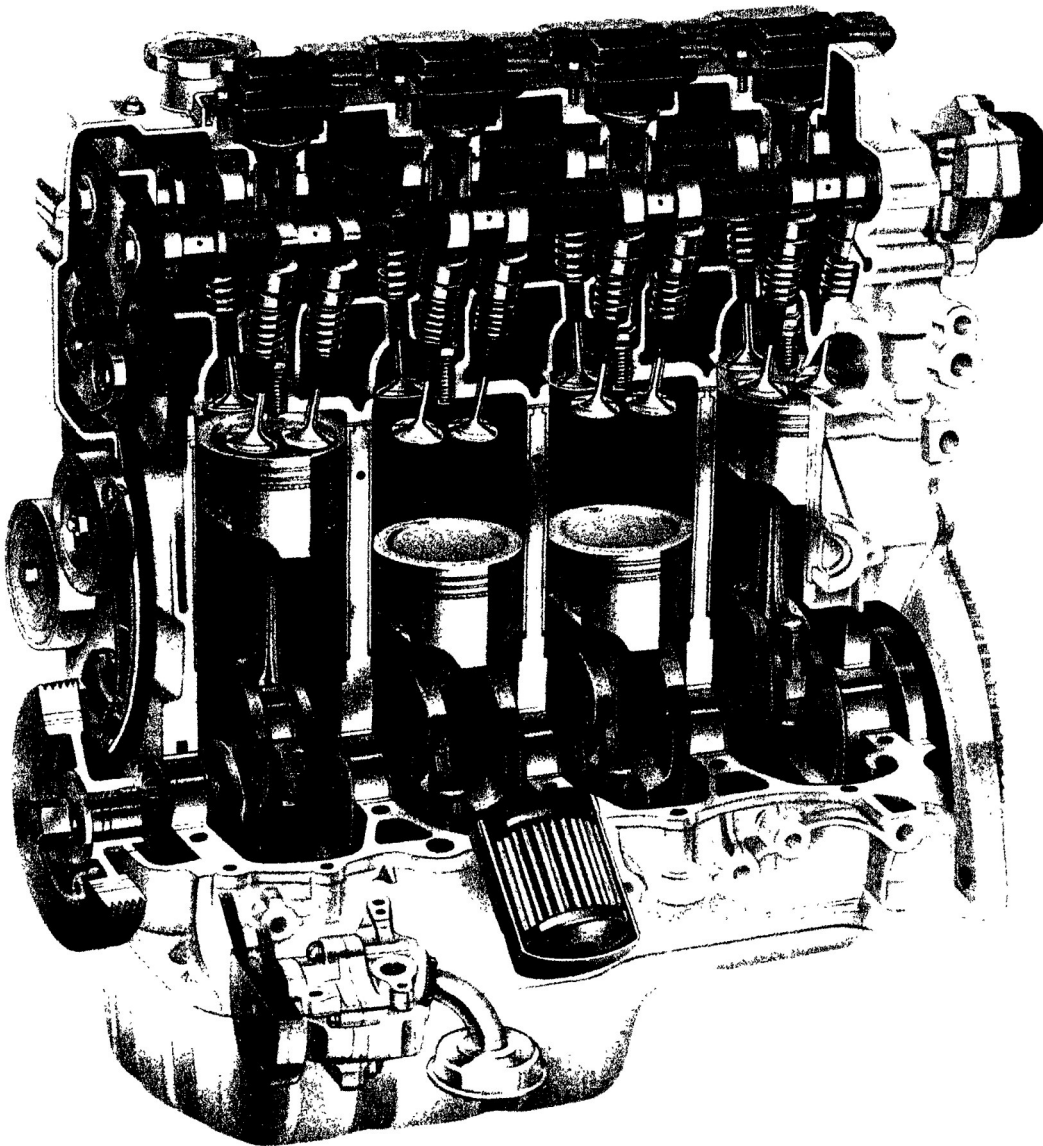


2005 ENGINE**Engine Mechanical - Aerio****GENERAL DESCRIPTION****ENGINE CONSTRUCTION DESCRIPTION**

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



I2RH01140001

Fig. 1: Identifying Engine Constructional Diagram
Courtesy of SUZUKI OF AMERICA CORP.

AIR CLEANER ELEMENT INTRODUCTION

This air cleaner element is dry type. Remember that it needs cleaning .

DIAGNOSTIC INFORMATION AND PROCEDURES

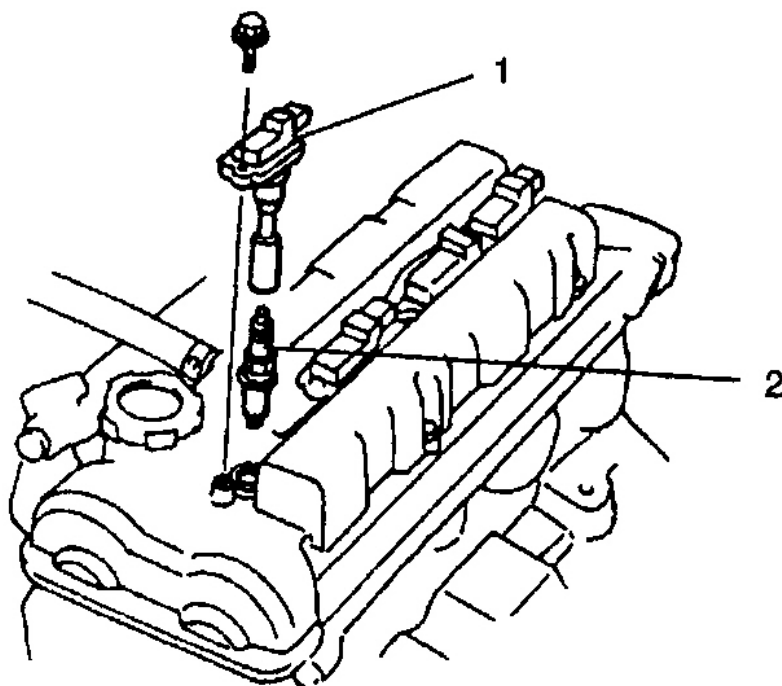
COMPRESSION CHECK

Check compression pressure on all 4 cylinders as follows:

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

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

3. Remove engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".
4. Disconnect ignition coil couplers.
5. Disconnect ignition coils (1).
6. Remove all spark plugs (2).



I2RH01140002

Fig. 2: Removing Spark Plugs

Courtesy of SUZUKI OF AMERICA CORP.

7. Disconnect fuel injector wire harness at the coupler.
8. Install special tool (Compression gauge) into spark plug hole.

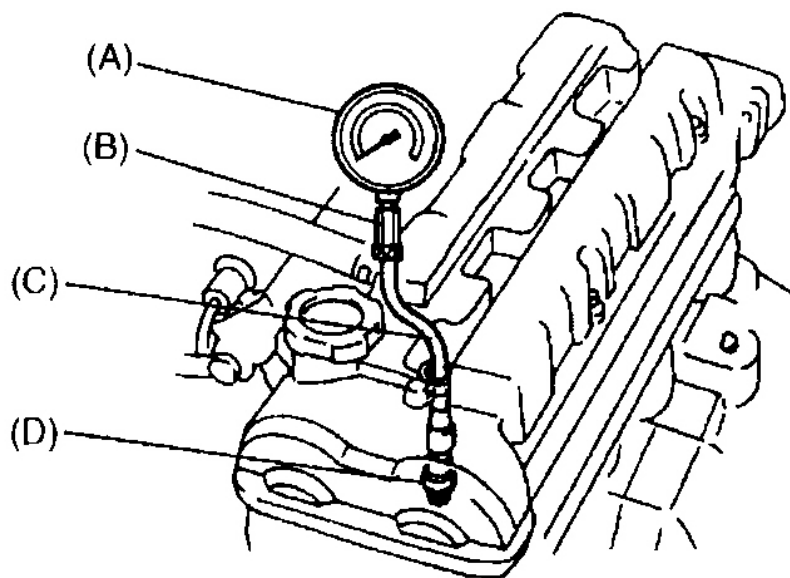
Special tool

(A): 09915-64510-001

(B): 09915-64510-002

(C): 09915-64530

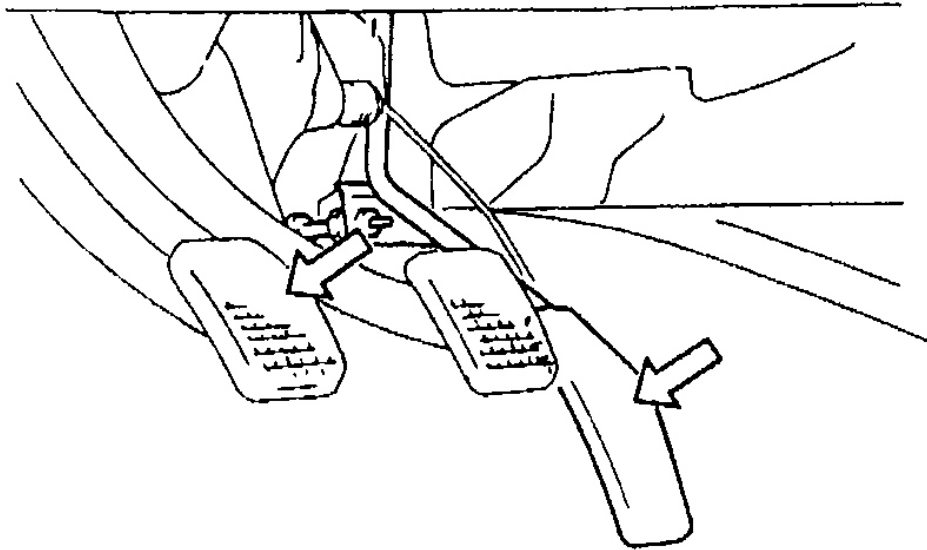
(D): 09915-67010



I2RH01140003

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

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



I2RH01140004

Fig. 4: Disengaging Clutch For M/T Vehicle And Depressing Accelerator Pedal
Courtesy of SUZUKI OF AMERICA CORP.

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

NOTE: For measuring compression pressure, crank engine at least 250 RPM by using fully charged battery.

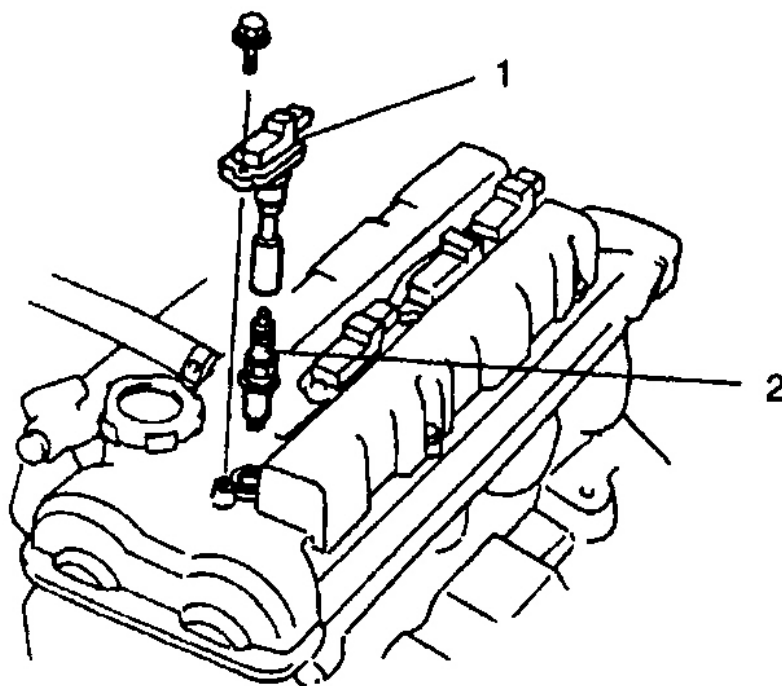
Compression pressure

Standard: 1400 kPa (14.0 kg/cm² , 199.0 psi)

Limit: 1200 kPa (12.0 kg/cm² , 170.0 psi)

Max. difference between any two cylinders: 100 kPa (1.0 kg/cm² , 14.2 psi)

11. Carry out Steps 8), 9) and 10) on each cylinder to obtain 4 readings.
12. After checking, install spark plugs (2) and ignition coils (1).



I2RH01140002

Fig. 5: Installing Spark Plugs And Ignition Coils
Courtesy of SUZUKI OF AMERICA CORP.

13. Install ignition coil couplers.
14. Connect injector wire harness at coupler.
15. Install engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".

ENGINE VACUUM CHECK

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

1. Warm up engine to normal operating temperature and make sure that engine idle speed is within specification.

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

2. Stop engine and remove engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".

3. Disconnect vacuum hose between vacuum pipe (2) and intake manifold (1) from vacuum pipe.
4. Connect special tools (vacuum gauge and hose joint) to vacuum hose of intake manifold side.

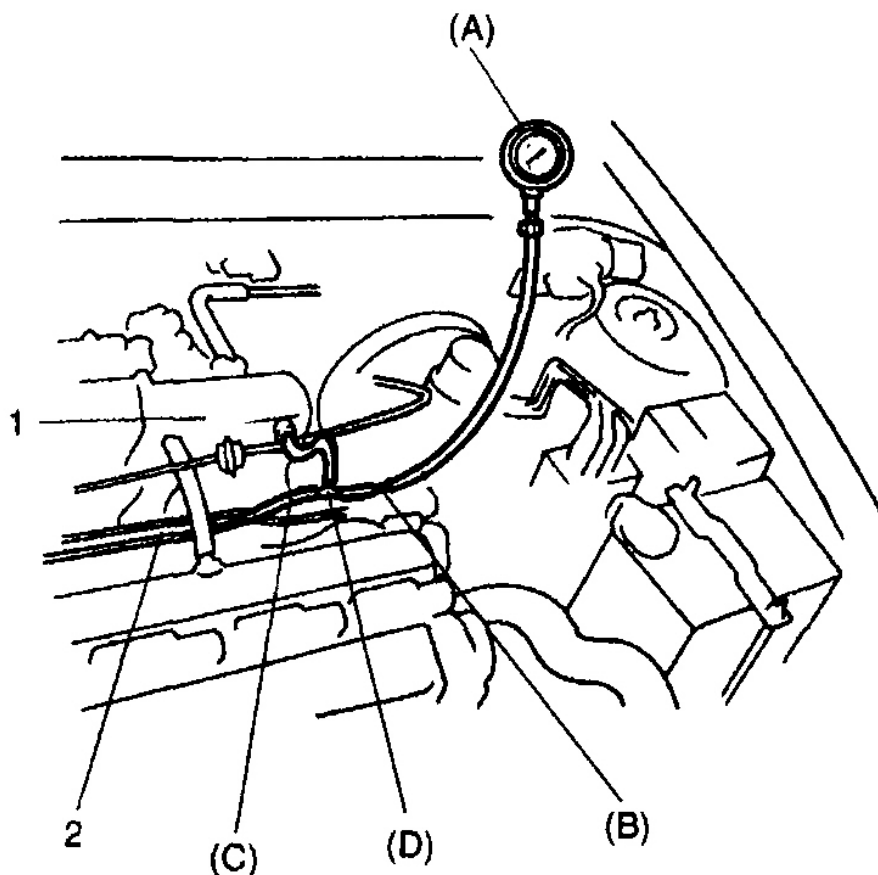
Special tool

(A): 09915-67311

(B): 09918-08210

(C): 09355-35754-600 (Hose, SUZUKI GENUINE PARTS)

(D): 09367-04002 (3-way joint, SUZUKI GENUINE PARTS)



I2RH01140005

Fig. 6: Connecting Special Tools (Vacuum Gauge And Hose Joint) To Vacuum Hose Of Intake Manifold Side

Courtesy of SUZUKI OF AMERICA CORP.

5. Start engine and run engine at specified idle speed (Refer to **IDLE AIR CONTROL (IAC) VALVE OPERATION CHECK**), and read vacuum gauge. Vacuum should be within specification.

Vacuum specification

52.6 - 65.8 kPa (40 - 50 cmHg, 15.7 - 19.7 in.Hg) at specified idle speed

6. After checking, remove special tools.
7. Connect vacuum hose to vacuum pipe.
8. Install engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION**".

REPAIR INSTRUCTIONS

VALVE LASH ADJUSTER NOISE DIAGNOSIS

In case of the following, valve lash adjuster noise may be caused by air trapped into valve lash adjusters.

- Vehicle is left for 24 hours or more.
- Engine oil is changed.
- Hydraulic lash adjuster is replaced or reinstalled.
- Engine is overhauled.

If noise from valve lash adjusters is suspected, perform the following checks.

1. Check engine oil for the following.
 - Oil level in oil pan

If oil level is low, add oil up to Full level hole on oil level gauge.

- Oil quality

If oil is discolored, or deteriorated, change it. For particular oil to be used, refer to **ENGINE OIL AND FILTER CHANGE** .

- Oil leaks

If leak is found, repair it.

- Oil pressure (refer to **ENGINE LUBRICATION SYSTEM -- AERIO** .

If defective pressure is found, repair it.

2. Run engine for about half an hour at about 2,000 to 3,000 RPM, and then air will be purge and tapping sound will cease.
3. Should tapping sound not cease, it is possible that hydraulic valve lash adjuster is defective. Replace it if

defective.

If defective adjuster can't be located by hearing among 16 of them, check as follows.

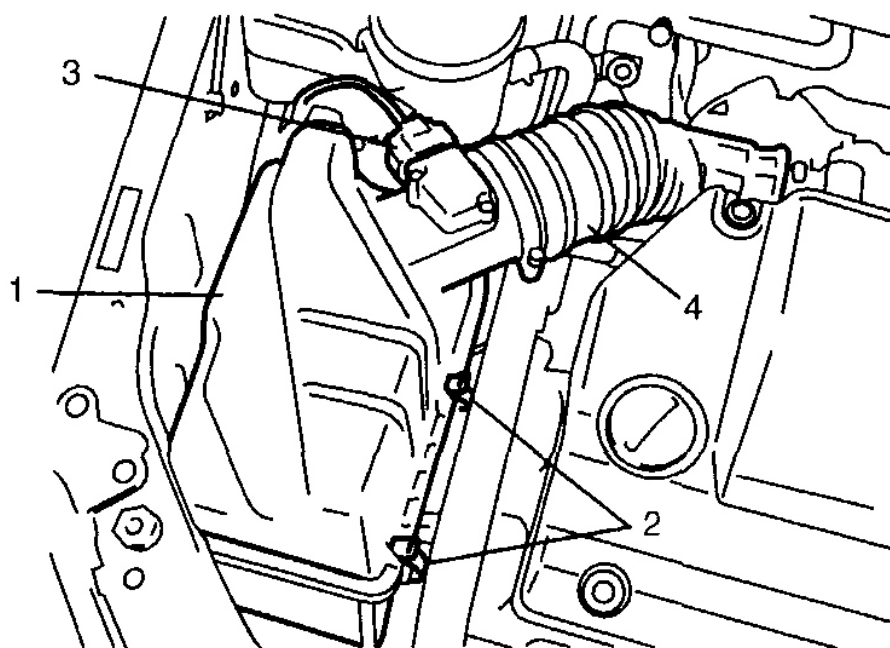
- a. Stop engine and remove cylinder head cover referring to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**".
- b. Push adjuster downward by hand (with less than 20 kg or 44 lbs. force) when cam crest is not on adjuster to check if clearance exists between cam and adjuster.

If it does, adjuster is defective and needs replacement.

AIR CLEANER ELEMENT REMOVAL AND INSTALLATION

Removal

1. Disconnect MAF sensor coupler (3) and air cleaner outlet hose (4) from air cleaner upper case (1).
2. Remove air cleaner upper case (1) from lower case after hooking clamps (2) from upper case.
3. Remove air cleaner element.



I4RH01140001

Fig. 7: Removing Air Cleaner Upper Case From Lower Case
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reverse removal procedure for installation.

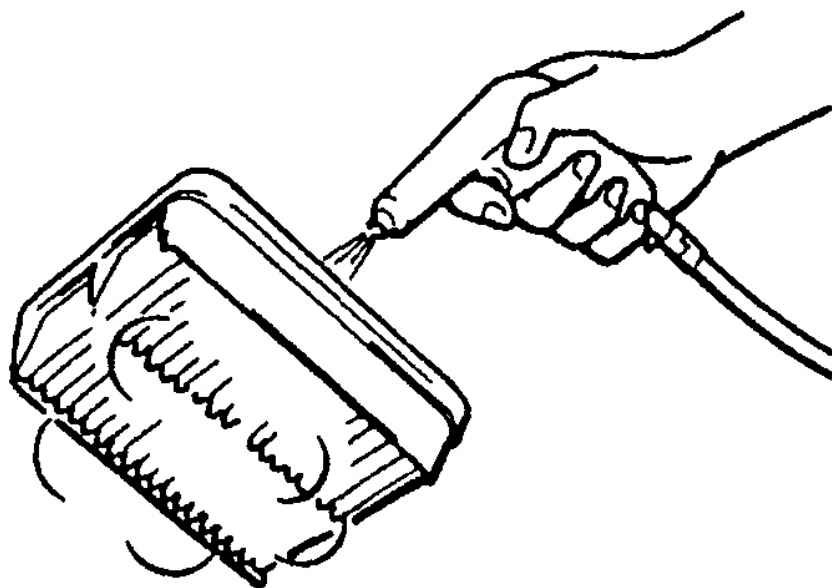
AIR CLEANER ELEMENT INSPECTION AND CLEANING

Inspection

Check air cleaner element for dirt.

Cleaning

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



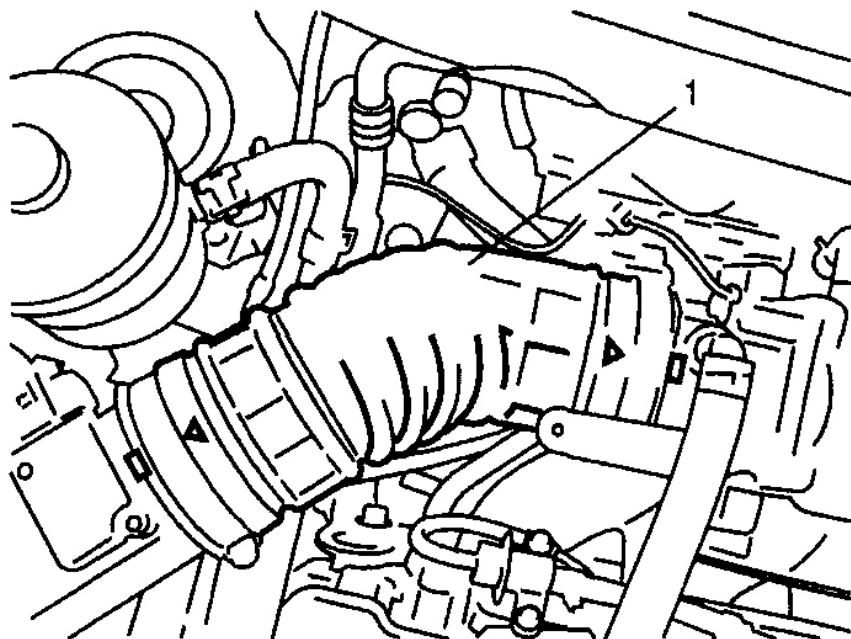
I2RH01140007

Fig. 8: Cleaning Dust By Compressed Air From Air Outlet Side Of Element
Courtesy of SUZUKI OF AMERICA CORP.

AIR CLEANER OUTLET HOSE REMOVAL AND INSTALLATION

Removal

1. Remove air cleaner outlet hose (1).



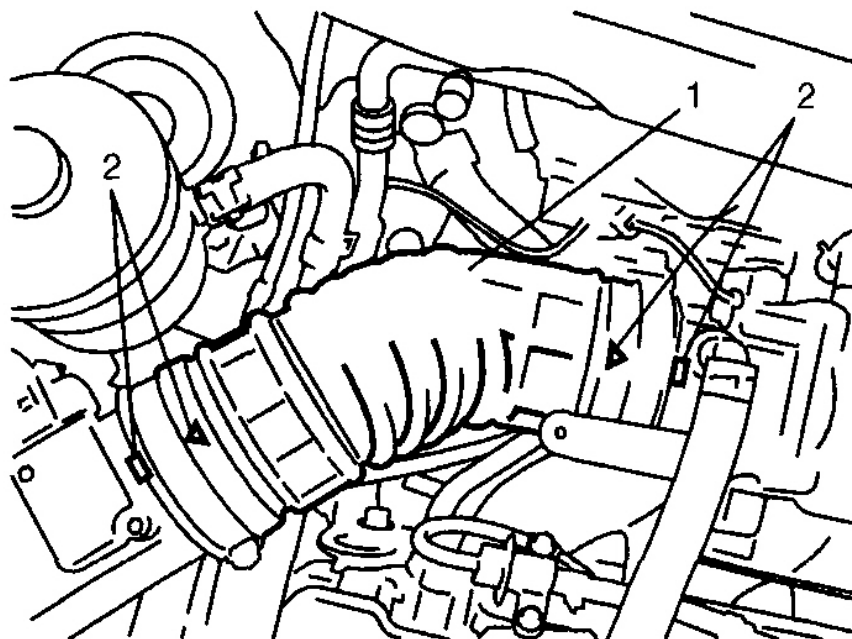
I4RH01140002

Fig. 9: Removing Air Cleaner Outlet Hose
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reverse removal procedure for installation.

1. Install air cleaner outlet hose (1) by aligning match marks (2) as shown in figure.



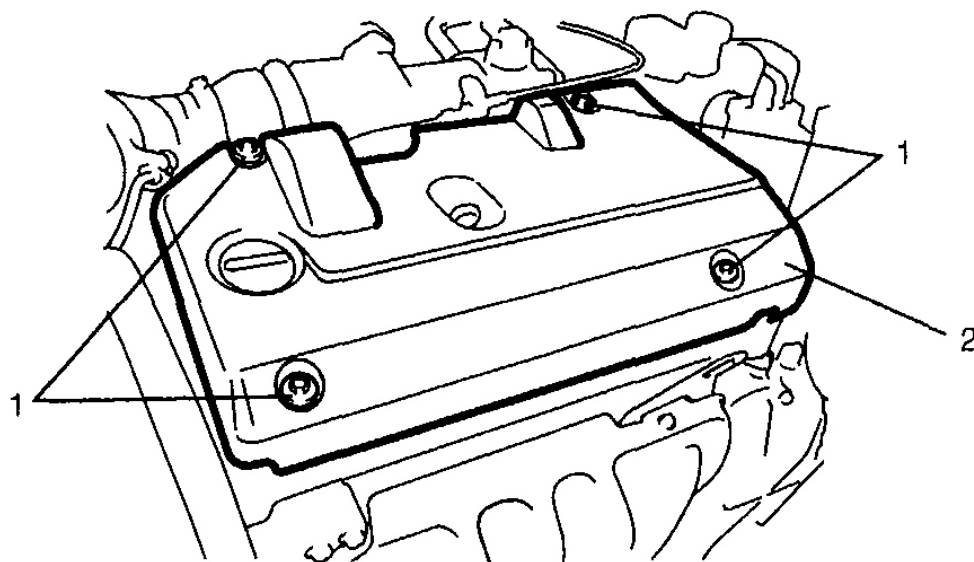
I4RH01140003

Fig. 10: Installing Air Cleaner Outlet Hose
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE COVER REMOVAL AND INSTALLATION

Removal

1. Remove engine cover bolts (1).
2. Remove engine cover (2) from cylinder head cover.



I3RH01140041

Fig. 11: Removing Engine Cover From Cylinder Head Cover
Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Install engine cover (2) from cylinder head cover.
2. Install engine cover bolts (1).

Tightening torque

Engine cover bolt (a): 8 N.m (0.8 kg-m, 5.8 lb-ft)

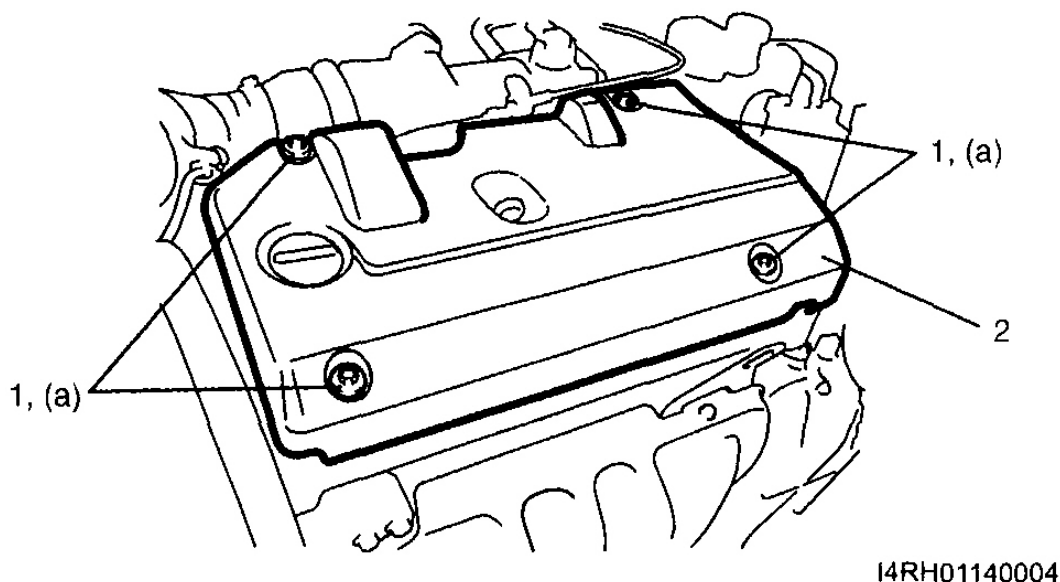


Fig. 12: Installing Engine Cover To Cylinder Head Cover
Courtesy of SUZUKI OF AMERICA CORP.

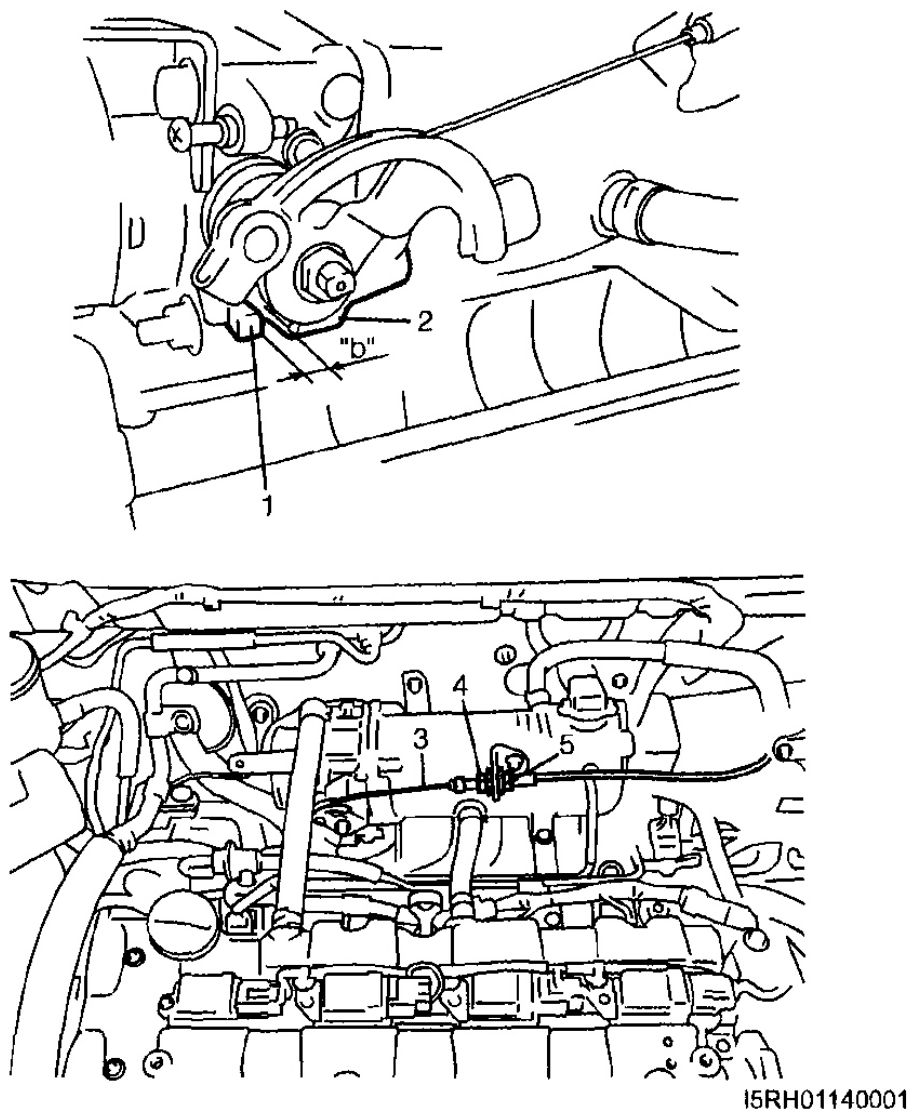
ACCELERATOR CABLE ADJUSTMENT

With accelerator pedal depressed fully, check clearance between throttle lever (2) and lever stopper (1) (throttle body) which should be within the following specification.

Clearance between throttle lever and lever stopper (with pedal depressed fully) "b"

0.5 - 2.0 mm (0.02 - 0.07 in.)

If measured value is out of specification, adjust it to specification with cable adjusting nut (4).

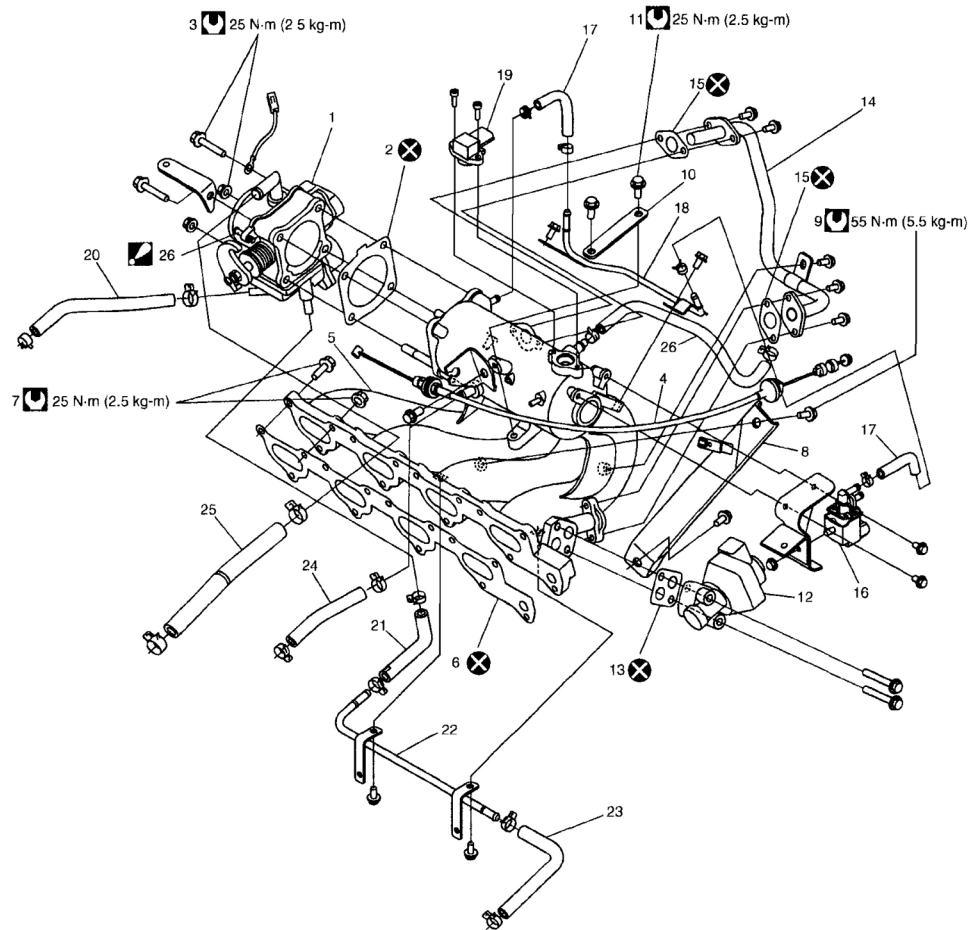


3 Accelerator cable

5 Lock nut

Fig. 13: Checking Clearance Between Throttle Lever And Lever Stopper
 Courtesy of SUZUKI OF AMERICA CORP.

THROTTLE BODY AND INTAKE MANIFOLD COMPONENTS



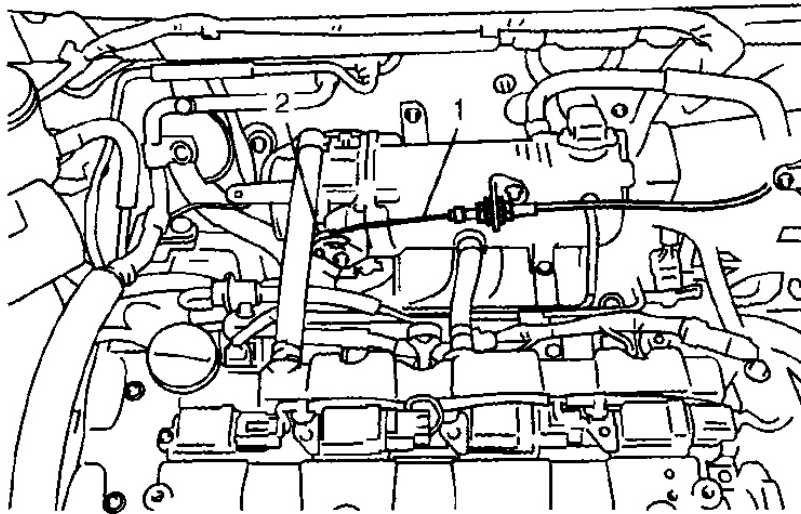
14RH01140006

1. Throttle body	8. Intake manifold rear stiffener	15. Gasket	22. Coolant pipe
2. Gasket	9. Intake manifold rear stiffener bolt	16. EVAP canister purge valve	23. Coolant pipe hose
3. Throttle body bolt and nut	10. Intake manifold front stiffener	17. EVAP canister purge valve hose	24. PCV valve hose
4. Accelerator cable	11. Intake manifold front stiffener bolt	18. EVAP canister purge valve pipe	25. Breather hose
5. Intake manifold	12. EGR valve	19. MAP sensor	26. Throttle stop screw : Do not remove or adjust this screw as it is factory adjusted precisely.
6. Gasket	13. Gasket	20. Throttle body coolant inlet hose	Tightening torque
7. Intake manifold bolt and nut	14. EGR pipe	21. Throttle body coolant outlet hose	Do not reuse.

Fig. 14: Identifying Throttle Body And Intake Manifold Components
Courtesy of SUZUKI OF AMERICA CORP.

THROTTLE BODY ON-VEHICLE INSPECTION

Check that throttle valve lever (2) moves smoothly.



I4RH01140007

1. Accelerator cable

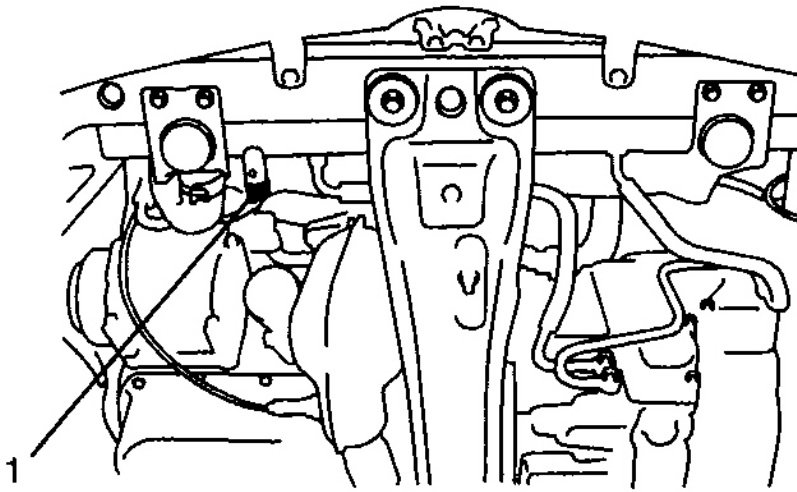
Fig. 15: Checking Throttle Valve Lever
Courtesy of SUZUKI OF AMERICA CORP.

THROTTLE BODY REMOVAL AND INSTALLATION

Removal

1. Disconnect negative cable at battery.
2. Drain coolant.

WARNING: To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.

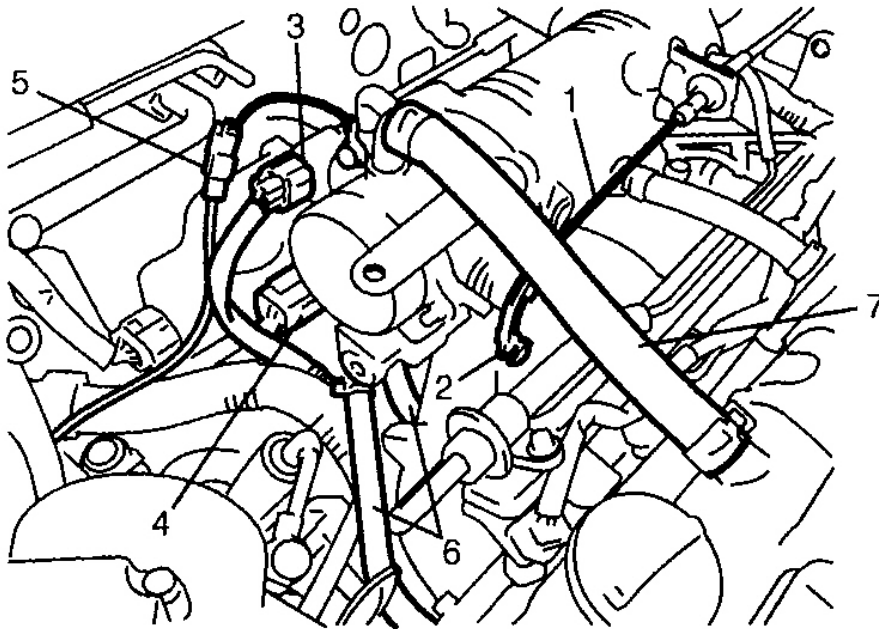


I2RH01140011

Fig. 16: Identifying Drain Plug

Courtesy of SUZUKI OF AMERICA CORP.

3. Remove engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".
4. Remove air cleaner outlet hose (referring to "**AIR CLEANER OUTLET HOSE REMOVAL AND INSTALLATION:**").
5. Remove generator drive belt referring to **GENERATOR DRIVE BELT REMOVAL AND INSTALLATION** .
6. With hose connected, detach P/S pump from its bracket.
7. Disconnect accelerator cable (1) from throttle valve lever (2).
8. Disconnect couplers of TP sensor (3), IAC valve (4) and ground connector (5).
9. Disconnect coolant hoses (6) and breather hose (7) from throttle body.



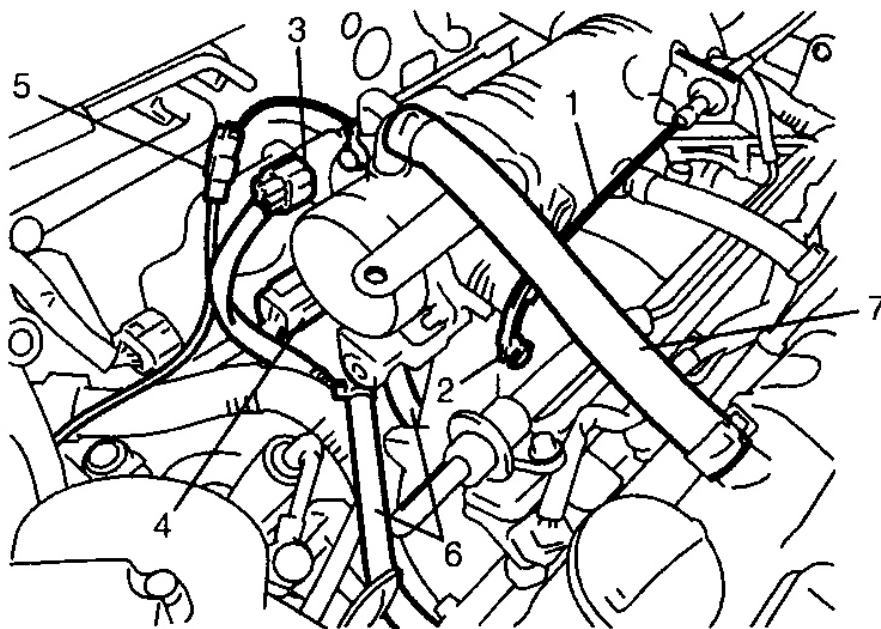
I4RH01140008

Fig. 17: Disconnecting Coolant Hoses And Breather Hose From Throttle Body
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove throttle body from intake manifold.

Installation

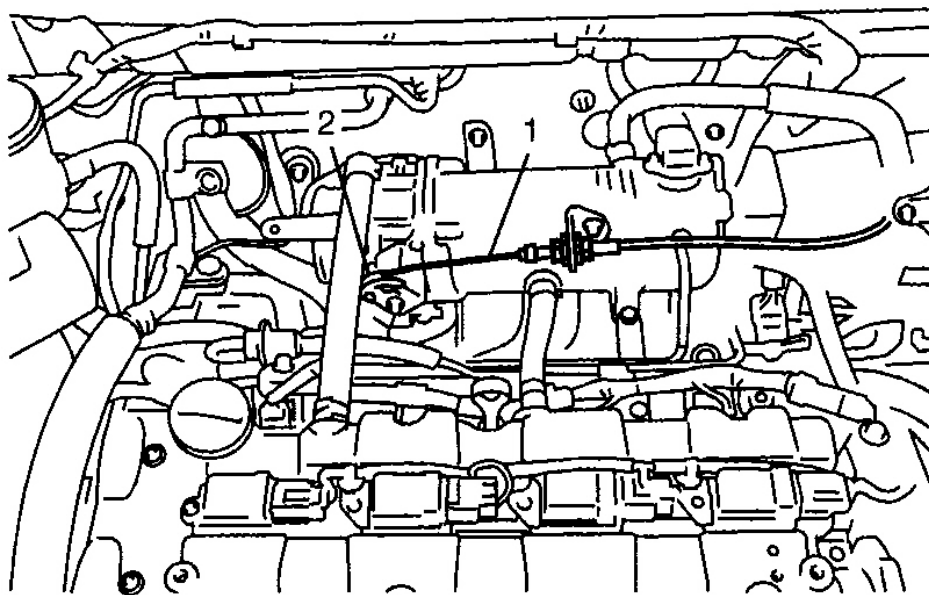
1. Clean mating surfaces and install throttle body gasket to intake manifold.
Use new gasket.
2. Install throttle body to intake manifold and tighten bolts and nuts.
3. Connect coolant hoses (6) and breather hose (7).
4. Connect couplers of TP sensor (3), IAC sensor (4) and ground terminal (5).



I4RH01140008

Fig. 18: Connecting Couplers Of TP Sensor, IAC Sensor And Ground Terminal
Courtesy of SUZUKI OF AMERICA CORP.

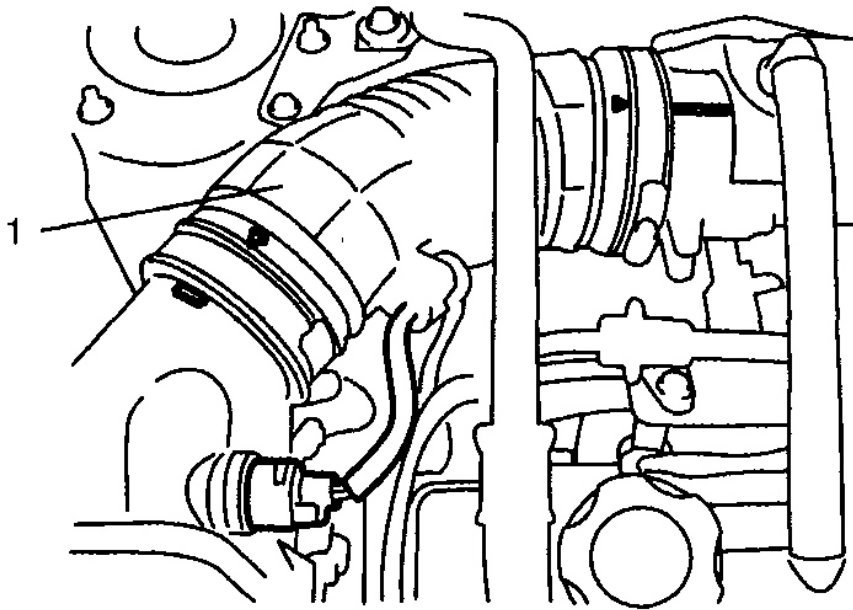
5. Connect accelerator cable (1) to throttle valve lever (2).



I4RH01140007

Fig. 19: Connecting Accelerator Cable To Throttle Valve Lever
Courtesy of SUZUKI OF AMERICA CORP.

6. Install P/S pump to its bracket referring to **P/S PUMP REMOVAL AND INSTALLATION** .
7. Install generator drive belt referring to **GENERATOR DRIVE BELT REMOVAL AND INSTALLATION** .
8. Install air cleaner outlet hose referring to "**AIR CLEANER OUTLET HOSE REMOVAL AND INSTALLATION**".



I2RH01140205

Fig. 20: Installing Air Cleaner Outlet Hose
Courtesy of SUZUKI OF AMERICA CORP.

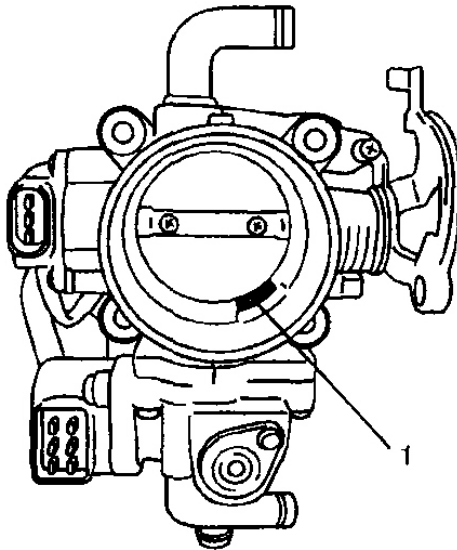
9. Install engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".
10. Refill cooling system referring to **COOLING SYSTEM FLUSH AND REFILL** .
11. Connect negative cable at battery.
12. Start engine and check for engine coolant leakage.

THROTTLE BODY CLEANING

Clean passages by blowing compressed air.

CAUTION:

- IAC valve, TP sensor, or other components containing rubber must not be placed in a solvent or cleaner both. A chemical reaction will cause these parts to swell, harden or get distorted.
- Don't put drills or wires into passages for cleaning. It causes damages in passages.



I4RH01140009

1. Idle air control valve passage

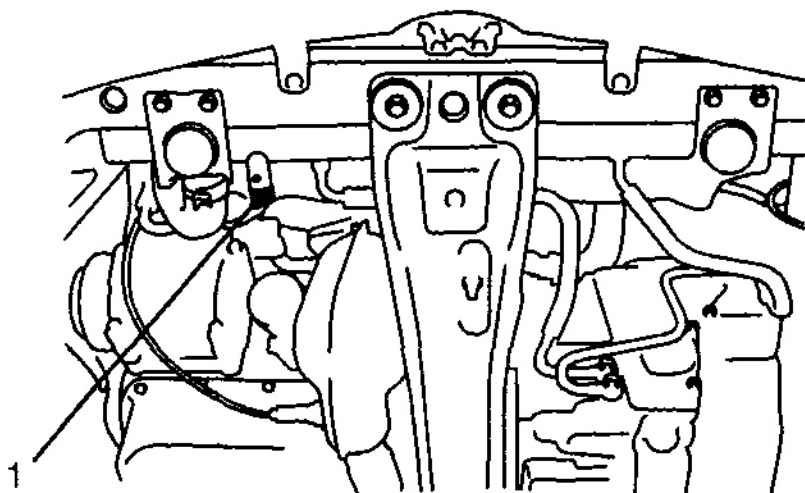
Fig. 21: Identifying Idle Air Control Valve Passage
Courtesy of SUZUKI OF AMERICA CORP.

INTAKE MANIFOLD REMOVAL AND INSTALLATION

Removal

1. Disconnect negative cable at battery.
2. Drain cooling system.

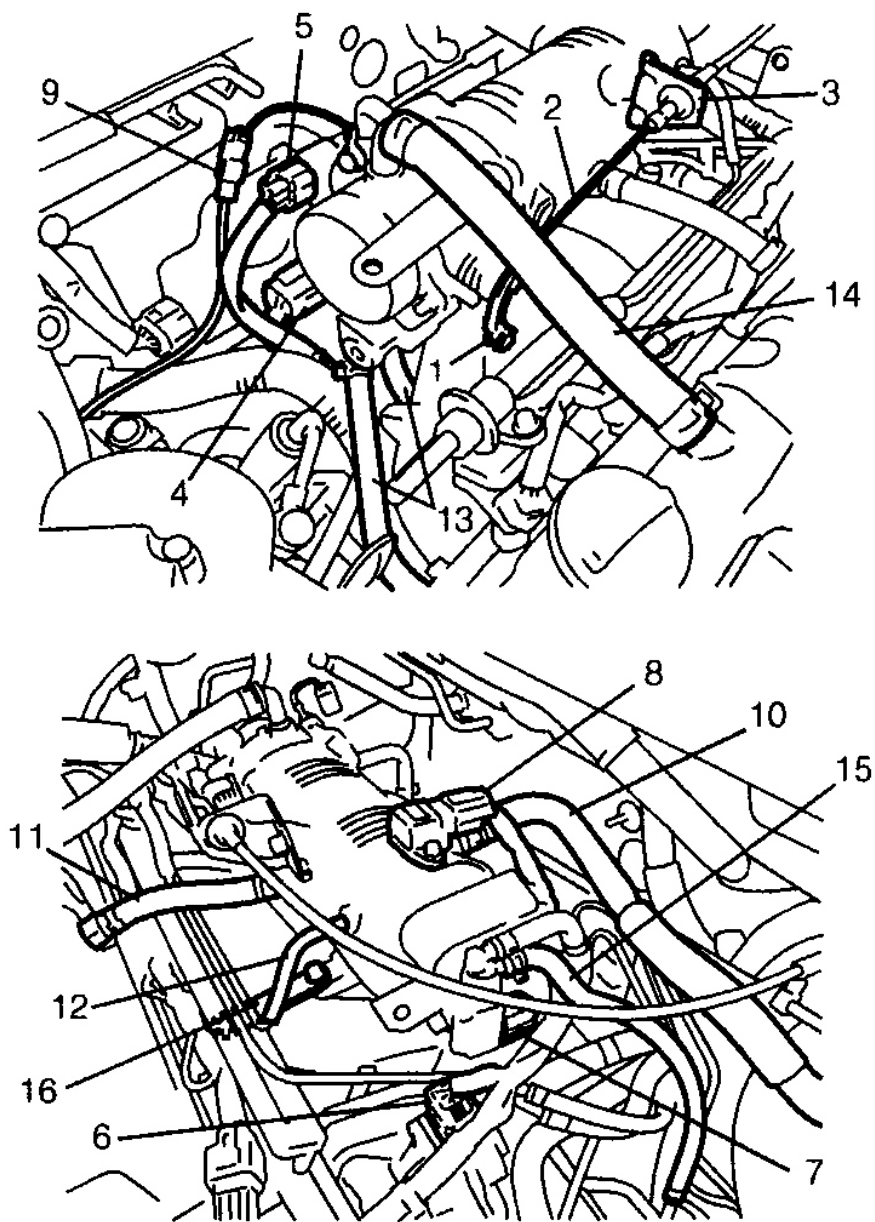
WARNING: To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



I2RH01140011

Fig. 22: Identifying Drain Plug**Courtesy of SUZUKI OF AMERICA CORP.**

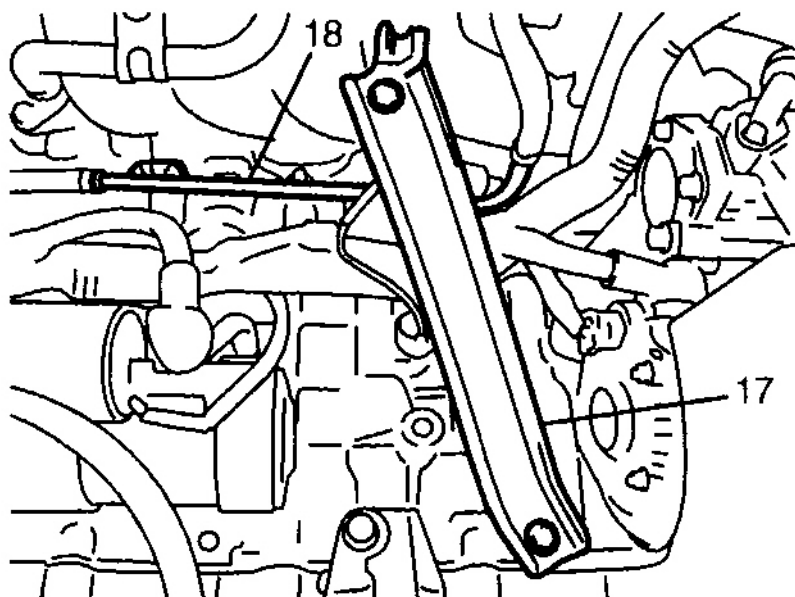
3. Remove engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".
4. Remove air cleaner outlet hose referring to "**AIR CLEANER OUTLET HOSE REMOVAL AND INSTALLATION:**".
5. Disconnect accelerator cable (2) from throttle valve lever (1).
6. Disconnect accelerator cable (2) with cable bracket (3) from intake manifold.
7. Disconnect the following electric lead wires:
 - IAC valve coupler (4)
 - TP sensor coupler (5)
 - EGR valve coupler (6)
 - EVAP canister purge valve coupler (7)
 - MAP sensor coupler (8)
 - Ground terminal (9) from throttle body
8. Disconnect the following hoses:
 - Brake booster hose (10) from intake manifold
 - PCV hose (11) from PCV valve
 - Fuel pressure regulator vacuum hose (12) from intake manifold
 - Coolant hoses from (13) throttle
 - Breather hose (14) from throttle body
 - Vacuum hose (15) from EVAP canister purge valve
9. Remove intake manifold front stiffener (16).



