

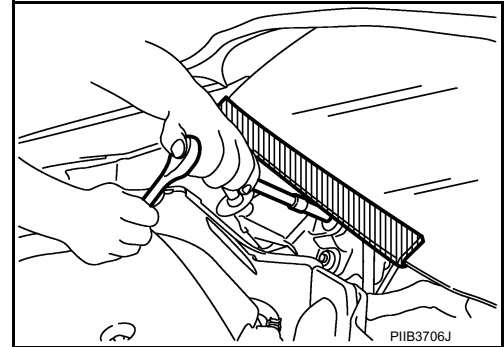
## PRECAUTION

### PRECAUTIONS

#### Precaution for Procedure without Cowl Top Cover

INFOID:000000006282241

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



#### Precautions Necessary for Steering Wheel Rotation After Battery Disconnection

INFOID:000000006881166

#### CAUTION:

Comply with the following cautions to prevent any error and malfunction.

- Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

#### OPERATION PROCEDURE

1. Connect both battery cables.  
**NOTE:**  
Supply power using jumper cables if battery is discharged.
2. Turn the ignition switch to ACC position.  
(At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT.

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

INFOID:000000006625126

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 "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

#### WARNING:

Always observe the following items for preventing accidental activation.

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision that would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.

# PRECAUTIONS

< PRECAUTION >

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- **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 "SRS AIR BAG".**
- **Never 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:**

**Always observe the following items for preventing accidental activation.**

- **When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never 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 3 minutes before performing any service.**

## Draining Engine Coolant

INFOID:000000006282244

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

## Disconnecting Fuel Piping

INFOID:000000006282245

- 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.

## Removal and Disassembly

INFOID:000000006282246

- 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.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

## Inspection, Repair and Replacement

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

## Assembly and Installation

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- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- 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:000000006282249

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:

## PRECAUTIONS

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### < PRECAUTION >

- 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:000000006282250

### REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.

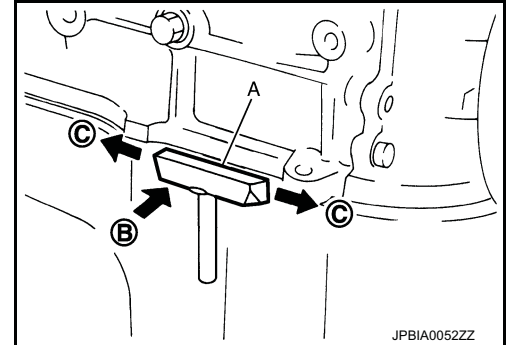
#### **CAUTION:**

**Never damage the mating surfaces.**

- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.

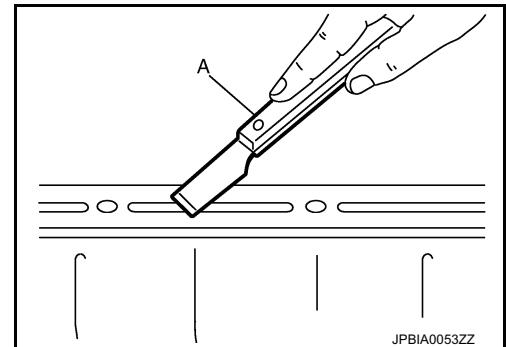
#### **CAUTION:**

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



### LIQUID GASKET APPLICATION PROCEDURE

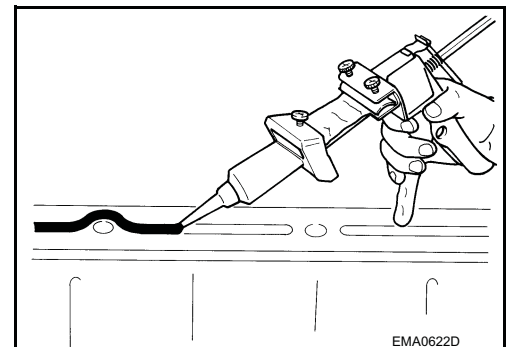
1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
  - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the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



3. Attach liquid gasket tube to the tube presser (commercial service tool).

**Use Genuine Liquid Gasket or equivalent.**

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.



## PRECAUTIONS

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### < PRECAUTION >

- 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.

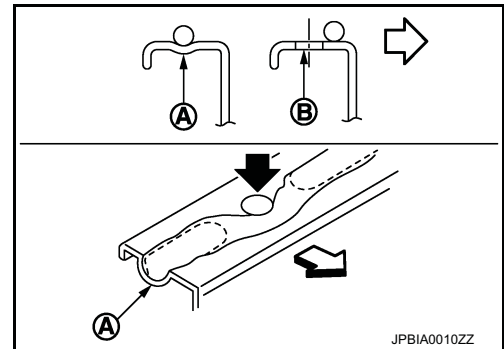
A : Groove

⇐ : 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 this manual, observe them.**



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# PREPARATION

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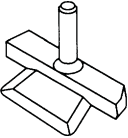
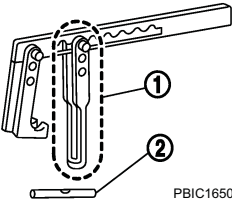
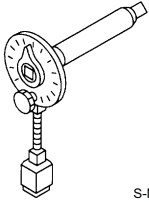
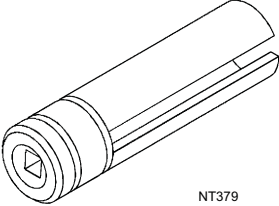
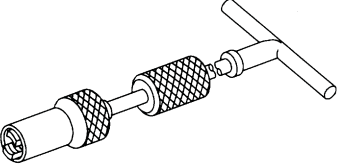
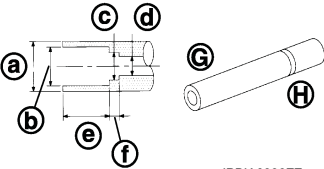
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## PREPARATION

### PREPARATION

#### Special Service Tools

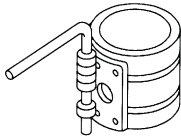
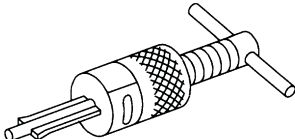
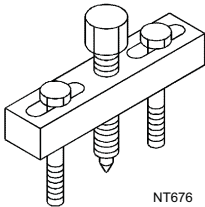
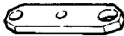
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Tool number Tool name		Description
KV10111100 Seal cutter	 S-NT046	Removing oil pan (upper and lower) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	 PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench	 S-NT014	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 Heated oxygen sensor wrench	 NT379	Loosening or tightening air fuel ratio sensor 1 <b>For 22 mm (0.87 in) width hexagon nut</b>
KV10107902 Valve oil seal puller	 NT011	Removing valve oil seal
KV10115600 Valve oil seal drift	 JPBI A0396ZZ	Installing valve oil seal <b>Use side A (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

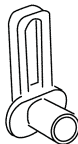
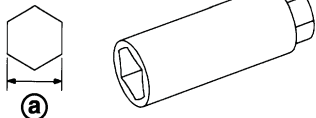
< PREPARATION >

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Tool number Tool name	Description	
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore	A
 S-NT044		EM
ST16610001 Pilot bushing puller	Removing pilot converter	C
 S-NT045		D
KV11103000 Pulley puller	Removing crankshaft pulley	E
 NT676		F
KV11105210 Stopper plate	Fixing drive plate	G
 ZZA0009D		H
		I
		J

## Commercial Service Tools



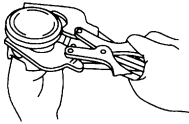
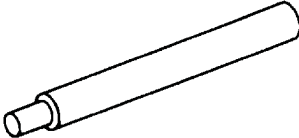
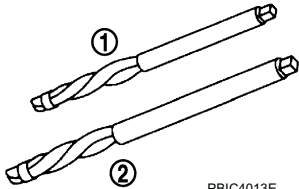
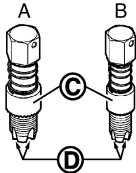

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Tool name	Description	
Quick connector release	Removing fuel tube quick connectors in engine room	L
 PBIC0198E		M
Spark plug wrench	Removing and installing spark plug a: 14 mm (0.55 in)	N
 JPBA0399ZZ		O
		P

# PREPARATION

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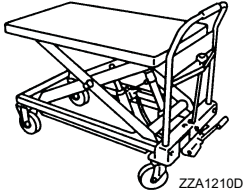
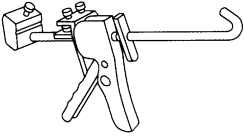
[HR15DE]

Tool name	Description
Pulley holder  ZZA1010D	Crankshaft pulley removing and installing
Valve seat cutter set  S-NT048	Finishing valve seat dimensions
Piston ring expander  S-NT030	Removing and installing piston ring
Valve guide drift  PBIC4012E	Removing and installing valve guide
Valve guide reamer  PBIC4013E	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide
Oxygen sensor thread cleaner  JPBIA0238ZZ	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor (Use with anti-seize lubricant shown below.) <b>A: For zirconia heated oxygen sensor [18mm (0.71 in) dia.]</b> <b>B: For titania heated oxygen sensor [12 mm (0.47 in) dia.]</b> C: Mating surface shave cylinder D: Flutes
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  EM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

# PREPARATION

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[HR15DE]

Tool name	Description
<p>Manual lift table caddy</p>  <p>ZZA1210D</p>	<p>Removing and installing engine</p>
<p>Tube presser</p>  <p>S-NT052</p>	<p>Pressing the tube of liquid gasket</p>

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## BASIC INSPECTION

## CAMSHAFT VALVE CLEARANCE

## Inspection and Adjustment

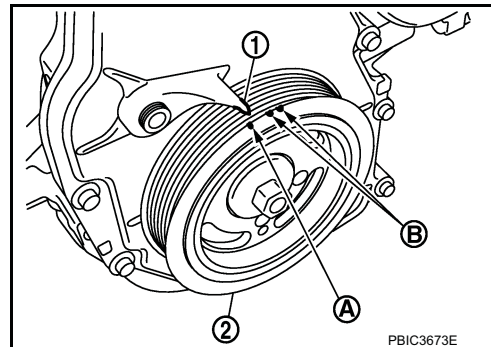
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## INSPECTION

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

1. Remove rocker cover. Refer to [EM-354, "Removal and Installation"](#).
2. Measure the valve clearance with the following procedure:
  - a. Set No. 1 cylinder at TDC of its compression stroke.
    - Rotate crankshaft pulley (2) clockwise and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

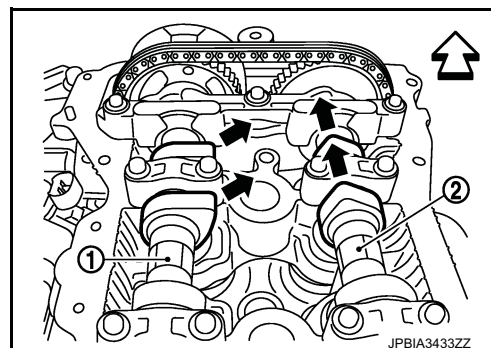
B : White paint mark (Not use for service)



- At the same time, check that both intake and exhaust cam noses of No. 1 cylinder face inside (↔) as shown in the figure.

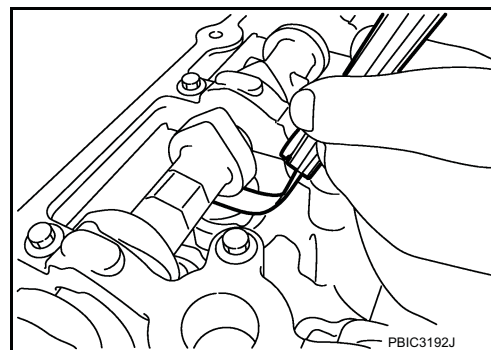
- 1 : Camshaft (INT)  
 2 : Camshaft (EXH)  
 ↔ : Engine front

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



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

Valve clearance : Refer to [EM-430, "Camshaft"](#).



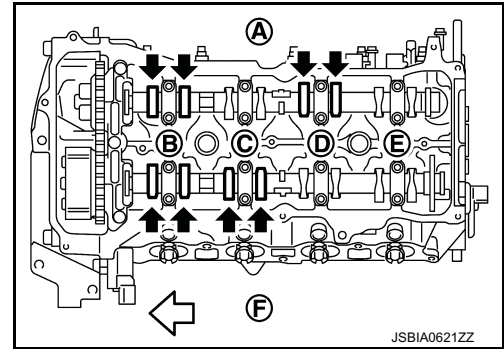
# CAMSHAFT VALVE CLEARANCE

[HR15DE]

## < BASIC INSPECTION >

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

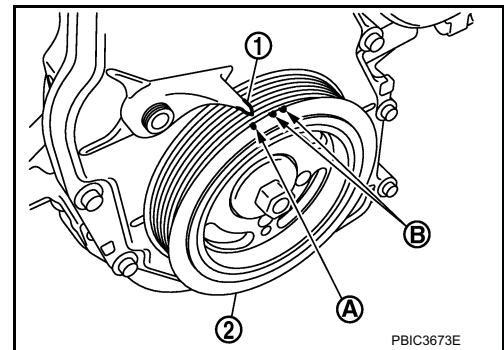
- A : Exhaust side  
 B : No.1 cylinder  
 C : No.2 cylinder  
 D : No.3 cylinder  
 E : No.4 cylinder  
 F : Intake side  
 ➡ : Engine front



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

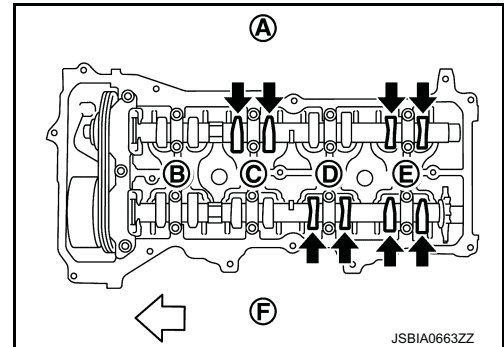
- c. Set No. 4 cylinder at TDC of its compression stroke.
- Rotate crankshaft pulley (2) one revolution (360 degrees) and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

- B : White paint mark (Not use for service)



- By referring to the figure, measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (➡)] with a feeler gauge.
- No. 4 cylinder compression TDC

- A : Exhaust side  
 B : No.1 cylinder  
 C : No.2 cylinder  
 D : No.3 cylinder  
 E : No.4 cylinder  
 F : Intake side  
 ➡ : Engine front



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

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

## ADJUSTMENT

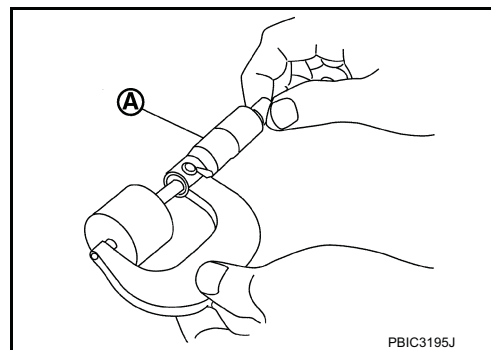
- Perform adjustment depending on selected head thickness of valve lifter.
- Remove camshaft. Refer to [EM-366, "Exploded View"](#).
  - Remove valve lifters at the locations that are out of the standard.

## CAMSHAFT VALVE CLEARANCE

< BASIC INSPECTION >

[HR15DE]

3. Measure the center thickness of the removed valve lifters with a micrometer (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

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

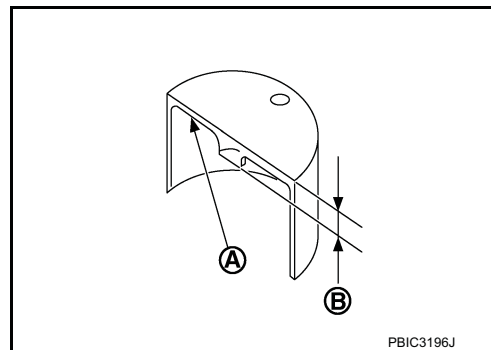
**C<sub>1</sub>** = Measured valve clearance

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

Intake : 0.30 mm (0.012 in)

Exhaust : 0.33 mm (0.013 in)

- 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 to 3.50 mm (0.1181 to 0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-430, "Camshaft"](#).

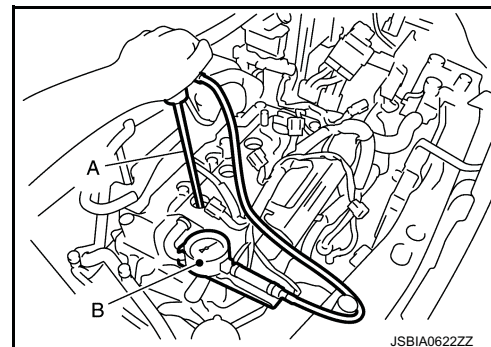
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-366, "Exploded View"](#).
7. Install timing chain and related parts. Refer to [EM-356, "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to "INSPECTION".
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

## COMPRESSION PRESSURE

### Inspection

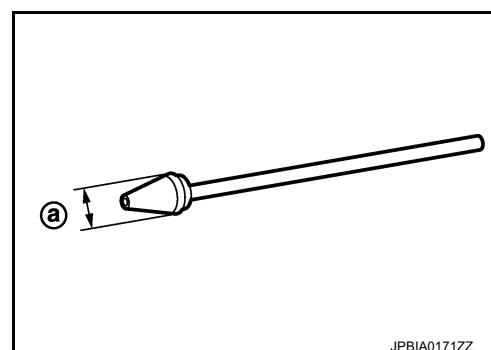
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1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC4-117, "Work Procedure"](#) (TYPE 1) or [EC4-401, "Work Procedure"](#) (TYPE 2).
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-354, "Exploded View"](#).
4. Connect engine tachometer (not required in use of CONSULT).
5. Install compression gauge (B) with an adapter (A) (commercial service tool) onto spark plug hole.



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

a : 20 mm (0.79 in)



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-429, "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. Refer to following.
- For maintenance required battery models: [PG-510, "FOR MAINTENANCE REQUIRED BATTERY MODELS : How to Handle Battery"](#).
- For maintenance free battery models: [PG-518, "FOR MAINTENANCE FREE BATTERY MODELS : How to Handle Battery"](#).
- 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 the 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.

## COMPRESSION PRESSURE

[HR15DE]

### < BASIC INSPECTION >

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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 [EC4-125, "Diagnosis Procedure"](#) (TYPE 1) or [EC4-404, "Diagnosis Procedure"](#) (TYPE 2).

## SYMPTOM DIAGNOSIS

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

#### NVH troubleshooting Chart

INFOID:000000006282255

A

EM

C

D

E

F

G

H

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K

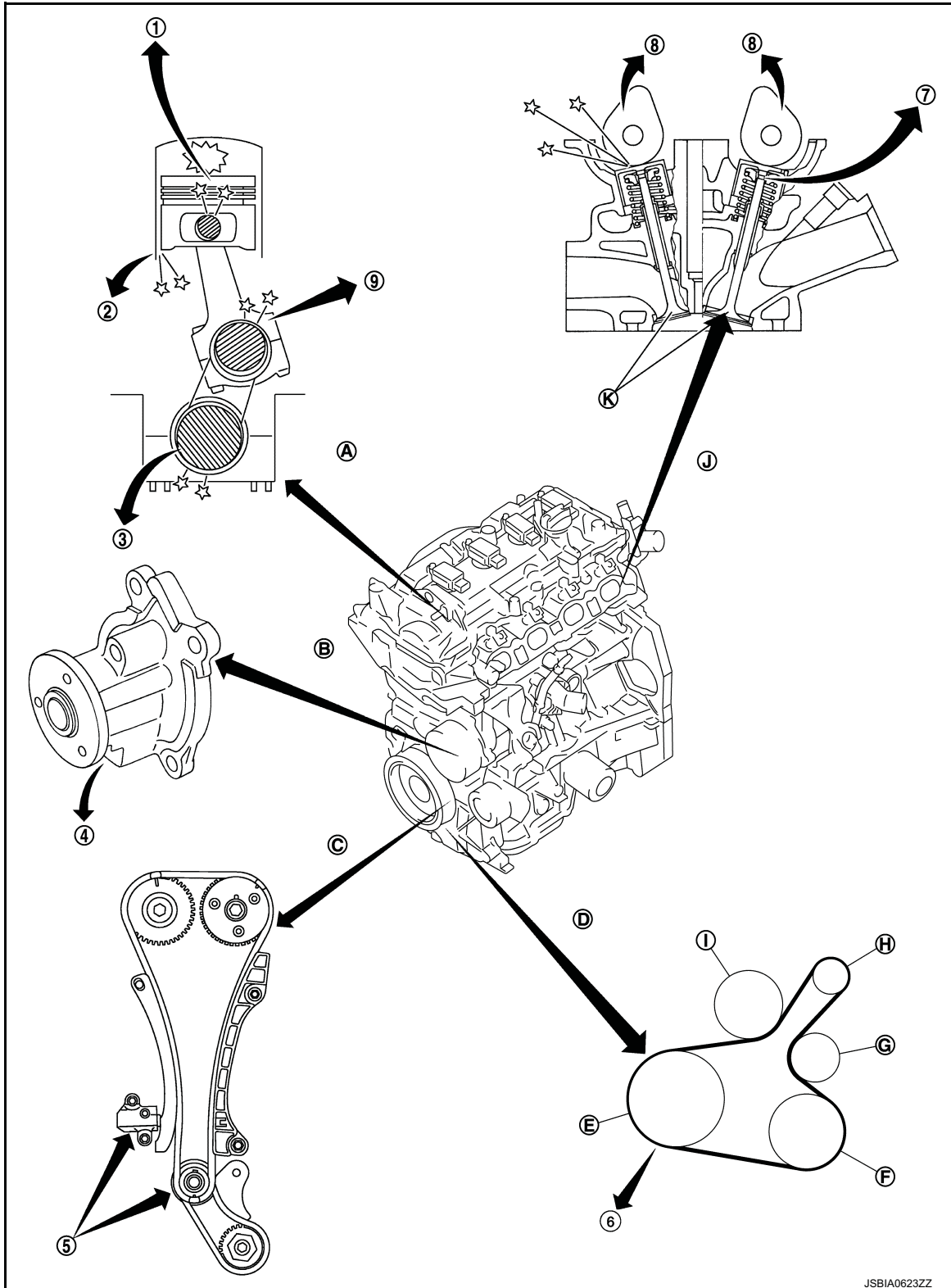
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M

N

O

P



# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR15DE]

- |                         |                                     |                                      |
|-------------------------|-------------------------------------|--------------------------------------|
| 1. Piston pin noise     | 2. Piston slap noise                | 3. Main bearing noise                |
| 4. Water pump noise     | 5. Timing chain and tensioner noise | 6. Drive belt noise (stick/slipping) |
| 7. Tappet noise         | 8. Camshaft bearing noise           | 9. Connecting rod noise              |
| A. Rotational mechanism | B. Water pump                       | C. Timing chain                      |
| D. Drive belt           | E. Crankshaft pulley                | F. A/C compressor                    |
| G. Tension pulley       | H. Alternator                       | I. Water pump                        |
| J. Valve mechanism      | K. Valves                           |                                      |

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

INFOID:000000006307776

1. Locate the area where noise occurs.
  2. Confirm the type of noise.
  3. Specify the operating condition of engine.
  4. Check specified noise source.
- If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When start-ing	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-322</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	<a href="#">EM-430</a>
Crank-shaft 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-434</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-434</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-434</a> <a href="#">EM-437</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-436</a> <a href="#">EM-434</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-364</a> <a href="#">EM-356</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	<a href="#">EM-429</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-75</a>

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR15DE]

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

A

EM

C

D

E

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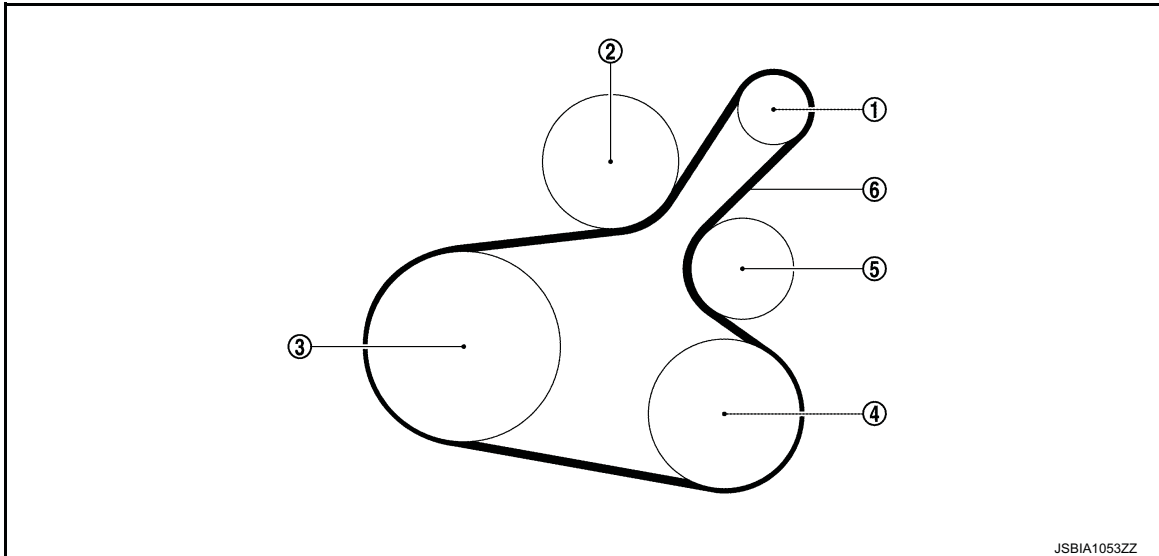


## PERIODIC MAINTENANCE

### DRIVE BELT

#### Exploded View

INFOID:000000006839888



- |  |                 |                      |
|--|-----------------|----------------------|
| 1. Alternator  | 2. Water pump   | 3. Crankshaft pulley |
| 4. A/C compressor (with A/C models)<br>Idler pulley (without A/C models) | 5. Idler pulley | 6. Drive belt        |

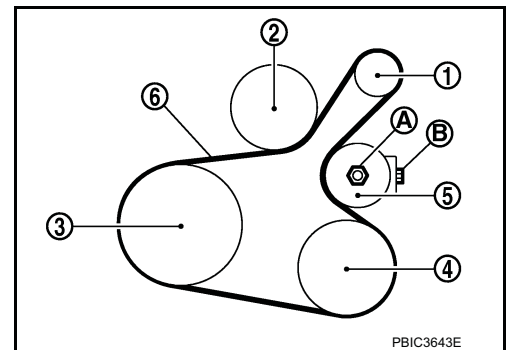
#### Removal and Installation

INFOID:000000006282258

##### REMOVAL

1. Remove the fender protector (RH) front side clip. And keep a service area. Refer to [EXT-21. "FENDER PROTECTOR : Exploded View"](#).
2. Loosen the lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

- |   |   |
|---|---|
| 1 | : Alternator  |
| 2 | : Water pump  |
| 3 | : Crankshaft pulley   |
| 4 | : A/C compressor (with A/C models)<br>Idler pulley (without A/C models) |
| 5 | : Idler pulley  |
| 6 | : Drive belt  |



3. Remove drive belt.

##### INSTALLATION

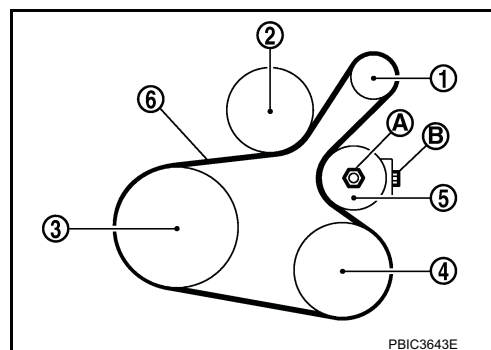
## DRIVE BELT

### < PERIODIC MAINTENANCE >

[HR15DE]

1. Pull the idler pulley in the loosening direction, and then temporarily tighten the lock nut (A) to the following torque.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)  
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt
- B : Adjusting bolt



 : 4.4 N·m (0.45 kg-m, 39 in-lb)

#### NOTE:

Do not move the lock nut from the tightened position. Go to step "2".

2. Install the drive belt to each pulley.

#### CAUTION:

- Check that there is no oil, grease, or coolant, etc. in pulley grooves.
- Check that the belt is securely inside the groove on each pulley.

3. Adjust drive belt tension by turning the adjusting bolt (B). Refer to [EM-332. "Adjustment"](#).

#### CAUTION:

- Perform the belt tension adjustment with the lock nut temporarily tightened at the step "1" so as not to tilt the idler pulley.
- Immediately after adjusting belt tension to the specified value, rotate crankshaft at least 2 turns and check belt tension again. If the belt tension is outside the specified value, readjust the tension to the specified value to prevent variations in each belt tension, and check belt tension again. If the belt tension is outside the specified value, readjust the tension to the specified value to prevent variations in each belt tension.

4. Tighten the lock nut.

 : 34.8 N·m (3.5 kg-m, 26 ft-lb)

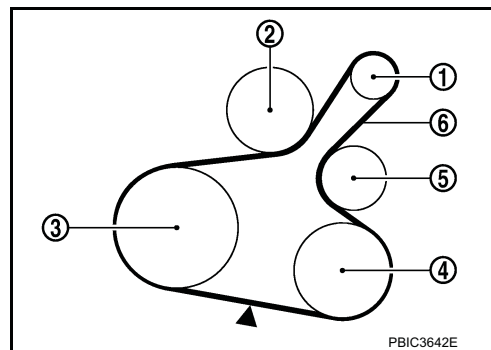
5. Check that belt tension of each belt within the standard.

### Inspection

INFOID:000000006839889

- Inspection should be done only when engine is cold or over 30 minutes after the engine is stopped.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)  
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt



- Visually check belts for wear, damage, and cracks on inside and edges.
- Turn crankshaft pulley two time clockwise, and check tension on all pulleys is equal before doing the test.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the (▼) marked point.
- Measure the belt tension and frequency with acoustic tension gauge (commercial service tool) at the (▼) marked point.

#### CAUTION:

- When the tension and frequency are measured, the acoustic tension gauge should be used.
- Immediately after adjusting belt tension to the specified value, rotate crankshaft at least 2 turns and check belt tension again. If the belt tension is outside the specified value, readjust the tension to the

# DRIVE BELT

< PERIODIC MAINTENANCE >

[HR15DE]

specified value to prevent variations in each belt tension, and check belt tension again. If the belt tension is outside the specified value, readjust the tension to the specified value to prevent variations in each belt tension.

Belt Deflection/Belt Tension and Frequency: Refer to [EM-429, "Drive Belt"](#).

## Adjustment

INFOID:000000006839890

Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

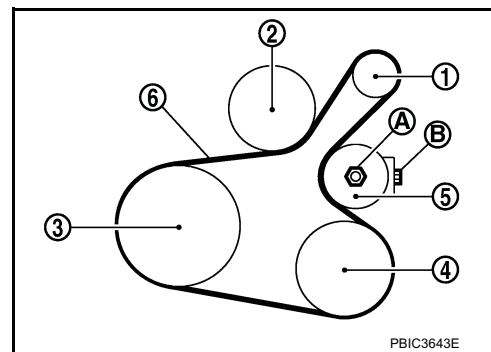
### CAUTION:

- When belt is replaced with new one, adjust belt tension to the value for "New belt", because new belt will not fully seat in the pulley groove.
- When tension of the belt being used exceeds "Limit", adjust it to the value for "After adjusted".
- When installing a belt, check it is correctly engaged with the pulley groove.
- Never allow oil or engine coolant to get on the belt.
- Never twist or bend the belt strongly.

1. Remove the fender protector (RH) front side clip. And keep a service area. Refer to [EXT-21, "FENDER PROTECTOR : Exploded View"](#).

2. Loosen the idler pulley lock nut (A) from the tightening position.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)  
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt
- B : Adjusting blot



3. Lock nut (A) is temporarily tightened by the following torque.

**Tightening torque** : 4.4N·m(0.45kg-m, 39in-lb)

4. Adjust the belt tension by turning the adjusting bolt. Refer to "ADJUSTMENT"

### CAUTION:

- Immediately after adjusting belt tension to the specified value, rotate crankshaft at least 2 turns and check belt tension again. If the belt tension is outside the specified value, readjust the tension to the specified value to prevent variations in each belt tension, and check belt tension again. If the belt tension is outside the specified value, readjust the tension to the specified value to prevent variations in each belt tension.
  - When the tension adjustment is performed, the lock nut should be in the condition at step "2". If the tension adjustment is performed when the lock nut is loosened more than the temporary tightening, the idler pulley tilts and the correct tension adjustment cannot be performed.
5. Tighten the lock nut.

: 34.8 N·m (3.5 kg-m, 26 ft-lb)

# AIR CLEANER FILTER

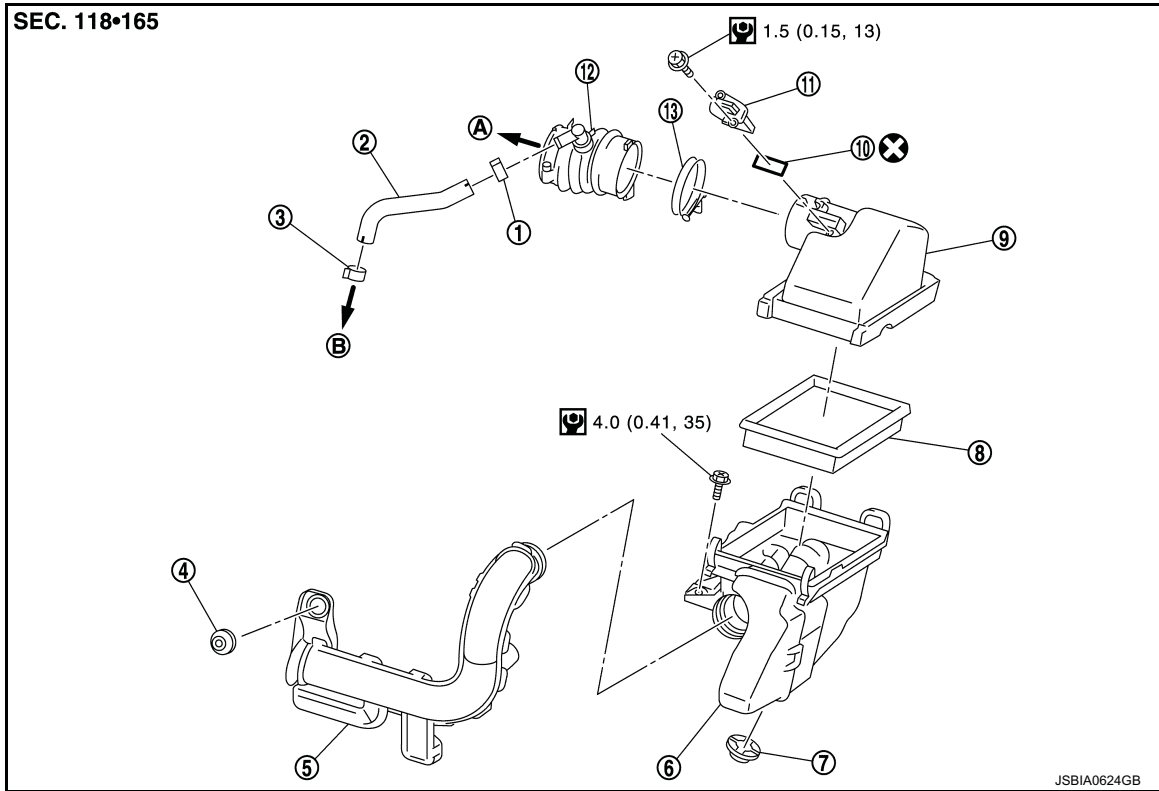
< PERIODIC MAINTENANCE >

[HR15DE]

## AIR CLEANER FILTER

### Exploded View

INFOID:000000006282259



- |                 |                          |                      |
|-----------------|--------------------------|----------------------|
| 1. Clamp        | 2. PCV hose              | 3. Clamp             |
| 4. Mount rubber | 5. Air duct (inlet)      | 6. Air cleaner body  |
| 7. Grommet      | 8. Air cleaner filter    | 9. Air cleaner cover |
| 10. O-ring      | 11. Mass air flow sensor | 12. Air duct         |
| 13. Clamp       |                          |                      |

A. To electric throttle control actuator B. To rocker cover

✕ : Always replace after every disassembly.

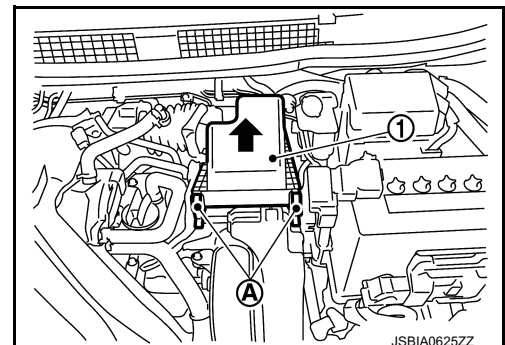
Ⓜ : N·m (kg-m, in-lb)

## Removal and Installation

INFOID:000000006282260

### REMOVAL

1. Unhook clips (A) and pull up the air cleaner cover upward (1).

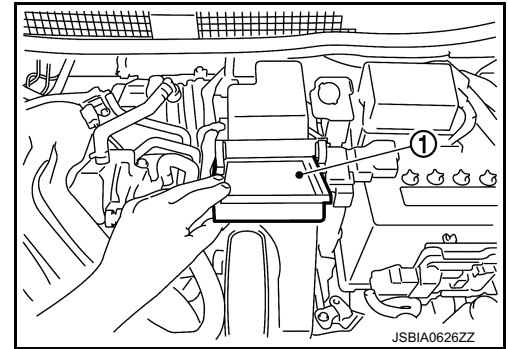


# AIR CLEANER FILTER

< PERIODIC MAINTENANCE >

[HR15DE]

2. Remove the air cleaner filter (1) from the air cleaner body.



## INSTALLATION

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

- Check that the air cleaner filter is securely placed in the air cleaner body.

## Inspection

INFOID:000000007161060

## INSPECTION AFTER REMOVAL

Examine with eyes that there is no stain, clogging, or damage on air cleaner element.

- Remove dusts (such as dead leaves) on air cleaner element surface and inside cleaner case.
- To clean air cleaner element, blow it from intake manifold side towards air intake side to remove trash or dust.
- If clogging or damage is observed, replace the air cleaner element.

## MAINTENANCE INTERVAL

Refer to [MA-38, "AIR CLEANER FILTER : Removal and Installation"](#).

# SPARK PLUG

< PERIODIC MAINTENANCE >

[HR15DE]

## SPARK PLUG

### Removal and Installation

INFOID:000000006282261

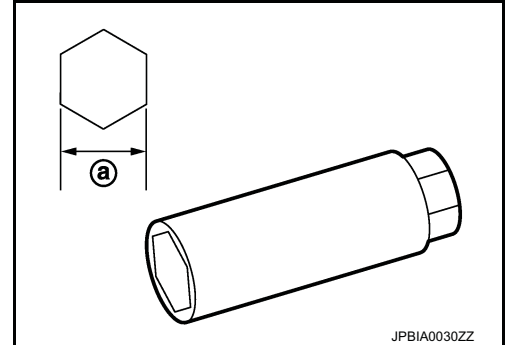
#### REMOVAL

1. Remove ignition coil. Refer to [EM-354, "Exploded View"](#).
2. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)

#### CAUTION:

Never drop or shock spark plug.



#### INSTALLATION

Install in the reverse order of removal.

