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# SECTION **EM**

## ENGINE MECHANICAL

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PRECAUTION

PRECAUTIONS

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:000000010287605

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the SR and SB section of this Service Manual.

**WARNING:**

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the SR section.
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

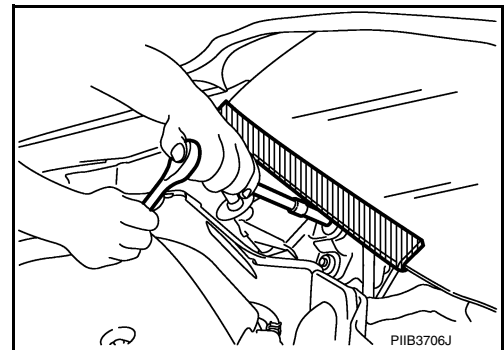
**WARNING:**

- When working near the Airbag Diagnosis Sensor Unit or other Airbag System sensors with the Ignition ON or engine running, DO NOT use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the Ignition OFF, disconnect the battery and wait at least three minutes before performing any service.

Precaution for Procedure without Cowl Top Cover

INFOID:000000009756929

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc to prevent damage to windshield.



Precautions For Engine Service

INFOID:000000009756930

DISCONNECTING FUEL PIPING

- Before starting work, check 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.

DRAINING ENGINE COOLANT

Drain engine coolant and engine oil when the engine is cooled.

INSPECTION, REPAIR AND REPLACEMENT

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

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# PRECAUTIONS

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## < PRECAUTION >

### REMOVAL AND DISASSEMBLY

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Must cover openings of engine system with a tape or equivalent, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

### ASSEMBLY AND INSTALLATION

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

### Parts Requiring Angle Tightening

INFOID:000000009756931

- Use the Tool for the final tightening of the following engine parts:

**Tool number : KV10112100 (BT-8653-A)**

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

### Liquid Gasket

INFOID:000000009756932

#### REMOVAL OF LIQUID GASKET SEALING

- After removing the bolts and nuts, separate the mating surface and remove the liquid gasket using Tool (A).

**Tool Number : KV10111100 (J-37228)**

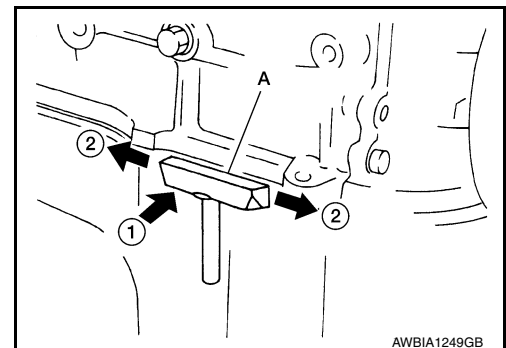
#### **CAUTION:**

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

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.

#### **CAUTION:**

**Do not damage the mating surfaces.**



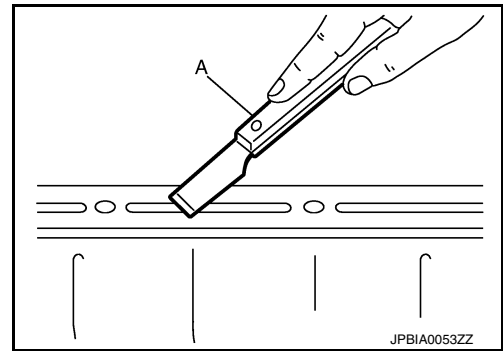
#### LIQUID GASKET APPLICATION PROCEDURE

# PRECAUTIONS

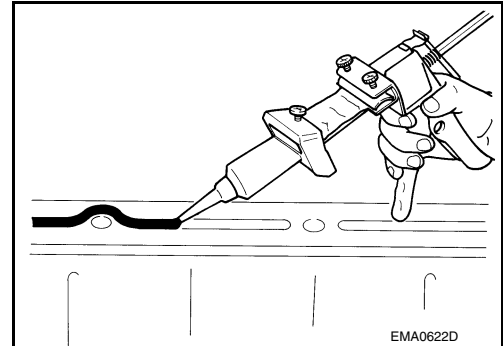
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## < PRECAUTION >

1. Using suitable tool (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
  - Remove 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 liquid gasket tube to the suitable tool.  
**Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21. "Recommended Chemical Products and Sealants".**
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
  - If there is a groove for liquid gasket application, apply liquid gasket to the groove.

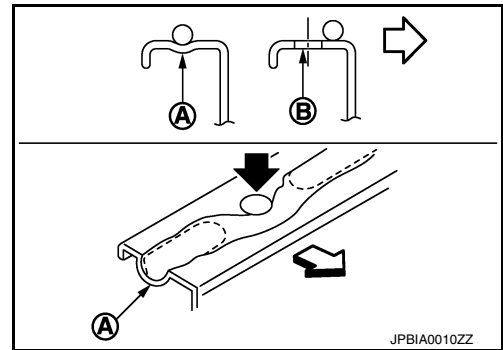


- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

(A) : Groove

⇐ : Inside

- Within five minutes of liquid gasket application, install the mating component.
- If 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 the procedures contained in this manual concerning liquid gasket application, observe them.

# PREPARATION

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< PREPARATION >

## PREPARATION

### PREPARATION

#### Special Service Tools

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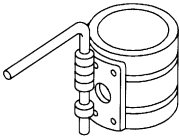
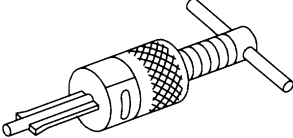
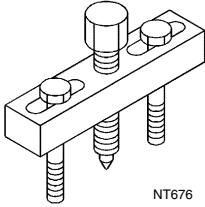
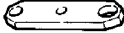
The actual shape of the tools may differ from those illustrated here.

Tool number (TechMate No.) Tool name	Description
KV1011100 (J-37228) Seal cutter	Removing oil pan (upper and lower) etc.
KV10116200 (J-26336-B) Valve spring compressor 1. KV10115900 ( — ) Attachment 2. KV10109220 (J-26336-B and J-26336-20) Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not.
KV10112100 (BT-8653-A) Angle wrench	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 ( — ) Heated oxygen sensor wrench	Loosening or tightening heated air fuel ratio sensor 1 <b>For 22 mm (0.87 in) width hexagon nut</b>
KV10107902 (J-38959) Valve oil seal puller	Removing valve oil seal
KV10115600 (J-38958) Valve oil seal drift	Installing valve oil seal <b>Use side (G).</b> a: 20 (0.79) dia.                      d: 8 (0.31) dia. b: 13 (0.51) dia.                      e: 10.7 (0.421) c: 10.3 (0.406) dia.                  f: 5 (0.20) H: Side B  Unit: mm (in)

# PREPARATION

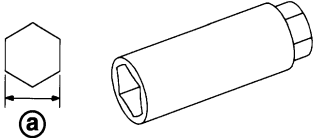
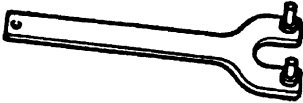
< PREPARATION >

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Tool number (TechMate No.) Tool name	Description	
EM03470000 (J-8037) Piston ring compressor	Installing piston assembly into cylinder bore   S-NT044	A <b>EM</b> C
ST16610001 (J-23907) Pilot bushing puller	Removing pilot converter   S-NT045	D E F
KV11103000 ( — ) Pulley puller	Removing crankshaft pulley   NT676	G H
KV11105210 (J-44716) Stopper plate	Lock drive plate   ZZA0009D	I J K

## Commercial Service Tools


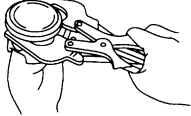
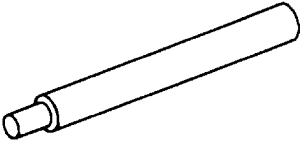
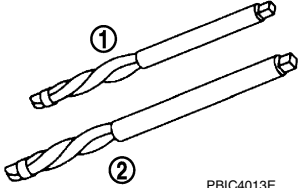
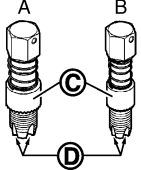
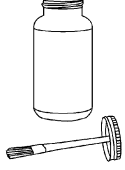
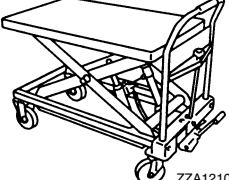
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Tool name	Description	
Spark plug wrench	Removing and installing spark plug a: 14 mm (0.55 in)   JPBIA0399ZZ	L M N
Pulley holder	Crankshaft pulley removing and installing   ZZA1010D	O P

# PREPARATION

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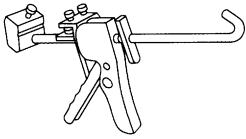

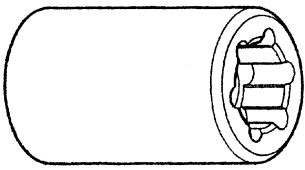
Tool name	Description
Valve seat cutter set   <p style="text-align: center;">S-NT048</p>	Finishing valve seat dimensions
Piston ring expander   <p style="text-align: center;">S-NT030</p>	Removing and installing piston ring
Valve guide drift   <p style="text-align: center;">PBIC4012E</p>	Removing and installing valve guide
Valve guide reamer   <p style="text-align: center;">PBIC4013E</p>	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide
Oxygen sensor thread cleaner   <p style="text-align: center;">JPBIA0238ZZ</p>	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor (Use with anti-seize lubricant shown below.) <b>A: J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor</b> <b>B: J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor</b> C: Mating surface shave cylinder D: Flutes
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)   <p style="text-align: center;">AEM489</p>	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Manual lift table caddy   <p style="text-align: center;">ZZA1210D</p>	Removing and installing engine



# PREPARATION

< PREPARATION >

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Tool name	Description
<p>Tube presser</p> <div style="text-align: center;">  <p>S-NT052</p> </div>	<p>Pressing the tube of liquid gasket</p>
<p>Power tool</p> <div style="text-align: center;">  <p>PIIB1407E</p> </div>	<p>Loosening nuts, screws and bolts</p>
<p>(J-45816) E20 ®Socket</p> <div style="text-align: center;">  <p>LBI A0285E</p> </div>	<p>Removing and installing CVT drive plate bolts</p>

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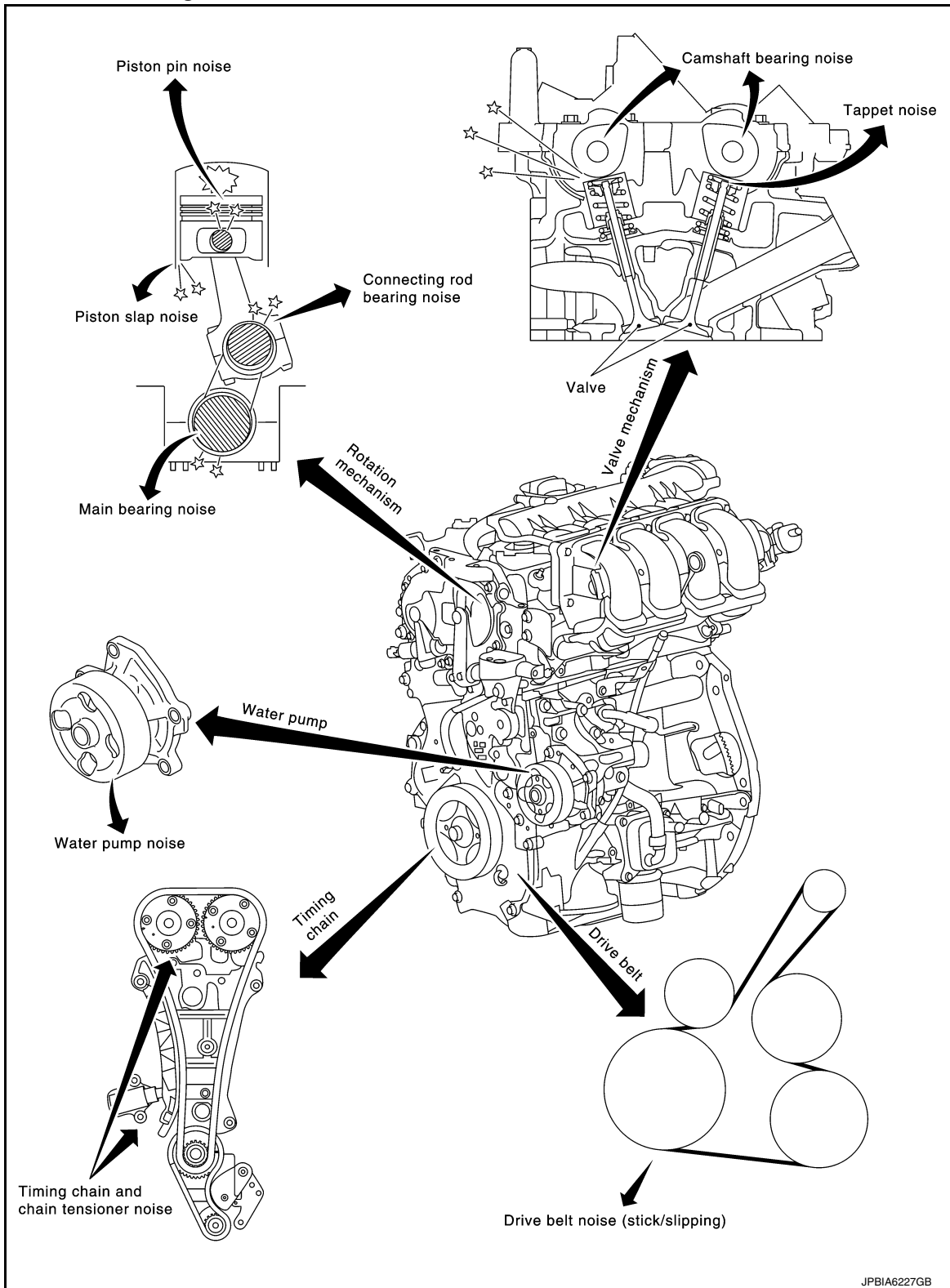
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**SYMPTOM DIAGNOSIS**

**NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING**

**NVH troubleshooting Chart**

INFOID:000000009756935



JPBIA6227GB

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

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[MRA8DE]

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-20</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	<a href="#">EM-119</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-123</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-123</a>
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	<a href="#">EM-123</a> <a href="#">EM-127</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-127</a> <a href="#">EM-123</a>
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	<a href="#">EM-58</a> <a href="#">EM-48</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	<a href="#">EM-15</a>
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	<a href="#">CO-19</a>

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

# SPARK PLUG

< PERIODIC MAINTENANCE >

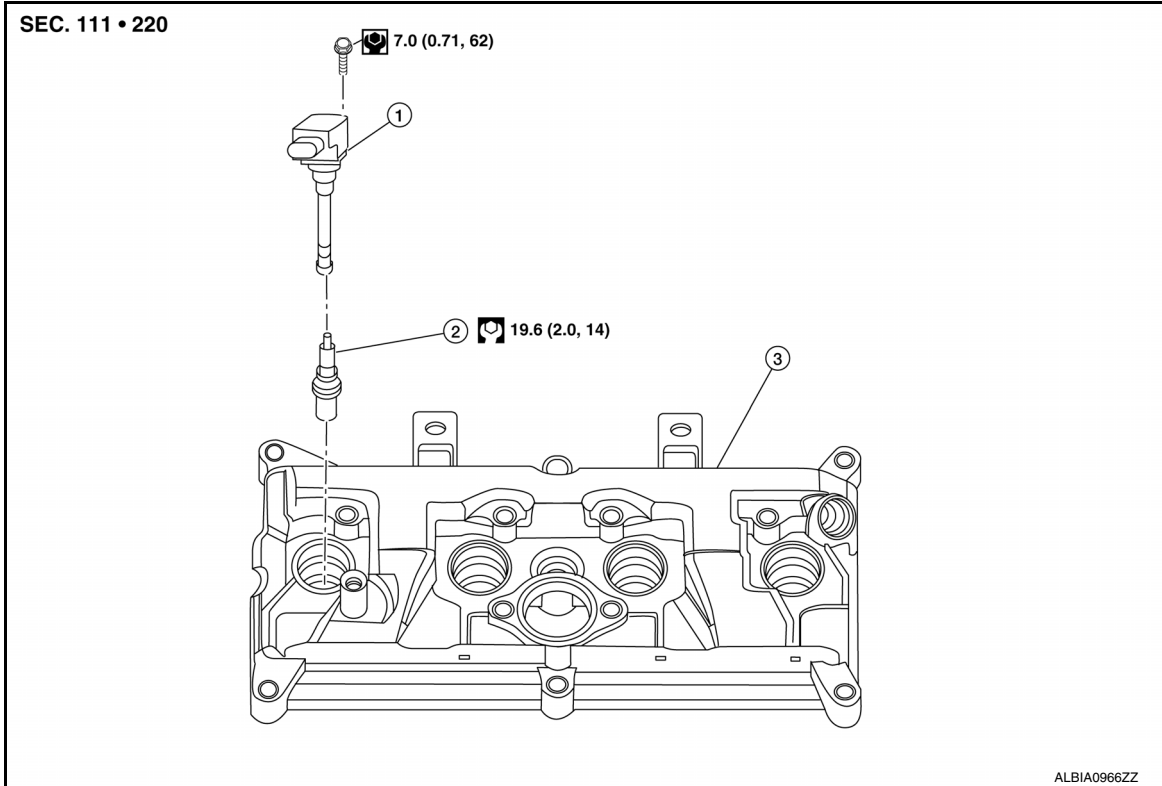
[MRA8DE]

## PERIODIC MAINTENANCE

### SPARK PLUG

#### Exploded View

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1. Ignition coil

2. Spark plug

3. Rocker cover

### Removal and Installation

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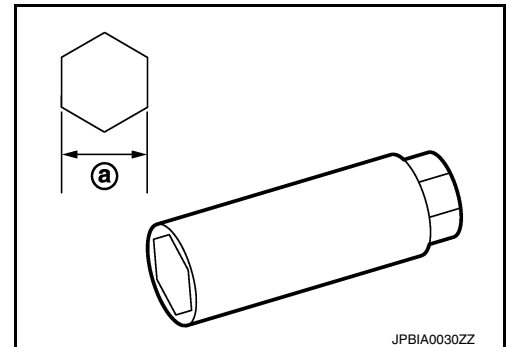
#### REMOVAL

1. Remove engine cover. Refer to [EM-24, "Exploded View"](#).
2. Remove ignition coil. Refer to [EM-46, "Exploded View"](#).
3. Remove spark plug using suitable tool.

(a) : 14 mm (0.55 in)

#### CAUTION:

Do not drop or shock spark plug.



#### INSTALLATION

Installation is in the reverse order of removal.

# SPARK PLUG

< PERIODIC MAINTENANCE >

[MRA8DE]

Standard type*	DENSO
	PLZKAR6A-11 (except California) DILKAR6A-11 (California)
Gap (nominal)	1.1 mm (0.043 in)

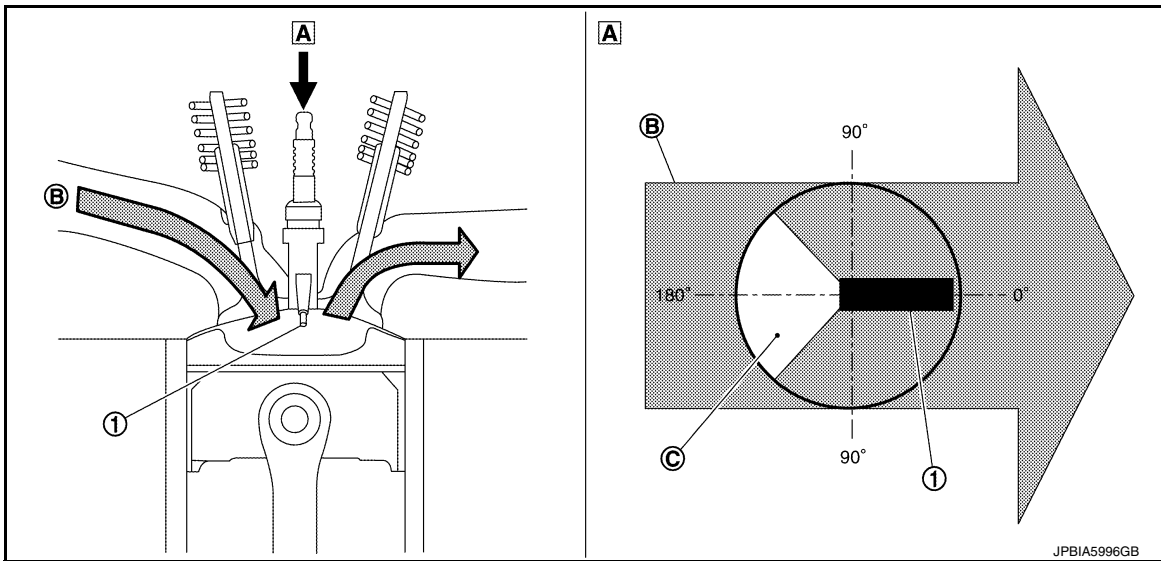
\*: Always check with the Parts Department for the latest parts information.

**CAUTION:**

Always tighten the spark plug to specified torque to align the orientation of electrodes. The ground electrode of a genuine spark plug is positioned in the area of maximum ignitability by tightening to the specified torque. When replacing spark plugs, use genuine spark plugs of which the ground electrode is adjusted.

**NOTE:**

The ground electrode of the spark plug is positioned in the area of maximum ignitability to improve combustion efficiency in the cylinder, reduce CO<sub>2</sub> (carbon dioxide) emission and improve fuel economy.



1. Ground electrode of spark plug      A. Top view  
C. Poor ignitability region

B. Air-fuel mixture flow

## Inspection

INFOID:000000009756938

### INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

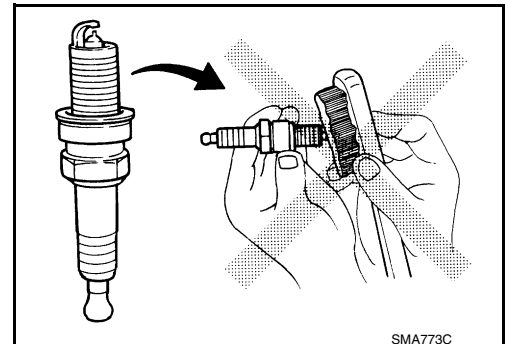
Spark plug (Standard type) : Refer to [EM-118, "Spark Plug"](#).

**CAUTION:**

- Do not drop or shock spark plug.
- Do not use a 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



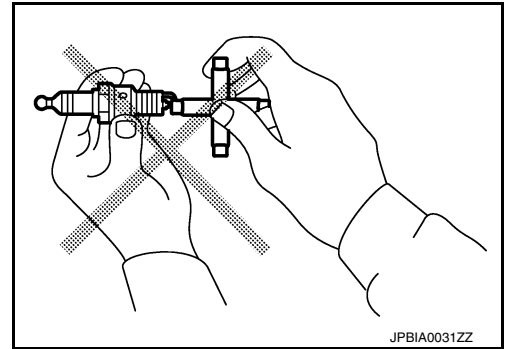
SMA773C

## SPARK PLUG

[MRA8DE]

< PERIODIC MAINTENANCE >

- Spark plug gap adjustment is not required between replacement intervals.
- Measure spark plug gap. when it exceeds the limit, replace spark plug even if it is with in the specified replacement mileage. Refer to [EM-118, "Spark Plug"](#).



# DRIVE BELT

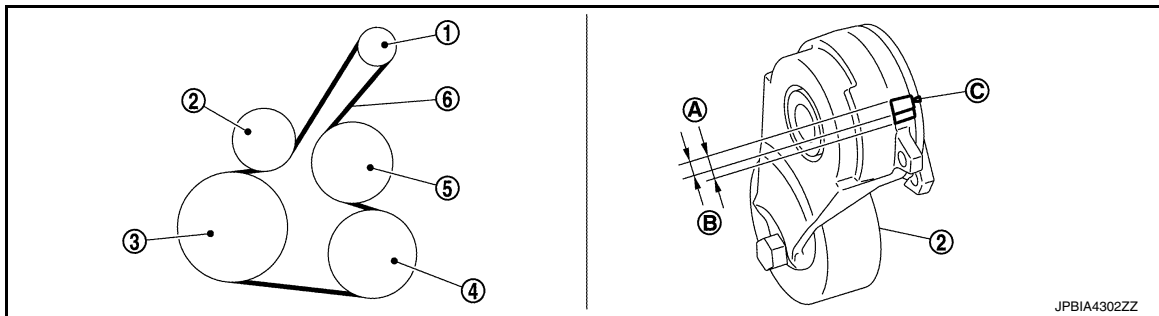
< PERIODIC MAINTENANCE >

[MRA8DE]

## DRIVE BELT

### Exploded View

INFOID:000000009756939



- |                       |                              |                      |
|-----------------------|------------------------------|----------------------|
| 1. Alternator         | 2. Drive belt auto-tensioner | 3. Crankshaft pulley |
| 4. A/C compressor     | 5. Water pump                | 6. Drive belt        |
| A. Possible use range | B. New drive belt range      | C. Indicator         |

### Removal and Installation

INFOID:000000009756940

#### REMOVAL

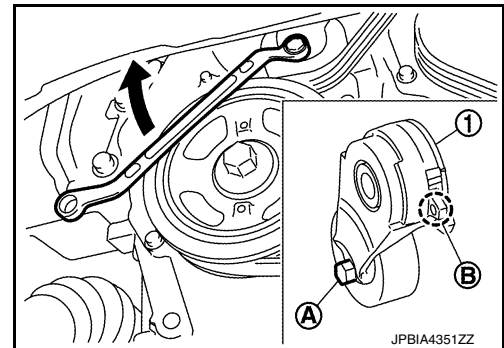
1. Remove the front fender protector (RH) front side bolts and clips. Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).

2. Hold the hexagonal part (A) of drive belt auto-tensioner (1) with a wrench securely. Then move the wrench handle in the direction of arrow (loosening direction of drive belt auto-tensioner).

**WARNING:**

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

3. Insert a rod approximately 6 mm (0.24 in) in diameter into the hole (B) of the retaining boss to lock drive belt auto-tensioner.
  - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.
4. Remove drive belt.



#### INSTALLATION

1. Install drive belt.

**CAUTION:**

- Confirm drive belt is completely set to pulleys.
- Check for engine oil and engine coolant, be sure they are not adhered to drive belt and each pulley groove.

2. Release drive belt auto-tensioner, and apply tension to drive belt.

**WARNING:**

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

3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to [EM-15, "Exploded View"](#).
5. Install the front fender protector (RH) front side bolts and clips. Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).

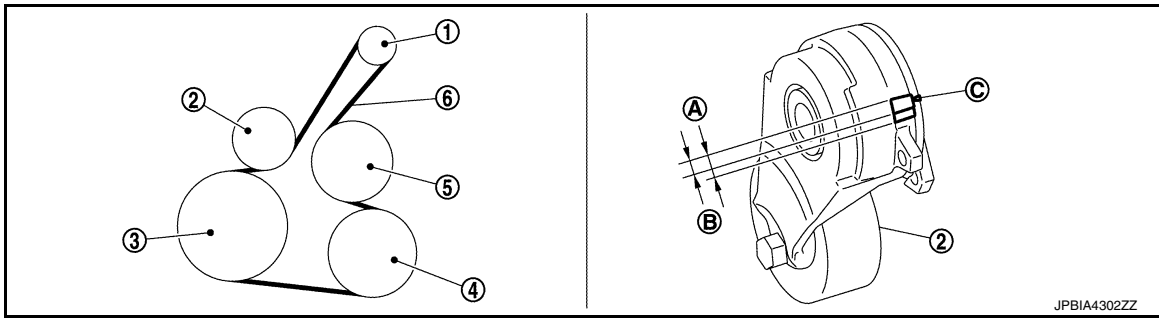
# DRIVE BELT

< PERIODIC MAINTENANCE >

[MRA8DE]

## Inspection

INFOID:000000009756941



JPBIA4302ZZ

- |                       |                              |                      |
|-----------------------|------------------------------|----------------------|
| 1. Alternator         | 2. Drive belt auto-tensioner | 3. Crankshaft pulley |
| 4. A/C compressor     | 5. Water pump                | 6. Drive belt        |
| A. Possible use range | B. New drive belt range      | C. Indicator         |

### WARNING:

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

- Check that the indicator of drive belt auto-tensioner is within the possible use range.

### NOTE:

- Check the drive belt auto-tensioner indication when the engine is cold.
- When new drive belt is installed, the indicator should be within the new drive belt range.
- Visually check entire drive belt for wear, damage or cracks.
- If the indicator is out of the possible use range or belt is damaged, replace drive belt.

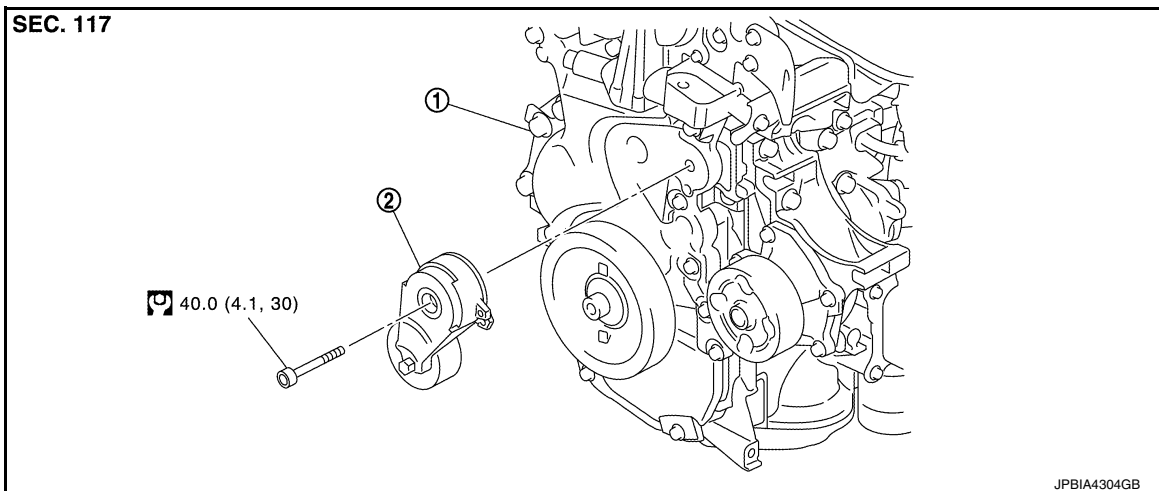
## Adjustment

INFOID:000000009756942

Belt tension is not necessary, as it is automatically adjusted by drive belt auto-tensioner.

## Exploded View

INFOID:000000009756943



JPBIA4304GB

- |                |                              |
|----------------|------------------------------|
| 1. Front cover | 2. Drive belt auto-tensioner |
|----------------|------------------------------|

## Removal and Installation

INFOID:000000009756944

### Removal

1. Remove engine under cover. Refer to [EXT-31, "ENGINE UNDER COVER : Exploded View"](#).
2. Remove engine room cover. Refer to [EM-24, "Exploded View"](#).
3. Partially remove fender protector side cover (RH). Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).



## DRIVE BELT

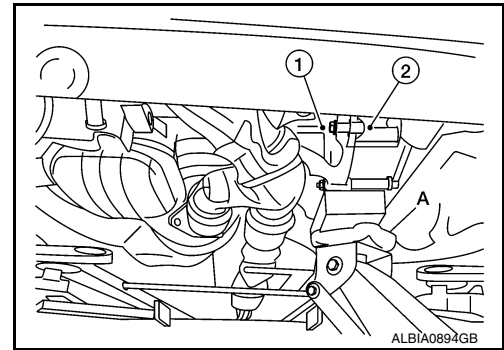
[MRA8DE]

### < PERIODIC MAINTENANCE >

4. Remove drive belt. Refer to [EM-15. "Exploded View"](#).
5. Support engine (1) and transaxle (2) using suitable jack (A).

**CAUTION:**

- Position a suitable jack under the engine and transaxle assembly as shown.
- Do not damage the front exhaust tube or transaxle oil pan with the jack.



6. Remove upper torque rod and engine mounting insulator (RH). Refer to [EM-82. "M/T : Exploded View"](#) (for M/T) or [EM-86. "CVT : Exploded View"](#) (for CVT).
7. Remove drive belt auto-tensioner.

### Installation

Installation is in the reverse order of removal.

**CAUTION:**

**When installing drive belt auto-tensioner, be careful not to interfere with water pump pulley.**

# AIR CLEANER FILTER

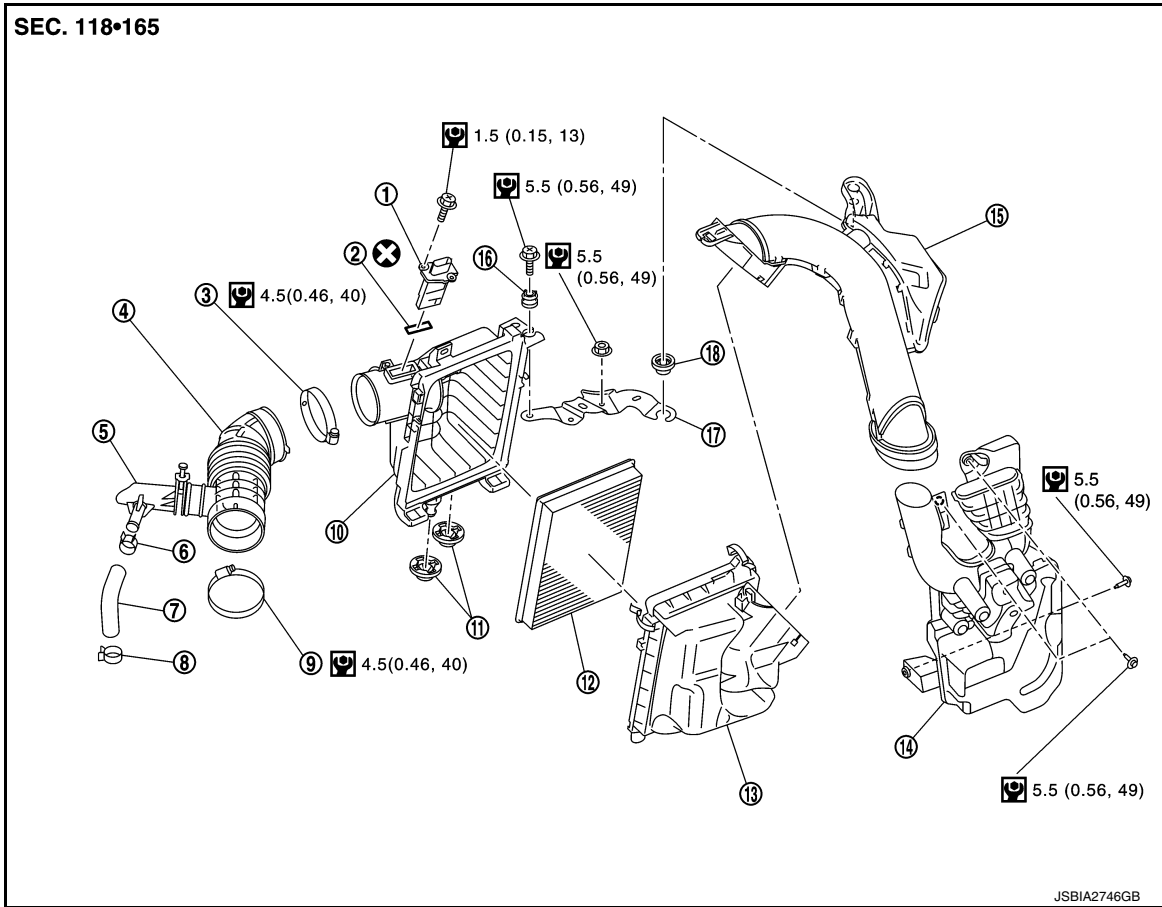
< PERIODIC MAINTENANCE >

[MRA8DE]

## AIR CLEANER FILTER

### Exploded View

INFOID:000000009756945



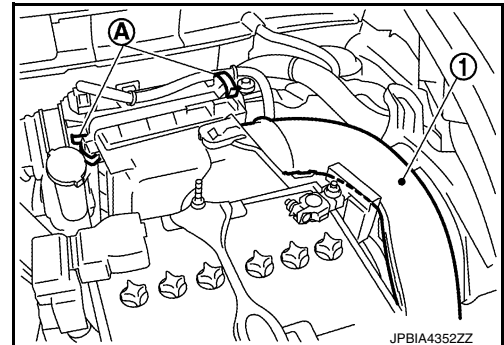
- |                            |                            |                            |
|----------------------------|----------------------------|----------------------------|
| 1. Mass air flow sensor    | 2. Mass air flow gasket    | 3. Clamp                   |
| 4. Air duct (suction side) | 5. Resonator               | 6. Clamp                   |
| 7. PCV hose                | 8. Clamp                   | 9. Clamp                   |
| 10. Air cleaner cover      | 11. Mounting rubber        | 12. Air cleaner filter     |
| 13. Air cleaner body       | 14. Air duct inlet (lower) | 15. Air duct inlet (upper) |
| 16. Grommet                | 17. Bracket                | 18. Grommet                |

### Removal and Installation

INFOID:000000009756946

#### REMOVAL

1. Remove air duct inlet (upper) (1).
2. Unhook the tabs (A) of both ends of the air cleaner cover.

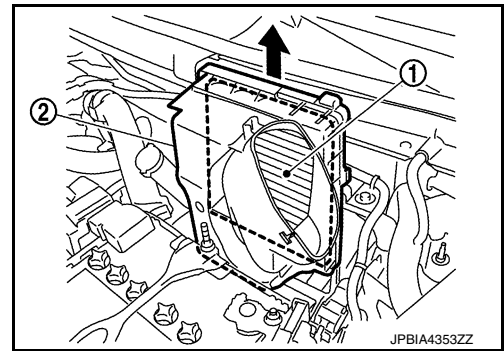


# AIR CLEANER FILTER

[MRA8DE]

## < PERIODIC MAINTENANCE >

3. Remove the air cleaner filter (1) and air cleaner body (2) from the air cleaner cover.
4. Remove the air cleaner filter from the air cleaner body.



## INSTALLATION

Installation is in the reverse order of removal.

- Tabs shall be fixed after inserting air cleaner body protrusion to air cleaner case notch hole.
- Make sure that whether air cleaner body has been firmly installed by shaking it.

## Inspection

INFOID:000000009756947

## INSPECTION AFTER REMOVAL

Examine the air cleaner filter for stains, clogging, or damage.

- Remove dirt and foreign objects (such as dead leaves) on air cleaner filter surface and inside air cleaner cover and air cleaner body.
- If clogging or damage is observed, replace the air cleaner filter.

### **CAUTION:**

**Do not clean the viscous paper type air cleaner filter by blowing as there is risk of deterioration of its performance.**

# CAMSHAFT VALVE CLEARANCE

[MRA8DE]

< PERIODIC MAINTENANCE >

## CAMSHAFT VALVE CLEARANCE

### Inspection and Adjustment

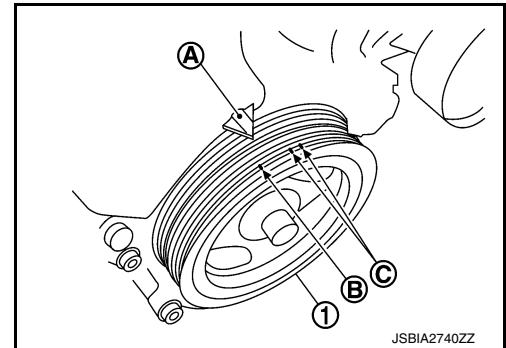
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#### INSPECTION

Perform inspection after removal, installation or replacement of camshaft or valve-related parts, or if there are unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to [EM-46, "Exploded View"](#).
2. Measure the valve clearance with the following procedure:
  - a. Set No. 1 cylinder at TDC of its compression stroke.
    - Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

(C) : White paint mark (Not used for service)



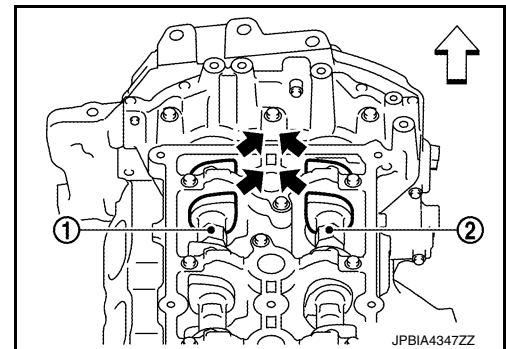
- At this time, check that both intake and exhaust cam lobes of No. 1 cylinder face inside (←) as shown.

(1) : Camshaft (INT)

(2) : Camshaft (EXH)

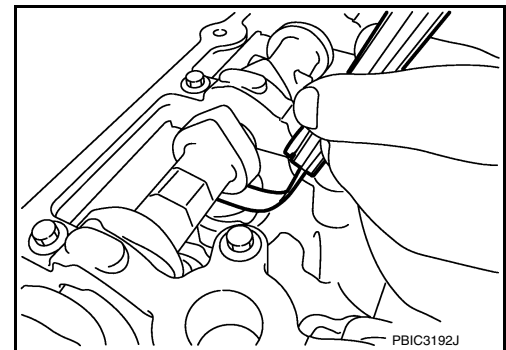
↔ : Engine front

- If they do not face inside, rotate crankshaft pulley once more (360 degrees) and align as shown.



- b. Measure the clearance between valve lifter and camshaft using suitable tool as shown.

**Valve clearance** : Refer to [EM-119, "Camshaft"](#).



- Measure the valve clearances at locations marked "x" [locations indicated with black arrow (←)] as shown using suitable tool.

(A) : Exhaust side

(B) : Intake side

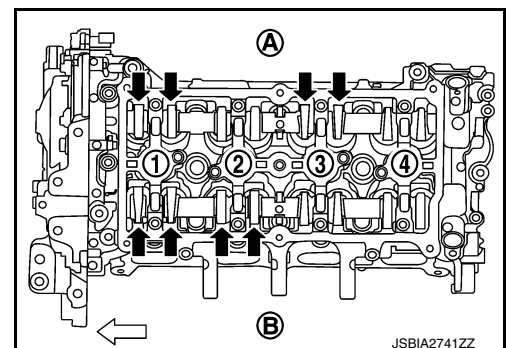
(1) : No. 1 cylinder

(2) : No. 2 cylinder

(3) : No. 3 cylinder

(4) : No. 4 cylinder

↔ : Engine front



# CAMSHAFT VALVE CLEARANCE

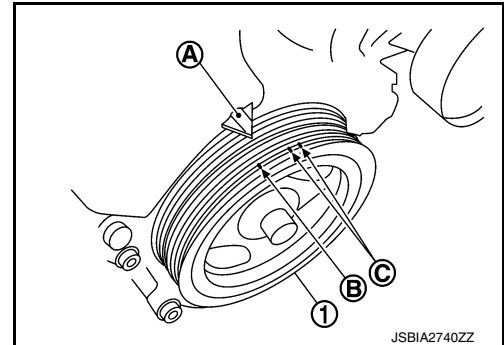
[MRA8DE]

< PERIODIC MAINTENANCE >

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

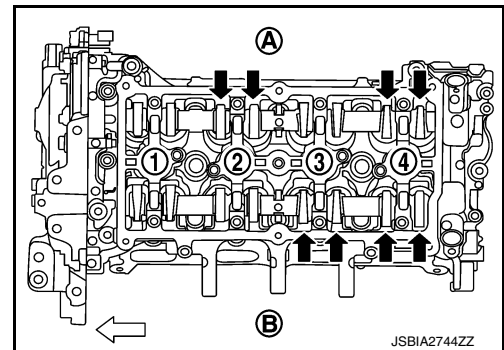
- c. Set No. 4 cylinder at TDC of its compression stroke.
- Rotate crankshaft pulley (1) one revolution (360 degrees) and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

(C) : White paint mark (Not used for service)



- Measure the valve clearance at locations marked “×” [locations indicated with black arrow (↖)] as shown using suitable tool.