I5RH01140002

Fig. 23: Disconnecting Electric Lead Wires And Hoses
Courtesy of SUZUKI OF AMERICA CORP.

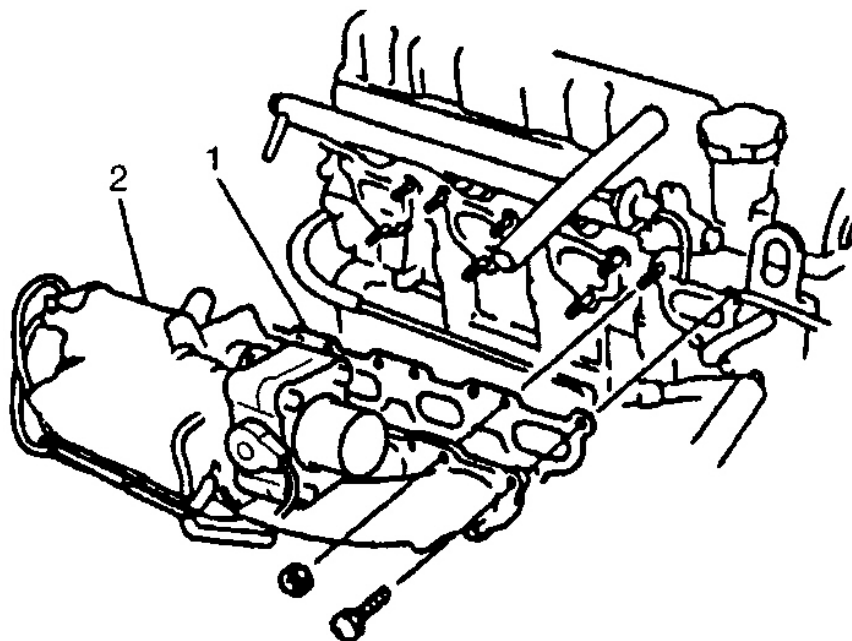
10. Remove rear stiffener (17), and disconnect coolant pipe (18) from intake manifold.



I4RH01140011

Fig. 24: Removing Rear Stiffener And Coolant Pipe From Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

11. Remove intake manifold (2) with throttle body from cylinder head, and then its gasket (1).



I4RH01140012

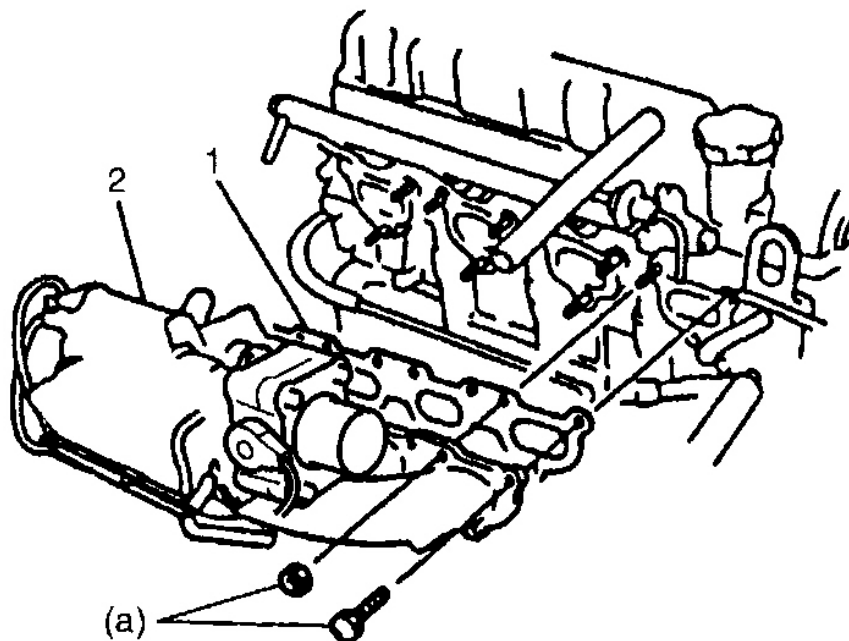
Fig. 25: Removing Intake Manifold

Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Install new intake manifold gasket (1) to cylinder head.
2. Install intake manifold (2) with throttle body. Tighten bolts and nuts to specified torque.

Tightening torque**Intake manifold bolt and nut (a): 25 N.m (2.5 kg-m, 18.0 lb-ft)**



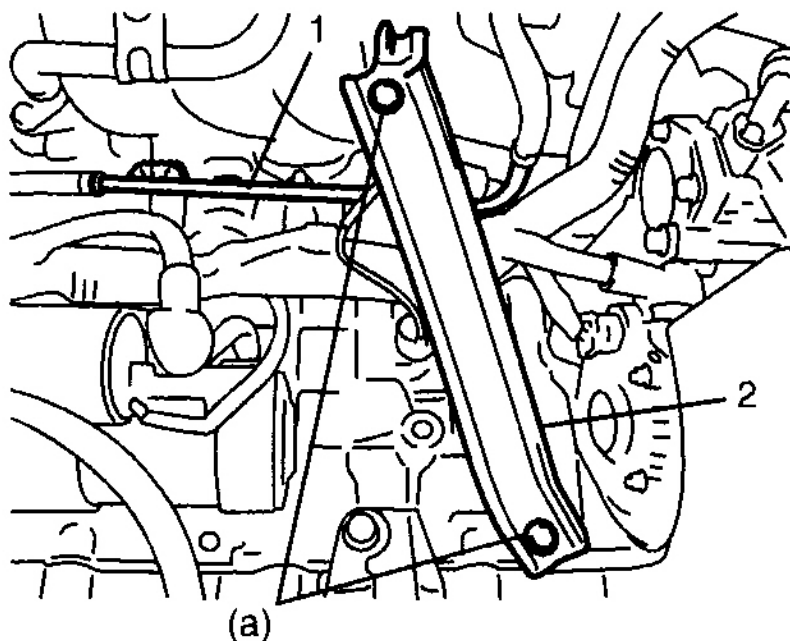
I4RH01140013

Fig. 26: Installing Intake Manifold

Courtesy of SUZUKI OF AMERICA CORP.

3. Connect coolant pipe (1) to intake manifold and install rear stiffener (2). Tighten bolts to specified torque.

Tightening torque**Intake manifold rear stiffener bolt (a): 25 N.m (2.5 kg-m, 18.0 lb-ft)**



I4RH01140014

Fig. 27: Tightening Intake Manifold Rear Stiffener Bolt
Courtesy of SUZUKI OF AMERICA CORP.

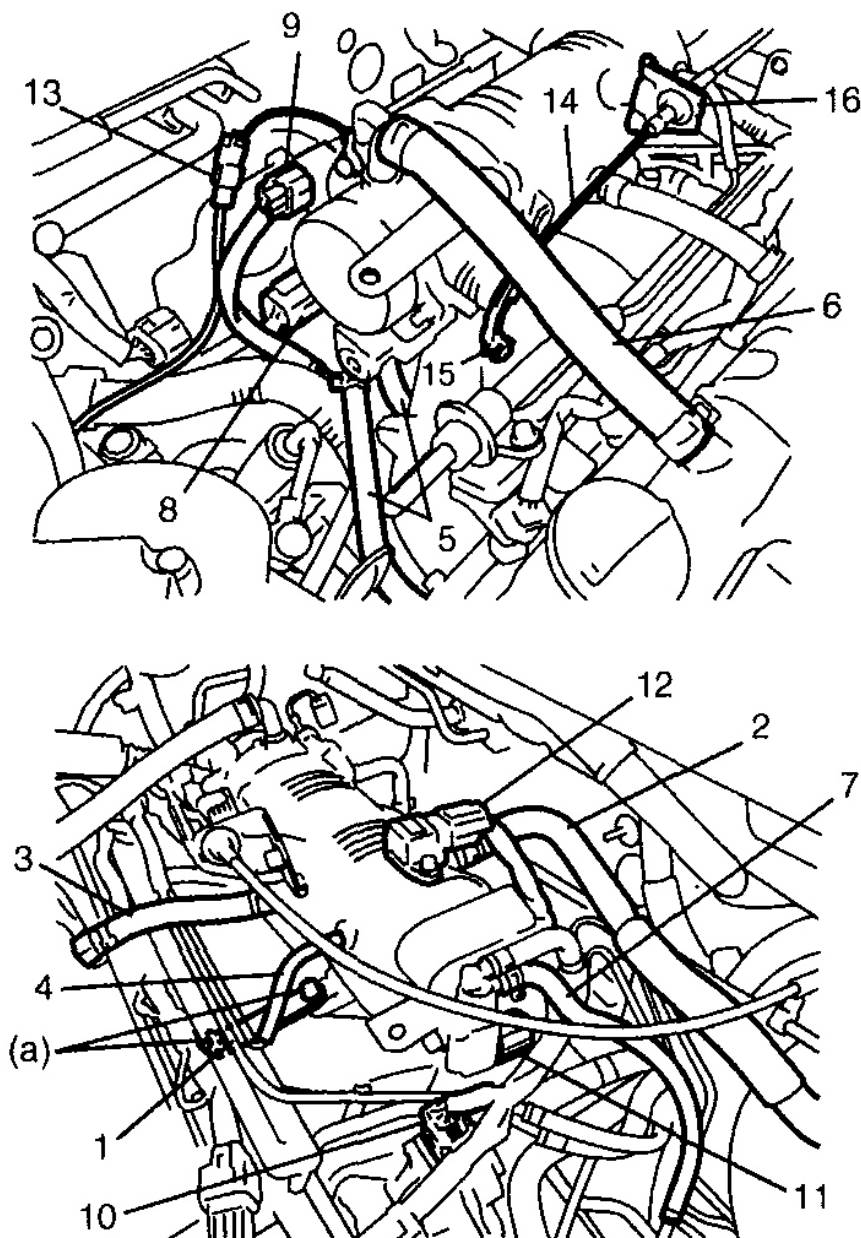
4. Install intake manifold front stiffener (1). Tighten bolts to specified torque.

Tightening torque

Intake manifold front stiffener bolt (a): 55 N.m (5.5 kg-m, 40.0 lb-ft)

5. Connect the following hoses:
 - Brake booster hose (2) to intake manifold
 - PCV hose (3) to PCV valve
 - Fuel pressure regulator vacuum hose (4) to intake manifold
 - Coolant hoses (5) to throttle body
 - Breather hose (6) to throttle body
 - Vacuum hose (7) to EVAP canister purge valve
6. Connect the following electric lead wires:
 - IAC valve (8)
 - TP sensor (9)
 - EGR valve (10)
 - EVAP canister purge valve (11)

- MAP sensor (12)
 - Ground terminal (13) to throttle body
7. Connect accelerator cable (14) to throttle valve lever (15) and install its bracket (16) to intake manifold. Adjust accelerator cable play, referring to "**ACCELERATOR CABLE ADJUSTMENT**".



I5RH01140003

Fig. 28: Connecting Electric Lead Wires And Hoses

Courtesy of SUZUKI OF AMERICA CORP.

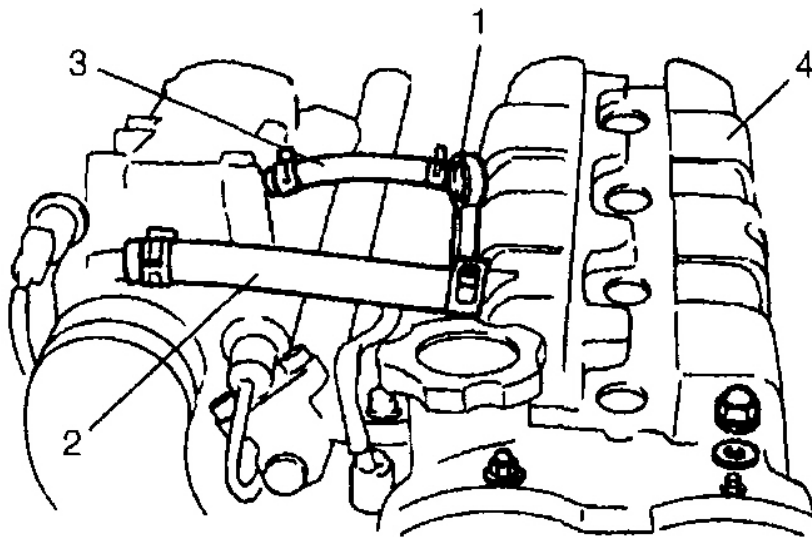
8. Install air cleaner outlet hose referring to "**AIR CLEANER OUTLET HOSE REMOVAL AND INSTALLATION**".
9. Install engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION**".
10. Check to ensure that all removed parts are back in place.

Reinstall any necessary parts which have not been reinstalled.

11. Refill cooling system referring to **COOLING SYSTEM FLUSH AND REFILL** .
12. Connect negative cable at battery.
13. Start engine and check for engine coolant leaks.

CYLINDER HEAD COVER REMOVAL AND INSTALLATION**Removal**

1. Disconnect negative cable at battery.
2. Remove engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION**".
3. Disconnect ignition coil couplers.
4. Remove ignition coils.
5. Remove oil level gauge.
6. Disconnect breather hose (2) and PCV hose (3) from cylinder head cover (4).
7. Remove cylinder head cover (4).



I4RH01140016

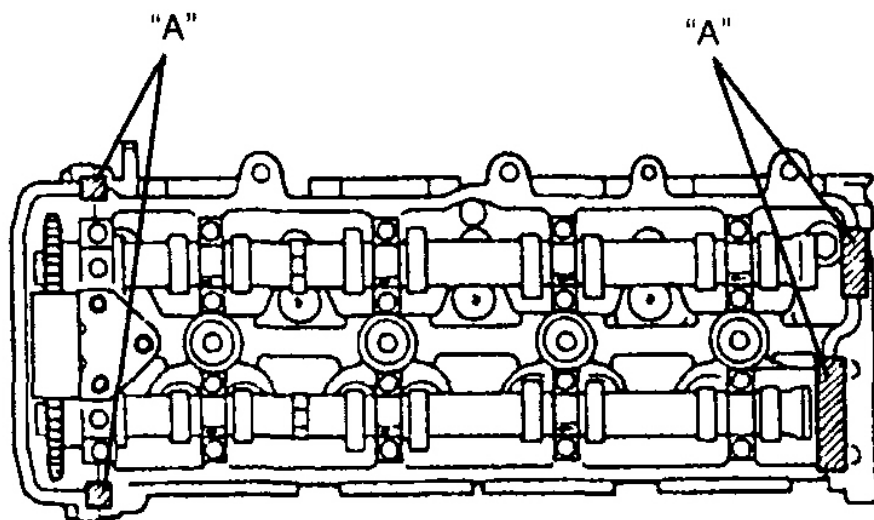
Fig. 29: Removing Cylinder Head Cover
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove PCV valve (1) from cylinder head cover (4), if equipped.

Installation

1. Install PCV valve to cylinder head cover referring to **PCV VALVE REMOVAL AND INSTALLATION**.
2. Remove oil, old sealant and dust from sealing surfaces on cylinder head and cover. After cleaning, apply sealant "A" to cylinder head sealing surface area as shown in figure.

"A": Sealant 99000-31250



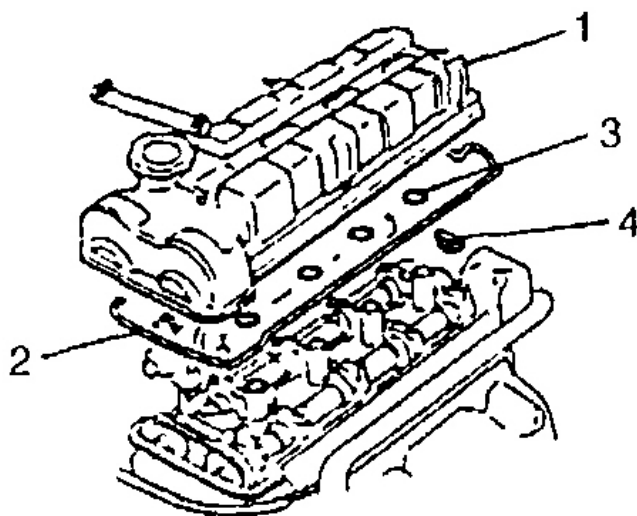
I2RH01140038

Fig. 30: Applying Sealant To Cylinder Head Sealing Surface Area
 Courtesy of SUZUKI OF AMERICA CORP.

3. Install new O-rings (3) and new cylinder head cover gasket (2) to cylinder head cover (1).

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

4. Install new cylinder head side seal (4) and cylinder head cover to cylinder head.



I2RH01140039

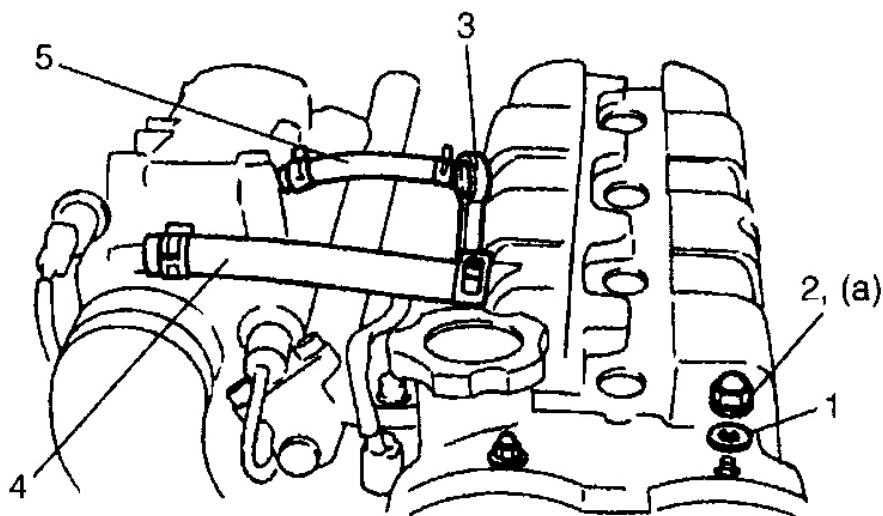
Fig. 31: Installing New Cylinder Head Side Seal And Cylinder Head Cover To Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

5. Tighten nuts (2) to specified torque.
 - Use new seal washers (1).

Tightening torque

Cylinder head cover nut (a): 11 N.m (1.1 kg-m, 8.0 lb-ft)

6. Install oil level gauge (3).
7. Connect breather hose (4) and PCV hose (5) to cylinder head cover.



I2RH01140040

Fig. 32: Connecting Breather Hose And PCV Hose To Cylinder Head Cover
Courtesy of SUZUKI OF AMERICA CORP.

8. Install ignition coils and connect ignition coil couplers.
9. Install engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION:**".
10. Connect negative cable at battery.

CYLINDER BLOCK HEATER (IF EQUIPPED) COMPONENTS

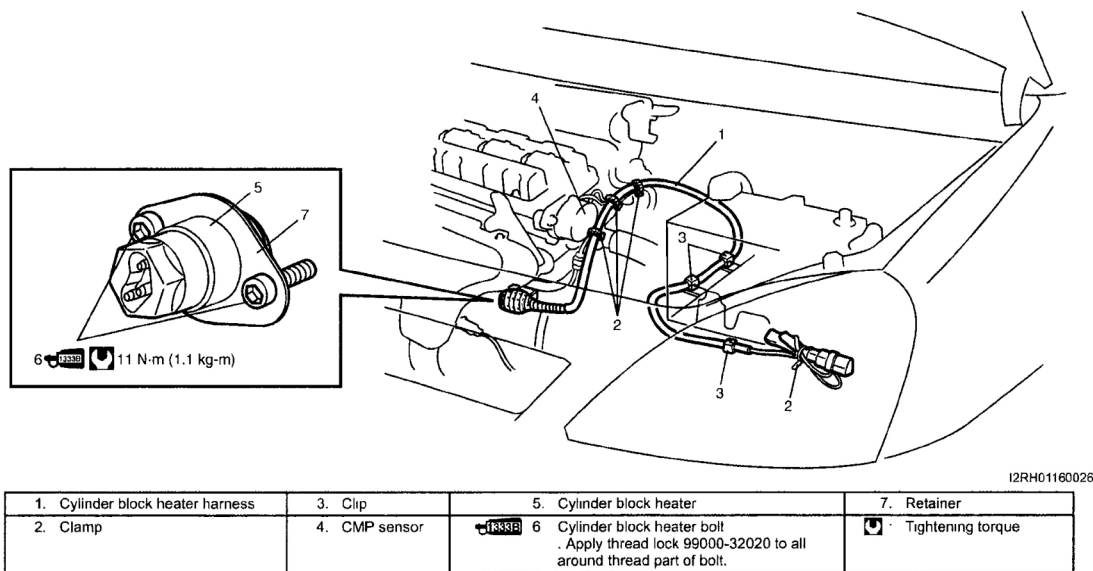


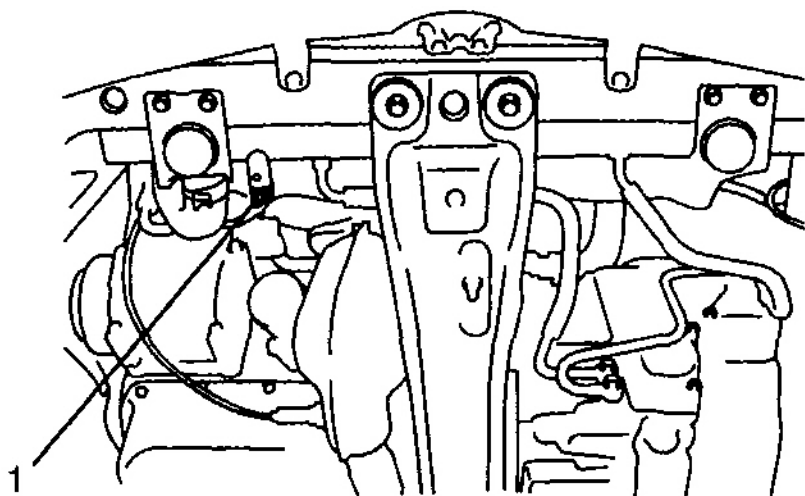
Fig. 33: Identifying Cylinder Block Heater Components
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER BLOCK HEATER (IF EQUIPPED) REMOVAL AND INSTALLATION

Removal

1. Disconnect negative (-) cable battery.
2. Drain coolant.

WARNING: To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



I2RH01140011

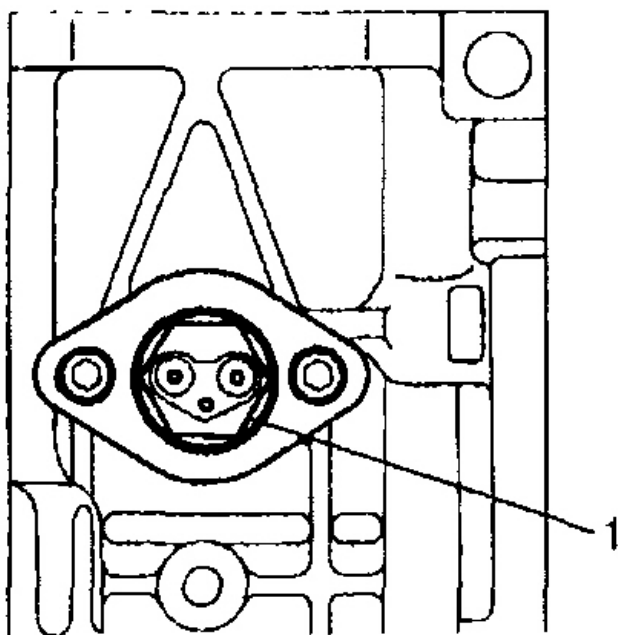
Fig. 34: Identifying Drain Plug
Courtesy of SUZUKI OF AMERICA CORP.

3. Disconnect cylinder block heater connector and remove cylinder block heater (1).

Installation

Reverse removal procedure for installation noting the following.

- Install cylinder block heater (1) in the direction as shown in the figure.



I2RH01160027

Fig. 35: Installing Cylinder Block Heater
Courtesy of SUZUKI OF AMERICA CORP.

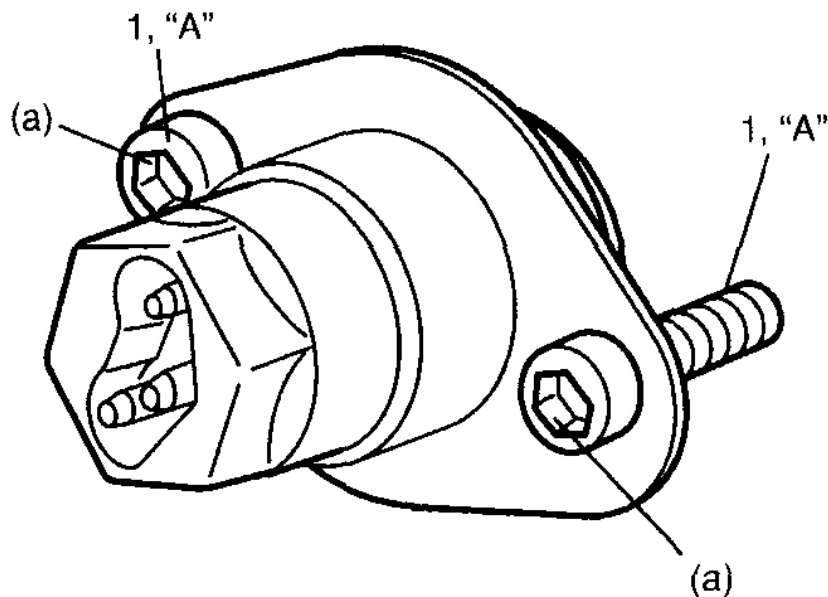
- Apply thread lock cement to block heater bolts (1).

"A": Thread lock cement 99000-32020

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

Tightening torque

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



I2RH01160028

Fig. 36: Tightening Cylinder Block Heater Bolt
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER BLOCK HEATER (IF EQUIPPED) INSPECTION

1. Check continuity between terminal "a" and "c" by using ohmmeter.

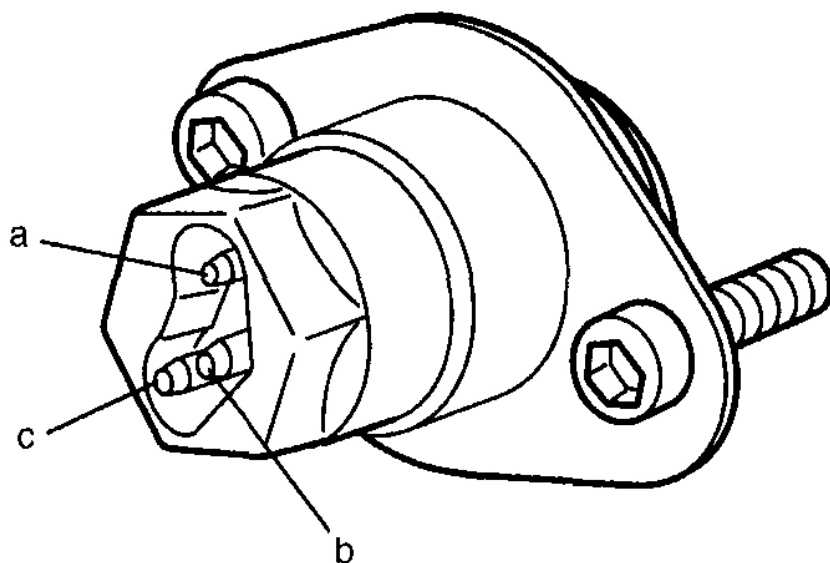
If there is no continuity, replace cylinder block heater.

2. Check that there is no continuity between terminal "a" and "b" or "c" and "b".

If there is continuity, replace cylinder block heater.

3. Check no continuity between "c" and block heater body.

If there is continuity, replace cylinder block heater.



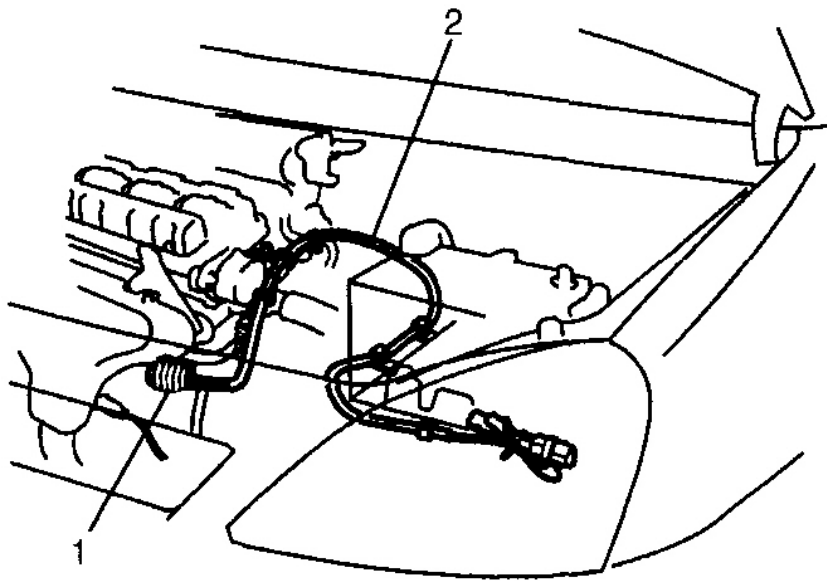
I2RH01160029

Fig. 37: Identifying Cylinder Block Heater Terminals
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER BLOCK HEATER HARNESS (IF EQUIPPED) REMOVAL AND INSTALLATION

Removal

1. Disconnect cylinder block heater connector (1) from block heater.
2. Unclamp cylinder block heater harness (2) and then remove it.

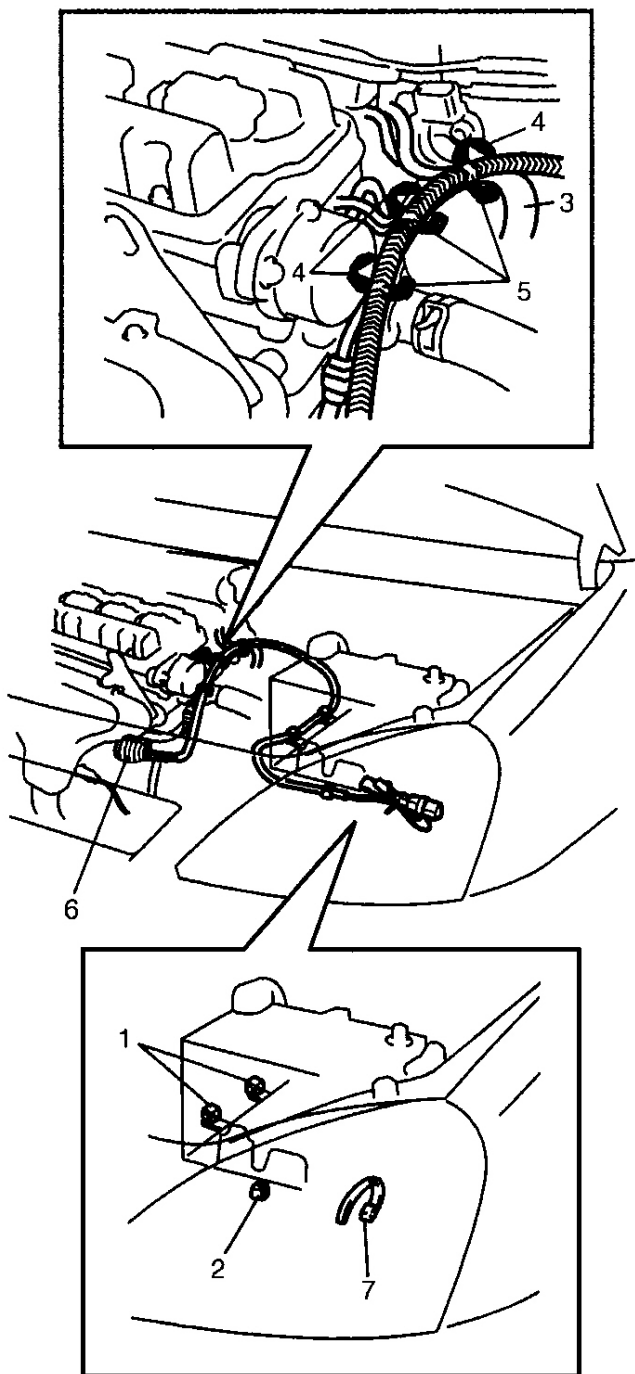


I2RH01160030

Fig. 38: Disconnecting Cylinder Block Heater Connector From Block Heater
Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Connect cylinder block heater connector to block heater.
2. Install clips (1) with open end facing left side and clip (2) with open end facing upward and clamp (7) to body.
3. Fix cylinder block heater harness with clips (1 and 2) and clamp (7) securely.
4. Fix cylinder block heater harness to engine harness (3) with clamps (4) at white tape parts (5).
5. Check to make sure that harness protector (6) is installed as shown and its open end faces downward.



I5RH01140004

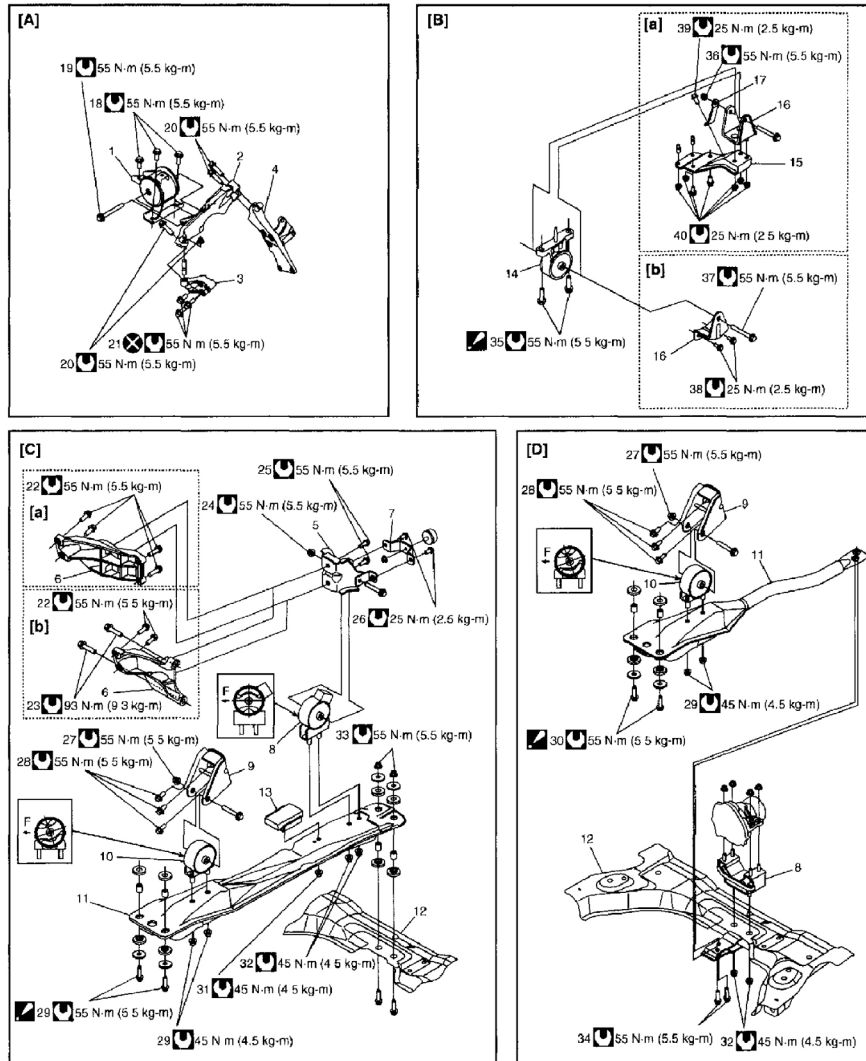
Fig. 39: Connecting Cylinder Block Heater Connector To Block Heater
Courtesy of SUZUKI OF AMERICA CORP.

CYLINDER BLOCK HEATER HARNESS (IF EQUIPPED) INSPECTION

- Check cylinder block heater harness for damage.

ENGINE MOUNTINGS COMPONENTS**WARNING:**

- "A": Tighten mounting member to suspension frame nuts or bolts first, and tighten mounting member to body bolts with specified torque.
- "B": Tighten engine right mounting No.1 bracket bolts first, and tighten engine left mounting bolts with specified torque.



4RH01140017

[A] Engine right mounting assembly	12 Suspension frame	29 Engine front mounting nut
[B] Engine left mounting assembly	13 Dynamic damper	30 Mounting member to body bolt
[C] Engine front and rear mounting assemblies for 2WD model	14 Engine left mounting	31 Dynamic damper nut
[D] Engine front and rear mounting assemblies for 4WD model	15 Engine left mounting No.1 bracket	32 Engine rear mounting nut
[a] For M/T model	16 Engine left mounting No.2 bracket	33 Mounting member to suspension frame nut
[b] For A/T model	17 Engine left mounting stiffener	34 Mounting member to suspension frame bolt
1 Engine right mounting	18 Engine right mounting bolt	35 Engine left mounting bolt
2 Engine right mounting No.1 bracket	19 Engine right mounting bolt	36 Engine left mounting No.2 bracket nut
3 Engine right mounting bracket	20 Engine right mounting No.1 bracket bolt and nut	37 Engine left mounting No.2 bracket bolt (long)
4 Generator and P/S pump bracket	21 Engine right mounting bracket bolt	38 Engine left mounting No.2 bracket bolt (short)
5 Engine rear mounting No.1 bracket	22 Engine rear mounting No.2 bracket bolt (short)	39 Engine left mounting stiffener bolt
6 Engine rear mounting No.2 bracket	23 Engine rear mounting No.2 bracket bolt (long)	40 Engine left mounting No.1 bracket bolt and nut
7 Engine rear mounting No.3 bracket	24 Engine rear mounting No.1 bracket nut	F Forward
8 Engine rear mounting	25 Engine rear mounting No.1 bracket bolt	T Tightening torque
9 Engine front bush bracket	26 Engine rear mounting No.3 bracket bolt	⊗ Do not reuse
10 Engine front mounting	27 Engine front bush bracket nut	
11 Mounting member	28 Engine front bush bracket bolt	

G04013965

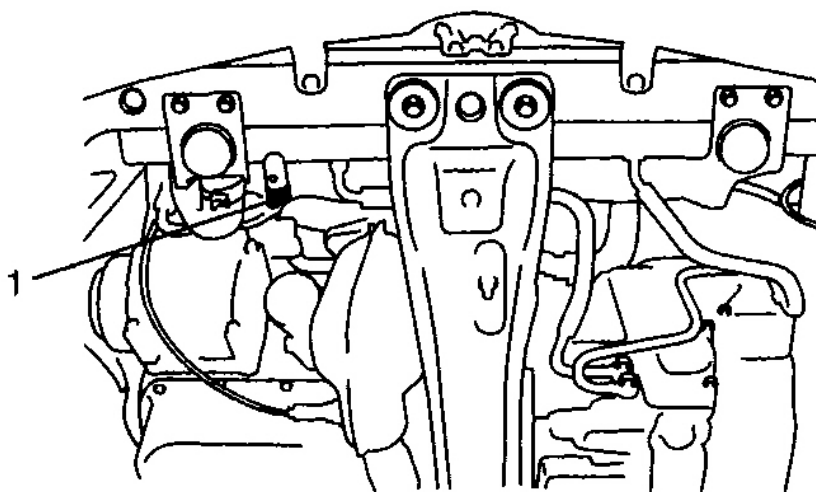
Fig. 40: Identifying Engine Mountings Components
Courtesy of SUZUKI OF AMERICA CORP.

ENGINE ASSEMBLY REMOVAL AND INSTALLATION

Removal

1. Release fuel pressure in fuel feed line by referring to **FUEL PRESSURE RELIEF PROCEDURE** .
2. Disconnect negative cable at battery.
3. Remove engine hood after disconnecting windshield washer hose.
4. Drain cooling system.

WARNING: To help avoid danger of being burned, do not remove drain plug (1) and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.

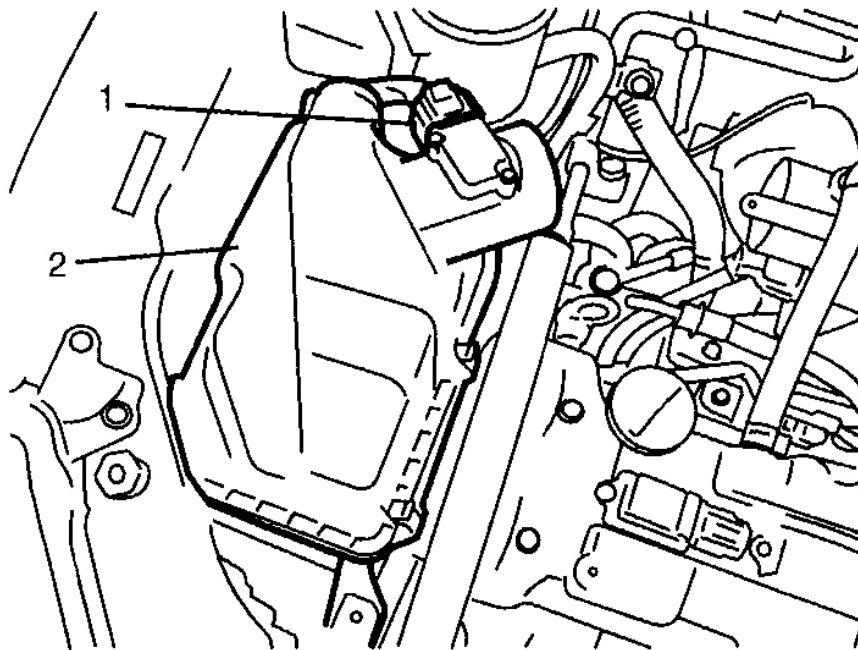


I2RH01140041

Fig. 41: Identifying Drain Plug

Courtesy of SUZUKI OF AMERICA CORP.

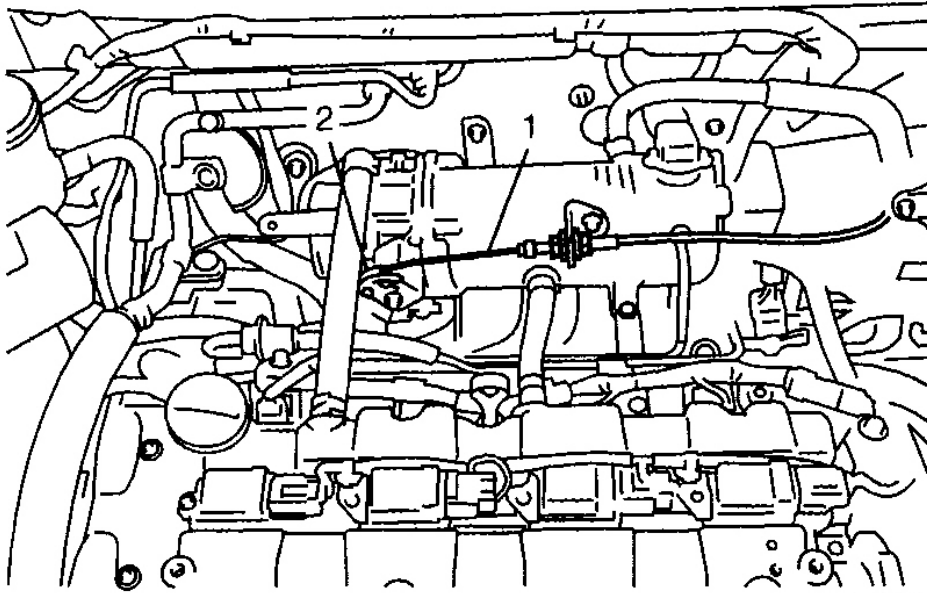
5. Remove radiator referring to **RADIATOR REMOVAL AND INSTALLATION** .
6. Remove engine cover referring to "**ENGINE COVER REMOVAL AND INSTALLATION**".
7. Remove air cleaner outlet hose referring to "**AIR CLEANER OUTLET HOSE REMOVAL AND INSTALLATION**".
8. Disconnect MAF sensor coupler (1).
9. Remove air cleaner case assembly (2).



I4RH01140018

Fig. 42: Removing Air Cleaner Case Assembly
Courtesy of SUZUKI OF AMERICA CORP.

10. Disconnect the following cables.
- Accelerator cable (1) from throttle valve lever (2).
 - Shift and select cable from transaxle (for M/T model)
 - Gear select cable from transaxle (for A/T model)



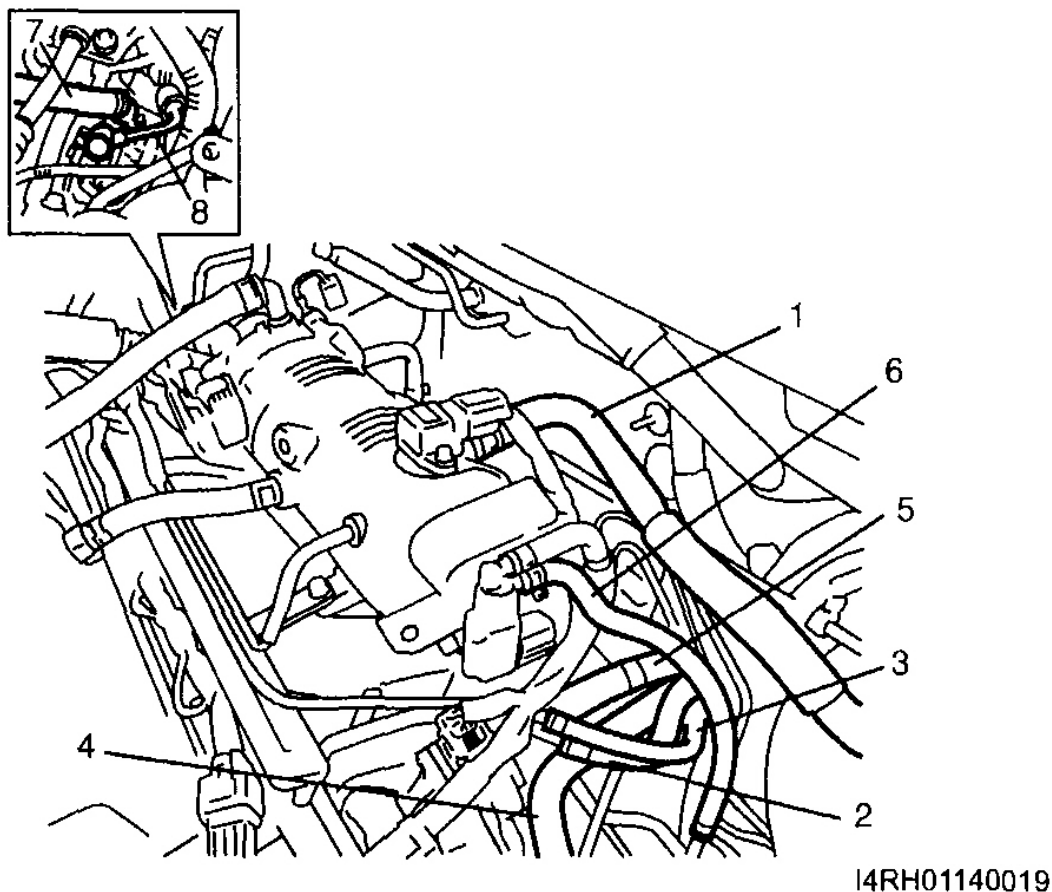
I4RH01140007

Fig. 43: Disconnecting Accelerator Cable From Throttle Valve Lever
 Courtesy of SUZUKI OF AMERICA CORP.

11. Remove accelerator cable with its bracket from intake manifold.
12. Disconnect the following hoses:

DISCONNECTED HOSES DESCRIPTION

Brake booster hose (1) from intake manifold	Heater outlet hose (5) from heater outlet pipe
Fuel feed hose (2) from delivery pipe	Vacuum hose (6) from EVAP canister purge valve
Fuel return hose (3) from return pipe	P/S suction hose (7) and high pressure pipe (8) from P/S pump
Heater inlet hose (4) from water outlet cap	



I4RH01140019

Fig. 44: Disconnecting Hoses

Courtesy of SUZUKI OF AMERICA CORP.

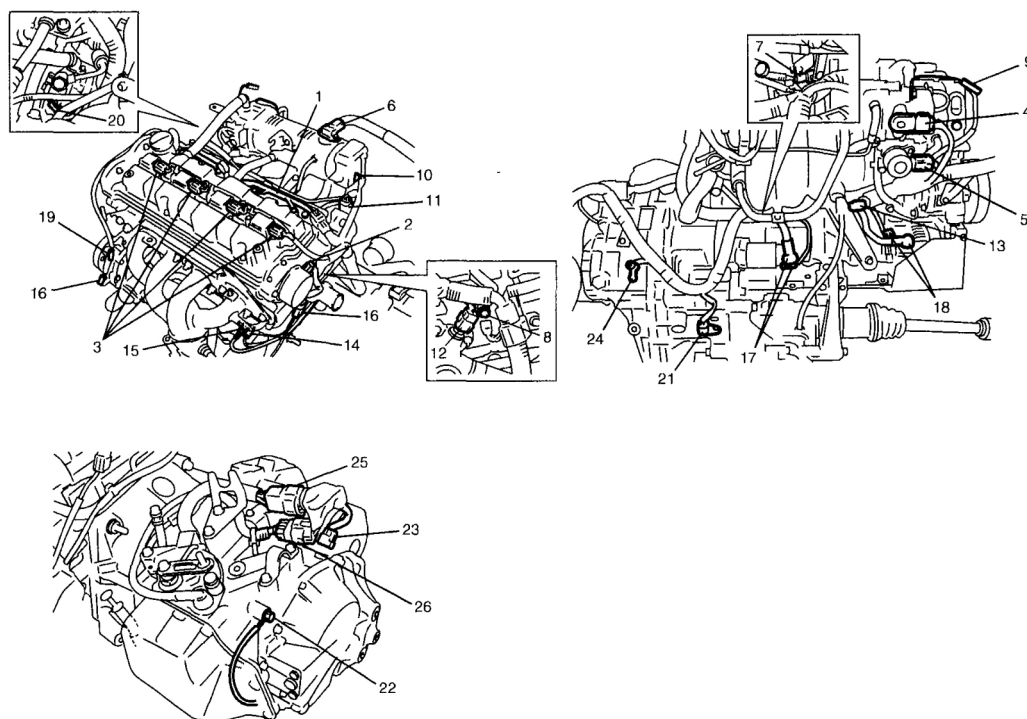
13. Disconnect the following electric wires:

DISCONNECTED ELECTRIC WIRES DESCRIPTION

Injector wire (1)	Cylinder block heater connector (15) (if equipped)
CMP sensor coupler (2)	Heated oxygen sensor wire (16)
Ignition coil wire (3)	Starter wires (17)
TP sensor coupler (4)	Generator wires (18)
IAC valve coupler (5)	A/C magnetic switch wire (19) (if equipped)
IAC valve coupler (6)	Power steering pressure switch coupler (20)
MAP sensor coupler (6)	Vehicle speed sensor (21)
CKP sensor coupler (7)	Battery negative cable from transmission (22)
Ground terminals from cylinder head (8) and throttle body (9)	Input shaft speed sensor (23) (A/T)

EVAP canister purge valve coupler (10)	Output shaft speed sensor (24) (A/T)
EGR valve coupler (11)	Transmission range switch (25) (for A/T model)
ECT sensor coupler (12)	Valve body and transmission fluid temperature sensor connector (26) (for A/T model)
Knock sensor coupler (13)	Back-up light switch (for M/T model)
Oil pressure switch wire (14)	

14. Release the wire harness from clamps.

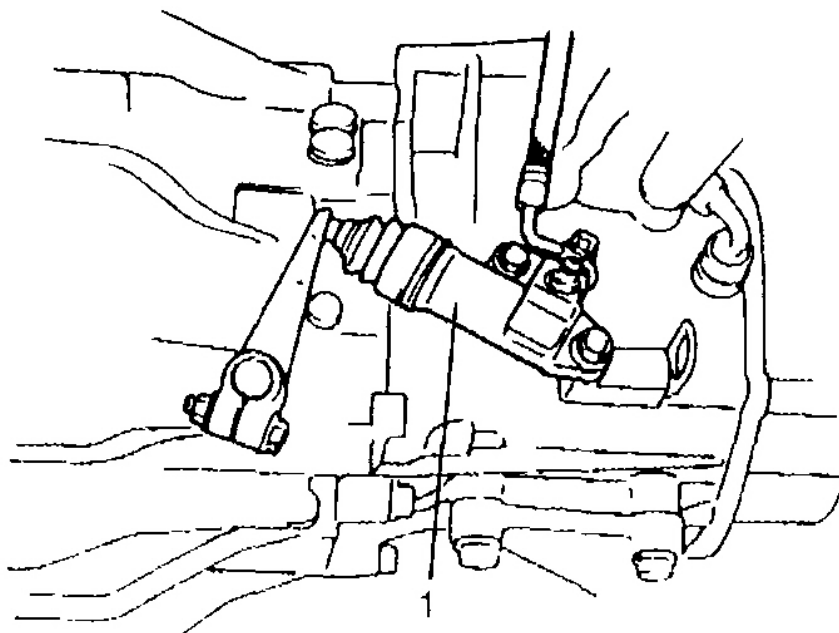


I4RH01140020

Fig. 45: Disconnecting Electric Wires
Courtesy of SUZUKI OF AMERICA CORP.

15. Remove clutch operating cylinder (1) from transmission with hose still attached (for M/T model).

NOTE: Suspend removed clutch operating cylinder at a place free from any possible damage during removal and installation of engine assembly.



