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# SECTION **EM**

## ENGINE MECHANICAL

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## PRECAUTIONS

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### Precautions for Drain Engine Coolant

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Drain engine coolant when engine is cooled.

### Precautions for Disconnecting Fuel Piping

GBS000FO

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

### Precautions for Removal and Disassembly

GBS000FP

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

### Precautions for Inspection, Repair and Replacement

GBS000FO

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

### Precautions for Assembly and Installation

GBS000FR

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, make sure that dowel pins are installed in the original position.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gasses for leakage.

### Parts Requiring Angle Tightening

GBS000FS

- Use angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Lower cylinder block bolts
  - Connecting rod cap bolts
  - Crankshaft pulley bolt
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

# PRECAUTIONS

[VQ]

GBS000FT

## Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST] and remove the old liquid gasket sealing.

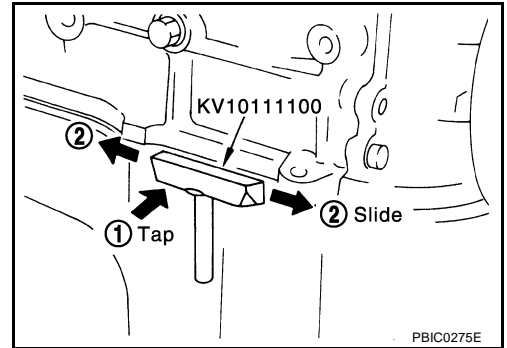
**CAUTION:**

**Be careful not to damage the mating surfaces.**

- Tap seal cutter to insert it, and then slide it by tapping on the side as shown in the figure.
- In areas where seal cutter [SST] is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

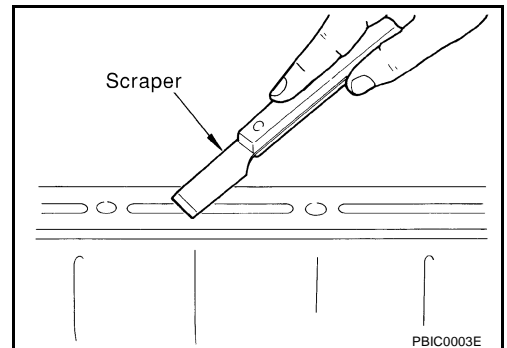
**CAUTION:**

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

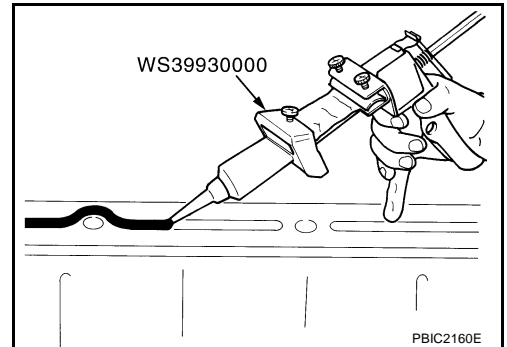


## LIQUID GASKET APPLICATION PROCEDURE

- Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.
  - Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
- Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



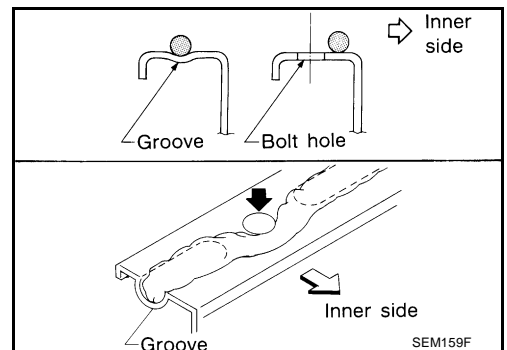
- Attach liquid gasket tube to tube presser [SST].  
**Use Genuine Liquid Gasket or equivalent.**
- Apply the liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



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

**CAUTION:**

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



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# PREPARATION

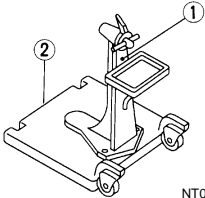
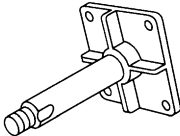
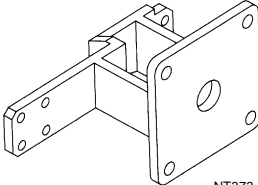
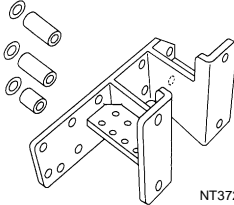
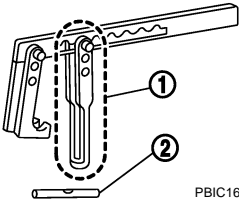
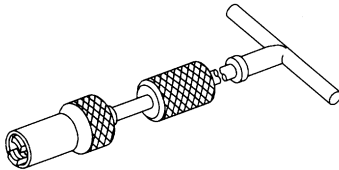

[VQ]

PFP:00002

GBS000FU

## PREPARATION

### Special Service Tools

Tool number Tool name	Description
ST0501S000 Engine stand assembly 1. ST05011000 Engine stand 2. ST05012000 Base	Disassembling and assembling engine  <p style="text-align: right;">NT042</p>
KV10106500 Engine stand shaft	 <p style="text-align: right;">NT028</p>
KV10117000 Engine sub-attachment	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).  <p style="text-align: right;">NT373</p>
KV10117001 Engine sub-attachment	Installing on cylinder block  <p style="text-align: right;">NT372</p>
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.  <p style="text-align: right;">PBIC1650E</p>
KV10107902 Valve oil seal puller	Replacing valve oil seal  <p style="text-align: right;">NT011</p>
KV10115600 Valve oil seal drift	Installing valve oil seal  <p style="text-align: right;">ZZA0996D</p>

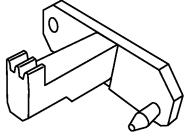
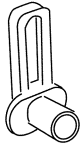
# PREPARATION

[VQ]

Tool number Tool name	Description	
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore	A  EM  C
ST16610001 Pilot bushing puller	Removing pilot bushing (M/T models) or pilot converter (A/T models)	D  E
KV10111100 Seal cutter	Removing oil pan (lower and upper), front and rear timing chain case, etc.	F  G
WS39930000 Tube presser	Pressing the tube of liquid gasket	H  I  J
KV10112100 Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle	K  L
KV991- J0050 Heated oxygen sensor wrench	Loosening or tightening air fuel ratio sensor 1 <b>a: 22 mm (0.87 in)</b>	M
KV10114400 Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 2 <b>a: 22 mm (0.87 in)</b>	

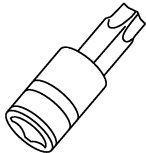
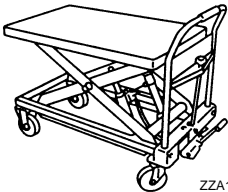
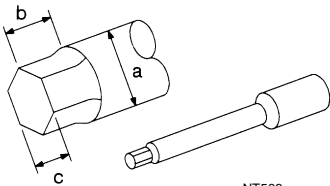
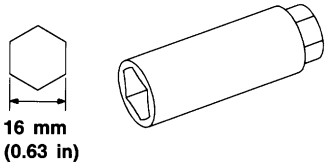

# PREPARATION

[VQ]

Tool number Tool name	Description
KV10117700 Ring gear stopper	Removing and installing crankshaft pulley
 <p style="margin-top: 5px;">NT822</p>	
— Quick connector release	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
 <p style="margin-top: 5px;">PBIC0198E</p>	

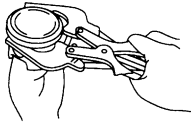
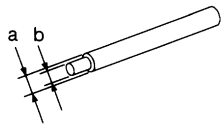
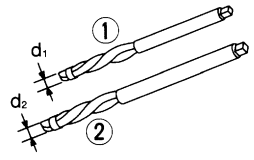
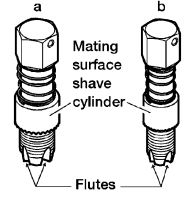

## Commercial Service Tools

GBS000FV

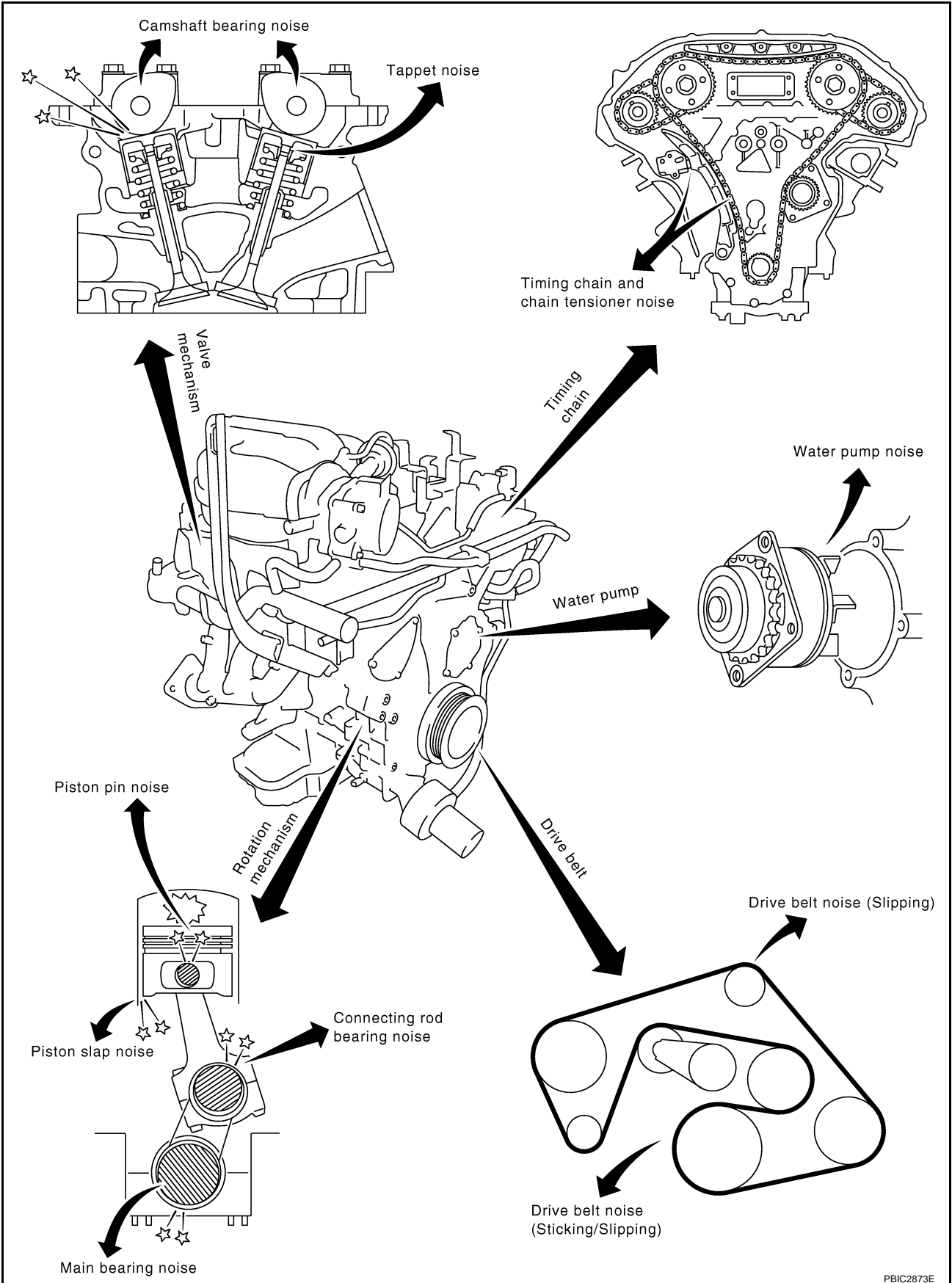
Tool name	Description
TORX socket	Removing and installing flywheel <b>Size: T55</b>
 <p style="margin-top: 5px;">PBIC1113E</p>	
Manual lift table caddy	Removing and installing engine
 <p style="margin-top: 5px;">ZZA1210D</p>	
Cylinder head bolt wrench	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100] <b>a: 13 (0.51) dia.</b> <b>b: 12 (0.47)</b> <b>c: 10 (0.39)</b> Unit: mm (in)
 <p style="margin-top: 5px;">NT583</p>	
Spark plug wrench	Removing and installing spark plug
 <p style="margin-top: 5px;"><b>16 mm (0.63 in)</b></p> <p style="margin-top: 5px;">NT047</p>	
Valve seat cutter set	Finishing valve seat dimensions
 <p style="margin-top: 5px;">NT048</p>	

# PREPARATION

[VQ]

Tool name	Description
<p>Piston ring expander</p>  <p>NT030</p>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p>  <p>NT015</p>	<p>Removing and installing valve guide  <b>Intake and Exhaust:</b>  <b>a: 9.5 mm (0.374 in) dia.</b>  <b>b: 5.5 mm (0.217 in) dia.</b></p>
<p>Valve guide reamer</p>  <p>NT016</p>	<p>(1): Reaming valve guide inner hole  (2): Reaming hole for oversize valve guide  <b>Intake and Exhaust:</b>  <b>d1 : 6.0 mm (0.236 in) dia.</b>  <b>d2 : 10.2 mm (0.402 in) dia.</b></p>
<p>Oxygen sensor thread cleaner</p>  <p>AEM488</p>	<p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.)  <b>a: 18 mm (0.71 in) dia. for zirconia heated oxygen sensor</b>  <b>b: 12 mm (0.47 in) dia. for titania heated oxygen sensor</b></p>
<p>Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)</p>  <p>AEM489</p>	<p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>

A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M





# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[VQ]

GBS000FX

## Use the Chart Below to Help You Find the Cause of the Symptom.

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

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	<a href="#">EM-83</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal oil clearance	<a href="#">EM-75</a> <a href="#">EM-76</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	<a href="#">EM-124</a> <a href="#">EM-126</a>
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	<a href="#">EM-128</a> <a href="#">EM-125</a> <a href="#">EM-125</a> <a href="#">EM-126</a>
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance (Big end)	<a href="#">EM-126</a> <a href="#">EM-130</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-131</a> <a href="#">EM-130</a>
Front of engine Timing chain case	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	<a href="#">EM-61</a> <a href="#">EM-53</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	<a href="#">EM-14</a>
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	<a href="#">CO-23</a>

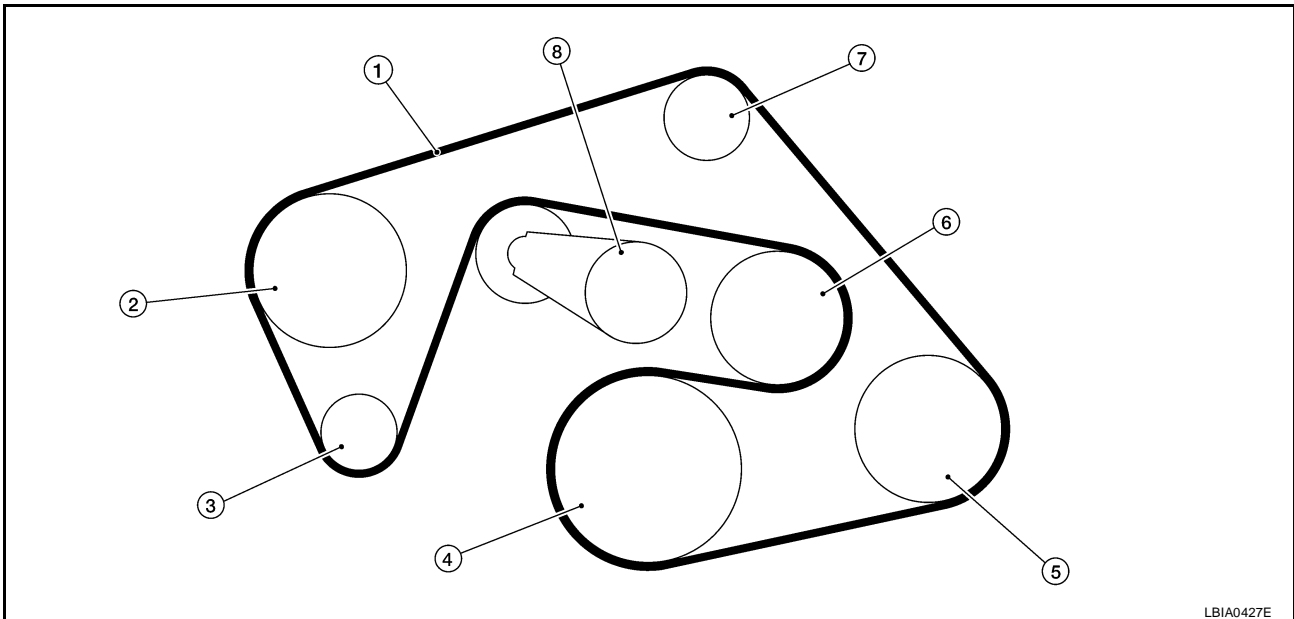
A: Closely related B: Related C: Sometimes related —: Not related

## DRIVE BELTS

PFP:02117

### Checking Drive Belts

GBS000FY



LBIA0427E

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

#### WARNING:

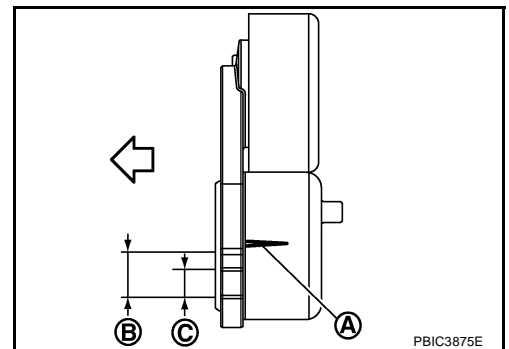
Be sure to perform when engine is stopped.

- Remove engine undercover front and air-duct-and-resonator-assembly when inspecting drive belt. Refer to [EI-17, "REAR BUMPER"](#) and [EM-17, "AIR CLEANER AND AIR DUCT"](#).
- Make sure that indicator (A) of auto tensioner is within the allowable working range (between three line notches "B").

↔ Engine front

#### NOTE:

- Check auto tensioner indication when engine is cold.
- When new drive belt is installed, the range should be (C).
- The indicator notch is located on the moving side of auto tensioner for alternator, water pump and A/C compressor belt, while it is found on the fixed side for power steering oil pump belt.
- Visually check drive belt for wear, damage or cracks.
- If the indicator is out of allowable working range or belt is damaged, replace drive belt.



PBIC3875E

### Tension Adjustment

GBS000FZ

Belt tensioning is not necessary, as it is automatically adjusted by auto tensioner.

### Removal and Installation

GBS000G0

#### REMOVAL

- Remove engine undercover front and air-duct-and-resonator-assembly when inspecting drive belt. Refer to [EI-15, "FRONT BUMPER"](#) and [EM-17, "AIR CLEANER AND AIR DUCT"](#).

# DRIVE BELTS

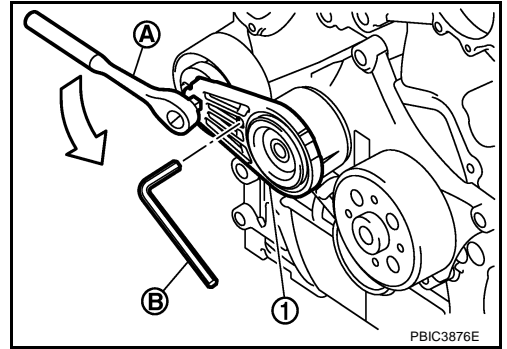
[VQ]

2. While securely holding the square hole in pulley center of auto tensioner (1) with a spinner handle (A), move spinner handle in the direction of arrow (loosening direction of tensioner).

**CAUTION:**

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

3. Under the above condition, insert a metal bar (B) of approximately 6 mm (0.24 in) in diameter (hexagonal bar wrench shown as example in the figure) through the holding boss to lock auto tensioner (1) pulley arm.
  - Leave auto tensioner pulley arm locked until drive belt is installed again.
4. Remove drive belt.



## INSTALLATION

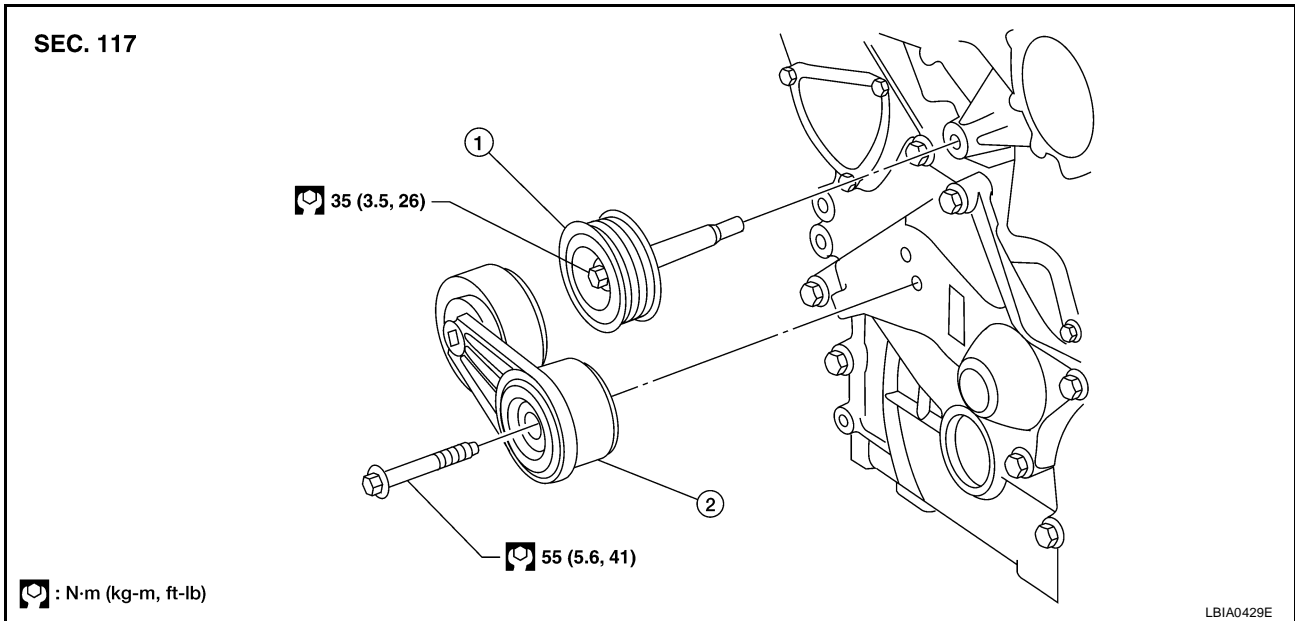
Note the following, and install in the reverse order of removal.

**CAUTION:**

- Make sure drive belt is securely installed around all pulleys.
- Make sure drive belt is correctly engaged with the pulley groove.
- Check for engine oil and engine coolant are not adhered drive belt and pulley groove.
- Check that drive belt tension is within the allowable working range, using indicator notch on auto tensioner. Refer to [EM-14, "Checking Drive Belts"](#).

## Drive Belt Auto Tensioner and Idler Pulley

GBS000G1



1. Idler pulley

2. Drive belt auto tensioner

### REMOVAL

1. Remove engine undercover front and air-duct-and-resonator-assembly when inspecting drive belt. Refer to [EI-15, "FRONT BUMPER"](#) and [EM-17, "AIR CLEANER AND AIR DUCT"](#).
2. Remove drive belt. Refer to [EM-14, "Removal and Installation"](#).
  - Keep auto tensioner pulley arm locked after belt is removed.
3. Remove auto tensioner and idler pulley.
  - Keep auto tensioner pulley arm locked to install or remove auto tensioner.

### INSTALLATION

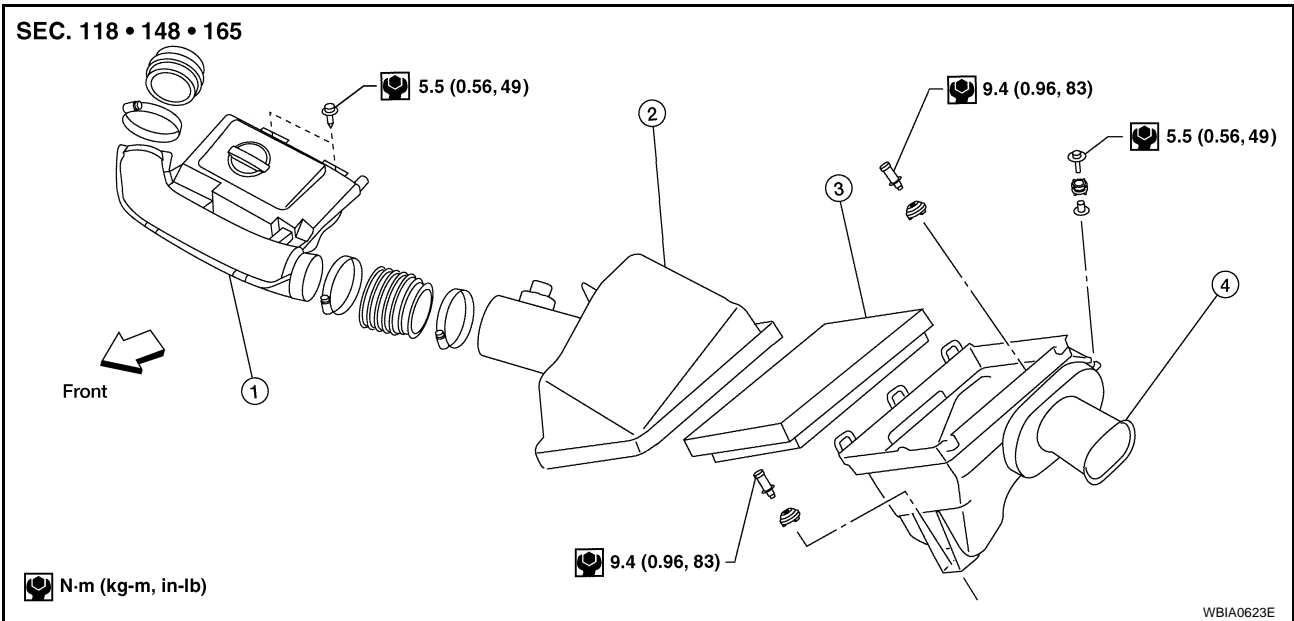
Installation is the reverse order of removal.

## AIR CLEANER AND AIR DUCT

PFP:16500

### Components

GBS000G2



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

### Removal and Installation

GBS000G3

#### REMOVAL

1. Disconnect harness connector from mass air flow sensor.
2. Disconnect PCV hose.
3. Remove air cleaner case/mass air flow sensor assembly and air duct assembly disconnecting their joints.
  - Add marks as necessary for easier installation.

#### CAUTION:

Handle mass air flow sensor with care.

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

#### INSPECTION AFTER REMOVAL

Inspect air duct for crack or tear.

- If anything found, replace air duct.

#### INSTALLATION

Note the following, and install in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.

### Changing Air Cleaner Filter

GBS000G4

#### REMOVAL

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

#### INSTALLATION

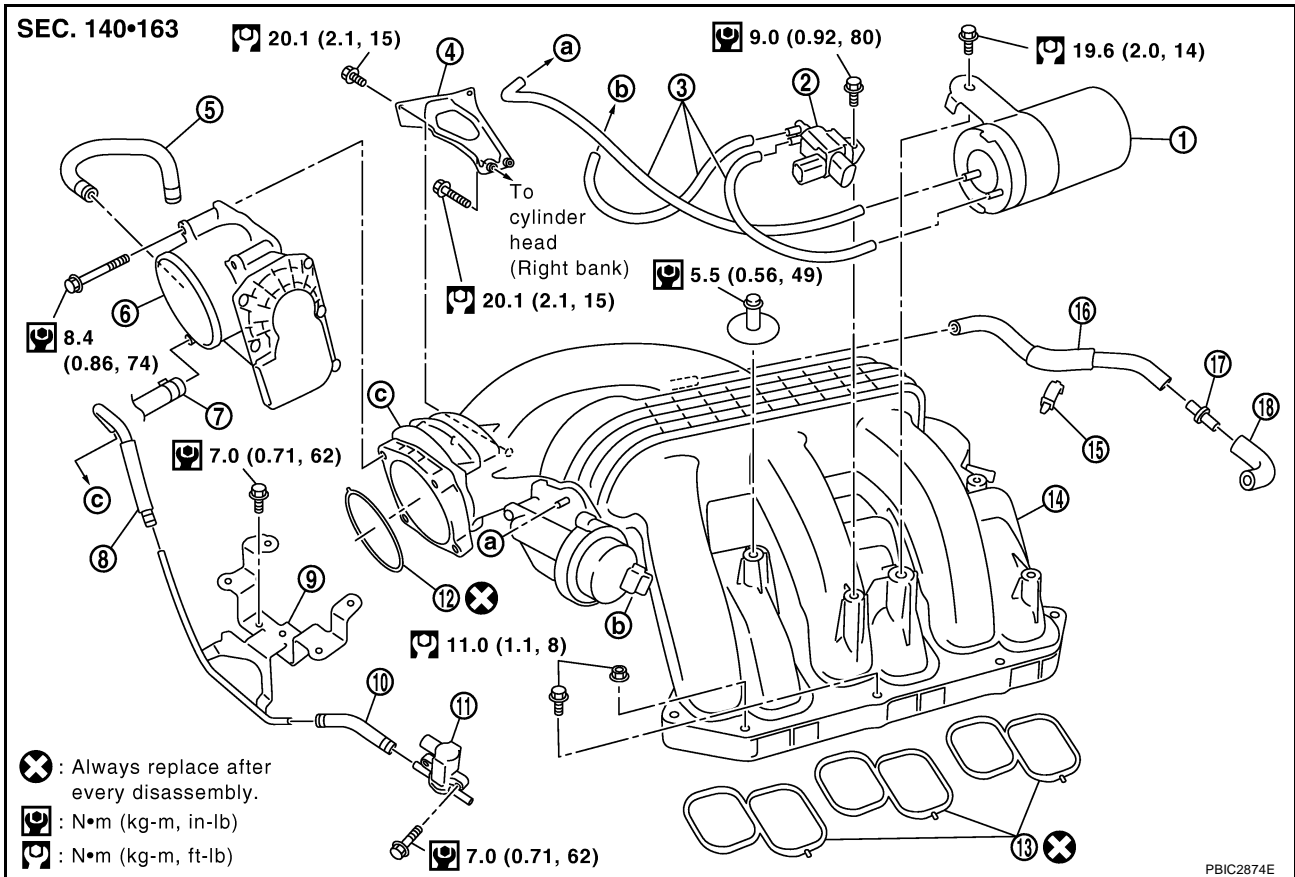
Installation is the reverse order of removal.

## INTAKE MANIFOLD COLLECTOR

PFP:14003

### Components

GBS000G5



- |                                      |   |                                       |
|--------------------------------------|---|---------------------------------------|
| 1. Vacuum tank                       | 2. VIAS control solenoid valve                        | 3. Vacuum hose                        |
| 4. Intake manifold collector support | 5. Water hose   | 6. Electric throttle control actuator |
| 7. Water hose                        | 8. EVAP hose  | 9. Bracket                            |
| 10. EVAP hose                        | 11. EVAP canister purge volume control solenoid valve | 12. Gasket                            |
| 13. Gasket                           | 14. Intake manifold collector                         | 15. Clip                              |
| 16. PCV hose                         | 17. Connector   | 18. PCV hose                          |

### Removal and Installation

#### REMOVAL

GBS000G6

#### WARNING:

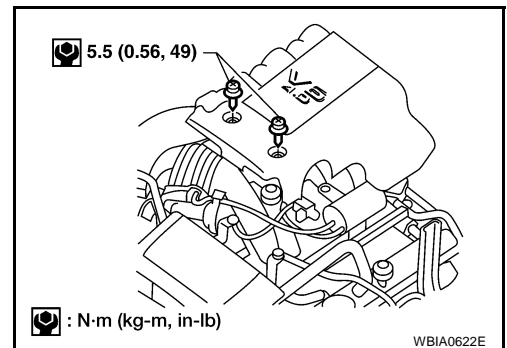
To avoid the danger of being scalded, never drain engine coolant when engine is hot.

1. Remove engine cover.

#### CAUTION:

Be careful not to damage or scratch engine cover.

- a. Loosen mounting bolts.
- b. Lift up on engine cover firmly to dislodge snap fit mounts.



2. Remove air cleaner case (upper) with mass air flow sensor and air duct assembly. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).
3. Remove electric throttle control actuator as follows:

# INTAKE MANIFOLD COLLECTOR

[VQ]

- a. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-10, "Changing Engine Coolant"](#).

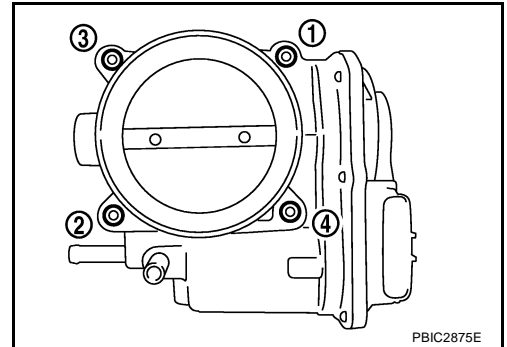
**CAUTION:**

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

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

**CAUTION:**

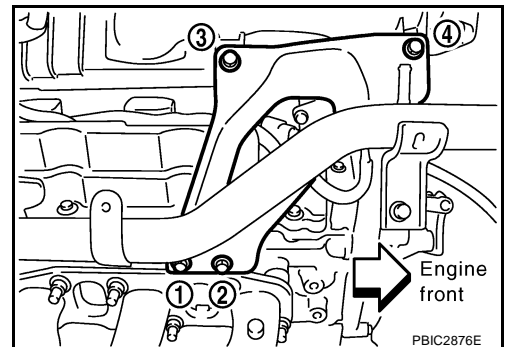
- Handle carefully to avoid any shock to electric throttle control actuator.
- Do not disassemble.



4. Remove the following parts:

- Vacuum hose (to brake booster)
- PCV hose

5. Loosen mounting bolts in reverse order as shown in the figure to remove intake manifold collector support.



6. Disconnect EVAP hoses and harness connector from EVAP canister purge volume control solenoid valve.

7. Remove EVAP canister purge volume control solenoid valve.

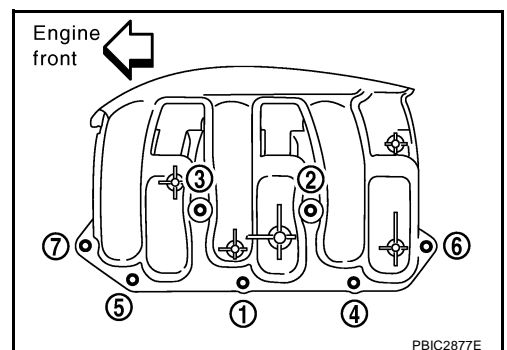
8. Remove VIAS control solenoid valve and vacuum tank.

- Add mating marks as necessary for easier installation.

9. Loosen mounting nuts and bolts in reverse order as shown in the figure, and remove intake manifold collector.

**CAUTION:**

**Cover engine openings to avoid entry of foreign materials.**



## INSTALLATION

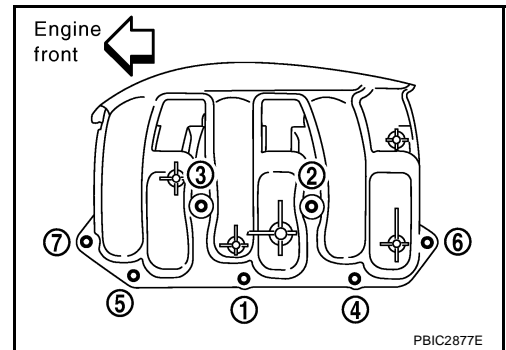
Note the following, and install in the reverse order of removal.

### Intake Manifold Collector

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

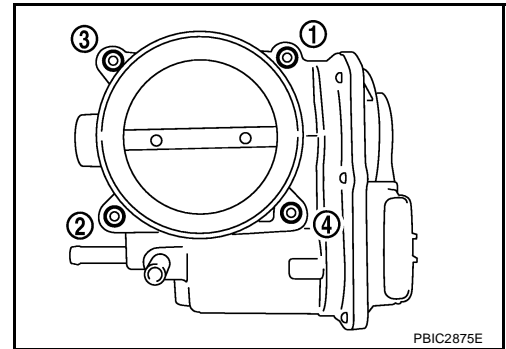
: 6.9 N·m (0.70 kg·m, 61 in-lb)

- Tighten mounting nuts and bolts in numerical order as shown in the figure.



## Electric Throttle Control Actuator

- Tighten mounting bolts in numerical order as shown in the figure.
- Perform the “Throttle Valve Closed Position Learning” when harness connector of electric throttle control actuator is disconnected. Refer to [EC-71, "Throttle Valve Closed Position Learning"](#) (models for Australia) or [EC-614, "Throttle Valve Closed Position Learning"](#) (models except for Australia).
- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when electric throttle control actuator is replaced. Refer to [EC-71, "Idle Air Volume Learning"](#) (models for Australia) or [EC-614, "Idle Air Volume Learning"](#) (models except for Australia).





## INTAKE MANIFOLD

PFP:14003

### Components

GBS000G7

A

EM

C

D

E

F

G

H

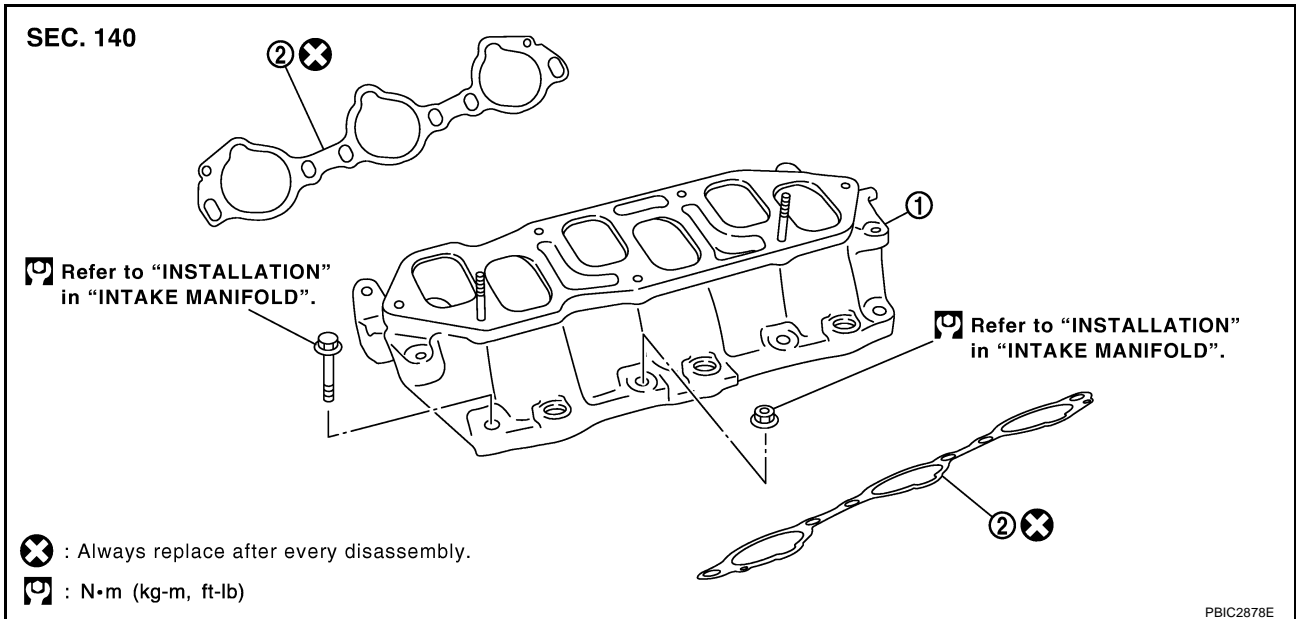
I

J

K

L

M



1. Intake manifold

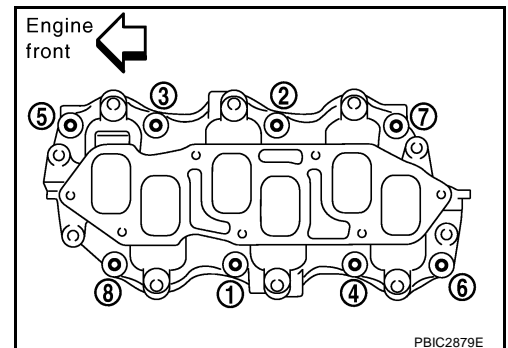
2. Gasket

### Removal and Installation

GBS000G8

#### REMOVAL

1. Release fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
2. Remove intake manifold collector. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove fuel tube and fuel injector assembly. Refer to [EM-36, "FUEL INJECTOR AND FUEL TUBE"](#).
4. Loosen mounting nuts and bolts with power tool in reverse order as shown in the figure to remove intake manifold.



5. Remove gaskets.

**CAUTION:**

Cover engine openings to avoid entry of foreign materials.

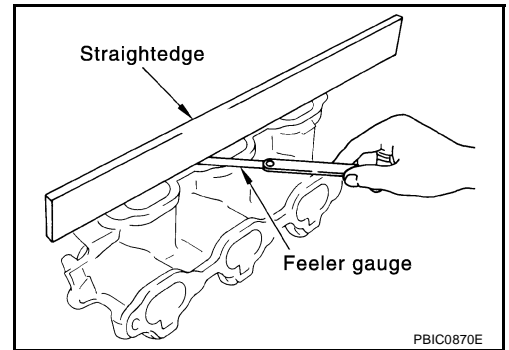
## INSPECTION AFTER REMOVAL

### Surface Distortion

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

**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace intake manifold.




## INSTALLATION

Note the following, and install in the reverse order of removal.

### Intake Manifold

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

: **10.8 N·m (1.1 kg·m, 8 ft·lb)**

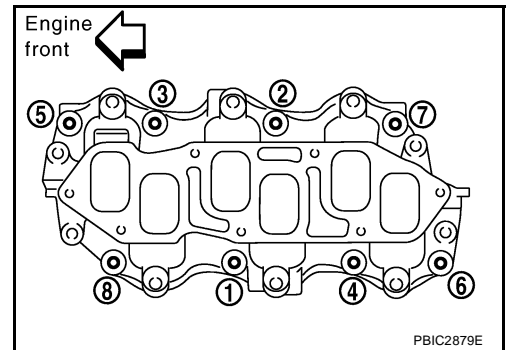
- Tighten all mounting nuts and bolts to the specified torque in two or more steps in numerical order shown in the figure.

 **1st step**

: **7.4 N·m (0.75 kg·m, 5 ft·lb)**

 **2nd step and after**

: **29.0 N·m (3.0 kg·m, 21 ft·lb)**



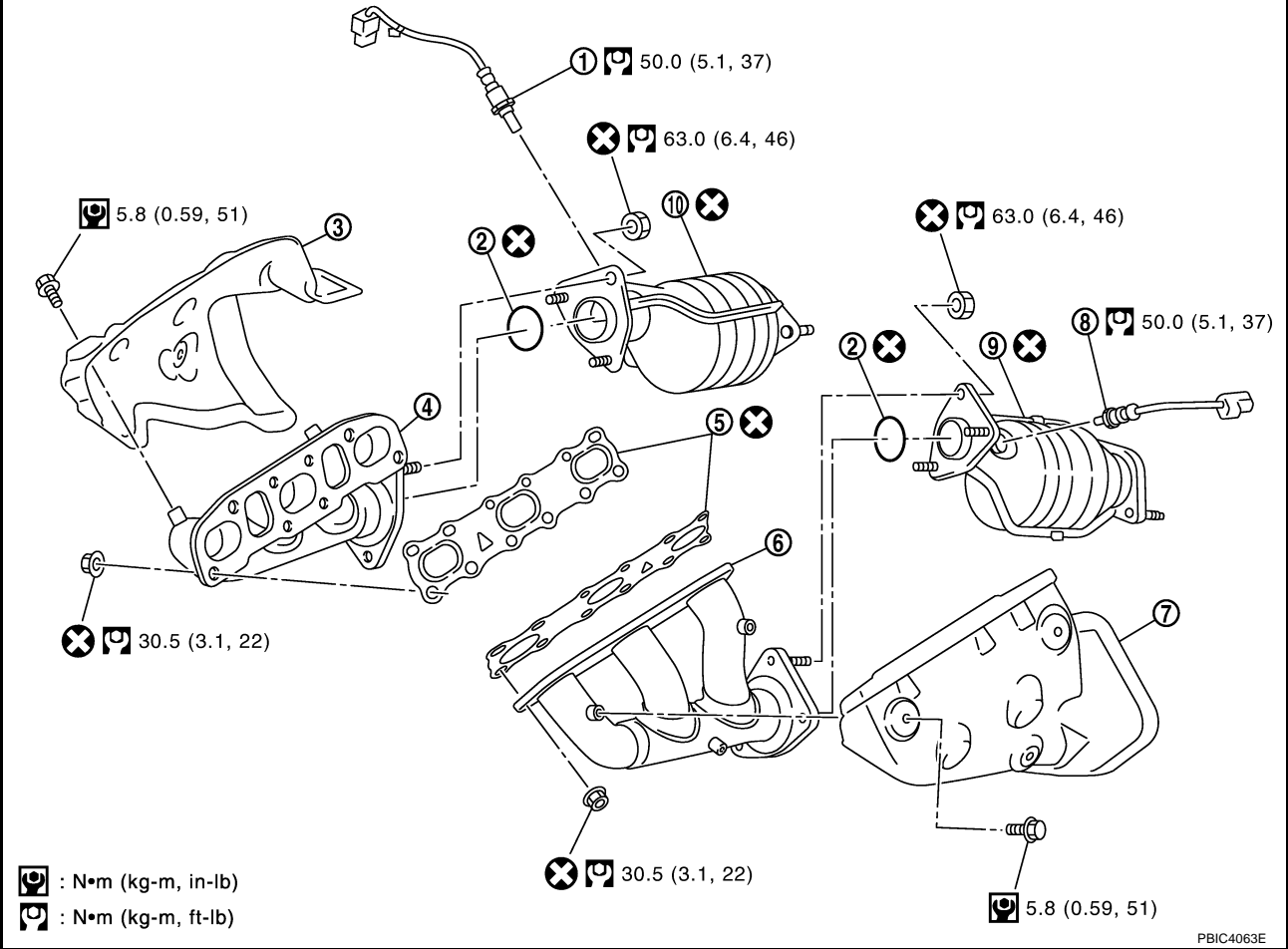
## EXHAUST MANIFOLD AND THREE WAY CATALYST

PF14004

### Components

GBS000G9

SEC. 140•147•208•226



- |  |                                     |  |
|--|-------------------------------------|--|
| 1. Air fuel ratio sensor 1 (bank 1)            | 2. Ring gasket                      | 3. Exhaust manifold cover (right bank)       |
| 4. Exhaust manifold (right bank)               | 5. Gasket                           | 6. Exhaust manifold (left bank)              |
| 7. Exhaust manifold cover (left bank)          | 8. Air fuel ratio sensor 1 (bank 2) | 9. Three way catalyst (manifold) (left bank) |
| 10. Three way catalyst (manifold) (right bank) |                                     |  |

- Refer to [GI-10. "Components"](#) for symbol marks in the figure.

### Removal and Installation

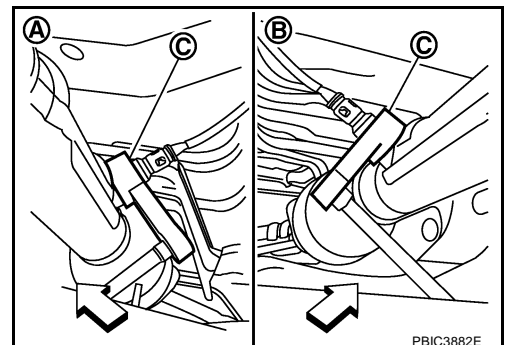
#### REMOVAL (LEFT BANK)

- Remove air cleaner case and air duct. Refer to [EM-17. "AIR CLEANER AND AIR DUCT"](#).
- Remove engine undercover front and engine undercover middle. Refer to [EI-15. "FRONT BUMPER"](#).
- Disconnect harness connector and remove heated oxygen sensor 2 on both banks using heated oxygen sensor wrench (C) [SST: KV10114400].

- A : Right bank
- B : Left bank
- : Vehicle front

#### CAUTION:

- Be careful not to damage heated oxygen sensor 2.



# EXHAUST MANIFOLD AND THREE WAY CATALYST

[VQ]

- Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.

4. Fasten main muffler temporarily to the vehicle, and remove exhaust front tube (left bank). Refer to [EX-2, "EXHAUST SYSTEM"](#).

5. Remove exhaust manifold cover (left bank).

6. Disconnect harness connector and remove air fuel ratio sensor 1 on both banks using heated oxygen sensor wrench (C) [SST: KV991- J0050].

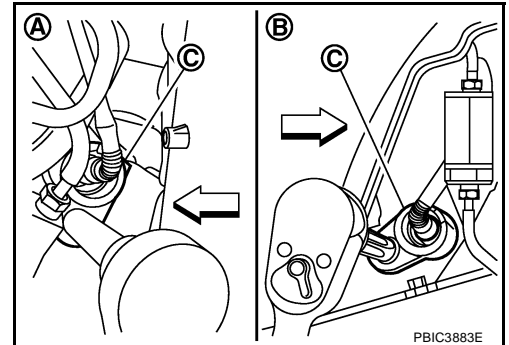
A : Left bank

B : Right bank

⇐ : Vehicle front

### CAUTION:

- Be careful not to damage air fuel ratio sensor 1.
- Discard any air fuel ratio sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.

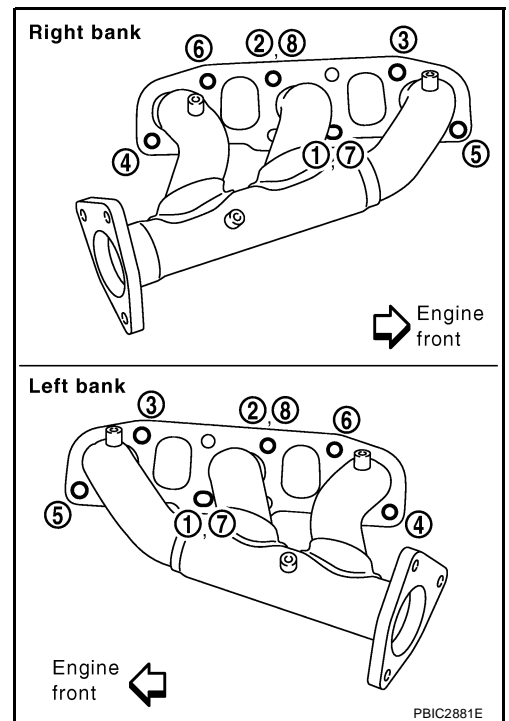


7. Remove three way catalyst (manifold) (left bank).

8. Loosen mounting nuts in reverse order as shown in the figure to remove exhaust manifold.

### NOTE:

Disregard the numerical order No. 7 and 8 in removal.



9. Remove gaskets.

### CAUTION:

Cover engine openings to avoid entry of foreign materials.

# EXHAUST MANIFOLD AND THREE WAY CATALYST

[VQ]

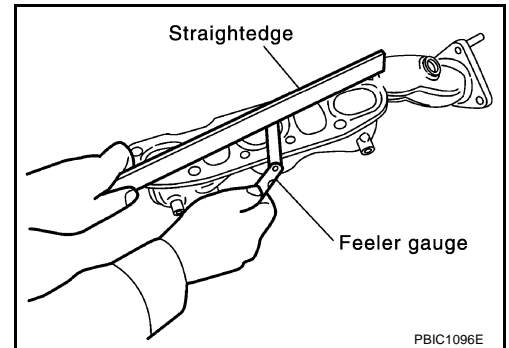
## INSPECTION AFTER REMOVAL (LEFT BANK)

### Surface Distortion

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

**Limit : 0.3 mm (0.012 in)**

- If it exceeds the limit, replace exhaust manifold.

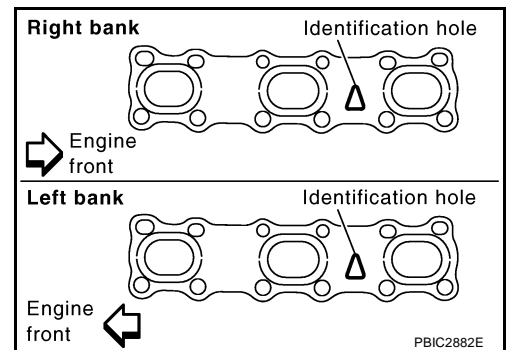


## INSTALLATION (LEFT BANK)

Note the following, and install in the reverse order of removal.

### Exhaust Manifold Gasket

Install in direction shown in the figure.



### Exhaust Manifold

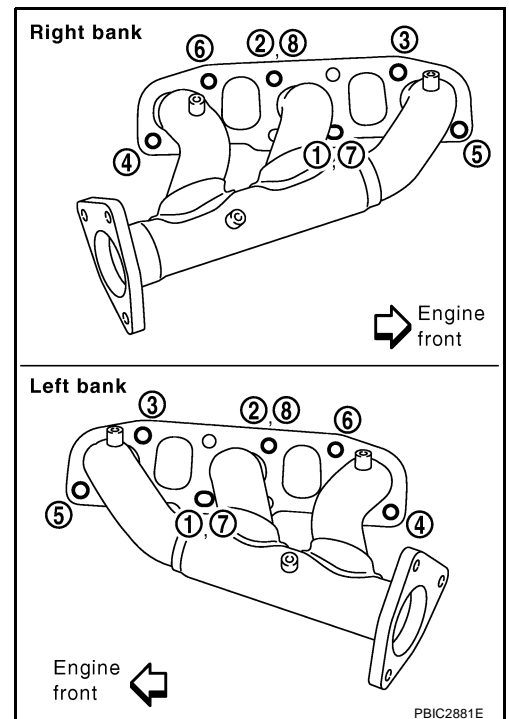
- If stud bolts (between engine and exhaust manifold) were removed, install them and tighten to the specified torque below.

: **14.7 N·m (1.5 kg·m, 11 ft·lb)**

- Install exhaust manifold and tighten mounting nuts in numerical order as shown in the figure.

#### NOTE:

Tighten nuts No. 1 and 2 in two steps. The numerical order No. 7 and 8 shows second step.



## Three Way Catalyst

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

: 25.4 N·m (2.6 kg-m, 19 ft-lb)

## Heated Oxygen Sensor

### CAUTION:

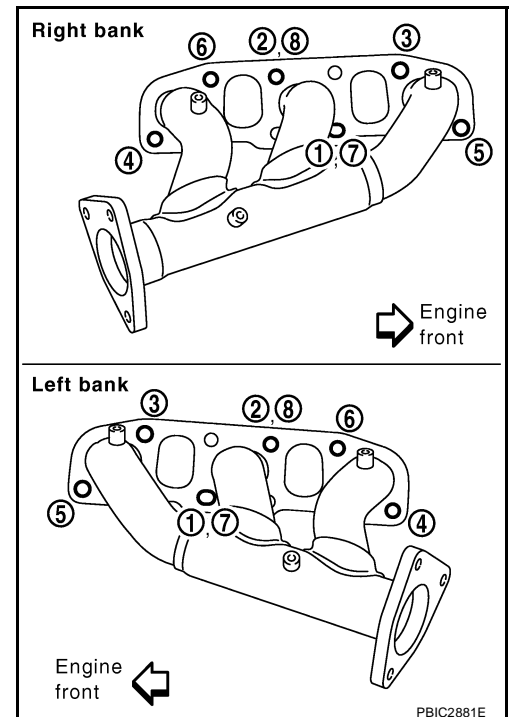
- Before installing a new air fuel ratio sensor 1 and heated oxygen sensor 2, clean exhaust system threads using oxygen sensor thread cleaner (commercial service tool) and apply anti-seize lubricant (commercial service tool).
- Do not over torque air fuel ratio sensor 1 and heated oxygen sensor 2. Doing so may cause damage to air fuel ratio sensor 1 and heated oxygen sensor 2, resulting in the "MIL" coming on.

## REMOVAL (RIGHT BANK)

1. Remove engine assembly. Refer to [EM-103, "ENGINE ASSEMBLY"](#) .
2. Loosen nuts in reverse order as shown.

### NOTE:

Disregard the numerical order No. 7 and 8 in removal.



3. Remove gasket.

### CAUTION:

Cover engine openings to avoid entry of foreign materials.

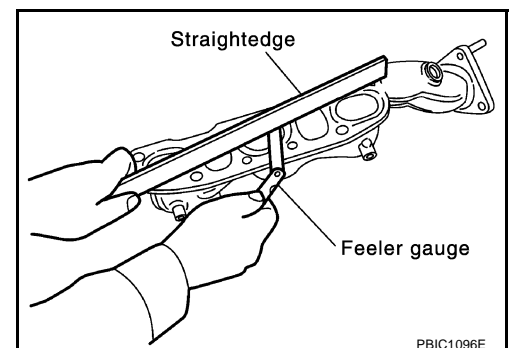
## INSPECTION AFTER REMOVAL (RIGHT BANK)

### Surface Distortion

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

**Limit : 0.3 mm (0.012 in)**

- If it exceeds the limit, replace exhaust manifold.

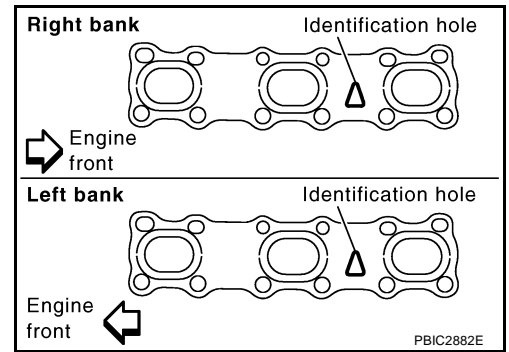


## INSTALLATION (RIGHT BANK)

Note the following, and install in the reverse order of removal.

## Exhaust Manifold Gasket

Install in direction shown in the figure.



## Exhaust Manifold

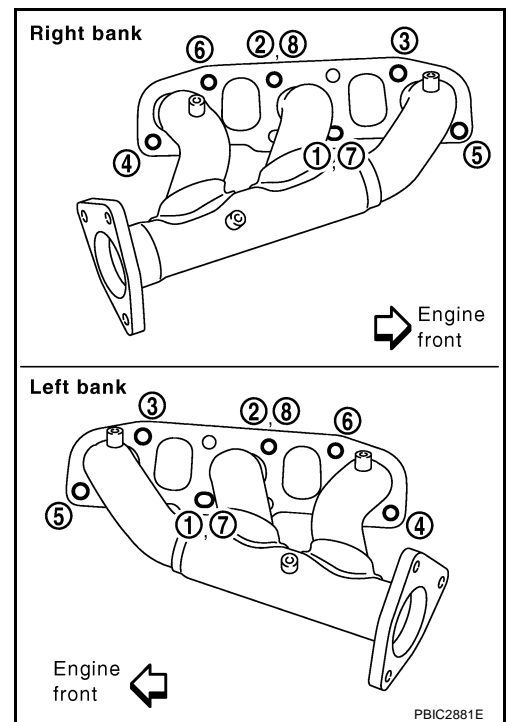
- If stud bolts were removed, install them and tighten to the specified torque below.

: 14.7 N·m (1.5 kg·m, 11 ft·lb)

- Install exhaust manifold and tighten mounting nuts in numerical order as shown in the figure.

**NOTE:**

Tighten nuts No. 1 and 2 in two steps. The numerical order No. 7 and 8 shows second step.



## Three Way Catalyst

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

: 25.4 N·m (2.6 kg·m, 19 ft·lb)

## Heated Oxygen Sensor

**CAUTION:**

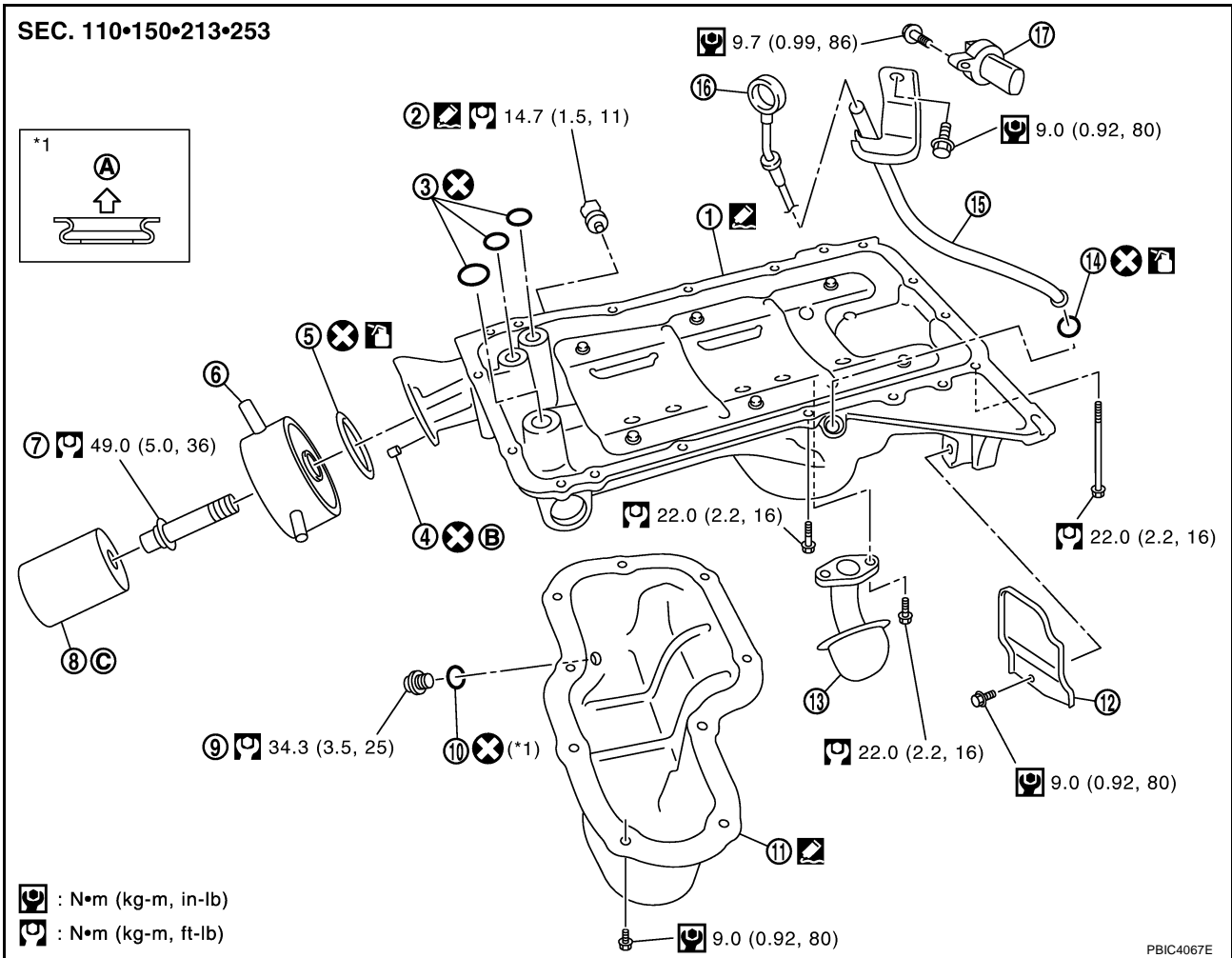
- Before installing a new air fuel ratio sensor 1 and heated oxygen sensor 2, clean exhaust system threads using oxygen sensor thread cleaner (commercial service tool) and apply anti-seize lubricant (commercial service tool).
- Do not over torque air fuel ratio sensor 1 and heated oxygen sensor 2. Doing so may cause damage to air fuel ratio sensor 1 and heated oxygen sensor 2, resulting in the "MIL" coming on.

## OIL PAN AND OIL STRAINER

PFP:11110

### Components

GBS000GB



- |                       |                                      |                                     |
|-----------------------|--------------------------------------|-------------------------------------|
| 1. Oil pan (upper)    | 2. Oil pressure switch               | 3. O-ring                           |
| 4. Relief valve       | 5. O-ring                            | 6. Oil cooler                       |
| 7. Connector bolt     | 8. Oil filter                        | 9. Drain plug                       |
| 10. Drain plug washer | 11. Oil pan (lower)                  | 12. Rear cover plate                |
| 13. Oil strainer      | 14. O-ring                           | 15. Oil level gauge guide           |
| 16. Oil level gauge   | 17. Crankshaft position sensor (POS) |                                     |
| A. Oil pan side       | B. Refer to <a href="#">LU-11</a> .  | C. Refer to <a href="#">LU-10</a> . |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

### REMOVAL

GBS000GC

#### WARNING:

To avoid the danger of being scalded, do not drain engine oil when engine is hot.

#### NOTE:

To remove oil pan (lower) only, take step 3 and step 4, then step 14. Step 1 to 2, 5 to 13 and 15 to 19 are unnecessary.

- Remove engine cover. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
- Remove air duct. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).
- Remove engine undercover front and engine undercover middle. Refer to [EI-15, "FRONT BUMPER"](#).
- Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).

#### CAUTION:

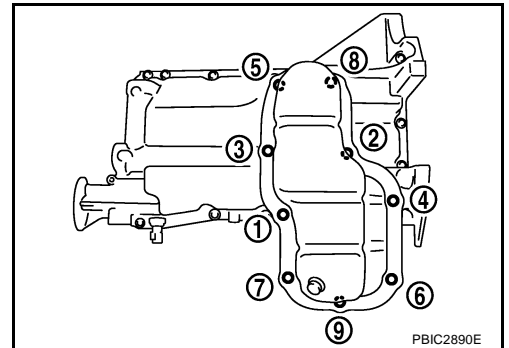
- Perform this step when engine is cold.



# OIL PAN AND OIL STRAINER

[VQ]

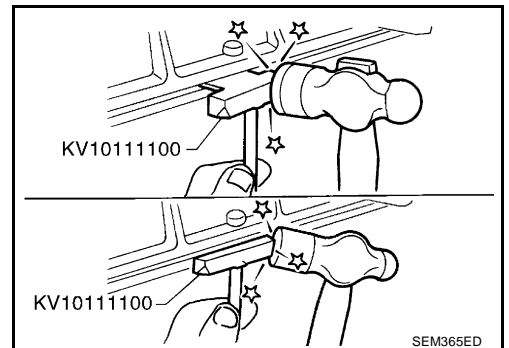
- Do not spill engine oil on drive belts.
5. Drain engine coolant. Refer to [CO-10, "Changing Engine Coolant"](#) .  
**CAUTION:**
    - Perform this step when engine is cold.
    - Do not spill engine coolant on drive belts.
  6. Remove front final drive assembly (4WD models). Refer to [FFD-15, "FRONT FINAL DRIVE ASSEMBLY"](#) .
  7. Disconnect steering gear lower joint shaft bolt and steering gear nuts and bolts, position out of the way. Refer to [PS-14, "POWER STEERING GEAR AND LINKAGE"](#) .
  8. Remove starter motor. Refer to [SC-36, "Removal and Installation"](#) .
  9. Disconnect A/T fluid cooler tube brackets and position out of the way (A/T models). Refer to [AT-251, "A/T FLUID COOLER"](#) .
  10. Install engine slinger to sling engine assembly for positioning. Refer to [EM-103, "ENGINE ASSEMBLY"](#) .
  11. Disconnect oil cooler water hoses, and remove oil cooler water pipe mounting bolt. Refer to [LU-11, "OIL COOLER"](#) .
  12. Remove oil filter. Refer to [LU-10, "OIL FILTER"](#) .
  13. Remove oil cooler. Refer to [LU-11, "OIL COOLER"](#) .
  14. Remove oil pan (lower) as follows:
    - a. Loosen mounting bolts in reverse order as shown in the figure to remove.



- b. Insert seal cutter [SST] between oil pan (upper) and oil pan (lower).

**CAUTION:**

- Be careful not to damage the mating surfaces.
- Do not insert screwdriver, this will damage the mating surfaces.



- c. Slide seal cutter by tapping on the side of the tool with hammer. Remove oil pan (lower).
15. Remove oil strainer.
16. Remove transmission joint bolts which pierce oil pan (upper). Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-254, "TRANSMISSION ASSEMBLY"](#) (A/T models).
17. Remove rear cover plate.

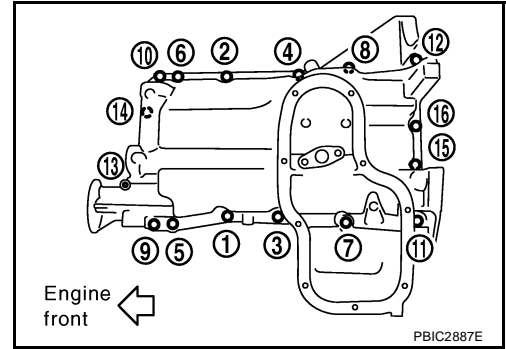
# OIL PAN AND OIL STRAINER

[VQ]

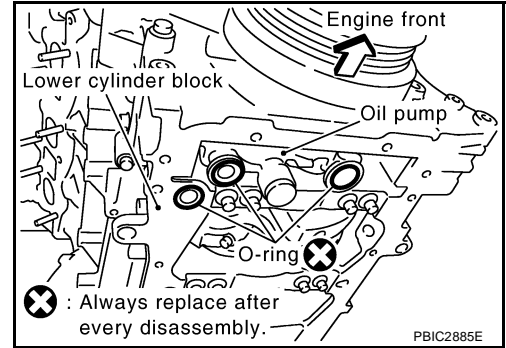
18. Loosen mounting bolts in reverse order as shown in the figure to remove.
  - Insert seal cutter [SST: KV10111100] between oil pan (upper) and lower cylinder block. Slide seal cutter by tapping on the side of tool with hammer. Remove oil pan (upper).

**CAUTION:**

**Be careful not to damage mating surfaces.**



19. Remove O-rings from bottom of lower cylinder block and oil pump.



## INSPECTION AFTER REMOVAL

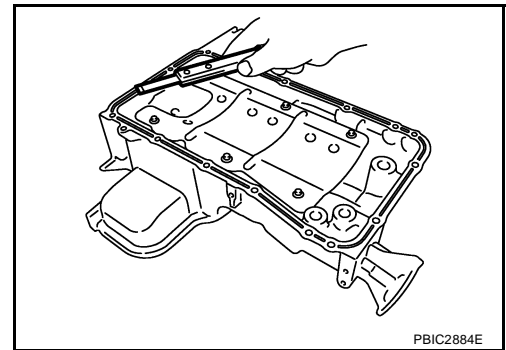
Clean oil strainer if any object attached.

## INSTALLATION

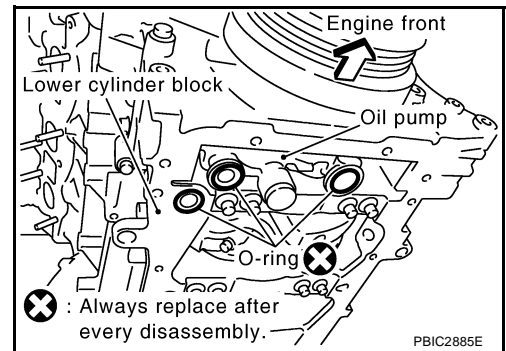
1. Install oil pan (upper) as follows:
  - a. Use scraper to remove old liquid gasket from mating surfaces.
    - Also remove the old liquid gasket from mating surface of lower cylinder block.
    - Remove old liquid gasket from the bolt holes and threads.

**CAUTION:**

**Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.**



- b. Install new O-rings on the bottom of lower cylinder block and oil pump.



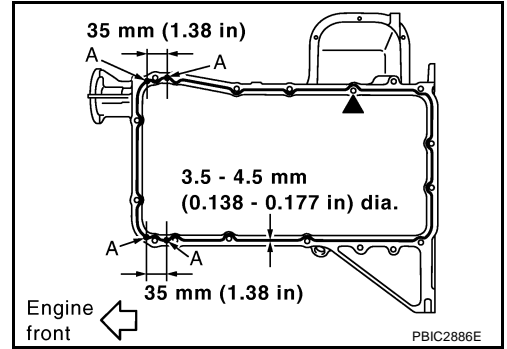
# OIL PAN AND OIL STRAINER

[VQ]

- c. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to the lower cylinder block mating surfaces of oil pan (upper) to a limited portion as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

**CAUTION:**

- For bolt holes with ▲ mark, apply liquid gasket outside the hole.
- Apply a bead of 4.5 to 5.5 mm (0.177 to 0.217 in) in diameter to area "A".
- Attaching should be done within 5 minutes after coating.



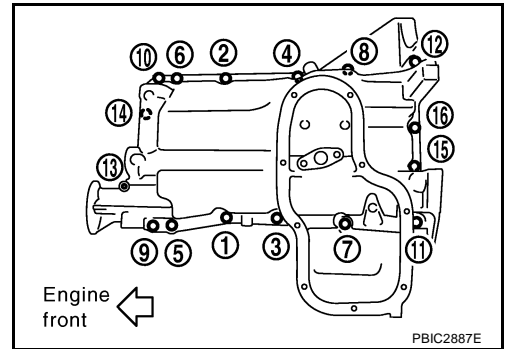
- d. Install oil pan (upper).

**CAUTION:**

**Install avoiding misalignment of both oil pan gaskets and O-rings.**

- Tighten mounting bolts in numerical order as shown in the figure.
- There are two types of mounting bolts. Refer to the following for locating bolts.

- M8 × 100 mm (3.97 in) : 7, 11, 12, 13**
- M8 × 25 mm (0.98 in) : Except the above**



- e. Tighten transmission joint bolts. Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-254, "TRANSMISSION ASSEMBLY"](#) (A/T models).

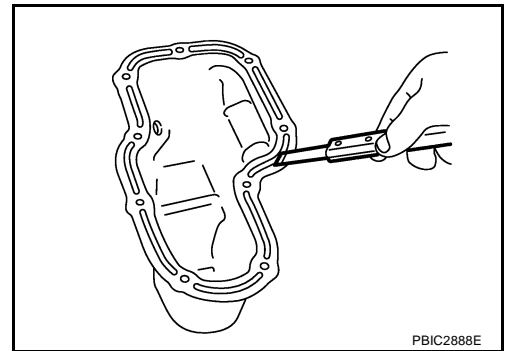
2. Install oil strainer to oil pan (upper).

3. Install oil pan (lower) as follows:

- a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove old liquid gasket from mating surface of oil pan (upper).
  - Remove old liquid gasket from the bolt holes and thread.

**CAUTION:**

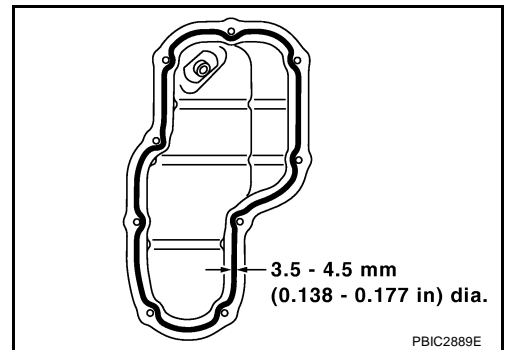
**Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.**



- b. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to the oil pan (lower) as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

**CAUTION:**

**Attaching should be done within 5 minutes after coating.**

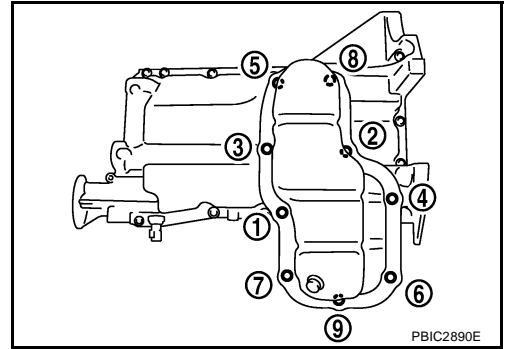


- c. Install oil pan (lower).

## OIL PAN AND OIL STRAINER

[VQ]

- Tighten mounting bolts in numerical order as shown in the figure.



4. Install oil pan drain plug.
  - Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-28, "Components"](#).
5. Installation is the reverse order of removal after this step.

**NOTE:**

At least 30 minutes after oil pan is installed, pour engine oil.

### INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-7, "ENGINE OIL"](#).
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-7, "ENGINE OIL"](#).

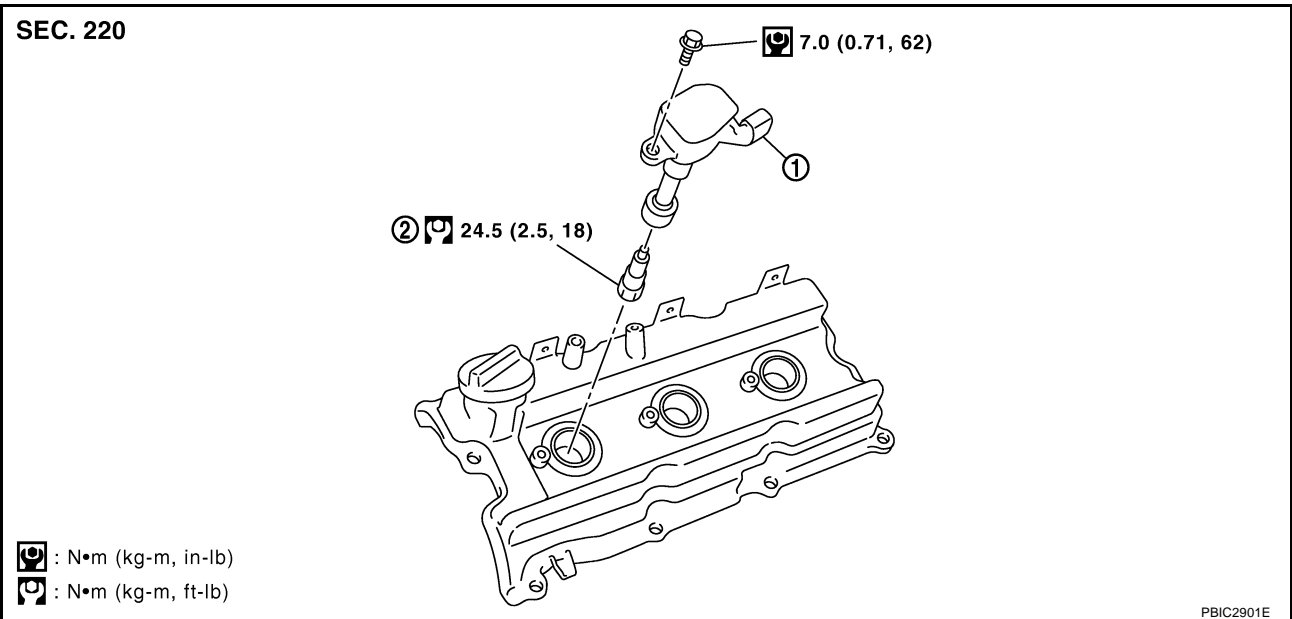
## IGNITION COIL

PFP:22448

### Components

GBS000GD

SEC. 220



1. Ignition coil

2. Spark plug

### Removal and Installation

GBS000GE

#### REMOVAL (LEFT BANK)

1. Remove engine cover. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove air cleaner case and air duct. (At the left bank side, remove ignition coil) Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
3. Move aside harness, harness bracket, and hoses located above ignition coil.
4. Disconnect harness connector from ignition coil.
5. Remove ignition coil.

**CAUTION:**  
Do not shock it.

#### INSTALLATION (LEFT BANK)

Installation is the reverse order of removal.

#### REMOVAL (RIGHT BANK)

1. Remove intake manifold collector. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Move aside harness, harness bracket, and hoses located above ignition coil.
3. Disconnect harness connector from ignition coil.
4. Remove ignition coil.

**CAUTION:**  
Do not shock it.

#### INSTALLATION (RIGHT BANK)

Installation is the reverse order of removal.

# SPARK PLUG (PLATINUM-TIPPED TYPE)

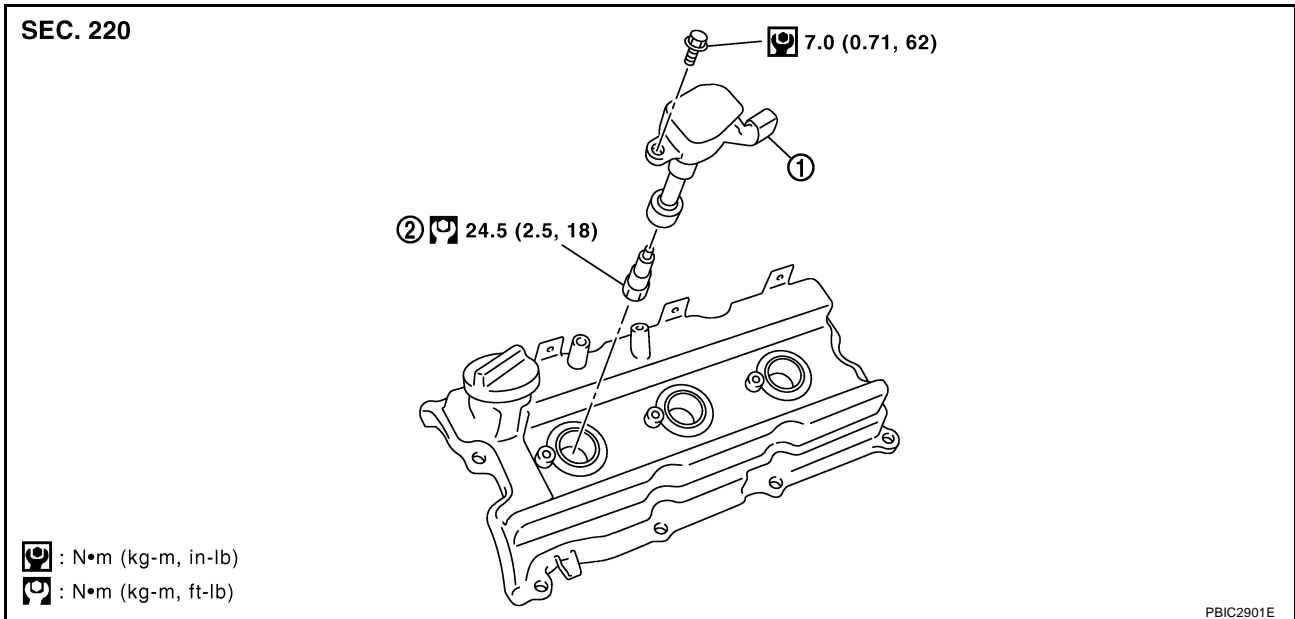
[VQ]

## SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

### Components

GBS000GF



1. Ignition coil

2. Spark plug

### Removal and Installation

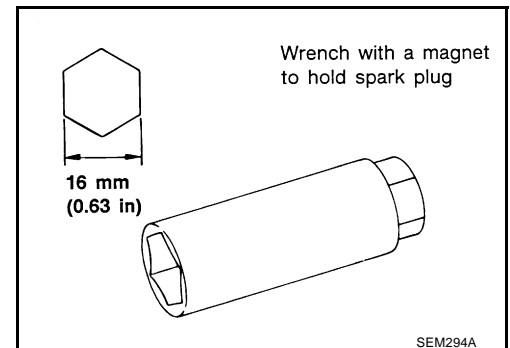
GBS000GG

#### REMOVAL

1. Remove ignition coil. Refer to [EM-33, "IGNITION COIL"](#).
2. Remove spark plug using spark plug wrench (commercial service tool).

#### CAUTION:

Do not drop or shock it.



#### INSPECTION AFTER REMOVAL

Use standard type spark plug for normal condition.

Hot type spark plug is suitable when fouling occurs with standard type spark plug under conditions such as:

- Frequent engine starts
- Low ambient temperatures

Cold type spark plug is suitable when spark plug knock occurs with standard type spark plug under conditions such as:

- Extended highway driving
- Frequent high engine revolution

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11

Gap (Nominal) : 1.1 mm (0.043 in)

# SPARK PLUG (PLATINUM-TIPPED TYPE)

[VQ]

## CAUTION:

- Do not drop or shock spark plug.
- Do not use wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

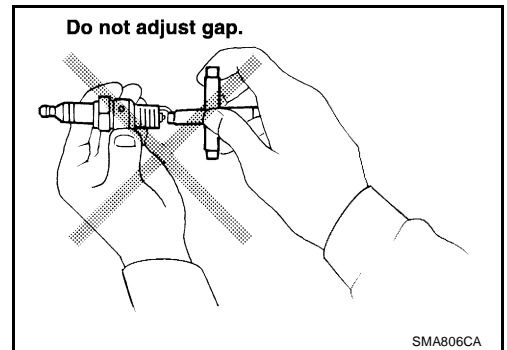
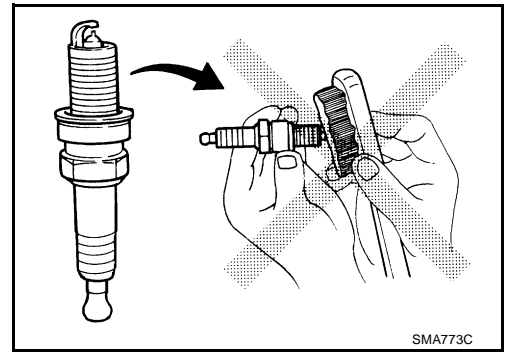
Cleaner air pressure:

Less than 588 kPa (6 kg/cm<sup>2</sup> , 85 psi)

Cleaning time:

Less than 20 seconds

- Checking and adjusting plug gap is not required between change intervals.



## INSTALLATION

Installation is the reverse order of removal.

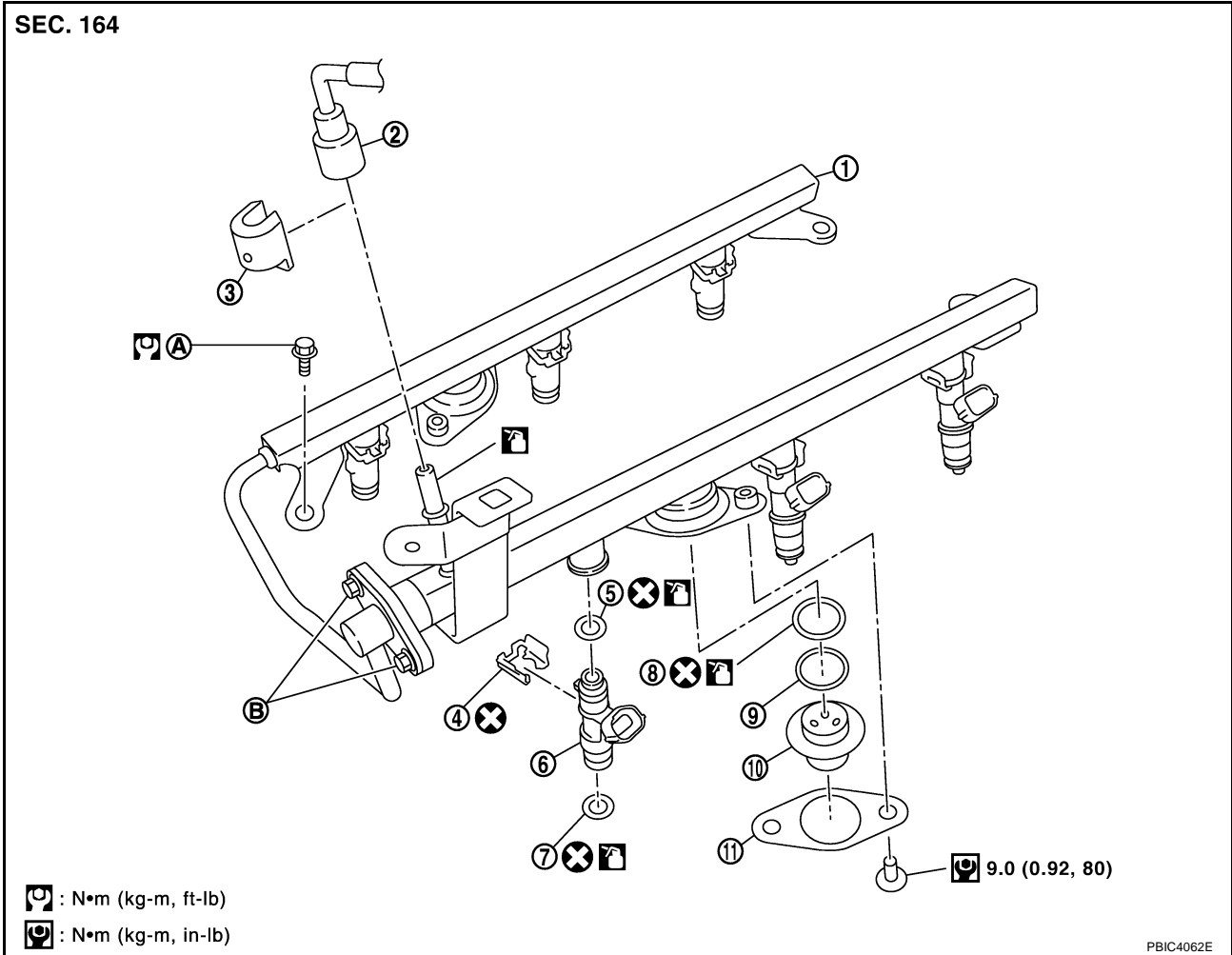
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## FUEL INJECTOR AND FUEL TUBE

PFP:16600

### Components

GBS000GH



- |                                     |                               |                        |
|-------------------------------------|-------------------------------|------------------------|
| 1. Fuel tube                        | 2. Fuel feed hose             | 3. Quick connector cap |
| 4. Clip                             | 5. O-ring (blue)              | 6. Fuel injector       |
| 7. O-ring (brown)                   | 8. O-ring                     | 9. Spacer              |
| 10. Fuel damper                     | 11. Fuel damper cap           |                        |
| A. Refer to <a href="#">EM-39</a> . | B. Do not loosen these bolts. |                        |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

GBS000GI

### REMOVAL

#### WARNING:

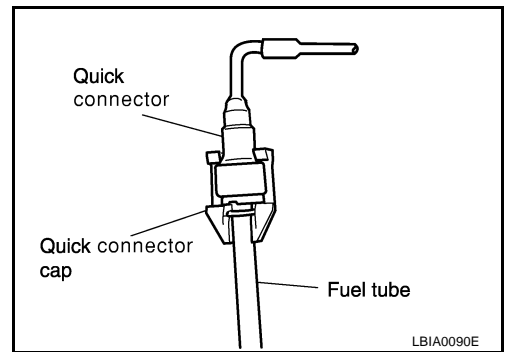
- Put a "CAUTION INFLAMMABLE" sign in the workshop.
  - Be sure to work in a well-ventilated area and furnish workshop with a CO<sub>2</sub> fire extinguisher.
  - Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.
  - To avoid the danger of being scalded, do not drain engine coolant when engine is hot.
- Remove intake manifold collector. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
  - Release fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
  - Disconnect quick connector on the engine side as follows:



# FUEL INJECTOR AND FUEL TUBE

[VQ]

- a. Remove quick connector cap.



- b. Disconnect quick connector as follows:

**CAUTION:**

**Disconnect quick connector by using quick connector release (A) [SST], not by picking out retainer tabs.**

- i. With the sleeve side (B) of quick connector release (A) facing to quick connector (1), install quick connector release (A) onto fuel tube (2).
- ii. Insert quick connector release (A) into quick connector (1) until sleeve (B) contacts and goes no further (D). Hold quick connector release (A) on that position.

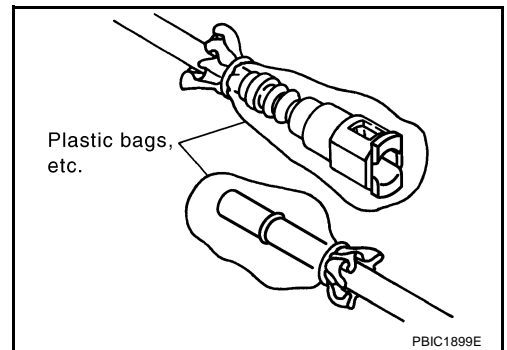
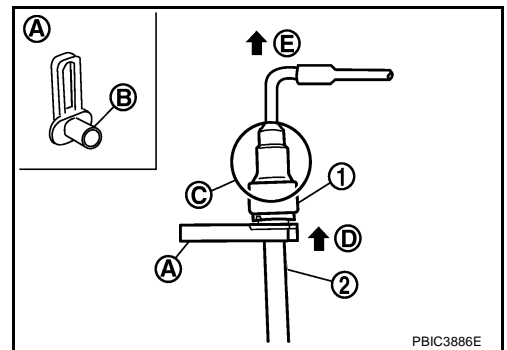
**CAUTION:**

**Inserting quick connector release (A) hard will not disconnect quick connector (1). Hold quick connector release (A) where it contacts and goes no further (D).**

- iii. Draw and pull out (E) quick connector (1) straight from fuel tube (2).

**CAUTION:**

- Pull quick connector holding (C) position as shown in the figure.
- Do not pull with lateral force applied. O-ring inside quick connector (1) may be damaged.
- Prepare container and cloth beforehand as fuel will leak out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Do not expose parts to battery electrolyte or other acids.
- Do not bend or twist connection between quick connector and fuel tube during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



4. Remove PCV hose between rocker covers (right and left banks).
5. Disconnect harness connector from fuel injector.

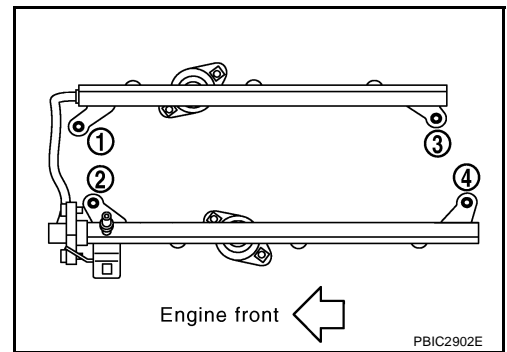
## FUEL INJECTOR AND FUEL TUBE

[VQ]

6. Loosen mounting bolts in reverse order as shown in the figure, and remove fuel tube and fuel injector assembly.

**CAUTION:**

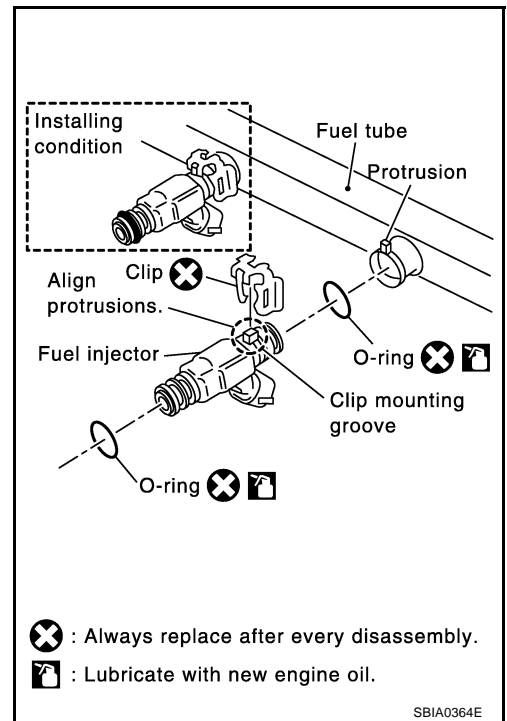
- Do not tilt it, or remaining fuel in pipes may flow out from pipes.
- Do not disassemble fuel tube.



7. Remove fuel injector from fuel tube as follows:
- a. Open and remove clip.
  - b. Remove fuel injector from fuel tube by pulling straight.

**CAUTION:**

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage injector nozzles during removal.
- Do not bump or drop fuel injector.
- Do not disassemble fuel injector and fuel tube.



8. Loosen mounting bolts, to remove fuel damper cap and fuel damper, if necessary.

## INSTALLATION

1. Install fuel damper as follows:
  - a. Install new O-ring to fuel tube as shown in the figure.
    - When handling new O-rings, be careful of the following caution:
 

**CAUTION:**

      - Handle O-ring with bare hands. Do not wear gloves.
      - Lubricate O-ring with new engine oil.
      - Do not clean O-ring with solvent.
      - Make sure that O-ring and its mating part are free of foreign material.
      - When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.
      - Insert new O-ring straight into fuel tube. Do not decenter or twist it.
  - b. Install spacer to fuel damper.
  - c. Insert fuel damper straight into fuel tube.
    - Insert fuel damper until "B" is hit "A" of fuel tube.
  - d. Tighten mounting bolts evenly in turn.
    - After tightening mounting bolts, make sure that there is no gap between fuel damper cap and fuel tube.
2. Install new O-rings to fuel injector, paying attention to the following.

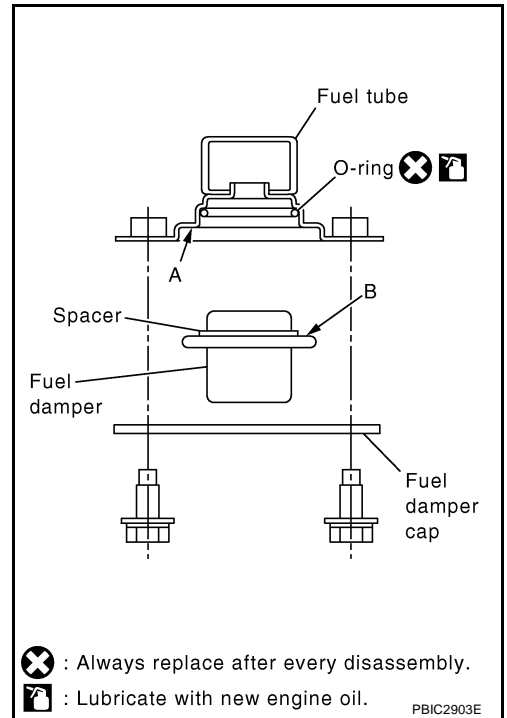
**CAUTION:**

- Upper and lower O-ring are different. Be careful not to confuse them.

**Fuel tube side : Blue**

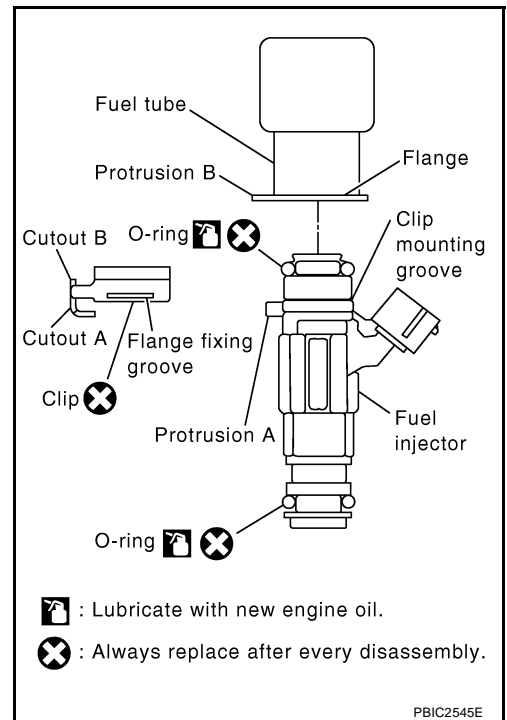
**Nozzle side : Brown**

- Handle O-ring with bare hands. Do not wear gloves.
- Lubricate O-ring with new engine oil.
- Do not clean O-ring with solvent.
- Make sure that O-ring and its mating part are free of foreign material.
- When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.
- Insert O-ring straight into fuel injector. Do not decenter or twist it.



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3. Install fuel injector to fuel tube as follows:
  - a. Insert clip into clip mounting groove on fuel injector.
    - Insert clip so that protrusion "A" of fuel injector matches cutout "A" of clip.
  - CAUTION:**
    - **Do not reuse clip. Replace it with a new one.**
    - **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**
  - b. Insert fuel injector into fuel tube with clip attached.
    - Insert it while matching it to the axial center.
    - Insert fuel injector so that protrusion "B" of fuel tube matches cutout "B" of clip.
    - Make sure that fuel tube flange is securely fixed in flange fixing groove on clip.
  - c. Make sure that installation is complete by checking that fuel injector does not rotate or come off.
    - Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.



4. Install fuel tube and fuel injector assembly to intake manifold.

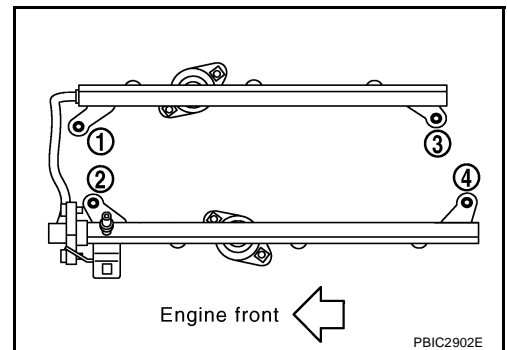
**CAUTION:**

**Be careful not to let tip of injector nozzle come in contact with other parts.**

- Tighten mounting bolts in two steps in numerical order as shown in the figure.

**1st step**  
: 10.1 N·m (1.0 kg·m, 7 ft·lb)

**2nd step**  
: 22.0 N·m (2.2 kg·m, 16 ft·lb)



5. Connect fuel injector harness connector.
6. Install intake manifold collector. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
7. Install in the reverse order of removal after this step.

## INSPECTION AFTER INSTALLATION

### Check on Fuel Leakage

1. Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.

**NOTE:**

Use mirrors for checking at points out of clear sight.