- (A) : Exhaust side
- (B) : Intake side
- (1) : No. 1 cylinder
- (2) : No. 2 cylinder
- (3) : No. 3 cylinder
- (4) : No. 4 cylinder
- ↖ : Engine front

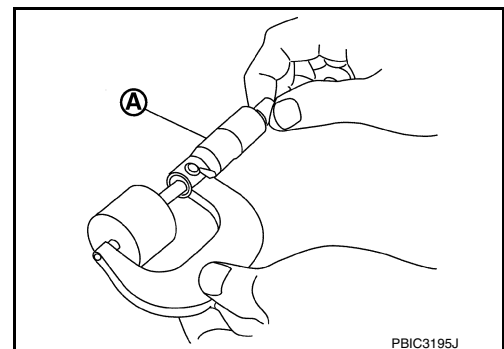


Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	EXH		×		×
	INT			×	×

3. If out of standard, perform adjustment. Refer to “ADJUSTMENT”.

## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
- Remove camshaft. Refer to [EM-60. "Exploded View"](#).
  - Remove valve lifters at the locations that are out of the standard.
  - Measure the center thickness of the removed valve lifters using suitable tool (A).



4. 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**

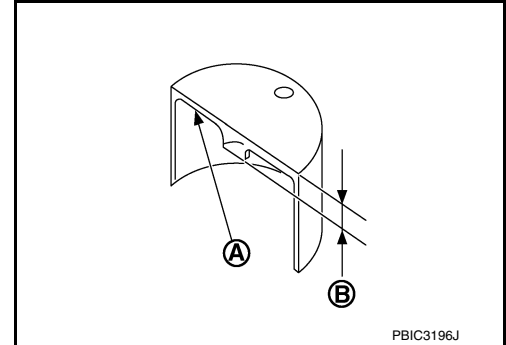
# CAMSHAFT VALVE CLEARANCE

[MRA8DE]

< PERIODIC MAINTENANCE >

- t<sub>1</sub>** = Removed valve lifter thickness
- C<sub>1</sub>** = Measured valve clearance
- C<sub>2</sub>** = Standard valve clearance:
  - Intake** : 0.29 mm (0.011 in)
  - Exhaust** : 0.32 mm (0.013 in)

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
- Stamp mark "302" indicates 3.02 mm (0.1189 in) in thickness.



## NOTE:

Available thickness of valve lifter: 26 sizes range 3.00-3.50 mm (0.1181-0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-119, "Camshaft"](#).

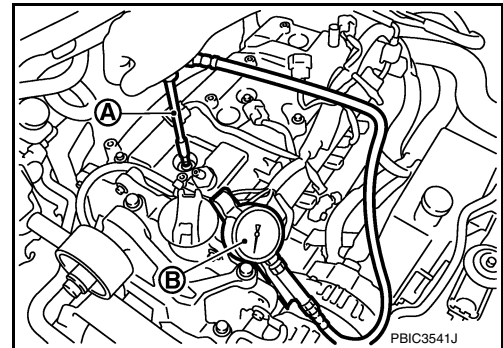
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-60, "Exploded View"](#).
7. Install timing chain and related parts. Refer to [EM-48, "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances are within the standard. Refer to "INSPECTION".
10. Installation of remaining components is in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

## COMPRESSION PRESSURE

### Inspection

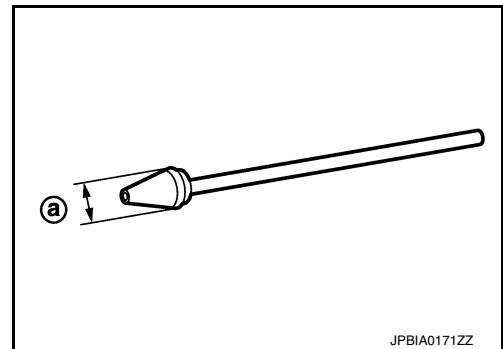
INFOID:000000009756949

1. Warm up the engine to full operating temperature.
2. Release fuel pressure. Refer to [EC-143, "Work Procedure"](#).
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-46, "Exploded View"](#).
4. Connect engine tachometer (not required in use of CONSULT).
5. Install compression gauge (B) with an adapter (A) into spark plug hole.



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

(a) : 20 mm (0.79 in) or less



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

**Compression pressure** : Refer to [EM-118, "General Specification"](#).

**CAUTION:**

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

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the 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, and cylinder head gasket). After checking, measure compression pressure again.
  - If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to recheck it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
  - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
7. After inspection is completed, install removed parts.
  8. Start the engine, and check that the engine runs smoothly.
  9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-55, "Diagnosis Description"](#).

# ENGINE ROOM COVER

< REMOVAL AND INSTALLATION >

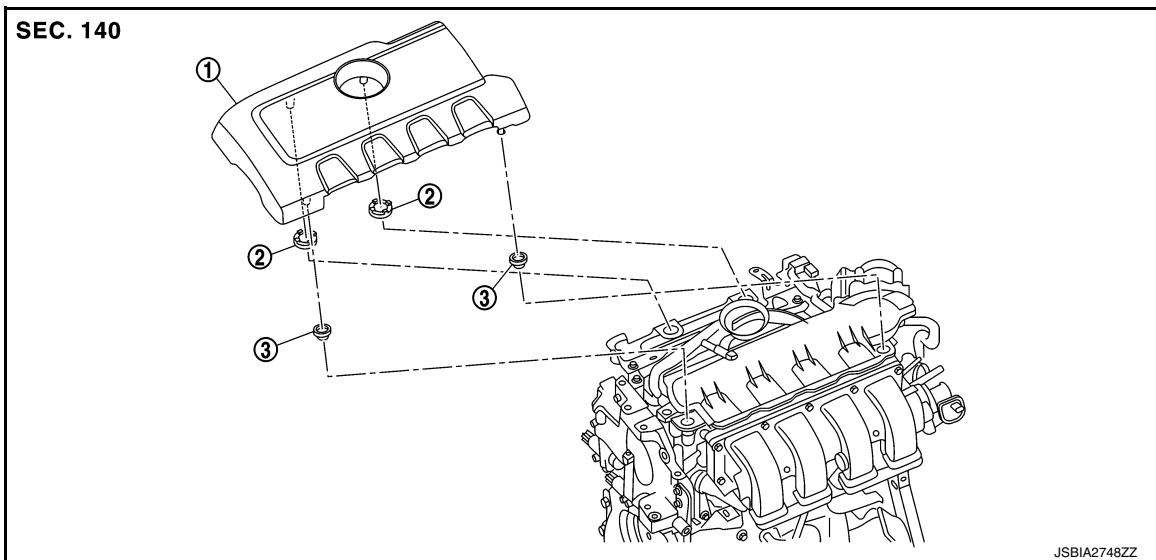
[MRA8DE]

## REMOVAL AND INSTALLATION

### ENGINE ROOM COVER

Exploded View

INFOID:000000009756950



1. Engine room cover

2. Mounting rubber (Black)

3. Mounting rubber (Gray)

### Removal and Installation

INFOID:000000009756951

#### REMOVAL

##### **CAUTION:**

**Do not damage or scratch engine room cover when installing or removing.**  
Remove engine room cover by pulling straight up to release mounting rubber.

#### INSTALLATION

Installation is in the reverse order of removal.



# AIR CLEANER AND AIR DUCT

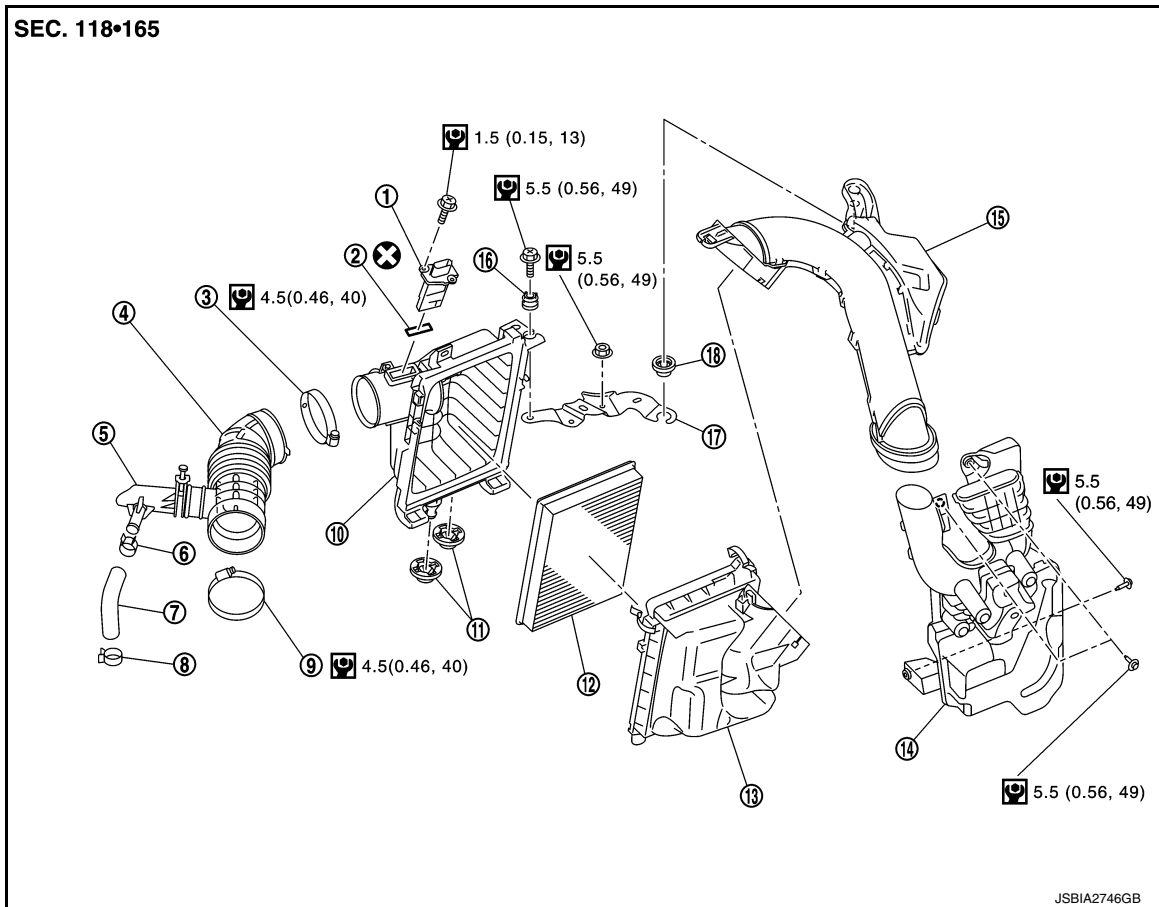
< REMOVAL AND INSTALLATION >

[MRA8DE]

## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:000000009756952



- |                            |                            |                            |
|----------------------------|----------------------------|----------------------------|
| 1. Mass air flow sensor    | 2. Mass air flow gasket    | 3. Clamp                   |
| 4. Air duct (suction side) | 5. Resonator               | 6. Clamp                   |
| 7. PCV hose                | 8. Clamp                   | 9. Clamp                   |
| 10. Air cleaner cover      | 11. Mounting rubber        | 12. Air cleaner filter     |
| 13. Air cleaner body       | 14. Air duct inlet (lower) | 15. Air duct inlet (upper) |
| 16. Mounting rubber        | 17. Bracket                | 18. Grommet                |

### Removal and Installation

INFOID:000000009756953

#### REMOVAL

##### NOTE:

Mass air flow sensor is removable under the car-mounted condition.

1. Remove engine room cover. Refer to [EM-24, "Exploded View"](#).
2. Remove air duct inlet (upper).
3. Remove air cleaner filter from the air cleaner cover.
4. Disconnect mass air flow sensor harness connector, and remove harness clamp from air cleaner body assembly.
5. Disconnect PCV hose and transaxle breather hose.
6. Remove air cleaner body.
7. Remove air duct (suction side).
  - Add matching marks if necessary for easier installation.
8. Remove air cleaner cover.

# AIR CLEANER AND AIR DUCT

[MRA8DE]

## < REMOVAL AND INSTALLATION >

9. Remove mass air flow sensor from air cleaner cover, if necessary.

**CAUTION:**

**Handle the mass air flow sensor with following cares.**

- Do not shock the mass air flow sensor.
- Do not disassemble the mass air flow sensor.
- Do not touch the sensor of the mass air flow sensor.

10. Remove air duct inlet (lower) with the following procedure.

- a. Remove front combination lamp (LH). Refer to [EXL-119, "Exploded View"](#).
- b. Remove air duct inlet (lower).

## INSTALLATION

**CAUTION:**

**Do not reuse O-rings.**

Installation is in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.
- Tabs shall be fixed after inserting air cleaner body assembly protrusion to air cleaner case notch hole.
- Make sure whether air cleaner body has been firmly installed by shaking it.

## Inspection

INFOID:000000009756954

## INSPECTION AFTER REMOVAL

Inspect air duct (suction side), air duct inlet (upper), air duct inlet (lower) and resonator for crack or tear.

- If anything is found, replace air duct (suction side), air duct inlet (upper), air duct inlet (lower) and resonator.

# INTAKE MANIFOLD

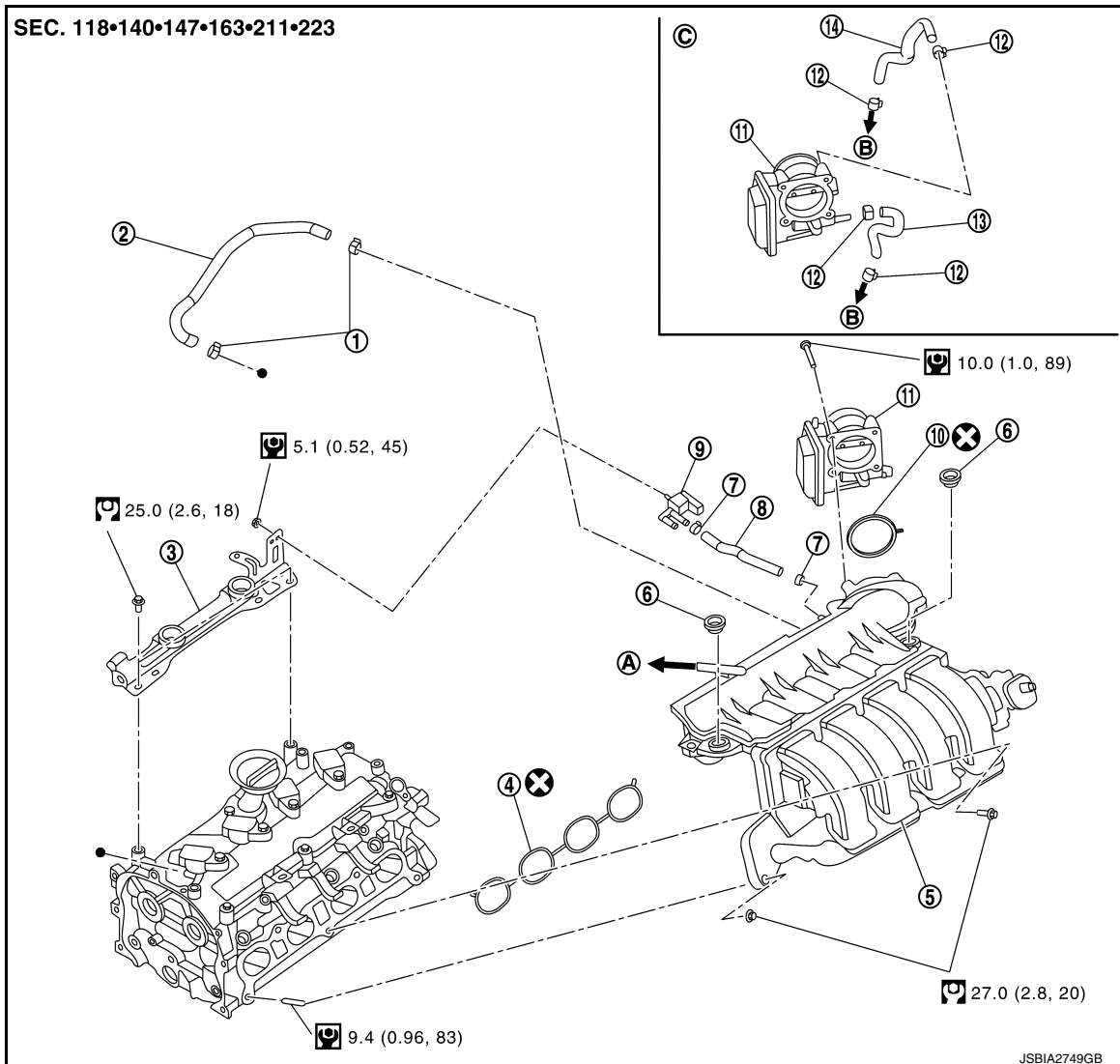
< REMOVAL AND INSTALLATION >

[MRA8DE]

## INTAKE MANIFOLD

### Exploded View

INFOID:000000009756955



- |   |   |  |
|---|---|--|
| 1. Clamp                                      | 2. PCV hose   | 3. Bracket   |
| 4. Intake manifold gasket                     | 5. Intake manifold                                  | 6. Mount rubber                                      |
| 7. Clamp                                      | 8. EVAP hose  | 9. EVAP canister purge volume control solenoid valve |
| 10. Electric throttle control actuator gasket | 11. Electric throttle control actuator              | 12. Clamp  |
| 13. Water hose                                | 14. Water hose                                      | A. To brake booster                                  |
| B. To water outlet                            | C. Electric throttle control actuator exploded view |  |

### Removal and Installation

INFOID:000000009756956

#### NOTE:

When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

#### REMOVAL

1. Remove engine room cover. Refer to [EM-46. "Exploded View"](#).

# INTAKE MANIFOLD

[MRA8DE]

## < REMOVAL AND INSTALLATION >

- Remove air cleaner body. Refer to [EM-25, "Exploded View"](#).
- Disconnect the radiator hose (upper) from the water outlet. Refer to [CO-15, "Exploded View"](#).
- Disconnect water hoses from electric throttle control actuator.
- Disconnect electric throttle control actuator harness connector.
- Remove electric throttle control actuator.  
**CAUTION:**
  - Handle carefully to avoid any shock to electric throttle control actuator.
  - Do not disassemble electric throttle control actuator.
- Pull out oil level gauge.  
**CAUTION:**  
Cover the oil level gauge guide openings to avoid entry of foreign materials.
- Disconnect vacuum hose and EVAP hose from intake manifold.
- Disconnect PCV hose from intake manifold.
- Disconnect harness connectors from the runner control valve, runner control valve position sensor, and the tuning valve.
- Loosen intake manifold nuts and bolts in the reverse order as shown.

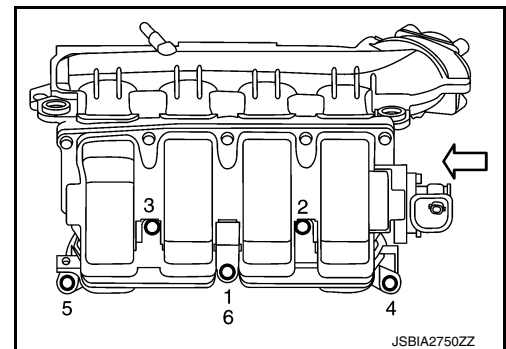
⇐ : Engine front

### NOTE:

Disregard the numerical order No.6 in removal.

### CAUTION:

Cover engine openings to avoid entry of foreign materials.



- Remove intake manifold and intake manifold gasket.

## INSTALLATION

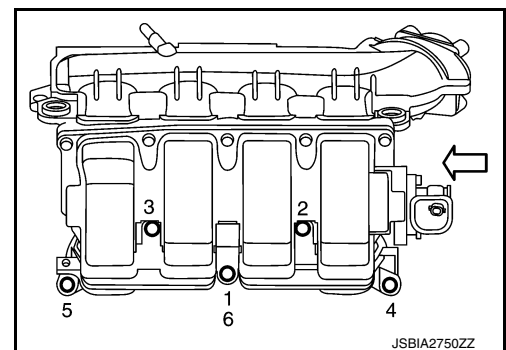
Installation is in the reverse order of removal.

### Intake Manifold

- Securely install intake manifold gasket to the mounting groove of the intake manifold.  
**CAUTION:**  
Do not reuse intake manifold gasket.
- Install intake manifold with the following procedure:
  - Tighten intake manifold nuts and bolts in the numerical order as shown.

⇐ : Engine front

- Tighten No. 1 bolt again.



- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.

### NOTE:

After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

- Perform "Throttle Valve Closed Position Learning" after repair when removing harness connector of the electric throttle control actuator. Refer to [EC-139, "Description"](#).
- Perform "Idle Air Volume Learning" after repair when replacing electric throttle control actuator. Refer to [EC-140, "Description"](#).

## INSPECTION AFTER INSTALLATION

# INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[MRA8DE]

Check for engine oil leaks and engine coolant leaks with engine at operating temperature and running at idle.

**WARNING:**

**Do not touch engine immediately after stopping as engine is extremely hot.**

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

# EXHAUST MANIFOLD

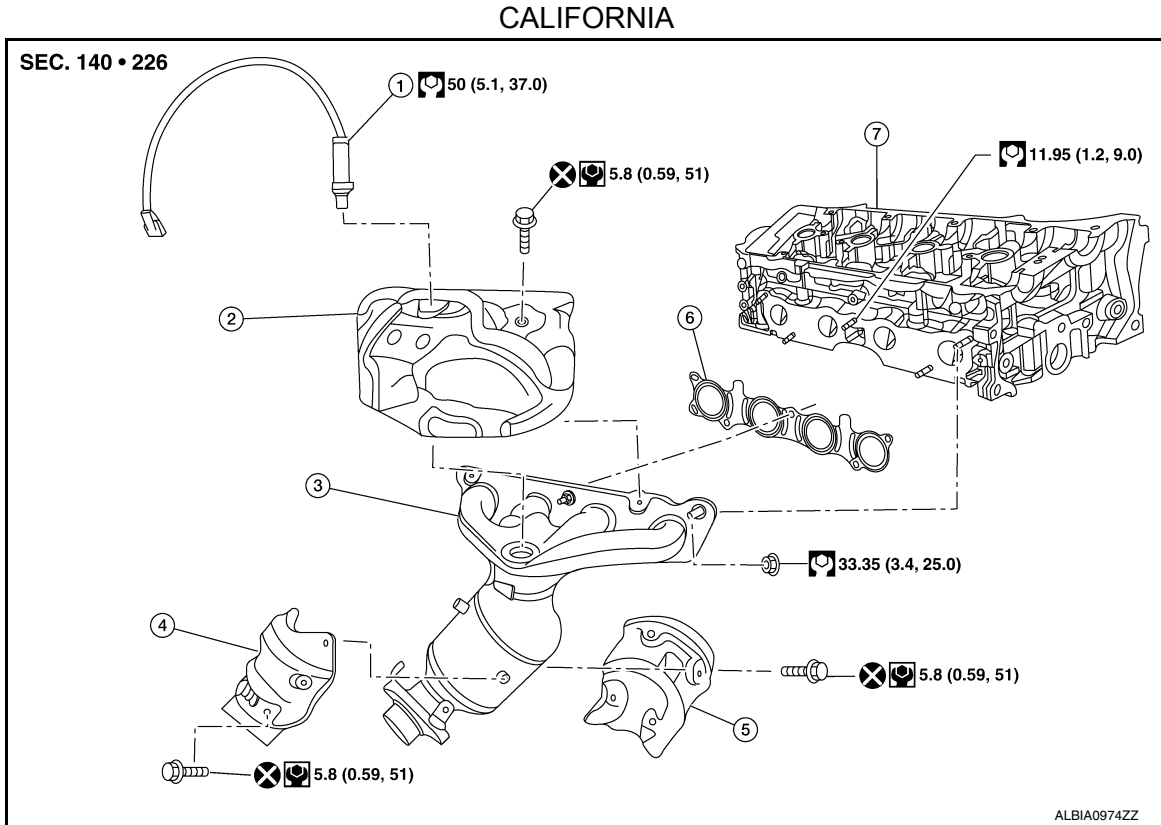
< REMOVAL AND INSTALLATION >

[MRA8DE]

## EXHAUST MANIFOLD

Exploded View

INFOID:000000009756957



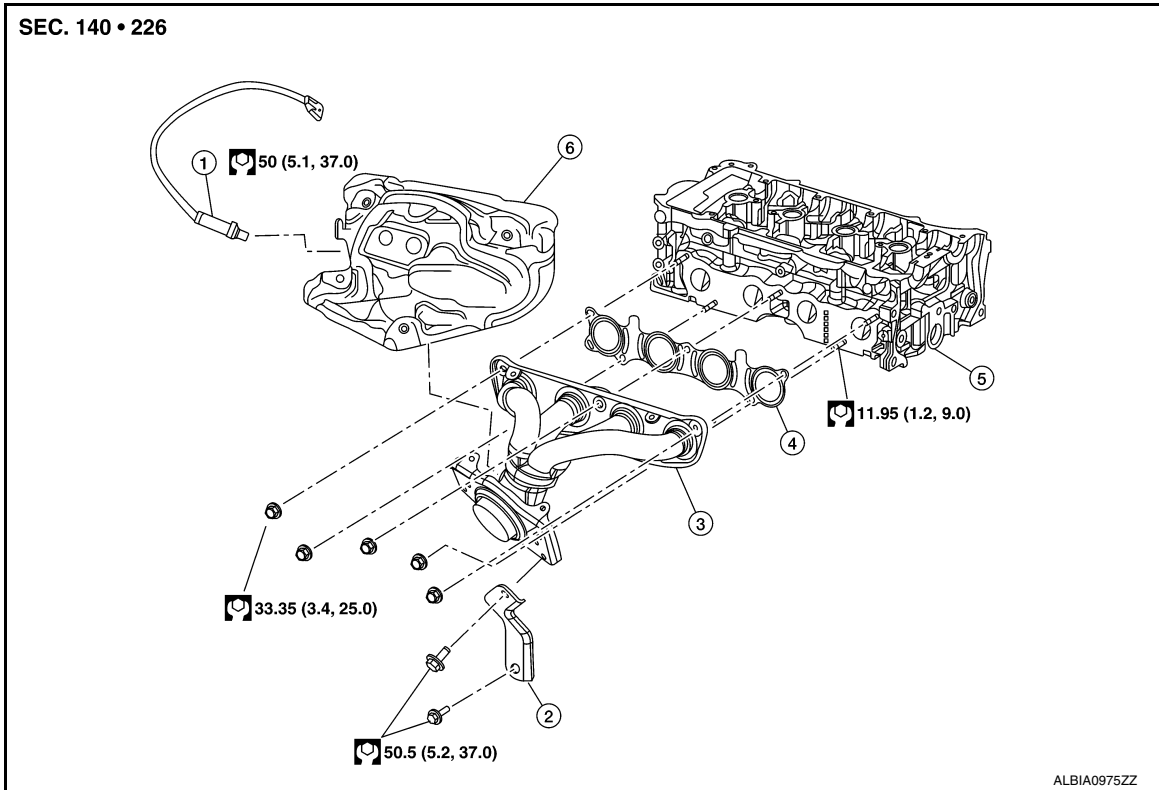
1. Air fuel ratio sensor
2. Exhaust manifold heat shield (upper)
3. Exhaust manifold and three way catalyst
4. Exhaust manifold heat shield (rear)
5. Exhaust manifold heat shield (front)
6. Exhaust manifold gasket
7. Cylinder head

# EXHAUST MANIFOLD

< REMOVAL AND INSTALLATION >

[MRA8DE]

EXCEPT CALIFORNIA



- |                            |                  |                                 |
|----------------------------|------------------|---------------------------------|
| 1. Air fuel ratio sensor   | 2. Bracket       | 3. Exhaust manifold             |
| 4. Exhaust manifold gasket | 5. Cylinder head | 6. Exhaust manifold heat shield |

## Removal and Installation

INFOID:000000009756958

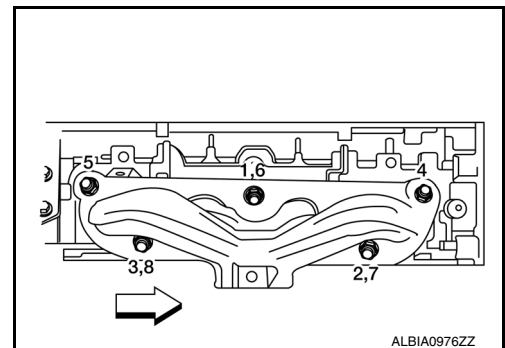
### REMOVAL

1. Remove the cowl top. Refer to [EXT-25. "Exploded View"](#).
2. Remove front exhaust tube. Refer to [EX-5. "Exploded View"](#).
3. Disconnect air fuel ratio sensor harness connector and remove air fuel ratio sensor if necessary.
4. Remove exhaust manifold cover.
5. Remove exhaust manifold.
  - Loosen nuts in reverse order as shown.

← : Engine front

#### NOTE:

Disregard the numerical order No. 6-8 in removal.



6. Remove exhaust manifold gasket.

#### CAUTION:

Cover engine openings to avoid entry of foreign materials.

### INSTALLATION

# EXHAUST MANIFOLD

[MRA8DE]

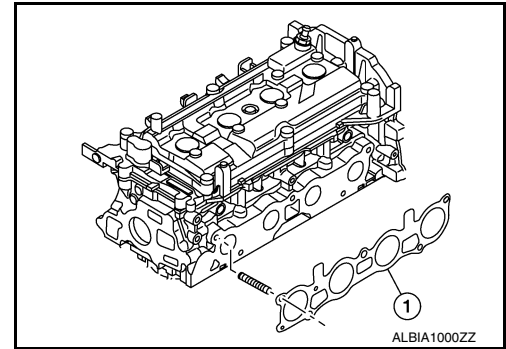
## < REMOVAL AND INSTALLATION >

1. Install exhaust manifold gasket (1) to cylinder head as shown.

↔ : Engine front

**CAUTION:**

**Do not reuse exhaust manifold gasket (1).**

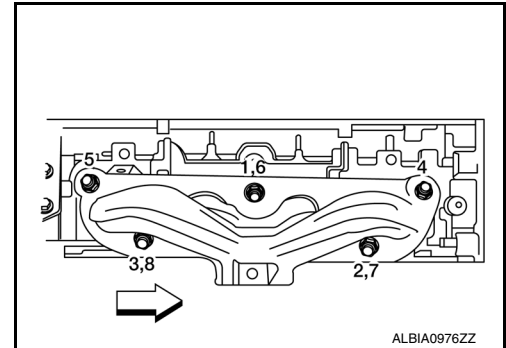


2. Install exhaust manifold with the following procedure:
  - a. Tighten nuts in numerical order as shown.

↔ : Engine front

**NOTE:**

- Tighten nuts the No.1-3 in two steps.
- The numerical order No.6-8 shows the second step.



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

## Inspection

INFOID:000000009756959

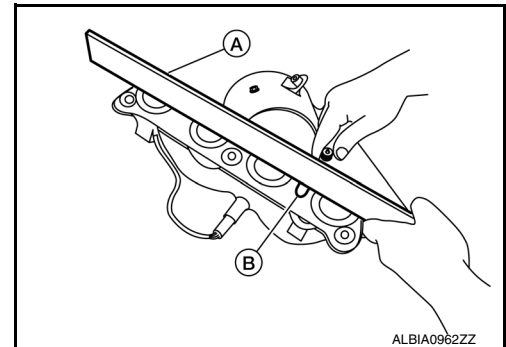
### INSPECTION AFTER REMOVAL

#### Surface Distortion

- Using feeler gauge (A) and straightedge (B), check the surface distortion of exhaust manifold mating surface in each exhaust port and entire part.

**Limit** : Refer to [EM-119, "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.





# OIL PAN

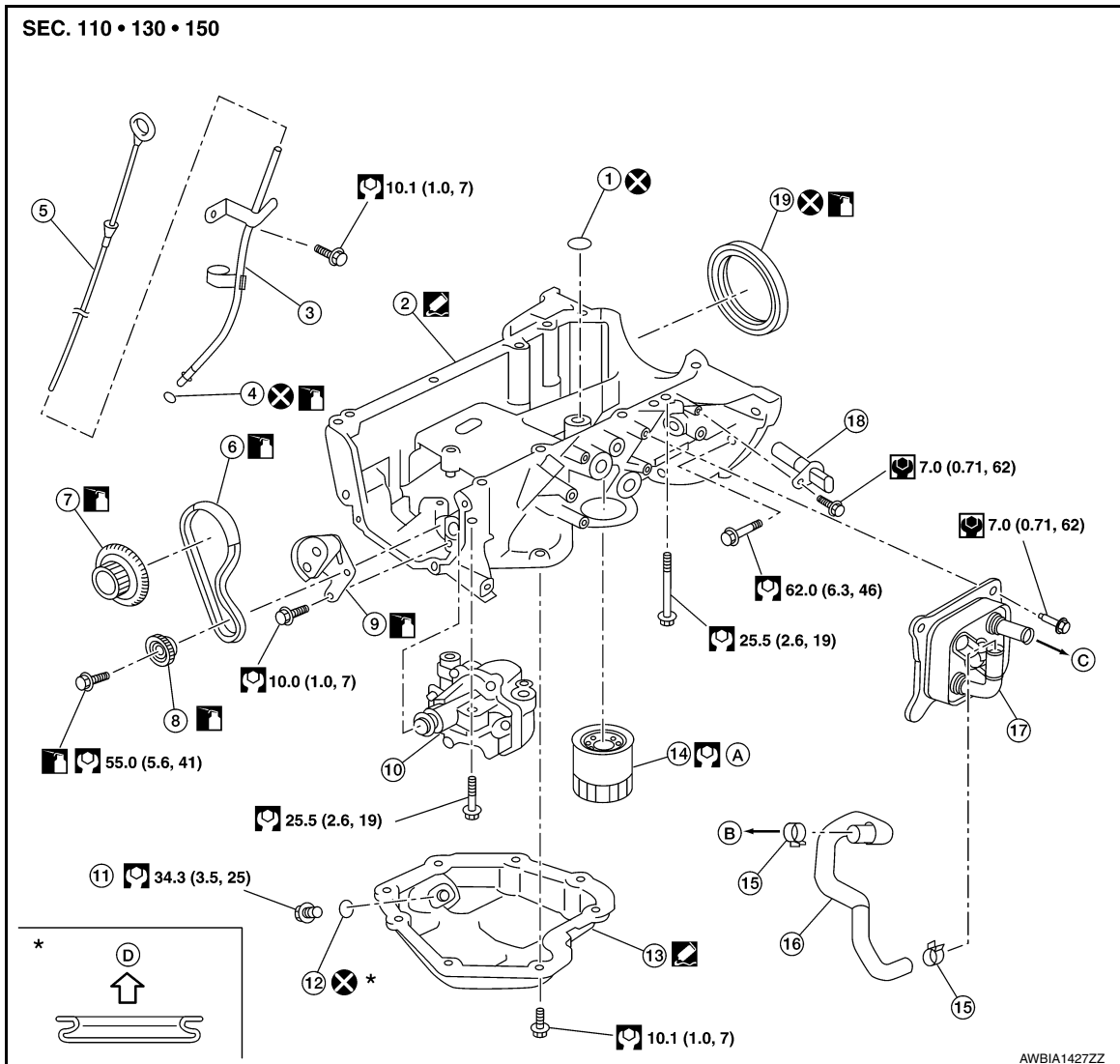
< REMOVAL AND INSTALLATION >

[MRA8DE]

## OIL PAN

### Exploded View

INFOID:000000009756960



- |   |                                   |                                |
|---|-----------------------------------|--------------------------------|
| 1. O-ring   | 2. Oil pan (upper)                | 3. Oil level gauge guide       |
| 4. O-ring   | 5. Oil level gauge                | 6. Oil pump drive chain        |
| 7. Crankshaft sprocket  | 8. Oil pump sprocket              | 9. Oil pump chain tensioner    |
| 10. Oil pump  | 11. Drain plug                    | 12. Drain plug washer          |
| 13. Oil pan (lower)   | 14. Oil filter                    | 15. Clamp                      |
| 16. Water hose  | 17. Oil cooler                    | 18. Crankshaft position sensor |
| 19. Rear oil seal   | A. Refer to <a href="#">LU-10</a> | B. To thermostat housing       |
| C. To thermostat housing (M/T models)<br>To CVT oil warmer (CVT models) | D. Oil pan side                   |                                |

### Removal and Installation (Lower Oil Pan)

INFOID:000000009756961

#### REMOVAL

1. Drain engine oil. Refer to [LU-8, "Draining"](#).

# OIL PAN

[MRA8DE]

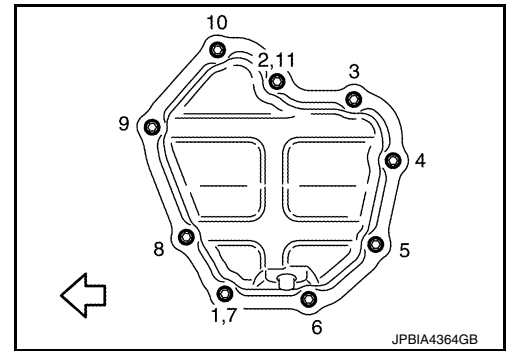
## < REMOVAL AND INSTALLATION >

2. Remove oil pan (lower) bolts in reverse order as shown.

⇐ : Engine front

### NOTE:

Disregard the numerical order No.7 and 11 in removal.



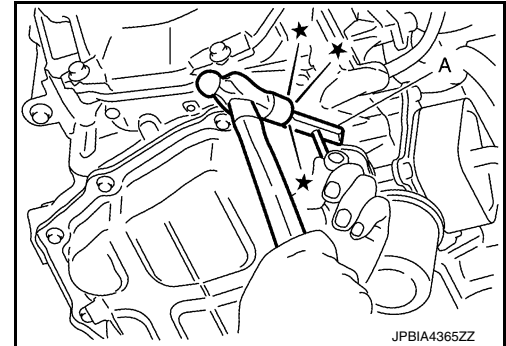
3. Insert Tool between oil pan (upper) and oil pan (lower).

### CAUTION:

- Do not damage the mating surface.
- Do not insert a screwdriver. This damages the mating surfaces.
- Slide Tool by tapping on the side of Tool (A) using a plastic hammer.

Tool number : KV10111100 (J-37228)

4. Remove oil pan (lower).



## INSTALLATION

### CAUTION:

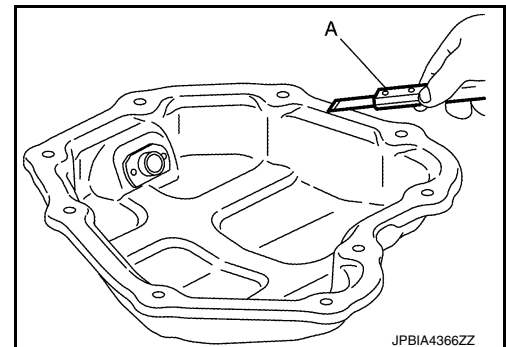
Do not reuse O-rings or washers.

1. Install oil pan (lower) as follows:

- a. Use a suitable tool (A) 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 threads.

### CAUTION:

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



# OIL PAN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

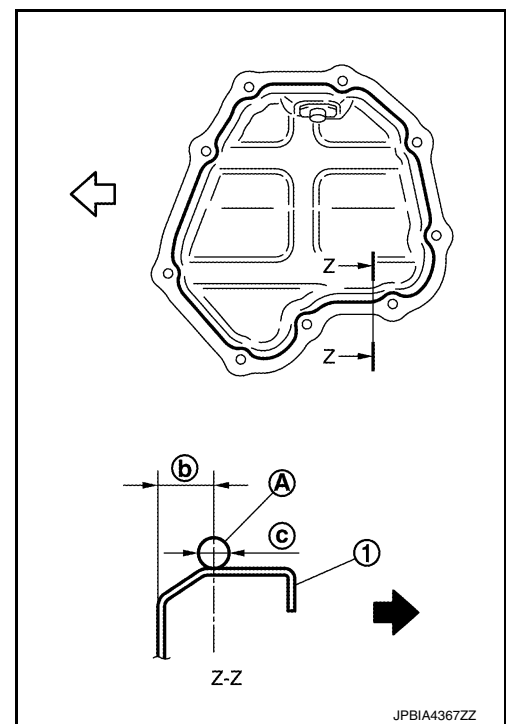
- b. Apply a continuous bead of liquid gasket (A) using suitable tool as shown as shown.

- (1) : Oil pan (lower)
- (b) : 7.5-9.5mm (0.295 - 0.374 in)
- (c) : 4.0 - 5.0 mm (0.157 - 0.197 in)
- ← : Engine outside
- ⇐ : Engine front

Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).

### CAUTION:

- Installation should be done within 5 minutes after applying liquid gasket.
- Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.

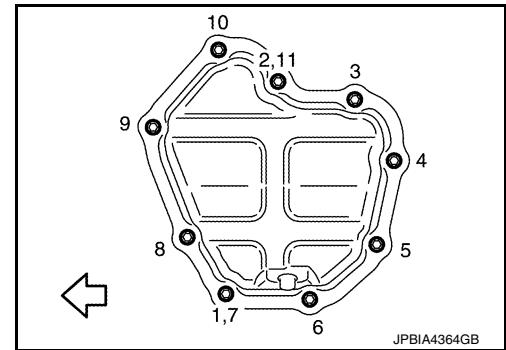


- c. Tighten bolts in numerical order as shown.

- ⇐ : Engine front

### NOTE:

- Tighten bolts the No.1 and 2 in two steps.
- The numerical order No.7 and 11 shows the second steps.



2. Install oil pan drain plug.

### CAUTION:

- Do not reuse drain plug washer.
- Refer to exploded view installation direction of drain plug washer. Refer to [EM-33, "Exploded View"](#).

3. Refill the engine with engine oil. Refer to [LU-9, "Refilling"](#).

## Inspection

INFOID:000000009756962

### INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

### INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-7, "Inspection"](#).
2. Start engine, and check for leaks of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-7, "Inspection"](#).

## Removal and Installation (Upper Oil Pan)

INFOID:000000009756963

### REMOVAL

1. Remove the engine and transaxle assembly. Refer to [EM-82, "M/T : Exploded View"](#) (M/T) or [EM-86, "CVT : Exploded View"](#) (CVT).

# OIL PAN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

2. Remove the clutch cover and clutch disc. Refer to [CL-17, "Exploded View"](#).
3. Remove the flywheel (M/T) or drive plate (CVT). Refer to [EM-90, "Exploded View"](#) (M/T) or [EM-92, "Exploded View"](#) (CVT).
4. Mount the engine on an engine stand. Refer to [EM-72, "Removal and Installation"](#).
5. Remove the generator and generator bracket. Refer to [CHG-29, "Exploded View"](#).
6. Remove oil pan (lower). Refer to [EM-33, "Removal and Installation \(Lower Oil Pan\)"](#).
7. Remove oil filter. Refer to [LU-10, "Removal and Installation"](#).
8. Remove timing chain. Refer to [EM-48, "Exploded View"](#).
9. Remove oil level gauge and oil level gauge guide.
10. Remove oil pump if necessary. Refer to [LU-12, "Exploded View"](#).