#### Inspection

INFOID:000000006282262

#### INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

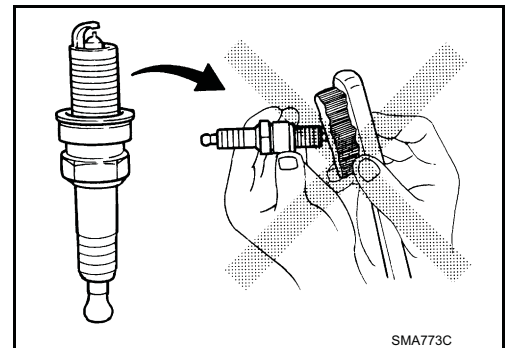
Spark plug (Standard type) : Refer to [EM-430, "Spark Plug"](#).

#### CAUTION:

- Never drop or shock spark plug.
- Never 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



## REMOVAL AND INSTALLATION

### DRIVE BELT IDLER PULLEY

#### Removal and Installation

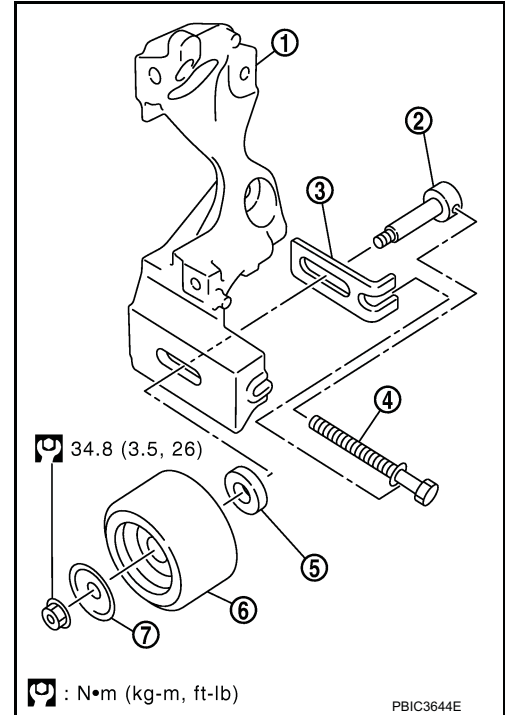
INFOID:000000006282263

#### REMOVAL

1. Remove drive belt. Refer to [EM-330, "Removal and Installation"](#).
2. Remove the lock nut, and then remove the plate (7), idler pulley (6), and washer (5).

1 : Alternator bracket

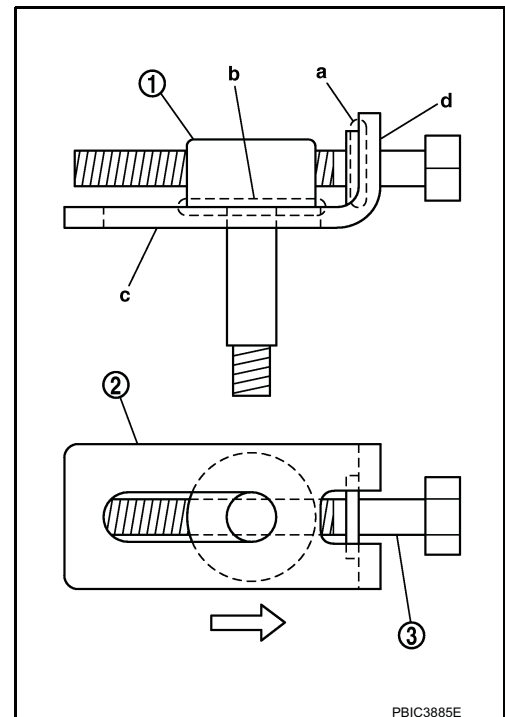
3. Remove the center shaft (2) together with the spacer (3) with inserting the adjusting bolt (4).



#### INSTALLATION

1. Insert the center shaft (1) into the slide groove of the spacer (2). Fully screw in the adjusting bolt (3) in the belt loosening direction (↵).
  - At that time, place the flange (a) of the adjusting bolt and the seat (b) of the center shaft on the spacer.
2. Place each surface (c and d) of the spacer on the alternator bracket. Install the washer, idler pulley, and plate, and then temporarily tighten the lock nut.

: 4.4 N·m (0.45 kg-m, 39 in-lb)



3. Install removed parts in the reverse order of removal.

# AIR CLEANER AND AIR DUCT

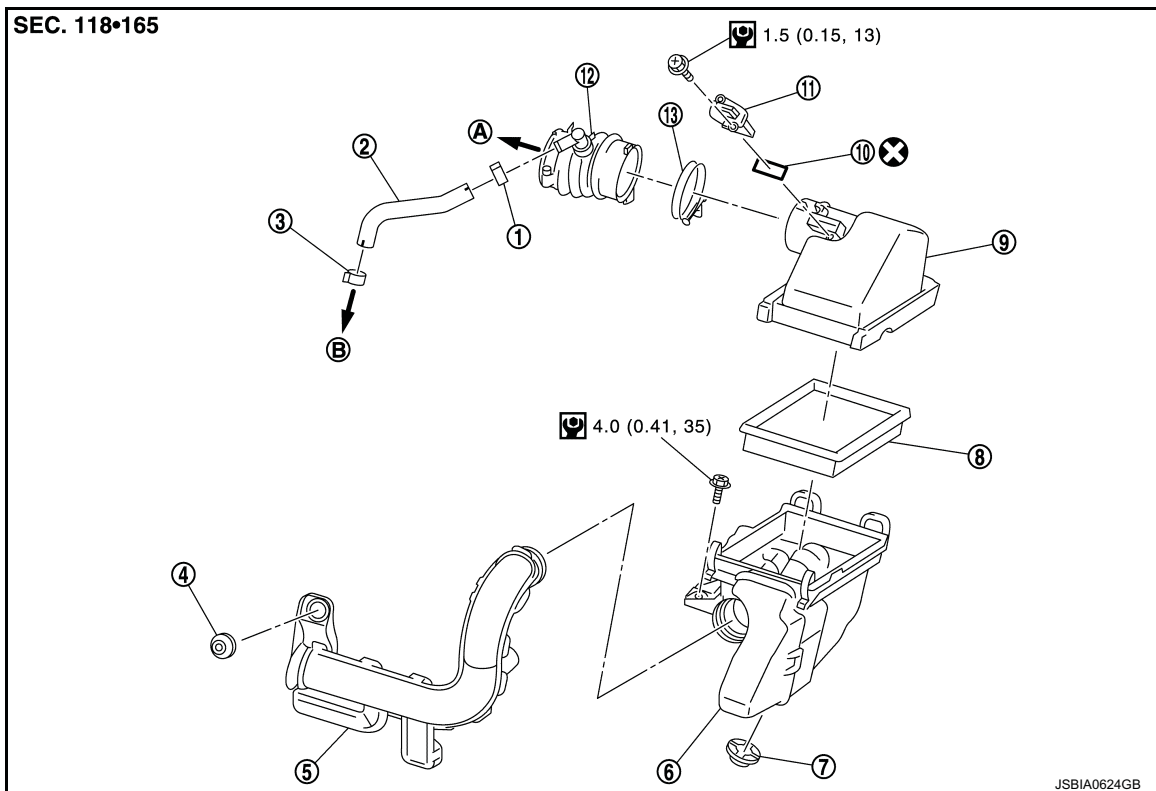
< REMOVAL AND INSTALLATION >

[HR15DE]

## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:000000006282264



- |                 |                          |                      |
|-----------------|--------------------------|----------------------|
| 1. Clamp        | 2. PCV hose              | 3. Clamp             |
| 4. Mount rubber | 5. Air duct (inlet)      | 6. Air cleaner body  |
| 7. Grommet      | 8. Air cleaner filter    | 9. Air cleaner cover |
| 10. O-ring      | 11. Mass air flow sensor | 12. Air duct         |
| 13. Clamp       |                          |                      |

A. To electric throttle control actuator B. To rocker cover

⊗ : Always replace after every disassembly.

Ⓐ : N·m (kg-m, in-lb)

## Removal and Installation

INFOID:000000006282265

### REMOVAL

#### NOTE:

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

- Remove air duct (inlet) from the air cleaner body.
- Remove the air cleaner filter from the air cleaner body.
- Disconnect PCV hose.
- Remove the air duct (between air cleaner case and electric throttle control actuator).
  - Add matching marks if necessary for easier installation.
- Remove air cleaner case with the following procedure.
  - Disconnect mass air flow sensor harness connector.
  - Remove the air cleaner case.
- Remove mass air flow sensor from air cleaner case, if necessary.

#### CAUTION:

Handle the mass air flow sensor with following cares.



## AIR CLEANER AND AIR DUCT

### < REMOVAL AND INSTALLATION >

[HR15DE]

- **Never shock the mass air flow sensor.**
- **Never disassemble the mass air flow sensor.**
- **Never touch the sensor of the mass air flow sensor.**

### INSTALLATION

#### **CAUTION:**

**Do not reuse O-rings.**

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

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

### Inspection

INFOID:000000006282266

### INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

- If anything found, replace air duct and resonator assembly.

# INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

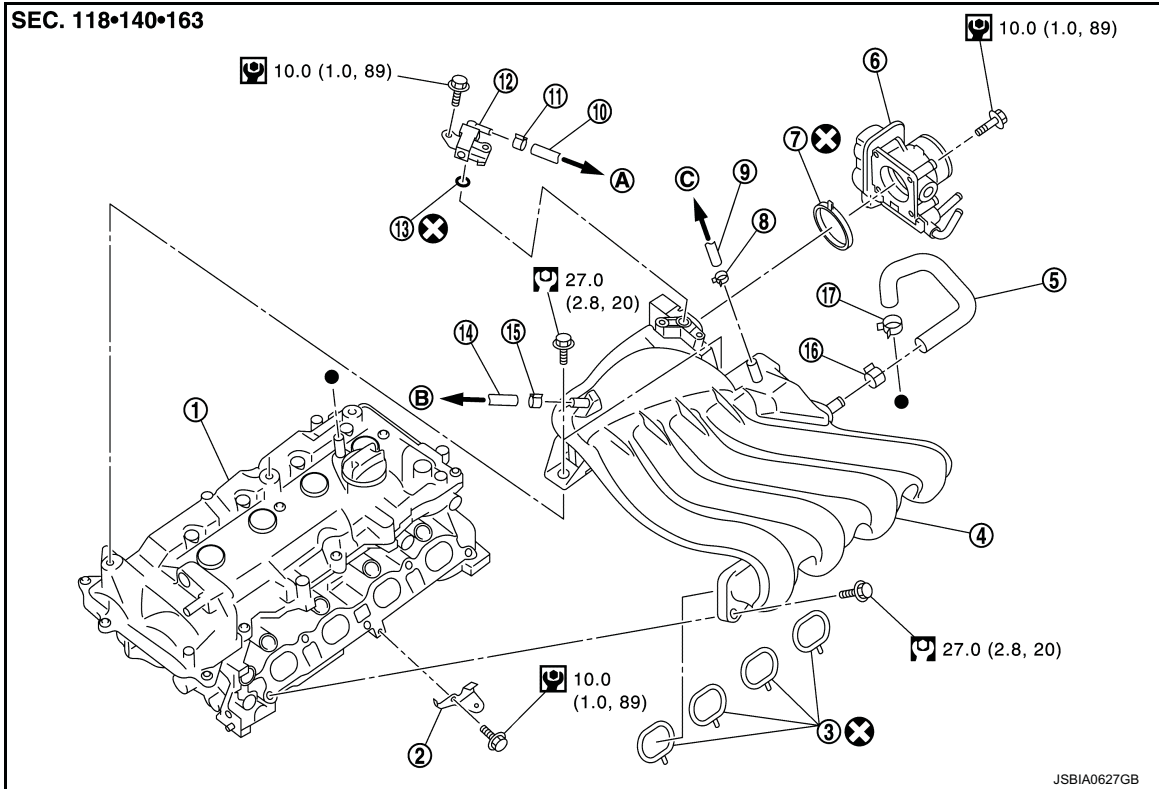
[HR15DE]

## INTAKE MANIFOLD

### Exploded View

INFOID:000000006282267

For China



- |                                      |                            |   |
|--------------------------------------|----------------------------|---|
| 1. Cylinder head                     | 2. Intake manifold support | 3. Gasket   |
| 4. Intake manifold                   | 5. PCV hose                | 6. Electric throttle control actuator                 |
| 7. Gasket                            | 8. Clamp                   | 9. PCV hose   |
| 10. Vacuum hose                      | 11. Clamp                  | 12. EVAP canister purge volume control solenoid valve |
| 13. O-ring                           | 14. Vacuum hose            | 15. Clamp   |
| 16. Clamp                            | 17. Clamp                  |   |
| A. To centralized under-floor piping | B. To brake booster        | C. To air duct  |

⊗ : Always replace after every disassembly.

🔧 : N·m (kg-m, in-lb)

🔧 : N·m (kg-m, ft-lb)

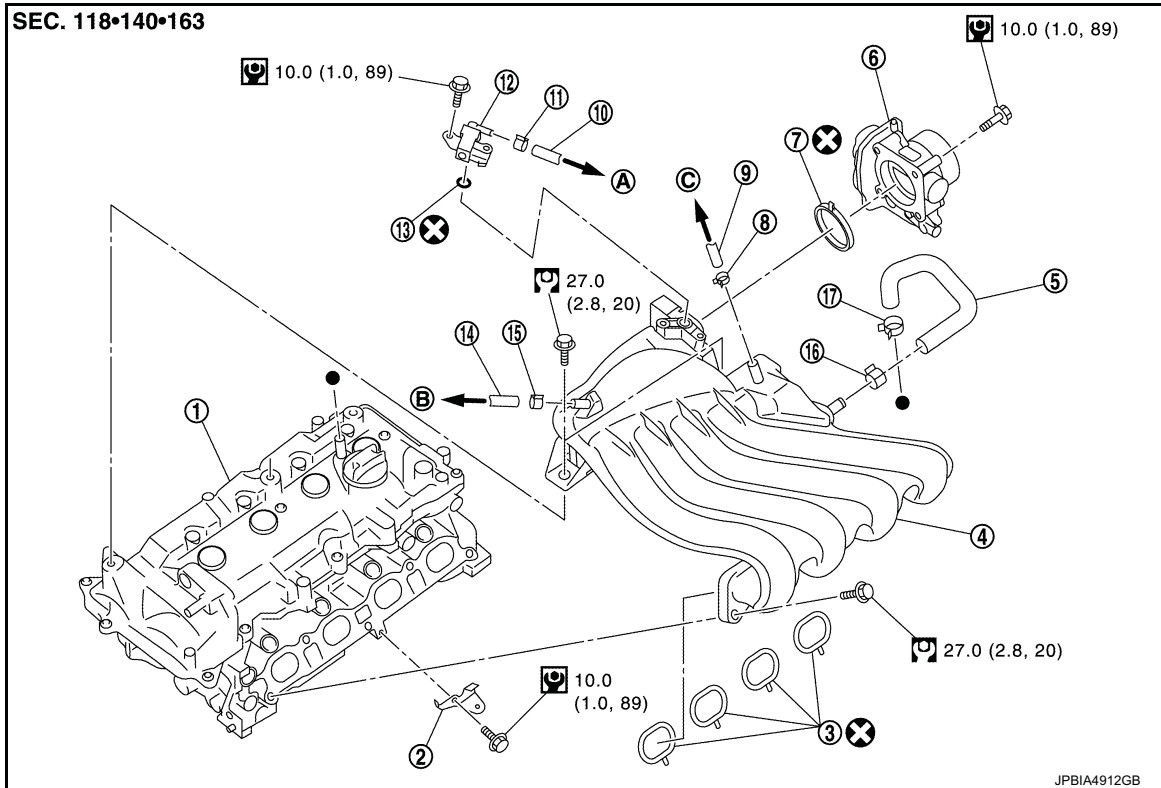
● : Indicates that the part is connected at points with same symbol in actual vehicle.

# INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[HR15DE]

Except for China



- |                                      |                            |   |
|--------------------------------------|----------------------------|---|
| 1. Cylinder head                     | 2. Intake manifold support | 3. Gasket   |
| 4. Intake manifold                   | 5. PCV hose                | 6. Electric throttle control actuator                 |
| 7. Gasket                            | 8. Clamp                   | 9. PCV hose   |
| 10. Vacuum hose                      | 11. Clamp                  | 12. EVAP canister purge volume control solenoid valve |
| 13. O-ring                           | 14. Vacuum hose            | 15. Clamp   |
| 16. Clamp                            | 17. Clamp                  |   |
| A. To centralized under-floor piping | B. To brake booster        | C. To air duct  |

⊗ : Always replace after every disassembly.

🔧 : N·m (kg-m, in-lb)

🔧 : N·m (kg-m, ft-lb)

● : Indicates that the part is connected at points with same symbol in actual vehicle.

## Removal and Installation

INFOID:000000006282268

### REMOVAL

- Remove air duct (inlet) and air duct assembly. Refer to [EM-337, "Exploded View"](#).
- Drain engine coolant. Refer to [CO-65, "Draining"](#) (For China).  
**CAUTION:**  
• Perform this step when the engine is cold.  
• Never spill engine coolant on drive belt.
- Pull out oil level gauge.  
**CAUTION:**  
**Cover the oil level gauge guide openings to avoid entry of foreign materials.**
- Disconnect water hoses from electric throttle control actuator (For China) as follows:  
• Drain engine coolant from radiator or attach plug to prevent engine coolant leakage when engine coolant is not drained. Refer to [CO-65, "Draining"](#).  
**CAUTION:**  
**Perform this step when the engine is cold.**

# INTAKE MANIFOLD

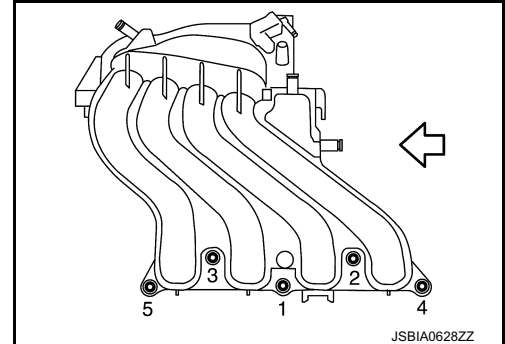
## < REMOVAL AND INSTALLATION >

[HR15DE]

5. Remove electric throttle control actuator.
  - CAUTION:**
    - Handle carefully to avoid any shock to electric throttle control actuator.
    - Never disassemble electric throttle control actuator.
6. Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.
  - CAUTION:**
    - Handle it carefully and avoid impacts.
7. Disconnect vacuum hose for brake booster from intake manifold.
8. Remove intake manifold with the following procedure:
  - a. Loosen mounting bolts between intake manifold and rocker cover.
  - b. Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front

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

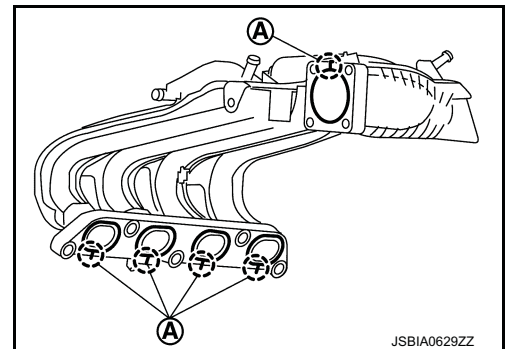


## INSTALLATION

**CAUTION:**  
Do not reuse O-ring,  
Note the following, and install in the reverse order of removal.

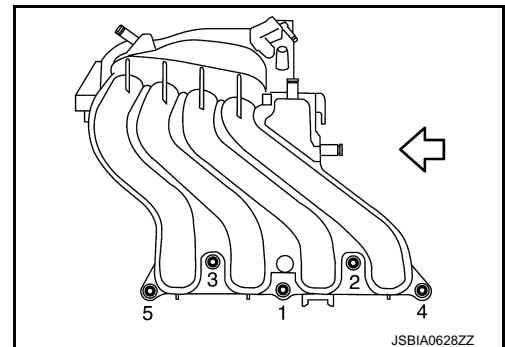
### Intake Manifold

1. Install the gasket to the intake manifold.
  - Align the protrusion (A) of gasket to the groove of intake manifold.



2. Place the intake manifold into the installation position.
  - CAUTION:**
    - Check that the oil level gauge guide is not disconnected from the fixing clip of water inlet due to interference with intake manifold.
3. Tighten bolts in the numerical order as shown in the figure.

← : Engine front



Electric Throttle Control Actuator

## INTAKE MANIFOLD

### < REMOVAL AND INSTALLATION >

[HR15DE]

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform “Throttle Valve Closed Position Learning” after repair when removing harness connector of the electric throttle control actuator. Refer to [EC4-109, "Work Procedure"](#) (TYPE 1) or [EC4-393, "Work Procedure"](#) (TYPE 2).
- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer to [EC4-109, "Work Procedure"](#) and [EC4-110, "Work Procedure"](#) (TYPE 1) or [EC4-393, "Work Procedure"](#) and [EC4-394, "Work Procedure"](#) (TYPE 2).

# EXHAUST MANIFOLD

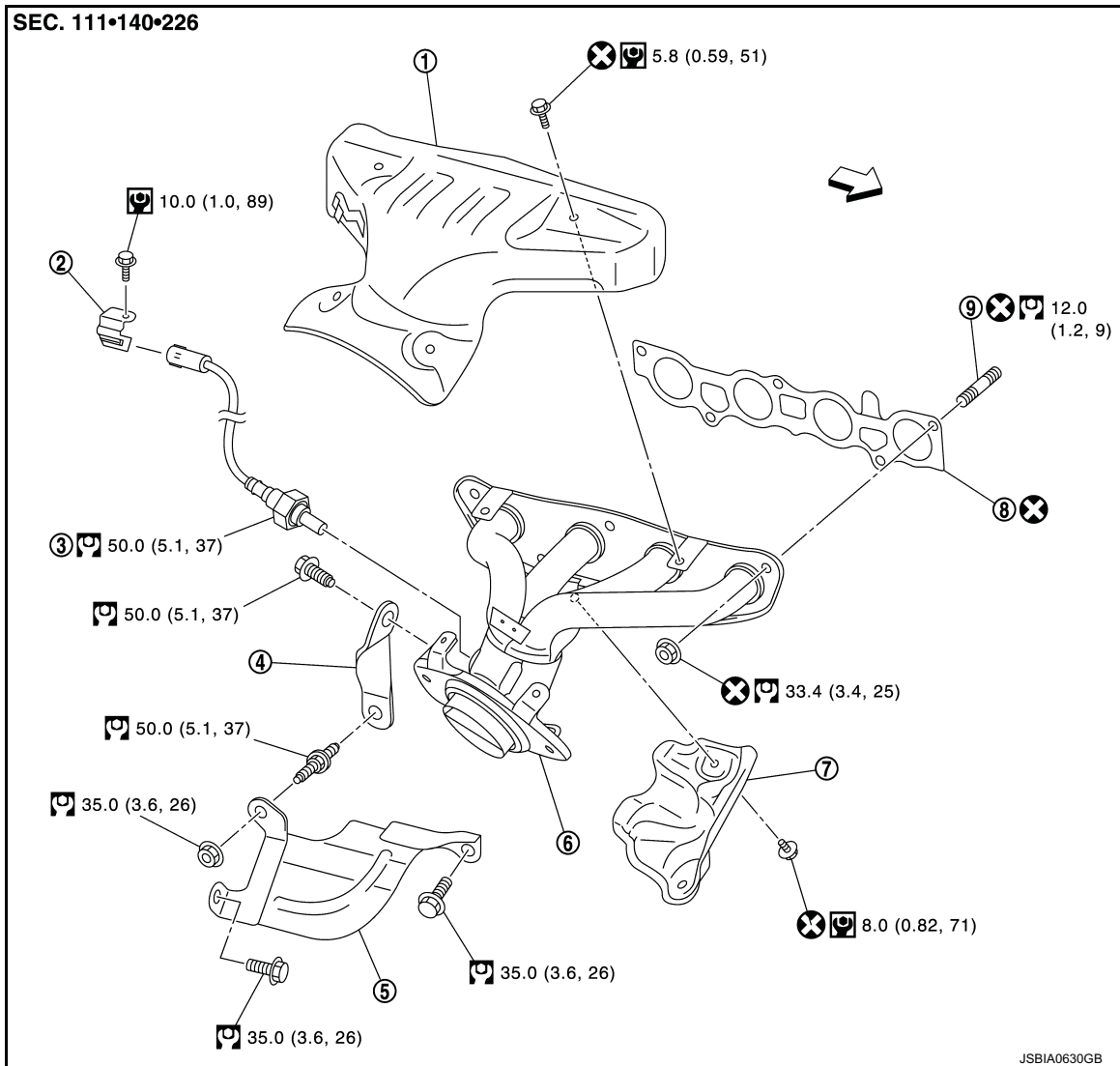
< REMOVAL AND INSTALLATION >

[HR15DE]

## EXHAUST MANIFOLD

### Exploded View

INFOID:000000006282269



- |                           |                    |                            |
|---------------------------|--------------------|----------------------------|
| 1. Exhaust manifold cover | 2. Harness bracket | 3. Air fuel ratio sensor 1 |
| 4. Exhaust manifold stay  | 5. Heat insulator  | 6. Exhaust manifold        |
| 7. Exhaust manifold cover | 8. Gasket          | 9. Stud bolt               |

⇐ : Engine front

⊗ : Always replace after every disassembly.

⊗ : N·m (kg-m, in-lb)

⊗ : N·m (kg-m, ft-lb)

## Removal and Installation

INFOID:000000006282270

### REMOVAL

1. Remove exhaust front tube. Refer to [EX-5. "Exploded View"](#).
2. Remove air cleaner assembly and the air duct (between air cleaner case and electric throttle control actuator). Refer to [EM-337. "Exploded View"](#).
3. Disconnect throttle control actuator harness connector.

# EXHAUST MANIFOLD

[HR15DE]

## < REMOVAL AND INSTALLATION >

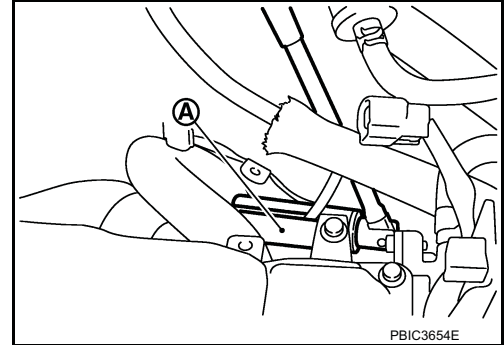
4. Remove electric throttle control actuator assembly.
5. Disconnect air fuel ratio sensor 1 harness connector.
6. Remove exhaust manifold cover.
7. Remove exhaust manifold side mounting bolt of exhaust manifold stay.
8. Remove the air fuel ratio sensor 1.
  - Using heated oxygen sensor wrench [SST: KV10117100], remove air fuel ratio sensor 1.

### CAUTION:

- Discard air fuel ratio sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; use a new one.
- Before installing new air fuel ratio sensor 1, clean exhaust system threads using oxygen sensor thread cleaner (commercial service tool) and approved Anti-seize lubricant (commercial service tool).

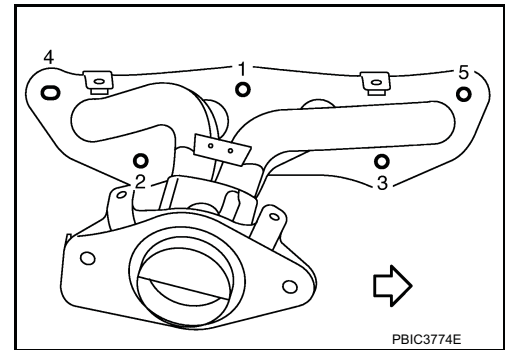
### NOTE:

The exhaust manifold can be removed and installed without removing the air fuel ratio sensor 1 (Disassembly of harness connector is necessary).



9. Remove exhaust manifold.
  - Loosen nuts in reverse order as shown in the figure.

⇐ : Engine front



10. Remove stud bolt from cylinder head.
  - Using TORX socket.
11. Remove exhaust manifold cover from exhaust manifold back side.

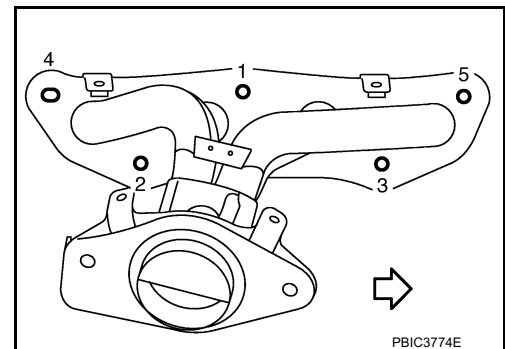
## INSTALLATION

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

### Exhaust manifold

1. Tighten nuts in numerical order as shown in the figure.

⇐ : Engine front



2. Tighten to the specified torque again.

### AIR FUEL RATIO SENSOR 1

#### CAUTION:

- Before installing a new air fuel ratio sensor 1, clean exhaust system threads using heated oxygen sensor thread cleaner tool (commercial service tool) and apply anti-seize lubricant.
- Never over torque air fuel ratio sensor 1. Doing so may cause damage to air fuel ratio sensor 1, resulting in the "MI" coming on.
- Prevent rust preventives from adhering to the sensor body.

# EXHAUST MANIFOLD

< REMOVAL AND INSTALLATION >

[HR15DE]

## Inspection

INFOID:000000006282271

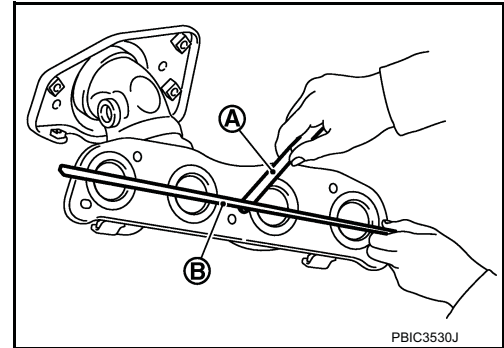
### INSPECTION AFTER REMOVAL

#### 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-430, "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P



**[HR15DE]**

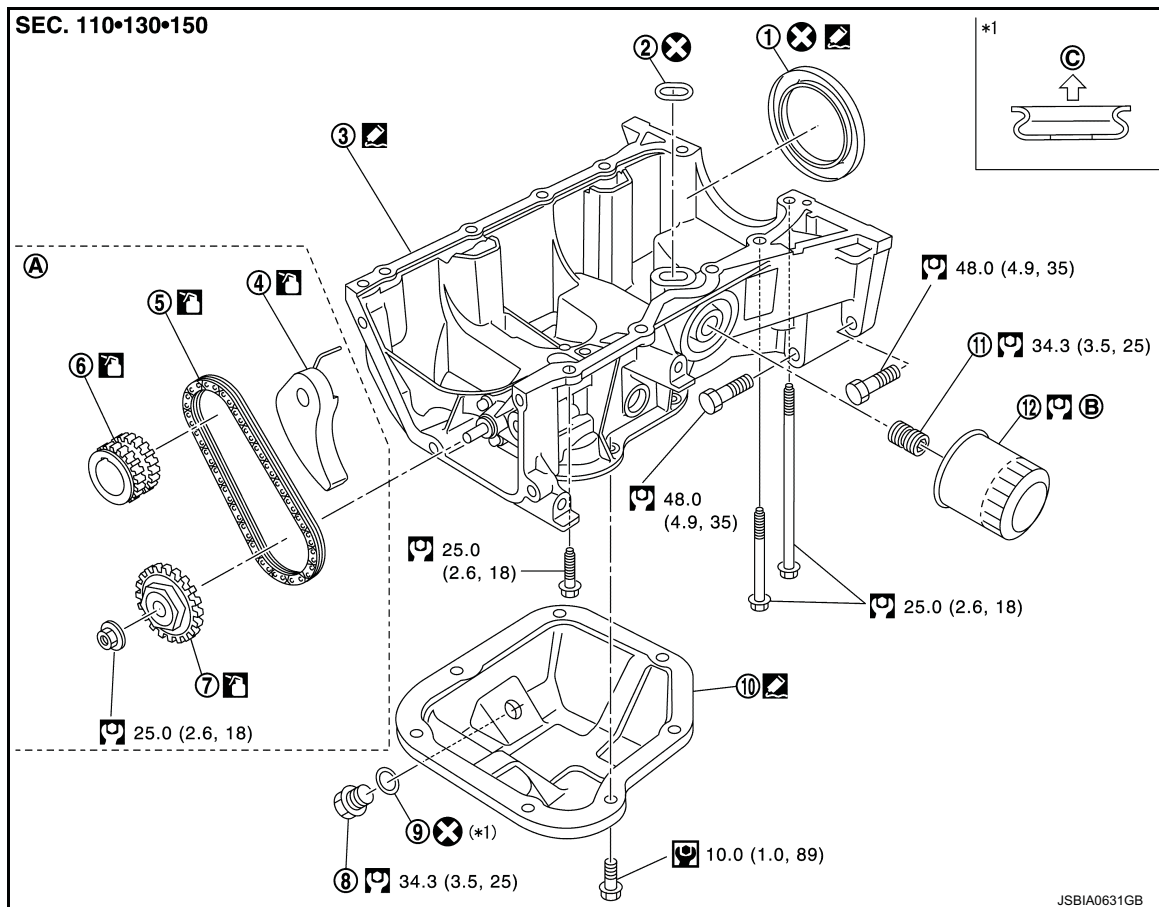
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OIL PAN (LOWER)

## Exploded View

INFOID:0000000006282272



- |  |                          |                        |
|--|--------------------------|------------------------|
| 1. Rear oil seal                                       | 2. O-ring                | 3. Oil pan (upper)     |
| 4. Oil pump chain tensioner (for oil pump drive chain) | 5. Oil pump drive chain  | 6. Crankshaft sprocket |
| 7. Oil pump sprocket                                   | 8. Oil pan drain plug    | 9. Drain plug washer   |
| 10. Oil pan (lower)                                    | 11. Oil filter stud bolt | 12. Oil filter         |

A. Comply with the assembly procedure when tightening. Refer to [EM-356](#)


B. Comply with the assembly procedure when tightening. Refer to [LU-33](#)

C. Oil pan (lower) side

**⊗** : Always replace after every disassembly.

 : N·m (kg-m, in-lb)

 : N·m (kg-m, ft-lb)

 : Should be lubricated with oil.

 : Sealing point

## Removal and Installation

INFOID:0000000006282273

## REMOVAL

1. Drain engine oil. Refer to [CO-65, "Draining"](#).
2. Remove oil pan (lower) with the following procedure:

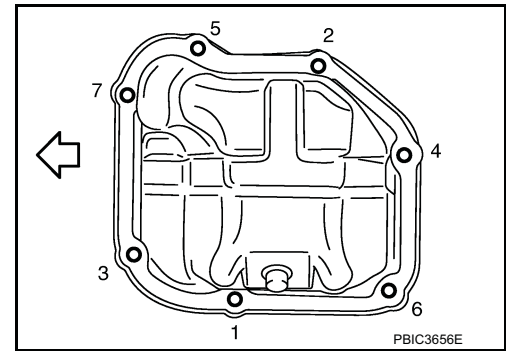
## OIL PAN (LOWER)

### < REMOVAL AND INSTALLATION >

[HR15DE]

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

⇐ : Engine front

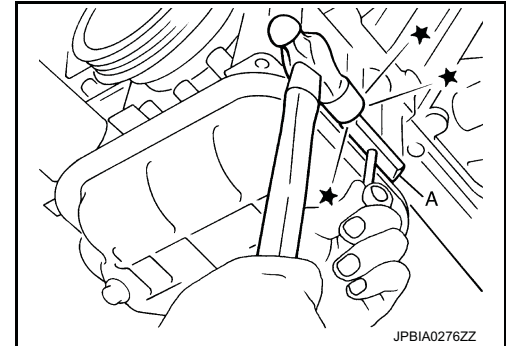


- b. Insert seal cutter [SST: KV10111100] (A) between oil pan (upper) and oil pan (lower).

**CAUTION:**

- **Never damage the mating surface.**
- **Never insert a screwdriver. This damages the mating surfaces.**

- c. Slide the seal cutter [SST: KV10111100] by tapping on the side of tool with a hammer.
- d. Remove oil pan (lower).



### INSTALLATION

**CAUTION:**

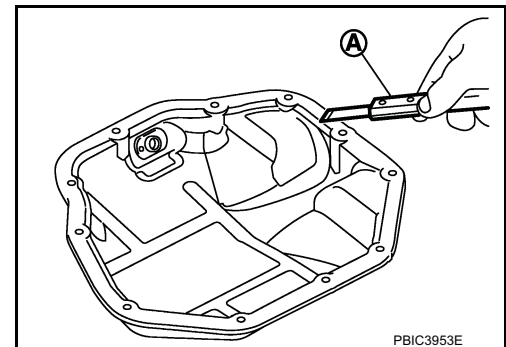
**Do not reuse drain plug washer.**

1. Install oil pan (lower) as follows:

- a. Use a scraper (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:**

**Never scratch or damage the mating surface when cleaning off old liquid gasket.**



## OIL PAN (LOWER)

[HR15DE]

### < REMOVAL AND INSTALLATION >

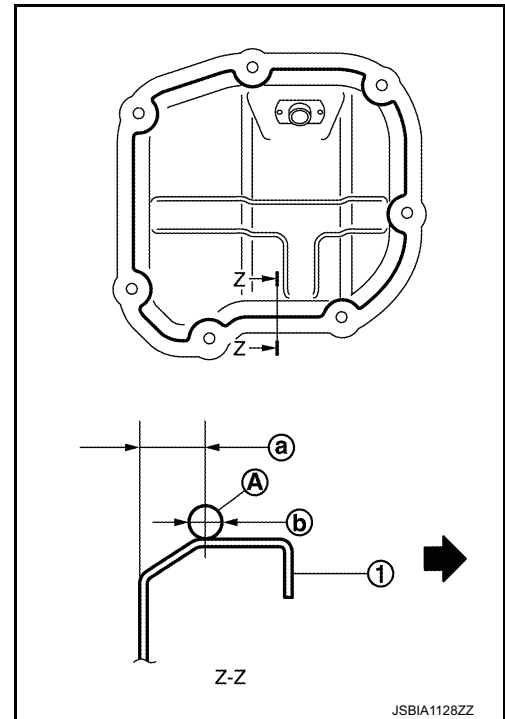
- b. Apply a continuous bead of liquid gasket (A) with a tube presser (commercial service tool) as shown in the figure.

- 1 : Oil pan (lower)  
a : 7.5 - 9.5 mm (0.295 - 0.374 in)  
b :  $\phi$ 4.0 - 5.0 mm (0.157 - 0.197 in)  
← : Engine outside

Use Genuine Liquid Gasket or equivalent.

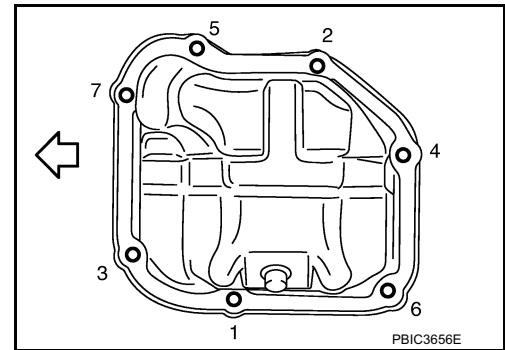
**CAUTION:**

Attaching should be done within 5 minutes after liquid gasket application.