2. Start engine. With engine speed increased, check again for fuel leakage at connection points.

**CAUTION:**

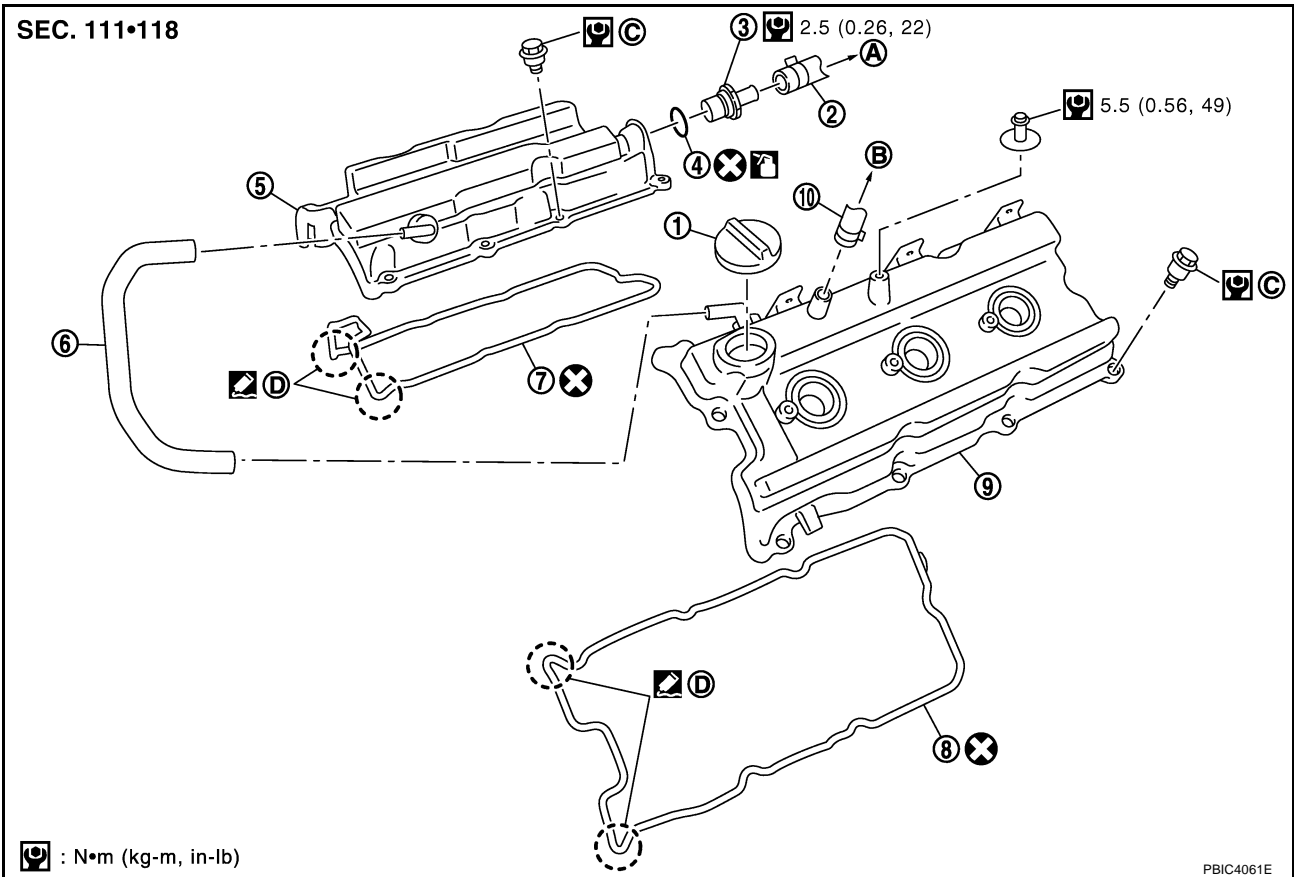
**Do not touch engine immediately after stopped, as engine becomes extremely hot.**

## ROCKER COVER

PFPP:13264

### Components

GBS000GJ



- |                                     |                                    |                                     |
|-------------------------------------|------------------------------------|-------------------------------------|
| 1. Oil filler cap                   | 2. PCV hose                        | 3. PCV valve                        |
| 4. O-ring                           | 5. Rocker cover (right bank)       | 6. PCV hose                         |
| 7. Rocker cover gasket (right bank) | 8. Rocker cover gasket (left bank) | 9. Rocker cover (left bank)         |
| 10. PCV hose                        |                                    |                                     |
| A. To intake manifold collector     | B. To air duct                     | C. Refer to <a href="#">EM-42</a> . |
| D. Camshaft bracket side            |                                    |                                     |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

### REMOVAL

GBS000GK

1. Remove engine cover. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-10, "Changing Engine Coolant"](#) and [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .

### CAUTION:

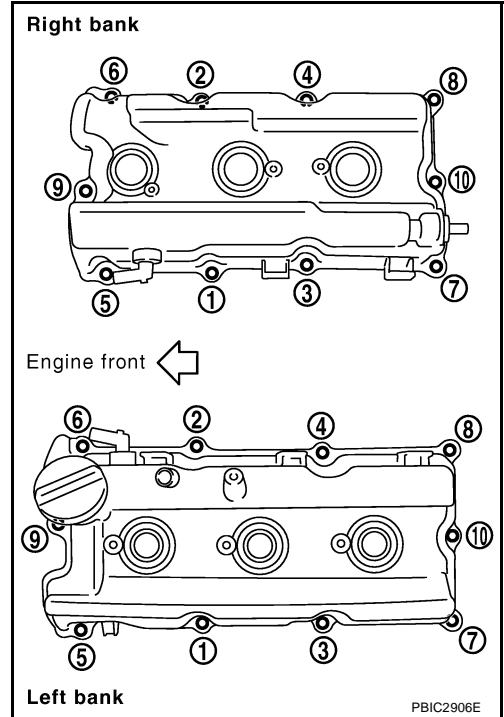
**Perform this step when engine is cold.**

3. Remove intake manifold collector. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
4. Separate engine harness removing their brackets from rocker covers.
5. Remove harness bracket from cylinder head (right bank). Refer to [EM-91, "CYLINDER HEAD"](#) .
6. Remove ignition coil. Refer to [EM-33, "IGNITION COIL"](#) .
7. Remove PCV hoses from rocker covers.
8. Remove PCV valve and O-ring from rocker cover (right bank), if necessary.
9. Remove oil filler cap from rocker cover (left bank), if necessary.

# ROCKER COVER

[VQ]

- Loosen mounting bolts with power tool in reverse order as shown in the figure.



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

**CAUTION:**

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

## INSTALLATION

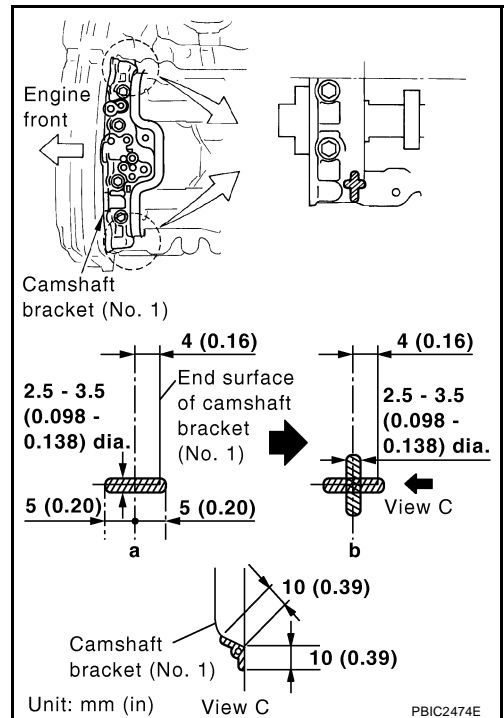
- Apply liquid gasket with tube presser [SST: WS39930000] to joint part among rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

**Use Genuine Liquid Gasket or equivalent.**

**NOTE:**

The figure shows an example of left bank side [zoomed in shows camshaft bracket (No. 1)].

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




- Install new rocker cover gasket to rocker cover.
- Install rocker cover.
  - Check if rocker cover gasket is not dropped from installation groove of rocker cover.

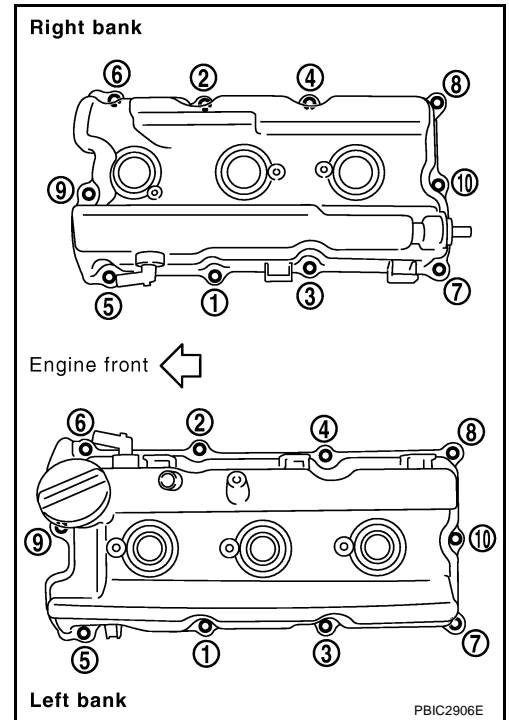
# ROCKER COVER

[VQ]

4. Tighten bolts in two steps separately in numerical order as shown in the figure.

 **1st step**  
: 1.96 N·m (0.20 kg·m, 17 in·lb)

 **2nd step**  
: 8.33 N·m (0.85 kg·m, 74 in·lb)



5. Install oil filter cap to rocker cover (left bank), if removed.
6. Install new O-ring and PCV valve to rocker cover (right bank), if removed.
7. Install PCV hose.
- Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
  - When installing, be careful not to twist or come in contact with other parts.
8. Install in the reverse order of removal after this step.

## FRONT TIMING CHAIN CASE

PFP:13599

## Removal and Installation

GBS000GL

## NOTE:

- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in the reverse order of removal. Refer to [EM-53, "TIMING CHAIN"](#) .
- Refer to [EM-53, "TIMING CHAIN"](#) for component parts location.

## REMOVAL

1. Remove engine cover. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove engine undercover front and engine undercover middle. Refer to [EI-15, "FRONT BUMPER"](#) .
3. Release the fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
4. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#) .

**CAUTION:**

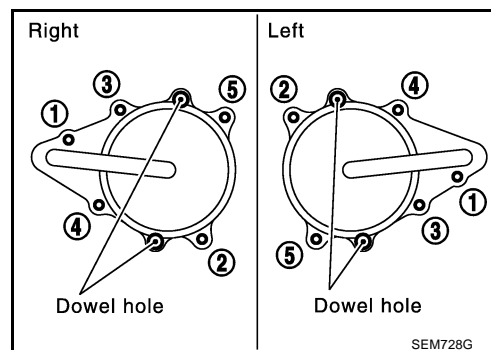
- Perform this step when engine is cold.
  - Do not spill engine oil on drive belts.
5. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#) .

**CAUTION:**

- Perform this step when engine is cold.
  - Do not spill engine coolant on drive belts.
6. Remove radiator cooling fan assembly. Refer to [CO-21, "COOLING FAN"](#) .
  7. Separate engine harnesses removing their brackets from front timing chain case.
  8. Remove drive belt. Refer to [EM-14, "DRIVE BELTS"](#) .
  9. Remove power steering oil pump from bracket with piping connected, and temporarily secure it to aside. Refer to [PS-24, "POWER STEERING OIL PUMP"](#) .
  10. Remove power steering oil pump bracket. Refer to [PS-24, "POWER STEERING OIL PUMP"](#) .
  11. Remove alternator. Refer to [SC-25, "Removal and Installation"](#) .
  12. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
  13. Remove right and left intake valve timing control covers.
    - Loosen mounting bolts in reverse order as shown in the figure.
    - Use seal cutter [SST: KV10111100] to cut liquid gasket for removal.

**CAUTION:**

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

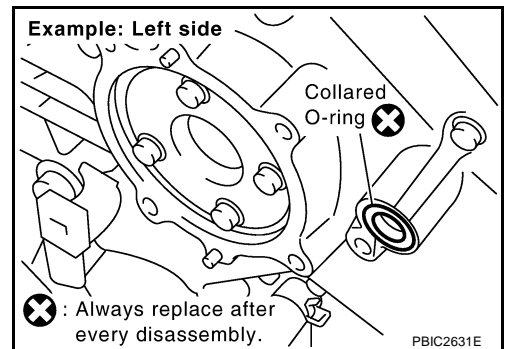




# FRONT TIMING CHAIN CASE

[VQ]

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



15. Remove rocker covers (right and left banks). Refer to [EM-41, "ROCKER COVER"](#) .

**NOTE:**

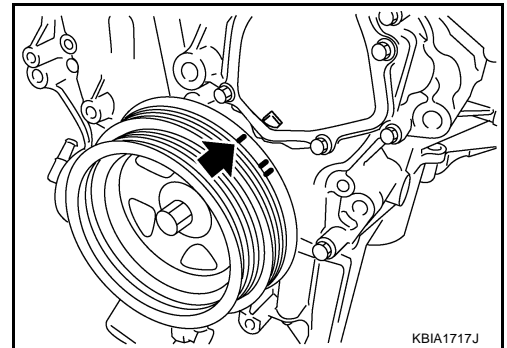
When only timing chain (primary) is removed, rocker cover does not need to be removed.

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

**NOTE:**

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

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

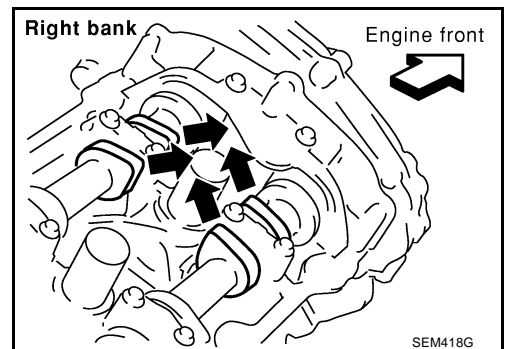


- b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.

- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.

**NOTE:**

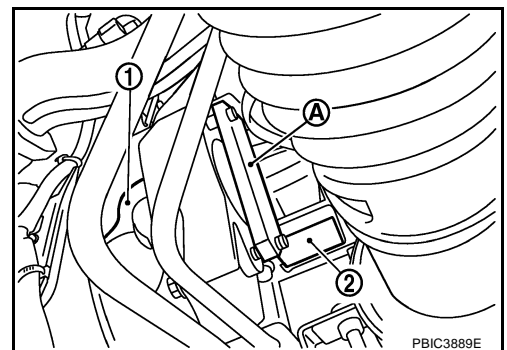
When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to [EM-62, "INSTALLATION"](#) .



17. Remove crankshaft pulley as follows:

- a. Remove starter motor and set ring gear stopper (A) [SST: KV10117700] as shown in the figure. Refer to [SC-36, "Removal and Installation"](#) .

- 1 : Transmission
- 2 : Oil pan (upper)



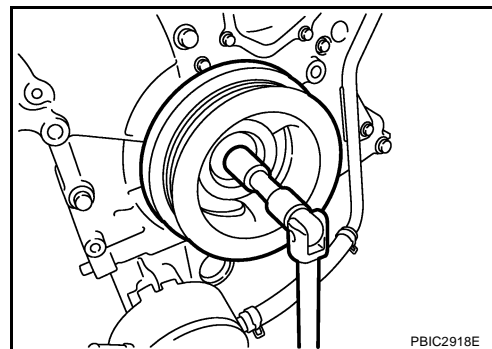
# FRONT TIMING CHAIN CASE

[VQ]

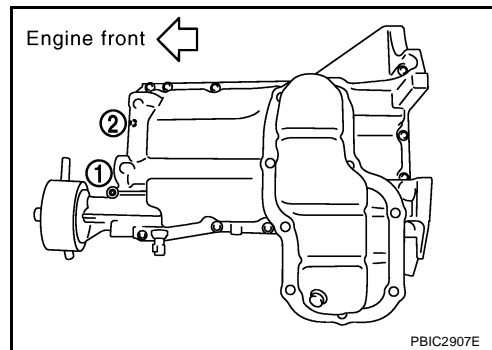
- b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

**CAUTION:**

**Do not remove crankshaft pulley bolt. Keep loosened crankshaft pulley bolt in place to protect removed crankshaft pulley from dropping.**

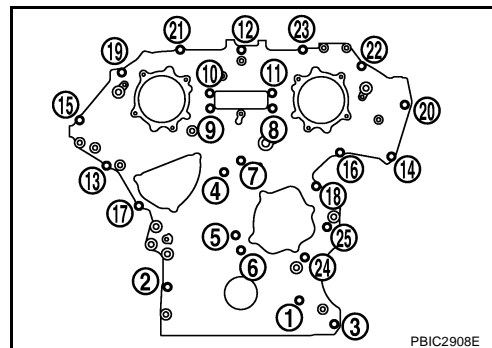


- c. Pull crankshaft pulley with both hands to remove it.
18. Loosen two mounting bolts in front of oil pan (upper) in reverse order as shown in the figure.



19. Remove front timing chain case as follows:

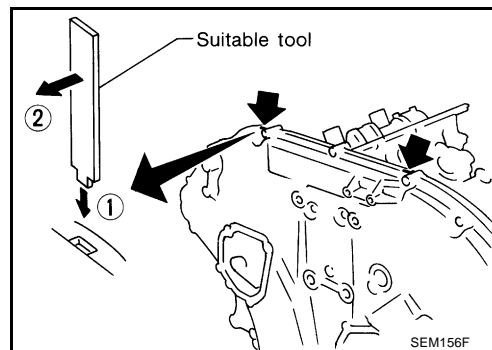
- a. Loosen mounting bolts in reverse order as shown in the figure.



- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).
- c. Pry off case by moving tool as shown (2).
- Use seal cutter [SST: KV10111100] to cut liquid gasket for removal.

**CAUTION:**

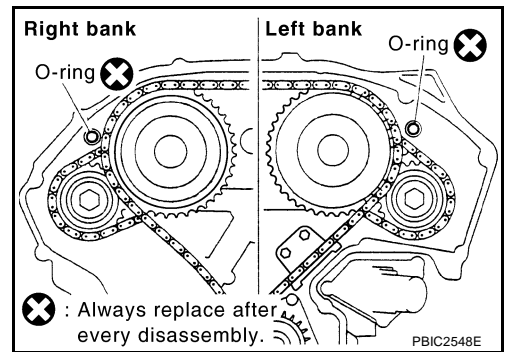
- **Do not use screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**



# FRONT TIMING CHAIN CASE

[VQ]

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



21. Remove water pump cover and chain tensioner cover from front timing chain case, if necessary.

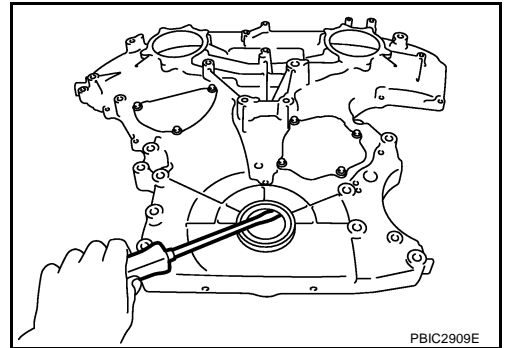
- Use seal cutter [SST: KV10111100] to cut liquid gasket for removal.

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

- Use screwdriver for removal.

**CAUTION:**

**Be careful not to damage front timing chain case.**

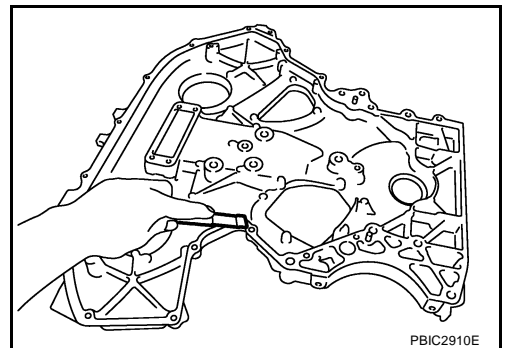


23. Remove timing chain and related parts. Refer to [EM-53, "TIMING CHAIN"](#).

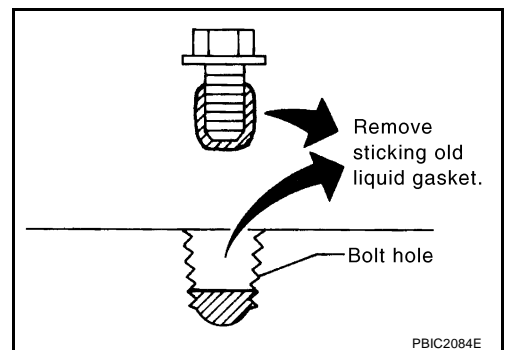
24. Use a scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

**CAUTION:**

**Be careful not to allow gasket fragments to enter oil pan.**



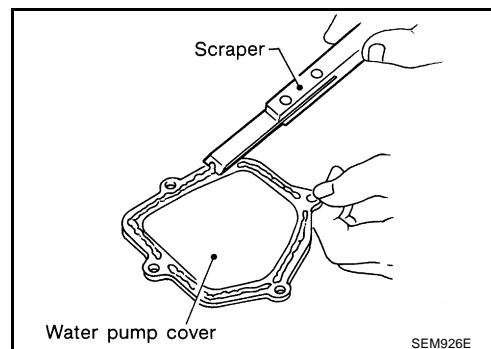
- Remove old liquid gasket from bolt hole and thread.



# FRONT TIMING CHAIN CASE

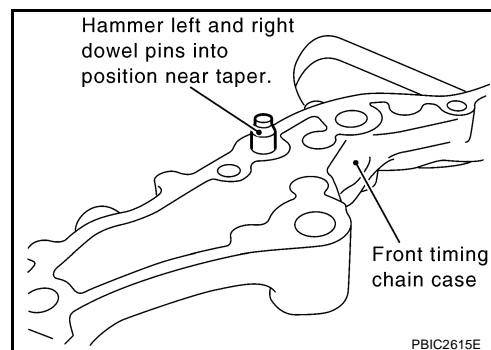
[VQ]

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

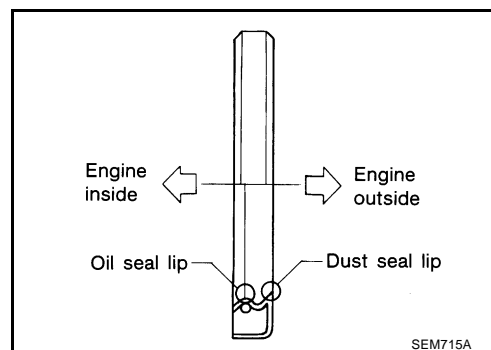


## INSTALLATION

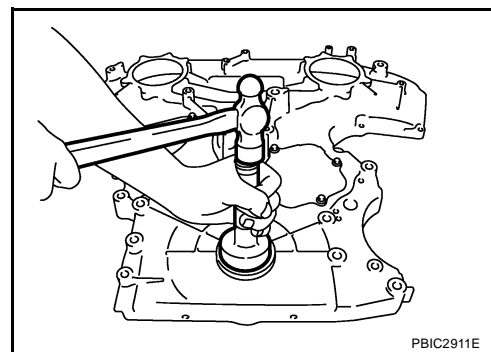
1. Install timing chain and related parts. Refer to [EM-53, "TIMING CHAIN"](#).
2. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.



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



- Using suitable drift [outer diameter: 60 mm (2.36 in)], press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.

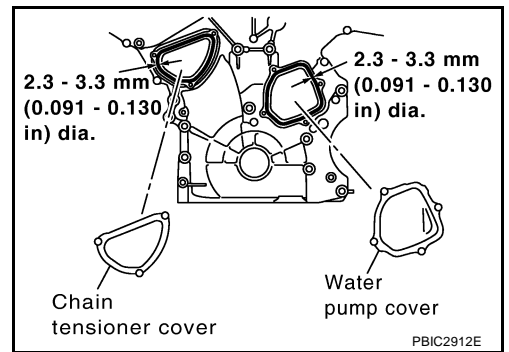


4. Install water pump cover and chain tensioner cover to front timing chain case, if removed.

# FRONT TIMING CHAIN CASE

[VQ]

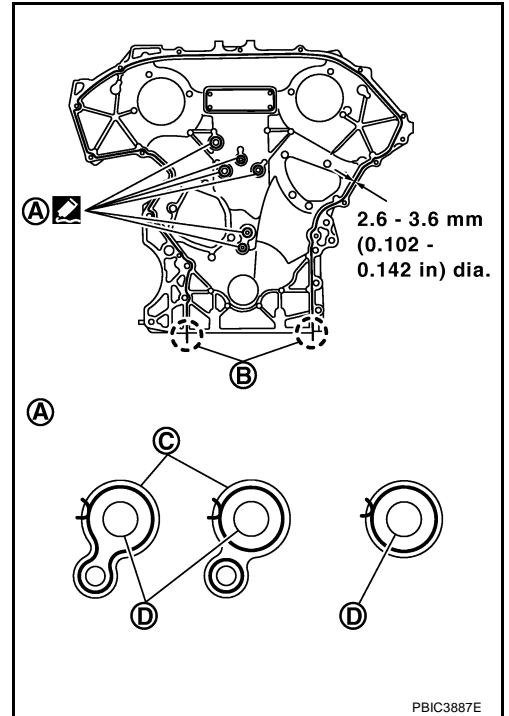
- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to front timing chain case as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**



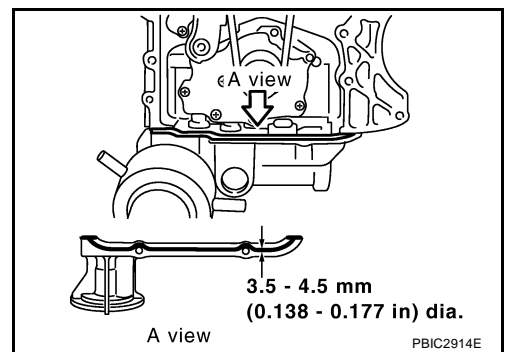
5. Install front timing chain case as follows:

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to front timing chain case back side as shown in the figure.
  - B : Protrusion
  - C : Both permissible
  - D : Bolt hole

**Use Genuine Liquid Gasket or equivalent.**



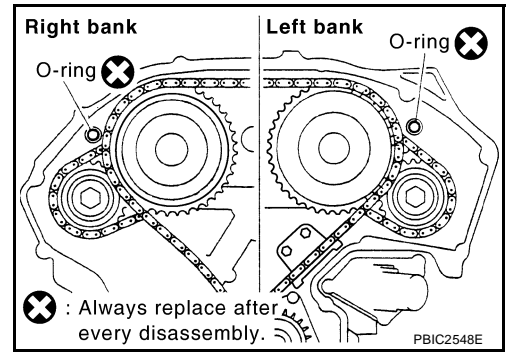
- Apply liquid gasket with tube presser [SST: WS39930000] to top surface of oil pan (upper) as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**



# FRONT TIMING CHAIN CASE

[VQ]

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

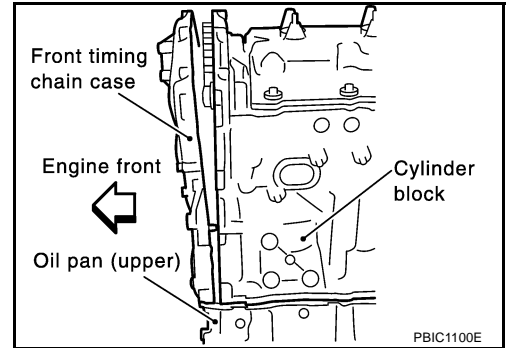


d. Assemble front timing chain case as follows:

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

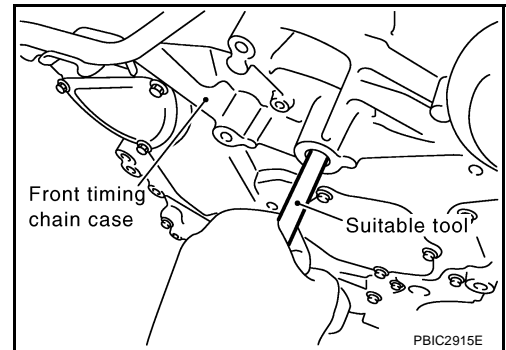
**CAUTION:**

**Be careful that oil pan gasket is in place.**



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

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



e. Tighten mounting bolts to the specified torque in numerical order as shown in the figure.

● There are four type of mounting bolts. Refer to the following for locating bolts.

**M10 × 70mm (2.76 in) : 5**

: 55.0 N·m (5.6 kg-m, 41 ft-lb)

**M10 × 90mm (3.54 in) : 1, 2, 3, 4**

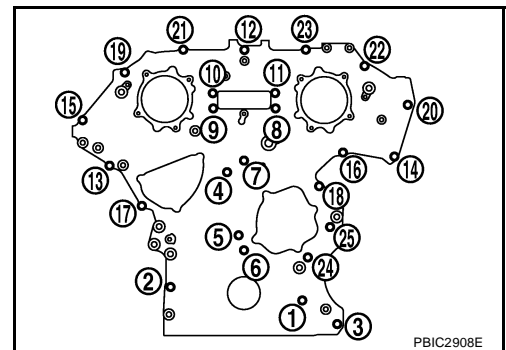
: 55.0 N·m (5.6 kg-m, 41 ft-lb)

**M6 × 40mm (1.57 in) : 24, 25**

: 12.7 N·m (1.3 kg-m, 9 ft-lb)

**M6 × 25mm (0.98 in) : Except above**

: 12.7 N·m (1.3 kg-m, 9 ft-lb)



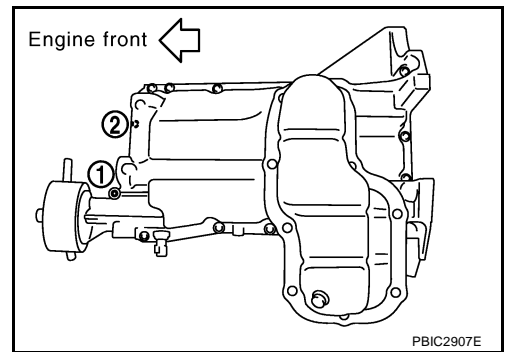
f. After all bolts tightened, retighten them to the specified torque in numerical order as shown in the figure.

# FRONT TIMING CHAIN CASE

[VQ]

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

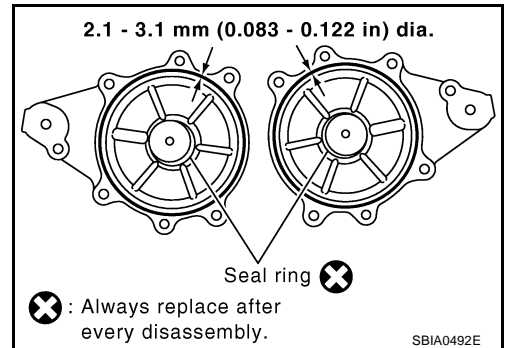
: 22.0 N·m (2.2 kg-m, 16 ft-lb)



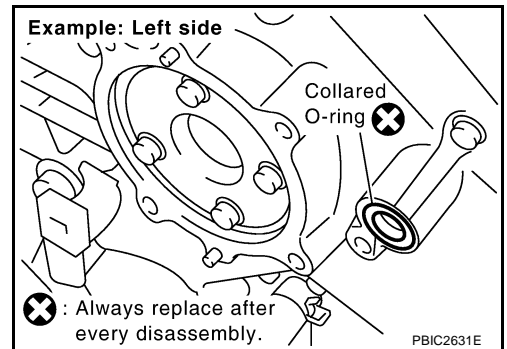
7. Install right and left intake valve timing control covers as follows:

- Install new seal rings in shaft grooves.
- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to intake valve timing control covers as shown in the figure.

**Use Genuine Liquid Gasket or equivalent.**

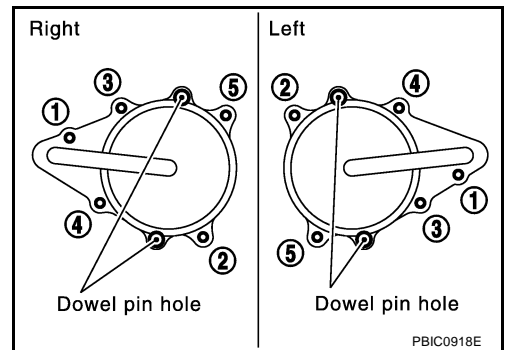


- Install new collared O-rings in front timing chain case oil hole (left and right sides).



- Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.

- Tighten mounting bolts in numerical order as shown in the figure.



8. Install crankshaft pulley as follows:

- Fix crankshaft using ring gear stopper [SST: KV10117700].
- Install crankshaft pulley, taking care not to damage front oil seal.
  - When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).
- Tighten crankshaft pulley bolt.

A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

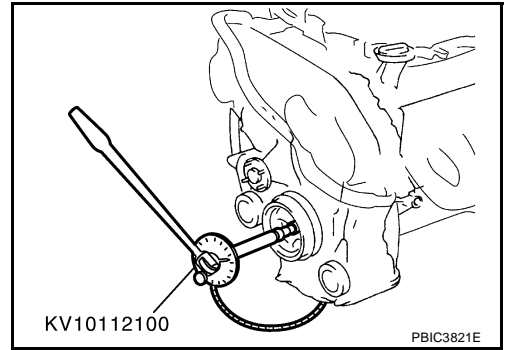
: 44.1 N-m (4.5 kg-m, 33 ft-lb)

- d. Turn crankshaft pulley bolt 90 degrees clockwise (angle tightening).

**CAUTION:**

**Check the tightening angle by using the angle wrench [SST]. Avoid judgement by visual inspection without SST.**

- Check tightening angle indicated on the angle wrench indicator plate.



9. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
10. Install in the reverse order of removal after this step.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

**NOTE:**

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

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

**Summary of the inspection items:**

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

\* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.



# TIMING CHAIN

[VQ]

## TIMING CHAIN

PPF:13028

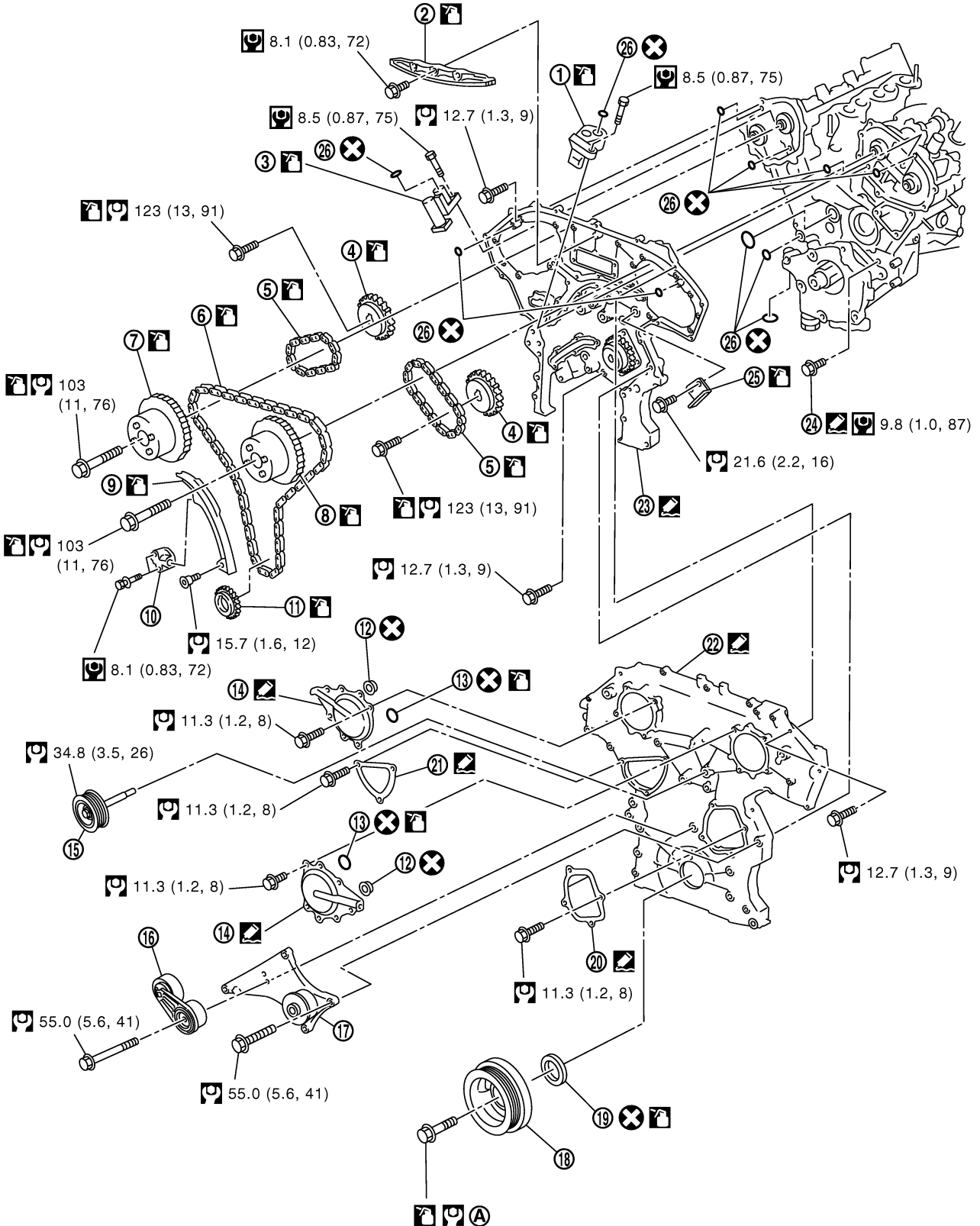
### Components

GBS000GM

A  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

EM

SEC. 120•130•150•210•275



ⓐ : N•m (kg-m, ft-lb)  
ⓑ : N•m (kg-m, in-lb)

PBIC3888E

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

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## NOTE:

- This section describes procedures for removing/installing front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.
- To remove/install front timing chain case, timing chain, and its related parts without removing oil pan (upper), refer to [EM-44, "FRONT TIMING CHAIN CASE"](#).

## Removal and Installation

GBS000GN

### REMOVAL

1. Remove engine cover. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air duct and resonator. Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#).
3. Remove engine undercover front and engine undercover middle. Refer to [EI-15, "FRONT BUMPER"](#).
4. Release the fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
5. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#).

### CAUTION:

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

6. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).

### CAUTION:

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

7. Remove radiator cooling fan assembly. Refer to [CO-21, "COOLING FAN"](#).
8. Separate engine harnesses removing their brackets from front timing chain case.
9. Remove drive belt. Refer to [EM-14, "DRIVE BELTS"](#).
10. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on its piping. Refer to [MTC-115, "Removal and Installation for Compressor"](#).
11. Remove power steering oil pump from bracket with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on its piping. Refer to [PS-24, "POWER STEERING OIL PUMP"](#).
12. Remove power steering oil pump bracket. Refer to [PS-24, "POWER STEERING OIL PUMP"](#).
13. Remove alternator. Refer to [SC-25, "Removal and Installation"](#).
14. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
15. Remove right and left intake valve timing control covers.

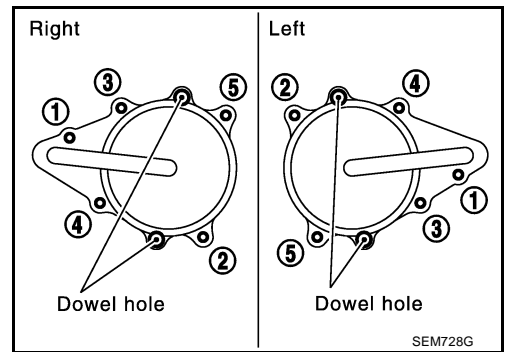
# TIMING CHAIN

[VQ]

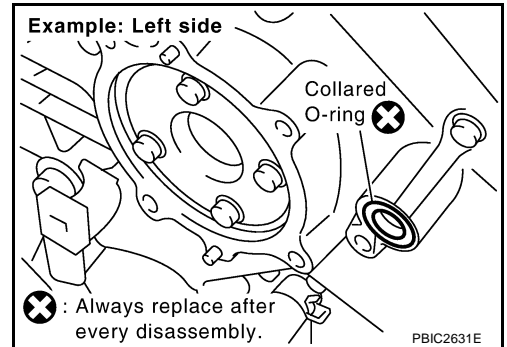
- Loosen mounting bolts in reverse order as shown in the figure.
- Use seal cutter [SST: KV10111100] to cut liquid gasket for removal.

**CAUTION:**

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



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



17. Remove rocker covers (right and left banks). Refer to [EM-41, "ROCKER COVER"](#) .

**NOTE:**

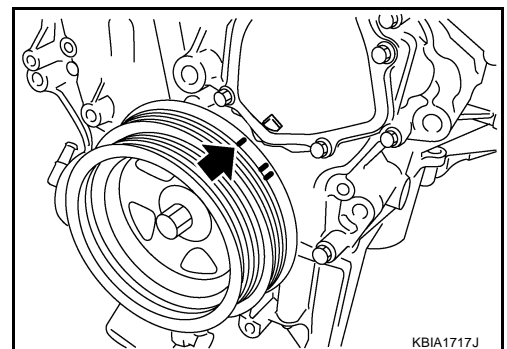
When only timing chain (primary) is removed, rocker cover does not need to be removed.

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

**NOTE:**

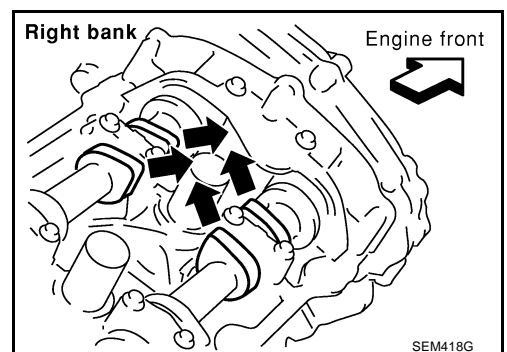
When timing chain is not removed/installed, this step is not required.

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



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

- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.



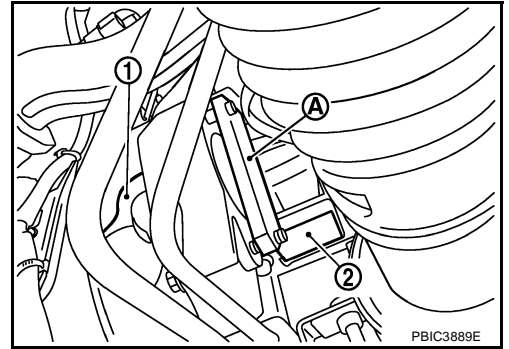
19. Remove crankshaft pulley as follows:

# TIMING CHAIN

[VQ]

- a. Remove starter motor and set ring gear stopper (A) [SST: KV10117700] as shown in the figure. Refer to [SC-36, "Removal and Installation"](#) .

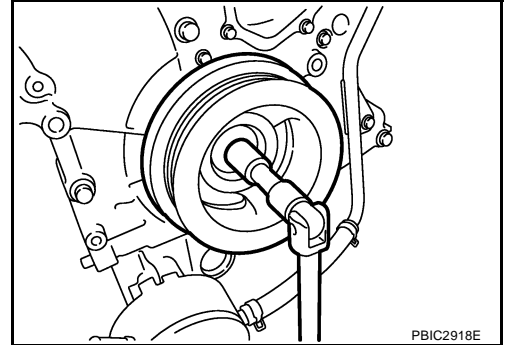
- 1 : Transmission
- 2 : Oil pan (upper)



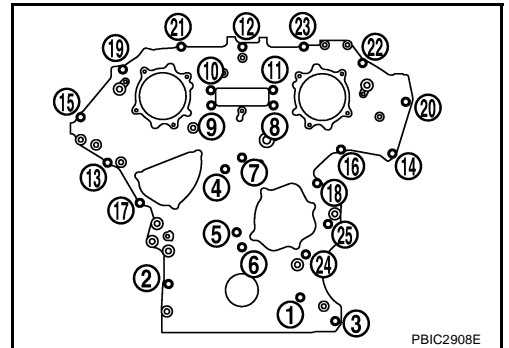
- b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

**CAUTION:**

**Do not remove crankshaft pulley bolt. Keep loosened crankshaft pulley bolt in place to protect removed crankshaft pulley from dropping.**



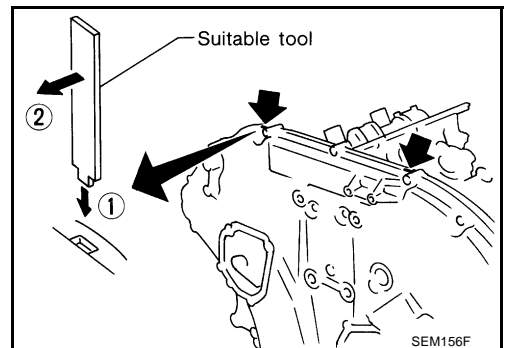
- c. Pull crankshaft pulley with both hands to remove it.
20. Remove oil pans (upper and lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .
21. Remove front timing chain case as follows:
- a. Loosen mounting bolts in reverse order as shown in the figure.



- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).
- c. Pry off case by moving the tool as shown (2).
- Use seal cutter [SST: KV10111100] to cut liquid gasket for removal.

**CAUTION:**

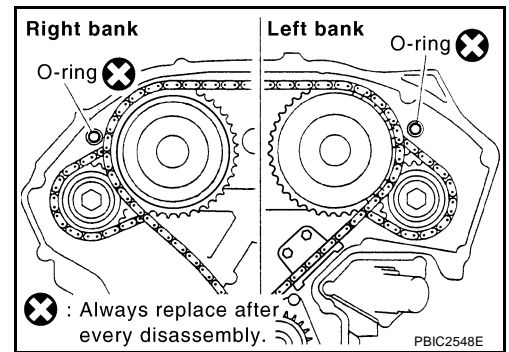
- **Do not use screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**



# TIMING CHAIN

[VQ]

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



23. Remove water pump cover and chain tensioner cover from front timing chain case.

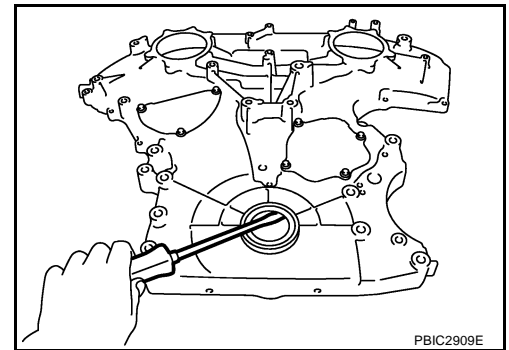
- Use seal cutter [SST: KV10111100] to cut liquid gasket for removal.

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

- Use screwdriver for removal.

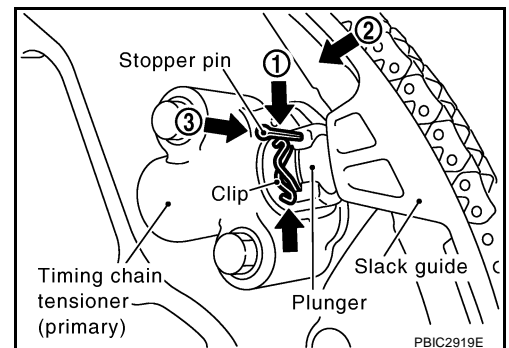
**CAUTION:**

**Be careful not to damage front timing chain case.**



25. Remove timing chain tensioner (primary) as follows:

- Loosen clip of timing chain tensioner (primary), and release plunger stopper. (1)
- Insert plunger into tensioner body by pressing slack guide. (2)
- Keep slack guide pressed and hold plunger in by pushing stopper pin through the tensioner body hole and plunger groove. (3)



d. Remove mounting bolts and remove timing chain tensioner (primary).

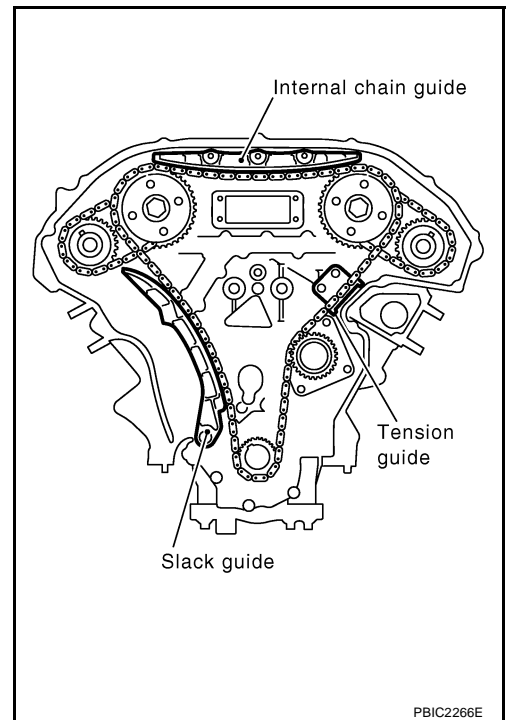
# TIMING CHAIN

[VQ]

26. Remove internal chain guide, tension guide and slack guide.

**NOTE:**

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



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

**CAUTION:**

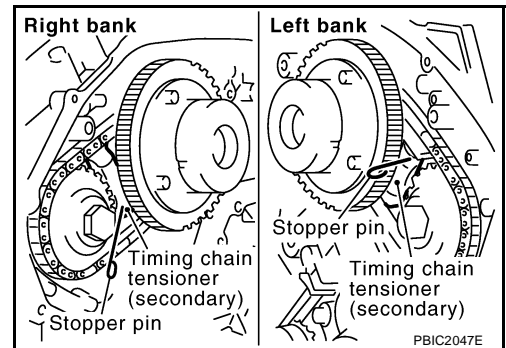
After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.

28. Remove timing chain (secondary) and camshaft sprockets as follows:

- a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).

**NOTE:**

- Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.
- For removal of timing chain tensioner (secondary), refer to [EM-73. "CAMSHAFT"](#) . [Removing camshaft bracket (No. 1) is required.]

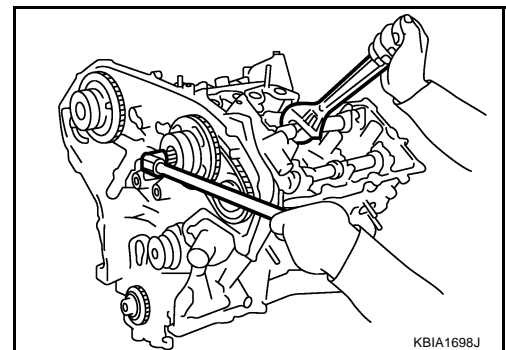


- b. Remove camshaft sprocket (INT and EXH) bolts.

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

**CAUTION:**

Do not loosen mounting bolts with securing anything other than the camshaft hexagonal portion or with tensioning the timing chain.



- c. Remove timing chain (secondary) together with camshaft sprockets.

- Turn camshaft slightly to secure slackness of timing chain on timing chain tensioner (secondary) side.

# TIMING CHAIN

[VQ]

- Insert 0.5 mm (0.020 in)-thick metal or resin plate between timing chain and timing chain tensioner plunger (guide). Remove timing chain (secondary) together with camshaft sprockets with timing chain loose from guide groove.

**CAUTION:**

**Be careful of plunger coming-off when removing timing chain (secondary). This is because plunger of timing chain tensioner (secondary) moves during operation, leading to coming-off of fixed stopper pin.**

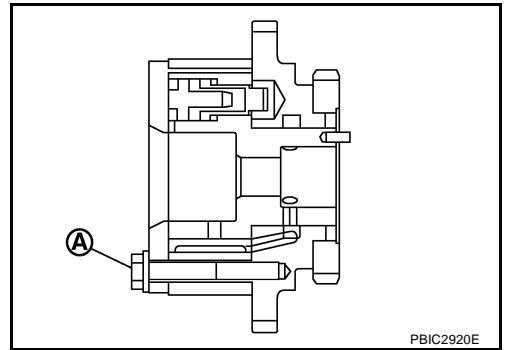
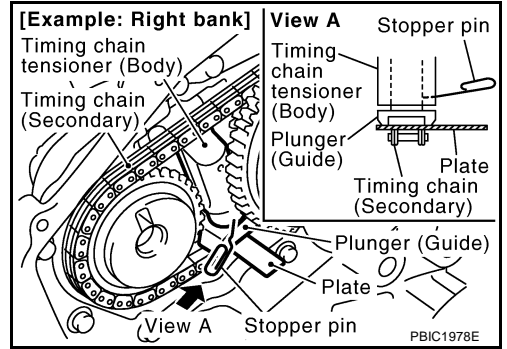
**NOTE:**

Camshaft sprocket (INT) is two-for-one structure of sprockets for timing chain (primary) and for timing chain (secondary).

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

**CAUTION:**

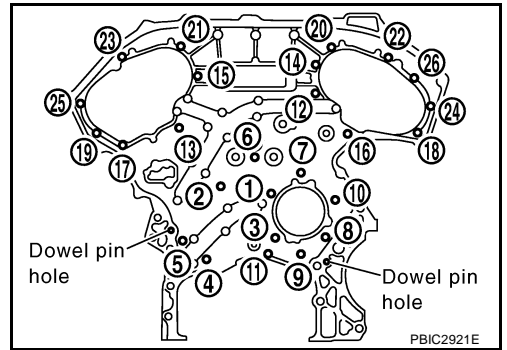
- Handle carefully to avoid any shock to camshaft sprocket.
- Do not disassemble. (Do not loosen bolts "A" as shown in the figure).



29. Remove water pump. Refer to [CO-23. "WATER PUMP"](#) .

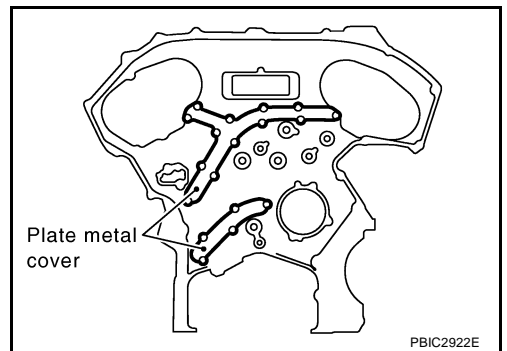
30. Remove rear timing chain case as follows:

- Loosen and remove mounting bolts in reverse order as shown in the figure.
- Cut liquid gasket using seal cutter [SST: KV10111100] and remove rear timing chain case.



**CAUTION:**

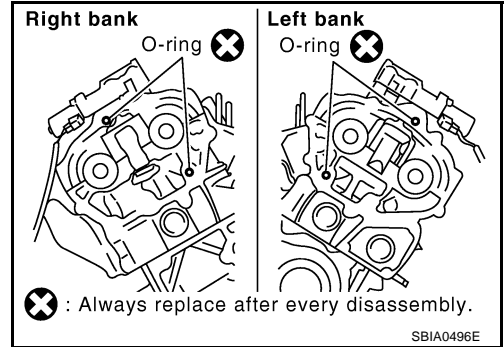
- Do not remove plate metal cover of oil passage.
- After removal, handle rear timing chain case carefully so it does not tilt, cant, or warp under a load.



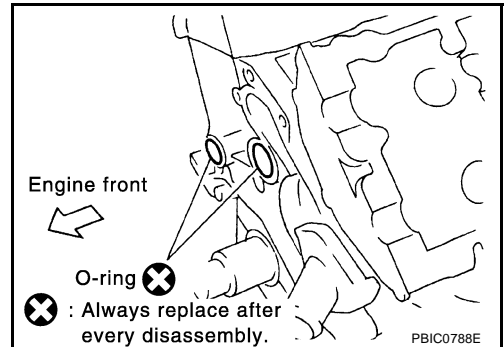
# TIMING CHAIN

[VQ]

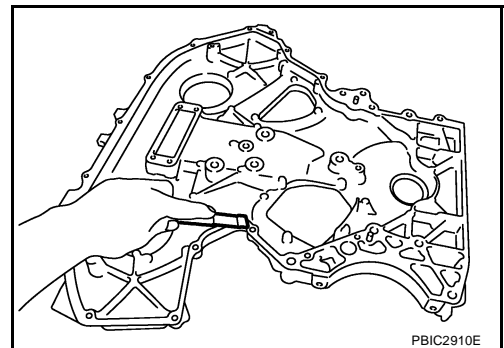
31. Remove O-rings from cylinder head and camshaft bracket (No. 1).



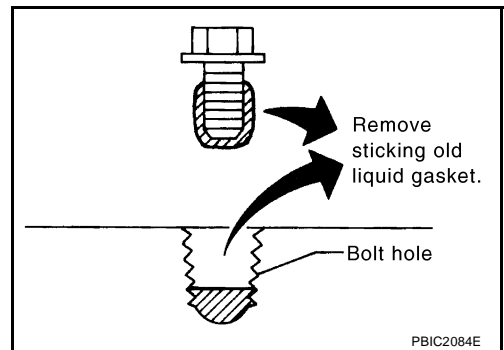
32. Remove O-rings from cylinder block.



33. Remove timing chain tensioners (secondary) from cylinder head as follows, if necessary.
- a. Remove camshaft brackets (No. 1). Refer to [EM-74, "REMOVAL"](#).
  - b. Remove timing chain tensioners (secondary) with stopper pin attached.
34. Use scraper to remove all traces of old liquid gasket from front and rear timing chain cases, and opposite mating surfaces.



- Remove old liquid gasket from bolt hole and thread.

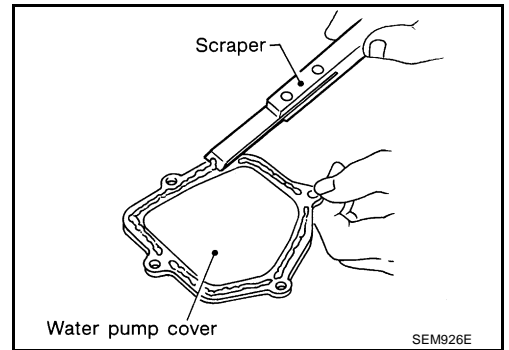




# TIMING CHAIN

[VQ]

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



A

EM

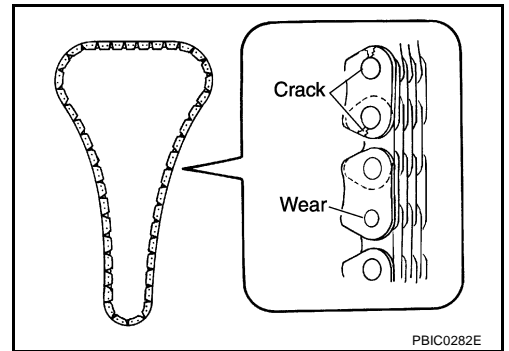
C

D

## INSPECTION AFTER REMOVAL

### Timing Chain

Check for cracks and any excessive wear at link plates and roller links of timing chain. Replace timing chain as necessary.



E

F

G

H

I

J

K

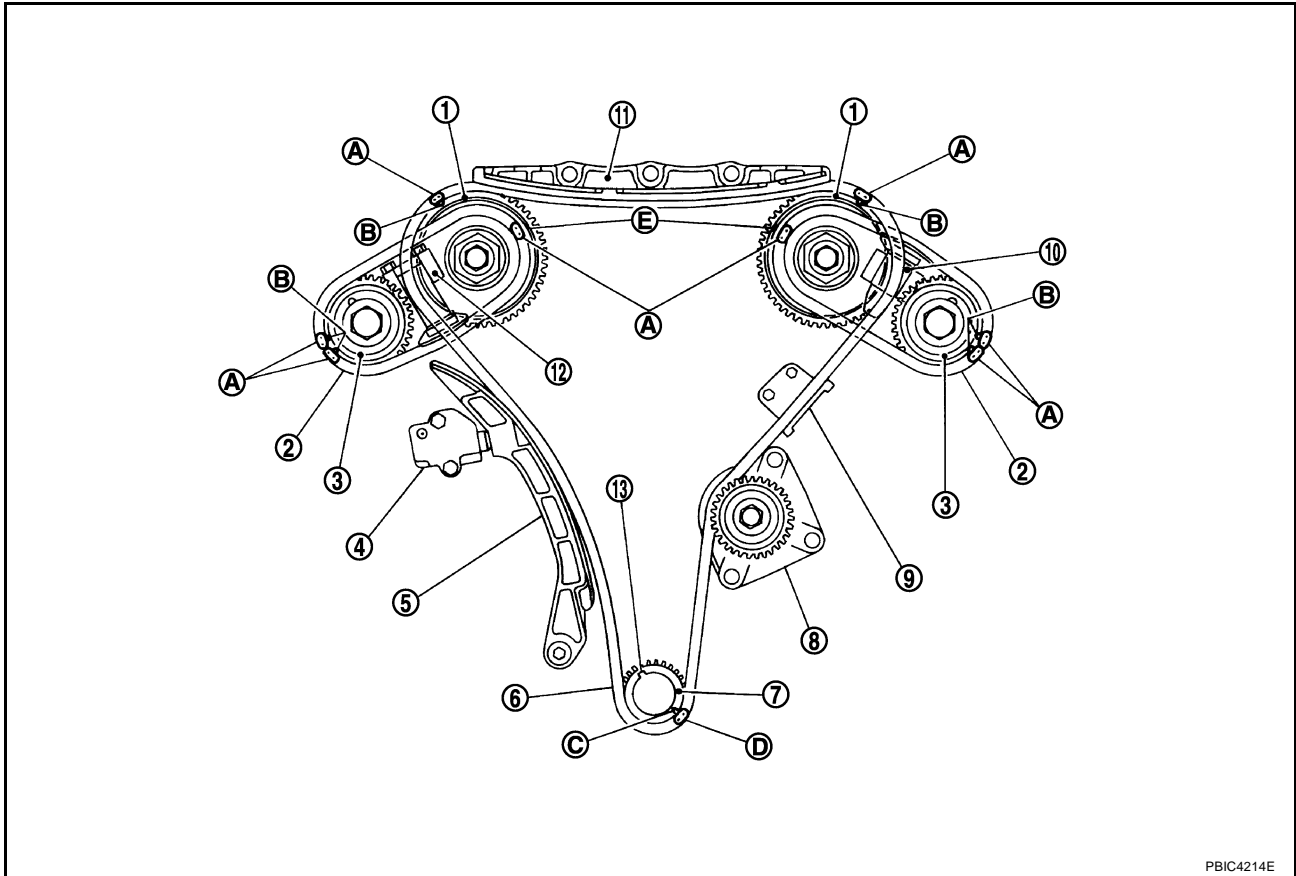
L

M

## INSTALLATION

### NOTE:

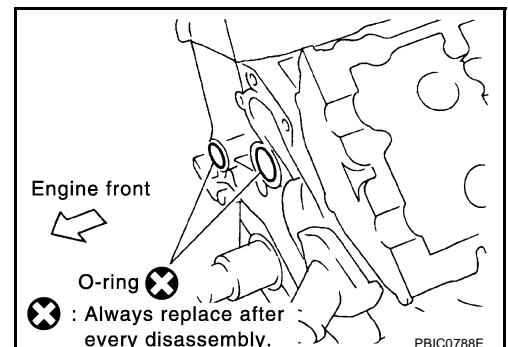
The below figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.



PBIC4214E

- |  |                             |  |
|--|-----------------------------|--|
| 1. Camshaft sprocket (INT)             | 2. Timing chain (secondary) | 3. Camshaft sprocket (EXH)             |
| 4. Timing chain tensioner (primary)    | 5. Slack guide              | 6. Timing chain (primary)              |
| 7. Crankshaft sprocket                 | 8. Water pump               | 9. Tension guide                       |
| 10. Timing chain tensioner (secondary) | 11. Internal chain guide    | 12. Timing chain tensioner (secondary) |
| 13. Crankshaft key                     |                             |  |
| A. Mating mark (copper color link)     | B. Mating mark (punched)    | C. Mating mark (notched)               |
| D. Mating mark (yellow paint)          | E. Mating mark (back side)  |  |

1. Install timing chain tensioners (secondary) to cylinder head as follows if removed. Refer to [EM-53, "Components"](#) .
  - a. Install timing chain tensioners (secondary) with stopper pin attached and new O-ring.
  - b. Install camshaft brackets (No. 1). Refer to [EM-78, "INSTALLATION"](#) .
2. Install rear timing chain case as follows:
  - a. Install new O-rings onto cylinder block.

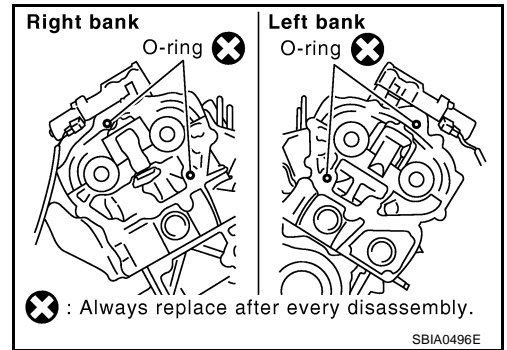


PBIC0788E

# TIMING CHAIN

[VQ]

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

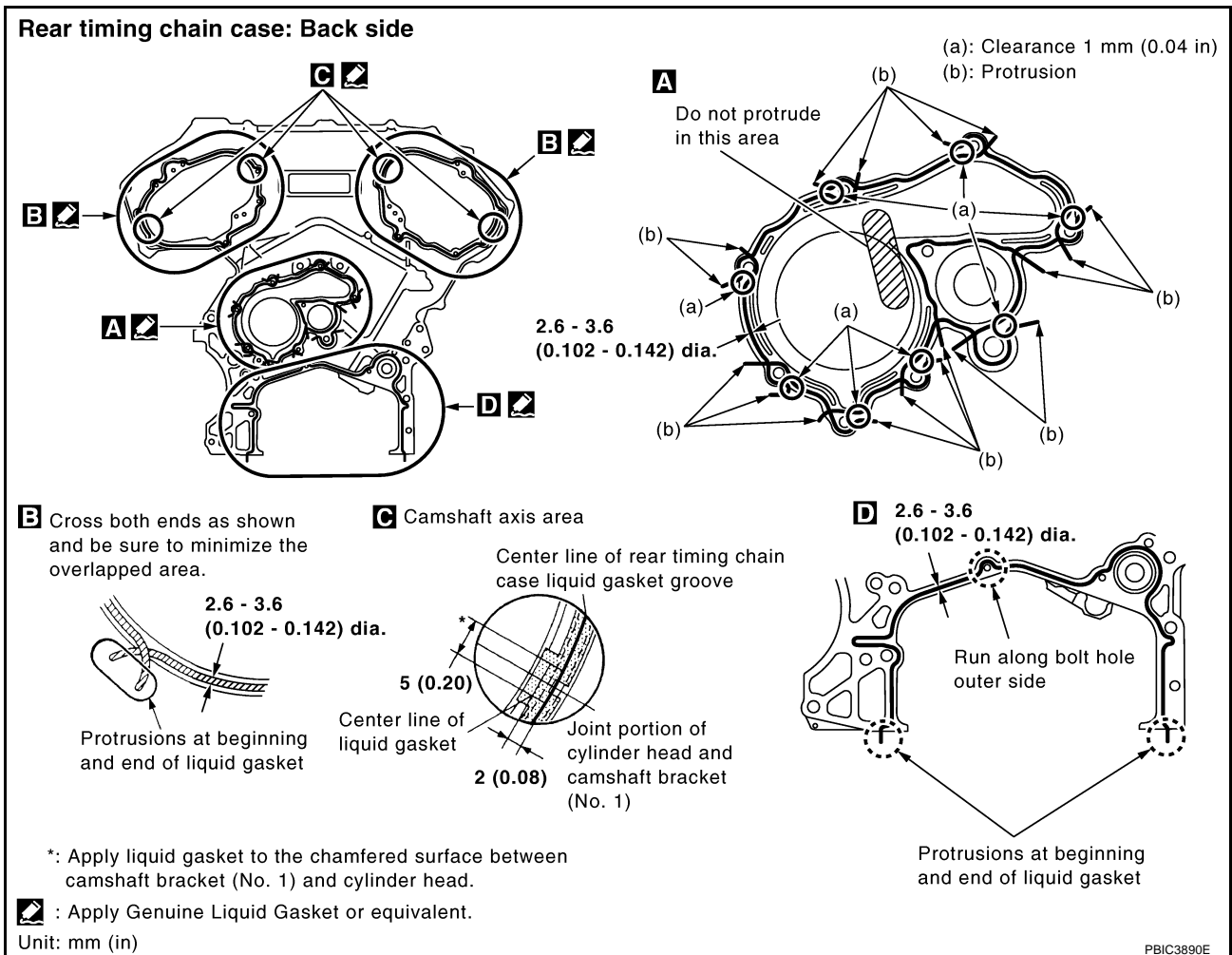


- c. Apply liquid gasket with tube presser [SST: WS39930000] to rear timing chain case back side as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

**CAUTION:**

- For "A" in the figure, completely wipe out liquid gasket extended on a portion touching at engine coolant.
- Apply liquid gasket on installation position of water pump and cylinder head very completely.



- d. Align rear timing chain case with dowel pins (right and left) on cylinder block and install rear timing chain case.


- Make sure O-rings stay in place during installation to cylinder block, cylinder head and camshaft bracket (No. 1).

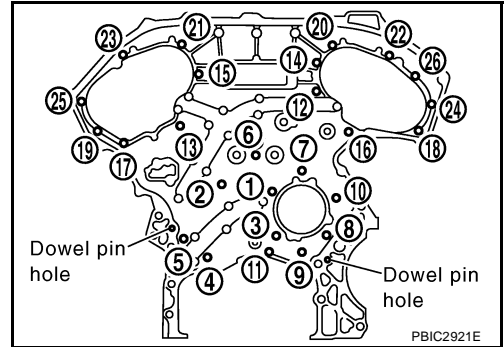
# TIMING CHAIN

[VQ]

- e. Tighten mounting bolts in numerical order as shown in the figure.
- There are two type of mounting bolts. Refer to the following for locating bolts.

Bolt length:	Bolt position
20 mm (0.79 in)	: 1, 2, 3, 6, 7, 8, 9, 10
16 mm (0.63 in)	: Except the above

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



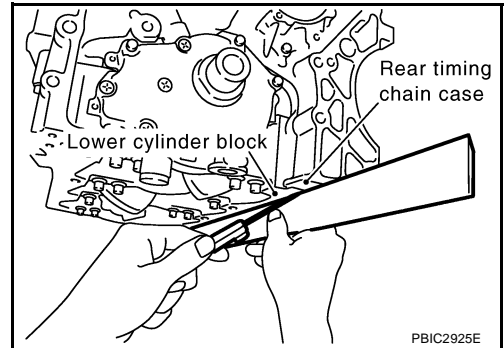
- f. After all bolts are tightened, retighten them to the specified torque in numerical order as shown in the figure.
- If liquid gasket protrudes, wipe it off immediately.

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

**Standard**

**Rear timing chain case to lower cylinder block:**  
**-0.24 to 0.14 mm (-0.0094 to 0.0055 in)**

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



3. Install water pump with new O-rings. Refer to [CO-23, "WATER PUMP"](#) .

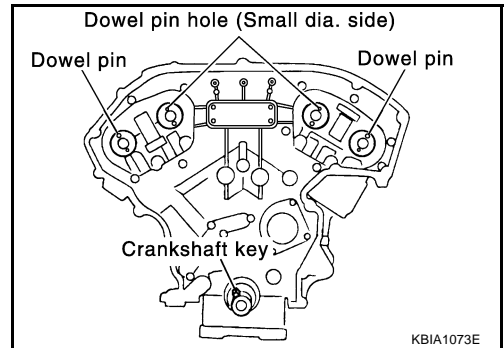
4. Make sure that dowel pin hole, dowel pin of camshaft and crankshaft key are located as shown in the figure. (No. 1 cylinder at compression TDC)

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

**Camshaft dowel pin hole (intake side)**  
**: At cylinder head upper face side in each bank.**

**Camshaft dowel pin (exhaust side)**  
**: At cylinder head upper face side in each bank.**

**Crankshaft key**  
**: At cylinder head side of right bank.**



**CAUTION:**

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

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

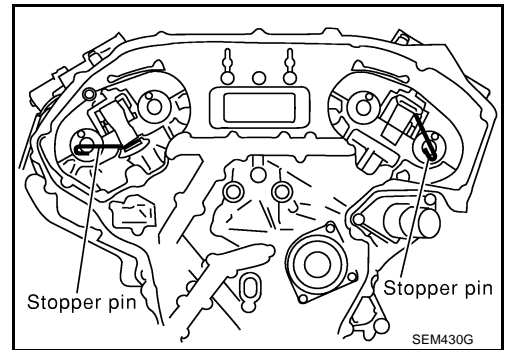
**CAUTION:**

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

# TIMING CHAIN

[VQ]

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



- b. Install timing chains (secondary) and camshaft sprockets (INT and EXH).

- Align the mating marks on timing chain (secondary) (copper color link) with the ones on camshaft sprockets (INT and EXH) (punched), and install them.

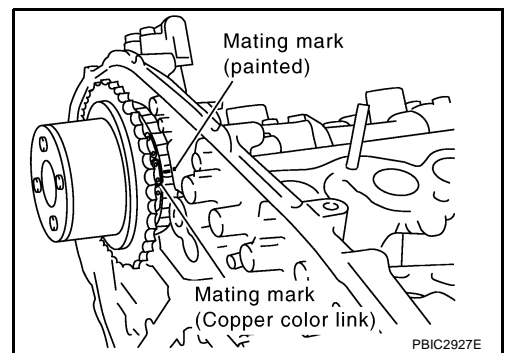
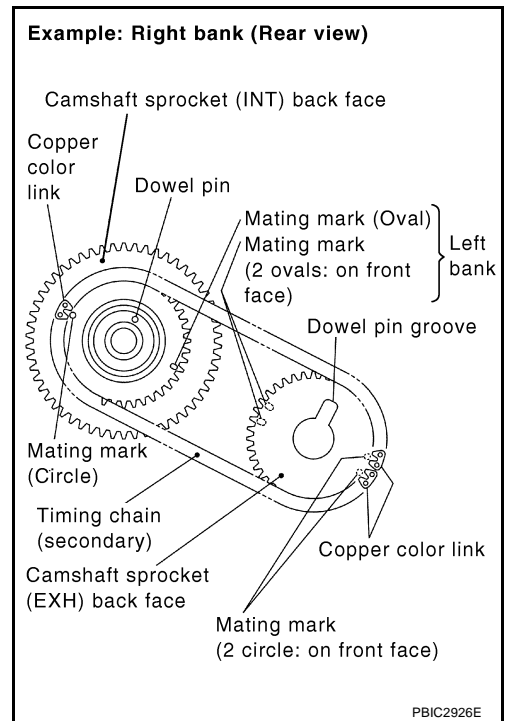
**NOTE:**

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

**Right bank : Use circle type.**

**Left bank : Use oval type.**

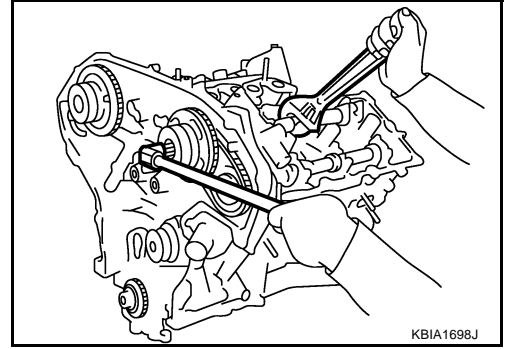
- Align dowel pin and pin hole on camshafts with the groove and dowel pin on sprockets, and install them.
- On the intake side, align pin hole on the small diameter side of the camshaft front end with dowel pin on the back side of camshaft sprocket, and install them.
- On the exhaust side, align dowel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



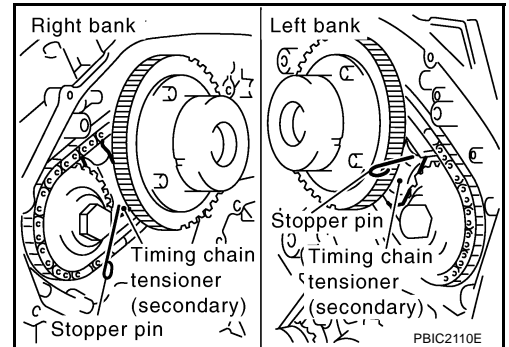
# TIMING CHAIN

[VQ]

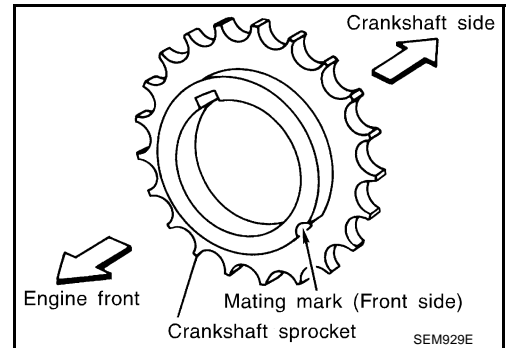
- c. After confirming the mating marks are aligned, tighten camshaft sprocket mounting bolts.
- Secure camshaft using wrench at the hexagonal portion to tighten mounting bolts.



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



6. Install tension guide.
7. Install timing chain (primary) as follows:
- a. Install crankshaft sprocket.
- Make sure the mating marks on crankshaft sprocket face the front of engine.



- b. Install timing chain (primary).

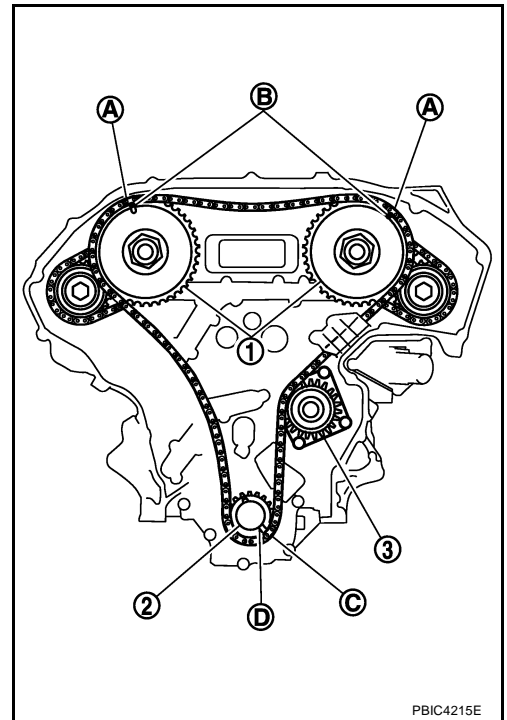
# TIMING CHAIN

[VQ]

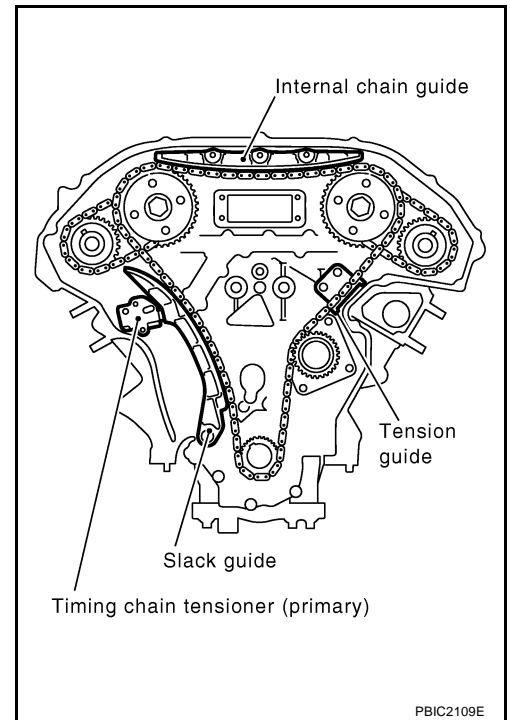
- Install timing chain (primary) so the mating mark (punched) (B) on camshaft sprocket (1) is aligned with the copper color link (A) on timing chain, while the mating mark (notched) (D) on crankshaft sprocket (2) is aligned with the yellow paint (C) on timing chain, as shown in the figure.

3 : Water pump

- When it is difficult to align mating marks of timing chain (primary) with each sprocket, gradually turn camshaft using wrench on the hexagonal portion to align it with the mating marks.
- During alignment, be careful to prevent dislocation of mating mark alignments of timing chains (secondary).



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



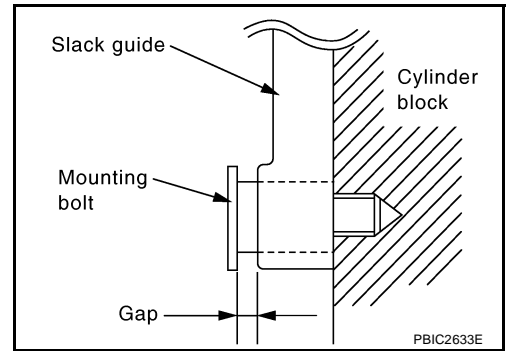
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M

# TIMING CHAIN

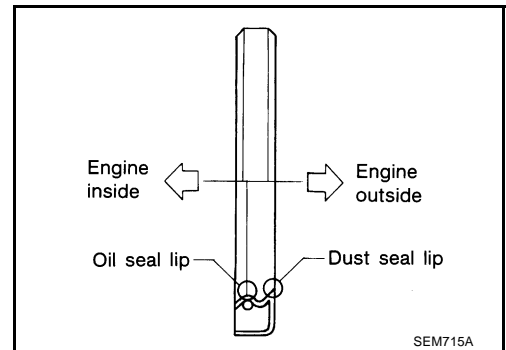
[VQ]

**CAUTION:**

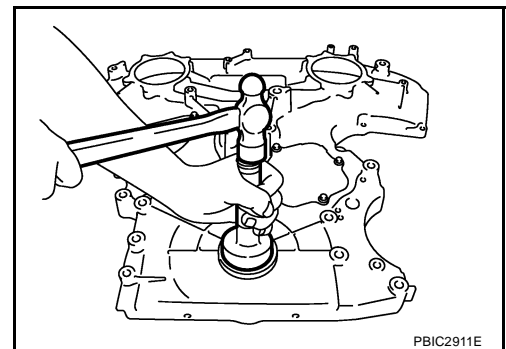
Do not overtighten slack guide mounting bolts. It is normal for a gap to exist under the bolt seats when mounting bolt are tightened to specification.



- When installing timing chain tensioner (primary), push in plunger and keep it pressed in with stopper pin.
  - Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner (primary).
  - After installation, pull out stopper pin by pressing slack guide.
9. Make sure again that the mating marks on camshaft sprockets and timing chain have not slipped out of alignment.
10. Install new front oil seal on front timing chain case.
- Apply new engine oil to both oil seal lip and dust seal lip.
  - Install it so that each seal lip is oriented as shown in the figure.



- Using suitable drift [outer diameter: 60 mm (2.36 in)], press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



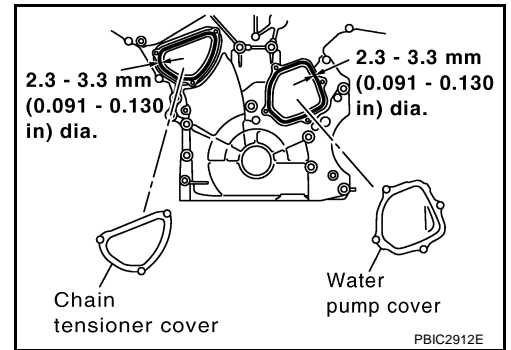
11. Install water pump cover and chain tensioner cover to front timing chain case.



# TIMING CHAIN

[VQ]

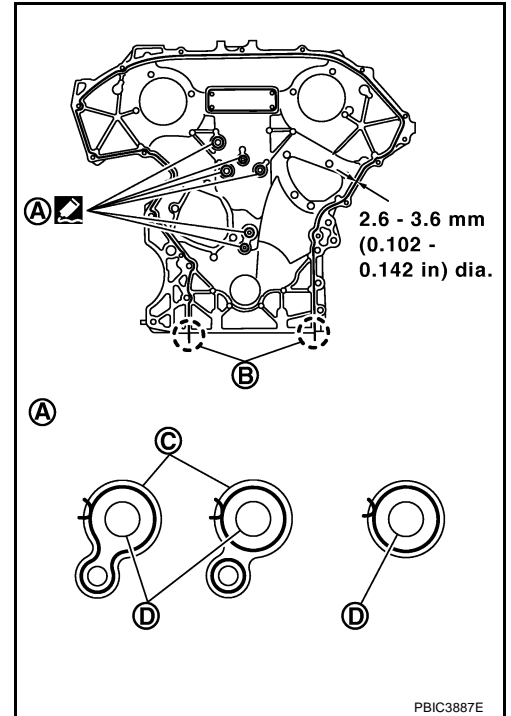
- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to front timing chain case as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**



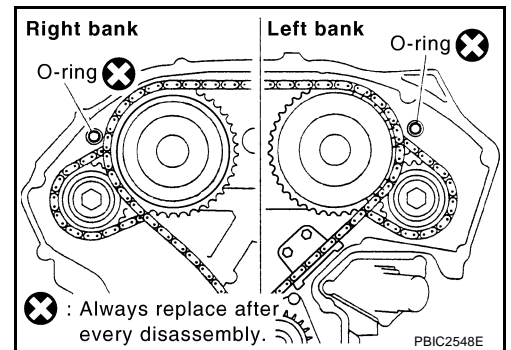
12. Install front timing chain case as follows:

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to front timing chain case back side as shown in the figure.
  - B : Protrusion
  - C : Both permissible
  - D : Bolt hole

**Use Genuine Liquid Gasket or equivalent.**



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



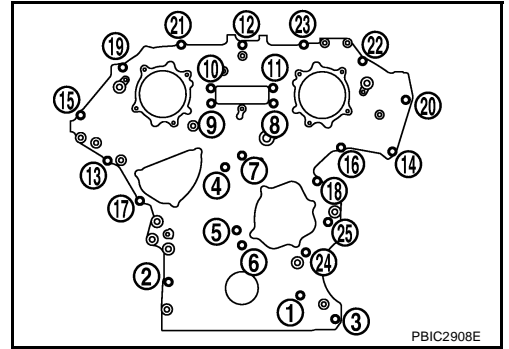
- Install front timing chain case as to fit its dowel pin hole together dowel pin on rear timing chain case.

# TIMING CHAIN

[VQ]

- d. Tighten mounting bolts to the specified torque in numerical order as shown in the figure.
- There are four type of mounting bolts. Refer to the following for locating bolts.

- M10 × 70 mm (2.76 in) : 5**  
: 55.0 N-m (5.6 kg-m, 41 ft-lb)
- M10 × 90 mm (3.54 in) : 1, 2, 3, 4**  
: 55.0 N-m (5.6 kg-m, 41 ft-lb)
- M6 × 40 mm (1.57 in) : 24, 25**  
: 12.7 N-m (1.3 kg-m, 9 ft-lb)
- M6 × 25 mm (0.98 in) : Except above**  
: 12.7 N-m (1.3 kg-m, 9 ft-lb)



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

**CAUTION:**

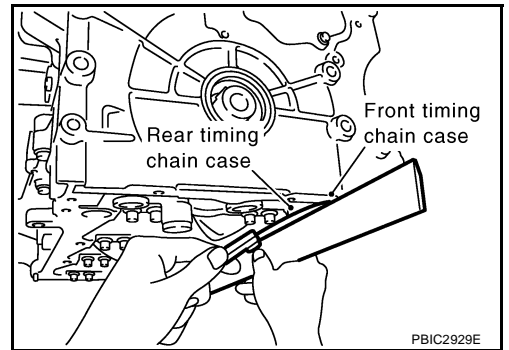
**Be sure to wipe off any excessive liquid gasket leaking on surface mating with oil pan (upper).**

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

**Standard**

**Front timing chain case to rear timing chain case:  
 -0.14 to 0.14 mm (-0.005 to 0.0055 in)**

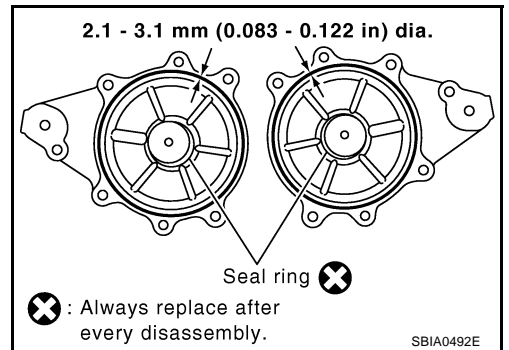
- If not within the standard, repeat the installation procedure.



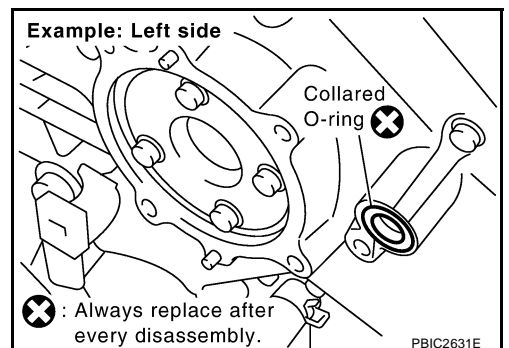
13. Install right and left intake valve timing control covers as follows:

- Install new seal rings in shaft grooves.
- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to intake valve timing control covers as shown in the figure.

**Use Genuine Liquid Gasket or equivalent.**



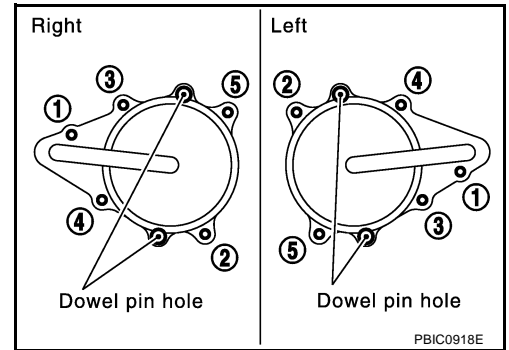
- Install new collared O-rings in front timing chain case oil hole (left and right sides).



## TIMING CHAIN

[VQ]

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



14. Install oil pans (upper and lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).
15. Install rocker covers (right and left banks). Refer to [EM-41, "ROCKER COVER"](#).
16. Install crankshaft pulley as follows:
  - a. Fix crankshaft using ring gear stopper [SST: KV10117700].
  - b. Install crankshaft pulley, taking care not to damage front oil seal.
    - When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).
  - c. Tighten crankshaft pulley bolt.

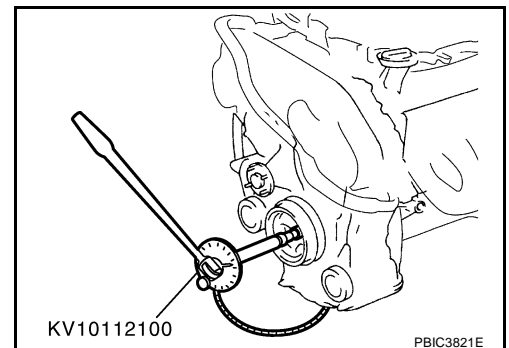
: 44.1 N·m (4.5 kg-m, 33 ft-lb)

- d. Turn crankshaft pulley bolt 90 degrees clockwise (angle tightening).

**CAUTION:**

**Check the tightening angle by using the angle wrench [SST]. Avoid judgement by visual inspection without SST.**

- Check tightening angle indicated on the angle wrench indicator plate.



17. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.
18. Install in the reverse order of removal after this step.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricant leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

**NOTE:**

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

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

**Summary of the inspection items:**

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

\* Transmission/transaxle/CVT fluid. power steering fluid, brake fluid, etc.

# CAMSHAFT

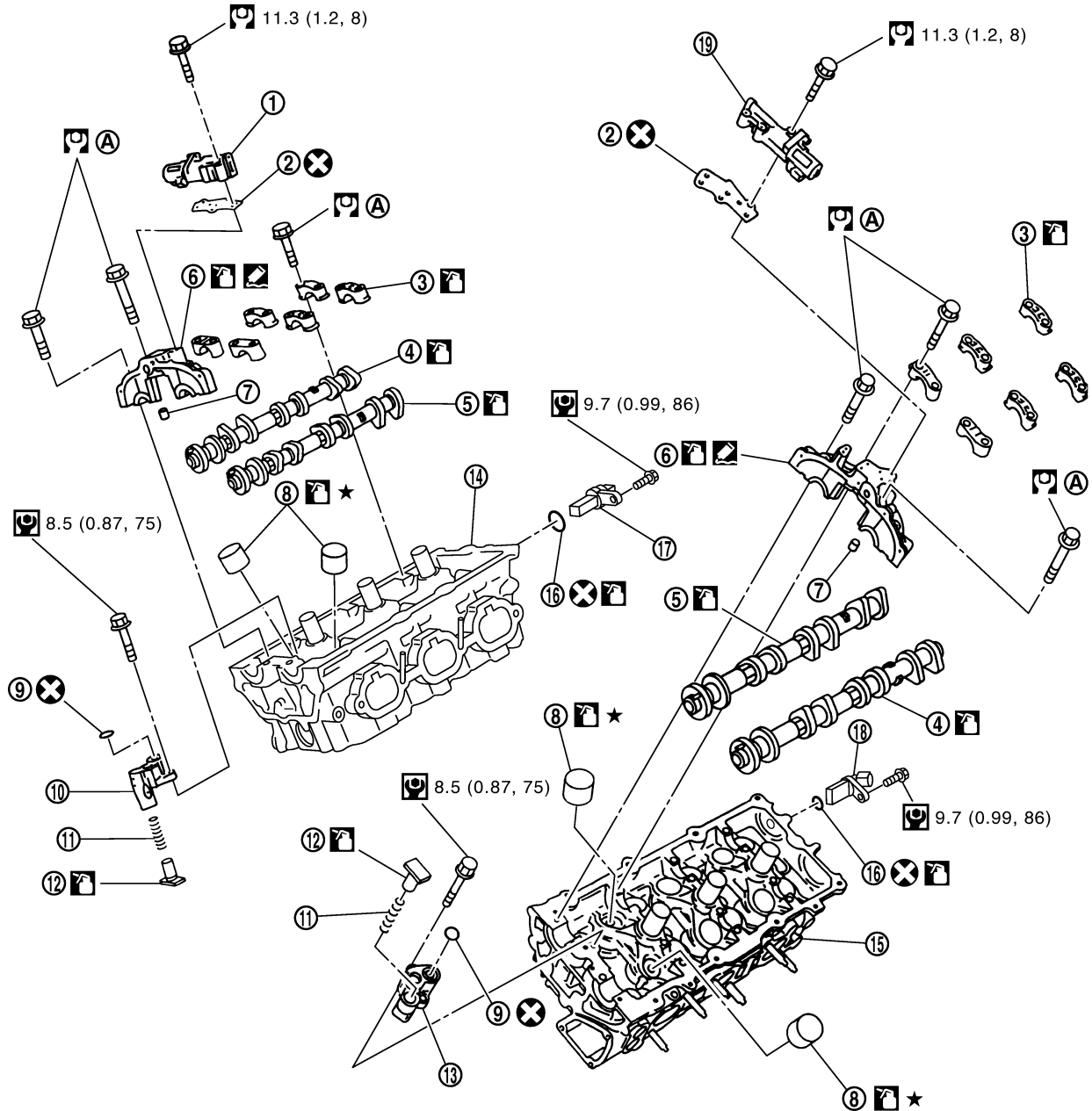
[VQ]

PFP:13001

GBS000GO

## CAMSHAFT Components

SEC. 111•130



: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

PBIC3891E

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

19. Intake valve timing control solenoid valve (left bank)
  - A. Refer to [EM-78](#).

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

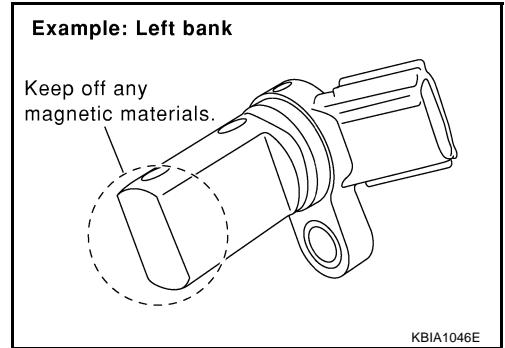
GBS000GP

### REMOVAL

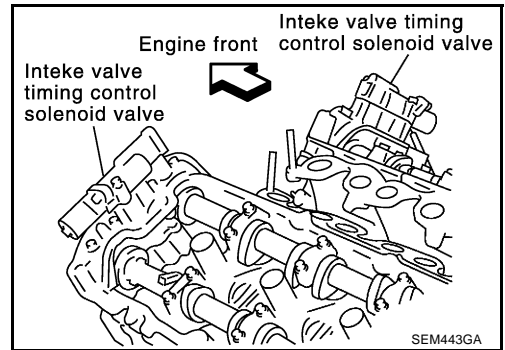
1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [EM-53, "TIMING CHAIN"](#).
2. Remove camshaft position sensor (PHASE) (right and left banks) from cylinder head back side.

**CAUTION:**

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



3. Remove intake valve timing control solenoid valves.
  - Discard intake valve timing control solenoid valve gaskets and use new gaskets for installation.

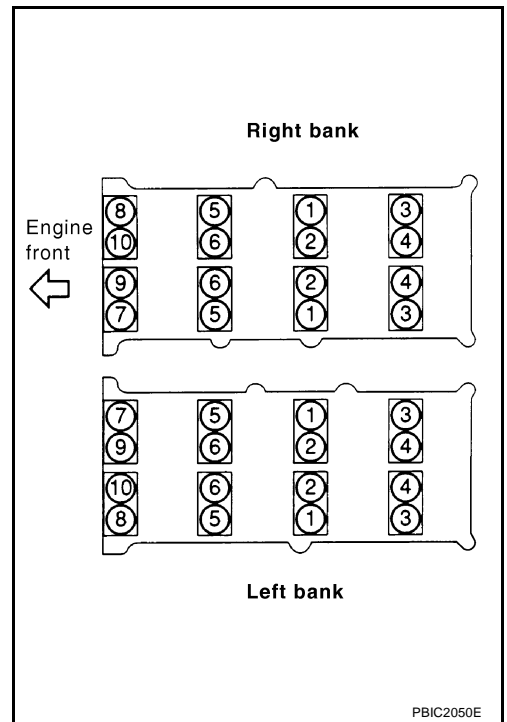


4. Remove camshaft brackets.
  - Mark camshafts, camshaft brackets and bolts so they are placed in the same position and direction for installation.

# CAMSHAFT

[VQ]

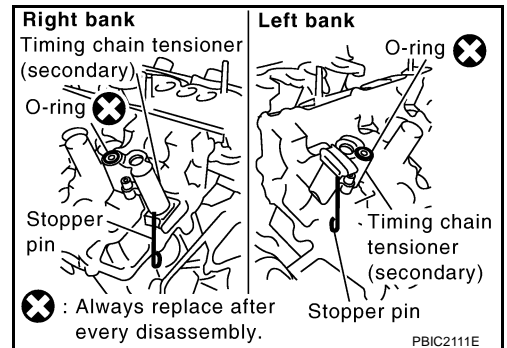
- Equally loosen camshaft bracket bolts in several steps in reverse order as shown in the figure.



- Remove camshafts.
- Remove valve lifters.
  - Identify installation positions, and store them without mixing them up.
- Remove timing chain tensioner (secondary) from cylinder head.
  - Remove timing chain tensioner (secondary) with its stopper pin attached.

**NOTE:**

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



## INSPECTION AFTER REMOVAL

### Camshaft Runout

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

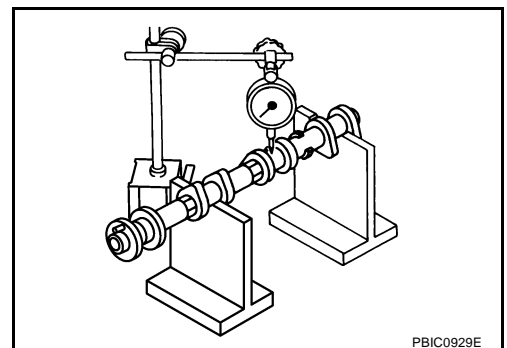
**CAUTION:**

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

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

**Standard** : Less than 0.02 mm (0.001 in)  
**Limit** : 0.05 mm (0.002 in)

- If it exceeds the limit, replace camshaft.



## Camshaft Cam Height

1. Measure the camshaft cam height with micrometer.

**Standard:**

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

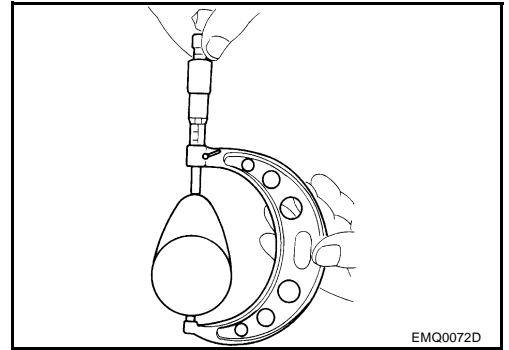
**Exhaust** : 45.075 - 45.265 mm (1.7746 - 1.7821 in)

**Limit:**

**Intake** : 45.265 mm (1.7821 in)

**Exhaust** : 44.875 mm (1.7667 in)

2. If wear exceeds the limit, replace camshaft.



## Camshaft Journal Oil Clearance

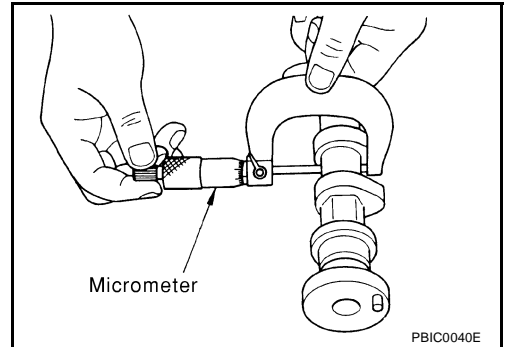
### CAMSHAFT JOURNAL DIAMETER

- Measure the outer diameter of camshaft journal with micrometer.

**Standard:**

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

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



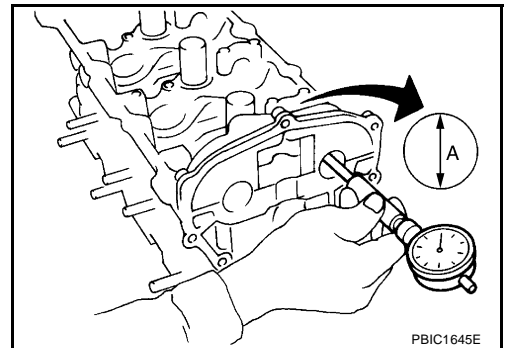
### CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolt with the specified torque. Refer to [EM-78, "INSTALLATION"](#) for the tightening procedure.
- Measure the inner diameter "A" of camshaft bracket with bore gauge.

