: Removal and Installation**]
B.	Refer to [**Timing Chain:**				

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Fig. 30: Exploded View Of Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

TIMING CHAIN: REMOVAL AND INSTALLATION

REMOVAL

1. Release the fuel pressure. Refer to [**FUEL PRESSURE CHECK: QR25DE**]
2. Remove the air cleaner and air duct assembly. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].
3. Remove the spark plugs. Refer to [**SPARK PLUG: REMOVAL AND INSTALLATION**]
4. Remove the rocker cover. Refer to [**ROCKER COVER: REMOVAL AND INSTALLATION [QR25DE]**].
5. Remove the coolant overflow reservoir tank.
6. Remove the drive belt auto-tensioner. Refer to [**DRIVE BELT AUTO TENSIONER AND IDLER PULLEY: REMOVAL AND INSTALLATION**].
7. Remove the generator. Refer to [**GENERATOR: REMOVAL AND INSTALLATION - QR25DE MODELS**]
8. Remove the strut tower brace. Refer to [**FRONT SUSPENSION ASSEMBLY: COMPONENT**]
9. Dismount and position aside the A/C compressor with the piping attached.
10. Dismount and position aside the power steering pump and reservoir tank with the piping attached.
11. Remove the oil pan, and oil strainer. Refer to [**OIL PAN: REMOVAL AND INSTALLATION**]
12. Remove IVT control cover bolts in the order as shown.

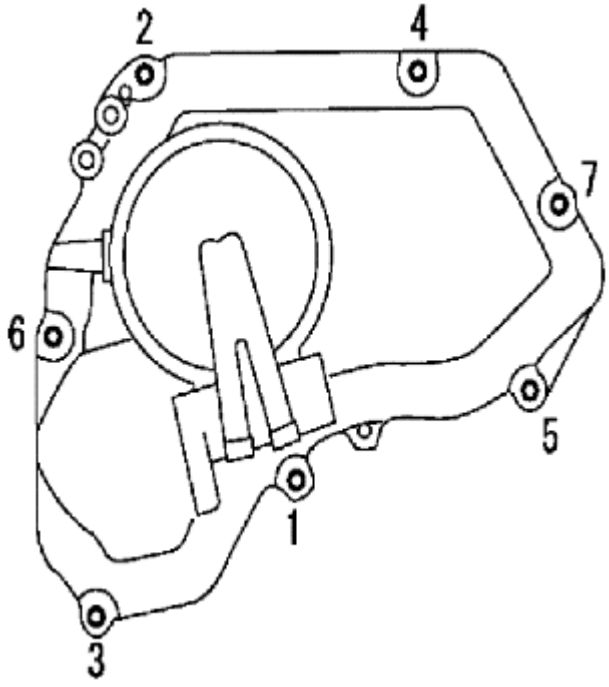


Fig. 31: IVT Control Cover Bolts Removing Order

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Courtesy of SUZUKI OF AMERICA CORP.

13. Remove the IVT control cover by cutting the sealant using Tool.

    Tool number: KV10111100 (J-37228)

14. Pull chain guide between camshaft sprockets out through front cover.
15. Set the No. 1 cylinder at TDC on the compression stroke with the following procedure:

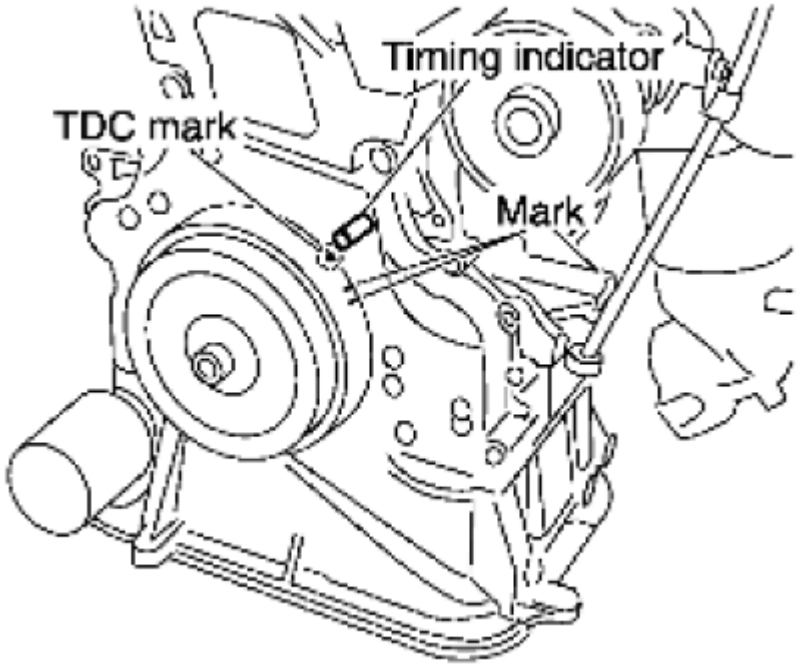


Fig. 32: Identifying TDC Mark And Timing Indicator
Courtesy of SUZUKI OF AMERICA CORP.

a. Rotate the crankshaft pulley clockwise and align the mating marks to the timing indicator on the front cover.
b. At the same time, make sure that the mating marks on the camshaft sprockets are lined up as shown.

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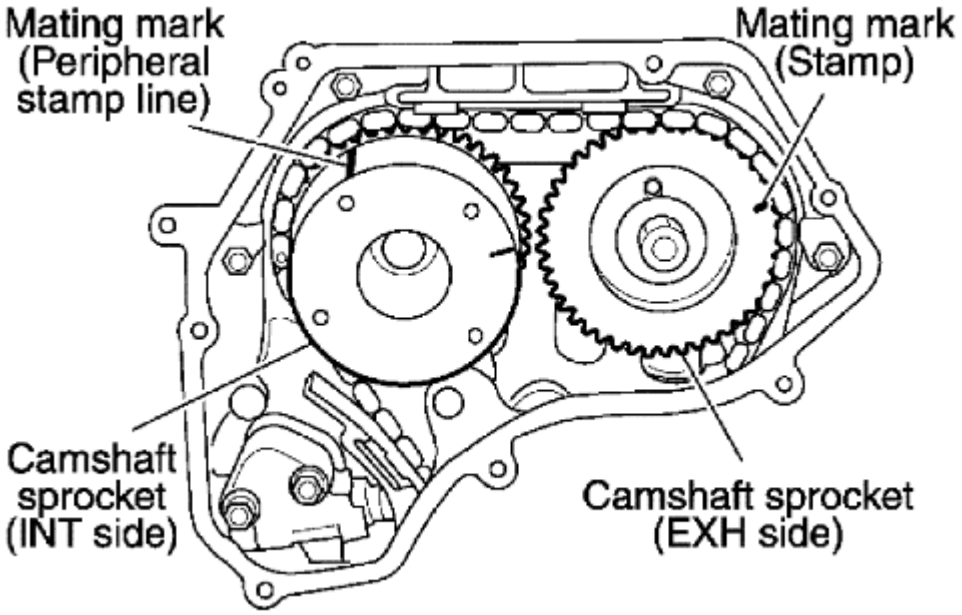


Fig. 33: Identifying Mating Marks On Camshaft Sprockets
Courtesy of SUZUKI OF AMERICA CORP.

- If not lined up, rotate the crankshaft pulley one more turn to line up the mating marks to the positions as shown.

1. Remove crankshaft pulley with the following procedure:

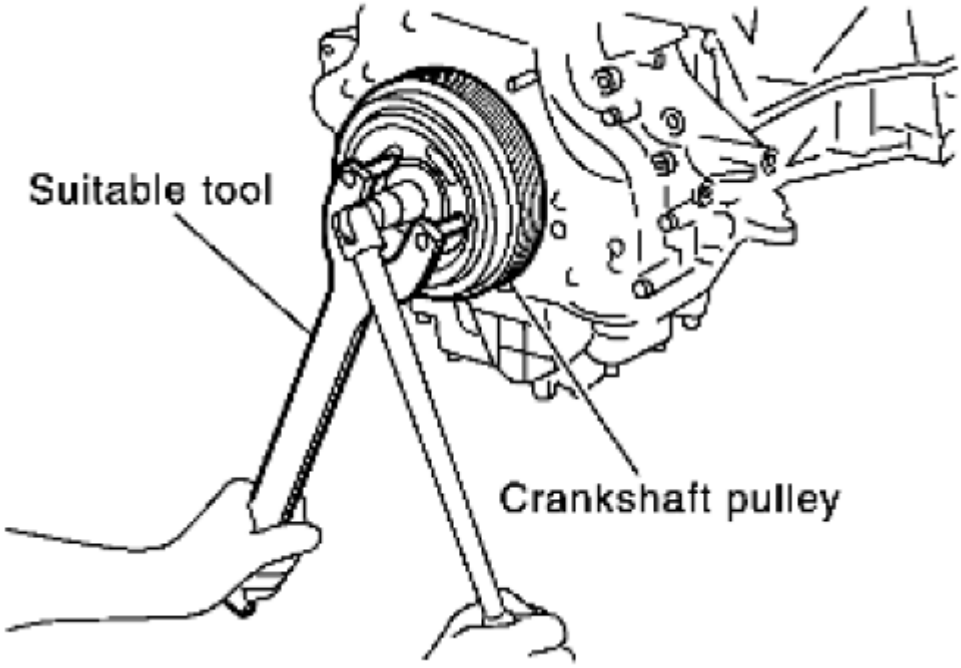


Fig. 34: Removing Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

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a. Hold the crankshaft pulley with a suitable tool, then loosen the crankshaft pulley bolt, and pull the pulley out about 10 mm (0.39 in). Remove the crankshaft pulley bolt.
b. Attach a pulley puller in the M6 (0.24 in diameter) thread hole on crankshaft pulley, and remove crankshaft pulley.

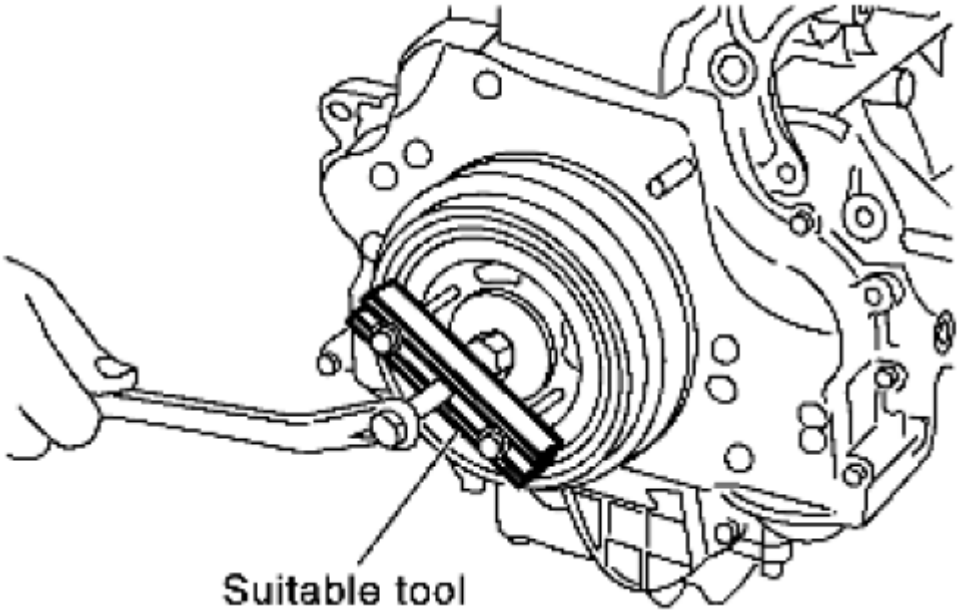


Fig. 35: Removing Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

2. If the front oil seal needs to be replaced, remove it using a suitable tool.

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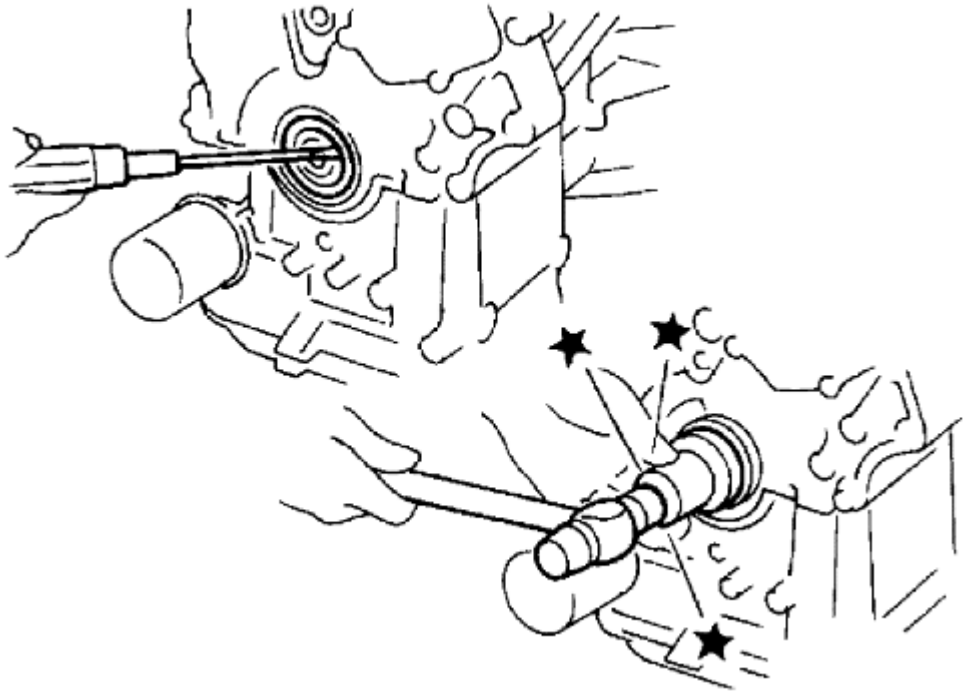


Fig. 36: Removing Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove the front cover as follows:

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Front cover bolt loosening sequence

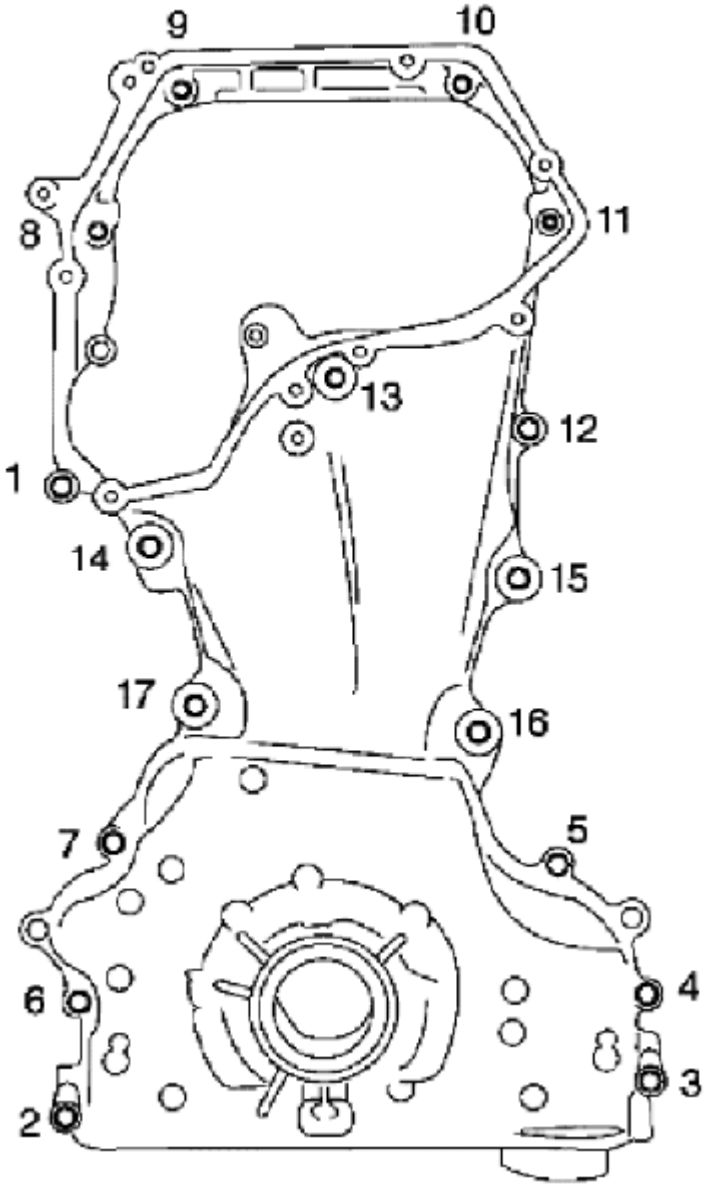


Fig. 37: Front Cover Bolt Loosening Sequence
Courtesy of SUZUKI OF AMERICA CORP.

a. Loosen the front cover bolts in the order as shown, and remove them.
b. Remove the front cover.

CAUTION:
- **Be careful not to damage the mating surface.**

4. Remove timing chain with the following procedure:

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a. Push in chain tensioner plunger. Insert a stopper pin into hole on chain tensioner body to secure chain tensioner plunger and remove chain tensioner.

NOTE: Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.

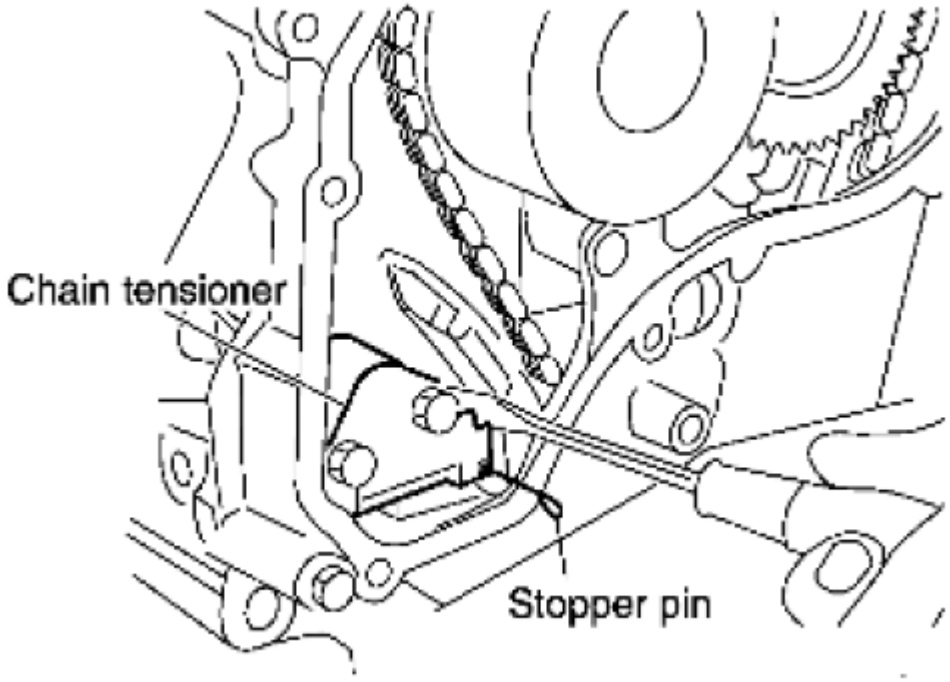


Fig. 38: Removing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

b. Remove timing chain.

CAUTION: Do not rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.

5. Remove camshaft sprockets. Refer to .
6. Remove timing chain slack guide, timing chain tension guide and spacer.
7. Remove balancer unit timing chain tensioner with the following procedure:
   a. Lift lever up, and release ratchet claw for return proof.

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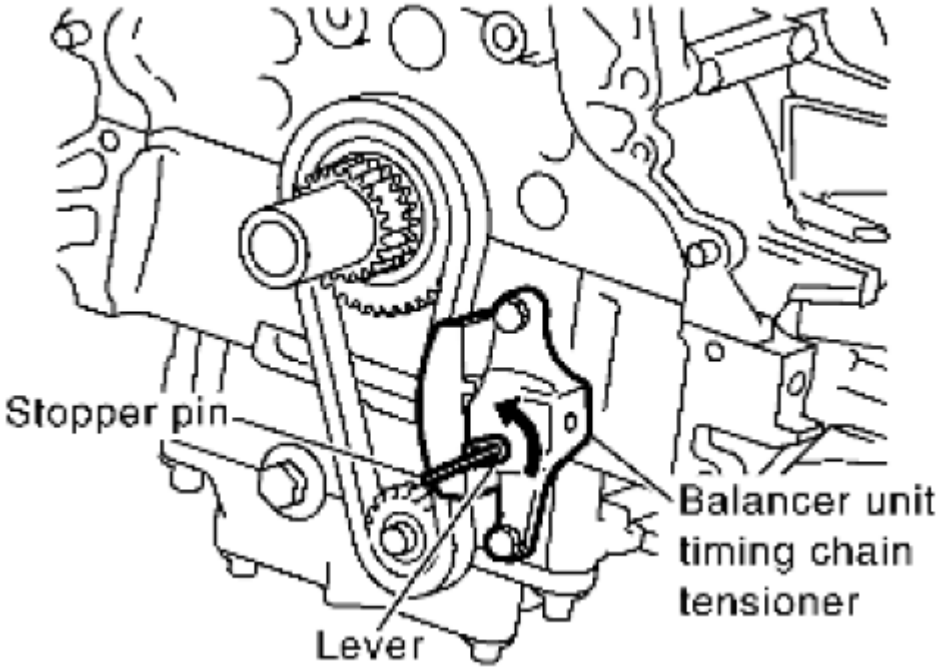


Fig. 39: Removing Balancer Unit Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

b. Push tensioner sleeve in, and hold it.
c. Matching the hole on lever with the one on body, insert a stopper pin to secure tensioner sleeve.

NOTE: Use approximately 1 mm (0.04 in) dia. hard metal pin as a stopper pin.

d. Remove balancer unit timing chain tensioner.

8. Secure the hexagonal portion of the balancer shaft using a suitable tool. Loosen the balancer unit sprocket bolt.
9. Remove balancer unit timing chain, balancer unit sprocket and crankshaft sprocket.

NOTE: When removing balancer unit timing chain, remove crankshaft sprocket and balancer unit sprocket at the same time.

1. Loosen bolts in reverse order as shown, and remove balancer unit.

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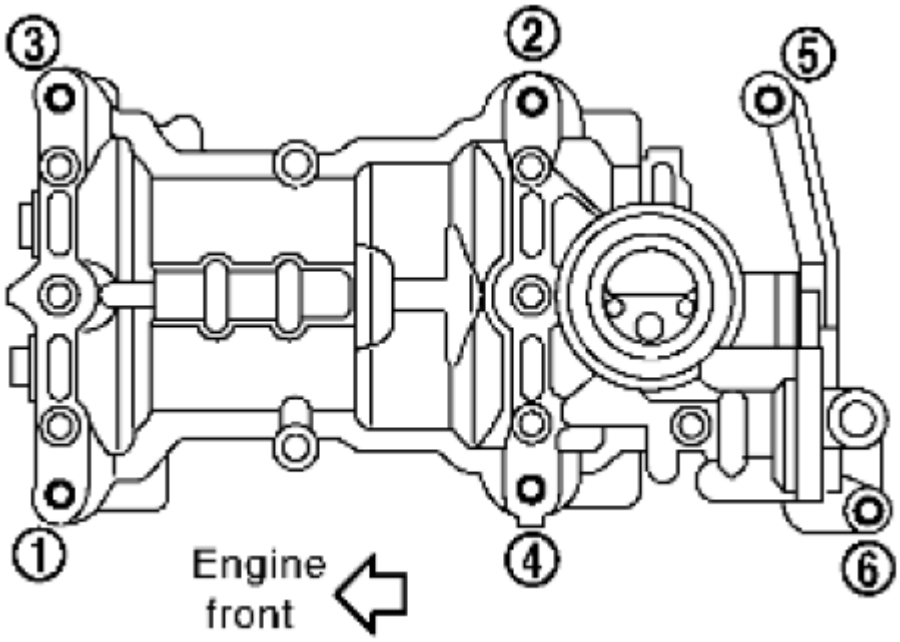


Fig. 40: Tightening Order Of Balancer Unit Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not disassemble balancer unit.

NOTE: Use TORX socket (size E14) for bolts No. 1 to 4.

INSPECTION AFTER REMOVAL

Timing Chain

Check timing chain for cracks and any excessive wear at the roller links of timing chain. Replace timing chain if necessary.

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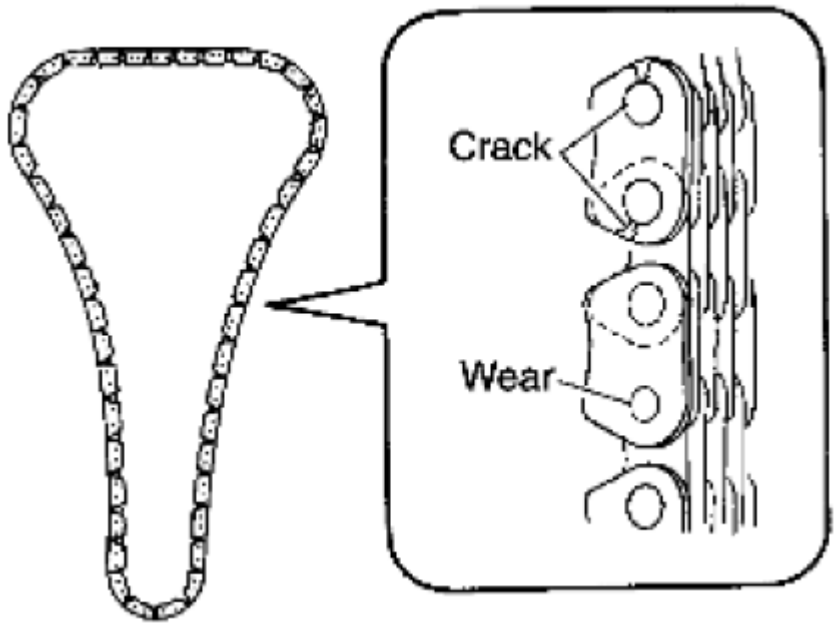


Fig. 41: Identifying Cracks And Wear On Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

Balancer Unit Bolt Outer Diameter

- Measure outer diameters [(d1), (d2)] at two positions as shown.

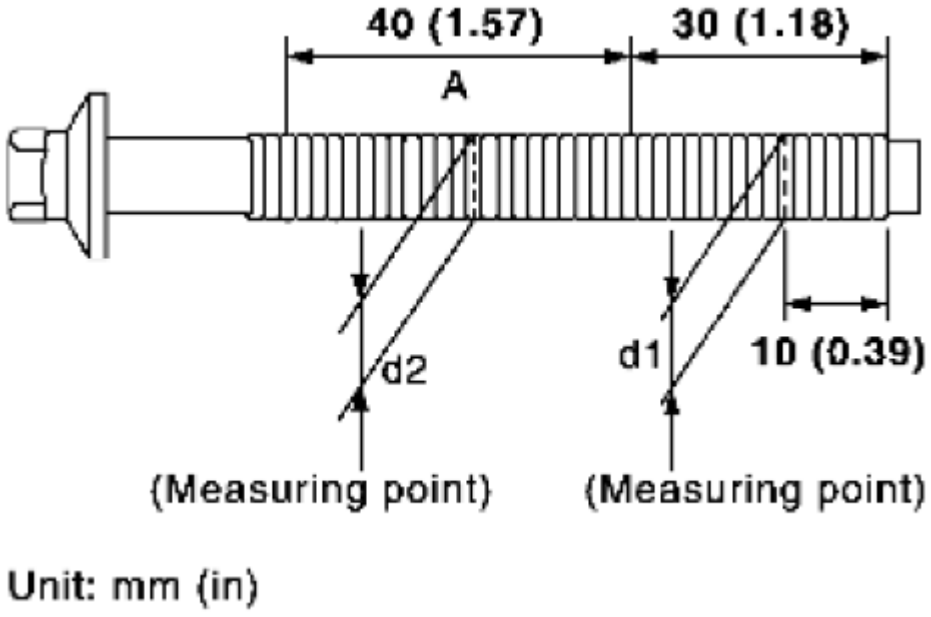


Fig. 42: Identifying Balancer Unit Bolt Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- If reduction appears in (A) range, regard it as (d2).

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Limit [(d1) - (d2)]: 0.15 mm (0.0059 in)

- If it exceeds the limit (large difference in dimensions), replace balancer unit bolt with a new one.

Balancer Unit Bolt Length

Measure balancer unit bolt length. If it exceeds the limit, replace balancer unit bolt with a new one.

Limit: 172 mm (6.77 in)

INSTALLATION

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

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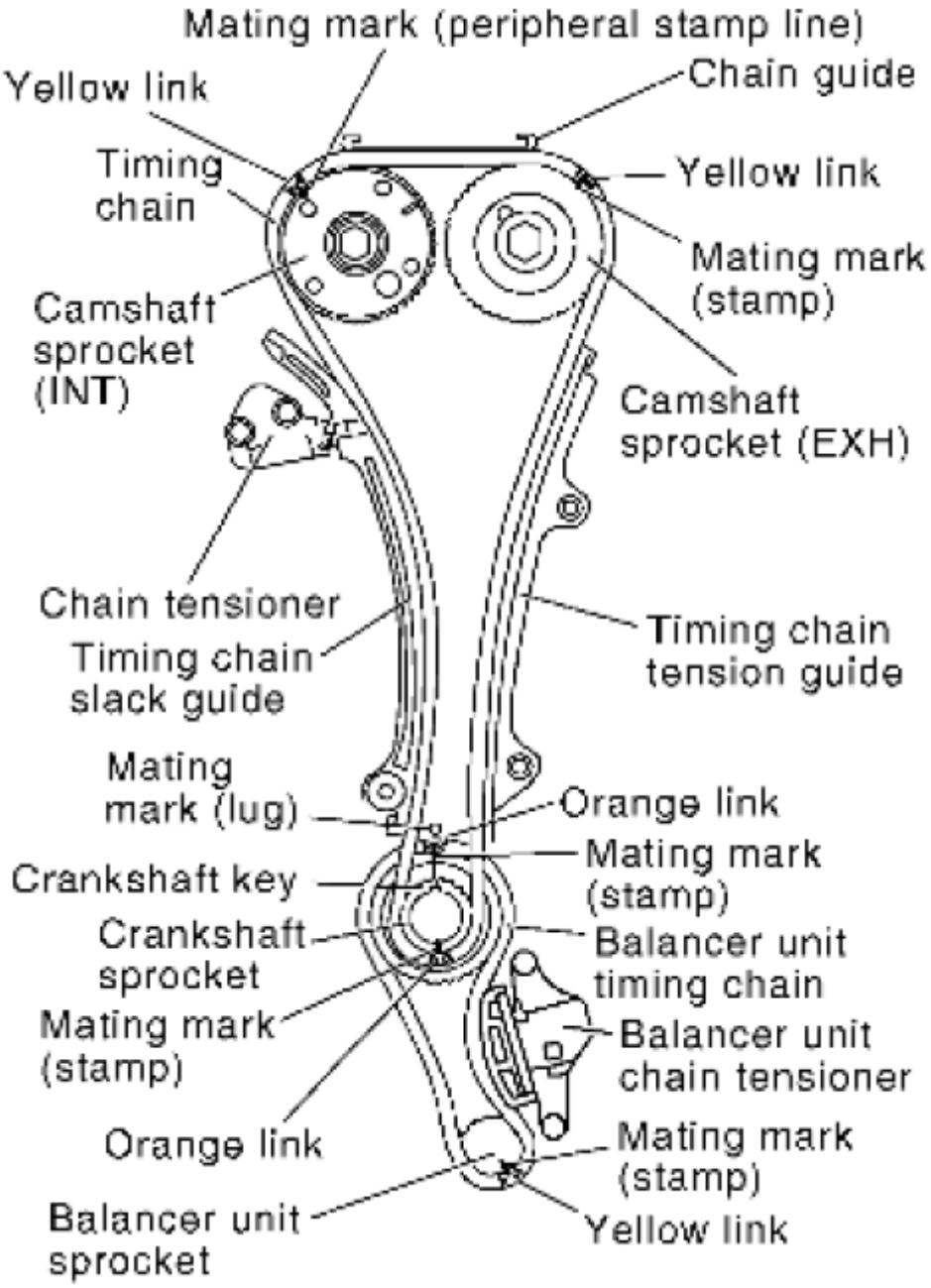


Fig. 43: Relationship Diagram Between Mating Mark On Each Timing Chain And Corresponding Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

1. Make sure that crankshaft key points straight up.
2. Install O-ring to balancer unit.
3. Tighten bolts in numerical order as shown with the following procedure to install balancer unit, using Tool.

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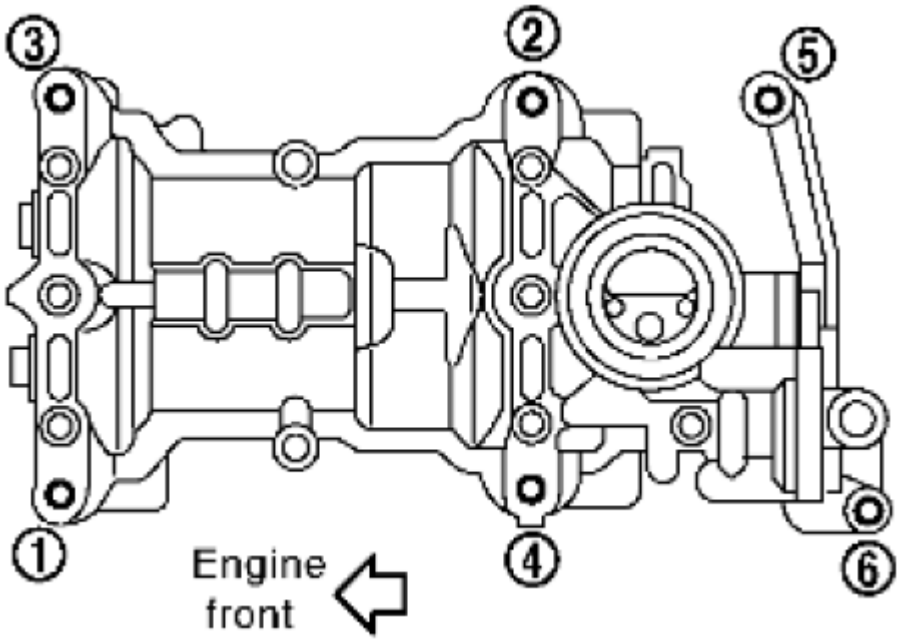


Fig. 44: Tightening Order Of Balancer Unit Bolts
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10112100 (BT8653-A)

CAUTION: If bolts are re-used, check their outer diameter before installation. Follow the "Balancer Unit Bolt Outer Diameter" procedure.

CAUTION:
- **Check tightening angle using Tool or a protractor. Do not make judgment by visual check alone.**
- **In step 3, loosen bolts in reverse order as shown.**

NOTE: Apply new engine oil to threads and seat surfaces of bolts.

Balancer bolt torque

Step 1 bolts 1 - 4: 48.1 N.m (4.9 kg-m, 35 ft-lb)

Step 2 bolts 1 - 4: 100° clockwise

Step 3 bolts 1 - 4: 0 N.m (0 kg-m, 0 ft-lb)

Step 4 bolts 1 - 4: 48.1 N.m (4.9 kg-m, 35 ft-lb)

Step 5 bolts 1 - 4: 100° clockwise

Step 6 bolts 5 - 6: 30.1 N.m (3.1 kg-m, 22 ft-lb)

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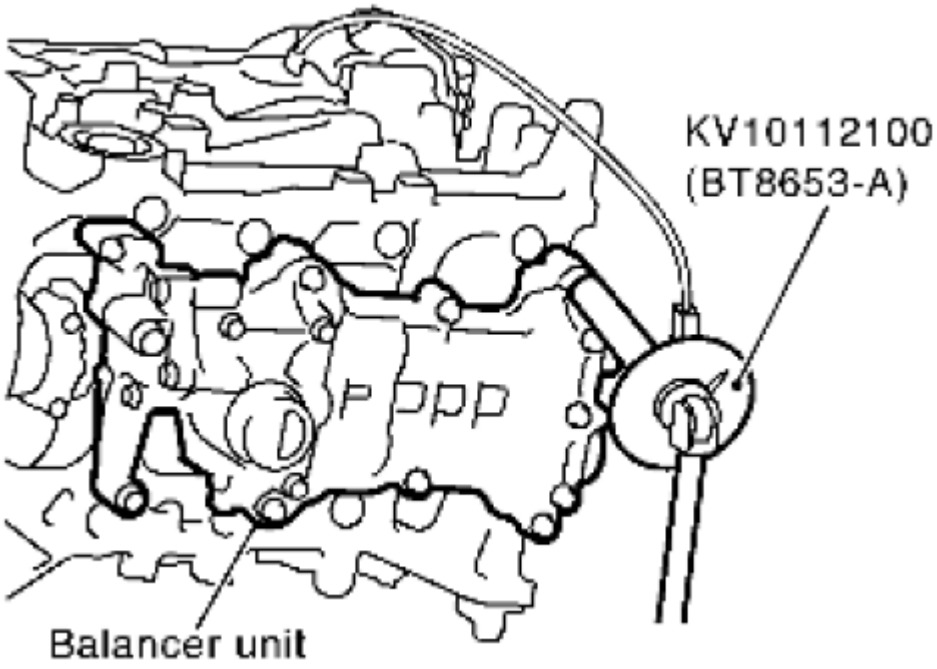


Fig. 45: Tightening Balancer Unit Bolt
Courtesy of SUZUKI OF AMERICA CORP.

4. Install crankshaft sprocket, balancer unit sprocket and balancer unit timing chain.

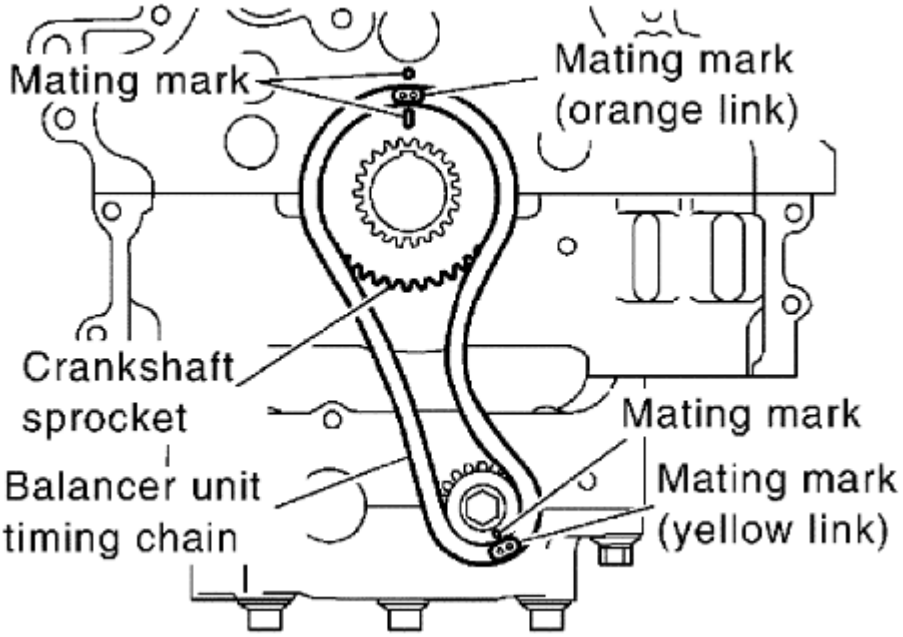


Fig. 46: Identifying Crankshaft Sprocket, Balancer Unit Timing Chain With Mating Marks
Courtesy of SUZUKI OF AMERICA CORP.

- Make sure that crankshaft sprocket is positioned with mating marks on cylinder block and

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crankshaft sprocket meeting at the top.

- Install it by aligning mating marks on each sprocket and balancer unit timing chain.
- Secure the hexagonal portion of the balancer shaft using a suitable tool. Tighten the balancer unit sprocket bolt to the specified torque.

NOTE: Install crankshaft sprocket, balancer unit sprocket and balancer unit timing chain at the same time.

5. Install balancer unit timing chain tensioner.

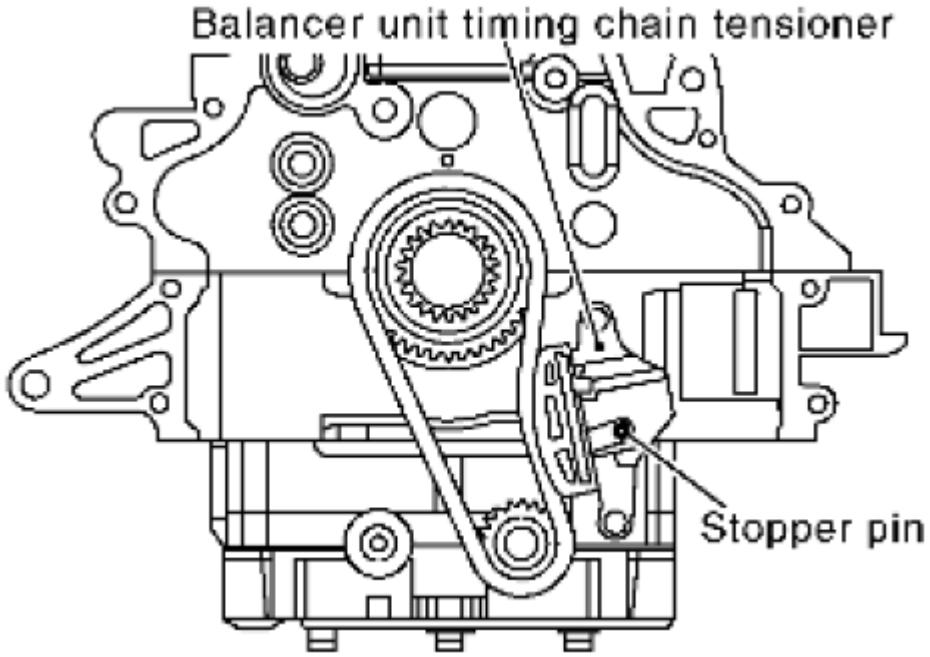


Fig. 47: Identifying Balancer Unit Timing Chain Tensioner And Stopper Pin
Courtesy of SUZUKI OF AMERICA CORP.

- After installation, make sure the mating marks have not slipped, then remove stopper pin and release tensioner sleeve.

6. Install timing chain and related parts.

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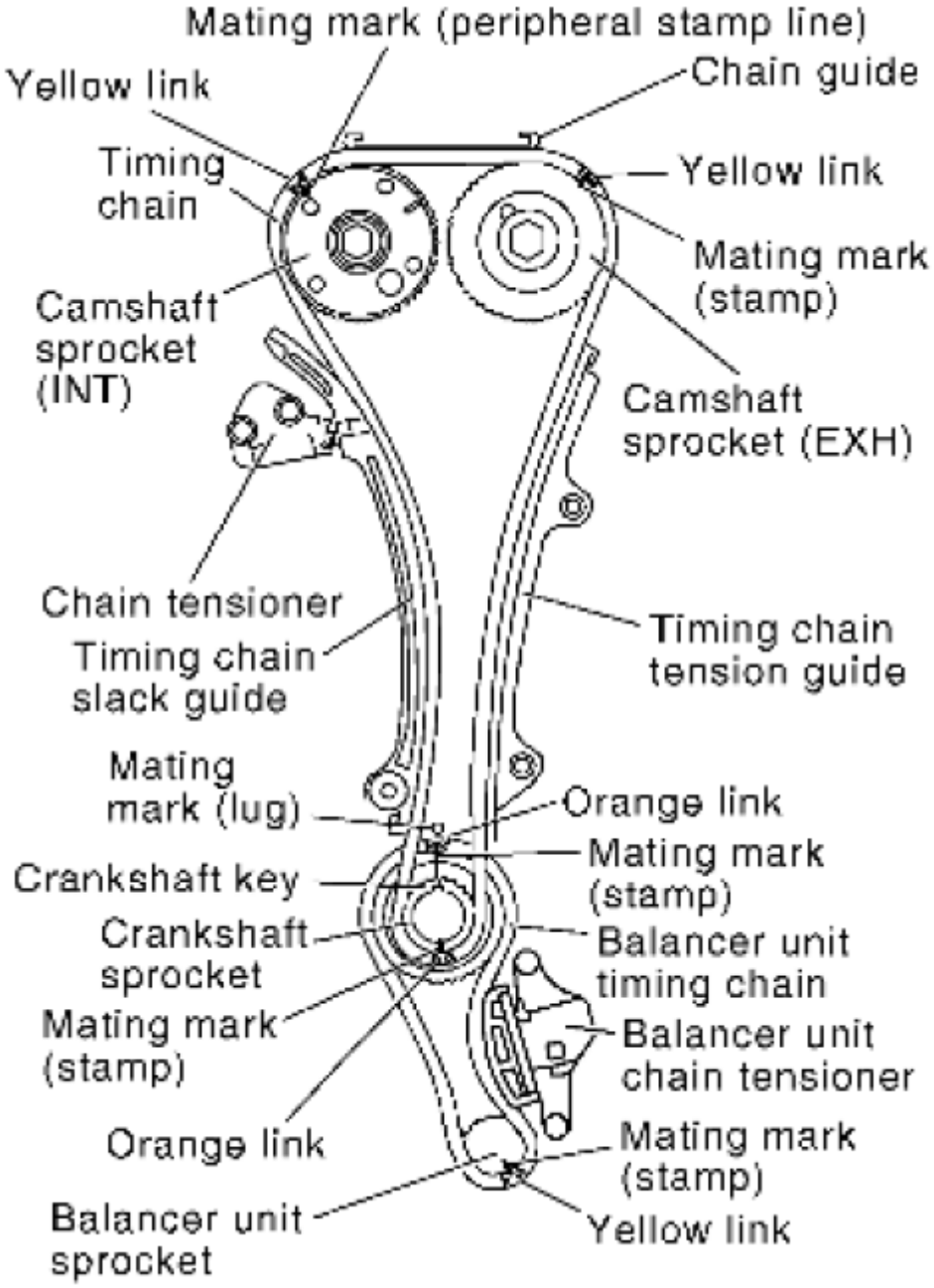


Fig. 48: Identifying Timing Chain With Related Components
Courtesy of SUZUKI OF AMERICA CORP.

- Install by aligning mating marks on each sprocket and timing chain.
- Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.
- After installing chain tensioner, remove stopper pin, and make sure that tensioner moves freely.

CAUTION:
- **For the following note, after the mating marks are aligned,**

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keep them aligned by holding them with a hand.

- **To avoid skipped teeth, do not rotate crankshaft and camshaft until front cover is installed.**

NOTE: Before installing chain tensioner, it is possible to change the position of mating mark on timing chain for that on each sprocket for alignment.

7. Install front oil seal to front cover. Refer to [**FRONT OIL SEAL: REMOVAL AND INSTALLATION**].
8. Install O-rings to cylinder head and cylinder block.
9. Apply a continuous bead of liquid gasket with the tube presser to front cover as shown, using Tool.

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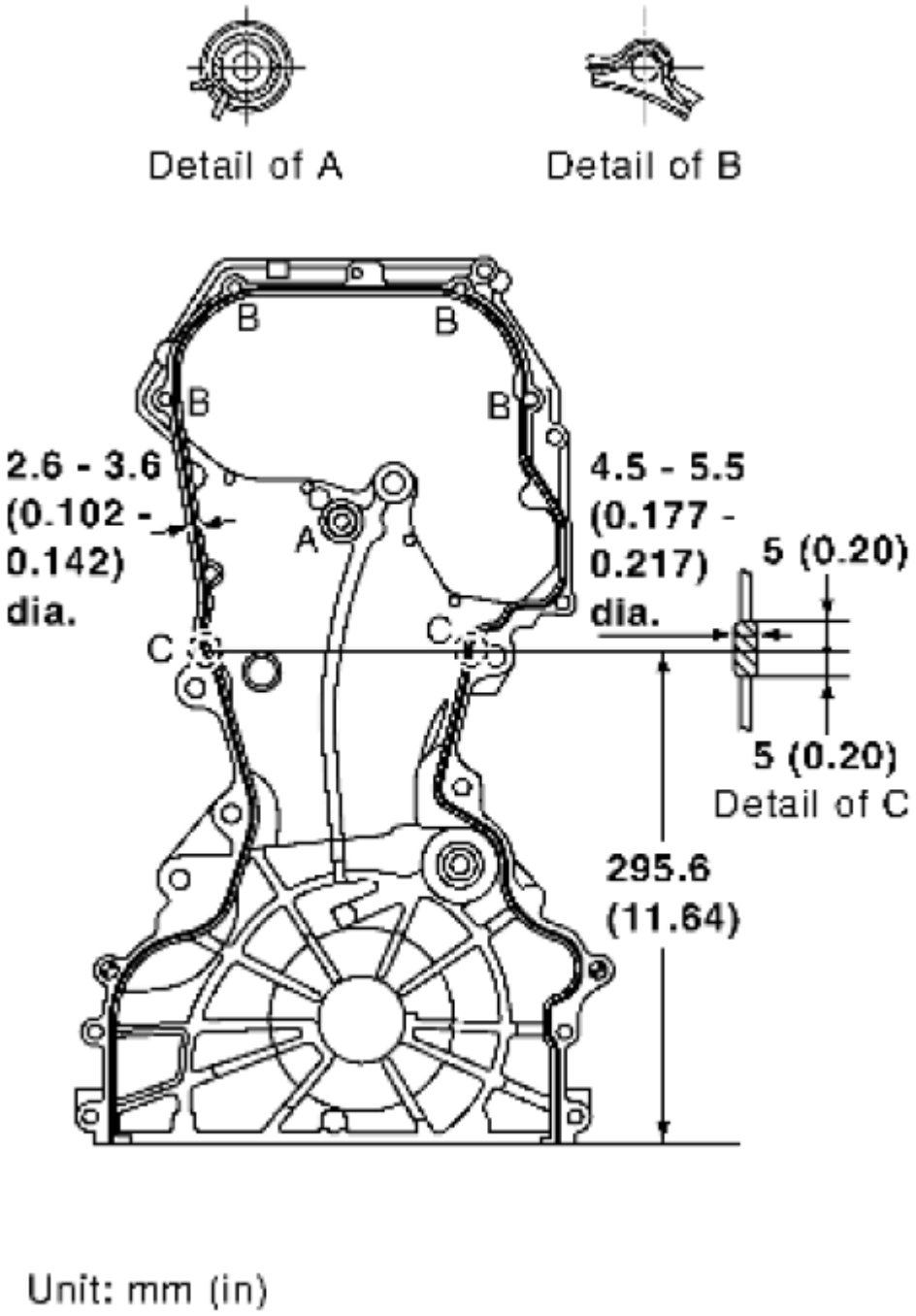


Fig. 49: Identifying Liquid Gasket Applying Specifications On Front Cover
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

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

NOTE: Application instruction differs depending on the position.

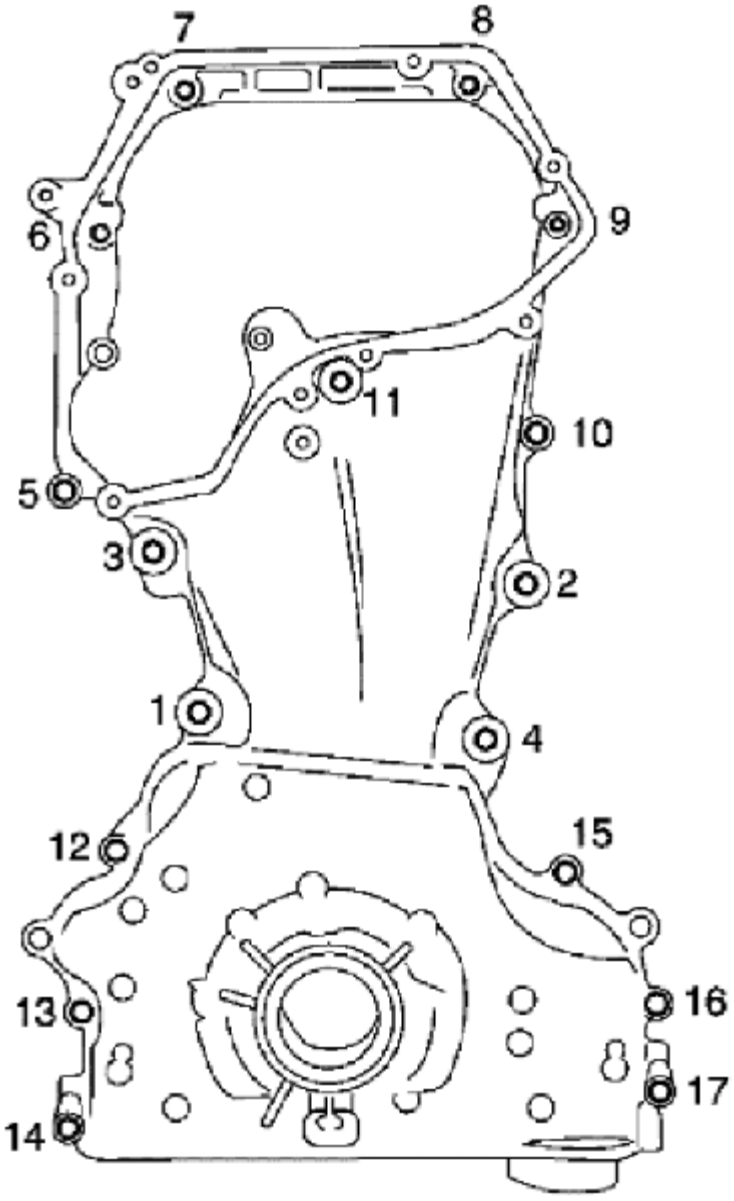
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Detail of A: Cross over the start of the application and the end.
Detail of B: Apply liquid gasket outside of bolt holes. (For all bolt holes other than B, apply to the inside.)
Detail of C: Between here only, apply 4.5 - 5.5 mm (0.177 - 0.217 in) dia.