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

- ⇐ : Engine front



2. Install oil pan drain plug.  
• Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-346, "Exploded View"](#).
3. Install in the reverse order of removal after this step.  
**NOTE:**  
Wait at last 30 minutes after oil pan (lower) is installed before pouring engine oil.

### Inspection

INFOID:000000006282274

#### 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-30, "Inspection"](#).
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-30, "Inspection"](#).

# FUEL INJECTOR AND FUEL TUBE

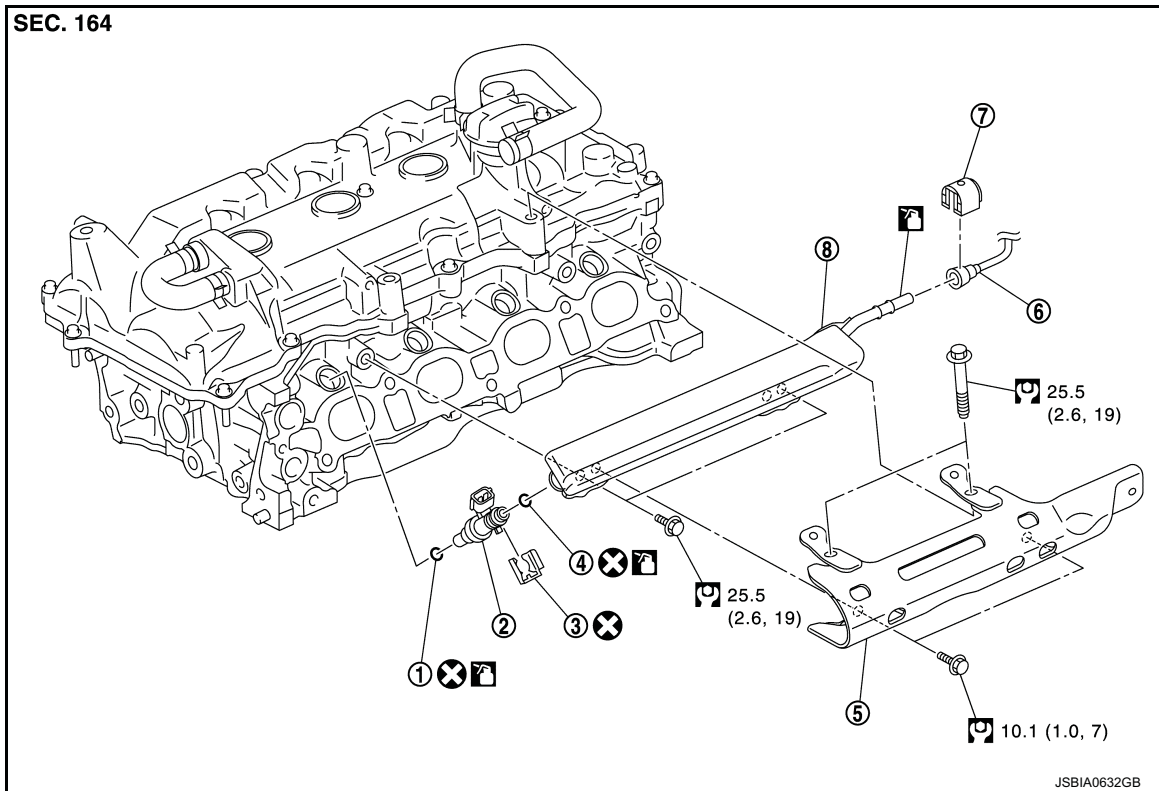
< REMOVAL AND INSTALLATION >

[HR15DE]

## FUEL INJECTOR AND FUEL TUBE

### Exploded View

INFOID:000000006282275



- |                        |                        |                   |
|------------------------|------------------------|-------------------|
| 1. O-ring (green)      | 2. Fuel injector       | 3. Clip           |
| 4. O-ring (black)      | 5. Fuel tube protector | 6. Fuel feed tube |
| 7. Quick connector cap | 8. Fuel tube           |                   |

⊗ : Always replace after every disassembly.

Ⓐ : N·m (kg·m, ft·lb)

🛢 : Should be lubricated with oil.

### CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.

### Removal and Installation

INFOID:000000006282276

### WARNING:

- Put a "CAUTION: FLAMMABLE" sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO<sub>2</sub> fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

### REMOVAL

1. Release the fuel pressure. Refer to [EC4-117, "Work Procedure"](#) (TYPE 1) or [EC4-401, "Work Procedure"](#) (TYPE 2).
2. Remove intake manifold. Refer to [EM-339, "Exploded View"](#).

# FUEL INJECTOR AND FUEL TUBE

[HR15DE]

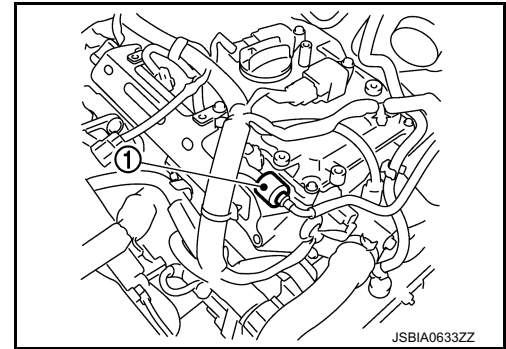
## < REMOVAL AND INSTALLATION >

3. Disconnect quick connector with the following procedure. Disconnect fuel feed tube from fuel tube.

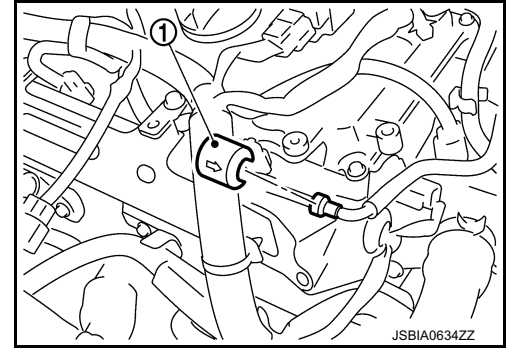
1 : Quick connector cap

### NOTE:

There is no fuel return path.



- a. Remove quick connector cap (engine side) (1) from quick connector connection.  
b. Disconnect fuel feed hose from hose clamp.



- c. With the sleeve side of quick connector release facing quick connector, install quick connector release (commercial service tool) onto fuel tube.  
d. Insert quick connector release (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold quick connector release on that position.

D : Insert and retain

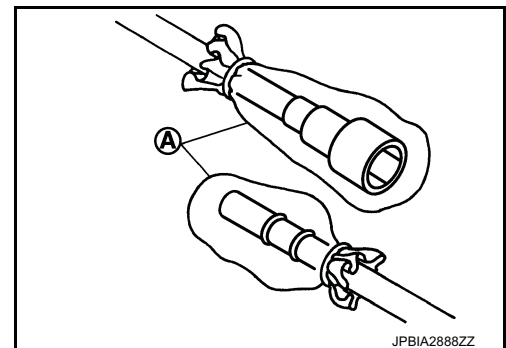
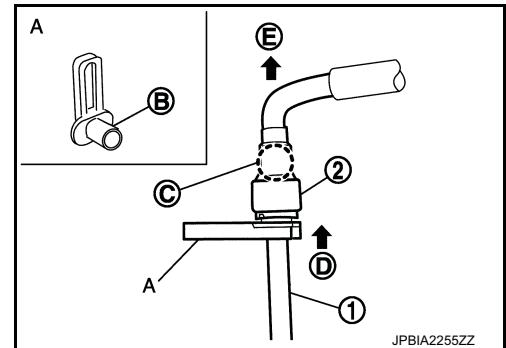
### CAUTION:

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

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

### CAUTION:

- Pull quick connector (E) holding position (C) in the figure.
- Never pull with lateral force applied. O-ring inside quick connector may be damaged.
- Prepare container and cloth beforehand as fuel will leakage out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Never expose parts to battery electrolyte or other acids.
- Never bend or twist connection between quick connector and fuel feed tube during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.



4. Disconnect harness connector from fuel injector.

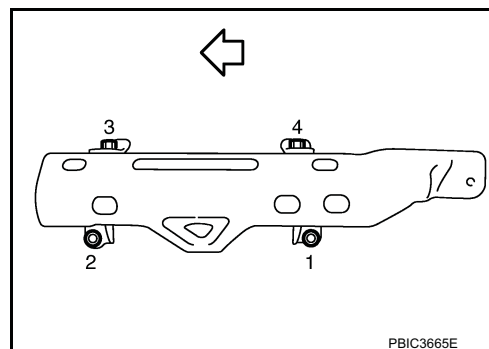
# FUEL INJECTOR AND FUEL TUBE

## < REMOVAL AND INSTALLATION >

[HR15DE]

5. Remove fuel tube protector.
  - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

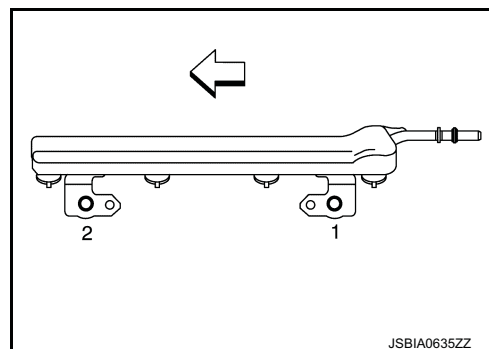


6. Remove fuel tube and fuel injector assembly.
  - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

### CAUTION:

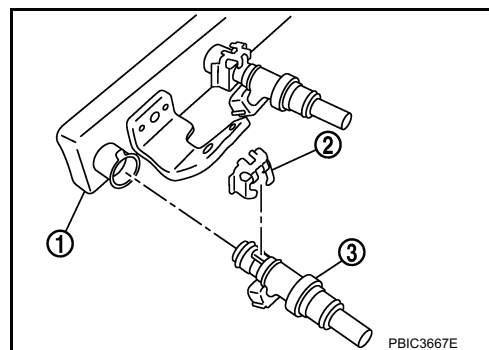
- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leakage from fuel tube.



7. 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 go out from fuel tube.
- Never damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



## INSTALLATION

### CAUTION:

Do not reuse O-rings.

1. Note the following, and install O-rings to fuel injector.

### CAUTION:

- Do not reuse O-rings.
- 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. Never wear gloves.
  - Lubricate O-ring with new engine oil.
  - Never 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, never insert it quickly into fuel tube.
  - Insert O-ring straight into fuel tube. Never decenter or twist it.
2. Install fuel injector to fuel tube with the following procedure:

# FUEL INJECTOR AND FUEL TUBE

## < REMOVAL AND INSTALLATION >

[HR15DE]

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

3 : O-ring (black)

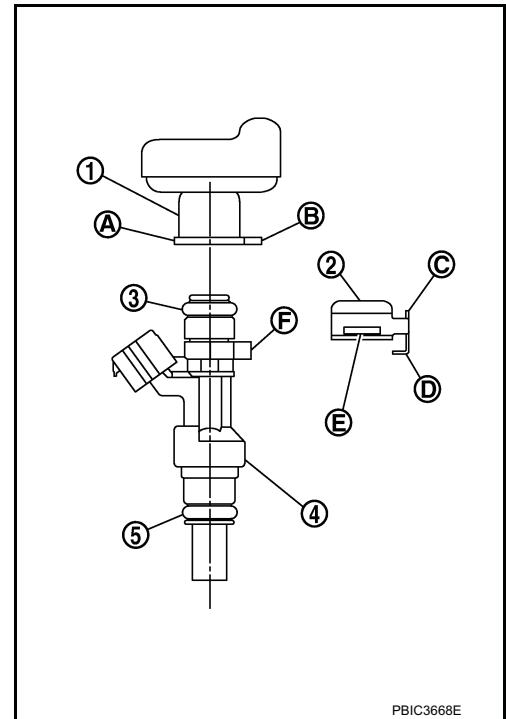
5 : O-ring (green)

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

**CAUTION:**

- **Never 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 fixed in flange fixing groove (E) on clip.
- c. Check that installation is complete by checking that fuel injector does not rotate or come off.



PBIC3668E

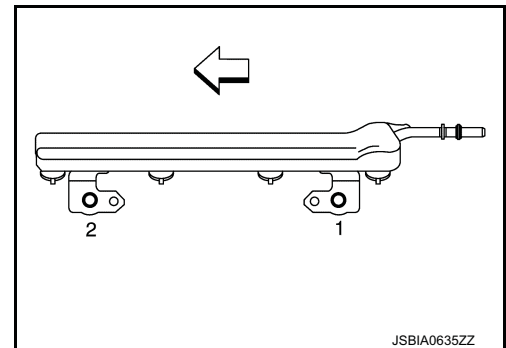
3. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

**CAUTION:**

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

4. Install fuel tube and injector assembly onto cylinder.
- Tighten mounting bolts in numerical order as shown in the figure.

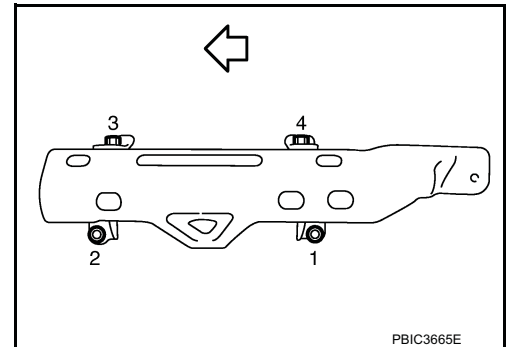
⇐ : Engine front



JSBIA0635ZZ

5. Install fuel tube protector.
- Tighten mounting bolts in numerical order as shown in the figure.

⇐ : Engine front



PBIC3665E

6. Connect harness connector to fuel injector.
7. Connect fuel feed tube with the following procedure.
- Check for damage or foreign material on the fuel tube and quick connector.
  - Apply new engine oil lightly to area around the top of fuel tube.
  - Align center to insert quick connector straightly into fuel tube.

# FUEL INJECTOR AND FUEL TUBE

## < REMOVAL AND INSTALLATION >

[HR15DE]

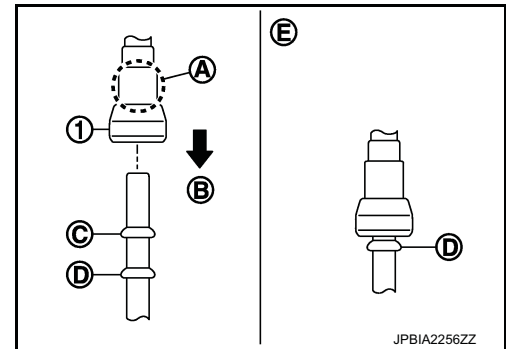
- Insert quick connector (1) to fuel tube until the top spool (C) on fuel tube is inserted completely and the 2nd level spool (D) is positioned slightly below quick connector bottom end.

B : Upright insertion

E : Fitted condition

### CAUTION:

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



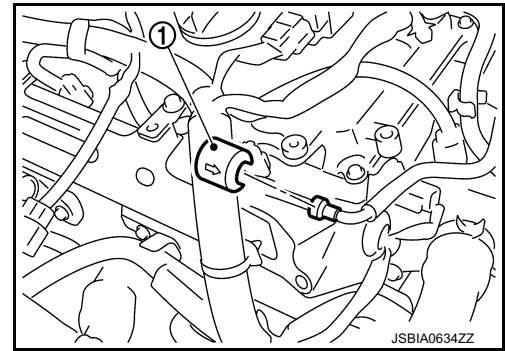
- d. Pull quick connector hard by hand holding position. Check it is completely engaged (connected) so that it does not come out from fuel tube.

- e. Install quick connector cap (engine side) (1) to quick connector connection.

- 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. Install remaining parts in the reverse order of removal.

## Inspection

INFOID:000000006282277

## 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 leakage at connection points.

### 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 leakage at connection points.

### CAUTION:

Never touch the engine immediately after stopped, as the engine becomes extremely hot.



# IGNITION COIL, SPARK PLUG AND ROCKER COVER

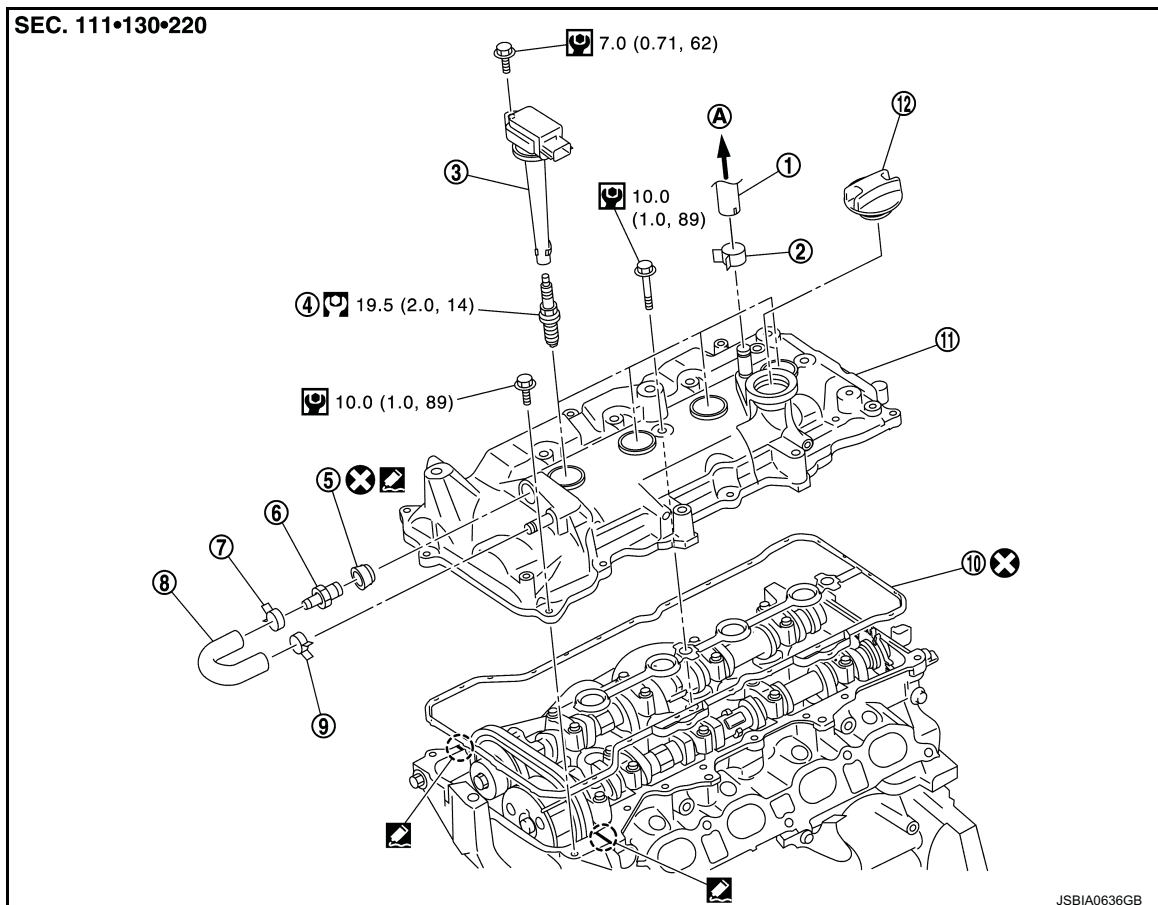
< REMOVAL AND INSTALLATION >

[HR15DE]

## IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:000000006282278



- |               |                  |                    |
|---------------|------------------|--------------------|
| 1. PCV hose   | 2. Clamp         | 3. Ignition coil   |
| 4. Spark plug | 5. Grommet       | 6. PCV valve       |
| 7. Clamp      | 8. PCV hose      | 9. Clamp           |
| 10. Gasket    | 11. Rocker cover | 12. Oil filler cap |

A. To air duct assembly

✕: Always replace after every disassembly.

🔧: N·m (kg-m, in-lb)

🔧: N·m (kg-m, ft-lb)

🔧: Sealing point

## Removal and Installation

INFOID:000000006282279

### REMOVAL

1. Remove intake manifold. Refer to [EM-339, "Exploded View"](#).

2. Remove ignition coil.

#### CAUTION:

- Never drop or shock ignition coil.
- Never disassemble ignition coil.

3. Remove fuel tube protector. Refer to [EM-349, "Exploded View"](#).

4. Remove PCV valve and PCV hose, if necessary.

5. Remove engine mount bracket link. Refer to [EM-392, "Exploded View"](#).

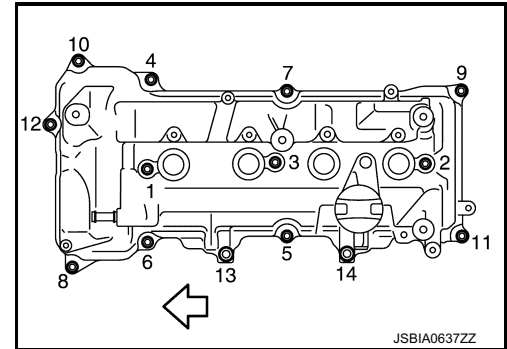
# IGNITION COIL, SPARK PLUG AND ROCKER COVER

## < REMOVAL AND INSTALLATION >

[HR15DE]

6. Remove rocker cover.
  - Loosen bolts in reverse order as shown in the figure.

⇐ : Engine front



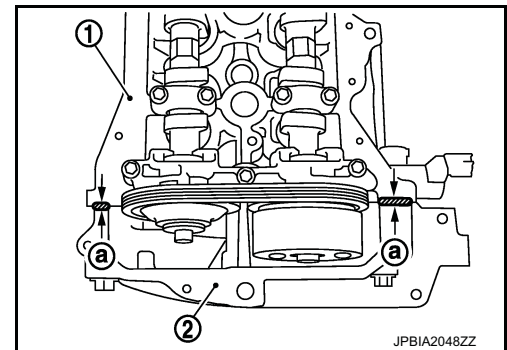
7. Remove rocker cover gasket from rocker cover.
8. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.  
**CAUTION:**  
**Never scratch or damage the mating surface when cleaning off old liquid gasket.**

## INSTALLATION

1. Rocker cover with the following procedure:
  - a. Install the rocker cover gasket to rocker cover.
  - b. Apply liquid gasket to the position as shown in the figure.

- 1 : Cylinder head
- 2 : Front cover
- a :  $\phi 2.5 - 3.5$  mm

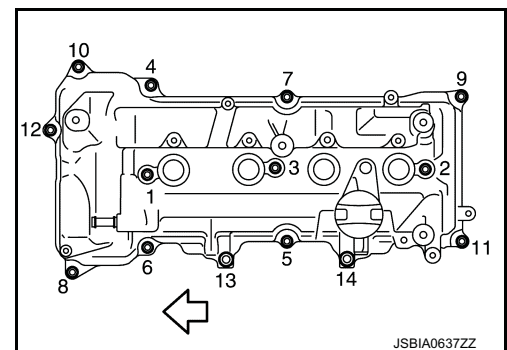
**Use Genuine Liquid Gasket or equivalent.**



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

⇐ : Engine front

2. Install in the reverse order of removal, for the rest of parts.



# TIMING CHAIN

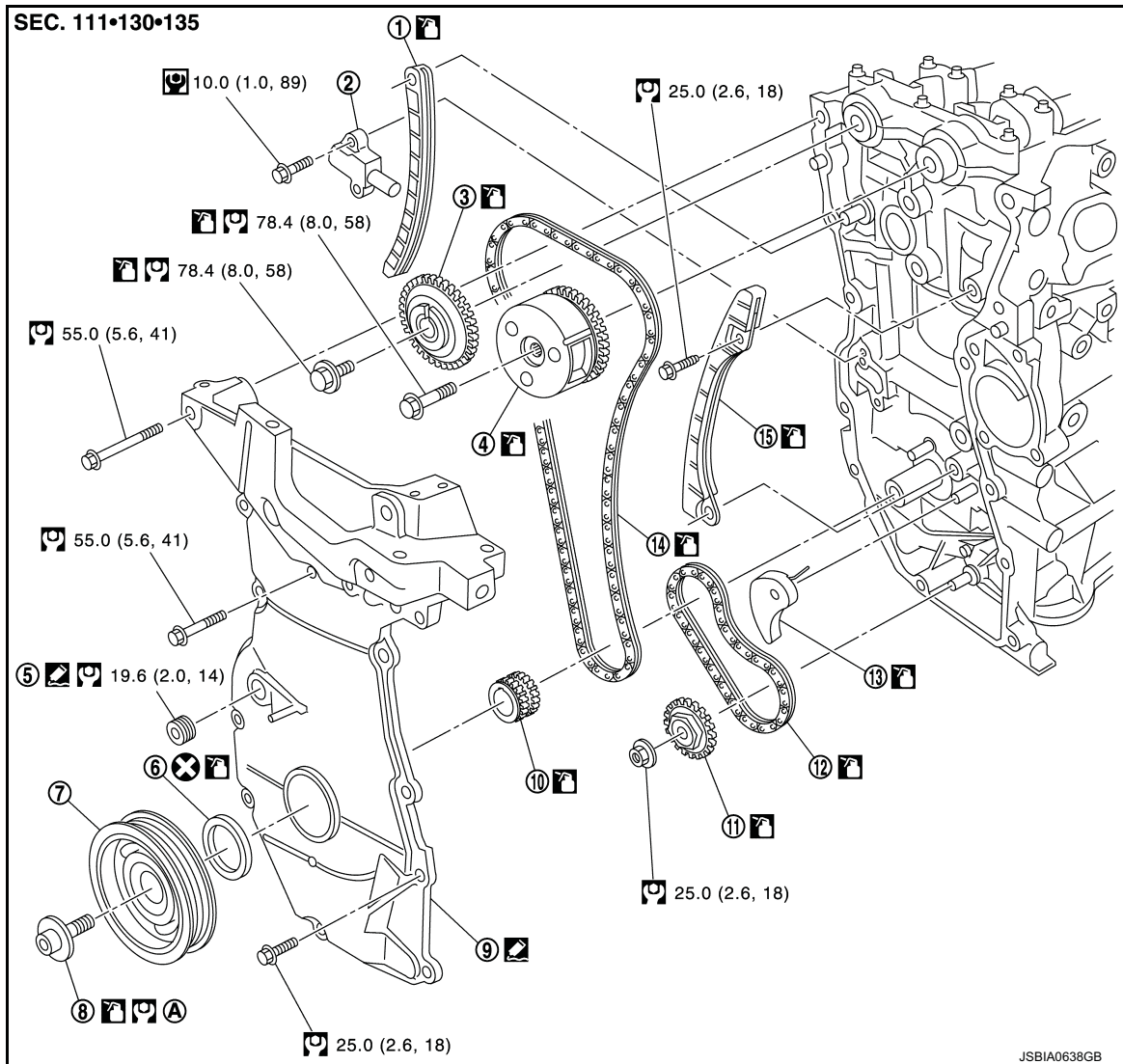
< REMOVAL AND INSTALLATION >

[HR15DE]

## TIMING CHAIN

### Exploded View

INFOID:000000006282280



- |  |                           |                                |
|--|---------------------------|--------------------------------|
| 1. Timing chain slack guide                    | 2. Timing chain tensioner | 3. Camshaft sprocket (EXH)     |
| 4. Camshaft sprocket (INT)                     | 5. Plug                   | 6. Front oil seal              |
| 7. Crankshaft pulley                           | 8. Crankshaft pulley bolt | 9. Front cover                 |
| 10. Crankshaft sprocket                        | 11. Oil pump sprocket     | 12. Oil pump drive chain       |
| 13. Chain tensioner (for oil pump drive chain) | 14. Timing chain          | 15. Timing chain tension guide |

Comply with the assembly procedure  
A. when tightening.  
Refer to [EM-357](#)

⊗: Always replace after every disassembly.

⊙: N·m (kg-m, in-lb)

⊙: N·m (kg-m, ft-lb)

🛢: Should be lubricated with oil.

🔧: Sealing point

## Removal and Installation

INFOID:000000006282281

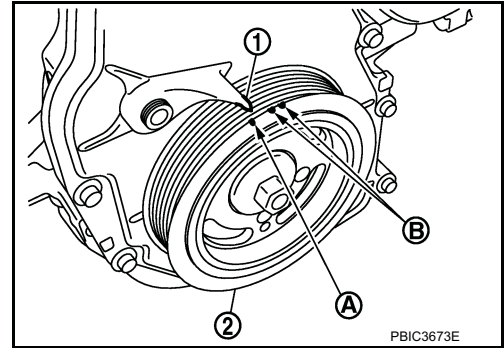
### CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

### REMOVAL

1. Remove front road wheel (RH).
2. Remove front fender protector (RH). Refer to [EXT-21, "FENDER PROTECTOR : Exploded View"](#).
3. Drain engine oil. Refer to [LU-31, "Draining"](#).  
**NOTE:**  
Perform this step when engine is cold.
4. Remove the following parts.
  - Rocker cover: Refer to [EM-354, "Exploded View"](#).
  - Drive belt: Refer to [EM-330, "Removal and Installation"](#).
  - Water pump pulley: Refer to [CO-75, "Exploded View"](#).
  - Ground cable [between engine mounting bracket (RH)]
  - Low pressure flexible hose: Refer to [HA-35, "Exploded View"](#).
5. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-392, "Exploded View"](#).
6. Set No. 1 cylinder at TDC of its compression stroke with the following procedure:
  - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

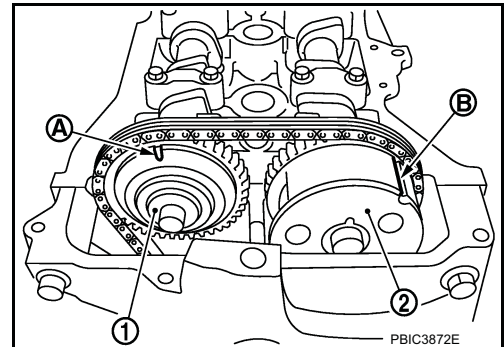
B : White paint mark (Not use for service)



- b. Check the matching marks on each camshaft sprocket are positioned as shown in the figure.

- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- A : Matching mark (stamp)
- B : Matching mark (peripheral stamp line)

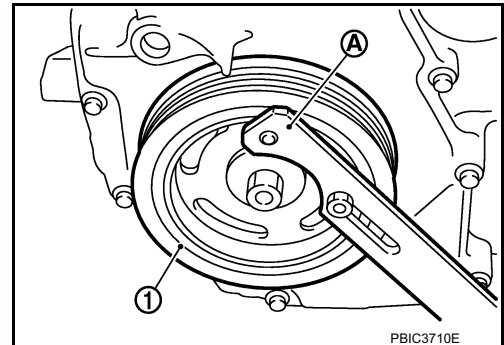
- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.



7. Remove crankshaft pulley with the following procedure:
  - a. Secure crankshaft pulley (1) using a pulley holder (commercial service tool) (A).
  - b. Loosen and pull out crankshaft pulley bolts.

### CAUTION:

Never remove the mounting bolts as they will be used as a supporting point for the pulley puller [SST: KV11103000].



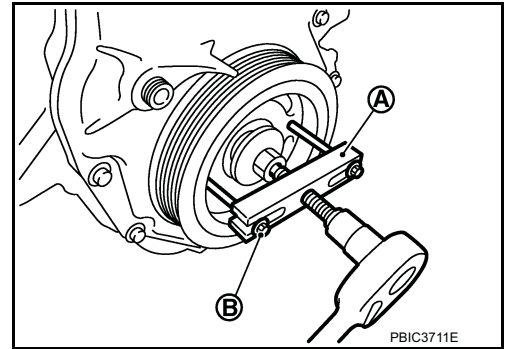
## TIMING CHAIN

### < REMOVAL AND INSTALLATION >

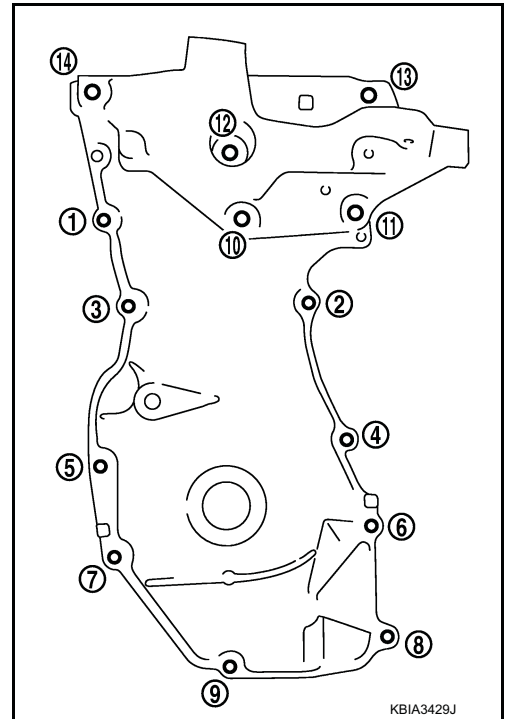
[HR15DE]

- c. Attach a pulley puller [SST: KV11103000] (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

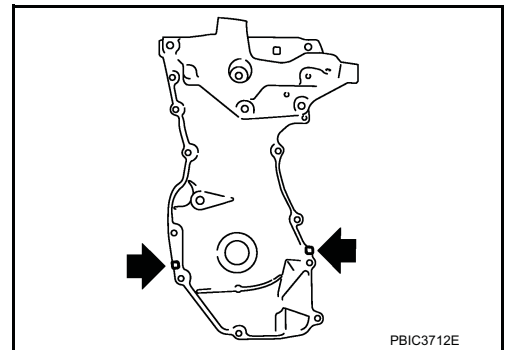
B : M6 bolt



8. Remove front cover with the following procedure:  
a. Loosen bolts in the reverse of the order as shown in the figure.



- b. Cut liquid gasket by prying the position (↖) as shown in the figure, and then remove the front cover.



9. Remove front oil seal from front cover.  
• Remove by lifting it up using a suitable tool.

**CAUTION:**

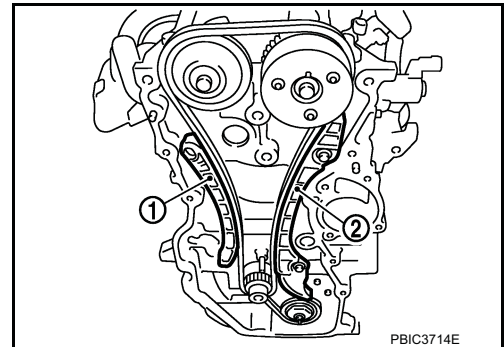
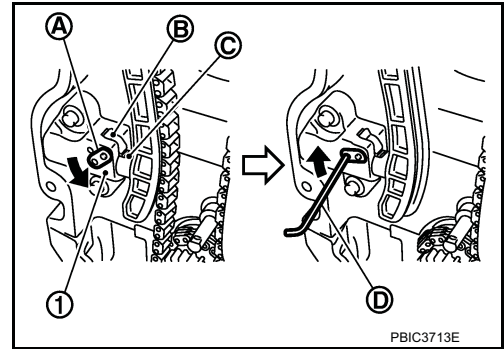
**Never damage the front cover.**

## TIMING CHAIN

[HR15DE]

### < REMOVAL AND INSTALLATION >

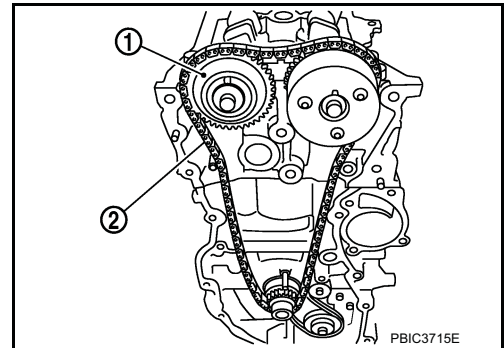
10. Remove chain tensioner (1) with the following procedure.
  - a. Fully push down the chain tensioner lever (A), and then push the plunger (C) into the inside of tensioner.
    - The tab (B) is released by fully pushing the lever down. As a result, the plunger can be moved.
  - b. Pull up the lever to align its hole position with the body hole position.
    - When the lever hole is aligned with the body hole position, the plunger is fixed.
    - When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.
  - c. Insert the stopper pin (D) into the body hole through the lever hole, and then fix the lever at the upper position.
    - Figure shows the example that a hexagonal wrench for 2.5 mm (0.098 in) is used.
  - d. Remove chain tensioner.
11. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



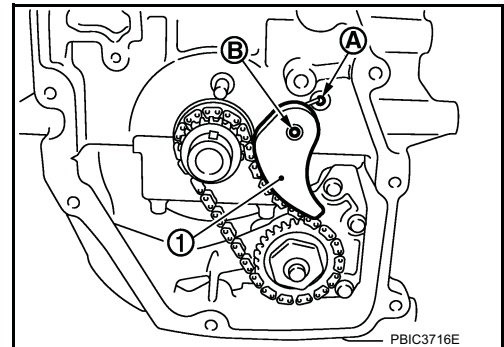
12. Remove the timing chain (2).
  - Pull the looseness of timing chain toward the camshaft sprocket (EXH) (1), and then remove the timing chain and start the removal from camshaft sprocket (EXH) side.

#### **CAUTION:**

**Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.**



13. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.
  - a. Remove chain tensioner (1).
    - Pull out from the shaft (B) and spring fixing holes (A).

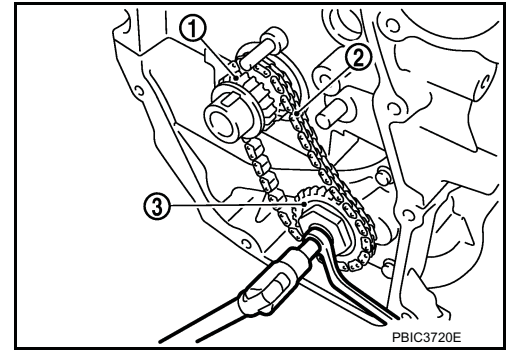


## TIMING CHAIN

### < REMOVAL AND INSTALLATION >

[HR15DE]

- b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then loosen the oil pump sprocket nuts and remove them.
- c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

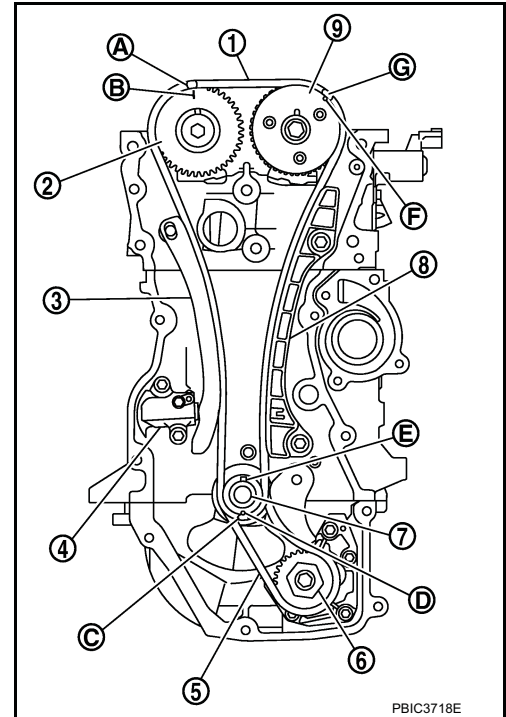


### INSTALLATION

#### 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 : Timing chain slack guide
- 4 : Chain tensioner
- 5 : Oil pump drive chain
- 6 : Oil pump sprocket
- 7 : Crankshaft sprocket
- 8 : Timing chain tension guide
- 9 : Camshaft sprocket (INT)
- A : Blue link
- B : Matching mark (stamp)
- C : Orange link
- D : Matching mark (stamp)
- E : Crankshaft key (point straight up)
- F : Matching mark (peripheral stamp line)
- G : Blue link



1. Install the crankshaft sprocket and the oil pump drive related parts with the following procedure:

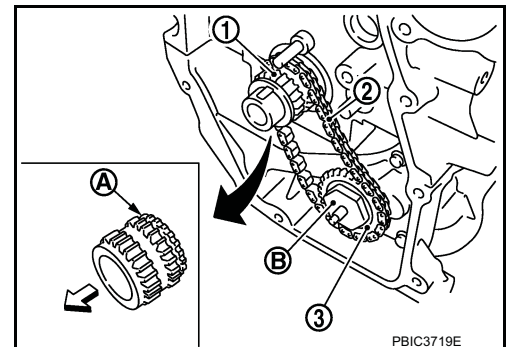
- a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇐ : Engine front

- Install the crankshaft sprocket so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket so that its hexagonal surface faces (B) the front of engine.

