

# SECTION **EM**

## ENGINE MECHANICAL

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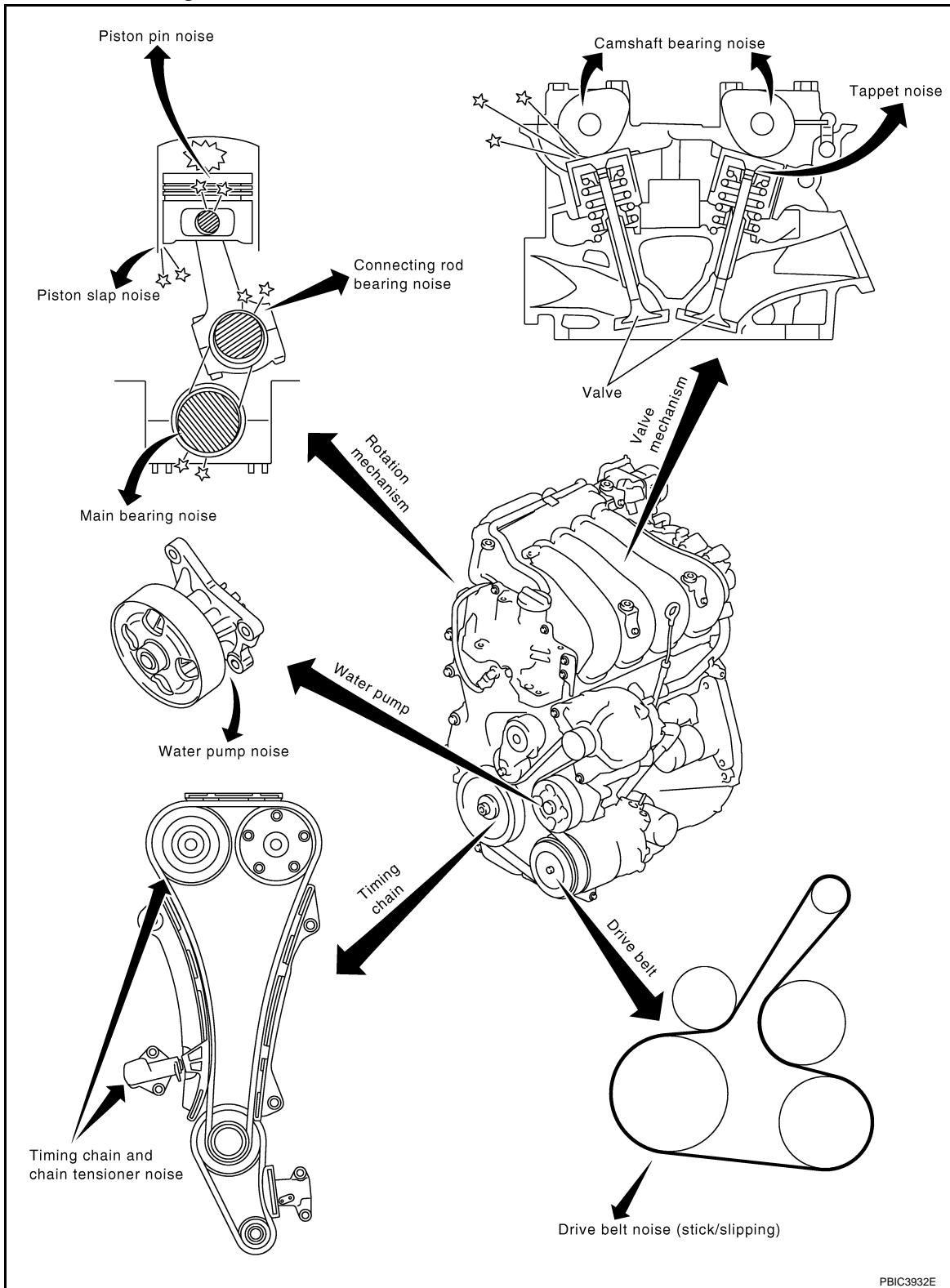
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**SYMPTOM DIAGNOSIS**

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

**NVH troubleshooting Chart**

INFOID:000000001160509



PBIC3932E

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

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[MR20DE]

4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	<a href="#">EM-20</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	<a href="#">EM-120</a> <a href="#">EM-120</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	<a href="#">EM-124</a> <a href="#">EM-124</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-124</a> <a href="#">EM-124</a> <a href="#">EM-124</a> <a href="#">EM-124</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-124</a> <a href="#">EM-127</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-128</a> <a href="#">EM-128</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-52</a> <a href="#">EM-44</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	<a href="#">EM-15</a>
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	<a href="#">CO-25</a>

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

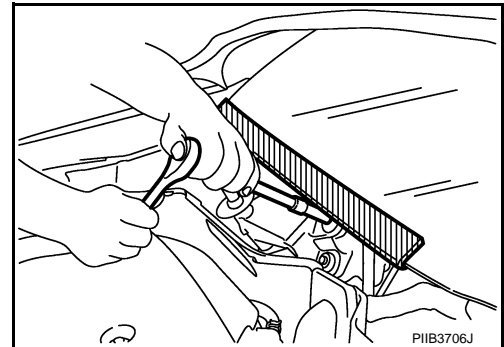
## PRECAUTION

### PRECAUTIONS

#### Precaution for Procedure without Cowl Top Cover

INFOID:000000001160510

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



#### Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000001160511

**NOTE:**

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the "LOCK" position.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the 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. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.
5. When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT-III.

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

INFOID:000000001278939

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 AIRBAG" and "SEAT BELT" of this Service Manual.

**WARNING:**

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

# PRECAUTIONS

[MR20DE]

< PRECAUTION >

- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the “SRS AIRBAG”.**
- **Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

A

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## Draining Engine Coolant

INFOID:000000001160512

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

C

## Disconnecting Fuel Piping

INFOID:000000001160513

- 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.

D

E

## Removal and Disassembly

INFOID:000000001160514

- 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 re-assembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

F

G

H

## Inspection, Repair and Replacement

INFOID:000000001160515

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

I

J

## Assembly and Installation

INFOID:000000001160516

- 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.

K

L

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N

## Parts Requiring Angle Tightening

INFOID:000000001160517

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

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# PRECAUTIONS

[MR20DE]

< PRECAUTION >

## Liquid Gasket

INFOID:000000001160518

### REMOVAL OF LIQUID GASKET SEALING

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

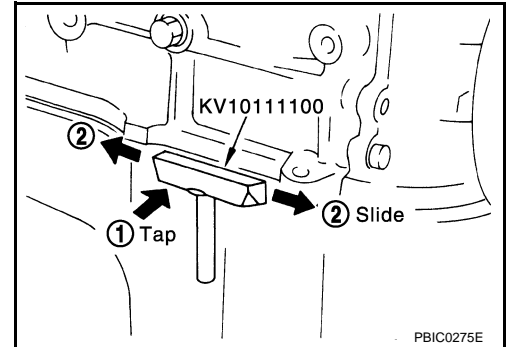
**CAUTION:**

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

- Tap the seal cutter to insert it (1), and then slide it (2) by tapping on the side as shown in the figure.
- In areas where the seal cutter (SST) is difficult to use, use a plastic hammer to lightly tap the parts, to remove it.

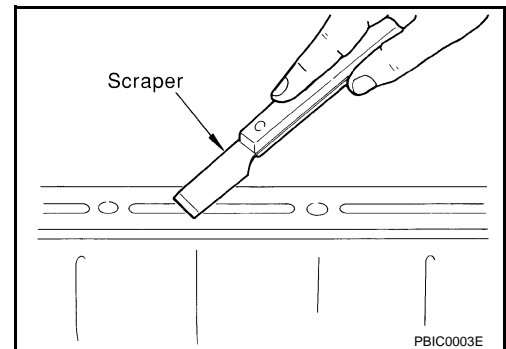
**CAUTION:**

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



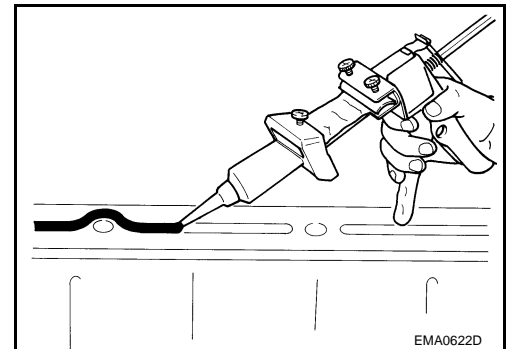
### LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, 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).

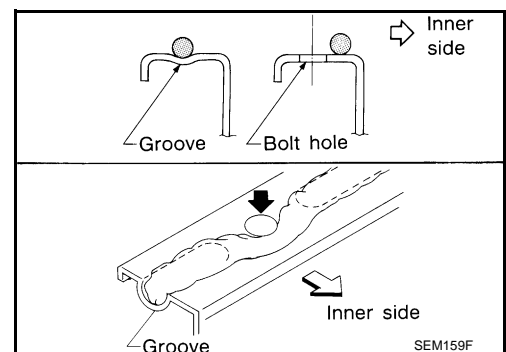
**Use Genuine Liquid Gasket or equivalent.**
4. Apply liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



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



# PREPARATION

< PREPARATION >

[MR20DE]

## PREPARATION

### PREPARATION

#### Special Service Tools

INFOID:000000001160519

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Tool number Tool name	Description
KV10111100 Seal cutter	Removing oil pan (upper and lower) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 1 <b>For 22 mm (0.87 in) width hexagon nut</b>
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	Removing valve oil seal
KV10115600 Valve oil seal drift	Installing valve oil seal <b>Use side A.</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) Unit: mm (in)

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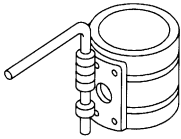
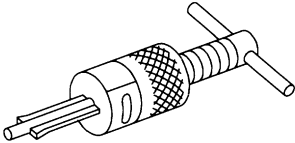
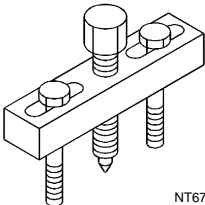
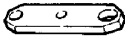
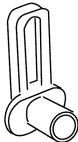
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# PREPARATION

< PREPARATION >

[MR20DE]

Tool number Tool name	Description
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore
 S-NT044	
ST16610001 Pilot bushing puller	Removing pilot converter (A/T models)
 S-NT045	
KV11103000 Pulley puller	Removing crankshaft pulley
 NT676	
KV11105210 Stopper plate	Fixing drive plate and flywheel
 ZZA0009D	
Quick connector release	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
 PBIC0198E	

Commercial Service Tools

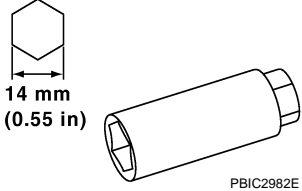

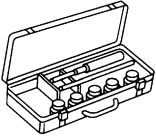
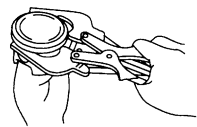
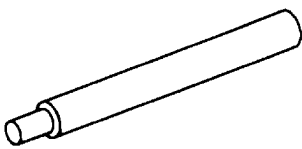
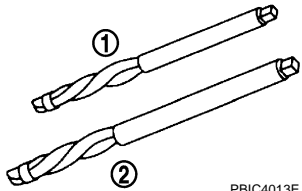
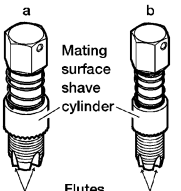
INFOID:000000001160520



# PREPARATION

< PREPARATION >

[MR20DE]

Tool name	Description
<p>Spark plug wrench</p>  <p style="text-align: center;">14 mm (0.55 in)</p> <p style="text-align: right;">PBIC2982E</p>	<p>Removing and installing spark plug</p>
<p>Pulley holder</p>  <p style="text-align: right;">ZZA1010D</p>	<p>Crankshaft pulley removing and installing</p>
<p>Valve seat cutter set</p>  <p style="text-align: right;">S-NT048</p>	<p>Finishing valve seat dimensions</p>
<p>Piston ring expander</p>  <p style="text-align: right;">S-NT030</p>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p>  <p style="text-align: right;">PBIC4012E</p>	<p>Removing and installing valve guide</p>
<p>Valve guide reamer</p>  <p style="text-align: right;">PBIC4013E</p>	<p>1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide</p>
<p>Oxygen sensor thread cleaner</p>  <p style="text-align: right;">AEM488</p>	<p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) <b>a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor</b> <b>b = 12 mm (0.47 in) dia. for titania heated oxygen sensor</b></p>

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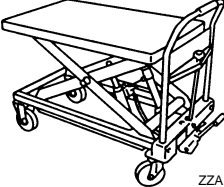
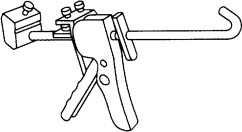
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# PREPARATION

< PREPARATION >

[MR20DE]

Tool name	Description
<p>Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)</p>  <p>AEM489</p>	<p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>
<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>

## ON-VEHICLE MAINTENANCE

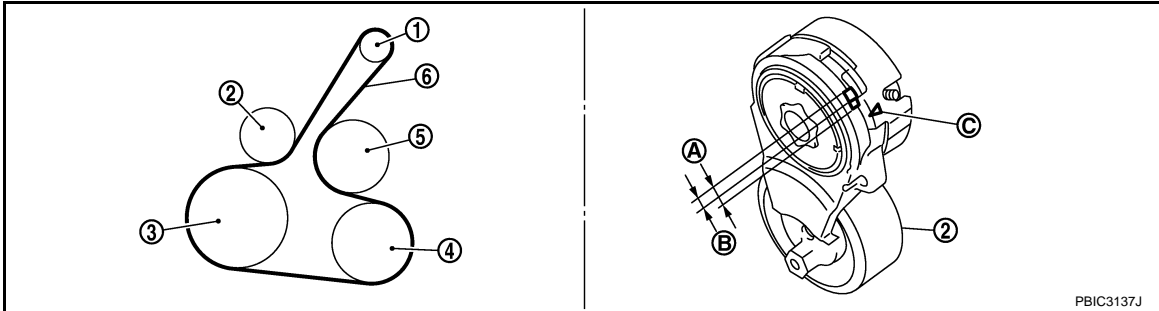
### DRIVE BELTS

#### Exploded View

INFOID:000000001160521

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- |  |   |                      |
|--|---|----------------------|
| 1. Alternator  | 2. Drive belt auto-tensioner              | 3. Crankshaft pulley |
| 4. A/C compressor (with A/C models)<br>Idler pulley (without A/C models) | 5. Water pump                             | 6. Drive belt        |
| A. Possible use range  | B. Range when new drive belt is installed | C. Indicator         |

#### Checking

INFOID:000000001160522

#### **WARNING:**

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

- Check that the indicator (notch on fixed side) of drive belt auto-tensioner is within the possible use range (A) in the figure.

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#### **NOTE:**

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

#### Tension Adjustment

INFOID:000000001160523

Refer to : [EM-119, "Drive Belt"](#).

#### Removal and Installation

INFOID:000000001160524

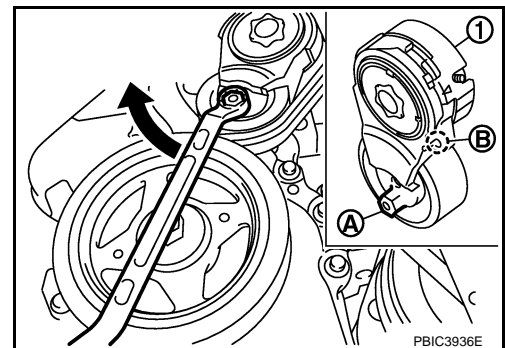
#### REMOVAL

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

#### **CAUTION:**

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

2. Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole (B) of the retaining boss to fix drive belt auto-tensioner.
  - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.



3. Remove drive belt.

#### INSTALLATION

1. Install drive belt.

## DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

[MR20DE]

**CAUTION:**

- Confirm drive belt is completely set to pulleys.
  - Check for engine oil, working fluid and engine coolant are not adhered to drive belt and each pulley groove.
2. Release drive belt auto-tensioner, and apply tension to drive belt.
  3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
  4. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to [EM-15, "Exploded View"](#).

# AIR CLEANER FILTER

< ON-VEHICLE MAINTENANCE >

[MR20DE]

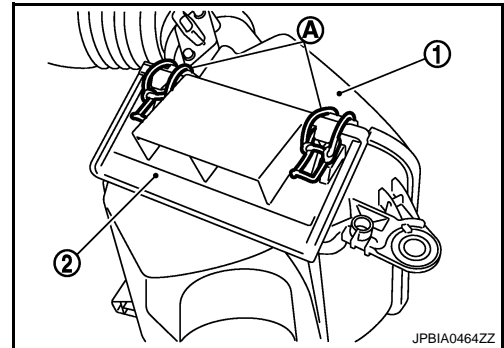
## AIR CLEANER FILTER

### Removal and Installation

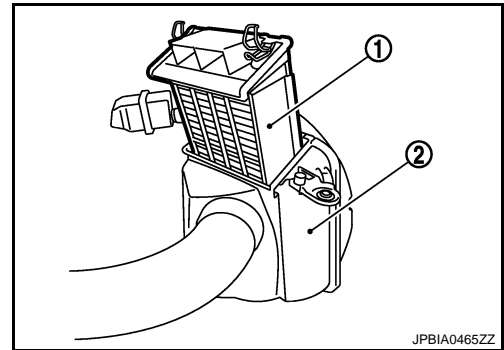
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#### REMOVAL

1. Unhook clips (A) and remove holder (2) from air cleaner case (1).



2. Remove air cleaner filter (1) from air cleaner case (2).



#### INSTALLATION

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

- Install the air cleaner filter by aligning the seal with the notch of air cleaner case.

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# SPARK PLUG

< ON-VEHICLE MAINTENANCE >

[MR20DE]

## Inspection

INFOID:000000001160528

### INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

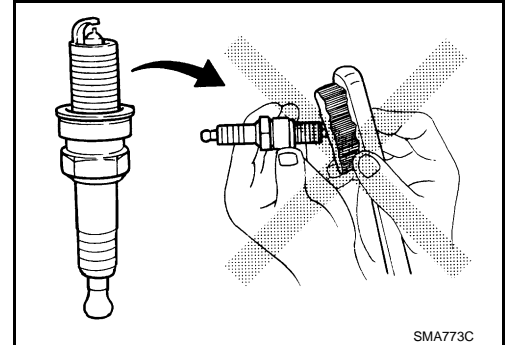
Spark plug (standard) : Refer to [EM-119, "Spark Plug"](#).

#### CAUTION:

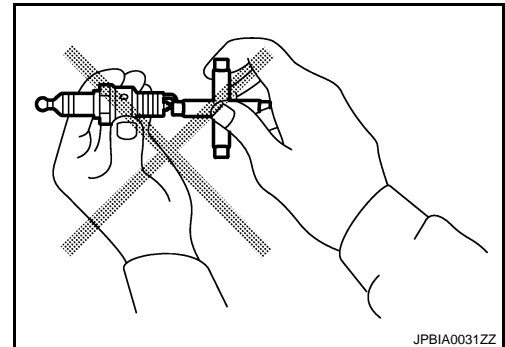
- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

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

Cleaning time : Less than 20 seconds



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



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# CAMSHAFT VALVE CLEARANCE

< ON-VEHICLE MAINTENANCE >

[MR20DE]

## CAMSHAFT VALVE CLEARANCE

### Inspection and Adjustment

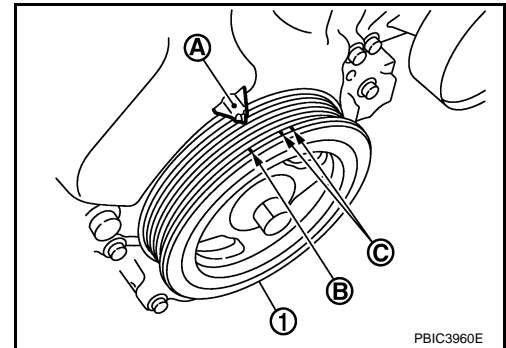
INFOID:000000001160529

#### 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-41, "Exploded View"](#).
2. Measure the valve clearance with the following procedure:
  - a. Set No. 1 cylinder at TDC of its compression stroke.
    - Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

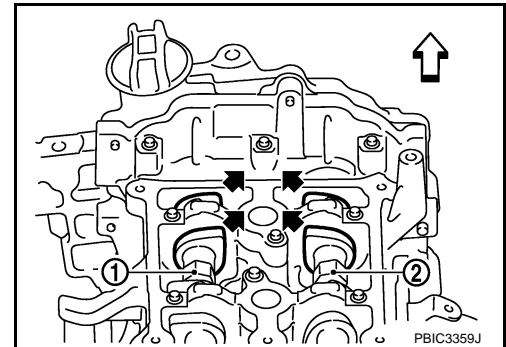
C : White paint mark (Not use for service)



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

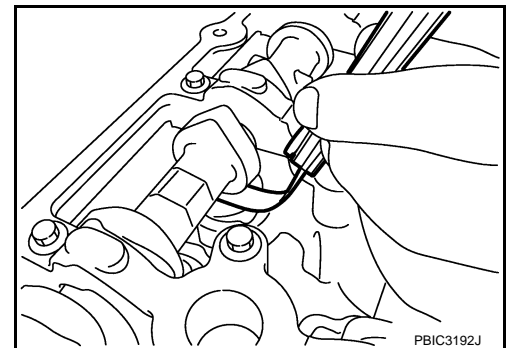
1 : Camshaft (INT)  
2 : Camshaft (EXH)  
← : Engine front

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



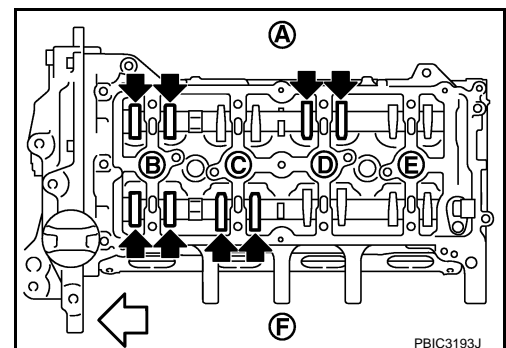
- b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

**Valve clearance** : Refer to [EM-120, "Camshaft"](#).



- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below [locations indicated with black arrow (←) in the figure] with a feeler gauge.

A : Exhaust side  
B : No. 1 cylinder  
C : No. 2 cylinder  
D : No. 3 cylinder  
E : No. 4 cylinder





# CAMSHAFT VALVE CLEARANCE

< ON-VEHICLE MAINTENANCE >

[MR20DE]

- F : Intake side
- ↶ : Engine front

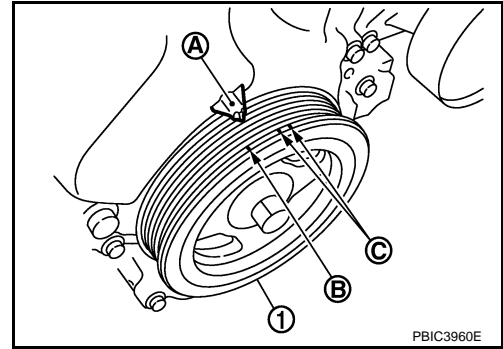
A

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

EM

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

C : White paint mark (Not use for service)



C

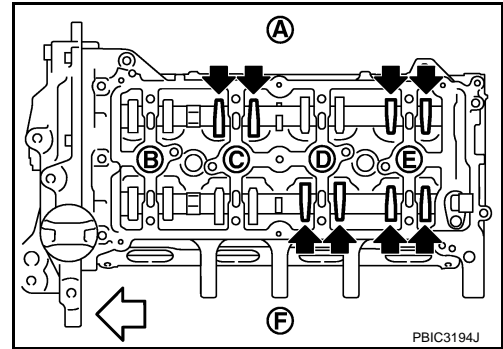
D

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- By referring to the figure, measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (↖) in the figure] with a feeler gauge.

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



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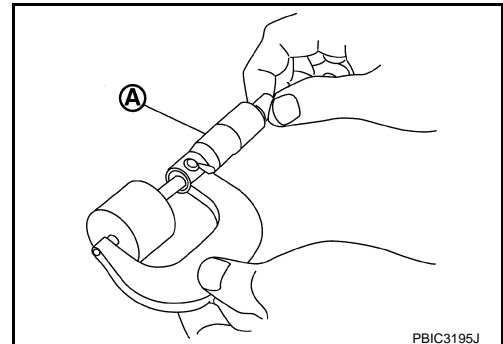
P

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

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

## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
1. Remove camshaft. Refer to [EM-54, "Exploded View"](#).
  2. Remove valve lifters at the locations that are out of the standard.
  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.

# CAMSHAFT VALVE CLEARANCE

< ON-VEHICLE MAINTENANCE >

[MR20DE]

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

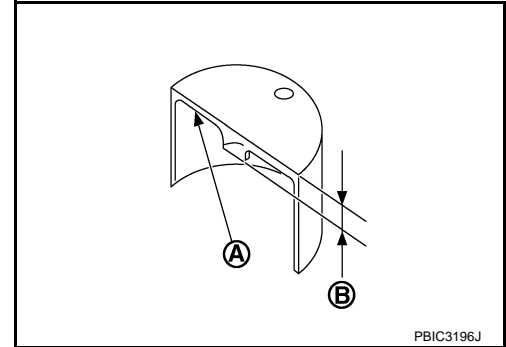
**C<sub>1</sub>** = Measured valve clearance

**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-120, "Camshaft"](#).

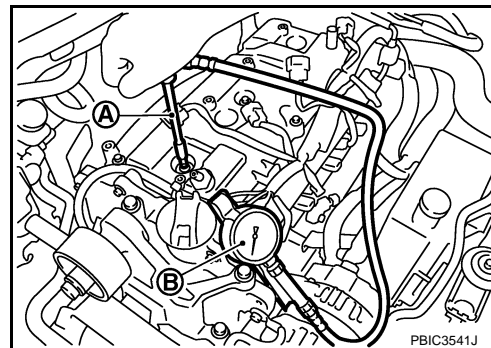
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-54, "Exploded View"](#).
7. Install timing chain and related parts. Refer to [EM-43, "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to "INSPECTION".
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

## COMPRESSION PRESSURE

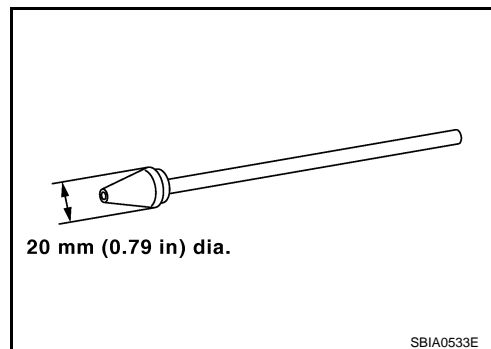
### Inspection

INFOID:000000001160530

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [ECM-349, "Inspection"](#).
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-41, "Exploded View"](#).
4. Connect engine tachometer (not required in use of CONSULT-III).
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.



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-119, "General Specification"](#).

**CAUTION:**

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

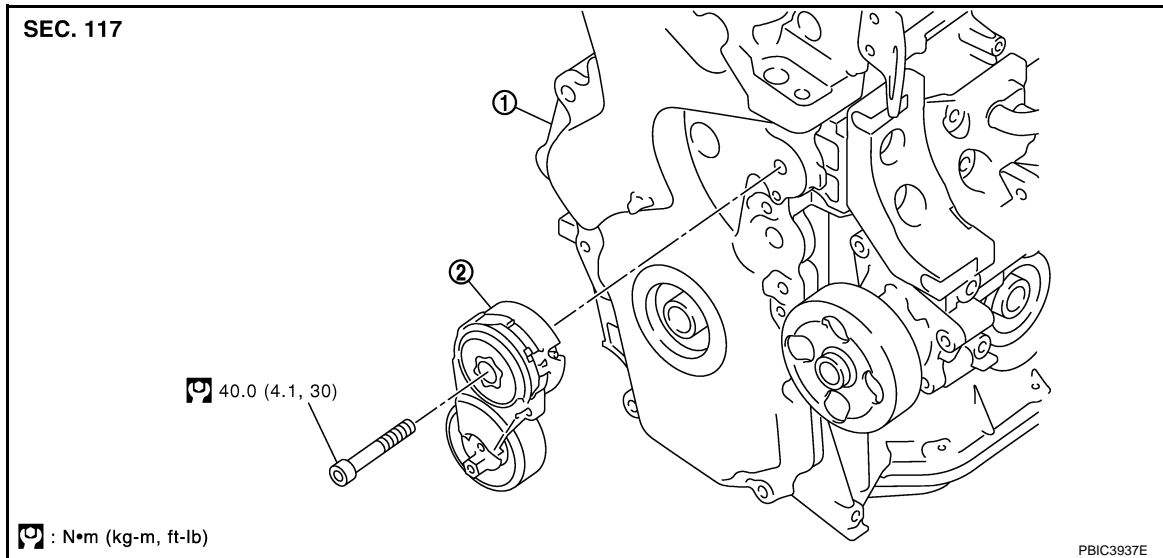
- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the engine speed again with normal battery gravity.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, 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 re-check it for compression.
    - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
    - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
  - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
7. After inspection is completed, install removed parts.
  8. Start the engine, and check that the engine runs smoothly.
  9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [ECM-96, "Description"](#).

## ON-VEHICLE REPAIR

## DRIVE BELT AUTO-TENSIONER

## Exploded View

INFOID:000000001160531



1. Front cover

2. Drive belt auto-tensioner

## Removal and Installation

INFOID:000000001160532

## Removal

- Remove drive belt. Refer to [EM-15, "Exploded View"](#).
  - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.
- Remove front fender protector (RH). Refer to [EXT-21, "Exploded View"](#).
- Support the bottom surface of engine using a transmission jack, and then remove the engine mounting stay and the engine mounting insulator (RH). Refer to [EM-75, "M/T : Exploded View"](#) (M/T models) or [EM-81, "CVT : Exploded View"](#) (CVT models).
- Loosen mounting bolt and remove drive belt auto-tensioner.
  - Lift the front side of the engine with a jack sustaining engine base to remove mounting bolt.

**NOTE:**

Use TORX socket (size T50).

## Installation

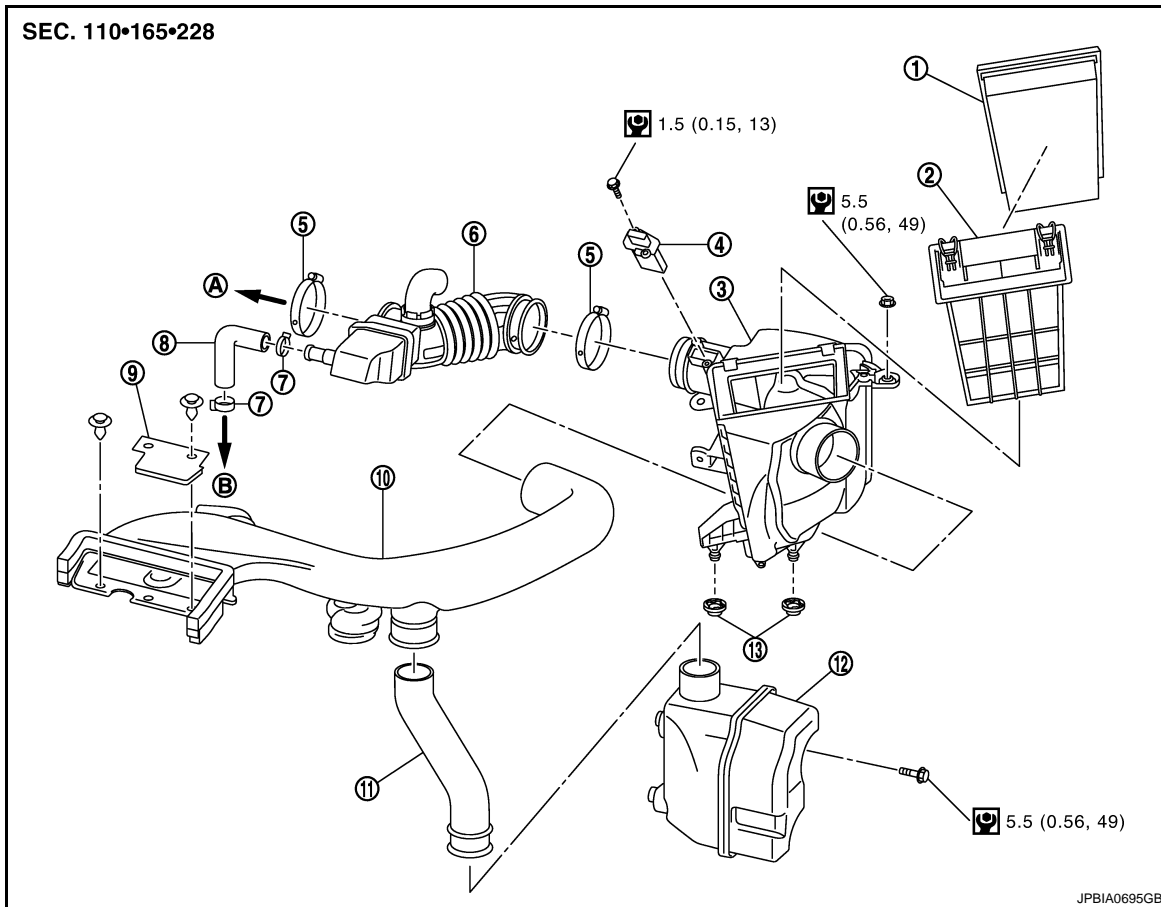
Installation is the reverse order of removal.

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

## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:000000001160533



- |  |                    |                                    |
|--|--------------------|------------------------------------|
| 1. Air cleaner filter                    | 2. Holder          | 3. Air cleaner case                |
| 4. Mass air flow sensor                  | 5. Clamp           | 6. Air duct and resonator assembly |
| 7. Clamp                                 | 8. PCV hose        | 9. Cover                           |
| 10. Air duct (inlet)                     | 11. Air duct       | 12. Resonator                      |
| 13. Grommet                              |                    |                                    |
| A. To electric throttle control actuator | B. To rocker cover |                                    |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160534

### REMOVAL

- Remove air duct (inlet).
- Remove engine cover. Refer to [EM-27, "Exploded View"](#).
- Disconnect mass air flow sensor harness connector.
- Disconnect PCV hose.
- Remove the battery stay, and then move the battery.
- Remove air cleaner case and mass air flow sensor assembly and air duct and resonator assembly disconnecting their joints.
  - Add marks as necessary for easier installation.
- Remove mass air flow sensor from air cleaner case, if necessary.

### CAUTION:

- **Never shock mass air flow sensor.**

## AIR CLEANER AND AIR DUCT

< ON-VEHICLE REPAIR >

[MR20DE]

- **Never disassemble mass air flow sensor.**
- **Never touch its sensor.**

### INSTALLATION

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

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

### Inspection

INFOID:000000001160535

### INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

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

# INTAKE MANIFOLD

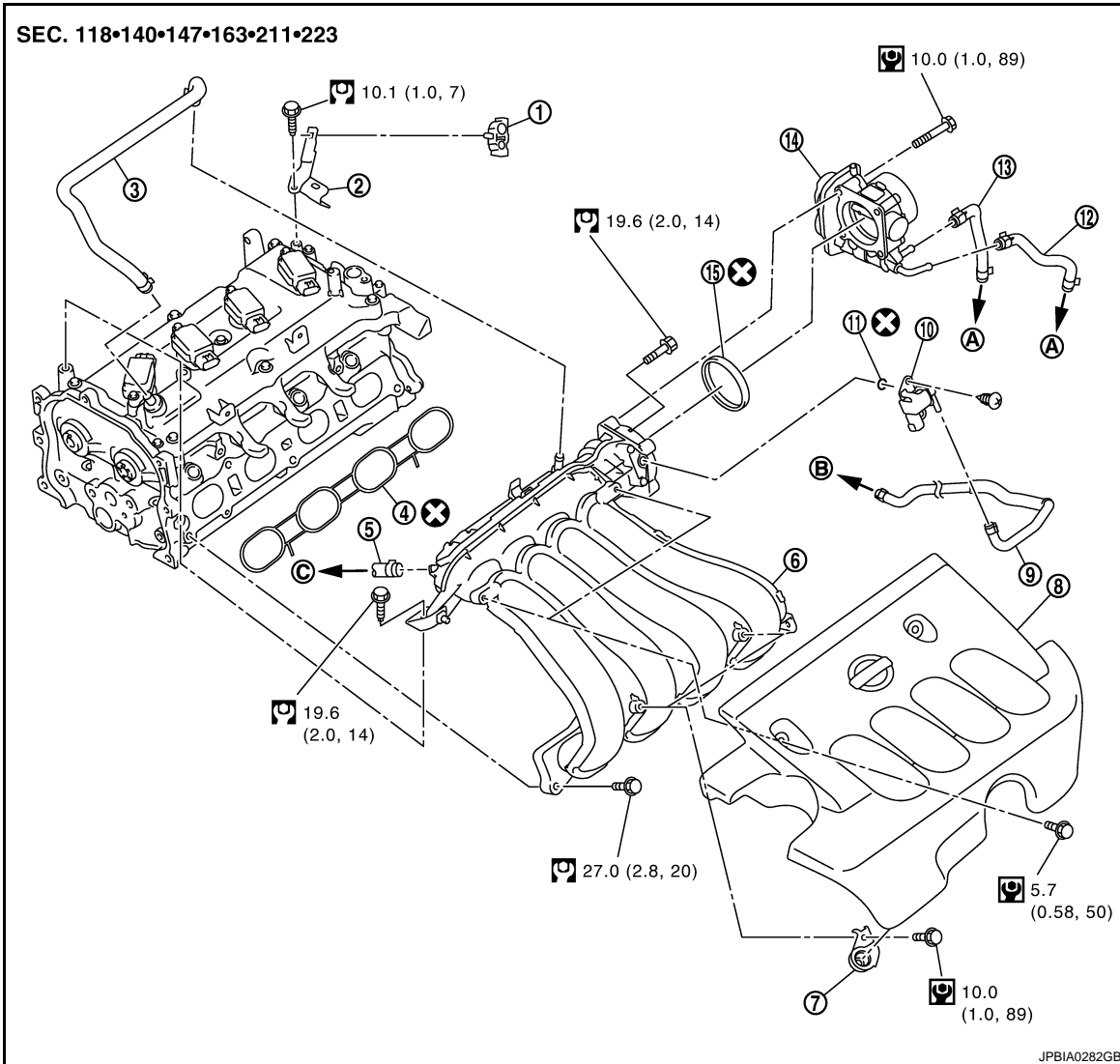
< ON-VEHICLE REPAIR >

[MR20DE]

## INTAKE MANIFOLD

### Exploded View

INFOID:000000001160536



- |   |  |                     |
|---|--|---------------------|
| 1. Clamp  | 2. Harness bracket                     | 3. PCV hose         |
| 4. Gasket   | 5. Vacuum hose                         | 6. Intake manifold  |
| 7. Bracket  | 8. Engine cover                        | 9. EVAP hose        |
| 10. EVAP canister purge volume control solenoid valve | 11. O-ring                             | 12. Water hose      |
| 13. Water hose  | 14. Electric throttle control actuator | 15. Gasket          |
| A. To water outlet                                    | B. To centralized under-floor piping   | C. To brake booster |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160537

### REMOVAL

1. Remove engine cover.
2. Pull out oil level gauge.  
**CAUTION:**  
**Cover the oil level gauge guide openings to avoid entry of foreign materials.**
3. Disconnect PCV hose from intake manifold and rocker cover.

# INTAKE MANIFOLD

[MR20DE]

## < ON-VEHICLE REPAIR >

4. Remove air duct and resonator assembly. Refer to [EM-25, "Exploded View"](#).
5. Disconnect vacuum hose from intake manifold. Refer to [EM-27, "Exploded View"](#).
6. Disconnect water hoses from electric throttle control actuator, attach blind plug to prevent engine coolant leakage.

**CAUTION:**

- Perform this step when the engine is cold.
- Never spill engine coolant on drive belts.

7. Remove electric throttle control actuator.

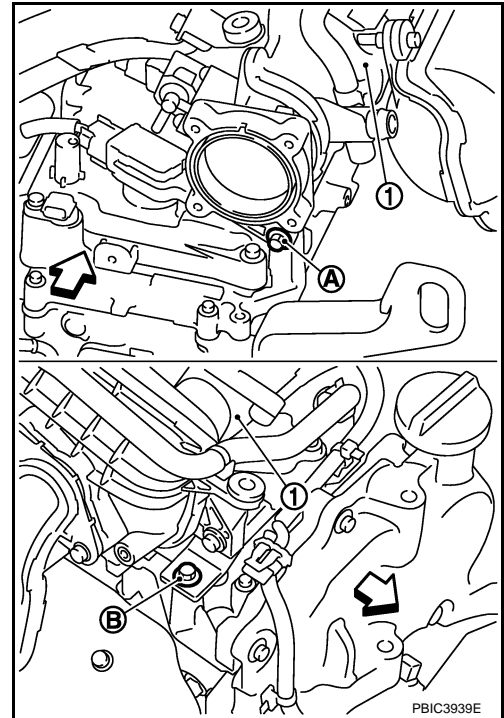
**CAUTION:**

- Handle carefully to avoid any shock to electric throttle control actuator.
- Never disassemble electric throttle control actuator.

8. Remove intake manifold (1) with the following procedure:

⇐ : Engine front

- a. Loosen and remove intake manifold mounting bolts (A) and (B).

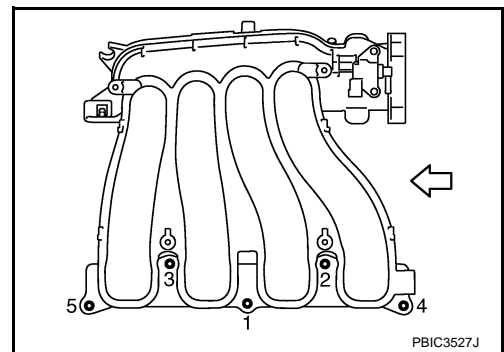


- b. Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

**CAUTION:**

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



9. Remove brackets from intake manifold, if necessary.
10. Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.

## INSTALLATION

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

### Intake Manifold

1. Check if gasket is not dropped from the installation groove of intake manifold.
2. Install intake manifold with the following procedure:



# INTAKE MANIFOLD

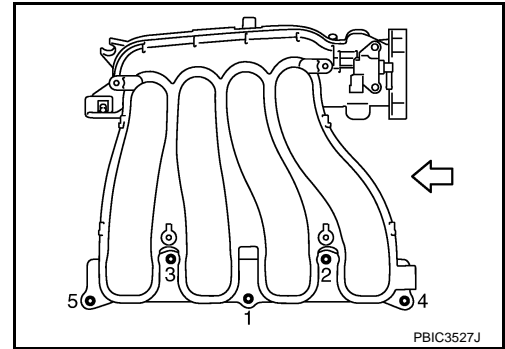
[MR20DE]

## < ON-VEHICLE REPAIR >

- a. Tighten in numerical order as shown in the figure.

↔ : Engine front

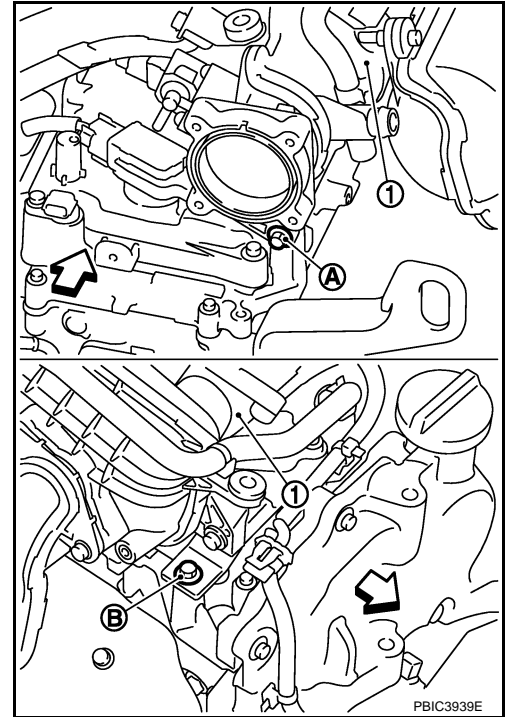
- b. Tighten No. 1 bolt again.



- c. Tighten intake manifold mounting bolt (A). Then tighten intake manifold mounting bolt (B).

1 : Intake manifold

↔ : Engine front



### Electric Throttle Control Actuator

- 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 [ECM-14, "THROTTLE VALVE CLOSED POSITION LEARNING : Description"](#).
- Perform "Throttle Valve Closed Position Learning" and "Idle Air Volume Learning" after repair when replacing electric throttle control actuator. Refer to [ECM-14, "THROTTLE VALVE CLOSED POSITION LEARNING : Description"](#) and [ECM-15, "IDLE AIR VOLUME LEARNING : Description"](#).

A  
EM  
C  
D  
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P

# EXHAUST MANIFOLD

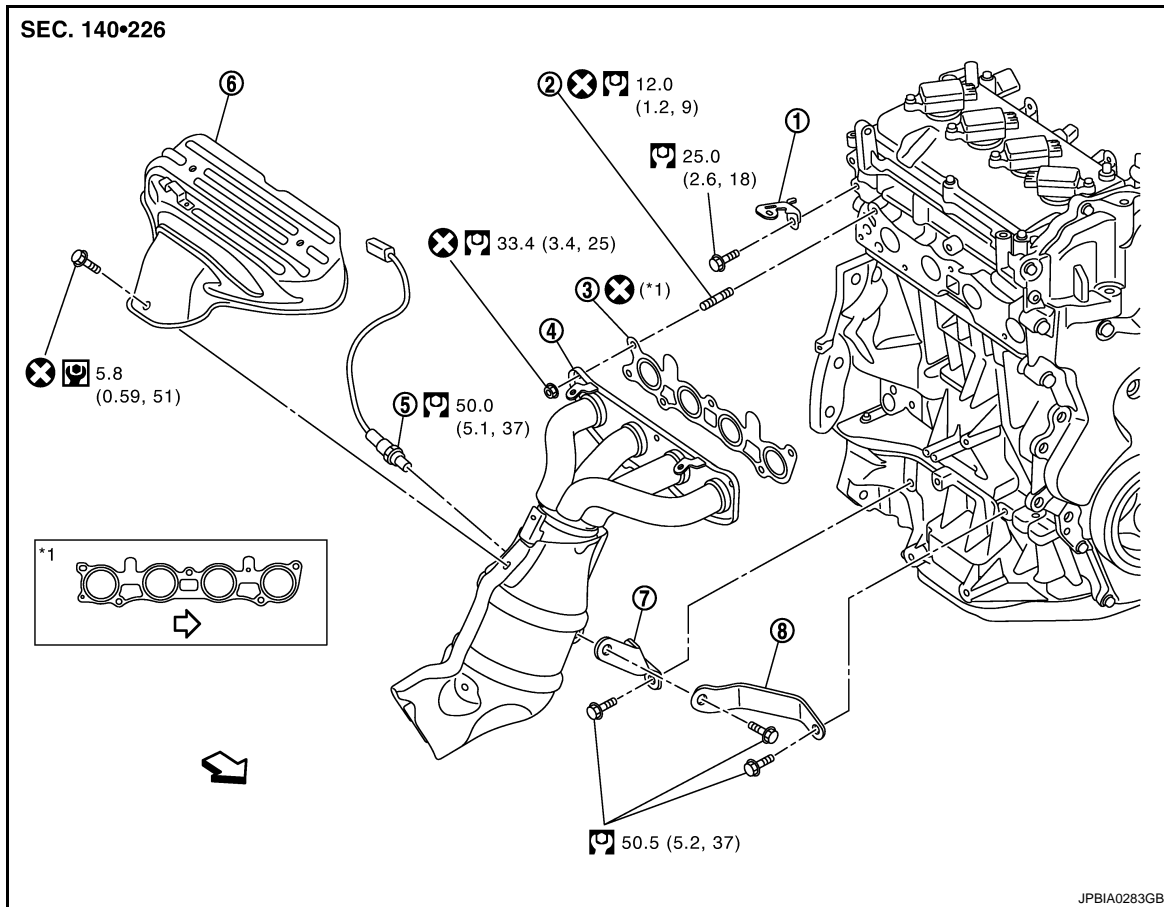
< ON-VEHICLE REPAIR >

[MR20DE]

## EXHAUST MANIFOLD

### Exploded View

INFOID:000000001160538



- |                                       |                                       |                           |
|---------------------------------------|---------------------------------------|---------------------------|
| 1. Harness bracket                    | 2. Stud bolt                          | 3. Gasket                 |
| 4. Exhaust manifold                   | 5. Heated oxygen sensor 1             | 6. Exhaust manifold cover |
| 7. Exhaust manifold stay (2WD models) | 8. Exhaust manifold stay (4WD models) |                           |

⇐ : Engine front

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160539

### REMOVAL

1. Remove exhaust front tube. Refer to [EX-5, "Exploded View"](#).
2. Remove exhaust manifold cover.
3. Remove the heated oxygen sensor 1.
  - Using heated oxygen sensor wrench [SST: KV10117100], remove heated oxygen sensor 1.

#### **CAUTION:**

**Handle heated oxygen sensor 1 carefully and avoid impacts.**

#### **NOTE:**

The exhaust manifold can be removed and installed without removing the heated oxygen sensor 1 (Disassembly of harness connector is necessary)

4. Remove drive shaft (RH) and drive shaft support bearing bracket. Refer to [FAX-19, "MR20DE : Exploded View"](#) (2WD models) or [FAX-52, "MR20DE : Exploded View"](#) (4WD models).
5. Remove exhaust manifold stay.
6. Remove exhaust manifold.

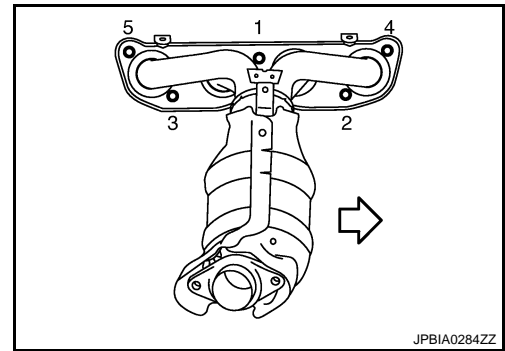
# EXHAUST MANIFOLD

[MR20DE]

## < ON-VEHICLE REPAIR >

- Loosen nuts in reverse order as shown in the figure

↶ : Engine front



- Remove gasket.

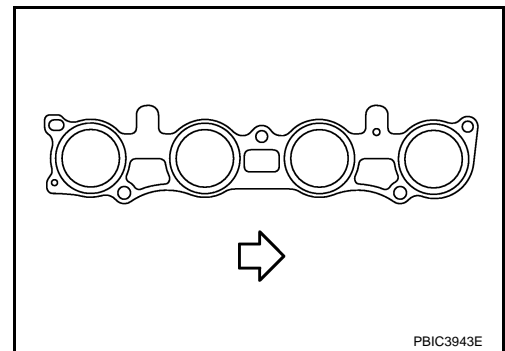
**CAUTION:**

Cover engine openings to avoid entry of foreign materials.

## INSTALLATION

- Install gasket to cylinder head as shown in the figure.

↶ : Engine front

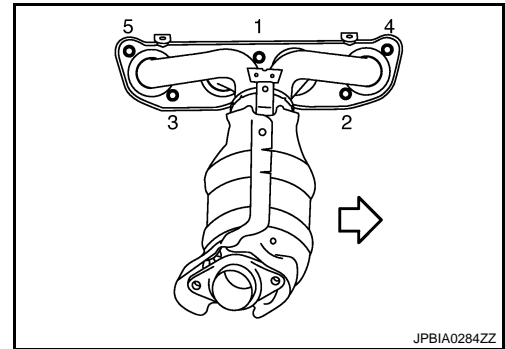


- Install exhaust manifold with the following procedure:

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

↶ : Engine front

- Tighten nuts in numerical order as shown in the figure again.



- Install exhaust manifold stay (2) in the direction as shown in the figure.

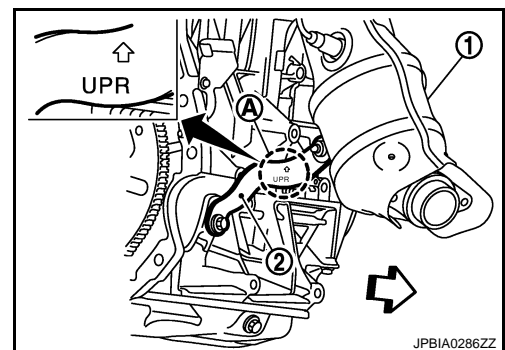
1 : Exhaust manifold

A : Upper mark

↶ : Engine front

**NOTE:**

This figure shows 2WD models as an example.



- Install remaining parts in the reverse order of removal.

## Inspection

INFOID:000000001160540

## INSPECTION AFTER REMOVAL

## EXHAUST MANIFOLD

[MR20DE]

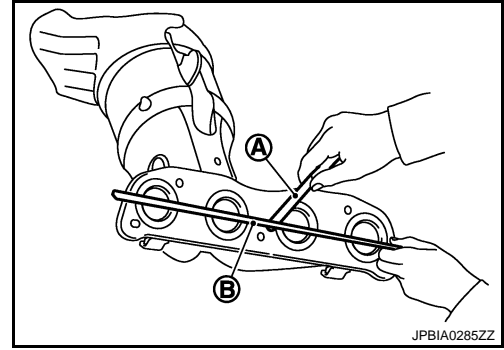
< ON-VEHICLE REPAIR >

### Surface Distortion

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

**Limit** : Refer to [EM-120, "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.



# OIL PAN (LOWER)

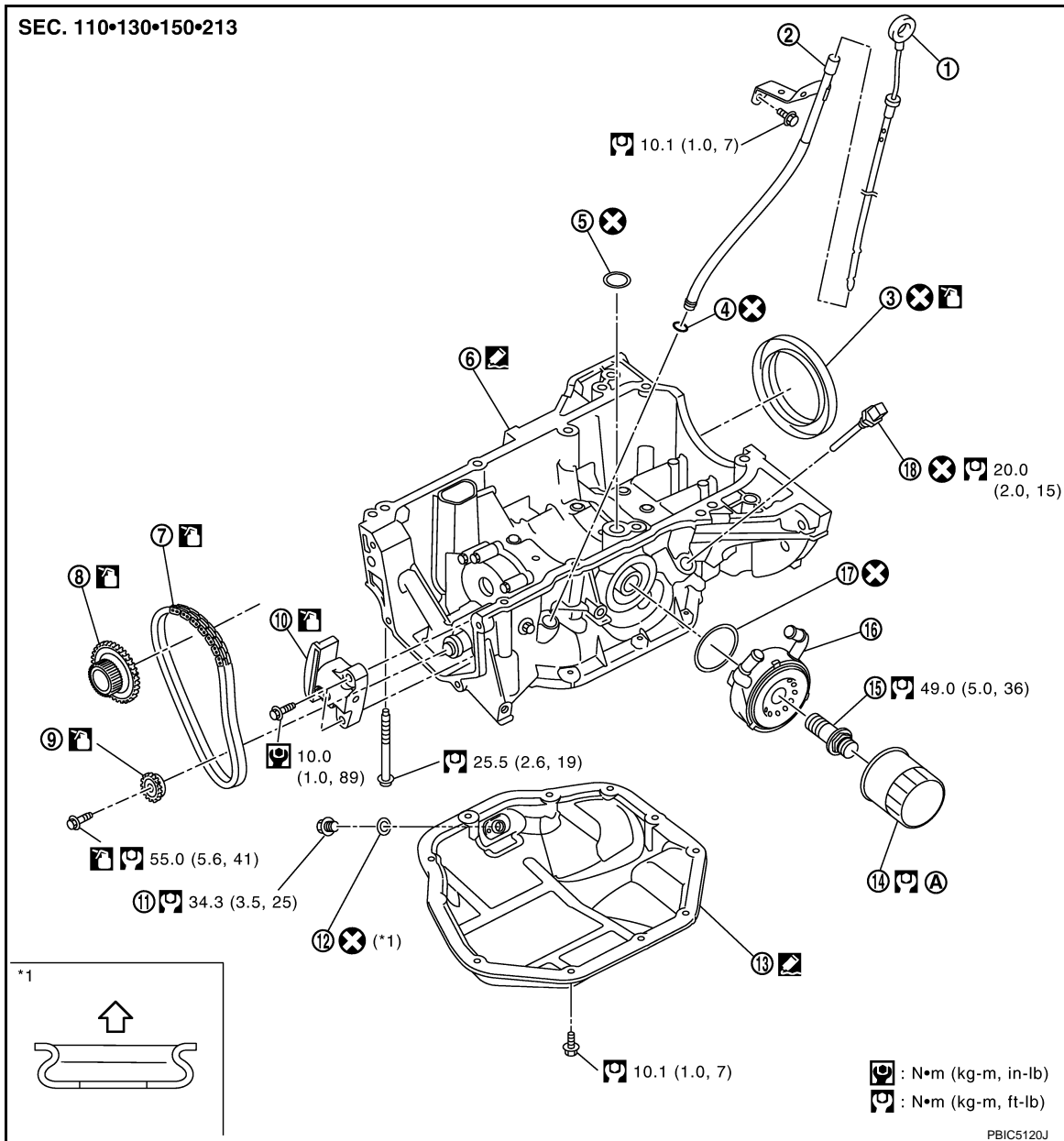
[MR20DE]

< ON-VEHICLE REPAIR >

## OIL PAN (LOWER)

Exploded View

INFOID:000000001160541



- |  |                          |                           |
|--|--------------------------|---------------------------|
| 1. Oil level gauge                       | 2. Oil level gauge guide | 3. Rear oil seal          |
| 4. O-ring                                | 5. O-ring                | 6. Oil pan (upper)        |
| 7. Balancer unit timing chain            | 8. Crankshaft sprocket   | 9. Balancer unit sprocket |
| 10. Balancer unit timing chain tensioner | 11. Drain plug           | 12. Drain plug washer     |
| 13. Oil pan (lower)                      | 14. Oil filter           | 15. Connector bolt        |
| 16. Oil cooler                           | 17. O-ring               | 18. Oil level sensor      |

A. Refer to [LU-9](#)

← : Oil pan side

Refer to [GI-4, "Components"](#) for symbols in the figure.

# OIL PAN (LOWER)

< ON-VEHICLE REPAIR >

[MR20DE]

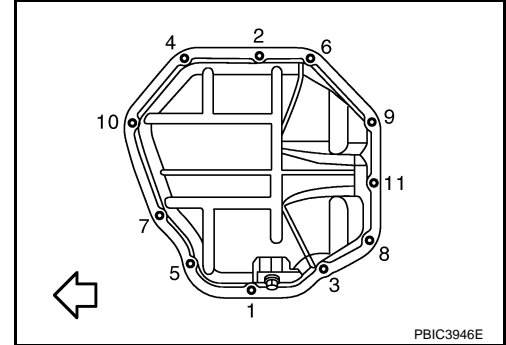
INFOID:000000001160542

## Removal and Installation

### REMOVAL

1. Remove engine undercover.
2. Drain engine oil. Refer to [LU-7, "Draining"](#).
3. Remove oil pan (lower) with the following procedure:
  - a. Loosen mounting bolts in reverse order as shown in the figure.

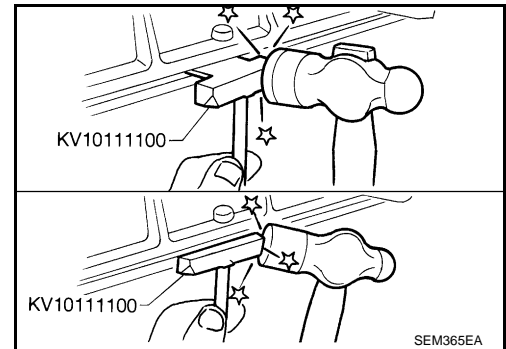
⇐ : Engine front



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

**CAUTION:**

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



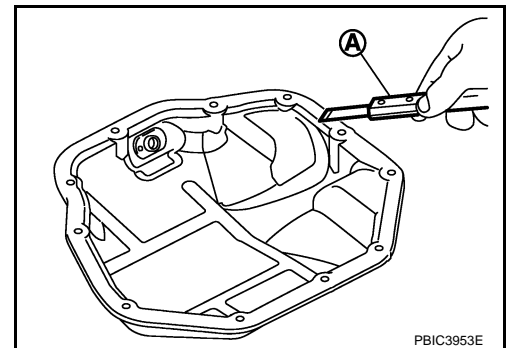
### INSTALLATION

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

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

[MR20DE]

## < ON-VEHICLE REPAIR >

- 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)

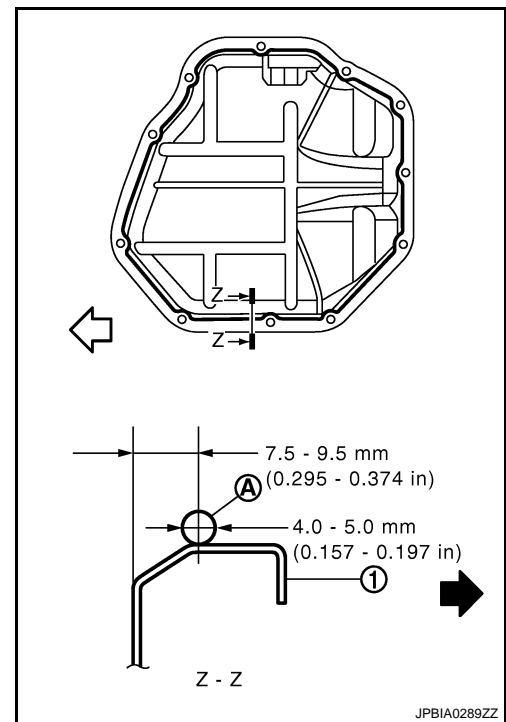
↶ : Engine front

➡ : Engine outside

Use Genuine Liquid Gasket or equivalent.

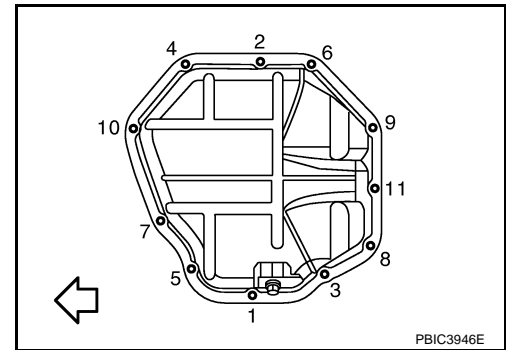
**CAUTION:**

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



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

↶ : Engine front



## Inspection

INFOID:000000001160543

### INSPECTION AFTER REMOVAL

Clean oil strainer portion [part of the oil pan (upper)] if any object attached.

### INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-6, "Inspection"](#).
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-6, "Inspection"](#).

# FUEL INJECTOR AND FUEL TUBE

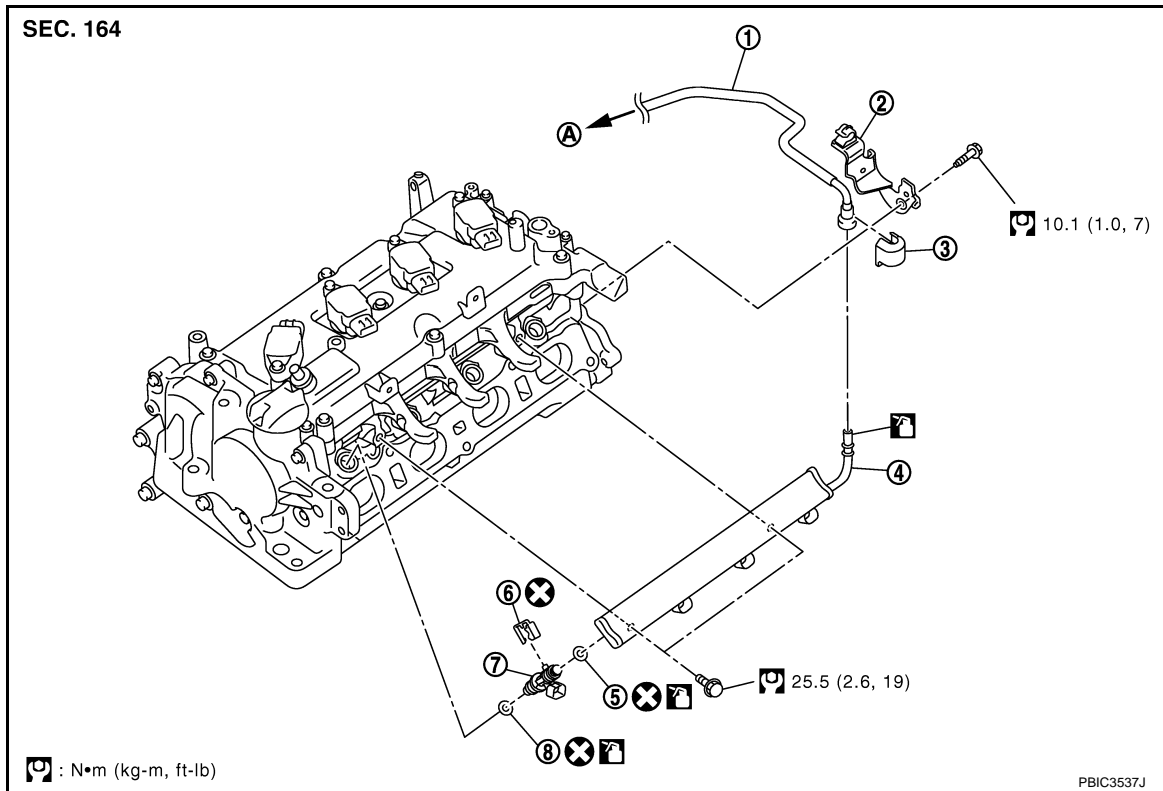
< ON-VEHICLE REPAIR >

[MR20DE]

## FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:000000001160544



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

A. To centralized under-floor piping

Refer to [GI-4, "Components"](#) for symbols in the figure.

### CAUTION:

Never remove or disassemble parts unless instructed in the figure.

### Removal and Installation

INFOID:000000001160545

### 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 [ECM-349, "Inspection"](#).
2. Remove intake manifold. Refer to [EM-27, "Exploded View"](#).



# FUEL INJECTOR AND FUEL TUBE

[MR20DE]

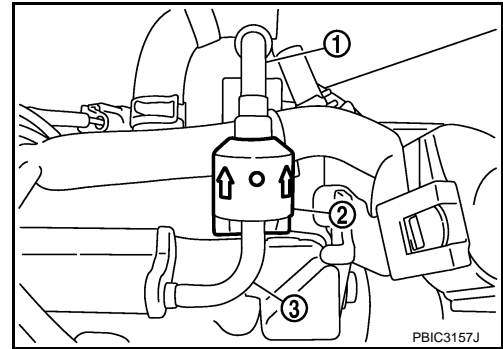
< ON-VEHICLE REPAIR >

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

**NOTE:**

There is no fuel return path.

- a. Remove quick connector cap (2) 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 onto fuel tube.
- d. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

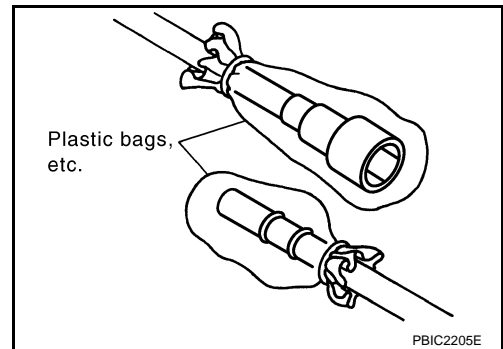
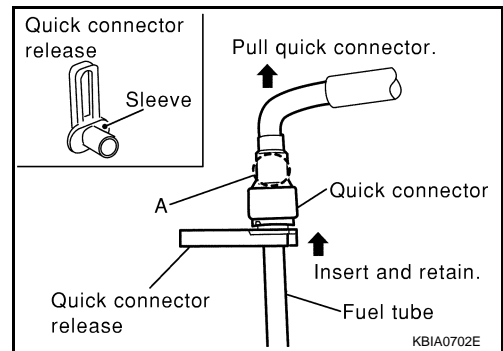
**CAUTION:**

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.

**CAUTION:**

- Pull quick connector holding "A" position 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 leak 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 hose during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



4. Disconnect harness connector from fuel injector.
5. Remove fuel tube and fuel injector assembly.

# FUEL INJECTOR AND FUEL TUBE

[MR20DE]

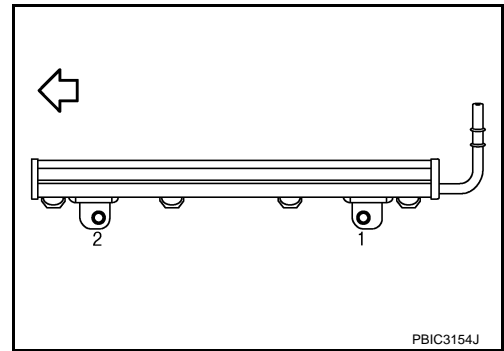
## < ON-VEHICLE REPAIR >

- 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 leaks from fuel tube.

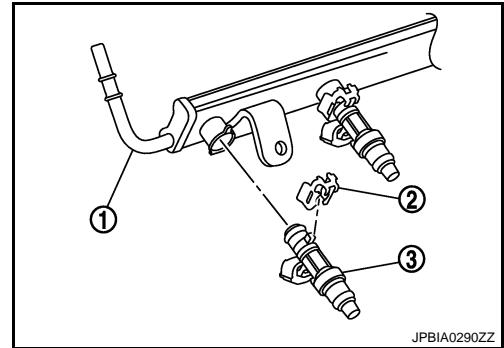


6. Remove fuel injector (3) from fuel tube (1) with the following procedure:

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

### CAUTION:

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



## INSTALLATION

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

### CAUTION:

- 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.

# FUEL INJECTOR AND FUEL TUBE

[MR20DE]

## < ON-VEHICLE REPAIR >

2. Install fuel injector (4) to fuel tube (1) with the following procedure:

- 3 : O-ring (black)
- 5 : O-ring (green)

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

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

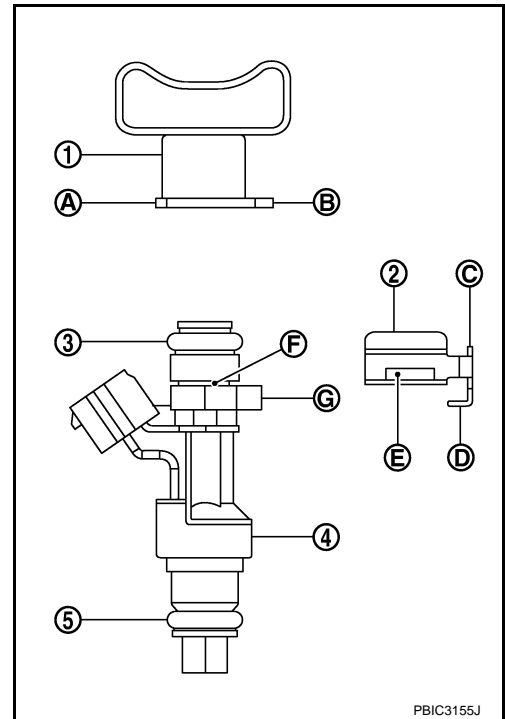
**CAUTION:**

- **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 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 making sure that fuel injector does not rotate or come off.



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

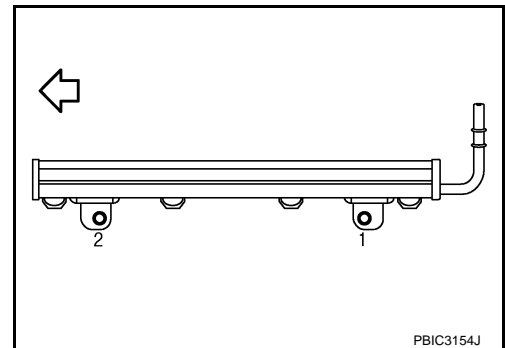
**CAUTION:**

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

4. Install fuel tube and injector assembly onto cylinder.

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

⇐ : Engine front



5. Connect harness connector to fuel injector.

6. Connect fuel feed hose with the following procedure.

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

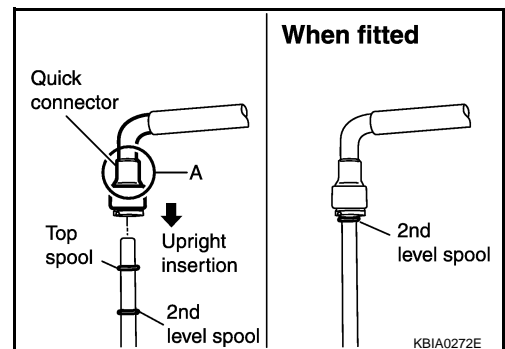
b. Apply new engine oil lightly to area around the top of fuel tube.

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

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

**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. Before clamping fuel feed hose with hose clamp, pull quick connector hard by hand holding "A" position. Check it is completely engaged (connected) so that it does not come out from fuel tube.

# FUEL INJECTOR AND FUEL TUBE

[MR20DE]

< ON-VEHICLE REPAIR >

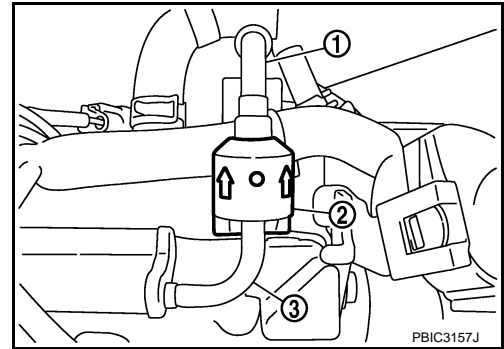
e. Install quick connector cap (2) to quick connector connection.

1. Fuel feed hose
3. Fuel tube

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

**CAUTION:**

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



f. Install fuel feed hose to hose clamp.

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

## Inspection

INFOID:000000001160546

### INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

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

**NOTE:**

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leaks at connection points.

**CAUTION:**

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

# IGNITION COIL, SPARK PLUG AND ROCKER COVER

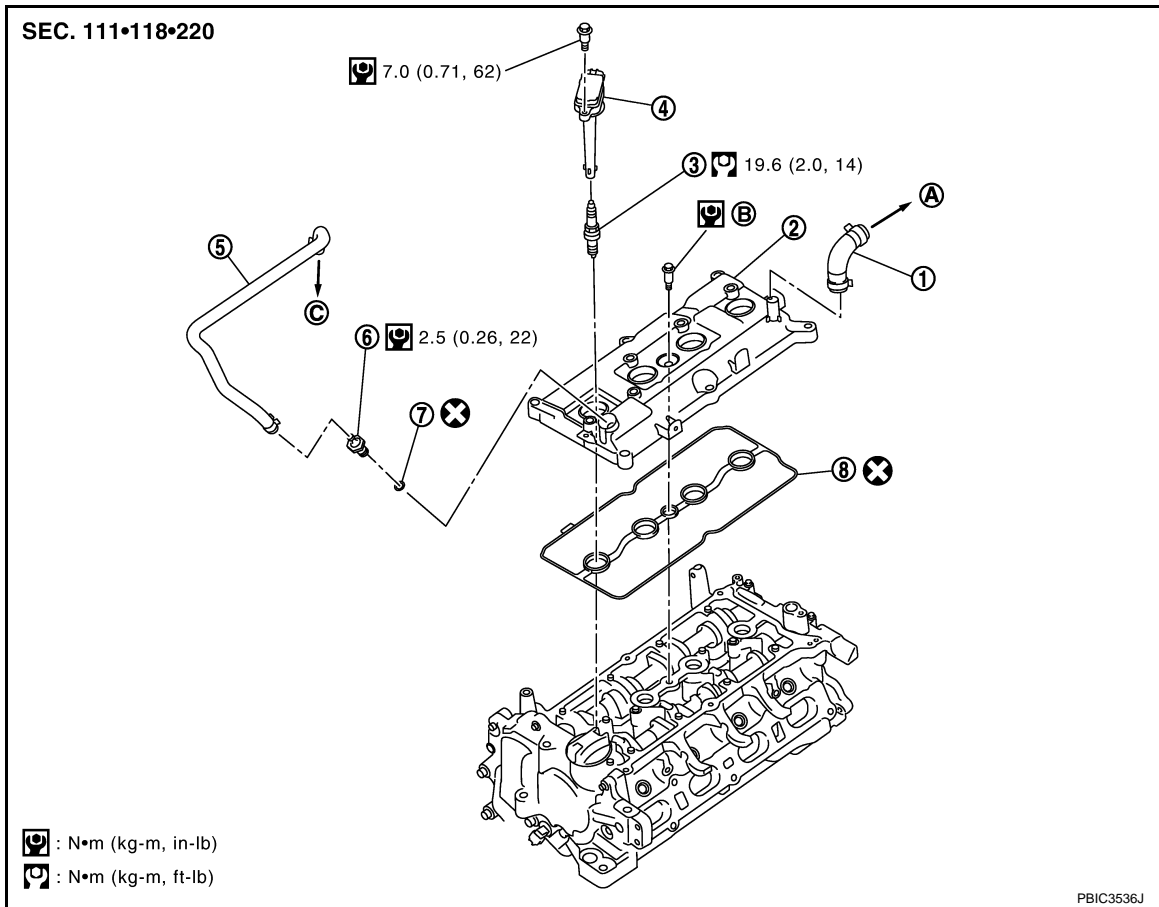
< ON-VEHICLE REPAIR >

[MR20DE]

## IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:000000001160547



- |                  |                                   |                       |
|------------------|-----------------------------------|-----------------------|
| 1. PCV hose      | 2. Rocker cover                   | 3. Spark plug         |
| 4. Ignition coil | 5. PCV hose                       | 6. PCV valve          |
| 7. O-ring        | 8. Gasket                         |                       |
| A. To air duct   | B. Refer to <a href="#">EM-41</a> | C. To intake manifold |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160548

### REMOVAL

1. Remove intake manifold. Refer to [EM-27, "Removal and Installation"](#).
2. Remove ignition coil.  
**CAUTION:**
  - Never drop or shock ignition coil.
  - Never disassemble ignition coil.
3. Remove rocker cover.

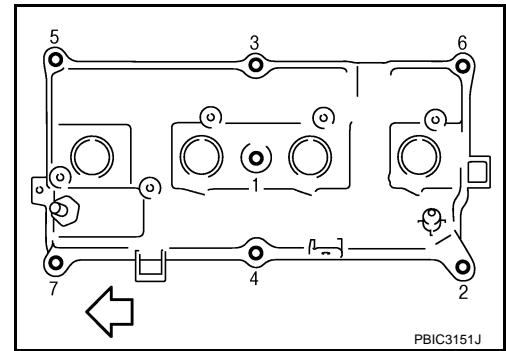
# IGNITION COIL, SPARK PLUG AND ROCKER COVER

< ON-VEHICLE REPAIR >

[MR20DE]

- Loosen bolts in reverse order shown in the figure.

← : Engine front



4. Remove rocker cover gasket from rocker cover.
5. 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

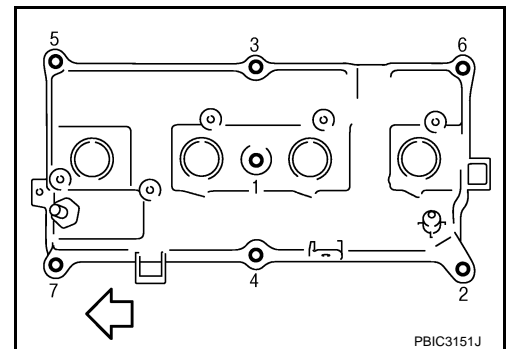
1. Install the rocker cover gasket to rocker cover.  
**CAUTION:**  
Check the gasket is not dropped.
2. Install rocker cover.
  - Tighten bolts in two steps separately in numerical order as shown in the figure.

← : Engine front

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

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

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



# TIMING CHAIN

< ON-VEHICLE REPAIR >

[MR20DE]

## TIMING CHAIN

### Exploded View

INFOID:000000001160549

A

EM

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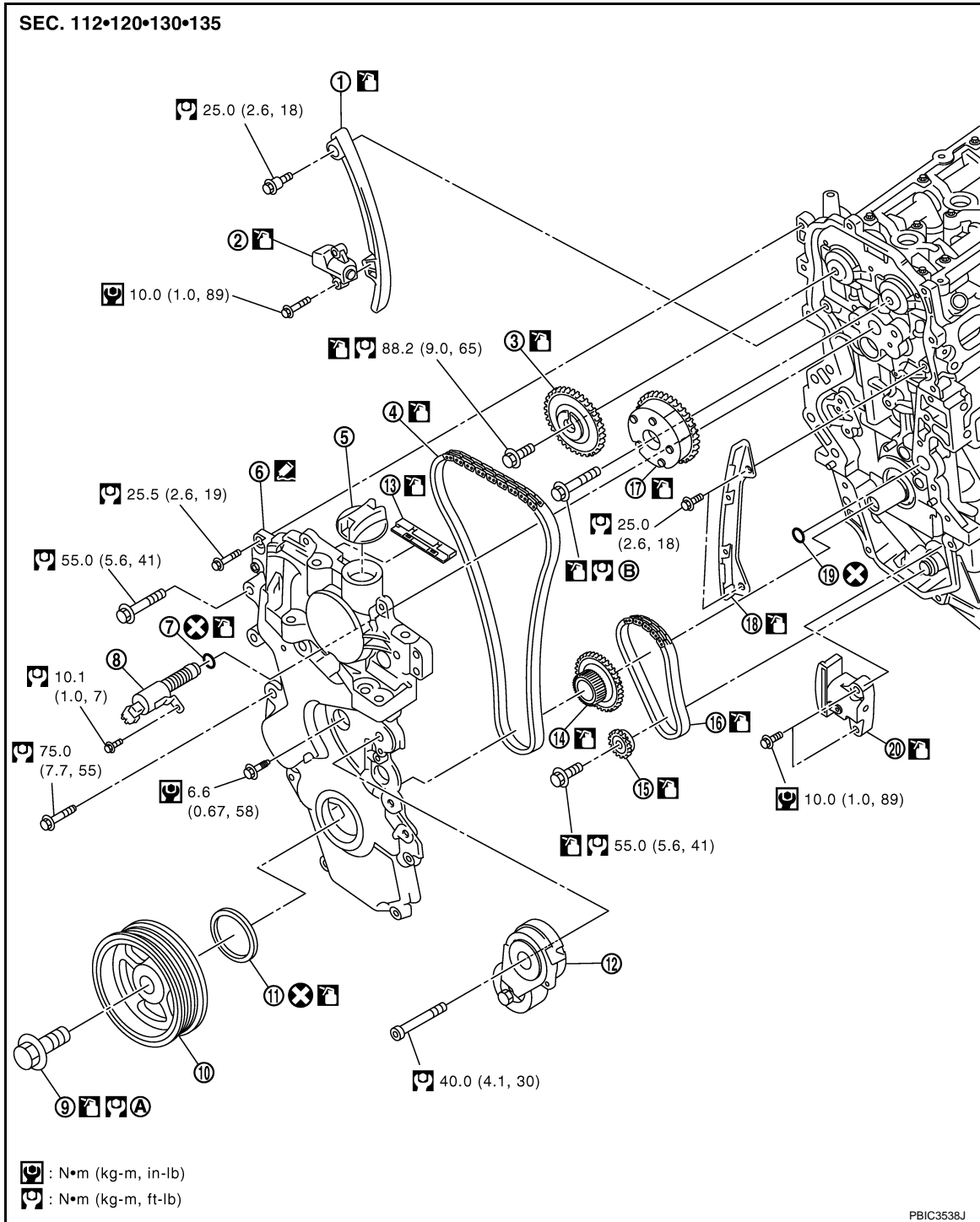
L

M

N

O

P



- |   |   |                               |
|---|---|-------------------------------|
| 1. Timing chain slack guide                       | 2. Timing chain tensioner                     | 3. Camshaft sprocket (EXH)    |
| 4. Timing chain                                   | 5. Oil filler cap                             | 6. Front cover                |
| 7. O-ring   | 8. Intake valve timing control solenoid valve | 9. Crankshaft pulley bolt     |
| 10. Crankshaft pulley                             | 11. Front oil seal                            | 12. Drive belt auto-tensioner |
| 13. Timing chain tension guide (front cover side) | 14. Crankshaft sprocket                       | 15. Balancer unit sprocket    |

# TIMING CHAIN

[MR20DE]

< ON-VEHICLE REPAIR >

- |                                   |  |                                |
|-----------------------------------|--|--------------------------------|
| 16. Balancer unit timing chain    | 17. Camshaft sprocket (INT)              | 18. Timing chain tension guide |
| 19. O-ring                        | 20. Balancer unit timing chain tensioner |                                |
| A. Refer to <a href="#">EM-44</a> | B. Refer to <a href="#">EM-54</a>        |                                |
- Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160550

### REMOVAL

#### CAUTION:

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

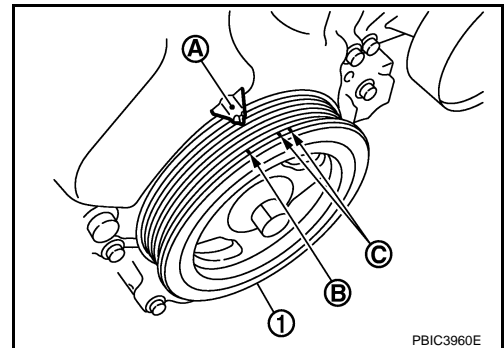
1. Remove front wheel (RH). Refer to [WT-3, "Adjustment"](#).
2. Remove front fender protector (RH). Refer to [EXT-21, "Exploded View"](#).
3. Drain engine oil. Refer to [LU-7, "Draining"](#).

#### CAUTION:

Perform this step when engine is cold.

4. Remove the following parts.
  - Intake manifold: Refer to [EM-27, "Exploded View"](#).
  - Rocker cover: Refer to [EM-41, "Exploded View"](#).
  - Drive belt: Refer to [EM-15, "Removal and Installation"](#).
5. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
  - a. Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

C : White paint mark (Not use for service)



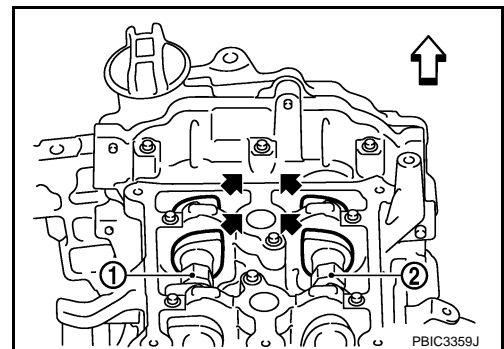
- b. At the same time, check that the cam noses of the No. 1 cylinder are located (←) as shown in the figure.

1 : Camshaft (INT)

2 : Camshaft (EXH)

← : Engine front

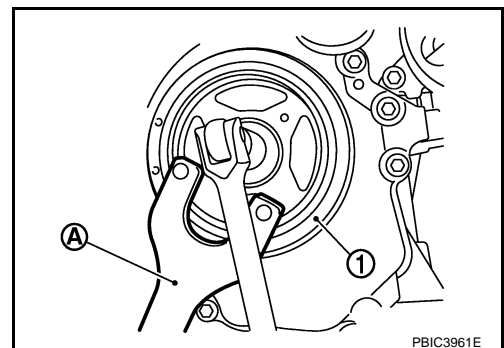
- If not, rotate crankshaft pulley one revolution (360 degrees) and align as shown in the figure.



6. Remove crankshaft pulley with the following procedure:
  - a. Fix crankshaft pulley (1) with a pulley holder (A) (commercial service tool), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.

#### CAUTION:

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



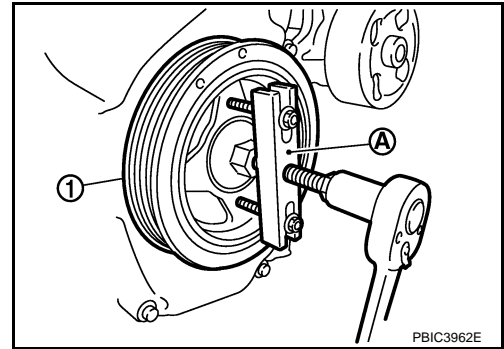


# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

- b. Attach a pulley puller (A) [SST: KV11103000] in the M6 thread hole on crankshaft pulley (1), and remove crankshaft pulley.

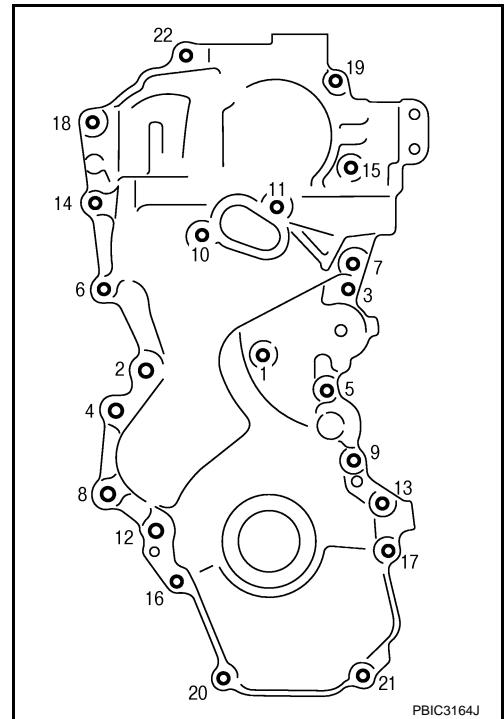


7. Remove rear torque rod. Refer to [EM-75. "M/T : Exploded View"](#) (M/T models) or [EM-81. "CVT : Exploded View"](#) (CVT models).
8. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting stay and the engine mounting insulator (RH). Refer to [EM-75. "M/T : Exploded View"](#) (M/T models) or [EM-81. "CVT : Exploded View"](#) (CVT models).
9. Remove oil pan (lower). Refer to [EM-33. "Exploded View"](#).

**NOTE:**

If crankshaft sprocket and balancer unit component are not removed, this step is unnecessary.

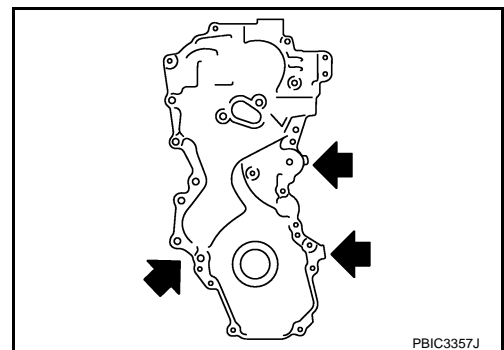
10. Remove intake valve timing control solenoid valve.
11. Remove drive belt auto-tensioner.
12. Remove front cover with the following procedure:
- a. Loosen mounting bolts in reverse order as shown in the figure.



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

**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 the position not specified.



# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

13. Remove front oil seal from front cover.

**CAUTION:**

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

- Lift up front oil seal using a screwdriver.

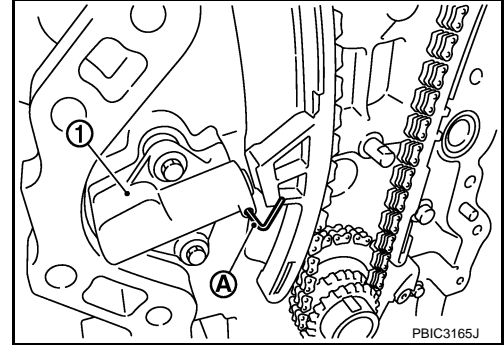
14. Remove timing chain tensioner with the following procedure:

- Push in timing chain tensioner plunger.
- Insert a stopper pin (A) into the body hole, and then fix it with the plunger pushed in.

**NOTE:**

Use approximately 1.5 mm (0.059 in) diameter, hard metal pin as a stopper pin.

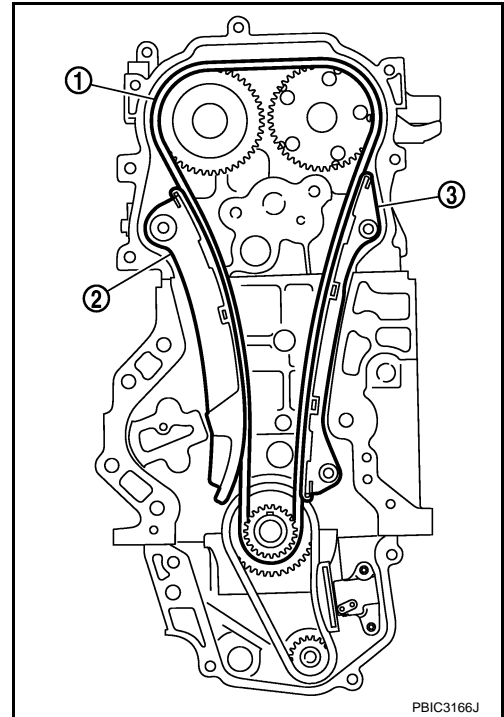
- Remove timing chain tensioner (1).



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

**CAUTION:**

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



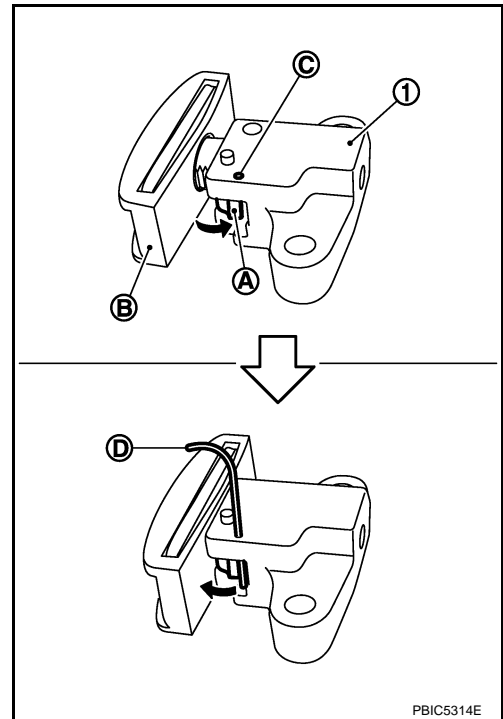
16. Remove crankshaft sprocket and balancer unit drive component with the following procedure:

# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

- a. Press stopper tab (A) in the direction shown in the figure to push the timing chain slack guide (B) toward timing chain tensioner (for oil pump) (1).
  - The slack guide is released by pressing the stopper tab. As the result, the slack guide can be moved.
- b. Insert a stopper pin (D) into tensioner body hole (C) to secure the timing chain slack guide.  
**NOTE:**  
Use a hard metal pin with the diameter of approximately 1.2 mm (0.047 in) as a stopper pin.
- c. Remove balancer unit timing chain tensioner.
  - When the holes on lever and tensioner body cannot be aligned, align these holes by slightly moving the slack guide.



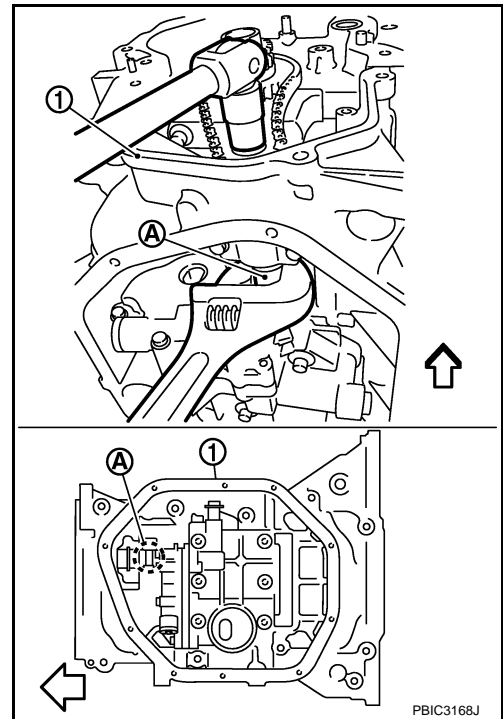
- d. Hold the WAF part of balancer shaft [WAF:19.0 mm (0.75 in)] (A), and then loosen the balancer unit sprocket bolt.

1 : Oil pan (upper)

⇐ : Engine front

### CAUTION:

- Secure the balancer unit shaft with the WAF part.
  - Never loosen the balancer unit sprocket bolt by tightening the balancer unit drive chain.
- e. Remove crankshaft sprocket, balancer unit sprocket and balancer unit timing chain as a set.