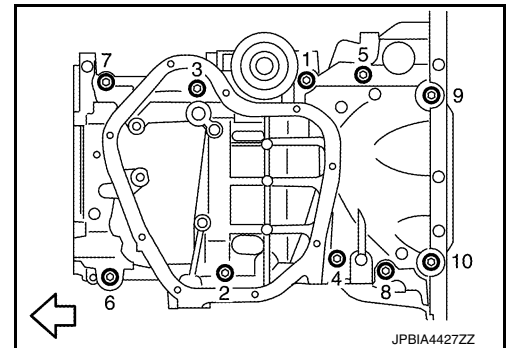
### NOTE:

The oil pan (upper) can be removed and installed without removing the oil pump.

11. Remove oil pan (upper) with the following procedure:

- a. Loosen bolts in reverse order as shown.

⇐ : Engine front

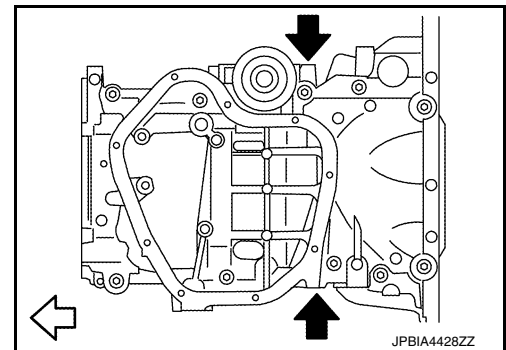


- b. Using suitable tool as shown by the arrow (⇐) open up a crack between oil pan (upper) and cylinder block.

⇐ : Engine front

### CAUTION:

Do not use suitable tool anywhere other than shown, sealant used is more adhesive than previous types when shipped.



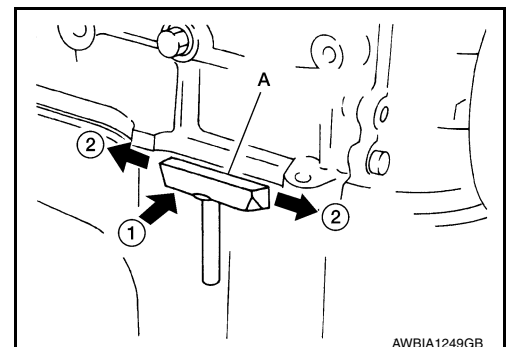
- c. Insert Tool (A) between oil pan (upper) and cylinder block.

Tool Number : KV10111100 (J-37228)

### CAUTION:

Do not damage the mating surface.

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.



12. Remove O-ring between cylinder block and oil pan (upper).

## INSTALLATION

### CAUTION:

Do not reuse O-rings or washers.

1. Install oil pan (upper) with the following procedure:

# OIL PAN

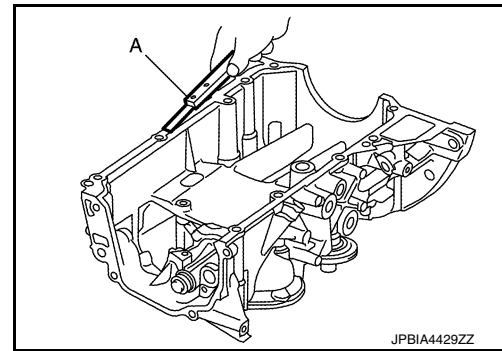
[MRA8DE]

## < REMOVAL AND INSTALLATION >

- a. Use a suitable tool (A) to remove old liquid gasket from mating surfaces.
- Remove the old liquid gasket from mating surface of 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. Apply a continuous bead of liquid gasket (D) using suitable tool as shown.

- (1) : Oil pan (upper)
- (A) : 2 mm (0.08 in) protruded to outside
- (B) : 2 mm (0.08 in) protruded to rear oil seal mounting side
- (c) : 5.5 - 7.5 mm (0.217 - 0.295 in)
- (e) : 4.0 - 5.0 mm (0.157 - 0.197 in)
- ← : Engine front
- ← : Engine outside

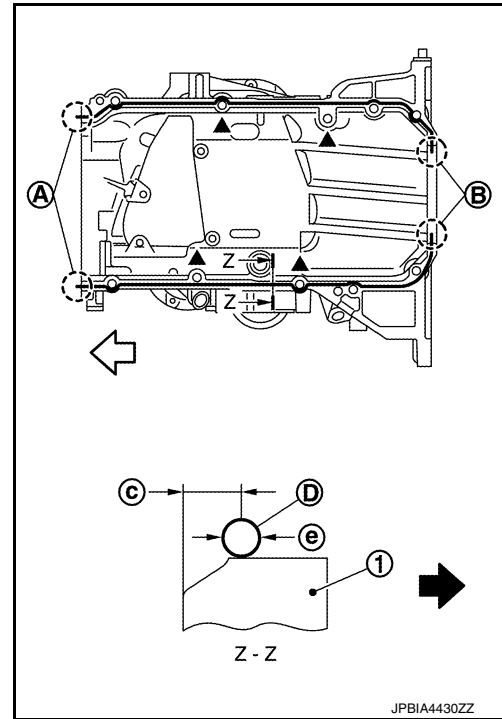
Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).

**CAUTION:**

- Installation should be done with 5 minutes after applying liquid gasket.
- Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.

**NOTE:**

Apply liquid gasket to the outside of bolt holes show by ▲ mark



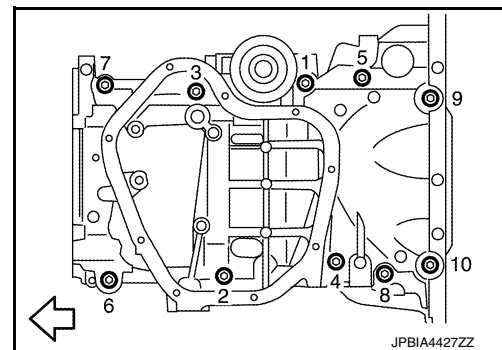
- c. Install new O-ring at cylinder block side.

**CAUTION:**

- Install avoiding misalignment of O-ring.
- Do not reuse O-ring.

- d. Tighten bolts in numerical order as shown.

- ← : Engine front



2. Install rear oil seal with the following procedure.

**CAUTION:**

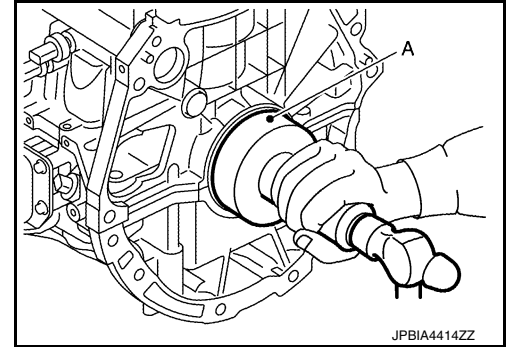
- The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
- Always replace rear oil seal with new one.
- Do not touch oil seal lip.
- Do not reuse rear oil seal.

# OIL PAN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

- a. Wipe off liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using suitable tool.
- b. Apply engine oil to entire outside area of rear oil seal.
- c. Press-fit the rear oil seal using a suitable drift (A) with outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in).



- Press-fit to the specified dimensions as shown.

(1) : Rear oil seal

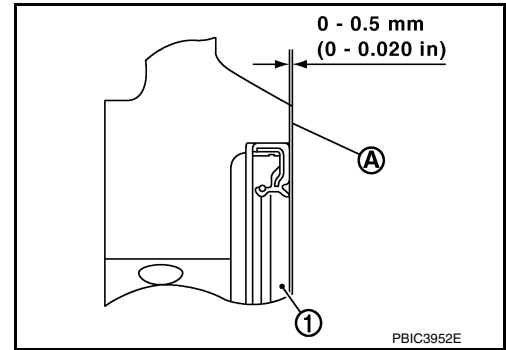
(A) : Cylinder block rear end surface

### CAUTION:

- Do not touch the grease applied to the oil seal lip.
- Be careful not to damage the rear oil seal mounting part of oil pan (upper) and cylinder block or the crankshaft.
- Press-fit straight, checking that rear oil seal does not curl or tilt.

### NOTE:

The standard surface of the dimension is the rear end surface of cylinder block.



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

## INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If there is less than required quantity, fill to the specified level. Refer to [MA-11, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to 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
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gas		—	Leakage	—

# OIL PAN

< REMOVAL AND INSTALLATION >

[MRA8DE]

\*Power steering fluid, brake fluid, etc.

## Inspection

INFOID:000000009756964

A

### INSPECTION AFTER REMOVAL

Clean oil strainer portion (part of the oil pump) if any object attached.

EM

C

D

E

F

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K

L

M

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O

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# FUEL INJECTOR AND FUEL TUBE

[MRA8DE]

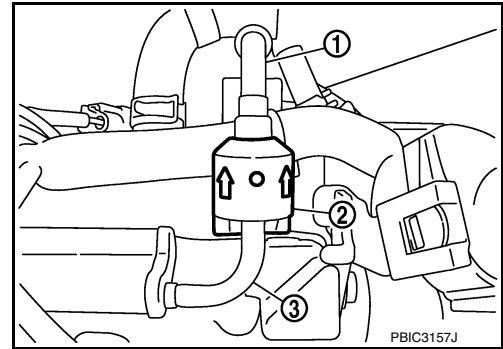
## < REMOVAL AND INSTALLATION >

4. Disconnect quick connector with the following procedure. Disconnect fuel feed tube (1) from fuel tube (3).

**NOTE:**

There is no fuel return path.

- a. Remove quick connector cap (engine side) (2) from quick connector connection.



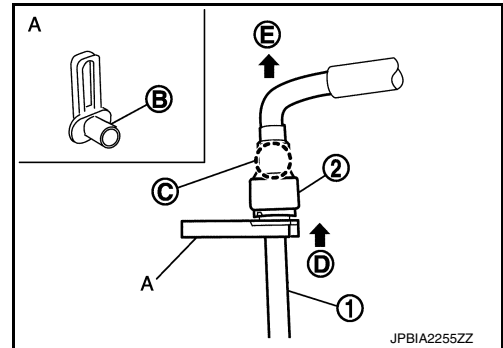
- b. With the sleeve (B) side of Tool (A) facing quick connector, install Tool (A) onto fuel tube.

- c. Insert Tool (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold quick connector release on that position (C).

(D) : Insert and retain

**CAUTION:**

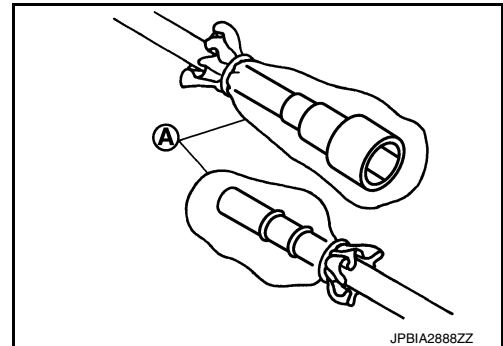
Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.



- d. Draw and pull out quick connector straight from fuel tube (1).

**CAUTION:**

- Pull quick connector (E) holding position (C).
- Do not pull with lateral force applied. O-ring inside quick connector 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 feed tube during installation/removal.
- To keep the connecting portion clean and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.



5. Disconnect harness connector from fuel injector.  
6. Loosen fuel tube bracket nuts and end bolts and remove fuel tube brackets.  
7. Remove fuel tube and fuel injector assembly.

# FUEL INJECTOR AND FUEL TUBE

[MRA8DE]

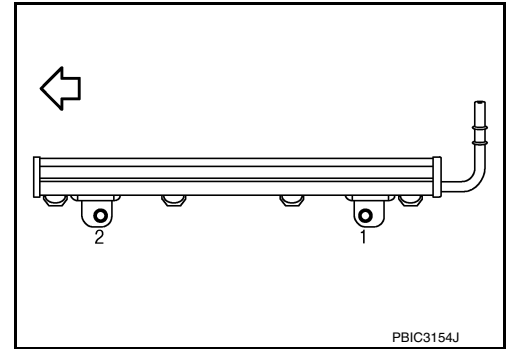
## < REMOVAL AND INSTALLATION >

- Loosen bolts in the reverse order as shown.

← : Engine front

### CAUTION:

- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leaks from fuel tube.

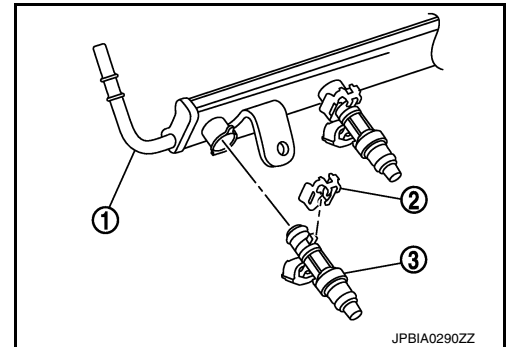


8. Remove fuel injector from fuel tube with the following procedure:

- a. Open and remove clip (2).
- b. Remove fuel injector (3) from fuel tube (1) by pulling straight.

### CAUTION:

- Be careful with remaining fuel that may leak from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Do not bump or drop fuel injector.
- Do not disassemble fuel injector.



## INSTALLATION

1. Install O-rings to fuel injector.

### CAUTION:

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

Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Do not wear gloves.
  - Lubricate O-ring with new engine oil.
  - Do not clean O-ring with solvent.
  - Check 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 is stretched while installing, do not insert it quickly into fuel tube.
  - Insert O-ring straight onto fuel injector. Do not decenter or twist it.
2. Install fuel injector to fuel tube with the following procedure:

# FUEL INJECTOR AND FUEL TUBE

[MRA8DE]

## < REMOVAL AND INSTALLATION >

a. Insert clip (2) into clip mounting groove (F) on fuel injector (4).

(3) : O-ring (black)

(5) : O-ring (green)

- Insert clip so that protrusion (G) of fuel injector matches cut-out (D) of clip.

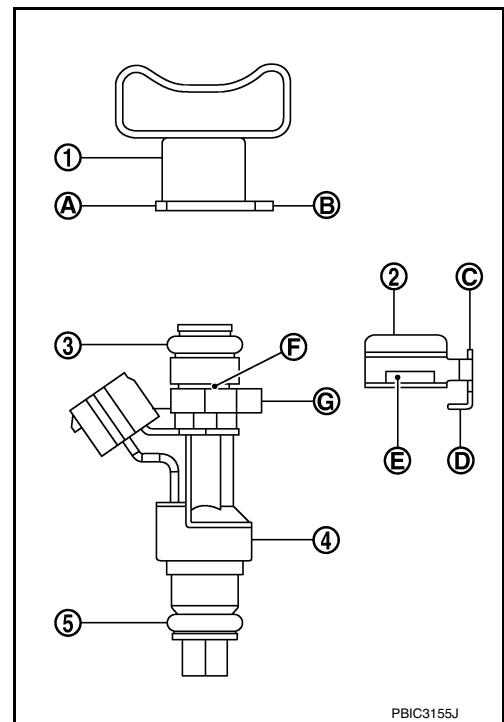
**CAUTION:**

- 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 (1) with clip attached.

- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion (B) of fuel tube matches cut-out (C) of clip.
- Check that fuel tube flange (A) is securely locked in flange groove (E) on clip.

c. Check that installation is complete by checking that fuel injector does not rotate or come off.



3. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

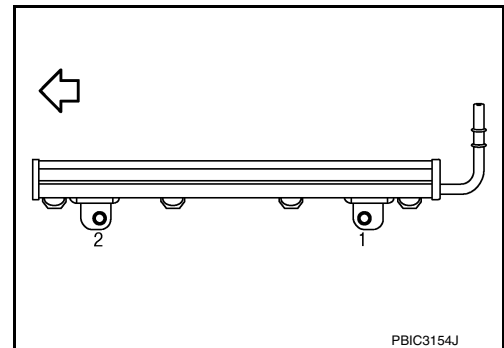
**CAUTION:**

For installation, be careful not to interfere with fuel injector nozzle.

4. Install fuel tube and injector assembly onto cylinder head.

- Tighten bolts in the order as shown.

← : Engine front



5. Connect harness connector to fuel injector.

6. Install fuel tube bracket.

7. Connect fuel feed tube with the following procedure.

a. Check for damage or foreign material on the fuel tube and quick connector.

b. Apply new engine oil lightly to area around the top of fuel tube.

c. Align center to insert quick connector straightly into fuel tube.

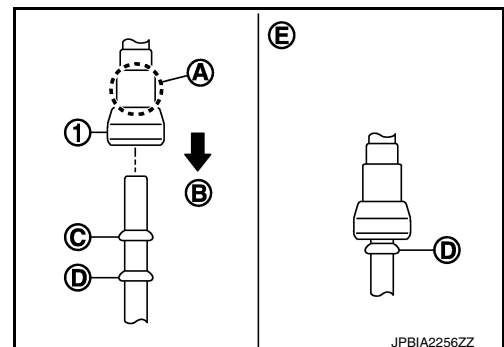
- Insert quick connector (1) to fuel tube until the top spool (3) on fuel tube is inserted completely and the 2nd level spool (D) is positioned slightly below quick connector bottom end.

(B) : Insertion direction

(E) : Fitted condition

**CAUTION:**

- Hold (A) position when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.



# FUEL INJECTOR AND FUEL TUBE

[MRA8DE]

## < REMOVAL AND INSTALLATION >

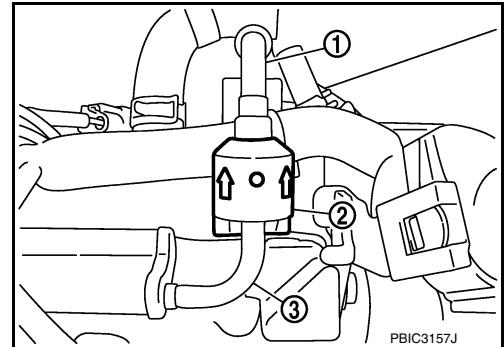
- **Insert until you hear a “click” sound and actually feel the engagement.**
  - **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**
- d. Pull quick connector hard by hand holding position. Check it is completely engaged (connected) so that it does not come out from fuel tube.
- e. Install quick connector cap (engine side) (2) to quick connector connection.

- (1) : Fuel feed hose  
(3) : Fuel tube

- Install quick connector cap (engine side) with the side arrow facing quick connector side (fuel feed tube side).

### CAUTION:

- **Check that the quick connector and fuel tube are securely engaged with the quick connector cap (engine side) mounting groove.**
- **Quick connector may not be connected correctly if quick connector cap (engine side) cannot be installed easily. Remove the quick connector cap (engine side), and then check the connection of quick connector again.**



- f. Install fuel feed hose to hose clamp.
8. Installation of remaining components is in the reverse order of removal.

## Inspection

INFOID:000000009756967

## INSPECTION AFTER INSTALLATION

### Check on Fuel Leakage

1. Turn ignition switch “ON” (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leaks at connection points. Refer to.

### NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leaks at connection points.
- Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to [EC-139, "Description"](#).
  - If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to [EC-140, "Description"](#).

### CAUTION:

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

# IGNITION COIL

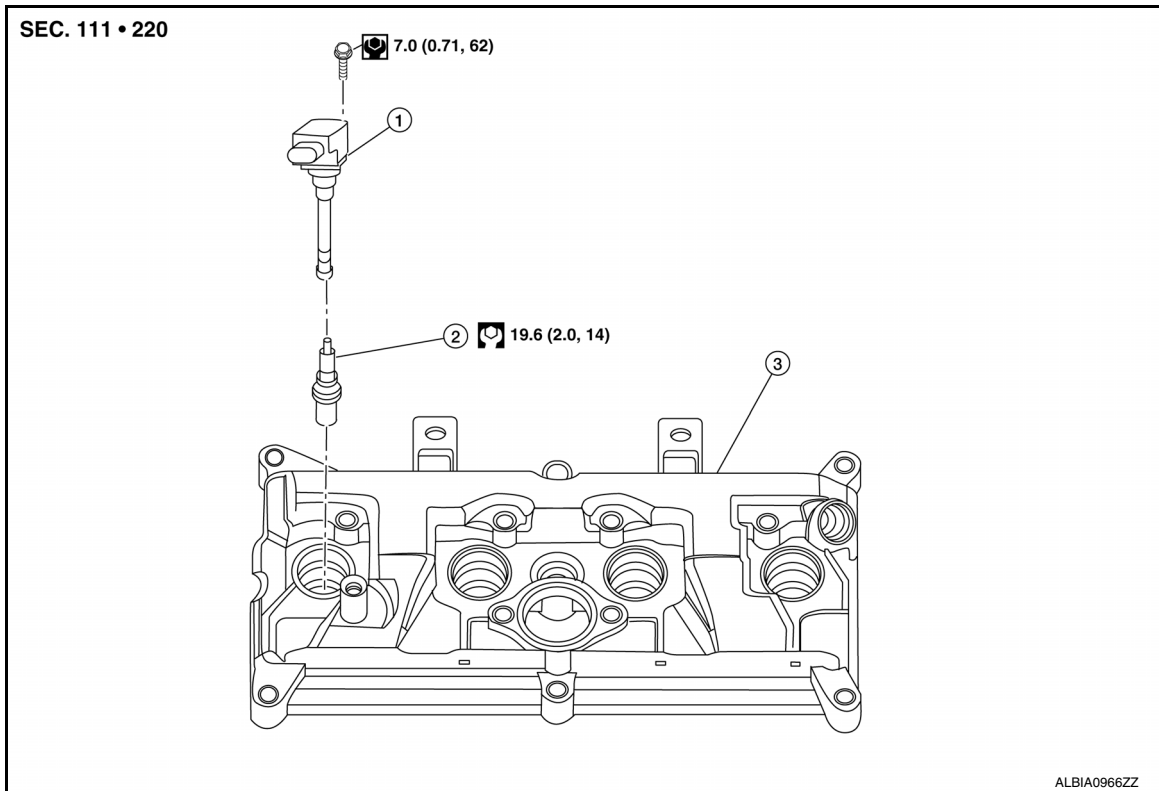
< REMOVAL AND INSTALLATION >

[MRA8DE]

## IGNITION COIL

### Exploded View

INFOID:000000009756968



1. Ignition coil

2. Spark plug

3. Rocker cover

## Removal and Installation

INFOID:000000009756969

### REMOVAL

1. Remove the engine room cover. Refer to [EM-24. "Exploded View"](#).
2. Disconnect the harness connector from the ignition coil.
3. Remove the ignition coil.

#### **CAUTION:**

**Do not drop or shock it.**

### INSTALLATION

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

# ROCKER COVER

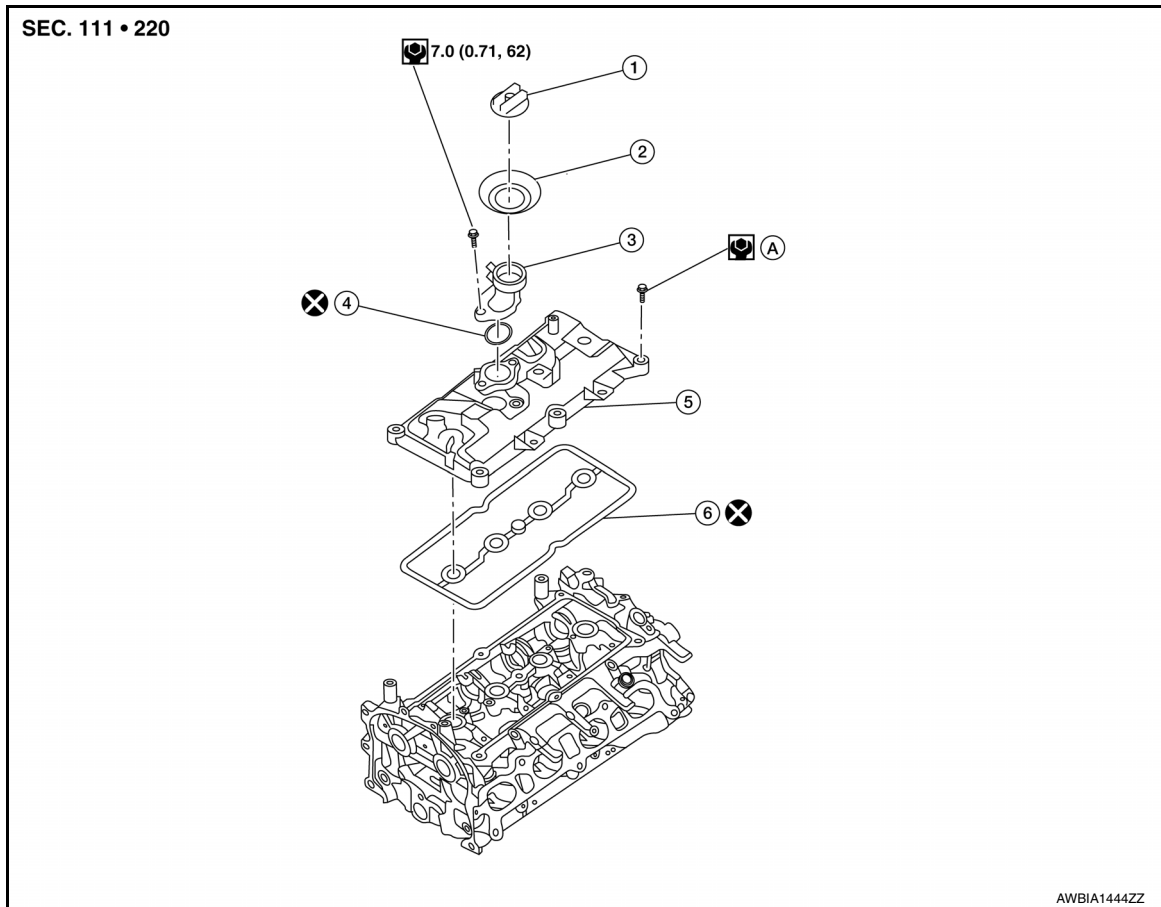
< REMOVAL AND INSTALLATION >

[MRA8DE]

## ROCKER COVER

Exploded View

INFOID:000000009756970



- |                          |                           |                        |
|--------------------------|---------------------------|------------------------|
| 1. Oil filler cap        | 2. Rocker cover protector | 3. Oil filler tube     |
| 4. O-ring                | 5. Rocker cover           | 6. Rocker cover gasket |
| A. Refer to INSTALLATION |                           |                        |

## Removal and Installation

INFOID:000000009756971

### REMOVAL

1. Remove intake manifold. Refer to [EM-27, "Exploded View"](#).
2. Remove rocker cover protector.
3. Remove ignition coils. Refer to [EM-45, "Exploded View"](#).  
**CAUTION:**
  - Do not drop or shock ignition coil.
  - Do not disassemble ignition coil.
4. Move ignition harness aside.
5. Remove rocker cover.

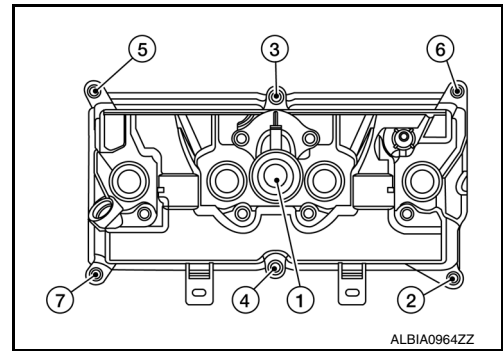
# ROCKER COVER

[MRA8DE]

## < REMOVAL AND INSTALLATION >

- Loosen bolts in reverse order shown.

⇐ : Engine front



6. Remove PCV valve and PCV hose, if necessary.
7. Remove rocker cover gasket from rocker cover.

## INSTALLATION

### CAUTION:

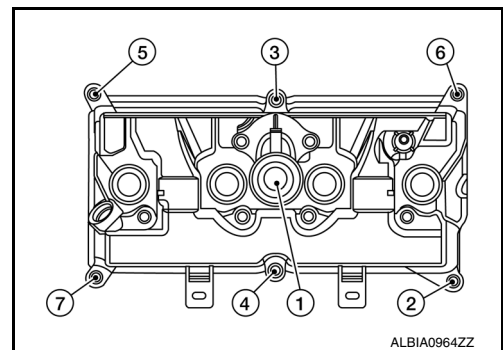
**Do not reuse O-rings.**

1. Install the rocker cover gasket to rocker cover.  
**CAUTION:**  
**Check the gasket is not dropped.**
2. Install rocker cover.
  - Tighten bolts in two steps separately in numerical order as shown.

⇐ : Engine front

- Step 1** : 1.96 N·m (0.20 kg-m, 17 in-lb)  
**Step 2** : 8.33 N·m (0.85 kg-m, 74 in-lb)

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



## INSPECTION AFTER INSTALLATION

Check for engine oil leaks and engine coolant leaks with engine at operating temperature and running at idle.

### WARNING:

**Do not touch engine immediately after stopping as engine is extremely hot.**

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# TIMING CHAIN

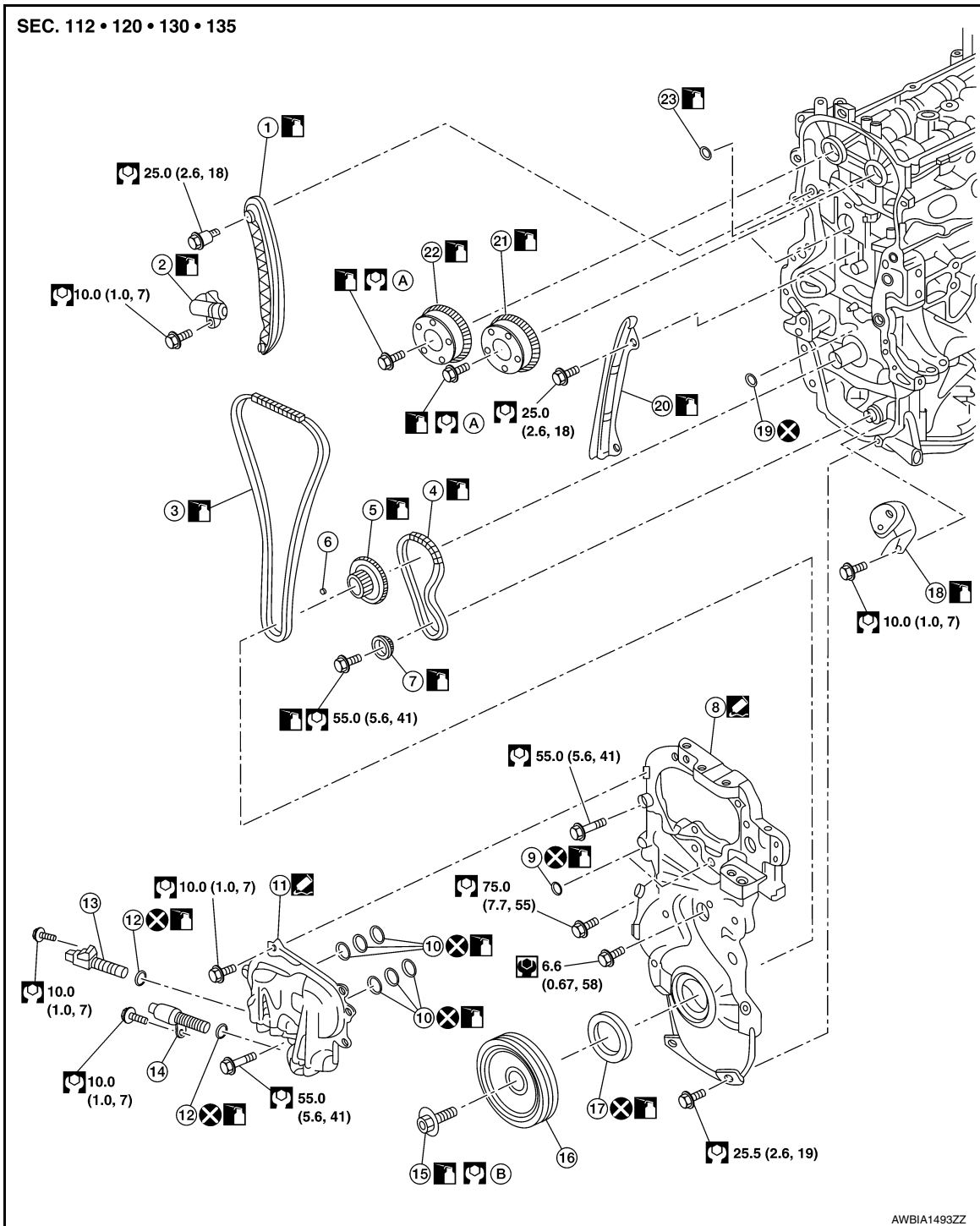
< REMOVAL AND INSTALLATION >

[MRA8DE]

## TIMING CHAIN

Exploded View

INFOID:00000009756972



AWBIA1493ZZ

- |   |   |                                    |
|---|---|------------------------------------|
| 1. Timing chain slack guide                   | 2. Timing chain tensioner                     | 3. Timing chain                    |
| 4. Oil pump drive chain                       | 5. Crankshaft sprocket                        | 6. Crankshaft key                  |
| 7. Oil pump sprocket                          | 8. Front cover                                | 9. O-ring                          |
| 10. O-ring                                    | 11. Valve timing control solenoid valve cover | 12. O-ring                         |
| 13. Valve timing control solenoid valve (EXH) | 14. Valve timing control solenoid valve (INT) | 15. Crankshaft pulley bolt         |
| 16. Crankshaft pulley                         | 17. Front oil seal                            | 18. Oil pump drive chain tensioner |



# TIMING CHAIN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

- |                             |                                |                                   |
|-----------------------------|--------------------------------|-----------------------------------|
| 19. O-ring                  | 20. Timing chain tension guide | 21. Camshaft sprocket (INT)       |
| 22. Camshaft sprocket (EXH) | 23. O-ring                     | A. Refer to <a href="#">EM-60</a> |
| B. Refer to INSTALLATION    |                                |                                   |

## Removal and Installation

INFOID:000000009756973

EM

### REMOVAL

#### CAUTION:

The rotating direction is shown from the engine front.

1. Disconnect battery negative terminal. Refer to [PG-50, "Exploded View"](#).
2. Drain engine oil. Refer to [LU-8, "Draining"](#).

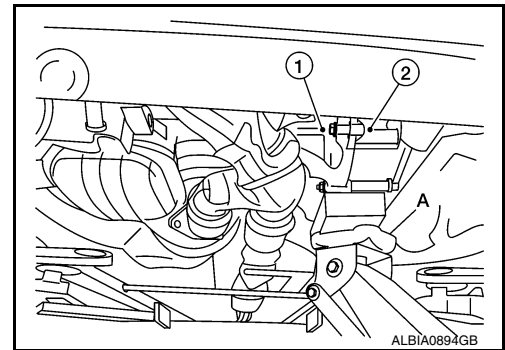
#### CAUTION:

Perform this step when engine is cold.

3. Remove intake manifold. Refer to [EM-27, "Exploded View"](#).
4. Remove the rocker cover. Refer to [EM-12, "Exploded View"](#).
5. Remove fender protector side cover (RH). Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).
6. Support engine (1) and transaxle (2) using suitable jack (A).

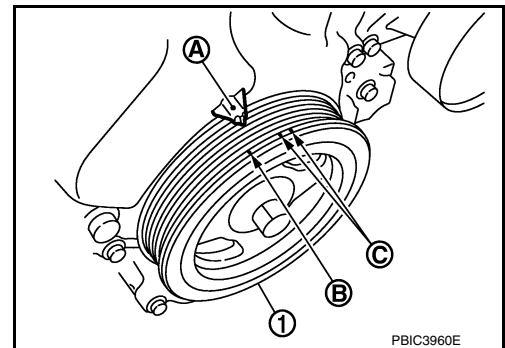
#### CAUTION:

- Position a suitable jack under the engine and transaxle assembly as shown.
- Do not damage the front exhaust tube or transaxle oil pan with the jack.



7. Remove upper torque rod and engine mounting insulator (RH). Refer to [EM-82, "M/T : Exploded View"](#) (M/T) or [EM-86, "CVT : Exploded View"](#) (CVT).
8. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
  - a. Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

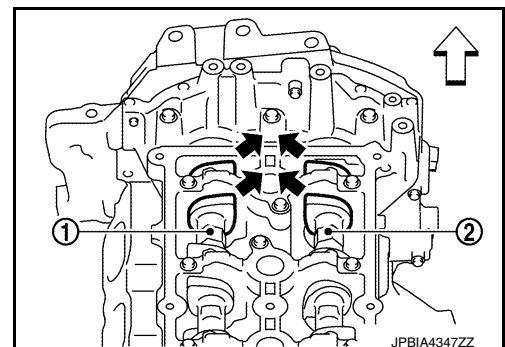
(C) : White paint mark (Not used for service)



- b. At the same time, check that the cam lobes of the No. 1 cylinder are located (←) as shown.

- (1) : Camshaft (INT)  
(2) : Camshaft (EXH)  
← : Engine front

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



9. Remove crankshaft pulley with the following procedure:
  - a. Remove drive belt. Refer to [EM-15, "Exploded View"](#).

# TIMING CHAIN

[MRA8DE]

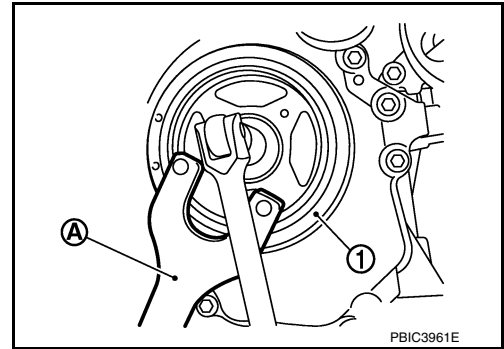
## < REMOVAL AND INSTALLATION >

- b. Lock crankshaft pulley (1) using suitable tool (A), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.

**CAUTION:**

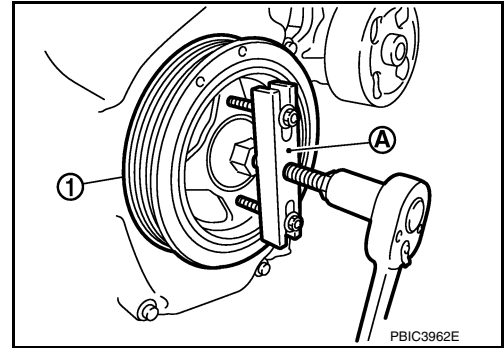
**Do not remove the crankshaft pulley bolt as it will be used as a supporting point for the Tool.**

**Tool number** : KV11103000 ( — )



- c. Attach Tool (A) in the M6 thread hole on crankshaft pulley (1), and remove crankshaft pulley.

**Tool number** : KV11103000 ( — )

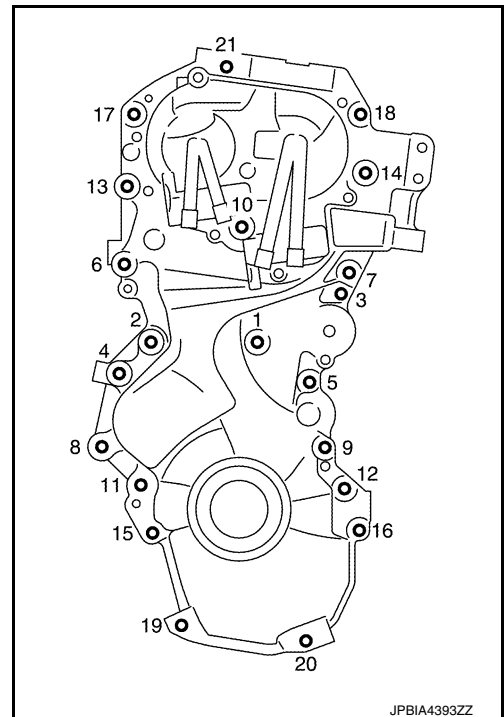


10. Remove oil pan (lower). Refer to [EM-33. "Exploded View"](#).

**NOTE:**

If crankshaft sprocket and oil pump drive component are not removed, this step is unnecessary.

11. Remove intake valve timing control solenoid valve.  
12. Remove drive belt auto-tensioner. Refer to [EM-16. "Exploded View"](#).  
13. Remove front cover with the following procedure:  
a. Loosen bolts in reverse order as shown.



# TIMING CHAIN

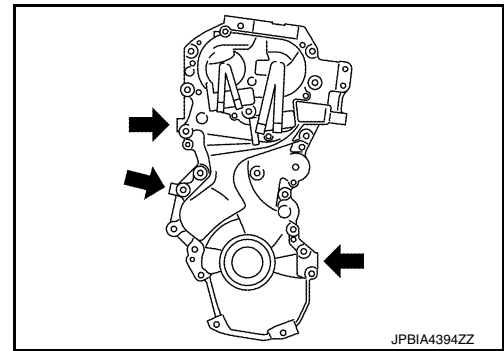
[MRA8DE]

## < REMOVAL AND INSTALLATION >

- b. Cut liquid gasket by prying the position (←) shown using suitable tool, and then remove the front cover.

**CAUTION:**

- Be careful not to damage the mating surface.
- Do not use suitable tool anywhere other than shown, sealant used is more adhesive than previous types when shipped.



14. Remove front oil seal from front cover.

**CAUTION:**

**Be careful not to damage front cover.**

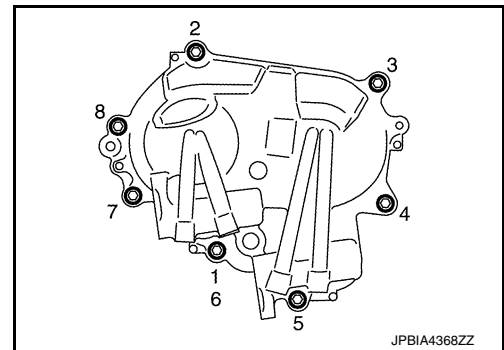
- Pull out front oil seal using suitable tool.

15. Remove valve timing control cover, if necessary.

- Loosen bolts in reverse order as shown.

**NOTE:**

Disregard the numerical order No.1 in removal.



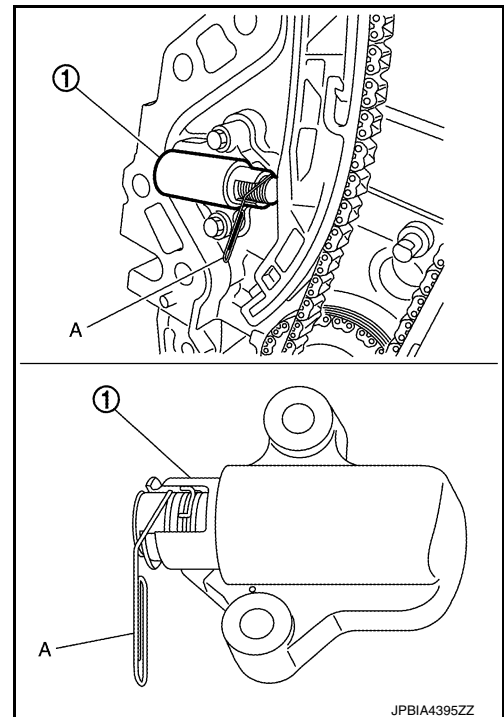
16. Remove timing chain tensioner with the following procedure:

- a. Insert a stopper pin (A) into the top groove with the timing chain tensioner plunger pressed.

**NOTE:**

Timing chain tensioner plunger is securely locked by inserting a stopper pin.

- b. Remove timing chain tensioner (1).



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# TIMING CHAIN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

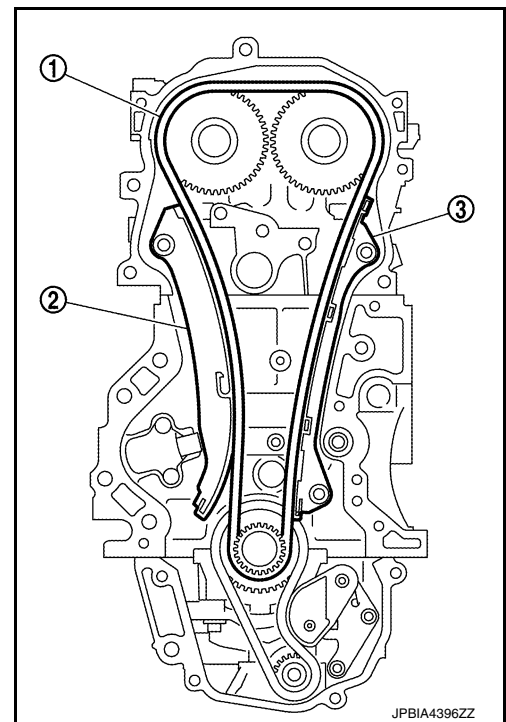
17. Remove slack guide (2), tension guide (3) and timing chain (1).