#### NOTE:

There is no matching mark in the oil pump drive related parts.





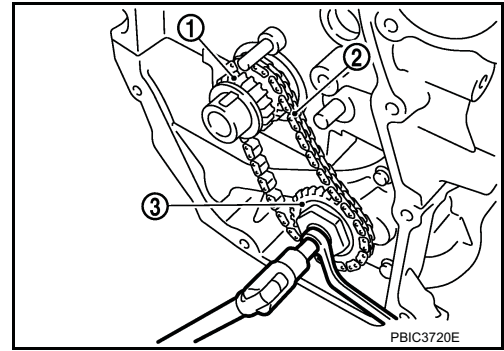
# TIMING CHAIN

## < REMOVAL AND INSTALLATION >

[HR15DE]

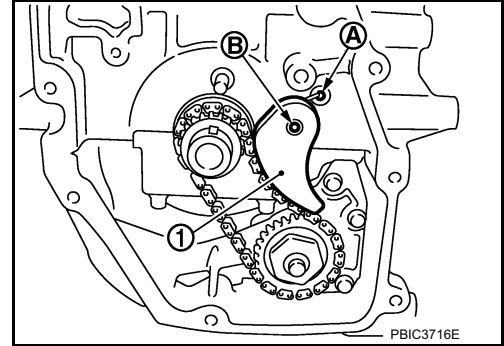
- b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then tighten the oil pump sprocket nuts.

- 1 : Crankshaft sprocket
- 2 : Oil pump drive chain
- 3 : Oil pump sprocket



- c. Install chain tensioner (1).

- Insert the body into the shaft (B) while inserting the spring into the fixing hole (A) of cylinder block front surface.
- Check that the tension is applied to the oil pump drive chain after installing.



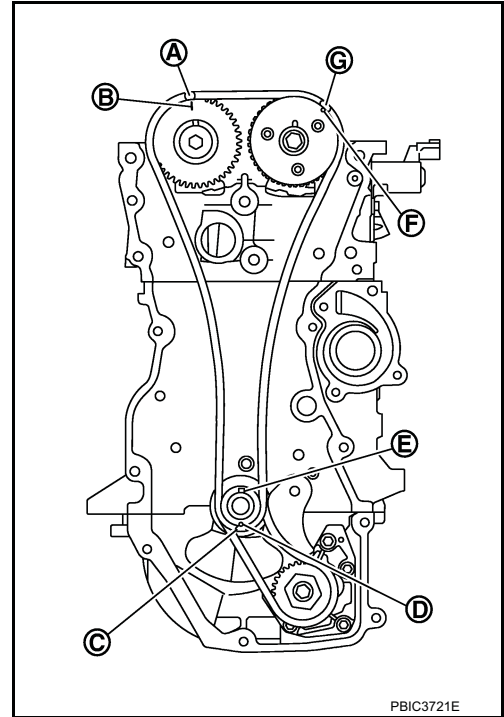
2. Install timing chain with the following procedure.

- A : Blue link
- B : Matching mark (stamp)
- C : Orange link
- D : Matching mark (stamp)
- E : Crankshaft key (point straight up)
- F : Matching mark (peripheral stamp line)
- G : Blue link

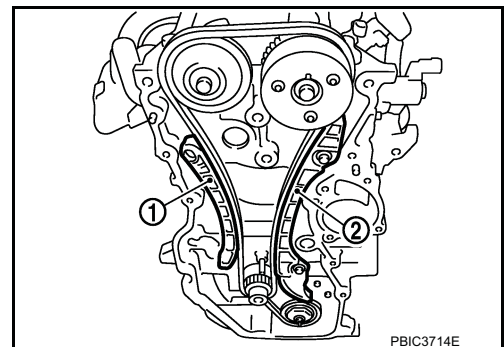
- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

### CAUTION:

- For the following note, after the matching marks are aligned, keep them aligned by holding them with a hand.
- To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.



3. Install timing chain tension guide (2) and timing chain slack guide (1).



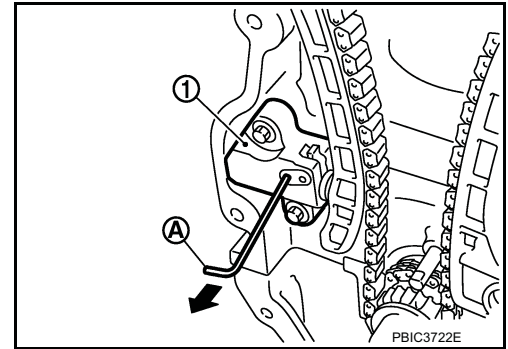


## TIMING CHAIN

### < REMOVAL AND INSTALLATION >

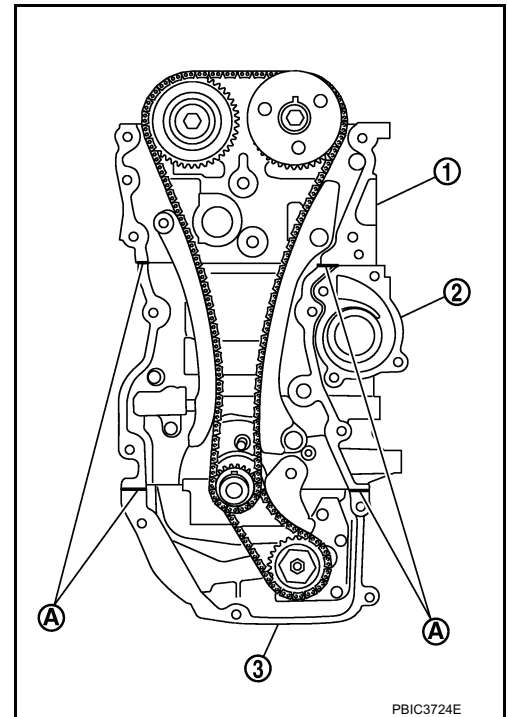
[HR15DE]

4. Install chain tensioner (1).
  - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
  - Securely pull out the stopper pin after installing the chain tensioner.



5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to [EM-383, "FRONT OIL SEAL : Removal and Installation"](#)
7. Install front cover with the following procedure:
  - a. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**

- 1 : Cylinder head
- 2 : Cylinder block
- 3 : Oil pan (upper)
- A : Liquid gasket application area [ $\phi$ 3.0 - 4.0 mm (0.12 - 0.16 in)]



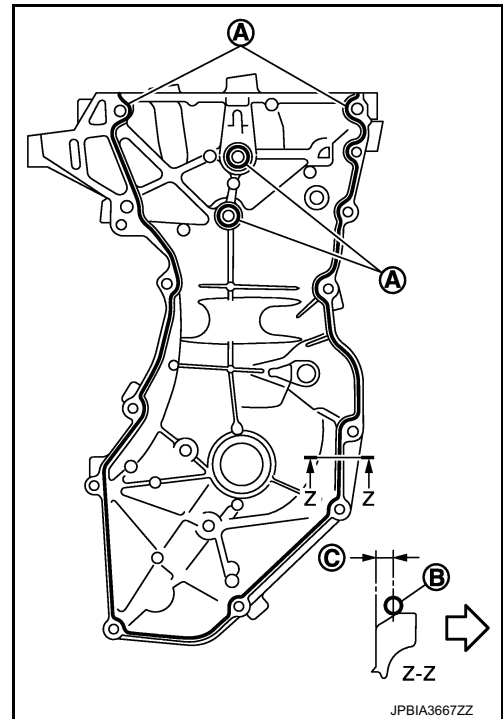
# TIMING CHAIN

## < REMOVAL AND INSTALLATION >

[HR15DE]

- b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**

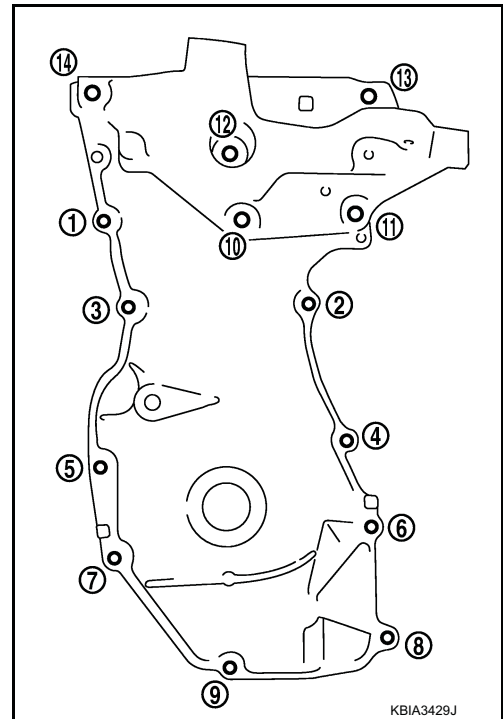
- A : Liquid gasket application area  
B : Liquid gasket  
C : 3.0 - 4.0 mm (0.12 - 0.16 in)  
⇐ : Engine outside



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

**CAUTION:**

**Be sure to wipe off any excessive liquid gasket leaking to surface.**



8. Insert crankshaft pulley by aligning with crankshaft key.  
• When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).  
**CAUTION:**  
**Install protecting front oil seal lip section from any damage.**
9. Tighten crankshaft pulley bolt with the following procedure:  
• Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.
- a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.  
b. Tighten crankshaft pulley bolt.

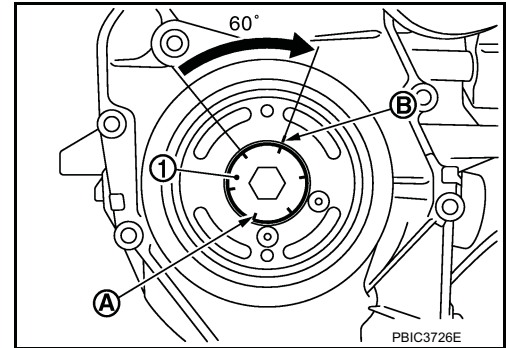
# TIMING CHAIN

< REMOVAL AND INSTALLATION >

[HR15DE]

 : 35.0 N·m (3.6 kg-m, 26 ft-lb)

- c. Put a paint mark (B) on crankshaft pulley, mating with any one of six easy to recognize angle marks (A) on crankshaft bolt flange (1).
- d. Turn another 60 degrees clockwise (angle tightening).
  - Check the tightening angle with movement of one angle mark.



10. Check that crankshaft turns smoothly by rotating by hand clockwise.
11. Install in the reverse order of removal.

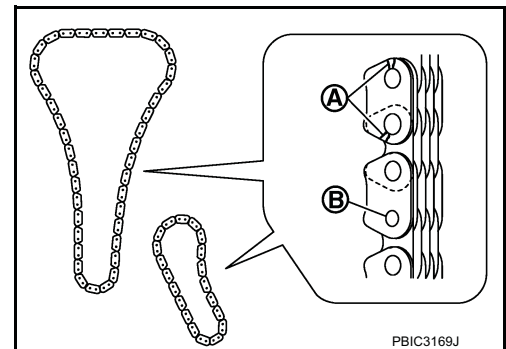
## Inspection

INFOID:000000006282282

### 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

#### Inspection for Leakage

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

- 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-29, "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/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. 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:

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

**TIMING CHAIN**

< REMOVAL AND INSTALLATION >

**[HR15DE]**

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	—

A  
EM

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

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



# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

### NOTE:

This section describes the procedure for removal and installation of camshaft without front cover. If the front cover is removed first, change the following procedure.

- Step 8 : After camshaft sprocket (INT) is removed, remove the camshaft brackets (No. 2 to 5).
- Step 9 : The camshaft (EXH) can be removed simultaneously with the camshaft (INT).
- Step 10 : When the camshaft sprocket (INT) mounting bolt is removed, the lifting up of camshaft is not necessary.

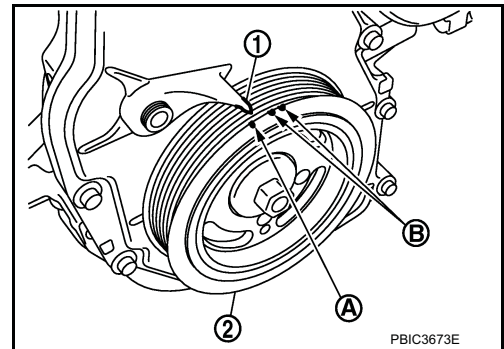
1. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-392, "Exploded View"](#).
2. Remove rocker cover. Refer to [EM-354, "Exploded View"](#).
3. Remove camshaft position sensor (PHASE) from rear end of cylinder head.

### CAUTION:

**Handle it carefully and avoid impacts.**

4. Place cylinder No. 1 at TDC of its compression stroke with the following procedure.
  - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

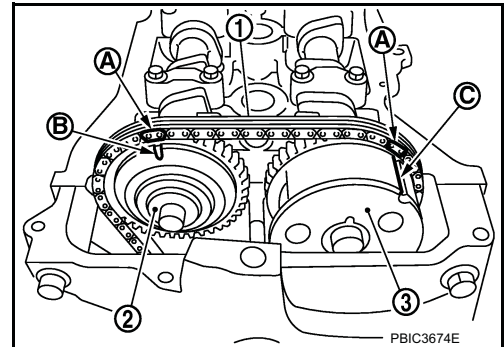
B : White paint mark (Not use for service)



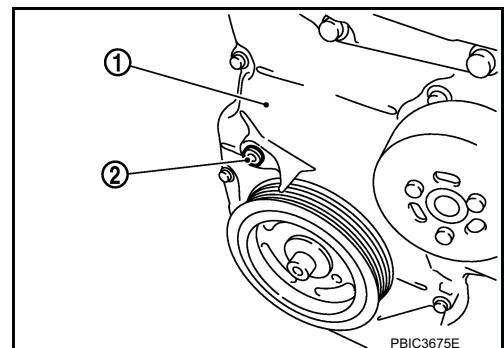
- b. Check that the matching marks on each the camshaft sprockets are in the position as shown in the figure.

- 1. : Timing chain
- 2. : Camshaft sprocket (EXH)
- 3. : Camshaft sprocket (INT)
- A : Matching mark (Paint)
- B : Matching mark (Stamp)
- C : Matching mark (Peripheral stamp line)

- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.



- c. Paint matching marks (A) on the timing chain links
5. Secure the plunger of chain tensioner in the fully compressed position with the following procedure. And then, loosen the timing chain tension.
- a. Remove the plug (2) from the front cover (1).



# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

- b. Fully push down the lever (B) of chain tensioner (2) from the plug hole, and then insert the stopper pin (A) into the body side hole and secure the lever at the lowest position.

C : Front cover has been omitted

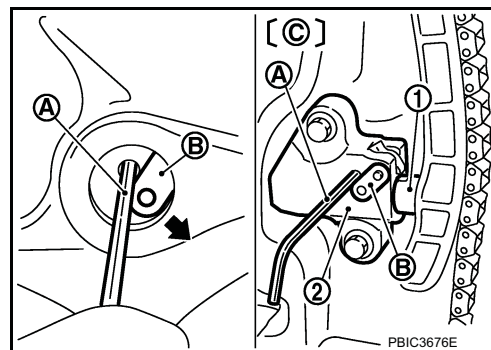
- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

### NOTE:

Hexagonal wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.

### CAUTION:

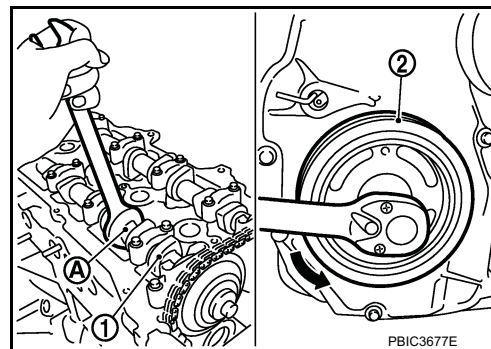
The stopper pin must use a shape that cannot fall in the front cover when dropping out.



- c. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) fixing. Apply the tension to the timing chain, and then push the plunger of into the inside of chain tensioner.

### CAUTION:

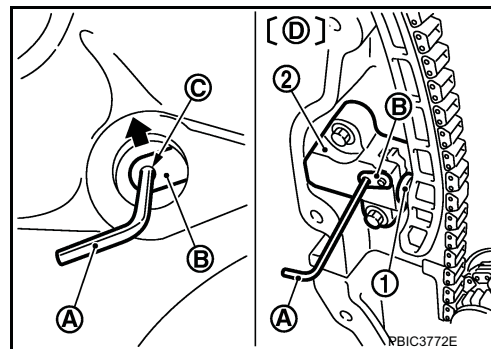
Hold the camshaft hexagonal part (A), and then secure the camshaft.



- d. Pull out the stopper pin (A) of chain tensioner (2) side from plug hole. Lift the lever (B) up to align its hole position with the hole of the body.

D : Front cover has been omitted

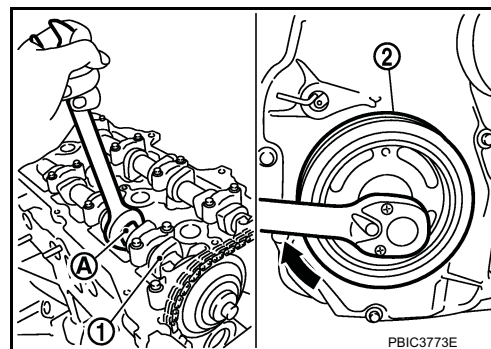
- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



- e. Insert the stopper pin into the body hole through the lever hole, and then fix the lever at the upper position.
- f. Slightly rotate the crankshaft pulley (2) clockwise to loosen the timing chain on camshaft sprocket (EXH) (1) side.

### CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.





# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

6. Remove camshaft sprocket (EXH) (1).

### CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Never rotate crankshaft and camshaft separately, so as not to contact valve with piston in the following steps.

### NOTE:

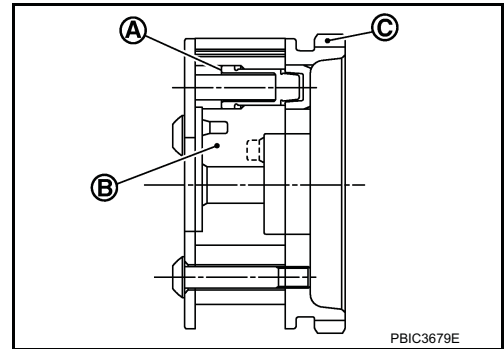
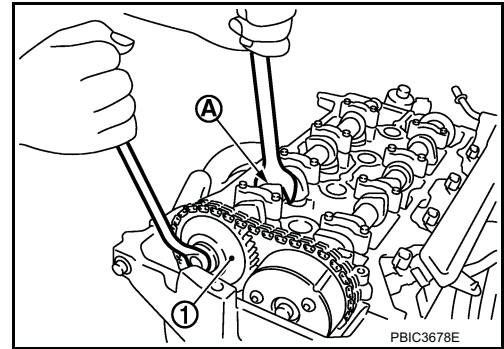
The timing chain with the front cover installed is not disengaged from the crankshaft sprocket and it is not dropped into the front cover. Therefore, the timing chain tension holding device is not necessary.

7. Turn the camshaft sprocket (INT) to the most advanced position.

### CAUTION:

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position for the following reasons, so check that you follow the procedure exactly.

- The sprocket (C) and vane (camshaft coupling) (B) are designed to spin and move within the range of a certain angle.
- With the engine stopped and the vane in the most retarded angle, it will not spin because it is locked to the sprocket side by the internal lock pin (A).
- If the camshaft sprocket mounting bolts are turned in the situation described above, the lock pin will become damaged and cause malfunctions because of the increased horizontal load (cutting force) on the lock pin.

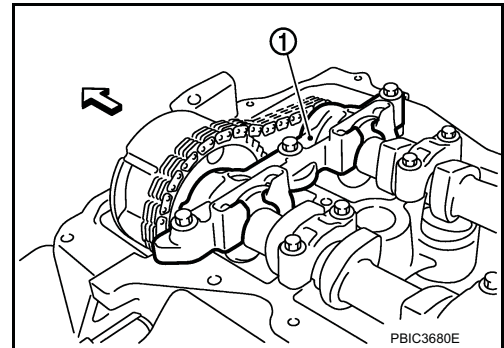


- Put the camshaft sprocket (INT) in the most advance position with the following procedure.

- a. Remove camshaft bracket (No. 1) (1).

↶ : Engine front

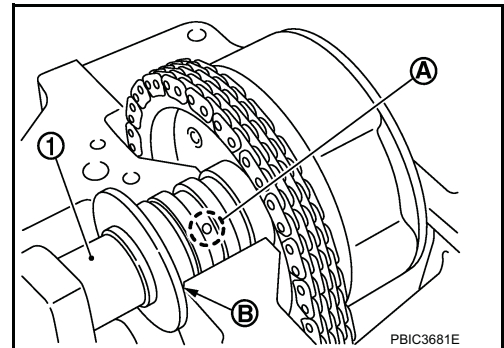
- Loosen the bolts in several steps, and then remove them.



- b. Apply the following air pressure to the No. 1 journal oil hole (A) of camshaft (INT) (1) shown in the figure using an air gun.

**Pressure : 300 kPa (3.0 bar, 3.1 kg/cm<sup>2</sup>, 44psi) or more**

- Apply the air pressure into the oil hole on the second groove from the front of camshaft thrust (B).
- Proceed all the way through step "e" with the air pressure on.





# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

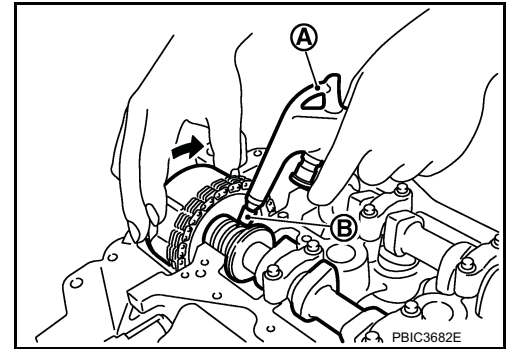
- Attach the rubber nozzle (B) narrowed to the top of the air gun (A) to prevent air leakage from the oil hole. Securely apply the air pressure to the oil hole.

### CAUTION:

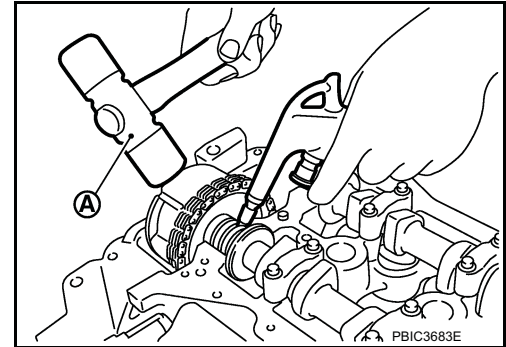
- There are other oil holes in the side grooves. Never use the incorrect oil holes.
- Be sure not to damage the oil path with the tip of the air gun.
- Wipe all the oil off the air gun to prevent oil from being blown all over along with the air, and the area around the air gun should be wiped with a rag when applying air pressure. Eye protection should be worn as needed.

### NOTE:

The air pressure is used to move the lock pin into the disengage position.



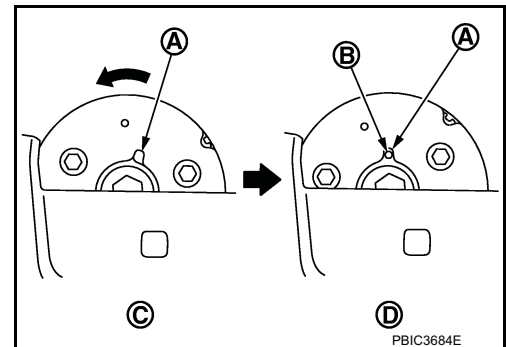
- Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternatively.
  - Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (←)].
  - Perform the work while applying the air pressure to the oil hole.
  - If the lock pin is not released by hands, tap the camshaft sprocket (INT) lightly with a plastic hammer (A).
  - If the camshaft sprocket (INT) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.



- While doing the above, once you hear a click (the sound of the internal lock pin disengaging) from inside the camshaft sprocket (INT), start turning the camshaft sprocket (INT) in the counterclockwise direction in the most advanced angle position.

C : Lock pin engaged

D : Most advanced angle



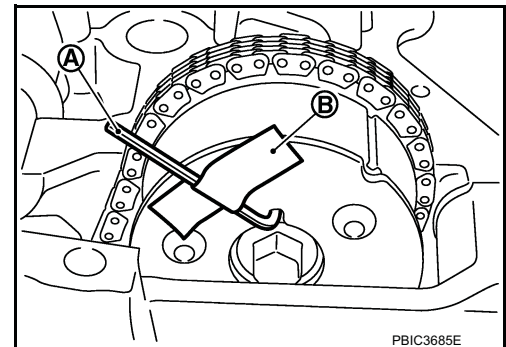
- Keep the air pressure on.
  - If there is no click, as soon as the vane-side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.
  - Check that it is in the most advanced angle position by seeing if the stopper pin groove (A) and the stopper pin hole (B) are matched up as shown in the figure.
- Complete the applying procedure of air pressure and the holding procedure of camshaft (INT).
  - Insert the stopper pin (A) into the stopper pin holes in the camshaft sprocket (INT) and lock in the most advanced angle position.

### CAUTION:

No load is exerted on the stopper pin (spring reaction, etc.). Since it comes out easily, secure it with tape (B) to prevent it from coming out.

### NOTE:

The stopper pin in the figure shows one example of a hexagonal wrench for 2.5 mm (0.098 in) [length of inserted section: approximately 15 mm (0.59 in)].



- Remove camshaft brackets (No. 2 to 5).

# CAMSHAFT

## < REMOVAL AND INSTALLATION >

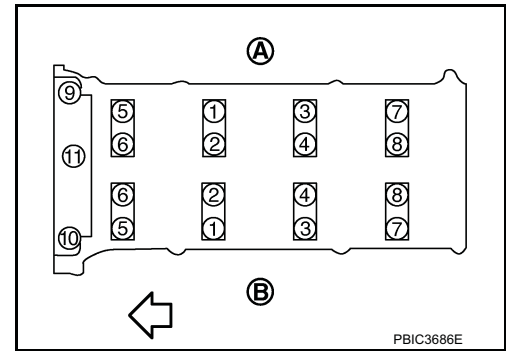
[HR15DE]

- Loosen bolts in several steps in the reverse of the order as shown in the figure.

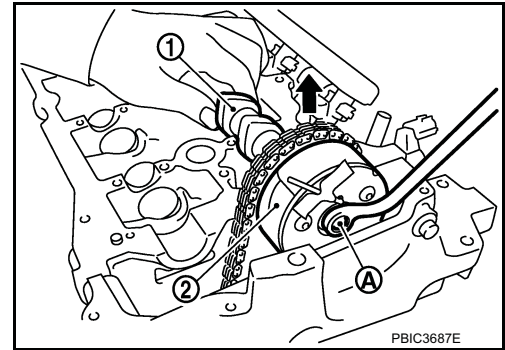
A : EXH side  
B : INT side  
⇐ : Engine front

### NOTE:

The camshaft bracket (No. 1) has been already removed.

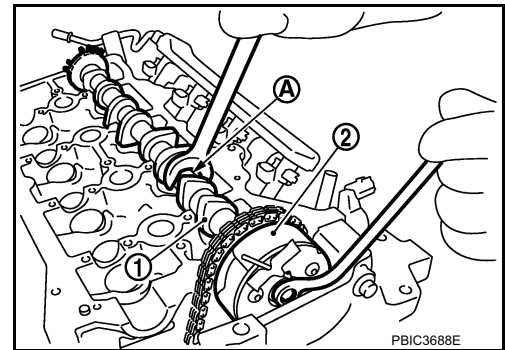


9. Remove camshaft (EXH).
10. Remove the camshaft (INT) (1) and the camshaft sprocket (INT) (2) with the following procedure.
  - a. Lift up the camshaft sprocket (INT), and then set the thin tools (a box wrench, etc.) to the mounting bolt (A).
  - b. Return the camshaft (INT) to the cylinder head journal quietly.

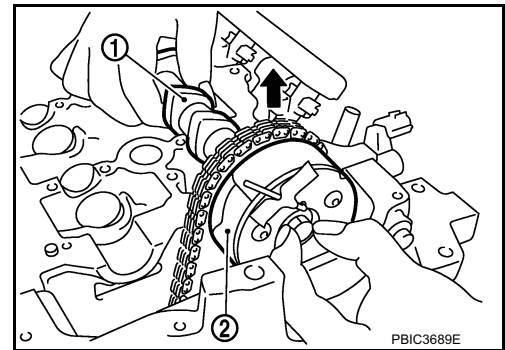


- c. Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

1. Camshaft (INT)



- d. Lift up the camshaft (INT) (1), and then disassemble the camshaft from the camshaft sprocket (INT) (2).



- e. Remove camshaft (INT) rearward.

### CAUTION:

Never damage the signal plate of rear end.

## CAMSHAFT

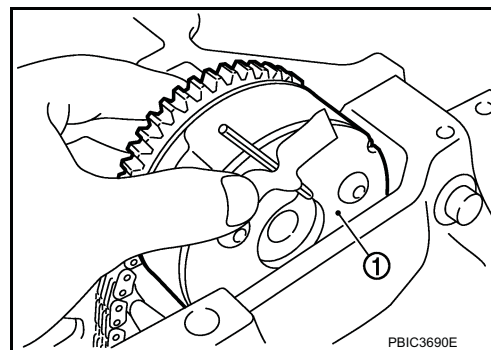
### < REMOVAL AND INSTALLATION >

[HR15DE]

- f. Remove camshaft sprocket (INT) (1).

**CAUTION:**

Never drop stopper pin.

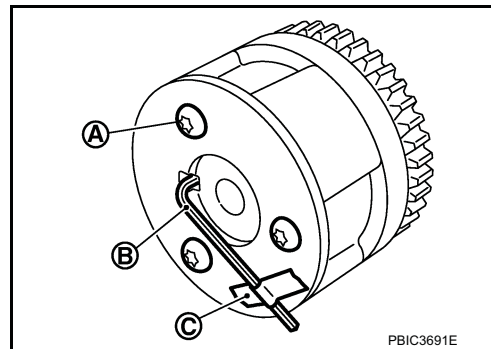


**CAUTION:**

- Tape (C) the stopper pin (B) so it does not come out.
- Never subject it to impact by dropping.
- Never disassemble. [Never loosen the three mounting bolts (A)].

**NOTE:**

While removing the camshaft sprocket (INT), if you have taken out the stopper pin and the lock pin has been rejoined in the most retarded angle, do the following to restore it.

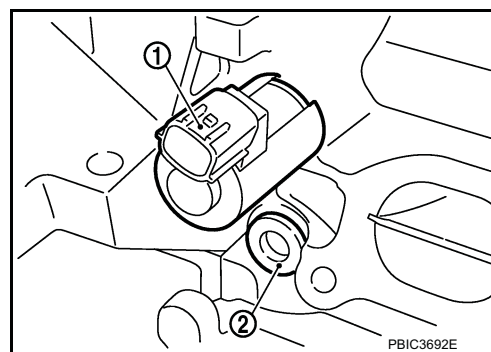


- i. Install the camshaft (INT) and tighten the mounting bolts enough to prevent air from leaking out.

**CAUTION:**

The internal lock pin will get damaged, so keep the torque on the mounting bolts to the minimum required to prevent air from escaping.

- ii. Apply the air pressure, disengage the lock pin, and turn the vane to the most advanced angle position.
- iii. Insert the stopper pin.
- iv. Remove camshaft sprocket (INT) from the camshaft.
11. Remove valve lifter.
- Identify installation positions, and store them without mixing them up.
12. Remove intake valve timing control solenoid valve (1).
13. Remove the alternator and bracket, remove the plug (2), and then remove the oil filter. Refer to [EM-366. "Exploded View"](#).



### INSTALLATION

**CAUTION:**

Do not reuse O-rings or washers.

# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

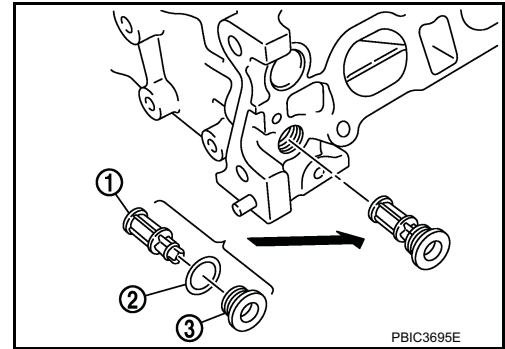
1. Install the oil filter (1).

2 : Washer

- The oil filter is assembled to the plug (3), and then install it to the cylinder head.

**CAUTION:**

**Do not reuse washer.**



2. Install intake valve timing control solenoid valve.

- Insert it straightly into the cylinder head.
- Tighten bolts after placing it completely.

3. Install valve lifter.

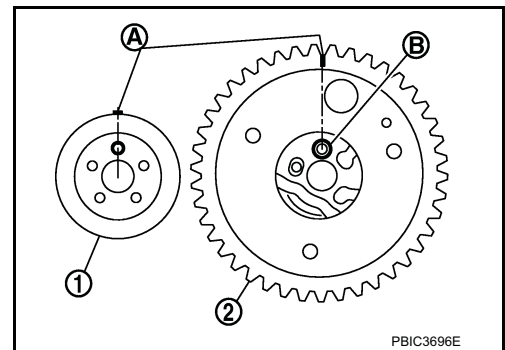
- If it is reused, install in its original positions.

4. Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT) with the following procedure.

**NOTE:**

It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (INT).

- a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.
- Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)
- b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (INT) (2). (The figure shows an example.)
- Put the marks on the visible position with it installed to the camshaft.

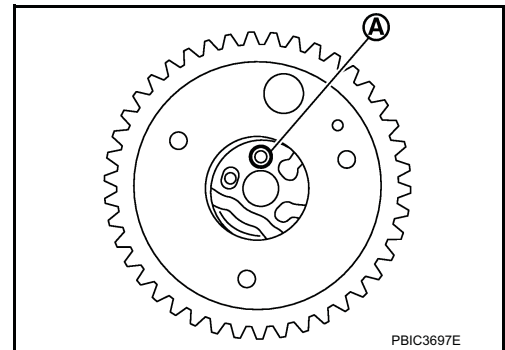


5. Set the camshaft sprocket (INT) to between cylinder head and front cover.

- Set it with the knock pin hole (A) facing up.

**CAUTION:**

**Check the stopper pin is inserted at the most advanced position beforehand.**



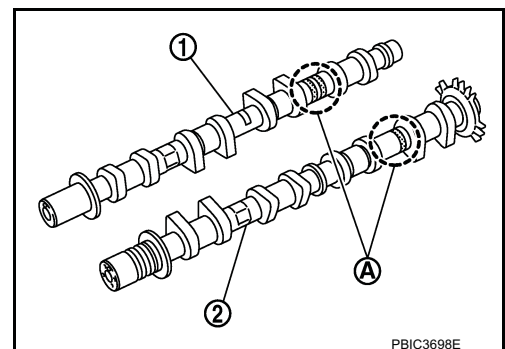
6. Install camshaft.

1 : Camshaft (EXH)

2 : Camshaft (INT)

A : Identification mark

- Distinction between camshaft (INT and EXH) is performed with the different shapes of rear end.



# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

- Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown in the figure.

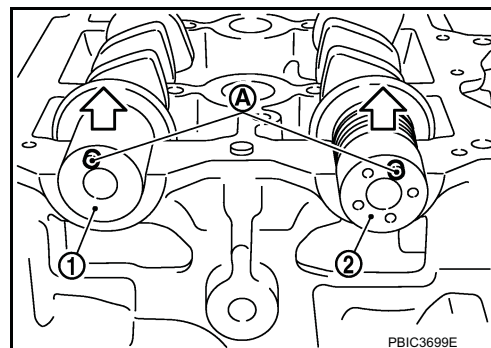
1 : Camshaft (EXH)

2 : Camshaft (INT)

⇐ : Upper side

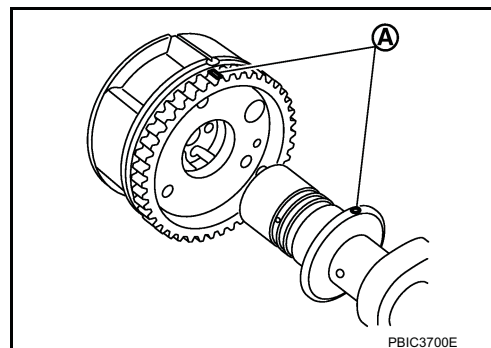
### NOTE:

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



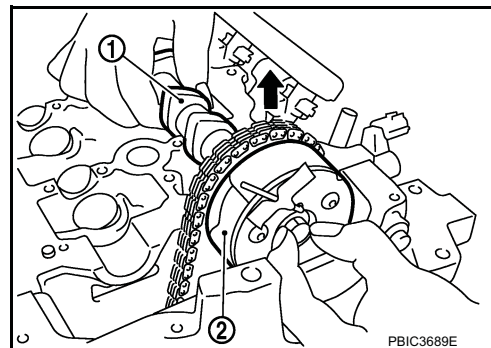
7. Install the camshaft sprocket (INT) to the camshaft (INT) with the following procedure.

- a. Refer to the matching mark (A) put according to step "4". Securely align the knock pin and the pin hole, and then install them.



- b. Lift up the front side of camshaft (INT) (1), and then temporarily tighten the bolt.

2 : Camshaft sprocket (INT)

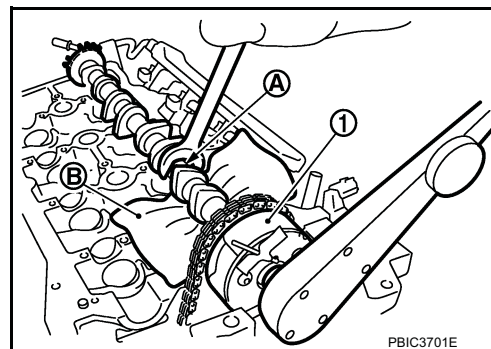


8. Put a thick shop cloth (B) to the lower surface, and then set the tools to the bolt while lifting up the front side of camshaft (INT) (1).

9. Tighten the mounting bolt.

### CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



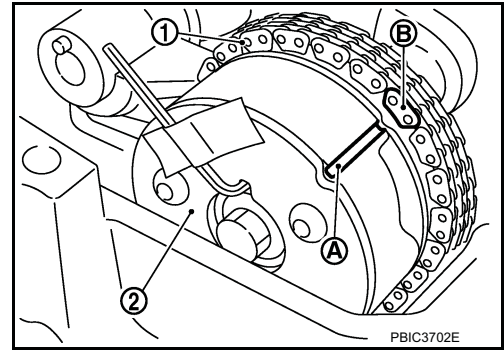
10. Return the camshaft (INT) to the cylinder head quietly.

# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

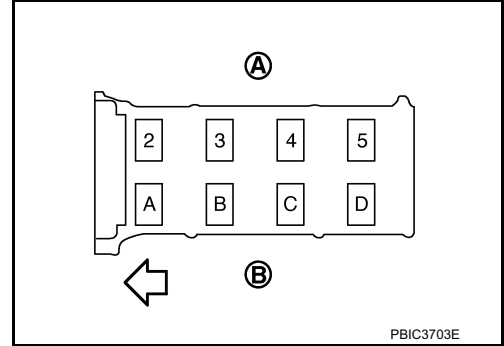
11. Install timing chain (1) by aligning its matching mark (marked when timing chain is removed) (B) with matching mark (peripheral stamp line) (A) on camshaft sprocket (INT) (2).



12. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown in the figure.

A : EXH side  
B : INT side  
⇐ : Engine front

- Install so that identification mark can be correctly read when viewed from the INT side.



13. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

A : EXH side  
B : INT side  
⇐ : Engine front

- a. Tighten No. 9 to 11 in numerical order.

: **2.0 N·m (0.2 kg-m, 1 ft-lb)**

- b. Tighten No. 1 to 8 in numerical order.

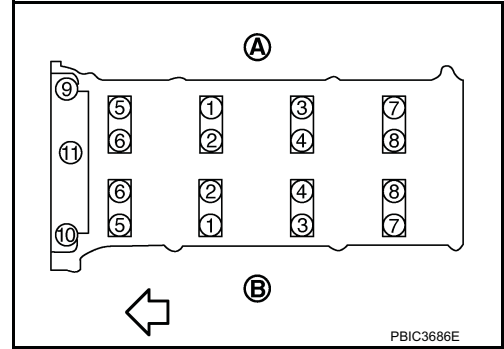
: **2.0 N·m (0.2 kg-m, 1 ft-lb)**

- c. Tighten all bolts in numerical order.

: **5.9 N·m (0.6 kg-m, 4 ft-lb)**

- d. Tighten all bolts in numerical order.

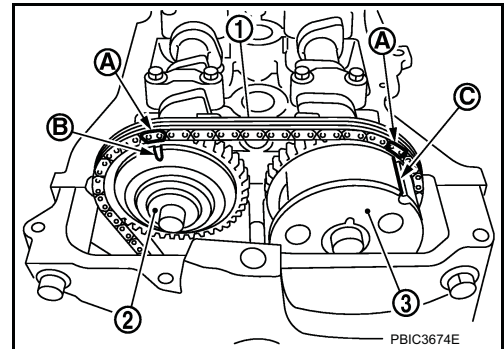
: **10.4 N·m (1.1 kg-m, 8 ft-lb)**



14. Install the camshaft (EXH) to the camshaft sprocket (EXH) (2) while aligning the matching mark (marked when timing chain is removed) (A) and the matching mark (stamp) (B) of camshaft sprocket (EXH).

1 : Timing chain  
3 : Camshaft sprocket (INT)  
C : Matching mark (peripheral stamp line)

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.



# CAMSHAFT

## < REMOVAL AND INSTALLATION >

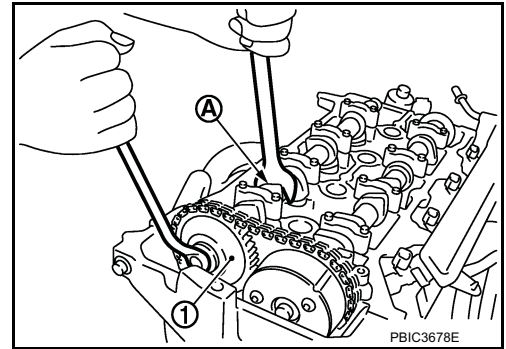
[HR15DE]

15. Tighten the mounting bolt.

1 : Camshaft sprocket (EXH)

### CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Check that the matching mark (marked when timing chain is removed) and each camshaft sprocket matching mark are in the correct location.



16. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.

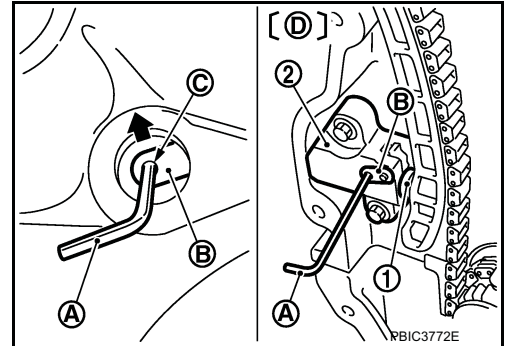
1 : Plunger

2 : Chain tensioner

B : Lever

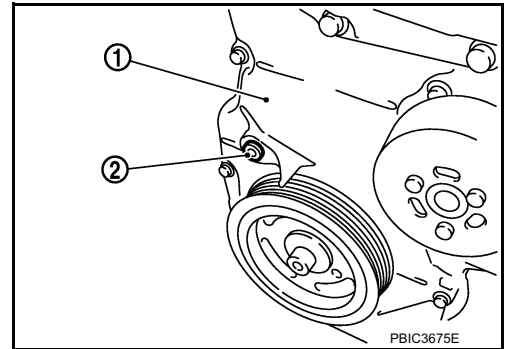
C : Lever hole

D : Front cover has been omitted



17. Install the plug (2) to the front cover (1).

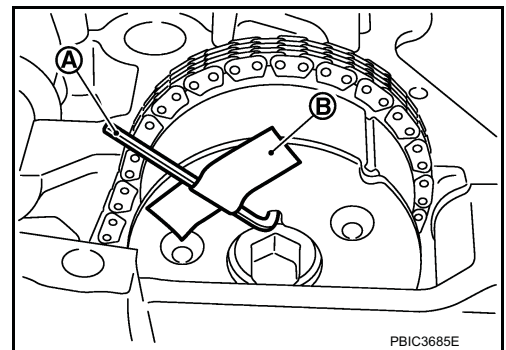
- Apply liquid gasket to the threads, and tighten them.
- Use Genuine Liquid Gasket or equivalent.**



18. Return the camshaft sprocket (INT) in the most retarded position with the following procedure.

a. Remove the stopper pin (A) from the camshaft sprocket (INT).

B : Tape



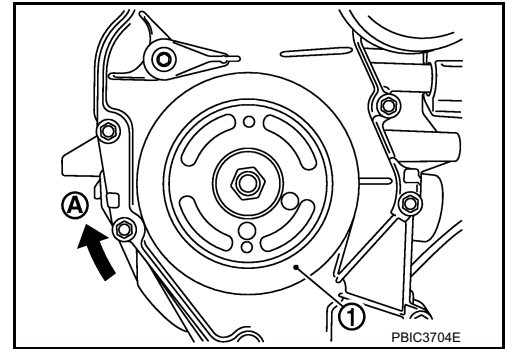


# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

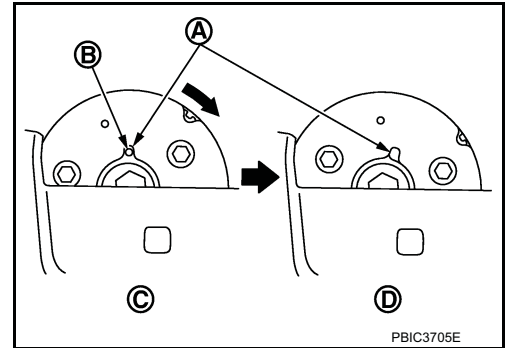
- b. Turn the crankshaft pulley (1) slowly clockwise (A) and return the camshaft sprocket (INT) to the most retarded angle position.



- When first turning the crankshaft the camshaft sprocket (INT) will turn. Once it is turned more, and the vane (camshaft) also turns, then it has reached the most retarded angle position.

- B : Stopper pin hole
- C : Most advanced angle
- D : Lock pin engaged

- The most retarded angle position can be checked by seeing if the stopper pin groove (A) is shifted clockwise.
- After spinning the crankshaft slightly in the counterclockwise direction, you can check the lock pin has joined by seeing if the vane (camshaft) and the sprocket move together.



19. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.

- Tighten bolts with it seated completely.

20. Check and adjust valve clearance. Refer to [EM-322, "Inspection and Adjustment"](#).

21. Install in the reverse order of removal.

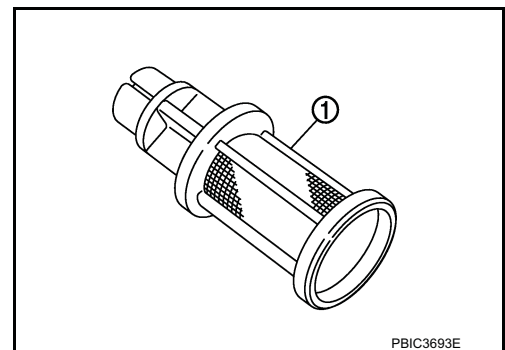
## Inspection

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## INSPECTION AFTER REMOVAL

### Oil Filter

- Check that there is no foreign material on the oil filter (1) and check it for clogging.
- Check the oil filter for damage.
- If there is some damage, replace the oil filter, the plug, and the washer as a set.



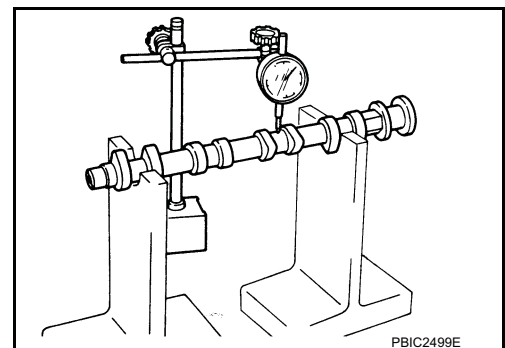
### Camshaft Runout

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

#### CAUTION:

**Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.**

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





## Standard and Limit

: Refer to [EM-430, "Camshaft"](#).

- If it exceeds the limit, replace camshaft.

### Camshaft Cam Height

- Measure the camshaft cam height with a micrometer (A).

## Standard and Limit

### Intake

: Refer to [EM-430, "Camshaft"](#).

### Exhaust

## Cam wear limit:

: Refer to [EM-430, "Camshaft"](#).

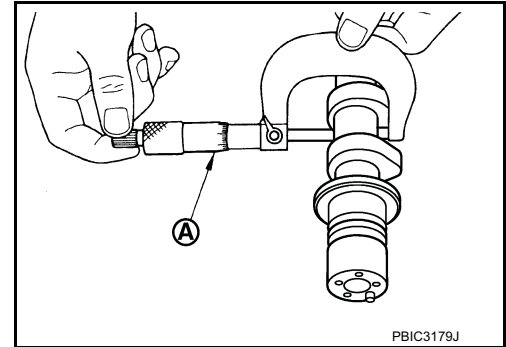
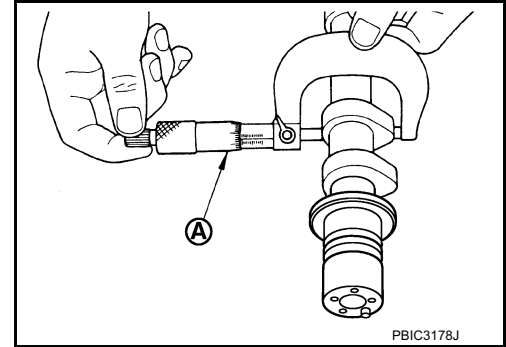
- If wear exceeds the limit, replace camshaft.

### Camshaft Journal Oil Clearance

## CAMSHAFT JOURNAL DIAMETER

Measure the outer diameter of camshaft journal with a micrometer (A).

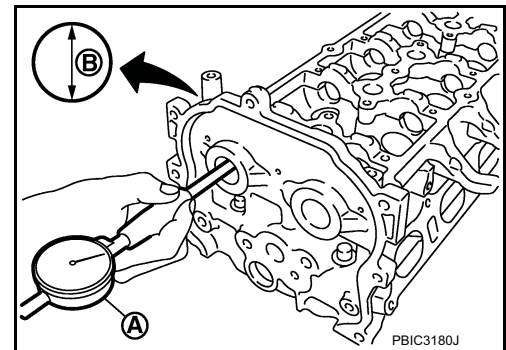
Standard: : Refer to [EM-430, "Camshaft"](#).



## CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard : Refer to [EM-430, "Camshaft"](#).



## CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard and Limit : Refer to [EM-430, "Camshaft"](#).

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

### NOTE:

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

### Camshaft End Play

# CAMSHAFT

[HR15DE]

## < REMOVAL AND INSTALLATION >

1. Install camshaft in cylinder head. Refer to [EM-366, "Removal and Installation"](#) for tightening procedure.
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

**Standard and Limit : Refer to [EM-430, "Camshaft"](#).**

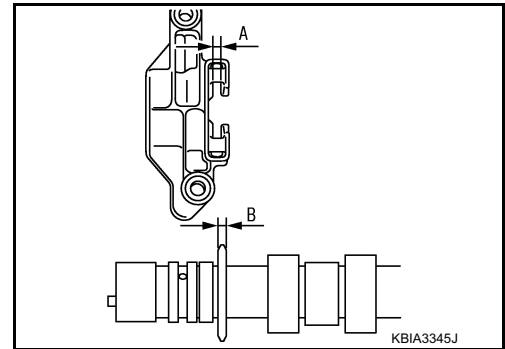
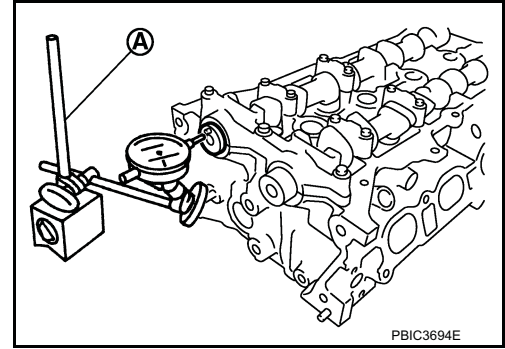
- Measure the following parts if out of the standard.
- Dimension "A" for cylinder head No. 1 journal bearing

**Standard : 4.000 - 4.030 mm (0.1574 - 0.1586 in)**

- Dimension "B" for camshaft thrust

**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.

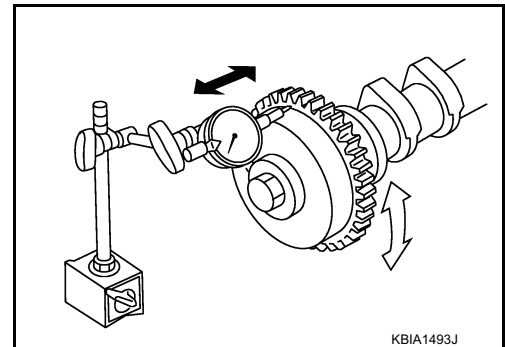
#### **CAUTION:**

**Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.**

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

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

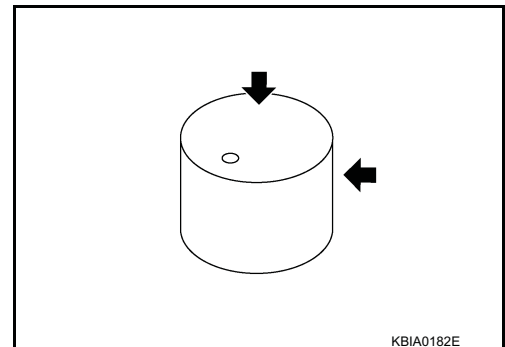
- If it exceeds the limit, replace camshaft sprocket.



### Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-430, "Camshaft"](#).



### Valve Lifter Clearance

#### **VALVE LIFTER OUTER DIAMETER**

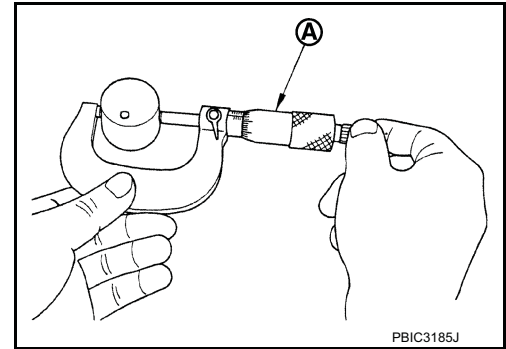
# CAMSHAFT

[HR15DE]

## < REMOVAL AND INSTALLATION >

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

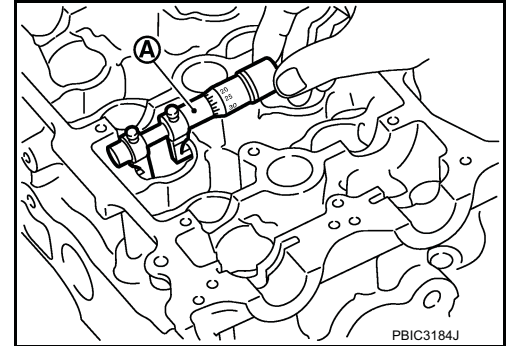
**Standard** : Refer to [EM-430, "Camshaft"](#).



## VALVE LIFTER HOLE DIAMETER

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

**Standard** : Refer to [EM-430, "Camshaft"](#).



## VALVE LIFTER CLEARANCE

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

**Standard** : Refer to [EM-430, "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 for Leaks

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-29, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

### NOTE:

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

- Warm up engine thoroughly to 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:

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

# CAMSHAFT

## < REMOVAL AND INSTALLATION >

[HR15DE]

Other oils and fluids*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

Inspection of Camshaft Sprocket (INT) Oil Groove

### CAUTION:

- Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to [EC4-138, "Diagnosis Procedure"](#) (TYPE 1) or [EC4-417, "Diagnosis Procedure"](#) (TYPE 2).
  - Check when engine is cold so as to prevent burns from the splashing engine oil.
1. Check engine oil level. Refer to [LU-30, "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 [LU-30, "Inspection"](#).
    - b. Remove intake manifold. Refer to [EM-339, "Exploded View"](#).
    - c. Disconnect ignition coil and injector harness connectors. Refer to [EM-354, "Exploded View"](#).
  3. Remove intake valve timing control solenoid valve. Refer to [EM-366, "Exploded View"](#).
  4. Crank engine, and then check that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.

1 : Plug

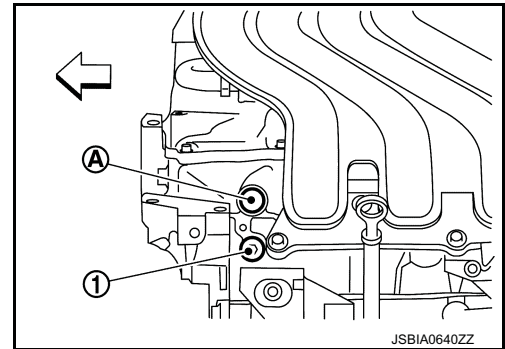
↔ : Engine front

### WARNING:

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

### CAUTION:

- 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 belts, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.
5. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.
    - Remove oil filter, and then clean it. Refer to [EM-415, "Inspection"](#).
    - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-29, "Engine Lubrication System"](#).
  6. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
    - Clean oil groove if necessary. Refer to [LU-29, "Engine Lubrication System"](#).
  7. After inspection, install removed parts in the reverse order.



## OIL SEAL

## VALVE OIL SEAL

## VALVE OIL SEAL : Removal and Installation

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## REMOVAL

1. Remove camshafts. Refer to [EM-366, "Exploded View"](#).
2. Remove valve lifters. Refer to [EM-366, "Exploded View"](#).
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

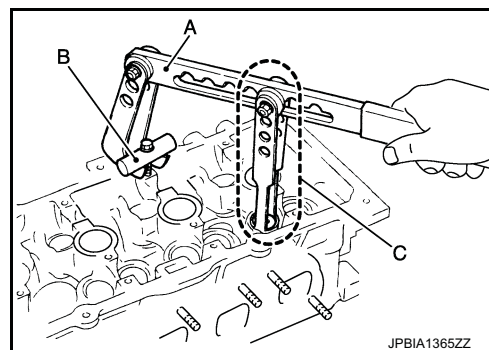
**CAUTION:**

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

4. Remove valve collet.
  - Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Remove valve collet with magnet hand.

**CAUTION:**

**Never damage valve lifter holes.**

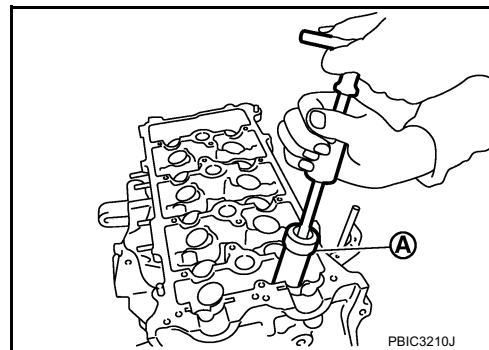


5. Remove valve spring retainer and valve spring (with valve spring seat).

**CAUTION:**

**Never remove valve spring seat from valve spring.**

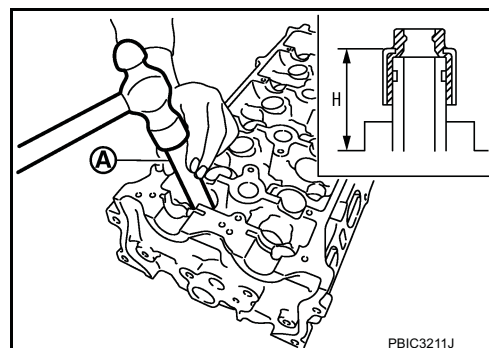
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



## INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height (H) shown in the figure with the valve oil seal drift [SST: KV10115600] (A).

**Height (H) : 13.2 - 13.8 mm (0.520 - 0.543 in)**



3. Install in the reverse order of removal, for the rest of parts.

## FRONT OIL SEAL

## FRONT OIL SEAL : Removal and Installation

## REMOVAL



- Remove the following parts.
  - Front fender protector (RH): Refer to [EXT-21, "FENDER PROTECTOR : Exploded View"](#).
  - Drive belt: Refer to [EM-330, "Removal and Installation"](#).
  - Crankshaft pulley: Refer to [EM-356, "Exploded View"](#).
- Remove front oil seal with a suitable tool.

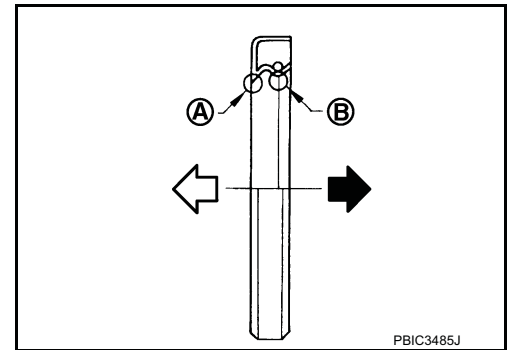
**CAUTION:**

**Never damage front cover and crankshaft.**

## INSTALLATION

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

- A : Dust seal lip  
 B : Oil seal lip  
 : Engine outside  
 : Engine inside



- Press-fit front oil seal using a suitable drift with outer diameter 50 mm (1.97 in) and inner diameter 44 mm (1.73 in).

**CAUTION:**

- Never damage front cover and crankshaft.**
- Press-fit oil seal straight to avoid causing burrs or tilting.**

- Install in the reverse order of removal, for the rest of parts.

## REAR OIL SEAL

## REAR OIL SEAL : Removal and Installation

## REMOVAL

- Remove transaxle assembly. Refer to [TM-38, "HR15DE : Exploded View"](#) (M/T models) or [TM-315, "Exploded View"](#) (A/T models).
- Remove clutch cover and clutch disk (M/T models). Refer to [CL-26, "HR12DE, HR12DDR : Exploded View"](#).
- Remove flywheel (M/T models) or drive plate (A/T models). Refer to [EM-399, "Exploded View"](#) (M/T models) or [EM-401, "Exploded View"](#) (A/T models).
- Remove rear oil seal with a suitable tool.

**CAUTION:**

**Never damage crankshaft and cylinder block.**

## INSTALLATION

- Apply the liquid gasket lightly to entire outside area of new rear oil seal.  
**Use Genuine Liquid Gasket or equivalent.**

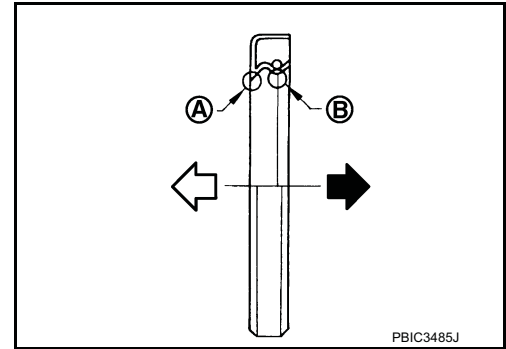
## OIL SEAL

### < REMOVAL AND INSTALLATION >

[HR15DE]

2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

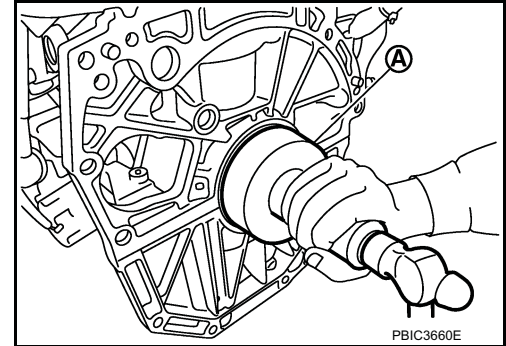
- A : Dust seal lip  
B : Oil seal lip  
⇐ : Engine outside  
➡ : Engine inside



- Press-fit rear oil seal with a suitable drift (A) outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in).

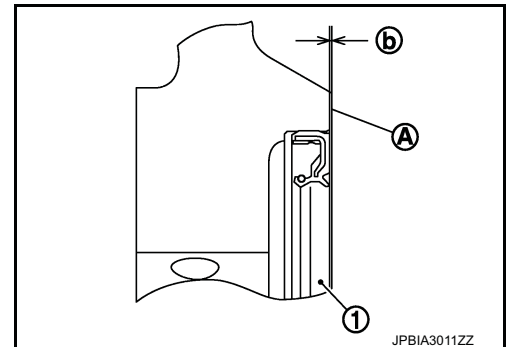
**CAUTION:**

- **Never damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Never touch grease applied onto oil seal lip.**



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

- A : Rear end surface of cylinder block  
b : 0 - 0.5 mm (0 - 0.020 in)



3. Install in the reverse order of removal, for the rest of parts.

# CYLINDER HEAD

< REMOVAL AND INSTALLATION >

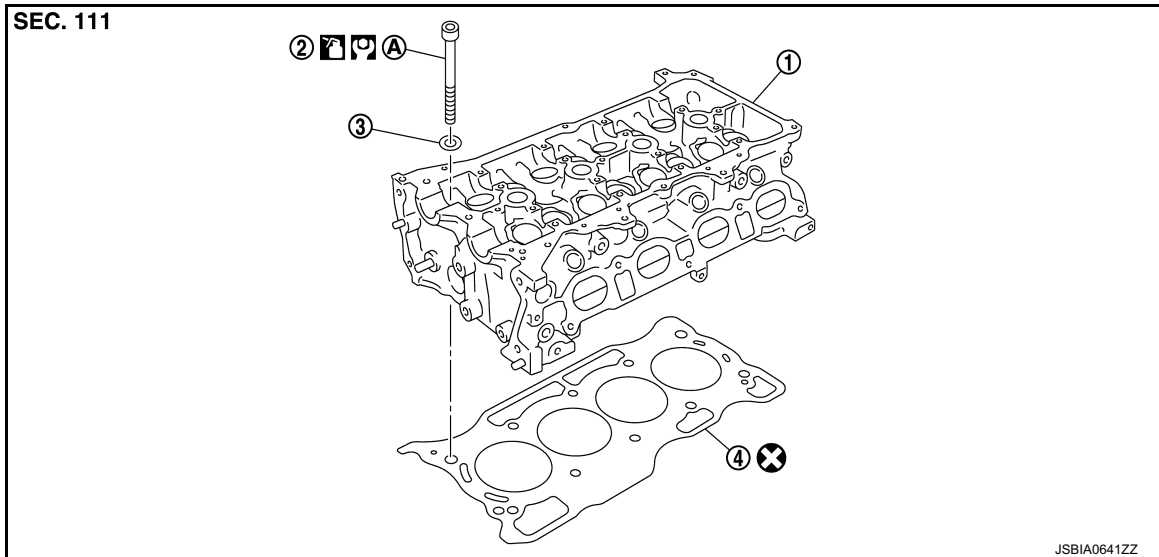
[HR15DE]

## CYLINDER HEAD

### Exploded View

INFOID:000000006282289

### REMOVAL



- 1. Cylinder head assembly
- 2. Cylinder head bolt
- 3. Washer
- 4. Cylinder head gasket

A. Comply with the assembly procedure when tightening. Rfer to [EM-386](#)

⊗ : Always replace after every disassembly.

Ⓐ : N·m (kg-m, ft-lb)

Ⓐ : Should be lubricated with oil.

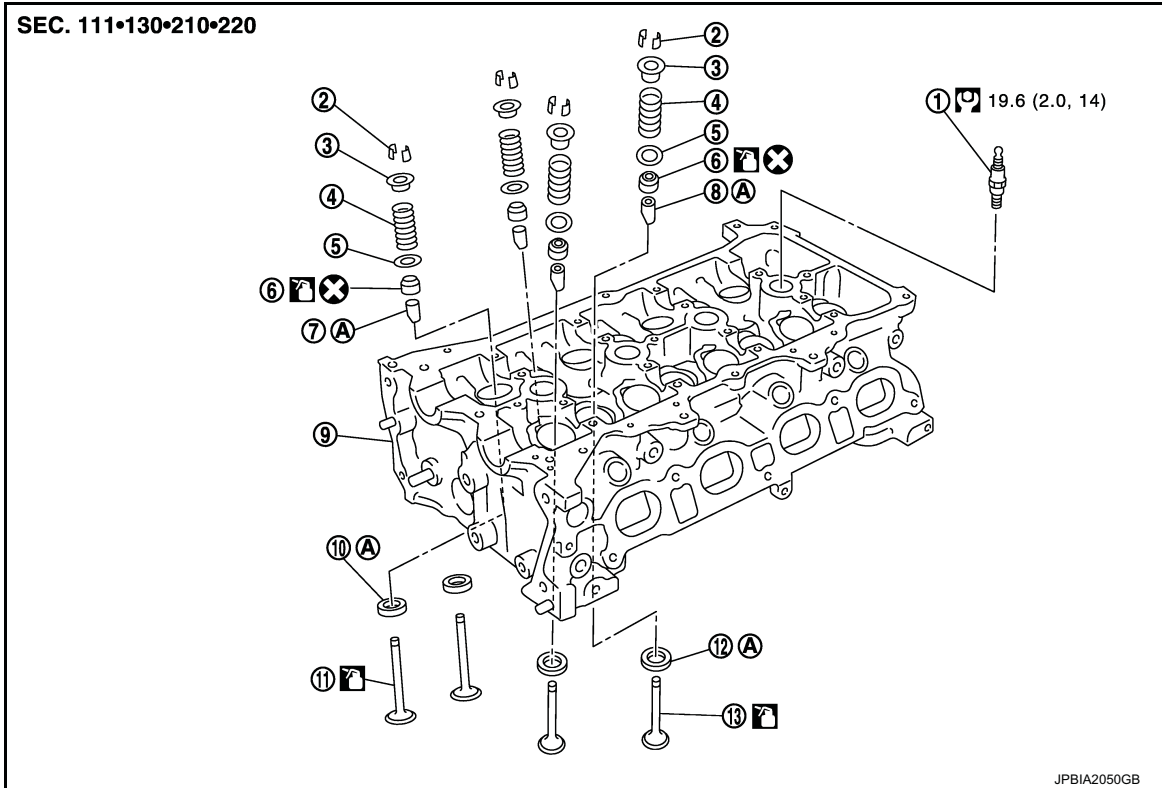
### DISASSEMBLY



# CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR15DE]



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

A. Comply with the assembly procedure when tightening. Refer to [EM-388](#)

⊗: Always replace after every disassembly.

Ⓐ: N·m (kg-m, ft-lb)

Ⓐ: Should be lubricated with oil.

## Removal and Installation

INFOID:000000006282290

### REMOVAL

- Release fuel pressure. Refer to [EC4-117, "Work Procedure"](#) (TYPE 1) or [EC4-401, "Work Procedure"](#) (TYPE 2).
- Drain engine coolant and engine oil. Refer to [CO-65, "Draining"](#) and [LU-31, "Draining"](#).  
**CAUTION:**  
**Perform this step when the engine is cold.**
- Remove the following components and related parts.
  - Front road wheel and tire (RH): Refer to [WT-7, "Exploded View"](#).
  - Front fender protector (RH): Refer to [EXT-21, "FENDER PROTECTOR : Exploded View"](#).
  - Drive belt: Refer to [EM-330, "Removal and Installation"](#).
  - Air duct: Refer to [EM-337, "Exploded View"](#).
  - Intake manifold: Refer to [EM-339, "Exploded View"](#).
  - Fuel tube and fuel injector: Refer to [EM-349, "Exploded View"](#).
  - Water outlet: Refer to [CO-79, "Exploded View"](#).
  - Exhaust manifold: Refer to [EM-343, "Exploded View"](#).
  - Rocker cover: Refer to [EM-354, "Exploded View"](#).
  - Front cover and timing chain: Refer to [EM-356, "Exploded View"](#).

# CYLINDER HEAD

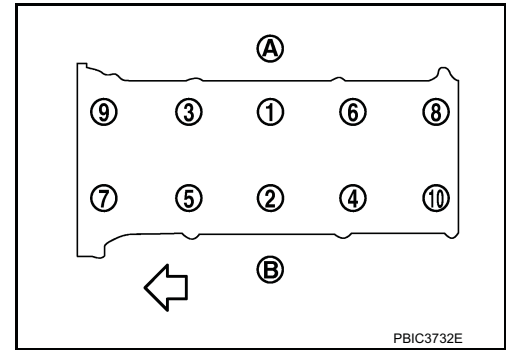
## < REMOVAL AND INSTALLATION >

[HR15DE]

- Camshaft: Refer to [EM-366](#). "Exploded View".

- Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

A : EXH side  
B : INT side  
⇐ : Engine front



- Remove cylinder head gasket.

## INSTALLATION

- Install new cylinder head gasket.
- Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.

A : EXH side  
B : INT side  
⇐ : Engine front

### CAUTION:

If cylinder head bolts are reused, check their outer diameters before installation. Refer to "Cylinder Head Bolts Outer Diameter".

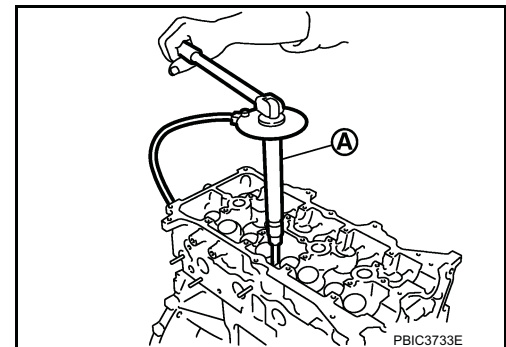
- Apply new engine oil to threads and seating surfaces of mounting bolts.
- Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- Turn all bolts 60 degrees clockwise (angle tightening).

### CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

### CAUTION:

In this step, loosen bolts in reverse order of that indicated in the figure.

- Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- Turn all bolts 75 degrees clockwise (angle tightening).

# CYLINDER HEAD

## < REMOVAL AND INSTALLATION >

[HR15DE]

- g. Turn all bolts 75 degrees clockwise again (angle tightening).
3. Install in the reverse order of removal after this step.

## Disassembly and Assembly

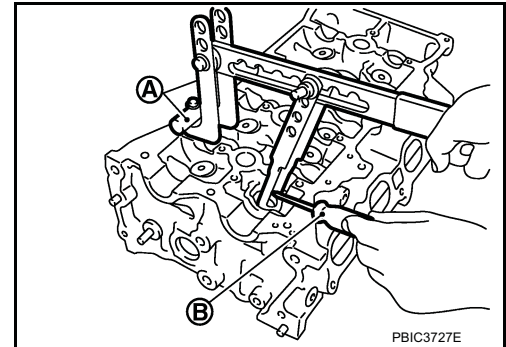
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### DISASSEMBLY

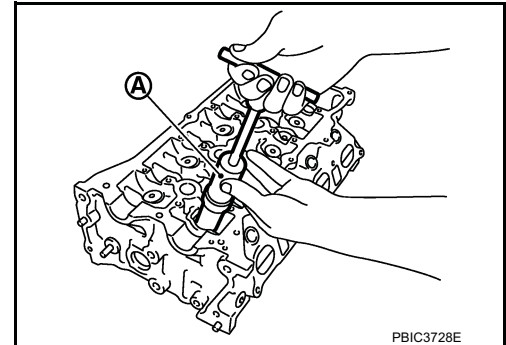
1. Remove spark plug with a spark plug wrench (commercial service tool).
2. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
  - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand (B).

#### CAUTION:

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



4. Remove valve spring retainer and 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 with the valve oil seal puller [SST: KV10107902] (A).

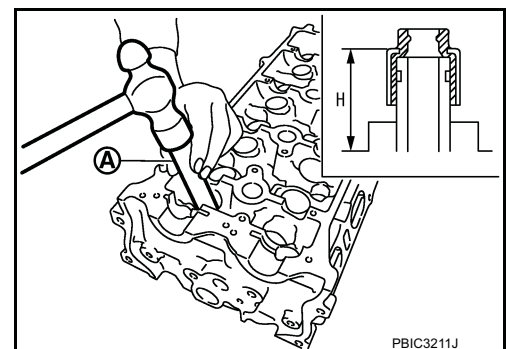


7. Remove valve spring seat.
8. When valve seat must be replaced, Refer to [EM-389, "Inspection"](#) to removal.
9. When valve guide must be replaced, Refer to [EM-389, "Inspection"](#) to removal.

### ASSEMBLY

1. Install valve guide if removed. Refer to [EM-389, "Inspection"](#).
2. Install valve seat if removed. Refer to [EM-389, "Inspection"](#).
3. Install valve oil seal.
  - Install with the valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.

Height "H" : 13.2 - 13.8 mm (0.519 - 0.543 in)



4. Install valve spring seat.

# CYLINDER HEAD

## < REMOVAL AND INSTALLATION >

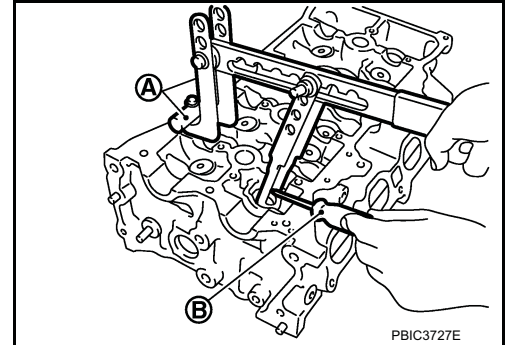
[HR15DE]

5. Install valve.
  - Install larger diameter to intake side.
6. Install valve spring.

**NOTE:**  
It can be installed in either direction.
7. Install valve spring retainer.
8. Install valve collet.
  - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Install valve collet with a magnet hand (B).