17. Remove timing chain tension guide (front cover side) from front cover, if necessary.

## INSTALLATION

### NOTE:

# TIMING CHAIN

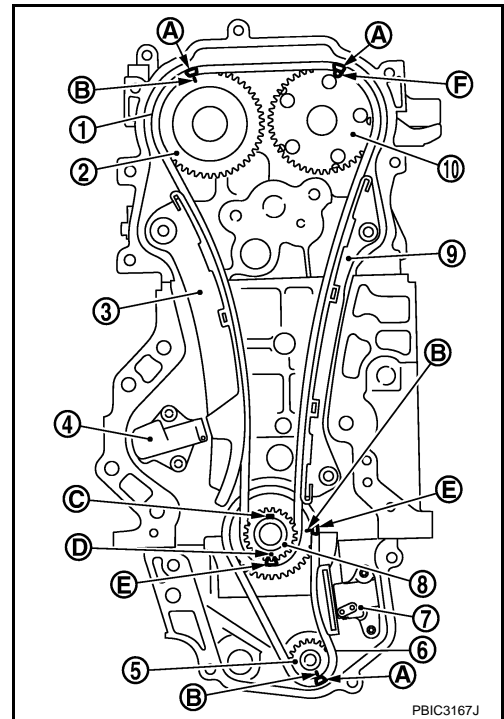
[MR20DE]

## < ON-VEHICLE REPAIR >

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

1. Check that crankshaft key points straight up.

- 1 : Timing chain
- 2 : Camshaft sprocket (EXH)
- 3 : Timing chain slack guide
- 4 : Timing chain tensioner
- 5 : Balancer unit sprocket
- 6 : Balancer unit drive chain
- 7 : Balancer unit timing chain tensioner
- 8 : Crankshaft sprocket
- 9 : Timing chain tension guide
- 10 : Camshaft sprocket (INT)
- A : Matching mark (dark blue link)
- B : Matching mark (stamping)
- C : Crankshaft key position (straight up)
- D : Matching mark (stamping)
- E : Matching mark (orange link)
- F : Matching mark (outer groove\*)



\*: There are two outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

2. If the timing chain tension guide (front cover side) is removed, install it to the front cover.

### **CAUTION:**

**Check the joint condition by sound or feeling.**

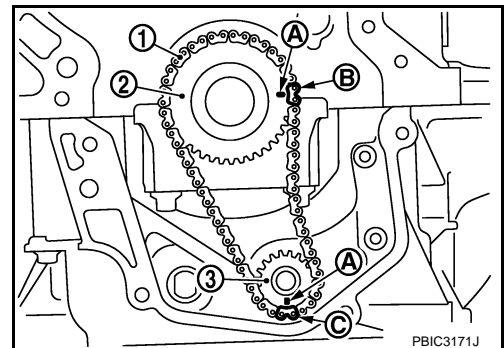
3. Install crankshaft sprocket (2), balancer unit sprocket (3) and balancer unit timing chain (1).

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

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

### **CAUTION:**

**Check matching mark position of each sprocket after installing the balancer unit timing chain.**



# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

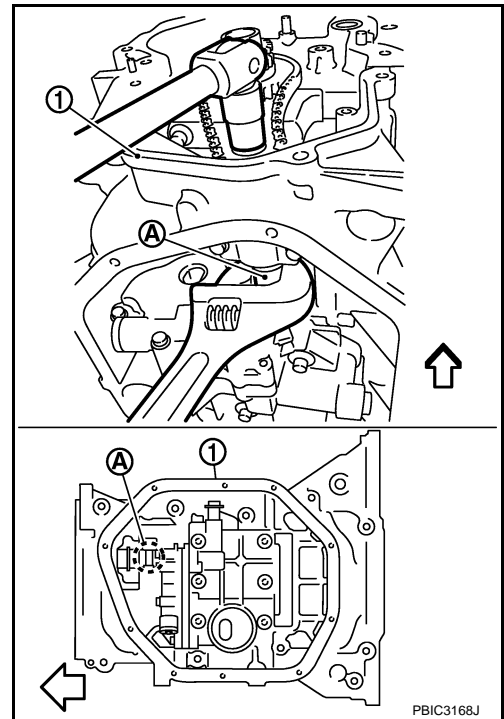
4. Hold the WAF part of balancer unit shaft [WAF: 19.0 mm (0.75 in)] (A), and then tighten the balancer shaft sprocket bolt.

1 : Oil pan (upper)

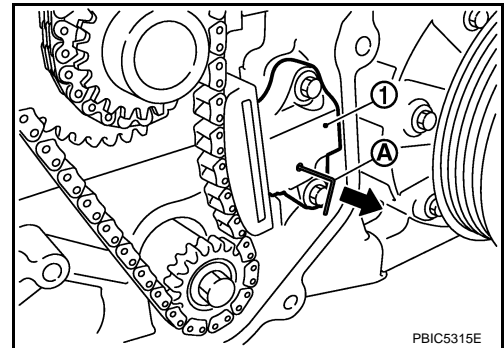
⇐ : Engine front

### CAUTION:

- Secure the balancer unit shaft with the WAF part.
- Never loosen the balancer shaft sprocket bolt by tightening the balancer unit timing chain.



5. Install balancer unit timing 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 balancer unit timing chain tensioner.
  - Check matching mark position of balancer unit timing chain and each sprocket again.



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# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

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

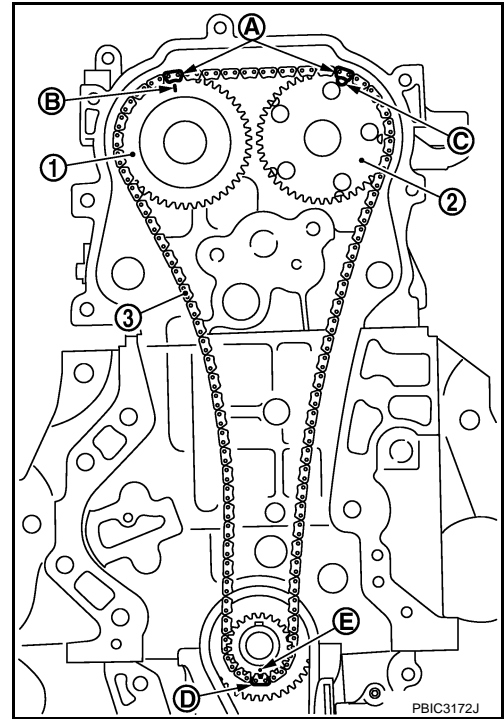
- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- 3 : Timing chain
- A : Matching mark (dark blue link)
- B : Matching mark (stamping)
- C : Matching mark (outer groove\*)
- D : Matching mark (orange link)
- E : Matching mark (stamping)

\*: There are 2 outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

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

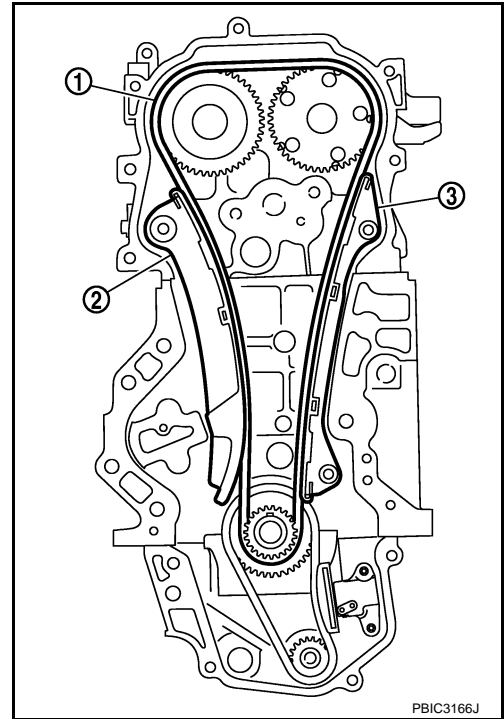
**CAUTION:**

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



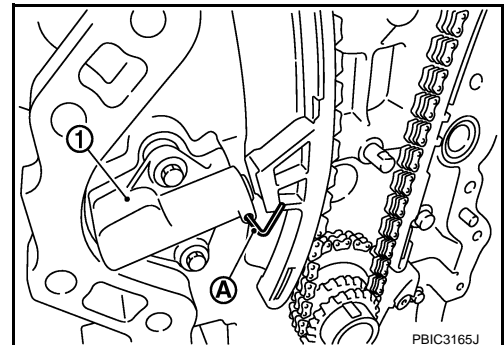
7. Install the timing chain tension guide (3) and the timing chain slack guide (2).

- 1 : Timing chain



8. Install timing 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 timing chain tensioner.



# TIMING CHAIN

[MR20DE]

< ON-VEHICLE REPAIR >

9. Check matching mark position of timing chain and each sprocket again.
10. Install front oil seal. Refer to [EM-64, "FRONT OIL SEAL : Removal and Installation"](#).
11. Install front cover with the following procedure:

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

**CAUTION:**

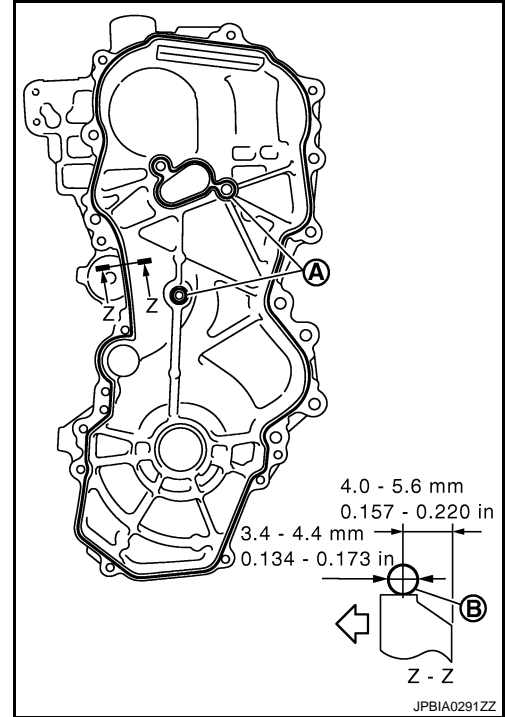
**Never misalign O-ring.**

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

A : Liquid gasket application area

← : Engine outside

**Use Genuine Liquid Gasket or equivalent.**



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

**CAUTION:**

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

- d. Install front cover, and tighten mounting bolts in numerical order as shown in the figure.

- Refer to the following for the installation position of bolts.

**M6** : No. 1

**M10** : No. 6, 7, 10, 11, 14

**M12** : No. 2, 4, 8, 12

**M8** : Except the above

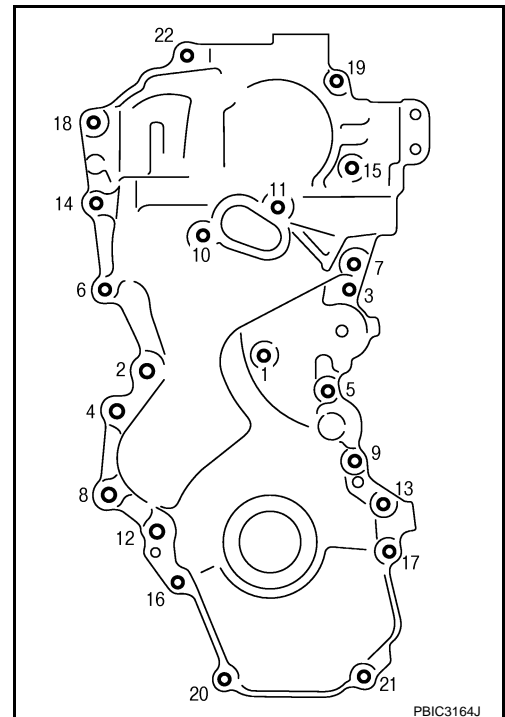
**CAUTION:**

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

- e. 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.**



12. Install crankshaft pulley with the following procedure:



# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

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

**CAUTION:**

**Never damage front oil seal lip section.**

- b. Secure crankshaft pulley (1) with a pulley holder (A) (commercial service tool).  
c. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.  
d. Tighten crankshaft pulley bolt.

 : 68.6 N·m (7.0 kg-m, 51 ft-lb)

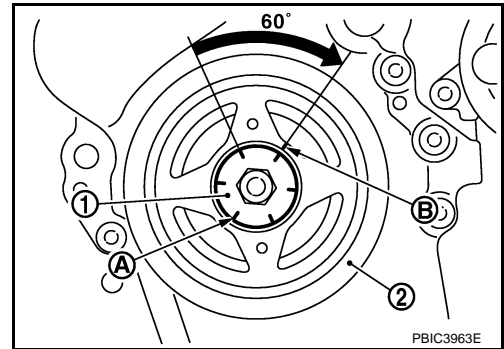
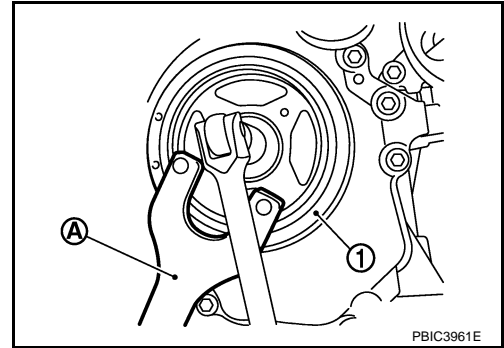
- e. Completely loosen.

 : 0 N·m (0 kg-m, 0 ft-lb)

- f. Tighten crankshaft pulley bolt.

 : 29.4 N·m (3.0 kg-m, 22 ft-lb)

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



- i. Check that crankshaft rotates clockwise smoothly.  
13. Install remaining parts in the reverse order of removal.

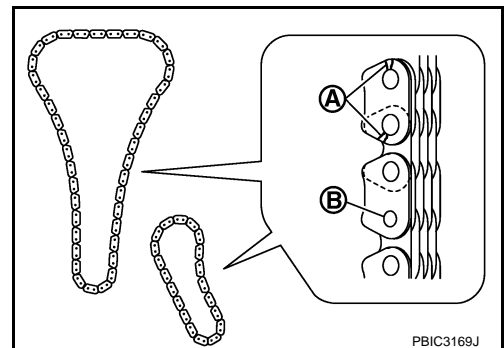
## Inspection

INFOID:000000001160551

### 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 as necessary.



### 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-22, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.



# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

- 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.

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**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
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

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

# CAMSHAFT

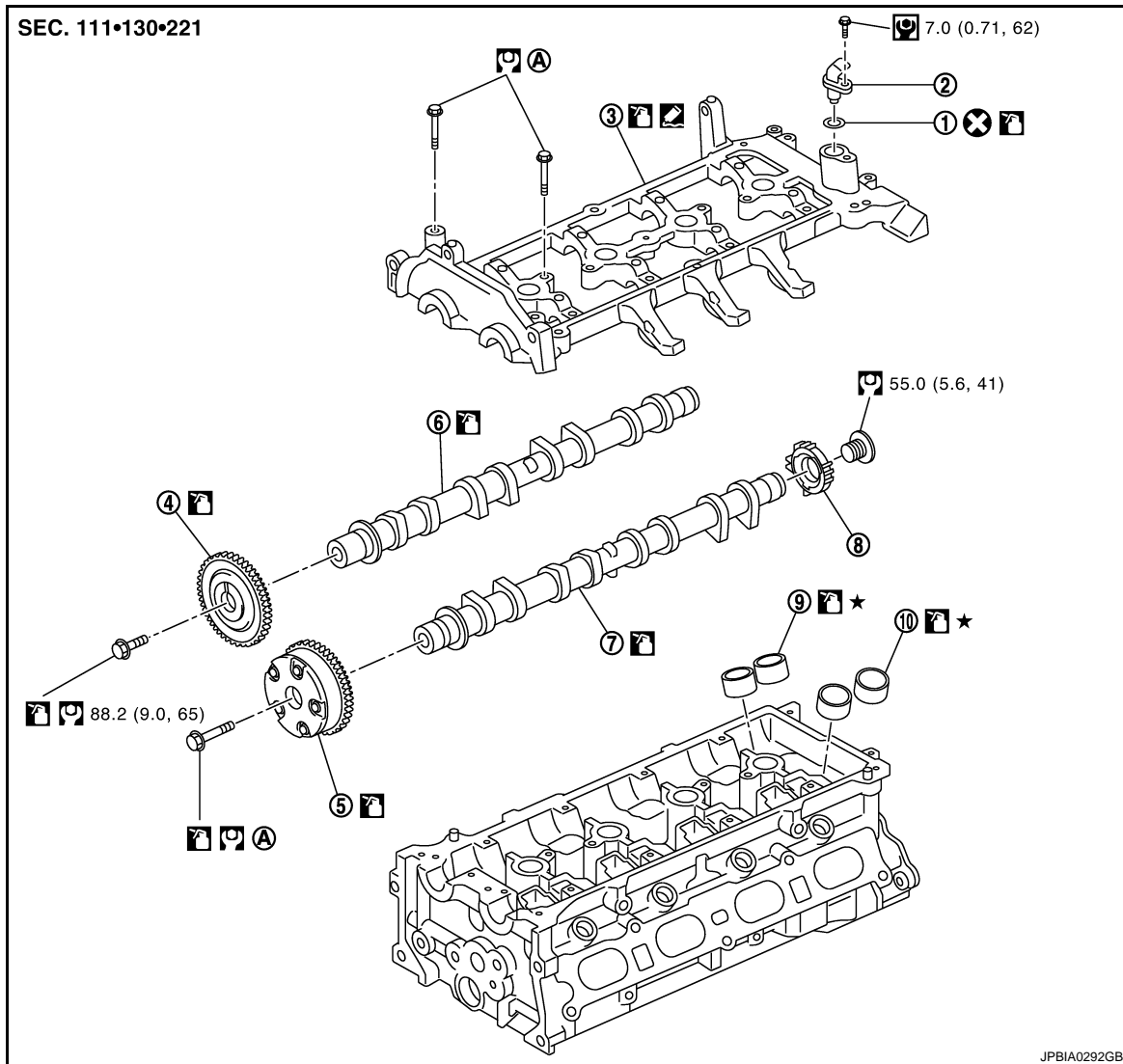
< ON-VEHICLE REPAIR >

[MR20DE]

## CAMSHAFT

### Exploded View

INFOID:000000001160552



- |                            |                                     |                       |
|----------------------------|-------------------------------------|-----------------------|
| 1. O-ring                  | 2. Camshaft position sensor (PHASE) | 3. Camshaft bracket   |
| 4. Camshaft sprocket (EXH) | 5. Camshaft sprocket (INT)          | 6. Camshaft (EXH)     |
| 7. Camshaft (INT)          | 8. Signal plate                     | 9. Valve lifter (EXH) |
| 10. Valve lifter (INT)     |                                     |                       |

A. Refer to [EM-54](#)

Refer to [GI-4. "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160553

### CAUTION:

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

### REMOVAL

- Remove the following parts.
  - Intake manifold: Refer to [EM-27. "Exploded View"](#).
  - Rocker cover: Refer to [EM-41. "Exploded View"](#).
  - Front cover and timing chain related parts: Refer to [EM-43. "Exploded View"](#).

### NOTE:

# CAMSHAFT

[MR20DE]

## < ON-VEHICLE REPAIR >

Removal of balancer unit related part is not necessary.

2. Remove camshaft position sensor (PHASE) from camshaft bracket.

**CAUTION:**

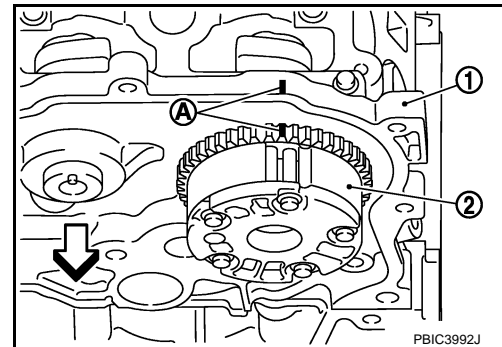
- Handle camshaft position sensor (PHASE) carefully and avoid impacts.
- Never disassemble camshaft position sensor (PHASE).
- Never place sensor where it is exposed to magnetism.

3. Put the matching mark (A) on the camshaft sprocket (INT) (2) and the camshaft bracket (1) as shown in the figure.

← : Engine front

**NOTE:**

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

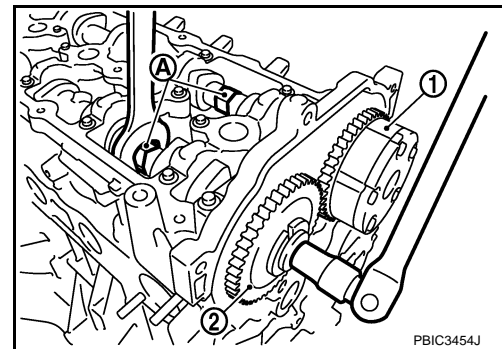


4. Remove camshaft sprockets (INT) (1) and (EXH) (2).

• Secure hexagonal part (A) of camshaft with a wrench. Loosen camshaft sprocket mounting bolts and remove camshaft sprocket.

**CAUTION:**

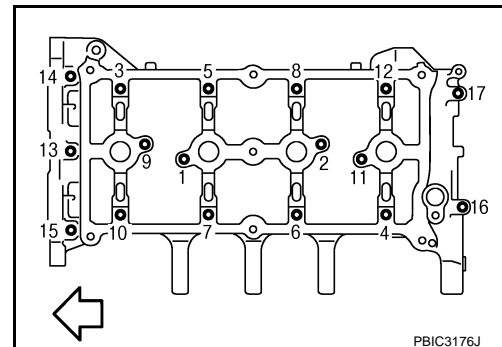
- Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.
- Never loosen the mounting bolts with securing anything other than the camshaft hexagonal part or with tensioning the timing chain.



5. Remove camshaft bracket with the following procedure:

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

← : Engine front

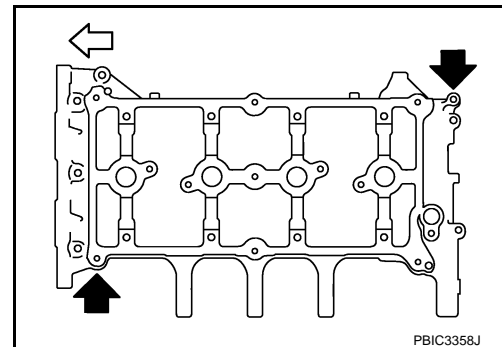


- b. Cut liquid gasket by prying the position (↖) shown in the figure, and then remove the camshaft bracket.

← : Engine front

**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 the position not specified.



6. Remove camshafts.

7. Remove valve lifters.

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

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# CAMSHAFT

[MR20DE]

< ON-VEHICLE REPAIR >

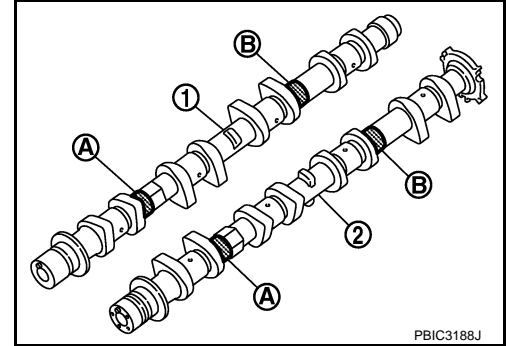
8. Remove signal plate from camshaft (INT), if necessary.

## INSTALLATION

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

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

Identification color	A	B
Camshaft (EXH)	—	White
Camshaft (INT)	White	—

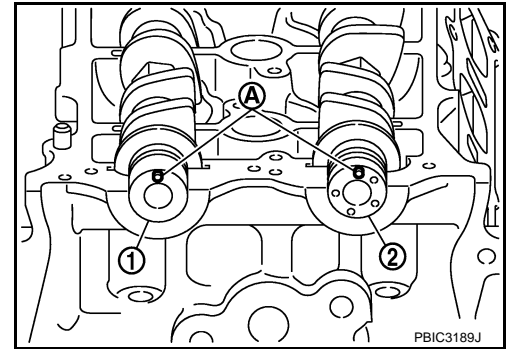


- Install camshafts so that camshaft dowel pins (A) on the front side are positioned as shown in the figure.

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

**NOTE:**

Though camshaft does not stop at the positions 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.

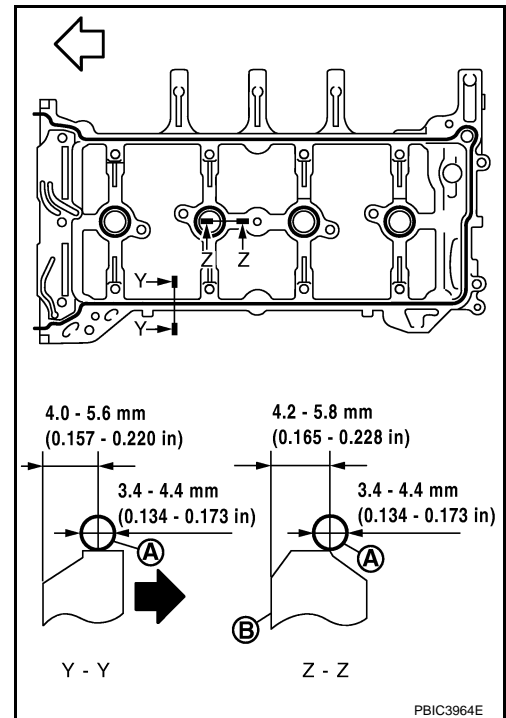


3. Install camshaft bracket with the following procedure:

- a. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- b. Apply liquid gasket (A) to camshaft bracket as shown in the figure.

- B : Plug hole inner wall
- ⇐ : Engine front
- ⇐ : Engine outside

**Use Genuine Liquid Gasket or equivalent.**



# CAMSHAFT

[MR20DE]

## < ON-VEHICLE REPAIR >

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

↶ : Engine front

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

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

**M6 bolts [thread length: 35.00 mm (1.378 in)]**  
: Except the above

- i. Tighten mounting bolts in numerical order.

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

- ii. Tighten mounting bolts in numerical order.

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

- iii. Tighten mounting bolts in numerical order.

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

### CAUTION:

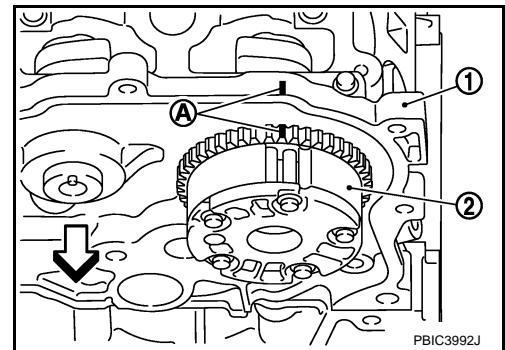
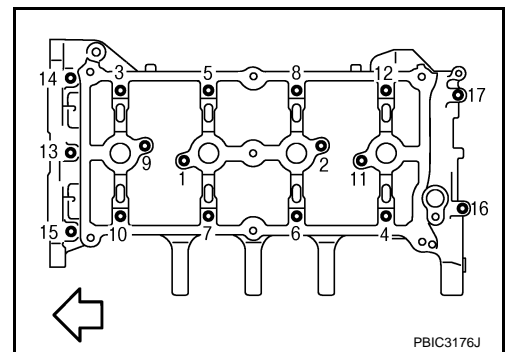
**After tightening mounting bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the mating surface of cylinder head.**

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

- a. When the camshaft sprocket (INT) (2) is removed, refer to the paint mark (A) put according to step "3". Securely align the knock pin and the pin hole, and then install them.

1 : Camshaft bracket

↶ : Engine front



- b. Tighten bolts in the following steps.

- Secure the hexagonal part of camshaft (INT) using wrench to tighten mounting bolt.

- i. Tighten camshaft (INT) mounting bolt.

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

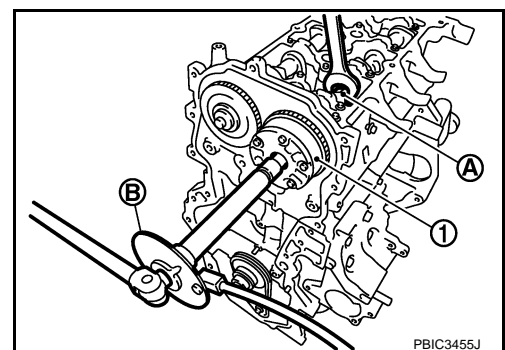
- ii. Turn 67 degrees clockwise (angle tightening).

1 : Camshaft sprocket (INT)

A : Camshaft (INT) hexagonal part

### CAUTION:

**Check the tightening angle by using an angle wrench [SST: KV10112100] (B) or protractor. Never judge by visual inspection without an angle wrench.**



# CAMSHAFT

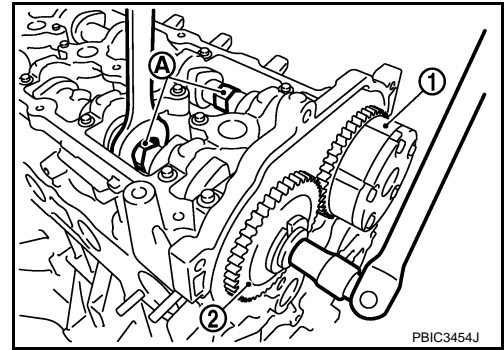
[MR20DE]

## < ON-VEHICLE REPAIR >

### 5. Install camshaft sprocket (EXH) (2).

1 : Camshaft sprocket (INT)

- Secure the hexagonal part (A) of camshaft (EXH) using wrench to tighten mounting bolt.



### 6. Install timing chain and related parts. Refer to [EM-43. "Exploded View"](#).

### 7. Inspect and adjust valve clearance. Refer to [EM-20. "Inspection and Adjustment"](#).

### 8. Install remaining parts in the reverse order of removal.

## Inspection

INFOID:000000001160554

## INSPECTION AFTER REMOVAL

### Camshaft Runout

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

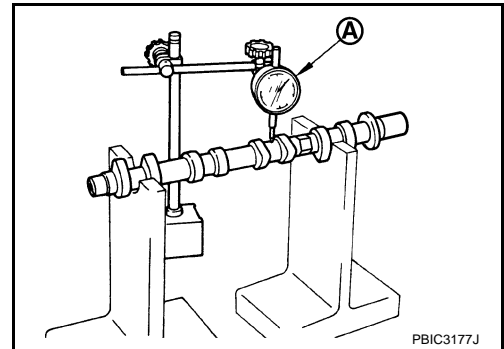
#### **CAUTION:**

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

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

**Standard and Limit** : Refer to [EM-120. "Camshaft"](#).

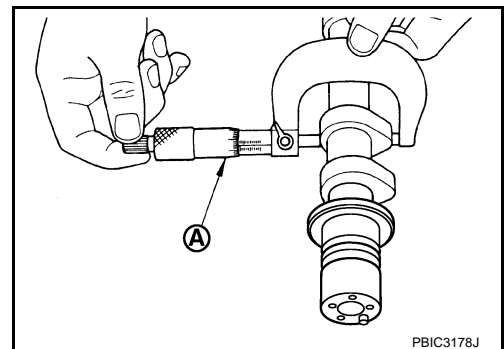
4. If it exceeds the limit, replace camshaft.



### Camshaft Cam Height

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

**Standard and Limit** : Refer to [EM-120. "Camshaft"](#).



2. If it exceeds the limit, replace camshaft.

### Camshaft Journal Oil Clearance

## CAMSHAFT JOURNAL OUTER DIAMETER

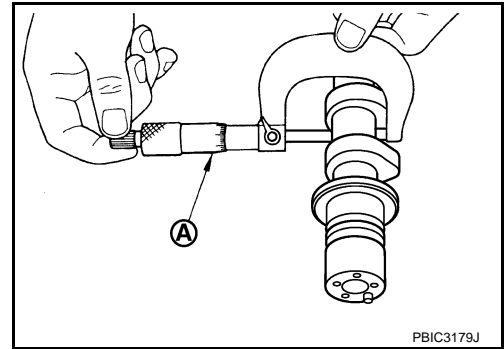
# CAMSHAFT

[MR20DE]

## < ON-VEHICLE REPAIR >

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

**Standard** : Refer to [EM-120, "Camshaft"](#).

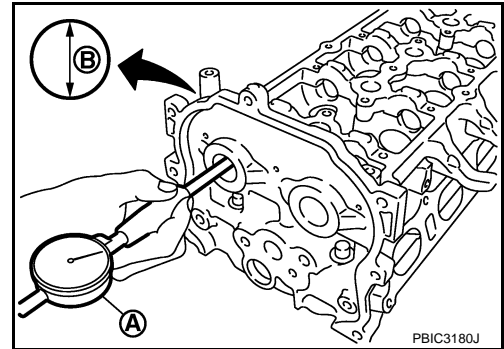


### CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque. Refer to [EM-54, "Removal and Installation"](#).
- Measure the inner diameter of camshaft bracket with a bore gauge (A).

B : Measuring direction of inner diameter

**Standard** : Refer to [EM-120, "Camshaft"](#).



### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard and Limit** : Refer to [EM-120, "Camshaft"](#).

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

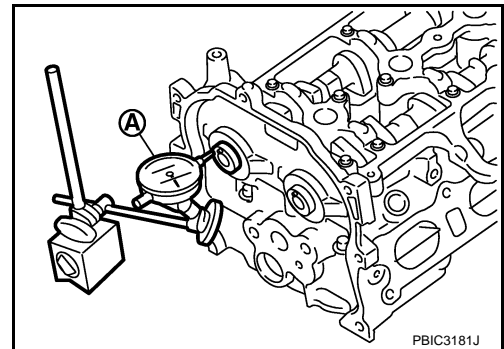
#### NOTE:

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

### Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-54, "Removal and Installation"](#).
2. Install dial indicator in thrust direction on front end of camshaft. Read the end play of dial indicator (A) when camshaft is moved forward/backward (in direction to axis).

**Standard and Limit** : Refer to [EM-120, "Camshaft"](#).



# CAMSHAFT

[MR20DE]

## < ON-VEHICLE REPAIR >

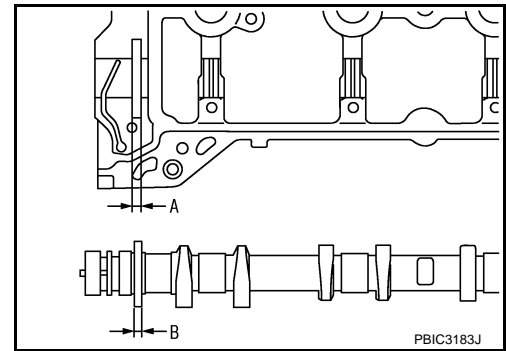
- Measure the following parts if out of the standard.
  - Dimension "A" for groove of cylinder head No. 1 journal

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

- Dimension "B" for camshaft flange

**Standard : 3.877 - 3.925 mm (0.1526 - 0.1545 in)**

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



### Camshaft Sprocket Runout

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

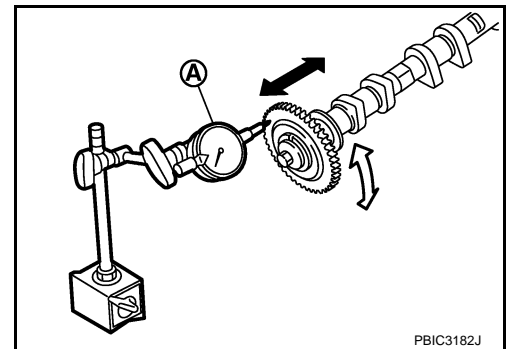
**CAUTION:**

**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 (A).  
(Total indicator reading)

**Limit : Refer to [EM-120, "Camshaft"](#).**

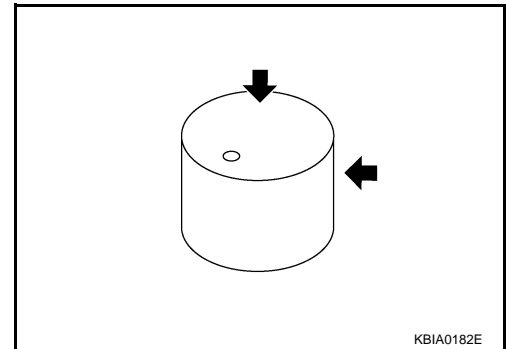
- If it exceeds the limit, replace camshaft sprocket.



### Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-120, "Camshaft"](#).

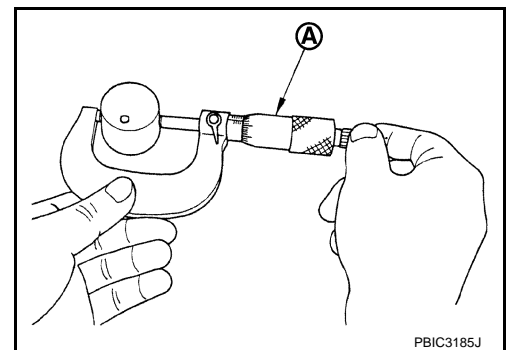


### Valve Lifter Clearance

#### VALVE LIFTER OUTER DIAMETER

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

**Standard : Refer to [EM-120, "Camshaft"](#).**



#### VALVE LIFTER HOLE DIAMETER



# CAMSHAFT

< ON-VEHICLE REPAIR >

[MR20DE]

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

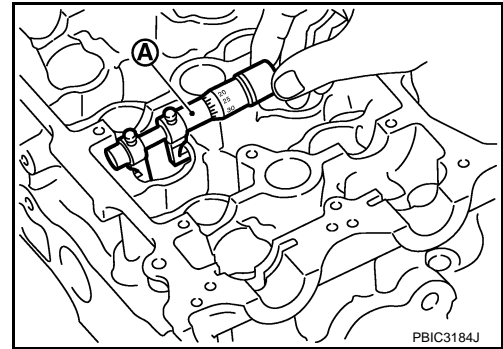
**Standard** : Refer to [EM-120, "Camshaft"](#).

## VALVE LIFTER CLEARANCE

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

**Standard** : Refer to [EM-120, "Camshaft"](#).

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



## INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

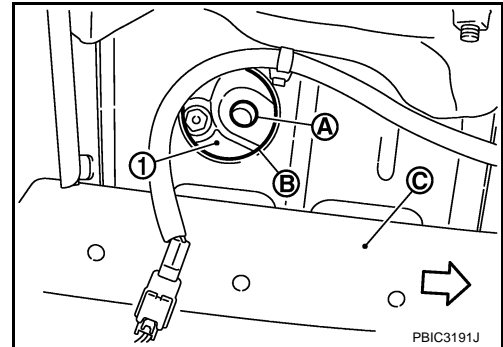
### CAUTION:

- Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-III and it is directed according to inspection procedure of EC section. Refer to [ECM-111, "Diagnosis Procedure"](#).

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

1. Check engine oil level. Refer to [LU-6, "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 [ECM-349, "Inspection"](#).
  - b. Remove intake manifold. Refer to [EM-27, "Exploded View"](#).
  - c. Disconnect ignition coil and injector harness connectors.
3. Remove intake valve timing control solenoid valve. Refer to [EM-43, "Exploded View"](#).
4. Clean the mounting area of intake valve timing control solenoid valve, and then insert a clean waste with no oil adhesion into the oil hole (A) of the cylinder head.

- 1 : Front cover
- B : Service hole
- C : Member on RH side
- ⇐ : Engine front



5. Install engine mounting insulator (RH). (After the removal of intake valve timing control solenoid valve and insertion of a waste into the oil hole.)
6. Perform cranking to check that engine oil comes out from the oil hole (mounting hole of intake valve timing control solenoid valve) of cylinder head.
  - Regarding the engine oil check, judge it by the amount of oil adhered to the wasted inserted into the oil hole.

### WARNING:

- Never insert fingers into the oil hole from the service hole of the member on the RH side.
- Be careful not to touch rotating parts (drive belt, idler pulleys and crankshaft pulley, etc.).

### CAUTION:

- Never perform cranking without installing the engine mounting insulator (RH).
  - Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.
  - Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belt, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.
7. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.

## CAMSHAFT

[MR20DE]

### < ON-VEHICLE REPAIR >

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- Remove oil filter (for intake valve timing control solenoid), and then clean it. Refer to [EM-43. "Exploded View"](#).
  - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-3. "Engine Lubrication System"](#) and [LU-3. "Engine Lubrication System Schematic"](#).
8. 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-3. "Engine Lubrication System"](#) and [LU-3. "Engine Lubrication System Schematic"](#).
  9. After inspection, install removed parts in the reverse order.

## OIL SEAL

## VALVE OIL SEAL

## VALVE OIL SEAL : Removal and Installation

INFOID:000000001160555

A

EM

## REMOVAL

1. Remove camshafts. Refer to [EM-54. "Exploded View"](#).
2. Remove valve lifters. Refer to [EM-54. "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.

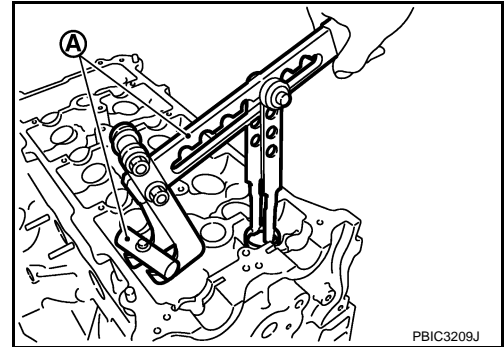
**CAUTION:**

**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, the attachment and the adapter [SST: KV10116200] (A).

**CAUTION:**

**Be careful not to damage valve lifter holes.**

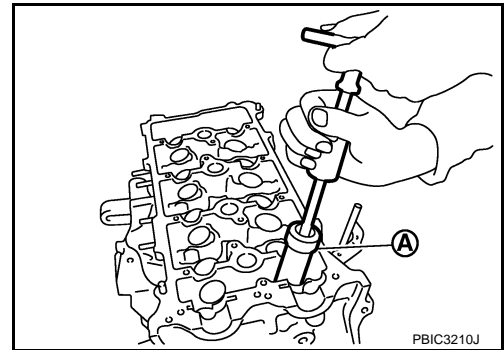


5. Remove valve spring retainer and valve spring (with valve spring seat).

**CAUTION:**

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

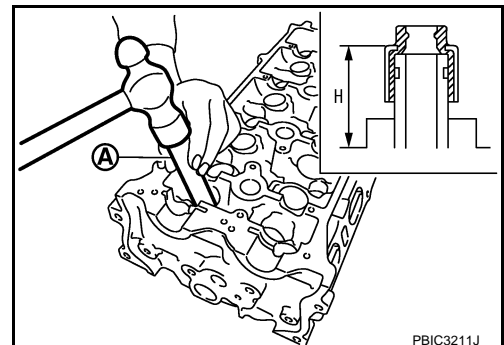
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



## 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" : 15.1 - 15.7 mm (0.594 - 0.618 in)**



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

## FRONT OIL SEAL

## FRONT OIL SEAL : Removal and Installation

INFOID:000000001160556

### REMOVAL

1. Remove the following parts.
  - Front fender protector (RH): Refer to [EXT-21, "Exploded View"](#).
  - Drive belt: Refer to [EM-15, "Exploded View"](#).
  - Crankshaft pulley: Refer to [EM-43, "Exploded View"](#).
2. Remove front oil seal with a suitable tool.

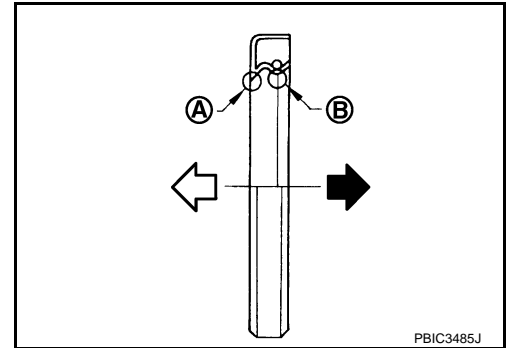
**CAUTION:**

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

### INSTALLATION

1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown 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 57 mm (2.24 in) and inner diameter 45 mm (1.77 in).

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

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

**CAUTION:**

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

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

## REAR OIL SEAL

### REAR OIL SEAL : Removal and Installation

INFOID:000000001160557

### REMOVAL

1. Remove transaxle assembly. Refer to following.
  - [TM-26, "Exploded View"](#) [M/T(2WD models)]
  - [TM-85, "Exploded View"](#) [M/T(4WD models)]
  - [TM-546, "MR20DE : Exploded View"](#) (CVT models)
2. Remove clutch cover and clutch disk (M/T models). Refer to [CL-18, "MR20DE, QR25DE : Exploded View"](#).
3. Remove drive plate (CVT models) or flywheel (M/T models). Refer to [EM-93, "Exploded View"](#).
4. Remove rear oil seal with a suitable tool.

**CAUTION:**

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

### INSTALLATION

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

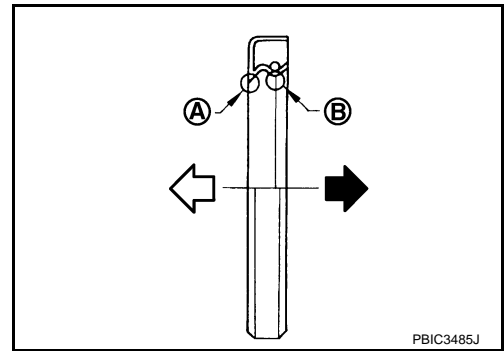
# OIL SEAL

< ON-VEHICLE REPAIR >

[MR20DE]

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

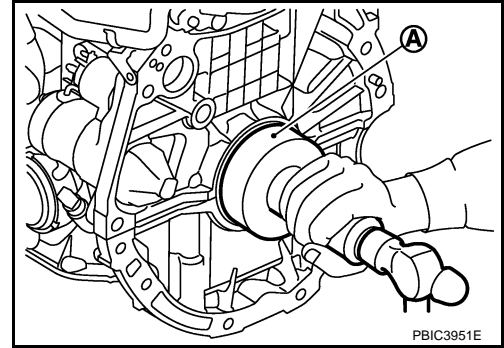
- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



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

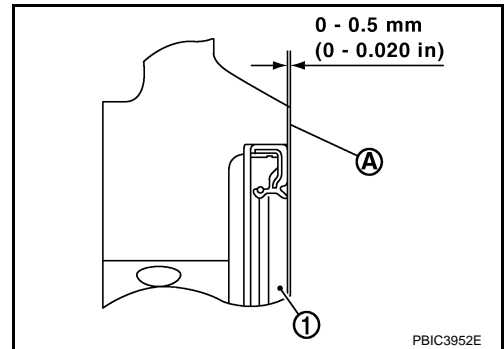
**CAUTION:**

- Be careful not to 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



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

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

# CYLINDER HEAD

< ON-VEHICLE REPAIR >

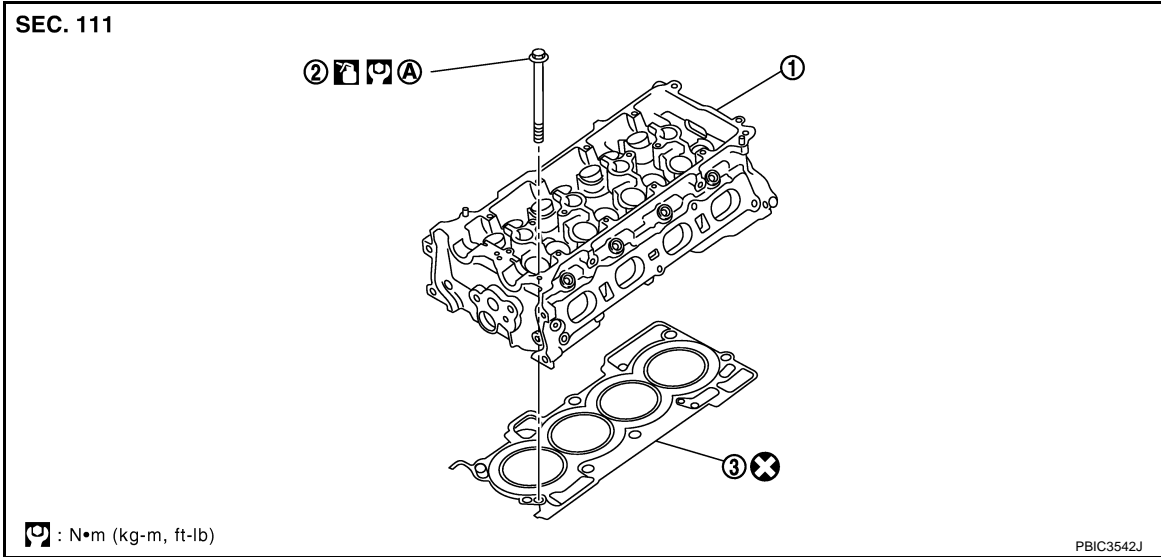
[MR20DE]

## CYLINDER HEAD

Exploded View

INFOID:000000001160558

REMOVAL



1. Cylinder head assembly

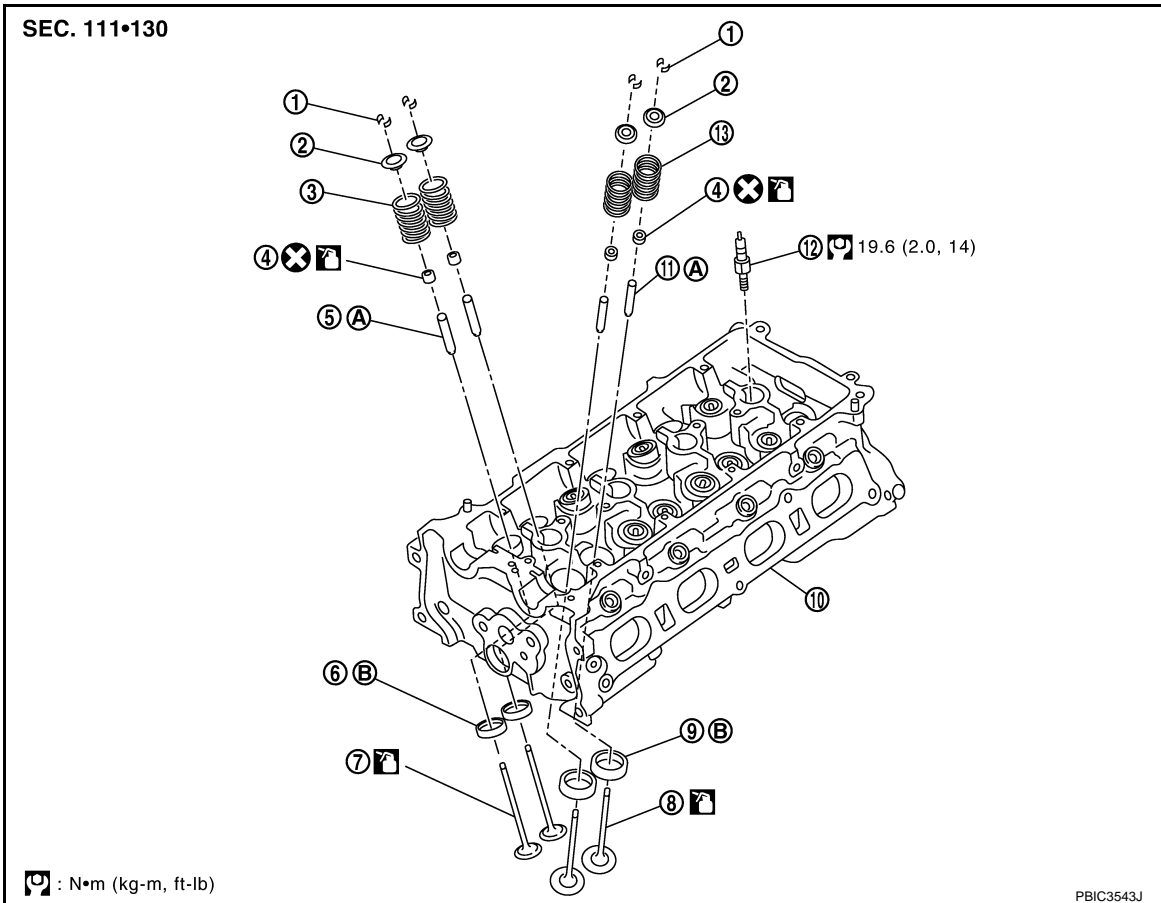
2. Cylinder head bolt

3. Cylinder head gasket

A. Refer to [EM-67](#)

Refer to [GI-4. "Components"](#) for symbols in the figure.

DISSASSEMBLY



EM-66

# CYLINDER HEAD

< ON-VEHICLE REPAIR >

[MR20DE]

- |  |                          |   |
|--|--------------------------|---|
| 1. Valve collet                                    | 2. Valve spring retainer | 3. Valve spring (EXH)<br>(with valve spring seat) |
| 4. Valve oil seal                                  | 5. Valve guide (EXH)     | 6. Valve seat (EXH)                               |
| 7. Valve (EXH)                                     | 8. Valve (INT)           | 9. Valve seat (INT)                               |
| 10. Cylinder head                                  | 11. Valve guide (INT)    | 12. Spark plug                                    |
| 13. Valve spring (INT)<br>(with valve spring seat) |                          |   |
- A. Refer to [EM-68](#)                      B. Refer to [EM-68](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

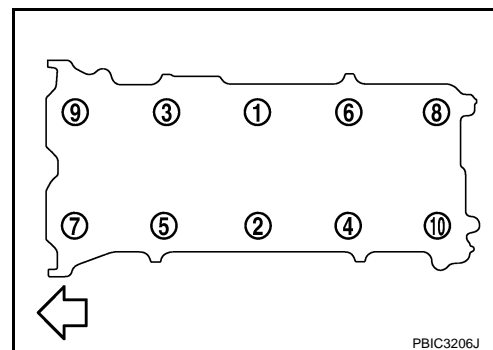
INFOID:000000001160559

### REMOVAL

1. Release fuel pressure. Refer to [ECM-349, "Inspection"](#).
2. Drain engine coolant and engine oil. Refer to [CO-10, "Draining"](#) and [LU-7, "Draining"](#).
3. Remove the following components and related parts.
  - Exhaust manifold: Refer to [EM-30, "Exploded View"](#).
  - Intake manifold: Refer to [EM-27, "Exploded View"](#).
  - Fuel tube and fuel injector assembly: Refer to [EM-36, "Exploded View"](#).
  - Water outlet: Refer to [CO-30, "Exploded View"](#).
  - Rocker cover: Refer to [EM-41, "Exploded View"](#).
  - Front cover, timing chain: Refer to [EM-43, "Exploded View"](#).
  - Camshaft: Refer to [EM-54, "Exploded View"](#).
4. Remove cylinder head.
  - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

- Using TORX socket (size E18), loosen cylinder head bolts.



5. Remove cylinder head gasket.

### INSTALLATION

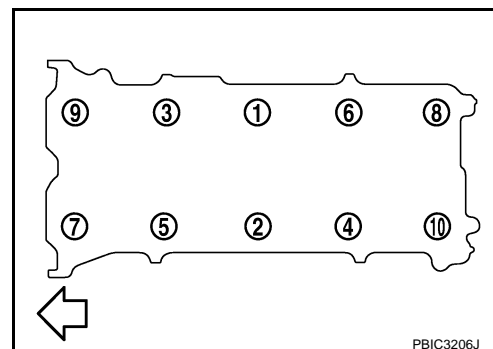
1. Install cylinder head gasket.
2. Install cylinder head, and tighten cylinder head bolts in numerical order as shown in figure with the following procedure.

⇐ : Engine front

#### CAUTION:

**If cylinder head bolts are re-used, check their outer diameters before installation. Refer to [EM-72, "Inspection"](#).**

- a. Apply new engine oil to threads and seating surface of mounting bolts.
- b. Tighten all bolts.



: **40.0 N·m (4.1 kg-m, 30 ft-lb)**

# CYLINDER HEAD

[MR20DE]

< ON-VEHICLE REPAIR >

- c. Turn all bolts 100 degrees clockwise (angle tightening).

**CAUTION:**

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100] (A) or protractor. Never judge by visual inspection without the tool.

- d. Completely loosen.

: 0 N·m (0 kg·m, 0 ft·lb)

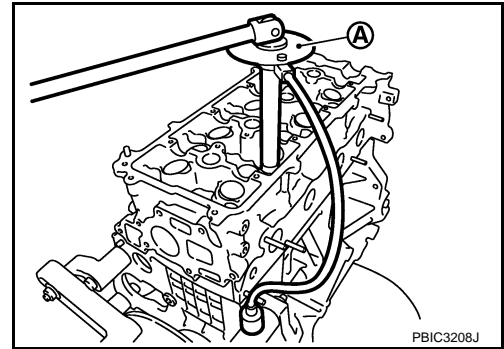
**CAUTION:**

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

- e. Tighten all bolts.

: 40.0 N·m (4.1 kg·m, 30 ft·lb)

- f. Turn all bolts 100 degrees clockwise (angle tightening).  
g. Turn all bolts 100 degrees clockwise again (angle tightening).  
3. Install in the reverse order of removal, for the rest of parts.



PBIC3208J

## Disassembly and Assembly

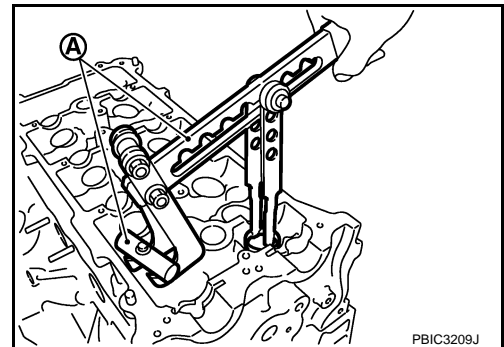
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### DISASSEMBLY

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

**CAUTION:**

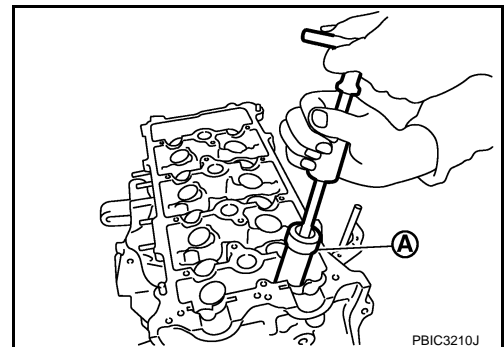
Be careful not to damage valve lifter holes.



PBIC3209J

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

**CAUTION:**  
Never remove valve spring seat from valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
  - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal with a valve oil seal puller [SST: KV10107902] (A).



PBIC3210J

7. When valve seat must be replaced.



# CYLINDER HEAD

[MR20DE]

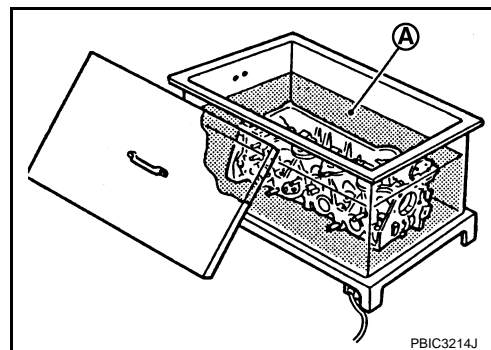
## < ON-VEHICLE REPAIR >

- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-121, "Cylinder Head"](#).

**CAUTION:**

**Never bore excessively to prevent cylinder head from scratching.**

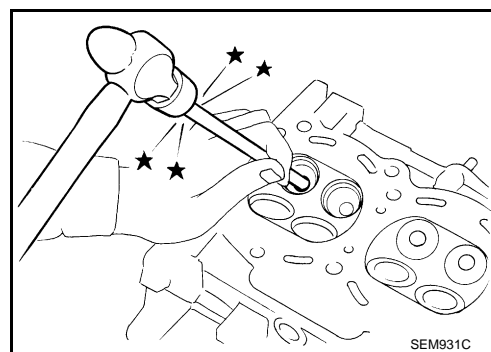
8. When valve guide must be replaced.
  - a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



- b. Drive out valve guide with a hammer and valve guide drift (commercial service tool).

**CAUTION:**

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



## ASSEMBLY

1. When valve guide is removed, install it.

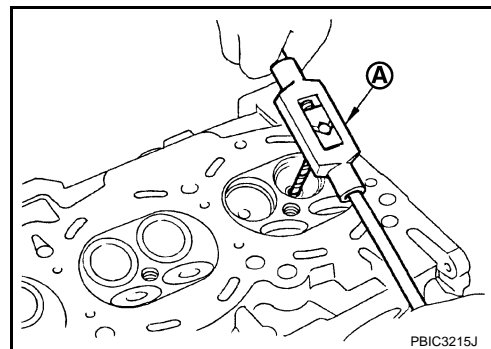
**CAUTION:**

**Replace with oversize [0.2 mm (0.008 in)] valve guide.**

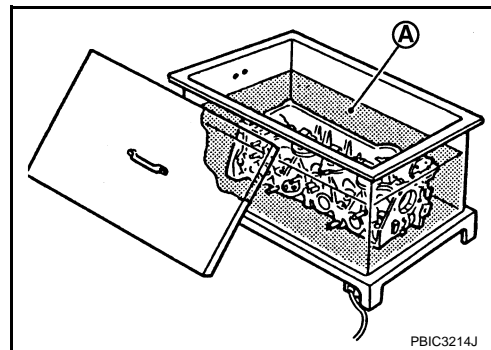
- a. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool) (A).

**For service parts: Oversize [0.2 mm (0.008 in)]**

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



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



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# CYLINDER HEAD

[MR20DE]

## < ON-VEHICLE REPAIR >

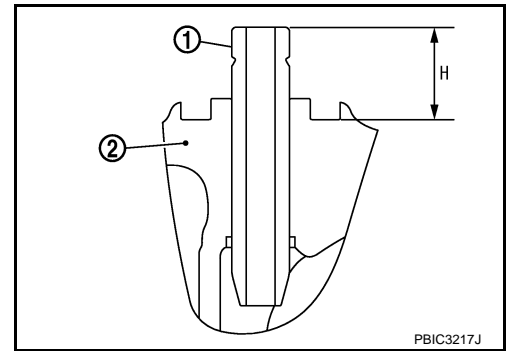
- c. Press valve guide (1) from camshaft side to dimensions as shown in the figure.

2 : Cylinder head

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

**CAUTION:**

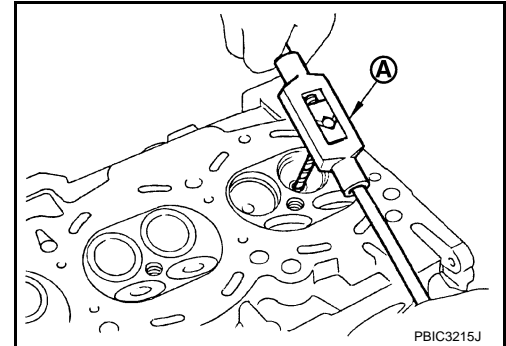
Cylinder head contains heat, wear protective equipment to avoid getting burned.



PBIC3217J

- d. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool) (A).

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



PBIC3215J

2. When valve seat is removed, install it.

**CAUTION:**

Replace with oversize [0.5 mm (0.020 in)] valve seat.

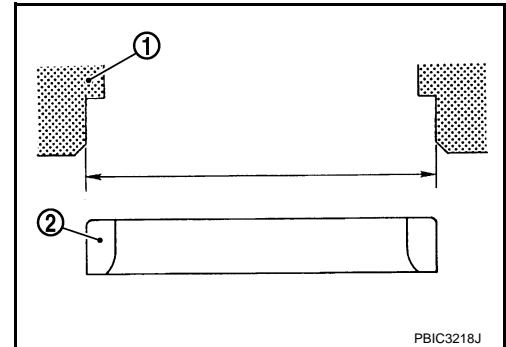
- a. Ream cylinder head (1) recess diameter for service valve seat.

2 : Valve seat

**For service parts: Oversize [0.5 mm (0.020 in)]**

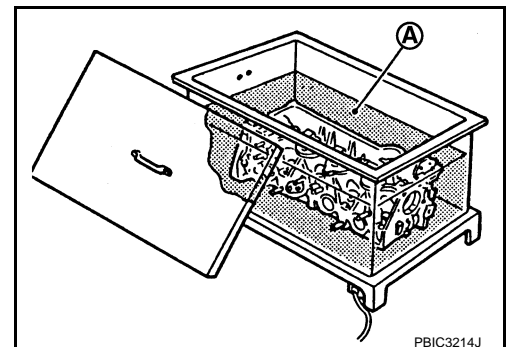
**Refer to [EM-121, "Cylinder Head"](#).**

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



PBIC3218J

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



PBIC3214J

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

**CAUTION:**

- Never touch cold valve seats directly.
- Cylinder head contains heat, wear protective equipment to avoid getting burned.

# CYLINDER HEAD

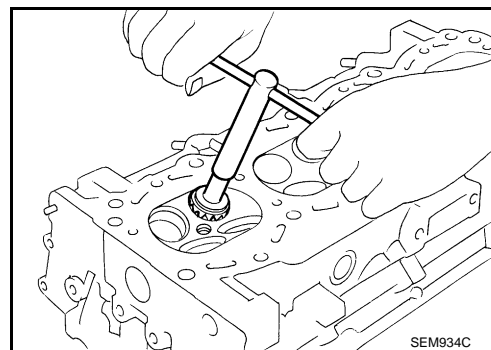
[MR20DE]

## < ON-VEHICLE REPAIR >

- d. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to [EM-121. "Cylinder Head"](#).

**CAUTION:**

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



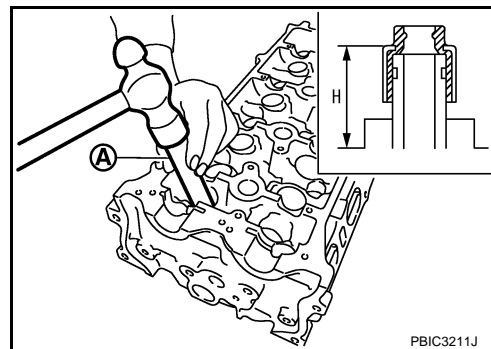
- e. Using compound, grind to adjust valve fitting.  
f. Check again for normal contact. Refer to [EM-72. "Inspection"](#).  
3. Install valve oil seal.

- Install with a valve oil seal drift [SST:KV10115600] (A) to match dimension in the figure.

**NOTE:**

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

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



4. Install valve.  
• Install larger diameter to intake side.

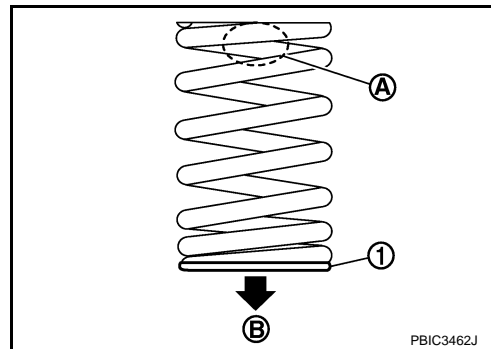
5. Install valve spring (with valve spring seat).  
• Install smaller pitch (valve spring seat side) to cylinder head side (B).

1 : Valve spring seat (Do not remove from valve spring.)

- Confirm identification color (A) of valve spring.

**Intake : Green**

**Exhaust : Purple**



6. Install valve spring retainer.

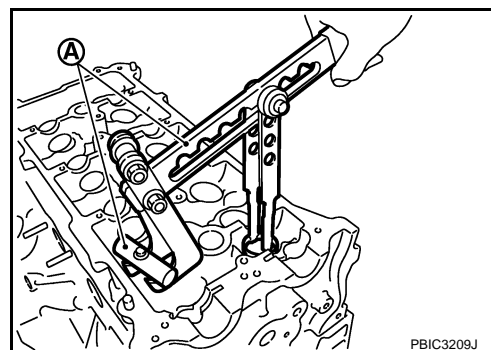
7. Install valve collet.

- Compress valve spring with a valve spring compressor, attachment and adapter [SST: KV10116200] (A). Install valve collet with a magnet hand.

**CAUTION:**

**Be careful not to damage valve lifter holes.**

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



8. Install valve lifter.

- Install it in the original position.

# CYLINDER HEAD

[MR20DE]

< ON-VEHICLE REPAIR >

9. Install spark plug with spark plug wrench (commercial service tool).

## Inspection

INFOID:000000001160561

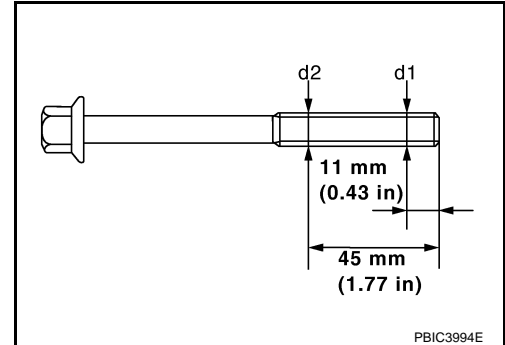
### INSPECTION AFTER REMOVAL

#### 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 checked. Refer to [EM-124, "Cylinder Block"](#).

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

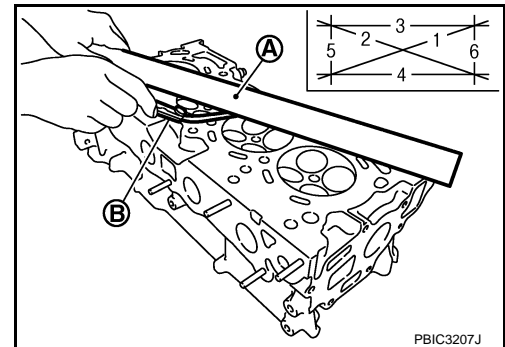
##### CAUTION:

**Never allow gasket debris to enter passages for engine oil or water.**

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions using straightedge (A) and feeler gauge (B).

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

- If it exceeds the limit, replace cylinder head.



### INSPECTION AFTER DISASSEMBLY

#### VALVE DIMENSIONS

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

#### VALVE GUIDE CLEARANCE

##### Valve Stem Diameter

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

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

##### Valve Guide Inner Diameter

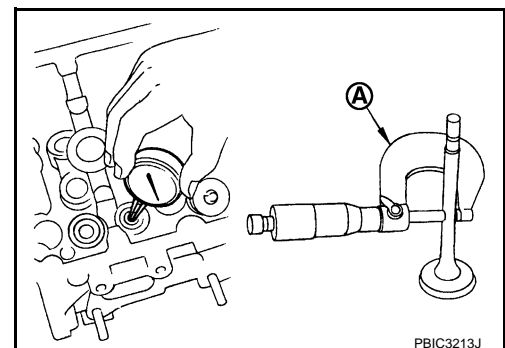
- Measure the inner diameter of valve guide with bore gauge.

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

##### Valve Guide Clearance

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

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



# CYLINDER HEAD

[MR20DE]

## < ON-VEHICLE REPAIR >

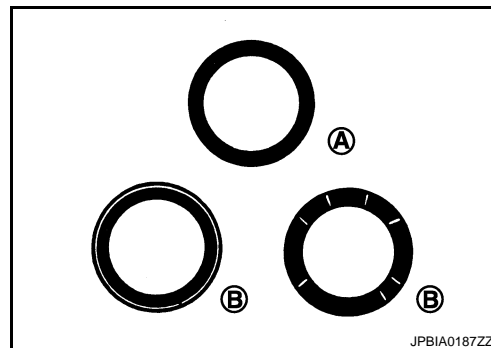
- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to [EM-68, "Disassembly and Assembly"](#).

### 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  
B : NG

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace valve seat. Refer to [EM-68, "Disassembly and Assembly"](#).



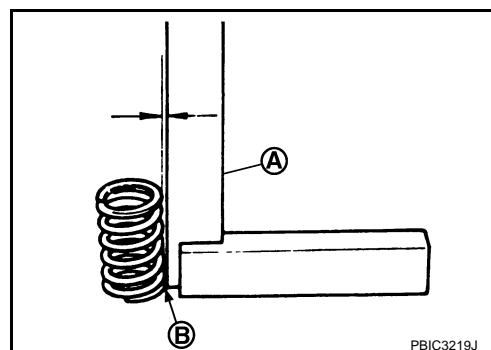
### VALVE SPRING SQUARENESS

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

B : Contact

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

- If it exceeds the limit, replace valve spring.



### VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

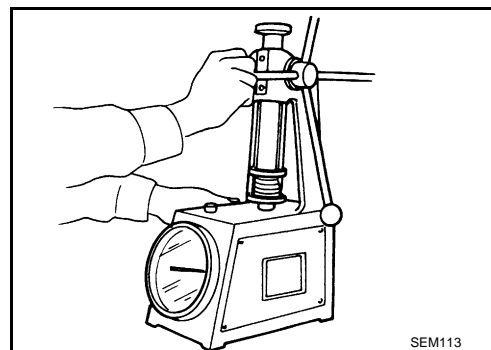
- Check valve spring pressure with valve spring seat installed at the specified spring height.

#### **CAUTION:**

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

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

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



## 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-22, "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.

# CYLINDER HEAD

< ON-VEHICLE REPAIR >

[MR20DE]

Summary of the inspection items:

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

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

# ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

[MR20DE]

## REMOVAL AND INSTALLATION

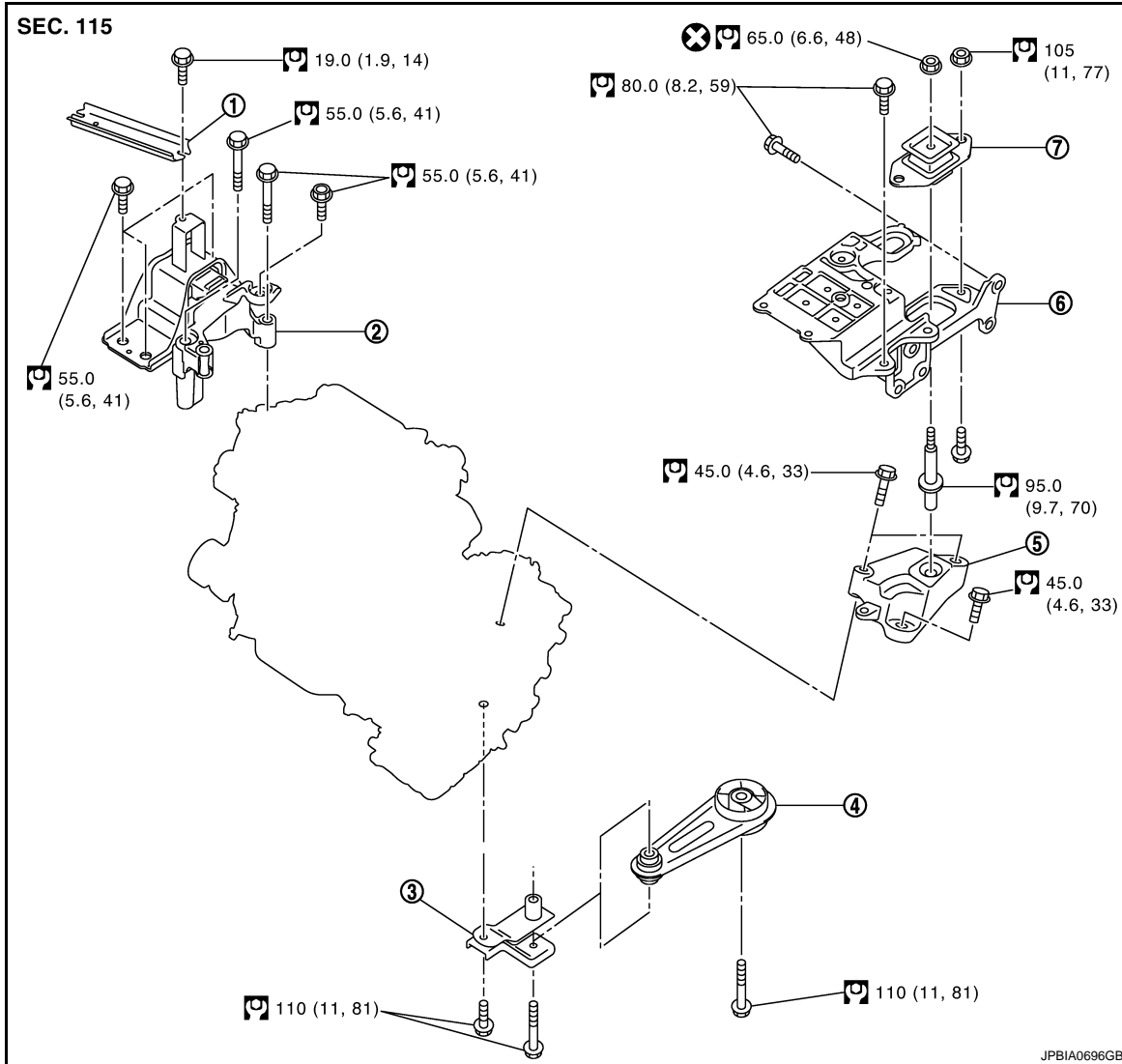
### ENGINE ASSEMBLY

M/T

M/T : Exploded View

INFOID:000000001160562

2WD models



1. Engine mounting stay
2. Engine mounting insulator (RH)
3. Rear engine mounting bracket
4. Rear torque rod
5. Engine mounting bracket (LH)
6. Engine mounting bracket support (LH)
7. Engine mounting insulator (LH)

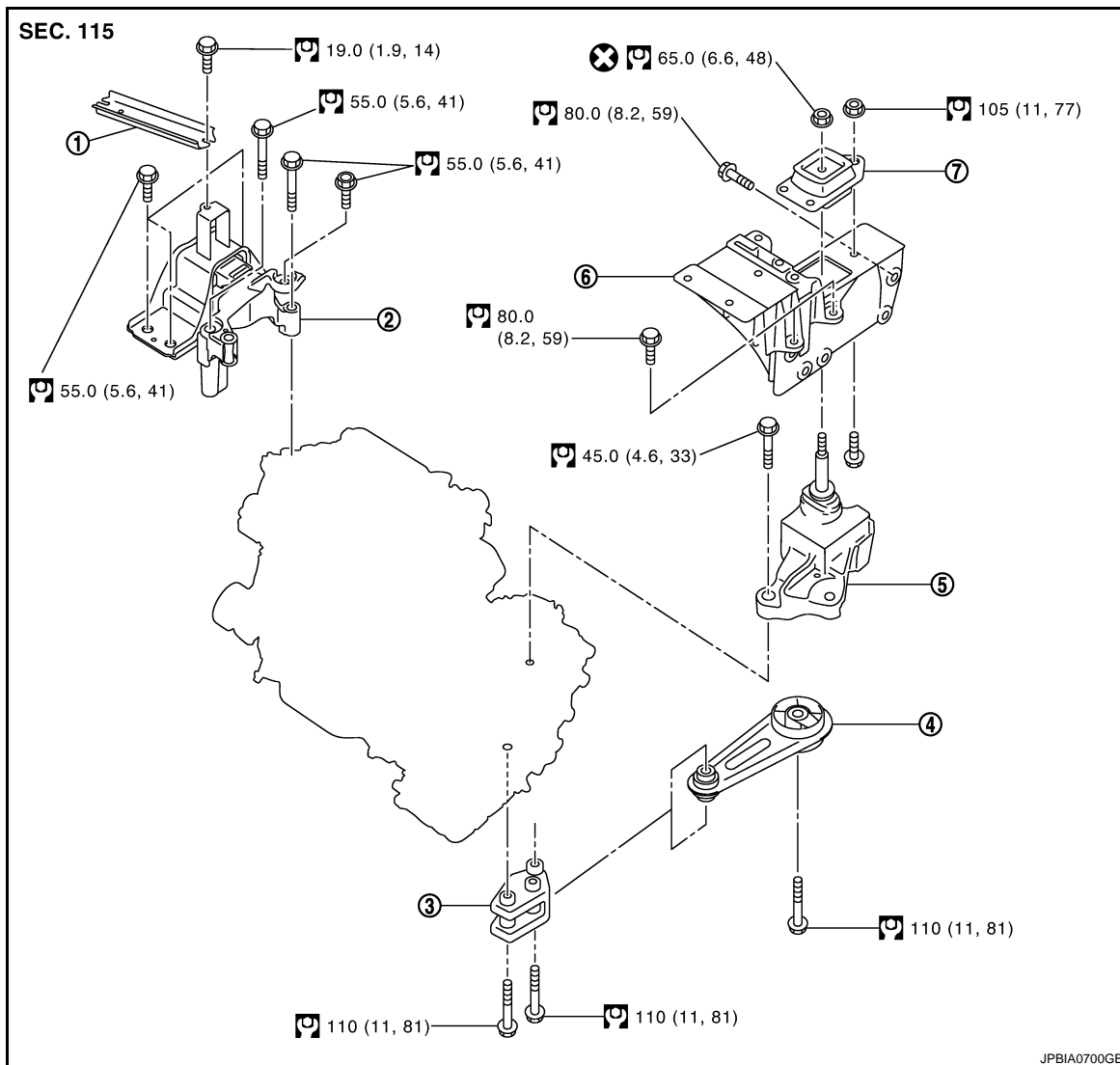
Refer to [GI-4. "Components"](#) for symbols in the figure.

4WD models

# ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

[MR20DE]



- |                                   |                                   |   |
|-----------------------------------|-----------------------------------|---|
| 1. Engine mounting stay           | 2. Engine mounting insulator (RH) | 3. Rear engine mounting bracket         |
| 4. Rear torque rod                | 5. Engine mounting bracket (LH)   | 6. Engine mounting bracket support (LH) |
| 7. Engine mounting insulator (LH) |                                   |   |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## M/T : Removal and Installation

INFOID:000000001160563

### 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.
- 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-33, "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 [ECM-349, "Inspection"](#).
2. Drain engine coolant from radiator. Refer to [CO-10, "Draining"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belt.
3. Remove the following parts.
  - Engine undercover
  - Front road wheels and tires: Refer to [WT-3, "Adjustment"](#).
  - Front fender protector (RH and LH): Refer to [EXT-21, "Exploded View"](#).
  - Engine cover: Refer to [EM-27, "Exploded View"](#).
  - Battery and battery tray: Refer to [PG-133, "Exploded View"](#).
  - Air duct and air cleaner case assembly: Refer to [EM-25, "Exploded View"](#).
  - Radiator hose (upper and lower) and cooling fan assembly: Refer to [CO-16, "Exploded View"](#).
  - Exhaust front tube: Refer to [EX-5, "Exploded View"](#).

## Engine Room LH

1. Disconnect all connections of engine harness around the engine mounting insulator (LH), 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 fuel feed hose at engine side. Refer to [EM-36, "Exploded View"](#).
3. Disconnect heater hoses. Refer to [CO-30, "Exploded View"](#).
4. Disconnect control linkage from transaxle. Refer to [TM-21, "Exploded View"](#).

## Engine Room RH

1. Disconnect vacuum hose from intake manifold. Refer to [EM-27, "Exploded View"](#).
2. Remove A/C compressor without disconnecting A/C piping, and temporarily fasten it on vehicle with a rope (with A/C models). Refer to [HA-44, "MR20DE : Exploded View"](#).
3. Disconnect reservoir tank hoses. Refer to [CO-16, "Exploded View"](#).

## Vehicle inside

- Disconnect steering lower joint at steering gear assembly side, and release steering lower shaft. Refer to [ST-13, "Exploded View"](#).

## Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-67, "FRONT WHEEL SENSOR : Exploded View"](#).
3. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-42, "BRAKE CALIPER ASSEMBLY : Exploded View"](#) (LHD models) or [BR-89, "BRAKE CALIPER ASSEMBLY : Exploded View"](#) (RHD models).
4. Disconnect steering outer sockets from steering knuckle. Refer to [ST-13, "Exploded View"](#).
5. Remove rear torque rod.
6. Remove drive shafts (LH and RH). Refer to [FAX-19, "MR20DE : Exploded View"](#) (2WD models) or [FAX-52, "MR20DE : Exploded View"](#) (4WD models).
7. Disconnect csc tube. Refer to [CL-14, "Exploded View"](#).
8. Remove propeller shaft (4WD models). Refer to [DLN-121, "Exploded View"](#).
9. Remove stabilizer connecting rod. Refer to [FSU-16, "Exploded View"](#).
10. Remove front suspension member. Refer to [FSU-18, "Exploded View"](#).
11. Preparation for the separation work of transaxle is as follows:

# ENGINE ASSEMBLY

[MR20DE]

## < REMOVAL AND INSTALLATION >

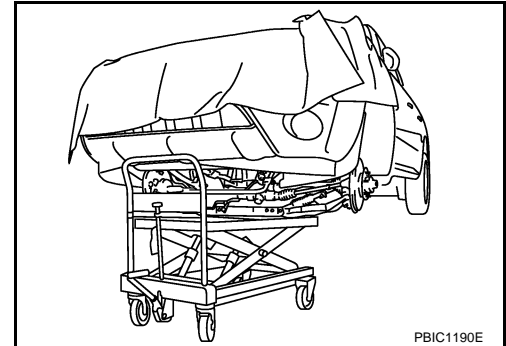
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-33. "Exploded View"](#).

### Removal

- Use a manual lift table caddy (commercial service tool) 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.

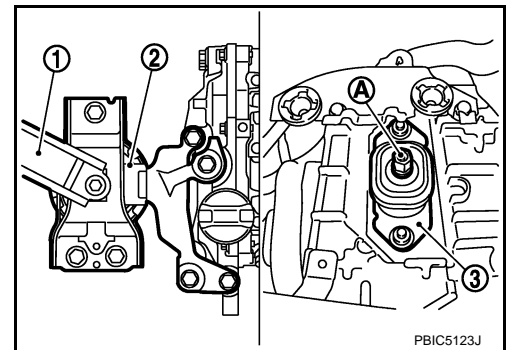


- Remove engine mounting bolts on engine mounting insulator (RH) (2).

1 : Engine mounting stay

3 : Engine mounting insulator (LH)

- Remove engine mounting through bolt-securing nut (A).



- 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

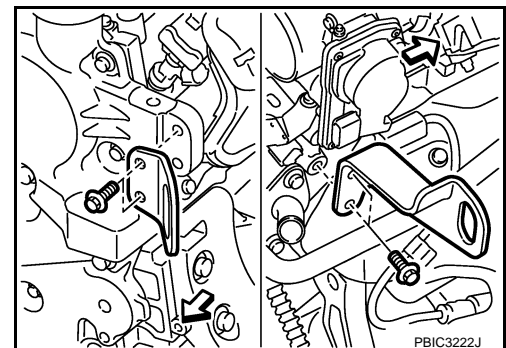
- Install engine slinger to front cover front left side and cylinder head rear right side.

⇐ : Engine front

**Slinger bolts**

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

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



- Remove starter motor. Refer to [STR-27. "MR20DE MODELS : Exploded View"](#).
- Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-26. "Exploded View"](#) (2WD models) or [TM-85. "Exploded View"](#) (4WD 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.

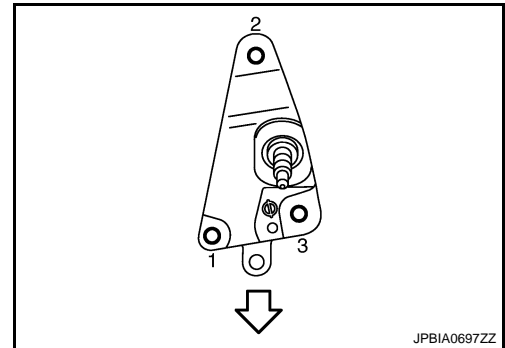
< REMOVAL AND INSTALLATION >

Preparation

1. Install the engine mounting bracket (LH) to the engine.
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

↔ : Vehicle front

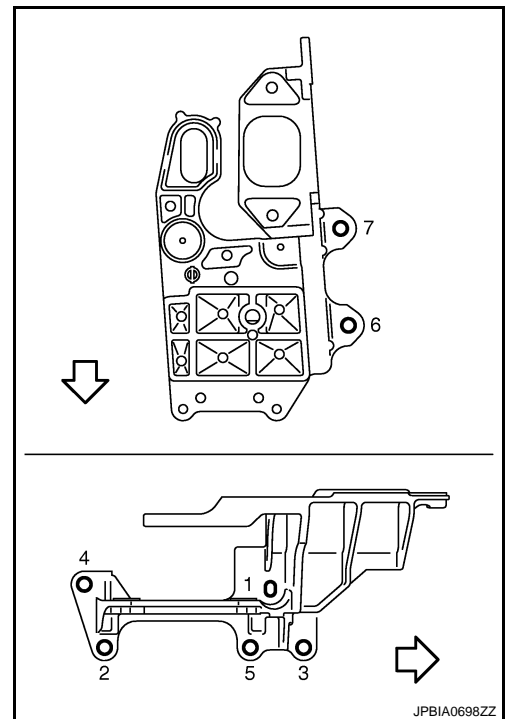
- b. Tighten the bolt No. 2, 3 in numerical order as shown in the figure. (specified torque)
  - c. Tighten the bolt No. 1 as shown in the figure. (specified torque)



2. Install the engine mounting insulator (RH) to the body temporarily.
3. Install the engine mounting bracket support (LH) to the body as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

↔ : Vehicle front

- b. Tighten the bolts No. 6, 7 in numerical order as shown in the figure. (specified torque)
  - c. Tighten the bolts No. 2, 3, 4, 5 in numerical order as shown in the figure. (specified torque)
  - d. Tighten the bolt No. 1 as shown in the figure. (specified torque)

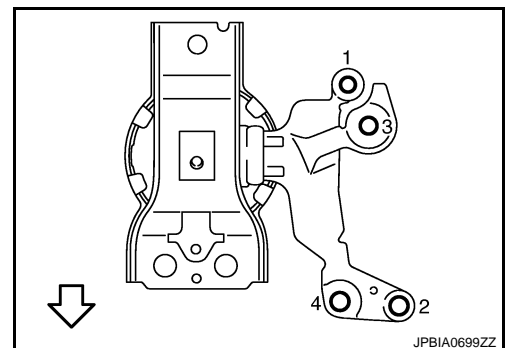


Installation

1. Install the rear bracket to the transaxle, and then tighten mounting bolts. (specified torque)
2. Install the rear torque rod to the suspension member and transaxle, and then tighten mounting bolts. (specified torque)
3. Tighten the engine mounting insulator (LH) to the specified torque.
4. Install the engine mounting insulator (RH) to the engine and tighten as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

↔ : Vehicle front

- b. Tighten the bolts No. 2, 3, 4 in numerical order as shown in the figure. (specified torque)
  - c. Tighten the bolt No. 1 as shown in the figure. (specified torque)



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# ENGINE ASSEMBLY

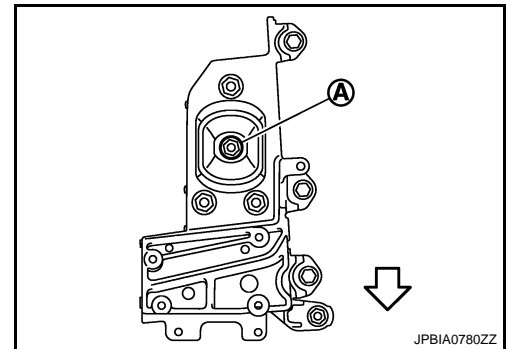
[MR20DE]

## < REMOVAL AND INSTALLATION >

- Tighten engine mounting through bolt-securing nut (A) to the specified torque.

↔ : Vehicle front

- Tighten the engine mounting insulator bolts (RH) to the body. (specified torque)



INFOID:000000001160564

## M/T : Inspection

### 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-22, "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
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

## CVT

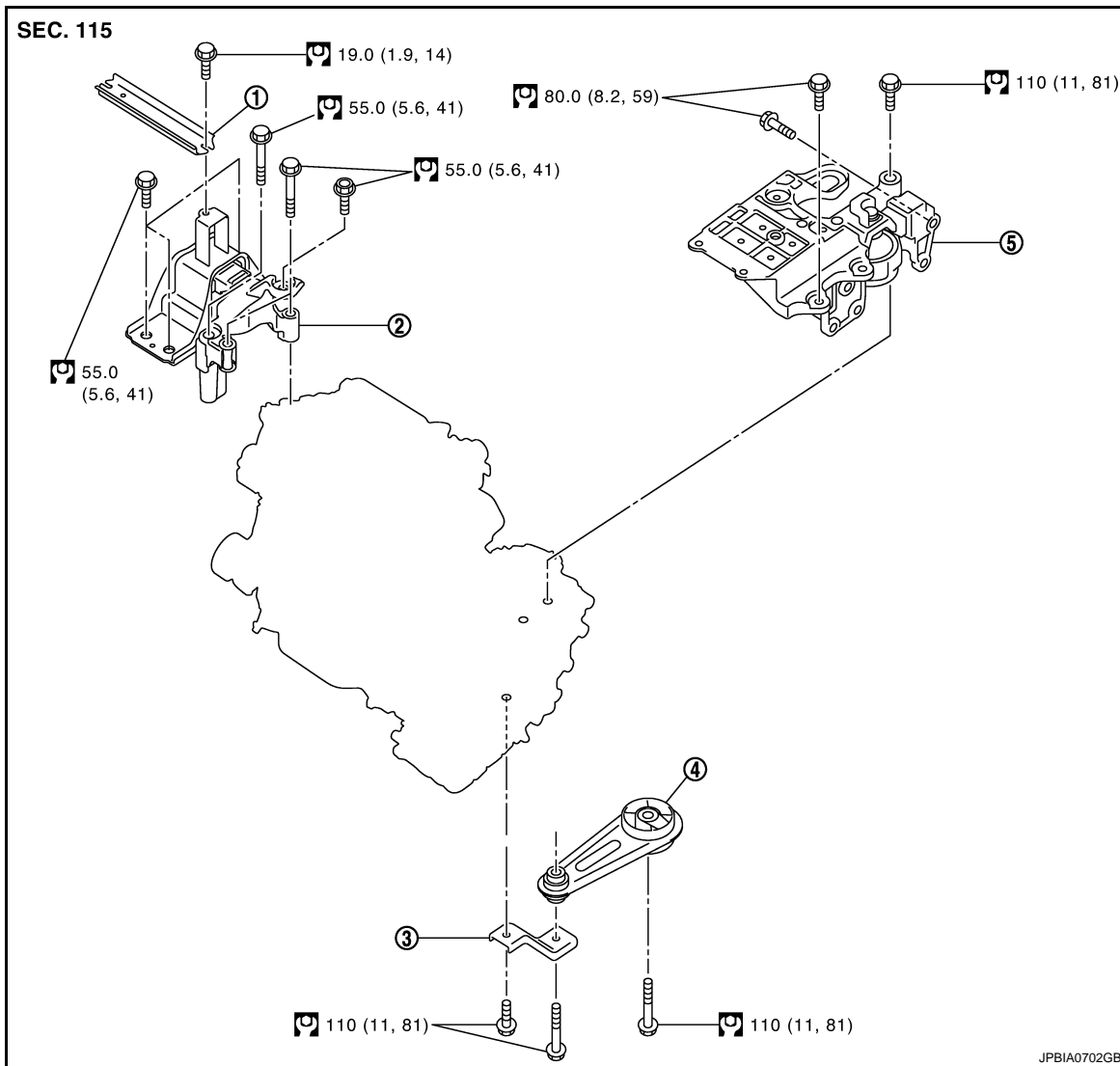
# ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

[MR20DE]

CVT : Exploded View

INFOID:000000001160565



1. Engine mounting stay
2. Engine mounting insulator (RH)
3. Rear engine mounting bracket
4. Rear torque rod
5. Engine mounting insulator (LH)

Refer to [GI-4, "Components"](#) for symbols in the figure.

CVT : Removal and Installation

INFOID:000000001160566

## 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.
- 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-33, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

## &lt; REMOVAL AND INSTALLATION &gt;

## 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 [ECM-349, "Inspection"](#).
2. Drain engine coolant from radiator. Refer to [CO-10, "Draining"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belt.
3. Remove the following parts.
  - Engine undercover
  - Front road wheels and tires: Refer to [WT-3, "Adjustment"](#).
  - Front fender protector (RH and LH): Refer to [EXT-21, "Exploded View"](#).
  - Engine cover: Refer to [EM-27, "Exploded View"](#).
  - Battery and battery tray: Refer to [PG-133, "Exploded View"](#).
  - Air duct and air cleaner case assembly: Refer to [EM-25, "Exploded View"](#).
  - Radiator hose (upper and lower), CVT fluid cooler hose and cooling fan assembly: Refer to [CO-16, "Exploded View"](#).
  - Exhaust front tube: Refer to [EX-5, "Exploded View"](#).

## Engine Room LH

1. Disconnect all connections of engine harness around the engine mounting insulator (LH), 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 fuel feed hose at engine side. Refer to [EM-36, "Exploded View"](#).
3. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining. Refer to [CO-30, "Exploded View"](#).
4. Disconnect control cable from transaxle. Refer to [TM-519, "MR20DE : Exploded View"](#).

## Engine Room RH

1. Disconnect vacuum hose from intake manifold. Refer to [EM-27, "Exploded View"](#).
2. Remove A/C compressor without disconnecting A/C piping, and temporarily fasten it on vehicle with a rope (with A/C models). Refer to [HA-44, "MR20DE : Exploded View"](#).
3. Disconnect reservoir tank hoses. Refer to [CO-16, "Exploded View"](#).

## Vehicle inside

- Disconnect steering lower joint at steering gear assembly side, and release steering lower shaft. Refer to [ST-13, "Exploded View"](#).

## Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-67, "FRONT WHEEL SENSOR : Exploded View"](#).
3. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-42, "BRAKE CALIPER ASSEMBLY : Exploded View"](#) (LHD models) or [BR-89, "BRAKE CALIPER ASSEMBLY : Exploded View"](#) (RHD models).
4. Disconnect steering outer sockets from steering knuckle. Refer to [ST-13, "Exploded View"](#).
5. Remove rear torque rod.
6. Remove drive shafts (LH and RH). Refer to [FAX-52, "MR20DE : Exploded View"](#).
7. Remove propeller shaft. Refer to [DLN-121, "Exploded View"](#).
8. Remove stabilizer connecting rod. Refer to [FSU-16, "Exploded View"](#).
9. Remove front suspension member. Refer to [FSU-18, "Exploded View"](#).
10. Preparation for the separation work of transaxle is as follows:

# ENGINE ASSEMBLY

[MR20DE]

## < REMOVAL AND INSTALLATION >

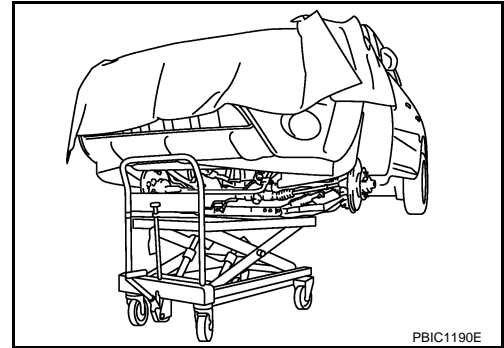
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-33, "Exploded View"](#).