I4RH01140021

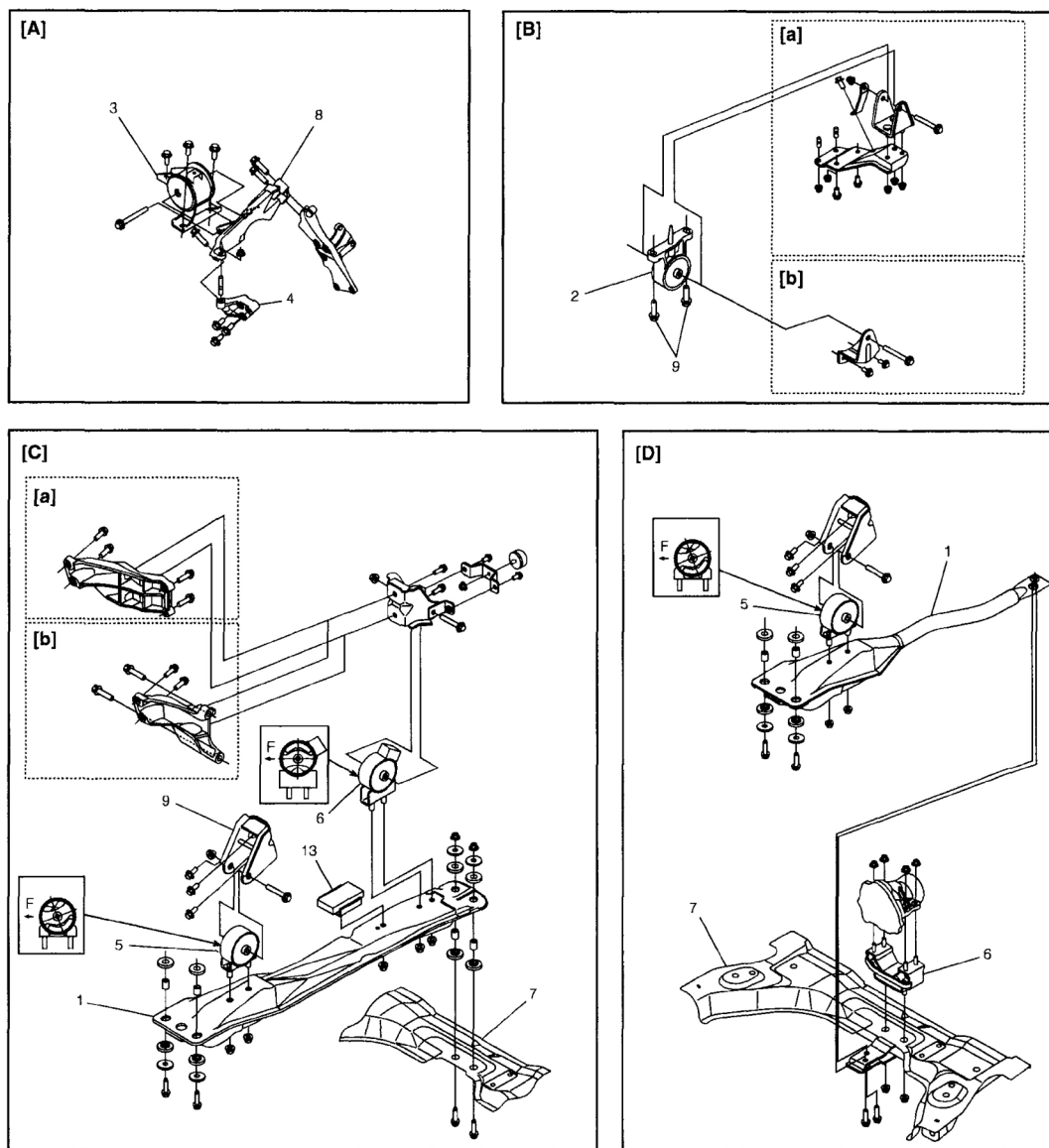
Fig. 46: Removing Clutch Operating Cylinder From Transmission
Courtesy of SUZUKI OF AMERICA CORP.

16. Remove right and left engine under covers.
17. Remove generator belt (Power steering pump drive belt) for equipped with A/C referring to **GENERATOR DRIVE BELT REMOVAL AND INSTALLATION**.
18. Remove exhaust No.1 pipe and No. 2 pipe referring to **EXHAUST PIPE REMOVAL AND INSTALLATION**.
19. Drain engine oil, transaxle oil for M/T vehicle or A/T fluid for A/T vehicle and transfer oil for 4WD vehicle.
20. Remove drive shafts referring to **FRONT DRIVE SHAFT ASSEMBLY REMOVAL AND INSTALLATION**.
21. Separate propeller shaft front end from transfer output flange for 4WD vehicle.
22. Remove A/C compressor from compressor bracket with hoses still attached, if equipped with A/C.

NOTE: Suspend removed compressor at a place free from any possible damage during removal and installation of engine assembly.

23. Remove intake manifold rear stiffener.
24. Install lifting device.
25. Remove mounting member (1) from front member and suspension frame (7).

26. Remove suspension frame (7) with stabilizer bar and suspension control arms referring to **FRONT SUSPENSION FRAME REMOVAL AND INSTALLATION**.
27. Remove engine left mounting bolts (9).
28. Remove engine right mounting No. 1 bracket (8).



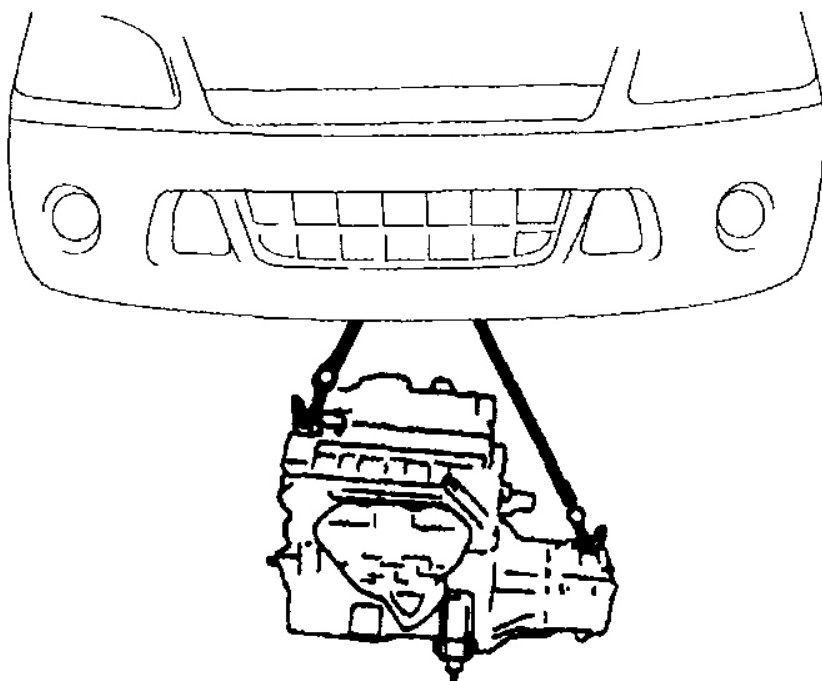
14RH01140022

[A] Engine right mounting assembly	[a] For M/T model	4 Engine right mounting bracket
[B] Engine left mounting assembly	[b] For A/T model	5 Engine front mounting
[C] Engine front and rear mounting assemblies for 2WD model	2 Engine left mounting	6 Engine rear mounting
[D] Engine front and rear mounting assemblies for 4WD model	3 Engine right mounting	F: Forward

Fig. 47: Removing Engine Left Mounting Bolts
Courtesy of SUZUKI OF AMERICA CORP.

29. Before removing engine with transaxle and transfer (for 4WD model) from vehicle body, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transaxle.
30. Lower engine with transaxle and transfer (for 4WD model) from vehicle body.

NOTE: Before lowering engine, to avoid damage to A/C compressor, raise it through clearance made on engine crankshaft pulley side. At this time, use care so that no excessive force is applied to hoses.



I2RH01140048

Fig. 48: Lowering Engine With Transaxle And Transfer (For 4WD Model) From Vehicle Body
Courtesy of SUZUKI OF AMERICA CORP.

31. Disconnect transfer from transaxle referring to **TRANSFER DISMOUNTING AND REMOUNTING** .
32. Disconnect transaxle from engine referring to **MANUAL TRANSAXLE UNIT DISMOUNTING AND REMOUNTING** or **AUTOMATIC TRANSAXLE UNIT DISMOUNTING AND REMOUNTING** .
33. Remove clutch cover and clutch disk referring to **CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION** .

Installation

1. Install clutch cover and clutch disk referring to **CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION**).

2. Connect transaxle to engine referring to **MANUAL TRANSAXLE UNIT DISMOUNTING AND REMOUNTING** or **AUTOMATIC TRANSAXLE UNIT DISMOUNTING AND REMOUNTING**.
3. Connect transfer to transaxle referring to **TRANSFER DISMOUNTING AND REMOUNTING**.
4. Lift engine with transaxle and transfer (for 4WD model) into engine compartment, but do not remove lifting device.
5. Install engine right mounting No. 1 bracket (8) to right mounting bracket (4), generator & P/S bracket and engine right mounting (3) with temporal tightening its bolts.
6. Install engine left mounting bolts (9) with temporal tightening its nut.
7. Install mounting member (1) to front member and suspension frame (7).
8. Install suspension frame (7) with stabilizer bar and suspension control arms referring to **FRONT SUSPENSION FRAME REMOVAL AND INSTALLATION**.
9. Tighten bolts and nuts of all parts installed in steps 5), 6) and 7) to specified torque.

NOTE:

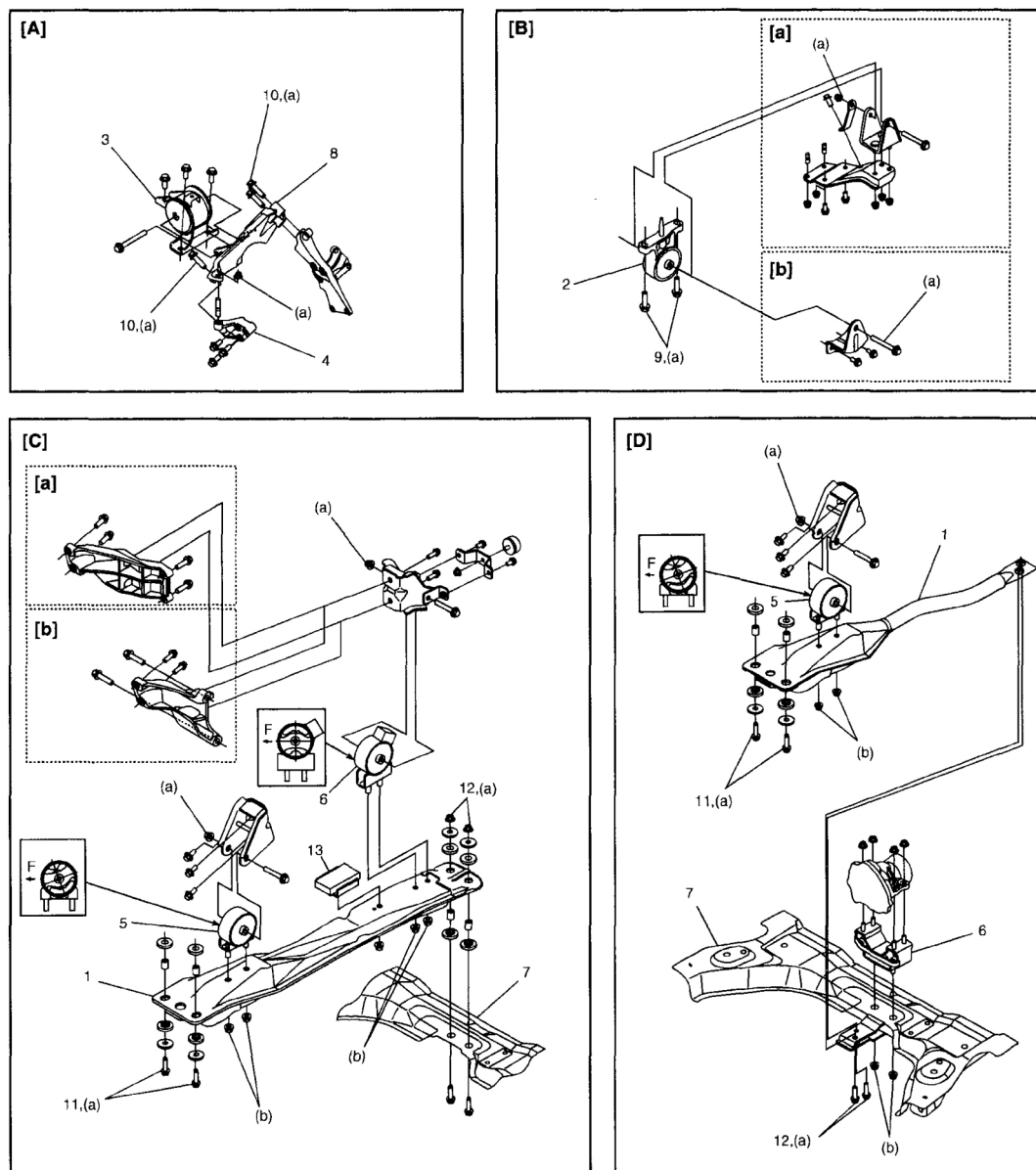
- Be sure to tighten engine right mounting No.1 bracket bolt (10) previously, and tighten engine left mounting bolts (9).
- Be sure to tighten mounting member to suspension frame bolts (12) or nuts (12) previously, and tighten mounting member to body bolts (11).

Tightening torque

Engine mounting bolts and nut (a): 55 N.m (5.5 kg-m, 40.0 lb-ft)

Engine front and rear mounting nut (b): 45 N.m (4.5 kg-m, 32.5 lb-ft)

10. Remove lifting device.
11. Reverse removal procedures for installation of reminder.
 - Push in each drive shaft joint fully so that snap ring engages with differential gear or center bearing support. Use care not to damage oil seal lip when inserting.
 - Clamp electric wire securely.



I4RH01140023

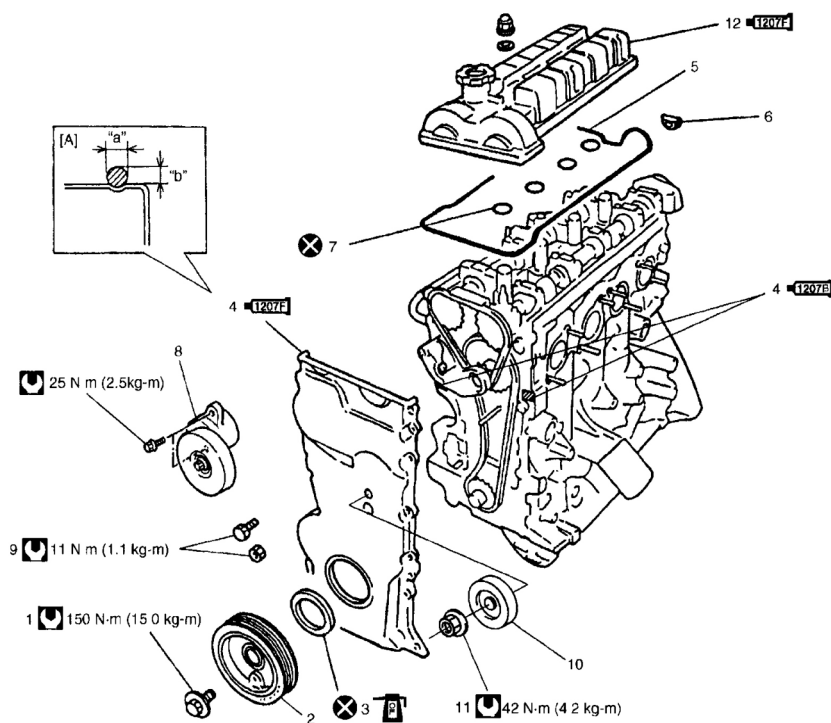
[A]: Engine right mounting assembly	[a]. For M/T model	6. Engine rear mounting
[B]: Engine left mounting assembly	[b] For A/T model	F Forward
[C]: Engine front and rear mounting assemblies for 2WD model	2 Engine left mounting	
[D]: Engine front and rear mounting assemblies for 4WD model	5. Engine front mounting	

Fig. 49: Tightening Engine Mounting Bolts And Nut
Courtesy of SUZUKI OF AMERICA CORP.

12. For 4WD model, connect propeller shaft referring to **PROPELLER SHAFT REMOVAL AND INSTALLATION**.
13. Adjust gear shift control cable, referring to **GEAR SHIFT LEVER AND CABLE REMOVAL AND INSTALLATION**.

14. Install generator belt (Power steering pump drive belt) referring to **GENERATOR DRIVE BELT REMOVAL AND INSTALLATION**.
15. Refill transaxle with A/T fluid or gear oil, referring to **AUTOMATIC TRANSAXLE FLUID REPLACEMENT** or **MANUAL TRANSAXLE OIL REPLACEMENT**.
16. For 4WD model, refill transfer with transfer oil referring to **TRANSFER OIL CHANGE**.
17. Refill engine with engine oil, referring to **ENGINE OIL AND FILTER CHANGE**.
18. Refill cooling system, referring to **COOLING SYSTEM FLUSH AND REFILL**.
19. Upon completion of installation, check to make sure that there is no fuel leakage, coolant leakage, transaxle oil leakage, transfer oil leakage or exhaust gas leakage at each connection.
20. Adjust accelerator cable play, referring to **"ACCELERATOR CABLE ADJUSTMENT:"**.

TIMING CHAIN COVER COMPONENTS



4RH01140024

[A]: Sealant application amount	4 Timing chain cover : See "A" : See "B"	10 Generator belt idler pulley
"a": 3 mm (0.12 in.)	5. Cylinder head cover gasket	11 Generator belt idler pulley nut
"b": 2 mm (0.08 in.)	6. Cylinder head side seal	12. Cylinder head cover : See "C"
1 Crankshaft pulley bolt	7 O-ring	Tightening torque
2. Crankshaft pulley	8. Generator belt tensioner	Do not reuse
3. Oil seal : Apply engine oil to oil seal lip.	9. Timing chain cover bolt and nut	
"A". Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head.		
"B". Apply sealant 99000-31250 to the mating surface of timing chain cover referring to the figure of Step 1) in "Timing Chain Cover Removal and Installation."		
"C". Apply sealant 99000-31250 to the sealing point for timing chain cover mating surface and cylinder head sealing point. Refer to "Cylinder Head Cover Removal and Installation."		

Fig. 50: Identifying Timing Chain Cover Components

Courtesy of SUZUKI OF AMERICA CORP.

TIMING CHAIN COVER REMOVAL AND INSTALLATION

Removal

1. Remove engine assembly from vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION**".
2. Remove oil pan referring to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION** .
3. Remove cylinder head cover referring to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**".
4. Remove crankshaft pulley bolt.

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

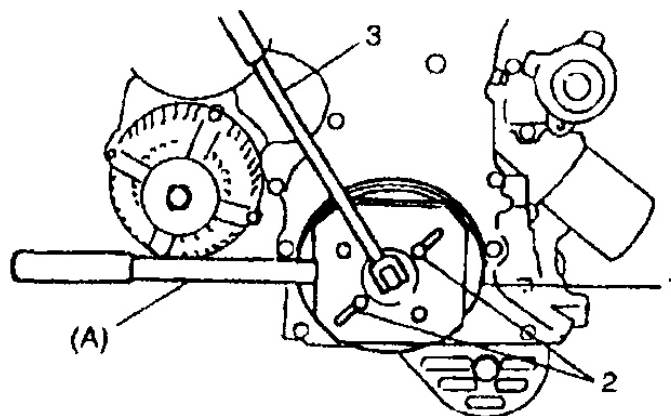
Special tool

(a): 09917-68221

NOTE: Be sure to use the following bolts instead of pins for fixing special tool to crankshaft pulley.

Bolt size: M8, P1.25 L = 25 mm (0.98 in.)

Strength: 7T



I2RH01140051

2 Bolt

3 Wrench

Fig. 51: Removing Crankshaft Pulley Bolt
Courtesy of SUZUKI OF AMERICA CORP.

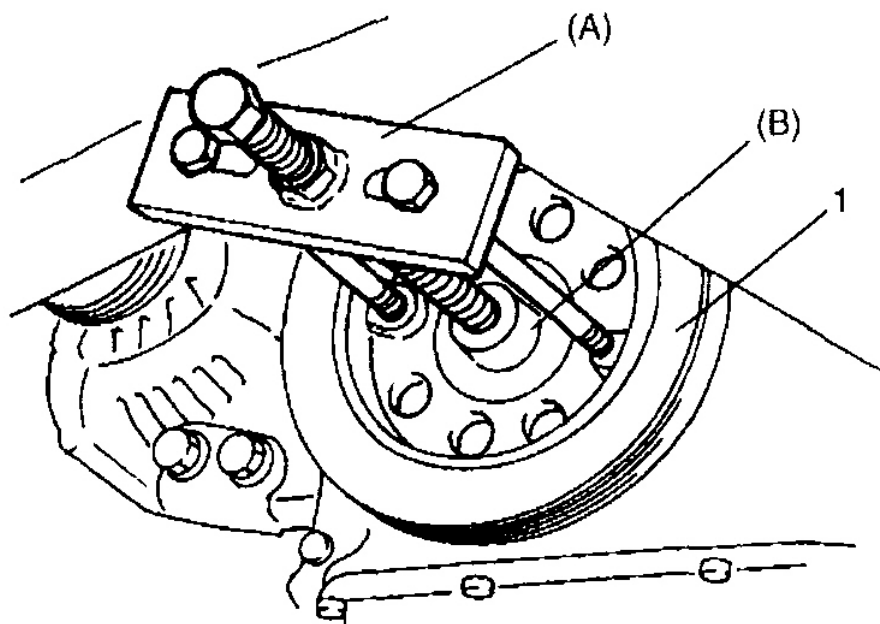
5. Remove crankshaft pulley (1).

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

Special tool

(A): 09944-36011

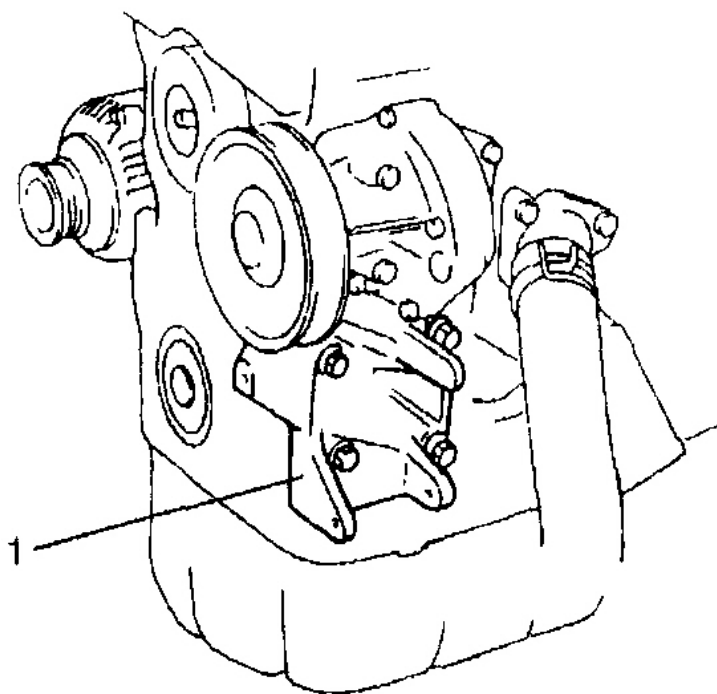
(B): 09926-58010



I2RH01140052

Fig. 52: Removing Crankshaft Pulley
Courtesy of SUZUKI OF AMERICA CORP.

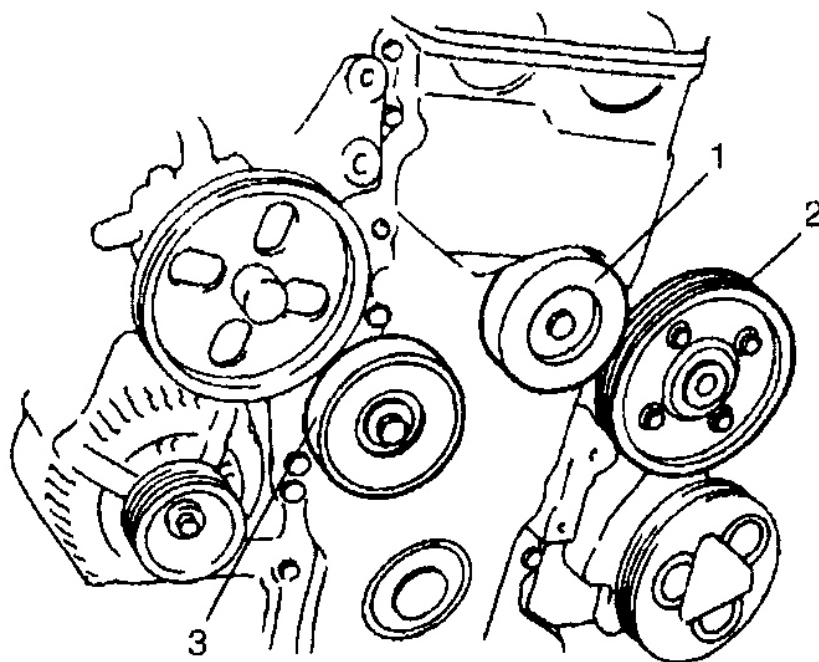
6. Remove A/C compressor bracket (1).



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Fig. 53: Removing A/C Compressor Bracket
Courtesy of SUZUKI OF AMERICA CORP.

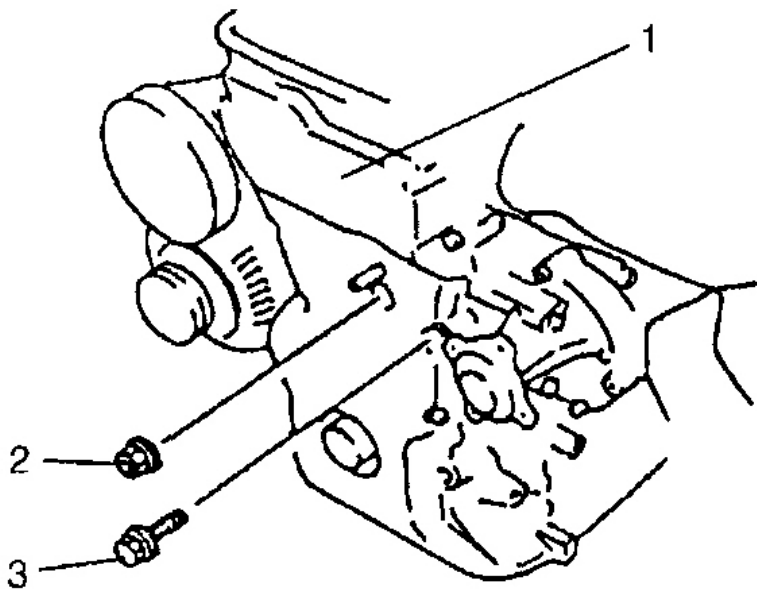
7. Remove generator belt idler pulley (1), water pump pulley (2) and generator belt tensioner (3).



I2RH01140054

Fig. 54: Removing Generator Belt Idler Pulley, Water Pump Pulley And Generator Belt Tensioner
Courtesy of SUZUKI OF AMERICA CORP.

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



I2RH01140055

Fig. 55: Removing Timing Chain Cover
Courtesy of SUZUKI OF AMERICA CORP.

Installation

Reverse removal sequence to install timing chain cover (1) noting the following points.

1. Apply sealant "A" and "B" to area as shown in figure.

"A": Sealant 99000-31250

"B": Sealant 99000-31140

Sealant amount for timing chain cover

"a": 3 mm (0.12 in.)

"b": 2 mm (0.08 in.)

"c": 6 mm (0.24 in.)

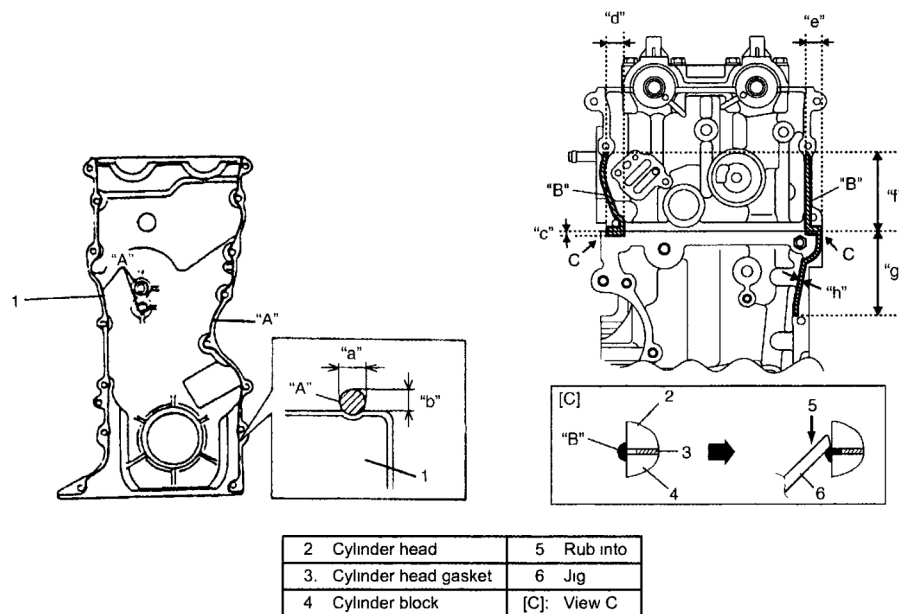
"d": 16 mm (0.63 in.)

"e": 14 mm (0.55 in.)

"f": 65 mm (2.56 in.)

"g": 73 mm (2.87 in.)

"h": 4 mm (0.16 in.)



14RH01140054

Fig. 56: Applying Sealant To Timing Chain Cover

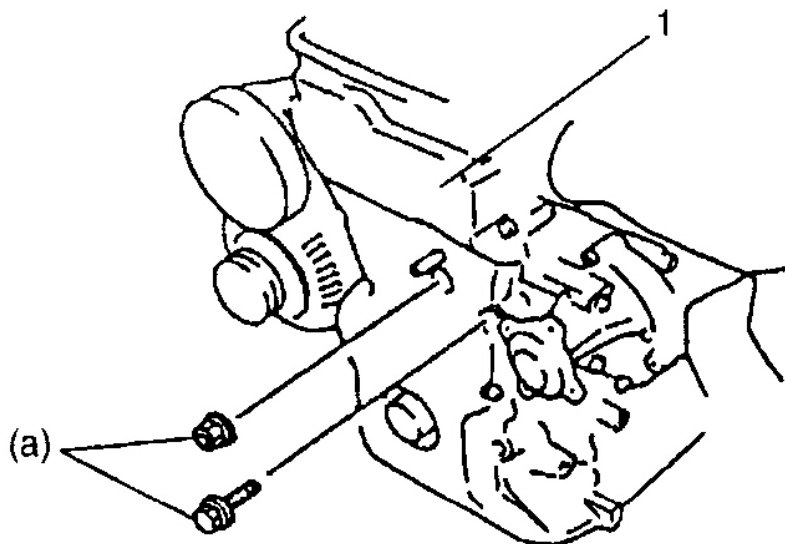
Courtesy of SUZUKI OF AMERICA CORP.

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

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

Tightening torque

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



I2RH01140057

Fig. 57: Installing Timing Chain Cover
Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque

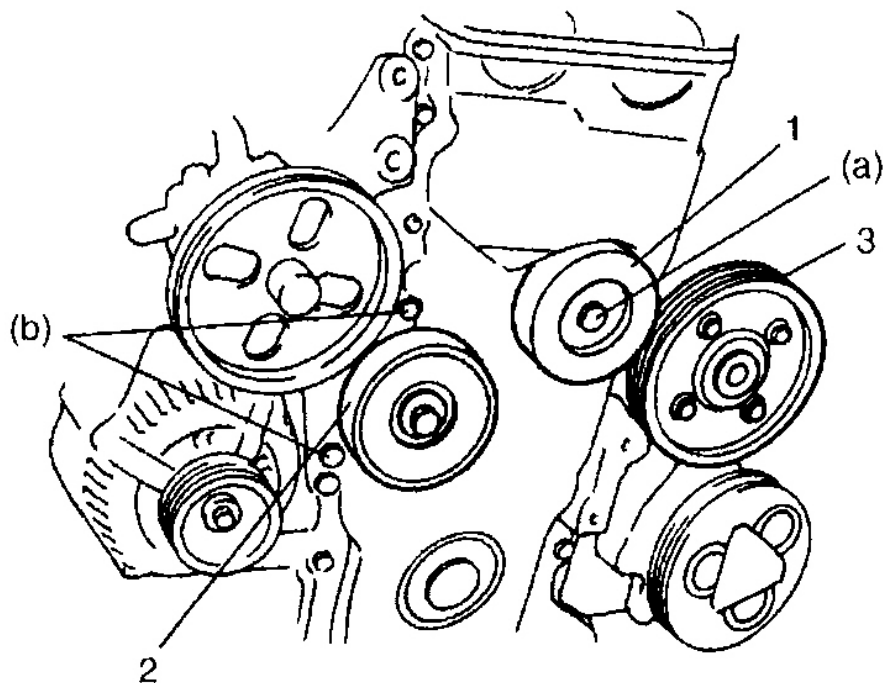
Generator belt idler pulley nut (a): 42 N.m (4.2 kg-m, 30.5 lb-ft)

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

Tightening torque

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

5. Install water pump pulley (3).



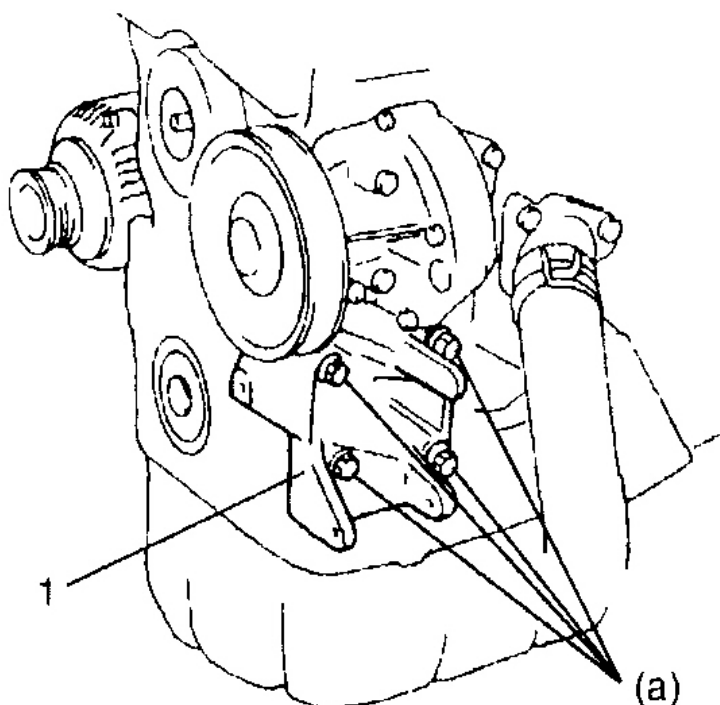
I2RH01140058

Fig. 58: Tightening Timing Chain Cover Bolt And Generator Belt Tensioner Bolt
Courtesy of SUZUKI OF AMERICA CORP.

6. Install A/C compressor bracket (1) if equipped. Tighten bracket bolts to specified torque.

Tightening torque

A/C compressor bracket bolt (a): 55 N.m (5.5 kg-m, 40.0 lb-ft)



I2RH01140059

Fig. 59: Tightening A/C Compressor Bracket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

7. Install cylinder head cover referring to "CYLINDER HEAD COVER REMOVAL AND INSTALLATION".
8. Install oil pan. Refer to OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION.
9. Install crankshaft pulley. To lock crankshaft pulley (1), use special tool (camshaft pulley holder) with it as shown in figure.

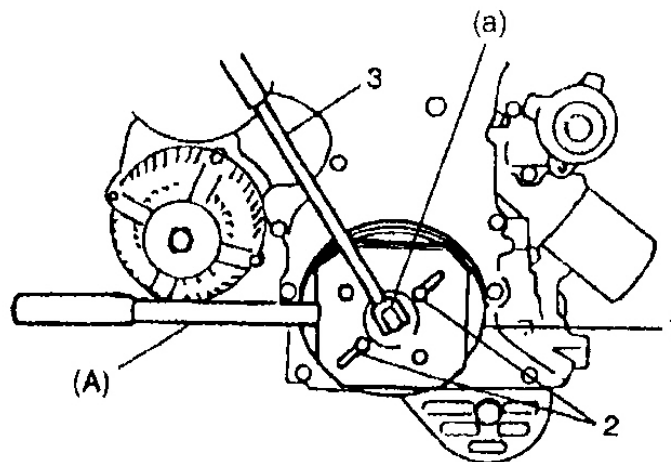
Special tool

(A): 09917-68221

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

Tightening torque

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



I2RH01140060

2 Bolt

3 Wrench

Fig. 60: Installing Crankshaft Pulley

Courtesy of SUZUKI OF AMERICA CORP.

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

TIMING CHAIN COVER CLEANING AND INSPECTION

Clean

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

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

Inspection

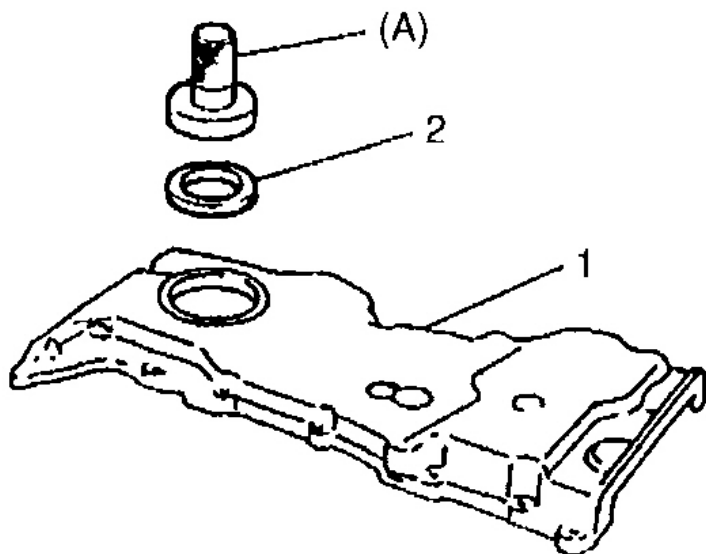
Check oil seal lip for fault or other damage. Replace as necessary.

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

To install oil seal, use special tool (bearing installer).

Special tool

(A): 09913-75510



I2RH01140061

Fig. 61: Installing New Oil Seal
Courtesy of SUZUKI OF AMERICA CORP.

2ND TIMING CHAIN AND CHAIN TENSIONER COMPONENTS

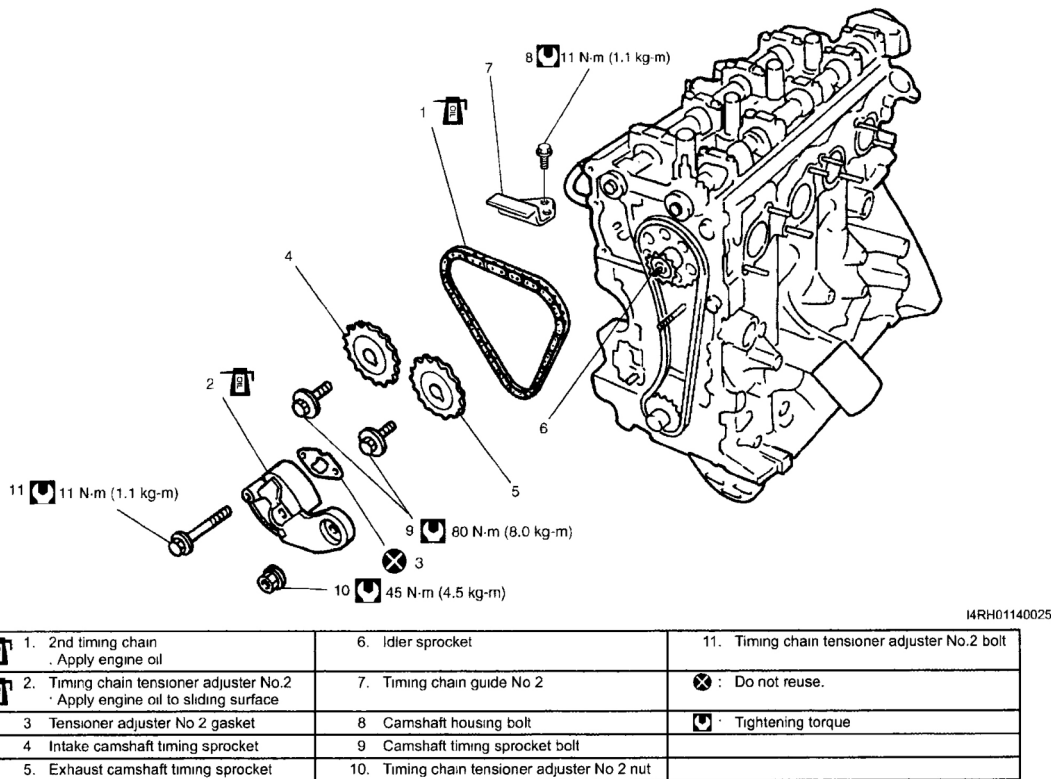


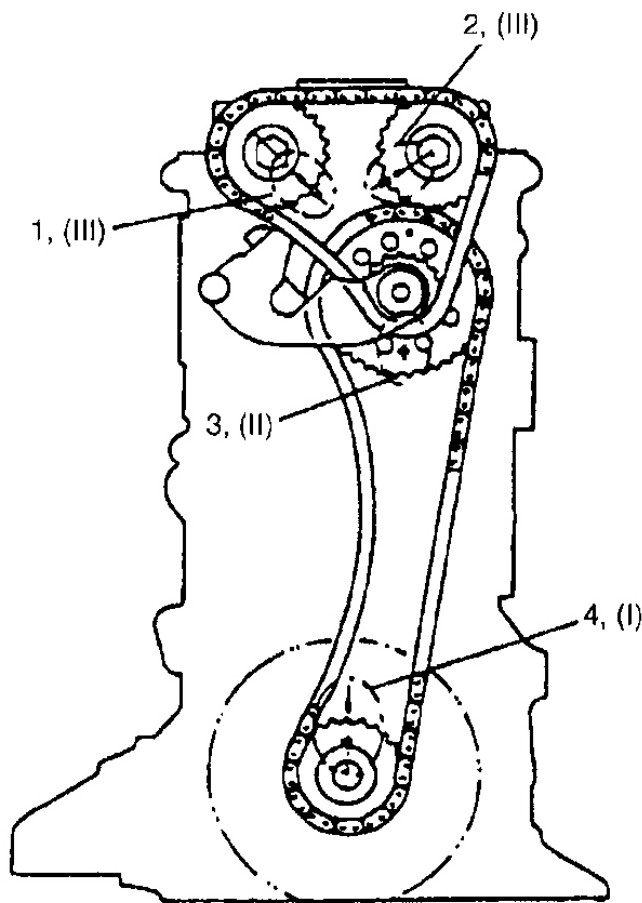
Fig. 62: Identifying 2Nd Timing Chain And Chain Tensioner Components
 Courtesy of SUZUKI OF AMERICA CORP.

2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION

Removal

1. Remove engine assembly from vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION**".
2. Remove oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION**.
3. Remove cylinder head cover. Refer to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**:" for removal.
4. Remove timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION**:" for removal.
5. Turn crankshaft to meet following conditions.
 - Key (I) on crankshaft is positioned as shown.
 - Arrow mark on idler sprocket (II) points upward.
 - Marks on sprockets (III) match with marks on cylinder head.

Note that this step must be followed for reinstallation of timing chain.

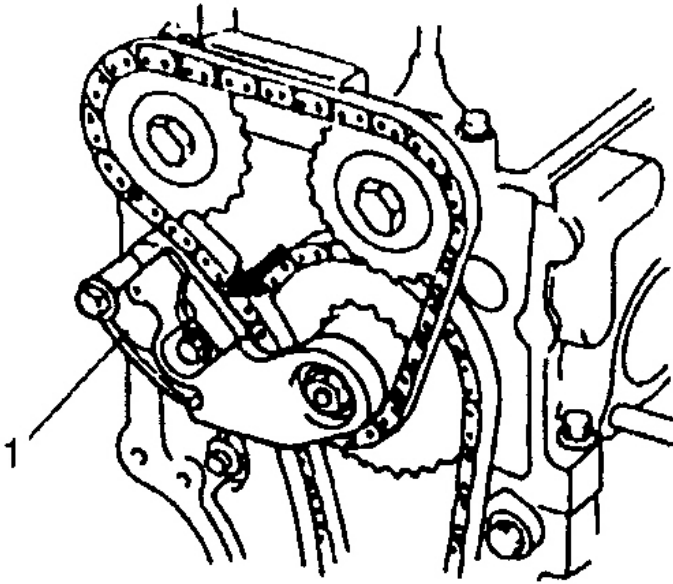


I2RH01140063

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

Fig. 63: Aligning Marks On Sprockets With Marks On Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

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

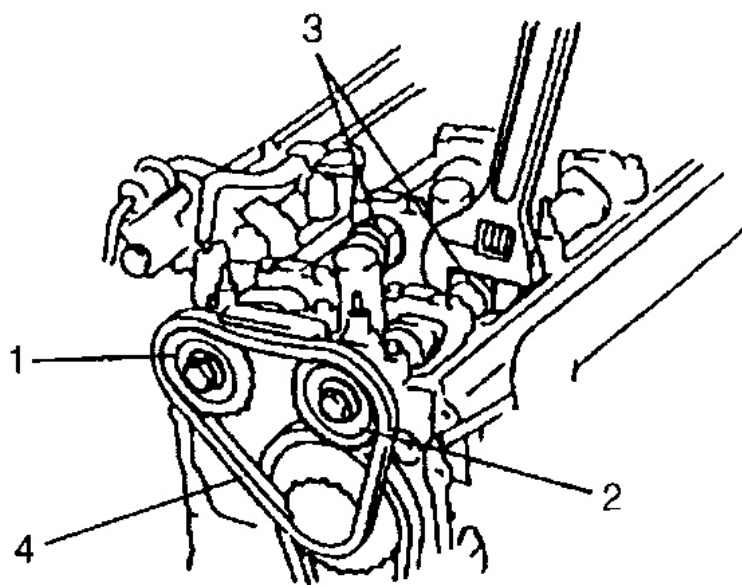


I2RH01140064

Fig. 64: Removing Timing Chain Tensioner Adjuster No 2
Courtesy of SUZUKI OF AMERICA CORP.

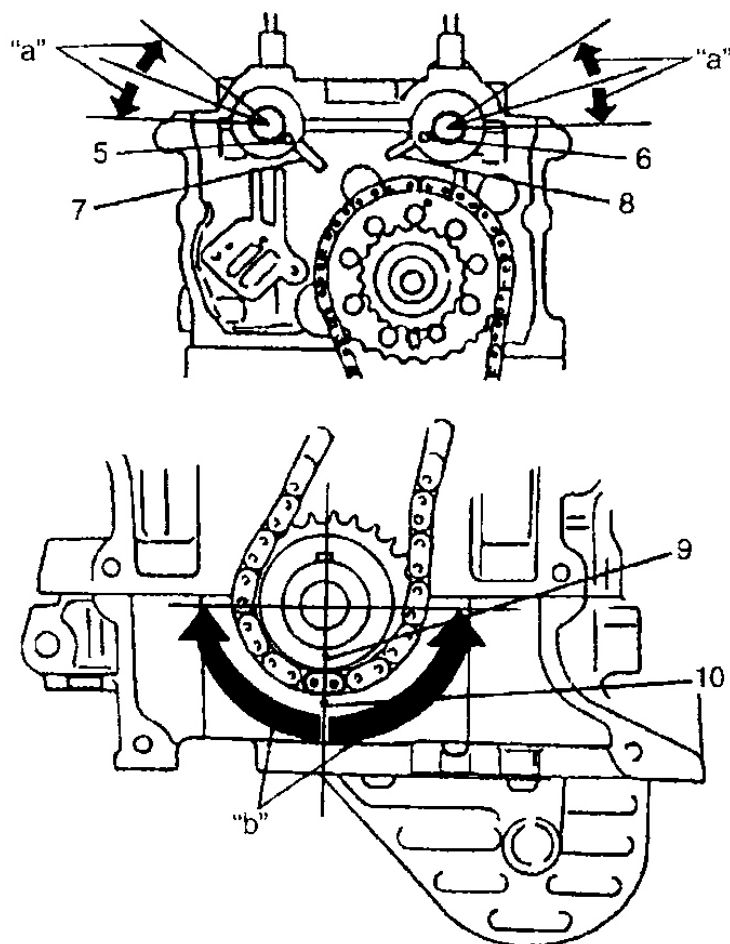
7. Remove intake (1) and exhaust (2) camshaft timing sprocket bolts. To remove them, fit a spanner to hexagonal part (3) at the center of camshaft to hold it stationary.
8. Remove camshaft timing sprockets and 2nd timing chain (4).

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



I2RH01140065

Fig. 65: Removing Intake And Exhaust Camshaft Timing Sprocket Bolts
Courtesy of SUZUKI OF AMERICA CORP.



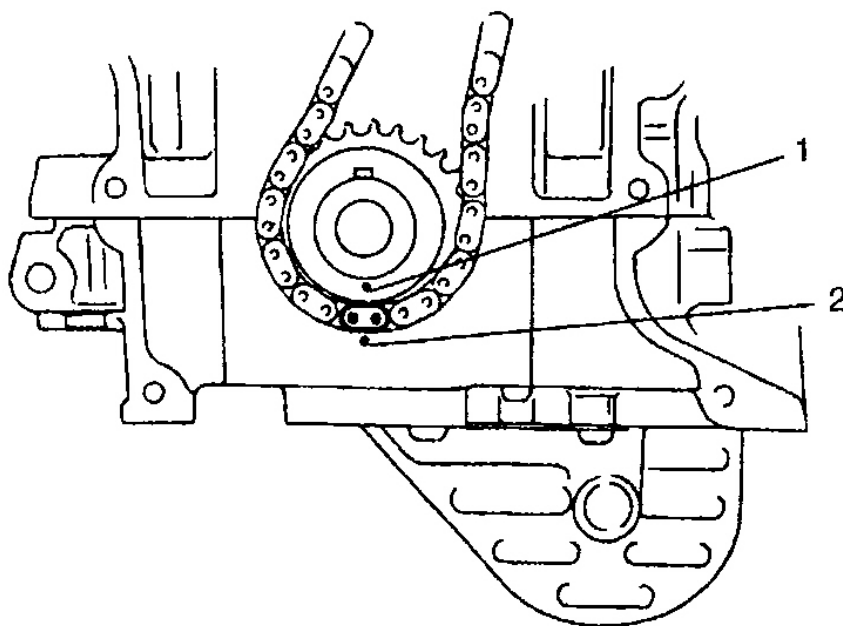
I5RH01140005

5 Knock pin of intake camshaft	9 Match mark on crank timing sprocket
6 Knock pin of exhaust camshaft	10 Timing mark on lower crankcase
7 Timing mark of intake side	"a": Camshafts (IN & EX) allowable turning range. . Within 20° on both right and left
8 Timing mark of exhaust side	"b": Crankshaft allowable turning range..... Within 90° on both right and left

Fig. 66: Removing Camshaft Timing Sprockets And 2Nd Timing Chain
 Courtesy of SUZUKI OF AMERICA CORP.

Installation

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

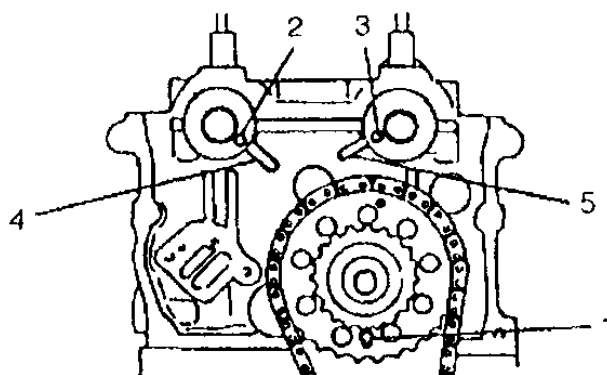


I2RH01140067

Fig. 67: Aligning Match Mark On Crank Timing Sprocket With Timing Mark On Lower Crankcase

Courtesy of SUZUKI OF AMERICA CORP.

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



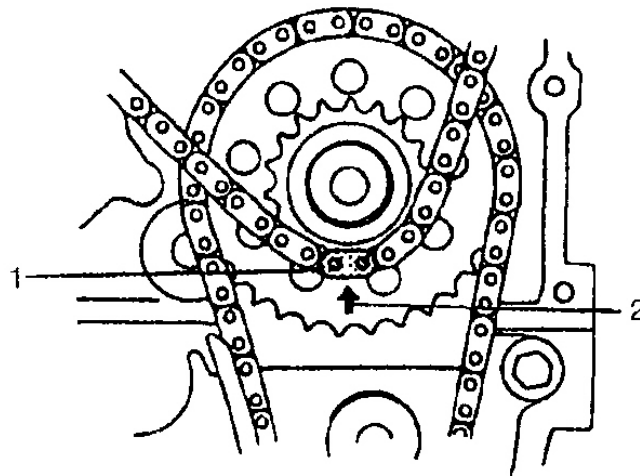
I2RH01140068

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

Fig. 68: Aligning Knock Pins Of Intake And Exhaust Camshafts With Timing Marks On Cylinder Head

Courtesy of SUZUKI OF AMERICA CORP.

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



I2RH01140069

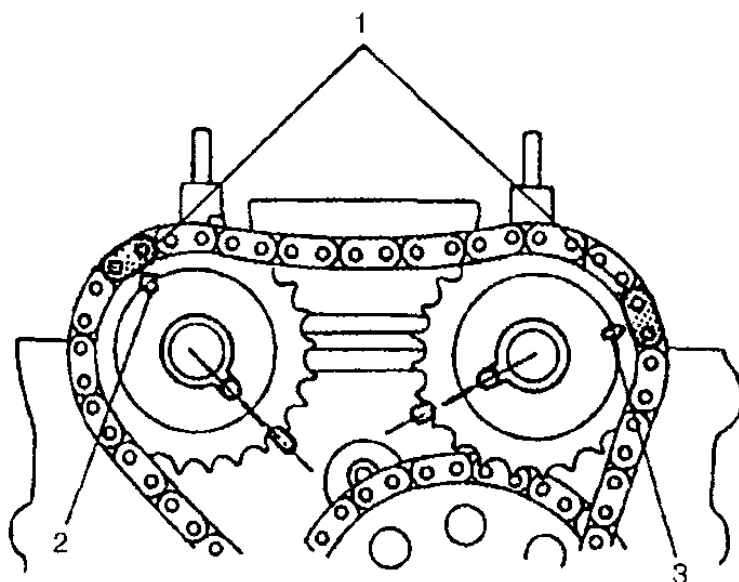
2 Match mark of 2nd timing chain (Arrow mark)

Fig. 69: Installing 2nd Timing Chain By Matching Marks On Idler Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

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

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

NOTE: As an arrow mark is provided on both sides, camshaft timing sprocket has no specific installation direction.



I2RH01140070

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

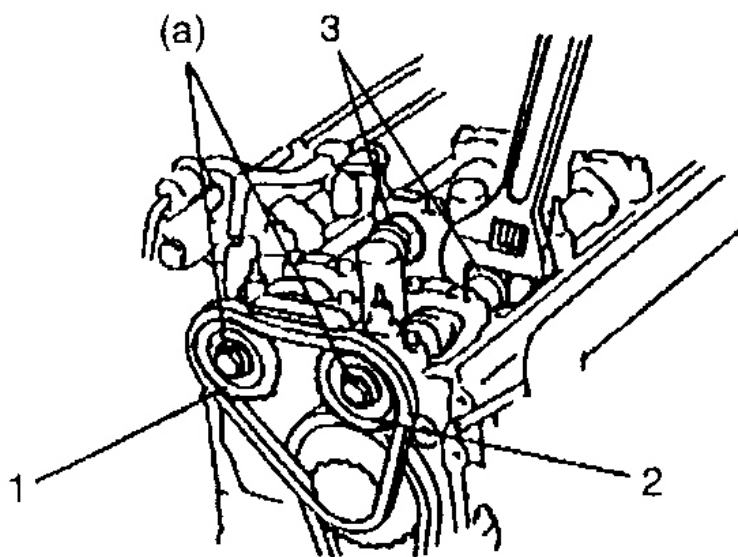
Fig. 70: Aligning Dark Blue Plate Of 2nd Timing Chain With Match Marks On Intake And Exhaust Sprocket

Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque

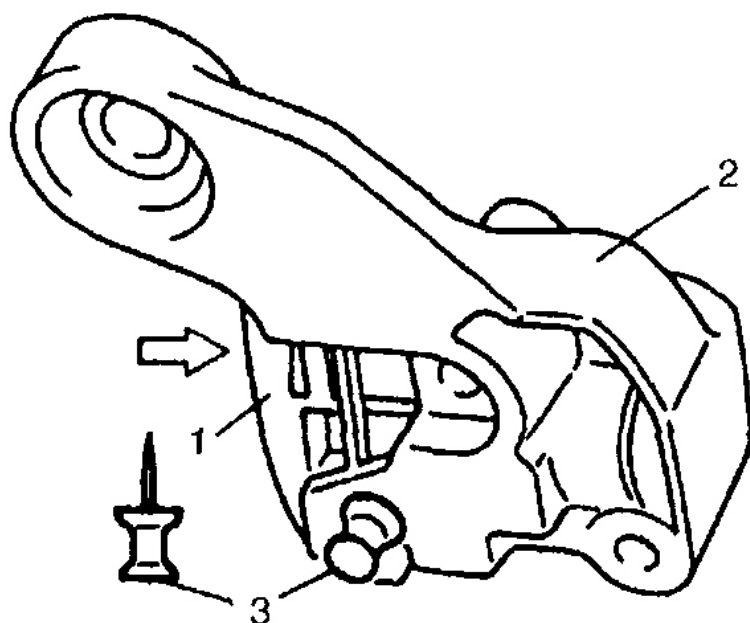
Camshaft timing sprocket bolt (a): 80 N.m (8.0 kg-m, 57.5 lb-ft)



I4RH01140027

Fig. 71: Installing Intake And Exhaust Camshaft Timing Sprocket Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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



I2RH01140072

Fig. 72: Inserting Stopper Into Tensioner Body
Courtesy of SUZUKI OF AMERICA CORP.