10. Make sure that mating marks of timing chain and each sprocket are still aligned. Then install front cover.

CAUTION: Be careful not to damage front oil seal by interference with front end of crankshaft.

11. Tighten bolts in numerical order as shown.



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Fig. 50: Tightening Order Of Front Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

- Use the following for locating M6 bolts.

  Bolt position Bolt length

  5, 10, 14, 17: 45 mm (1.77 in)

  Except the above: 20 mm (0.79 in)

  (Except 1 through 4)

- Tighten bolts to the specified torque.

  Bolt position Torque specification

  5 through 17: 12.8 N.m (1.3 kg-m, 9 ft-lb)

  1 through 4: 49.0 N.m (5.0 kg-m, 36 ft-lb)

12. After all bolts are tightened, retighten them to the specified torque in numerical order as shown.

CAUTION: Be sure to wipe off any excessive liquid gasket leaking to surface for fitting oil pan.

13. Install chain guide between camshaft sprockets.
14. Install O-rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
15. Install O-ring to front cover.
16. Apply a continuous bead of liquid gasket using Tool to intake valve timing control cover as shown.

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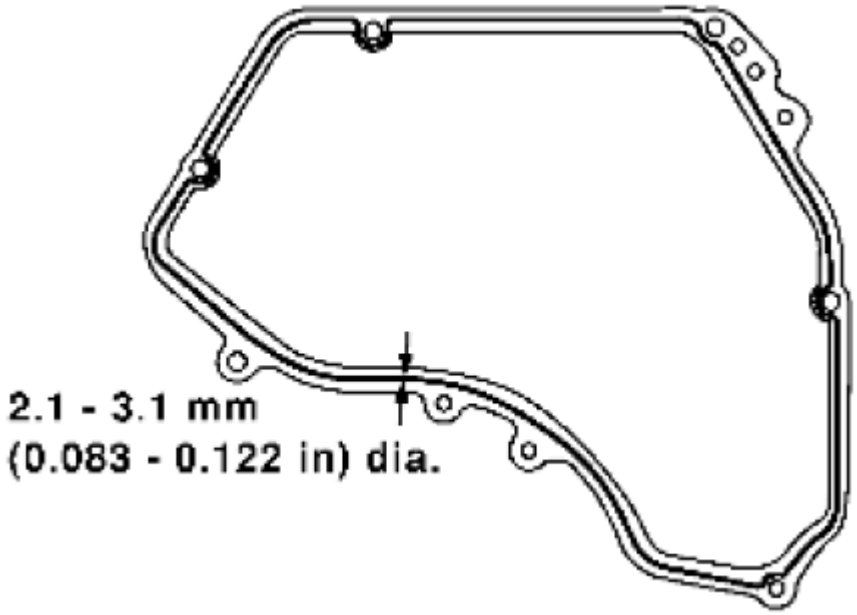


Fig. 51: Identifying Liquid Gasket Applying Specifications On Intake Valve Timing Control Cover
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

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

17. Tighten bolts in numerical order as shown.

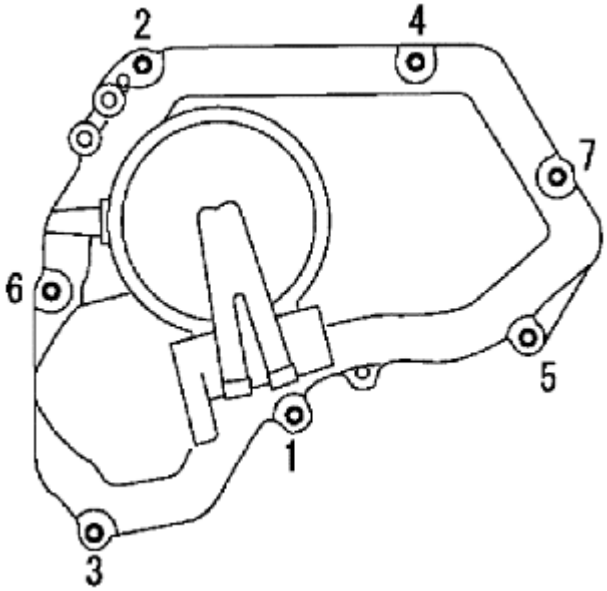


Fig. 52: Tightening Order Of Intake Valve Timing Control Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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18. Install intake valve timing control solenoid valve to intake valve timing control cover if removed.
19. Connect ground cables, and install harness clip.
20. Insert crankshaft pulley by aligning with crankshaft key.
    - When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).

CAUTION: Do not damage front oil seal lip section.

21. Tighten crankshaft pulley bolt using Tool.

    Tool number: KV10112100 (BT-8653-A)

    - Secure crankshaft pulley using suitable tool, and tighten crankshaft pulley bolt.
      a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
      b. Tighten crankshaft pulley bolt.

         : 42.1 N.m (4.3 kg-m, 31 ft-lb)

      c. Put a paint mark on crankshaft pulley, mating with any one of six easy to recognize angle marks on bolt flange.

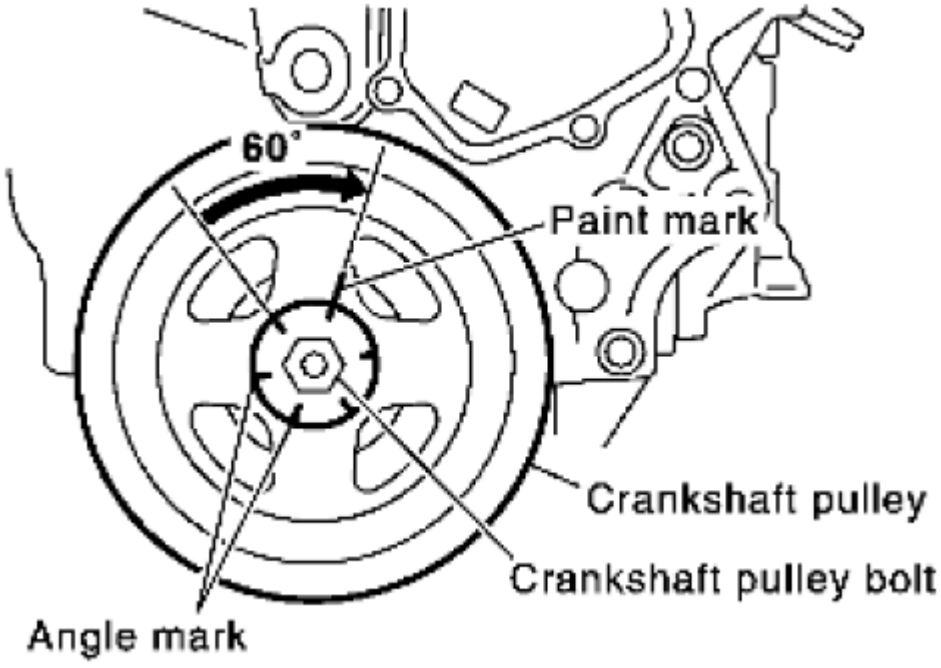


Fig. 53: Tightening Position Of Crankshaft Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

      d. Turn another 60° degrees clockwise (angle tightening).

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- Check the tightening angle with movement of one angle mark.

22. Installation 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.

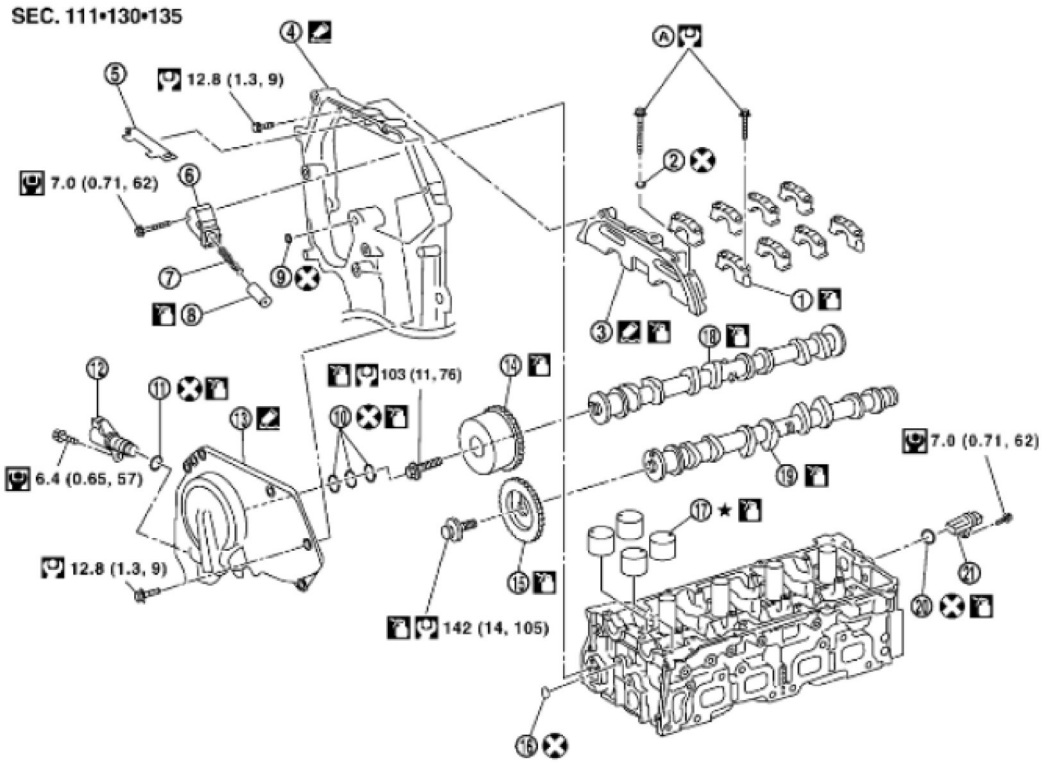
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and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

SUMMARY OF INSPECTION ITEMS

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.			

CAMSHAFT: EXPLODED VIEW

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Expand image

1.	Camshaft bracket (No. 2 to 5)	2.	Seal washer	3.	Camshaft bracket (No. 1)
4.	Front cover	5.	Chain guide	6.	Chain tensioner
7.	Spring	8.	Chain tensioner plunger	9.	O-ring
10.	Oil ring	11.	O-ring	12.	Intake valve timing control solenoid valve
13.	Intake valve timing control cover	14.	Camshaft sprocket (INT)	15.	Camshaft sprocket (EXH)
16.	O-ring	17.	Valve lifter	18.	Camshaft (INT)
19.	Camshaft (EXH)	20.	O-ring	21.	Camshaft position sensor (PHASE)

Fig. 54: Exploded View Of Camshaft
Courtesy of SUZUKI OF AMERICA CORP.

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

CAMSHAFT: REMOVAL AND INSTALLATION

NOTE: This section describes removal/installation procedure of camshaft without

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removing front cover. If front cover is removed or installed, refer to .

REMOVAL

1. Remove the rocker cover. Refer to [**ROCKER COVER: REMOVAL AND INSTALLATION [QR25DE]**].
2. Remove the drive belt. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
3. Disconnect and remove the camshaft position sensor (PHASE).
4. Disconnect the IVT control solenoid electrical connector.
5. Disconnect the ground electrical connections from the front cover.
6. Remove IVT control cover bolts in the order as shown.

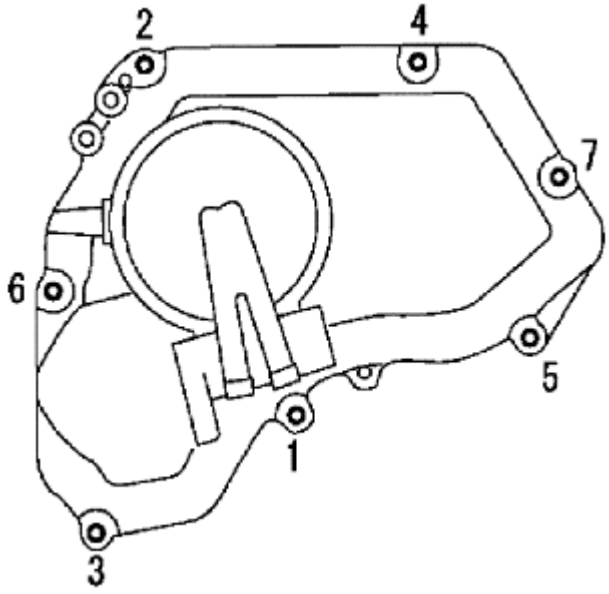


Fig. 55: Removing Order Of IVT Control Cover Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove the IVT control cover by cutting the sealant using Tool.

   Tool number: KV10111100 (J-37228)

8. Set the No. 1 cylinder at TDC on its compression stroke as follows:

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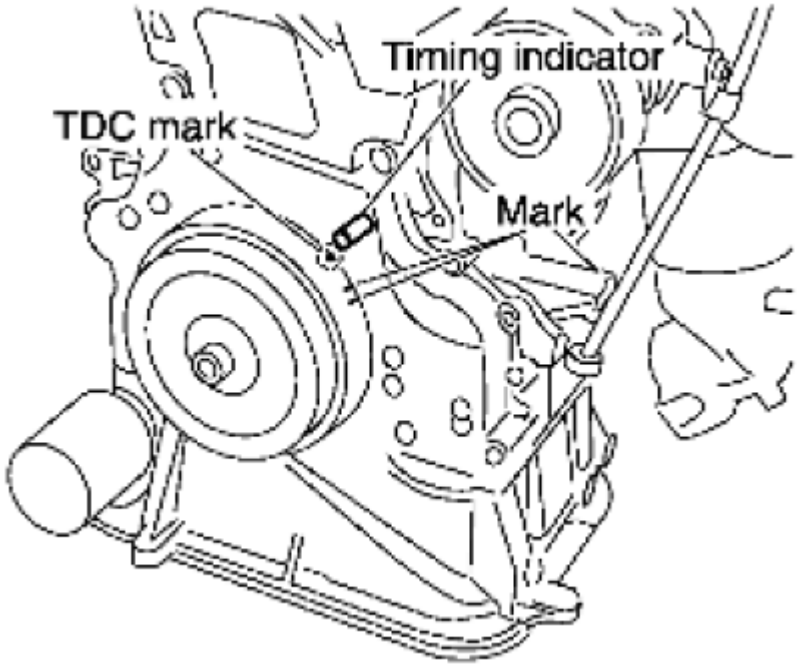


Fig. 56: Identifying TDC Mark, Timing Indicator And Mark
Courtesy of SUZUKI OF AMERICA CORP.

a. Rotate crankshaft pulley clockwise, and align mating marks for TDC with timing indicator on front cover, as shown.
b. Make sure that the mating marks on camshaft sprockets are lined up with the yellow links in the timing chain, as shown.

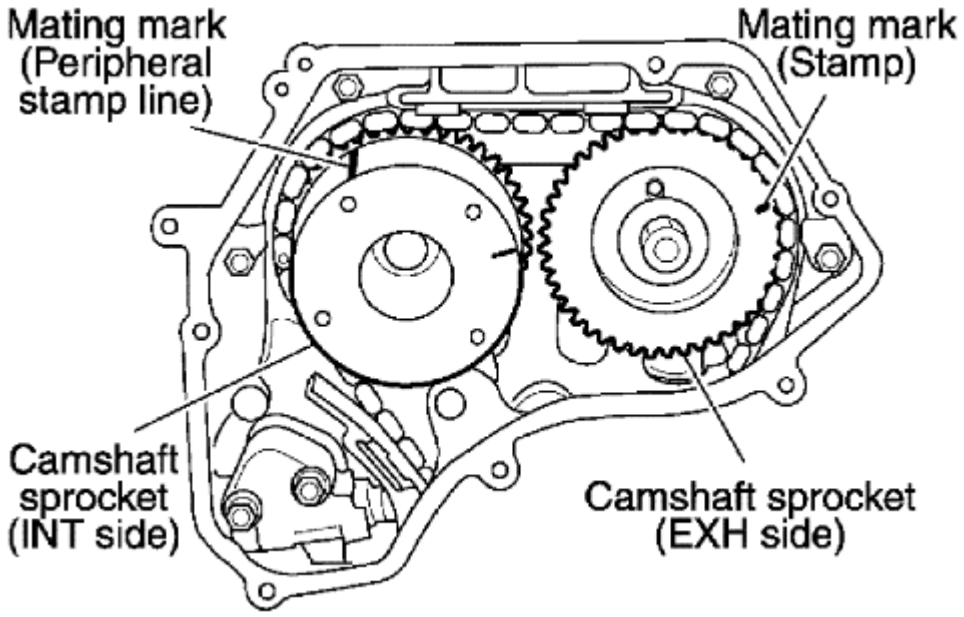


Fig. 57: Identifying Mating Marks On Camshaft Sprockets
Courtesy of SUZUKI OF AMERICA CORP.

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- If not, rotate crankshaft pulley one more turn to line up the mating marks to the yellow links, as shown.

9. Pull the timing chain guide out between the camshaft sprockets through front cover.
10. Line up the mating marks on camshaft sprockets with the yellow links in the timing chain, and paint an indelible mating mark on the sprocket and timing chain link plate.

CAUTION: Do not rotate the crankshaft or camshaft while the timing chain is removed. It causes interference between valve and piston.

NOTE: Maintaining chain tension is not necessary. Crankshaft sprocket and timing chain do not disconnect structurally while front cover is attached.

11. Push in the tensioner plunger and hold. Insert a stopper pin into the hole on tensioner body to hold the chain tensioner. Remove the timing chain tensioner.

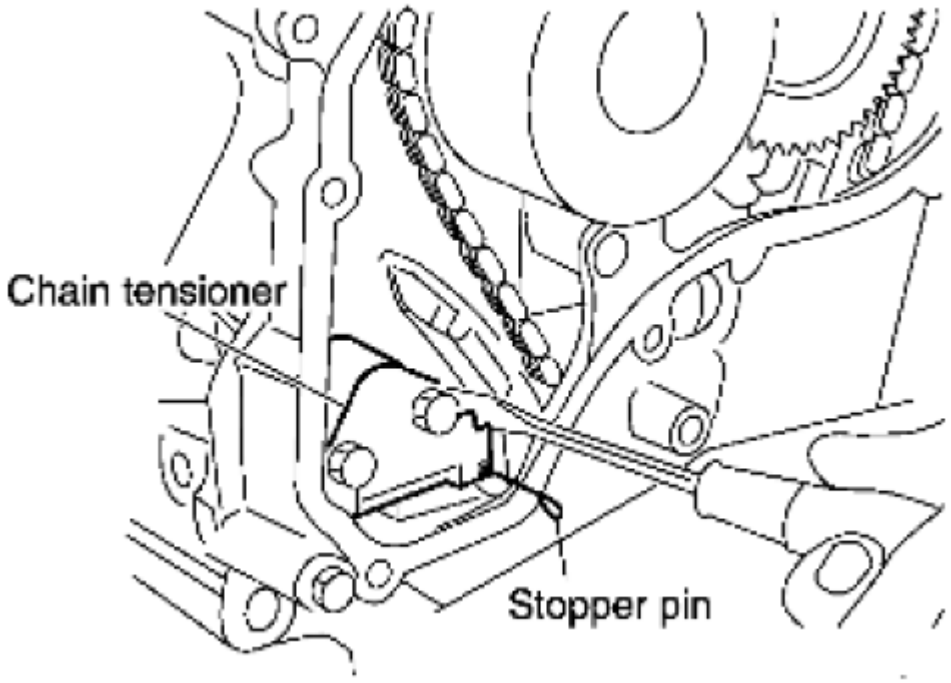


Fig. 58: Removing Timing Chain Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

- Use a wire with 0.5 mm (0.02 in) diameter for a stopper pin.

12. Secure the camshaft using a suitable tool as shown. Loosen the camshaft sprocket bolts and remove the camshaft sprockets.

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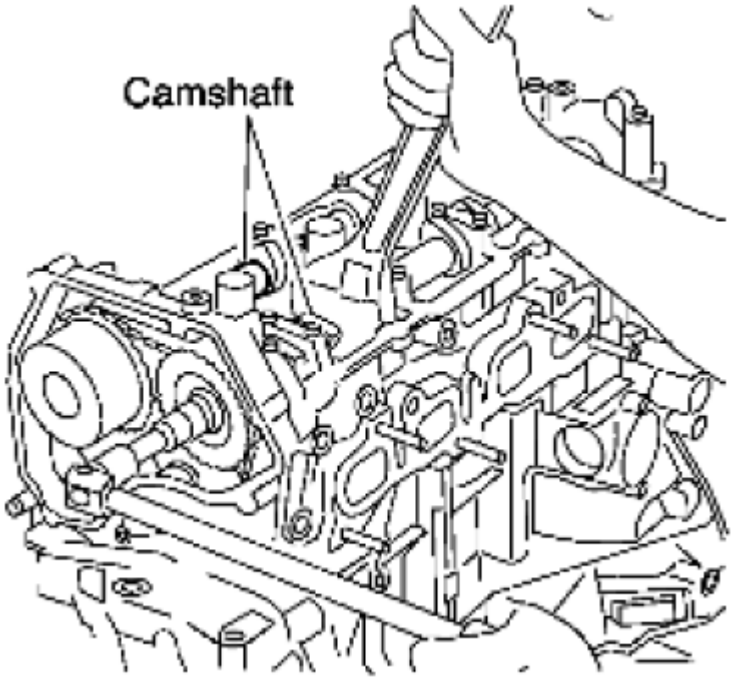


Fig. 59: Securing Camshaft Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

13. Loosen the camshaft bracket bolts in the order as shown, and remove the camshaft brackets and camshafts.

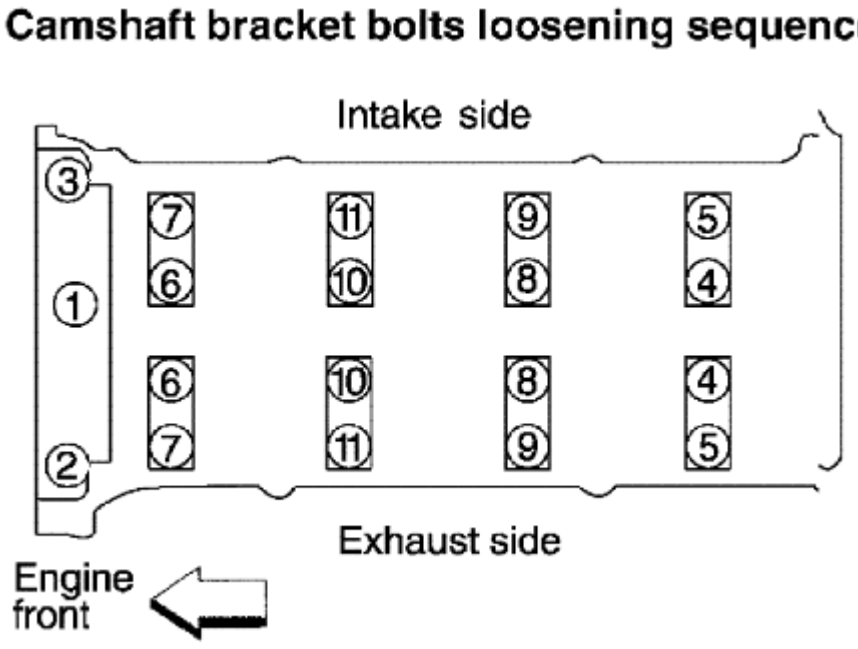


Fig. 60: Camshaft Bracket Bolts Loosening Order
Courtesy of SUZUKI OF AMERICA CORP.

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- Remove No. 1 camshaft bracket by slightly tapping it with a rubber mallet.
- Note positions, and set them aside in the order removed.

14. Remove the valve lifters.
    - Note positions, and set them aside in the order removed.

INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 5 journals of camshaft.

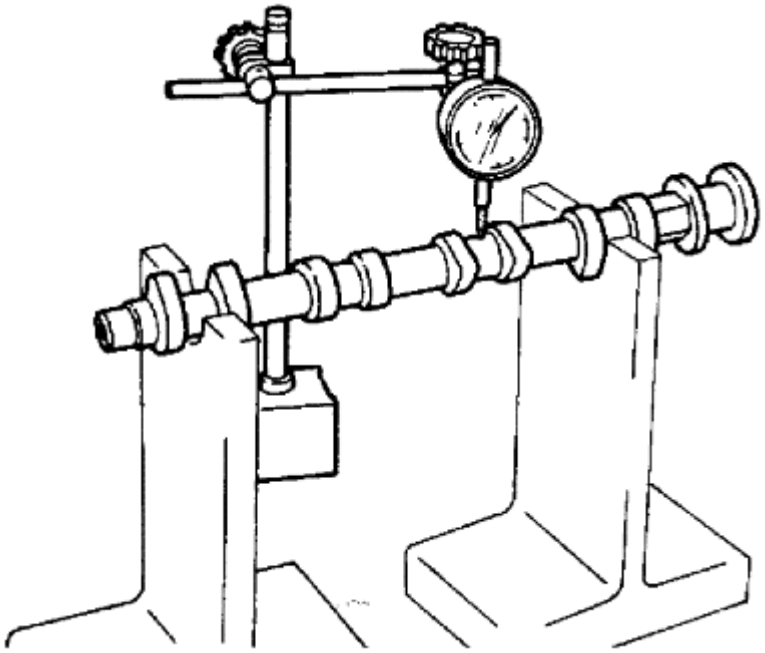


Fig. 61: Measuring Camshaft Runout
Courtesy of SUZUKI OF AMERICA CORP.

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

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

   Standard: Less than 0.02 mm (0.0008 in).

4. If out of the standard, replace camshaft.

Camshaft Cam Height

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1. Measure the camshaft cam height with a micrometer.

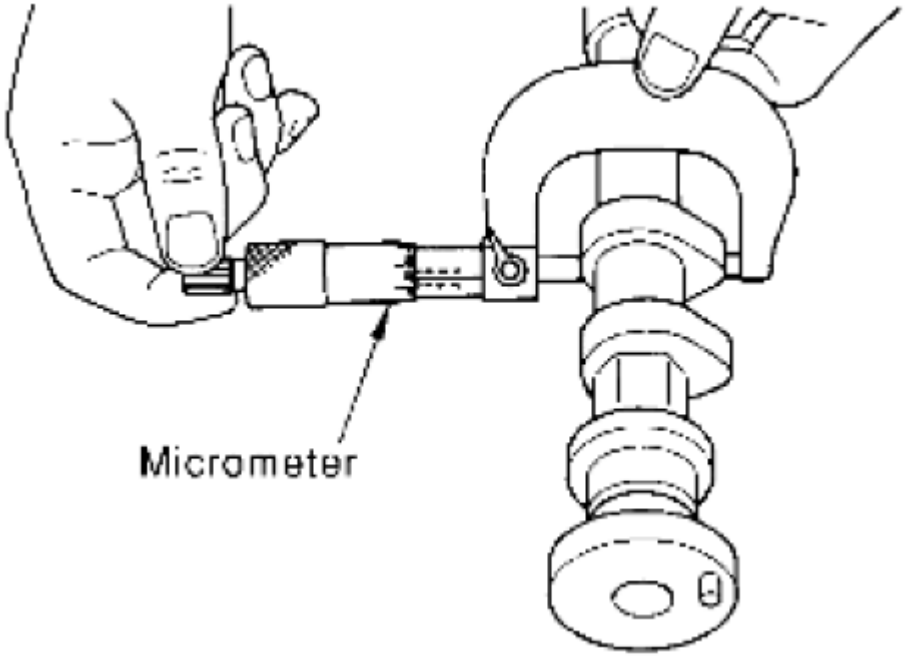


Fig. 62: Measuring Camshaft Cam Height Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

Intake: 45.015 - 45.205 mm (1.7722 - 1.7797 in)

Exhaust: 43.975 - 44.165 mm (1.7313 - 1.7388 in)

Cam wear limit: 0.2 mm (0.008 in)

1. If wear is beyond the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

Measure the outer diameter of camshaft journal with a micrometer.

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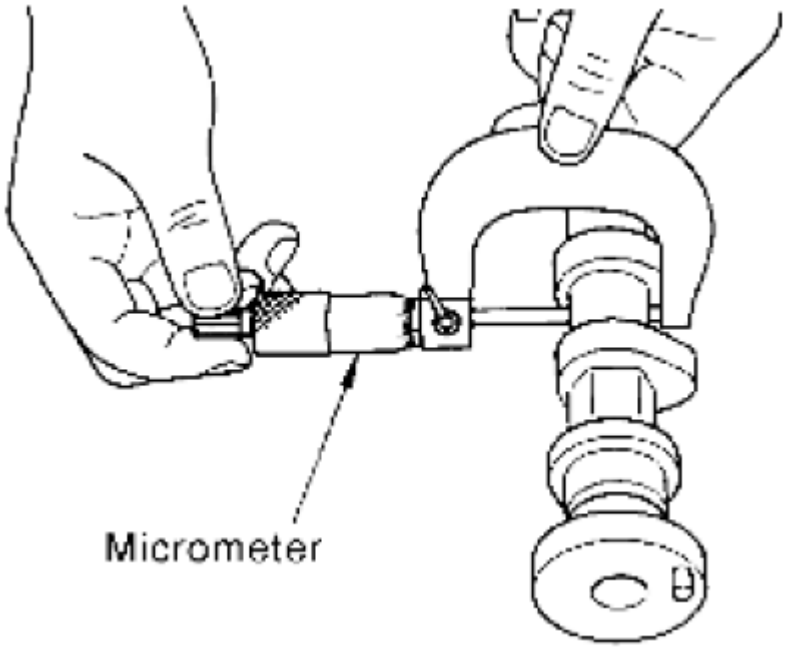


Fig. 63: Measuring Outer Diameter Of Camshaft Journal Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

No. 1: 27.935 - 27.955 mm (1.0998 - 1.1006 in)

No. 2, 3, 4, 5: 23.435 - 23.455 mm (0.9226 - 0.9234 in)

CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
- Measure inner diameter "A" of camshaft bracket with a bore gauge.

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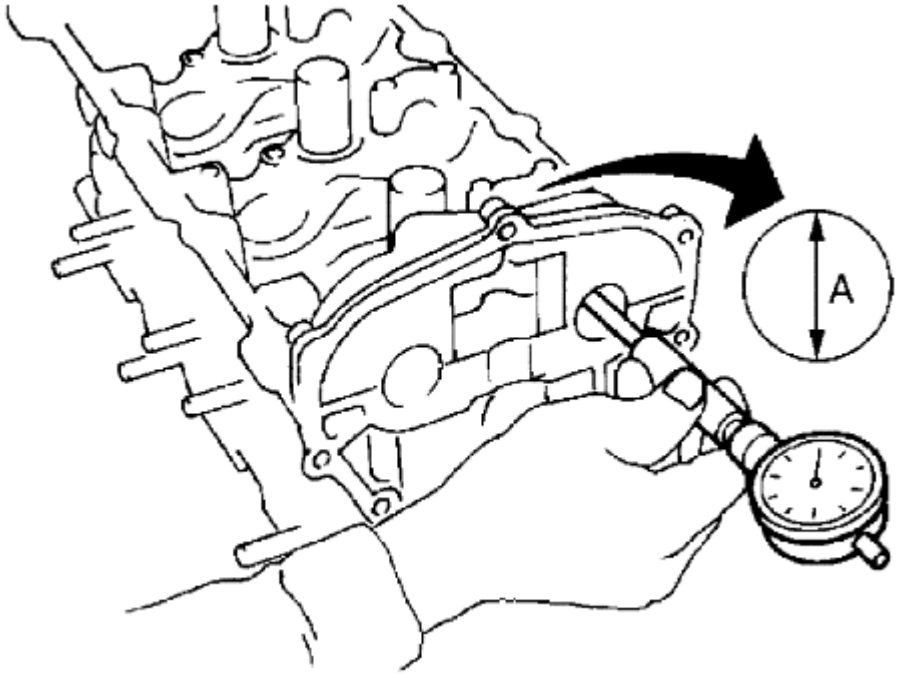


Fig. 64: Measuring Inner Diameter "A" Of Camshaft Bracket Using Bore Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

No. 1: 28.000 - 28.021 mm (1.1024 - 1.1032 in)

No. 2, 3, 4, 5: 23.500 - 23.521 mm (0.9252 - 0.9260 in)

CAMSHAFT JOURNAL OIL CLEARANCE

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

  Standard: 0.045 - 0.086 mm (0.0018 - 0.0034 in)

- If out of the standard, replace either or both camshaft and cylinder head.

NOTE: Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to [**CAMSHAFT: REMOVAL AND INSTALLATION**].
2. Install a dial indicator in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

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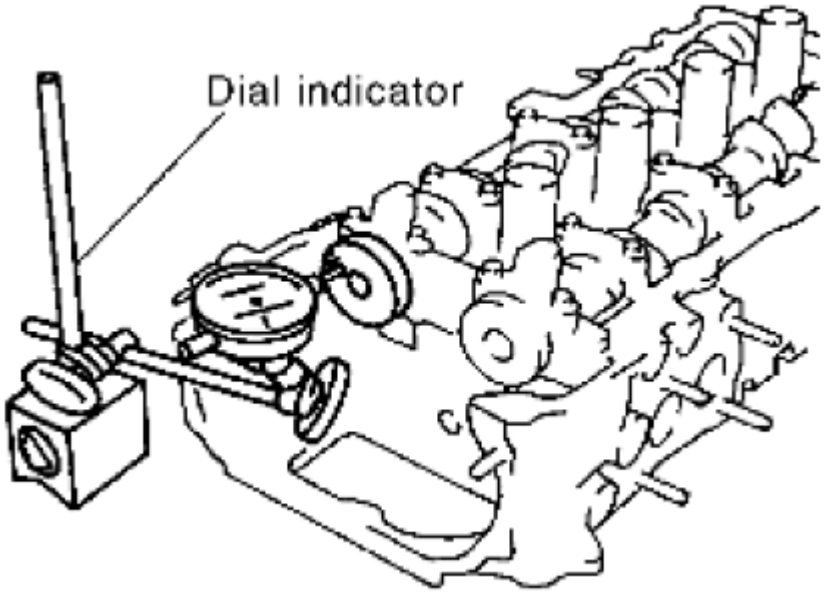


Fig. 65: Measuring Camshaft End Play
Courtesy of SUZUKI OF AMERICA CORP.

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

- Measure the following parts if out of the standard.

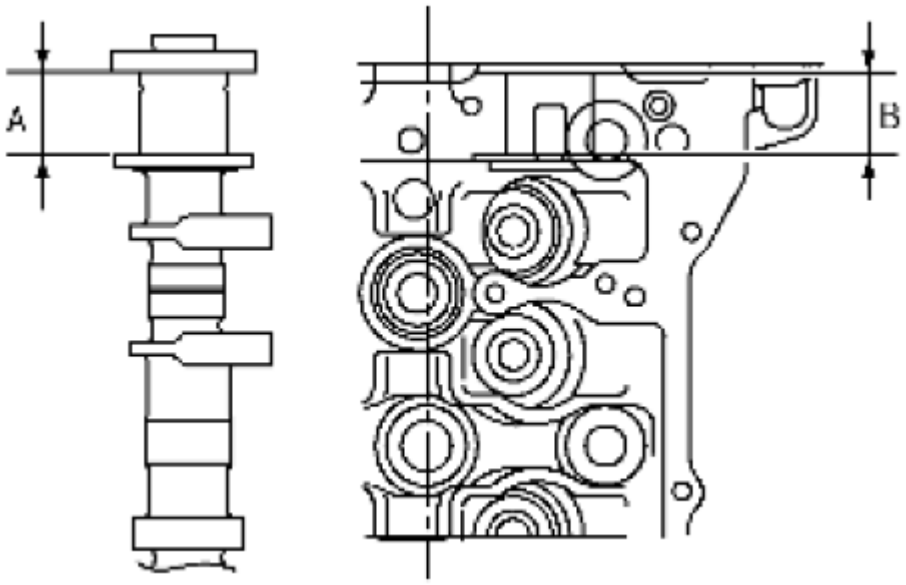


Fig. 66: Identifying Camshaft No. 1 Journal And Cylinder Head No. 1 Journal Bearing Dimension
Courtesy of SUZUKI OF AMERICA CORP.

  - Dimension "A" for camshaft No. 1 journal

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Standard: 25.800 - 25.848 mm (1.0157 - 1.0176 in)

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

Standard: 25.660 - 25.685 mm (1.0102 - 1.0112 in)

- Use the standards above, and then replace camshaft and/or cylinder head, if necessary.

Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

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

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

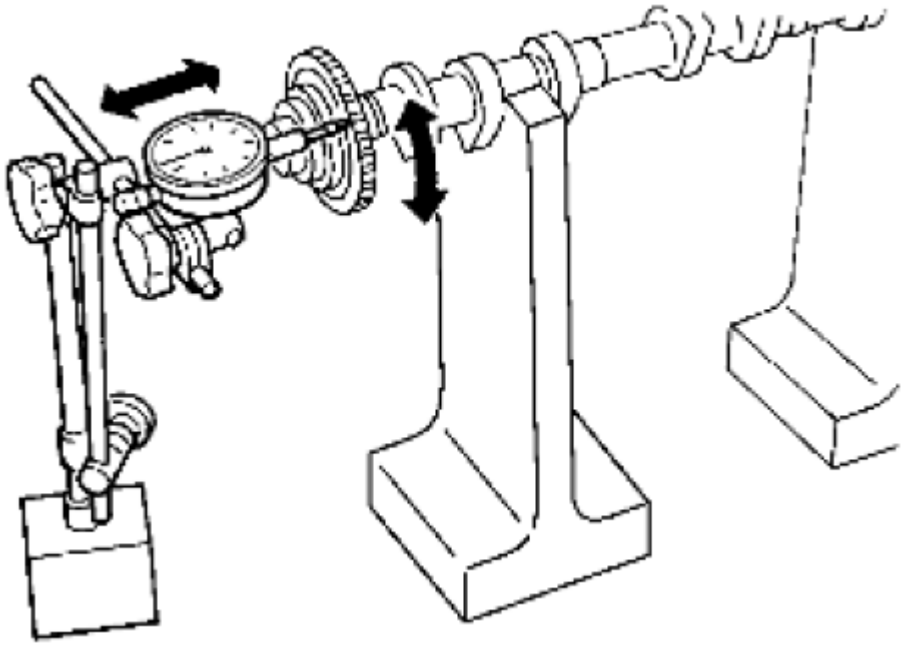


Fig. 67: Measuring Camshaft Sprocket Runout
Courtesy of SUZUKI OF AMERICA CORP.

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.

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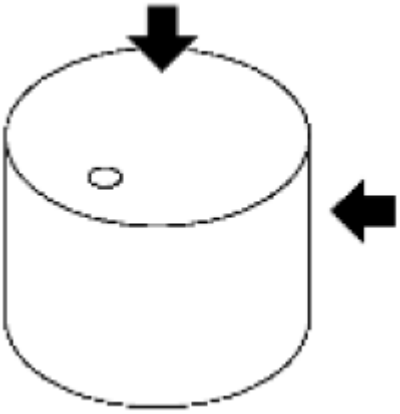


Fig. 68: Locating Valve Lifter Surface For Checking Wear Or Cracks
Courtesy of SUZUKI OF AMERICA CORP.

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

Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of valve lifter with a micrometer.

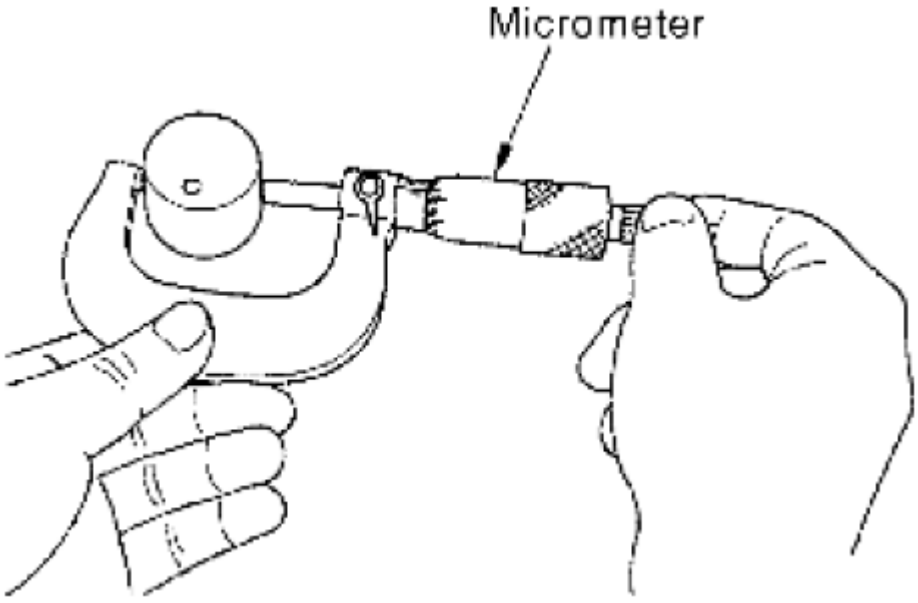


Fig. 69: Measuring Outer Diameter Of Valve Lifter Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 33.965 - 33.980 mm (1.3372 - 1.3378 in)

VALVE LIFTER HOLE DIAMETER

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

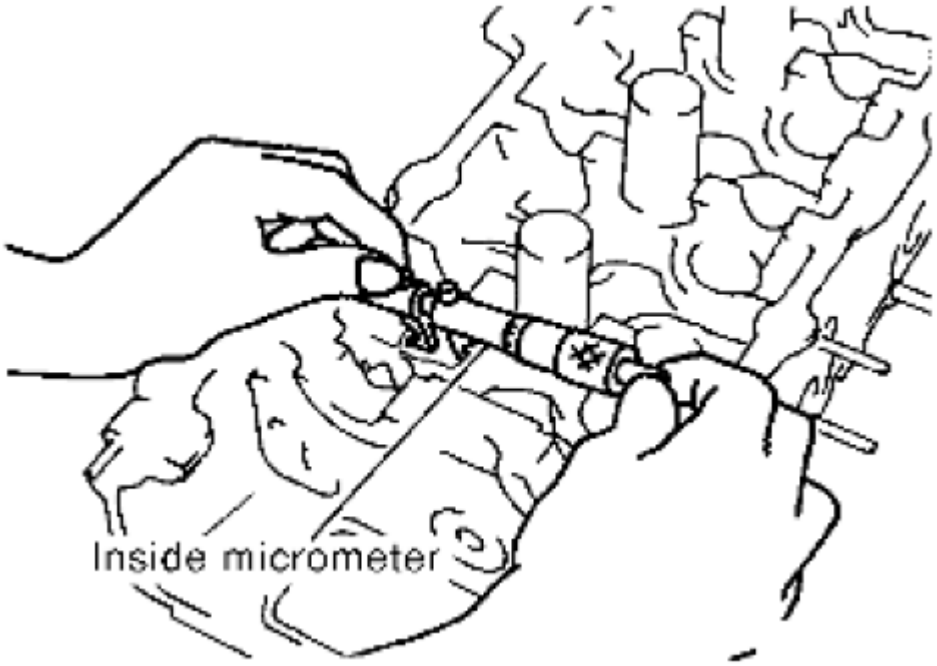


Fig. 70: Measuring Diameter Of Valve Lifter Hole Of Cylinder Head Using Inside Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 34.000 - 34.021 mm (1.3386 - 1.3394 in)

VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) - (Valve lifter outer diameter)

  Standard: 0.020 - 0.056 mm (0.0008 - 0.0022 in)

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

INSTALLATION

1. Install valve lifters.
   - Install them in the original positions.
2. Install camshafts.

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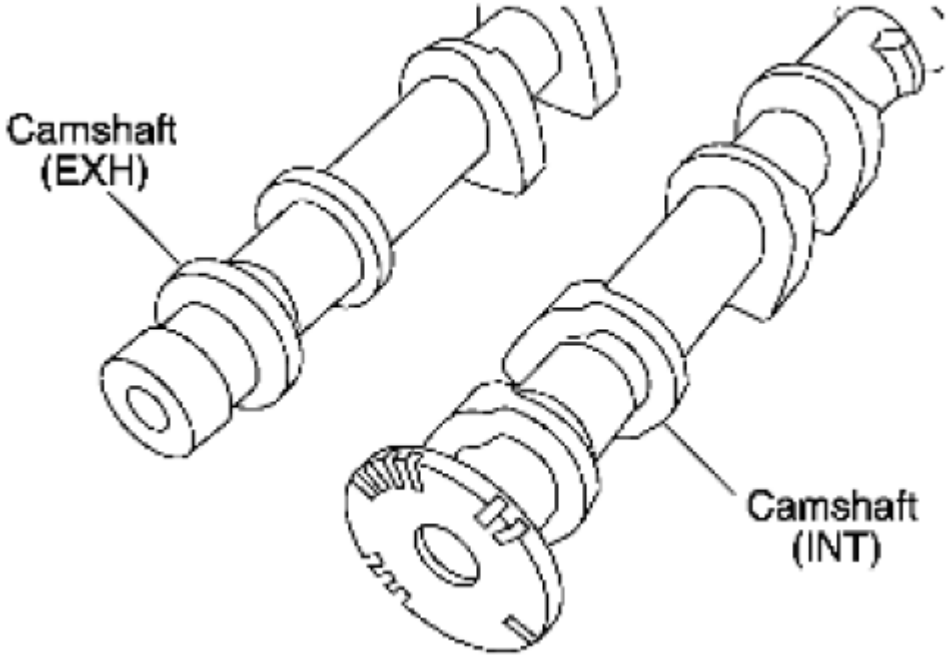


Fig. 71: Identifying Camshafts
Courtesy of SUZUKI OF AMERICA CORP.

- Distinction between intake and exhaust camshafts is performed with the different shapes of rear end.

  Intake: Signal plate shape for camshaft position sensor (PHASE)

  Exhaust: Cone end shape

- Install camshafts so that camshaft dowel pins on the front side are positioned as shown.

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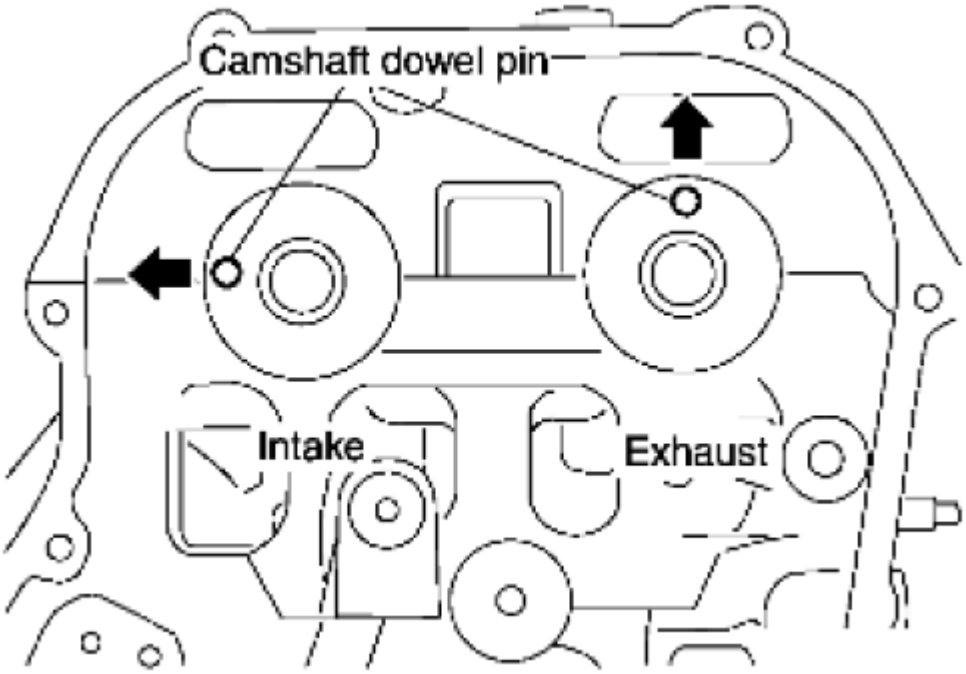


Fig. 72: Camshaft Installation Position
Courtesy of SUZUKI OF AMERICA CORP.

3. Install camshaft brackets with the following procedure:
   a. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
   b. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown.

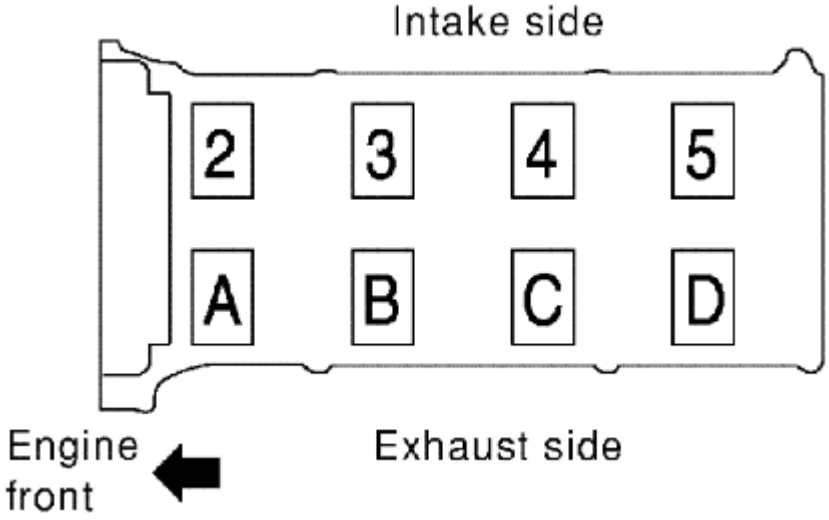


Fig. 73: Aligning Identification Marks On Upper Surface
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Install so that identification mark can be correctly read when viewed

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from the exhaust side.

c. Install camshaft bracket (No. 1) with the following procedure:
   i. Apply liquid gasket to camshaft bracket (No. 1) as shown.

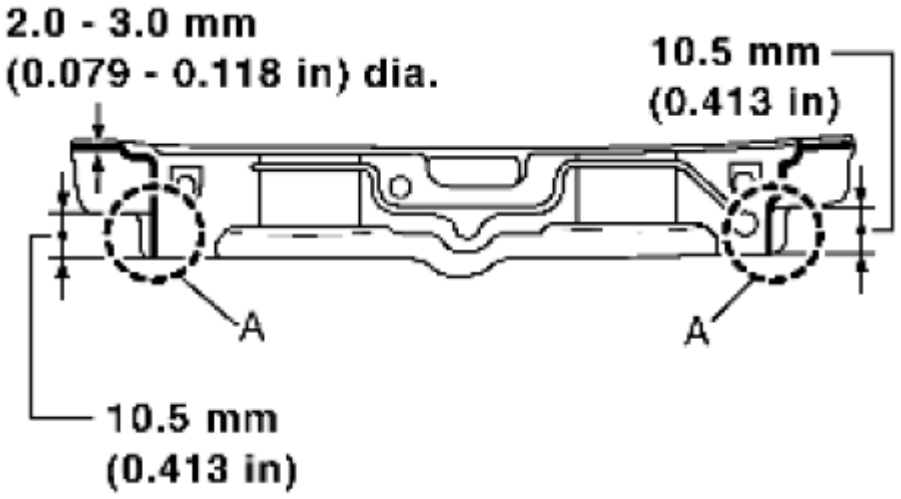


Fig. 74: Identifying Liquid Gasket Applying Specification On Camshaft Bracket (No. 1)
Courtesy of SUZUKI OF AMERICA CORP.

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

CAUTION: After installation, be sure to wipe off any excessive liquid gasket leaking from part (A).

   ii. Apply liquid gasket to camshaft bracket (No. 1) contact surface on the front cover backside.

