

# Power Unit Mechanical

## General Description

### Power Unit Construction Description

CENDG2111401001

The power unit is direct water cooled, in line 4 cylinder, 4 stroke gasoline unit with its DOHC (Double overhead camshaft) valve mechanism for "V" type valve configuration and 16 valves (4 valves/one cylinder).

The double overhead camshaft is mounted over the cylinder head, it is driven from crankshaft through driven gear and timing chain, and no pushed rods are provided in the valve train system.

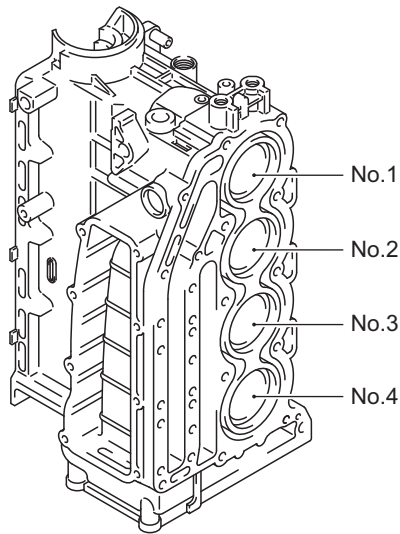
### Powerhead Direction of Rotation

#### NOTE

This is a left hand (LH) rotation powerhead.

### Cylinder Number

Cylinder number is as mentioned in figure.



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## Diagnostic Information and Procedures

### Cylinder Compression Check

CENDG2111404001

Refer to "Cylinder Compression Pressure Check" in Section 0B (Page 0B-20).

### Oil Pressure Check

CENDG2111404002

Refer to "Oil Pressure Check" in Section 0B (Page 0B-19).

## Service Instructions

### Tappet Clearance Inspection

CENDG2111406001

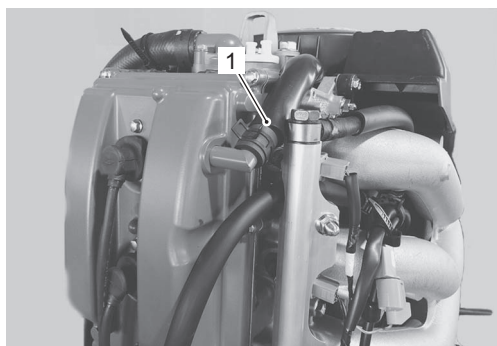
Refer to "Tappet Clearance Inspection and Adjustment" in Section 0B (Page 0B-7).

### Cylinder Head Cover Removal and Installation

CENDG2111406003

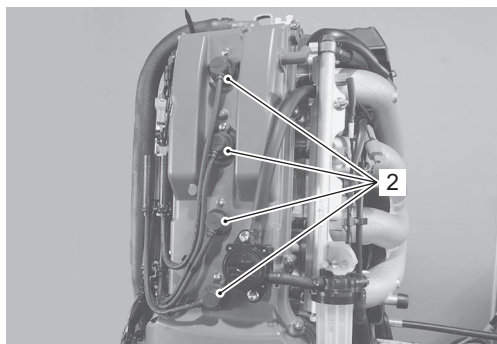
#### Removal

- 1) Remove both lower side covers.  
Refer to "Lower Side Cover Removal and Installation" in Section 2A (Page 2A-3).
- 2) Loosen the clamp securing breather hose (1), then disconnect the breather hose from cylinder head cover.



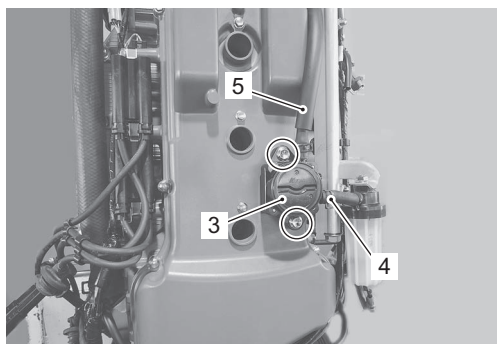
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- 3) Disconnect all spark plug caps (2).



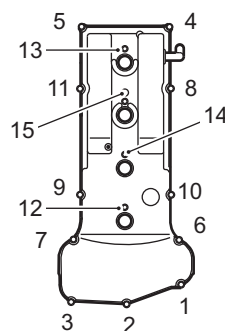
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- 4) Disconnect fuel inlet hose (4) and outlet hose (5) from low pressure fuel pump (3).  
Remove bolts and low pressure fuel pump.



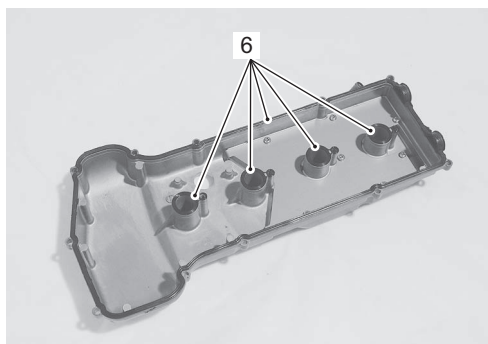
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- 5) Loosen the fifteen bolts securing cylinder head cover in ascending order of numbers, then remove the cylinder head cover.



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- 6) Remove the gaskets (6) from cylinder head cover.



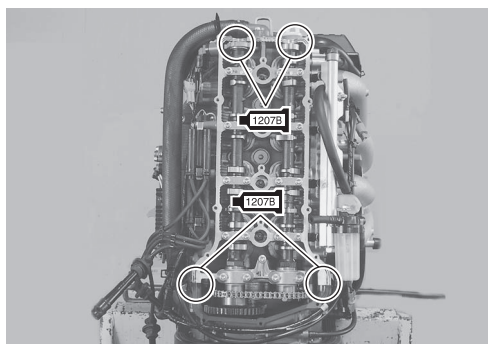
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#### Installation

Installation is reverse order of removal with special attention to the following steps.

- Clean sealing surface on cylinder head and cover.
- Remove oil, old sealant, and dust from sealing surfaces.
- After cleaning, apply sealant to cylinder head sealing surface area as shown in figure.

**1207B : Sealant 99000-31140 (SUZUKI Bond 1207B (100 g))**



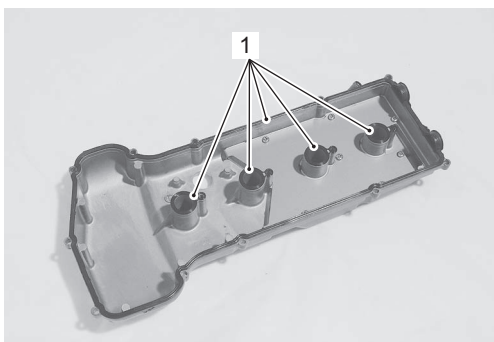
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- Install new gaskets (1) to cylinder head cover.

**NOTICE**

**A previously used gasket may leak, resulting in engine damage.**

**Do not reuse gasket once removed. Always use a new one.**



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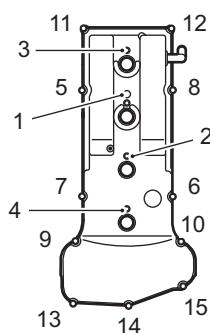
- Install cylinder head cover to cylinder head, then tighten cylinder head cover bolts in ascending order of numbers.

**NOTE**

**Use care when installing cylinder head cover. Be certain cylinder head cover gaskets remain in their correct position.**

**Tightening torque**

**Cylinder head cover bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)**



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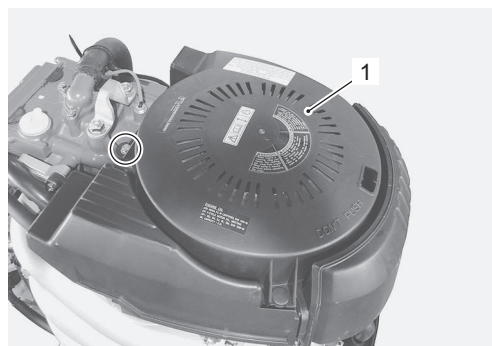
- Install the low pressure fuel pump. Refer to "Low Pressure Fuel Pump Removal and Installation" in Section 1G (Page 1G-25).
- Perform the following final assembly checks to ensure proper and safe operation.
  - All parts removed have been returned to their original positions.
  - Wire and hose routing matches service manual illustration. Refer to "Fuel Hose Routing" in Section 4B (Page 4B-1) and "Water Hose Routing" in Section 4B (Page 4B-5).
  - No oil leakage is evident during final test running.

**Air Intake Silencer Case Removal and Installation**

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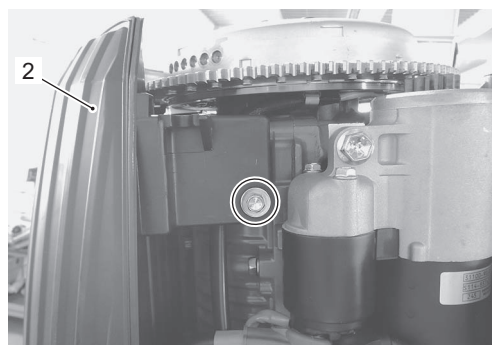
**Removal**

- 1) Remove the ring gear cover (1).

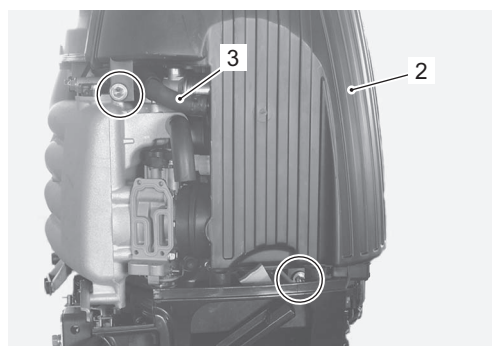


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- 2) Remove the three bolts securing air intake silencer case (2).
- 3) Disconnect the breather hose (3) and remove the air intake silencer case.

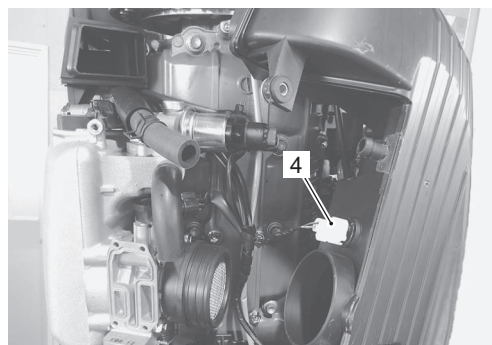


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IDG211140013-02

- 4) Disconnect the IAT sensor connector (4).



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### Installation

Installation is reverse order of removal.

### Electric Parts Holder Removal and Installation

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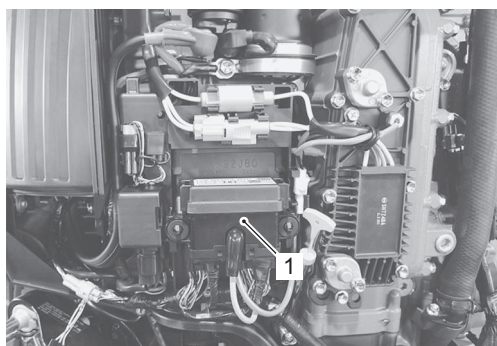
#### Removal

#### ▲ CAUTION

Failure to take proper precaution when removing electrical parts may result in personal injury and/or damage to electronic components.

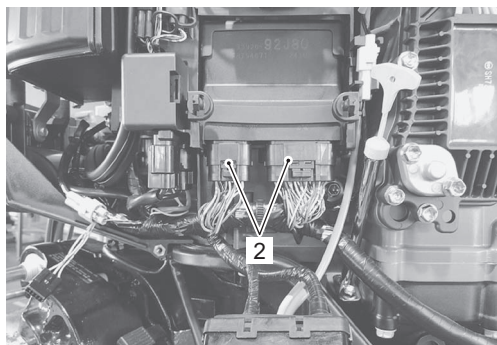
Prior to removing electrical parts, disconnect battery cables from battery.

- 1) Remove the lower side covers.  
Refer to "Lower Side Cover Removal and Installation" in Section 2A (Page 2A-3).
- 2) Pull and remove the fuse box (1) from electric parts holder.



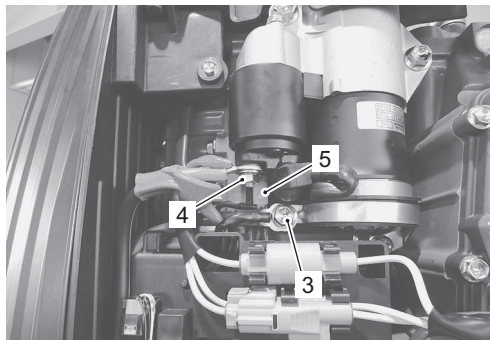
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- 3) Disconnect the connectors (2) from ECM.



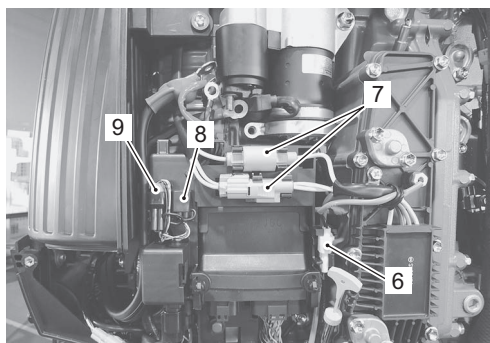
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- 4) Remove the bolt (3) securing main harness GND lead wire and negative (-) battery cable. Remove the nut (4) securing positive (+) battery cable and main harness (R) lead wire. Disconnect the red lead wire connector (5) from terminal "S" on starter magnetic switch.



IDG211140017-01

- 5) Pull off EX. temp. sensor lead wire connector (6), rectifier/regulator lead wire connectors (7), SDS service connector (8), gauge connector (9) from electric parts holder.

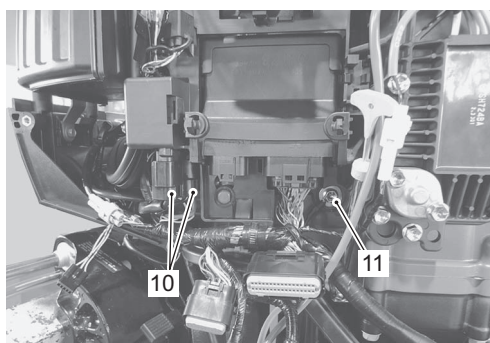


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- 6) Disconnect the connectors (10) from PTT motor relay. Remove the bolt (11) securing harness GND lead wire and electric parts holder.
- 7) Remove the electric parts holder from cylinder block.

#### NOTE

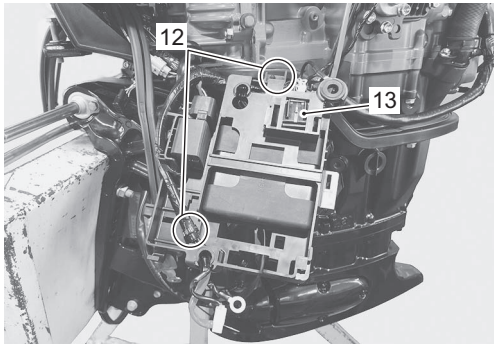
To remove the electric parts holder from cylinder block, slide it downward first.



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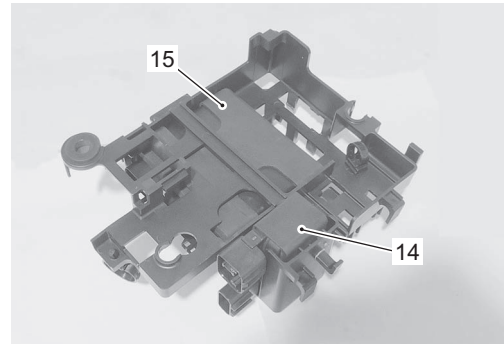


- 8) Remove the harness clamps (12) and connector (13) from electric parts holder.



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- 9) Remove the PTT motor relay (14) and ECM (15) from electric parts holder.



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### Installation

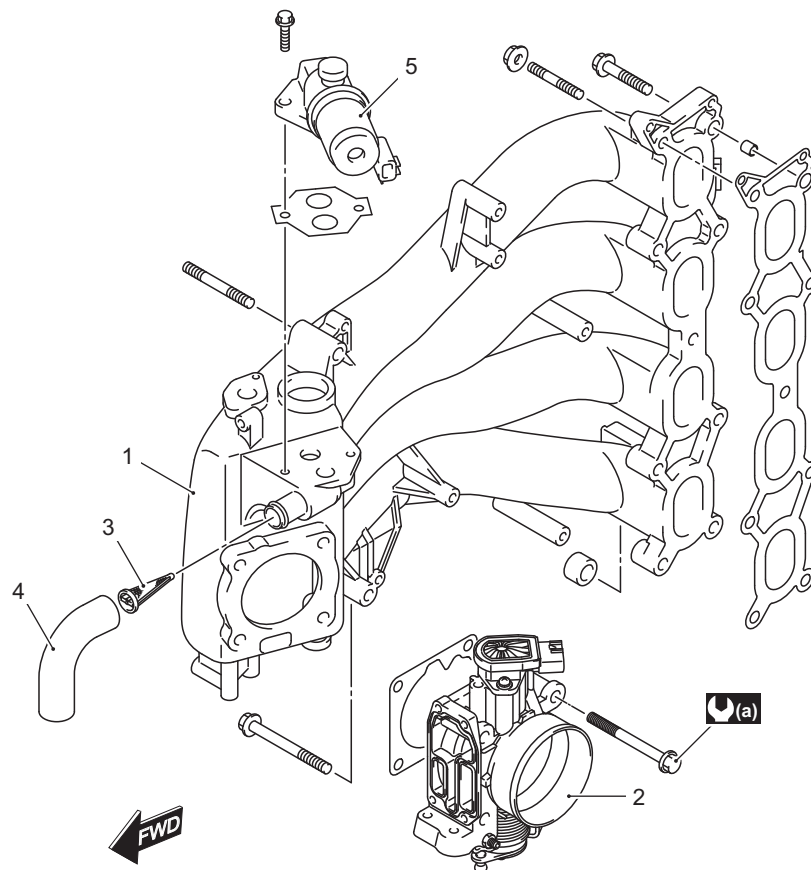
Installation is reverse order.

Perform the following final assembly checks to ensure proper and safe operation.

- All parts removed have been returned to their original positions.
- Wire routing matches service manual illustration. Refer to "Wiring Harness Routing Diagram" in Section 4A (Page 4A-3).

## Intake Manifold and Throttle Body Components

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IDG211140022-02

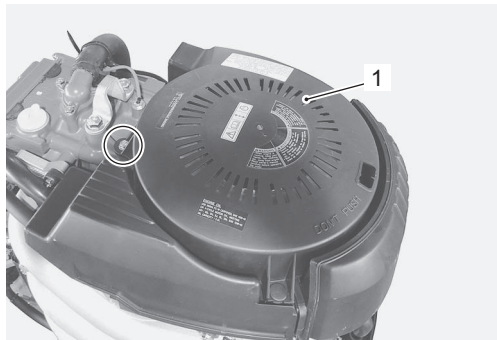
1. Intake manifold assembly	3. Filter	5. IAC valve
2. Throttle body assembly	4. IAC valve hose	(a) : 23 N-m (2.3 kgf-m, 16.5 lbf-ft)

## Intake Manifold Removal and Installation

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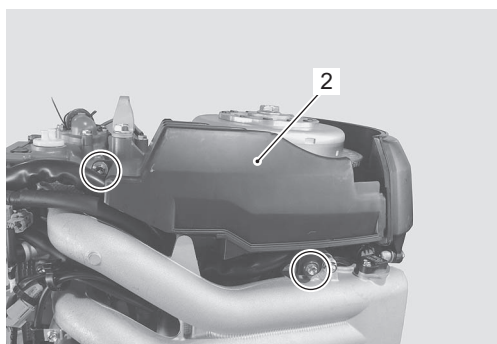
### Removal

- 1) Relieve fuel pressure.  
Refer to "Fuel Pressure Relief Procedure" in Section 1G (Page 1G-14).
- 2) Disconnect the battery cables from battery.
- 3) Remove the lower side covers.  
Refer to "Lower Side Cover Removal and Installation" in Section 2A (Page 2A-3).
- 4) Remove the ring gear cover (1).



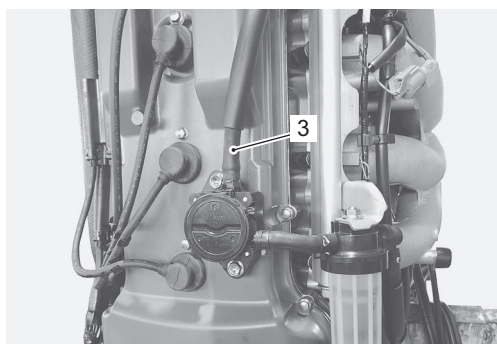
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- 5) Remove the two bolts and air duct (2).



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- 6) Disconnect fuel outlet hose (3) from the low pressure fuel pump.



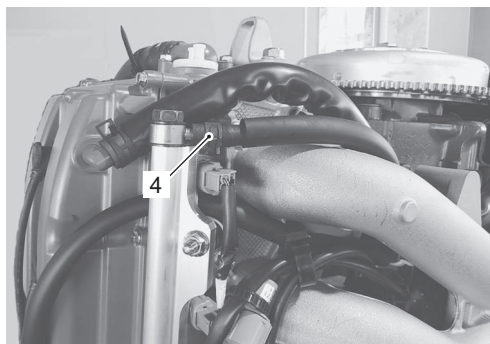
IDG211140025-02

- 7) Loosen clamp and place a large cloth over end of fuel feed hose (4).  
Slowly pull fuel feed hose from fuel delivery pipe.  
Drain any excess fuel in hose into a small container.

### **⚠ WARNING**

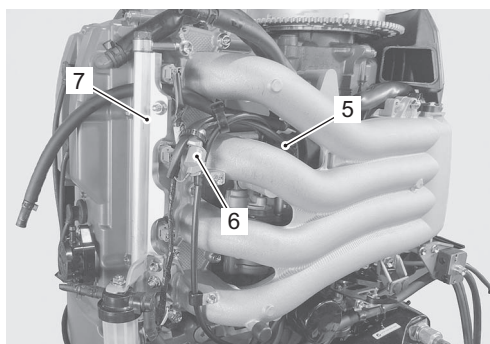
**Gasoline is a flammable material that can cause fire hazard or burns.**

**A small amount of fuel may be released when the fuel feed hose is disconnected. Place container under the fuel feed hose or fuel delivery pipe upper union with a shop cloth so that the released fuel is caught in the container or absorbed by the cloth. Place the fuel soaked cloth in an approved container.**



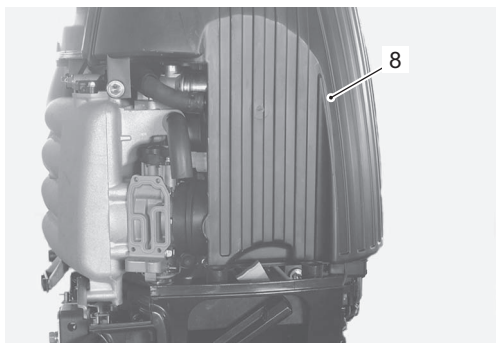
IDG211140026-02

- 8) Disconnect the high pressure fuel pump connector (5).  
Disconnect the knock sensor lead wire connector (6). (DF115A/140A)  
Remove the fuel delivery pipe assembly (7).  
Refer to "Fuel Injector Removal and Installation" in Section 1G (Page 1G-23).



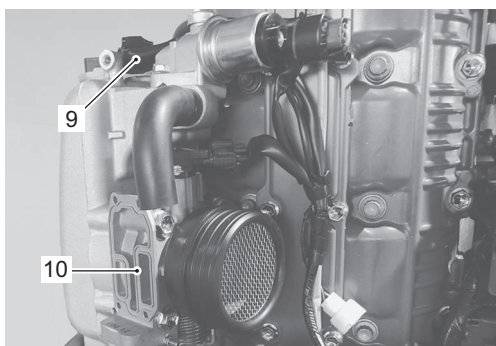
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- 9) Remove the air intake silencer case (8).  
Refer to "Air Intake Silencer Case Removal and Installation" (Page 1D-3).



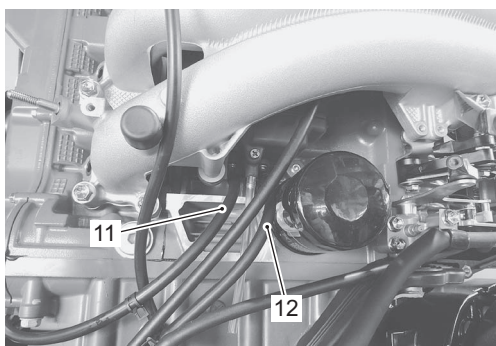
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- 10) Disconnect MAP sensor connector (9) at MAP sensor.  
Remove the throttle body (10).  
Refer to "Throttle Body Removal and Installation" (Page 1D-8).