**Standard:**

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

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



### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard:**

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

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

**Limit** : 0.15 mm (0.0059 in)

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

**NOTE:**

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

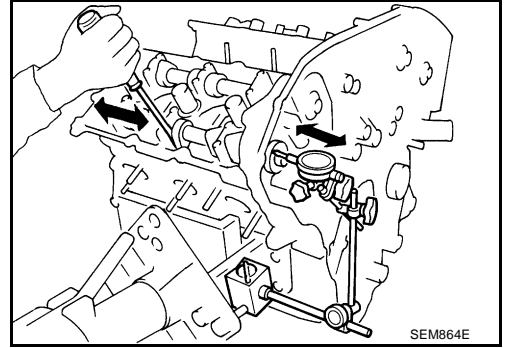


## Camshaft End Play

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

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

**Limit : 0.24 mm (0.0094 in)**



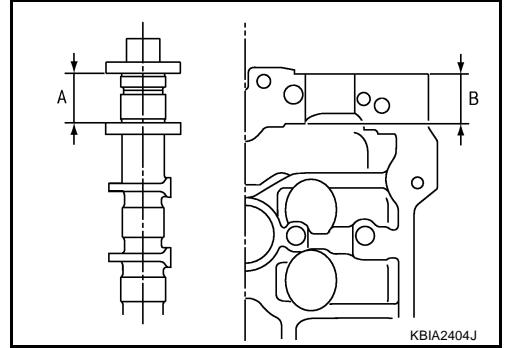
- Measure the following parts if out of the limit.
  - Dimension "A" for camshaft No. 1 journal

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

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

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

- Refer to the standards above, and then replace camshaft and/or cylinder head.



## Camshaft Sprocket Runout

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

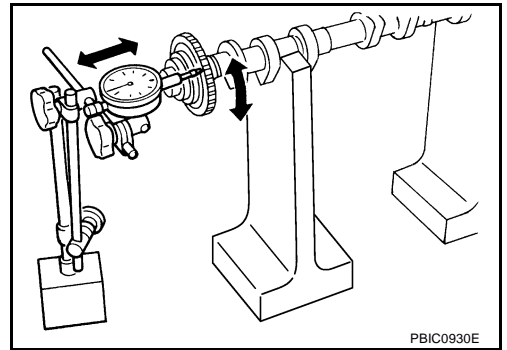
**CAUTION:**

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

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

**Limit : 0.15 mm (0.0059 in)**

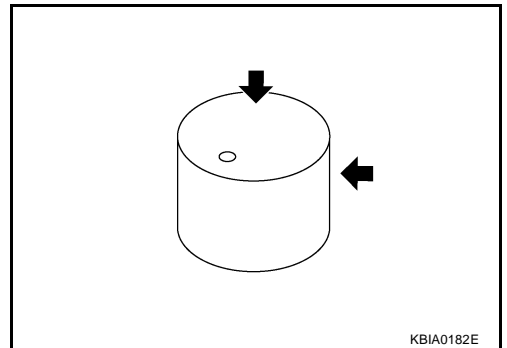
- If it exceeds the limit, replace camshaft sprocket.



## Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-138](#), "[Available Valve Lifter](#)".



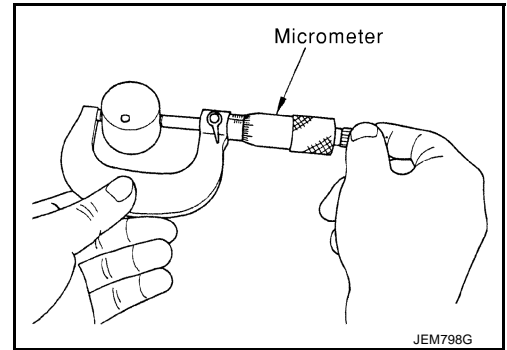
## Valve Lifter Clearance

### VALVE LIFTER OUTER DIAMETER

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

**Standard (Intake and exhaust)**

**: 33.977 - 33.987 mm (1.3377 - 1.3381 in)**

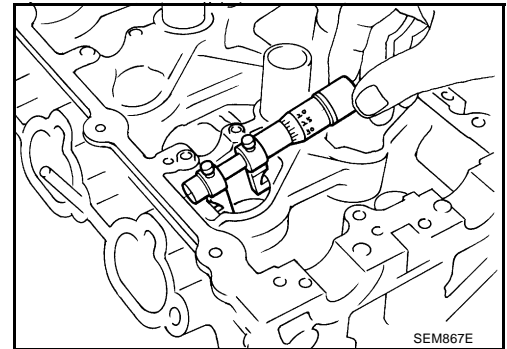


### VALVE LIFTER HOLE DIAMETER

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

**Standard (Intake and exhaust)**

**: 34.000 - 34.016 mm (1.3386 - 1.3392 in)**



### VALVE LIFTER CLEARANCE

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

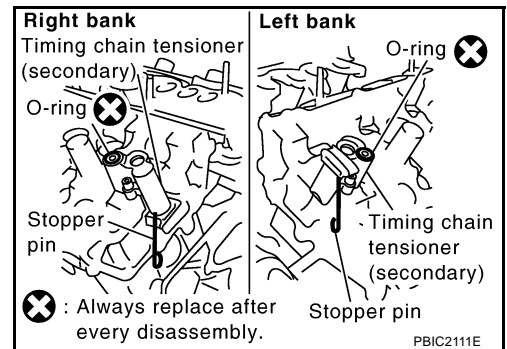
**Standard (Intake and exhaust)**

**: 0.013 - 0.039 mm (0.0005 - 0.0015 in)**

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

## INSTALLATION

1. Install timing chain tensioners (secondary) on both sides of cylinder head.
  - Install timing chain tensioner with its stopper pin attached.
  - Install timing chain tensioner with sliding part facing downward on right-side cylinder head, and with sliding part facing upward on left-side cylinder head.
  - Install new O-rings as shown in the figure.

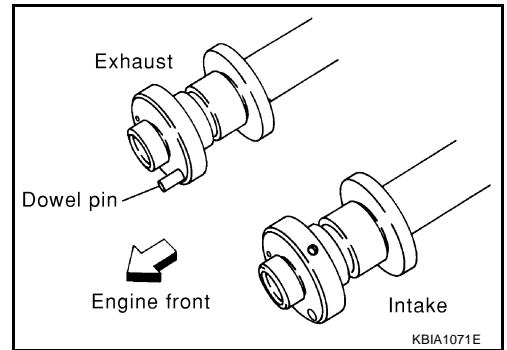


2. Install valve lifters.
  - Install it in the original position.
3. Install camshafts.

# CAMSHAFT

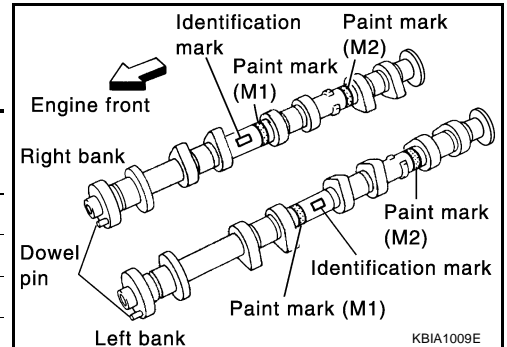
[VQ]

- Install camshaft with dowel pin attached to its front end face on the exhaust side.



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

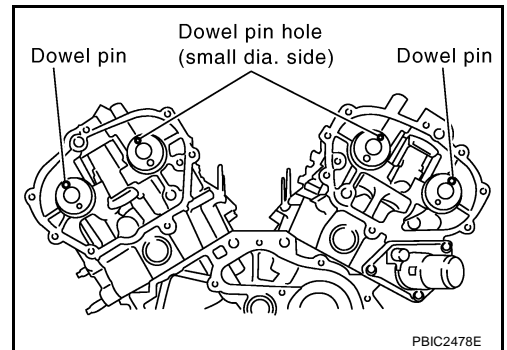
Bank	INT/EXH	Dowel pin	Paint marks		Identification mark
			M1	M2	
RH	INT	No	Green	No	RE
	EXH	Yes	No	White	RE
LH	INT	No	Green	No	LH
	EXH	Yes	No	White	LH



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

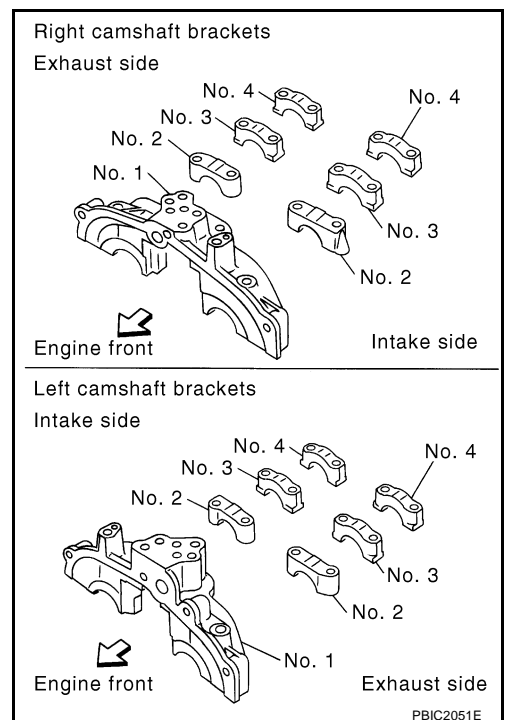
**NOTE:**

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



4. Install camshaft brackets.

- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Install camshaft bracket in original position and direction as shown in the figure.



A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

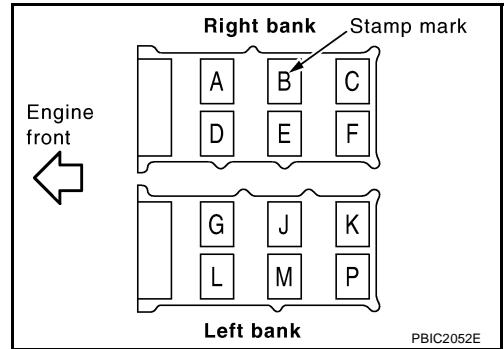
# CAMSHAFT

[VQ]

- Install camshaft brackets (No. 2 to 4) aligning the stamp marks as shown in the figure.

**NOTE:**

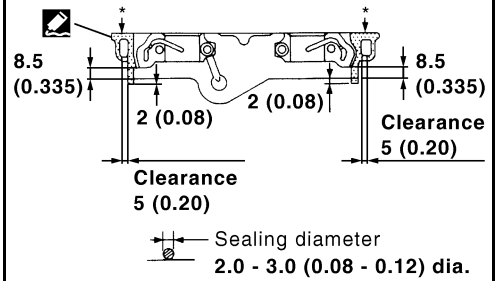
There are no identification marks indicating left and right for camshaft bracket (No. 1).



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

**Use Genuine Liquid Gasket or equivalent.**

**Camshaft bracket (No. 1)**



\* : Remove the protruding liquid gasket from front face. (Remove the hardened liquid gasket from surface only.)

☒ : Apply Genuine Liquid Gasket or equivalent.

Unit: mm (in)

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

- a. Tighten No. 7 to 10 in order as shown.

☒: **1.96 N·m (0.2 kg-m, 1 ft-lb)**

- b. Tighten No. 1 to 6 in order as shown.

☒: **1.96 N·m (0.2 kg-m, 1 ft-lb)**

- c. Tighten No. 1 to 10 in numerical order as shown.

☒: **5.88 N·m (0.6 kg-m, 4 ft-lb)**

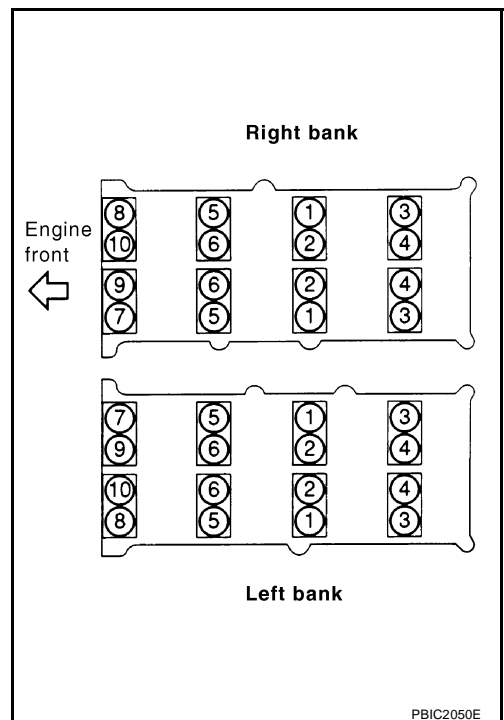
- d. Tighten No. 1 to 10 in numerical order as shown.

☒: **10.4 N·m (1.1 kg-m, 8 ft-lb)**

**CAUTION:**

After tightening mounting bolts of camshaft brackets (No. 1), be sure to wipe off excessive liquid gasket from the parts list below.

- Mating surface of rocker cover
- Mating surface of rear timing chain case



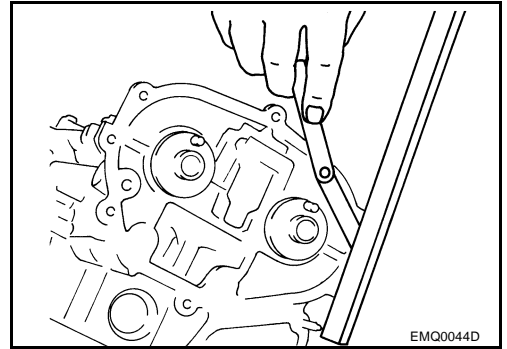
# CAMSHAFT

[VQ]

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

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

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



7. Check and adjust the valve clearance. Refer to [EM-83, "Valve Clearance"](#) .
8. Install in the reverse order of removal after this step.

A

EM

C

D

E

F

G

H

I

J

K

L

M

**INSPECTION AFTER INSTALLATION****Inspection of Camshaft Sprocket (INT) Oil Groove****CAUTION:**

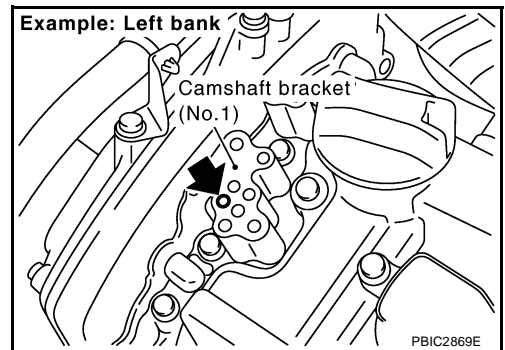
- Perform this inspection only when DTC P0011 or P0021 are detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to [EC-111, "SELF-DIAG RESULTS MODE"](#) (models for Australia) or [EC-654, "SELF-DIAG RESULTS MODE"](#) (models except for Australia).
- Check when engine is cold so as to prevent burns from any splashing engine oil.
  1. Check the engine oil level. Refer to [LU-7, "ENGINE OIL LEVEL"](#) .
  2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
    - a. Release fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
    - b. Disconnect ignition coil and injector harness connectors.
    3. Remove intake valve timing control solenoid valve. Refer to [EM-73, "CAMSHAFT"](#) .
    4. Crank the engine, and then make sure that engine oil comes out from camshaft bracket (No. 1) oil hole. End crank after checking.

**WARNING:**

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

**CAUTION:**

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



- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from camshaft bracket (No. 1) oil hole. Refer to [LU-5, "LUBRICATION SYSTEM"](#) .
- 5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
  - Clean oil groove if necessary. Refer to [LU-5, "LUBRICATION SYSTEM"](#) .
- 6. After inspection, install removed parts.

**Inspection for Leaks**

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

**NOTE:**

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

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

**Summary of the inspection items:**

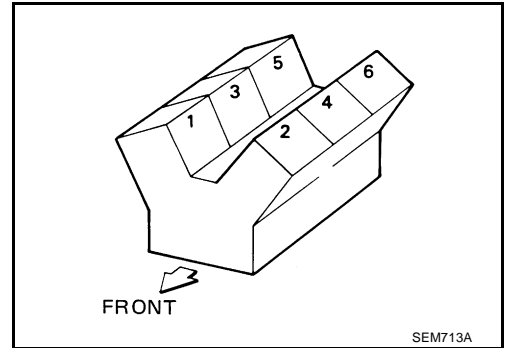
Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

\* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

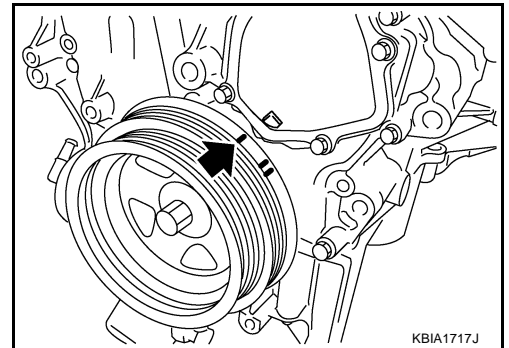
## Valve Clearance INSPECTION

GBS000GQ

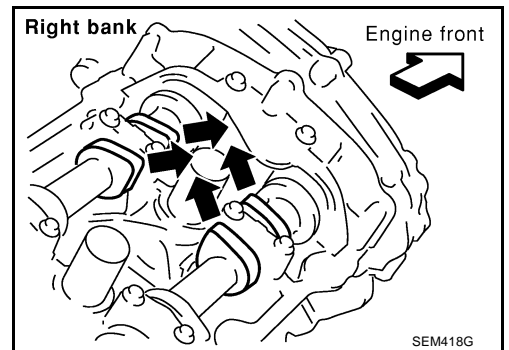
In cases of removing/installing or replacing camshaft and valve-related parts, or of unusual engine conditions due to changes in valve clearance (found malfunctions during stating, idling or causing noise), perform inspection as follows:



1. Remove rocker covers (right and left banks). Refer to [EM-41. "ROCKER COVER"](#) .
2. Measure the valve clearance as follows:
  - a. Set No. 1 cylinder at TDC of its compression stroke.
    - Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



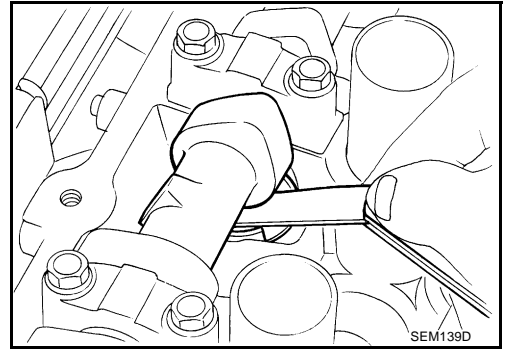
- Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
- If not, rotate crankshaft one revolution (360 degrees) and align as shown in the figure.



# CAMSHAFT

[VQ]

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



## Valve clearance:

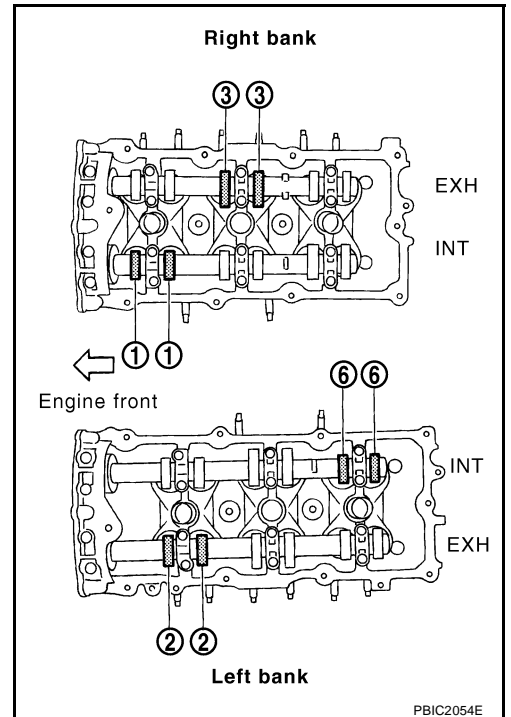
Unit: mm (in)

	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

\*: Approximately 80°C (176°F)

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure) with feeler gauge.
- No. 1 cylinder at compression TDC

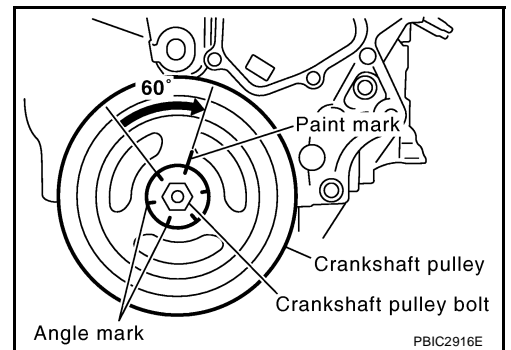
Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 1 cylinder at compression TDC	EXH		x	
	INT	x		
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 1 cylinder at compression TDC	INT			x
	EXH	x		



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

### NOTE:

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



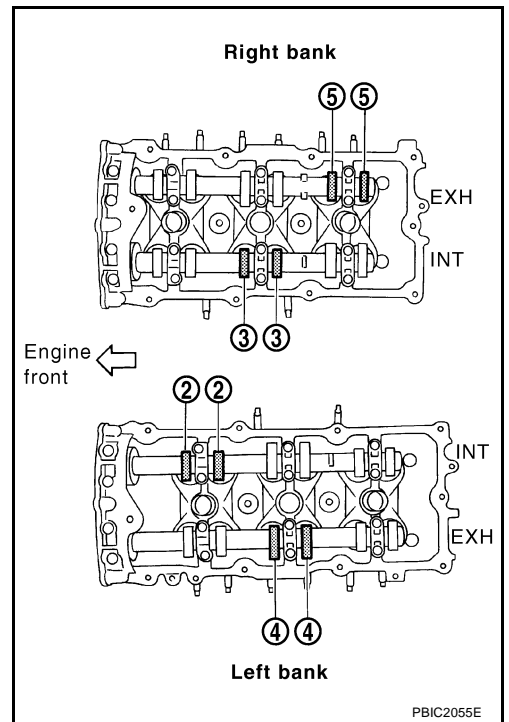


# CAMSHAFT

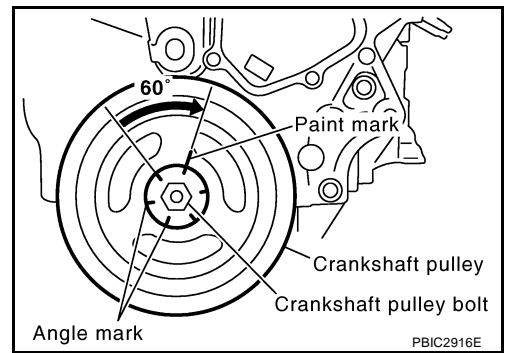
[VQ]

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure) with feeler gauge.
- No. 3 cylinder at compression TDC

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

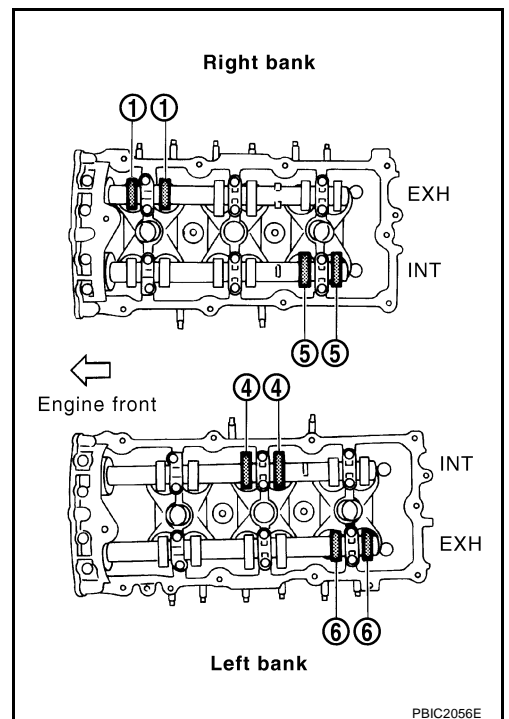


- d. Rotate crankshaft by 240 degrees clockwise (when viewed from engine front) to align No. 5 cylinder at TDC of compression stroke.



- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure) with feeler gauge.
- No. 5 cylinder at compression TDC

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

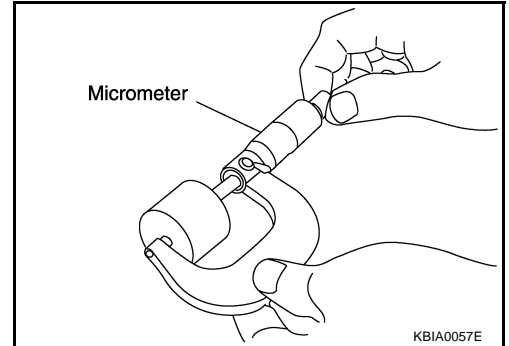


A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

3. Perform adjustment if the measured value is out of the standard. Refer to [EM-86, "ADJUSTMENT"](#) .

## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
- 1. Measure the valve clearance. Refer to [EM-83, "INSPECTION"](#) .
- 2. Remove camshaft. Refer to [EM-74, "REMOVAL"](#) .
- 3. Remove valve lifters at the locations that are out of the standard.
- 4. Measure the center thickness of removed valve lifters with micrometer.



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

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

**t = Valve lifter thickness to be replaced**

**t<sub>1</sub> = Removed valve lifter thickness**

**C<sub>1</sub> = Measured valve clearance**

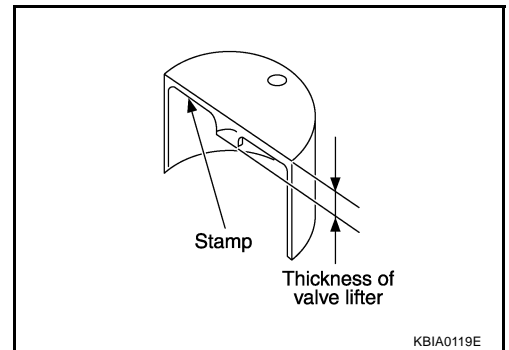
**C<sub>2</sub> = Standard valve clearance:**

**Intake : 0.30 mm (0.012 in)\***

**Exhaust : 0.33 mm (0.013 in)\***

**\*: Approximately 20°C (68°F)**

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



### Intake

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

Available thickness of valve lifter: 27 sizes with range 7.88 to 8.40 mm (0.3102 to 0.3307 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-138, "Available Valve Lifter"](#) .

# CAMSHAFT

[VQ]

## Exhaust

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

Available thickness of valve lifter: 25 sizes with range 7.88 to 8.36 mm (0.3102 to 0.3291 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-138, "Available Valve Lifter"](#).

**CAUTION:**

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

6. Install selected valve lifter.
7. Install camshaft. Refer to [EM-78, "INSTALLATION"](#).
8. Manually turn crankshaft pulley a few turns.
9. Make sure that the valve clearances for cold engine are within the specifications by referring to the specified values.
10. Installation of all removed parts is in the reverse order of removal. Refer to [EM-78, "INSTALLATION"](#).
11. Start the engine, and check for unusual noise and vibration.

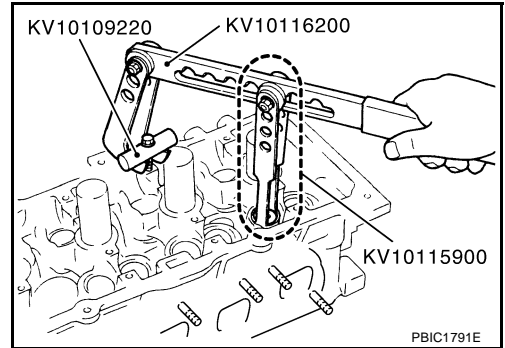
## OIL SEAL

### Removal and Installation of Valve Oil Seal REMOVAL

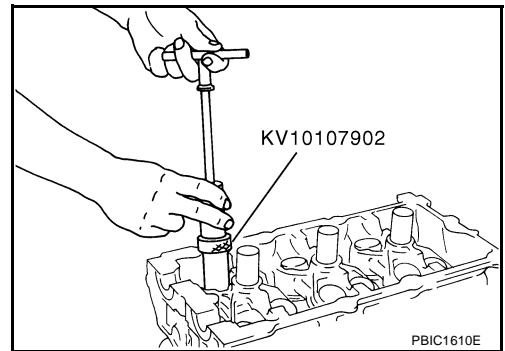
1. Turn crankshaft until the cylinder requiring new valve oil seals is at TDC. This will prevent valve from dropping into cylinder.
2. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-73, "CAMSHAFT"](#) .
3. Remove valve lifters. Refer to [EM-73, "CAMSHAFT"](#) .
4. Remove valve collet.
  - Compress valve spring with valve spring compressor, attachment, adapter [SST]. Remove valve collet with magnet hand.

**CAUTION:**

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



5. Remove valve spring retainer and valve spring.
6. Remove valve oil seal using valve oil seal puller [SST].



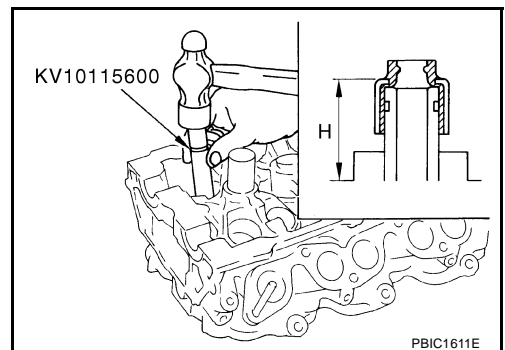
### INSTALLATION

1. Apply new engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift [SST], press fit valve seal to height "H" shown in the figure.

**NOTE:**

Dimension "H": Height measured before valve spring seat installation

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



3. Install in the reverse order of removal after this step.

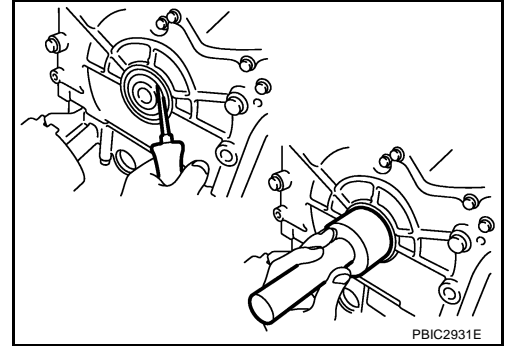
## Removal and Installation of Front Oil Seal

### REMOVAL

1. Remove the following parts:
  - Engine undercover front, engine undercover middle; Refer to [EI-15, "FRONT BUMPER"](#) .
  - Drive belts; Refer to [EM-14, "DRIVE BELTS"](#) .
  - Radiator cooling fan assembly; Refer to [CO-21, "COOLING FAN"](#) .
  - Crankshaft pulley; Refer to [EM-53, "TIMING CHAIN"](#) .
2. Remove front oil seal using suitable tool.

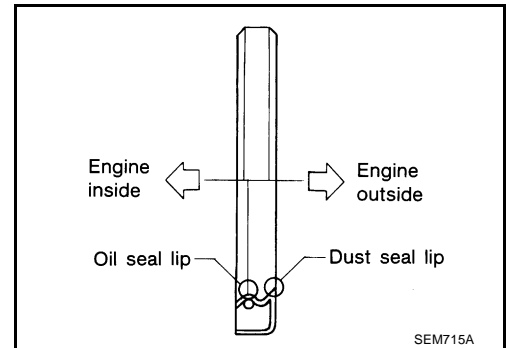
**CAUTION:**

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



### INSTALLATION

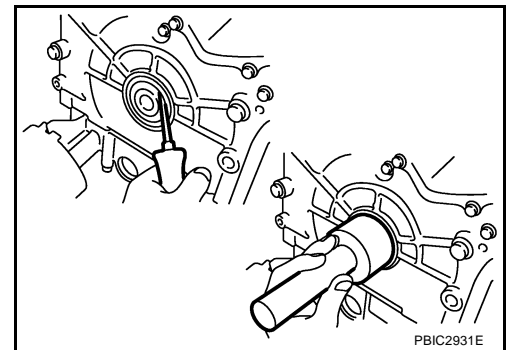
1. Apply new engine oil to both oil seal lip and dust seal lip of new front oil seal.
2. Install front oil seal.
  - Install front oil seal so that each seal lip is oriented as shown in the figure.



- Using suitable drift, press-fit until the height of front oil seal is level with the mounting surface.
- Suitable drift: outer diameter 60 mm (2.36 in), inner diameter 50 mm (1.97 in).

**CAUTION:**

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



3. Install in the reverse order of removal after this step.

## Removal and Installation of Rear Oil Seal

### REMOVAL

1. Remove transmission assembly. Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-254, "TRANSMISSION ASSEMBLY"](#) (A/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to [CL-18, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#) .
3. Remove flywheel (M/T models) or drive plate (A/T models). Refer to [CL-18, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#) (M/T models) or [EM-107, "CYLINDER BLOCK"](#) (A/T models).

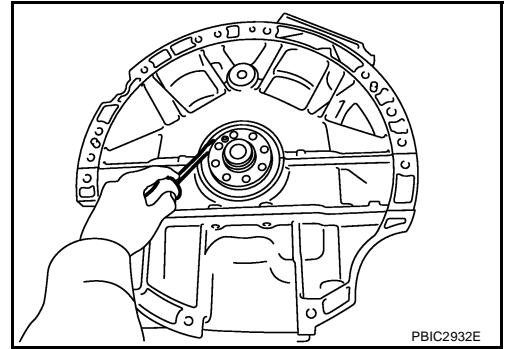
# OIL SEAL

[VQ]

4. Remove rear oil seal with a suitable tool.

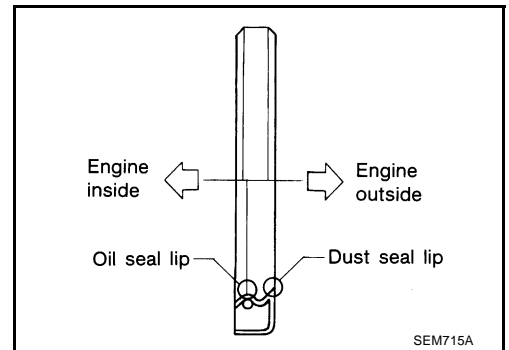
**CAUTION:**

Be careful not to damage crankshaft and cylinder block.

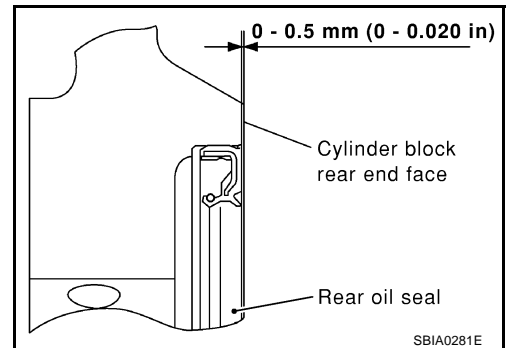


## INSTALLATION

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



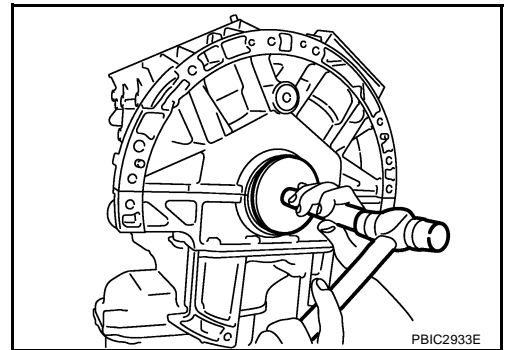
- Press in rear oil seal to the position as shown in the figure.



- Press-fit rear oil seal with a suitable drift [outside diameter 104 mm (4.09 in), inside diameter 88 mm (3.46 in)].

**CAUTION:**

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



3. Installation of the remaining parts is the reverse order of removal.

## CYLINDER HEAD

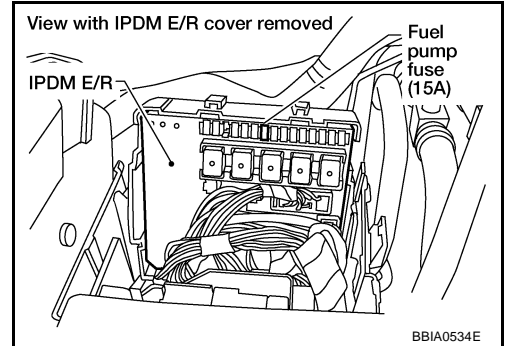
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### On-Vehicle Service

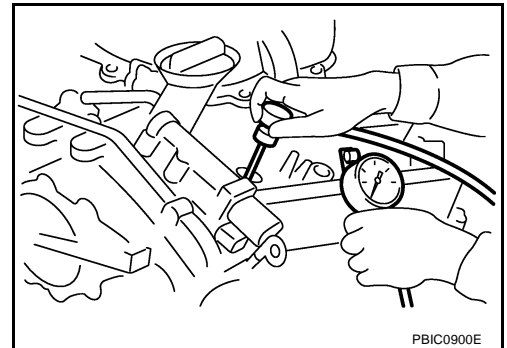
GBS000GU

### CHECKING COMPRESSION PRESSURE

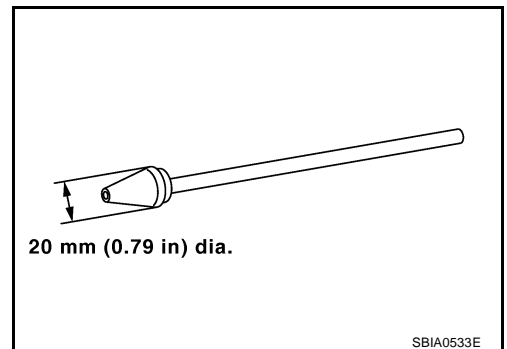
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.



4. Remove intake manifold collector. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-33, "IGNITION COIL"](#) and [EM-34, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#).
6. Connect engine tachometer (not required in use of CONSULT-II).
7. Install compression tester with adapter onto spark plug hole.



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



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

#### Compression pressure:

Unit: kPa (kg/cm<sup>2</sup>, psi) /rpm

Standard	Minimum	Differential limit between cylinders
1,275 (13.0, 185) / 300	981 (10.0, 142) / 300	98 (1.0, 14) / 300

#### CAUTION:

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

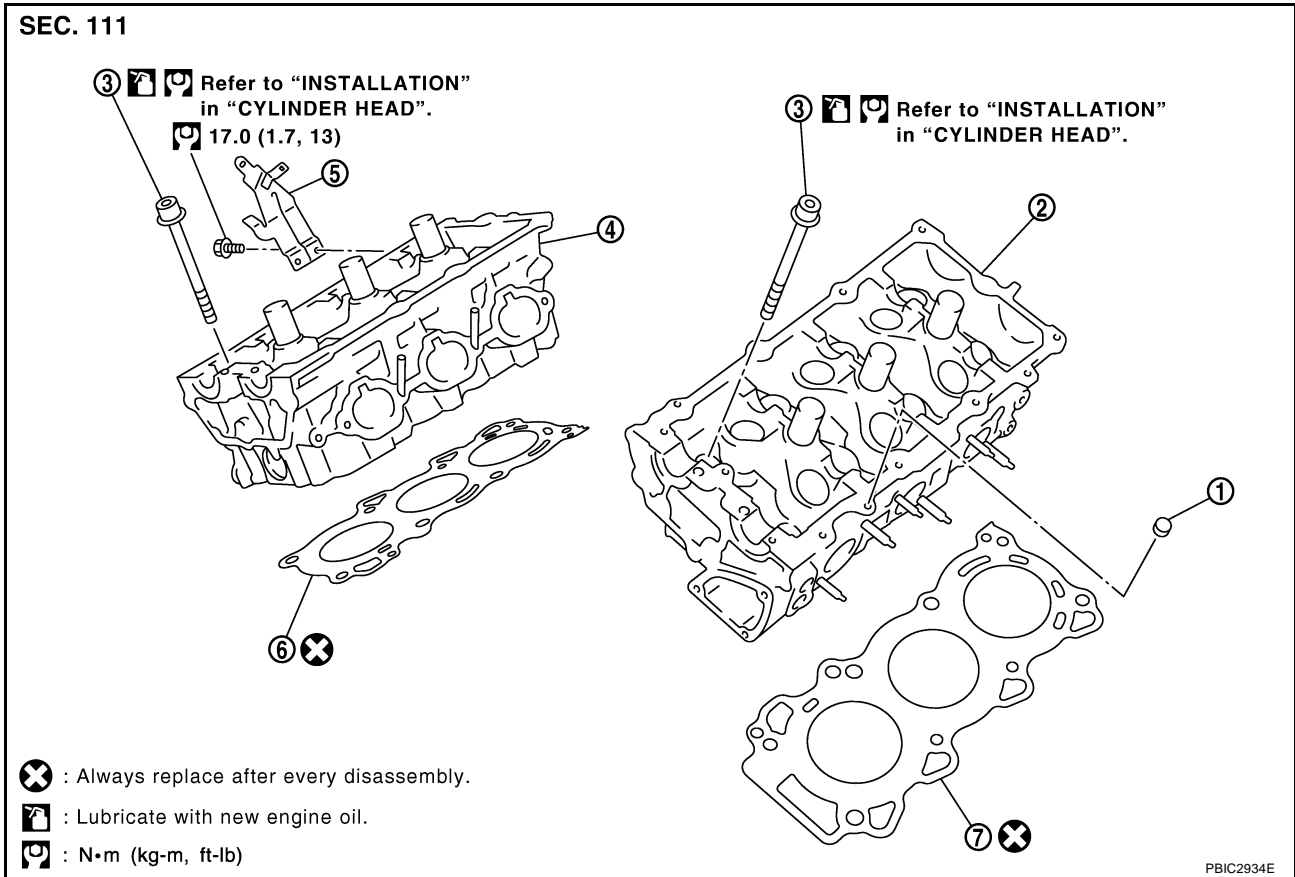
# CYLINDER HEAD

[VQ]

- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
  - If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
    - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check the piston rings and replace if necessary.
    - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
  - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
9. After inspection is completed, install removed parts.
10. Start engine, and make sure that engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-77, "TROUBLE DIAGNOSIS"](#) (models for Australia) or [EC-620, "TROUBLE DIAGNOSIS"](#) (models except for Australia).

## Components

GBS000GV



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

## Removal and Installation

### REMOVAL

1. Remove camshaft. Refer to [EM-73, "CAMSHAFT"](#).
2. Release the hoist from hanging, then remove the engine slingers.
3. Remove the following parts:

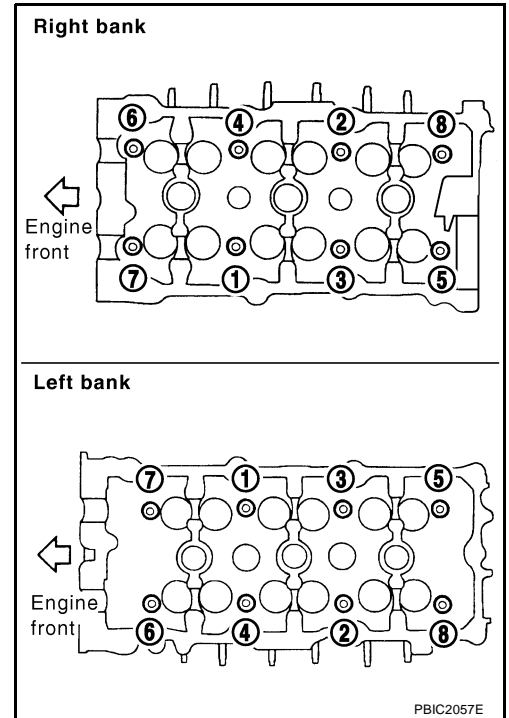
GBS000GW



# CYLINDER HEAD

[VQ]

- Intake manifold; Refer to [EM-21, "INTAKE MANIFOLD"](#) .
  - Exhaust manifold; Refer to [EM-23, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
  - Water inlet and thermostat assembly; Refer to [CO-27, "WATER INLET AND THERMOSTAT ASSEMBLY"](#) .
  - Water outlet, water pipe and heater pipe; Refer to [CO-29, "WATER OUTLET AND WATER PIPING"](#) .
4. Remove cylinder head bolts in reverse order as shown in the figure with cylinder head bolt wrench (commercial service tool) and power tool to remove cylinder heads (right and left banks).



5. Remove cylinder head gaskets.

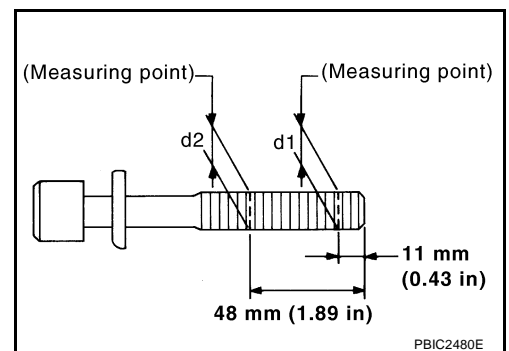
## INSPECTION AFTER REMOVAL

### Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between "d1" and "d2" exceeds the limit, replace them with new one.

**Limit ("d1" – "d2") : 0.11 mm (0.0043 in)**

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



### Cylinder Head Distortion

#### NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to [EM-127, "CYLINDER BLOCK DISTORTION"](#) .

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

#### CAUTION:

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

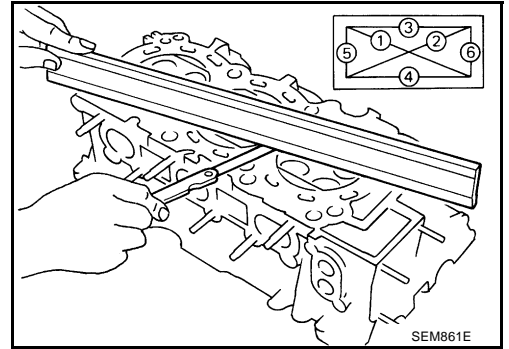
# CYLINDER HEAD

[VQ]

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

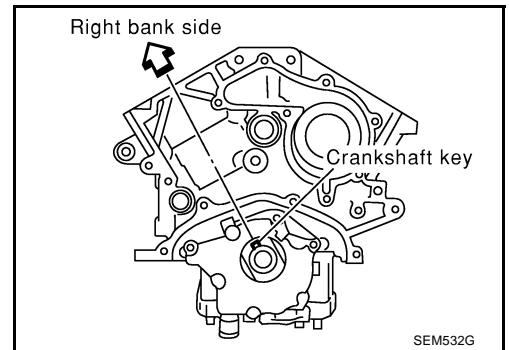
**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace cylinder head.



## INSTALLATION

- Install new cylinder head gasket.
- Turn crankshaft until No. 1 piston is set at TDC.
  - Crankshaft key should line up with the right bank cylinder center line as shown in the figure.



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

### CAUTION:

If cylinder head bolts re-used, check their outer diameters before installation. Refer to [EM-93, "Cylinder Head Bolts Outer Diameter"](#).

- Apply new engine oil to threads and seat surface of cylinder head bolts.
- Tighten all cylinder head bolts.

: 98.1 N-m (10 kg-m, 72 ft-lb)

- Completely loosen all cylinder head bolts.

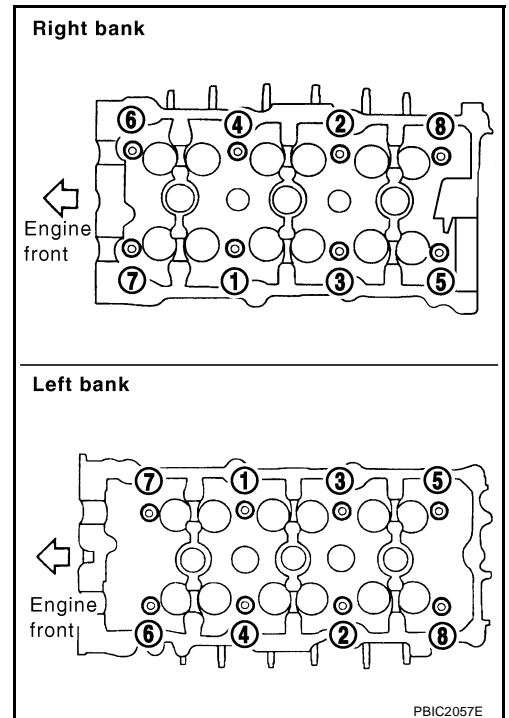
: 0 N-m (0 kg-m, 0 ft-lb)

### CAUTION:

In step "c", loosen cylinder head bolts in reverse order of that indicated in the figure.

- Tighten all cylinder head bolts.

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



# CYLINDER HEAD

[VQ]

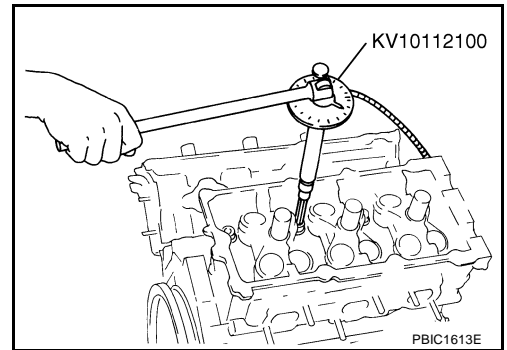
- e. Turn all cylinder head bolts 90 degrees clockwise (angle tightening).

**CAUTION:**

**Check the tightening angle by using angle wrench [SST].  
Avoid judgment by visual inspection without tool.**

- Check tightening angle indicated on angle wrench [SST] indicator plate.

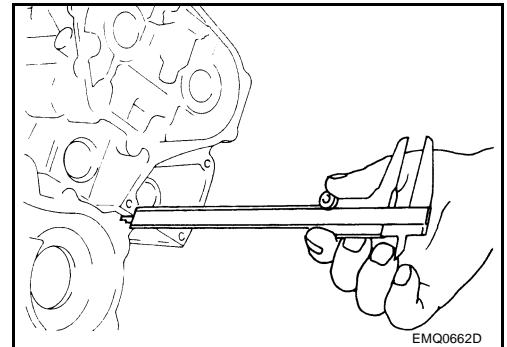
- f. Turn all cylinder head bolts 90 degrees clockwise again.



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

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

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



5. Install in the reverse order of removal after this step.

A  
EM  
C  
D  
E  
F  
G  
H  
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## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

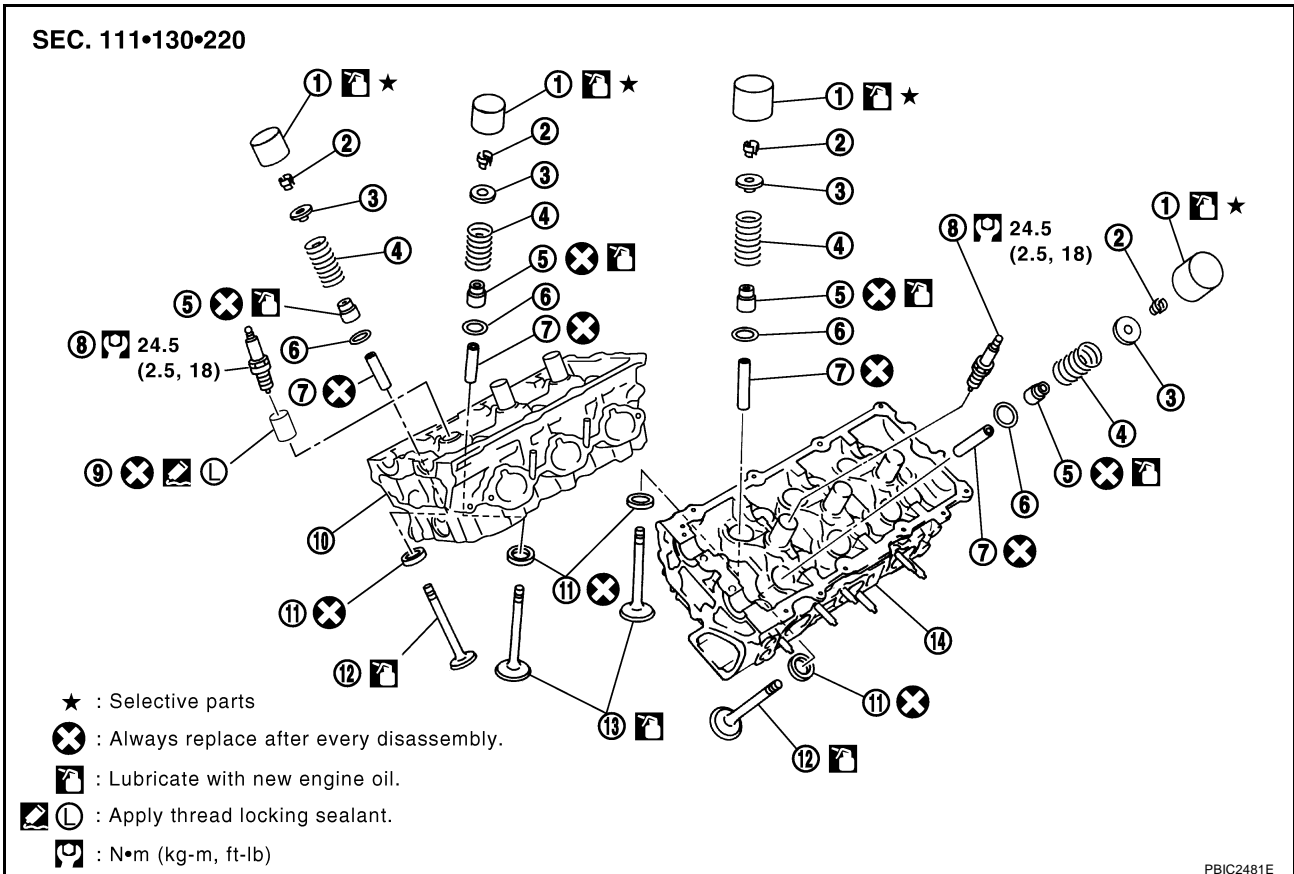
### Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

## Components

GBS000GX



# CYLINDER HEAD

[VQ]

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

A

EM

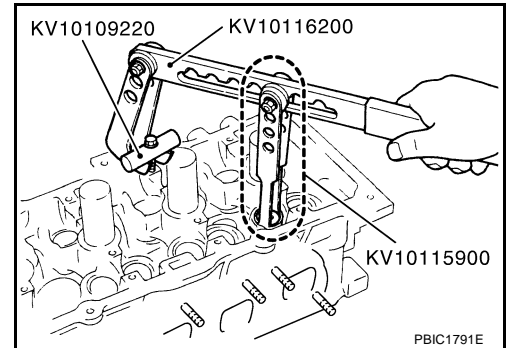
## Disassembly and Assembly DISASSEMBLY

GBS000GY

1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
  - Compress valve spring with valve spring compressor, attachment and adapter [SST]. Remove valve collet with magnet hand.

### CAUTION:

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



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

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7. If valve seat must be replaced, refer to [EM-101, "VALVE SEAT REPLACEMENT"](#).
8. If valve guide must be replaced, refer to [EM-99, "VALVE GUIDE REPLACEMENT"](#).
9. Remove spark plug tube, as necessary.

### CAUTION:

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

## ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-99, "VALVE GUIDE REPLACEMENT"](#).
2. When valve seat is removed, install it. Refer to [EM-101, "VALVE SEAT REPLACEMENT"](#).

M

# CYLINDER HEAD

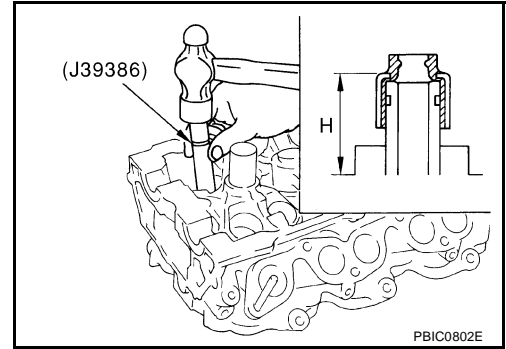
[VQ]

3. Install valve oil seals.

- Install with valve oil seal drift [SST] to match dimension in the figure.

**Height “H” (Without valve spring seat installed)**

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



4. Install valve spring seat.

5. Install valves.

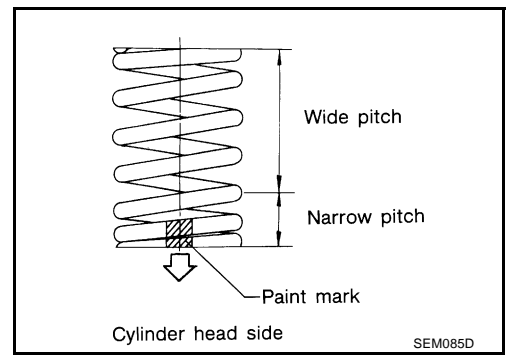
- Install it in the original position.

**NOTE:**

Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type).

- Install narrow pitch end (paint mark) to cylinder head side (valve spring seat side).
- Intake side and exhaust side valve springs are different. Install them referring to the following paint mark collar.



7. Install valve spring retainer.

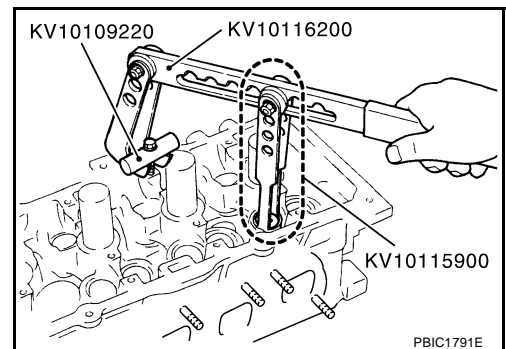
8. Install valve collet.

- Compress valve spring with valve spring compressor, attachment and adapter [SST]. Install valve collet with magnet hand.

**CAUTION:**

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

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



9. Install valve lifter.

- Install it in the original position.

10. Install spark plug tube.

- Press-fit spark plug tube as follows:

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

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

**Use Genuine High Strength Locking Sealant or equivalent.**

# CYLINDER HEAD

[VQ]

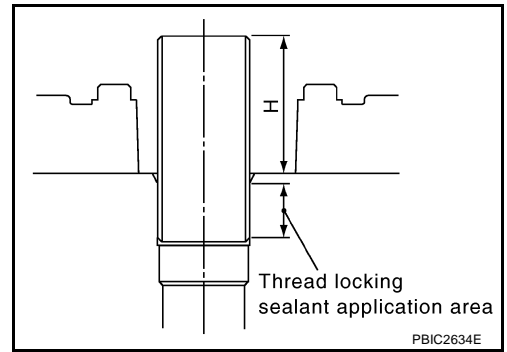
- c. Using drift, press-fit spark plug tube so that its height "H" is as specified in the figure.

**Standard press-fit height "H":**

**: 38.1 - 39.1 mm (1.500 - 1.539 in)**

**CAUTION:**

- When press-fitting, take care not to deform spark plug tube.
  - After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.
11. Install spark plug with spark plug wrench (commercial service tool).



GBS000GZ

## Inspection After Disassembly VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [EM-99, "VALVE DIMENSIONS"](#).
- If dimensions are out of the standard, replace valve and check the valve seat contact. Refer to [EM-101, "VALVE SEAT CONTACT"](#).

## VALVE GUIDE CLEARANCE

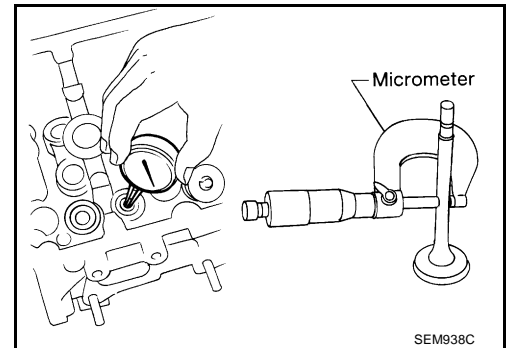
### Valve Stem Diameter

Measure the diameter of valve stem with micrometer.

**Standard**

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

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



### Valve Guide Inner Diameter

Measure the inner diameter of valve guide with inside micrometer.

**Standard**

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

### Valve Guide Clearance

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

**Valve guide clearance:**

**Standard**

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

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

**Limit**

**Intake : 0.08 mm (0.003 in)**

**Exhaust : 0.09 mm (0.004 in)**

- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced, refer to [EM-99, "VALVE GUIDE REPLACEMENT"](#).

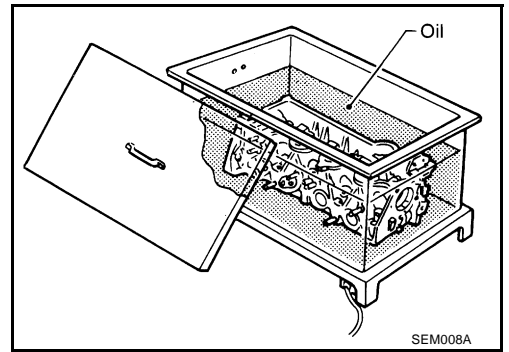
## VALVE GUIDE REPLACEMENT

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

# CYLINDER HEAD

[VQ]

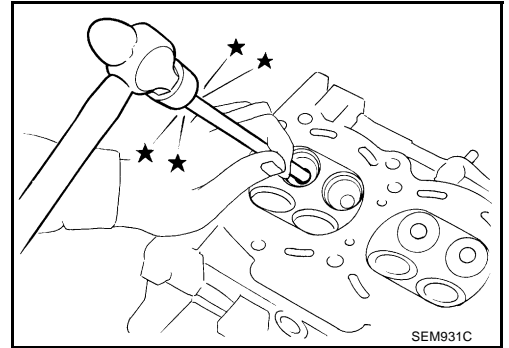
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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

**CAUTION:**

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

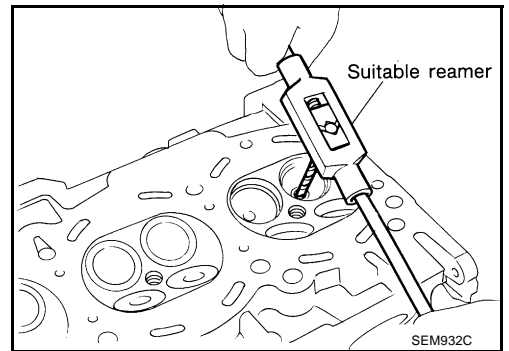


3. Using valve guide reamer (commercial service tool), ream cylinder head valve guide hole.

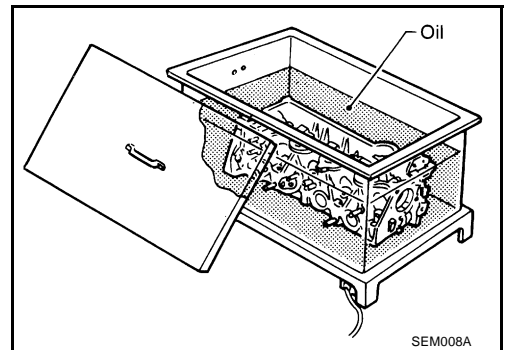
**Valve guide hole diameter (for service parts):**

**Intake and exhaust**

**: 10.175 - 10.196 mm (0.4006 - 0.4014 in)**



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



5. Using valve guide drift (commercial service tool), press valve guide from camshaft side to the dimensions as in the figure.

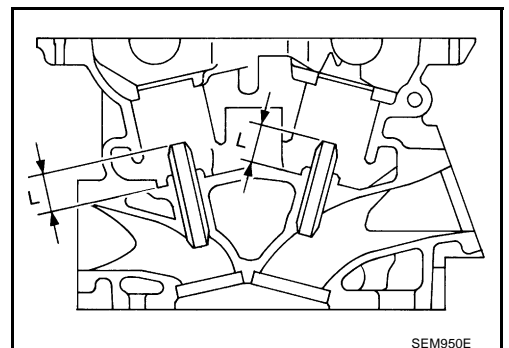
**Projection "L"**

**Intake and exhaust**

**: 12.6 - 12.8 mm (0.496 - 0.504 in)**

**CAUTION:**

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





# CYLINDER HEAD

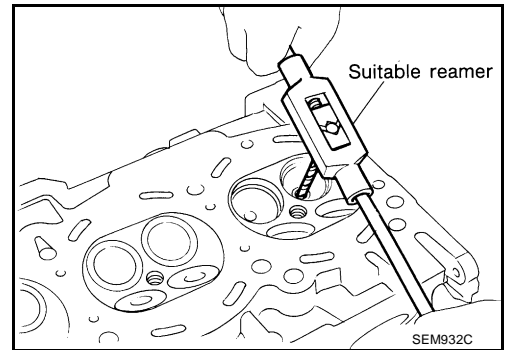
[VQ]

- Using valve guide reamer (commercial service tool), apply reamer finish to valve guide.

**Standard:**

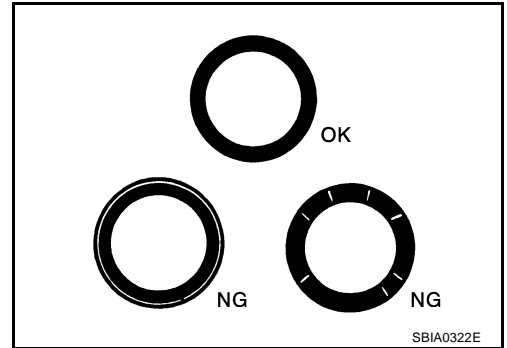
**Intake and exhaust**

**: 6.000 - 6.018 mm (0.2362 - 0.2369 in)**



## VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace valve seat. Refer to [EM-101, "VALVE SEAT REPLACEMENT"](#).



## VALVE SEAT REPLACEMENT

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

- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-141, "Valve Seat"](#).

**CAUTION:**

**Prevent to scratch cylinder head by excessive boring.**

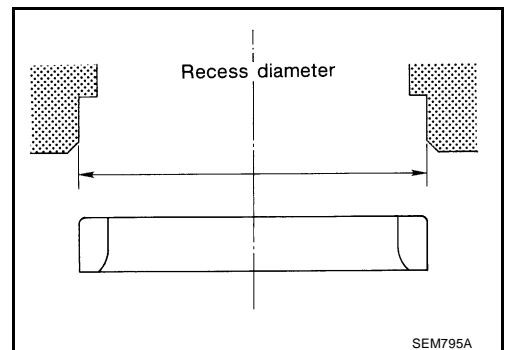
- Ream cylinder head recess diameter for service valve seat.

**Oversize [0.5 mm (0.020 in)]**

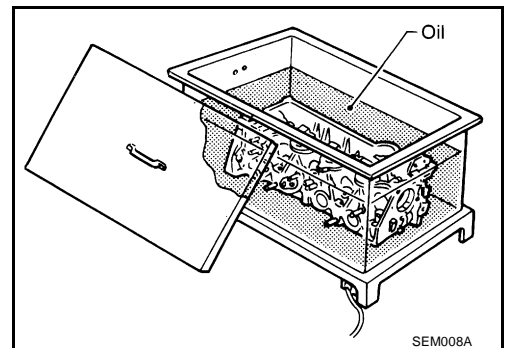
**Intake : 38.500 - 38.516 mm (1.5157 - 1.5164 in)**

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

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



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



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

**CAUTION:**

- Avoid directly touching cold valve seats.**

# CYLINDER HEAD

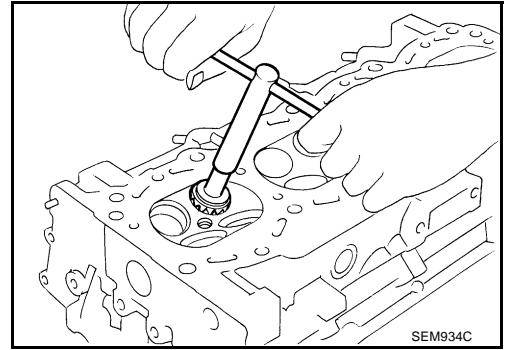
[VQ]

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

5. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish seat to the specified dimensions. Refer to [EM-141, "Valve Seat"](#) .

**CAUTION:**

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



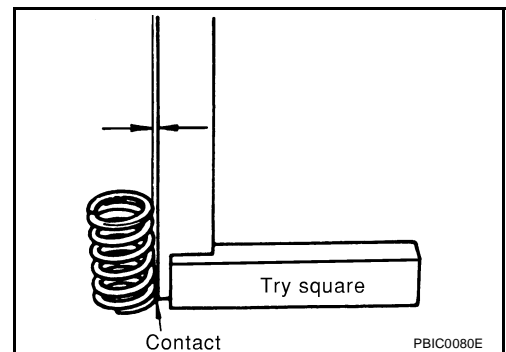
6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Refer to [EM-101, "VALVE SEAT CONTACT"](#) .

## VALVE SPRING SQUARENESS

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

**Limit : 2.1 mm (0.083 in)**

- If it exceeds the limit, replace valve spring.



## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure at the specified spring height.

**Standard:**

**Intake and exhaust**

**Free height**

**: 47.07 mm (1.8531 in)**

**Installation height**

**: 37.00 mm (1.4567 in)**

**Installation load**

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

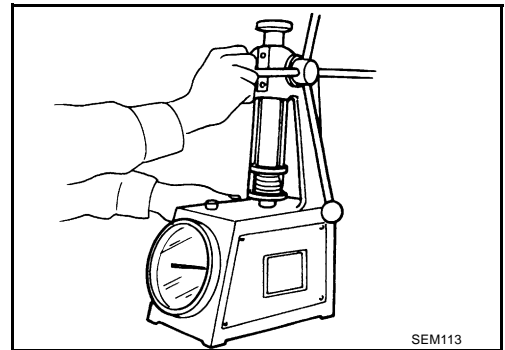
**Height during valve open**

**: 27.20 mm (1.0709 in)**

**Load with valve open**

**: 373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb)**

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



# ENGINE ASSEMBLY

[VQ]

## ENGINE ASSEMBLY

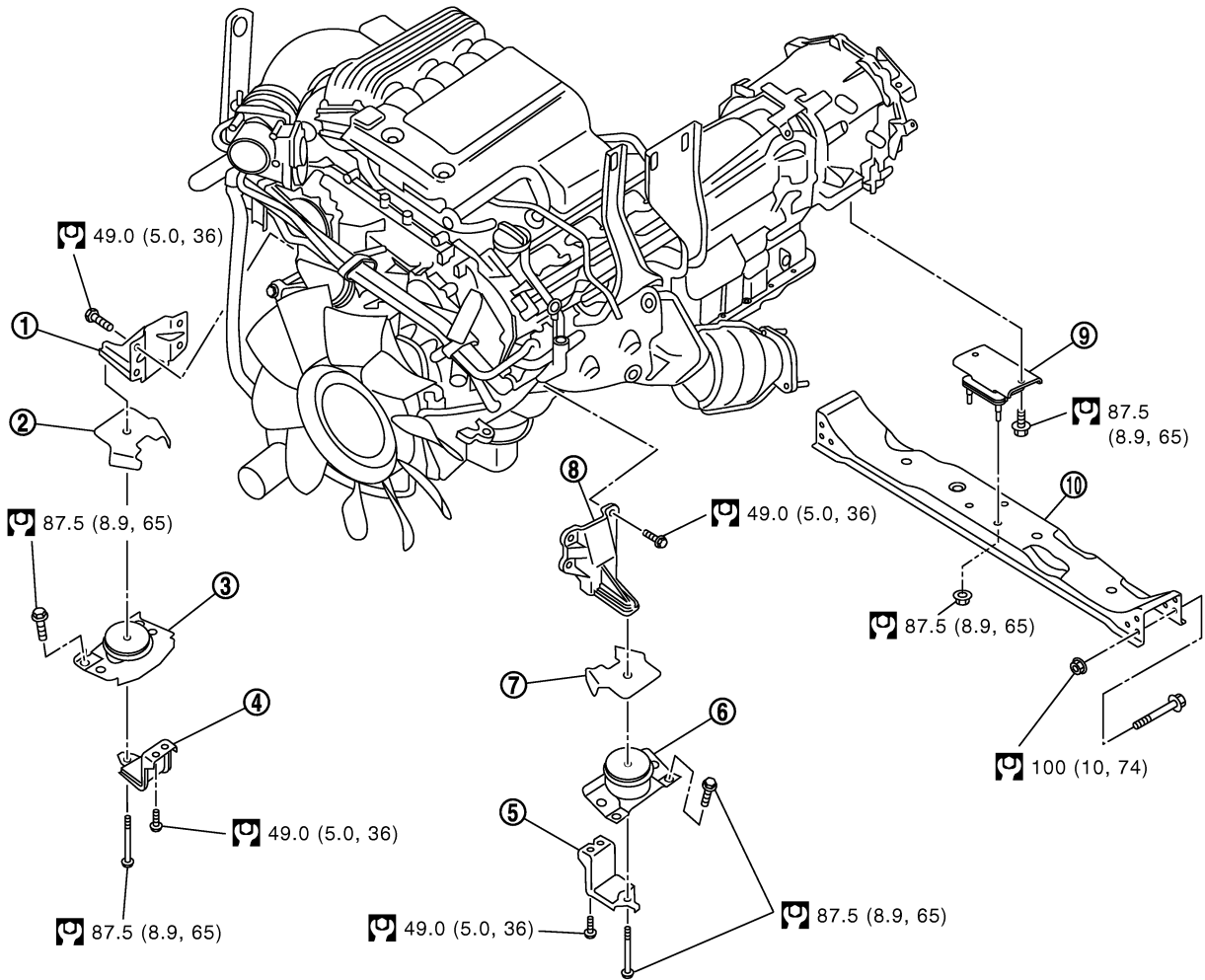
PFP:10001

### Components

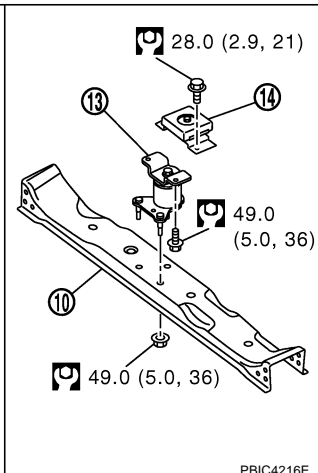
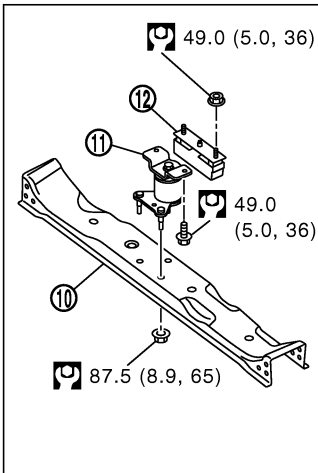
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SEC. 112



: N•m (kg-m, ft-lb)



PBIC4216E

- |                                       |                                       |  |
|---------------------------------------|---------------------------------------|--|
| 1. RH engine mounting bracket (upper) | 2. RH heat shield plate               | 3. RH engine mounting insulator                  |
| 4. RH engine mounting bracket (lower) | 5. LH engine mounting bracket (lower) | 6. LH engine mounting insulator                  |
| 7. LH heat shield plate               | 8. LH engine mounting bracket (upper) | 9. Engine mounting insulator (rear) (4WD models) |

- |  |  |                                     |
|--|--|-------------------------------------|
| 10. Transmission cross member                  | 11. Engine mounting insulator (2WD M/T models) | 12. Dynamic damper (2WD M/T models) |
| 13. Engine mounting insulator (2WD A/T models) | 14. Dynamic damper (2WD A/T models)            |                                     |

## WARNING:

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

## CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and engine coolant are cooled sufficiently.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-point lift type or separate type lift. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-49, "Pantograph Jack, Garage Jack and Safety Stand"](#) .

## Removal and Installation

GBS000H1

### REMOVAL

#### Preparation

1. Release fuel pressure. Refer to [EC-74, "FUEL PRESSURE RELEASE"](#) (models for Australia) or [EC-617, "FUEL PRESSURE RELEASE"](#) (models except for Australia).
2. Disconnect both battery cables. Refer to [SC-5, "BATTERY"](#) .
3. Drain engine coolant. Refer to [CO-10, "Changing Engine Coolant"](#) .
4. Remove the following parts.
  - Engine undercover front; Refer to [EI-15, "FRONT BUMPER"](#) .
  - Engine undercover middle, engine undercover rear
  - Hood assembly; Refer to [BL-13, "Removal and Installation of Hood Assembly"](#) .
  - Battery; Refer to [SC-5, "BATTERY"](#) .
  - Engine cover; Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
  - Air duct and air cleaner case assembly; Refer to [EM-17, "AIR CLEANER AND AIR DUCT"](#) .
  - Radiator, radiator shroud (upper and lower) and cooling fan assembly; Refer to [CO-13, "RADIATOR"](#) and [CO-21, "COOLING FAN"](#) .
  - Drive belt; Refer to [EM-14, "DRIVE BELTS"](#) .
5. Disconnect vacuum hose between vehicle and engine and set it aside.
6. Disconnect the engine room harness from the engine side and set it aside for easier work.
7. Disconnect the engine harness grounds.
8. Remove power steering fluid reservoir tank from engine and move it aside for easier work. Refer to [PS-33, "HYDRAULIC LINE"](#) .
9. Remove power steering oil pump from engine. Move it from its location and secure with a rope for easier work. Refer to [PS-24, "Removal and Installation"](#) .
10. Remove the A/C compressor bolts and set aside. Refer to [MTC-115, "Removal and Installation for Compressor"](#) .
11. Disconnect brake booster vacuum line.
12. Disconnect EVAP line.
13. Disconnect the fuel hose at the engine side connection. Refer to [EM-36, "FUEL INJECTOR AND FUEL TUBE"](#) .
14. Disconnect the heater hoses at cowl, and install plugs to avoid leakage of engine coolant.
15. Remove the A/T oil level indicator and indicator tube. Refer to [AT-254, "TRANSMISSION ASSEMBLY"](#) .

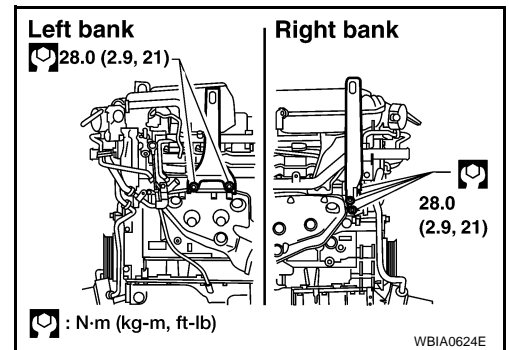
# ENGINE ASSEMBLY

[VQ]

16. Remove front final drive assembly (4WD models). Refer to [FFD-15, "FRONT FINAL DRIVE ASSEMBLY"](#).
17. Remove three way catalyst. Refer to [EM-23, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
18. Install engine slingers into left bank and right bank.

## Engine slinger bolts:

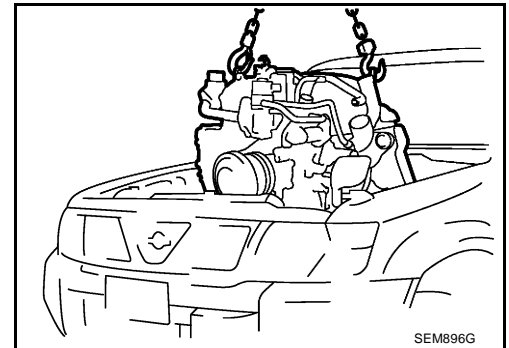
: 28.0 N·m (2.9 kg-m, 21 ft-lb)



19. Remove transmission. Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-254, "TRANSMISSION ASSEMBLY"](#) (A/T models).
20. Lift with hoist and secure the engine in position.
21. Loosen LH and RH engine mounting insulator mounting bolts.
22. Remove engine.

## CAUTION:

- During the operation, make sure that no part interferes with the body side.
- Before and during this lifting, always check if any harnesses are left connected.



23. Remove alternator. Refer to [SC-25, "Removal and Installation"](#).
24. Remove engine mounting insulator bracket (upper).

## INSTALLATION

Installation is the reverse order of removal.

- Do not allow engine oil to get on mounting insulator. Be careful not to damage mounting insulator.
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.
- Insert vacuum hose to vacuum gallery until vacuum hose comes in contact with the stopper when a stopper is provided at vacuum gallery.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

# ENGINE ASSEMBLY

[VQ]

## Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\*1: Transmission/transaxle/AT fluid, power steering fluid, brake fluid, etc.

\*2: Check engine oil level 10 minutes after engine stopped.

# CYLINDER BLOCK

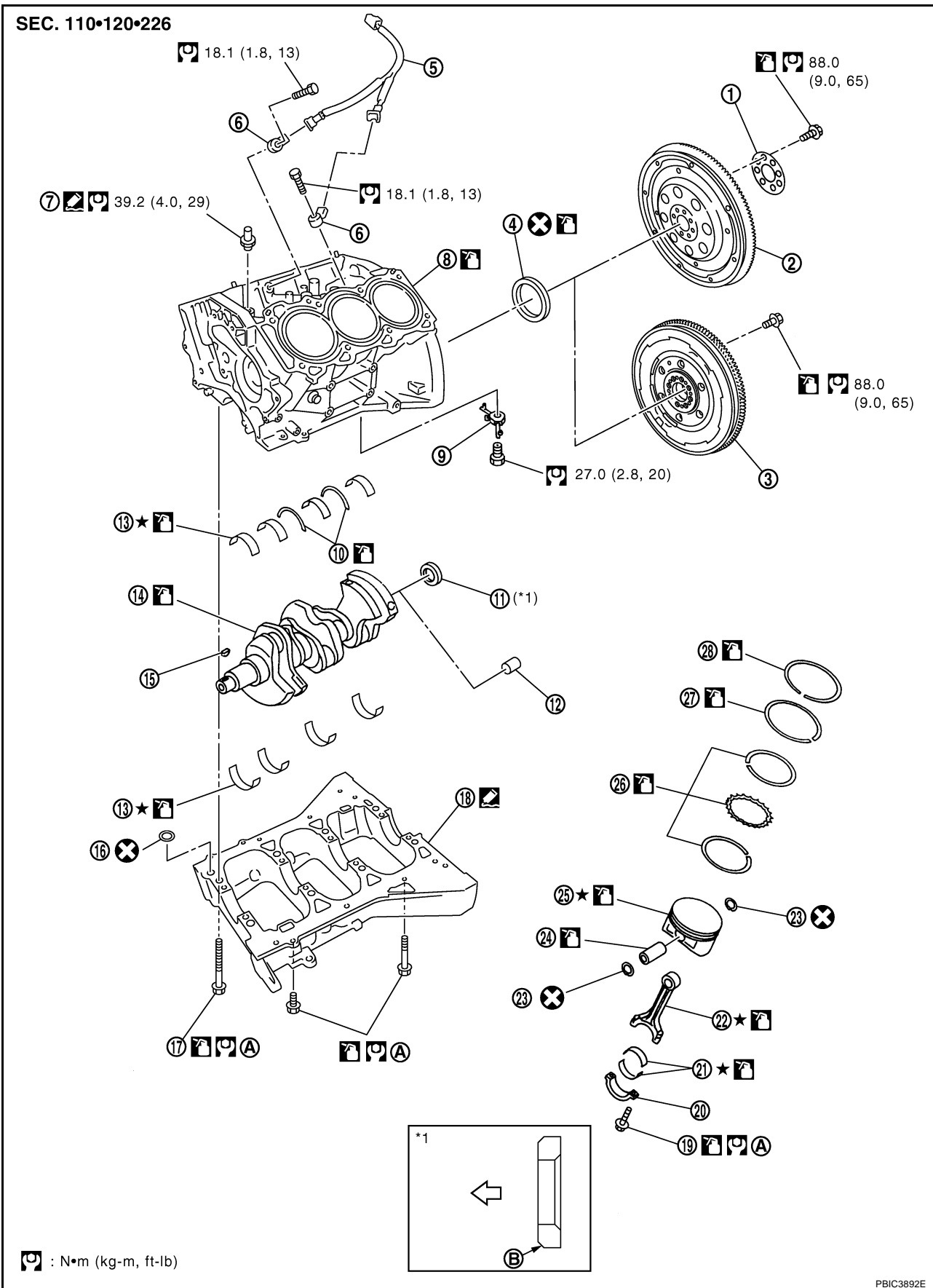
[VQ]

## CYLINDER BLOCK

PF1:11010

### Components

GBS000H2



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# CYLINDER BLOCK

[VQ]

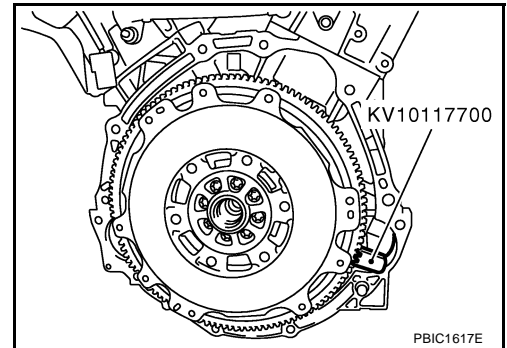
- |                                      |                                  |                                |
|--------------------------------------|----------------------------------|--------------------------------|
| 1. Reinforcement plate               | 2. Drive plate (A/T models)      | 3. Flywheel (M/T models)       |
| 4. Rear oil seal                     | 5. Sub harness                   | 6. Knock sensor                |
| 7. Water connector                   | 8. Cylinder block                | 9. Oil jet                     |
| 10. Thrust bearing                   | 11. Pilot converter (A/T models) | 12. Pilot bushing (M/T models) |
| 13. Main bearing                     | 14. Crankshaft                   | 15. Crankshaft key             |
| 16. O-ring                           | 17. Lower cylinder block bolt    | 18. Lower cylinder block       |
| 19. Connecting rod bolt              | 20. Connecting rod bearing cap   | 21. Connecting rod bearing     |
| 22. Connecting rod                   | 23. Snap ring                    | 24. Piston pin                 |
| 25. Piston                           | 26. Oil ring                     | 27. Second ring                |
| 28. Top ring                         |                                  |                                |
| A. Refer to <a href="#">EM-111</a> . | B. Chamfered                     | ↩ Crankshaft side              |

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

## Disassembly and Assembly DISASSEMBLY

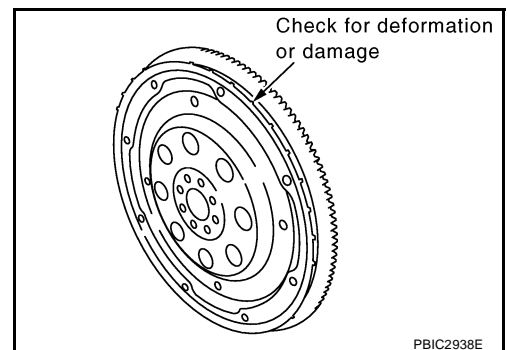
GBS000H3

1. Remove engine assembly from vehicle. Refer to [EM-103, "ENGINE ASSEMBLY"](#).
2. Remove both exhaust manifolds. Refer to [EM-23, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
3. Install engine to engine stand as follows.
  - a. Remove clutch cover and clutch disc (M/T models). Refer to [CL-18, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#).
  - b. Remove flywheel (M/T models) or drive plate (A/T models). Fix crankshaft with ring gear stopper [SST], and remove mounting bolts.
    - Loosen mounting bolts in diagonal order.
    - Use TORX socket for flywheel mounting bolts (size: T55, commercial service tool).



### CAUTION:

- Do not disassemble flywheel (M/T models) or drive plate (A/T models).
- Do not place drive plate (A/T models) with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.

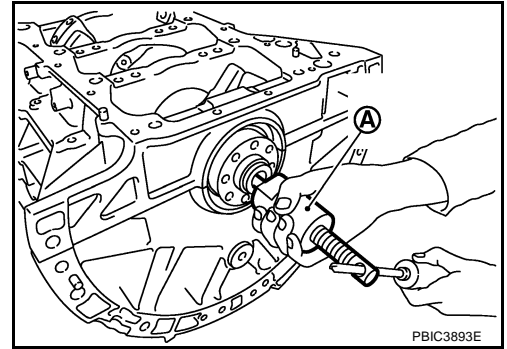




# CYLINDER BLOCK

[VQ]

- c. Remove pilot bushing (M/T models) or pilot converter (A/T models) using pilot bushing puller (A) [SST: 16610001] as necessary.



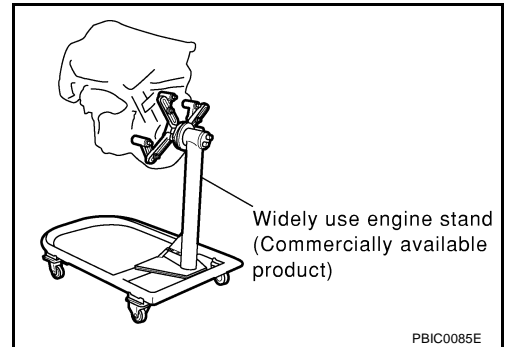
- d. Hoist engine and install it to the engine stand (commercial service tool).

**CAUTION:**

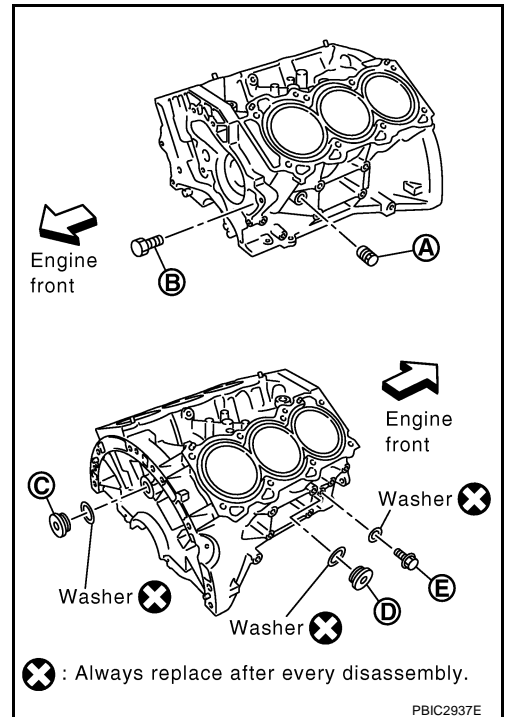
Use engine stand that has a load capacity [approximately 220 kg (441 lb) or more] large enough for supporting the engine weight.

**NOTE:**

The figure shows an example of general-purpose engine stand that can hold mating surface of transmission with flywheel (M/T models) or drive plate (A/T models) removed.



4. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#) .
5. Drain engine coolant by removing water drain plugs from cylinder block left side at "A" and cylinder block front side at "B" as shown in the figure.



6. Remove cylinder head. Refer to [EM-91, "CYLINDER HEAD"](#) .
7. Remove sub harness, and remove knock sensors.

**CAUTION:**

Carefully handle sensor avoiding shocks.

8. Remove piston and connecting rod assembly as follows:

- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-124, "CONNECTING ROD SIDE CLEARANCE"](#) .

**CAUTION:**

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

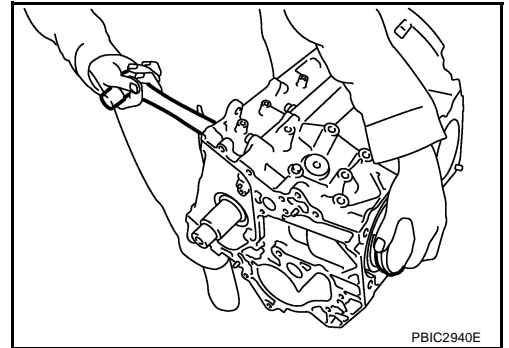
# CYLINDER BLOCK

[VQ]

- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod bearing cap.
- c. Using hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

**CAUTION:**

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



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

**CAUTION:**

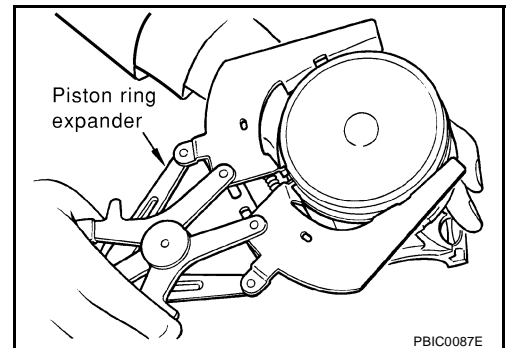
**Identify installation position, and store them without mixing them up.**

10. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to [EM-125, "PISTON RING SIDE CLEARANCE"](#).
- Use piston ring expander (commercial service tool).

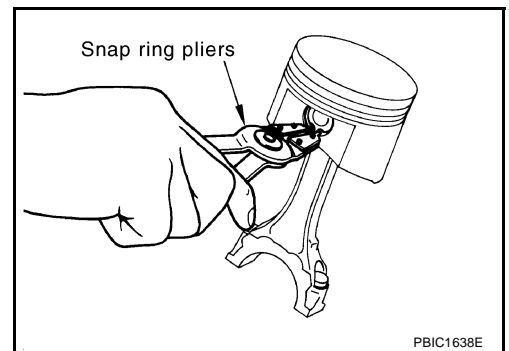
**CAUTION:**

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

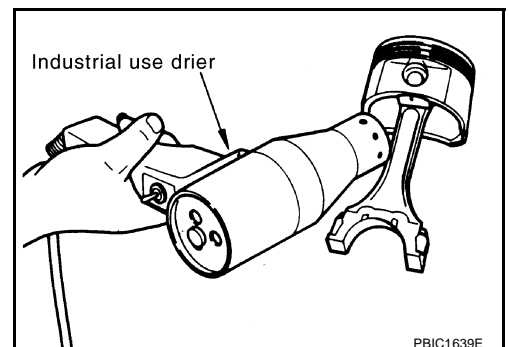


11. Remove piston from connecting rod as follows:

- a. Using snap ring pliers, remove snap rings.



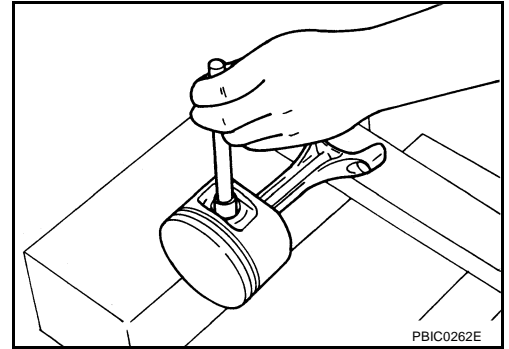
- b. Heat piston to 60 to 70°C (140 to 158°F) with industrial use drier or equivalent.



# CYLINDER BLOCK

[VQ]

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

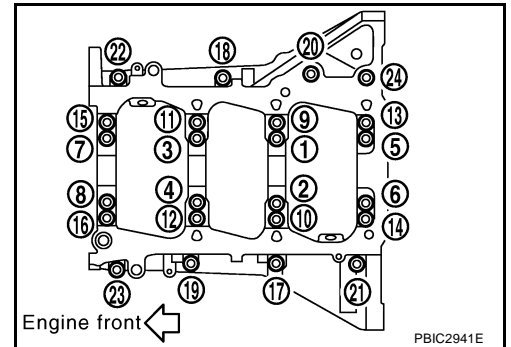


12. Remove lower cylinder block bolts.

- Before loosening lower cylinder block bolts, measure the crankshaft end play. Refer to [EM-124, "CRANKSHAFT END PLAY"](#).
- Loosen lower cylinder block bolts in reverse order as shown in the figure in several different steps.

**NOTE:**

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



13. Remove lower cylinder block.

- Use seal cutter [SST: KV10111100] to cut liquid gasket for removal. Refer to [EM-7, "REMOVAL OF LIQUID GASKET SEALING"](#).

**CAUTION:**

**Be careful not to damage the mounting surfaces.**

14. Remove crankshaft.

15. Pull rear oil seal out from rear end of crankshaft.

**NOTE:**

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

**CAUTION:**

**Be careful not to damage crankshaft and cylinder block.**

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

**CAUTION:**

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

17. Remove oil jet.

## ASSEMBLY

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

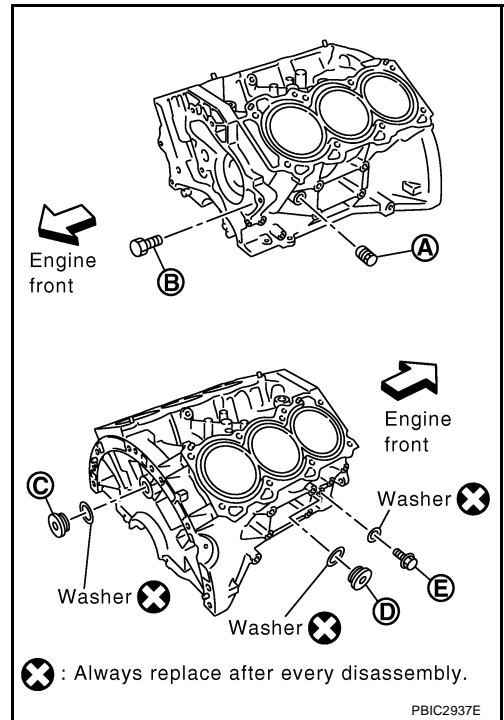
**CAUTION:**

**Use a goggles to protect your eye.**

# CYLINDER BLOCK

[VQ]

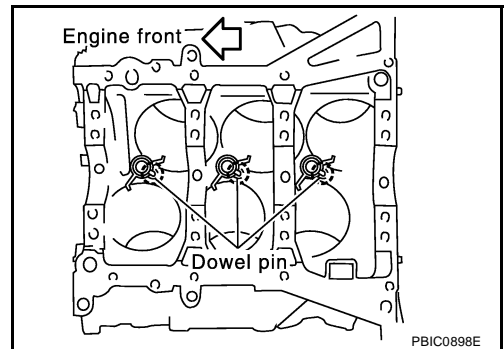
2. Install each plug to cylinder block as shown in the figure.
  - Apply sealant to the thread of water drain plugs “A” and “B”.  
**Use Genuine Liquid Gasket or equivalent.**
  - Apply sealant to the thread of plugs “C” and “E”.  
**Use Genuine Thread Locking Sealant or equivalent.**
  - Apply sealant to the thread of plug “D”.  
**Use Anaerobic Liquid Gasket or equivalent.**
  - Replace washers with new one.



- Tighten each plug as specified below.

Part	Washer	Tightening torque
A	No	19.6 N·m (2.0 kg·m, 14 ft·lb)
B	No	Reuse: 9.8 N·m (1.0 kg·m, 87 in·lb)
		New: 6.0 N·m (0.61 kg·m, 53 in·lb)
C	Yes	78 N·m (8.0 kg·m, 58 ft·lb)
D	Yes	62 N·m (6.3 kg·m, 46 ft·lb)
E	Yes	12.3 N·m (1.3 kg·m, 9 ft·lb)

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

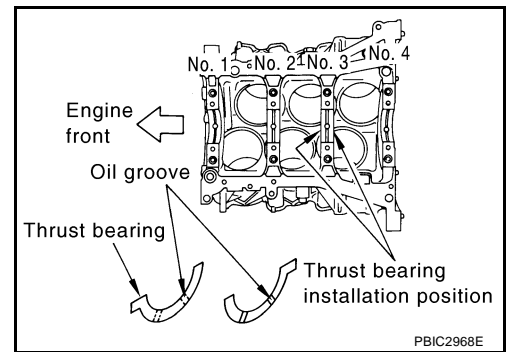


4. Install main bearings and thrust bearings as follows:
  - a. Remove dust, dirt, and engine oil on bearing mating surfaces of cylinder block and lower cylinder block.

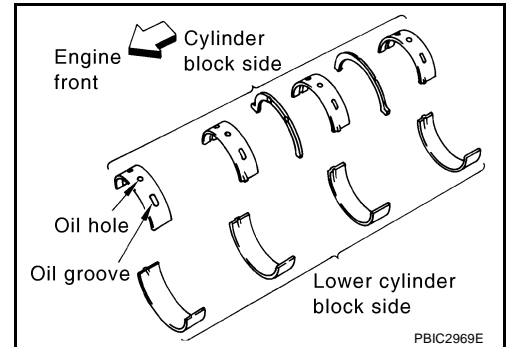
# CYLINDER BLOCK

[VQ]

- b. Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block.
- Install thrust bearings with the oil groove facing crankshaft arm (outside).
  - Install thrust bearing with a projection on one end on cylinder block, and thrust bearing with a projection at center on lower cylinder block. Align each projection with mating notch.



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



5. Install crankshaft to cylinder block.
- While turning crankshaft by hand, check that it turns smoothly.
6. Inspect the outer diameter of lower cylinder block bolt. Refer to [EM-132. "LOWER CYLINDER BLOCK BOLT OUTER DIAMETER"](#).
7. Install lower cylinder block as follows:

**NOTE:**

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

- a. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000] to lower cylinder block as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

**CAUTION:**

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

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

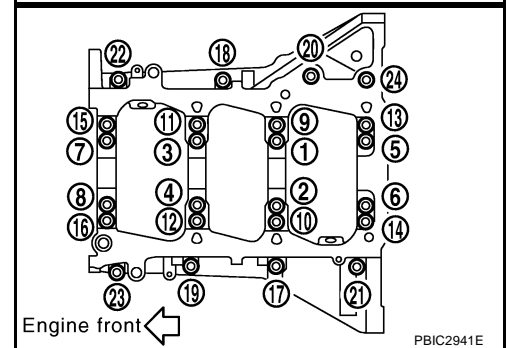
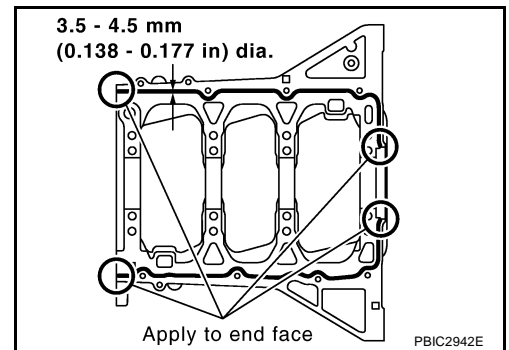
: 22.1 N·m (2.3 kg·m, 16 ft·lb)

**CAUTION:**

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

**NOTE:**

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



- c. Install rear oil seal. Refer to [EM-89. "Removal and Installation of Rear Oil Seal"](#).
- d. Restart tightening of lower cylinder block bolts as follows:

# CYLINDER BLOCK

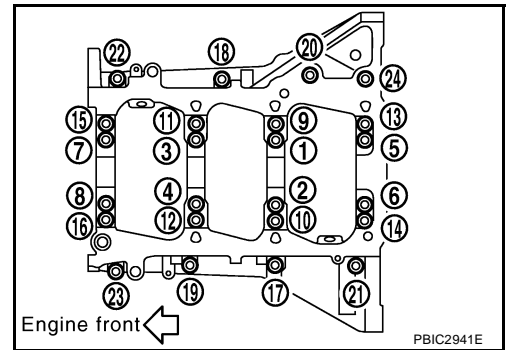
[VQ]

- i. Tighten M10 bolts in numerical order from No. 1 to 16 in the figure.