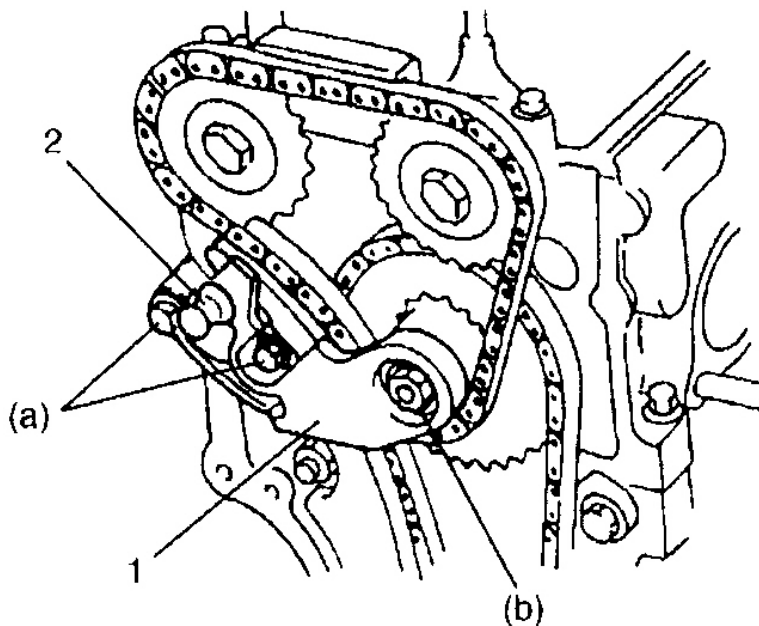
8. Install timing chain tensioner adjuster No.2 (1) with new gasket.

Tightening torque

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

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

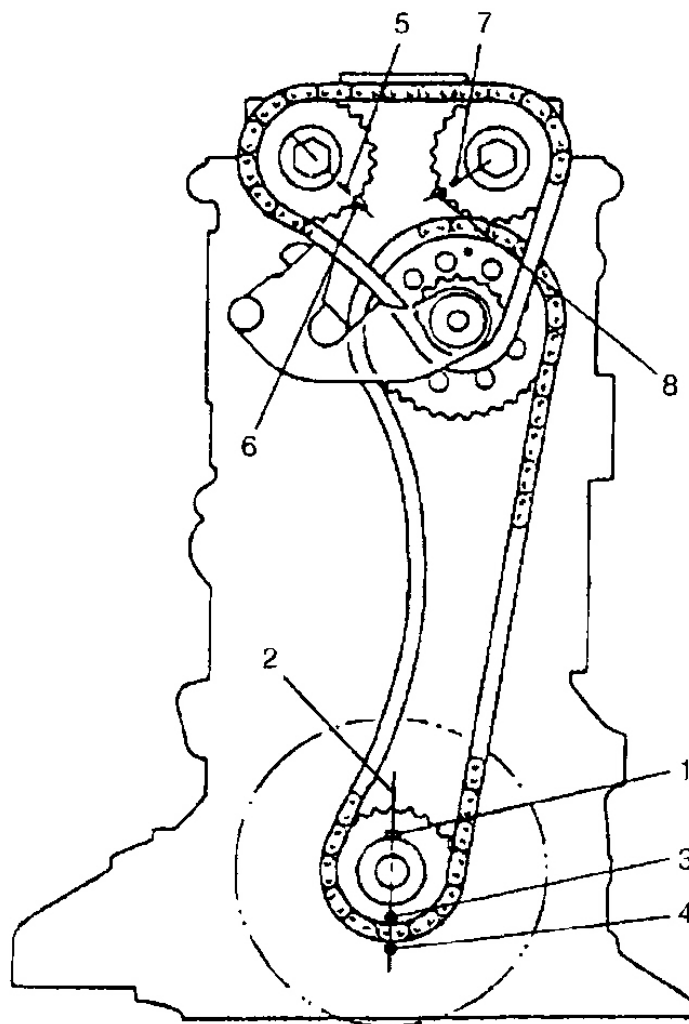
9. Pull out stopper (2) from timing chain tensioner adjuster No.2.



I2RH01140073

Fig. 73: Installing Timing Chain Tensioner Adjuster No 2
Courtesy of SUZUKI OF AMERICA CORP.

10. Turn crankshaft two rotations clockwise then align timing mark on crankshaft and timing mark on cylinder block as shown in figure. Check that timing marks of cylinder head and cylinder block are in match with match marks on sprockets respectively.



I2RH01140074

1. Crankshaft timing sprocket key	5. Timing mark on intake camshaft timing sprocket
2. Timing mark of crank timing sprocket key	6. Timing mark of intake camshaft timing sprocket
3. Match mark on crank timing sprocket	7. Timing mark on exhaust camshaft timing sprocket
4. Timing mark on lower crankcase	8. Timing mark of exhaust camshaft timing sprocket

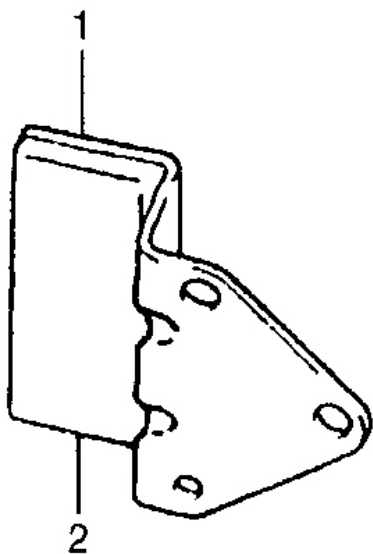
Fig. 74: Aligning Timing Mark On Crankshaft And Timing Mark On Cylinder Block
 Courtesy of SUZUKI OF AMERICA CORP.

11. Apply oil to timing chains, tensioner, tensioner adjusters, sprockets, and guides.
12. Install timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION:**" for installation.
13. Install cylinder head cover. Refer to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION:**" for installation.
14. Install oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION** .
15. Install engine assembly to vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".

2ND TIMING CHAIN AND CHAIN TENSIONER INSPECTION

Timing Chain Guide No.2

Check shoe for wear or damage.



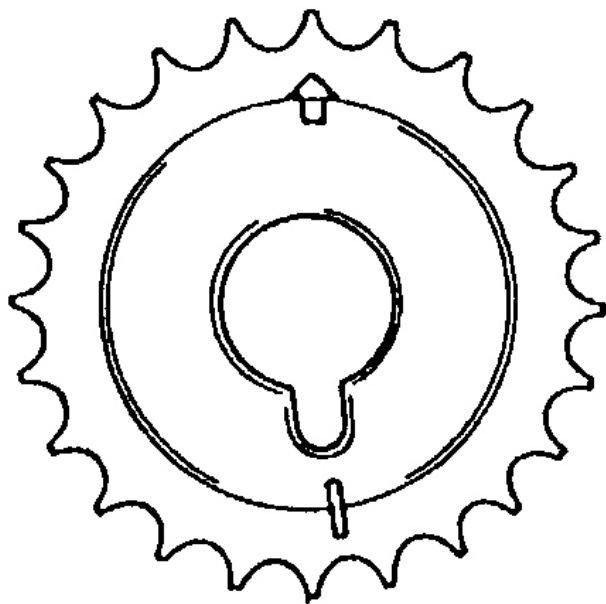
I2RH01140075

1.	Timing chain guide No.2
2	Shoe

Fig. 75: Identifying Timing Chain Guide No 2 Shoe
Courtesy of SUZUKI OF AMERICA CORP.

Camshaft Sprocket

Check teeth of sprocket for wear or damage.

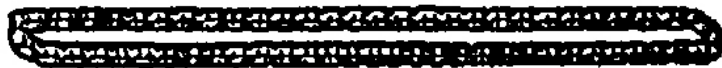


I2RH01140076

Fig. 76: Identifying Camshaft Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain

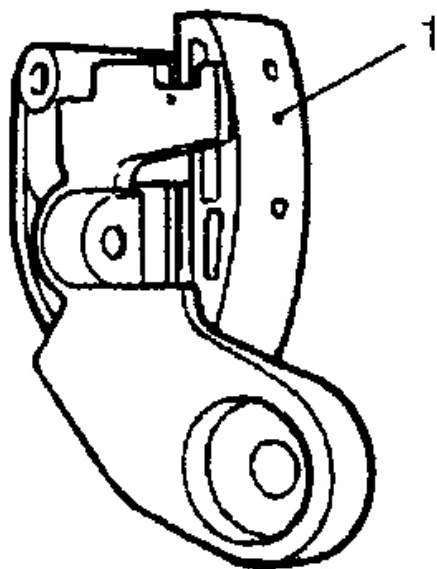
Check timing chain for wear or damage.

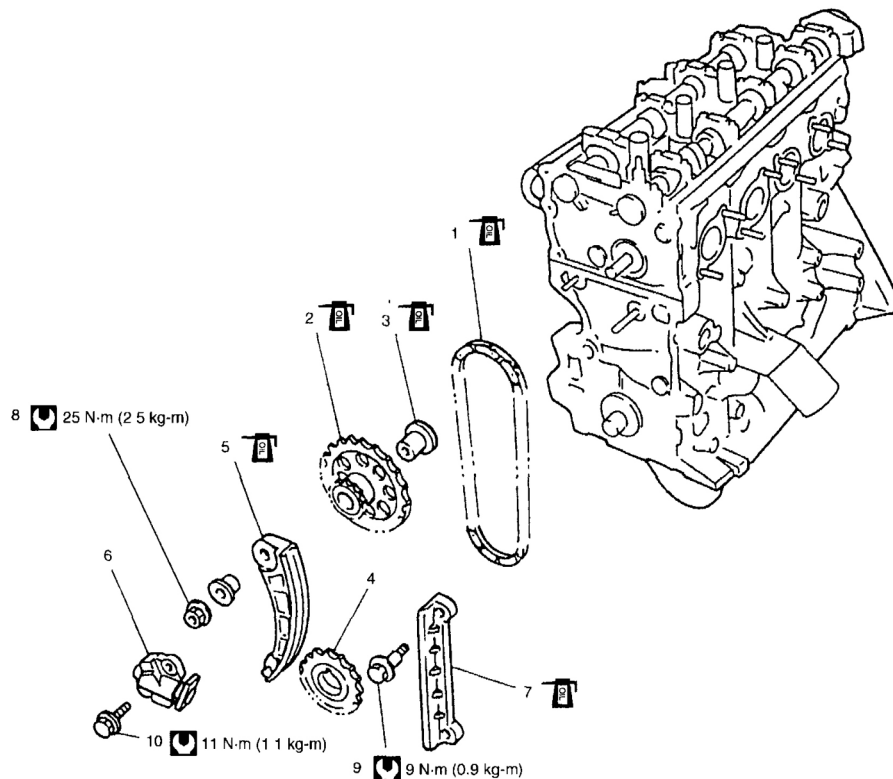


I2RH01140077

Fig. 77: Identifying Timing Chain**Courtesy of SUZUKI OF AMERICA CORP.****Tensioner Adjuster No.2**

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

**I2RH01140078****Fig. 78: Identifying Tensioner Adjuster No 2 Shoe****Courtesy of SUZUKI OF AMERICA CORP.****1ST TIMING CHAIN AND CHAIN TENSIONER COMPONENTS**



I4RH01140028

1. 1st timing chain	5. Timing chain tensioner	9. Timing chain guide No.1 bolt
2. Idler sprocket	6. Timing chain tensioner adjuster No.1	10. Timing chain tensioner adjuster No.1 bolt
3. Idler sprocket shaft	7. Timing chain guide No 1	: Tightening torque
4. Crankshaft timing sprocket	8. Timing chain tensioner nut	: Apply engine oil to sliding surface

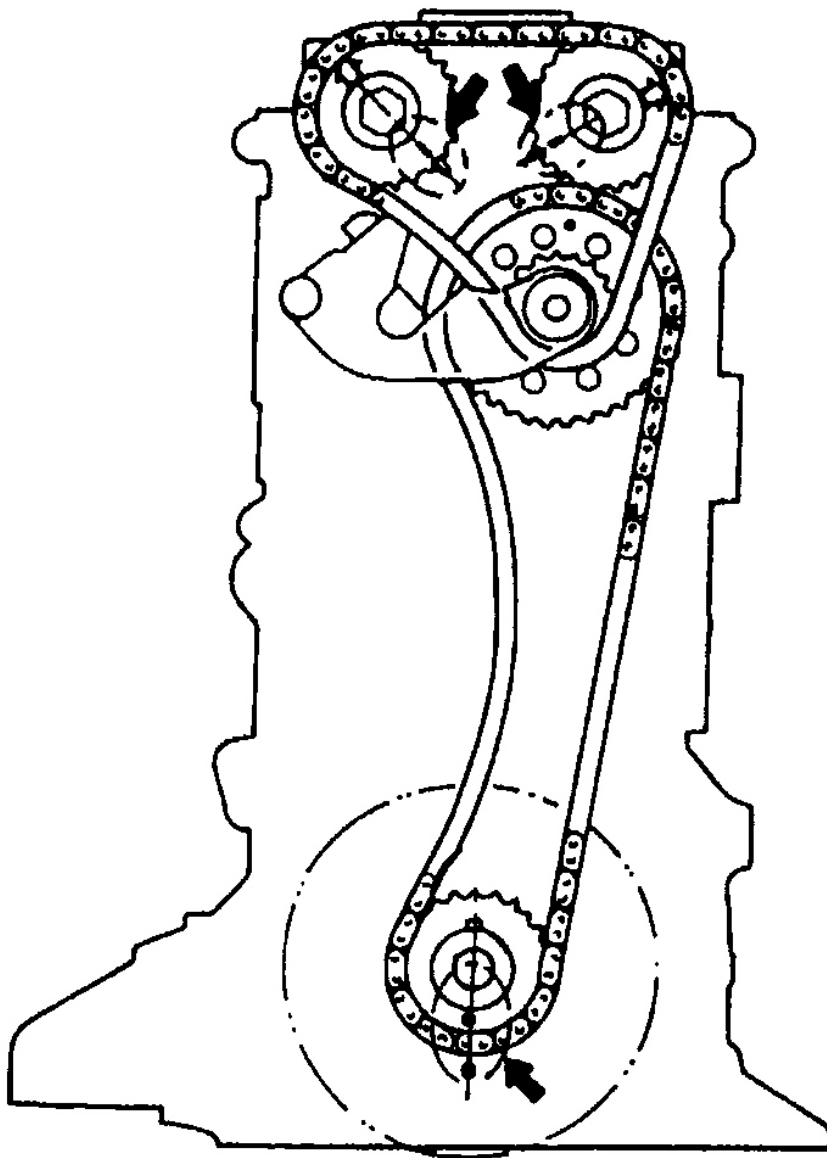
Fig. 79: Identifying 1st Timing Chain And Chain Tensioner Components
 Courtesy of SUZUKI OF AMERICA CORP.

1ST TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION

Removal

1. Remove engine assembly from vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION**".
2. Remove oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION**.
3. Remove cylinder head cover. Refer to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**:" for removal.
4. Remove timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION**:" for removal.
5. For reinstallation of timing chain, turn crankshaft so that timing marks on cylinder head and lower crankcase match with those on sprockets as shown in figure.
6. Remove 2nd timing chain. Refer to "**2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL**".

AND INSTALLATION:" for removal.

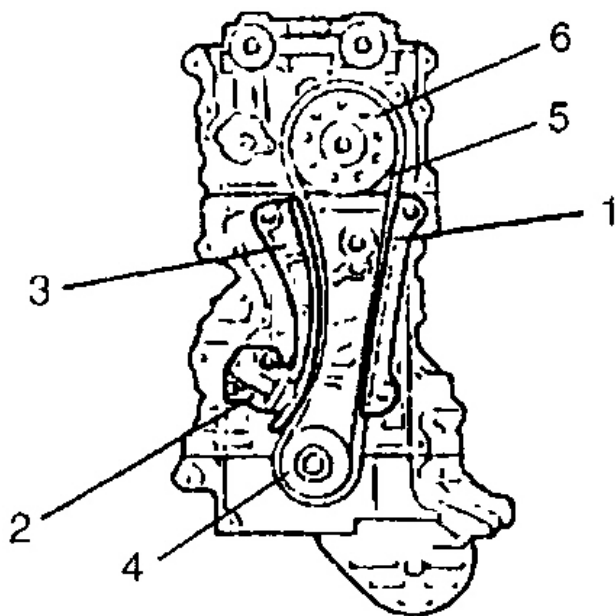


I2RH01140080

Fig. 80: Aligning Timing Marks On Cylinder Head And Lower Crankcase With Sprockets
Courtesy of SUZUKI OF AMERICA CORP.

7. Remove timing chain guide No.1 (1).
8. Remove timing chain tensioner adjuster No.1 (2).
9. Remove timing chain tensioner (3).

10. Remove idler sprocket (4) and 1st timing chain (5).
11. Remove crankshaft timing sprocket (6).

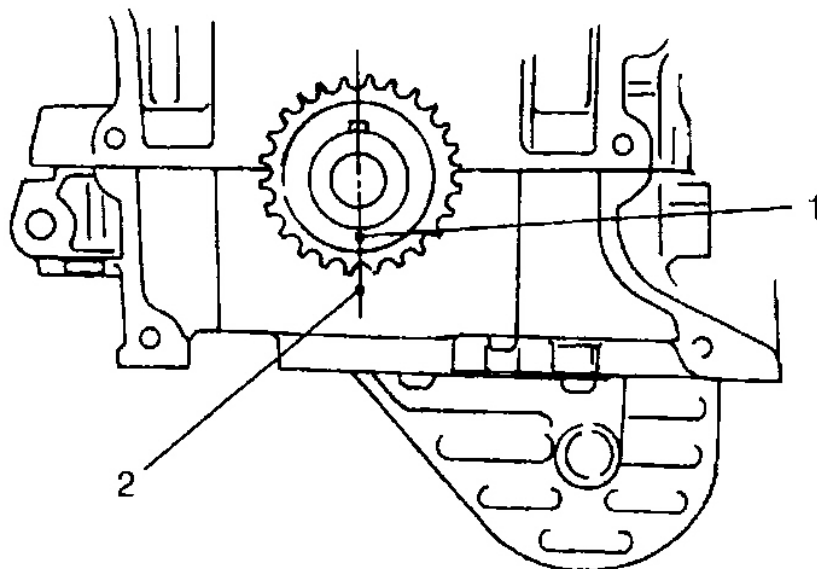


I4RH01140029

Fig. 81: Removing Crankshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

Installation

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

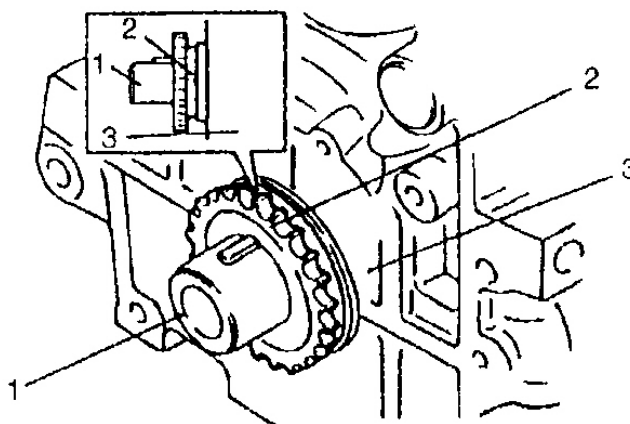


I2RH01140082

Fig. 82: Aligning Match Mark On Crankshaft Timing Sprocket With Timing Mark On Lower Crankcase

Courtesy of SUZUKI OF AMERICA CORP.

2. Install crankshaft timing sprocket (2) as shown in figure.



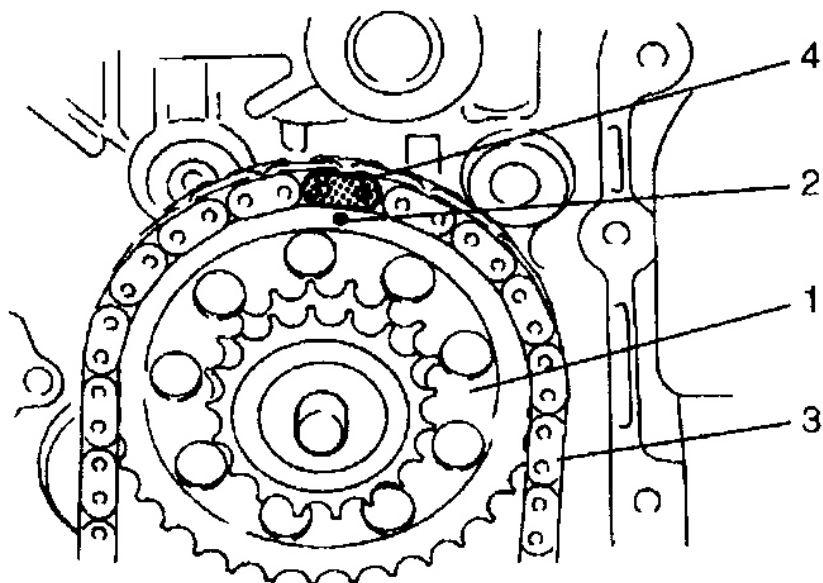
I2RH01140083

1. Crankshaft

3. Cylinder block

Fig. 83: Installing Crankshaft Timing Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

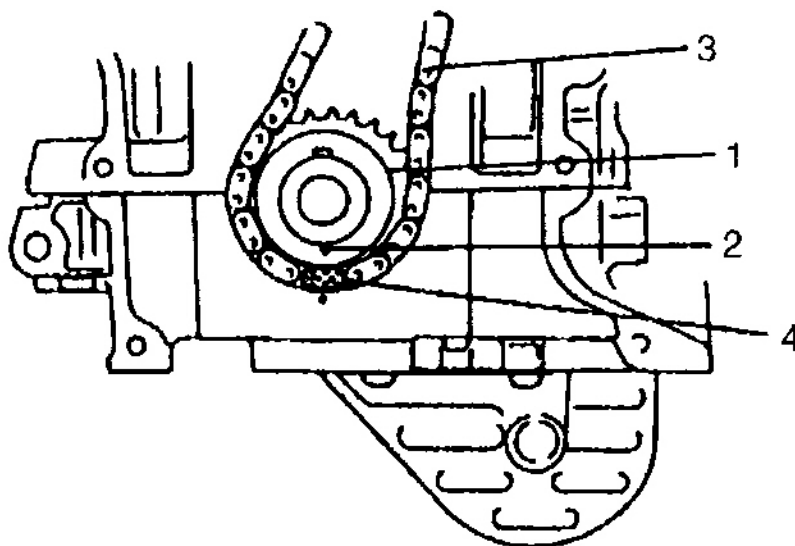
3. Apply oil to bush of idler sprocket (1).
4. Install idler sprocket and sprocket shaft.
5. Install 1st timing chain by aligning dark blue plate (4) of 1st timing chain (3) and match mark (2) on idler sprocket (1).



I2RH01140084

Fig. 84: Installing 1st Timing Chain By Matching Mark On Idler Sprocket
Courtesy of SUZUKI OF AMERICA CORP.

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



I2RH01140085

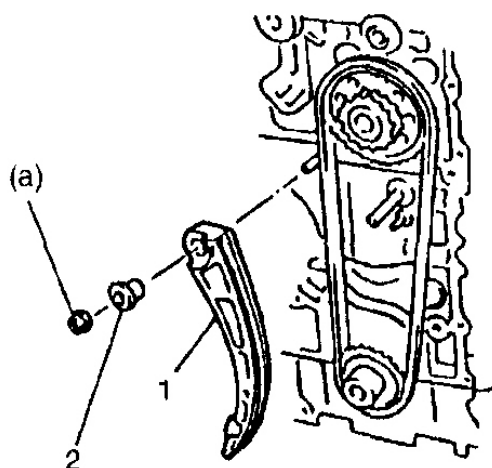
Fig. 85: Aligning Yellow Plate Of 1st Timing Chain With Match Mark On Crankshaft Timing Sprocket

Courtesy of SUZUKI OF AMERICA CORP.

7. Apply engine oil to sliding surface of timing chain tensioner (1) and then install it as shown in figure. Tighten tensioner nut to specified torque.

Tightening torque

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



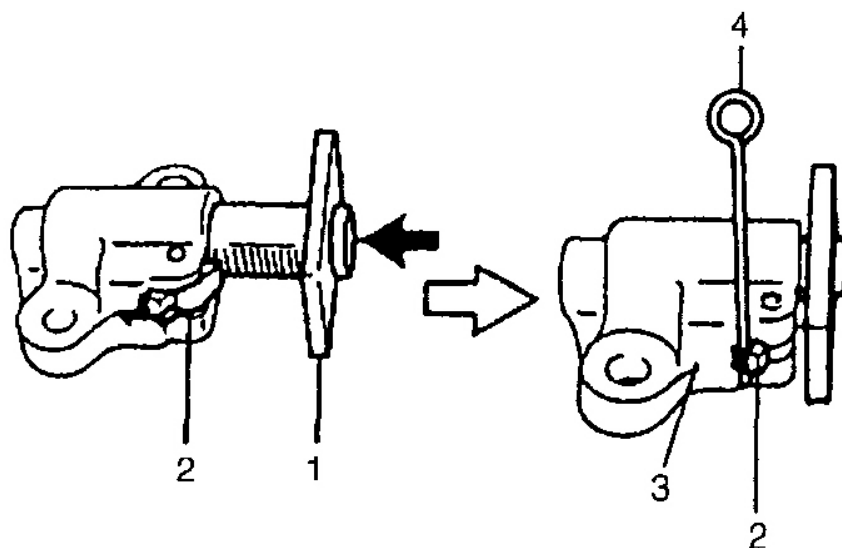
I2RH01140086

2. Spacer

Fig. 86: Tightening Timing Chain Tensioner Nut
Courtesy of SUZUKI OF AMERICA CORP.

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

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



I2RH01140087

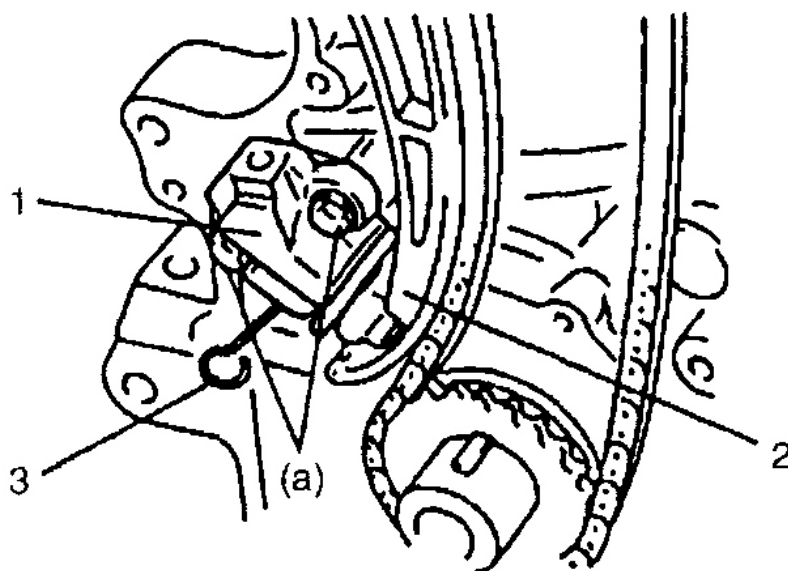
Fig. 87: Inserting Stopper Into Latch And Body
Courtesy of SUZUKI OF AMERICA CORP.

9. Install timing chain tensioner (2) adjuster No.1 (1).

Tightening torque

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

10. Pull out stopper (3) from adjuster No.1.



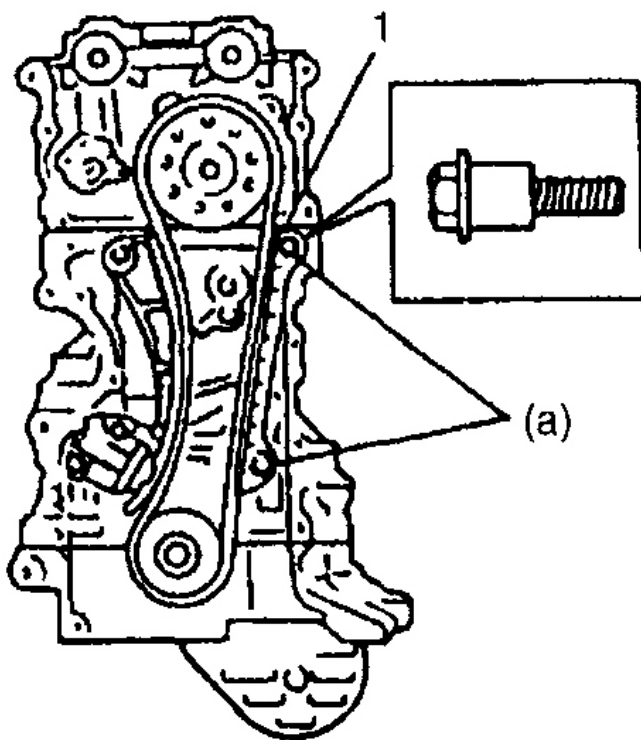
I2RH01140088

Fig. 88: Pulling Out Stopper From Adjuster No 1
Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque

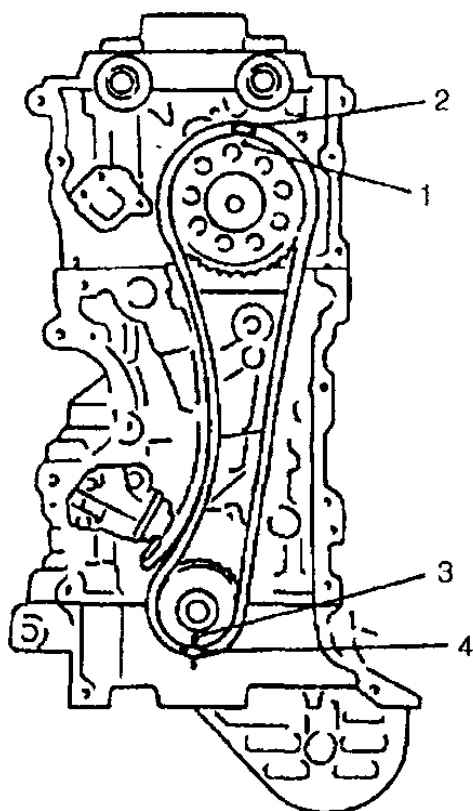
Timing chain guide No.1 bolt (a): 9 N.m (0.9 kg-m, 6.5 lb-ft)



I2RH01140089

Fig. 89: Tightening Timing Chain Guide No 1 Bolt
Courtesy of SUZUKI OF AMERICA CORP.

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



I2RH01140090

1. Match mark on idler sprocket	3 Match mark on crank timing sprocket
2 Dark blue plate	4. Yellow plate

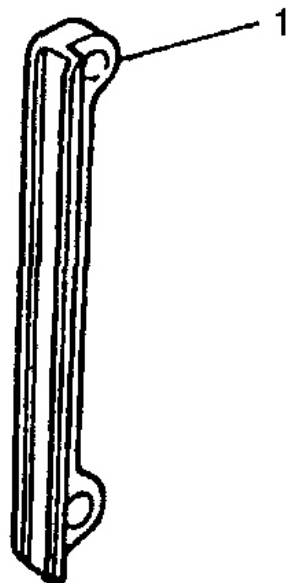
Fig. 90: Aligning Dark Blue And Yellow Plates Of 1st Timing Chain With Match Marks On Sprockets

Courtesy of SUZUKI OF AMERICA CORP.

13. Install 2nd timing chain. Refer to "**2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION:**" for installation.
14. Install timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION:**" for installation.
15. Install cylinder head cover. Refer to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION:**" for installation.
16. Install oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION**.
17. Install engine assembly to vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".

1ST TIMING CHAIN AND CHAIN TENSIONER INSPECTION**Timing Chain Guide No.1**

Check shoe for wear or damage.



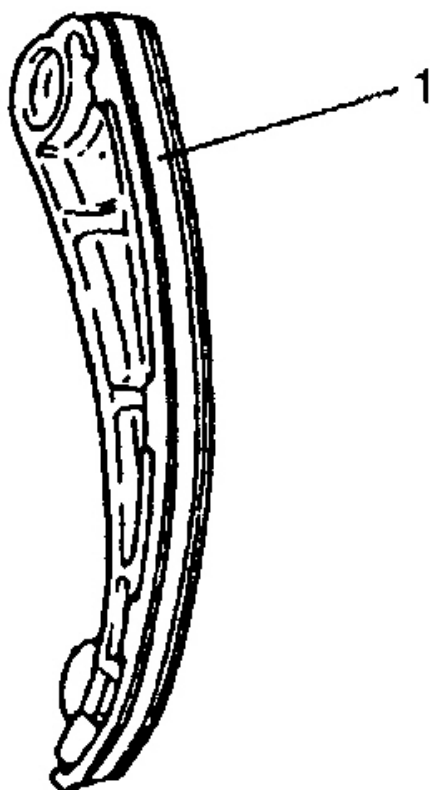
I2RH01140091

1 Timing chain guide No 1

Fig. 91: Identifying Timing Chain Guide No 1 Shoe
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain Tensioner

Check shoe (1) for wear or damage.

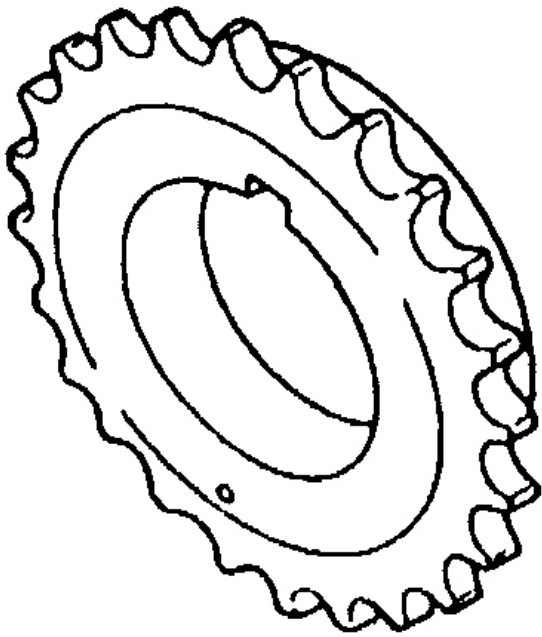


I2RH01140092

Fig. 92: Identifying Timing Chain Tensioner Shoe
Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft Timing Sprocket

Check teeth of sprocket for wear or damage.

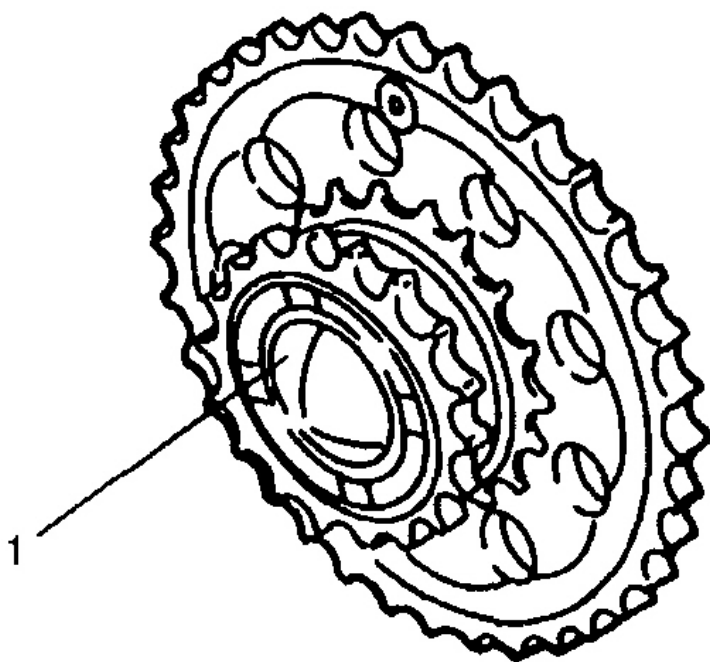


I2RH01140093

Fig. 93: Identifying Crankshaft Timing Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

Idler Sprocket

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

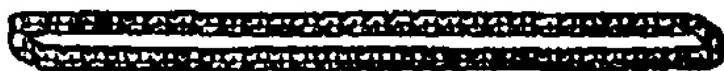


I2RH01140094

Fig. 94: Identifying Idler Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

1st Timing Chain

Check timing chain for wear or damage.

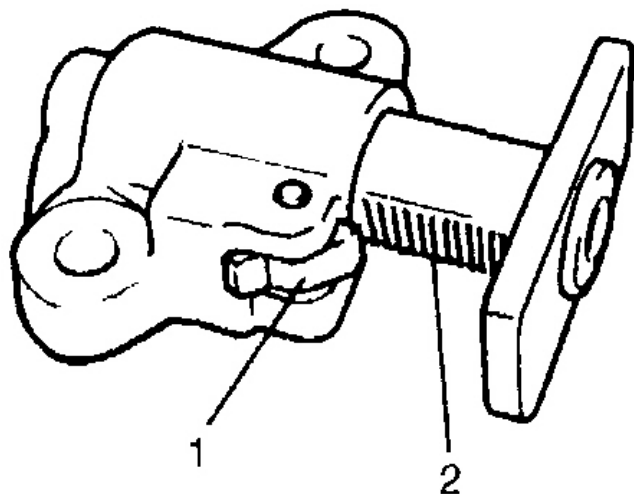


I2RH01140077

Fig. 95: Identifying 1st Timing Chain
Courtesy of SUZUKI OF AMERICA CORP.

Timing Chain Tensioner Adjuster No.1

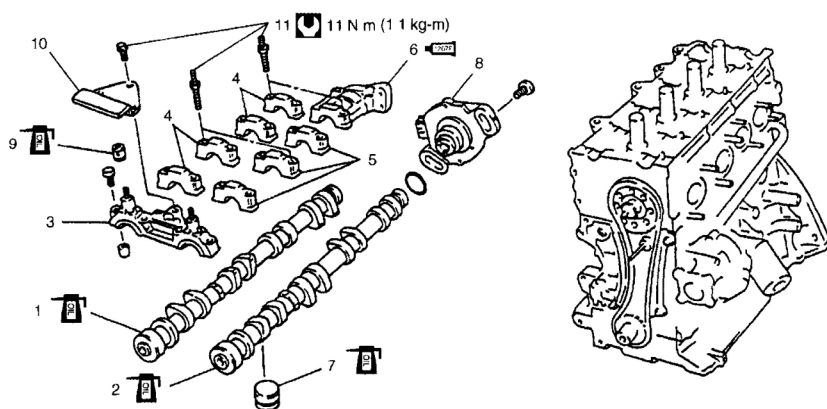
Check that latch (1) and tooth surface (2) are free from damage and latch functions properly.



I2RH01140095

Fig. 96: Identifying Latch And Tooth Surface Timing Chain Tensioner Adjuster No 1
Courtesy of SUZUKI OF AMERICA CORP.

CAMSHAFTS AND VALVE LASH ADJUSTERS COMPONENTS



I4RH01140050

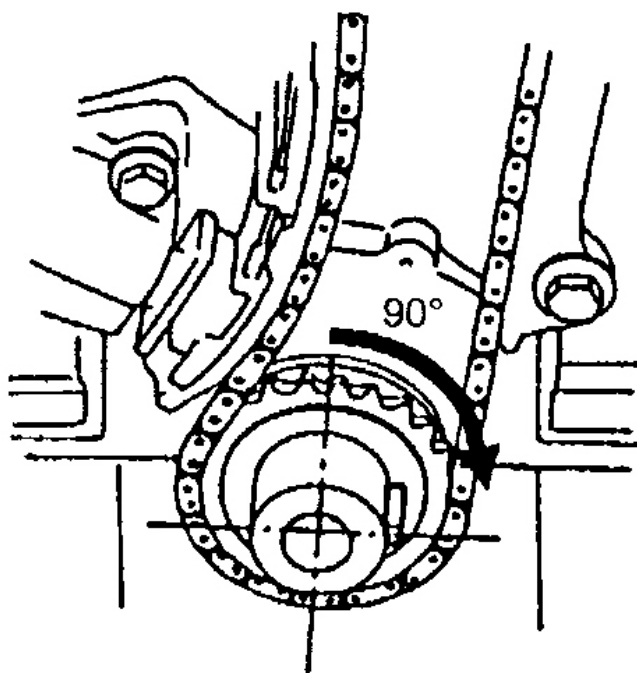
1. Intake camshaft	6. Exhaust camshaft end housing :See "A"	11 Camshaft housing bolt
2 Exhaust camshaft	7. Valve lash adjuster	Tightening torque
3 Camshaft housing	8 CMP sensor	: Apply engine oil to sliding surface of each part
4 Intake camshaft housing	9 Oil relief valve	
5. Exhaust camshaft housing	10. Timing chain guide No.2	
"A": Apply sealant 1207F to the mating surface between exhaust camshaft end housing and cylinder head referring to the figure of Step 6) in "Camshafts and Valve Lash Adjusters Removal and installation:".		

Fig. 97: Identifying Camshafts And Valve Lash Adjusters Components
 Courtesy of SUZUKI OF AMERICA CORP.

CAMSHAFTS AND VALVE LASH ADJUSTERS REMOVAL AND INSTALLATION

Removal

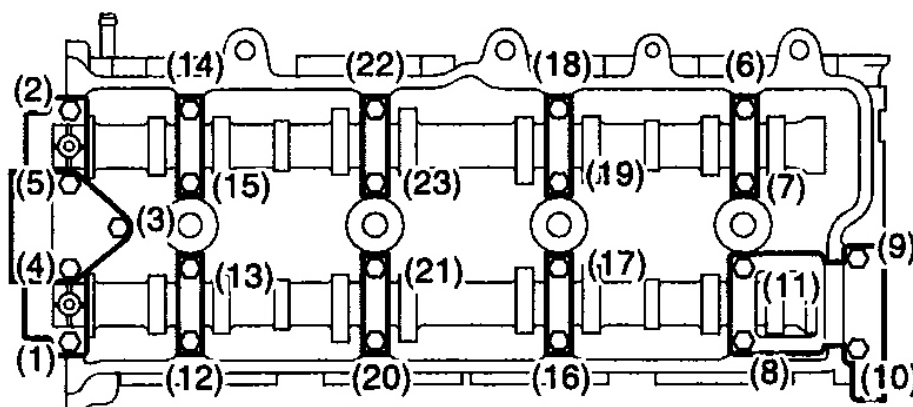
1. Remove engine assembly from vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION**:".
2. Remove oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION** .
3. Remove cylinder head cover. Refer to "**CYLINDER HEAD COVER REMOVAL AND INSTALLATION**:" for removal.
4. Remove timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION**:" for removal.
5. Remove 2nd timing chain. Refer to "**2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**:" for removal.
6. Remove CMP sensor. Refer to **CMP (CAMSHAFT POSITION) SENSOR REMOVAL AND INSTALLATION** .
7. To secure work in the following steps, reinstall mounting member, engine front torque bush, rear mounting and rear mounting No.2 bracket.
8. Set key on crankshaft in position as shown by turning crankshaft. This is to prevent interference between valves and piston.



I2RH01140097

Fig. 98: Setting Key On Crankshaft In Position
 Courtesy of SUZUKI OF AMERICA CORP.

9. Loosen camshaft housing bolts in such order as indicated in figure and remove them.



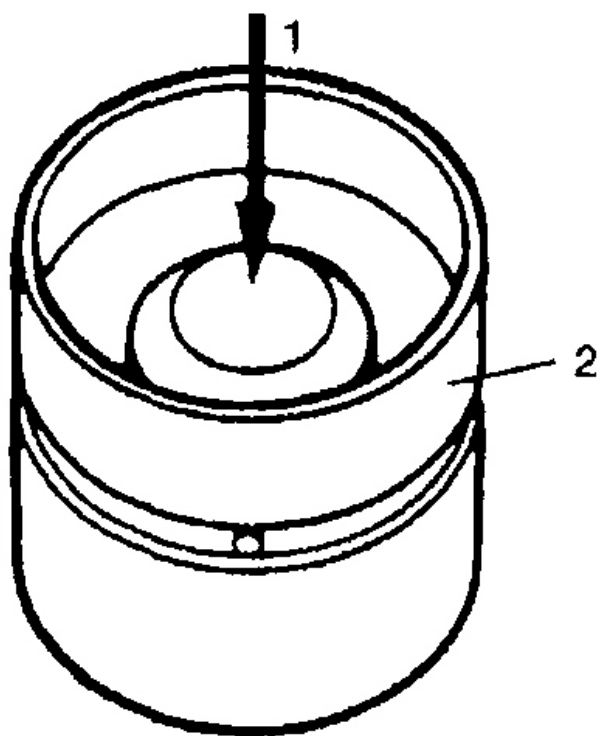
I4RH01140051

Fig. 99: Loosening Camshaft Housing Bolts
Courtesy of SUZUKI OF AMERICA CORP.

10. Remove camshaft housings.
11. Remove camshafts.
12. Remove valve lash adjusters (2).

NOTE:

- Never disassemble hydraulic valve lash adjuster.
- Don't apply force (1) to body of adjuster, oil in high pressure chamber in adjuster will leak.

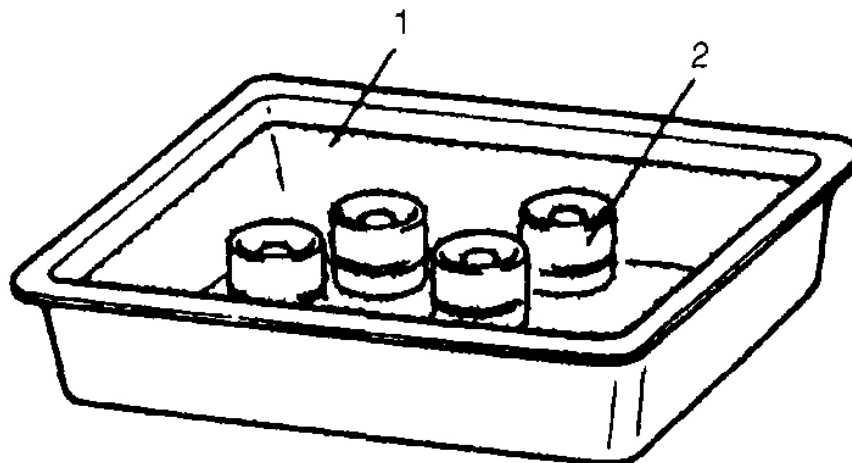


I2RH01140099

Fig. 100: Removing Valve Lash Adjusters
Courtesy of SUZUKI OF AMERICA CORP.

- Immerse removed adjuster (2) in clean engine oil (1) and keep it there till reinstalling it so as to prevent oil leakage. If it is left in air, place it with its bucket body facing down. Don't place on its side or with bucket body

facing up.



I2RH01140100

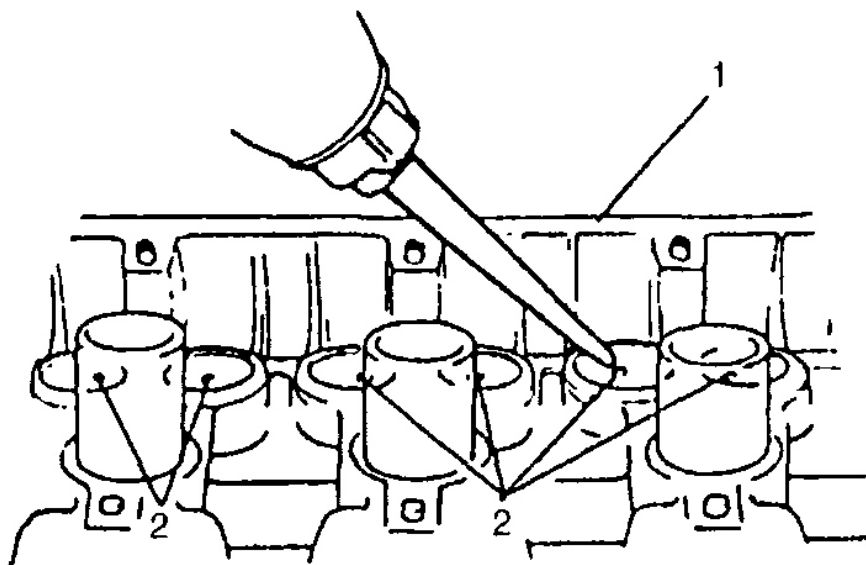
Fig. 101: Immersing Removed Adjuster In Clean Engine Oil
Courtesy of SUZUKI OF AMERICA CORP.

Installation

1. Before installing valve lash adjuster to cylinder head (1), fill oil passage of cylinder head with engine oil according to following procedure.

Pour engine oil through oil holes (2) and check that oil comes out from oil holes in sliding part of valve lash adjuster.

Perform this check on both intake and exhaust sides.

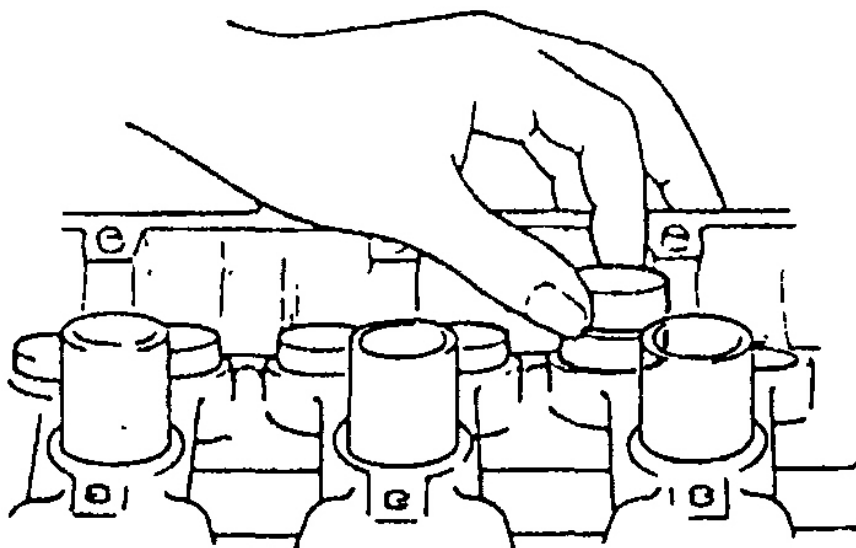


I2RH01140101

Fig. 102: Pouring Engine Oil Through Oil Holes
Courtesy of SUZUKI OF AMERICA CORP.

2. Install valve lash adjusters to cylinder head.

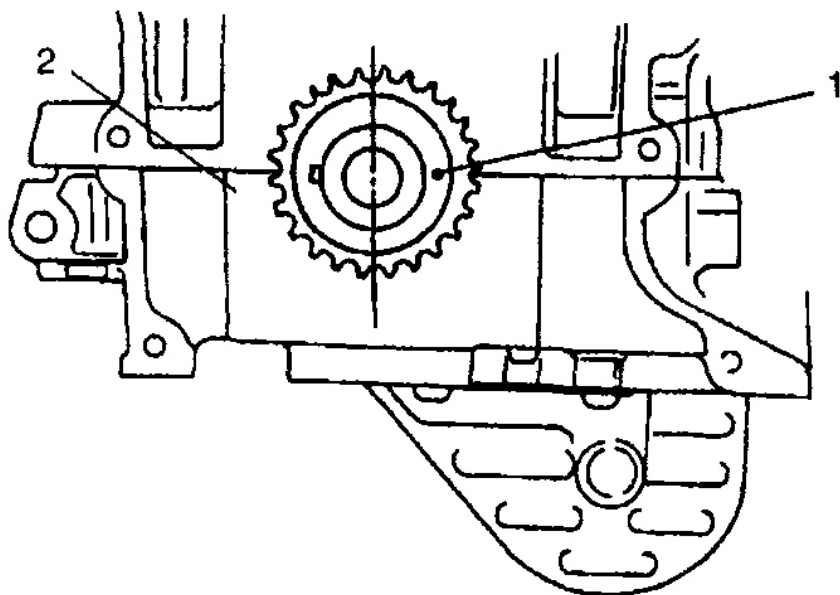
Apply engine oil around valve lash adjuster and then install it to cylinder head.



I2RH01140102

Fig. 103: Installing Valve Lash Adjusters To Cylinder Head
Courtesy of SUZUKI OF AMERICA CORP.

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



I2RH01140103

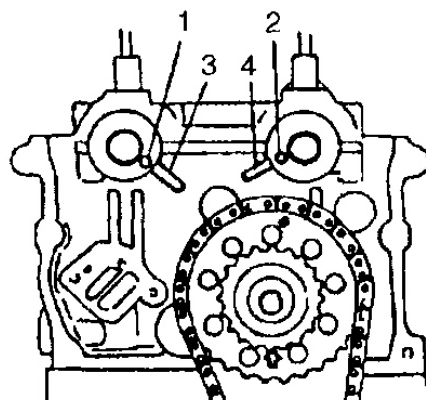
Fig. 104: Matching Match Mark On Crank Timing Sprocket And Mating Surface Of Cylinder Block

Courtesy of SUZUKI OF AMERICA CORP.

4. Install camshafts.

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

NOTE: Install camshaft in such direction that its end with groove for CMP sensor installation comes to exhaust side.

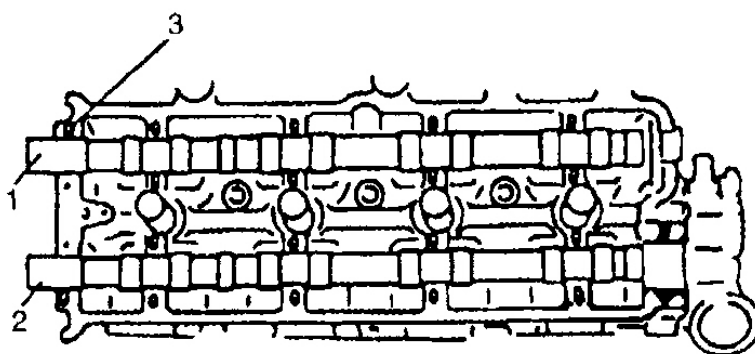


I2RH01140104

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

Fig. 105: Aligning Match Marks On Cylinder Head And Camshafts
 Courtesy of SUZUKI OF AMERICA CORP.

5. Install camshaft housing pins (3) as shown in figure.



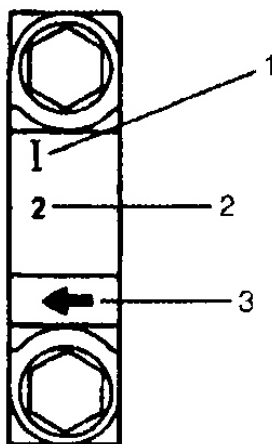
I4RH01140032

1. Intake camshaft
2 Exhaust camshaft

Fig. 106: Installing Camshaft Housing Pins
 Courtesy of SUZUKI OF AMERICA CORP.

6. Check position of camshaft housings.

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



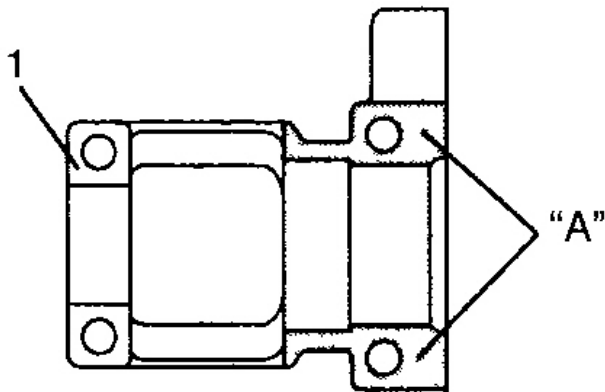
I2RH01140106

1 Intake side or Exhaust side	3 Pointing to timing chain side
2 Position from timing chain side	

Fig. 107: [Identifying Embossed Marks Provided On Each Camshaft Housing]
Courtesy of SUZUKI OF AMERICA CORP.