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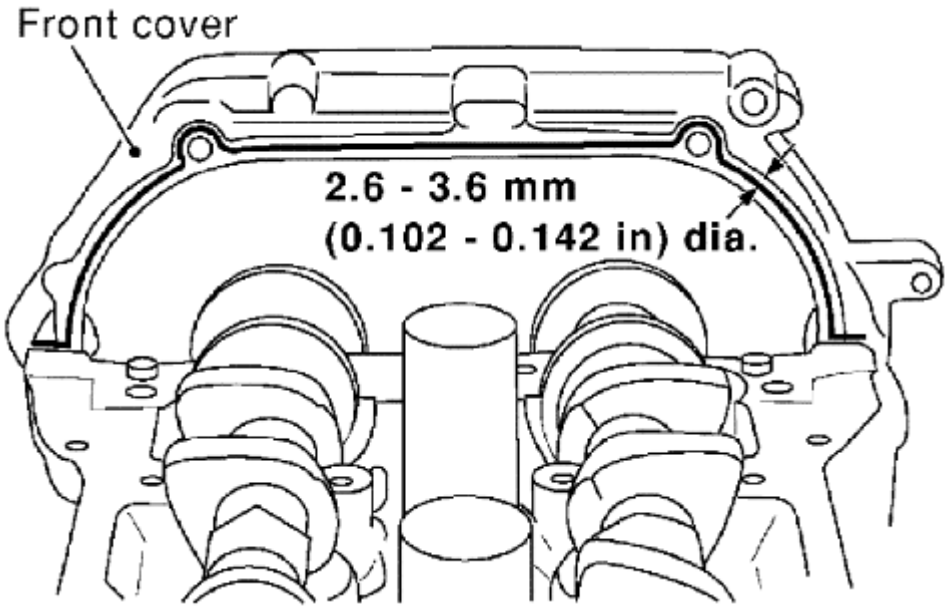
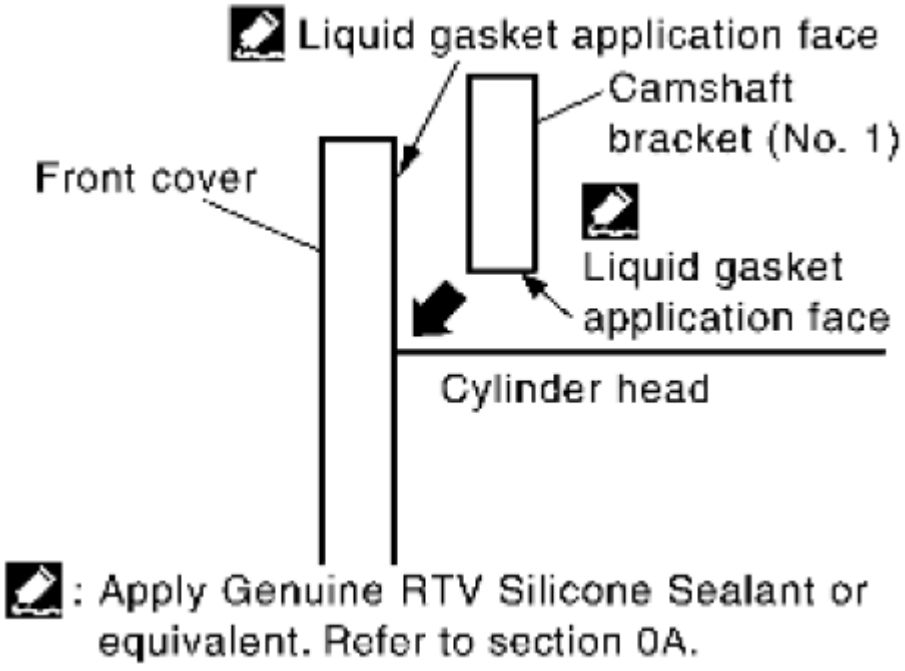


Fig. 75: Identifying Liquid Gasket Applying Specification On Camshaft Bracket (No. 1)
Courtesy of SUZUKI OF AMERICA CORP.

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

- Apply liquid gasket to the outside of bolt hole on front cover.

iii. Locate camshaft bracket (No. 1) near installation position, and install it without disturbing the liquid gasket applied to the surfaces.



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Fig. 76: Identifying Liquid Gasket Application Face
Courtesy of SUZUKI OF AMERICA CORP.

4. Tighten bolts of camshaft brackets in the following steps, in numerical order as shown.

   Step 1 (bolts 9 - 11): 2.0 N.m (0.2 kg-m, 17 in-lb)

   Step 2 (bolts 1 - 8): 2.0 N.m (0.2 kg-m, 17 in-lb)

   Step 3 (bolts 1 - 11): 5.9 N.m (0.6 kg-m, 52 in-lb)

   Step 4 (bolts 1 - 11): 10.4 N.m (1.1 kg-m, 92 in-lb)

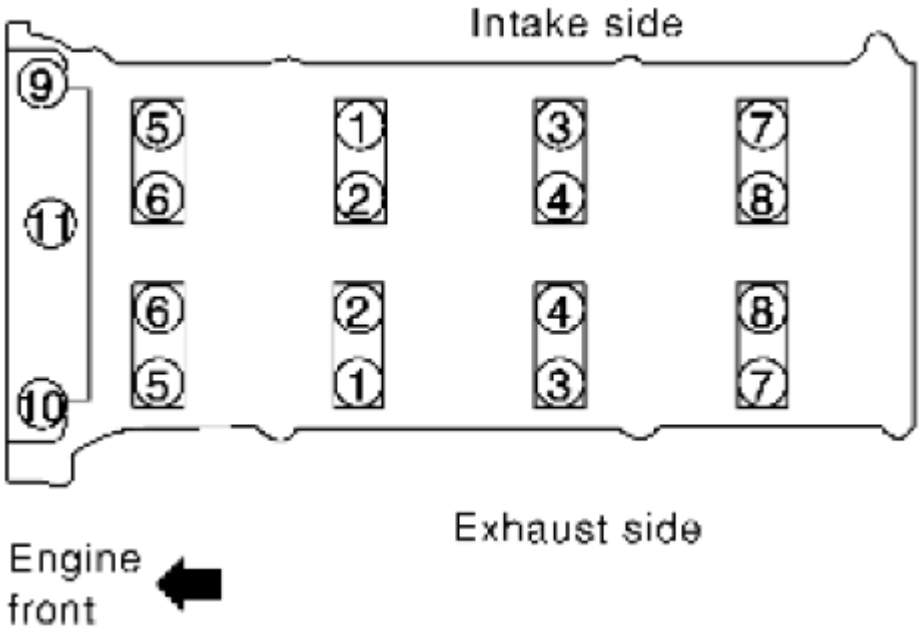


Fig. 77: Tightening Order Of Camshaft Brackets Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: After tightening bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the parts.

1. Install camshaft position sensor (PHASE).
2. Install camshaft sprockets.
   - Install them by aligning the mating marks on each camshaft sprocket with the paint marks on the timing chain link plates during removal.

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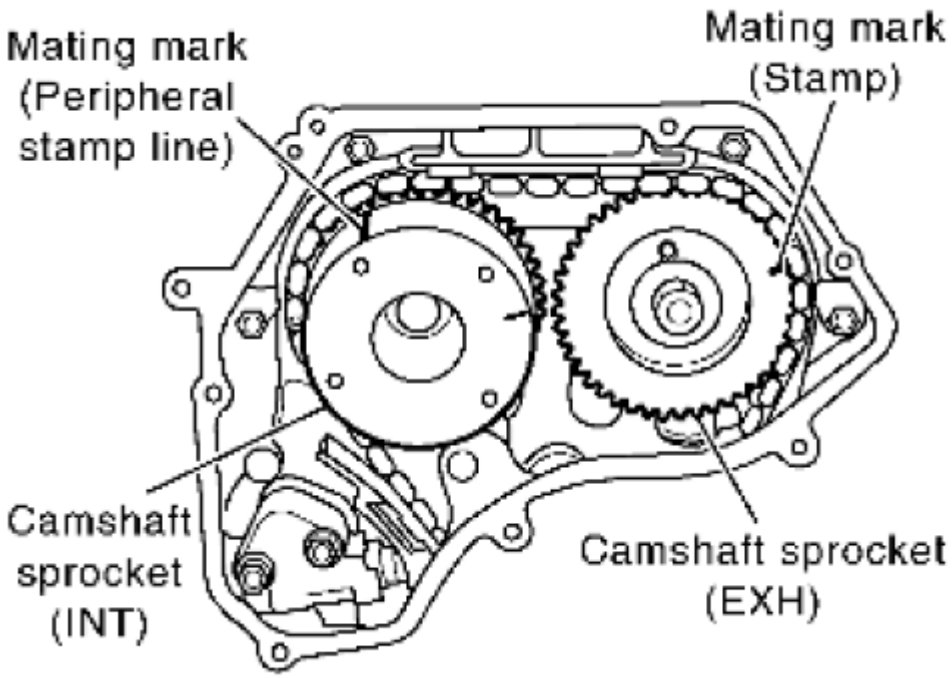


Fig. 78: Identifying Mating Marks On Camshaft Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Aligned mating marks could slip. Therefore, after matching them, hold the timing chain in place by hand.**
- **Before and after installing chain tensioner, make sure again that mating marks have not slipped.**

NOTE: **Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.**

3. Install chain tensioner.

CAUTION: After installation, pull the stopper pin off completely, and make sure that chain tensioner plunger is released.

4. Install chain guide.
5. Install O-rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
6. Install O-ring to front cover.
7. Apply liquid gasket using Tool to intake valve timing control cover as shown.

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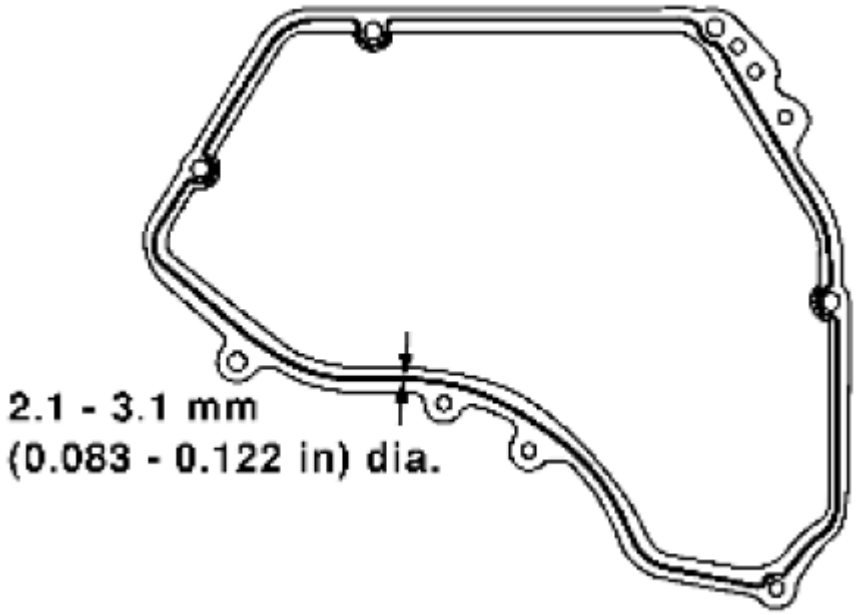


Fig. 79: Identifying Liquid Gasket Applying Specifications On Intake Valve Timing Control Cover
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

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

8. Tighten bolts in numerical order as shown.

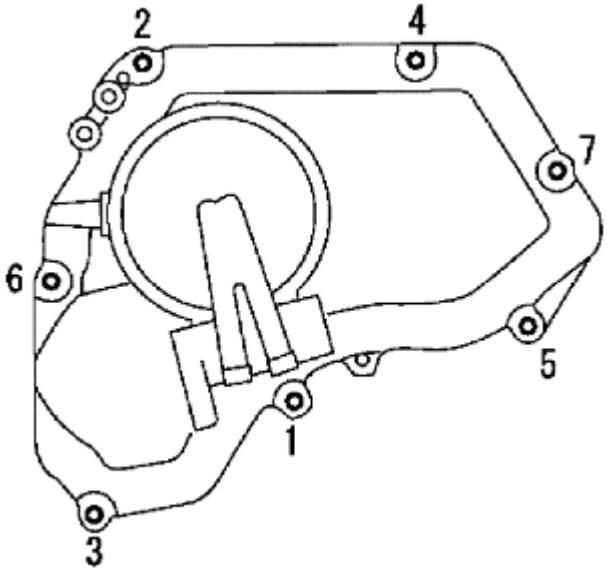


Fig. 80: Tightening Order Of Intake Valve Timing Control Cover
Courtesy of SUZUKI OF AMERICA CORP.

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9. Install intake valve timing control solenoid valve to intake valve timing control cover if removed.
10. Connect ground cables, and install harness clip.
11. Check and adjust valve clearance. Refer to [**SERVICE DATA AND SPECIFICATIONS**].
12. Installation is in the reverse order of removal after this step.

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 the engine start. However, this is normal. Noise will stop after hydraulic pressure rises.**

INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:
- **Perform this inspection only when DTC P0011 is detected in "DTC check" of SDT and it is directed according to inspection procedure of section 1A. Refer to [P0011 IVT CONTROL].**
- **Check when the 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: QR25DE**]
   b. Disconnect ignition coil and injector harness connectors.
   c. Remove drive belt. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
3. Remove intake valve timing control solenoid valve. Refer to [**TIMING CHAIN: EXPLODED VIEW**].
4. Crank the engine, and then make sure that engine oil comes out from intake valve timing control cover oil hole. Stop cranking after checking.

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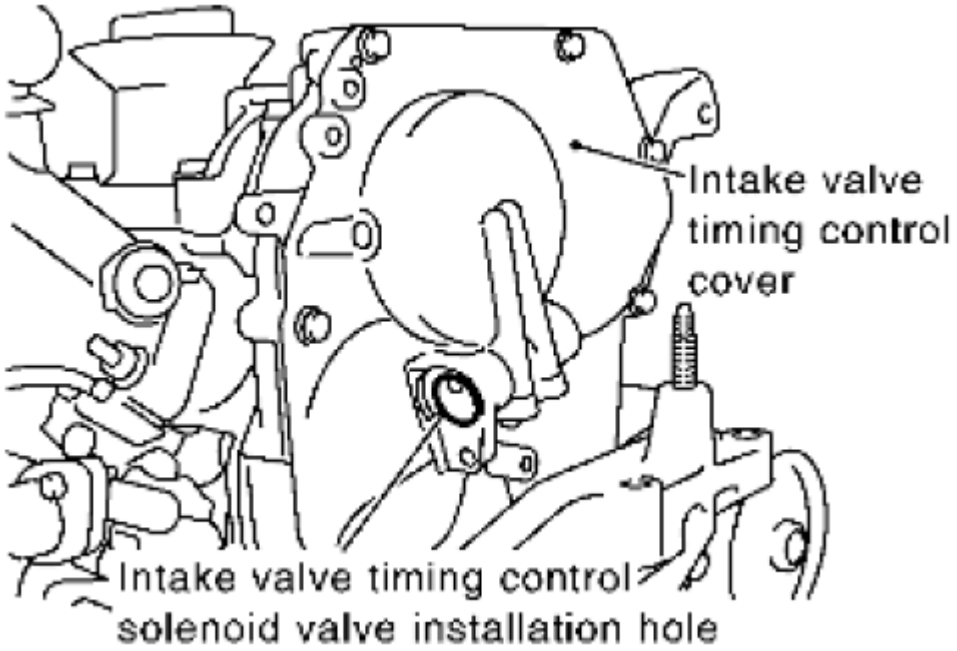


Fig. 81: Identifying Intake Valve Timing Control Cover Oil Hole
Courtesy of SUZUKI OF AMERICA CORP.

WARNING: Be careful not to touch rotating parts (drive belt, 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 protect the engine 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 intake valve timing control cover oil hole. Refer to [**LUBRICATION CIRCUIT**]

5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
   - Clean oil groove if necessary. Refer to [**LUBRICATION CIRCUIT**]
6. Installation is in the reverse order of removal.

VALVE OIL SEAL: REMOVAL AND INSTALLATION

REMOVAL

1. Remove fan shroud (lower). Refer to [**RADIATOR: EXPLODED VIEW**]
2. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.

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

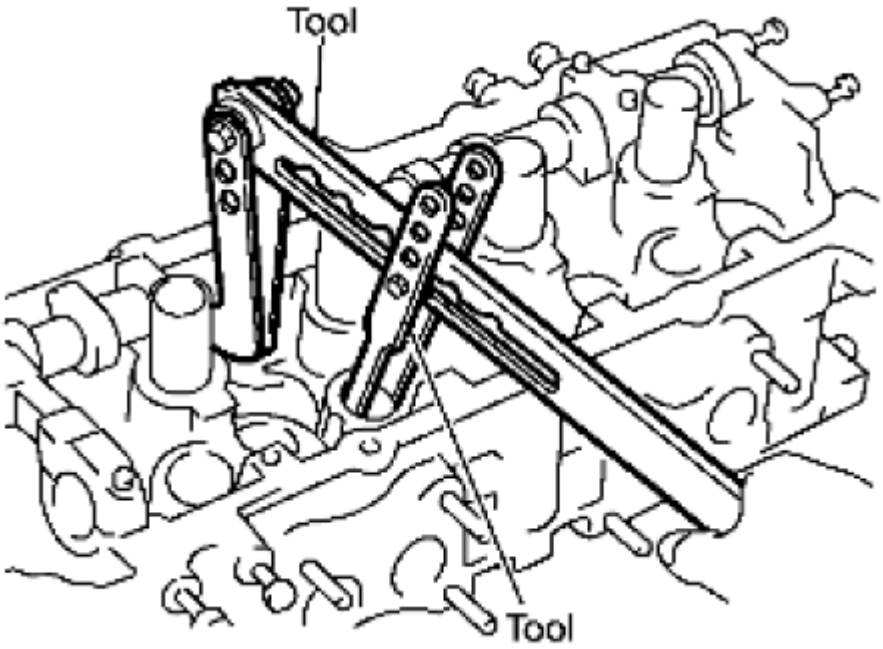


Fig. 82: Removing Valve Collet, Valve Spring Retainer And Valve Spring Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **When working, be careful not to damage valve lifter holes.**
- **Do not remove valve spring seat from valve spring.**

Tool numbers: KV10116200 (J-26336-B)

: KV10115900 (J-26336-20)

- Compress valve spring using Tool. Remove valve collet with magnetic hand.

6. Remove valve oil seal using Tool.

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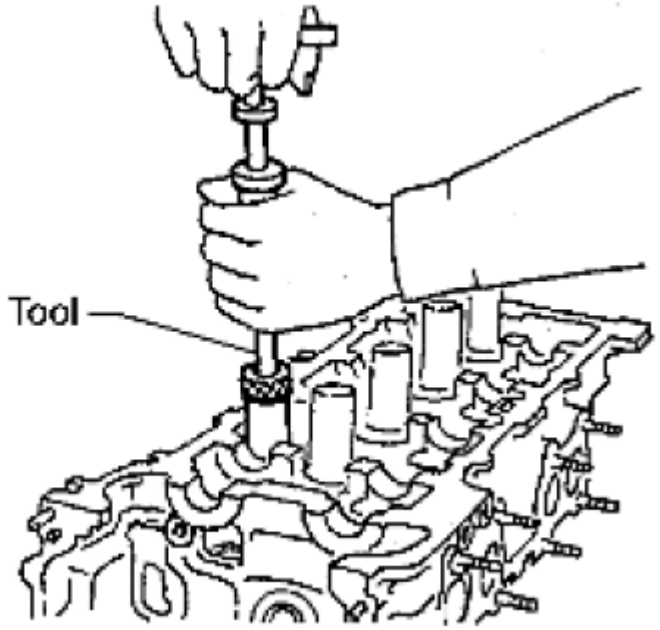
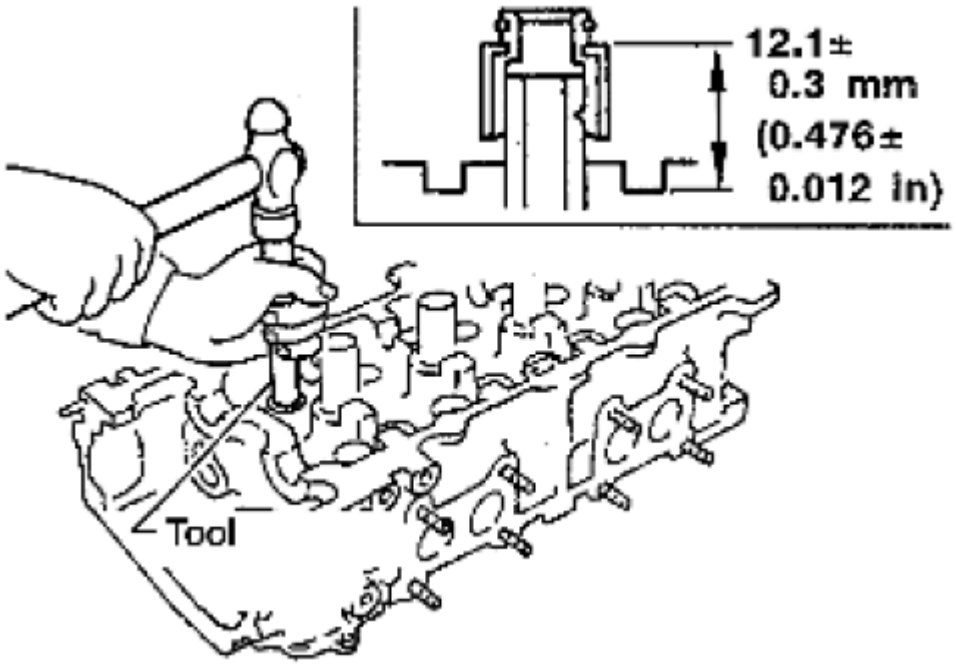


Fig. 83: Removing Valve Oil Seal Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool numbers: KV10107902 (J-38959)

INSTALLATION

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



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Fig. 84: Pressing In Valve Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

Tool numbers: KV10115600 (J-38958)

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 tool.
2. Remove fan shroud (lower). Refer to [**RADIATOR: EXPLODED VIEW**]
3. Remove cooing fan. Refer to [**COOLING FAN: REMOVAL AND INSTALLATION (CRANKSHAFT DRIVEN TYPE)**]
4. Remove drive belt. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
5. Remove crankshaft pulley. Refer to **Timing Chain: Removal and Installation** .
6. Remove front oil seal using a suitable tool.

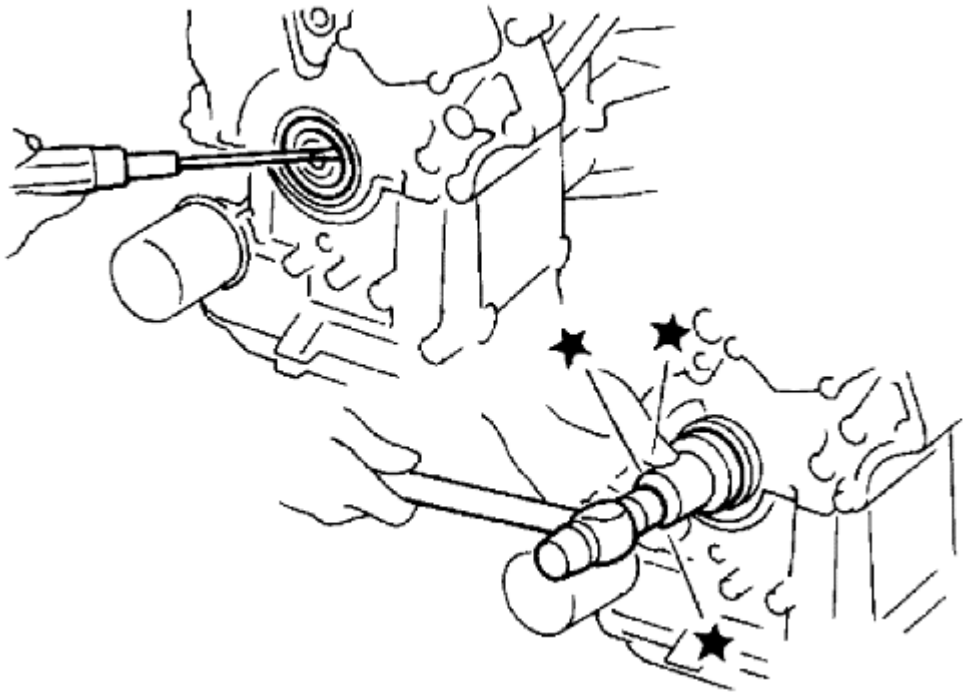


Fig. 85: Removing Front Oil Seal Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Be careful not to damage front cover and crankshaft.

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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.

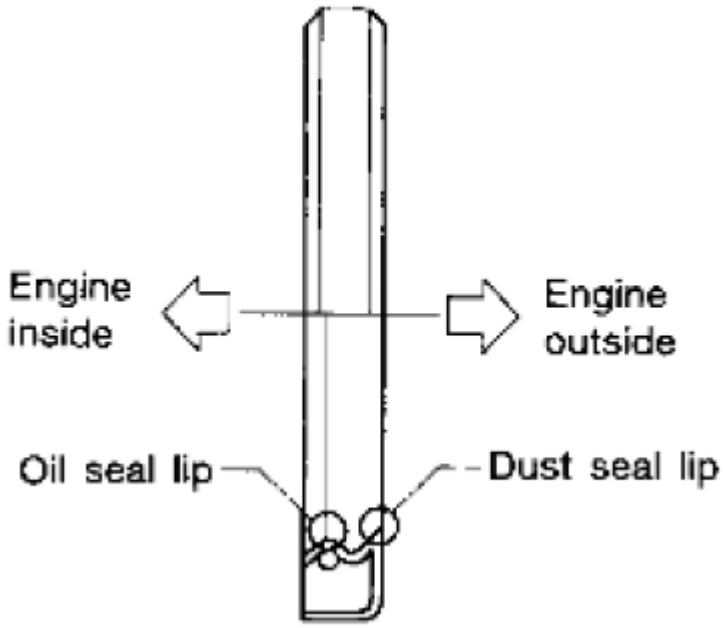


Fig. 86: Identifying Seal Lip Oriention For Installing Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

   - Press-fit front oil seal until it is flush with front end surface of front cover using suitable tool.

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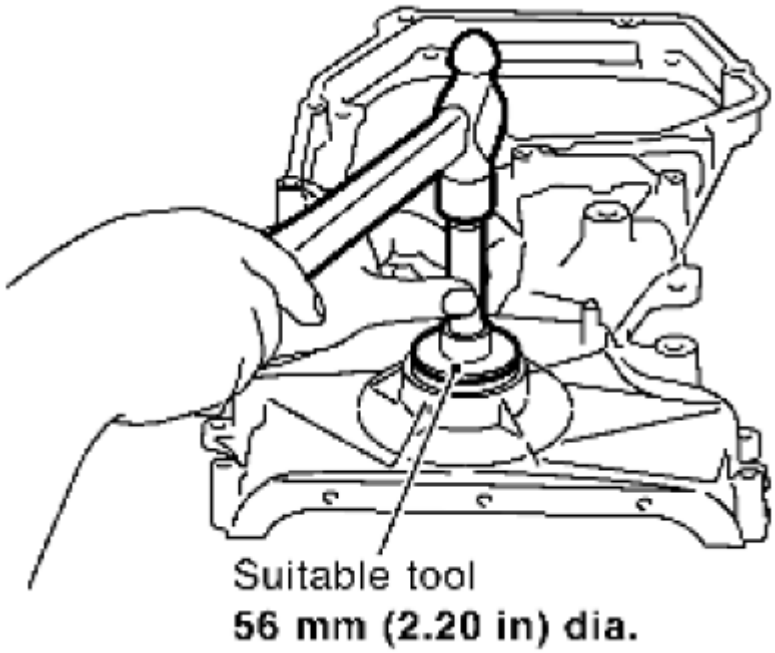


Fig. 87: Installing Front Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Be careful not to damage front cover 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 FS5R30A M/T or **TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE (FOR 4WD MODELS)** for FS5R30A M/T, or [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FOR QR25DE**] (A/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to [**CLUTCH DISC, CLUTCH COVER: REMOVAL AND INSTALLATION [5M/T]**]
3. Remove drive plate (A/T models) or flywheel (M/T models) with power tool. Refer to [**ENGINE UNIT: EXPLODED VIEW**].
4. Remove rear oil seal with a suitable tool.

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

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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.

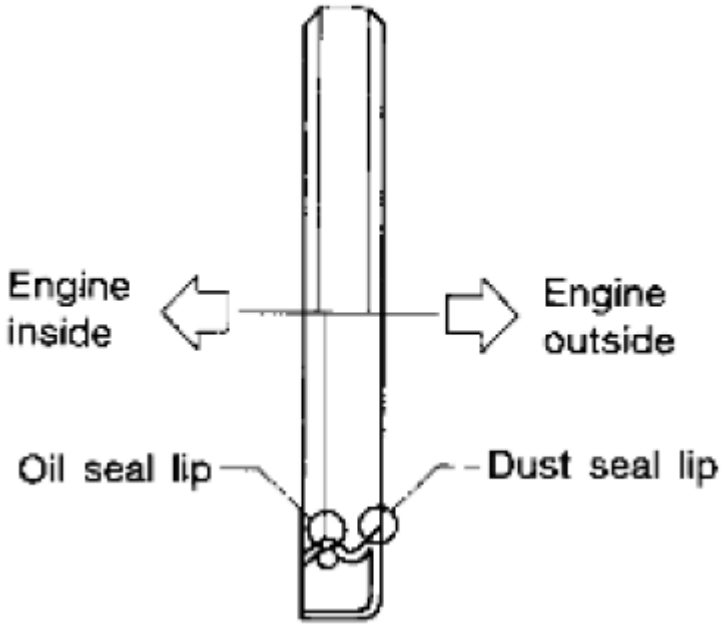


Fig. 88: Identifying Seal Lip Orientation For Installing Rear Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

- Install new rear oil seal using suitable tool. [outside diameter 102 mm (4.02 in), inside diameter 86 mm (3.39 in)].

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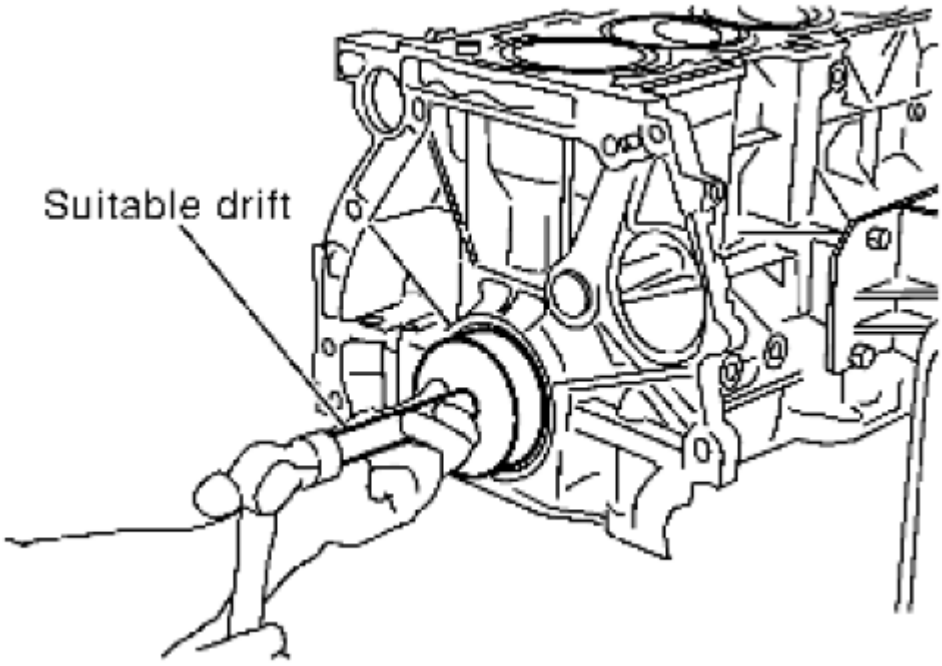


Fig. 89: Installing Rear Oil Seal Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

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.

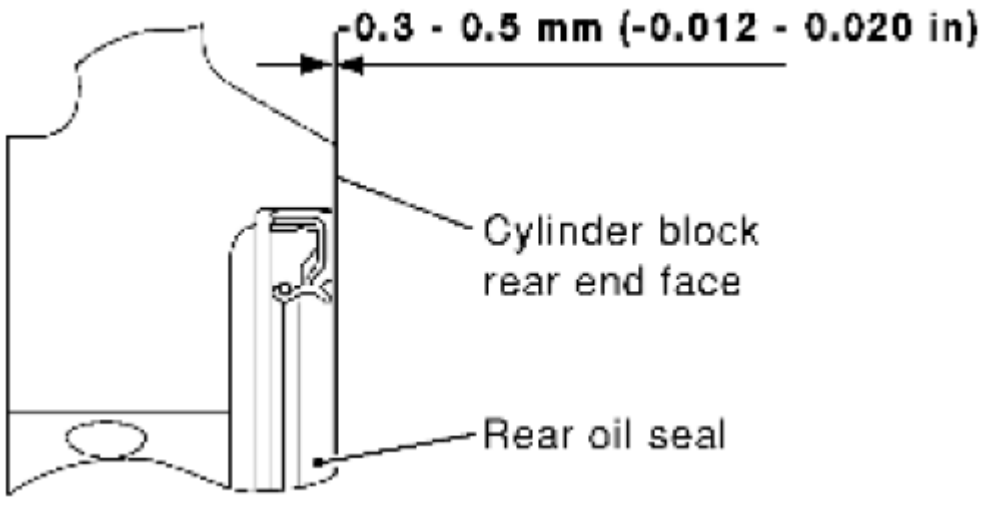


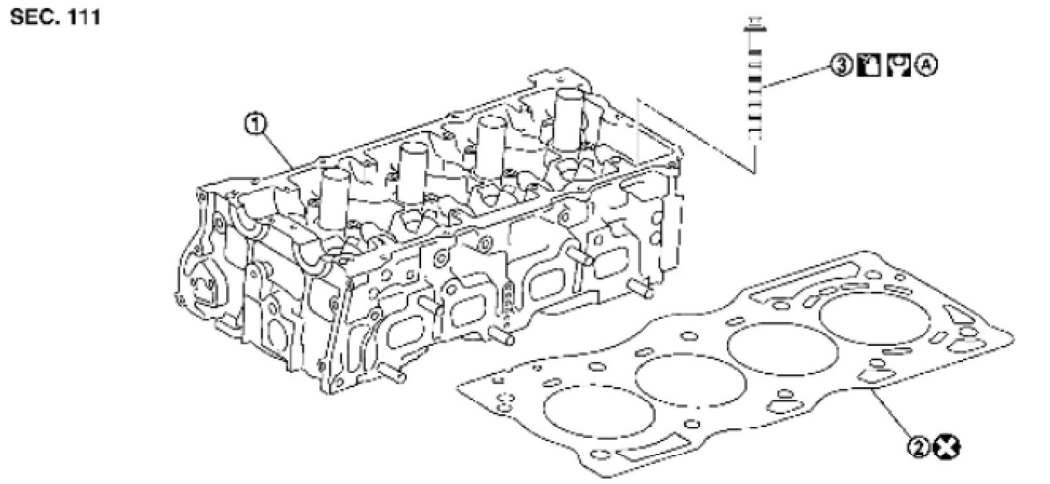
Fig. 90: Position Of Pressing Rear Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

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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)



Expand image

1. Cylinder head assembly	2. Cylinder head gasket	3. Cylinder head bolt

Fig. 91: Exploded View Of Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER HEAD: REMOVAL AND INSTALLATION

REMOVAL

1. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: QR25DE**]
2. Drain engine coolant. Refer to [**CHANGING ENGINE COOLANT**]

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

3. Drain engine oil. Refer to [**CHANGING ENGINE OIL**]

CAUTION:
- **Perform this step when the engine is cold.**

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- **Do not spill engine oil on drive belt.**

4. Remove intake manifold. Refer to **INTAKE MANIFOLD: REMOVAL AND INSTALLATION** .
5. Remove fuel injector and fuel tube assembly. Refer to **FUEL INJECTOR AND FUEL TUBE: EXPLODED VIEW [QR25DE]** .
6. Remove exhaust manifold and three way catalyst assembly. Refer to **EXHAUST MANIFOLD AND THREE WAY CATALYST: REMOVAL AND INSTALLATION [QR25DE]** .
7. Remove water outlet. Refer to [**WATER OUTLET AND WATER PIPING: REMOVAL AND INSTALLATION**]
8. Remove heater outlet. Refer to [**WATER OUTLET AND WATER PIPING: EXPLODED VIEW**]

NOTE: Can be removed and installed even when assembled with cylinder head.

9. Remove front cover and timing chain. Refer to **Timing Chain: Removal and Installation** .
10. Remove camshafts. Refer to **CAMSHAFT: REMOVAL AND INSTALLATION** .
11. Loosen cylinder head bolts in reverse order as shown using power tool.

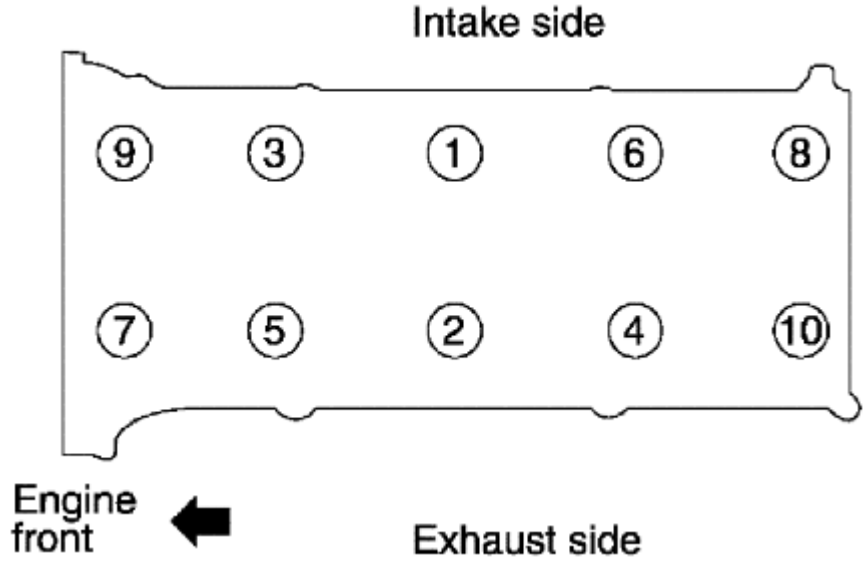


Fig. 92: Tightening Order Of Cylinder Head Bolts
Courtesy of SUZUKI OF AMERICA CORP.

12. Remove cylinder head.
13. Remove cylinder head gasket.

INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference

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between (d1) and (d2) exceeds the limit, replace them with a new one.

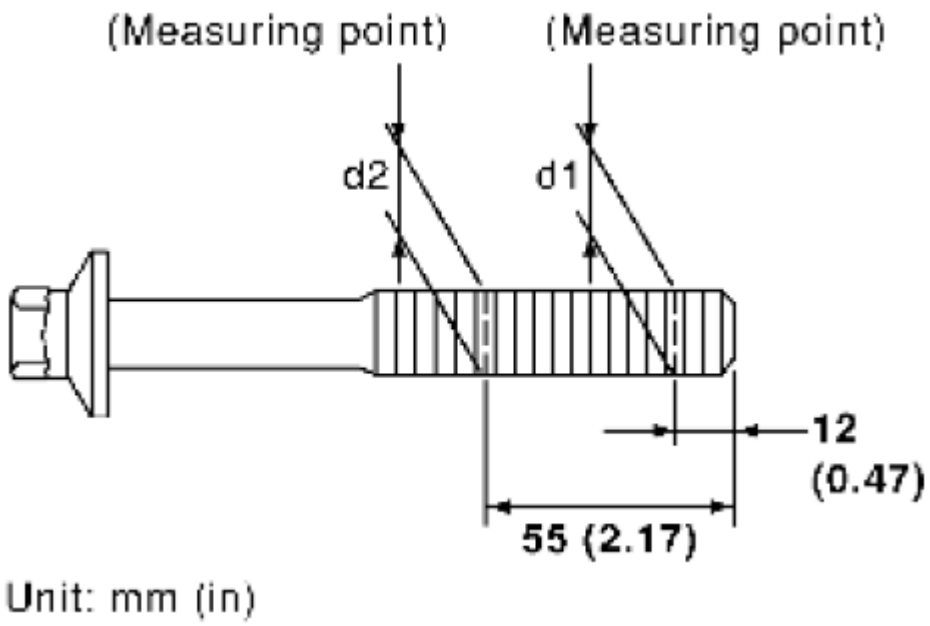


Fig. 93: Identifying Cylinder Head Bolts Measuring Point
Courtesy of SUZUKI OF AMERICA CORP.

Limit [(d1) (d2)]: 0.23 mm (0.0091 in)

- If reduction of outer diameter appears in a position other than (d2), use it as (d2) point.

Cylinder Head Distortion

NOTE: When performing this inspection, cylinder block distortion should also be 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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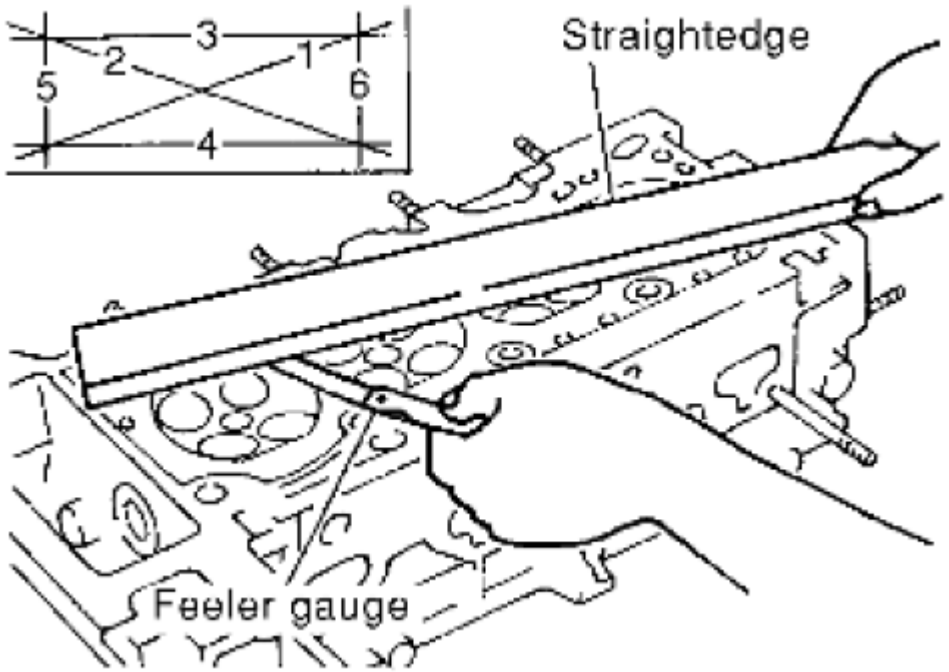


Fig. 94: Measuring Cylinder Head Distortion
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.

INSTALLATION

1. Install new cylinder head gasket.
2. Install cylinder head following the steps below to tighten cylinder head bolts in numerical order as shown.

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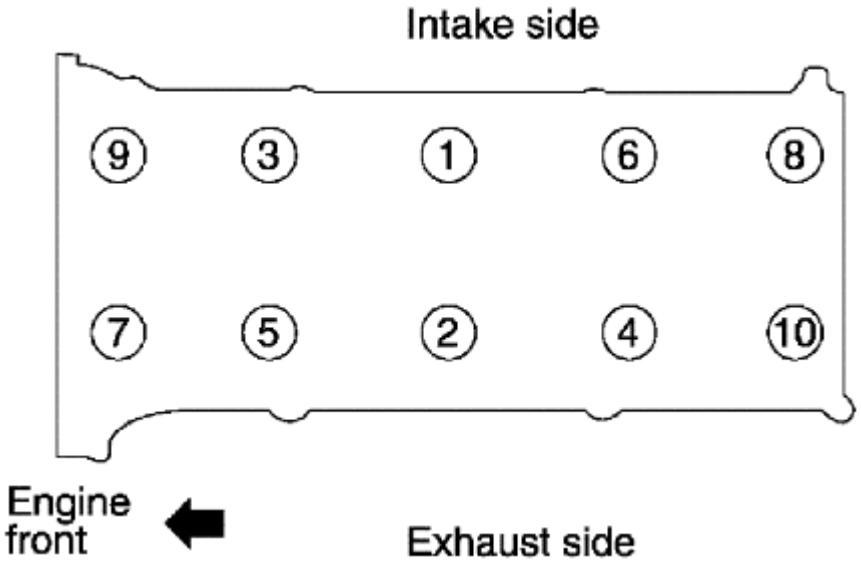


Fig. 95: Tightening Order Of Cylinder Head Bolts
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: If cylinder head bolts re-used, check their outer diameters before installation. Follow the "Cylinder Head Bolts Outer Diameter" procedure.

NOTE: Apply new engine oil to threads and seating surfaces of mounting bolts.

Step a: 50 N.m (5.1 kg-m, 37 ft-lb)

- Measure the tightening angle using Tool.

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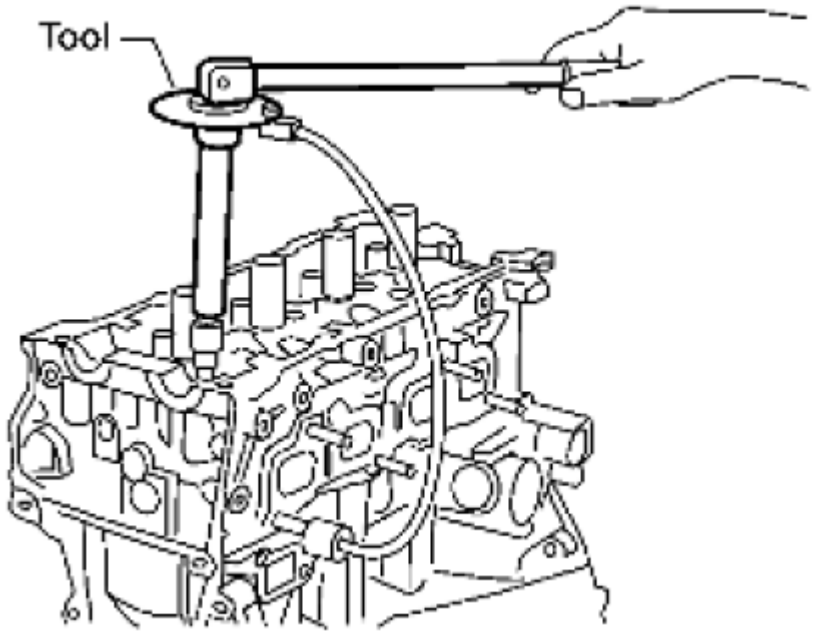


Fig. 96: Measuring Tightening Angle Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10112100 (BT-8653-A)

Step b: 60° clockwise

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

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

Step e: 75° clockwise

Step f: 75° clockwise

3. Installation of the remaining parts is in 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.

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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.

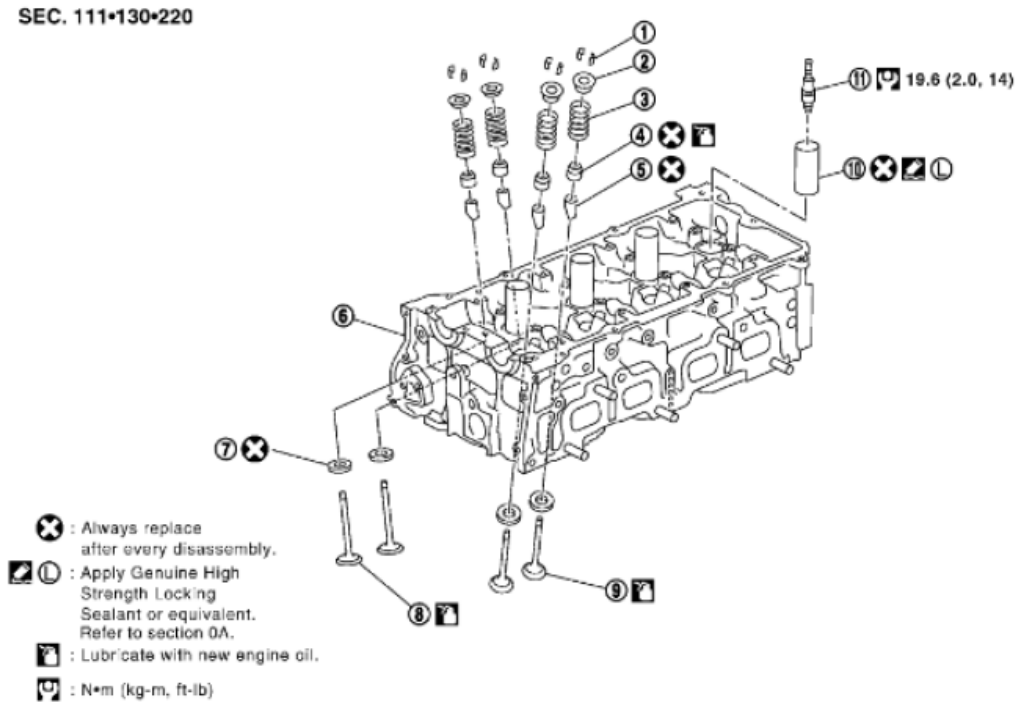
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and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

SUMMARY OF INSPECTION ITEMS

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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Expand image

1. Valve collet	2. Valve spring retainer	3. Valve spring (with valve spring seat)
4. Valve oil seal	5. Valve guide	6. Cylinder head
7. Valve seat	8. Valve (INT)	9. Valve (EXH)
10. Spark plug tube	11. Spark plug	

Fig. 97: Exploded View Of Cylinder Head
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, valve spring retainer and valve spring using Tool.

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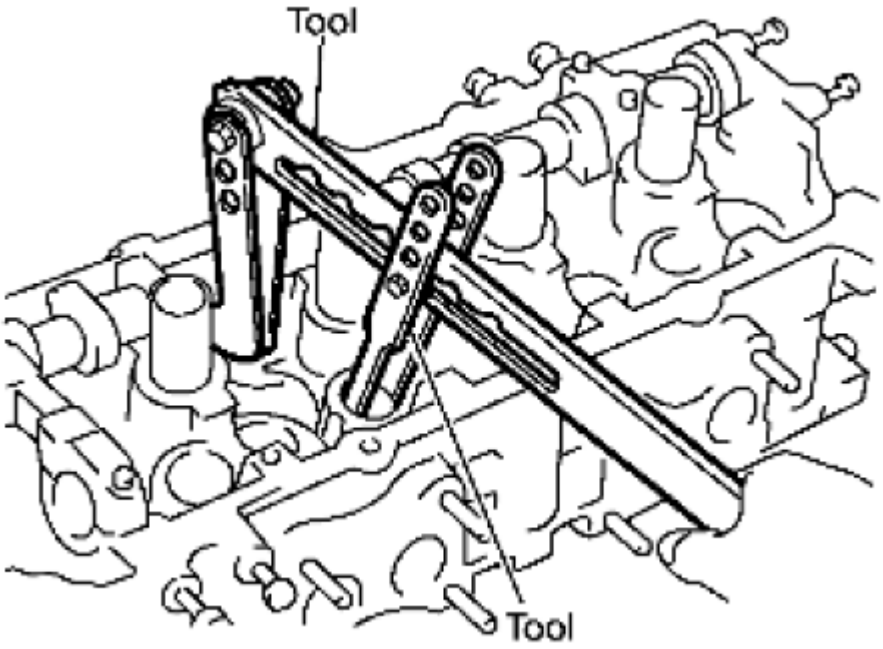


Fig. 98: Removing Valve Collet, Valve Spring Retainer And Valve Spring Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool numbers: KV10116200 (J-26336 -B)

: KV10115900 (J-26336 -20)

CAUTION:
- **When working, be careful not to damage valve lifter holes.**
- **Do not remove valve spring seat from valve spring.**

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

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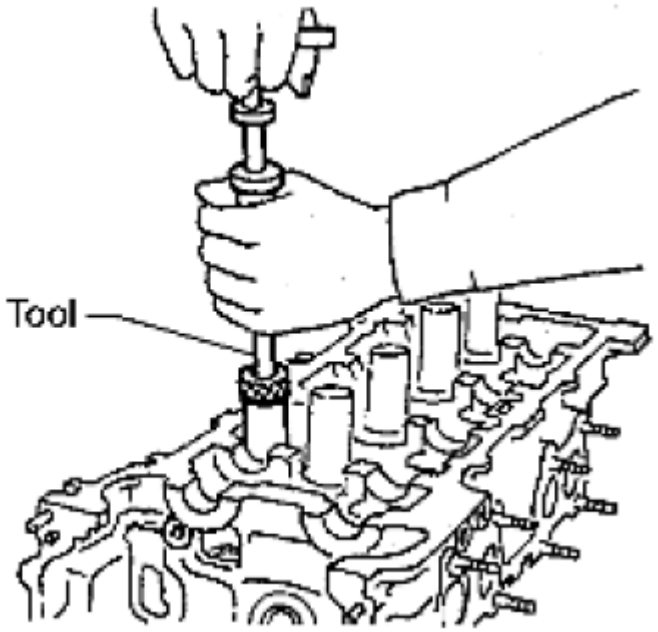


Fig. 99: Removing Valve Oil Seal Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool numbers: KV10115600 (J-38958)

6. When valve seat must be replaced, refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
7. When valve guide must be replaced, refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
8. Remove spark plug tube, if necessary.
   - Remove it from cylinder head using suitable tool.