**NOTE:**

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

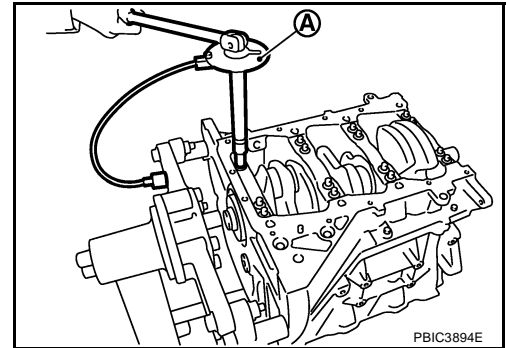
: 35.3 N·m (3.6 kg·m, 26 ft·lb)



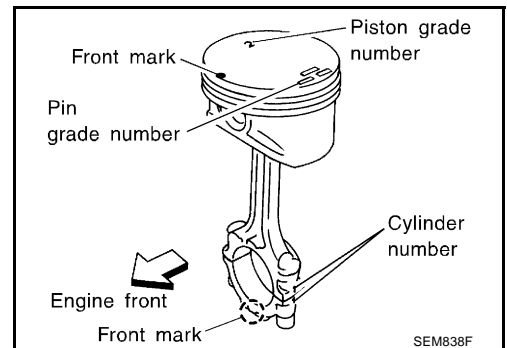
- ii. Turn M10 bolts 90 degrees clockwise (angle tightening) in numerical order from No. 1 to 16 in the figure.

**CAUTION:**

Use angle wrench (A) [SST: KV10112100] to check tightening angle. Do not make judgement by visual inspection.



- After installing the mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
  - Wipe off completely any protruding liquid gasket on front side of the engine.
  - Check the crankshaft end play. Refer to [EM-124, "CRANKSHAFT END PLAY"](#).
8. Inspect the outer diameter of connecting rod bolt. Refer to [EM-133, "CONNECTING ROD BOLT OUTER DIAMETER"](#).
9. Install piston to connecting rod as follows:
- a. Using snap ring pliers, install new snap ring to the groove of piston rear side.
    - Insert it fully into groove to install.
  - b. Install piston to connecting rod.
    - Using industrial use drier or similar tool, heat piston until piston pin can be pushed in by hand without excess force [approx. 60 to 70 °C (140 to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.
    - Assemble so that the front mark on the piston head and the cylinder number on connecting rod are positioned as shown in the figure.
  - c. Install new snap ring to the groove of the piston front side.
    - Insert it fully into groove to install.
    - After installing, make sure that connecting rod moves smoothly.



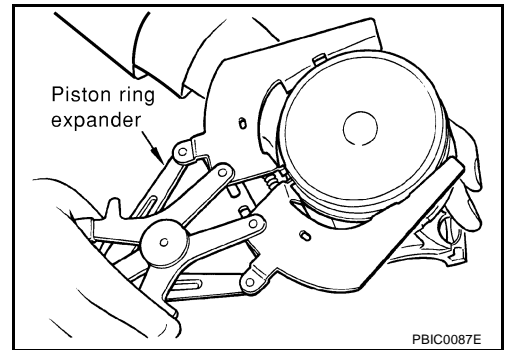
# CYLINDER BLOCK

[VQ]

10. Using piston ring expander (commercial service tool), install piston rings.

**CAUTION:**

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



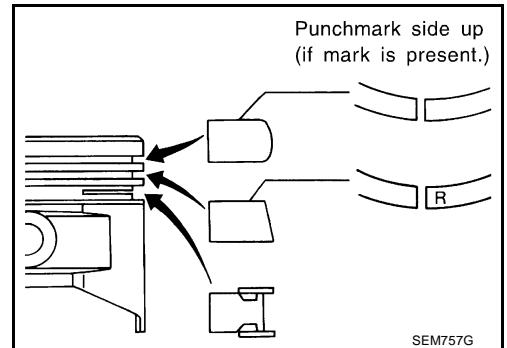
- If there is stamped mark on ring, mount it with marked side up.

**NOTE:**

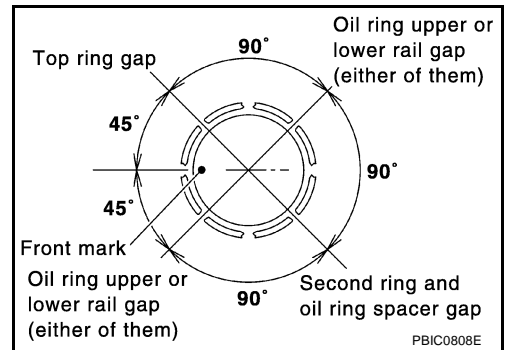
If there is no stamp on ring, no specific orientation is required for installation.

**Stamped mark:**

- Top ring : —
- Second ring : R



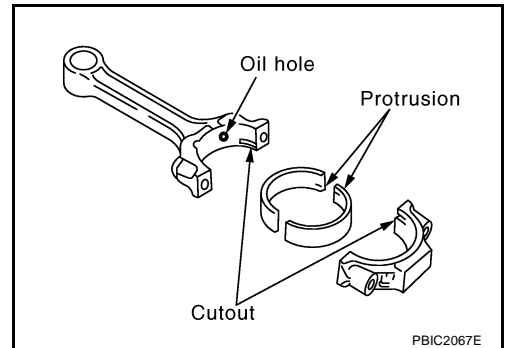
- Position each ring with the gap as shown in the figure referring to the piston front mark.



- Check the piston ring side clearance. Refer to [EM-125, "PISTON RING SIDE CLEARANCE"](#) .

11. Install connecting rod bearings to connecting rod and connecting rod bearing cap.

- Before installing connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- When installing, align connecting rod bearing stopper protrusion with cutout of connecting rods and connecting rod bearing caps to install.
- Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.



12. Install piston and connecting rod assembly to crankshaft.

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin journal.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Be sure that front mark on piston head is facing front of engine.



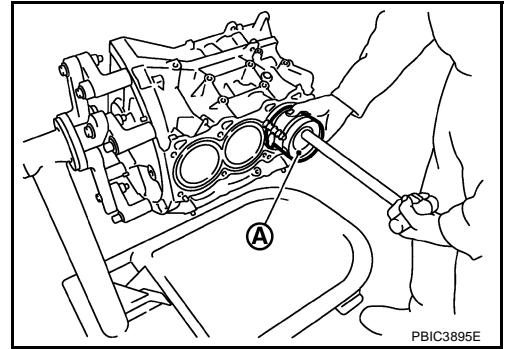
# CYLINDER BLOCK

[VQ]

- Using piston ring compressor (A) [SST: EM03470000] or suitable tool, install piston with the front mark on the piston head facing the front of engine.

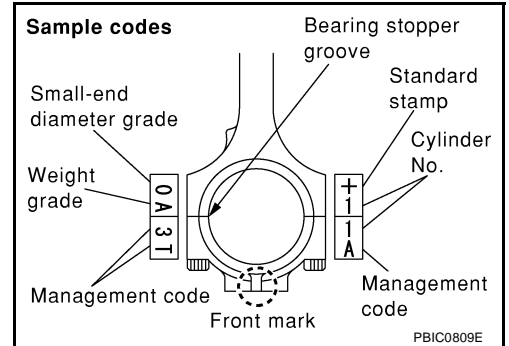
**CAUTION:**

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



13. Install connecting rod bearing cap.

- Match the stamped cylinder number marks on connecting rod with those on connecting rod bearing cap to install.
- Be sure that front mark on connecting rod bearing cap is facing front of engine.



14. Tighten connecting rod bolts as follows:

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

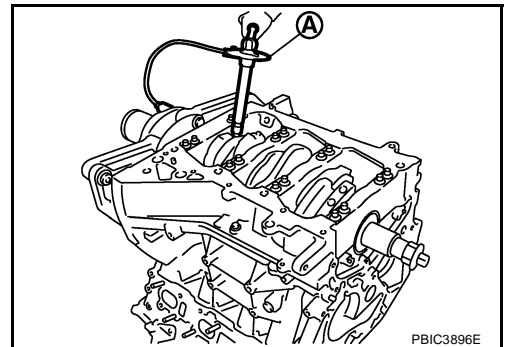
: 19.6 N·m (2.0 kg·m, 14 ft·lb)

- c. Then tighten all connecting rod bolts 90 degrees clockwise (Angle tightening).

**CAUTION:**

Always use angle wrench (A) [SST: KV10112100]. Avoid tightening based on visual check alone.

- After tightening connecting rod bolts, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-124, "CONNECTING ROD SIDE CLEARANCE"](#).

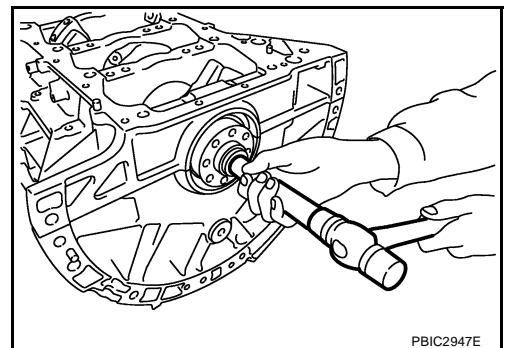


15. Install pilot bushing (M/T models) or pilot converter (A/T models).

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

**Pilot bushing** : Approx. 17 mm (0.67 in)

**Pilot converter** : Approx. 33 mm (1.30 in)

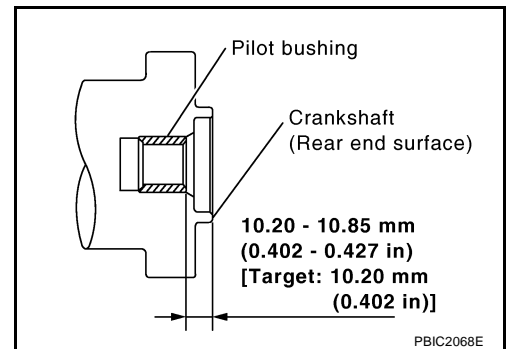




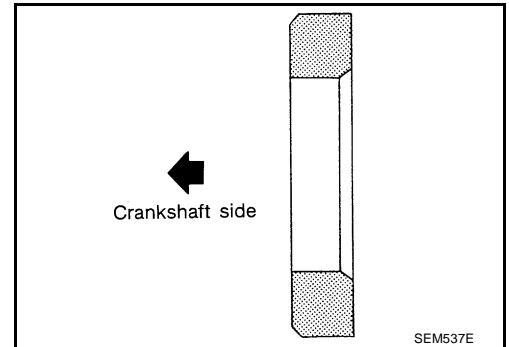
# CYLINDER BLOCK

[VQ]

- Press-fit pilot bushing as the dimension in the figure. (M/T models)



- Press-fit pilot converter with its chamfer facing crankshaft as shown in the figure. (A/T models)



## 16. Install knock sensors.

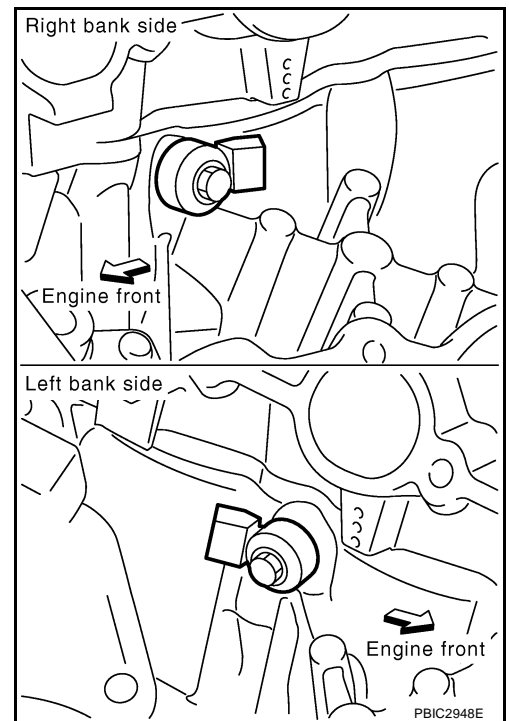
- Install knock sensor so that connector faces rear of engine.
- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

### CAUTION:

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

### NOTE:

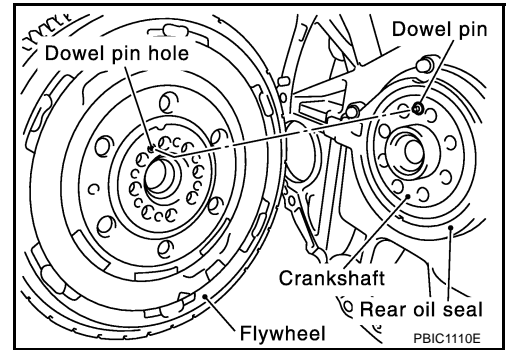
- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Make sure that knock sensor does not interfere with other parts.



- 17. Note the following, assemble in the reverse order of disassembly after this step.

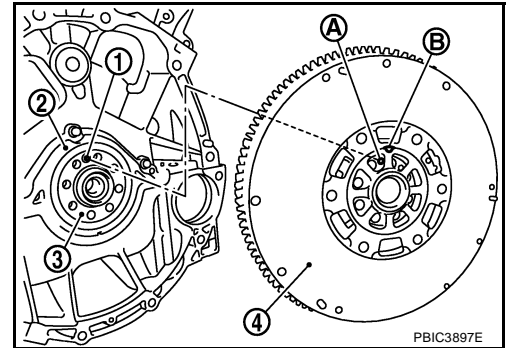
## Flywheel (M/T models)

- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin hole.

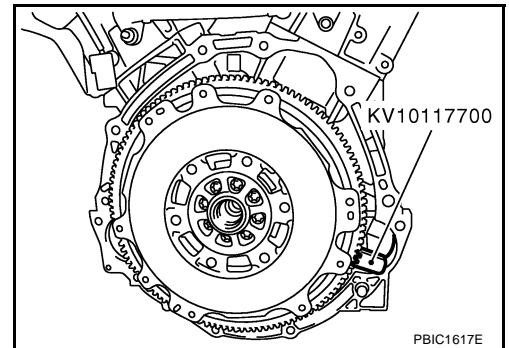


- There is a mating mark (B) on the clutch cover side of flywheel(4). Refer it during installation.

- 1 : Dowel pin
- 2 : Rear oil seal
- 3 : Crankshaft
- A : Dowel pin hole

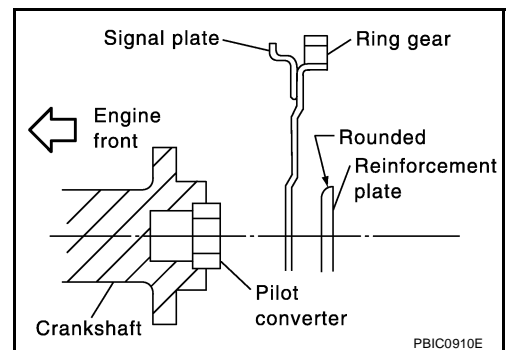


- Holding ring gear with ring gear stopper [SST], tighten securing bolts with TORX socket (size: T55, commercial service tool).
- Tighten mounting bolts crosswise over several times.



## Drive plate (A/T models)

- Install drive plate and reinforcement plate as shown in the figure.
- Holding ring gear with ring gear stopper [SST: KV10117700].
- Tighten mounting bolts crosswise over several times.



# CYLINDER BLOCK

[VQ]

GBS000H4

## How to Select Piston and Bearing DESCRIPTION

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block and piston	Piston and piston pin assembly (Piston is available together with piston pin as assembly.)	Piston grade (piston skirt diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
Between piston and connecting rod*	—	—	—

\*: For the service parts, the grade for fitting cannot be selected between piston pin and connecting rod. (Only "0" grade is available.) The information at the shipment from the plant is described as a reference.

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

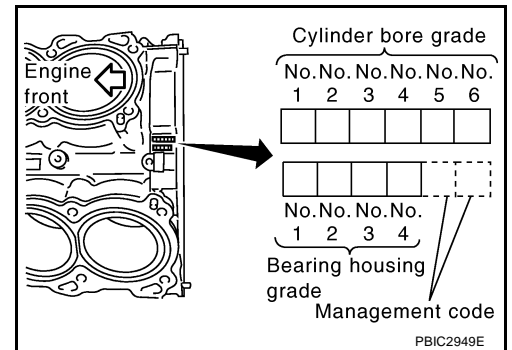
### HOW TO SELECT PISTON

#### When New Cylinder Block is Used

Check the cylinder bore grade ("1", "2", or "3") on rear side of cylinder block, and select piston of the same grade.

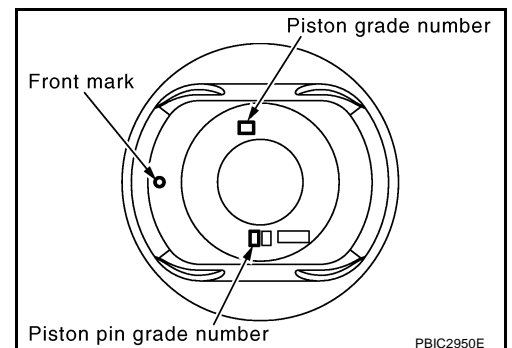
#### NOTE:

Piston is available with piston pin as a set for the service part. (Only "0" grade piston pin is available.)



#### When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to [EM-128, "Cylinder Bore Inner Diameter"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".



3. Select piston of the same grade.

# CYLINDER BLOCK

[VQ]

## Piston Selection Table

Unit: mm (in)

Grade	1	2 (or no mark)	3
Cylinder bore inner diameter	95.500 - 95.510 (3.7598 - 3.7602)	95.510 - 95.520 (3.7602 - 3.7606)	95.520 - 95.530 (3.7606 - 3.7610)
Piston skirt diameter	95.480 - 95.490 (3.7590 - 3.7594)	95.490 - 95.500 (3.7594 - 3.7598)	95.500 - 95.510 (3.7598 - 3.7602)

### NOTE:

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

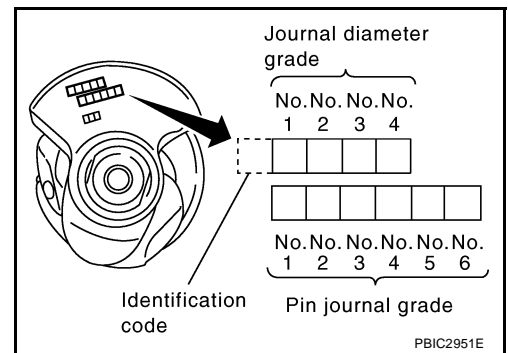
## HOW TO SELECT CONNECTING ROD BEARING

### When New Connecting Rod and Crankshaft are Used

Check pin journal grade ("0", "1", or "2") on front of crankshaft, and select connecting rod bearing of the same grade.

### NOTE:

There is no grading for connecting rod big end diameter.



### When Crankshaft and Connecting Rod are Reused

1. Measure the connecting rod big end diameter. Refer to [EM-126, "CONNECTING ROD BIG END DIAMETER"](#).
2. Make sure that the connecting rod big end diameter is within the standard value.
3. Measure the crankshaft pin journal diameter. Refer to [EM-130, "CRANKSHAFT PIN JOURNAL DIAMETER"](#).
4. Determine the grade of crankshaft pin journal grade by corresponding to the measured dimension in "Crankshaft pin journal diameter" column of "Connecting Rod Bearing Selection Table".
5. Select connecting rod bearing of the same grade.

## Connecting Rod Bearing Selection Table

Unit: mm (in)

Connecting rod big end diameter	57.000 - 57.013 (2.2441 - 2.2446)
---------------------------------	-----------------------------------

Unit: mm (in)

Crankshaft		Connecting rod bearing		
Crankshaft pin journal diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
53.968 - 53.974 (2.1247 - 2.1250)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
53.962 - 53.968 (2.1245 - 2.1247)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
53.956 - 53.962 (2.1242 - 2.1245)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

## Undersize Bearings Usage Guide

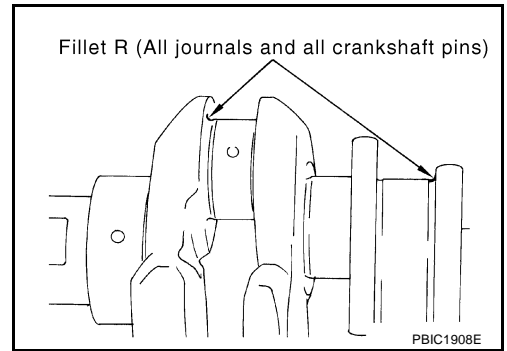
- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

# CYLINDER BLOCK

[VQ]

**CAUTION:**

In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].



A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

**Bearing undersize table**

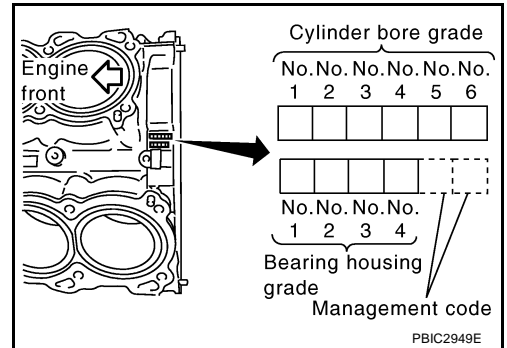
Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

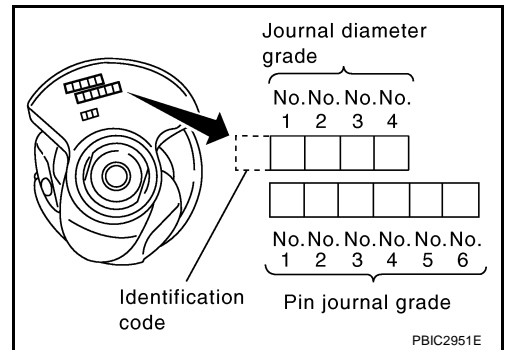
**HOW TO SELECT MAIN BEARING**

**When New Cylinder Block and Crankshaft are Used**

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



2. "Main Bearing Selection Table" columns correspond to journal diameter grade on front side of crankshaft.



3. Select main bearing grade at the point where selected row and column meet in "Main Bearing Selection Table".

**When Cylinder Block and Crankshaft are Reused**

1. Measure cylinder block main bearing housing inner diameter and crankshaft main journal diameter. Refer to [EM-128, "MAIN BEARING HOUSING INNER DIAMETER"](#) and [EM-129, "CRANKSHAFT MAIN JOURNAL DIAMETER"](#).
2. Correspond the measured dimension in "Cylinder block main bearing housing inner diameter" row of "Main Bearing Selection Table".
3. Correspond the measured dimension in "Crankshaft main journal diameter" column of "Main Bearing Selection Table".
4. Select main bearing grade at the point where selected row and column meet in following selection table.

# CYLINDER BLOCK

[VQ]

**Main Bearing Selection Table**

Cylinder block main bearing housing inner diameter Unit: mm (in)  Crankshaft main journal diameter Unit: mm (in)		Hole diameter																								
		Mark																								
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7	
		74.993 - 74.994 (2.9525 - 2.9525) 74.994 - 74.995 (2.9525 - 2.9526) 74.995 - 74.996 (2.9526 - 2.9526) 74.996 - 74.997 (2.9526 - 2.9526) 74.997 - 74.998 (2.9526 - 2.9527) 74.998 - 74.999 (2.9527 - 2.9527) 74.999 - 75.000 (2.9527 - 2.9528) 75.000 - 75.001 (2.9528 - 2.9528) 75.001 - 75.002 (2.9528 - 2.9528) 75.002 - 75.003 (2.9528 - 2.9529) 75.003 - 75.004 (2.9529 - 2.9529) 75.004 - 75.005 (2.9529 - 2.9529) 75.005 - 75.006 (2.9529 - 2.9530) 75.006 - 75.007 (2.9530 - 2.9530) 75.007 - 75.008 (2.9530 - 2.9531) 75.008 - 75.009 (2.9531 - 2.9531) 75.009 - 75.010 (2.9531 - 2.9531) 75.010 - 75.011 (2.9531 - 2.9532) 75.011 - 75.012 (2.9532 - 2.9532) 75.012 - 75.013 (2.9532 - 2.9533) 75.013 - 75.014 (2.9533 - 2.9533) 75.014 - 75.015 (2.9533 - 2.9533) 75.015 - 75.016 (2.9533 - 2.9534) 75.016 - 75.017 (2.9534 - 2.9534)																								
Mark	Axle diameter																									
A	69.975 - 69.974 (2.7549 - 2.7549)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	
B	69.974 - 69.973 (2.7549 - 2.7548)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
C	69.973 - 69.972 (2.7548 - 2.7548)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
D	69.972 - 69.971 (2.7548 - 2.7548)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4
E	69.971 - 69.970 (2.7548 - 2.7547)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45
F	69.970 - 69.969 (2.7547 - 2.7547)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45
G	69.969 - 69.968 (2.7547 - 2.7546)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45
H	69.968 - 69.967 (2.7546 - 2.7546)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5
J	69.967 - 69.966 (2.7546 - 2.7546)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5
K	69.966 - 69.965 (2.7546 - 2.7545)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5
L	69.965 - 69.964 (2.7545 - 2.7545)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56
M	69.964 - 69.963 (2.7545 - 2.7544)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56
N	69.963 - 69.962 (2.7544 - 2.7544)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56
P	69.962 - 69.961 (2.7544 - 2.7544)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6
R	69.961 - 69.960 (2.7544 - 2.7543)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6
S	69.960 - 69.959 (2.7543 - 2.7543)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
T	69.959 - 69.958 (2.7543 - 2.7542)	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
U	69.958 - 69.957 (2.7542 - 2.7542)	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67
V	69.957 - 69.956 (2.7542 - 2.7542)	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67
W	69.956 - 69.955 (2.7542 - 2.7541)	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	7
X	69.955 - 69.954 (2.7541 - 2.7541)	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	7	7
Y	69.954 - 69.953 (2.7541 - 2.7540)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7
4	69.953 - 69.952 (2.7540 - 2.7540)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	X
7	69.952 - 69.951 (2.7540 - 2.7540)	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	X	X

WBIA0625E

# CYLINDER BLOCK

[VQ]

**Main Bearing Grade Table (All Journals)**

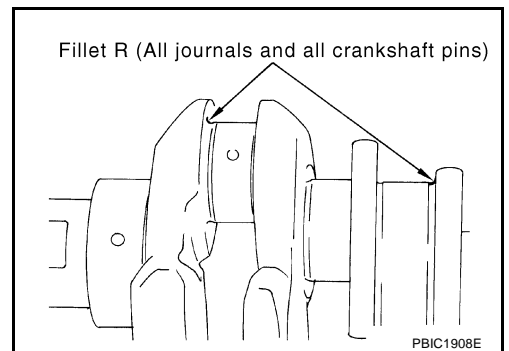
Grade number	Thickness Unit: mm (in)	Width Unit: mm (in)	Identification color	Remarks	
0	2.500 - 2.503 (0.0984 - 0.0985)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.	
1	2.503 - 2.506 (0.0985 - 0.0987)		Brown		
2	2.506 - 2.509 (0.0987 - 0.0988)		Green		
3	2.509 - 2.512 (0.0988 - 0.0989)		Yellow		
4	2.512 - 2.515 (0.0989 - 0.0990)		Blue		
5	2.515 - 2.518 (0.0990 - 0.0991)		Pink		
6	2.518 - 2.521 (0.0991 - 0.0993)		Purple		
7	2.521 - 2.524 (0.0993 - 0.0994)		White	Grade is different for upper and lower bearings.	
01	UPR		2.503 - 2.506 (0.0985 - 0.0987)		Brown
	LWR		2.500 - 2.503 (0.0984 - 0.0985)		Black
12	UPR		2.506 - 2.509 (0.0987 - 0.0988)		Green
	LWR		2.503 - 2.506 (0.0985 - 0.0987)		Brown
23	UPR		2.509 - 2.512 (0.0988 - 0.0989)		Yellow
	LWR		2.506 - 2.509 (0.0987 - 0.0988)		Green
34	UPR	2.512 - 2.515 (0.0989 - 0.0990)	Blue		
	LWR	2.509 - 2.512 (0.0988 - 0.0989)	Yellow		
45	UPR	2.515 - 2.518 (0.0990 - 0.0991)	Pink		
	LWR	2.512 - 2.515 (0.0989 - 0.0990)	Blue		
56	UPR	2.518 - 2.521 (0.0991 - 0.0993)	Purple		
	LWR	2.515 - 2.518 (0.0990 - 0.0991)	Pink		
67	UPR	2.521 - 2.524 (0.0993 - 0.0994)	White		
	LWR	2.518 - 2.521 (0.0991 - 0.0993)	Purple		

**Undersize Bearing Usage Guide**

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use underside (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

**CAUTION:**

**In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].**



**Bearing undersize table**

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.633 - 2.641 (0.1037 - 0.1040)

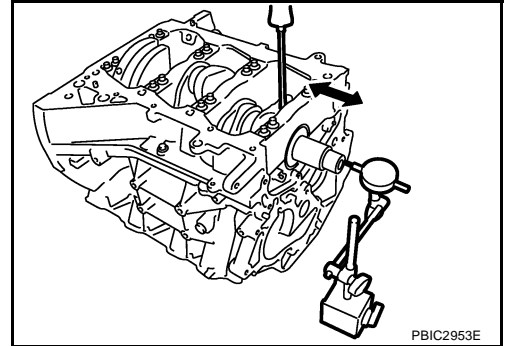
## Inspection After Disassembly CRANKSHAFT END PLAY

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

**Standard : 0.14 - 0.22 mm (0.0055 - 0.0087 in)**

**Limit : 0.30 mm (0.0118 in)**

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



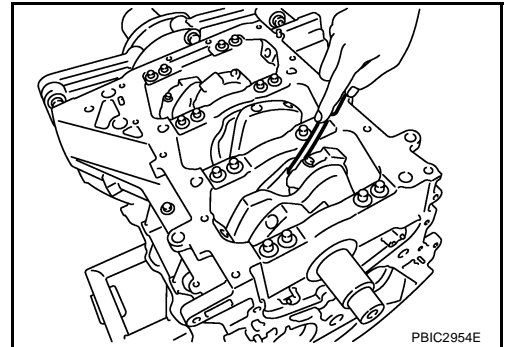
## CONNECTING ROD SIDE CLEARANCE

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

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

**Limit : 0.40 mm (0.0157 in)**

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

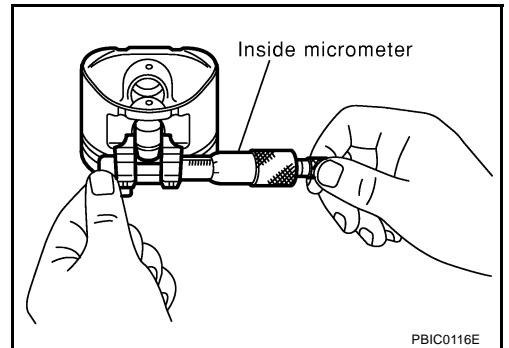


## PISTON TO PISTON PIN OIL CLEARANCE

### Piston Pin Hole Diameter

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

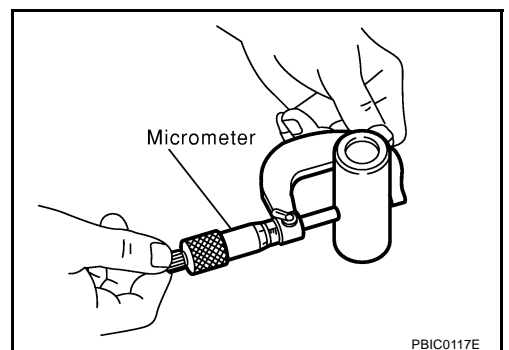
**Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)**



### Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

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



### Piston to Piston Pin Oil Clearance

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

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

- If the calculated value is out of the standard, replace piston and piston pin assembly.



- When replacing piston and piston pin assembly, refer to [EM-119, "HOW TO SELECT PISTON"](#) .

**NOTE:**

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

**PISTON RING SIDE CLEARANCE**

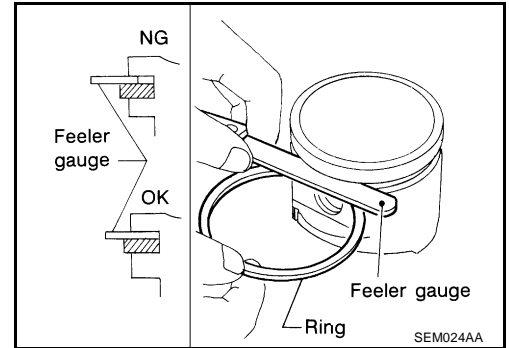
- Measure side clearance of piston ring and piston ring groove with feeler gauge.

**Standard:**

- Top ring** : 0.045 - 0.080 mm (0.0018 - 0.0031 in)
- 2nd ring** : 0.030 - 0.070 mm (0.0012 - 0.0028 in)
- Oil ring** : 0.065 - 0.135 mm (0.0026 - 0.0053 in)

**Limit:**

- Top ring** : 0.11 mm (0.0043 in)
- 2nd ring** : 0.10 mm (0.0039 in)



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

**PISTON RING END GAP**

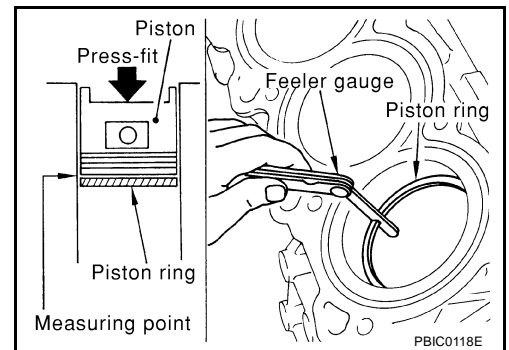
- Make sure that the cylinder bore inner diameter is within the specification. Refer to [EM-128, "Cylinder Bore Inner Diameter"](#) .
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure the piston ring end gap with feeler gauge.

**Standard:**

- Top ring** : 0.23 - 0.33 mm (0.0091 - 0.0130 in)
- 2nd ring** : 0.33 - 0.48 mm (0.0130 - 0.0189 in)
- Oil ring** : 0.20 - 0.50 mm (0.0079 - 0.0197 in)

**Limit:**

- Top ring** : 0.56 mm (0.0220 in)
- 2nd ring** : 0.68 mm (0.0268 in)
- Oil ring** : 0.85 mm (0.0335 in)



- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, re-bore cylinder and use oversize piston and piston rings.

## CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner.

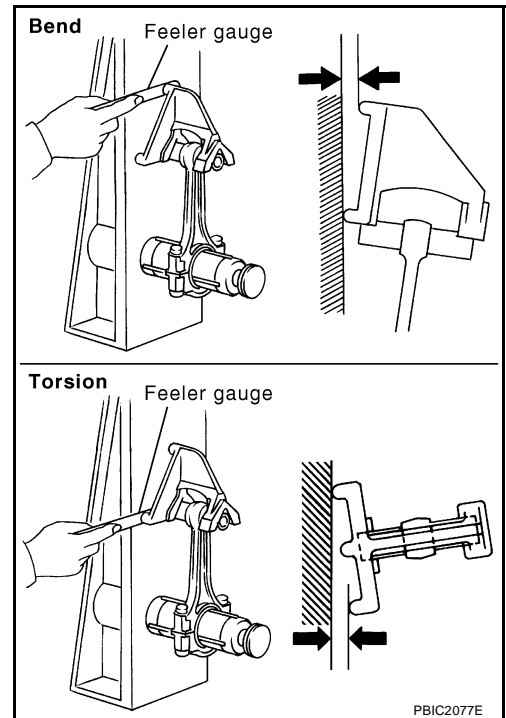
### Bend:

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

### Torsion:

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

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

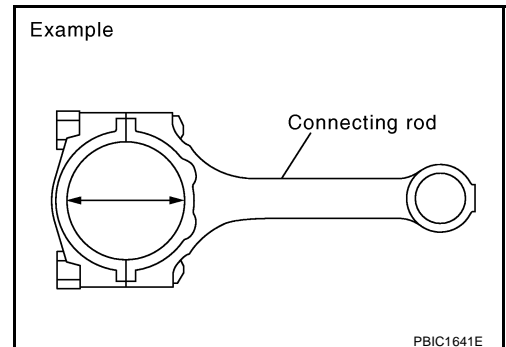


## CONNECTING ROD BIG END DIAMETER

- Install connecting rod bearing cap without installing connecting rod bearing, and tightening connecting rod bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of connecting rod big end with inside micrometer.

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

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

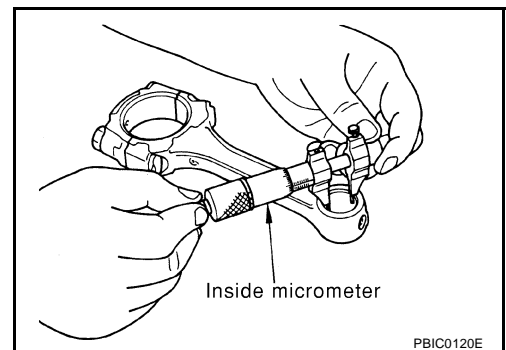


## CONNECTING ROD BUSHING OIL CLEARANCE

### Connecting Rod Bushing Inner Diameter

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

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



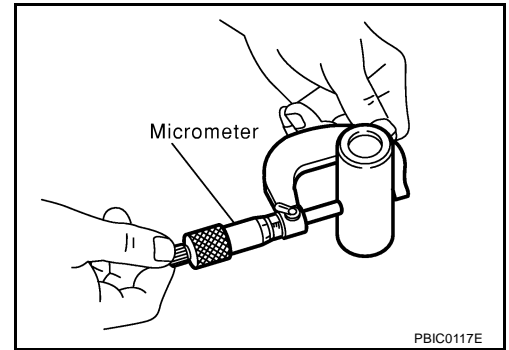
# CYLINDER BLOCK

[VQ]

## Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

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



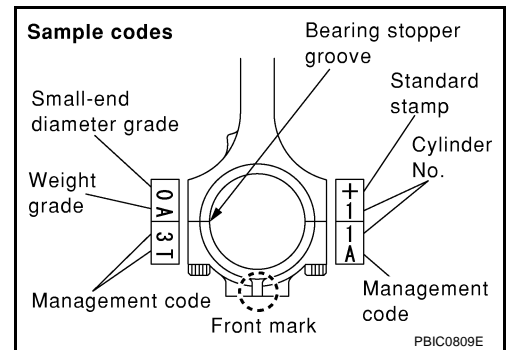
## Connecting Rod Bushing Oil Clearance

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

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

**Limit : 0.030 mm (0.0012 in)**

- If the calculated value exceeds the limit, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to [EM-119, "HOW TO SELECT PISTON"](#).
- If replacing connecting rod assembly, refer to [EM-130, "CONNECTING ROD BEARING OIL CLEARANCE"](#) to select the connecting rod bearing.

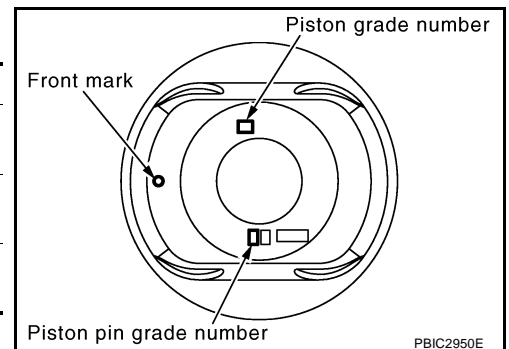


## Factory installed parts grading:

- Service parts apply only to grade "0".

Grade	Unit: mm (in)	
	0	1
Connecting rod bushing inner diameter *	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)

\*: After installing in connecting rod



## CYLINDER BLOCK DISTORTION

- Using scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

### CAUTION:

**Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.**

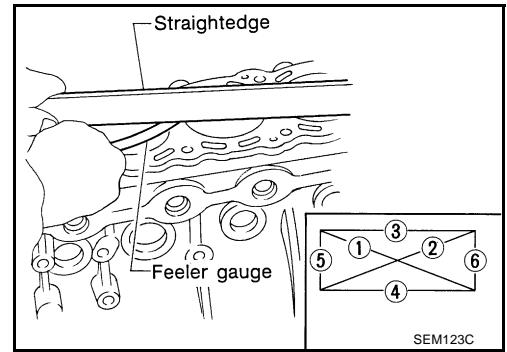
# CYLINDER BLOCK

[VQ]

- Measure the distortion on the cylinder block upper face at some different points in six directions with straightedge and feeler gauge.

**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace cylinder block.



## MAIN BEARING HOUSING INNER DIAMETER

- Install lower cylinder block without installing main bearings, and tighten lower cylinder block bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

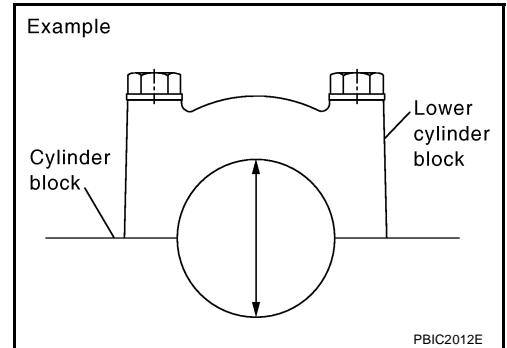
- Measure the inner diameter of main bearing housing with bore gauge.

**Standard : 74.993 - 75.017 mm (2.9525 - 2.9534 in)**

- If out of the standard, replace cylinder block and lower cylinder block as assembly.

### NOTE:

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



## PISTON TO CYLINDER BORE CLEARANCE

### Cylinder Bore Inner Diameter

- Using bore gauge, measure cylinder bore for wear, out-of-round and taper at six different points on each cylinder. ("X" and "Y" directions at "A", "B" and "C") ("X" is in longitudinal direction of engine)

**Standard inner diameter:**

**95.500 - 95.530 mm (3.7598 - 3.7610 in)**

**Out-of-round (Difference between "X" and "Y"):**

**0.015 mm (0.0006 in)**

**Taper limit (Difference between "A" and "C"):**

**0.01 mm (0.0004 in)**

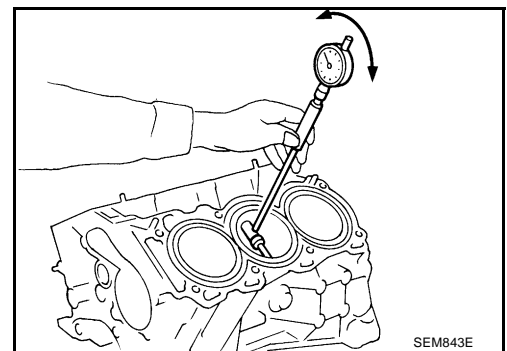
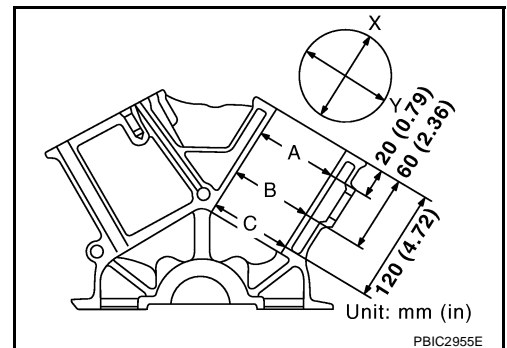
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or re-bore the inner wall.

- Oversize piston is provided. When using oversize piston, re-bore cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.

### CAUTION:

**When using oversize piston, use oversize pistons for all cylinders with oversize piston rings.**

**Oversize (OS) : 0.2 mm (0.008 in)**



## Piston Skirt Diameter

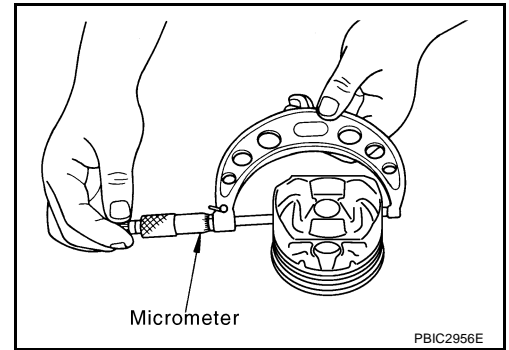
Measure the outer diameter of piston skirt with micrometer.

### Measure point

: Distance from the top 43.03 mm (1.6941 in)

### Standard

: 95.480 - 95.510 mm (3.7590 - 3.7602 in)



## Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction "Y", position "B").  
 (Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter).

**Standard** : 0.010 - 0.030 mm (0.0004 - 0.0012 in)

**Limit** : 0.08 mm (0.0031 in)

- If the calculated value exceeds the limit, replace piston and piston pin assembly. Refer to [EM-119, "HOW TO SELECT PISTON"](#).

## Re-boring Cylinder Bore

1. Cylinder bore size is determined by adding piston to cylinder bore clearance to piston skirt diameter.

**Re-bored size calculation:  $D = A + B - C$**

where,

**D: Bored diameter**

**A: Piston skirt diameter as measured**

**B: Piston to cylinder bore clearance (standard value)**

**C: Honing allowance 0.02 mm (0.0008 in)**

2. Install lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

### NOTE:

- When any cylinder needs boring, all other cylinders must also be bored.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.

4. Hone cylinders to obtain the specified piston to cylinder bore clearance.
5. Measure finished the cylinder bore for out-of-round and taper.

### NOTE:

Measurement should be done after cylinder bore cools down.

## CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with micrometer.

**Standard** : 69.951 - 69.975 mm (2.7540 - 2.7549 in) dia.

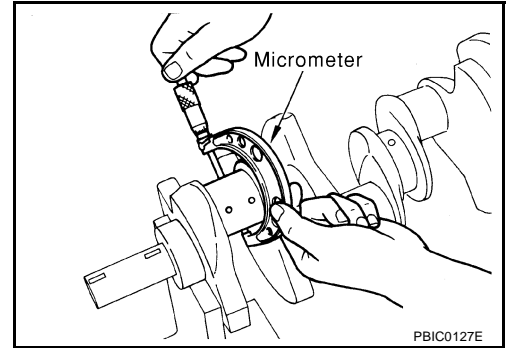
- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-131, "MAIN BEARING OIL CLEARANCE"](#).

## CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard : 53.956 - 53.974 mm (2.1242 - 2.1250 in) dia.**

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-130, "CONNECTING ROD BEARING OIL CLEARANCE"](#).



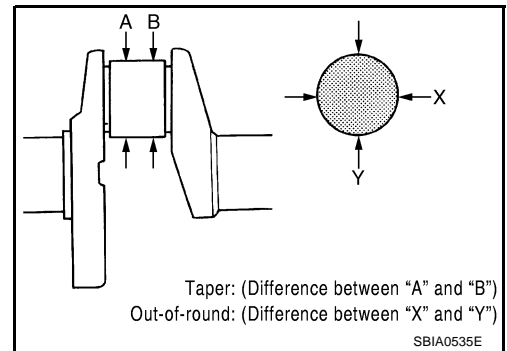
## CRANKSHAFT OUT-OF-ROUND AND TAPER

- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with micrometer.
- Out-of-round is indicated by the difference in the dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in the dimensions between "A" and "B" at "X" and "Y".

**Limit:**

**Out-of-round (Difference between "X" and "Y")  
: 0.002 mm (0.0001 in)**

**Taper (Difference between "A" and "B")  
: 0.002 mm (0.0001 in)**



- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select the main bearing and/or connecting rod bearing. Refer to [EM-131, "MAIN BEARING OIL CLEARANCE"](#) and/or [EM-130, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

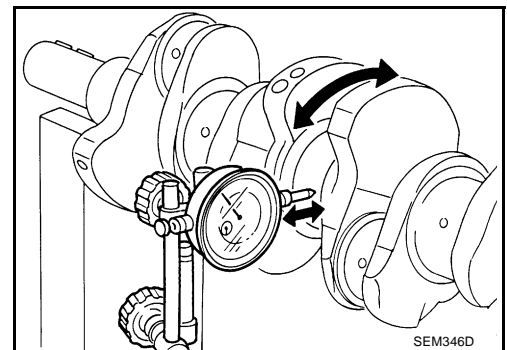
## CRANKSHAFT RUNOUT

- Place V-block on precise flat table, and support the journals on the both end of crankshaft.
- Place dial indicator straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on dial indicator. (Total indicator reading)

**Standard : Less than 0.05 mm (0.0020 in)**

**Limit : 0.10 mm (0.0039 in)**

- If it exceeds the limit, replace crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

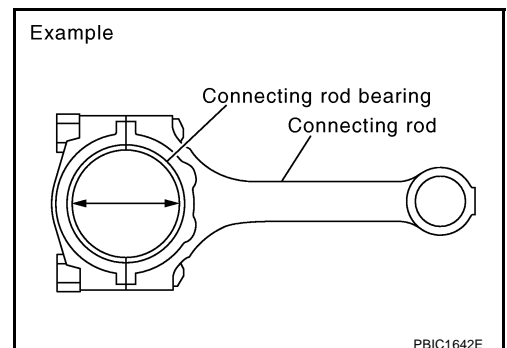
### Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of connecting rod bearing with inside micrometer.

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

**Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 in)  
(actual clearance)**

**Limit : 0.070 mm (0.0028 in)**



- If the calculated value exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to [EM-120, "HOW TO SELECT CONNECTING ROD BEARING"](#).

## Method of Using Plastigage

- Remove oil and dust on crankshaft pin journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

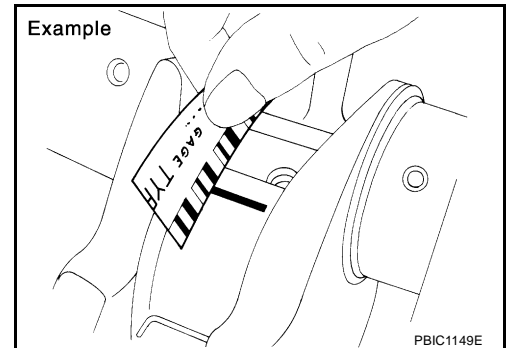
**CAUTION:**

**Do not rotate crankshaft.**

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

**NOTE:**

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



## MAIN BEARING OIL CLEARANCE

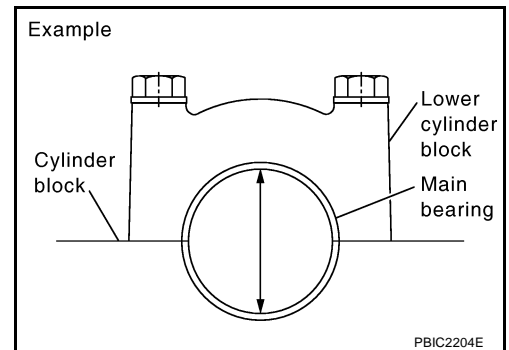
### Method by Calculation

- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing with bore gauge.  
(Bearing clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

**Standard** : 0.035 - 0.045 mm (0.0014 - 0.0018 in)  
(actual clearance)

**Limit** : 0.065 mm (0.0026 in)

- If the calculated value exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-121, "HOW TO SELECT MAIN BEARING"](#).



### Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

**CAUTION:**

**Do not rotate crankshaft.**

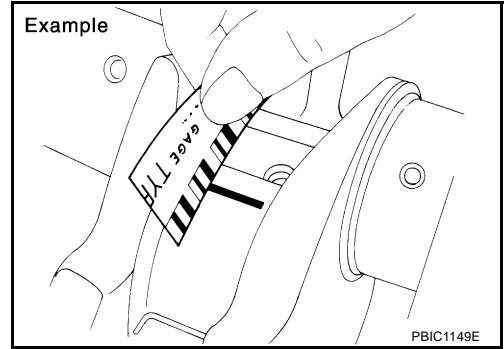
# CYLINDER BLOCK

[VQ]

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

**NOTE:**

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".

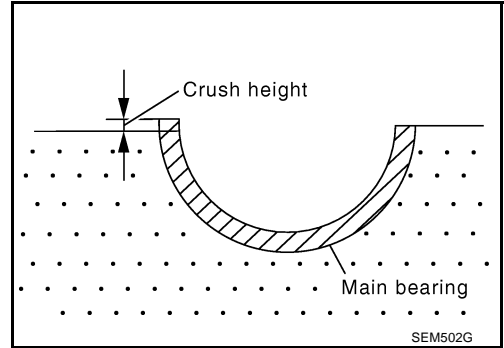


## CRUSH HEIGHT OF MAIN BEARING

- When lower cylinder block is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

**Standard** : There must be crush height.

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

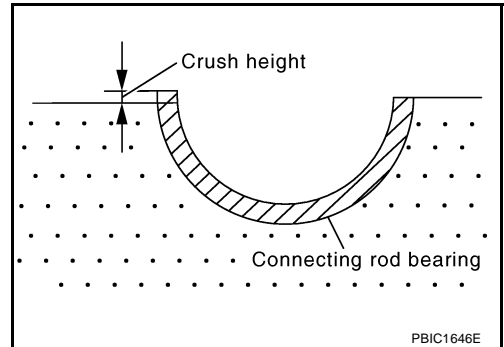


## CRUSH HEIGHT OF CONNECTING ROD BEARING

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

**Standard** : There must be crush height.

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

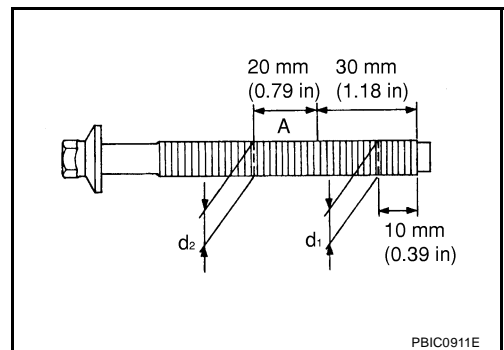


## LOWER CYLINDER BLOCK BOLT OUTER DIAMETER

- Measure the outer diameters ("d1", "d2") at two positions as shown in the figure.
- If reduction appears in "A" range, regard it as "d2".

**Limit ("d1" - "d2")** : 0.11 mm (0.0051 in)

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



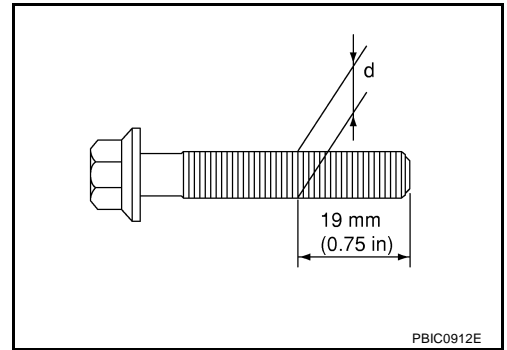


## CONNECTING ROD BOLT OUTER DIAMETER

- Measure the outer diameter “d” at position shown in the figure.
- If the reduction appears in a position other than “d”, regard it as “d”.

**Limit : 7.75 mm (0.3051 in)**

- When “d” exceeds the limit (when it becomes thinner), replace connecting rod bolt with new one.

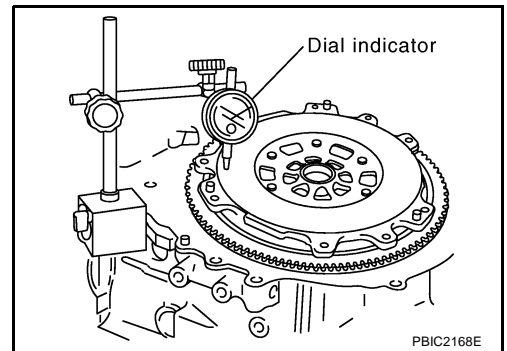


## FLYWHEEL DEFLECTION (M/T MODELS)

- Measure the deflection of flywheel contact surface to clutch with dial indicator.
- Measure the deflection at 250 mm (9.84 in) dia.

**Standard : 0.45 mm (0.0177 in) or less**

- If the measured value is out of the standard, replace flywheel.



## MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

### CAUTION:

Do not disassemble double mass flywheel.

### Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

**Standard : 1.3 mm (0.051 in) or less**

- If the measured value is out of the standard, replace flywheel.

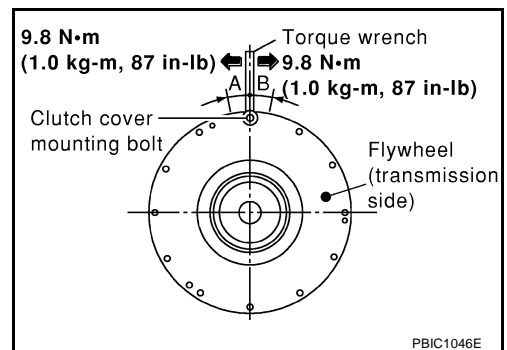
### Movement Amount of Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction as follows:

1. Install bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
  - Tighten bolt at a force of 9.8 N·m (1.0 kg·m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg·m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure dimensions of movement amounts “A” and “B” on circumference of flywheel on the transmission side.

**Standard : 24 mm (0.94 in) or less**

- If the measured value is out of the standard, replace flywheel.

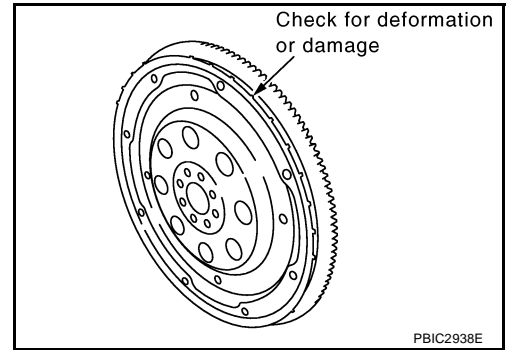


## DRIVE PLATE (A/T MODELS)

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

### CAUTION:

- Do not disassemble drive plate.
- Do not place drive plate with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.
- If anything is found, replace drive plate.

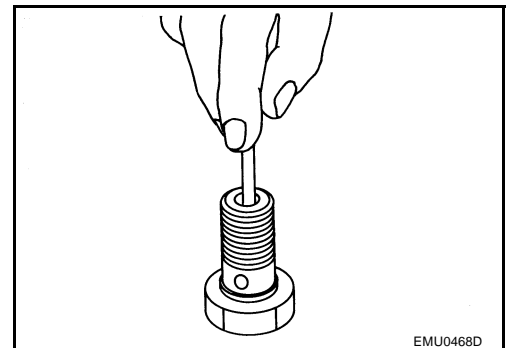


## OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, clean or replace oil jet.

## OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not satisfied, replace oil jet relief valve.



# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

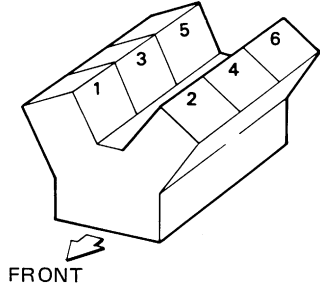
## SERVICE DATA AND SPECIFICATIONS (SDS)

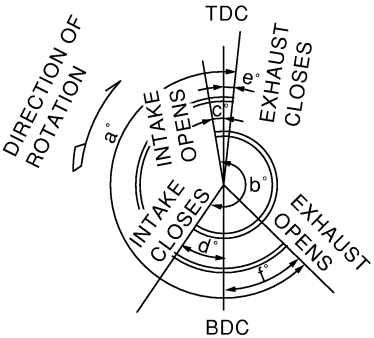
PFP:00100

### Standard and Limit GENERAL SPECIFICATIONS

GBS000H6

Cylinder arrangement		V-6
Displacement cm <sup>3</sup> (cu in)		3,954 (241.27)
Bore and stroke mm (in)		95.5 × 92.0 (3.76 × 3.622)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		9.7
Compression pressure kPa (kg/cm <sup>2</sup> , psi)/300 rpm	Standard	1,275 (13.0, 185)
	Minimum	981 (10.0, 142)
	Differential limit between cylinders	98 (1.0, 14)

Cylinder number	 <p style="text-align: right; margin-top: 10px;">SEM713A</p>
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Valve timing (Intake valve timing control - "OFF")	 <p style="text-align: right; margin-top: 10px;">PBIC0187E</p>
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Unit: degree

a	b	c	d	e	f
244	240	-4	64	6	58

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## DRIVE BELT

Tension of drive belts

Auto adjustment by auto tensioner

## INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

## SPARK PLUG

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (nominal)	1.1 mm (0.043 in)

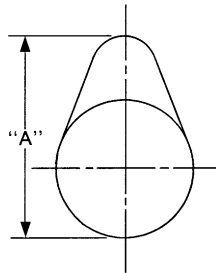
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)	
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft cam height "A"	Intake	45.465 - 45.655 (1.7900 - 1.7921)	45.265 (1.7821)
	Exhaust	45.075 - 45.265 (1.7746 - 1.7821)	44.875 (1.7667)
Camshaft runout [TIR* <sup>1</sup> ]		Less than 0.02 mm (0.001)	0.05 (0.002)
Camshaft sprocket runout [TIR* <sup>2</sup> ]		—	0.15 (0.0059)



SEM671

\*<sup>1</sup> : Total indicator reading

## Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.013 - 0.039 (0.0005 - 0.0015)

## Valve Clearance

Unit: mm (in)

Items	Cold	Hot* (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

\*: Approximately 80°C (176°F)

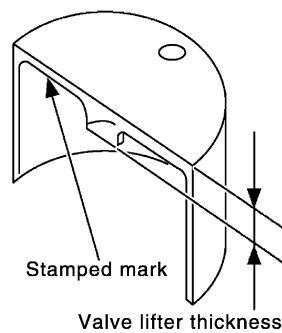
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## Available Valve Lifter VQ40DE

Unit: mm (in)

Identification (stamped) mark		Thickness
Intake	Exhaust	
788U	N788	7.88 (0.3102)
790U	N790	7.90 (0.3110)
792U	N792	7.92 (0.3118)
794U	N794	7.94 (0.3126)
796U	N796	7.96 (0.3134)
798U	N798	7.98 (0.3142)
800U	N800	8.00 (0.3150)
802U	N802	8.02 (0.3157)
804U	N804	8.04 (0.3165)
806U	N806	8.06 (0.3173)
808U	N808	8.08 (0.3181)
810U	N810	8.10 (0.3189)
812U	N812	8.12 (0.3197)
814U	N814	8.14 (0.3205)
816U	N816	8.16 (0.3213)
818U	N818	8.18 (0.3220)
820U	N820	8.20 (0.3228)
822U	N822	8.22 (0.3236)
824U	N824	8.24 (0.3244)
826U	N826	8.26 (0.3252)
828U	N828	8.28 (0.3260)
830U	N830	8.30 (0.3268)
832U	N832	8.32 (0.3276)
834U	N834	8.34 (0.3283)
836U	N836	8.36 (0.3291)
838U	—	8.38 (0.3299)
840U	—	8.40 (0.3307)



SEM758G

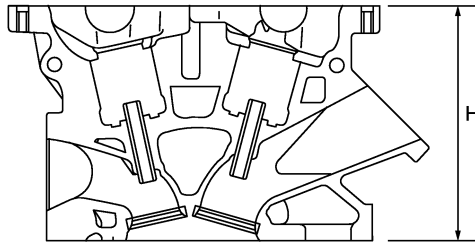
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## CYLINDER HEAD

Unit: mm (in)

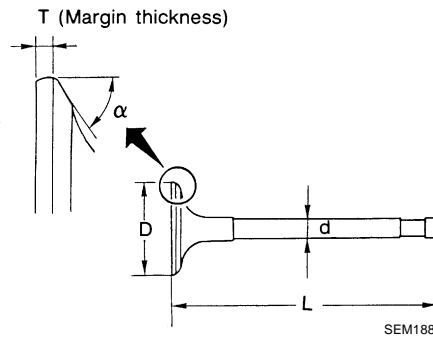
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height "H"	126.3 - 126.5 (4.972 - 4.980)	—



PBIC0924E

## Valve Dimensions

Unit: mm (in)



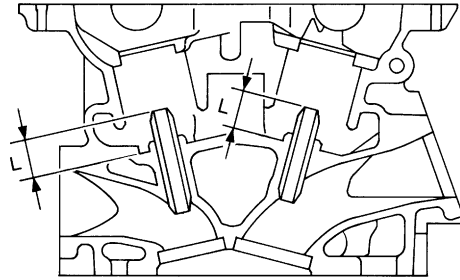
Valve head diameter "D"	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	96.46 (3.7976)
	Exhaust	93.99 (3.7004)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## Valve Guide

Unit: mm (in)



SEM950E

Items		Standard	0.2 (0.008) oversize (Service)
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length "L"		12.6 - 12.8 (0.496 - 0.504)	

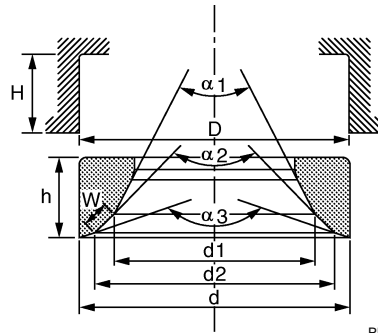


# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter "D"	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat outer diameter "d"	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter "d1"*1	Intake	35 (1.38)	
	Exhaust	28.7 (1.130)	
Diameter "d2"*2	Intake	36.6 - 36.8 (1.441 - 1.449)	
	Exhaust	30.6 - 30.8 (1.205 - 1.213)	
Angle "α1"	Intake	60°	
	Exhaust	60°	
Angle "α2"	Intake	88°45' - 90°15'	
	Exhaust	88°45' - 90°15'	
Angle "α3"	Intake	120°	
	Exhaust	120°	
Contacting width "W"*3	Intake	1.09 - 1.31 (0.043 - 0.052)	
	Exhaust	1.29 - 1.51 (0.051 - 0.059)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"		6.0 (0.236)	

\*1 : Diameter made by intersection point of conic angles "α1" and "α2"

\*2 : Diameter made by intersection point of conic angles "α2" and "α3"

\*3 : Machining data

## Valve Spring

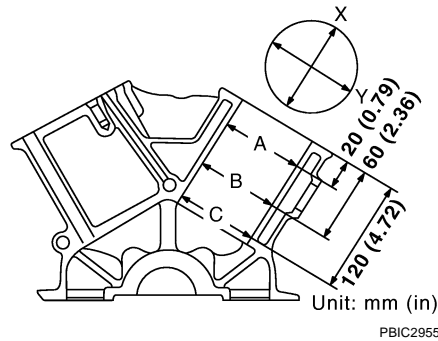
Free height	mm (in)	47.07 (1.8531)
Pressure	N (kg, lb) at height mm (in)	166 - 188 (16.9 - 19.2, 37 - 42) at 37.00 (1.4567)
		373 - 421 (38.0 - 42.9, 84 - 95) at 27.20 (1.0709)
Squareness	mm (in)	Limit 2.1 (0.083)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## CYLINDER BLOCK

Unit: mm (in)



Surface flatness		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Main bearing housing inner diameter		Standard		74.993 - 75.017 (2.9525 - 2.9534)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
Out-of-round (Difference between "X" and "Y")		Limit		0.015 (0.0006)
Taper (Difference between "A" and "C")		Limit		0.01 (0.0004)
Main bearing housing inner diameter (Without bearing)		Grade No. A		74.993 - 74.994 (2.9525 - 2.9525)
		Grade No. B		74.994 - 74.995 (2.9525 - 2.9526)
		Grade No. C		74.995 - 74.996 (2.9526 - 2.9526)
		Grade No. D		74.996 - 74.997 (2.9526 - 2.9526)
		Grade No. E		74.997 - 74.998 (2.9526 - 2.9527)
		Grade No. F		74.998 - 74.999 (2.9527 - 2.9527)
		Grade No. G		74.999 - 75.000 (2.9527 - 2.9528)
		Grade No. H		75.000 - 75.001 (2.9528 - 2.9528)
		Grade No. J		75.001 - 75.002 (2.9528 - 2.9528)
		Grade No. K		75.002 - 75.003 (2.9528 - 2.9529)
		Grade No. L		75.003 - 75.004 (2.9529 - 2.9529)
		Grade No. M		75.004 - 75.005 (2.9529 - 2.9529)
		Grade No. N		75.005 - 75.006 (2.9529 - 2.9530)
		Grade No. P		75.006 - 75.007 (2.9530 - 2.9530)
		Grade No. R		75.007 - 75.008 (2.9530 - 2.9531)
		Grade No. S		75.008 - 75.009 (2.9531 - 2.9531)
		Grade No. T		75.009 - 75.010 (2.9531 - 2.9531)
Grade No. U		75.010 - 75.011 (2.9531 - 2.9532)		
Grade No. V		75.011 - 75.012 (2.9532 - 2.9532)		
Grade No. W		75.012 - 75.013 (2.9532 - 2.9533)		
Grade No. X		75.013 - 75.014 (2.9533 - 2.9533)		
Grade No. Y		75.014 - 75.015 (2.9533 - 2.9533)		
Grade No. 4		75.015 - 75.016 (2.9533 - 2.9534)		
Grade No. 7		75.016 - 75.017 (2.9534 - 2.9534)		
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

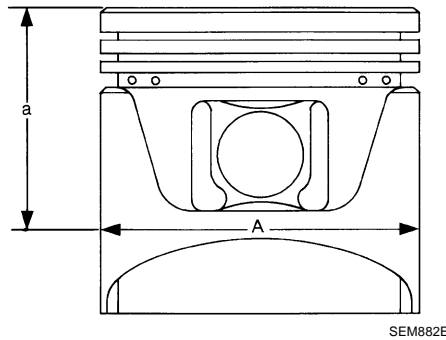
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## PISTON, PISTON RING AND PISTON PIN

### Available Piston

Unit: mm (in)



Items		Standard	0.20 (0.0079) oversize
Piston skirt diameter "A"	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)	—
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)	—
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)	—
	Service	—	95.680 - 95.710 (3.7669 - 3.7681)
Items		Standard	Limit
"a" dimension		43.03 (1.6941)	—
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	—
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	—
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)	0.08 (0.0031)

### Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.56 (0.0220)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.68 (0.0268)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.85 (0.0335)

### Piston Pin

Unit: mm (in)

Items		Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
Piston to piston pin oil clearance		0.002 - 0.006 (0.0001 - 0.0002)	—
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## CONNECTING ROD

Unit: mm (in)

Items		Standard	Limit
Center distance		165.82 - 165.92 (6.5283 - 6.5323)	—
Bend [per 100 (3.94)]		—	0.15 (0.0059)
Torsion [per 100 (3.94)]		—	0.30 (0.0118)
Connecting rod bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)	—
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)	—
Connecting rod big end diameter (Without bearing)		57.000 - 57.013 (2.2441 - 2.2446)	—
Side clearance		0.20 - 0.35 (0.0079 - 0.0138)	0.40 (0.0157)

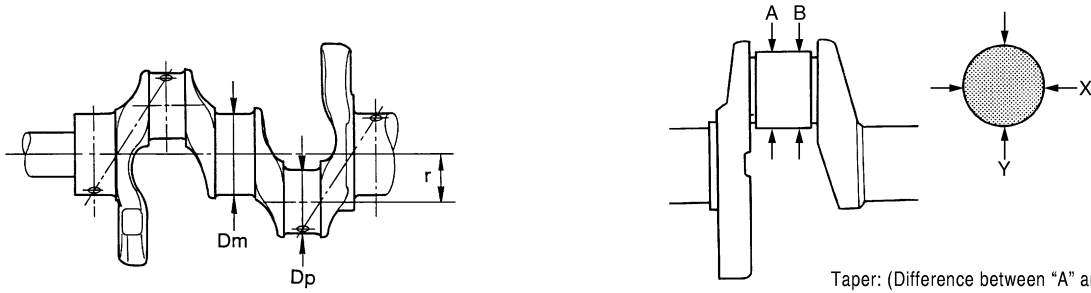
\*: After installing in connecting rod

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## CRANKSHAFT

Unit: mm (in)



SEM645

SBIA0535E

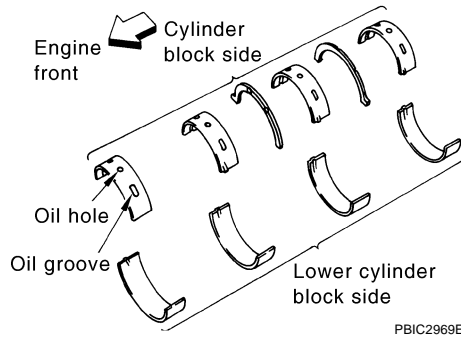
Main journal diameter. "Dm" grade	Standard	Grade No. A	69.975 - 69.974 (2.7549 - 2.7549)
		Grade No. B	69.974 - 69.973 (2.7549 - 2.7548)
		Grade No. C	69.973 - 69.972 (2.7548 - 2.7548)
		Grade No. D	69.972 - 69.971 (2.7548 - 2.7548)
		Grade No. E	69.971 - 69.970 (2.7548 - 2.7547)
		Grade No. F	69.970 - 69.969 (2.7547 - 2.7547)
		Grade No. G	69.969 - 69.968 (2.7547 - 2.7546)
		Grade No. H	69.968 - 69.967 (2.7546 - 2.7546)
		Grade No. J	69.967 - 69.966 (2.7546 - 2.7546)
		Grade No. K	69.966 - 69.965 (2.7546 - 2.7545)
		Grade No. L	69.965 - 69.964 (2.7545 - 2.7545)
		Grade No. M	69.964 - 69.963 (2.7545 - 2.7544)
		Grade No. N	69.963 - 69.962 (2.7544 - 2.7544)
		Grade No. P	69.962 - 69.961 (2.7544 - 2.7544)
		Grade No. R	69.961 - 69.960 (2.7544 - 2.7543)
		Grade No. S	69.960 - 69.959 (2.7543 - 2.7543)
		Grade No. T	69.959 - 69.958 (2.7543 - 2.7542)
Grade No. U	69.958 - 69.957 (2.7542 - 2.7542)		
Grade No. V	69.957 - 69.956 (2.7542 - 2.7542)		
Grade No. W	69.956 - 69.955 (2.7542 - 2.7541)		
Grade No. X	69.955 - 69.954 (2.7541 - 2.7541)		
Grade No. Y	69.954 - 69.953 (2.7541 - 2.7540)		
Grade No. 4	69.953 - 69.952 (2.7540 - 2.7540)		
Grade No. 7	69.952 - 69.951 (2.7540 - 2.7540)		
Pin journal diameter. "Dp"	Standard	Grade No. 0	53.968 - 53.974 (2.1247 - 2.1250)
		Grade No. 1	53.962 - 53.968 (2.1245 - 2.1247)
		Grade No. 2	53.956 - 53.962 (2.1242 - 2.1245)
Center distance "r"			45.96 - 46.04 (1.8094 - 1.8126)
Taper (Difference between "A" and "B")	Limit		0.002 (0.0001)
Out-of-round (Difference between "X" and "Y")			0.002 (0.0001)
Crankshaft runout [TIR*]	Standard		Less than 0.05 (0.002)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.14 - 0.22 (0.0055 - 0.0087)
	Limit		0.30 (0.0118)

\*: Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## MAIN BEARING



Grade number	UPR/LWR	Thickness mm (in)	Width mm (in)	Identification color	Remarks
0	—	2.500 - 2.503 (0.0984 - 0.0985)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	—	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
2	—	2.506 - 2.509 (0.0987 - 0.0988)		Green	
3	—	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
4	—	2.512 - 2.515 (0.0989 - 0.0990)		Blue	
5	—	2.515 - 2.518 (0.0990 - 0.0991)		Pink	
6	—	2.518 - 2.521 (0.0991 - 0.0993)		Purple	
7	—	2.521 - 2.524 (0.0993 - 0.0994)		White	Grade is different for upper and lower bearings.
01	UPR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
	LWR	2.500 - 2.503 (0.0984 - 0.0985)		Black	
12	UPR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
	LWR	2.503 - 2.506 (0.0985 - 0.0987)		Brown	
23	UPR	2.509 - 2.512 (0.0988 - 0.0989)		Yellow	
	LWR	2.506 - 2.509 (0.0987 - 0.0988)		Green	
34	UPR	2.512 - 2.515 (0.0989 - 0.0990)	Blue		
	LWR	2.509 - 2.512 (0.0988 - 0.0989)	Yellow		
45	UPR	2.515 - 2.518 (0.0990 - 0.0991)	Pink		
	LWR	2.512 - 2.515 (0.0989 - 0.0990)	Blue		
56	UPR	2.518 - 2.521 (0.0991 - 0.0993)	Purple		
	LWR	2.515 - 2.518 (0.0990 - 0.0991)	Pink		
67	UPR	2.521 - 2.524 (0.0993 - 0.0994)	White		
	LWR	2.518 - 2.521 (0.0991 - 0.0993)	Purple		

### Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.633 - 2.641 (0.1037 - 0.1040)	Grind so that bearing clearance is the specified value.

### Main Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Main bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018)*	0.065 (0.0026)

\*: Actual clearance

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VQ]

## CONNECTING ROD BEARING

Grade number	Thickness mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

## Undersize

Unit: mm (in)

Items	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

## Connecting Rod Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.034 - 0.059 (0.0013 - 0.0023)*	0.070 (0.0028)

\*: Actual clearance

---

## PRECAUTIONS

PF0:00001

### Precautions for Draining Engine Coolant

GBS00001

Drain engine coolant when engine is cooled.

### Precautions for Disconnecting Fuel Piping

GBS00002

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

### Precautions for Removal and Disassembly

GBS00003

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

### Precautions for Inspection, Repair and Replacement

GBS00004

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

### Precautions for Assembly and Installation

GBS00005

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new liquid gasket, packing, oil seal or O-ring.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, make sure that dowel pins are installed in the original position.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust systems for leakage.

### Parts Requiring Angle Tightening

GBS00006

- Use an angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Main bearing cap bolts
  - Connecting rod cap nuts
  - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.



# PRECAUTIONS

[YD]

GBS00007

## Precautions For Liquid Gasket REMOVAL OF LIQUID GASKET

- After removing the mounting bolts and nuts, separate the mating surface using the seal cutter [SST] and remove the old liquid gasket sealing.

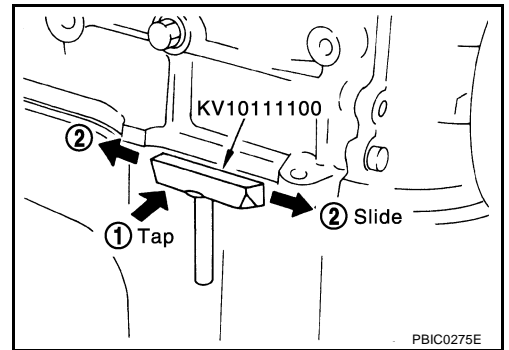
**CAUTION:**

**Be careful not to damage the mating surfaces.**

- Tap seal cutter to insert it, and then slide it by tapping on the side as shown in the figure.
- In areas where seal cutter [SST] is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

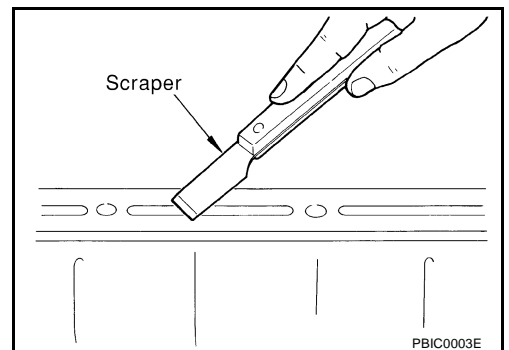
**CAUTION:**

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

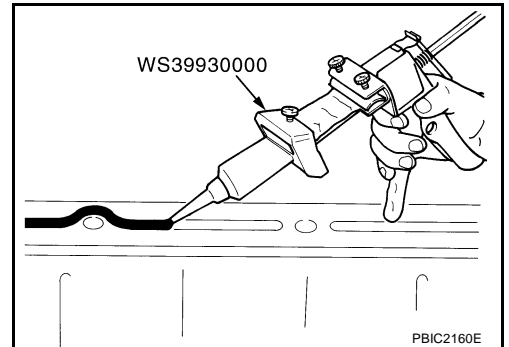


## LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.
  - Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



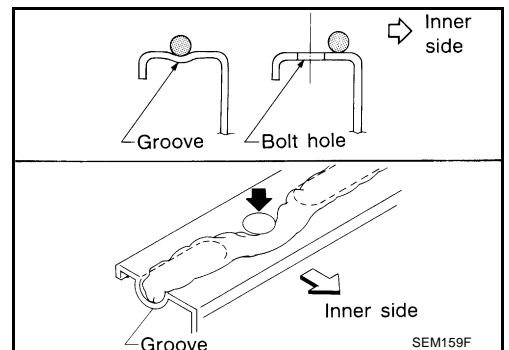
3. Attach the liquid gasket tube to the tube presser [SST].  
**Use Genuine Liquid Gasket or equivalent.**
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



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

**CAUTION:**

**If there are instructions in this manual, observe them.**



A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

# PREPARATION

[YD]

PFP:00002

GBS00008

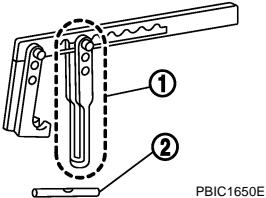
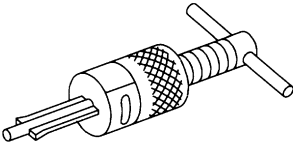
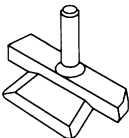
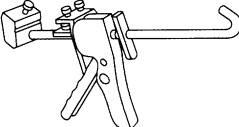
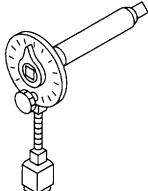
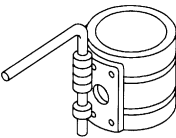
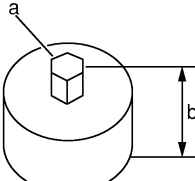
## PREPARATION

### Special Service Tools

Tool number Tool name	Description
KV10115600 Valve oil seal drift	Installing valve oil seal <b>Use side A.</b> <b>Side A</b> <b>a: 20 (0.79) dia.</b> <b>b: 13 (0.51) dia.</b> <b>c: 10.3 (0.406) dia.</b> <b>d: 8 (0.31) dia.</b> <b>e: 10.7 (0.421)</b> <b>f: 5 (0.20)</b> Unit: mm (in)
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	Removing valve oil seal
KV11103000 Pulley puller	Removing crankshaft pulley
ED19600610 Compression gauge adapter	Checking compression pressure
KV101056S0 Ring gear stopper 1. KV10105630 Adapter 2. KV10105610 Plate	Preventing crankshaft from rotating <b>a: 3 (0.12)</b> <b>b: 6.4 (0.252)</b> <b>c: 2.8 (0.110)</b> <b>d: 6.6 (0.260)</b> <b>e: 107 (4.21)</b> <b>f: 14 (0.55)</b> <b>g: 20 (0.79)</b> <b>h: 14 (0.55) dia.</b> Unit: mm (in)
KV101151S0 Lifter stopper set 1. KV10115110 Camshaft pliers 2. KV10115120 Lifter stopper	Changing adjusting shim

# PREPARATION

[YD]

Tool number Tool name	Description	A
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	 Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.	EM
ST16610001 Pilot bushing puller	 Removing crankshaft pilot bush	D
KV10111100 Seal cutter	 Removing oil pan upper, oil pan lower and rear chain case, etc.	F
WS39930000 Tube presser	 Pressing the tube of liquid gasket	H
KV10112100 Angle wrench	 Tightening bolts for bearing cap, cylinder head, etc.	K
EM03470000 Piston ring compressor	 Installing piston assembly into cylinder bore	M
KV11106010 Hexagon wrench	 Removing and installing chain tensioner <b>a: 5 mm (0.20 in) (Face to face)</b> <b>b: 20 mm (0.79 in)</b>	

# PREPARATION

[YD]

Tool number Tool name	Description
KV11106020 Hexagon wrench	Removing and installing slack guide <b>a: 6 mm (0.24 in) (Face to face)</b> <b>b: 20 mm (0.79 in)</b>
KV11106030 Positioning stopper pin	Fixing fuel pump sprocket <b>a: 6 mm (0.24 in) dia.</b> <b>b: 80 mm (3.15 in)</b>
KV11106040 TORX wrench	Removing and installing fuel pump sprocket nut <b>a: T70</b> <b>b: 26 mm (1.02 in)</b>
KV11106050 Hexagonal wrench	Removing and installing fuel pump sprocket <b>a: 6 mm (0.24 in) (Face to face)</b> <b>b: 42 mm (1.65 in)</b>
KV11106060 Sprocket holder	Holding fuel pump sprocket

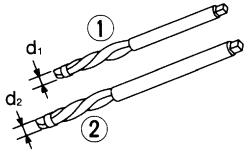
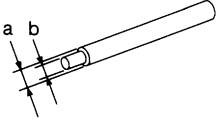
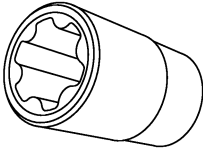
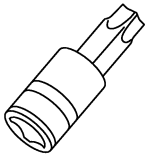
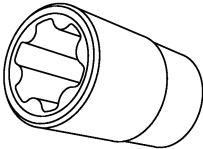
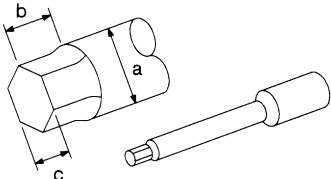
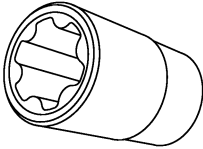
## Commercial Service Tools

GBS00009

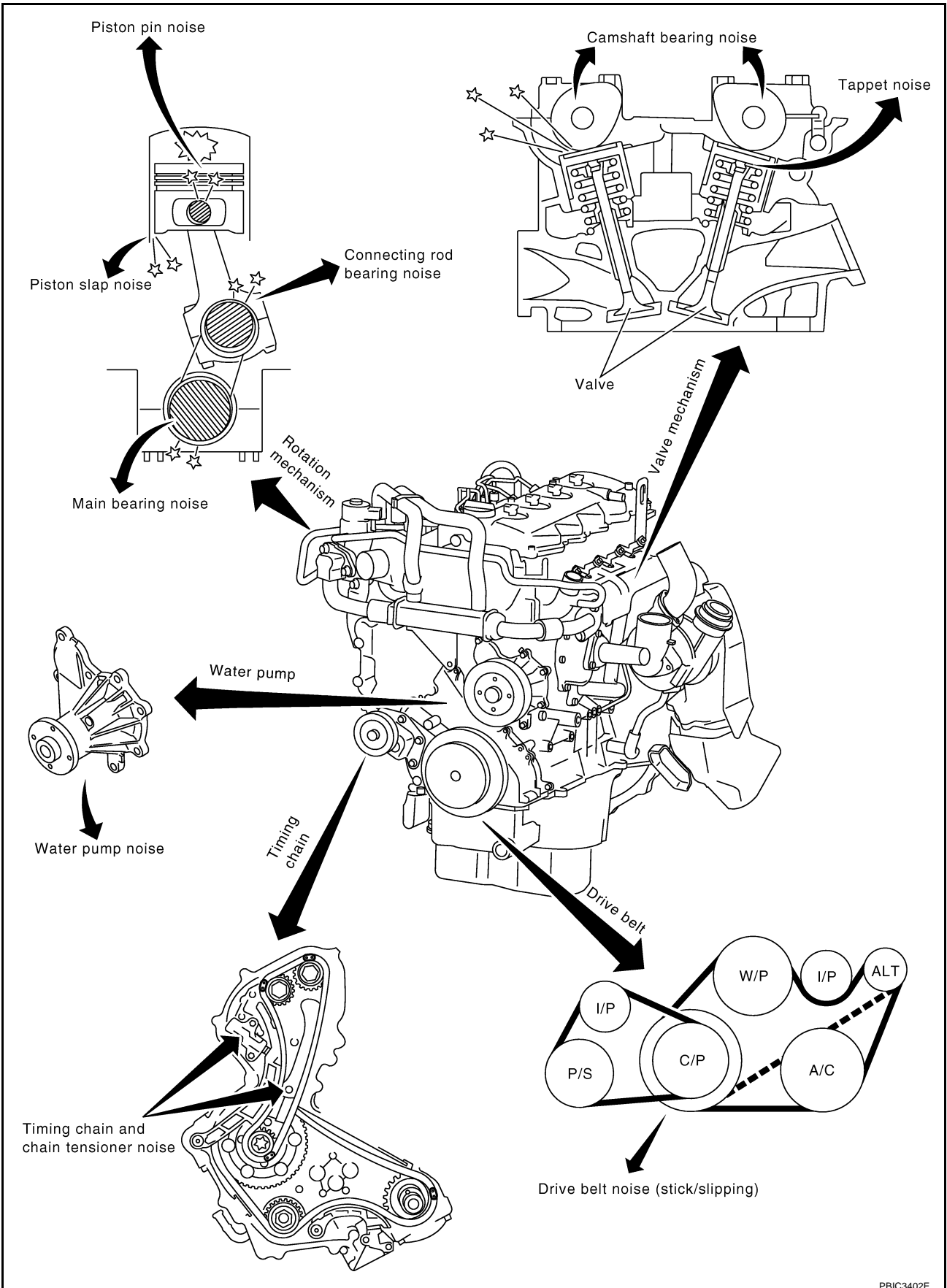
Tool name	Description
Valve seat cutter set	Finishing valve seat dimensions
Piston ring expander	Removing and installing piston ring

# PREPARATION

[YD]

Tool name	Description
Valve guide reamer  <p style="text-align: center;">NT016</p>	Reaming valve guide with (1) or hole for oversize valve guide with (2) <b>Intake and Exhaust:</b> <b>d1 = 6.0 mm (0.236 in) dia.</b> <b>d2 = 10.2 mm (0.402 in) dia.</b>
Valve guide drift  <p style="text-align: center;">NT015</p>	Removing and installing valve guide <b>Intake and Exhaust:</b> <b>a = 9.5 mm (0.374 in) dia.</b> <b>b = 5.5 mm (0.217 in) dia.</b>
TORX socket  <p style="text-align: center;">NT807</p>	Loosening and tightening fuel pump mounting bolt <b>Size: E10</b>
TORX socket  <p style="text-align: center;">PBIC1113E</p>	Loosening and tightening flywheel mounting bolt <b>Size: T55</b>
TORX socket  <p style="text-align: center;">NT807</p>	Loosening and tightening drive plate mounting bolt <b>Size: E20</b>
Cylinder head bolt wrench  <p style="text-align: center;">NT583</p>	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100] <b>a: 13 (0.51) dia.</b> <b>b: 12 (0.47)</b> <b>c: 10 (0.39)</b> Unit: mm (in)
TORX socket  <p style="text-align: center;">NT807</p>	Loosening and tightening main bearing cap bolt <b>Size: E14</b>

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# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[YD]

GBS0000B

## Use the Chart Below to Help You Find the Cause of the Symptom.

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

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	<a href="#">EM-210</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft oil clearance Camshaft runout	<a href="#">EM-205</a> <a href="#">EM-205</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin clearance Connecting rod bushing oil clearance	<a href="#">EM-269</a> <a href="#">EM-271</a>
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	<a href="#">EM-273</a> <a href="#">EM-270</a> <a href="#">EM-270</a> <a href="#">EM-271</a>
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance (Big end)	<a href="#">EM-271</a> <a href="#">EM-275</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-276</a> <a href="#">EM-275</a>
Front of engine Timing chain case	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	<a href="#">EM-219</a> <a href="#">EM-228</a> <a href="#">EM-223</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	<a href="#">EM-156</a>
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	<a href="#">CO-50_ "WATER PUMP"</a>

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

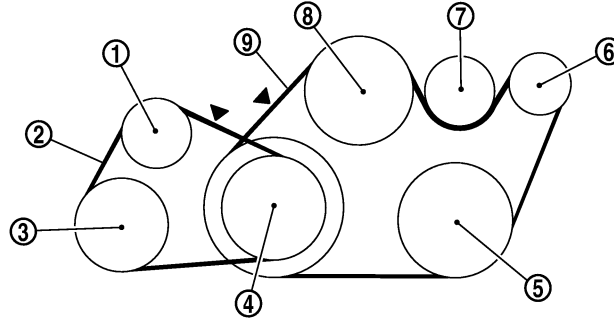
## DRIVE BELTS

PFP:02117

### Checking Drive Belts

GBS0000C

SEC. 117



PBIC4038E

- |                      |  |  |
|----------------------|--|--|
| 1. Idler pulley      | 2. Power steering oil pump belt  | 3. Power steering oil pump                           |
| 4. Crankshaft pulley | 5. A/C compressor (Models with A/C)<br>Dummy pulley (Models without A/C) | 6. Alternator  |
| 7. Idler pulley      | 8. Water pump pulley   | 9. A/C compressor, alternator and<br>water pump belt |

- Before inspecting engine, make sure engine has cooled down; wait approximately 30 minutes after engine has been stopped.
- Visually inspect all belts for wear, damage or cracks on contacting surfaces and edge areas.
- Measure deflection at the marked point (▲).

**CAUTION:**

- **When checking belt deflection immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**
- **Tighten idler pulley lock nut by hand and measure deflection without looseness.**

**Belt Deflection:**

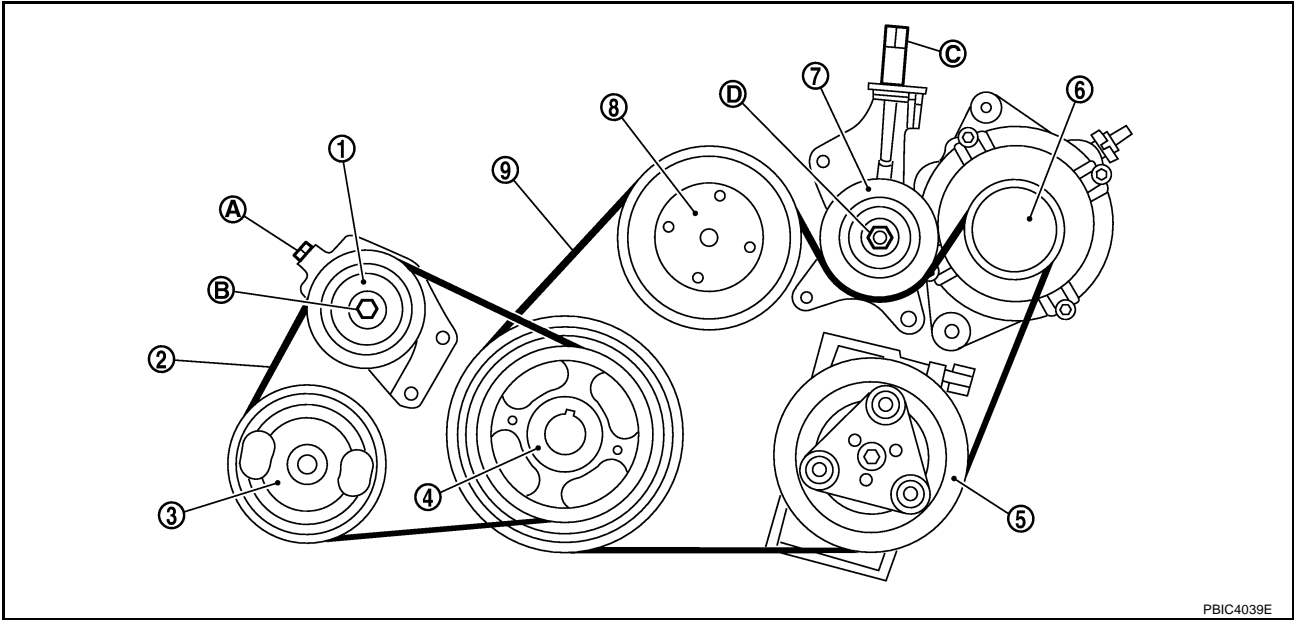
Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied* mm (in)		
	New	Adjusted	Limit for re-adjusting
A/C compressor, alternator and water pump belt	2.9 - 3.4 (0.114 - 0.134)	3.9 - 4.4 (0.154 - 0.173)	8.5 (0.335)
Power steering oil pump belt	4.6 - 5.4 (0.181 - 0.213)	7.1 - 7.7 (0.280 - 0.303)	11.3 (0.445)

\*: When engine is cold.



## Deflection Adjustment

GBS0000D



- |                          |  |  |
|--------------------------|--|--|
| 1. Idler pulley          | 2. Power steering oil pump belt  | 3. Power steering oil pump                           |
| 4. Crankshaft pulley     | 5. Dummy pulley (Models without A/C)<br>A/C compressor (Models with A/C) | 6. Alternator  |
| 7. Idler pulley          | 8. Water pump pulley   | 9. A/C compressor, alternator and<br>water pump belt |
| A. Adjusting bolt        | B. Idler pulley lock nut   | C. Adjusting nut                                     |
| D. Idler pulley lock nut |  |  |

- Adjust belts with the parts shown below.

Applied belt	Belt adjustment method
Power steering oil pump belt	Adjusting bolt on idler pulley (A)
Alternator and water pump belt or A/C compressor, alternator and water pump belt	Adjusting nut on idler pulley (C)

**CAUTION:**

- When a new belt is installed as a replacement, adjust it to the specified value under “New” value because of insufficient adaptability with pulley grooves.
- If the belt deflection of the current belt is out of the “Limit for re-adjusting”, adjust to the “Adjusted” value.
- When checking belt deflection immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust it to the specified value to avoid variation in deflection between pulleys.
- Make sure the belts are fully fitted into the pulley grooves during installation.
- Handle with care to avoid smearing the belts with engine oil or engine coolant.
- Do not twist or bend the belts with strong force.

### POWER STEERING OIL PUMP BELT

1. Remove engine undercover front. Refer to [EI-15, "FRONT BUMPER"](#) .
2. Loosen idler pulley lock nut (B).
3. Turn adjusting bolt (A) to adjust. Refer to [EM-157, "Deflection Adjustment"](#) .
4. Tighten idler pulley lock nut (B).

**Nut B:**

: 28.0 N·m (2.9 kg-m, 21 ft-lb)

---

## A/C COMPRESSOR, ALTERNATOR AND WATER PUMP BELT

1. Loosen idler pulley lock nut (D).
2. Turn adjusting nut (C) to adjust. Refer to [EM-157, "Deflection Adjustment"](#) .
3. Tighten lock nut (D).

### Nut D:

: 45.0 N·m (4.6 kg-m, 33 ft-lb)

## Removal and Installation

GBS0000E

### REMOVAL

1. Loosen each belt. Refer to [EM-157, "Deflection Adjustment"](#) .
2. Remove power steering oil pump belt. Refer to [EM-157, "POWER STEERING OIL PUMP BELT"](#) .
3. Remove A/C compressor, alternator and water pump belt. Refer to [EM-158, "A/C COMPRESSOR, ALTERNATOR AND WATER PUMP BELT"](#) .

### INSTALLATION

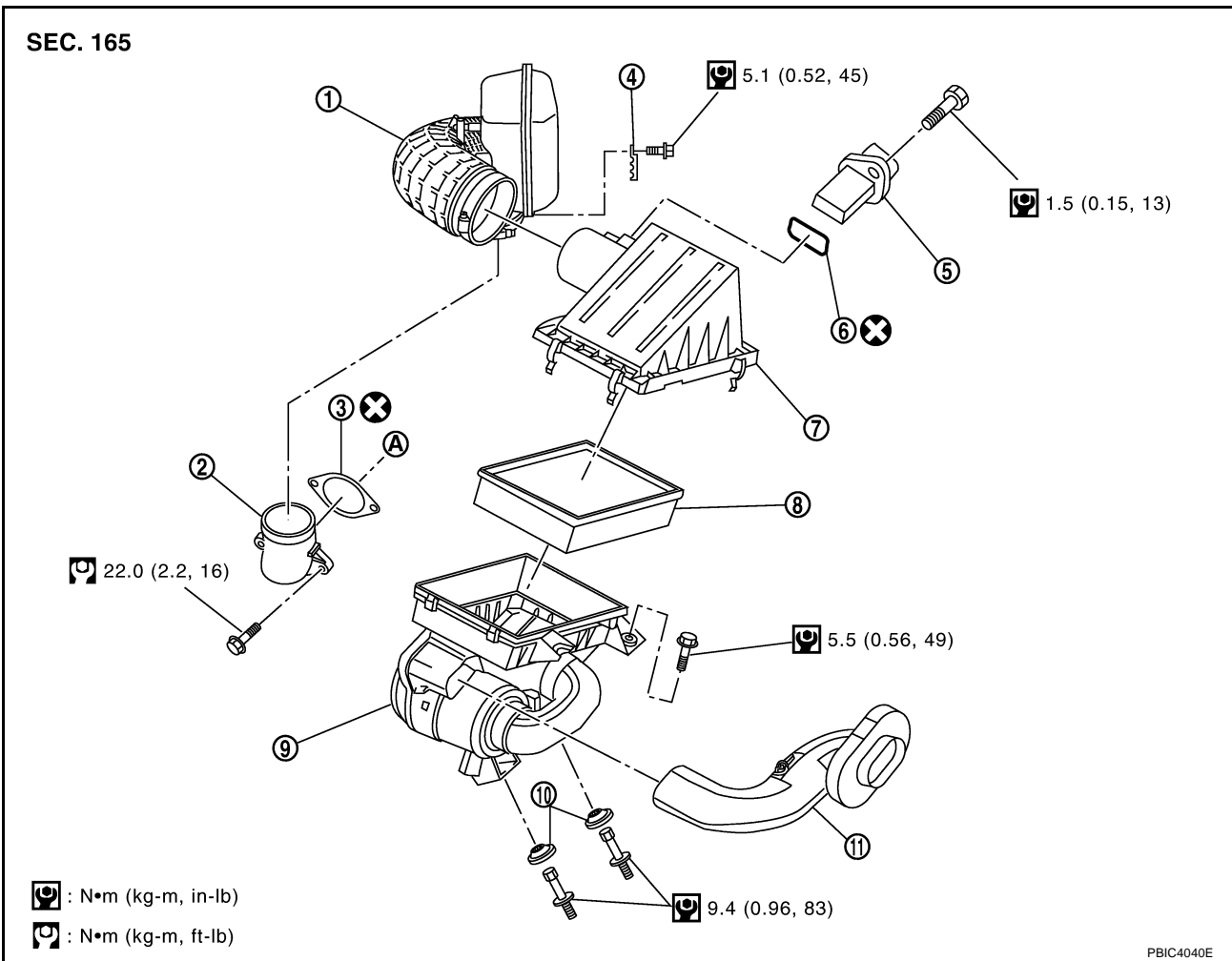
1. Install each belt on pulley in the reverse order of removal.
2. Adjust belt deflection. Refer to [EM-157, "Deflection Adjustment"](#) .
3. Tighten nuts provided for adjustment to the specified torque.
4. Make sure again that each belt deflection is as specified.