**CAUTION:**

Do not rotate each crankshaft and camshaft individually while timing chain is removed. It causes interference between valve and piston.

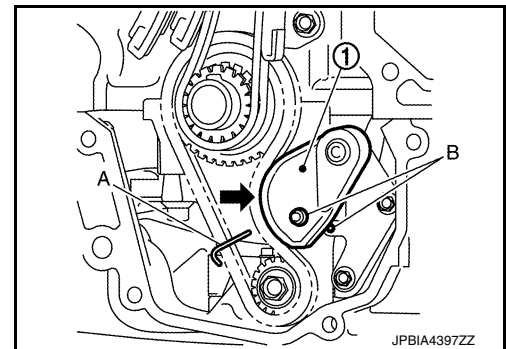
**NOTE:**

If timing chain is difficult to remove, remove camshaft sprocket (EXH) first to remove timing chain.



18. Remove crankshaft sprocket and oil pump drive component with the following procedure:

- Push oil pump drive chain tensioner (1) in the direction as shown.
- Insert a stopper pin (A) into the body hole (B).
- Remove oil pump chain tensioner.
  - When the holes on lever and tensioner body cannot be aligned, align these holes by slightly moving the oil pump chain tensioner slack guide.



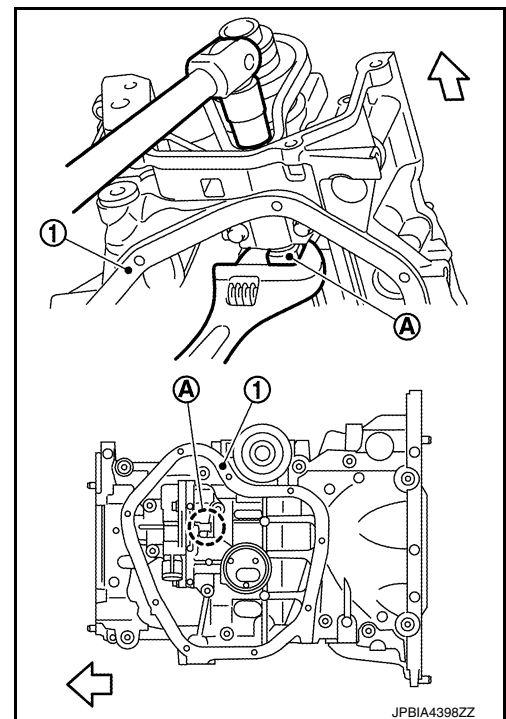
- Hold the WAF part of oil pump shaft [WAF: 10 mm (0.39 in)] (A), and then loosen the oil pump sprocket bolt and remove it.

(1) : Oil pan (upper)

⇐ : Engine front

**CAUTION:**

- Secure the oil pump shaft with the WAF part.
- Do not loosen the oil pump sprocket bolt by tightening the oil pump drive chain.



# TIMING CHAIN

< REMOVAL AND INSTALLATION >

[MRA8DE]

## INSTALLATION

### CAUTION:

Do not reuse O-rings.

### NOTE:

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

- (1) : Timing chain
- (2) : Camshaft sprocket (EXH)
- (3) : Slack guide
- (4) : Timing chain tensioner
- (5) : Crankshaft sprocket
- (6) : Oil pump drive chain
- (7) : Oil pump sprocket
- (8) : Oil pump drive chain tensioner
- (9) : Tension guide
- (10) : Camshaft sprocket (INT)
- (A) : Matching mark (dark blue link)
- (B) : Matching mark (outer groove)
- (C) : Crankshaft key position (straight up)
- (D) : Matching mark (stamping)
- (E) : Matching mark (white link)
- (F) : Matching mark (yellow link)
- (G) : Matching mark (outer groove)

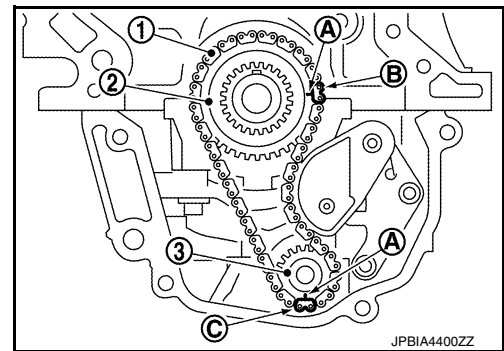
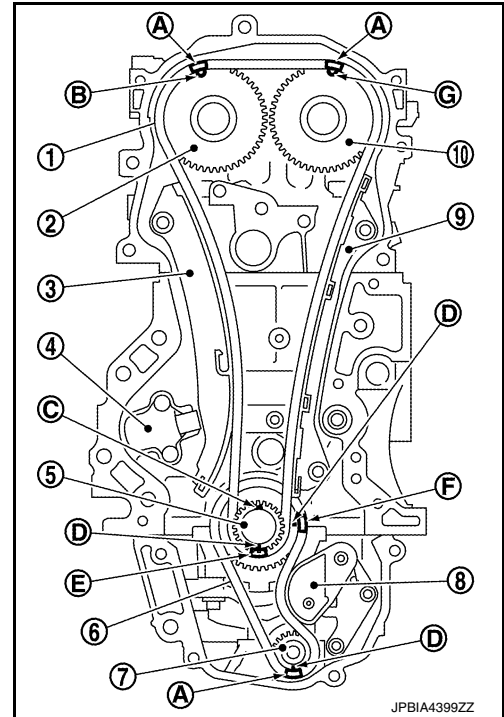
1. Check that crankshaft key points straight up.
2. Install crankshaft sprocket (2), oil pump sprocket (3) and oil pump drive chain (1).

- (A) : Matching mark (stamping)
- (B) : Matching mark (yellow link)
- (C) : Matching mark (dark blue link)

- Install it by aligning matching marks on each sprockets and oil pump drive chain.
- If these matching marks are not aligned, rotate the oil pump shaft slightly to correct the position.

### CAUTION:

Check matching mark position of each sprocket after installing the oil pump drive chain.



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# TIMING CHAIN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

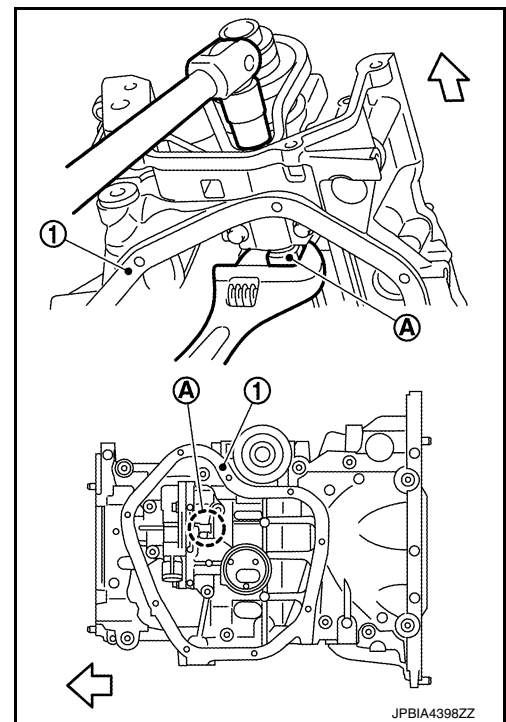
3. Hold the WAF part of oil pump shaft [WAF: 10 mm (0.39 in)] (A), and then tighten the oil pump shaft sprocket bolt.

(1) : Oil pan (upper)

⇐ : Engine front

**CAUTION:**

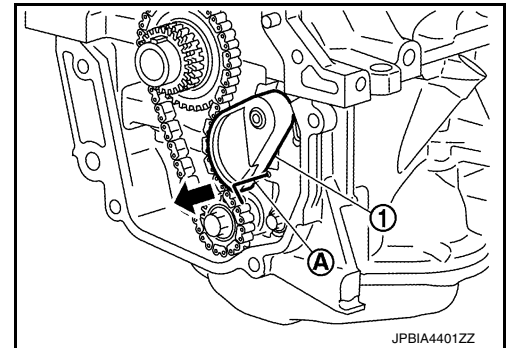
- Secure the oil pump shaft with the WAF part.
- Do not loosen the oil pump shaft sprocket bolt by tightening the oil pump drive chain.



JPBIA4398ZZ

4. Install oil pump chain tensioner (1).

- Fix the face of the oil pump tensioner at the most compressed position using a stopper pin (A), and then install it.
- Securely pull out (⇐) the stopper pin after installing the oil pump chain tensioner.
- Check matching mark position of oil pump drive chain and each sprocket again.



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# TIMING CHAIN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

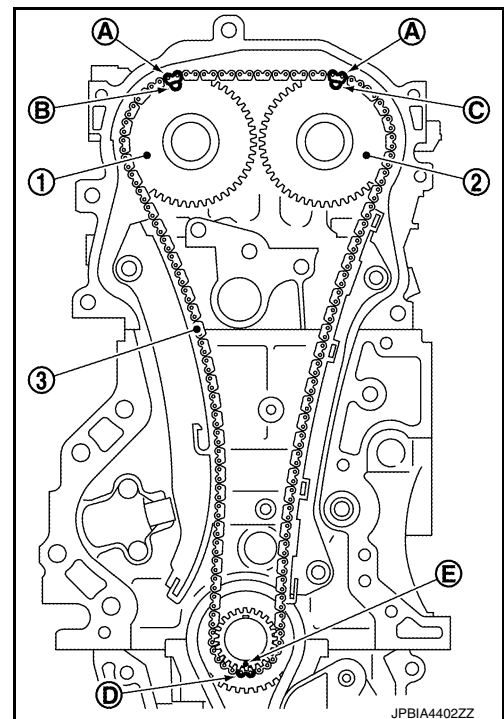
5. Align the matching marks of each sprocket with the matching marks of timing chain.

- (1) : Camshaft sprocket (EXH)
- (2) : Camshaft sprocket (INT)
- (3) : Timing chain
- (A) : Matching mark (dark blue link)
- (B) : Matching mark (outer groove)
- (C) : Matching mark (outer groove)
- (D) : Matching mark (copper link)
- (E) : Matching mark (stamping)

- If these matching marks are not aligned, rotate the camshaft slightly by holding the hexagonal portion to correct the position.

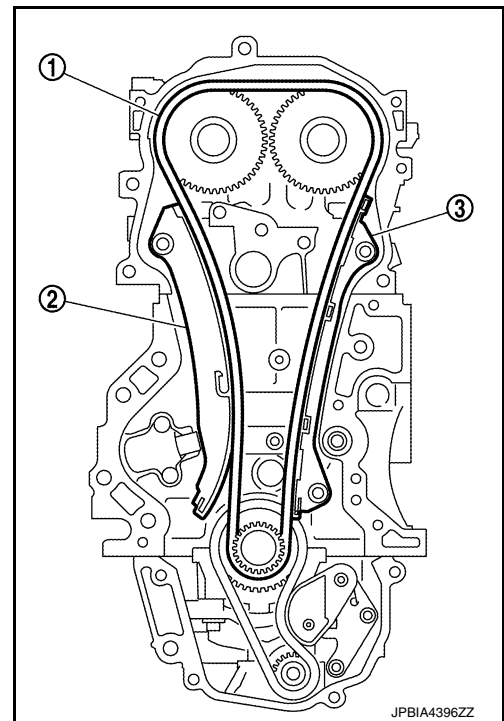
**CAUTION:**

**Check matching mark position of each sprocket and timing chain again after installing the timing chain.**



6. Install the slack guide (2) and the tension guide (3).

- (1) : Timing chain



7. Install timing chain tensioner.

- Lock the plunger at the most compressed position using a stopper pin, and then install it.
- Securely pull out the stopper pin after installing the timing chain tensioner.

**CAUTION:**

- **After installing tensioner on the cam side, pull out lock pin.**
- **If plunger pops out after pulling out lock pin without installing the tensioner to the engine, do not use the tensioner. (If used, the plunger does not side smoothly.)**
- **To reuse tensioner on the cam side:**  
**After installation, pick up and move ratchet clip toward the tip of the plunger and position the tensioner parallel to the groove of the plunger.**

8. Check matching mark position of timing chain and each sprocket again.

9. Install front oil seal. Refer to [EM-70. "FRONT OIL SEAL : Removal and Installation"](#).



# TIMING CHAIN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

10. Install front cover with the following procedure:

- a. Install valve timing control cover, if removed.
- Apply a continuous bead of liquid gasket (E) using suitable tool to valve timing control cover as shown.

- (1) : Front cover
- (2) : Valve timing control cover
- (A) : Start and end of gasket application
- (B) : Liquid gasket application area
- (E) : Gasket
- (c) : 4.0 - 5.6 mm (0.157 - 0.220 in)
- (d) : 3.4 - 4.4 mm (0.134 - 0.173 in)

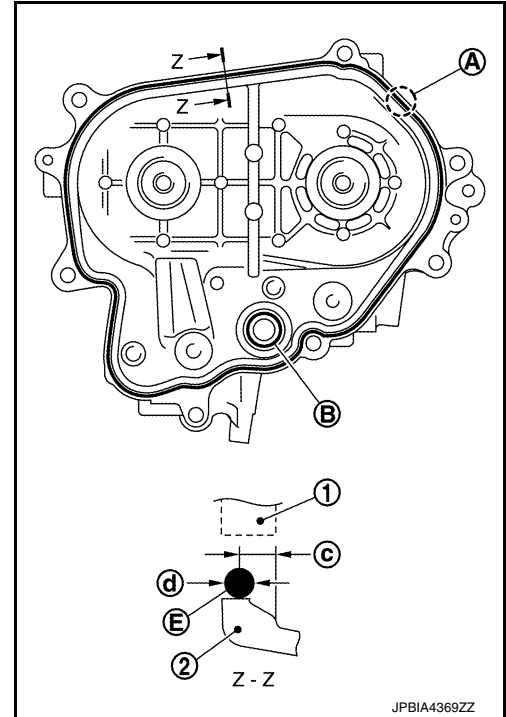
**NOTE:**

The start and end of gasket application must overlap 5 mm or more with one another.

Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).

**CAUTION:**

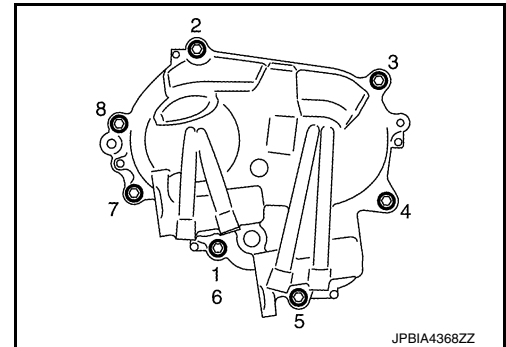
- Installation should be done within 5 minutes after applying liquid gasket.
- Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.



- Tighten bolts in numerical order as shown.

**NOTE:**

Tighten bolt the No.1 in two step. The numerical order No.6 shows the second step.



- b. Install new O-ring to cylinder block.

**CAUTION:**

- Do not misalign O-ring.
- Do not reuse O-ring.



# TIMING CHAIN

[MRA8DE]

## < REMOVAL AND INSTALLATION >

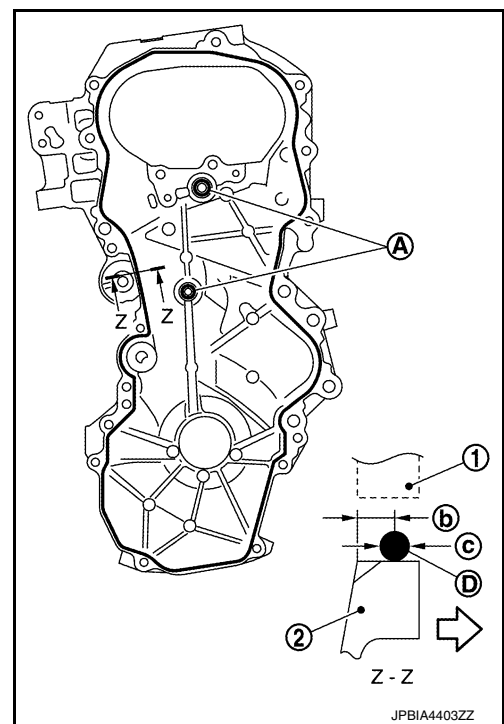
- c. Apply a continuous bead of liquid gasket (D) using suitable tool to front cover as shown.

- (1) : Cylinder head
- (2) : Front cover
- (A) : Liquid gasket application area
- (b) : 4.0 - 5.6 mm (0.157 - 0.220 in)
- (c) : 3.4 - 4.4 mm (0.134 - 0.173 in)
- ↶ : Engine outside

Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).

**CAUTION:**

- Installation should be done within 5 minutes after applying liquid gasket.
- Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.



- d. Check that matching marks of timing chain and each sprocket are still aligned. Then install front cover.

**CAUTION:**

- Check O-ring on cylinder block is correctly installed.
- Be careful not to damage front oil seal by interference with front end of crankshaft.

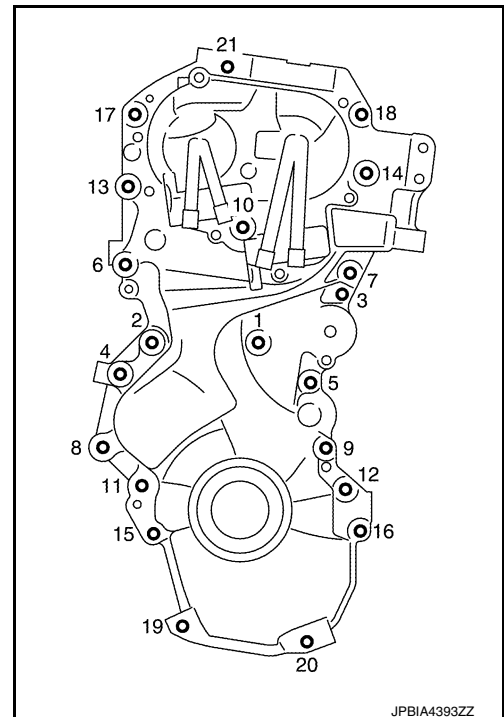
- e. Install front cover, and tighten bolts in numerical order as shown.
- Refer to the following for the installation position of bolts.

- M6 bolt** : No. 1
- M10 bolts** : No. 6, 7, 10, 13, 21
- M12 bolts** : No. 2, 4, 8, 11
- M8 bolts** : Except the above

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

**CAUTION:**

Be sure to wipe off any excessive liquid gasket.



11. Install crankshaft pulley with the following procedure:

- a. When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).

**CAUTION:**

Do not damage front oil seal lip.

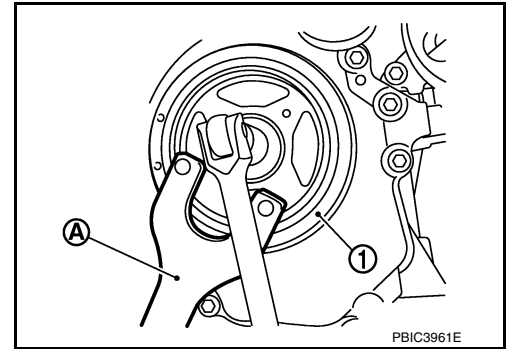
# TIMING CHAIN

[MRA8DE]

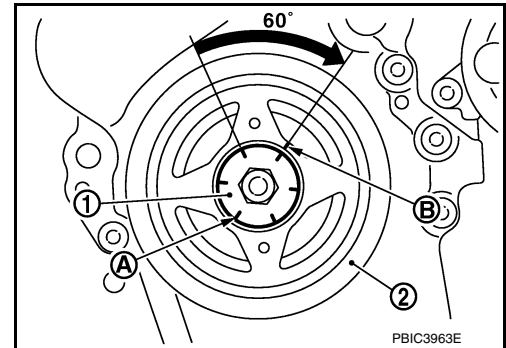
## < REMOVAL AND INSTALLATION >

- b. Secure crankshaft pulley (1) using suitable tool (A).
- c. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
- d. Tighten crankshaft pulley bolt.

**Crankshaft pulley bolt : 29.4 N·m (3.0 kg-m, 22 ft-lb)**



- e. Put a paint mark (B) on crankshaft pulley (2), matching with any one of six easy to recognize angle marks (A) on crankshaft pulley bolt (1) flange.
- f. Turn another 60 degrees clockwise (angle tightening).
  - Check the tightening angle with movement of one angle mark.
- g. Check that crankshaft rotates clockwise smoothly.



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

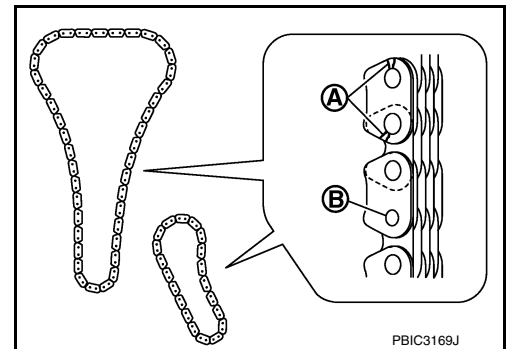
## Inspection

INFOID:000000009756974

## INSPECTION AFTER REMOVAL

### Timing Chain

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



## INSPECTION AFTER INSTALLATION

- 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-11, "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 chain tensioner drops after removal and installation, slack in guide may generate a pounding noise during and just after the engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, 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:

# TIMING CHAIN

< REMOVAL AND INSTALLATION >

[MRA8DE]

Items		Before starting engine	Engine running	After engine stopped	A
Engine coolant		Level	Leakage	Level	
Engine oil		Level	Leakage	Level	
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage	EM
	MT Models	Level / Leakage	Leakage	Level / Leakage	
Other oils and fluids*		Level	Leakage	Level	C
Fuel		Leakage	Leakage	Leakage	
Exhaust gases		—	Leakage	—	D

\*: Power steering fluid, brake fluid, etc.

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# CAMSHAFT

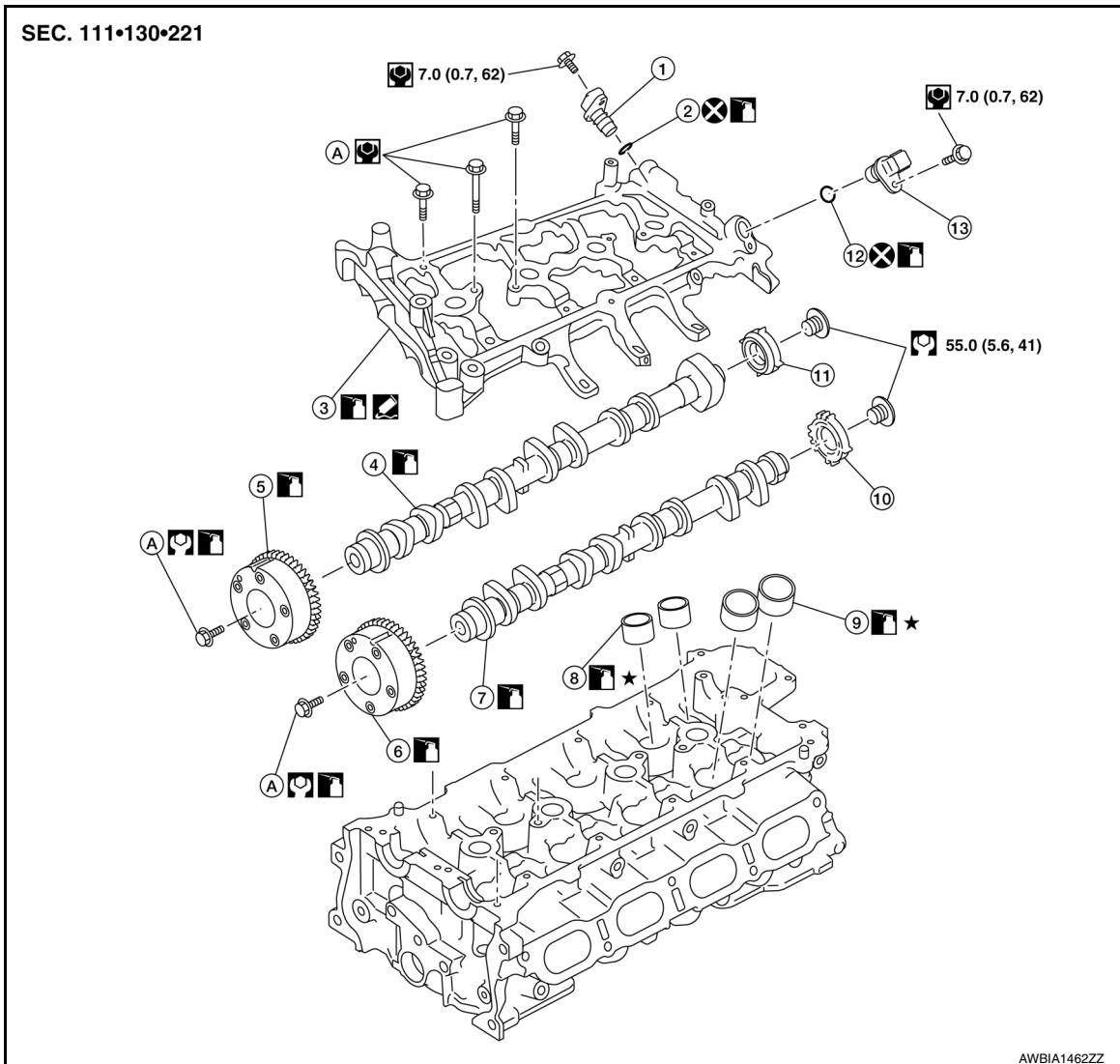
< REMOVAL AND INSTALLATION >

[MRA8DE]

## CAMSHAFT

### Exploded View

INFOID:000000009756975



AWBIA1462ZZ

- |                                    |                            |                            |
|------------------------------------|----------------------------|----------------------------|
| 1. Camshaft position sensor (EXH)  | 2. O-ring                  | 3. Camshaft bracket        |
| 4. Camshaft (EXH)                  | 5. Camshaft sprocket (EXH) | 6. Camshaft sprocket (INT) |
| 7. Camshaft (INT)                  | 8. Valve lifter (EXH)      | 9. Valve lifter (INT)      |
| 10. Signal plate (INT)             | 11. Signal plate (EXH)     | 12. O-ring                 |
| 13. Camshaft position sensor (INT) | A. Refer to INSTALLATION   |                            |

### Removal and Installation

INFOID:000000009756976

**CAUTION:**  
The rotating direction is shown from the engine front.

#### REMOVAL

1. Remove intake manifold. Refer to [EM-27. "Exploded View"](#).
2. Remove rocker cover. Refer to [EM-12. "Exploded View"](#).
3. Remove timing chain. Refer to [EM-48. "Exploded View"](#).

**NOTE:**

Removal of oil pump drive related part is not necessary.

4. Remove camshaft position sensor (INT) and camshaft position sensor (EXH) from camshaft bracket.

# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[MRA8DE]

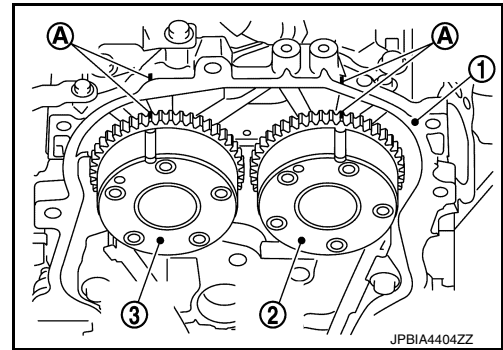
**CAUTION:**

- Handle camshaft position sensor (INT) and camshaft position sensor (EXH) carefully and avoid impacts.
- Do not disassemble camshaft position sensor (INT) and camshaft position sensor (EXH).
- Do not place sensor where it is exposed to magnetism.

- Put painted matching mark (A) on the camshaft sprocket (INT) (2), camshaft sprocket (EXH) (3) and the camshaft bracket (1) as shown.

**NOTE:**

When camshaft alignment is as show in installation, it prevents the knock pin of the camshaft (INT) from engaging with the incorrect pin hole when installing the camshaft sprocket (INT).

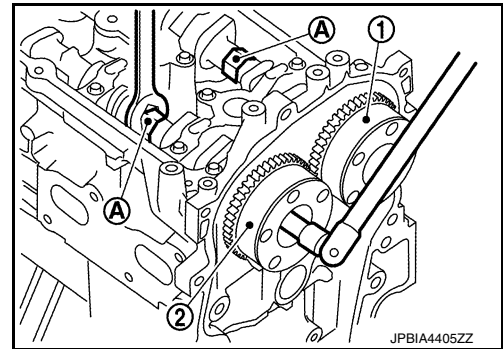


- Remove camshaft sprockets (INT and EXH).
  - Secure hexagonal part (A) of camshaft using suitable tool. Loosen camshaft sprocket bolts and remove camshaft sprocket.

- (1) : Camshaft sprocket (INT)
- (2) : Camshaft sprocket (EXH)

**CAUTION:**

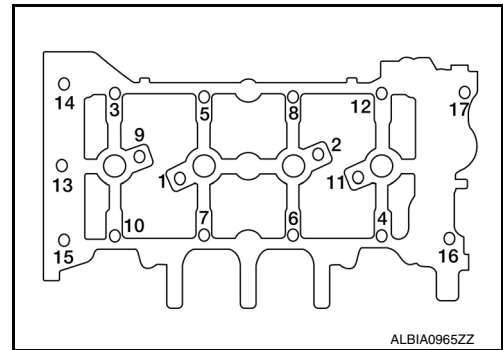
- Do not rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.
- Do not loosen the bolts with securing anything other than the camshaft hexagonal part.



- Remove camshaft bracket with the following procedure:

- Loosen bolts in reverse order as shown.

↔ : Engine front

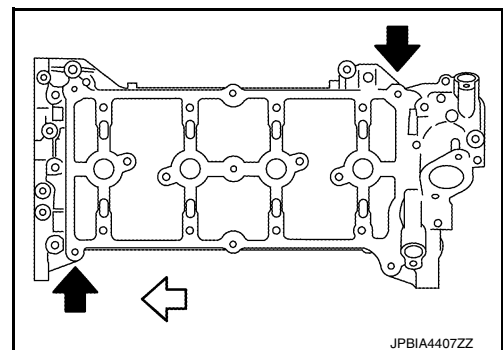


- Cut liquid gasket by prying the position (↔) shown using suitable tool, and then remove the camshaft bracket.

↔ : Engine front

**CAUTION:**

- Do not damage the mating surface.
- Do not use suitable tool anywhere other than shown, sealant used is more adhesive than previous types when shipped.



- Remove camshafts.
- Remove valve lifters, if necessary.

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# CAMSHAFT

[MRA8DE]

## < REMOVAL AND INSTALLATION >

- Identify installation positions, and store them without mixing them up.

10. Remove signal plate from camshaft, if necessary.

## INSTALLATION

### CAUTION:

**Do not reuse O-rings.**

1. Install valve lifters.
  - Install them in the original positions.
2. Install camshafts.
  - Clean camshaft journal to remove any foreign material.
  - Distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft or using the identification colors (A) and (B).

(1) : Camshaft (EXH)

(2) : Camshaft (INT)

Identification color	M1 (A)	M2 (B)
Camshaft (EXH)	No	Blue
Camshaft (INT)	Yellow	No

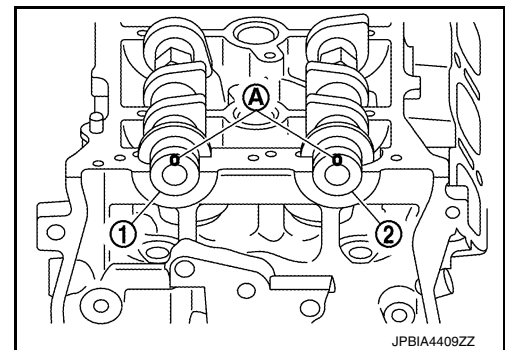
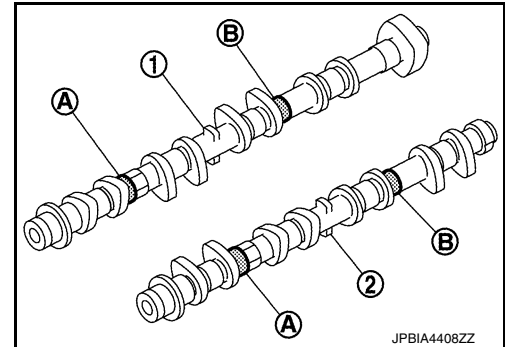
- Install camshafts so that camshaft dowel pins (A) on the front side are positioned as shown.

(1) : Camshaft (EXH)

(2) : Camshaft (INT)

### NOTE:

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



3. Install camshaft bracket with the following procedure:
  - a. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.

# CAMSHAFT

[MRA8DE]

## < REMOVAL AND INSTALLATION >

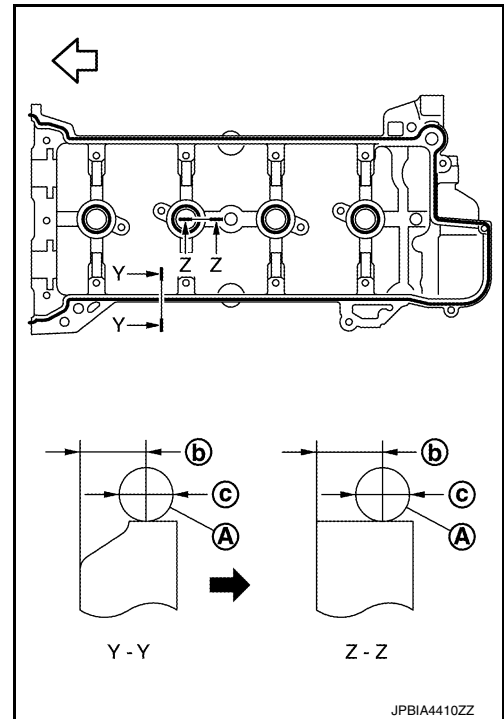
b. Apply liquid gasket (A) to camshaft bracket as shown.

- (b) : Plug hole inner wall
- (c) : 3.4 - 4.4 mm (0.134 - 0.173 in)
- ↶ : Engine front
- ← : Engine outside

Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).

**CAUTION:**

- Installation should be done within 5 minutes after applying liquid gasket.
- Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.



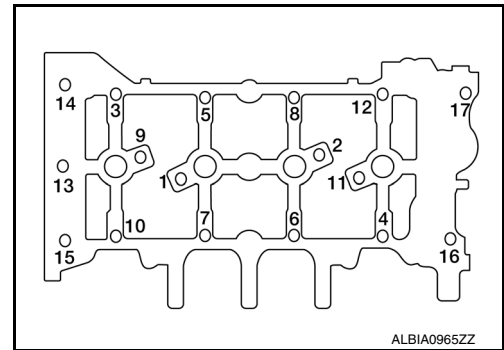
c. Tighten bolts of camshaft brackets in the following steps, in numerical order as shown.

- ↶ : Engine front

- There are two types of bolts. Refer to the following for locating bolts.

**M6 bolts [thread length: 57.5 mm (2.264 in)]**  
: 13, 14, and 15

**M6 bolts [thread length: 35.0 mm (1.378 in)]**  
: Except the above



i. Tighten bolts to the specified torque in three steps in the order as shown.

**Step 1 : 1.96 N·m (0.20 kg-m, 17 in-lb)**

**Step 2 : 5.88 N·m (0.60 kg-m, 52 in-lb)**

**Step 3 : 9.5 N·m (0.97 kg-m, 84 in-lb)**

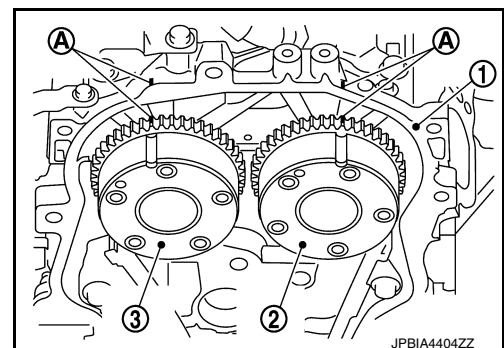
**CAUTION:**

After tightening bolts of camshaft bracket, be sure to wipe off excessive liquid gasket from the mating surface of cylinder head.

4. Install the camshaft sprocket to the camshaft with the following procedure.

a. When the camshaft sprocket (INT) (2) and camshaft sprocket (EXH) (3) is installed, refer to the paint matching marks (A) made during removal. Securely align the knock pin and the pin hole, and then install them.

- (1) : Camshaft bracket





# CAMSHAFT

[MRA8DE]

## < REMOVAL AND INSTALLATION >

- b. Tighten bolts in the following steps.
- Secure the hexagonal part of camshaft using suitable tool to tighten bolt.

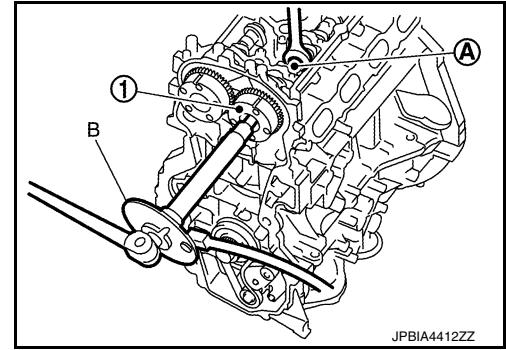
**CAUTION:**

**Check the tightening angle using Tool (B). Do not judge by visual inspection.**

**Step 1 : 35.0 N·m (3.6 kg-m, 26 ft-lb)**

**Step 2 : 30.5 degrees rotation**

**Tool number : KV10112100 (BT-8653-A)**



(1) : Camshaft sprocket

(A) : Camshaft hexagonal part

5. Install timing chain. Refer to [EM-48, "Exploded View"](#).  
6. Inspect and adjust valve clearance. Refer to [EM-20, "Inspection and Adjustment"](#).  
7. Installation of remaining components is in the reverse order of removal.

## Inspection

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### INSPECTION AFTER REMOVAL

#### Camshaft Runout

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

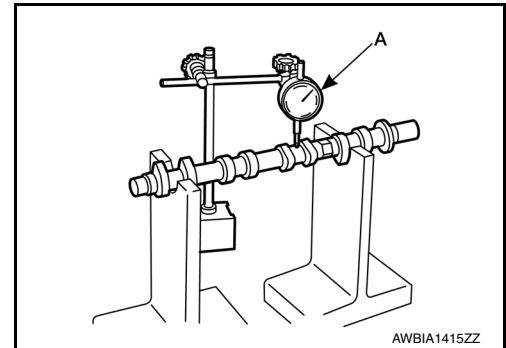
**CAUTION:**

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

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

**Standard and Limit : Refer to [EM-119, "Camshaft"](#).**

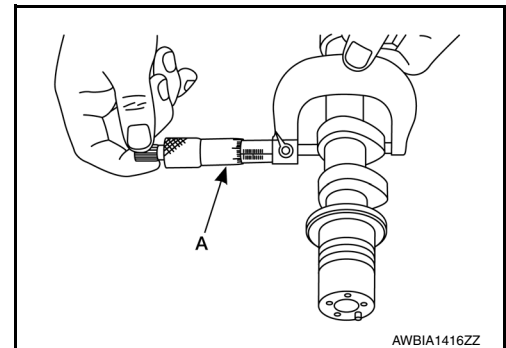
4. If it exceeds the limit, replace camshaft.



#### Camshaft Cam Height

1. Measure the camshaft cam height using suitable tool (A).

**Standard and Limit : Refer to [EM-119, "Camshaft"](#).**



2. If it exceeds the limit, replace camshaft.

#### Camshaft Journal Oil Clearance

### CAMSHAFT JOURNAL OUTER DIAMETER



# CAMSHAFT

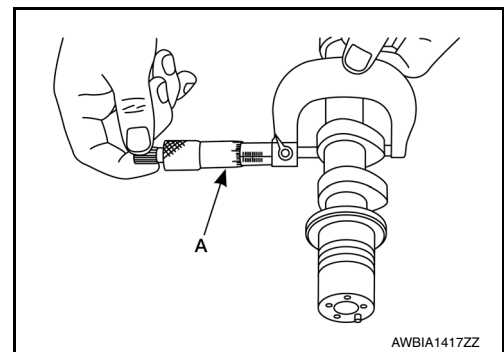
[MRA8DE]

## < REMOVAL AND INSTALLATION >

Measure the outer diameter of camshaft journal using suitable tool (A).

**Standard** : Refer to [EM-119, "Camshaft"](#).

If it exceeds the limit, replace camshaft.



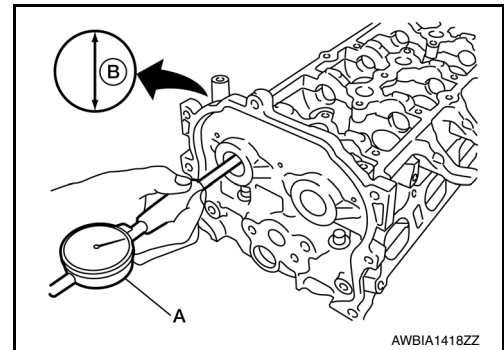
## CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque. Refer to [EM-60, "Removal and Installation"](#).
- Measure the inner diameter of camshaft bracket using suitable tool (A).

(B) : Measuring direction of inner diameter

**Standard** : Refer to [EM-119, "Camshaft"](#).

- If it exceeds limit, replace camshaft bracket.



## CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard and Limit** : Refer to [EM-119, "Camshaft"](#).

- If it exceeds the limit, replace camshaft or cylinder head, or both.

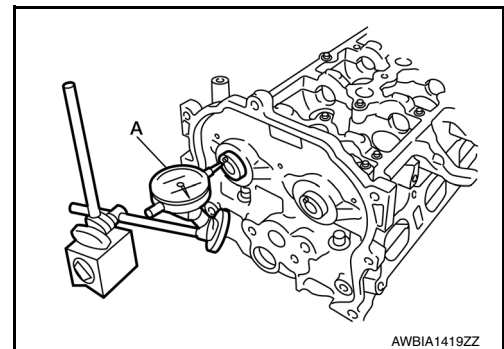
### NOTE:

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

## Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-60, "Removal and Installation"](#).
2. Install suitable tool in thrust direction on front end of camshaft. Read the end play on suitable tool (A) when camshaft is moved forward/backward (in direction to axis).

**Standard and Limit** : Refer to [EM-119, "Camshaft"](#).



- Measure the following parts if out of the standard.

# CAMSHAFT

[MRA8DE]

## < REMOVAL AND INSTALLATION >

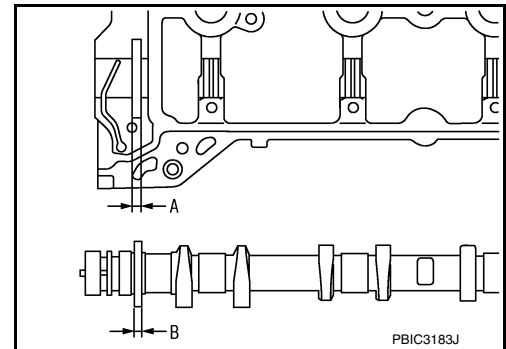
- Dimension (A) for groove of cylinder head No. 1 journal

**Standard : 4.000 - 4.030 mm (0.1575 - 0.1587 in)**

- Dimension (B) for camshaft flange

**Standard : 3.877 - 3.925 mm (0.1526 - 0.1545 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 5 journals of camshaft.