CAUTION:
- **Be careful 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. Install valve guide if removed. Refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
2. Install valve seat if removed. Refer to [**CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY**].
3. Install valve oil seal using Tool.

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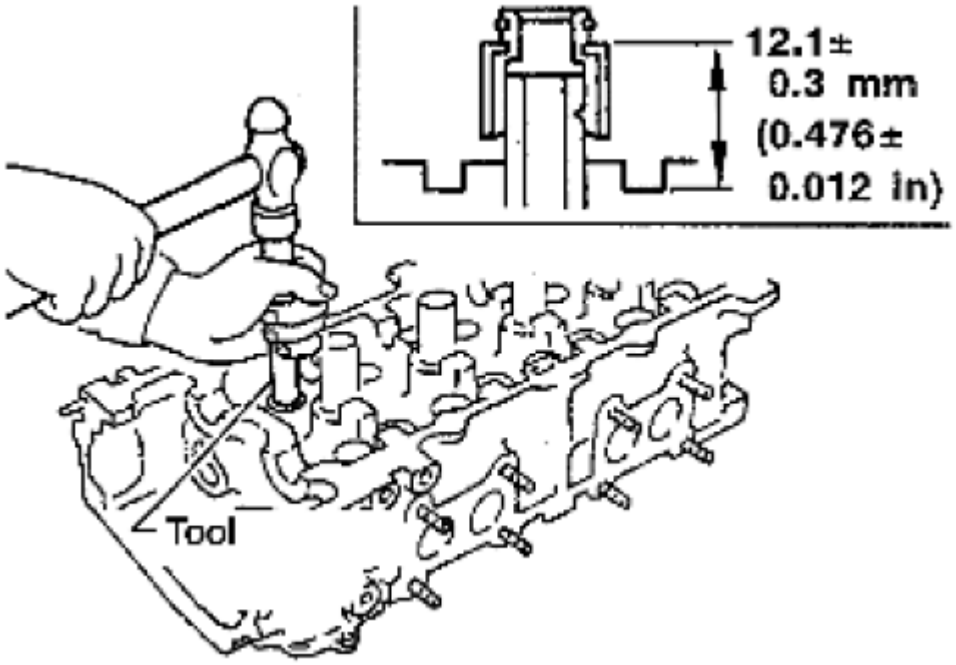


Fig. 100: Installing Valve Oil Seal Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool numbers: KV10115600 (J-38958)

NOTE: Install with the valve oil seal to match dimension as shown.

Height (H): 11.8 - 12.4 mm (0.465 - 0.488 in)

4. Install valve.

NOTE: Install larger diameter to intake side.

5. Install valve spring (with valve spring seat).

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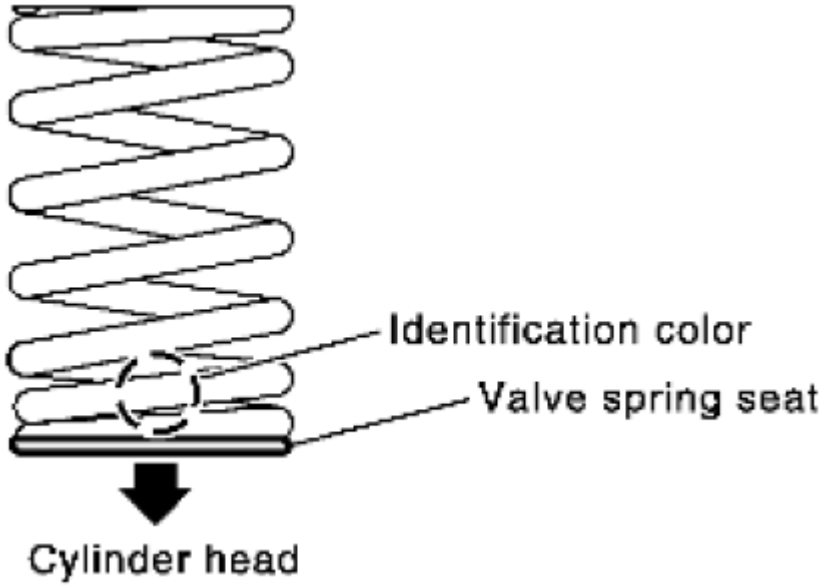


Fig. 101: Identifying Identification Color On Valve Spring Seat
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Install smaller pitch (valve spring seat side) to cylinder head side.**
- **Confirm identification color of valve spring.**

  Intake: Pink

  Exhaust: Green

6. Install valve spring retainer.
7. Install valve collet using Tool.

Tool numbers: KV10116200 (J-26336 -B)

: KV10115900 (J-26336 -20)

- Install valve collet with a magnet hand.

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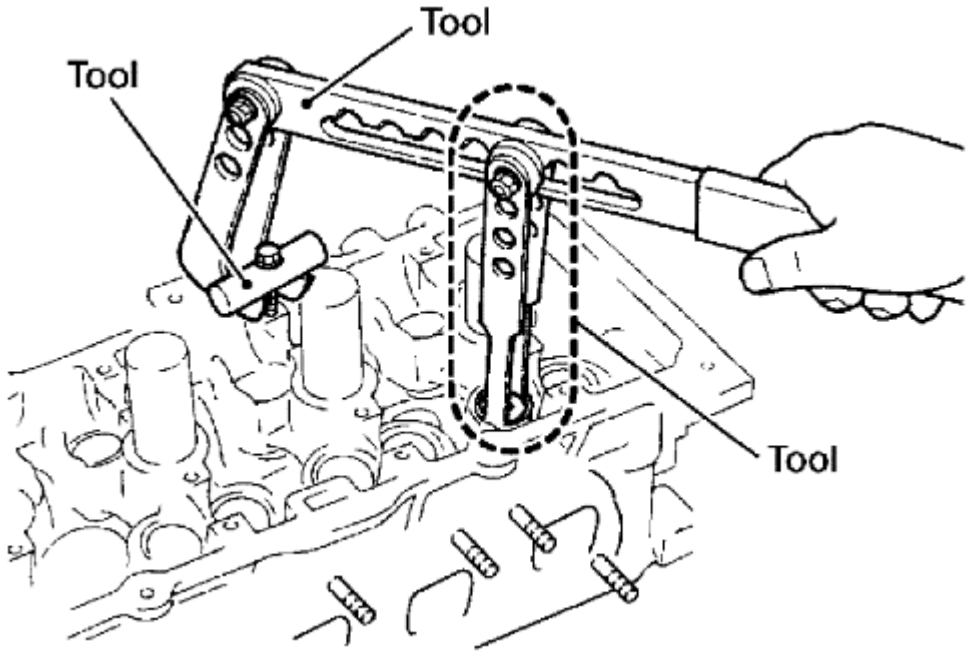


Fig. 102: Installing Valve Collet Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: When working, be careful not to damage valve lifter holes.

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

8. Install valve lifter.
    - Install it in the original position.
9. Install spark plug tube if removed.

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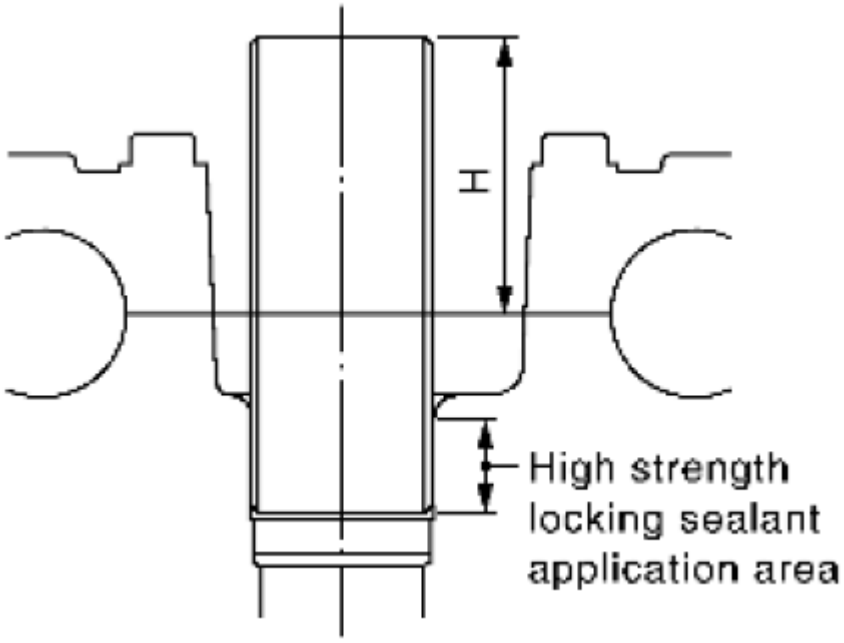


Fig. 103: Identifying Height For Press-Fit Spark Plug Tube
Courtesy of SUZUKI OF AMERICA CORP.

- Press-fit it into cylinder head as follows:

a. Remove old sealant from cylinder head side installation hole.
b. Apply sealant 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 tool.

   Standard press-fit height (H): 41.2 - 42.2 mm (1.622 - 1.661 in)

CAUTION:
- **When press-fitting, be careful not to deform spark plug tube.**
- **After press-fitting, wipe off any protruding sealant on top surface of cylinder head.**

10. Install spark plug.

CYLINDER HEAD: INSPECTION AFTER DISASSEMBLY

VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [**SERVICE DATA AND SPECIFICATIONS**].

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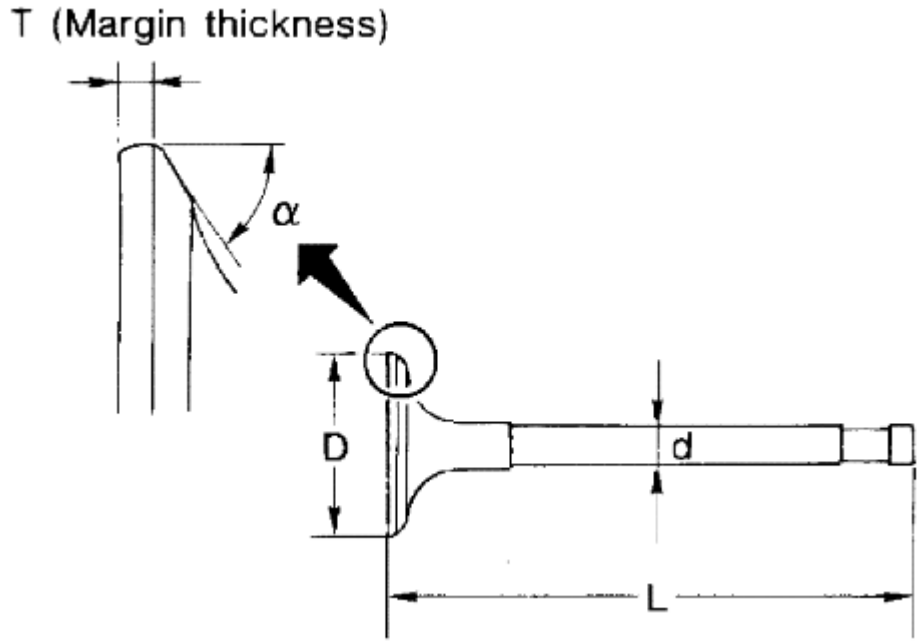


Fig. 104: Identifying Valve Dimensions
Courtesy of SUZUKI OF AMERICA CORP.

- 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.

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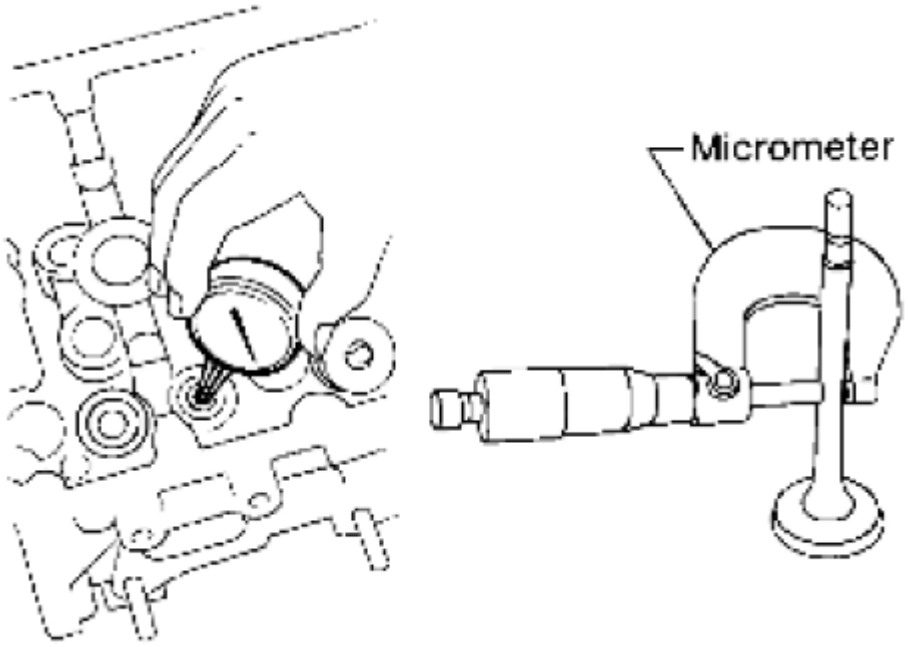


Fig. 105: Measuring Valve Stem Diameter Using Micrometer
Courtesy of SUZUKI OF AMERICA CORP.

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

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Intake: 0.08 mm (0.003 in)

Exhaust: 0.09 mm (0.004 in)

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

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.

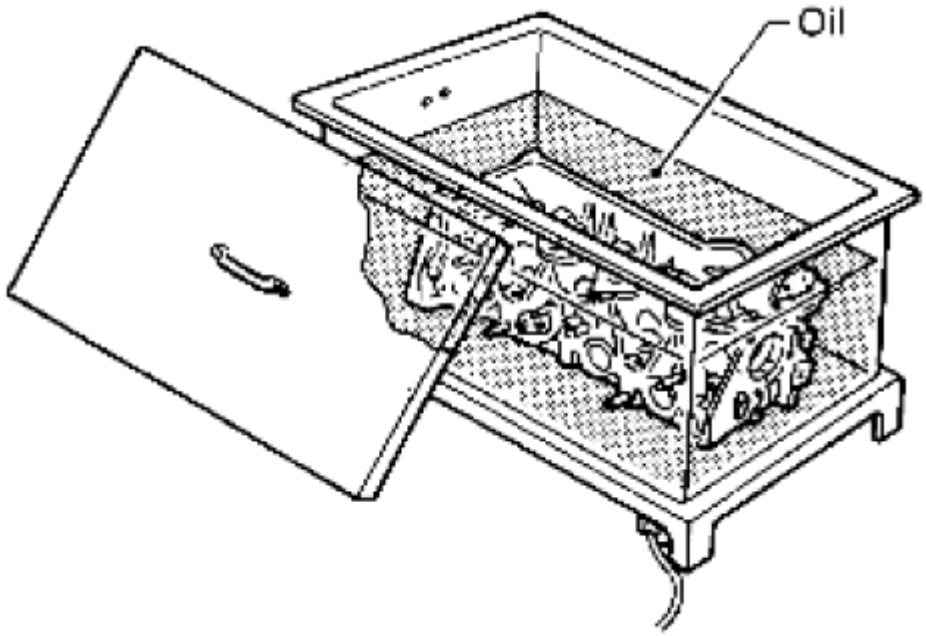


Fig. 106: Heating Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

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

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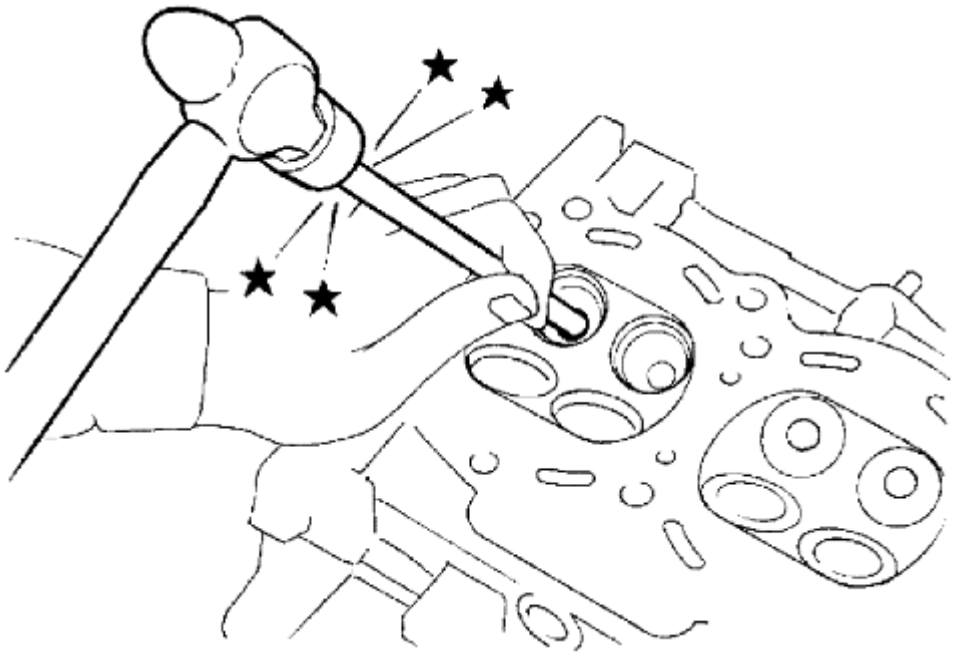
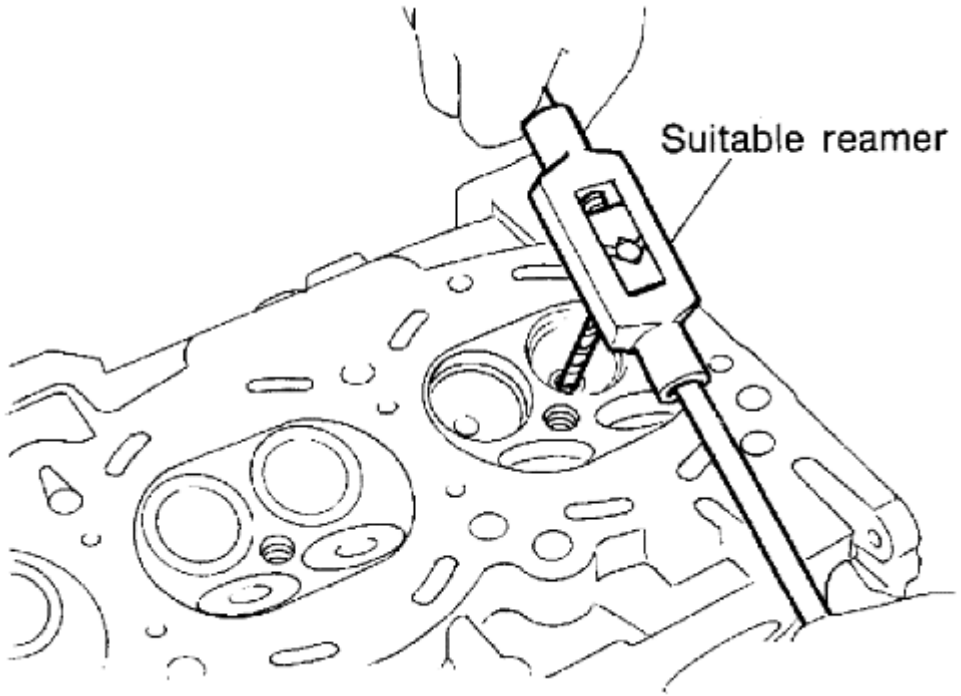


Fig. 107: Driving Out Valve Guide Using Press And Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

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

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



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Fig. 108: Reaming Cylinder Head Valve Guide Hole
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.

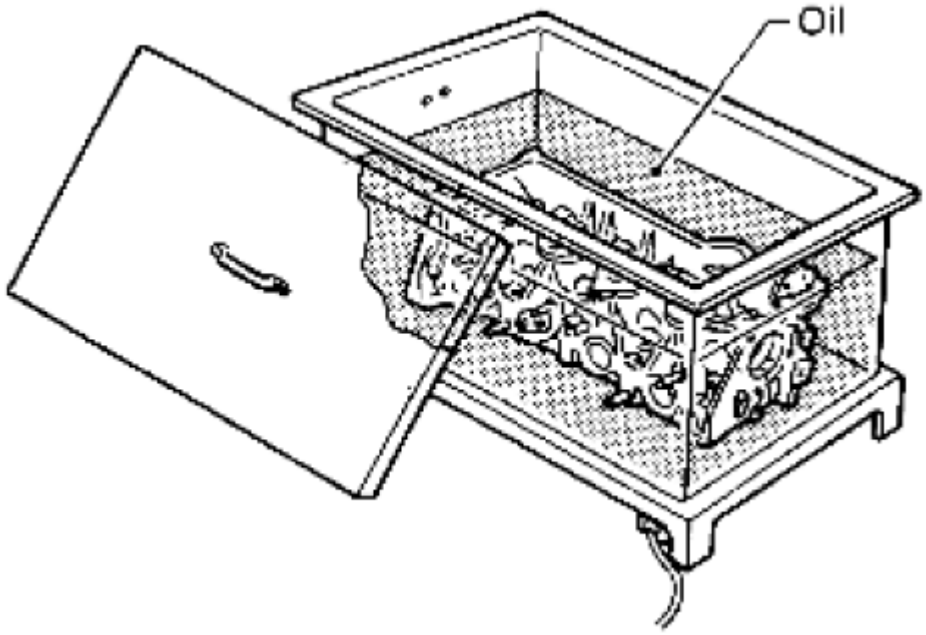


Fig. 109: Heating Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

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

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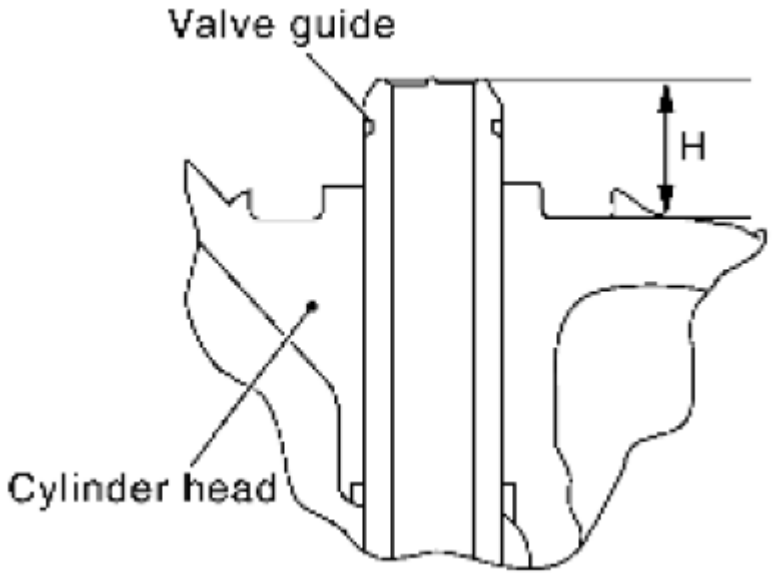


Fig. 110: Identifying Projection For Pressing Valve Guide From Camshaft Side
Courtesy of SUZUKI OF AMERICA CORP.

Projection (H)

Intake: 10.1 - 10.3 mm (0.398 - 0.406 in)

Exhaust: 10.0 - 10.4 mm (0.394 - 0.409 in)

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

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

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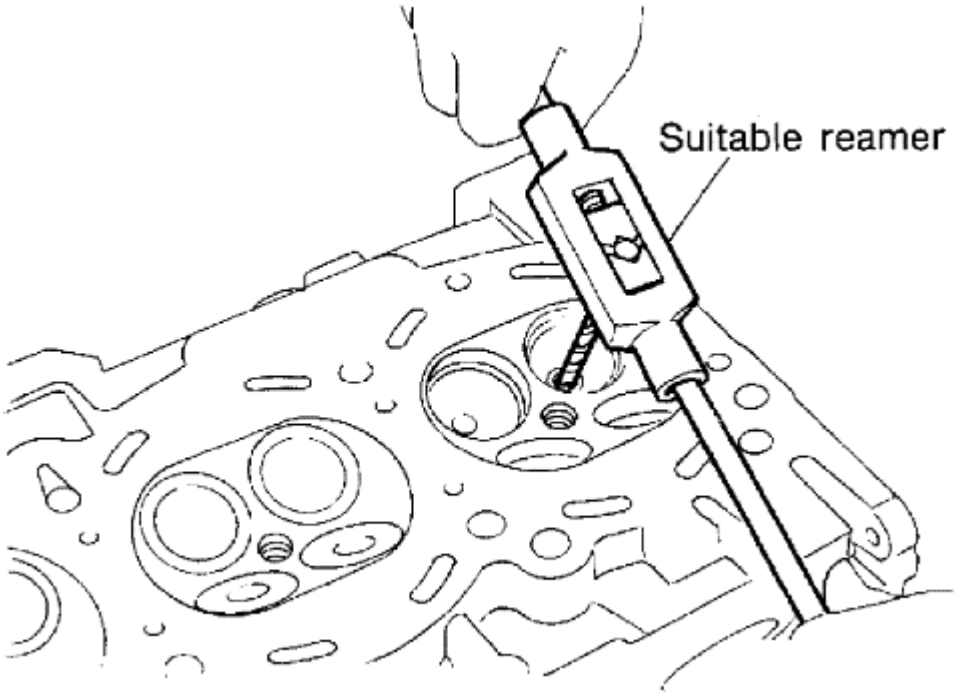


Fig. 111: Reaming Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

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 specifications, perform this procedure.

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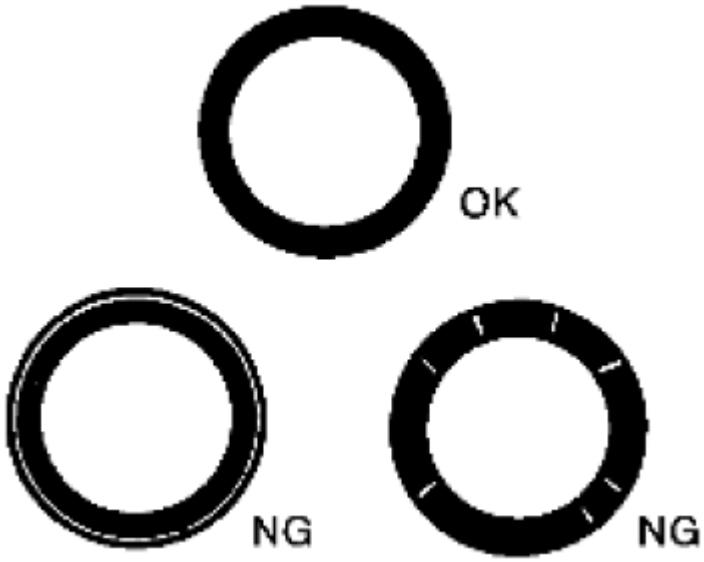


Fig. 112: Identifying Correct And Incorrect Valve Seat Contact
Courtesy of SUZUKI OF AMERICA CORP.

- 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 scratching cylinder head by excessive boring.

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

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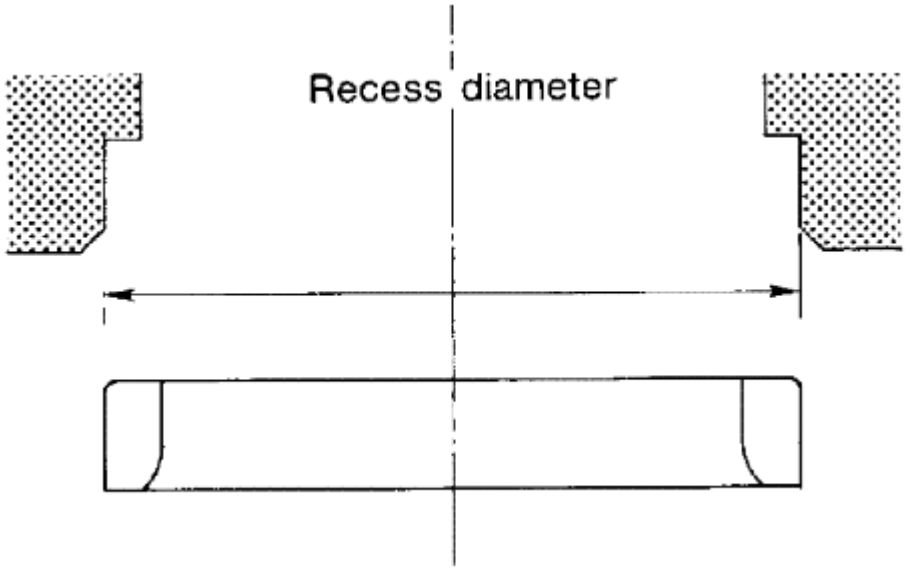


Fig. 113: Identifying Cylinder Head Recess Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Oversize [0.5 mm (0.020 in)]

Intake: 37.000 - 37.016 mm (1.4567 - 1.4573 in)

Exhaust: 32.000 - 32.016 mm (1.2598 - 1.2605 in)

- Be sure to ream in circles concentric to the valve guide center. This will enable valve seat 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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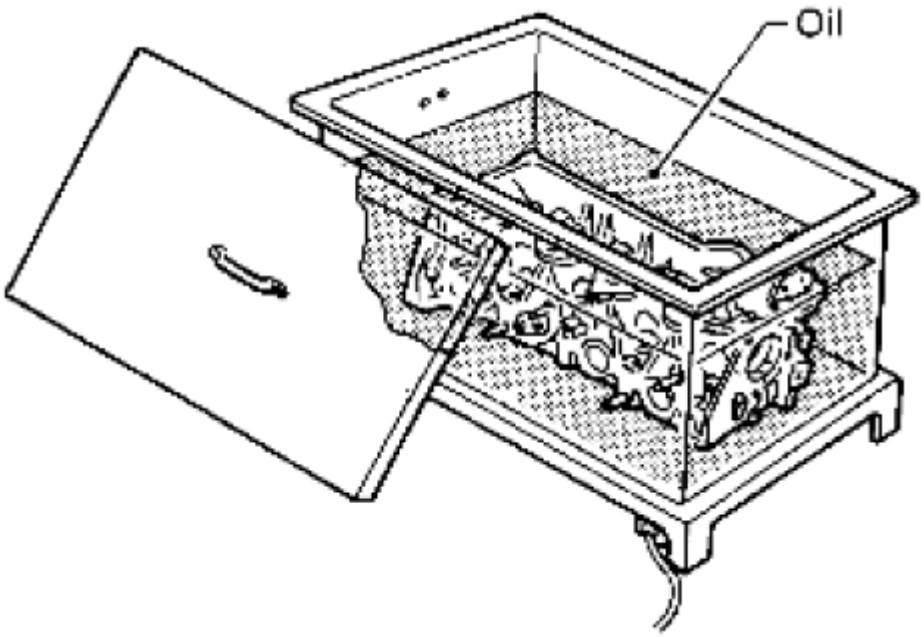


Fig. 114: Heating Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

4. Provide valve seats cooled well with dry ice. Force fit valve seats 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**].

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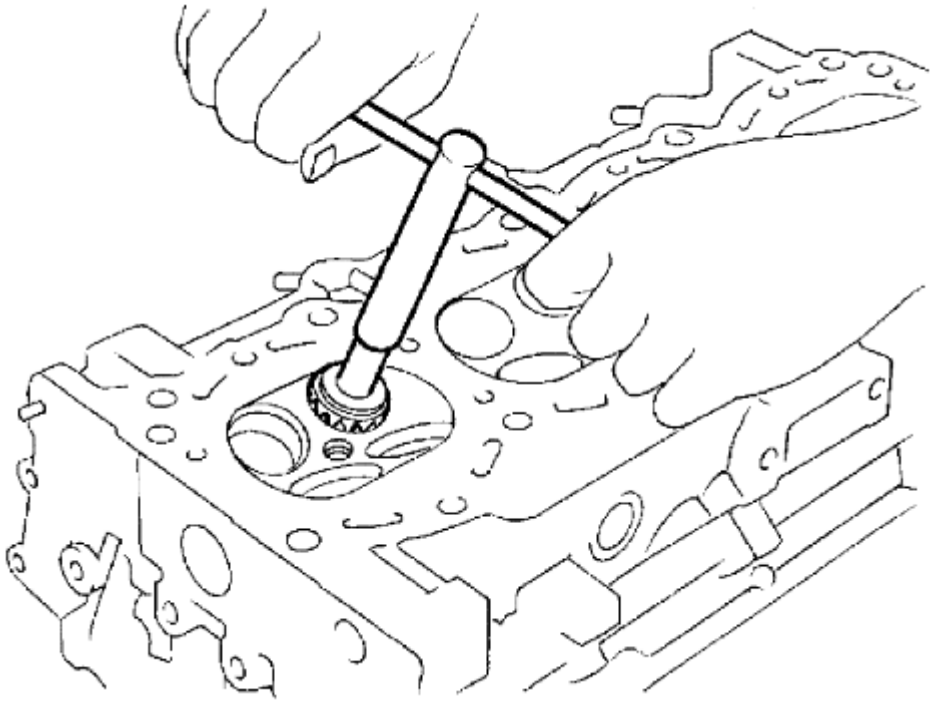


Fig. 115: Finishing Valve Seat Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

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 the 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.

VALVE SPRING SQUARENESS

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

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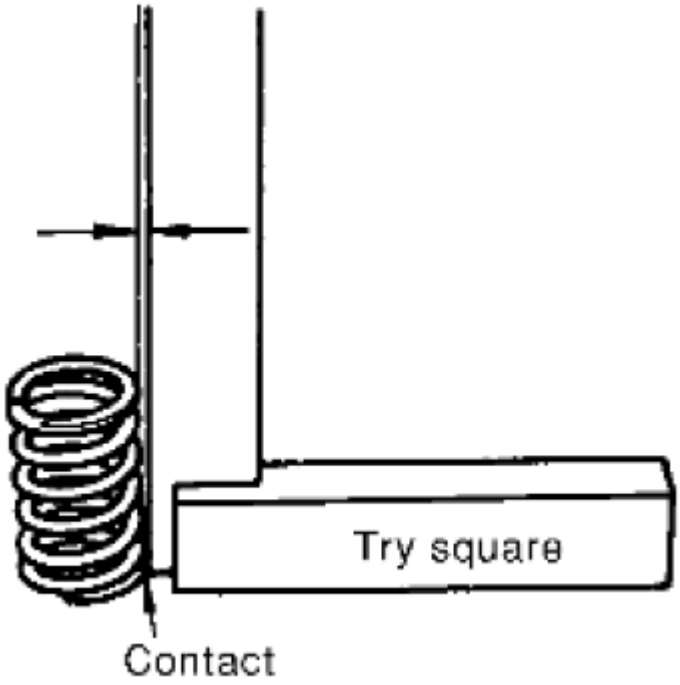


Fig. 116: Measuring Valve Spring Squareness
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not remove valve spring seat from valve spring.

Limit

Intake: 1.8 mm (0.071 in)

Exhaust: 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring.

VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure with valve spring seat installed at the specified spring height. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

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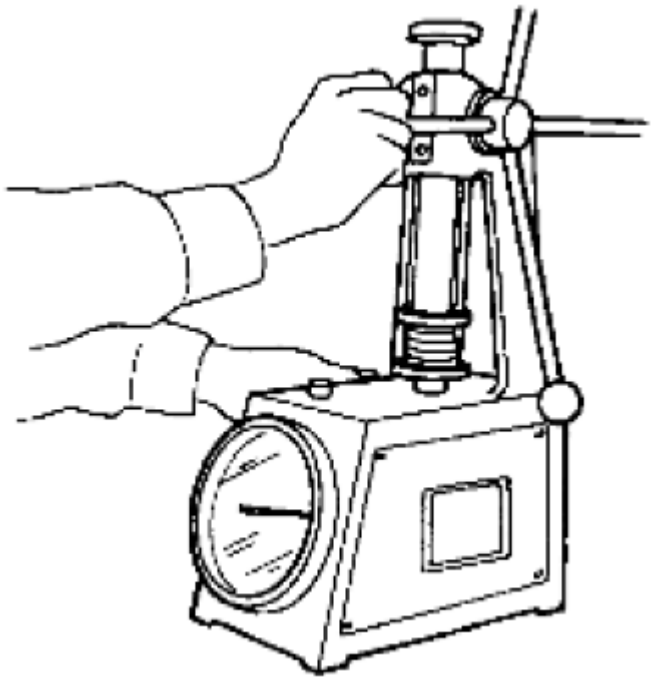


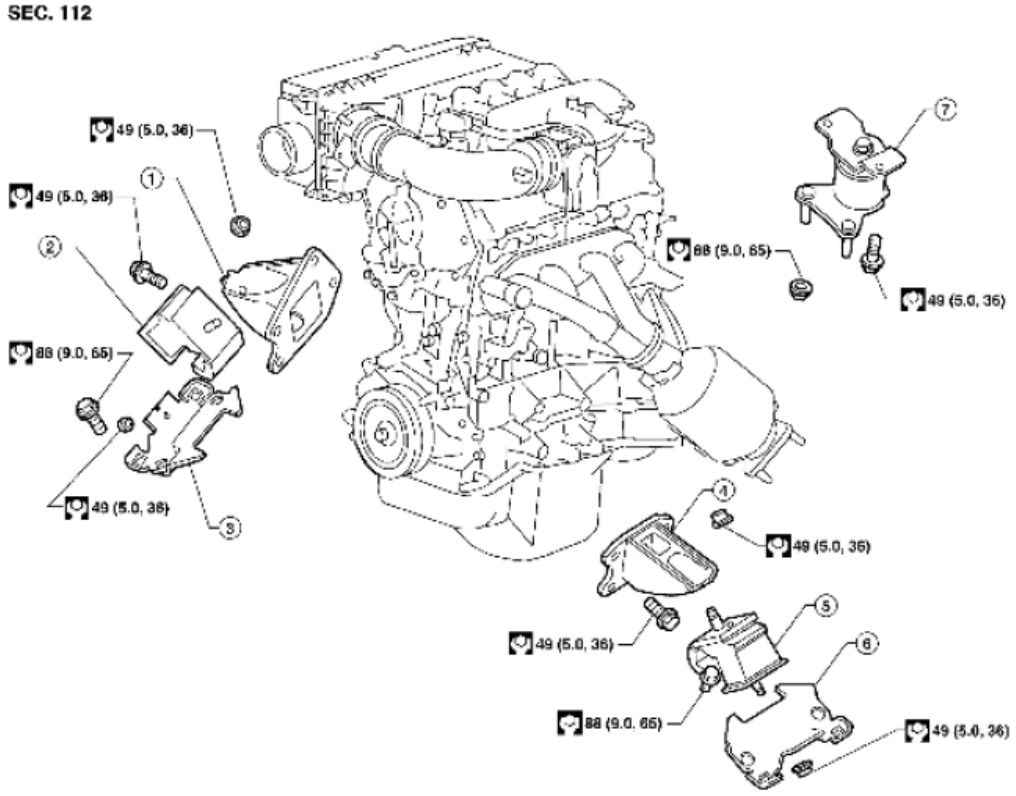
Fig. 117: Checking Valve Spring Pressure
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Do not remove valve spring seat from valve spring.

- 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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Expand image

1. RH engine mounting bracket (upper)	2. RH engine mounting insulator	3. RH engine mounting bracket (lower)
4. LH engine mounting bracket (upper)	5. LH engine mounting insulator	6. LH engine mounting bracket (lower)
7. Rear engine mounting insulator		

Fig. 118: Exploded View Of Engine Assembly
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.**
- **Do not start working until exhaust system and engine coolant are cooled sufficiently.**

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- **If items or work required are not covered by the engine section, follow the procedures in the applicable procedures.**
- **Always use the support point specified for lifting.**
- **Use either 2-pole 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

1. Drain engine coolant. Refer to [**CHANGING ENGINE COOLANT**]
2. Partially drain A/T fluid. Refer to [**CHANGING THE A/T FLUID (ATF)**]
3. Release fuel pressure. Refer to [**FUEL PRESSURE CHECK: QR25DE**]
4. Remove the engine hood. Refer to [**HOOD ASSEMBLY: REMOVAL AND INSTALLATION**]
5. Remove the air duct and air cleaner case assembly. Refer to [**AIR CLEANER AND AIR DUCT: REMOVAL AND INSTALLATION**].
6. Disconnect vacuum hose between vehicle and engine and set it aside.
7. Remove the radiator assembly and hoses. Refer to [**RADIATOR: REMOVAL AND INSTALLATION**]
8. Remove the drive belts. Refer to [**DRIVE BELTS: REMOVAL AND INSTALLATION**].
9. Remove the engine cooling fan. Refer to [**COOLING FAN: REMOVAL AND INSTALLATION (CRANKSHAFT DRIVEN TYPE)**]
10. Disconnect the engine room harness from the engine side and set it aside for easier work.
11. Disconnect the engine harness grounds.
12. Disconnect the reservoir tank for power steering from engine and move it aside for easier work.
13. Disconnect power steering oil pump from engine and position out of the way for easier work. Refer to [**POWER STEERING OIL PUMP: REMOVAL AND INSTALLATION**]
14. Remove the A/C compressor bolts and set aside. Refer to [**COMPRESSOR: REMOVAL AND INSTALLATION**]
15. Disconnect brake booster vacuum line.
16. Disconnect EVAP line.
17. Disconnect the fuel hose at the engine side connection. Refer to [**FUEL INJECTOR AND FUEL TUBE: REMOVAL AND INSTALLATION [QR25DE]**]
18. Disconnect the heater hoses at cowl, and install plugs to avoid leakage of engine coolant.
19. Remove the A/T oil level indicator and indicator tube.
20. Remove three way catalyst. Refer to [**EXHAUST MANIFOLD AND THREE WAY CATALYST: REMOVAL AND INSTALLATION [QR25DE]**]
21. Install front and rear engine slingers.

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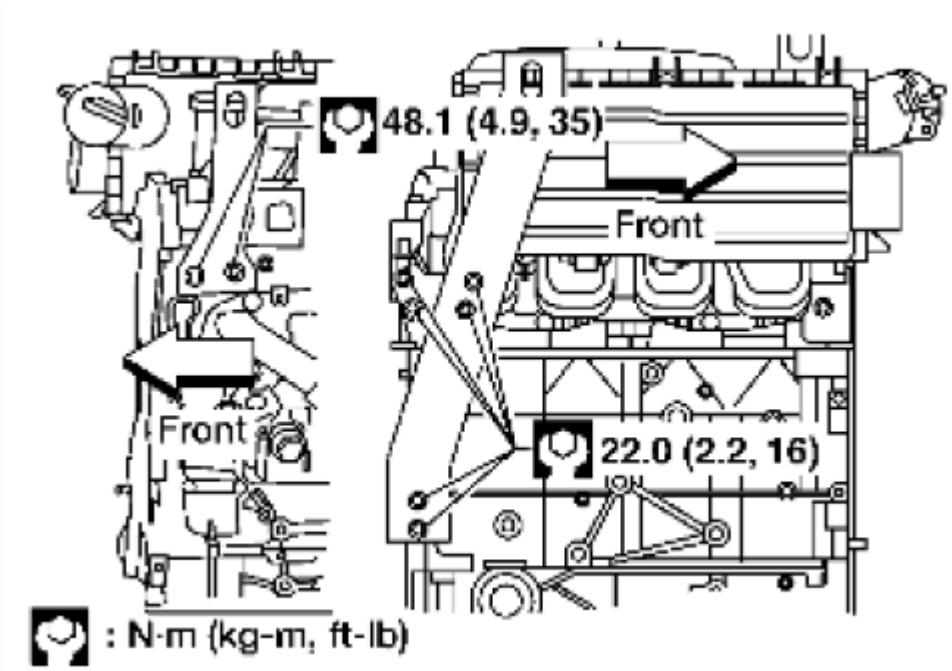


Fig. 119: Identifying Front And Rear Engine Slingers Torques
Courtesy of SUZUKI OF AMERICA CORP.

Engine slinger torque

Front engine slinger: 48.1 N.m (4.9 kg-m, 35 ft-lb)

Rear engine slinger: 22.0 N.m (2.2 kg-m, 16 ft-lb)

22. Remove transmission. Refer to [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE** for FS5R30A M/T or **TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FROM VEHICLE (FOR 4WD MODELS)** for FS5R30A M/T, or [**TRANSMISSION ASSEMBLY: REMOVAL AND INSTALLATION FOR QR25DE**] (A/T models).
23. Lift with hoist and secure the engine in position.
24. Remove engine assembly from vehicle, avoiding interference with vehicle body.

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

25. 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.**

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a. Remove drive plate.
   - 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).**

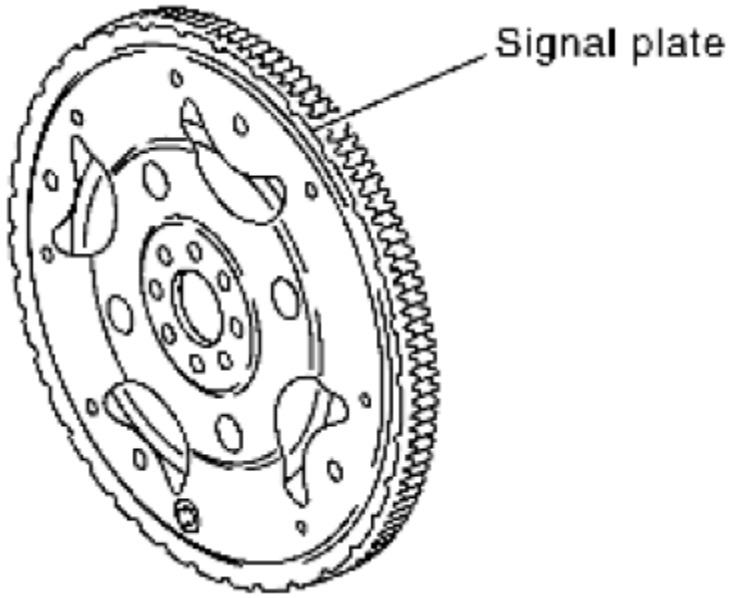


Fig. 120: Identifying Signal Plate
Courtesy of SUZUKI OF AMERICA CORP.

- **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 [QR25DE]]**
  - **Remove intake manifold. Refer to [INTAKE MANIFOLD: REMOVAL AND INSTALLATION].**

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- **Remove rocker cover. Refer to [ROCKER COVER: REMOVAL AND INSTALLATION [QR25DE]].**
- **Other removable brackets.**

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

26. Remove generator. Refer to [**GENERATOR: REMOVAL AND INSTALLATION - QR25DE MODELS**]
27. 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.**

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to the figure of components.
- Make sure that each mounting insulator is seated properly, and tighten nuts and bolts.

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.

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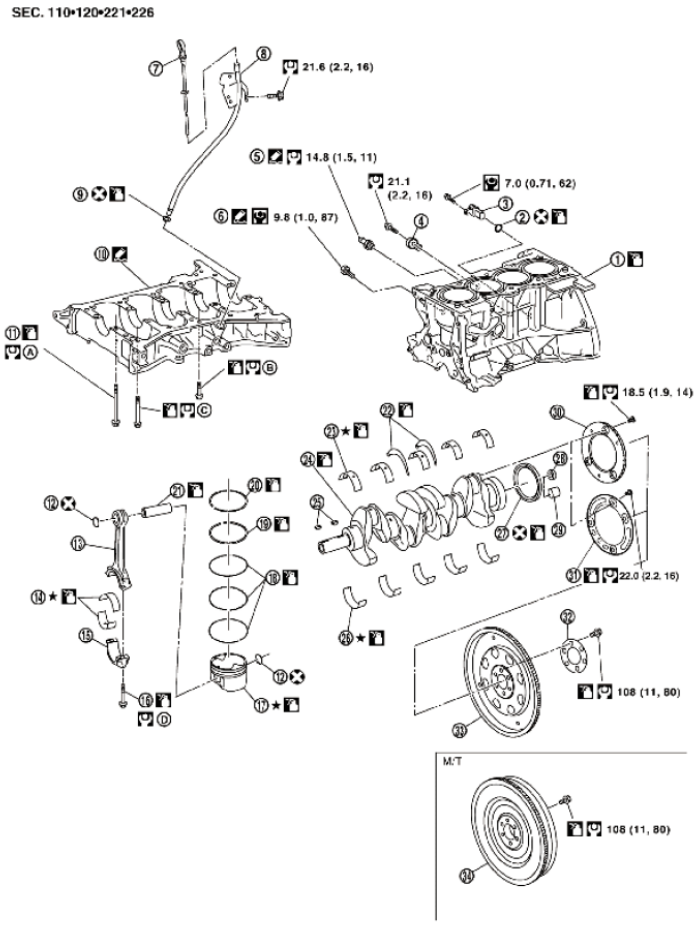
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oil/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down the engine, again check oil/fluid levels including engine oil and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

SUMMARY OF INSPECTION ITEMS

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.			

ENGINE UNIT: EXPLODED VIEW

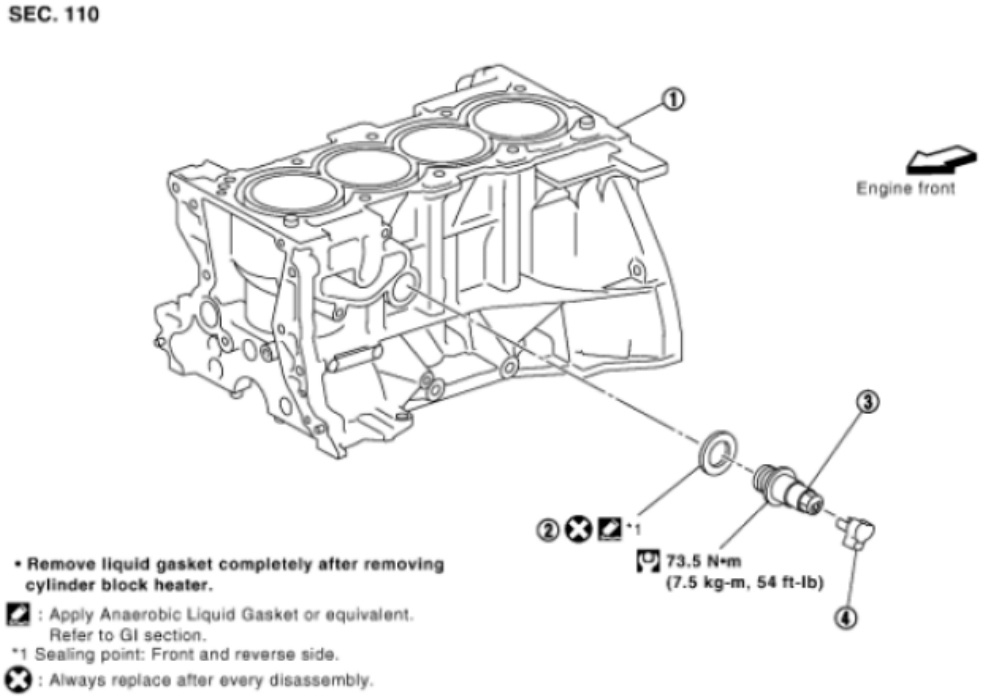
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1. Cylinder block	2. O-ring	3. Crankshaft position sensor (POS)
4. Knock sensor	5. Oil pressure switch	6. Water drain plug
7. Oil level gauge	8. Oil level gauge guide	9. O–ring
10. Lower cylinder block	11. Lower cylinder block mounting bolt	12. Snap ring
13. Connecting rod	14. Connecting rod bearing	15. Connecting rod bearing cap
16. Connecting rod bolt	17. Piston	18. Oil ring
19. Second ring	20. Top ring	21. Piston pin
22. Thrust bearing	23. Main bearing upper	24. Crankshaft
25. Crankshaft key	26. Main bearing lower	27. Rear oil seal
28. Pilot convertor (A/T models)	29. Pilot bushing (M/T models)	30. Signal plate (type 1)
31. Signal plate (type 2)	32. Reinforcement plate (A/T models)	33. Drive plate (A/T models)
34. Flywheel (M/T models)	A. Refer to [**Engine Unit: Disassembly and Assembly**]	B. Refer to [**Engine Unit: Disassembly and Assembly**]
C. Refer to [**Engine Unit: Disassembly and Assembly**]	D. Refer to [**Engine Unit: Disassembly and Assembly**]	

Fig. 121: Exploded View Of Engine Unit
Courtesy of SUZUKI OF AMERICA CORP.

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

Fig. 122: Exploded View Of Cylinder Block Heater
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 .
2. Remove clutch cover and clutch disc (M/T models). Refer to [**CLUTCH DISC, CLUTCH COVER: REMOVAL AND INSTALLATION [5M/T]**]
3. Remove flywheel (M/T models) or drive plate (A/T models) with power tool.