### Removal

- Use a manual lift table caddy (commercial service tool) 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.

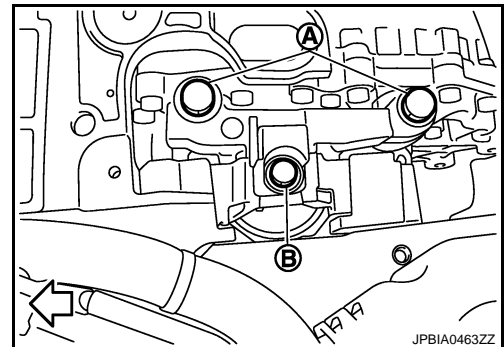


- Remove four mounting bolts on engine mounting insulator (RH) (front cover side).
- Remove two mounting bolts (A) on engine mounting insulator (LH) (transaxle side).

← : Vehicle front

**CAUTION:**

Never remove the bolt (B) coupling insulator and bracket. (part not for disassembly)



- 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

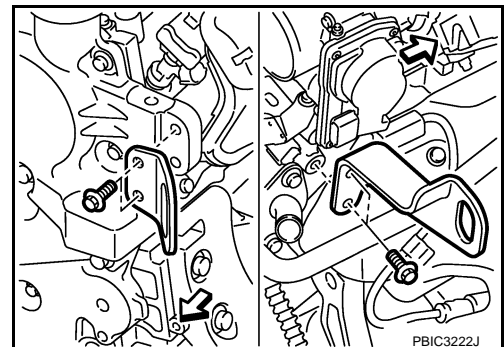
- Install engine slinger to front cover front left side and cylinder head rear right side.

← : Engine front

**Slinger bolts**

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

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



- Remove starter motor. Refer to [STR-27, "MR20DE MODELS : Exploded View"](#).
- Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-546, "MR20DE : Exploded View"](#).

### 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.

# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[MR20DE]

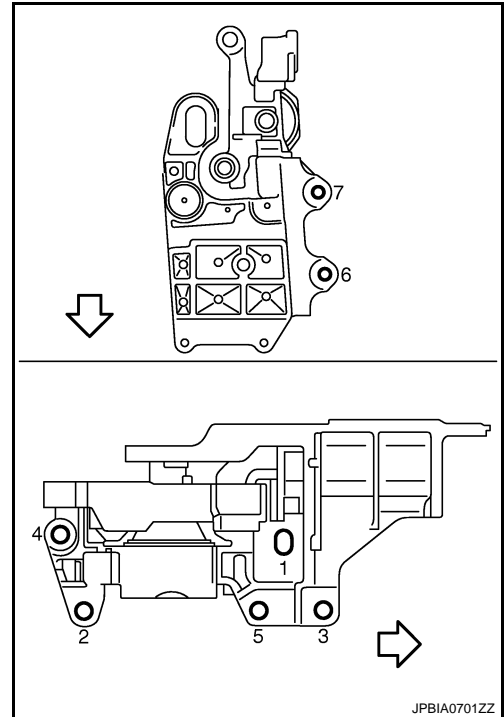
- Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.

### Preparation

1. Install the engine mounting insulator (RH) to the body temporarily.
2. Install the engine mounting insulator (LH) to the body as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

⇐ : Vehicle front

- b. Tighten the bolts No. 6, 7 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolts No. 2, 3, 4, 5 in numerical order as shown in the figure. (specified torque)
- d. Tighten the bolt No. 1 as shown in the figure. (specified torque)

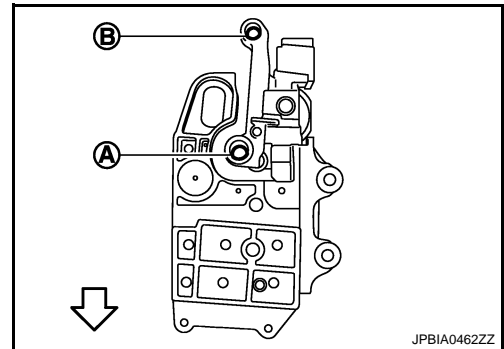


### Installation

1. Install the rear bracket to the transaxle, and then tighten mounting bolts. (specified torque)
2. Install the rear torque rod to the suspension member and transaxle, and then tighten mounting bolts. (specified torque)
3. Install the engine mounting insulator bolts (LH) to the transaxle and tighten as follows:
  - a. Tighten the bolt (A) as shown in the figure. (temporarily)

⇐ : Vehicle front

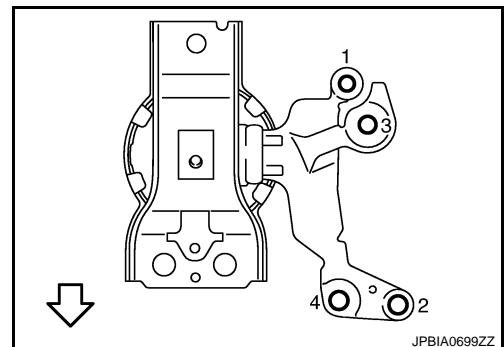
- b. Tighten the bolt (B) as shown in the figure. (temporarily)
- c. Tighten the bolt (A) to the specified torque.
- d. Tighten the bolt (B) to the specified torque.



4. Install the engine mounting insulator bolts (RH) to the engine and tighten as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

⇐ : Vehicle front

- b. Tighten the bolts No. 2, 3, 4 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolt No. 1 as shown in the figure. (specified torque)
5. Tighten the engine mounting insulator bolts (RH) to the body side. (temporarily)





## CVT : Inspection

INFOID:000000001160567

### 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-22. "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
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

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**DISASSEMBLY AND ASSEMBLY****ENGINE STAND SETTING****Setting**

INFOID:000000001160568

**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-75. "M/T : Exploded View"](#) (M/T models) or [EM-81. "CVT : Exploded View"](#) (CVT models).
2. Install engine to engine stand with the following procedure:
  - a. Remove flywheel (M/T models) or drive plate (1) (CVT models).
    - Secure flywheel or drive plate with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.

**CAUTION:**

- Never disassemble them.
- Never place them with signal plate facing down.
- When handling signal plate, take care not to damage or scratch them.
- Handle signal plate in a manner that prevents them from becoming magnetized.

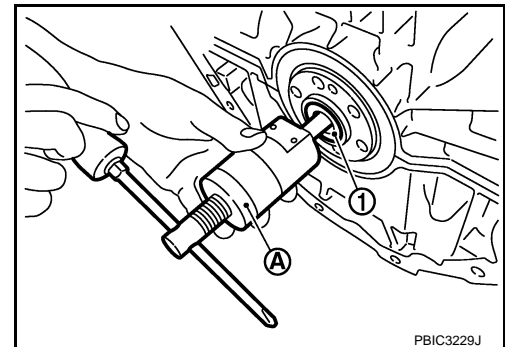
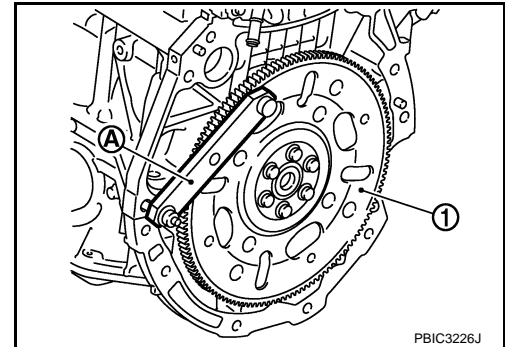
**NOTE:**

This figure shows CVT models as an example.

- b. Remove pilot converter (1) using pilot bushing puller [SST: ST16610001] (A) or suitable tool. (CVT models)

**NOTE:**

M/T models have no pilot converter.



- c. Lift the engine with a hoist to install it onto widely use engine stand.

**CAUTION:**

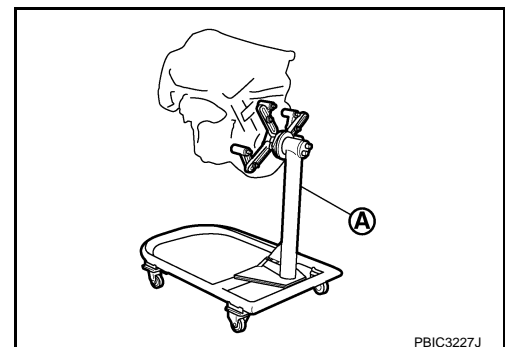
- Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to [EM-27. "Exploded View"](#).
  - Exhaust manifold: Refer to [EM-30. "Exploded View"](#).
  - Rocker cover: Refer to [EM-41. "Exploded View"](#).

**NOTE:**

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

**CAUTION:**

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



# ENGINE STAND SETTING

[MR20DE]

< DISASSEMBLY AND ASSEMBLY >

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

**CAUTION:**

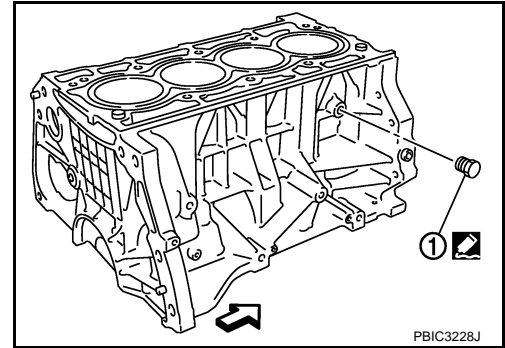
**Be sure to clean drain plug and install with new washer.**

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

⇐ : Engine front

**Tightening torque** : Refer to [EM-94, "Disassembly and Assembly"](#).

**Use Genuine Liquid Gasket or equivalent.**



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## ENGINE UNIT

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### Disassembly

INFOID:000000001160569

1. Remove intake manifold. Refer to [EM-27, "Exploded View"](#).
2. Remove exhaust manifold. Refer to [EM-30, "Exploded View"](#).
3. Remove oil pan (lower). Refer to [EM-33, "Exploded View"](#).
4. Remove oil cooler. Refer to [LU-10, "Exploded View"](#).
5. Remove ignition coil, spark plug and rocker cover. Refer to [EM-41, "Exploded View"](#).
6. Remove fuel injector and fuel tube. Refer to [EM-36, "Exploded View"](#).
7. Remove timing chain. Refer to [EM-43, "Exploded View"](#).
8. Remove camshaft. Refer to [EM-54, "Exploded View"](#).
9. Remove water inlet. Refer to [CO-27, "Exploded View"](#).
10. Remove water outlet. Refer to [CO-30, "Exploded View"](#).
11. Remove cylinder head. Refer to [EM-66, "Exploded View"](#).

### Assembly

INFOID:000000001160570

Assembly is the reverse order of disassembly.

# OIL PAN (UPPER)

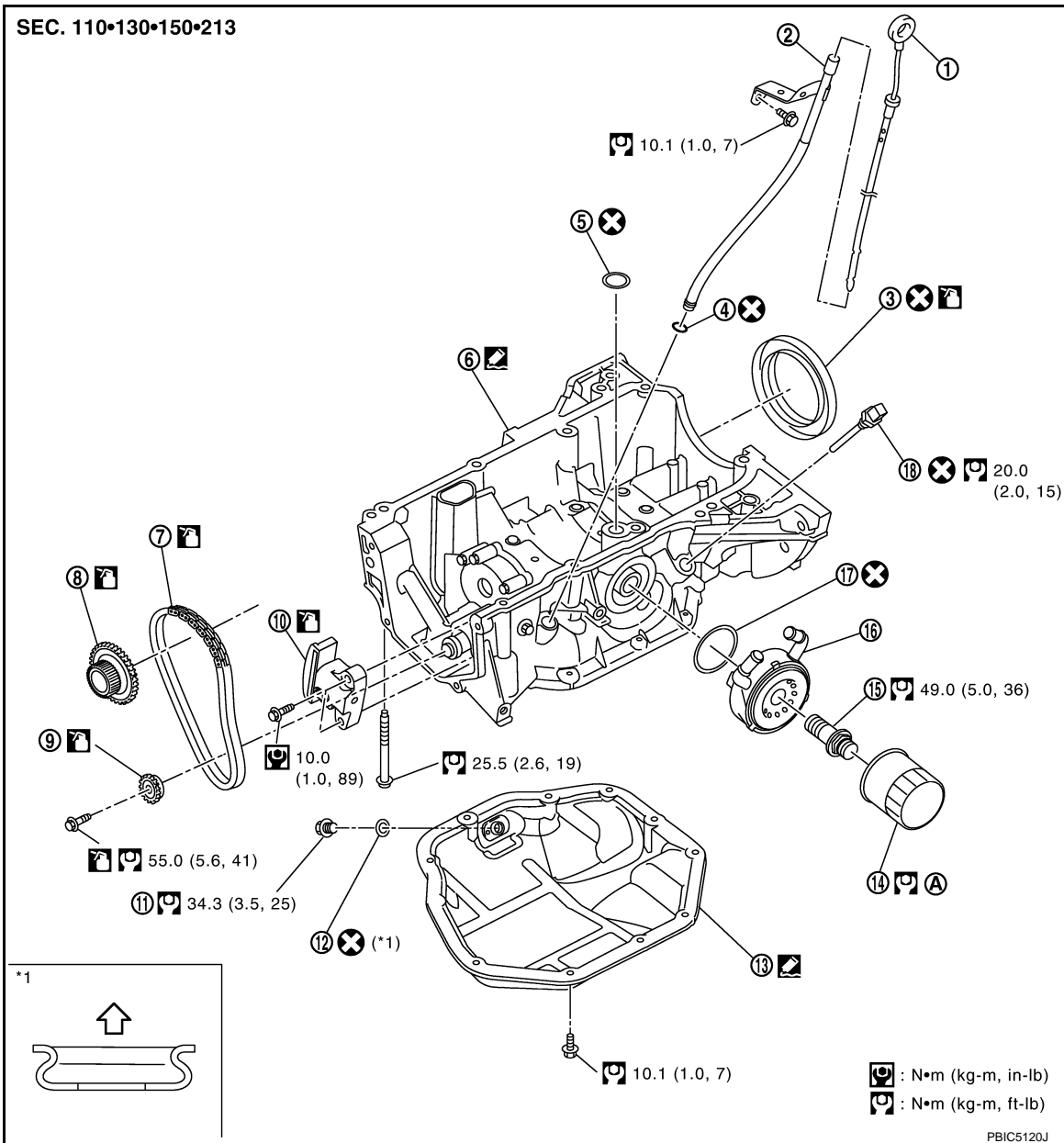
< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

## OIL PAN (UPPER)

Exploded View

INFOID:000000001160571



- |  |                          |                           |
|--|--------------------------|---------------------------|
| 1. Oil level gauge                       | 2. Oil level gauge guide | 3. Rear oil seal          |
| 4. O-ring                                | 5. O-ring                | 6. Oil pan (upper)        |
| 7. Balancer unit timing chain            | 8. Crankshaft sprocket   | 9. Balancer unit sprocket |
| 10. Balancer unit timing chain tensioner | 11. Drain plug           | 12. Drain plug washer     |
| 13. Oil pan (lower)                      | 14. Oil filter           | 15. Connector bolt        |
| 16. Oil cooler                           | 17. O-ring               | 18. Oil level sensor      |

A. Refer to [LU-9](#)

← : Oil pan side

Refer to [GI-4, "Components"](#) for symbols in the figure.

# OIL PAN (UPPER)

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

INFOID:000000001160572

## Removal and Installation

### REMOVAL

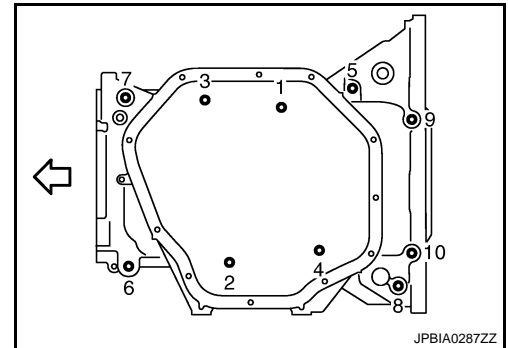
1. Remove oil pan (lower). Refer to [EM-33, "Exploded View"](#).
  2. Remove oil cooler and oil filter. Refer to [LU-10, "Exploded View"](#).
- NOTE:**  
For reference when installing, put a matching mark on oil cooler and oil pan (upper).
3. Remove front cover, timing chain, balancer unit timing chain and other related parts. Refer to [EM-43, "Exploded View"](#).
  4. Remove oil level gauge and oil level gauge guide.
  5. Remove oil level sensor, if necessary.

**CAUTION:**

**Never drop or shock oil level sensor.**

6. Remove oil pan (upper) with the following procedure:
  - a. Loosen bolts in reverse order as shown in the figure.

← : Engine front

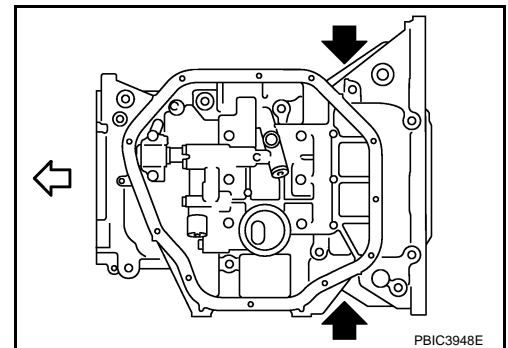


- b. Insert a screwdriver shown by the arrow (↖) in the figure and open up a crack between oil pan (upper) and cylinder block.

← : Engine front

**CAUTION:**

**A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.**



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

**CAUTION:**

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

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

### INSTALLATION

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

# OIL PAN (UPPER)

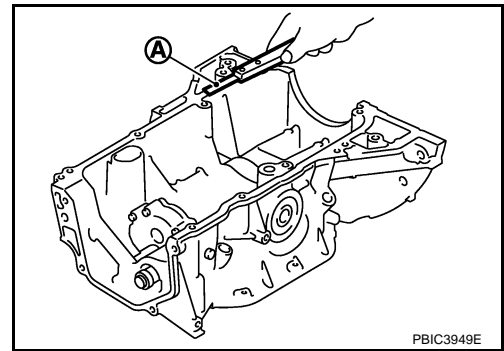
[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- a. Use a scraper (A) to remove old liquid gasket from mating surfaces.
  - Remove the old liquid gasket from mating surface of cylinder block.
  - Remove old liquid gasket from the bolt holes and threads.

**CAUTION:**

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



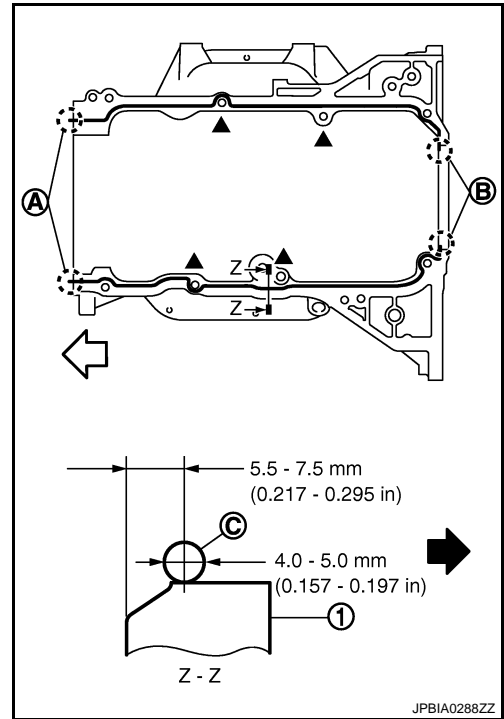
- b. Apply a continuous bead of liquid gasket (C) with a tube presser (commercial service tool) as shown in the figure.

- 1 : Oil pan (upper)
- A : 2 mm protruded to outside
- B : 2 mm protruded to rear oil seal mounting side
- ← : Engine front
- : Engine outside

**Use Genuine Liquid Gasket or equivalent.**

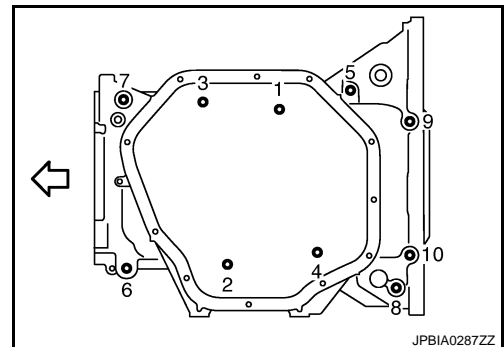
**CAUTION:**

- Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.
- Attaching should be done within 5 minutes after liquid gasket application.



- c. Install new O-ring at cylinder block side.
- CAUTION:**  
**Install avoiding misalignment of O-ring.**
- d. Tighten bolts in numerical order as shown in the figure.

- ← : Engine front



2. Install rear oil seal with the following procedure.
 

**CAUTION:**

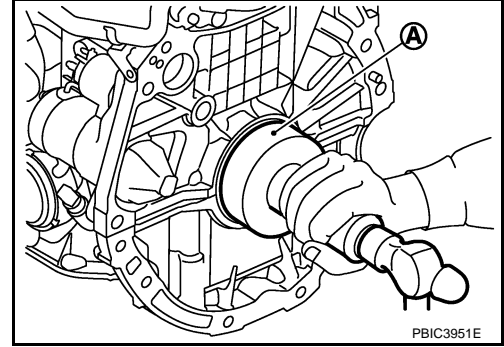
  - The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
  - Always replace rear oil seal with new one.
  - Never touch oil seal lip.
- a. Wipe off liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a scraper.

# OIL PAN (UPPER)

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- b. Apply engine oil to entire outside area of rear oil seal.
- c. Press-fit the rear oil seal using a suitable drift (A) with outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in).



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

1 : Rear oil seal

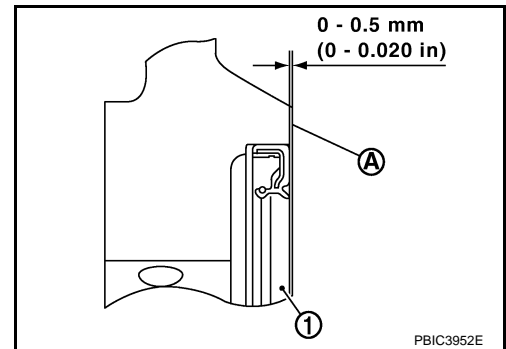
A : Cylinder block rear end surface

### 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, making sure that rear oil seal does not curl or tilt.

### NOTE:

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



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

## Inspection

INFOID:000000001160573

## INSPECTION AFTER REMOVAL

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



# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

## CYLINDER BLOCK

Exploded View

INFOID:000000001160574

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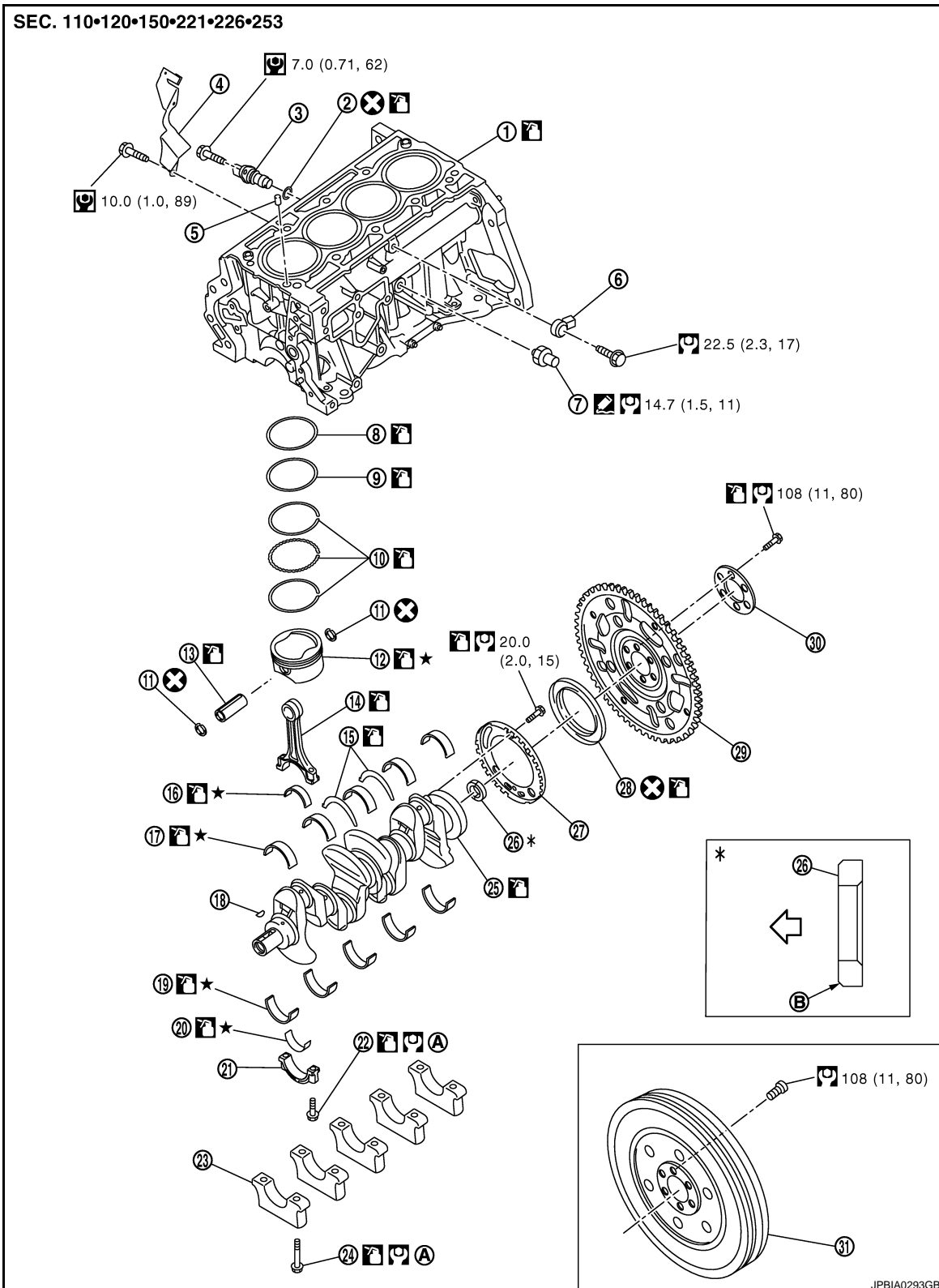
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- |   |   |                                     |
|---|---|-------------------------------------|
| 1. Cylinder block                         | 2. O-ring                                       | 3. Crankshaft position sensor (POS) |
| 4. Crankshaft position sensor (POS) cover | 5. Oil filter (for intake valve timing control) | 6. Knock sensor                     |
| 7. Oil pressure switch                    | 8. Top ring                                     | 9. Second ring                      |

# CYLINDER BLOCK

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- |                                    |                                    |                                      |
|------------------------------------|------------------------------------|--------------------------------------|
| 10. Oil ring                       | 11. Snap ring                      | 12. Piston                           |
| 13. Piston pin                     | 14. Connecting rod                 | 15. Thrust bearing                   |
| 16. Connecting rod bearing (upper) | 17. Main bearing (upper)           | 18. Crankshaft key                   |
| 19. Main bearing (lower)           | 20. Connecting rod bearing (lower) | 21. Connecting rod cap               |
| 22. Connecting rod cap bolt        | 23. Main bearing cap               | 24. Main bearing cap bolt            |
| 25. Crankshaft                     | 26. Pilot converter (CVT models)   | 27. Signal plate                     |
| 28. Rear oil seal                  | 29. Drive plate (CVT models)       | 30. Reinforcement plate (CVT models) |
| 31. Flywheel (M/T models)          |                                    |                                      |
- A. Refer to [EM-94](#)                      B. Chamfered

↶ : Crankshaft side

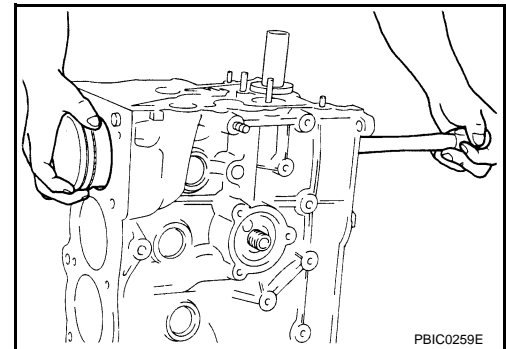
Refer to [GI-4, "Components"](#) for symbols in the figure.

## Disassembly and Assembly

INFOID:000000001160575

### DISASSEMBLY

1. Remove oil pan (upper). Refer to [EM-89, "Exploded View"](#).
2. Remove thermostat housing. Refer to [CO-27, "Exploded View"](#).
3. Remove knock sensor.  
**CAUTION:**  
**Handle it carefully and avoid impacts.**
4. Remove crankshaft position sensor (POS) cover and crankshaft position sensor (POS).  
**CAUTION:**
  - Handle it carefully and avoid impacts.
  - Never disassemble.
  - Never place sensor in a location where it is exposed to magnetism.
5. Remove oil filter (for intake valve timing control).
6. 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-102, "Inspection"](#).
  - a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
  - b. Remove connecting rod cap.
  - c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.  
**CAUTION:**
    - Be careful not to damage matching surface with connecting rod cap.
    - Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.
7. Remove connecting rod bearings.  
**CAUTION:**  
**When removing them, note the installation position. Keep them in the correct.**
8. Remove piston rings from piston.
  - Before removing piston rings, check the piston ring side clearance. Refer to [EM-102, "Inspection"](#).

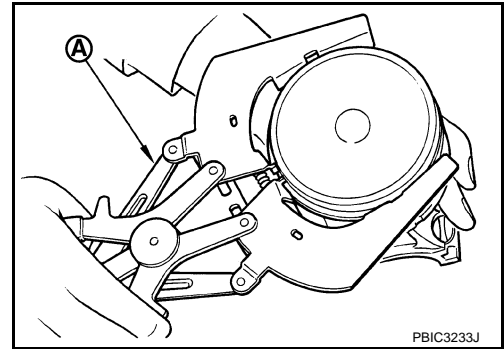


# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

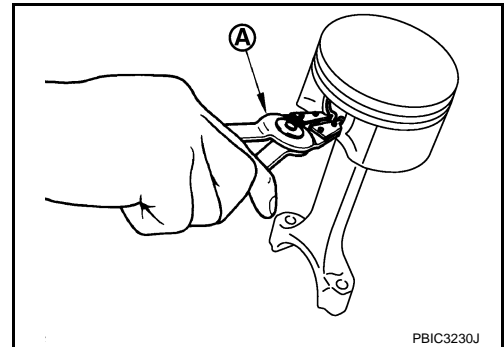
[MR20DE]

- 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.

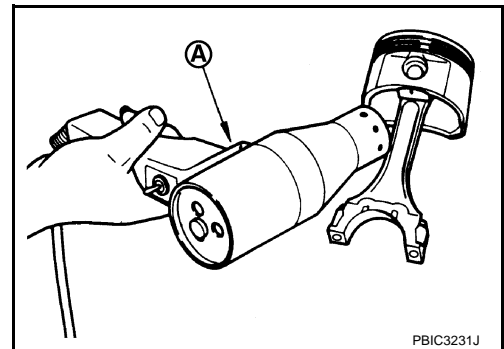


9. Remove piston from connecting rod with the following procedure:

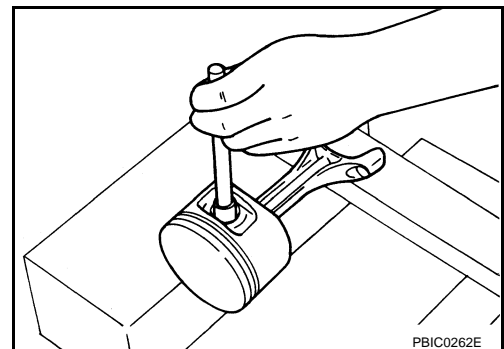
a. Using snap ring pliers (A), remove snap rings.



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



c. Push out piston pin with stick of outer diameter approximately 18 mm (0.71 in).



10. Remove main bearing cap mounting bolts.

- Measure crankshaft end play before loosening main bearing cap mounting bolts. Refer to [EM-102](#), "[Inspection](#)".

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

# CYLINDER BLOCK

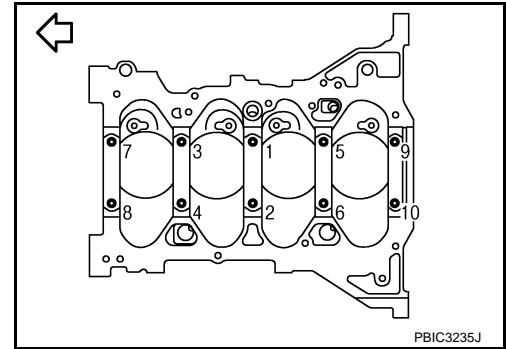
[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- Loosen and remove bolts in reverse order as shown in the figure.

↶ : Engine front

- Use TORX socket (size E14).



- Remove main bearing caps.
  - Tap main bearing caps lightly with a plastic hammer for removal.

**CAUTION:**

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

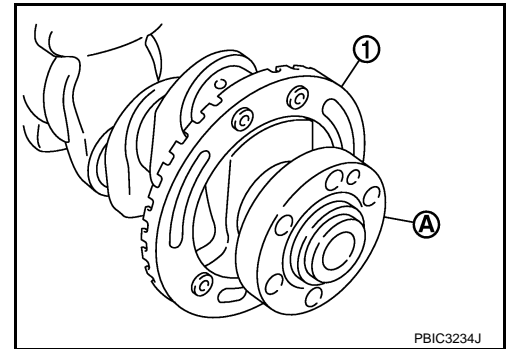
- Remove crankshaft.

**CAUTION:**

- Be careful not to damage or deform signal plate (1) mounted on rear end of crankshaft (A).
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.
- Never remove signal plate unless it is necessary to do so.

**NOTE:**

When removing or installing signal plate, use TORX socket (size T30).



- Pull rear oil seal out from rear end of crankshaft.
- Remove main bearings and thrust bearings from cylinder block and main bearing caps.

**CAUTION:**

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

## ASSEMBLY

- 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.**

- Install each plug to cylinder block as shown in the figure.

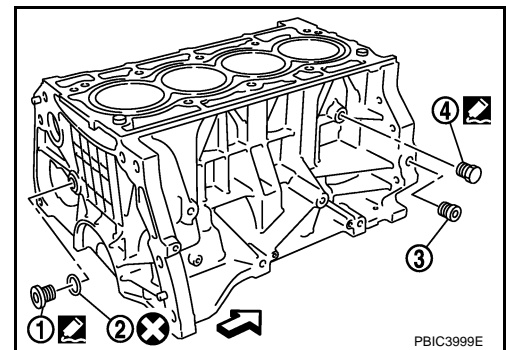
2 : Washer

↶ : Engine front

- Apply liquid gasket to the thread of water drain plug (4).  
**Use Genuine Liquid Gasket or equivalent.**
- Apply sealant to the thread of plug (1).  
**Use Thread Locking Sealant or equivalent.**

**NOTE:**

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



- Tighten each plug as specified below.

Part	Washer	Tightening torque
1	Yes	54.0 N·m (5.5 kg·m, 40 ft·lb)

# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

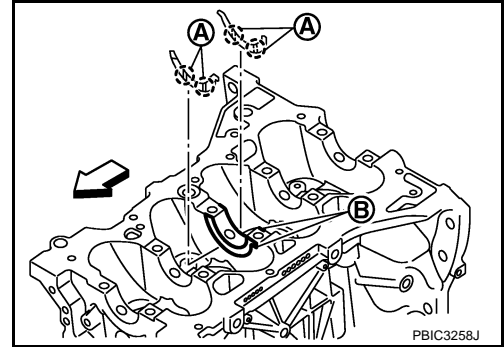
Part	Washer	Tightening torque
3	No	19.6 N·m (2.0 kg·m, 14 ft·lb)
4	No	9.8 N·m (1.0 kg·m, 87 in·lb)

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

- a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and main bearing cap.
- b. Install thrust bearings to 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).

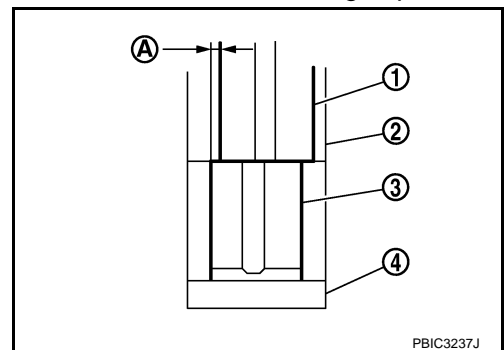


c. Install the main bearings paying attention to the direction.

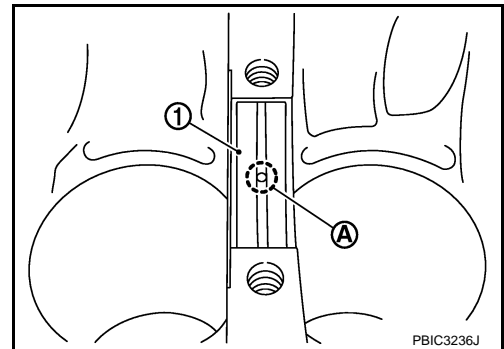
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing to the center position of cylinder block and main bearing cap.
- The difference (A) between main bearing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

2 : Cylinder block

4 : Main bearing cap



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



4. Install signal plate to crankshaft if removed.

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

# CYLINDER BLOCK

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- c. Position crankshaft (2) and signal plate (1) using a dowel pin (service part), and tighten mounting bolts in numerical order as shown in the figure using TORX socket.

A : Dowel pin hole

**NOTE:**

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

- d. Tighten mounting bolts in numerical order as shown in the figure again.  
e. Remove dowel pin. (service parts)

**CAUTION:**

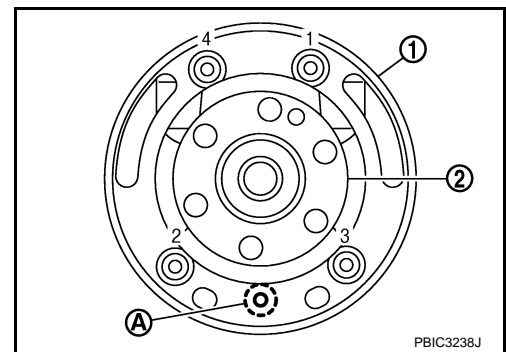
**Be sure to remove dowel pin.**

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

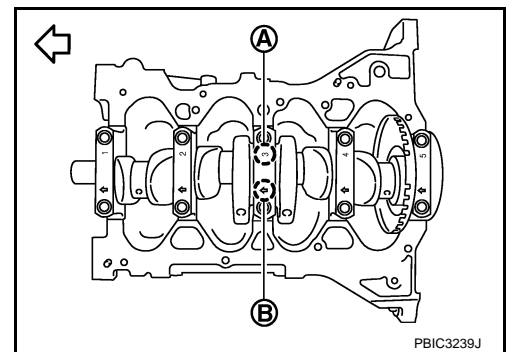
← : Engine front

**NOTE:**

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



PBIC3238J



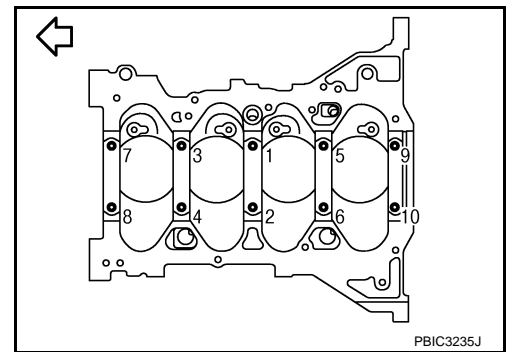
PBIC3239J

- b. Tighten main bearing cap bolts in numerical order as shown in the figure with the following procedure:

← : Engine front

- i. Apply new engine oil to threads and seat surfaces of mounting bolts.  
ii. Tighten main bearing cap bolts.

: 34.3 N·m (3.5 kg·m, 25 ft·lb)

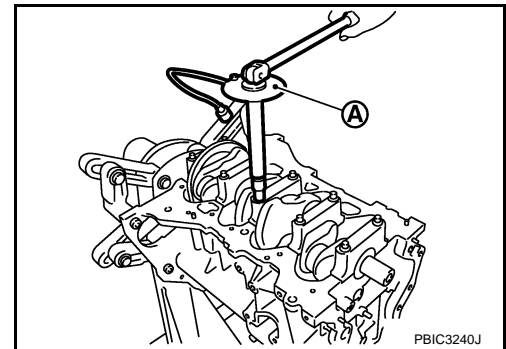


PBIC3235J

- iii. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in order from No. 1 to 10 in the figure.

**CAUTION:**

**Confirm the tightening angle by using an angle wrench [SST: KV10112100] (A) or protractor. Never judge by visual inspection without the tool.**



PBIC3240J

- After installing mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-102. "Inspection"](#).

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

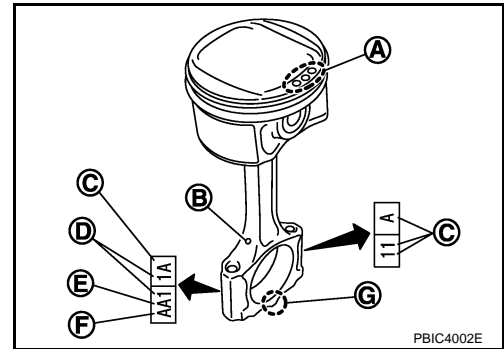
- a. Using snap ring pliers, install new snap ring to the groove of the piston rear side.  
• Insert it fully into groove to install.  
b. Assemble piston to connecting rod.

# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- Using an industrial use drier or similar tool, heat the piston until the piston pin can be pushed in by hand without excess force [approximately 60 to 70°C (140 to 158°F)]. From the front to the rear, insert piston pin into piston and connecting rod.
- Assemble so that the front mark (A) on the piston head and the oil hole (B) and the cylinder number (D) on connecting rod are positioned as shown in the figure.



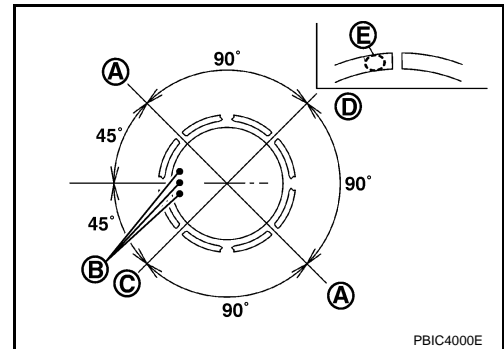
- C : Management code
- E : Big end diameter grade
- F : Small end diameter grade
- G : Front mark (connecting rod cap)

- Install new snap ring to the groove of the piston front side.
  - Insert it fully into groove to install.
  - After installing, check that connecting rod moves smoothly.
- Using a piston ring expander (commercial service tool), install piston rings.

**CAUTION:**

- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark.

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



**CAUTION:**

Never contact the rail end gap under the oil ring with the oil drain cast groove of piston.

- Install second ring with the stamped surface facing upward.

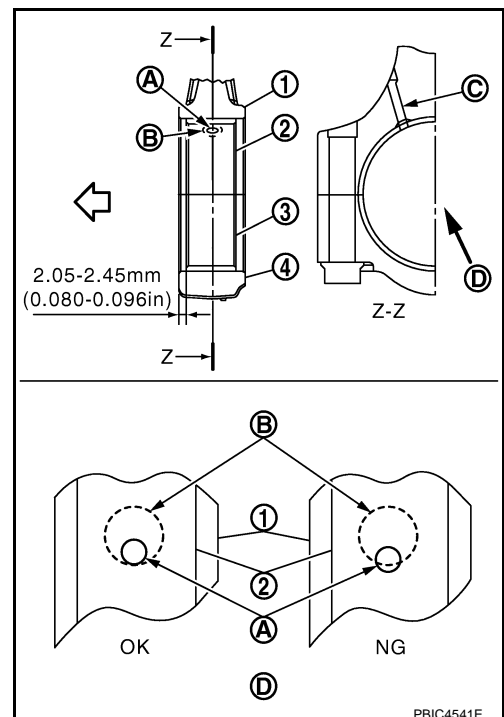
- Install connecting rod bearing upper (2) and lower (3) to connecting rod (1) and connecting rod cap (4).

- C : Oil hole (connecting rod)
- D : Arrow view
- ↔ : Engine front

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

**NOTE:**

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



- Install piston and connecting rod assembly to crankshaft.
  - Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.

# CYLINDER BLOCK

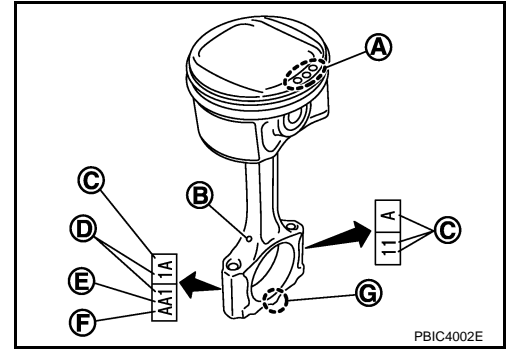
[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number (D) on connecting rod to install.

- B : Oil hole
- C : Management code
- E : Big end diameter grade
- F : Small end diameter grade
- G : Front mark (connecting rod cap)

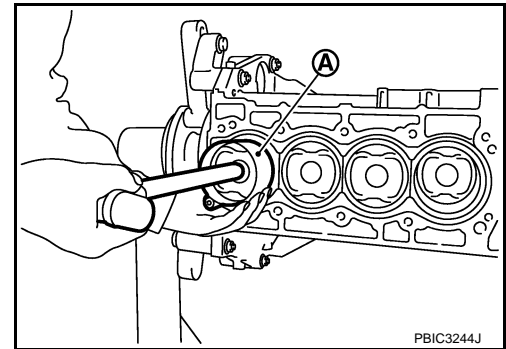
- Install so that front mark (A) on the piston head faces the front of engine.



- Using a 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:**

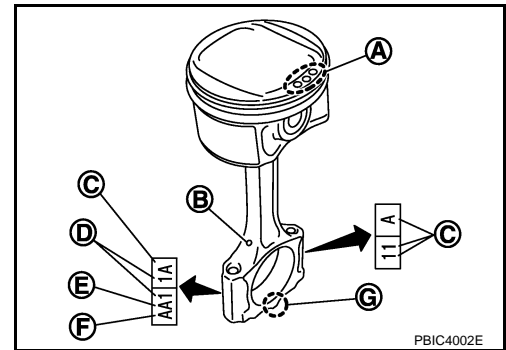
**Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**



### 11. Install connecting rod cap.

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

- A : Front mark (piston)
- B : Oil hole
- C : Management code
- E : Big end diameter grade
- F : Small end diameter grade
- G : Front mark (connecting rod cap)



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

**CAUTION:**

- Check that there is no gap in the thrust surface (A) of the joint between connecting rod (1) and connecting rod cap (2) and that these parts are in the correct position. And then, tighten the connecting rod cap bolts.
- If the connecting rod bolts are reused, measure the outer diameter. Refer to [EM-102. "Inspection"](#).

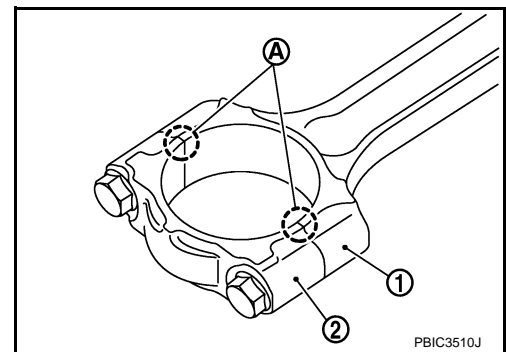
- a. Apply new engine oil to the threads and seats of connecting rod cap bolts.
- b. Tighten bolts.

: 27.4 N·m (2.8 kg-m, 20 ft-lb)

- c. Completely loosen bolts.

: 0 N·m (0 kg-m, 0 ft-lb)

- d. Tighten bolts.





# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

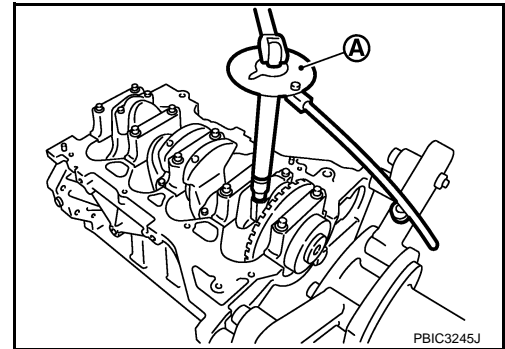
[MR20DE]

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

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

**CAUTION:**

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100] (A) or protractor. Never judge by visual inspection without the tool.



- After tightening connecting rod cap bolt, check that crankshaft rotates smoothly.
  - Check the connecting rod side clearance. Refer to [EM-102, "Inspection"](#).
13. Install oil pan (upper). Refer to [EM-89, "Exploded View"](#).

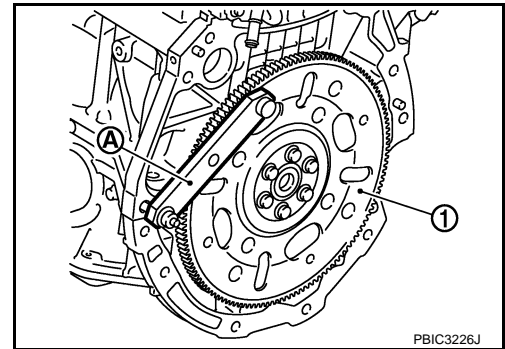
**NOTE:**

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

14. Install rear oil seal. Refer to [EM-64, "REAR OIL SEAL : Removal and Installation"](#).
15. Install drive plate (1) (CVT models) or flywheel (M/T models).

**Drive plate**

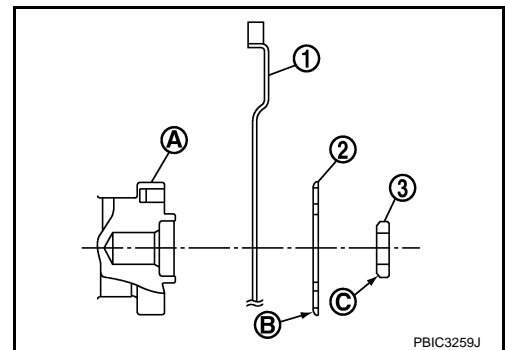
- Secure crankshaft with a stopper plate [SST: KV11105210] (A), and tighten mounting bolts crosswise over several times.



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

A : Crankshaft rear end  
B : Rounded  
C : Chamfered

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



**Flywheel**

- Secure crankshaft with a stopper plate [SST: KV11105210], and tighten mounting bolts crosswise over several times.

**NOTE:**

M/T models have no pilot bushing and reinforcement plate.

16. Install knock sensor.

# CYLINDER BLOCK

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- Install knock sensor (1) with harness connector facing toward the rear of engine.

A : Cylinder block left side

⇐ : Engine front

### CAUTION:

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

### NOTE:

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

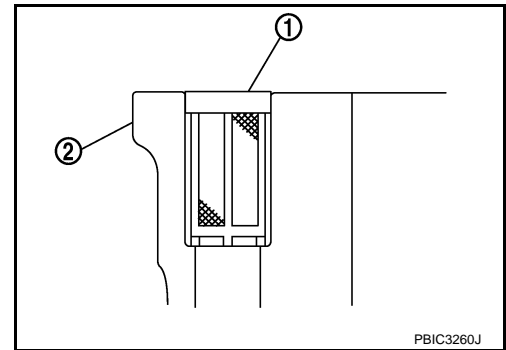
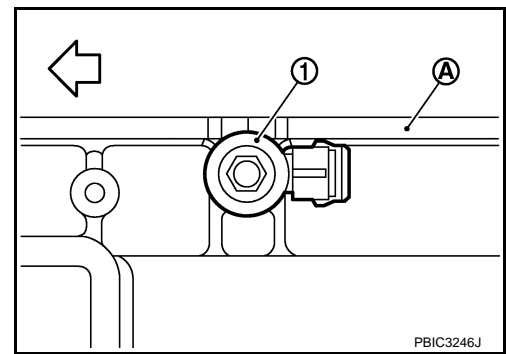
17. Install crankshaft position sensor (POS) and crankshaft position sensor (POS) cover.

### CAUTION:

- **Handle it carefully and avoid impacts.**
- **Never disassemble.**
- **Never place sensor in a location where it is exposed to magnetism.**

18. Install oil filter (for intake valve timing control) (1) in the direction shown in the figure.

- Check that the oil filter does not protrude from the upper surface of cylinder block (2) after installation.



19. Assemble in the reverse order of disassembly.

## Inspection

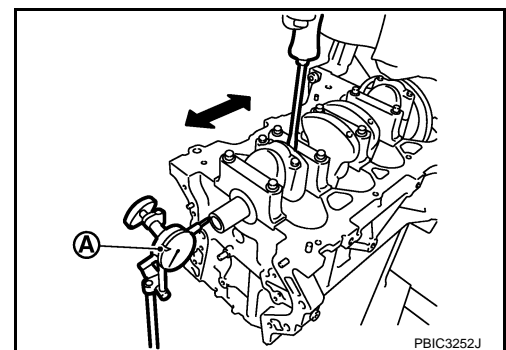
INFOID:000000001160576

### CRANKSHAFT END PLAY

- 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-124, "Cylinder Block"](#).

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



### CONNECTING ROD SIDE CLEARANCE

# CYLINDER BLOCK

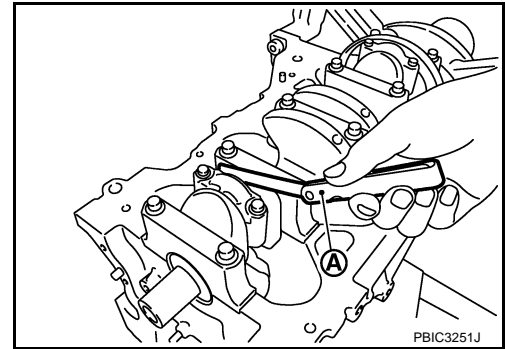
[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

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

**Standard and Limit** : Refer to [EM-124, "Cylinder Block"](#).

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

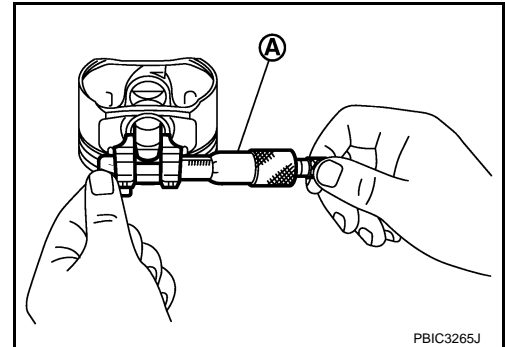


## PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

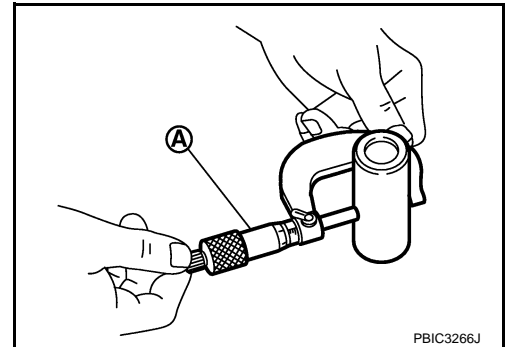
**Standard** : Refer to [EM-124, "Cylinder Block"](#).



Piston Pin Outer Diameter

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

**Standard** : Refer to [EM-124, "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-124, "Cylinder Block"](#).

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

### NOTE:

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

## PISTON RING SIDE CLEARANCE

# CYLINDER BLOCK

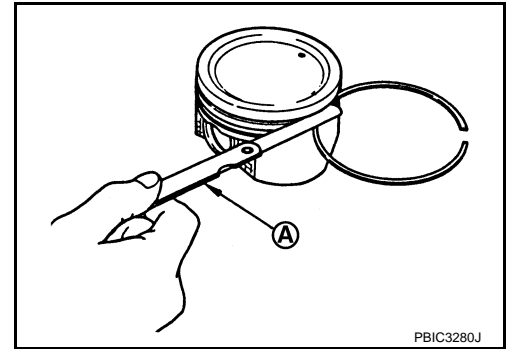
## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

**Standard and Limit** : Refer to [EM-124, "Cylinder Block"](#).

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

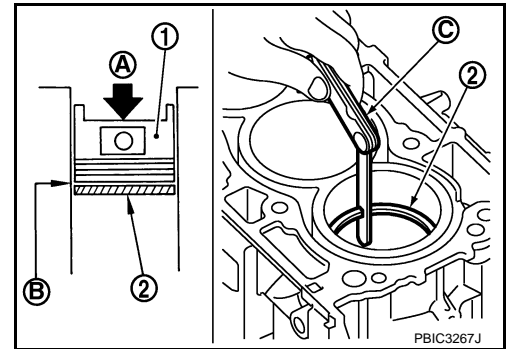


## PISTON RING END GAP

- 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-124, "Cylinder Block"](#).

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



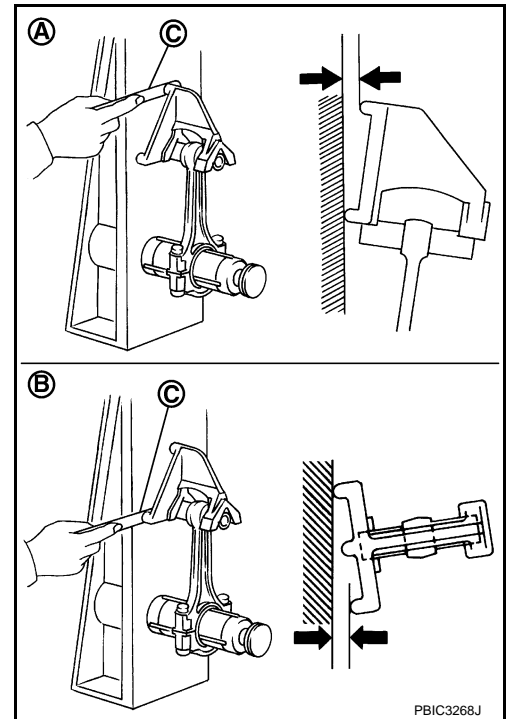
## CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

A : Bend  
B : Torsion  
C : Feeler gauge

**Limit** : Refer to [EM-124, "Cylinder Block"](#).

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



## CONNECTING ROD BIG END DIAMETER

# CYLINDER BLOCK

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-94. "Disassembly and Assembly"](#).

2 : Connecting rod

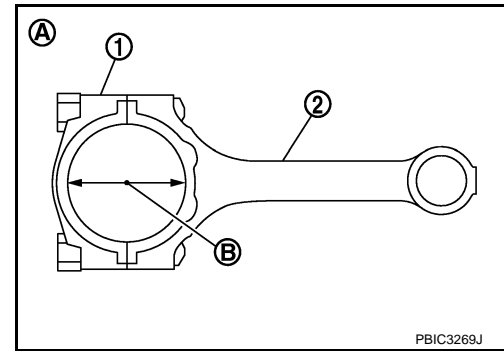
A : Example

B : Measuring direction of inner diameter

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

**Standard** : Refer to [EM-124. "Cylinder Block"](#).

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

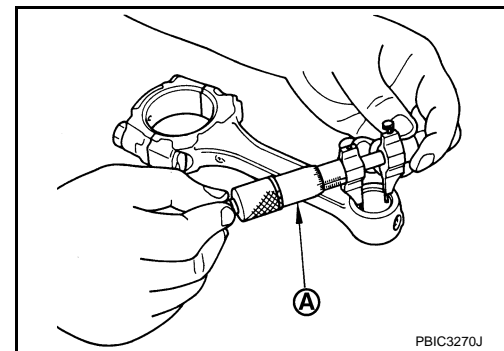


## CONNECTING ROD BUSHING OIL CLEARANCE

### Connecting Rod Bushing Inner Diameter

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

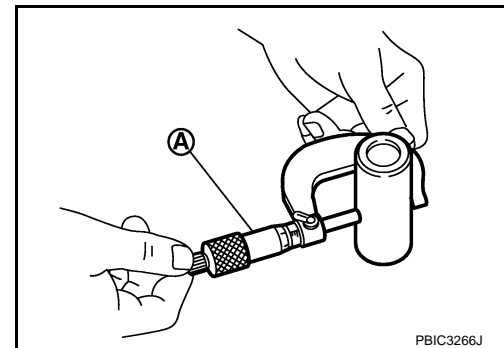
**Standard** : Refer to [EM-124. "Cylinder Block"](#).



### Piston Pin Outer Diameter

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

**Standard** : Refer to [EM-124. "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-124. "Cylinder Block"](#).

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

## CYLINDER BLOCK TOP SURFACE DISTORTION

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

### **CAUTION:**

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

# CYLINDER BLOCK

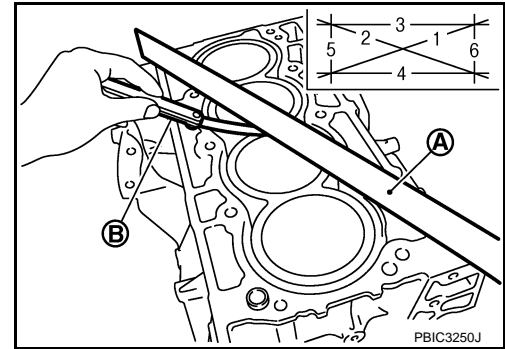
[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- 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-124, "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-94, "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.

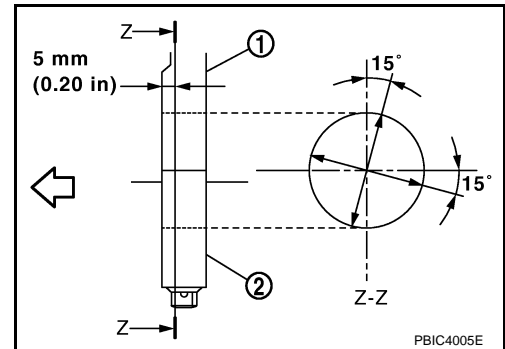
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

**Standard** : Refer to [EM-124, "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 (A), measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. ("X" and "Y" directions at "A", "B" and "C") ("Y" is in longitudinal direction of engine)

**NOTE:**

When determining cylinder bore grade, measure the cylinder bore "X" direction at "B" position.

**Standard:**

**Cylinder bore inner diameter**

: Refer to [EM-124, "Cylinder Block"](#).

**Limit:**

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

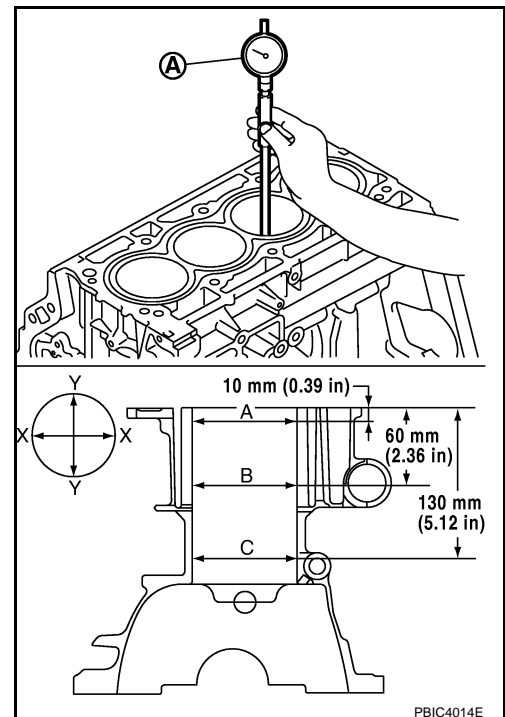
**Taper (Difference between "A" and "B")**

: Refer to [EM-124, "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.



### Piston Skirt Diameter

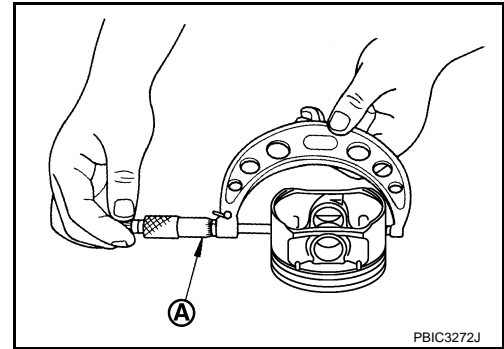
# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

**Standard** : Refer to [EM-124, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction "X", position "B").

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

**Standard and Limit** : Refer to [EM-124, "Cylinder Block"](#).

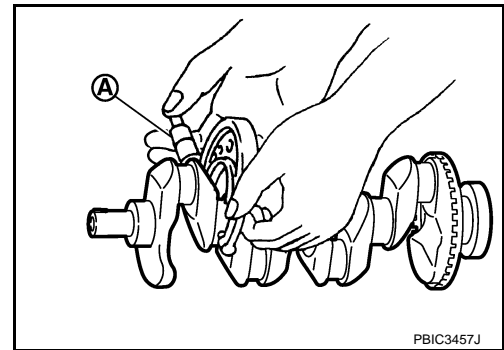
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-112, "Piston"](#).

CRANKSHAFT MAIN JOURNAL DIAMETER

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

**Standard** : Refer to [EM-124, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-128, "Main Bearing"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard** : Refer to [EM-124, "Cylinder Block"](#).

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

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

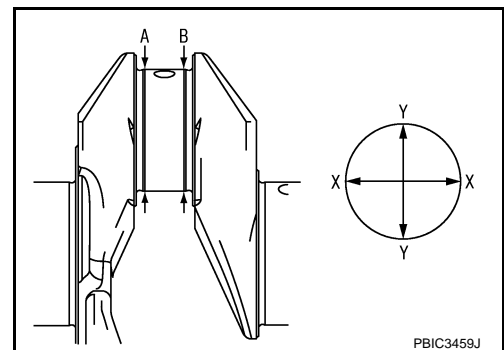
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in dimension between "A" and "B" at "X"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

**Limit:**

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

**Taper (Difference between "A" and "B")**

: Refer to [EM-124, "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-127, "Connecting Rod Bearing"](#) and/or [EM-128, "Main Bearing"](#).

CRANKSHAFT RUNOUT



# CYLINDER BLOCK

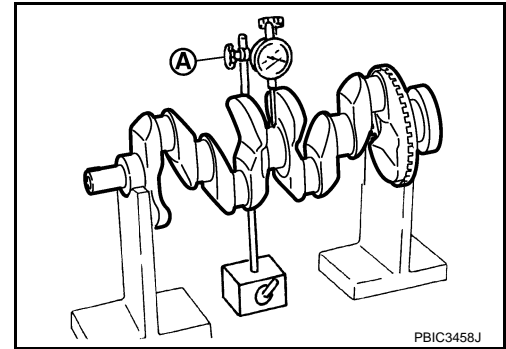
[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- 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-124, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



PBIC3458J

## CONNECTING ROD BEARING OIL CLEARANCE

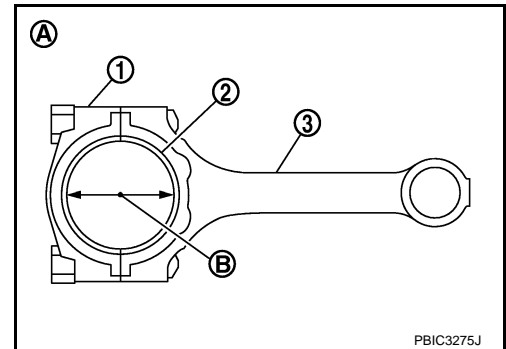
### Method by Calculation

- 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-94, "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)



PBIC3275J

**Standard and Limit** : Refer to [EM-124, "Cylinder Block"](#).

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

### Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-94, "Disassembly and Assembly"](#).

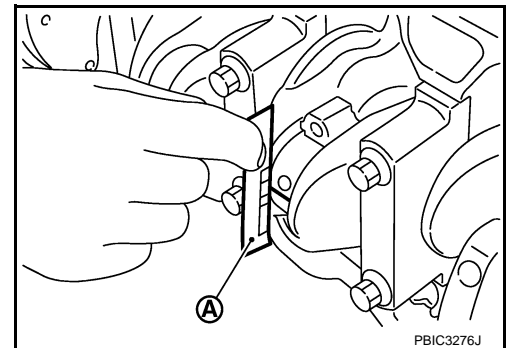
### CAUTION:

**Never rotate crankshaft.**

- 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".



PBIC3276J

## MAIN BEARING OIL CLEARANCE

### Method by Calculation



# CYLINDER BLOCK

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

- 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-94. "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-124. "Cylinder Block"](#).

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-115. "Main Bearing"](#).

### Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-94. "Disassembly and Assembly"](#).

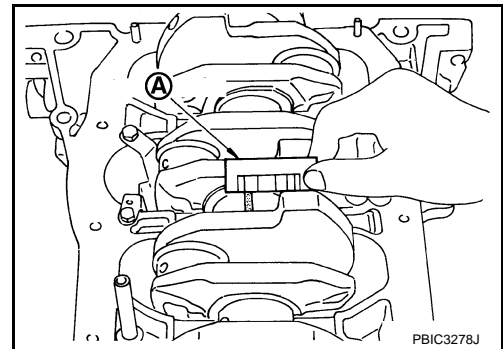
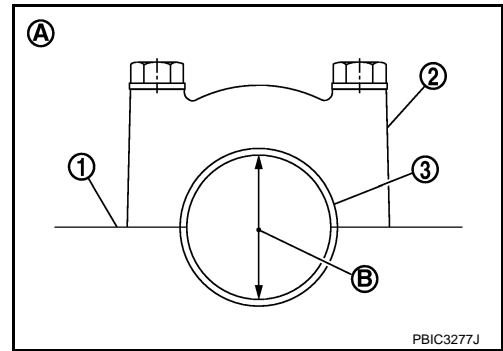
### CAUTION:

**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".



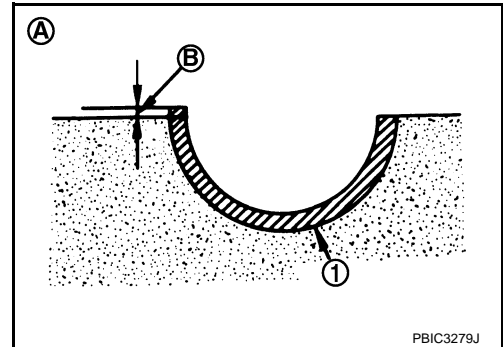
## MAIN BEARING CRUSH HEIGHT

- 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-94. "Disassembly and Assembly"](#).

A : Example

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

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



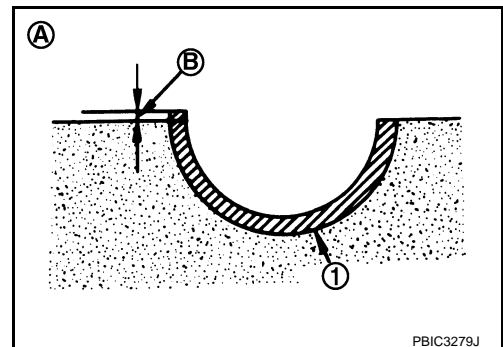
## CONNECTING ROD BEARING CRUSH HEIGHT

- 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-94. "Disassembly and Assembly"](#).

A : Example

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

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



# CYLINDER BLOCK

[MR20DE]

## < DISASSEMBLY AND ASSEMBLY >

### MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (“d1”, “d2”) at two positions as shown in the figure.

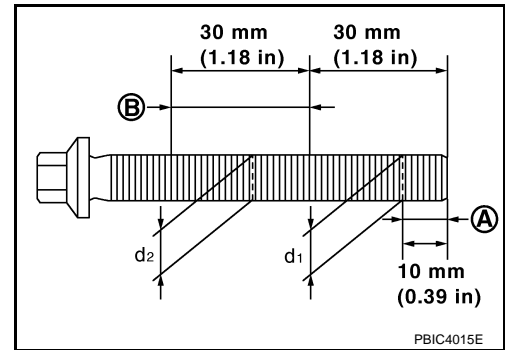
A : “d1” measuring position

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.

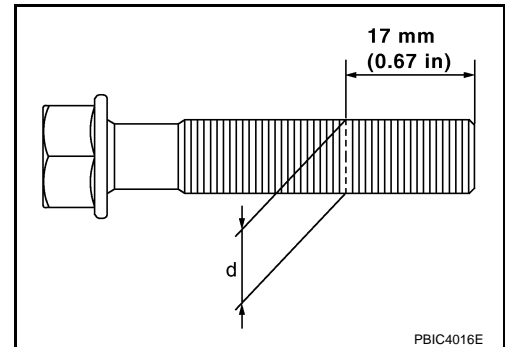


### CONNECTING ROD CAP BOLT OUTER DIAMETER

- 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”.

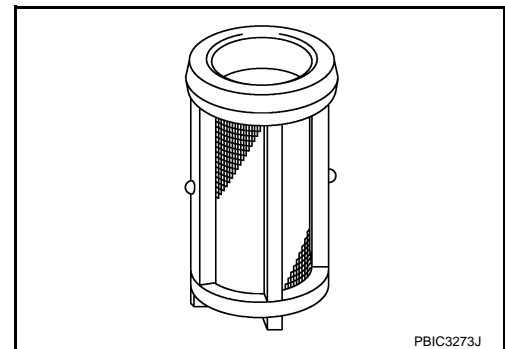
**Limit: 7.75 mm (0.3051 in)**

- When “d” exceeds the limit (when it becomes thinner), replace connecting rod cap bolt with a new one.



### CLOGGED OR DAMAGED OIL FILTER (FOR INTAKE VALVE TIMING CONTROL)

- Check that there is no foreign material on the oil filter and check it for clogging.
  - Clean it if necessary.
- Check the oil filter for damage.
  - Replace it if necessary.



### FLYWHEEL DEFLECTION (M/T MODELS)

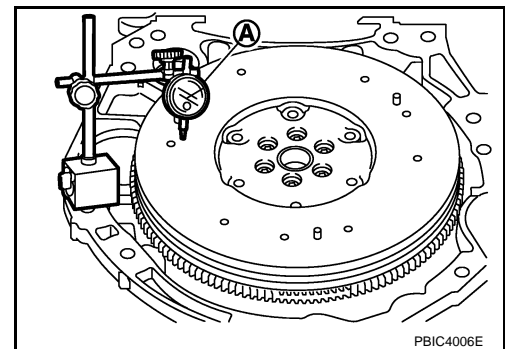
- Measure the deflection of flywheel contact surface to torque with a dial indicator (A).
- Measure the deflection at 210 mm (8.27 in) diameter.

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

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

#### **CAUTION:**

**When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.**



### MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

#### **CAUTION:**

**Never disassemble double mass flywheel.**

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

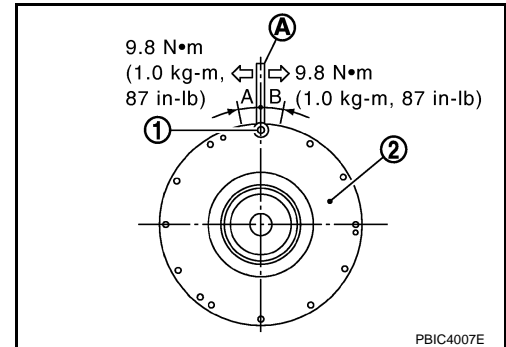
**Standard : 1.8 mm (0.071 in) or less**

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

Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install clutch cover mounting bolt (1) to clutch cover mounting hole, and place a torque wrench (A) on the extended line of the flywheel (2) center line.
  - Tighten bolt at a force of 9.8 N·m (1.0 kg·m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg·m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transaxle side.
4. Measure the dimensions of movement amounts "A" and "B" on circumference of the flywheel on the transaxle side.



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

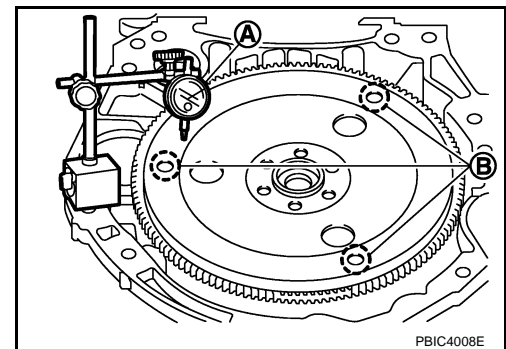
- If measured value is out of the standard, replace flywheel.

DRIVE PLATE DEFLECTION (CVT MODELS)

- 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.



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:000000001160577

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

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

### Piston

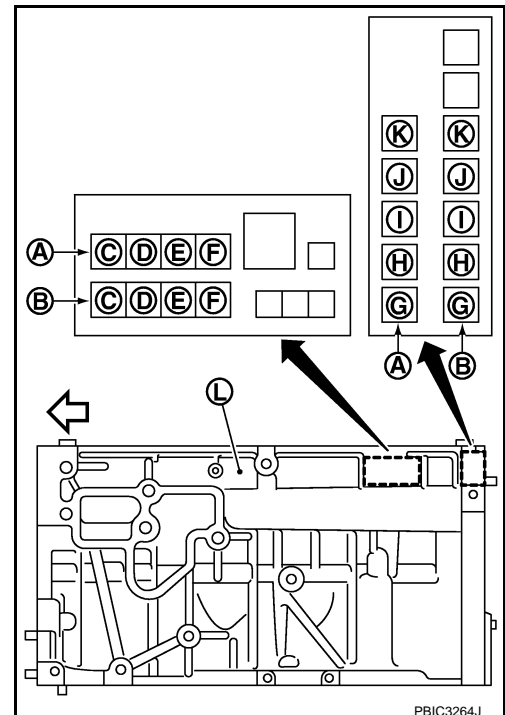
INFOID:000000001160578

#### WHEN NEW CYLINDER BLOCK IS USED

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

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

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



#### WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter. Refer to [EM-124, "Cylinder Block"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".

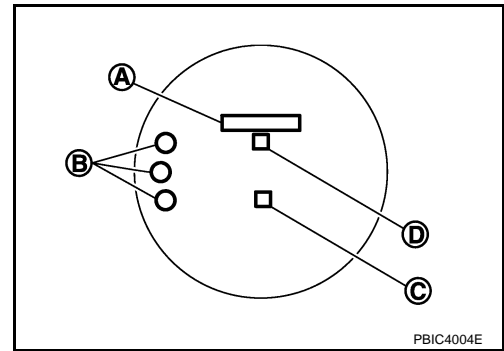
# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

## 3. Select piston of the same grade.

- A : Identification code
- B : Front mark
- C : Sub grade number
- D : Piston grade number



## PISTON SELECTION TABLE

Unit: mm (in)

Grade number (Mark)	1	2 [or no mark (piston only)]
Cylinder bore Inner diameter	84.000 - 84.010 (3.3071 - 3.3075)	84.010 - 84.020 (3.3075 - 3.3079)
Piston skirt diameter	83.970 - 83.980 (3.3059 - 3.3063)	83.980 - 83.990 (3.3063 - 3.3067)

### NOTE:

Piston is available together with piston pin as an assembly.

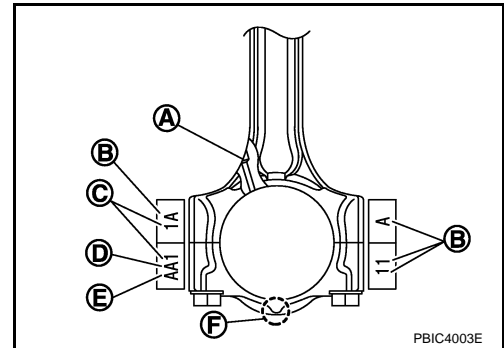
## Connecting Rod Bearing

INFOID:000000001160579

### WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

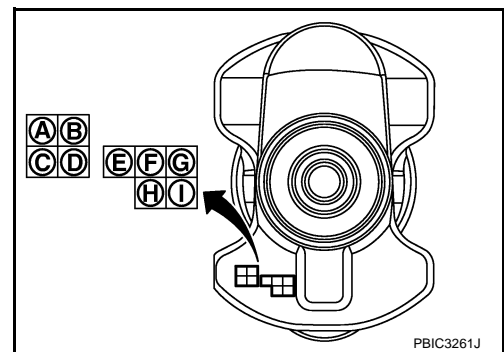
- Apply connecting rod big end diameter grade stamped on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- A : Oil hole
- B : Management code
- C : Cylinder number
- D : Big end diameter grade
- E : Small end diameter grade
- F : Front mark



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

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



- 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.

### WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

- Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-102, "Inspection"](#).

# HOW TO SELECT PISTON AND BEARING

[MR20DE]

< DISASSEMBLY AND ASSEMBLY >

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

## CONNECTING ROD BEARING SELECTION TABLE

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

PBIC4077E

## CONNECTING ROD BEARING GRADE TABLE

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

## UNDERSIZE BEARINGS USAGE GUIDE

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

**CAUTION:**

# HOW TO SELECT PISTON AND BEARING

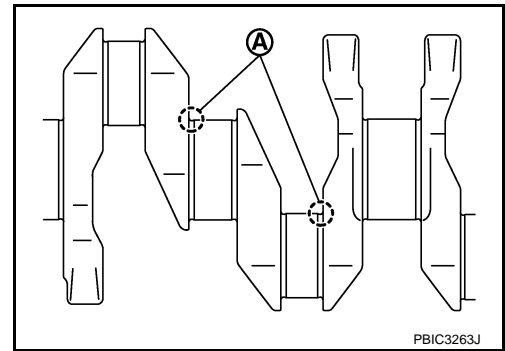
< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

## Bearing undersize table

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



INFOID:000000001160580

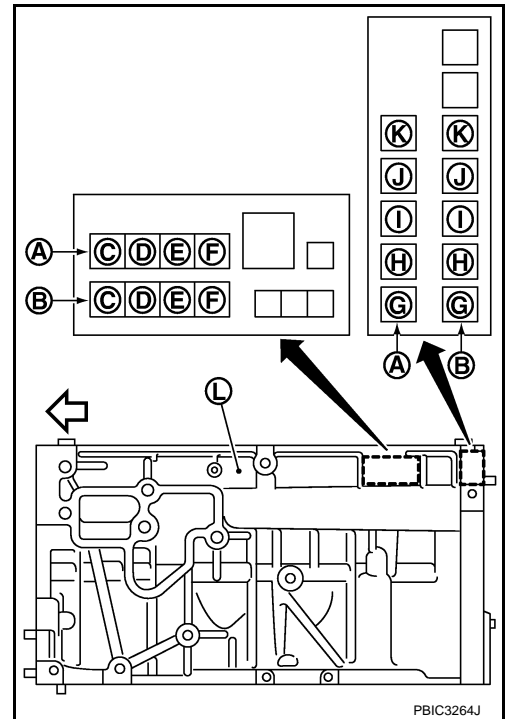
## Main Bearing

### WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

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

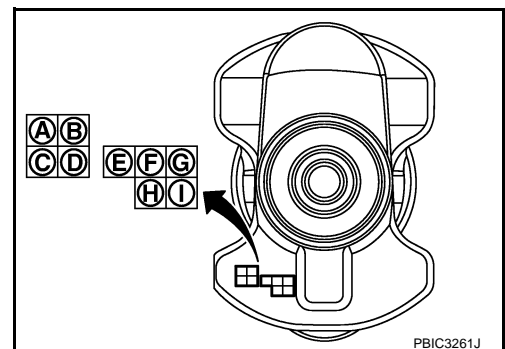
- A : Correction stamp
- B : Standard stamp
- C : Cylinder No. 1 bore grade
- D : Cylinder No. 2 bore grade
- E : Cylinder No. 3 bore grade
- F : Cylinder No. 4 bore grade
- G : No. 1 main bearing housing grade
- H : No. 2 main bearing housing grade
- I : No. 3 main bearing housing grade
- J : No. 4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

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



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

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



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

### CAUTION:

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



# HOW TO SELECT PISTON AND BEARING

[MR20DE]

< DISASSEMBLY AND ASSEMBLY >

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-102, "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”.

**CAUTION:**

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

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.

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

Cylinder block main bearing housing inner diameter Unit: mm (in)	Crankshaft main journal diameter Unit: mm (in)	Mark		Hole diameter																						
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W					
Mark	Axle diameter	55.997 - 55.998 (2.2046 - 2.2046)	55.998 - 55.999 (2.2046 - 2.2047)	55.999 - 56.000 (2.2047 - 2.2047)	56.000 - 56.001 (2.2047 - 2.2048)	56.001 - 56.002 (2.2048 - 2.2048)	56.002 - 56.003 (2.2048 - 2.2048)	56.003 - 56.004 (2.2048 - 2.2049)	56.004 - 56.005 (2.2049 - 2.2049)	56.005 - 56.006 (2.2049 - 2.2050)	56.006 - 56.007 (2.2050 - 2.2050)	56.007 - 56.008 (2.2050 - 2.2050)	56.008 - 56.009 (2.2050 - 2.2051)	56.009 - 56.010 (2.2051 - 2.2051)	56.010 - 56.011 (2.2051 - 2.2052)	56.011 - 56.012 (2.2052 - 2.2052)	56.012 - 56.013 (2.2052 - 2.2052)	56.013 - 56.014 (2.2052 - 2.2053)	56.014 - 56.015 (2.2053 - 2.2053)	56.015 - 56.016 (2.2053 - 2.2053)	56.016 - 56.017 (2.2053 - 2.2054)					
A	51.978 - 51.979 (2.0464 - 2.0464)	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23		
B	51.977 - 51.978 (2.0463 - 2.0464)	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23		
C	51.976 - 51.977 (2.0463 - 2.0463)	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	23			
D	51.975 - 51.976 (2.0463 - 2.0463)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3		
E	51.974 - 51.975 (2.0462 - 2.0463)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	3		
F	51.973 - 51.974 (2.0462 - 2.0462)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	3	3		
G	51.972 - 51.973 (2.0461 - 2.0462)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	3	3	34		
H	51.971 - 51.972 (2.0461 - 2.0461)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	3	3	34	34		
J	51.970 - 51.971 (2.0461 - 2.0461)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	3	3	34	34	34		
K	51.969 - 51.970 (2.0460 - 2.0461)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4		
L	51.968 - 51.969 (2.0460 - 2.0460)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4		
M	51.967 - 51.968 (2.0459 - 2.0460)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4		
N	51.966 - 51.967 (2.0459 - 2.0459)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	45		
P	51.965 - 51.966 (2.0459 - 2.0459)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	45		
R	51.964 - 51.965 (2.0458 - 2.0459)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	45		
S	51.963 - 51.964 (2.0458 - 2.0458)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	45		
T	51.962 - 51.963 (2.0457 - 2.0458)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	45		
U	51.961 - 51.962 (2.0457 - 2.0457)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	45		
V	51.960 - 51.961 (2.0457 - 2.0457)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	45		
W	51.959 - 51.960 (2.0456 - 2.0457)	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	45		



# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

Cylinder block main bearing housing inner diameter Unit: mm (in)	Crankshaft main journal diameter Unit: mm (in)	Mark		Hole diameter																						
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W					
Mark	Axle diameter																									
A	51.978 - 51.979 (2.0464 - 2.0464)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45			
B	51.977 - 51.978 (2.0463 - 2.0464)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45				
C	51.976 - 51.977 (2.0463 - 2.0463)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45					
D	51.975 - 51.976 (2.0463 - 2.0463)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5			
E	51.974 - 51.975 (2.0462 - 2.0463)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5				
F	51.973 - 51.974 (2.0462 - 2.0462)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5			
G	51.972 - 51.973 (2.0461 - 2.0462)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5	56			
H	51.971 - 51.972 (2.0461 - 2.0461)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56			
J	51.970 - 51.971 (2.0461 - 2.0461)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	56			
K	51.969 - 51.970 (2.0460 - 2.0461)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6			
L	51.968 - 51.969 (2.0460 - 2.0460)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6			
M	51.967 - 51.968 (2.0459 - 2.0460)	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	6			
N	51.966 - 51.967 (2.0459 - 2.0459)	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	6	67			
P	51.965 - 51.966 (2.0459 - 2.0459)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	6	67	67			
R	51.964 - 51.965 (2.0458 - 2.0459)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	6	67	67	67			
S	51.963 - 51.964 (2.0458 - 2.0458)	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	67	7			
T	51.962 - 51.963 (2.0457 - 2.0458)	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7			
U	51.961 - 51.962 (2.0457 - 2.0457)	4	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7			
V	51.960 - 51.961 (2.0457 - 2.0457)	4	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	7			
W	51.959 - 51.960 (2.0456 - 2.0457)	45	45	45	5	5	5	56	56	56	6	6	6	6	67	67	67	7	7	7	7	7	7			

PBIC4079E

## MAIN BEARING GRADE TABLE (ALL JOURNALS)

Main bearing grade table (All journals) : Refer to [EM-128, "Main Bearing"](#).

### UNDERSIZE BEARING USAGE GUIDE

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

**CAUTION:**

## HOW TO SELECT PISTON AND BEARING

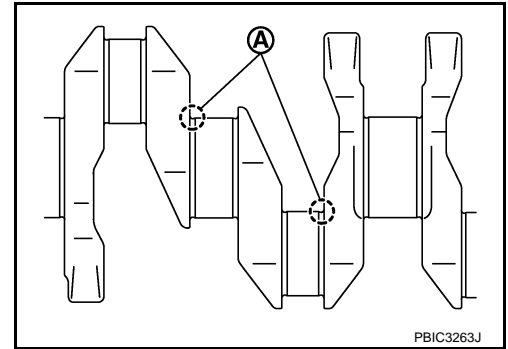
< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

Bearing undersize table:

Refer to [EM-128](#). "Main Bearing".