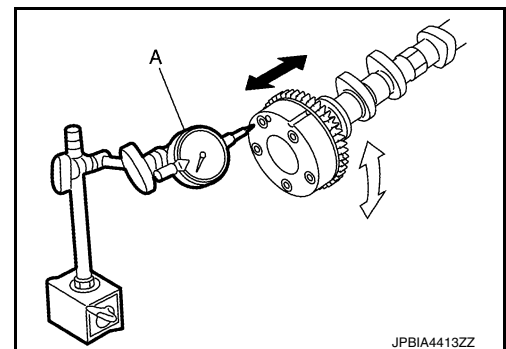
**CAUTION:**

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

2. Measure the camshaft sprocket runout using suitable tool (A). (Total indicator reading)

**Limit : Refer to [EM-119, "Camshaft"](#).**

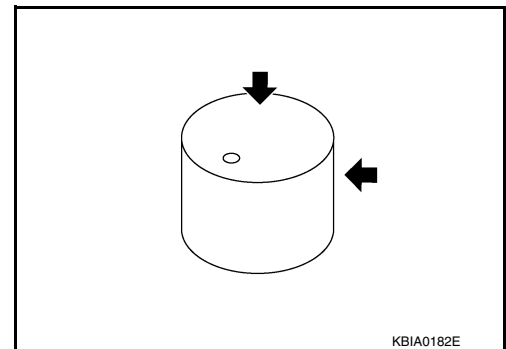
- If it exceeds the limit, replace camshaft sprocket.



### Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-119, "Camshaft"](#).

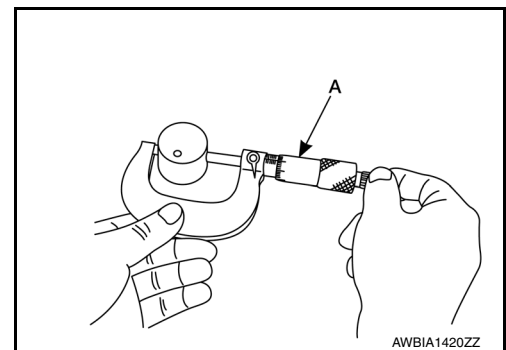


### Valve Lifter Clearance

#### VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of valve lifter using suitable tool (A).

**Standard : Refer to [EM-119, "Camshaft"](#).**



#### VALVE LIFTER HOLE DIAMETER

# CAMSHAFT

[MRA8DE]

## < REMOVAL AND INSTALLATION >

Measure the inner diameter of valve lifter hole of cylinder head using suitable tool (A).

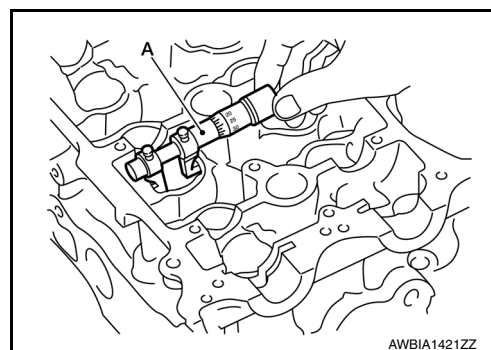
**Standard** : Refer to [EM-119, "Camshaft"](#).

### VALVE LIFTER CLEARANCE

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

**Standard** : Refer to [EM-119, "Camshaft"](#).

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



### INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT), (EXH) Oil Groove

#### **WARNING:**

**Check when engine is cold so as to prevent burns by the splashing engine oil.**

#### **CAUTION:**

**Perform this inspection only when DTC P0011 or P0014 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to [EC-171, "Diagnosis Procedure"](#) (P0011) or [EC-174, "Diagnosis Procedure"](#) (P0014).**

1. Check engine oil level. Refer to [LU-7, "Inspection"](#).
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
  - a. Release the fuel pressure. Refer to [EC-143, "Work Procedure"](#).
  - b. Remove intake manifold. Refer to [EM-27, "Exploded View"](#).
  - c. Disconnect ignition coil and injector harness connectors.
  - d. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket (RH) and engine mounting insulator (RH). Refer to [EM-82, "M/T : Exploded View"](#).
3. Remove intake or exhaust valve timing control solenoid valve. Refer to [EM-48, "Exploded View"](#).
  - Lift the front side of the engine with a jack base to remove intake or exhaust valve timing control solenoid valve.
4. Clean the mounting area of intake or exhaust valve timing control solenoid valve, and then insert a clean shop cloth with no oil adhesion into the oil hole of the cylinder head.
5. Install engine mounting insulator (RH) and engine mounting bracket (RH). (After the removal of intake or exhaust valve timing control solenoid valve and insertion of a shop cloth into the oil hole.)
6. Perform cranking to check that engine oil comes out from the oil hole (mounting hole of intake or exhaust valve timing control solenoid valve) of cylinder head.
  - Regarding the engine oil check, judge it by the amount of oil adhered to the shop cloth inserted into the oil hole.

#### **WARNING:**

- Do not insert fingers into the oil hole.
- Be careful not to touch rotating parts (drive belt, idler pulleys and crankshaft pulley, etc.).

#### **CAUTION:**

- Do not perform cranking without installing the engine mounting insulator (RH) and engine mounting bracket (RH).
  - Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.
  - Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belt, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.
7. Perform the following inspection if engine oil does not come out from intake or exhaust valve timing control solenoid valve oil hole of the cylinder head.
    - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-6, "Engine Lubrication System Schematic"](#).

## CAMSHAFT

[MRA8DE]

### < REMOVAL AND INSTALLATION >

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8. Remove components between intake or exhaust valve timing control solenoid valve and camshaft sprocket (INT) or (EXH), and then check each oil groove for clogging.
  - Clean oil groove if necessary. Refer to [LU-6. "Engine Lubrication System Schematic"](#).
9. Installation of remaining components is in the reverse order of removal.

## OIL SEAL VALVE OIL SEAL

### VALVE OIL SEAL : Removal and Installation

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A

EM

#### REMOVAL

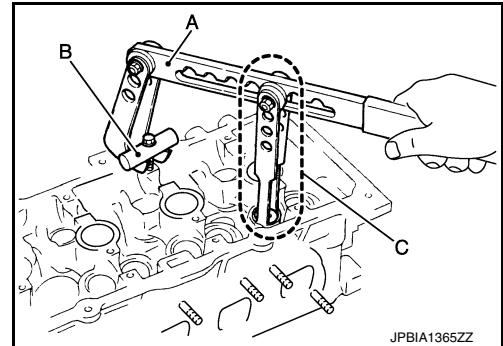
1. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

**CAUTION:**

**When rotating crankshaft, be careful to avoid scarring front cover with timing chain.**

2. Remove camshafts. Refer to [EM-60, "Exploded View"](#).
3. Remove valve lifters. Refer to [EM-60, "Exploded View"](#).
4. Remove valve collet, valve spring retainer, and valve spring using Tools.

- Tool number (A) : KV1016200 (J-26336-A)**  
**Tool number (B) : KV10109220 ( — )**  
**Tool number (C) : KV10115900 (J-26336-20)**



C

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E

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G

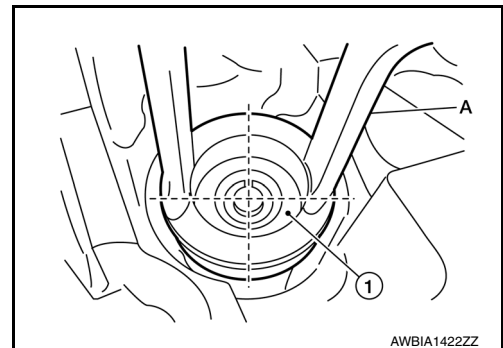
H

**CAUTION:**

- Do not damage valve lifter holes.
- Install Tool (A) in the center of valve spring retainer to press it.

- (1) : Valve spring retainer  
 (A) : Attachment

- Tool number : KV10115900 (J-26336-20)**



I

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K

L

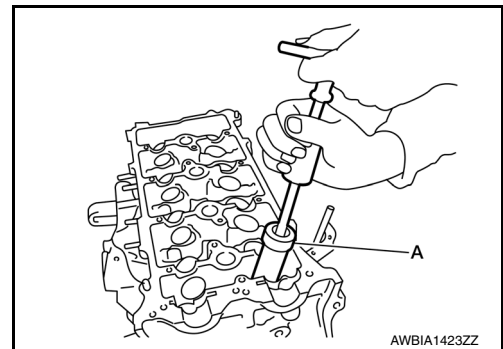
5. Remove valve spring retainer and valve spring (with valve spring seat).

**CAUTION:**

**Do not remove valve spring seat from valve spring.**

6. Remove valve oil seal using Tool (A).

- Tool number : KV10107902 (J-38959)**



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#### INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.

# OIL SEAL

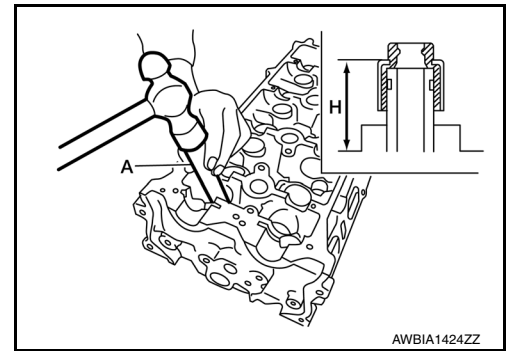
[MRA8DE]

## < REMOVAL AND INSTALLATION >

2. Press in valve oil seal to the height (H) shown using Tool (A).

**Height (H)** : 15.1 - 15.7 mm (0.594 - 0.618 in)

**Tool number** : KV10115600 (J-38958)



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

## FRONT OIL SEAL

### FRONT OIL SEAL : Removal and Installation

INFOID:000000009756979

#### REMOVAL

1. Remove front fender protector (RH). Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).
2. Remove drive belt. Refer to [EM-15, "Exploded View"](#).
3. Remove crankshaft pulley. Refer to [EM-48, "Exploded View"](#).
4. Remove front oil seal using suitable tool.

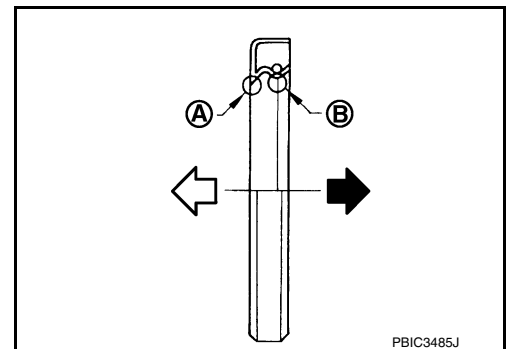
**CAUTION:**

**Do not damage front cover 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.

- (A) : Dust seal lip  
(B) : Oil seal lip  
⇐ : Engine outside  
⇨ : Engine inside



- Press-fit front oil seal using a suitable tool with outer diameter 57 mm (2.24 in) and inner diameter 45 mm (1.77 in).

**Within 0.3 mm (0.012 in) toward engine front (crankshaft pulley side)**

**Within 0.5 mm (0.020 in) toward engine rear (crankshaft sprocket side)**

**CAUTION:**

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

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

## REAR OIL SEAL

### REAR OIL SEAL : Removal and Installation

INFOID:000000009756980

#### REMOVAL

1. Remove engine and transaxle assembly. Refer to [EM-86, "CVT : Exploded View"](#) (CVT models) or [TM-28, "Exploded View"](#) (M/T models).

# OIL SEAL

[MRA8DE]

## < REMOVAL AND INSTALLATION >

2. Remove clutch cover and clutch disc (M/T models). Refer to [CL-17, "Exploded View"](#).
3. Remove drive plate (CVT models) or flywheel (M/T models). Refer to [EM-94, "Exploded View"](#).
4. Remove rear oil seal using suitable tool.

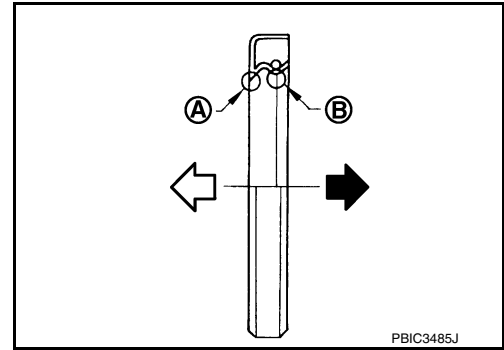
**CAUTION:**

**Do not damage crankshaft and cylinder block.**

## INSTALLATION

1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.  
**Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).**
2. Install rear oil seal so that each seal lip is oriented as shown.

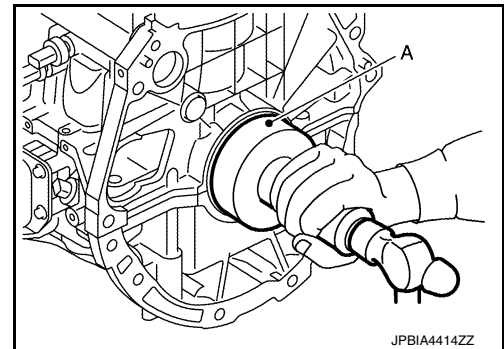
- (A) : Dust seal lip
- (B) : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



- Press-fit rear oil seal using suitable tool (A) with outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in).

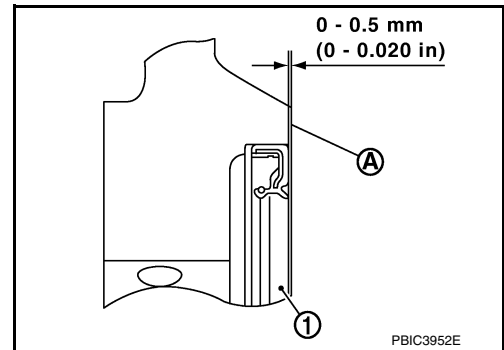
**CAUTION:**

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



- Press in rear oil seal (1) to the position as shown.

- (A) : Rear end surface of cylinder block



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

# CYLINDER HEAD

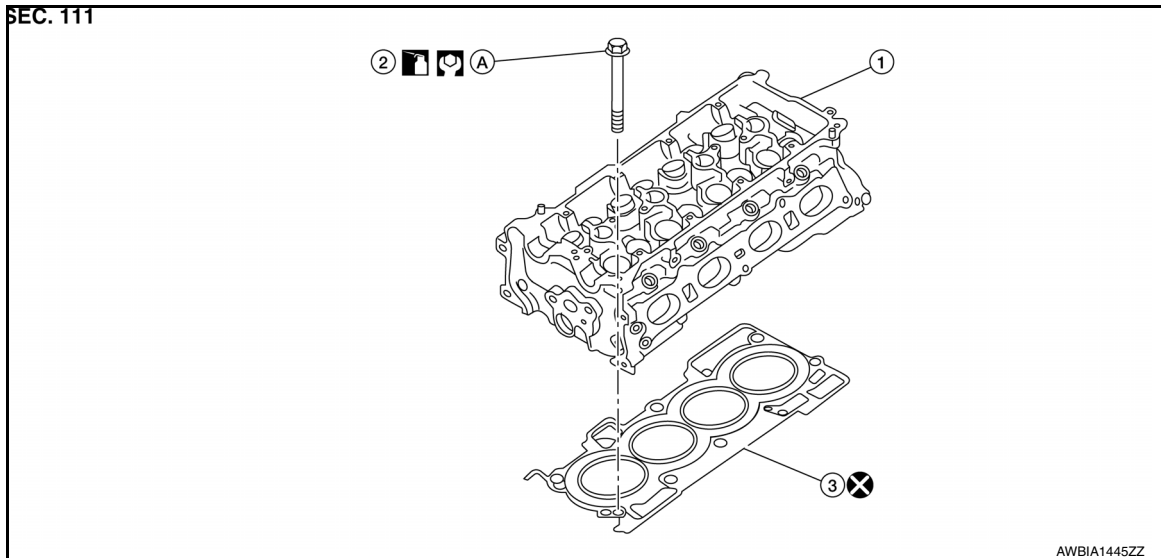
< REMOVAL AND INSTALLATION >

[MRA8DE]

## CYLINDER HEAD

### Exploded View

INFOID:000000009756981



- 1. Cylinder head assembly
- 2. Cylinder head bolt
- 3. Cylinder head gasket
- A. Refer to INSTALLATION

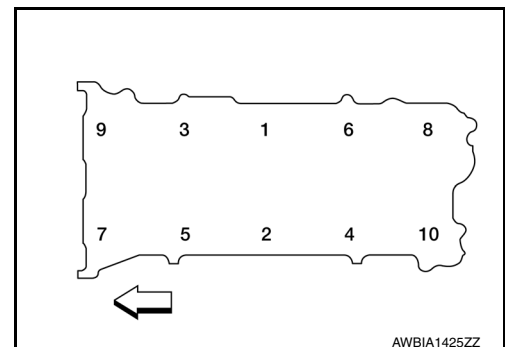
### Removal and Installation

INFOID:000000009756982

#### REMOVAL

1. Release fuel pressure. Refer to [EC-143, "Work Procedure"](#).
2. Drain engine coolant and engine oil. Refer to [CO-12, "Changing Engine Coolant"](#) (for Coolant) and [LU-8, "Draining"](#) (for Oil).
3. Remove fan motor and shroud assembly. Refer to [CO-17, "Component"](#).
4. Remove the exhaust manifold. Refer to [EM-30, "Exploded View"](#)
5. Remove the intake manifold. Refer to [EM-27, "Exploded View"](#).
6. Remove the fuel injector and fuel tube assembly. Refer to [EM-40, "Exploded View"](#).
7. Remove the water outlet. Refer to [CO-24, "Exploded View"](#).
8. Remove the rocker cover. Refer to [EM-46, "Exploded View"](#).
9. Remove the front cover and timing chain. Refer to [EM-48, "Exploded View"](#).
10. Remove the camshaft. Refer to [EM-60, "Exploded View"](#).
11. Remove cylinder head.
  - Loosen cylinder head bolts in the reverse order as shown.

⇐ : Engine front



12. Remove cylinder head gasket.

#### INSTALLATION



# CYLINDER HEAD

[MRA8DE]

## < REMOVAL AND INSTALLATION >

1. Install cylinder head gasket.

**CAUTION:**

**Do not reuse cylinder head gasket.**

2. Install cylinder head, and tighten cylinder head bolts in order as shown using Tool (A).

- Clean threads and seating surfaces of bolts.
- Apply new engine oil to threads and seating surface of bolts.

**CAUTION:**

- **If cylinder head bolts are reused, check their outer diameters before installation. Refer to [EM-79, "Inspection"](#).**
- **Check and confirm the tightening angle by using Tool. Do not judge by visual inspection without the tool.**

**Tool number : KV10112100 (BT-8653-A)**

**Step 1 : 40.0 N·m (4.1 kg-m, 30 ft-lb)**

**Step 2 : 100° clockwise in order**

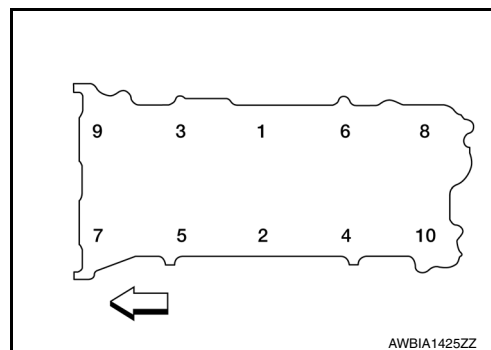
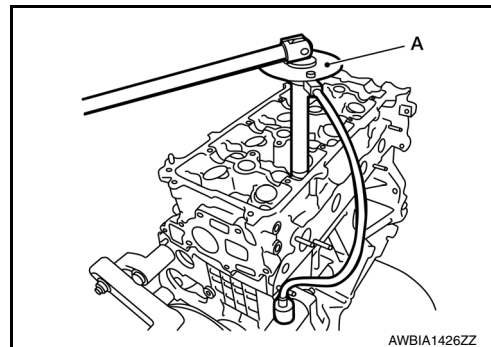
**Step 3 : 0 N·m (0 kg-m, 0 ft-lb)**

**Step 4 : 40.0 N·m (4.1 kg-m, 30 ft-lb)**

**Step 5 : 100° clockwise in order**

**Step 6 : 100° clockwise in order**

← : Engine front



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

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

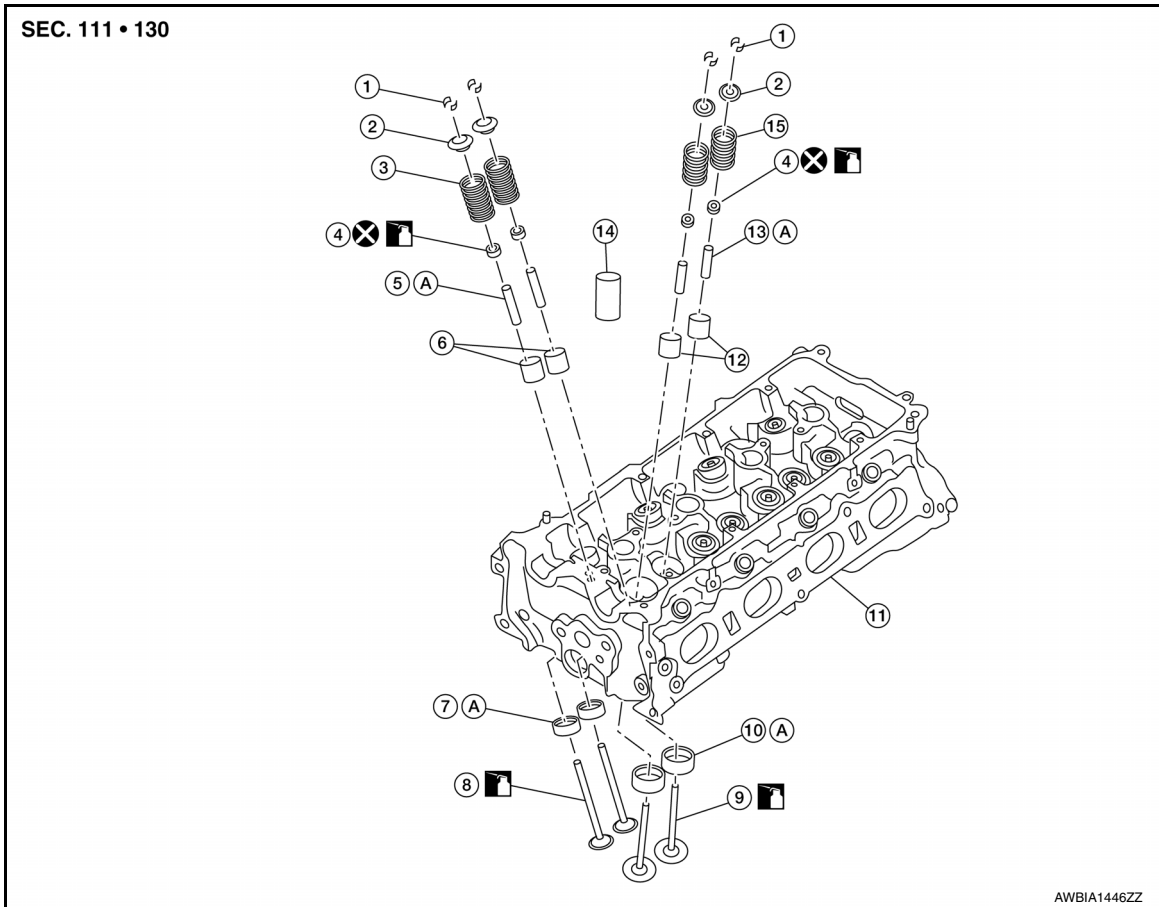
# CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[MRA8DE]

## Exploded View

INFOID:000000009756983



- |                       |                          |  |
|-----------------------|--------------------------|--|
| 1. Valve collet       | 2. Valve spring retainer | 3. Valve spring (EXH)<br>(with valve spring seat)  |
| 4. Valve oil seal     | 5. Valve guide (EXH)     | 6. Valve lifter (EXH)                              |
| 7. Valve seat (EXH)   | 8. Valve (EXH)           | 9. Valve (INT)                                     |
| 10. Valve seat (INT)  | 11. Cylinder head        | 12. Valve lifter (INT)                             |
| 13. Valve guide (INT) | 14. Spark plug tube      | 15. Valve spring (INT)<br>(with valve spring seat) |

A. Refer to INSTALLATION

## Disassembly and Assembly

INFOID:000000009756984

### DISASSEMBLY

1. Remove spark plug using suitable tool.
2. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.

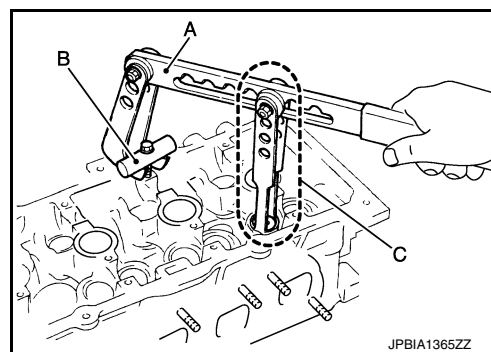
## CYLINDER HEAD

[MRA8DE]

### < REMOVAL AND INSTALLATION >

3. Remove valve collet, valve spring retainer, and valve spring using Tools.

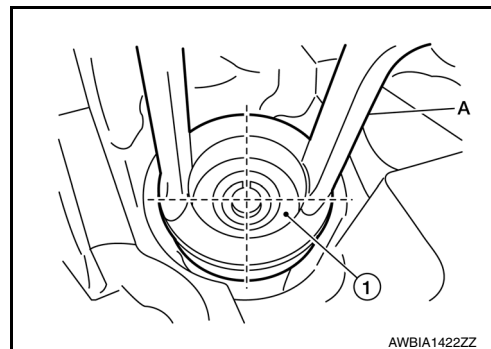
Tool number (A) : KV1016200 (J-26336-A)  
Tool number (B) : KV10109220 ( — )  
Tool number (C) : KV10115900 (J-26336-20)



#### CAUTION:

- Do not damage valve lifter holes.
- Install Tool (A) in the center of valve spring retainer (1) to install it.

Tool number : KV10115900 (J-26336-20)



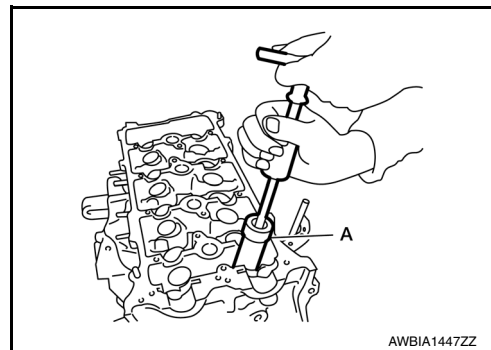
4. Remove valve spring retainer and valve spring (with valve spring seat).

#### CAUTION:

**Do not remove valve spring seat from valve spring.**

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 seal using Tool (A).

Tool number : KV10107902 (J-38959)



7. Remove valve seat, if necessary.
- 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-121, "Cylinder Head"](#).

#### CAUTION:

**Do not bore excessively to prevent damage to cylinder head.**

8. Remove valve guide, if necessary.

# CYLINDER HEAD

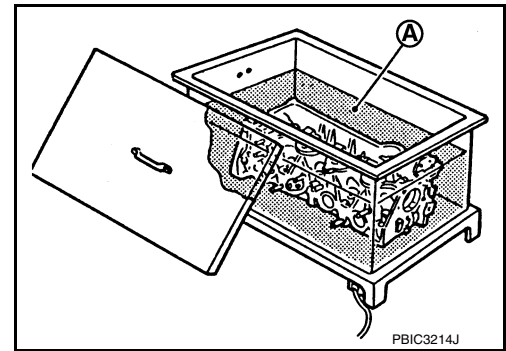
[MRA8DE]

## < REMOVAL AND INSTALLATION >

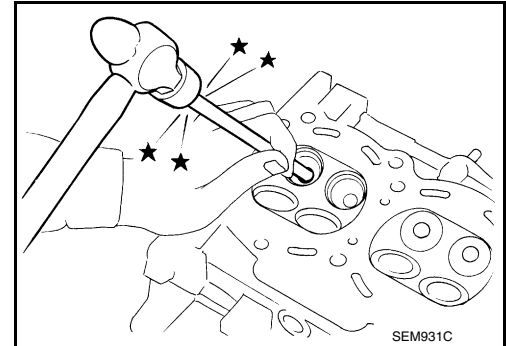
- a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).

**WARNING:**

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



- b. Drive out valve guide using suitable tool.



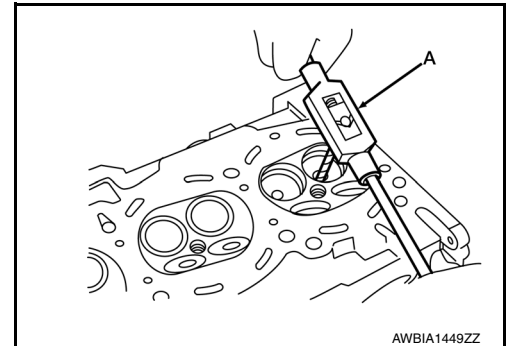
## ASSEMBLY

1. Install valve guide, if removed.

**CAUTION:**

Replace with oversize [0.2 mm (0.008 in)] valve guide. Refer to [EM-121, "Cylinder Head"](#).

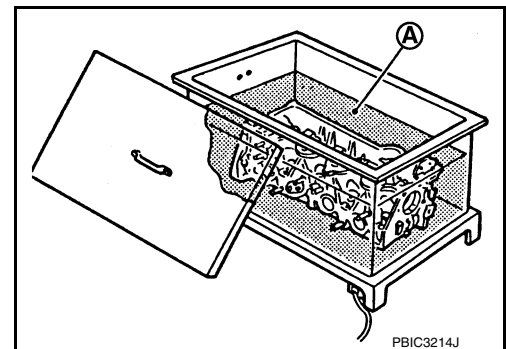
- a. Ream cylinder head valve guide hole using suitable tool (A).



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

**WARNING:**

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



# CYLINDER HEAD

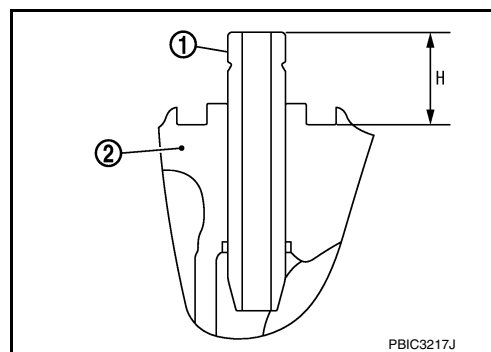
[MRA8DE]

## < REMOVAL AND INSTALLATION >

- c. Press valve guide (1) from camshaft side to dimension as shown.

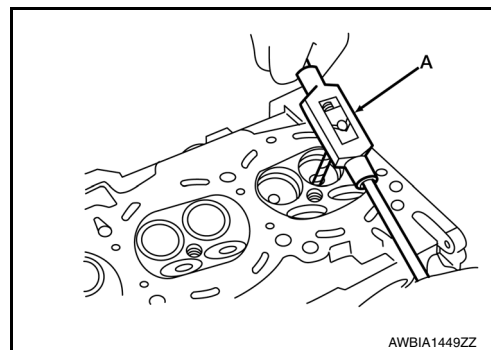
(2) : Cylinder head

**Projection (H)** : Refer to [EM-121, "Cylinder Head"](#).



- d. Apply reamer finish to valve guide using suitable tool (A).

**Standard** : Refer to [EM-121, "Cylinder Head"](#).



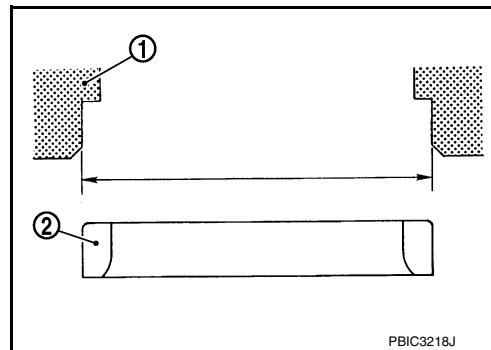
2. Install valve seat, if removed.

**CAUTION:**

**Replace with oversize [0.5 mm (0.020 in)] valve seat. Refer to [EM-121, "Cylinder Head"](#).**

- a. Ream cylinder head (1) recess diameter for service valve seat (2).

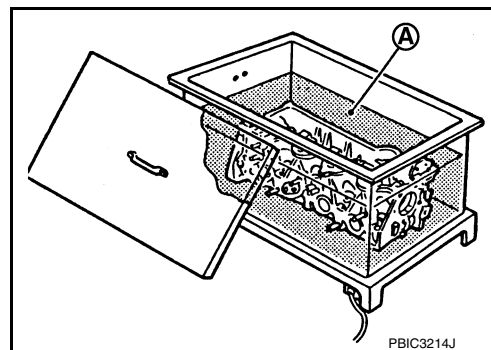
- Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.



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

**WARNING:**

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



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

**CAUTION:**

**Do not touch cold valve seats directly.**

# CYLINDER HEAD

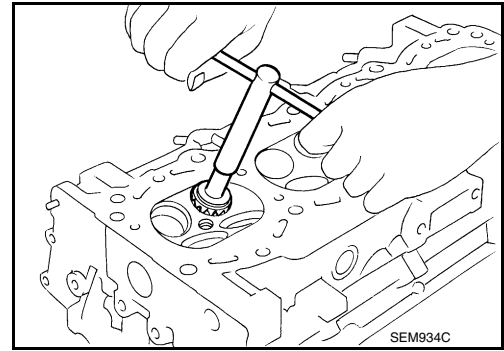
[MRA8DE]

## < REMOVAL AND INSTALLATION >

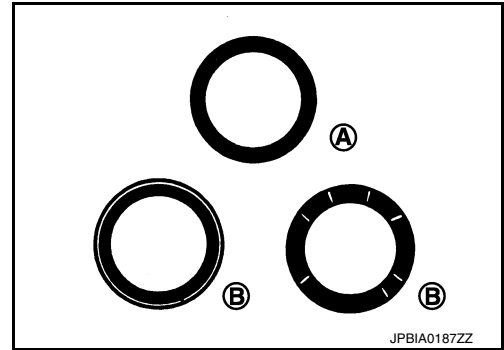
- d. Finish valve seat to the specified dimension using suitable tool. Refer to [EM-121, "Cylinder Head"](#).

**CAUTION:**

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



- e. Using compound, grind to adjust valve.  
f. Check again for normal contact. Refer to [EM-121, "Cylinder Head"](#).



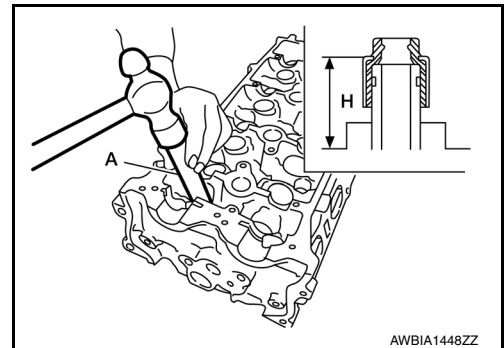
3. Install valve oil seal using Tool (A).

**NOTE:**

Dimension is height measured before installing valve spring (with valve spring seat).

**Height (H) : 15.1 - 15.7 mm (0.594 - 0.618 in)**

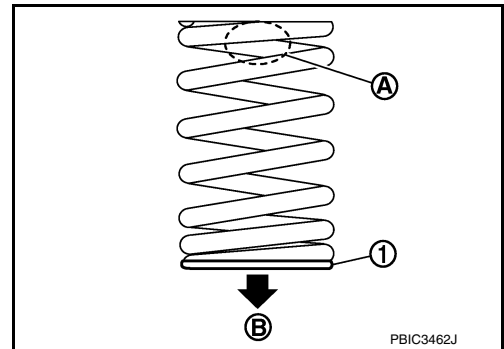
**Tool number : KV10115600 (J-38958)**



4. Install valve.  
• Install larger diameter to intake side.  
5. Install valve spring with valve spring seat (1) (do not remove from valve spring).  
• Install smaller pitch (valve spring seat side) to cylinder head side (B).  
• Confirm identification color (A) of valve spring.

**Intake : White**

**Exhaust : Orange**



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

# CYLINDER HEAD

[MRA8DE]

## < REMOVAL AND INSTALLATION >

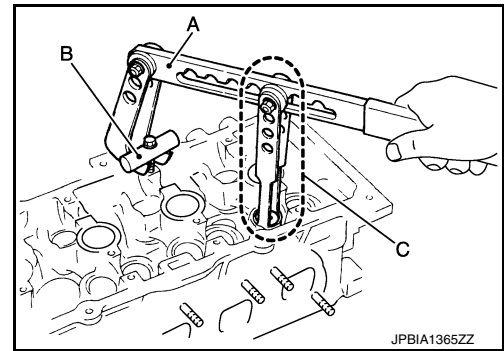
- Compress valve spring using Tool. Install valve collet with a magnet hand.

Tool number (A) : KV1016200 (J-26336-A)  
Tool number (B) : KV10109220 ( — )  
Tool number (C) : KV10115900 (J-26336-20)

### CAUTION:

When working do not damage valve lifter holes.

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



- Install valve lifter.
  - Install it in the original position.
- Install spark plug. Refer to [EM-12. "Exploded View"](#).

## Inspection

INFOID:000000009756985

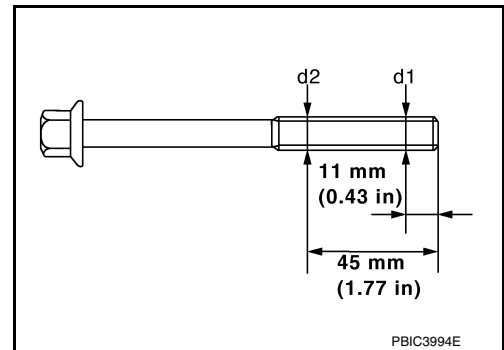
### INSPECTION AFTER REMOVAL

#### 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 a new one.

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

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



#### Cylinder Head Distortion

### NOTE:

When performing this inspection, cylinder block distortion should also be checked. Refer to [EM-123. "Cylinder Block"](#).

- Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

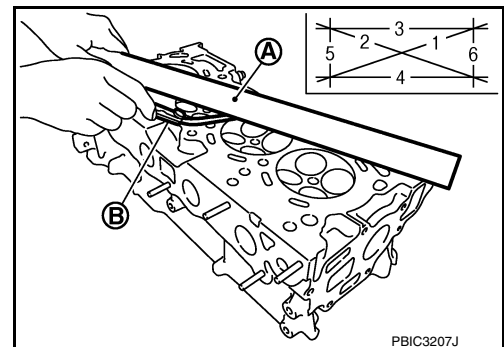
### CAUTION:

Do not allow gasket debris to enter passages for engine oil or water.

- At each of several locations on bottom surface of cylinder head, measure the distortion in six directions using suitable tools (A, B).

Limit: Refer to [EM-121. "Cylinder Head"](#).

- If it exceeds the limit, replace cylinder head.



### INSPECTION AFTER DISASSEMBLY

#### Valve Dimensions

- Check the dimensions of each valve. Refer to [EM-121. "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

#### Valve Guide Clearance

# CYLINDER HEAD

[MRA8DE]

## < REMOVAL AND INSTALLATION >

### Valve Stem Diameter

- Measure the diameter of valve stem using suitable tool (A).

**Standard:** Refer to [EM-121, "Cylinder Head"](#).

### Valve Guide Inner Diameter

- Measure the inner diameter of valve guide using suitable tool.

**Standard:** Refer to [EM-121, "Cylinder Head"](#).

### Valve Guide Clearance

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

**Standard and Limit:** Refer to [EM-121, "Cylinder Head"](#).

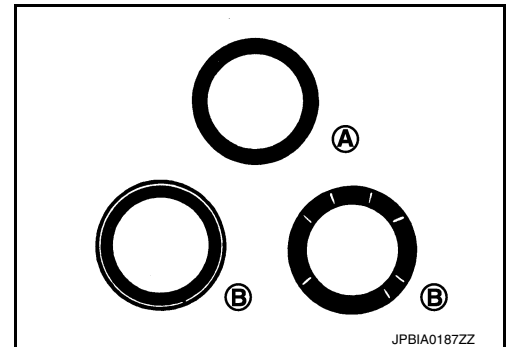
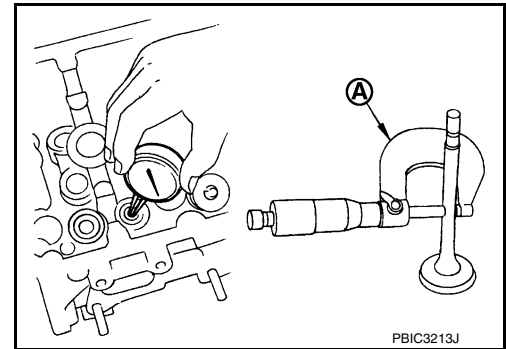
- If the calculated value exceeds the limit, replace valve and/or valve guide, when valve guide must be replaced. Refer to [EM-74, "Disassembly and Assembly"](#).

### 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.

(A) : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions (B) even after the recheck, replace valve seat. Refer to [EM-74, "Disassembly and Assembly"](#).



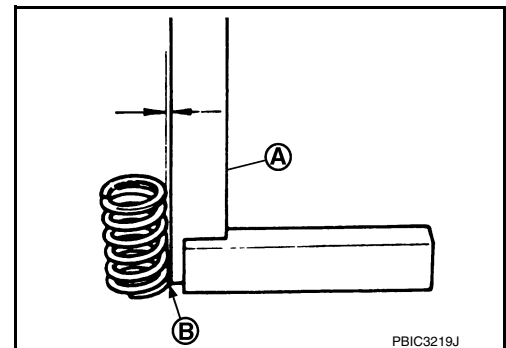
### VALVE SPRING SQUARENESS

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

(B) : Contact

**Limit** : Refer to [EM-121, "Cylinder Head"](#).

- If it exceeds the limit, replace valve spring.



### VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

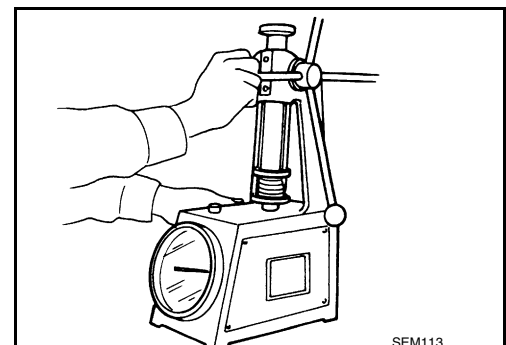
- Check valve spring pressure with valve spring seat installed at the specified spring height.

#### **CAUTION:**

**Do not remove valve spring seat from valve spring.**

**Standard** : Refer to [EM-121, "Cylinder Head"](#).

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





# CYLINDER HEAD

[MRA8DE]

## < REMOVAL AND INSTALLATION >

### INSPECTION AFTER INSTALLATION

- 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-11, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check 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:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

\*: Power steering fluid, brake fluid, etc.