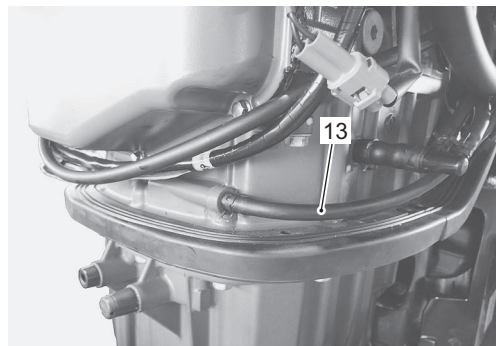
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- 11) Disconnect the water inlet hose (11) and outlet hose (12) from fuel vapor separator.



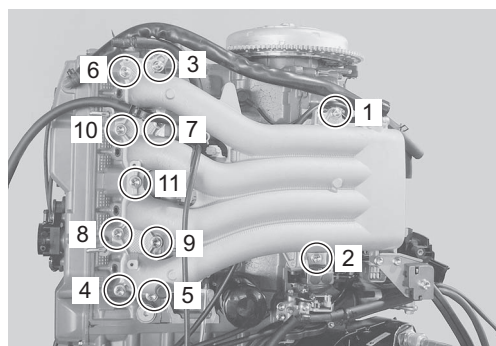
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- 12) Disconnect the water hose (13) from engine holder.



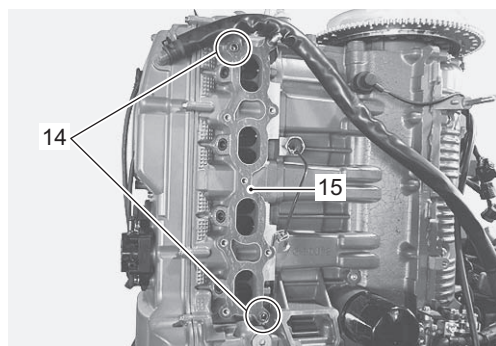
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- 13) Loosen the nine bolts and two nuts in ascending order of numbers.  
Remove the intake manifold assembly.



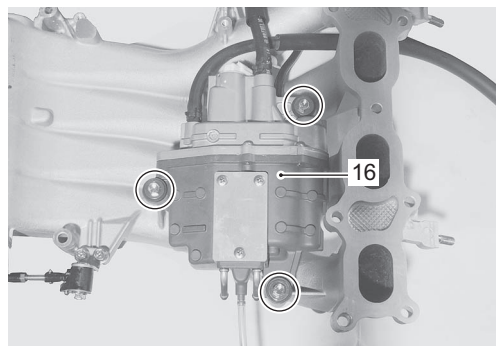
IDG211140032-02

- 14) Remove the dowel pins (14) and gasket (15).



IDG211140033-03

- 15) Remove the fuel vapor separator (16) from intake manifold.  
Refer to "Fuel Vapor Separator Removal and Installation" in Section 1G (Page 1G-16).



IDG211140034-02



### Installation

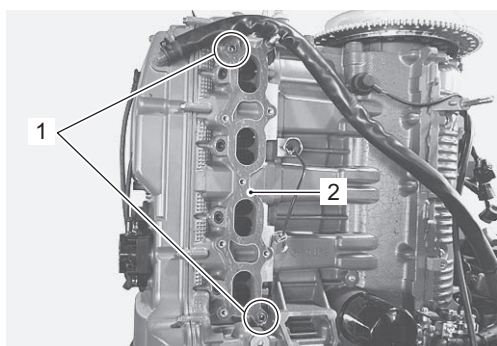
Installation is reverse order of removal with special attention to the following steps.

#### NOTICE

**Air leakage will induce a lean air/fuel mix which will result in severe engine damage.**

**Do not reuse gasket once removed.  
Always use a new gasket.**

- Install the fuel vapor separator to intake manifold. Refer to "Fuel Vapor Separator Removal and Installation" in Section 1G (Page 1G-16).
- Install the dowel pins (1) and gasket (2).

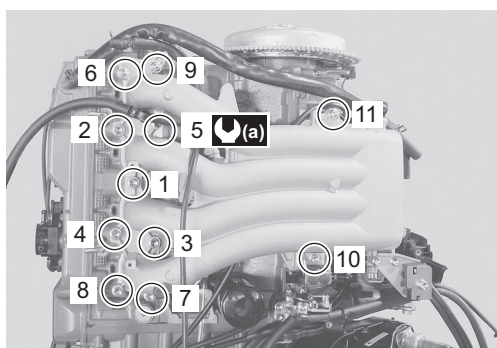


IDG211140071-03

- Install the intake manifold assembly, then tighten bolts and nuts in ascending order of numbers.

#### Tightening torque

**Intake manifold bolt/nut (a): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)**



IDG211140072-03

- Install fuel delivery pipe assembly. Refer to "Fuel Injector Removal and Installation" in Section 1G (Page 1G-23).
- Install the throttle body. Refer to "Throttle Body Removal and Installation" (Page 1D-8).
- Perform the following final assembly checks to ensure proper and safe operation.
  - All parts removed have been returned to their original positions.

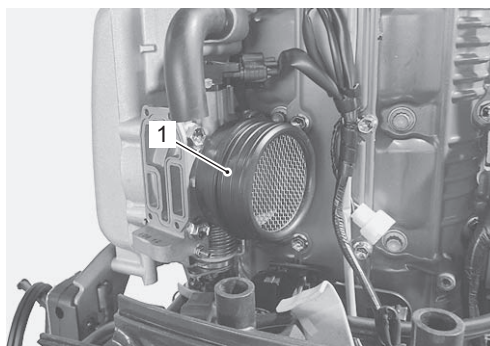
- Wire and hose routing matches service manual illustration. Refer to "Wiring Harness Routing Diagram" in Section 4A (Page 4A-3) and "Fuel Hose Routing" in Section 4B (Page 4B-1).
- No fuel leakage is evident during final test running.

### Throttle Body Removal and Installation

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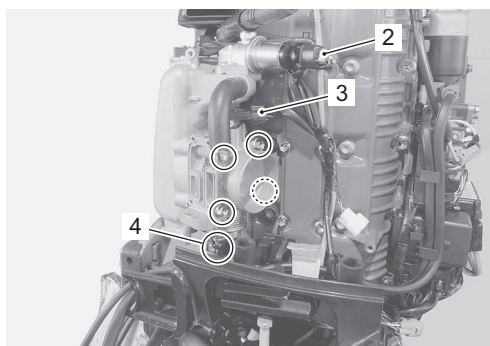
#### Removal

- 1) Remove the air intake silencer case. Refer to "Air Intake Silencer Case Removal and Installation" (Page 1D-3).
- 2) Remove the flame arrester (1).



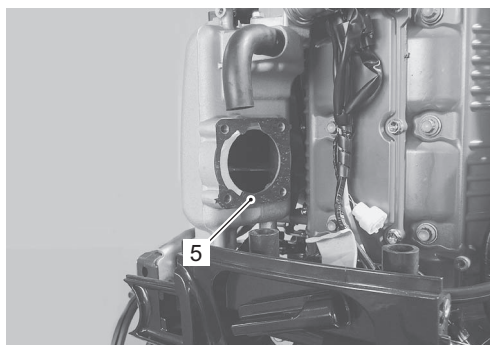
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- 3) Disconnect IAC valve connector (2). Disconnect TPS connector (3). Remove the throttle link rod (4) from throttle body.
- 4) Remove the four bolts securing throttle body to intake manifold, then detach throttle body.



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- 5) Remove the gasket (5).



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## Installation

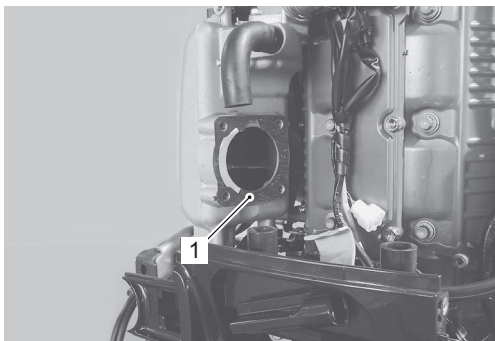
Installation is reverse order of removal with special attention to the following steps.

### NOTICE

**Air leakage will induce a lean air/fuel mix which will result in severe engine damage.**

**Do not reuse gasket once removed.  
Always use a new gasket.**

- Install the gasket (1).

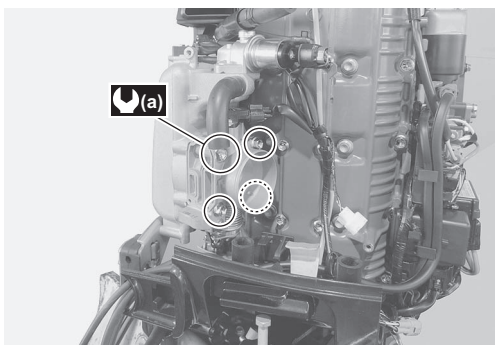


IDG211140038-01

- Install the throttle body to intake manifold, then securely tighten the four bolts to specified torque.

### Tightening torque

**Throttle body bolt (a): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)**



IDG211140039-02

- Install the air intake silencer case. Refer to "Air Intake Silencer Case Removal and Installation" (Page 1D-3).

## Throttle Body Inspection

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### NOTICE

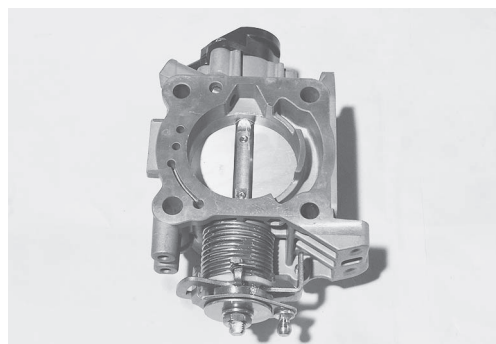
**The throttle body will lose its original performance if it has been disassembled and reassembled.**

- Do not try to disassemble the throttle body.
- Do not try to adjust or remove any of the throttle body component parts (Throttle position sensor, throttle valve, throttle stop screw, etc.).  
These components have been factory adjusted to precise specifications.

- Clean throttle body bore by compressed air.
- Check that throttle lever and throttle valve moves smoothly.
- Replace throttle body if necessary.



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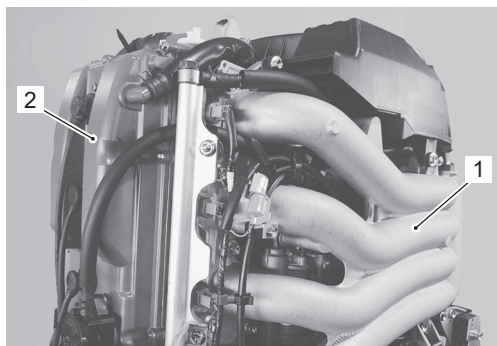
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## Power Unit Removal and Installation

CENDG2111406010

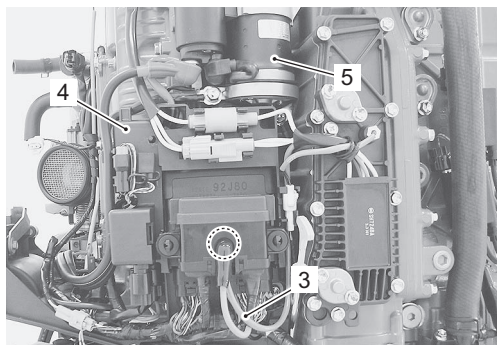
### Removal

- 1) Relieve fuel pressure.  
Refer to "Fuel Pressure Relief Procedure" in Section 1G (Page 1G-14).
- 2) Drain engine oil.
- 3) Disconnect battery cables from battery.
- 4) Remove the intake manifold assembly (1).  
Refer to "Intake Manifold Removal and Installation" (Page 1D-6).
- 5) Remove the cylinder head cover (2) and spark plugs.  
Refer to "Cylinder Head Cover Removal and Installation" (Page 1D-2).



IDG211140042-02

- 6) Disconnect the rectifier/regulator lead wire "Gr" (3) from the fuse box.  
Remove the electric parts holder (4).  
Refer to "Electric Parts Holder Removal and Installation" (Page 1D-4).
- 7) Remove the starter motor (5).  
Refer to "Starter Motor Removal and Installation" in Section 1I (Page 1I-4).



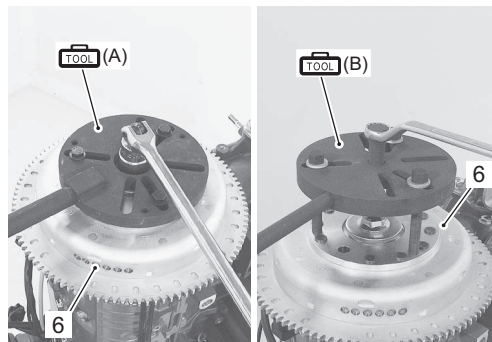
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- 8) Remove the flywheel (6).  
Refer to "Flywheel Removal and Installation" in Section 1K (Page 1K-4).

### Special tool

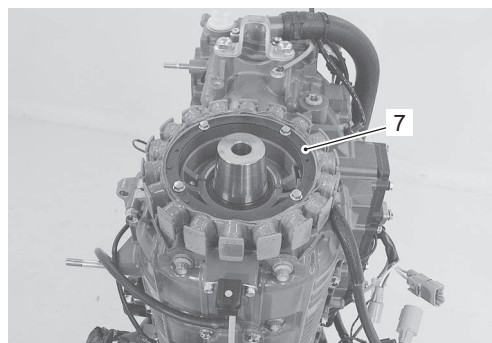
**TOOL (A): 09930-49220 (Flywheel holder)**

**TOOL (B): 09930-39220 (Flywheel remover)**



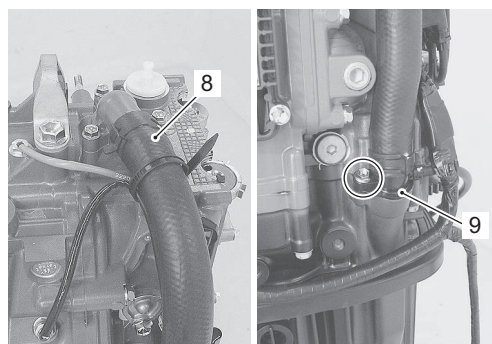
IDG211140044-03

- 9) Remove the battery charge coil (7).  
Refer to "Battery Charge Coil Removal and Installation" in Section 1K (Page 1K-5).



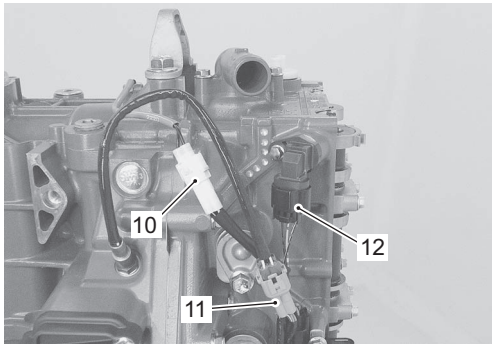
IDG211140045-01

- 10) Disconnect water return hose (8) from thermostat cover.  
Remove bolt and water return hose pipe (9).



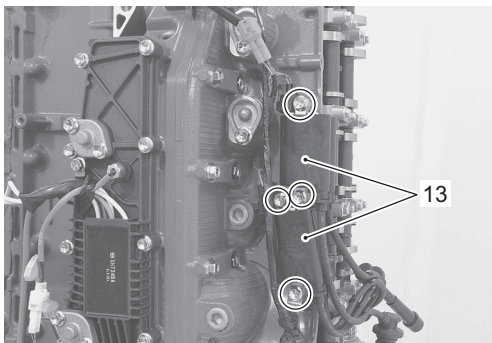
IDG211140046-01

- 11) Disconnect cylinder temp. sensor lead wire connector (10), O2 sensor lead wire connector (11) and CMP sensor connector (12).



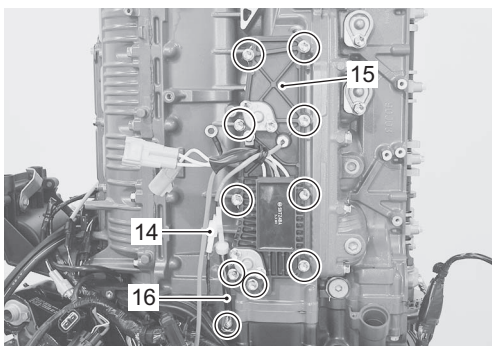
IDG211140047-01

- 12) Disconnect two ignition coil connectors, then remove four bolts and ignition coils (13).



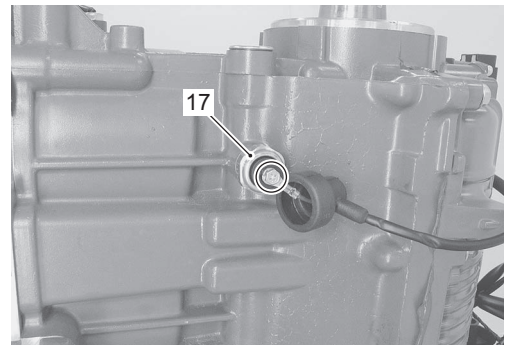
IDG211140048-01

- 13) Disconnect EX. manifold temp. sensor lead wire connector (14).  
Remove nine bolts and rectifier/regulator (15).  
Refer to "Rectifier / Regulator Removal and Installation" in Section 1K (Page 1K-6).  
Remove oil level gauge guide (16).



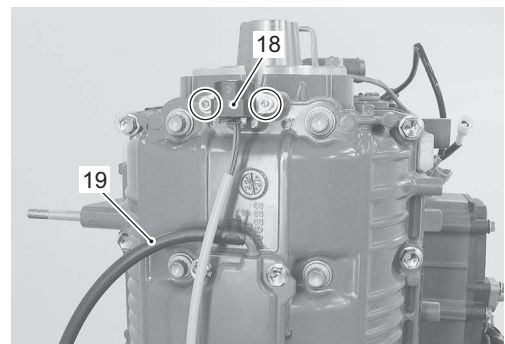
IDG211140049-01

- 14) Loosen screw and disconnect blue lead wire from oil pressure switch (17).



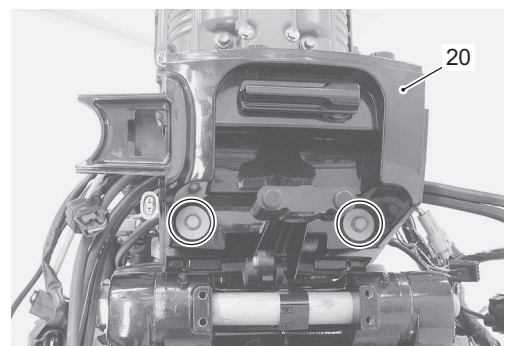
IDG211140050-01

- 15) Remove CKP sensor (18).  
Disconnect water hose (19).



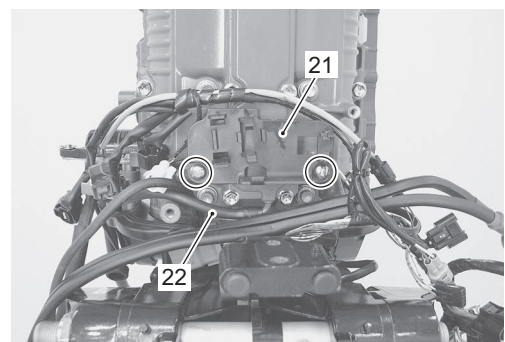
IDG211140051-01

- 16) Remove the two bolts and front panel (20).



IDG211140052-01

- 17) Remove the screws securing the connector holder (21).  
Disconnect the water hose (22).

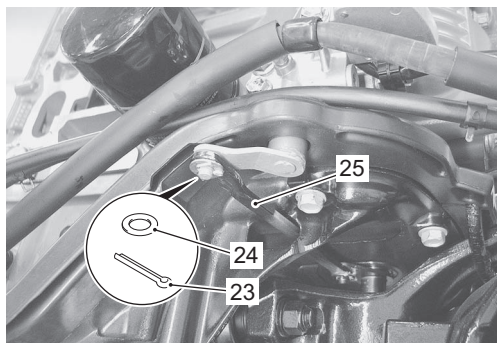


IDG211140053-01



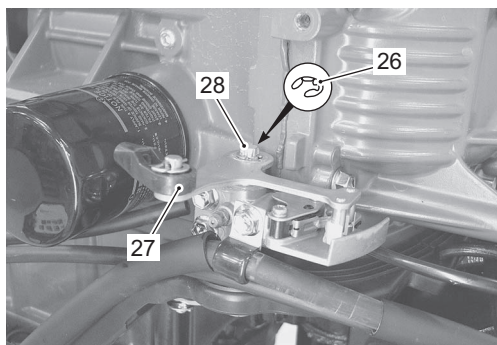
## 1D-12 Power Unit Mechanical:

- 18) Remove the cotter pin (23) and washer (24).  
Remove the clutch lever link (25) from the clutch shaft arm.



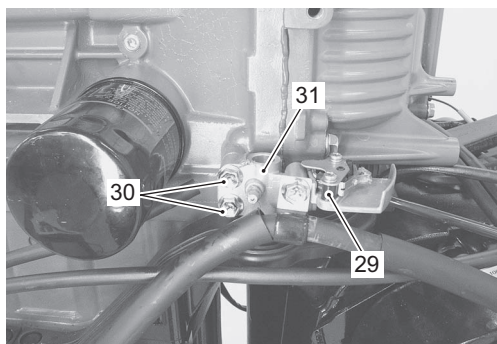
IDG211140054-01

- 19) Remove E-ring (26), clutch control lever (27) and clutch shaft arm (28).



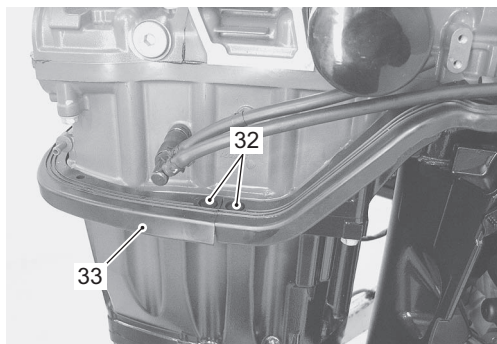
IDG211140055-01

- 20) Disconnect the lead wire connector of neutral switch (29).  
Remove two bolts (30), then clutch lever holder (31) with fuel hose.



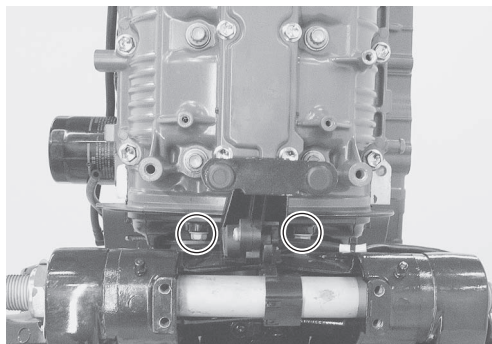
IDG211140056-01

- 21) Remove the pins (32) and side cover seal (33).

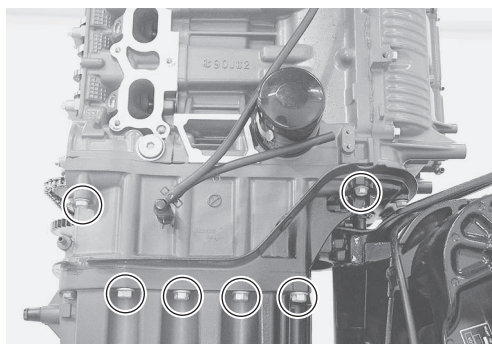


IDG211140057-01

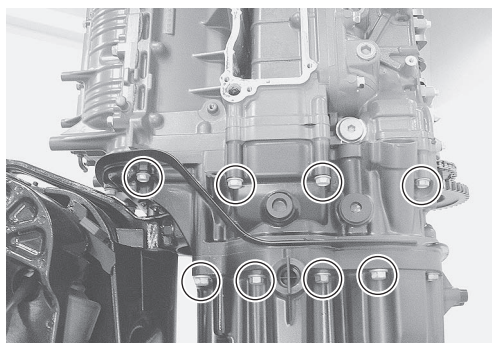
- 22) Remove the sixteen bolts securing power unit.



IDG211140058-01

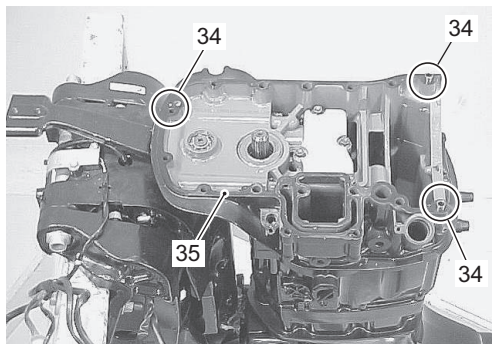


IDG211140059-01



IDG211140060-01

- 23) Lift up and remove power unit from engine holder.  
24) Remove the dowel pins (34) and gasket (35).



IDG211140061-01

**Installation**

Installation is reverse order of removal with special attention to the following step.