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification

INFOID:000000001160581

A

EM

#### GENERAL SPECIFICATIONS

Engine type		MR20DE
Cylinder arrangement		In-line 4
Displacement	cm <sup>3</sup> (cu in)	1,997 (121.86)
Bore and stroke	mm (in)	84.0 x 90.1 (3.307 x 3.547)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		10.2
Compression pressure kPa (bar, kg/cm <sup>2</sup> , psi)/250 rpm	Standard	1,390 (13.9, 14.2, 202)
	Minimum	1,140 (11.4, 11.6, 165)
	Differential limit between cylinders	100 (1.0, 1.0, 15)

C

D

E

F

G

H

I

J

K

L

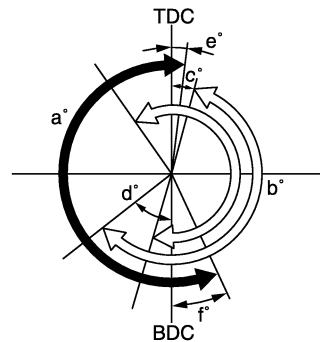
M

N

O

P

Valve timing  
( ) : Valve timing control "ON"  
↶ : Intake valve  
↷ : Exhaust valve



PBIC5304E

Unit: degree

a	b	c	d	e	f
220	232	13 (-27) ATDC	65 (25) ABDC	7	33

#### Drive Belt

INFOID:000000001160582

#### DRIVE BELT

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

#### Spark Plug

INFOID:000000001160583

#### SPARK PLUG

Unit: mm (in)

Make	NGK
Standard type	PLZKAR6A-11
Gap (Nominal)	1.1 (0.043)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

## Exhaust Manifold

INFOID:000000001160584

### EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Each exhaust port	0.3 (0.012)
	Entire part	0.7 (0.028)

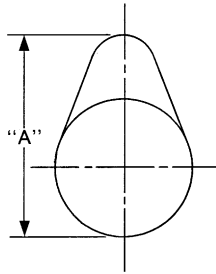
## Camshaft

INFOID:000000001160585

### CAMSHAFT

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0012 - 0.0028)	
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9843 - 0.9851)	—
Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9823 - 0.9381)	—
Camshaft end play		0.075 - 0.153 (0.0030 - 0.0060)	0.24 (0.0094)
Camshaft cam height "A"	Intake	45.265 - 45.455 (1.7821 - 1.7896)	45.065 (1.7742)
	Exhaust	43.775 - 43.965 (1.7234 - 1.7309)	43.575 (1.7155)
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)



SEM671

\*: Total indicator reading

## VALVE LIFTER

Unit: mm (in)

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

## VALVE CLEARANCE

Unit: mm (in)

Items	Cold	Hot* (reference data)
-------	------	-----------------------

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

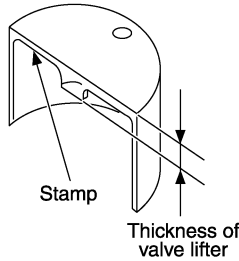
[MR20DE]

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

\*: Approximately 80°C (176°F)

## AVAILABLE VALVE LIFTER

Thickness mm (in)	Identification mark
-------------------	---------------------



KBIA0119E

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

Cylinder Head

INFOID:000000001160586

CYLINDER HEAD

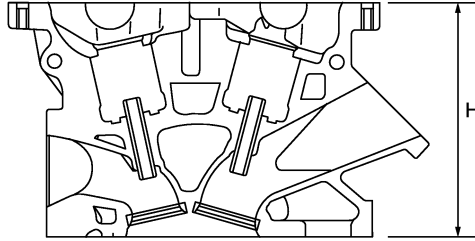
# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Unit: mm (in)

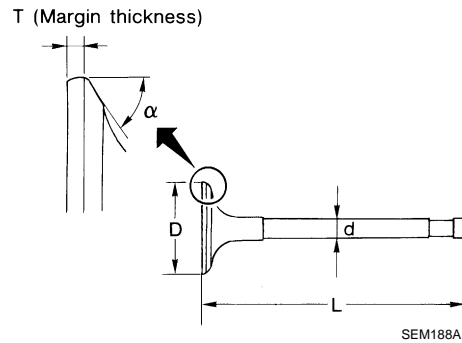
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	130.9 (5.15)	—



PBIC0924E

## VALVE DIMENSIONS

Unit: mm (in)



Valve head diameter "D"	Intake	33.8 - 34.1 (1.331 - 1.343)
	Exhaust	27.6 - 27.9 (1.087 - 1.098)
Valve length "L"	Intake	106.27 (4.18)
	Exhaust	105.26 (4.14)
Valve stem diameter "d"	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.455 - 5.470 (0.2148 - 0.2154)
Valve seat angle "α"		45°15' - 45°45'
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	1.2 (0.047)

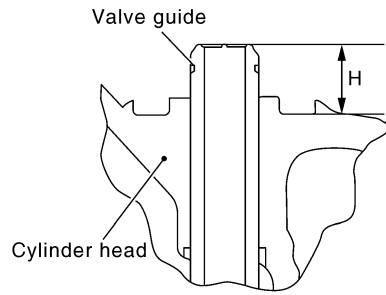
## VALVE GUIDE

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Unit: mm (in)

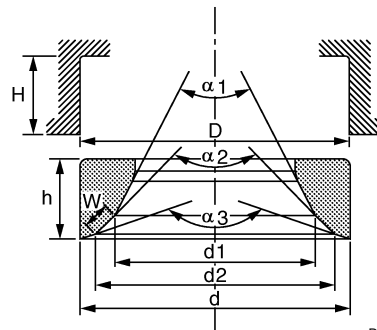


PBIC2187E

Items		Standard	Oversize (service) [0.2 (0.008)]
Valve guide	Outer diameter	9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size)	5.500 - 5.518 (0.2165 - 0.2172)	
Cylinder head valve guide hole diameter		9.475 - 9.496 (0.3730 - 0.3739)	9.675 - 9.696 (0.3809 - 0.3817)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
Projection length "H"		13.35 - 13.65 (0.5256 - 0.5374)	

## VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (service) [0.5 (0.02)]
Cylinder head seat recess diameter "D"	Intake	34.700 - 34.727 (1.3661 - 1.3672)	35.200 - 35.227 (1.3858 - 1.3869)
	Exhaust	28.700 - 28.727 (1.1299 - 1.1310)	29.200 - 29.227 (1.1496 - 1.1507)
Valve seat outer diameter "d"	Intake	34.808 - 34.824 (1.3704 - 1.3710)	35.308 - 35.324 (1.3901 - 1.3907)
	Exhaust	28.808 - 28.824 (1.1342 - 1.1348)	29.308 - 29.324 (1.1539 - 1.1545)
Valve seat interference fit		0.081 - 0.124 (0.0032 - 0.0049)	
Diameter "d1"*1	Intake	31.8 (1.252)	
	Exhaust	25.3 (0.996)	
Diameter "d2"*2	Intake	33.1 - 33.6 (1.303 - 1.323)	
	Exhaust	26.9 - 27.4 (1.059 - 1.079)	
Angle "α1"	Intake	60°	
	Exhaust	45°	
Angle "α2"		88°45' - 90°15'	
Angle "α3"		120°	

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Contacting width "W" <sup>*3</sup>	Intake	1.0 - 1.4 (0.039 - 0.055)	
	Exhaust	1.2 - 1.6 (0.047 - 0.063)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.03 - 5.13 (0.1980 - 0.2020)
	Exhaust		4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"	Intake	6.04 (0.2378)	
	Exhaust	6.05 (0.2382)	

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

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

\*3: Machining data

## VALVE SPRING

Items	Standard	
	Intake	Exhaust
Free height	46.18 - 46.68 mm (1.8181 - 1.8378 in)	45.67 - 46.17 mm (1.7980 - 1.8177 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	151 - 175 N (15.4 - 17.9 kg, 34 - 39 lb)	140 - 162 N (14.3 - 16.5 kg, 31 - 36 lb)
Height during valve open	25.70 mm (1.0118 in)	26.88 mm (1.0583 in)
Load with valve open	333 - 379 N (34.0 - 38.7 kg, 75 - 85 lb)	283 - 323 N (28.9 - 32.9 kg, 64 - 73 lb)
Identification color	Green	Purple

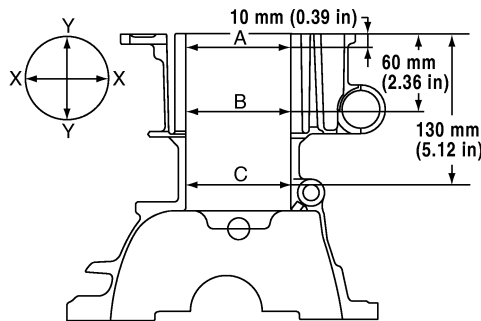
Items	Limit
Valve spring squareness	2.0 mm (0.079 in)

## Cylinder Block

INFOID:000000001160587

## CYLINDER BLOCK

Unit: mm (in)



PBIC4017E

Cylinder block top surface distortion	Limit	0.1 (0.004)
Cylinder bore inner diameter	Standard	Grade No. 1
		Grade No. 2
		84.000 - 84.010 (3.3071 - 3.3075)
		84.010 - 84.020 (3.3075 - 3.3079)



# SERVICE DATA AND SPECIFICATIONS (SDS)

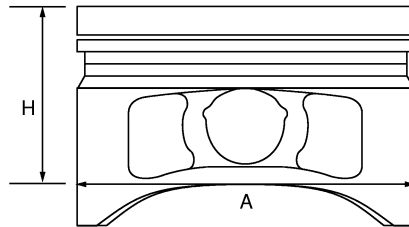
< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Out-of-round	Limit	0.015 (0.0006)	
Taper		0.010 (0.0004)	
Main bearing housing inner diameter grade	Grade No. A	55.997 - 55.998	(2.2046 - 2.2046)
	Grade No. B	55.998 - 55.999	(2.2046 - 2.2047)
	Grade No. C	55.999 - 56.000	(2.2047 - 2.2047)
	Grade No. D	56.000 - 56.001	(2.2047 - 2.2048)
	Grade No. E	56.001 - 56.002	(2.2048 - 2.2048)
	Grade No. F	56.002 - 56.003	(2.2048 - 2.2048)
	Grade No. G	56.003 - 56.004	(2.2048 - 2.2049)
	Grade No. H	56.004 - 56.005	(2.2049 - 2.2049)
	Grade No. J	56.005 - 56.006	(2.2049 - 2.2050)
	Grade No. K	56.006 - 56.007	(2.2050 - 2.2050)
	Grade No. L	56.007 - 56.008	(2.2050 - 2.2050)
	Grade No. M	56.008 - 56.009	(2.2050 - 2.2051)
	Grade No. N	56.009 - 56.010	(2.2051 - 2.2051)
	Grade No. P	56.010 - 56.011	(2.2051 - 2.2052)
	Grade No. R	56.011 - 56.012	(2.2052 - 2.2052)
	Grade No. S	56.012 - 56.013	(2.2052 - 2.2052)
	Grade No. T	56.013 - 56.014	(2.2052 - 2.2053)
Grade No. U	56.014 - 56.015	(2.2053 - 2.2053)	
Grade No. V	56.015 - 56.016	(2.2053 - 2.2053)	
Grade No. W	56.016 - 56.017	(2.2053 - 2.2054)	

## AVAILABLE PISTON

Unit: mm (in)



PBIC0188E

Piston skirt diameter "A"	Standard	Grade No. 1	83.970 - 83.980 (3.3059 - 3.3063)
		Grade No. 2	83.980 - 83.990 (3.3063 - 3.3067)
Measure point "H"			39.9 (1.571)
Piston pin hole diameter			19.993 - 19.999 (0.7871 - 0.7874)
Piston to cylinder bore clearance	Standard		0.020 - 0.040 (0.0008 - 0.0016)
	Limit		0.08 (0.0031)

## PISTON RING

Unit: mm (in)

Items		Standard	Limit
Piston ring side clearance	Top	0.04 - 0.08 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.03 - 0.07 (0.0012 - 0.0028)	0.10 (0.004)
	Oil ring	0.015 - 0.185 (0.006 - 0.0073)	—
Piston ring end gap	Top	0.20 - 0.30 (0.008 - 0.012)	0.51 (0.0201)
	2nd	0.50 - 0.65 (0.020 - 0.0256)	0.83 (0.0327)
	Oil (rail ring)	0.15 - 0.45 (0.0059 - 0.0177)	0.78 (0.0307)

## PISTON PIN

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Unit: mm (in)

Items	Standard	Limit
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	—
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	—

## CONNECTING ROD

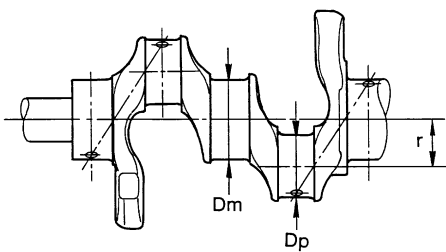
Unit: mm (in)

Center distance		138.97 - 139.07 (5.47 - 5.48)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.012)
Connecting rod bushing inner diameter*	Standard	20.000 - 20.012 (0.7874 - 0.7879)
Connecting rod bushing oil clearance	Standard	0.005 - 0.023 (0.0002 - 0.0009)
	Limit	0.03 (0.0012)
Connecting rod side clearance	Standard	0.20 - 0.35 (0.008 - 0.0138)
	Limit	0.4 (0.016)
Connecting rod big end diameter	Grade No. A	47.000 - 47.001 (1.8504 - 1.8504)
	Grade No. B	47.001 - 47.002 (1.8504 - 1.8505)
	Grade No. C	47.002 - 47.003 (1.8505 - 1.8505)
	Grade No. D	47.003 - 47.004 (1.8505 - 1.8505)
	Grade No. E	47.004 - 47.005 (1.8505 - 1.8506)
	Grade No. F	47.005 - 47.006 (1.8506 - 1.8506)
	Grade No. G	47.006 - 47.007 (1.8506 - 1.8507)
	Grade No. H	47.007 - 47.008 (1.8507 - 1.8507)
	Grade No. J	47.008 - 47.009 (1.8507 - 1.8507)
	Grade No. K	47.009 - 47.010 (1.8508 - 1.8508)
	Grade No. L	47.010 - 47.011 (1.8508 - 1.8508)
	Grade No. M	47.011 - 47.012 (1.8508 - 1.8509)
Grade No. N	47.012 - 47.013 (1.8509 - 1.8509)	

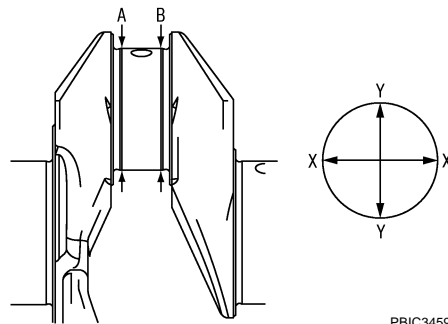
\*: After installing in connecting rod

## CRANKSHAFT

Unit: mm (in)



SEM645



PBIC3459J

Center distance "r"		44.89 - 44.97 (1.7673 - 1.7705)
Out-of-round	Limit	0.0035 (0.0001)
	Limit	
Taper	Limit	0.05 (0.0020)
	Limit	
Runout [TIR*]	Standard	0.05 (0.0020)
	Limit	0.1 (0.004)
Crankshaft end play	Standard	0.10 - 0.26 (0.004 - 0.0102)
	Limit	0.3 (0.012)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Crankshaft pin journal diameter grade. "Dp"	Grade No. A	43.970 - 43.971 (1.7311 - 1.7311)	A  EM  C  D  E  F  G  H  I  J  K  L  M  N  O  P
	Grade No. B	43.969 - 43.970 (1.7311 - 1.7311)	
	Grade No. C	43.968 - 43.969 (1.7310 - 1.7311)	
	Grade No. D	43.967 - 43.968 (1.7310 - 1.7310)	
	Grade No. E	43.966 - 43.967 (1.7309 - 1.7310)	
	Grade No. F	43.965 - 43.966 (1.7309 - 1.7309)	
	Grade No. G	43.964 - 43.965 (1.7309 - 1.7309)	
	Grade No. H	43.963 - 43.964 (1.7308 - 1.7309)	
	Grade No. J	43.962 - 43.963 (1.7308 - 1.7308)	
	Grade No. K	43.961 - 43.962 (1.7307 - 1.7308)	
	Grade No. L	43.960 - 43.961 (1.7307 - 1.7307)	
	Grade No. M	43.959 - 43.960 (1.7307 - 1.7307)	
	Grade No. N	43.958 - 43.959 (1.7306 - 1.7307)	
	Grade No. P	43.957 - 43.958 (1.7306 - 1.7306)	
	Grade No. R	43.956 - 43.957 (1.7305 - 1.7306)	
	Grade No. S	43.955 - 43.956 (1.7305 - 1.7305)	
	Grade No. T	43.954 - 43.955 (1.7305 - 1.7305)	
Grade No. U	43.953 - 43.954 (1.7304 - 1.7305)		
Crankshaft main journal diameter grade. "Dm"	Grade No. A	51.978 - 51.979 (2.0464 - 2.0464)	
	Grade No. B	51.977 - 51.978 (2.0463 - 2.0464)	
	Grade No. C	51.976 - 51.977 (2.0463 - 2.0463)	
	Grade No. D	51.975 - 51.976 (2.0463 - 2.0463)	
	Grade No. E	51.974 - 51.975 (2.0462 - 2.0463)	
	Grade No. F	51.973 - 51.974 (2.0462 - 2.0462)	
	Grade No. G	51.972 - 51.973 (2.0461 - 2.0462)	
	Grade No. H	51.971 - 51.972 (2.0461 - 2.0461)	
	Grade No. J	51.970 - 51.971 (2.0461 - 2.0461)	
	Grade No. K	51.969 - 51.970 (2.0460 - 2.0461)	
	Grade No. L	51.968 - 51.969 (2.0460 - 2.0460)	
	Grade No. M	51.967 - 51.968 (2.0459 - 2.0460)	
	Grade No. N	51.966 - 51.967 (2.0459 - 2.0459)	
	Grade No. P	51.965 - 51.966 (2.0459 - 2.0459)	
	Grade No. R	51.964 - 51.965 (2.0458 - 2.0459)	
	Grade No. S	51.963 - 51.964 (2.0458 - 2.0458)	
	Grade No. T	51.962 - 51.963 (2.0457 - 2.0458)	
Grade No. U	51.961 - 51.962 (2.0457 - 2.0457)		
Grade No. V	51.960 - 51.961 (2.0457 - 2.0457)		
Grade No. W	51.959 - 51.960 (2.0456 - 2.0457)		

\*: Total indicator reading

## Connecting Rod Bearing

INFOID:000000001160588

### CONNECTING ROD BEARING GRADE TABLE

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

## SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

### UNDERSIZE TABLE

Unit: mm (in)

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

### CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

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

### Main Bearing

INFOID:000000001160589

### MAIN BEARING GRADE TABLE (ALL JOURNALS)

Unit: mm (in)

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

### UNDERSIZE TABLE

Unit: mm (in)

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

### MAIN BEARING OIL CLEARANCE

Unit: mm (in)

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

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting Chart

INFOID:000000001157935

A

EM

C

D

E

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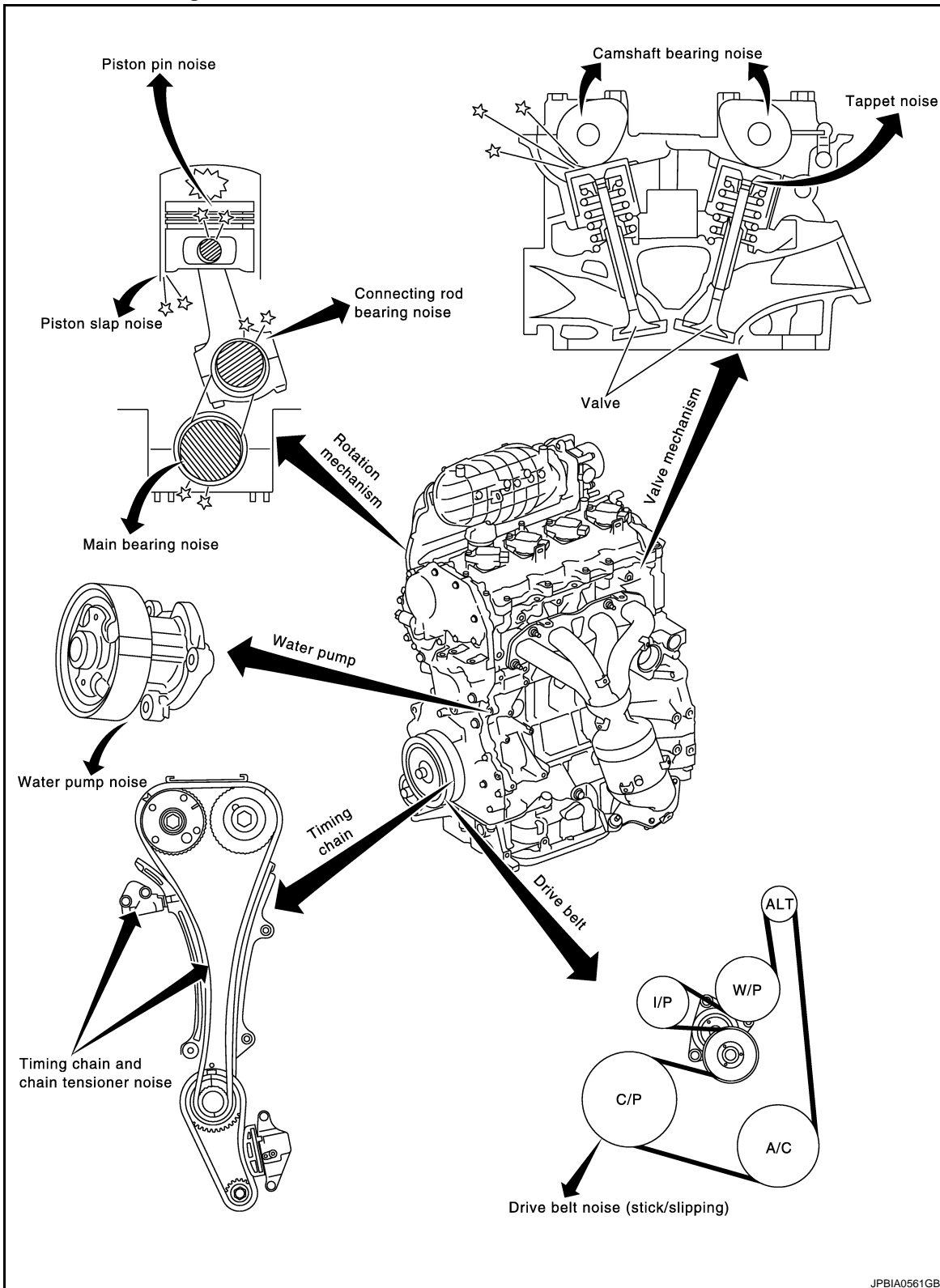
L

M

N

O

P



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

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[QR25DE]

4. Check specified noise source.

If necessary, repair or replace these parts.

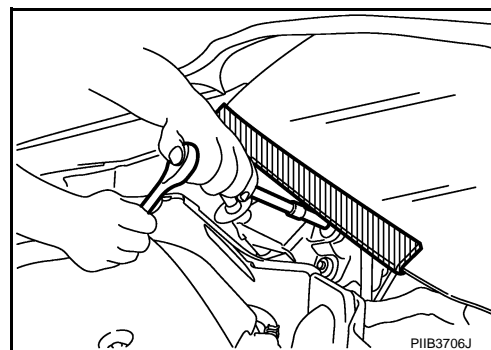
Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	<a href="#">EM-143</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	<a href="#">EM-175</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	<a href="#">EM-218</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-240</a> <a href="#">EM-240</a> <a href="#">EM-240</a> <a href="#">EM-240</a>
	Knock	B	A	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	<a href="#">EM-240</a> <a href="#">EM-244</a>
	Knock	B	A	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-243</a> <a href="#">EM-240</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-199</a> <a href="#">EM-193</a>
Front of engine	Squeaking or fizzing	A	B	—	B	B	B	Drive belt (Sticking or slipping)	Drive belt deflection	<a href="#">EM-138</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-55, "Exploded View"</a>

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

**PRECAUTION****PRECAUTIONS****Procedures without Cowl Top Cover**

INFOID:000000001157924

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

**Precaution Necessary for Steering Wheel Rotation After Battery Disconnect**

INFOID:000000001279179

**NOTE:**

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the "LOCK" position.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the 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. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.
5. When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT-III.

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

INFOID:000000001279180

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 AIRBAG" and "SEAT BELT" of this Service Manual.

**WARNING:**

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

# PRECAUTIONS

[QR25DE]

< PRECAUTION >

- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the “SRS AIRBAG”.**
- **Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

## Draining Engine Coolant

INFOID:000000001157926

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

## Disconnecting Fuel Piping

INFOID:000000001157927

- 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:000000001157928

- 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 re-assembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

## Inspection, Repair and Replacement

INFOID:000000001157929

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

## Assembly and Installation

INFOID:000000001157930

- 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:000000001157931

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



# PRECAUTIONS

< PRECAUTION >

[QR25DE]

## Liquid Gasket

INFOID:000000001157932

### REMOVAL OF LIQUID GASKET SEALING

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

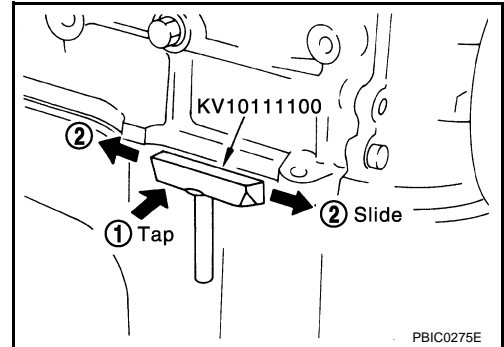
**CAUTION:**

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

- Tap the seal cutter to insert it (1), and then slide it (2) by tapping on the side as shown in the figure.
- In areas where the seal cutter (SST) is difficult to use, use a plastic hammer to lightly tap the parts, to remove it.

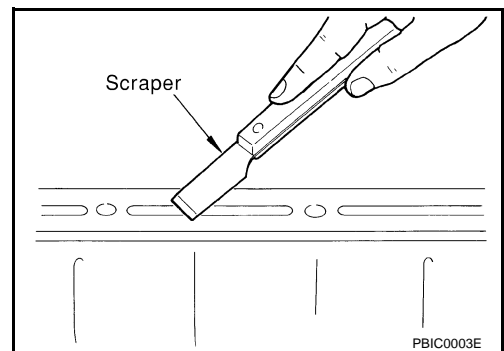
**CAUTION:**

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



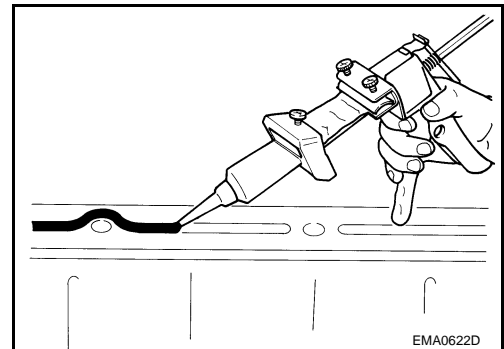
### LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, 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).

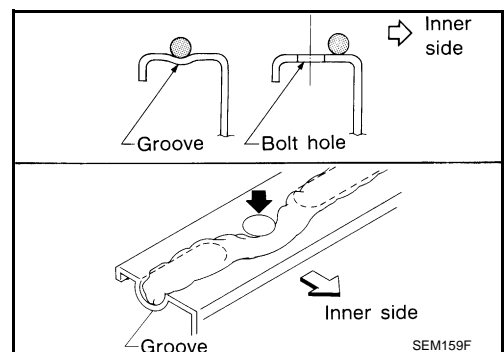
**Use Genuine Liquid Gasket or equivalent.**
4. Apply liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



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

< PREPARATION >

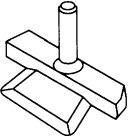
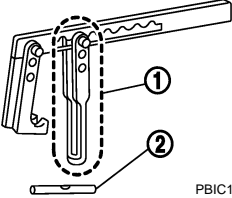
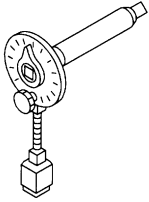
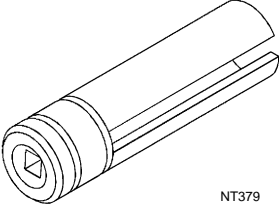
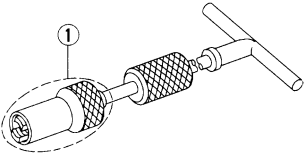
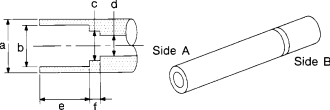
[QR25DE]

## PREPARATION

### PREPARATION

#### Special Service Tools

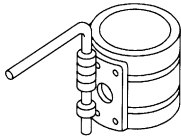
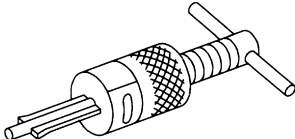
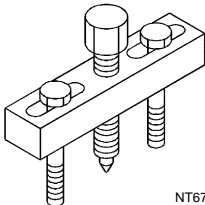
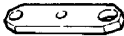
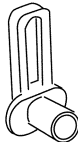
INFOID:000000001157933

Tool number Tool name	Description
KV10111100 Seal cutter	Removing oil pan and timing chain case   <p style="text-align: center;">S-NT046</p>
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.   <p style="text-align: center;">PBIC1650E</p>
KV10112100 Angle wrench	Tightening bolts for bearing cap, cylinder head, etc.   <p style="text-align: center;">S-NT014</p>
KV10117100 Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensors with 22 mm (0.87 in) hexagon nut   <p style="text-align: center;">NT379</p>
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	Removing valve oil seal   <p style="text-align: center;">S-NT605</p>
KV10115600 Valve oil seal drift	Installing valve oil seal <b>Use side A.</b> a: 20 (0.79) dia.                      d: 8 (0.31) dia. b: 13 (0.51) dia.                      e: 10.7 (0.421) dia. c: 10.3 (0.406) dia.                  f: 5 (0.20) dia. <span style="float: right;">Unit: mm (in)</span>   <p style="text-align: center;">S-NT603</p>

# PREPARATION

< PREPARATION >

[QR25DE]

Tool number Tool name	Description
EM03470000 Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 Pilot bushing puller  S-NT045	Removing pilot converter
KV11103000 Pulley puller  NT676	Removing crankshaft pulley
KV11105210 Stopper plate  ZZA0009D	Fixing drive plate and flywheel
Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)

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Commercial Service Tools

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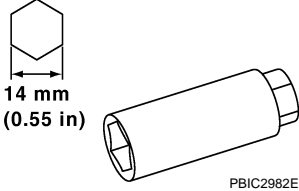

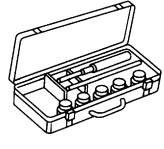
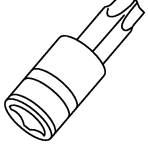
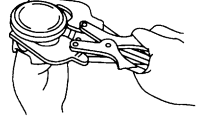
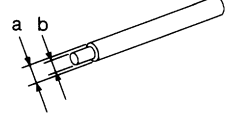
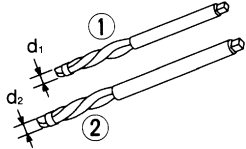
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# PREPARATION

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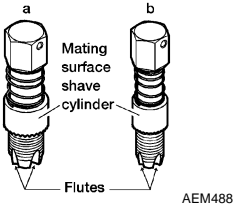

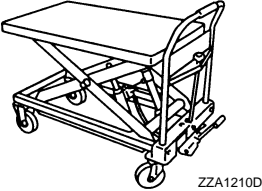
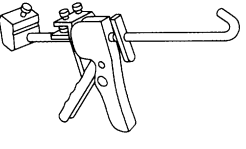
[QR25DE]

Tool name	Description
<p>Spark plug wrench</p>  <p style="text-align: center;">14 mm (0.55 in)</p> <p style="text-align: right;">PBIC2982E</p>	<p>Removing and installing spark plug</p>
<p>Pulley holder</p>  <p style="text-align: right;">ZZA1010D</p>	<p>Crankshaft pulley removing and installing</p>
<p>Valve seat cutter set</p>  <p style="text-align: right;">S-NT048</p>	<p>Finishing valve seat dimensions</p>
<p>TORX socket</p>  <p style="text-align: right;">PBIC1113E</p>	<p>Removing and installing flywheel <b>Size: T55</b></p>
<p>Piston ring expander</p>  <p style="text-align: right;">S-NT030</p>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p>  <p style="text-align: right;">S-NT015</p>	<p>Removing and installing valve guide <b>Intake &amp; Exhaust:</b> <b>a: 9.5 mm (0.374 in) dia.</b> <b>b: 5.5 mm (0.217 in) dia.</b></p>
<p>Valve guide reamer</p>  <p style="text-align: right;">S-NT016</p>	<p>1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide <b>Intake &amp; Exhaust:</b> <b>d1: 6.0 mm (0.236 in) dia.</b> <b>d2: 10.2 mm (0.402 in) dia.</b></p>

# PREPARATION

< PREPARATION >

[QR25DE]

Tool name	Description
<p>Oxygen sensor thread cleaner</p> 	<p>Reconditioning the exhaust system threads before installing a new air fuel ratio sensor and heated oxygen sensor (Use with anti-seize lubricant shown below.)  <b>a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor and air fuel ratio sensor</b>  <b>b = 12 mm (0.47 in) dia. for titania heated oxygen sensor</b></p>
<p>Anti-seize lubricant i.e.: (Permatex™ 133AR or equivalent meeting MIL specification MIL-A-907)</p> 	<p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>
<p>Manual lift table caddy</p> 	<p>Removing and installing engine</p>
<p>Tube presser</p> 	<p>Pressing the tube of liquid gasket</p>

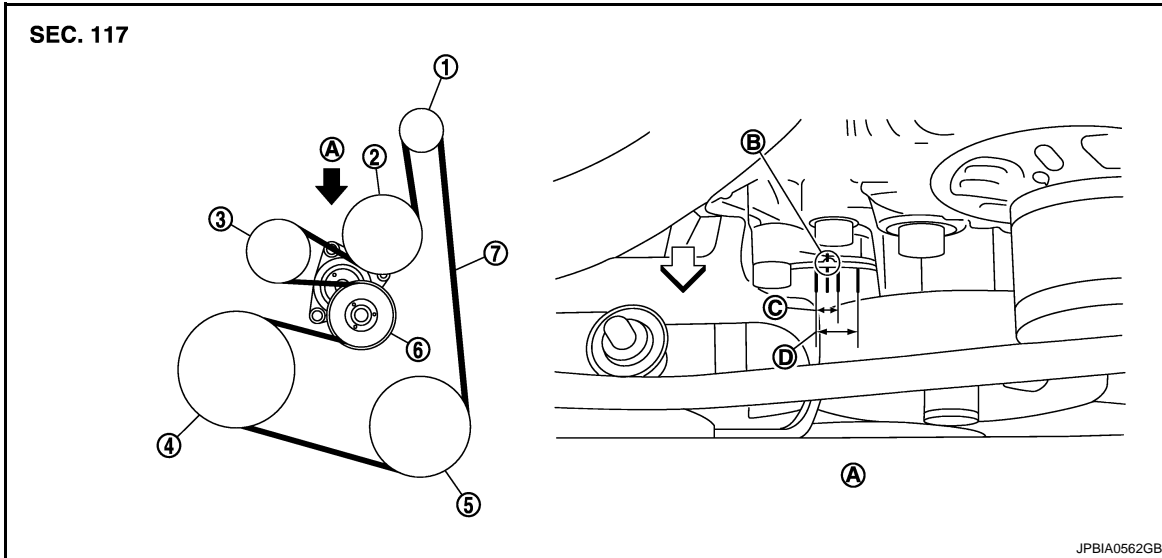
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## ON-VEHICLE MAINTENANCE

### DRIVE BELTS

#### Exploded View

INFOID:000000001316757



- |                      |                   |                              |
|----------------------|-------------------|------------------------------|
| 1. Alternator        | 2. Water pump     | 3. Idler pulley              |
| 4. Crankshaft pulley | 5. A/C compressor | 6. Drive belt auto-tensioner |
| 7. Drive belt        |                   |                              |
- 
- |                       |  |   |
|-----------------------|--|---|
| A. View A             | B. Indicator (notch on the fixed side) | C. Range when new drive belt is installed |
| D. Possible use range |  |   |
- ↶ : Engine front

#### Checking

INFOID:000000001157936

#### WARNING:

**Be sure to perform this step when the engine is stopped.**

- Check that the indicator (notch on fixed side) of drive belt auto-tensioner is within the possible use range (between four line notches on moving side).

#### NOTE:

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

#### Tension Adjustment

INFOID:000000001157937

Refer to : [EM-235, "Drive belt"](#).

#### Removal and Installation

INFOID:000000001157938

#### REMOVAL

1. Remove front wheel and tire (RH).
2. Remove front fender protector (RH). Refer to [EXT-21, "Exploded View"](#).

# DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

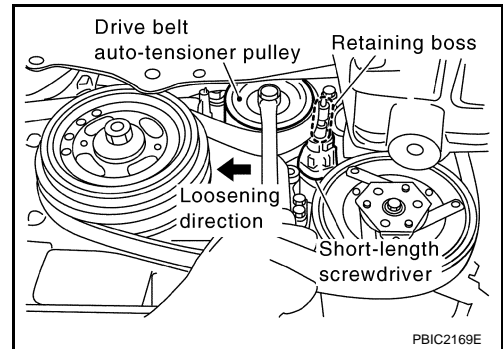
[QR25DE]

3. Hold the hexagonal part in center of drive belt auto-tensioner pulley with a box wrench securely. Then move the wrench handle in the direction of arrow (loosening direction of tensioner).

**CAUTION:**

- Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
- Never loosen the hexagonal part in center of drive belt auto-tensioner pulley (Do not turn it counterclockwise). If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including the pulley.

4. Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole of the retaining boss to fix drive belt auto-tensioner pulley.
5. Loosen drive belt from water pump pulley in sequence, and remove it.



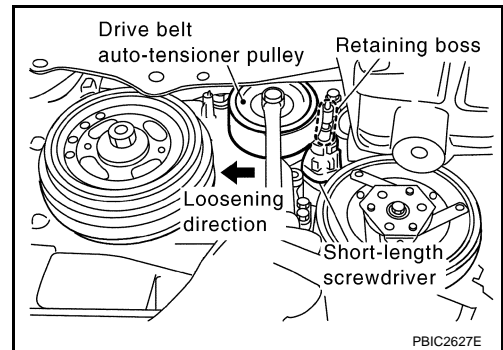
## INSTALLATION

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

**CAUTION:**

- Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.
- Never loosen the hexagonal part in center of drive belt auto-tensioner pulley (Do not turn it counterclockwise). If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including the pulley.

2. Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole of retaining boss to fix drive belt auto-tensioner pulley.



3. Hook drive belt onto all pulleys except for water pump, and then onto water pump pulley finally.

**CAUTION:**

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

4. Release drive belt auto-tensioner, and apply tension to drive belt.
5. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
6. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to [EM-138, "Exploded View"](#).

# AIR CLEANER FILTER

< ON-VEHICLE MAINTENANCE >

[QR25DE]

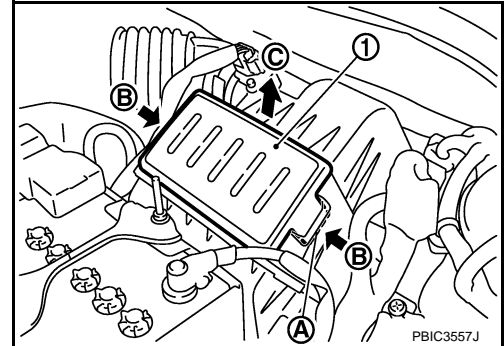
## AIR CLEANER FILTER

### Removal and Installation

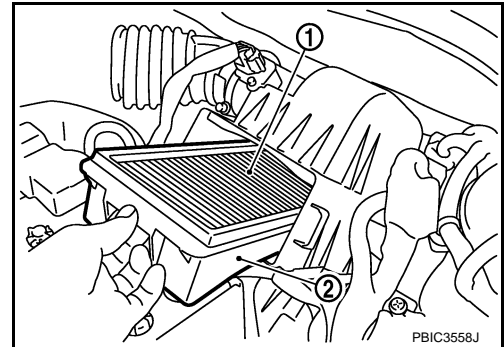
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#### REMOVAL

1. Push the tabs (A) of both ends of the air cleaner cover (1) into the inside (B).
2. Pull up the air cleaner cover forward (C) and remove it.



3. Remove the air cleaner filter (1) and holder (2) assembly from the air cleaner case.
4. Remove the air cleaner filter from the holder.



#### INSTALLATION

Installation is the reverse order of removal.



# SPARK PLUG

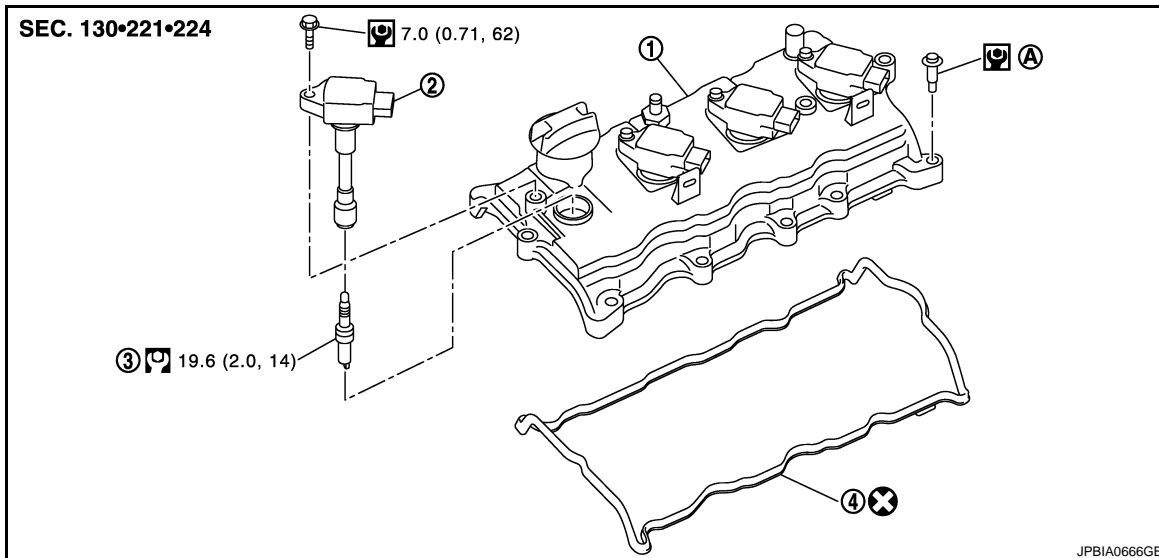
< ON-VEHICLE MAINTENANCE >

[QR25DE]

## SPARK PLUG

### Exploded View

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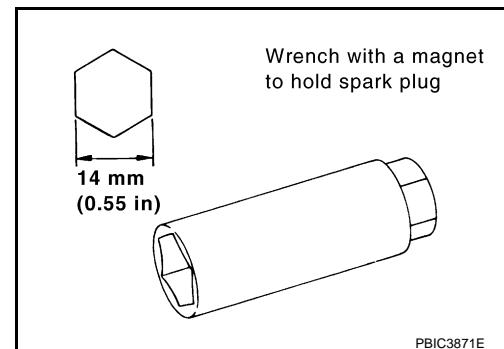
1. Rocker cover
  2. Ignition coil
  3. Spark plug
  4. Gasket
- A. Refer to [EM-164](#)  
Refer to [GI-4, "Components"](#) for symbols in the figure.

### Removal and Installation

INFOID:000000001157941

#### REMOVAL

1. Remove ignition coil. Refer to [EM-164, "Removal and Installation"](#).
2. Remove spark plug with spark plug wrench (commercial service tool).  
**CAUTION:**  
**Never drop or shock spark plug.**



#### INSTALLATION

Installation is the reverse order of removal.

#### Inspection

INFOID:000000001157942

#### INSPECTION AFTER REMOVAL

Use standard type spark plug for normal condition.

**Spark plug (standard) : Refer to [EM-235, "Spark Plug"](#).**

#### **CAUTION:**

- Never drop or shock spark plug.

# SPARK PLUG

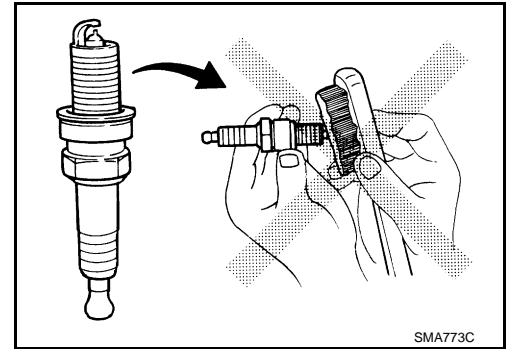
< ON-VEHICLE MAINTENANCE >

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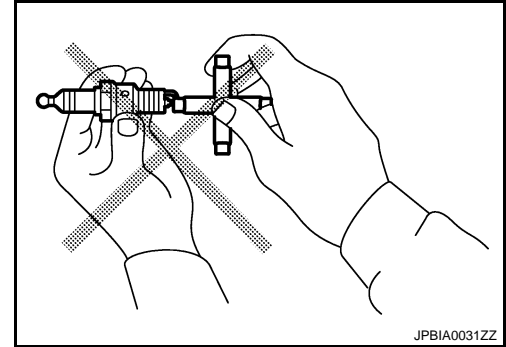
- Never use wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

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

Cleaning time: Less than 20 seconds



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



## CAMSHAFT VALVE CLEARANCE

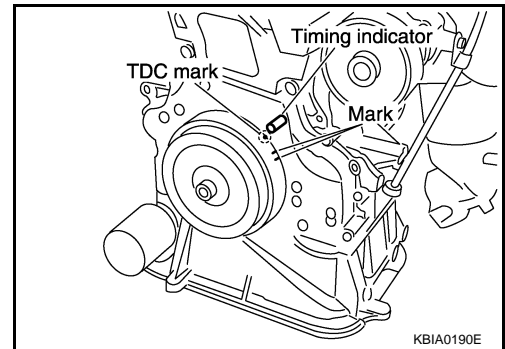
### Inspection and Adjustment

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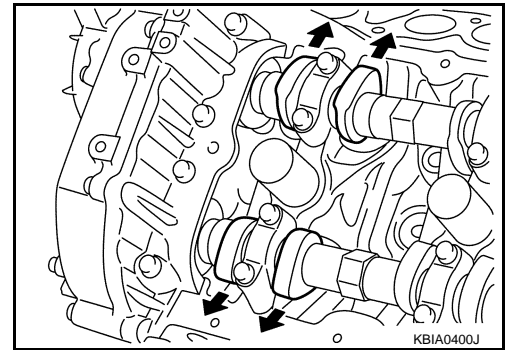
#### INSPECTION

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. Start the engine and warm it up.
2. Stop the engine.
3. Remove rocker cover. Refer to [EM-164, "Exploded View"](#).
4. Remove splash guard on RH fender protector.
5. Measure the valve clearance with the following procedure:
  - a. Set No. 1 cylinder at TDC of its compression stroke.
    - Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.

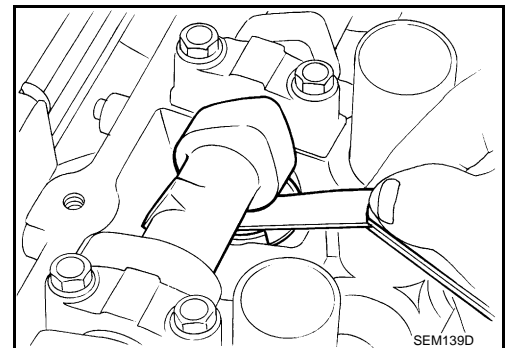


- At the same time, check that both intake and exhaust cam noses of No. 1 cylinder face outside as shown in the figure.
- If they do not face outside, rotate crankshaft pulley once more (360 degrees) and align as shown in the figure.



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

**Valve clearance** : Refer to [EM-236, "Camshaft"](#).



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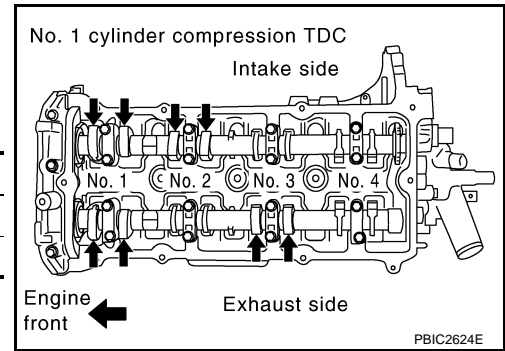
# CAMSHAFT VALVE CLEARANCE

[QR25DE]

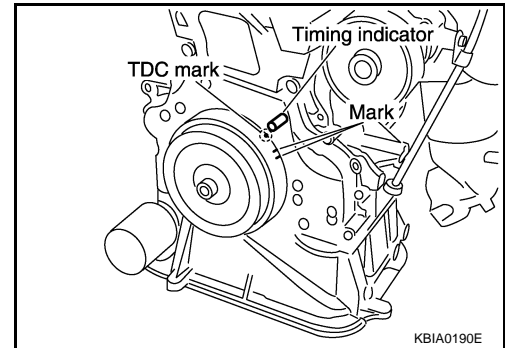
## < ON-VEHICLE MAINTENANCE >

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

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

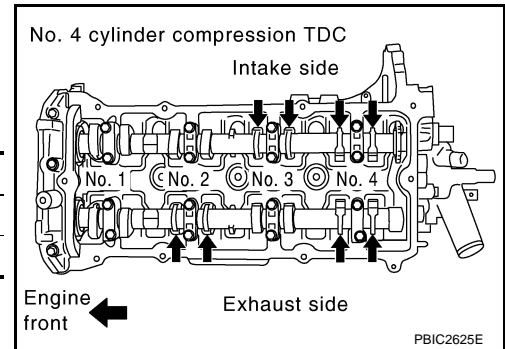


- c. Rotate crankshaft pulley one revolution (360 degrees) and align TDC mark to timing indicator on front cover.



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

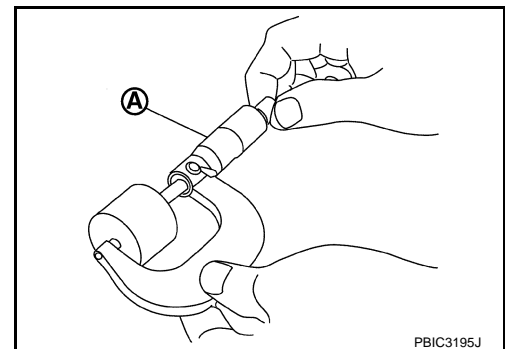
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	INT			x	x
	EXH		x		x



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

### ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
1. Remove camshaft. Refer to [EM-170. "Exploded View"](#).
  2. Remove valve lifters at the locations that are out of the standard.
  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**

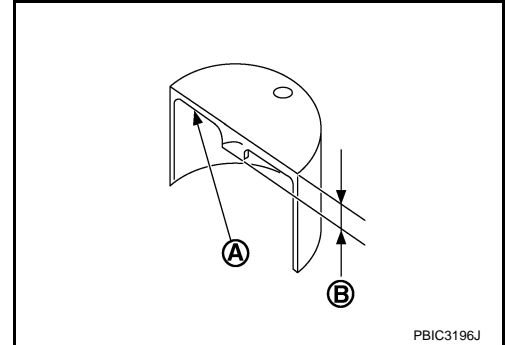
# CAMSHAFT VALVE CLEARANCE

< ON-VEHICLE MAINTENANCE >

[QR25DE]

- t1 = Removed valve lifter thickness
- C1 = Measured valve clearance
- C2 = Standard valve clearance:
  - Intake : 0.28 mm (0.011 in)
  - Exhaust : 0.30 mm (0.012 in)

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder). Stamp mark "788" indicates 7.88 mm (0.3102 in) in thickness.



## NOTE:

Available thickness of valve lifter: 26 sizes range 7.88 to 8.38 mm (0.3102 to 0.3299 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-236. "Camshaft"](#).

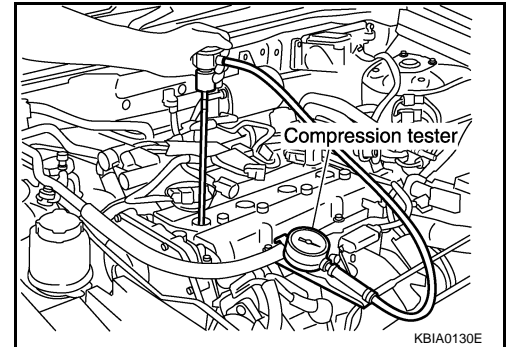
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-170. "Exploded View"](#).
7. Manually rotate crankshaft pulley a few rotations.
8. Check that valve clearances for cold engine are within specifications by referring to the specified values. Refer to "INSPECTION".
9. Install all removed parts in the reverse order of removal.
10. Warm up the engine, and check for unusual noise and vibration.

## COMPRESSION PRESSURE

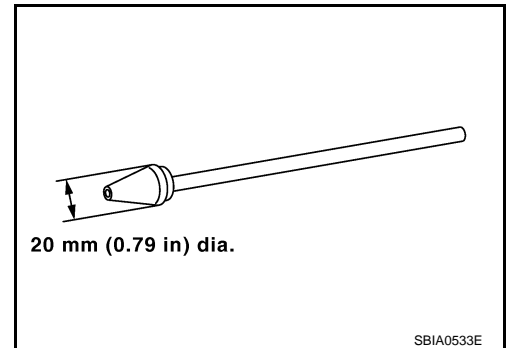
### Inspection

INFOID:000000001157944

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [ECQ-356. "Inspection"](#).
3. Disconnect fuel pump fuse to avoid fuel injection during measurement. Refer to [ECQ-22. "Component Parts Location"](#).
4. Remove ignition coil and spark plug from each cylinder. Refer to [EM-164. "Exploded View"](#).
5. Connect engine tachometer (not required in use of CONSULT-III).
6. Install compression tester with adapter 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.



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

**Compression pressure** : Refer to [EM-235. "General Specification"](#).

**CAUTION:**

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

- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the 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 re-check 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, gaskets are leaking. In such a case, replace cylinder head gaskets.
8. After inspection is completed, install removed parts.
  9. Start engine, and confirm that engine runs smoothly.

# COMPRESSION PRESSURE

< ON-VEHICLE MAINTENANCE >

[QR25DE]

10. Perform trouble diagnosis. If DTC appears, erase it. Refer to [ECQ-98. "Description"](#).

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# DRIVE BELT AUTO-TENSIONER

< ON-VEHICLE REPAIR >

[QR25DE]

Never loosen the hexagonal part in center of drive belt auto-tensioner pulley (Do not turn it counterclockwise). If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including the pulley.

A

## Installation

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

EM

### CAUTION:

- When installing drive belt auto-tensioner, be careful not to interfere with water pump pulley.
- If there is damage greater than peeled paint, replace drive belt auto-tensioner.
- Never swap the pulley between new and old drive belt auto-tensioner.

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# AIR CLEANER AND AIR DUCT

[QR25DE]

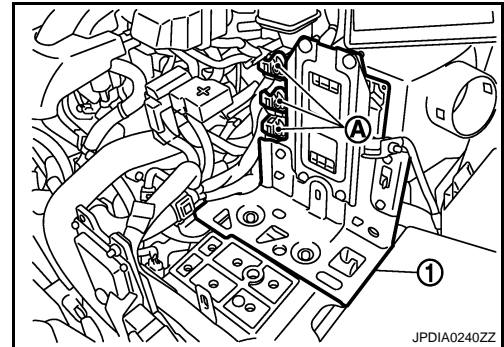
## < ON-VEHICLE REPAIR >

3. Disconnect harness connectors (A) and then remove bracket (1).
4. Disconnect mass air flow sensor harness connector.
5. Disconnect PCV hose.
6. Remove air cleaner case and mass air flow sensor assembly and air duct and air duct and resonator assembly disconnecting their joints.
  - Add marks as necessary for easier installation.
7. Remove mass air flow sensor from air cleaner case, if necessary.

### **CAUTION:**

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

- **Never shock mass air flow sensor.**
- **Never disassemble mass air flow sensor.**
- **Never touch its sensor.**



## INSTALLATION

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

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

## Inspection

INFOID:000000001157949

## INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

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

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# INTAKE MANIFOLD

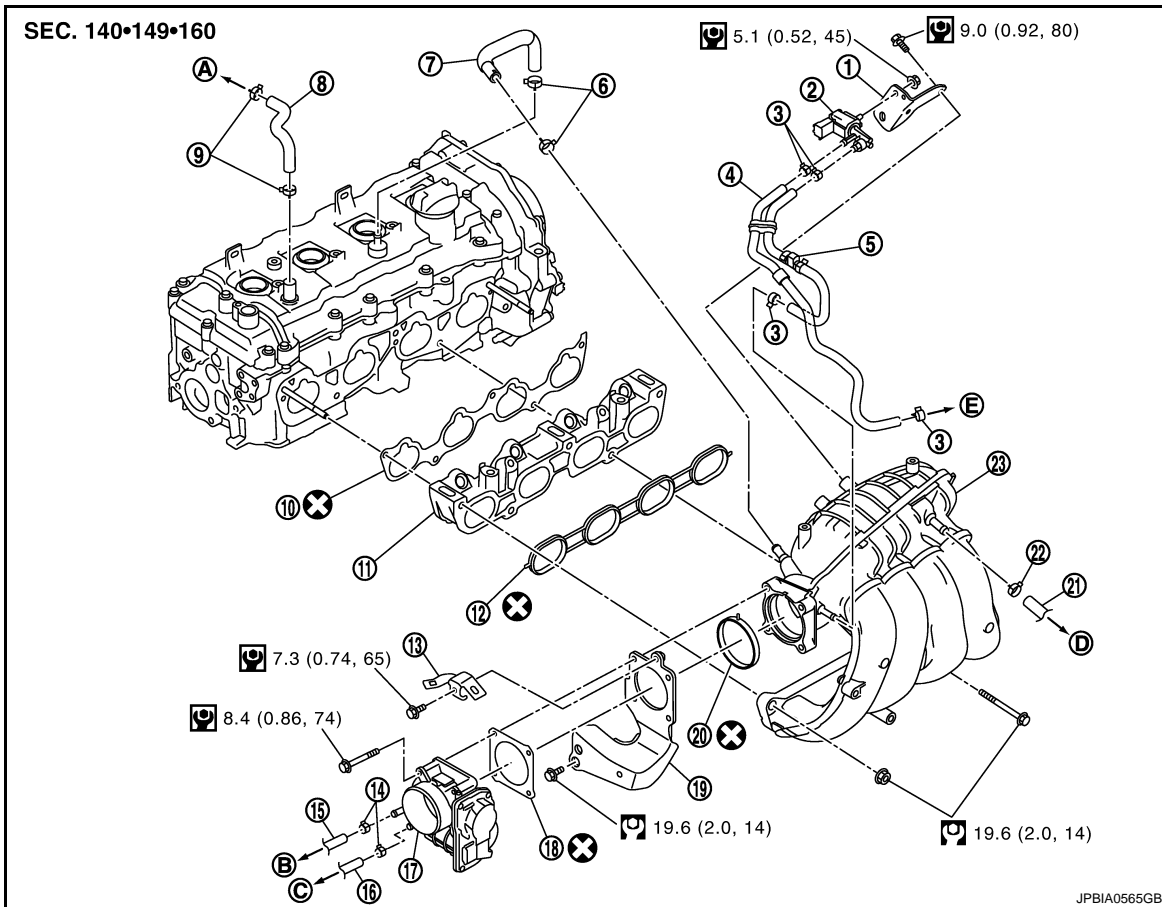
< ON-VEHICLE REPAIR >

[QR25DE]

## INTAKE MANIFOLD

### Exploded View

INFOID:000000001157950



- |                             |  |                    |
|-----------------------------|--|--------------------|
| 1. Bracket                  | 2. EVAP canister purge volume control solenoid valve | 3. Clamp           |
| 4. EVAP hose                | 5. EVAP hose assembly                                | 6. Clamp           |
| 7. PCV hose                 | 8. Fresh air hose                                    | 9. Clamp           |
| 10. Gasket                  | 11. Intake manifold adapter                          | 12. Gasket         |
| 13. Bracket                 | 14. Clamp  | 15. Water hose     |
| 16. Water hose              | 17. Electric throttle control actuator               | 18. Gasket         |
| 19. Intake manifold support | 20. Gasket   | 21. Vacuum hose    |
| 22. Clamp                   | 23. Intake manifold                                  |                    |
| A. To air duct              | B. To heater pipe                                    | C. To water outlet |
| D. To brake booster         | E. To vacuum pipe (canister)                         |                    |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001157951

### REMOVAL

1. Release fuel pressure. Refer to [ECQ-356, "Inspection"](#).
2. Remove cowl top cover. Refer to [EXT-19, "Exploded View"](#).
3. Remove air cleaner case, mass air flow sensor and air duct and resonator assembly. Refer to [EM-150, "Exploded View"](#).
4. Remove electric throttle control actuator with the following procedure:
  - a. Disconnect harness connector.

# INTAKE MANIFOLD

[QR25DE]

## < ON-VEHICLE REPAIR >

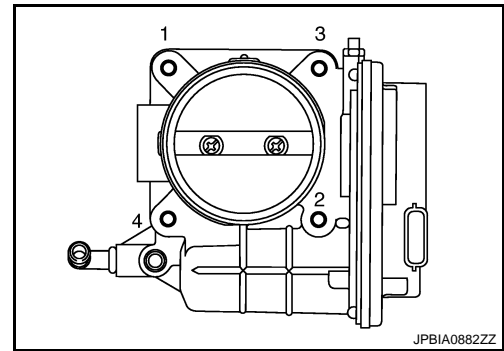
- b. Loosen mounting bolts in reverse order as shown in the figure, and remove electric throttle control actuator and gasket.

**CAUTION:**

- Handle carefully to avoid any shock to electric throttle control actuator.
- Never disassemble.

**NOTE:**

- When removing only intake manifold, move electric throttle control actuator without disconnecting the water hose.



5. Disconnect harness, vacuum hose and PCV hose from intake manifold, and move them aside.
6. Remove intake manifold support.
7. Loosen mounting bolts and nuts in reverse order as shown in the figure, and remove intake manifold and gasket.

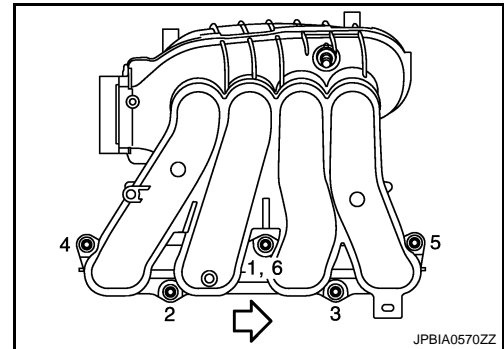
⇐ : Engine front

**CAUTION:**

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

**NOTE:**

Disregard No. 6 when loosening.



8. Disconnect sub-harness from fuel injector. Refer to [EM-166. "Exploded View"](#).
9. Remove fuel tube and fuel injector assembly from intake manifold adaptor. Refer to [EM-166. "Exploded View"](#).
10. Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.

## INSTALLATION

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

Intake Manifold

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

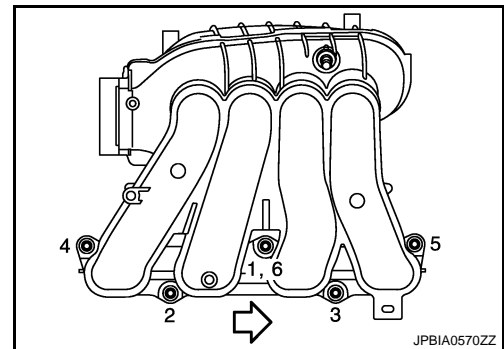
: **9.4 N·m (0.96 kg·m, 83 in·lb)**

- Tighten in numerical order as shown in the figure.

⇐ : Engine front

**NOTE:**

No. 6 means double tightening of bolt No. 1.



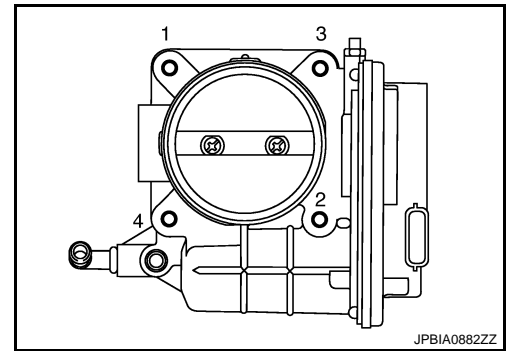
Electric Throttle Control Actuator

# INTAKE MANIFOLD

[QR25DE]

## < ON-VEHICLE REPAIR >

- Tighten mounting bolts equally and diagonally in several steps and in numerical order as shown in the figure.
- Perform the "Throttle Valve Closed Position Learning" when harness connector of electric throttle control actuator is disconnected. Refer to [ECQ-19, "THROTTLE VALVE CLOSED POSITION LEARNING : Description"](#).
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when electric throttle control actuator is replaced. Refer to [ECQ-17, "IDLE SPEED : Description"](#) or [ECQ-19, "THROTTLE VALVE CLOSED POSITION LEARNING : Description"](#).



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## Inspection

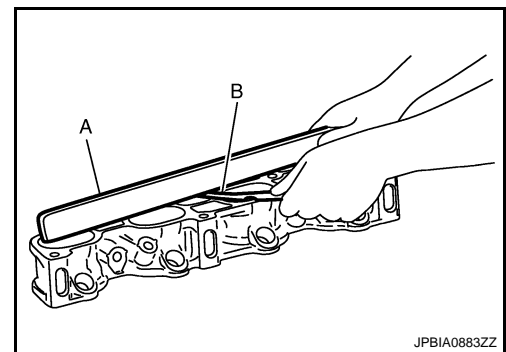
### INSPECTION AFTER REMOVAL

#### Surface Distortion

- Using straightedge (A) and feeler gauge (B), check the surface distortion of both the intake manifold adaptor mating surface.

**Limit** : Refer to [EM-236, "Intake Manifold"](#).

- If it exceeds the limit, replace intake manifold and/or intake manifold adaptor.



# EXHAUST MANIFOLD AND THREE WAY CATALYST

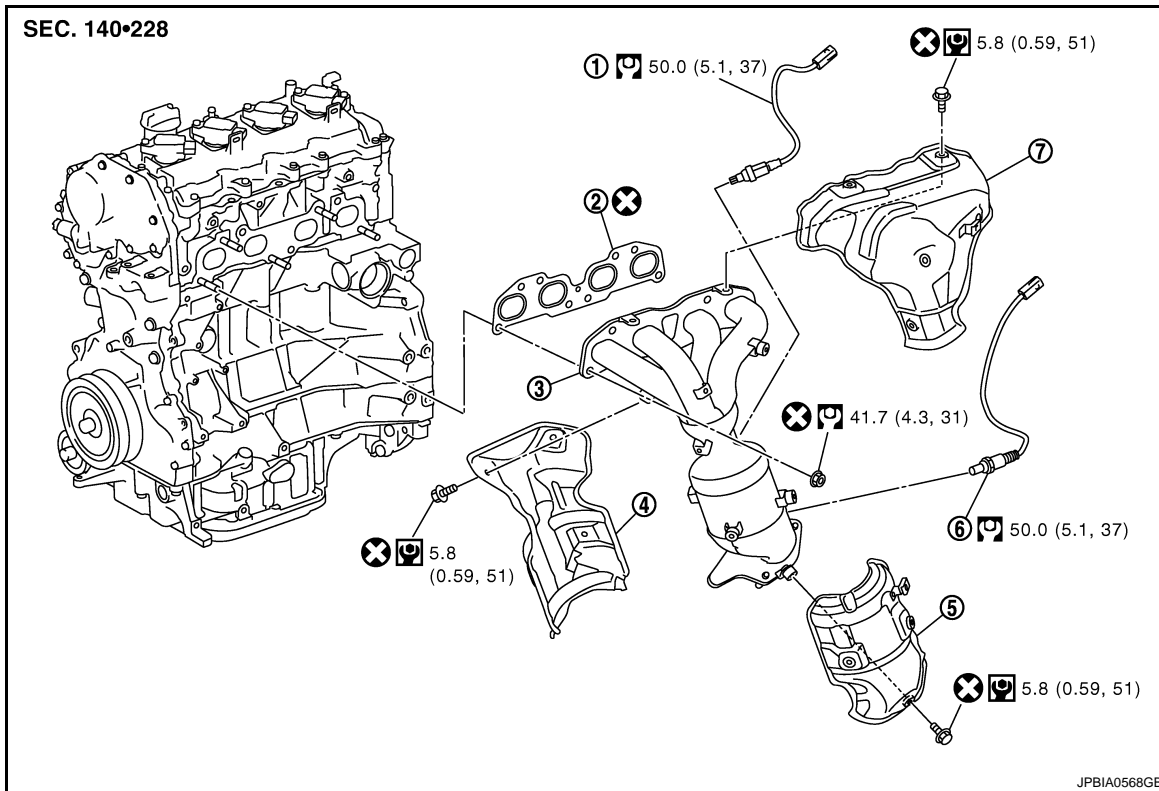
< ON-VEHICLE REPAIR >

[QR25DE]

## EXHAUST MANIFOLD AND THREE WAY CATALYST

### Exploded View

INFOID:000000001157953



- |                                   |                                   |   |
|-----------------------------------|-----------------------------------|---|
| 1. Heated oxygen sensor 1         | 2. Gasket                         | 3. Exhaust manifold and three way catalyst assembly |
| 4. Three way catalyst cover       | 5. Exhaust manifold cover (lower) | 6. Heated oxygen sensor 2                           |
| 7. Exhaust manifold cover (upper) |                                   |   |

Refer to [GI-4, "Components"](#) for symbols in the figure.

### Removal and Installation

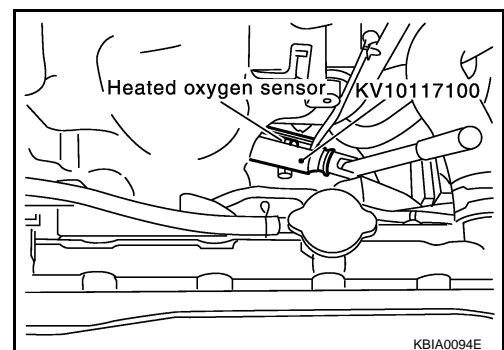
INFOID:000000001157954

#### Removal

- Remove heated oxygen sensors with the following procedure:
  - Disconnect harness connector of each heated oxygen sensor, and harness from bracket and middle clamp.
  - Using heated oxygen sensor wrench (SST), remove heated oxygen sensors.

#### CAUTION:

- Be careful not to damage heated oxygen sensor.
- Discard any heated oxygen sensor which has been dropped onto a hard surface such as a concrete floor. Replace with a new one.



- Remove exhaust front tube. Refer to [EX-10, "Exploded View"](#).
- Remove alternator. Refer to [CHG-30, "QR25DE MODELS : Exploded View"](#).
- Remove exhaust manifold cover (upper).

# EXHAUST MANIFOLD AND THREE WAY CATALYST

< ON-VEHICLE REPAIR >

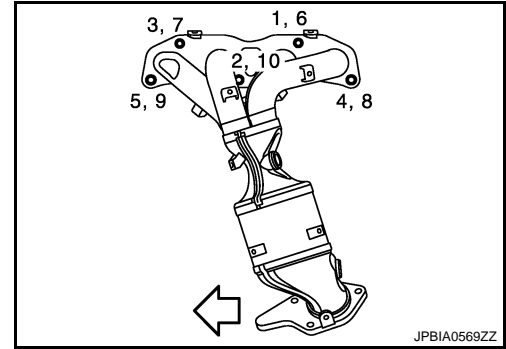
[QR25DE]

- Loosen nuts in reverse order as shown in the figure to remove exhaust manifold and three way catalyst assembly.

← : Engine front

**NOTE:**

Disregard No. 6 to 10 when loosening.



- Remove gasket.

**CAUTION:**

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

- Remove exhaust manifold cover (lower) and three way catalyst cover from exhaust manifold and three way catalyst assembly.

### Installation

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

#### EXHAUST MANIFOLD

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

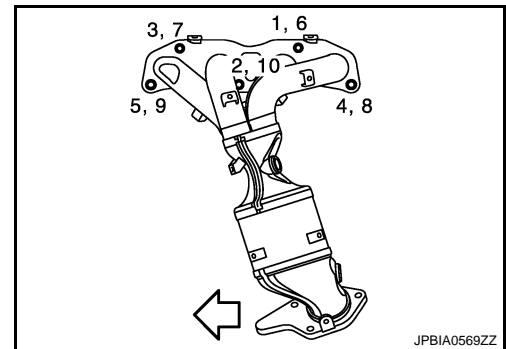
: **14.7 N·m (1.5 kg-m, 11 ft-lb)**

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

← : Engine front

**NOTE:**

No. 6 to 10 mean double tightening of bolts No. 1 and 5.



#### HEATED OXYGEN SENSOR

**CAUTION:**

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

#### Inspection

INFOID:000000001157955

#### INSPECTION AFTER REMOVAL

Surface Distortion



# EXHAUST MANIFOLD AND THREE WAY CATALYST

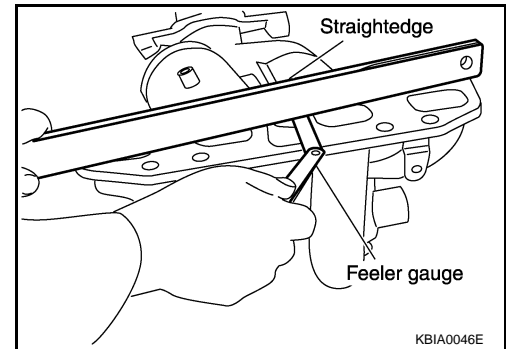
[QR25DE]

< ON-VEHICLE REPAIR >

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

**Limit** : Refer to [EM-236. "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.



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# OIL PAN (LOWER)

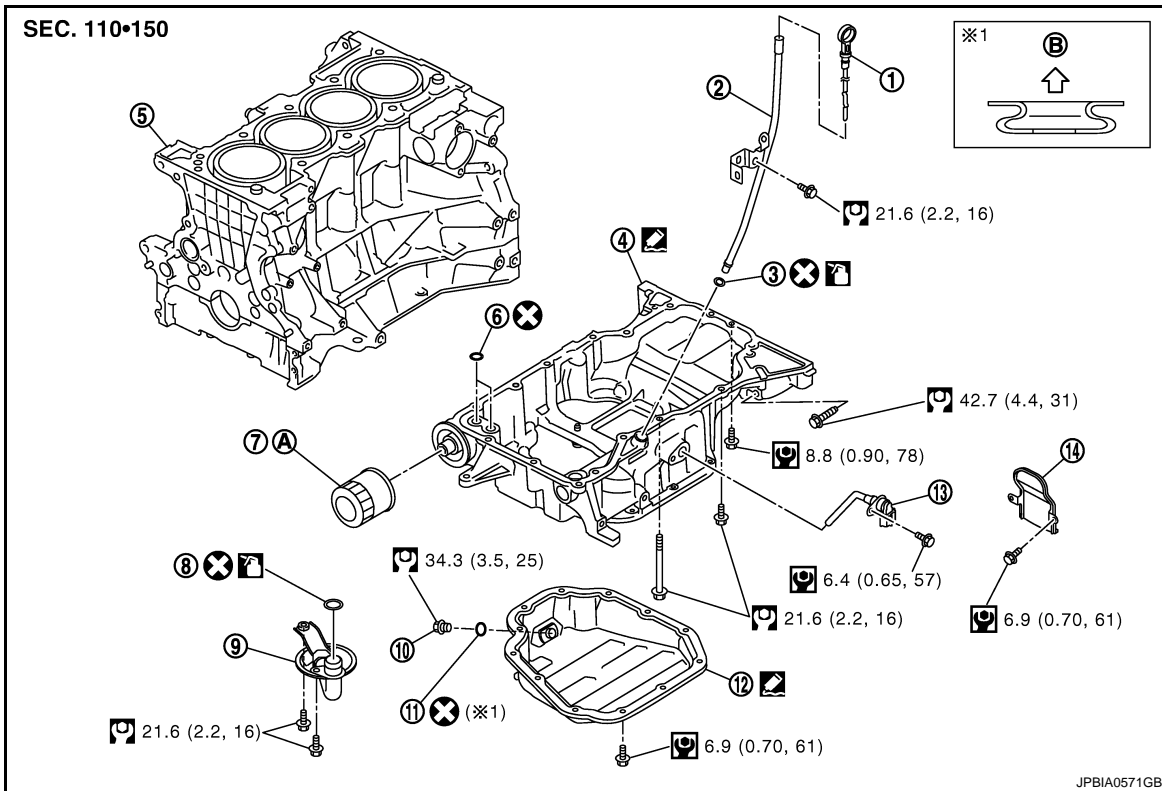
< ON-VEHICLE REPAIR >

[QR25DE]

## OIL PAN (LOWER)

Exploded View

INFOID:000000001157956



- |                                  |                          |                     |
|----------------------------------|--------------------------|---------------------|
| 1. Oil level gauge               | 2. Oil level gauge guide | 3. O-ring           |
| 4. Oil pan (upper)               | 5. Cylinder block        | 6. O-ring           |
| 7. Oil filter                    | 8. O-ring                | 9. Oil strainer     |
| 10. Drain plug                   | 11. Drain plug washer    | 12. Oil pan (lower) |
| 13. Oil level sensor (with WVTA) | 14. Rear plate cover     |                     |
- A. Refer to [LU-19](#)  
 B. Oil pan side

Refer to [GI-4. "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001157957

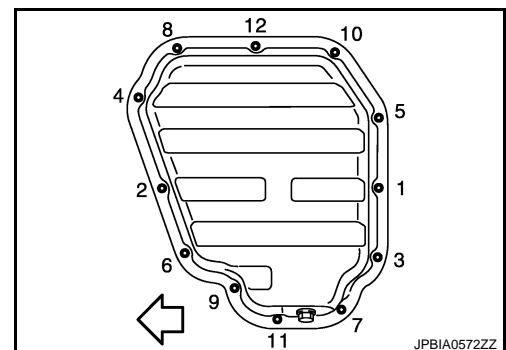
### REMOVAL

#### **WARNING:**

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

1. Drain engine oil. Refer to [LU-17. "Draining"](#).
2. Remove oil pan (lower) with the following procedure:
  - a. Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front



# OIL PAN (LOWER)

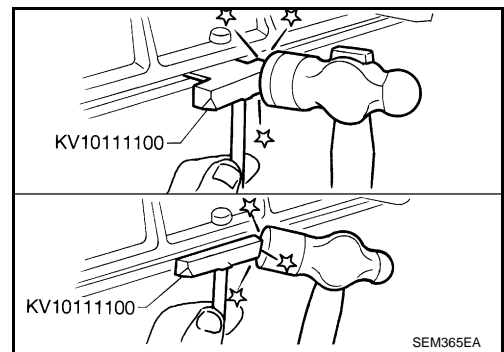
< ON-VEHICLE REPAIR >

[QR25DE]

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

**CAUTION:**

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

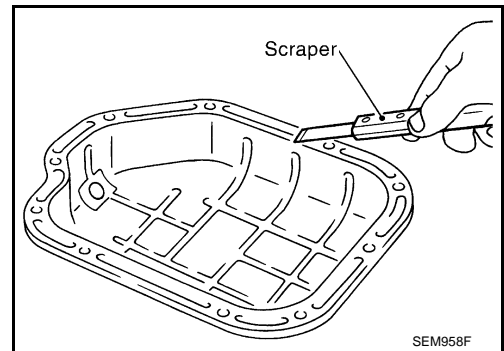


## INSTALLATION

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

**CAUTION:**

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



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

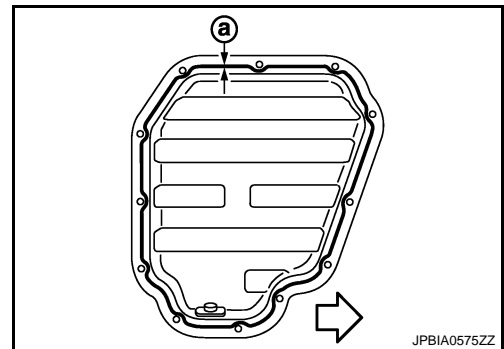
⇐ : Engine front

**a : 4.0 – 5.0 mm (0.157 – 0.197 in)**

**Use Genuine Liquid Gasket or equivalent.**

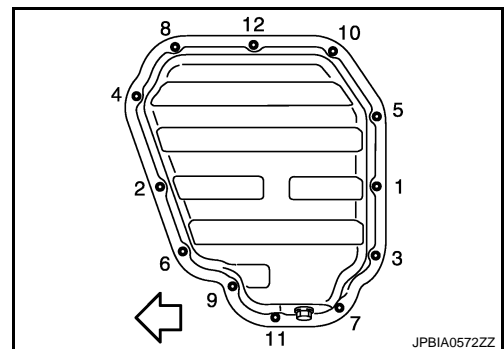
**CAUTION:**

**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 washer. Refer to [EM-158](#), "[Exploded View](#)".
3. Install in the reverse order of removal after this step.
- NOTE:**  
Pour engine oil at least 30 minutes after oil pan is installed.

Inspection

## OIL PAN (LOWER)

< ON-VEHICLE REPAIR >

[QR25DE]

### INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-16. "Inspection"](#).
2. Start engine, and check there is no leaks of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-16. "Inspection"](#).

### Inspection

INFOID:000000001157958

### INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-16. "Inspection"](#).
2. Start engine, and check there is no leaks of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-16. "Inspection"](#).



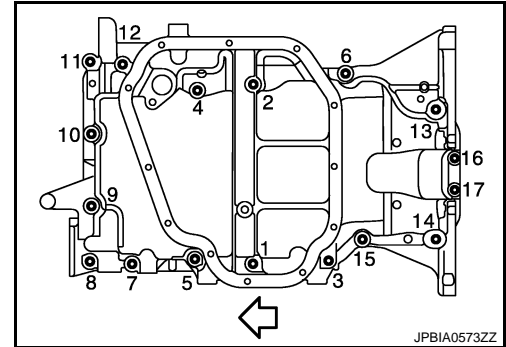
# OIL PAN (UPPER) AND OIL STRAINER

[QR25DE]

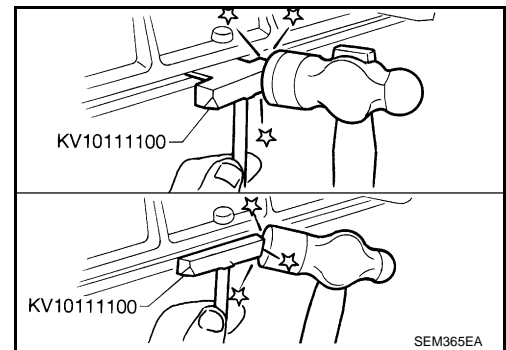
< ON-VEHICLE REPAIR >

11. Remove oil strainer.
12. Remove oil pan (upper) with the following procedure:
  - a. Loosen bolts in reverse order as shown in the figure.

← : Engine front



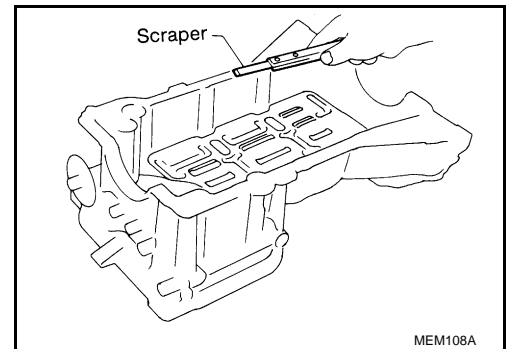
- b. Insert seal cutter (SST) between oil pan (upper) and lower cylinder block, and slide it by tapping on the side of the tool with a hammer.  
**CAUTION:**  
Be careful not to damage the mating surface.



13. Remove O-rings at front cover side.

## INSTALLATION

1. Install oil pan (upper) with the following procedure:
  - a. Use a 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. Apply a continuous bead of liquid gasket with a tube presser (commercial service tool) as shown in the figure.

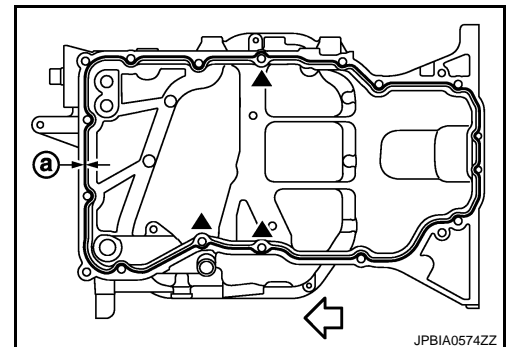
← : Engine front

**a** : 4.0 – 5.0 mm (0.157 – 0.197 in)

Use Genuine Liquid Gasket or equivalent.

**CAUTION:**

- For bolt holes with ▲ marks (3 locations), apply liquid gasket out side the holes.
- Attaching should be done within 5 minutes after liquid gasket application.



- c. Install new O-rings at front cover side.  
**CAUTION:**

# OIL PAN (UPPER) AND OIL STRAINER

< ON-VEHICLE REPAIR >

[QR25DE]

## Install avoiding misalignment of O-rings.

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

← : Engine front

### NOTE:

Refer to the following for locating bolts.

<b>M6 × 20 mm (0.79 in)</b>	<b>: No. 16, 17</b>
<b>M8 × 25 mm (0.98 in)</b>	<b>: No. 4, 6, 11, 13, 14, 15</b>
<b>M8 × 60 mm (2.36 in)</b>	<b>: No. 7, 8, 9, 10</b>
<b>M8 × 100 mm (3.97 in)</b>	<b>: No. 1, 2, 3, 5, 12</b>

**Tightening torque** : Refer to [EM-161, "Exploded View"](#).

2. Install oil strainer.
3. Install front suspension member. Refer to [FSU-18, "Exploded View"](#).
4. Install oil pan (lower). Refer to [EM-158, "Removal and Installation"](#).
5. Install oil pan drain plug.
  - Refer to the figure of components of former page for installation direction of washer. Refer to [EM-161, "Exploded View"](#).
6. Install in the reverse order of removal after this step.

### NOTE:

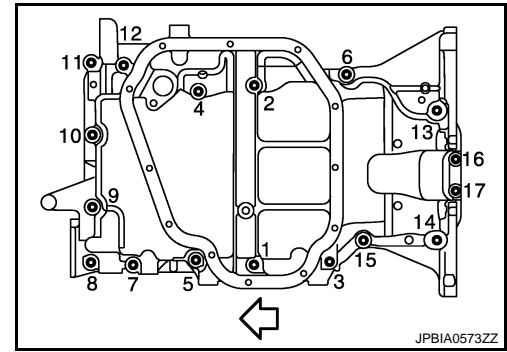
Pour engine oil at least 30 minutes after oil pan is installed.

## Inspection

INFOID:000000001321885

## INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-16, "Inspection"](#).
2. Start engine, and check there is no leaks of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-16, "Inspection"](#).



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# IGNITION COIL, SPARK PLUG AND ROCKER COVER

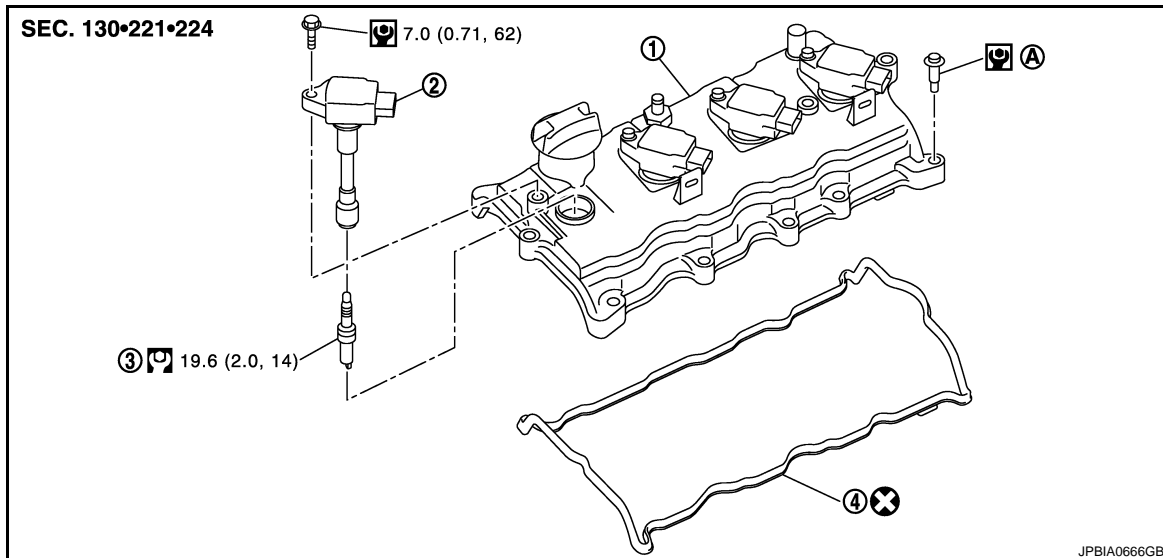
< ON-VEHICLE REPAIR >

[QR25DE]

## IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:000000001157959



1. Rocker cover
  2. Ignition coil
  3. Spark plug
  4. Rocker cover gasket
  - A. Refer to [EM-164](#)
- Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001157962

### REMOVAL

1. Remove air duct and resonator assembly. Refer to [EM-150, "Exploded View"](#).
2. Remove electric throttle control actuator without disconnecting water hose. Refer to [EM-152, "Exploded View"](#).
3. Loosen intake manifold mounting bolts and nuts.
4. Remove intake manifold. Refer to [EM-152, "Removal and Installation"](#).
5. Disconnect harness connector from ignition coil.
6. Support the bottom surface of engine using a transmission jack.
7. Remove ground cable and harness from engine mounting bracket (RH).
8. Remove ignition coil.  
**CAUTION:**
  - Never drop or shock ignition coil.
  - Never disassemble ignition coil.
9. Disconnect PCV hose from rocker cover.
10. Remove engine mounting bracket (RH). Refer to [EM-192, "Exploded View"](#).
11. Remove PCV valve and O-ring from rocker cover, if necessary.
12. Remove oil filler cap from rocker cover, if necessary.



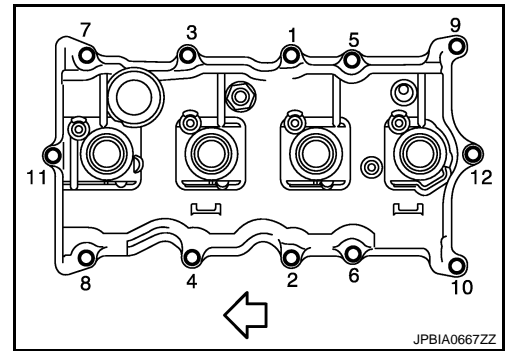
# IGNITION COIL, SPARK PLUG AND ROCKER COVER

< ON-VEHICLE REPAIR >

[QR25DE]

13. Loosen bolts in reverse order shown in the figure.

← : Engine front



14. Remove rocker cover gasket from rocker cover.

15. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

**CAUTION:**

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

## INSTALLATION

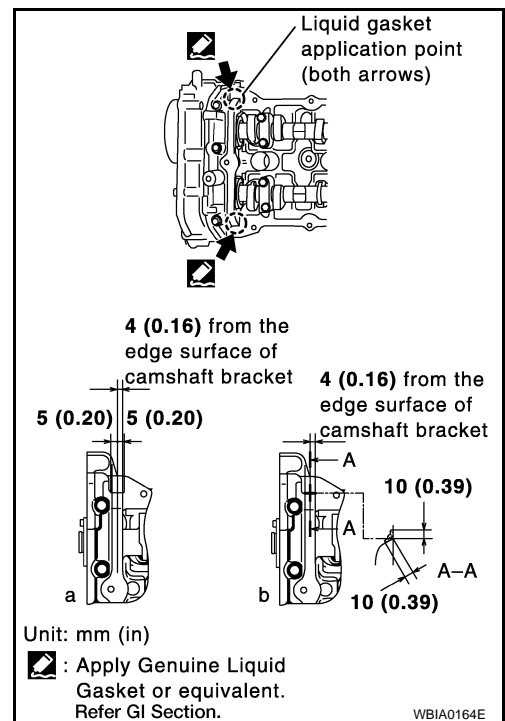
1. Apply liquid gasket to the position shown in the figure (4 places of cylinder head front and back) with the following procedure:

- Refer to figure "a" to apply liquid gasket to joint part of camshaft bracket (No. 1) and cylinder head.
- Refer to figure "b" to apply liquid gasket in 90 degrees to figure "a".

**Use Genuine Liquid Gasket or equivalent.**

**CAUTION:**

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



2. Install rocker cover gasket to rocker cover.

3. Install rocker cover.

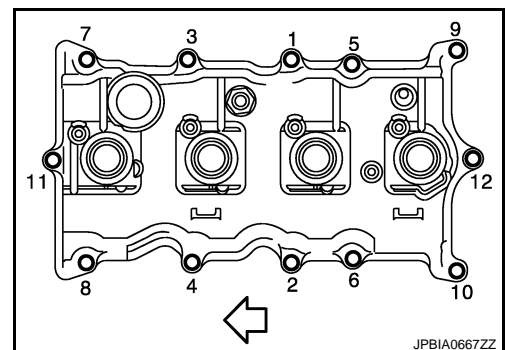
- Check if rocker cover gasket is not dropped from the installation groove of rocker cover.

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

← : Engine front

**1st step** : 1.96 N-m (0.2 kg-m, 17 in-lb)

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



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

# FUEL INJECTOR AND FUEL TUBE

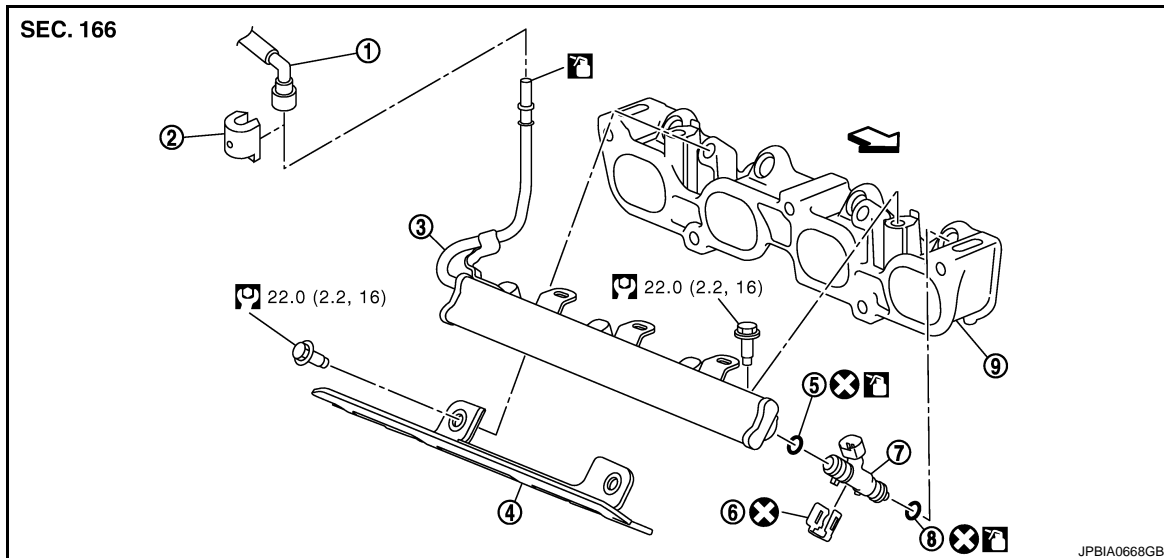
< ON-VEHICLE REPAIR >

[QR25DE]

## FUEL INJECTOR AND FUEL TUBE

### Exploded View

INFOID:000000001157963



- |                        |                        |                            |
|------------------------|------------------------|----------------------------|
| 1. Fuel feed hose      | 2. Quick connector cap | 3. Fuel tube               |
| 4. Fuel tube protector | 5. O-ring (blue)       | 6. Clip                    |
| 7. Fuel injector       | 8. O-ring (brown)      | 9. Intake manifold support |

← : Engine front

Refer to [GI-4, "Components"](#) for symbols in the figure.

### CAUTION:

Never remove or disassemble parts unless instructed in the figure.

### Removal and Installation

INFOID:000000001157964

#### REMOVAL

#### WARNING:

- Put a "CAUTION: FLAMMABLE" sign in the work shop.
- Be sure to work in a well ventilated area and furnish work shop with a CO2 fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

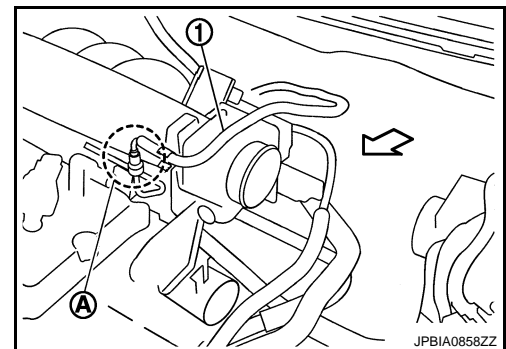
1. Release fuel pressure. Refer to [ECQ-356, "Inspection"](#).
2. Remove air cleaner case, mass air flow sensor and air duct assembly. Refer to [EM-150, "Exploded View"](#).
3. Disconnect quick connector (A) with the following procedure:

1 : Fuel feed hose

← : Vehicle front

### CAUTION:

Disconnect quick connector by using quick connector release, not by picking out retainer tabs.

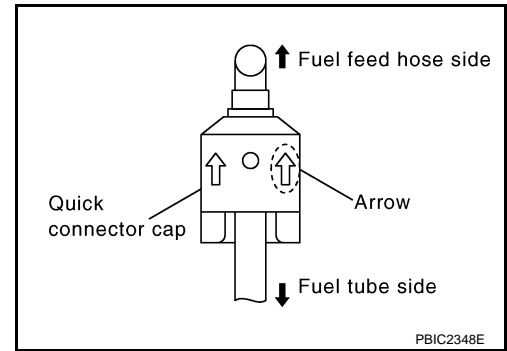


# FUEL INJECTOR AND FUEL TUBE

[QR25DE]

< ON-VEHICLE REPAIR >

- a. Remove quick connector cap.



- b. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.  
 c. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

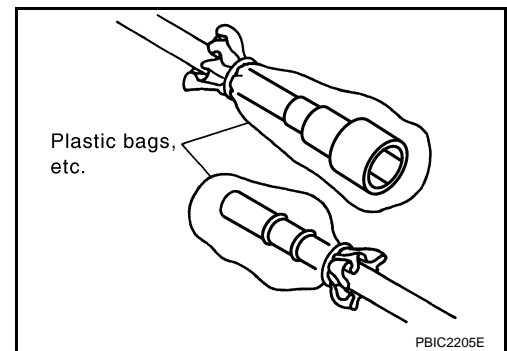
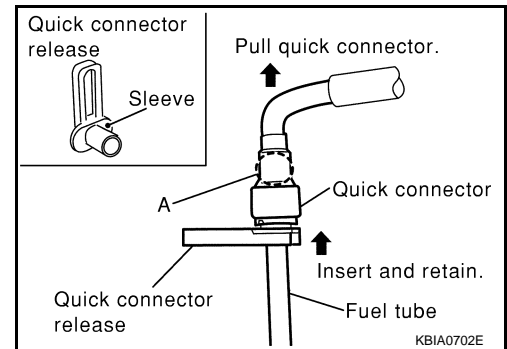
**CAUTION:**

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

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

**CAUTION:**

- Pull quick connector holding "A" position 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 leak 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 hose during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.

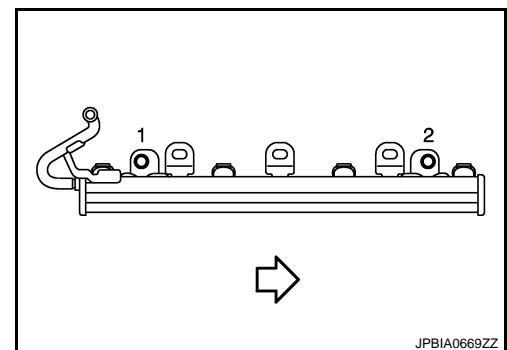


4. Remove intake manifold. Refer to [EM-152. "Removal and Installation"](#).  
 5. Disconnect sub-harness for fuel injector.  
 6. Remove fuel tube and fuel injector assembly.  
 • Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

**CAUTION:**

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



# FUEL INJECTOR AND FUEL TUBE

< ON-VEHICLE REPAIR >

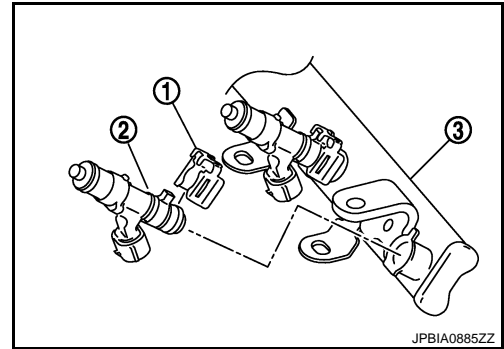
[QR25DE]

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

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

**CAUTION:**

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



## INSTALLATION

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

**CAUTION:**

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

**Fuel tube side : Blue**

**Nozzle side : Brown**

- 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 was stretched while it was being attached, 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:

**2 : O-ring (Blue)**

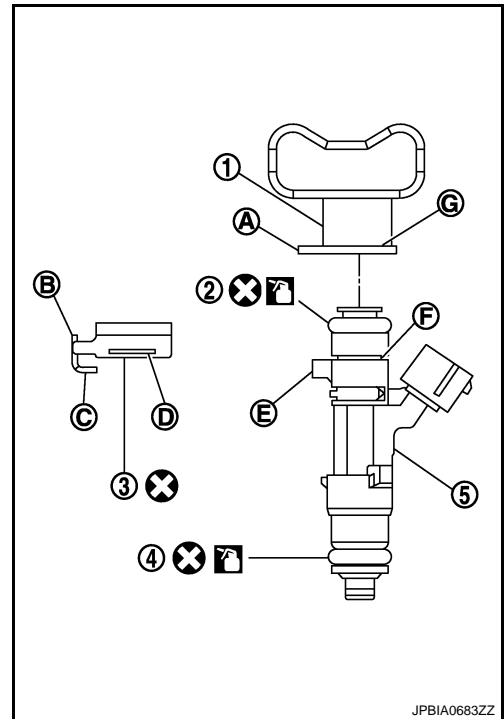
**4 : O-ring (Brown)**

- a. Insert clip (3) into clip mounting groove (F) on fuel injector (5).
  - Insert clip so that protrusion (E) of fuel injector matches cutout (C) 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 with clip attached.
  - Insert it while matching it to the axial center.
  - Insert fuel injector so that protrusion (A) of fuel tube (1) matches cutout (B) of clip.
  - Check that fuel tube flange (G) is securely fixed in flange fixing groove (D) on clip.
- c. Check that installation is complete by making sure that fuel injector does not rotate or come off.



3. Install fuel tube and fuel injector assembly with the following procedure:

- a. Insert the tip of each fuel injector into intake manifold support.

# FUEL INJECTOR AND FUEL TUBE

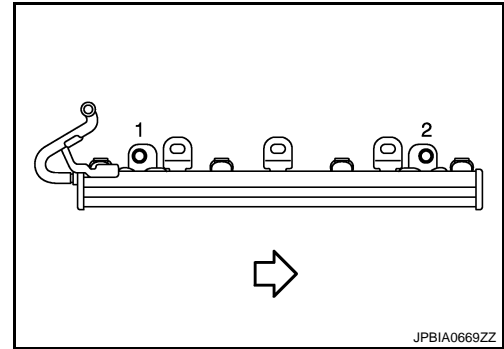
[QR25DE]

## < ON-VEHICLE REPAIR >

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

← : Engine front

4. Connect sub-harness for fuel injector.



5. Install intake manifold. Refer to [EM-152. "Exploded View"](#).  
 6. Note the following, and connect quick connector to install fuel feed hose.  
 a. Check the connection for foreign material and damage.  
 b. Align center to insert quick connector straightly into fuel tube.