A  
EM  
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# ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[MRA8DE]

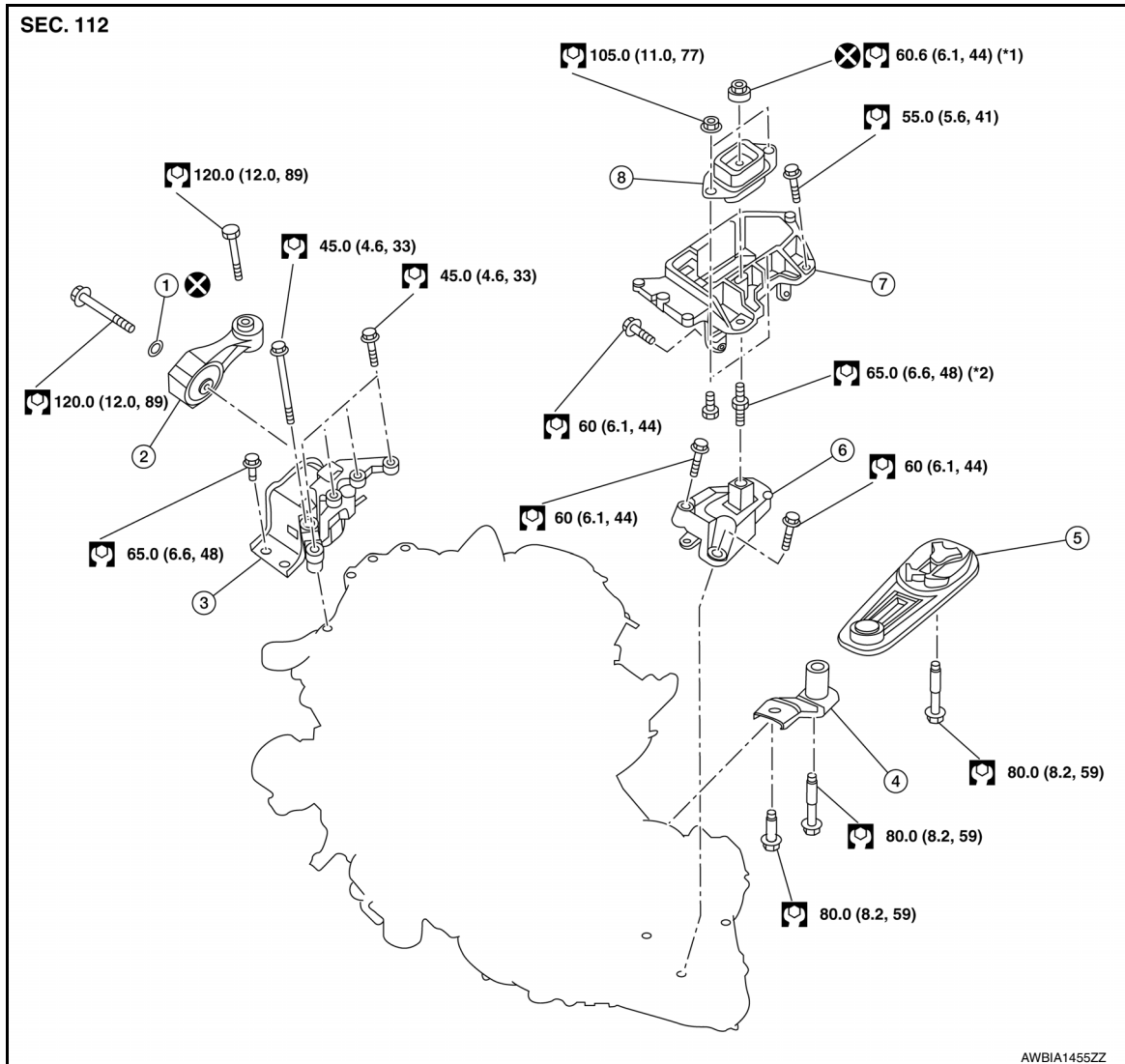
## UNIT REMOVAL AND INSTALLATION

### ENGINE ASSEMBLY

M/T

M/T : Exploded View

INFOID:000000009756986



- |                                       |                                   |                                   |
|---------------------------------------|-----------------------------------|-----------------------------------|
| 1. Washer                             | 2. Upper torque rod (RH)          | 3. Engine mounting insulator (RH) |
| 4. Rear torque rod bracket            | 5. Rear torque rod                | 6. Engine mounting bracket (LH)   |
| 7. Engine mounting frame support (LH) | 8. Engine mounting insulator (LH) |                                   |

#### CAUTION:

Check that the stud bolt (\*2) is tight at the specified torque before tightening the nut (\*1) shown. [Stud bolt (\*2) may be loosened after loosening the nut (\*1)]

M/T : Removal and Installation

INFOID:000000009756987

#### WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.

#### CAUTION:

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

# ENGINE ASSEMBLY

[MRA8DE]

## < UNIT REMOVAL AND INSTALLATION >

- Do not start working until exhaust system and coolant are cool enough.
- 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-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 a 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-31, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

### NOTE:

When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

## REMOVAL

### Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

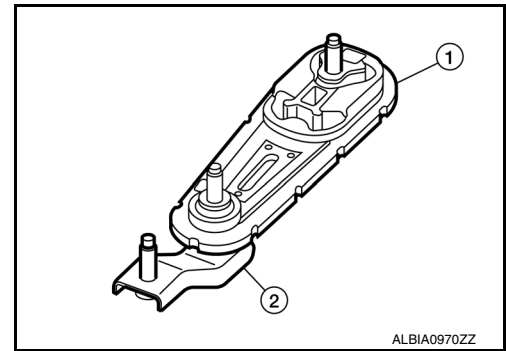
1. Remove hood assembly. Refer to [DLK-149, "HOOD ASSEMBLY : Removal and Installation"](#).
2. Release fuel pressure. Refer to [EC-143, "Work Procedure"](#).
3. Remove battery and battery tray. Refer to [PG-50, "Exploded View"](#).
4. Remove engine room cover. Refer to [EM-24, "Exploded View"](#).
5. Remove cowl top. Refer to [EXT-26, "Removal and Installation"](#).
6. Remove air cleaner body. Refer to [EM-25, "Exploded View"](#).
7. Remove engine under cover. Refer to [EM-24, "Exploded View"](#).
8. Drain engine coolant from radiator. Refer to [CO-12, "Changing Engine Coolant"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Do not spill engine coolant on drive belts.
9. Remove front wheels and tires (RH/LH) using power tool. Refer to [WT-47, "Adjustment"](#).
10. Remove front fender protector side covers (RH/LH). Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).
11. Remove drive belt. Refer to [EM-15, "Removal and Installation"](#).
12. Disconnect vacuum hose from intake manifold. Refer to [EM-27, "Exploded View"](#).
13. Remove radiator hoses (upper and lower). Refer to [CO-15, "Exploded View"](#).
14. Remove radiator and fan motor and shroud assembly. Refer to [CO-15, "Exploded View"](#).
15. Remove ECM bracket, and then temporarily secure the engine harness on the engine side.  
**CAUTION:**  
**Protect harness connectors using a resin bag against foreign materials during the operation.**
16. Disconnect fuel feed hose quick connector. Refer to [EM-40, "Exploded View"](#).
17. Disconnect heater hoses. Refer to [CO-24, "Exploded View"](#).
18. Disconnect control linkage from transaxle. Refer to [TM-22, "Exploded View"](#).
19. Remove EVAP hoses. Refer to [FL-14, "Exploded View"](#).
20. Disconnect clutch tube on transaxle side from concentric slave cylinder (CSC). Refer to [CL-14, "Exploded View"](#).
21. Remove A/C compressor bolts and position A/C compressor aside. Refer to [HA-30, "Exploded View"](#).
22. Remove ground cable at engine side.
23. Remove ground cable at transaxle side.
24. Remove drive shafts (RH/LH). Refer to [FAX-18, "6M/T : Exploded View \(LH\)"](#).
25. Remove exhaust front tube. Refer to [EX-5, "Exploded View"](#).

# ENGINE ASSEMBLY

[MRA8DE]

## < UNIT REMOVAL AND INSTALLATION >

26. Remove rear torque rod (1) and torque rod bracket (2).



27. Remove stabilizer connecting rod. Refer to [FSU-12. "Exploded View"](#).

28. Remove front suspension member. Refer to [FSU-16. "Exploded View"](#).

29. Preparation for the separation work of transaxle is as follows:

- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-33. "Exploded View"](#).

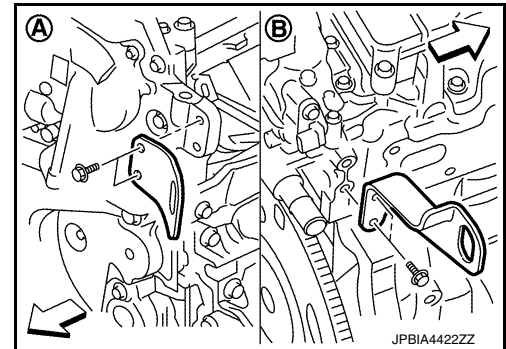
30. Install engine slinger to front cover front (LH) side (A) and cylinder head rear (RH) side (B).

⇐ : Engine front

### Slinger bolts

**Front cover front (LH) side:** : 32.9 N·m (3.4 kg-m, 24 ft-lb)

**Cylinder head rear (RH) side:** : 25.0 N·m (2.6 kg-m, 18 ft-lb)

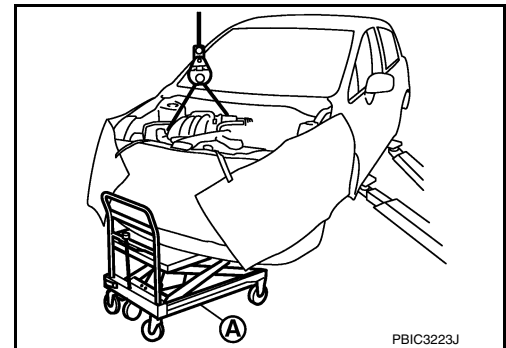


31. Support engine and transaxle assembly with engine lifting equipment from the top with the vehicle raised on a hoist.

32. Use a manual lift table caddy (A) or equivalent rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

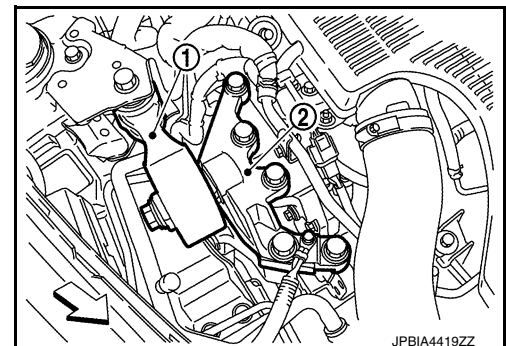
### CAUTION:

**Put a piece of wood or equivalent as the supporting surface, secure a completely stable condition.**



33. Remove upper torque rod (1) and engine mounting insulator (RH) (2).

⇐ : Front



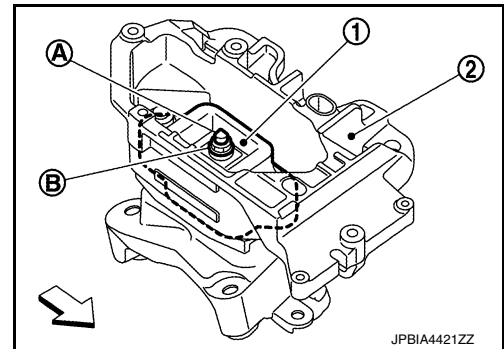
# ENGINE ASSEMBLY

[MRA8DE]

## < UNIT REMOVAL AND INSTALLATION >

34. Remove engine mounting bracket (LH) through bolt nut (B).

- (1) : Engine mounting insulator (LH)
- (2) : Engine mounting bracket support (LH)
- (A) : Through bolt
- ↔ : Front



35. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.

**CAUTION:**

- Check that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support the vehicle by setting jack or suitable tool at the rear.

36. Remove starter motor. Refer to [STR-30, "Exploded View"](#).

37. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-28, "Exploded View"](#).

## INSTALLATION

Installation is in the reverse order of removal.

**NOTE:**

Tighten all mounts to specification.

**CAUTION:**

- Do not allow engine oil to get on engine insulator. Be careful not to damage engine mounting insulator.
- Check that each mounting insulator is seated properly, and tighten nuts and bolts.
- When installation directions are specified, install parts according to the direction marks on them referring to the illustration of components. Refer to [EM-82, "M/T : Exploded View"](#).

## M/T : Inspection

INFOID:000000009756988

## INSPECTION AFTER INSTALLATION

- 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-11, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check 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:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level

# ENGINE ASSEMBLY

## < UNIT REMOVAL AND INSTALLATION >

[MRA8DE]

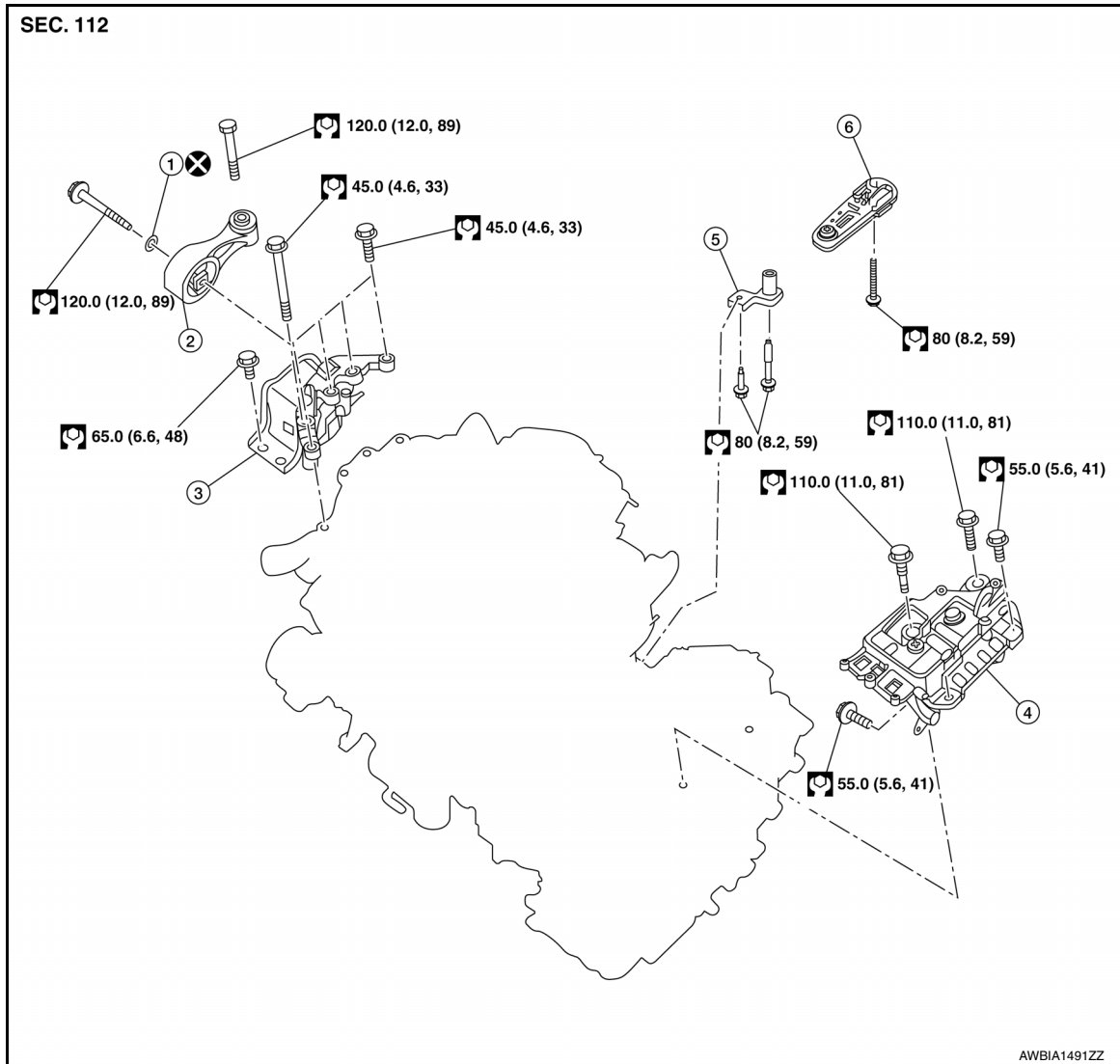
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

\*: Power steering fluid, brake fluid, etc.

## CVT

### CVT : Exploded View

INFOID:000000009756989



- |                                   |                            |                                   |
|-----------------------------------|----------------------------|-----------------------------------|
| 1. Washer                         | 2. Upper torque rod (RH)   | 3. Engine mounting insulator (RH) |
| 4. Engine mounting insulator (LH) | 5. Rear torque rod bracket | 6. Rear torque rod                |

### CVT : Removal and Installation

INFOID:000000009756990

#### **WARNING:**

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.

#### **CAUTION:**

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



# ENGINE ASSEMBLY

[MRA8DE]

< UNIT REMOVAL AND INSTALLATION >

- Do not start working until exhaust system and coolant are cool enough.
- 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-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 a 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-31, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

## NOTE:

When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

## REMOVAL

### Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

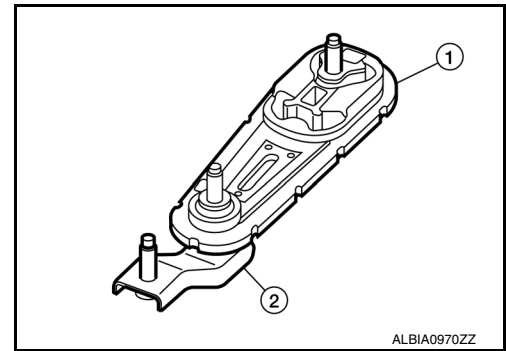
1. Remove hood assembly. Refer to [DLK-149, "HOOD ASSEMBLY : Removal and Installation"](#).
2. Release fuel pressure. Refer to [EC-143, "Work Procedure"](#).
3. Remove battery and battery tray. Refer to [PG-50, "Exploded View"](#).
4. Remove engine room cover. Refer to [EM-24, "Exploded View"](#).
5. Remove cowl top. Refer to [EXT-26, "Removal and Installation"](#).
6. Remove air cleaner body. Refer to [EM-25, "Exploded View"](#).
7. Remove engine under cover. Refer to [EM-24, "Exploded View"](#).
8. Drain engine coolant from radiator. Refer to [CO-12, "Changing Engine Coolant"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Do not spill engine coolant on drive belts.
9. Remove front wheels and tires (RH/LH) using power tool. Refer to [WT-47, "Adjustment"](#).
10. Remove front fender protector side covers (RH). Refer to [EXT-27, "FENDER PROTECTOR : Exploded View"](#).
11. Remove drive belt. Refer to [EM-15, "Removal and Installation"](#).
12. Disconnect vacuum hose from intake manifold. Refer to [EM-27, "Exploded View"](#).
13. Remove radiator hose (upper and lower). Refer to [CO-15, "Exploded View"](#).
14. Remove radiator and fan shroud and motor assembly. Refer to [CO-15, "Exploded View"](#).
15. Remove TCM and bracket. Refer to [TM-263, "Exploded View"](#).
16. Remove ECM bracket, and then temporarily secure the engine harness on the engine side.  
**CAUTION:**  
**Protect harness connectors using a resin bag against foreign materials during the operation.**
17. Disconnect fuel feed hose quick connector. Refer to [EM-40, "Exploded View"](#).
18. Disconnect heater hoses. Refer to [CO-24, "Exploded View"](#).
19. Disconnect control cable from transaxle. Refer to [TM-256, "Exploded View"](#).
20. Disconnect lines from CVT oil warmer. Refer to [TM-273, "Exploded View"](#).
21. Remove EVAP hoses. Refer to [FL-14, "Exploded View"](#).
22. Remove A/C compressor bolts and position A/C compressor aside. Refer to [HA-30, "Exploded View"](#).
23. Remove ground cable at engine side.
24. Remove ground cable at transaxle side.
25. Remove drive shafts (RH/LH). Refer to [FAX-25, "EXCEPT 6M/T : Exploded View"](#).
26. Remove exhaust front tube. Refer to [EX-5, "Exploded View"](#).
27. Remove rear cover plate.
28. Remove torque converter nuts.

# ENGINE ASSEMBLY

[MRA8DE]

## < UNIT REMOVAL AND INSTALLATION >

29. Remove rear torque rod (1) and torque rod bracket (2).



30. Remove stabilizer connecting rod. Refer to [FSU-12. "Exploded View"](#).

31. Remove front suspension member. Refer to [FSU-16. "Exploded View"](#).

32. Preparation for the separation work of transaxle is as follows:

- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-33. "Exploded View"](#).

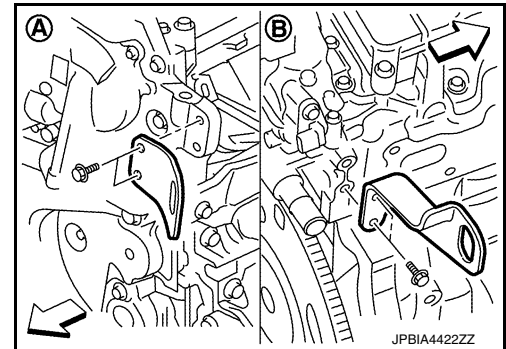
33. Install engine slinger to front cover front (LH) side (A) and cylinder head rear (RH) side (B).

⇐ : Engine front

### Slinger bolts

**Front cover front (LH) side:** : 32.9 N·m (3.4 kg-m, 24 ft-lb)

**Cylinder head rear (RH) side:** : 25.0 N·m (2.6 kg-m, 18 ft-lb)

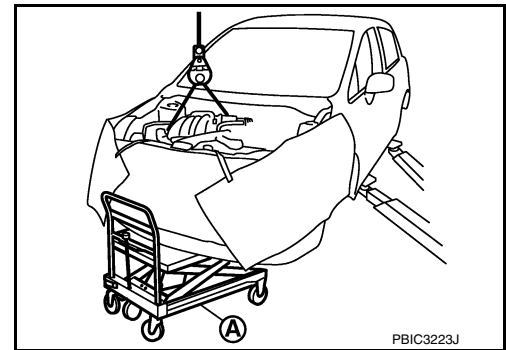


34. Support engine and transaxle assembly with engine lifting equipment from the top with the vehicle raised on a hoist.

35. Use a manual lift table caddy (A) or equivalent rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

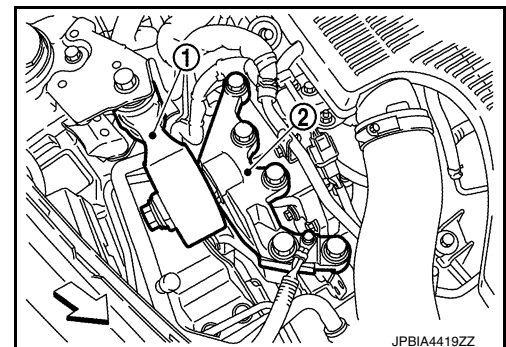
### CAUTION:

**Put a piece of wood or equivalent as the supporting surface, secure a completely stable condition.**



36. Remove upper torque rod (1) and engine mounting insulator (RH) (2).

⇐ : Front



37. Remove engine mounting insulator (LH).

38. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.



# ENGINE ASSEMBLY

[MRA8DE]

## < UNIT REMOVAL AND INSTALLATION >

### CAUTION:

- Check that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support the vehicle by setting jack or suitable tool at the rear.

39. Remove starter motor. Refer to [STR-30, "Exploded View"](#).

40. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-28, "Exploded View"](#).

### INSTALLATION

Installation is in the reverse order of removal.

#### NOTE:

Tighten all mounts to specification.

### CAUTION:

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Check that each mounting insulator is seated properly, and tighten nuts and bolts.
- When installation directions are specified, install parts according to the direction marks on them referring to the illustration of components. Refer to [EM-86, "CVT : Exploded View"](#).

### CVT : Inspection

INFOID:000000009756991

### INSPECTION AFTER INSTALLATION

- 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-11, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check 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:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

\*: Power steering fluid, brake fluid, etc.

# FLYWHEEL

< UNIT DISASSEMBLY AND ASSEMBLY >

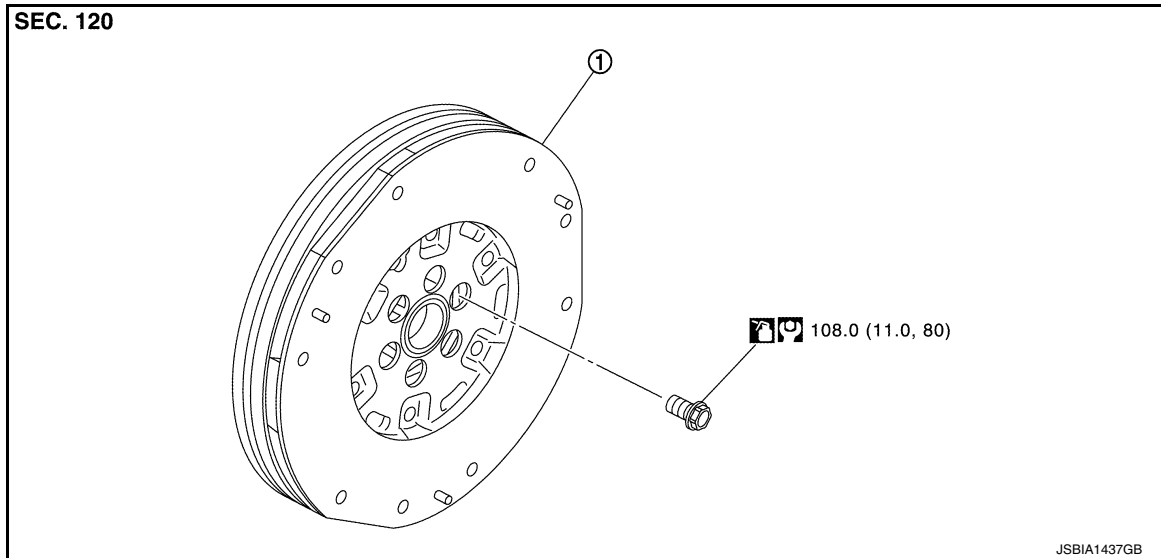
[MRA8DE]

## UNIT DISASSEMBLY AND ASSEMBLY

### FLYWHEEL

#### Exploded View

INFOID:000000009756992



1. Flywheel

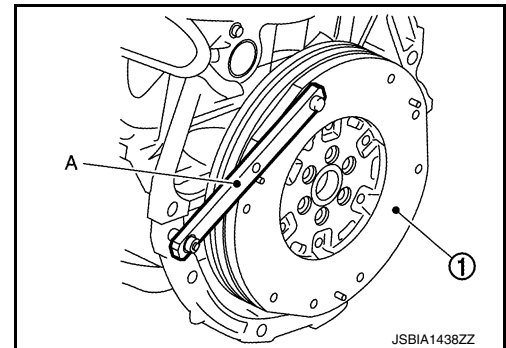
### Removal and Installation

INFOID:000000009756993

#### REMOVAL

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [TM-28, "Exploded View"](#).
2. Remove flywheel.
  - Secure flywheel (1) using Tool (A), and remove bolts using suitable tool.

**Tool number** : KV11105210 (J-44716)



#### CAUTION:

- Do not disassemble flywheel.
- Do not place flywheel with signal plate facing down.
- When handling signal plate, take care not to damage or scratch.
- Handle signal plate, do so in a manner that prevents it from becoming magnetized.

#### INSTALLATION

1. Install flywheel.

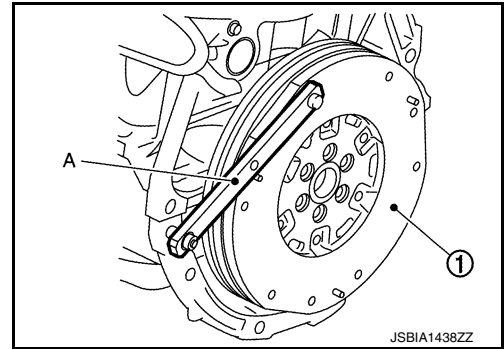
# FLYWHEEL

< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

- Secure flywheel (1) using Tool (A), and install bolts.

**Tool number** : KV11105210 (J-44716)



## CAUTION:

Be careful not to damage or scratch the contact surface of flywheel.

## Inspection

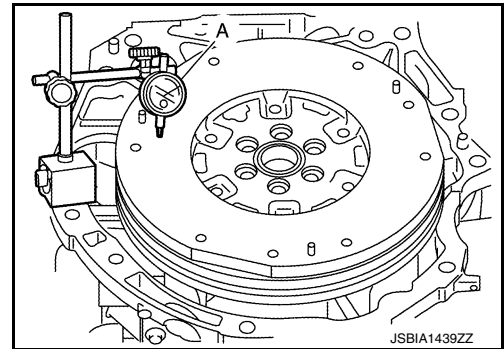
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### FLYWHEEL DEFLECTION

- Measure the deflection of flywheel contact surface to torque with a dial indicator (A).
- Measure the deflection at 210 mm (8.27 in) diameter.

**Limit** : 0.45 mm (0.0177 in) or less.

- If measured value is out of the standard, replace flywheel.
- If a trace of burn or discoloration is found on the surface, repair it with sandpaper.



### 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.

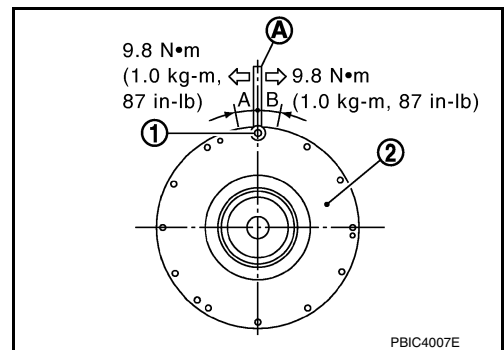
**Standard** : 1.8 mm (0.071 in) or less

- 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 clutch cover bolt (1) to clutch cover hole, and place a torque wrench (A) on the extended line of the flywheel (2) 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 transaxle side.
4. Measure the dimensions of movement amounts (A) and (B) on circumference of the flywheel on the transaxle side.



**Limit** : 33.2 mm (1.307 in) or less.

- If measured value is out of the standard, replace flywheel.

# DRIVE PLATE

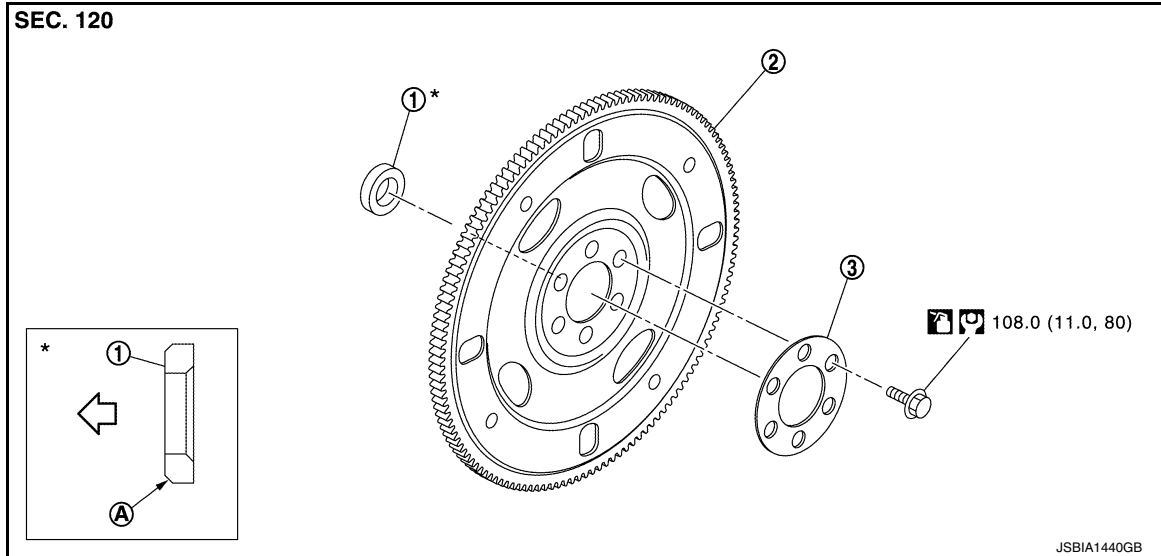
< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

## DRIVE PLATE

### Exploded View

INFOID:000000009756995



1. Pilot converter

2. Drive plate

3. Reinforcement plate

A. Chamfered

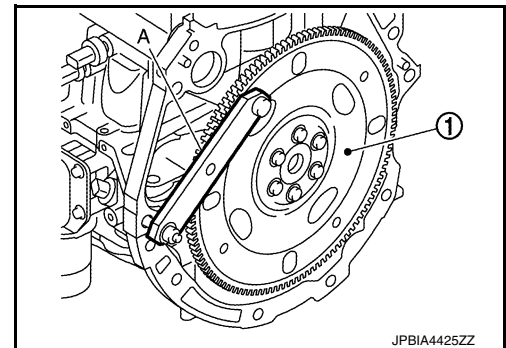
## Removal and Installation

INFOID:000000009756996

### REMOVAL

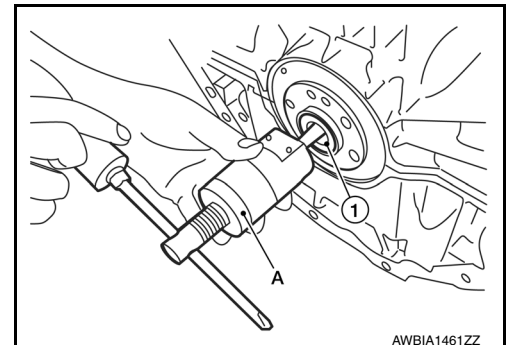
1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-86, "CVT : Exploded View"](#).
2. Remove drive plate.
  - Secure drive plate (1) using Tool (A), and remove bolts using suitable tool.

**Tool number : KV11105210 (J-44716)**



3. Remove pilot converter (1), from the rear end of the crankshaft. Use Tool (A), if necessary.

**Tool number : ST16610000 (J-23907)**



# DRIVE PLATE

< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

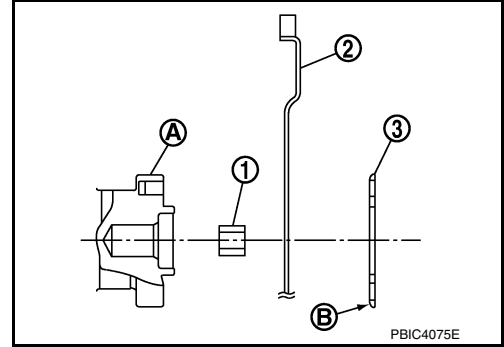
## INSTALLATION

1. Install pilot converter (1), drive plate (2) and reinforcement plate (3) as shown.

(A) : Crankshaft rear end

(B) : Rounded

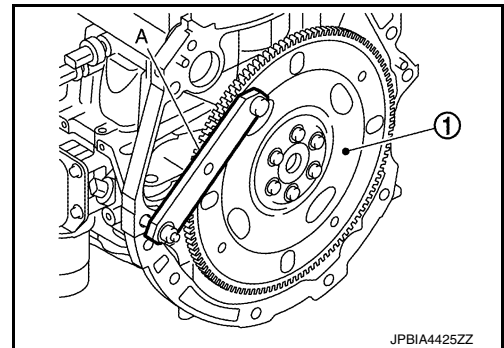
- Using a drift of 33 mm (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops.



2. Install drive plate.

- Secure drive plate (1) using Tool (A), and install bolts using suitable tool.

**Tool number** : KV11105210 (J-44716)



### CAUTION:

Be careful not to damage or scratch contact surface.

## Inspection

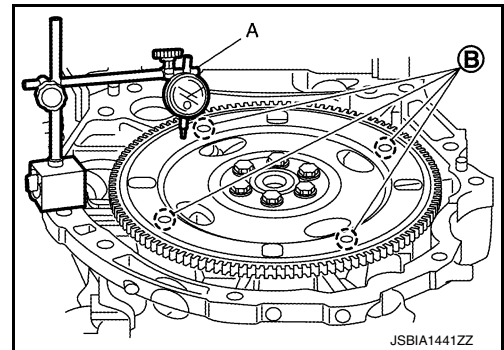
INFOID:000000009756997

### DRIVE PLATE DEFLECTION

- Measure the deflection of drive plate contact surface to torque converter with a dial indicator (A).
- Measure the deflection at the area limited between 12.4 mm (0.488 in) dia and 20.0 mm (0.787 in) dia around hole (B).

**Limit** : 0.35 mm (0.0138 in) or less.

- If measured value is out of the standard, replace drive plate.



# CYLINDER BLOCK

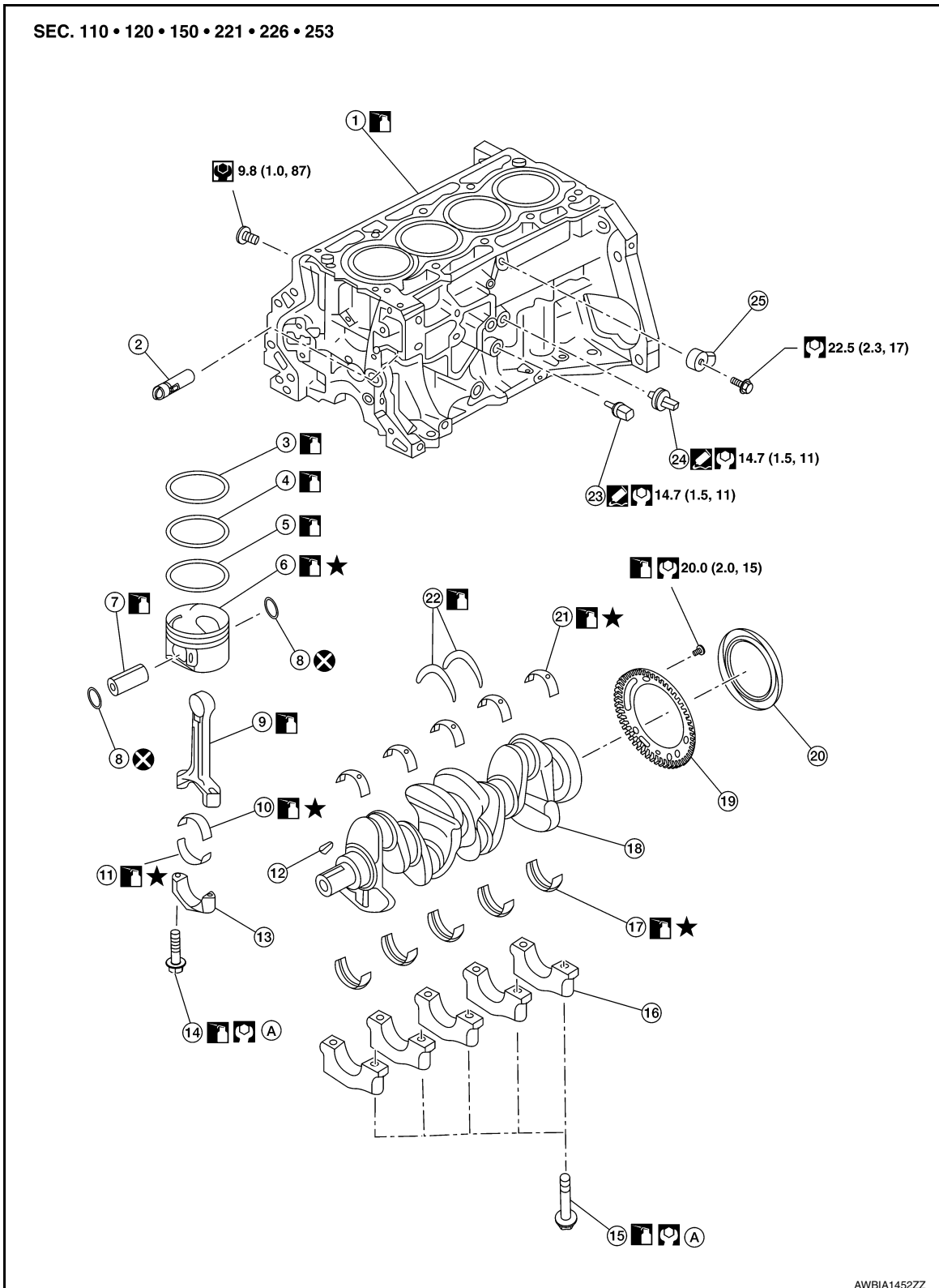
< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

## CYLINDER BLOCK

Exploded View

INFOID:000000009756998



AWBIA145ZZ

- |                   |                              |                   |
|-------------------|------------------------------|-------------------|
| 1. Cylinder block | 2. Block heater (for Canada) | 3. Top ring       |
| 4. Second ring    | 5. Oil ring                  | 6. Piston         |
| 7. Piston pin     | 8. Snap ring                 | 9. Connecting rod |

Revision: October 2013

EM-94

2014 Sentra NAM

# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- |                                    |                                    |                           |
|------------------------------------|------------------------------------|---------------------------|
| 10. Connecting rod bearing (upper) | 11. Connecting rod bearing (lower) | 12. Crankshaft key        |
| 13. Connecting rod cap             | 14. Connecting rod cap bolt        | 15. Main bearing cap bolt |
| 16. Main bearing cap               | 17. Main bearing (lower)           | 18. Crankshaft            |
| 19. Signal plate                   | 20. Rear oil seal                  | 21. Main bearing (upper)  |
| 22. Thrust bearing                 | 23. Oil temperature sensor         | 24. Oil pressure sensor   |
| 25. Knock sensor                   | A. Refer to INSTALLATION           |                           |

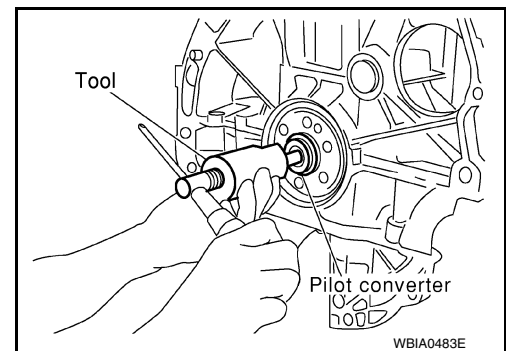
## Disassembly and Assembly

INFOID:000000009756999

### DISASSEMBLY

1. Remove engine and transaxle assembly from the vehicle. Refer to [EM-82, "M/T : Exploded View"](#) (M/T) or [EM-86, "CVT : Exploded View"](#) (CVT).
2. Remove the clutch cover and clutch. Refer to [CL-17, "Exploded View"](#).
3. Remove the flywheel or drive plate. Refer to [EM-90, "Exploded View"](#) (M/T) or [EM-92, "Exploded View"](#) (CVT).
4. Remove pilot converter using Tool.

**Tool Number** : ST16610001 (J-23907)



5. Remove the rear oil seal. Refer to [EM-70, "REAR OIL SEAL : Removal and Installation"](#).  
**CAUTION:**  
**Do not damage the crankshaft or cylinder block when removing the rear oil seal.**
6. Install engine to engine stand with the following procedure:
  - a. Remove flywheel or drive plate. Refer to [EM-90, "Exploded View"](#) (M/T models) or [EM-92, "Exploded View"](#) (CVT models).
  - b. Remove pilot converter. Refer to [EM-92, "Exploded View"](#) (CVT models).
  - c. Lift the engine with a hoist to install it onto widely use engine stand.

#### **CAUTION:**

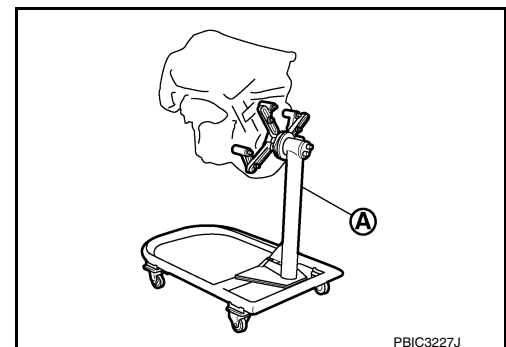
- Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to [EM-27, "Exploded View"](#).
  - Rocker cover: Refer to [EM-46, "Exploded View"](#).

#### **NOTE:**

The illustration shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel (M/T models) or drive plate (CVT models) removed.