**NOTICE**

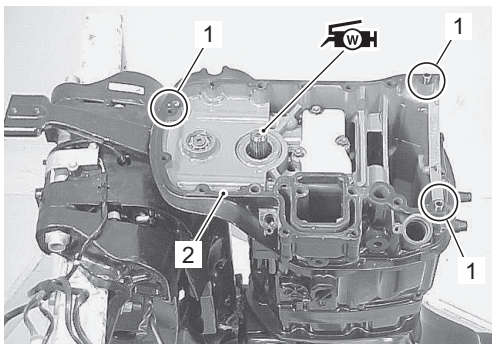
Previously used gasket may leak oil and/or cooling water, resulting in engine damage.

Do not reuse gasket. Always replace with new part.

**Power unit**

- Install dowel pins (1) and gasket (2).  
Apply water resistant grease to driveshaft splines.


 **Grease 99000-25350 (SUZUKI Water Resistant Grease EP2 (250 g))**

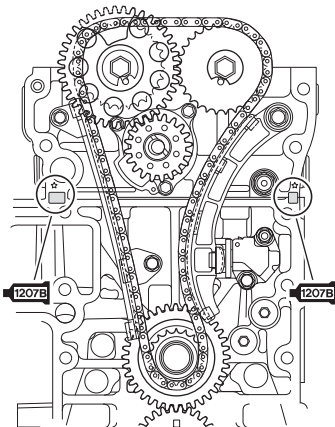


IDG211140062-01

**NOTE**

Before installing power unit, apply sealant to the two hatched areas shown in the illustration at below.

 **Sealant 99000-31140 (SUZUKI Bond 1207B (100 g))**



IDG211140063-01

- Lower the power unit onto engine holder.

**NOTE**

Rotate crankshaft to aid alignment of driveshaft and counter shaft splines.

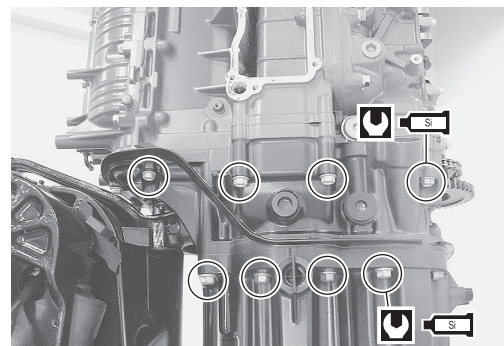
- Apply suzuki silicone seal to power unit mounting bolts and tighten bolts to specified torque.

 **Sealant 93691-80030 (SUZUKI Silicone Seal (100 g))**

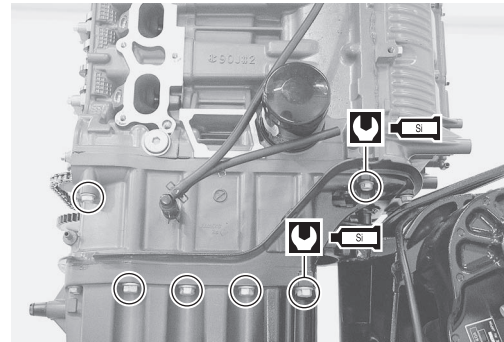
**Tightening torque**

**Power unit mounting bolt (10 mm): 50 N·m (5.0 kgf-m, 36.0 lbf-ft)**

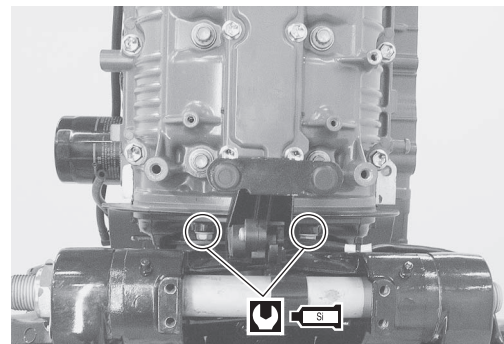
**Power unit mounting bolt (8 mm): 23 N·m (2.3 kgf-m, 16.5 lbf-ft)**



IDG211140064-04



IDG211140065-04

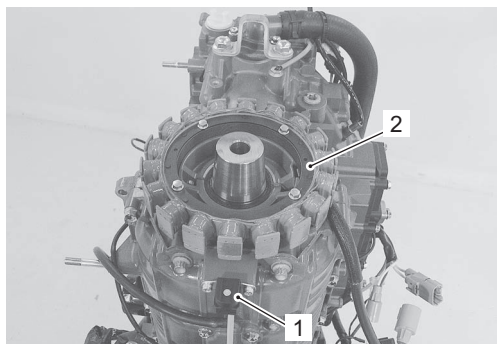


IDG211140066-03



### Flywheel

- Install CKP sensor (1).  
Refer to “CKP Sensor Removal and Installation” in Section 1C (Page 1C-10).
- Install battery charge coil (2).  
Refer to “Battery Charge Coil Removal and Installation” in Section 1K (Page 1K-5).




IDG211140067-01

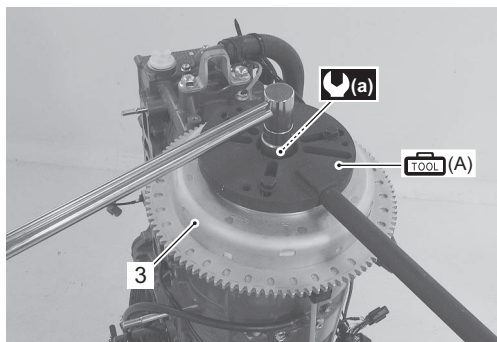
- Install flywheel (3) and tighten flywheel bolts to specified torque.  
Refer to “Flywheel Removal and Installation” in Section 1K (Page 1K-4).

### Tightening torque

Flywheel bolt (a): 245 N·m (24.5 kgf-m, 177 lbf-ft)

### Special tool

 (A): 09930-49220 (Flywheel holder)



IDG211140068-01

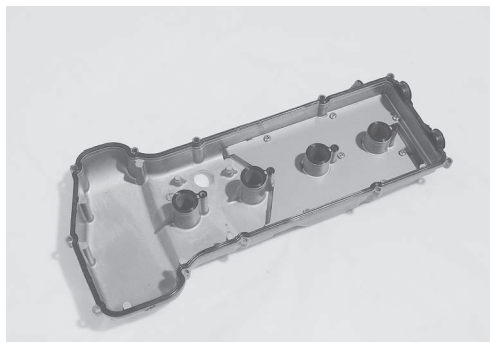
### Cylinder head cover

- Install cylinder head cover.  
Refer to “Cylinder Head Cover Removal and Installation” (Page 1D-2).

### NOTICE

**A previously used gasket may leak, resulting in engine damage.**

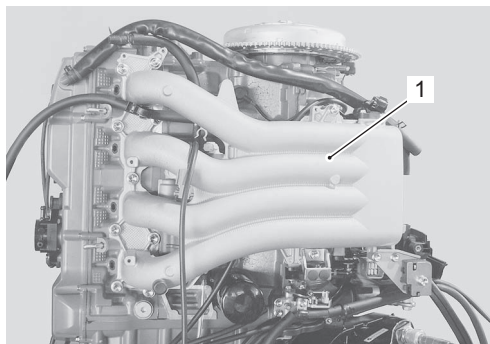
**Do not reuse gasket once removed. Always use a new one.**



IDG211140069-02

### Intake manifold

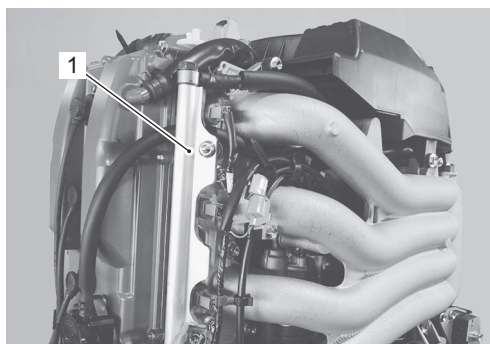
- Install intake manifold (1).  
Refer to “Intake Manifold Removal and Installation” (Page 1D-6).



IDG211140073-02

### Fuel injectors

- Install fuel injectors and fuel delivery pipe (1).  
Refer to “Fuel Injector Removal and Installation” in Section 1G (Page 1G-23).



IDG211140070-02



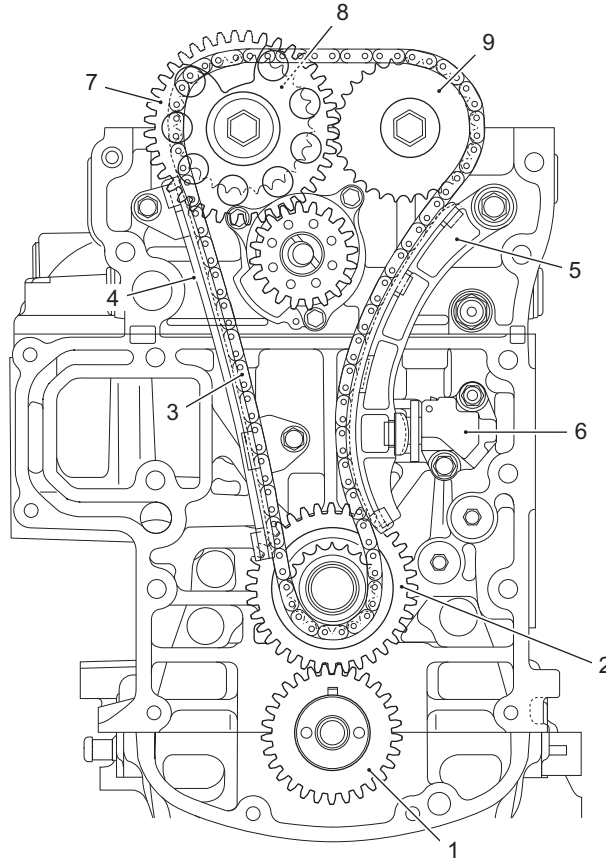
**Perform the following final assembly checks to ensure proper and safe operation.**

- All parts removed have been returned to their original positions.
- Fuel and water hose routing matches service manual illustration.  
Refer to "Fuel Hose Routing" in Section 4B (Page 4B-1) and "Water Hose Routing" in Section 4B (Page 4B-5).

- Wire routing matches service manual illustration.  
Refer to "Wiring Harness Routing Diagram" in Section 4A (Page 4A-3).
- No fuel leakage is evident when fuel system is pressurized.  
Refer to "Fuel Leakage Check Procedure" in Section 1G (Page 1G-14).
- No water leakage is evident during final test running.

**Timing Chain, Chain Tensioner and Camshaft Sprockets Components**

CENDG2111406011



IDG211140074-01

1. Crankshaft/Drive gear	4. Timing chain guide	7. Oil pump drive sprocket
2. Driven gear/Timing sprocket	5. Timing chain tensioner	8. Exhaust camshaft and timing sprocket
3. Timing chain	6. Timing chain tensioner adjuster	9. Intake camshaft and timing sprocket

## Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation

CENDG2111406012

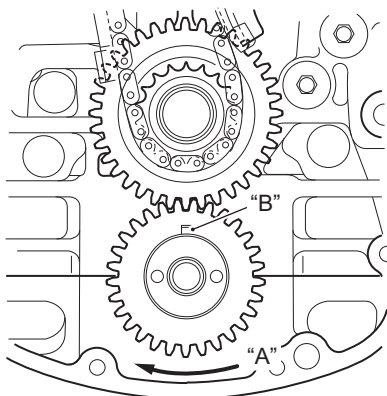
### Removal

- 1) Remove the power unit.  
Refer to "Power Unit Removal and Installation" (Page 1D-10).
- 2) Turn the crankshaft in its normal running direction "A" until the matching mark "B" (key) on the crankshaft drive gear points to 12 o'clock position (toward cylinder head).

### NOTICE

After the timing chain has been removed, independently turning camshaft or crankshaft will cause interference between piston and valve, which cause damage to these related parts.

Do not rotate the camshaft and/or crankshaft with timing chain removed.



IDG211140075-01

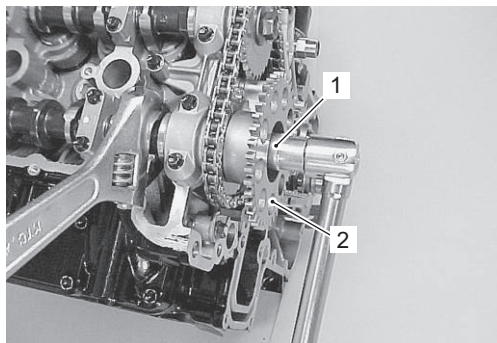
"A": Crankshaft normal running direction

"B": Matching mark (key)

- 3) Remove bolt (1) and oil pump drive sprocket (2).

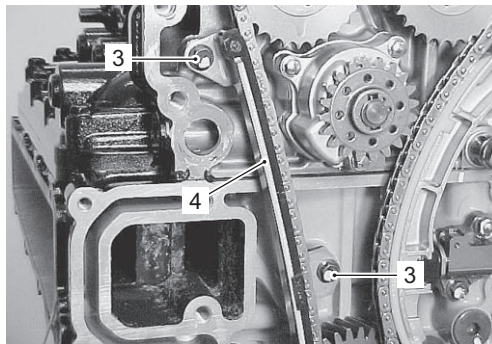
### NOTE

Hold camshaft by placing a wrench on the hexagon area of camshaft.



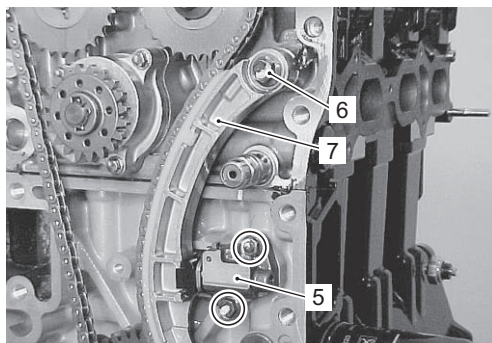
IDG211140076-01

- 4) Remove bolts (3) and timing chain guide (4).



IDG211140077-01

- 5) Remove bolt, nut and chain tensioner adjuster (5).  
Remove bolt (6) and chain tensioner (7).

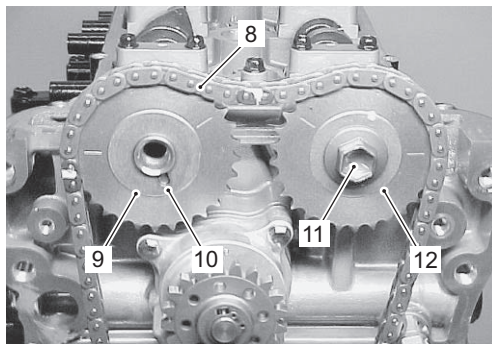


IDG211140078-01

- 6) Remove timing chain (8), exhaust camshaft timing sprocket (9) and pin (10).  
Remove bolt (11), intake camshaft timing sprocket (12) and pin.

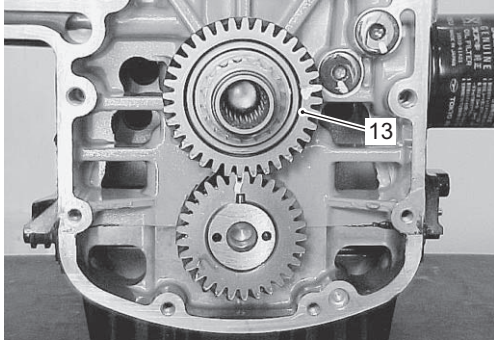
### NOTE

Hold camshaft by placing a wrench on the hexagon area of camshaft.



IDG211140079-01

- 7) Remove driven gear (13).

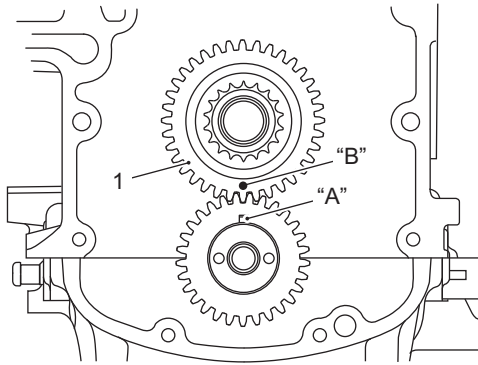


IDG211140080-01

### Installation

Installation is reverse order of removal with special attention to the following steps.

- 1) Check that matching mark (key way) "A" on the crankshaft drive gear points to 12 o'clock position (towards cylinder head).
- 2) Install the driven gear (1) on the cylinder block so that matching mark "A" aligns with matching mark "B" on the driven gear as shown in illustration.

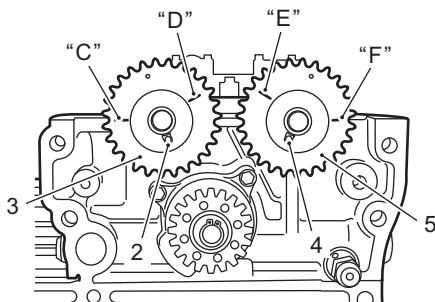


IDG211140081-01

- 3) Install pin (2) and sprocket (3) on exhaust camshaft. Install pin (4) and sprocket (5) on intake camshaft.

### NOTE

**When installing camshaft timing sprocket, position side of sprocket with two engraved lines "C", "D", "E" and "F" facing down toward engine holder as shown in figure.**



IDG211140082-01

- 4) Tighten the bolt (6) to the specified torque.

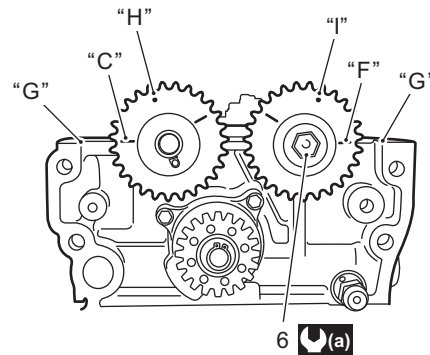
### NOTE

**Hold camshaft by placing a wrench on the hexagon area of camshaft.**

### Tightening torque

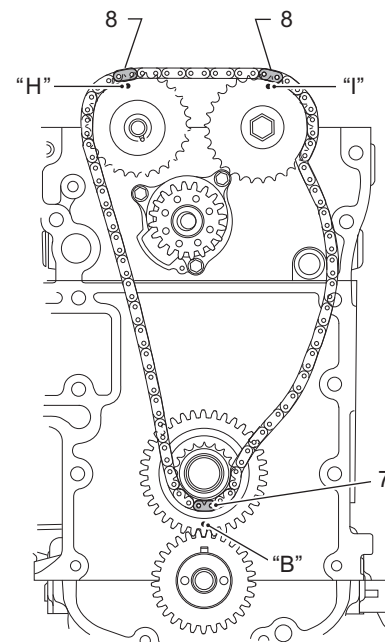
**IN. timing sprocket bolt (a): 78 N·m (7.8 kgf-m, 56.5 lbf-ft)**

- 5) Check that engraved lines "C" and "F" on sprockets are opposite each other and aligned with mating face "G" of cylinder head cover when matching marks (dot) "H" and "I" on sprockets are located as shown in figure.



IDG211140083-02

- 6) As shown in figure, position timing chain on driven gear sprocket with GOLD plate (7) of chain aligned with matching mark "B" on driven gear, then engage timing chain with exhaust sprocket with one BLUE plate (8) of chain aligned with matching mark "H" of exhaust sprocket.
- 7) As shown in figure, engage timing chain with intake sprocket with another BLUE plate (8) of chain aligned with matching mark "I" of intake sprocket.

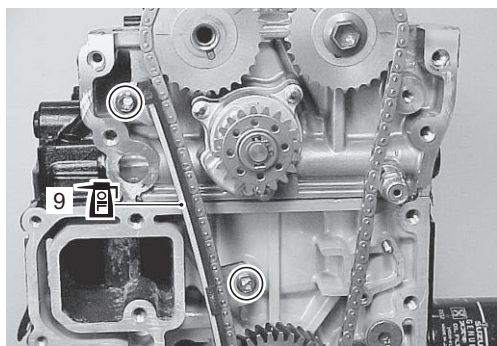


IDG211140084-01



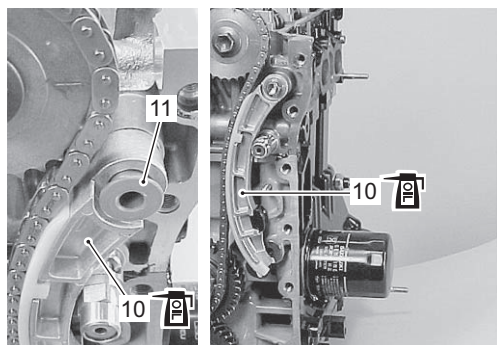
## 1D-18 Power Unit Mechanical:

- 8) Apply engine oil to the timing chain guide (9). Install the timing chain guide, then tighten bolts securely.



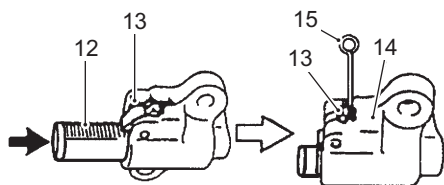
IDG211140085-01

- 9) Apply engine oil to chain tensioner (10). Insert spacer (11) into chain tensioner. Install chain tensioner as shown in figure.



IDG211140086-01

- 10) With latch of tensioner adjuster pushed in and plunger pushed back into body, insert stopper between latch and body. After inserting stopper, check to make sure that plunger will not come out.



IDG211140087-01

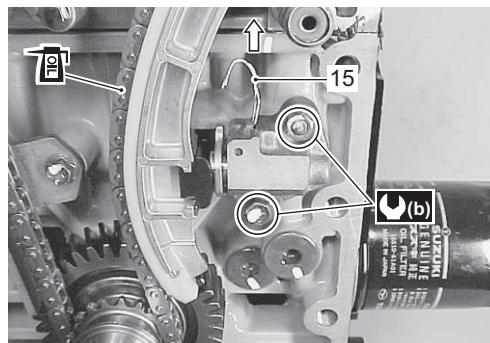
12. Plunger	14. Body
13. Latch	15. Stopper

- 11) Install timing chain tensioner adjuster. Tighten bolt and nut to specified torque.

### Tightening torque

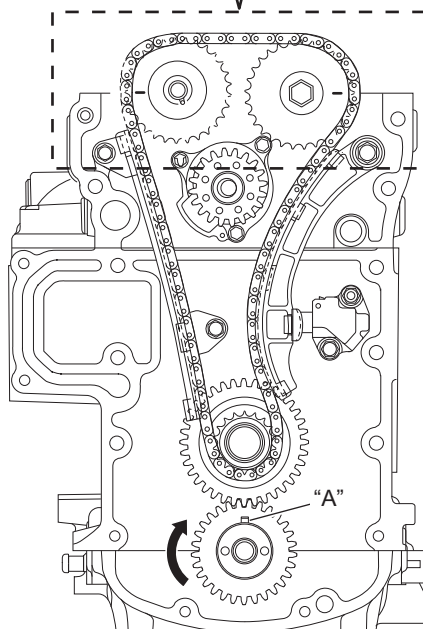
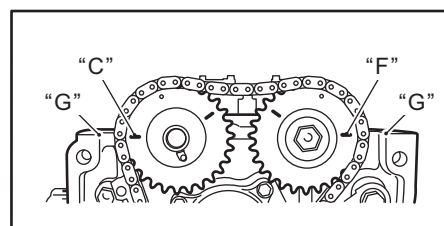
Timing chain tensioner adjuster bolt/nut (b): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)

- 12) Apply engine oil to timing chain. Remove stopper (15) from tensioner adjuster to release plunger.



IDG211140088-05

- 13) Turn crankshaft in normal running direction two complete turns and check that crankshaft matching mark (key way) "A" points toward the top and at the same time, engraved lines "C" and "F" on sprockets aligns with cylinder head cover mating face "G".



IDG211140089-01

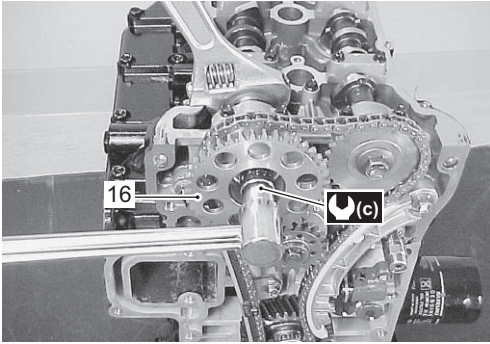
- 14) Install oil pump drive sprocket (16) and tighten bolt to specified torque.

### NOTE

Hold camshaft by placing a wrench on the hexagon area of camshaft.

**Tightening torque**

**Oil pump drive sprocket bolt (c): 78 N·m (7.8 kgf-m, 56.5 lbf-ft)**



IDG211140090-02

### Timing Chain, Chain Tensioner and Camshaft Sprockets Inspection

CENDG2111406013

**NOTE**

**If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.**

**Timing Chain**

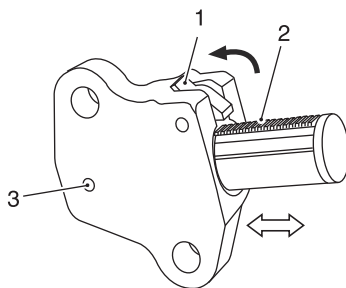
Inspect timing chain for wear or damage.  
If excessive wear or other damage is found, replace it.