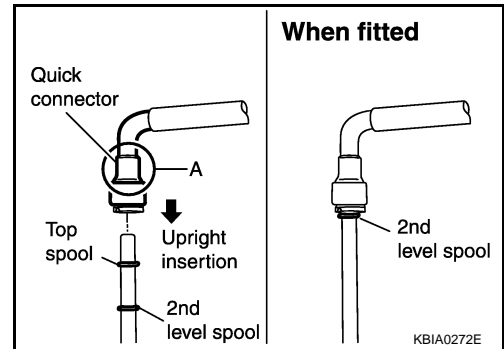
**NOTE:**

The figure shows engine side as an example.

- Insert fuel tube into quick connector until the top spool on fuel tube is inserted completely and the second level spool is positioned slightly below quick connector bottom end.

**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.

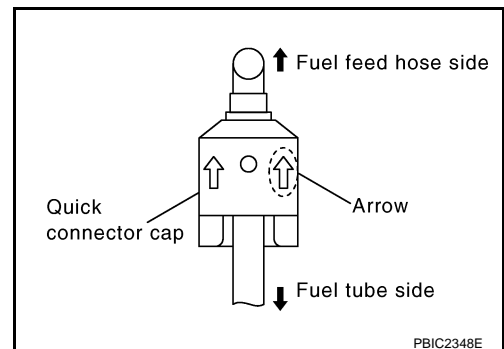


- c. Before clamping fuel feed hose with hose clamps, pull quick connector hard by hand holding "A" position. Check it is completely engaged (connected) so that it does not come out from fuel feed tube.  
 d. Install quick connector cap to quick connector connection.

**CAUTION:**

- Install so that the arrow mark on the side faces up.
- Check that quick connector and fuel tube are securely fit into quick connector cap installation groove.
- If quick connector cap cannot be installed smoothly, quick connector may have not been installed correctly. Check connection again.

7. Install fuel feed hose to hose clamp.  
 8. Install in the reverse order of removal after this step.



## Inspection

INFOID:000000001157965

### INSPECTION AFTER INSTALLATION

#### Check on Fuel Leakage

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

**NOTE:**

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leaks at connection points.

**CAUTION:**

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

# CAMSHAFT

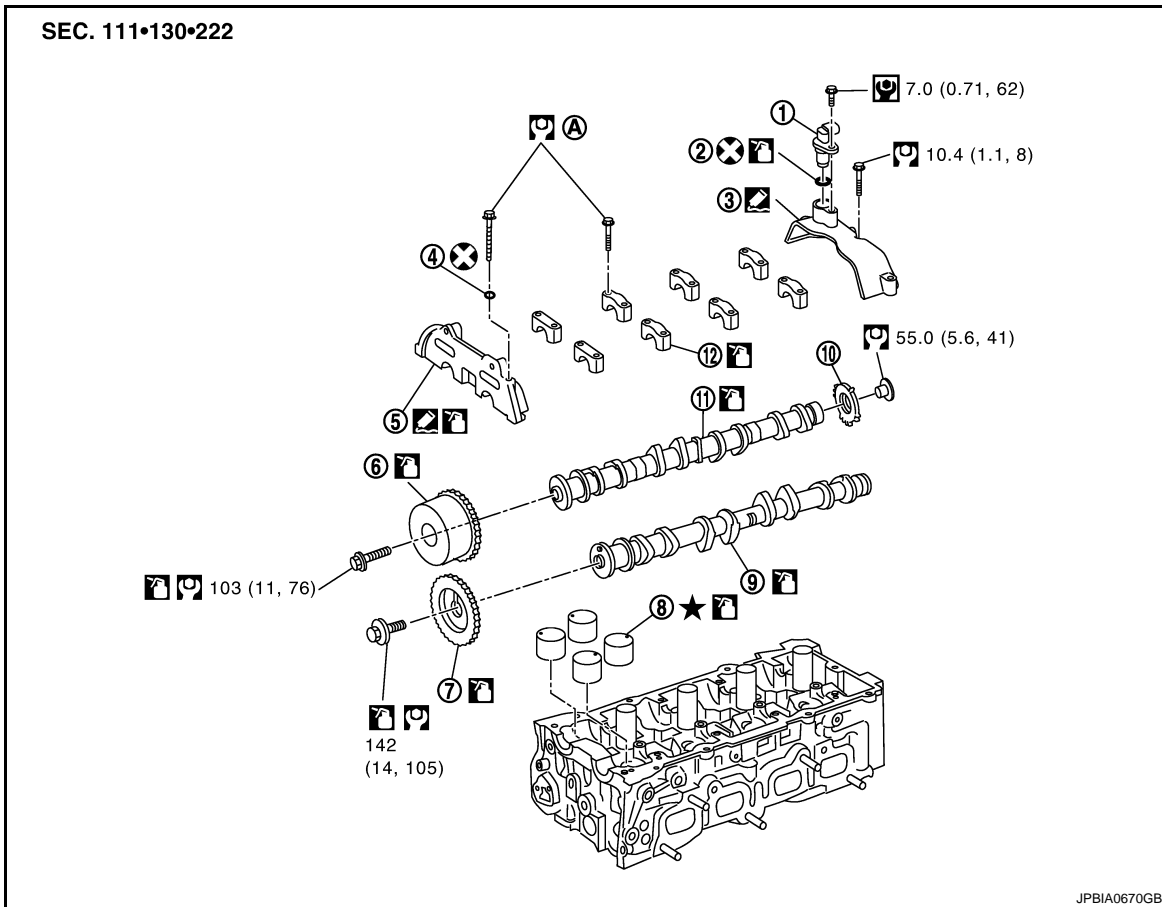
< ON-VEHICLE REPAIR >

[QR25DE]

## CAMSHAFT

### Exploded View

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- |                                     |                             |                                     |
|-------------------------------------|-----------------------------|-------------------------------------|
| 1. Camshaft position sensor (PHASE) | 2. O-ring                   | 3. Camshaft position sensor bracket |
| 4. Seal washer                      | 5. Camshaft bracket (No. 1) | 6. Camshaft sprocket (INT)          |
| 7. Camshaft sprocket (EXH)          | 8. Valve lifter             | 9. Camshaft (EXH)                   |
| 10. Signal plate                    | 11. Camshaft (INT)          | 12. Camshaft bracket (No. 2 to 5)   |

A. Refer to [EM-170](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

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### REMOVAL

#### NOTE:

This section describes removal/installation procedure of camshaft without removing front cover. If front cover is removed or installed, removal of camshaft bracket (No. 1) is easier before step 9 and installation is easier after step 4. Regarding removal and installation of front cover, refer to [EM-192, "Exploded View"](#).

1. Release fuel pressure. Refer to [ECQ-356, "Inspection"](#).
2. Remove the following parts.
  - Intake manifold: Refer to [EM-152, "Exploded View"](#).
  - Rocker cover: Refer to [EM-164, "Removal and Installation"](#).
3. Remove camshaft position sensor (PHASE).

#### CAUTION:

- Handle carefully to avoid dropping and shocks.
- Never disassemble.
- Never allow metal powder to adhere to magnetic part at sensor tip.

# CAMSHAFT

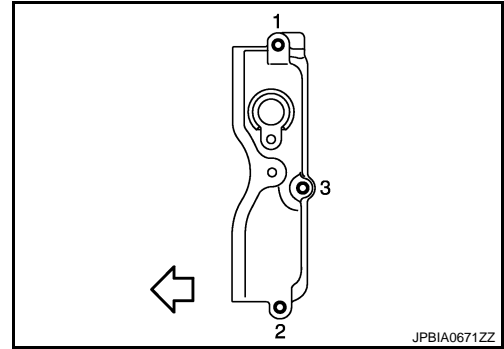
< ON-VEHICLE REPAIR >

[QR25DE]

- **Never place sensor in a location where it is exposed to magnetism.**

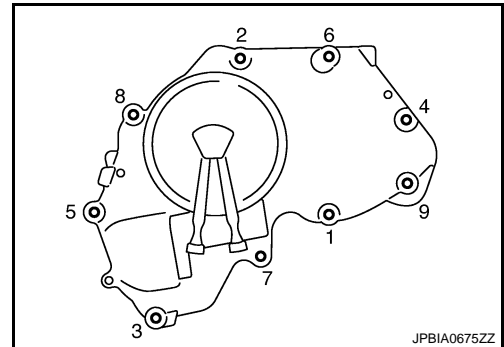
4. Remove camshaft position sensor bracket.
  - Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front

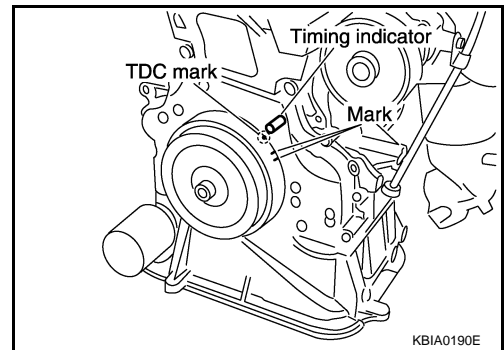


5. Remove intake valve timing control cover with the following procedure:
  - a. Disconnect intake valve timing control solenoid valve harness connector.
  - b. Remove intake valve timing control solenoid valve, if necessary.

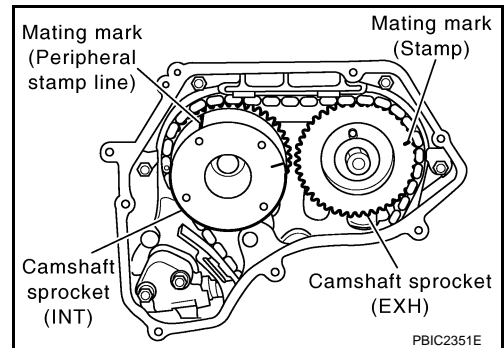
- c. Loosen bolts in reverse order as shown in the figure.
- d. Use a seal cutter [SST: KV10111100] or equivalent tool to cut liquid gasket for removal.



6. Pull chain guide between camshaft sprockets out through front cover.
7. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
  - a. Open splash guard on RH undercover.
  - b. Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.



- c. At the same time, check that the mating marks on camshaft sprockets are located as shown in the figure.
  - If not, rotate crankshaft pulley one more turn to align mating marks to the positions in the figure.



8. Remove camshaft sprockets with the following procedure:
  - a. Line up the mating marks on camshaft sprockets, and paint indelible mating marks on timing chain link plate.

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

# CAMSHAFT

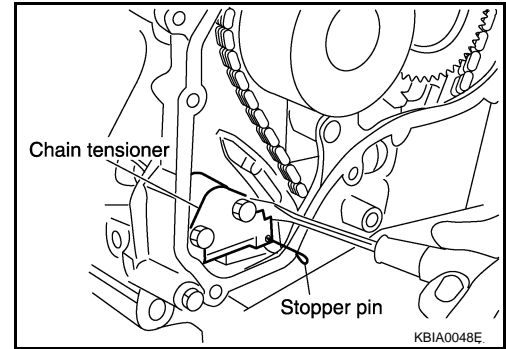
[QR25DE]

## < ON-VEHICLE REPAIR >

- b. Push in chain tensioner plunger. Insert a stopper pin into hole on chain tensioner body to secure chain tensioner plunger and remove chain tensioner.

**NOTE:**

Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.



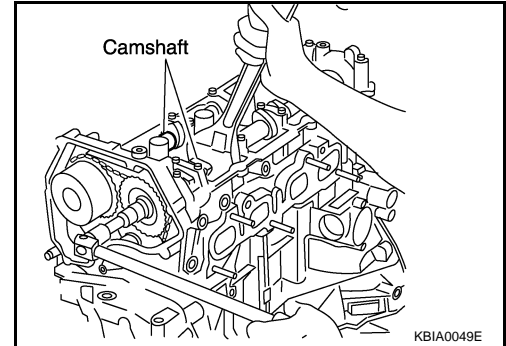
- c. Secure hexagonal part of camshaft with a wrench. Loosen camshaft sprocket mounting bolts and remove camshaft sprockets.

**CAUTION:**

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

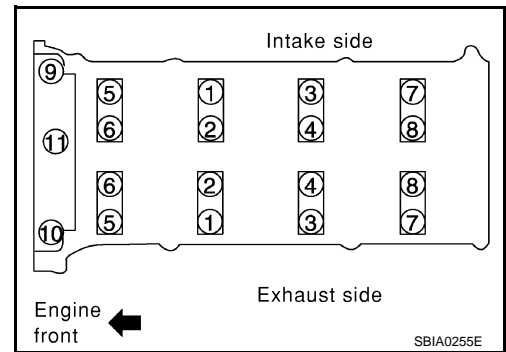
**NOTE:**

Chain tension holding work is not necessary. Crankshaft sprocket and timing chain do not disconnect structurally while front cover is attached.



9. Loosen mounting bolts in reverse order as shown in the figure, and remove camshaft brackets and camshafts.

- Remove camshaft bracket (No. 1) by slightly tapping it with a plastic hammer.



10. Remove valve lifters.

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

## INSTALLATION

1. Install valve lifters.

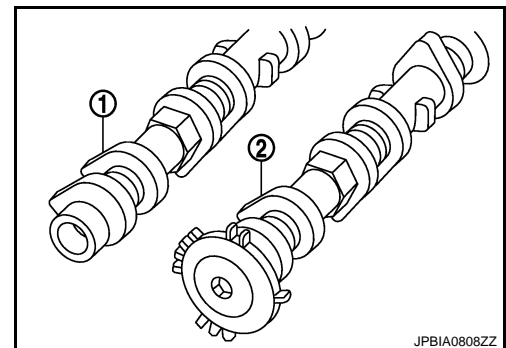
- Install them in the original positions.

2. Install camshafts.

- Distinction between intake and exhaust camshafts is performed with the different shapes of rear end.

1 : Camshaft (EXH)

2 : Camshaft (INT)



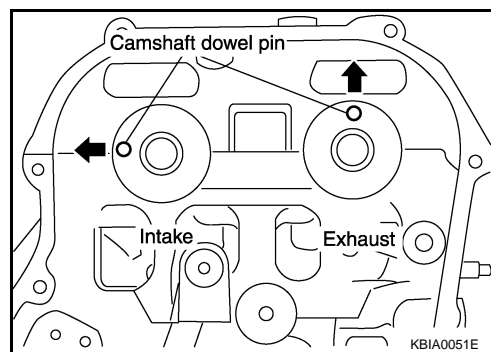


# CAMSHAFT

[QR25DE]

## < ON-VEHICLE REPAIR >

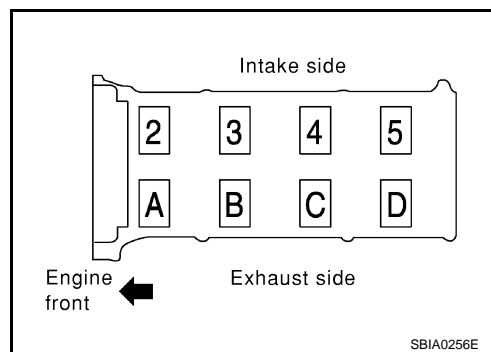
- Install camshafts so that camshaft dowel pins on the front side are positioned as shown in the figure.



3. Install camshaft brackets with the following procedure:
  - a. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
  - b. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown in the figure.

**NOTE:**

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

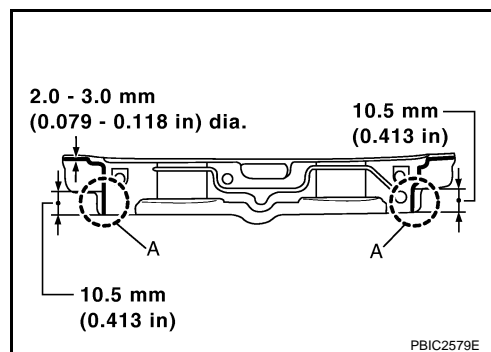


- c. Install camshaft bracket (No. 1) with the following procedure:
      - i. Apply liquid gasket to camshaft bracket (No. 1) as shown in the figure.

**Use Genuine Liquid Gasket or equivalent.**

**CAUTION:**

After installation, be sure to wipe off any excessive liquid gasket leaking from part "A".



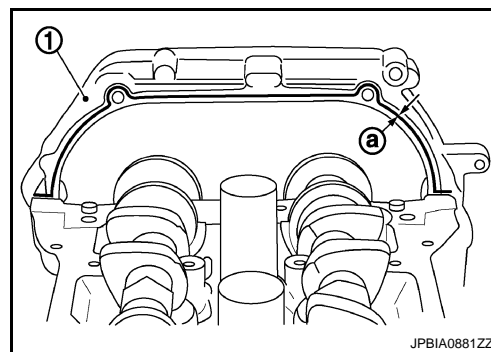
- ii. Apply liquid gasket to camshaft bracket (No. 1) contact surface on the front cover backside.

1 : Front cover

a : 3.4 – 4.4 mm (0.134 – 0.173 in)

**Use Genuine Liquid Gasket or equivalent.**

- Apply liquid gasket to the outside of bolt hole on front cover.

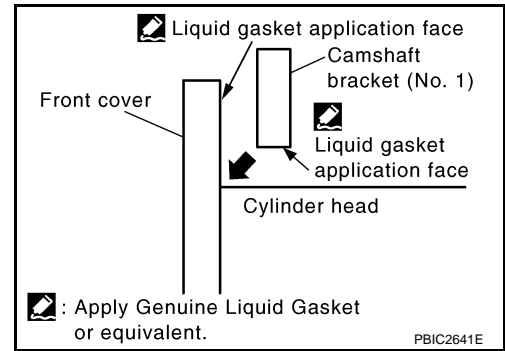


# CAMSHAFT

[QR25DE]

## < ON-VEHICLE REPAIR >

- iii. For camshaft bracket (No. 1) near installation position, and install it without disturbing the liquid gasket applied to the surfaces.



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

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

: 2.0 N·m (0.2 kg-m, 1 in-lb)

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

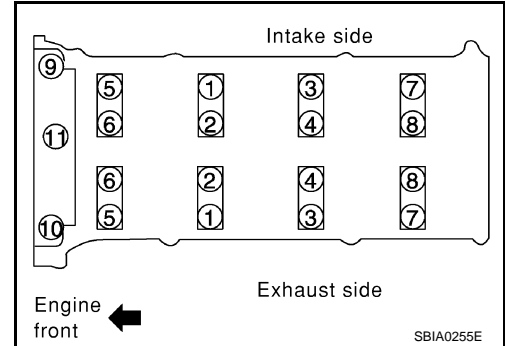
: 2.0 N·m (0.2 kg-m, 1 in-lb)

- c. Tighten all bolts in numerical order.

: 5.9 N·m (0.6 kg-m, 4 in-lb)

- d. Tighten all bolts in numerical order.

: 10.4 N·m (1.1 kg-m, 8 ft-lb)



### CAUTION:

After tightening mounting bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the parts listed below.

- Mating surface of rocker cover.
- Mating surface of front cover. (When installed without front cover)

5. Install camshaft sprockets.

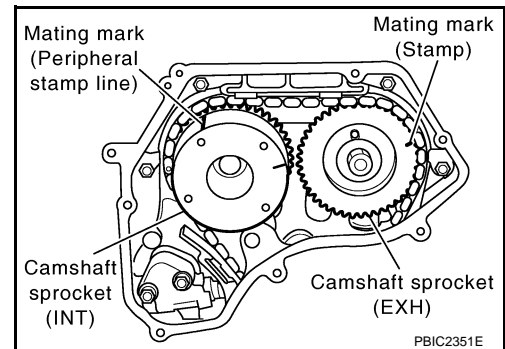
- Install them by aligning the mating marks on each camshaft sprocket with the ones painted on timing chain link plate during removal.

### CAUTION:

- Aligned mating marks could slip. Therefore, after matching them, hold the timing chain in place by hand.
- Before and after installing chain tensioner, check again that mating marks have not slipped.

### NOTE:

Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.



6. Install chain tensioner.

### CAUTION:

After installation, pull the stopper pin off completely, and check that chain tensioner plunger is released.

7. Install chain guide.

8. Install intake valve timing control cover with the following procedure:

- Install intake valve timing control solenoid valve to intake valve timing control cover if removed.
- Install oil rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
- Install new O-ring to front cover.

# CAMSHAFT

[QR25DE]

## < ON-VEHICLE REPAIR >

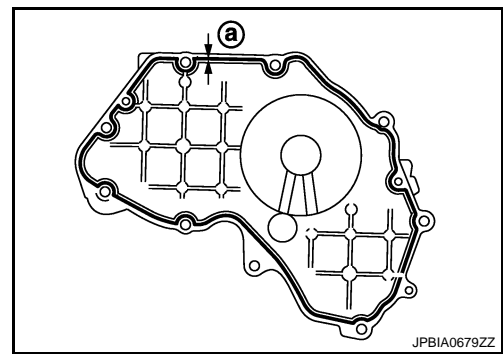
- d. Apply liquid gasket with a tube presser (Commercial Service Tool) to intake valve timing control cover as shown in the figure.

**a** : 3.4 – 4.4 mm (0.134 – 0.173 in)

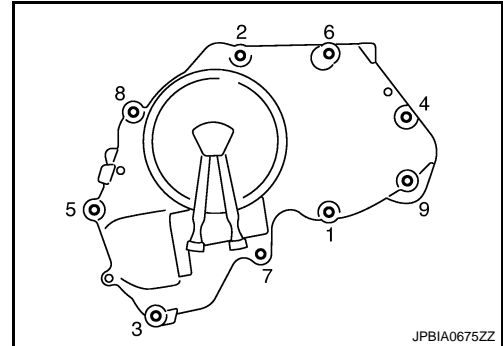
Use Genuine Liquid Gasket or equivalent.

**CAUTION:**

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



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



9. Install camshaft position sensor bracket.

- a. Apply liquid gasket with a tube presser (commercial service tool) to camshaft position sensor bracket as shown in the figure.

← : Engine front

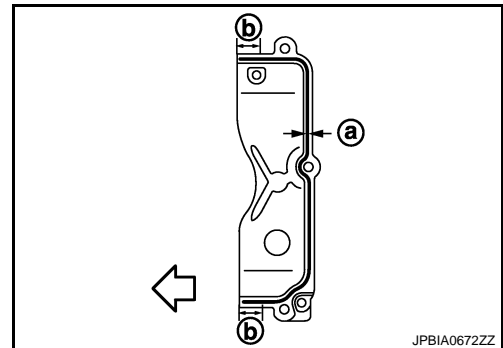
**a** : 2.0 – 3.0 mm (0.079 – 0.118 in)

**b** : 10.5 mm (0.413 in)

Use Genuine Liquid Gasket or equivalent.

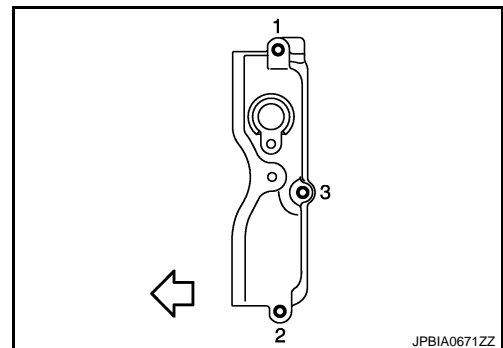
**CAUTION:**

- After installation, be sure to wipe off any excessive liquid gasket leaking from part “b”
- Attaching should be done within 5 minutes after liquid gasket application.



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

← : Engine front



10. Install camshaft position sensor (PHASE).

11. Inspect and adjust valve clearance. Refer to [EM-143. "Inspection and Adjustment"](#).

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

## Inspection

### INSPECTION AFTER REMOVAL

Camshaft Runout

INFOID:000000001157971

# CAMSHAFT

[QR25DE]

## < ON-VEHICLE REPAIR >

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

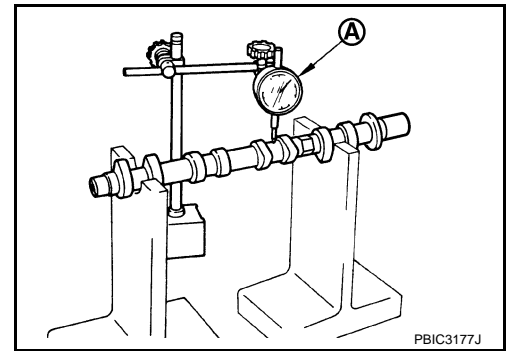
**CAUTION:**

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

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

**Standard:** Refer to [EM-236, "Camshaft"](#).

4. If out of the standard, replace camshaft.

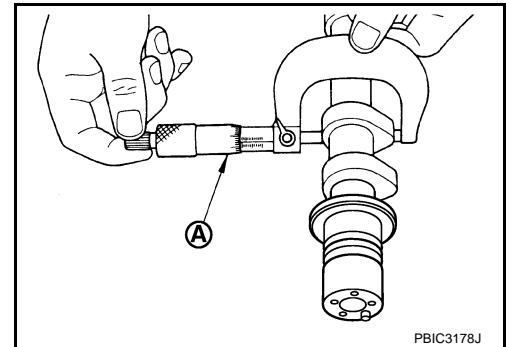


### Camshaft Cam Height

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

**Standard and Limit :** Refer to [EM-236, "Camshaft"](#).

2. If it exceeds the limit, replace camshaft.

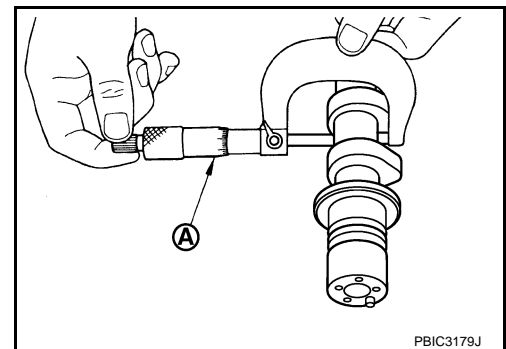


### Camshaft Journal Oil Clearance

#### CAMSHAFT JOURNAL DIAMETER

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

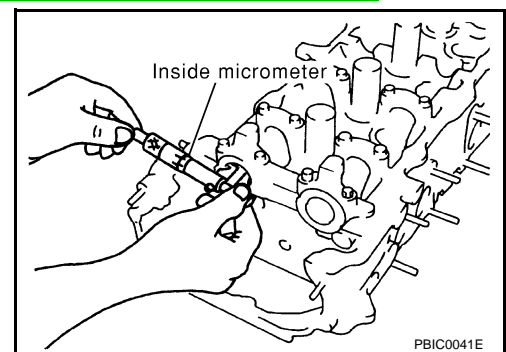
**Standard:** Refer to [EM-236, "Camshaft"](#).



#### CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque. Refer to [EM-170, "Removal and Installation"](#).
- Measure the inner diameter of camshaft bracket with an inside micrometer.

**Standard:** Refer to [EM-236, "Camshaft"](#).



#### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard :** Refer to [EM-236, "Camshaft"](#).

# CAMSHAFT

[QR25DE]

## < ON-VEHICLE REPAIR >

- If out of the standard, replace either or both camshaft and cylinder head.

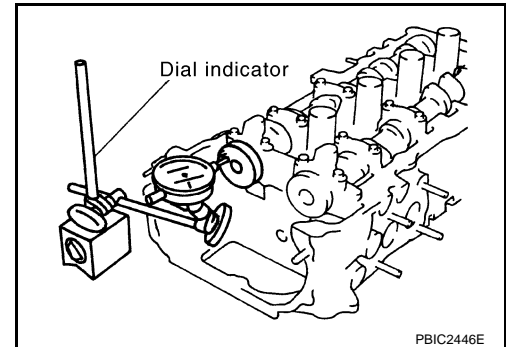
### NOTE:

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

### Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-170, "Removal and Installation"](#).
2. Install dial indicator in thrust direction on front end of camshaft. Read the end play of dial indicator when camshaft is moved forward/backward (in direction to axis).

**Standard :** Refer to [EM-236, "Camshaft"](#).



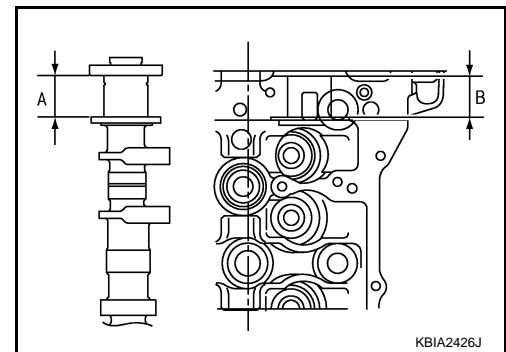
- Measure the following parts if out of the standard.
  - Dimension "A" for camshaft No. 1 journal

**Standard : 25.800 - 25.848 mm (1.0157 - 1.0176 in)**

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

**Standard : 25.660 - 25.685 mm (1.0102 - 1.0112 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.

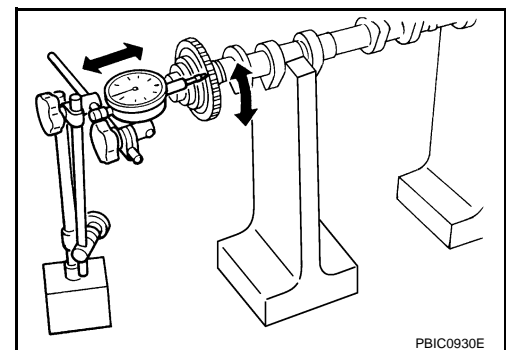
### CAUTION:

**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 :** Refer to [EM-236, "Camshaft"](#).

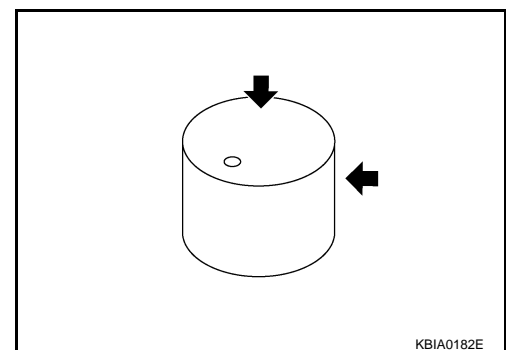
- If it exceeds the limit, replace camshaft sprocket.



### Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-236, "Camshaft"](#).



# CAMSHAFT

[QR25DE]

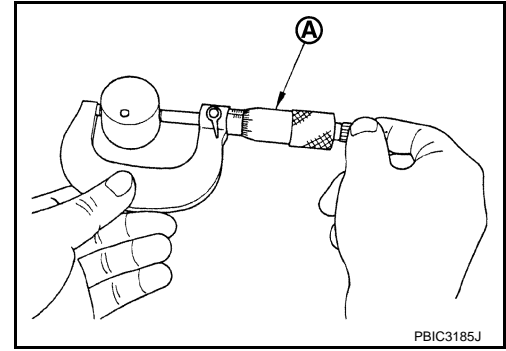
< ON-VEHICLE REPAIR >

Valve Lifter Clearance

## VALVE LIFTER OUTER DIAMETER

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

Standard: Refer to [EM-236, "Camshaft"](#).



## VALVE LIFTER HOLE DIAMETER

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

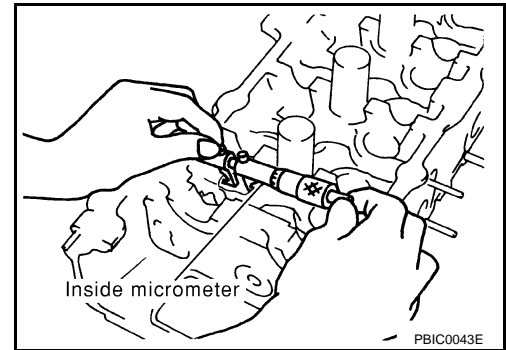
Standard: Refer to [EM-236, "Camshaft"](#).

## VALVE LIFTER CLEARANCE

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

Standard: Refer to [EM-236, "Camshaft"](#).

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



## INSPECTION AFTER INSTALLATION

Inspection of camshaft sprocket (INT) oil Groove.

**CAUTION:**

## OIL SEAL

## VALVE OIL SEAL

## VALVE OIL SEAL : Removal and Installation

INFOID:000000001157972

A

EM

## REMOVAL

1. Remove camshafts. Refer to [EM-170. "Exploded View"](#).
2. Remove valve lifters. Refer to [EM-170. "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.

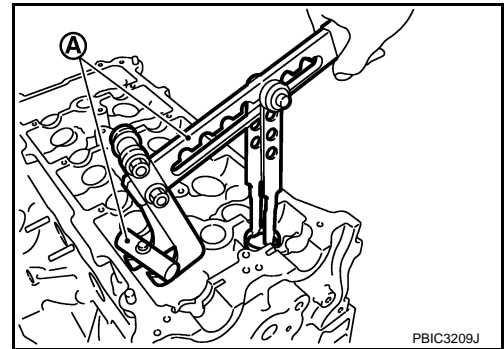
**CAUTION:**

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

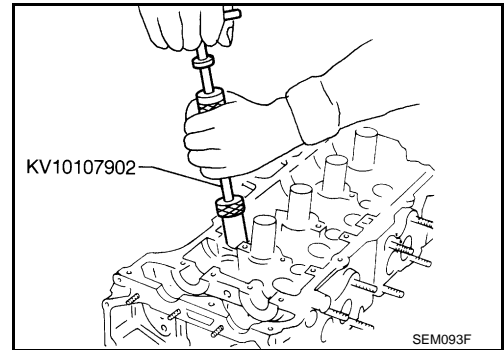
4. Remove valve collet.
  - Compress valve spring with valve spring compressor, attachment and adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand.

**CAUTION:**

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



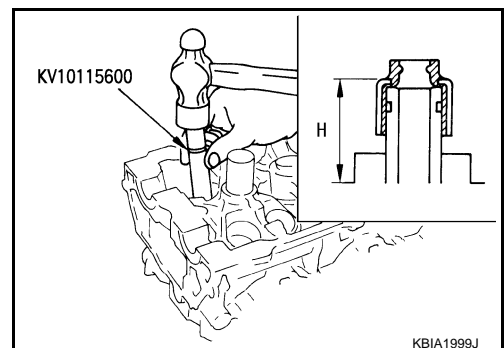
5. Remove valve spring retainer and valve spring.
  - CAUTION:**  
**Never remove valve spring seat from valve spring.**
6. Remove valve oil seal with a valve oil seal puller (SST).



## 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 a valve oil seal drift (SST).

**Height "H" : 11.8 - 12.4 mm (0.465 - 0.488 in)**



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

## FRONT OIL SEAL

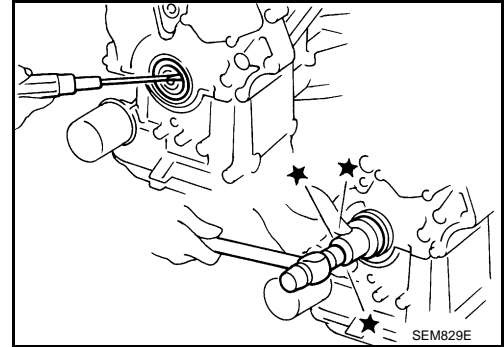
## FRONT OIL SEAL : Removal and Installation

INFOID:000000001157973

### REMOVAL

1. Remove the following parts.
  - Under cover
  - Front fender protector: Refer to [EXT-21, "Exploded View"](#).
  - Drive belt: Refer to [EM-138, "Removal and Installation"](#).
  - Crankshaft pulley: Refer to [EM-192, "Exploded View"](#).
2. Remove front oil seal with a suitable tool.

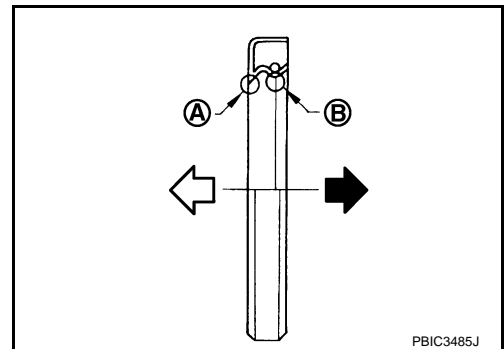
**CAUTION:**  
Be careful not to damage front cover and crankshaft.



### INSTALLATION

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

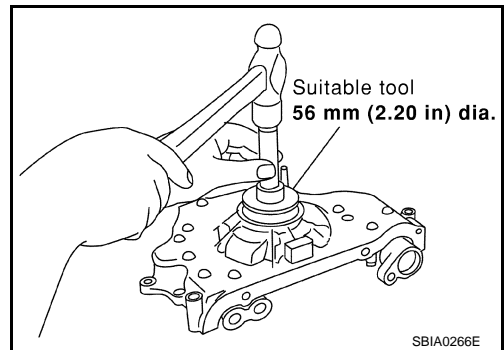
- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



- Press-fit front oil seal until it is flush with front end surface of front cover using a suitable drift with outer diameter 56 mm (2.20 in) and inner diameter 48 mm (1.89 in).

**CAUTION:**

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



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

## REAR OIL SEAL

### REAR OIL SEAL : Removal and Installation

INFOID:000000001157974

### REMOVAL

1. Remove transaxle assembly. Refer to [TM-85, "Exploded View"](#) (M/T models) or [TM-550, "QR25DE : Exploded View"](#) (CVT models).
2. Remove clutch cover and clutch disc (M/T models). Refer to [CL-18, "MR20DE, QR25DE : Exploded View"](#).
3. Remove drive plate (CVT models) or flywheel (M/T models). Refer to [EM-210, "Exploded View"](#).



# OIL SEAL

< ON-VEHICLE REPAIR >

[QR25DE]

4. Remove rear oil seal with a suitable tool.

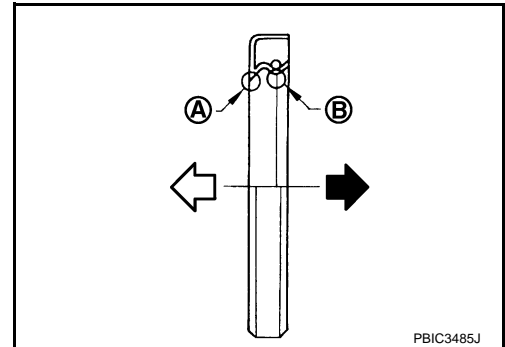
**CAUTION:**

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

## INSTALLATION

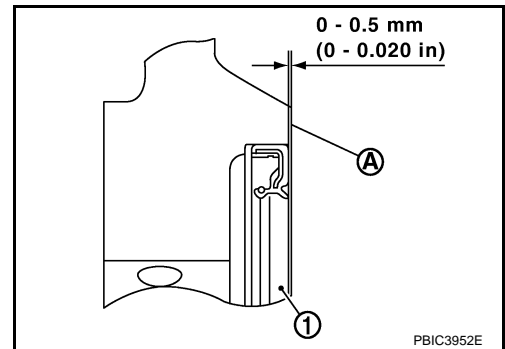
1. Apply new engine oil to new rear oil seal joint surface and seal lip.
2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

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



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

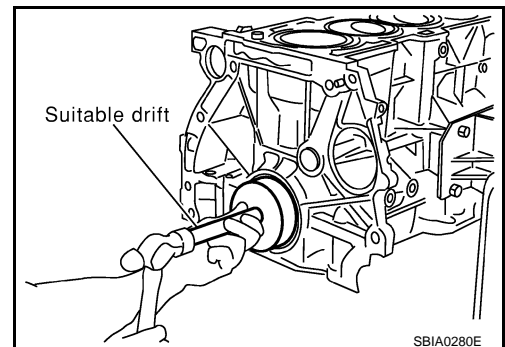
- A : Rear end surface of cylinder block



- Press-fit rear oil seal with a suitable drift [outer diameter 102 mm (4.02 in), inner diameter 86 mm (3.39 in)].

**CAUTION:**

- **Be careful not to damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Never touch grease applied onto oil seal lip.**



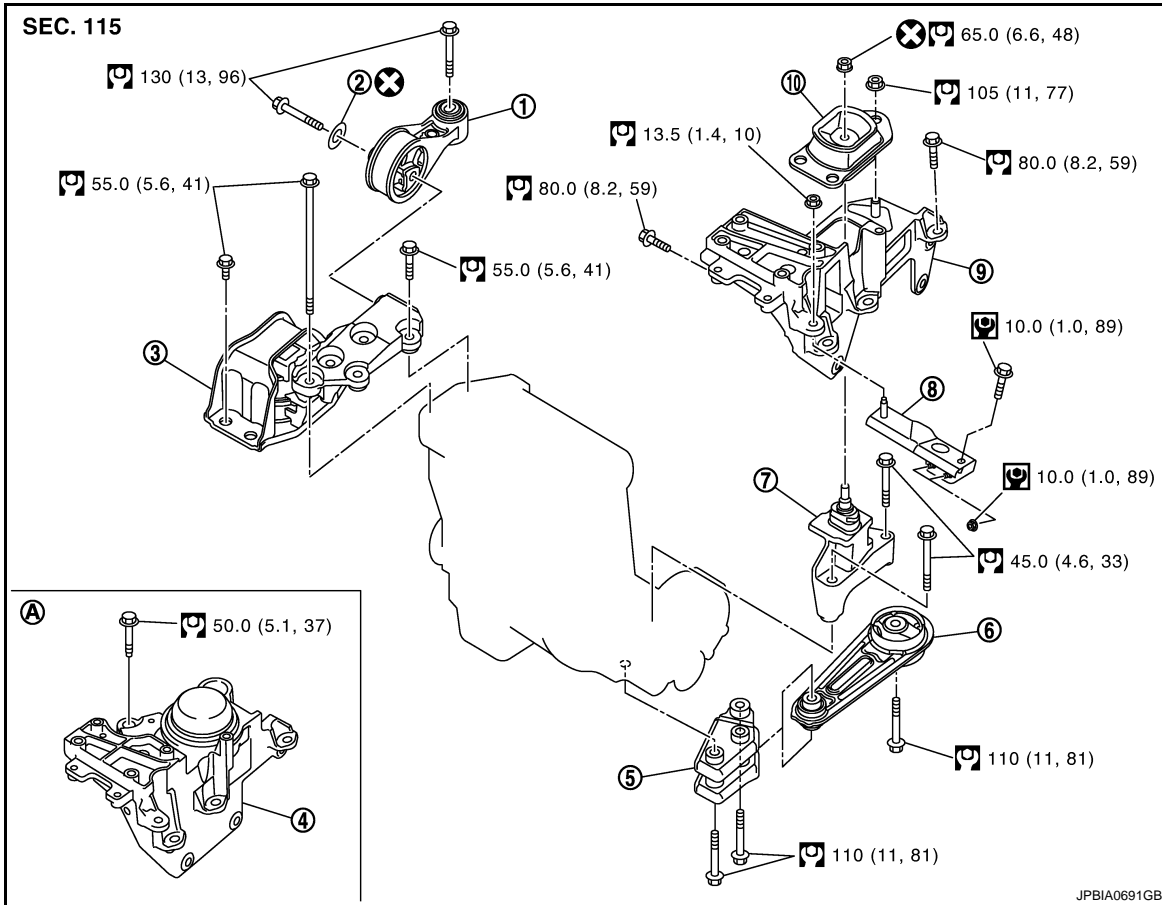
3. Install in the reverse order of removal after this step.

## REMOVAL AND INSTALLATION

### ENGINE ASSEMBLY

#### Exploded View

INFOID:000000001277855



- |                                    |                                 |                                   |
|------------------------------------|---------------------------------|-----------------------------------|
| 1. Upper torque rod                | 2. Washer                       | 3. Engine mounting insulator (RH) |
| 4. Engine mounting insulator (LH)  | 5. Rear engine mounting bracket | 6. Rear torque rod                |
| 7. Engine mounting bracket         | 8. Engine mounting stay         | 9. Engine mounting insulator (LH) |
| 10. Engine mounting insulator (LH) |                                 |                                   |

A. CVT models

Refer to [Gl-4, "Components"](#) for symbols in the figure.

#### Removal and Installation

INFOID:000000001277856

#### **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.
- 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.

# ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

[QR25DE]

- For supporting points for lifting and jacking point at rear axle, refer to [GI-33, "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 [ECQ-356, "Inspection"](#).
2. Drain engine coolant from radiator. Refer to [CO-41, "Draining"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belt.
3. Remove the following parts.
  - Air duct and air cleaner case assembly: Refer to [EM-150, "Exploded View"](#).
  - Battery and battery tray: Refer to [PG-133, "Exploded View"](#).
  - Engine undercover
  - Radiator hose (upper and lower) and cooling fan assembly: Refer to [CO-47, "Exploded View"](#).
  - Front road wheels and tires: Refer to [WT-3, "Adjustment"](#).
  - Front fender protector (RH and LH): Refer to [EXT-21, "Exploded View"](#).
  - Exhaust front tube: Refer to [EX-10, "Exploded View"](#).

### Engine Room LH

1. Disconnect all connections of engine harness around the engine mounting insulator (LH), 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 fuel feed hose at engine side. Refer to [EM-36, "Exploded View"](#).
3. Disconnect heater hoses. Refer to [CO-57, "Exploded View"](#).
4. Disconnect control linkage (M/T models) or control cable (CVT models) from transaxle. Refer to [TM-79, "Exploded View"](#) (M/T models) or [TM-520, "QR25DE : Exploded View"](#) (CVT models).
5. Remove ground cable at transaxle side.
6. Disconnect CVT fluid cooler hose. Refer to [TM-550, "QR25DE : Exploded View"](#).

### Engine Room RH

1. Remove alternator. Refer to [CHG-30, "QR25DE MODELS : Exploded View"](#).
2. Disconnect vacuum hose from intake manifold. Refer to [EM-27, "Exploded View"](#).
3. Remove A/C compressor without disconnecting A/C piping, and temporarily fasten it on vehicle with a rope (with A/C models). Refer to [HA-45, "QR25DE : Exploded View"](#).

### Vehicle inside

Disconnect steering lower joint at steering gear assembly side, and release steering lower shaft. Refer to [ST-13, "Exploded View"](#).

### Vehicle Underbody

1. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-67, "FRONT WHEEL SENSOR : Exploded View"](#).
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-42, "BRAKE CALIPER ASSEMBLY : Exploded View"](#) (LHD models) or [BR-89, "BRAKE CALIPER ASSEMBLY : Exploded View"](#) (RHD models).
3. Disconnect steering outer sockets from steering knuckle. Refer to [ST-13, "Exploded View"](#).
4. Remove transverse link from steering knuckle. Refer to [FSU-13, "Exploded View"](#).
5. Remove drive shafts (LH and RH). Refer to [FAX-60, "QR25DE : Exploded View"](#).
6. Remove propeller shaft. Refer to [DLN-121, "Exploded View"](#).
7. Remove stabilizer connecting rod. Refer to [FSU-16, "Exploded View"](#).
8. Remove rear torque rod.
9. Remove front suspension member. Refer to [FSU-18, "Exploded View"](#).

# ENGINE ASSEMBLY

[QR25DE]

## < REMOVAL AND INSTALLATION >

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

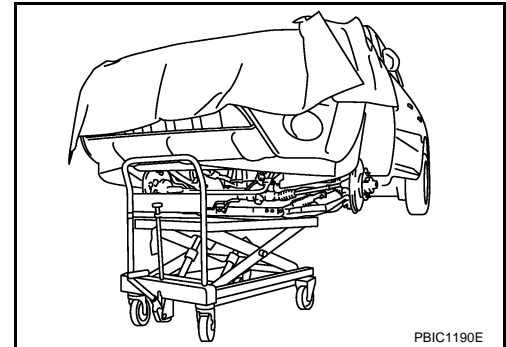
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-158, "Exploded View"](#).

### Removal

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

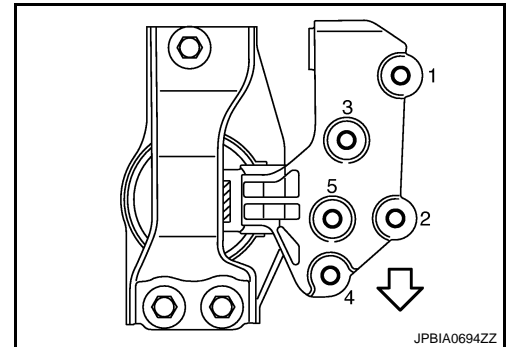
**CAUTION:**

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



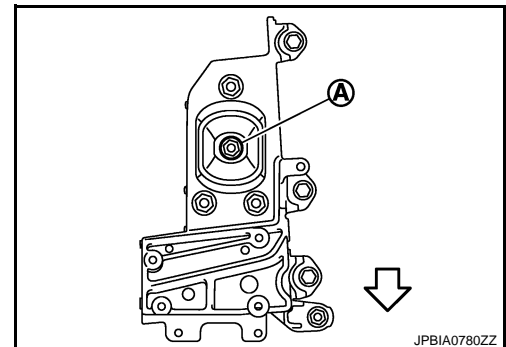
2. Remove upper torque rod.
3. Remove engine mounting insulator bolts (RH).
  - Loosen the mounting bolts in the reverse order as shown in the figure.

⇐ : Engine front



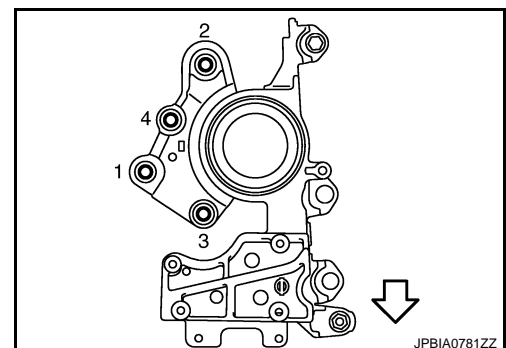
4. Remove engine mounting through bolt-securing nut (A). (M/T models)

⇐ : Engine front



5. Remove engine mounting insulator bolts (LH). (CVT models)
  - Loosen the mounting bolts in the reverse order as shown in the figure.

⇐ : Engine front



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

**CAUTION:**

# ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

[QR25DE]

- 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

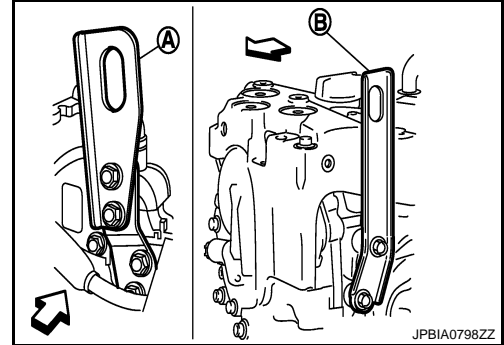
1. Install engine slingers into front left of cylinder head and rear right of cylinder head.
  - Use alternator bracket mounting bolt holes for the front side.

⇐ : Engine front

### Slinger bolts

Cylinder head side (A) : : 28.0 N·m (2.9 kg·m, 21 ft·lb)

Front cover side (B) : : 45.0 N·m (4.6 kg·m, 33 ft·lb)



2. Remove starter motor. Refer to [STR-32, "QR25DE \(M/T\) MODELS : Exploded View"](#) (M/T models) or [STR-37, "QR25DE \(CVT\) MODELS : Exploded View"](#) (CVT models).
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-85, "Exploded View"](#) (M/T models) or [TM-550, "QR25DE : Exploded View"](#) (CVT models).

## INSTALLATION (M/T models)

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

### CAUTION:

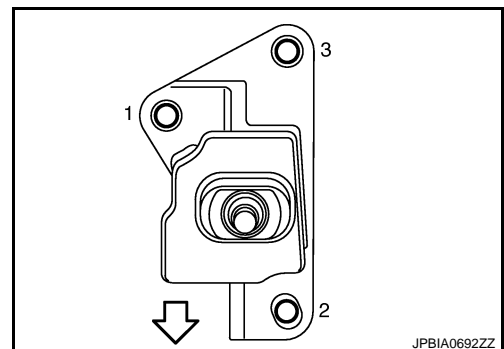
- Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.

## Preparation

1. Install the engine mounting bracket (LH) to the engine.
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

⇐ : Vehicle front

- b. Tighten the bolts No. 2, 3 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolt No. 1 as shown in the figure. (specified torque)



2. Install the engine mounting insulator (RH) to the body temporarily.
3. Install the upper torque rod to the body side bracket temporarily.
4. Install the engine mounting stay (LH) to the body, and tighten.(specified torque)
5. Install the engine mounting insulator (LH) to the engine mounting bracket support (LH) temporarily.
6. Install the engine mounting bracket support (LH) to the body as follows:

# ENGINE ASSEMBLY

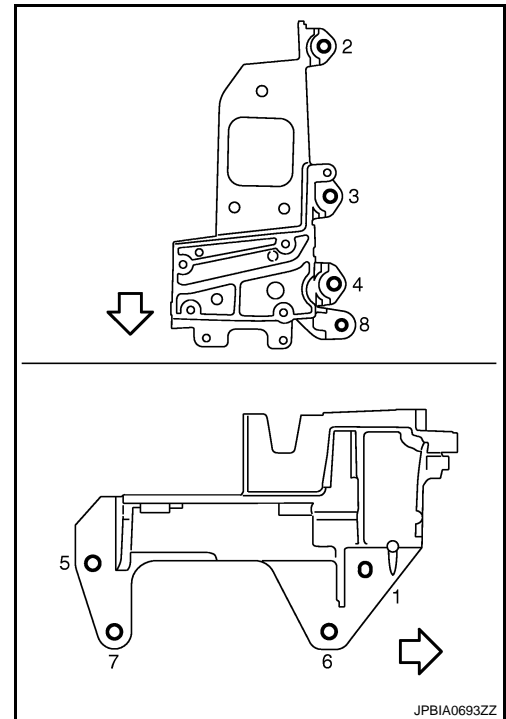
[QR25DE]

## < REMOVAL AND INSTALLATION >

- a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

⇐ : Vehicle front

- b. Tighten the bolts No. 2, 3, 4 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolts No. 5, 6, 7 in numerical order as shown in the figure. (specified torque)
- d. Tighten the bolt No. 1 as shown in the figure. (specified torque)
- e. Tighten the bolt No. 8 as shown in the figure. (specified torque)
7. Install the rear bracket to the transaxle and tighten. (specified torque)

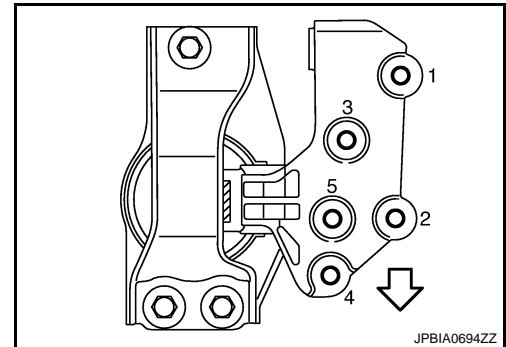


### Installation

1. Tighten the engine mounting insulator (LH) to the specified torque.
2. Install the engine mounting insulator bolts (RH) to the engine and tighten as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

⇐ : Vehicle front

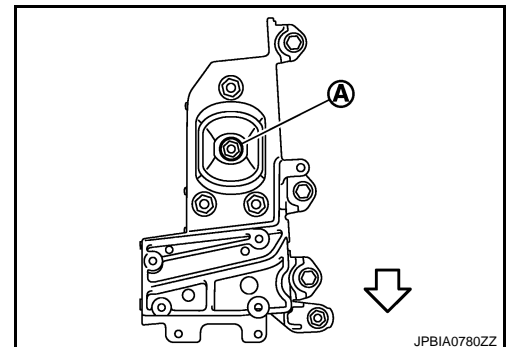
- b. Tighten the bolts No. 2, 3, 4, 5 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolt No. 1 as shown in the figure. (specified torque)



3. Tighten engine mounting through bolt-securing nut (A) to the specified torque.

⇐ : Vehicle front

4. Install the rear torque rod and tighten. (specified torque)
5. Tighten the upper torque rod. (specified torque)



### INSTALLATION (CVT models)

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.

### Preparation

1. Install the engine mounting insulator (RH) to the body temporarily.

# ENGINE ASSEMBLY

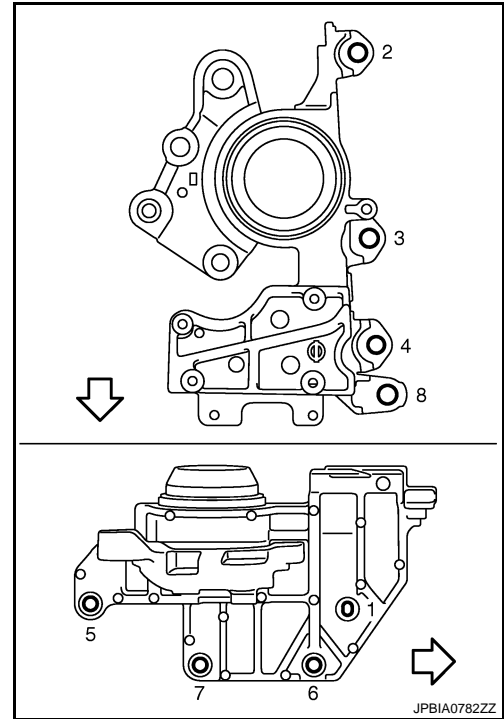
## < REMOVAL AND INSTALLATION >

[QR25DE]

2. Install the upper torque rod to the body side bracket temporarily.
3. Install the engine mounting stay (LH) to the body and tighten. (specified torque)
4. Install the engine mounting insulator (LH) to the body as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

↔ : Vehicle front

- b. Tighten the bolts No. 2, 3, 4 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolts No. 5, 6, 7 in numerical order as shown in the figure. (specified torque)
- d. Tighten the bolt No. 1 as shown in the figure. (specified torque)
- e. Tighten the bolt No. 8 as shown in the figure. (specified torque)
5. Install the rear bracket to the transaxle and tighten. (specified torque)

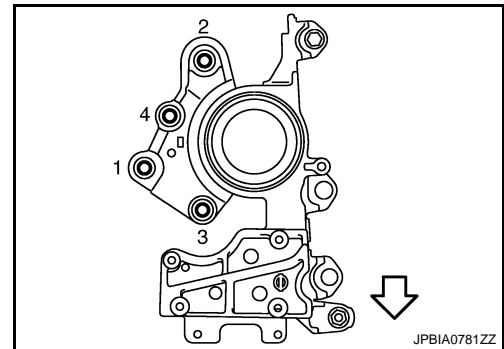


### Installation

1. Install the engine mounting insulator bolts (LH) to the transaxle and tighten as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

↔ : Vehicle front

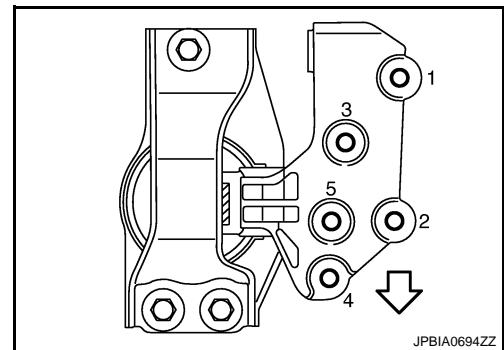
- b. Tighten the bolts No. 2, 3, 4 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolt No. 1 as shown in the figure. (specified torque)



2. Install the engine mounting insulator bolts (RH) to the engine and tighten as follows:
  - a. Tighten the bolt No. 1 as shown in the figure. (temporarily)

↔ : Vehicle front

- b. Tighten the bolts No. 2, 3, 4, 5 in numerical order as shown in the figure. (specified torque)
- c. Tighten the bolt No. 1 as shown in the figure. (specified torque)
3. Install the rear torque rod and tighten. (specified torque)
4. Tighten the upper torque rod. (specified torque)



### Inspection

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### INSPECTION AFTER INSTALLATION

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# ENGINE ASSEMBLY

[QR25DE]

## < REMOVAL AND 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-22. "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
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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



## DISASSEMBLY AND ASSEMBLY

### ENGINE STAND SETTING

#### Setting

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A  
EM

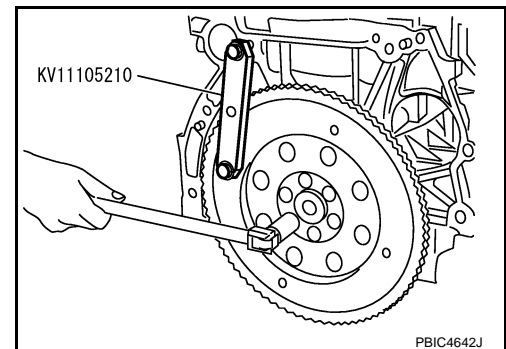
#### NOTE:

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-75. "M/T : Exploded View"](#) (M/T models) or [EM-81. "CVT : Exploded View"](#) (CVT models).
2. Install engine to engine stand with the following procedure:
  - a. Remove flywheel (M/T models) or drive plate (CVT models).
    - Secure flywheel or drive plate with a stopper plate (SST) and use a suitable tool to remove mounting bolts.

**Flywheel (M/T models) : size T55 (commercial service tool)**

**Drive plate (CVT models) : size E20**



#### CAUTION:

- Never disassemble them.
- Never place them with signal plate facing down.
- When handling signal plate, take care not to damage or scratch them.
- Handle signal plate in a manner that prevents them from becoming magnetized.

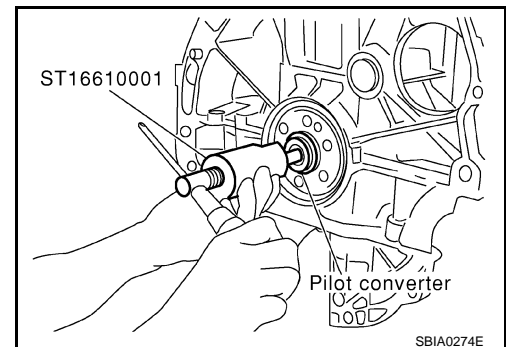
#### NOTE:

The flywheel, two block construction, allows fly movement in response to transaxle side pressure, or when twisted in its rotation direction. Therefore, some amount of noise is normal.

- b. Remove pilot converter using pilot bushing puller (SST) or suitable tool. (CVT models)

#### NOTE:

M/T models have no pilot bushing.



- c. Lift the engine with a hoist to install it onto widely use engine stand.

#### CAUTION:

- Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to [EM-152. "Exploded View"](#).
  - Exhaust manifold: Refer to [EM-155. "Exploded View"](#).
  - Rocker cover: Refer to [EM-164. "Exploded View"](#).

#### NOTE:

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## ENGINE STAND SETTING

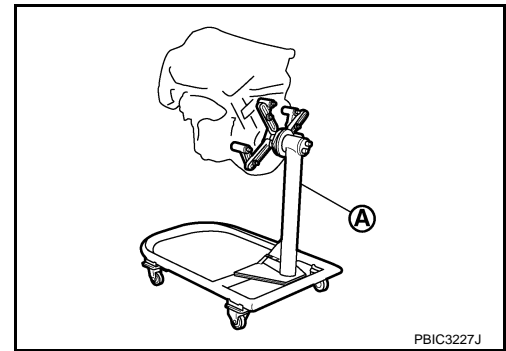
< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

**CAUTION:**

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



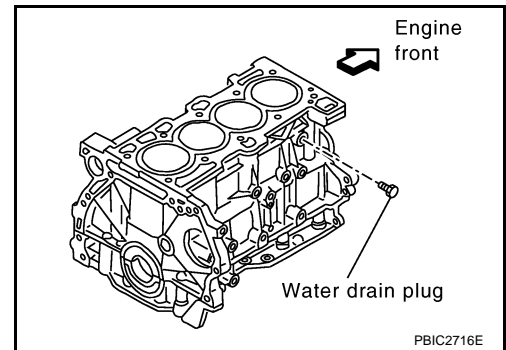
3. Drain engine oil. Refer to [LU-17, "Draining"](#).

**CAUTION:**

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

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

**Tightening torque** : Refer to [EM-210, "Exploded View"](#).



**ENGINE UNIT****Disassembly**

INFOID:000000001277863

1. Remove intake manifold. Refer to [EM-152, "Exploded View"](#).
2. Remove exhaust manifold. Refer to [EM-155, "Exploded View"](#).
3. Remove oil pan (lower). Refer to [EM-158, "Exploded View"](#).
4. Remove oil cooler. Refer to [LU-20, "Exploded View"](#).
5. Remove ignition coil, spark plug and rocker cover. Refer to [EM-164, "Exploded View"](#).
6. Remove fuel injector and fuel tube. Refer to [EM-166, "Exploded View"](#).
7. Remove timing chain. Refer to [EM-192, "Exploded View"](#).
8. Remove camshaft. Refer to [EM-170, "Exploded View"](#).
9. Remove water inlet. Refer to [CO-57, "Exploded View"](#).
10. Remove water outlet. Refer to [CO-57, "Exploded View"](#).
11. Remove cylinder head. Refer to [EM-201, "Exploded View"](#).

**Assembly**

INFOID:000000001277864

Assembly is the reverse order of disassembly.

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

# TIMING CHAIN

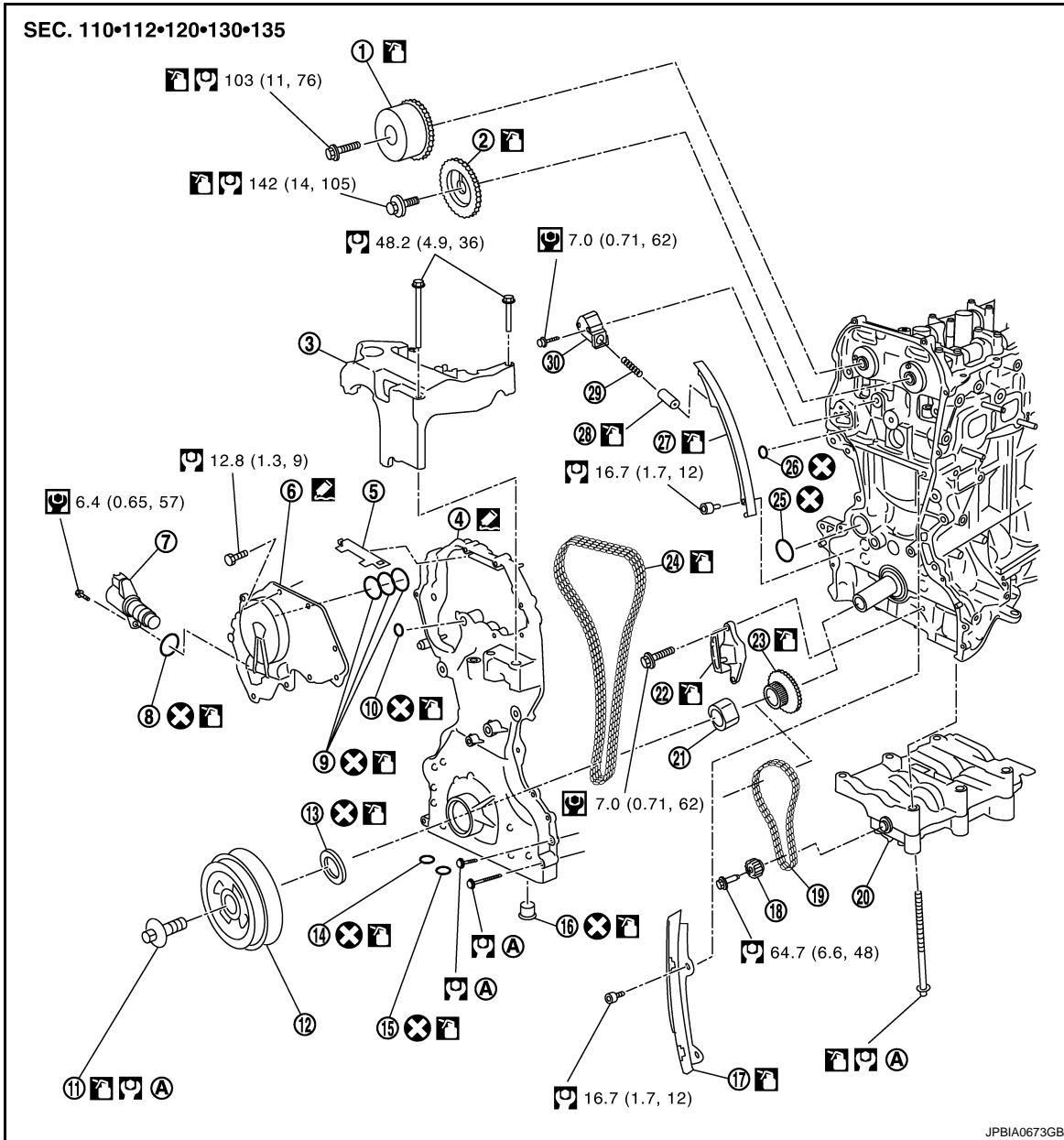
< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

## TIMING CHAIN

Exploded View

INFOID:000000001321925



JPBIA0673GB

- |  |                                |                                      |
|--|--------------------------------|--------------------------------------|
| 1. Camshaft sprocket (INT)               | 2. Camshaft sprocket (EXH)     | 3. Engine mounting bracket (RH)      |
| 4. Front cover                           | 5. Chain guide                 | 6. Intake valve timing control cover |
| 7. Intake valve timing control solenoid  | 8. O-ring                      | 9. O-ring                            |
| 10. O-ring                               | 11. Crankshaft pulley bolt     | 12. Crankshaft pulley                |
| 13. Front oil seal                       | 14. O-ring                     | 15. O-ring                           |
| 16. O-ring                               | 17. Timing chain tension guide | 18. Balancer unit sprocket           |
| 19. Balancer unit timing chain           | 20. Balancer unit              | 21. Oil pump drive spacer            |
| 22. Balancer unit timing chain tensioner | 23. Crankshaft sprocket        | 24. Timing chain                     |
| 25. O-ring                               | 26. O-ring                     | 27. Timing chain slack guide         |
| 28. Chain tensioner plunger              | 29. Spring                     | 30. Chain tensioner                  |

A. Refer to [EM-193](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

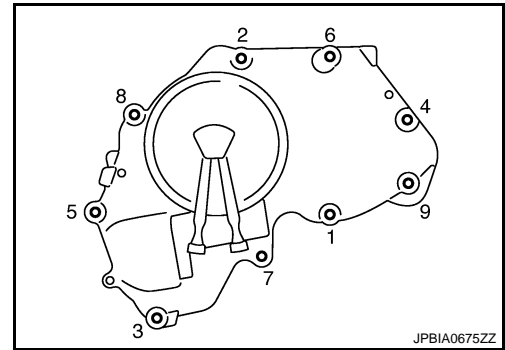
## Removal and Installation

### REMOVAL

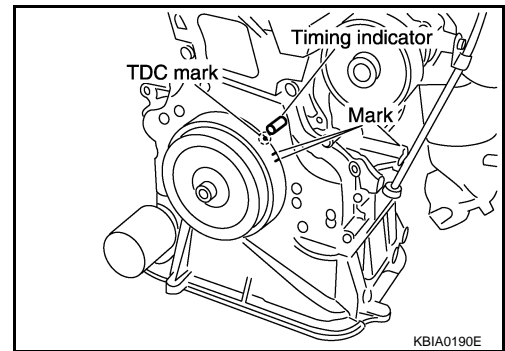
1. Remove the following parts.
  - PCV hose: Refer to [EM-152, "Exploded View"](#).
  - Intake manifold: Refer to [EM-152, "Exploded View"](#).
  - Ignition coil: Refer to [EM-164, "Exploded View"](#).
  - Drive belt: Refer to [EM-138, "Removal and Installation"](#).
  - Drive belt auto-tensioner: Refer to [EM-138, "Exploded View"](#).
2. Remove engine mounting bracket (RH).
3. Remove rocker cover. Refer to [EM-164, "Removal and Installation"](#).
4. Remove oil pan (lower). Refer to [EM-158, "Exploded View"](#).
5. Remove oil pan (upper), and oil strainer. Refer to [EM-161, "Exploded View"](#).
6. Remove intake valve timing control cover.
  - Loosen bolts in reverse order as shown in the figure.
  - Use a seal cutter [SST: KV10111100] or equivalent tool to cut liquid gasket for removal.

**CAUTION:**

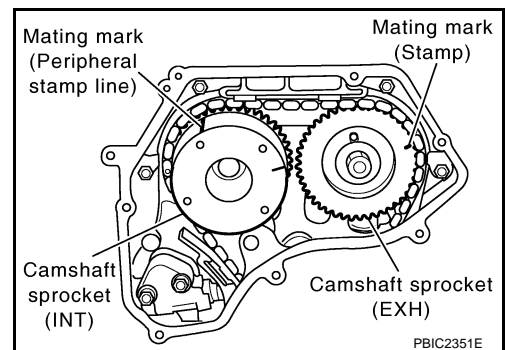
**Be careful not to damage mounting surface.**



7. Pull chain guide between camshaft sprockets out through front cover.
8. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
  - a. Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.



- b. At the same time, check that the mating marks on camshaft sprockets are located as shown in the figure.
      - If not, rotate crankshaft pulley one more turn to align mating marks to the positions in the figure.



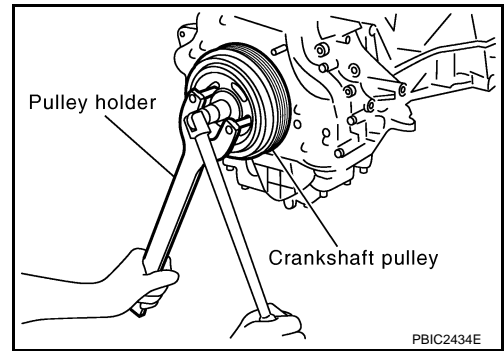
9. Remove crankshaft pulley with the following procedure:

# TIMING CHAIN

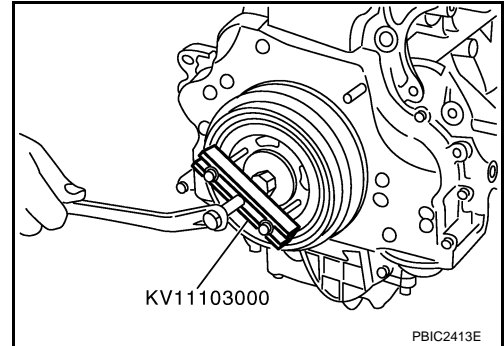
[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

- a. Fix crankshaft pulley with a pulley holder (commercial service tool), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.



- b. Attach a pulley puller (SST) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.



10. Remove front cover with the following procedure:

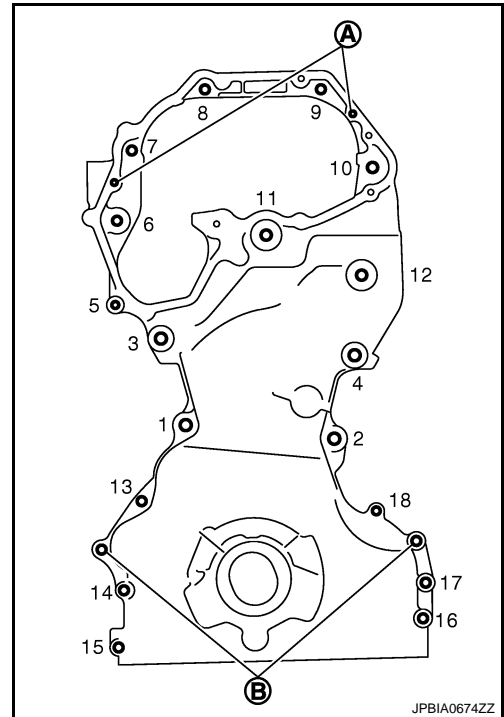
- a. Loosen mounting bolts in reverse order as shown in the figure, and remove them.

- A : Dowel pin  
B : Dowel pin hole

- b. Use a seal cutter [SST: KV10111100] or equivalent tool to cut liquid gasket for removal.

**CAUTION:**

**Be careful not to damage mounting surface.**



11. If front oil seal needs to be replaced, lift it with a suitable tool, and remove it.

**CAUTION:**

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

12. Remove timing chain and camshaft sprockets with the following procedure:

# TIMING CHAIN

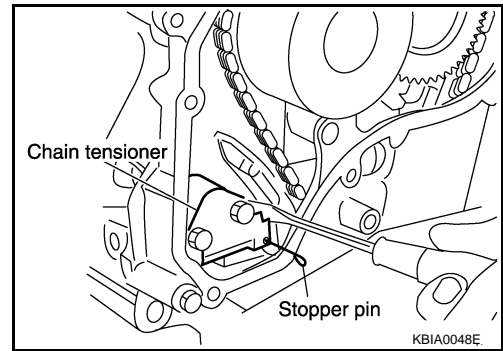
[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

- a. Push in chain tensioner plunger. Insert a stopper pin into hole on chain tensioner body to secure chain tensioner plunger and remove chain tensioner.

**NOTE:**

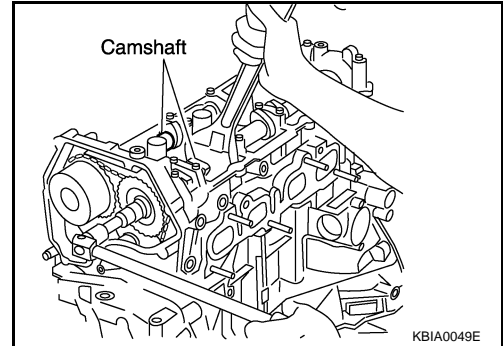
Use approx. 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.



- b. Secure hexagonal part of camshaft with a wrench. Loosen camshaft sprocket mounting bolts and remove timing chain and camshaft sprockets.

**CAUTION:**

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



13. Remove timing chain slack guide, timing chain tension guide and oil pump drive spacer.

14. Remove balancer unit timing chain tensioner with the following procedure:

- a. Press stopper tab (A) in the direction shown in the figure to push the timing chain slack guide (B) toward timing chain tensioner (for oil pump) (1).

- The slack guide is released by pressing the stopper tab. As the result, the slack guide can be moved.

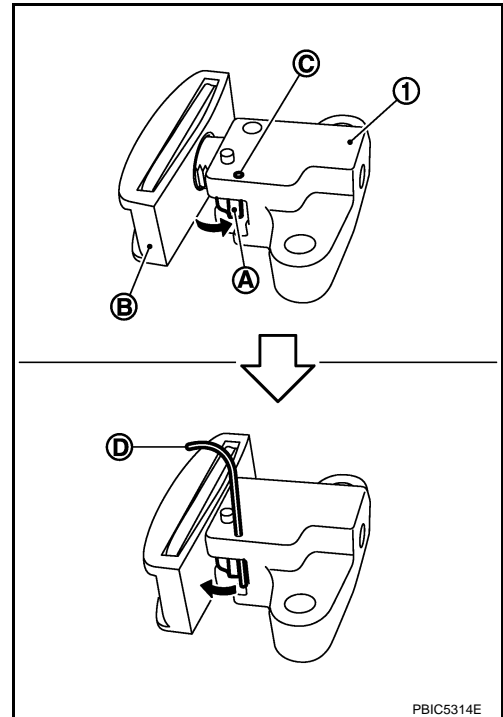
- b. Insert a stopper pin (D) into tensioner body hole (C) to secure the timing chain slack guide.

**NOTE:**

Use a hard metal pin with the diameter of approximately 1.2 mm (0.047 in) as a stopper pin.

- c. Remove balancer unit timing chain tensioner.

- When the holes on lever and tensioner body cannot be aligned, align these holes by slightly moving the slack guide.



15. Remove balancer unit timing chain and crankshaft sprocket.

# TIMING CHAIN

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

- Loosen mounting bolts in reverse order as shown in the figure, and remove balancer unit.

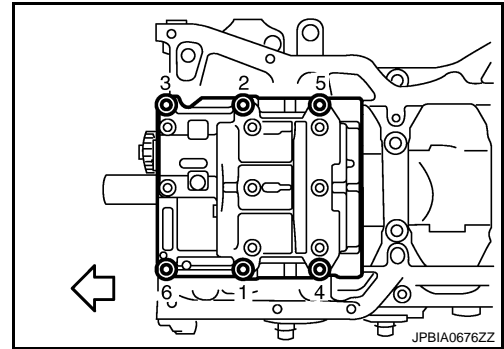
← : Engine front

**CAUTION:**

**Never disassemble balancer unit.**

**NOTE:**

Use TORX socket (size E14).

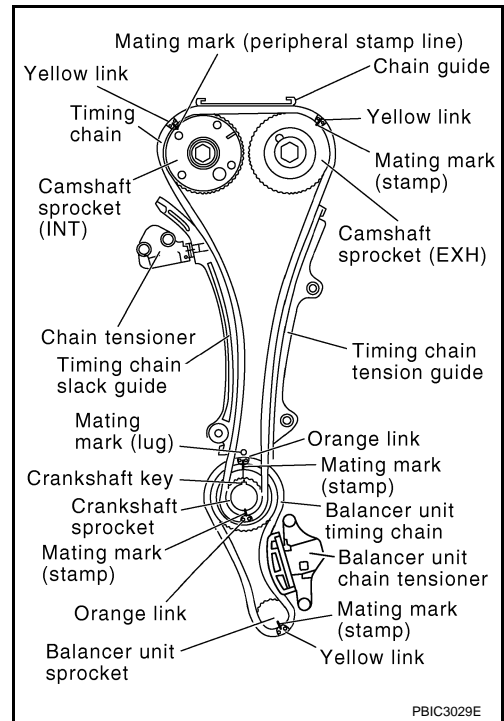


## INSTALLATION

**NOTE:**

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

- Check that crankshaft key points straight up.



- Tighten mounting bolts in numerical order as shown in figure with the following procedure, and install balancer unit.

← : Engine front

**CAUTION:**

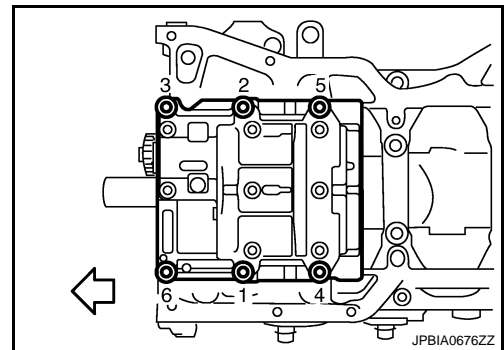
**If mounting bolts are re-used, check their outer diameter before installation. Refer to [EM-199, "Inspection"](#).**

- Apply new engine oil to threads and seat surfaces of mounting bolts.
- Tighten No. 1 to 5 bolts.

: 42.0 N·m (4.3 kg·m, 35 ft·lb)

- Tighten No. 6 bolt.

: 36.0 N·m (3.7 kg·m, 27 ft·lb)





# TIMING CHAIN

[QR25DE]

< DISASSEMBLY AND ASSEMBLY >

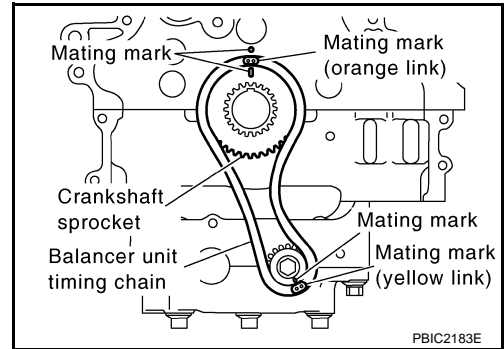
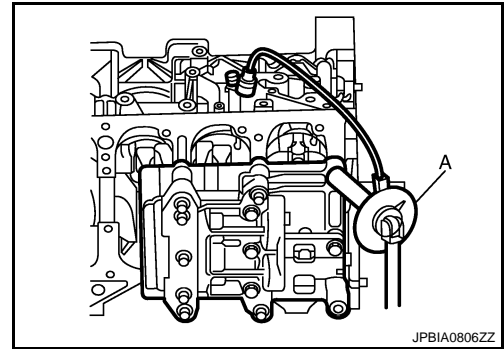
- d. Turn No. 1 to 5 bolts 120 degrees clockwise (angle tightening).  
**CAUTION:**  
**Use the angle wrench [SST: KV10112100] (A) to check tightening angle. Never make judgment by visual inspection.**
- e. Turn No. 6 bolt 90 degrees clockwise (angle tightening).
- f. Completely loosen all bolts.

: 0 N·m (0 kg·m, 0 ft·lb)

**CAUTION:**  
**In this step, loosen bolts in reverse order as shown in the figure.**

- g. Repeat step b to e.

3. Install crankshaft sprocket and balancer unit timing chain.
  - Check that crankshaft sprocket is positioned with mating marks on cylinder block and crankshaft sprocket meeting at the top.
  - Install it by aligning mating marks on each sprocket and balancer unit timing chain.



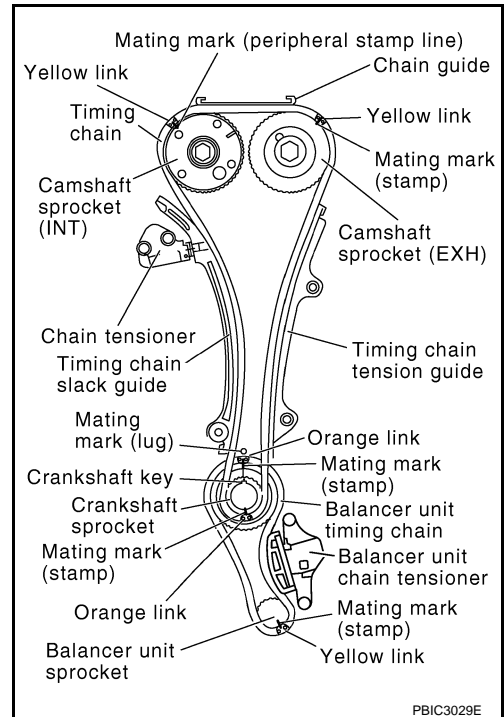
4. Install balancer unit timing chain tensioner.
  - Be careful not to let mating marks of each sprocket and timing chain slip.
  - After installation, check the mating marks have not slipped, then remove stopper pin and release tensioner sleeve.

5. Install timing chain and related parts.
  - Install by aligning mating marks on each sprocket and timing chain.
  - Before and after installing chain tensioner, check again to check that mating marks have not slipped.
  - After installing chain tensioner, remove stopper pin, and check that tensioner moves freely.

**CAUTION:**

- For the following note, after the mating 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.

**NOTE:**  
 Before installing chain tensioner, it is possible to change the position of mating mark on timing chain for that on each sprocket for alignment.



6. Install front oil seal to front cover. Refer to [EM-180. "FRONT OIL SEAL : Removal and Installation"](#).
7. Install front cover with the following procedure:
  - a. Install O-rings to cylinder head and cylinder block.

# TIMING CHAIN

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

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

- a : 35.7 mm (1.406 in)
- b : 4.8 – 5.8 mm (0.189 – 0.228 in)
- c : 3.4 – 4.4 mm (0.134 – 0.173 in)
- d : 179.6 mm (7.07 in)
- e : 35.5 mm (1.398 in)
- f : 31.3 mm (1.232 in)
- G : Dowel pin hole

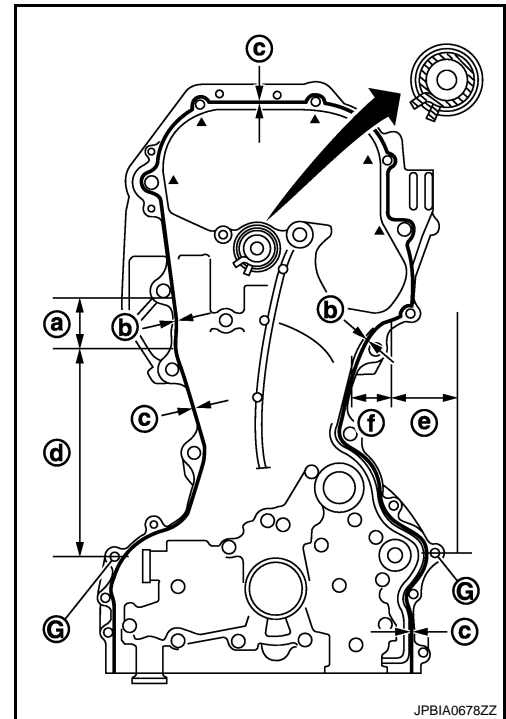
Use Genuine Liquid Gasket or equivalent.

**CAUTION:**

- For bolt holes with ▲ marks (5 locations), apply liquid gasket out side the holes.
- Attaching should be done within 5 minutes after coating.

**NOTE:**

Application instruction differs depending on the position.



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

**CAUTION:**

**Be careful not to damage front oil seal by interference with front end of crankshaft.**

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

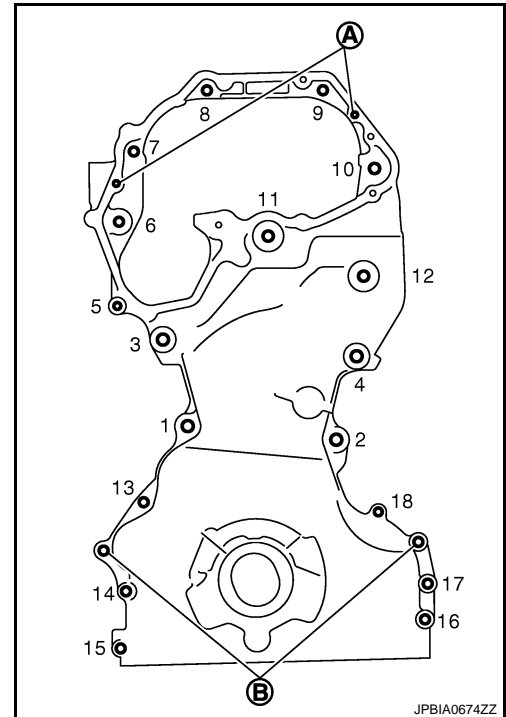
- A : Dowel pin
- B : Dowel pin hole

**CAUTION:**

**Be sure to wipe off any excessive liquid gasket leaking to surface for fitting oil pan.**

**Tightening torque**

- M10 bolt : 49.0 N·m (5.0 kg·m, 36 ft·lb)
- M6 bolt : 12.8 N·m (1.3 kg·m, 9 ft·lb)



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8. Install chain guide between camshaft sprockets.
9. Install intake valve timing control cover with the following procedure:
- a. Install intake valve timing control solenoid valves to intake valve timing control cover if removed.
  - b. Install new oil rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
  - c. Install new O-ring to front cover.

# TIMING CHAIN

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

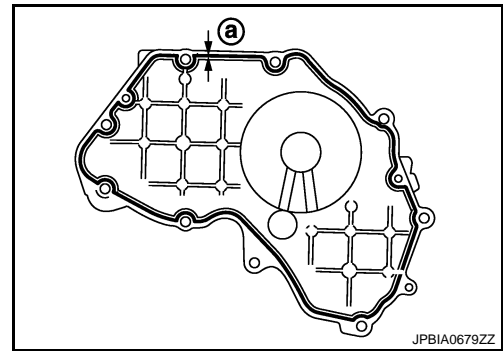
- d. Apply a continuous bead of liquid gasket with a tube presser (commercial service tool) to intake valve timing control cover as shown in the figure.

**a** : 3.4 – 4.4 mm (0.134 – 0.173 in)

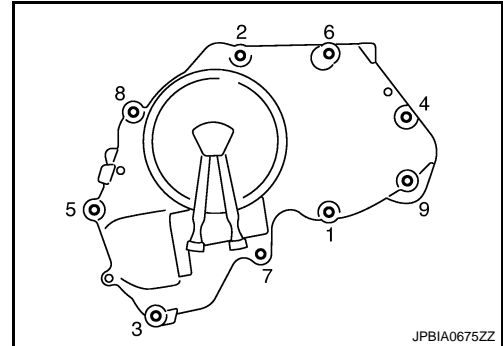
Use Genuine Liquid Gasket or equivalent.

**CAUTION:**

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



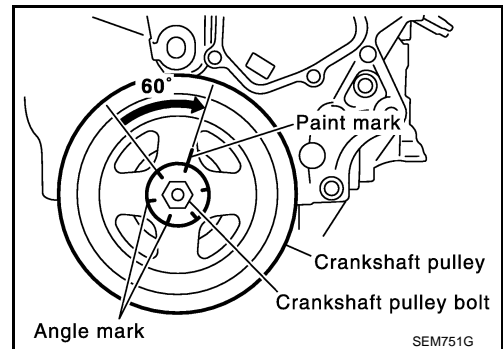
- e. Tighten mounting bolts in numerical order as shown in the figure.



10. 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.
11. Tighten crankshaft pulley bolt.
- Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.
  - Perform angle tightening with the following procedure:
- a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
- b. Tighten crankshaft pulley bolt.

 : 42.1 N·m (4.3 kg·m, 31 ft·lb)

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



12. Install all removed parts in the reverse order of removal.

## Inspection

### INSPECTION AFTER REMOVAL

#### Timing Chain

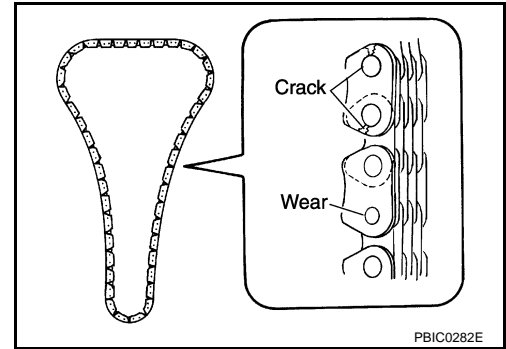
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# TIMING CHAIN

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

Check timing chain for cracks and any excessive wear at the roller links of timing chain. Replace timing chain if necessary.

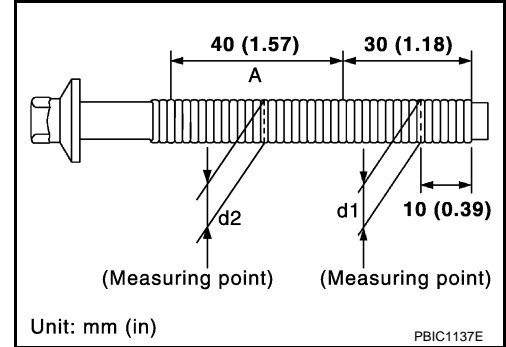


### Balancer Unit Mounting Bolt Outer Diameter

- Measure the outer diameters (“d1”, “d2”) at two positions as shown in the figure.
- If reduction appears in “A” range, regard it as “d2”.

**Limit (“d1”–“d2”) : 0.15 mm (0.0059 in)**

- If it exceeds the limit (large difference in dimensions), replace it with a new one.



## 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-22, "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, 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
Other oils and fluid*	Level	Leakage	Level
Fuel	—	Leakage	—

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

# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

## CYLINDER HEAD

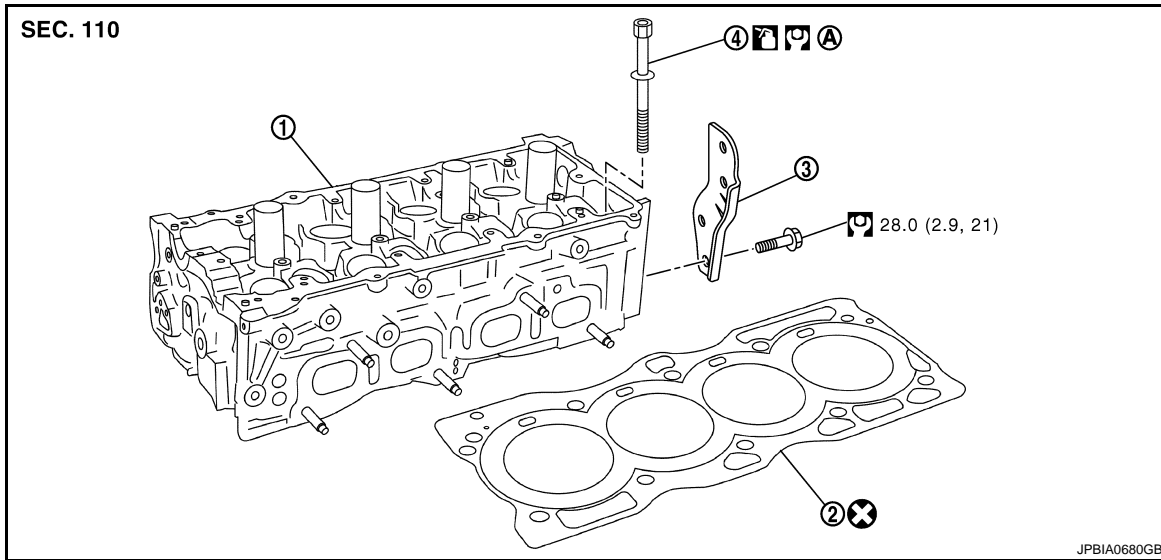
Exploded View

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REMOVAL

A

EM

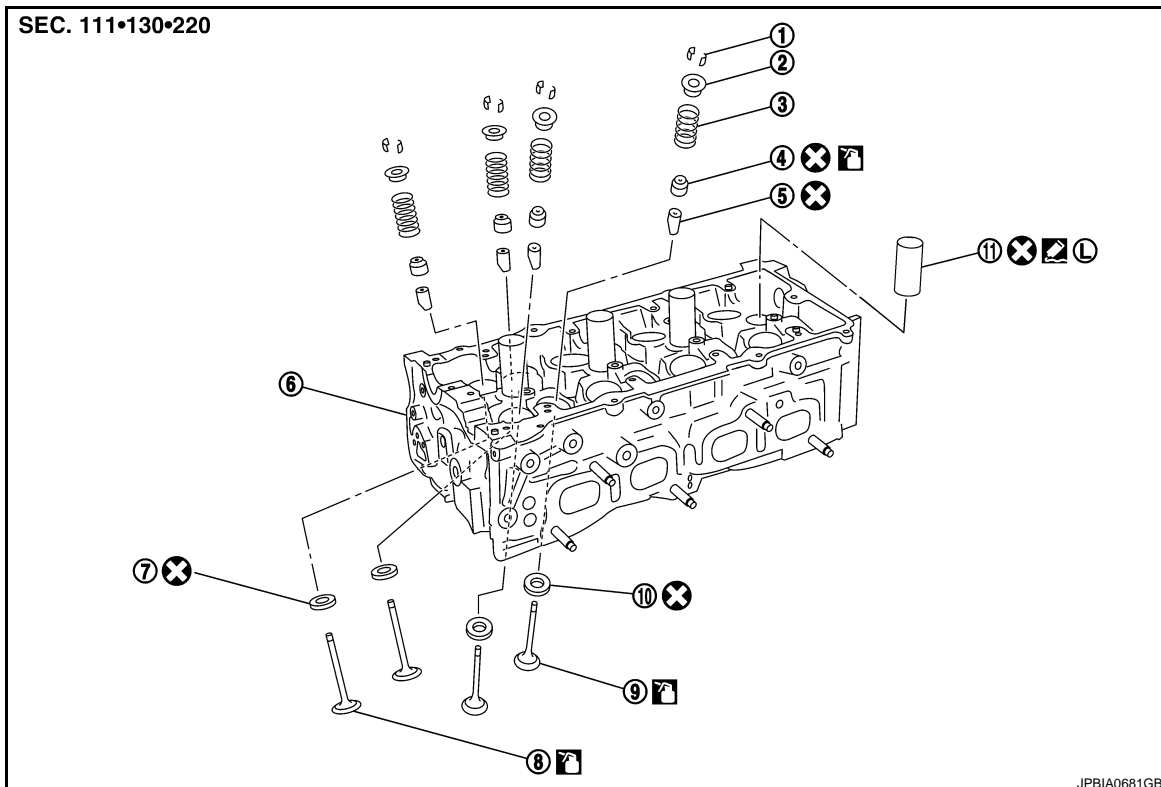


- 1. Cylinder head assembly
- 2. Cylinder head gasket
- 3. Engine rear lower slinger
- 4. Cylinder head bolt

A : Refer to [EM-202](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

DISASSEMBLY



C

D

E

F

G

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L

M

N

O


P

# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

 : Apply thread locking sealant.