## AIR CLEANER AND AIR DUCT

PFP:16500

### Components

GBS0000F



- |                             |                         |                             |
|-----------------------------|-------------------------|-----------------------------|
| 1. Air duct                 | 2. Air inlet pipe       | 3. Gasket                   |
| 4. Bracket                  | 5. Mass air flow sensor | 6. O-ring                   |
| 7. Air cleaner case (upper) | 8. Air cleaner filter   | 9. Air cleaner case (lower) |
| 10. Mounting rubber         | 11. Air duct side       |                             |
- A. To turbocharger

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

### Removal and Installation

#### REMOVAL

1. Remove mass air flow sensor harness clamp from air cleaner case (upper).
2. Disconnect harness connector from mass air flow sensor.
3. Remove air cleaner case (upper) and air cleaner filter.
  - Add marks as necessary for easier installation.
4. Remove mass air flow sensor from air cleaner case (upper).

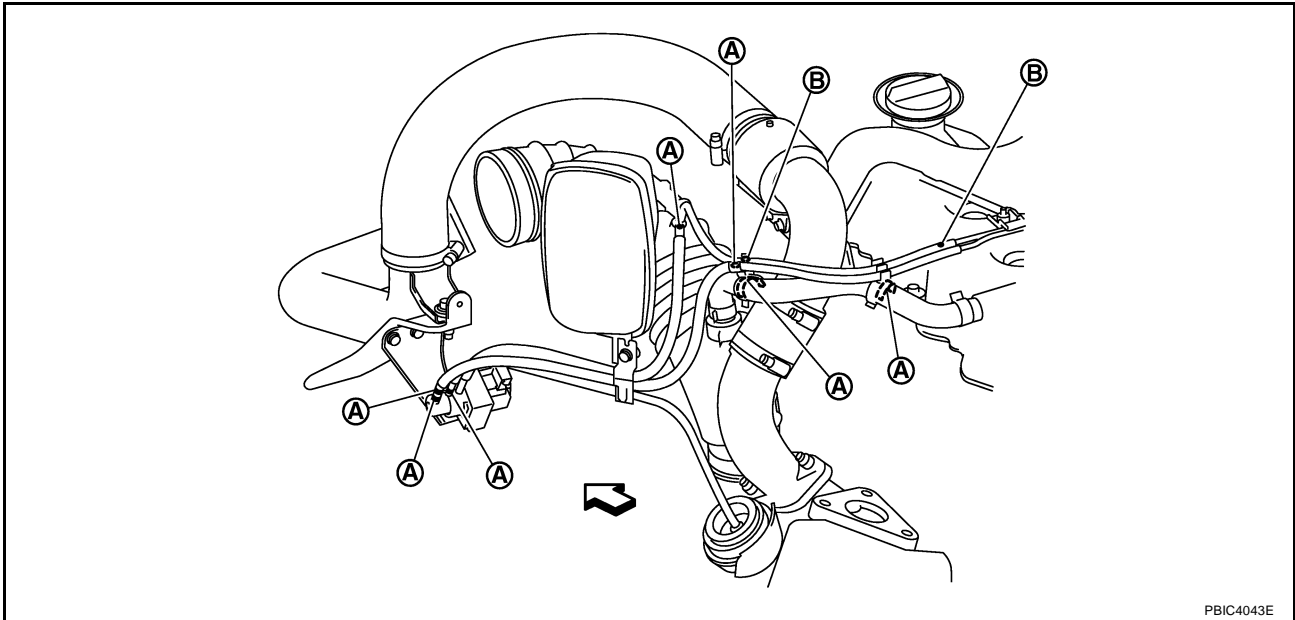
#### CAUTION:

- **Do not shock it.**
  - **Do not disassemble it.**
  - **Do not touch its sensor.**
5. Remove air duct with ventilation hose and vacuum hoses disconnected.
    - Add marks as necessary for easier installation.

GBS0000G

# AIR CLEANER AND AIR DUCT

[YD]



PBIC4043E

A. White mark

B. Yellow mark

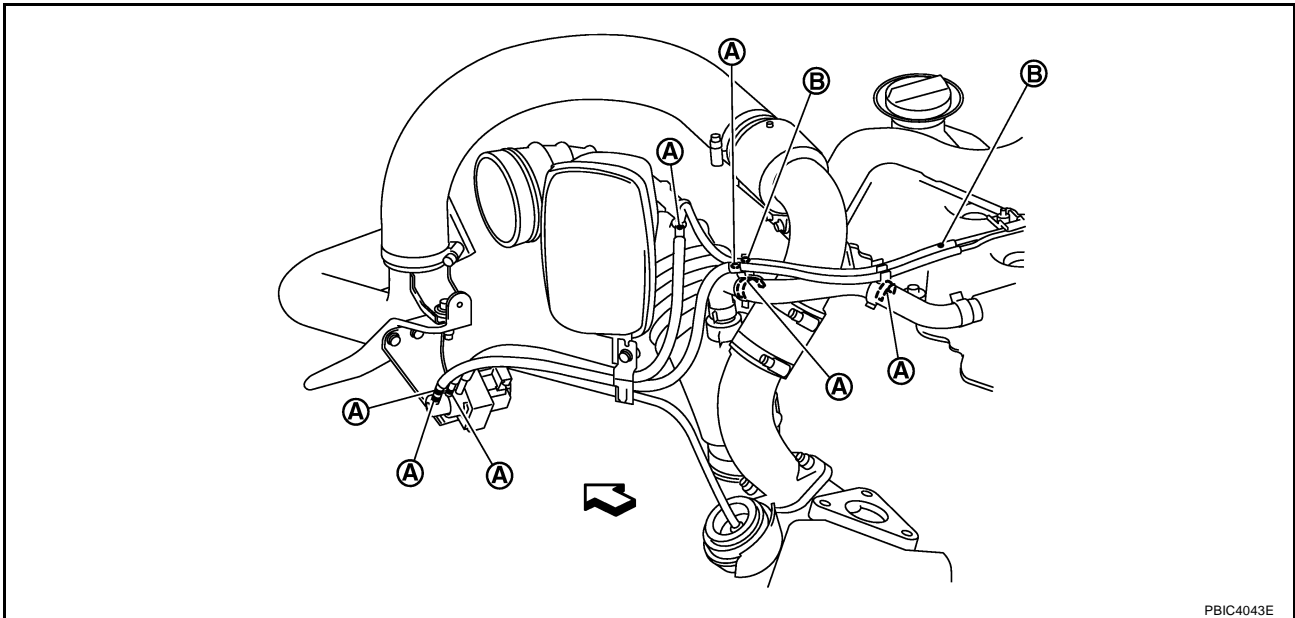
← Vehicle front

6. Remove air cleaner case (lower) and air duct side.

## INSTALLATION

Note the following, and install in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.
- Install ventilation hose and vacuum hoses as shown in the figure.



PBIC4043E

A. White mark

B. Yellow mark

← Vehicle front

- Install vacuum hose by referring to paint marks avoiding twisting.
- When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

**Dimension A** :15 - 20 mm (0.591 - 0.787 in)

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the stopper.

---

## CHANGING AIR CLEANER FILTER

### Removal

1. Remove mass air flow sensor harness clamp from air cleaner case (upper).
2. Disconnect harness connector from mass air flow sensor.
3. Unfasten clips and lift up air cleaner case (upper).
4. Remove air cleaner filter.

### Installation

Installation is the reverse order of removal.

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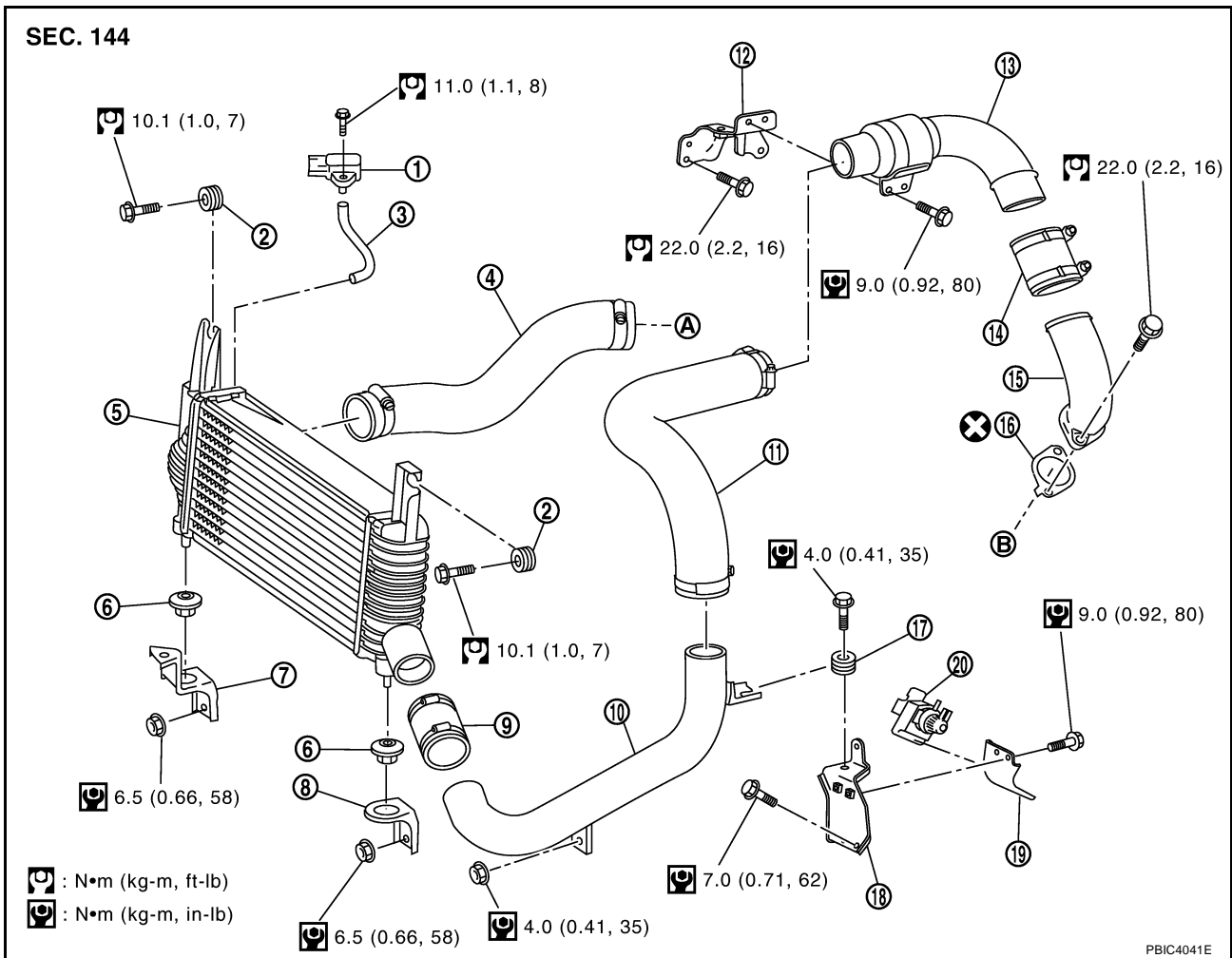
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## CHARGE AIR COOLER

PFP:14461

### Components

GBS0000H



- |                              |   |                    |
|------------------------------|---|--------------------|
| 1. Turbocharger boost sensor | 2. Grommet                                    | 3. Vacuum hose     |
| 4. Air inlet hose            | 5. Charge air cooler                          | 6. Mounting rubber |
| 7. Bracket                   | 8. Bracket                                    | 9. Air inlet hose  |
| 10. Air inlet tube           | 11. Air inlet hose                            | 12. Bracket        |
| 13. Air inlet tube           | 14. Air inlet hose                            | 15. Air inlet pipe |
| 16. Gasket                   | 17. Grommet                                   | 18. Bracket        |
| 19. Bracket                  | 20. Turbocharger boost control solenoid valve |                    |
- A. To throttle chamber  
B. To turbocharger

## Removal and Installation

### REMOVAL

GBS0000I

- Remove front grille. Refer to [EI-19, "FRONT GRILLE"](#).
- Disconnect harness connector from turbocharger boost sensor.
- Remove turbocharger boost control solenoid valve.
- Remove air inlet tube and air inlet hose.
  - Add marks as necessary for easier installation.
- Remove charge air cooler.
- Remove turbocharger boost sensor if necessary.

### CAUTION:

When removing charge air cooler, close opening on turbocharger and on intake manifold with shop cloth or other suitable material.

# CHARGE AIR COOLER

[YD]

## INSPECTION AFTER REMOVAL

Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler if necessary.

- **Be careful not to deform core fins.**
- **For cleaning procedure of charge air cooler core, refer to [CO-42, "Checking Radiator"](#).**

## INSTALLATION

Note the following, and install in the reverse order of removal.

- Pay attention to identification mark color and direction when installing air inlet hose.
- Align marks. Attach each joint. Screw clamps firmly.

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# INTAKE MANIFOLD

[YD]

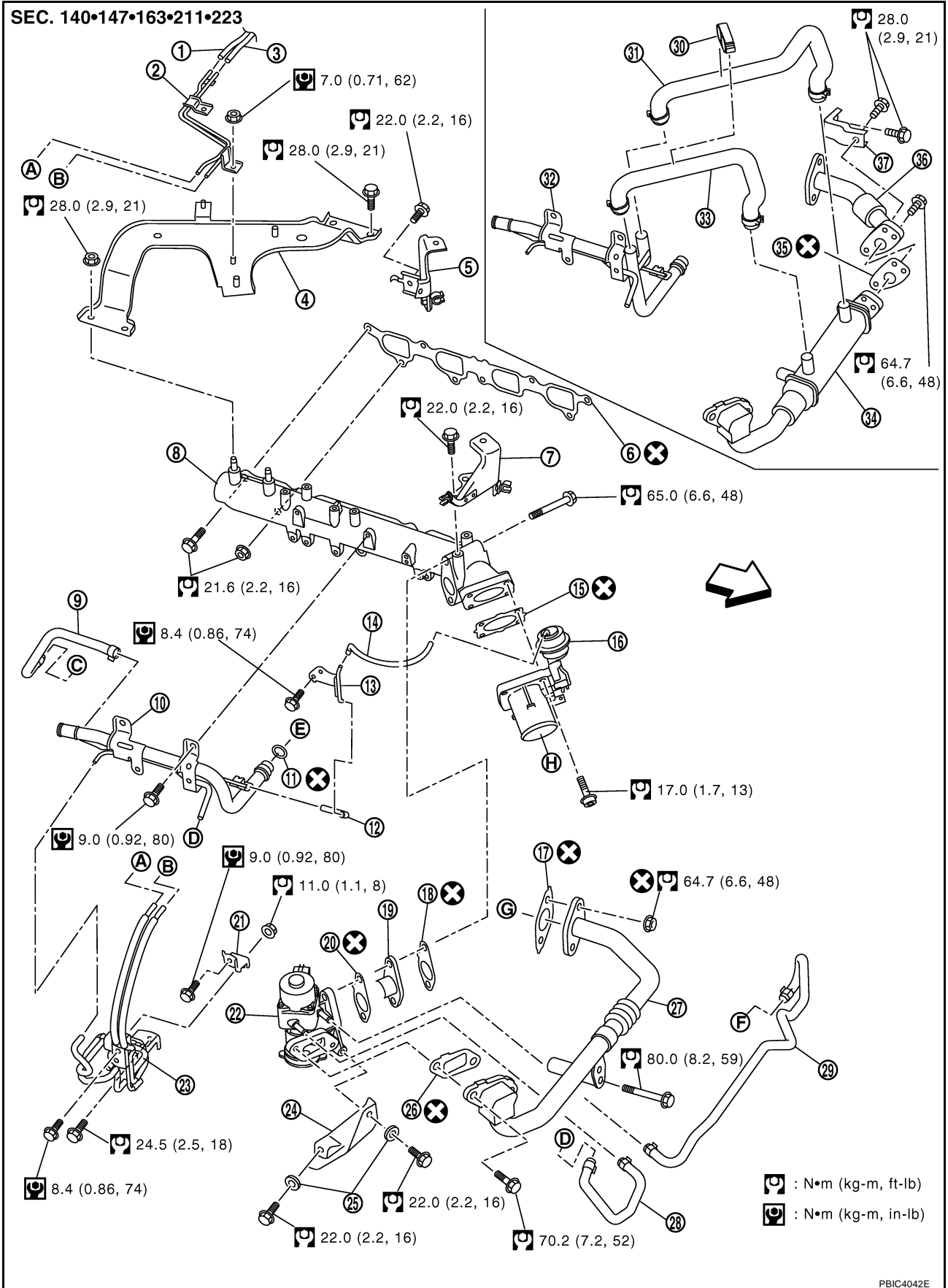
## INTAKE MANIFOLD

PFP:14003

### Components

GBS0000J

SEC. 140•147•163•211•223



: N•m (kg-m, ft-lb)  
 : N•m (kg-m, in-lb)

PBIC4042E



- |                                   |                                   |                             |
|-----------------------------------|-----------------------------------|-----------------------------|
| 1. Vacuum hose                    | 2. Vacuum gallery                 | 3. Vacuum hose              |
| 4. Bracket                        | 5. Bracket                        | 6. Gasket                   |
| 7. Bracket                        | 8. Intake manifold                | 9. Water hose               |
| 10. Heater feed pipe (M/T models) | 11. O-ring                        | 12. Vacuum hose             |
| 13. Vacuum gallery                | 14. Vacuum hose                   | 15. Gasket                  |
| 16. Throttle chamber              | 17. Gasket                        | 18. Gasket                  |
| 19. EGR passage                   | 20. Gasket                        | 21. Bracket                 |
| 22. EGR volume control valve      | 23. Vacuum gallery                | 24. Bracket                 |
| 25. Washer                        | 26. Gasket                        | 27. EGR tube (M/T models)   |
| 28. Water hose                    | 29. Water hose                    | 30. Clip (A/T models)       |
| 31. Water hose (A/T models)       | 32. Heater feed pipe (A/T models) | 33. Water hose (A/T models) |
| 34. EGR cooler (A/T models)       | 35. Gasket (A/T models)           | 36. EGR tube (A/T models)   |
| 37. Bracket (A/T models)          |                                   |                             |
| C. To heater return pipe          | E. To cylinder head               | F. To water outlet          |
| G. To exhaust manifold            | H. To air inlet hose              |                             |
- ↶ Vehicle front

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- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

## Removal and Installation

### REMOVAL

GBS0000K

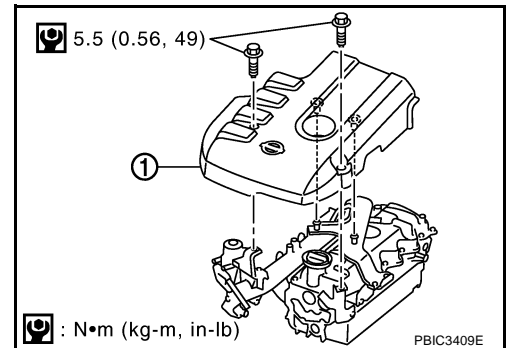
#### WARNING:

To avoid the danger of being scalded, do not drain engine coolant when engine is hot.

1. Drain engine coolant. Refer to [CO-37, "Changing Engine Coolant"](#).
2. Remove engine cover (1).

#### CAUTION:

Be careful not to damage engine cover surface.



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3. Disconnect air inlet hose from throttle chamber. Refer to [EM-162, "CHARGE AIR COOLER"](#).
4. Remove fuel filter. Refer to [FL-15, "FUEL FILTER"](#).
5. Remove oil level gauge guide. Refer to [EM-180, "OIL PAN AND OIL STRAINER"](#).
6. Remove fuel hoses and fuel gallery. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#).
  - To prevent fuel from flowing out, plug the opening of the hose with plug after disconnection.

#### CAUTION:

Be careful not to spill fuel in the engine component.

- Add marks as necessary for easier installation.
7. Remove vacuum galleries and vacuum hoses.
    - Add marks as necessary for easier installation.
  8. Disconnect EGR volume control valve water hoses and wiring harness.
  9. Disconnect heater feed hose, water hoses, and remove heater feed pipe.
  10. Remove EGR cooler (A/T models) or EGR tube (M/T models).
  11. Remove injection tube center. Refer to [EM-188, "Removal and Installation"](#).

#### CAUTION:

Be careful not to spill fuel in the engine component.

12. Remove water pipe.

M

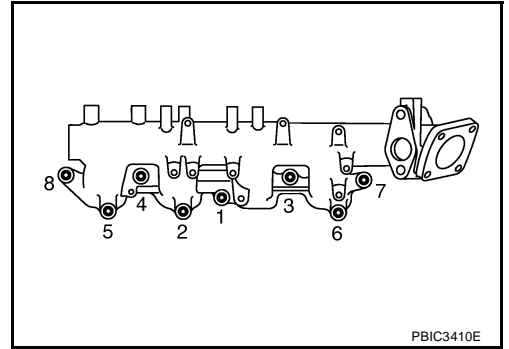
# INTAKE MANIFOLD

[YD]

- Loosen bolts and nuts in the reverse order of that shown in the figure, and remove intake manifold.

**CAUTION:**

Cover engine openings to avoid entry of foreign materials.



- Remove EGR volume control valve and throttle chamber from intake manifold.

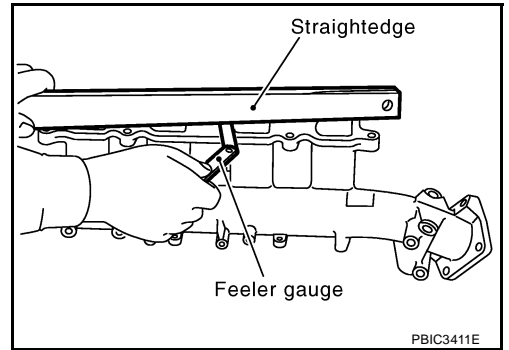
## INSPECTION AFTER REMOVAL

### Surface Distortion

- Check distortion on the mounting surface with a straightedge and feeler gauge.

**Limit : 0.1 mm (0.004 in)**


- If it exceeds the limit, replace intake manifold.

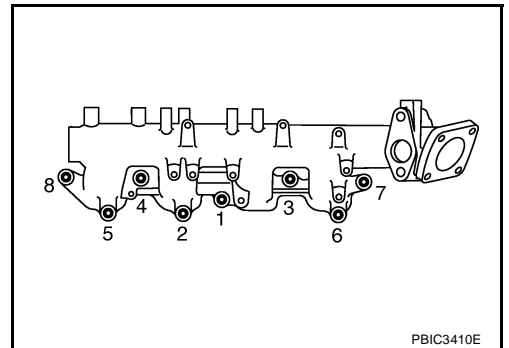


## INSTALLATION

Note the following, and install in the reverse order of removal.

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

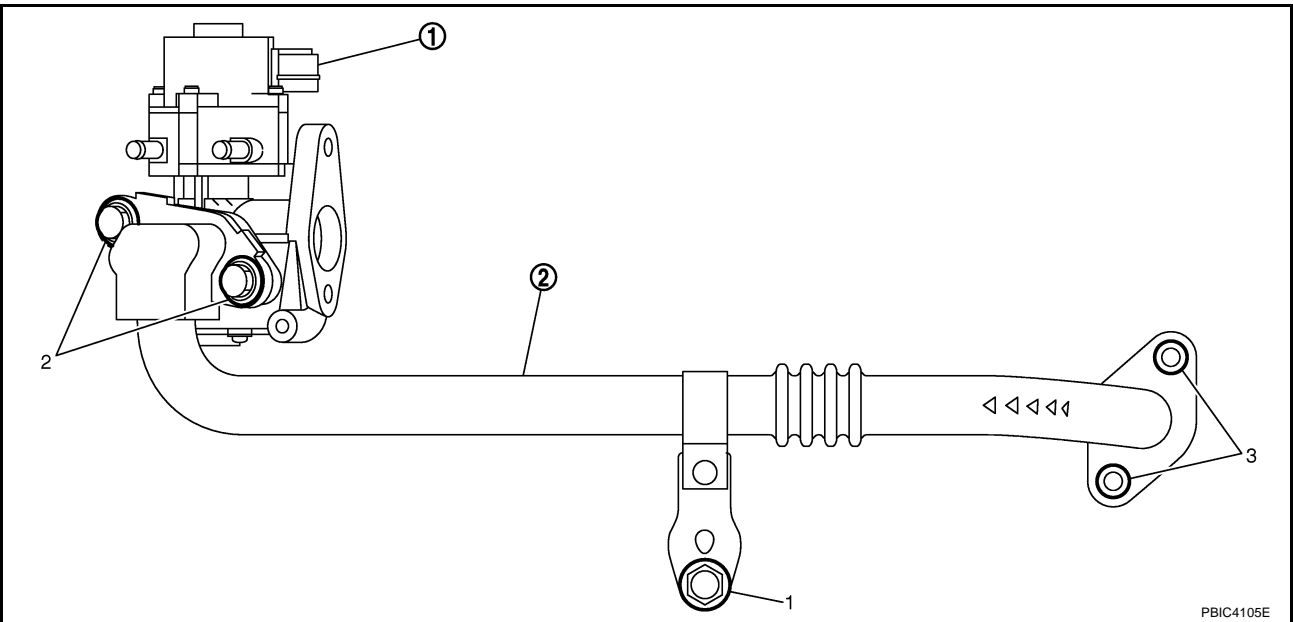
: **10.8 N·m (1.1 kg·m, 8 ft·lb)**



- Install EGR tube (M/T models).
  - Tighten fixing bolts and nuts in numerical order as shown in the figure.

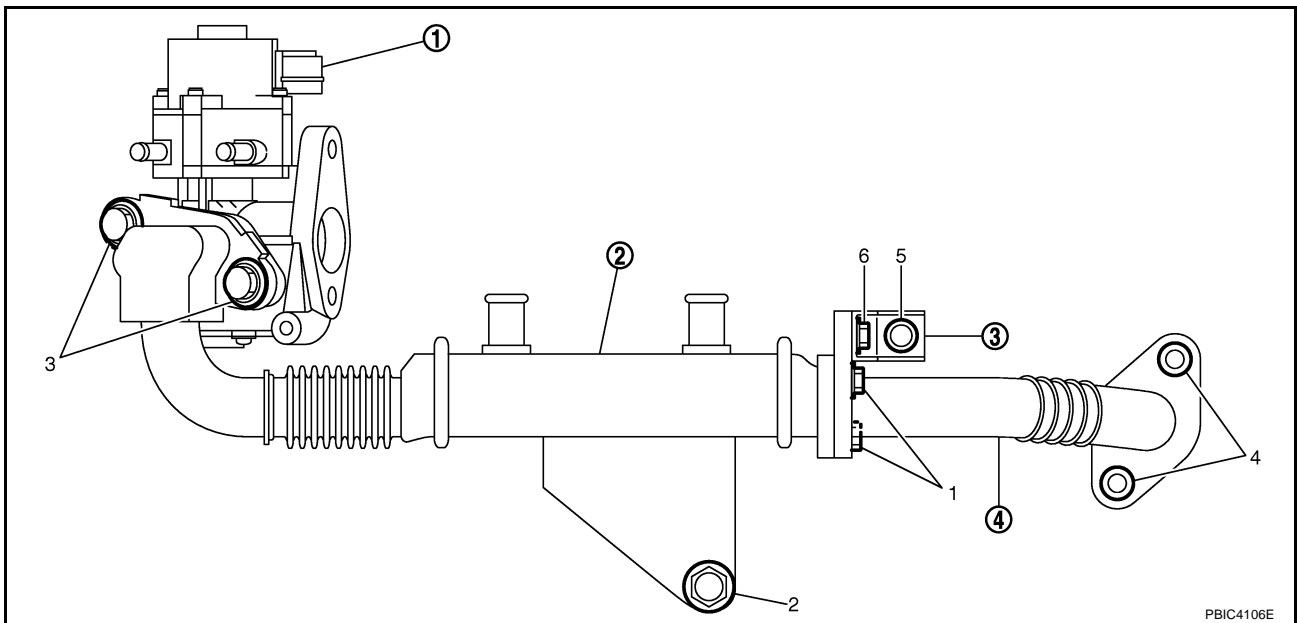
# INTAKE MANIFOLD

[YD]



1. EGR volume control valve      2. EGR tube

- Install EGR cooler (A/T models).
- Tighten fixing bolts and nuts in numerical order as shown in the figure.

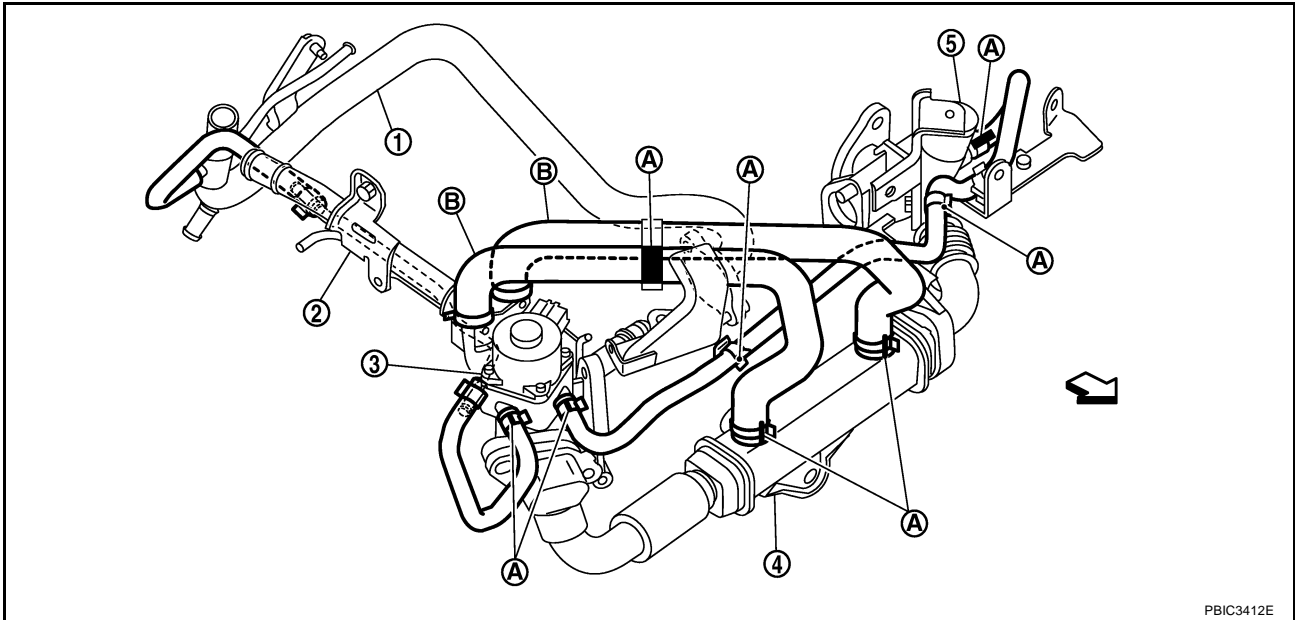


1. EGR volume control valve      2. EGR cooler      3. Bracket  
4. EGR tube

- Install water hoses and heater feed hose.

# INTAKE MANIFOLD

[YD]



PBIC3412E

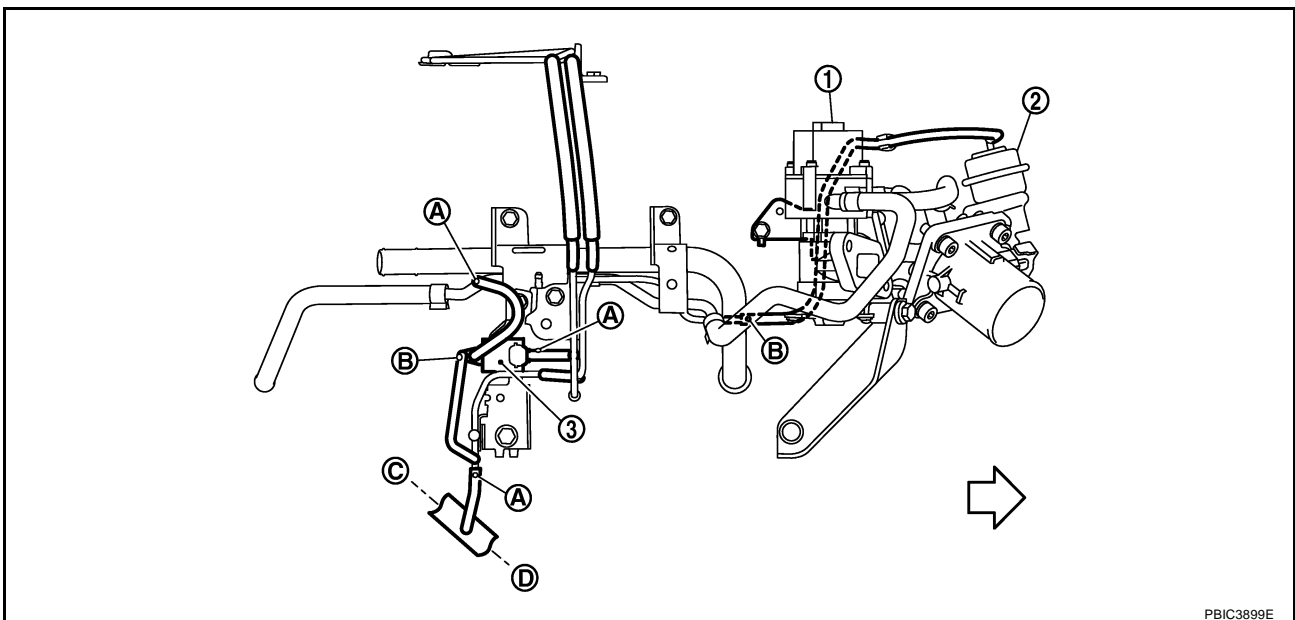
- |   |                     |                             |
|---|---------------------|-----------------------------|
| 1. Heater return pipe                               | 2. Heater feed pipe | 3. EGR volume control valve |
| 4. EGR cooler (A/T models)<br>EGR tube (M/T models) | 5. Water outlet     |                             |
| A. Paint mark                                       | B. A/T models only  |                             |

← Vehicle front

- Install water hose by referring to paint marks avoiding twisting.
- When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

**Dimension A : 27 - 32 mm (1.063 - 1.260 in)**

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the stopper.
- Install vacuum hoses.



PBIC3899E

- |                             |                     |  |
|-----------------------------|---------------------|--|
| 1. EGR volume control valve | 2. Throttle chamber | 3. Intake shutter control solenoid valve |
| A. Yellow paint             | B. White paint      | C. To brake booster                      |
| D. To vacuum pump           | ← Vehicle front     |  |

- Install vacuum hose by referring to paint marks avoiding twisting.

# INTAKE MANIFOLD

[YD]

- When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

A

**Dimension A : 15 – 20 mm (0.591 – 0.787 in)**

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the stopper.
- Before starting engine, bleed air from fuel piping. Refer to [FL-17, "Air Bleeding"](#) .

EM

## INSPECTION AFTER INSTALLATION

Start engine and increase engine speed to check for fuel leak.

C

### **CAUTION:**

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

D

### **NOTE:**

Use mirrors for checking at points out of clear sight.

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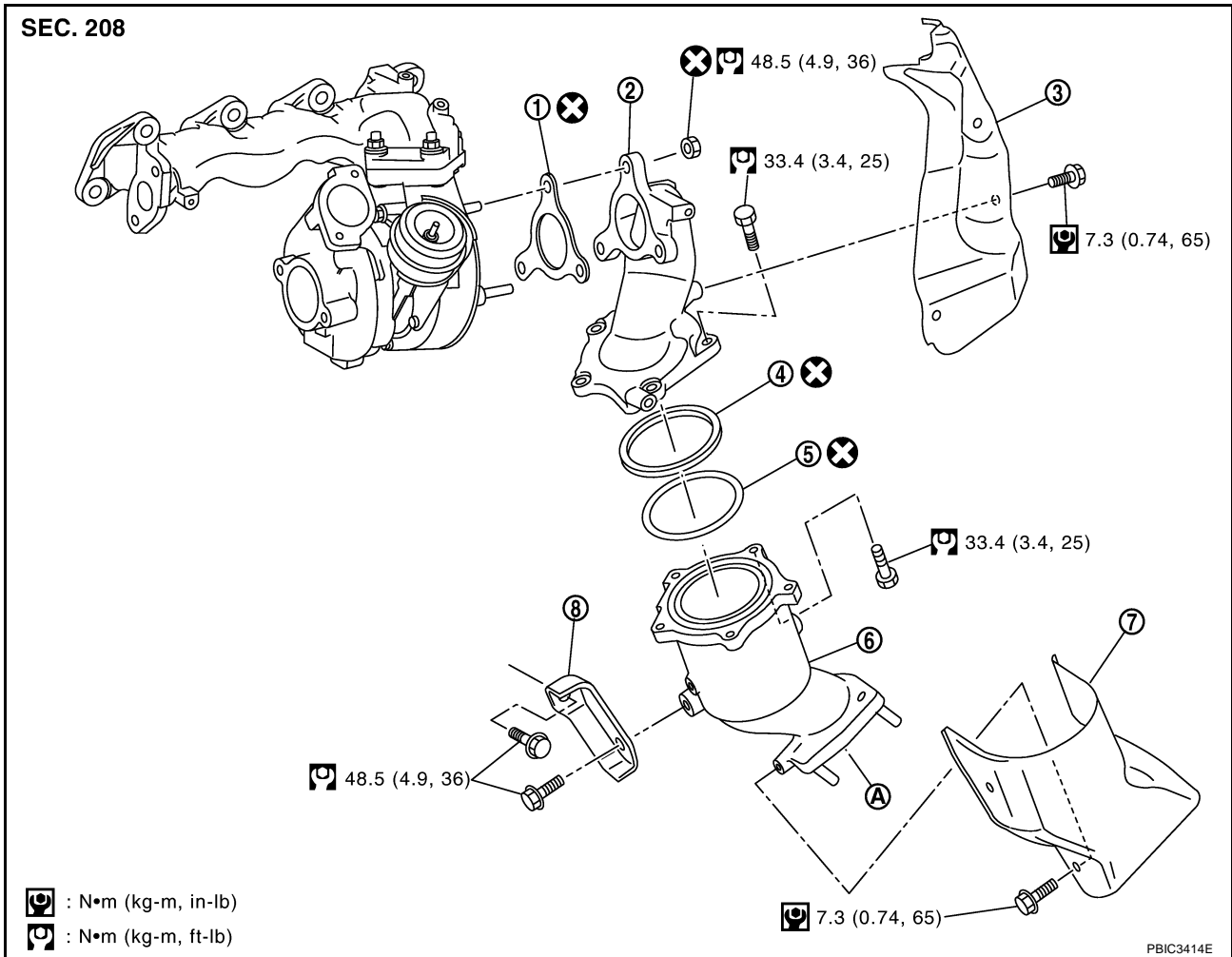
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## CATALYST Components



- |                          |                   |                         |
|--------------------------|-------------------|-------------------------|
| 1. Gasket                | 2. Exhaust outlet | 3. Exhaust outlet cover |
| 4. Gasket                | 5. Gasket cap     | 6. Catalyst             |
| 7. Catalyst cover        | 8. Bracket        |                         |
| A. To exhaust front tube |                   |                         |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.



## Removal and Installation REMOVAL

GBS0000M

- Remove engine undercover.
- Remove catalyst cover and exhaust outlet cover.
- Remove exhaust front tube. Refer to [EX-2, "EXHAUST SYSTEM"](#).
- Remove air inlet hose and air inlet tube. Refer to [EM-162, "CHARGE AIR COOLER"](#).
- Remove exhaust manifold cover. Refer to [EM-178, "EXHAUST MANIFOLD"](#).
- Remove catalyst and exhaust outlet.
- Remove catalyst from exhaust outlet, as necessary.

## INSTALLATION

Note the following, and install in the reverse order of removal.

- If stud bolts of turbocharger were removed, tighten them to the specified torque.
  -  : **25.5 N·m (2.6 kg-m, 19 ft-lb)**
- If stud bolts of catalyst were removed, tighten them to the specified torque.
  -  : **45.0 N·m (4.6 kg-m, 33 ft-lb)**
- Pushing bracket against the cylinder block and the catalyst, temporarily tighten the mounting bolt. And then tighten it to the specified torque.

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# TURBO CHARGER

[YD]

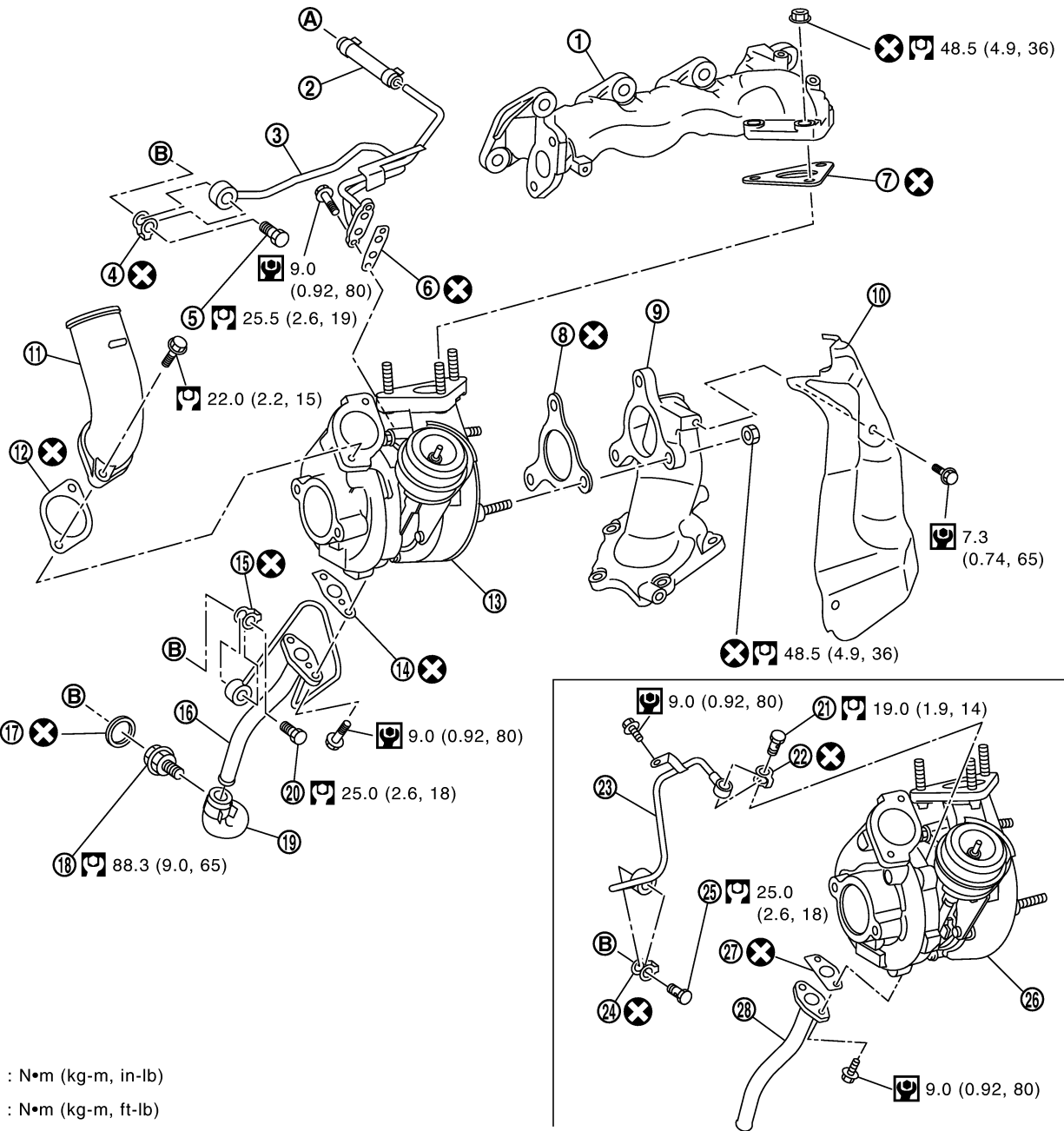
## TURBO CHARGER

PFP:14411

### Components

GBS0000N

SEC. 144



PBIC4095E

- |  |                                |                                |
|--|--------------------------------|--------------------------------|
| 1. Exhaust manifold                                | 2. Water hose (4WD models)     | 3. Water tube (4WD models)     |
| 4. Copper washer (4WD models)                      | 5. Eye-bolt (4WD models)       | 6. Gasket (4WD models)         |
| 7. Gasket  | 8. Gasket                      | 9. Exhaust outlet              |
| 10. Exhaust outlet cover                           | 11. Air inlet pipe             | 12. Gasket                     |
| 13. Turbocharger (4WD models)                      | 14. Gasket (4WD models)        | 15. Copper washer (4WD models) |
| 16. Oil feed tube and oil return tube (4WD models) | 17. Washer                     | 18. Connector                  |
| 19. Oil return hose                                | 20. Eye-bolt (4WD models)      | 21. Eye-bolt (2WD models)      |
| 22. Cooper washer (2WD models)                     | 23. Oil feed tube (2WD models) | 24. Cooper washer (2WD models) |
| 25. Eye-bolt (2WD models)                          | 26. Turbocharger (2WD models)  | 27. Gasket (2WD models)        |



28. Oil return tube (2WD models)

A. To heater return pipe

B. To cylinder block

A

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

GBS00000

EM

### REMOVAL

- After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.
1. Drain engine coolant (4WD models). Refer to [CO-37, "Changing Engine Coolant"](#) .
  2. Remove air inlet hose and air inlet pipe. Refer to [EM-162, "CHARGE AIR COOLER"](#) .
  3. Remove air duct and air inlet pipes. Refer to [EM-159, "AIR CLEANER AND AIR DUCT"](#) .
  4. Remove exhaust manifold cover. Refer to [EM-178, "EXHAUST MANIFOLD"](#) .
  5. Remove exhaust outlet and catalyst. Refer to [EM-170, "CATALYST"](#) .
  6. Remove eye bolt and water hose from water tube (4WD models).
  7. Loosen and remove eye-bolts from oil feed tube.
  8. Disconnect oil return hose from oil return tube.
  9. Remove turbocharger with water tube (4WD models) and oil feed tube and oil return tube.

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#### **CAUTION:**

**Be careful not to deform water tube and oil feed tube and oil return tube.**

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10. Remove water tube (4WD models) and oil feed tube and oil return tube from turbocharger.

#### **CAUTION:**

- Do not disassemble or adjust the turbocharger.
- Be careful not to contact with the vehicle.
- Do not hold turbocharger boost control actuator and actuator rod.

H

### Water Tube and Oil Tube

- Clean inside of water tube (4WD models), oil feed tube and oil return tube, and check tubes for clogging.
- Replace water tube (4WD models), oil feed tube and/or oil return tube if clogging still exists after cleaning.

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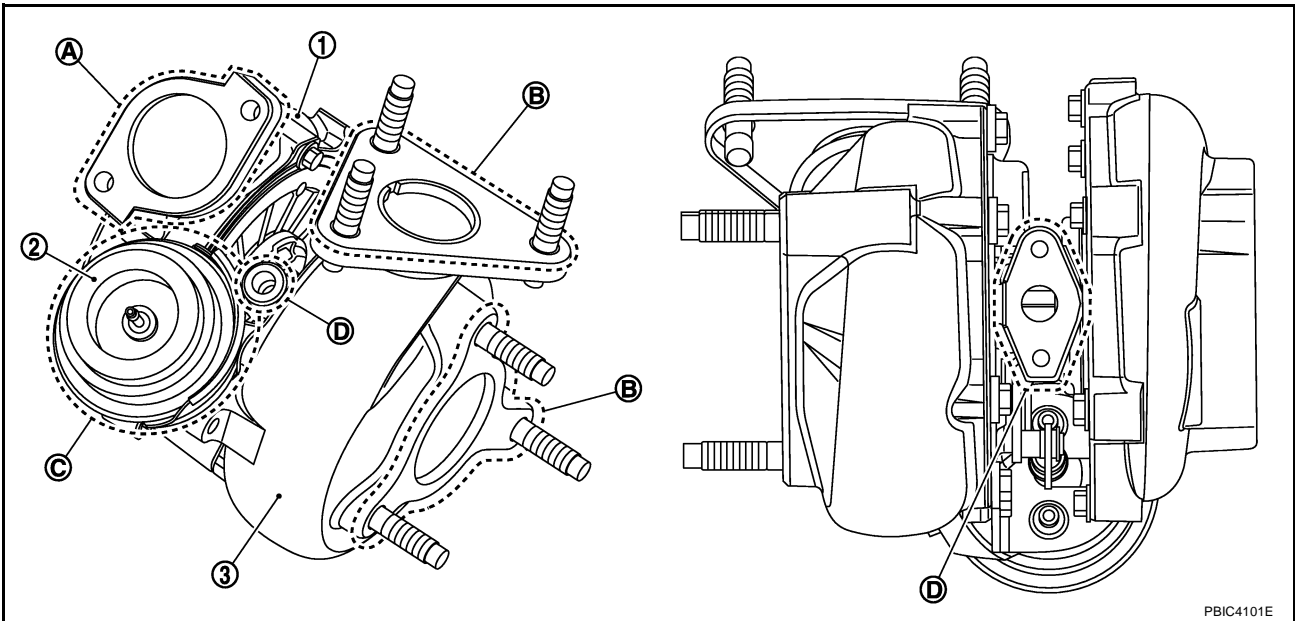
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# TURBO CHARGER

[YD]

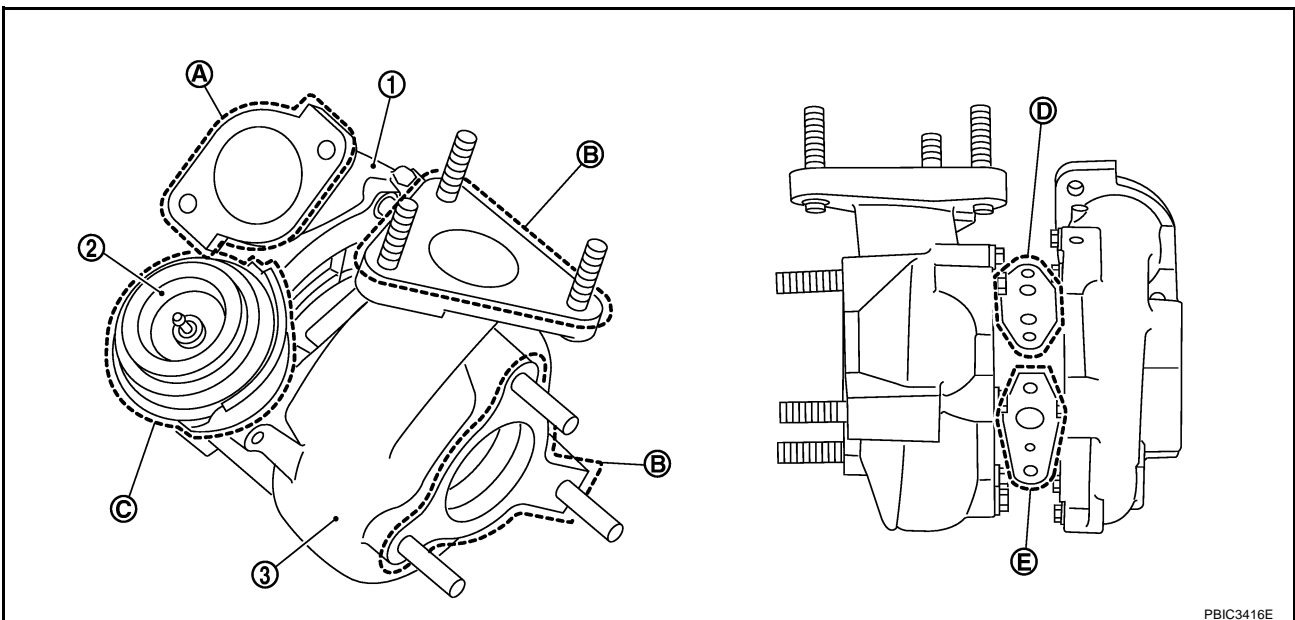
## INSPECTION AFTER REMOVAL

### 2WD Models



- |  |  |  |
|--|--|--|
| 1. Compressor housing                  | 2. Turbocharger boost control actuator | 3. Turbine housing                       |
| A. Check for charge air pressure leaks | B. Check for exhaust gas leaks         | C. Check for negative air pressure leaks |
| D. Check for engine oil leaks          |  |  |

### 4WD Models



- |  |  |  |
|--|--|--|
| 1. Compressor housing                  | 2. Turbocharger boost control actuator | 3. Turbine housing                       |
| A. Check for charge air pressure leaks | B. Check for exhaust gas leaks         | C. Check for negative air pressure leaks |
| D. Check for engine coolant leaks      | E. Check for engine oil leaks          |  |

### CAUTION:

When the compressor wheel turbine, wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary malfunction:

**Suction side** : Between turbocharger and charge air cooler

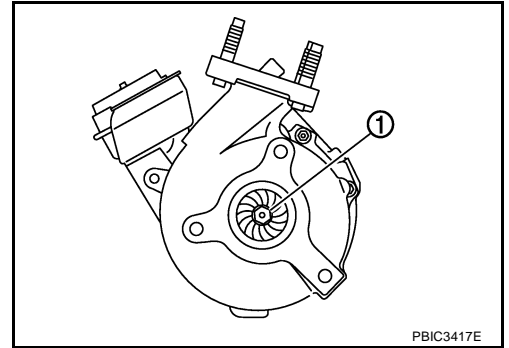
**Exhaust side** : Between turbocharger and catalyst

## Rotor Shaft Clearance

- Make sure that the rotor shaft (1) rotates smoothly without any resistance when it is rotated by your fingertips.
- Make sure that the rotor shaft (1) is not loose when it is moved vertically or horizontally.
- Measure looseness with a dial gauge inserting its measuring rod through oil drain hole of turbocharger.

**Standard : 0.086 - 0.117 mm (0.0034 - 0.0046 in)**

- Replace turbocharger if out of standard.

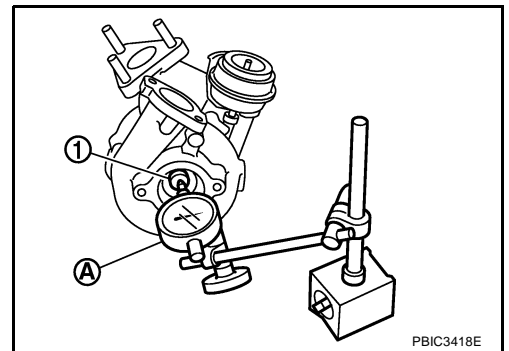


## Rotor Shaft End Play

- Place a dial gauge (A) at the rotor shaft (1) end in the axial direction to measure the end play.

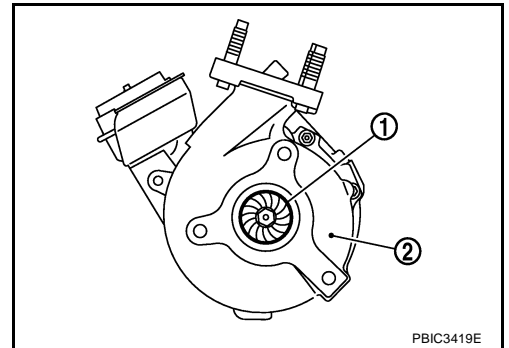
**Standard : 0.036 - 0.090 mm (0.0014 - 0.0035 in)**

- Replace turbocharger if out of standard.



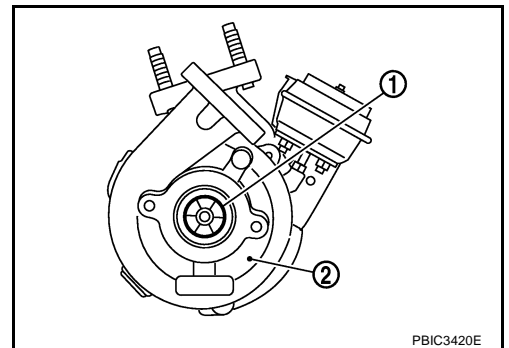
## Turbine Wheel

- Make sure that there is no engine oil adhesion.
- Make sure that there is no carbon accumulation.
- Make sure that blades of turbine wheel (1) are not bent or broken.
- Make sure that turbine wheel (1) does not interfere with turbine housing (2).



## Compressor Wheel

- Make sure that there is no engine oil adhesion inside the air inlet.
- Make sure that compressor wheel (1) does not interfere with compressor housing (2).
- Make sure that compressor wheel (1) is not bent or broken.



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## Turbocharger Boost Control Actuator

- Connect the handy vacuum pump (B) to the turbocharger boost control actuator (1), and make sure that the rod (2) strokes smoothly in compliance with the following pressure.

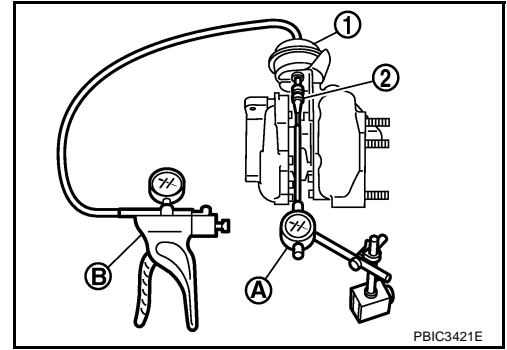
A : Dial gauge

- Pressure to be applied at the turbocharger boost control actuator (1) part to move rod (2) end as follows:

**Standard (Pressure/rod stroke amount):**

**: -52.0 to -54.6 kPa (-520 to -546 mbar, -390 to -410 mmHg, -15.4 to -16.1 inHg)/0.2 mm (0.0079 in)**

**: -32.0 to -40.0 kPa (-320 to -400 mbar, -240 to -300 mmHg, -9.45 to -11.8 inHg)/5.0 mm (0.197 in)**



## TROUBLE DIAGNOSIS OF TURBOCHARGER

Preliminary check:

- Make sure that the engine oil level is between MIN and MAX of the oil level gauge. (When engine oil amount is more than MAX, engine oil flows into the inlet duct through blow-by gas passage, and turbocharger is misjudged malfunction.)
- Ask the customer if he/she always runs the vehicle in idle engine speed to cool the engine oil down after driving.
- Replace the turbocharger assembly when any malfunction is found after unit inspections specified in the table below.
- If no malfunction is found after the unit inspections, judge that the turbocharger body has no malfunction. Check the other parts again.

Inspection item	Inspection result	Symptom (when each inspection item meets each inspection result)			
		Engine oil leakage	Smoke	Noise	Insufficient power/acceleration malfunction
Turbine wheel	Engine oil leaks	C	A	C	C
	Carbon is accumulated	C	A	B	B
	Friction with housing	C	B	A	B
	Blades are bent or broken	—	—	A	A
Compressor wheel	Inside the air inlet is seriously contaminated by engine oil.	B	B	—	—
	Friction with housing	C	B	A	B
	Blades are bent or broken	—	—	A	A
After checking both turbine and compressor, inspect rotor shaft end play.	There is resistance when the rotor shaft is rotated by your fingertips.	—	C	C	B
	The rotor shaft sometimes does not rotate by your fingertips.	—	—	—	A
	There is too much play in the bearing.	C	C	B	C
Oil return port	Carbon or sludge is accumulated in the waste oil hole.	C	A	C	C

A: Large possibility  
 B: Medium possibility  
 C: Small possibility

## INSTALLATION

Note the following, and install in the reverse order of removal.

- When a stud bolt is pulled out, replace it with a new one and tighten it to the following torque.

: **25.5 N·m (2.6 kg-m, 19 ft-lb)**

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# EXHAUST MANIFOLD

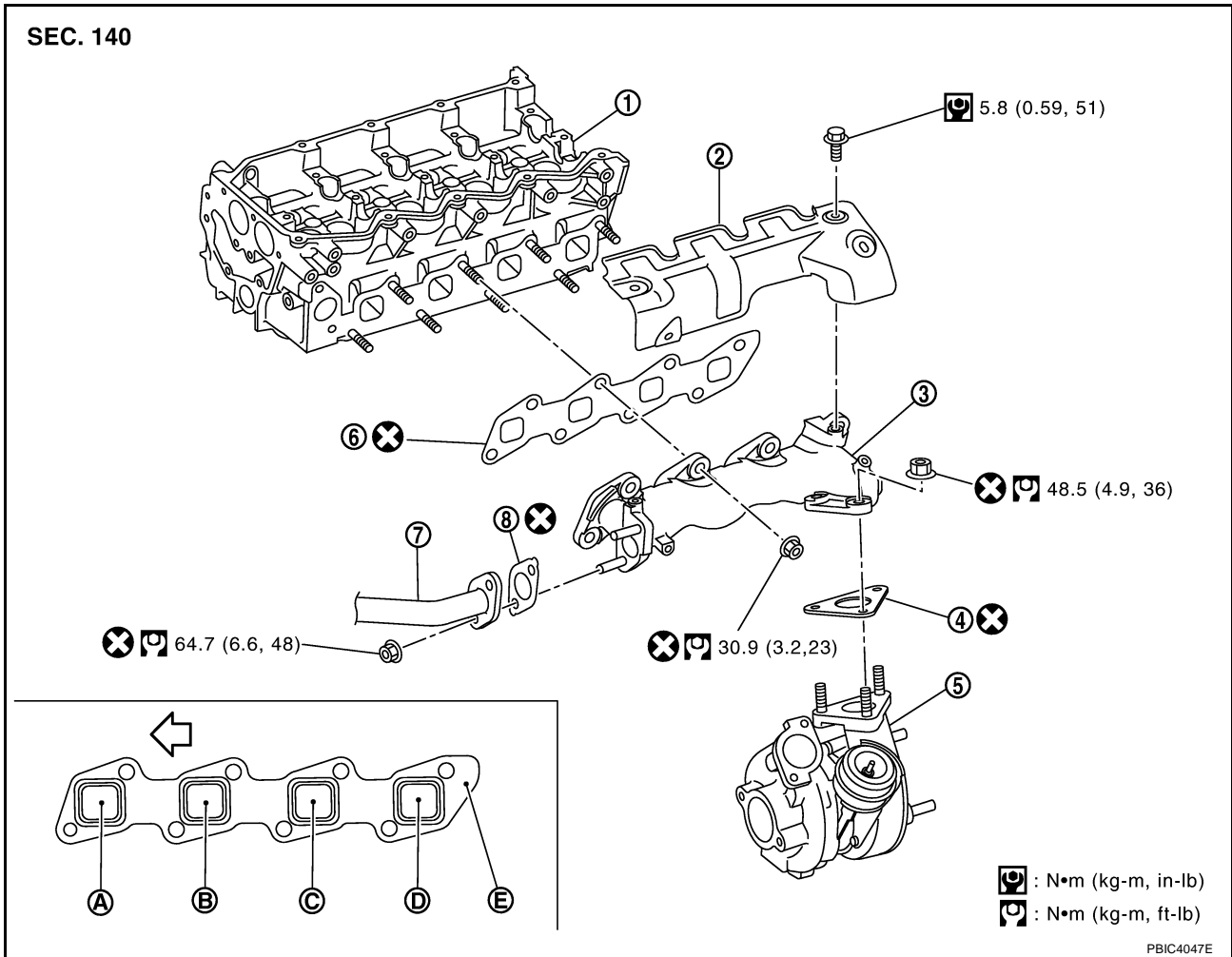
[YD]

## EXHAUST MANIFOLD

PFP:14004

### Components

GBS0000P



- |                  |                           |                     |
|------------------|---------------------------|---------------------|
| 1. Cylinder head | 2. Exhaust manifold cover | 3. Exhaust manifold |
| 4. Gasket        | 5. Turbocharger           | 6. Gasket           |
| 7. EGR tube      | 8. Gasket                 |                     |
| A. No.1 port     | B. No.2 port              | C. No.3 port        |
| D. No.4 port     | E. Alignment protrusion   |                     |
- ← Vehicle front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

## Removal and Installation

### REMOVAL

GBS0000Q

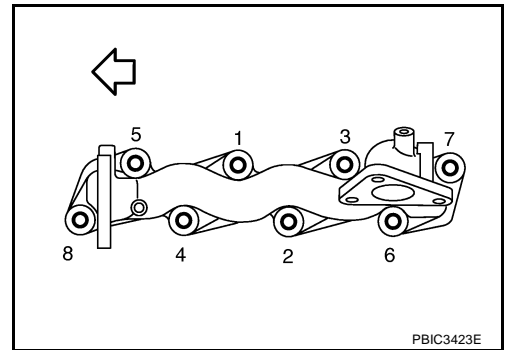
- Drain engine coolant. Refer to [CO-37, "Changing Engine Coolant"](#).
- Remove exhaust manifold cover.
- Remove turbocharger. Refer to [EM-172, "TURBO CHARGER"](#).
- Remove EGR tube (M/T models) or EGR cooler (A/T models). Refer to [EM-164, "INTAKE MANIFOLD"](#).

# EXHAUST MANIFOLD

[YD]

5. Loosen exhaust manifold mounting nuts in the reverse order in the figure.

← : Vehicle front



6. Rotate exhaust manifold.

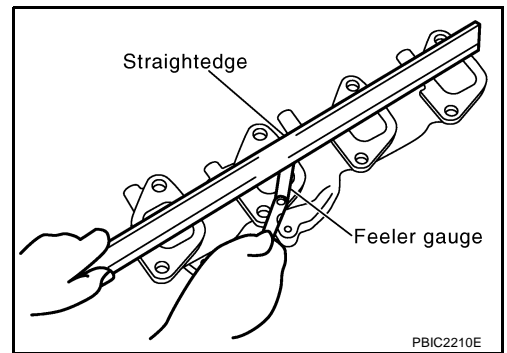
## INSPECTION AFTER REMOVAL

### Surface Distortion

- Use a reliable straight edge and feeler gauge to check the flatness of exhaust manifold fitting surface.

**Limit :0.3 mm (0.012 in)**

- If it exceeds the limit, replace exhaust manifold.



## INSTALLATION

- If stud bolts were removed, replace them with new ones, and tighten them to the specified torque:

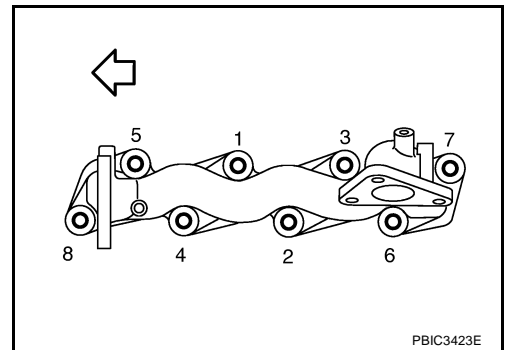
: **14.7 N·m (1.5 kg·m, 11 ft·lb)**

- Tighten the exhaust manifold mounting nuts in the following procedure:

- Install gasket so that the alignment protrusion faces the No. 4 port. Refer to [EM-178, "Removal and Installation"](#).
- Tighten the nuts in order specified in the figure.

← : Vehicle front

- Re-tighten the nuts 1 to 8.
- Install in the reverse order of removal.



## INSPECTION AFTER INSTALLATION

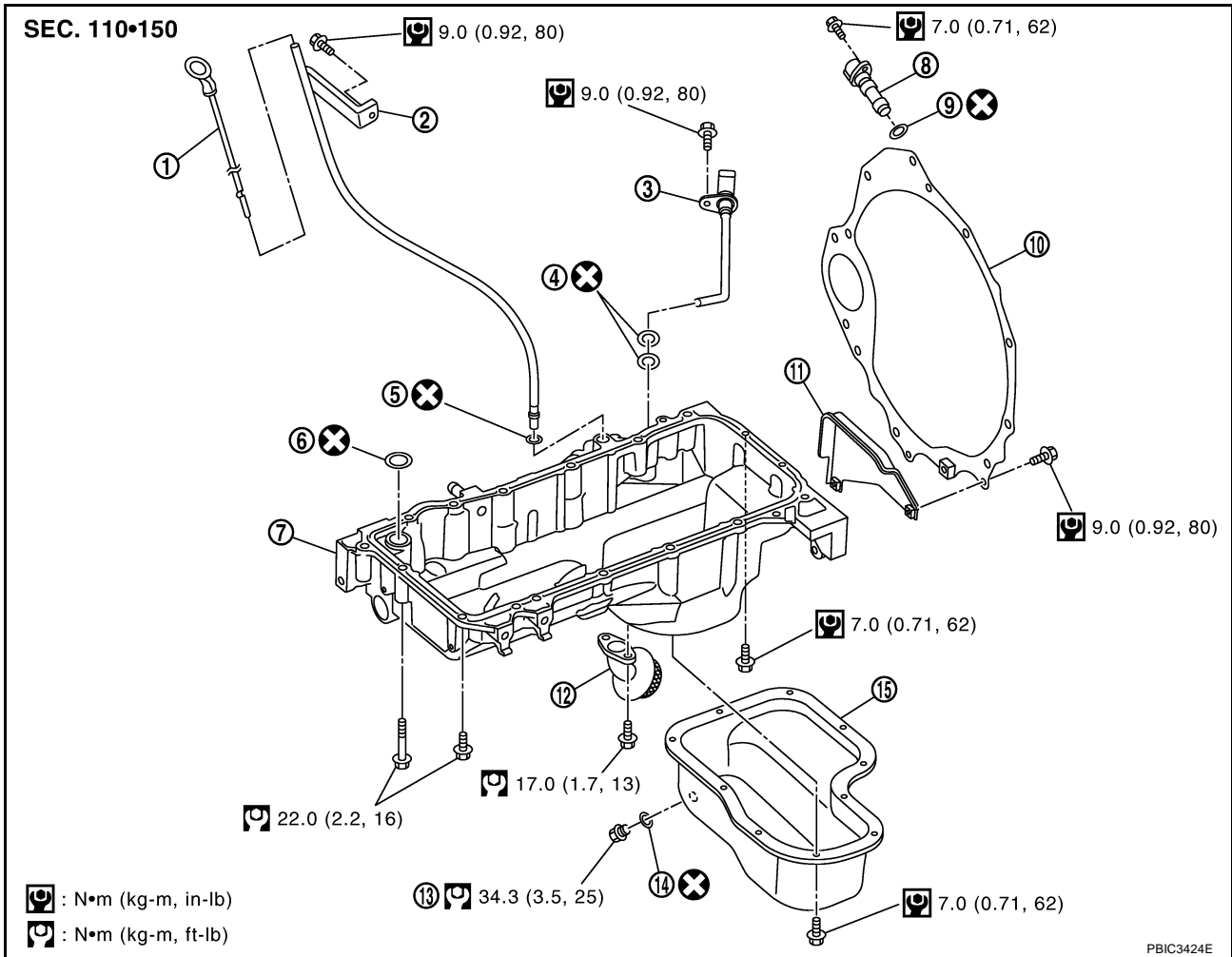
Start engine and raise engine speed to check no exhaust gas and engine oil leaks.

## OIL PAN AND OIL STRAINER

PFP:11110

### Components

GBS0000R



- |                        |                               |                     |
|------------------------|-------------------------------|---------------------|
| 1. Oil level gauge     | 2. Oil level gauge guide      | 3. Oil level sensor |
| 4. O-ring              | 5. O-ring                     | 6. O-ring           |
| 7. Oil pan upper       | 8. Crankshaft position sensor | 9. O-ring           |
| 10. Rear plate         | 11. Rear plate cover          | 12. Oil strainer    |
| 13. Oil pan drain plug | 14. Drain plug washer         | 15. Oil pan lower   |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

### Removal and Installation

#### REMOVAL

#### **WARNING:**

**To avoid the danger of being scalded, do not drain engine oil when engine is hot.**

- Remove engine undercover front and engine undercover middle. Refer to [EI-17, "REAR BUMPER"](#).
- Drain engine oil. Refer to [LU-21, "Changing Engine Oil"](#).

GBS0000S

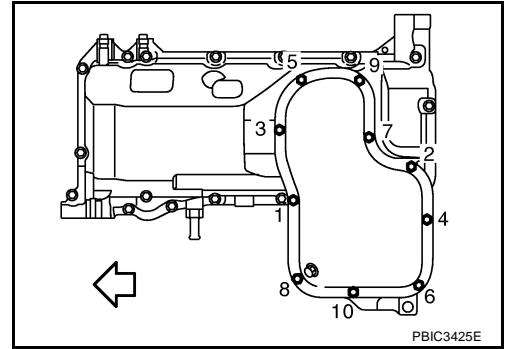


# OIL PAN AND OIL STRAINER

[YD]

3. Remove oil pan lower bolts, loosen bolts in the reverse order of that shown in the figure.

← : Vehicle front



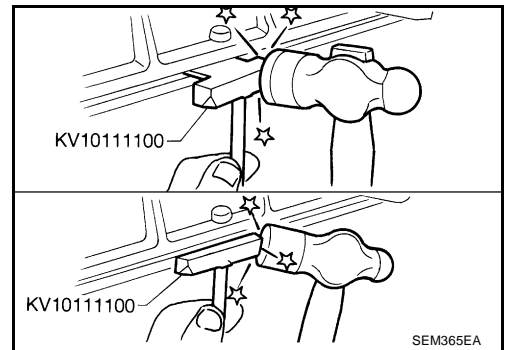
4. Remove oil pan lower.

- a. Insert the seal cutter [SST] between oil pan upper and oil pan lower.

**CAUTION:**

- Be careful not to damage aluminum mating surface.
- Do not insert screwdriver, or oil pan flange will be deformed.

- b. Slide the seal cutter by tapping on the side of the seal cutter with a hammer.
- c. Remove oil pan lower.



5. Remove oil strainer.

6. Remove power steering oil pump belt. Refer to [EM-156, "DRIVE BELTS"](#) .

7. Remove power steering oil pump bracket and move power steering oil pump aside with its piping connected. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [PS-24, "POWER STEERING OIL PUMP"](#) .

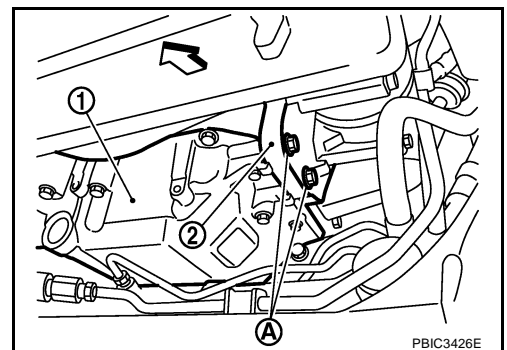
8. Disconnect oil return hose (vacuum pump) from oil pan upper. Refer to [EM-186, "VACUUM PUMP"](#) .

9. Remove A/C compressor bracket mounting bolts (A).

1 : Oil pan upper

2 : A/C compressor bracket

← : Vehicle front



10. Remove crankshaft position sensor and oil level sensor.

**CAUTION:**

- Avoid impacts such as a dropping.
- Do not disassemble.
- Keep it away from metal particles.
- Do not place sensor close to magnetic materials.

11. Remove front propeller shaft (4WD models). Refer to [PR-3, "FRONT PROPELLER SHAFT"](#) .

12. Remove RH and LH front drive shaft (4WD models). Refer to [FAX-7, "DRIVE SHAFT"](#) .

13. Remove front final drive assembly (4WD models). Refer to [FFD-15, "FRONT FINAL DRIVE ASSEMBLY"](#) .

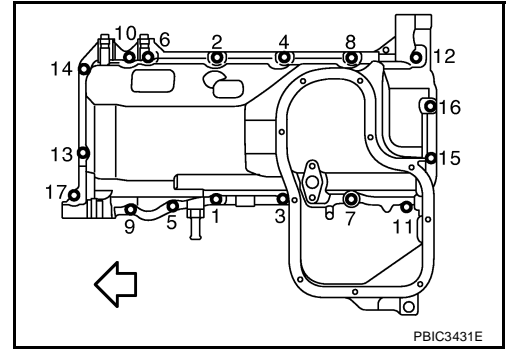
14. Remove rear plate cover and transmission joint bolts.

# OIL PAN AND OIL STRAINER

[YD]

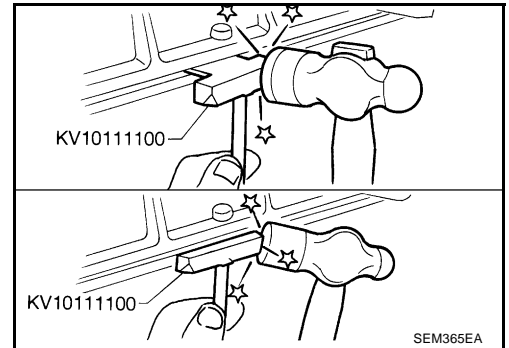
15. Loosen bolts in the reverse order of illustration to remove oil pan upper.

← : Vehicle front



16. Remove oil pan upper.

- Insert the seal cutter [SST] between oil pan upper and cylinder block. Slide the seal cutter by tapping on the side of the seal cutter with a hammer. Remove oil pan upper.
- **Be careful not to damage aluminum mating surface.**
- **Do not insert screwdriver, or oil pan flange will be deformed.**



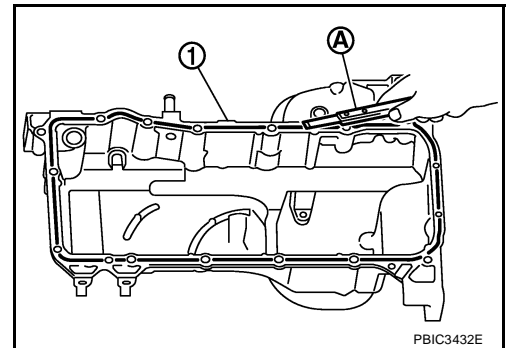
## INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

## INSTALLATION

Note the following, and install in the reverse order of removal.

- Install oil pan upper with the following procedure.
  - Use the scraper (A) to remove old liquid gasket from mating surface of oil pan upper (1).
- **Also remove old liquid gasket from mating surface of cylinder block and rear chain case.**
- **Remove old liquid gasket from the bolt hole and thread.**



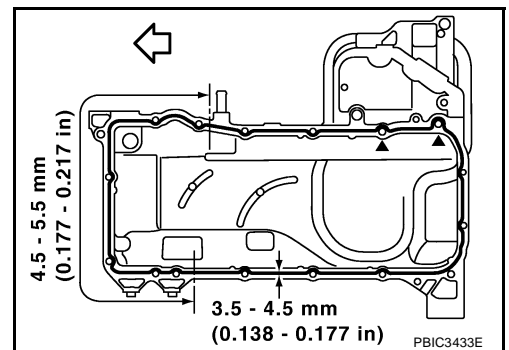
- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] to areas shown in the figure.

← : Vehicle front

**Use Genuine Liquid Gasket or equivalent.**

### CAUTION:

- **At the 2 bolt holes marked ▲, liquid gasket should be applied outside holes.**
- **Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) or 4.5 to 5.5 mm (0.177 to 0.217 in) wide. (Be careful that the diameter of the liquid gasket bead is different around the front.)**
- **Attaching should be done within 5 minutes after coating.**
- Install oil pan upper.



# OIL PAN AND OIL STRAINER

[YD]

**CAUTION:**

**Install avoiding misalignment of O-ring.**

- Tighten bolts in numerical order to the specified torque.

← : Vehicle front

- Bolt dimensions vary depending on the installation location. Refer to the following and use appropriate bolts.

**M6 x 30 mm (1.18 in) : Bolt No. 15, 16**

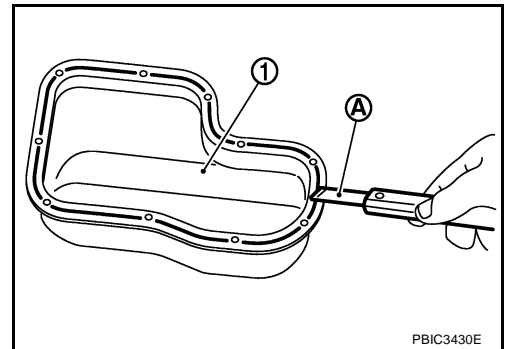
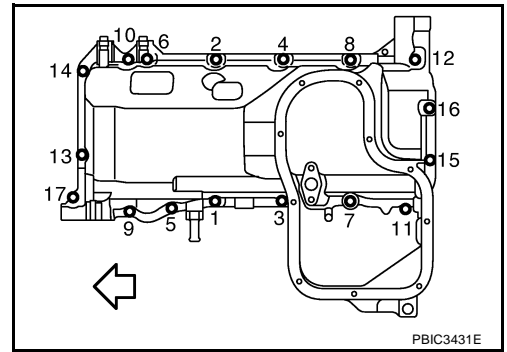
**M8 x 25 mm (0.98 in) : Bolt No. 2, 4, 5, 8, 9, 10, 14**

**M8 x 60 mm (2.36 in) : Bolt No. 1, 3, 6, 7, 11, 12, 13, 17**

- The shank length under the bolt neck above is the length of the threaded part (pilot portion not included).
- Install oil pan lower with the following procedure.
- Use a scraper (A) to remove old liquid gasket from mating surface of oil pan lower (1).

**CAUTION:**

- Also remove old liquid gasket from mating surface of oil pan upper.
- Remove old liquid gasket from bolt hole and thread.

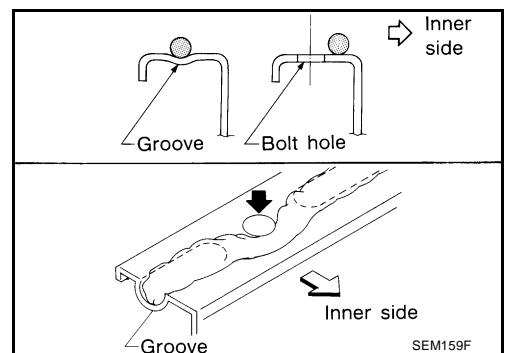
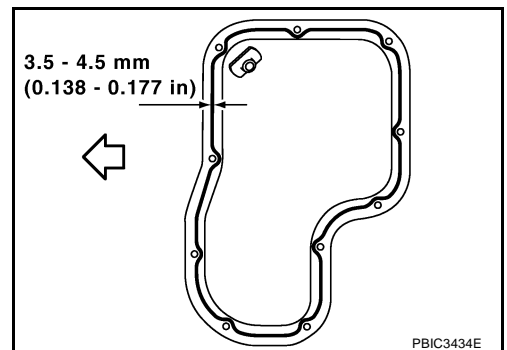


- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.

← : Vehicle front

**Use Genuine Liquid Gasket or equivalent.**

- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.
- Attaching should be done within 5 minutes after coating.



- Install oil pan lower.

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# OIL PAN AND OIL STRAINER

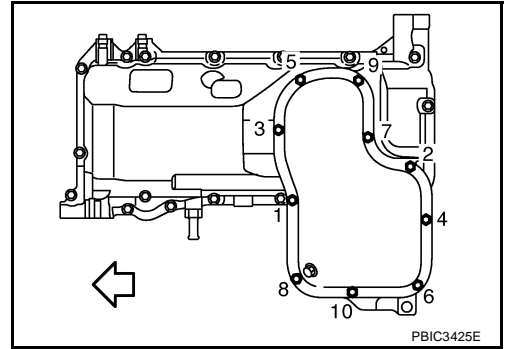
[YD]

- Tighten bolts in numerical order to the specified torque.

← : Vehicle front

**NOTE:**

Pour engine oil or start engine at least 30 minutes after oil pan is installed.



## INSPECTION AFTER INSTALLATION

1. Check engine oil level and add engine oil. Refer to [LU-20, "ENGINE OIL"](#) .
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-20, "ENGINE OIL"](#) .

## GLOW PLUG

PPF:22401

### Components

GBS0000T

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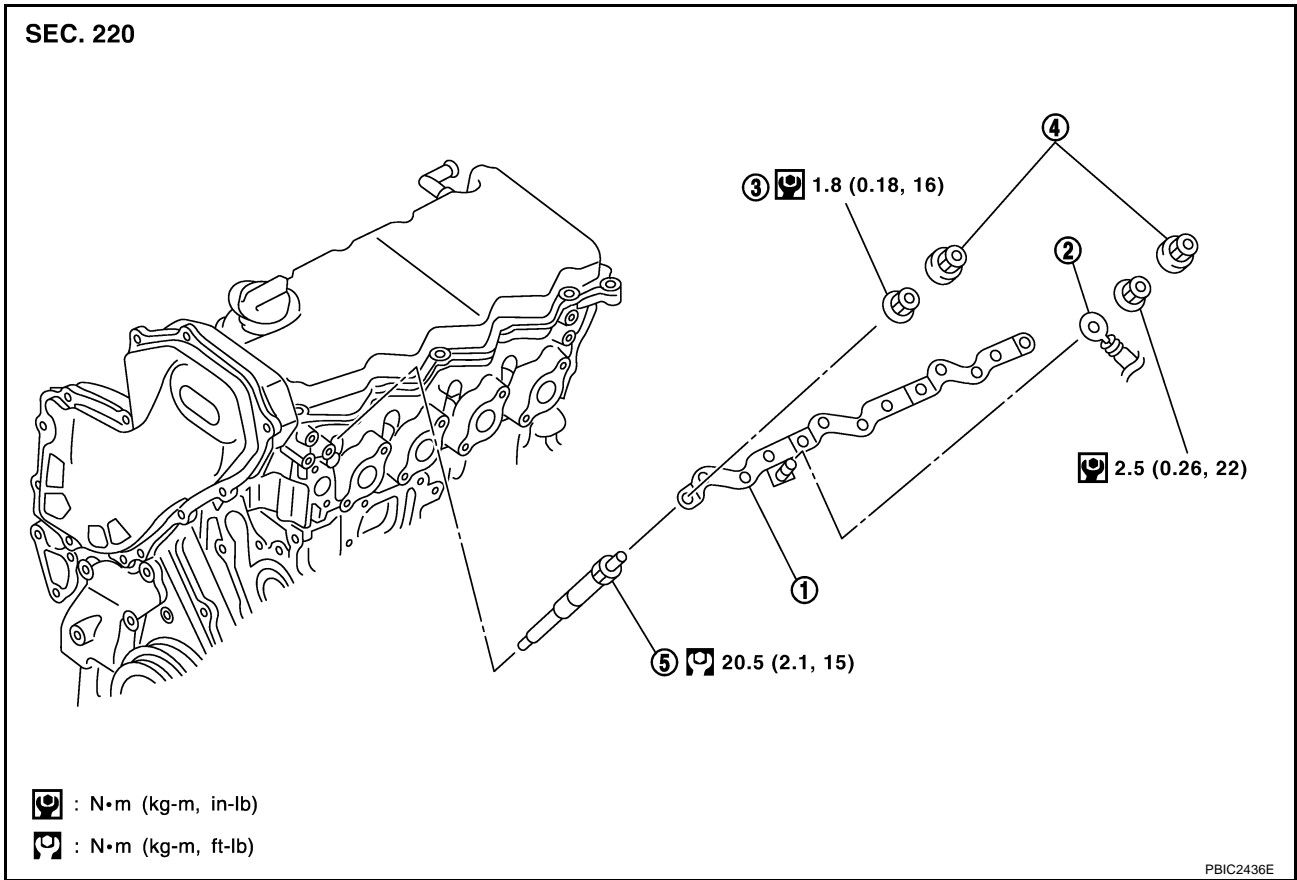
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1. Glow plate

2. Glow harness

3. Glow nut

4. Cap

5. Glow plug

## Removal and Installation

### REMOVAL

GBS0000U

#### CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect glow harness from glow plate.
2. Remove glow nut to remove glow plate.
3. Remove glow plug.

#### CAUTION:

- When removing or installing, do not use such tools as an air impact wrench.
- Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]

### INSTALLATION

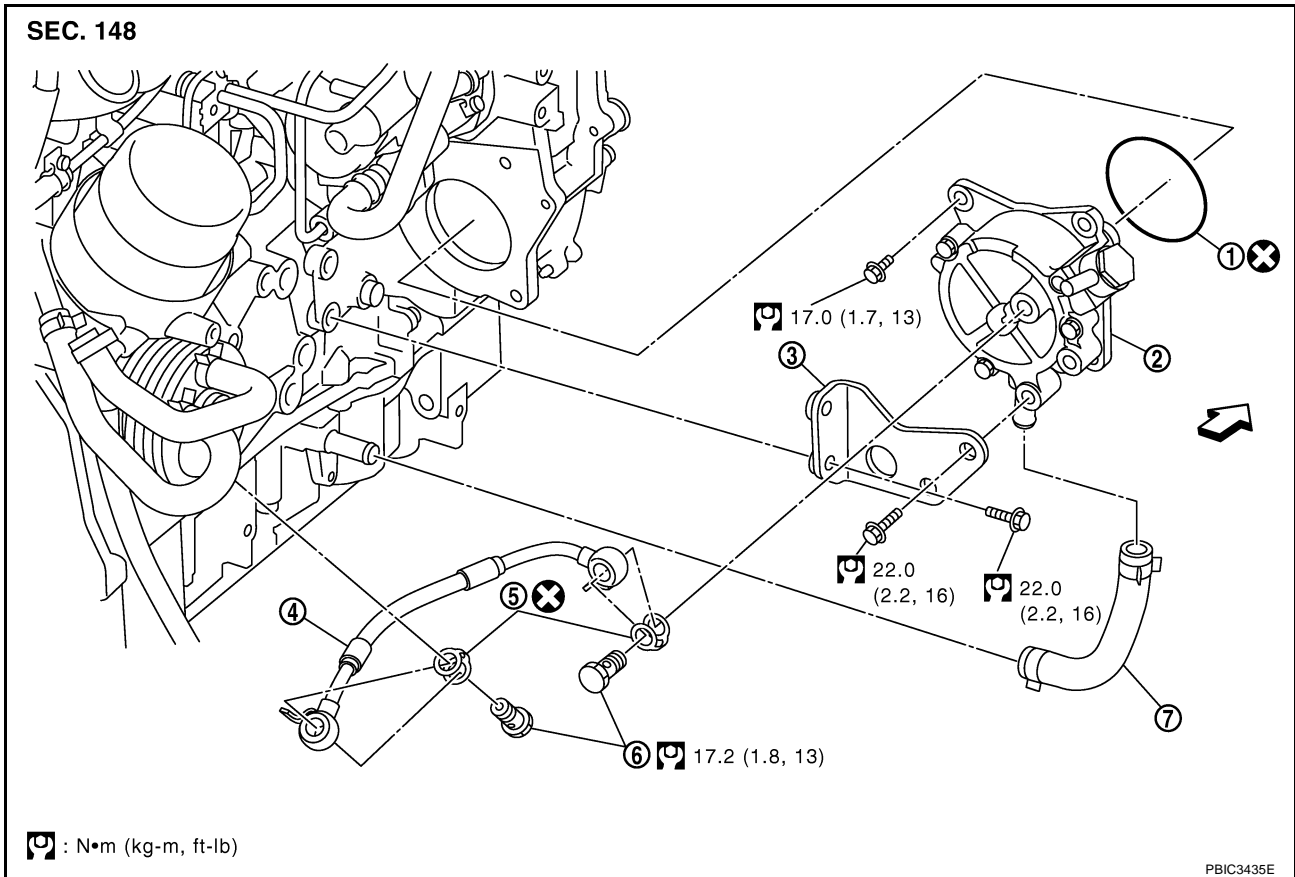
1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in the reverse order of removal.

## VACUUM PUMP

PFP:41920

### Components

GBS0000V



- |                    |                  |             |
|--------------------|------------------|-------------|
| 1. O-ring          | 2. Vacuum pump   | 3. Bracket  |
| 4. Oil feed tube   | 5. Cooper washer | 6. Eye-bolt |
| 7. Oil return hose |                  |             |

← Vehicle front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

## Removal and Installation

### INSPECTION BEFORE REMOVAL

GBS0000W

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
  - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

#### Standard:

**-94.0 to -96.1 kPa (-940 to -961 mbar, -705 to -721 mmHg, -27.76 to -28.38 inHg)**

- If out of standard, check for air suction in vacuum route, and measure again.
- If still outside of standard, replace vacuum pump.

### REMOVAL

1. Drain engine oil. Refer to [LU-21, "Changing Engine Oil"](#).
2. Remove primary timing chain. Refer to [EM-223, "PRIMARY TIMING CHAIN"](#).
3. Disconnect vacuum hose from vacuum pump side.
4. Remove oil feed tube and oil return hose.
5. Remove bracket.
6. Remove vacuum pump and O-ring.

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## INSTALLATION

Installation is the reverse order of removal.

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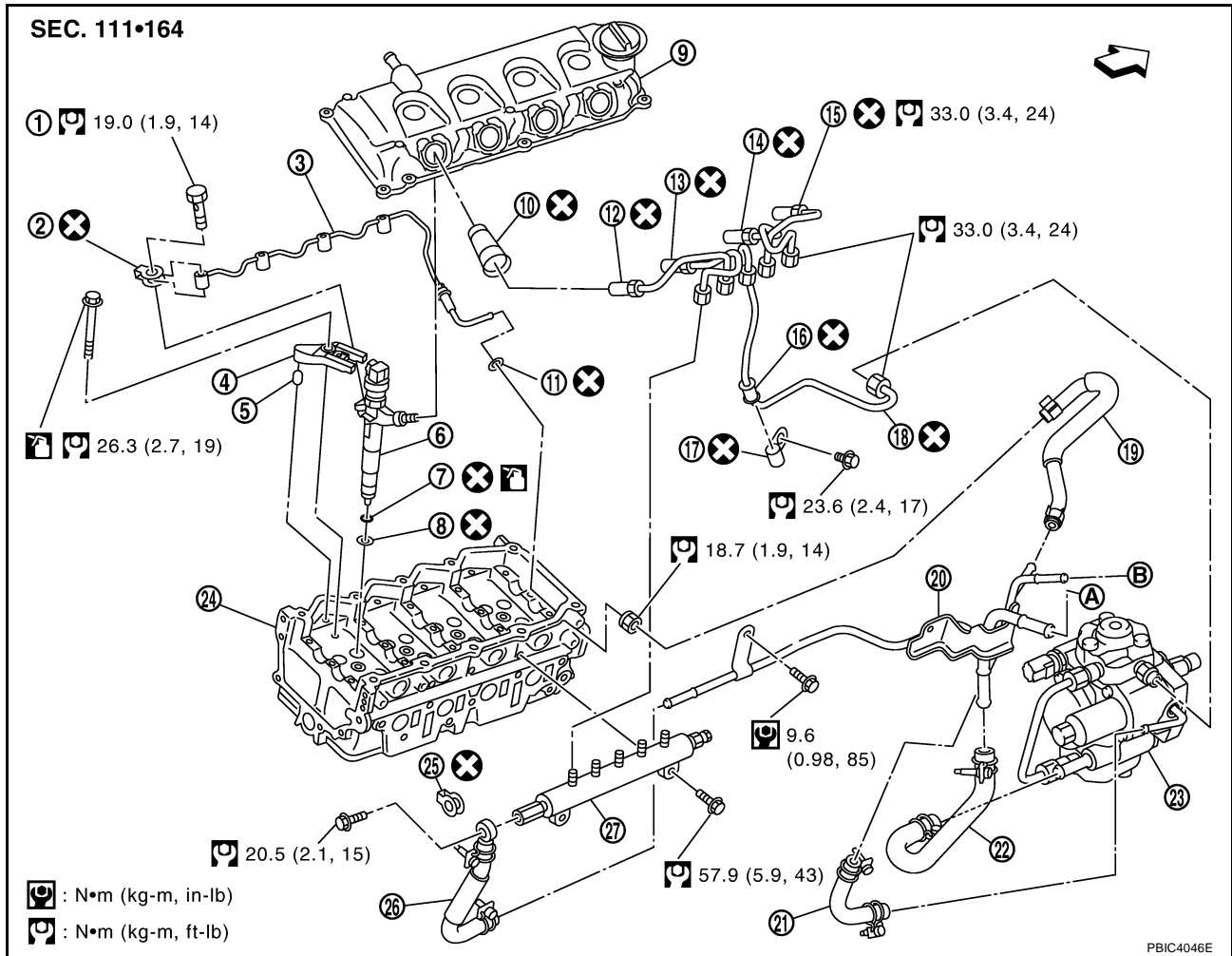
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## INJECTION TUBE AND FUEL INJECTOR

PFP:00018

### Components

GBS0000X



- |                          |                          |                           |
|--------------------------|--------------------------|---------------------------|
| 1. Eye-bolt              | 2. Cooper washer         | 3. Spill tube             |
| 4. Nozzle support        | 5. Pin                   | 6. Fuel injector          |
| 7. O-ring                | 8. Nozzle gasket         | 9. Rocker cover           |
| 10. Nozzle oil seal      | 11. Washer               | 12. Injection tube No. 4  |
| 13. Injection tube No. 3 | 14. Injection tube No. 2 | 15. Injection tube No. 1  |
| 16. Insert rubber        | 17. Clip                 | 18. Injection tube center |
| 19. Spill hose           | 20. Fuel gallery         | 21. Spill hose            |
| 22. Fuel hose            | 23. Fuel pump            | 24. Cylinder head         |
| 25. Cooper washer        | 26. Fuel hose            | 27. Fuel rail             |

- A. To fuel filter
- B. To fuel cooler (under floor) (4WD models)  
To fuel tank (2WD models)

← Vehicle front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

### Removal and Installation

#### REMOVAL

GBS0000Y

- Remove engine cover. Refer to [EM-164, "INTAKE MANIFOLD"](#).
- Remove fuel filter. Refer to [FL-15, "FUEL FILTER"](#).

#### CAUTION:

Be careful not to allow leaked fuel to contaminate engine room. Especially, ensure to keep engine mounting insulator clear of fuel.



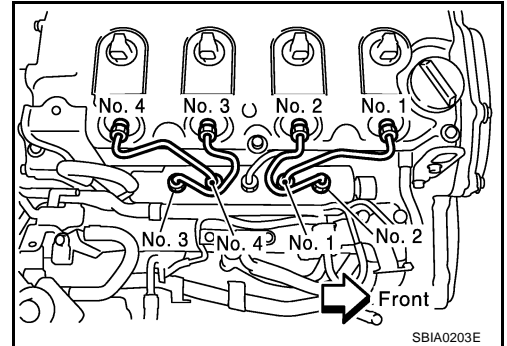
# INJECTION TUBE AND FUEL INJECTOR

[YD]

3. Disconnect harness connector from fuel injector.
4. Remove spill hose.
5. Following steps below, remove injection tubes.
  - a. Put a paint mark or tag on injection tubes to identify each cylinder.
    - Use a fuel-resistant method.
  - b. Remove injection tubes in order of 2-1-4-3 individually.

**CAUTION:**

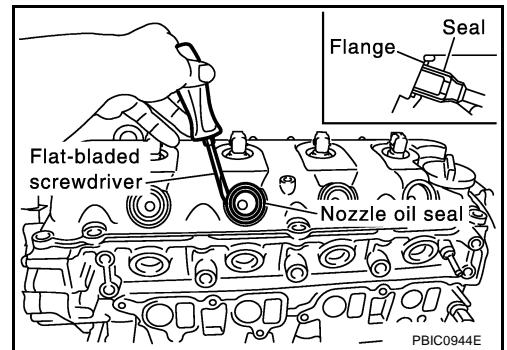
Be careful not to allow leaked fuel to contaminate engine room. Especially, ensure to keep engine mounting insulator clear of fuel.



6. Remove nozzle oil seal.
  - Using the flat-bladed screwdriver, pry flange to remove oil seal.

**NOTE:**

Nozzle oil seal seals between fuel injector and rocker cover. If only injection tube shall be removed and installed, nozzle oil seal replacement is not required.



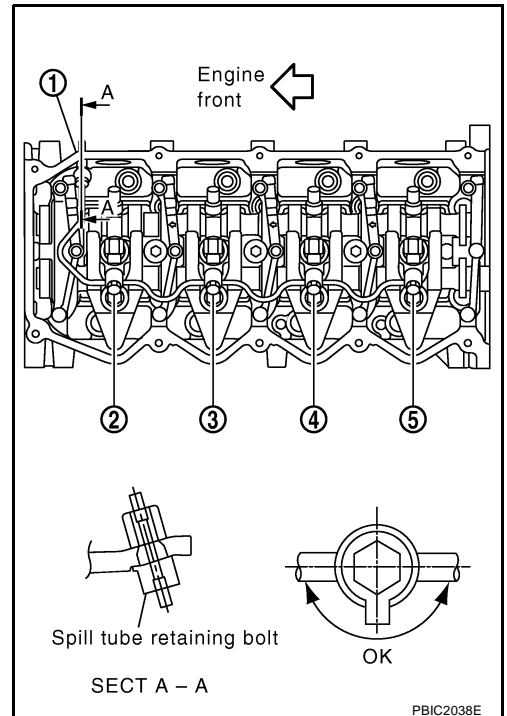
7. Remove rocker cover. Refer to [EM-200, "ROCKER COVER"](#).

8. Remove spill tube mounting bolts and nut.

- Loosen bolts and nut to the reverse order in the figure and remove them.

**CAUTION:**

When loosening nut, fix spill tube retaining bolt with spanner.



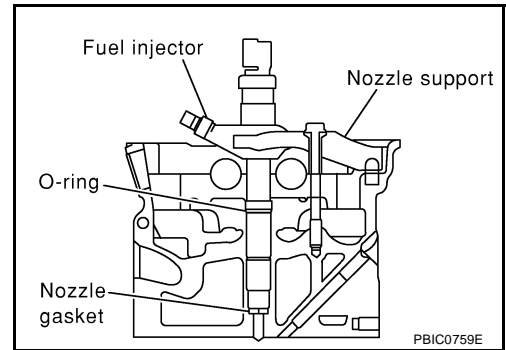
# INJECTION TUBE AND FUEL INJECTOR

[YD]

9. Following steps below, remove fuel injector.
  - a. Remove nozzle support.
  - b. Remove fuel injector. While rotating it to left and right, raise it to remove.

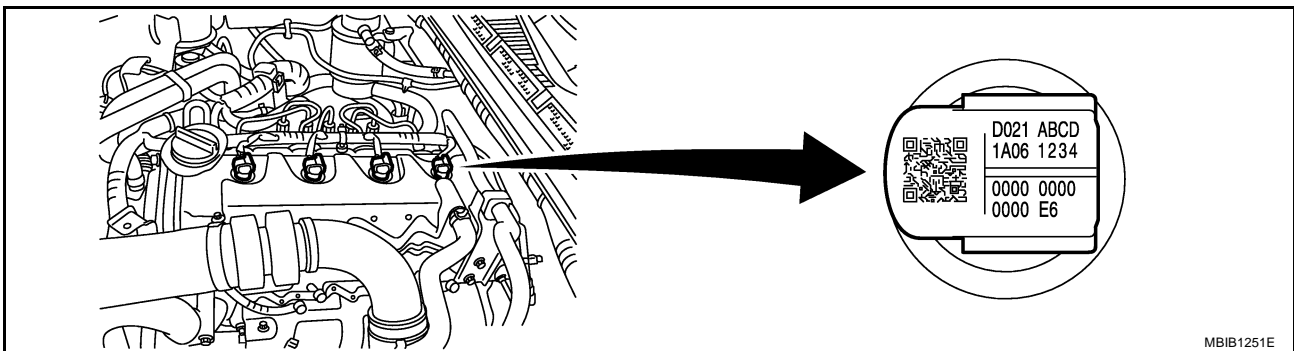
**CAUTION:**

- Handle fuel injector carefully without giving any impact.
  - Do not disassemble fuel injector.
- c. If nozzle gasket remains in cylinder head, hook it with tip of a flat-bladed screwdriver and pull it out.
  - d. Remove O-ring from fuel injector.