#### **CAUTION:**

**Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.**



7. Drain engine oil. Refer to [LU-8, "Draining"](#).

#### **CAUTION:**

# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

**Be sure to clean drain plug and install with new drain plug washer.**

8. Drain fluids and lubricants by removing drain plugs (1, 3 and 4) the cylinder block.

↔ : Engine front

**Tightening torque** : Refer to [EM-95, "Disassembly and Assembly"](#).

**Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).**

9. Remove the engine harness.  
10. Remove the oil pan (upper). Refer to [EM-33, "Exploded View"](#).  
11. Remove the water pump. Refer to [CO-19, "Exploded View"](#).  
12. Remove thermostat housing. Refer to [CO-21, "Exploded View"](#).  
13. Remove the water outlet. Refer to [CO-24, "Exploded View"](#).  
14. Remove the cylinder head. Refer to [EM-72, "Exploded View"](#).  
15. Remove knock sensor (2).

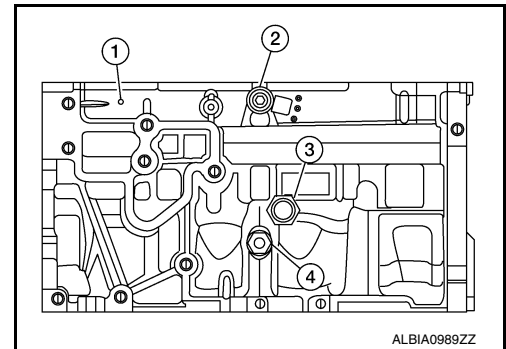
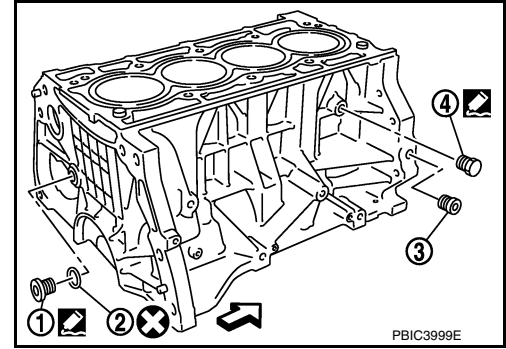
**CAUTION:**

**Carefully handle sensor avoiding shocks.**

16. Remove the oil pressure (3) and oil temp sensor (4).

**CAUTION:**

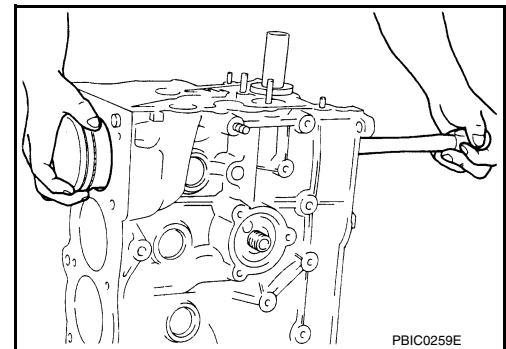
**Do not reuse O-ring.**



17. Remove piston and connecting rod assembly with the following procedure:
- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-103, "Inspection"](#).
- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.  
b. Remove connecting rod cap. Number connecting rod caps so they can be assembled in the same position and direction.  
c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

**CAUTION:**

- **Do not damage matching surface with connecting rod cap.**
- **Do not damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**



18. Remove connecting rod bearings.

**CAUTION:**

**When removing them, note the installation position. Keep them in the correct order.**

19. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to [EM-103, "Inspection"](#).



# CYLINDER BLOCK

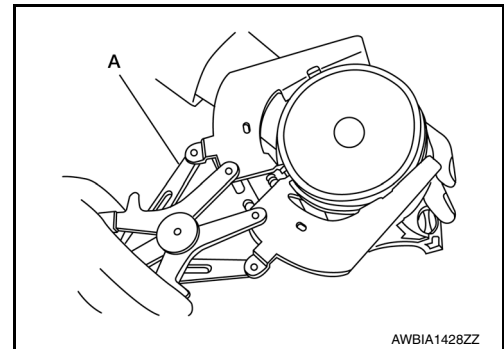
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Remove piston rings using suitable tool (A).

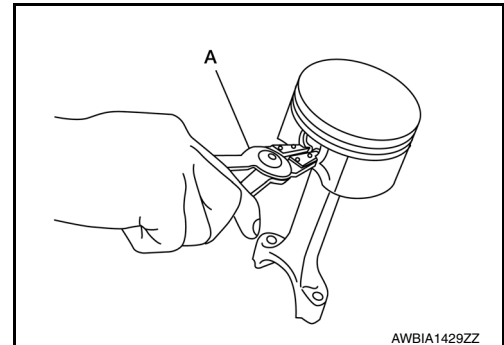
**CAUTION:**

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

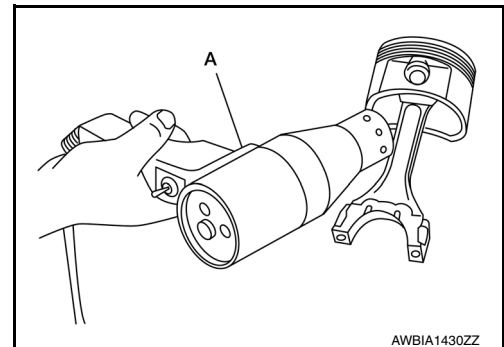


20. Remove piston from connecting rod with the following procedure:

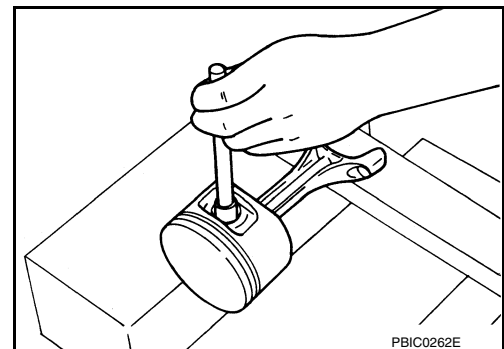
- a. Using snap ring pliers (A), remove snap rings.



- b. Heat piston to 60 to 70°C (140 to 158°F) with a heat gun (A).



- c. Push out piston pin using a punch of outer diameter approximately 18 mm (0.71 in).



21. Remove main bearing cap bolts.

- Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-103. "Inspection"](#).

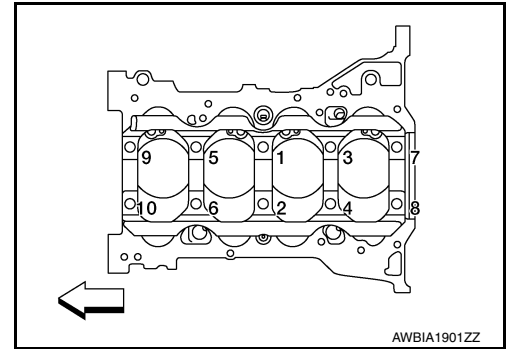
# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Loosen and remove main bearing cap bolts in reverse order as shown.

⇐ : Engine front



### 22. Remove main bearing caps.

- Tap main bearing caps lightly with a plastic hammer for removal. Number main bearing caps so they can be assembled in the same position and direction.

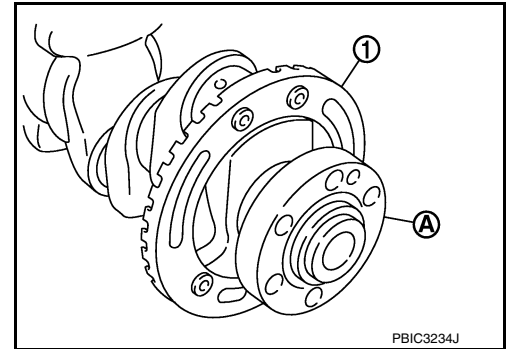
**CAUTION:**

**Do not damage the mounting surface.**

### 23. Remove crankshaft.

**CAUTION:**

- Do not damage or deform signal plate (1) mounted on rear end of crankshaft (A).
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.
- Do not remove signal plate unless it is necessary to do so.



### 24. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

**CAUTION:**

**When removing them, note the installation position. Keep them in the correct order.**

## ASSEMBLY

**CAUTION:**

**Do not reuse washers.**

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

**CAUTION:**

**Use goggles to protect your eyes.**

- Install each plug to cylinder block as shown.

(2) : Washer

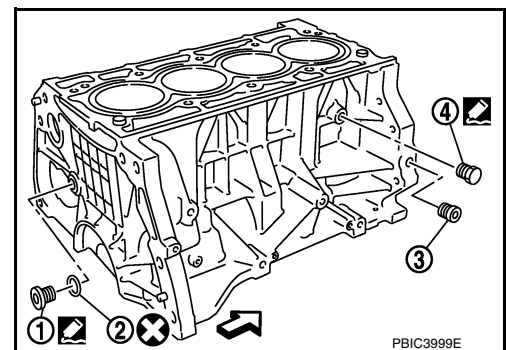
⇐ : Engine front

- Apply liquid gasket to the thread of water drain plug (4).  
**Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).**

- Apply sealant to the thread of plug (1).  
**Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-21, "Recommended Chemical Products and Sealants"](#).**

**NOTE:**

Do not apply liquid gasket or high strength thread locking sealant to the plug (3).



- Tighten each plug as specified below.

# CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

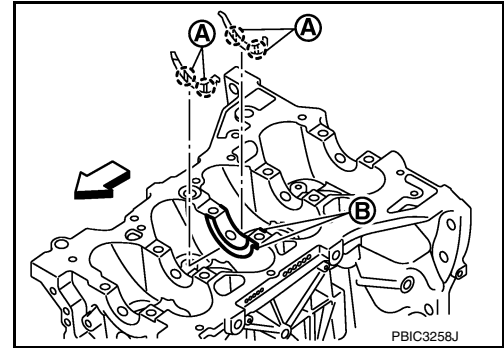
Part	Washer	Tightening torque
(1)	Yes	54.0 N·m (5.5 kg-m, 40 ft-lb)
(3)	No	19.6 N·m (2.0 kg-m, 14 ft-lb)
(4)	No	9.8 N·m (1.0 kg-m, 87 in-lb)

3. Install main bearings and thrust bearings with the following procedure:

- a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and main bearing cap.
- b. Install thrust bearings to both sides of the No. 3 journal housing (B) on cylinder block.

↔ : Engine front

- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).

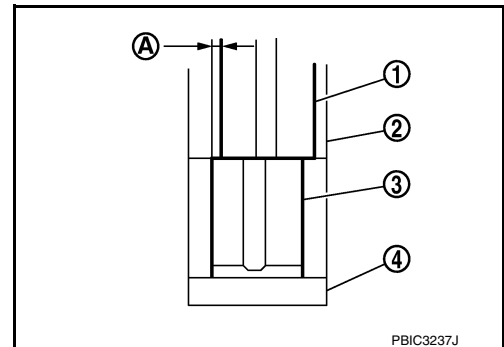


c. Install the main bearings paying attention to the direction.

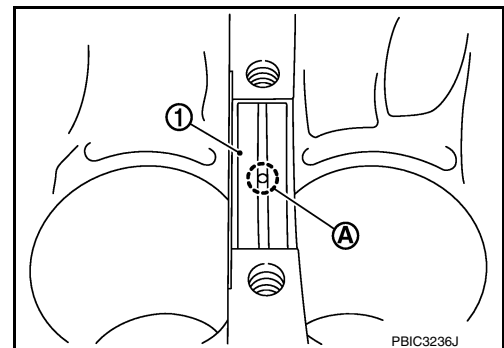
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing to the center position of cylinder block and main bearing cap.
- The difference (A) between main bearing (upper) (1) and main bearing (lower) (3) should be 0.85 mm (0.0335 in) or less when installing.

(2) : Cylinder block

(4) : Main bearing cap



- Ensure the oil holes on cylinder block and oil holes (A) on the main bearings (1) are aligned.



4. Install signal plate to crankshaft if removed.

- a. Set the signal plate with the flange facing toward the counter weight side (engine front side) to the crankshaft rear surface.
- b. Apply new engine oil to threads and seat surfaces of bolts.

# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- c. Position crankshaft (2) and signal plate (1) using a dowel pin, and tighten bolts in numerical order as shown.

(A) : Dowel pin hole

**NOTE:**

Dowel pin of crankshaft and signal plate is provided as a set for each.

- d. Remove dowel pin.

**CAUTION:**

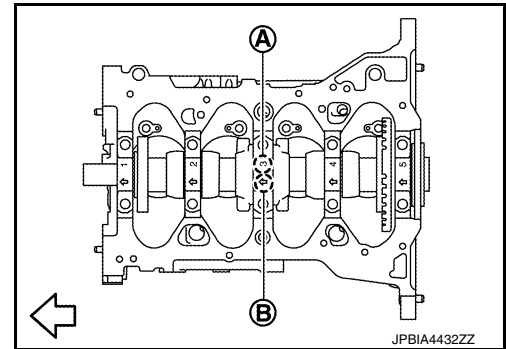
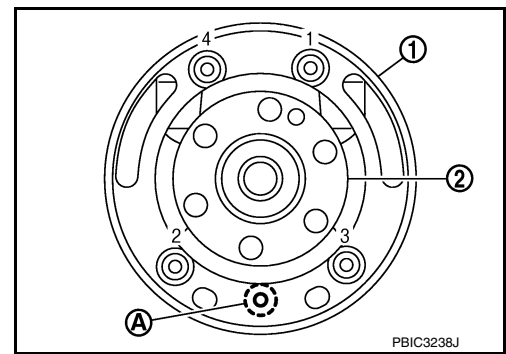
**Be sure to remove dowel pin.**

5. Install crankshaft to cylinder block.  
 • While turning crankshaft by hand, check that it turns smoothly.
6. Install main bearing caps with the following procedure:  
 a. Install main bearing caps referring to the journal No. stamp (A) and front mark (B) as shown.

⇐ : Engine front

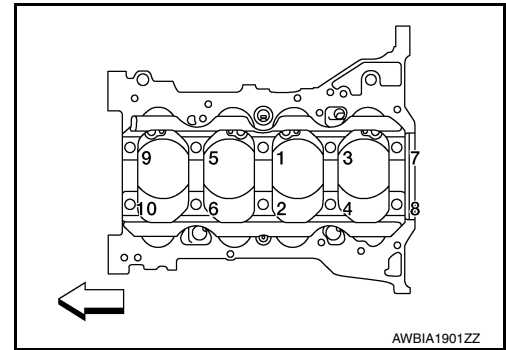
**NOTE:**

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



- b. Tighten main bearing cap bolts in numerical order as shown.  
 • Apply new engine oil to threads and seat surfaces of bolts.

⇐ : Engine front



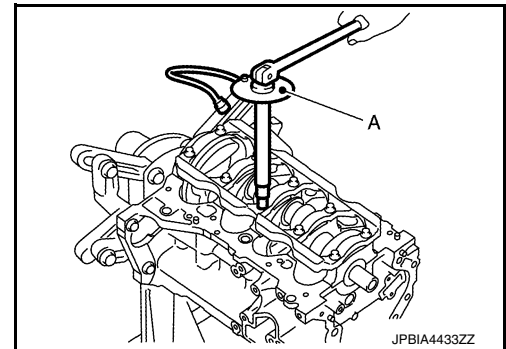
**CAUTION:**

Confirm the tightening angle by using Tool (A). Do not judge by visual inspection without the tool.

**Step 1 : 34.3 N·m (3.5 kg-m, 25 ft-lb)**

**Step 2 : 60° clockwise in numerical order**

**Tool number : KV10112100 (BT-8653-A)**



- After installing bolts, check that crankshaft can be rotated smoothly by hand.
  - Check crankshaft end play. Refer to [EM-103, "Inspection"](#).
7. Install piston to connecting rod with the following procedure:  
 a. Using snap ring pliers, install new snap ring to the groove of the piston rear side.  
 • Insert it fully into groove to install.  
 b. Assemble piston to connecting rod.

# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Using a heat gun, heat the piston until the piston pin can be pushed in by hand without excess force [approximately 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 (A) on the piston head and the oil hole (B) and the cylinder number (D) on connecting rod are positioned as shown.

- (C) : Engine type
- (E) : Large end hole diameter grade
- (F) : Front mark (connecting rod)

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

**CAUTION:**

**Do not reuse snap rings.**

8. Using a suitable tool, install piston rings.

**CAUTION:**

- Do not damage piston.**
- Do not damage piston rings by expanding them excessively.**
- Position each ring with the gap as shown referring to the piston front mark.

- (A) : Oil ring upper or lower rail gap
- (B) : Front mark
- (C) : Second ring and oil ring spacer gap
- (D) : Top ring gap
- (E) : Stamped mark

**CAUTION:**

**Do not contact the rail end gap under the oil ring with the oil drain cast groove of piston.**

- Install second ring with the stamped surface facing upward.

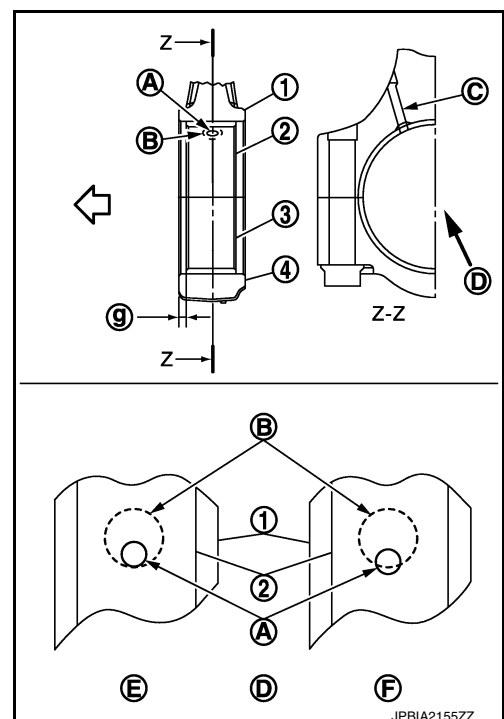
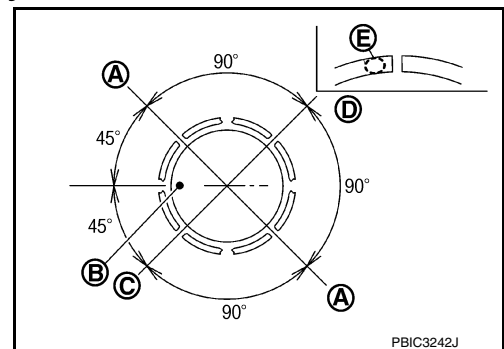
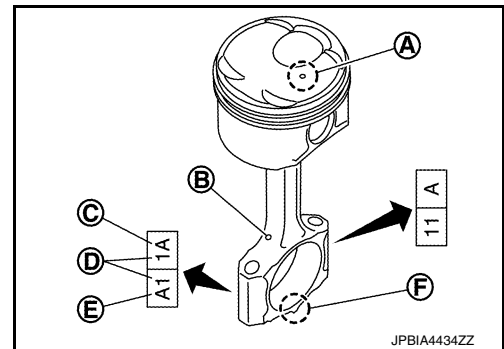
9. Install connecting rod bearing upper (2) and lower (3) to connecting rod (4) and connecting rod cap (4).

- (C) : Oil hole (connecting rod)
- (D) : View D
- (E) : OK
- (F) : NG
- (g) : 2.55 - 2.95 mm (0.1004 - 0.1161 in)
- ← : Engine front

- Install the connecting rod in the direction shown.
- Check that connecting rod bearing oil hole (A) is completely in the inside of connecting rod oil hole chamfered area (B).
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.

**NOTE:**

- There is no positioning tab.
- Install the connecting rod bearings in the center of connecting rod and connecting rod cap as shown. For service operation, the center position can be checked, visually.



10. Install piston and connecting rod assembly to crankshaft.

# CYLINDER BLOCK

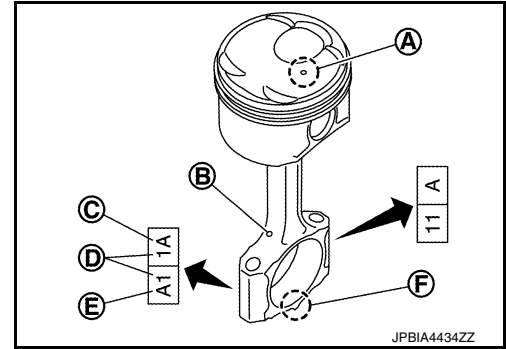
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number (D) on connecting rod to install.

- (A) : Front mark (piston)
- (B) : Oil hole
- (C) : Engine type
- (E) : Large end hole diameter grade
- (F) : Front mark (connecting rod)

- Install so that front mark (A) on the piston head faces the front of engine.

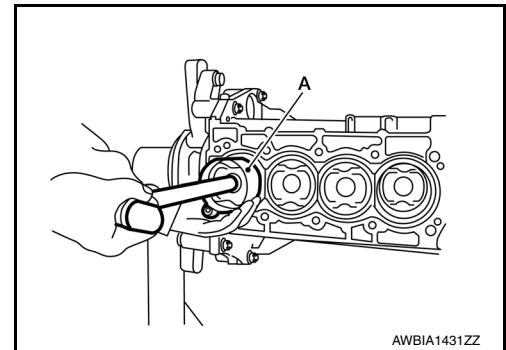


- Install piston with the front mark on the piston head facing the front of the engine using Tool (A).

### CAUTION:

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

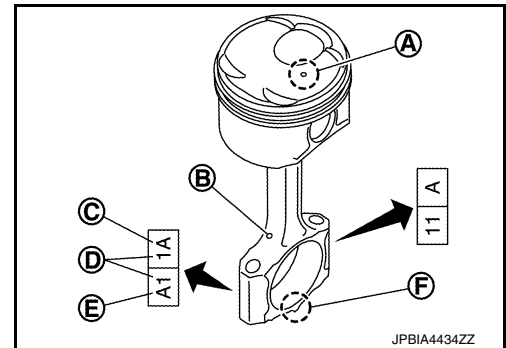
**Tool number : EM03470000 (J-8037)**



### 11. Install connecting rod cap.

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

- (A) : Front mark (piston)
- (B) : Oil hole
- (C) : Engine type
- (E) : Large end hole diameter grade
- (F) : Front mark (connecting rod)



- 12. Tighten connecting rod cap bolt using Tool (A) as follows: Apply new engine oil to the threads and seats of connecting rod cap bolts.

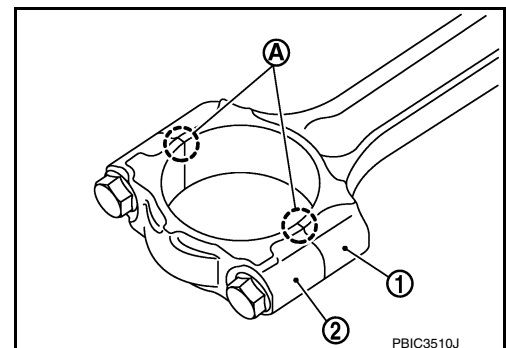
**Tool number : KV10112100 (BT-8653-A)**

### CAUTION:

- Check that there is no gap in the thrust surface (A) of the joint between connecting rod (1) and connecting rod cap (2) and that these parts are in the correct position. And then, tighten the connecting rod cap bolts.
- If the connecting rod cap bolts are reused, measure the outer diameter. Refer to [EM-103, "Inspection"](#).

**Step 1 : 19.6 N·m (2.0 kg-m, 14 ft-lb)**

**Step 2 : 65° clockwise**



### CAUTION:

# CYLINDER BLOCK

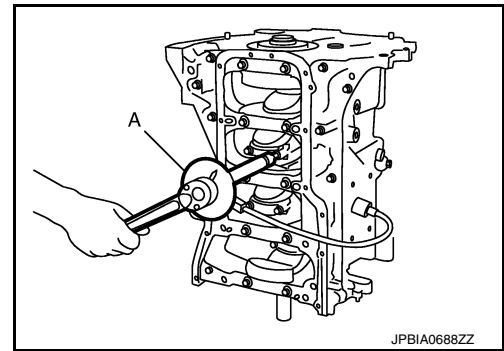
[MRA8DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

Check and confirm the tightening angle by using Tool. Do not judge by visual inspection without the tool.

**Tool number** : KV10112100 (BT-8653-A)

- After tightening connecting rod cap bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-103, "Inspection"](#).



13. Install oil pan (upper). Refer to [EM-33, "Exploded View"](#).
14. Install rear oil seal. Refer to [EM-70, "REAR OIL SEAL : Removal and Installation"](#).
15. Install flywheel or drive plate. Refer to [EM-90, "Removal and Installation" \(M/T\)](#) or [EM-92, "Removal and Installation" \(CVT\)](#).
16. Install knock sensor.
  - Install knock sensor (1) with harness connector facing toward the rear of engine.

(A) : Cylinder block left side

← : Engine front

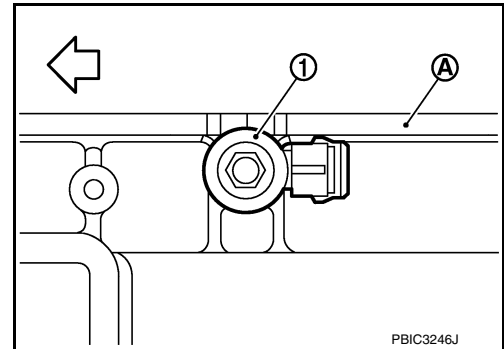
### CAUTION:

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

### NOTE:

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

17. Assembly is in the reverse order of disassembly.



## Inspection

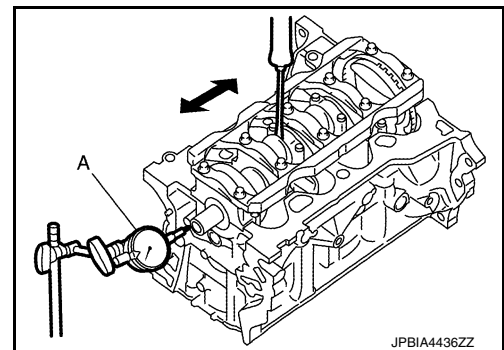
INFOID:000000009757000

### CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward using suitable tool (A).

**Standard and Limit** : Refer to [EM-123, "Cylinder Block"](#).

- 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



# CYLINDER BLOCK

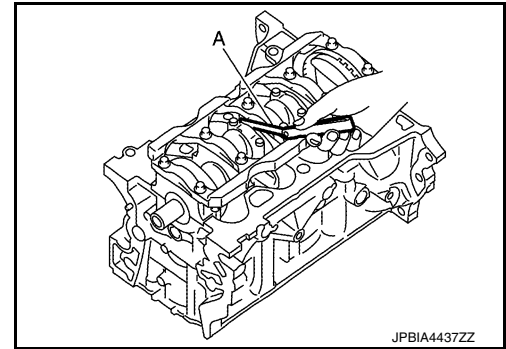
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the side clearance between connecting rod and crankshaft arm using suitable tool (A).

**Standard and Limit** : Refer to [EM-123. "Cylinder Block"](#).

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

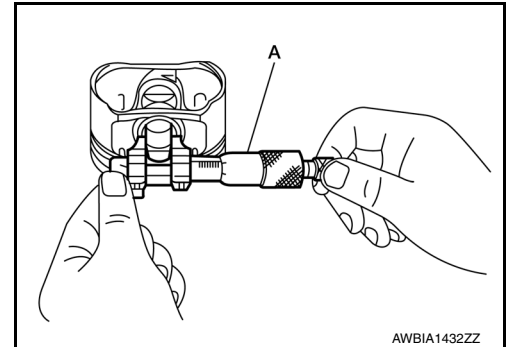


## PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole using suitable tool (A).

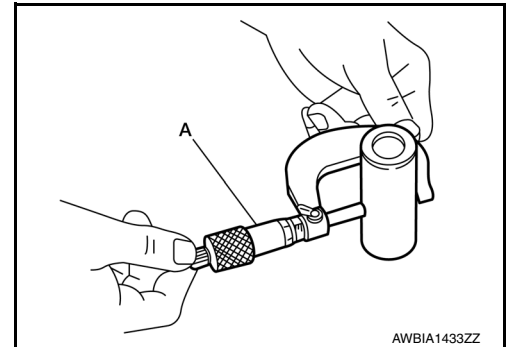
**Standard** : Refer to [EM-123. "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin using suitable tool (A).

**Standard** : Refer to [EM-123. "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

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

**Standard** : Refer to [EM-123. "Cylinder Block"](#).

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to [EM-112. "Description"](#).

### NOTE:

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

## PISTON RING SIDE CLEARANCE



# CYLINDER BLOCK

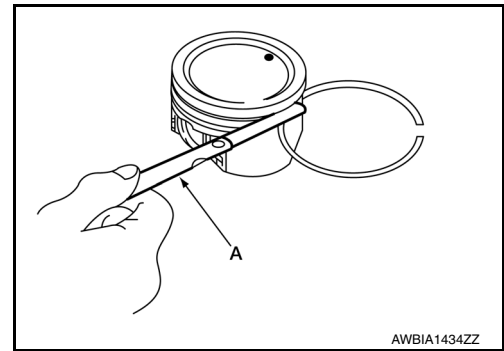
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the side clearance of piston ring and piston ring groove using suitable tool (A).

**Standard and Limit** : Refer to [EM-123, "Cylinder Block"](#).

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

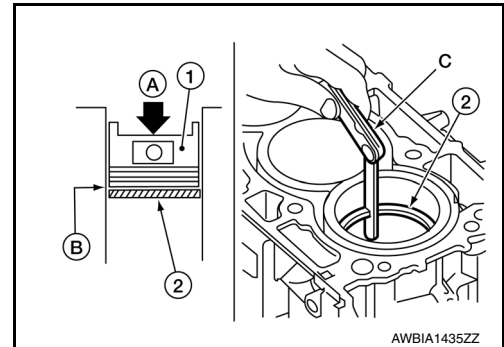


## PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "PISTON TO CYLINDER BORE CLEARANCE".
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap using suitable tool (C).

**Standard and Limit** : Refer to [EM-123, "Cylinder Block"](#).

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



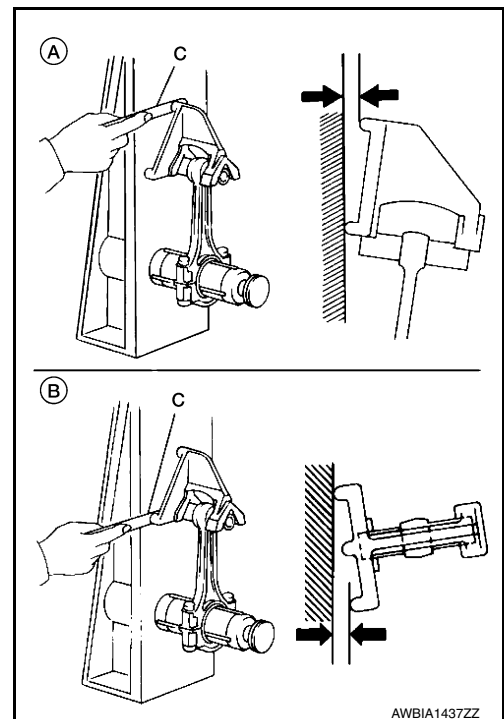
## CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

- (A) : Bend
- (B) : Torsion
- (C) : Feeler gauge

**Limit** : Refer to [EM-123, "Cylinder Block"](#).

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



## CONNECTING ROD BIG END DIAMETER

# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-95. "Disassembly and Assembly"](#).

(2) : Connecting rod

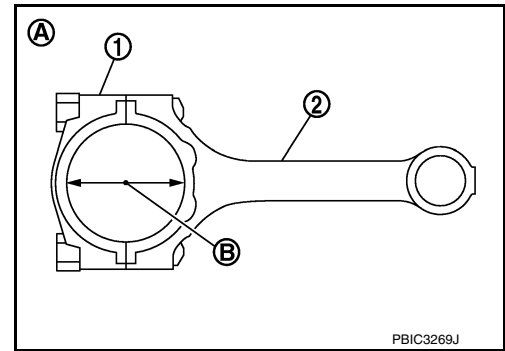
(A) : Example

(B) : Measuring direction of inner diameter

- Measure the inner diameter of connecting rod big end using suitable tool.

**Standard** : Refer to [EM-123. "Cylinder Block"](#).

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

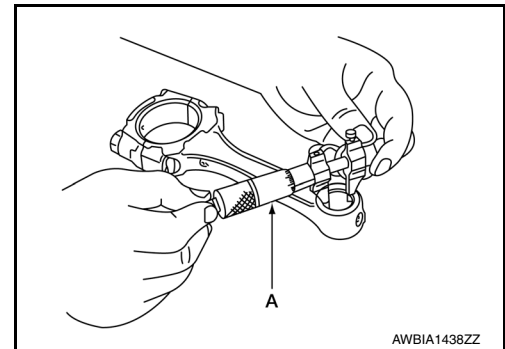


## CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing using suitable tool (A).

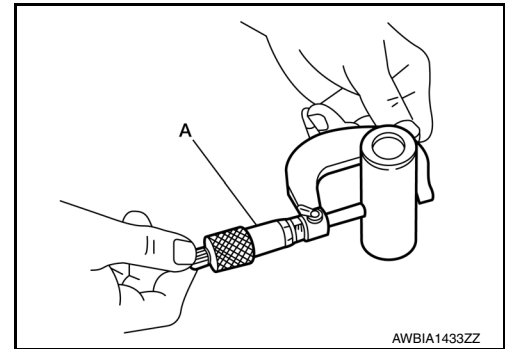
**Standard** : Refer to [EM-123. "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin using suitable tool (A).

**Standard** : Refer to [EM-123. "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

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

**Standard and Limit** : Refer to [EM-123. "Cylinder Block"](#).

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to [EM-112. "Piston"](#).
- If replacing connecting rod assembly. Refer to [EM-113. "Connecting Rod Bearing"](#).

## CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a 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

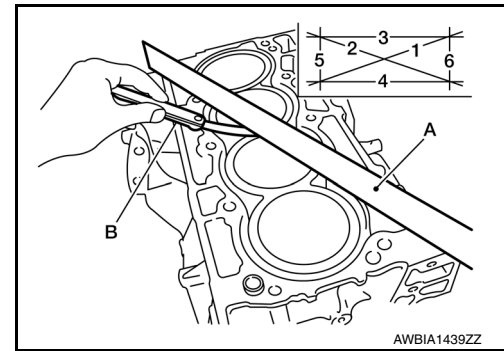
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the distortion on the cylinder block upper face at some different points in six directions using suitable tools (A,B).

**Limit** : Refer to [EM-123, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



## MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to [EM-95, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing using suitable tool.
- Measure the position shown [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown. The smaller one is the measured value.

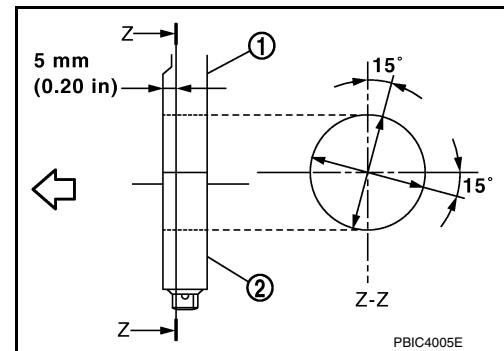
- (1) : Cylinder block
- (2) : Main bearing cap
- ⇐ : Engine front

**Standard** : Refer to [EM-123, "Cylinder Block"](#).

- If out of the standard, replace cylinder block and main bearing caps assembly.

**NOTE:**

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



## PISTON TO CYLINDER BORE CLEARANCE

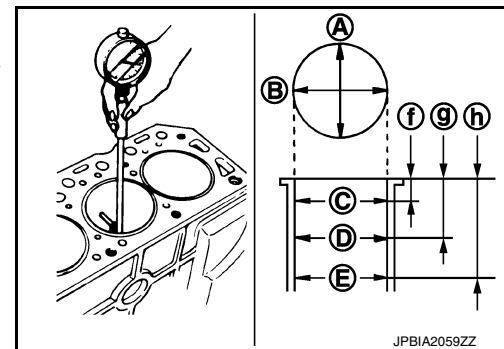
### Cylinder Bore Inner Diameter

- Measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder using suitable tool. [(A) and (B) directions at (C), (D), and (E)] [(A) is in longitudinal direction of engine]

- (f) : 10 mm (0.39 in)
- (g) : 60 mm (2.36 in)
- (h) : 130 mm (5.12 in)

**NOTE:**

When determining cylinder bore grade, measure the cylinder bore (B) direction at (D) position.



**Standard:**

**Cylinder bore inner diameter**

: Refer to [EM-123, "Cylinder Block"](#).

**Limit:**

**Out-of-round [Difference between (A) and (B)]**

**Taper [Difference between (C) and (D)]**

: Refer to [EM-123, "Cylinder Block"](#).

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

**NOTE:**

Oversize piston is not provided.

# CYLINDER BLOCK

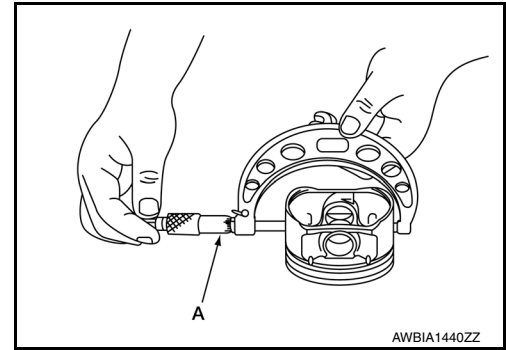
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

### Piston Skirt Diameter

Measure the outer diameter of piston skirt using suitable tool (A).

**Standard** : Refer to [EM-123, "Cylinder Block"](#).

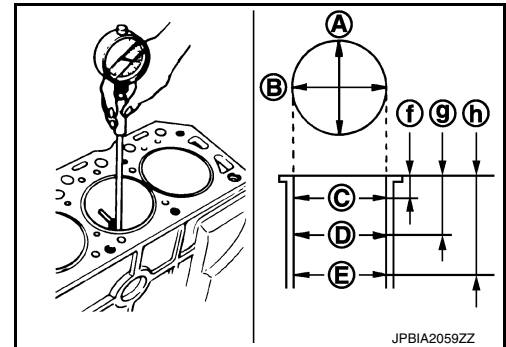


### Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].

- (A) : Direction A
- (C) : Position C
- (E) : Position E
- (f) : 10 mm (0.39 in)
- (g) : 60 mm (2.36 in)
- (h) : 130 mm (5.12 in)

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)



**Standard and Limit** : Refer to [EM-123, "Cylinder Block"](#).

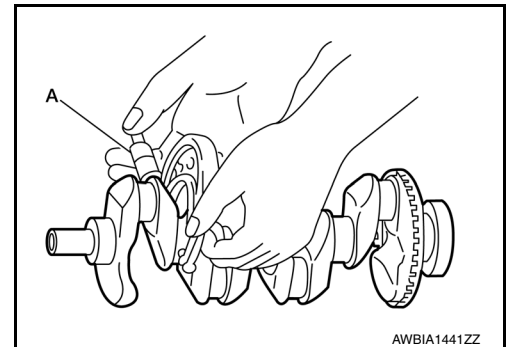
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-112, "Piston"](#).

### CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals using suitable tool (A).

**Standard** : Refer to [EM-123, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-127, "Main Bearing"](#).



### CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal using suitable tool.

**Standard** : Refer to [EM-123, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-127, "Connecting Rod Bearing"](#).

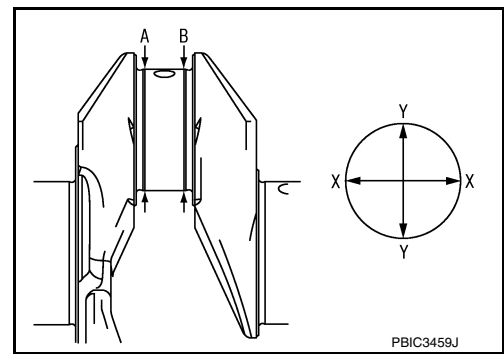
### OUT-OF-ROUND AND TAPER OF CRANKSHAFT

# CYLINDER BLOCK

[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the dimensions at four different points as shown on each main journal and pin journal using suitable tool.
- Out-of-round is indicated by the difference in dimensions between (X) and (Y) at (A) and (B).
- Taper is indicated by the difference in dimension between (A) and (B) at (X) and (Y).



### Limit:

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

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

: Refer to [EM-123, "Cylinder Block"](#).

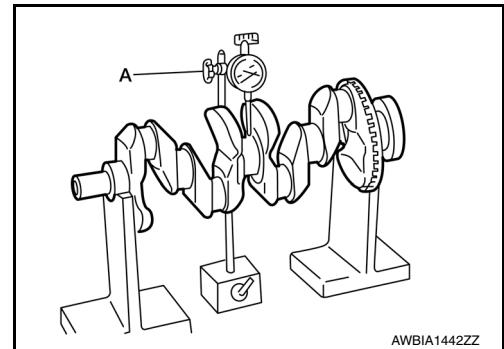
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-113, "Connecting Rod Bearing"](#) and/or [EM-115, "Main Bearing"](#).

## CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on both ends of the crankshaft.
- Place a suitable tool (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the suitable tool (A). (Total indicator reading)

**Standard and Limit** : Refer to [EM-123, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

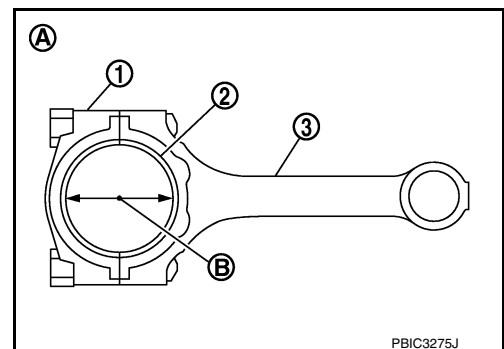
### Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to [EM-95, "Disassembly and Assembly"](#).

(A) : Example

(B) : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing using suitable tool.  
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



**Standard and Limit** : Refer to [EM-127, "Connecting Rod Bearing"](#).

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to [EM-113, "Connecting Rod Bearing"](#).

### Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-95, "Disassembly and Assembly"](#).

### CAUTION:

**Do not rotate crankshaft.**

# CYLINDER BLOCK

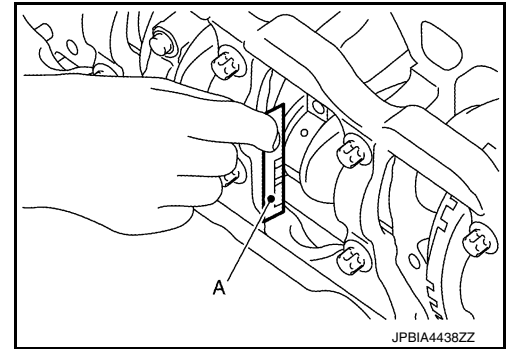
[MRA8DE]

## < UNIT DISASSEMBLY AND ASSEMBLY >

- Remove connecting rod cap and bearing, and using the scale (A) on the 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

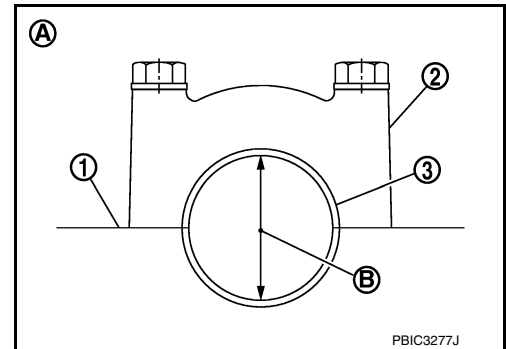
- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap bolts to the specified torque. Refer to [EM-95. "Disassembly and Assembly"](#).