IDG211140092-01

**Tensioner Adjuster**

Inspect tensioner adjuster for smooth operation.  
Replace if fault is noted.  
Check oil delivery passage to tensioner.

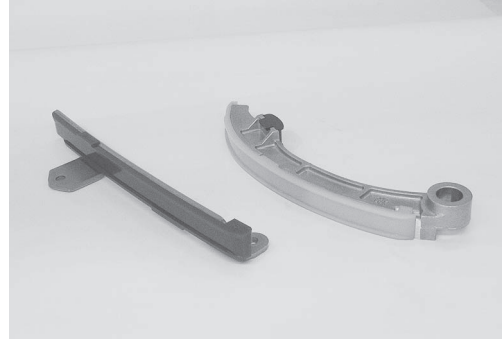


I9J011140182-01

1. Latch	3. Oil passage
2. Tooth surface	

**Timing Chain Tensioner / Chain Guide**

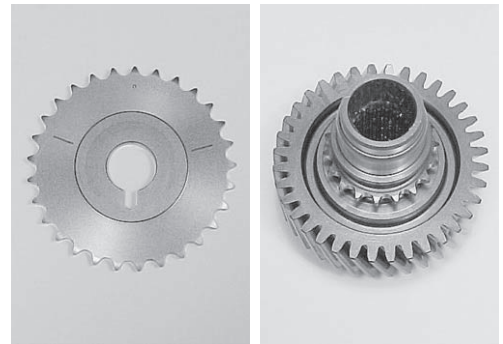
- Check chain tensioner shoe for wear or damage.  
If excessive wear or other damage is found, replace it.
- Check chain guide shoe for wear or damage.  
If excessive wear or other damage is found, replace it.



IDG211140093-01

**Camshaft Timing Sprocket**

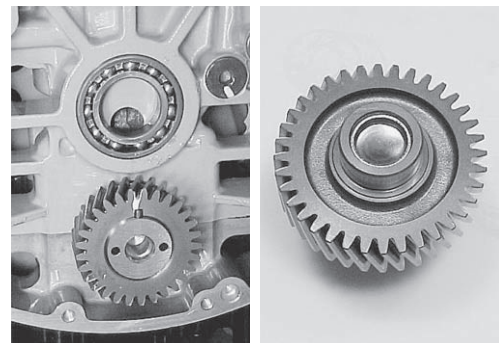
Check teeth of sprocket for wear or damage.  
If excessive wear or other damage is found, replace it.



IDG211140094-01

**Driven Gear and Drive Gear Bearing**

- Inspect drive gear and driven gear for wear or other damage.  
Replace if necessary.
- Inspect driven gear bearing for pitting, rough or other damage.  
Replace if necessary.



IDG211140091-01

## Camshaft, Tappet and Shim Removal and Installation

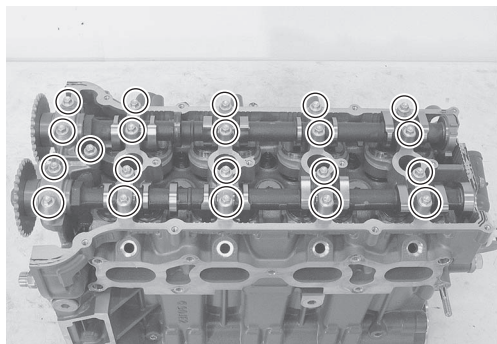
CENDG2111406014

### Removal

- 1) Remove the power unit.  
Refer to "Power Unit Removal and Installation" (Page 1D-10).
- 2) Remove the timing chain and chain tensioner.  
Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-16).
- 3) Remove the bolts securing camshaft housing to cylinder head, then remove each camshaft housing.

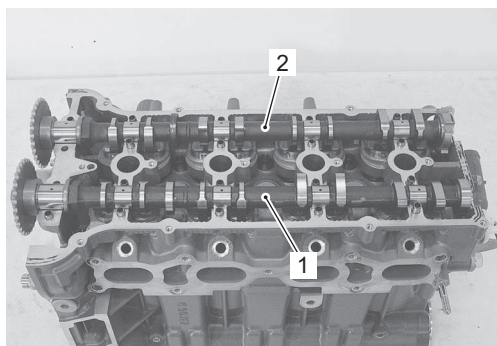
### NOTE

For ease of assembly, note position of each individual camshaft housing.



IDG211140095-01

- 4) Remove intake camshaft (1) and exhaust camshaft (2).

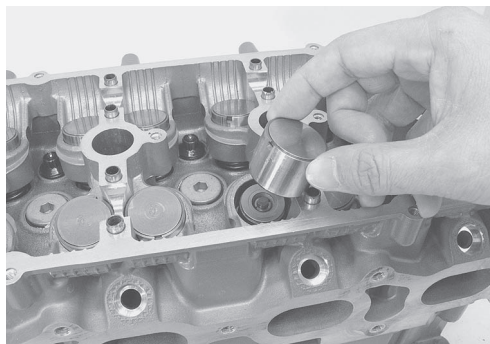


IDG211140096-02

- 5) Remove tappets and tappet shims.

### NOTE

All tappets and tappet shims must be installed in their original positions.  
For ease of assembly, lay out tappets and record shim thickness for each individual cylinder/valve position.

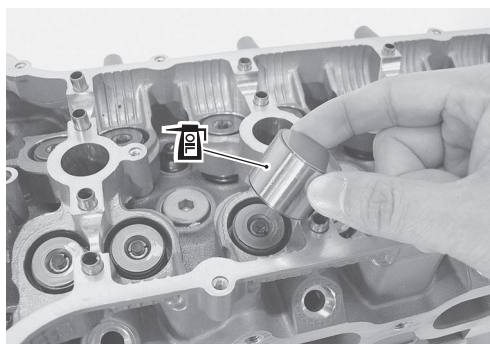


IDG211140097-01

### Installation

Installation is reverse order of removal with special attention to the following steps.

- 1) Apply engine oil around tappets.
- 2) Install tappets and tappet shims.



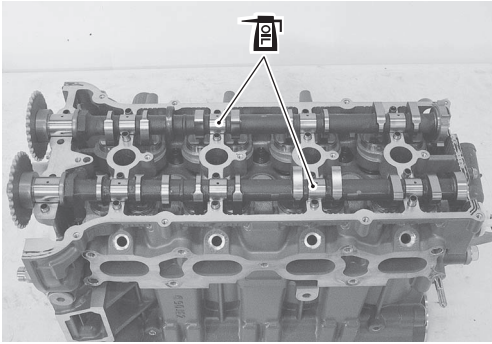
IDG211140098-01

- 3) Apply engine oil to surface of each camshaft lobe and journal, then place them onto cylinder head.

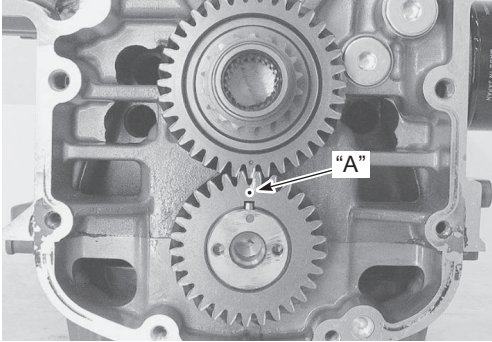
### NOTE

Before installing camshafts, turn crankshaft until the matching mark (key way) "A" on the crankshaft drive gear points to 12 o'clock (toward cylinder head).



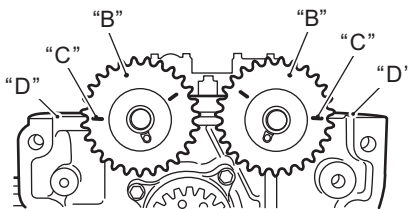


IDG211140099-01



IDG211140100-01

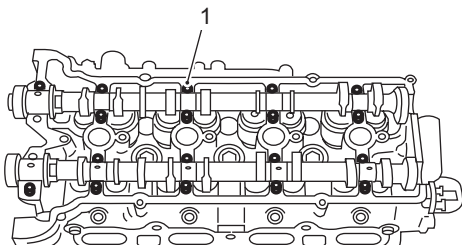
- 4) Adjust relative position between sprockets and chain so that matching marks (dot) "B" on timing sprockets are as shown in figure and engraved lines "C" on sprockets align with cylinder head cover mating face "D".



IDG211140101-01

"B": Matching mark
"C": Engraved line
"D": Cylinder head cover mating face

- 5) Install camshaft housing pins as shown in figure.



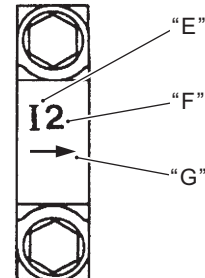
IDG211140185-01

1. Pin

- 6) Check position of camshaft housing. Install housings as indicated by these marks.

#### NOTE

Embossed marks are provided on each camshaft housing indicating position and direction of installation.



IDG211140103-01

"E": I: Intake side, E: Exhaust side
"F": Position from flywheel magneto side
"G": Pointing to flywheel magneto side

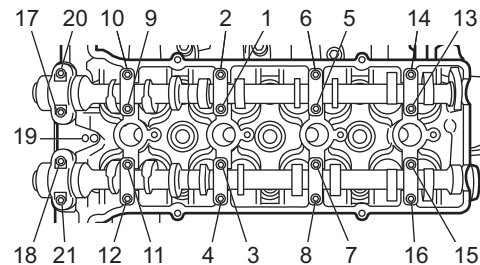
- 7) Lightly seat all housing bolts.  
According to numerical order in figure, tighten bolts to 1/3 of specified torque, then 2/3 of specified torque and finally to full specified torque.

#### NOTE

Apply engine oil lightly to housing bolt.

#### Tightening torque

Camshaft housing bolt (a): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)



IDG211140104-01

- 8) Install timing chain.  
Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-16).
- 9) Adjust tappet clearance.  
Refer to "Tappet Clearance Inspection and Adjustment" in Section 0B (Page 0B-7).

**Camshaft, Tappet and Shim Inspection**

CENDG2111406015

**NOTE**

**If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.**

**Cam Face**

Inspect cam face for scratches and wear.

If any of the above conditions are found, replace camshaft.

**Cam Wear**

Using micrometer, measure cam height.

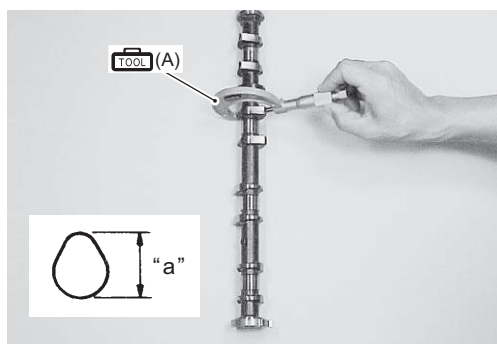
If measurement exceeds service limit, replace camshaft.

**Special tool**

 (A): 09900-20202 (Micrometer (25 – 50 mm))

**Cam height “a” (For DF100A/115A/140A)**

	Standard	Service limit
IN	39.520 – 39.680 mm (1.5559 – 1.5622 in)	39.420 mm (1.5520 in)
EX	39.320 – 39.480 mm (1.5480 – 1.5543 in)	39.220 mm (1.5441 in)



IDG211140105-01


**Camshaft Runout**


Support camshaft on a surface plate using a set of V-blocks.

Measure runout using a dial gauge.

If measurement exceeds service limit, replace camshaft.

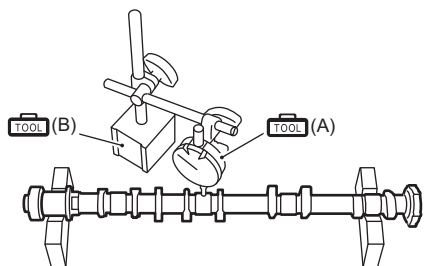
**Special tool**

 (A): 09900-20606 (Dial gauge)

 (B): 09900-20701 (Magnetic stand)

**Camshaft runout**

**Service limit: 0.10 mm (0.004 in.)**



IDG211140106-02

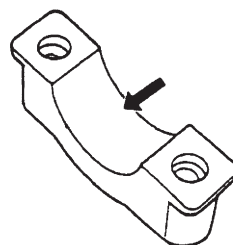
**Camshaft Journal Wear**

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

If any of the above conditions are found, replace camshaft or cylinder head with housing.

**NOTE**

**Camshaft housing and cylinder head must be replaced as a set.**




I9J011140030-01

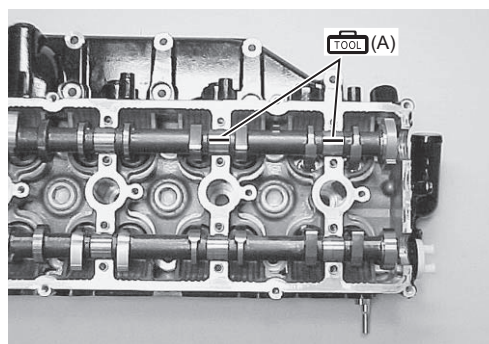
**Camshaft Journal Oil Clearance**

Check journal oil clearance using Plastigauge as follows.

- 1) Clean housing and camshaft journals.
- 2) Install camshaft to cylinder head.
- 3) Place Plastigauge across the full width of camshaft journal (parallel to camshaft).

**Special tool**

 (A): 09900-22301 (Plastigauge (0.025 – 0.076 mm))



IDG211140107-01

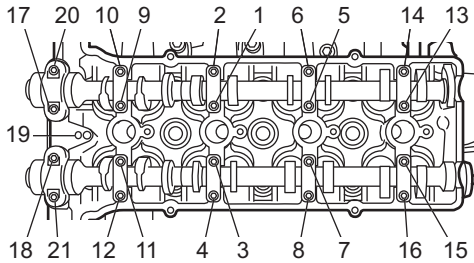
- 4) Install camshaft housing. Tighten housing bolts in 3 steps (1/3 of specification, 2/3 of specification, full torque specification) in the indicated order.

#### Tightening torque

**Camshaft housing bolt: 11 N·m (1.1 kgf-m, 8.0 lbf-ft)**

#### NOTE

**Do not rotate camshaft while Plastigauge is installed.**



IDG211140108-01

- 5) Remove camshaft housing.  
6) Using scale (1) on Plastigauge envelope, measure Plastigauge (2) at its widest point.

#### Camshaft journal oil clearance No.1 – No.4

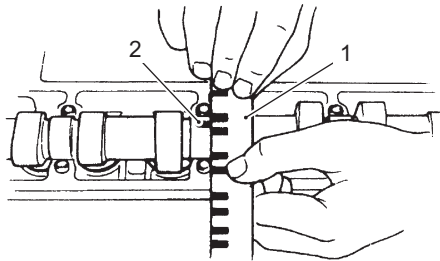
**Standard: 0.020 – 0.062 mm (0.0008 – 0.0024 in.)**

**Service limit: 0.120 mm (0.0047 in.)**

#### Camshaft journal oil clearance No.5

**Standard: 0.045 – 0.087 mm (0.0018 – 0.0034 in.)**

**Service limit: 0.120 mm (0.0047 in.)**



IDG211140184-02

1. Scale	2. Plastigauge
----------	----------------

If journal oil clearance exceeds the service limit, measure camshaft journal (outside dia.) and camshaft housing (inner dia.). Based on measurements, replace camshaft and/or cylinder head with camshaft housing.

#### Camshaft journal outside diameter No.1 – No.4

**Standard: 22.959 – 22.980 mm (0.9039 – 0.9047 in.)**

#### Camshaft journal outside diameter No.5

**Standard: 25.934 – 25.955 mm (1.0210 – 1.0219 in.)**

#### Camshaft journal (housing) inside diameter No.1 – No.4

**Standard: 23.000 – 23.021 mm (0.9055 – 0.9063 in.)**

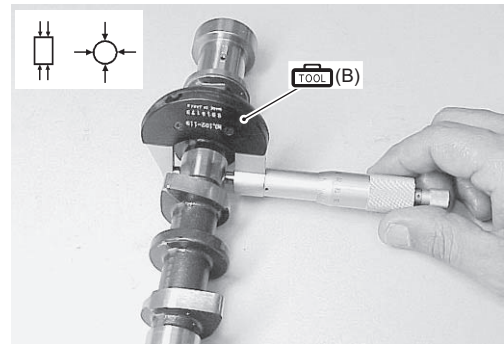
#### Camshaft journal (housing) inside diameter No.5

**Standard: 26.000 – 26.021 mm (1.0236 – 1.0244 in.)**

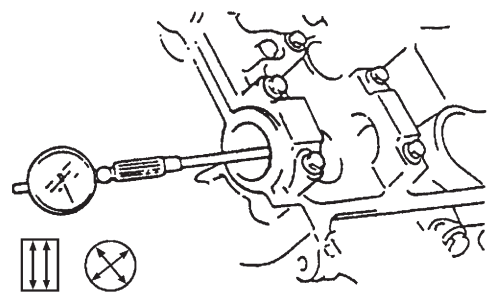
#### Special tool

**TOOL (B): 09900-20202 (Micrometer (25 – 50 mm))**

**TOOL (B): 09900-20205 (Micrometer (0 – 25 mm))**



IDG211140109-01

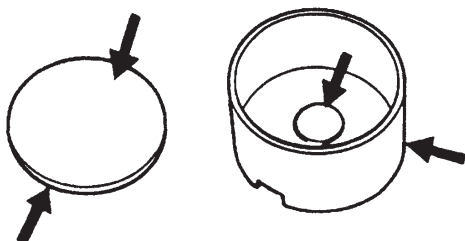


I9J011140200-02



### Wear of Tappet and Shim

Check tappet and shim for pitting, scratches, or damage. If any above conditions are found, replace component.



I9J011140076-01

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

### Special tool

 : 09900-20202 (Micrometer (25 – 50 mm))

### Cylinder head bore to tappet clearance

Standard: 0.025 – 0.066 mm (0.0010 – 0.0026 in.)

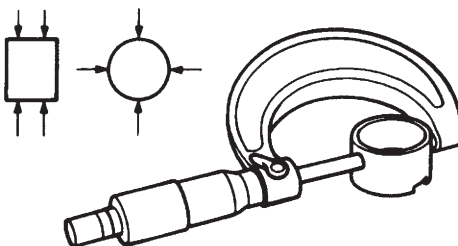
Service limit: 0.150 mm (0.0059 in.)

### Tappet outer diameter

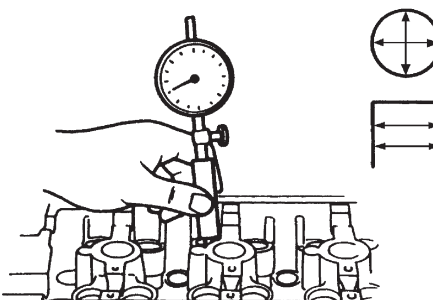
Standard: 30.959 – 30.975 mm (1.2189 – 1.2195 in.)

### Cylinder head tappet bore

Standard: 31.000 – 31.025 mm (1.2205 – 1.2215 in.)



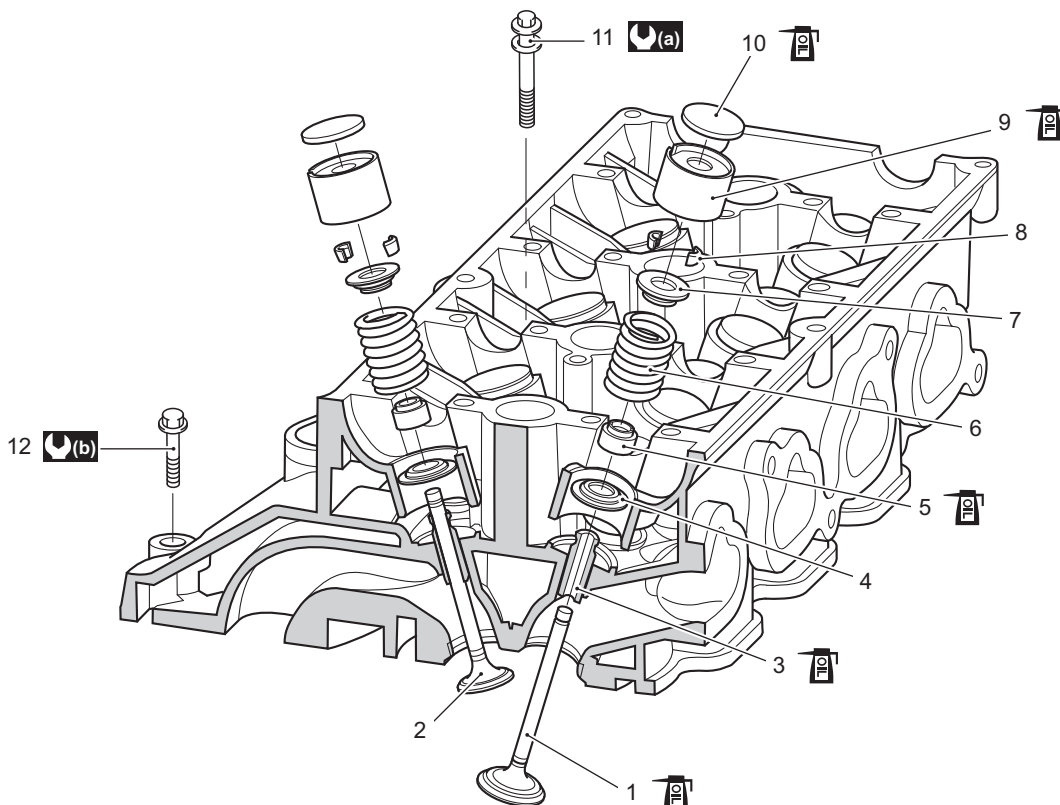
I9J011140031-01






I9J011140032-01

### Cylinder Head Assembly Components

CENDG2111406016



IDG211140110-01

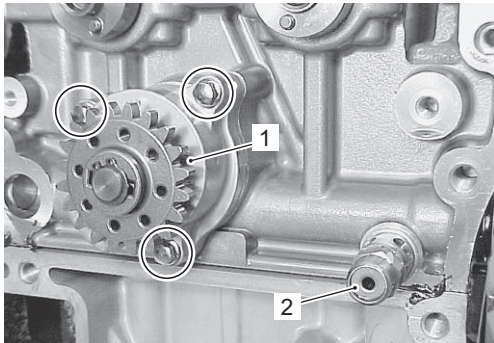
1. Intake valve	5. Valve stem seal	9. Tappet	 (a) : 70 N·m (7.0 kgf-m, 50.5 lbf-ft)
2. Exhaust valve	6. Valve spring	10. Tappet shim	 (b) : 25 N·m (2.5 kgf-m, 18.0 lbf-ft)
3. Valve guide	7. Valve spring retainer	11. Cylinder head bolt (10 mm)	 : Apply engine oil.
4. Valve spring seat	8. Valve cotter	12. Cylinder head bolt (8 mm)	

## Cylinder Head Removal and Installation

CENDG2111406017

### Removal

- 1) Prior to removing cylinder head assembly;
  - Remove the power unit.  
Refer to "Power Unit Removal and Installation" (Page 1D-10).
  - Remove the timing chain.  
Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-16).
  - Remove the IN. and EX. camshafts.  
Refer to "Camshaft, Tappet and Shim Removal and Installation" (Page 1D-20).
  - Remove bolts and oil pump (1).  
Refer to "Oil Pump Removal and Installation" in Section 1E (Page 1E-3).
  - Remove oil relief valve (2).



IDG211140186-01

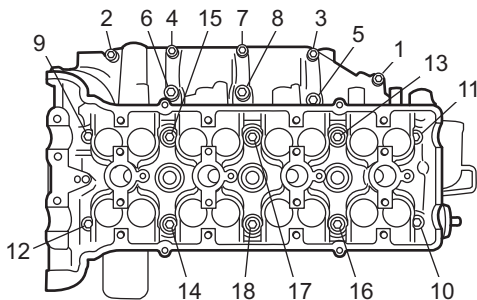
- 2) Loosen and remove eighteen cylinder head bolts in the order indicated in figure.  
Remove cylinder head assembly and head gasket.

### NOTE

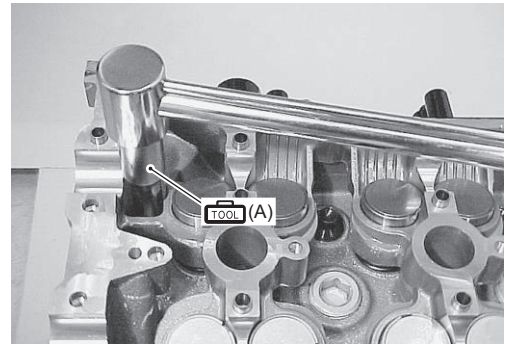
Use special tool (10 mm deep socket wrench) when loosening cylinder head bolts.

### Special tool

**TOOL (A):** 09919-16010 (Deep socket wrench (10 mm))



IDG211140111-01



IDG211140112-01

### Installation

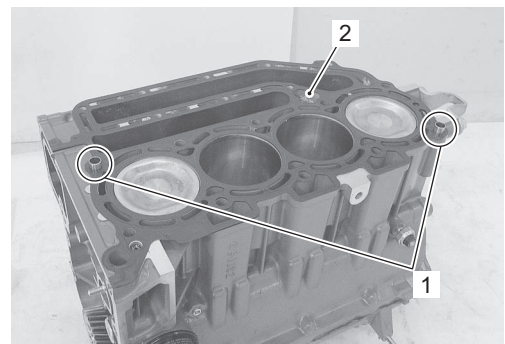
Installation is in reverse order of removal paying special attention to the following steps.