7. Apply sealant "A" to exhaust camshaft end housing (1) sealing surface area as shown in figure.

"A": Sealant 99000-31250



I4RH01140031

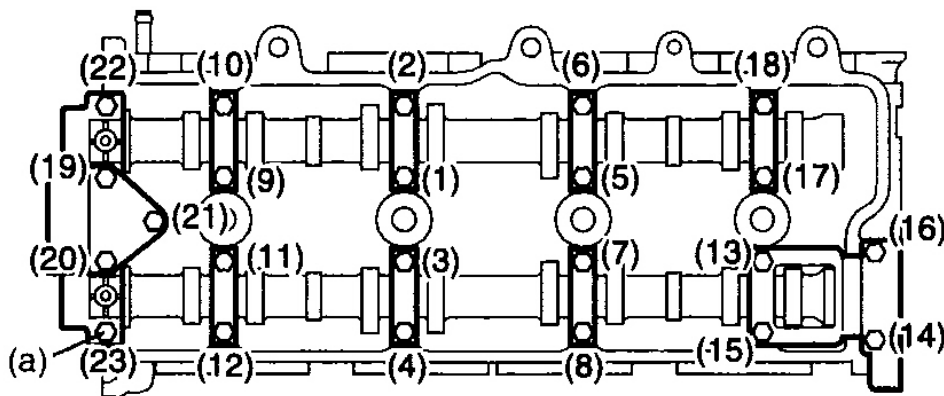
Fig. 108: Applying Sealant To Exhaust Camshaft End Housing Sealing Surface Area
 Courtesy of SUZUKI OF AMERICA CORP.

8. After applying oil to housing bolts, tighten them temporarily first. Then tighten them by following numerical order in figure.

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

Tightening torque

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



I4RH01140033

Fig. 109: Identifying Tightening Sequence Of Camshaft Housing Bolts
 Courtesy of SUZUKI OF AMERICA CORP.

9. Install CMP sensor. Refer to **CMP (CAMSHAFT POSITION) SENSOR REMOVAL AND INSTALLATION**.
10. Install 2nd timing chain. Refer to **"2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION:"** for installation.
11. Install timing chain cover. Refer to **"TIMING CHAIN COVER REMOVAL AND INSTALLATION:"** for installation.
12. Install cylinder head cover. Refer to **"CYLINDER HEAD COVER REMOVAL AND INSTALLATION:"** for installation.
13. Install oil pan. Refer to **OIL PAN AND OIL PUMP STRAINER REMOVAL AND INSTALLATION**.
14. Install engine assembly to vehicle referring to **"ENGINE ASSEMBLY REMOVAL AND INSTALLATION:"**.

CAUTION:

- Don't turn camshafts or start engine (i.e., valves should not be operated) for about half an hour after reinstalling hydraulic valve lash adjusters and camshafts. As it takes time for valves to settle in place, operating engine within half an hour after their installation may cause interference to occur between valves themselves or valves and piston.
- If air is trapped in valve lash adjuster, valve may make tapping sound when engine is operated after valve lash adjuster is installed. In such a case, run engine for about half an hour at about 2,000 to 3,000 RPM, and then air will be purged and tapping sound will cease. Should tapping sound not cease, it is possible that valve lash adjuster is defective. Replace it if defective. If defective adjuster can't be located by hearing among 16 of them, check as follows.
 - Stop engine and remove cylinder head cover.
 - Push adjuster downward by hand (with less than 20 kg or 44 lbs force) when cam crest is not on adjuster to be checked and check if clearance exists between cam and adjuster. If it does, adjuster is defective and needs replacement.

CAMSHAFT AND VALVE LASH ADJUSTER INSPECTION

Cam Wear

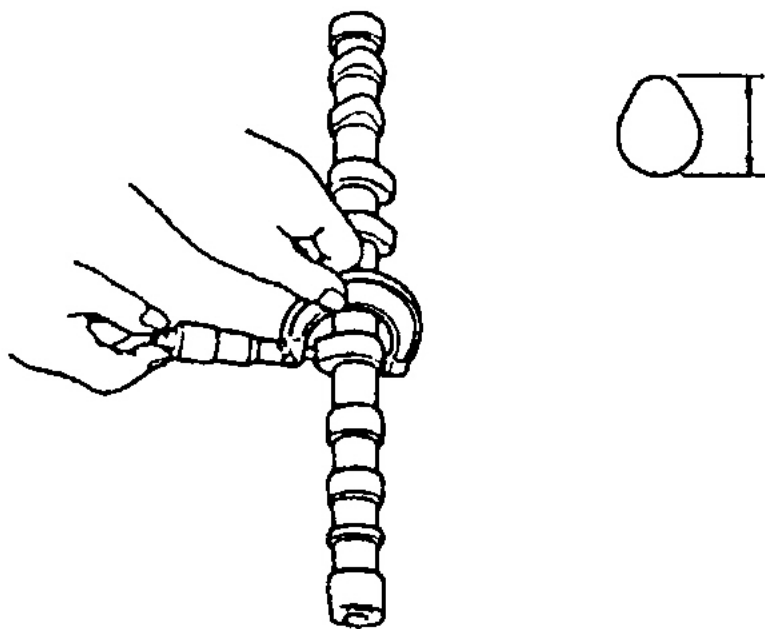
Using a micrometer, measure cam height. If measured height is below its limit, replace camshaft.

Cam height

CAM HEIGHT SPECIFICATION

Cam height	Standard	Limit
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Intake cam	40.410--40.570 mm (1.5910--1.5972 in.)	40.210 mm (1.5831 in.)
Exhaust cam	39.917--40.077 mm (1.5716--1.5778 in.)	39.725 mm (1.5640 in.)



I2RH01140108

Fig. 110: Measuring Cam Height

Courtesy of SUZUKI OF AMERICA CORP.

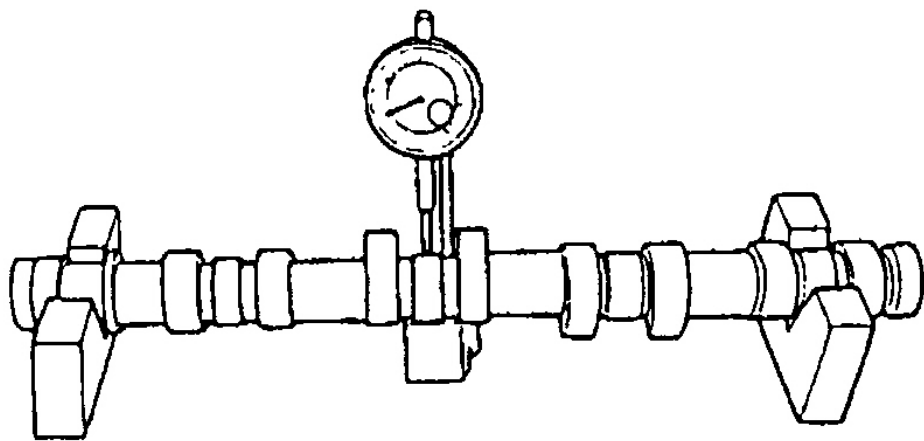
Camshaft Runout

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

If measured runout exceeds the specified limit, replace camshaft.

Runout limit

0.03 mm (0.0012 in.)



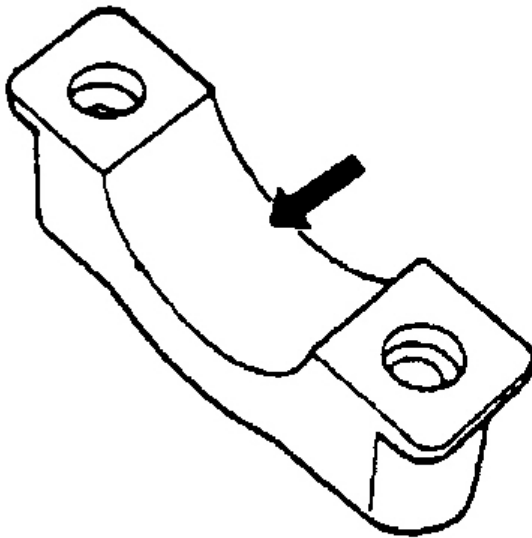
I2RH01140109

Fig. 111: Checking Camshaft Runout
Courtesy of SUZUKI OF AMERICA CORP.

Camshaft Journal Wear

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

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



IYSQ01143105

Fig. 112: Identifying Camshaft Journal
Courtesy of SUZUKI OF AMERICA CORP.

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

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

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

Tightening torque

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

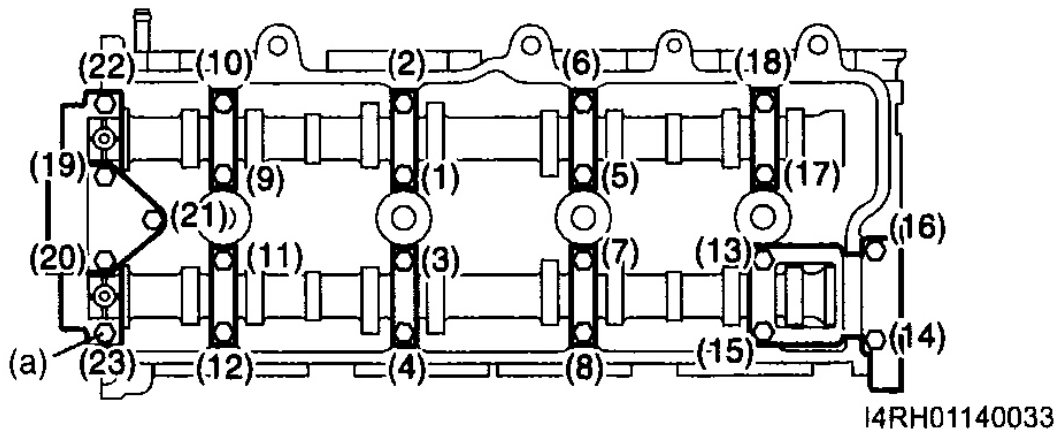


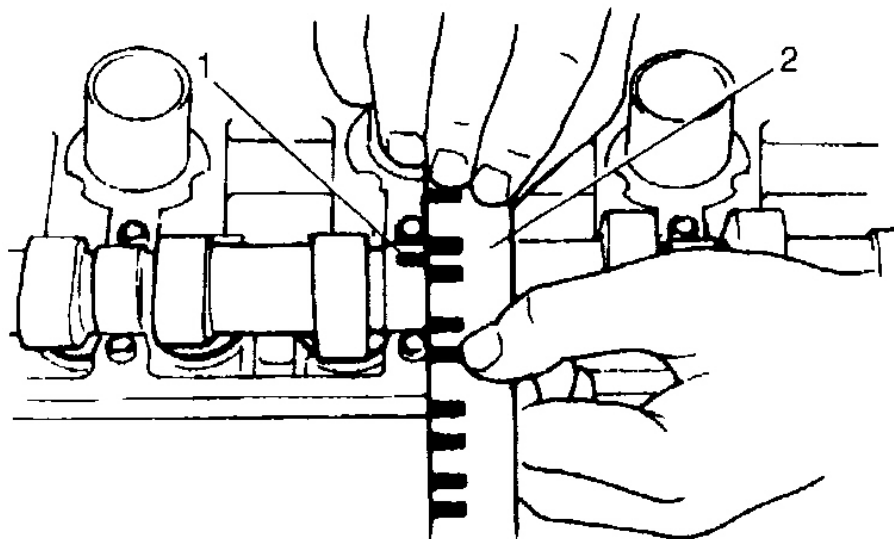
Fig. 113: Identifying Tightening Sequence Of Camshaft Housing Bolts
 Courtesy of SUZUKI OF AMERICA CORP.

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

Journal clearance

JOURNAL CLEARANCE SPECIFICATION

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



IYSQ01143107

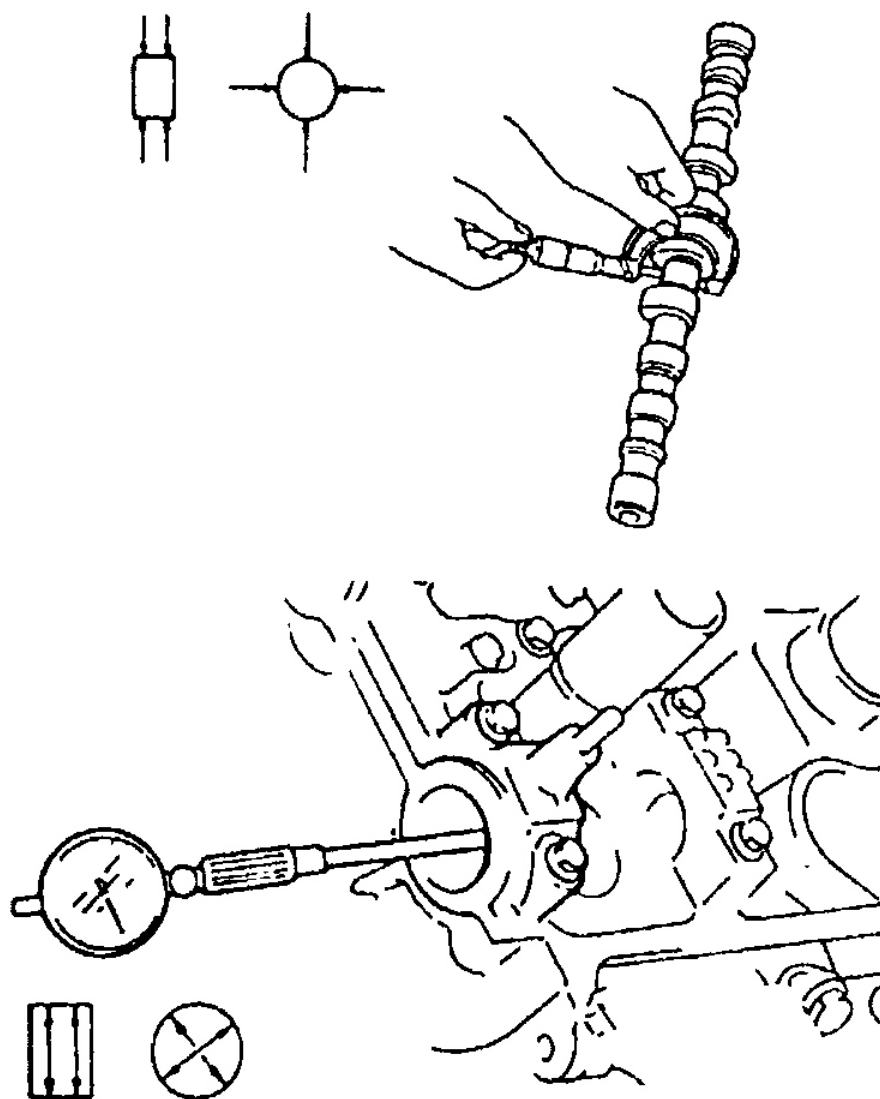
Fig. 114: Measuring Gauging Plastic Width At Its Widest Point
Courtesy of SUZUKI OF AMERICA CORP.

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

Camshaft journal

CAMSHAFT JOURNAL SPECIFICATION

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

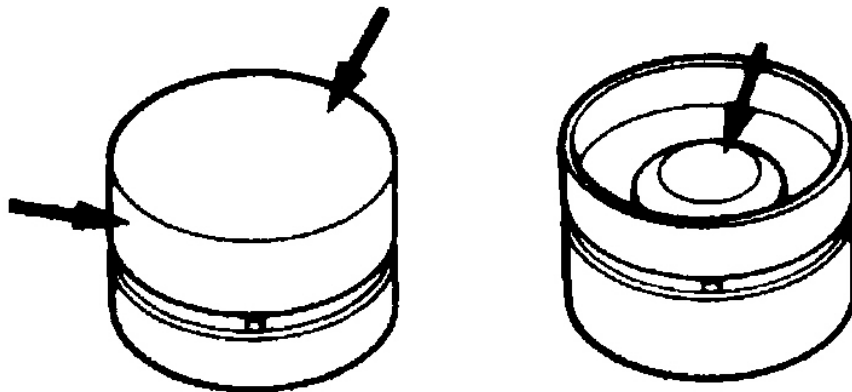


I5RH01140006

Fig. 115: Checking Journal (Housing) Bore And Outside Diameter Of Camshaft Journal
Courtesy of SUZUKI OF AMERICA CORP.

Wear of Hydraulic Valve Lash Adjuster

Check adjuster for pitting, scratches, or damage. If any malcondition is found, replace.



IYSQ01143109

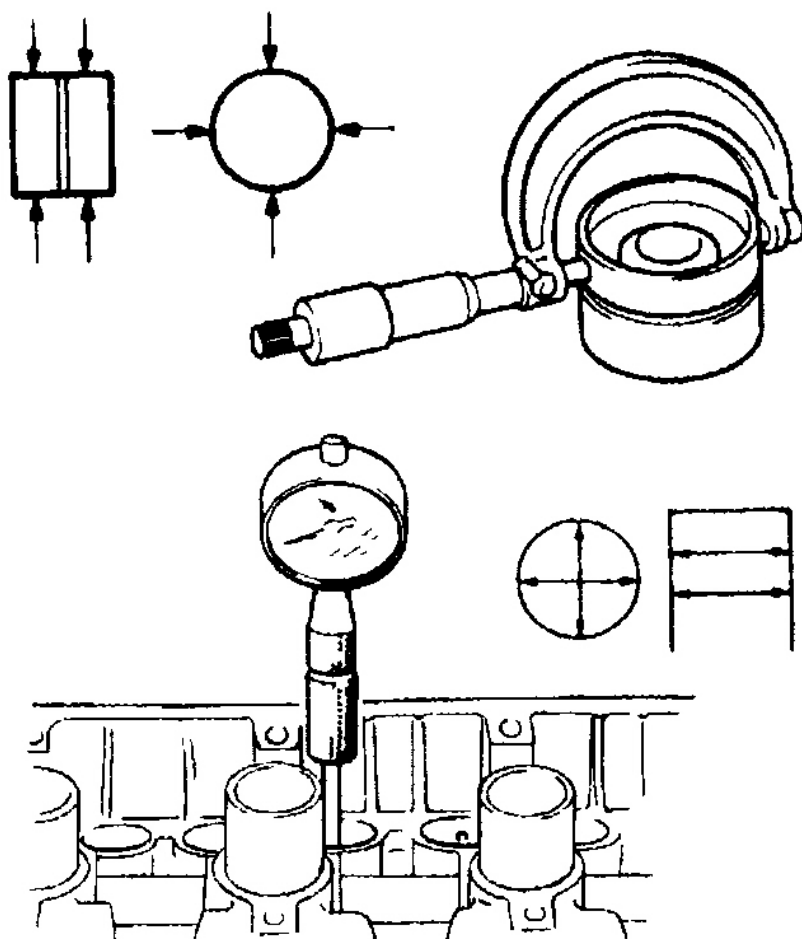
Fig. 116: Identifying Hydraulic Valve Lash Adjuster
 Courtesy of SUZUKI OF AMERICA CORP.

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

Cylinder head bore and adjuster outside diameter

CYLINDER HEAD BORE AND ADJUSTER OUTSIDE DIAMETER SPECIFICATION

Item	Standard	Limit
Hydraulic valve lash adjuster	30.959--30.975 mm (1.2189--1.2194 in.)	-
Cylinder head bore	31.000--31.025 mm (1.2205--1.2214 in.)	-
Cylinder head to adjuster clearance	0.025 - 0.066 mm (0.0010--0.0025 in.)	0.15 mm (0.0059 in.)

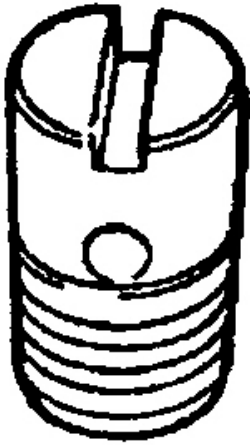


I5RH01140007

Fig. 117: Checking Cylinder Head Bore And Adjuster Outside Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Oil Relief Valve

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



I2RH01140111

Fig. 118: Identifying Oil Relief Valve
Courtesy of SUZUKI OF AMERICA CORP.

VALVES AND CYLINDER HEAD COMPONENTS

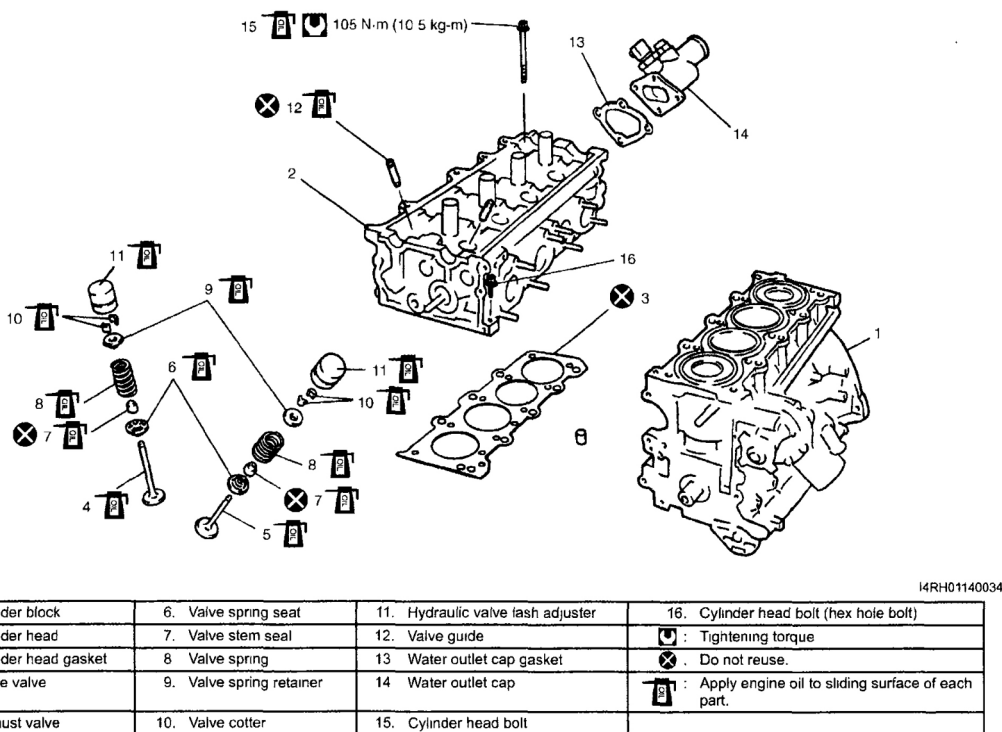
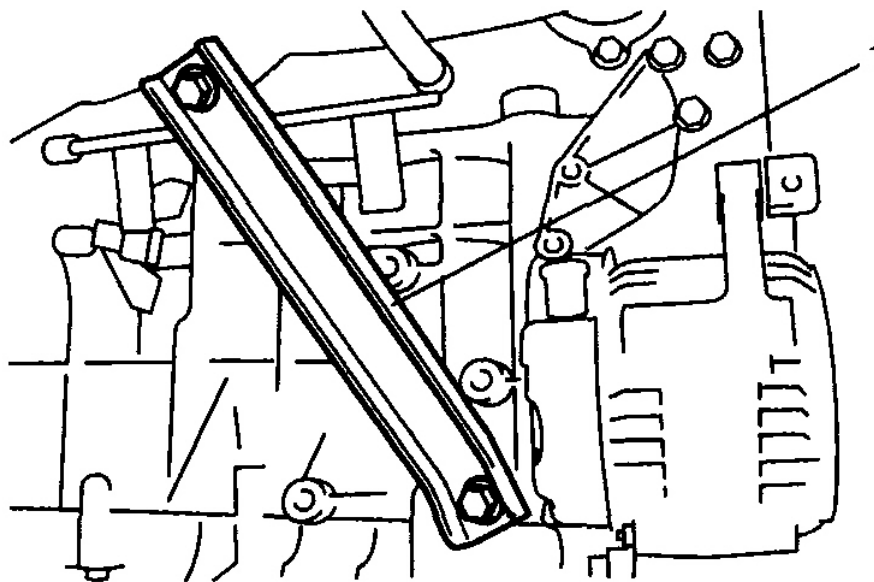


Fig. 119: Identifying Valves And Cylinder Head Components
 Courtesy of SUZUKI OF AMERICA CORP.

VALVES AND CYLINDER HEAD REMOVAL AND INSTALLATION

Removal

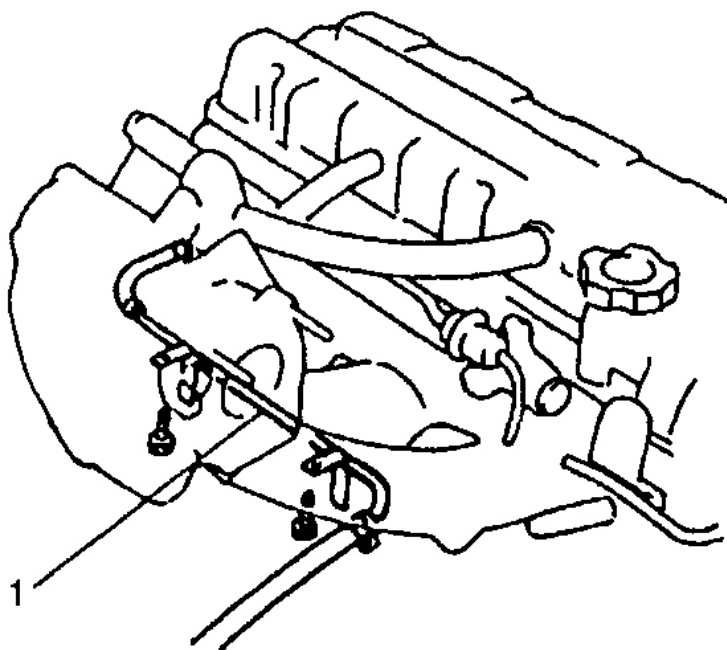
1. Remove engine assembly from vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION**".
2. Remove timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION**" for removal.
3. Remove 2nd timing chain and 1st timing chain. Refer to "**2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**" and "**1ST TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION**" for removal.
4. Remove camshafts and valve lash adjuster. Refer to "**CAMSHAFTS AND VALVE LASH ADJUSTERS REMOVAL AND INSTALLATION**" for removal.
5. Remove intake manifold rear stiffener (1).



I2RH01140113

Fig. 120: Removing Intake Manifold Rear Stiffener
Courtesy of SUZUKI OF AMERICA CORP.

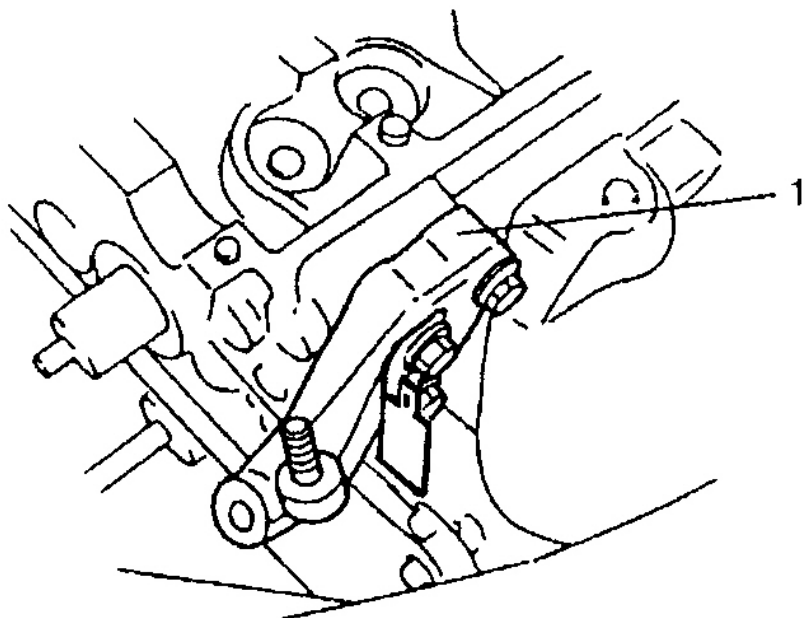
6. Disconnect coolant pipe (1) from intake manifold.



I2RH01140114

Fig. 121: Disconnecting Coolant Pipe From Intake Manifold
Courtesy of SUZUKI OF AMERICA CORP.

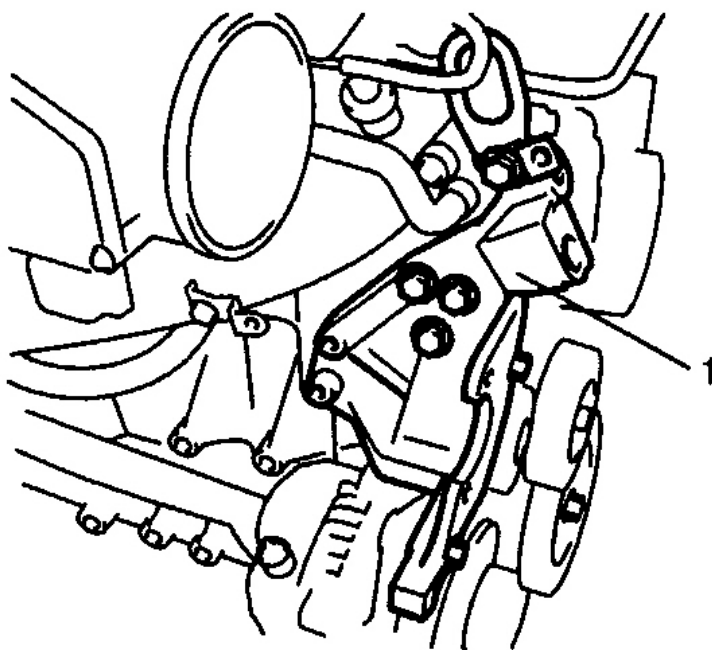
7. Remove engine RH mounting bracket (1).



I2RH01140115

Fig. 122: Removing Engine RH Mounting Bracket
Courtesy of SUZUKI OF AMERICA CORP.

8. Remove P/S pump bracket (1).

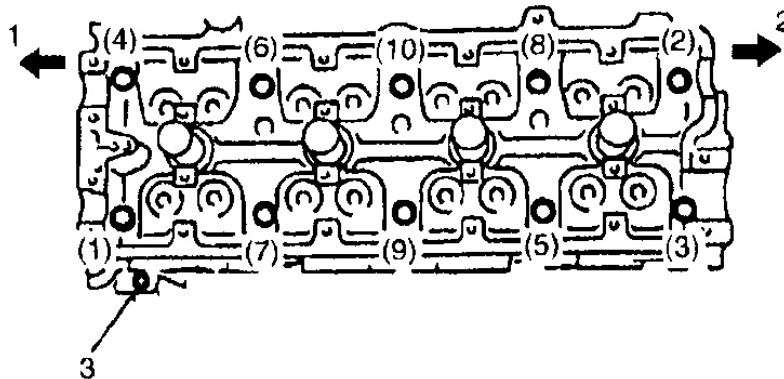


I2RH01140116

Fig. 123: Removing P/S Pump Bracket
Courtesy of SUZUKI OF AMERICA CORP.

9. Loosen cylinder head bolts in such order as numbered in figure and remove them.

NOTE: Don't forget to remove bolt (M6) (3) as shown in figure.



I2RH01140117

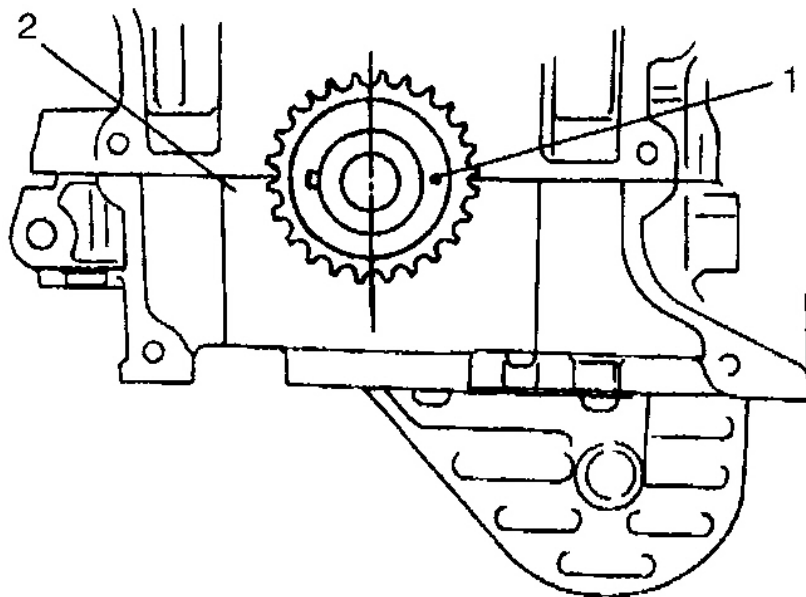
- | |
|---------------------------|
| 1. Crankshaft pulley side |
| 2. Flywheel side |

Fig. 124: Loosening Cylinder Head Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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

Installation

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

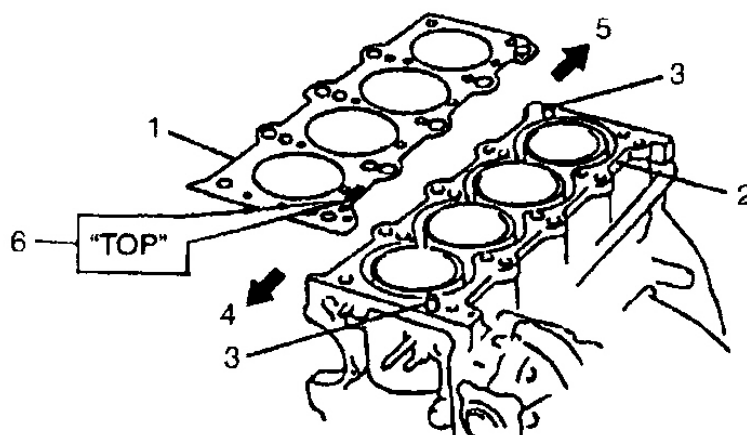


I2RH01140118

Fig. 125: Matching Match Mark On Crank Timing Sprocket And Mating Surface Of Cylinder Block

Courtesy of SUZUKI OF AMERICA CORP.

2. Clean mating surface of cylinder head and cylinder block (2). Remove oil, old gasket and dust from mating surface.
3. Install knock pins (3) to cylinder block.
4. Install new cylinder head gasket (1) to cylinder block. Top mark (6) provided on gasket comes to crankshaft pulley side (4), facing up (toward cylinder head side).



I2RH01140119

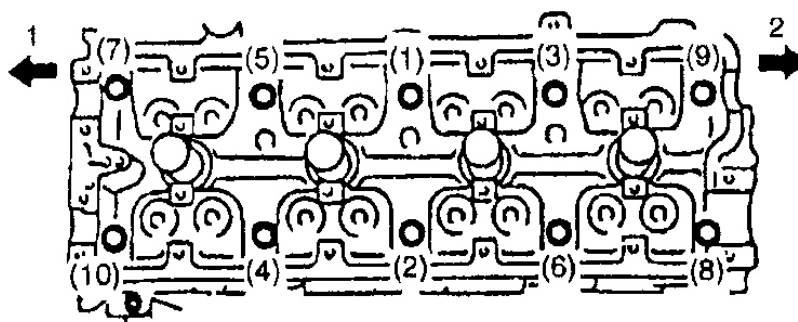
5. Flywheel side

Fig. 126: Installing New Cylinder Head Gasket To Cylinder Block
 Courtesy of SUZUKI OF AMERICA CORP.

5. Install cylinder head to cylinder block.

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

- Tighten all bolts to 53 N.m (5.3 kg-m, 38.5 lb-ft) according to numerical order in figure.
- In the same manner as in step a), retighten them to 84 N.m (8.4 kg-m, 61.0 lb-ft).



I2RH01140120

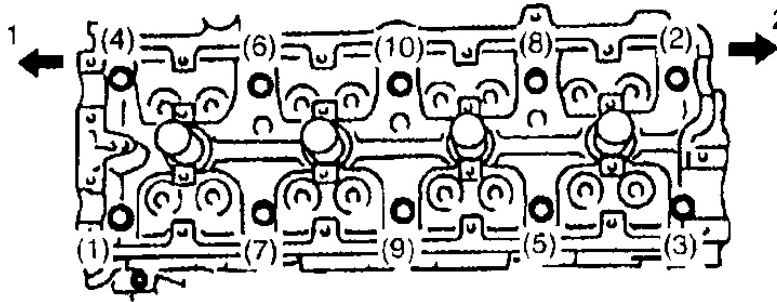
1. Crankshaft pulley side

2 Flywheel side

Fig. 127: Tightening Cylinder Head Bolts (1 Of 3)

Courtesy of SUZUKI OF AMERICA CORP.

- c. Loosen all bolts until tightening torque is reduced to 0 according to numerical order in figure.



I2RH01140121

1. Crankshaft pulley side
2 Flywheel side

Fig. 128: Tightening Cylinder Head Bolts (2 Of 3)

Courtesy of SUZUKI OF AMERICA CORP.

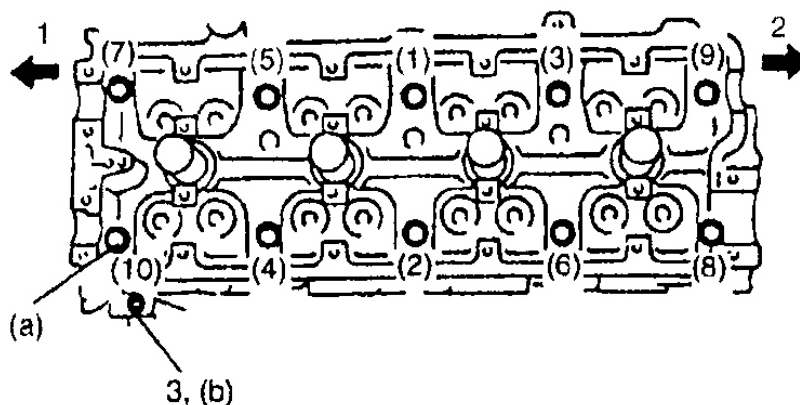
- d. Tighten all bolts to 53 N.m (5.3 kg-m, 38.5 lb-ft) according to numerical order in figure.
e. In the same manner as in step b), retighten them to specified torque.

Tightening torque

Cylinder head bolt (a): 105 N.m (10.5 kg-m, 76.0 lb-ft)

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

NOTE: Be sure to tighten M6 bolt (3) after securing other bolts.



I2RH01140122

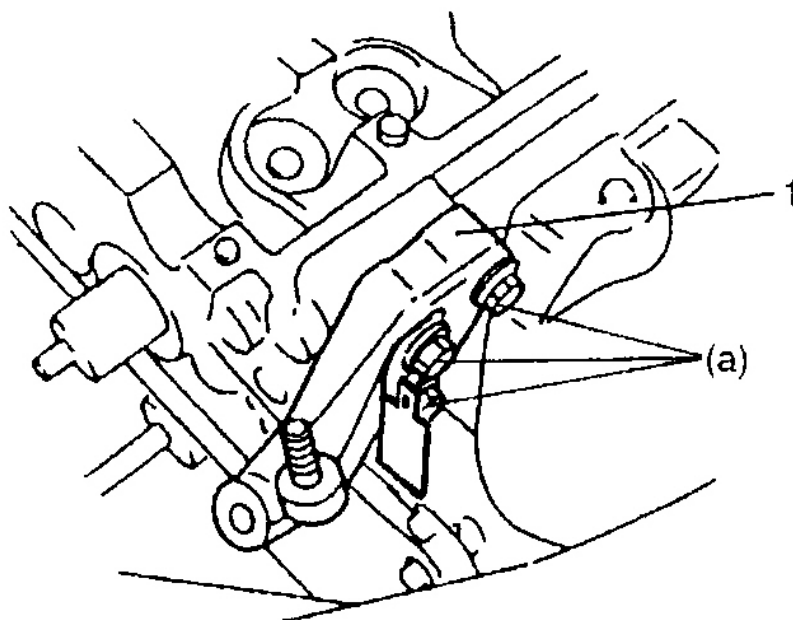
1	Crankshaft pulley side
2.	Flywheel side

Fig. 129: Tightening Cylinder Head Bolts (3 Of 3)
Courtesy of SUZUKI OF AMERICA CORP.

6. Install engine RH mounting bracket (1) using new bracket bolts. Tighten bracket bolts to specified torque.

Tightening torque

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



I2RH01140123

Fig. 130: Installing Engine RH Mounting Bracket
Courtesy of SUZUKI OF AMERICA CORP.

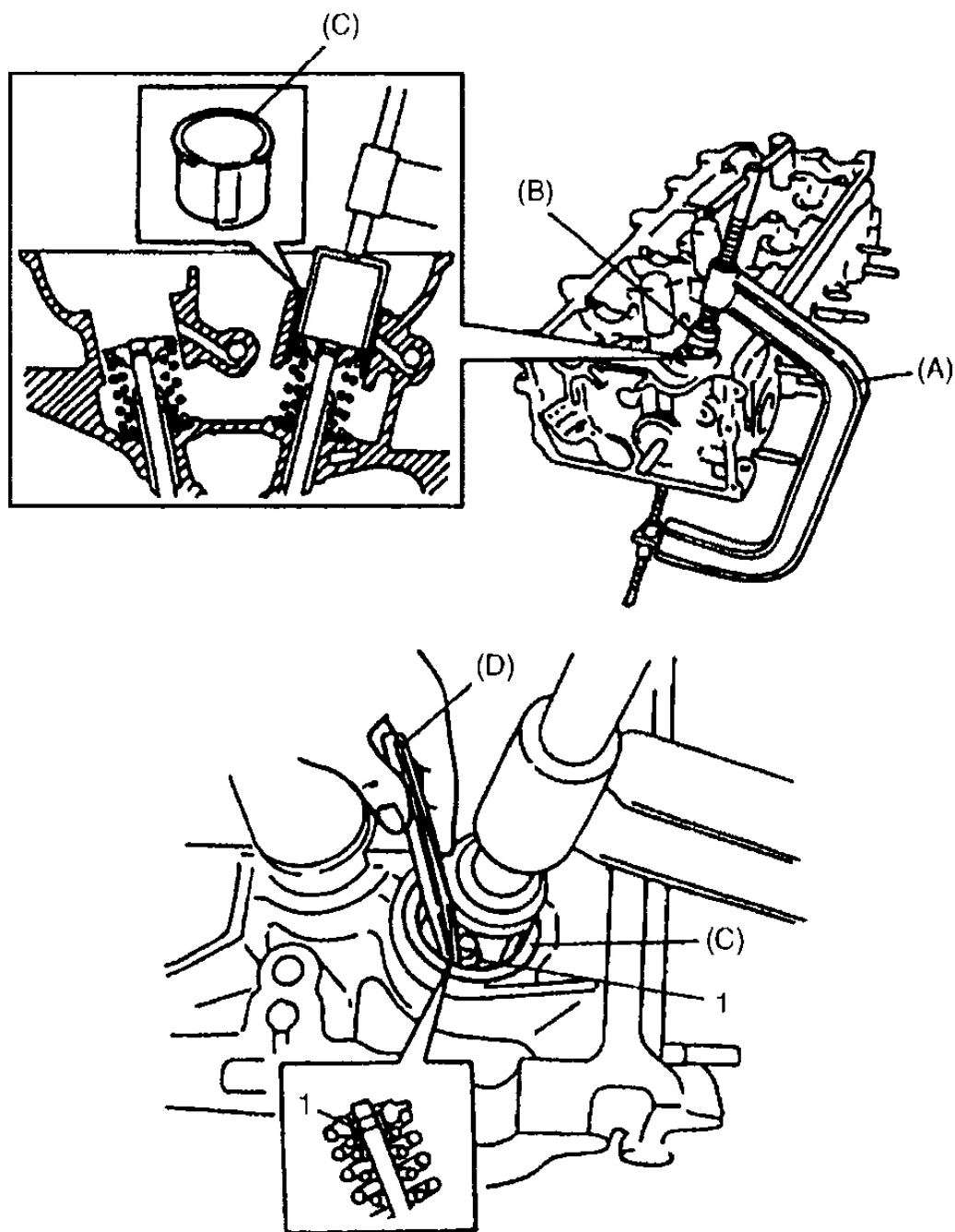
7. Install P/S pump bracket.
8. Install camshafts and valve lash adjuster. Refer to "**CAMSHAFTS AND VALVE LASH ADJUSTERS REMOVAL AND INSTALLATION:**" for installation.
9. Install 1st timing chain. Refer to "**1ST TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION:**" for installation.
10. Install 2nd timing chain. Refer to "**2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION:**" for installation.
11. Install timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION:**" for installation.
12. Install engine assembly to vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".

VALVES AND CYLINDER HEAD DISASSEMBLY AND ASSEMBLY

Disassembly

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

Special tool**(A): 09916-14510****(B): 09916-16510****(C): 09919-28610****(D): 09916-84511**



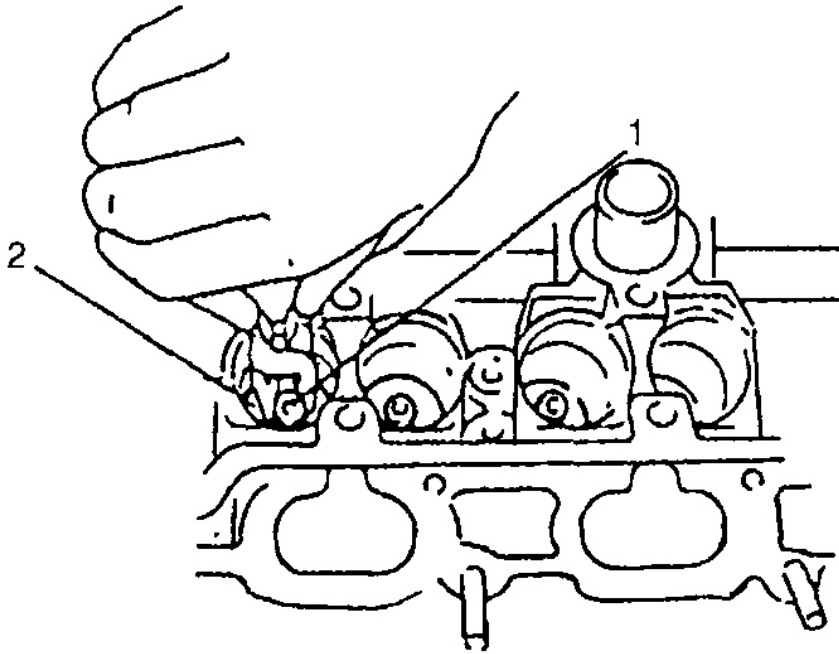
I5RH01140008

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

3. Release special tool, and remove spring retainers and valve springs.
4. Remove valve from combustion chamber side.

5. Remove valve stem seal (1) from valve guide, and then valve spring seat (2).

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



I2RH01140125

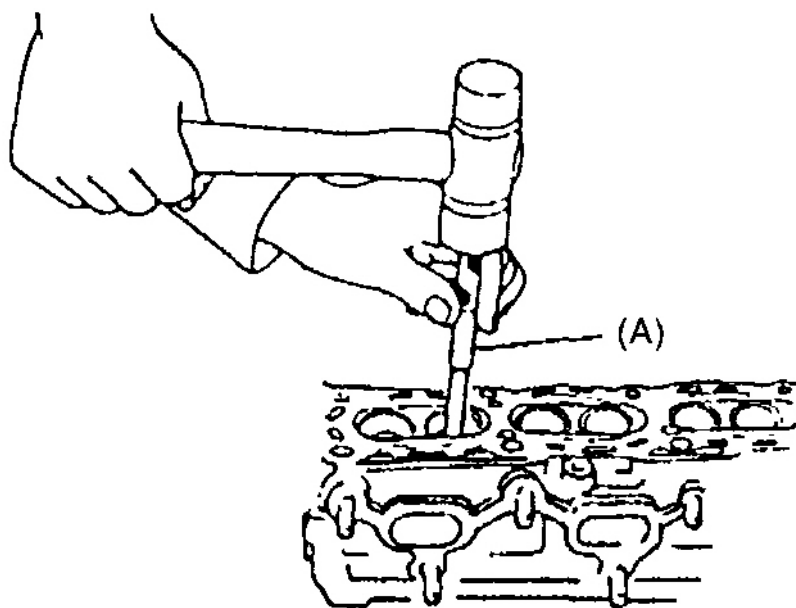
Fig. 132: Removing Valve Stem Seal From Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

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

Special tool

(A): 09916-46020

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



I2RH01140126

Fig. 133: Removing Valve Guide

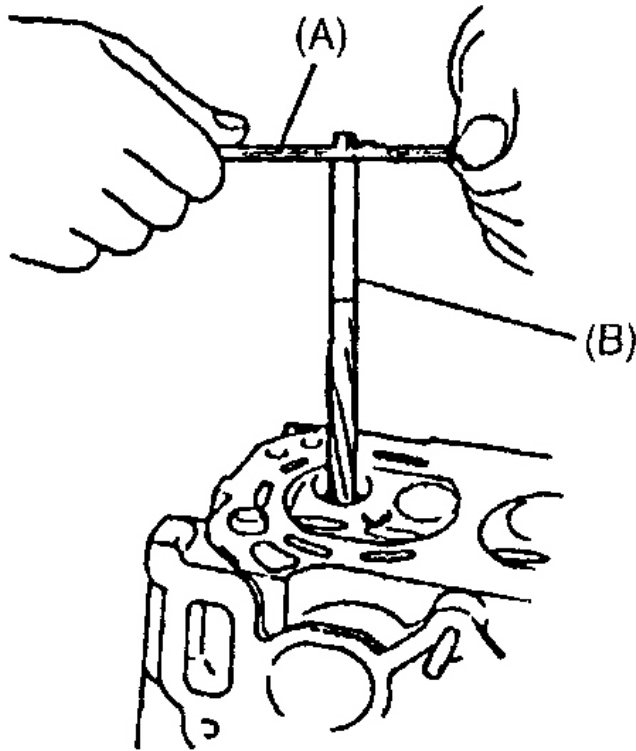
Courtesy of SUZUKI OF AMERICA CORP.

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

Assembly

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

Special tool**(A): 09916-34542****(B): 09916-38210**



I2RH01140127

Fig. 134: Reaming Guide Hole With Special Tool
Courtesy of SUZUKI OF AMERICA CORP.

2. Install valve guide to cylinder head.

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

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

After installing, make sure that valve guide protrudes by 13.5 mm (0.53 in.) from cylinder head.

Special tool

(A): 09916-57350

(B): 09916-57340

NOTE:

- Do not reuse valve guide once disassembled. Install new valve guide

(Oversize).

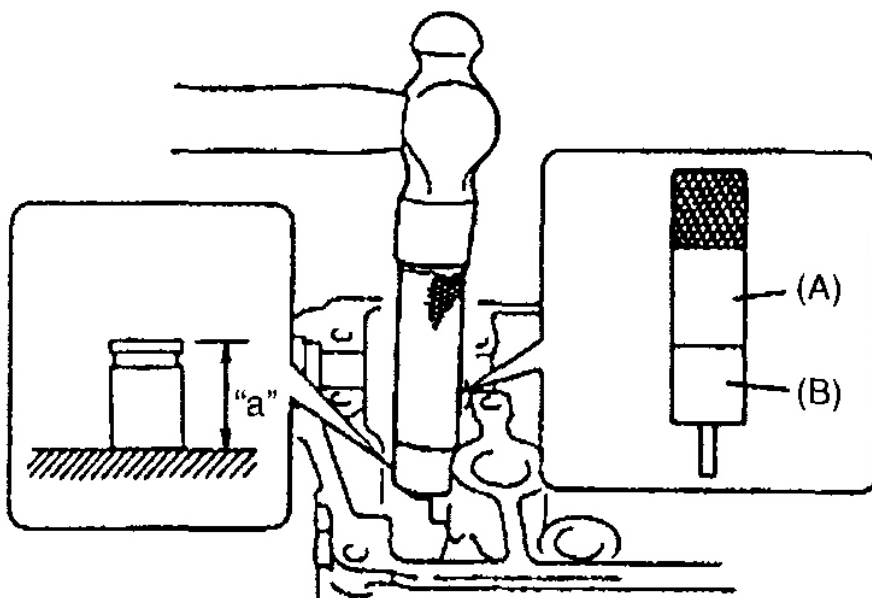
- Intake and exhaust valve guides are identical.

Valve guide oversize

0.03 mm (0.0012 in.)

Valve guide protrusion "a" (In and Ex)

13.0 mm (0.51 in.)



I2RH01140128

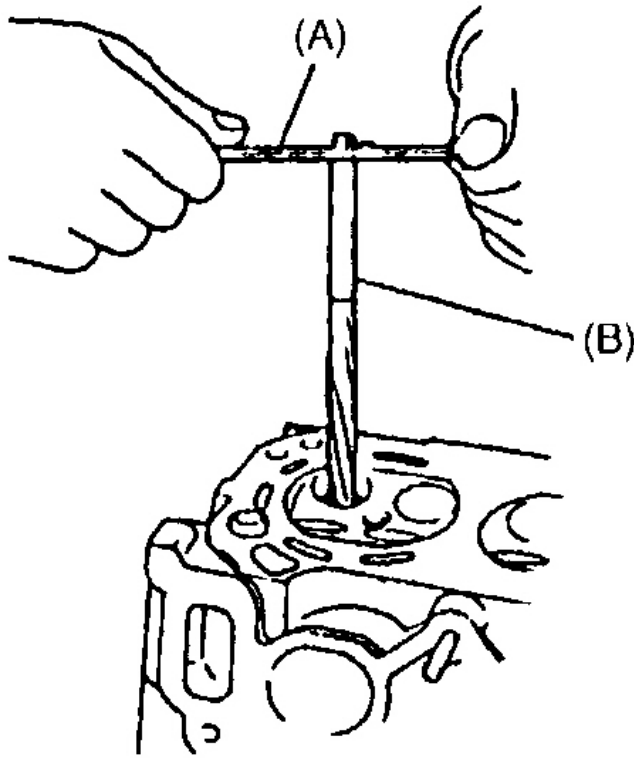
Fig. 135: Identifying Valve Guide Protrusion
Courtesy of SUZUKI OF AMERICA CORP.

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

Special tool

(A): 09916-34542

(B): 09916-37810



I2RH01140127

Fig. 136: Reaming Valve Guide Bore With Special Tool
Courtesy of SUZUKI OF AMERICA CORP.

4. Install valve spring seat to cylinder head.
5. Install new valve stem seal (1) to valve guide. After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.

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

Special tool

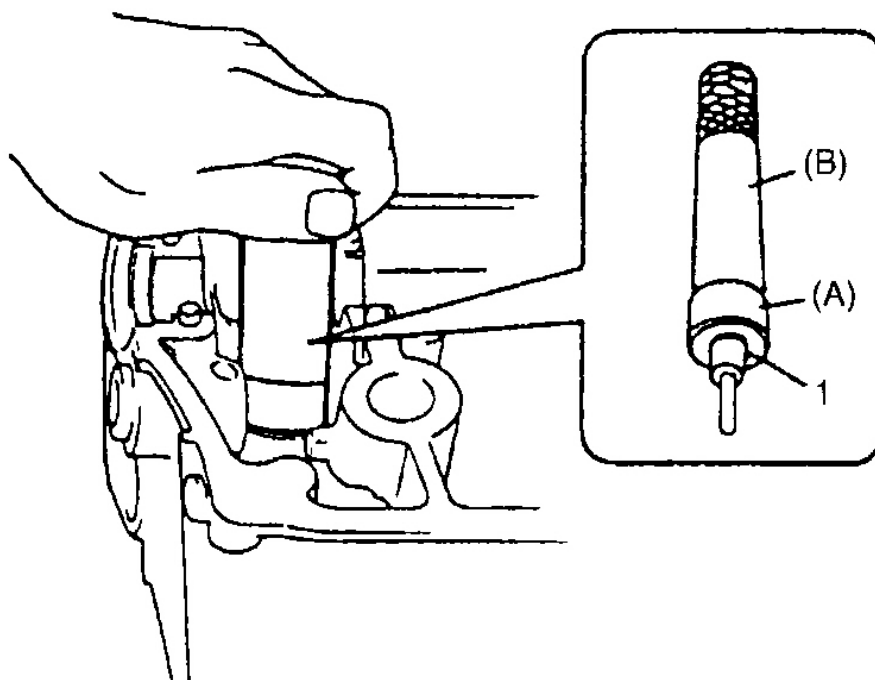
(A): 09917-98221

(B): 09916-57350

NOTE:

- Do not reuse seal once disassembled. Be sure to install new seal.
- When installing, never tap or hit special tool with a hammer or else.

Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.