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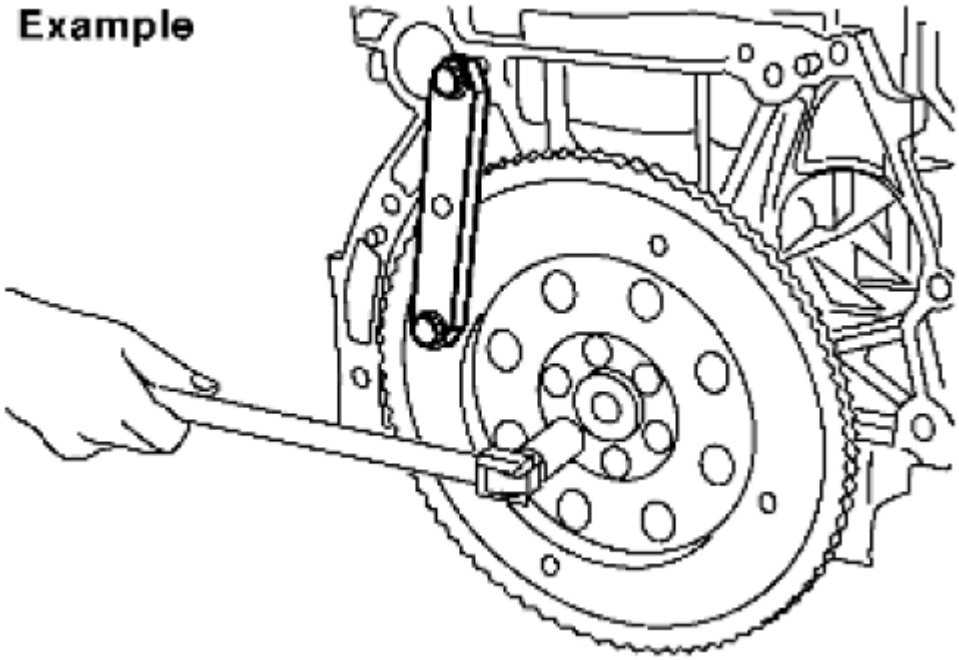


Fig. 123: Removing Flywheel Using Power Tool
Courtesy of SUZUKI OF AMERICA CORP.

- Secure crankshaft with a stopper plate, and remove bolts.
- Loosen bolts using suitable tool.

Flywheel (M/T models): size T55 (commercial service tool)

Drive plate (A/T models): size E20

CAUTION: Be careful not to damage or scratch drive plate (A/T models) and contact surface for clutch disc of flywheel (M/T models).

NOTE: The flywheel, two block construction, allows movement in response to transmission side pressure, or when twisted in its rotational direction. Therefore, some amount of noise is normal.

4. Lift engine, and mount to engine stand.

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

- A widely used engine stand can be used.

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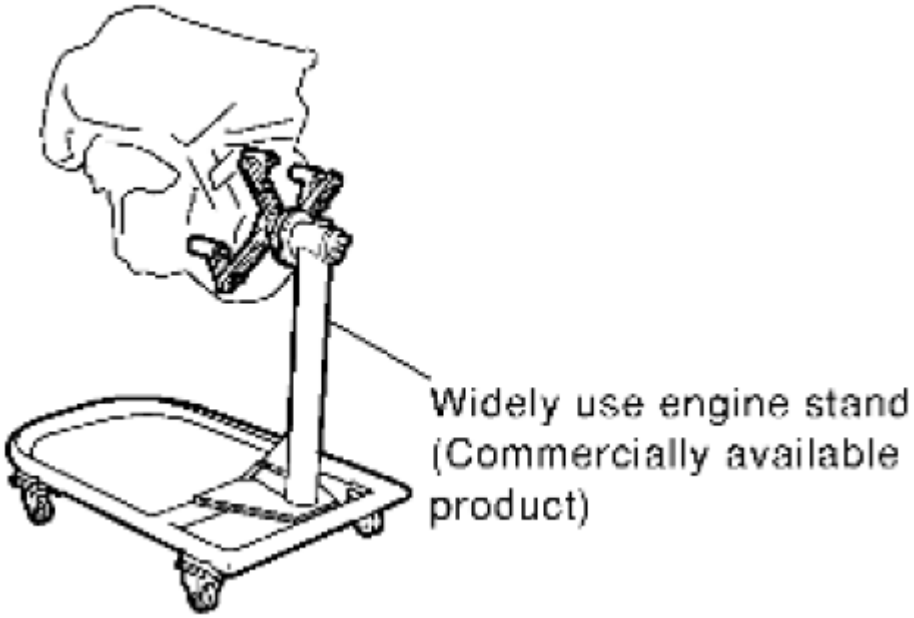


Fig. 124: Identifying Widely Used Engine Stand
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Use engine stand that has a load capacity [approximately 240kg (529 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 water drain plug from side of the engine.

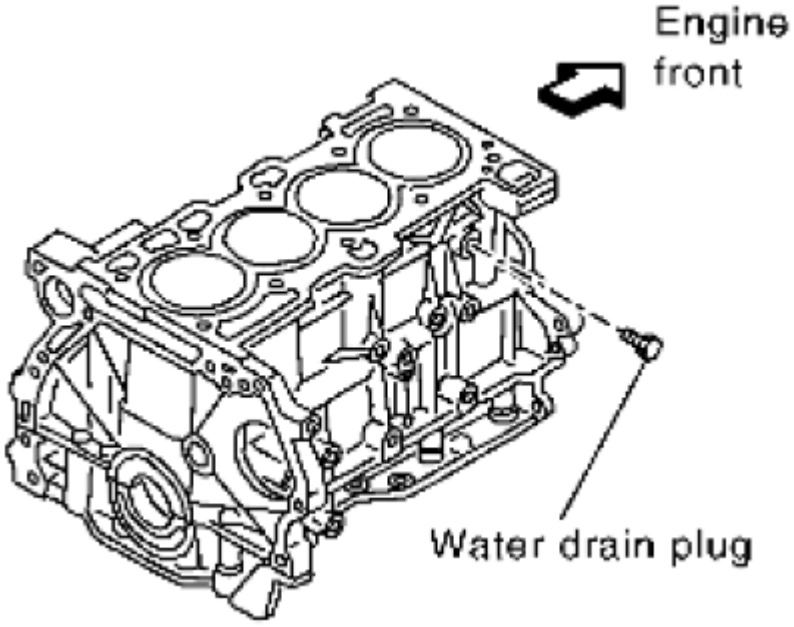


Fig. 125: Identifying Water Drain Plug

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Courtesy of SUZUKI OF AMERICA CORP.

7. Remove cylinder head. Refer to [**CYLINDER HEAD: REMOVAL AND INSTALLATION**].
8. Remove knock sensor.

CAUTION: Carefully handle knock sensor avoiding shocks.

9. Remove crankshaft position sensor (POS).

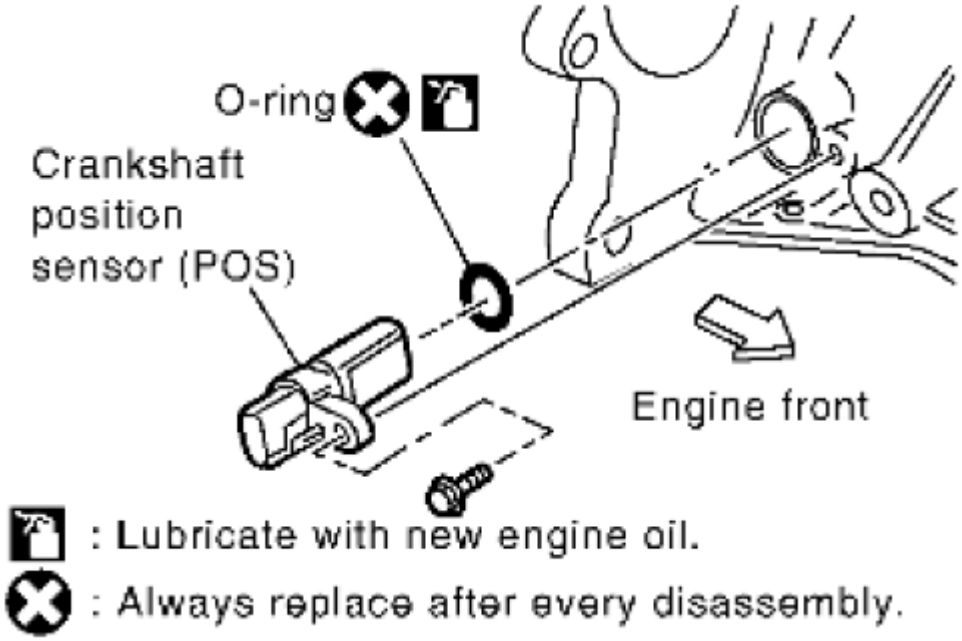


Fig. 126: Identifying Crankshaft Position Sensor, O-Ring And Mounting Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION:
- **Avoid impacts such as a dropping.**
- **Do not disassemble.**
- **Keep it away from metal particles.**
- **Do not place the sensor in a location where it is exposed to magnetism.**

10. Remove oil pressure switch using a suitable tool.

CAUTION: Do not drop or shock oil pressure switch.

11. Remove pilot converter (A/T models) or pilot bushing (M/T models) using Tool.

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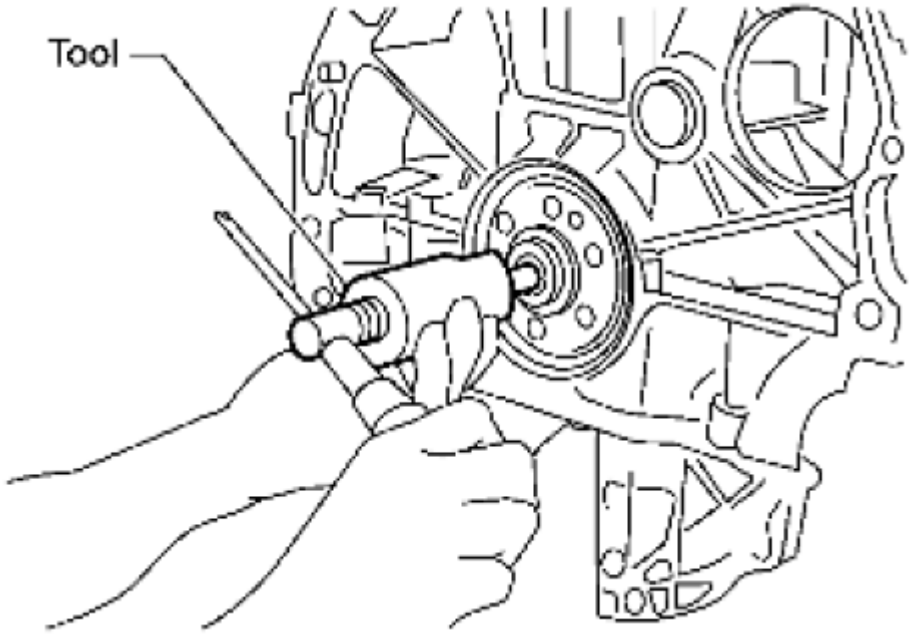


Fig. 127: Removing Pilot Converter Or Pilot Bushing Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: ST16610001 (J-23907)

12. 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 no to drop connecting rod bearing, and to scratch the surface.

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

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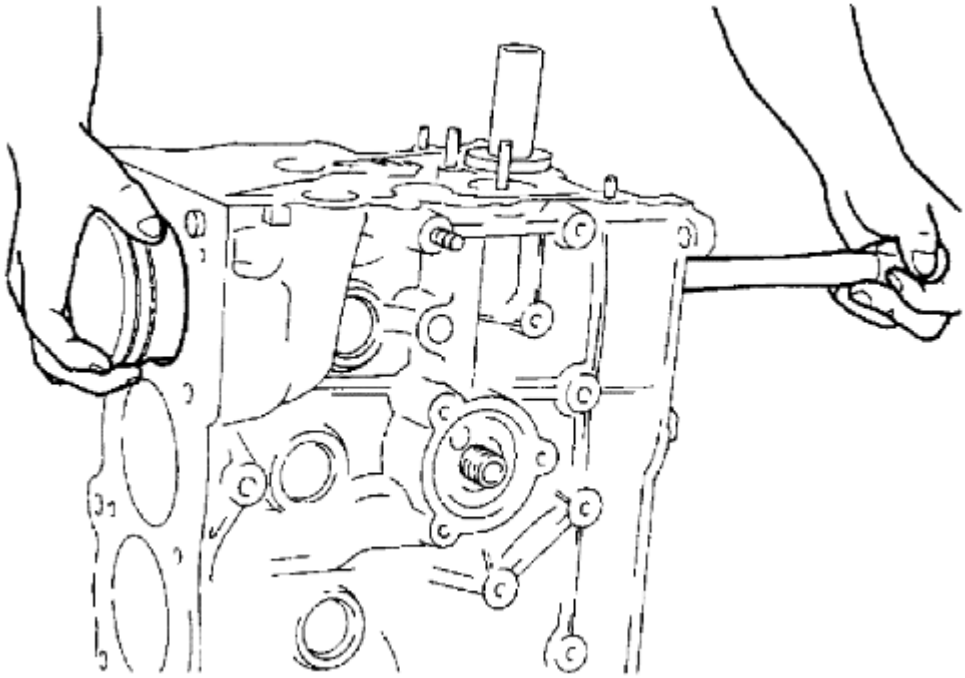


Fig. 128: Pushing Piston And Connecting Rod Assembly Using Suitable Tool
Courtesy of SUZUKI OF AMERICA CORP.

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

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

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

17. Remove piston rings from piston.
    - Before removing piston rings, check the piston ring side clearance. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
    - Remove piston rings using piston ring expander or suitable tool.

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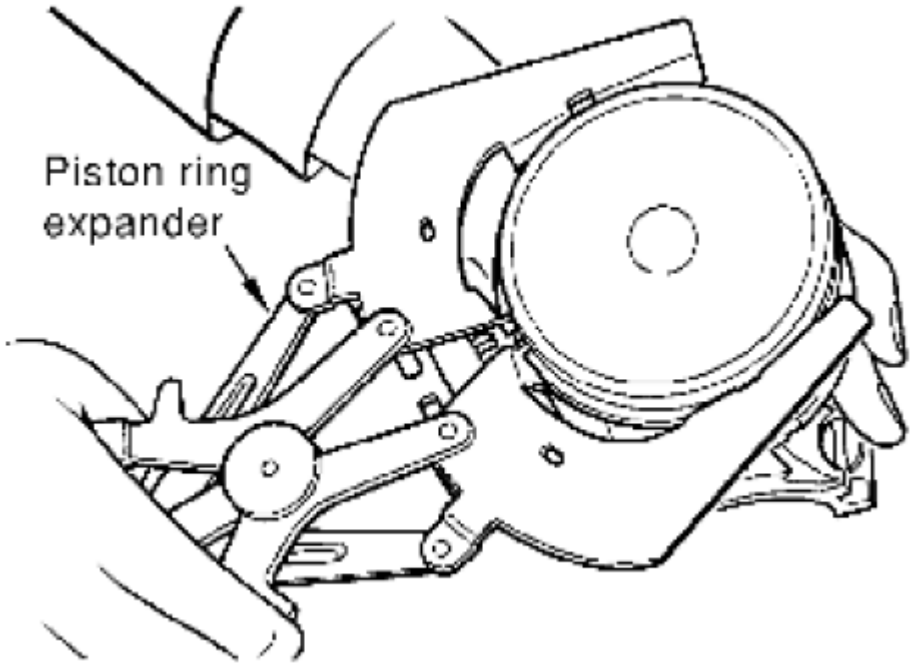


Fig. 129: Removing Piston Rings Using Piston Ring Expander
Courtesy of SUZUKI OF AMERICA CORP.

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

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

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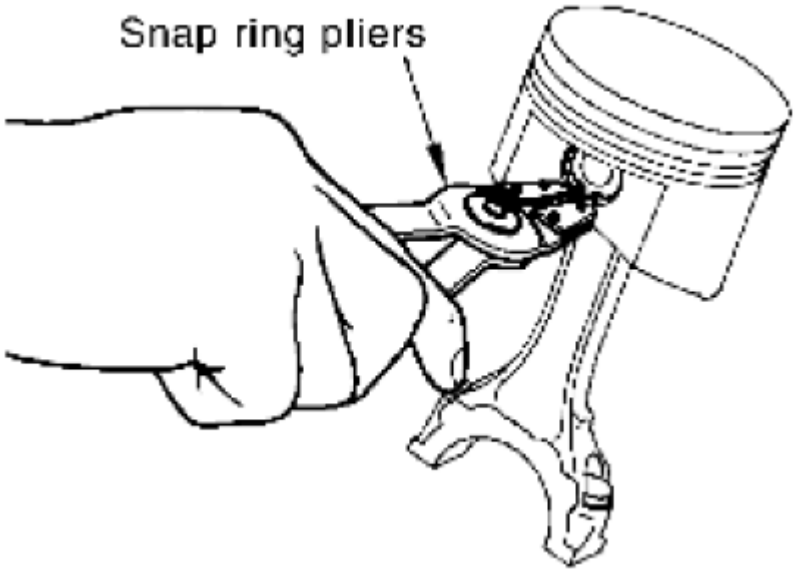


Fig. 130: Removing Snap Rings Using Snap Ring Plier
Courtesy of SUZUKI OF AMERICA CORP.

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

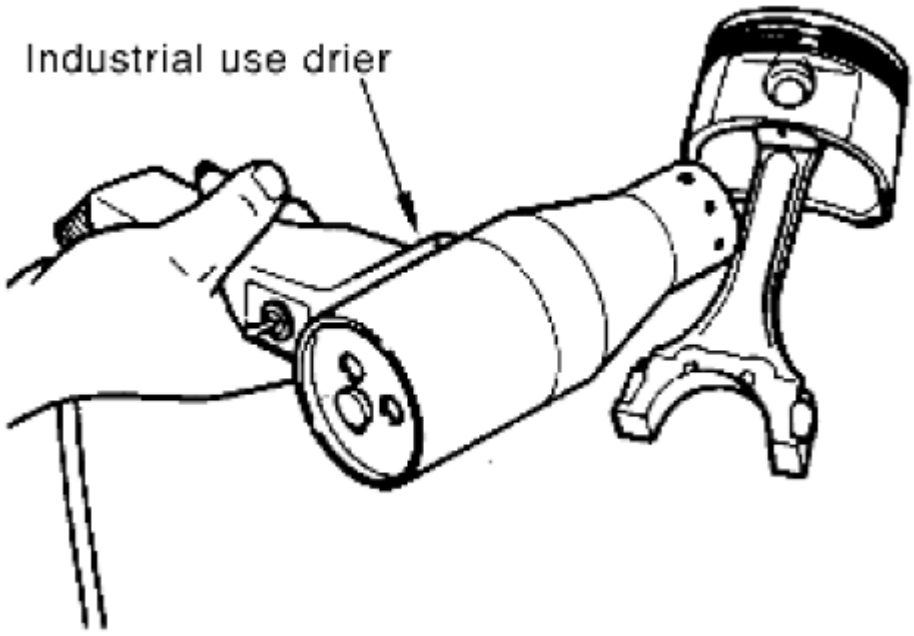


Fig. 131: Heating Piston Using Industrial Use Drier
Courtesy of SUZUKI OF AMERICA CORP.

c. Push out piston pin with stick of outer diameter approximately 19 mm (0.75 in).

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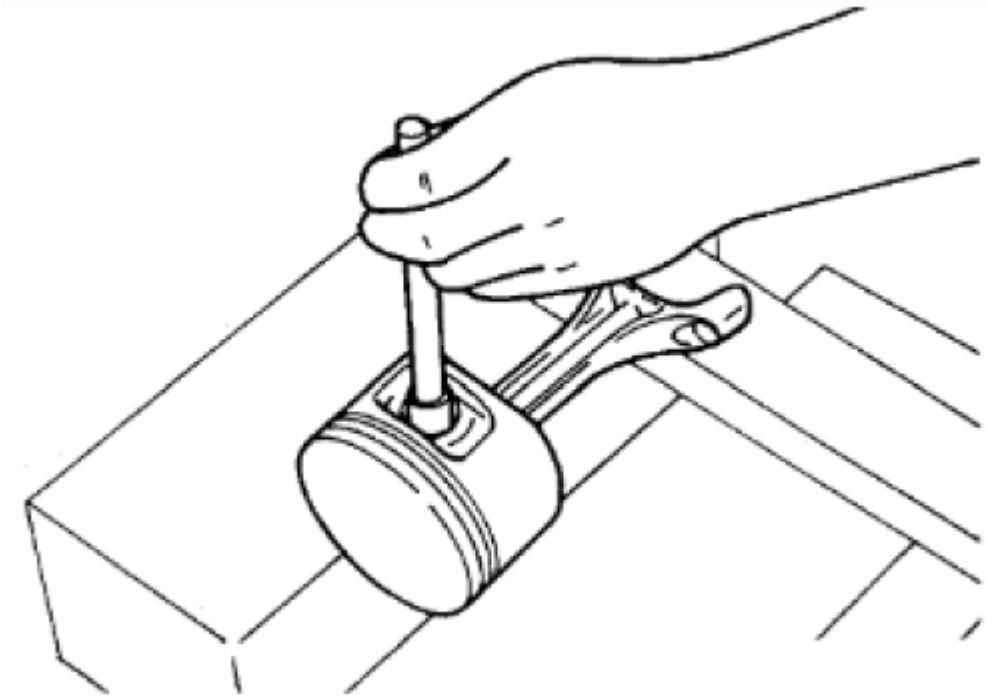
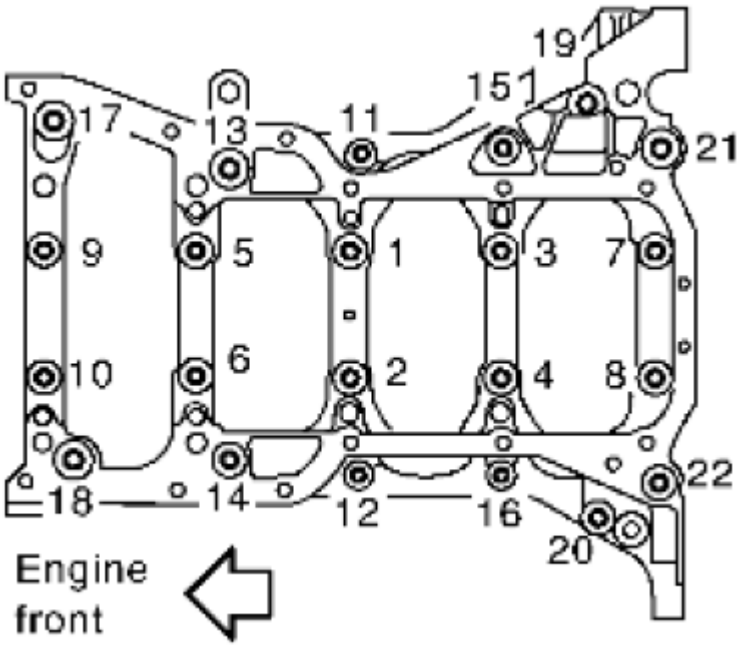


Fig. 132: Pushing Out Piston Pin
Courtesy of SUZUKI OF AMERICA CORP.

19. Remove lower cylinder block bolts.
    - Before loosening lower cylinder block bolts, measure 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. 133: Tightening Order Of Lower Cylinder Block Bolts
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Use TORX socket (size E14) for bolts No. 1 to 10.

20. Remove lower cylinder block.
    - Use Tool to cut liquid gasket for removal.

    Tool number: KV10111100 (J-37228)

    CAUTION: Be careful not to damage the mounting surfaces.

21. Remove crankshaft.

    CAUTION:
    - **Be careful not damage or deform signal plate mounted on crankshaft.**

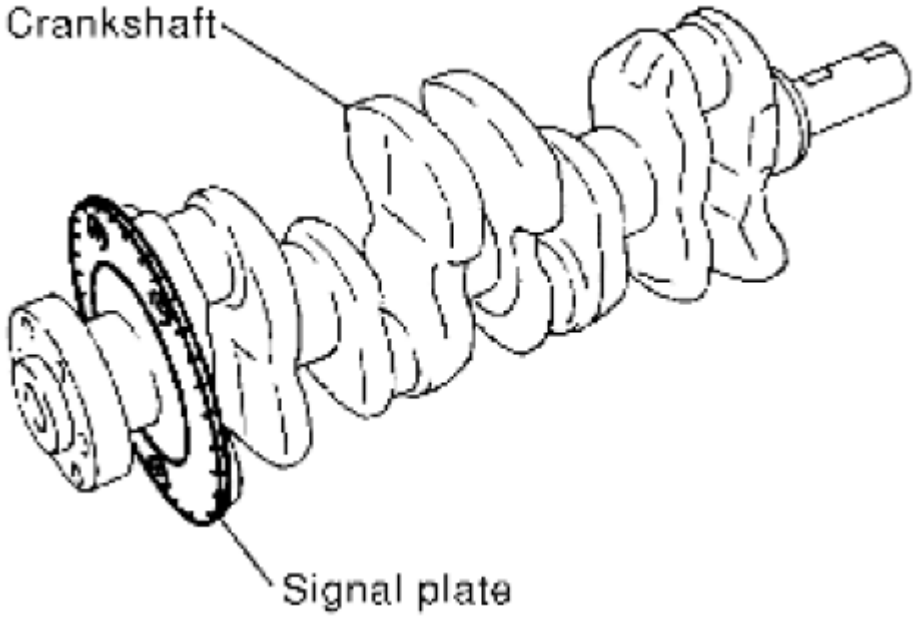


Fig. 134: Identifying Crankshaft And Signal Plate
Courtesy of SUZUKI OF AMERICA CORP.

- **When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.**
- **Do not remove signal plate unless it is necessary to do so.**

NOTE: When removing or installing signal plate, use TORX socket (size T30).

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22. 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 remove the oil seal installed between crankshaft and cylinder block out.

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

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

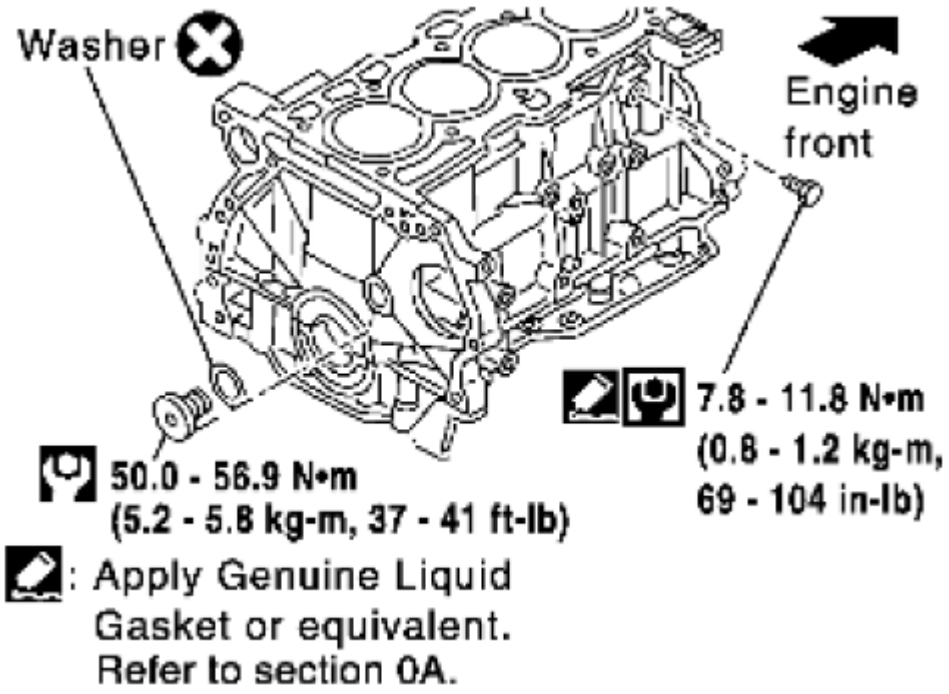
CAUTION:
- **Do not drop main bearing, or scratch the surface.**
- **Identify installation positions, and store them without mixing them up.**

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 approved safety glasses to protect your eyes.

2. Apply Silicone RTV Sealant to the drain plugs. Install the drain plugs on the cylinder block.



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Fig. 135: Identifying Drain Plugs With Torque Specifications
Courtesy of SUZUKI OF AMERICA CORP.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS**]
- Replace the copper washers with new ones.

3. Install main bearings and thrust bearings as follows:

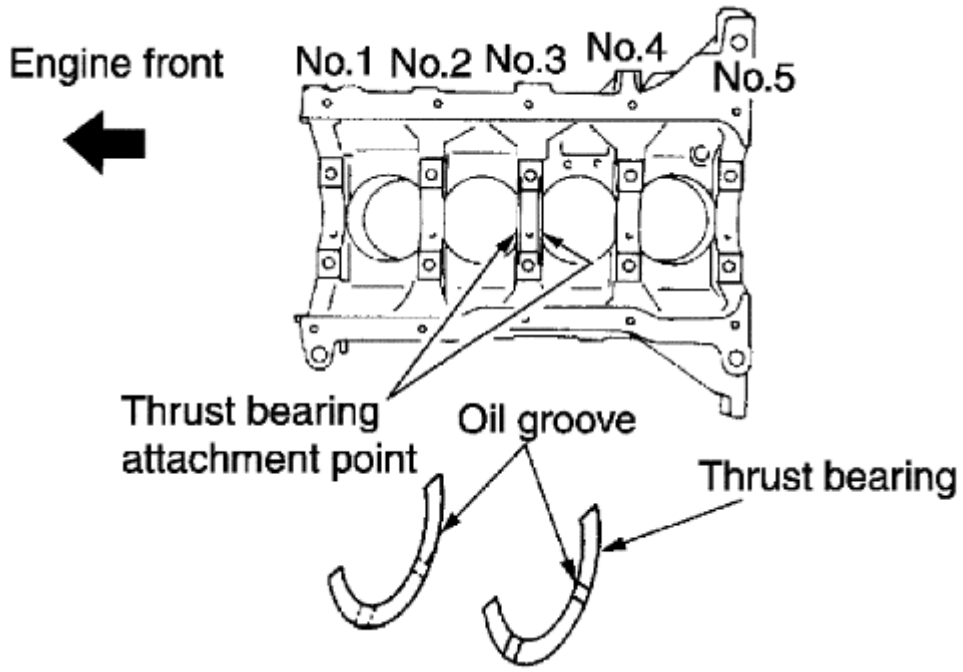


Fig. 136: Identifying Thrust Bearing, Thrust Bearing Attachment Point And Oil Groove
Courtesy of SUZUKI OF AMERICA CORP.

a. Remove dust, dirt, and engine oil from the bearing mating surfaces of the cylinder block and lower cylinder block.
b. Install the thrust bearings to both sides of the No. 3 main bearing journal on the cylinder block.
   - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).
c. Install the main bearings paying attention to their position and direction.

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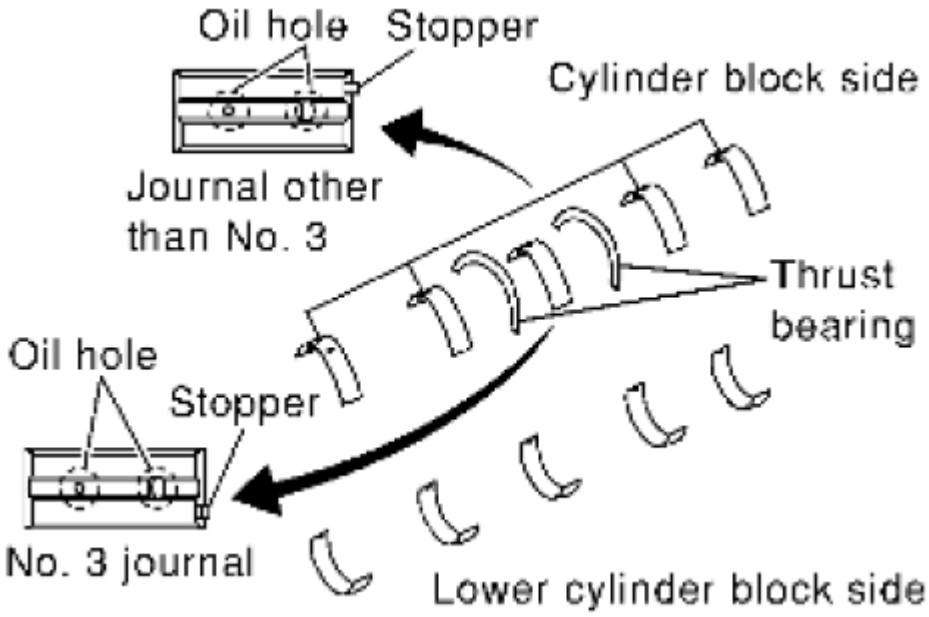


Fig. 137: Position Of Installing Main Bearings
Courtesy of SUZUKI OF AMERICA CORP.

- The main bearing with an oil hole and groove goes on the cylinder block. The one without them goes on the lower cylinder block.
- Only the main bearing (on the cylinder block) for No. 3 journal has different specifications.
- Before installing the bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
- When installing, align the bearing stopper to the notch.
- Make sure that the oil holes on the cylinder block and those on the corresponding bearing are aligned.

4. Install the signal plate to the crankshaft.

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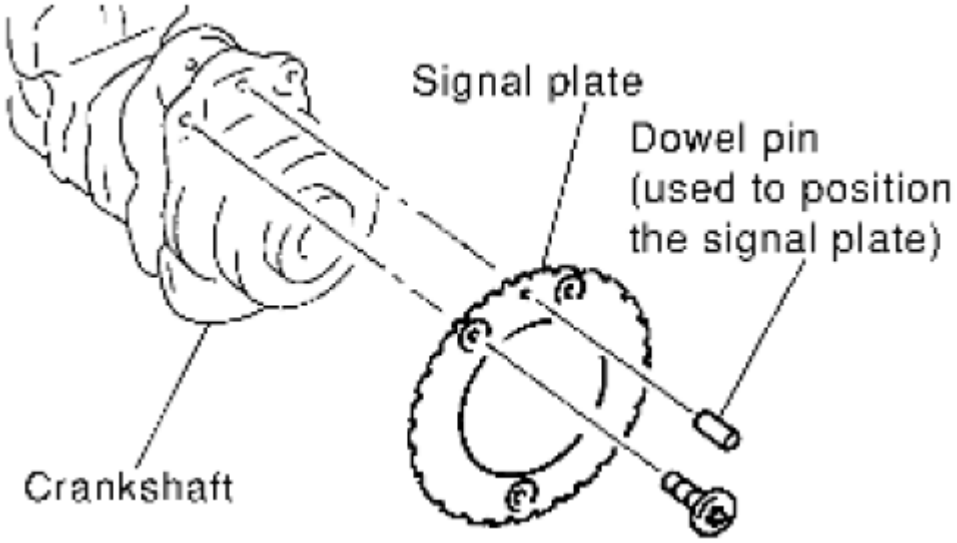


Fig. 138: Identifying Signal Plate And Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

a. Position the crankshaft and signal plate using a positioning dowel pin, and tighten the signal plate bolts to specification.

Signal plate bolts

Type 1: 18.5 N.m (1.9 kg-m, 14 ft-lb)

Type 2: 22.0 N.m (2.2 kg-m, 16 ft-lb)

b. Remove the dowel pin.

CAUTION: Be sure to remove dowel pin before installing the crankshaft.

NOTE: Dowel pins for the crankshaft and signal plate are supplied as a set for each.

5. Install crankshaft to the cylinder block.
   - While turning the crankshaft by hand, check that it turns smoothly.

CAUTION: Do not install rear oil seal at this time.

6. Apply a continuous bead of liquid gasket using Tool to positions shown and install the lower cylinder block.

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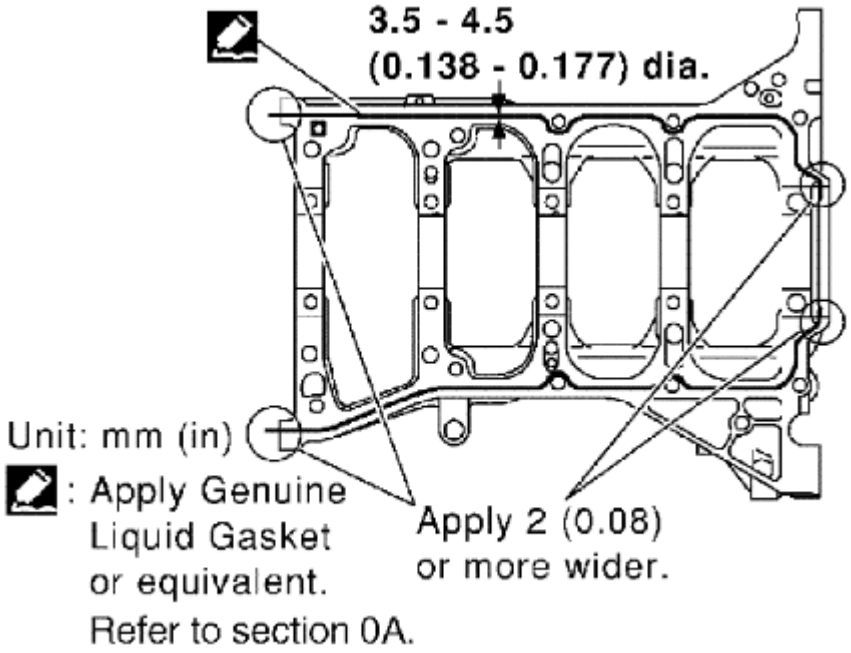


Fig. 139: Identifying Liquid Gasket Applying Specifications On Lower Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: WS39930000 (-)

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

CAUTION: After liquid gasket is applied, the lower cylinder block installation must be finished within 5 minutes.

NOTE: Cylinder block and lower cylinder block are machined together. Neither of them can be replaced separately.

7. Tighten lower cylinder block bolts in three steps in the order as shown using Tool.

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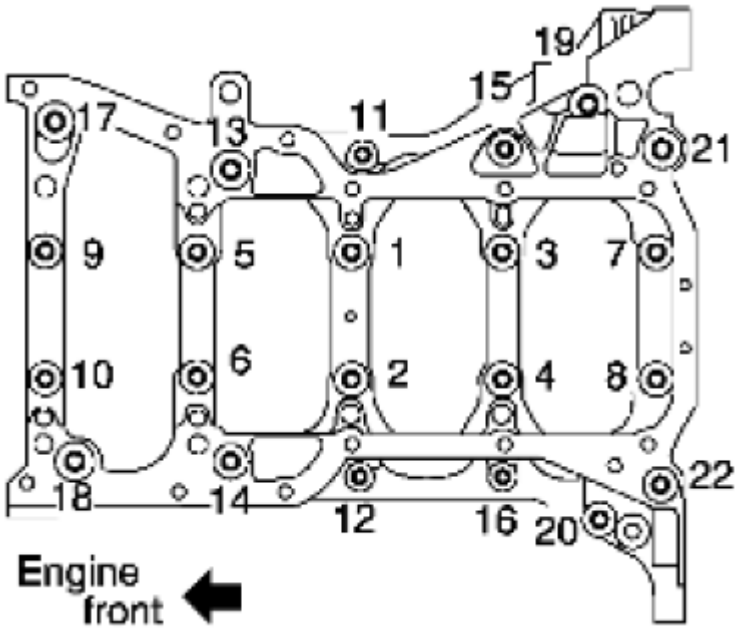


Fig. 140: Tightening Order Of Lower Cylinder Block Bolts
Courtesy of SUZUKI OF AMERICA CORP.

NOTE:

- **Apply new engine oil to threads and seat surfaces of the bolts.**

Tool number: KV10112100 (BT-8653-A)

CAUTION: There are more processes to complete the tightening of lower cylinder bolts. However stop procedure after step 1 and install rear oil seal.
Lower cylinder block bolts
Step 1 (bolts 11 - 22): 25.1 N.m (2.6 kg-m, 19 ft-lb)
Step 2 (bolts 1 - 10): 39.2 N.m (4.0 kg-m, 29 ft-lb)
Step 3 (bolts 1 - 10): 60° - 65° (target: 60°)
Apply new engine oil to new rear oil seal and install it using a suitable tool.

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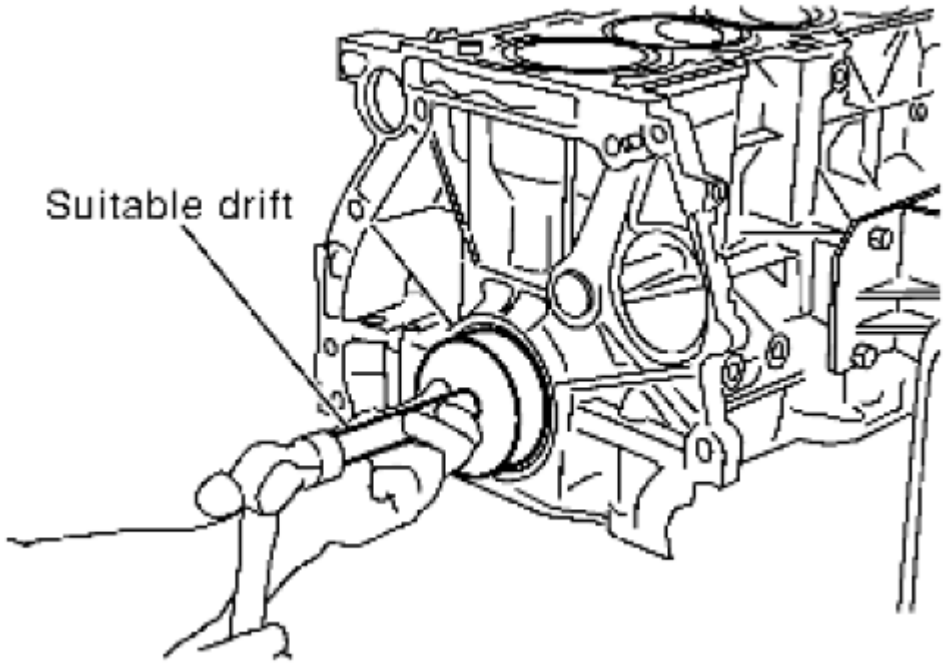
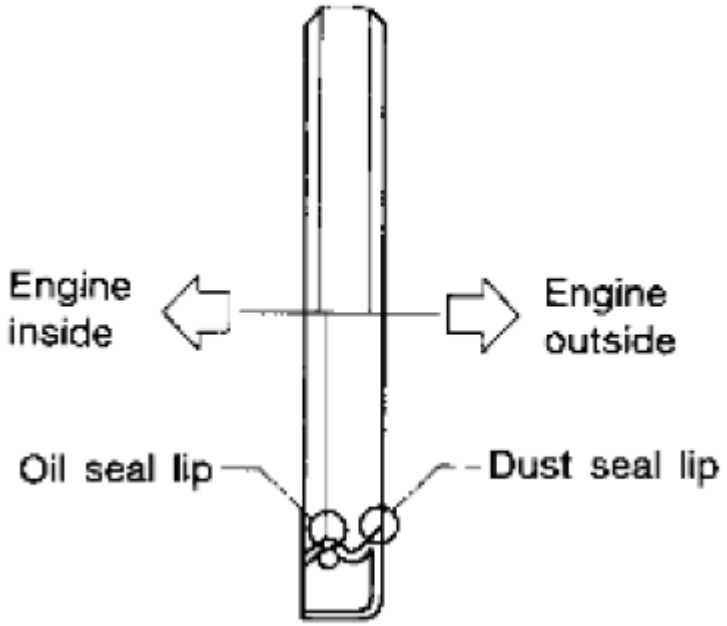


Fig. 141: Installing Oil Seal Using Suitable Drift
Courtesy of SUZUKI OF AMERICA CORP.

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

- Install new oil seal in the direction shown.



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Fig. 142: Identifying Oil Seal Lip And Dust Seal Lip Orientation For Installing Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

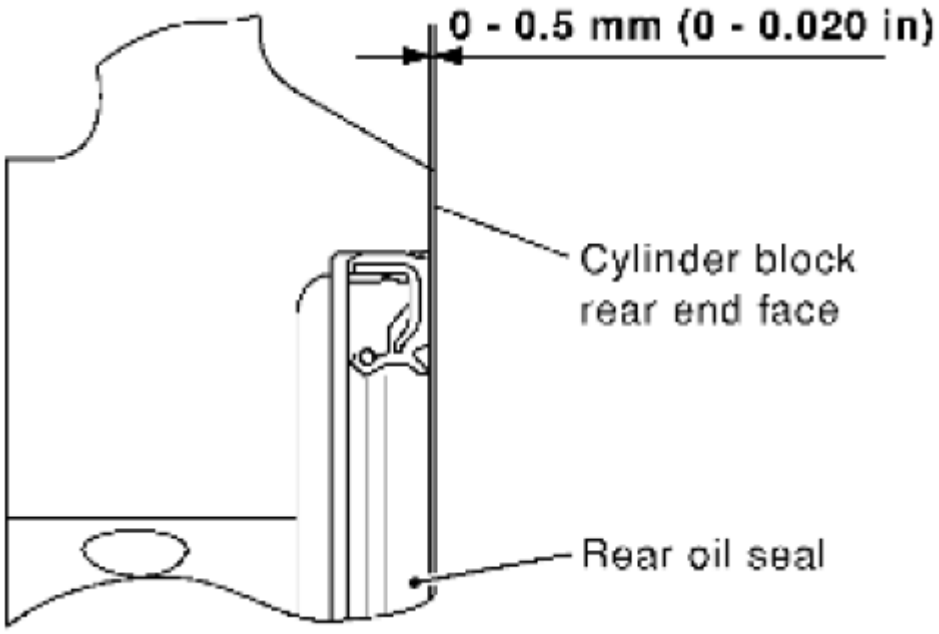


Fig. 143: Identifying Rear Oil Seal Projection
Courtesy of SUZUKI OF AMERICA CORP.

CAUTION: Check tightening angle using Tool. Do not tighten by visual inspection.

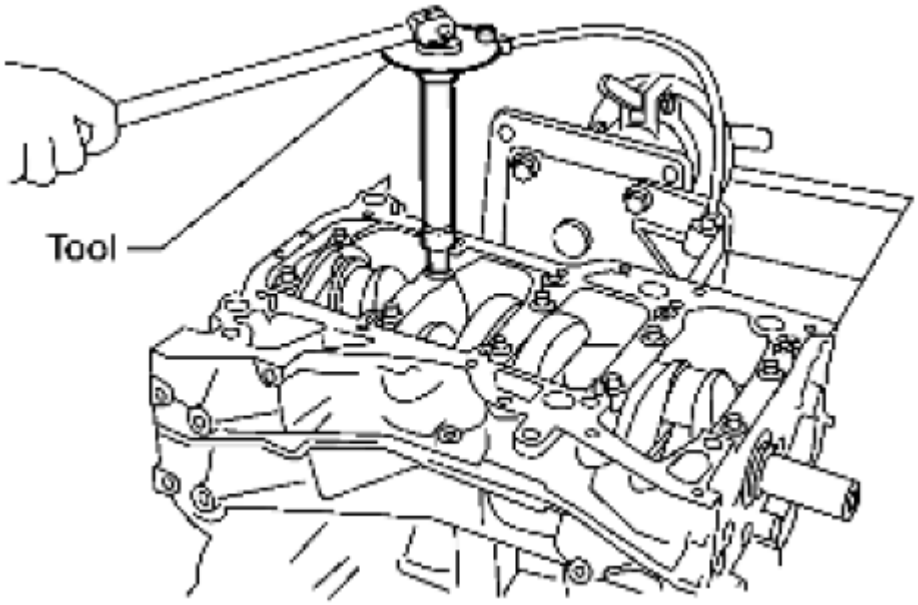


Fig. 144: Checking Tightening Angle Using Tool

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Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10112100 (BT-8653-A)

- Wipe off completely any protruding Silicone RTV Sealant on the exterior of engine.
- Check crankshaft side clearance. Refer to [**SERVICE DATA AND SPECIFICATIONS**].
- After installing the bolts, make sure that the crankshaft can be rotated smoothly by hand.

8. Install the piston to the connecting rod. Assemble the components in their original positions.
   a. Using a snap ring pliers, install the snap ring into the grooves of the piston's rear side.
      - Insert the piston pin snap ring fully into groove.
   b. Install the piston to the connecting rod.
      - Using a heat gun, heat the piston [approximately 60° - 70°C (140° - 158°F)] until the piston pin can be pushed in by hand without excessive force. From the front to the rear, insert the piston pin into the piston and the connecting rod.
      - Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown.

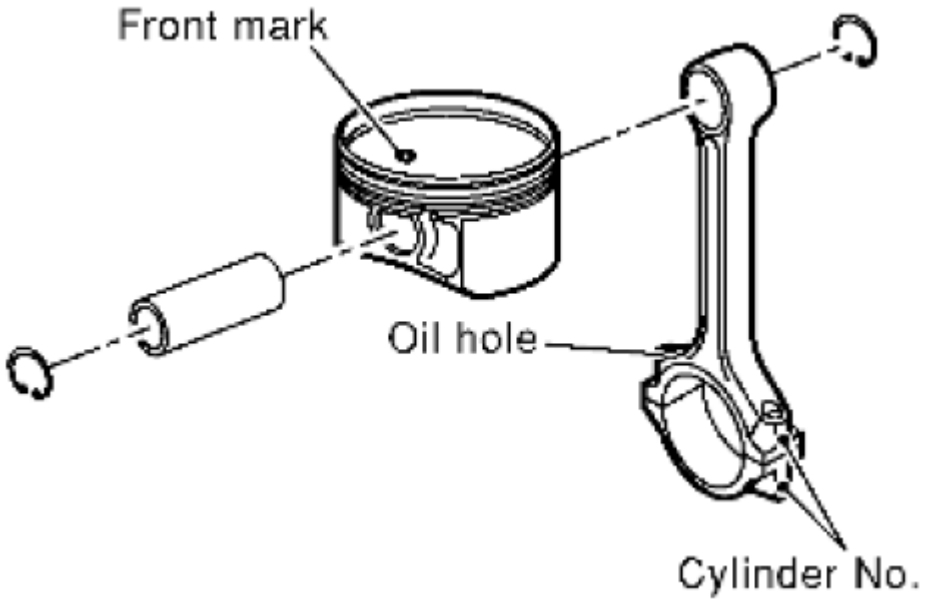


Fig. 145: Positioning Front Mark On Piston Crown And Oil Holes And Cylinder No. On Connecting Rod
Courtesy of SUZUKI OF AMERICA CORP.

   c. Install the piston pin snap ring into the front of the piston.
      - Check that the connecting rod moves smoothly.

9. Using a piston ring expander, install the piston rings. Assemble the components in their original positions.

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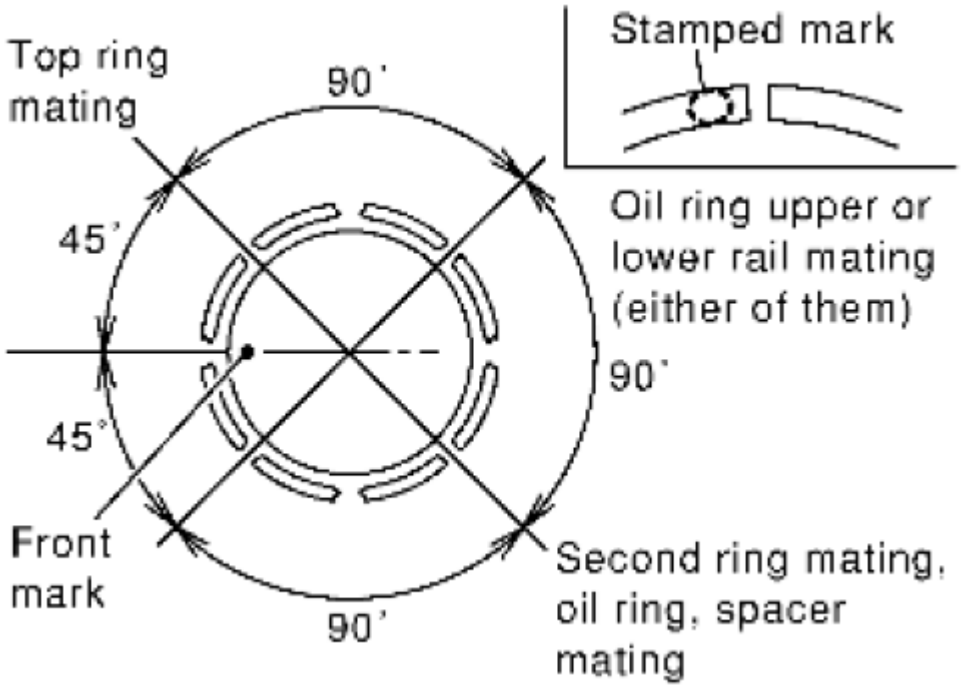


Fig. 146: Position Of Installing Piston Rings
Courtesy of SUZUKI OF AMERICA CORP.

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

- Position each ring with the gap as shown, referencing the piston front mark as the starting point.
- Install the top ring and the second ring with the stamped surface facing upward.

Stamped mark: 2ND (second ring)

10. Install the connecting rod bearings to the connecting rod and the connecting rod cap. Assemble the components in their original positions.