### NOTICE

A previously used gasket may leak combustion gas and/or cooling water, resulting in engine damage.

Do not reuse gasket once removed.  
Always use a new gasket.

- 1) Insert the dowel pins (1) and place a new cylinder head gasket (2) into position on the cylinder.

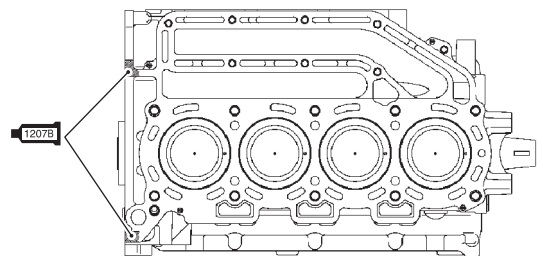


IDG211140113-01

### NOTE

Before installing cylinder head gasket, apply sealant to both surfaces of the hatched areas shown in illustration.

**1207B** : Sealant 99000-31140 (SUZUKI Bond 1207B (100 g))



IDG211140187-02

- 2) Position cylinder head on cylinder.

### NOTE

**Use special tool (10 mm deep socket wrench) when tightening cylinder head bolts.**

### Special tool

**TOOL (A): 09919-16010 (Deep socket wrench (10 mm))**

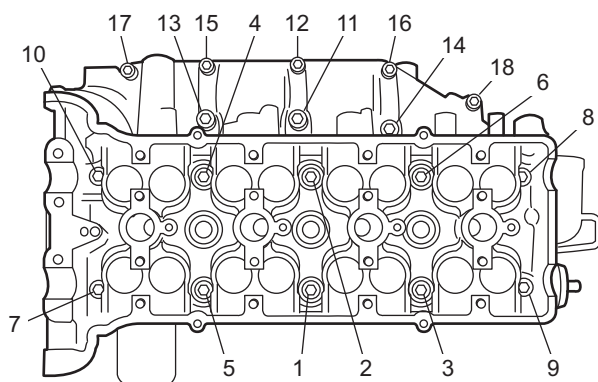
- 3) Apply engine oil to cylinder head bolts and tighten them gradually as follows.
  - a) Tighten all cylinder head bolts to 50 percent (%) of specified torque according to sequence in figure.

### Tightening torque

**Cylinder head bolt (1st step) [10 mm]: 35**

**N·m (3.5 kgf-m, 25.5 lbf-ft)**

**Cylinder head bolt (1st step) [8 mm]: 12 N·m (1.2 kgf-m, 8.5 lbf-ft)**



IDG211140114-01

- b) Loosen all cylinder head bolts to 0 N·m (0 kgf-m, 0 lbf-ft.) according to reverse sequence in figure.
- c) Again tighten all cylinder head bolts to 50 percent (%) of specified torque according to sequence in figure.

### Tightening torque

**Cylinder head bolt (3rd step) [10 mm]: 35**

**N·m (3.5 kgf-m, 25.5 lbf-ft)**

**Cylinder head bolt (3rd step) [8 mm]: 12 N·m (1.2 kgf-m, 8.5 lbf-ft)**

- d) Finally tighten all cylinder head bolts to specified torque according to sequence in figure.

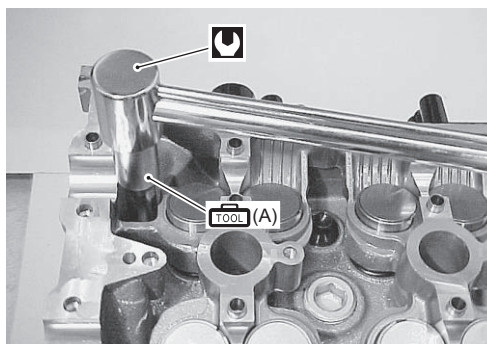
### Tightening torque

**Cylinder head bolt (Final step) [10 mm]: 70**

**N·m (7.0 kgf-m, 50.5 lbf-ft)**

**Cylinder head bolt (Final step) [8 mm]: 25**

**N·m (2.5 kgf-m, 18.0 lbf-ft)**



IDG211140115-01

- 4) Install the IN. and EX. camshafts.  
Refer to "Camshaft, Tappet and Shim Removal and Installation" (Page 1D-20).
- 5) Install the oil pump and oil relief valve.  
Refer to "Oil Pump Removal and Installation" in Section 1E (Page 1E-3).
- 6) Install the timing chain.  
Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-16).

## Cylinder Head Disassembly and Assembly

CENDG2111406018

### Disassembly

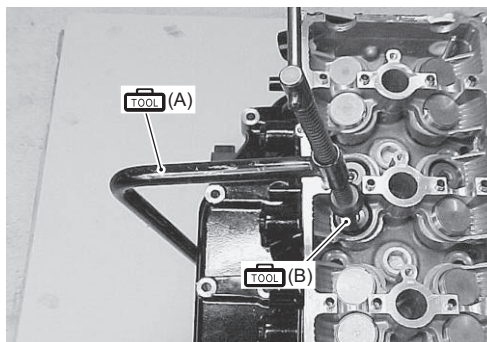
- 1) Using valve lifter and attachment, remove valve cotters (1) while compressing valve spring.

### Special tool

**TOOL (A): 09916-19030 (Valve lifter)**

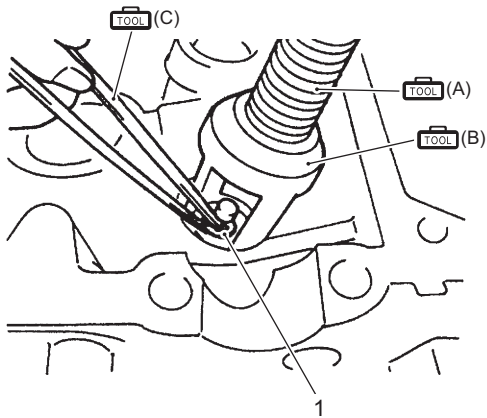
**TOOL (B): 09916-14910 (Valve lifter attachment)**

**TOOL (C): 09916-84511 (Tweezers)**



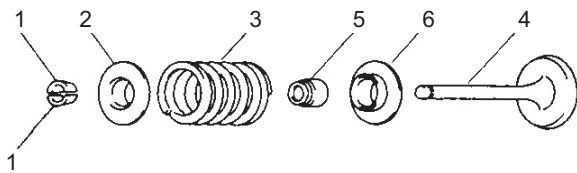
IDG211140116-02





I9J011140209-01

- 2) Remove valve spring retainer (2), valve spring (3) and valve (4).

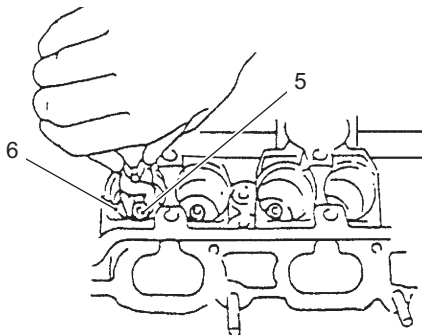


I9J011140210-01

- 3) Remove valve stem seal (5) and valve spring seat (6).

#### NOTE

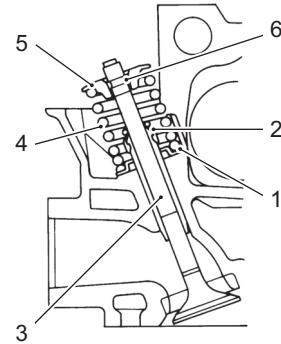
Reassemble each valve and valve spring in their original positions.



I9J011140211-02

#### Assembly

Reassemble in reverse order of disassembly paying special attention to the following steps.



I9J011140212-03

- 1) Install valve spring seat (1) to cylinder head.
- 2) After applying engine oil to stem seal (2) and spindle of special tool (A), fit stem seal to spindle. Then, pushing special tool by hand, install stem seal to valve guide. Check to be sure that seal is properly fixed to valve guide.

#### NOTICE

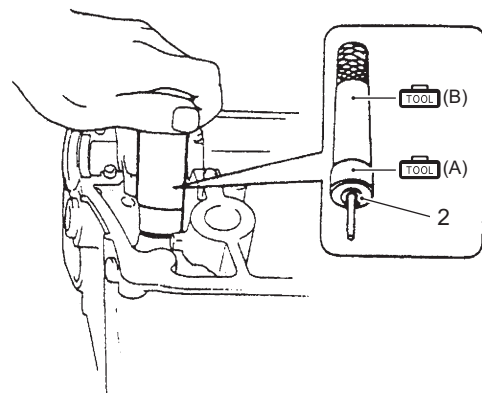
Removing the stem seal can be damaged, causing oil to get down past the seal.

Do not reuse stem seal once removed. Always install new seal.

#### Special tool

**TOOL (A): 09917-98221 (Valve guide stem seal installer attachment)**

**TOOL (B): 09916-57350 (Valve guide installer handle)**



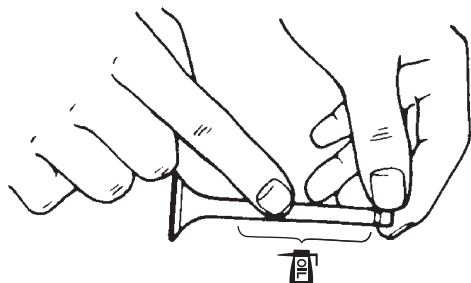
I9J011140033-03

## 1D-28 Power Unit Mechanical:

- 3) Apply engine oil to stem seal, valve guide bore and valve stem.
- 4) Install valve (3) to valve guide.

### NOTE

Reassemble each valve and valve spring to their original position.

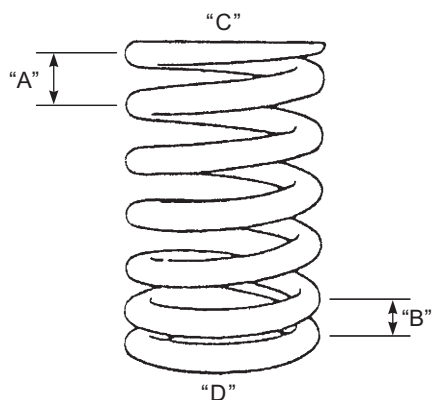


I9J011140034-01

- 5) Install valve spring (4), and valve retainer (5).

### NOTE

Set valve spring in place with narrow spiral area facing valve seat.



I9J011140035-01


"A": Large-pitch	"C": Valve spring retainer side
"B": Small-pitch	"D": Valve spring seat side


- 6) Hold valve spring compressed with special tool and install valve cotters (6).  
Make sure valve cotters are properly seated in groove "A".


### NOTE

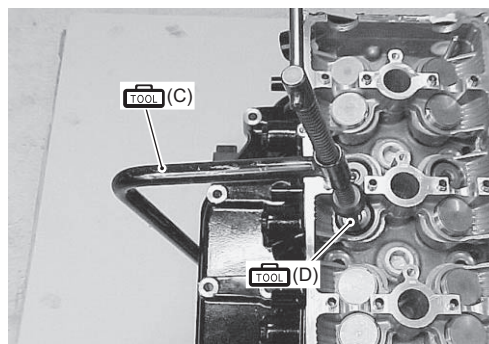
When compressing the valve spring, be careful not to damage the tappet hole.

### Special tool

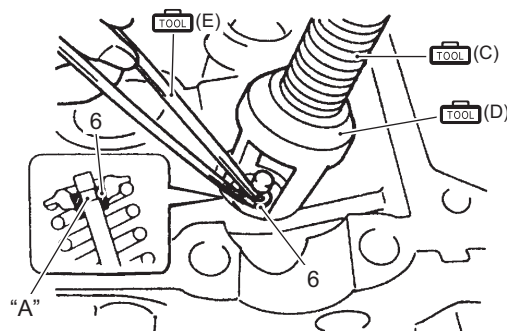
 (C): 09916-19030 (Valve lifter)

 (D): 09916-14910 (Valve lifter attachment)

 (E): 09916-84511 (Tweezers)



IDG211140117-03



I9J011140036-02

## Cylinder Head Components Inspection and Servicing

CENDG2111406019

### NOTE

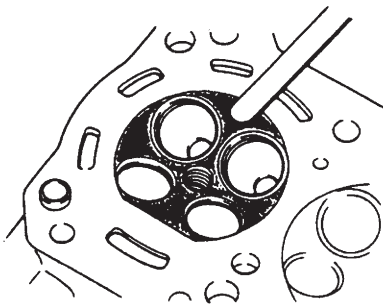
If cracks, excessive wear or other damage is found on any component, replace component.

### Cylinder Head

- Remove all carbon from combustion chambers.

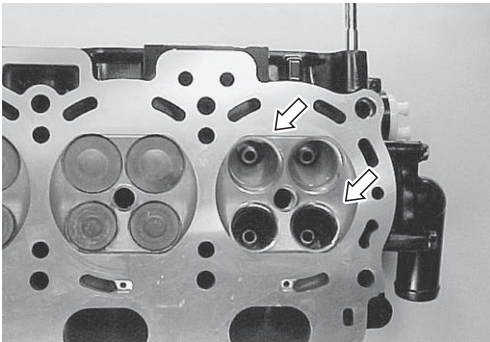
### NOTE

- Do not use any sharp edged tool to scrape carbon off cylinder head or its components.
- Be careful not to scuff or nick metal surfaces when decarbonizing.



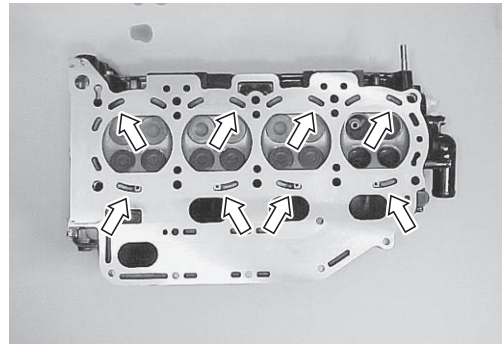
I9J011140037-01

- Check cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface.
- Check valve seat, if cracks or other damage is found, replace cylinder head.



IDG211140118-01

- Check water jackets. If clogged or obstructed, clean water jackets.




IDG211140119-01

### Cylinder head distortion

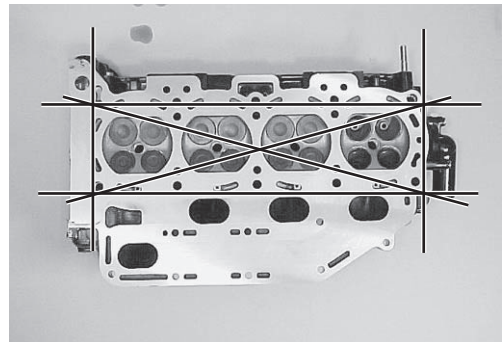
- Using a straightedge and thickness gauge, measure cylinder head distortion (gasket surface) at a total of six locations as shown. If measurement exceeds service limit, resurface or replace cylinder head.

### Special tool

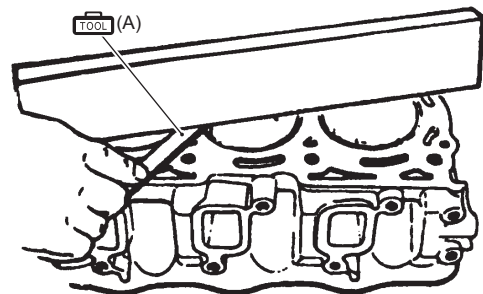
 (A): 09900-20803 (Thickness gauge)

### Cylinder head distortion

Service limit: 0.05 mm (0.002 in.)



IDG211140120-01



IDG211140121-01



### Manifold seating faces distortion

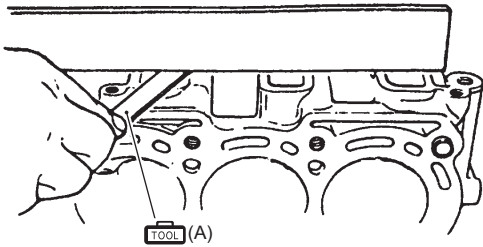
Using a straightedge and thickness gauge, check cylinder head to manifold seating faces.  
If measurement exceeds service limit, resurface or replace cylinder head.

#### Special tool

 (A): 09900-20803 (Thickness gauge)

### Manifold seating faces distortion

Service limit: 0.10 mm (0.004 in.)



IDG211140122-01

### Valve and Valve Guide

#### Valve guide to valve stem clearance

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

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

If measurement exceeds service limit, replace valve and/or valve guide.

Refer to "Valve guide replacement" (Page 1D-33).

#### Special tool

 (A): 09900-20205 (Micrometer (0 – 25 mm))

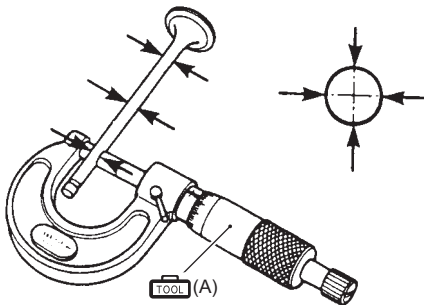
#### Valve stem outside diameter

Using micrometer, measure valve stem outside diameter.

#### Valve stem outside diameter

Standard (IN.): 5.965 – 5.980 mm (0.2348 – 0.2354 in.)

Standard (EX.): 5.940 – 5.955 mm (0.2339 – 0.2344 in.)



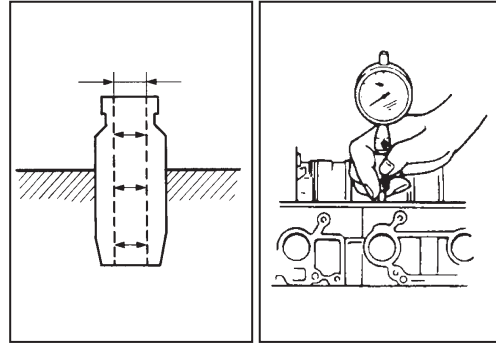
I9J011140039-02

### Valve guide inside diameter

Using a small bore gauge, measure valve guide inside diameter.

#### Valve guide inside diameter

Standard (IN., EX.): 6.000 – 6.012 mm (0.2362 – 0.2367 in.)



I9J011140040-01

#### Valve guide to valve stem clearance

Standard (IN.): 0.020 – 0.047 mm (0.0008 – 0.0019 in.)

Standard (EX.): 0.045 – 0.072 mm (0.0018 – 0.0028 in.)

Service limit (IN.): 0.070 mm (0.0028 in.)

Service limit (EX.): 0.090 mm (0.0035 in.)

#### Valve stem deflection

If unable to measure valve guide inside diameter, check "Valve stem deflection".


If measurement exceeds service limit, replace valve.


If measurement still exceeds service limit with new valve, replace valve guide.

Measure valve stem deflection as follows;

- 1) Install valve into valve guide.
- 2) Position valve head at approx. 5 mm away from valve seat.
- 3) Move valve stem end in the direction "a" – "b", and measure deflection.

#### Special tool

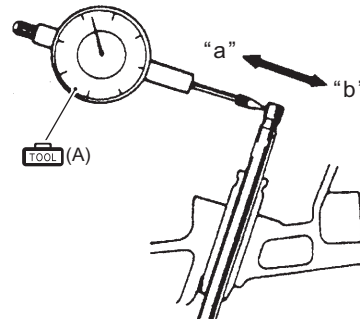
 (A): 09900-20606 (Dial gauge)

 : 09900-20701 (Magnetic stand)

#### Valve stem deflection

Service limit (IN.): 0.14 mm (0.0055 in.)

Service limit (EX.): 0.18 mm (0.0071 in.)



IDG211140123-02

**Valve stem end**

Inspect valve stem end face for pitting and wear. If pitting or wear is found, valve stem end may be resurfaced. Use caution when resurfacing, do not grind away stem end chamfer. When chamfer has been worn away, replace valve.



I9J011140041-01

**Valve stem runout**

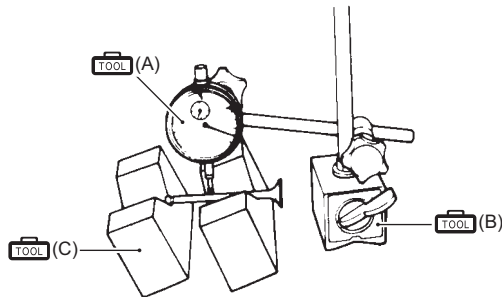
Measure valve stem runout. If measurement exceeds service limit, replace valve.

**Special tool**

- TOOL (A):** 09900-20606 (Dial gauge)  
**TOOL (B):** 09900-20701 (Magnetic stand)  
**TOOL (C):** 09900-21304 (Steel "V" block set)

**Valve stem runout**

Service limit: 0.05 mm (0.0020 in.)



I9J011140042-02

**Valve head radial runout**

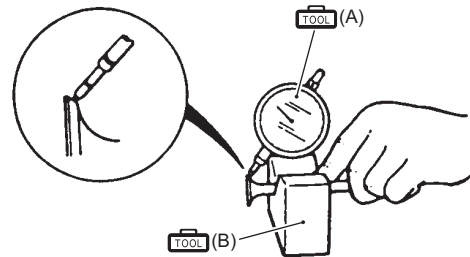
Measure valve head radial runout. To measure runout, rotate valve slowly. If measurement exceeds service limit, replace valve.

**Special tool**

- TOOL (A):** 09900-20606 (Dial gauge)  
**TOOL (B):** 09900-21304 (Steel "V" block set)  
**TOOL :** 09900-20701 (Magnetic stand)

**Valve head radial runout**

Service limit: 0.08 mm (0.003 in.)



I9J011140043-03

**Valve head thickness**

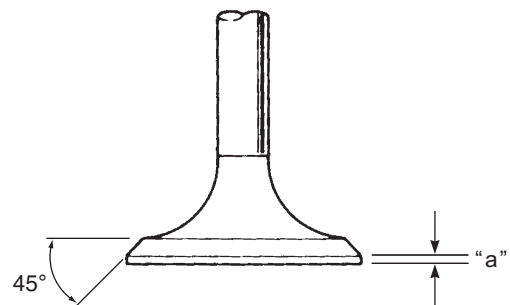
Measure thickness "a" of valve head. If measurement exceeds service limit, replace valve.

**Special tool**

- TOOL :** 09900-20101 (Vernier calipers (150 mm))

**Valve head thickness**

Standard (IN.): 1.0 mm (0.04 in.)  
 Standard (EX.): 1.2 mm (0.05 in.)  
 Service limit (IN.): 0.7 mm (0.03 in.)  
 Service limit (EX.): 0.7 mm (0.03 in.)




I9J011140044-01

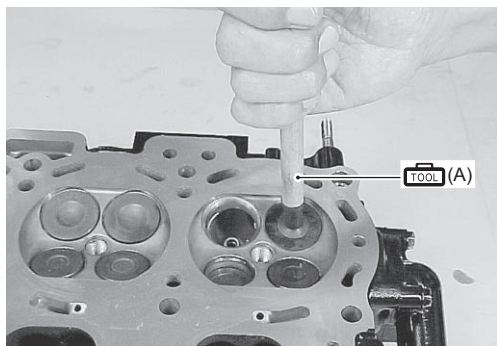
### Valve seat contact width

Measure valve seat contact width as follows:

- 1) Remove all carbon from valve and seat.
- 2) Coat valve seat evenly with prussian blue (or equivalent).
- 3) Install valve into valve guide.
- 4) Put valve lapper on valve.

#### Special tool

 (A): 09916-10911 (Valve lapper)



IDG211140124-01

- 5) Rotate valve while gently tapping valve contact area against seat.
- 6) Continue until a pattern is on valve seat face with prussian blue.
- 7) Measure valve seat contact width "b".

#### Special tool

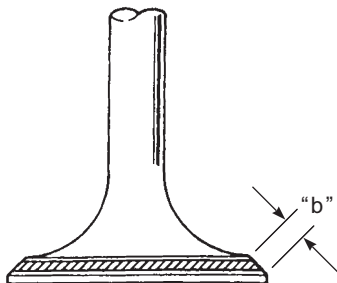
 : 09900-20101 (Vernier calipers (150 mm))

#### Valve seat contact width "b"

**Standard (IN., EX.): 1.1 – 1.3 mm (0.04 – 0.05 in.)**

If measurement exceeds specification, repair valve seat.

Refer to "Valve seat servicing" (Page 1D-32).



I9J011140045-01

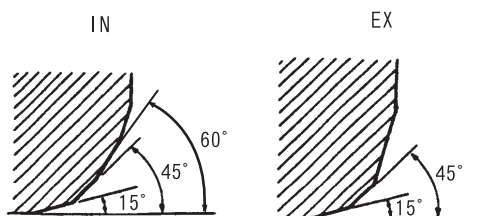
### Valve seat servicing

If valve seat contact width is out of specification, reface valve seat as follows:

#### Valve seat angle

**Intake side: 15°/45°/60°**

**Exhaust side: 15°/45°**



IDG211140125-01

To reface a valve seat, use the following valve seat cutting tool.