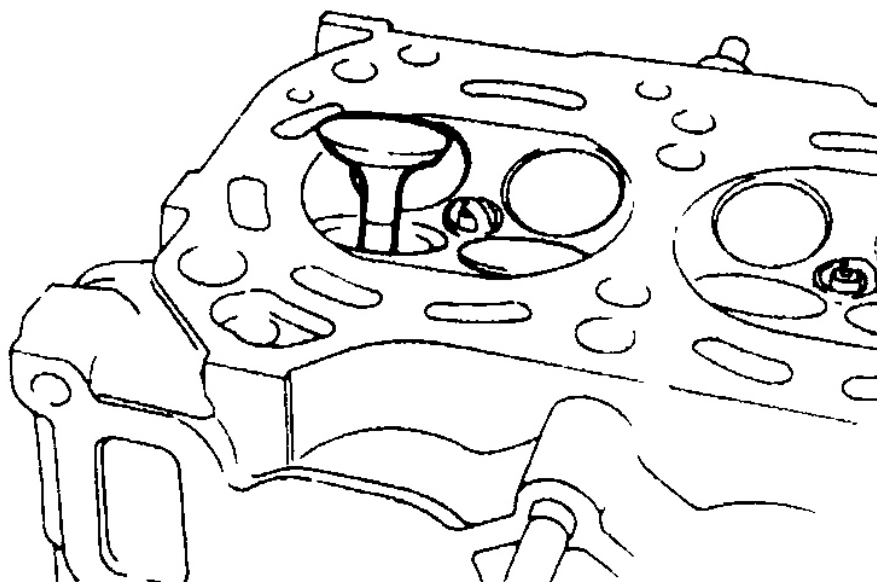


I2RH01140129

Fig. 137: Installing New Valve Stem Seal To Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

6. Install valve to valve guide.

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



I2RH01140130

Fig. 138: Installing Valve To Valve Guide
Courtesy of SUZUKI OF AMERICA CORP.

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

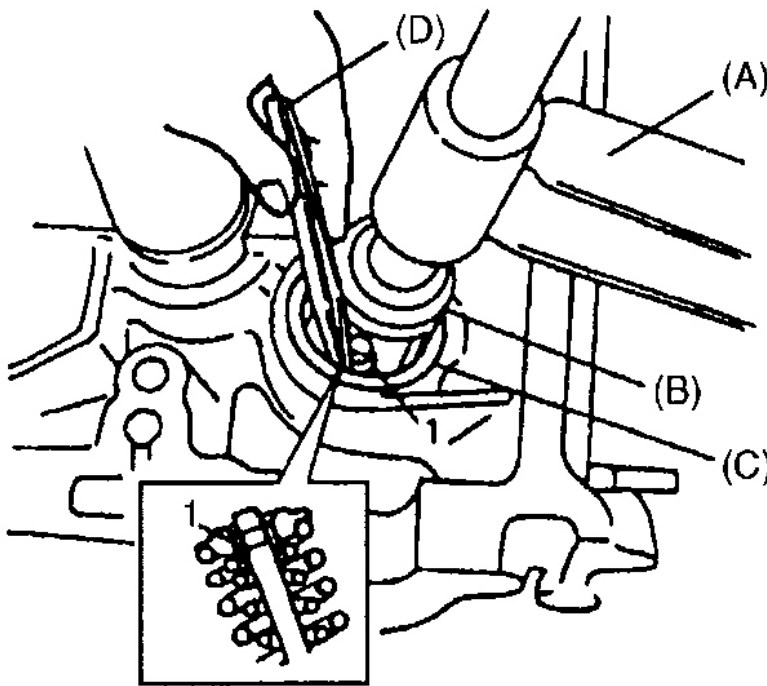
Special tool

(A): 09916-14510

(B): 09916-16510

(C): 09919-28610

(D): 09916-84511



I2RH01140132

Fig. 139: Installing Valve Cotters Into Groove In Valve Stem
 Courtesy of SUZUKI OF AMERICA CORP.

9. Install intake manifold, injectors, exhaust manifold and water outlet cap to cylinder head.

VALVES AND CYLINDER HEAD INSPECTION

Valve Guides

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

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

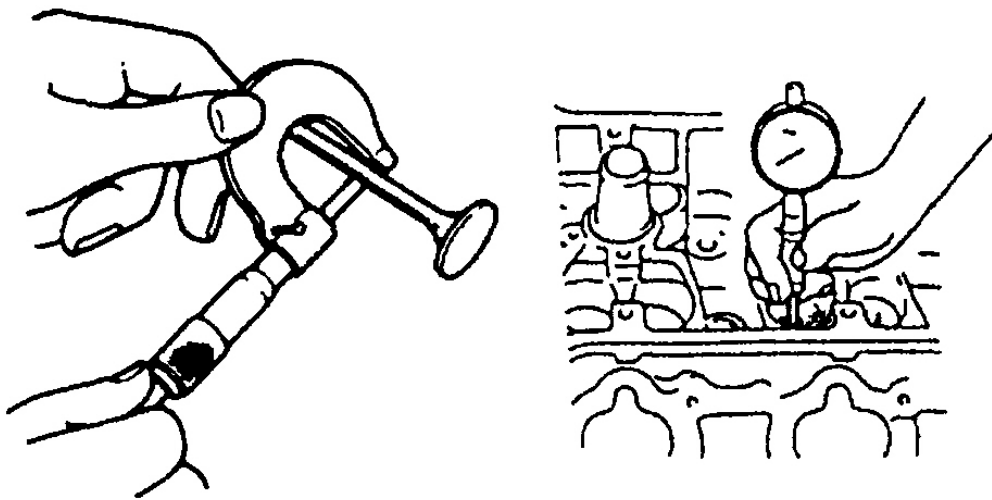
If clearance exceeds limit, replace valve and valve guide.

Valve stem and valve guide

VALVE STEM DIAMETER SPECIFICATION

Item		Standard	Limit
Valve stem diameter	In	5.965 - 5.980 mm (0.2348 - 0.2354 in.)	-

	Ex	5.940 - 5.955 mm (0.2339 - 0.2344 in.)	-
Valve guide I.D.	In & Ex	6.000--6.012 mm (0.2362 - 0.2366 in.)	-
Stem-to-guide clearance	In	0.020 - 0.047 mm (0.0008--0.0018 in.)	0.07 mm (0.0027 in.)
	Ex	0.045 - 0.072 mm (0.0018--0.0028 in.)	0.09 mm (0.0035 in.)



I2RH01140133

Fig. 140: Checking Valve Stem Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Valves

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem and, as necessary, replace it.
- Measure thickness (1) of valve head. If measured thickness exceeds limit, replace valve.

Valve specification

VALVE SPECIFICATION

Item	Standard	Limit
In	1.0 mm (0.039 in.)	0.6 mm (0.024 in.)
Ex	1.2 mm (0.047 in.)	0.7 mm (0.028 in.)

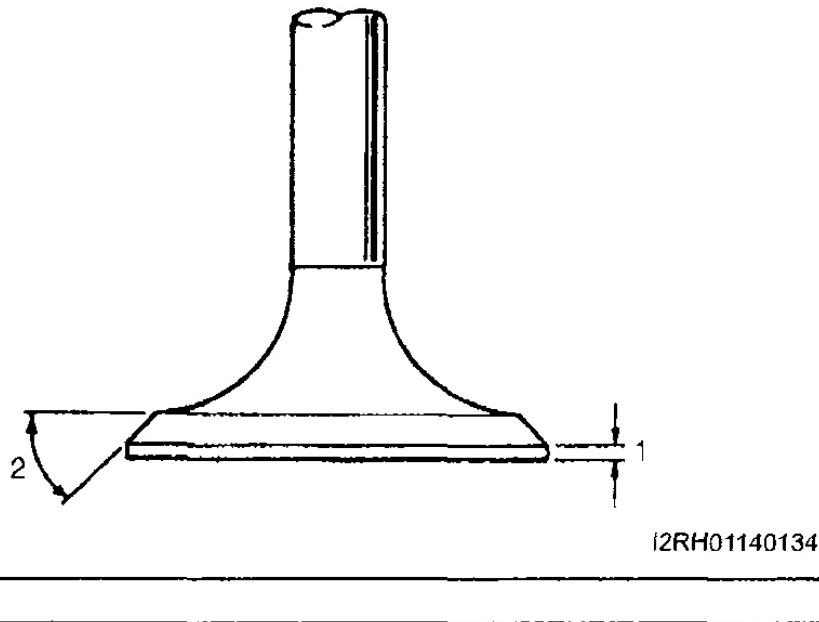


Fig. 141: Identifying Thickness Of Valve Head
Courtesy of SUZUKI OF AMERICA CORP.

- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not so much as to grind off its chamber. When it is worn out so much that its chamber is gone, replace valve.

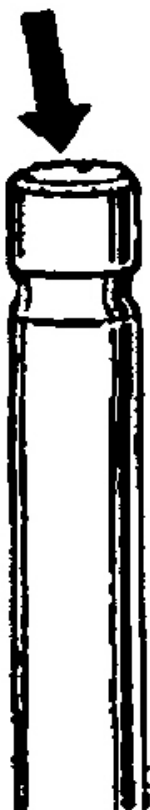
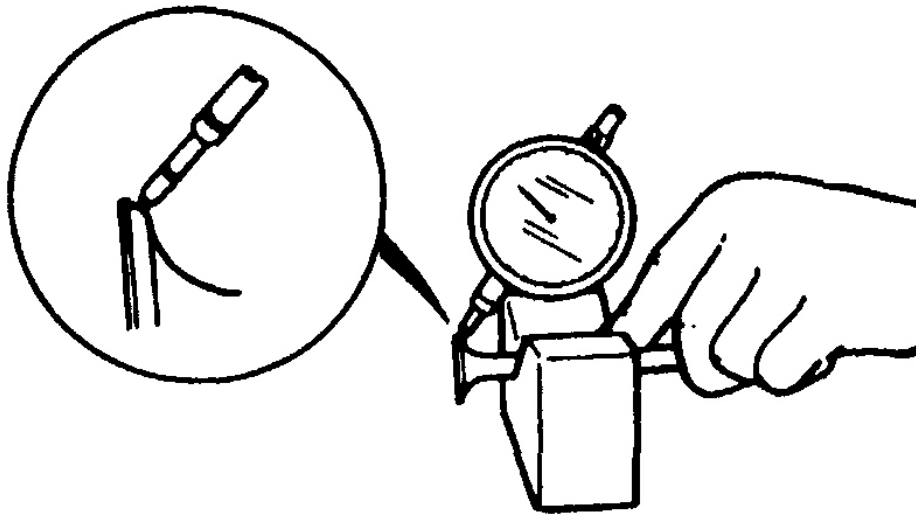
**I2RH01140135**

Fig. 142: Identifying Valve Stem End Face
Courtesy of SUZUKI OF AMERICA CORP.

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

Limit on valve head radial runout

0.08 mm (0.003 in.)



I2RH01140136

Fig. 143: Checking Valve Radial Runout
Courtesy of SUZUKI OF AMERICA CORP.

- Seating contact width:

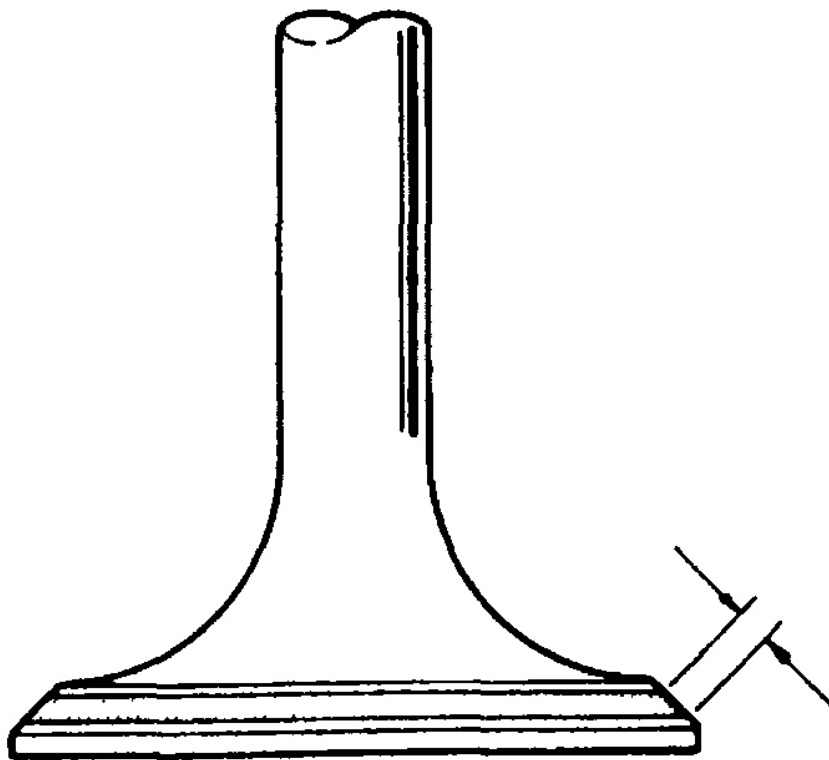
Create contact pattern on each valve in the usual manner, i.e., by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.

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

Standard seating width revealed by contact pattern on valve face

Intake: 0.9 - 1.1 mm (0.0355 - 0.0433 in.)

Exhaust: 1.1 - 1.3 mm (0.0433 - 0.0512 in.)



I2RH01140137

Fig. 144: Identifying Valve Seat Width
Courtesy of SUZUKI OF AMERICA CORP.

- Valve seat repair:

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

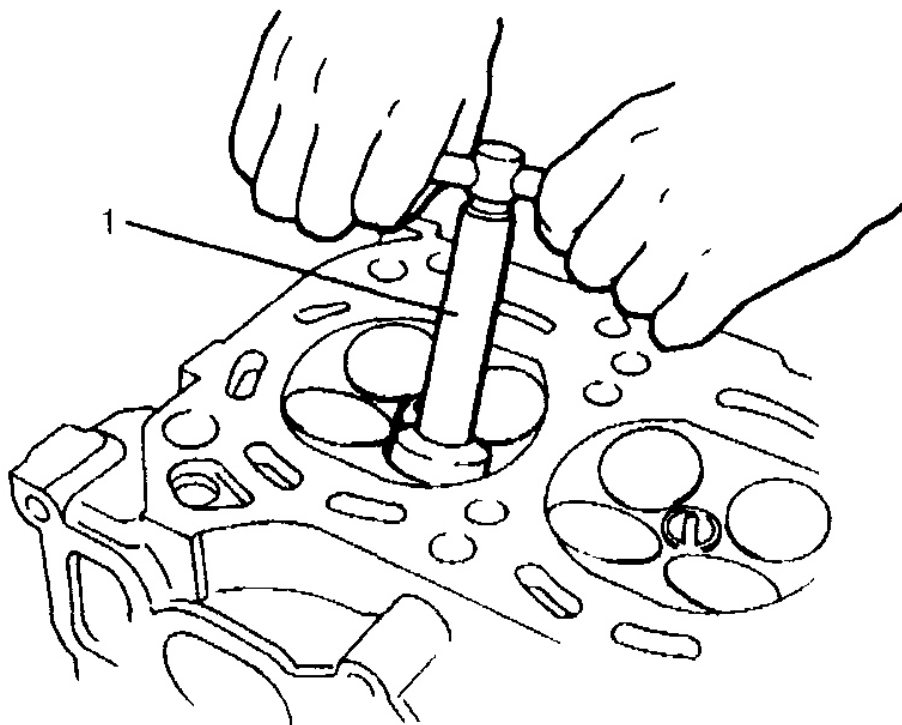
- a. VALVE SEAT: Use valve seat cutters (1) to make three cuts as illustrated in figure. Three cutters must be used: the 1st for making 30° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

Seat width for intake valve seat

0.9 - 1.1 mm (0.0355 - 0.0433 in.)

Seat width for exhaust valve seat

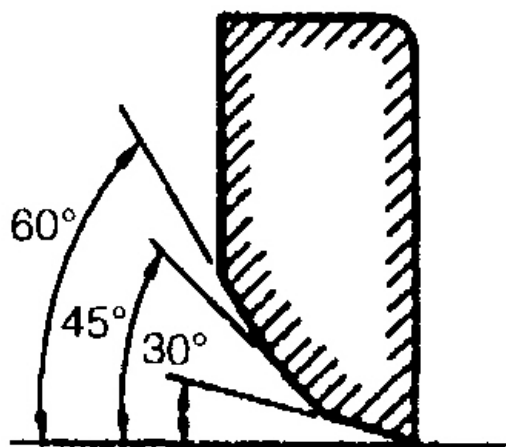
1.1 - 1.3 mm (0.0433 - 0.0512 in.)



I2RH01140138

Fig. 145: Repairing Valve Seat Width
Courtesy of SUZUKI OF AMERICA CORP.

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



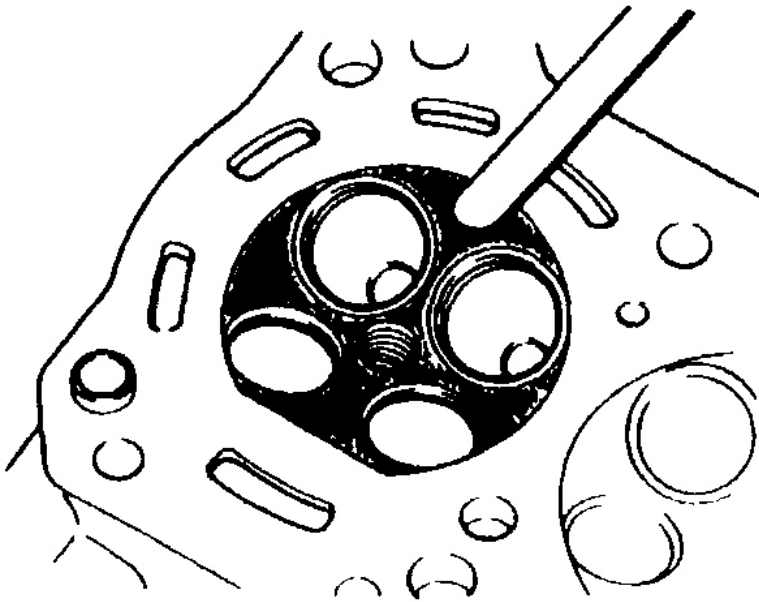
I4RH01140035

Fig. 146: Identifying Valve Lapping Angles
Courtesy of SUZUKI OF AMERICA CORP.

Cylinder Head

- Remove all carbon from combustion chambers.

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



I2RH01140140

Fig. 147: Removing All Carbon From Combustion Chambers
Courtesy of SUZUKI OF AMERICA CORP.

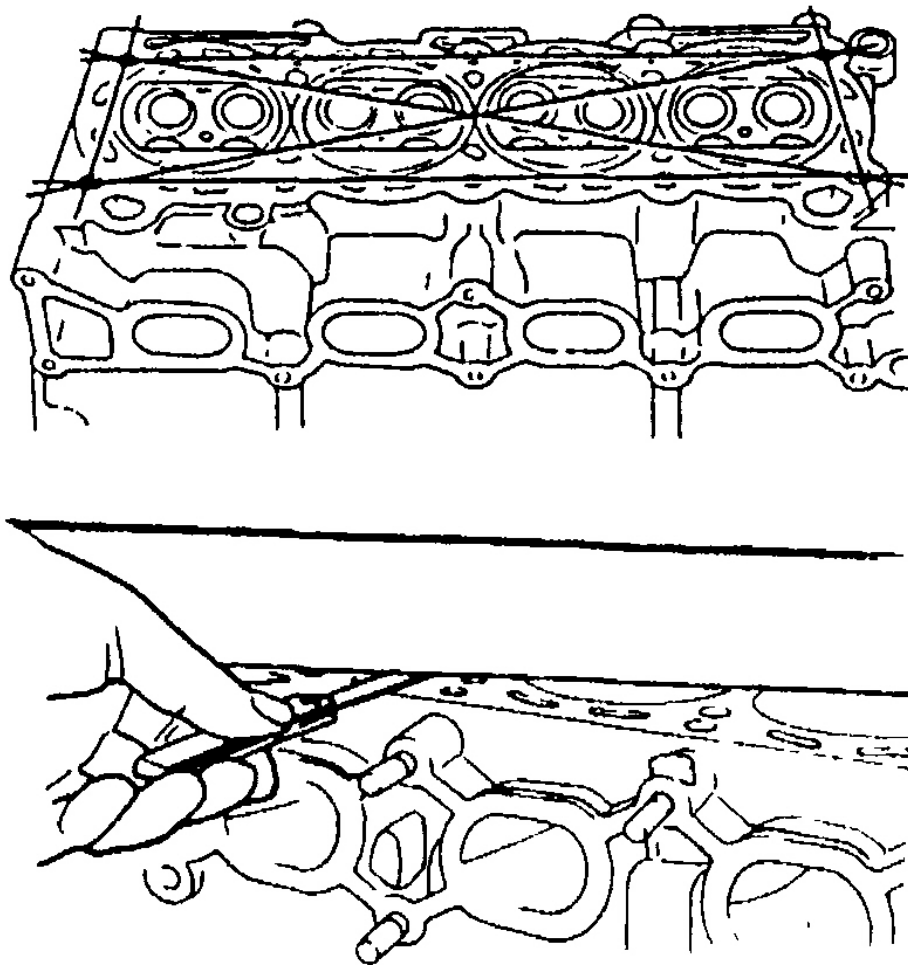
- Check cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface at a total of 6 locations. If distortion limit is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper):

Place paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head.

Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

Limit of distortion

0.05 mm (0.002 in.)



I5RH01140009

Fig. 148: Checking Cylinder Head For Cracks In Intake And Exhaust Ports, Combustion Chambers And Head Surface

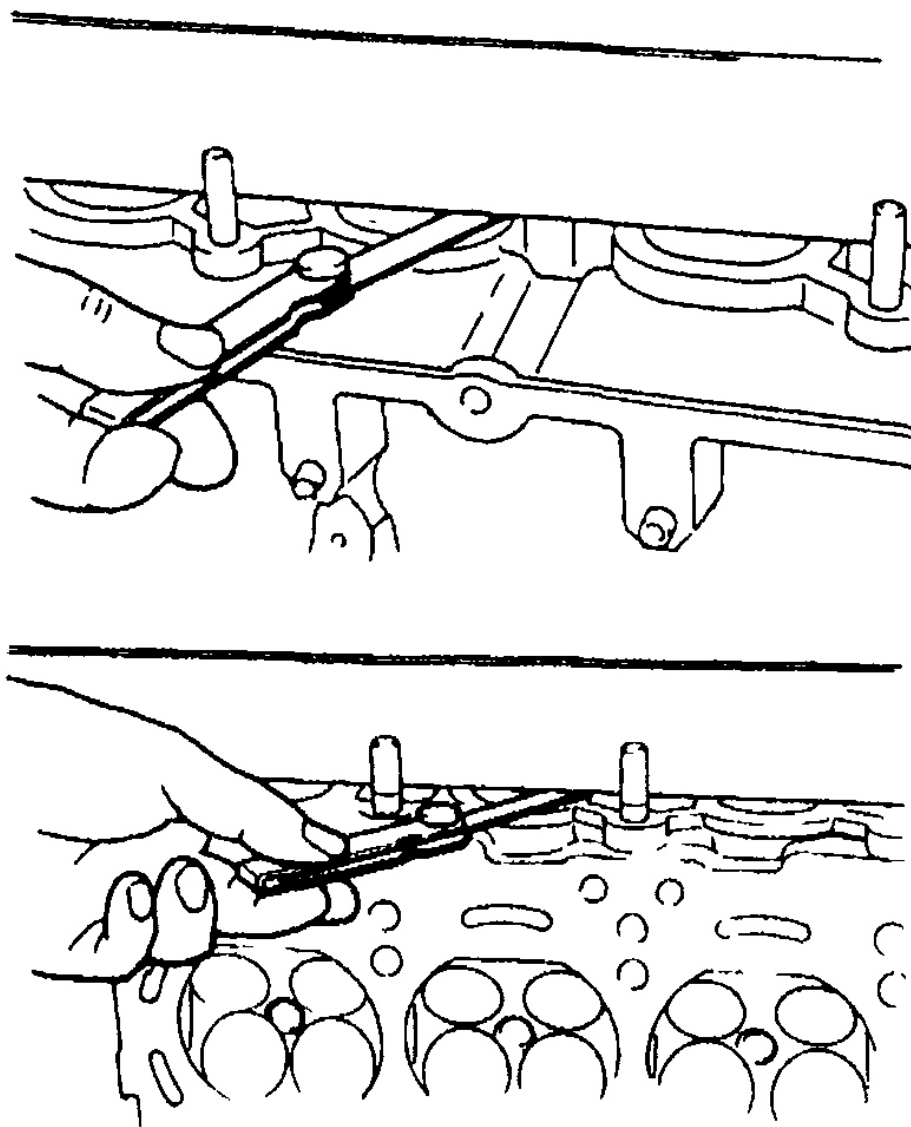
Courtesy of SUZUKI OF AMERICA CORP.

- Distortion of manifold seating faces:

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

Limit of distortion

0.10 mm (0.004 in.)



I5RH01140010

Fig. 149: Checking Seating Faces Of Cylinder Head For Manifolds Using Thickness Gauge
Courtesy of SUZUKI OF AMERICA CORP.

Valve Springs

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

Valve spring free length

VALVE SPRING FREE LENGTH SPECIFICATION

Standard	Limit
44.29 mm (1.7437 in.)	42.60 mm (1.6772 in.)

Valve spring preload

VALVE SPRING PRELOAD SPECIFICATION

Standard	Limit
22.3 - 25.6 kg for 33.8 mm (49.2 - 56.4 lb/1.33 in.)	24.0 kg for 33.8 mm (52.91 lb/1.33 in.)

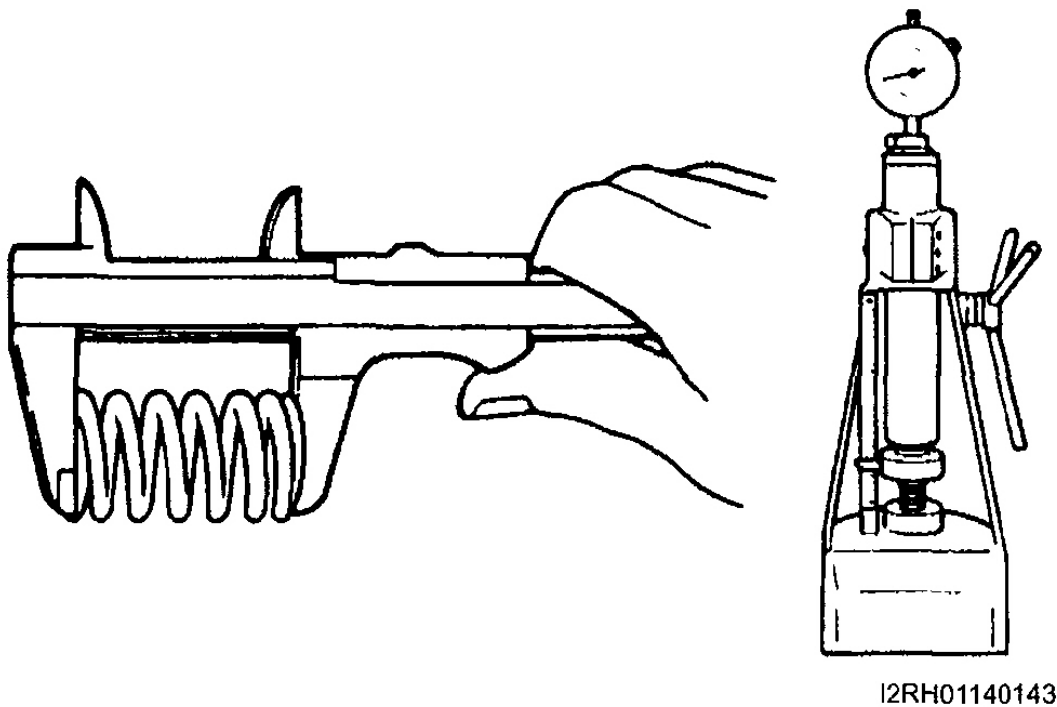


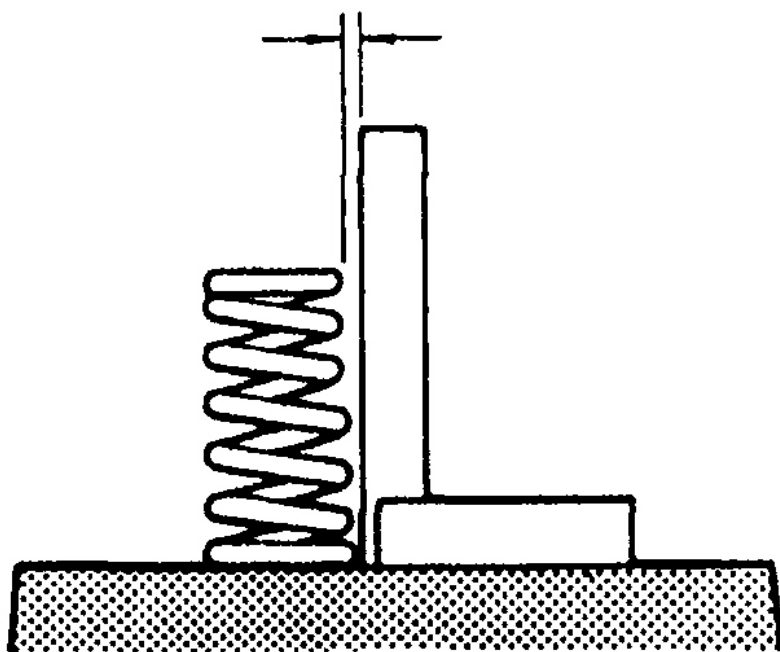
Fig. 150: Checking Valve Spring Free Length
Courtesy of SUZUKI OF AMERICA CORP.

- Spring squareness:

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

Valve spring squareness limit

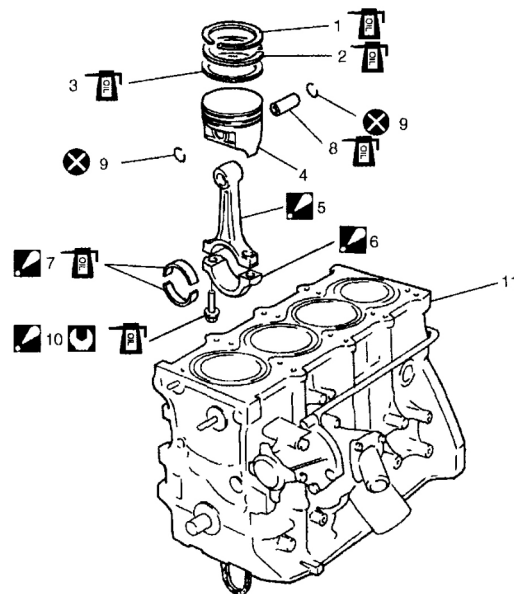
2.0 mm (0.079 in.)



I2RH01140144

Fig. 151: Checking Clearance Between End Of Valve Spring And Square
Courtesy of SUZUKI OF AMERICA CORP.

PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS COMPONENTS



I4RH01140052

1 Top ring	10 Connecting rod bolt Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45° and 45° by the specified procedure
2 2nd ring	11. Cylinder block
3 Oil ring	12. Oil pump
4. Piston	13 Oil pump sprocket cover
5. Connecting rod : See "A"	Tightening torque
6. Connecting rod bearing cap : See "B"	Apply engine oil to sliding surface of each part
7 Connecting rod bearing : See "C"	Do not reuse.
8. Piston pin	
9 Piston pin circlip	
"A". Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Check of rod bolt diameter when reuse it due to plastic deformation tightening. Refer to "Pistons, Piston Rings, Connecting Rods and Cylinders Inspection and Cleaning."	
"B". Point arrow mark on cap to crankshaft pulley side. Do not apply engine oil to inner surface of bearing cap	
"C". Do not apply engine oil between con-rod big end and bearing, between cap and bearing	

Fig. 152: Identifying Pistons, Piston Rings, Connecting Rods And Cylinders Components
 Courtesy of SUZUKI OF AMERICA CORP.

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

Removal

1. Remove engine assembly from vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".
2. Remove oil pump with oil pump strainer. Refer to **OIL PUMP REMOVAL AND INSTALLATION** for removal.
3. Remove cylinder head. Refer to "**VALVES AND CYLINDER HEAD REMOVAL AND INSTALLATION:**" for removal.
4. Mark cylinder number on all pistons, connecting rods and connecting rod caps.
5. Remove connecting rod bearing caps.

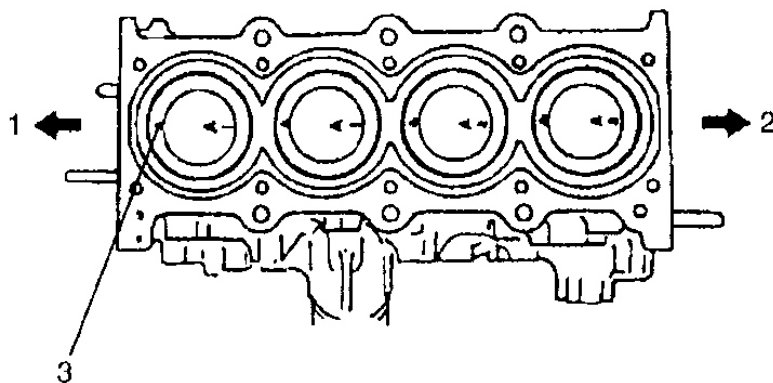
6. Clean carbon from top of cylinder bore before removing piston from cylinder.
7. Push piston and connecting rod assembly out through the top of cylinder bore.

Installation

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

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

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



I2RH01140148

2 Flywheel side

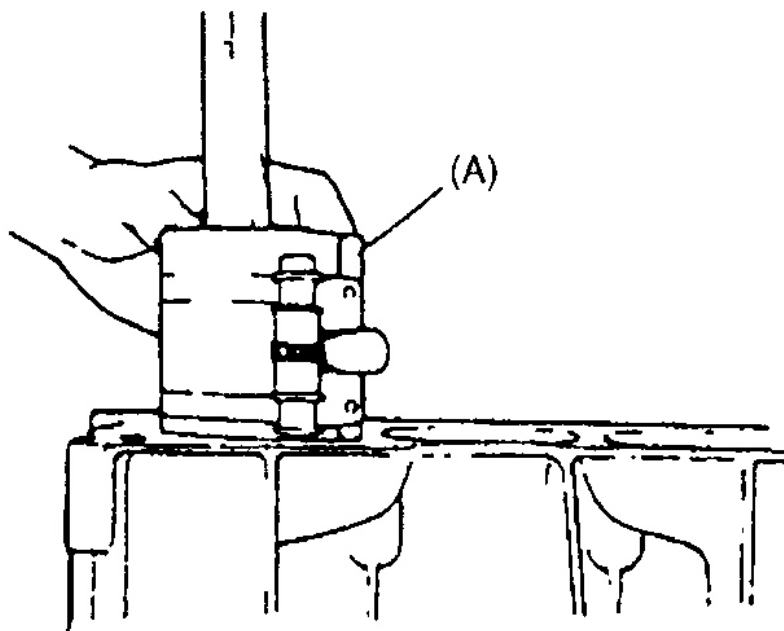
Fig. 153: Identifying Front Mark On Piston Head To Crankshaft Pulley Side
Courtesy of SUZUKI OF AMERICA CORP.

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

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

Special tool

(A): 09916-77310



I2RH01140149

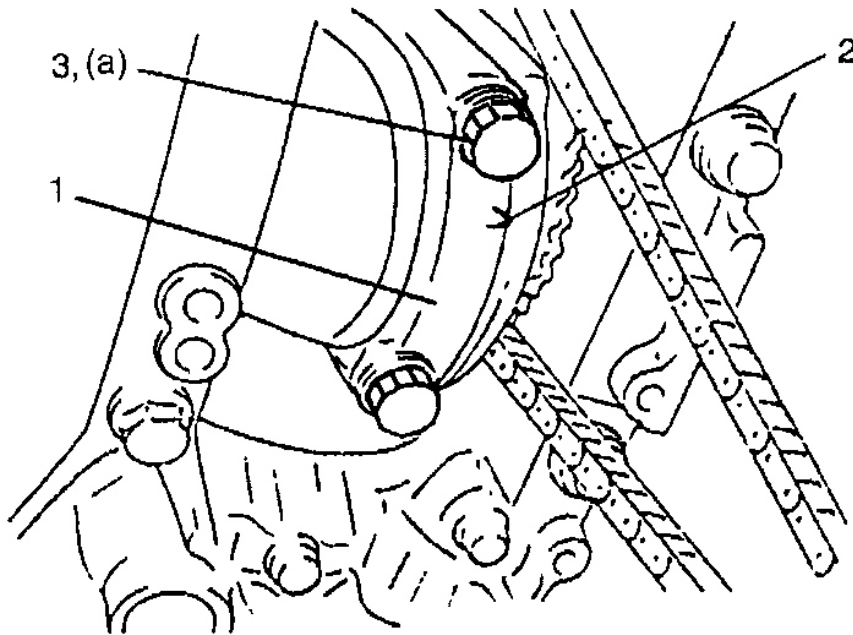
Fig. 154: Installing Piston And Connecting Rod Assembly Into Cylinder Bore
Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque

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

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



I4RH01140037

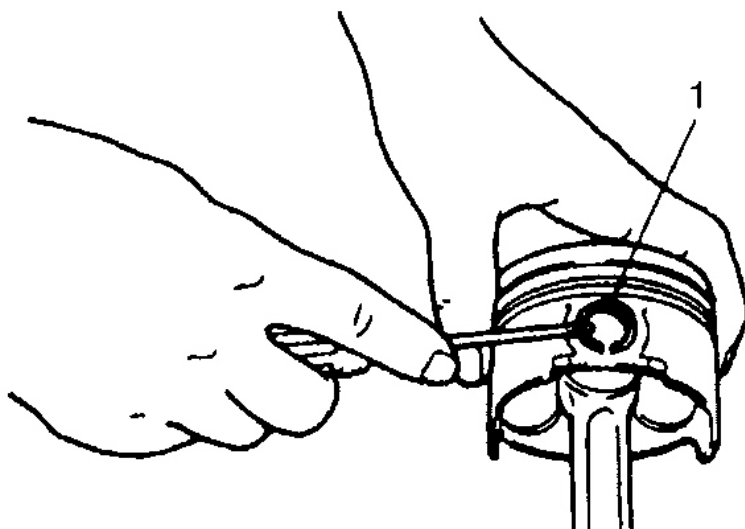
Fig. 155: Tightening Connecting Rod Bearing Cap Bolts
Courtesy of SUZUKI OF AMERICA CORP.

5. Install cylinder head. Refer to "**VALVES AND CYLINDER HEAD REMOVAL AND INSTALLATION:**" for installation.
6. Install oil pan. Refer to **OIL PUMP REMOVAL AND INSTALLATION** for installation.
7. Install engine assembly to vehicle referring to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".

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

Disassembly

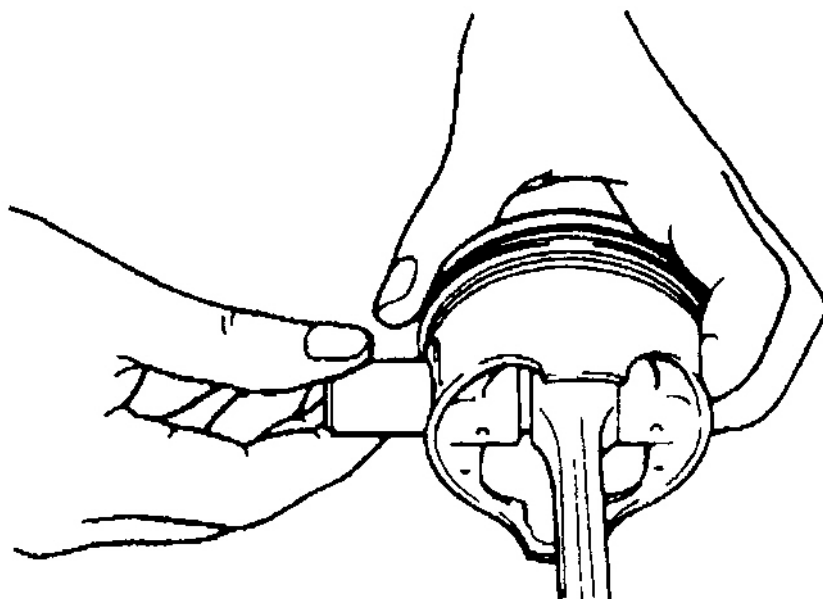
1. Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
2. Remove piston pin from connecting rod.
 - Ease out piston pin circlips (1), as shown.



I2RH01140151

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

- Force piston pin out.



I2RH01140152

Fig. 157: Removing Piston Pin

Courtesy of SUZUKI OF AMERICA CORP.

Assembly

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

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

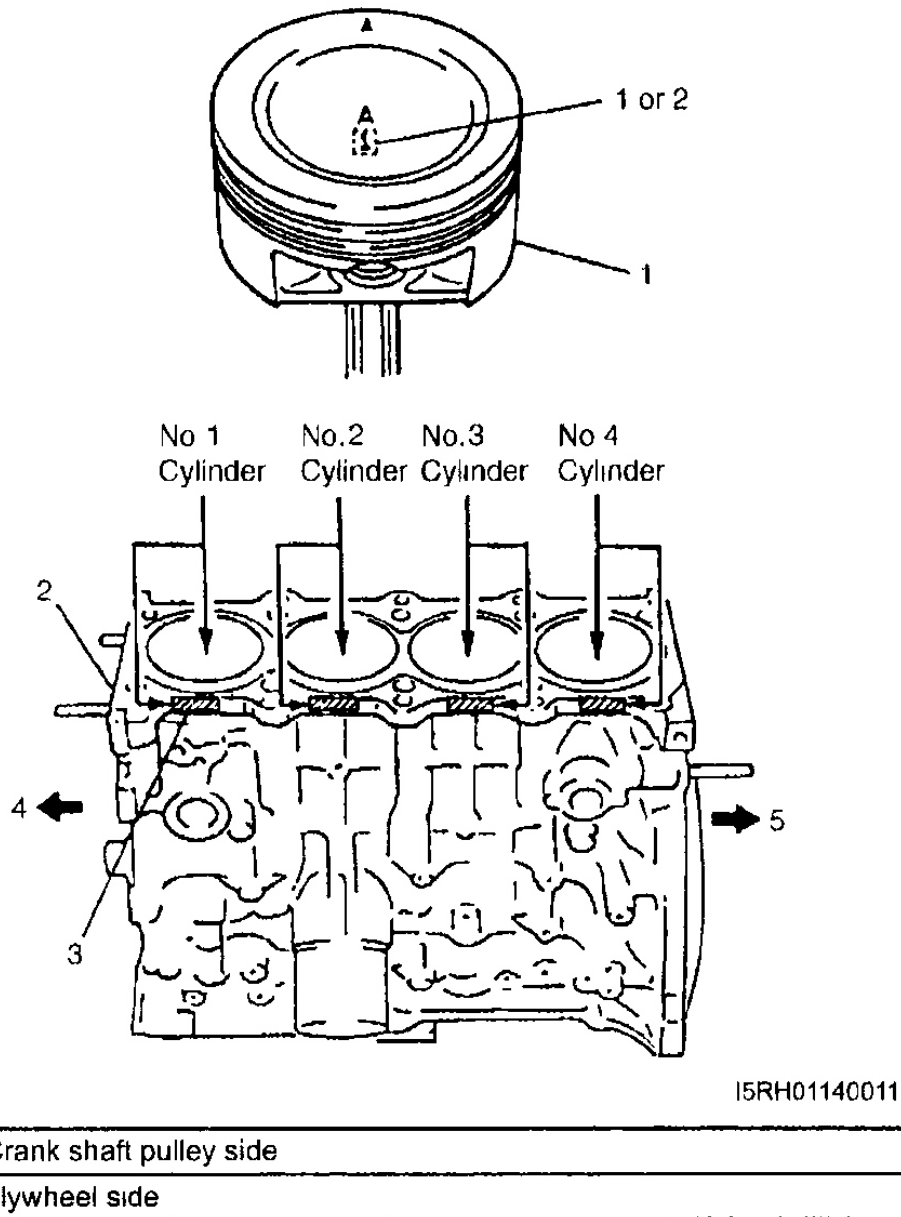


Fig. 158: Identifying Outer Diameter Of Piston Stamped On Piston
 Courtesy of SUZUKI OF AMERICA CORP.

- Stamped number on piston and stamped mark on cylinder block should correspond. That is, install number 2 stamped piston to cylinder which is identified with mark blue and a number 1 piston to cylinder with mark red. Also, a letter A or B is stamped on piston head but ordinarily it is not necessary to discriminate each piston by this letter.

Piston and cylinder specifications

2005 Suzuki Aerio S

2005 ENGINE Engine Mechanical - Aerio

PISTON AND CYLINDER SPECIFICATIONS

Piston		Cylinder		Piston-to-cylinder clearance>
Number at the top (mark)	Outer diameter	Mark	Bore diameter	
1	89.98 - 89.99 mm (3.5426 - 3.5429 in.)	Red	90.01 - 90.02 mm (3.5438 - 3.5440 in.)	0.02 - 0.04 mm (0.0008-- 0.0015 in.)
2	89.97 - 89.98 mm (3.5422 - 3.5425 in.)	Blue	90.00 - 90.01 mm (3.5434 - 3.5437 in.)	0.02 - 0.04 mm (0.0008-- 0.0015 in.)

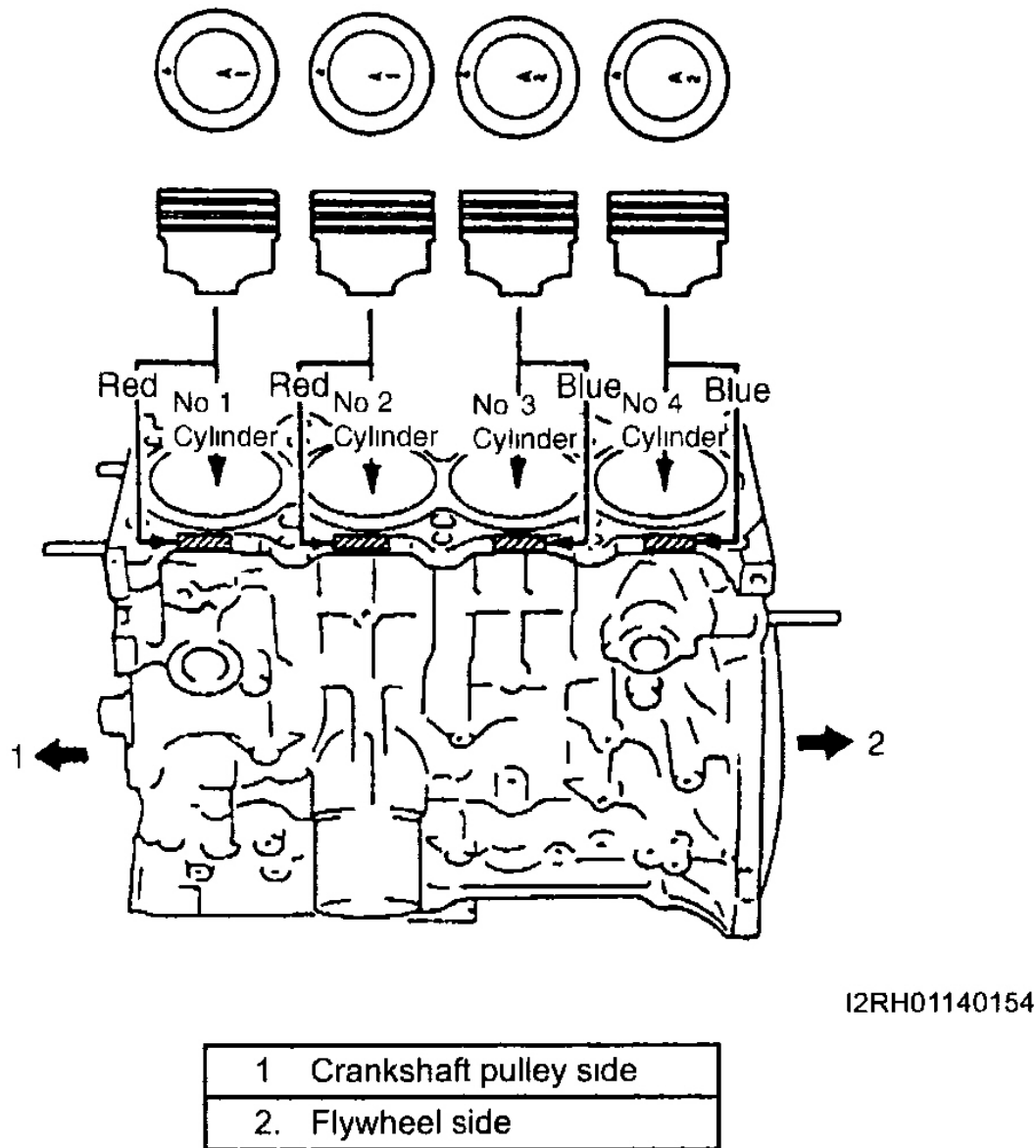
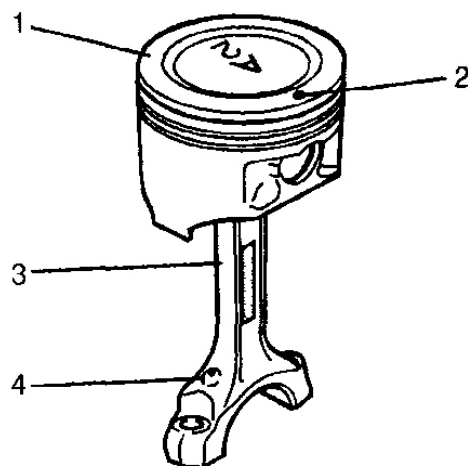


Fig. 159: Aligning Stamped Number On Piston And Stamped Mark On Cylinder Block
 Courtesy of SUZUKI OF AMERICA CORP.

4. Install piston pin to piston (1) and connecting rod (3): After applying engine oil to piston pin and piston pin holes in piston and connecting rod, fit connecting rod to piston as shown in figure and insert piston pin to piston and connecting rod, and install piston pin circlips.

NOTE: Oil hole (4) come on intake side.

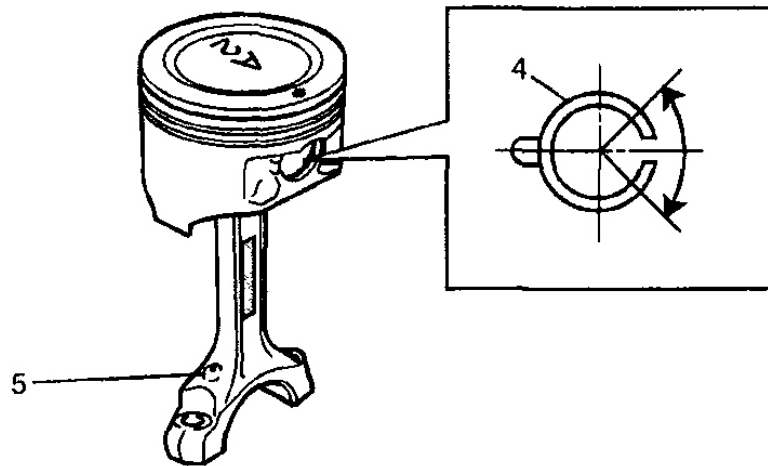


I4RH01140038

2	Front mark
4.	Oil hole

Fig. 160: Installing Connecting Rod To Piston
Courtesy of SUZUKI OF AMERICA CORP.

NOTE: Circlip (4) should be installed so that circlip end gap comes within such range as indicated by arrow.



I4RH01140039

1 Piston	3 Connecting rod
2. Front mark	5. Oil hole

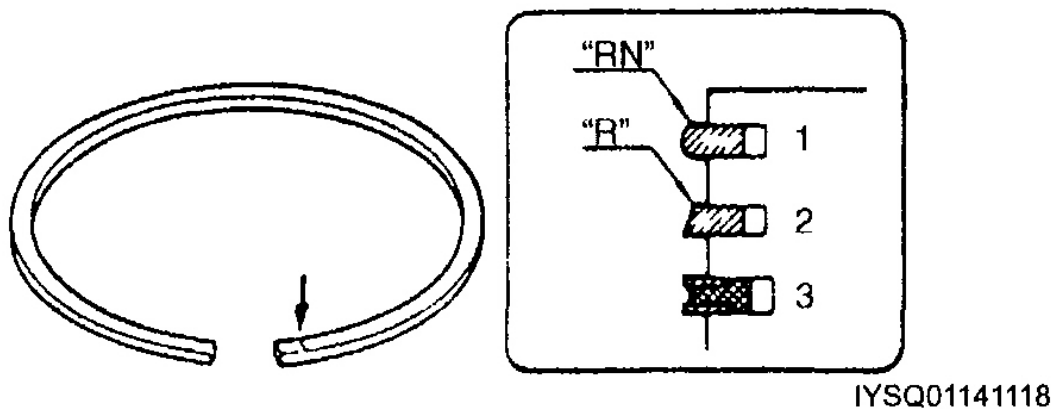
Fig. 161: Installing Piston Pin Circlip
Courtesy of SUZUKI OF AMERICA CORP.

5. Install piston rings to piston:

- As indicated in figure at the left, 1st and 2nd rings have "RN" or "R" mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
- 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall.

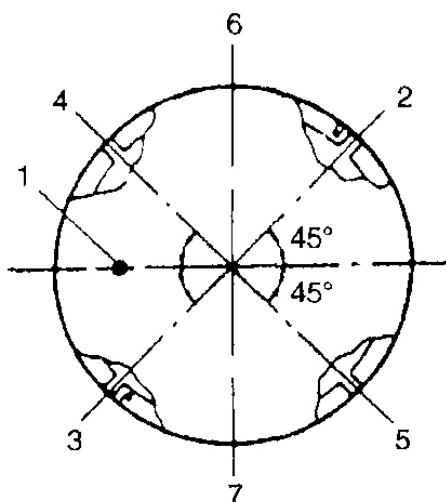
Distinguish 1st ring from 2nd ring by referring to figure.

- When installing oil ring (3), install spacer first and then two rails.

**Fig. 162: Identifying Piston Ring**

Courtesy of SUZUKI OF AMERICA CORP.

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



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

Fig. 163: Identifying Piston Rings End Gap

Courtesy of SUZUKI OF AMERICA CORP.

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

Inspection

Cylinder

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

If any of following conditions is noted, rebore cylinder.

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

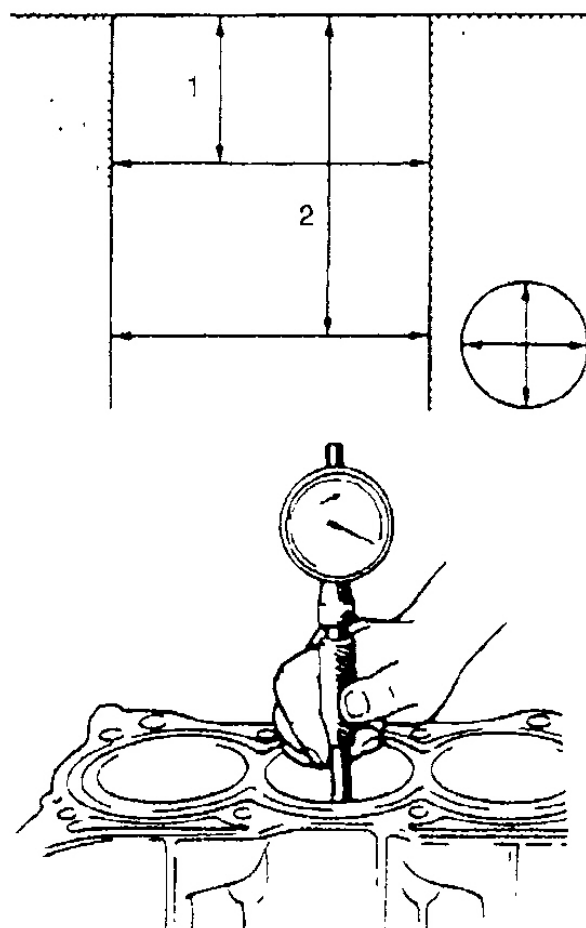
Cylinder bore diameter limit

90.050 mm (3.5433 in.)

Taper and out-of-round limit

0.10 mm (0.004 in.)

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



I5RH01140012

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

Fig. 164: Checking Cylinder Bore Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Pistons

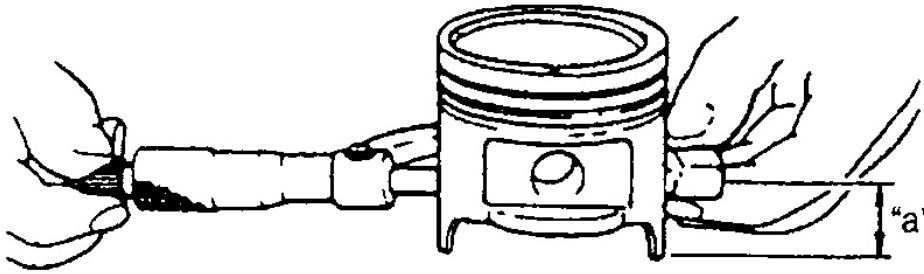
- Inspect piston for faults, cracks or other damages. Damaged or faulty piston should be replaced.
- Piston diameter:

As indicated in figure, piston diameter should be measured at a position 27.5 mm (1.08 in.) ("a") from piston skirt end in the direction perpendicular to piston pin.