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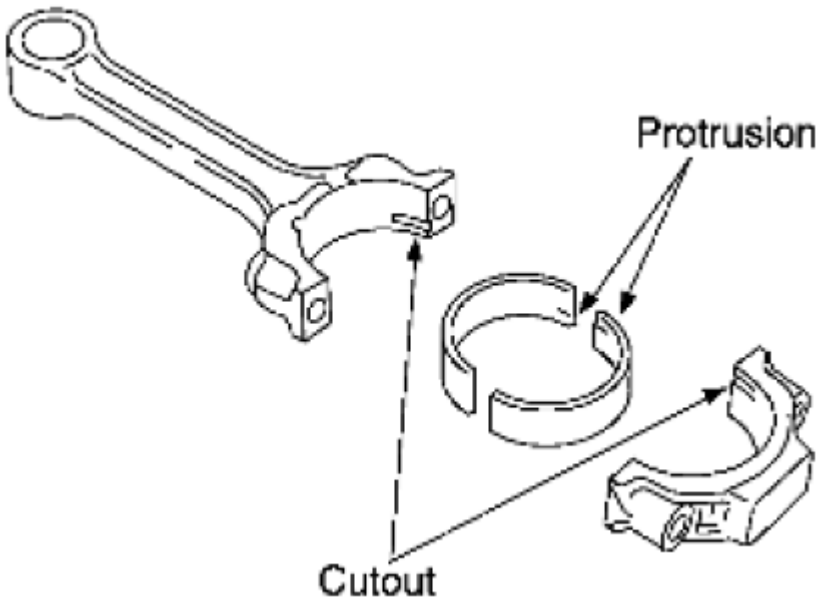
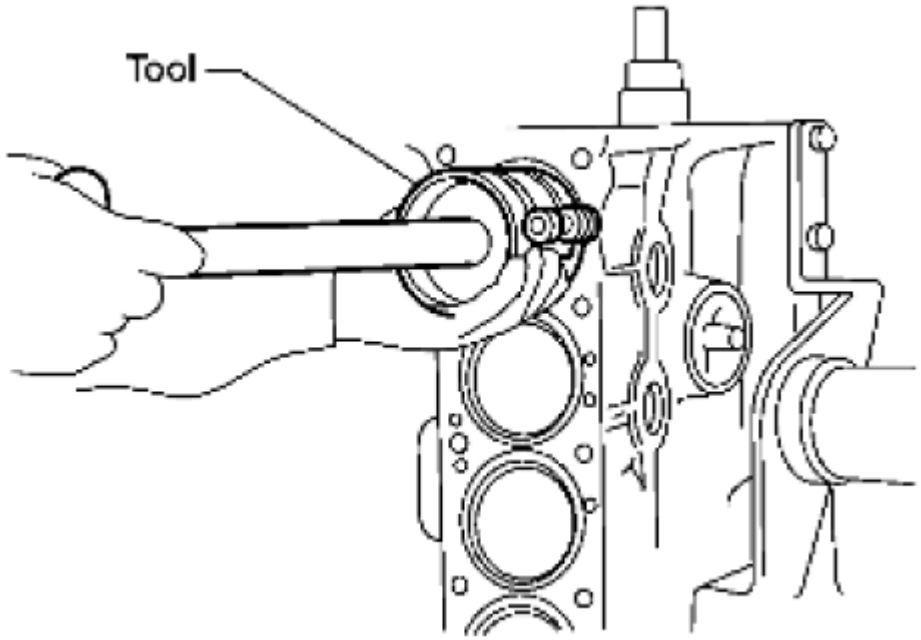


Fig. 147: Identifying Cutout On Connecting Rod Bearing
Courtesy of SUZUKI OF AMERICA CORP.

- When installing the connecting rod bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean the back.
- When installing, align the connecting rod bearing stopper protrusion with the notch of the connecting rod to install.
- Check the oil holes on the connecting rod and those on the corresponding bearing are aligned.

11. Install the piston and connecting rod assembly to the crankshaft. Assemble the components in their original positions.



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Fig. 148: Installing Piston And Connecting Rod Assembly To Crankshaft
Courtesy of SUZUKI OF AMERICA CORP.

- Rotate the crankshaft so the pin corresponding to the connecting rod to be installed is at the bottom dead center position.
- Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
- Match the cylinder position number with the cylinder No. on the connecting rod for installation.
- Install the piston with the front mark on the piston crown facing the front of the engine using Tool.

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.

12. Install the connecting rod bearing caps. Assemble the components in their original positions.

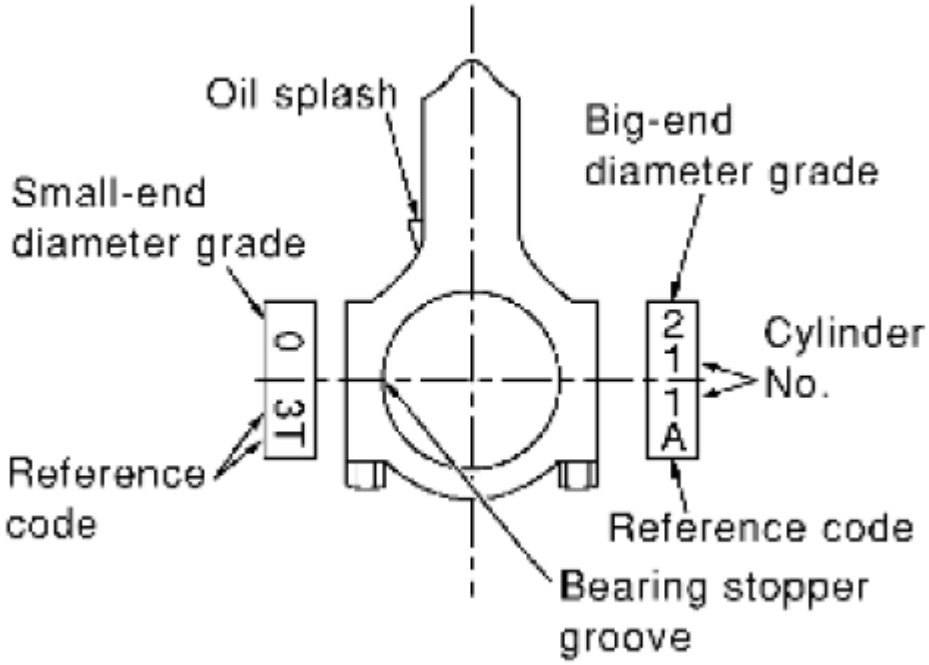


Fig. 149: Position Of Installing Connecting Rod Bearing Caps
Courtesy of SUZUKI OF AMERICA CORP.

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

13. Tighten the connecting rod bolts using Tool in four steps as follows:

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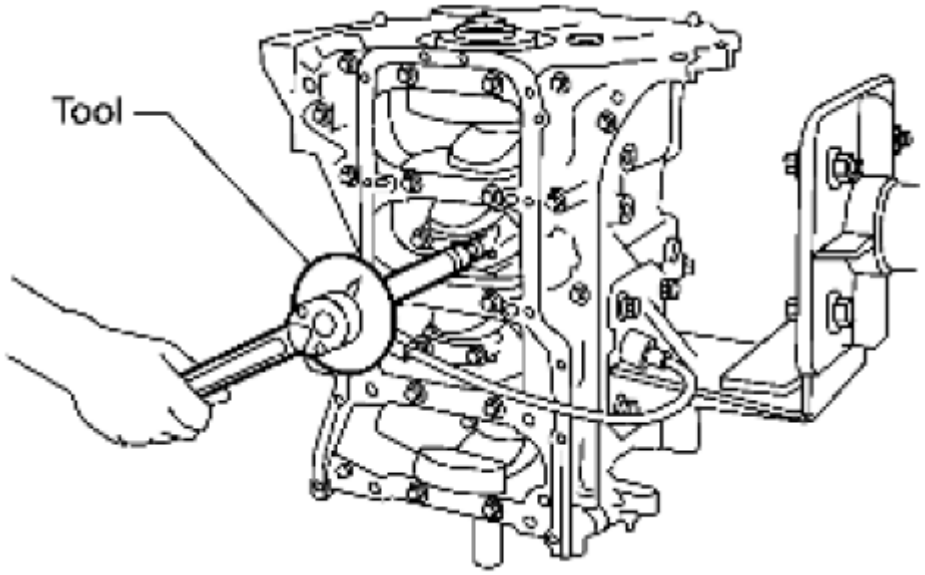


Fig. 150: Tightening Connecting Rod Bolts Using Tool
Courtesy of SUZUKI OF AMERICA CORP.

Tool number: KV10112100 (BT-8653-A)

- Apply engine oil to the threads and seats of the connecting rod bolts.

CAUTION: Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.

Step 1: 27.4 N.m (2.8 kg-m, 20 ft-lb)

Step 2: 0 N.m (0 kg-m, 0 ft-lb)

Step 3: 19.6 N.m (2.0 kg-m, 14 ft-lb)

Step 4: 85° - 95° (target 90° degrees)

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

14. Install flywheel (M/T Models), or drive plate (A/T Models).

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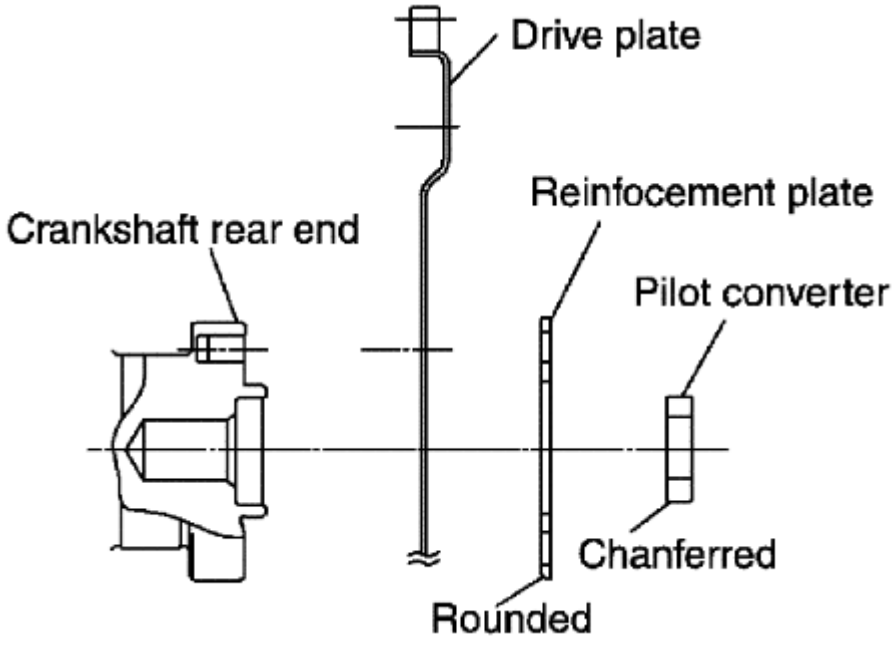


Fig. 151: Identifying Crankshaft Rear End And Drive Plate
Courtesy of SUZUKI OF AMERICA CORP.

- Install drive plate, reinforcement plate and pilot converter as shown.
- Using a drift with 33 mm (1.30 in) diameter, push pilot converter into the end of the crankshaft.
- Press fit pilot bushing into the crankshaft as shown; using a suitable drift of 19 mm (0.75 in)

15. Install the cylinder block heater.

    Cylinder block heater: 73.5 N.m (7.5 kg-m, 54 ft-lb)

16. Install the knock sensor.

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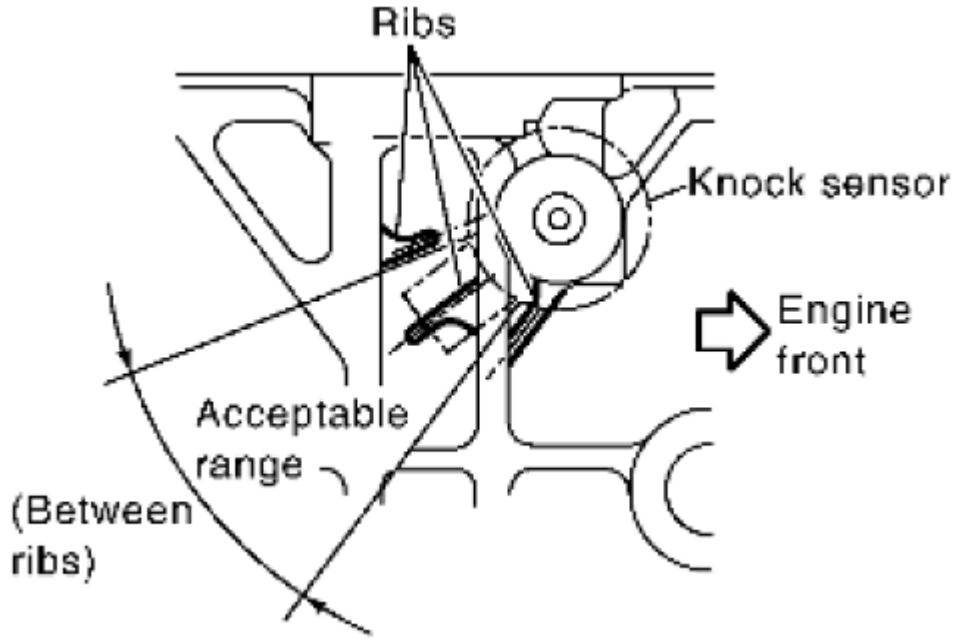


Fig. 152: Position Of Installing Knock Sensor
Courtesy of SUZUKI OF AMERICA CORP.

- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
- Install the knock sensor with the connector facing lower left by 45° as shown.
- Do not tighten the knock sensor bolt while holding the connector.
- Make sure that the knock sensor does not interfere with other components.

Knock sensor bolt: 21.1 N.m (2.2 kg-m, 16 ft-lb)

CAUTION: If the knock sensor is dropped, replace it with new one.

17. Install the crankshaft position sensor (POS).

Crankshaft position sensor bolt: 7.0 N.m (0.71 kg-m, 62 in-lb)

18. Installation of remaining components is in reverse order of removal.

ENGINE UNIT: INSPECTION AFTER DISASSEMBLY

CRANKSHAFT END PLAY

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

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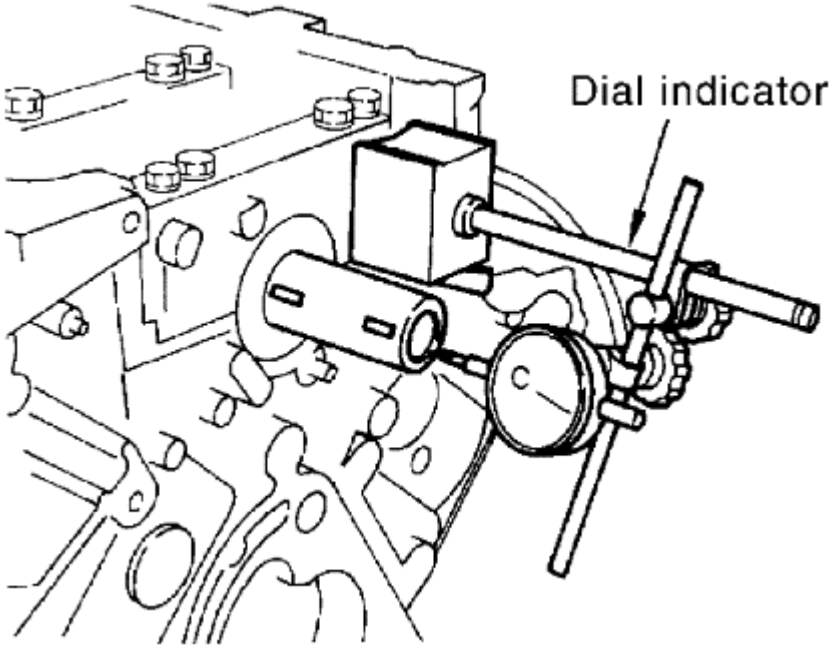


Fig. 153: Measuring Crankshaft End Play
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 0.10 - 0.26 mm (0.0039 - 0.0102 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 a feeler gauge.

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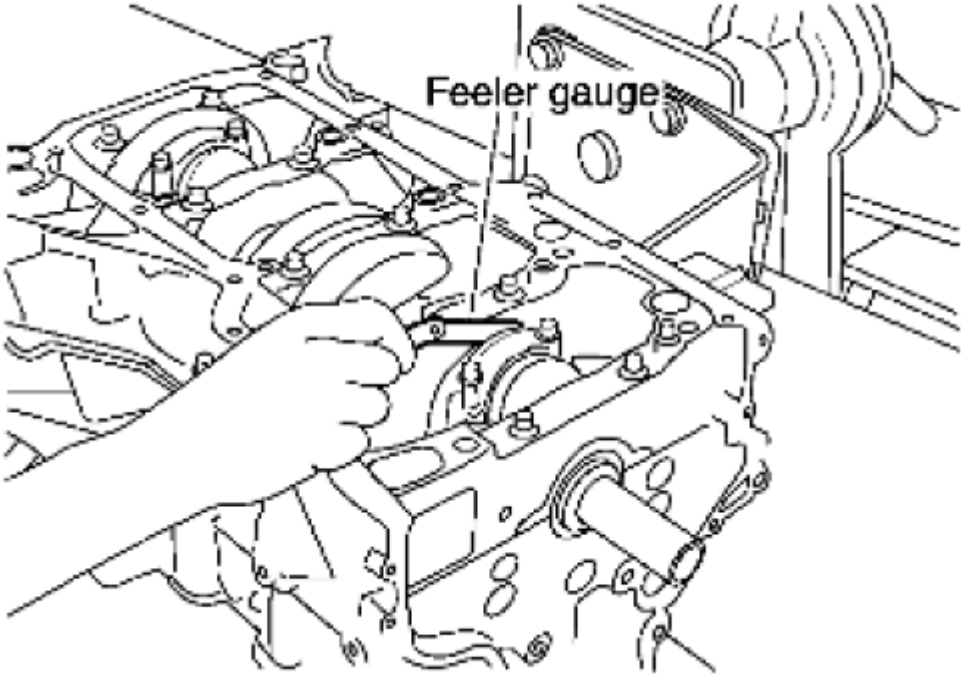


Fig. 154: Measuring Connecting Rod Side Clearance
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 0.20 - 0.35 mm (0.0079 - 0.138 in)

Limit: 0.50 mm (0.0197 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 OIL CLEARANCE

Piston Pin Hole Diameter

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

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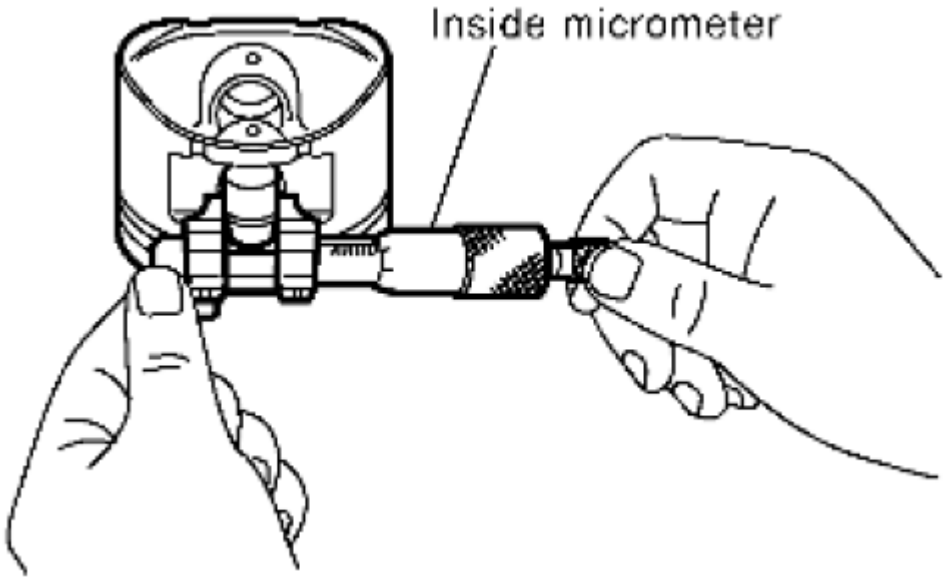


Fig. 155: Measuring Inner Diameter Of Piston Pin Hole
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 19.993 - 20.005 mm (0.7871 - 0.7876 in)

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

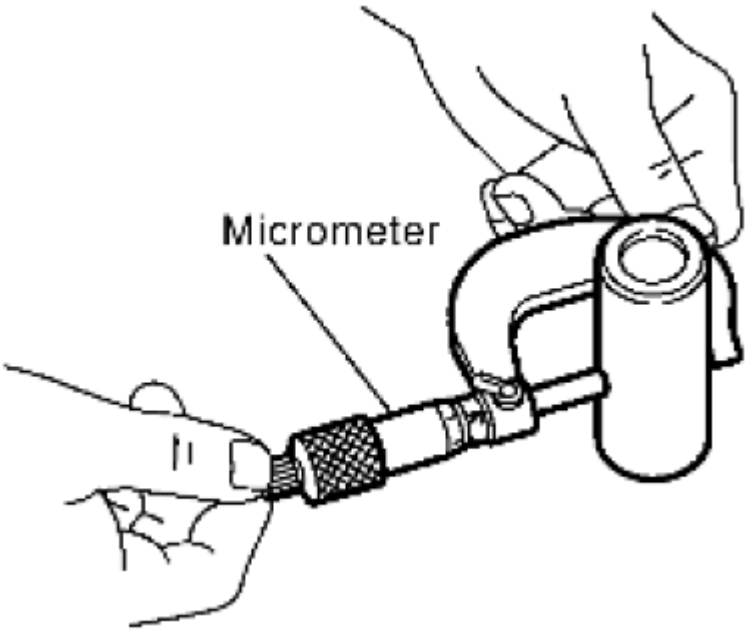


Fig. 156: Measuring Piston Pin Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

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Standard: 19.989 - 20.001 mm (0.7870 - 0.7874 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 oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, refer to [**SERVICE DATA AND SPECIFICATIONS**].

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 grades can be selected. (Only grade "0" is available.)**

PISTON RING SIDE CLEARANCE

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

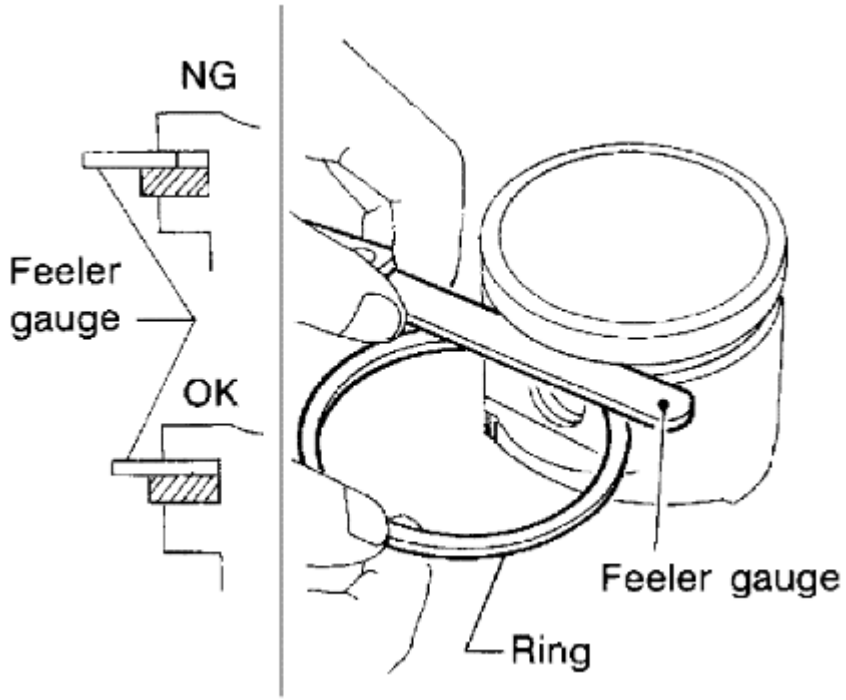


Fig. 157: Measuring Side Clearance Of Piston Ring And Piston Ring Groove Using Feeler Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Standard:

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

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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 cylinder bore inner diameter is within the specification. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

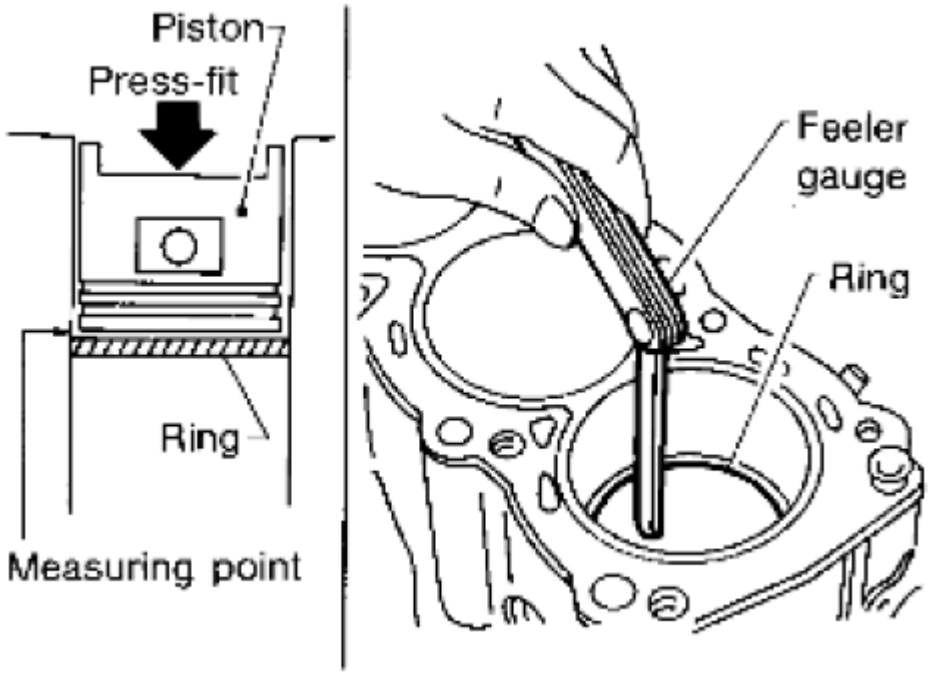


Fig. 158: Measuring Piston Ring End Gap
Courtesy of SUZUKI OF AMERICA CORP.

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

Standard:

Top ring: 0.21 - 0.31 mm (0.0083 - 0.0122 in)

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2nd ring: 0.32 - 0.47 mm (0.0126 - 0.0185 in)

Oil ring (rail ring): 0.20 - 0.60 mm (0.0079 - 0.0236 in)

Limit:

Top ring: 0.54 mm (0.0213 in)

2nd ring: 0.65 mm (0.0256 in)

Oil ring (rail ring): 0.95 mm (0.0374 in)

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

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

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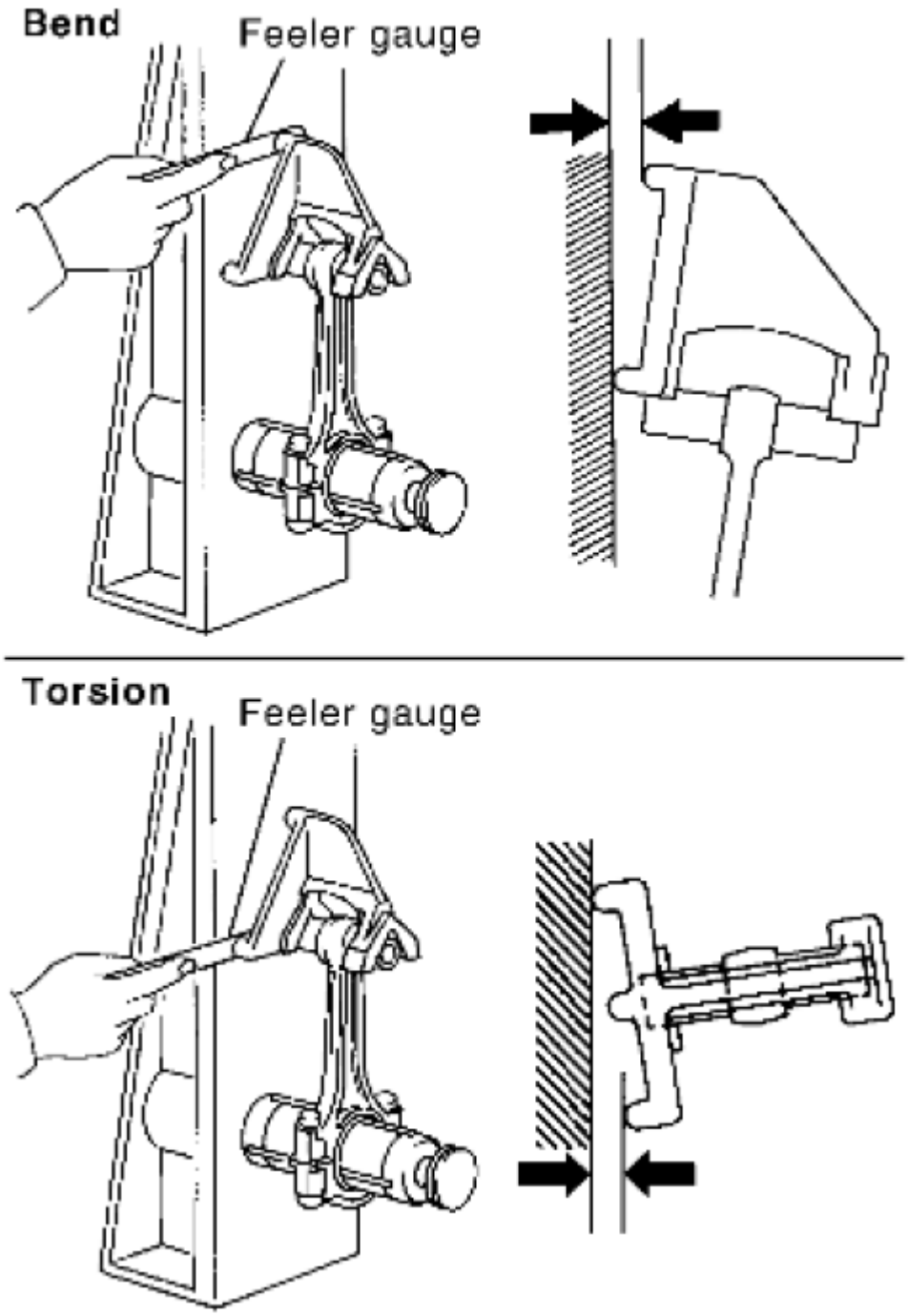


Fig. 159: Checking Connecting Rod Bend And Torsion
Courtesy of SUZUKI OF AMERICA CORP.

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 BIG END DIAMETER

- Install connecting rod bearing cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.
- Measure the inner diameter of connecting rod big end with an inside micrometer.

Example

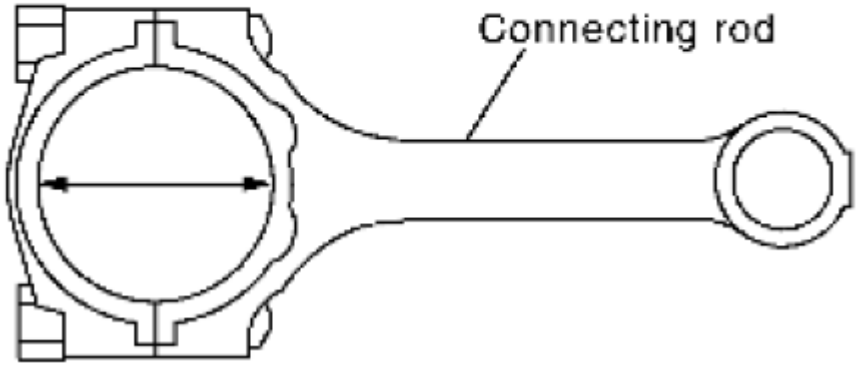


Fig. 160: Identifying Inner Diameter Of Connecting Rod Big End
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 48.000 - 48.013 mm (1.8898 - 1.8903 in)

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

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer.

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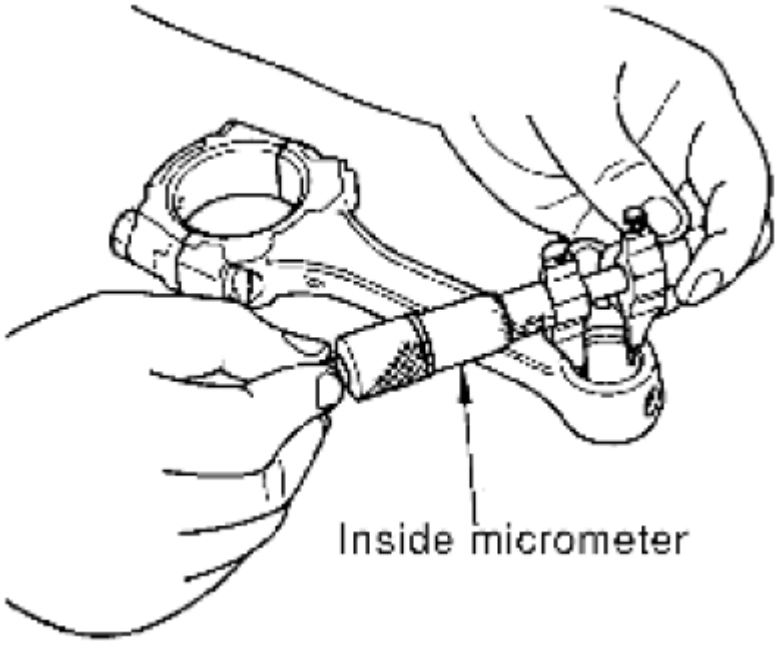


Fig. 161: Measuring Connecting Rod Bushing Inner Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Standard: 20.000 - 20.012 mm (0.7874 - 0.7879 in)

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

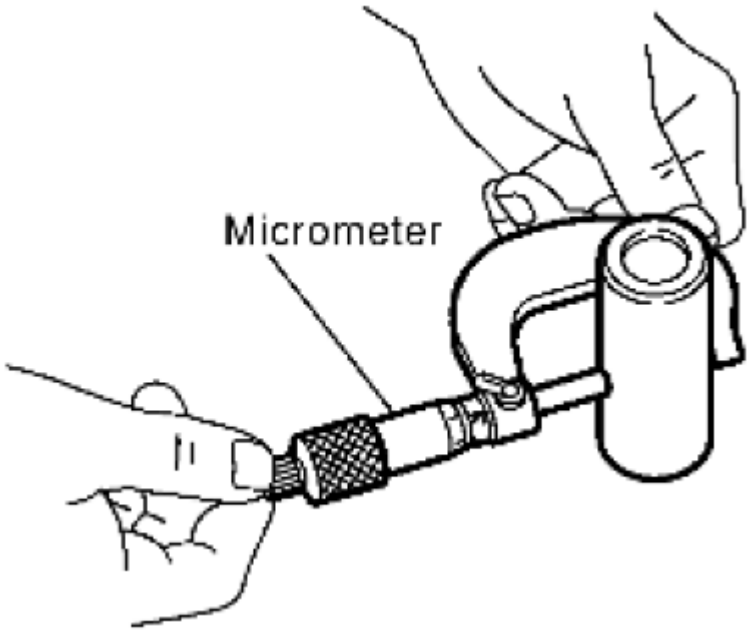


Fig. 162: Measuring Piston Pin Outer Diameter

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Courtesy of SUZUKI OF AMERICA CORP.

Standard: 19.989 - 20.001 mm (0.7870 - 0.7874 in)

Connecting Rod Bushing Oil Clearance

(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)

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to [**SERVICE DATA AND SPECIFICATIONS**].
- If replacing connecting rod assembly, refer to [**SERVICE DATA AND SPECIFICATIONS**] to select connecting rod bearing.

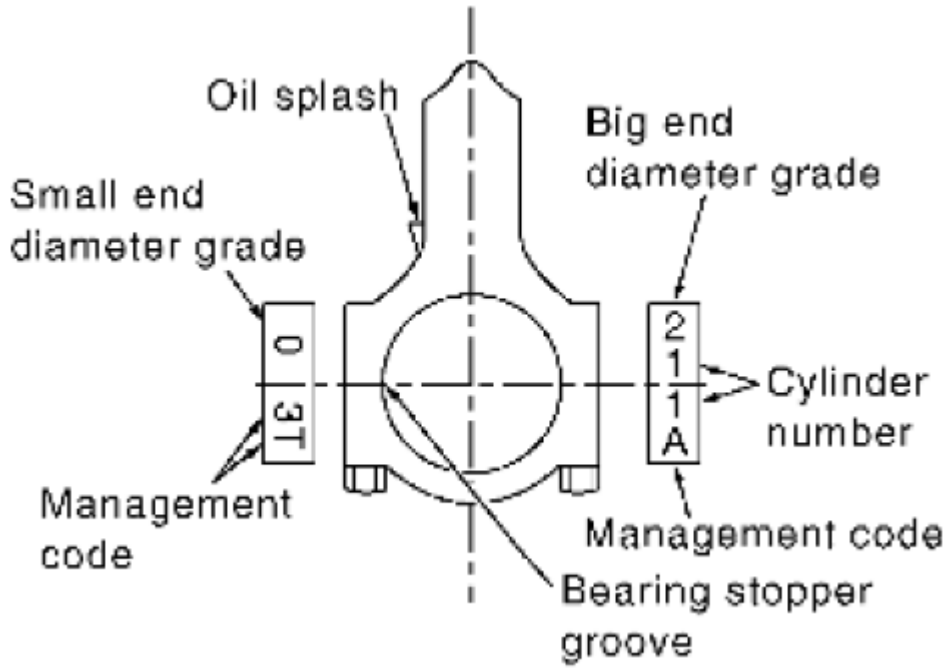


Fig. 163: Identifying Small End Diameter Grade And Cylinder Number
Courtesy of SUZUKI OF AMERICA CORP.

Factory installed parts grading:

- Service parts apply only to grade "0".

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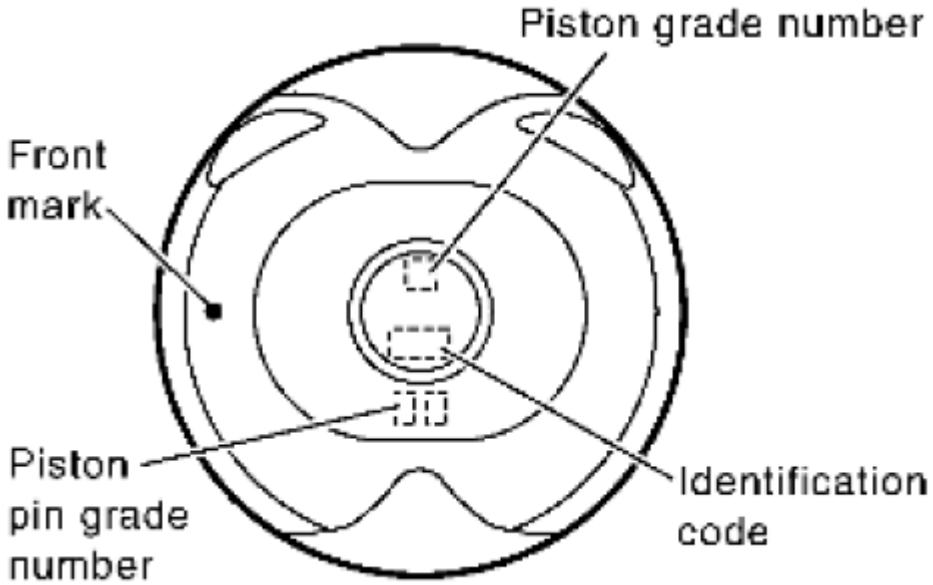


Fig. 164: Identifying Piston Pin Grade Number And Identification Code
Courtesy of SUZUKI OF AMERICA CORP.

GRADE NUMBER REFERENCE CHART

		Unit: mm (in)
Grade	**0**	**1**
Connecting rod bushing inner diameter (1)	20.000 - 20.006 (0.7874 - 0.7876)	20.006 - 20.012 (0.7876 - 0.7879)
Piston pin hole diameter	19.993 - 19.999 (0.7871 - 0.7874)	19.999 - 20. 005 (0.7874 - 0.7876)
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	19.995 - 20.001 (0.7872 - 0.7874)
(1) After installing in connecting rod.		

CYLINDER BLOCK DISTORTION

- Remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination; using suitable tool.

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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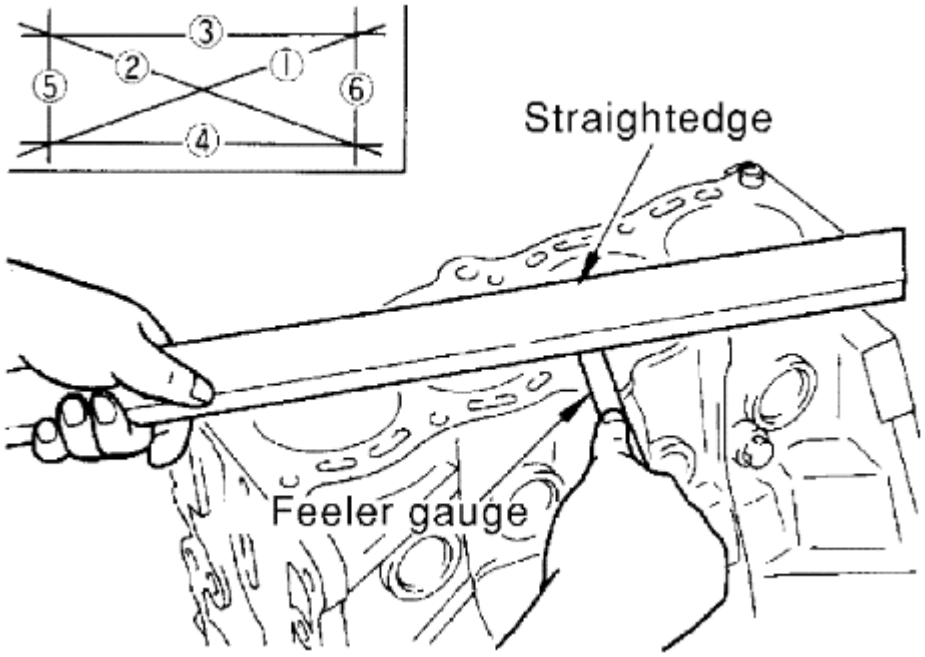


Fig. 165: Measuring Cylinder Block Distortion
Courtesy of SUZUKI OF AMERICA CORP.

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block and lower cylinder block assembly.

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

MAIN BEARING HOUSING INNER DIAMETER

- Install lower cylinder block without main bearings installed, 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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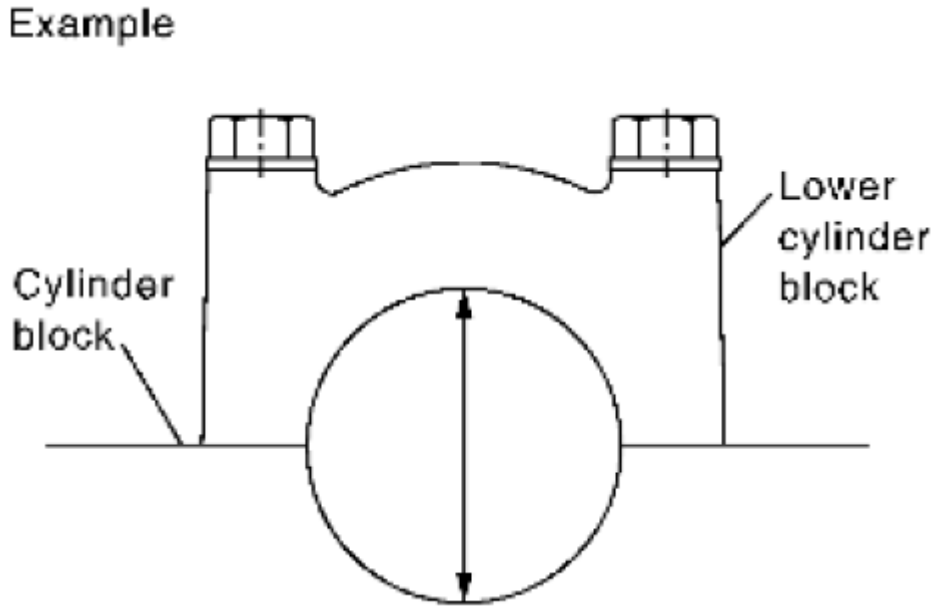


Fig. 166: Identifying Main Bearing Housing Inner Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- Measure the inner diameter of main bearing housing with a bore gauge.

  Standard: 58.944 - 58.968 mm (2.3206 - 2.3216 in)

- If out of the standard, replace cylinder block and lower cylinder block 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 a bore gauge, measure the 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)] [(Y) is in longitudinal direction of the engine].

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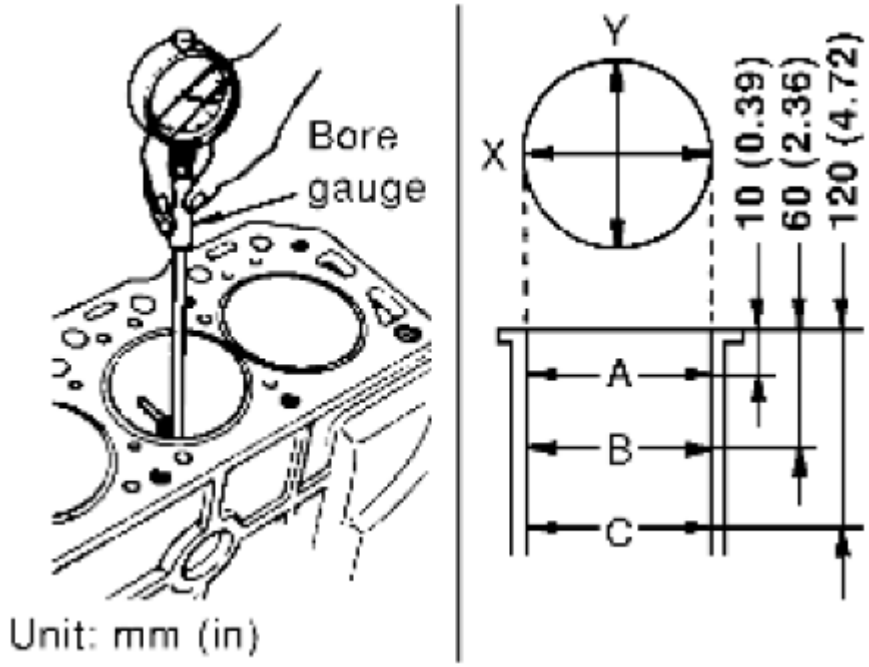


Fig. 167: Measuring Cylinder Bore Inner Diameter
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: When determining cylinder bore grade, measure cylinder bore at (B) position.

Standard inner diameter:

89.010 - 89.030 mm (3.5043 - 3.5051 in)

Wear limit:

0.2 mm (0.008 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 cylinder inner wall.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer.

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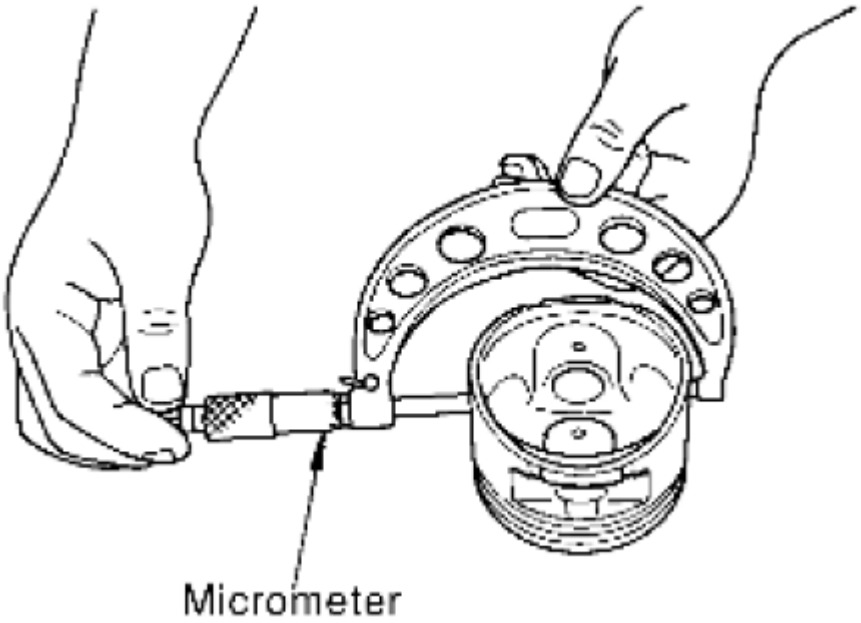


Fig. 168: Measuring Outer Diameter Of Piston Skirt
Courtesy of SUZUKI OF AMERICA CORP.

Measure point

: Distance from the top 42.98 mm (1.692 in)

Standard

: 88.990 - 89.010 mm (3.5035 - 3.5043 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 it 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

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where,

D: Bored diameter

A: Piston 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 bolts to the specified torque. Otherwise, cylinder bores may be distorted in final assembly. Refer to [**ENGINE UNIT: DISASSEMBLY AND ASSEMBLY**] for the tightening procedure.
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.
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 a micrometer.

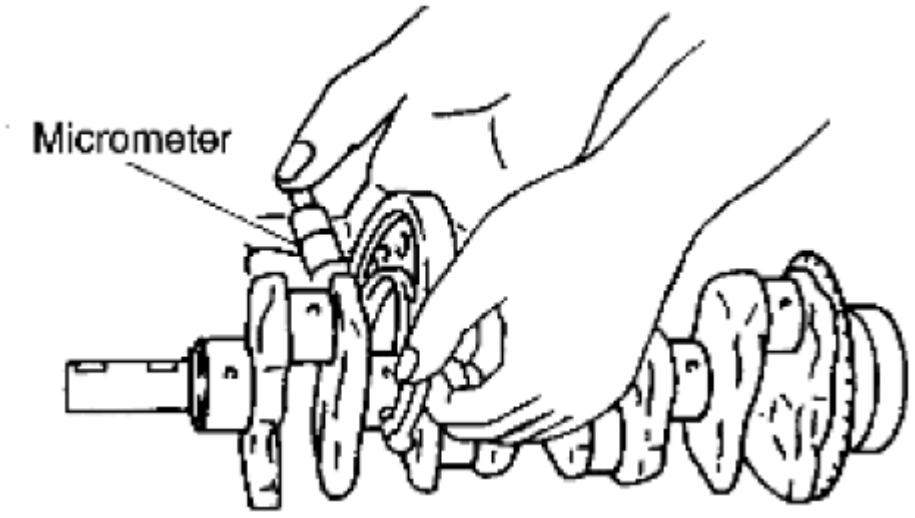


Fig. 169: Measuring Outer Diameter Of Crankshaft Main Journal

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Courtesy of SUZUKI OF AMERICA CORP.

Standard: 54.955 - 54.979 mm (2.1636 - 2.1645 in) dia.

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer.

Standard: 44.956 - 44.974 mm (1.7699-1.7706 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure the dimensions at four different points as shown on each main journal and pin journal with a micrometer.

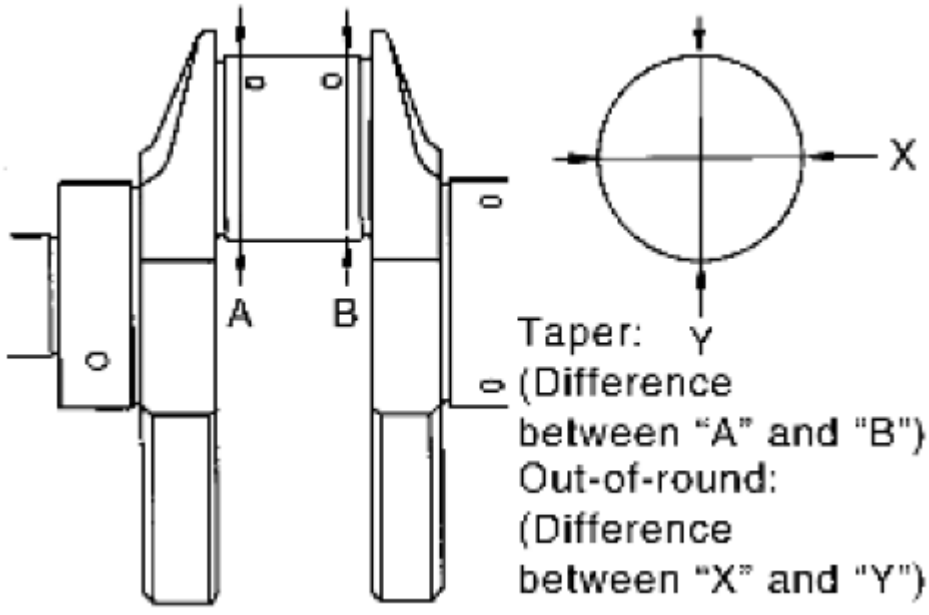


Fig. 170: Identifying Main Journal Dimensions
Courtesy of SUZUKI OF AMERICA CORP.