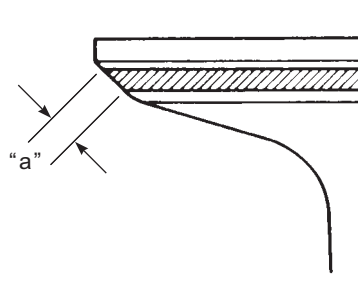
- Valve seat cutter 45° (Neway 122)
- Valve seat cutter 15° (Neway 121)
- Valve seat cutter 60° (Neway 114)
- Solid pilot (Neway, N-120-6.0)
- Handle (Neway, N-505) (09916-54910)

#### NOTE

**Turn cutter clockwise, never counterclockwise.**

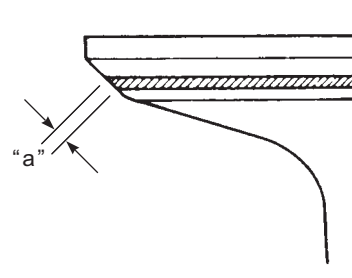
- 1) Remove all carbon from valve and valve seat.
- 2) Using 45° angle cutter, reface valve seat.
- 3) Check valve seat contact width "a".  
Refer to "Valve seat contact width" (Page 1D-32).

#### Too high (wide)



I9J011140047-01

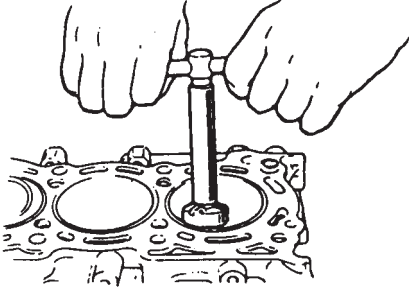
#### Too low (narrow)



I9J011140048-01



- If width "a" is too high (or wide), reface valve seat using 15° angle cutter.
- If width "a" is too low (or narrow), reface valve seat using 60° angle cutter (Intake side).
- If width "a" is too low (or narrow), reface valve seat using 45° angle cutter (Exhaust side).



IDG211140126-01

- 4) Clean up any burrs using 45° angle cutter very lightly.

#### NOTE

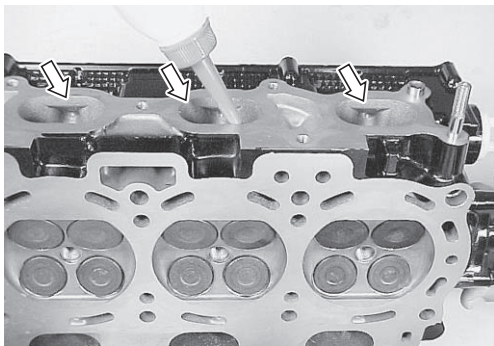
**Cut seat areas minimally only.  
Do not cut more than necessary.**

- 5) Lap valve on seat in two steps, first with coarse grit lapping compound applied to face and the second with fine grit compound.
- 6) Recheck valve seat contact width "a".

#### NOTE

**Clean and assemble cylinder head and valve components.**

**Fill intake and exhaust ports with solvent to check for leaks between valve seat and valve. If any leaks occur, inspect valve seat and face for burrs or other things that could prevent valve from sealing.**



IDG211140127-01

## Valve guide replacement

### NOTE

**Be careful not to damage cylinder head when replacing valve guide.**


- 1) Using valve guide remover, drive valve guide out from combustion chamber side towards valve spring side.

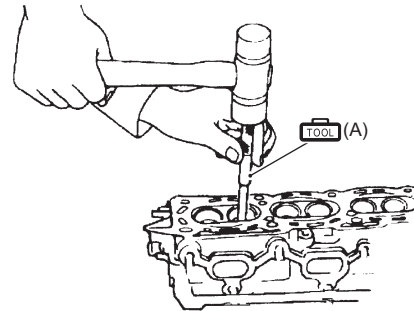
### NOTE

**Do not reuse valve guide once it has been removed.**

**Always use a new valve guide (oversize) when assembling.**

### Special tool

 (A): 09916-46020 (Valve guide remover)



I9J011140050-01


- 2) Ream valve guide hole with  $\varnothing$  11 mm reamer to true hole and remove burrs.


### NOTICE

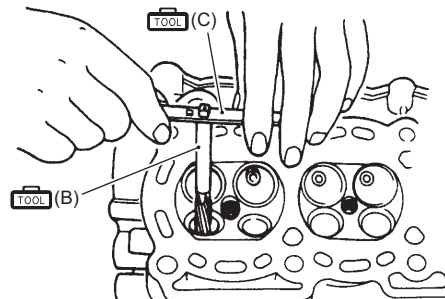
**Improper handling of the reamer will cause damage to the valve guide hole.**

**When refinishing or removing the reamer from the valve guide hole, always turn it clockwise.**

### Special tool

 (B): 09916-38210 (Valve guide reamer ( $\varnothing$  11 mm))

 (C): 09916-34542 (Valve guide reamer handle)



IDG211140128-01

### 3) Install valve guide to cylinder head.

- Heat cylinder head to a temperature of 80 – 100 °C (176 – 212 °F).  
Apply heat uniformly so that head will not be distorted.
- Use special tools to drive new valve guide into hole.  
Drive in new valve guide until special tool (valve guide installer attachment) contacts cylinder head.
- After installing, check valve guide protrusion "a".

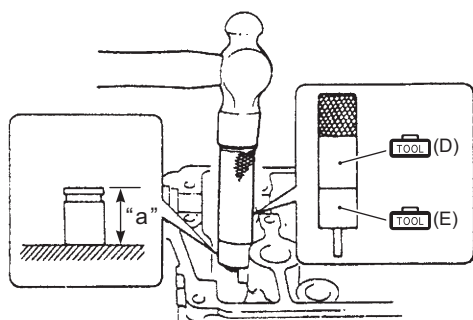
#### Special tool

**TOOL (D): 09916–57350 (Valve guide installer handle)**

**TOOL (E): 09917–87810 (Valve guide installer attachment)**

#### Valve guide protrusion "a"

**Standard (IN., EX.): 13.3 – 13.7 mm (0.52 – 0.54 in.)**



I9J011140052-01

### 4) Ream valve guide bore with ø 6 mm reamer.

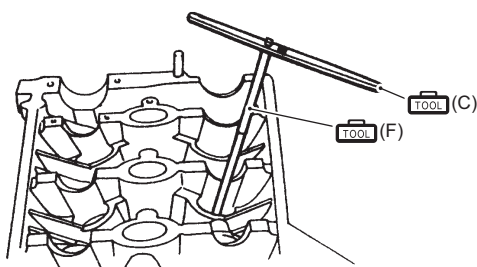
#### NOTE

**Clean and oil valve guide bore after reaming.**

#### Special tool

**TOOL (F): 09916–37810 (Valve guide reamer (ø 6 mm))**

**TOOL (C): 09916–34542 (Valve guide reamer handle)**



IDG211140129-02

#### Valve spring free length

Check spring strength by measuring free length.  
If lower than service limit, replace valve spring.

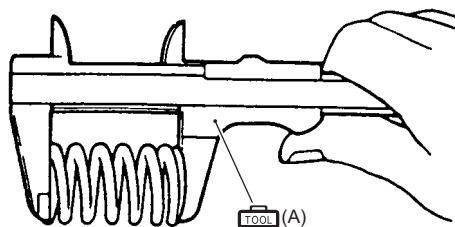
#### Special tool

**TOOL (A): 09900–20101 (Vernier calipers (150 mm))**

#### Valve spring free length

**Standard (IN., EX.): 42.73 mm (1.682 in.)**

**Service limit (IN., EX.) 41.02 mm (1.615 in.)**



I9J011140054-02

#### Valve spring preload

Measure valve spring preload.

If lower than service limit, replace valve spring.

#### Special tool

**TOOL : 09900–20101 (Vernier calipers (150 mm))**

#### Valve spring preload

**Standard (IN., EX.): 164 – 190 N (16.7 – 19.4 kg, 36.8 – 42.7 lbs.) at 32.6 mm (1.28 in.)**

**Service limit (IN., EX.): 151 N (15.1 kg, 33.3 lbs.) at 32.6 mm (1.28 in.)**



I9J011140055-01

#### Valve spring squareness

Use a square and surface plate to check each spring for squareness (clearance between end of valve spring and square).

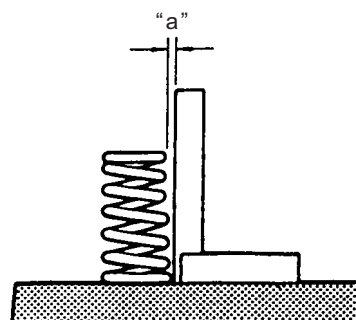
If measurement exceeds service limit, replace valve spring.

#### Special tool

**TOOL : 09900–20101 (Vernier calipers (150 mm))**

#### Valve spring squareness "a"

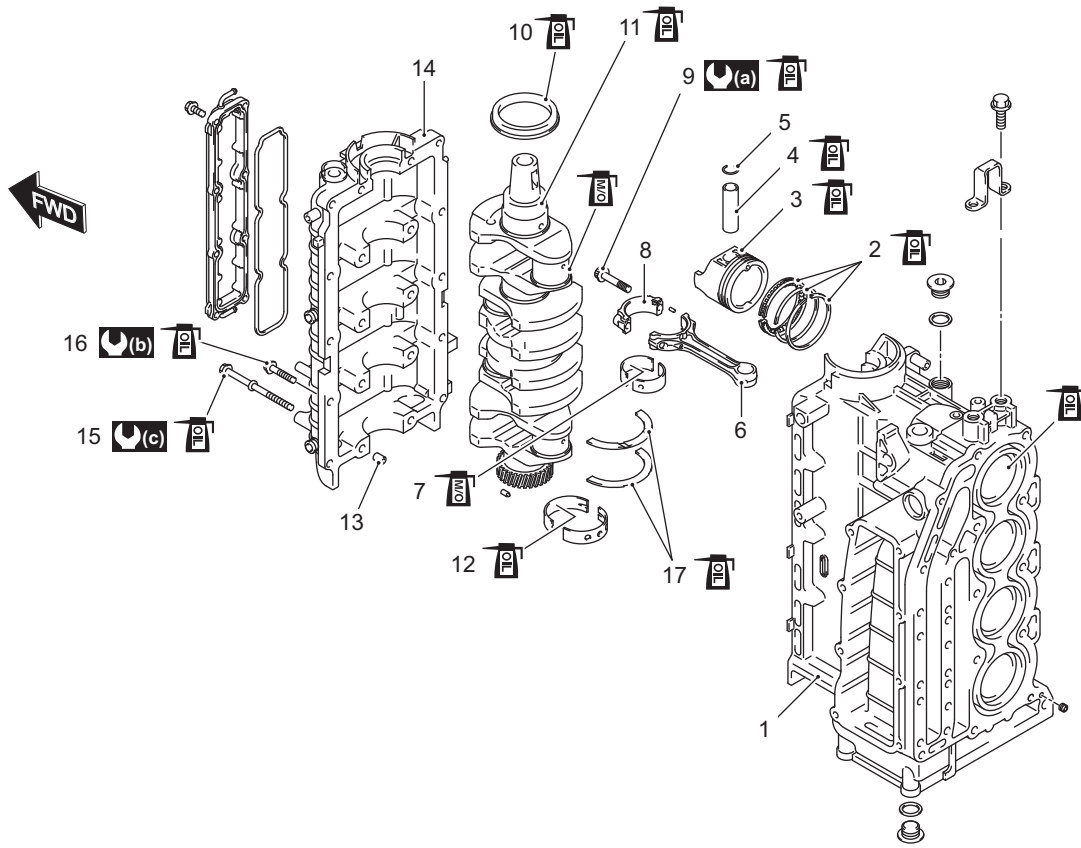
**Service limit (IN., EX.): 2.0 mm (0.08 in.)**



I9J011140056-02

## Pistons, Piston Rings, Connecting Rods, Cylinder and Crankshaft Components

CENDG2111406020



IDG211140130-03

1. Cylinder block	7. Conrod bearing	13. Dowel pin	: 25 N·m (2.5 kgf-m, 18.0 lbf-ft)
2. Piston ring set	8. Conrod cap	14. Crankcase	: 52 N·m (5.2 kgf-m, 37.5 lbf-ft)
3. Piston	9. Conrod cap bolt	15. Crankcase (inside) bolt	: Apply engine oil.
4. Piston pin	10. Oil seal	16. Crankcase (outside) bolt	: Apply Molybdenum oil solution.
5. Circlip	11. Crankshaft	17. Thrust bearing	
6. Conrod	12. Crankshaft main bearing	: 17 N·m (1.7 kgf-m, 12.3 lbf-ft), then plus turn in 60 degrees.	



## Pistons, Piston Rings, Connecting Rods, Cylinder and Crankshaft Disassembly and Assembly

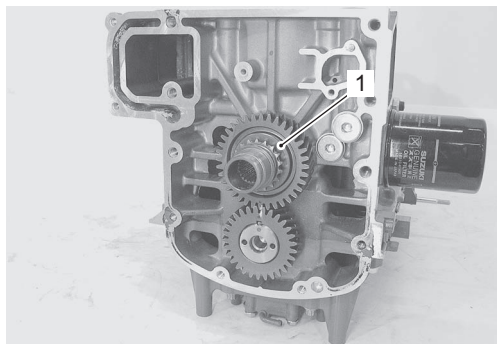
CENDG2111406021

### Disassembly

1) Before performing service work in this section:

- Remove power unit.  
Refer to "Power Unit Removal and Installation" (Page 1D-10).
- Remove timing chain.  
Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-16).
- Remove cylinder head.  
Refer to "Cylinder Head Removal and Installation" (Page 1D-25).

2) Remove driven gear (1).



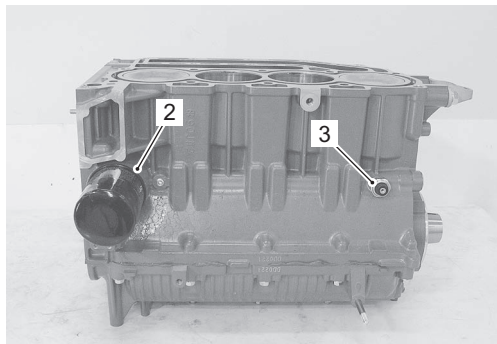
IDG211140131-01

3) Remove oil filter (2).

Remove oil pressure switch (3).

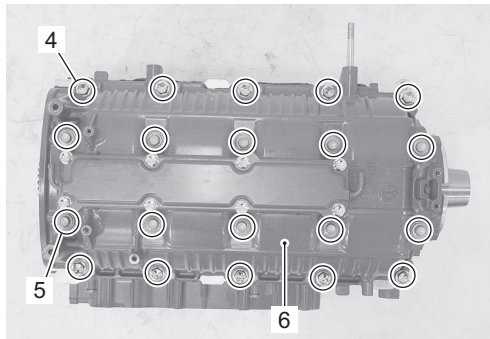
#### Special tool

 : 09915-47341 (Oil filter wrench)



IDG211140132-01

- 4) Remove ten crankcase (outside) bolts (4).  
Remove ten crankcase (inside) bolts (5).  
Remove crankcase (6) from cylinder block.

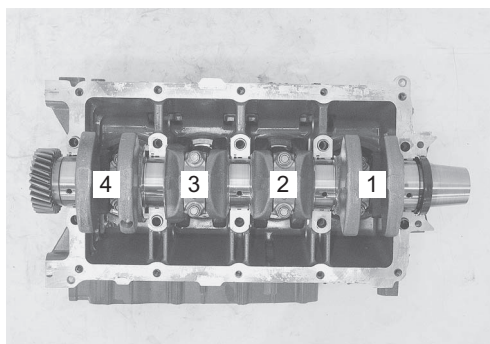


IDG211140133-01

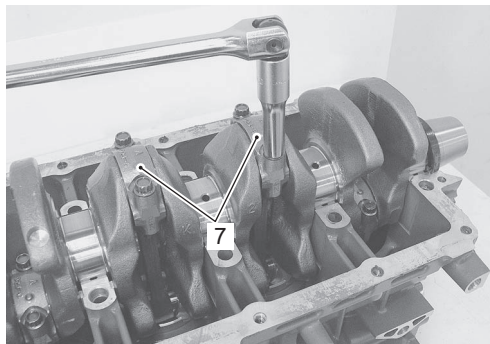
- 5) Remove all conrod cap bolts and conrod caps (7).

#### NOTE

**For proper assembly, mark cylinder number on all pistons, conrods, and conrod caps, using quick drying paint.**

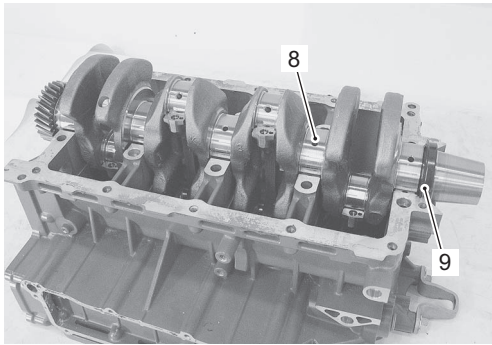


IDG211140134-02



IDG211140135-01

- 6) Remove crankshaft (8).  
Remove oil seal (9) from crankshaft.

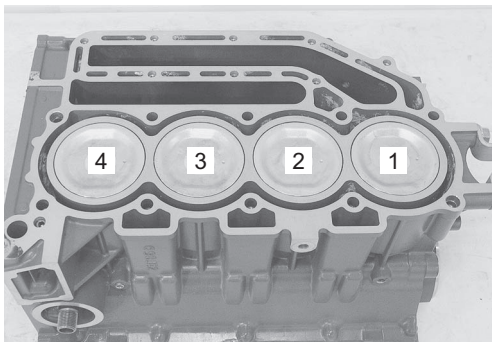


IDG211140136-01

- 7) Mark cylinder number on pistons using quick dry paint.  
Push piston (with conrod) out through the top of cylinder bore.

#### NOTE

- To prevent damage to piston rings, decarbon top of cylinder bore wall before removing piston.
- Reassemble each conrod cap to its original position after removing piston from bore.



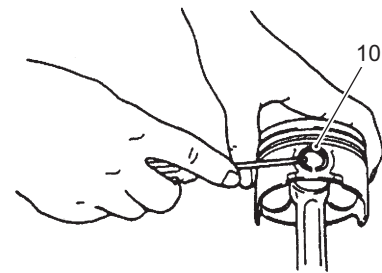
IDG211140137-01

- 8) Remove two compression rings (top and 2nd) and oil ring from piston. Mark cylinder number on conrod using quick dry paint.



IDG211140138-01

- 9) Remove piston pin circlips (10) as shown.

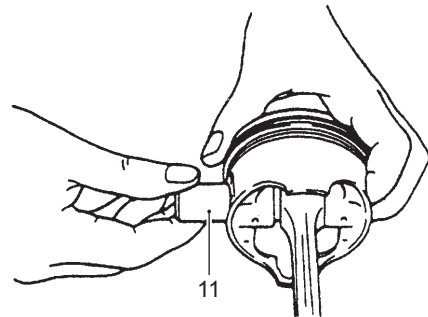


IDG211140139-01

- 10) Remove piston pin (11) from conrod.

#### NOTE

Reassemble each piston, piston pin and conrod in their original combination and position.



IDG211140140-01

## Assembly

Assembly is reverse order of disassembly paying special attention to the following steps.

### NOTICE

If any of the parts is reinstalled into a position different from the original position, engine problems could occur.

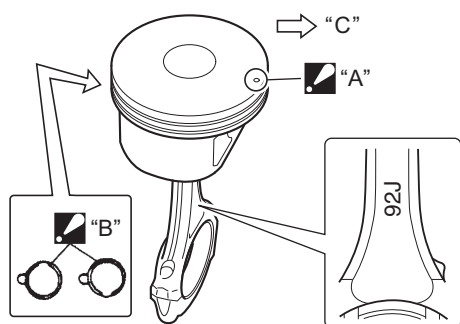
If original components are not replaced, each piston, piston pin and conrod is to be assembled and installed in its original order and position.

### Piston to conrod

- Apply engine oil to piston pin (1), piston pin bore and conrod (2).
- Assemble conrod (2) to piston (3) as shown in figure and insert piston pin (1) through piston and conrod.
- Install piston pin circlips (4).

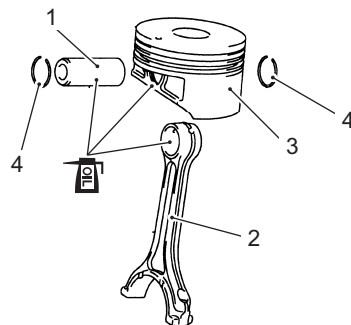
### NOTE

- “92J” mark on conrod and up mark “A” on piston dome must face toward flywheel side.
- Always use new piston pin circlip.
- Install so that circlip end gap comes within such range as indicated by arrow. End gap of the circlip should not be aligned with the cutaway in the piston pin bore.



IDG211140141-02

"A": Up mark	"C": Flywheel side
"B": Circlip end gap direction	

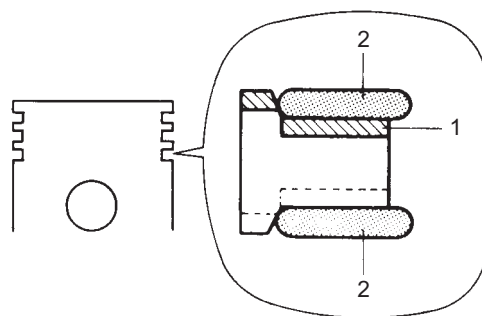


I9J011140010-01

### Piston ring to piston

#### 1) Install the oil ring.

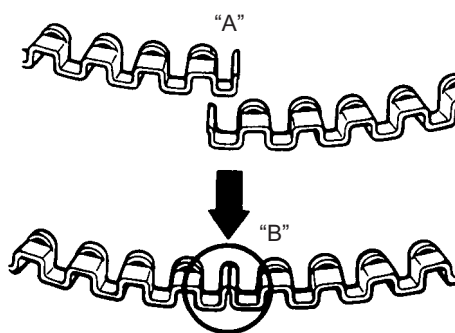
- Apply engine oil to piston rings.
- Install spacer (1) first, then side rails (2) to piston.



I9J011140011-01

### NOTE

When installing spacer, do not allow spacer ends to overlap in groove.



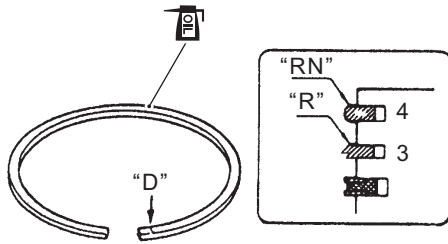
I9J011140012-01

"A": Incorrect	"B": Correct
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2) Install the piston rings.

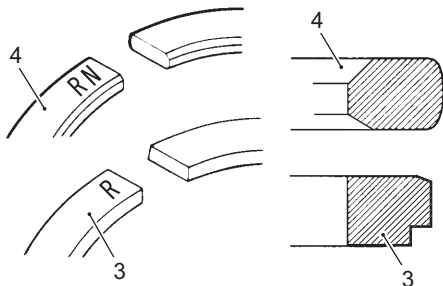
- Apply engine oil to piston rings.
- Install 2nd ring (3) and 1st ring (4) to piston.



IDG211140142-01

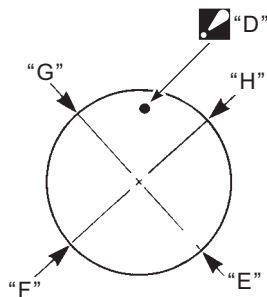
#### NOTE

- 1st ring (4) and 2nd ring (3) differ in shape as shown in figure.
- Also indicated in figure, the 1st and 2nd ring are marked "D" with the letter "R" or "RN" which must face towards top of piston.



IDG211140188-01

3) Position piston rings so gaps are staggered at approximately 90 degree angles as shown.



I9J011140016-01

"D": Up mark	"G": 2nd ring and oil ring spacer
"E": 1st ring	"H": Oil ring upper side rail
"F": Oil ring lower side rail	

#### Piston to cylinder

1) Install conrod bearing (1) to conrod (2) and cap (3).

#### NOTICE

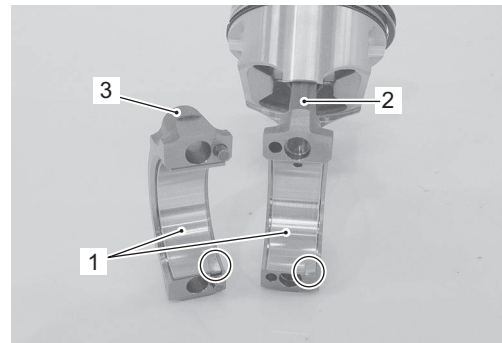
If the bearing is reinstalled into a position different from the original position, engine problems could occur.

If original bearings are not replaced, assemble each bearing to its original position.

#### NOTICE

If oil is present between the bearing's outside surface and conrod surface, the bearing could heat up to very high temperature, resulting in seizure.