Piston diameter

PISTON DIAMETER SPECIFICATION

Standard	89.970 - 89.990 mm (3.5422 - 3.5429 in.)
Oversize: 0.50 mm (0.0196 in.)	90.470 - 90.490 mm (3.5619--3.5626 in.)



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Fig. 165: Checking Piston Diameter
 Courtesy of SUZUKI OF AMERICA CORP.

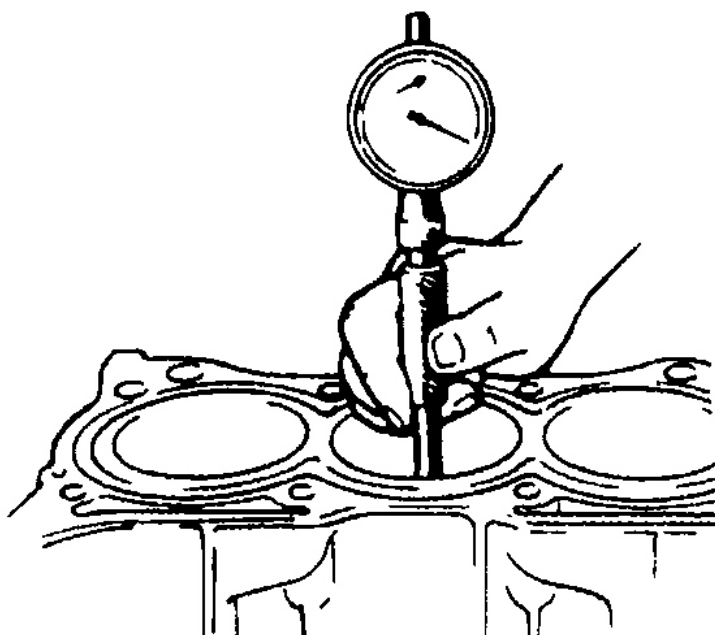
- Piston clearance:

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

Piston clearance

0.02 - 0.04 mm (0.0008 - 0.0015 in.)

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



I2RH01140158

Fig. 166: Checking Cylinder Bore Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- Ring groove clearance:

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

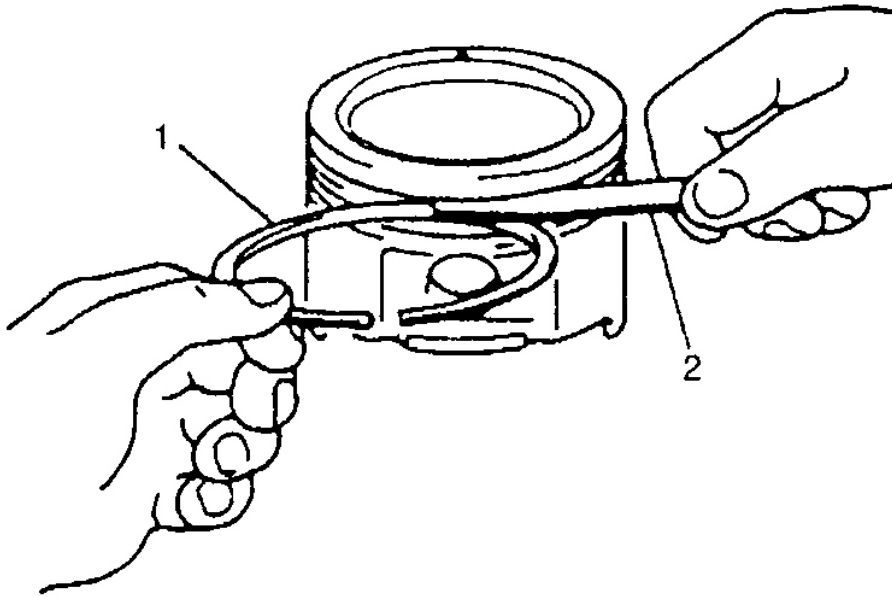
Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2).

If clearance is out of specification, replace piston.

Ring groove clearance

Top: 0.03 - 0.07 mm (0.0012 - 0.0027 in.)

2nd: 0.02 - 0.06 mm (0.0008 - 0.0023 in.)



I2RH01140159

Fig. 167: Checking Piston Ring Groove Clearance
Courtesy of SUZUKI OF AMERICA CORP.

Piston pin

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

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

Piston pin clearance in small end (standard)

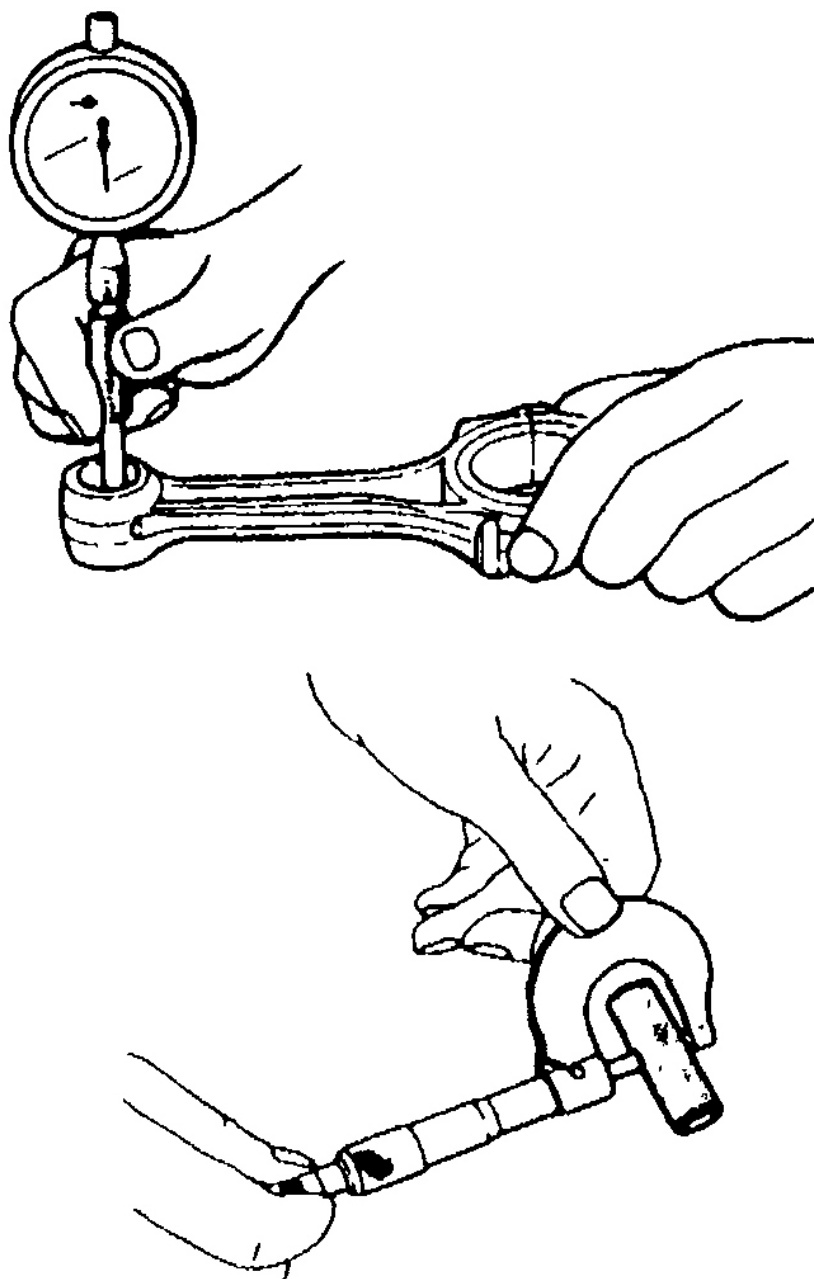
0.003 - 0.014 mm (0.0001 - 0.0005 in.)

Small-end bore

21.003 - 21.011 mm (0.8269 - 0.8272 in.)

Piston pin diameter

20.997 - 21.000 mm (0.8267 - 0.8268 in.)



I5RH01140013

Fig. 168: Checking Piston Pin Clearance In Small End And Piston Pin Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Piston rings

2005 Suzuki Aerio S

2005 ENGINE Engine Mechanical - Aerio

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

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

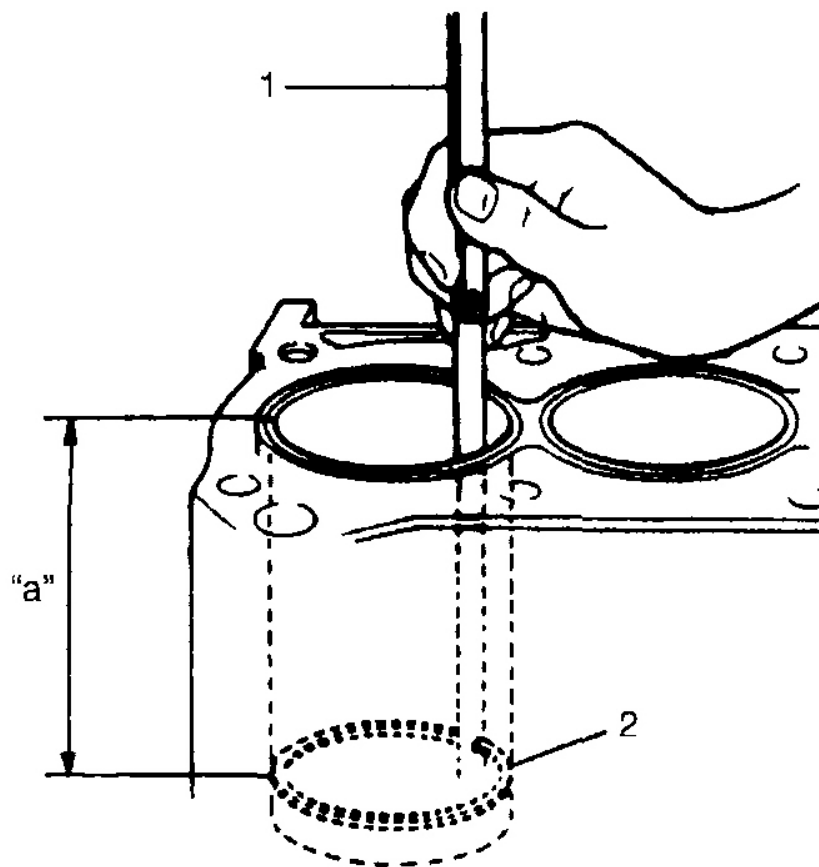
Piston ring end gap

PISTON RING END GAP SPECIFICATION

Item	Standard	Limit
Top ring	0.20 - 0.32 mm (0.0079--0.0125 in.)	0.7 mm (0.0276 in.)
2nd ring	0.32 - 0.47 mm (0.0126--0.0185 in.)	0.7 mm (0.0276 in.)
Oil ring	0.20--0.50 mm (0.0079--0.0196 in.)	1.8 mm (0.0709 in.)

Piston rings end gap

"a": 120 mm (4.72 in.)



I2RH01140161

Fig. 169: Checking Piston Ring End Gap
Courtesy of SUZUKI OF AMERICA CORP.

Connecting rod

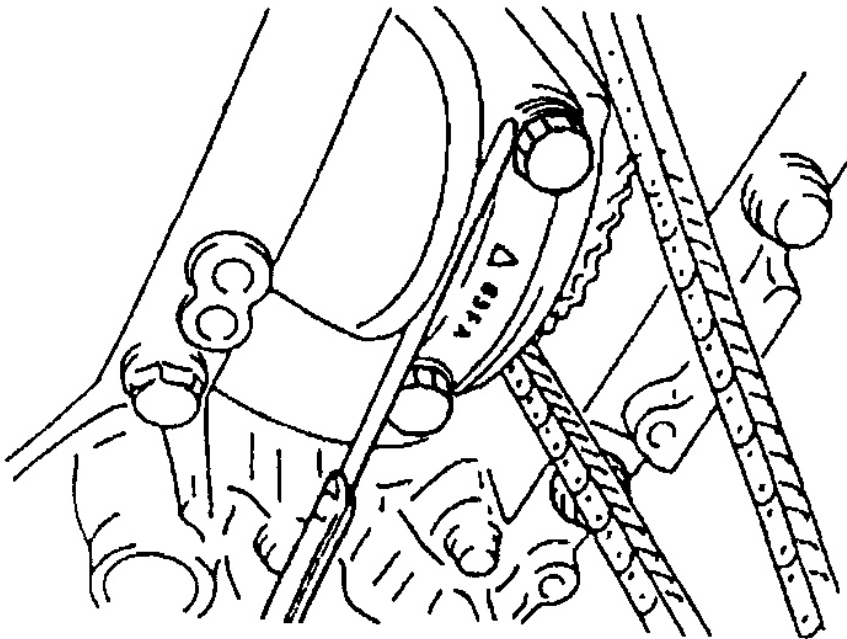
- Big-end side clearance:

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

Big-end side clearance

BIG-END SIDE CLEARANCE SPECIFICATION

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



I4RH01140041

Fig. 170: Checking Big-End Of Connecting Rod For Side Clearance
Courtesy of SUZUKI OF AMERICA CORP.

- Connecting rod alignment:

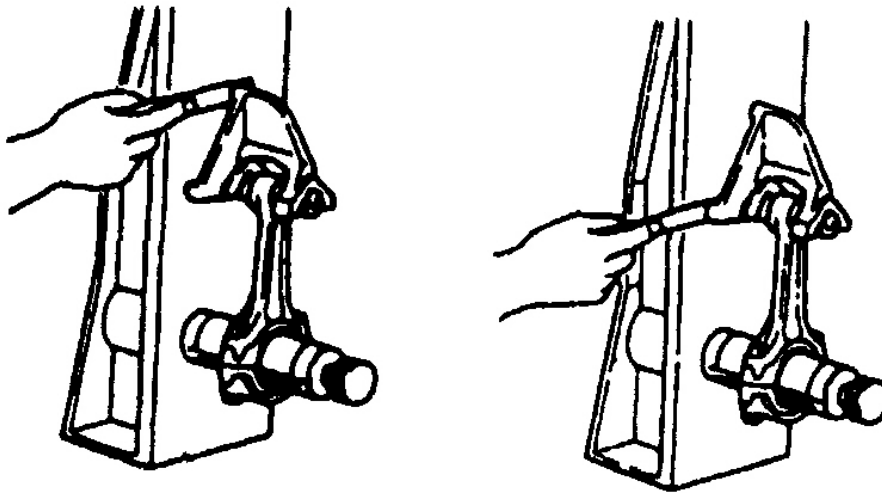
Mount connecting rod on aligner to check it for bow and twist. If limit is exceeded, replace it.

Limit on bow

0.05 mm (0.0020 in.)

Limit on twist

0.10 mm (0.0039 in.)



I4RH01140053

Fig. 171: Aligning Connecting Rod
 Courtesy of SUZUKI OF AMERICA CORP.

Crank pin and connecting rod bearings

- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged, or out-of round or taper is out of limit, replace crankshaft or regrind crank pin referring to the following step 6).

Connecting rod bearing and crank pin

CONNECTING ROD BEARING AND CRANK PIN SPECIFICATION

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

Out-of-round

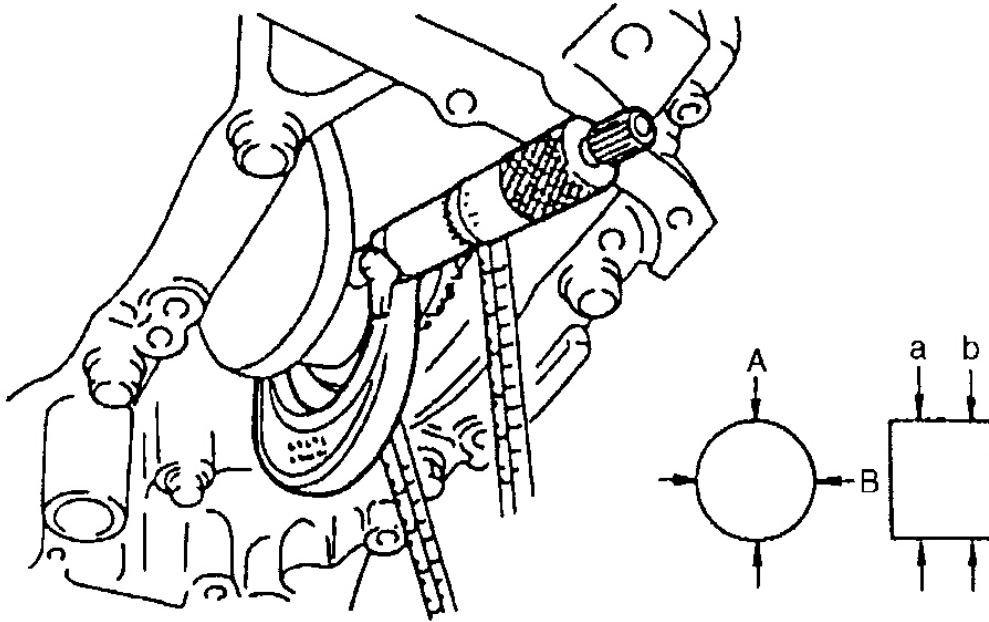
"A" - "R"

Taper

"a" - "b"

Out-of-round and taper limits

0.01 mm (0.0004 in.)

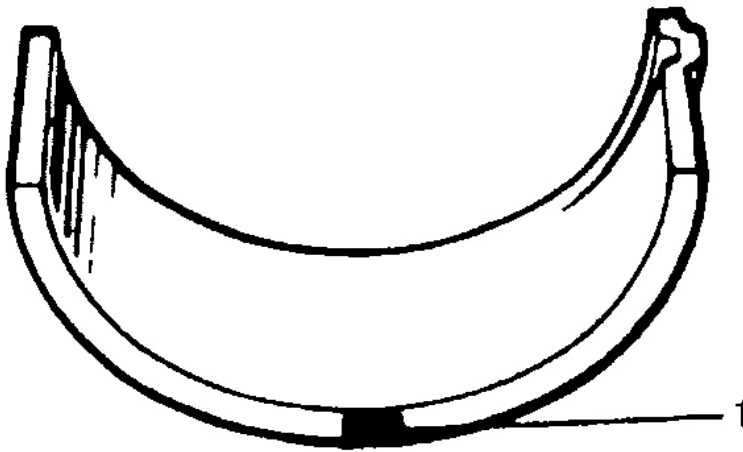


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Fig. 172: Measuring Crank Pin For Out-Of-Round Or Taper With Micrometer
 Courtesy of SUZUKI OF AMERICA CORP.

- **Connecting rod bearing general information:**

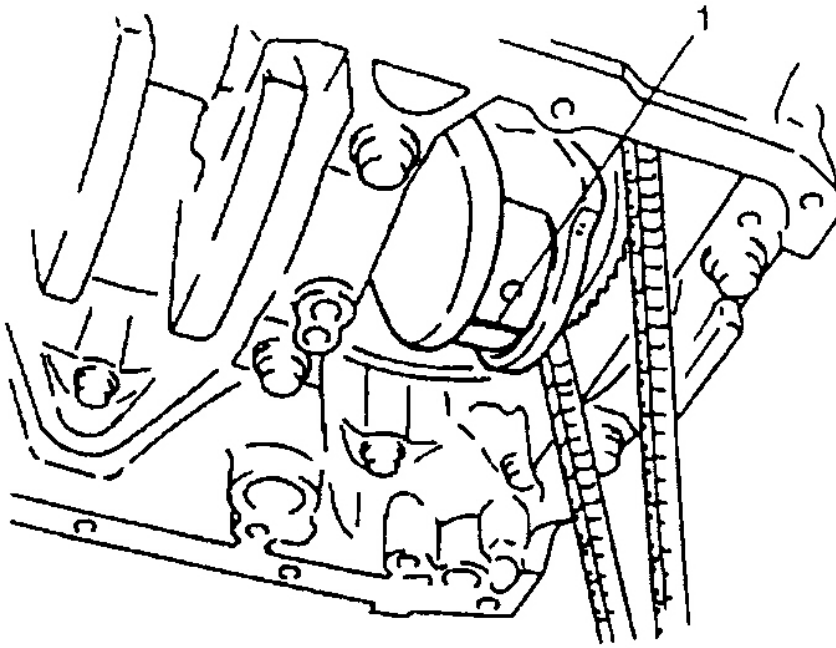
Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced. Two kinds of connecting rod bearings are available; standard size bearing and 0.25 mm (0.0098 in.) undersize bearing. For identification of undersize bearing, it is painted red (1) at the position as indicated in the figure, undersize bearing thickness is 1.605 - 1.615 mm (0.0632--0.0635 in.) at the center of it.



I2RH01140164

Fig. 173: Identifying Connecting Rod Bearing
Courtesy of SUZUKI OF AMERICA CORP.

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



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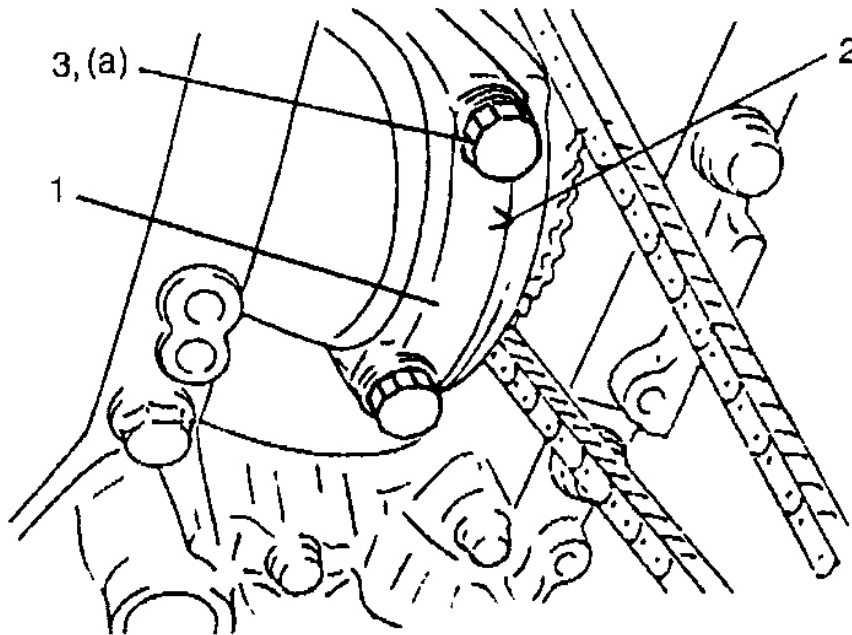
Fig. 174: Placing Piece Of Gauging Plastic To Full Width Of Crank Pin
Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque

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

NOTE: DO NOT turn crankshaft with gauging plastic installed.



I4RH01140037

Fig. 175: Tightening Connecting Rod Cap Bolts
Courtesy of SUZUKI OF AMERICA CORP.

- e. Remove connecting rod bearing cap, and using a scale (2) on gauging plastic envelope, measure gauging plastic (1) width at the widest point (clearance).

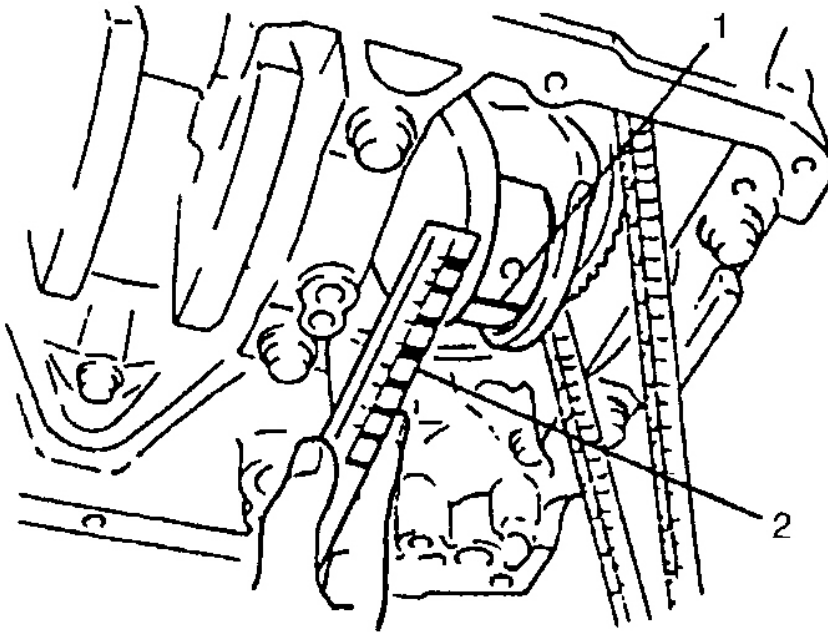
If clearance exceeds its limit, select connecting rod bearing referring to "**PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS INSPECTION AND CLEANING:**" below mentioned item.

After selecting new bearing, recheck clearance.

Bearing clearance

BEARING CLEARANCE SPECIFICATION

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



I2RH01140167

Fig. 176: Measure Gauging Plastic Width At Widest Point
Courtesy of SUZUKI OF AMERICA CORP.

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

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

- Confirm that bearing clearance is within the standard value.

NOTE: After checking the connecting rod bearing clearance, make sure that checking for "Connecting rod bolt deformation".

- Selection of connecting rod bearings:

NOTE:

- If bearing is in malcondition or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.

- **When replacing crankshaft or connecting rod and its bearing due to any reason, select new standard bearings to be installed referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No. 3 cylinder.**

- a. Check stamped numbers on connecting rod and its cap as shown.

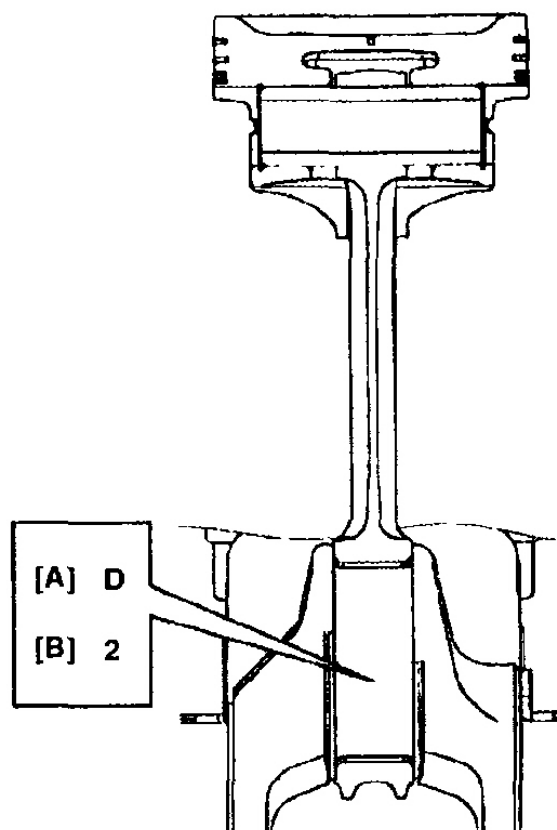
Three kinds of numbers ("1", "2" and "3") represent the following connecting rod big end inside diameters.

For example, stamped number "1" indicates that corresponding connecting rod big-end inside diameter is 53.0000 - 53.0060 mm (2.0867 - 2.0868 in.).

Connecting rod big-end inside diameter

CONNECTING ROD BIG-END INSIDE DIAMETER SPECIFICATION

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



I2RH01140210

[A]: Weight indication mark
[B]: Connecting rod big-end inside diameter number

Fig. 177: Identifying Connecting Rod Big-End Inside Diameter Number
Courtesy of SUZUKI OF AMERICA CORP.

- b. Next, check crank pin diameter. On crank web of No. 3 cylinder, four alphabets are stamped as shown in the figure.

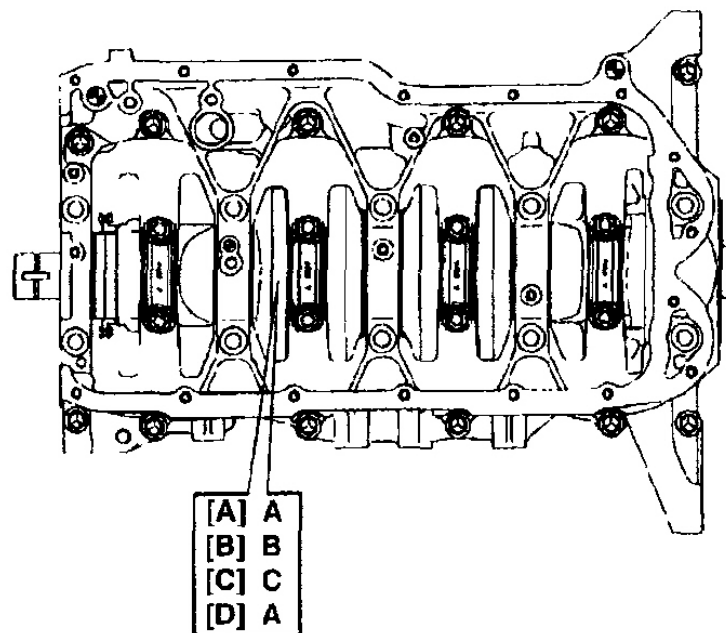
Three kinds of alphabet ("A", "B" and "C") represent the following crank pin diameter respectively.

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

Crank pin diameter

CRANK PIN DIAMETER SPECIFICATION

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



I4RH01140044

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

Fig. 178: Identifying Crank Pin Diameter Measuring Location
 Courtesy of SUZUKI OF AMERICA CORP.

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

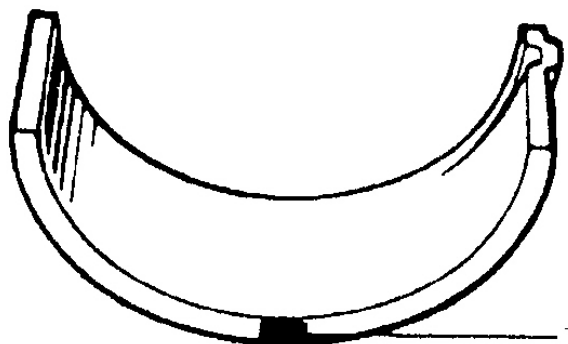
Each color indicated the following thickness at the center of bearing.

Standard size of connecting rod bearing thickness

CONNECTING ROD BEARING STANDARD SIZE THICKNESS SPECIFICATION

Color painted	Bearing thickness>
---------------	--------------------

Blue	1.494--1.497 mm (0.05882 - 0.05893 in.)
Yellow	1.491 - 1.494 mm (0.05871 - 0.05881 in.)
Nothing	1.488--1.491 mm (0.05859 - 0.05870 in.)
Black	1.485--1.488 mm (0.05847 - 0.05858 in.)
Green	1.482--1.485 mm (0.05835 - 0.05846 in.)



IYSQ01141169

1. Paint

Fig. 179: Identifying Paint On Bearing Represent Thickness
Courtesy of SUZUKI OF AMERICA CORP.

- d. From number stamped on connecting rod and its cap and alphabet stamped on crank web No. 3 cylinder, determine new standard bearing to be installed to connecting rod big-end inside, by referring to the table.

For example, if number stamped on connecting rod and its cap is "1" and alphabet stamped on crank web No. 3 cylinder is "B", install a new standard bearing painted in "Black" to its connecting rod big-end inside.

Specifications of new standard connecting rod bearing size

CONNECTING ROD BEARING STANDARD SIZE SPECIFICATION

		Number stamped on connecting rod and its cap (Connecting rod big end inside diameter)>		
		1	2	3
Alphabet stamped on crank web of No. 3 cylinder (Crank pin diameter)	A	Green	Black	Nothing
	B	Black	Nothing	Yellow
	C	Nothing	Yellow	Blue
		New standard bearing to be installed.		

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

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

- **Connecting rod bolt deformation**

Measure each thread diameter of connecting rod bolts (1) at "A" on 28.5 mm (1.12 in.) from bolt mounting surface and "B" on 42.0 mm (1.65 in.) from bolt mounting surface by using a micrometer (2). Calculate difference in diameters ("A" - "B"). If it exceeds limit, replace connecting rod.

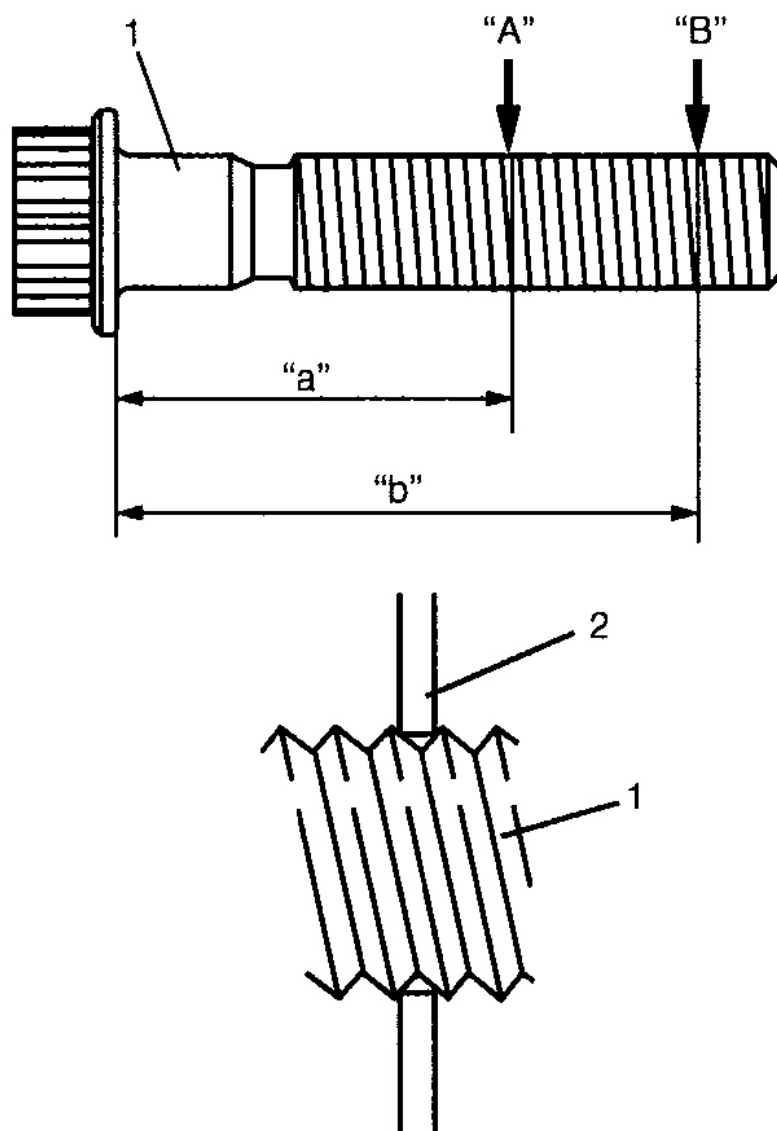
Connecting rod bolt measurement points

"a": 28.5 mm (1.12 in.)

"b": 42.0 mm (1.65 in.)

Connecting rod bolt diameter difference

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



I4RH01140043

Fig. 180: Identifying Thread Diameter Of Connecting Rod Bolts
Courtesy of SUZUKI OF AMERICA CORP.

Cleaning

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

MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK COMPONENTS



"a" 3 mm (0.12 in.)	7. Thrust bearing	15. Crankcase bolt (10 mm thread diameter)
"b". 2 mm (0.08 in.)	8. Rear oil seal	16. Crankcase bolt (8 mm thread diameter)
1. Cylinder block	9. Check valve	 17. Flywheel mounting bolt "See "C"
 2. Lower crankcase "See "A"	10. Flywheel	18. Knock sensor
3. Crankshaft	11. Water pump	 Tightening torque
4. O-ring	12. Heater outlet pipe	 : Do not reuse.
5. Oil pump chain	13. CKP sensor	 . Apply engine oil to inside / sliding surface.
 6. Main bearing "See "B"	14. Oil pump chain guide	
"A": Apply sealant 99000-31250 to mating surface.		
"B": Do not apply engine oil between cylinder block and bearing, between lower crankcase and bearing.		
"C": Apply sealant 99000-31110 to thread part.		

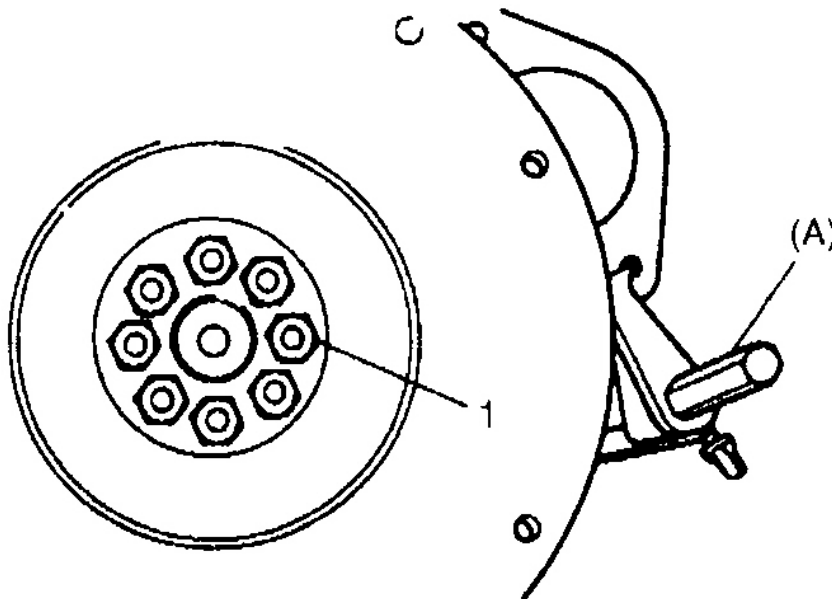
MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION

Removal

1. Remove engine assembly from vehicle. Refer to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".
2. Remove clutch and flywheel (M/T) or drive plate (A/ T). For clutch removal, refer to **CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION** .

Special tool

(A): 09924-17810



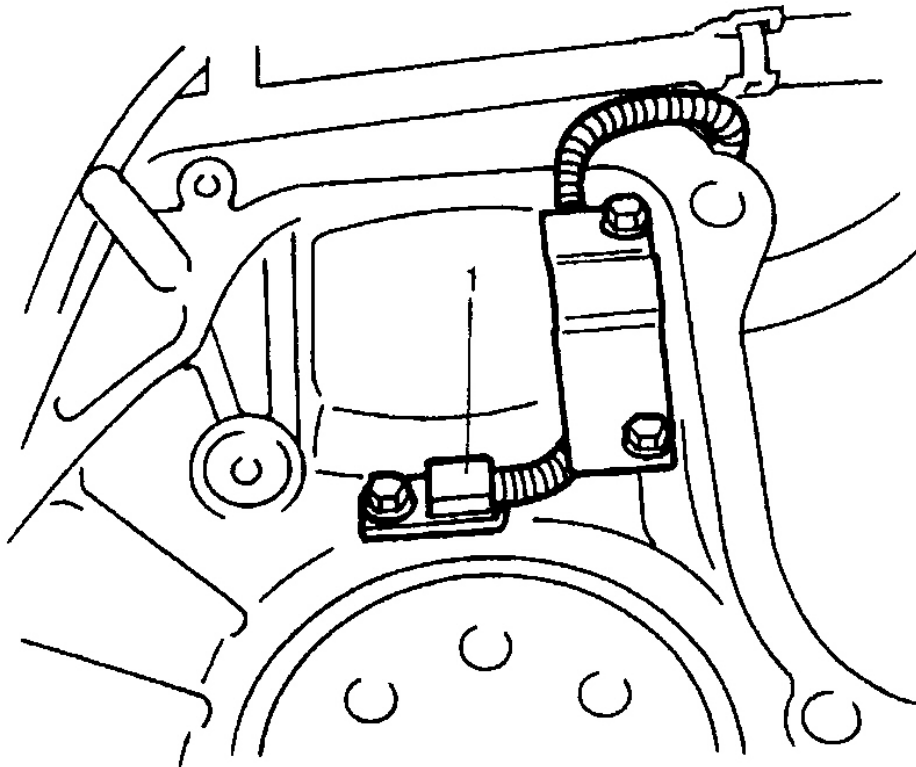
I2RH01140169

1. Flywheel bolt

Fig. 182: Removing Flywheel Bolts
Courtesy of SUZUKI OF AMERICA CORP.

3. Remove throttle body, intake manifold, exhaust manifold.
4. Remove oil pan.
5. Remove oil pump with oil pump strainer.
6. Remove cylinder head cover.
7. Remove timing chain cover. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION:**" for removal.

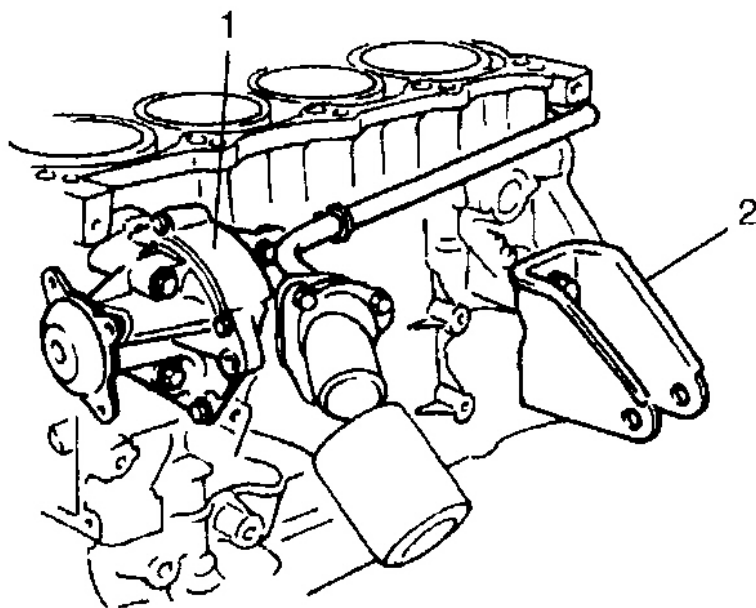
8. Remove timing chain guide, chain tensioner, tensioner adjusters, 2nd timing chain and 1st timing chain.
9. Remove cylinder head assembly.
10. Remove pistons and connecting rods.
11. Remove CKP sensor (1).



I2RH01140170

Fig. 183: Removing CKP Sensor
Courtesy of SUZUKI OF AMERICA CORP.

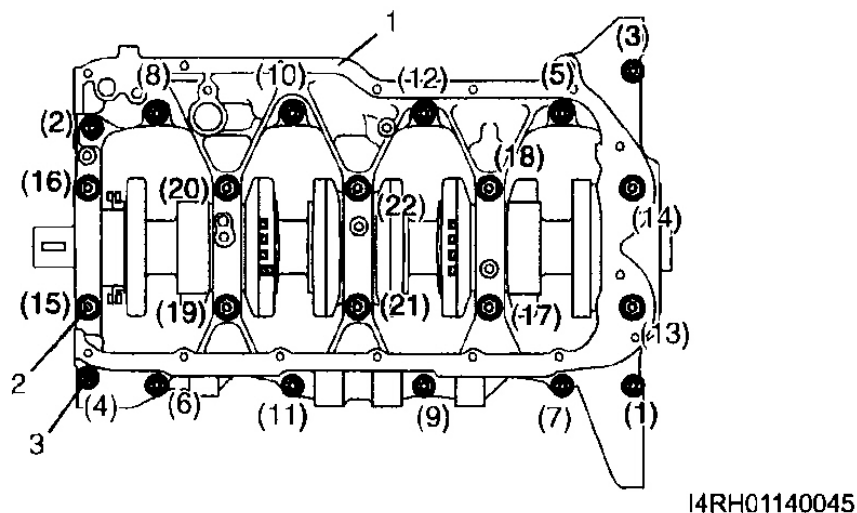
12. Remove water pump (1) and heater outlet pipe.
13. Remove engine front mounting bracket (2).



I2RH01140171

Fig. 184: Removing Engine Front Mounting Bracket
Courtesy of SUZUKI OF AMERICA CORP.

14. Loosen crankcase bolts, in sequence shown in figure and remove them.



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

Fig. 185: Identifying Removal Sequence Of Crankcase Bolts
 Courtesy of SUZUKI OF AMERICA CORP.

15. Remove crankshaft from cylinder block.

Installation

NOTE:

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

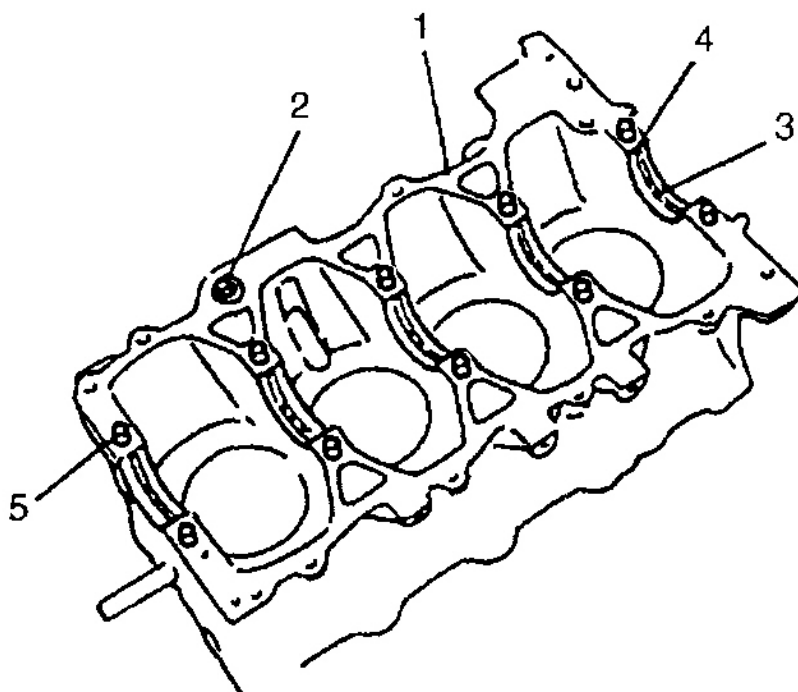
1. Fit main bearings to cylinder block (1).

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

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

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

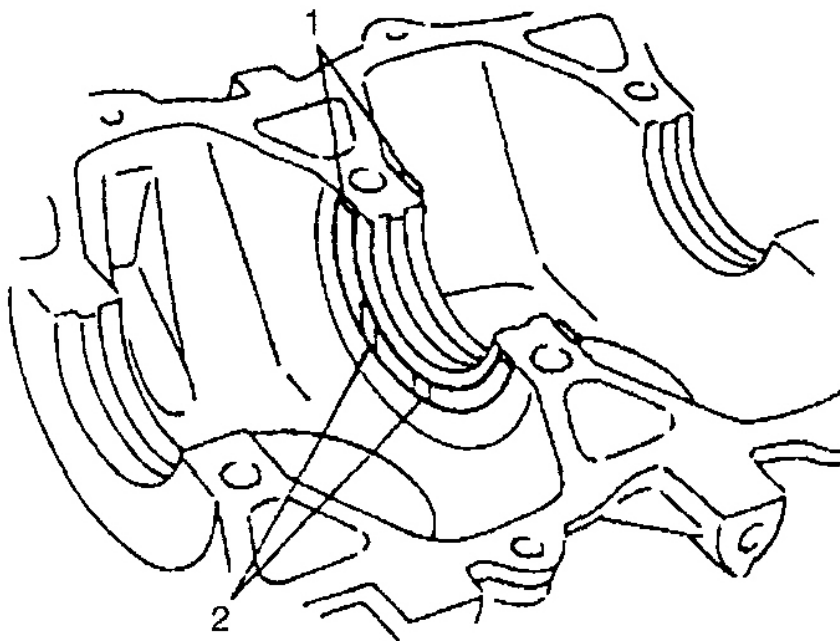
2. Install new O-ring (2) to cylinder block.
3. Install knock pins (5) to cylinder block.



I4RH01140055

Fig. 186: Installing Knock Pins To Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

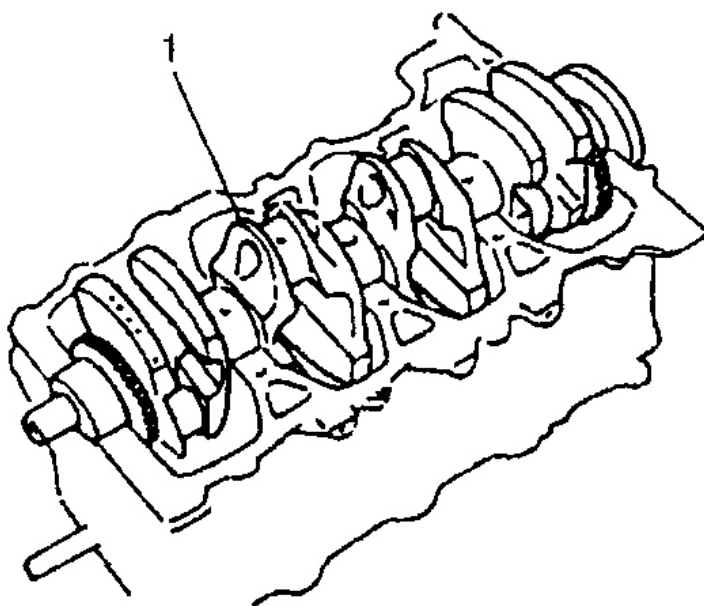
4. Fit thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.



I2RH01140174

Fig. 187: Installing Thrust Bearings To Cylinder Block Between No 2 And No 3 Cylinders
Courtesy of SUZUKI OF AMERICA CORP.

5. Put crankshaft (1) with oil pump chain to cylinder block.



I2RH01140175

Fig. 188: Putting Crankshaft To Cylinder Block
Courtesy of SUZUKI OF AMERICA CORP.

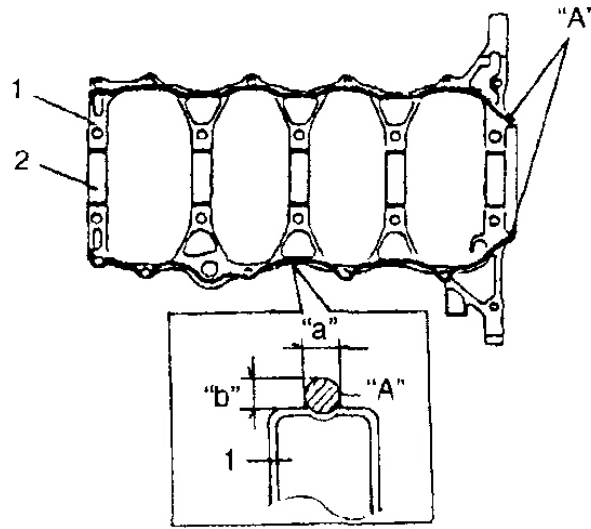
6. Apply sealant "A" to lower crankcase (1) mating surface area as shown in figure.

"A": Sealant 99000-31250

Sealant amount for lower crankcase

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

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



I2RH01140176

2 Bearing

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

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

After applying engine oil to all crankcase bolts ((1) -(22)), tighten them gradually as follows.

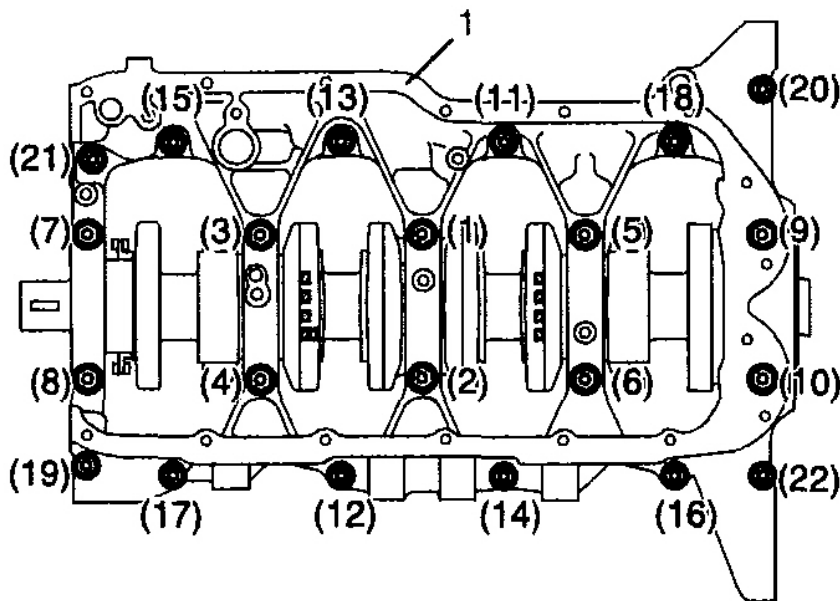
- a. Tighten bolts ((1) - (10)) to 40 N.m (4.0 kg-m, 29.0 lb-ft) according to numerical order as shown.
- b. Loosen bolts ((1) - (10)) until tightening torque is reduced to 0 (zero) in reverse order of tightening.
- c. In the same manner as in step a), tighten them to 40 N.m (4.0 kg-m, 29.0 lb-ft).
- d. In the same manner as in step a), tighten them to the specified torque.
- e. Tighten bolts ((11) - (22)) to the specified torque according to numerical order as shown.

Tightening torque

Crankcase bolt with 10 mm thread diameter ((1) - (10)): 58 N.m (5.8 kg-m, 42.0 lb-ft)

Crankcase bolt with 8 mm thread diameter ((11) - (22)): 25 N.m (2.5 kg-m, 18.0 lb-ft)

NOTE: After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.



I4RH01140046

Fig. 190: Identifying Tightening Sequence Of Crankcase Bolts
Courtesy of SUZUKI OF AMERICA CORP.

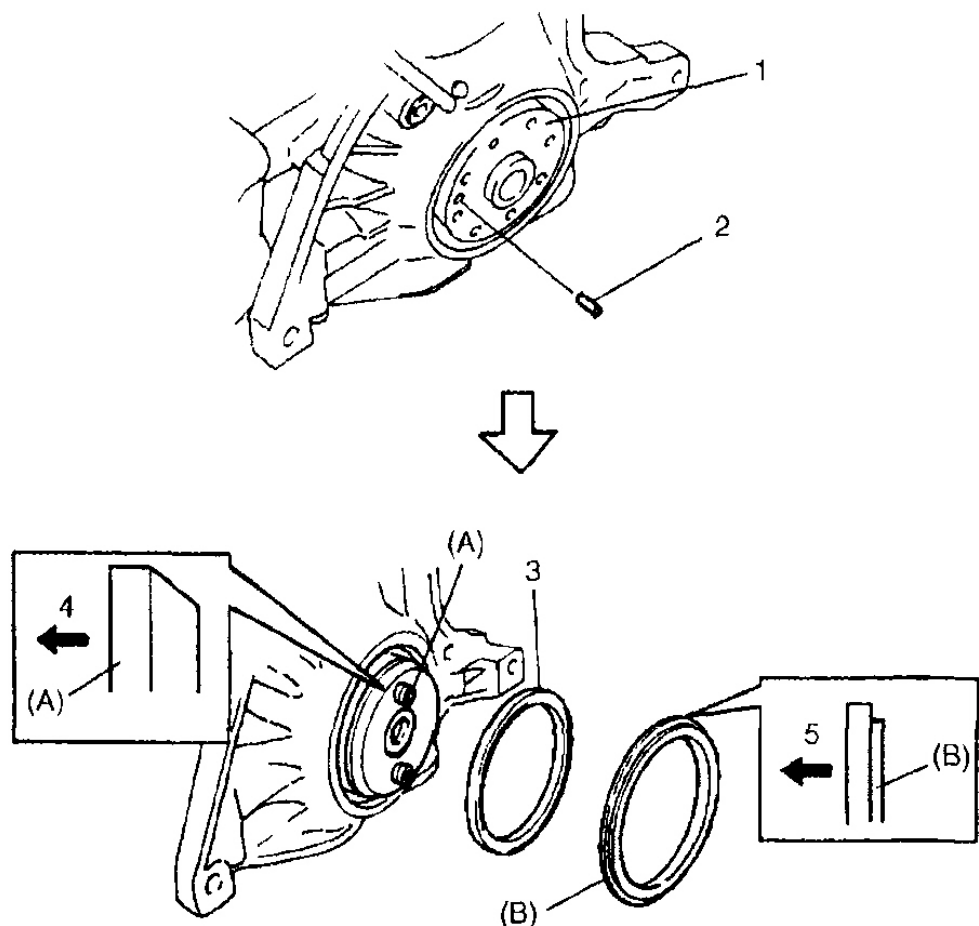
8. Pull out dowel pin (2) from crankshaft (1) and then install rear oil seal (3) by using special tools and plastic hammer.