(A) : Example

(B) : Inner diameter measuring direction

- Measure the inner diameter of main bearing using suitable tool.  
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

**Standard and Limit** : Refer to [EM-127. "Main Bearing"](#).



- If clearance 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-115. "Main Bearing"](#).

### Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap bolts to the specified torque. Refer to [EM-95. "Disassembly and Assembly"](#).

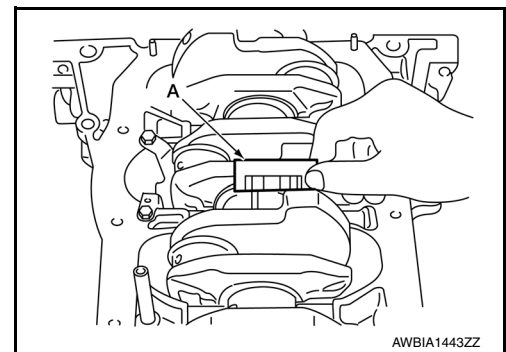
**CAUTION:**

**Do not rotate crankshaft.**

- Remove main bearing cap and bearings, and using the scale (A) on the plastigage bag, measure the plastigage width.

**NOTE:**

The procedure when the measured value exceeds the limit is the same as that described in the "Method by Calculation".



## MAIN BEARING CRUSH HEIGHT

# CYLINDER BLOCK

[MRA8DE]

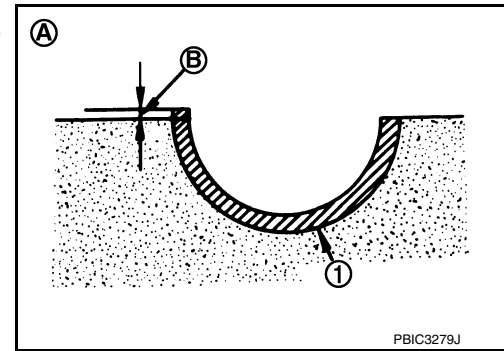
## < UNIT DISASSEMBLY AND ASSEMBLY >

- When main bearing cap is removed after being tightened to the specified torque with main bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-95. "Disassembly and Assembly"](#).

(A) : Example

**Standard : There must be crush height.**

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



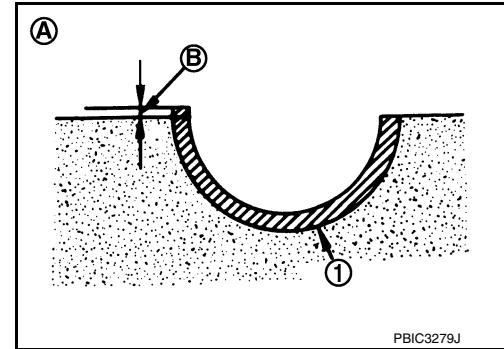
## CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-95. "Disassembly and Assembly"](#).

(A) : Example

**Standard : There must be crush height.**

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



## MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (d1) and (d2) at two positions as shown.

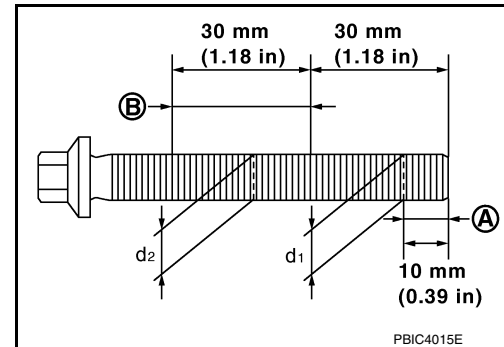
(A) : (d1) measuring position

(B) : (d2) measuring position

- If reduction appears in places other than (B) range, regard it as (d2).

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

- If it exceeds the limit (a large difference in dimensions), replace main bearing cap mounting bolt with a new one.

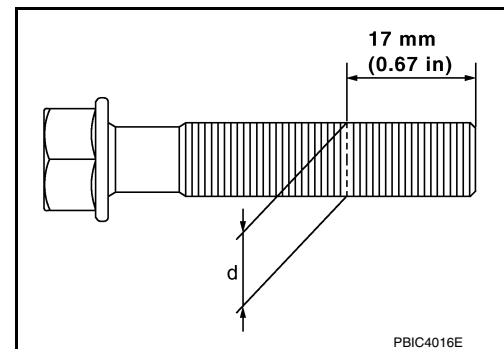


## CONNECTING ROD CAP BOLT OUTER DIAMETER

- Measure the outer diameter (d) at position as shown.
- If 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 cap bolt with a new one.





# HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:000000009757001

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 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.

### Piston

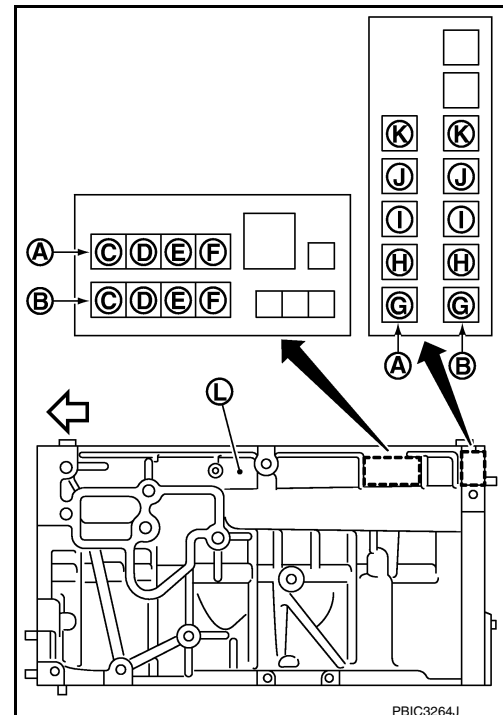
INFOID:000000009757002

#### WHEN NEW CYLINDER BLOCK IS USED

- Check the cylinder bore grade on rear (LH) side of cylinder block (L), and select piston of the same grade.

- (A) : Correction stamp
- (B) : Standard stamp
- (C) : Cylinder No. 1 bore grade
- (D) : Cylinder No. 2 bore grade
- (E) : Cylinder No. 3 bore grade
- (F) : Cylinder No. 4 bore grade
- (G) : No. 1 main bearing housing grade
- (H) : No. 2 main bearing housing grade
- (I) : No. 3 main bearing housing grade
- (J) : No. 4 main bearing housing grade
- (K) : No. 5 main bearing housing grade
- ← : Engine front

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



#### WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter. Refer to [EM-123. "Cylinder Block"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".



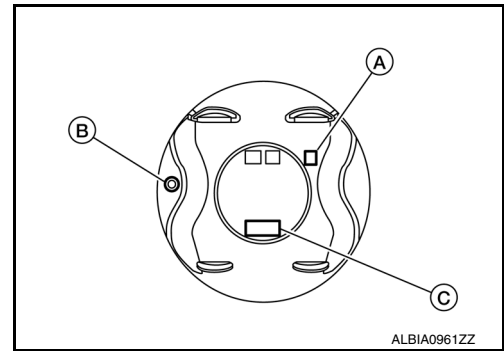
# HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

3. Select piston of the same grade.

- (A) : Piston grade number
- (B) : Front mark
- (C) : Identification code



## PISTON SELECTION TABLE

Unit: mm (in)

Grade number (Mark)	1	2 [or no mark (piston only)]
Cylinder bore Inner diameter	79.700 - 79.710 (3.1378 - 3.1382)	79.710 - 79.720 (3.1382 - 3.1386)
Piston skirt diameter	79.660 - 79.670 (3.1362 - 3.1366)	79.670 - 79.680 (3.1362 - 3.1370)

### NOTE:

Piston is available together with piston pin as an assembly.

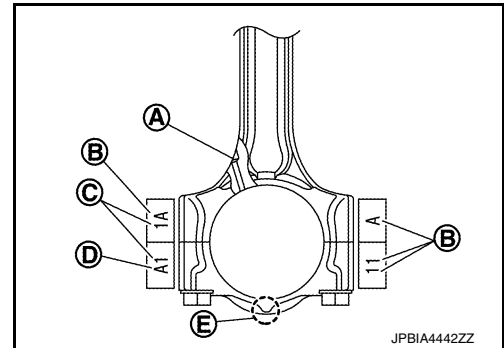
## Connecting Rod Bearing

INFOID:000000009757003

### WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

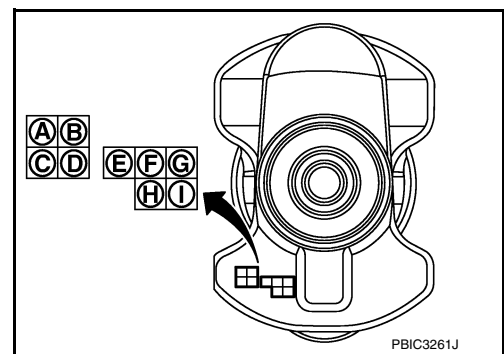
1. Apply connecting rod big end diameter grade stamped on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- (A) : Oil hole
- (B) : Engine type
- (C) : Cylinder number
- (D) : Big end diameter grade
- (E) : Front mark



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

- (A) : No. 1 pin journal diameter grade
- (B) : No. 2 pin journal diameter grade
- (C) : No. 3 pin journal diameter grade
- (D) : No. 4 pin journal diameter grade
- (E) : No. 1 main journal diameter grade
- (F) : No. 2 main journal diameter grade
- (G) : No. 3 main journal diameter grade
- (H) : No. 4 main journal diameter grade
- (I) : No. 5 main journal diameter grade



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

4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

### WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-103. "Inspection"](#).

# HOW TO SELECT PISTON AND BEARING

[MRA8DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

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

## CONNECTING ROD BEARING SELECTION TABLE

Mark	Axle diameter Unit: mm (in)	Connecting rod big end diameter Unit: mm (in)															
		Hole diameter															
		A	B	C	D	E	F	G	H	J	K	L	M	N			
A	43.970 - 43.971 (1.7311 - 1.7311)	0	0	0	0	0	01	01	01	1	1	1	12	12			
B	43.969 - 43.970 (1.7311 - 1.7311)	0	0	0	0	01	01	01	1	1	1	12	12	12			
C	43.968 - 43.969 (1.7310 - 1.7311)	0	0	0	01	01	01	1	1	1	12	12	12	2			
D	43.967 - 43.968 (1.7310 - 1.7310)	0	0	01	01	01	1	1	1	12	12	12	2	2			
E	43.966 - 43.967 (1.7309 - 1.7310)	0	01	01	01	1	1	1	12	12	12	2	2	2			
F	43.965 - 43.966 (1.7309 - 1.7309)	01	01	01	1	1	1	12	12	12	2	2	2	23			
G	43.964 - 43.965 (1.7309 - 1.7309)	01	01	1	1	1	12	12	12	2	2	2	23	23			
H	43.963 - 43.964 (1.7308 - 1.7309)	01	1	1	1	12	12	12	2	2	2	23	23	23			
J	43.962 - 43.963 (1.7308 - 1.7308)	1	1	1	12	12	12	2	2	2	23	23	23	3			
K	43.961 - 43.962 (1.7307 - 1.7308)	1	1	12	12	12	2	2	2	23	23	23	3	3			
L	43.960 - 43.961 (1.7307 - 1.7307)	1	12	12	12	2	2	2	23	23	23	3	3	3			
M	43.959 - 43.960 (1.7307 - 1.7307)	12	12	12	2	2	2	23	23	23	3	3	3	34			
N	43.958 - 43.959 (1.7306 - 1.7307)	12	12	2	2	2	23	23	23	3	3	3	34	34			
P	43.957 - 43.958 (1.7306 - 1.7306)	12	2	2	2	23	23	23	3	3	3	34	34	34			
R	43.956 - 43.957 (1.7305 - 1.7306)	2	2	2	23	23	23	3	3	3	34	34	34	4			
S	43.955 - 43.956 (1.7305 - 1.7305)	2	2	23	23	23	3	3	3	34	34	34	4	4			
T	43.954 - 43.955 (1.7305 - 1.7305)	2	23	23	23	3	3	3	34	34	34	4	4	4			
U	43.953 - 43.954 (1.7304 - 1.7305)	23	23	23	3	3	3	34	34	34	4	4	4	4			

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## CONNECTING ROD BEARING GRADE TABLE

Connecting rod bearing grade table : Refer to [EM-127, "Connecting Rod Bearing"](#).

## UNDERSIZE BEARINGS USAGE GUIDE

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

**CAUTION:**

# HOW TO SELECT PISTON AND BEARING

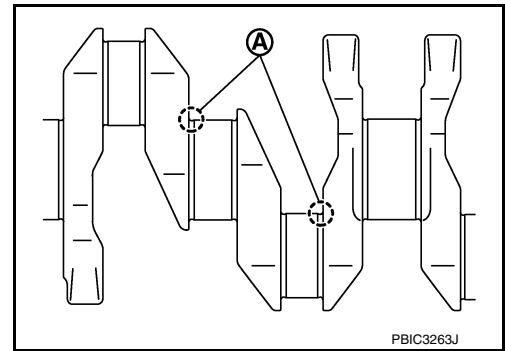
< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

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

## Bearing undersize table

: Refer to [EM-127, "Connecting Rod Bearing"](#).



INFOID:000000009757004

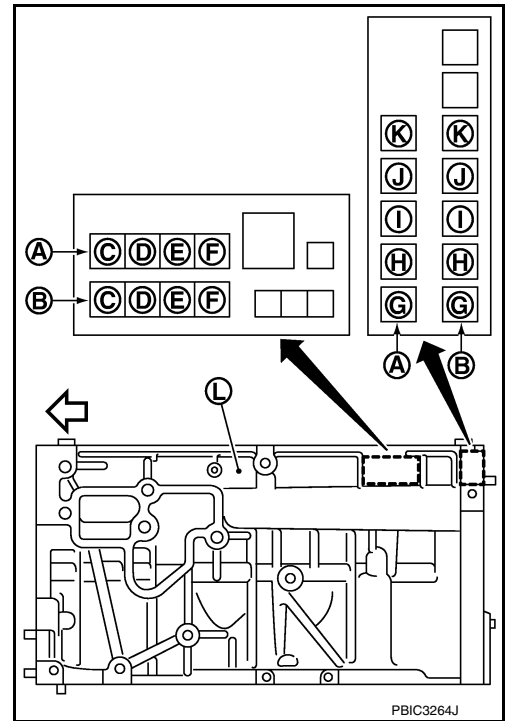
## Main Bearing

### WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear (LH) side of cylinder block (L).

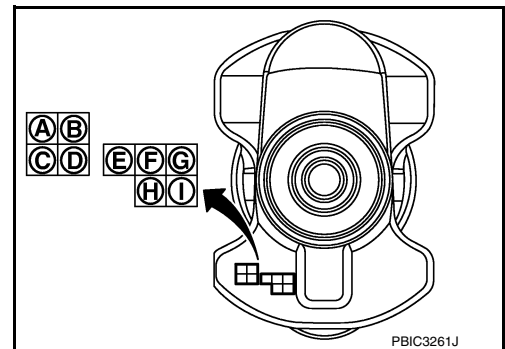
- (A) : Correction stamp
- (B) : Standard stamp
- (C) : Cylinder No. 1 bore grade
- (D) : Cylinder No. 2 bore grade
- (E) : Cylinder No. 3 bore grade
- (F) : Cylinder No. 4 bore grade
- (G) : No. 1 main bearing housing grade
- (H) : No. 2 main bearing housing grade
- (I) : No. 3 main bearing housing grade
- (J) : No. 4 main bearing housing grade
- (K) : No. 5 main bearing housing grade
- ← : Engine front

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



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".

- (A) : No. 1 pin journal diameter grade
- (B) : No. 2 pin journal diameter grade
- (C) : No. 3 pin journal diameter grade
- (D) : No. 4 pin journal diameter grade
- (E) : No. 1 main journal diameter grade
- (F) : No. 2 main journal diameter grade
- (G) : No. 3 main journal diameter grade
- (H) : No. 4 main journal diameter grade
- (I) : No. 5 main journal diameter grade



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

### CAUTION:

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

# HOW TO SELECT PISTON AND BEARING

[MRA8DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.

**NOTE:**

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

## WHEN CYLINDER BLOCK AND CRANKSHAFT ARE REUSED

- Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-103, "Inspection"](#).
- Apply the measured dimension to the “Main Bearing Selection Table”.
- Read the symbol at the cross point of selected row and column in the “Main Bearing Selection Table”.

**CAUTION:**

**There are two main bearing selection tables. One is for No. 1, 4, and 5 journals and the other is for No. 2 and 3 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.**

- Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.

**NOTE:**

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

## MAIN BEARING SELECTION TABLE (No. 1, 4, AND 5 JOURNAL)

Cylinder block main bearing housing inner diameter Unit: mm (in)		Crankshaft main journal diameter Unit: mm (in)		Mark																						
				Hole diameter																						
Mark	Axle diameter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W					
A	51.978 - 51.979 (2.0464 - 2.0464)	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23				
B	51.977 - 51.978 (2.0463 - 2.0464)	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23				
C	51.976 - 51.977 (2.0463 - 2.0463)	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	23				
D	51.975 - 51.976 (2.0463 - 2.0463)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3				
E	51.974 - 51.975 (2.0462 - 2.0463)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3				
F	51.973 - 51.974 (2.0462 - 2.0462)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3				
G	51.972 - 51.973 (2.0461 - 2.0462)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	34				
H	51.971 - 51.972 (2.0461 - 2.0461)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34				
J	51.970 - 51.971 (2.0461 - 2.0461)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	34				
K	51.969 - 51.970 (2.0460 - 2.0461)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4				
L	51.968 - 51.969 (2.0460 - 2.0460)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4				
M	51.967 - 51.968 (2.0459 - 2.0460)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4				
N	51.966 - 51.967 (2.0459 - 2.0459)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45				
P	51.965 - 51.966 (2.0459 - 2.0459)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	45				
R	51.964 - 51.965 (2.0458 - 2.0459)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	45	45				
S	51.963 - 51.964 (2.0458 - 2.0458)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	45	45	5				
T	51.962 - 51.963 (2.0457 - 2.0458)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	45	45	5				
U	51.961 - 51.962 (2.0457 - 2.0457)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	45	45	5				
V	51.960 - 51.961 (2.0457 - 2.0457)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	45	45	5				
W	51.959 - 51.960 (2.0456 - 2.0457)	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	45	45	5				

PBIC4078E

# HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MRA8DE]

## MAIN BEARING SELECTION TABLE (No. 2 AND 3 JOURNAL)

Cylinder block main bearing housing inner diameter Unit: mm (in)	Crankshaft main journal diameter Unit: mm (in)	Mark	Hole diameter																					
			A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W		
Mark	Axle diameter																							
A	51.978 - 51.979 (2.0464 - 2.0464)	1	12	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
B	51.977 - 51.978 (2.0463 - 2.0464)	12	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	45
C	51.976 - 51.977 (2.0463 - 2.0463)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45
D	51.975 - 51.976 (2.0463 - 2.0463)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	5
E	51.974 - 51.975 (2.0462 - 2.0463)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	5	5
F	51.973 - 51.974 (2.0462 - 2.0462)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	5	5	5
G	51.972 - 51.973 (2.0461 - 2.0462)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	5	5	5	56
H	51.971 - 51.972 (2.0461 - 2.0461)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	45	5	5	5	56
J	51.970 - 51.971 (2.0461 - 2.0461)	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	45	45	5	5	5	56
K	51.969 - 51.970 (2.0460 - 2.0461)	23	3	3	3	34	34	34	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
L	51.968 - 51.969 (2.0460 - 2.0460)	3	3	3	34	34	34	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
M	51.967 - 51.968 (2.0459 - 2.0460)	3	3	34	34	34	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
N	51.966 - 51.967 (2.0459 - 2.0459)	3	34	34	34	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
P	51.965 - 51.966 (2.0459 - 2.0459)	34	34	34	4	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
R	51.964 - 51.965 (2.0458 - 2.0459)	34	34	4	4	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
S	51.963 - 51.964 (2.0458 - 2.0458)	34	4	4	4	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
T	51.962 - 51.963 (2.0457 - 2.0458)	4	4	4	4	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
U	51.961 - 51.962 (2.0457 - 2.0457)	4	4	4	4	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
V	51.960 - 51.961 (2.0457 - 2.0457)	4	4	4	4	4	4	4	4	4	4	4	45	45	45	45	45	45	45	45	5	5	5	56
W	51.959 - 51.960 (2.0456 - 2.0457)	45	45	45	5	5	5	5	5	5	5	5	56	56	56	56	56	56	56	56	56	56	56	56

AWBIA1895ZZ

## MAIN BEARING GRADE TABLE (ALL JOURNALS)

Main bearing grade table (All journals) : Refer to [EM-127, "Main Bearing"](#).

### UNDERSIZE BEARING USAGE GUIDE

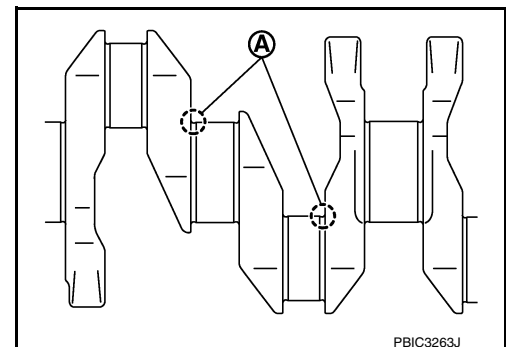
- When the specified main bearing oil clearance is not obtained with standard size main bearings, use undersize (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the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

**CAUTION:**

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

Bearing undersize table:

Refer to [EM-127, "Main Bearing"](#).



PBIC3263J

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification

INFOID:000000009757005

#### GENERAL SPECIFICATIONS

Engine type	MRA8DE	
Cylinder arrangement	In-line 4	
Displacement cm <sup>3</sup> (cu. in)	1,798 (109.7)	
Bore and stroke mm (in)	79.7x90.1 (3.138x3.547)	
Valve arrangement	DOHC	
Firing order	1-3-4-2	
Number of piston rings	Compression	2
	Oil	1
Compression ratio	9.9	
Compression pressure kPa (bar, kg/cm <sup>2</sup> , psi)/250 rpm	Standard	1,380 (13.8, 14.1, 200.2)
	Minimum	1,220 (12.2, 12.4, 176.9)
	Differential limit between cylinders	100 (1.0, 1.0, 14.5)

Unit: degree

Valve timing ⇐ Intake valve ⇐ Exhaust valve	<p style="text-align: right;">JPBIA4228ZZ</p>					
	a	b	c	d	e	f
	220	228	-4 (35) ATDC	52 (13) ABDC	4 (64) ATDC	36 (-24) BBDC

( ) : Valve timing control "ON"

#### Drive Belt

INFOID:000000009757006

#### DRIVE BELT

Tension of drive belt	Belt tension is not necessary, as it is automatically adjusted by drive belt auto-tensioner.
-----------------------	--

#### Spark Plug

INFOID:000000009757007

#### SPARK PLUG

Unit: mm (in)

Make	NGK	
Standard type*	DILKAR6A-11 (California) or PLZKAR6A-11 (except California)	
Gap (Nominal)	Standard	0.9 (0.035)
	Limit	1.1 (0.043)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

\*:Always check with the Parts Department for the latest parts information.

## Exhaust Manifold

INFOID:000000009757008

### EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Each exhaust port	0.1 (0.004)
	Entire part	0.3 (0.012)

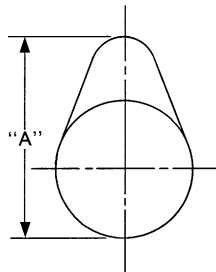
## Camshaft

INFOID:000000009757009

### CAMSHAFT

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, 5	0.030 - 0.071 (0.0012 - 0.0028)	
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9843 - 0.9851)	—
Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9823 - 0.9831)	—
Camshaft end play		0.075 - 0.153 (0.0030 - 0.0060)	0.24 (0.0094)
Camshaft cam height "A"	Intake	44.605 - 44.795 (1.7561 - 1.7636)	44.66 (1.75827)
	Exhaust	43.175 - 43.365 (1.6998 - 1.7073)	44.20 (1.74016)
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)



SEM671

\*: Total indicator reading

## VALVE LIFTER

Unit: mm (in)

Items		Standard
Valve lifter outer diameter	Intake	33.977 - 33.987 (1.3377 - 1.3381)
	Exhaust	29.977 - 29.987 (1.1802 - 1.1806)
Valve lifter hole diameter	Intake	34.000 - 34.021 (1.3386 - 1.3394)
	Exhaust	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance		0.013 - 0.044 (0.0005 - 0.0017)

## VALVE CLEARANCE

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

Unit: mm (in)

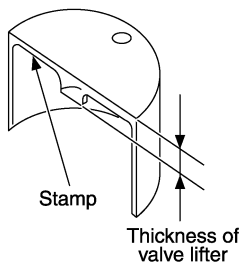
Items	Cold	Hot* (reference data)
Intake	0.25 - 0.33 (0.01 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.28 - 0.36 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

\*: Approximately 80°C (176°F)

## AVAILABLE VALVE LIFTER

Unit: mm (in)

Identification mark*	Thickness
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KBIA0119E

300	3.00 (0.1181)
302	3.02 (0.1189)
304	3.04 (0.1197)
306	3.06 (0.1205)
308	3.08 (0.1213)
310	3.10 (0.1220)
312	3.12 (0.1228)
314	3.14 (0.1236)
316	3.16 (0.1244)
318	3.18 (0.1252)
320	3.20 (0.1260)
322	3.22 (0.1268)
324	3.24 (0.1276)
326	3.26 (0.1283)
328	3.28 (0.1291)
330	3.30 (0.1299)
332	3.32 (0.1307)
334	3.34 (0.1315)
336	3.36 (0.1323)
338	3.38 (0.1331)
340	3.40 (0.1339)
342	3.42 (0.1346)
344	3.44 (0.1354)
346	3.46 (0.1362)
348	3.48 (0.1370)
350	3.50 (0.1378)

\*:Always check with the Parts Department for the latest parts information.



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

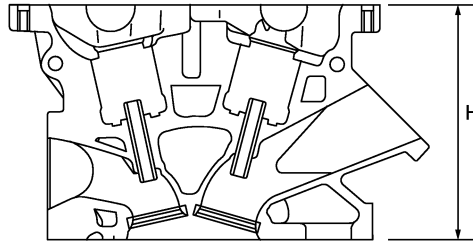
## Cylinder Head

INFOID:000000009757010

### CYLINDER HEAD

Unit: mm (in)

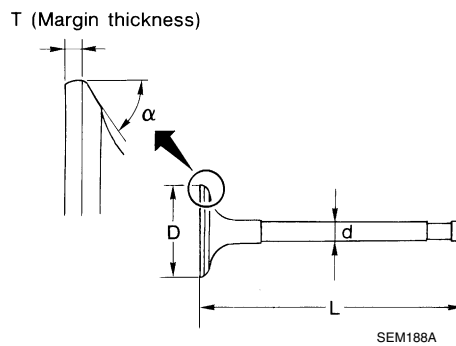
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	130.9 (5.15)	—



PBIC0924E

### VALVE DIMENSIONS

Unit: mm (in)



Valve head diameter "D"	Intake	31.2 - 31.5 (1.228 - 1.240)
	Exhaust	25.6 - 25.9 (1.008 - 1.020)
Valve length "L"	Intake	107.08 (4.22)
	Exhaust	106.06 (4.18)
Valve stem diameter "d"	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.455 - 5.470 (0.2148 - 0.2154)
Valve seat angle " $\alpha$ "		45°15' - 45°45'
Valve margin "T"	Intake	1.4 (0.055)
	Exhaust	1.4 (0.055)

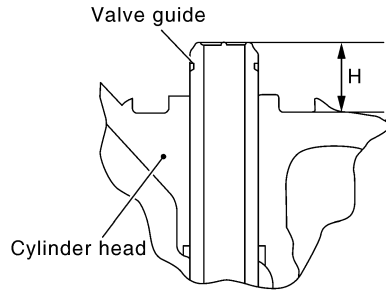
### VALVE GUIDE

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

Unit: mm (in)

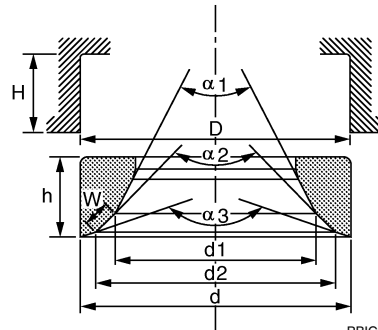


PBIC2187E

Items		Standard	Oversize (service) [0.2 (0.008)]
Valve guide	Outer diameter	9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size)	5.500 - 5.518 (0.2165 - 0.2172)	
Cylinder head valve guide hole diameter		9.475 - 9.496 (0.3730 - 0.3739)	9.675 - 9.696 (0.3809 - 0.3817)
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)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
Projection length "H"		13.35 - 13.65 (0.5256 - 0.5374)	

## VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (service) [0.5 (0.020)]
Cylinder head seat recess diameter "D"	Intake	31.900 - 31.927 (1.2559 - 1.2570)	35.200 - 35.227 (1.3858 - 1.3869)
	Exhaust	26.300 - 26.327 (1.0354 - 1.0365)	29.200 - 29.227 (1.1496 - 1.1507)
Valve seat outer diameter "d"	Intake	31.997 - 32.013 (1.2597 - 1.2604)	32.497 - 32.513 (1.2794 - 1.2800)
	Exhaust	26.408 - 26.424 (1.0397 - 1.0403)	
Valve seat interference fit		0.07 - 0.113 (0.0028 - 0.0044)	
Diameter "d1"*1	Intake	29.2 (1.150)	
	Exhaust	23.3 (0.917)	
Diameter "d2"*2	Intake	30.5 - 31.0 (1.201 - 1.220)	
	Exhaust	24.9 - 25.4 (0.980 - 1.0)	
Angle "alpha 1"	Intake	70°	
	Exhaust	45°	
Angle "alpha 2"		88°45' - 90°15'	
Angle "alpha 3"		120°	

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

Contacting width "W"*3	Intake	1.0 - 1.4 (0.039 - 0.055)	
	Exhaust	1.2 - 1.6 (0.047 - 0.063)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.09 - 5.10 (0.2004 - 0.2008)
	Exhaust		
Depth "H"	Intake	6.01 (0.2366)	
	Exhaust	6.07 (0.2390)	

\*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

Items	Standard	
	Intake	Exhaust
Free height	49.4 - 49.6 mm (1.945 - 1.953 in)	54.5 - 54.7 mm (2.146 - 2.154 in)
Installation height	38.46 mm (1.514 in)	38.46 mm (1.514 in)
Installation load	151 - 175 N (15.4 - 17.9 kg, 34 - 39 lb)	257 - 289 N (26.2 - 29.5 kg, 57.8 - 65.0 lb)
Height during valve open	28.86 mm (1.1362 in)	30.03 mm (1.1823 in)
Load with valve open	344 - 392 N (35.0 - 40.0 kg, 77.3 - 88.1 lb)	450 - 502 N (45.9 - 51.2 kg, 101.2 - 112.9 lb)
Identification color	White	Yellow green

Unit: mm (in)

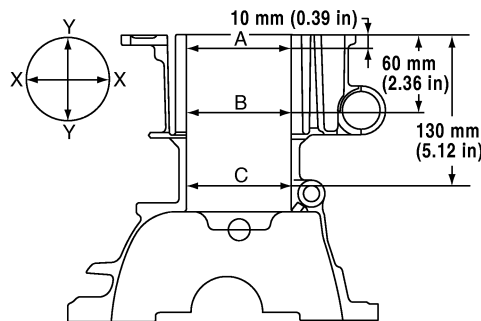
Items	Limit
Valve spring squareness	1.0 (0.039)

## Cylinder Block

INFOID:000000009757011

## CYLINDER BLOCK

Unit: mm (in)



PBIC4017E

Cylinder block top surface distortion	Limit	0.1 (0.004)	
Cylinder bore inner diameter	Standard	Grade No. 1	79.700 - 79.710 (3.1378 - 3.1382)
		Grade No. 2	79.710 - 79.720 (3.1382 - 3.1386)
Out-of-round	Limit	0.015 (0.0006)	
Taper		0.010 (0.0004)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

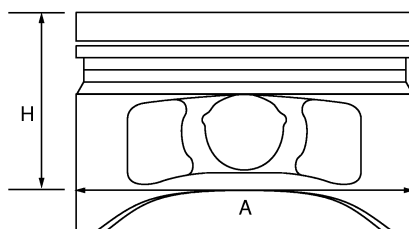
< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

Main bearing housing inner diameter grade	Grade No. A	55.997 - 55.998 (2.2046 - 2.2046)
	Grade No. B	55.998 - 55.999 (2.2046 - 2.2047)
	Grade No. C	55.999 - 56.000 (2.2047 - 2.2047)
	Grade No. D	56.000 - 56.001 (2.2047 - 2.2048)
	Grade No. E	56.001 - 56.002 (2.2048 - 2.2048)
	Grade No. F	56.002 - 56.003 (2.2048 - 2.2048)
	Grade No. G	56.003 - 56.004 (2.2048 - 2.2049)
	Grade No. H	56.004 - 56.005 (2.2049 - 2.2049)
	Grade No. J	56.005 - 56.006 (2.2049 - 2.2050)
	Grade No. K	56.006 - 56.007 (2.2050 - 2.2050)
	Grade No. L	56.007 - 56.008 (2.2050 - 2.2050)
	Grade No. M	56.008 - 56.009 (2.2050 - 2.2051)
	Grade No. N	56.009 - 56.010 (2.2051 - 2.2051)
	Grade No. P	56.010 - 56.011 (2.2051 - 2.2052)
	Grade No. R	56.011 - 56.012 (2.2052 - 2.2052)
	Grade No. S	56.012 - 56.013 (2.2052 - 2.2052)
	Grade No. T	56.013 - 56.014 (2.2052 - 2.2053)
	Grade No. U	56.014 - 56.015 (2.2053 - 2.2053)
Grade No. V	56.015 - 56.016 (2.2053 - 2.2053)	
Grade No. W	56.016 - 56.017 (2.2053 - 2.2054)	

## AVAILABLE PISTON

Unit: mm (in)



Piston skirt diameter "A"	Standard*	Grade No. 1	79.660 - 79.670 (3.1362 - 3.1366)
		Grade No. 2	79.670 - 79.680 (3.1362 - 3.1370)
Measure point "H"			43.4 (1.7087)
Piston pin hole diameter			21.993 - 21.999 (0.8658 - 0.8661)
Piston to cylinder bore clearance	Standard		0.020 - 0.040 (0.0008 - 0.0016)
	Limit		0.08 (0.0031)

\*:Always check with the Parts Department for the latest parts information.

## PISTON RING

Unit: mm (in)

Items	Standard	Limit
Piston ring side clearance	Top	0.04 - 0.08 (0.0016 - 0.0031)
	2nd	0.03 - 0.07 (0.0012 - 0.0028)
	Oil ring	0.055 - 0.145 (0.0022 - 0.0057)
		—

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

Piston ring end gap	Top	0.19 - 0.29 (0.0075 - 0.0114)	0.48 (0.0189)
	2nd	0.29 - 0.44 (0.0114 - 0.0173)	0.60 (0.0236)
	Oil (rail ring)	0.15 - 0.45 (0.0059 - 0.0177)	0.76 (0.0299)

## PISTON PIN

Unit: mm (in)

Items	Standard	Limit
Piston pin outer diameter	19.991 - 19.995 (0.7870- 0.7872)	—
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	—

## CONNECTING ROD

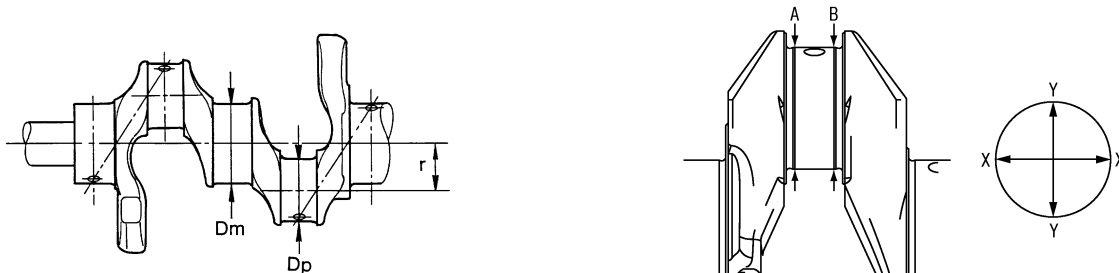
Unit: mm (in)

Center distance		138.97 - 139.07 (5.47 - 5.48)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*	Standard	22.000 - 22.012 (0.8661 - 0.8666)
Connecting rod bushing oil clearance	Standard	0.037 - 0.047 (0.00015 - 0.0019)
	Limit	0.07 (0.0028)
Connecting rod side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.4 (0.016)
Connecting rod big end diameter grade	Grade No. A	47.000 - 47.001 (1.8504 - 1.8504)
	Grade No. B	47.001 - 47.002 (1.8504 - 1.8505)
	Grade No. C	47.002 - 47.003 (1.8505 - 1.8505)
	Grade No. D	47.003 - 47.004 (1.8505 - 1.8505)
	Grade No. E	47.004 - 47.005 (1.8505 - 1.8506)
	Grade No. F	47.005 - 47.006 (1.8506 - 1.8506)
	Grade No. G	47.006 - 47.007 (1.8506 - 1.8507)
	Grade No. H	47.007 - 47.008 (1.8507 - 1.8507)
	Grade No. J	47.008 - 47.009 (1.8507 - 1.8507)
	Grade No. K	47.009 - 47.010 (1.8507 - 1.8508)
	Grade No. L	47.010 - 47.011 (1.8508 - 1.8508)
	Grade No. M	47.011 - 47.012 (1.8508 - 1.8509)
	Grade No. N	47.012 - 47.013 (1.8509 - 1.8509)

\*: After installing in connecting rod

## CRANKSHAFT

Unit: mm (in)



SEM645

PBIC3459J

Center distance "r"	40.41 - 40.49 (1.5909 - 1.5940)
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# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

Out-of-round	Limit	0.0035 (0.0001)
Taper	Limit	
Runout [TIR*]	Standard	0.05 (0.0020)
	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)
Crankshaft pin journal diameter "Dp" grade.	Grade No. A	43.970 - 43.971 (1.7311 - 1.7311)
	Grade No. B	43.969 - 43.970 (1.7311 - 1.7311)
	Grade No. C	43.968 - 43.969 (1.7310 - 1.7311)
	Grade No. D	43.967 - 43.968 (1.7310 - 1.7310)
	Grade No. E	43.966 - 43.967 (1.7309 - 1.7310)
	Grade No. F	43.965 - 43.966 (1.7309 - 1.7309)
	Grade No. G	43.964 - 43.965 (1.7309 - 1.7309)
	Grade No. H	43.963 - 43.964 (1.7308 - 1.7309)
	Grade No. J	43.962 - 43.963 (1.7308 - 1.7308)
	Grade No. K	43.961 - 43.962 (1.7307 - 1.7308)
	Grade No. L	43.960 - 43.961 (1.7307 - 1.7307)
	Grade No. M	43.959 - 43.960 (1.7307 - 1.7307)
	Grade No. N	43.958 - 43.959 (1.7306 - 1.7307)
	Grade No. P	43.957 - 43.958 (1.7306 - 1.7306)
	Grade No. R	43.956 - 43.957 (1.7305 - 1.7306)
	Grade No. S	43.955 - 43.956 (1.7305 - 1.7305)
	Grade No. T	43.954 - 43.955 (1.7305 - 1.7305)
Grade No. U	43.953 - 43.954 (1.7304 - 1.7305)	
Crankshaft main journal diameter "Dm" grade.	Grade No. A	51.978 - 51.979 (2.0464 - 2.0464)
	Grade No. B	51.977 - 51.978 (2.0463 - 2.0464)
	Grade No. C	51.976 - 51.977 (2.0463 - 2.0463)
	Grade No. D	51.975 - 51.976 (2.0463 - 2.0463)
	Grade No. E	51.974 - 51.975 (2.0462 - 2.0463)
	Grade No. F	51.973 - 51.974 (2.0462 - 2.0462)
	Grade No. G	51.972 - 51.973 (2.0461 - 2.0462)
	Grade No. H	51.971 - 51.972 (2.0461 - 2.0461)
	Grade No. J	51.970 - 51.971 (2.0461 - 2.0461)
	Grade No. K	51.969 - 51.970 (2.0460 - 2.0461)
	Grade No. L	51.968 - 51.969 (2.0460 - 2.0460)
	Grade No. M	51.967 - 51.968 (2.0459 - 2.0460)
	Grade No. N	51.966 - 51.967 (2.0459 - 2.0459)
	Grade No. P	51.965 - 51.966 (2.0459 - 2.0459)
	Grade No. R	51.964 - 51.965 (2.0458 - 2.0459)
	Grade No. S	51.963 - 51.964 (2.0458 - 2.0458)
	Grade No. T	51.962 - 51.963 (2.0457 - 2.0458)
Grade No. U	51.961 - 51.962 (2.0457 - 2.0457)	
Grade No. V	51.960 - 51.961 (2.0457 - 2.0457)	
Grade No. W	51.959 - 51.960 (2.0456 - 2.0457)	

\*: Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

## Connecting Rod Bearing

INFOID:000000009757012

### CONNECTING ROD BEARING GRADE TABLE

Unit: mm (in)

Grade number*		Thickness	Identification color	Remarks
0		1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1		1.497 - 1.500 (0.0589 - 0.0591)	Brown	
2		1.500 - 1.503 (0.0591 - 0.0592)	Green	
3		1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
4		1.506 - 1.509 (0.0593 - 0.0594)	Blue	
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
	LWR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
23	UPR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
	LWR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
34	UPR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
	LWR	1.506 - 1.509 (0.0593 - 0.0594)	Blue	

\*:Always check with the Parts Department for the latest parts information.

### UNDERSIZE TABLE

Unit: mm (in)

Items	Thickness	Crank pin journal diameter
US 0.25 (0.0098)	1.623 - 1.631 (0.0639 - 0.0642)	Grind so that bearing clearance is the specified value.

### CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.037 - 0.047 (0.0015 - 0.0019)
	Limit	0.07 (0.0028)

## Main Bearing

INFOID:000000009757013

### MAIN BEARING GRADE TABLE (ALL JOURNALS)

Unit: mm (in)

Grade number*	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0786 - 0.0787)	Black	Grade and color are the same for upper and lower bearings.
1	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
2	2.002 - 2.005 (0.0788 - 0.0789)	Green	
3	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
4	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
5	2.011 - 2.014 (0.0792 - 0.0793)	Pink	
6	2.014 - 2.017 (0.0793 - 0.0794)	Purple	
7	2.017 - 2.020 (0.0794 - 0.0795)	White	

## SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MRA8DE]

01	UPR	1.996 - 1.999 (0.0786 - 0.0787)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
	LWR	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
	LWR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
45	UPR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
	LWR	2.011 - 2.014 (0.0792 - 0.0793)	Pink	
56	UPR	2.011 - 2.014 (0.0792 - 0.0793)	Pink	
	LWR	2.014 - 2.017 (0.0793 - 0.0794)	Purple	
67	UPR	2.014 - 2.017 (0.0793 - 0.0794)	Purple	
	LWR	2.017 - 2.020 (0.0794 - 0.0795)	White	

\*:Always check with the Parts Department for the latest parts information.

### UNDERSIZE TABLE

Unit: mm (in)

Items	Thickness	Main journal diameter
US 0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)	Grind so that bearing clearance is the specified value.

### MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Main bearing oil clearance	Standard	No. 1, 4 and 5	0.024 - 0.034 (0.0009 - 0.0013)
		No. 2 and 3	0.012 - 0.022 (0.0005 - 0.0009)
	Limit		0.065 (0.0026)