Be sure to thoroughly wipe off any trace of oil that is present between the bearing's outside surface and conrod surface.



IDG211140143-01

## 1D-40 Power Unit Mechanical:

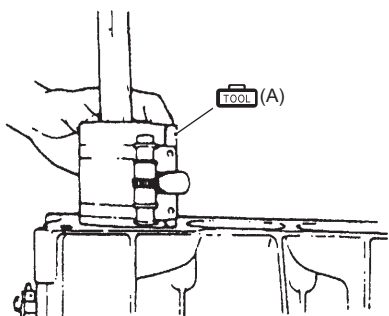
- 2) Apply engine oil to piston and cylinder walls.
- 3) Insert piston and conrod assembly (4) into cylinder bore from cylinder head side using special tool.

### NOTE

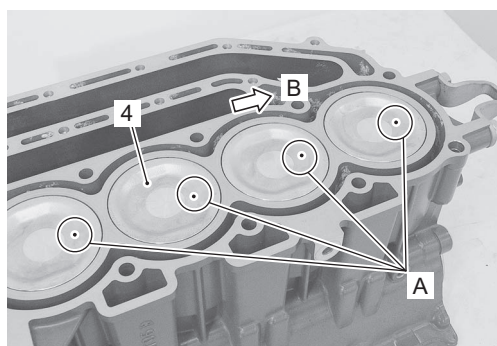
Position the up mark "A" on piston head to flywheel side "B".

### Special tool

 (A): 09916-77310 (Piston ring compressor)



IDG211140144-01



IDG211140145-02

"A": Up mark

"B": Flywheel side

### Crankshaft to cylinder

Install crankshaft main bearings (1) in cylinder and crankcase.

Apply engine oil to bearings.

### NOTICE

If the bearing is reinstalled into a position different from the original position, engine problems could occur.

If original bearings are not replaced, assemble each bearing to its original position.

### NOTICE

If oil is present between the bearing's outside surface and crank bearing holder surface, the bearing could heat up to very high temperature, resulting in seizure.

Be sure to thoroughly wipe off any trace of oil that is present between the bearing's outside surface and crank bearing holder surface.

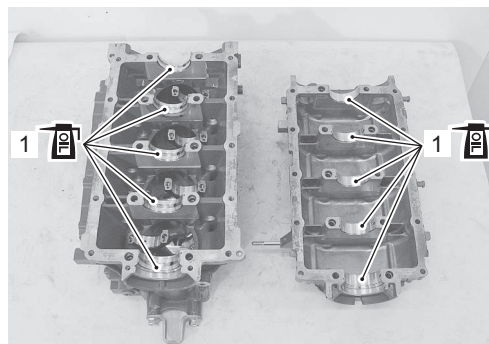
### NOTE

Assemble main bearing half containing oil groove/hole to cylinder block.

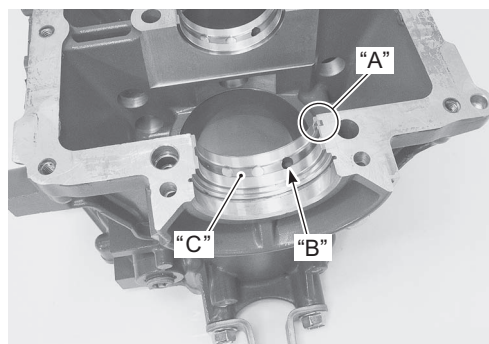
Assemble the main bearing half without oil groove to crankcase.

### NOTE

Align bearing tab "A" with notch in cylinder and crankcase.



IDG211140146-02



IDG211140147-01

"A": Bearing tab

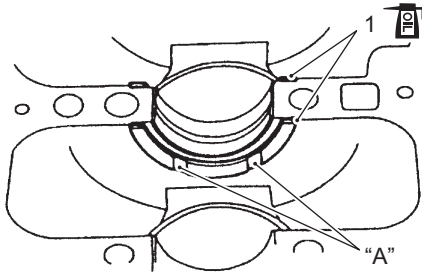
"B": Oil hole

"C": Oil groove

**Thrust bearing**

Apply engine oil to the thrust bearings and install them in cylinder block overlapping both sides of the No.4 main journal.

Oil grooves "A" on the thrust bearing must face towards crank webs.



IDG211140148-02

1. Thrust bearing	"A": Oil groove
-------------------	-----------------

**Crankshaft****NOTE**

Replace the oil seal with new one.

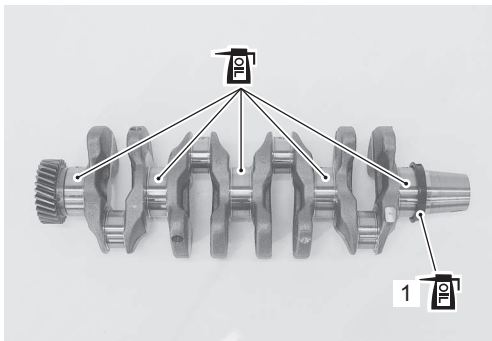
**NOTE**

Install upper oil seal with its spring/lipped side facing inward.

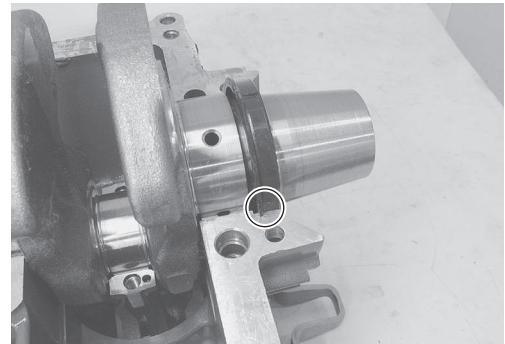
- 1) Apply engine oil to upper oil seal lip. Install upper oil seal (1) to crankshaft.
- 2) Apply engine oil to crank pin and crankshaft main journal and install crankshaft in cylinder.

**NOTE**

When installing crankshaft to cylinder, be sure to fit tab of upper oil seal in groove of cylinder.



IDG211140149-01



IDG211140150-01

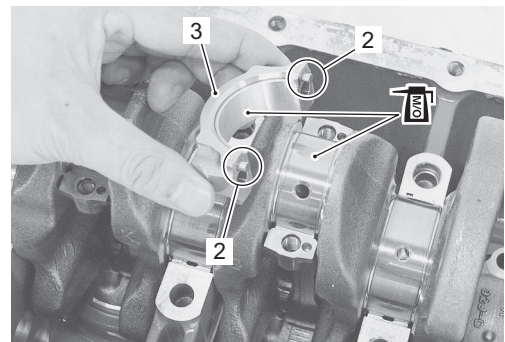
**3) Install conrod cap.**

- a) Apply molybdenum oil solution to crank pin and conrod bearing.
- b) Install dowel pins (2) and conrod cap (3) (with bearing) to conrod with embossed mark on the cap toward flywheel side.

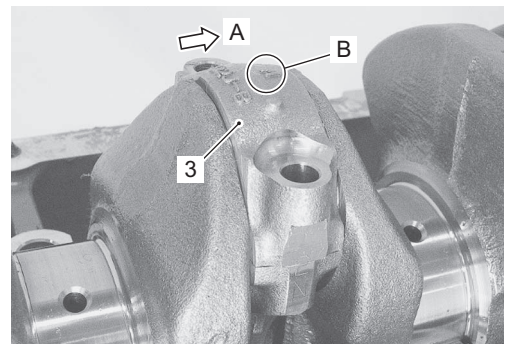
**NOTE**

Reassemble each conrod cap to its original position.

Do not mix them in position.



IDG211140151-03



IDG211140152-02

3. Conrod cap	"B": Embossed mark (>)
"A": Flywheel side	



- 4) Apply engine oil to conrod bolts.  
Tighten conrod cap bolts in three steps as follows.
- Lightly seat all conrod bolts at first, then tighten bolts 12 N·m (1.2 kgf-m, 8.7 lbf-ft) of specified torque.

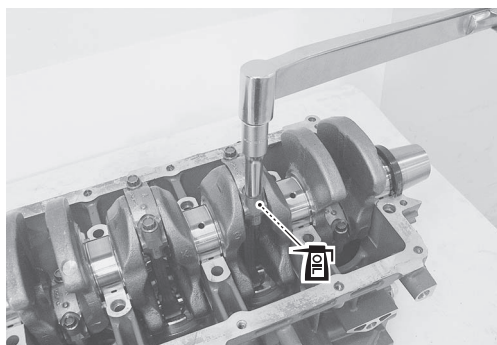
**Tightening torque**

**Conrod cap bolt (1st step): 12 N·m (1.2 kgf-m, 8.7 lbf-ft)**

- Tighten bolts 17 N·m (1.7 kgf-m, 12.3 lbf-ft) of specified torque.

**Tightening torque**

**Conrod cap bolt (2nd step): 17 N·m (1.7 kgf-m, 12.3 lbf-ft)**



IDG211140153-01

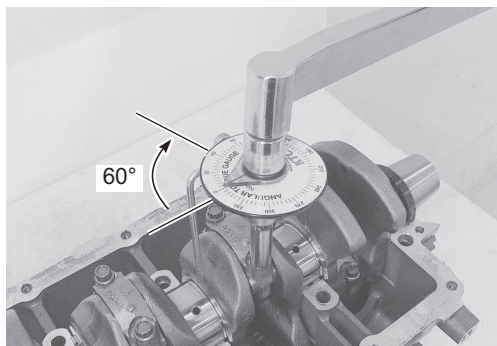
- Finally tighten bolts 60 degrees turn from the point of step (b) using an angular torque gauge.

**Tightening torque**

**Conrod cap bolt (Final step): 60 degrees**

**NOTE**

**Purchase a commercially available angular torque gauge for this step of tightening bolts.**



IDG211140154-01

- Pour approx. 2 ml of engine oil to each side surface of the conrod big end for initial lubrication.

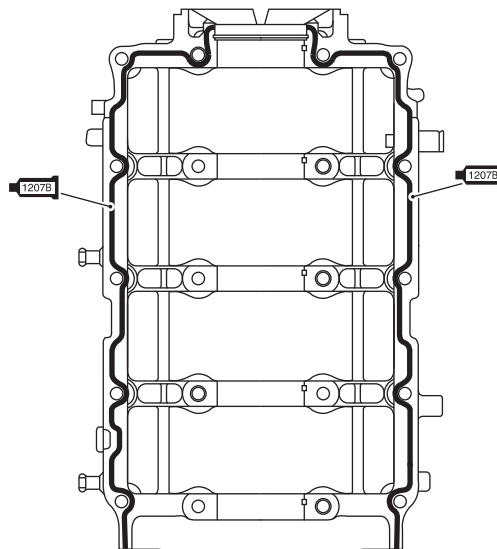
**Crankcase to cylinder**

- Clean mating surface of cylinder and crankcase.  
Apply suzuki bond to mating surface of crankcase as shown.

**NOTE**

**Apply bond to mating surface only.  
Do not allow bond to contact surface of bearing.**

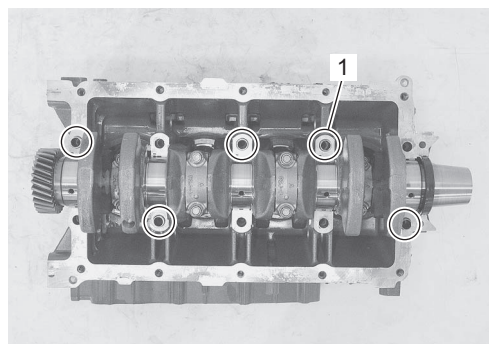
**1207B : Sealant 99000-31140 (SUZUKI Bond 1207B (100 g))**



IDG211140155-01

**"A": Apply bond "—" marked line.**

- Install five dowel pins (1).



IDG211140156-02

- 3) Install crankcase to cylinder.  
Apply engine oil to crankcase bolts.  
Tighten crankcase bolts in three steps following the order indicated below.

#### NOTE

**Tighten 10 mm (0.394 in.) thread diameter bolts first (following the order shown in figure), then tighten 8 mm (0.315 in.) thread diameter bolts.**

#### Tightening torque

**Crankcase (inside) bolt (10 mm thread diameter)**

**[1st step]: 11 N·m (1.1 kgf-m, 8.0 lbf-ft)**

**Crankcase (inside) bolt (10 mm thread diameter)**

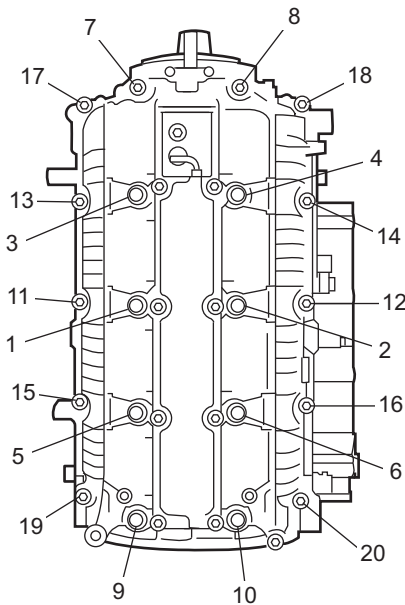
**[2nd step]: 21 N·m (2.1 kgf-m, 15.0 lbf-ft)**

**Crankcase (inside) bolt (10 mm thread diameter)**

**[Final step]: 52 N·m (5.2 kgf-m, 37.5 lbf-ft)**

#### Tightening torque

**Crankcase (outside) bolt (8 mm thread diameter): 25 N·m (2.5 kgf-m, 18.1 lbf-ft)**



IDG211140157-01

#### NOTE

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

#### Cylinder head

Refer to "Cylinder Head Removal and Installation" (Page 1D-25).

#### Timing chain

Refer to "Timing Chain, Chain Tensioner and Camshaft Sprockets Removal and Installation" (Page 1D-16).

#### Oil pump

Refer to "Oil Pump Removal and Installation" in Section 1E (Page 1E-3).

#### Power unit

Refer to "Power Unit Removal and Installation" (Page 1D-10).

#### Cylinder, Piston and Piston Ring Inspection and Servicing

CENDG2111406022

#### NOTE


**If cracks, excessive wear or other damage is found on any component, replace component.**

#### Cylinder Distortion

Using a straightedge and thickness gauge, measure cylinder distortion (gasket surface) at a total of six locations as shown.

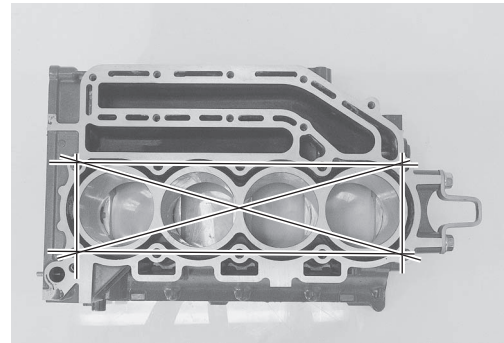
If measurement exceeds service limit, resurface or replace cylinder.

#### Special tool

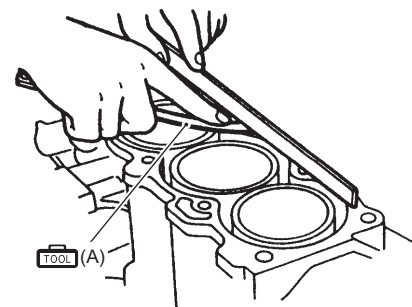
 (A): 09900-20803 (Thickness gauge)

#### Cylinder distortion

**Service limit: 0.05 mm (0.002 in.)**



IDG211140158-01

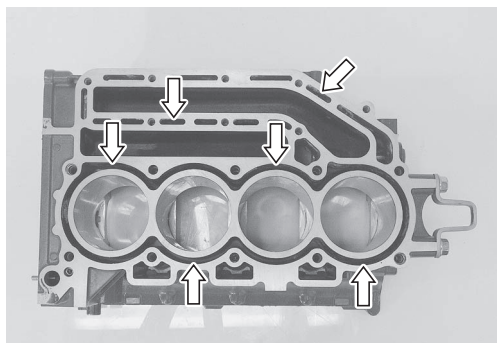


IDG211140159-01

### Water Jackets

Check water jackets.

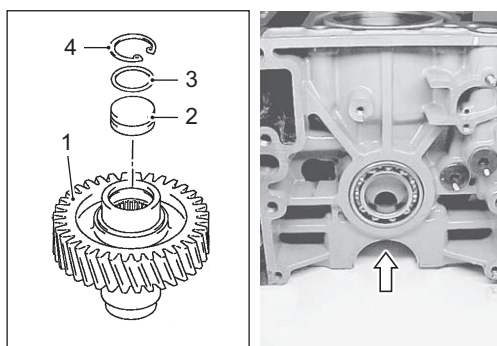
If clogged or obstruction is found, clean water jacket.



IDG211140160-01

### Driven Gear / Bearing

- Inspect driven gear for wear or other damage.  
Replace if necessary.
- Inspect driven gear bearing for pitting, rough or other damage.  
Replace if necessary.



IDG211140161-01

1. Driven gear	3. O-ring
2. Plug	4. Circlip

### Cylinder Bore

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

If cylinder bore is very rough, deeply scratched or ridged, bore cylinder and use oversize piston.

### Cylinder Bore Wear (Difference)

Using telescoping gauge (1), measure cylinder bore in both axial (vertical line, following crankshaft) and transverse (horizontal line across crankshaft) directions at two positions as shown in figure.

#### NOTE

**Purchase a commercially available telescoping gauge for this measurement.**

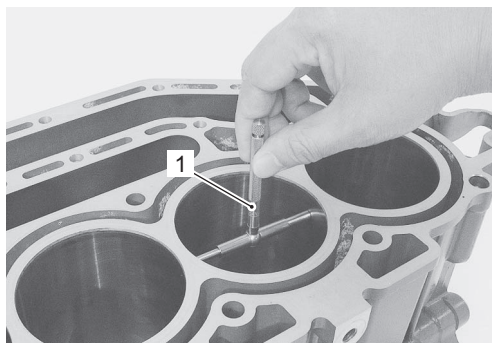
Check the following:

- Difference between measurements at the two positions (Taper).
- Difference between axial and transverse measurement (Out-of-round).

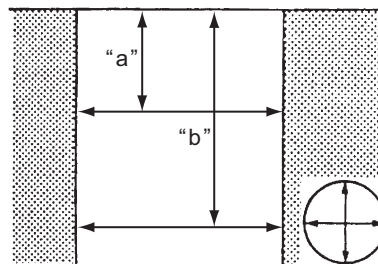
If measurement exceeds service limit, bore or replace cylinder.

### Cylinder bore wear (difference)

**Service limit: 0.10 mm (0.0039 in.)**



IDG211140162-01



I9J011140060-01

"a": 50 mm (1.97 in.)	"b": 90 mm (3.54 in.)
-----------------------	-----------------------

**Piston to Cylinder Clearance**

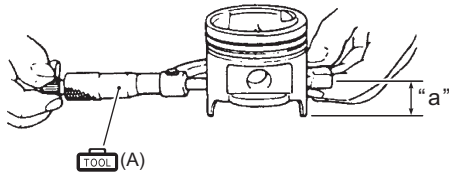
- 1) Measure the piston diameter at a point 26.5 mm (1.04 in.) above the piston skirt at a right angle to the piston pin bore.

**Special tool**

**TOOL (A): 09900-20204 (Micrometer (75 – 100 mm))**

**Piston skirt diameter**

**Standard: 85.970 – 85.990 mm (3.3846 – 3.3854 in.)**



I9J011140061-02

"a": 26.5 mm (1.04 in.)

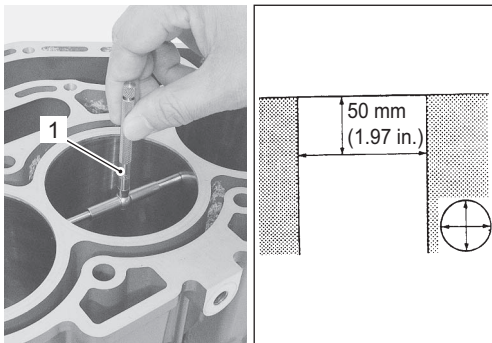
- 2) Measure the cylinder bore at 50 mm (1.97 in.) below the cylinder head gasket surface at a right angle to the crankshaft pin.

**NOTE**

**Purchase a commercially available telescoping gauge (1) for this measurement.**

**Cylinder bore diameter**

**Standard: 86.000 – 86.020 mm (3.3858 – 3.3866 in.)**



IDG211140163-02

- 3) Calculate the piston/cylinder clearance (Clearance equals difference between piston diameter and cylinder bore measurements).  
If clearance exceeds service limit, replace piston and/or cylinder or bore cylinder.

**Piston to cylinder clearance**

**Standard: 0.020 – 0.040 mm (0.0008 – 0.0016 in.)**

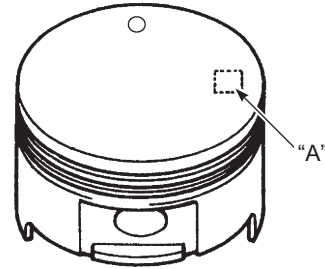
**Service limit: 0.100 mm (0.0039 in.)**

**Identification of Oversize Piston / Piston Ring**

One oversize piston/piston ring components, 0.50 mm is available. Oversize piston/piston ring are marked as shown, below.

**Piston**

Oversize	I.D. mark
0.50 mm	50

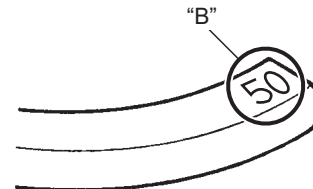


I9J011140062-02

"A": I.D. mark

**1st and 2nd Piston ring**

Oversize	I.D. mark
0.50 mm	50

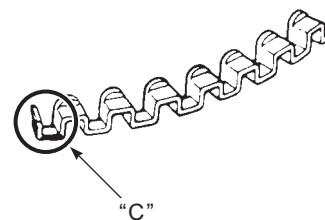
**1st, 2nd ring**

I9J011140063-03

"B": I.D. mark

**Oil ring**

Oversize	I.D. mark
0.50 mm	One white paint

**Oil ring spacer**

I9J011140064-02

"C": I.D. mark



## Piston

### Visual inspection

Inspect piston for faults, cracks or other damage. Damaged or faulty piston(s) should be replaced.

### Piston ring to groove clearance

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

Fit piston ring into piston groove, and measure clearance between ring and ring groove using thickness gauge. If measurement exceeds service limit, replace piston and/or piston ring.

### Special tool

**TOOL (A): 09900-20803 (Thickness gauge)**

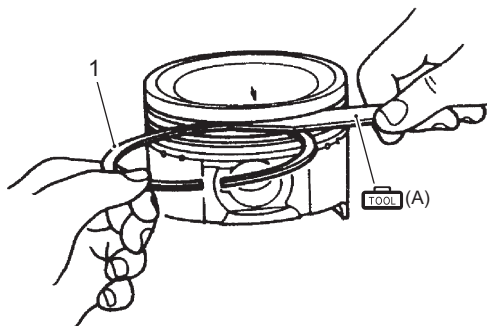
### Piston ring to groove clearance

**Standard (1st): 0.030 – 0.070 mm (0.0012 – 0.0028 in.)**

**Standard (2nd): 0.020 – 0.060 mm (0.0008 – 0.0024 in.)**

**Service limit (1st): 0.12 mm (0.0047 in.)**

**Service limit (2nd): 0.10 mm (0.0039 in.)**



I9J011140065-03

1. Piston ring

### Piston ring groove width

**Standard (1st): 1.22 – 1.24 mm (0.048 – 0.049 in.)**

**Standard (2nd): 1.51 – 1.53 mm (0.059 – 0.060 in.)**

**Standard (Oil): 2.51 – 2.53 mm (0.099 – 0.100 in.)**

### Piston ring thickness

**Standard (1st): 1.17 – 1.19 mm (0.046 – 0.047 in.)**

**Standard (2nd): 1.47 – 1.49 mm (0.058 – 0.059 in.)**

## Piston Ring

### Piston ring end gap

Measure piston ring end gap with piston ring in the lowest position of cylinder bore.

If measurement exceeds service limit, replace piston ring.

### Special tool

**TOOL (A): 09900-20803 (Thickness gauge)**

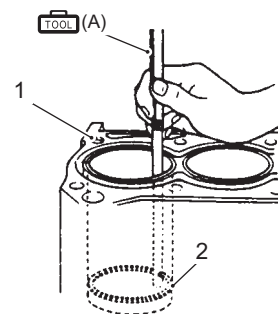
### Piston ring end gap

**Standard (1st): 0.20 – 0.35 mm (0.008 – 0.014 in.)**

**Standard (2nd): 0.35 – 0.50 mm (0.014 – 0.020 in.)**

**Service limit (1st): 0.70 mm (0.028 in.)**

**Service limit (2nd): 1.00 mm (0.039 in.)**



I9J011140066-02

1. Cylinder 2. Piston ring

### Piston ring free end gap

Measure piston ring free end gap using vernier calipers.

If measurement exceeds service limit, replace piston ring.