- Out-of-round is indicated by the difference in dimensions between (X) and (Y) at (A) and (B).
- Taper is indicated by the difference in dimension between (A) and (B) at (X) and (Y).

Limit:

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Out-of-round [Difference between (X) and (Y)]

: 0.0025 mm (0.0001 in)

Taper [Difference between (A) and (B)]

: 0.0025 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 main bearing and/or connecting rod bearing. Refer to [**SERVICE DATA AND SPECIFICATIONS**].

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of crankshaft.

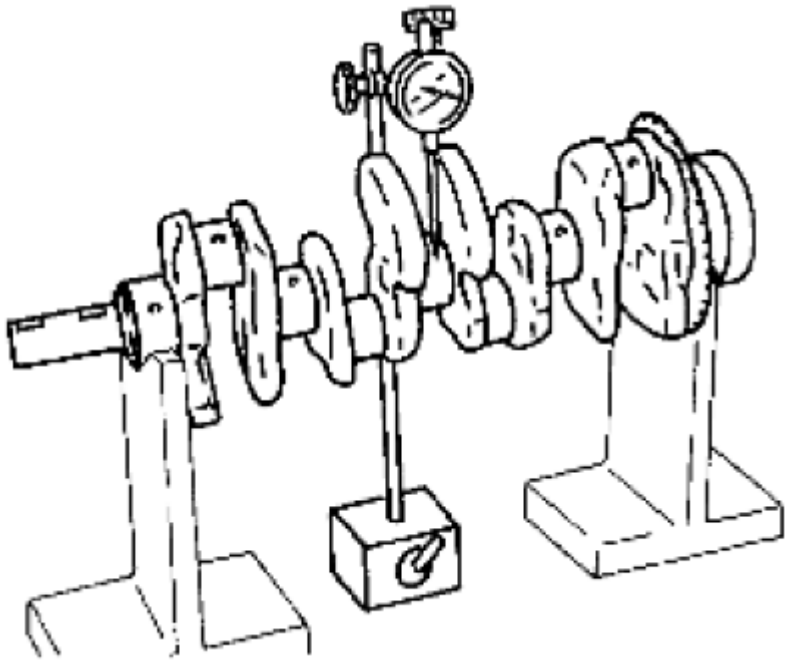


Fig. 171: Measuring Crankshaft Runout
Courtesy of SUZUKI OF AMERICA CORP.

- Place a dial indicator straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial indicator. (Total indicator reading)

Limit: 0.05 mm (0.0020 in)

- If it exceeds the limit, replace crankshaft.

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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 tightening procedure.
- Measure the inner diameter of connecting rod bearing with an inside micrometer.

Example

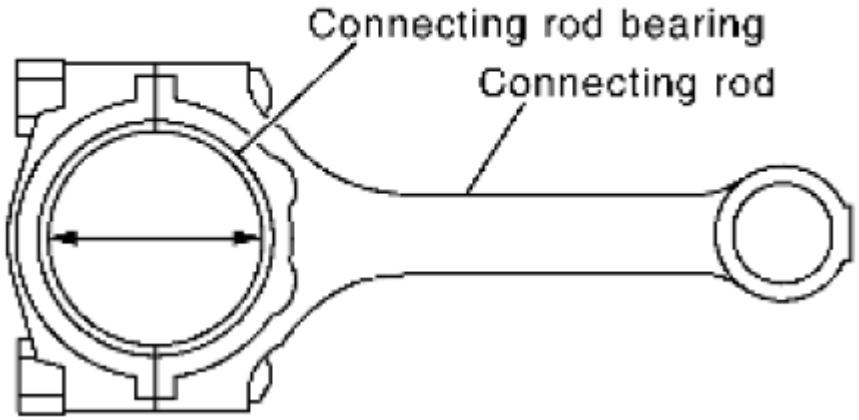


Fig. 172: Identifying Inner Diameter Of Connecting Rod Bearing
Courtesy of SUZUKI OF AMERICA CORP.

(Bearing oil clearance) = (Connecting rod bearing inner diameter) - (Crankshaft pin journal diameter)

Standard: 0.035 - 0.045 mm (0.0014 - 0.0018 in)

- If the clearance 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 engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a 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.

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- Remove connecting rod cap and bearing, and using the scale on the plastigage bag, measure the plastigage width.

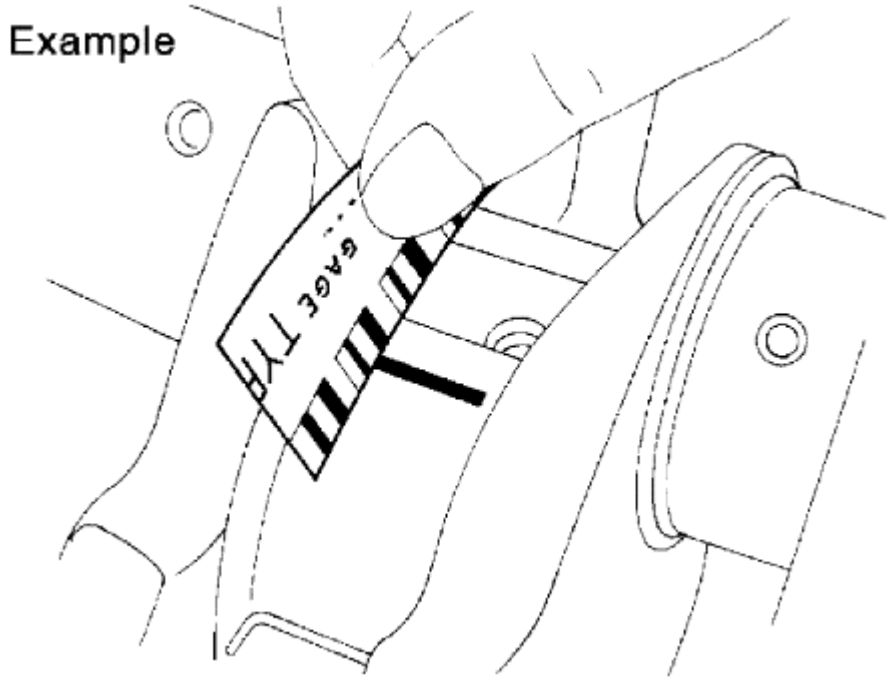


Fig. 173: Measuring Plastigage Width
Courtesy of SUZUKI OF AMERICA CORP.

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.
- Measure the inner diameter of main bearing with a bore gauge.

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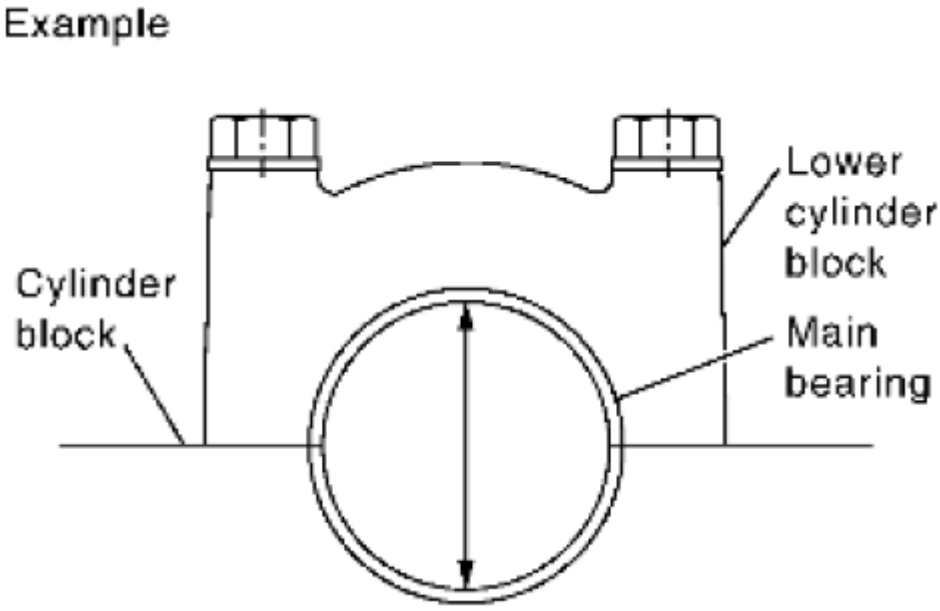


Fig. 174: Identifying Inner Diameter Of Main Bearing
Courtesy of SUZUKI OF AMERICA CORP.

(Bearing oil clearance) = (Main bearing inner diameter) - (Crankshaft main journal diameter)

Standard:

No. 1, 3 and 5 journals: 0.028 - 0.042 mm (0.0011 - 0.0017 in)

No. 2 and 4 journals: 0.041 - 0.056 mm (0.0016 - 0.0022 in)

Limit: 0.1 mm (0.004 in)

- If the clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain the 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 a 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.

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- Remove lower cylinder block and bearings, and using the scale on the plastigage bag, measure the plastigage width.

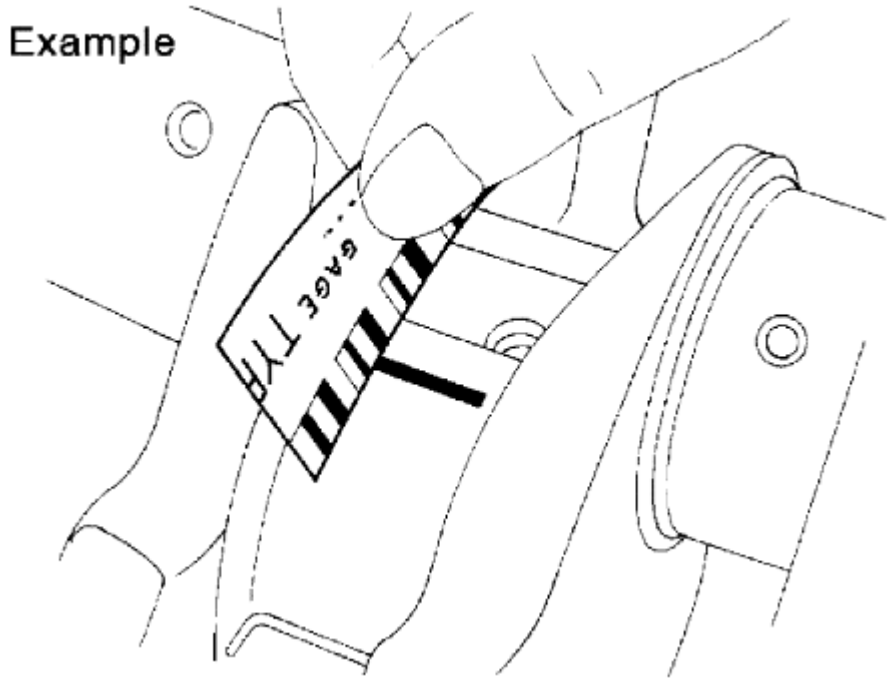


Fig. 175: Measuring Plastigage Width
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: The procedure when the measured value exceeds the limit is same as that described in the "METHOD BY CALCULATION".

MAIN BEARING CRUSH HEIGHT

- 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.

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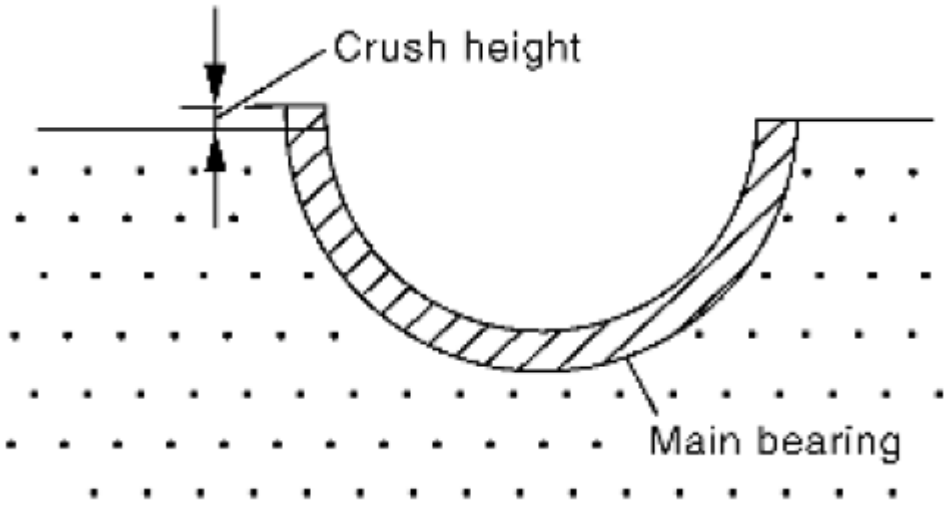


Fig. 176: Identifying Main Bearing Crush Height
Courtesy of SUZUKI OF AMERICA CORP.

Standard: There must be crush height.

- If the standard is not met, replace main bearings.

CONNECTING ROD BEARING CRUSH HEIGHT

- 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.

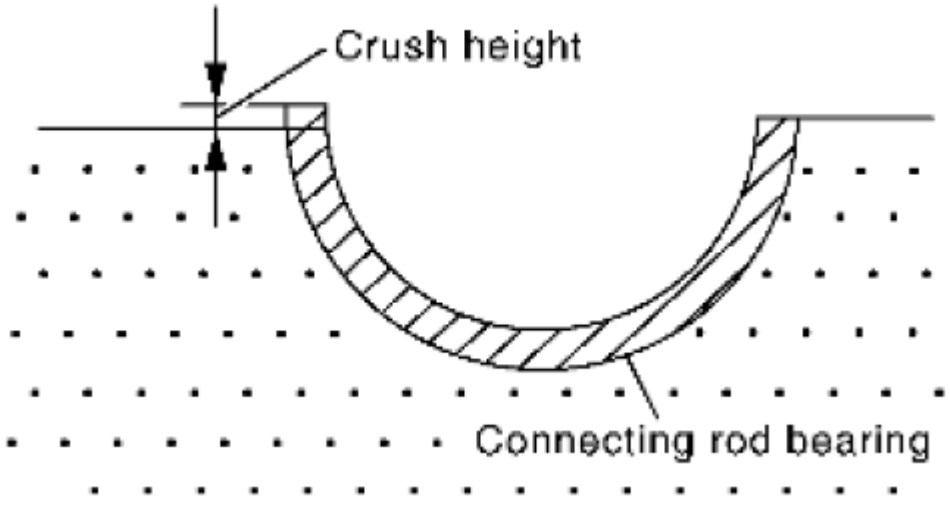


Fig. 177: Identifying Connecting Rod Bearing Crush Height
Courtesy of SUZUKI OF AMERICA CORP.

Standard: There must be crush height.

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- If the standard is not met, replace connecting rod bearings.

LOWER CYLINDER BLOCK MOUNTING BOLT OUTER DIAMETER

- Perform only with M10 bolts.
- Measure the outer diameters [(d_1), (d_2)] at two positions as shown.

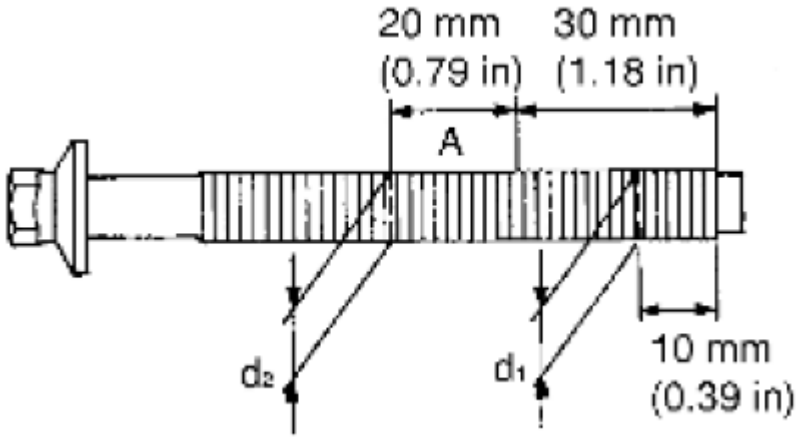


Fig. 178: Identifying Lower Cylinder Block Mounting Bolt Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- If reduction appears in (A) range, regard it as (d2).

  Limit [(d_1)-(d_2)]: 0.13 mm (0.0051 in)

- If it exceeds the limit (a large difference in dimensions), replace lower cylinder block bolt with a new one.

CONNECTING ROD BOLT OUTER DIAMETER

- Measure the outer diameter (d) at position as shown.

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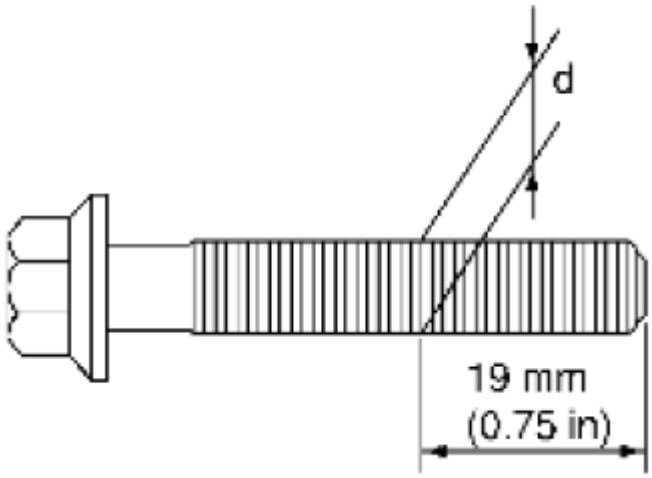


Fig. 179: Identifying Connecting Rod Bolt Outer Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- If reduction appears in a position other than (d), regard it as (d).

  Limit: 7.75 mm (0.3051 in)

- When (d) falls below the limit (when it becomes thinner), replace connecting rod bolt 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

- 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).

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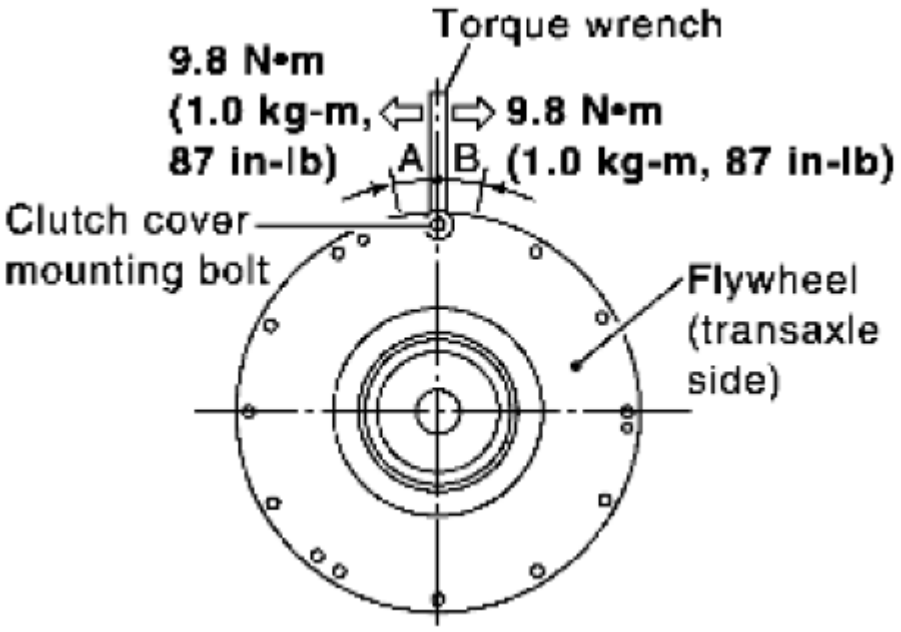


Fig. 180: Identifying Dimensions Of Movement Amounts On Circumference Of Flywheel
Courtesy of SUZUKI OF AMERICA CORP.

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.

DRIVE PLATE (A/T MODELS)

- Check drive plate and signal plate for deformation or cracks.

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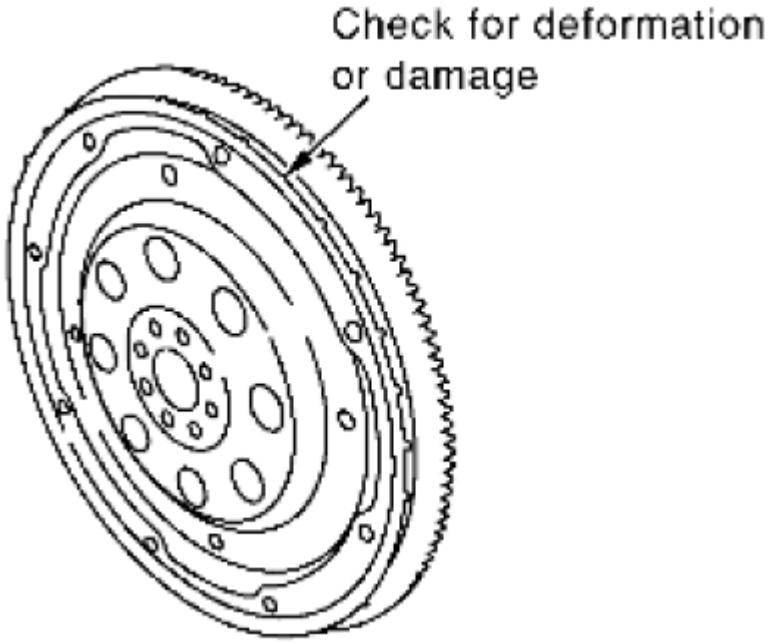


Fig. 181: Identifying Drive Plate Deformation Or Damage Checking Position
Courtesy of SUZUKI OF AMERICA CORP.

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.

HOW TO SELECT PISTON AND BEARING

DESCRIPTION

PISTON AND BEARING SELECTION METHODS

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.

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Between cylinder block and piston	Piston and piston pin assembly (piston is available together with piston pin as an assembly.)	Piston grade (piston skirt diameter)	Piston grade = cylinder bore grade (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 grade "0" 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 on rear-left side of cylinder block, and select piston of the same grade.

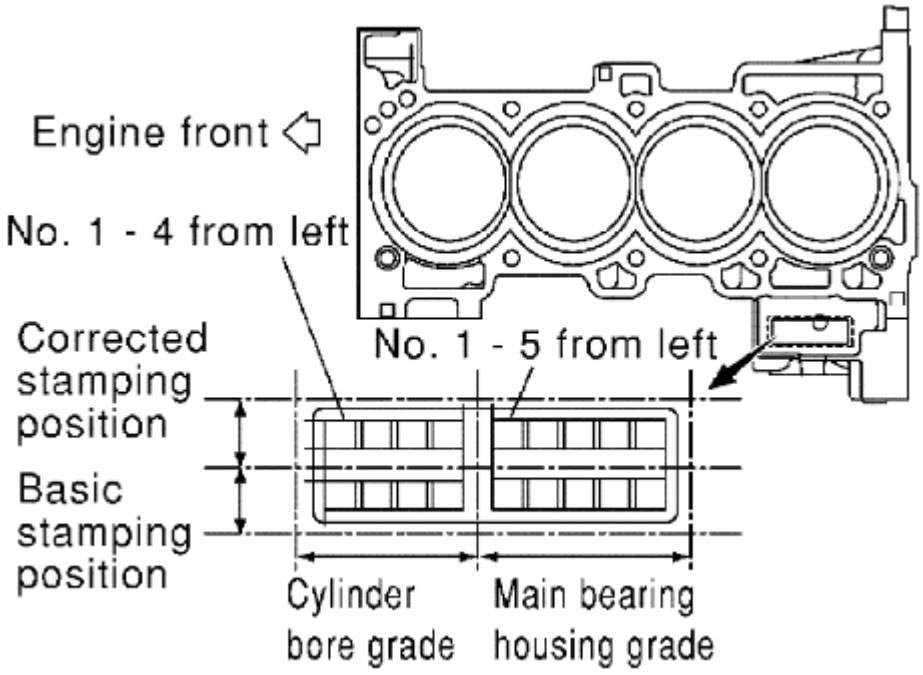


Fig. 182: Identifying Cylinder Bore Grade
Courtesy of SUZUKI OF AMERICA CORP.

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- If there is a corrected stamp mark on cylinder block, use it as a correct reference.

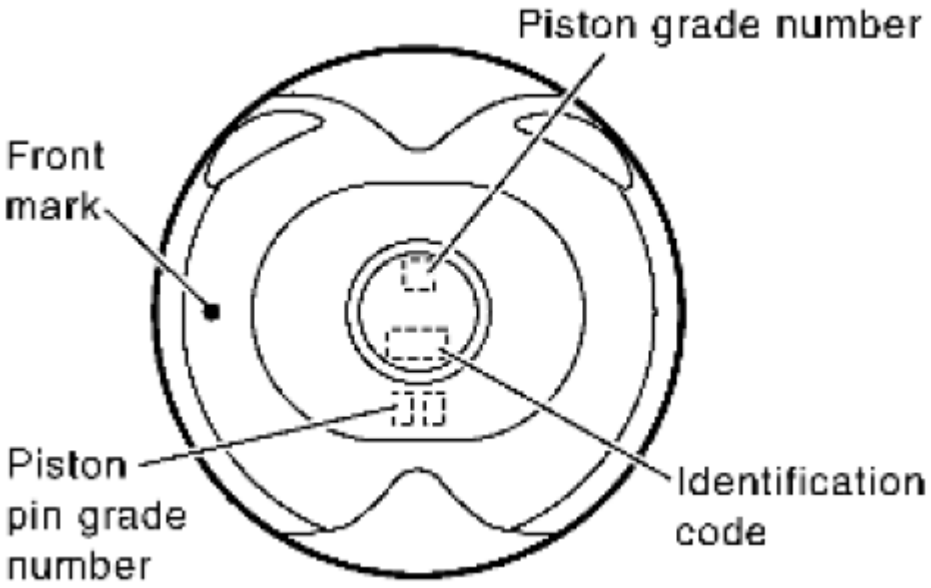


Fig. 183: Identifying Piston And Piston Pin Grade Number
Courtesy of SUZUKI OF AMERICA CORP.

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".
3. Select piston of the same grade.

Piston Selection Table

PISTON SELECTION REFERENCE CHART

		Unit: mm (in)
Grade number (Mark)	**2 (or no mark)**	**3**
Cylinder bore Inner diameter	89.010 - 89.020 (3.5043 - 3.5047)	89.020 - 89.030 (3.5047 - 3.5051)
Piston skirt diameter	88.990 - 89.000 (3.5035 - 3.5039)	89.000 - 89.010 (3.5039 - 3.5043)

NOTE:

- **There is no piston grade "1".**
- **Piston is available together with piston pin as an assembly.**
- **The piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)**

HOW TO SELECT CONNECTING ROD BEARING

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When New Connecting Rod and Crankshaft Are Used

1. Apply connecting rod big end diameter grade stamped on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

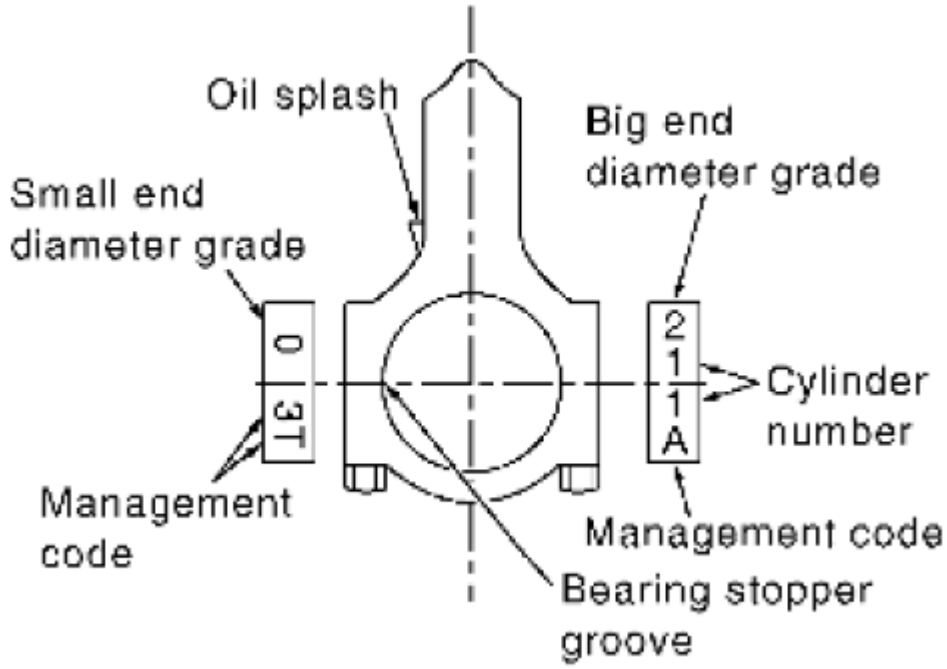


Fig. 184: Identifying Connecting Rod Small And Big End Diameter Grade
Courtesy of SUZUKI OF AMERICA CORP.

2. Apply crankshaft pin journal diameter grade stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".

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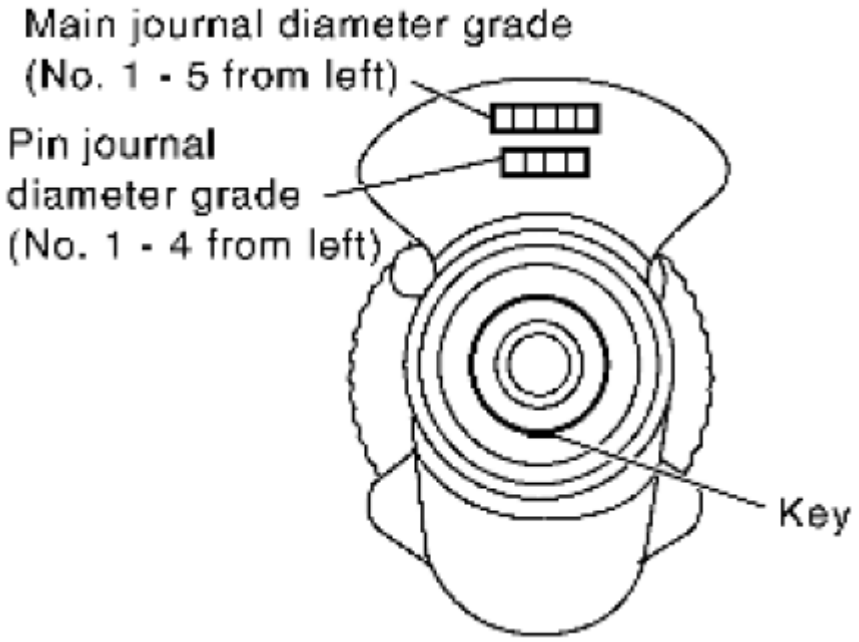


Fig. 185: Identifying Crankshaft Pin Journal Diameter Grade And Main Journal Diameter Grade
Courtesy of SUZUKI OF AMERICA CORP.

3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

When Crankshaft and Connecting Rod Are Reused

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**] and [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
2. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

Connecting Rod Bearing Selection Table

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Crankshaft pin journal diameter / Mark	Outer diameter Unit: mm (in)	Connecting rod big end diameter / Mark	0	1	2	3	4	5	6	7	8	9	A	B	C
		Inner diameter Unit: mm (in)	48.000 - 48.001 (1.8898 - 1.8898)	48.001 - 48.002 (1.8898 - 1.8898)	48.002 - 48.003 (1.8898 - 1.8899)	48.003 - 48.004 (1.8899 - 1.8899)	48.004 - 48.005 (1.8899 - 1.8900)	48.005 - 48.006 (1.8900 - 1.8900)	48.006 - 48.007 (1.8900 - 1.8900)	48.007 - 48.008 (1.8900 - 1.8901)	48.008 - 48.009 (1.8901 - 1.8901)	48.009 - 48.010 (1.8901 - 1.8902)	48.010 - 48.011 (1.8902 - 1.8902)	48.011 - 48.012 (1.8902 - 1.8902)	48.012 - 48.013 (1.8902 - 1.8903)
A	44.974 - 44.973 (1.7706 - 1.7706)		0	0	0	0	01	01	01	1	1	1	12	12	12
B	44.973 - 44.972 (1.7706 - 1.7705)		0	0	0	01	01	01	1	1	1	12	12	12	2
C	44.972 - 44.971 (1.7705 - 1.7705)		0	0	01	01	01	1	1	1	12	12	12	2	2
D	44.971 - 44.970 (1.7705 - 1.7705)		0	01	01	01	1	1	1	12	12	12	2	2	2
E	44.970 - 44.969 (1.7705 - 1.7704)		01	01	01	1	1	1	12	12	12	2	2	2	23
F	44.969 - 44.968 (1.7704 - 1.7704)		01	01	1	1	1	12	12	12	2	2	2	23	23
G	44.968 - 44.967 (1.7704 - 1.7704)		01	1	1	1	12	12	12	2	2	2	23	23	23
H	44.967 - 44.966 (1.7704 - 1.7703)		1	1	1	12	12	12	2	2	2	23	23	23	3
J	44.966 - 44.965 (1.7703 - 1.7703)		1	1	12	12	12	2	2	2	23	23	23	3	3
K	44.965 - 44.964 (1.7703 - 1.7702)		1	12	12	12	2	2	2	23	23	23	3	3	3
L	44.964 - 44.963 (1.7702 - 1.7702)		12	12	12	2	2	2	23	23	23	3	3	3	34
M	44.963 - 44.962 (1.7702 - 1.7701)		12	12	2	2	2	23	23	23	3	3	3	34	34
N	44.962 - 44.961 (1.7702 - 1.7701)		12	2	2	2	23	23	23	3	3	3	34	34	34
P	44.961 - 44.960 (1.7701 - 1.7701)		2	2	2	23	23	23	3	3	3	34	34	34	4
R	44.960 - 44.959 (1.7701 - 1.7700)		2	2	23	23	23	3	3	3	34	34	34	4	4
S	44.959 - 44.958 (1.7700 - 1.7700)		2	23	23	23	3	3	3	34	34	34	4	4	4
T	44.958 - 44.957 (1.7700 - 1.7700)		23	23	23	3	3	3	34	34	34	4	4	4	4
U	44.957 - 44.956 (1.7700 - 1.7699)		23	23	3	3	3	34	34	34	4	4	4	4	4

Fig. 186: Connecting Rod Bearing Selection Reference Chart
Courtesy of SUZUKI OF AMERICA CORP.

Connecting Rod Bearing Grade Table

CONNECTING ROD BEARING GRADE REFERENCE CHART

Unit: mm (in)

Grade number	0	1	2	3	4
Thickness	1.493 - 1.496 (0.0588 -	1.496 - 1.499 (0.0589 -	1.499 - 1.502 (0.0590 -	1.502 - 1.505 (0.0591 -	1.505 - 1.508 (0.0593 -

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	0.0589)	0.0590)	0.0591)	0.0593)	0.0594)
Identification color	Black	Brown	Green	Yellow	Blue

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 the 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)].

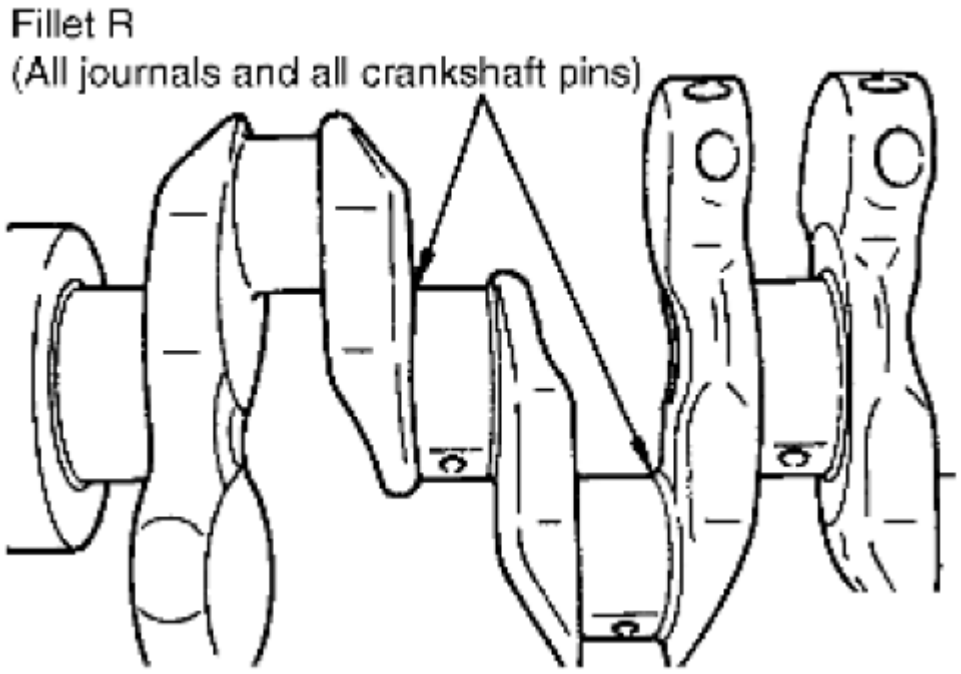


Fig. 187: Identifying Fillet R
Courtesy of SUZUKI OF AMERICA CORP.

Bearing undersize table

BEARING UNDERSIZE REFERENCE CHART

	Unit: mm (in)
Size	**Thickness**
US 0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0642)

HOW TO SELECT MAIN BEARING

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When New Cylinder Block and Crankshaft Are Used

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear-left side of cylinder block.

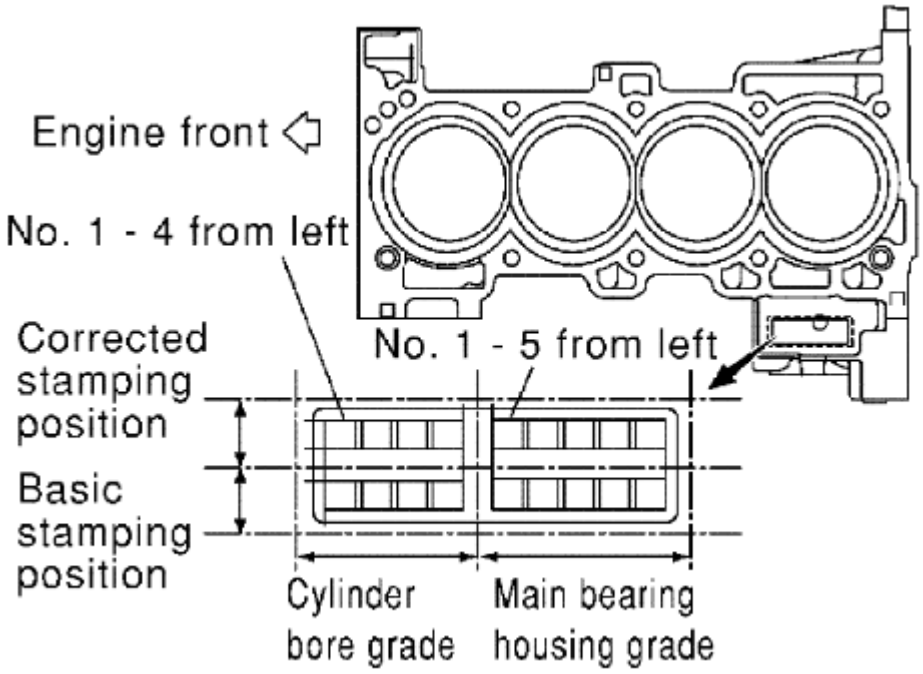


Fig. 188: Identifying Main Bearing Housing Grade And Cylinder Bore Grade
Courtesy of SUZUKI OF AMERICA CORP.

   - If there is a corrected stamp mark on cylinder block, use it as a correct reference.
2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".

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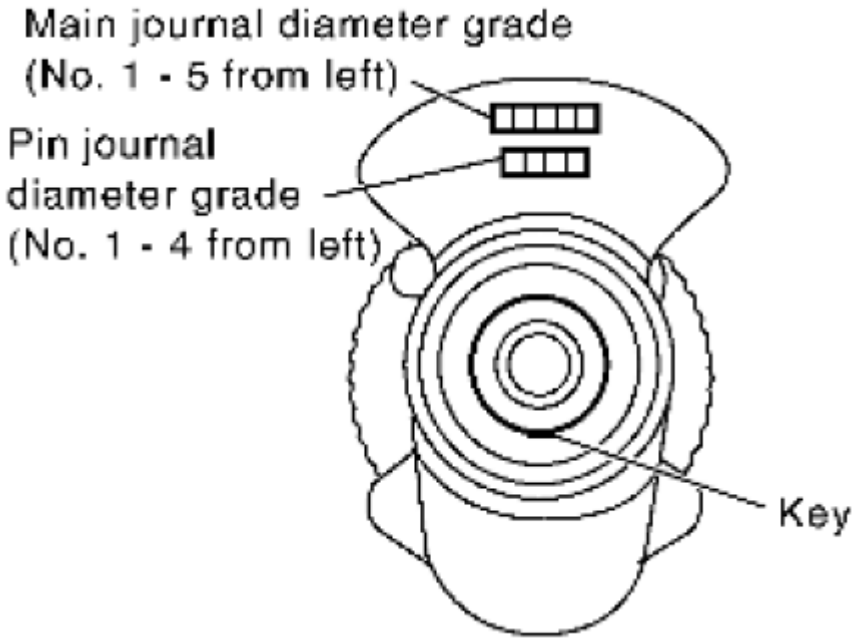


Fig. 189: Identifying Crankshaft Pin Journal Diameter Grade And Main Journal Diameter Grade
Courtesy of SUZUKI OF AMERICA CORP.

3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

CAUTION: There are two main bearing selection tables. One is for odd-numbered journals (No. 1, 3 and 5) and the other is for even-numbered journals (No. 2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE: Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**] and [**ENGINE UNIT: INSPECTION AFTER DISASSEMBLY**].
2. Apply the measured dimension to the "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

CAUTION: There are two main bearing selection tables. One is for odd-numbered journals (No. 1, 3 and 5) and the other is for even-numbered journals (No. 2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.

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4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE: Service part is available as a set of both upper and lower.

Main Bearing Selection Table (No. 1, 3 and 5 journals)

Crankshaft main journal diameter: Mark / Outer diameter Unit: mm (in)	Cylinder block main bearing housing inner diameter: Mark / Inner diameter Unit: mm (in)	A 58.944 - 58.945 (2.3206 - 2.3207)	B 58.945 - 58.946 (2.3207 - 2.3207)	C 58.946 - 58.947 (2.3207 - 2.3207)	D 58.947 - 58.948 (2.3207 - 2.3208)	E 58.948 - 58.949 (2.3208 - 2.3208)	F 58.949 - 58.950 (2.3208 - 2.3209)	G 58.950 - 58.951 (2.3209 - 2.3209)	H 58.951 - 58.952 (2.3209 - 2.3209)	J 58.952 - 58.953 (2.3209 - 2.3210)	K 58.953 - 58.954 (2.3210 - 2.3210)	L 58.954 - 58.955 (2.3210 - 2.3211)	M 58.955 - 58.956 (2.3211 - 2.3211)	N 58.956 - 58.957 (2.3211 - 2.3211)	P 58.957 - 58.958 (2.3211 - 2.3212)	R 58.958 - 58.959 (2.3212 - 2.3212)	S 58.959 - 58.960 (2.3212 - 2.3213)	T 58.960 - 58.961 (2.3213 - 2.3213)	U 58.961 - 58.962 (2.3213 - 2.3213)	V 58.962 - 58.963 (2.3213 - 2.3214)	W 58.963 - 58.964 (2.3214 - 2.3214)	X 58.964 - 58.965 (2.3214 - 2.3215)	Y 58.965 - 58.966 (2.3215 - 2.3215)	4 58.966 - 58.967 (2.3215 - 2.3215)	7 58.967 - 58.968 (2.3215 - 2.3216)
A	54.979 - 54.978 (2.1645 - 2.1645)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
B	54.978 - 54.977 (2.1645 - 2.1644)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
C	54.977 - 54.976 (2.1644 - 2.1644)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
D	54.976 - 54.975 (2.1644 - 2.1644)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
E	54.975 - 54.974 (2.1644 - 2.1643)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
F	54.974 - 54.973 (2.1643 - 2.1643)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
G	54.973 - 54.972 (2.1643 - 2.1642)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
H	54.972 - 54.971 (2.1642 - 2.1642)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
J	54.971 - 54.970 (2.1642 - 2.1642)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
K	54.970 - 54.969 (2.1642 - 2.1641)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
L	54.969 - 54.968 (2.1641 - 2.1641)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
M	54.968 - 54.967 (2.1641 - 2.1641)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
N	54.967 - 54.966 (2.1641 - 2.1640)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
P	54.966 - 54.965 (2.1640 - 2.1640)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
R	54.965 - 54.964 (2.1640 - 2.1639)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
S	54.964 - 54.963 (2.1639 - 2.1639)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
T	54.963 - 54.962 (2.1639 - 2.1639)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
U	54.962 - 54.961 (2.1639 - 2.1638)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
V	54.961 - 54.960 (2.1638 - 2.1638)	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
W	54.960 - 54.959 (2.1638 - 2.1637)	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
X	54.959 - 54.958 (2.1637 - 2.1637)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
Y	54.958 - 54.957 (2.1637 - 2.1637)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7
4	54.957 - 54.956 (2.1637 - 2.1636)	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7
7	54.956 - 54.955 (2.1636 - 2.1636)	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7	7

Fig. 190: Main Bearing Selection Reference Chart (No. 1, 3 And 5 Journals)
Courtesy of SUZUKI OF AMERICA CORP.

Main Bearing Selection Table (No. 2 and 4 journals)

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Crankshaft main journal diameter / Cylinder block main bearing housing inner diameter		Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
		Inner diameter Unit: mm (in)	58.2410 - 58.2413 (2.3206 - 2.3207)	58.2414 - 58.2417 (2.3207 - 2.3207)	58.2418 - 58.2421 (2.3207 - 2.3207)	58.2422 - 58.2425 (2.3207 - 2.3208)	58.2426 - 58.2429 (2.3208 - 2.3208)	58.2430 - 58.2433 (2.3208 - 2.3209)	58.2434 - 58.2437 (2.3209 - 2.3209)	58.2438 - 58.2441 (2.3209 - 2.3209)	58.2442 - 58.2445 (2.3209 - 2.3210)	58.2446 - 58.2449 (2.3210 - 2.3210)	58.2450 - 58.2453 (2.3210 - 2.3211)	58.2454 - 58.2457 (2.3211 - 2.3211)	58.2458 - 58.2461 (2.3211 - 2.3211)	58.2462 - 58.2465 (2.3211 - 2.3212)	58.2466 - 58.2469 (2.3212 - 2.3212)	58.2470 - 58.2473 (2.3212 - 2.3213)	58.2474 - 58.2477 (2.3213 - 2.3213)	58.2478 - 58.2481 (2.3213 - 2.3213)	58.2482 - 58.2485 (2.3213 - 2.3214)	58.2486 - 58.2489 (2.3214 - 2.3214)	58.2490 - 58.2493 (2.3214 - 2.3215)	58.2494 - 58.2497 (2.3215 - 2.3215)	58.2498 - 58.2501 (2.3215 - 2.3215)	58.2502 - 58.2505 (2.3215 - 2.3216)	58.2506 - 58.2509 (2.3216 - 2.3216)
Mark	Outer diameter Unit: mm (in)																									
A	54.979 - 54.978 (2.1645 - 2.1645)		0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3
B	54.978 - 54.977 (2.1645 - 2.1644)		0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3
C	54.977 - 54.976 (2.1644 - 2.1644)		0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3
D	54.976 - 54.975 (2.1644 - 2.1644)		0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34
E	54.975 - 54.974 (2.1644 - 2.1643)		0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34
F	54.974 - 54.973 (2.1643 - 2.1643)		0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
G	54.973 - 54.972 (2.1643 - 2.1642)		0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
H	54.972 - 54.971 (2.1642 - 2.1642)		0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
J	54.971 - 54.970 (2.1642 - 2.1642)		01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
K	54.970 - 54.969 (2.1642 - 2.1641)		01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
L	54.969 - 54.968 (2.1641 - 2.1641)		01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
M	54.968 - 54.967 (2.1641 - 2.1641)		1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
N	54.967 - 54.966 (2.1641 - 2.1640)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
P	54.966 - 54.965 (2.1640 - 2.1640)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
R	54.965 - 54.964 (2.1640 - 2.1639)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
S	54.964 - 54.963 (2.1639 - 2.1639)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
T	54.963 - 54.962 (2.1639 - 2.1639)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
U	54.962 - 54.961 (2.1639 - 2.1638)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
V	54.961 - 54.960 (2.1638 - 2.1638)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
W	54.960 - 54.959 (2.1638 - 2.1637)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
X	54.959 - 54.958 (2.1637 - 2.1637)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
Y	54.958 - 54.957 (2.1637 - 2.1637)		23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
4	54.957 - 54.956 (2.1637 - 2.1636)		23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
7	54.956 - 54.955 (2.1636 - 2.1636)		3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67

Fig. 191: Main Bearing Selection Reference Chart (No. 2 And 4 Journals)
Courtesy of SUZUKI OF AMERICA CORP.

Main Bearing Grade Table (All Journals)

MAIN BEARING GRADE REFERENCE CHART (ALL JOURNALS)

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
0	1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2	1.979 - 1.982 (0.0779- 0.0780)	Green	
3	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	

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4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	White	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
23	UPR	1.979 - 1.982 (0.0779- 0.0780)	Green	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)	White	

Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use undersize (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 fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].

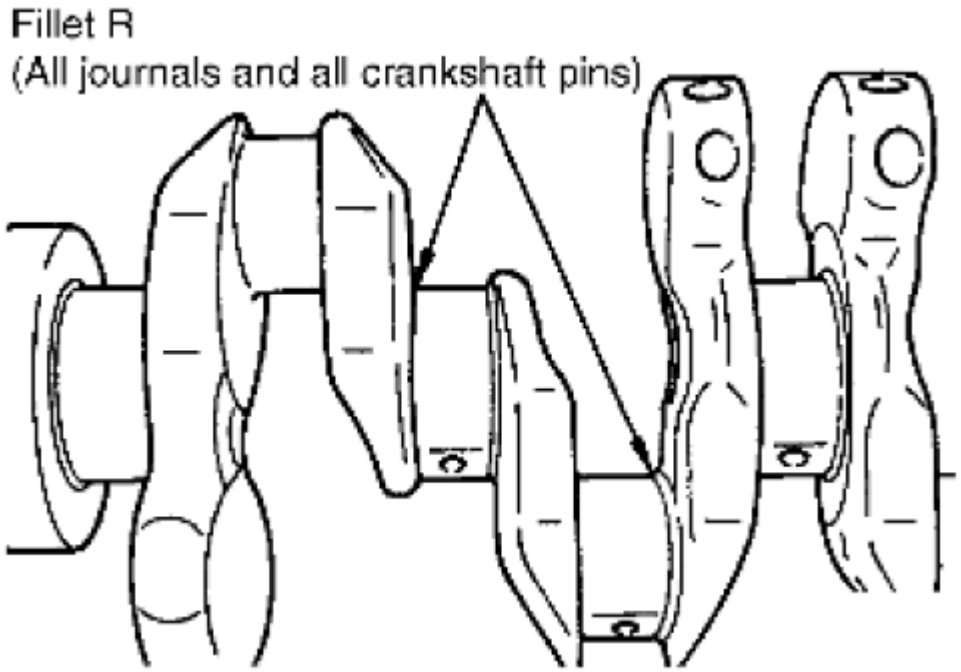


Fig. 192: Identifying Fillet R
Courtesy of SUZUKI OF AMERICA CORP.