Special tool

(A): 09911-97710

(B): 09911-97810

9. Install dowel pin.



I5RH01140014

4. Crankshaft side

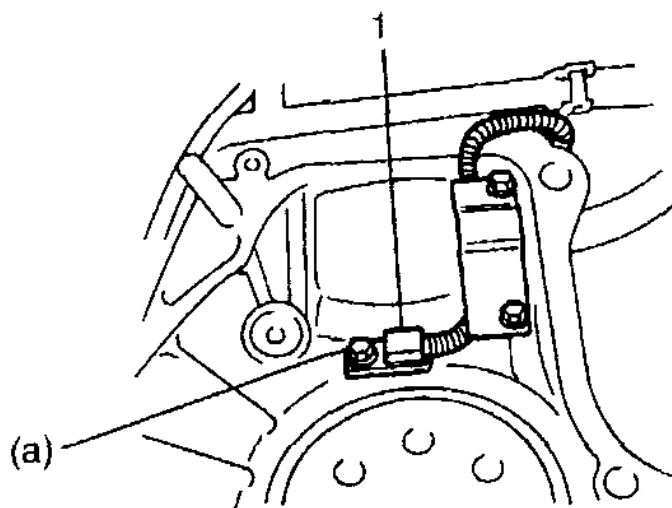
5 Oil seal side

Fig. 191: Installing Rear Oil Seal

Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque**CKP sensor bolt (a): 6 N.m (0.6 kg-m, 4.5 lb-ft)**

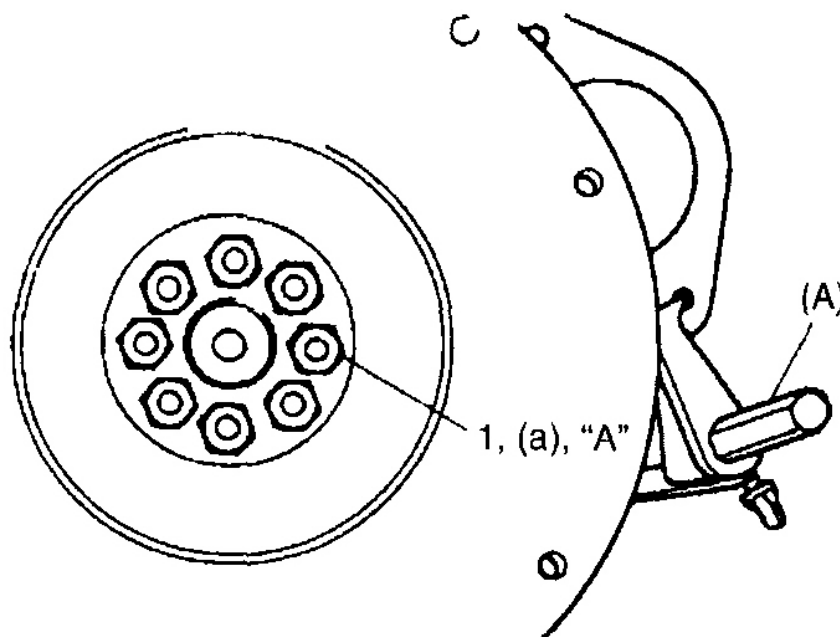


I2RH01140179

Fig. 192: Installing CKP Sensor**Courtesy of SUZUKI OF AMERICA CORP.****11. Install flywheel or drive plate.**

Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts (1) applied with sealant to specification.

"A": Sealant 99000-31110**Special tool****(A): 09924-17810****Tightening torque****Flywheel or drive plate bolt (a): 70 N.m (7.0 kg-m, 51.0 lb-ft)**



I2RH01140180

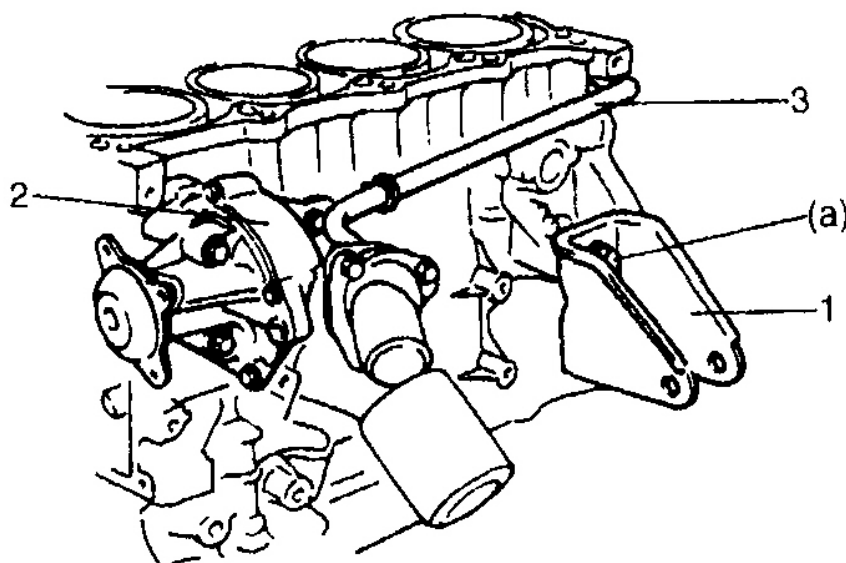
Fig. 193: Tightening Flywheel Or Drive Plate Bolts
Courtesy of SUZUKI OF AMERICA CORP.

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

Tightening torque

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

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



I2RH01140181

Fig. 194: Installing Water Pump And Heater Outlet Pipe
 Courtesy of SUZUKI OF AMERICA CORP.

14. Install pistons and connecting rods. Refer to "**PISTONS, PISTON RINGS, CONNECTING RODS AND CYLINDERS REMOVAL AND INSTALLATION:**".
15. Install oil pump. Refer to **OIL PUMP REMOVAL AND INSTALLATION** .
16. Install cylinder head assembly to cylinder. Refer to "**VALVES AND CYLINDER HEAD REMOVAL AND INSTALLATION:**".
17. Install, timing chain sprockets, timing chains, timing chain tensioners, tensioner adjusters, timing chain guides, timing chain cover, crankshaft pulley, water pump pulley. Refer to "**TIMING CHAIN COVER REMOVAL AND INSTALLATION:**", "**2ND TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION:**" and "**1ST TIMING CHAIN AND CHAIN TENSIONER REMOVAL AND INSTALLATION:**".
18. Install oil pump strainer and oil pan.
19. Install clutch to flywheel (for M/T vehicle). For clutch installation, refer to **CLUTCH COVER, CLUTCH DISC AND FLYWHEEL REMOVAL AND INSTALLATION** .
20. Install engine assembly to vehicle. Refer to "**ENGINE ASSEMBLY REMOVAL AND INSTALLATION:**".

MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK INSPECTION

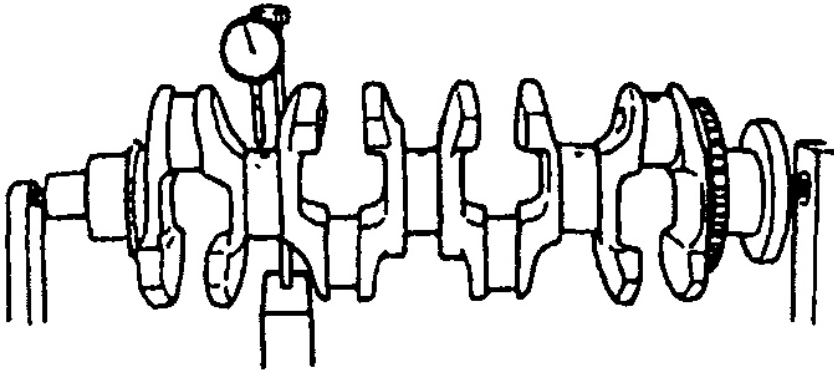
Crankshaft

Crankshaft runout

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

Limit on runout

0.06 mm (0.0023 in.)



I2RH01140182

Fig. 195: Checking Crankshaft Runout
Courtesy of SUZUKI OF AMERICA CORP.

Crankshaft thrust play

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

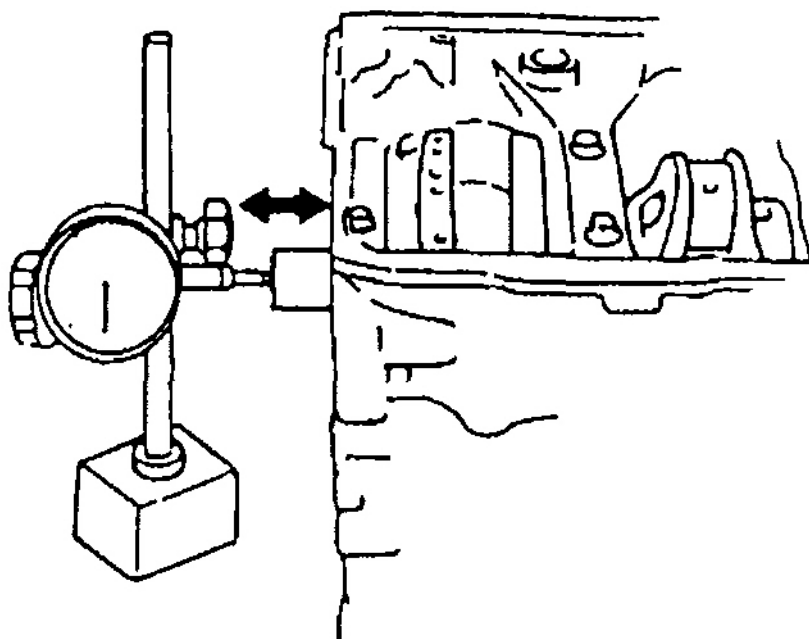
Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

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

Crankshaft Thrust Play

Standard: 0.10 - 0.35 mm (0.0039 - 0.0138 in.)

Limit: 0.42 mm (0.0149 in.)



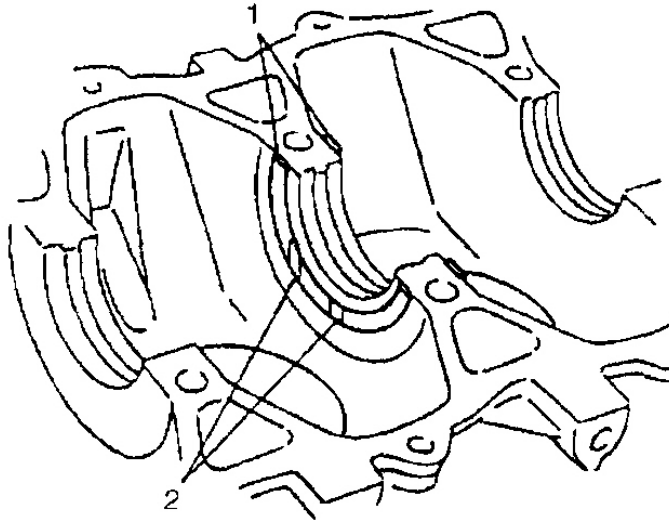
I2RH01140183

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

Thickness of crankshaft thrust bearing

CRANKSHAFT THRUST BEARING THICKNESS SPECIFICATION

Standard	2.425 - 2.475 mm (0.0955 - 0.0974 in.)
Oversize: 0.125 mm (0.0049 in.)	2.488 - 2.538 mm (0.0980 - 0.0999 in.)



I2RH01140184

1	Thrust bearing
2	Oil groove

Fig. 197: Installing Thrust Bearing

Courtesy of SUZUKI OF AMERICA CORP.

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

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

Limit on out-of-round and taper

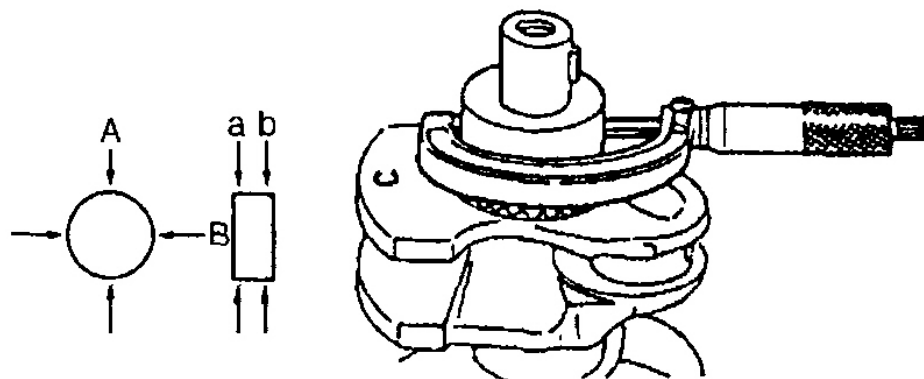
0.01 mm (0.0004 in.)

Out-of-round

"A" - "B"

Taper

"a" - "b"



I2RH01140185

Fig. 198: Checking Out-Of-Round And Taper Diameter Of Journals
 Courtesy of SUZUKI OF AMERICA CORP.

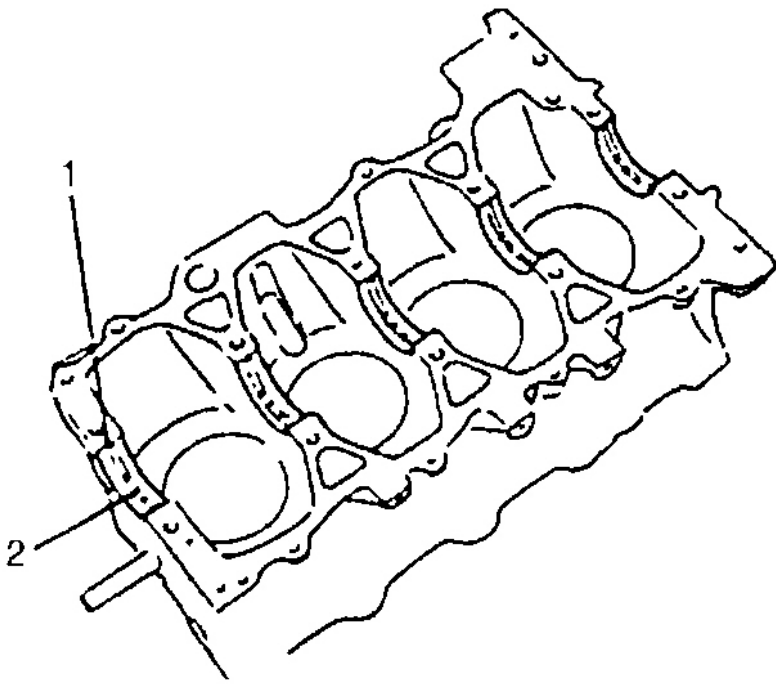
Main Bearings

Main bearings general information

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

Install this half with oil groove to cylinder block.

- Lower half of bearing does not have oil groove.



I2RH01140186

Fig. 199: Identifying Oil Groove Of Bearing
Courtesy of SUZUKI OF AMERICA CORP.

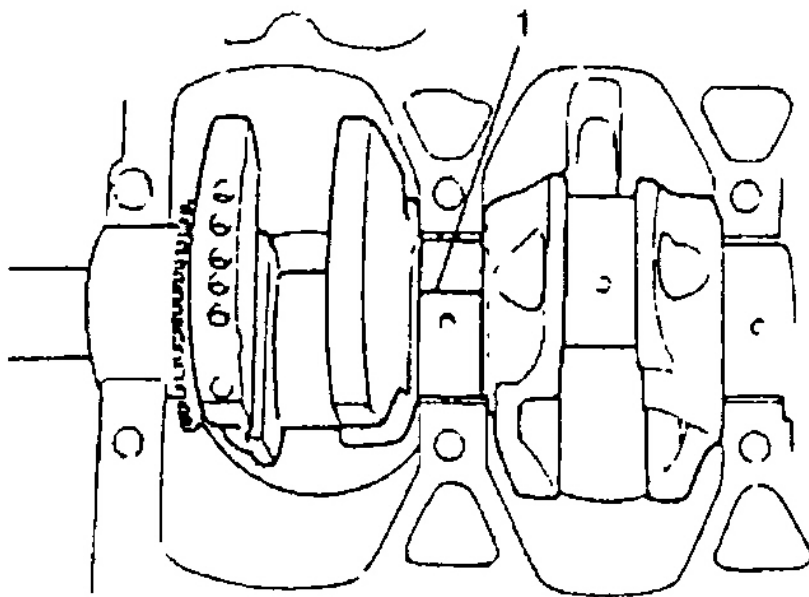
Main bearings inspection

Check bearings for pitting, scratches, wear or damage. If any malcondition is found, replace both upper and lower halves. Never replace either half without replacing the other half.

Main bearing clearance

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

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



I2RH01140187

Fig. 200: Placing Piece Of Gauging Plastic To Full Width Of Bearing On Journal
Courtesy of SUZUKI OF AMERICA CORP.

4. Install lower crankcase to cylinder block referring to "**MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK REMOVAL AND INSTALLATION:**".

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

5. Remove lower crankcase and using scale (2) on gauging plastic envelop (1), measure gauging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.

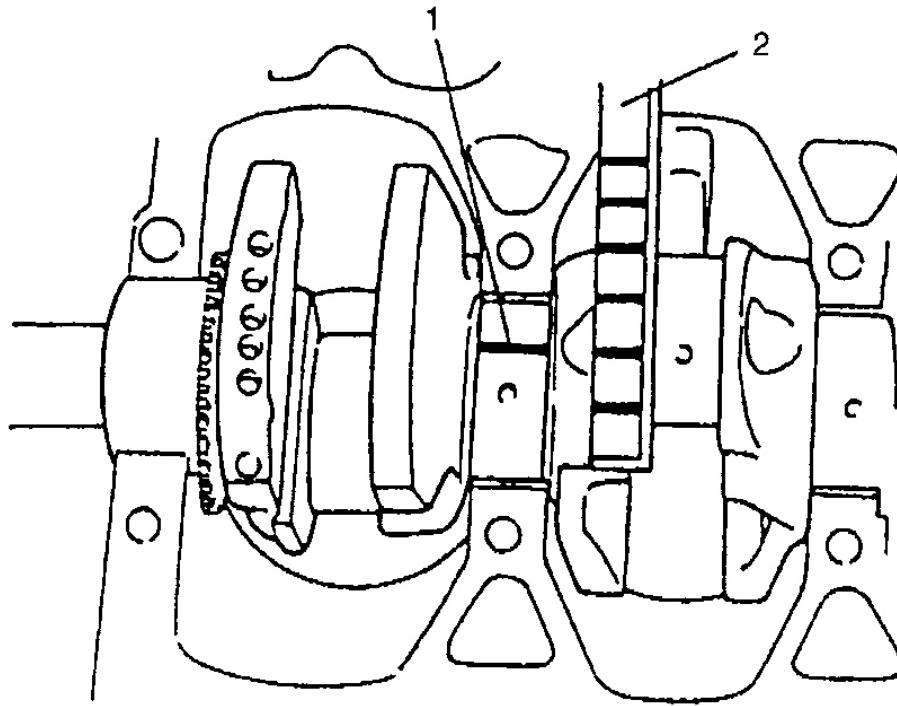
A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.

After selecting new bearing, recheck clearance.

Main Bearing Clearance

Standard: 0.032 - 0.050 mm (0.0013 - 0.0019 in.)

Limit: 0.060 mm (0.0023 in.)



I2RH01140188

Fig. 201: Measuring Gauging Plastic Width At Its Widest Point
 Courtesy of SUZUKI OF AMERICA CORP.

Selection of main bearings

STANDARD BEARING:

If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.

1. First check journal diameter. As shown in figure, crank web No.2 has stamped numbers. Three kinds of numbers ("1", "2" and "3") represent following journal diameters.

Journal diameter

JOURNAL DIAMETER SPECIFICATION

Stamped numbers	Journal diameter>
1	58.0000 - 58.0060 mm (2.2835--2.2837 in.)
2	57.9940 - 57.9999 mm (2.2832 - 2.2834 in.)
3	57.9880 - 57.9939 mm (2.2830 - 2.2832 in.)

Stamped numbers on crank web No.2 (3) represent journal diameters marked with an arrow in figure respectively. For example, stamped number "1" indicates that corresponding journal diameter is 58.0000 - 58.0060 mm (2.2835 - 2.2837 in.).

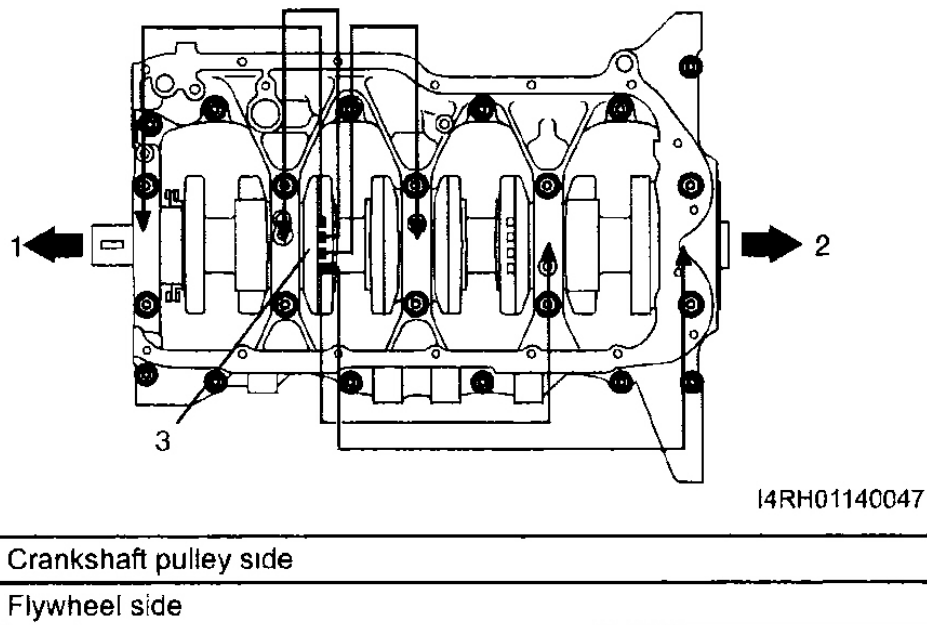


Fig. 202: Checking Journal Diameter
Courtesy of SUZUKI OF AMERICA CORP.

- Next, check crankcase (bearing cap) bore diameter without bearing. On lower crankcase five alphabets are stamped as shown in figure.

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

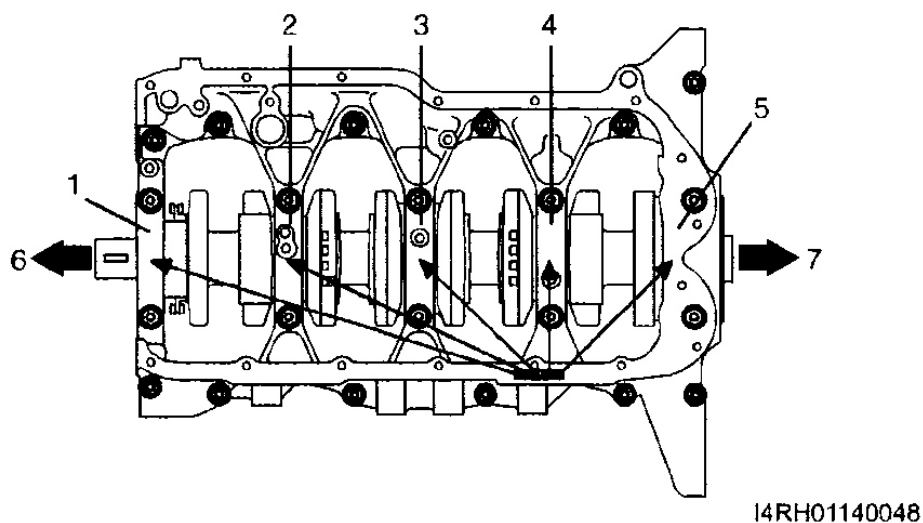
Bore diameter for bearing cap

BEARING CAP BORE DIAMETER SPECIFICATION

Stamped alphabet	A	61.9940--62.0000 mm (2.4407 - 2.4409 in.)
	B	62.0001 - 62.0060 mm (2.4410--2.4411 in.)
	C	62.0061 - 62.0120 mm (2.4412--2.4414 in.)

Stamped alphabets on lower crankcase represent crankcase bore diameter marked with an arrow in figure respectively.

For example, stamped alphabet "A" at bearing cap No.2 indicates that bearing cap bore diameter of bearing cap No.2 is 61.9940 - 62.0000 mm (2.4407 - 2.4409 in.).



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

Fig. 203: Identifying Bearing Caps

Courtesy of SUZUKI OF AMERICA CORP.

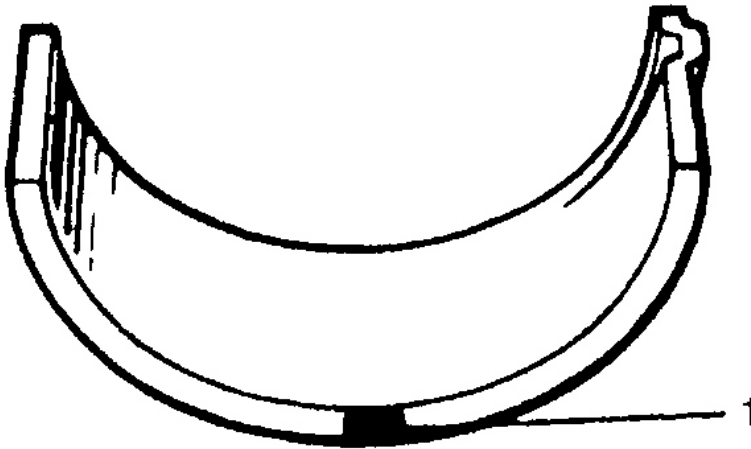
3. There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted (1) in the following colors at the position as indicated in figure.

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

Standard size main bearing thickness

STANDARD SIZE MAIN BEARING THICKNESS SPECIFICATION

Color painted	Bearing thickness
Green	1.991--1.994 mm (0.0784 - 0.0785 in.)
Black	1.994--1.997 mm (0.0785--0.0786 in.)
Colorless (no paint)	1.997--2.000 mm (0.0786--0.0787 in.)
Yellow	2.000 - 2.003 mm (0.0787 - 0.0788 in.)
Blue	2.003 - 2.006 mm (0.0788 - 0.0789 in.)



I2RH01140191

Fig. 204: Identifying Paint Mark On Bearing
 Courtesy of SUZUKI OF AMERICA CORP.

4. From number stamped on crank web No.2 and alphabets stamped on lower crankcase, determine new standard bearing to be installed to journal, by referring to table shown.

For example, if number stamped on crank web No.2 is "1" and alphabet stamped on lower crankcase is "B", install a new standard bearing painted in "Black" to its journal.

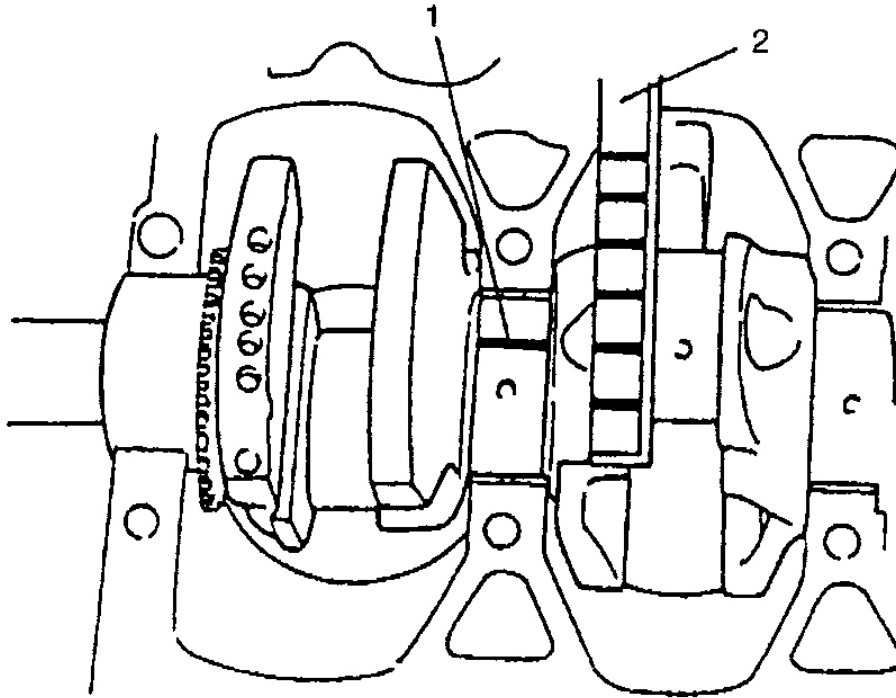
New standard size bearing specification

STANDARD SIZE BEARING SPECIFICATION

		Number stamped on connecting rod and its cap (Connecting rod big end inside diameter)>		
		1	2	3
Alphabet stamped on lower crankcase (Cap bore diameter)	A	Green	Black	Colorless
	B	Black	Colorless	Yellow
	C	Colorless	Yellow	Blue

5. Using gauging plastic (1) and scale (2), check bearing clearance with newly selected standard bearing.

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



I2RH01140188

Fig. 205: Checking Bearing Clearance
 Courtesy of SUZUKI OF AMERICA CORP.

6. When replacing crankshaft or cylinder block and lower crank case due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new lower crankcase.

UNDERSIZE BEARING (0.25 mm):

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

To distinguish them, each bearing is painted (1) in the following colors at such position as indicated in figure.

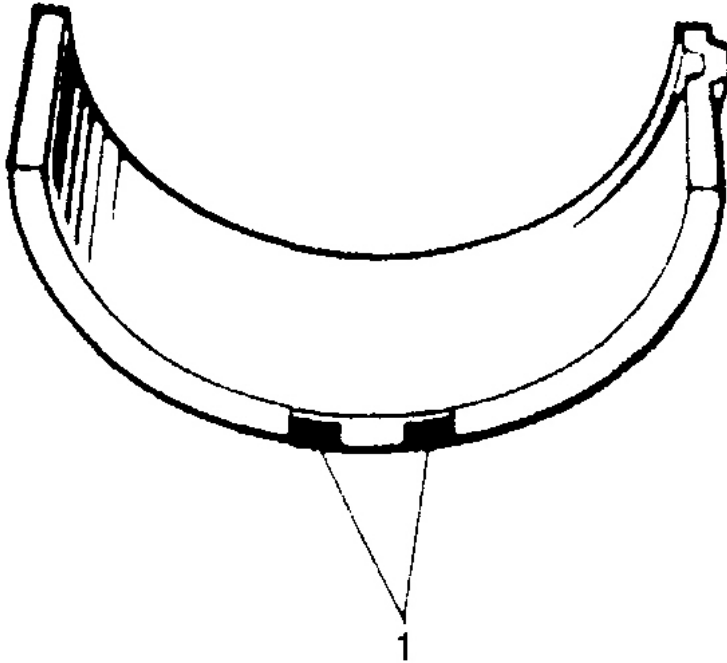
Each color represents the following thickness at the center of bearing.

Undersize main bearing thickness

UNDERSIZE MAIN BEARING THICKNESS SPECIFICATION

Color painted	Bearing thickness>
Green & Red	2.116--2.119 mm (0.0833 - 0.0834 in.)

Black & Red	2.119--2.122 mm (0.0834 - 0.0835 in.)
Red only	2.122--2.125 mm (0.0835 - 0.0836 in.)
Yellow & Red	2.125--2.128 mm (0.0836 - 0.0837 in.)
Blue & Red	2.128--2.131 mm (0.0837 - 0.0838 in.)



I2RH01140192

Fig. 206: Identifying Paint Mark On Bearing
 Courtesy of SUZUKI OF AMERICA CORP.

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

Finished journal diameter

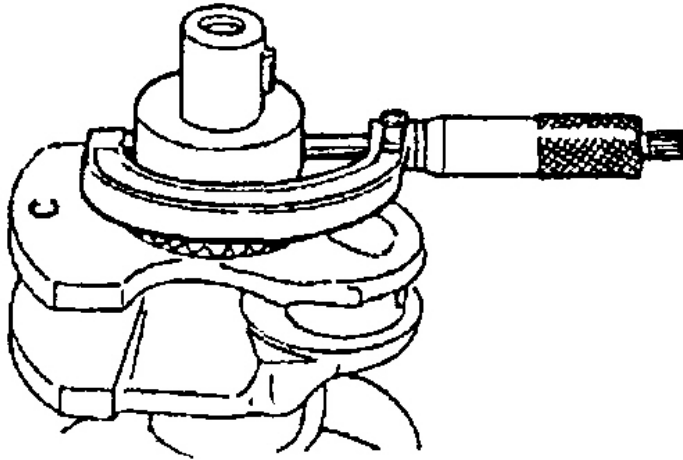
57.7380 - 57.7506 mm (2.2731 - 2.2738 in.)

- b. Using micrometer, measure reground journal diameter.

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

- c. Using journal diameter measured and alphabets stamped on lower crankcase, select an undersize

bearing by referring to the following table. Check bearing clearance with newly selected undersize bearing.



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Fig. 207: Checking Reground Journal Diameter
Courtesy of SUZUKI OF AMERICA CORP.

Undersize bearing specification

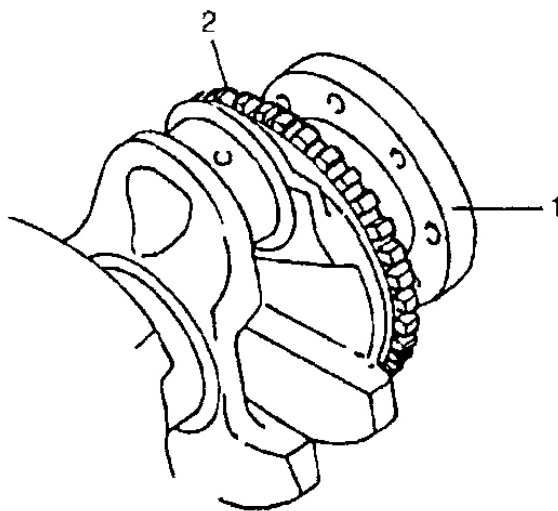
JOURNAL DIAMETER SPECIFICATION

		Measured journal diameter>		
		57.7500 - 57.7506 mm (2.2737 - 2.2738 in.)	57.7440 - 57.7499 mm (2.2734 - 2.2736 in.)	57.7380 - 57.7439 mm (2.2731 - 2.2733 in.)
Alphabets stamped on lower crankcase	A	Green & Red	Black & Red	Red only
	B	Black & Red	Red only	Yellow & Red
	C	Red only	Yellow & Red	Blue & Red

Crankshaft Position Sensor Plate

Check teeth of plate for damage.

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



I2RH01140194

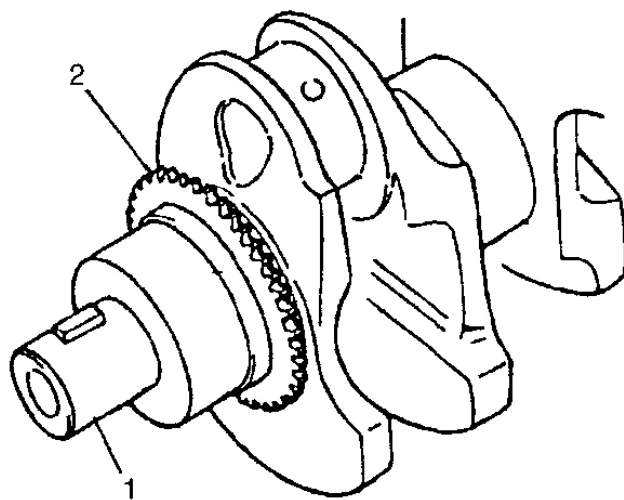
2. Crankshaft position sensor plate

Fig. 208: Identifying Crankshaft Position Sensor Plate Teeth
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pump Sprocket

Check teeth of sprocket for wear or damage.

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



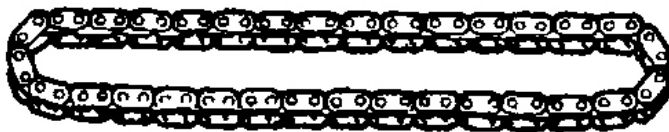
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2. Oil pump sprocket

Fig. 209: Identifying Oil Pump Sprocket Teeth
Courtesy of SUZUKI OF AMERICA CORP.

Oil Pump Chain

Check oil pump chain for wear or damage.



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Fig. 210: Identifying Oil Pump Chain
Courtesy of SUZUKI OF AMERICA CORP.

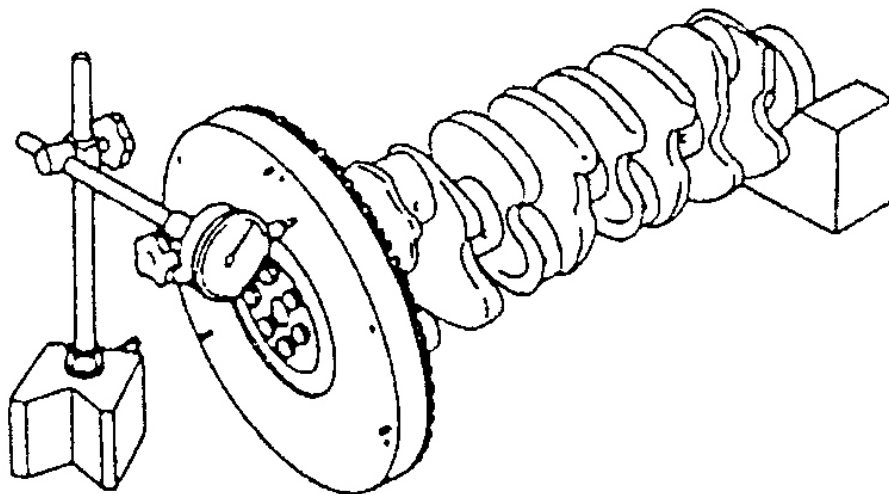
Flywheel

- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.

- Check flywheel for face runout with a dial gauge. If runout exceeds its limit, replace flywheel.

Limit on runout

0.2 mm (0.0078 in.)



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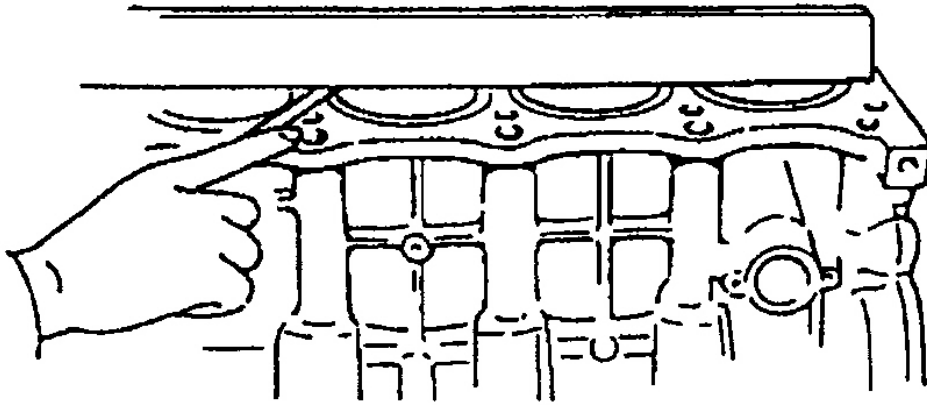
Fig. 211: Checking Flywheel Runout
Courtesy of SUZUKI OF AMERICA CORP.

Cylinder Block

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

Flatness Limit

0.06 mm (0.0024 in.)



I2RH01140199

Fig. 212: Checking Cylinder Block For Distortion And Flatness
 Courtesy of SUZUKI OF AMERICA CORP.

Honing or reboring cylinders

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

Oversize piston specification

OVERSIZE PISTON SPECIFICATION

Size	Piston diameter>
STD	89.970 - 89.990 mm (3.5422 - 3.5429 in.)
O/S 0.50	90.470 - 90.490 mm (3.5619--3.5626 in.)

2. Using micrometer, measure piston diameter.
3. Calculate cylinder bore diameter to be rebored as follows.

$$D = A + B - C$$

D: Cylinder bore diameter to be rebored.

A: Piston diameter as measured.

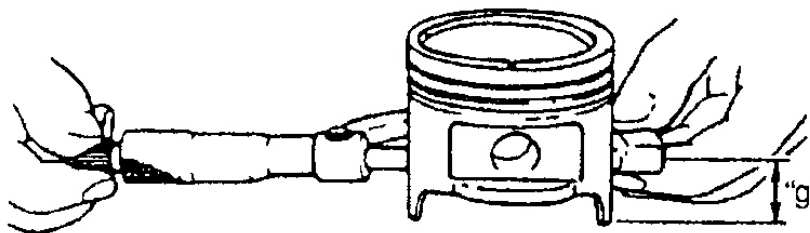
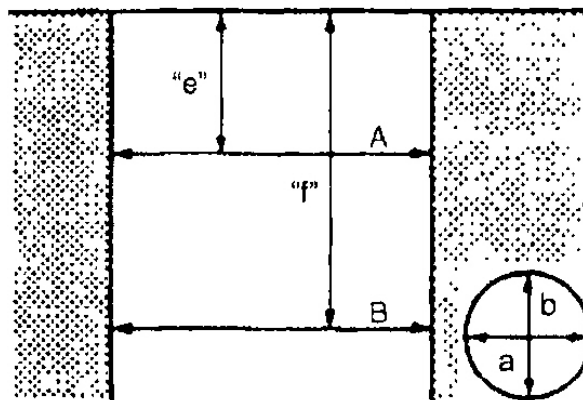
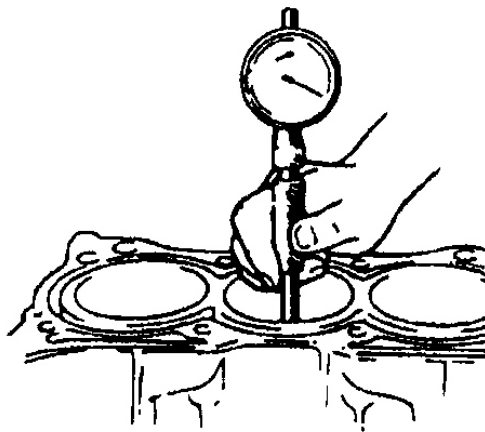
B: Piston clearance = 0.02 - 0.04 mm (0.0008 - 0.0015 in.)

C: Allowance for honing = 0.02 mm (0.0008 in.)

4. Rebore and hone cylinder to calculated dimension.

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

5. Measure piston clearance after honing.



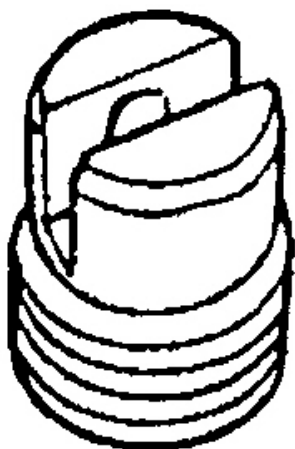
I5RH01140015

"e" 50 mm (1.96 in)	"g": 27.5 mm (1.08 in.)
"f": 95 mm (3.74 in)	

Fig. 213: Measuring Piston Diameter
 Courtesy of SUZUKI OF AMERICA CORP.

Check Valve

Check check valve for clogging and ball for being stuck.



I2RH01140201

Fig. 214: Identifying Check Valve
 Courtesy of SUZUKI OF AMERICA CORP.

SPECIFICATIONS

TIGHTENING TORQUE SPECIFICATIONS

TIGHTENING TORQUE SPECIFICATIONS

Fastening part	Tightening torque		
	N.m	kg-m	lb-ft
Engine cover bolt	8	0.8	5.8
Intake manifold bolt and nut	25	2.5	18.0
Intake manifold rear stiffener bolt	25	2.5	18.0
Intake manifold front stiffener bolt	55	5.5	40.0
Cylinder head cover nut	11	1.1	8.0
Cylinder block heater bolt	11	1.1	8.0

2005 Suzuki Aerio S

2005 ENGINE Engine Mechanical - Aerio

Engine mounting bolts and nut	55	5.5	40.0
Engine front and rear mounting nut	45	4.5	32.5
Timing chain cover bolt and nut	11	1.1	8.0
Generator belt idler pulley nut	42	4.2	30.5
Generator belt tensioner bolt	25	2.5	18.5
A/C compressor bracket bolt	55	5.5	40.0
Crankshaft pulley bolt	150	15.0	108.5
Camshaft timing sprocket bolt	80	8.0	57.5
Timing chain tensioner adjuster No.2 bolt	11	1.1	8.0
Timing chain tensioner adjuster No.2 nut	45	4.5	33.0
Timing chain tensioner nut	25	2.5	18.0
Timing chain tensioner adjuster No.1 bolt	11	1.1	8.0
Timing chain guide No.1 bolt	9	0.9	6.5
Camshaft housing bolt	11	1.1	8.0
Cylinder head bolt	105	10.5	76.0
Cylinder head bolt (hex hole bolt)	11	1.1	8.0
Engine RH mounting bracket bolt	55	5.5	40.0
Connecting rod bolt	15 (45° and 45° by the specified procedure)	1.5 (45° and 45° by the specified procedure)	11.0 (45° and 45° by the specified procedure)
Crankcase bolt with 10 mm thread diameter ((1) - (10))	58	5.8	42.0
Crankcase bolt with 8 mm thread diameter ((11) - (22))	25	2.5	18.0
CKP sensor bolt	6	0.6	4.5
Flywheel or drive plate bolt	70	7.0	51.0
Engine front mounting bracket bolt	55	5.5	40.0

SPECIAL TOOLS AND EQUIPMENT

RECOMMENDED SERVICE MATERIAL

RECOMMENDED SERVICE MATERIAL SPECIFICATION

Material	SUZUKI recommended product or Specification	
Sealant	SUZUKI Bond No.1215	P/No.: 99000-31110
	SUZUKI Bond No.1207B	P/No.: 99000-31140
	SUZUKI Bond No.1207F	P/No.: 99000-31250
Thread lock cement	Thread Lock Cement Super 1333B	P/No.: 99000-32020

SPECIAL TOOL

SPECIAL TOOLS DESCRIPTION

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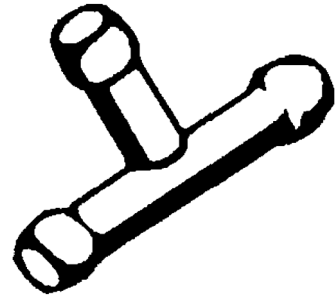
2005 Suzuki Aerio S

2005 ENGINE Engine Mechanical - Aerio

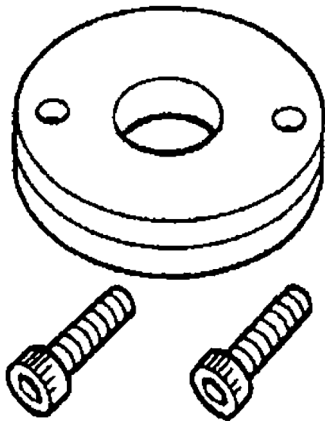
09355-35754-600 Hose



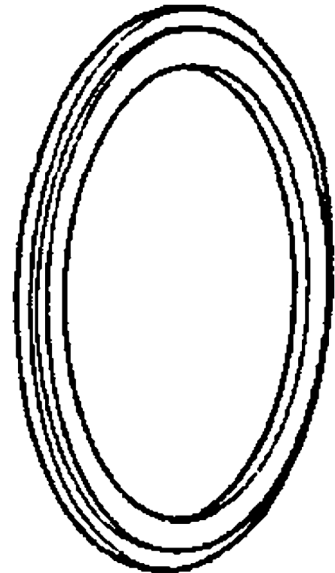
09367-04002 3-way joint



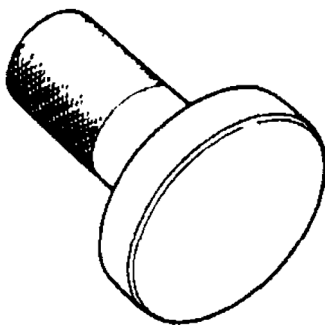
09911-97710 Oil seal guide



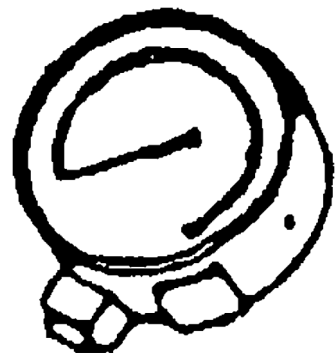
09911-97810 Oil seal installer



09913-75510 Bearing installer



09915-64510-001
Compression gauge (0-
20 kg/cm²)



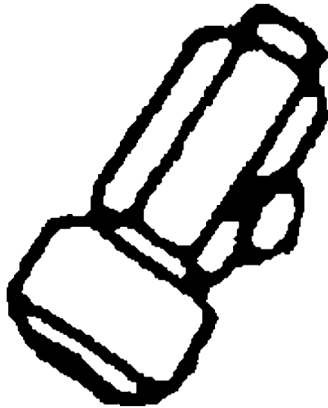
09915-64510-002

09915-64530

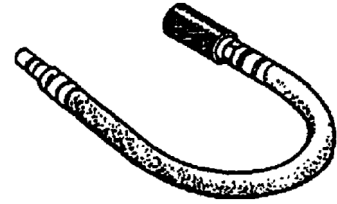
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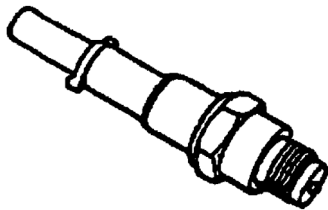
Connector



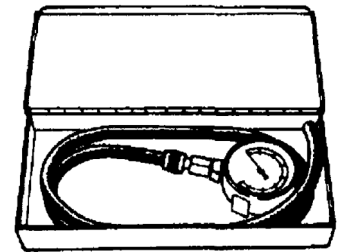
Compression gauge
hose



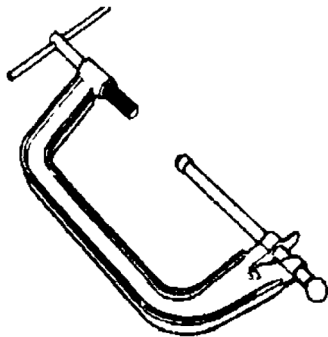
09915-67010
Compression gauge
attachment (C)



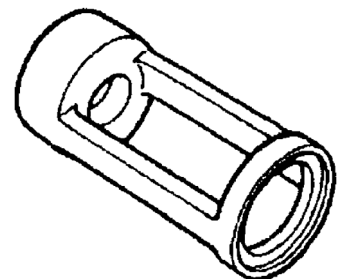
09915-67311 Vacuum
gauge



09916-14510 Valve
lifter /



09916-16510 Valve
lifter attachment /

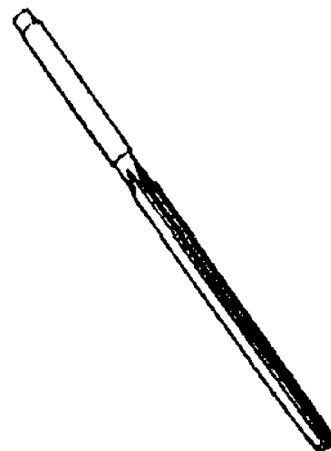
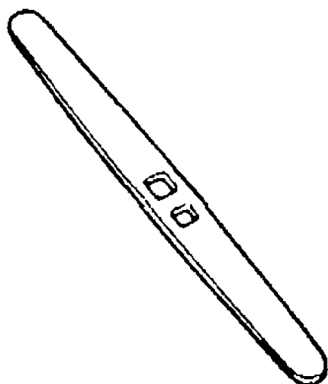


09916-34542 Reamer
handle /

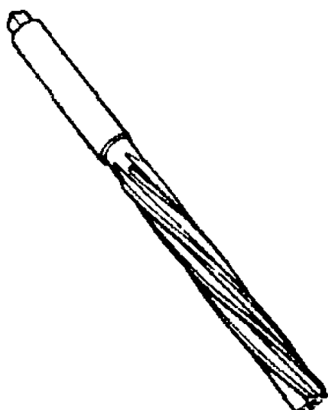
09916-37810 Valve
guide reamer (6 mm)

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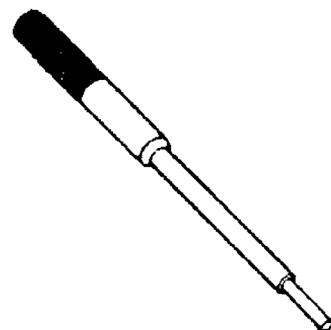
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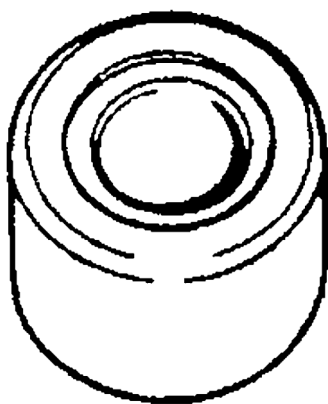
09916-38210 Valve
guide reamer (11 mm)



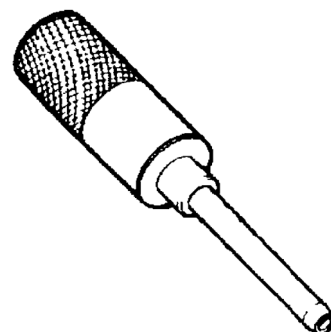
09916-46020 Valve
guide remover



09916-57340 Valve
guide installer
attachment

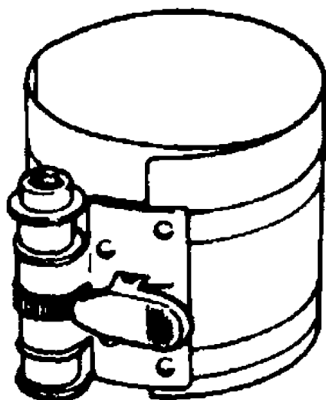


09916-57350 Valve
guide installer handle (6
mm) /

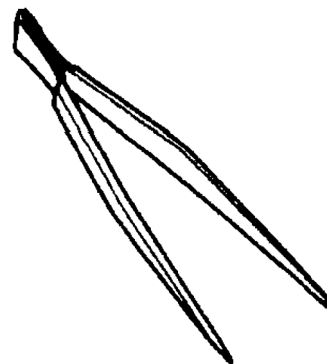


09916-77310 Piston

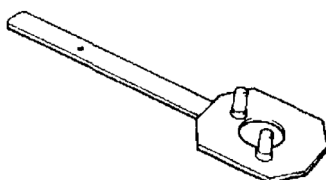
ring compressor (50-125 mm)



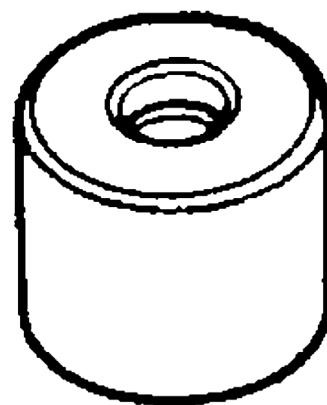
09916-84511 Forceps /



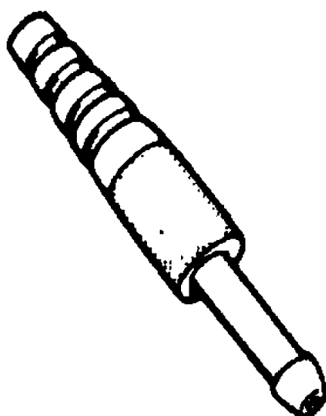
09917-68221 Camshaft pulley holder /



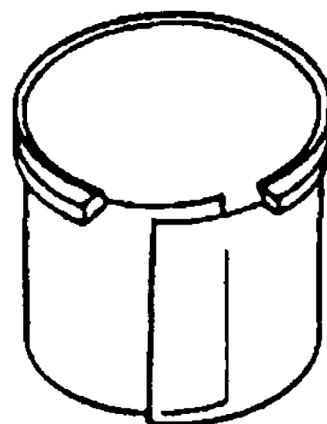
09917-98221 Valve guide stem attachment



09918-08210 Vacuum gauge hose joint



09919-28610 Protector sleeve /

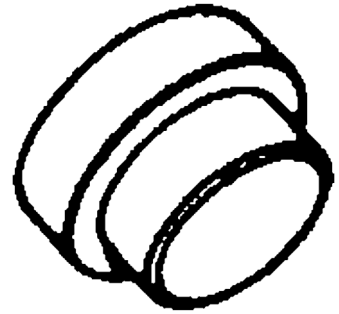
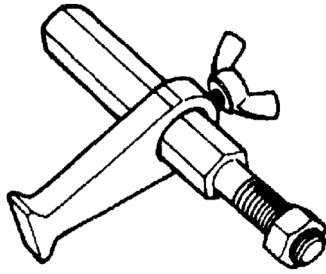


09924-17810 Flywheel holder (drive plate stopper) /

09926-58010 Bearing remover attachment

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09944-36011 Steering
wheel remover