## INSTALLATION

1. Record "INJECTOR ADJUSTMENT VALUE" on the top surface when replacing fuel injector.
  - Refer to [EC-1014, "Injector Adjustment Value Registration"](#) for use of "INJECTOR ADJUSTMENT VALUE".



**Example: Injector Adjustment value = D021ABCD1A061234000000000000E6**

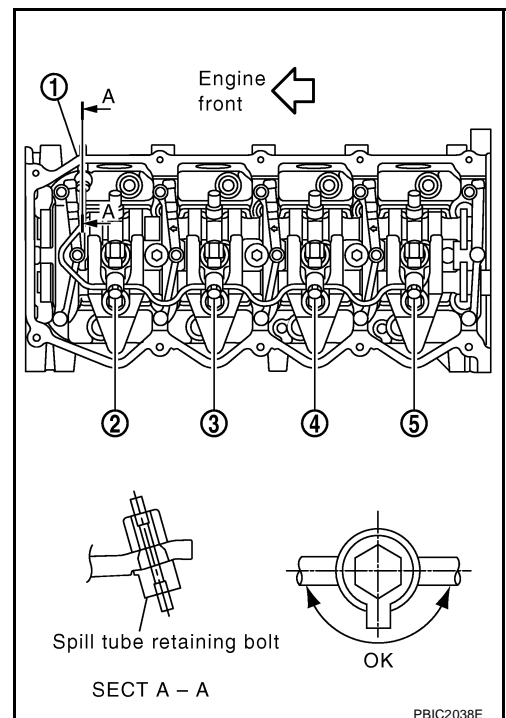
2. Following steps below, install fuel injector.
  - a. Install O-ring and nozzle gasket to fuel injector, and insert them into cylinder head.
  - b. Tighten injection tubes temporarily in the order of 3-4-1-2.
  - c. Be sure to fit nozzle support and pin without looseness.
  - d. Tighten nozzle support bolts.
  - e. Loosen injection tubes in the order of 2-1-4-3.
3. Connect spill tube.
  - Tighten fixing bolts and nut in numerical order shown in the figure.

**CAUTION:**

**When tightening nut, fix spill tube retaining bolt with spanner.**

**NOTE:**

Connection of spill tube gasket may be broken, even if it is tighten to the specified torque. It does not affect performance.



# INJECTION TUBE AND FUEL INJECTOR

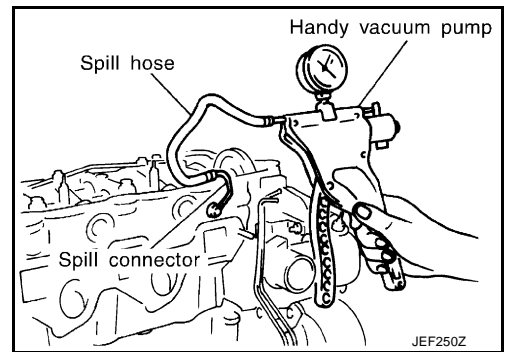
[YD]

4. Perform air tightness test for spill tube.
  - Connect a handy vacuum pump to spill connector. Make sure that vacuum is retained while applying following vacuum.

**Standard:**

- 53.3 to - 66.7 kPa (- 533 to - 667 mbar, - 400 to - 500 mmHg, - 15.75 to - 19.69 inHg)

- If outside of standard, reconnect spill tube. (Replace gasket in this case.)
5. Install rocker cover. Refer to [EM-200, "Removal and Installation"](#)

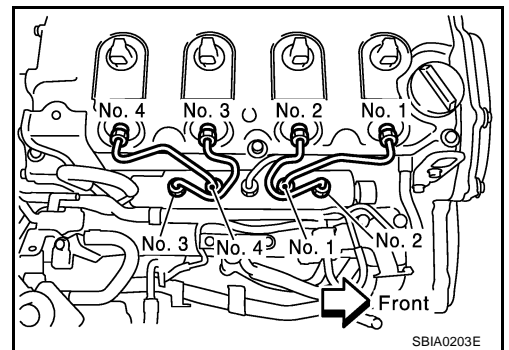


6. Install nozzle oil seal.
  - Insert it straight until its flange fully contacts rocker cover.

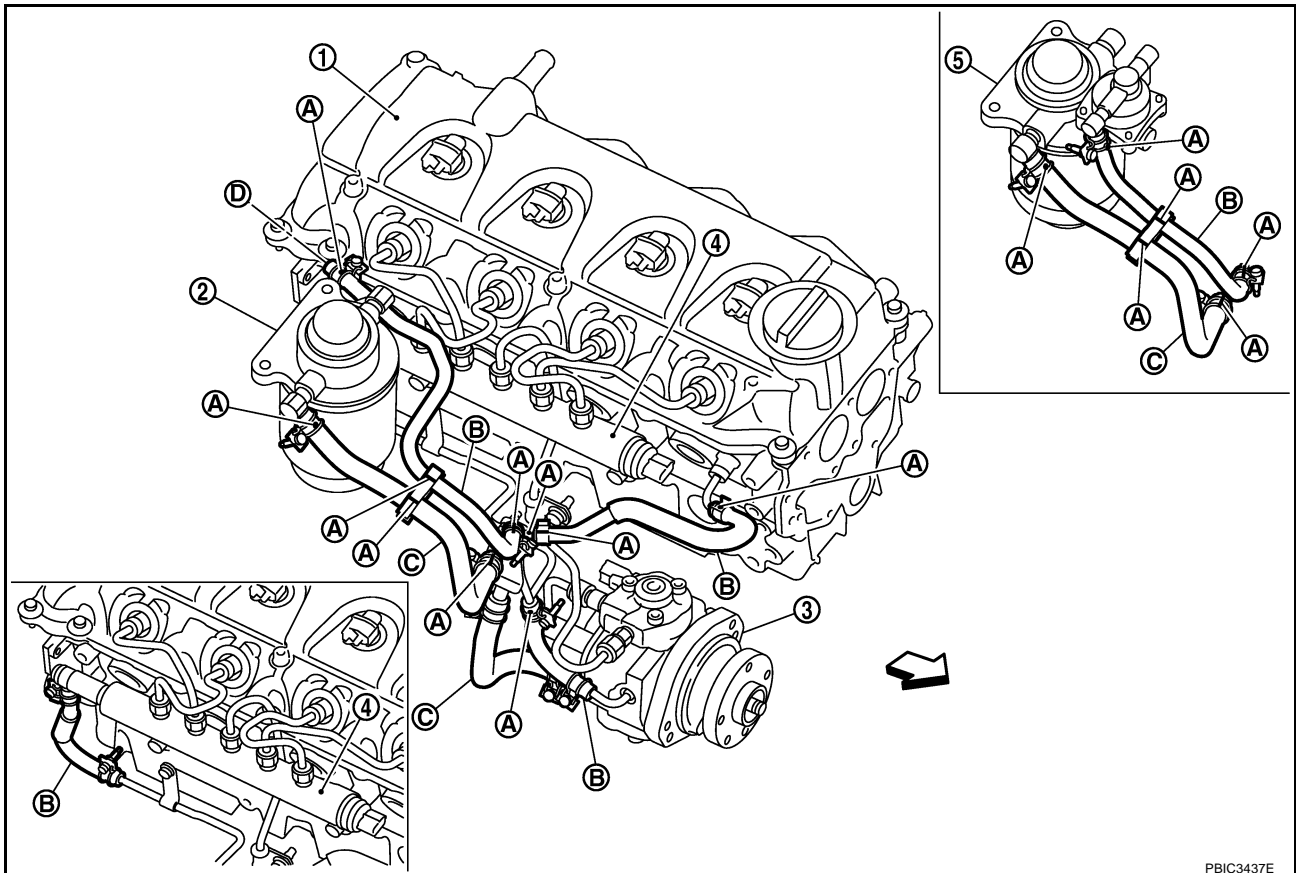
**CAUTION:**

- Check gutter spring in nozzle oil seal on fuel injector for missing.

7. Connect injection tubes individually to each cylinder in order of 3-4-1-2.



8. Install fuel hoses, spill hose and fuel gallery as shown in the figure.



# INJECTION TUBE AND FUEL INJECTOR

[YD]

1. Rocker cover
  2. Fuel filter (standard models)
  3. Fuel pump
  4. Fuel rail
  5. Fuel filter (models for cold area)
  - A. Align paint mark
  - B. Insert the hose up to 26 mm (1.02 in)
  - C. Insert the hose up to 28 mm (1.10 in)
  - D. To fuel cooler (under floor)
- ↩ Vehicle front

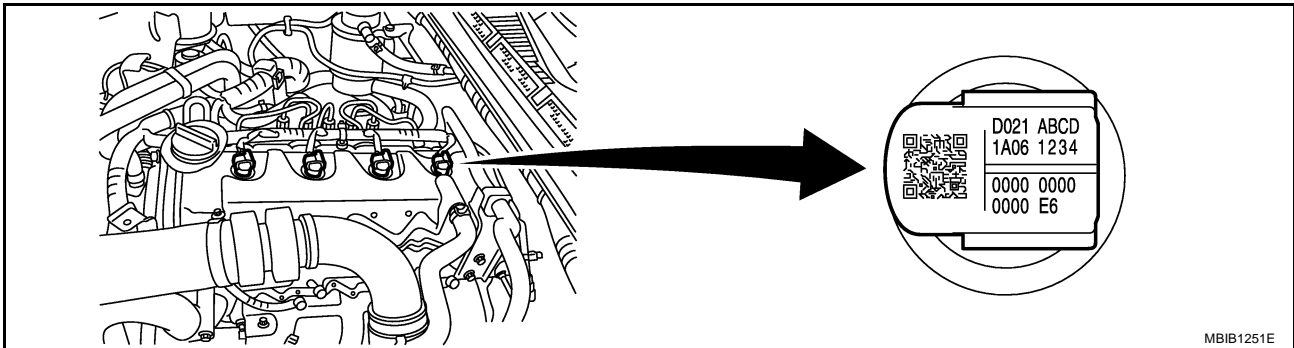
## NOTE:

Intake manifold and other related parts are omitted for explanation.

9. Install remaining parts in the reverse order of removal.

## INSPECTION AFTER INSTALLATION

- Input "INJECTOR ADJUSTMENT VALUE" to ECM after installing to the vehicle when replacing fuel injector. Refer to [EC-1014, "Injector Adjustment Value Registration"](#).



**Example: Injector Adjustment value = D021ABCD1A061234000000000000E6**

- Start engine and increase engine speed to check for fuel leak.

## CAUTION:

**Do not touch engine immediately after stopped as engine becomes extremely hot.**

## FUEL PUMP Components

PFP:17042

GBS0000Z

A

EM

C

D

E

F

G

H

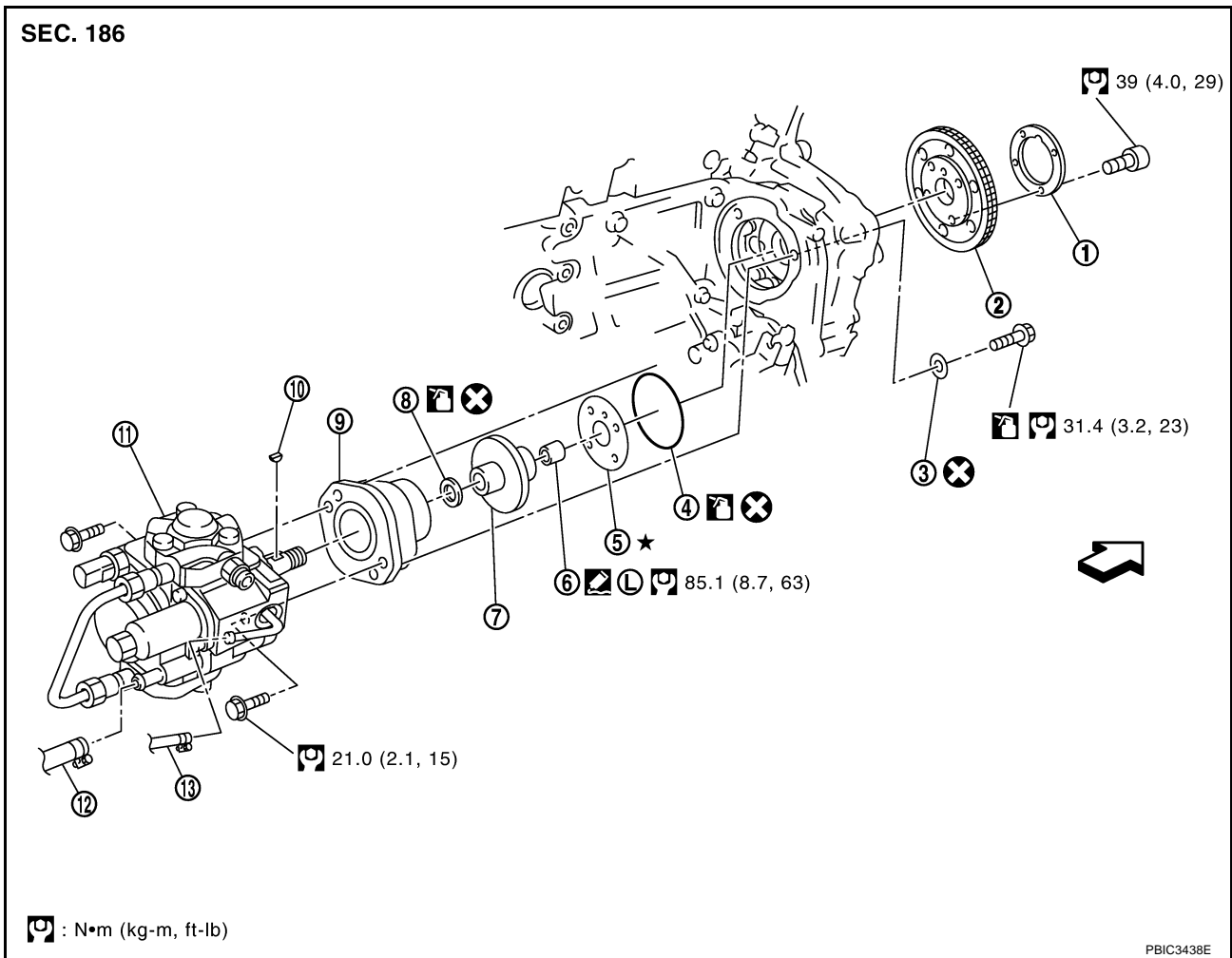
I

J

K

L

M



- |                |                       |                 |
|----------------|-----------------------|-----------------|
| 1. Washer      | 2. Fuel pump sprocket | 3. Seal washer  |
| 4. O-ring      | 5. Adjusting shim     | 6. Sprocket nut |
| 7. Coupling    | 8. Oil seal           | 9. Spacer       |
| 10. Key        | 11. Fuel pump         | 12. Fuel hose   |
| 13. Spill hose |                       |                 |
- ⇐ Engine front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

## Removal and Installation

GBS00010

### CAUTION:

- Before removing and installing fuel pump, be sure to remove sprocket. Do not loosen or remove installation nut in the center of fuel pump. If loosened or removed, replace fuel pump.
- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- When fuel pump is replaced with new one or another one, perform fuel pump leaning value cleaning before starting engine. Refer to [EC-1013, "Fuel Pump Learning Value Clearing"](#).

### REMOVAL

- Remove engine cover, vacuum gallery and heater feed pipe. Refer to [EM-164, "INTAKE MANIFOLD"](#).

# FUEL PUMP

[YD]

- Remove fuel hose and spill hose from fuel pump. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#).

**CAUTION:**

**Be careful not to spill fuel in the engine component.**

- Disconnect harness connectors from fuel pump.
- Remove injection tube center, clip and insert rubber. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#).

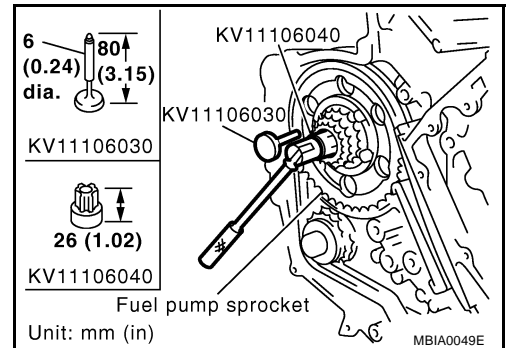
**CAUTION:**

**Be careful not to spill fuel in the engine component.**

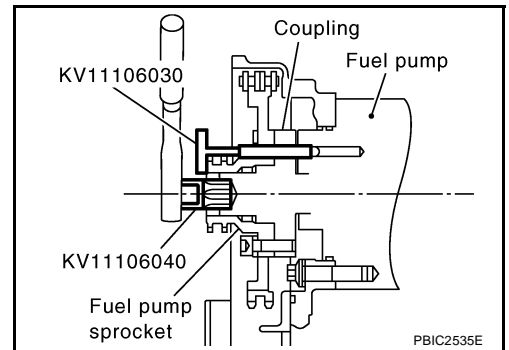
- Remove secondary timing chain. Refer to [EM-217, "SECONDARY TIMING CHAIN"](#).

- Hold fuel pump sprocket and remove bolt.

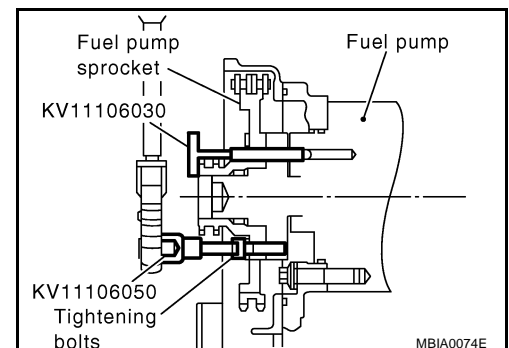
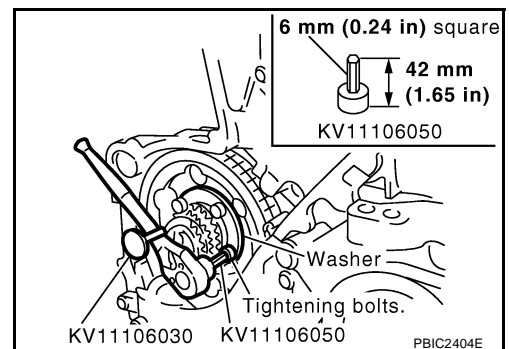
- Insert the positioning stopper pin [SST] into the hole 6 mm (0.24 in) in the diameter on the fuel pump sprocket.
- Using the TORX wrench [SST], turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.
- Push the positioning stopper pin [SST] through fuel pump sprocket to fuel pump body to hold fuel pump sprocket.



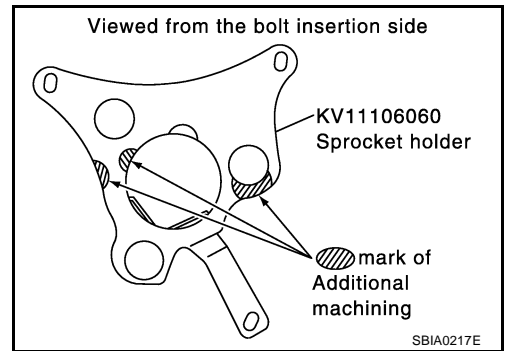
- Insert the positioning stopper pin until its flange contacts the fuel pump sprocket.



- Using the hexagon wrench [SST] remove tightening bolts of fuel pump sprocket.



8. Using the sprocket holder [SST], hold fuel pump sprocket to prevent falling.
  - For sprocket holder, use KV11106060 machined as shown in the figure, because the previous bore is not fitting.

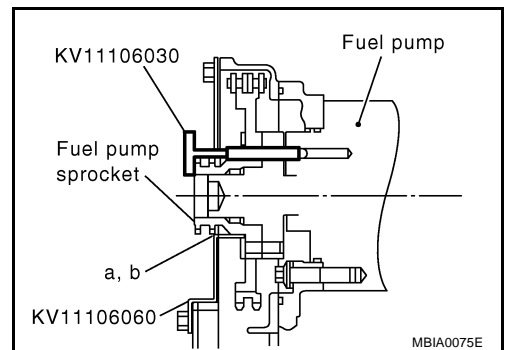
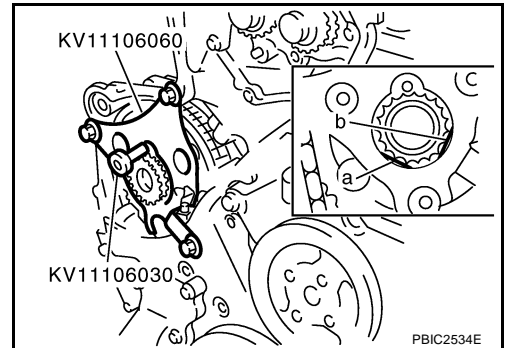


- When the sprocket holder is installed, if the positioning stopper pin [SST] interferes, pull out the positioning stopper pin approximately 10 mm (0.39 in), then install it.
- After the sprocket holder is installed temporarily, tighten the sprocket holder after making extension bar and TORX socket (size: E10) (commercial service tool) insert into the machined bore.
- The length of the sprocket holder mounting bolts should be approximately 15 mm (0.59 in) (M6 thread length).
- Make sure that the a- and b-faces of the sprocket holder contact the bottom side of the sprocket (small diameter side).

**CAUTION:**

**Do not remove the sprocket holder [SST] until fuel pump is installed.**

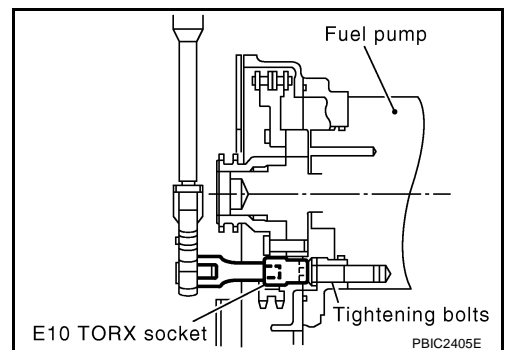
- After the sprocket holder is installed, pull out the positioning stopper pin from fuel pump sprocket.



9. Using the extension bar and the TORX socket (size: E10) (commercial service tool), remove the tightening bolts.

**CAUTION:**

**Do not disassemble or adjust fuel pump.**



10. Remove the fuel pump toward the rear of engine.

**CAUTION:**

**For removal, be careful not to drop the seal washer into the engine.**

**NOTE:**

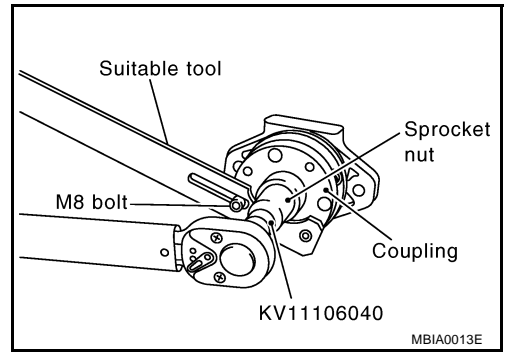
The seal washer of the tightening bolts cannot be reused.

11. Remove adjusting shim.
12. Attach a suitable tool in the M8 bolt hole on coupling.

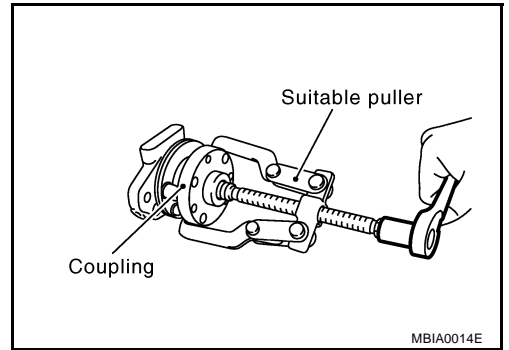
# FUEL PUMP

[YD]

13. Loosen sprocket nut with the TORX wrench [SST].



14. Remove coupling with a suitable puller.



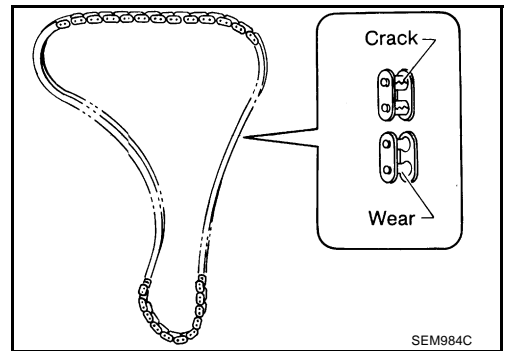
15. Remove spacer from fuel pump.

16. Remove oil seal from spacer.

## INSPECTION AFTER REMOVAL

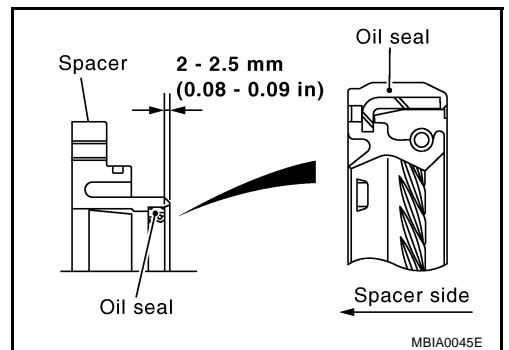
### Timing Chain

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



## INSTALLATION

1. Install new oil seal to spacer.



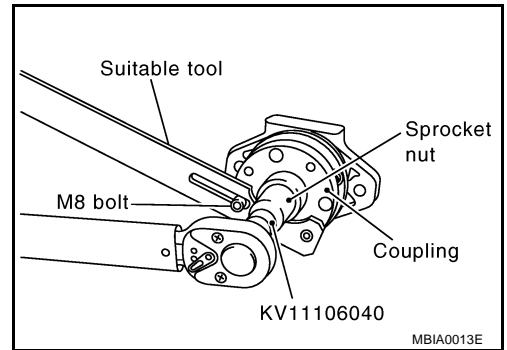
2. Install spacer to fuel pump.



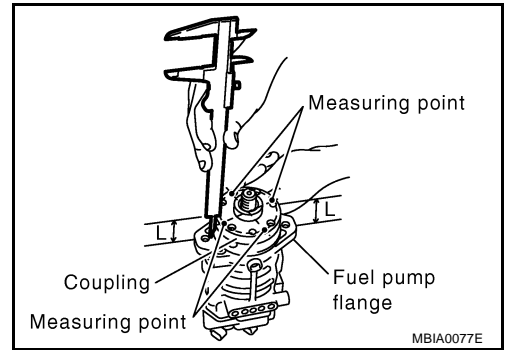
# FUEL PUMP

[YD]

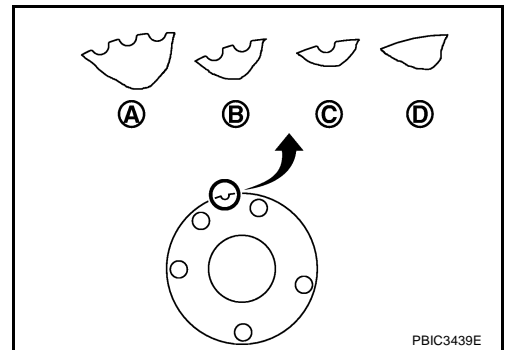
3. Install coupling to fuel pump of spacer.
  - Using the TORX wrench [SST], tighten the sprocket nut to fix the coupling.



4. Install adjusting shim.
  - For shim adjustment, measure dimension L [Distance between front surface of coupling and the fuel pump flange (spacer)] at two opposing points near the coupling bolt center. Use the average of these two measurements to select the shim grade that marked on adjusting shim.



- The shim adjustment is required only when the fuel pump is replaced.

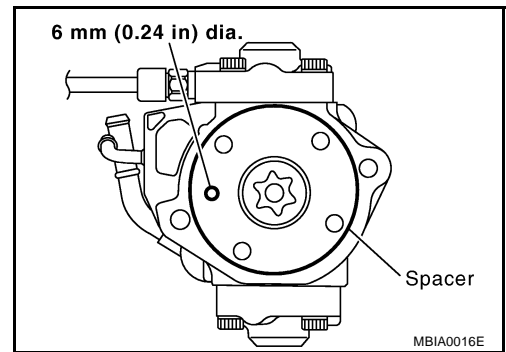


Part No. of adjusting shim	Grade number	Measuring dimension L mm (in)	Type
16614 8H800	0.5 t	38.23 - 39.77 (1.5051 - 1.5657)	A
16614 8H810	1.0 t	38.76 - 38.23 (1.5260 - 1.5051)	B
16614 8H860	1.2 t	38.57 - 38.76 (1.5185 - 1.5260)	C
16614 8H820	1.6 t	38.18 - 38.57 (1.5031 - 1.5185)	D
16614 8H800 + 16614 8H860	0.5 t + 1.2 t	38.09 - 38.18 (1.4996 - 1.5031)	A + C
16614 8H810 + 16614 8H810	1.0 t + 1.0 t	37.80 - 38.09 (1.4882 - 1.4996)	B + B
16614 8H860 + 16614 8H810	1.2 t + 1.0 t	37.60 - 37.80 (1.4803 - 1.4882)	C + B
16614 8H820 + 16614 8H810	1.6 t + 1.0 t	37.21 - 37.60 (1.4650 - 1.4803)	D + B

# FUEL PUMP

[YD]

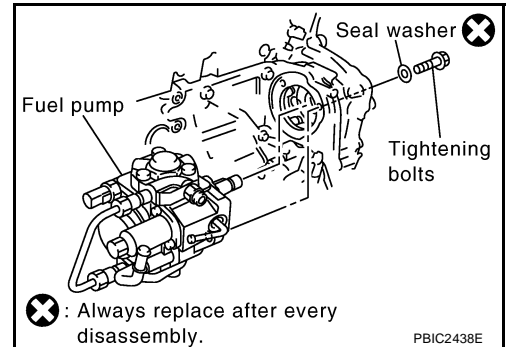
- Before fuel pump is installed, make sure that spacer and the 6 mm (0.24 in) dia. hole on coupling are aligned.



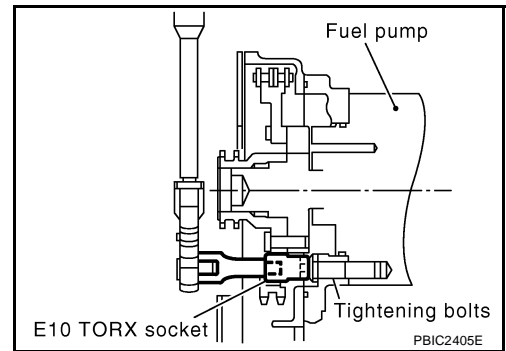
- Insert fuel pump to the mounting position from the rear side of the engine, and install the tightening bolts with seal washer.

**CAUTION:**

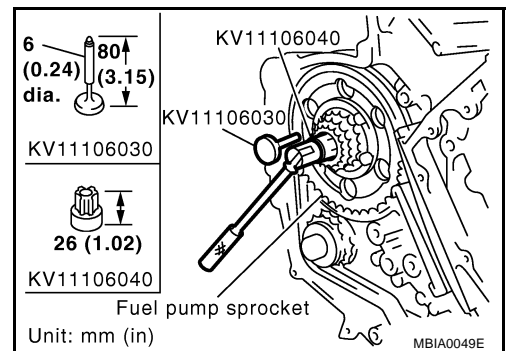
**Be careful not to drop the seal washer into engine.**



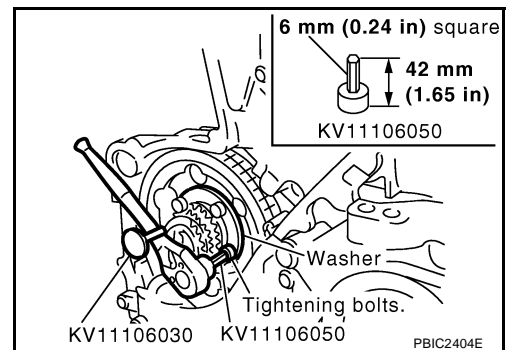
- Using the extension bar and the TORX socket (size: E10) (commercial service tool), tighten the tightening bolts of fuel pump.
- Remove the sprocket holder [SST].



- Using the TORX wrench [SST], turn the pump shaft gradually to adjust the position of fuel pump sprocket. Then, insert the positioning stopper pin [SST] to the 6 mm (0.24 in) dia. hole of the fuel pump sprocket through the pump body.
- Remove the TORX wrench [SST].



- Using the hexagon wrench [SST], tighten the sprocket tightening bolt.
  - When the washer of the fuel pump sprocket is removed, install it with the marking "F" (front) facing the front of the engine.
- Pull out the positioning stopper pin [SST].



# FUEL PUMP

[YD]

13. Install secondary timing chain. Refer to [EM-217, "SECONDARY TIMING CHAIN"](#) .
14. Following steps below, install injection tube center. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .
  - a. Pre-set clip and insert rubber to injection tube center.
  - b. Pre-tight nut of injection tube center to fuel pump and fuel rail by hand. (until seal surface touched)
  - c. Adjust clip dimension and tight bolt for clip to intake manifold by tool.
  - d. Tight nut of injection tube center to fuel pump by tool.
  - e. Tight nut of injection tube center to fuel rail by tool.
15. Connect the harness connector to fuel pump.
16. Install fuel hoses. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .
17. Hereafter, install in the reverse order of removal.

**CAUTION:**

When fuel pump is replaced with new one or another one, perform fuel pump leaning value cleaning before starting engine. Refer to [EC-1013, "Fuel Pump Learning Value Clearing"](#) .

A

EM

C

D

E

F

G

H

I

J

K

L

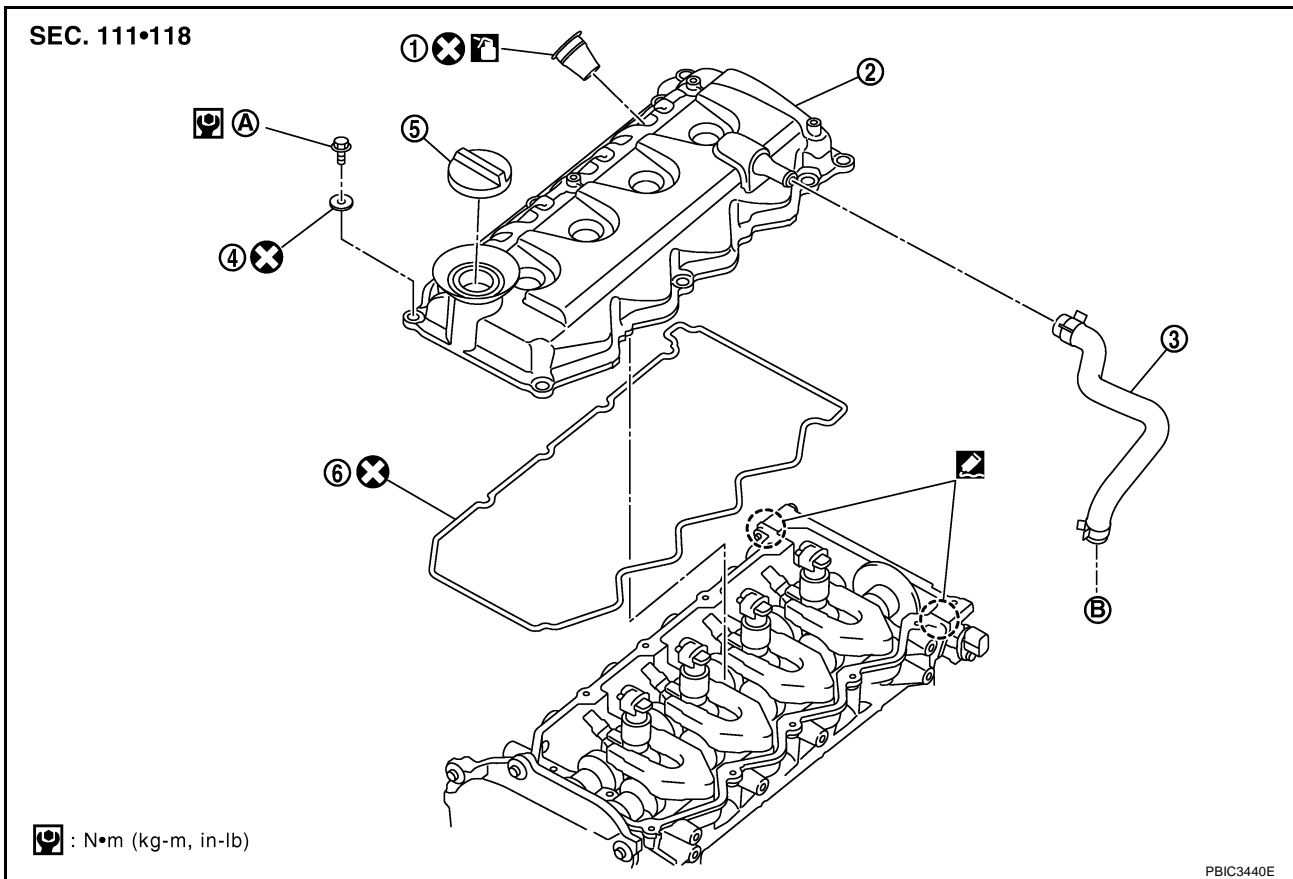
M

## ROCKER COVER

PFP:13264

### Components

GBS00011



- |  |                   |                        |
|--|-------------------|------------------------|
| 1. Nozzle oil seal                           | 2. Rocker cover   | 3. Ventilation hose    |
| 4. Washer                                    | 5. Oil filler cap | 6. Gasket              |
| A. Refer to "INSTALLATION" in "ROCKER COVER" |                   | B. To ventilation hose |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

### REMOVAL

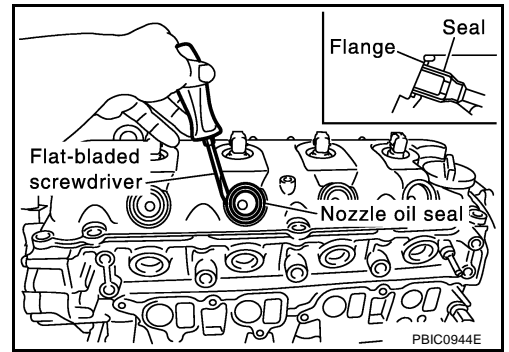
GBS00012

1. Remove engine cover. Refer to [EM-164, "INTAKE MANIFOLD"](#) .
  2. Remove vacuum gallery and engine cover bracket on rocker cover and ventilation hose. Refer to [EM-164, "INTAKE MANIFOLD"](#) and [EM-159, "AIR CLEANER AND AIR DUCT"](#) .
  3. Disconnect harness connector from fuel injector. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .
  4. Following steps below, remove injection tube. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .
    - a. Put a paint mark or tag on injection tubes to identify each cylinder.
      - Use a fuel-resistant method.
    - b. Remove injection tubes in order of 2-1-4-3 individually.
- CAUTION:**  
**Be careful not to allow leaked fuel to contaminate engine room. Especially, ensure to keep engine mounting insulator clear of fuel.**
5. Remove injection nozzle oil seal.

# ROCKER COVER

[YD]

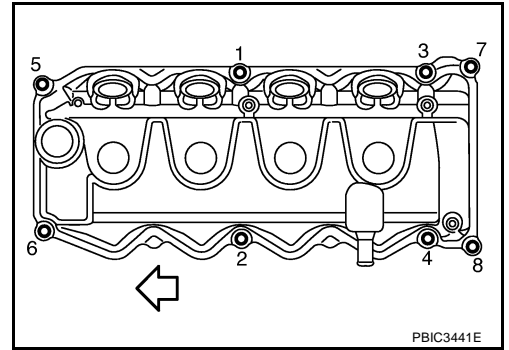
- Using the flat-bladed screwdriver, pry flange to remove nozzle oil seal.



## 6. Remove rocker cover.

- Loosen holding bolts in the reverse order of that shown in the figure and remove.

⇐ : Engine front



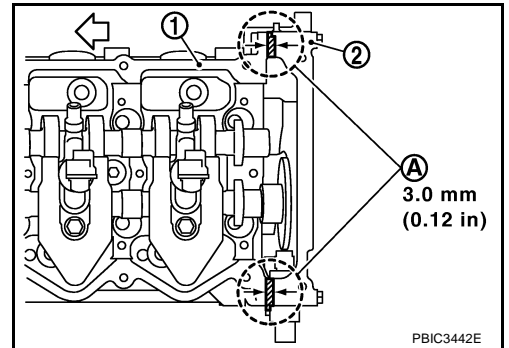
## 7. Remove gasket from rocker cover.

### INSTALLATION

1. Install new gasket to rocker cover.
2. Apply liquid gasket with tube presser [SST: WS39930000] on locations shown in the figure.

- **Use Genuine Liquid Gasket or equivalent.**

1 : Cylinder head  
2 : Cylinder head rear cover  
A : Liquid gasket application area  
⇐ : Engine front

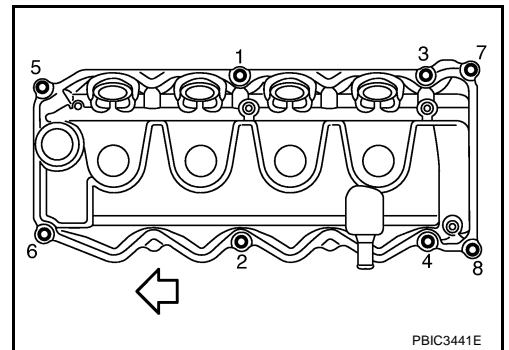


## 3. Tighten holding bolts in numerical order shown in the figure.

⇐ : Engine front

 : **7.8 N·m (0.8 kg·m, 69 in·lb)**

Re-tighten to the same torque in the same order as above.



## 4. Install nozzle oil seal.

- Insert it straight until flange fully contacts rocker cover.
5. Install remaining parts in the reverse order of removal.
  6. Before starting engine, bleed air from fuel piping. Refer to [FL-17, "Air Bleeding"](#).

## INSPECTION AFTER INSTALLATION

Start engine and increase engine speed to check for fuel leak and engine oil leak.

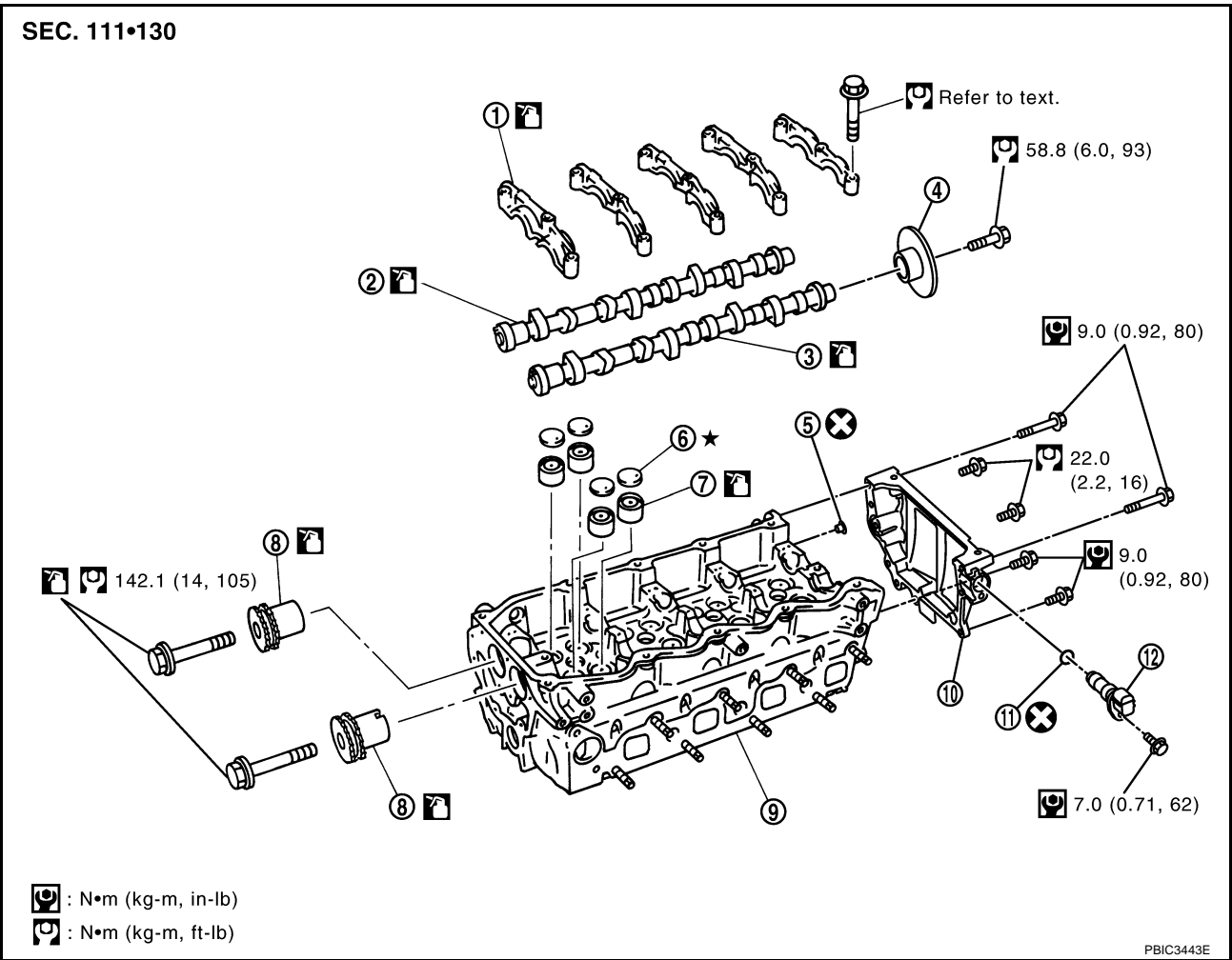
**CAUTION:**

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

## CAMSHAFT Components

PFP:13001

GBS00013



- |                              |                          |                              |
|------------------------------|--------------------------|------------------------------|
| 1. Camshaft bracket          | 2. Camshaft (right side) | 3. Camshaft (left side)      |
| 4. Signal plate              | 5. Rubber washer         | 6. Adjusting shim            |
| 7. Valve lifter              | 8. Camshaft sprocket     | 9. Cylinder head             |
| 10. Cylinder head rear cover | 11. O-ring               | 12. Camshaft position sensor |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

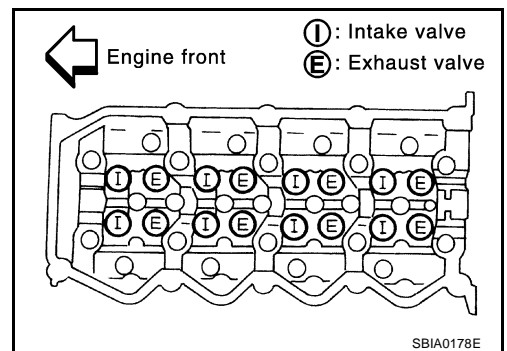
**CAUTION:**

- This engine will have a different valve arrangement from normal DOHC 4-valve type engines. As both camshafts on this engine have intake and exhaust camshafts, in this chapter they are named as follows:

**Camshaft (right side) : Intake manifold side**

**Camshaft (left side) : Exhaust manifold side**

- Refer to the figure for intake and exhaust valve arrangement. (The camshafts have, alternately, either intake valve or an exhaust valve.)



## Removal and Installation REMOVAL

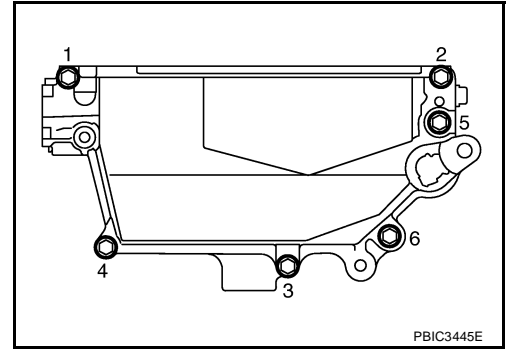
GBS00014

- Drain engine coolant. Refer to [CO-37, "Changing Engine Coolant"](#).
- Remove rocker cover. Refer to [EM-200, "ROCKER COVER"](#).

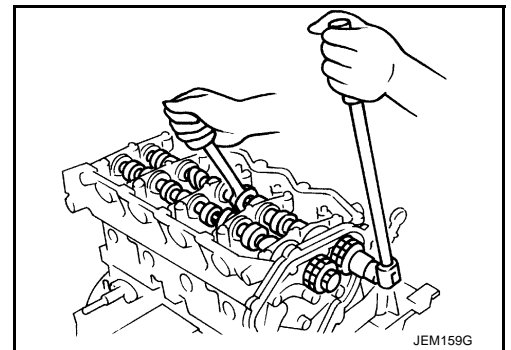
# CAMSHAFT

[YD]

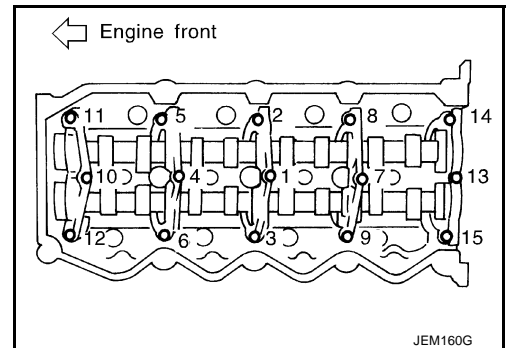
3. Remove cylinder head rear cover, camshaft position sensor and rubber washer.  
Loosen cylinder head rear cover mounting bolts in the reverse order shown in the figure.



4. Remove fuel injector. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#).
5. Remove secondary timing chain. Refer to [EM-217, "SECONDARY TIMING CHAIN"](#).
6. Remove camshaft sprockets and signal plate.
  - Loosen the camshaft sprocket mounting bolts and signal plate mounting bolt by fixing the hexagonal portion of camshaft.



7. Remove camshaft.
  - Place distinguishing marks on the right and left sides with paint.
  - Loosen and remove the camshaft sprocket bolts in the reverse order shown in the figure.



8. Remove adjusting shim and valve lifter.
  - Remove by taking notice of the installation position, and place outside engine in order to prevent confusion.

## INSPECTION AFTER REMOVAL

### Visual Check of Camshaft

- Check the camshaft for one sided wear or scratches.
- Replace the camshaft if there are abnormalities.

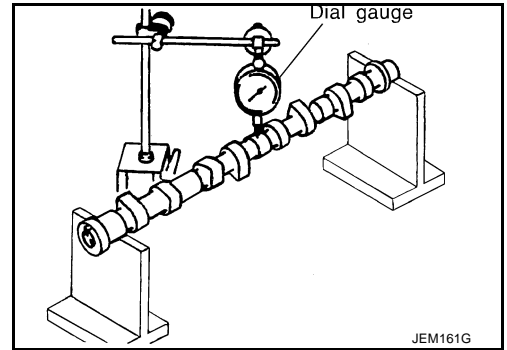


## Camshaft Runout

- Prepare V-block on a flat surface and secure camshaft journals No. 2 and No. 5.
- Set the dial gauge vertically on journal No. 3.
- Rotate camshaft in one direction by hand, then read needle movement on dial gauge. (Total indicator reading)

**Limit : 0.02 mm (0.0008 in)**

- If it exceeds the limit, replace camshaft.



## Height of Cam Nose

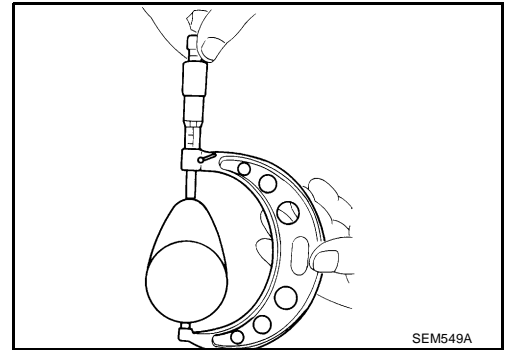
- Measure the height of cam nose using the micrometer.

**Standard:**

**Intake : 39.505 - 39.695 mm (1.5553 - 1.5628 in)**

**Exhaust : 39.905 - 40.095 mm (1.5711 - 1.5785 in)**

- If out of the standard, replace camshaft.



## Camshaft Journal Oil Clearance

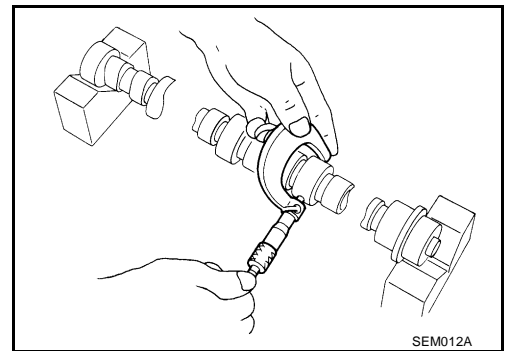
### CAMSHAFT JOURNAL OUTER DIAMETER

- Measure outer diameter of camshaft journal with micrometer.

**Standard:**

**No. 1 : 30.435 - 30.455 mm  
(1.1982 - 1.1990 in)**

**No. 2, 3, 4, 5 : 23.935 - 23.955 mm  
(0.9423 - 0.9431 in)**



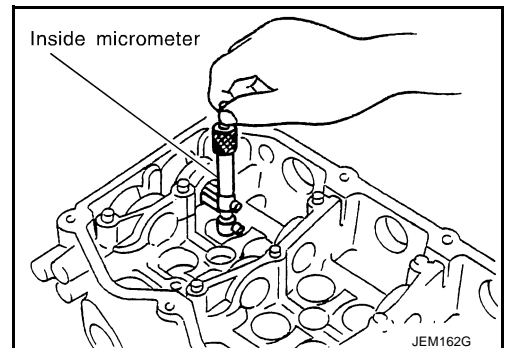
### CAMSHAFT BRACKET INNER DIAMETER

- Install camshaft bracket and tighten bolts to the specified torque. Refer to [EM-207, "INSTALLATION"](#) for the tightening procedure.
- Measure inner diameter of camshaft bracket using the inside micrometer.

**Standard:**

**No. 1 : 30.500 - 30.521 mm  
(1.2008 - 1.2016 in)**

**No. 2, 3, 4, 5 : 24.000 - 24.021 mm  
(0.9449 - 0.9457 in)**



### CAMSHAFT OIL CLEARANCE CALCULATIONS

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

A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

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

- If out of standard, refer to the standard value of each unit, then replace the camshaft and/or cylinder head.

**NOTE:**

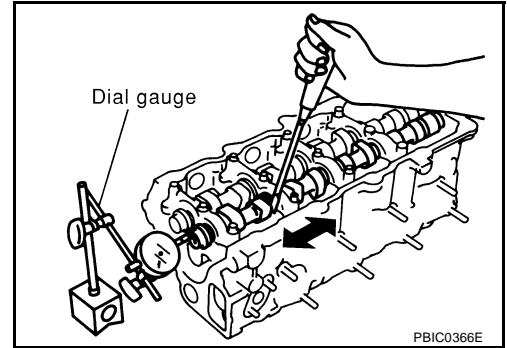
As the camshaft bracket is manufactured with the cylinder head, it is impossible to replace only the camshaft bracket.

**Camshaft End Play**

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

**Standard : 0.070 - 0.148 mm (0.0028 - 0.0058 in)**

**Limit : 0.24 mm (0.0094 in)**



- Measure the following parts if out of the standard.

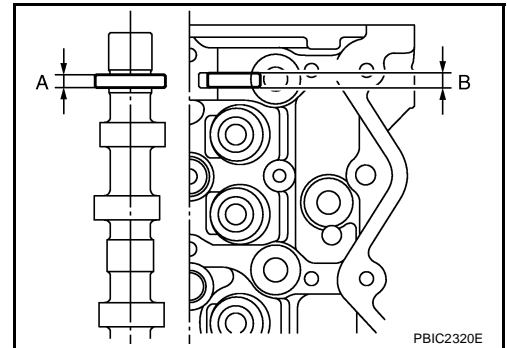
- Dimension "A" for camshaft

**Standard : 6.882 - 6.930 mm (0.2709 - 0.2728 in)**

- Dimension "B" for cylinder head

**Standard : 7.000 - 7.030 mm (0.2755 - 0.2767 in)**

- Refer to the standards above, and then replace camshaft and/or cylinder head.

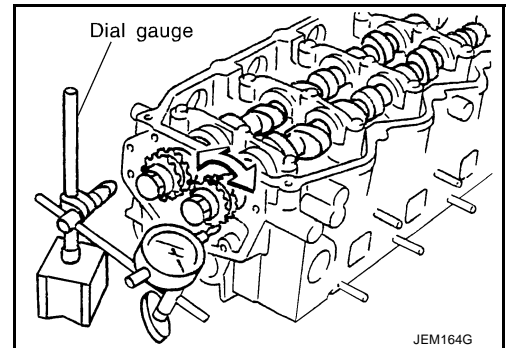


**Camshaft Sprocket Runout**

1. Install camshaft in cylinder head. Refer to [EM-207, "INSTALLATION"](#) for the tightening procedure.
2. Install sprocket on camshaft. Refer to [EM-207, "INSTALLATION"](#).
3. Measure camshaft sprocket runout. (Total indicator reading)

**Limit : 0.15 mm (0.0059 in)**

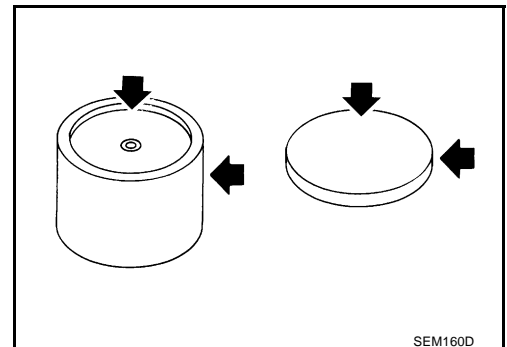
- If it exceeds the limit, replace camshaft sprocket.



**Visual Inspection of Valve Lifter and Adjusting Shim**

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

- If anything above is found, replace valve lifter or adjusting shim.

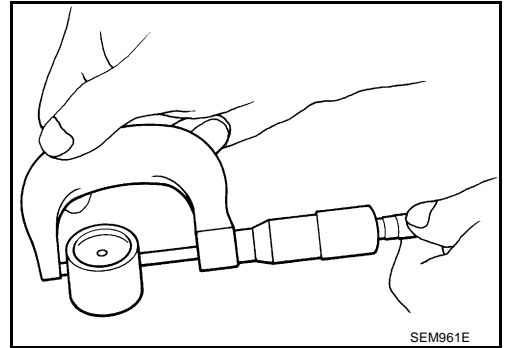


## Valve Lifter Clearance

### VALVE LIFTER OUTER DIAMETER

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

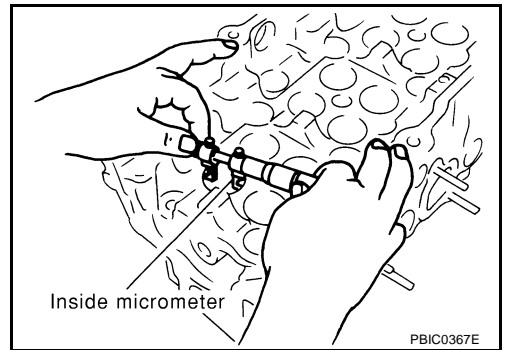
**Standard : 29.960 - 29.975 mm (1.1795 - 1.1801 in)**



### VALVE LIFTER BORE DIAMETER

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

**Standard : 30.000 - 30.021 mm (1.1811 - 1.1819 in)**



### VALVE LIFTER CLEARANCE CALCULATIONS

- (Clearance) = (Valve lifter bore diameter) – (Valve lifter outer diameter)

**Standard : 0.025 - 0.061 mm (0.0010 - 0.0024 in)**

- If out of standard, refer to the outer diameter and bore diameter standard values and replace valve lifter and/or cylinder head.

### INSTALLATION

1. Install valve lifter and adjusting shim.
  - Make sure that these are installed in the same position as before the removal process.
2. Install camshaft.

⇐ : Engine front

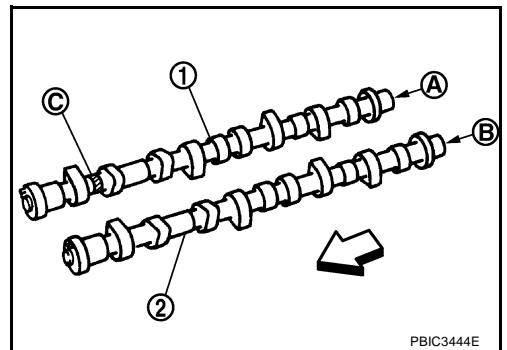
- Identify camshafts by the paint position and screw hole at the rear end.

**Camshaft (right side) Intake manifold side (1):**

**Paint is at position (C) (Blue) without screw hole (A).**

**Camshaft (left side) Exhaust manifold side (2):**

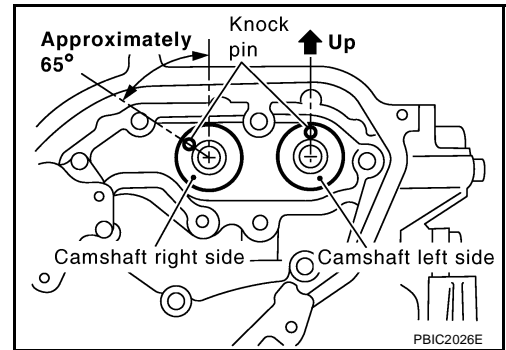
**No paint with screw hole (B).**



# CAMSHAFT

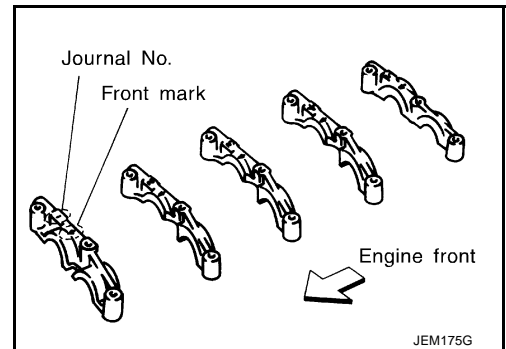
[YD]

- Install so that knock pins are positioned in the directions shown in the figure.



### 3. Install camshaft brackets.

- Completely remove any foreign material on back surfaces of camshaft brackets and top surface of cylinder head.
- Install correctly, identifying brackets by the journal No. and front mark on top surface.



### 4. Tighten bolts in the order shown in the figure according to the following procedure:

#### a. Tighten all bolts.


 : 2 N·m (0.2 kg-m, 1 ft-lb)

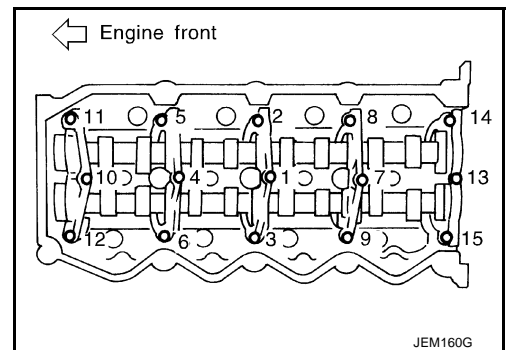
- Make sure camshaft thrusting parts (on rear side) securely fit in their mating parts on the cylinder head.

#### b. Tighten all bolts.

 : 6 N·m (0.6 kg-m, 4 ft-lb)

#### c. Tighten all bolts.

 : 12 - 13 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

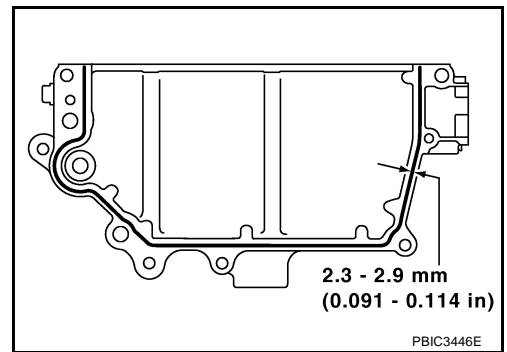


### 5. Install camshaft sprockets and signal plate.

- Camshaft sprockets are commonly used for right side and left side.
- Align camshaft sprocket and knock pin on camshaft, and install.
- Holding the hexagonal part of camshaft with a wrench, tighten bolt securing camshaft sprockets and signal plate.

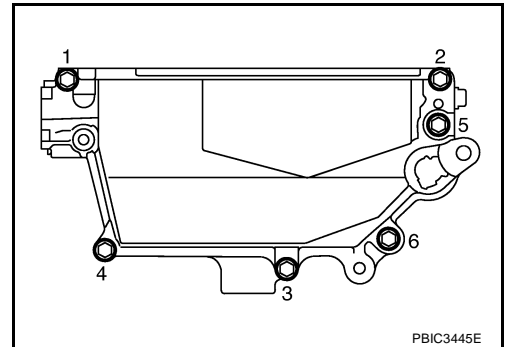
### 6. Install rubber washer to cylinder head rear side.

7. Apply liquid gasket to cylinder head rear cover as shown in the figure.  
**Use Genuine Liquid Gasket or Equivalent.**



8. Install cylinder head rear cover and tighten mounting bolts in numerical order shown in the figure.

- M6 × 50 mm : Bolt No.1, 2**
- M6 × 20 mm : Bolt No.3, 4**
- M8 × 20 mm : Bolt No.5, 6**



9. Before installing spill tube after installing secondary timing chain, check and adjust valve clearance. Refer to [EM-210, "Valve Clearance"](#).
10. Hereafter, install in the reverse order of removal.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

#### Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\*1: Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

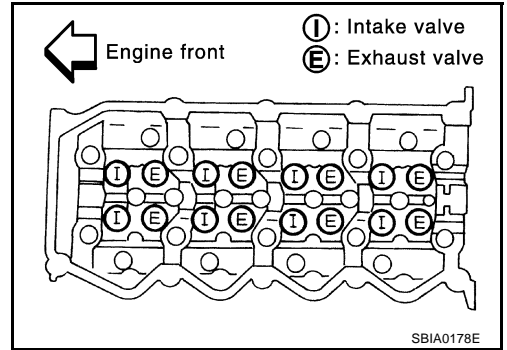
\*2: Check engine oil level 10 minutes after engine stopped.

## Valve Clearance INSPECTION

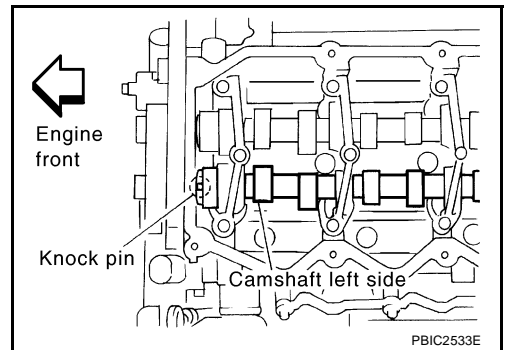
- When the camshaft or parts in connection with valves are removed or replaced, and a malfunction has occurred (poor starting, idling, or other malfunction) due to the misadjustment of the valve clearance, inspect as follows.
- Inspect and adjust when the engine is cool (at normal temperature).
- Be careful of the intake and exhaust valve arrangement. The valve arrangement is different from that in a normal engine.

**NOTE:**

The camshafts have, alternately, either intake valve or exhaust valve. (Refer to figure.)

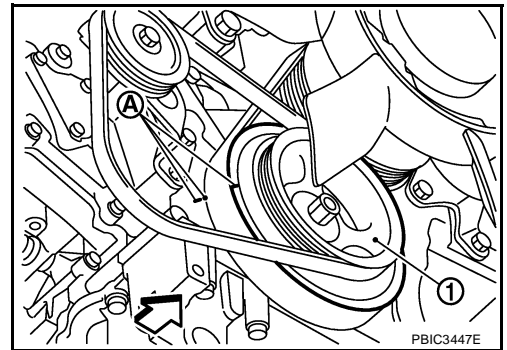


1. Remove rocker cover. Refer to [EM-200, "ROCKER COVER"](#).
2. Remove fuel injector. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#).
3. Set the No. 1 piston to TDC on its compression stroke.
  - Turn crankshaft pulley clockwise so that the knock pin on camshaft left side faces straight above. (No position indicator, etc. is provided on the crankshaft pulley.)



4. Remove undercover, put an alignment mark with paint, etc. on crankshaft pulley and on oil pump housing as an angle indicator.

- 1 : Crankshaft pulley
- A : Alignment mark
- ↔ : Vehicle front

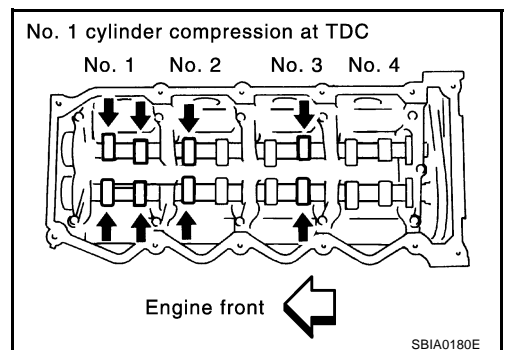


5. While referring to the figure, measure the valve clearance marked in the table below.

Measuring point	No. 1		No. 2		No. 3		No. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 1 cylinder is in the TDC	X	X	X			X		

**NOTE:**

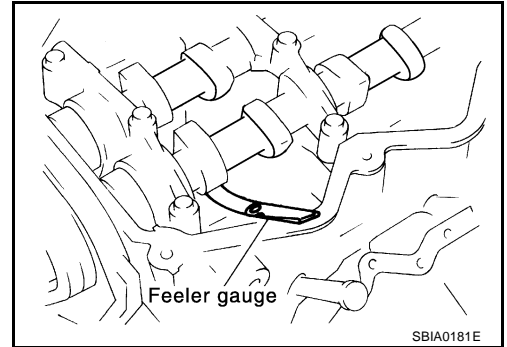
- The injection order is 1-3-4-2.



# CAMSHAFT

[YD]

- Measure the valve clearance using the feeler gauge when engine is cool (at normal temperature).



## Valve clearance:

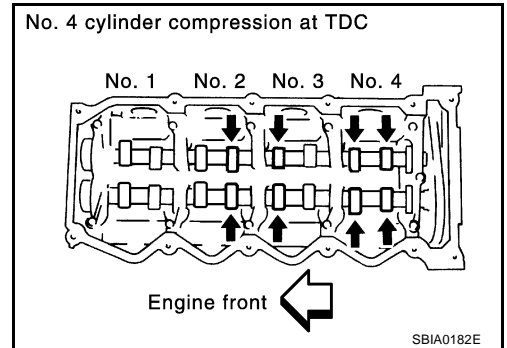
Unit: mm (in)

Item	Cold	Hot* (Reference data)
Intake	0.24 - 0.32 (0.0094 - 0.0126)	0.274 - 0.386 (0.0108 - 0.0152)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.0121 - 0.0170)

\*: Reference data approximately 80°C (176°F)

6. Set the No. 4 cylinder at TDC by rotating the crankshaft clockwise once. (360 degrees)
7. While referring to the figure, measure the valve clearance marked in the table below.

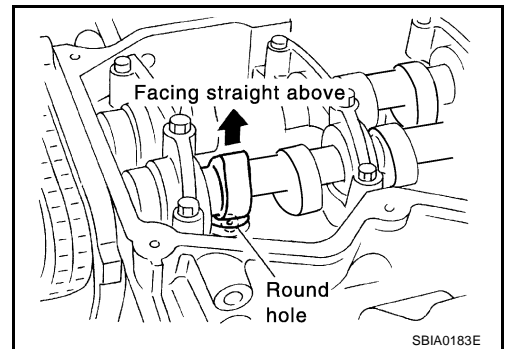
Measuring point	No. 1		No. 2		No. 3		No. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 4 cylinder is in the TDC				X	X		X	X



8. If the valve clearance is outside the specification, adjust as follows.

## ADJUSTMENTS

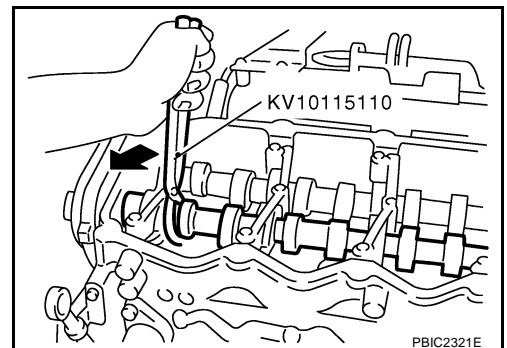
- Remove adjusting shim for parts which are outside the specified valve clearance.
1. Extract engine oil on the upper side of the cylinder head (for the air blowing in step 6).
  2. Rotate crankshaft to face the camshaft for adjusting shims that are to be removed upward.



3. Grip camshaft with the camshaft pliers [SST], then using camshaft as a support point, push adjusting shim downward to compress valve spring.

### CAUTION:

Do not damage camshaft, cylinder head and the outer circumference of valve lifter.





# CAMSHAFT

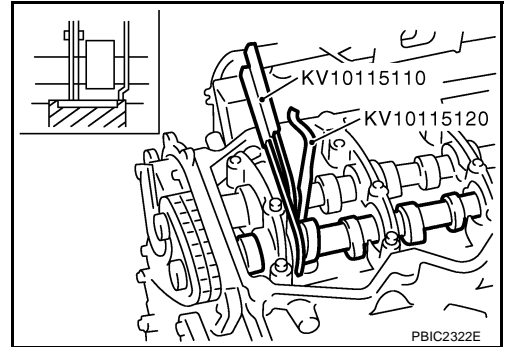
[YD]

4. With valve spring in a compressed state, remove the camshaft pliers [SST] by securely setting the outer circumference of the valve lifter with the end of the lifter stopper [SST].

- Hold the lifter stopper by hand until the shim is removed.

**CAUTION:**

**Do not retrieve the camshaft pliers forcefully, as camshaft will be damaged.**



5. Move the round hole of adjusting shim to the front with the very thin screwdriver or like that.

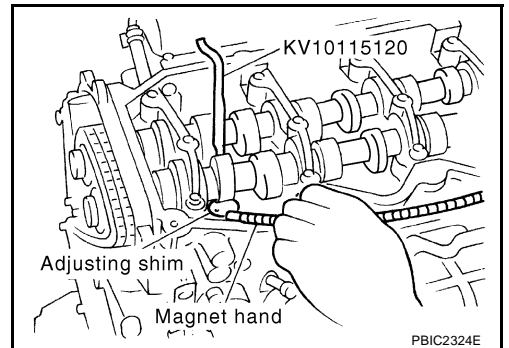
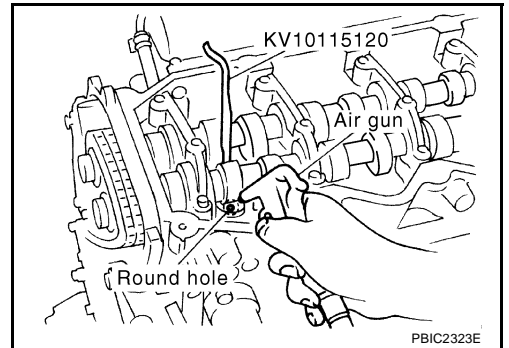
- When adjusting shim on valve lifter will not rotate smoothly, restart from step 3 to release the end of the lifter stopper [SST] from touching adjusting shim.

6. Remove adjusting shim from valve lifter by blowing air through the round hole of the adjusting shim with the air gun.

**CAUTION:**

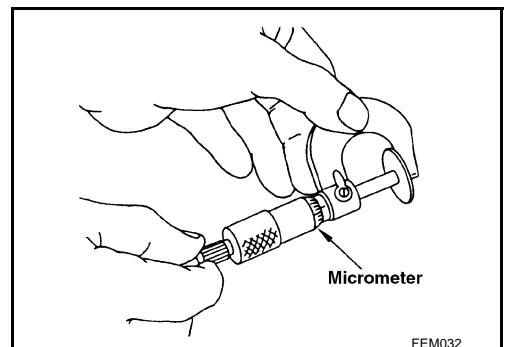
**To prevent any remaining engine oil from being blown around, thoroughly wipe the area clean and wear protective goggles.**

7. Remove adjusting shim by using the magnet hand.



8. Measure the thickness of adjusting shim using the micrometer.

- Measure near the center of the shim (the part that touches camshaft).



9. Select the new adjusting shim from the following methods.

**Calculation method of the adjusting shim thickness:**

**R = Thickness of removed shim**

**N = Thickness of new shim**

**M = Measured valve clearance**

**Intake**

$$N = R + [M - 0.28 \text{ mm (0.0010 in)}]$$

**Exhaust**

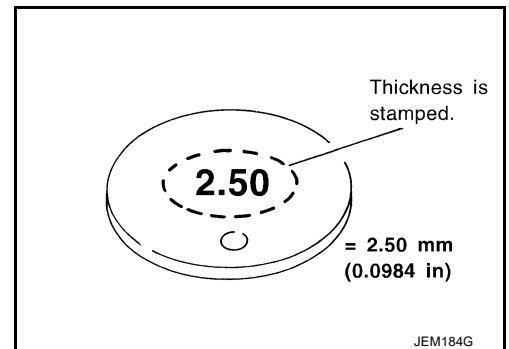
$$N = R + [M - 0.30 \text{ mm (0.0118 in)}]$$



# CAMSHAFT

[YD]

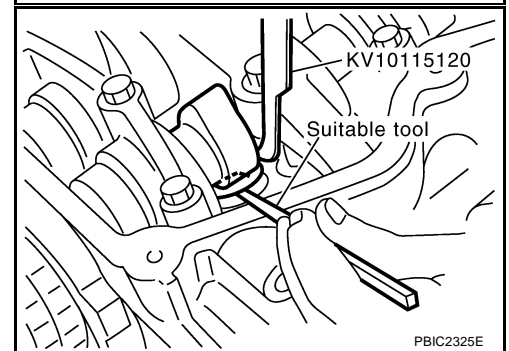
- New adjusting shims have the thickness stamped on the rear side.
- Shims are available in 33 size from 2.10 mm (0.0827 in) to 2.74 mm (0.1079 in), in steps of 0.02 mm (0.0008 in). Refer to [EM-281, "Available Shims"](#).



10. Fit the selected adjusting shim to valve lifter.

**CAUTION:**

**Place the stamped side of adjusting shim to valve lifter.**



11. Compress valve spring using the camshaft pliers [SST: KV10115110] and remove the lifter stopper [SST].
12. Rotate crankshaft 2 to 3 turns by hand.
13. Confirm that the valve clearance is within the specification. Refer to [EM-210, "INSPECTION"](#).
14. Install remaining parts in the reverse order of removal.
15. Warm up engine, and check for unusual noise and vibration.

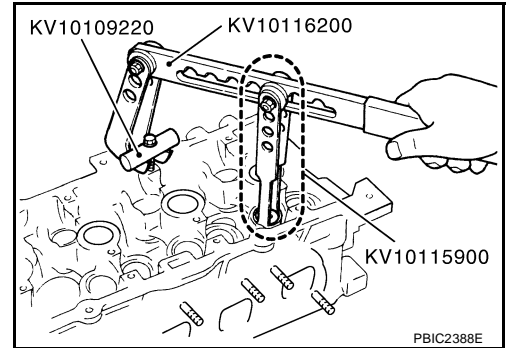
## OIL SEAL

### Removal and Installation of Valve Oil Seal REMOVAL

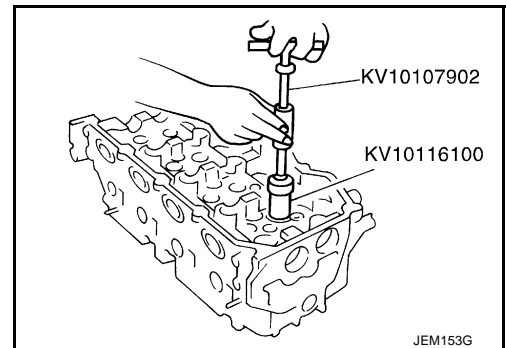
1. Turn crankshaft until the cylinder requiring new valve oil seals is at TDC. This will prevent valve from dropping into cylinder.
2. Remove camshafts. Refer to [EM-203, "CAMSHAFT"](#) .
3. Remove adjusting shims and valve lifters. Refer to [EM-203, "CAMSHAFT"](#) .
  - Check the installation positions, and keep them to avoid being confused.
4. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.
5. Remove valve collet.
  - Compress the valve spring with valve spring compressor, attachment and adapter [SST]. Remove valve collet with a magnet hand.

**CAUTION:**

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

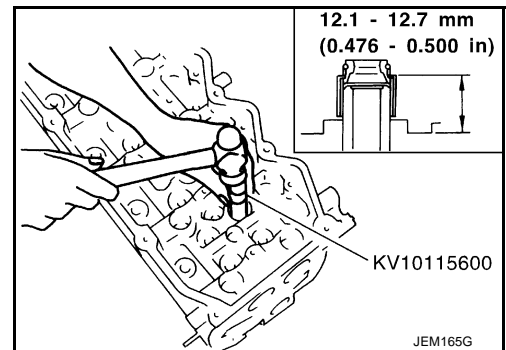


6. Remove valve spring retainer and valve spring.
7. Remove valve oil seal with the valve oil seal puller [SST].



### INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Using the valve oil seal drift [SST], install valve oil seals referring to the dimension shown in the figure.



3. Install in the reverse order of removal.

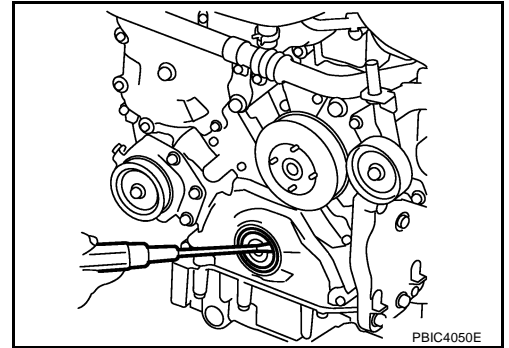
## Removal and Installation of Front Oil Seal

### REMOVAL

1. Remove the following parts.
  - Undercover
  - Drive belt; Refer to [EM-156, "DRIVE BELTS"](#) .
  - Crankshaft pulley; Refer to [EM-223, "PRIMARY TIMING CHAIN"](#) .
2. Remove front oil seal with a suitable tool.

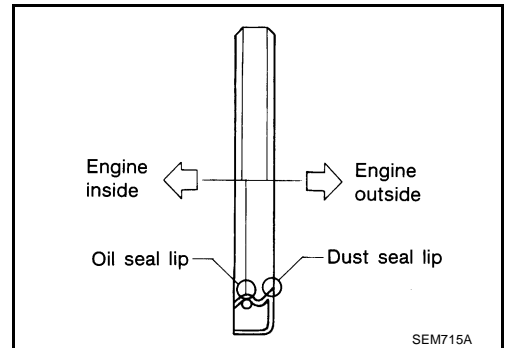
**CAUTION:**

Be careful not to damage oil pump housing and crankshaft.



### INSTALLATION

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

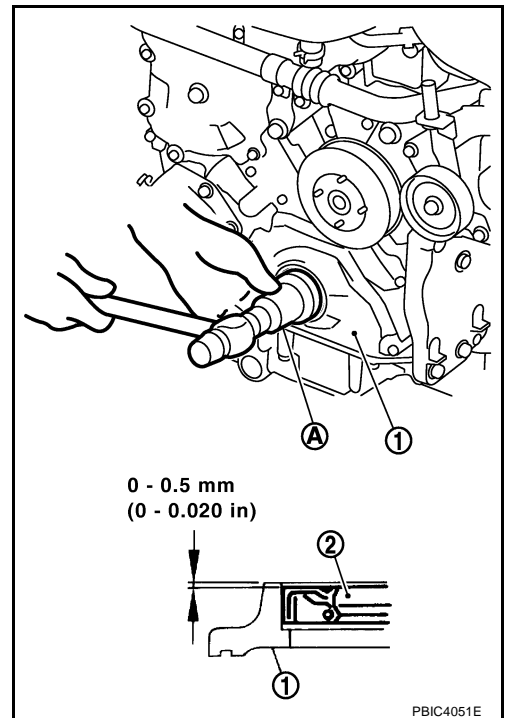


- Using the suitable drift [60 mm (2.36 in) dia.] (A), press fit the oil seal (2) so that the dimension is as specified in the figure.

1 : Oil pump

**CAUTION:**

Do not touch lips of oil seal. Make sure seal surfaces are free of foreign materials.



3. Install in the reverse order of removal.

## Removal and Installation of Rear Oil Seal

### REMOVAL

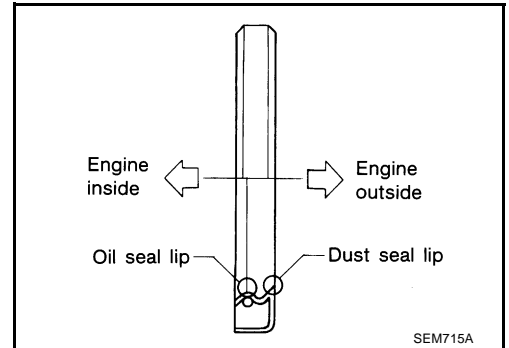
1. Remove transmission and transfer assembly. Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) (M/T models) and [AT-254, "TRANSMISSION ASSEMBLY"](#) (A/T models).
2. Remove flywheel (M/T models) or drive plate (A/T models). Refer to [EM-254, "CYLINDER BLOCK"](#).
3. Remove rear oil seal with a suitable tool.

**CAUTION:**

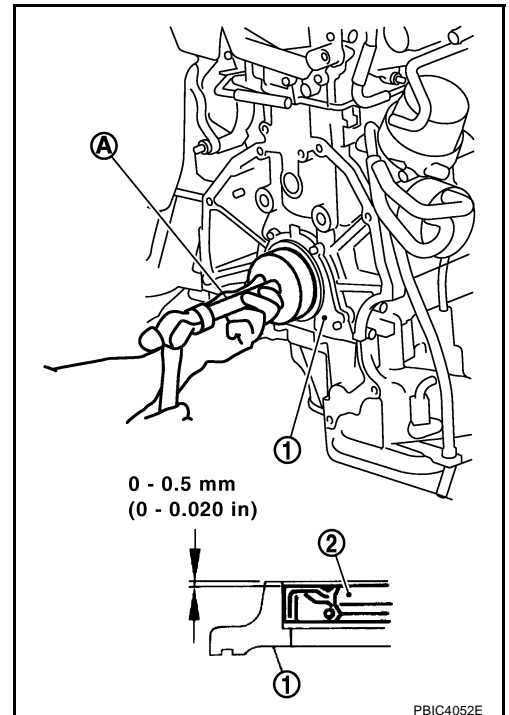
**Be careful not to damage crankshaft and cylinder block.**

### INSTALLATION

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



- Press in rear oil seal (2) to rear oil seal retainer (1) as shown in the figure.
- Using the drift [100 mm (3.94 in) dia.] (A), press fit so that the dimension is as specified in the figure.
- Avoid inclined fitting. Force fit perpendicularly.



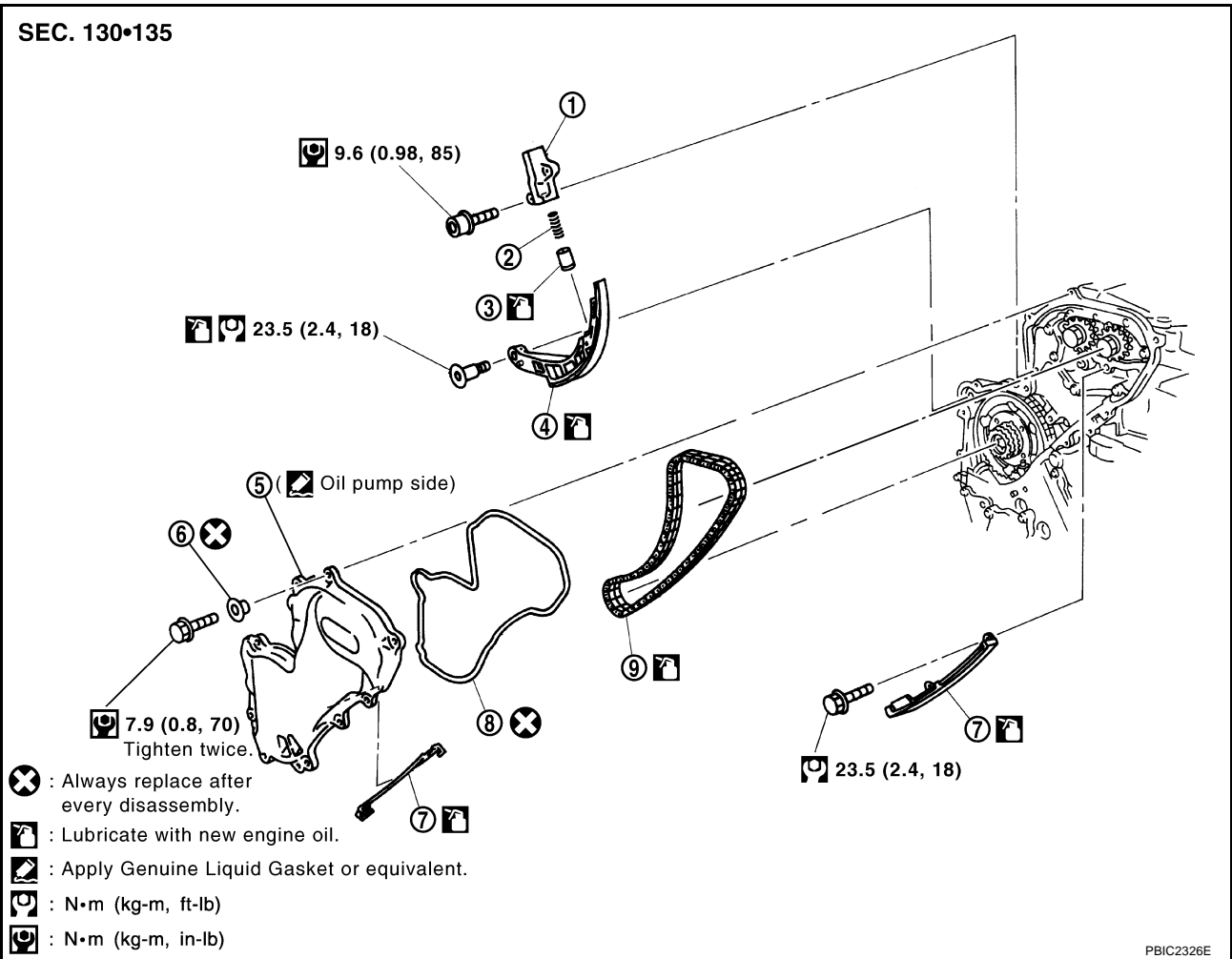
3. Install in the reverse order of removal after this step.

## SECONDARY TIMING CHAIN

PFP:13028

### Components

GBS00019



- |                    |                     |                           |
|--------------------|---------------------|---------------------------|
| 1. Chain tensioner | 2. Spring           | 3. Plunger                |
| 4. Slack guide     | 5. Front chain case | 6. Rubber washer          |
| 7. Tension guide   | 8. Gasket           | 9. Secondary timing chain |

### Removal and Installation

GBS0001A

#### CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.

#### REMOVAL

- For preparative work for removing/installing secondary timing chain to remove/install fuel pump, refer to [EM-193, "FUEL PUMP"](#).
  - To prepare for removing/installing secondary timing chain to remove/install camshaft, refer to [EM-203, "Removal and Installation"](#).
1. Remove radiator shroud (upper and lower) and cooling fan (crankshaft driven type). Refer to [CO-40, "RADIATOR"](#) and [CO-48, "COOLING FAN"](#).
  2. Remove EGR cooler (A/T models) and related water hoses, or EGR tube (M/T models).

#### CAUTION:

- Perform this step when engine is cold.
  - Do not spill engine coolant on drive belts.
3. Remove front chain case.

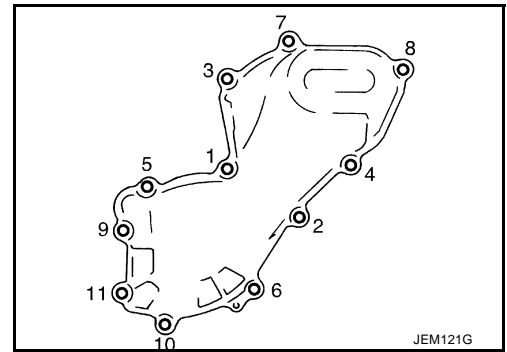
## SECONDARY TIMING CHAIN

[YD]

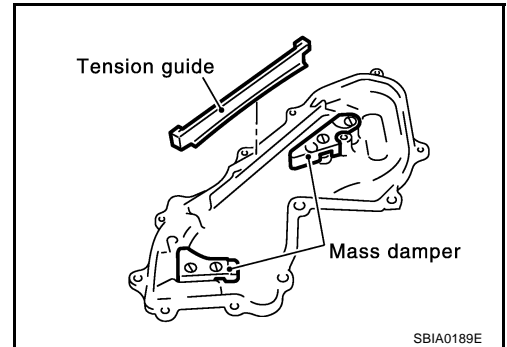
- Loosen fixing bolts in reverse order of that shown in the figure and remove them.

**CAUTION:**

- While front chain case is removed, cover openings to prevent entry of foreign material into engine.

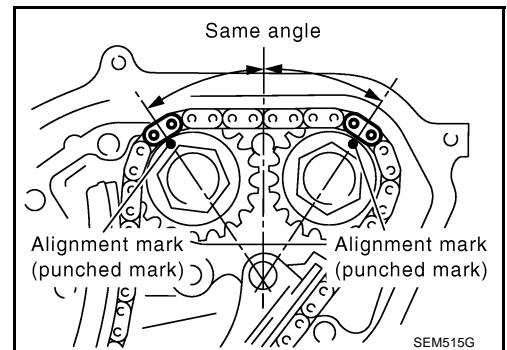


- Do not remove two mass dampers on the back of cover.



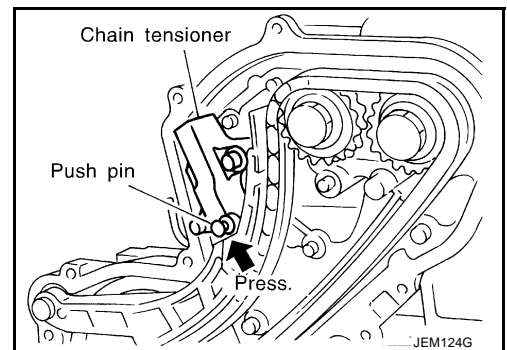
- Set the No. 1 piston to TDC on its compression stroke.

- Turn crankshaft pulley clockwise so that the alignment mark (punched mark) on each camshaft sprocket is positioned as shown in the figure.
- No position indicator is provided on crankshaft pulley.
- When installing, color coded links on secondary timing chain can be used as alignment marks. Marking may not be necessary for removal; however, make alignment marks as required because the alignment mark on fuel pump sprocket may not be easy to see.



- Remove chain tensioner.

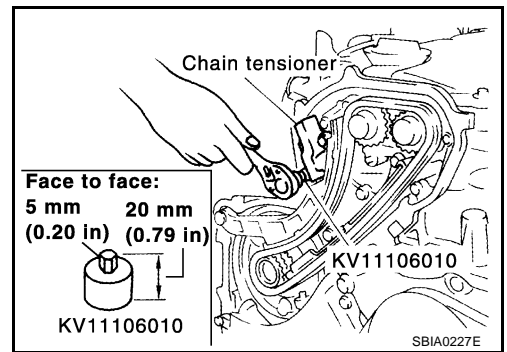
- Push the plunger of chain tensioner and keep it pressed with a push pin.



# SECONDARY TIMING CHAIN

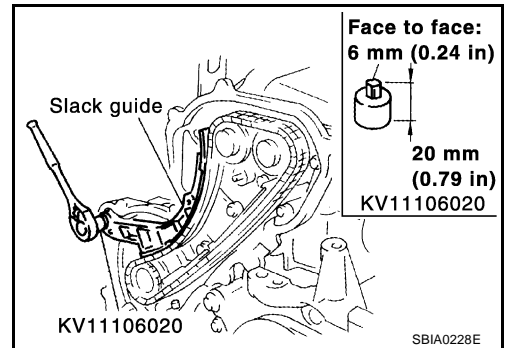
[YD]

- b. Using the hexagon wrench [SST], remove bolts to remove chain tensioner.



6. Remove slack guide.

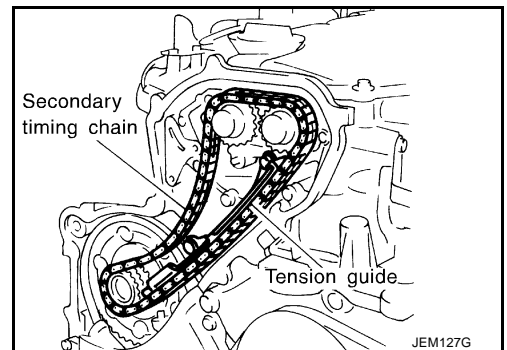
- Using the hexagon wrench [SST], remove bolt to remove slack guide.



7. Remove tension guide.

8. Remove secondary timing chain.

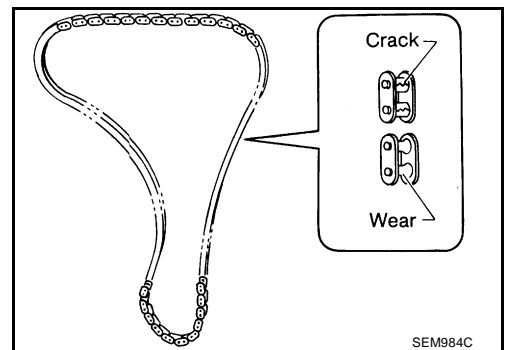
- Timing chain alone can be removed without removing sprockets.



## INSPECTION AFTER REMOVAL

### Timing Chain

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



## INSTALLATION

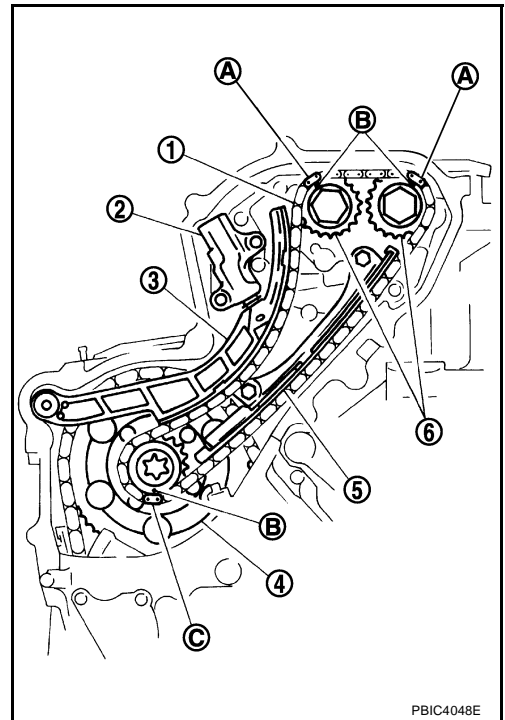
1. Install secondary timing chain.

## SECONDARY TIMING CHAIN

[YD]

- When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on the timing chain.

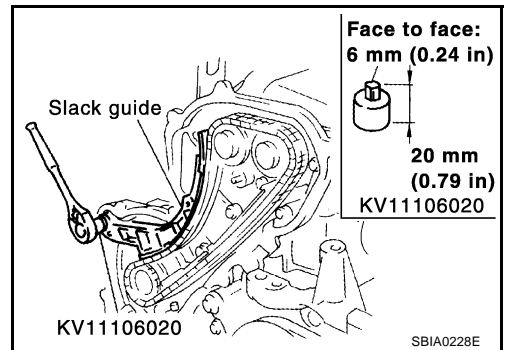
- 1 : Secondary timing chain
- 2 : Chain tensioner
- 3 : Slack guide
- 4 : Fuel pump sprocket
- 5 : Tension guide
- 6 : Camshaft sprocket
- A : Alignment mark (silver link)
- B : Alignment mark (punched mark)
- C : Alignment mark (yellow link)



### 2. Install tension guide.

- The upper bolt has a longer shank than the lower bolt.

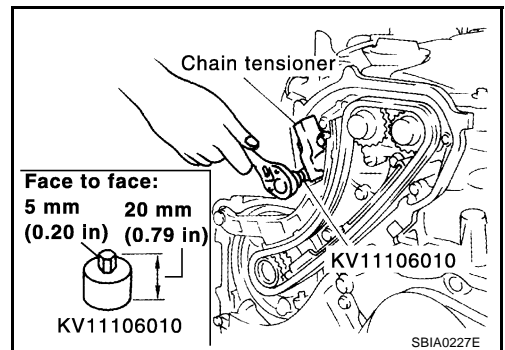
### 3. Using the hexagon wrench [SST], install slack guide.



### 4. Install chain tensioner.

- Push the plunger of chain tensioner. While holding it with a push pin, install chain tensioner.
- Using the hexagon wrench [SST], tighten bolts.
- Pull out the push pin, etc. holding the plunger.

- Make sure again that the alignment marks on the sprockets and the colored alignment marks on the timing chain are aligned.**



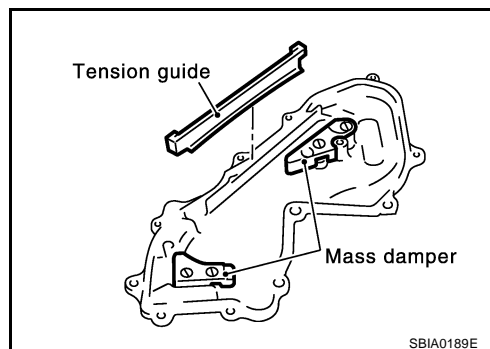
### 5. Install front chain case.