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

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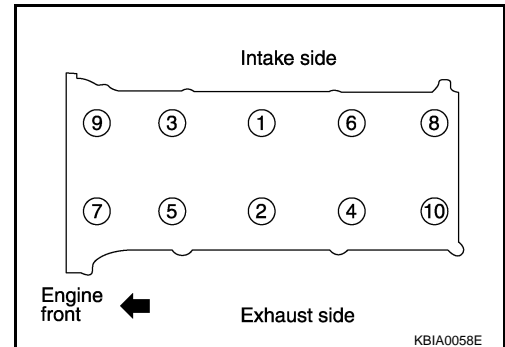
### REMOVAL

1. Release fuel pressure. Refer to [ECQ-356, "Inspection"](#).
2. Drain engine coolant and engine oil. Refer to [CO-41, "Draining"](#) and [LU-17, "Draining"](#).
3. Remove the following components and related parts.
  - Exhaust manifold and three way catalyst assembly: Refer to [EM-155, "Removal and Installation"](#).
  - Intake manifold and fuel tube assembly: Refer to [EM-152, "Removal and Installation"](#).
  - Water control valve and water control valve housing (water outlet): Refer to [CO-57, "Exploded View"](#).

#### NOTE:

Can be removed and installed even when assembled with cylinder head.

4. Remove front cover and timing chain. Refer to [EM-192, "Exploded View"](#).
5. Remove camshafts. Refer to [EM-170, "Removal and Installation"](#).
6. Securely support bottom of cylinder block with a jack or equivalent tool, and release the hoist that was supporting it.
7. Remove cylinder head loosening bolts in reverse order as shown in the figure.
  - Using TORX socket (size E20), loosen cylinder head bolts.
8. Remove cylinder head gasket.



### INSTALLATION

1. Install cylinder head gasket.
2. Tighten cylinder head bolts in numerical order as shown in figure with the following procedure, and install cylinder head.

#### CAUTION:

If cylinder head bolts are re-used, check their outer diameters before installation. Refer to [EM-207, "Inspection"](#).

- a. Apply new engine oil to threads and seating surface of mounting bolts.
- b. Tighten all bolts.

 : 50.0 N·m (5.1 kg·m, 37 ft·lb)

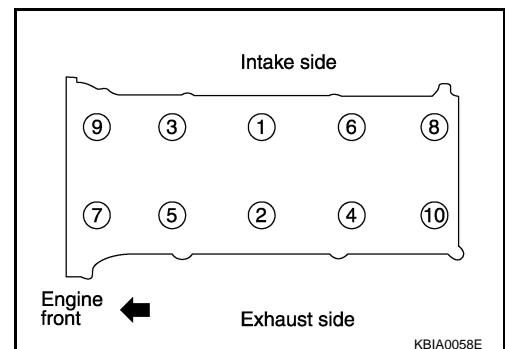
- c. Turn all bolts 60 degrees clockwise (angle tightening).
- d. Completely loosen.

 : 0 N·m (0 kg·m, 0 ft·lb)

#### CAUTION:

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

- e. Tighten all bolts.



# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

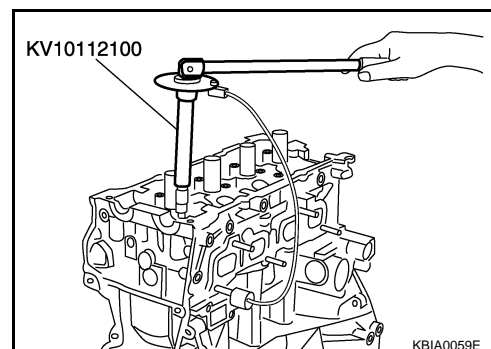
[QR25DE]

 : 39.2 N·m (4.0 kg-m, 29 ft-lb)

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

**CAUTION:**

Check and confirm the tightening angle by using an angle wrench (SST) or protractor. Avoid judgment by visual inspection without the tool.



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

## Disassembly and Assembly

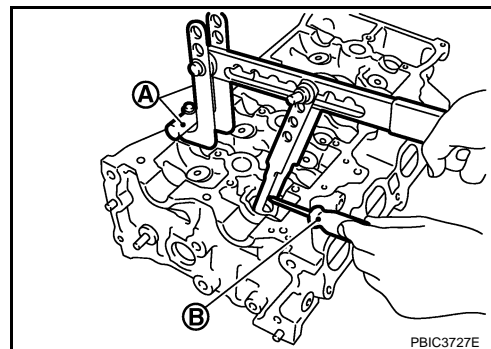
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### DISASSEMBLY

1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove spark plug tube, if necessary.
  - Using pliers, remove it from cylinder head.
3. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.
4. Remove valve collet.
  - Compress valve spring with valve spring compressor, attachment and adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand (B).

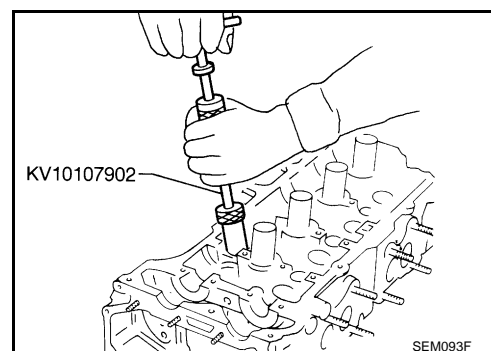
**CAUTION:**

When working, be careful not to 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. Push valve stem to combustion chamber side, and remove valve.
  - Identify installation positions, and store them without mixing them up.
7. Remove valve oil seal with a valve oil seal puller (SST).





# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

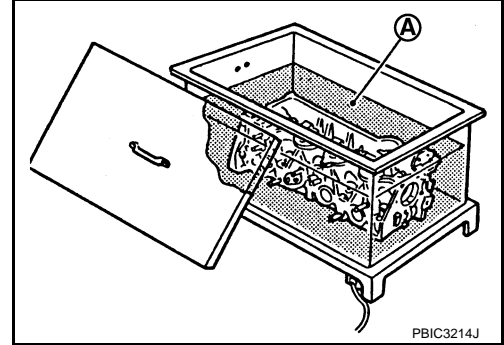
[QR25DE]

8. Remove valve seat, if valve seat must be replaced.
  - Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-238. "Cylinder Head"](#).

**CAUTION:**

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

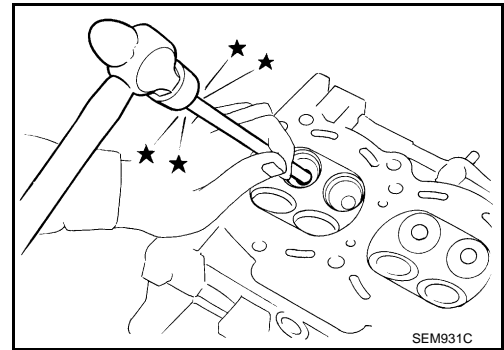
9. Remove valve guide, if valve guide must be replaced.
  - a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



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

**CAUTION:**

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



## ASSEMBLY

1. Install valve guide if removed.

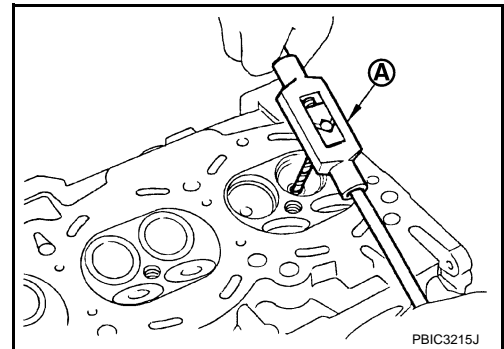
**CAUTION:**

**Replace with oversize [0.2 mm (0.008 in)] valve guide.**

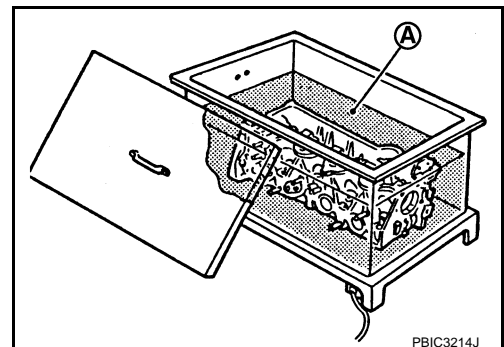
- a. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool) (A).

**For service parts : Oversize [0.2 mm (0.008 in)]**

**Refer to [EM-238. "Cylinder Head"](#).**



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





# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

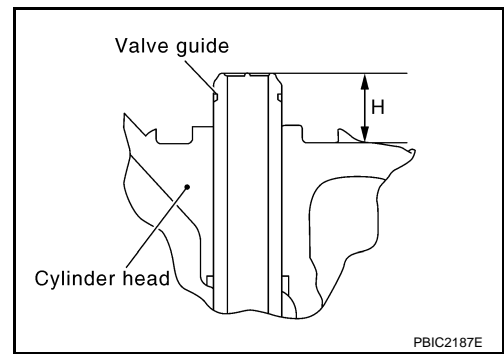
[QR25DE]

- c. Press valve guide from camshaft side to dimensions as shown in the figure.

**Projection "H"** : Refer to [EM-238, "Cylinder Head"](#).

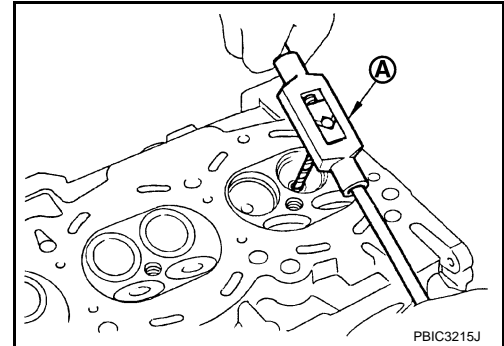
**CAUTION:**

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



- d. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool) (A).

**Standard** : Refer to [EM-238, "Cylinder Head"](#).



2. Install valve seat if removed.

**CAUTION:**

Replace with **oversize [0.5 mm (0.020 in)] valve seat**.

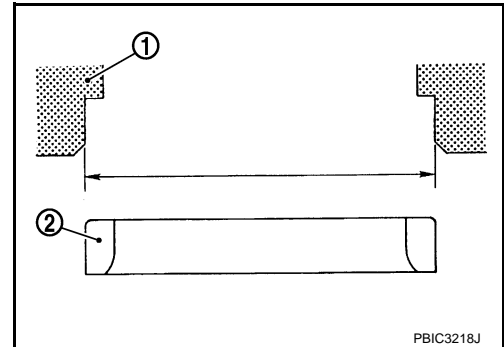
- a. Ream cylinder head (1) recess diameter for service valve seat.

2 : Valve seat

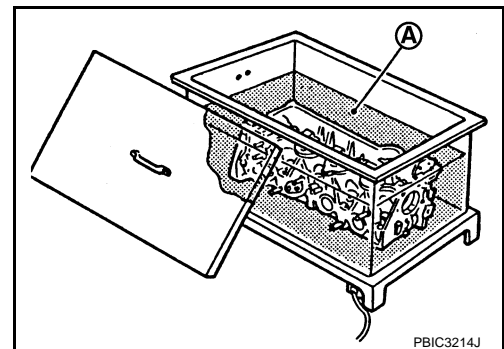
**For service parts** : **Oversize [0.5 mm (0.020 in)]**

Refer to [EM-238, "Cylinder Head"](#).

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



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



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

**CAUTION:**

- Avoid directly to touching cold valve seats.
- Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.

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

# CYLINDER HEAD

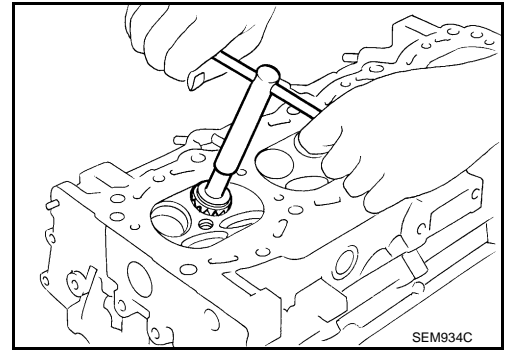
[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

- d. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to [EM-238. "Cylinder Head"](#).

**CAUTION:**

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



- e. Using compound, grind to adjust valve fitting.  
f. Check again for normal contact. Refer to [EM-207. "Inspection"](#).

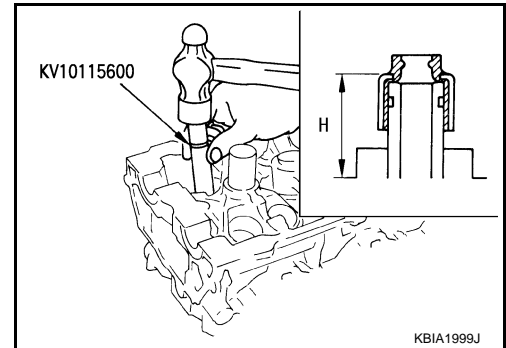
3. Install valve oil seal.

- Install with a valve oil seal drift (SST) to match dimension in the figure.

**NOTE:**

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

**Height "H" : 11.8 - 12.4 mm (0.465 - 0.488 in)**

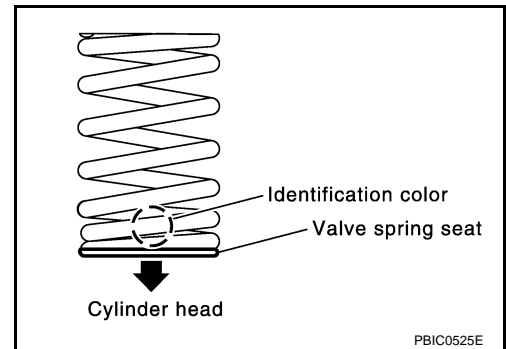


4. Install valve.  
• Install larger diameter to intake side.

5. Install valve spring (with valve spring seat).  
• Install smaller pitch (valve spring seat side) to cylinder head side.  
• Confirm identification color of valve spring.

**Intake : Pink**

**Exhaust : Yellowish green**



6. Install valve spring retainer.

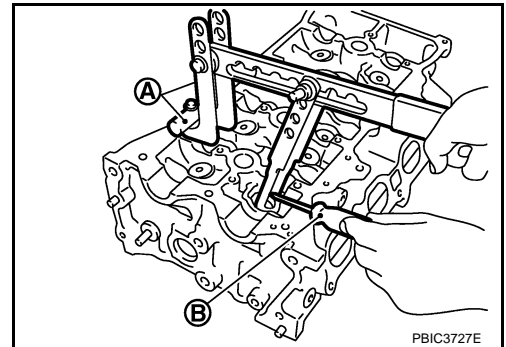
7. Install valve collet.

- Compress valve spring with a valve spring compressor, attachment and 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.



8. Install valve lifter.

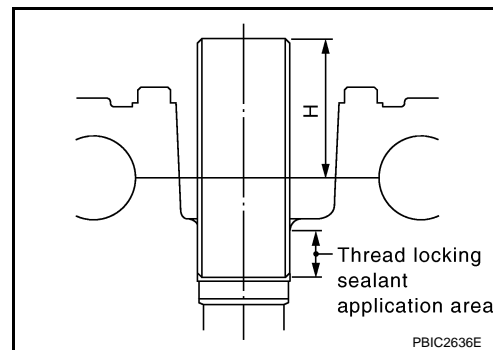
- Install it in the original position.

# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

9. Install spark plug tube if removed.
  - Press-fit it into cylinder head with the following procedure:
    - a. Remove old thread locking sealant from cylinder head side installation hole.
    - b. Apply thread locking sealant all round on spark plug tube within approximately 12 mm (0.47 in) width from edge of spark plug tube on the press-fit side.  
**Use Genuine Thread Locking Sealant or equivalent.**
    - c. Using a drift, press-fit spark plug tube so that height is as same as "H" shown in figure.



**Standard press-fit height "H":**  
**41.2 - 42.2 mm (1.622 - 1.661 in)**

**CAUTION:**

- **When press-fitting, be careful not to deform spark plug tube.**
- **After press-fitting, wipe off any protruding thread locking sealant on top surface of cylinder head.**

10. Install spark plug with spark plug wrench (commercial service tool).

## Inspection

INFOID:000000001157988

### INSPECTION AFTER REMOVAL

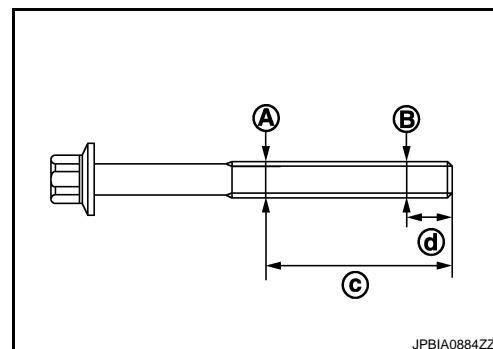
#### Cylinder Head Bolts Outer Diameter

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

c : 55.0 mm (2.17 in)  
 d : 12.0 mm (0.47 in)

**Limit ("B"-"A") : 0.23 mm (0.0091 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-218, "Inspection"](#).

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

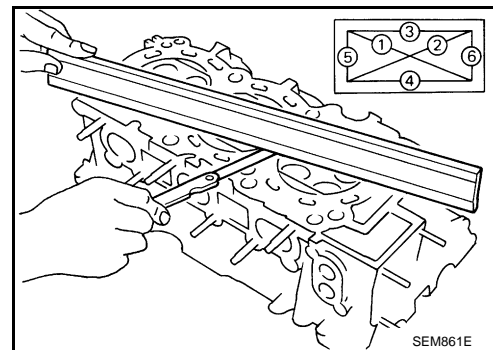
**CAUTION:**

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

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

**Limit : Refer to [EM-238, "Cylinder Head"](#).**

- If it exceeds the limit, replace cylinder head.



### VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [EM-238, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve.

# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

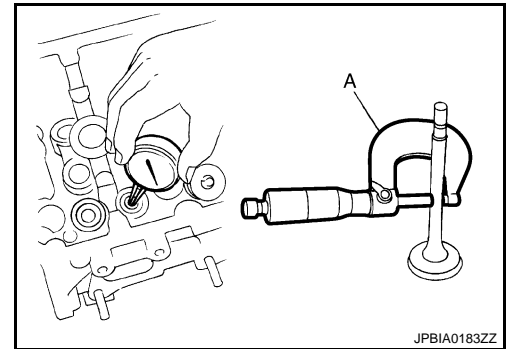
[QR25DE]

## VALVE GUIDE CLEARANCE

Valve Stem Diameter

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

**Standard** : Refer to [EM-238, "Cylinder Head"](#).



Valve Guide Inner Diameter

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

**Standard** : Refer to [EM-238, "Cylinder Head"](#).

Valve Guide Clearance

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

**Standard and Limit** : Refer to [EM-238, "Cylinder Head"](#).

- If it exceeds the limit, replace valve guide and/or valve. When valve guide must be replaced. Refer to [EM-203, "Disassembly and Assembly"](#).

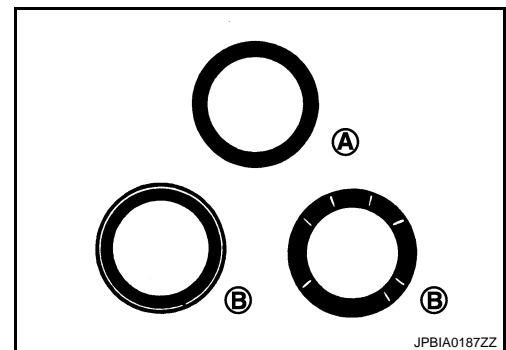
## VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within 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

B : NG

- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace valve seat. Refer to [EM-203, "Disassembly and Assembly"](#).



## VALVE SPRING SQUARENESS

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

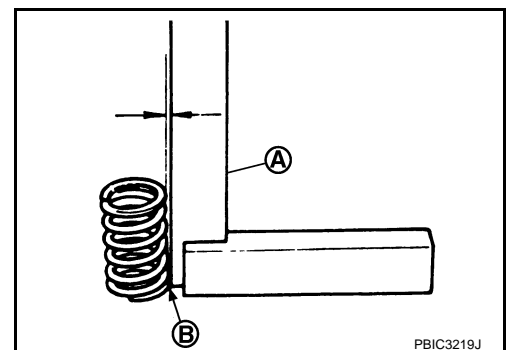
B : Contact

### CAUTION:

Never remove valve spring seat from valve spring.

**Limit** : Refer to [EM-238, "Cylinder Head"](#).

- If it exceeds the limit, replace valve spring (with valve spring seat).



## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

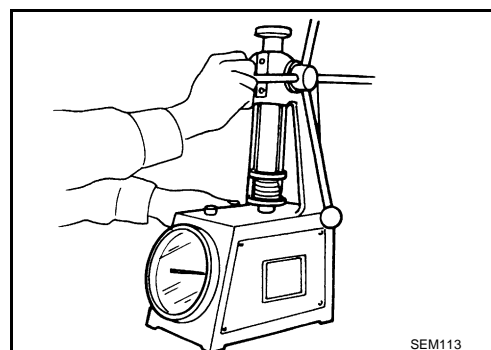
[QR25DE]

- 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-238, "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-22, "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
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

# CYLINDER BLOCK

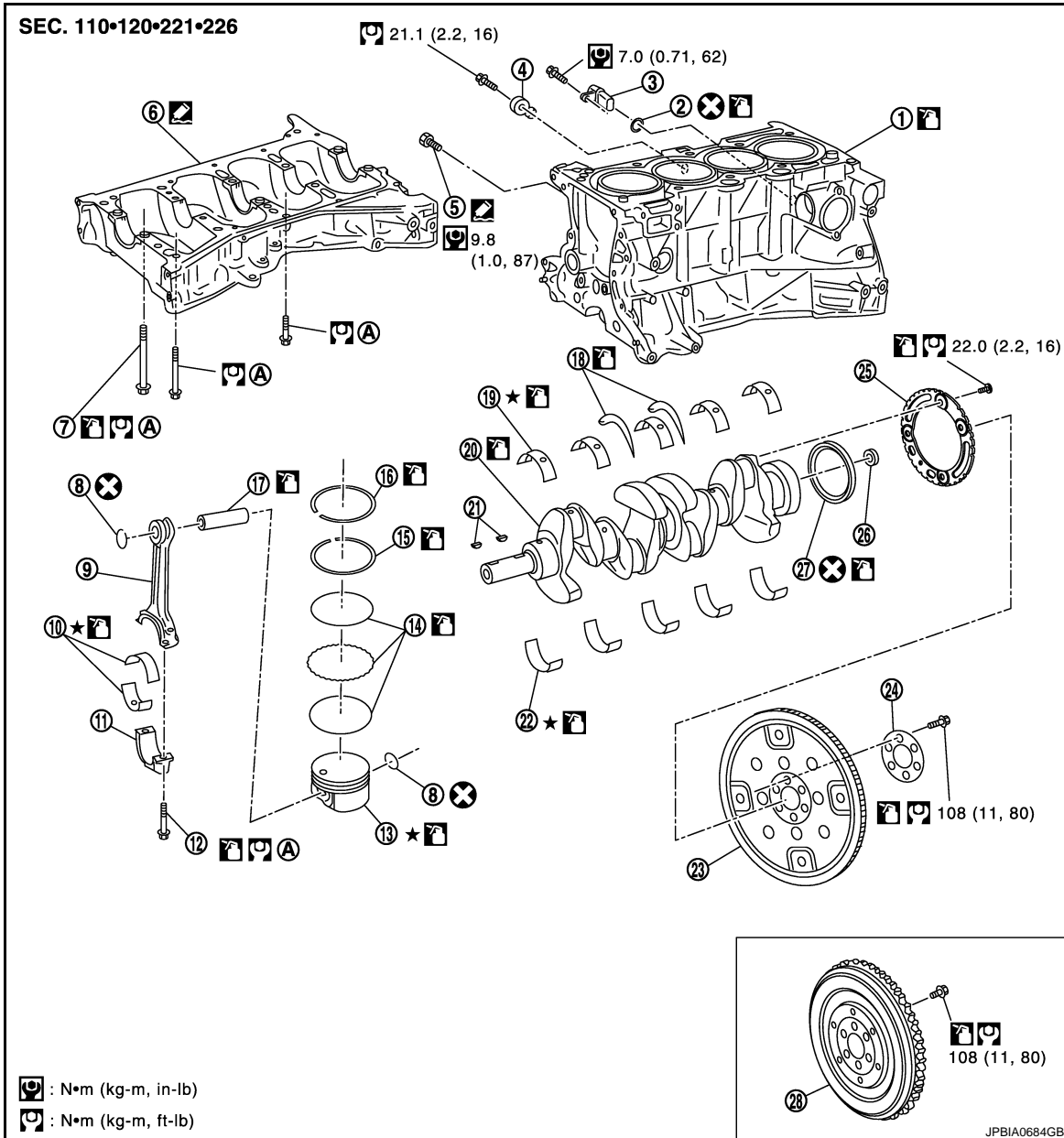
< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

## CYLINDER BLOCK

Exploded View

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- |                                       |                                  |                                     |
|---------------------------------------|----------------------------------|-------------------------------------|
| 1. Cylinder block                     | 2. O-ring                        | 3. Crankshaft position sensor (POS) |
| 4. Knock sensor                       | 5. Water drain plug              | 6. Lower cylinder block             |
| 7. Lower cylinder block mounting bolt | 8. Snap ring                     | 9. Connecting rod                   |
| 10. Connecting rod bearing            | 11. Connecting rod bearing cap   | 12. Connecting rod bolt             |
| 13. Piston                            | 14. Oil ring                     | 15. Second ring                     |
| 16. Top ring                          | 17. Piston pin                   | 18. Thrust bearing                  |
| 19. Main bearing upper                | 20. Crankshaft                   | 21. Crankshaft key                  |
| 22. Main bearing lower                | 23. Drive plate (CVT models)     | 24. Reinforce plate (CVT models)    |
| 25. Signal plate                      | 26. Pilot converter (CVT models) | 27. Rear oil seal                   |
| 28. Flywheel (M/T models)             |                                  |                                     |

A : Refer to [EM-211](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

## Disassembly and Assembly

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### DISASSEMBLY

1. Remove cylinder head. Refer to [EM-201, "Exploded View"](#).
2. Remove knock sensor.

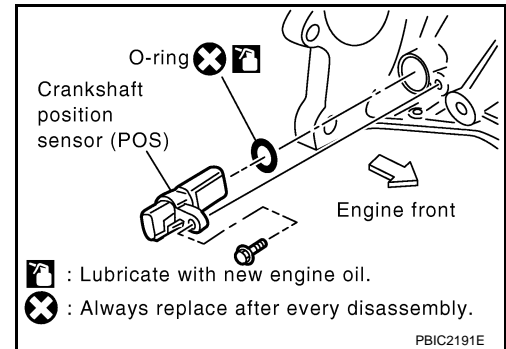
**CAUTION:**

**Carefully handle knock sensor avoiding shocks.**

3. Remove crankshaft position sensor (POS).

**CAUTION:**

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

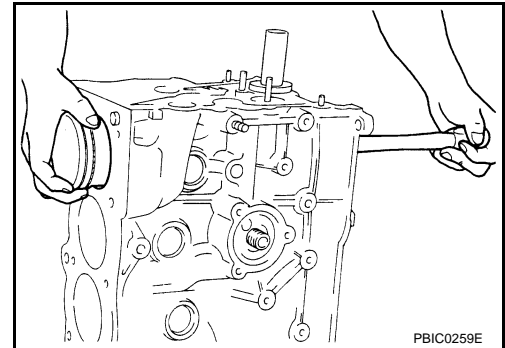


4. Remove piston and connecting rod assembly with the following procedure:
  - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-218, "Inspection"](#).

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

**CAUTION:**

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



5. Remove connecting rod bearings.

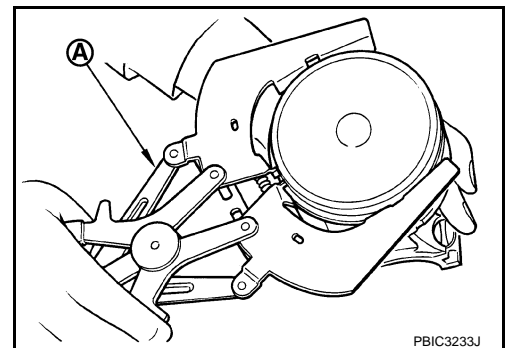
**CAUTION:**

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

6. Remove piston rings from piston.
  - 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.



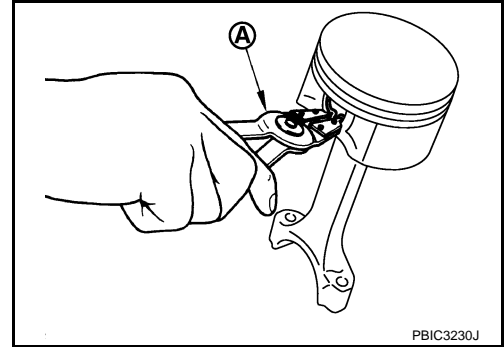
7. Remove piston from connecting rod with the following procedure:

# CYLINDER BLOCK

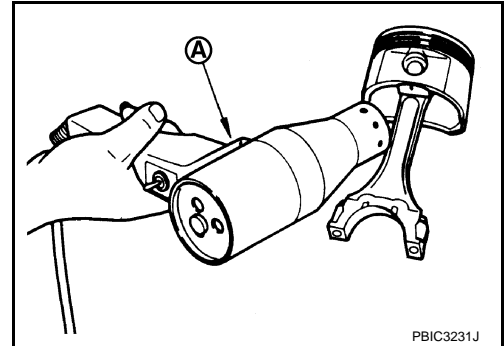
< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

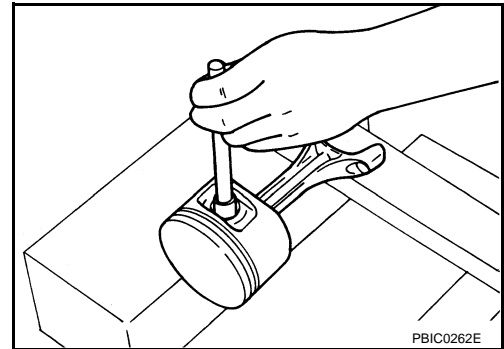
- a. Using snap ring pliers (A), remove snap ring.



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



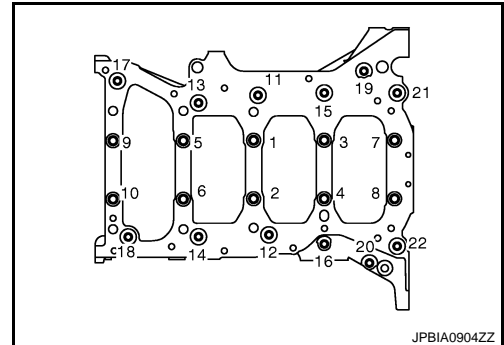
- c. Push out piston pin with stick of outer diameter approximately 19 mm (0.75 in).



8. Remove lower cylinder block mounting bolts.  
• Loosen them in reverse order as shown in the figure, and remove them.

← : Engine front

- Use TORX socket (size E14) for bolts No. 1 to 10.
- Before loosening lower cylinder block mounting bolts, measure crankshaft end play. Refer to [EM-218, "Inspection"](#).



9. Remove lower cylinder block.  
• Use a seal cutter [SST: KV10111100] or equivalent tool to cut liquid gasket for removal.

**CAUTION:**

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

10. Remove crankshaft.

**CAUTION:**



# CYLINDER BLOCK

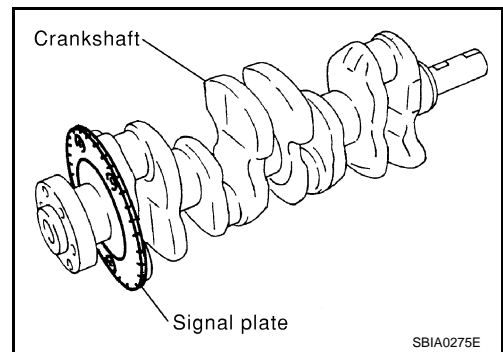
< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

- Be careful not damage or deform signal plate 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 T30).



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

**NOTE:**

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

**CAUTION:**

Be careful not to damage crankshaft and cylinder block.

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

**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.

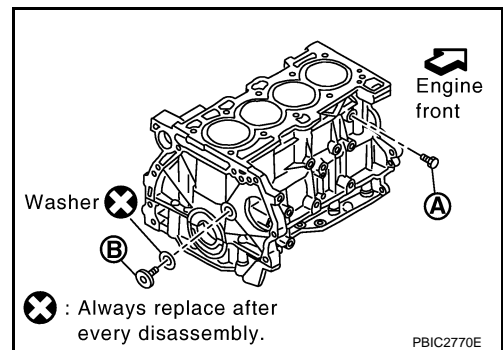
**CAUTION:**

Use a goggles to protect your eye.

2. Install each plug to cylinder block as shown in the figure.
- Apply liquid gasket to the thread of water drain plug "A".
  - Use Genuine Liquid Gasket or equivalent.

**NOTE:**

Do not apply liquid gasket to the thread of plug "B".

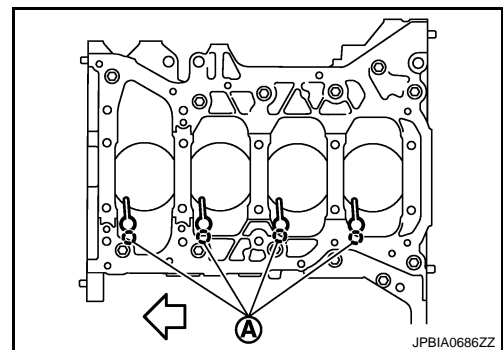


- Tighten each plug as specified below.

Part	Washer	Tightening torque
A	No	9.8 N·m (1.0 kg·m, 87 in·lb)
B	Yes	53.9 N·m (5.5 kg·m, 40 ft·lb)

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

← : Engine front



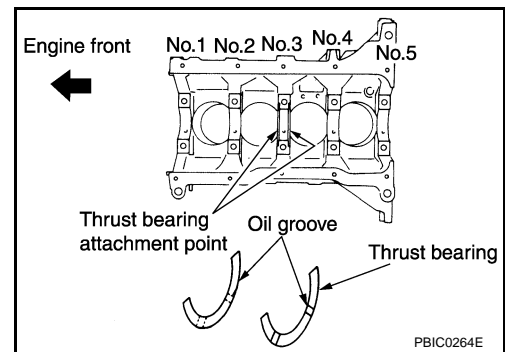
4. Install main bearings and thrust bearings with the following procedure:
- Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and lower cylinder block.

# CYLINDER BLOCK

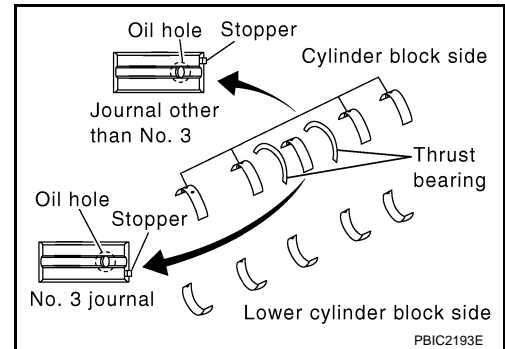
[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

- b. Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block.
- Install thrust bearings with the oil groove facing crankshaft arm (outside).



- c. Install the main bearings paying attention to the direction.
- Main bearing with an oil hole and groove goes on cylinder block. The one without them goes on lower cylinder block.
  - Only main bearing (on cylinder block) for No. 3 journal has different specifications.
  - Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
  - When installing, align main bearing stopper to the notch.
  - Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



5. Install signal plate to crankshaft if removed.
- a. Position crankshaft and signal plate using a dowel pin, and tighten mounting bolts.

- 1 : Signal plate
- 2 : Crankshaft
- A : Dowel pin (used to position the signal plate)

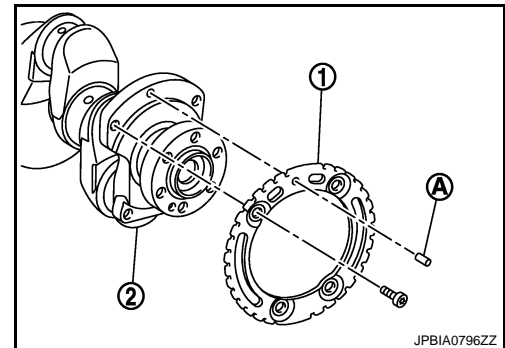
- b. Remove dowel pin.

**CAUTION:**

**Be sure to remove dowel pin.**

**NOTE:**

Dowel pin of crankshaft and signal plate is provided as a set for each. If dowel pin is not available (when reusing crankshaft and signal), use M6 bolt [length 10 mm (0.39 in) or more] as a substitute.



6. Install crankshaft to cylinder block.
- While turning crankshaft by hand, check that it turns smoothly.
7. Install lower cylinder block with the following procedure:
- a. Apply liquid gasket with a tube presser (commercial service tool) to lower cylinder block as shown in the figure.

- a : 3.5 - 4.0 mm (0.138 - 0.157 in)
- B : Apply liquid gasket to an end

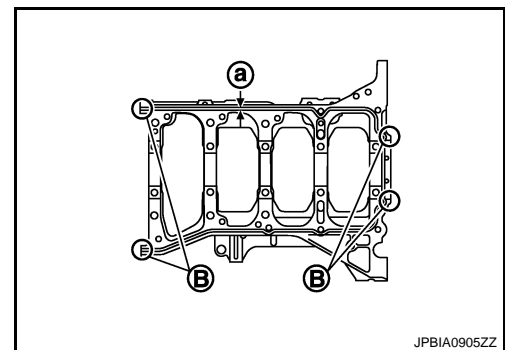
**Use Genuine Liquid Gasket or equivalent.**

**CAUTION:**

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

**NOTE:**

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



- b. Tighten lower cylinder block mounting bolts with the following procedure:
- i. Apply new engine oil to threads and seat surfaces of mounting bolts.

# CYLINDER BLOCK

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

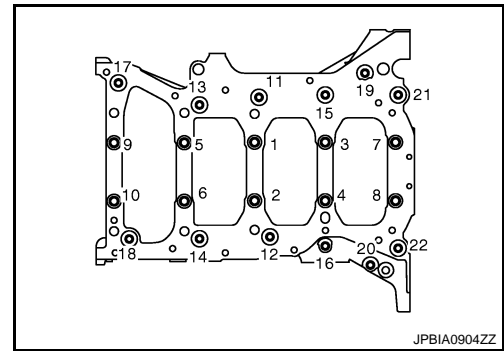
- ii. Tighten M8 bolts in numerical order from No. 11 to 22 in the figure.

← : Engine front

 : 25.1 N-m (2.6 kg-m, 19 ft-lb)

### NOTE:

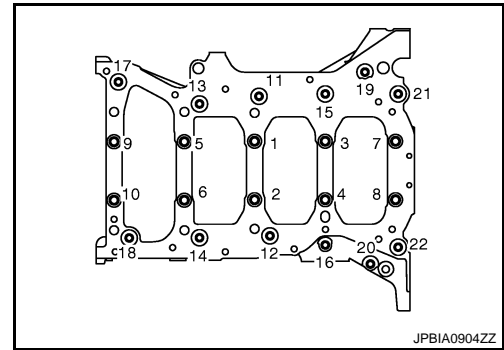
There are more processes to complete the tightening of mounting bolts. However stop procedure here to install rear oil seal.



- c. Install rear oil seal. Refer to [EM-180. "REAR OIL SEAL : Removal and Installation"](#).  
 d. Restart tightening of lower cylinder block mounting bolts with the following procedure:  
 i. Tighten M10 bolts in numerical order from No. 1 to 10.

← : Engine front

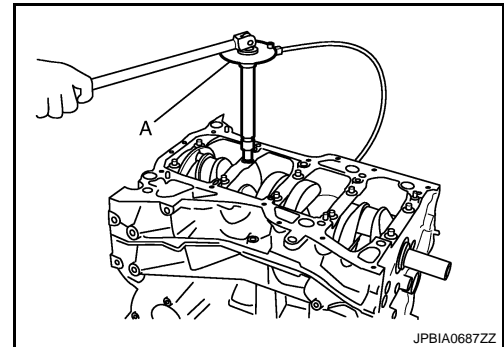
 : 39.2 N-m (4.0 kg-m, 29 ft-lb)



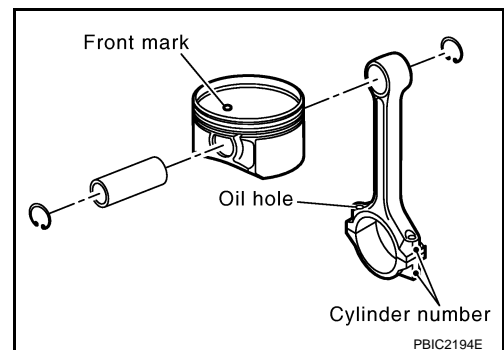
- ii. Turn M10 bolts 60 degrees clockwise (angle tightening) in order from No. 1 to 10 in the figure.

### CAUTION:

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



- After installing mounting bolts, check that crankshaft can be rotated smoothly by hand.
  - Wipe off completely any protruding liquid gasket on front side of engine.
  - Check crankshaft end play. Refer to [EM-218. "Inspection"](#).
8. Install piston to connecting rod with the following procedure:
- Using snap ring pliers, install new snap ring to the groove of the piston rear side.
    - Insert it fully into groove to install.
  - Assemble piston to connecting rod.
    - Using an industrial use drier or similar tool, heat the piston until the piston pin can be pushed in by hand without excess force [approx. 60 to 70 °C (140 to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.
    - Assemble so that the front mark on the piston head and the oil holes and the cylinder number on connecting rod are positioned as shown in the figure.
  - Install new snap ring to the groove of the piston front side.
    - Insert it fully into groove to install.
    - After installing, check that connecting rod moves smoothly.



# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

**CAUTION:**

**Be careful not to damage piston.**

- Position each ring with the gap as shown in the figure referring to the piston front mark.
- Install second ring with the stamped surface facing upward.

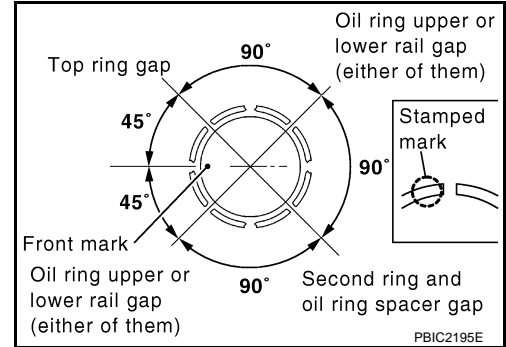
**Stamped mark:**

**Top ring** : —

**Second ring** : 2 K

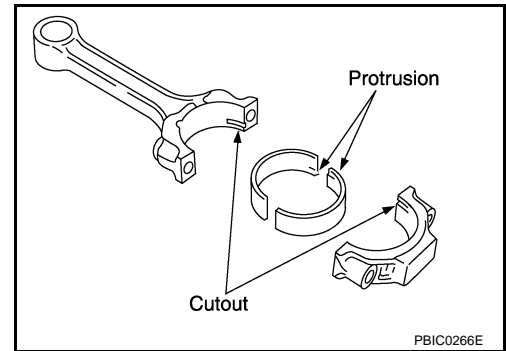
**NOTE:**

If there is no stamped mark on piston ring, no specific orientation is required for installation.



10. 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 new engine oil to the back surface, but thoroughly clean it.
- When installing, align the connecting rod bearing stopper protrusion with the cutout of connecting rod and connecting rod cap to install.
- Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.

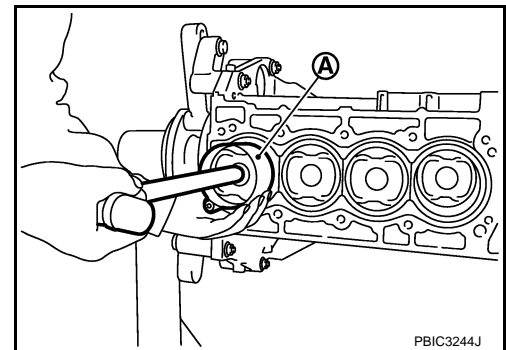


11. Install piston and connecting rod assembly to crankshaft.

- 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 a 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.

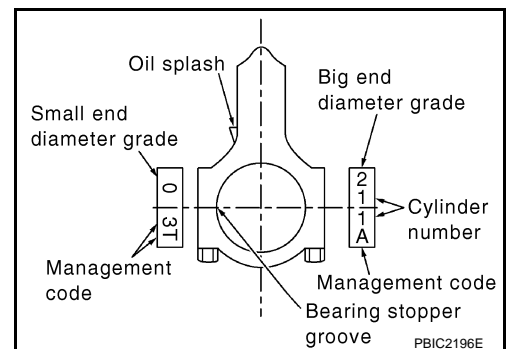
**CAUTION:**

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



12. Install connecting rod cap.

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



# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

13. Tighten connecting rod bolt with the following procedure:
- Apply new engine oil to the threads and seats of connecting rod bolts.
  - Tighten bolts.

 : 27.4 N·m (2.8 kg·m, 20 ft·lb)

- Completely loosen bolts.

 : 0 N·m (0 kg·m, 0 ft·lb)

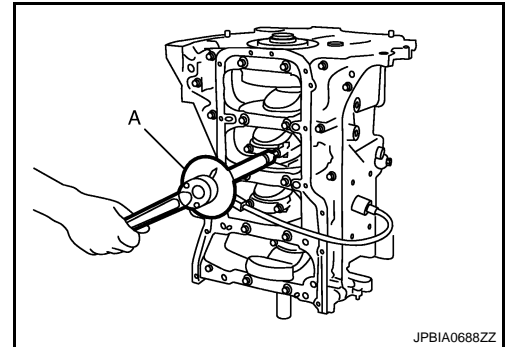
- Tighten bolts.

 : 19.6 N·m (2.0 kg·m, 14 ft·lb)

- Then turn all bolts 90 degrees clockwise (Angle tightening).

**CAUTION:**

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment 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-218, "Inspection"](#).

14. Install flywheel (M/T models) or drive plate (CVT models).

**CAUTION:**

Check that dowel pin is installed at the rear end of crankshaft.

- When installing flywheel (M/T models) or drive plate (CVT models) to crankshaft, check that align crankshaft side dowel pin with flywheel/drive-plate side dowel pin hole correctly.

**CAUTION:**

If these are not aligned correctly, engine runs roughly and "MI" turns on.

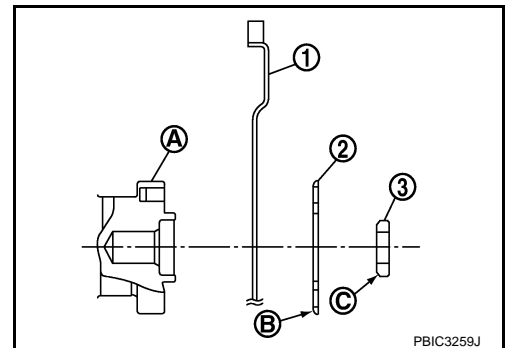
- Secure crankshaft with a stopper plate, and tighten mounting bolts crosswise over several times.
- Install drive plate (1), reinforcement plate (2) and pilot converter (3) as shown in figure (CVT models).

A : Crankshaft rear end

B : Rounded

C : Chamfered

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



15. Install knock sensor.

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[QR25DE]

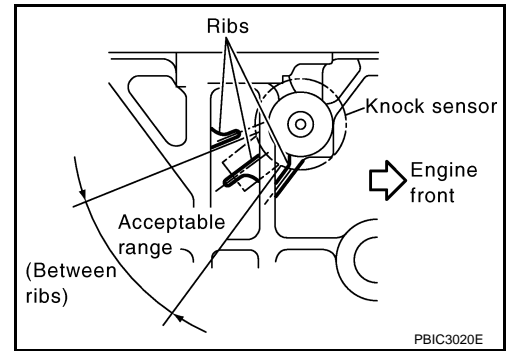
- Install knock sensor with harness connector facing lower left as shown in the figure.

### CAUTION:

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

### NOTE:

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



16. Install crankshaft position sensor (POS).

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

## Inspection

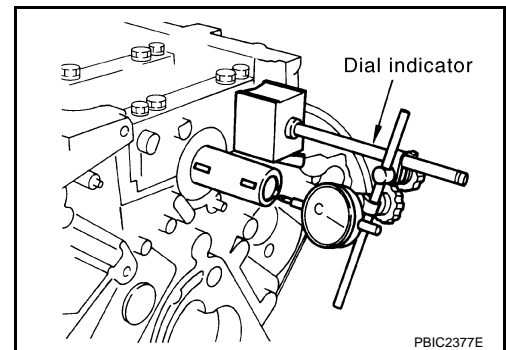
INFOID:000000001157992

### CRANKSHAFT END PLAY

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

**Standard and Limit** : Refer to [EM-240, "Cylinder Block"](#).

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

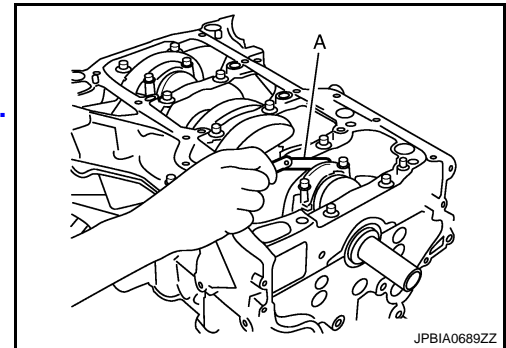


### CONNECTING ROD SIDE CLEARANCE

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

**Standard and Limit** : Refer to [EM-240, "Cylinder Block"](#).

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

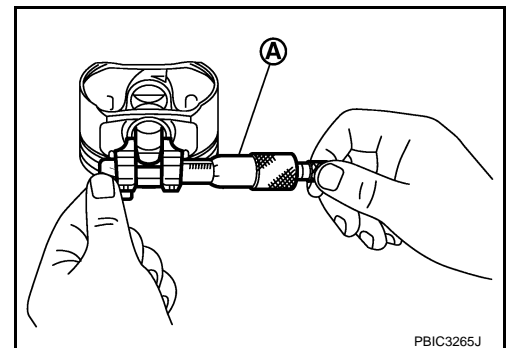


### PISTON TO PISTON PIN OIL CLEARANCE

#### Piston Pin Hole Diameter

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

**Standard** : Refer to [EM-240, "Cylinder Block"](#).



#### Piston Pin Outer Diameter

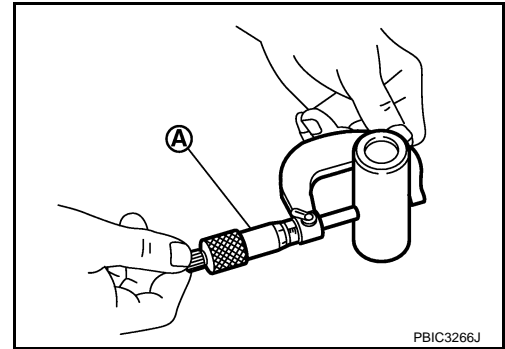
# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

**Standard** : Refer to [EM-240, "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-240, "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 "PISTON TO CYLINDER BORE CLEARANCE".

**NOTE:**

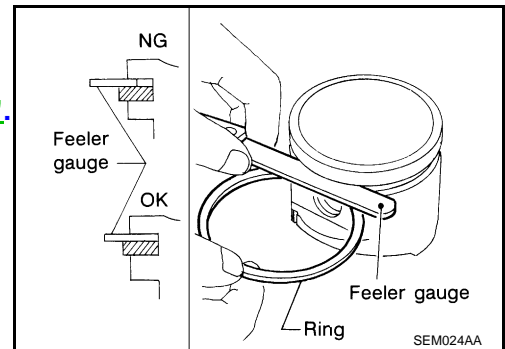
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

## PISTON RING SIDE CLEARANCE

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

**Standard and Limit** : Refer to [EM-240, "Cylinder Block"](#).

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

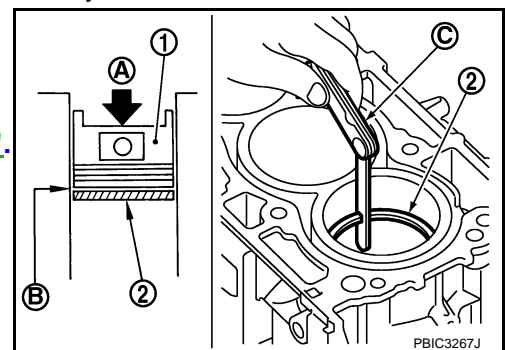


## PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "Cylinder Bore Inner Diameter".
- 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-240, "Cylinder Block"](#).

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



## CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.



# CYLINDER BLOCK

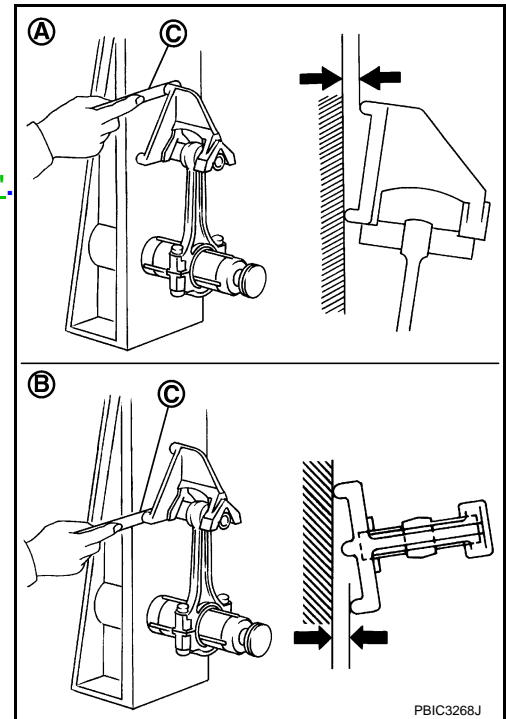
< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

**Bend and Torsion** : Refer to [EM-240, "Cylinder Block"](#).

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

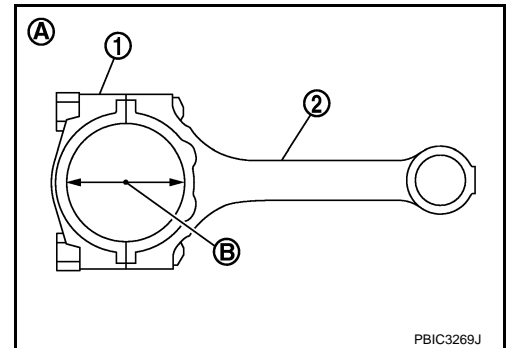


## CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to [EM-211, "Disassembly and Assembly"](#) for the tightening procedure.

- 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-240, "Cylinder Block"](#).

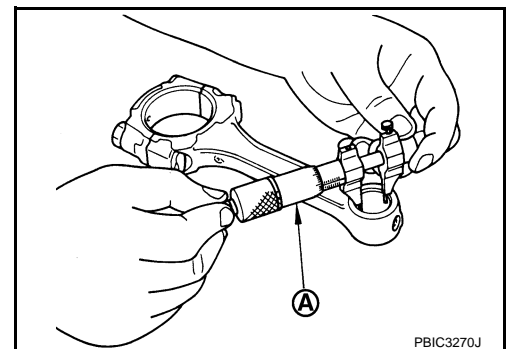
- If out of the standard, replace connecting rod assembly.

## 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-240, "Cylinder Block"](#).



Piston Pin Outer Diameter



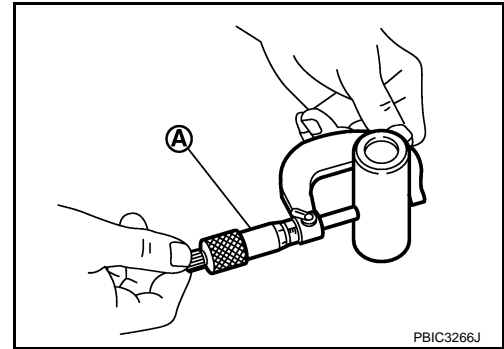
# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

**Standard** : Refer to [EM-240, "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

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

**Standard** : Refer to [EM-240, "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-228, "Piston"](#).
- If replacing connecting rod assembly. Refer to [EM-229, "Connecting Rod Bearing"](#) to select connecting rod bearing.

## CYLINDER BLOCK DISTORTION

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

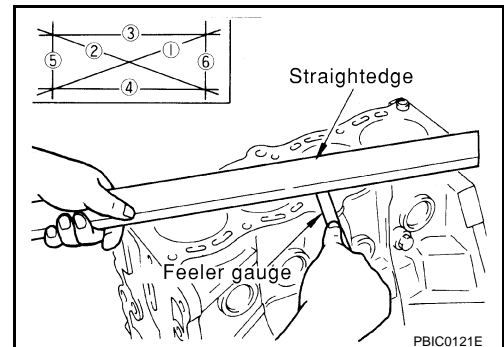
### CAUTION:

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

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

**Limit** : Refer to [EM-240, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



## MAIN BEARING HOUSING INNER DIAMETER

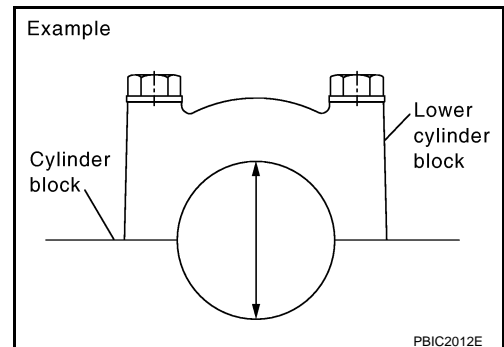
- Install lower cylinder block without main bearings installed, and tighten lower cylinder block mounting bolts to the specified torque. Refer to [EM-211, "Disassembly and Assembly"](#) for the tightening procedure.
- Measure the inner diameter of main bearing housing with a bore gauge.

**Standard** : Refer to [EM-240, "Cylinder Block"](#).

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

### NOTE:

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



## PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

# CYLINDER BLOCK

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

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

### NOTE:

When determining cylinder bore grade, measure the cylinder bore at "B" position.

### Standard :

**Cylinder bore inner diameter**

: Refer to [EM-240, "Cylinder Block"](#).

### Limit :

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

**Taper (Difference between "A" and "B")**

: Refer to [EM-240, "Cylinder Block"](#).

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or re-bore the cylinder inner wall.
- Oversize piston is provided. When using oversize piston, re-bore the cylinder so that the clearance of the piston to cylinder bore satisfies the standard.

### CAUTION:

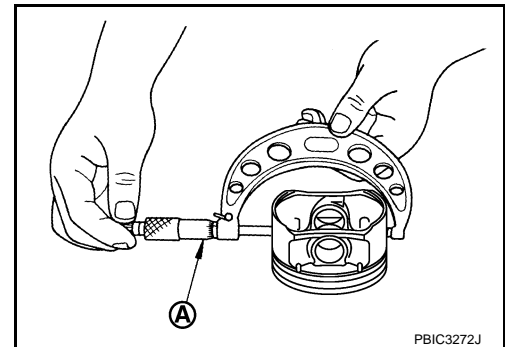
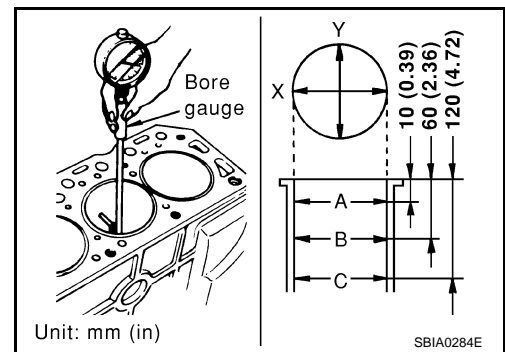
**When using oversize piston, use it for all cylinders with oversize piston rings.**

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

Piston Skirt Diameter

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

**Standard** : Refer to [EM-240, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction "X", position "B").

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

**Standard and Limit** : Refer to [EM-240, "Cylinder Block"](#).

- If it exceeds the limit, replace piston and piston pin assembly. Refer to [EM-228, "Piston"](#).

Re-boring Cylinder Bore

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

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

**where,**

**D: Bored diameter**

**A: Piston diameter as measured**

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

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

# CYLINDER BLOCK

[QR25DE]

## < DISASSEMBLY AND ASSEMBLY >

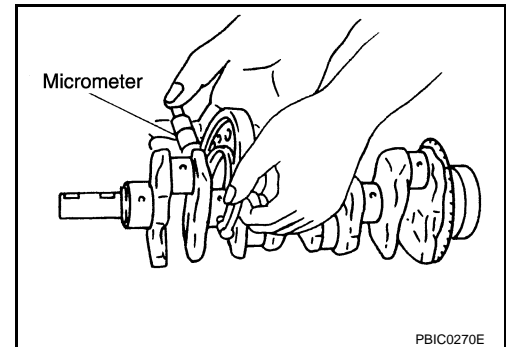
2. Install lower cylinder block, and tighten mounting bolts to the specified torque. Otherwise, cylinder bores may be distorted in final assembly. Refer to [EM-211, "Disassembly and Assembly"](#) for the tightening procedure.
3. Cut cylinder bores.  
**NOTE:**
  - When any cylinder needs boring, all other cylinders must also be bored.
  - Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
4. Hone cylinders to obtain specified piston to cylinder bore clearance.
5. Measure the finished cylinder bore for out-of-round and taper.  
**NOTE:**  
Measurement should be done after cylinder bore cools down.

## CRANKSHAFT MAIN JOURNAL DIAMETER

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

**Standard** : Refer to [EM-240, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-243, "Main Bearing"](#).



## CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard** : Refer to [EM-240, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-244, "Connecting Rod Bearing"](#).

## OUT-OF-ROUND AND TAPER OF CRANKSHAFT

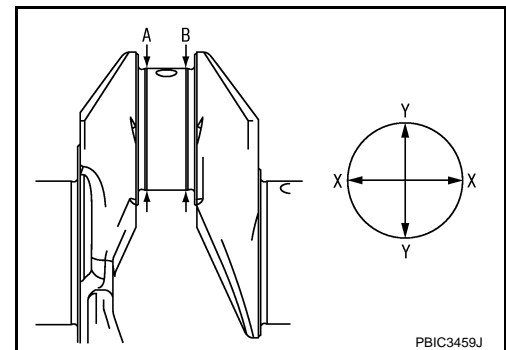
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in dimension between "A" and "B" at "X"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

### Limit:

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

**Taper (Difference between "A" and "B")**

: Refer to [EM-240, "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-244, "Connecting Rod Bearing"](#) and/or [EM-243, "Main Bearing"](#).

## CRANKSHAFT RUNOUT

# CYLINDER BLOCK

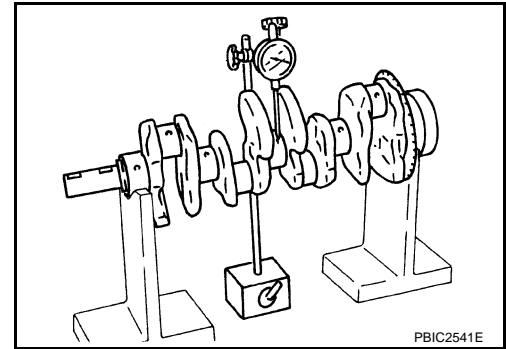
## < DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

**Limit** : Refer to [EM-240, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.

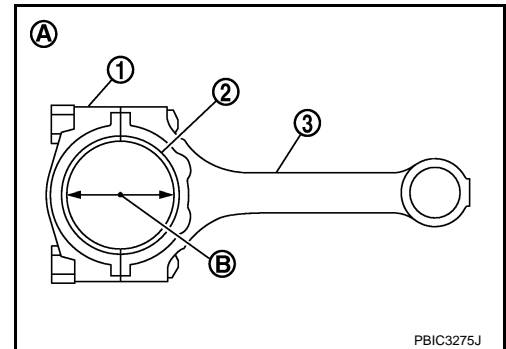


## CONNECTING ROD BEARING OIL CLEARANCE

### Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-211, "Disassembly and Assembly"](#) for tightening procedure.

- 1 : Connecting rod bearing cap
- 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-240, "Cylinder Block"](#).

- 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-229, "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 bolts to the specified torque. Refer to [EM-211, "Disassembly and Assembly"](#) for the tightening procedure.

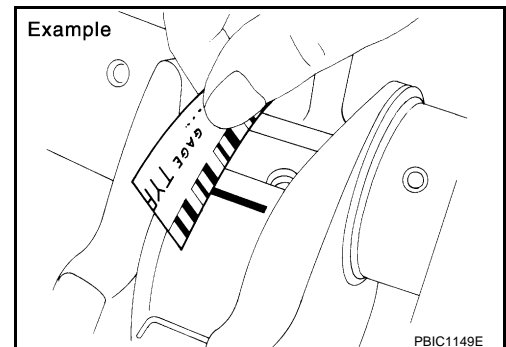
#### **CAUTION:**

#### **Never rotate crankshaft.**

- Remove connecting rod cap and bearing, and using the scale 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

# CYLINDER BLOCK

[QR25DE]

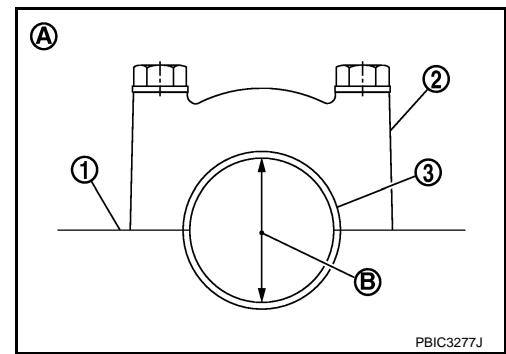
## < DISASSEMBLY AND ASSEMBLY >

- Install main bearings (3) to cylinder block (1) and lower cylinder block (2), and tighten lower cylinder block mounting bolts to the specified torque. Refer to [EM-211, "Disassembly and Assembly"](#) for the tightening procedure.

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-240, "Cylinder Block"](#).

- 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-211, "Disassembly and Assembly"](#).

### 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 lower cylinder block, and tighten lower cylinder block mounting bolts to the specified torque. Refer to [EM-211, "Disassembly and Assembly"](#) for the tightening procedure.

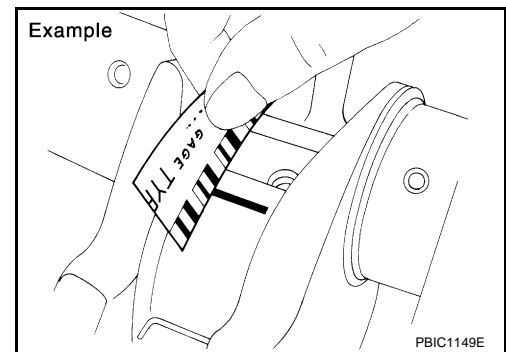
### CAUTION:

**Never rotate crankshaft.**

- Remove lower cylinder block and bearings, and using the scale 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".



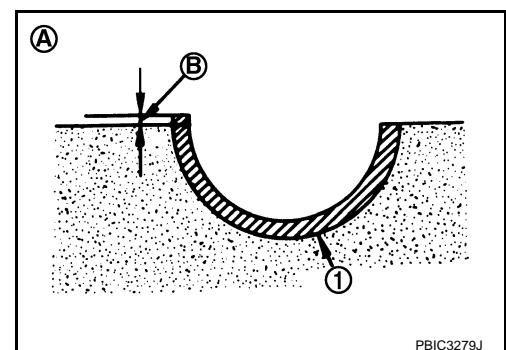
## MAIN BEARING CRUSH HEIGHT

- When lower cylinder block 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-211, "Disassembly and Assembly"](#) for the tightening procedure.

A : Example

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

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



## CONNECTING ROD BEARING CRUSH HEIGHT

# CYLINDER BLOCK

[QR25DE]

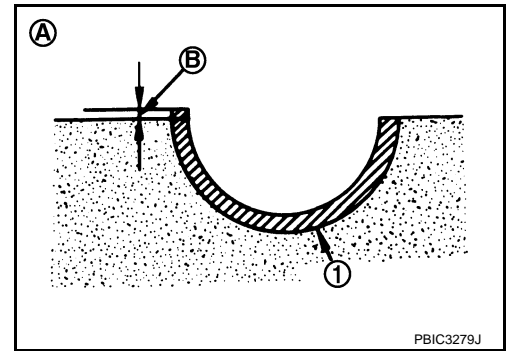
## < DISASSEMBLY AND ASSEMBLY >

- When connecting rod bearing 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-211, "Disassembly and Assembly"](#) for the tightening procedure.

A : Example

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

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



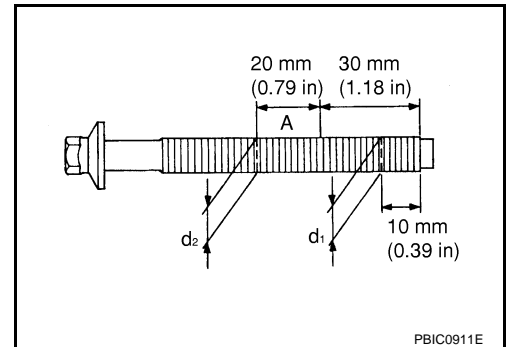
PBIC3279J

## LOWER CYLINDER BLOCK MOUNTING BOLT OUTER DIAMETER

- Perform only with M10 bolts.
- Measure the outer diameters ("d1", "d2") at two positions as shown in the figure.
- If reduction appears in "A" range, regard it as "d2".

**Limit ("d1" – "d2"): 0.13 mm (0.0051 in)**

- If it exceeds the limit (a large difference in dimensions), replace lower cylinder block mounting bolt with a new one.



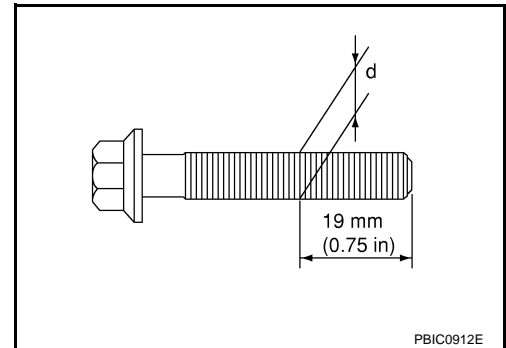
PBIC0911E

## CONNECTING ROD 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 bolt with a new one.



PBIC0912E

## FLYWHEEL DEFLECTION (M/T MODELS)

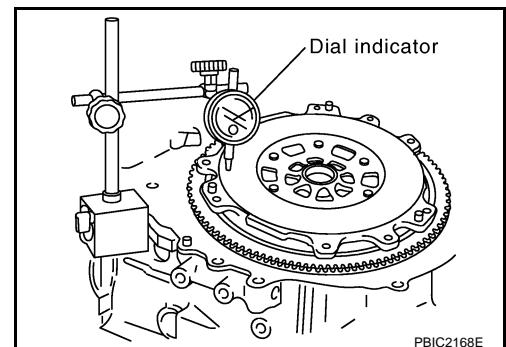
- Measure the deflection of flywheel contact surface to clutch with a dial indicator.
- Measure the deflection at 210 mm (8.27 in) dia.

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

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

### CAUTION:

When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.



PBIC2168E

## MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

### CAUTION:

Do not disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

**Standard** : 1.3 mm (0.051 in) or less.

# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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

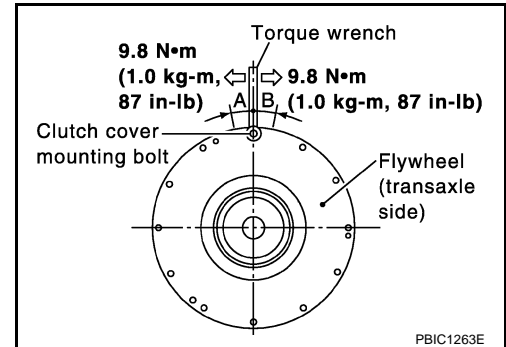
Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
  - Tighten bolt at a force of 9.8 N·m (1.0 kg-m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg-m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transaxle side.
4. Measure the dimensions of movement amounts "A" and "B" on circumference of the flywheel on the transaxle side.

**Standard: 33.0 mm (1.299 in) or less.**

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



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# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:000000001208151

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

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

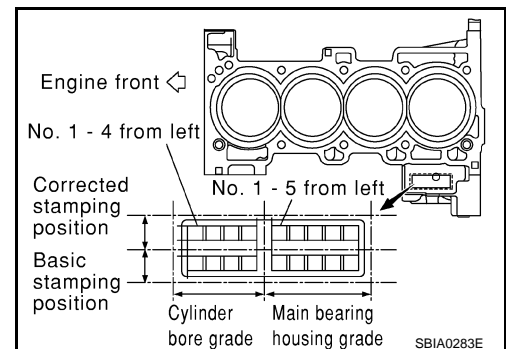
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

### Piston

INFOID:000000001208152

#### WHEN NEW CYLINDER BLOCK IS USED

- Check the cylinder bore grade on rear left side of cylinder block, and select piston of the same grade.
- If there is a corrected stamp mark on the cylinder block, use it as a correct reference.



#### WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter. Refer to [EM-218, "Inspection"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".



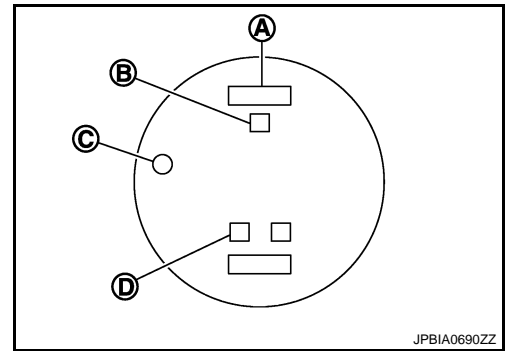
# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

3. Select piston of the same grade.

- A : Identification code
- B : Piston grade number
- C : Front mark
- D : Piston pin bore grade number



## PISTON SELECTION TABLE

Unit: mm (in)

Grade number (Mark)	2 (or no mark)	3
Cylinder bore Inner diameter	89.010 - 89.020 (3.5043 - 3.5047)	89.020 - 89.030 (3.5047 - 3.5051)
Piston skirt diameter	88.990 - 89.000 (3.5035 - 3.5039)	89.000 - 89.010 (3.5039 - 3.5043)

### NOTE:

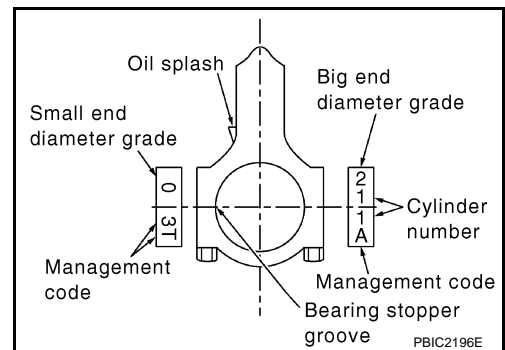
- There is no piston grade "1".
- Piston is available together with piston pin as an assembly.
- The piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

## Connecting Rod Bearing

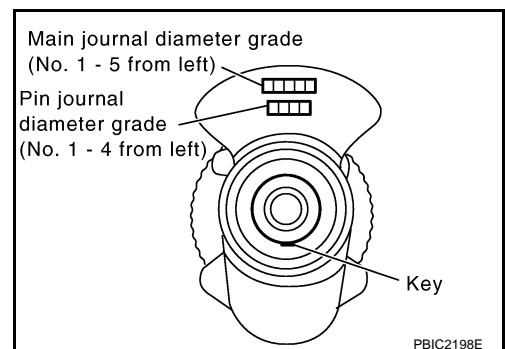
INFOID:000000001208153

### WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

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



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



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

### WHEN CRANKSHAFT AND CONNECTING ROD ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-218, "Inspection"](#).

# HOW TO SELECT PISTON AND BEARING

[QR25DE]

< DISASSEMBLY AND ASSEMBLY >

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

## CONNECTING ROD BEARING SELECTION TABLE

Connecting rod big end diameter Crankshaft pin journal diameter		Mark	0	1	2	3	4	5	6	7	8	9	A	B	C
		Inner diameter Unit: mm (in)	48.000 - 48.001 (1.8898 - 1.8898)	48.001 - 48.002 (1.8898 - 1.8898)	48.002 - 48.003 (1.8898 - 1.8899)	48.003 - 48.004 (1.8899 - 1.8899)	48.004 - 48.005 (1.8899 - 1.8900)	48.005 - 48.006 (1.8900 - 1.8900)	48.006 - 48.007 (1.8900 - 1.8900)	48.007 - 48.008 (1.8900 - 1.8901)	48.008 - 48.009 (1.8901 - 1.8901)	48.009 - 48.010 (1.8901 - 1.8902)	48.010 - 48.011 (1.8902 - 1.8902)	48.011 - 48.012 (1.8902 - 1.8902)	48.012 - 48.013 (1.8902 - 1.8903)
Mark	Outer diameter Unit: mm (in)														
A	44.974 - 44.973 (1.7706 - 1.7706)	0	0	0	0	01	01	01	1	1	1	12	12	12	12
B	44.973 - 44.972 (1.7706 - 1.7705)	0	0	0	01	01	01	1	1	1	1	12	12	12	2
C	44.972 - 44.971 (1.7705 - 1.7705)	0	0	01	01	01	1	1	1	1	12	12	12	2	2
D	44.971 - 44.970 (1.7705 - 1.7705)	0	01	01	01	1	1	1	1	12	12	12	2	2	2
E	44.970 - 44.969 (1.7705 - 1.7704)	01	01	01	1	1	1	12	12	12	2	2	2	2	23
F	44.969 - 44.968 (1.7704 - 1.7704)	01	01	1	1	1	12	12	12	2	2	2	2	23	23
G	44.968 - 44.967 (1.7704 - 1.7704)	01	1	1	1	12	12	12	2	2	2	2	23	23	23
H	44.967 - 44.966 (1.7704 - 1.7703)	1	1	1	12	12	12	2	2	2	2	23	23	23	3
J	44.966 - 44.965 (1.7703 - 1.7703)	1	1	12	12	12	2	2	2	2	23	23	23	3	3
K	44.965 - 44.964 (1.7703 - 1.7702)	1	12	12	12	2	2	2	2	23	23	23	3	3	3
L	44.964 - 44.963 (1.7702 - 1.7702)	12	12	12	2	2	2	23	23	23	3	3	3	3	34
M	44.963 - 44.962 (1.7702 - 1.7702)	12	12	2	2	2	23	23	23	3	3	3	3	3	34
N	44.962 - 44.961 (1.7702 - 1.7701)	12	2	2	2	23	23	23	3	3	3	3	34	34	34
P	44.961 - 44.960 (1.7701 - 1.7701)	2	2	2	23	23	23	3	3	3	3	34	34	34	4
R	44.960 - 44.959 (1.7701 - 1.7700)	2	2	23	23	23	3	3	3	3	34	34	34	4	4
S	44.959 - 44.958 (1.7700 - 1.7700)	2	23	23	23	3	3	3	3	34	34	34	4	4	4
T	44.958 - 44.957 (1.7700 - 1.7700)	23	23	23	3	3	3	34	34	34	4	4	4	4	4
U	44.957 - 44.956 (1.7700 - 1.7699)	23	23	3	3	3	34	34	34	4	4	4	4	4	4

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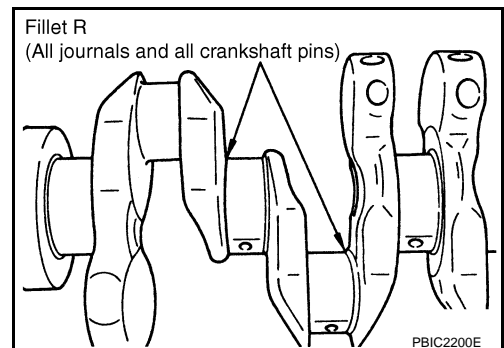
### UNDERSIZE BEARINGS USAGE GUIDE

- 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:**

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

Bearing under-size table : Refer to [EM-244](#), "[Connecting Rod Bearing](#)".



# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

## CONNECTING ROD BEARING GRADE TABLE

Connecting rod bearing grade table : Refer to [EM-244, "Connecting Rod Bearing"](#).

## Main Bearing

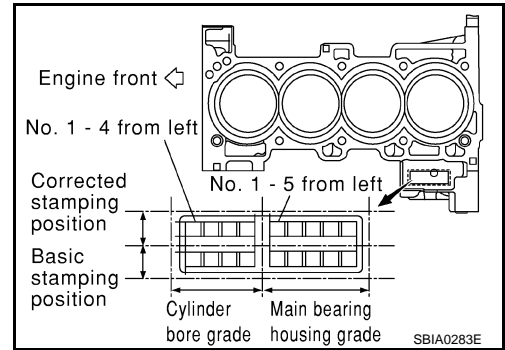
INFOID:000000001208154

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### WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear left side of cylinder block.
  - If there is a corrected stamp mark on cylinder block, use it as a correct reference.



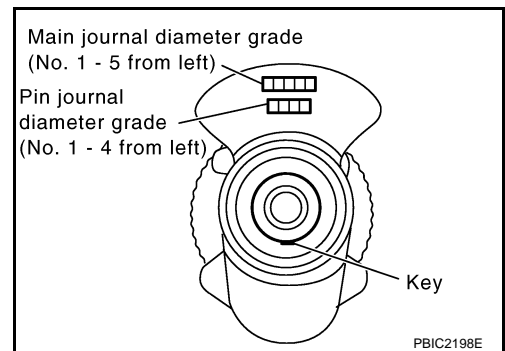
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2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".



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

**CAUTION:**

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

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.

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### 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-218, "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".

**CAUTION:**

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

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.

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# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

**MAIN BEARING SELECTION TABLE (No. 1, 3 and 5 journals)**

Cylinder block main bearing housing inner diameter		Mark																									
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7		
Crankshaft main journal diameter		Inner diameter Unit: mm (in)																									
		58.944 - 58.945 (2.3206 - 2.3207)	58.945 - 58.946 (2.3207 - 2.3207)	58.946 - 58.947 (2.3207 - 2.3207)	58.947 - 58.948 (2.3207 - 2.3208)	58.948 - 58.949 (2.3208 - 2.3208)	58.949 - 58.950 (2.3208 - 2.3209)	58.950 - 58.951 (2.3209 - 2.3209)	58.951 - 58.952 (2.3209 - 2.3209)	58.952 - 58.953 (2.3209 - 2.3210)	58.953 - 58.954 (2.3210 - 2.3210)	58.954 - 58.955 (2.3210 - 2.3211)	58.955 - 58.956 (2.3211 - 2.3211)	58.956 - 58.957 (2.3211 - 2.3211)	58.957 - 58.958 (2.3211 - 2.3212)	58.958 - 58.959 (2.3212 - 2.3212)	58.959 - 58.960 (2.3212 - 2.3213)	58.960 - 58.961 (2.3213 - 2.3213)	58.961 - 58.962 (2.3213 - 2.3213)	58.962 - 58.963 (2.3213 - 2.3214)	58.963 - 58.964 (2.3214 - 2.3214)	58.964 - 58.965 (2.3214 - 2.3215)	58.965 - 58.966 (2.3215 - 2.3215)	58.966 - 58.967 (2.3215 - 2.3215)	58.967 - 58.968 (2.3215 - 2.3216)		
Mark	Outer diameter Unit: mm (in)																										
A	54.979 - 54.978 (2.1645 - 2.1645)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	
B	54.978 - 54.977 (2.1645 - 2.1644)	0	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	
C	54.977 - 54.976 (2.1644 - 2.1644)	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	
D	54.976 - 54.975 (2.1644 - 2.1644)	01	01	1	1	1	12	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	45	
E	54.975 - 54.974 (2.1644 - 2.1643)	01	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	45	
F	54.974 - 54.973 (2.1643 - 2.1643)	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	45	45	
G	54.973 - 54.972 (2.1643 - 2.1642)	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	45	45	45	
H	54.972 - 54.971 (2.1642 - 2.1642)	1	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	
J	54.971 - 54.970 (2.1642 - 2.1642)	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	
K	54.970 - 54.969 (2.1642 - 2.1641)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	
L	54.969 - 54.968 (2.1641 - 2.1641)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	
M	54.968 - 54.967 (2.1641 - 2.1641)	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	
N	54.967 - 54.966 (2.1641 - 2.1640)	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	6	
P	54.966 - 54.965 (2.1640 - 2.1640)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	
R	54.965 - 54.964 (2.1640 - 2.1639)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	
S	54.964 - 54.963 (2.1639 - 2.1639)	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	
T	54.963 - 54.962 (2.1639 - 2.1639)	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	
U	54.962 - 54.961 (2.1639 - 2.1638)	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	
V	54.961 - 54.960 (2.1638 - 2.1638)	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	7	
W	54.960 - 54.959 (2.1638 - 2.1637)	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	7	7	
X	54.959 - 54.958 (2.1637 - 2.1637)	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	7	7	7	
Y	54.958 - 54.957 (2.1637 - 2.1637)	34	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	7	7	7	7	
4	54.957 - 54.956 (2.1637 - 2.1636)	34	4	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	7	7	7	7	7	
7	54.956 - 54.955 (2.1636 - 2.1636)	4	4	4	45	45	45	5	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7	7	

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## HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[QR25DE]

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Bearing undersize table : Refer to [EM-243, "Main Bearing"](#).

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification

INFOID:000000001157997

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#### GENERAL SPECIFICATIONS

Cylinder arrangement		In-line 4
Displacement	cm <sup>3</sup> (cu in)	2,488 (151.82)
Bore and stroke	mm (in)	89.0 x 100.0 (3.504 x 3.937)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.6
Compression pressure kPa (bar, kg/cm <sup>2</sup> , psi)/250 rpm	Standard	1,412 (14.1, 14.4, 204.7)
	Minimum	1,216 (12.2, 12.1, 176.3)
	Differential limit between cylinders	100 (1.0, 1.0, 14)

Unit: degree

Valve timing ◁ : Intake valve ◀ : Exhaust valve						
	a	b	c	d	e	f
	220	232	12 (-28) ATDC	64 (24) ABDC	10	30

( ) : Valve timing control "ON"

#### Drive belt

INFOID:000000001157998

#### DRIVE BELT

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

#### Spark Plug

INFOID:000000001157999

#### SPARK PLUG

Unit: mm (in)

Make	NGK
Standard type	DILKAR6A-11
Spark plug gap (Nominal)	1.1 (0.043)

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# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

## Intake Manifold

INFOID:000000001158000

### INTAKE MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Intake manifold adaptor	0.1 (0.004)

## Exhaust Manifold

INFOID:000000001158001

### EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Exhaust manifold	0.3 (0.012)

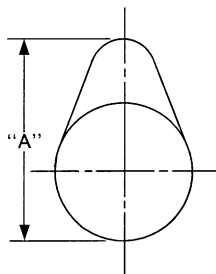
## Camshaft

INFOID:000000001158002

### CAMSHAFT

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance		0.045 - 0.086 (0.0018 - 0.0034)	—
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	23.435 - 23.455 (0.9226 - 0.9234)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	—
Camshaft cam height "A"	Intake	44.815 - 45.005 (1.7644 - 1.7718)	0.2 (0.008)*1
	Exhaust	43.975 - 44.165 (1.7313 - 1.7388)	
Camshaft runout [TIR*2]		Less than 0.02 mm (0.0008)	—
Camshaft sprocket runout [TIR*2]		—	0.15 (0.0059)



SEM671

\*1: Cam wear limit

\*2: Total indicator reading

## VALVE LIFTER

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.021 (1.3386 - 1.3394)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

### VALVE CLEARANCE



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

Unit: mm (in)

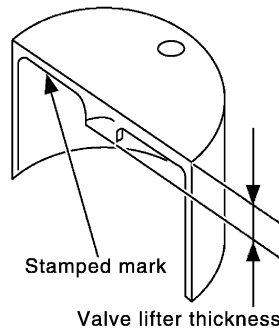
Items	Cold	Hot* (reference data)
Intake	0.24 - 0.32 (0.094 - 0.0126)	0.304 - 0.416 (0.0120 - 0.0164)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.0121 - 0.0170)

\*: Approximately 80°C (176°F)

## AVAILABLE VALVE LIFTER

Unit: mm (in)

Thickness	Identification (stamped) mark
7.88 (0.3102)	788J or 788T
7.90 (0.3110)	790J or 790T
7.92 (0.3118)	792J or 792T
7.94 (0.3126)	794J or 794T
7.96 (0.3134)	796J or 796T
7.98 (0.3142)	798J or 798T
8.00 (0.3150)	800J or 800T
8.02 (0.3157)	802J or 802T
8.04 (0.3165)	804J or 804T
8.06 (0.3173)	806J or 806T
8.08 (0.3181)	808J or 808T
8.10 (0.3189)	810J or 810T
8.12 (0.3197)	812J or 812T
8.14 (0.3205)	814J or 814T
8.16 (0.3213)	816J or 816T
8.18 (0.3220)	818J or 818T
8.20 (0.3228)	820J or 820T
8.22 (0.3236)	822J or 822T
8.24 (0.3244)	824J or 824T
8.26 (0.3252)	826J or 826T
8.28 (0.3260)	828J or 828T
8.30 (0.3268)	830J or 830T
8.32 (0.3276)	832J or 822T
8.34 (0.3283)	834J or 834T
8.36 (0.3291)	836J or 836T
8.38 (0.3299)	838J or 838T



SEM758G

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

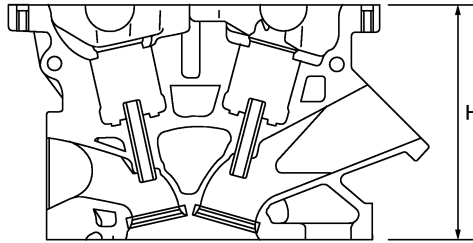
INFOID:000000001158003

## Cylinder Head

### CYLINDER HEAD

Unit: mm (in)

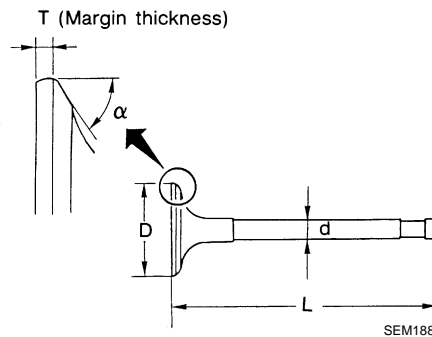
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height "H"	129.3 - 129.5 (5.091 - 5.098)	—



PBIC0924E

### VALVE DIMENSIONS

Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	35.5 - 35.8 (1.398 - 1.409)
	Exhaust	30.3 - 30.6 (1.193 - 1.205)
Valve length "L"	Intake	96.84 (3.8126)
	Exhaust	97.9 (3.854)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	1.4 (0.055)
Valve margin "T" limit		0.5 (0.020)
Valve stem end surface grinding limit		0.2 (0.008)

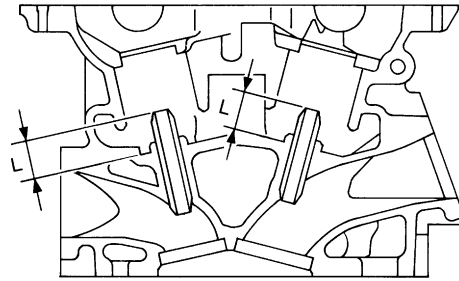
### VALVE GUIDE

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

Unit: mm (in)

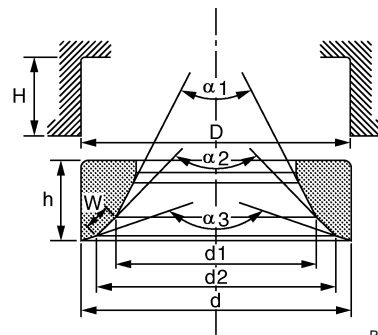


SEM950E

Items		Standard	Oversize (Service) [0.2 (0.008)]
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.0035)
Projection length "L"	Intake	10.1 - 10.3 (0.398 - 0.405)	
	Exhaust	10.0 - 10.4 (0.394 - 0.409)	

## VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (Service) [0.5 (0.02)]
Cylinder head seat recess diameter "D"	Intake	36.500 - 36.516 (1.4370 - 1.4376)	37.000 - 37.016 (1.4567 - 1.4573)
	Exhaust	31.500 - 31.516 (1.2402 - 1.2408)	32.000 - 32.016 (1.2598 - 1.2408)
Valve seat outer diameter "d"	Intake	36.597 - 36.613 (1.4408 - 1.4415)	37.097 - 37.113 (1.4605 - 1.4611)
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0034 - 0.0046)	
Diameter "d1"*1	Intake	33.5 (1.319)	
	Exhaust	28.0 (1.102)	
Diameter "d2"*2	Intake	34.8 - 35.3 (1.370 - 1.390)	
	Exhaust	29.6 - 30.1 (1.165 - 1.185)	
Angle "alpha 1"	Intake	60°	
	Exhaust	60°	

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

Angle "α2"	Intake	88°45' - 90°15'	
	Exhaust	88°45' - 90°15'	
Angle "α3"	Intake	120°	
	Exhaust	120°	
Contacting width "W"*3	Intake	0.99 - 1.35 (0.0390 - 0.0531)	
	Exhaust	1.19 - 1.55 (0.0469 - 0.0610)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.91 - 5.01 (0.1933 - 0.1972)
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

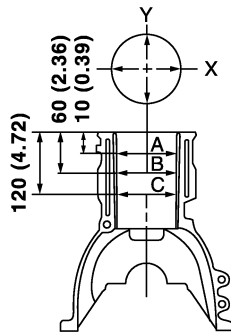
Items	Intake	Exhaust
Free height	43.72 - 43.92 (1.7213 - 1.7291)	45.29 - 45.49 (1.7831 - 1.7909)
Installation height	35.30 mm (1.3890 in)	35.30 mm (1.3890 in)
Installation load	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)
Height during valve open	25.30 mm (0.9961 in)	26.76 mm (1.0535 in)
Load with valve open	351 - 394 N (35.8 - 40.2 kg, 79 - 89 lb)	318 - 362 N (22.4 - 36.9 kg, 71 - 81 lb)
Identification color	Pink	Yellowish green
Out- of- Square	1.9 mm (0.075 in)	

## Cylinder Block

INFOID:000000001158004

## CYLINDER BLOCK

Unit: mm (in)



PBIC0281E

Surface distortion		Limit	0.1 (0.004)	
Cylinder bore	Inner diameter	Standard	Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit	0.2 (0.008)	
Out-of-round (Difference between "X" and "Y")		Limit	0.015 (0.0006)	
Taper (Difference between "A" and "C")			0.01 (0.0004)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

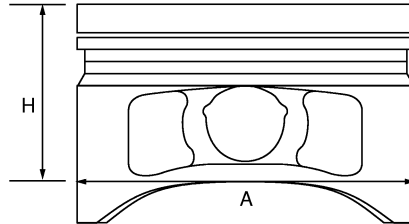
< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

Main bearing housing inner diameter grade	Grade No. A	58.944 - 58.945 (2.3206 - 2.3207)
	Grade No. B	58.945 - 58.946 (2.3207 - 2.3207)
	Grade No. C	58.946 - 58.947 (2.3207 - 2.3207)
	Grade No. D	58.947 - 58.948 (2.3207 - 2.3208)
	Grade No. E	58.948 - 58.949 (2.3208 - 2.3208)
	Grade No. F	58.949 - 58.950 (2.3208 - 2.3209)
	Grade No. G	58.950 - 58.951 (2.3209 - 2.3209)
	Grade No. H	58.951 - 58.952 (2.3209 - 2.3209)
	Grade No. J	58.952 - 58.953 (2.3209 - 2.3210)
	Grade No. K	58.953 - 58.954 (2.3210 - 2.3210)
	Grade No. L	58.954 - 58.955 (2.3210 - 2.3211)
	Grade No. M	58.955 - 58.956 (2.3211 - 2.3211)
	Grade No. N	58.956 - 58.957 (2.3211 - 2.3211)
	Grade No. P	58.957 - 58.958 (2.3211 - 2.3212)
	Grade No. R	58.958 - 58.959 (2.3212 - 2.3212)
	Grade No. S	58.959 - 58.960 (2.3212 - 2.3213)
	Grade No. T	58.960 - 58.961 (2.3213 - 2.3213)
	Grade No. U	58.961 - 58.962 (2.3213 - 2.3213)
	Grade No. V	58.962 - 58.963 (2.3213 - 2.3214)
	Grade No. W	58.963 - 58.964 (2.3214 - 2.3214)
Grade No. X	58.964 - 58.965 (2.3214 - 2.3215)	
Grade No. Y	58.965 - 58.966 (2.3215 - 2.3215)	
Grade No. 4	58.966 - 58.967 (2.3215 - 2.3215)	
Grade No. 7	58.967 - 58.968 (2.3215 - 2.3216)	
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

## AVAILABLE PISTON

Unit: mm (in)



PBIC0188E

Piston skirt diameter "A"	Standard	Grade No. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
		Oversize (Service) [0.20 (0.008)]	89.180 - 89.210 (3.5110 - 3.5122)
Piston height "H" dimension			37.5 (1.476)
Piston pin hole diameter	Grade No. 0	19.993 - 19.999 (0.7871 - 0.7874)	
	Grade No. 1	19.999 - 20.005 (0.7874 - 0.7876)	
Piston to cylinder bore clearance	Standard	0.010 - 0.030 (0.0004 - 0.0012)	
	Limit	0.08 (0.0031)	

## PISTON RING

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil ring	0.045 - 0.125 (0.0018 - 0.0049)	—

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.45 (0.008 - 0.0177)	0.90 (0.0354)

## PISTON PIN

Unit: mm (in)

Items	Standard	Limit	
Piston pin outer diameter	Grade No. 0	19.989 - 19.995 (0.7870 - 0.7872)	—
	Grade No. 1	19.995 - 20.001 (0.7872 - 0.7874)	—
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	—	
Connecting rod bushing oil clearance	0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)	

## CONNECTING ROD

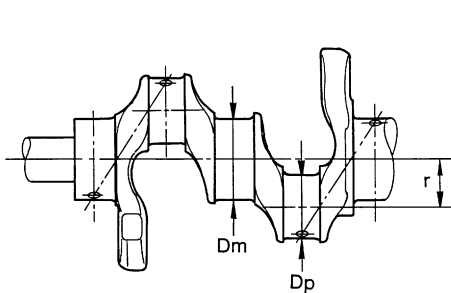
Unit: mm (in)

Center distance		143.00 – 143.10 (5.63 – 5.63)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.3 (0.012)
Connecting rod bushing inner diameter*	Grade No. 0	20.000 – 20.006 (0.7874 – 0.7876)
	Grade No. 1	20.006 – 20.012 (0.7876 – 0.7879)
Side clearance	Standard	0.20 – 0.35 (0.008 – 0.0138)
	Limit	0.5 (0.020)
Connecting rod big end diameter	Grade No. 0	48.000 – 48.001 (1.8898 – 1.8898)
	Grade No. 1	48.001 – 48.002 (1.8898 – 1.8898)
	Grade No. 2	48.002 – 48.003 (1.8898 – 1.8899)
	Grade No. 3	48.003 – 48.004 (1.8899 – 1.8899)
	Grade No. 4	48.004 – 48.005 (1.8899 – 1.8900)
	Grade No. 5	48.005 – 48.006 (1.8900 – 1.8900)
	Grade No. 6	48.006 – 48.007 (1.8900 – 1.8900)
	Grade No. 7	48.007 – 48.008 (1.8900 – 1.8901)
	Grade No. 8	48.008 – 48.009 (1.8901 – 1.8901)
	Grade No. 9	48.009 – 48.010 (1.8901 – 1.8902)
	Grade No. A	48.010 – 48.011 (1.8902 – 1.8902)
	Grade No. B	48.011 – 48.012 (1.8902 – 1.8902)
Grade No. C	48.012 – 48.013 (1.8902 – 1.8903)	

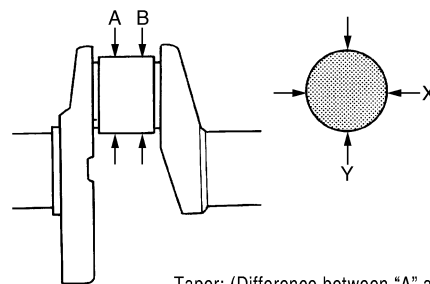
\*: After installing in connecting rod

## CRANKSHAFT

Unit: mm (in)



SEM645



Taper: (Difference between "A" and "B")  
Out-of-round: (Difference between "X" and "Y")

SBIA0535E

Center distance "r"		49.96 - 50.04 (1.9669 - 1.9701)
Out-of-round (Difference between "X" and "Y")	Limit	0.005 (0.0002)
Taper (Difference between "A" and "B")	Limit	0.005 (0.0002)
Runout [TIR*]	Limit	0.05 (0.0020)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

	Standard	0.10 - 0.26 (0.004 - 0.0102)
Crankshaft end play	Limit	0.3 (0.012)
Pin journal diameter grade. "Dp"	Grade No. A	44.974 - 44.973 (1.7706 - 1.7706)
	Grade No. B	44.973 - 44.972 (1.7706 - 1.7705)
	Grade No. C	44.972 - 44.971 (1.7705 - 1.7705)
	Grade No. D	44.971 - 44.970 (1.7705 - 1.7705)
	Grade No. E	44.970 - 44.969 (1.7705 - 1.7704)
	Grade No. F	44.969 - 44.968 (1.7704 - 1.7704)
	Grade No. G	44.968 - 44.967 (1.7704 - 1.7704)
	Grade No. H	44.967 - 44.966 (1.7704 - 1.7703)
	Grade No. J	44.966 - 44.965 (1.7703 - 1.7703)
	Grade No. K	44.965 - 44.964 (1.7703 - 1.7702)
	Grade No. L	44.964 - 44.963 (1.7702 - 1.7702)
	Grade No. M	44.963 - 44.962 (1.7702 - 1.7702)
	Grade No. N	44.962 - 44.961 (1.7702 - 1.7701)
	Grade No. P	44.961 - 44.960 (1.7701 - 1.7701)
	Grade No. R	44.960 - 44.959 (1.7701 - 1.7700)
	Grade No. S	44.959 - 44.958 (1.7700 - 1.7700)
	Grade No. T	44.958 - 44.957 (1.7700 - 1.7700)
Grade No. U	44.957 - 44.956 (1.7700 - 1.7699)	
Main journal diameter grade. "Dm"	Grade No. A	54.979 - 54.978 (2.1645 - 2.1645)
	Grade No. B	54.978 - 54.977 (2.1645 - 2.1644)
	Grade No. C	54.977 - 54.976 (2.1644 - 2.1644)
	Grade No. D	54.976 - 54.975 (2.1644 - 2.1644)
	Grade No. E	54.975 - 54.974 (2.1644 - 2.1643)
	Grade No. F	54.974 - 54.973 (2.1643 - 2.1643)
	Grade No. G	54.973 - 54.972 (2.1643 - 2.1642)
	Grade No. H	54.972 - 54.971 (2.1642 - 2.1642)
	Grade No. J	54.971 - 54.970 (2.1642 - 2.1642)
	Grade No. K	54.970 - 54.969 (2.1642 - 2.1641)
	Grade No. L	54.969 - 54.968 (2.1641 - 2.1641)
	Grade No. M	54.968 - 54.967 (2.1641 - 2.1641)
	Grade No. N	54.967 - 54.966 (2.1641 - 2.1640)
	Grade No. P	54.966 - 54.965 (2.1640 - 2.1640)
	Grade No. R	54.965 - 54.964 (2.1640 - 2.1639)
	Grade No. S	54.964 - 54.963 (2.1639 - 2.1639)
	Grade No. T	54.963 - 54.962 (2.1639 - 2.1639)
Grade No. U	54.962 - 54.961 (2.1639 - 2.1638)	
Grade No. V	54.961 - 54.960 (2.1638 - 2.1638)	
Grade No. W	54.960 - 54.959 (2.1638 - 2.1637)	
Grade No. X	54.959 - 54.958 (2.1637 - 2.1637)	
Grade No. Y	54.958 - 54.957 (2.1637 - 2.1637)	
Grade No. 4	54.957 - 54.956 (2.1637 - 2.1636)	
Grade No. 7	54.956 - 54.955 (2.1636 - 2.1636)	

\*: Total indicator reading

**Main Bearing**

**MAIN BEARING**

INFOID:000000001158005

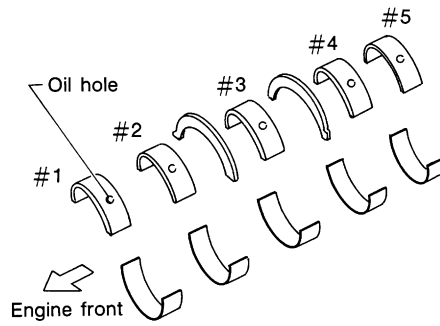
A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
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M  
N  
O  
P

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

Unit: mm (in)



SEM685D

Grade number		Thickness	Identification color	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2		1.979 - 1.982 (0.0779 - 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	White	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)	White	

## UNDERSIZE

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)	Grind so that bearing clearance is the specified value.

## MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Main bearing oil clearance	Standard	No. 1, 3 and 5	0.012 - 0.022 (0.0005 - 0.0009)
		No. 2 and 4	0.018 - 0.028 (0.0007 - 0.0011)
	Limit		

## Connecting Rod Bearing

INFOID:000000001158006

## CONNECTING ROD BEARING



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[QR25DE]

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
0	1.493 - 1.496 (0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1	1.496 - 1.499 (0.0589 - 0.0590)	Brown	
2	1.499 - 1.502 (0.0590 - 0.0591)	Green	
3	1.502 - 1.505 (0.0591 - 0.0593)	Yellow	
4	1.505 - 1.508 (0.0593 - 0.0594)	Blue	
01	UPR	1.493 - 1.496 (0.0588 - 0.0589)	Grade and color are different for upper and lower bearings.
	LWR	1.496 - 1.499 (0.0589 - 0.0590)	
12	UPR	1.496 - 1.499 (0.0589 - 0.0590)	
	LWR	1.499 - 1.502 (0.0590 - 0.0591)	
23	UPR	1.499 - 1.502 (0.0590 - 0.0591)	
	LWR	1.502 - 1.505 (0.0591 - 0.0593)	
34	UPR	1.502 - 1.505 (0.0591 - 0.0593)	
	LWR	1.505 - 1.508 (0.0593 - 0.0594)	

## UNDERSIZE

Unit: mm (in)

Items	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.622 - 1.630 (0.0639 - 0.0642)	Grind so that bearing clearance is the specified value.

## CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

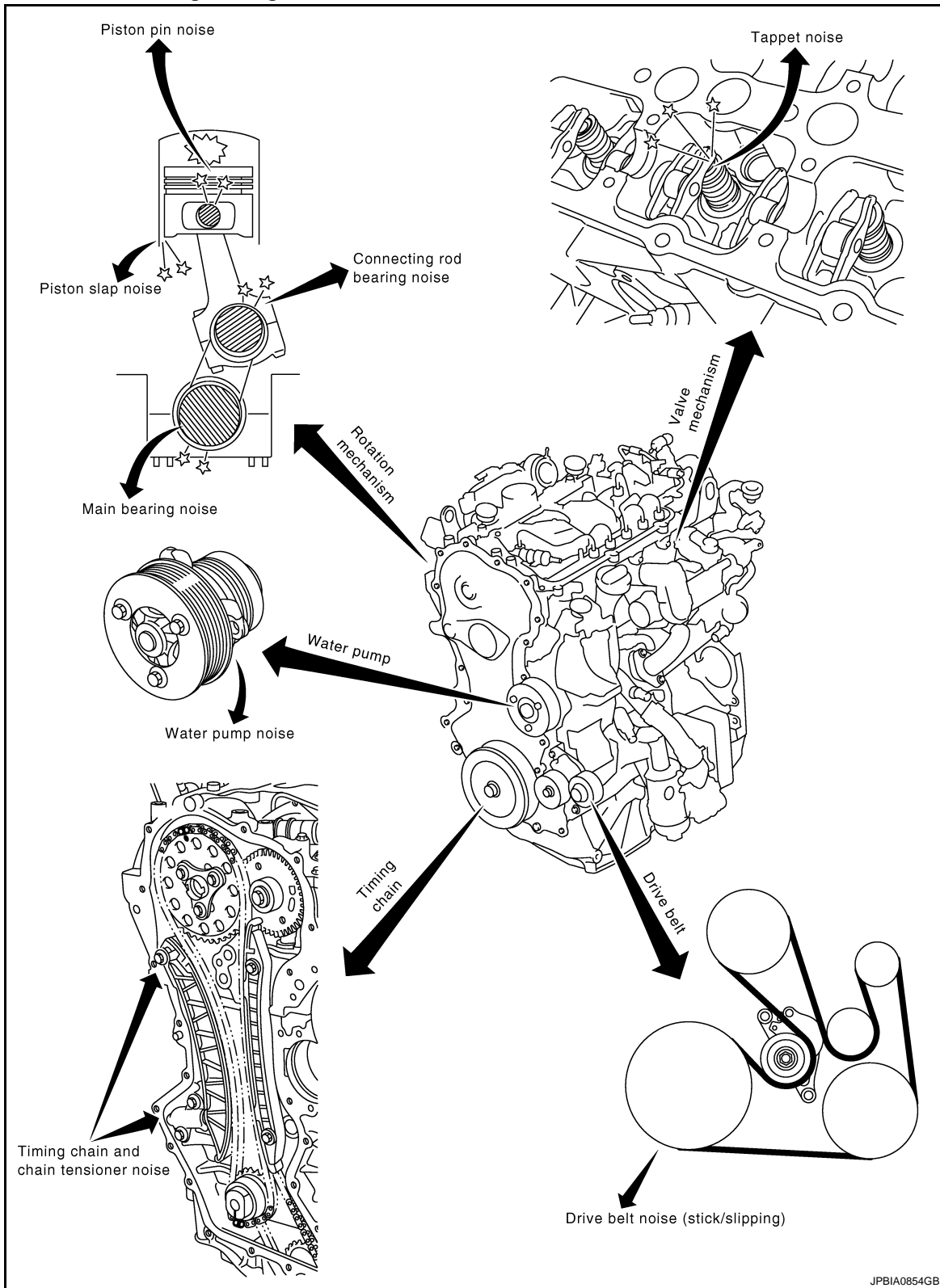
Items	Standard	Limit
Connecting rod bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018)	0.1 (0.004)

# SYMPTOM DIAGNOSIS

## NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

### NVH Troubleshooting - Engine Noise

INFOID:000000001160590



JPBIA0854GB

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[M9R]

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

INFOID:000000001160591

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

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Cylinder head	Ticking or clicking	A	C	—	B	B	—	Hydraulic tappet noise	Out of oil	<a href="#">EM-323</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance	<a href="#">EM-308</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap	
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	
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-293</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	<a href="#">EM-257</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-87</a>

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

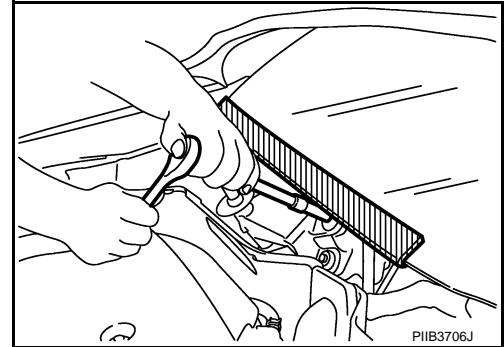
## PRECAUTION

### PRECAUTIONS

#### Precaution for Procedure without Cowl Top Cover

INFOID:000000001298308

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



#### Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000001298309

**NOTE:**

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the "LOCK" position.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the 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. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.
5. When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT-III.

#### Precaution for Drain Coolant

INFOID:000000001160592

Drain coolant when engine is cooled.

#### Precaution for Disconnecting Fuel Piping

INFOID:000000001160593

- Before starting work, check no fire or spark producing items are in the work area.
- After disconnecting pipes, plug openings to stop fuel leakage.

#### Precaution for Removal and Disassembly

INFOID:000000001160594

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.

# PRECAUTIONS

[M9R]

## < PRECAUTION >

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

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## Precaution for Inspection, Repair and Replacement

INFOID:000000001160595

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

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## Precaution for Assembly and Installation

INFOID:000000001160596

- Use torque wrench to tighten bolts or nuts to specified value.
- 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 same as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check oil or 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, spread the oil on sliding surfaces well.
- Release air within route when refilling after draining coolant.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

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## Parts Requiring Angular Tightening

INFOID:000000001160597

- Use an angle wrench for the final tightening of the following engine parts.
  - Cylinder head bolts
  - Main bearing cap bolts
  - Timing sprocket bolts
  - Crankshaft pulley bolt
  - Wear compensation gear bolt
  - Camshaft sprocket (for fuel pump) bolt
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

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## Precaution for Liquid Gasket

INFOID:000000001160598

### REMOVAL OF LIQUID GASKET

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

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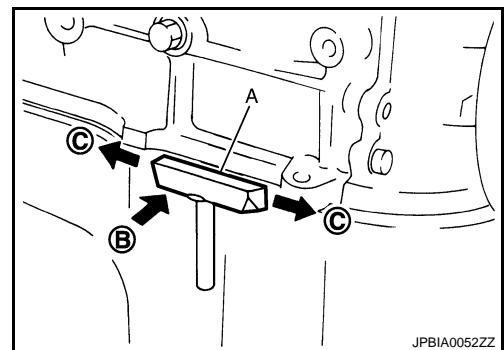
#### **CAUTION:**

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

- Tap the seal cutter 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 is difficult to use, use a plastic hammer to lightly tap the parts, to remove it.

#### **CAUTION:**

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



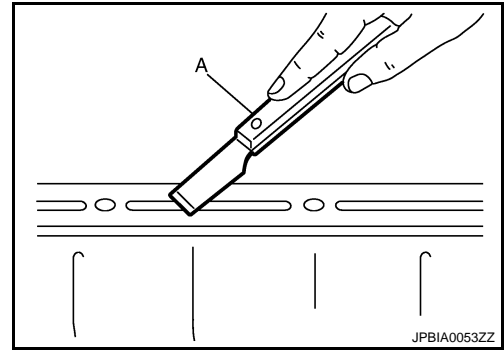
### LIQUID GASKET APPLICATION PROCEDURE

# PRECAUTIONS

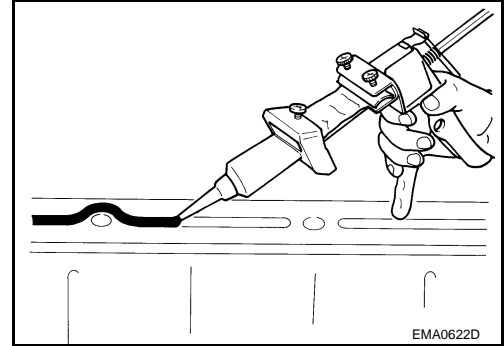
[M9R]

## < PRECAUTION >

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



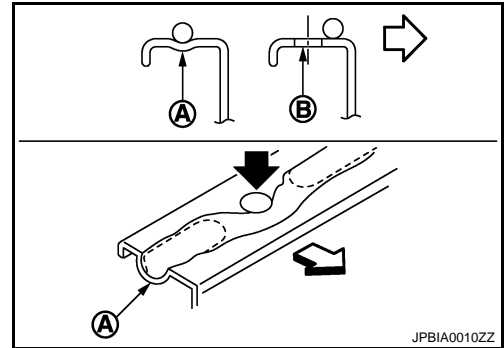
3. Attach the liquid gasket to the tube presser (commercial service tool).  
**Use Genuine Liquid Gasket or equivalent.**
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for the liquid gasket application, apply the gasket to the groove.



- As for the bolt holes, normally apply the gasket inside the holes. If specified, it should be applied outside the holes. Check to read the instruction in this manual.

A : Groove  
B : Bolt hole  
⇐ : Inside

- Within five minutes of gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- After 30 minutes or more have passed from the installation, fill the engine oil and coolant.



### **CAUTION:**

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

## Precaution for Diesel Equipment

INFOID:000000001160599

## CLEANLINESS

### **CLEANLINESS INSTRUCTIONS WHICH MUST BE FOLLOWED WHEN WORKING ON THE HIGH PRESSURE DIRECT INJECTION SYSTEM**

#### **Risks relating to contamination**

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:

- Damage or destruction of the high pressure injection system and the engine
- Seizing or leaking of a component

All After-Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) get into the system during dismantling or into the circuits via the fuel unions.

**The cleanliness principle must be applied from the fuel filter to the fuel injectors.**

#### **WHAT ARE THE SOURCES OF CONTAMINATION?**

Contamination is caused by:

- Metal or plastic chips
- Paint
- Fibers:
- Boxes
- Brushes

# PRECAUTIONS

[M9R]

## < PRECAUTION >

- Paper
- Clothing
- Cloths
- Foreign bodies such as hair
- Ambient air
- Etc.

### **WARNING:**

**It is not possible to clean the engine using a high pressure fuel pump because of the risk of damaging connections. In addition, moisture may collect in the connectors and create electrical connection malfunctions**

### **INSTRUCTIONS TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM**

- Check that you have the plugs for the unions to be opened (bag of plugs sold at the Parts Stores - Nissan part No. 16609 00Q0A, Renault part No. 77 01 209 062). Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.
- Check that you have hermetically resealable plastic bags for storing removed parts. Stored parts will therefore be less subject to the risk of impurities. The bags must be used only once, and after use they must be thrown away.
- Lint-free towelettes to be used for fuel pump related service purpose. The use of a normal cloth or paper for cleaning purposes is forbidden. These are not lint-free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

### **INSTRUCTIONS TO BE FOLLOWED BEFORE OPENING THE FUEL CIRCUIT**

- For each operation, use new thinner (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not shed its bristles).
- Use a brush and thinners to clean the connections to be opened.
- Blow compressed air over the cleaned parts (tools, cleaned the same way as the parts, connections and injection system zone). Check that no bristles remain adhered.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover these with latex gloves.

### **INSTRUCTIONS TO BE FOLLOWED DURING THE OPERATION**

- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available from the Parts Stores - Nissan part No. 16609 00Q0A, Renault part No. 77 01 209 062. They must not, under any circumstances, be reused.
- Close the hermetically sealed bag, even if it has to be reopened shortly afterwards. Ambient air carries contamination.
- All components of the injection system that are removed must be stored in a hermetically sealed plastic bag once the plugs have been inserted.
- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. These items are likely to allow impurities to enter the system.
- A new component replacing an old one must not be removed from its packaging until it is to be fitted to the vehicle.

### **Instructions for Fitting the Plugs**

Nissan part No. 16609 00Q0A

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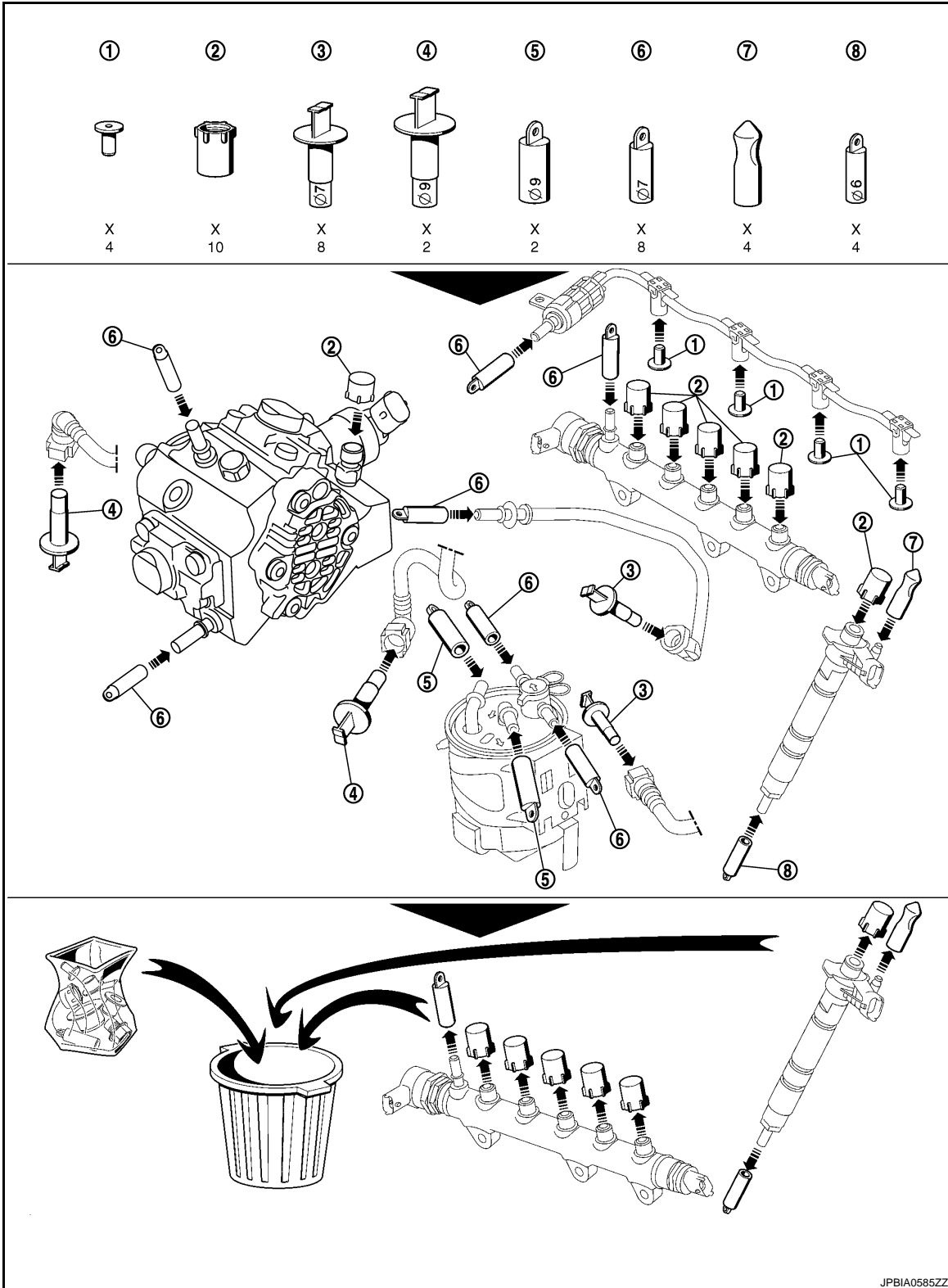
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# PRECAUTIONS

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< PRECAUTION >

(Renault part No. 77 01 209 062)



## SPECIAL FEATURES

### CAUTION:

- The engine must not operate with:
  - Use diesel fuel required by the regulations for cetane number. Refer to [GI-32, "FUEL : Diesel Engine Fuel"](#).
  - Petrol, even in tiny quantities



# PRECAUTIONS

[M9R]

< PRECAUTION >

- Before carrying out any work, check that the fuel rail is not under pressure and that the fuel temperature is not too high. [The system can inject the diesel into the engine at a pressure up to 160,000 kPa (1,600 bar, 1,632 kg/cm<sup>2</sup>, 23,200 psi)].
- Respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.
- Remove of the interior of the fuel pump and fuel injectors is prohibited.
- For safety reasons, it is strictly forbidden to slacken an injection tube union when the engine is running.
- It is not possible to remove the fuel pressure sensor from the fuel rail because this may cause circuit contamination malfunctions. If the fuel pressure sensor fails, the fuel pressure sensor, the fuel rail and the fuel injection tubes must be replaced.
- It is strictly forbidden to remove the fuel pump pulley.
- Applying 12 volts directly to any component in the system is prohibited.
- Ultrasonic carbon removal and cleaning are prohibited.
- Never start the engine without the battery being connected correctly.

## CHECKING SEALING AFTER REPAIR

### CAUTION:

**After any operation, check that there is no diesel leakage.**

- Start the engine and check for fuel leak for one minute after starting.
- Apply tracing fluid around the high pressure connections of the pipe that has been replaced.
- Once the engine coolant temperature is above 50°C (122F) and provided there are no malfunctions present, carry out a road test, taking the engine speed up to 4,000 rpm at least once to check that there is no leakage.
- Perform a visual inspection after the road test to check that there is no high pressure leakage.
- Clean off the tracing fluid.

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# PREPARATION

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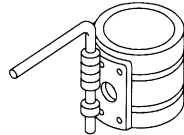
## PREPARATION

### PREPARATION

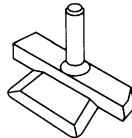
#### Special Service Tools

INFOID:000000001160601

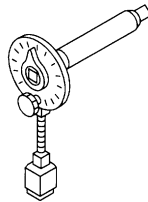
NISSAN tool number (RENAULT tool No.) Tool name	Description
EM03470000 ( — ) Piston ring compressor	Installing piston assembly into cylinder bore
KV10111100 ( — ) Seal cutter	Removing oil pan and front cover, etc
KV10112100 ( — ) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10114400 ( — ) Heated oxygen sensor wrench	Loosening or tightening air fuel ratio sensor <b>a: 22 mm (0.87 in)</b>
— (Mot. 1766) TDC set pin	To lock engine at TDC
— (Mot. 1769) Camshaft timing tool	To lock camshaft when changing timing chain



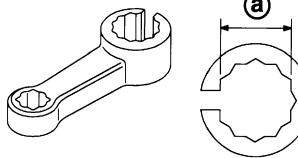
NT044



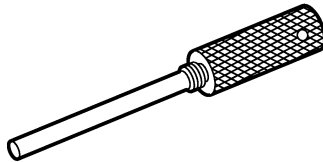
NT046



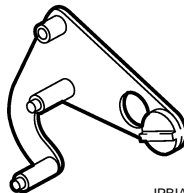
NT014



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# PREPARATION

< PREPARATION >

[M9R]

NISSAN tool number (RENAULT tool No.) Tool name	Description
— (Mot. 1770) Crankshaft pulley locking tool	To lock crankshaft pulley
— (Mot. 1772) Compression gauge adapter	Connecting compression gauge and glow plug hole
— (Mot. 1773) Positioning tool	To position the gear and apply for the right clearance (wear compensation gear)

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## Commercial Service Tools

INFOID:000000001160602

NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0040 (Mot. 251-01) Dial indicator stand set	Gauge stand used with KV113B0050 (Mot. 252-01)
KV113B0050 (Mot. 252-01) Dial indicator stand set	Thrust plate for measuring the protrusion of piston used with KV113B0040 (Mot. 251-01)
KV113B0090 (Mot. 1335) Valve seal remover	Tool for removing valve oil seals

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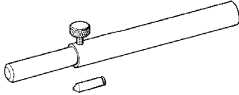
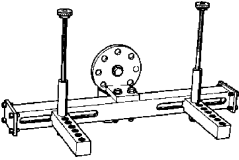
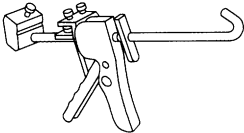
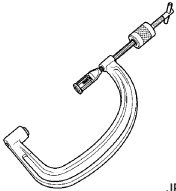
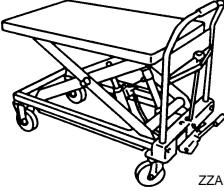
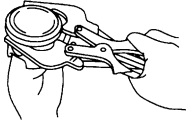
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# PREPARATION

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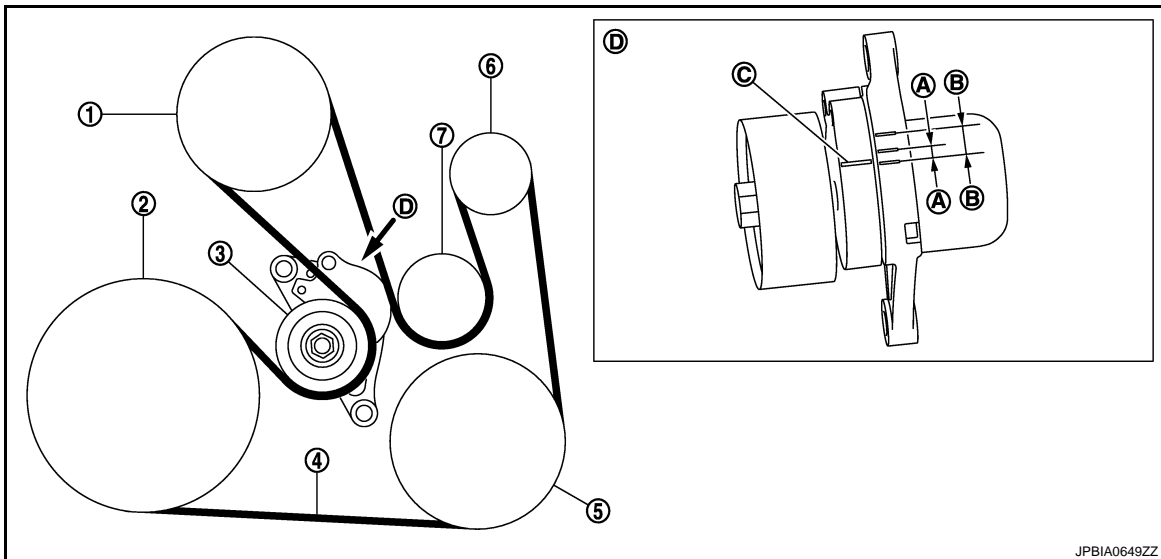
NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0180 (Mot. 1511-01) Valve seal drift  <p style="text-align: right; margin-right: 50px;">MBIB0378E</p>	Tool for installing valve oil seals
KV113B0200 (Mot. 1573) Cylinder head stand  <p style="text-align: right; margin-right: 50px;">MBIB0380E</p>	Cylinder head and cylinder head housing support
Tube presser  <p style="text-align: right; margin-right: 50px;">NT052</p>	Pressing the tube of liquid gasket
Valve spring compressor  <p style="text-align: right; margin-right: 50px;">JPBIA0770ZZ</p>	Disassembling valve mechanism
Manual lift table caddy  <p style="text-align: right; margin-right: 50px;">ZZA1210D</p>	Removing and installing engine
Piston ring expander  <p style="text-align: right; margin-right: 50px;">NT030</p>	Removing and installing piston ring

ON-VEHICLE MAINTENANCE

DRIVE BELTS

Exploded View

INFOID:000000001160603



- |   |                       |                              |
|---|-----------------------|------------------------------|
| 1. Water pump                             | 2. Crankshaft pulley  | 3. Drive belt auto-tensioner |
| 4. Drive belt                             | 5. A/C compressor     | 6. Alternator                |
| 7. Idler pulley                           |                       |                              |
| A. Range when new drive belt is installed | B. Possible use range | C. Indicator                 |
| D. View                                   |                       |                              |

Checking

INFOID:000000001160604

**WARNING:**

**Be sure to perform this step when the engine is stopped.**

- Check that the indicator (C) (notch on fixed side) of drive belt auto-tensioner is within the possible use range (B).

**NOTE:**

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

**CAUTION:**

**Drive belt auto-tensioner and idler pulley must be replaced with new ones when the drive belt is replaced.**

Tension Adjustment

INFOID:0000000011349267

Refer to [EM-329, "Drive Belts"](#).

Removal and Installation

INFOID:000000001160605

**CAUTION:**

- **Replace the drive belt that has been removed with a new one.**
- **Drive belt auto-tensioner and idler pulley must be replaced with new ones when the drive belt is replaced.**
- **Never run the engine without the drive belt to avoid damaging the crankshaft pulley.**

REMOVAL

1. Remove front fender protector (RH). Refer to [EXT-21, "Exploded View"](#).

# DRIVE BELTS

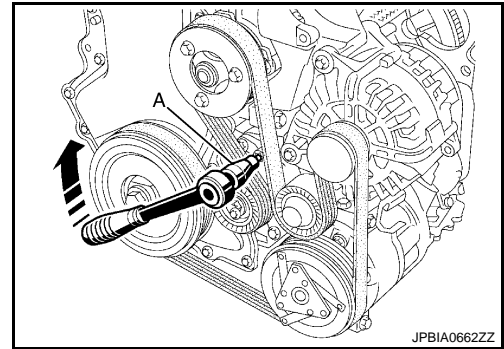
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## < ON-VEHICLE MAINTENANCE >

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

**CAUTION:**

Never place hand in a location where pinching may occur if the holding tool accidentally comes off.

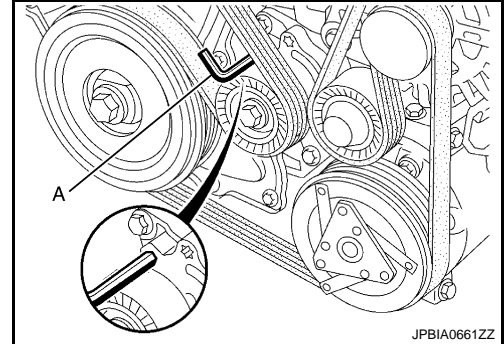


3. Insert a stopper pin (A) in diameter such as short-length screw-driver into the hole of the retaining boss to fix drive belt auto-tensioner pulley.

- Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.

**NOTE:**

Use approximately 3.0 mm (0.118 in) dia. hard metal pin as a stopper pin.



4. Remove drive belt.

## INSTALLATION

1. Install drive belt.

**CAUTION:**

- Check that drive belt is completely set to pulleys.
- Check for engine oil, working fluid and engine coolant are not adhered to drive belt and each pulley groove.

2. Release drive belt auto-tensioner, and apply tension to drive belt.
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Check that the indicator (notch on fixed side) of drive belt auto-tensioner is within the range when new drive belt is installed. Refer to [EM-257. "Checking"](#).

# AIR CLEANER FILTER

< ON-VEHICLE MAINTENANCE >

[M9R]

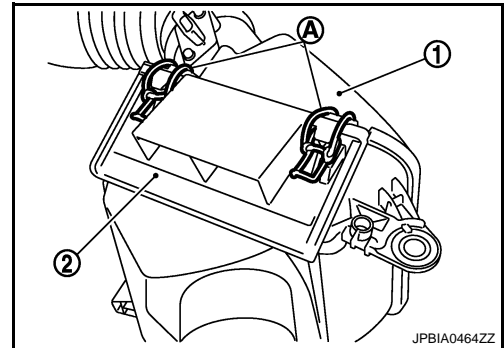
## AIR CLEANER FILTER

### Removal and Installation

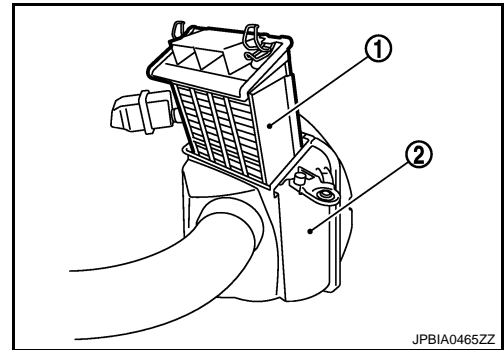
INFOID:000000001160606

#### REMOVAL

1. Unhook clips (A) and remove holder (2) from air cleaner case (1).



2. Remove air cleaner filter (1) from air cleaner case (2).



#### INSTALLATION

Install in the reverse order of removal.

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## COMPRESSION PRESSURE

### Inspection

INFOID:000000001160608

1. Warm up engine thoroughly. Then stop it.
2. Disconnect the battery cable from the negative terminal.
3. Remove glow plugs from all the cylinders.  
**CAUTION:**
  - Before removal, clean the surrounding area to prevent entry of any foreign materials into engine.
  - Carefully remove glow plugs to prevent any damage or breakage.
  - Handle with care to avoid applying any shock to glow plugs.
4. Disconnect fuel injector harness connectors to avoid fuel injection during measurement.
5. Install compression gauge (commercial service tool) with compression gauge adapter [SST: — (Mot. 1772)] to the hole for glow plug.
6. Turn ignition switch to START for cranking. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.

**Compression pressure :** Refer to [EM-329, "General Specification"](#).

**CAUTION:**

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

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
  - If some cylinder has low compression pressure, pour small amount of engine oil into the glow plug hole of the cylinder to re-check it for compression.
    - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check 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 remain slow even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
7. After inspection is completed, install removed parts.
  8. Start the engine, and check that the engine runs smoothly.
  9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [ECR-97, "Diagnosis Description"](#).



# DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

< ON-VEHICLE REPAIR >

[M9R]

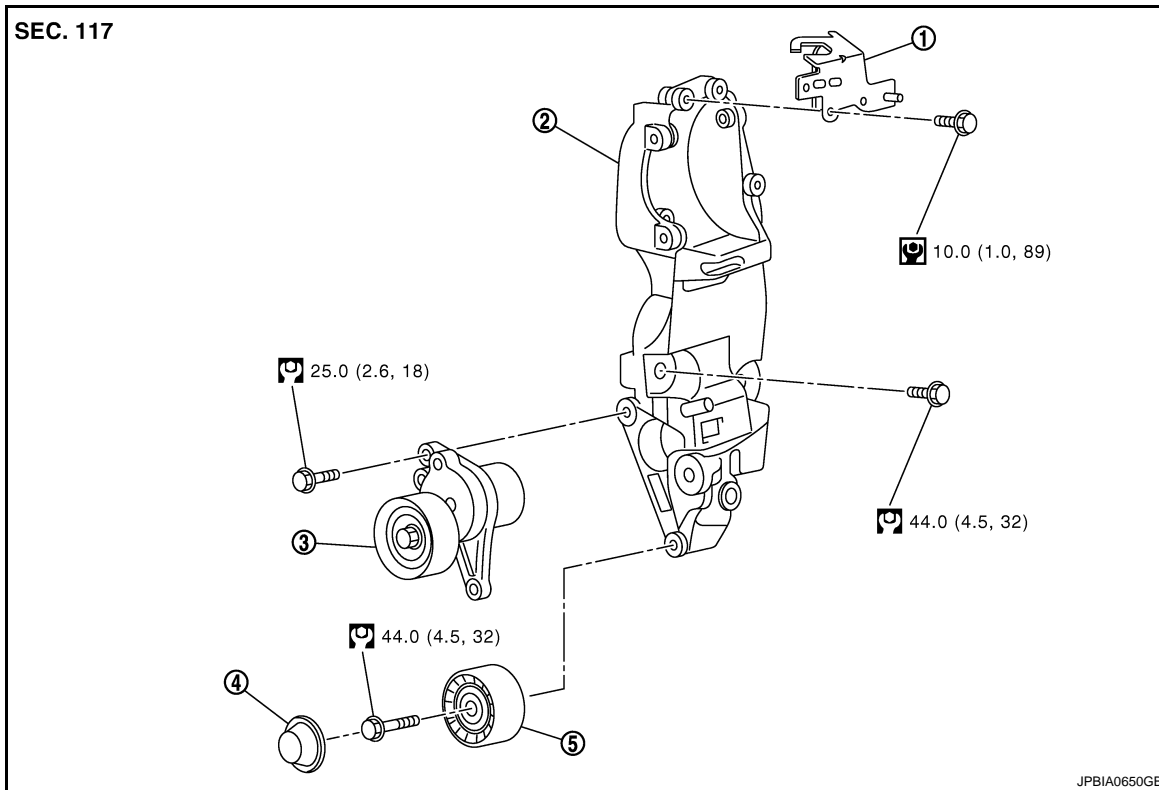
## ON-VEHICLE REPAIR

### DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

Exploded View

INFOID:000000001160609

A  
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1. Harness bracket
2. Multifunction support bracket
3. Drive belt auto-tensioner
4. Cover
5. Idler pulley

Refer to [GI-4, "Components"](#) for symbols in the figure.

K

## Removal and Installation

INFOID:000000001160610

L

### CAUTION:

- Replace the drive belt that has been removed with a new one.
- Drive belt auto-tensioner and idler pulley must be replaced with new ones when the drive belt is replaced.
- Never run the engine without the drive belt to avoid damaging the crankshaft pulley.

M

### REMOVAL

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1. Remove drive belt. Refer to [EM-257, "Removal and Installation"](#).
  - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.
2. Remove drive belt auto-tensioner.
3. Remove cover and idler pulley.
4. Remove multifunction support bracket with the following procedure:
  - a. Disconnect the battery cable from the negative terminal.
  - b. Remove alternator. Refer to [CHG-23, "M9R MODELS : Exploded View"](#).
  - c. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [HA-47, "M9R : Exploded View"](#).
  - d. Remove multifunction support bracket.

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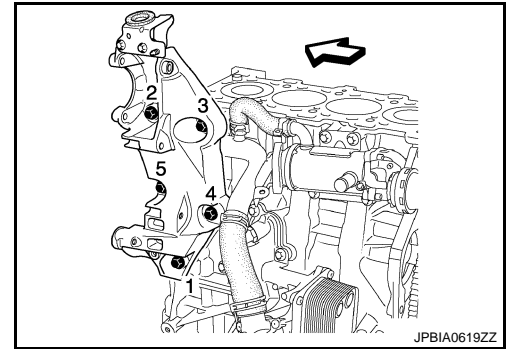
# DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

< ON-VEHICLE REPAIR >

[M9R]

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

⇐ : Engine front



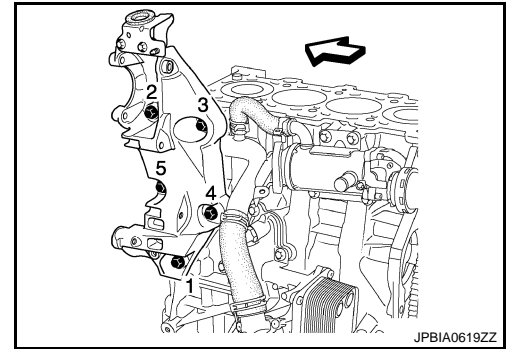
## INSTALLATION

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

Multifunction support bracket

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

⇐ : Engine front



# AIR CLEANER AND AIR DUCT

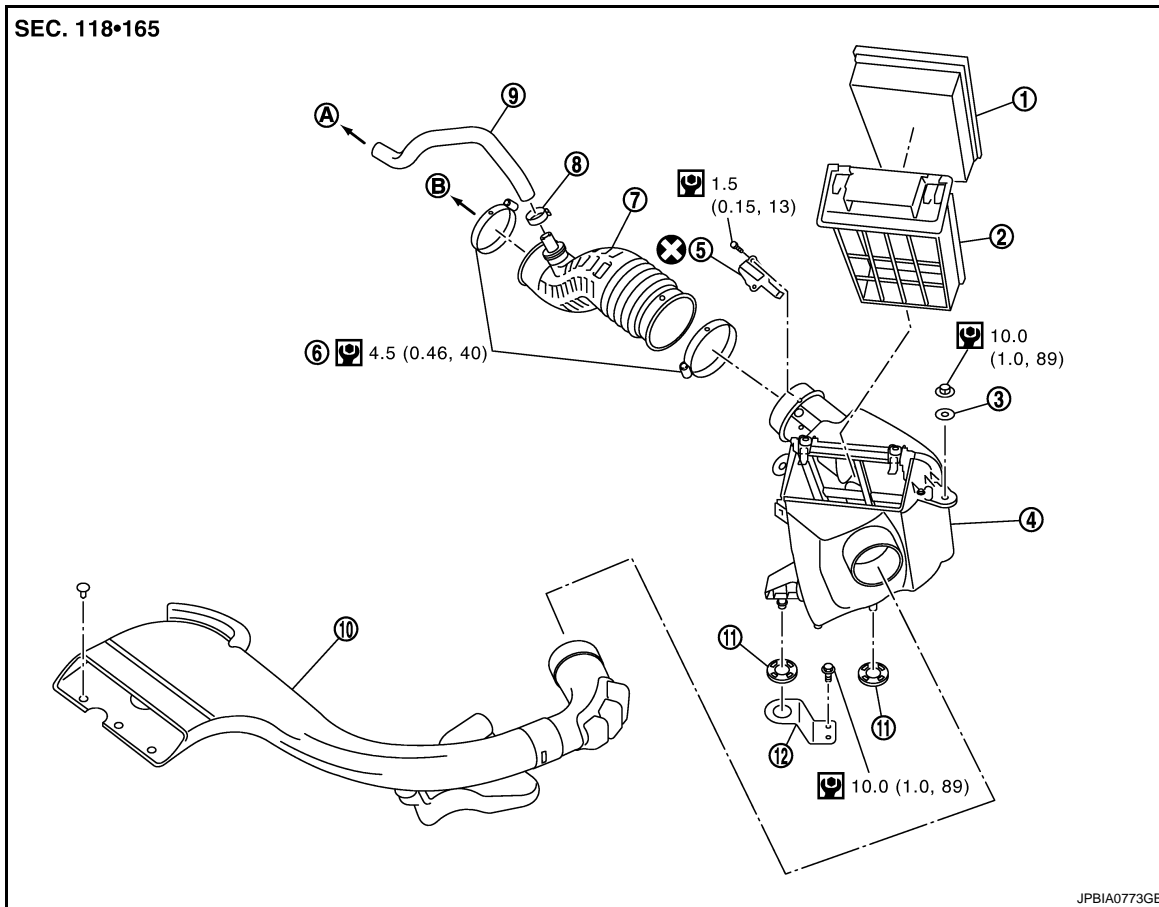
< ON-VEHICLE REPAIR >

[M9R]

## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:000000001160611



- |                       |                         |             |
|-----------------------|-------------------------|-------------|
| 1. Air cleaner filter | 2. Holder               | 3. Retainer |
| 4. Air cleaner case   | 5. Mass air flow sensor | 6. Clamp    |
| 7. Air duct assembly  | 8. Clamp                | 9. PCV hose |
| 10. Air duct (inlet)  | 11. Grommet             | 12. Bracket |
| A. To oil separator   | B. To turbocharger      |             |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160612

### REMOVAL

1. Remove battery. Refer to [PG-133, "Exploded View"](#).
2. Disconnect ECM harness connectors and remove ECM and ECM bracket. Refer to [ECR-329, "General Precautions"](#).
3. Remove engine cover. Refer to [EM-265, "Exploded View"](#).
4. Disconnect PCV hose.
5. Remove air duct (inlet).
6. Remove air cleaner case/mass air flow sensor assembly and air duct assembly disconnecting their joints.
  - Add marks as necessary for easier installation.
7. Remove mass air flow sensor from air cleaner case, if necessary.

### CAUTION:

- Never shock mass air flow sensor.
- Never disassemble mass air flow sensor.

## AIR CLEANER AND AIR DUCT

< ON-VEHICLE REPAIR >

[M9R]

- **Never touch mass air flow sensor.**

### INSTALLATION

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

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

### Inspection

INFOID:000000001301422

### INSPECTION AFTER REMOVAL

Inspect air duct assembly for crack or tear.

- If anything found, replace air duct assembly.

# ENGINE COVER

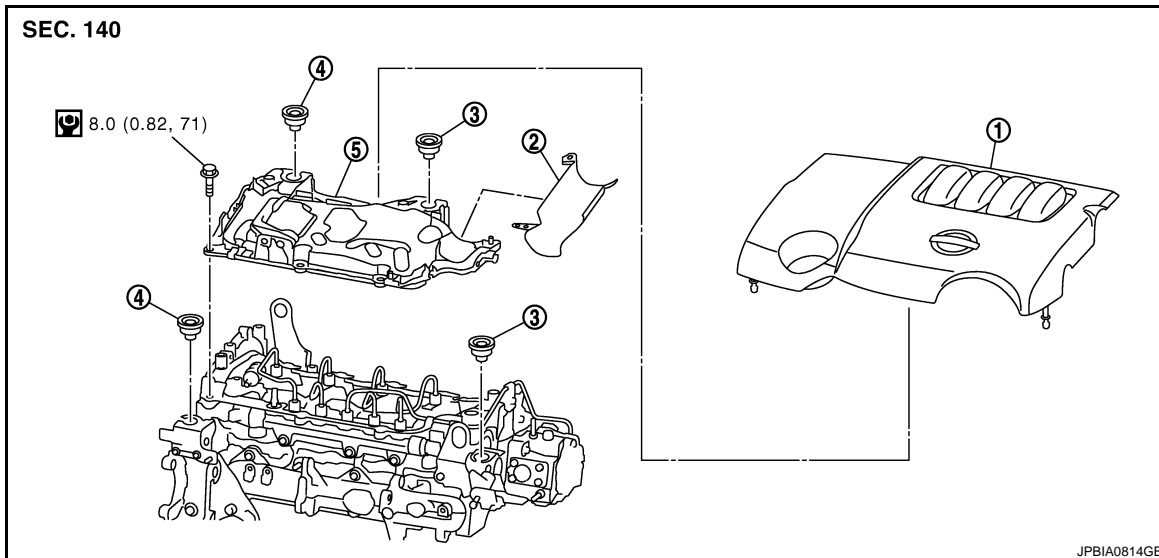
< ON-VEHICLE REPAIR >

[M9R]

## ENGINE COVER

### Exploded View

INFOID:000000001301419



1. Engine cover
2. Air inlet tube cover
3. Mounting rubber (brown)
4. Mounting rubber (black)
5. Fuel injection cover

Refer to [GI-4, "Components"](#) for symbols in the figure.

### Removal and Installation

INFOID:000000001301420

#### REMOVAL

1. Remove engine cover.
  - CAUTION:**
    - Never damage or scratch cover when installing or removing.
    - When detaching, hold the engine cover nearby the fixing point, and remove the pins one by one.
2. Remove air inlet hose and air inlet tube. Refer to [EM-266, "Exploded View"](#).
3. Move aside harness located above fuel injection cover.
4. Remove fuel injection cover and air inlet tube cover.

#### INSTALLATION

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

#### **CAUTION:**

**When installing, push the engine cover at the position on the pins.**

# CHARGE AIR COOLER

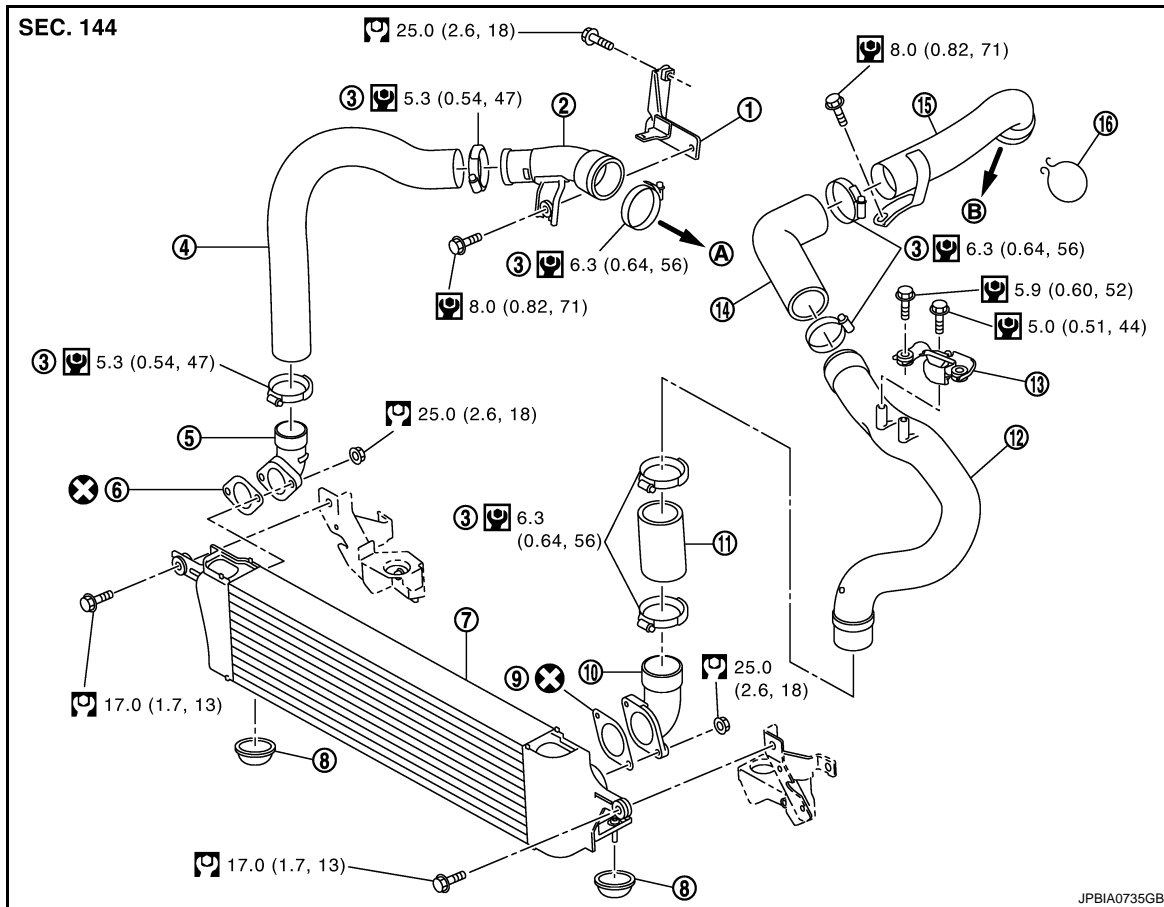
< ON-VEHICLE REPAIR >

[M9R]

## CHARGE AIR COOLER

### Exploded View

INFOID:000000001160613



- |                            |                    |                    |
|----------------------------|--------------------|--------------------|
| 1. Bracket                 | 2. Air inlet tube  | 3. Clamp           |
| 4. Air inlet hose          | 5. Air inlet tube  | 6. Gasket          |
| 7. Charge air cooler       | 8. Mounting rubber | 9. Gasket          |
| 10. Air inlet tube         | 11. Air inlet hose | 12. Air inlet tube |
| 13. Air inlet tube bracket | 14. Air inlet hose | 15. Air inlet tube |
| 16. Clip                   |                    |                    |

A. To electric throttle control actuator    B. To turbocharger

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160614

### REMOVAL

1. Remove engine cover. Refer to [EM-265, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-263, "Exploded View"](#).
3. Remove air inlet hoses and air inlet tubes.
  - Add marks as necessary for easier installation.

### CAUTION:

**When removing air inlet hose and air inlet tube, close opening on turbocharger and electric throttle control actuator with shop cloth or other suitable material.**

4. Remove front bumper. Refer to [EXT-12, "Exploded View"](#).
5. Remove charge air cooler.

### INSTALLATION

# CHARGE AIR COOLER

[M9R]

< ON-VEHICLE REPAIR >

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

- Apply a neutral detergent (fluid) to the joint between air inlet hoses and air inlet tubes (oil is not permissible).
- Align marks. Attach each joint. Screw clamps firmly.

## Inspection

INFOID:000000001160615

EM

## INSPECTION AFTER REMOVAL

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler if necessary.
  - Do not deform core fins.
  - For cleaning procedure of charge air cooler core, refer to [CO-71, "RADIATOR : Inspection"](#).

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# EGR SYSTEM

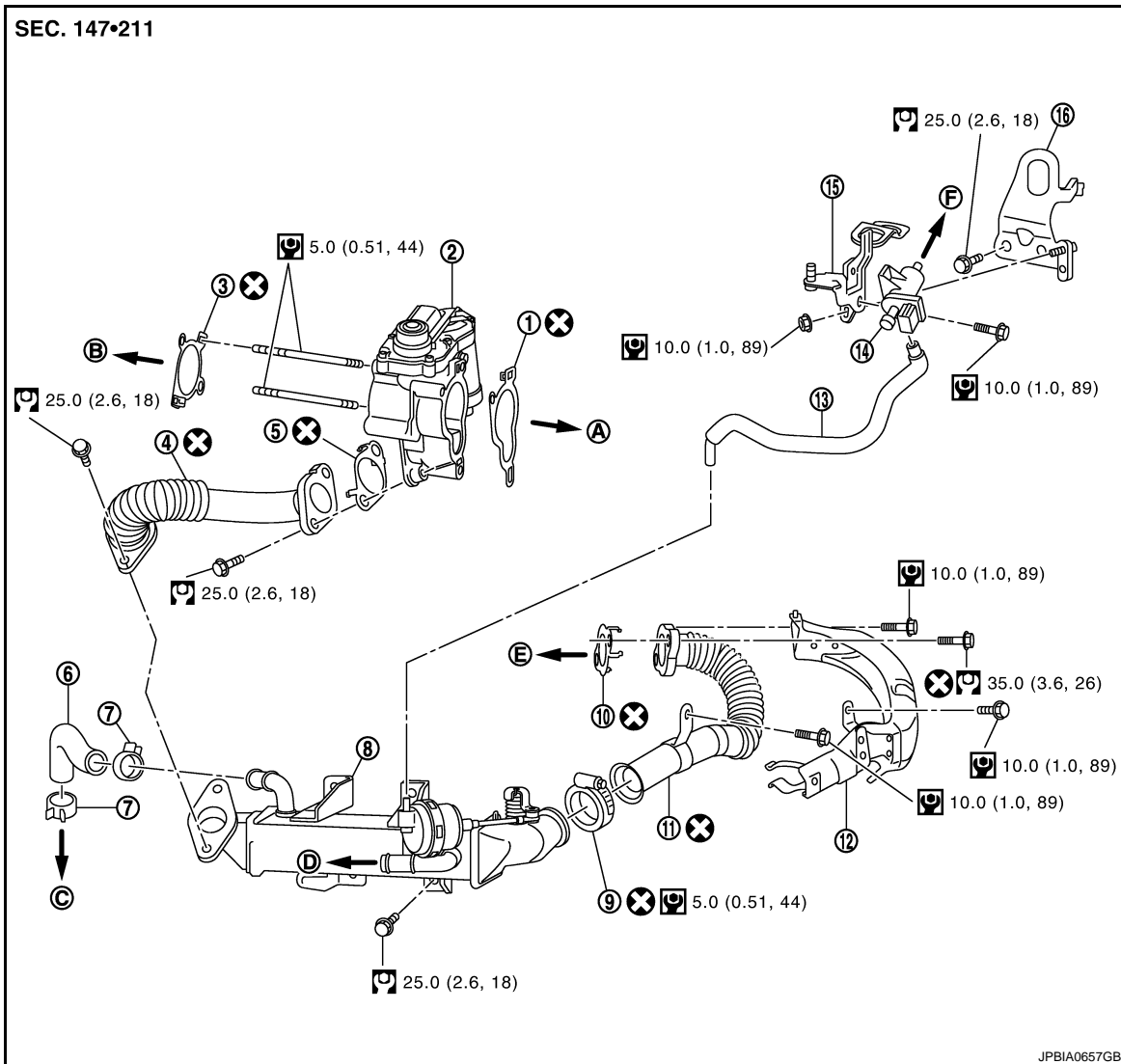
< ON-VEHICLE REPAIR >

[M9R]

## EGR SYSTEM

### Exploded View

INFOID:000000001160616



JPBIA0657GB

- |                           |  |                          |
|---------------------------|--|--------------------------|
| 1. Gasket                 | 2. EGR volume control valve                        | 3. Gasket                |
| 4. EGR tube (front)       | 5. Gasket  | 6. Water hose            |
| 7. Clamp                  | 8. EGR cooler tube                                 | 9. Clamp                 |
| 10. Gasket                | 11. EGR tube (rear)                                | 12. EGR tube insulator   |
| 13. Vacuum hose           | 14. EGR cooler bypass valve control solenoid valve | 15. Bracket              |
| 16. Engine slinger (rear) |  |                          |
| A. To intake manifold     | B. To turbocharger boost sensor housing            | C. To water suction pipe |
| D. To water pipe          | E. To exhaust manifold                             | F. To vacuum pump        |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160617

### REMOVAL

1. Drain engine coolant. Refer to [LU-29, "Draining"](#).  
**CAUTION:**  
Perform this step when the engine is cold.



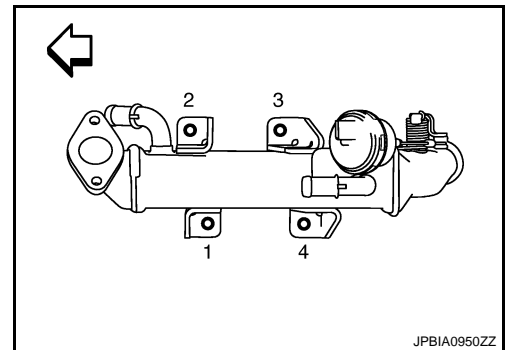
# EGR SYSTEM

[M9R]

## < ON-VEHICLE REPAIR >

2. Remove battery. Refer to [PG-133. "Exploded View"](#).
3. Remove electric throttle control actuator and turbocharger boost sensor housing. Refer to [EM-270. "Exploded View"](#).
4. Disconnect water hoses from EGR cooler tube.
5. Remove EGR tube (front) and EGR volume control valve assembly.  
**CAUTION:**
  - Handle carefully to avoid any shock to EGR volume control valve.
  - Never disassemble EGR volume control valve.
  - Cover engine openings to avoid entry of foreign materials.
6. Remove EGR tube (front) from EGR volume control valve.
7. Remove EGR cooler bypass valve control solenoid valve and vacuum hose.
8. Remove EGR tube insulator.
9. Remove water outlet and thermostat assembly. Refer to [CO-83. "Exploded View"](#)
10. Remove water pipe, bracket and heater pipe. Refer to [CO-83. "Exploded View"](#)
11. Remove EGR tube (rear).
12. Remove starter motor. Refer to [STR-22. "M9R MODELS : Exploded View"](#).
13. Remove EGR cooler tube.
  - Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front



## INSTALLATION

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

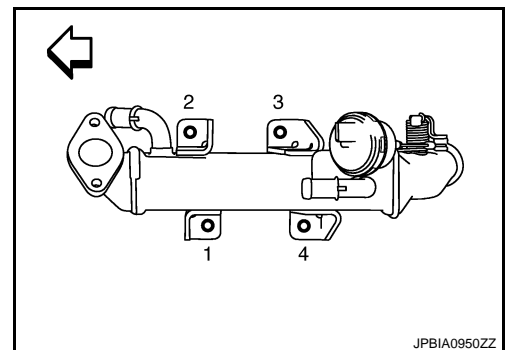
### **CAUTION:**

**Clean each joint surface before installation.**

#### EGR Cooler Tube

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

← : Engine front



#### EGR Volume Control Valve

Perform "EGR Volume Control Valve Closed Position Learning Value Clear" and "EGR Volume Control Valve Closed Position Learning" after repair when removing or replacing EGR volume control valve. Refer to [ECR-15. "EGR VOLUME CONTROL VALVE CLOSED POSITION LEARNING VALUE CLEAR : Description"](#) or [ECR-15. "EGR VOLUME CONTROL VALVE CLOSED POSITION LEARNING : Description"](#).

# INTAKE MANIFOLD

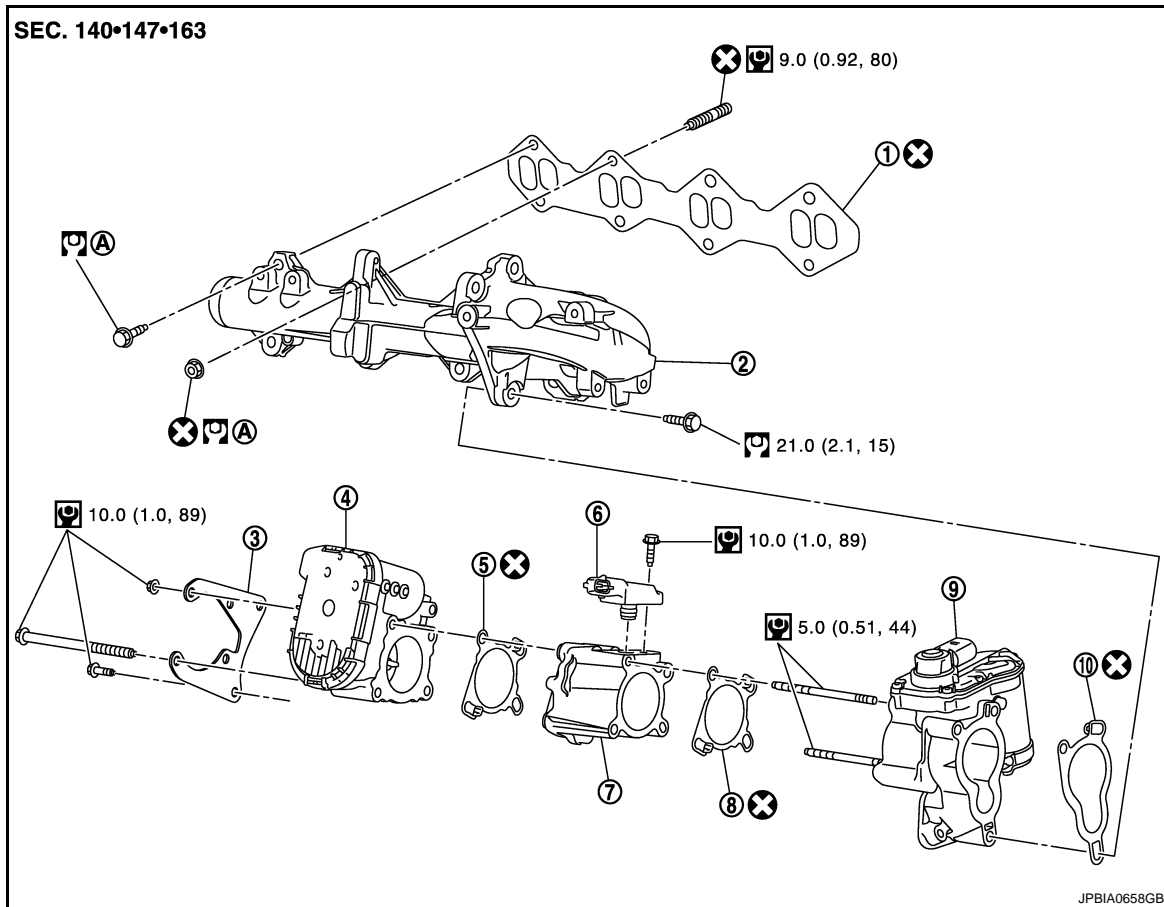
< ON-VEHICLE REPAIR >

[M9R]

## INTAKE MANIFOLD

### Exploded View

INFOID:000000001246512



- |                                       |                    |  |
|---------------------------------------|--------------------|--|
| 1. Gasket                             | 2. Intake manifold | 3. Electric throttle control actuator stay |
| 4. Electric throttle control actuator | 5. Gasket          | 6. Turbocharger boost sensor               |
| 7. Turbocharger boost sensor housing  | 8. Gasket          | 9. EGR volume control valve                |
| 10. Gasket                            |                    |  |

A. Refer to [EM-270](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001246513

### REMOVAL

1. Remove engine cover. Refer to [EM-265, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-263, "Exploded View"](#).
3. Remove air inlet hose and air inlet tube. Refer to [EM-266, "Exploded View"](#).
4. Remove oil level gauge and oil level gauge guide.
5. Remove electric throttle control actuator stay.
6. Remove electric throttle control actuator.  
**CAUTION:**
  - Handle carefully to avoid any shock to electric throttle control actuator.
  - Never disassemble electric throttle control actuator.
7. Remove turbocharger boost sensor and turbocharger boost sensor housing assembly.  
**CAUTION:**  
Handle carefully to avoid any shock to turbocharger boost sensor.

# INTAKE MANIFOLD

[M9R]

## < ON-VEHICLE REPAIR >

8. Loosen water pipe mounting bolts from intake manifold. Refer to [CO-83, "Exploded View"](#).
9. Remove EGR volume control valve and EGR tube (front) assembly. Refer to [EM-268, "Removal and Installation"](#).

**CAUTION:**

- Handle carefully to avoid any shock to EGR volume control valve.
- Never disassemble EGR volume control valve.

10. Remove multifunction support bracket. Refer to [EM-261, "Exploded View"](#).
11. Remove bracket from intake manifold. Refer to [CO-83, "Exploded View"](#).
12. Remove intake manifold with the following procedure:

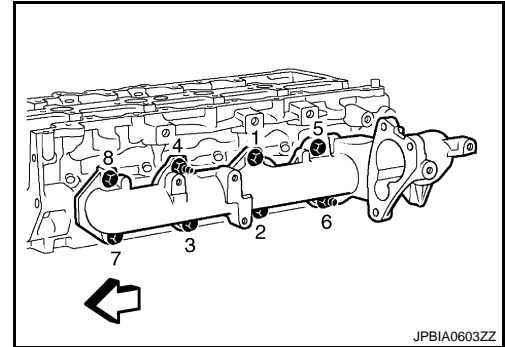
- a. Loosen mounting bolts and nuts in reverse order as shown in the figure.

⇐ : Engine front

- b. Remove intake manifold and gasket.

**CAUTION:**

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



## INSTALLATION

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

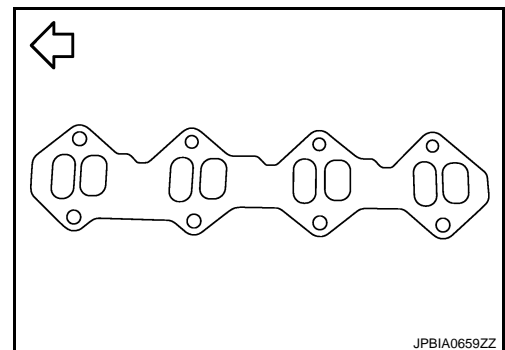
**CAUTION:**

**Clean each joint surface before installation.**

### Intake Manifold

1. Install gasket to cylinder head as shown in the figure.

⇐ : Engine front



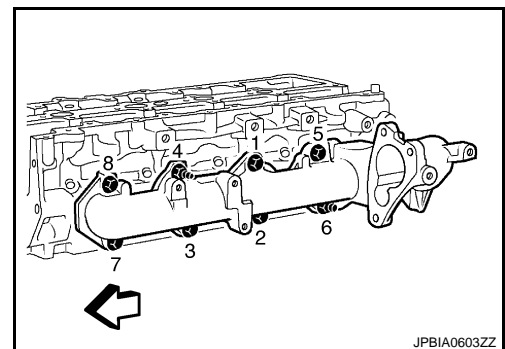
2. Install intake manifold.

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

⇐ : Engine front

 **1st step: 15.0 N·m (1.5 kg-m, 11 ft-lb)**

 **2nd step: 25.0 N·m (2.6 kg-m, 18 ft-lb)**



### Electric Throttle Control Actuator

- Tighten mounting bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform "Throttle Valve Closed Position Learning" and "Throttle Valve Closed Position Learning Value Clear" after repair when removing or replacing electric throttle control actuator. Refer to [ECR-16, "THROTTLE VALVE CLOSED POSITION LEARNING VALUE CLEAR : Description"](#) and [ECR-16, "THROTTLE VALVE CLOSED POSITION LEARNING : Description"](#).

# INTAKE MANIFOLD

< ON-VEHICLE REPAIR >

[M9R]

## Inspection

INFOID:000000001585766

### INSPECTION AFTER REMOVAL

#### Surface Distortion

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

**Standard** : Refer to [EM-329, "Intake Manifold"](#).

- If it exceeds the standard, replace intake manifold.



# CATALYST

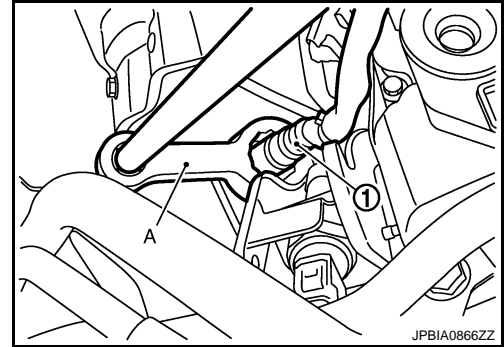
[M9R]

## < ON-VEHICLE REPAIR >

4. Remove air fuel ratio sensor (1) if necessary.
  - Using heated oxygen sensor wrench [SST: KV10114400] (A), remove air fuel ratio sensor.

**CAUTION:**

**Be careful not to impact or damage air fuel ratio sensor.**



5. Remove turbocharger insulator. Refer to [EM-275, "Exploded View"](#).
6. Loosen mounting nuts and remove stud bolts from turbocharger.
7. Remove exhaust front tube. Refer to [EX-14, "Exploded View"](#).
8. Remove right side drive shaft and support bearing bracket. Refer to [FAX-26, "M9R : Exploded View"](#)
9. Remove catalyst bracket.
10. Remove bracket (2WD models) or gusset (4WD models).
11. Remove catalyst insulator.
12. Remove catalyst support (upper).
13. Move catalyst in a rearward position of the vehicle to remove catalyst support (lower).
14. Remove mounting nut on the upper side of the stabilizer connecting rod. Refer to [FSU-20, "Exploded View"](#).
15. Pull out catalyst from the right side of the vehicle.

## INSTALLTION

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

Air Fuel Ratio Sensor

**CAUTION:**

- **Before installing a air fuel ratio sensor, clean catalyst thread.**
- **When installing, never use such tools as an air impact wrench.**

## Inspection

INFOID:000000001160620

## INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

# TURBOCHARGER

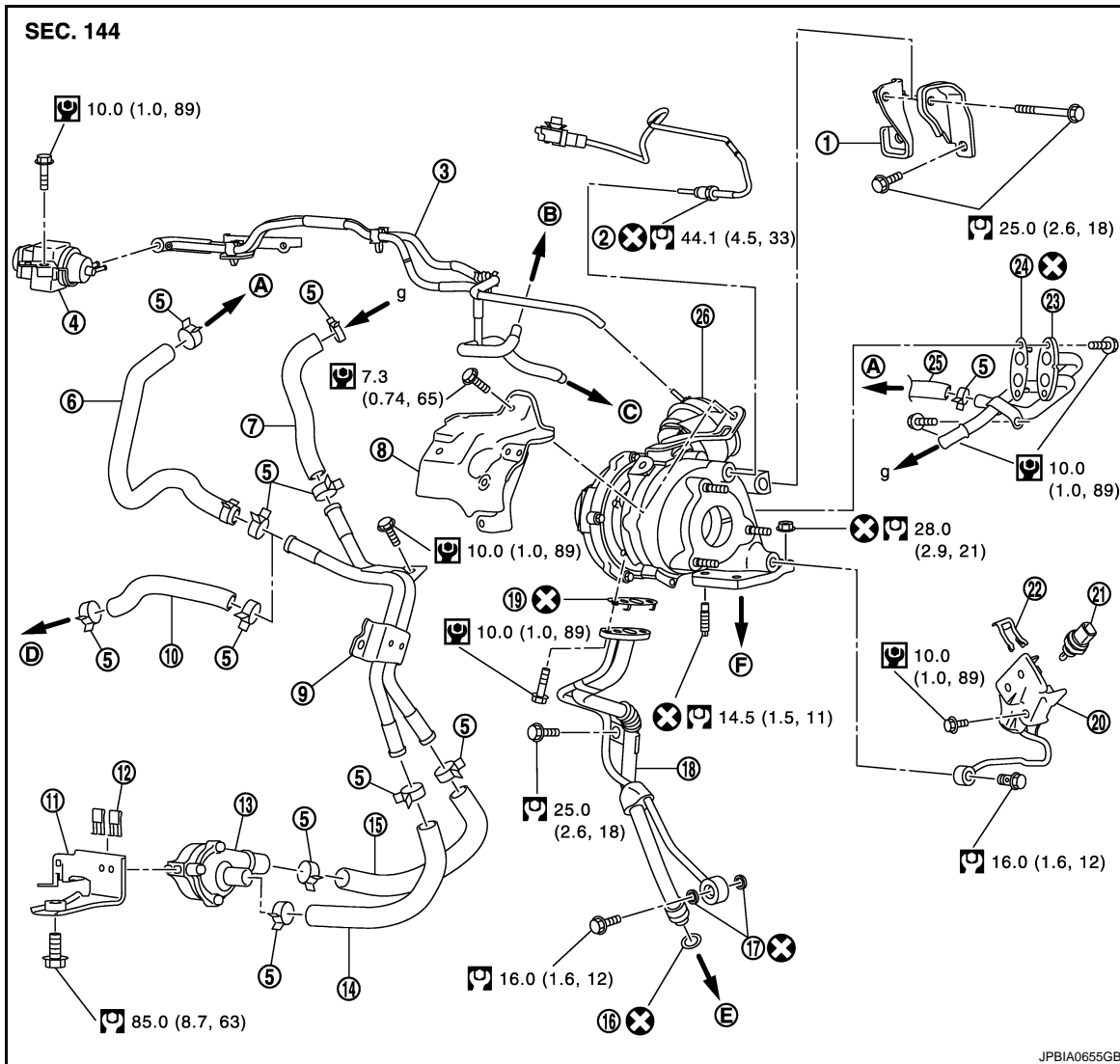
< ON-VEHICLE REPAIR >

[M9R]

## TURBOCHARGER

### Exploded View

INFOID:000000001160621



- |  |                                     |                                 |
|--|-------------------------------------|---------------------------------|
| 1. Bracket                                   | 2. Exhaust gas temperature sensor 1 | 3. Vacuum hose                  |
| 4. Turbocharger boost control solenoid valve | 5. Clamp                            | 6. Water hose (M/T models)      |
| 7. Water hose                                | 8. Turbocharger insulator           | 9. Water pipe                   |
| 10. Water hose (A/T models)                  | 11. Bracket                         | 12. Clip                        |
| 13. Turbocharger cooling pump                | 14. Water hose                      | 15. Water hose                  |
| 16. O-ring                                   | 17. Gasket                          | 18. Oil tube                    |
| 19. Gasket                                   | 20. Exhaust gas pressure tube       | 21. Exhaust gas pressure sensor |
| 22. Clip                                     | 23. Water tube                      | 24. Gasket                      |
| 25. Water hose                               | 26. Turbocharger                    |                                 |
- 
- |                        |                      |  |
|------------------------|----------------------|--|
| A. To heater pipe      | B. To vacuum pump    | C. To EGR cooler bypass valve control solenoid valve |
| D. To A/T fluid cooler | E. To cylinder block | F. To exhaust manifold                               |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160622

### REMOVAL

# TURBOCHARGER

[M9R]

## < ON-VEHICLE REPAIR >

1. Drain engine coolant. Refer to [LU-29, "Draining"](#).  
**CAUTION:**  
**Perform this step when the engine is cold.**
2. Remove air inlet tube from turbocharger. Refer to [EM-266, "Exploded View"](#).
3. Remove air duct assembly. Refer to [EM-263, "Exploded View"](#).
4. Remove cowl top cover and extension cowl top. Refer to [EXT-19, "Exploded View"](#).
5. Disconnect vacuum hose from turbocharger.
6. Disconnect water hose from water tube of turbocharger.
7. Remove exhaust front tube. Refer to [EX-14, "Exploded View"](#).
8. Remove catalyst. Refer to [EM-273, "Exploded View"](#).
9. Remove oil tube from turbocharger.
10. Disconnect exhaust gas temperature sensor 1 harness connector.
11. Remove exhaust gas pressure sensor and exhaust gas pressure tube assembly.  
**CAUTION:**  
**Be careful not to impact or damage exhaust gas pressure sensor.**
12. Remove turbocharger from exhaust manifold.  
**CAUTION:**  
**Never disassemble or adjust the turbocharger body.**
13. Remove turbocharger cooling pump.
14. Remove exhaust gas temperature sensor 1, if necessary.  
**CAUTION:**  
**Never remove exhaust gas temperature sensors except for replacing with new parts.**

## INSTALLTION

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

Exhaust Gas Temperature Sensor 1

### **CAUTION:**

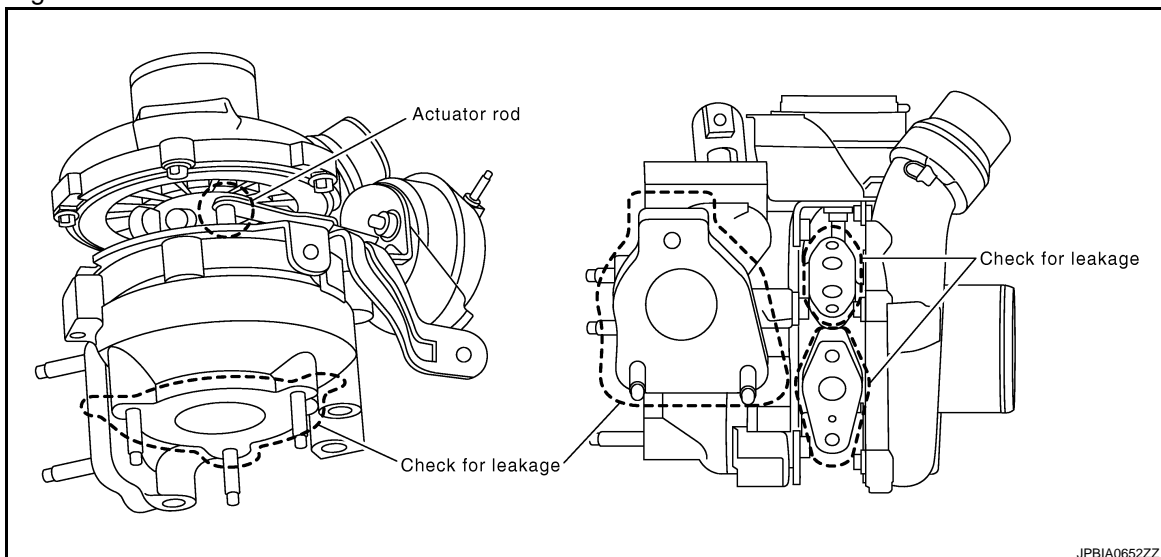
- Before installing a new exhaust gas temperature sensor, clean turbocharger thread.
- Be careful not to impact or damage exhaust gas temperature sensor 1.
- When installing, never use such tools as an air impact wrench.

## Inspection

INFOID:000000001160623

## INSPECTION AFTER REMOVAL

Turbocharger



### **CAUTION:**

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary malfunction:





# EXHAUST MANIFOLD

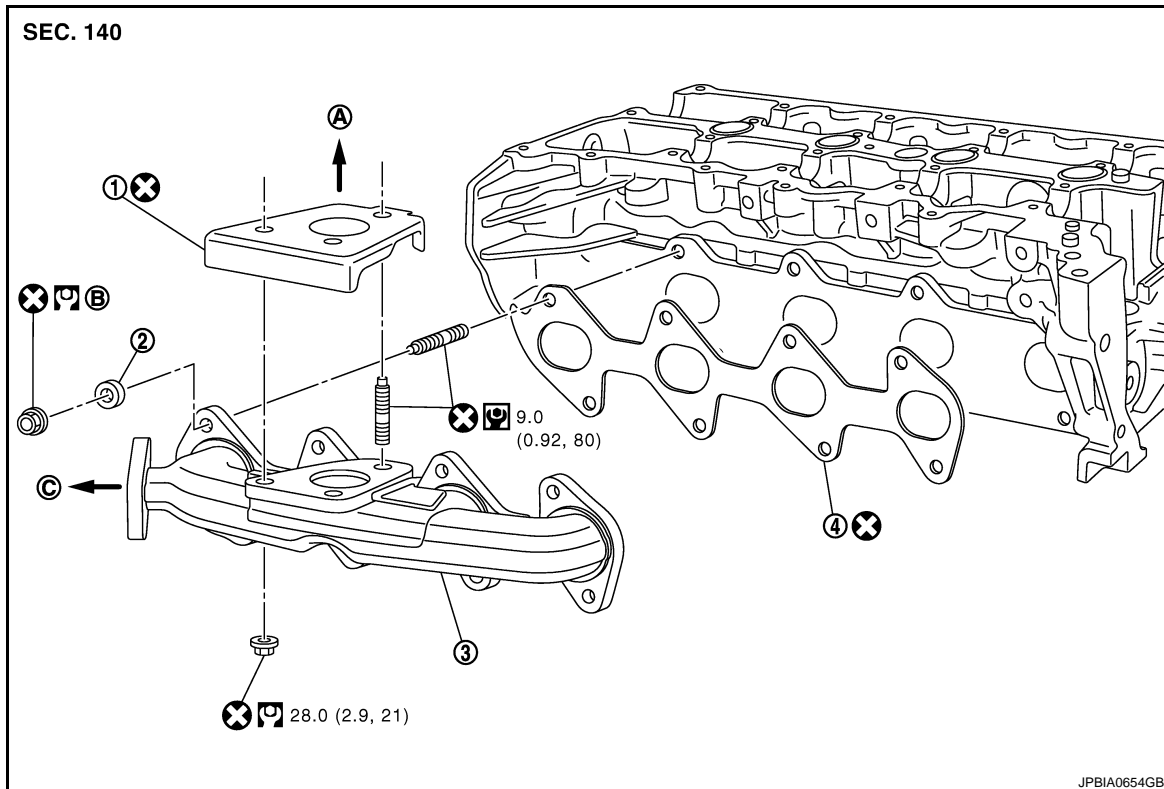
< ON-VEHICLE REPAIR >

[M9R]

## EXHAUST MANIFOLD

### Exploded View

INFOID:000000001160624



- 1. Gasket
- 2. Spacer
- 3. Exhaust manifold
- 4. Gasket
- A. To turbocharger
- B. Refer to [EM-278](#)
- C. To EGR tube (rear)

Refer to [GI-4. "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160625

### REMOVAL

1. Drain engine coolant. Refer to [CO-68. "Draining"](#).  
**CAUTION:**  
**Perform this step when the engine is cold.**
2. Remove catalyst. Refer to [EM-273. "Exploded View"](#).
3. Remove turbocharger. Refer to [EM-275. "Exploded View"](#).
4. Remove air cleaner case. Refer to [EM-263. "Exploded View"](#).
5. Remove EGR tube (rear) from exhaust manifold. Refer to [EM-268. "Exploded View"](#).
6. Remove exhaust manifold and spacers.

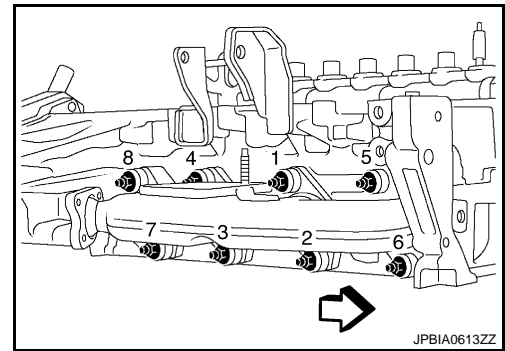
# EXHAUST MANIFOLD

[M9R]

## < ON-VEHICLE REPAIR >

- Loosen mounting nuts in the reverse order as shown in the figure.

← : Engine front



- Remove gasket.

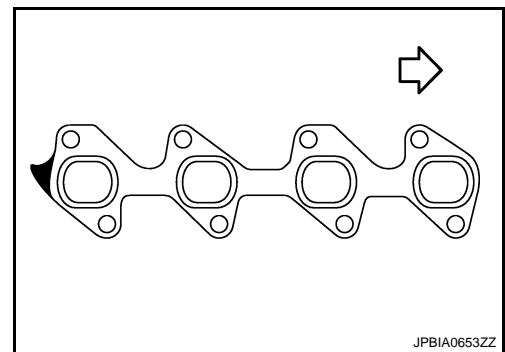
**CAUTION:**

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

## INSTALLATION

- Install gasket to cylinder head as shown in the figure.

← : Engine front



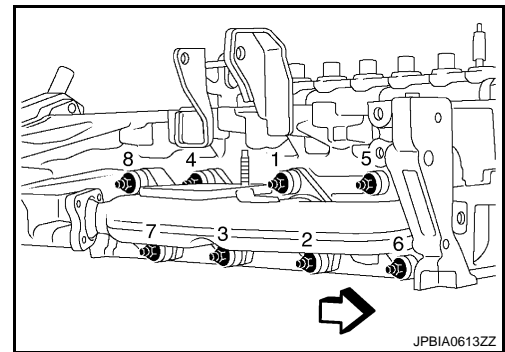
- Install exhaust manifold.

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

← : Engine front

 **1st step: 18.0 N·m (1.8 kg-m, 13 ft-lb)**

 **2nd step: 30.0 N·m (3.1 kg-m, 22 ft-lb)**



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

## Inspection

INFOID:000000001160626

## INSPECTION AFTER REMOVAL

### Surface Distortion

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

**Standard** : Refer to [EM-329, "Exhaust Manifold"](#).

- If it exceeds the standard, replace exhaust manifold.

## INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

# OIL PAN (LOWER) AND OIL STRAINER

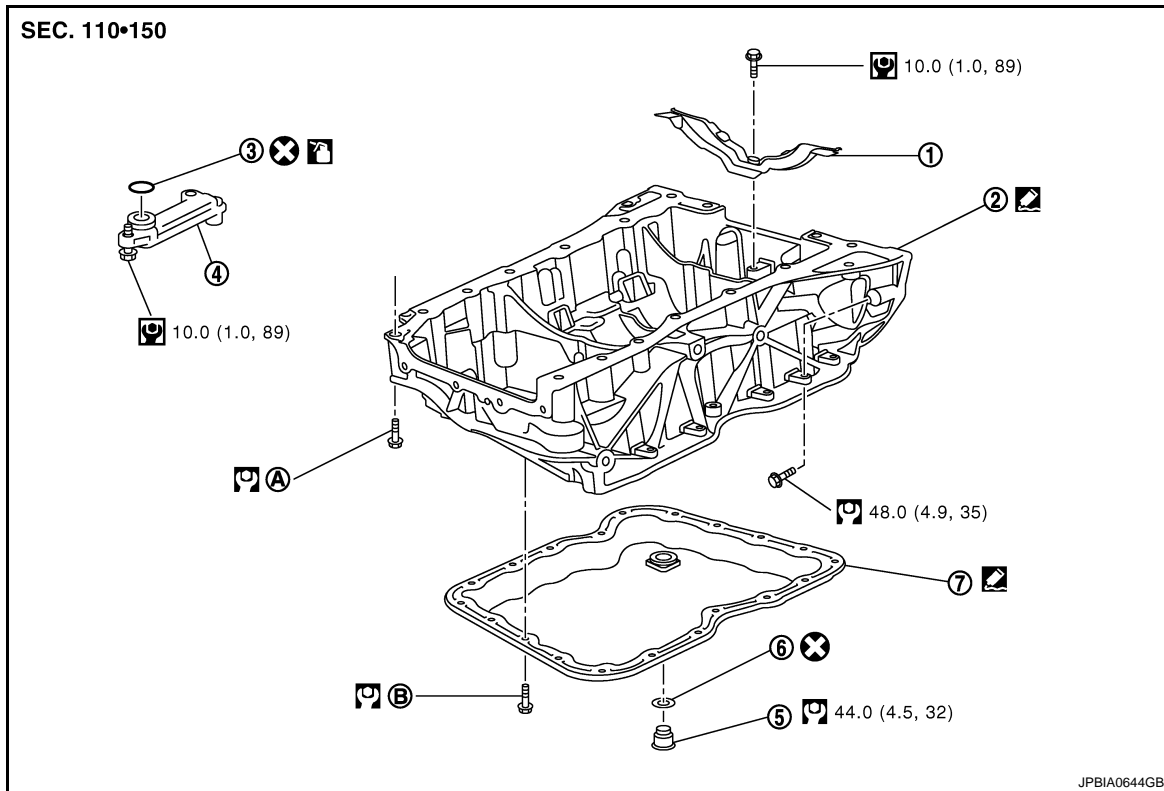
< ON-VEHICLE REPAIR >

[M9R]

## OIL PAN (LOWER) AND OIL STRAINER

Exploded View

INFOID:000000001160634



- |                                    |                                    |           |
|------------------------------------|------------------------------------|-----------|
| 1. Baffle plate                    | 2. Oil pan (upper)                 | 3. O-ring |
| 4. Oil strainer                    | 5. Oil pan drain plug              | 6. Gasket |
| 7. Oil pan (lower)                 |                                    |           |
| A. Refer to <a href="#">EM-320</a> | B. Refer to <a href="#">EM-280</a> |           |

Refer to [GI-4, "Components"](#) for symbols in the figure.

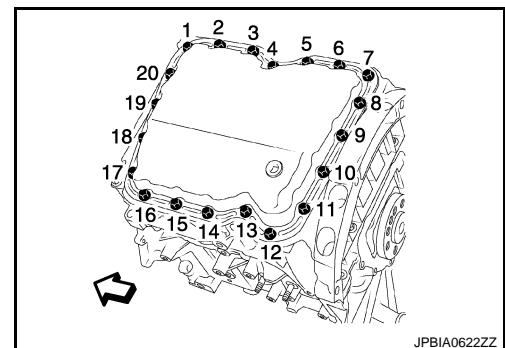
## Removal and Installation

INFOID:000000001160635

### REMOVAL

1. Remove engine undercover.
2. Drain engine oil. Refer to [LU-29, "Draining"](#).
- CAUTION:**  
**Perform this step when engine is cold.**
3. Remove oil pan (lower) with the following procedure:
  - a. Loosen mounting bolts in reverse order shown in the figure.