### Special tool

**TOOL (A): 09900-20101 (Vernier calipers (150 mm))**

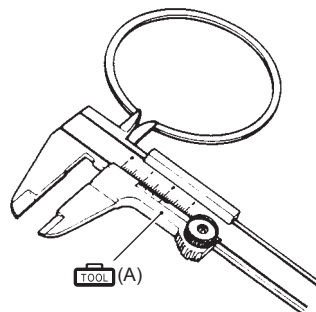
### Piston ring free end gap

**Standard (1st): Approx. 11.6 mm (0.46 in.)**

**Standard (2nd): Approx. 11.5 mm (0.45 in.)**

**Service limit (1st): 9.3 mm (0.37 in.)**

**Service limit (2nd): 9.2 mm (0.36 in.)**



I9J011140067-02

## Piston Pin and Conrod Inspection

CENDG2111406023

### Piston Pin

#### Visual inspection

- Check piston pin, conrod small end bore and piston pin hole for wear or damage.  
If badly worn or damaged, replace component.
- Apply engine oil on piston pin so that the piston pin can move smoothly in the piston pin hole.  
If improper condition is found, replace the piston pin and/or piston.

#### Piston pin clearance

Check the piston pin clearance in the conrod small end. Replace the conrod if its small end is badly worn or damaged or if clearance exceeds service limit. Measure the following item:

#### Special tool

**TOOL (A):** 09900-20205 (Micrometer (0 – 25 mm))

**TOOL (B):** 09900-20605 (Dial calipers (10 – 34 mm))

#### Piston pin outside diameter

**Standard:** 20.997 – 21.000 mm (0.8267 – 0.8268 in.)

**Service limit:** 20.980 (0.8260 in.)

#### Piston pin hole diameter

**Standard:** 21.006 – 21.014 mm (0.8270 – 0.8273 in.)

**Service limit:** 21.040 (0.8283 in.)

#### Conrod small end bore

**Standard:** 21.003 – 21.013 mm (0.8269 – 0.8273 in.)

#### Pin clearance in piston pin hole

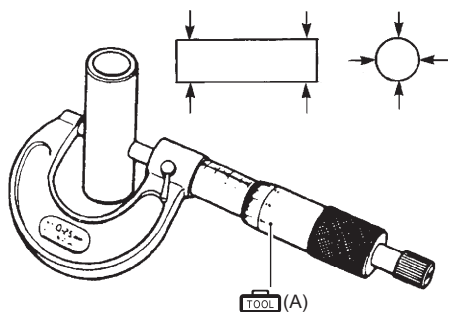
**Standard:** 0.006 – 0.017 mm (0.0002 – 0.0007 in.)

**Service limit:** 0.040 (0.0016 in.)

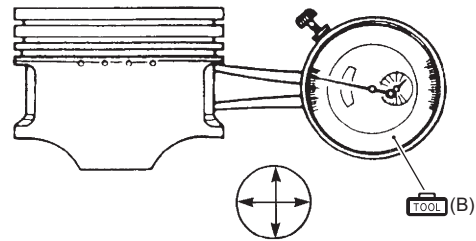
#### Pin clearance in conrod small end

**Standard:** 0.003 – 0.016 mm (0.0001 – 0.0006 in.)

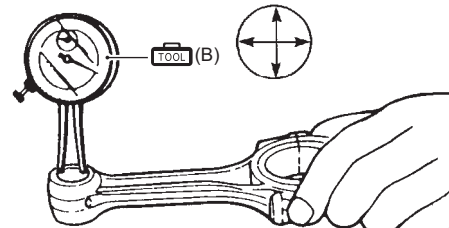
**Service limit:** 0.050 (0.0020 in.)



I9J011140068-02



I9J011140069-02



I9J011140070-02

#### Conrod big end side clearance

Measure conrod big end side clearance with conrod installed on crank pin as shown.

If measurement exceeds service limit, replace conrod and/or crankshaft.

#### Special tool

**TOOL (A):** 09900-20803 (Thickness gauge)

#### Conrod big end side clearance

**Standard:** 0.100 – 0.250 mm (0.0039 – 0.0098 in.)

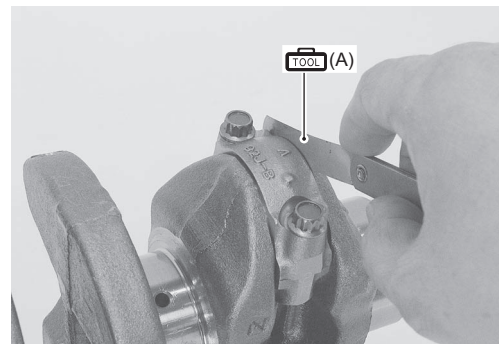
**Service limit:** 0.35 mm (0.0138 in.)

#### Conrod big end width

**Standard:** 21.950 – 22.000 mm (0.8642 – 0.8661 in.)

#### Crank pin width

**Standard:** 22.100 – 22.200 mm (0.870 – 0.8740 in.)



IDG211140164-01

## Crank Pin and Conrod Bearing Inspection

CENDG2111406024

### Crank Pin Diameter

Inspect crank pin for uneven wear or damage.

Measure crank pin for out-of-round "a" – "b" or taper "c" – "d" with micrometer.

If crank pin is damaged, out-of-round "a" – "b" or taper "c" – "d" is out of service limit, replace crankshaft.

### Special tool

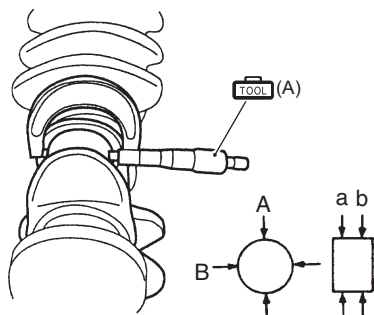
 (A): 09900–20202 (Micrometer (25 – 50 mm))

### Crank pin diameter

Standard: 43.982 – 44.000 mm (1.7316 – 1.7323 in.)

### Out-of-round and taper

Service limit: 0.01 mm (0.0004 in.)



IDG211140165-01

### Conrod Bearing Visual Inspection

Inspect bearing shell for proper contact pattern and signs of fusion, pitting, burning or flaking.

Bearing shells found in defective condition must be replaced.



I9J011140071-01

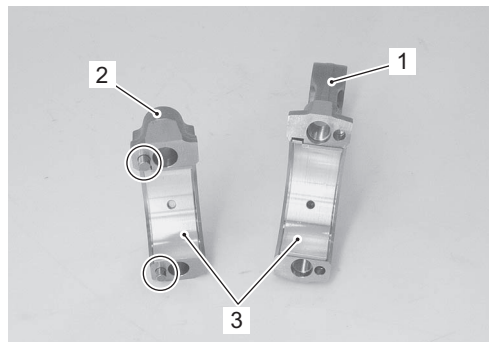
## Conrod Big End Oil Clearance

Check conrod big end oil clearance as follows:

- 1) Clean surface of conrod (1), conrod cap (2), conrod bearings and crank pin.
- 2) Install conrod bearing (3) onto conrod and conrod cap.

### NOTE


- Reassemble each bearing and conrod cap to their original position.
- Do not apply oil to bearing.

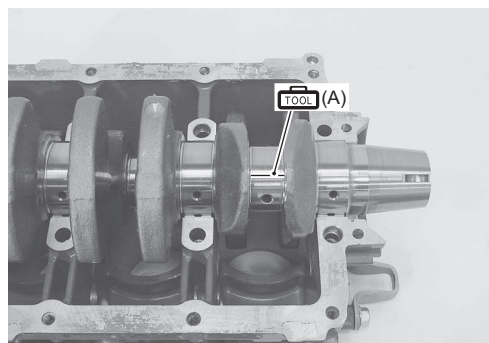


IDG211140166-02

- 3) Place a piece of Plastigauge on crank pin parallel to crankshaft. Avoid placing Plastigauge over oil hole.

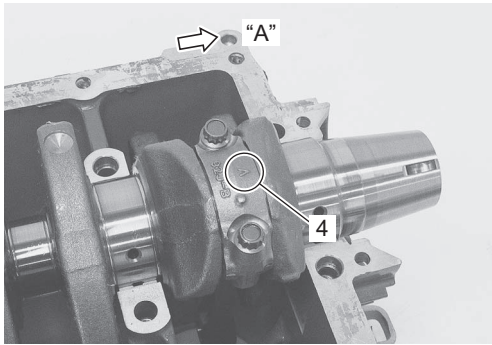
### Special tool

 (A): 09900–22301 (Plastigauge (0.025 – 0.076 mm))



IDG211140167-01

- 4) Install conrod cap (with bearing) to conrod with the embossed mark (4) on cap toward flywheel side.



IDG211140168-02

4. Embossed mark (>)	"A": Flywheel side
----------------------	--------------------

- 5) Apply engine oil to conrod bolts.  
Tighten conrod cap bolts in three steps as follows.

- a) Lightly seat all conrod bolts at first, then tighten bolts 12 N·m (1.2 kgf-m, 8.7 lbf-ft) of specified torque.

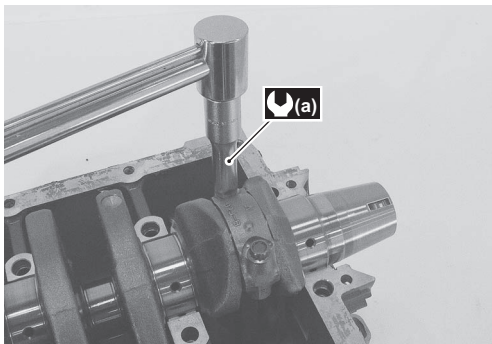
**Tightening torque**

**Conrod cap bolt (1st step): 12 N·m (1.2 kgf-m, 8.7 lbf-ft)**

- b) Tighten bolts 17 N·m (1.7 kgf-m, 12.3 lbf-ft) of specified torque.

**Tightening torque**

**Conrod cap bolt (2nd step) (a): 17 N·m (1.7 kgf-m, 12.3 lbf-ft)**



IDG211140169-01

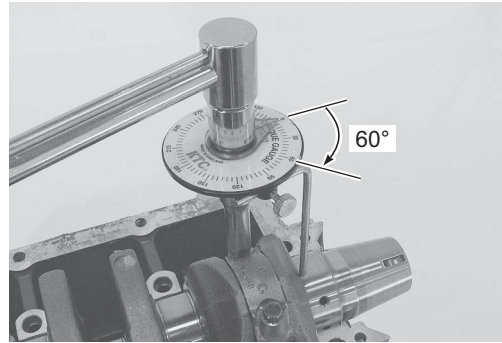
- c) Finally tighten bolts 60 degrees turn from the point of step b) using an angular torque gauge.

**Tightening torque**

**Conrod cap bolt (Final step): 60 degrees**

**NOTE**

**Purchase a commercially available angular torque gauge for this step of tightening bolts.**



IDG211140170-02

**NOTE**

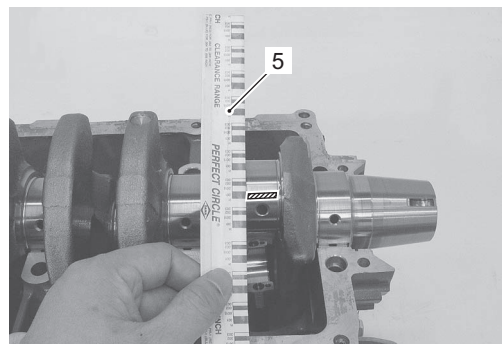
**Do not rotate conrod with Plastigauge in place.**

- 6) Remove conrod and conrod cap from crank pin.  
7) Using scale (5) on Plastigauge envelope, measure Plastigauge width at its widest point.  
If measurement exceeds service limit, replace conrod bearing.

**Conrod big end oil clearance**

**Standard: 0.032 – 0.050 mm (0.0013 – 0.0020 in.)**

**Service limit: 0.080 mm (0.0031 in.)**



IDG211140171-02

5. Scale
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## Crankshaft Inspection


CENDG2111406026

### Crankshaft Runout

Using a dial gauge, measure runout at center journal. If measurement exceeds service limit, replace crankshaft.

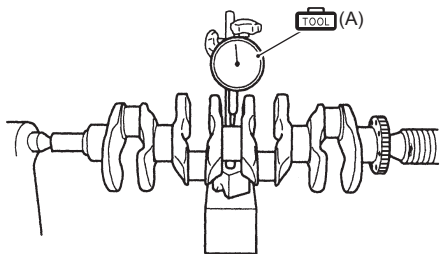
#### Special tool

 (A): 09900-20607 (Dial gauge)

 (B): 09900-20701 (Magnetic stand)

#### Crankshaft runout

Service limit: 0.04 mm (0.002 in.)



IDG211140173-02

### Crankshaft Thrust Play

- 1) Measure thrust play with crankshaft, thrust bearing, journal bearing and crankcase/cylinder block assembled in a normal manner.  
Tighten crankcase bolts to specified torque.

#### Tightening torque

**Crankcase (inside) bolt (10 mm): 52 N·m (5.2 kgf-m, 37.5 lbf-ft)**

**Crankcase (outside) bolt (8 mm): 25 N·m (2.5 kgf-m, 18.1 lbf-ft)**

- 2) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.  
If measurement exceeds service limit, replace crankshaft thrust bearing.

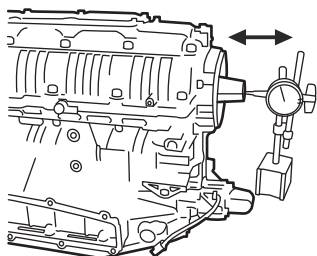
#### Crankshaft thrust play

Standard: 0.11 – 0.31 mm (0.004 – 0.012 in.)

Service limit: 0.35 mm (0.014 in.)

#### Crankshaft thrust bearing thickness

Standard: 2.425 – 2.475 mm (0.0955 – 0.0974 in.)



IDG211140174-01

### 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 journal is badly damaged or if measurements exceed service limit, replace crankshaft.

#### Special tool

 (A): 09900-20203 (Micrometer (50 – 75 mm))

#### Out-of-round and taper

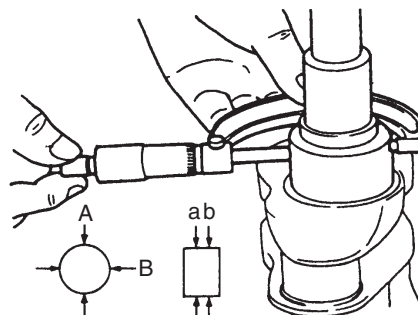
Service limit: 0.01 mm (0.0004 in.)

Out-of-round: A – B

Taper: a – b

#### Crankshaft journal outside diameter

Standard: 57.994 – 58.012 mm (2.2832 – 2.2839 in.)



IDG211140175-01

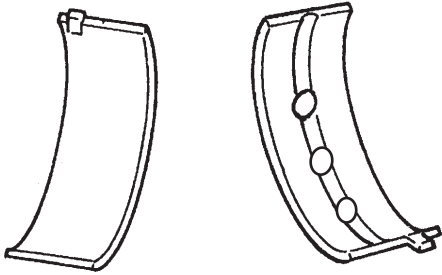
## Crankshaft Main Bearing Inspection

CENDG2111406027

### Crankshaft Main Bearing Visual Inspection

Check bearings for pitting, scratches, wear or damage. If any improper condition is found, replace both upper and lower halves.

Always replace both bearing halves, never replace only one half of a bearing set.



I9J011140073-01

### Crankshaft Journal Oil Clearance

Check clearance using Plastigauge according to the following procedure.

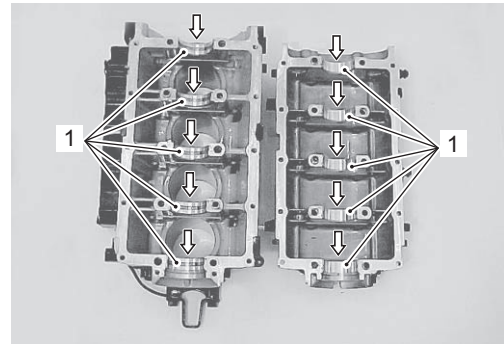
#### NOTE

**Assemble each bearing in its original position before checking clearance.**

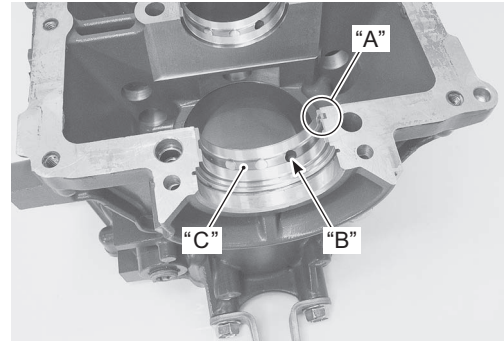
- 1) Clean surface of bearing holder (crankcase, and cylinder), bearing, and main bearing journal.
- 2) Install main bearing (1) to cylinder and crankcase.

#### NOTE

- Align tab "A" of bearing with notch in cylinder and crankcase.
- Do not apply engine oil to bearing.
- Install main bearing half with oil hole/groove towards cylinder side.



IDG211140176-01



IDG211140177-01

"A": Bearing tab	"B": Oil hole	"C": Oil groove
------------------	---------------	-----------------

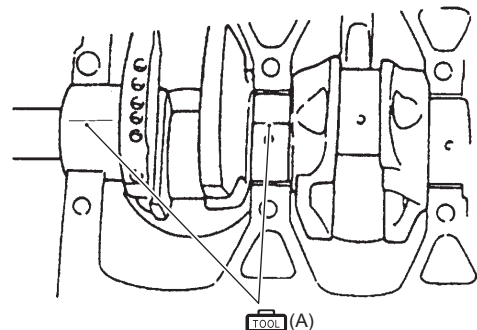
- 3) Install crankshaft to cylinder.
- 4) Place a piece of Plastigauge across full width of bearing (parallel to crankshaft) on journal. Do not place Plastigauge over oil hole.

#### Special tool

**TOOL (A): 09900-22301 (Plastigauge (0.025 – 0.076 mm))**

#### NOTE

**Do not rotate crankshaft while Plastigauge is installed.**



IDG211140178-01

- 5) Assemble crankcase to cylinder.
- 6) Apply engine oil to crankcase bolts.  
Tighten crankcase bolts in three steps following the order indicated below.

**NOTE**

Tighten 10 mm (0.394 in.) thread diameter bolts first (following the order shown in figure), then tighten 8 mm (0.315 in.) thread diameter bolts.

**Tightening torque**

Crankcase (inside) bolt (10 mm thread diameter)

[1st step]: 11 N·m (1.1 kgf-m, 8.0 lbf-ft)

Crankcase (inside) bolt (10 mm thread diameter)

[2nd step]: 21 N·m (2.1 kgf-m, 15.0 lbf-ft)

Crankcase (inside) bolt (10 mm thread diameter)

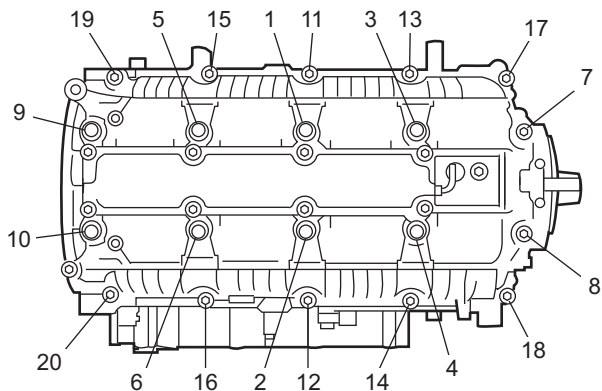
[Final step]: 52 N·m (5.2 kgf-m, 37.5 lbf-ft)

**Tightening torque**

Crankcase (outside) bolt (8 mm thread diameter): 25 N·m (2.5 kgf-m, 18.1 lbf-ft)

**NOTE**

Crankcase must be torqued to specification in order to assure proper compression of Plastigauge and accurate reading of clearance.



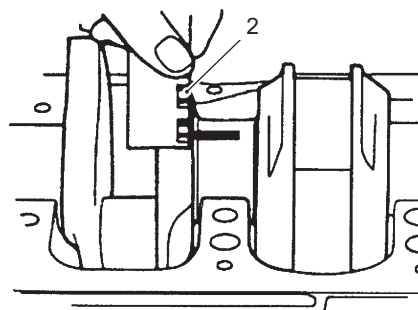
IDG211140179-01

- 7) Remove crankcase from cylinder.
- 8) Using scale (2) on Plastigauge envelope, measure Plastigauge width at its widest point.

**Crankshaft journal oil clearance**

**Standard: 0.020 – 0.040 mm (0.0008 – 0.0016 in.)**

**Service limit: 0.065 mm (0.0026 in.)**



IDG211140180-01

- 9) If measurement exceeds service limit, replace crankshaft main bearing.

**NOTE**

For bearing replacement, see the "Selection of Main Bearings" (Page 1D-52).

**Selection of Main Bearings**

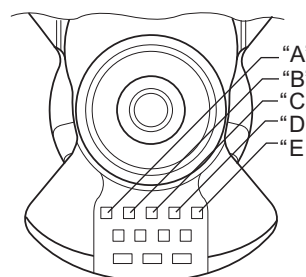
Whenever a bearing requires replacement, select a new bearing according to following procedure.

- 1) First, check journal diameter.

As shown in figure, upper (flywheel side) crank web of No.1 cylinder has five stamped code numerals.

The numerals (1, 2 and 3) represent the journal diameters shown below.

Numeral stamped	Journal diameter
1	58.0061 – 58.0120 mm (2.28370 – 2.28393 in.)
2	58.0001 – 58.0060 mm (2.28346 – 2.28370 in.)
3	57.9940 – 58.0000 mm (2.28322 – 2.28346 in.)



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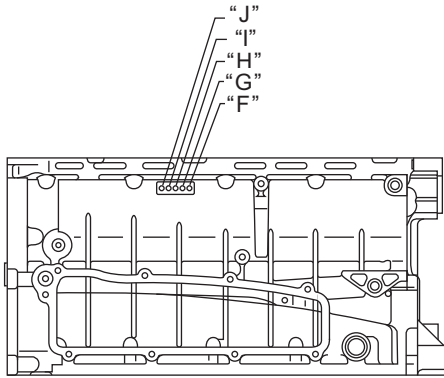
▣ "A": No.1 journal code	▣ "D": No.4 journal code
▣ "B": No.2 journal code	▣ "E": No.5 journal code
▣ "C": No.3 journal code	

- 2) Next, check bearing holder inside diameter without bearing.

As shown in figure, the cylinder block PORT side has five stamped code letters.

The letters (A, B and C) represent the bearing holder inside diameters shown below.

Code	Crank bearing holder inside diameter (w/o bearing)
A	62.0000 – 62.0060 mm (2.44094 – 2.44118 in.)
B	62.0061 – 62.0120 mm (2.44118 – 2.44141 in.)
C	62.0121 – 62.0180 mm (2.44142 – 2.44165 in.)



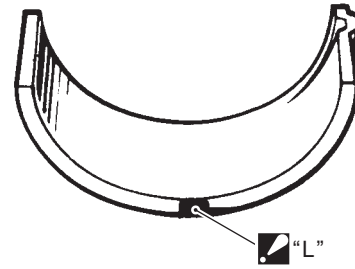
"K" →

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"F": No.1 holder code	"I": No.4 holder code
"G": No.2 holder code	"J": No.5 holder code
"H": No.3 holder code	"K": Flywheel side

- 3) There are five main bearings available, each of differing thickness.  
To distinguish them, a color mark is painted at the position indicated in figure.  
Each color represents the following thickness measured at the center of the bearing.

Color mark	Bearing thickness
Green	1.990 – 1.994 mm (0.0783 – 0.0785 in.)
Black	1.993 – 1.997 mm (0.0785 – 0.0786 in.)
No color mark	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Yellow	1.999 – 2.003 mm (0.0787 – 0.0789 in.)
Blue	2.002 – 2.006 mm (0.0788 – 0.0790 in.)



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"L": Color mark

- 4) Select crankshaft main bearing referring to the below table.

For example, If number stamped on crank web is "1" and alphabet stamped on cylinder block is "B", install a new bearing painted in "Black" to it's journal.

		Numeral stamped on crank web (journal outside diameter)		
		1	2	3
Code stamped on cylinder block (Bearing holder inside diameter)	A	Green	Black	No color
	B	Black	No color	Yellow
	C	No color	Yellow	Blue

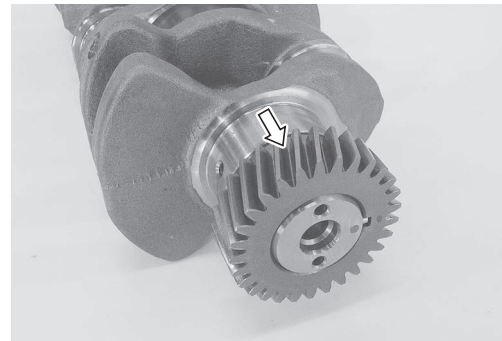
#### NOTE

Measure crankshaft journal oil clearance again after installing new bearing selected. Refer to "Crankshaft Journal Oil Clearance" (Page 1D-51).

#### Crankshaft Drive Gear Inspection

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Inspect drive gear. Replace crankshaft if the drive gear is damaged or worn.



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