## SECONDARY TIMING CHAIN

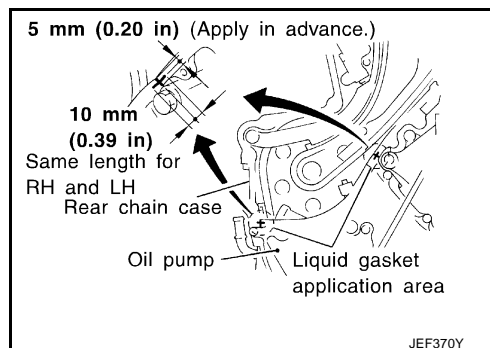
[YD]

- a. Install tension guide on the back surface of front chain case.
- Hold front chain case vertically when installing. Tension guide may come off if front chain case is tilted.

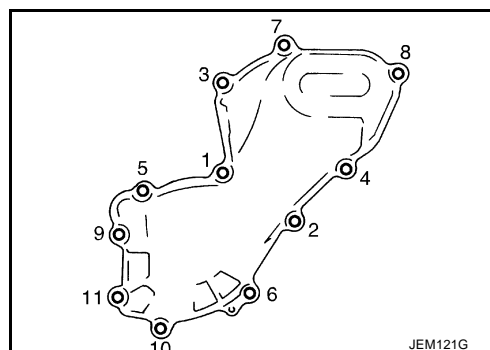


- b. Apply a continuous bead of liquid gasket on both ends of arched area (locations where rear chain case is adjoined) as shown in the figure.

- **Use Genuine Liquid Gasket or equivalent.**



- c. Install front chain case.
- When installing, align dowel pin on oil pump housing with the pin hole.
  - Install No. 6, 10 and 11 bolts with the rubber washer to front chain case.
- d. Tighten fixing bolts in numerical order shown in the figure.
- e. After tightening all the bolts, re-tighten in the same order.



6. Hereafter, install in the reverse order of removal.

### INSPECTION AFTER INSTALLATION

#### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

## SECONDARY TIMING CHAIN

[YD]

### Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\*1: Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

\*2: Check engine oil level 10 minutes after engine stopped.

# PRIMARY TIMING CHAIN

[YD]

## PRIMARY TIMING CHAIN

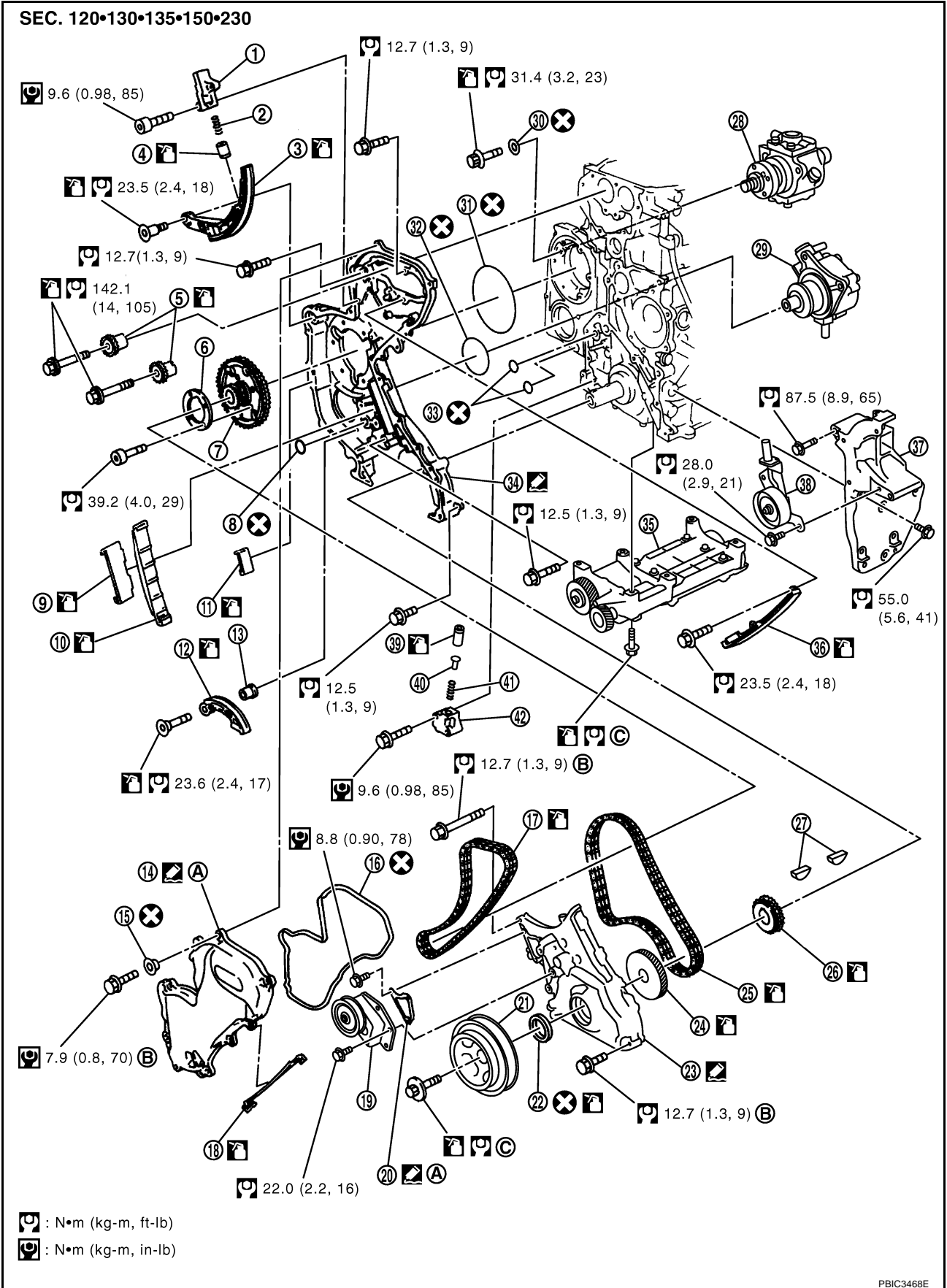
PFPP:13028

### Components

GBS0001B

A  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

EM



- |                            |                                |                                      |
|----------------------------|--------------------------------|--------------------------------------|
| 1. Chain tensioner         | 2. Spring                      | 3. Slack guide                       |
| 4. Plunger                 | 5. Camshaft sprocket           | 6. Washer                            |
| 7. Fuel pump sprocket      | 8. O-ring                      | 9. Tension guide                     |
| 10. Tension guide          | 11. Chain guide                | 12. Slack guide                      |
| 13. Spacer                 | 14. Front chain case           | 15. Rubber washer                    |
| 16. Gasket                 | 17. Secondary timing chain     | 18. Chain guide                      |
| 19. Idler pulley           | 20. Vacuum pump cover          | 21. Crankshaft pulley                |
| 22. Front oil seal         | 23. Oil pump housing           | 24. Crankshaft gear                  |
| 25. Primary timing chain   | 26. Crankshaft sprocket        | 27. Key                              |
| 28. Fuel pump              | 29. Vacuum pump                | 30. Seal washer                      |
| 31. O-ring                 | 32. O-ring                     | 33. O-ring                           |
| 34. Rear chain case        | 35. Balancer unit (4WD models) | 36. Tension guide                    |
| 37. A/C compressor bracket | 38. Idler pulley               | 39. Plunger                          |
| 40. Plug                   | 41. Spring                     | 42. Chain tensioner                  |
| A. Oil pump side.          | B. Tighten twice.              | C. Refer to <a href="#">EM-229</a> . |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

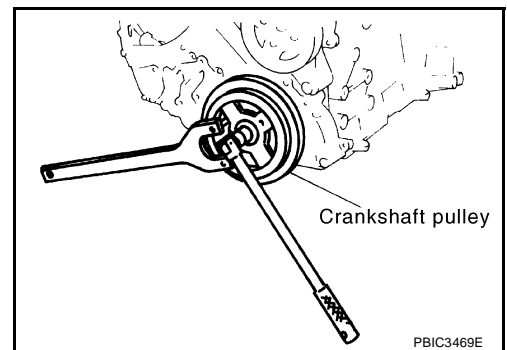
GBS0001C

### CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.

### REMOVAL

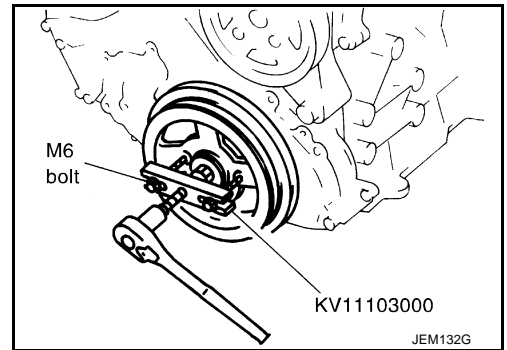
1. Remove power steering oil pump and power steering oil pump bracket. Refer to [PS-24, "POWER STEERING OIL PUMP"](#) .
2. Remove idler pulleys.
3. Remove rocker cover. Refer to [EM-200, "ROCKER COVER"](#) .
4. Remove oil pan (upper and lower). Refer to [EM-180, "OIL PAN AND OIL STRAINER"](#) .
5. Remove fuel injector. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .
6. Remove secondary timing chain and associated parts. Refer to [EM-217, "SECONDARY TIMING CHAIN"](#) .
7. When removing rear chain case, remove camshaft sprockets. Refer to [EM-203, "CAMSHAFT"](#) .
8. Remove crankshaft pulley.
  - a. Hold crankshaft pulley with the pulley holder (commercial service tool).
  - b. Loosen crankshaft pulley fixing bolt and pull out the bolt approximately 10 mm (0.39 in).



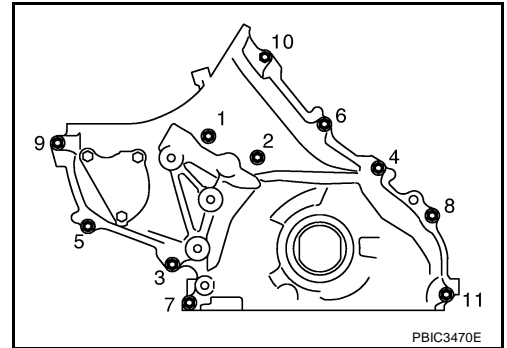
# PRIMARY TIMING CHAIN

[YD]

- c. Using the pulley puller [SST], remove crankshaft pulley.
- Use two M6 bolts with approx. 60 mm (2.36 in) shank length for securing crankshaft pulley.



9. Remove oil pump housing.
- Loosen bolts in reverse order of that shown in the figure and remove them.
  - Use the seal cutter [SST: KV10111100] etc. for removal.



10. Remove crankshaft gear.
- Remove crankshaft gear (1) with the following procedure (4WD models).

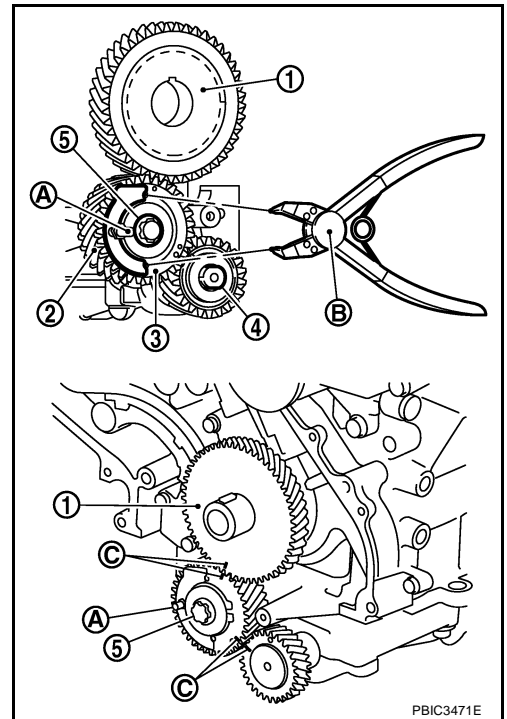
- a. Make sure that No.1 piston is TDC on its compression stroke.
- b. Turn the idler sub gear (3) counterclockwise with snap ring plier (B) or suitable tool for aligning idler sub gear (3) and idler main gear (2).
- If idler gear rotates, hold the flat faces on balancer drive shaft front end (4).

- c. Install internal mechanism securing bolt and plate (Service part: 13012 EB30A and 13013 EB30A) (A) and tighten to the specified torque.

 : 4.0 N·m (0.41 kg·m, 35 in·lb)

### CAUTION:

- Do not loosen idler gear mounting bolt (5).
- Only use the genuine internal mechanism securing bolt and plate (A), or the idler gear (2) and (3) will be damaged.
- Do not remove internal mechanism securing bolt and plate (A) from idler gear (2) and (3) until crankshaft gear (1) and all of the parts in connection have been installed.
- If internal mechanism securing bolt and plate (A) is not installed, internal mechanism of idler gear (2) and (3) will disengage after crankshaft gear (1) is removed. This will prohibit the balancer unit from being reusable.



- d. Apply mating marks (C) to crankshaft gear (1) and idler sub gear (3).
- e. Remove crankshaft gear (1).

11. Remove front oil seal from oil pump housing.

- Punch out the seal off from the back surface of the oil pump housing using a flat-bladed screwdriver.

### CAUTION:

Be careful not to damage oil pump housing.

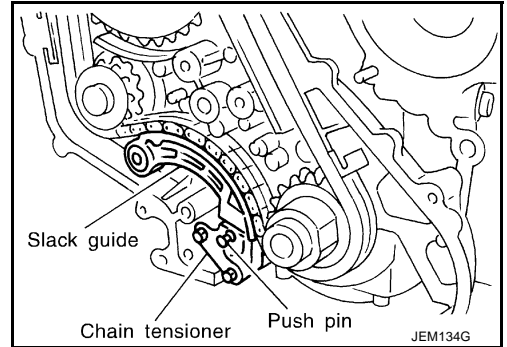
# PRIMARY TIMING CHAIN

[YD]

12. Remove chain tensioner.

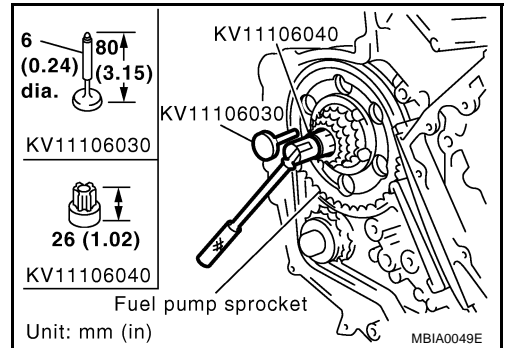
- When removing chain tensioner, push the plunger of chain tensioner and keep it pressed with a push pin, etc.

13. Remove slack guide.

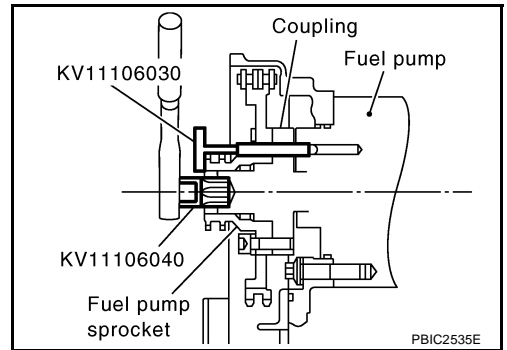


14. Hold fuel pump sprocket and remove bolt.

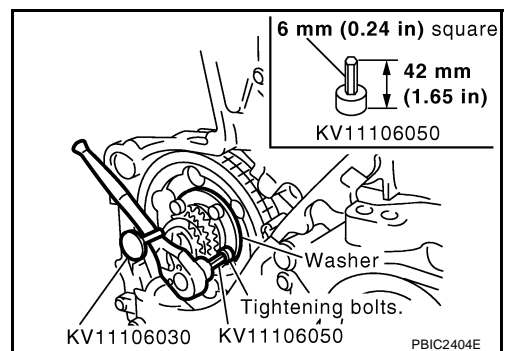
- Insert positioning stopper pin [SST] into the hole 6 mm (0.24 in) in the diameter on fuel pump sprocket.
- Using the TORX wrench, turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.
- Push positioning stopper pin through fuel pump sprocket to fuel pump body to hold fuel pump sprocket.



- Insert the positioning stopper pin until its flange contacts fuel pump sprocket.

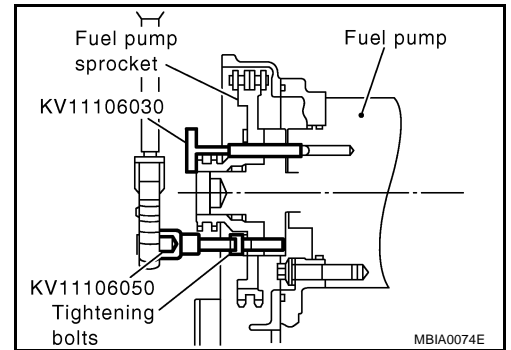


15. Using the hexagon wrench [SST] remove tightening bolts to fuel pump sprocket.



# PRIMARY TIMING CHAIN

[YD]



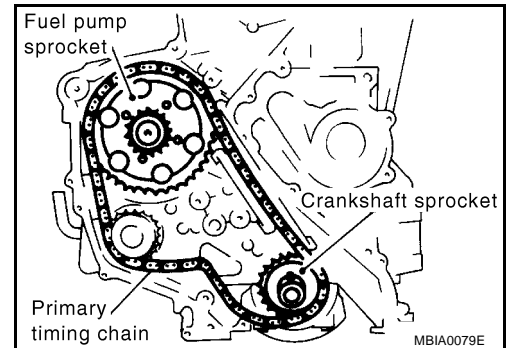
A

EM

C

D

16. Remove primary timing chain with fuel pump sprocket and crankshaft sprocket.

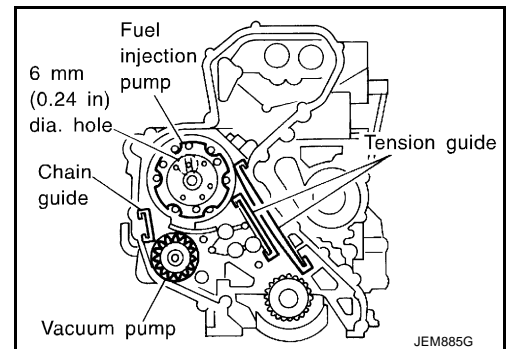


E

F

G

17. Remove chain guide and tension guides.



H

I

J

K

18. Remove fuel pump. Refer to [EM-193, "FUEL PUMP"](#) .  
19. Remove vacuum pump. Refer to [EM-186, "VACUUM PUMP"](#) .

L

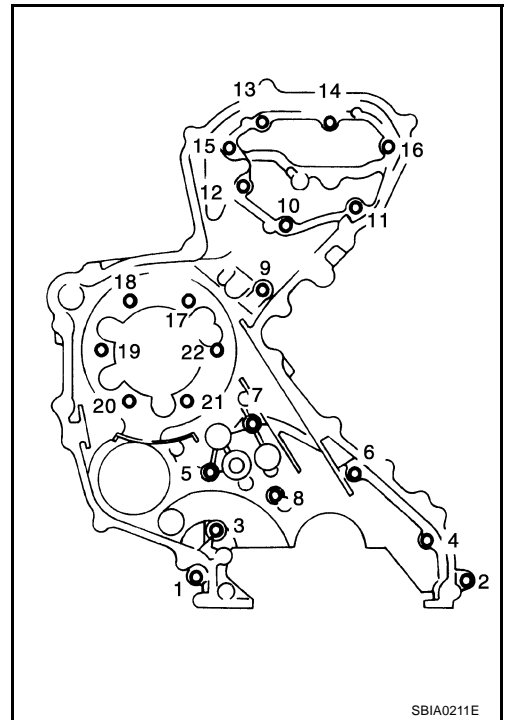
M

# PRIMARY TIMING CHAIN

[YD]

20. Remove rear chain case.

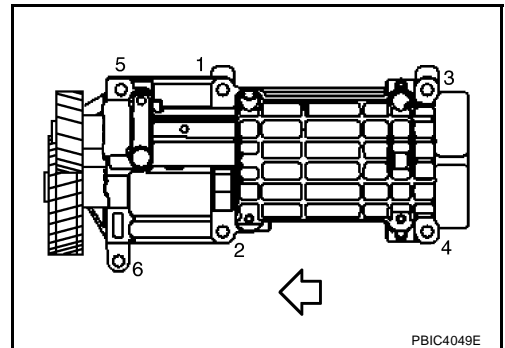
- Loosen fixing bolts in the reverse order of that shown in the figure and remove them.
- Use the seal cutter [SST: KV10111100] for removal.



21. Remove balancer unit (4WD models).

- Loosen mounting bolts in the reverse order as shown in the figure.

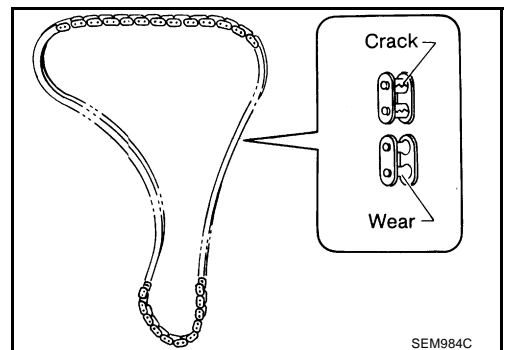
⇐ : Engine front



## INSPECTION AFTER REMOVAL

### Timing Chain

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





# PRIMARY TIMING CHAIN

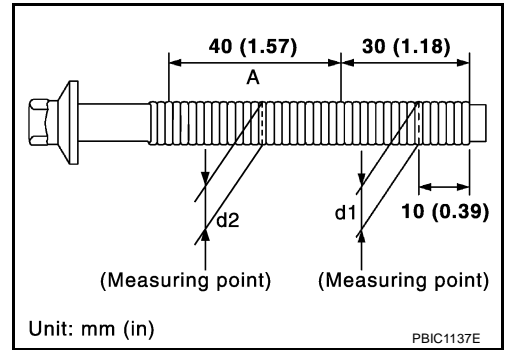
[YD]

## Balancer Unit Mounting Bolt Outer Diameter (4WD Models)

- Measure the outer diameters ("d1", "d2") at two positions as shown in the figure.
- If reduction appears in "A" range, regard it as "d2".

**Limit ("d1" - "d2" : 0.15 mm (0.0059 in))**

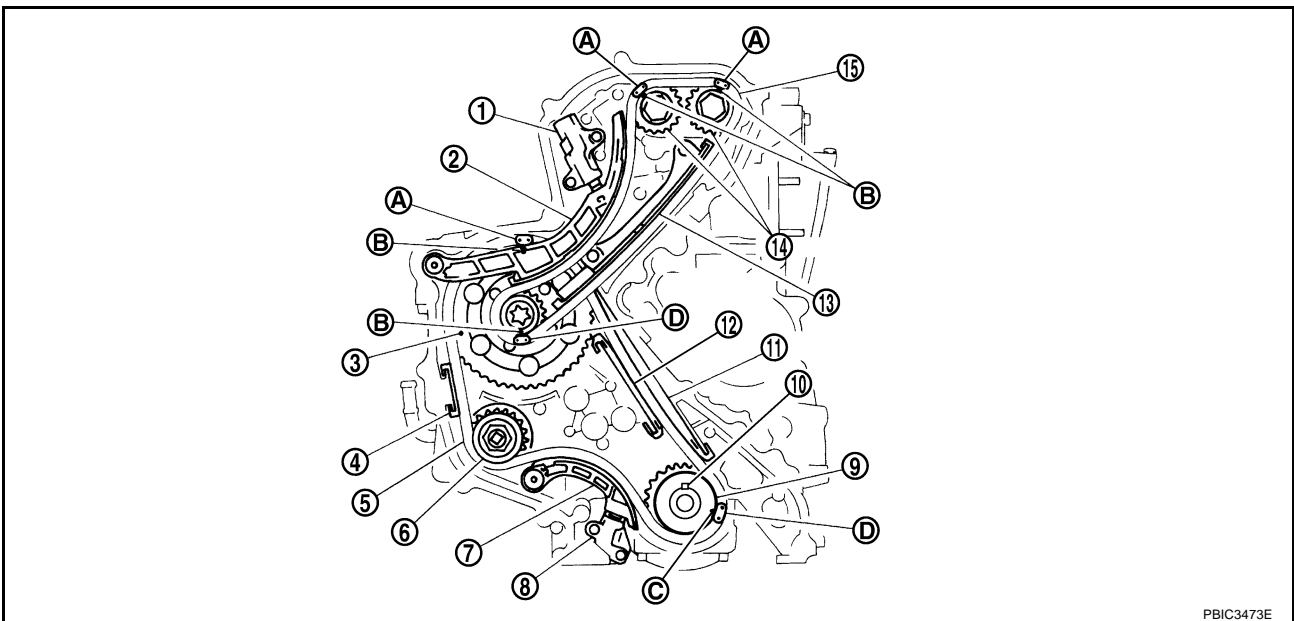
- If it exceeds the limit (large difference in dimensions), replace it with a new one.



## INSTALLATION

### NOTE:

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



- |                                 |                                  |                                  |
|---------------------------------|----------------------------------|----------------------------------|
| 1. Chain tensioner              | 2. Slack guide                   | 3. Fuel pump sprocket            |
| 4. Chain guide                  | 5. Primary timing chain          | 6. Vacuum pump sprocket          |
| 7. Slack guide                  | 8. Chain tensioner               | 9. Crankshaft sprocket           |
| 10. Key                         | 11. Tension guide                | 12. Tension guide                |
| 13. Tension guide               | 14. Camshaft sprocket            | 15. Secondary timing chain       |
| A. Alignment mark (silver link) | B. Alignment mark (punched mark) | C. Alignment mark (cut-out area) |
| D. Alignment mark (yellow link) |                                  |                                  |

### CAUTION:

**Before starting work, make sure that No. 1 piston is on its compression stroke.**

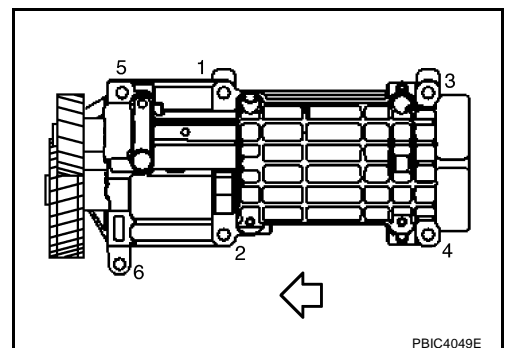
1. Install balancer unit, and tighten mounting bolts in numerical order as shown in the figure (4WD models).

← : Engine front

### CAUTION:

**If mounting bolts are re-used, check their outer diameter before installation. Refer to [EM-229, "Balancer Unit Mounting Bolt Outer Diameter \(4WD Models\)"](#).**

- a. Apply new engine oil to threads and seat surfaces of mounting bolts.
- b. Tighten all bolts.



: 29.4 N·m (3.0 kg-m, 22 ft-lb)

c. Turn all bolts 65 degrees clockwise (angle tightening).

1 : Balancer unit

A : KV10112100

d. Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

**CAUTION:**

**In this step, loosen bolts in the reverse order as shown in the figure.**

e. Tighten all bolts.

: 29.4 N·m (3.0 kg-m, 22 ft-lb)

f. Turn them another 65 degrees clockwise (angle tightening).

**CAUTION:**

**Check tightening angle with an angle wrench [SST] (A) or a protractor. Do not make judgment by visual check alone.**

2. Install rear chain case.

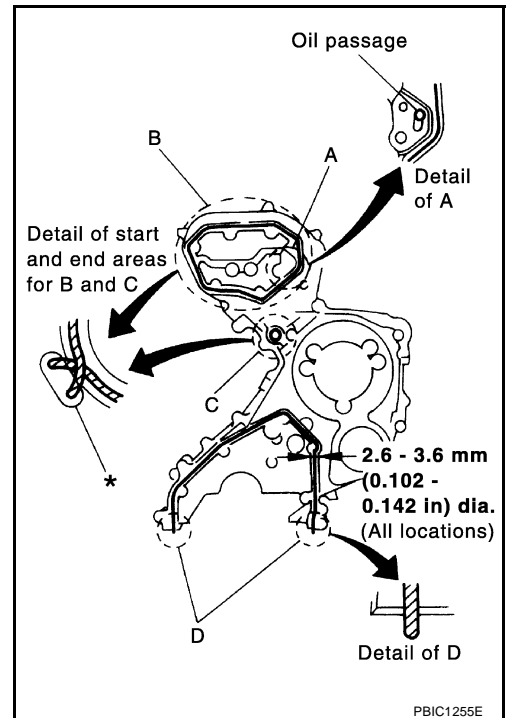
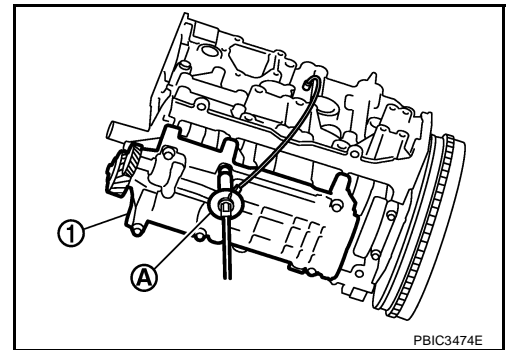
a. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] on locations shown in the figure.

**Use Genuine Liquid Gasket or equivalent.**

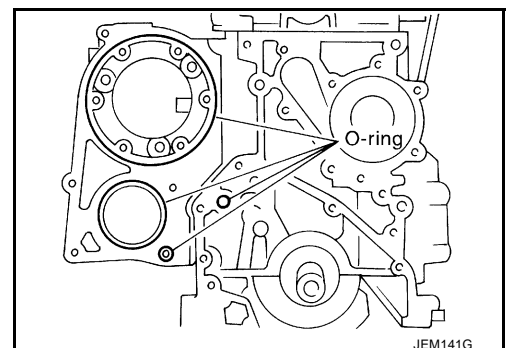
A: Apply bead so that it does not protrude into the oil passage.

B, C: Minimize overlapping area of bead, by starting and ending at areas of bead as shown in the figure. Apply so that the portion marked \* comes at an external location but cannot be viewed externally after engine assembly.

D: Leave the start and end areas of the bead slightly protruding from the case surface.



b. Install four O-rings to the grooves of the cylinder block and fuel pump bracket.



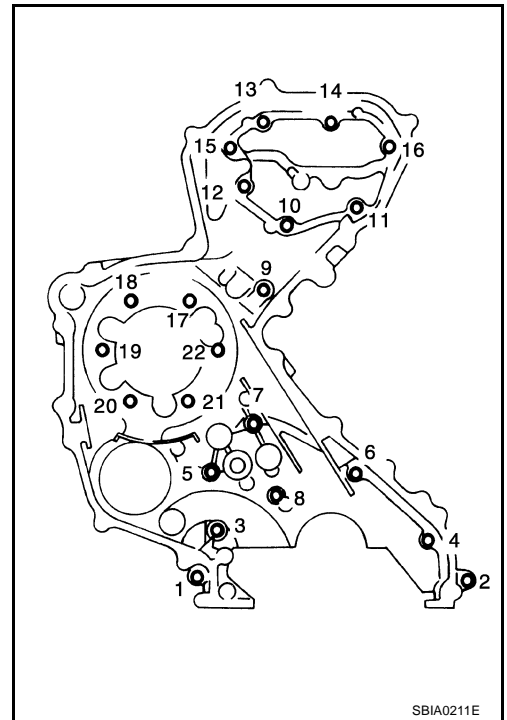
c. Install rear chain case.

- When installing, align the dowel pin with the pin hole.

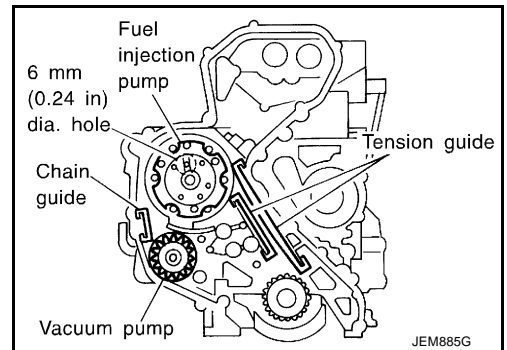
# PRIMARY TIMING CHAIN

[YD]

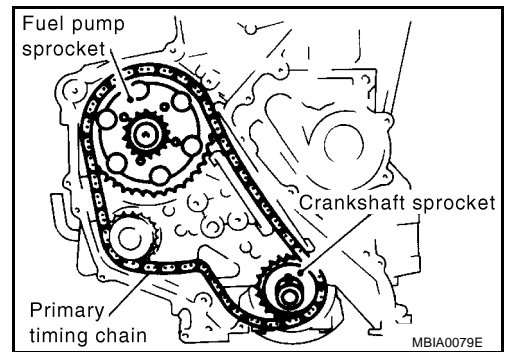
- d. Tighten bolts in numerical order shown in the figure.
- Install the following four types of bolts, referring to the figure.
    - 16 mm (0.63 in) : Bolt No. 1, 2, 16, 17, 18, 19, 20, 21, 22**
    - 20 mm (0.79 in) : Bolt No. 3, 4, 6, 9, 10, 11, 13, 14**
    - 25 mm (0.98 in) : Bolt No. 12, 15**
    - 35 mm (1.38 in) : Bolt No. 5, 7, 8**
  - The shank length under the bolt neck above is the length of threaded part (pilot portion not included).
- e. After tightening all the bolts, re-tighten in the same order.



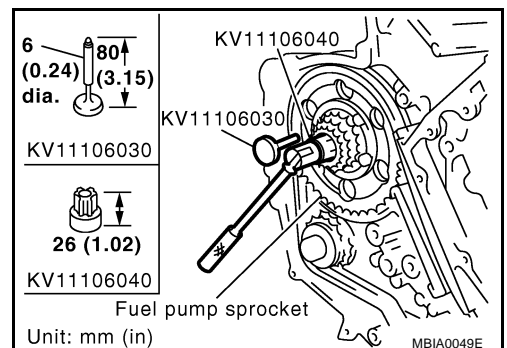
3. Install vacuum pump. Refer to [EM-186, "VACUUM PUMP"](#) .
4. Install fuel pump. Refer to [EM-193, "FUEL PUMP"](#) .
- Before installing, make sure that spacer and the hole 6 mm (0.24 in) in diameter on coupling are aligned.
5. Install chain guide and tension guides.
6. Install crankshaft sprocket, aligning it with crankshaft key on the far side.



7. Install primary timing chain with fuel pump sprocket.
- When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on primary timing chain.
  - Install fuel pump sprocket washer with the surface marked "F" (front mark) facing the front of the engine.
8. Install timing chain onto power steering oil pump sprocket and through chain guide.

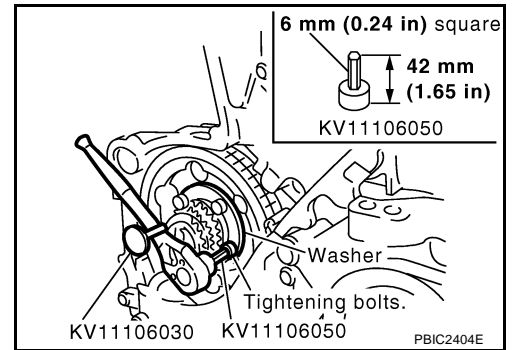


9. Use the positioning stopper pin [SST] to hold the fuel pump sprocket and install the bolt.
- Using the TORX wrench [SST], turn the fuel pump shaft little by little to adjust the position of the fuel pump sprocket. Insert positioning stopper pin into the hole 6 mm (0.24 in) in diameter on fuel pump sprocket so that the stopper pin goes through the fuel pump body. While the stopper pin is in place, install the bolt.



# PRIMARY TIMING CHAIN

[YD]



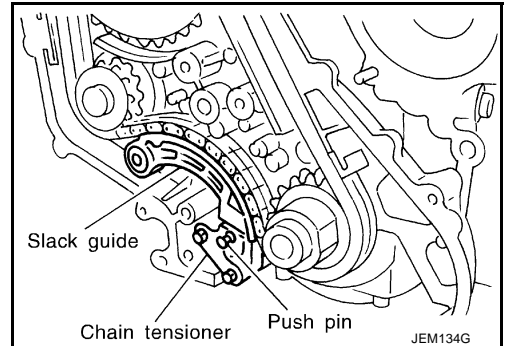
10. Install timing chain slack guide.

11. Install chain tensioner.

- Push the plunger of the chain tensioner. While keeping plunger pressed down with a push pin, etc., install chain tensioner.
- After installation, pull out the push pin holding the plunger.

**CAUTION:**

**Make sure again that the alignment marks on sprockets and the colored alignment marks on timing chain are aligned.**

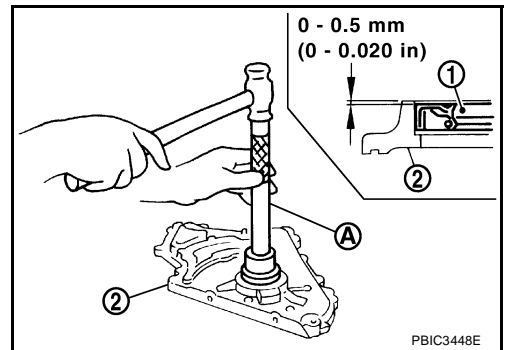


12. Install front oil seal (1) to oil pump housing (2).

- Using the suitable drift (A) [62 mm (2.44 in) dia.], force fit the seal until it hits the bottom.

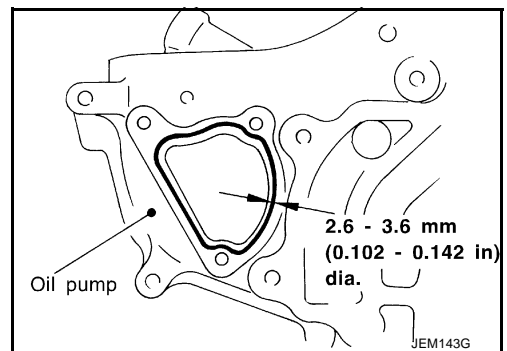
**CAUTION:**

**Do not touch lips of oil seal. Make sure seal surfaces are free of foreign materials.**



13. Install vacuum pump cover to oil pump housing.

- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**
- Apply liquid gasket on oil pump-side surface.



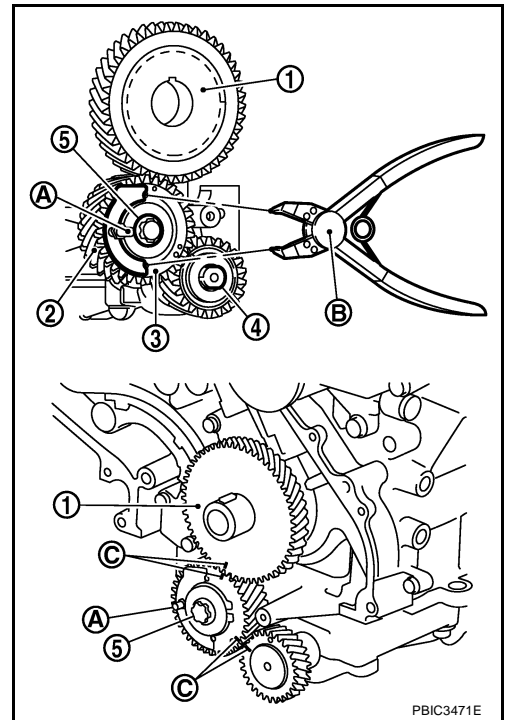
14. Install crankshaft gear.

- Install crankshaft gear with the following procedure (4WD models).

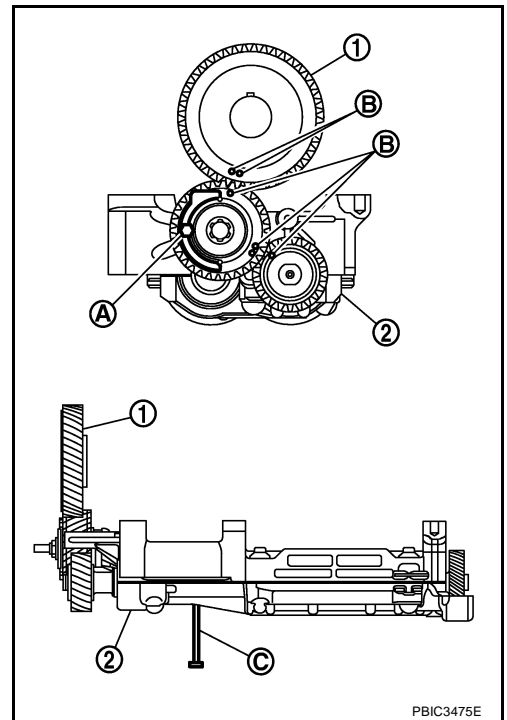
# PRIMARY TIMING CHAIN

[YD]

- Align crankshaft gear (1) mating mark and idler sub gear (3) mating mark (C).
- 2 : Idler main gear
- 4 : Balancer drive shaft front end
- 5 : Idler gear mounting bolt (do not loosen)
- B : Snap ring plier
- Remove internal mechanism securing bolt and plate (Service part: 13012 EB30A and 13013 EB30A) (A).

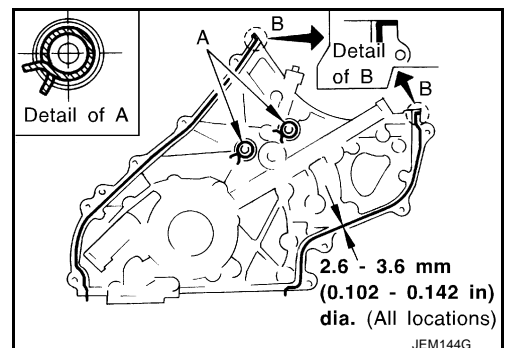


- If new balancer unit (2) is used, align matching marks (B) of each gear as shown in the figure.
- Remove securing-bolt-and-plate (A) and securing pin (C) after installing crankshaft gear (1).

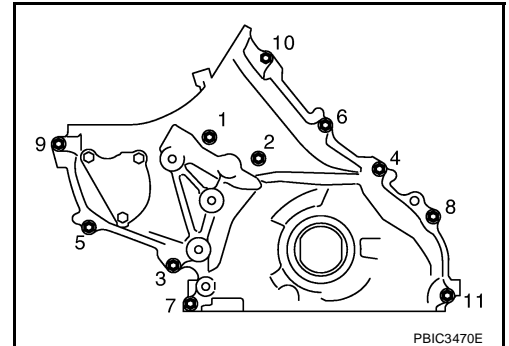


## 15. Install oil pump housing.

- a. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.
  - A: Leave the start and end areas of the bead slightly protruding from the surface.
  - B: Apply liquid gasket along upper end surface of oil pump housing.



- b. Install O-ring into the groove of rear chain case.
- c. Install oil pump housing.
  - When installing, align the inner rotor in the direction of the two facing flats of oil pump drive spacer.
  - When installing, align the dowel pin with the pin hole.
- d. Tighten fixing bolts in numerical order shown in the figure.
- e. After tightening all the bolts, re-tighten in the same order.



16. Check gaps on upper oil pan mounting surface.
  - Using straightedge and feeler gauge, measure gaps between the locations of the following parts:

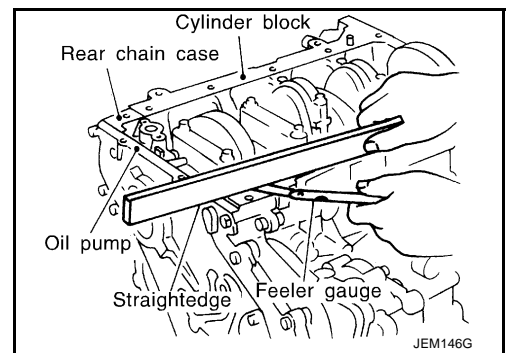
**Oil pump housing and rear chain case:**

**Standard : – 0.09 to 0.09 mm (– 0.0035 to 0.0035 in)**

**Rear chain case and cylinder block:**

**Standard : – 0.19 to 0.07 mm (– 0.0075 to 0.0028 in)**

- If the measured value is out of the standard, install again.



17. Install crankshaft pulley.

**CAUTION:**

**Be careful not to damage front oil seal.**

- a. Install crankshaft pulley to crankshaft.
- b. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
- c. Hold crankshaft pulley with the pulley holder [SST].
- d. Tighten crankshaft pulley fixing bolt.

 : 75.0 N·m (7.7 kg·m, 55 ft·lb)

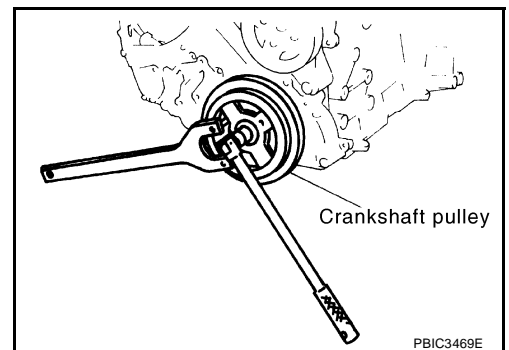
- e. Completely loosen.

 : 0 N·m (0 kg·m, 0 ft·lb)

- f. Tighten crankshaft pulley bolt.

 : 75.0 N·m (7.7 kg·m, 55 ft·lb)

- g. Put an alignment mark on crankshaft pulley that aligns with one of the punched marks on the bolt.

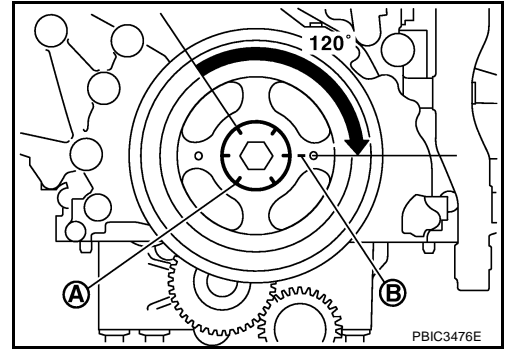


# PRIMARY TIMING CHAIN

[YD]

- h. Tighten fixing bolt another 120 degrees (angle tightening) (turn by 2 notch).

- A** : Indicate embossments
- B** : Alignment mark



18. Install secondary timing chain and the associated parts.  
Refer to [EM-219, "INSTALLATION"](#) .
19. Install in the reverse order of removal.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

### Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\*1: Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

\*2: Check engine oil level 10 minutes after engine stopped.



## CYLINDER HEAD

PFP:11041

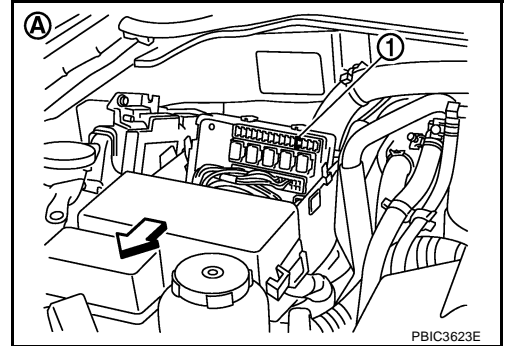
### On-Vehicle Service CHECKING COMPRESSION PRESSURE

GBS0001D

1. Warm up engine thoroughly. Then, stop it.
2. Using CONSULT-II, make sure no error codes are indicated for self-diagnosis items. Refer to [EC-1027](#), "[Basic Inspection](#)".
  - Do not disconnect CONSULT-II until the end of this operation; it will be used to check engine rpm and for error detection at the end of this operation.
3. Disconnect the battery cable from the negative terminal.
4. To prevent fuel from being injected during inspection, remove fuse [EGI (20A)] (1) from fuse box.

A : LHD models

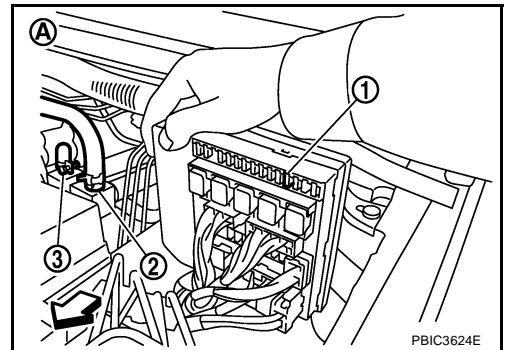
↶ : Vehicle front



A : RHD models

2 : Water hose (to reservoir tank)

3 : Air relief plug



5. Remove glow plugs from all the cylinders. Refer to [EM-185](#), "[GLOW PLUG](#)".

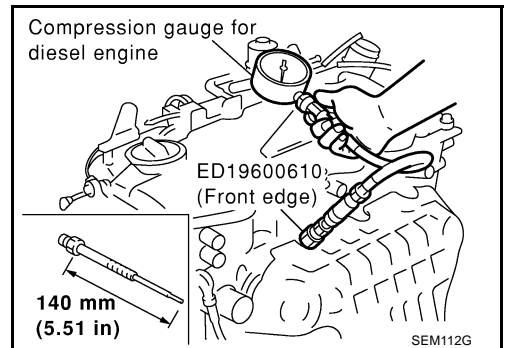
**CAUTION:**

- Before removal, clean the surrounding area to prevent entry of any foreign materials into engine.
- Carefully remove glow plugs to prevent any damage or breakage.
- Handle with care to avoid applying any shock to glow plugs.

6. Install compression gauge adapter [SST] to installation holes of glow plugs and connect compression gauge for diesel engine.

: 20.0 N·m (2.0 kg·m, 15 ft·lb)

7. Connect the battery cable to the negative terminal.
8. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.
  - Always use a fully-charged battery to obtain specified engine speed.





# CYLINDER HEAD

[YD]

## Compression pressure

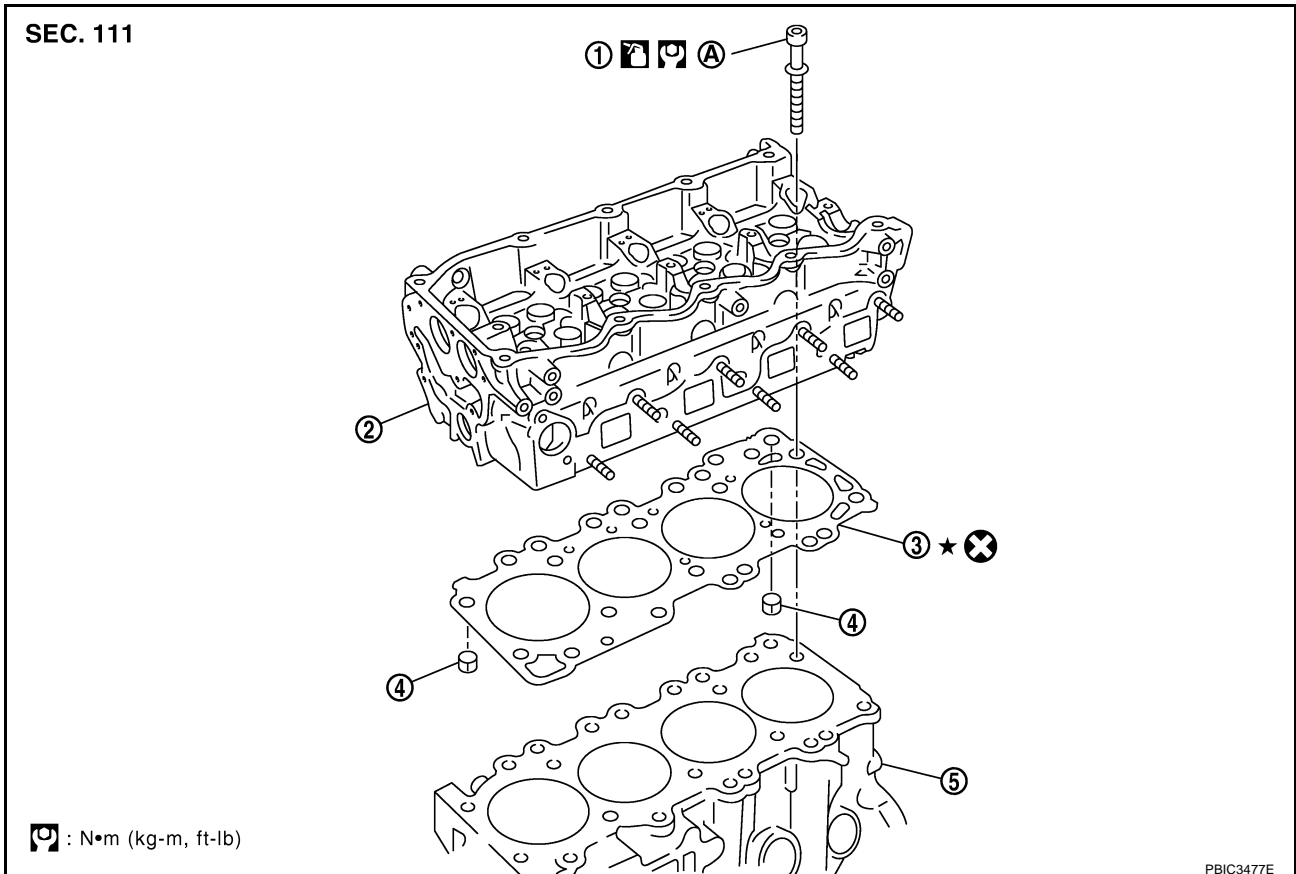
Unit: kPa (bar, kg/cm<sup>2</sup>, psi)/rpm

Standard	Minimum	Difference limit between cylinders
3,100 (31, 31.6, 450)/200	2,500 (25, 25.5, 363)/200	490 (4.9, 5.0, 71)/200

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
  - If engine rpm exceeds the limit, check valve clearance and combustion chamber components (valves, valve seats, cylinder head gaskets, piston rings, pistons, cylinder bores, cylinder block upper and lower surfaces) and measure again.
  - If compression pressure is low in some cylinders, apply engine oil from glow plug installation hole. Then check pressure again.
    - If compression pressure becomes normal after applying engine oil, piston ring may be worn or damaged. Check piston ring for malfunction. If any, replace piston ring.
    - If compression pressure is still low after applying engine oil, valve may be malfunctioning. Check valve for malfunction. If contact malfunction is found, replace valve or valve seat.
  - If compression pressure in adjacent two cylinders is low after applying engine oil, pressure may be leaking from gasket. In this case, replace cylinder head gasket.
9. Complete this operation as follows:
- a. Turn the ignition switch to "OFF".
  - b. Disconnect the battery cable from the negative terminal.
  - c. Install glow plug and install all the parts removed in step 4.
  - d. Install fuse [EGI (20A)].
  - e. Connect the battery cable to the negative terminal.
  - f. Using CONSULT-II make sure no DTC is indicated for items of self-diagnosis.

## Components

GBS0001E



- |                                      |                           |           |
|--------------------------------------|---------------------------|-----------|
| 1. Cylinder head bolt                | 2. Cylinder head assembly | 3. Gasket |
| 4. Dowel pin                         | 5. Cylinder block         |           |
| A. Refer to <a href="#">EM-240</a> . |                           |           |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Removal and Installation

### REMOVAL

GBS0001F

1. Drain engine coolant. Refer to [CO-37, "Changing Engine Coolant"](#) .
2. Remove the following:
  - Rocker cover (Refer to [EM-200, "ROCKER COVER"](#) .)
  - Spill tube and fuel injector (Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .)
  - Intake manifold (Refer to [EM-164, "INTAKE MANIFOLD"](#) .)
  - Turbocharger (Refer to [EM-172, "TURBO CHARGER"](#) .)
  - Exhaust manifold (Refer to [EM-178, "EXHAUST MANIFOLD"](#) .)
  - Secondary timing chain (Refer to [EM-217, "SECONDARY TIMING CHAIN"](#) .)
  - Camshaft (Refer to [EM-203, "CAMSHAFT"](#) .)
3. Remove cylinder head assembly.

- Remove cylinder head bolts in the reverse order as shown in the figure with the cylinder head bolt wrench (commercial service tool).
- Lift up cylinder head assembly to avoid interference with dowel pins located between the cylinder block and cylinder head, and remove cylinder head assembly.

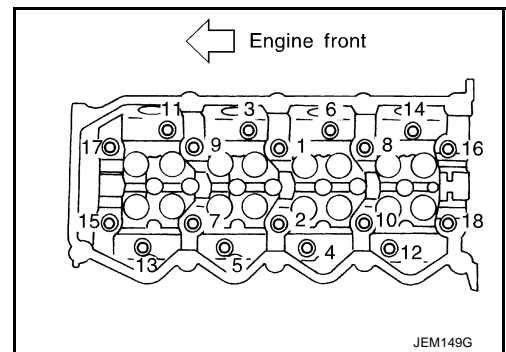
#### CAUTION:

Remove glow plug in advance to avoid damage as the tip of the glow plug projects from the bottom of cylinder head, or, place wood blocks beneath both ends of cylinder head to keep the cylinder bottom from any contact.

- For glow plug removal, the following shall be noted.

#### CAUTION:

- To avoid breakage, do not remove glow plug unless necessary.
- Perform continuity test with glow plug installed.
- Keep glow plug from any impact. [Replace if dropped from a height 10 cm (3.94 in) or higher.]
- Do not use air impact wrench.

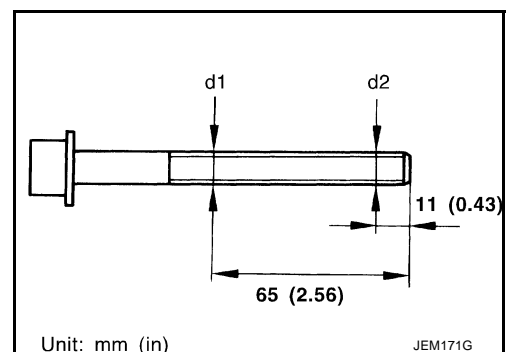


## INSPECTION AFTER REMOVAL

### Cylinder Head Bolt Deformation

- Using micrometer, measure the outer diameters d1 and d2 of bolt thread as shown in the figure.
- If the necking point can be identified, set it as measuring point d1.
- Calculate the difference between d1 and d2.
 

**Limit : 0.15 mm (0.0059 in)**
- If it exceeds the limit, replace cylinder head bolt.



### Cylinder Head Distortion

1. Wipe off oil and remove water scale (like deposit), gasket, sealer, carbon, etc. with scraper.

#### CAUTION:

Use utmost care not to allow gasket debris to enter passages for oil or water.

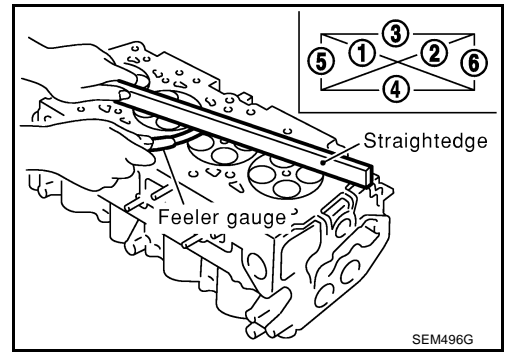
# CYLINDER HEAD

[YD]

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

**Limit : 0.1mm (0.004 in)**

- If it exceeds the limit, replace cylinder head.



A

EM

C

D

E

F

G

H

I

J

K

L

M

## INSTALLATION

Before installation, remove old liquid gasket from mating surface of all liquid gasket applied parts.

1. Install cylinder head gasket.

- Cylinder head gasket to be installed is selected by its thickness through the following procedure.
- **When replacing gasket alone**
- Install a gasket with same thickness as that of the one removed.
- Identify the thickness of gasket by the number of cut-outs on the rear RH side.

Gasket thickness* mm (in)	Number of grade	Number of cut-outs
0.900 (0.0354)	1	0
0.925 (0.0364)	2	1
0.950 (0.0374)	3	2
0.975 (0.0384)	4	3
1.000 (0.0394)	5	4
1.025 (0.0404)	6	5

\*: Measured with head bolts tightened

- Gasket (3) thickness can be identified at the location (A) shown in the figure by the numbers of cut-outs before removal.

- 1 : Cylinder head rear cover
- 2 : Oil filter
- ⇐ : Vehicle front

- Heater return tube is omitted for explanation.

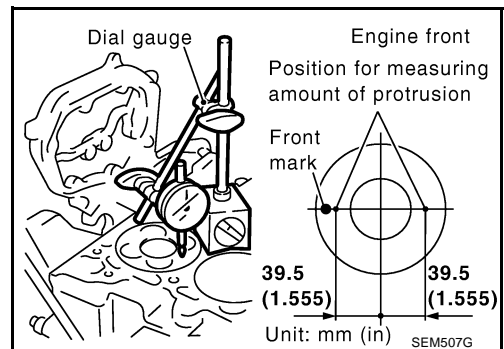
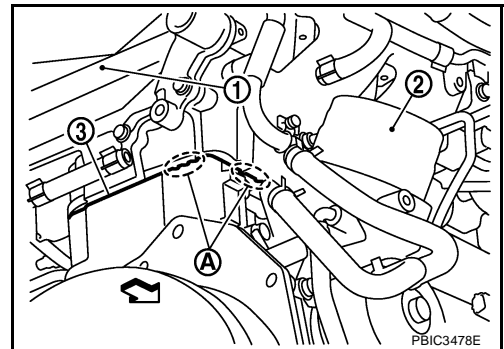
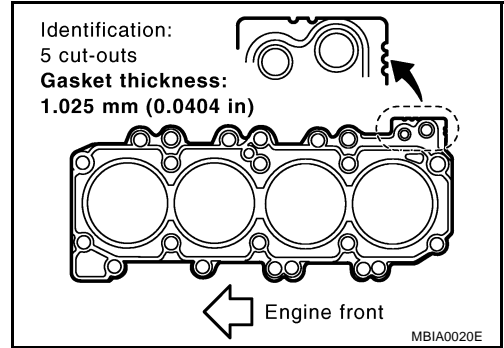
**NOTE:**

Use mirrors for checking at points out of clear sight.

- **When the following parts have been repaired/replaced:**

- With cylinder block upper surface and/or crankshaft pin journal ground
- With cylinder block, pistons, connecting rods, and/or crankshaft replaced

- a. Set piston at a point close to TDC.
- b. Set the dial gauge at the location as shown in the figure. Turning crankshaft gradually, set the gauge scale to "0" where the piston protrusion is maximized.
- c. Move the dial gauge stand so that the tip of dial gauge can contact cylinder block. Read the difference.
- d. Measure two points from each cylinder in order to obtain each mean value of them. Choose a properly thick gasket corresponding the highest number of the four values.



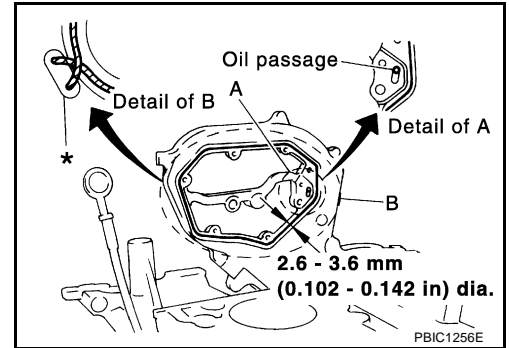
Piston protrusion mm (in)	Gasket thickness* mm (in)	Identification
		Number of cut-outs
0.230 - 0.255 (0.0091 - 0.0100)	0.900 (0.0354)	0
0.255 - 0.280 (0.0100 - 0.0110)	0.925 (0.0364)	1
0.280 - 0.305 (0.0110 - 0.0120)	0.950 (0.0374)	2
0.305 - 0.330 (0.0120 - 0.0130)	0.975 (0.0384)	3
0.330 - 0.355 (0.0130 - 0.0140)	1.000 (0.0394)	4
0.355 - 0.400 (0.0140 - 0.0157)	1.025 (0.0404)	5

# CYLINDER HEAD

[YD]

\*: Measured with head bolts tightened

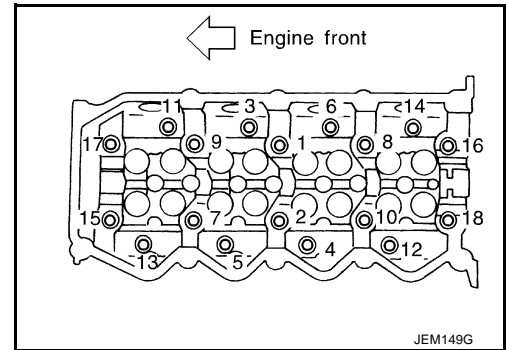
- e. If out of above protrusion, check replaced parts.
2. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.  
A: Apply bead so that it does not protrude into oil passage.  
B: Minimize the overlapping area of the bead, with start and end areas of bead as shown in the figure.  
Apply so that the portion marked \* comes at an external location but cannot be viewed externally after engine is assembled.



3. Install cylinder head assembly.
  - Tighten bolts in numerical order as shown in the figure according to the following procedure:

- a. Apply engine oil to bolt threads and seat surfaces.
- b. Tighten all bolts.

 : 39.2 N·m (4.0 kg-m, 29 ft-lb)



- c. Tighten 180 degrees (angle tightening).
- d. Loosen completely in the reverse order of that shown in the figure.

 : 0 N·m (0 kg-m, 0 ft-lb)

- e. Tighten all bolts.

 : 39.2 N·m (4.0 kg-m, 29 ft-lb)

- f. Tighten 90 degrees (angle tightening).
- g. Tighten another 90 degrees (angular tightening).

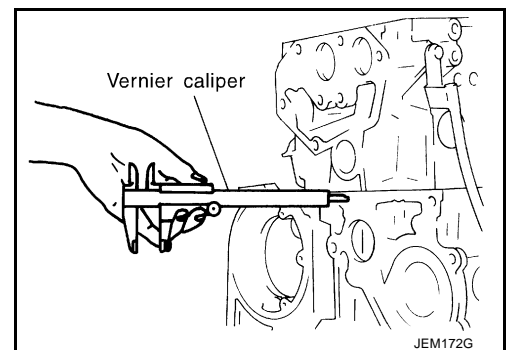
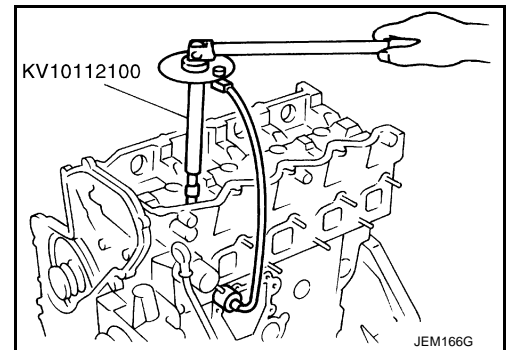
### CAUTION:

- When the angle wrench [SST] is not used, paint an alignment mark on the head of cylinder head bolt and cylinder head surface before tightening. Check the angle with a protractor.

4. After installing cylinder head, measure dimension from the front end surface of cylinder block to that of cylinder head.

**Standard** : 23.53 - 24.07 mm (0.9264 - 0.9476 in)

- If out of the standard, check fitting of dowel pins and cylinder head.



5. Install glow plug.

### CAUTION:

- To avoid damage, glow plugs should be removed only when required.
- Handle with care to avoid applying shock. When dropped from approx. 10 cm (3.94 in) or higher, always replace with a new one.

- Before installing, remove carbon depositing on mounting hole of glow plug with a reamer.

6. Install engine coolant temperature sensor.
7. Install in the reverse order of removal.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

### Summary of the inspection items:

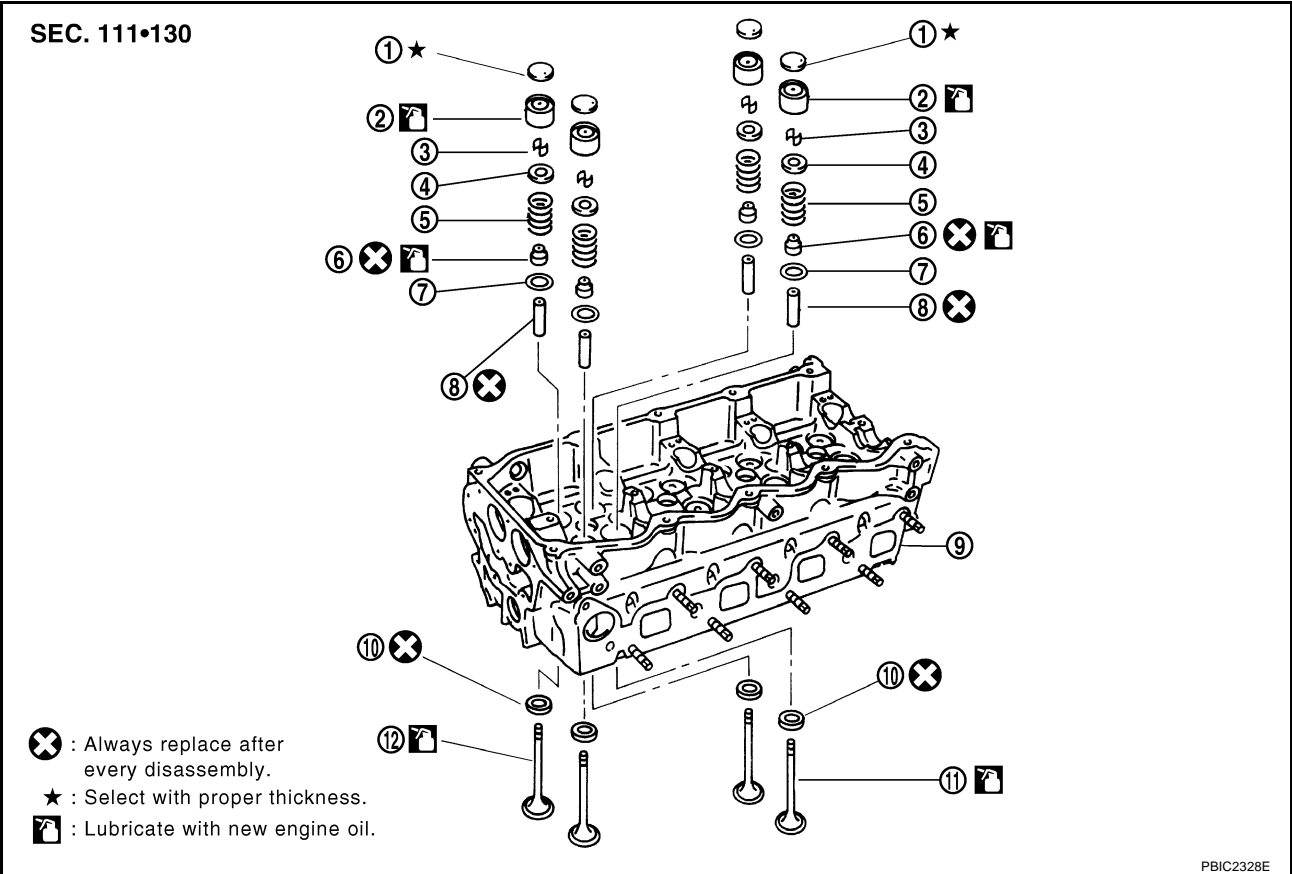
Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\*1: Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

\*2: Check engine oil level 10 minutes after engine stopped.

## Components

GBS0001G



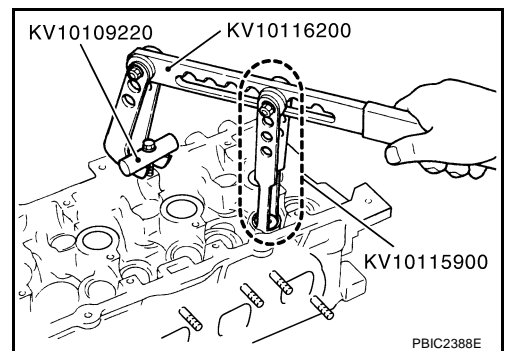
- |                          |                     |                    |
|--------------------------|---------------------|--------------------|
| 1. Adjusting shim        | 2. Valve lifter     | 3. Valve collet    |
| 4. Valve spring retainer | 5. Valve spring     | 6. Valve oil seal  |
| 7. Valve spring seat     | 8. Valve guide      | 9. Cylinder head   |
| 10. Valve seat           | 11. Valve (Exhaust) | 12. Valve (Intake) |

## Disassembly and Assembly

### DISASSEMBLY

GBS0001H

- Remove adjusting shims and valve lifters.
  - Check the installation positions, and keep them to avoid being confused.
- Remove valve collet.
  - Using the valve spring compressor [SST], compress valve spring. Using magnet hand, remove valve collets.



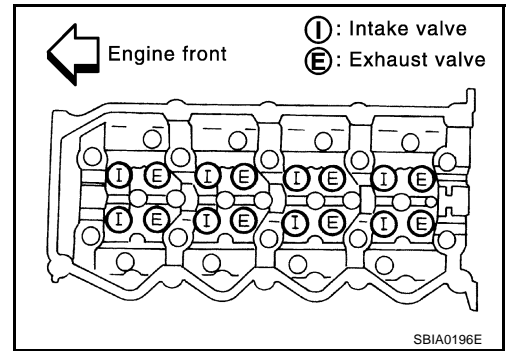
- Remove valve spring retainers and valve springs.
- Remove valves as pressing valve stems toward combustion chamber.
  - Before removing valve, check the valve guide clearance. Refer to [EM-245, "Valve Guide Clearance"](#).

# CYLINDER HEAD

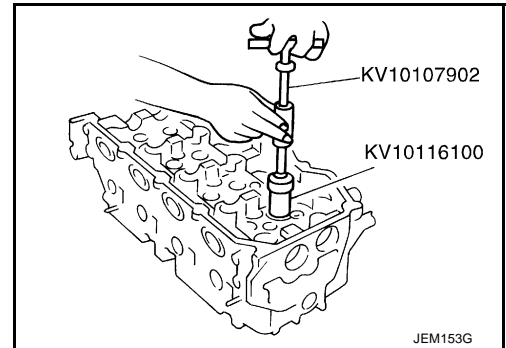
[YD]

## NOTE:

Refer to the figure for intake and exhaust valve positions. Intake and exhaust valve driving cams are provided alternately for each camshaft.

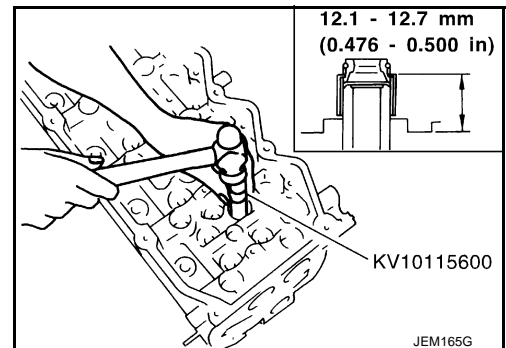


5. Remove valve oil seals using the valve oil seal puller [SST].
6. Remove valve spring seats.
7. Before removing valve seats, perform valve seat contact check. Refer to [EM-247, "Valve Seat Contact"](#).
8. Before removing valve guides, perform valve guide clearance check. Refer to [EM-245, "Valve Guide Clearance"](#).

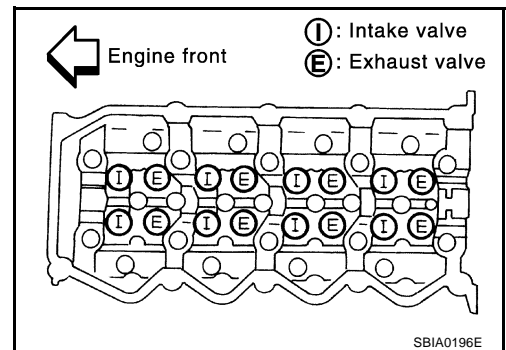


## ASSEMBLY

1. Install valve guides. Refer to [EM-246, "Valve Guide Replacement"](#).
2. Install valve seats. Refer to [EM-247, "Valve Seat Replacement"](#).
3. Using the valve oil seal drift [SST], install valve oil seals referring to the dimension shown in the figure.
4. Install valve spring seats.



5. Install valves.
  - Install the valves with bigger outer diameter to intake valve side.
  - Note that valve layout here is different from that of conventional engine.



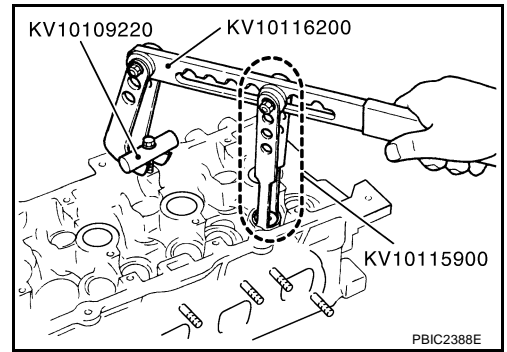
6. Install valve spring.
7. Install valve spring retainers.



# CYLINDER HEAD

[YD]

8. Using the valve spring compressor [SST], compress valve springs.  
Then install valve collets using magnet hand.
  - After installing valve collets, tap the stem end using the plastic hammer, and check the installation status.

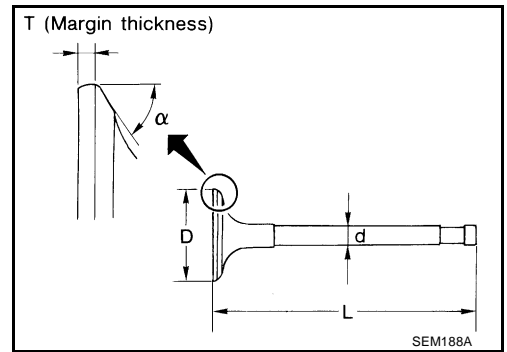


9. Install valve lifters and adjusting shims to the same positions as before.

## INSPECTION AFTER DISASSEMBLY

### Valve Dimension

- Check dimensions of each valve. For dimensions, refer to [EM-280, "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve.



### Valve Guide Clearance

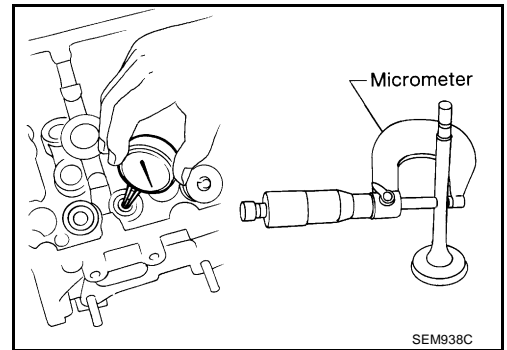
#### Valve Stem Diameter

- Measure diameter of valve stem with micrometer.

#### Standard

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

**Exhaust : 5.945 - 5.960 mm (0.2341 - 0.2346 in)**



#### Valve Guide Inner Diameter

- Measure inner diameter of valve guide with inside micrometer.

#### Standard

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

#### Valve Guide Clearance

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

#### Valve guide clearance:

##### Standard

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

**Exhaust : 0.040 - 0.073 mm (0.0016 - 0.0029 in)**

##### Limit

**Intake : 0.08 mm (0.0031 in)**

**Exhaust : 0.10 mm (0.0039 in)**

# CYLINDER HEAD

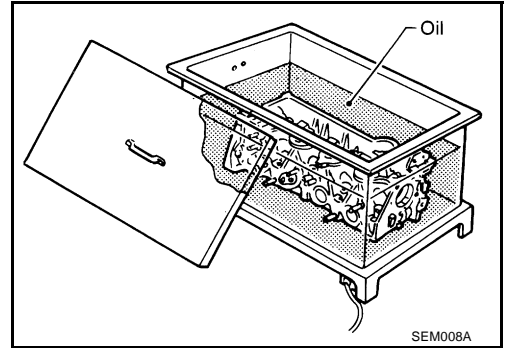
[YD]

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

## Valve Guide Replacement

When removing valve guide, replace it with oversized [0.2 mm (0.0008 in)] valve guide.

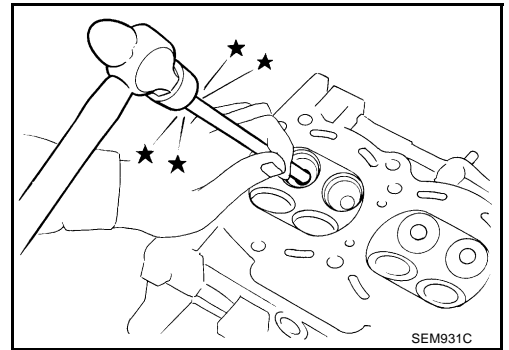
1. Heat cylinder head to 110 to 130°C (230 to 266°F) in oil bath.



2. Using the valve guide drift (commercial service tool), tap valve guides out from the combustion chamber side.

**WARNING:**

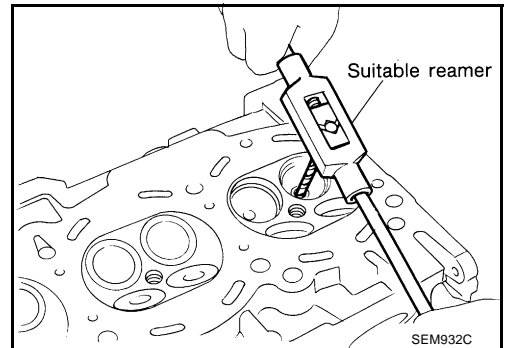
**Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.**



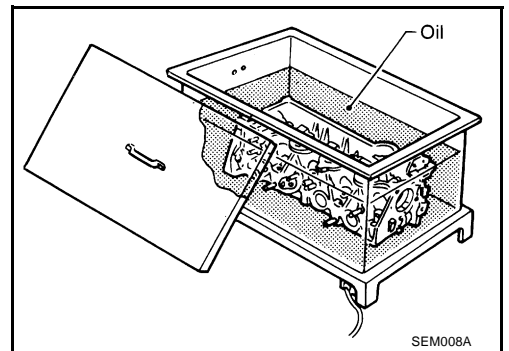
3. Ream cylinder head valve guide hole with the valve guide reamer (commercial service tool).

**Valve guide hole diameter (for service parts):**

**10.175 - 10.196 mm (0.4006 - 0.4014 in)**



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



# CYLINDER HEAD

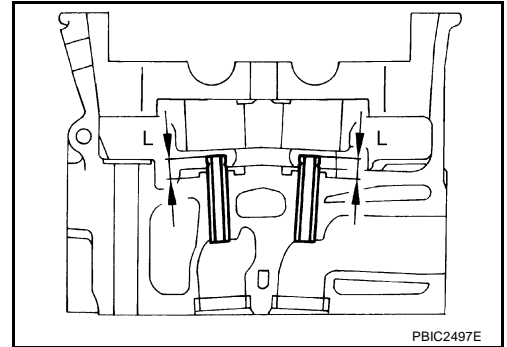
[YD]

5. Using the valve guide drift (commercial service tool), press fit valve guides from camshaft side, referring to the dimension shown in the figure.

**Projection "L" : 10.4 - 10.6 mm (0.409 - 0.417 in)**

**WARNING:**

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

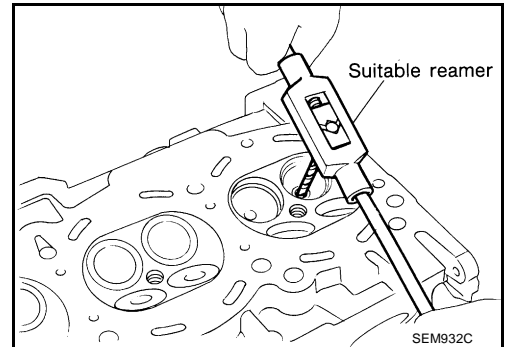


6. Using the valve guide reamer (commercial service tool), perform reaming to the press-fitted valve guides.

**Reaming specifications:**

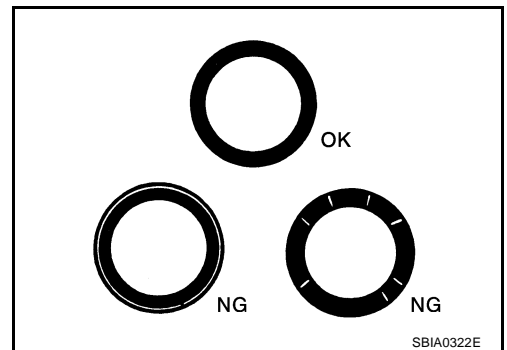
**Intake and Exhaust**

**6.000 - 6.018 mm (0.2362 - 0.2369 in)**



## Valve Seat Contact

- Before starting this check, confirm that the dimension of valve guide and valves are as specified.
- Apply red lead primer on contacting surfaces of valves seat and of valve face to examine the conditions of contacting surfaces.
- Make sure that the paint on contacting surfaces is continuous along the entire circumference.
- If there are abnormal indications, grind the valve and check the contact again. If malfunction indications still persist, replace valve seat.



## Valve Seat Replacement

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

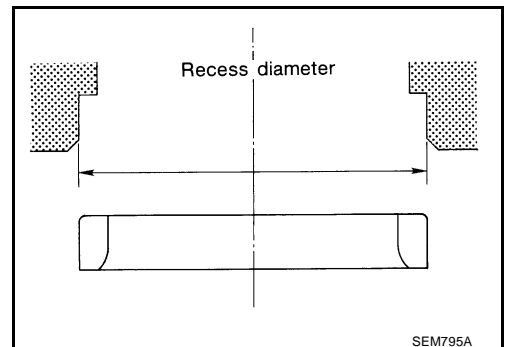
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-283, "Valve Seat"](#).
2. Ream cylinder head recess diameter for service valve seat.

**Oversize [0.5 mm (0.020 in)]:**

**Intake : 30.500 - 30.516 mm (1.2008 - 1.2014 in)**

**Exhaust : 29.500 - 29.516 mm (1.1614 - 1.1620 in)**

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



# CYLINDER HEAD

[YD]

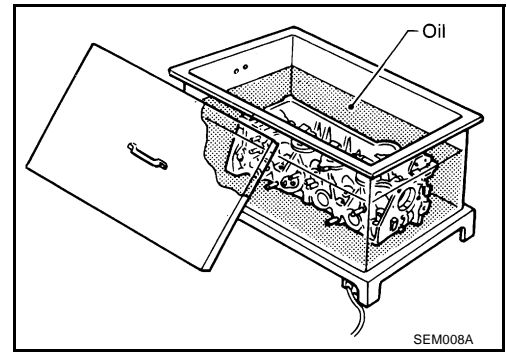
- Heat cylinder head to approximately 110 to 130°C (230 to 266°F) in oil bath.
- After cooling valve seats sufficiently with dry ice, press fit it to cylinder head.

**WARNING:**

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

**CAUTION:**

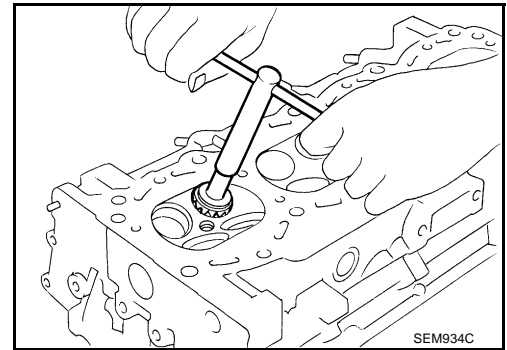
Do not touch the cooled valve seats directly by hand.



- Using the valve seat cutter set (commercial service tool), finish processing referring to the dimensions shown in the figure. Refer to [EM-283, "Valve Seat"](#).

**CAUTION:**

When using the valve seat cutter set, grasp cutter handle with both hands, press cutter onto contacting face all around, and cut thoroughly. If cutter is pressed unevenly or repeatedly, the valve seat surface may be damaged.

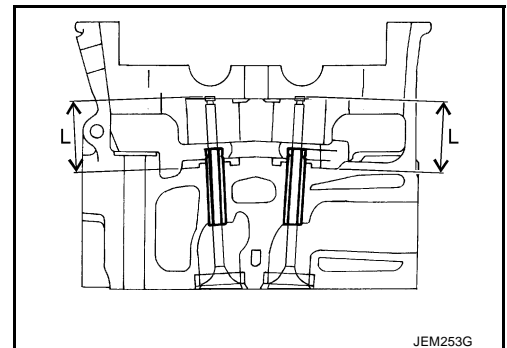


- Using compound, perform valve fitting.
- Check again to make sure that contacting status is satisfactory. For details, Refer to [EM-247, "Valve Seat Contact"](#).
- Use the depth gauge to measure the distance between the mounting surface of cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace valve seat with a new one.

**Valve seat resurface limit "L":**

**Intake** : 36.53 - 36.98 mm (1.4382 - 1.4559 in)

**Exhaust** : 36.53 - 37.01 mm (1.4382 - 1.4571 in)

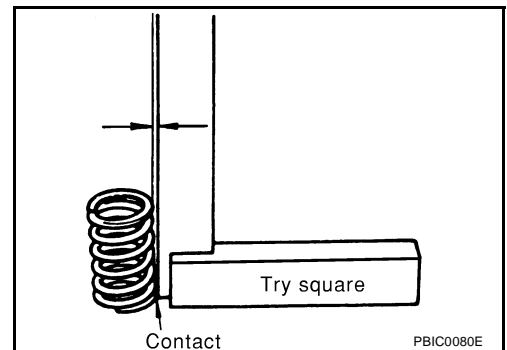


## Valve Spring Square

- Position the try square to valve spring, turn the spring, and measure the maximum clearance value between top surface of spring and the try square.

**Limit** : 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring.



# CYLINDER HEAD

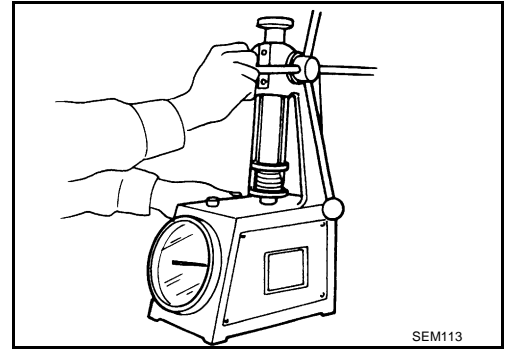
[YD]

## Valve Spring Dimensions and Valve Spring Pressure Load

- Using valve spring tester, check the following.

### Standard:

Free height	: 44.74 mm (1.76 in)
Installation height	: 32.82 mm (1.2921 in)
Installation load	: 184 - 208 N (18.77 - 21.22 kg, 41.4 - 46.8 lb)
Height during valve open	: 24.82 mm (0.9772 in)
Load with valve open	: 320 - 360 N (32.65 - 36.73 kg, 71.9 - 80.9 lb)



- If out of the standard, replace the valve spring.

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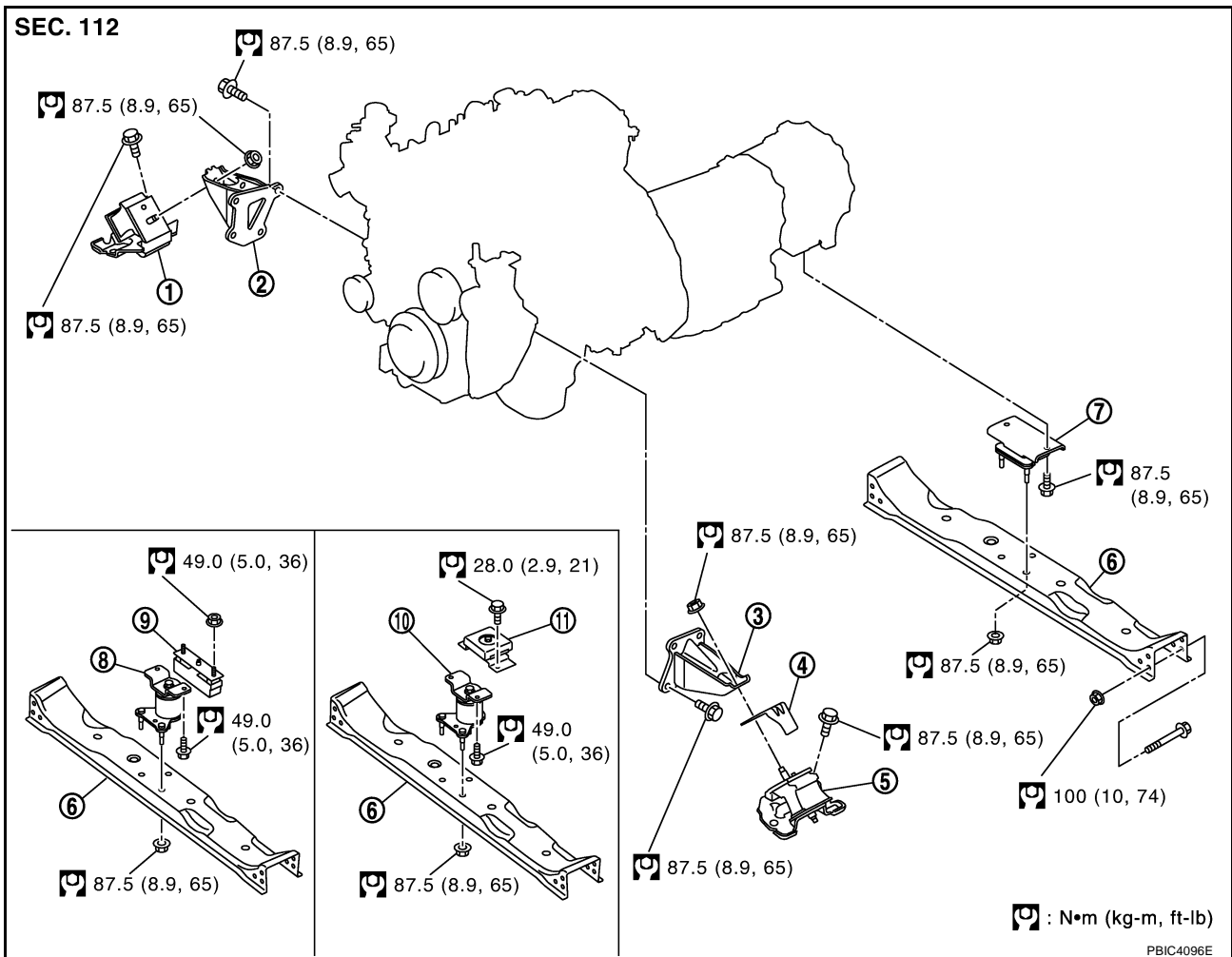
M

## ENGINE ASSEMBLY

PF10001

### Components

GBS00011



- |   |  |                                    |
|---|--|------------------------------------|
| 1. RH engine mounting insulator                       | 2. RH engine mounting bracket                        | 3. LH engine mounting bracket      |
| 4. Heat insulator                                     | 5. LH engine mounting insulator                      | 6. Transmission cross member       |
| 7. Engine mounting insulator (rear) (4WD models)      | 8. Engine mounting insulator (rear) (2WD M/T models) | 9. Dynamic damper (2WD M/T models) |
| 10. Engine mounting insulator (rear) (2WD A/T models) | 11. Dynamic damper (2WD A/T models)                  |                                    |

### Removal and Installation

GBS0001J

#### WARNING:

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

#### CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and engine coolant are cool enough.
- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.

- For supporting points for lifting and jacking point at rear axle, refer to [GI-49, "Pantograph Jack, Garage Jack and Safety Stand"](#) .

## REMOVAL

### Description of work

Remove transmission assembly from vehicle downward. Then hoist the engine from vehicle upward.

### Preparation

1. Disconnect battery cable from negative terminal. Refer to [SC-5, "BATTERY"](#) .
2. Drain engine coolant from radiator drain plug. Refer to [CO-37, "Changing Engine Coolant"](#) .
3. Remove the following parts.
  - Engine undercover front, engine undercover middle, engine undercover rear; Refer to [EI-15, "FRONT BUMPER"](#) .
  - Hood assembly; Refer to [BL-11, "HOOD"](#) .
  - Engine cover; Refer to [EM-164, "INTAKE MANIFOLD"](#) .
  - Drive belts; Refer to [EM-156, "DRIVE BELTS"](#) .
  - Cooling fan, fan coupling and water pump pulley; Refer to [CO-48, "COOLING FAN"](#) .
  - Air duct and air cleaner case; Refer to [EM-159, "AIR CLEANER AND AIR DUCT"](#) .
  - Air inlet tube and air inlet hose; Refer to [EM-162, "CHARGE AIR COOLER"](#) .
  - Alternator; Refer to [SC-25, "Removal and Installation"](#) .
  - Radiator, radiator shroud (upper and lower) and cooling fan assembly; Refer to [CO-40, "RADIATOR"](#) and [CO-48, "COOLING FAN"](#) .
4. Disconnect engine room harness from the engine side and set it aside for easier work.
5. Disconnect all the body-side vacuum hoses and air hoses at engine side.

### Engine room RH

1. Disconnect fuel feed hose and return hose, and plug it to prevent fuel from draining. Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .
2. Remove fuel filter. Refer to [FL-15, "FUEL FILTER"](#) .
3. Disconnect heater hose, and install plug it to prevent engine coolant from draining. Refer to [CO-52, "THERMOSTAT AND WATER PIPING"](#) .

### Engine room LH

1. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it. Refer to [MTC-115, "Removal and Installation for Compressor"](#) .

### Vehicle underbody

1. Remove exhaust front tube. Refer to [EX-3, "Removal and Installation"](#) .
2. Remove front propeller shaft (4WD models) and rear propeller shaft. Refer to [PR-3, "FRONT PROPELLER SHAFT"](#) (4WD models) and [PR-7, "REAR PROPELLER SHAFT"](#) .
3. Remove clutch operating cylinder from transmission, and move it aside (M/T models). Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) and [CL-12, "OPERATING CYLINDER"](#) .
4. Disconnect power steering fluid piping at a point between body and engine. Refer to [PS-33, "HYDRAULIC LINE"](#) .
5. Remove starter motor. Refer to [SC-36, "Removal and Installation"](#) .
6. Remove transmission assembly. Refer to [MT-17, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-254, "TRANSMISSION ASSEMBLY"](#) (A/T models).

## Removal

1. Install engine slingers into front right of cylinder head (A) and rear left of cylinder head (B).

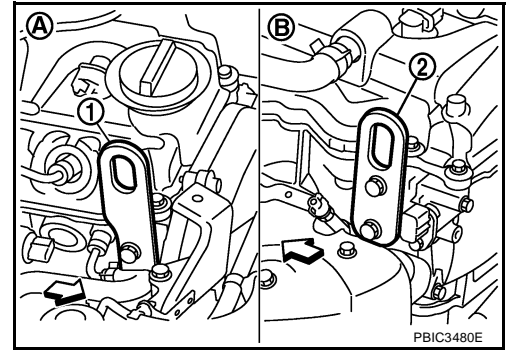
1 : Engine slinger (front)

2 : Engine slinger (rear)

↶ : Engine front

### Engine slinger bolts:

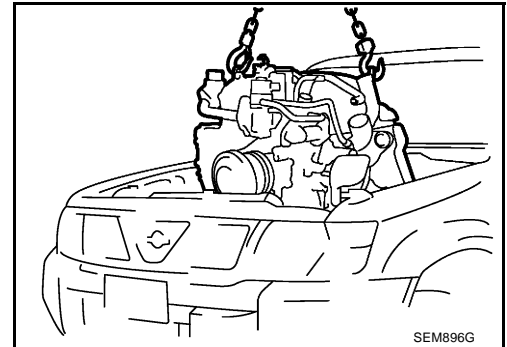
: 28.0 N-m (2.9 kg-m, 21 ft-lb)



2. Lift with hoist and secure engine in position.
3. Loosen LH and RH engine mounting insulator mounting nuts.
4. Remove engine.

### CAUTION:

- During the operation, make sure that no part interferes with body side.
- Before and during this lifting, always check if any harnesses are left connected.



## INSTALLATION

Install in the reverse order of removal.

- Do not allow engine oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to figure of components. Refer to [EM-250, "ENGINE ASSEMBLY"](#) .
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.
- Insert vacuum hose to vacuum gallery until vacuum hose comes in contact with the stopper when a stopper is provided at vacuum gallery.
- Insert vacuum hose up to 15 mm (0. 59 in) when a stopper is not provided at vacuum gallery.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-13, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
  - Before starting engine, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.



# ENGINE ASSEMBLY

[YD]

## Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

\*1: Transmission/transaxle/AT fluid, power steering fluid, brake fluid, etc.

\*2: Check engine oil level 10 minutes after engine stopped.