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

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



9. Install valve lifter.
10. Install spark plug with a spark plug wrench (commercial service tool).

## Inspection

INFOID:000000006282292

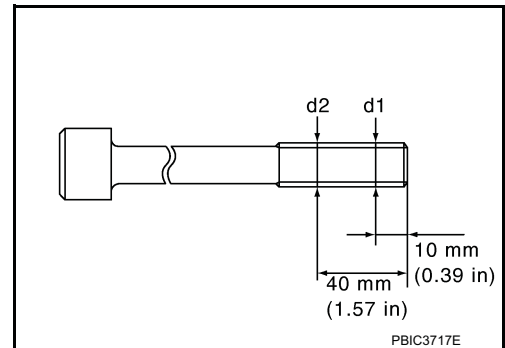
### INSPECTION AFTER REMOVAL

#### 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 be also checking. Refer to [EM-415, "Inspection"](#).

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

##### **CAUTION:**

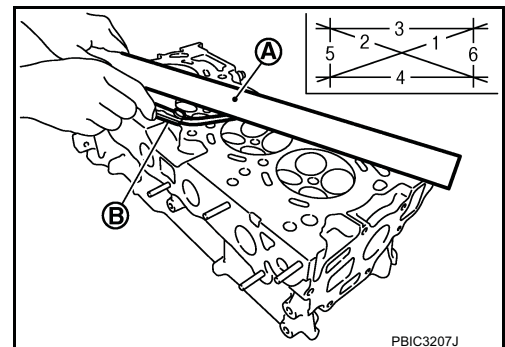
**Use utmost care not to allow gasket debris to enter passages for engine oil or engine coolant.**

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

- A : Straightedge  
B : Feeler gauge

**Limit : Refer to [EM-432, "Cylinder head"](#).**

- If it exceeds the limit, replace cylinder head.



### INSPECTION AFTER DISASSEMBLY

# CYLINDER HEAD

## < REMOVAL AND INSTALLATION >

[HR15DE]

### VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-432, "Cylinder head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

### VALVE GUIDE CLEARANCE

#### Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (A).

**Standard** : Refer to [EM-432, "Cylinder head"](#).

#### Valve Guide Inner Diameter

- Measure the inner diameter of valve guide with bore gauge.

**Standard** : Refer to [EM-432, "Cylinder head"](#).

#### Valve Guide Clearance

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

**Standard and Limit** : Refer to [EM-432, "Cylinder head"](#).

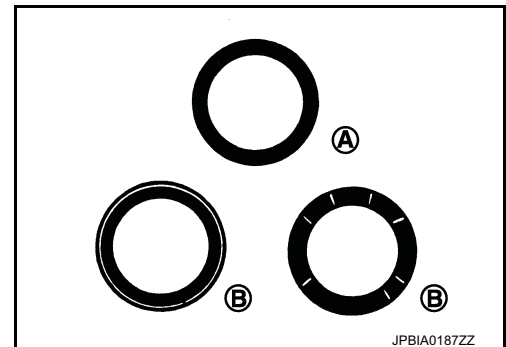
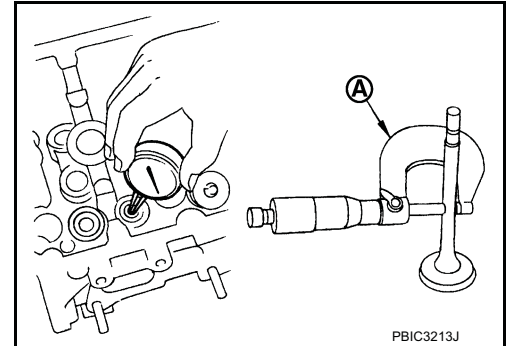
- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to [EM-388, "Disassembly and Assembly"](#).

### 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-388, "Disassembly and Assembly"](#).



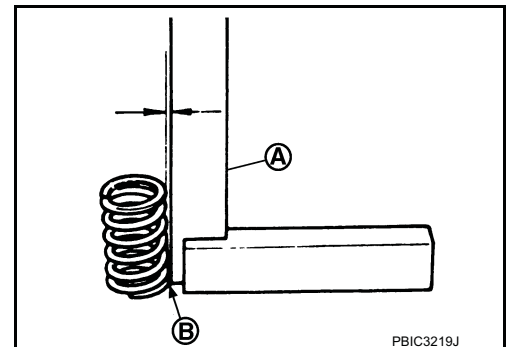
### VALVE SPRING SQUARENESS

- 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-432, "Cylinder head"](#).

- If it exceeds the limit, replace valve spring.



### VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

# CYLINDER HEAD

## < REMOVAL AND INSTALLATION >

[HR15DE]

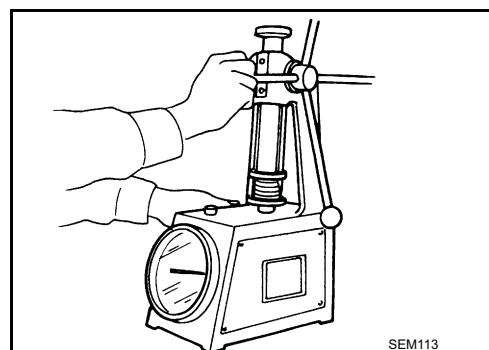
- Check valve spring pressure with valve spring seat installed at the specified spring height.

### CAUTION:

**Never remove valve spring seat from valve spring.**

**Standard** : Refer to [EM-432, "Cylinder head"](#).

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



## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-29, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
  - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

### NOTE:

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

- Warm up engine thoroughly to 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.

# ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

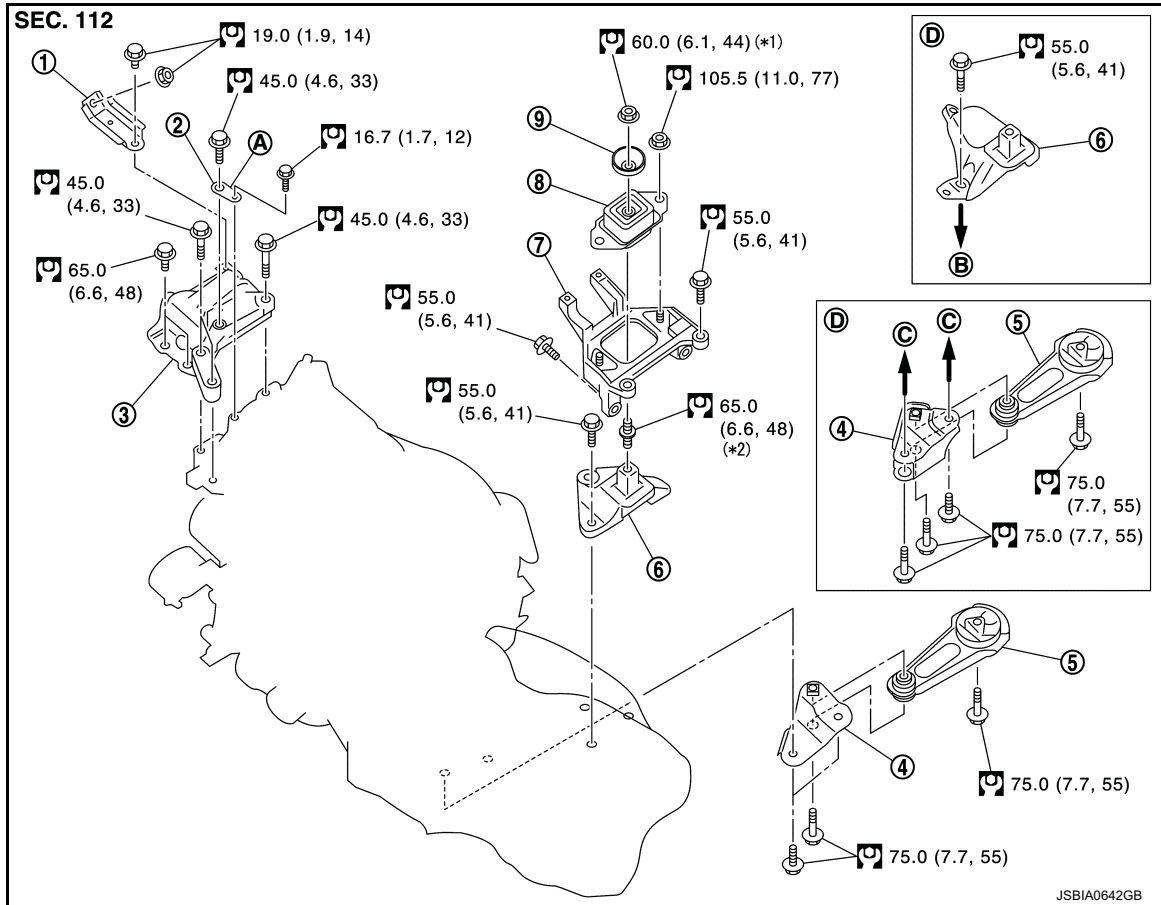
[HR15DE]

## UNIT REMOVAL AND INSTALLATION

### ENGINE ASSEMBLY

#### Exploded View

INFOID:000000006282293



- |  |                                   |                                   |
|--|-----------------------------------|-----------------------------------|
| 1. Engine mounting insulator (RH) stay | 2. Engine mount bracket link      | 3. Engine mounting insulator (RH) |
| 4. Rear engine mounting bracket        | 5. Rear torque rod                | 6. Engine mounting bracket (LH)   |
| 7. Engine mounting bracket (LH)        | 8. Engine mounting insulator (LH) | 9. Mass damper (M/T models)       |
| A. Front mark                          | B. To transaxle (upper)           | C. To transaxle (lower)           |
| D. M/T models                          |                                   |                                   |

: N·m (kg-m, ft-lb)

#### CAUTION:

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

#### Removal and Installation

INFOID:000000006282294

#### 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.
- Never 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.



# ENGINE ASSEMBLY

## < UNIT REMOVAL AND INSTALLATION >

[HR15DE]

- 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-46, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

### REMOVAL

#### Outline

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

#### Preparation

1. Release fuel pressure. Refer to [EC4-117, "Work Procedure"](#) (TYPE 1) or [EC4-401, "Work Procedure"](#) (TYPE 2).
2. Drain engine coolant from radiator. Refer to [CO-13, "Draining"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belts.
3. Remove the following parts.
  - Front road wheels and tires (RH and LH)
  - Front fender protector (RH and LH): Refer to [EXT-21, "FENDER PROTECTOR : Exploded View"](#).
  - Drive belt: Refer to [EM-330, "Removal and Installation"](#).
  - Battery and battery tray: Refer to [PG-529, "FOR MAINTENANCE REQUIRED BATTERY MODELS : Removal and Installation"](#).
  - Air duct (inlet), air duct, and air cleaner cover and body assembly: Refer to [EM-337, "Removal and Installation"](#).
  - Radiator hose (upper and lower): Refer to [CO-70, "Exploded View"](#).
  - Exhaust front tube: Refer to [EX-5, "Exploded View"](#).

#### Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.  
**CAUTION:**  
**Protect connectors using a resin bag against foreign materials during the operation.**
2. Disconnect heater hoses. Refer to [CO-79, "Exploded View"](#).
3. Disconnect fuel feed tube at engine side. Refer to [EM-349, "Exploded View"](#).
4. Disconnect control linkage from transaxle. Refer to [TM-30, "Removal and Installation"](#) (M/T models).
5. Disconnect clutch tube on transaxle side from clutch damper (M/T models). Refer to [CL-23, "Removal and Installation"](#).

#### Engine Room RH

1. Remove ground cable at engine side.
2. Remove alternator. Refer to [CHG-50, "HR15DE : Exploded View"](#).
3. Disconnect vacuum hose from intake manifold. Refer to [EM-339, "Exploded View"](#).
4. Remove EVAP hoses. Refer to [EM-339, "Exploded View"](#).
5. Remove A/C compressor. Refer to [HA-32, "COMPRESSOR : Removal and Installation"](#).

#### Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove drive shafts (RH and LH). Refer to [FAX-24, "Exploded View"](#).
3. Disconnect A/T fluid hose from radiator (A/T models).  
**NOTE:**  
Cap or plug openings to prevent fluid from spilling.



# ENGINE ASSEMBLY

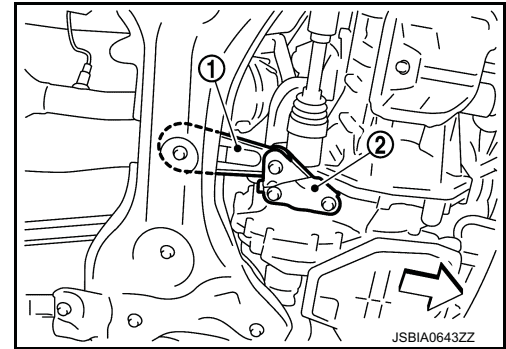
## < UNIT REMOVAL AND INSTALLATION >

[HR15DE]

### 4. Remove rear torque rod (1).

2 : Rear engine mounting bracket

⇐ : Vehicle front



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

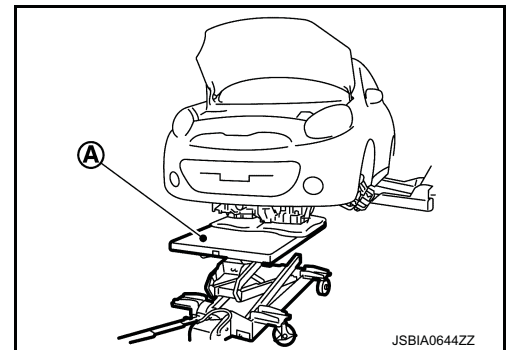
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-346, "Exploded View"](#).

#### Removal

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

#### CAUTION:

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



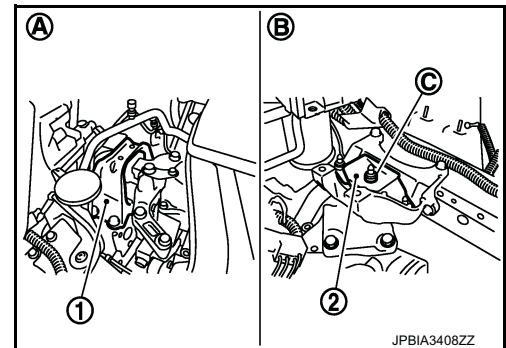
2. Remove engine mounting insulator (RH) (1).

2 : Engine mounting insulator (LH)

A : Engine front side

B : Transaxle side

3. Remove engine mounting through bolt-securing nut (C).



4. 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.

#### Separation

# ENGINE ASSEMBLY

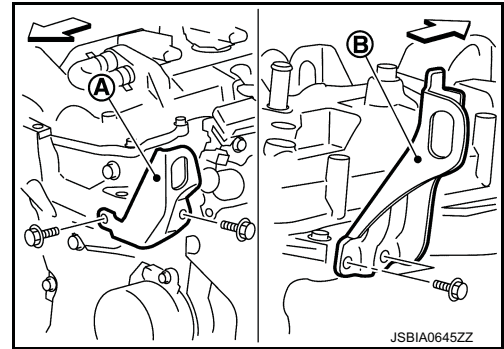
## < UNIT REMOVAL AND INSTALLATION >

[HR15DE]

1. When engine can be hoisted, install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.

↩ : Engine front

**Slinger bolts** : 25.0 N·m (2.6 kg-m, 18 ft-lb)



2. Remove starter motor. Refer to [STR-69, "HR15DE : Exploded View"](#).
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-38, "HR15DE : Exploded View"](#) (M/T models), [TM-315, "Exploded View"](#) (A/T models).

## INSTALLATION

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

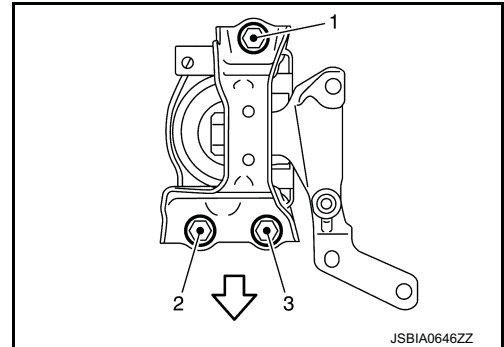
### CAUTION:

- **Never 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 mounting nuts and bolts.**
- **When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to [EM-392, "Exploded View"](#).**

Engine Mounting Bracket (RH)

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

↩ : Vehicle front



## Inspection

INFOID:000000006282295

## INSPECTION AFTER INSTALLATION

### Inspection for Leakage

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

- 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-29, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to 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 >

[HR15DE]

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.

## UNIT DISASSEMBLY AND ASSEMBLY

## ENGINE STAND SETTING

## Setting

INFOID:000000006282296

EM

**NOTE:**

Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-392, "Exploded View"](#).
2. Install engine to engine stand with the following procedure:
  - a. Remove flywheel or drive plate. Refer to [EM-399, "Removal and Installation"](#) (M/T models) or [EM-401, "Removal and Installation"](#) (A/T models).
  - b. Lift the engine with a hoist to install it onto widely use engine stand.

**CAUTION:**

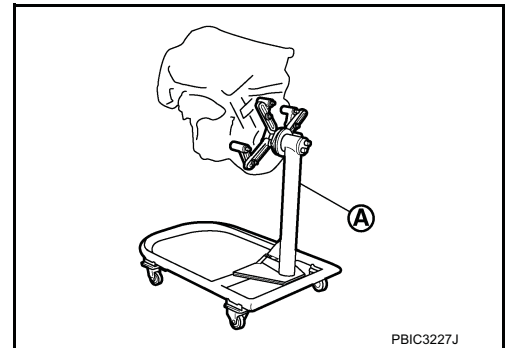
- Use the engine stand that has a load capacity [approximately 150 kg (331 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to [EM-339, "Exploded View"](#).
  - Exhaust manifold: Refer to [EX-5, "Exploded View"](#).
  - Rocker cover: Refer to [EM-354, "Exploded View"](#).

**NOTE:**

The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel removed.

**CAUTION:**

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



3. Drain engine oil. Refer to [LU-31, "Draining"](#).

**CAUTION:**

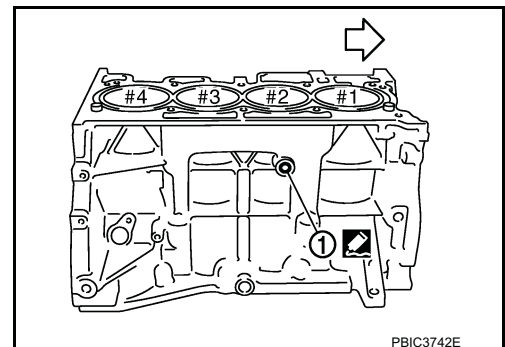
Be sure to clean drain plug and install with new drain plug washer.

4. Drain engine coolant by removing water drain plug (1) from inside of the engine.

↩ : Engine front

**Tightening torque** : Refer to [EM-407, "Exploded View"](#).

Use Genuine Liquid Gasket or equivalent.



---

**ENGINE UNIT****Disassembly**

INFOID:000000006282297

1. Remove intake manifold. Refer to [EM-339, "Exploded View"](#).
2. Remove exhaust manifold. Refer to [EX-5, "Exploded View"](#).
3. Remove oil pan (lower). Refer to [EM-346, "Exploded View"](#).
4. Remove ignition coil, spark plug, and rocker cover. Refer to [EM-354, "Exploded View"](#).
5. Remove fuel injector and fuel tube. Refer to [EM-349, "Exploded View"](#).
6. Remove front cover and timing chain. Refer to [EM-356, "Exploded View"](#).
7. Remove camshaft. Refer to [EM-366, "Exploded View"](#).
8. Remove cylinder head. Refer to [EM-385, "Exploded View"](#).

**Assembly**

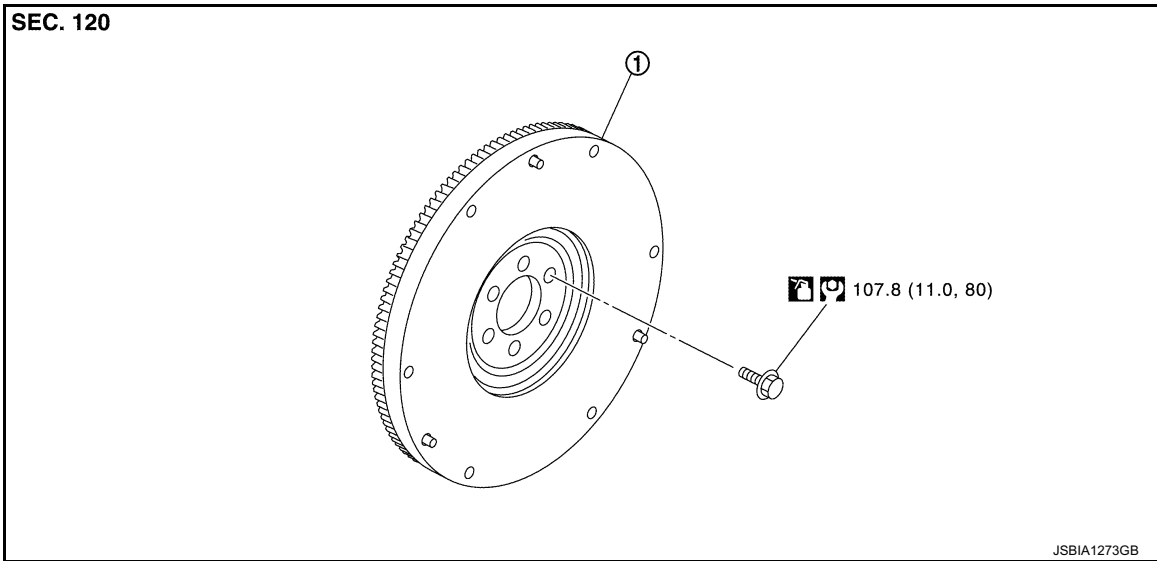
INFOID:000000006282298

Assemble in the reverse order of disassembly.

## FLYWHEEL

### Exploded View

INFOID:000000007172199



1. Flywheel

: N·m (kg-m, ft-lb)

: Should be lubricated with oil.

### Removal and Installation

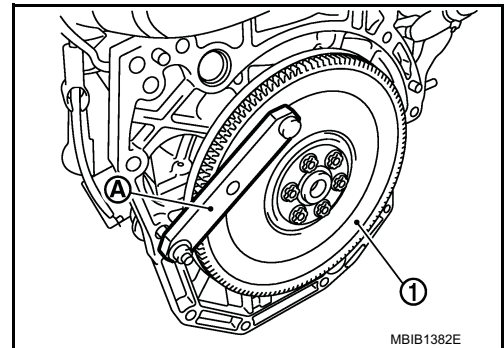
INFOID:000000007172200

#### REMOVAL

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-392, "Exploded View"](#).
2. Install engine to engine stand with the following procedure:
3. Remove flywheel or drive plate.
  - Secure flywheel (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
  - Using TORX socket (size E20), loosen mounting bolts.

#### CAUTION:

- **Never disassemble them.**
- **Never damage or scratch and contact surface for clutch disc of flywheel.**
- **Take care not to damage the periphery of the sensing area.**
- **Any dropped flywheel shall not be used. (The flywheel to which the sensing area shall not be placed on the floor.)**
- **Never touch flywheel with bare hands. Always use urethane coating gloves or skin gloves when removing these parts.**
- **Never use torn glove.**



#### INSTALLATION

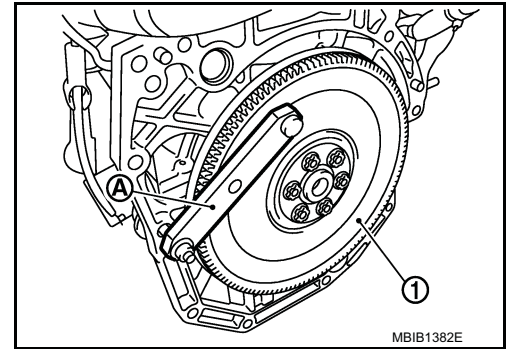
1. Install flywheel.

# FLYWHEEL

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Secure flywheel (1) with a stopper plate [SST: KV11105210] (A), and tighten mounting bolts.
- Using TORX socket (size E20), tighten mounting bolts.



### CAUTION:

Be careful about the installing direction (front/back).

- Before tightening bolts, anti-corrosive fluid shall be applied to the bolt threads and bolt flange.
- No impact shall be applied the flywheel.
- Not bringing the part which had magnetism close to the flywheel.
- Never damage or scratch and contact surface for clutch disc of flywheel.

## Inspection

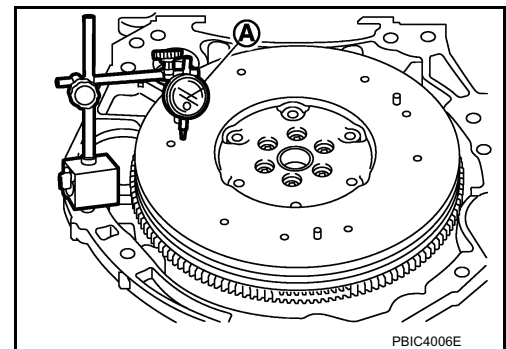
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### FLYWHEEL DEFLECTION

- 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 : 0.25 mm (0.0098 in) or less.**

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



# DRIVE PLATE

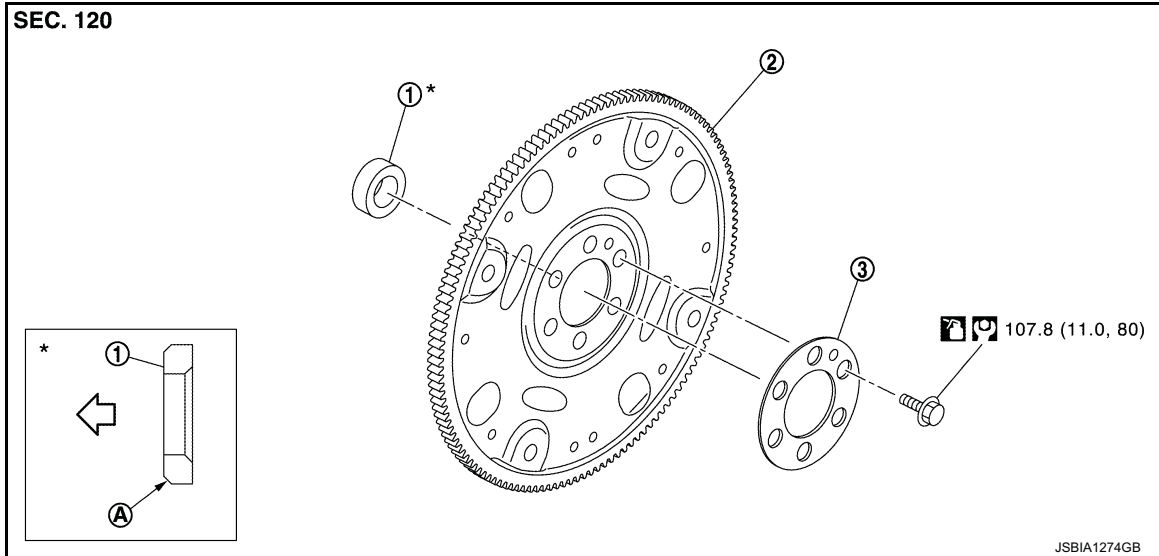
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

## DRIVE PLATE

### Exploded View

INFOID:000000007172202



1. Pilot converter

2. Drive plate

3. Reinforcement plate

A. Chamfered

← :Crankshaft side

: N·m (kg-m, ft-lb)

: Should be lubricated with oil.

## Removal and Installation

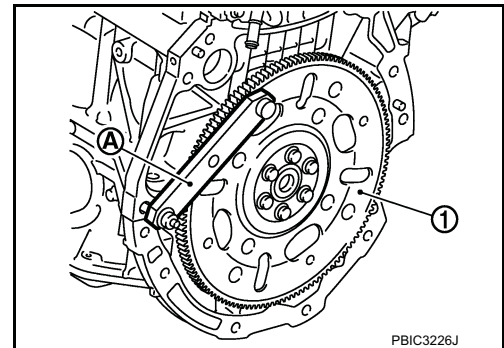
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### REMOVAL

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-392. "Exploded View"](#).
2. Remove drive plate.
  - Secure drive plate (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
  - Using TORX socket (size E20), loosen mounting bolts.

**CAUTION:**

  - **Never disassemble them.**
  - **Any dropped drive plate shall not be used.**



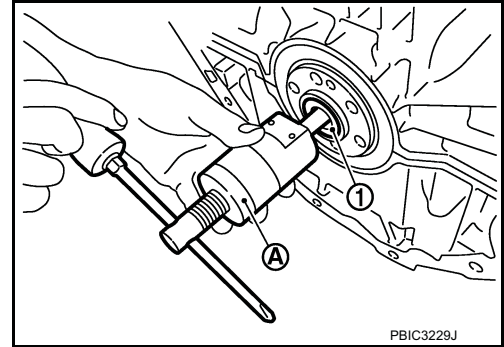


## DRIVE PLATE

### < UNIT DISASSEMBLY AND ASSEMBLY >

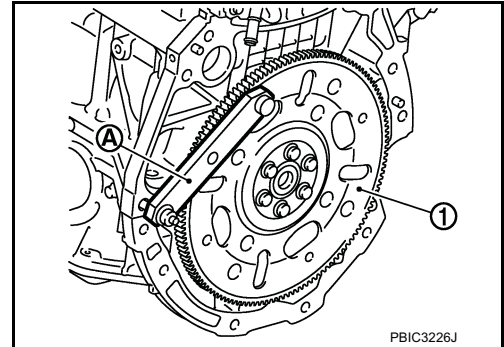
[HR15DE]

3. Remove pilot converter (1), from the rear end of the crankshaft.  
Use a pilot bush puller [SST: ST16610000] (A), if necessary.



### INSTALLATION

1. Install pilot converter.
2. Install drive plate.
  - Secure drive plate (1) with a stopper plate [SST: KV11105210] (A), and tighten mounting bolts.
  - Using TORX socket (size E20), tighten mounting bolts.



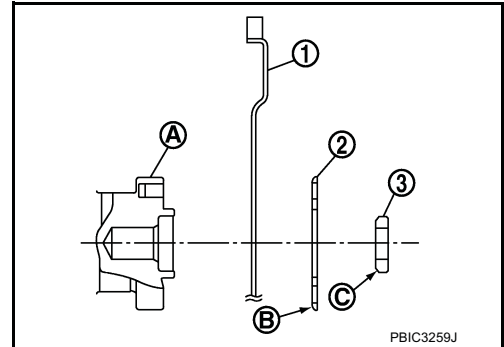
- Install drive plate (1), reinforcement plate (2) and pilot converter (3) as shown in figure.

- A :Crankshaft rear end  
B :Rounded  
C :Chamfered

#### CAUTION:

Be careful about the installing direction (front/back).

- Using a drift of 33 mm (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops.
- Before tightening bolts, anti-corrosive fluid shall be applied to the bolt threads and bolt flange.
- No impact shall be applied the drive plate.
- Reinforcing plate shall be attached so that the radius faces the drive plate side as shown in the above figure.



### Inspection

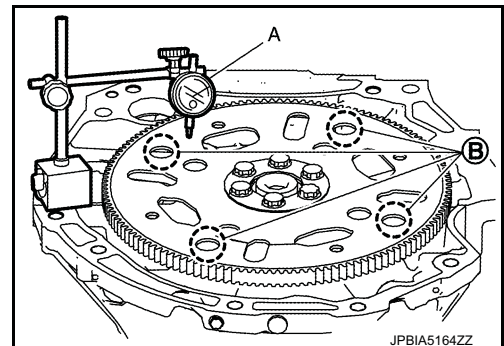
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#### DRIVE PLATE DEFLECTION

- 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.



# OIL PAN (UPPER)

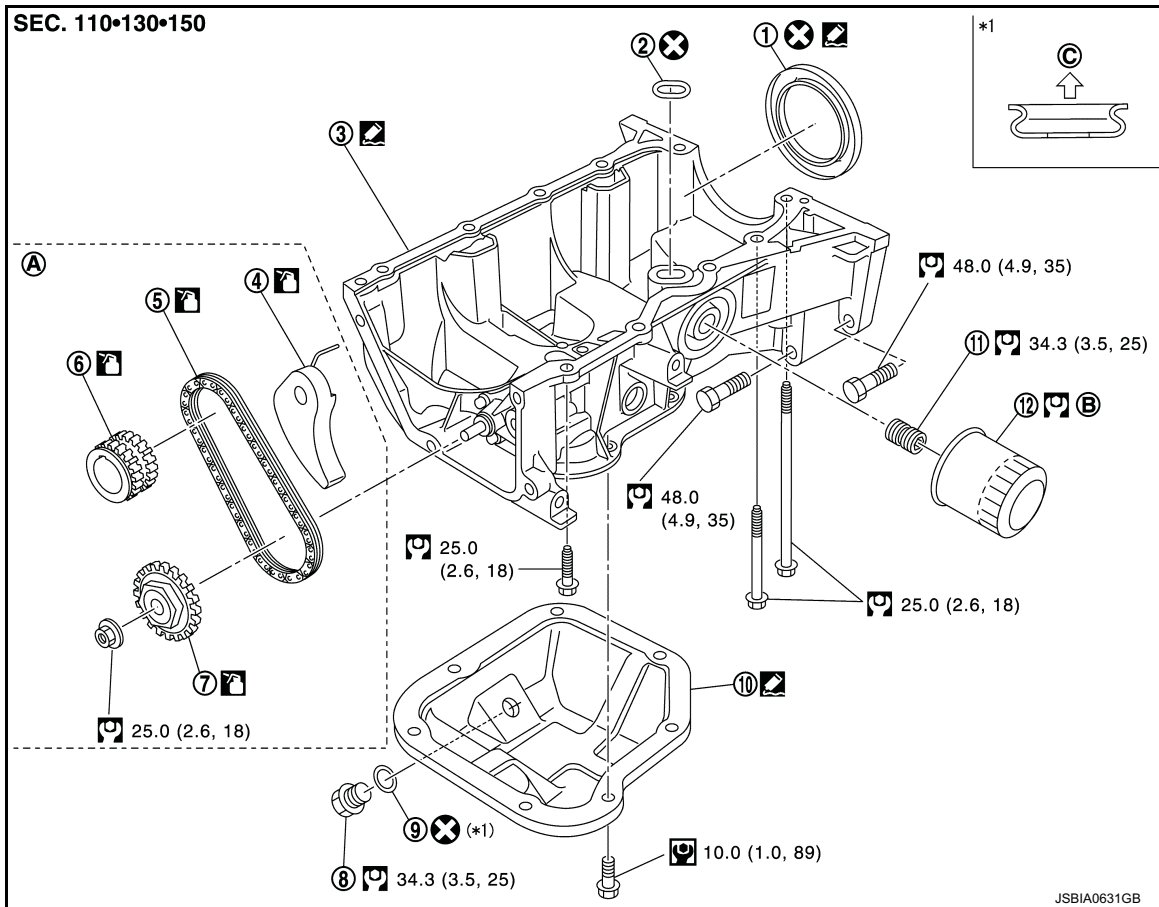
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

## OIL PAN (UPPER)

### Exploded View

INFOID:000000006282299



- |  |   |                         |
|--|---|-------------------------|
| 1. Rear oil seal   | 2. O-ring   | 3. Oil pan (upper)      |
| 4. Oil pump chain tensioner (for oil pump drive chain)                                 | 5. Oil pump drive chain   | 6. Crankshaft sprocket  |
| 7. Oil pump sprocket   | 8. Drain plug   | 9. Drain plug washer    |
| 10. Oil pan (lower)  | 11. Oil filter stud   | 12. Oil filter          |
| A. Comply with the assembly procedure when tightening. Refer to <a href="#">EM-356</a> | B. Comply with the assembly procedure when tightening. Refer to <a href="#">LU-33</a> | C. Oil pan (lower) side |

✕ : Always replace after every disassembly.

Ⓐ : N·m (kg-m, in-lb)

Ⓑ : N·m (kg-m, ft-lb)

Ⓒ : Sealing point

Ⓓ : Should be lubricated with oil.

## Removal and Installation

INFOID:000000006282300

### NOTE:

The oil strainer and oil pump are included in the oil pan (upper). Individual disassembly is prohibited.

### REMOVAL

1. Remove the oil pan (lower). Refer to [EM-346, "Exploded View"](#).

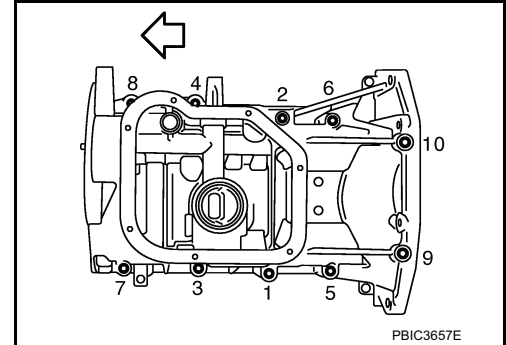
## OIL PAN (UPPER)

[HR15DE]

### < UNIT DISASSEMBLY AND ASSEMBLY >

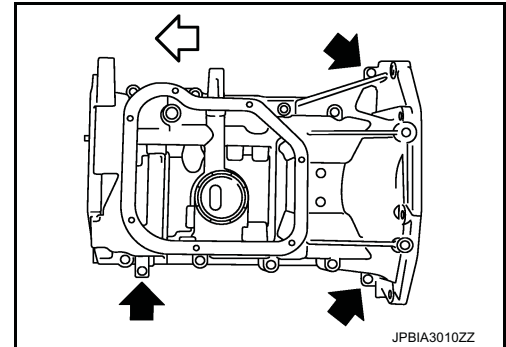
2. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to [EM-356](#).  
"Exploded View".
3. Remove oil pan (upper) with the following procedure.
  - a. Loosen oil pan (upper) mounting bolts in the reverse of the order as shown in the figure.

⇐ : Engine front



- b. Insert a flat-bladed offset screwdriver into the arrow (⇐) in the figure and open up a crack between the oil pan (upper) cylinder block.

⇐ : Engine front



- c. Insert the seal cutter [SST: KV10111100] between the oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of tool with a hammer.

**CAUTION:**

- Be careful not to damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a screwdriver, etc. outside the indicated location.
- Never remove oil pump and oil strainer from oil pan (upper).

4. Remove rear oil seal from crankshaft.

### INSTALLATION

**CAUTION:**

**Do not reuse O-ring or washers.**

1. Install the oil pan (upper) in the following procedure:
  - a. Use scraper to remove old liquid gasket from mating surfaces.
    - Also remove the old liquid gasket from mating surface of cylinder block.
    - Remove old liquid gasket from the bolt holes and threads.
  - CAUTION:**  
**Never scratch or damage the mating surfaces when cleaning off old liquid gasket.**
  - b. Install O-ring to the cylinder block.  
**CAUTION:**  
**Do not reuse O-ring.**

# OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

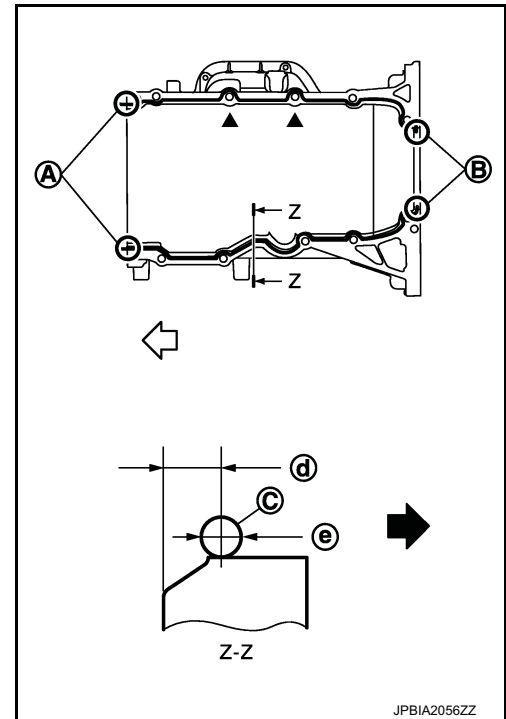
- c. Apply a continuous bead of liquid gasket (C) with the tube presser (commercial service tool) to areas as shown in the figure.