Bearing undersize table

BEARING UNDERSIZE REFERENCE CHART

	Unit: mm (in)
Size	**Thickness**
US 0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)

SPECIFICATIONS

SERVICE DATA AND SPECIFICATIONS

Standard and Limit

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Cylinder arrangement		In-line 4
Displacement	cm^3 (cu in)	2,488 (151.82)
Bore and stroke	mm (in)	89.0 x 100.0 (3.504 x 3.937)

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Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.5
Compression pressure kPa (kg/cm^2 , psi) / 250 rpm	Standard	1,304 (13.3, 189)
	Minimum	1,108 (11.3, 161)
	Differential limit between cylinders	100 (1.0, 14)

DRIVE BELT

DRIVE BELT SPECIFICATIONS

Tension of drive belt	Auto adjustment by auto-tensioner

EXHAUST MANIFOLD AND THREE WAY CATALYST ASSEMBLY

EXHAUST MANIFOLD AND THREE WAY CATALYST ASSEMBLY SPECIFICATIONS

Unit: mm (in)

Item	Limit
Surface distortion	0.3 (0.012)

SPARK PLUG

SPARK PLUG SPECIFICATIONS

Make	NGK
Standard type	PLZKAR6A-11
Gap (nominal)	1.1 mm (0.043 in)

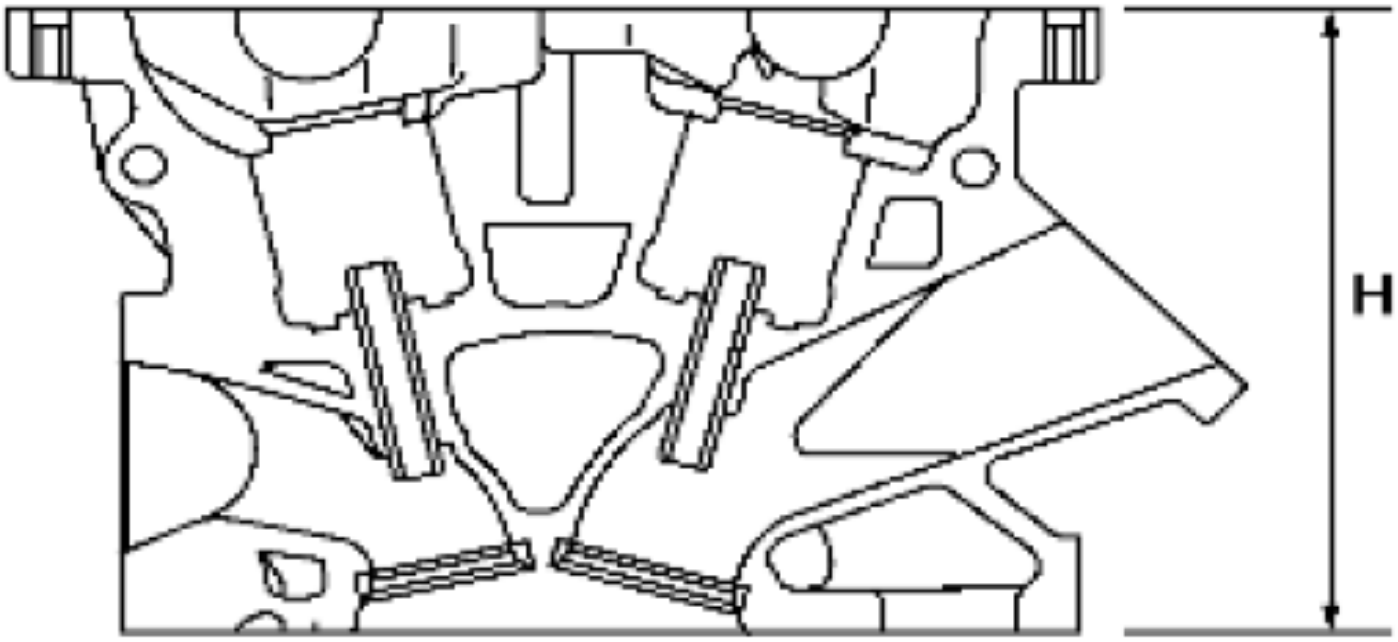
CYLINDER HEAD

CYLINDER HEAD SPECIFICATIONS

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)
Items	Standard
Camshaft bearing surface length	25.660 - 25.685 (1.0102 - 1.0112)

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Nominal cylinder head height:
H = 129.4 mm (5.09 in)

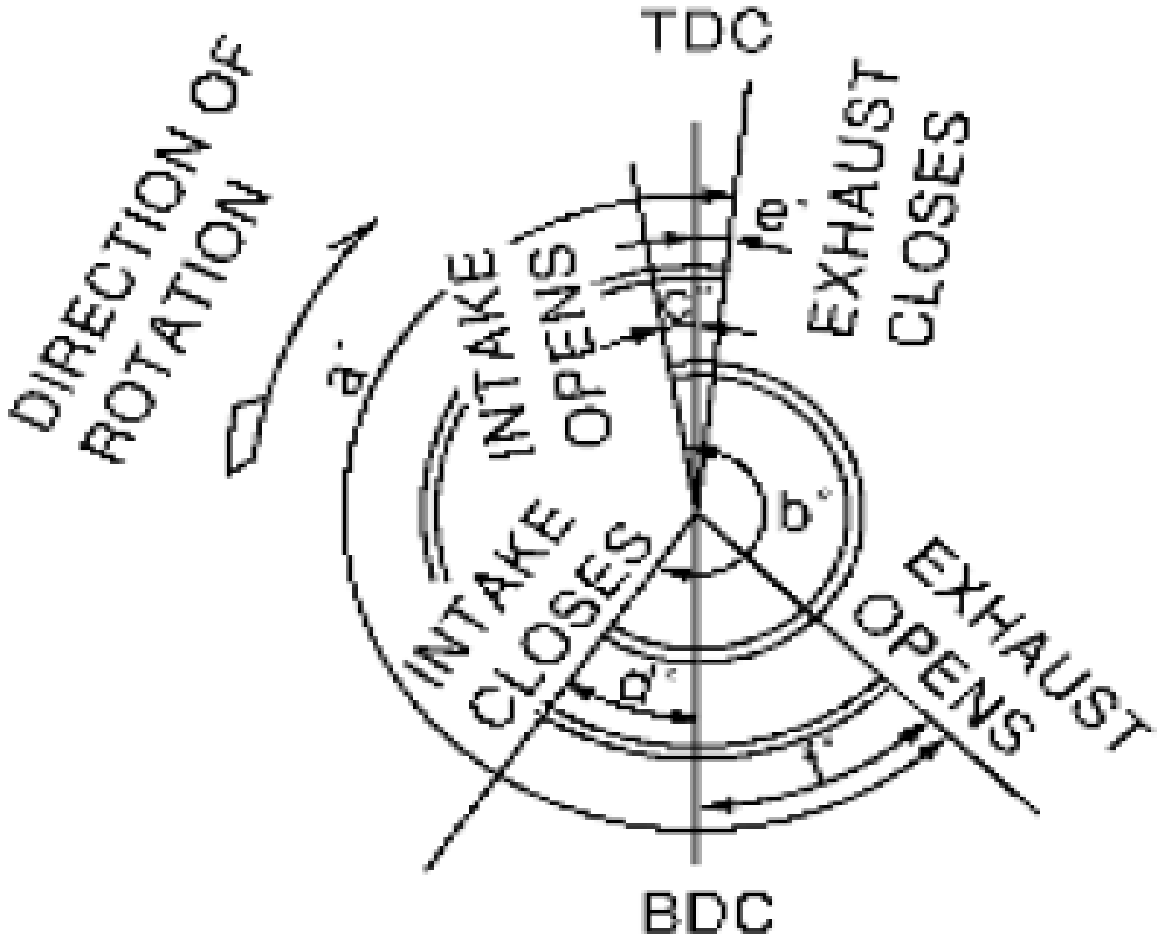
VALVE

Valve Timing

VALVE TIMING REFERENCE CHART

Valve timing	

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Unit: degree

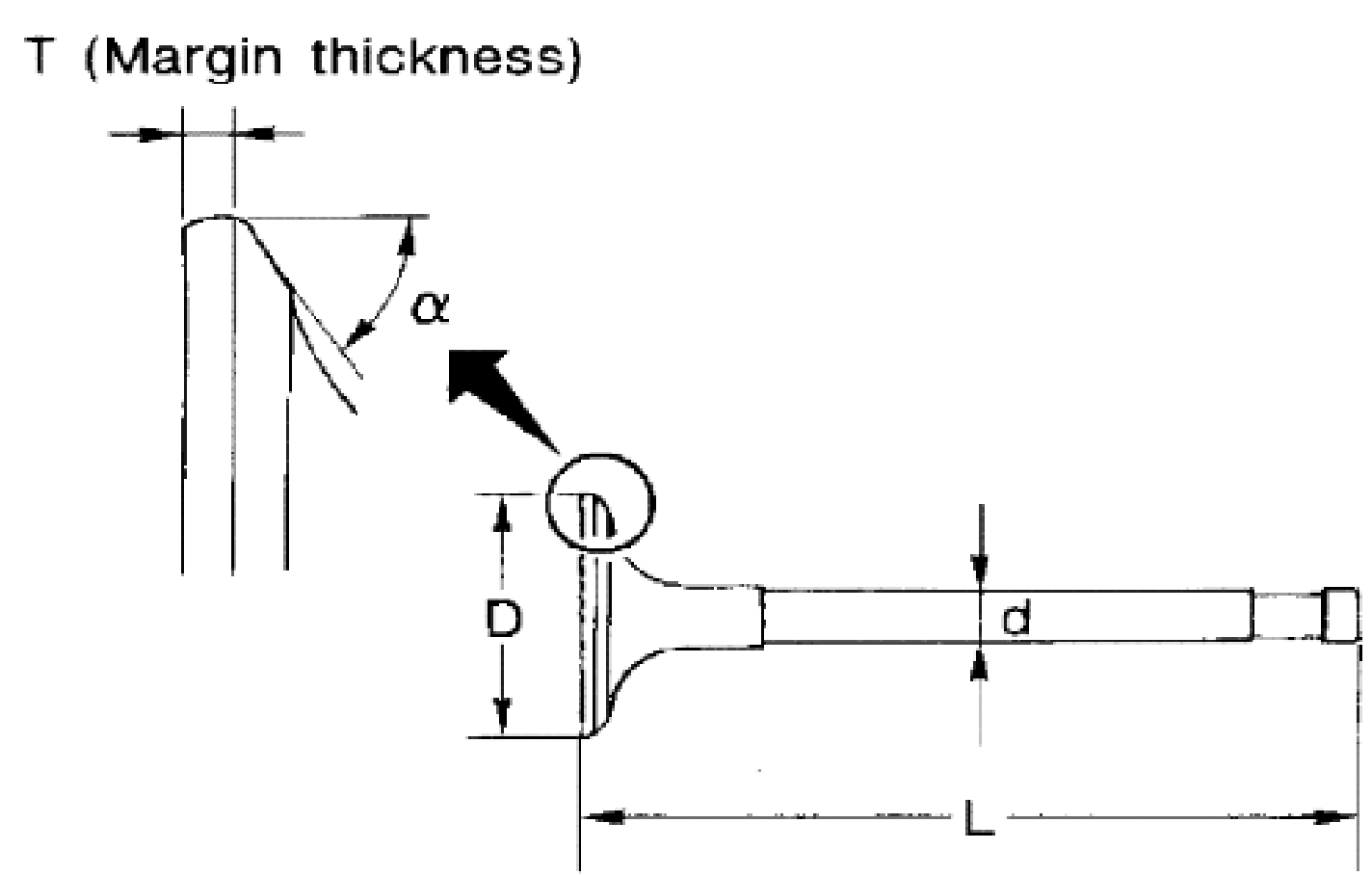
a	b	c	d	e	f
236	224	-4	60	32	37

Valve Dimensions

VALVE DIMENSIONS SPECIFICATIONS

Unit: mm (in)

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Valve head diameter "D"	Intake	35.5 - 35.8 (1.398 - 1.409)
	Exhaust	30.5 - 30.8 (1.201 - 1.213)
Valve length "L"	Intake	97.16 (3.8252)
	Exhaust	98.82 (3.8905)
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 Clearance

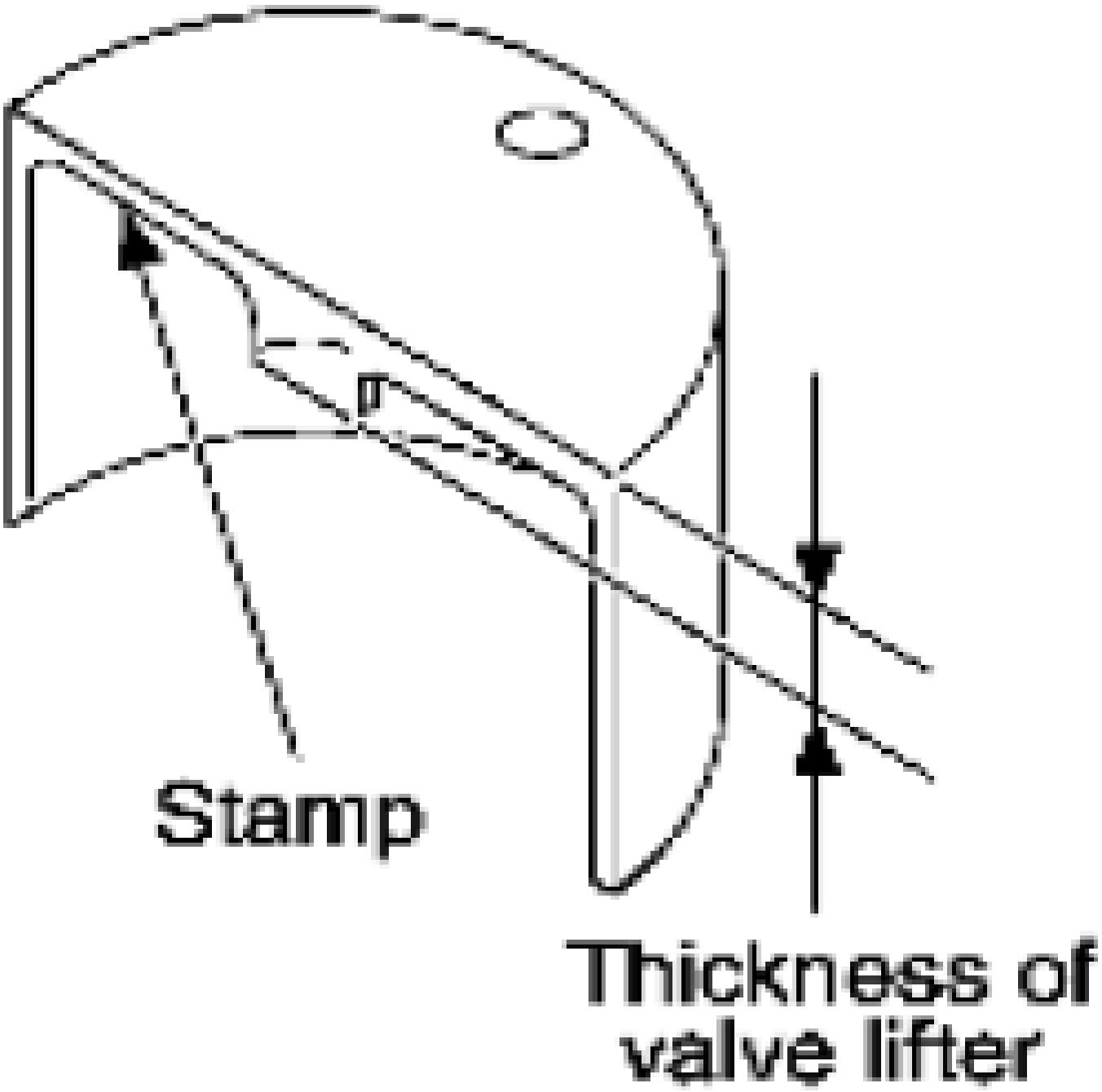
VALVE CLEARANCE SPECIFICATIONS

		Unit: mm (in)
Items	**Cold**	**Hot(1) (reference data)**
Intake	0.24 - 0.32 (0.009 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.308 - 0.432 (0.012 - 0.017)
(1) Approximately 80°C (176°F)		

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Available Valve Lifter

VALVE LIFTER SPECIFICATIONS

Thickness mm (in)	Identification mark
	
6.96 (0.2740)	696
6.98 (0.2748)	698
7.00 (0.2756)	700

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7.02 (0.2764)	702
7.04 (0.2772)	704
7.06 (0.2780)	706
7.08 (0.2787)	708
7.10 (0.2795)	710
7.12 (0.2803)	712
7.14 (0.2811)	714
7.16 (0.2819)	716
7.18 (0.2827)	718
7.20 (0.2835)	720
7.22 (0.2843)	722
7.24 (0.2850)	724
7.26 (0.2858)	726
7.28 (0.2866)	728
7.30 (0.2874)	730
7.32 (0.2882)	732
7.34 (0.2890)	734
7.36 (0.2898)	736
7.38 (0.2906)	738
7.40 (0.2913)	740
7.42 (0.2921)	742
7.44 (0.2929)	744
7.46 (0.2937)	746

Valve Spring

VALVE SPRING SPECIFICATIONS

Items	Intake	Exhaust
Free height	43.72 - 43.92 mm (1.7213 - 1.7291 in)	45.29 - 45.49 mm (1.7831 - 1.7909 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)
Height during valve open	25.3 mm (0.996 in)	26.76 mm (1.0535 in)
Load with valve open	351 - 394 N (35.8 - 40.2 kg, 79 - 89 lb)	318 - 362 N (32.4 - 36.9 kg, 71 - 81 lb)
Identification color	Pink	Green
Squareness limit	1.8 mm (0.071 in)	1.9 mm (0.075 in)

Valve Lifter

VALVE LIFTER SPECIFICATIONS

	Unit: mm (in)
Items	**Standard**
Valve lifter outer diameter	33.965 - 33.980 (1.3372 - 1.3378)

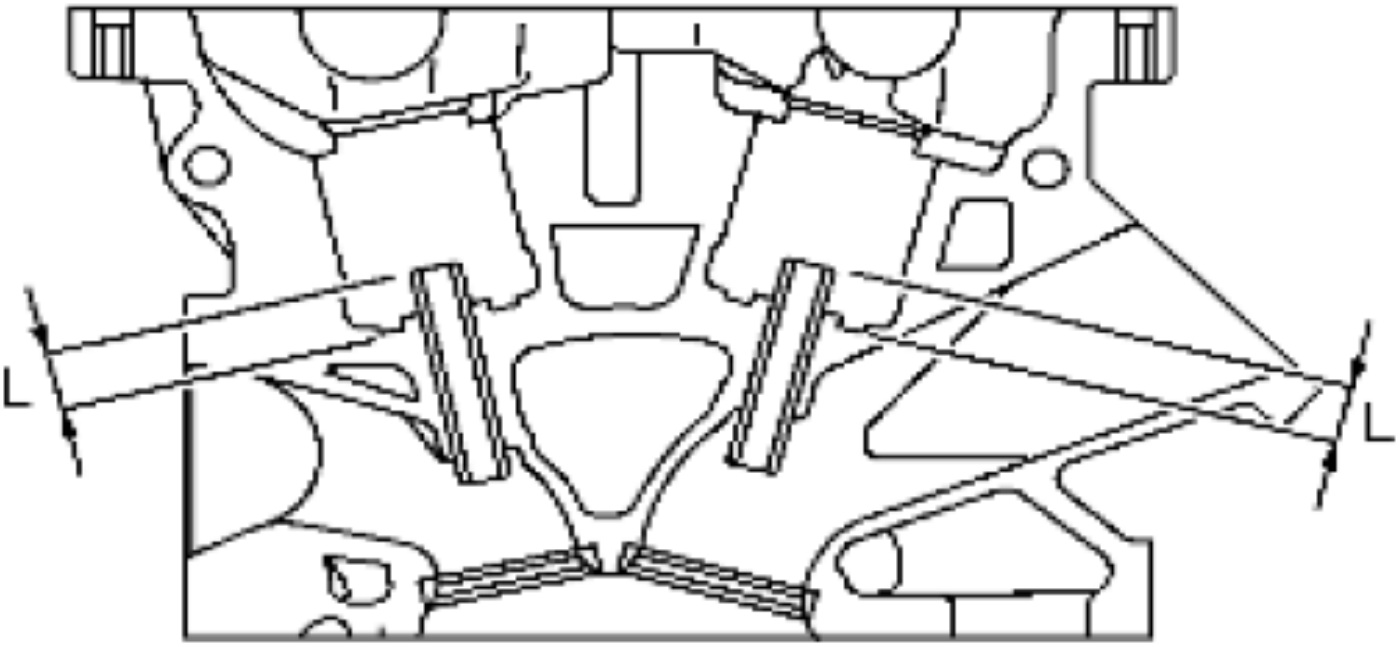
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Valve lifter hole diameter	34.000 - 34.021 (1.3386 - 1.3394)
Valve lifter clearance	0.020 - 0.056 (0.0008 - 0.0022)

Valve Guide

VALVE GUIDE SPECIFICATIONS

Unit: mm (in)



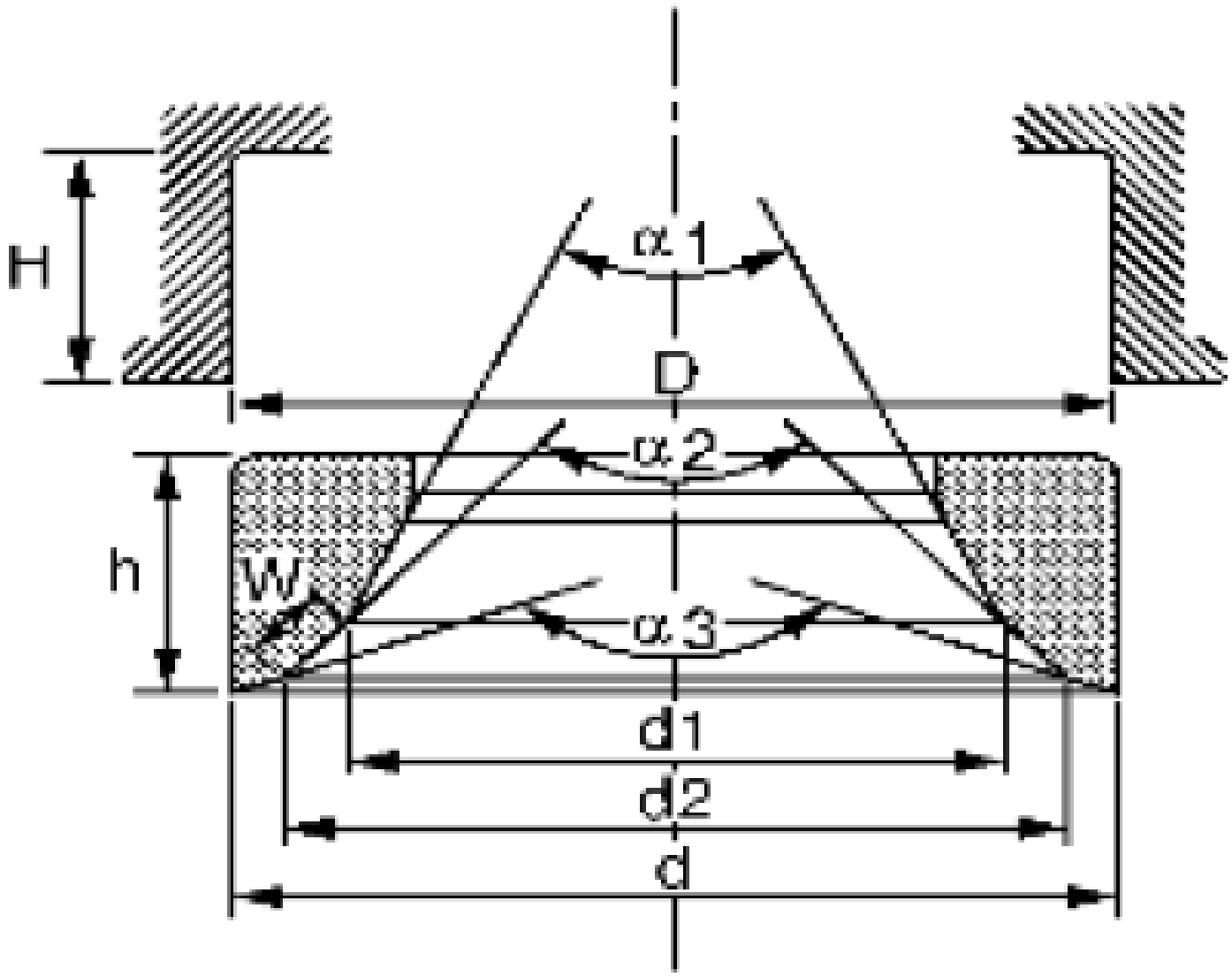
Items		Standard part	Service part
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
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"	Intake	10.1 - 10.3 (0.398 - 0.406)	
	Exhaust	10.0 - 10.4 (0.394 - 0.409)	

Valve Seat

VALVE SEAT SPECIFICATIONS

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Unit: mm (in)



Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter "D"	Intake	36.500 - 36.516 (1.4370 - 1.4376)	37.000 - 37.016 (1.4567 - 1.4573)
	Exhaust	31.500 - 31.516 (1.2402 - 1.2408)	32.000 - 32.016(1.2598 - 1.2605)
Valve seat outer diameter "d"	Intake	36.597 - 36.613 (1.4408 - 1.4415)	37.097 - 37.113 (1.4605 - 1.4611)
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0033 - 0.0046)	
Diameter "d1"(1)	Intake	33.5 (1.319)	
	Exhaust	28.0 (1.102)	

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Diameter "d2"(2)	Intake	35.1 - 35.3 (1.382 - 1.390)	
	Exhaust	29.9 - 30.1 (1.177 - 1.185)	
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	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.91 - 5.01 (0.1933 - 0.1972)
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 Seal

VALVE SEAL SPECIFICATIONS

	Unit: mm (in)
Items	**Standard**
Valve seal installed height	11.8 - 12.4 (0.465 - 0.488)

Spark Plug Tube

SPARK PLUG TUBE SPECIFICATIONS

	Unit: mm (in)
Items	**Standard**
Spark plug tube installed height	41.2 - 42.2 (1.622 - 1.661)

CAMSHAFT AND CAMSHAFT BEARING

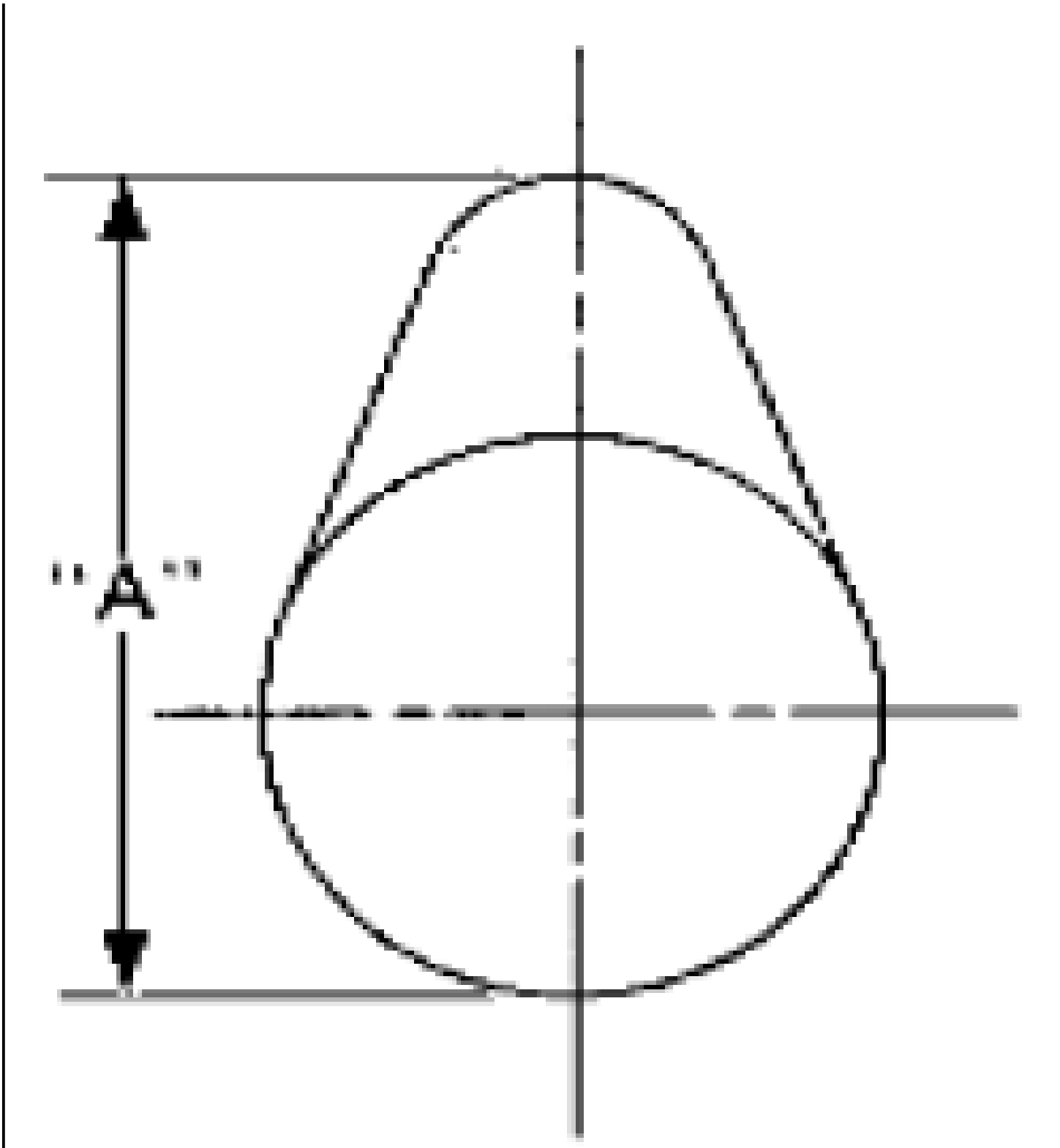
CAMSHAFT AND CAMSHAFT BEARING SPECIFICATIONS

			Unit: mm (in)
Items		**Standard**	**Limit**
Camshaft journal oil clearance		0.045 - 0.086 (0.0018 - 0.0034)	-
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	-
	No. 2, 3, 4, 5	23.500 - 23.521 (0.9252 - 0.9260)	-
Camshaft journal outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	-
	No. 2, 3, 4, 5	23.435 - 23.455 (0.9226 - 0.9234)	-

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Camshaft journal length	No. 1	25.800 - 25.848 (1.0157 - 1.0176)	-
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	-
Camshaft cam height "A"	Intake	45.015 - 45.205 (1.7722 - 1.7797)	0.2 (0.008)[1]
	Exhaust	43.975 - 44.165 (1.7313 - 1.7388)	
Camshaft runout [TIR[2]]		Less than 0.02 (0.0008)	-
Camshaft sprocket runout [TIR[2]]		-	0.15 (0.0059)

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(1) Cam wear limit

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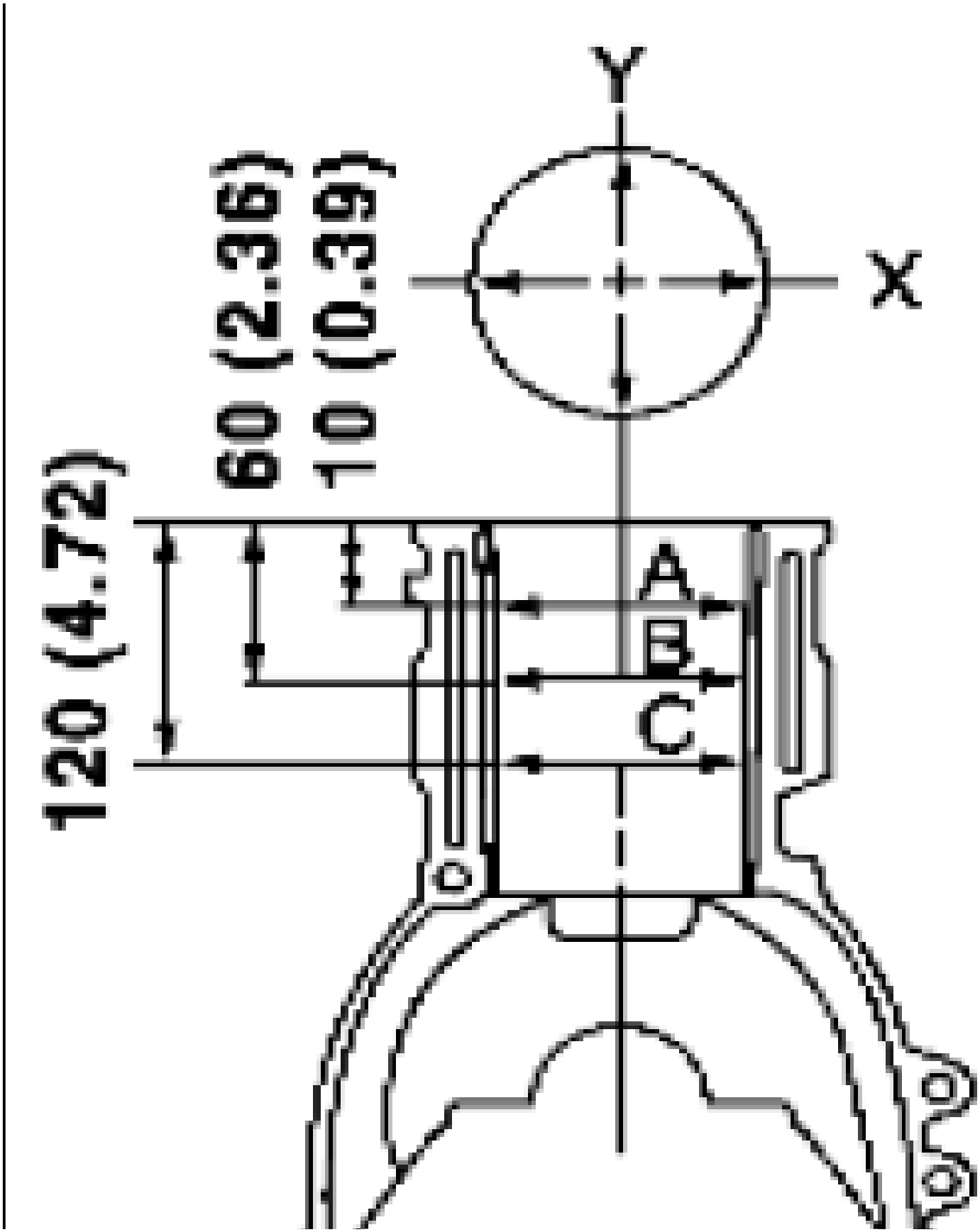
(2) Total indicator reading

CYLINDER BLOCK

CYLINDER BLOCK SPECIFICATIONS

Unit: mm (in)

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Surface distortion		Limit		0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.2 (0.008)
Out-of-round (Difference between "X" and "Y")		Limit		0.015 (0.0006)
Taper (Difference between "A" and "C")				0.01 (0.0004)
Main bearing housing inner diameter grade			Grade No. A	58.944 - 58.945 (2.3206 - 2.3207)
			Grade No. B	58.945 - 58.946 (2.3207 - 2.3207)
			Grade No. C	58.946 - 58.947 (2.3207 - 2.3207)
			Grade No. D	58.947 - 58.948 (2.3207 - 2.3208)
			Grade No. E	58.948 - 58.949 (2.3208 - 2.3208)
			Grade No. F	58.949 - 58.950 (2.3208 - 2.3209)
			Grade No. G	58.950 - 58.951 (2.3209 - 2.3209)
			Grade No. H	58.951 - 58.952 (2.3209 - 2.3209)
			Grade No. J	58.952 - 58.953 (2.3209 - 2.3210)
			Grade No. K	58.953 - 58.954 (2.3210 - 2.3210)
			Grade No. L	58.954 - 58.955 (2.3210 - 2.3211)
			Grade No. M	58.955 - 58.956 (2.3211 - 2.3211)
			Grade No. N	58.956 - 58.957 (2.3211 - 2.3211)
			Grade No. P	58.957 - 58.958 (2.3211 - 2.3212)
			Grade No. R	58.958 - 58.959 (2.3212 - 2.3212)
			Grade No. S	58.959 - 58.960 (2.3212 - 2.3213)
			Grade No. T	58.960 - 58.961 (2.3213 - 2.3213)
			Grade No. U	58.961 - 58.962 (2.3213 - 2.3213)
			Grade No. V	58.962 - 58.963 (2.3213 - 2.3214)
			Grade No. W	58.963 - 58.964 (2.3214 - 2.3214)
			Grade No. X	58.964 - 58.965 (2.3214 - 2.3215)
			Grade No. Y	58.965 - 58.966 (2.3215 - 2.3215)
			Grade No. 4	58.966 - 58.967 (2.3215 - 2.3215)
			Grade No. 7	58.967 - 58.968 (2.3215 - 2.3216)
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

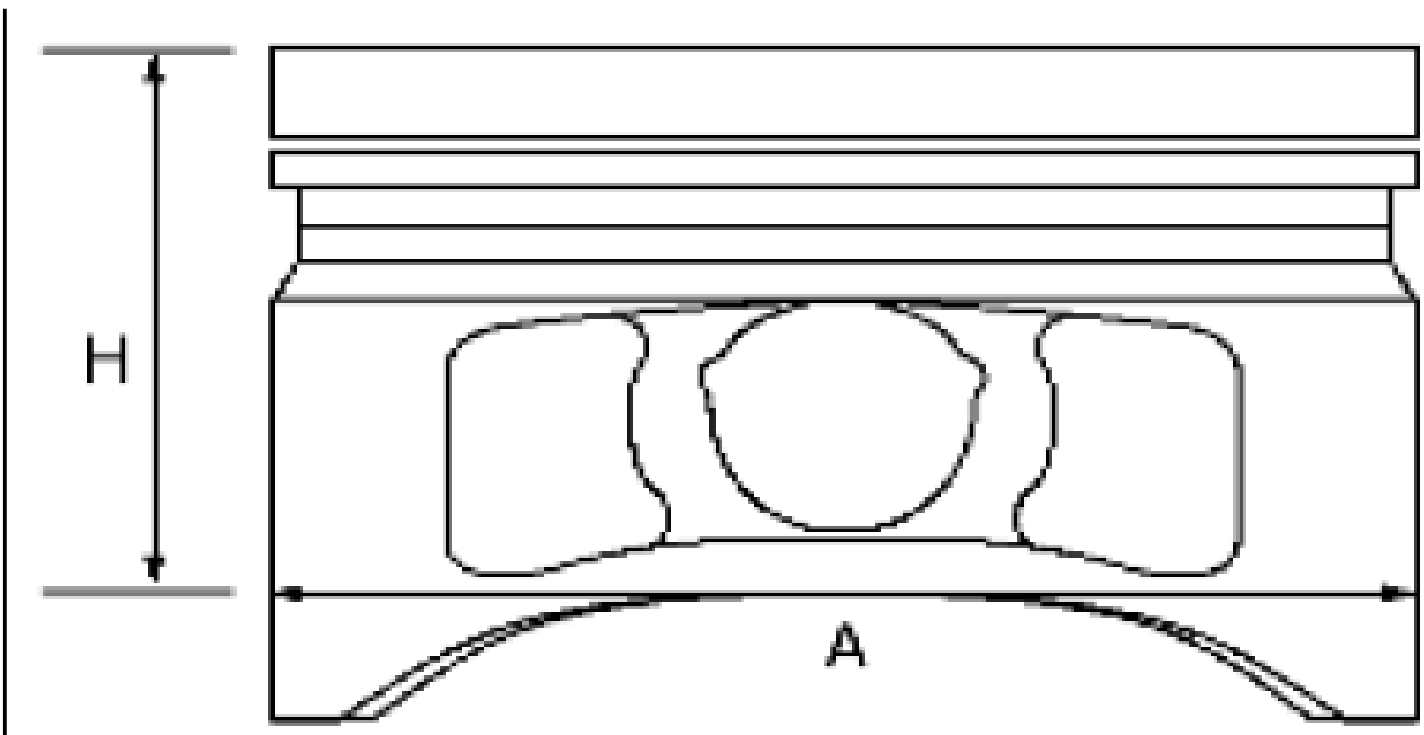
PISTON, PISTON RING AND PISTON PIN

Available Piston

PISTON SPECIFICATIONS

Unit: mm (in)

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Piston skirt diameter "A"	Standard	Grade No. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
Piston height "H" dimension			42.98 (1.692)
Piston pin hole diameter		Grade No. 0	19.993 - 19.999 (0.7871 - 0.7874)
		Grade No. 1	19.999 - 20.005 (0.7874 - 0.7876)
Piston to cylinder bore clearance		Standard	0.010 - 0.030 (0.0004 - 0.0012)
		Limit	0.08 (0.0031)

Piston Ring

PISTON RING SPECIFICATIONS

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 (rail ring)	0.065 - 0.135 (0.0026 - 0.0053)	-
End gap	Top	0.21- 0.31 (0.0083 - 0.0122)	0.54 (0.0213)
	2nd	0.32 - 0.47 (0.0126 - 0.0185)	0.65 (0.0256)
	Oil ring (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.95 (0.0374)

Piston Pin

PISTON PIN SPECIFICATIONS

Unit: mm (in)

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Piston pin outer diameter	Grade No. 0	19.989 - 19.995 (0.7870 - 0.7872)
	Grade No. 1	19.995 - 20.001 (0.7872 - 0.7874)
Piston to piston pin oil clearance	Standard	0.002 - 0.006 (0.0001 - 0.0002)
Connecting rod bushing oil clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)

CONNECTING ROD

CONNECTING ROD SPECIFICATIONS

Unit: mm (in)

Center distance		143.00 - 143.10 (5.630 - 5.634)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter(1)	Grade No. 0	20.000 - 20.006 (0.7874 - 0.7876)
	Grade No. 1	20.006 - 20.012 (0.7876 - 0.7879)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.50 (0.0197)
Connecting rod big end diameter	Grade No. 0	48.000 - 48.001 (1.8898 - 1.8898)
	Grade No. 1	48.001 - 48.002 (1.8898 - 1.8898)
	Grade No. 2	48.002 - 48.003 (1.8898 - 1.8899)
	Grade No. 3	48.003 - 48.004 (1.8899 - 1.8899)
	Grade No. 4	48.004 - 48.005 (1.8899 - 1.8900)
	Grade No. 5	48.005 - 48.006 (1.8900 - 1.8900)
	Grade No. 6	48.006 - 48.007 (1.8900 - 1.8900)
	Grade No. 7	48.007 - 48.008 (1.8900 - 1.8901)
	Grade No. 8	48.008 - 48.009 (1.8901 - 1.8901)
	Grade No. 9	48.009 - 48.010 (1.8901 - 1.8902)
	Grade No. A	48.010 - 48.011 (1.8902 - 1.8902)
	Grade No. B	48.011 - 48.012 (1.8902 - 1.8902)
	Grade No. C	48.012 - 48.013 (1.8902 - 1.8903)

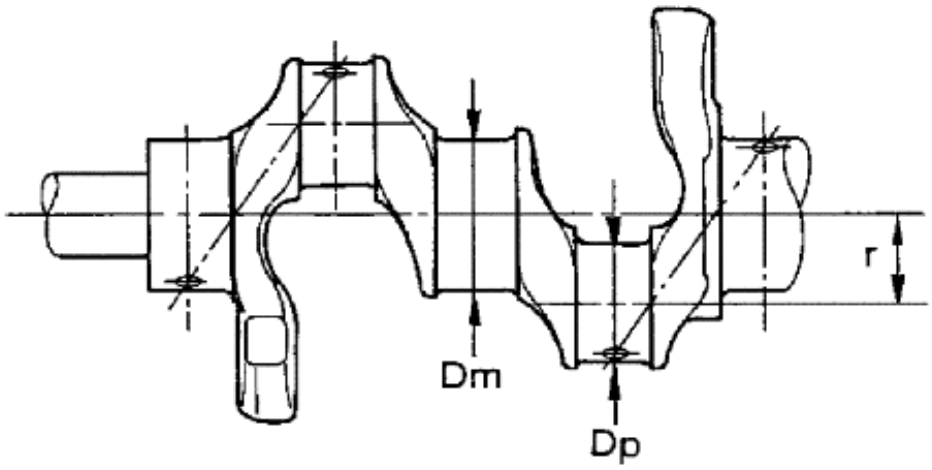
(1) After installing in connecting rod

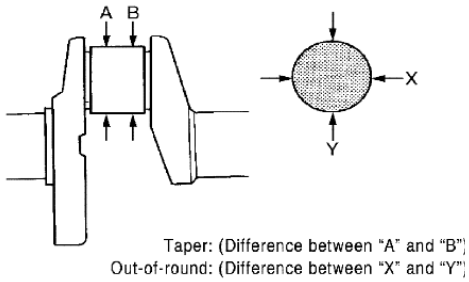
CRANKSHAFT

CRANKSHAFT SPECIFICATIONS

Unit: mm (in

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Center distance "r"		49.96 - 50.04 (1.9669 - 1.9701)
Out-of-round (Difference between "X" and "Y")	Limit	0.0025 (0.0001)
Taper (Difference between "A" and "B")	Limit	0.0025 (0.0001)
Runout [TIR(1)]	Limit	0.05 (0.0020)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)
Pin journal diameter grade. "DP"	Grade No. A	44.974 - 44.973 (1.7706 - 1.7706)
	Grade No. B	44.973 - 44.972 (1.7706 - 1.7705)
	Grade No. C	44.972 - 44.971 (1.7705 - 1.7705)
	Grade No. D	44.971 - 44.970 (1.7705 - 1.7705)
	Grade No. E	44.970 - 44.969 (1.7705 - 1.7704)
	Grade No. F	44.969 - 44.968 (1.7704 - 1.7704)
	Grade No. G	44.968 - 44.967 (1.7704 - 1.7704)
	Grade No. H	44.967 - 44.966 (1.7704 - 1.7703)
	Grade No. J	44.966 - 44.965 (1.7703 - 1.7703)
	Grade No. K	44.965 - 44.964 (1.7703 - 1.7702)
	Grade No. L	44.964 - 44.963 (1.7702 - 1.7702)
	Grade No. M	44.963 - 44.962 (1.7702 - 1.7702)
	Grade No. N	44.962 - 44.961 (1.7702 - 1.7701)
	Grade No. P	44.961 - 44.960 (1.7701 - 1.7701)
	Grade No. R	44.960 - 44.959 (1.7701 - 1.7700)
	Grade No. S	44.959 - 44.958 (1.7700 - 1.7700)
	Grade No. T	44.958 - 44.957 (1.7700 - 1.7700)
	Grade No. U	44.957 - 44.956 (1.7700 - 1.7699)
	Grade No. A	54.979 - 54.978 (2.1645 - 2.1645)
	Grade No. B	54.978 - 54.977 (2.1645 - 2.1644)
	Grade No. C	54.977 - 54.976 (2.1644 - 2.1644)
	Grade No. D	54.976 - 54.975 (2.1644 - 2.1644)
	Grade No. E	54.975 - 54.974 (2.1644 - 2.1643)
	Grade No. F	54.974 - 54.973 (2.1643 - 2.1643)

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Main journal diameter grade. "Dm"	Grade No. G	54.973 - 54.972 (2.1643 - 2.1642)
	Grade No. H	54.972 - 54.971 (2.1642 - 2.1642)
	Grade No. J	54.971 - 54.970 (2.1642 - 2.1642)
	Grade No. K	54.970 - 54.969 (2.1642 - 2.1641)
	Grade No. L	54.969 - 54.968 (2.1641 - 2.1641)
	Grade No. M	54.968 - 54.967 (2.1641 - 2.1641)
	Grade No. N	54.967 - 54.966 (2.1641 - 2.1640)
	Grade No. P	54.966 - 54.965 (2.1640 - 2.1640)
	Grade No. R	54.965 - 54.964 (2.1640 - 2.1639)
	Grade No. S	54.964 - 54.963 (2.1639 - 2.1639)
	Grade No. T	54.963 - 54.962 (2.1639 - 2.1639)
	Grade No. U	54.962 - 54.961 (2.1639 - 2.1638)
	Grade No. V	54.961 - 54.960 (2.1638 - 2.1638)
	Grade No. W	54.960 - 54.959 (2.1638 - 2.1637)
	Grade No. X	54.959 - 54.958 (2.1637 - 2.1637)
	Grade No. Y	54.958 - 54.957 (2.1637 - 2.1637)
	Grade No. 4	54.957 - 54.956 (2.1637 - 2.1636)
	Grade No. 7	54.956 - 54.955 (2.1636 - 2.1636)

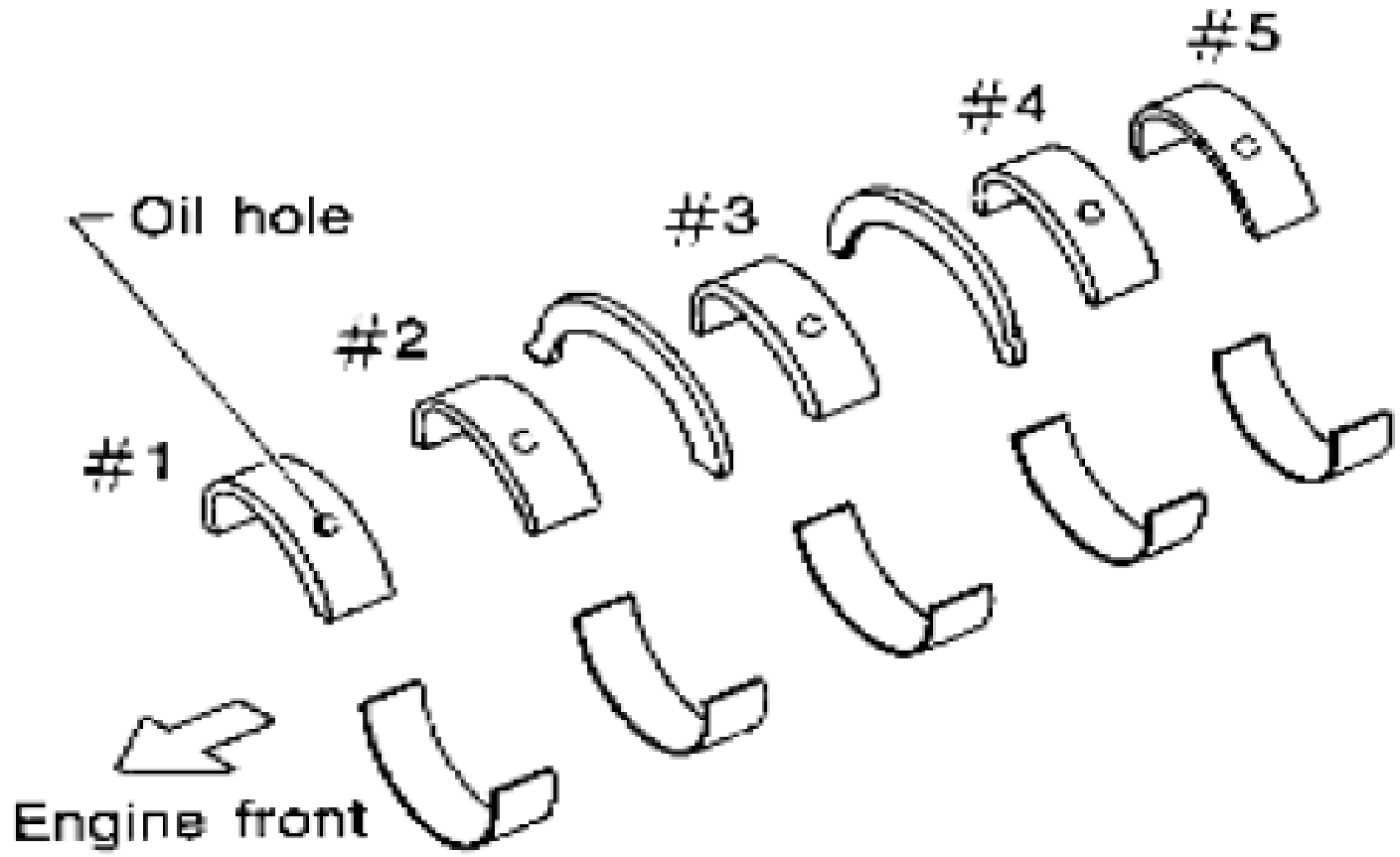
(1) Total indicator reading

MAIN BEARING

MAIN BEARING SPECIFICATIONS

Unit: mm (in)

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Grade number		Thickness	Identification color	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2		1.979 - 1.982 (0.0779 - 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	White	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black	
		1.976 - 1.979 (0.0778 -		

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	LWR	0.0779)	Brown	
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	Grade and color are different for upper and lower bearings.
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)	White	

Undersize

MAIN BEARING UNDERSIZE SPECIFICATIONS

		Unit: mm (in)
Item	**Thickness**	**Main journal diameter**
US 0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

BEARING OIL CLEARANCE SPECIFICATIONS

			Unit: mm (in)
Main bearing oil clearance	Standard	No. 1, 3 and 5	0.028 - 0.042 (0.0011 - 0.0017)
		No. 2 and 4	0.041 - 0.056 (0.0016 - 0.0022)
	Limit		0.1 (0.004)

CONNECTING ROD BEARING

CONNECTING ROD BEARING SPECIFICATIONS

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Grade number	Thickness mm (in)	Identification color
0	1.493 - 1.496 (0.0588 - 0.0589)	Black
1	1.496 - 1.499 (0.0589 - 0.0590)	Brown
2	1.499 - 1.502 (0.0590 - 0.0591)	Green
3	1.502 - 1.505 (0.0591 - 0.0593)	Yellow
4	1.505 - 1.508 (00.593 - 0.0594)	Blue

Undersize

CONNECTING ROD BEARING UNDERSIZE SPECIFICATIONS

		Unit: mm (in)
Item	**Thickness**	**Crank pin journal diameter**
US 0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

BEARING OIL CLEARANCE SPECIFICATIONS

		Unit: mm (in)
Connecting rod bearing oil clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)
	Limit	0.10 (0.0039)

SPECIAL TOOLS AND EQUIPMENT

SPECIAL SERVICE TOOL

Refer to [**SPECIAL SERVICE TOOL**].

COMMERCIAL SERVICE TOOL

Refer to [**COMMERCIAL SERVICE TOOL**].

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