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# CYLINDER BLOCK

[YD]

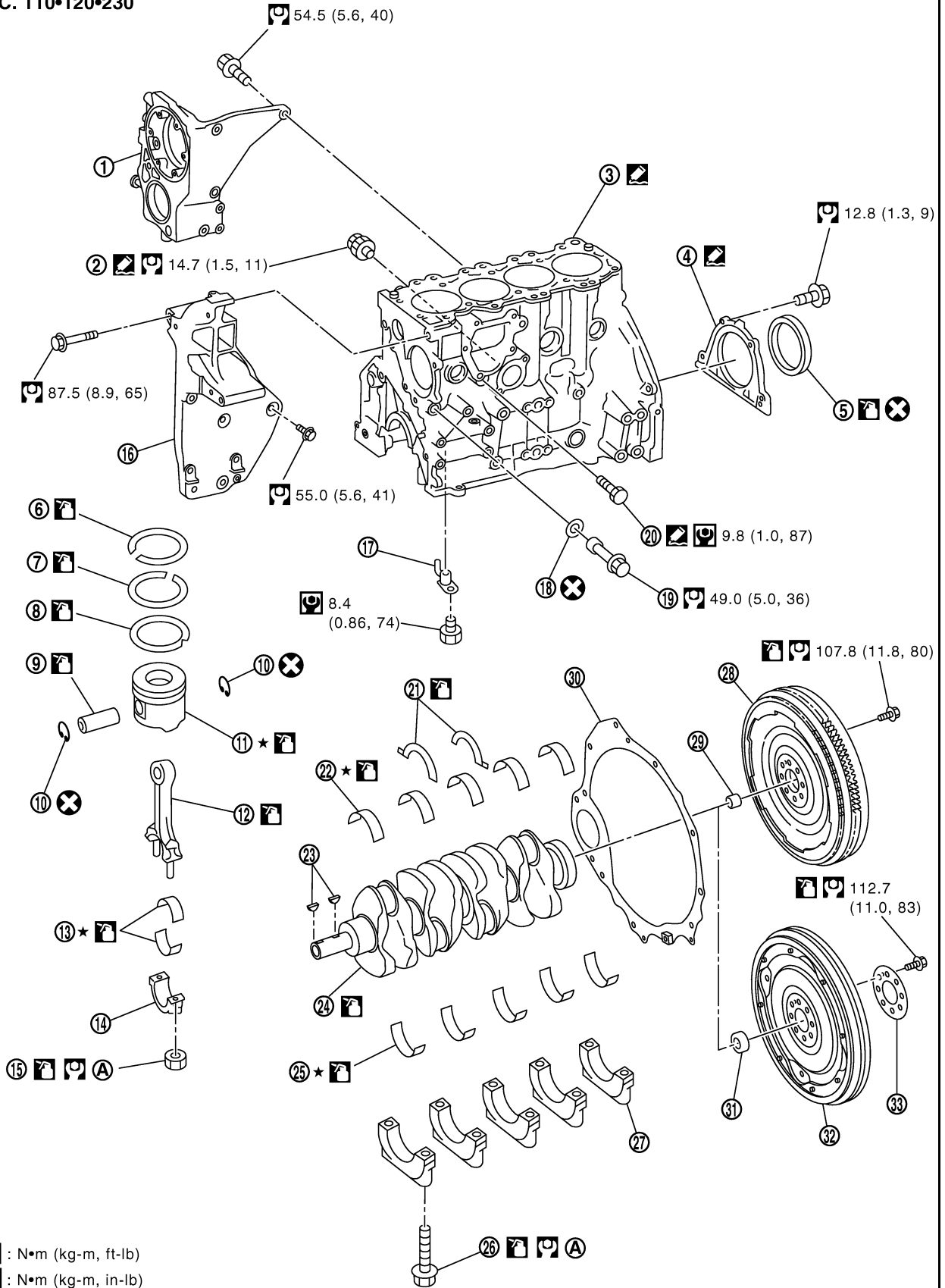
## CYLINDER BLOCK

PFP:11010

### Components

GBS0001K

SEC. 110•120•230



PBIC3481E

- |                                  |                                |                                      |
|----------------------------------|--------------------------------|--------------------------------------|
| 1. Fuel pump bracket             | 2. Oil pressure switch         | 3. Cylinder block                    |
| 4. Rear oil seal retainer        | 5. Rear oil seal               | 6. Top ring                          |
| 7. Second ring                   | 8. Oil ring                    | 9. Piston pin                        |
| 10. Snap ring                    | 11. Piston                     | 12. Connecting rod                   |
| 13. Connecting rod bearing       | 14. Connecting rod cap         | 15. Connecting rod nut               |
| 16. A/C compressor bracket       | 17. Oil jet                    | 18. Copper washer                    |
| 19. Oil jet relief valve         | 20. Drain plug                 | 21. Thrust bearing                   |
| 22. Main bearing upper           | 23. Key                        | 24. Crankshaft                       |
| 25. Main bearing lower           | 26. Main bearing cap bolt      | 27. Main bearing cap                 |
| 28. Flywheel (M/T models)        | 29. Pilot bushing (M/T models) | 30. Rear plate                       |
| 31. Pilot converter (A/T models) | 32. Drive plate (A/T models)   | 33. Reinforcement plate (A/T models) |
- A. Refer to [EM-258](#) .

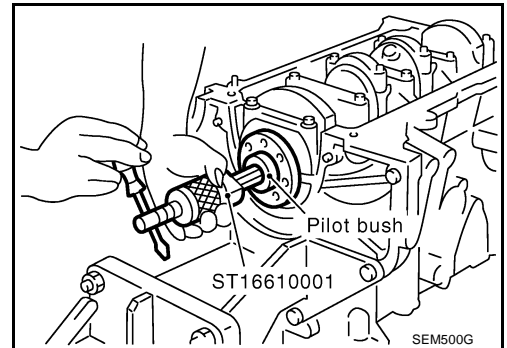
- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## Disassembly and Assembly

### DISASSEMBLY

GBS0001L

- Remove engine from the vehicle. Refer to [EM-250, "ENGINE ASSEMBLY"](#) .
- Remove clutch cover and disk. (M/T models) Refer to [CL-18, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#) .
- If they need to be replaced, replace pilot bush (M/T models) or pilot converter (A/T models).
  - Using the pilot bushing puller [SST], remove the pilot bush (M/T models) or pilot converter (A/T models) from rear end of crankshaft.

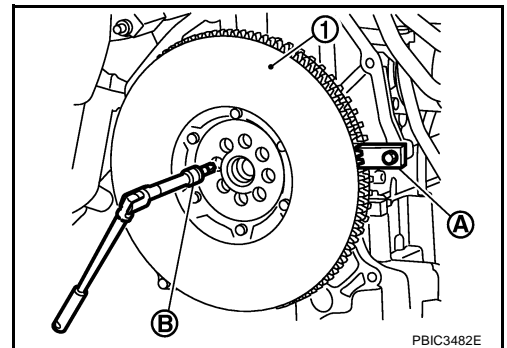


- Install engine to engine stand as follows.
  - Remove flywheel (M/T models) or drive plate (A/T models).
    - Secure ring gear with the ring gear stopper (A) [SST], then loosen mounting bolts with TORX socket (B) (commercial service tool) and remove them. As an alternative method hold crankshaft pulley with the pulley holder (commercial service tool) to remove flywheel (M/T models) or drive plate (A/T models).

1 : Flywheel (M/T models) or drive plate (A/T models)

A : KV10105630

B : TORX bit (size: T55)(M/T models) or TORX socket (size: E20)(A/T models)



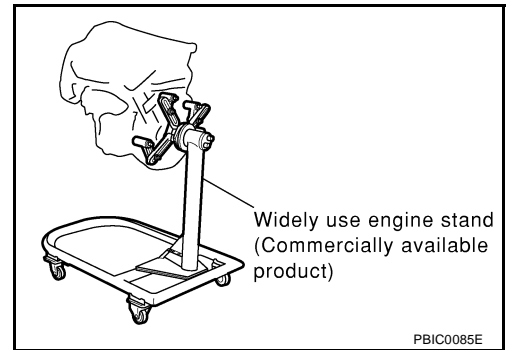
### CAUTION:

- Do not disassemble flywheel (M/T models) or drive plate (A/T models).
- Do not place flywheel (M/T models) or drive plate (A/T models) with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.

- b. Hoist engine and install it to the engine stand (commercial service tool).

**NOTE:**

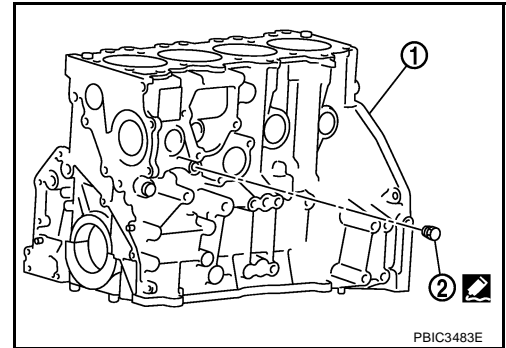
The figure shows an example of general-purpose engine stand that can hold mating surface of transmission with drive plate and rear plate removed.



5. Drain engine oil and engine coolant from inside engine. Refer to [LU-21, "Changing Engine Oil"](#) .

6. Drain engine coolant by removing drain plug from inside of engine.

- 1 : Cylinder block
- 2 : Drain plug



7. Remove the following parts and related parts. (Only major parts are listed.)

- Intake manifold (Refer to [EM-164, "INTAKE MANIFOLD"](#) .)
- Turbocharger (Refer to [EM-172, "TURBO CHARGER"](#) .)
- Exhaust manifold (Refer to [EM-178, "EXHAUST MANIFOLD"](#) .)
- Rocker cover (Refer to [EM-200, "ROCKER COVER"](#) .)
- Fuel injector (Refer to [EM-188, "INJECTION TUBE AND FUEL INJECTOR"](#) .)
- Oil pan and oil strainer (Refer to [EM-180, "OIL PAN AND OIL STRAINER"](#) .)
- Water pump (Refer to [CO-50, "WATER PUMP"](#) .)
- Thermostat and water piping (Refer to [CO-52, "THERMOSTAT AND WATER PIPING"](#) .)
- Secondary timing chain (Refer to [EM-217, "SECONDARY TIMING CHAIN"](#) .)
- Primary timing chain (Refer to [EM-223, "PRIMARY TIMING CHAIN"](#) .)
- Fuel pump (Refer to [EM-193, "FUEL PUMP"](#) .)
- Vacuum pump (Refer to [EM-186, "VACUUM PUMP"](#) .)
- Camshaft (Refer to [EM-203, "CAMSHAFT"](#) .)
- Cylinder head (Refer to [EM-236, "CYLINDER HEAD"](#) .)
- Oil cooler (Refer to [LU-26, "OIL COOLER"](#) .)
- Accessory, accessory bracket and mount brackets

8. Remove fuel pump bracket.

9. Remove rear oil seal retainer.

- Insert a flat-bladed screwdriver between main bearing cap and rear oil seal retainer to remove retainer.

10. Remove rear oil seal from rear oil seal retainer. Refer to [EM-214, "OIL SEAL"](#) .

- Punch out with a flat-bladed screwdriver.

**CAUTION:**

**Be careful not to damage rear oil seal retainer.**

# CYLINDER BLOCK

[YD]

11. Remove piston and connecting rod assembly.

- Before removing piston and connecting rod assembly, check connecting rod side clearance. Refer to [EM-269, "CONNECTING ROD SIDE CLEARANCE"](#).

- a. Move crankshaft pin to be removed to approximately BDC.
- b. Remove connecting rod caps.
- c. Using the grip of a hammer, press the piston and connecting rod assembly out to cylinder head side.

**CAUTION:**

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

- When removing piston and connecting rod assembly, prevent the big end of connecting rod from interfering with oil jet.

12. Remove connecting rod bearings from connecting rods and caps.

- Keep them by cylinder to avoid confusion.

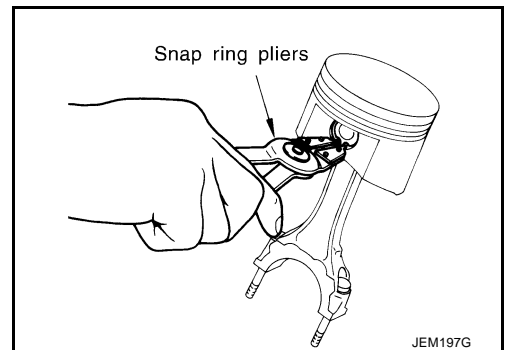
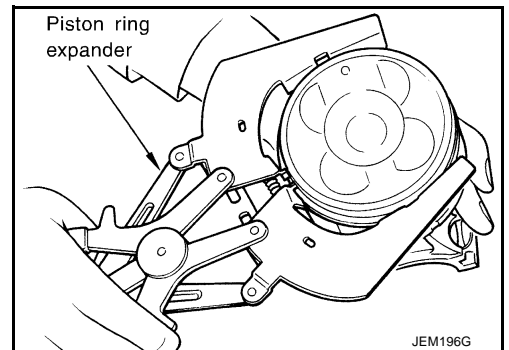
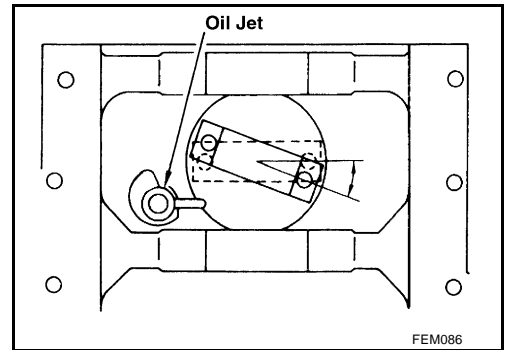
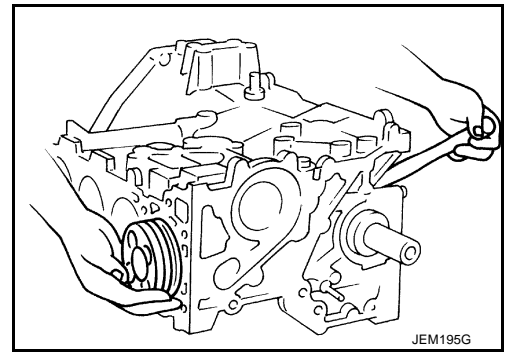
13. Remove piston rings from pistons using the piston ring expander (commercial service tool).

**CAUTION:**

- When removing, prevent pistons from being damaged.
- Do not expand piston rings excessively. This may damage piston rings.

14. Remove pistons from connecting rods.

- a. Using the snap ring pliers, remove snap rings.

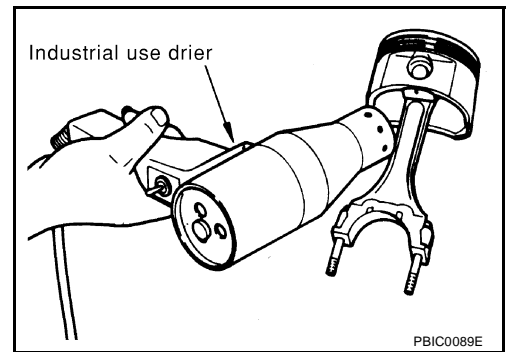


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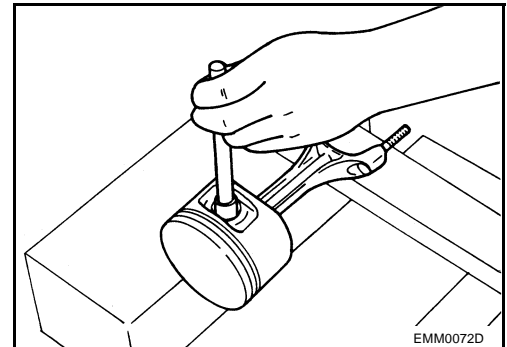
# CYLINDER BLOCK

[YD]

- b. Using the industrial use dryer, heat pistons up to 60 to 70°C (140 to 158°F).

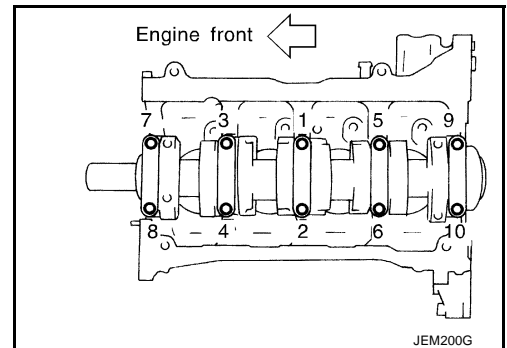


- c. Using rod with outer diameter of 26 mm (1.02 in), press piston pins out.



15. Remove main bearing cap bolts.

- With a TORX socket (size: E14, commercial service tool), loosen main bearing cap bolts in several stages in the reverse order of that shown in the figure and remove them.
- Before loosening main bearing cap bolts, measure crankshaft end play. Refer to [EM-269. "CRANKSHAFT END PLAY"](#).



16. Remove main bearing caps.

- Using main bearing cap bolts, remove by rocking bearing cap back and forth.

17. Remove crankshaft.

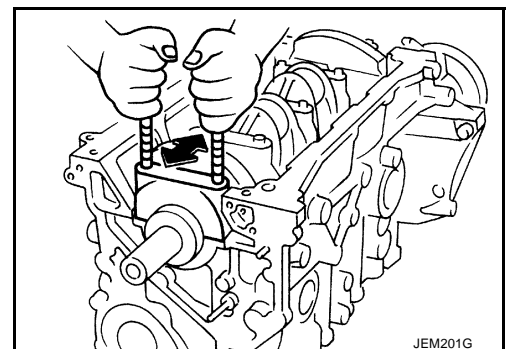
18. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

**CAUTION:**

**Check the correct installation locations of removed parts. Store them so they do not get mixed up.**

19. Remove oil jet.

20. Remove oil jet relief valve.



## ASSEMBLY

1. Blow air sufficiently to inside engine coolant passage, engine oil passage, crankcase and cylinder bore to remove foreign matter.

**CAUTION:**

**Use a goggles to protect your eye.**

# CYLINDER BLOCK

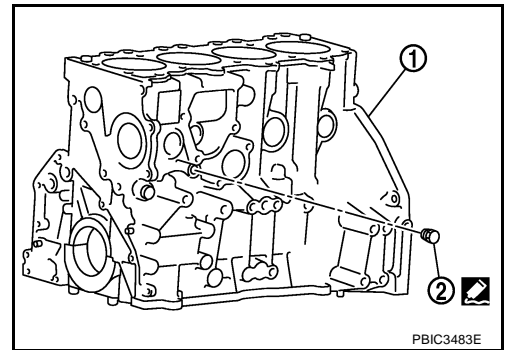
[YD]

## 2. Install drain plug to cylinder block.

1 : Cylinder block

2 : Drain plug

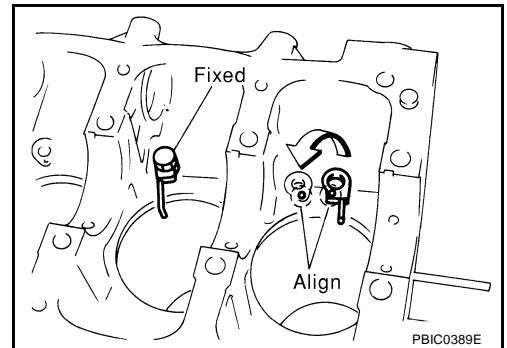
- Apply liquid gasket to drain plug.  
**Use Genuine Liquid Gasket or equivalent**



## 3. Install oil jet relief valve.

## 4. Install oil jet.

- Align knock pin on back of oil jet with hole on block when installing oil jet.

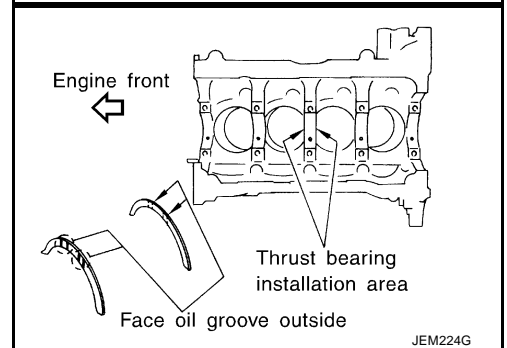


## 5. Install main bearings and thrust bearings.

### a. Remove contamination, dust and engine oil from bearing mounting positions on cylinder block and main bearing caps.

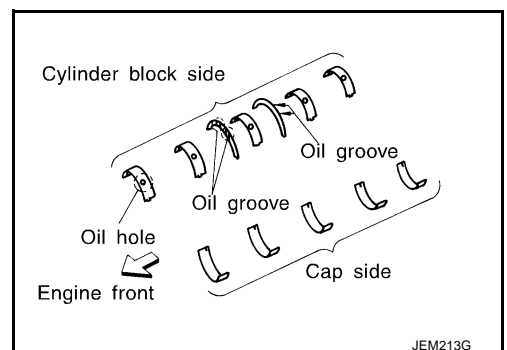
### b. Install thrust bearings on both sides of No. 3 housing on cylinder block.

- Install thrust bearings with oil groove facing to crankshaft arm (outside).



### c. Being careful with the direction, install main bearings.

- Install main bearings with the oil holes and grooves onto the cylinder block side, and those without oil holes and grooves onto the main cap side.
- While installing bearings, apply engine oil to bearing surfaces (inside). Do not apply engine oil to rear surfaces, but clean them completely.
- Align stopper notches on bearings to install them.
- Make sure that the oil holes on the cylinder block body are mated with the oil hole positions on the bearings.



## 6. Install crankshaft to cylinder block.

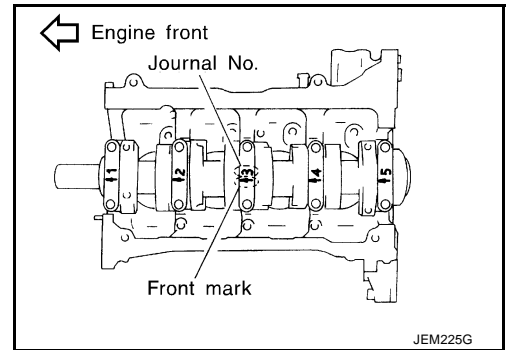
- Make sure crankshaft rotates smoothly by hand.

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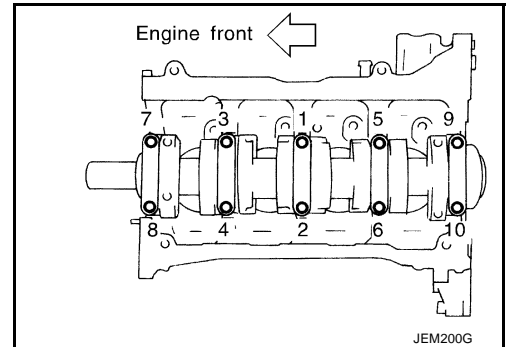
# CYLINDER BLOCK

[YD]

7. Install main bearing caps.
  - Identify main bearing caps by the punched mark. Install correctly matching the journal No. on the bearing cap and the journal with the front mark facing forward.
  - Main bearing caps are commonly processed with the cylinder block. Therefore, caps and cylinder block should be replaced as a set.
8. Check the main bearing cap bolts for deformation. Refer to [EM-277, "MAIN BEARING CAP BOLT DEFORMATION"](#).



9. With the TORX socket (size: E14, commercial service tool), tighten the main bearing cap bolts according to the following procedure:
  - a. Apply engine oil to the threaded part and seat surface of each bolt.
  - b. Tighten all bolts in numerical order shown in the figure.



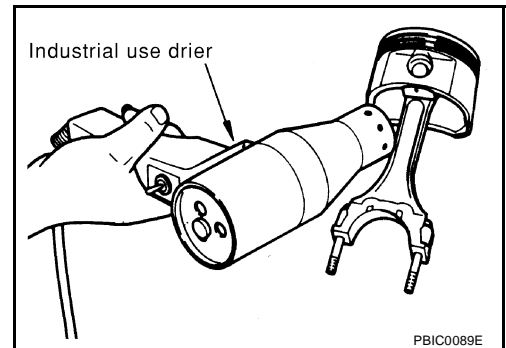
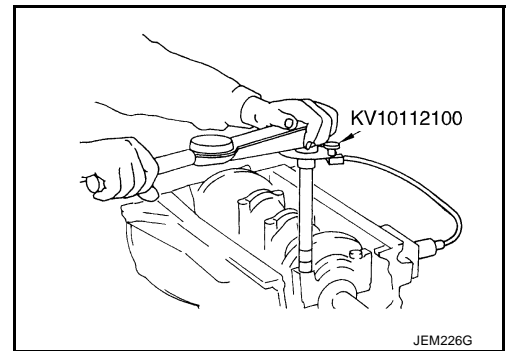
 : 27.0 N·m (2.8 kg-m, 20 ft-lb)

- c. Put alignment marks (with paint) on each bolt and the main bearing cap, all in the same direction. (When using a protractor)
  - d. Then, tighten 90 degrees. (angle tightening)

### CAUTION:

**Always use either the angle wrench [SST] or protractor during angular tightening. Avoid tightening based on visual checks alone.**

- After tightening bolts to specified torque, make sure that crankshaft rotates smoothly.
  - Check crankshaft end play. Refer to [EM-269, "CRANKSHAFT END PLAY"](#).
10. Check the outer diameter of connecting rod bolts. Refer to [EM-277, "CONNECTING ROD BOLT DEFORMATION"](#).
  11. Install piston to connecting rod.
    - a. Using the snap ring pliers, install snap rings to groove on piston rear side.
      - Fit snap ring correctly into grooves.
    - b. Install pistons to connecting rods.
      - Using the industrial use dryer, heat pistons up to approx. 60 to 70°C (140 to 158°F) until piston pin can be pressed down by finger touch. Then insert piston pin into piston and connecting rod from front side of piston toward rear.

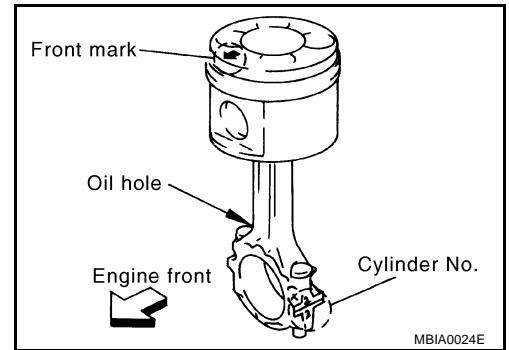




# CYLINDER BLOCK

[YD]

- Assemble piston and connecting rod with front mark of piston head and cylinder No. stamped on connecting rod being positioned as shown in the figure.
- c. Install snap ring to front side of piston.
- Refer to above step a for precaution on snap ring installation.
  - After installation, check connecting rods for smooth movement.



12. Use the piston ring expander (commercial service tool) to install piston rings.

**CAUTION:**

**When installing, prevent piston from being damaged.**

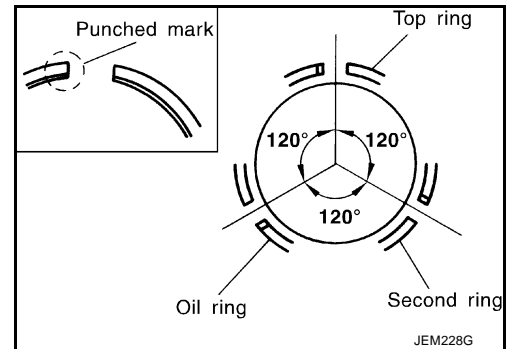
- Install top ring and second ring with punched mark surfaces facing upward.

**Punched mark:**

**Top ring : RTOP**

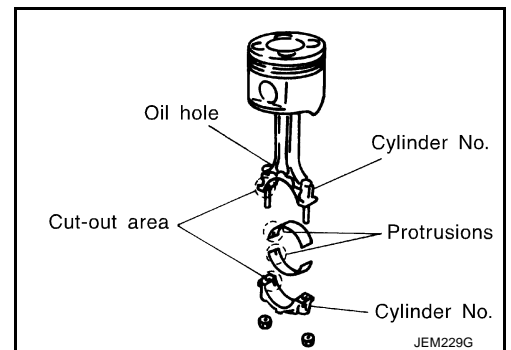
**Second ring : R2ND**

- Install rings so that three closed gap position 120 degrees apart one another.
- Closed gaps do not need to face in a specific directions, as long as each are positioned 120 degrees apart.



13. Install connecting rod bearing to connecting rod and cap.

- While installing connecting rod bearing, apply engine oil to bearing surfaces (inside). Do not apply engine oil to rear surfaces, but clean them completely.
- Align protrusions on connecting rod bearings with connecting rod cut-outs to install connecting rod bearings.

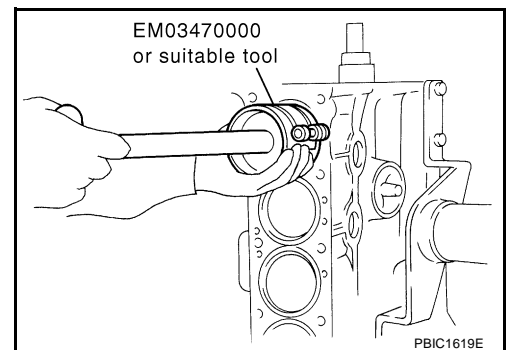


14. Install piston and connecting rod assembly to crankshaft.

- Move crankshaft pin to be assembled to BDC.
- Align cylinder position with cylinder No. on connecting rod to install piston and connecting rod assembly.
- Using the piston ring compressor [SST] or suitable tool, install piston and connecting rod assembly with front mark on piston head facing toward the front side of engine.

**CAUTION:**

**When installing piston and connecting rod assembly, prevent the big end of connecting rod from interfering with oil jet.**

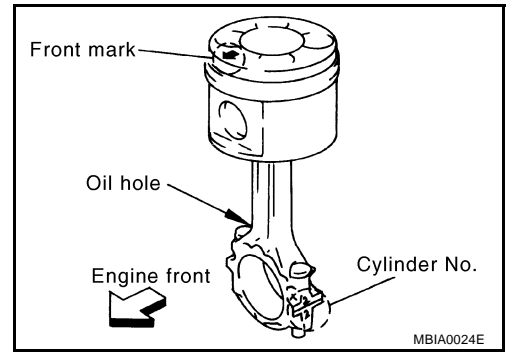


# CYLINDER BLOCK

[YD]

15. Install connecting rod caps and mounting nuts.

- Align cylinder No. stamped on connecting rod with that on cap to install connecting rod cap.
- Make sure that the front mark on connecting rod cap faces towards the front of the engine.



16. Tighten connecting rod nuts according to the following procedure:

- a. Apply engine oil on bolt threads and seat surface of nuts.
- b. Tighten bolts.

 : 29.4 N·m (3.0 kg-m, 22 ft-lb)

- c. Loosen completely.

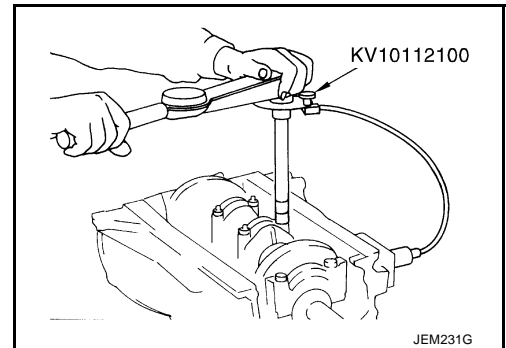
 : 0 N·m (0 kg-m, 0 in-lb)

- d. Tighten bolts.

 : 19.6 N·m (2.0 kg-m, 14 ft-lb)

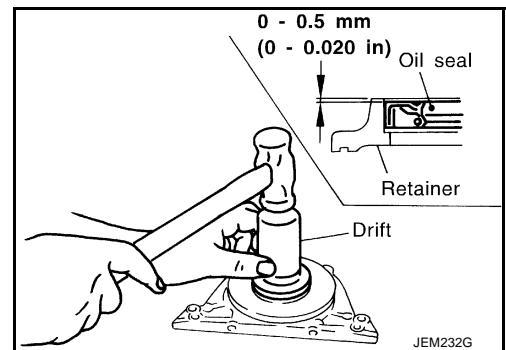
- e. Tighten 120 degrees. (angle tightening)

- **Always use either the angle wrench [SST] or protractor during angular tightening. Avoid tightening based on visual checks alone.**
- After tightening nuts, make sure that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to [EM-269](#). "[CONNECTING ROD SIDE CLEARANCE](#)".



17. Press fit rear oil seal into rear oil seal retainer.

- Using the drift [105 mm (4.13 in) dia.], press fit so that the dimension is as specified in the figure.
- Avoid inclined fitting. Force fit perpendicularly.

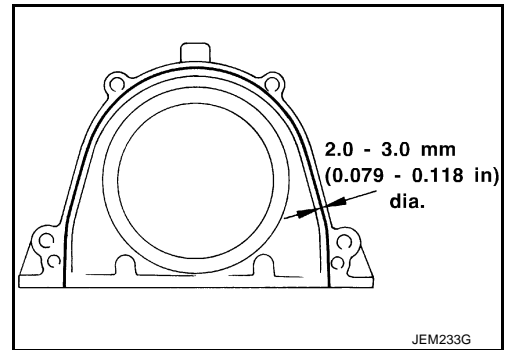


# CYLINDER BLOCK

[YD]

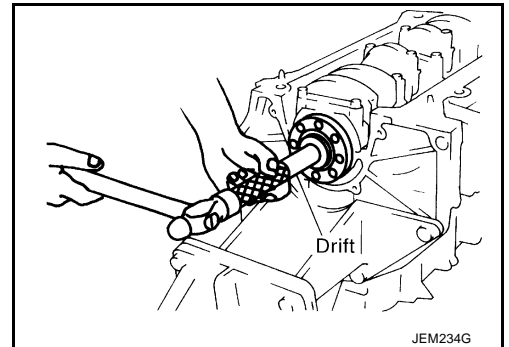
18. Install rear oil seal retainer to cylinder block.

- Apply new engine oil to the oil and dust seal lips.
- Apply liquid gasket to rear oil seal retainer using the tube presser [SST: WS39930000] as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**



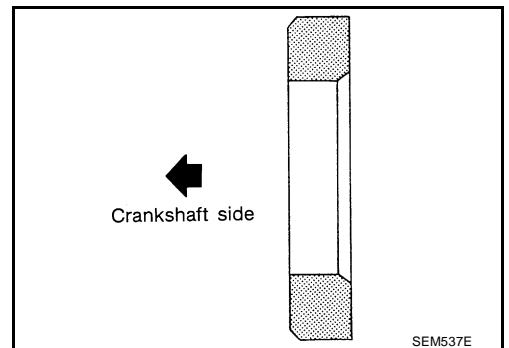
19. Press fit pilot bushing into crankshaft (M/T models).

- Using the drift with outer diameter of 19 mm (0.75 in), press fit pilot bushing until it stops.



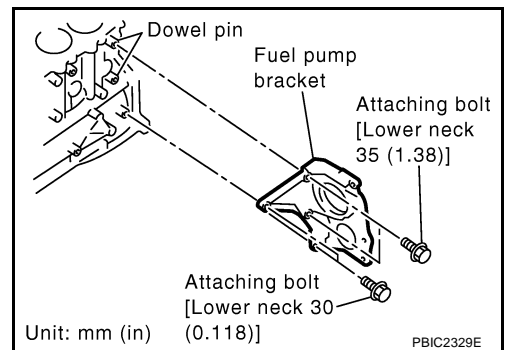
20. Press fit pilot converter into crankshaft (A/T models).

- Using the drift with outer diameter of 33 mm (1.30 in), press fit pilot converter until it stops.
- Press fit pilot converter with its chamfer facing crankshaft as shown in the figure.



21. Install fuel pump bracket.

- Align the bracket with the dowel pins on cylinder block to install.
- The two bolts used for dowel pins have a longer shanks than the other two.



22. Install parts to engine in the reverse order of disassembly.

23. Remove engine from engine stand in the reverse order of assembly.

24. Install flywheel (M/T models).

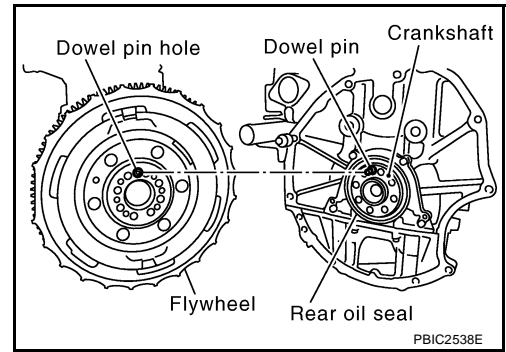
# CYLINDER BLOCK

[YD]

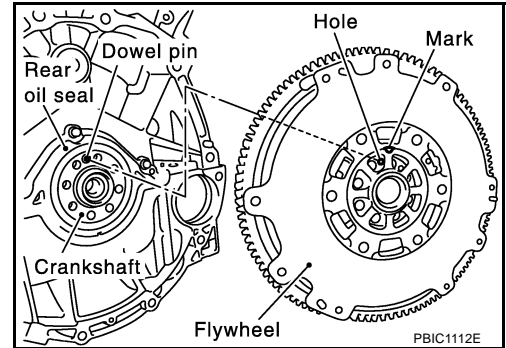
- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin hole.

**CAUTION:**

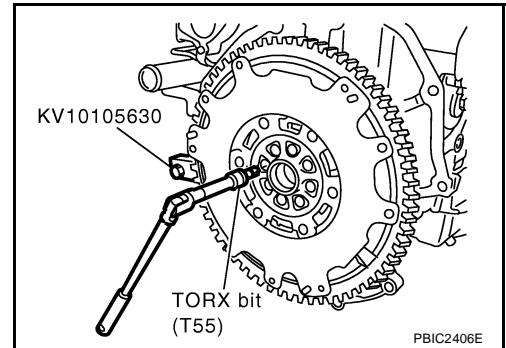
**If these are not aligned correctly, engine runs roughly and “MI” turns on.**



- There is a mating mark on the clutch cover side of flywheel. Refer it during installation.



- Holding ring gear with ring gear stopper [SST], tighten securing bolts with TORX socket (size: T55, commercial service tool).
- Tighten bolts uniformly in a crisscross manner.



- If these are not aligned correctly, engine runs roughly and “MI” turns on.

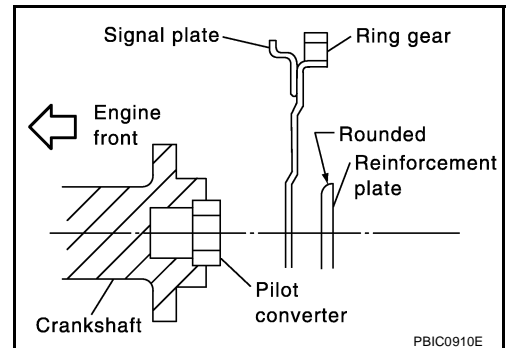
## 25. Install drive plate (A/T models).

- When installing drive plate to crankshaft, be sure to correctly align crankshaft side dowel pin and drive plate side dowel pin hole.

**CAUTION:**

**If these are not aligned correctly, engine runs roughly and “MI” turns on.**

- Install drive plate and reinforcement plate as shown in the figure.
- Holding ring gear with ring gear stopper [SST: KV10105630], tighten securing bolts with TORX socket (size: E20) (commercial service tool).
- Tighten bolts uniformly in a crisscross manner.



## 26. Install in the reverse order of removal.

# CYLINDER BLOCK

[YD]

GBS0001M

## How to Select Piston and Bearing DESCRIPTION

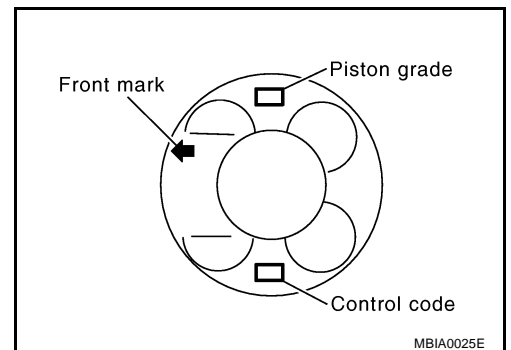
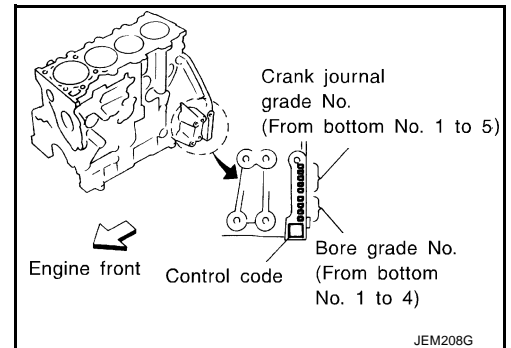
Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft to connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block to piston	Piston and piston pin assembly The piston is available together with piston pin as an assembly.	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

### HOW TO SELECT PISTON

#### When Using New Cylinder Block

1. Identify the cylinder bore grade (No. 1, 2, or 3) on LH surface at the rear of cylinder block.
2. Select piston of the same grade.
  - The part No. of piston is specified together with piston pin as an assembly.



## When Re-using an Old Cylinder Block

1. Measure cylinder bore inner diameter. Refer to [EM-273, "Cylinder Bore Inner Diameter"](#) .
2. Referring to “Cylinder bore inner diameter” in “Piston Selection Table”, determine the bore grade.
3. Select piston of the same grade.

## Piston Selection Table

Unit: mm (in)

Grade (punched)	1	2	3
Cylinder bore inner diameter	89.000 - 89.010 (3.5039 - 3.5043)	89.010 - 89.020 (3.5043 - 3.5047)	89.020 - 89.030 (3.5047 - 3.5051)
Piston outer diameter	88.928 - 88.942 (3.5011 - 3.5016)	88.938 - 88.952 (3.5015 - 3.5020)	88.948 - 88.962 (3.5019 - 3.5024)

### NOTE:

Piston is available together with piston pin as an assembly.

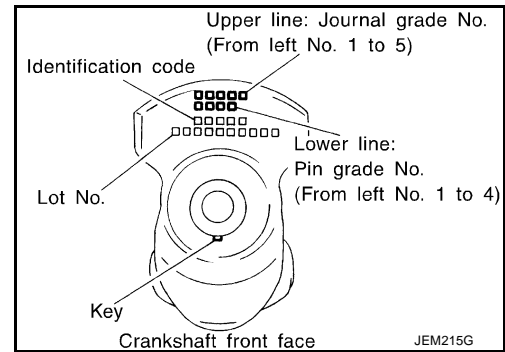
## HOW TO SELECT CONNECTING ROD BEARING

### When Using New Crankshaft and Connecting Rod

1. Identify the pin diameter grade (No. 0, 1, or 2) on front surface of crankshaft.
2. Select connecting rod bearings of the same grade.

### NOTE:

There is no grading for the inner diameter of the big end of the connecting rod.



### When Re-using the Removed Crankshaft and Connecting Rod

1. Measure the inner diameter of the big end of connecting rod and make sure it is within the specified range. Refer to [EM-271, "CONNECTING ROD BIG END INNER DIAMETER"](#) .
2. Measure the outer diameter of the crankshaft pin. Refer to [EM-274, "CRANKSHAFT PIN JOURNAL DIAMETER"](#) .
3. Determine the crankshaft pin grade by comparing the measurement with the values under the column “Crankshaft pin outer diameter” in “Selection Table of connecting Rod Bearing”.
4. Choose bearings of the same grade.

## Selection Table of connecting Rod Bearing

Unit: mm (in)

Connecting rod big end inner diameter	55.000 - 55.013 (2.1654 - 2.1659)
---------------------------------------	-----------------------------------

Unit: mm (in)

Crankshaft pin outer diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.492 - 1.496 (0.0587 - 0.0589)	STD 0	Black
51.961 - 51.968 (2.0457 - 2.0460)	1	1.496 - 1.500 (0.0589 - 0.0591)	STD 1	Brown
51.954 - 51.961 (2.0454 - 2.0457)	2	1.500 - 1.504 (0.0591 - 0.0592)	STD 2	Green

## Under Size Bearing Usage

- If bearing clearance is out of the specifications for connecting rod bearings in standard size, use under size bearings.
- When using under size bearings, measure bearing inner diameter with bearing installed, and grind crankshaft pins to adjust clearance to specification.

# CYLINDER BLOCK

[YD]

## Connecting Rod Bearing Under Size List

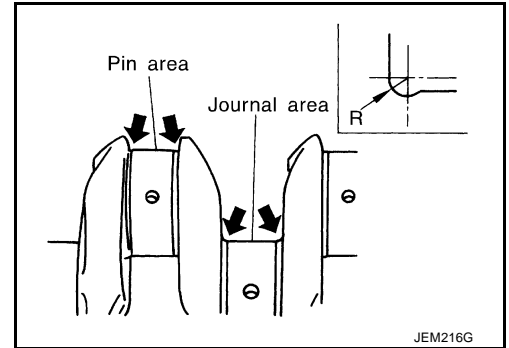
Unit: mm (in)

Size	Thickness
US 0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)
US 0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)
US 0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)

### CAUTION:

When grinding the crankshaft pin to use an under size bearing, avoid damaging the fillet R.

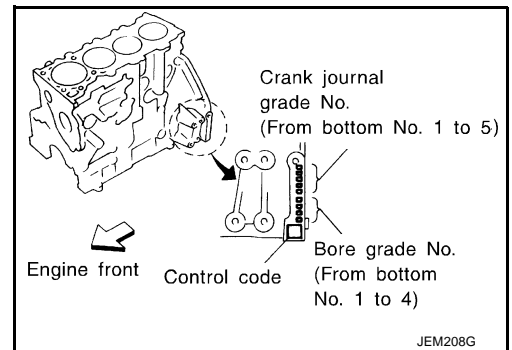
Standard dimension R : 1.5 - 1.7 mm (0.0591 - 0.0669 in)



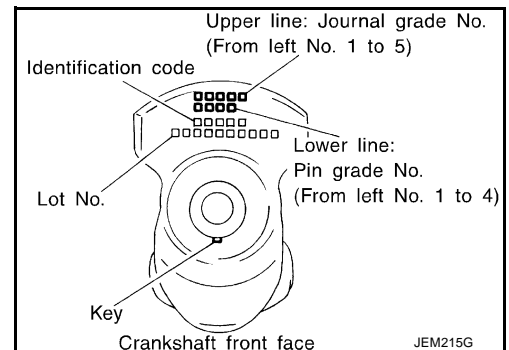
## HOW TO SELECT MAIN BEARING

### When Using New Cylinder Block and Crankshaft

1. Identify the crank journal grade (No. 0, 1, or 2) on LH surface at the rear of the cylinder block, and locate the applicable grade on the "Grade" row in the "Main Bearing Grade Table".



2. Identify the journal grade (No. 0, 1, or 2) on the front surface of crankshaft, and locate the applicable grade under the "Grade" column in the "Main Bearing Grade Table".



3. The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.

### When Re-using Removed Cylinder Block and Crankshaft

1. Measure the inner diameter of cylinder block main bearing housing. Refer to [EM-272, "MAIN BEARING HOUSING INNER DIAMETER"](#).
2. Locate the applicable cell where the measurement falls, on "Inner diameter of Cylinder block main bearing housing" row in the "Main Bearing Grade Table".
3. Measure the outer diameter of crankshaft journal. Refer to [EM-274, "CRANKSHAFT MAIN JOURNAL DIAMETER"](#).
4. Locate the applicable cell where the measurement falls, under "Crankshaft journal outer diameter" column in the "Main Bearing Grade Table".
5. The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.

# CYLINDER BLOCK

[YD]

## Main Bearing Grade Table

Unit: mm (in)

Inner diameter of Cylinder block main bearing housing			66.654 - 66.663 (2.6242 - 2.6245)	66.663 - 66.672 (2.6245 - 2.6249)	66.672 - 66.681 (2.6249 - 2.6252)
Crankshaft journal outer diameter	Grade (punched)		0	1	2
62.967 - 62.975 (2.4790 - 2.4793)	0	<ul style="list-style-type: none"> <li>● Bearing grade No.</li> <li>● Bearing thickness</li> <li>● Oil clearance</li> <li>● Identification color</li> </ul>	STD 0 1.816 - 1.820 (0.0715 - 0.0717) 0.039 - 0.066 (0.0015 - 0.0026) Black	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Brown	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green
62.959 - 62.967 (2.4787 - 2.6790)	1	<ul style="list-style-type: none"> <li>● Bearing grade No.</li> <li>● Bearing thickness</li> <li>● Oil clearance</li> <li>● Identification color</li> </ul>	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Brown	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow
62.951 - 62.959 (2.4784 - 2.4787)	2	<ul style="list-style-type: none"> <li>● Bearing grade No.</li> <li>● Bearing thickness</li> <li>● Oil clearance</li> <li>● Identification color</li> </ul>	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow	STD 4 1.832 - 1.836 (0.0721 - 0.0723) 0.039 - 0.066 (0.0015 - 0.0026) Blue

## Under Size Bearing Usage

- If bearing clearance is out of the specifications for main bearings in standard size, use under size bearings.
- When using under size bearings, measure bearing inner diameter with bearing installed, and grind crankshaft journals to adjust clearance to the specification.

## Main Bearing Under Size List

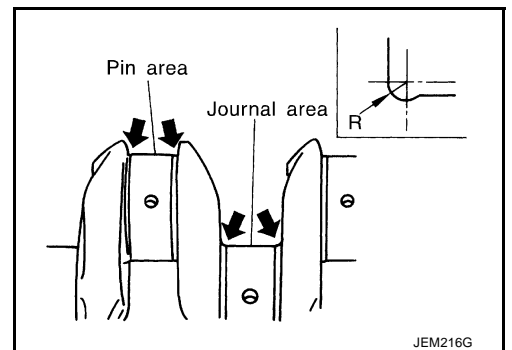
Unit: mm (in)

Size	Thickness
US 0.25(0.0098)	1.949 - 1.953 (0.0767 - 0.0769)

### CAUTION:

When grinding crank journals to use under size bearings, keep corners radius of fillet R. (All journals)

Standard dimension R : 1.5 - 1.7 mm (0.0591 - 0.0669 in)





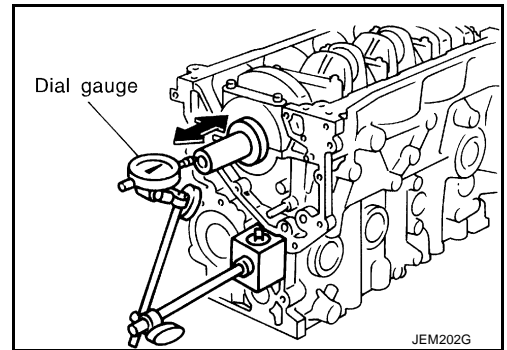
## Inspection After Disassembly CRANKSHAFT END PLAY

- Using dial gauge, measure crankshaft travel amount by moving the crankshaft forward or backward.

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

**Limit : 0.30 mm (0.0118 in)**

- If the value exceeds the limit, replace thrust bearings with new ones and measure again.  
If the measurement exceeds the limit again, replace crankshaft with a new one.



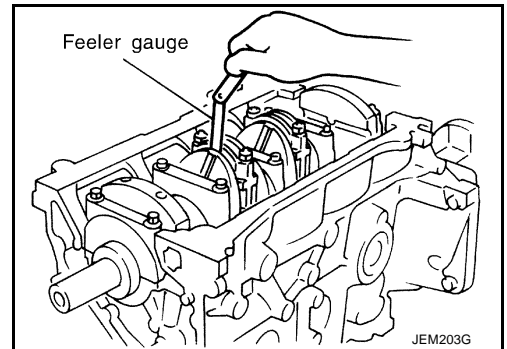
## CONNECTING ROD SIDE CLEARANCE

- Using feeler gauge, measure side clearance between connecting rod and crankshaft arm.

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

**Limit : 0.40 mm (0.0157 in)**

- If measured value exceeds the limit, replace connecting rod and repeat measurement.  
If measured value still exceeds the limit, replace crankshaft.

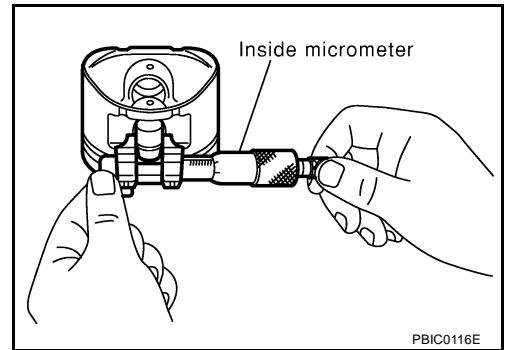


## PISTON TO PISTON PIN CLEARANCE

### Piston Pin Bore Diameter

Using inside micrometer, measure piston pin bore diameter.

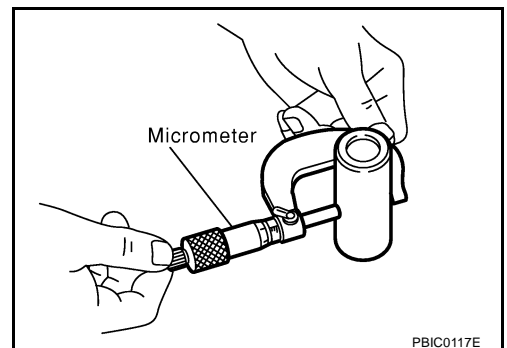
**Standard : 28.003 - 28.009 mm (1.1025 - 1.1027 in)**



### Piston Pin Outer Diameter

Using micrometer, measure piston pin outer diameter.

**Standard : 27.995 - 28.000 mm (1.1022 - 1.1024 in)**



## Calculation of Piston to Piston Pin Clearance

(Piston pin clearance) = (Piston pin bore diameter) – (Piston pin outer diameter)

**Standard : 0.003 - 0.014 mm (0.0001 - 0.0006 in)**

- If out of the standard, replace piston/piston pin assembly.

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**NOTE:**

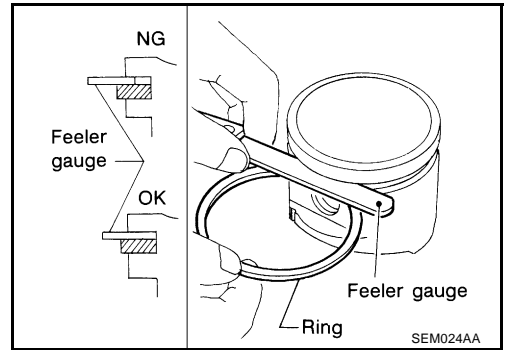
Piston is available together with piston pin as assembly.

**PISTON RING SIDE CLEARANCE**

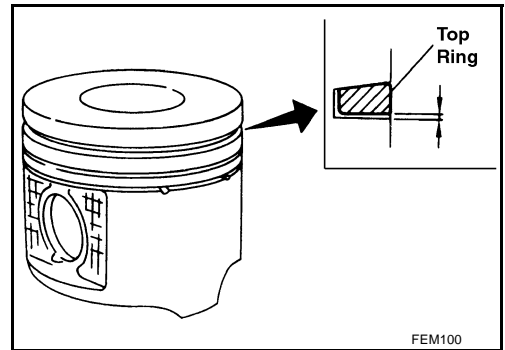
- Using feeler gauge, measure the side clearance between piston ring and piston ring groove.

Unit: mm (in)

Item	Standard	Limit
Top ring	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
2nd ring	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—



- Align top ring and external surface of piston. Measure lower side clearance of top ring with top ring pressed onto upper side of ring groove.
- If side clearance exceeds the limit, replace piston ring.
- Check clearance again. If side clearance still exceeds the limit, replace piston.

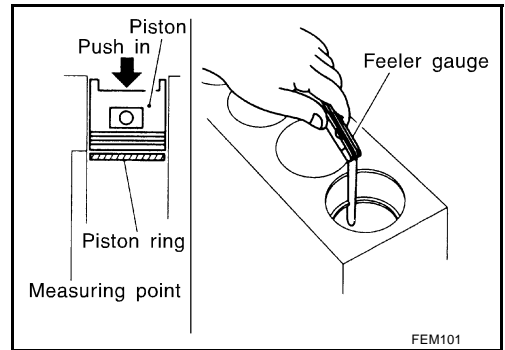


**PISTON RING END GAP**

- Make sure that cylinder bore diameter is within the specifications. Refer to [EM-273, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with feeler gauge.

Unit: mm (in)

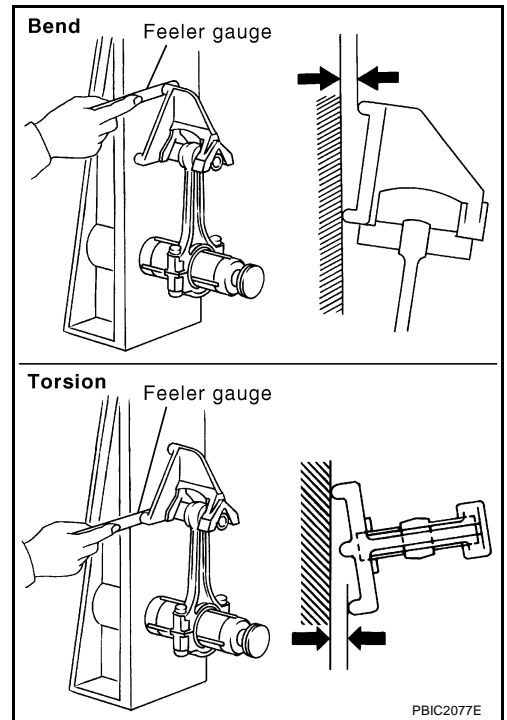
Item	Standard	Limit
Top ring	0.21 - 0.28 (0.0083 - 0.0110)	1.0 (0.039)
2nd ring	0.32 - 0.47 (0.0126 - 0.0185)	
Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	



- If out of the limit, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring. Refer to [EM-273, "PISTON TO CYLINDER BORE CLEARANCE"](#).

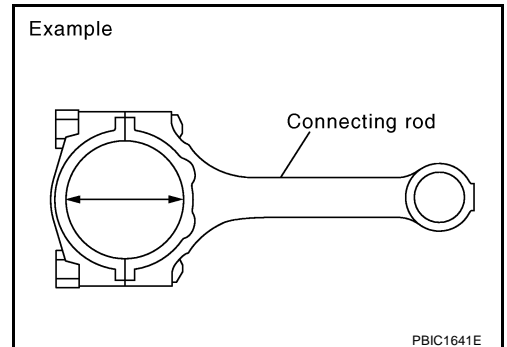
## CONNECTING ROD BEND AND TORSION

- Use connecting rod aligner to check bend and torsion.
  - Bend limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)**
  - Torsion limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)**
- If it exceeds the limit, replace connecting rod assembly.



## CONNECTING ROD BIG END INNER DIAMETER

- Install connecting rod caps without connecting rod bearings and tighten connecting rod nuts to the specified torque. Refer to [EM-258, "ASSEMBLY"](#).
- Using inside micrometer, measure connecting rod big end inner diameter.
  - Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)**
- If out of the standard, replace connecting rod.

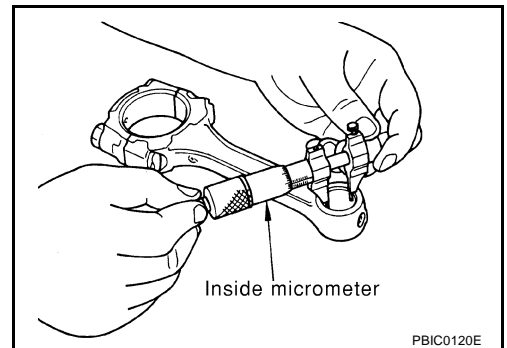


## CONNECTING ROD BUSHING OIL CLEARANCE

### Connecting Rod Bushing Inner Diameter

Use inside micrometer to measure bushing inner diameter.

**Standard : 28.026 - 28.038 mm (1.1034 - 1.1039 in)**

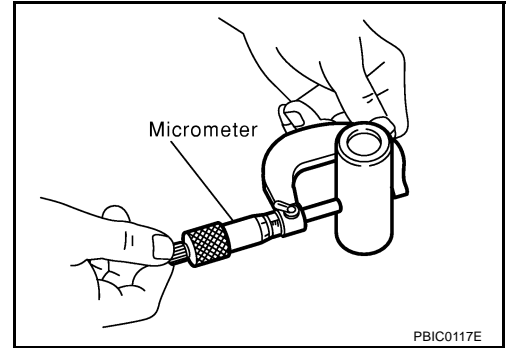


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## Piston Pin Outer Diameter

Use micrometer to measure piston pin outer diameter.

**Standard** : 27.995 - 28.000 mm (1.1022 - 1.1024 in)



## Calculation of Connecting Rod Bushing Clearance

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

**Standard** : 0.026 - 0.043 mm (0.0010 - 0.0017 in)

**Limit** : 0.057 mm (0.0022 in)

- If it exceeds the limit, replace connecting rod and/or piston and piston pin assembly. Refer to [EM-266, "HOW TO SELECT CONNECTING ROD BEARING"](#) and/or [EM-265, "HOW TO SELECT PISTON"](#).

## CYLINDER BLOCK TOP SURFACE DISTORTION

- Using scraper, remove gasket installed onto cylinder block surface. Remove contamination such as engine oil, scale, and carbon.

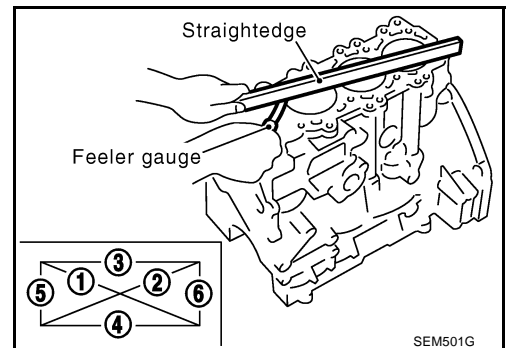
**CAUTION:**

**Keep broken pieces of gasket clear of engine oil and engine coolant passages.**

- Use straightedge and feeler gauge to check block upper surface for six distortion.

**Limit** : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.



## MAIN BEARING HOUSING INNER DIAMETER

- Without installing main bearings, install main bearing caps, and tighten bolts to the specified torque. Refer to [EM-258, "ASSEMBLY"](#).

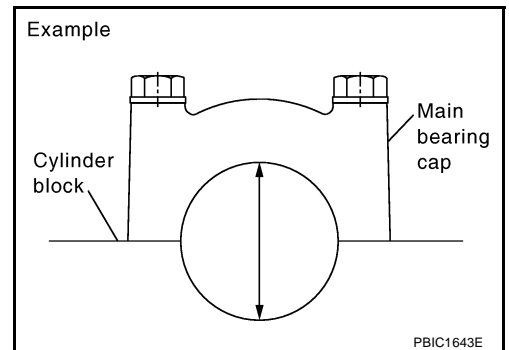
- Measure the inner diameter of main bearing housing with a bore gauge.

**Standard** : 66.654 - 66.681 mm (2.6242 - 2.6252 in)

- If the measurement is out of the standard, replace cylinder block and main bearing caps.

**NOTE:**

These components cannot be replaced as a single unit, because they were processed together.



## PISTON TO CYLINDER BORE CLEARANCE

### Cylinder Bore Inner Diameter

- Using bore gauge, measure cylinder inner diameters at six positions; top, middle, and bottom (A, B, C) in 2 directions (X, Y).

#### Cylinder bore inner diameter

: 89.000 – 89.030 mm (3.5039 – 3.5051 in)

#### Wear limit

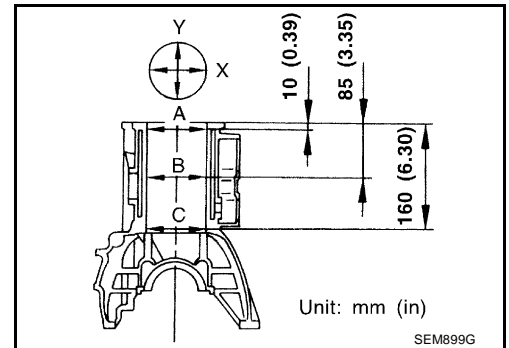
: 0.07 mm (0.028 in)

#### Out-of-round limit (Difference between X and Y)

: 0.015 mm (0.0006 in)

#### Taper limit (Difference between A and C)

: 0.010 mm (0.0004 in)



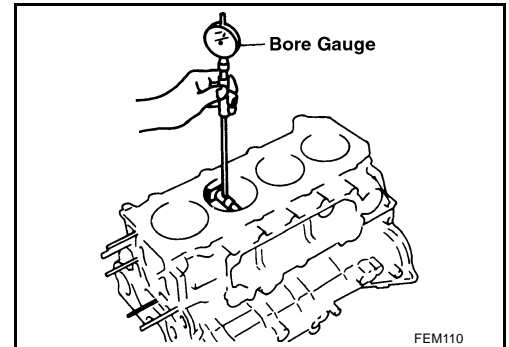
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or bore the inner wall.
- Oversize piston is provided. When using oversize piston, hone the cylinder so that the clearance between piston and cylinder satisfies the standard.

#### CAUTION:

If oversize piston is used, use it for all cylinders with oversize piston rings.

**Oversize (OS) : 0.25 mm (0.0098 in)**

**: 0.50 mm (0.0197 in)**



### Piston Outer Diameter

Use micrometer to measure piston outer diameter.

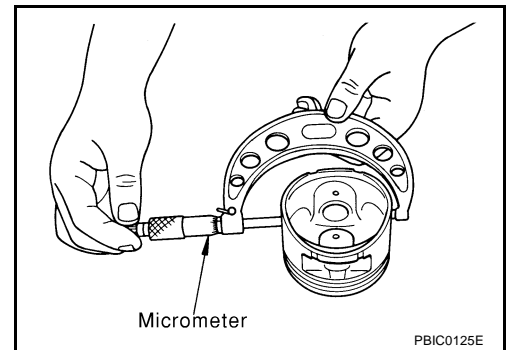
#### Piston outer diameter

**Measurement position : 11.0 mm (0.43 in)**  
**Distance from the bottom**

**Standard : 88.928 – 88.962 mm**  
**(3.5011 – 3.5024 in)**

**0.25 (0.0098) O/S : 89.188 – 89.202**  
**(3.5113 – 3.5119 in)**

**0.50 (0.0197) O/S : 89.438 – 89.452**  
**(3.5212 – 3.5217 in)**



### Calculation of Piston to Cylinder Bore Clearance

- Calculate using piston outer diameter and cylinder bore inner diameter (direction X, position B).  
(Clearance) = (Cylinder bore inner diameter) – (Piston outer diameter)

#### Specifications at room temperature [20°C (68°F)]:

**Standard : 0.058 - 0.082 mm (0.0023 - 0.0032 in)**

- If it exceeds the limit, replace piston and piston pin assembly. Refer to [EM-265, "HOW TO SELECT PISTON"](#).

### Reboring Cylinder Bore

- Determine the cylinder bore size by adding piston-to-cylinder bore clearance to piston diameter.

#### Rebore size calculation:

$$D = A + B - C$$

Where,

D: Bored diameter

- A: Piston outer diameter as measured**
- B: Piston-to-cylinder bore clearance**
- C: Honing allowance 0.02 mm (0.0008 in)**

2. Install main bearing caps and tighten bolts to the specified torque. Refer to [EM-258, "ASSEMBLY"](#) . This will prevent distortion of cylinder bores.
3. Cut cylinder bore.

**NOTE:**

- When any cylinder needs boring, all other cylinders must also be bored.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so at a time.

4. Hone cylinders to obtain the specified piston-to-cylinder bore clearance.
5. Measure finished cylinder bore for the out-of-round and taper.

**NOTE:**

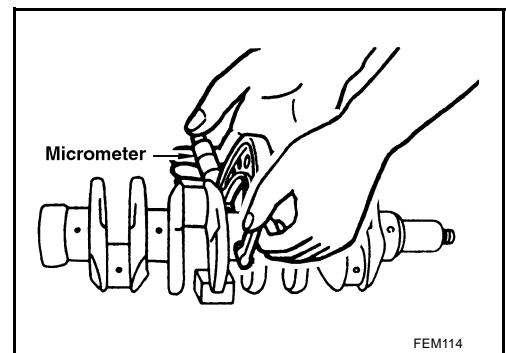
- Measurement should be done after cylinder bore cools down.

## CRANKSHAFT MAIN JOURNAL DIAMETER

- Use micrometer to measure crankshaft main journal diameter.

**Standard : 62.951 - 62.975 mm (2.4784 - 2.4793 in)**

- If out of the standard, measure the main bearing oil clearance. then use the undersize bearing. Refer to [EM-276, "MAIN BEARING OIL CLEARANCE"](#) .

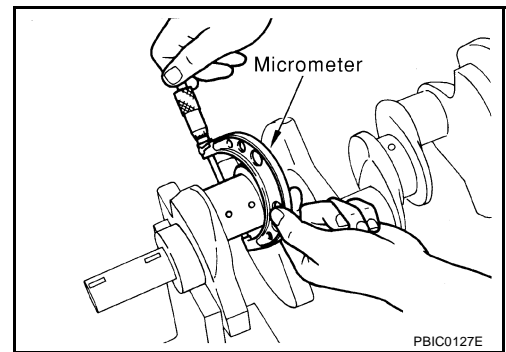


## CRANKSHAFT PIN JOURNAL DIAMETER

- Use micrometer to measure crankshaft pin journal diameter.

**Standard : 51.954 - 51.974 mm (2.0454 - 2.0462 in)**

- If out of the standard, measure the connecting rod bearing oil clearance. then use the undersize bearing. Refer to [EM-275, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .



## CRANKSHAFT OUT-OF-ROUND AND TAPER

- Using micrometer, measure each journal and pin at four points shown in the figure.
- Out-of-round value is indicated by difference in dimensions between directions X and Y at points A and B.
- Taper value is indicated by difference in dimensions between points A and B in directions X and Y.

**Out-of-round: (Difference between X and Y)**

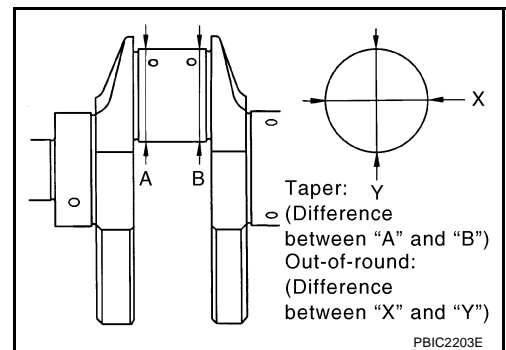
**Standard : 0.003 mm (0.0001 in)**

**Limit : 0.005 mm (0.0002 in)**

**Taper: (Difference between A and B)**

**Standard : 0.003 mm (0.0001 in)**

**Limit : 0.005 mm (0.0002 in)**

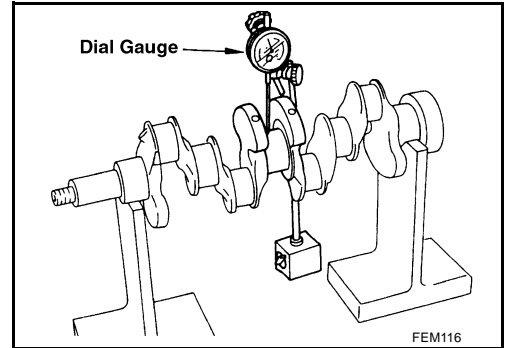


- If the measured value exceeds the limit, correct or replace crankshaft.

- If corrected, measure the bearing oil clearance of the corrected journal and/or pin. Then select the main bearing or connecting rod bearing. Refer to [EM-276, "MAIN BEARING OIL CLEARANCE"](#) and/or [EM-275, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

## CRANKSHAFT RUNOUT

- Place V-block onto surface plate to support journals at both ends of crankshaft.
  - Position dial gauge vertically onto No. 3 journal.
  - Rotate crankshaft to read needle movement on dial gauge. (Total indicator reading)
- Standard** : 0.05 mm (0.0020 in)  
**Limit** : 0.10 mm (0.0039 in)
- If it exceeds the limit, replace crankshaft.



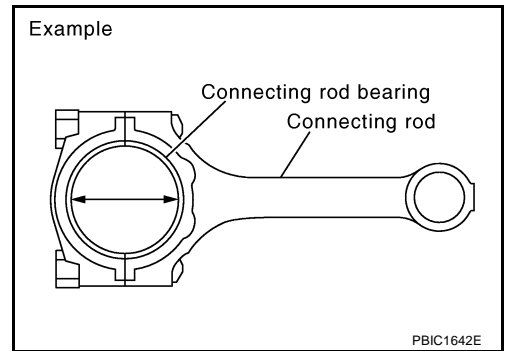
## CONNECTING ROD BEARING OIL CLEARANCE

### Method by Measurement

- Install connecting rod bearings to connecting rod and cap, and tighten connecting nuts to the specified torque. Refer to [EM-258, "ASSEMBLY"](#). Use inside micrometer to measure connecting rod bearing inner diameter.  
 (Bearing clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin outer diameter)

**Standard** : 0.039 - 0.070 mm (0.0015 - 0.0028 in)

- If clearance exceeds the standard, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin outer diameter to obtain specified bearing oil clearance. Refer to [EM-266, "HOW TO SELECT CONNECTING ROD BEARING"](#).



### Method of Using Plastigage

- Remove contamination such as engine oil, dust completely from crankshaft pins and each bearing surface.
- Cut plastigage slightly shorter than bearing width, place it in crankshaft direction, avoiding oil holes.
- Install connecting rod bearings to caps, and tighten connecting rod nuts to the specified torque.

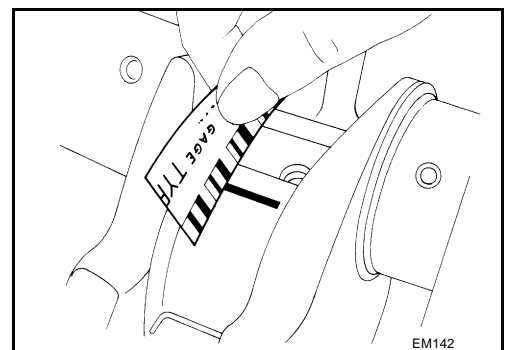
**CAUTION:**

**Do not rotate crankshaft.**

- Remove connecting rod caps and bearings, and measure plastigage width using scale on plastigage bag.

**NOTE:**

If out of specification, take same action mentioned in "Method by Measurement".





## MAIN BEARING OIL CLEARANCE

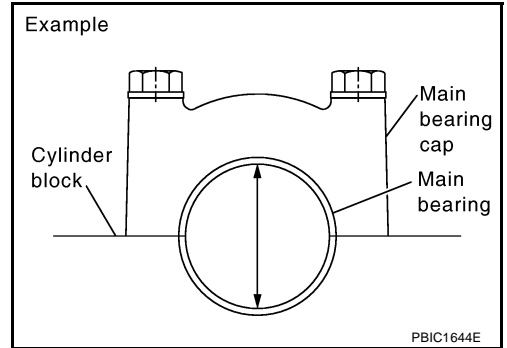
### Method by Measurement

- Install main bearings to cylinder block and bearing cap, and tighten the bolts to the specified torque. Refer to [EM-258, "ASSEMBLY"](#). Then, measure the inner diameter of main bearings.

(Bearing clearance) = (Bearing inner diameter) – (Crankshaft journal outer diameter)

**Standard : 0.047 - 0.077 mm (0.0019 - 0.0030 in)**

- If out of the standard, check main bearing housing inner diameter and crankshaft journal outer diameter, and select appropriate main bearing to adjust clearance to specifications. Refer to [EM-267, "HOW TO SELECT MAIN BEARING"](#).



### Method of Using Plastigage

- Remove contamination such as engine oil and dust completely from crankshaft journals and each bearing surface.
- Cut plastigage slightly shorter than bearing width. Place it in crankshaft turning direction, avoiding oil holes.
- Install main bearings and bearing cap and tighten to the specified torque. Refer to [EM-258, "ASSEMBLY"](#) for the tightening procedure.

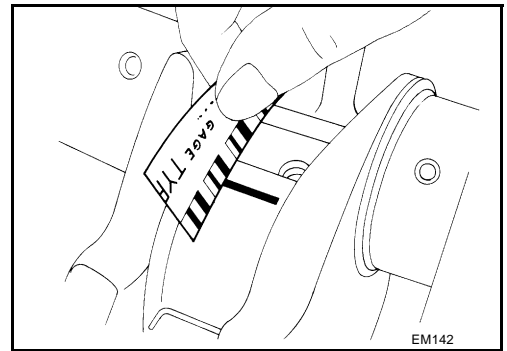
**CAUTION:**

**Do not rotate crankshaft.**

- Remove main bearings and bearing caps, and measure plastigage width using scale on plastigage bag.

**NOTE:**

If out of specification, take same action mentioned in "Method by Measurement".

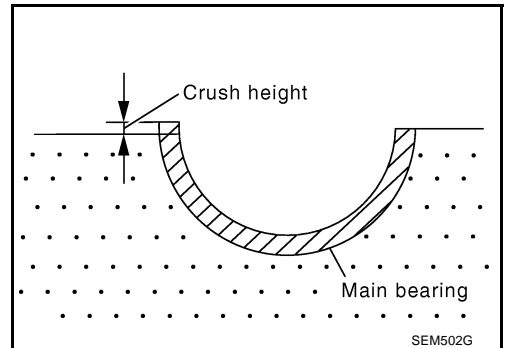


### CRUSH HEIGHT OF MAIN BEARING

- When bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-258, "ASSEMBLY"](#).

**Standard : There must be crush height.**

- If out of the standard, replace main bearings.

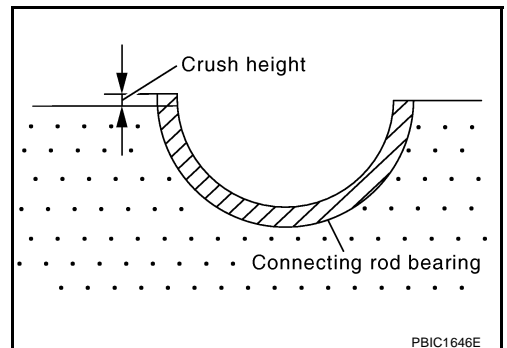


### CRUSH HEIGHT OF CONNECTING ROD BEARING

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [EM-258, "ASSEMBLY"](#).

**Standard : There must be crush height.**

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



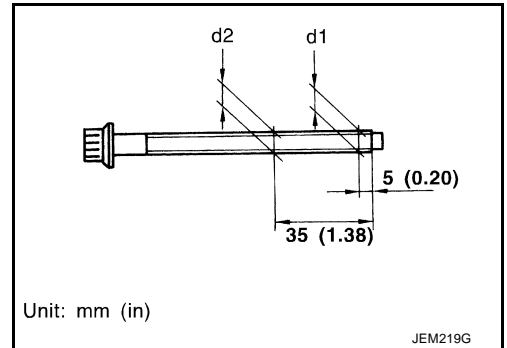


## MAIN BEARING CAP BOLT DEFORMATION

- Measure the outer diameter of threaded area, d1 and d2, at the points specified in the figure.
- When the necked point is identified at a point other than where specified, measure at the point as d2.
- Calculate the difference between d1 and d2.

**Limit : 0.13 mm (0.0051 in)**

- If it exceeds the limit, replace main bearing cap bolt.



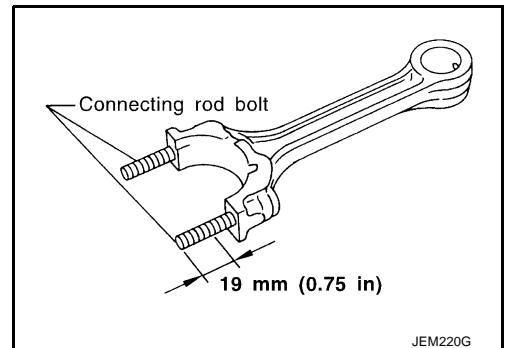
## CONNECTING ROD BOLT DEFORMATION

- Install nuts to connecting rod bolts. Make sure that the nut can be screwed smoothly on bolt threads by hand to the last thread on the bolt.
- If the nut does not screw in smoothly, measure the outer diameter of the bolt thread at the point specified in the figure.
- If a necked point is identified, measure at that point.

**Standard : 8.90 - 9.00 mm (0.3504 - 0.3543 in) dia.**

**Limit : 8.75 mm (0.3445 in) dia.**

- If it exceeds the limit, replace connecting rod bolts and nuts.

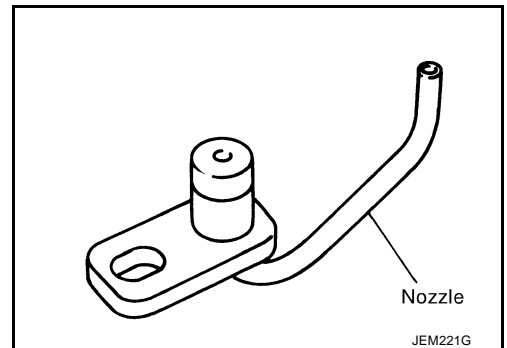


## OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.

**Standard : No deformation and no damage.**

- If out of the standard, replace oil jet.



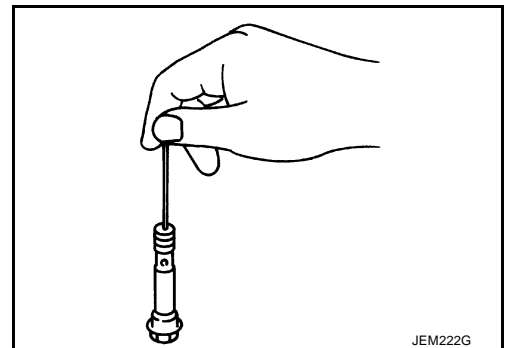
## OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.

**Standard:**

**Valve moves smoothly with proper reaction force.**

- If out of the standard, replace oil jet relief valve.



## FLYWHEEL DEFLECTION

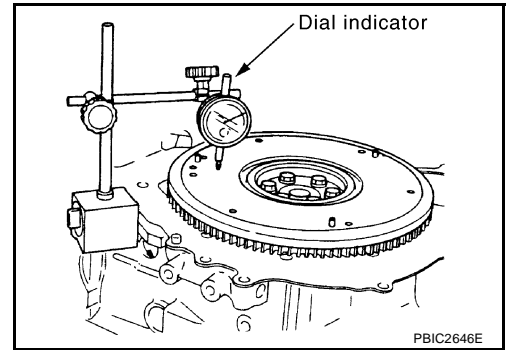
- Measure the deflection of flywheel contact surface to clutch with a dial indicator.
- Measure the deflection at 210 mm (8.27 in) dia.

**Standard : 0.45 mm (0.0177 in) or less.**

- If measured value is out of the standard, replace flywheel.

### CAUTION:

**When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.**



## MOVEMENT AMOUNT OF FLYWHEEL

### CAUTION:

**Do not disassemble double mass flywheel.**

### Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

**Standard : 1.3 mm (0.051 in) or less**

- If measured value is out of the standard, replace flywheel.

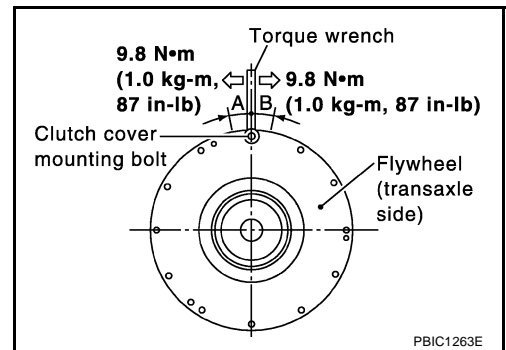
### Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
  - Tighten bolt at a force of 9.8 N·m (1.0 kg·m, 87 in·lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg·m, 87 in·lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure the dimensions of movement amounts "A" and "B" on circumference of the flywheel on the transmission side.

**Standard: 32.0 mm (1.620 in) or less.**

- If measured value is out of the standard, replace flywheel.

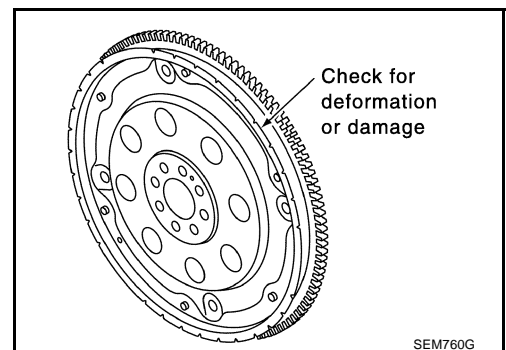


## DRIVE PLATE

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

### CAUTION:

- **Do not disassemble drive plate.**
- **Do not place drive plate with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch it.**
- **Handle signal plate in a manner that prevents it from becoming magnetized.**
- If anything is found, replace drive plate.



# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## SERVICE DATA AND SPECIFICATIONS (SDS)

PPF:00030

### Standard and Limit GENERAL SPECIFICATIONS

GBS00010

Cylinder arrangement		In-line 4
Displacement	Unit: cm <sup>3</sup> (cu in)	2,488 (151.82)
Bore and stroke	Unit: mm (in)	89.0 x 100 (3.504 x 3.937)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		16.5
Compression pressure Unit: kPa (bar, kg/cm <sup>2</sup> , psi)/200 rpm	Standard	3,100 (31, 31.6, 450)
	Minimum	2,500 (25, 25.5, 363)
	Differential limit between cylinders	490 (4.9, 5.0, 71)

Valve timing					
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Unit: degree

a	b	c	d	e	f
226	210	2	28	-2	48

### INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Item	Limit	
Surface distortion	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

### DRIVE BELTS

#### Belt Deflection:

Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied* mm (in)		
	New	Adjusted	Limit for re-adjusting
A/C compressor, alternator and water pump belt	2.9 - 3.4 (0.114 - 0.134)	3.9 - 4.4 (0.154 - 0.173)	8.5 (0.335)
Power steering oil pump belt	4.6 - 5.4 (0.181 - 0.213)	7.1 - 7.7 (0.280 - 0.303)	11.3 (0.445)

\*: When engine is cold.

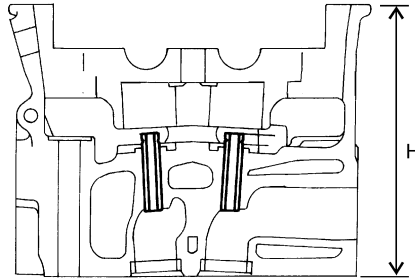
# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## CYLINDER HEAD

Unit: mm (in)

Item	Standard	Limit
Cylinder head distortion	Less than 0.04 (0.0016)	0.1 (0.004)



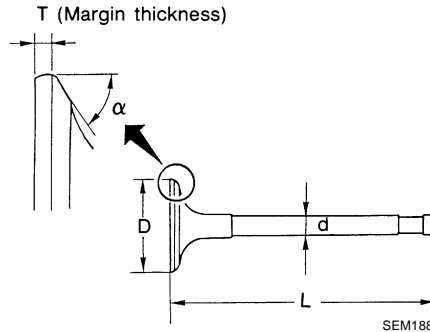
Nominal cylinder head height:  
H = 153.9 - 154.1 mm (6.059 - 6.067 in)

JEM204G

## VALVE

### Valve Dimensions

Unit: mm (in)



Valve head diameter "D"	Intake	28.0 - 28.3 (1.102 - 1.114)	
	Exhaust	26.0 - 26.3 (1.024 - 1.035)	
Valve length "L"	Intake	106.72 (4.2016)	
	Exhaust	106.36 (4.1874)	
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)	
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)	
Valve seat angle "alpha"	Intake and exhaust	45 degrees 15' - 45 degrees 45'	
Valve margin "T"	Intake	1.60 (0.0630)	
	Exhaust	2WD models	1.80 (0.0709)
		4WD models	1.48 (0.0583)
Valve margin "T" limit		More than 1.0 (0.039)	
Valve stem end surface grinding limit		Less than 0.2 (0.008)	

### Valve Clearance

Unit: mm (in)

Item	Cold	Hot* (Reference data)
Intake	0.24 - 0.32 (0.0094 - 0.0126)	0.274 - 0.386 (0.0108 - 0.0152)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.0121 - 0.0170)

\*: Approximately 80°C (176°F)

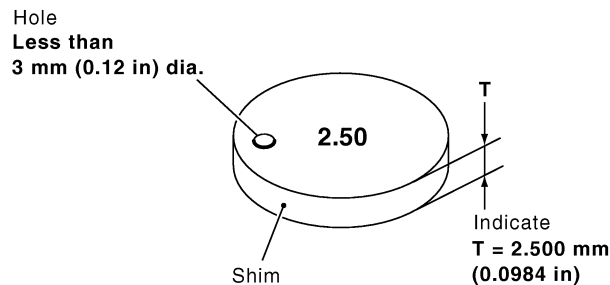
# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## Available Shims

Stamped mark	Thickness mm (in)
2.10	2.10 (0.0827)
2.12	2.12 (0.0835)
2.14	2.14 (0.0843)
2.16	2.16 (0.0850)
2.18	2.18 (0.0858)
2.20	2.20 (0.0866)
2.22	2.22 (0.0874)
2.24	2.24 (0.0882)
2.26	2.26 (0.0890)
2.28	2.28 (0.0898)
2.30	2.30 (0.0906)
2.32	2.32 (0.0913)
2.34	2.34 (0.0921)
2.36	2.36 (0.0929)
2.38	2.38 (0.0937)
2.40	2.40 (0.0945)
2.42	2.42 (0.0953)
2.44	2.44 (0.0961)
2.46	2.46 (0.0969)
2.48	2.48 (0.0976)
2.50	2.50 (0.0984)
2.52	2.52 (0.0992)
2.54	2.54 (0.1000)
2.56	2.56 (0.1008)
2.58	2.58 (0.1016)
2.60	2.60 (0.1024)
2.62	2.62 (0.1031)
2.64	2.64 (0.1039)
2.66	2.66 (0.1047)
2.68	2.68 (0.1055)
2.70	2.70 (0.1063)
2.72	2.72 (0.1071)
2.74	2.74 (0.1079)

A  
EM  
C  
D  
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L  
M



SEM512G

# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## Valve Spring

Valve spring square	mm (in)	1.9 (0.075)
Free height	mm (in)	44.74 (1.76)
Pressure	N (kg, lb) at height mm (in)	184 - 208 (18.77 - 21.22, 41.4 - 46.8) at 32.82 (1.2921)
Height during valve open	mm (in)	24.82 (0.9772)
Load with valve open	N (kg, lb)	320 - 360 (32.65 - 36.73, 71.9 - 80.9)

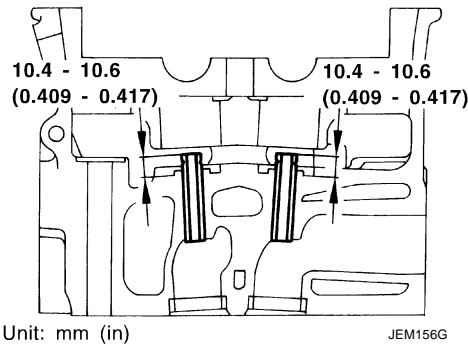
## Valve Lifter

Unit: mm (in)

Item	Standard
Valve lifter outer diameter	29.960 - 29.975 (1.1795 - 1.1801)
Valve lifter bore diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.025 - 0.061 (0.0010 - 0.0024)

## Valve Guide

Unit: mm (in)



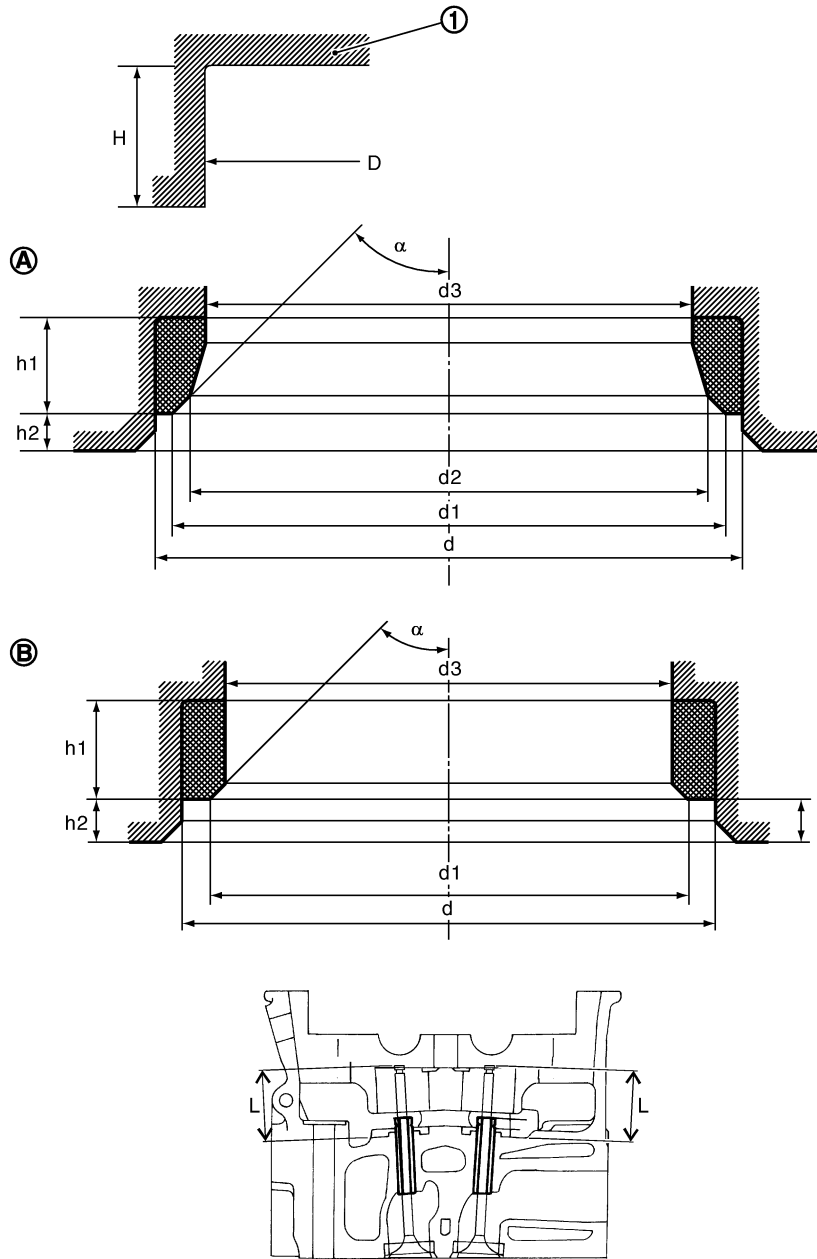
Item		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Item		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.10 (0.0039)
Projection length		10.4 - 10.6 (0.409 - 0.417)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## Valve Seat

Unit: mm (in)



PBIC4054E

JEM253G

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat (1) recess diameter "D"	Intake	30.000 - 30.016 (1.1811 - 1.1817)	30.500 - 30.516 (1.2008 - 1.2014)
	Exhaust	29.000 - 29.016 (1.1417 - 1.1424)	29.500 - 29.516 (1.1614 - 1.1620)
Valve seat outer diameter "d"	Intake (A)	30.080 - 30.100 (1.1842 - 1.1850)	30.580 - 30.600 (1.2039 - 1.2047)
	Exhaust (B)	29.080 - 29.096 (1.1449 - 1.1455)	29.580 - 29.596 (1.1646 - 1.1652)
Valve seat interference fit	Intake (A)	0.064 - 0.100 (0.0025 - 0.0039)	
	Exhaust (B)	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter "d1"	Intake (A)	27.15 - 27.65 (1.0689 - 1.0886)	26.05 - 26.55 (1.0256 - 1.0453)
	Exhaust (B)	24.95 - 25.45 (0.982 - 1.0020)	24.15 - 24.65 (0.9508 - 0.9705)

# SERVICE DATA AND SPECIFICATIONS (SDS)

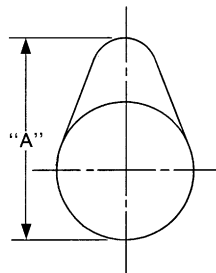
[YD]

Diameter "d2"	Intake (A)	26.00 - 26.50 (1.0236 - 1.0433)	—
	Exhaust (B)	—	
Diameter "d3"	Intake (A)	25.3 - 25.7 (0.996 - 1.012)	
	Exhaust (B)	23.3 - 23.7 (0.917 - 0.933)	
Angle "α"	43°30' - 46°30'		
Height "h1"	Intake (A)	7.0 - 7.1 (0.276 - 0.280)	6.6 - 6.7 (0.260 - 0.264)
	Exhaust (B)	6.7 - 6.8 (0.264 - 0.268)	6.3 - 6.4 (0.248 - 0.252)
Height "h2"	Intake (A)	2.23 - 2.43 (0.0878 - 0.0957)	2.13 - 2.53 (0.0839 - 0.0996)
	Exhaust (B)	2.76 - 2.96 (0.1087 - 0.1165)	2.66 - 3.06 (0.1047 - 0.1205)
Depth "H"	Intake	8.83 - 9.13 (0.3476 - 0.3594)	
	Exhaust	9.06 - 9.36 (0.3567 - 0.3685)	
Projection (L)	Intake	36.53 - 36.98 (1.4382 - 1.4559)	
	Exhaust	36.53 - 37.01 (1.4382 - 1.4571)	

## CAMSHAFT

Unit: mm (in)

Item	Standard	Limit
Camshaft journal oil clearance	0.045 - 0.086 (0.0018 - 0.0034)	
Camshaft bracket inner diameter	No.1	30.500 - 30.521 (1.2008 - 1.2016)
	No. 2, 3, 4, 5	24.000 - 24.021 (0.9449 - 0.9457)
Camshaft journal outer diameter	No. 1	30.435 - 30.455 (1.1982 - 1.1990)
	No. 2, 3, 4, 5	23.935 - 23.955 (0.9423 - 0.9431)
Camshaft runout [TIR*]	—	0.02 (0.0008)
Camshaft sprocket runout [TIR*]	—	0.15 (0.0059)
Camshaft end play	0.070 - 0.148 (0.0028 - 0.0058)	0.24 (0.0094)



Cam height "A"	Intake	39.505 - 39.695 (1.5553 - 1.5628)
	Exhaust	39.905 - 40.095 (1.5711 - 1.5785)

\*: Total indicator reading

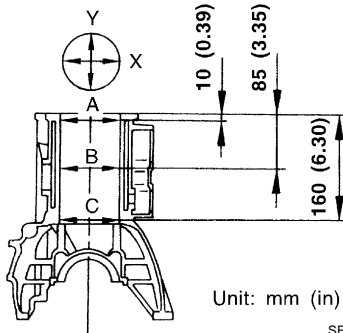


# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## CYLINDER BLOCK

Unit: mm (in)



Unit: mm (in)

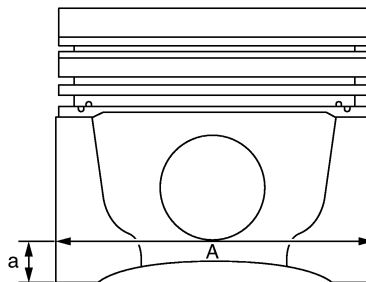
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Top surface distortion		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1	89.000 - 89.010 (3.5039 - 3.5043)
			Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.07 (0.0028)
Out-of-round (Difference between X and Y)		Limit	0.015 (0.0006)	
Taper (Difference between A and C)			0.010 (0.0004)	
Main bearing housing inner diameter (Without bearing)				66.654 - 66.681 (2.6242 - 2.6252)
Difference in inner diameter between cylinders		Limit		Less than 0.05 (0.0020)

## PISTON, PISTON RING AND PISTON PIN

### Available Piston

Unit: mm (in)



MBIA0026E

Piston outer diameter "A"	Standard	Grade No. 1	88.928 - 88.942 (3.5011 - 3.5016)
		Grade No. 2	88.938 - 88.952 (3.5015 - 3.5020)
		Grade No. 3	88.948 - 88.962 (3.5019 - 3.5024)
		0.25 (0.0098) O/S (Service)	89.188 - 89.202 (3.5113 - 3.5119)
		0.50 (0.0197) O/S (Service)	89.438 - 89.452 (3.5212 - 3.5217)
"a" dimension			11.0 (0.43)
Piston pin bore diameter			28.003 - 28.009 (1.1025 - 1.1027)
Piston to cylinder bore clearance			0.058 - 0.082 (0.0023 - 0.0032)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## Piston Ring

Unit: mm (in)

Item		Standard	Limit
Side clearance	Top	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
	2nd	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
	Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—
End gap	Top	0.21 - 0.28 (0.0083 - 0.0110)	1.0 (0.039)
	2nd	0.32 - 0.47 (0.0126 - 0.0185)	
	Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	

## Piston Pin

Unit: mm (in)

Piston pin outer diameter		27.995 - 28.000 (1.1022 - 1.1024)
Piston to piston pin clearance		0.003 - 0.014 (0.0001 - 0.0006)
Connecting rod bushing clearance	Standard	0.026 - 0.043 (0.0010 - 0.0017)
	Limit	0.057 (0.0022)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## CONNECTING ROD

Unit: mm (in)

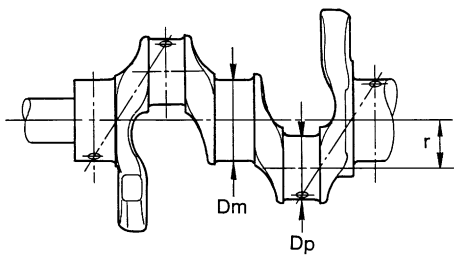
Center distance		154.5 (6.083)
Bend [per 100 (3.94)]	Limit	0.12 (0.0047)
Torsion [per 100 (3.94)]	Limit	0.12 (0.0047)
Connecting rod bushing inner diameter*		28.026 - 28.038 (1.1034 - 1.1039)
Connecting rod big end inner diameter*		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

\*: After installing in connecting rod

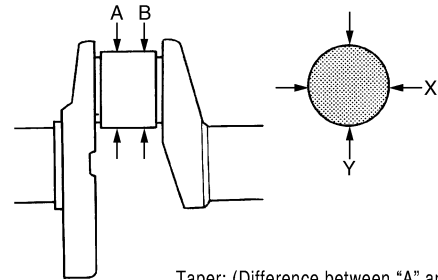
## CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"		62.951 - 62.975 (2.4784 - 2.4793)
Pin journal dia. "Dp"		51.954 - 51.974 (2.0454 - 2.0462)
Center distance "r"		49.97 - 50.03 (1.9673 - 1.9697)
Out-of-round (Difference between X and Y)	Standard	0.003 (0.0001)
	Limit	0.005 (0.0002)
Taper (Difference between A and B)	Standard	0.003 (0.0001)
	Limit	0.005 (0.0002)
Runout [TIR*]	Standard	0.05 (0.0020)
	Limit	0.10 (0.0039)
End play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)



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Taper: (Difference between "A" and "B")  
Out-of-round: (Difference between "X" and "Y")

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\*: Total indicator reading

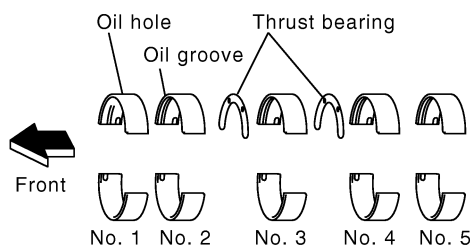
# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## AVAILABLE MAIN BEARING

### Main bearing

Unit: mm (in)



Grade number	Thickness "T"	Width "W"	Identification color
STD 0	1.816 - 1.820 (0.0715 - 0.0717)	19.9 - 20.1 (0.783 - 0.791)	Black
STD 1	1.820 - 1.824 (0.0717 - 0.0718)		Brown
STD 2	1.824 - 1.828 (0.0718 - 0.0720)		Green
STD 3	1.828 - 1.832 (0.0720 - 0.0721)		Yellow
STD 4	1.832 - 1.836 (0.0721 - 0.0723)		Blue

### Undersize

Unit: mm (in)

Size	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	1.949 - 1.953 (0.0767 - 0.0769)	Grind so that bearing clearance is the specified value.

## AVAILABLE CONNECTING ROD BEARING

### Connecting Rod Bearing

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color (mark)
STD 0	1.492 - 1.496 (0.0587 - 0.0589)	22.9 - 23.1 (0.902 - 0.909)	Black
STD 1	1.496 - 1.500 (0.0589 - 0.0591)		Brown
STD 2	1.500 - 1.504 (0.0591 - 0.0592)		Green

### Undersize

Unit: mm (in)

Size	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)	
0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)	

## MISCELLANEOUS COMPONENTS

### Flywheel

Unit: mm (in)

Flywheel deflection [TIR]*	Standard	0.45 (0.0177) or less

\*: Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

[YD]

## Bearing Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	0.047 - 0.077 (0.0019 - 0.0030)
Connecting rod bearing oil clearance	Standard	0.039 - 0.070 (0.0015 - 0.0028)

A

EM

C

D

E

F

G

H

I

J

K

L

M