**Use Genuine Liquid Gasket or equivalent.**

- A : 2 mm (0.07 in) protruded to outside  
 B : 2 mm (0.07 in) protruded to rear oil seal mounting side  
 d : 5.5 - 7.5 mm (0.217 - 0.295 in)  
 e :  $\phi$ 4.0 - 5.0 mm (0.157 - 0.197 in)  
 ⇐ : Engine front side  
 ← : Engine out side

**CAUTION:**

Attaching should be done within 5 minutes after coating.



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

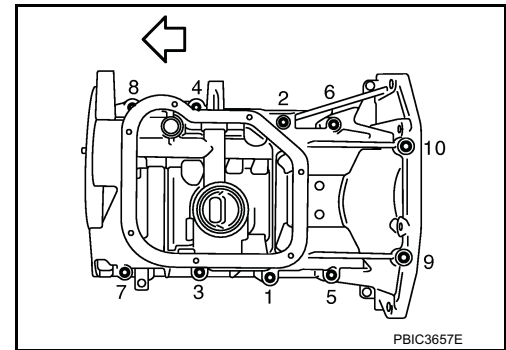
⇐ : Engine front

**CAUTION:**

Install avoiding misalignment of both oil pan gasket and O-ring.

- The bolts are different according to the installation position. Refer to the numbers as shown in the figure.

- M8×180 mm (7.09 in) : No. 9, 10**  
**M8×25 mm (0.98 in) : No. 3, 4, 7, 8**  
**M8×90 mm (3.54 in) : No. 1, 2, 5, 6**



2. Install rear oil seal with the following procedure:

**CAUTION:**

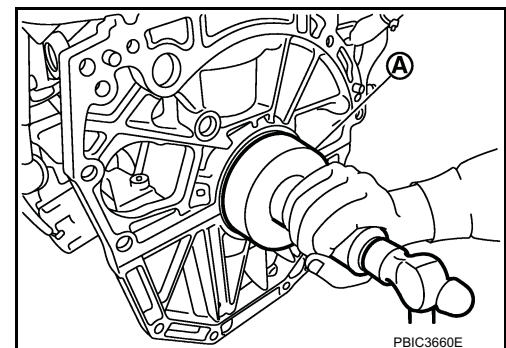
- The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
- Never touch oil seal lip.

- a. Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a spatula.

- b. Apply the liquid gasket lightly to entire outside area of new rear oil seal.

**Use Genuine Liquid Gasket or equivalent.**

- c. Press-fit the rear oil seal using a drift with outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).



## OIL PAN (UPPER)

### < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Press-fit to the dimensions specified as shown in the figure.

- 1 : Rear oil seal  
A : Rear end surface of cylinder block  
b : 0 - 0.5 mm (0 - 0.020 in)

#### CAUTION:

- Never 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 check that oil seal does not curl or tilt.

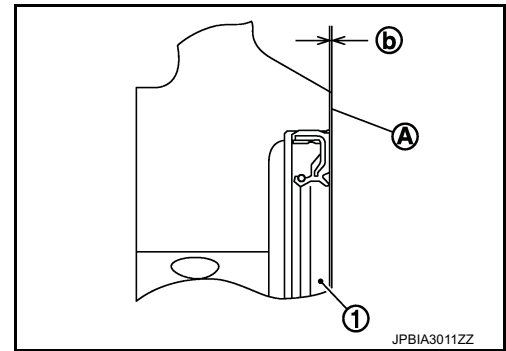
- d. After press-fitting the rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.
3. Install in the reverse order of removal, for the rest of parts.

### Inspection

INFOID:000000006282301

### INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-30, "Inspection"](#).
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-30, "Inspection"](#).



# CYLINDER BLOCK

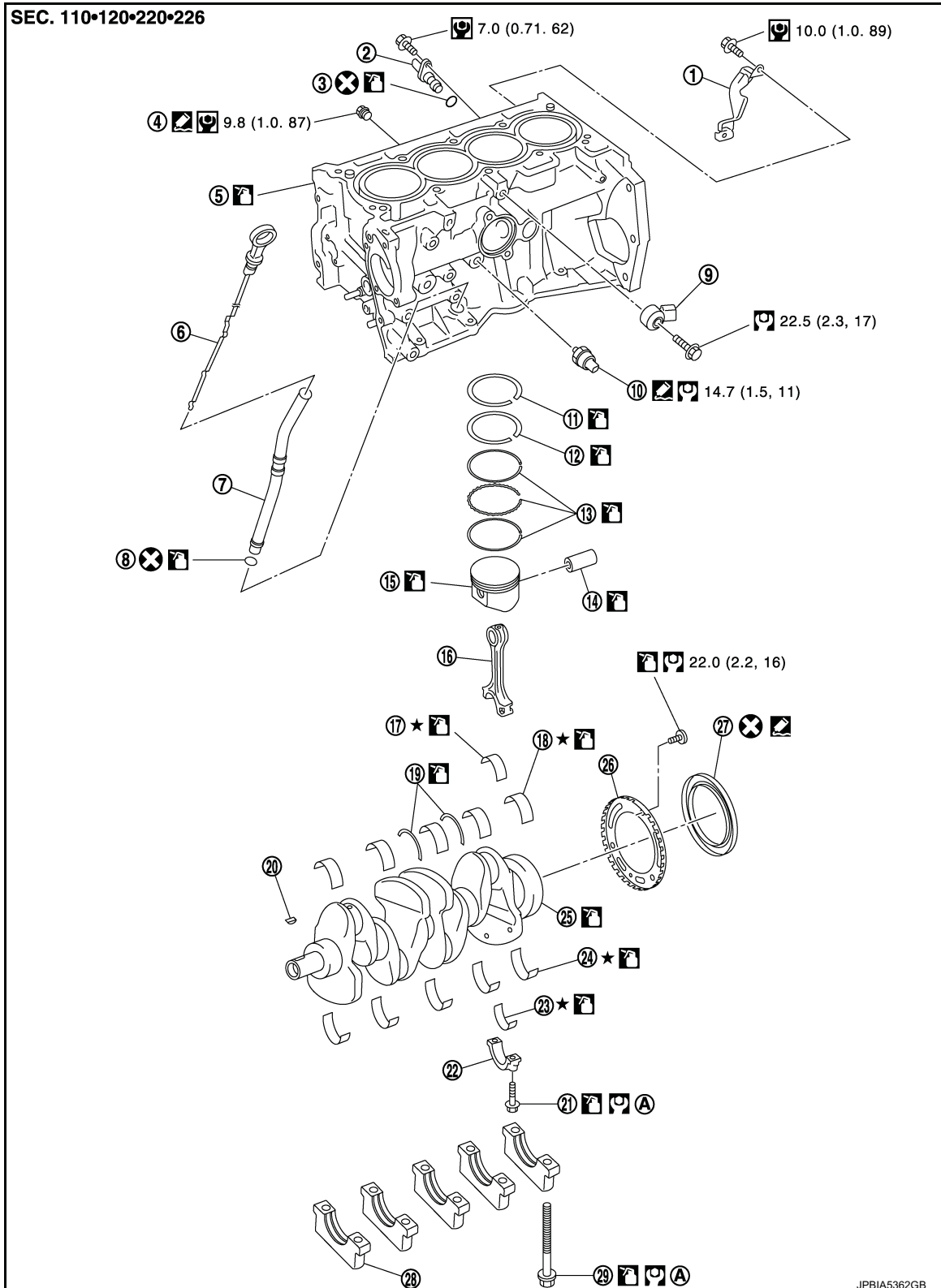
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

## CYLINDER BLOCK

Exploded View

INFOID:000000006282302



- |   |                                     |                    |
|---|-------------------------------------|--------------------|
| 1. Crankshaft position sensor (POS) cover | 2. Crankshaft position sensor (POS) | 3. O-ring          |
| 4. Drain plug                             | 5. Cylinder block                   | 6. Oil level gauge |
| 7. Oil level gauge guide                  | 8. O-ring                           | 9. Knock sensor    |

# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- |                         |                                    |                          |
|-------------------------|------------------------------------|--------------------------|
| 10. Oil pressure switch | 11. Top ring                       | 12. Second ring          |
| 13. Oil ring            | 14. Piston pin                     | 15. Piston               |
| 16. Connecting rod      | 17. Connecting rod bearing (upper) | 18. Main bearing (upper) |
| 19. Thrust bearing      | 20. Crankshaft key                 | 21. Connecting rod bolt  |
| 22. Connecting rod cap  | 23. Connecting rod bearing (lower) | 24. Main bearing (lower) |
| 25. Crankshaft          | 26. Signal plate                   | 27. Rear oil seal        |
| 28. Main bearing cap    | 29. Main bearing cap bolt          |                          |

- A. Comply with the assembly procedure when tightening. Refer to [EM-408](#)

⊗ : Always replace after every disassembly.

🔧 : N·m (kg-m, in-lb)

🔧 : N·m (kg-m, ft-lb)

🛢️ : Should be lubricated with oil.

🔧 : Sealing point

★ : Select with proper thickness.

## Disassembly and Assembly

INFOID:000000006282303

### DISASSEMBLY

#### NOTE:

Explained here is how to disassemble with an engine stand supporting mating surface of transaxle. When using different type of engine stand, note with difference in steps and etc.

1. Remove clutch cover and clutch disc (M/T models). Refer to [CL-28, "HR15DE : Exploded View"](#).
2. Remove flywheel or drive plate. Refer to [EM-399, "Exploded View"](#) (Flywheel) or [EM-401, "Exploded View"](#) (Drive plate).
3. Remove cylinder head. Refer to [EM-385, "Exploded View"](#).
4. Remove oil pan (upper and lower). Refer to [EM-403, "Exploded View"](#).
5. Remove knock sensor.

#### CAUTION:

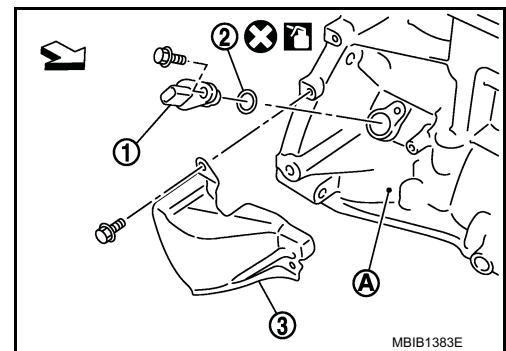
**Carefully handle knock sensor avoiding shocks.**

6. Remove cover, and then crankshaft position sensor (POS).

1. Crank shaft position sensor (POS)
  2. O-ring
  3. Cover
- A. Cylinder block LHD side  
 ⇐ : Engine front

#### CAUTION:

- Avoid impacts such as a dropping.
- Never disassemble.
- Keep it away from metal particles.
- Never place the sensor in a location where it is exposed to magnetism.



7. 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-415, "Inspection"](#).
- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod cap.

# CYLINDER BLOCK

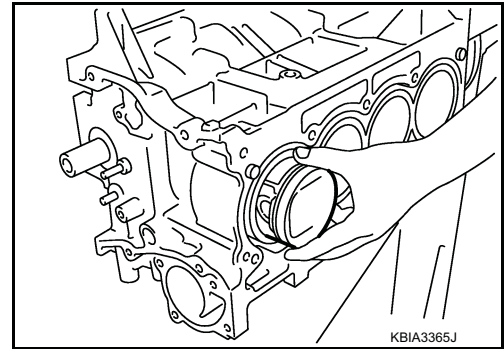
## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

**CAUTION:**

- Never damage matching surface with connecting rod cap.
- Never damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



8. Remove connecting rod bearings.

**CAUTION:**

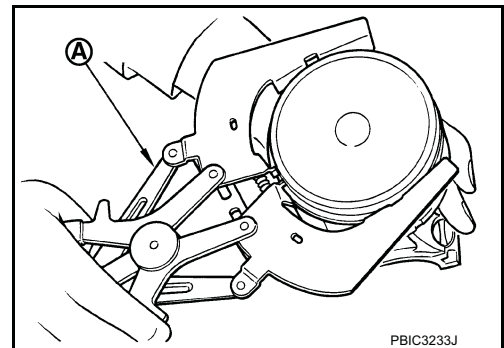
Identify installation positions, and store them without mixing them up.

9. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to [EM-415, "Inspection"](#).
- Use a piston ring expander (commercial service tool) (A).

**CAUTION:**

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



10. Remove piston from connecting rod.

- Use a piston pin press stand (SST) and a press to remove the piston pin.
- For the details of SST, refer to the following.

**A** : Drift [KV10109730]

**B** : Center cap [KV10110310]

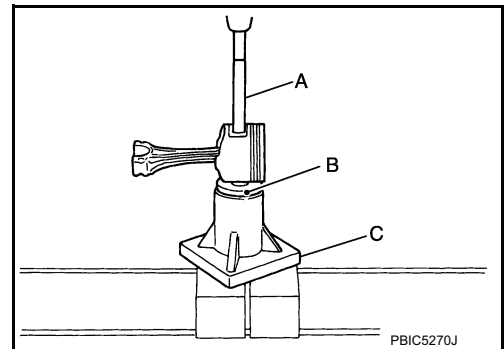
**C** : Press stand [ST13030020]

**CAUTION:**

- Never damage the piston and the connecting rod.
- Never reuse piston and piston pin after removing piston pin from connecting rod. The connecting rod is reusable.

**NOTE:**

The joint between the connecting rod and the piston pin is a press fit.



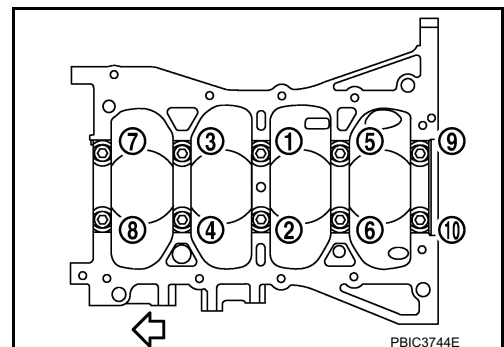
11. Remove the main bearing cap in the following procedure.

- Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-415, "Inspection"](#).

- a. Loosen and remove bolts in several steps in reverse of the numerical order as shown in the figure.

↩ : Engine front

- TORX socket (size: E14) can be used.





# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

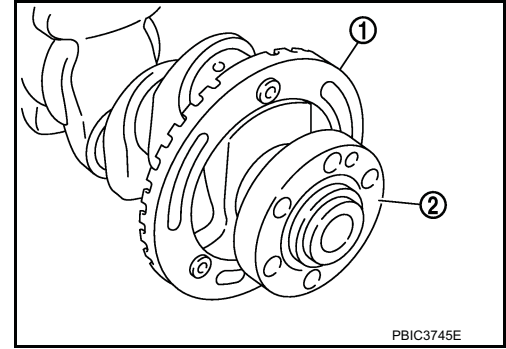
12. Remove crankshaft (2).

**CAUTION:**

- Never damage or deform signal plate (1) mounted on crankshaft.
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.
- Never remove signal plate unless it is necessary to do so.

**NOTE:**

When removing or installing signal plate, use TORX socket (size T40).



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

14. Remove main bearing (upper and lower) and thrust bearings from cylinder block and main bearing cap.

**CAUTION:**

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

## ASSEMBLY

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

**CAUTION:**

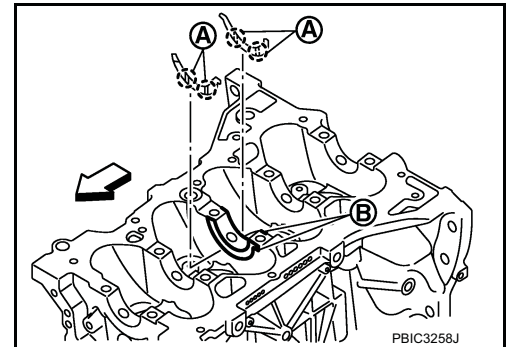
Use a goggles to protect your eye.

2. 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.
- b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

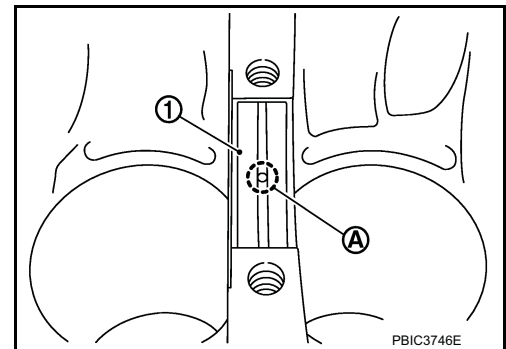
⇐ : Engine front

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



c. Install the main bearings (1) paying attention to the direction.

- Install the one with oil holes (A) onto cylinder block and the one without oil holes onto main bearing cap.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

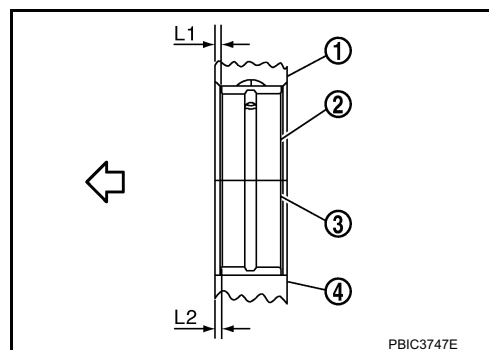
[HR15DE]

- Install the main bearing in the position as shown in the figure.

- 1 : Cylinder block  
 2 : Main bearing (upper)  
 3 : Main bearing (lower)  
 4 : Main bearing cap  
 ⇐ : Engine front

### NOTE:

Install the main bearing in the center position with the following dimension. For service operation, the center position can be checked visually.



Journal position	No. 1	No. 2	No. 3	No. 4	No. 5
L1 [Unit: mm (in)]	1.65 - 2.05 (0.064 - 0.080)	1.25 - 1.65 (0.049 - 0.064)	2.30 - 2.70 (0.090 - 0.106)	1.25 - 1.65 (0.049 - 0.064)	1.60 - 2.00 (0.062 - 0.078)
L2 [Unit: mm (in)]	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)	2.30 - 2.70 (0.090 - 0.106)	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)

### CAUTION:

**Dimension L1 of journal No. 3 is the distance from the housing base end surface (bulk) (it is not the distance from the thrust bearing mounting end surface).**

3. Install signal plate to crankshaft if removed.
- a. Set the signal plate (1) with the flange facing toward the counter-weight side (engine front side) to the crankshaft rear surface.

A : Dowel pin hole

- b. After positioning crankshaft and signal plate with positioning dowel pin, tighten bolt.

### NOTE:

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

- c. Remove dowel pin.

### CAUTION:

**Be sure to remove dowel pin.**

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

### CAUTION:

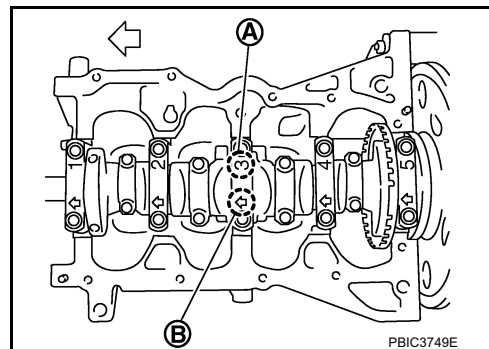
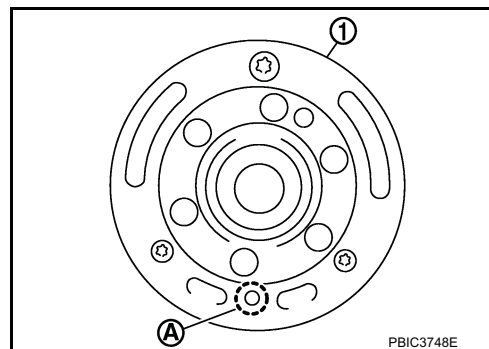
**Never install rear oil seal yet.**

5. Install main bearing caps.
  - Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

⇐ : Engine front

### NOTE:

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



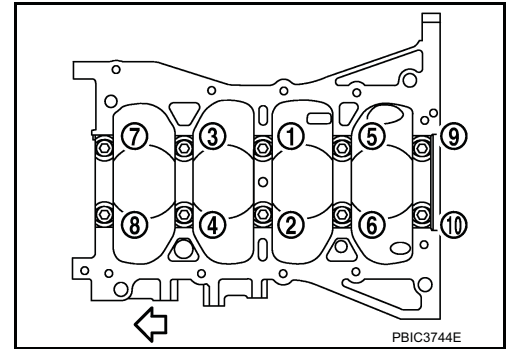
# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

6. Tighten main bearing cap bolts in numerical order as shown in the figure with the following steps.

↶ : Engine front



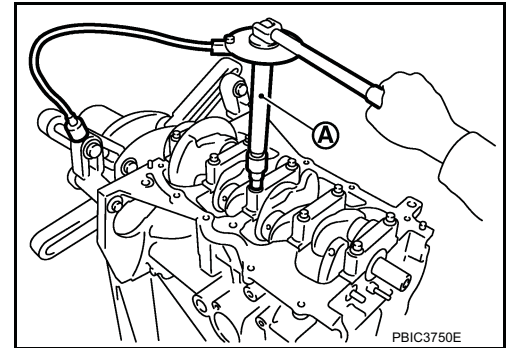
- a. Apply new engine oil to threads and seat surfaces of the mounting bolts.
- b. Tighten main bearing cap bolts.

: 32.4 N·m (3.3 kg-m, 24 ft-lb)

- c. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in numerical order as shown in the figure.

### CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- After installing the mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-415, "Inspection"](#).

7. Install piston to connecting rod with the following procedure:

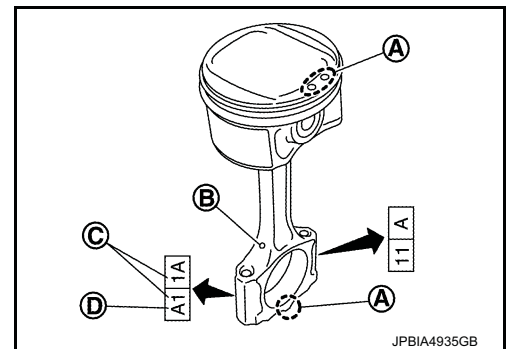
- a. Set so that the front mark (A) on the piston head and the cylinder number (C) are in the position as shown in the figure.

B : Oil hole

D : Connecting rod big end grade

### NOTE:

The symbols without notes are for management



# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- b. Press-fit the piston pin using the piston pin press stand (SST).
- For the details of SST, refer to the following.

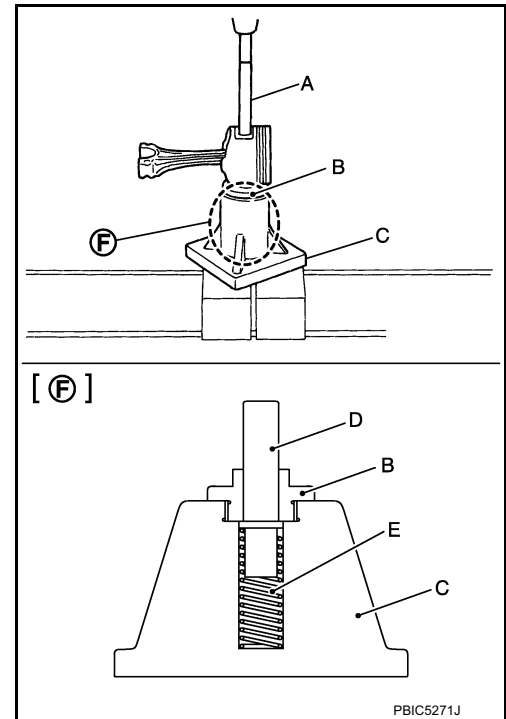
- A : Drift [KV10109730]  
 B : Center cap [KV10110310]  
 C : Press stand [ST13030020]  
 D : Center shaft KV10114120]  
 E : Spring [ST13030030]  
 F : Detail

### CAUTION:

Press-fit the piston so as not to damage it.

### NOTE:

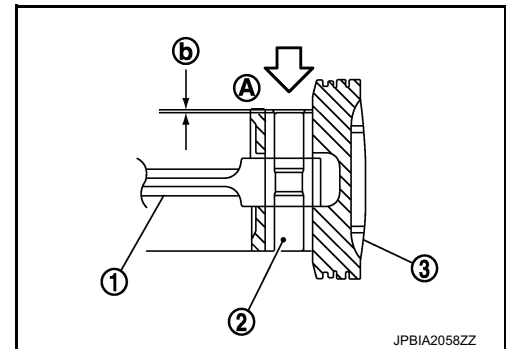
The joint between the connecting rod and the piston pin is a press fit.



- Press-fit the piston pin (2) from piston surface (A) to the depth of 2.35 mm (0.092 in) (b).

- 1 : Connecting rod  
 ⇐ : Press-fit direction

- After finishing work, check that the piston (3) moves freely.



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

### CAUTION:

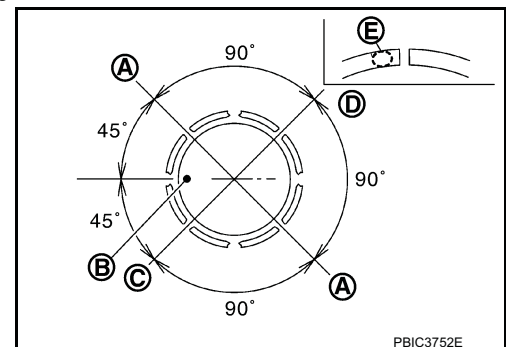
- Never damage piston.
- Never damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark (B).

- A : Oil ring upper or lower rail gap (either of them)  
 C : Second ring and oil ring spacer gap  
 D : Top ring gap

- Install second ring with the stamped mark (E) facing upward.

### Stamped mark:

Second ring : R



9. Install connecting rod bearings to connecting rod and connecting rod cap.
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
  - Install the bearing in the center position.

### NOTE:

There is no stopper tab.

- Check that the oil holes on connecting rod and connecting rod bearing are aligned.

# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

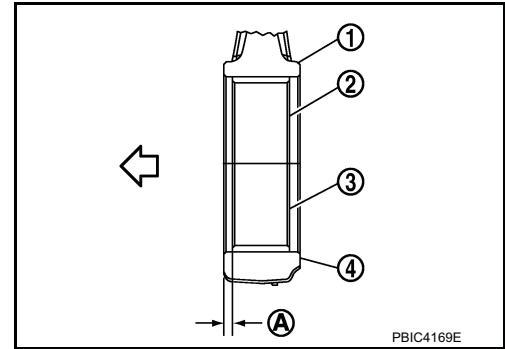
[HR15DE]

- Install the connecting rod in the dimension as shown in the figure.

- 1 : Connecting rod
- 2 : Connecting rod bearing (upper)
- 3 : Connecting rod bearing (lower)
- 4 : Connecting rod cap
- A : 1.7 - 2.1 mm (0.067 - 0.083 in)
- ⇐ : Engine front

### NOTE:

Install the connecting rod bearing in the center position with the dimension as shown in the figure. For service operation, the center position can be checked visually.

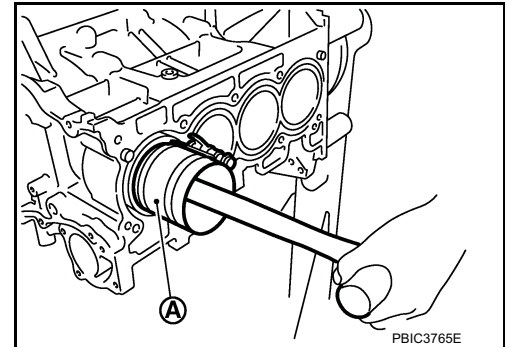


### 10. Install piston and connecting rod assembly to crankshaft.

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

### CAUTION:

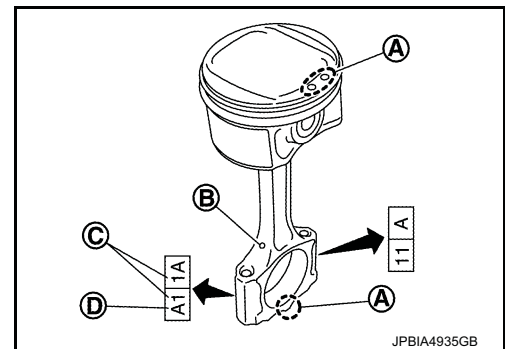
- **Never damage matching surface with connecting rod cap.**
- **Never damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**



### 11. Install connecting rod cap.

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

- A : Front mark
- B : Oil hole
- D : Connecting rod big end grade



### 12. Inspect outer diameter of connecting rod bolts. Refer to [EM-415. "Inspection"](#).

### 13. Tighten connecting rod bolt with the following procedure:

- Apply new engine oil to the threads and seats of connecting rod bolts.
- Tighten bolts in several steps.

: 27.4 N·m (2.8 kg-m, 20 ft-lb)

- Completely loosen bolts.

: 0 N·m (0 kg-m, 0 ft-lb)

- Tighten bolts in several steps.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

- Then turn all bolts 60 degrees clockwise (angle tightening).

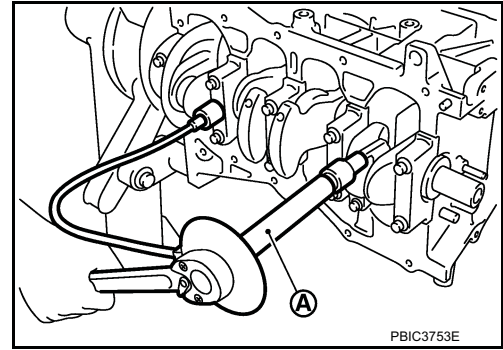
# CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

## CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgement by visual inspection without the tool.



- After tightening connecting rod bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-415, "Inspection"](#).

14. Install oil pan (upper). Refer to [EM-403, "Exploded View"](#).

## NOTE:

Install the rear oil seal after installing the oil pan (upper).

15. Install rear oil seal. Refer to [EM-383, "REAR OIL SEAL : Removal and Installation"](#).

16. Install flywheel or drive plate. Refer to [EM-399, "Exploded View"](#) (Flywheel) or [EM-401, "Exploded View"](#) (Drive plate).

17. Install knock sensor (1).

⇐ : Engine front

- Install connectors so that they are positioned towards the rear of the engine.

## CAUTION:

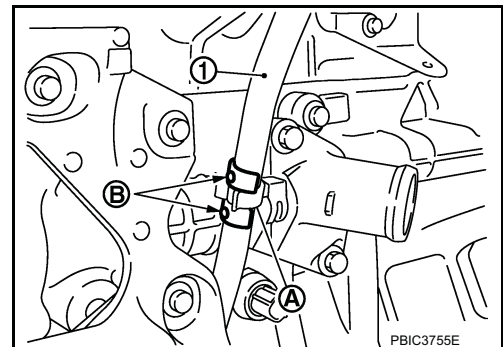
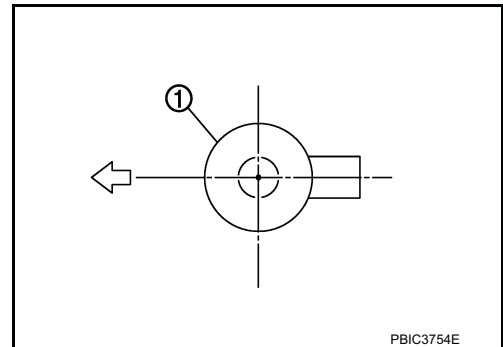
- **Never tighten mounting bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

## 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.

18. Install crankshaft position sensor (POS).  
• Tighten bolts with it seated completely.

19. For the oil level gauge guide (1), fix the position (B) shown in the figure to the water inlet clip (A) after inserting to the cylinder block side.



20. Assemble in the reverse order of disassembly after this step.

## Inspection

## CRANKSHAFT END PLAY

INFOID:000000006282304

# CYLINDER BLOCK

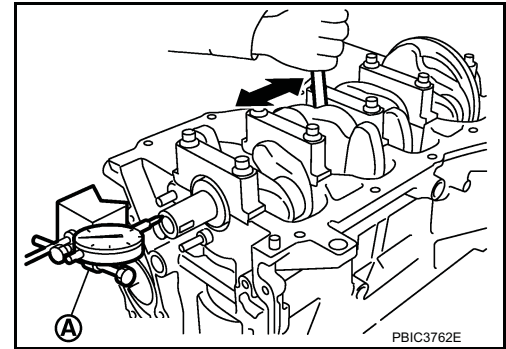
## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

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

**Standard and Limit** : Refer to [EM-434, "Cylinder Block"](#).

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

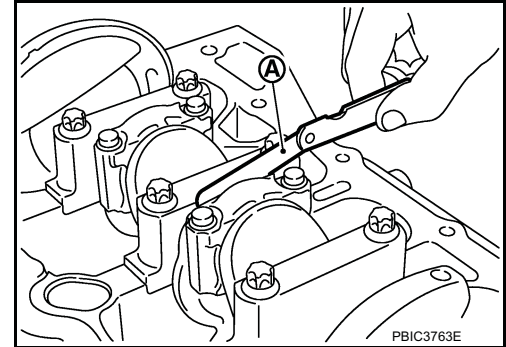


## CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

**Standard and Limit** : Refer to [EM-434, "Cylinder Block"](#).

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

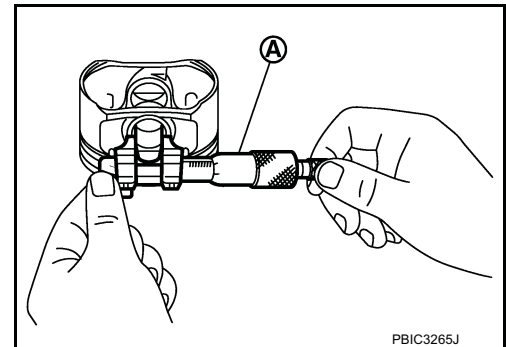


## PISTON TO PISTON PIN OIL CLEARANCE

### Piston Pin Hole Diameter

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

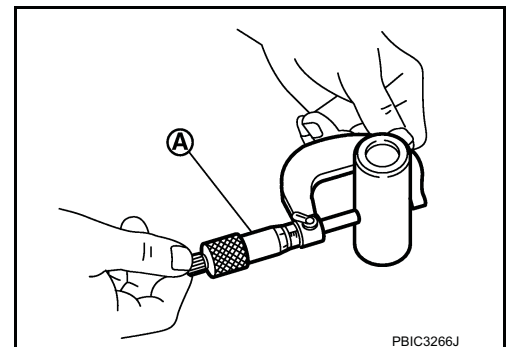
**Standard** : Refer to [EM-434, "Cylinder Block"](#).



### Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

**Standard** : Refer to [EM-434, "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-434, "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 "".

### NOTE:

- Piston is available together with piston pin as assembly.



# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

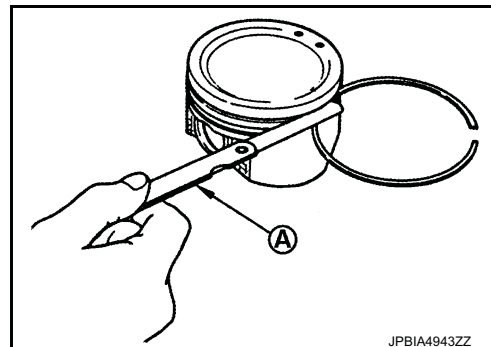
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

### PISTON RING SIDE CLEARANCE

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

**Standard and Limit** : Refer to [EM-434, "Cylinder Block"](#).

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

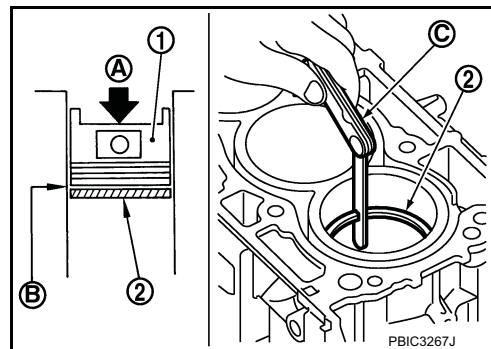


### PISTON RING END GAP

- 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 with a feeler gauge (C).

**Standard and Limit** : Refer to [EM-434, "Cylinder Block"](#).

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



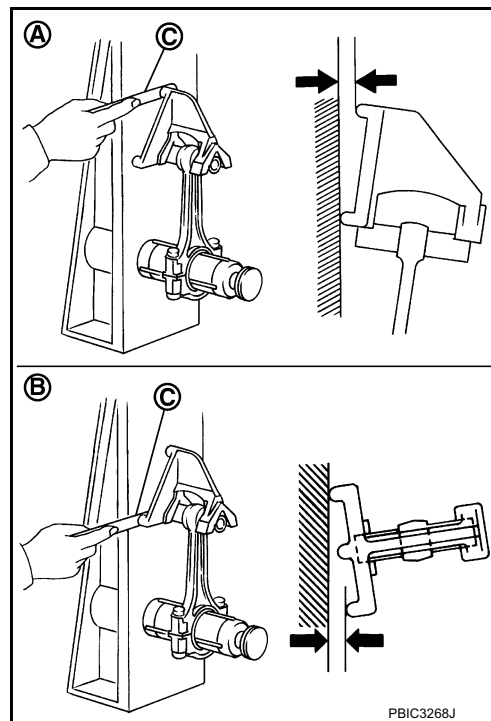
### CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

- A : Bend  
B : Torsion  
C : Feeler gauge

**Limit** : Refer to [EM-434, "Cylinder Block"](#).

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



### CONNECTING ROD BIG END DIAMETER



# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-407, "Exploded View"](#).

2 : Connecting rod

A : Example

B : Measuring direction of inner diameter

- Measure the inner diameter of connecting rod big end with an inside micrometer.

**Standard** : Refer to [EM-434, "Cylinder Block"](#).

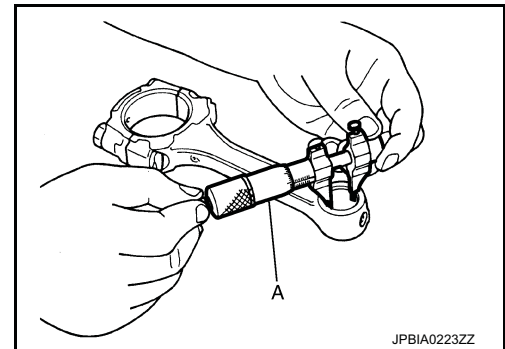
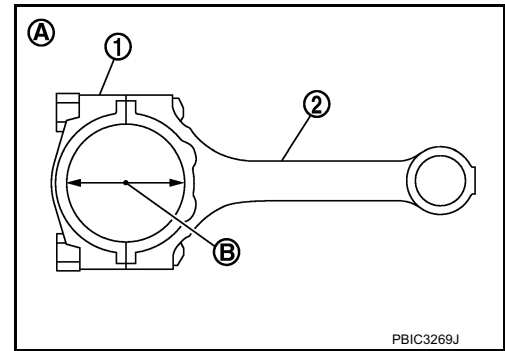
- If out of the standard, replace connecting rod assembly.

## CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

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

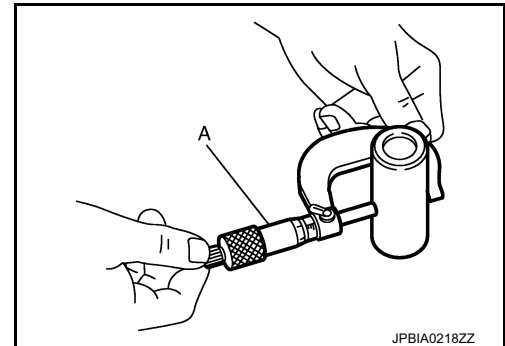
**Standard** : Refer to [EM-434, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

**Standard** : Refer to [EM-434, "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-434, "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-434, "Cylinder Block"](#).
- If replacing connecting rod assembly. Refer to [EM-437, "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:

**Never allow gasket flakes to enter engine oil or engine coolant passages.**

# CYLINDER BLOCK

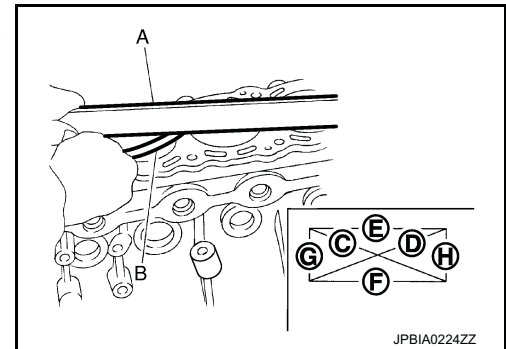
## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge (A) and feeler gauge (B).

**Limit** : Refer to [EM-434, "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 mounting bolts to the specified torque. Refer to [EM-408, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing with a bore gauge.
- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.

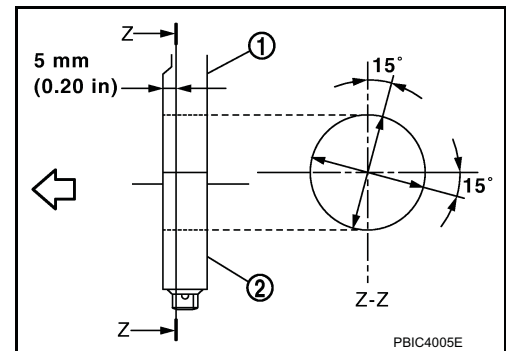
- 1 : Cylinder block  
2 : Main bearing cap  
⇐ : Engine front

**Standard** : Refer to [EM-434, "Cylinder Block"](#).

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

### NOTE:

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



## PISTON TO CYLINDER BORE CLEARANCE

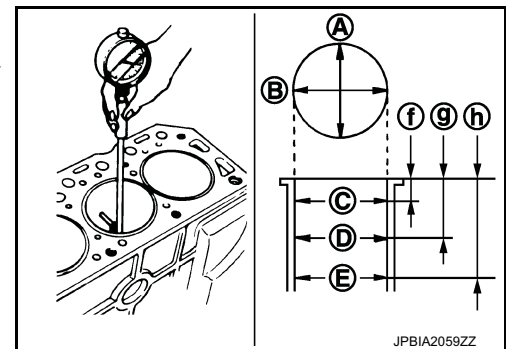
### Cylinder Bore Inner Diameter

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(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 : 124 mm (4.88 in)

### NOTE:

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



### Standard:

#### Cylinder bore inner diameter

: Refer to [EM-434, "Cylinder Block"](#).

### Limit:

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

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

: Refer to [EM-434, "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

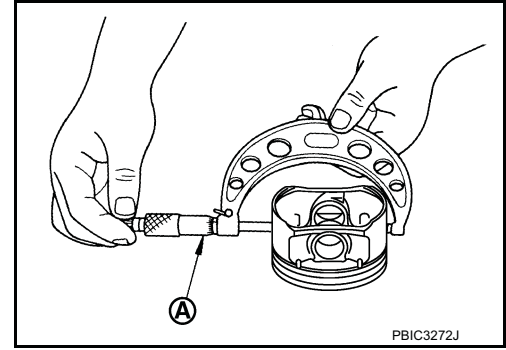
## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

### Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

**Standard** : Refer to [EM-434, "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

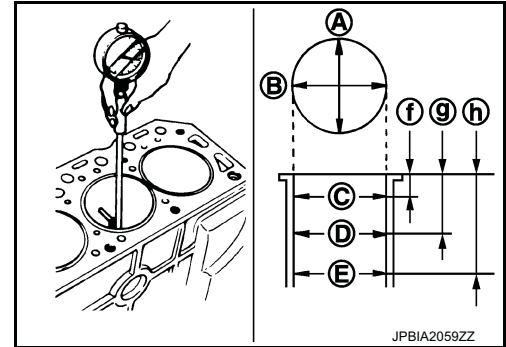
E : Position E

f : 10 mm (0.39 in)

g : 60 mm (2.36 in)

h : 124 mm (4.88 in)

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



**Standard and Limit** : Refer to [EM-434, "Cylinder Block"](#).

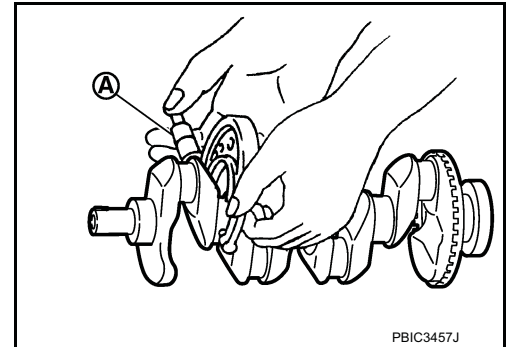
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-434, "Cylinder Block"](#).

### CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

**Standard** : Refer to [EM-434, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-436, "Main Bearing"](#).



### CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard** : Refer to [EM-434, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-437, "Connecting Rod Bearing"](#).

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

# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

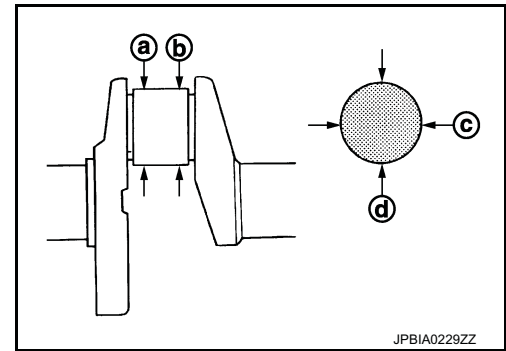
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (a) and (b) at (c) and (d).
- Taper is indicated by the difference in dimension between (c) and (d) at (a) and (b).

### Limit:

**Out-of-round [Difference between (a) and (b)]**

**Taper [Difference between (c) and (d)]**

: Refer to [EM-434, "Cylinder Block"](#).



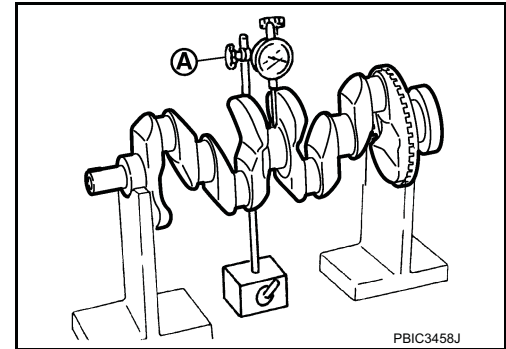
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-437, "Connecting Rod Bearing"](#) and/or [EM-436, "Main Bearing"](#).

## CRANKSHAFT RUNOUT

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

**Standard and Limit** : Refer to [EM-434, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

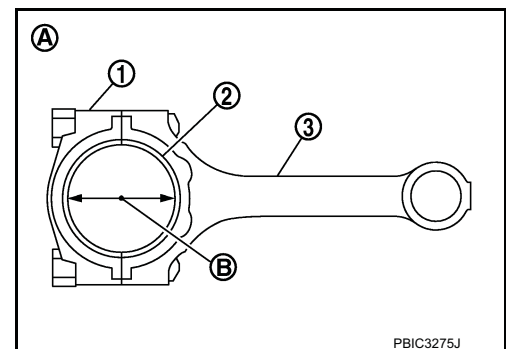
### Method by Calculation

- 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-408, "Disassembly and Assembly"](#).

A : Example

B : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with an inside micrometer.  
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



**Standard and Limit** : Refer to [EM-437, "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-437, "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-408, "Disassembly and Assembly"](#).

### CAUTION:

**Never rotate crankshaft.**

# CYLINDER BLOCK

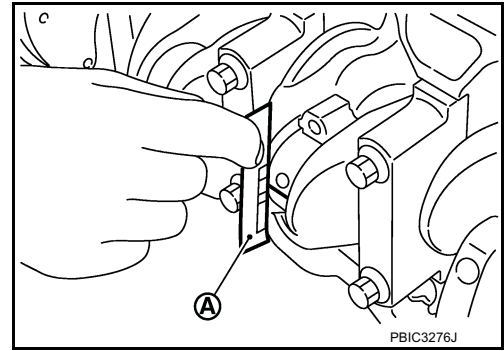
## < UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- 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

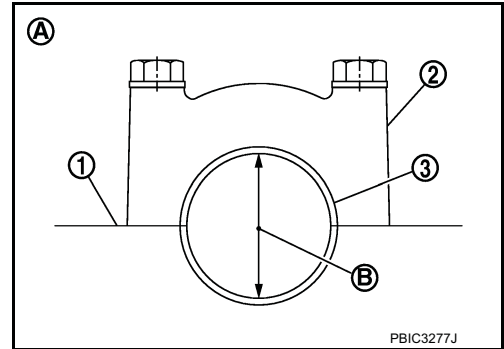
### Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-408, "Disassembly and Assembly"](#).

A : Example

B : Inner diameter measuring direction

- Measure the inner diameter of main bearing with a bore gauge.  
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)



**Standard and Limit** : Refer to [EM-436, "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-436, "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 mounting bolts to the specified torque. Refer to [EM-408, "Disassembly and Assembly"](#).

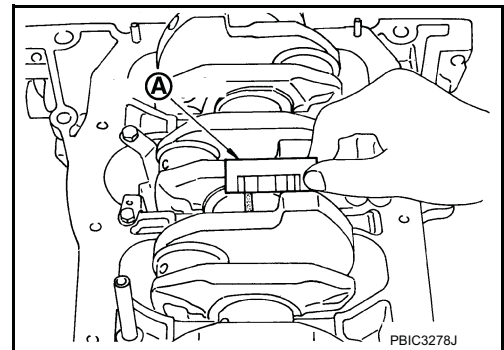
**CAUTION:**

**Never 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 same as that described in the "Method by Calculation".



## MAIN BEARING CRUSH HEIGHT

# CYLINDER BLOCK

## < UNIT DISASSEMBLY AND ASSEMBLY >

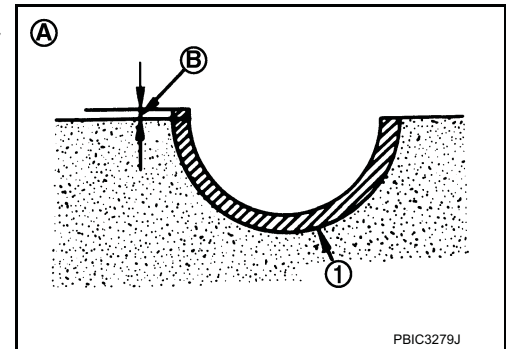
[HR15DE]

- 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-408, "Disassembly and Assembly"](#).

A : Example

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

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



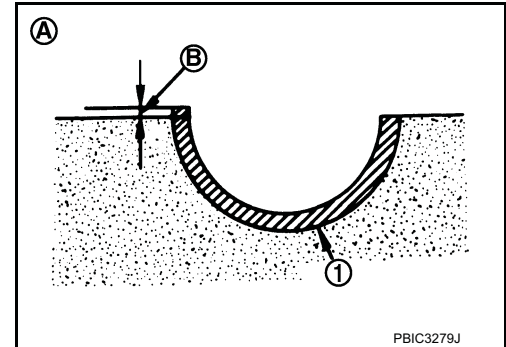
## CONNECTING ROD BEARING CRUSH HEIGHT

- 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-408, "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 in the figure.

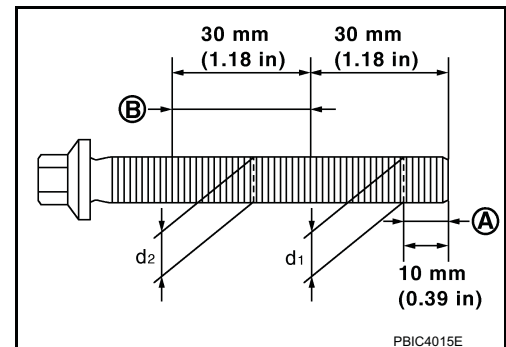
A : (d1) measuring position

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.

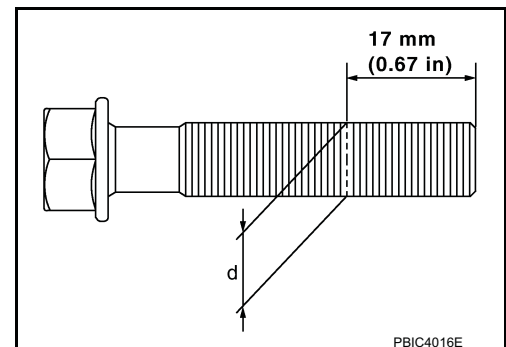


## CONNECTING ROD CAP BOLT OUTER DIAMETER

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

[HR15DE]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:000000006282305

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.

- 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.

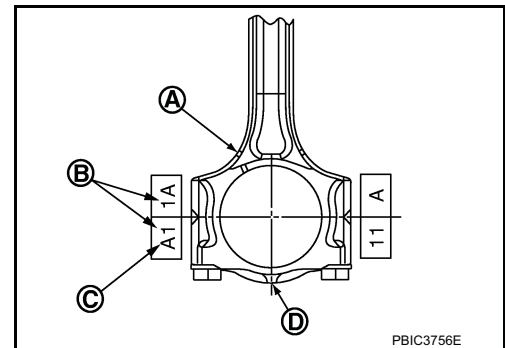
### Connecting Rod Bearing

INFOID:000000006282306

#### WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

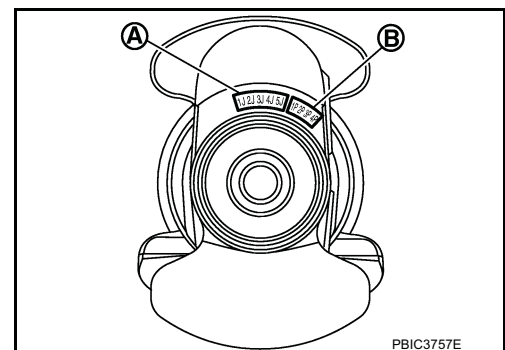
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- A : Oil hole  
B : Cylinder number  
D : Front mark



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

- A : Main journal diameter grade (No. 1 to 5 from left)  
B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



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-415, "Inspection"](#).



# HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

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

Connecting Rod Bearing Selection Table

Connecting rod big end diameter  Crankshaft pin journal diameter		I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N
		Hole diameter Unit: mm (in)	43.000 - 43.001 (1.6929 - 1.6929)	43.001 - 43.002 (1.6929 - 1.6930)	43.002 - 43.003 (1.6930 - 1.6930)	43.003 - 43.004 (1.6930 - 1.6931)	43.004 - 43.005 (1.6931 - 1.6931)	43.005 - 43.006 (1.6931 - 1.6931)	43.006 - 43.007 (1.6931 - 1.6932)	43.007 - 43.008 (1.6932 - 1.6932)	43.008 - 43.009 (1.6932 - 1.6933)	43.009 - 43.010 (1.6933 - 1.6933)	43.010 - 43.011 (1.6933 - 1.6933)	43.011 - 43.012 (1.6933 - 1.6934)	43.012 - 43.013 (1.6934 - 1.6934)
I.D. mark	Axle diameter Unit mm (in)														
A	39.971 - 39.970 (1.5737 - 1.5736)	0	0	0	0	0	01	01	01	01	1	1	1	12	12
B	39.970 - 39.969 (1.5736 - 1.5736)	0	0	0	0	01	01	01	01	1	1	1	12	12	12
C	39.969 - 39.968 (1.5736 - 1.5735)	0	0	0	01	01	01	1	1	1	1	12	12	12	2
D	39.968 - 39.967 (1.5735 - 1.5735)	0	0	01	01	01	1	1	1	1	12	12	12	2	2
E	39.967 - 39.966 (1.5735 - 1.5735)	0	01	01	01	1	1	1	1	12	12	12	2	2	2
F	39.966 - 39.965 (1.5735 - 1.5734)	01	01	01	1	1	1	12	12	12	12	2	2	2	23
G	39.965 - 39.964 (1.5734 - 1.5734)	01	01	1	1	1	12	12	12	12	2	2	2	23	23
H	39.964 - 39.963 (1.5734 - 1.5733)	01	1	1	1	12	12	12	12	2	2	2	23	23	23
J	39.963 - 39.962 (1.5733 - 1.5733)	1	1	1	12	12	12	12	2	2	2	23	23	23	3
K	39.962 - 39.961 (1.5733 - 1.5733)	1	1	12	12	12	12	2	2	2	23	23	23	3	3
L	39.961 - 39.960 (1.5733 - 1.5732)	1	12	12	12	12	2	2	2	23	23	23	3	3	3
M	39.960 - 39.959 (1.5732 - 1.5732)	12	12	12	2	2	2	23	23	23	23	3	3	3	34
N	39.959 - 39.958 (1.5732 - 1.5731)	12	12	2	2	2	23	23	23	23	3	3	3	34	34
P	39.958 - 39.957 (1.5731 - 1.5731)	12	2	2	2	23	23	23	23	3	3	3	34	34	34
R	39.957 - 39.956 (1.5731 - 1.5731)	2	2	2	23	23	23	23	3	3	3	34	34	34	4
S	39.956 - 39.955 (1.5731 - 1.5730)	2	2	23	23	23	23	3	3	3	34	34	34	4	4
T	39.955 - 39.954 (1.5730 - 1.5730)	2	23	23	23	23	3	3	3	34	34	34	4	4	4
U	39.954 - 39.953 (1.5730 - 1.5729)	23	23	23	23	3	3	3	34	34	34	34	4	4	4

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Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to [EM-437, "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

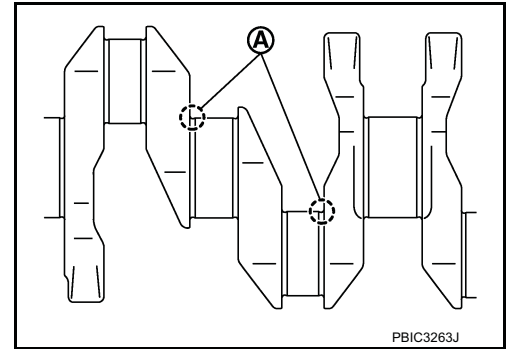
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

In grinding crankshaft pin to use undersize bearings, keep the fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to [EM-437, "Connecting Rod Bearing"](#).



INFOID:000000006282307

## Main Bearing

### HOW TO SELECT MAIN BEARING

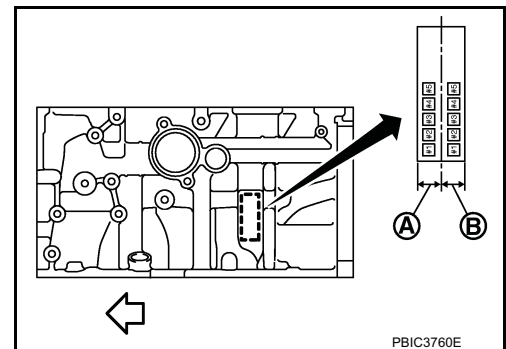
When New Cylinder Block and Crankshaft Are Used

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

A : Basic stamp mark

⇐ : Engine front

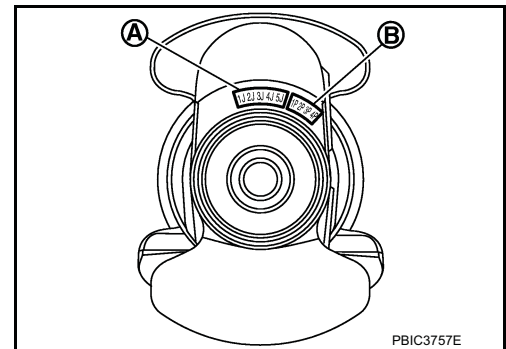
- If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



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

A : Main journal diameter grade (No. 1 to 5 from left)

B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



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

#### NOTE:

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

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-415, "Inspection"](#).
2. Apply the measured dimension to the "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

# HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

Main Bearing Selection Table

Cylinder block main bearing housing inner diameter		I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W
Crankshaft main journal diameter		Hole diameter Unit: mm (in)	51.997 - 51.998 (2.0471 - 2.0472)	51.998 - 51.999 (2.0472 - 2.0472)	51.999 - 52.000 (2.0472 - 2.0472)	52.000 - 52.001 (2.0472 - 2.0472)	52.001 - 52.002 (2.0473 - 2.0473)	52.002 - 52.003 (2.0473 - 2.0473)	52.003 - 52.004 (2.0474 - 2.0474)	52.004 - 52.005 (2.0474 - 2.0474)	52.005 - 52.006 (2.0474 - 2.0474)	52.006 - 52.007 (2.0475 - 2.0475)	52.007 - 52.008 (2.0475 - 2.0475)	52.008 - 52.009 (2.0476 - 2.0476)	52.009 - 52.010 (2.0476 - 2.0476)	52.010 - 52.011 (2.0476 - 2.0476)	52.011 - 52.012 (2.0477 - 2.0477)	52.012 - 52.013 (2.0477 - 2.0477)	52.013 - 52.014 (2.0478 - 2.0478)	52.014 - 52.015 (2.0478 - 2.0478)	52.015 - 52.016 (2.0478 - 2.0478)	52.016 - 52.017 (2.0479 - 2.0479)
I.D. mark	Axle diameter Unit mm (in)																					
A	47.979 - 47.978 (1.8889 - 1.8889)		0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23
B	47.978 - 47.977 (1.8889 - 1.8889)		0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23
C	47.977 - 47.976 (1.8889 - 1.8888)		0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23
D	47.976 - 47.975 (1.8888 - 1.8888)		0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3
E	47.975 - 47.974 (1.8888 - 1.8887)		0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3
F	47.974 - 47.973 (1.8887 - 1.8887)		0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3
G	47.973 - 47.972 (1.8887 - 1.8887)		0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34
H	47.972 - 47.971 (1.8887 - 1.8886)		01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34
J	47.971 - 47.970 (1.8886 - 1.8886)		01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
K	47.970 - 47.969 (1.8886 - 1.8885)		01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
L	47.969 - 47.968 (1.8885 - 1.8885)		1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
M	47.968 - 47.967 (1.8885 - 1.8885)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
N	47.967 - 47.966 (1.8885 - 1.8884)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
P	47.966 - 47.965 (1.8884 - 1.8884)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
R	47.965 - 47.964 (1.8884 - 1.8883)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
S	47.964 - 47.963 (1.8883 - 1.8883)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
T	47.963 - 47.962 (1.8883 - 1.8883)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
U	47.962 - 47.961 (1.8883 - 1.8882)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
V	47.961 - 47.960 (1.8882 - 1.8882)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5
W	47.960 - 47.959 (1.8882 - 1.8881)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5

PBIC3759E

Main Bearing Grade Table

Main Bearing Grade Table : Refer to [EM-436, "Main Bearing"](#).

Use Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use under-size (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:**

## HOW TO SELECT PISTON AND BEARING

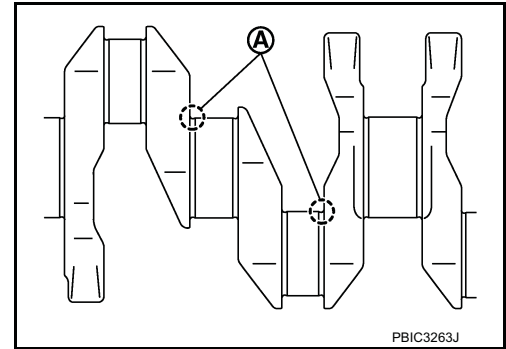
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

In grinding crankshaft main journal to use undersize bearings, keep fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to [EM-436, "Main Bearing"](#).



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification



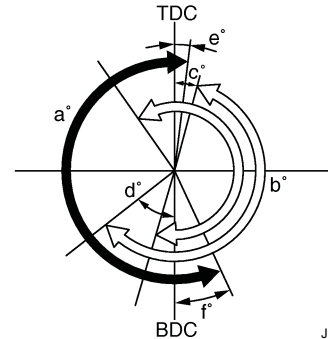
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#### GENERAL SPECIFICATIONS

Engine type		HR15DE
Cylinder arrangement		In-line 4
Displacement	cm <sup>3</sup> (cu in)	1,498 (91.41)
Bore and stroke	mm (in)	78.0×78.4 (3.070×3.087)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		10.1
Compression pressure kPa (bar, kg/cm <sup>2</sup> , psi) / 200 rpm	Standard	1,510 (15.1, 15.4, 219)
	Minimum	1,170 (11.7, 12.0, 170)
	Differential limit between cylinders	100 (1.0, 1.0, 14.5)

#### Valve Timing

Unit: degree

Valve timing  : Intake valve  : Exhaust valve	 <p>JPBIA055Z2Z</p>					
	a	b	c	d	e	f
	208	222	-14 (19) ATDC	56 (23) ABDC	7	21

( ): Valve timing control "ON"

#### Drive Belt

INFOID:0000000006282309

#### DRIVE BELT

##### Belt Deflection

Location	Deflection adjustment *		Unit: mm (in)
	Used belt		New belt
	Limit	After adjusted	
Drive belt	10.1 (0.398)	4.8 - 5.3 (0.19 - 0.21)	4.1 - 4.4 (0.16 - 0.17)
Applied pushing force	98 N (10 kg, 22 lb)		

\*: When engine is cold.

# SERVICE DATA AND SPECIFICATIONS (SDS)

## < SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

### Belt Tension and Frequency

Location	Tension adjustment *		Unit: N (kg, lb)	Frequency adjustment *		Unit: Hz
	Used belt		New belt	Used belt		New belt
	Limit	After adjusted		Limit	After adjusted	
Drive belt	350 (35.7, 79)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	145	229 - 239	253.5 - 261.5

\*: When engine is cold.

Necessary command for belt tension calculation.

**Belt span** : 0.196m  
**Belt unit mass** : 0.109 kg/m  
**Width of belt** : 3.56 mm/rib × 7 rib

## Spark Plug

INFOID:0000000006282310

### SPARK PLUG (PLATINUM-TIPPED TYPE)

Unit: mm (in)

Make	FEDERAL MOFUL	
Standard type	REA12WMB4	
Spark plug gap	Standard	1.1 (0.043)

## Exhaust Manifold

INFOID:0000000006282311

### EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion	0.3 (0.012)

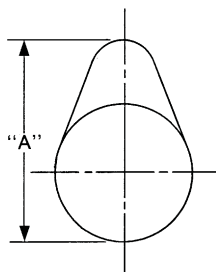
## Camshaft

INFOID:0000000006282312

### CAMSHAFT

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.0039)



SEM671

Camshaft cam height "A"	Intake	41.205 - 41.395 (1.6222 - 1.6297)	41.005 (1.6144)
	Exhaust	40.175 - 40.365 (1.5816 - 1.5891)	39.975 (1.5738)
Camshaft journal outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9822 - 0.9830)	—

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Items		Standard	Limit
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9842 - 0.9850)	—
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 (0.0011 - 0.0027)	0.15 (0.0059)
Camshaft end play		0.075 - 0.153 (0.0029 - 0.0060)	0.2 (0.0078)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)

\*: Total indicator reading

## Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.977 - 29.987 (1.1801 - 1.1805)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

## Valve Clearance

Unit: mm (in)

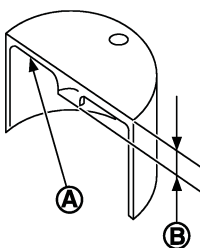
	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

\*: Approximately 80°C (176°F)

## Available Valve Lifter

Unit: mm (in)

Identification mark (A)	Thickness (B)
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JPBIA0170ZZ

300	3.00 (0.1181)
302	3.02 (0.1188)
304	3.04 (0.1196)
306	3.06 (0.1204)
308	3.08 (0.1212)
310	3.10 (0.1220)
312	3.12 (0.1228)
314	3.14 (0.1236)
316	3.16 (0.1244)
318	3.18 (0.1251)
320	3.20 (0.1259)
322	3.22 (0.1267)
324	3.24 (0.1275)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Identification mark (A)	Thickness (B)
326	3.26 (0.1283)
328	3.28 (0.1291)
330	3.30 (0.1299)
332	3.32 (0.1307)
334	3.34 (0.1314)
336	3.36 (0.1322)
338	3.38 (0.1330)
340	3.40 (0.1338)
342	3.42 (0.1346)
344	3.44 (0.1354)
346	3.46 (0.1362)
348	3.48 (0.1370)
350	3.50 (0.1377)

## Cylinder head

INFOID:000000006282313

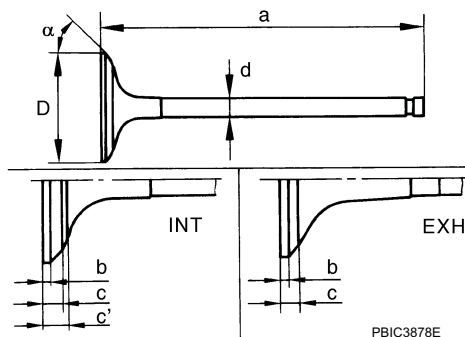
## CYLINDER HEAD

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)

## Valve Dimensions

Unit: mm (in)



PBIC3878E

Valve head diameter "D"	Intake	31.0 - 31.3 (1.220 - 1.232)
	Exhaust	25.3 - 25.6 (0.996 - 1.007)
Valve length "a"	Intake	101.73 (4.01)
	Exhaust	102.49 (4.04)
"b"	Intake	1.0 (0.0393)
	Exhaust	1.0 (0.0393)
"c"	Intake	2.1 - 2.8 (0.0826 - 0.1102)
	Exhaust	2.3 - 3.0 (0.0905 - 0.1181)
"c'"	Intake	3.0 (0.1181)
	Exhaust	—
"d "	Intake	4.965 - 4.980 (0.1954 - 0.1960)
	Exhaust	4.955 - 4.970 (0.1950 - 0.1956)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	

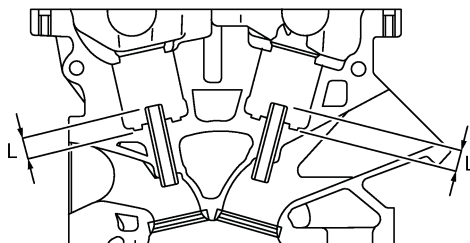
# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

## Valve Guide

Unit: mm (in)

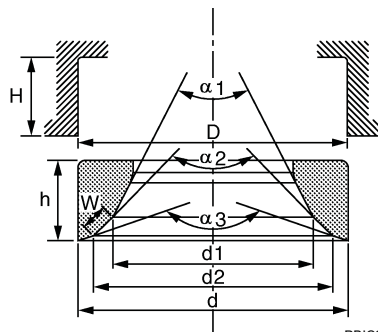


PBIC0184E

Items		Standard part	Service part
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3556)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1968 - 0.1975)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3541)	9.175 - 9.196 (0.3612 - 0.3620)
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)	0.1 (0.004)
Projection length "H"		11.4 - 11.8 (0.448 - 0.464)	

## Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter "D"	Intake	31.400 - 31.416 (1.2362 - 1.2368)	31.900 - 31.916 (1.2559 - 1.2565)
	Exhaust	25.900 - 25.916 (1.0196 - 1.0203)	26.400 - 26.416 (1.0393 - 1.0399)
Valve seat outer diameter "d"	Intake	31.497 - 31.513 (1.2400 - 1.2406)	31.997 - 32.013 (1.2597 - 1.2603)
	Exhaust	25.997 - 26.013 (1.0235 - 1.0241)	26.497 - 26.513 (1.0431 - 1.0438)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.081 - 0.113 (0.0032 - 0.0044)	
Diameter "d1"*1	Intake	29.0 (1.141)	
	Exhaust	23.0 (0.905)	
Diameter "d2"*2	Intake	30.6 - 30.8 (1.204 - 1.212)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle "α1"	Intake	60°	
	Exhaust	45°	



# SERVICE DATA AND SPECIFICATIONS (SDS)

## < SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Angle "α2"	Intake	89°45' - 90°15'	
	Exhaust	89°45' - 90°15'	
Angle "α3"	Intake	120°	
	Exhaust	120°	
Contacting width "W"*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height "h"	Intake	6.0 (0.236)	5.45 (0.214)
	Exhaust	6.0 (0.236)	5.43 (0.213)
Depth "H"		6.0 (0.236)	

\*1: Diameter made by intersection point of conic angles α1 and α2

\*2: Diameter made by intersection point of conic angles α2 and α3

\*3: Machining data

### Valve Spring

Standard:

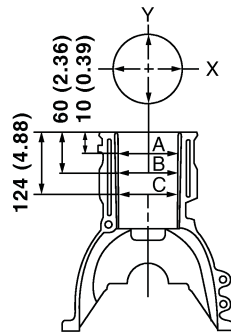
Free height	42.26 mm (1.6637 in)
Installation height	32.40 mm (1.2755 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)

### Cylinder Block

INFOID:000000006282314

### CYLINDER BLOCK

Unit: mm (in)



PBIC3924E

Surface distortion		Limit	0.1 (0.004)
Cylinder bore	Inner diameter	Standard	78.000 - 78.015 (3.0708 - 3.0714)
		Wear limit	0.2 (0.008)
Out-of-round (Difference between “a” and “b”)		Limit	0.015 (0.0006)
Taper (Difference between “c” and “d”)			0.010 (0.0004)

# SERVICE DATA AND SPECIFICATIONS (SDS)

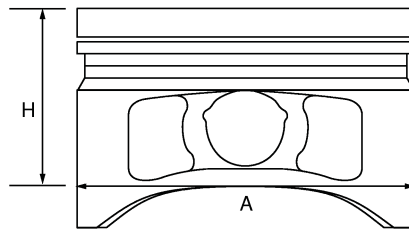
< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0472)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0473)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0474)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0475)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0476)
	Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)
	Grade No. S	52.012 - 52.013 (2.0477 - 2.0477)
	Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)
	Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)
	Grade No. V	52.015 - 52.016 (2.0478 - 2.0478)
	Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)
Difference in inner diameter between cylinders		Standard
		Less than 0.03 (0.0012)

Available Piston

Unit: mm (in)



PBIC0188E

Items	Standard	Limit
Piston skirt diameter "A"	77.965 - 77.980 (3.0694 - 3.0700)	—
Piston height "H" dimension	37.1 (1.460)	—
Piston pin hole diameter	19.010 - 19.016 (0.7484 - 0.7487)	—
Piston to cylinder bore clearance	0.020 - 0.050 (0.0007 - 0.0019)	0.09 (0.0035)

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0015 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil (rail ring)	0.045 - 0.125 (0.0017 - 0.0049)	—
End gap	Top	0.20 - 0.30 (0.0078 - 0.0118)	0.50 (0.0196)
	2nd	0.35 - 0.50 (0.0137 - 0.0196)	0.66 (0.0259)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.92 (0.0362)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		18.996 - 19.002 (0.7478 - 0.7481)
Piston to piston pin oil clearance	Standard	0.012 - 0.016 (0.0004 - 0.0006)
Connecting rod bushing oil clearance	Standard	-0.018 to -0.044 (-0.0007 to -0.0017)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## < SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

### Connecting Rod

Unit: mm (in)

Center distance		132.43 - 132.53 (5.2138 - 5.2177)
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*		18.958 - 18.978 (0.7463 - 0.7471)
Side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0138)
Connecting rod big end diameter	Grade No. A	43.000 - 43.001 (1.6929 - 1.6929)
	Grade No. B	43.001 - 43.002 (1.6929 - 1.6930)
	Grade No. C	43.002 - 43.003 (1.6930 - 1.6930)
	Grade No. D	43.003 - 43.004 (1.6930 - 1.6931)
	Grade No. E	43.004 - 43.005 (1.6931 - 1.6931)
	Grade No. F	43.005 - 43.006 (1.6931 - 1.6931)
	Grade No. G	43.006 - 43.007 (1.6931 - 1.6932)
	Grade No. H	43.007 - 43.008 (1.6932 - 1.6932)
	Grade No. J	43.008 - 43.009 (1.6932 - 1.6933)
	Grade No. K	43.009 - 43.010 (1.6933 - 1.6933)
	Grade No. L	43.010 - 43.011 (1.6933 - 1.6933)
	Grade No. M	43.011 - 43.012 (1.6933 - 1.6934)
	Grade No. N	43.012 - 43.013 (1.6934 - 1.6934)

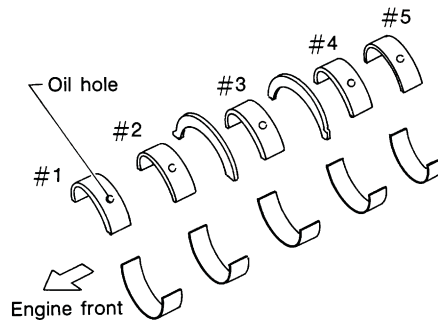
\*: After installing in connecting rod

### Main Bearing

INFOID:000000006282315

### MAIN BEARING

Unit: mm (in)



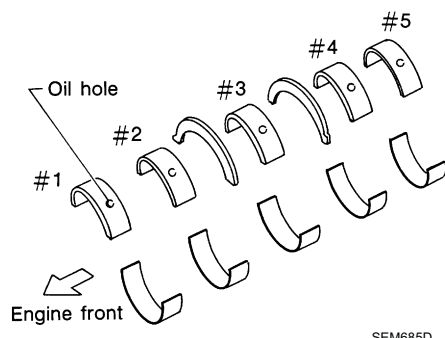
SEM685D

Grade number	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0785 - 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 - 0.0790)	Yellow	
4	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
5	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]



SEM685D

Grade number		Thickness	Identification color	Remarks
01	UPR	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are different for 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 - 0.0790)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
	LWR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
45	UPR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
	LWR	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

## Undersize

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.

## Bearing Oil Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	0.024 - 0.034 (0.0009 - 0.0013)
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## Connecting Rod Bearing

INFOID:000000006282316

## CONNECTING ROD BEARING

Unit: mm (in)

Grade number		Thickness	Identification color	Remarks
0		1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are the same for upper and lower bearings.
1		1.501 - 1.504 (0.0591 - 0.0592)	Brown	
2		1.504 - 1.507 (0.0592 - 0.0593)	Green	
3		1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
4		1.510 - 1.513 (0.0594 - 0.0596)	Blue	
01	UPR	1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	
12	UPR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	
	LWR	1.504 - 1.507 (0.0592 - 0.0593)	Green	
23	UPR	1.504 - 1.507 (0.0592 - 0.0593)	Green	
	LWR	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
34	UPR	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
	LWR	1.510 - 1.513 (0.0594 - 0.0596)	Blue	

## SERVICE DATA AND SPECIFICATIONS (SDS)

### < SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

#### Undersize

Unit: mm (in)

Items	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.627 - 1.635 (0.0640 - 0.0644)	Grind so that bearing clearance is the specified value.

#### Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.029 - 0.039 (0.0011 - 0.0015)
	Limit	0.10 (0.0039)