↶ : Engine front



# OIL PAN (LOWER) AND OIL STRAINER

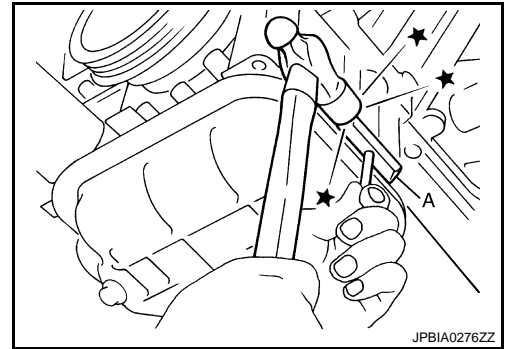
[M9R]

## < ON-VEHICLE REPAIR >

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

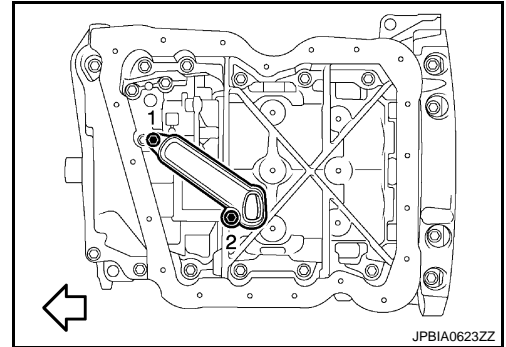
**CAUTION:**

- Be careful not to damage mating surface.
- Never insert screwdriver, or oil pan flange will be deformed.



- c. Remove oil pan (lower).  
4. Remove oil strainer.  
• Loosen mounting bolts in the reverse order as shown in the figure.

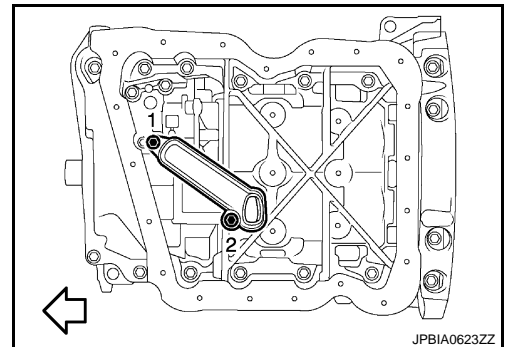
← : Engine front



## INSTALLATION

1. Install oil strainer.  
• Tighten mounting bolts in numerical order as shown in the figure.

← : Engine front

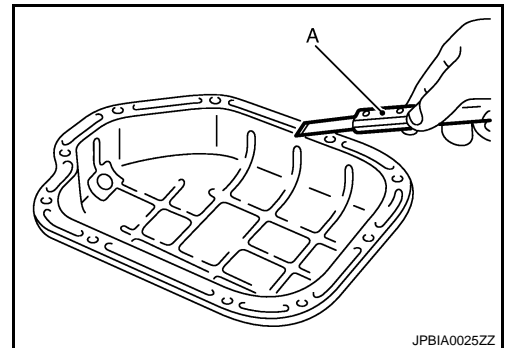


2. Install oil pan (lower) with the following procedure:  
a. Use a scraper (A) to remove old liquid gasket from mating surfaces.

**CAUTION:**

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

- Remove old liquid gasket from the bolt holes and threads.



A  
EM  
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P

# OIL PAN (LOWER) AND OIL STRAINER

[M9R]

< ON-VEHICLE REPAIR >

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

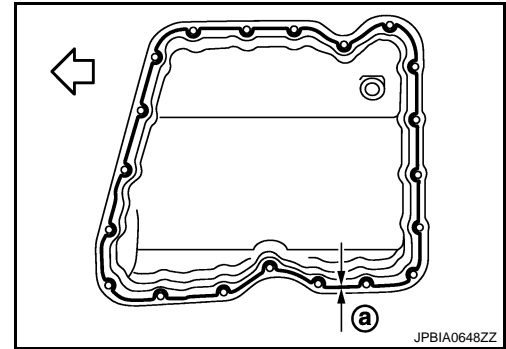
a : 3.0 - 7.0 mm (0.118 - 0.276 in)

↔ : Engine front

**Use Genuine Liquid Gasket or equivalent**

**CAUTION:**

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

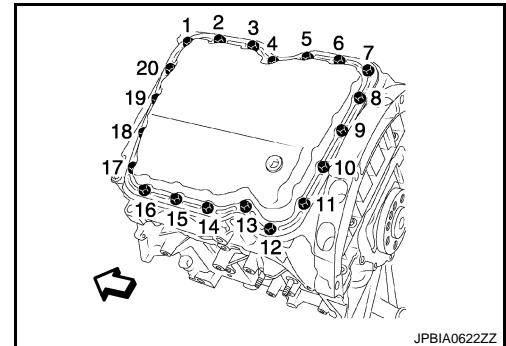


- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

↔ : Engine front

 **1st step: 5.0 N·m (0.51 kg·m, 4 ft·lb)**

 **2nd step: 16.0 N·m (1.6 kg·m, 12 ft·lb)**



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

**NOTE:**

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

## Inspection

INFOID:000000001160636

### 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-28. "Inspection"](#).
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-28. "Inspection"](#).

# GLOW PLUG

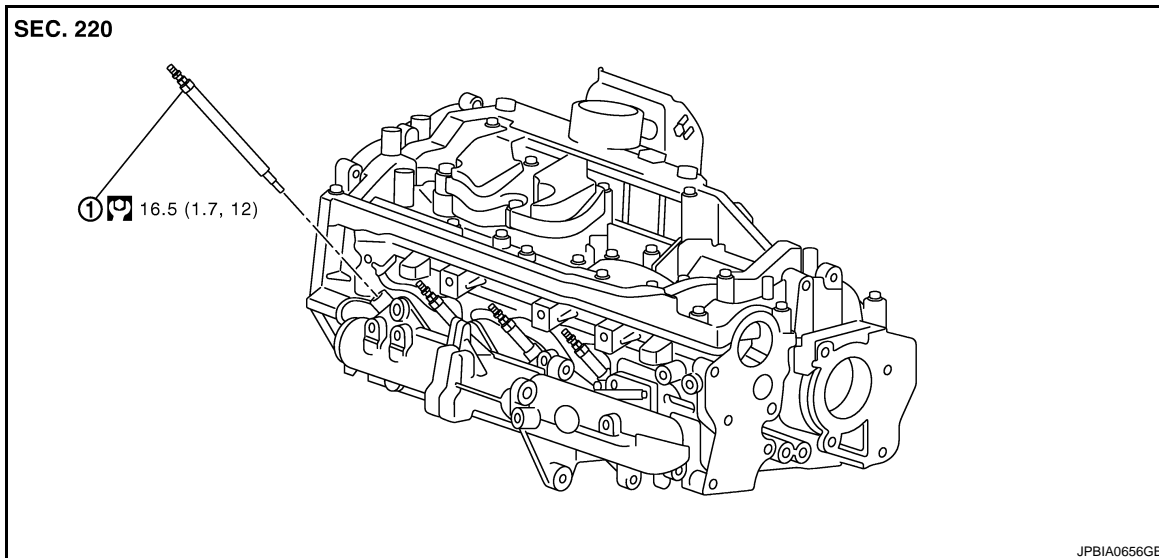
< ON-VEHICLE REPAIR >

[M9R]

## GLOW PLUG

### Exploded View

INFOID:000000001160627



1. Glow plug

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160628

### REMOVAL

#### **CAUTION:**

**Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.**

1. Disconnect the battery cable from the negative terminal.
2. Remove engine cover. Refer to [EM-265, "Exploded View"](#).
3. Disconnect harness connector from glow plug.
4. Remove glow plug.

#### **CAUTION:**

- **When removing or installing, never use such tools as an air impact wrench.**
- **Handle it carefully without giving any impact, even after removal.**

### INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install in the reverse order of removal, for the rest of parts.

# VACUUM PUMP

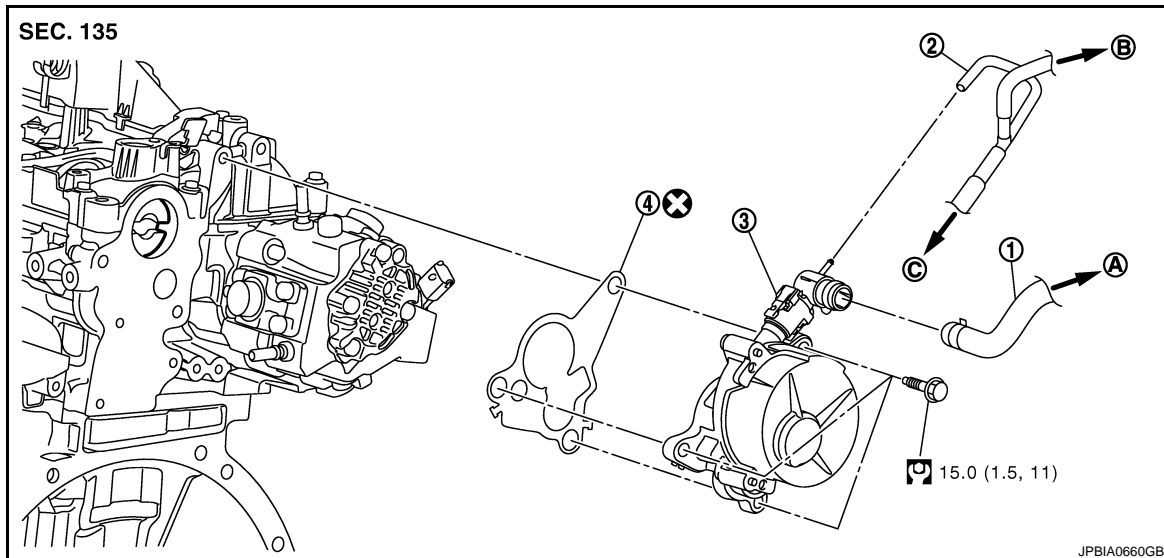
< ON-VEHICLE REPAIR >

[M9R]

## VACUUM PUMP

### Exploded View

INFOID:000000001160629



- |                     |   |  |
|---------------------|---|--|
| 1. Vacuum hose      | 2. Vacuum hose                                  | 3. Vacuum pump                                       |
| 4. Gasket           |   |  |
| A. To brake booster | B. To turbocharger boost control solenoid valve | C. To EGR cooler bypass valve control solenoid valve |

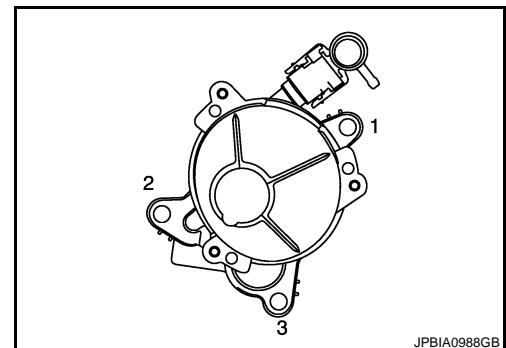
Refer to [GI-4, "Components"](#) for symbols in the figure.

### Removal and Installation

INFOID:000000001160630

#### REMOVAL

1. Remove engine cover. Refer to [EM-265, "Exploded View"](#).
2. Remove battery. Refer to [PG-133, "Exploded View"](#).
3. Disconnect vacuum hoses.
4. Remove vacuum pump.
  - Loosen mounting bolts in reverse order as shown in the figure.



#### INSTALLATION

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

Vacuum pump



# VACUUM PUMP

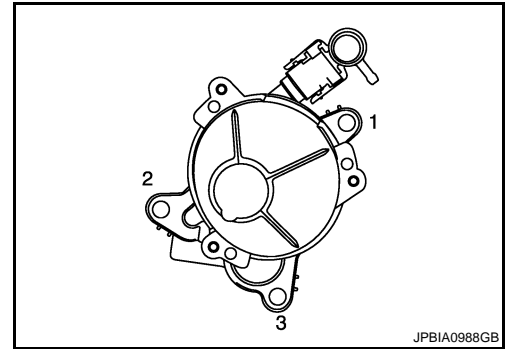
< ON-VEHICLE REPAIR >

[M9R]

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

**CAUTION:**

Be sure to check that the vacuum pump is in contact with the cylinder head before tightening the mounting bolts.



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# OIL SEPARATOR

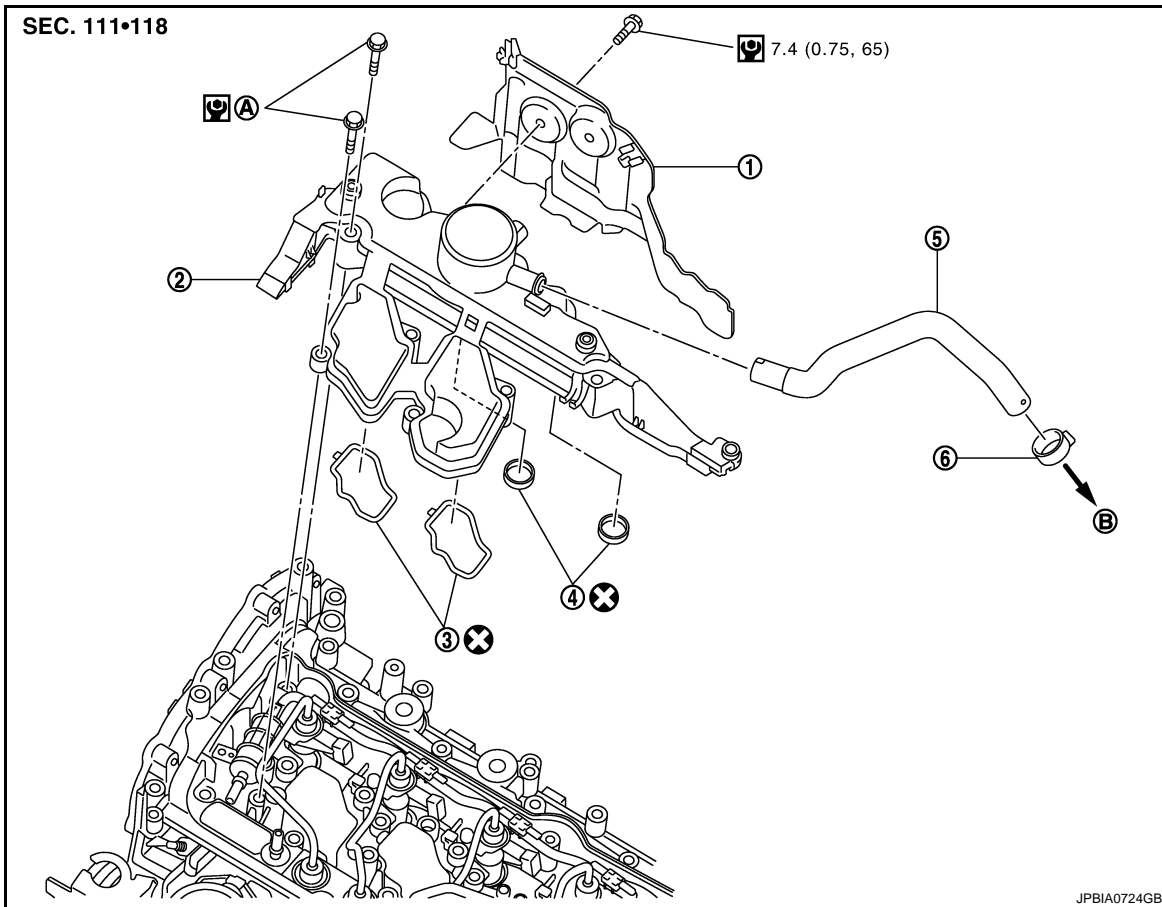
< ON-VEHICLE REPAIR >

[M9R]

## OIL SEPARATOR

### Exploded View

INFOID:000000001160639



- |                                    |                         |           |
|------------------------------------|-------------------------|-----------|
| 1. Oil separator insulator         | 2. Oil separator        | 3. Gasket |
| 4. Gasket                          | 5. PCV hose             | 6. Clamp  |
| A. Refer to <a href="#">EM-286</a> | B. To air duct assembly |           |

Refer to [GI-4. "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160640

### REMOVAL

1. Remove engine cover and fuel injection cover. Refer to [EM-265. "Exploded View"](#).
2. Remove PCV hose.
3. Disconnect harness connector of fuel injector (No. 1).
4. Loosen oil separator insulator mounting bolts.
5. Remove oil separator.

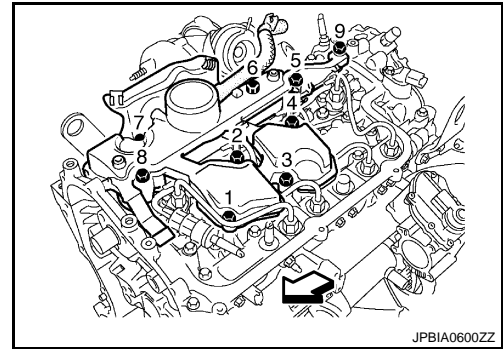
# OIL SEPARATOR

[M9R]

## < ON-VEHICLE REPAIR >

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

← : Engine front



- Remove oil separator insulator.

## INSTALLATION

- Install gaskets to oil separator.

**CAUTION:**

**Check the gasket is not dropped.**

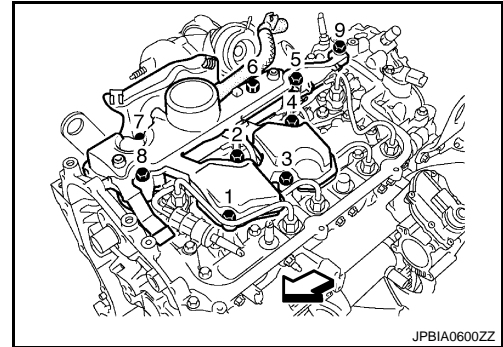
- Install oil separator.

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

← : Engine front

 **1st step: 5.0 N·m (0.51 kg-m, 44 in-lb)**

 **2nd step: 10.0 N·m (1.0 kg-m, 89 in-lb)**



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

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# INJECTION TUBE AND FUEL INJECTOR

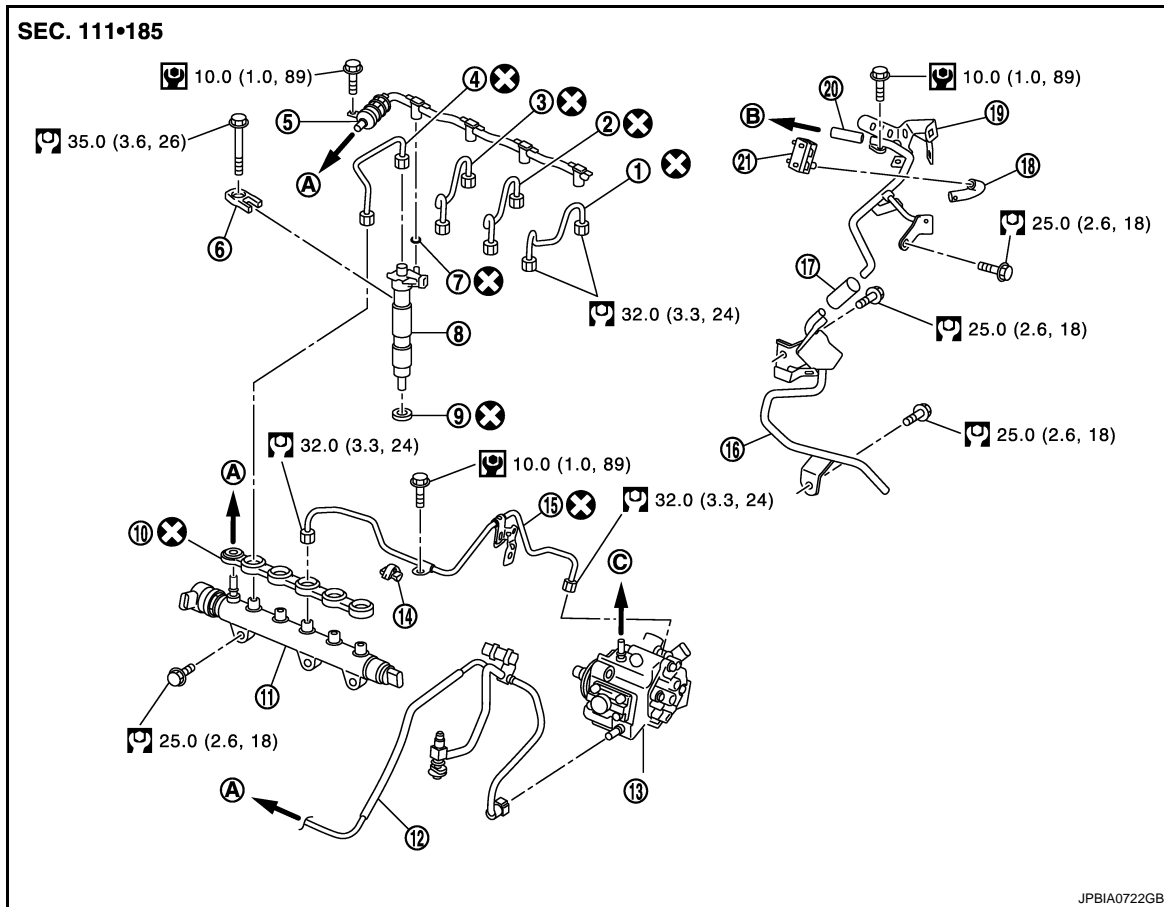
< ON-VEHICLE REPAIR >

[M9R]

## INJECTION TUBE AND FUEL INJECTOR

Exploded View

INFOID:000000001160632



JPBIA0722GB

- |                               |                             |                                      |
|-------------------------------|-----------------------------|--------------------------------------|
| 1. Injection tube No.4        | 2. Injection tube No.3      | 3. Injection tube No.2               |
| 4. Injection tube No.1        | 5. Spill hose               | 6. Fuel injector support             |
| 7. O-ring                     | 8. Fuel injector            | 9. Fuel injector spacer              |
| 10. Fuel rail seal            | 11. Fuel rail               | 12. Fuel hose                        |
| 13. Fuel pump                 | 14. Mounting rubber         | 15. Injection tube (center)          |
| 16. Diesel drain tube (lower) | 17. Diesel drain hose       | 18. Diesel drain hose                |
| 19. Diesel drain tube (upper) | 20. Diesel drain hose       | 21. Diesel collector                 |
| A. To fuel filter             | B. To cylinder head housing | C. To centralized under-floor piping |

Refer to [GI-4, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000001160633

### REMOVAL

#### CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-250, "Precaution for Diesel Equipment"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- It is forbidden to open an fuel injector. If you open an fuel injector by mistake, you will have to change it.

#### NOTE:

It is possible to replace a single injection tube.

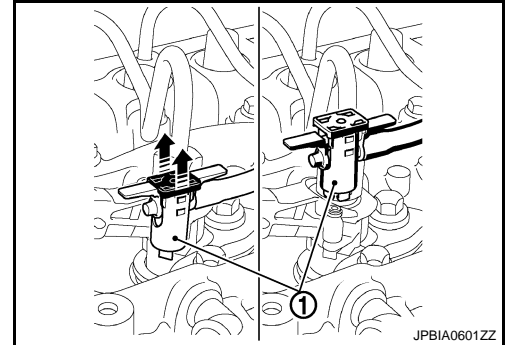
1. Remove the battery. Refer to [PG-133, "Exploded View"](#).

# INJECTION TUBE AND FUEL INJECTOR

[M9R]

< ON-VEHICLE REPAIR >

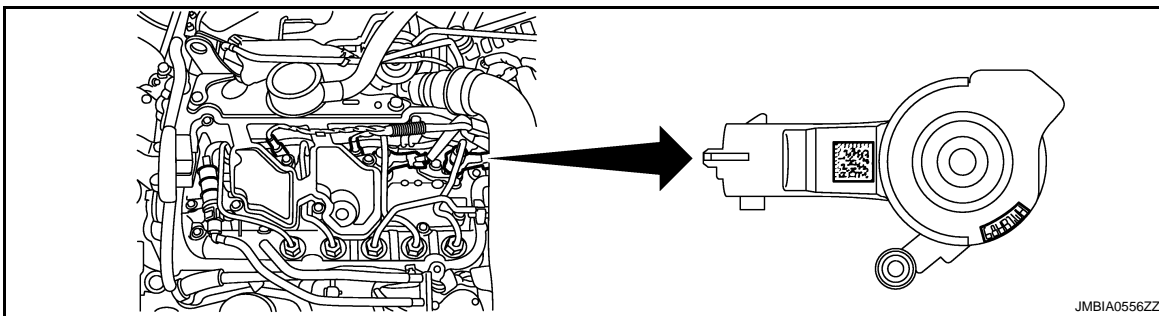
2. Remove oil separator. Refer to [EM-286. "Exploded View"](#).
3. Disconnect fuel hose from spill hose.
  - Pinch quick connector square-part with your fingers, and pull out the quick connector by hand.
4. Remove spill hose (1).
  - Lift the movable sections of the injector unions away from the spill hose.



5. Disconnect fuel hoses from fuel pump.
    - Pinch quick connector square-part with your fingers, and pull out the quick connector by hand.
  6. Remove diesel collector and injection tube (center).
  7. Remove injection tube (No. 1, 2, 3, 4).
    - Put a paint mark or tag on injection tubes to identify each cylinder.
  8. Remove fuel injectors with the following procedure:
    - a. Remove fuel injector support.
    - b. Remove fuel injector. While rotating it to left and right, raise it to remove.
      - If fuel injector spacer remains in cylinder head, hook it with tip of a flat-bladed screwdriver and pull it out.
- CAUTION:**
- **Handle fuel injector carefully without giving an impact.**
  - **Never disassemble fuel injector.**
9. Remove EGR volume control valve. Refer to [EM-268. "Exploded View"](#).
  10. Remove fuel rail and fuel rail seal.
  11. Plug all the holes in the injection circuit.
  12. Remove drain hose and diesel drain tube (upper and lower), if necessary.

## INSTALLATION

1. Record "INJECTOR ADJUSTMENT VALUE" on the top surface when replacing fuel injector. Refer to [ECR-205. "Description"](#).



Example: Injector adjustment value = 68HBLWH

2. Install fuel injector, injection tubes and fuel rail with the following procedure:
  - a. Install fuel injector spacer to fuel injector, and insert them into cylinder head.

**CAUTION:**

    - **Completely remove any foreign material among fuel injector and cylinder head.**

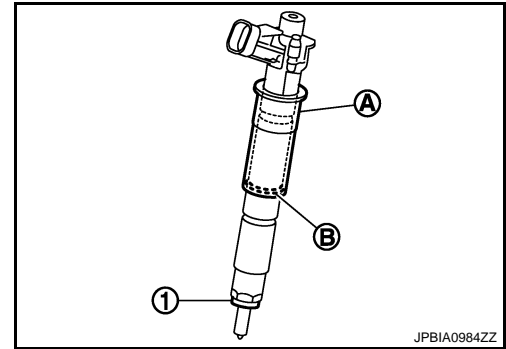
# INJECTION TUBE AND FUEL INJECTOR

< ON-VEHICLE REPAIR >

[M9R]

- Never mix ring (B) location. Upper location is mandatory.

- 1 :Fuel injector spacer
- A :Fuel injector guide



- Install fuel rail, fuel rail seal, injection tube (center) and mounting rubber (temporarily).
    - Finger tighten until contact the injection tube nuts.
  - Install fuel injector support. Tighten mounting bolt (specified torque).

**CAUTION:**  
**Be sure to fit fuel injector support without looseness.**
  - Install injection tube (No. 1, 2, 3, 4) in the original position (temporarily).
    - Finger tighten until contact the injection tube nuts.

**CAUTION:**  
**Never put injection tubes under stress.**
  - Tighten fuel rail mounting bolts and all injection tube nuts (specified torque).
- Install spill hose onto fuel injectors.
    - Align center to insert spill hose straightly into fuel injector.
  - Install in the reverse order of removal, for the rest of parts.
    - Before starting engine, bleed air from fuel piping. Refer to [FL-17, "Air Bleeding"](#).

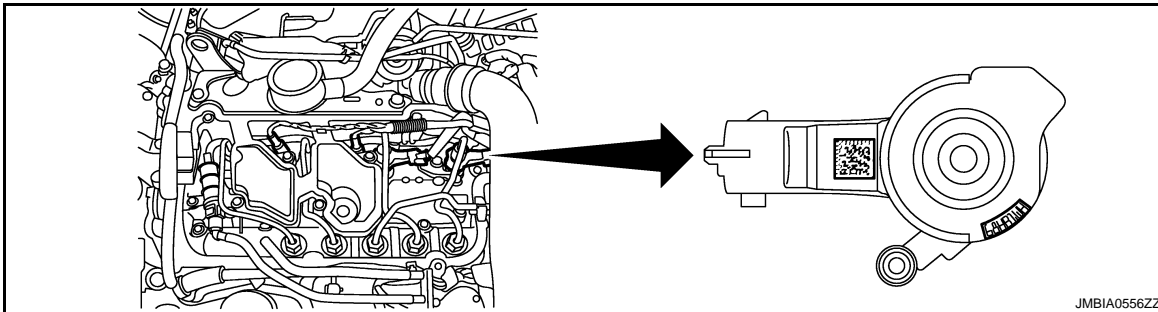
**NOTE:**  
Fill the fuel of at least 60 mℓ (2.11 Imp fl oz).

## Inspection

INFOID:000000001303471

### INSPECTION AFTER INSTALLATION

- Input "INJECTOR ADJUSTMENT VALUE" to ECM after installing to the vehicle when replacing fuel injector. Refer to [ECR-205, "Description"](#).



Example: Injector adjustment value = 68HBLWH

- Start the engine and check for fuel leak for one minute after starting.

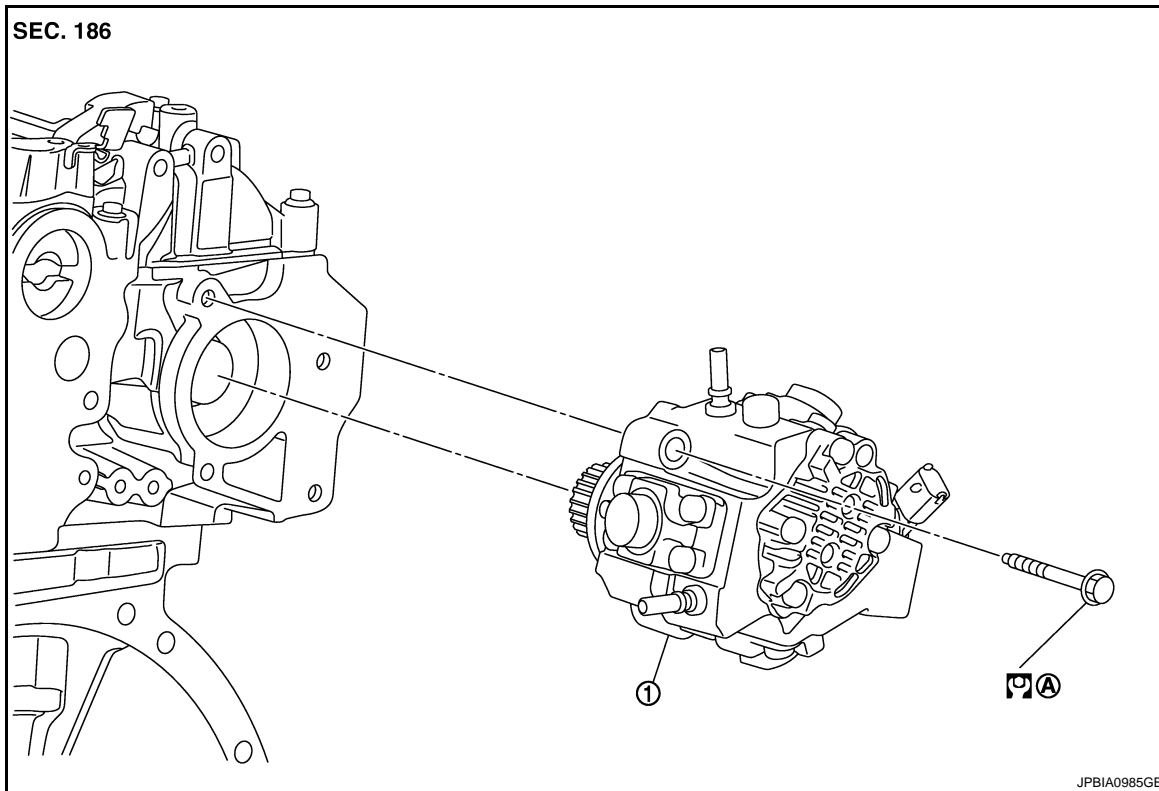
**CAUTION:**

**After any operation, check that there are no diesel leaks. Refer to [EM-250, "Precaution for Diesel Equipment"](#).**

## FUEL PUMP

### Exploded View

INFOID:000000001160637



1. Fuel pump

A. Refer to [EM-291](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

### Removal and Installation

INFOID:000000001160638

#### REMOVAL

##### **CAUTION:**

- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-250, "Precaution for Diesel Equipment"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- Never disassemble or adjust the fuel pump body.

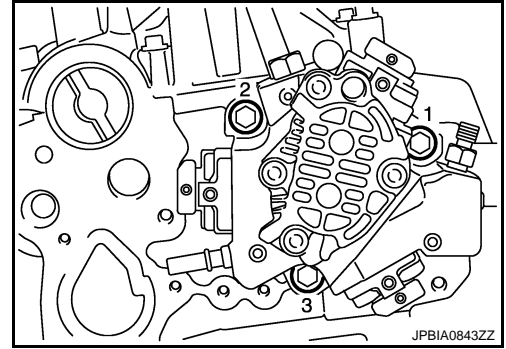
1. Remove the battery. Refer to [PG-133, "Exploded View"](#).
2. Remove engine cover and fuel injection cover. Refer to [EM-265, "Exploded View"](#).
3. Remove air duct assembly and air cleaner case. Refer to [EM-263, "Exploded View"](#).
4. Remove diesel collector. Refer to [EM-288, "Exploded View"](#).
5. Disconnect fuel hoses from fuel pump. Refer to [EM-288, "Exploded View"](#).
6. Remove the injection tube (center). Refer to [EM-288, "Exploded View"](#).
7. Plug all the holes of the injection circuit.
8. Remove the fuel pump.

# FUEL PUMP

[M9R]

## < ON-VEHICLE REPAIR >

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



## INSTALLATION

- Install fuel pump.

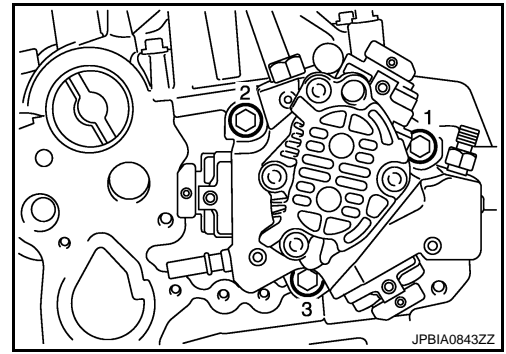
### CAUTION:

Be sure to check that the fuel pump is in contact with the cylinder head before tightening the mounting bolts.

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

 1st step: 5.0 N·m (0.51 kg·m, 4 ft·lb)

 2nd step: 25.0 N·m (2.6 kg·m, 18 ft·lb)



- Install the injection tube (center) and mounting rubber. Refer to [EM-288, "Exploded View"](#).
  - Finger tighten until contact the injection tube nuts.
- Install in the reverse order of removal, for the rest of parts.
  - Before starting engine, bleed air from fuel piping. Refer to [FL-17, "Air Bleeding"](#).

### NOTE:

Fill the fuel of at least 60 mℓ (2.11 Imp fl oz).

## Inspection

INFOID:000000001551235

## INSPECTION AFTER INSTALLATION

- Start the engine and check for fuel leak for one minute after starting.

### CAUTION:

After any operation, check that there are no diesel leaks. Refer to [EM-250, "Precaution for Diesel Equipment"](#).



# TIMING CHAIN

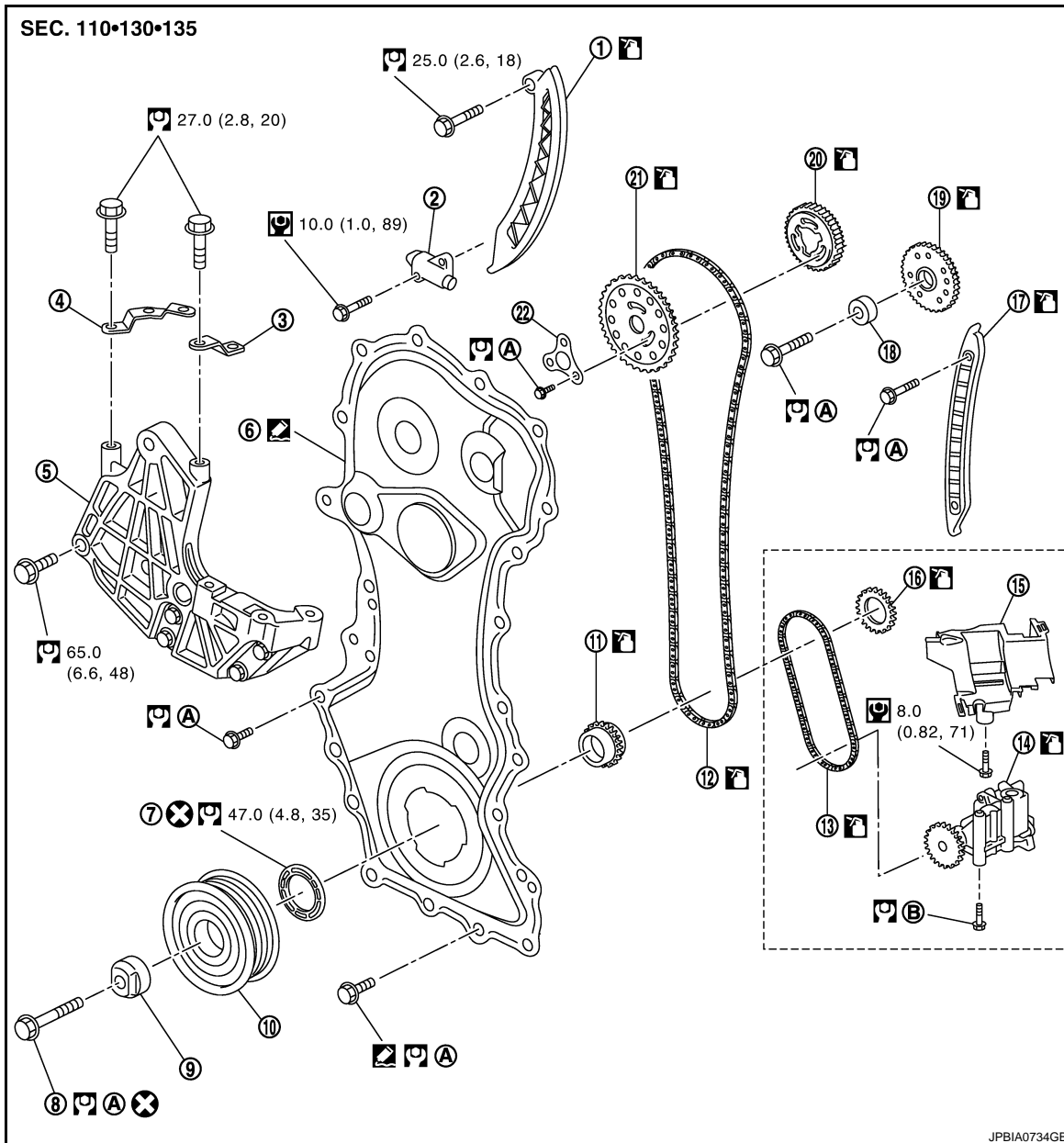
< ON-VEHICLE REPAIR >

[M9R]

## TIMING CHAIN

### Exploded View

INFOID:000000001160641



- |                                |                                |                                   |
|--------------------------------|--------------------------------|-----------------------------------|
| 1. Timing chain slack guide    | 2. Timing chain tensioner      | 3. Engine mounting stay (front)   |
| 4. Engine mounting stay (rear) | 5. Engine mounting bracket     | 6. Front cover                    |
| 7. Front oil seal              | 8. Crankshaft pulley bolt      | 9. Crankshaft spacer              |
| 10. Crankshaft pulley          | 11. Crankshaft sprocket        | 12. Timing chain                  |
| 13. Oil pump drive chain       | 14. Oil pump                   | 15. Oil pump baffle plate         |
| 16. Oil pump sprocket          | 17. Timing chain tension guide | 18. Wear compensation gear spacer |
| 19. Wear compensation gear     | 20. Timing sprocket (rear)     | 21. Timing sprocket (front)       |
| 22. Timing sprocket spacer     |                                |                                   |
- A. Refer to [EM-294](#)
- B. Refer to [EM-320](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

**NOTE:**

# TIMING CHAIN

[M9R]

< ON-VEHICLE REPAIR >

Oil pump related parts cannot be removed with an onboard condition. Refer to [EM-320. "Removal and Installation"](#).

## Removal and Installation

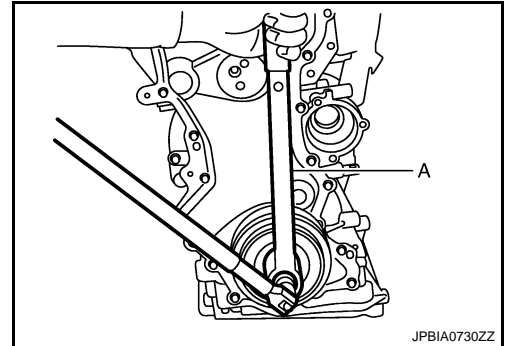
INFOID:000000001160642

### REMOVAL

#### CAUTION:

Never turn the engine in the direction opposite to that of normal operation.

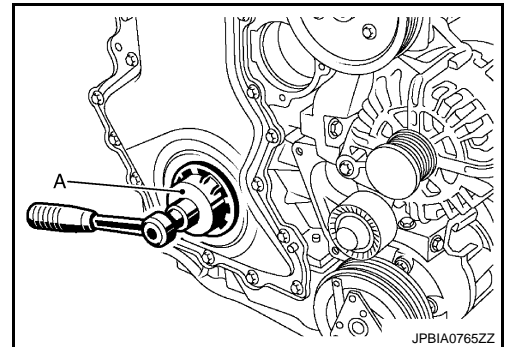
1. Drain engine oil. Refer to [LU-29. "Draining"](#).  
**CAUTION:**  
Perform this step when the engine is cold.
2. Disconnect the battery cable from the negative terminal.
3. Remove the following parts:
  - Engine undercover
  - Load wheel tire (RH)
  - Fender protector (RH): Refer to [EXT-21. "Exploded View"](#).
  - Drive belt: Refer to [EM-257. "Removal and Installation"](#).
  - Fuel filter: Refer to [FL-16. "Exploded View"](#).
4. Remove crankshaft pulley with the following procedure:
  - a. Set the crankshaft pulley locking tool [SST: — (Mot. 1770)] (A) and loosen crankshaft pulley bolt.



- b. Remove crankshaft pulley and spacer.
    - Pull crankshaft pulley with both hands to remove it.
5. Remove front oil seal.
    - Set logs of the service tool (A) the front oil seal notches. Turn counterclockwise until it locks.

#### NOTE:

The service tool is supplied in the new front oil seal parts kit.



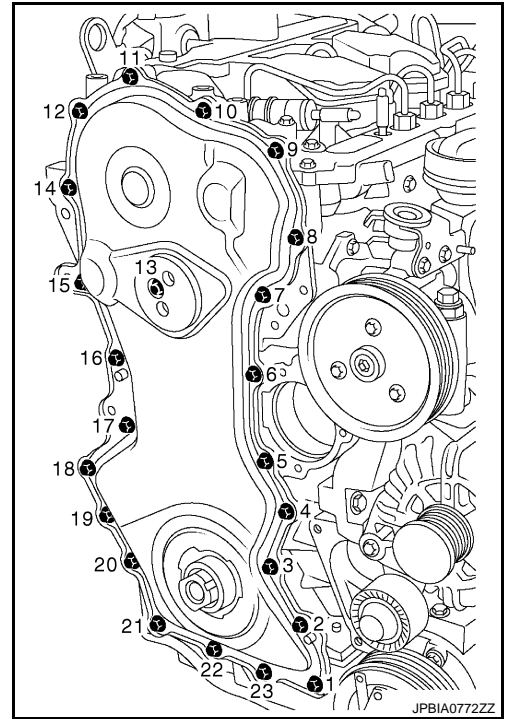
6. Remove the through bolt between lower torque rod and engine mounting bracket (rear), and hold the engine mounting bracket (rear) with a transmission jack. Refer to [EM-312. "Exploded View"](#).  
**CAUTION:**  
Never hold the oil pan (lower).
7. Remove the upper torque rod and the engine mounting insulator (RH). Refer to [EM-312. "Exploded View"](#).
8. Remove engine mounting bracket and engine mounting stay (front and rear).
9. Remove water pump pulley. Refer to [CO-86. "Exploded View"](#).
10. Remove front cover with the following procedure:

# TIMING CHAIN

[M9R]

## < ON-VEHICLE REPAIR >

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



- b. Use the seal cutter [SST: KV10111100 ( — )] to cut liquid gasket for removal.

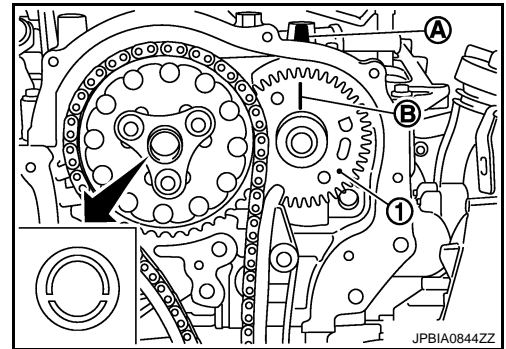
**CAUTION:**

**Never use a screwdriver or something similar.**

**NOTE:**

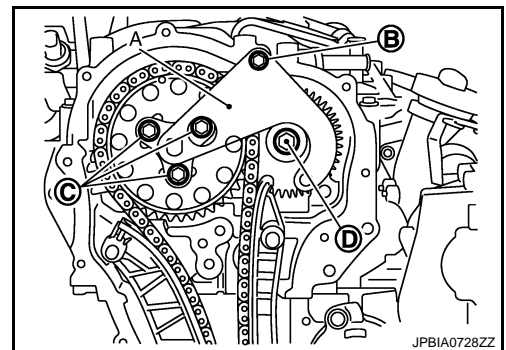
Unstick the front cover by hand, using a jerking motion to ensure it is not damaged.

11. Obtain No. 1 cylinder at TDC of its compression. Rotate crankshaft to set it in the position shown in the figure.
- Parallelize the groove of camshaft (right side) to face the offset side upward.
  - Fit the matching mark (B) of wear compensation gear (1) and boss (A) of cylinder head housing.



12. Remove the timing chain with the following procedure:

- a. Set the camshaft timing tool [SST: — (Mot.1769)] (A), and tighten mounting bolt [M6 × 50 mm (1.97 in)] (B).
- b. Loosen timing sprocket mounting bolts (C) and wear compensation gear mounting bolt (D).
- c. Remove the camshaft timing tool.



- d. Remove the timing chain tensioner.

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# TIMING CHAIN

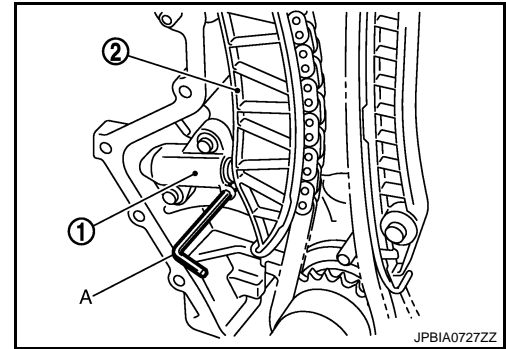
[M9R]

## < ON-VEHICLE REPAIR >

- Compress the timing chain tensioner (1) with timing chain slack guide (2), and then insert a stopper pin (A) into hole on timing chain tensioner.

**NOTE:**

Use approximately 3.0 mm (0.118 in) dia. hard metal pin as a stopper pin



- e. Remove timing chain slack guide and timing chain tension guide.
- f. Remove timing sprocket spacer, timing sprocket (front), crankshaft sprocket and timing chain.

**CAUTION:**

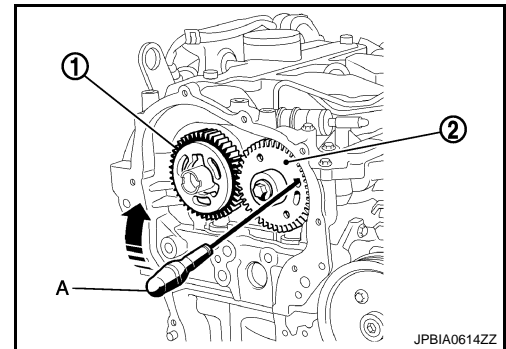
**Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.**

- g. Insert a screwdriver (A) and lift it up to move the gear of wear compensation gear (2).

**NOTE:**

To align two gear teeth of wear compensation gear.

- h. Remove timing sprocket (rear) (1) under the condition shown in Step "g".
- i. Remove wear compensation gear and spacer.



- 13. Remove oil pump related parts. Refer to [EM-320, "Removal and Installation"](#).

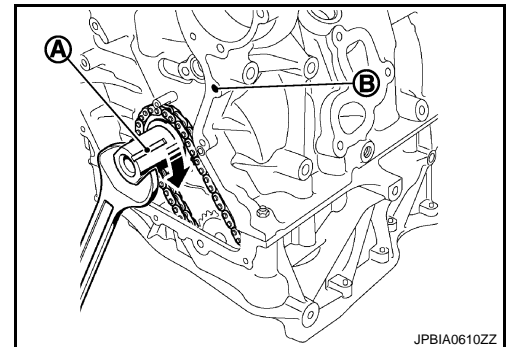
## INSTALLATION

- 1. Obtain No.1 cylinder at TDC of its compression stroke with the following procedure:

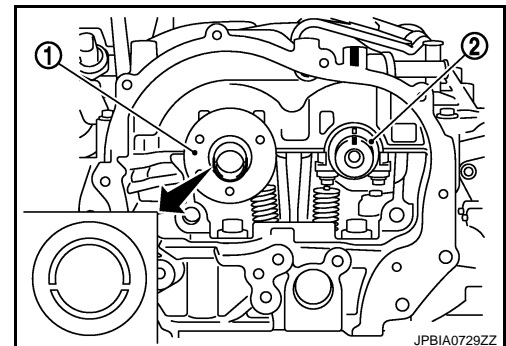
- a. Align the crankshaft groove (A) with the cylinder block hole (B).

**NOTE:**

This is for the purpose of preventing interferences of valve and piston head.



- b. Check that camshafts are located as shown in the figure.
  - Parallelize the groove of camshaft (right side) (1) to face the offset side upward.
  - Fit the matching mark of camshaft (left side) (2) and boss of cylinder head housing.

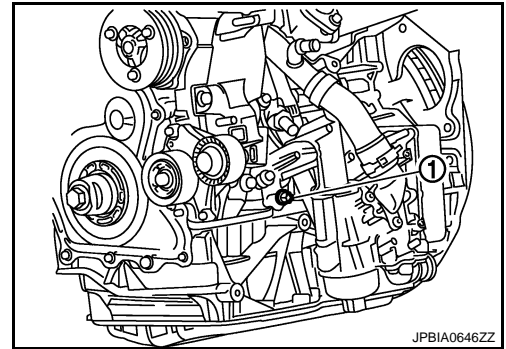


# TIMING CHAIN

< ON-VEHICLE REPAIR >

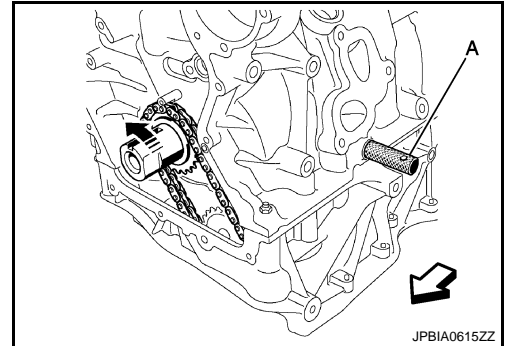
[M9R]

- c. Remove TDC pin plug (1).



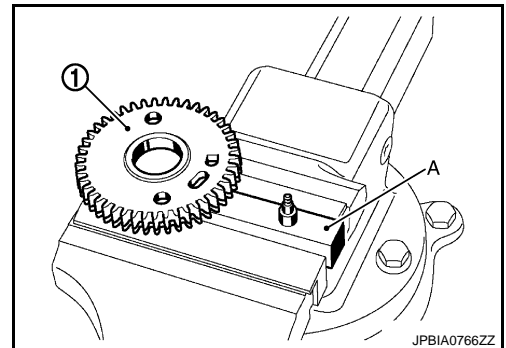
- d. Screw in the TDC set pin [SST: — (Mot. 1766)] (A). Turn the engine counterclockwise until the crankshaft touches the TDC set pin.

← : Engine front



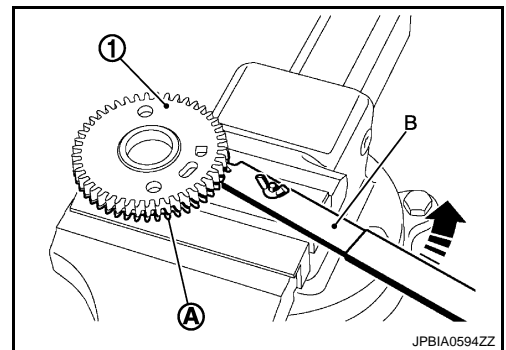
2. Install wear compensation gear with the following procedure:

- a. Set the wear compensation gear (1) on base plate of positioning tool [SST: — (Mot. 1773)] (A).



- b. Set the lever (B) in the lower gear teeth (A). Pivot the lever counterclockwise until the two gear teeth are aligned.

1 : Wear compensation gear



A  
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# TIMING CHAIN

[M9R]

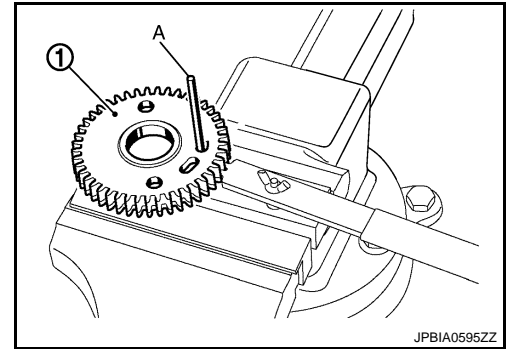
## < ON-VEHICLE REPAIR >

- c. Set a stopper pin (A) in the gear hole.

1 : Wear compensation gear

### NOTE:

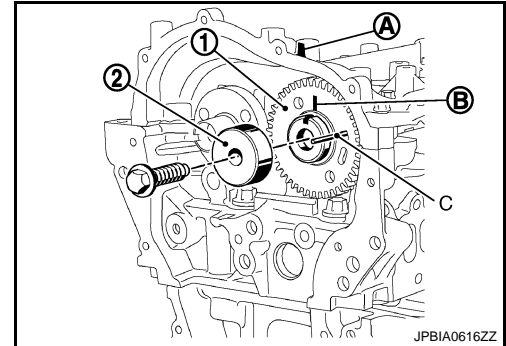
- Use approximately 4.0 mm (0.157 in) dia. hard metal pin as a stopper pin



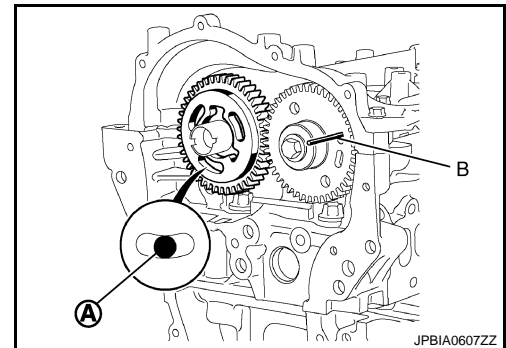
- d. Install wear compensation gear (1) and wear compensation gear spacer (2) to the camshaft (left side).
- e. Align matching mark (B) on wear compensation gear and boss (A) of cylinder head housing.

C : Stopper pin

- f. Temporarily tighten mounting bolt.



3. Install timing sprocket (rear) with the following procedure:
- a. Center the timing sprocket (rear) openings on the camshaft (right side) hub mounting holes (A).
- b. Set the timing sprocket (rear) fully onto the camshaft (right side) hub.
- c. Remove stopper pin (B).



# TIMING CHAIN

[M9R]

## < ON-VEHICLE REPAIR >

### 4. Install timing chain tension guide (2).

- A : Matching mark
- B : Matching mark (punched)
- C : Matching mark (notched)
- D : Matching mark

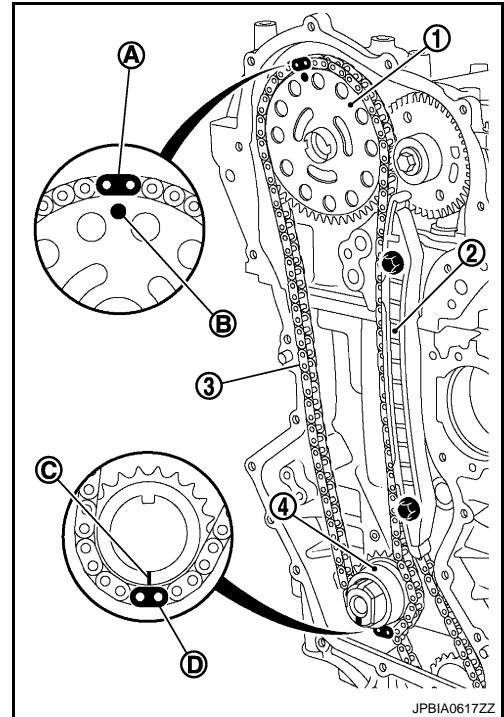
- Tighten timing chain tension guide mounting bolts in two steps.

 **1st step: 5.0 N·m (0.51 kg-m, 4 ft-lb)**

 **2nd step: 25.0 N·m (2.6 kg-m, 18 ft-lb)**

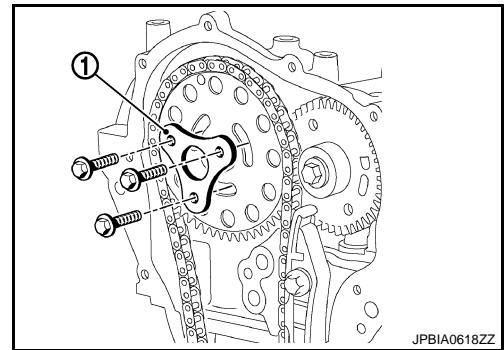
### 5. Install timing sprocket (front) (1), crankshaft sprocket (4) and timing chain (3).

- Align matching marks on each sprocket and timing chain.



### 6. Install timing sprocket spacer (1) on the timing sprocket (front) and temporarily tighten mounting bolt.

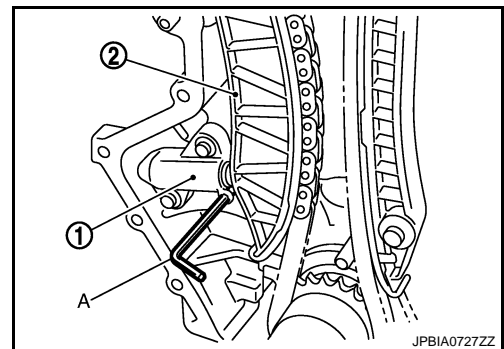
- Allow the timing sprocket to rotate freely.



### 7. Install timing chain slack guide (2).

### 8. Install timing chain tensioner (1).

- Check that the timing chain tensioner makes contact with the cylinder block before tightening the bolts.
- Pull out stopper pin (A) after installing, and the release plunger.



### 9. Tighten mounting bolts (timing sprockets and wear compensation gear) with the following procedure:



# TIMING CHAIN

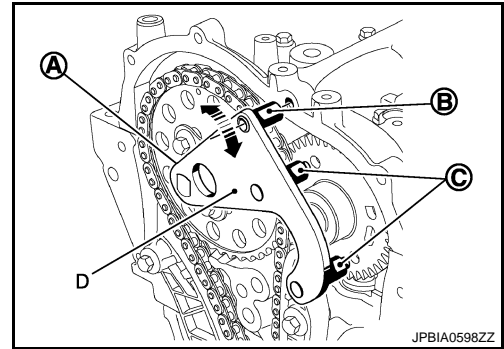
[M9R]

## < ON-VEHICLE REPAIR >

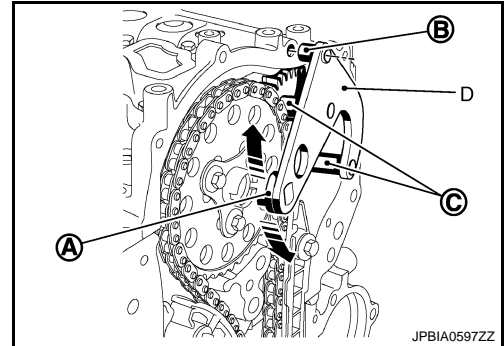
- a. Set the tool collet (A) of the timing adjustment tool [SST: — (Mot. 1769)] (D) in the camshaft groove (right side).

C : Tool pin

- b. Pivot the camshaft timing tool to align the axes of the spacer (B) and the bolt hole.



- c. Set tool pins (C) into the wear compensation gear holes.  
d. Pivot the camshaft timing tool [SST: — (Mot. 1769)] (D) to align the axes of the spacer (B) and the bolt hole.  
e. Set the tool collet (A), without force, into the camshaft groove (right side).



- f. Set the mounting bolt [M6 × 50 mm (1.97 in)] (B) onto spacer of the timing adjustment tool [SST: — (Mot. 1769)] (A).  
g. Tighten timing sprocket mounting bolts (C).

: 10.0 N·m (1.0 kg-m, 7 ft-lb)

- h. Turn 40 degrees clockwise (angle tightening).  
i. Tighten wear compensation gear mounting bolt (D).

: 20.0 N·m (2.0 kg-m, 15 ft-lb)

- j. Turn 35 degrees clockwise (angle tightening).

### CAUTION:

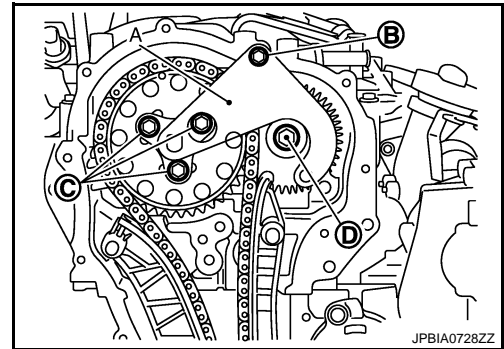
Check the tightening angle by using an angle wrench [SST: KV10112100 (—)] or protractor. Never judge by visual inspection without an angle wrench.

- k. Remove timing adjustment tool.  
10. Remove the TDC set pin [SST: — (Mot.1766)].  
11. Apply liquid gasket to TDC pin plug, and tighten it.

Tightening torque : 25.0 N·m (2.6 kg-m, 18 ft-lb)

Use Genuine Liquid Gasket or equivalent.

12. Install front cover with the following procedure:





# TIMING CHAIN

[M9R]

## < ON-VEHICLE REPAIR >

- a. Apply liquid gasket to the front cover side, referring to the application point shown in the figure.

**A (upper side):**

**2.5 - 4.5 mm (0.098 - 0.177 in) in diameter**

**B (lower side):**

**3.0 - 7.0 mm (0.118 - 0.276 in) in diameter**

**C area:**

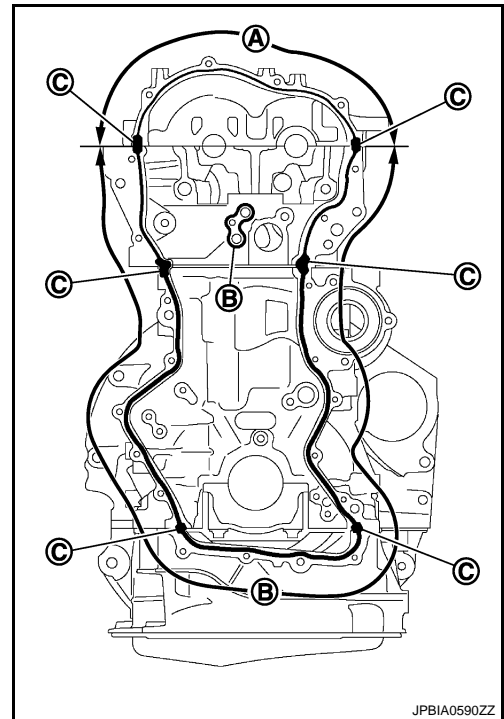
**9.0 - 13.0 mm (0.354 - 0.512 in) in diameter and**

**10.0 - 15.0 mm (0.394 - 0.591 in) long**

**Use Genuine Liquid Gasket or equivalent.**

**NOTE:**

Liquid gasket should be applied to the front cover side because the workspace is narrow.



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

- i. Tighten No. 1 to 23 in numerical order as shown.

- Apply liquid gasket to No. 23 bolt.

**Use Genuine Liquid Gasket or equivalent.**

: **5.0 N·m (0.51 kg·m, 4 ft·lb)**

- ii. Tighten No. 1 to 22 in numerical order as shown.

: **16.0 N·m (1.6 kg·m, 12 ft·lb)**

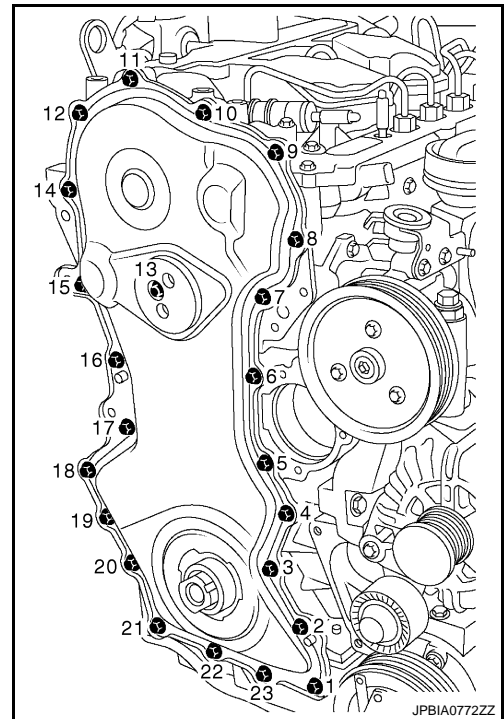
- iii. Tighten No. 23 bolt.

: **18.0 N·m (1.8 kg·m, 13 ft·lb)**

- Refer to the following for the installation position of bolts.

**M8: No. 23**

**M6: Except the above**



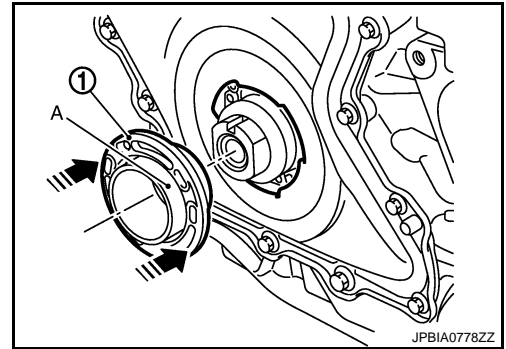
13. Install front oil seal with the following procedure:

# TIMING CHAIN

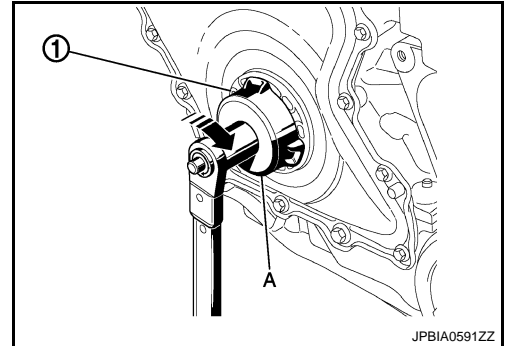
[M9R]

## < ON-VEHICLE REPAIR >

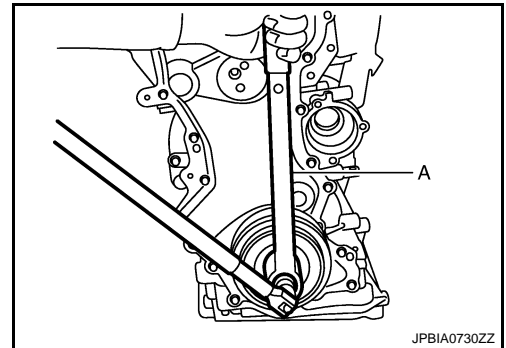
- a. Fit the protector (A) to front oil seal (1).
  - Align the front oil seal notches with front cover notches.**NOTE:**  
The protector is supplied in the new front oil seal parts kit.



- b. Tighten to front oil seal (1) using service tool (A).**NOTE:**  
The service tool is supplied in the new front oil seal parts kit.



- c. Remove the protector.
14. Install crankshaft pulley with the following procedure:
  - a. Secure crankshaft pulley with a crankshaft pulley locking tool [SST: — (Mot. 1770)] (A).



- b. Tighten crankshaft pulley bolt.

: 50.0 N·m (5.1 kg-m, 37 ft-lb)

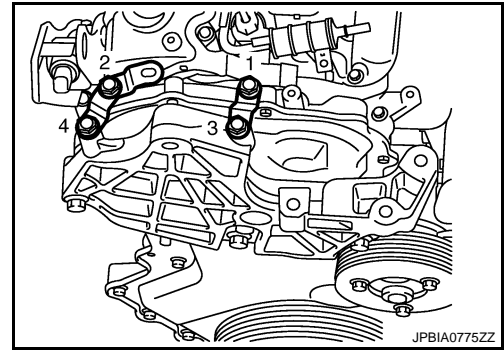
- c. Turn 85 degrees clockwise (angle tightening).**CAUTION:**  
**Check the tightening angle by using an angle wrench [SST: KV10112100 ( — )] or protractor. Never judge by visual inspection without an angle wrench.**
- d. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
15. Install engine mounting bracket and engine mounting stay (front and rear) with the following procedure:
  - a. Temporarily tighten engine mounting bracket bolts.
  - b. Temporarily tighten engine mounting stay (front and rear) bolts.

# TIMING CHAIN

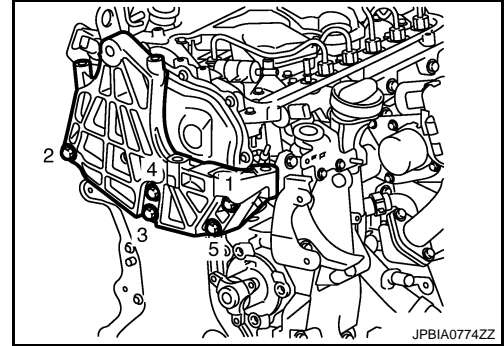
[M9R]

## < ON-VEHICLE REPAIR >

- c. Tighten engine mounting stay (front and rear) bolts in numerical order as shown in the figure.



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



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

## Inspection

INFOID:000000001550889

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

- 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-22, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
  - 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:

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

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

# CAMSHAFT

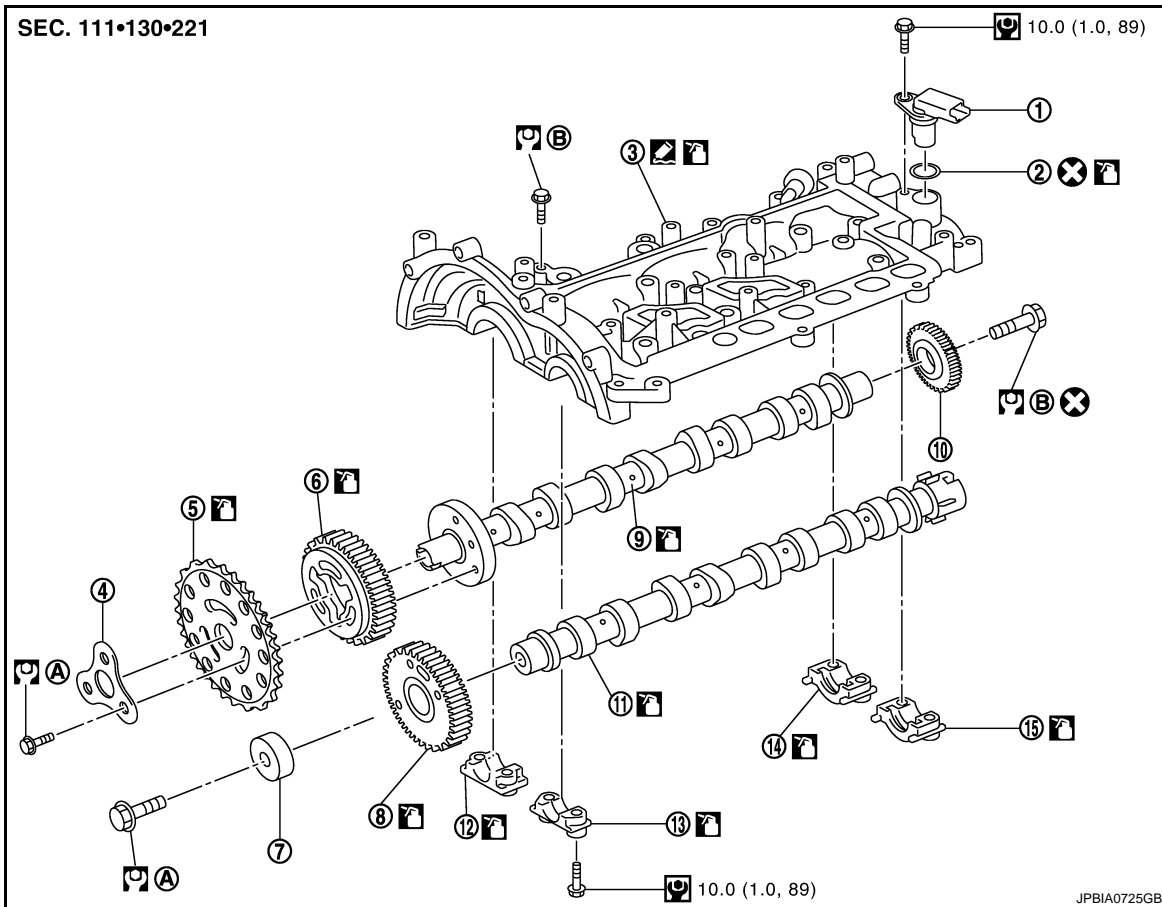
< ON-VEHICLE REPAIR >

[M9R]

## CAMSHAFT

Exploded View

INFOID:000000001277899



- |                                       |                            |                           |
|---------------------------------------|----------------------------|---------------------------|
| 1. Camshaft position sensor           | 2. O-ring                  | 3. Cylinder head housing  |
| 4. Timing sprocket spacer             | 5. Timing sprocket (front) | 6. Timing sprocket (rear) |
| 7. Wear compensation gear spacer      | 8. Wear compensation gear  | 9. Camshaft (right side)  |
| 10. Camshaft sprocket (for fuel pump) | 11. Camshaft (left side)   | 12. Camshaft bracket      |
| 13. Camshaft bracket                  | 14. Camshaft bracket       | 15. Camshaft bracket      |
- A. Refer to [EM-294](#)  
 B. Refer to [EM-304](#)

Refer to [GI-4, "Components"](#) for symbols shown in the figure.

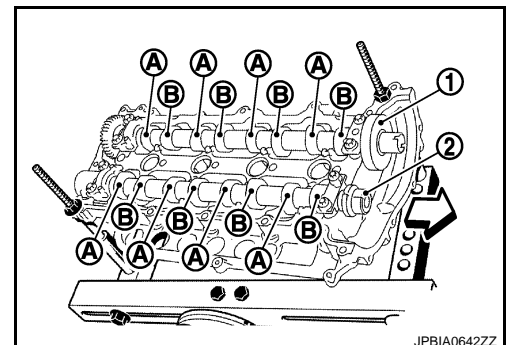
## Removal and Installation

INFOID:000000001277900

### CAUTION:

- This engine has a different valve arrangement from normal DOHC 4-valve type engines. As both camshafts on this engine have intake and exhaust camshafts.
- Refer to the figure for intake and exhaust valve arrangement. (The camshafts have, alternately, either intake valve or an exhaust valve.)

- |                          |
|--------------------------|
| 1. Camshaft (right side) |
| 2. Camshaft (left side)  |
| A. Intake cam            |
| B. Exhaust cam           |
| ← : Engine front         |



# CAMSHAFT

[M9R]

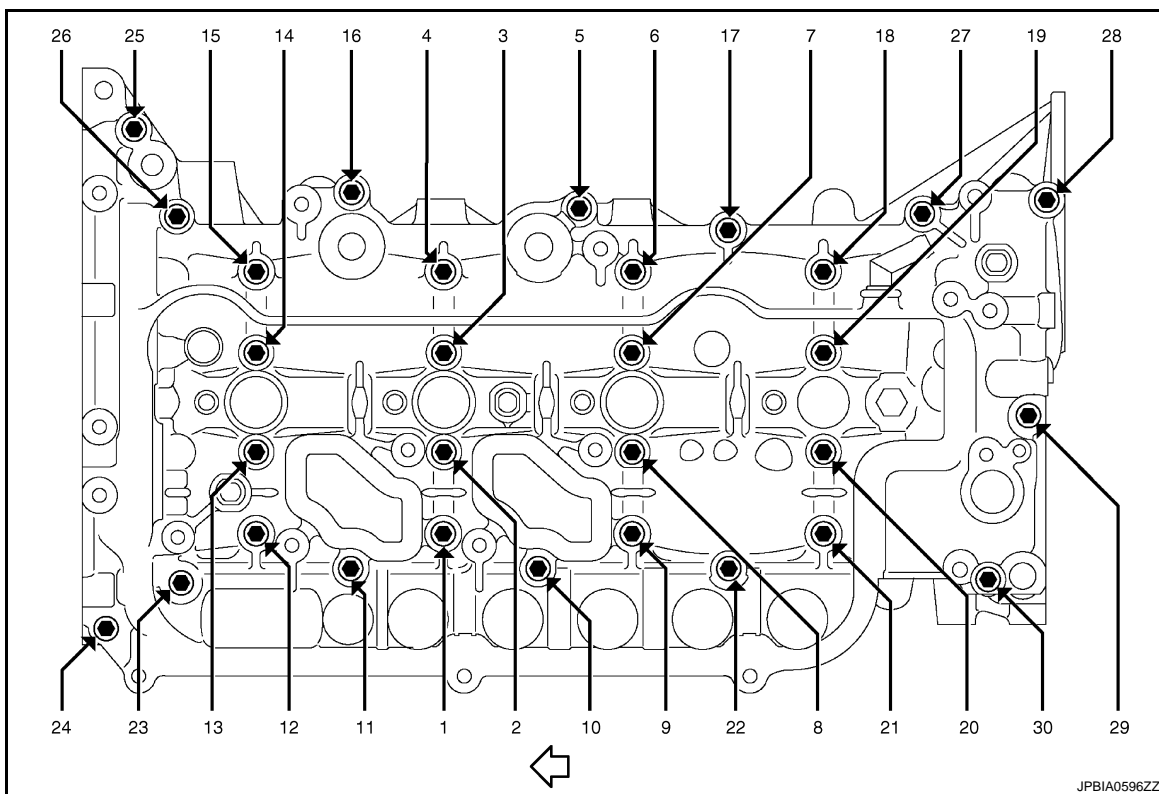
< ON-VEHICLE REPAIR >

## REMOVAL

1. Remove the following parts.
  - Oil separator: Refer to [EM-286, "Exploded View"](#).
  - Fuel injector: Refer to [EM-288, "Exploded View"](#).
  - Engine slinger (front side): Refer to [EM-323, "Exploded View"](#).
  - Front cover and timing chain related parts: Refer to [EM-293, "Exploded View"](#).
  - Fuel pump: Refer to [EM-291, "Exploded View"](#).
  - Vacuum pump: Refer to [EM-284, "Exploded View"](#).
2. Remove camshaft position sensor.

**CAUTION:**

  - **Handle camshaft position sensor carefully and avoid impacts.**
  - **Never disassemble camshaft position sensor.**
  - **Never place sensor where it is exposed to magnetism.**
3. Remove cylinder head housing with the following procedure:
  - a. Loosen mounting bolts in reverse order as shown in the figure.

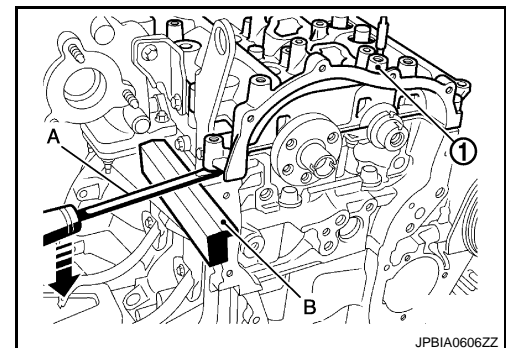


← : Engine front

- b. Remove the cylinder head housing (1) using a flat-blade screwdriver (A).

B : Protective shim (suitable tool)

**CAUTION:**  
**Be careful not to damage the mating surface.**



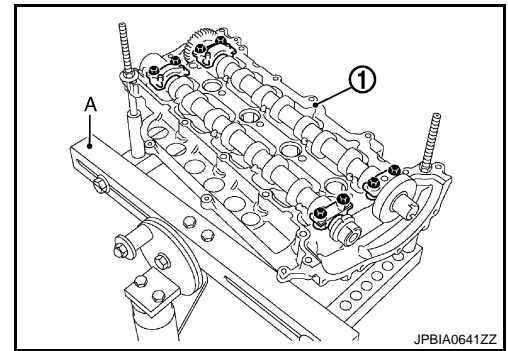
4. Remove camshafts with the following procedure:

# CAMSHAFT

[M9R]

## < ON-VEHICLE REPAIR >

- a. Install cylinder head housing (1) to cylinder head stand [commercial service tool: KV113B0200 (Mot.1573)] (A).
- b. Loosen mounting bolts, and remove camshaft brackets and camshafts.
  - Mark camshafts and camshaft brackets so they are placed in the same position and direction for installation.




5. Remove camshaft sprocket (for fuel pump) from camshaft (right side), if necessary.

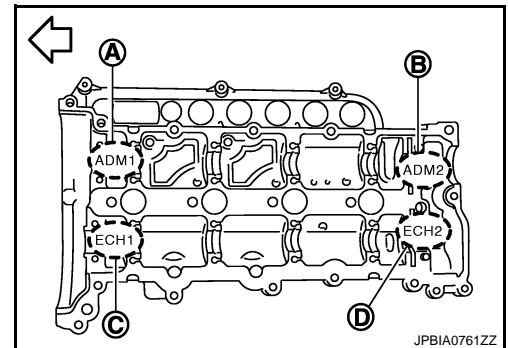
## INSTALLATION

1. When camshaft sprocket (for fuel pump) is removed, install it.
  - a. Tighten mounting bolt.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- b. Turn 34 degrees clockwise (angle tightening).
2. Install camshaft to cylinder head housing with the following procedure:
  - a. Clean camshaft journal to remove any foreign material.
  - b. Install camshafts.
  - c. Refer to the figure to install camshaft bracket in its original.

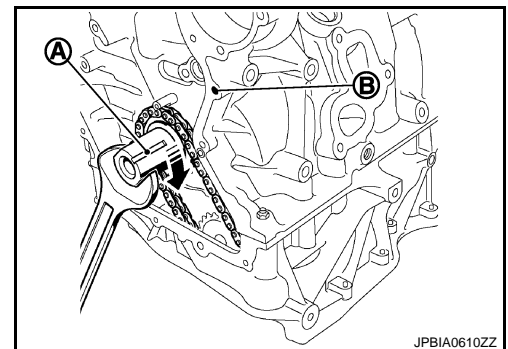
- A. : Part marking ADM1
- B. : Part marking ADM2
- C. : Part marking ECH1
- D. : Part marking ECH2
-  : Engine front



- d. Tighten camshaft bracket mounting bolts.
  - Finger tighten the camshaft bracket mounting bolts, until they just make contact.
3. Install cylinder head housing with the following procedure:
  - a. Align the crankshaft groove (A) with the cylinder block hole (B).

### NOTE:

This is for the purpose of preventing interferences of valve and piston head.



- b. Remove foreign material completely from cylinder head housing backside and cylinder head installation face.

# CAMSHAFT

[M9R]

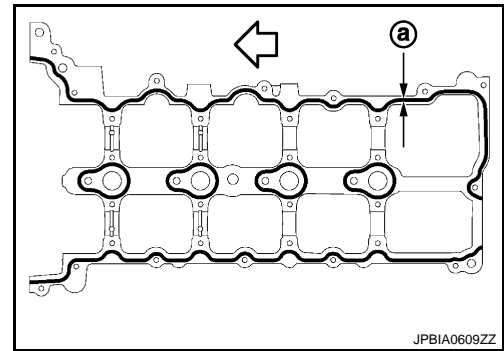
## < ON-VEHICLE REPAIR >

c. Apply liquid gasket to cylinder head as shown in the figure.

a : 0.5 - 2.5 mm (0.020 - 0.098 in)

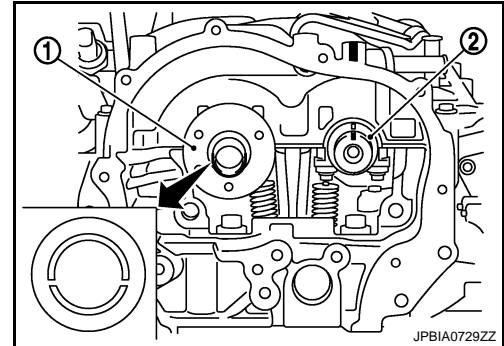
⇐ : Engine front

**Use Genuine Liquid Gasket or equivalent.**

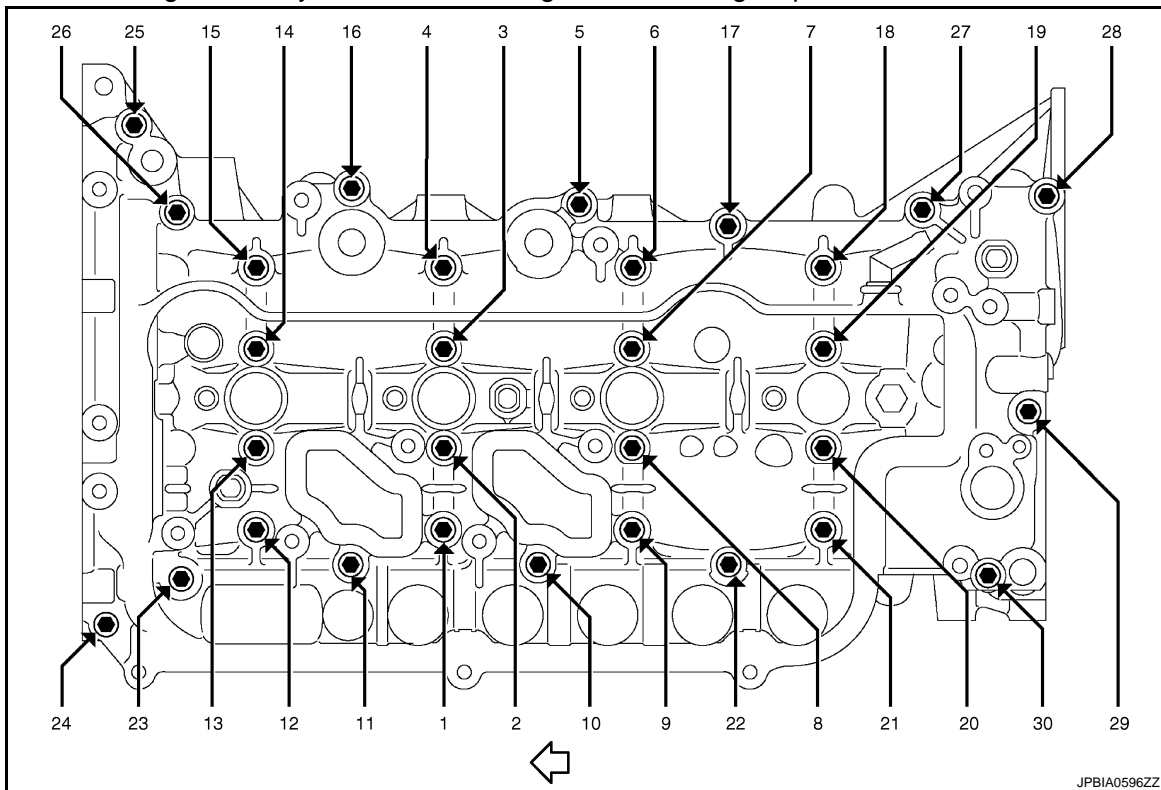


d. Install so that camshafts are positioned in the directions shown in the figure.

- Parallelize the groove of camshaft (right side) (1) to face the offset side upward.
- Fit the groove of camshaft (left side) (2) and boss of cylinder head housing.



e. Tighten mounting bolts of cylinder head housing in the following steps.



⇐ : Engine front


- Tighten in order and successively, the cylinder head housing bolts No. 2, 7, 14 and 20 to gradually fit the cylinder head housing on the cylinder head.
- Tighten the remaining bolts (temporarily).
- Loosen bolts No. 2, 7, 14 and 20.
- Tighten the bolts No. 2, 7, 14 and 20 (temporarily).
- Tighten bolts in numerical order.

A  
EM  
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P



: 5.0 N·m (0.51 kg-m, 4 ft-lb)

vi. Tighten bolts in numerical order.

: 12.0 N·m (1.2 kg-m, 9 ft-lb)

**CAUTION:**

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

4. Install timing chain and related parts. Refer to [EM-294, "Removal and Installation"](#).
5. Install in the reverse order of removal, for the rest of parts

## Inspection

INFOID:000000001277901

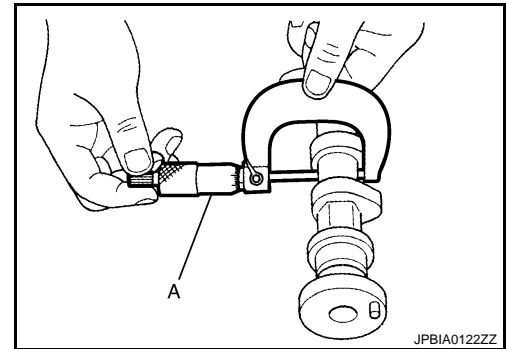
### INSPECTION AFTER REMOVAL

Camshaft Journal oil clearance

#### CAMSHAFT JOURNAL

- Measure the camshaft journal with a micrometer (A).

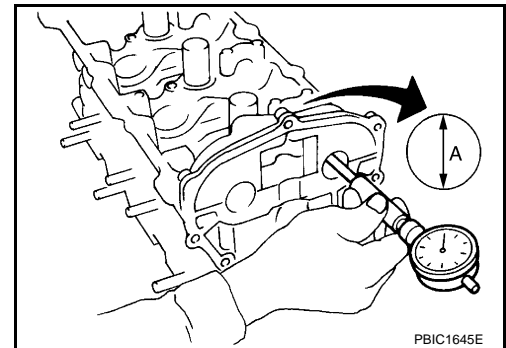
**Standard** : Refer to [EM-330, "Camshaft"](#).



#### CYLINDER HEAD HOUSING AND CAMSHAFT BRACKET INNER DIAMETER

- Measure the inner diameter (A) of cylinder head housing and camshaft bracket with a bore gauge.

**Standard** : Refer to [EM-330, "Camshaft"](#).



#### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard** : Refer to [EM-330, "Camshaft"](#).

- If it exceeds the standard, replace camshaft or/and cylinder head housing and cylinder head assembly.

**NOTE:**

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

### INSPECTION AFTER INSTALLATION

Inspection for Leaks

- 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-22, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.



# CAMSHAFT

**[M9R]**

**< ON-VEHICLE REPAIR >**

- 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.

A  
EM

Summary of the inspection items:

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

C  
D  
E

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

F  
G  
H  
I  
J  
K  
L  
M  
N  
O  
P

## OIL SEAL

## FRONT OIL SEAL

## FRONT OIL SEAL : Removal and Installation

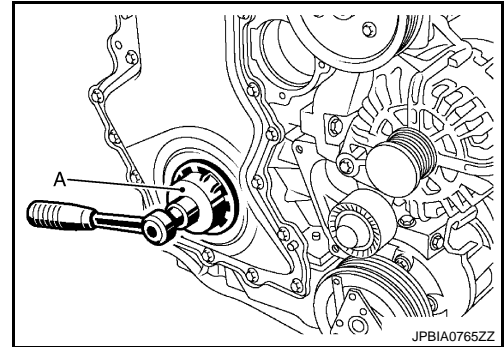
INFOID:000000001277903

## REMOVAL

1. Remove the following parts.
  - Front fender protector (RH): Refer to [EXT-19, "Exploded View"](#).
  - Drive belt: Refer to [EM-257, "Removal and Installation"](#).
  - Crankshaft pulley: Refer to [EM-293, "Exploded View"](#).
2. Remove front oil seal using service tool (A).

**NOTE:**

The service tool is supplied in the new seal parts kit.

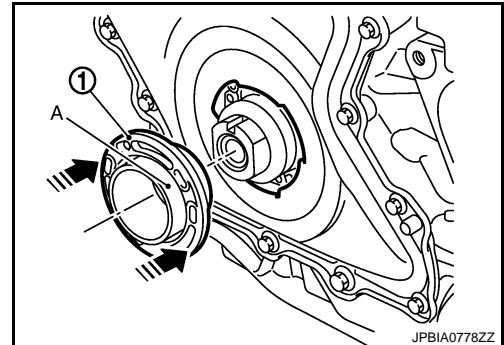


## INSTALLATION

1. Install front oil seal with the following procedure:
  - a. Fit the protector (A) to front oil seal (1).
    - Align the front oil seal notches with front cover notches.

**NOTE:**

The protector is supplied in the new seal parts kit.

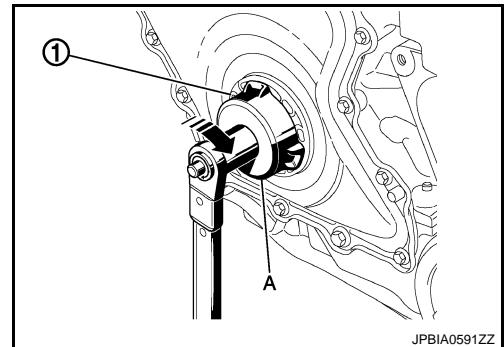


- b. Tighten to front oil seal (1) using service tool (A).

**Tightening torque:** Refer to [EM-293, "Exploded View"](#).

**NOTE:**

The service tool is supplied in the new seal parts kit.



- c. Remove the protector.
2. Install in the reverse order of removal, for the rest of parts.

## REAR OIL SEAL

## REAR OIL SEAL : Removal and Installation

INFOID:000000001277904

## REMOVAL

# OIL SEAL

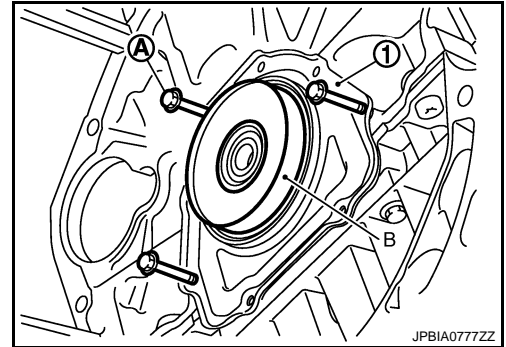
[M9R]

## < ON-VEHICLE REPAIR >

1. Remove transaxle assembly. Refer to [TM-85, "Exploded View"](#) (M/T models) or [TM-351, "Exploded View"](#) (A/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to [CL-20, "M9R : Exploded View"](#).
3. Remove drive plate (A/T models) or flywheel (M/T models).
4. Remove rear oil seal retainer.

## INSTALLATION

1. Install rear oil seal retainer with the following procedure:
  - a. Set guide bolt (A) and protector (B) to rear oil seal retainer (1).  
**NOTE:**  
The protector is supplied in the new seal parts kit.
  - b. Move the rear oil seal retainer evenly by hand until it makes contact with the cylinder block.

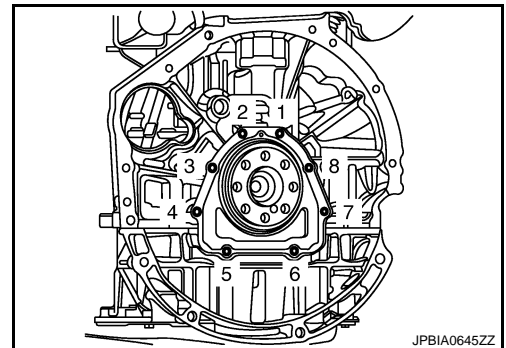


- c. Remove guide bolts and protector.
- d. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.
- i. Tighten bolts No. 1 and 5.

: **5.0 N·m (0.51 kg·m, 44 in-lb)**

- ii. Tighten No. 1 to 8 in numerical order as shown.

: **10.0 N·m (1.0 kg·m, 89 in-lb)**



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

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

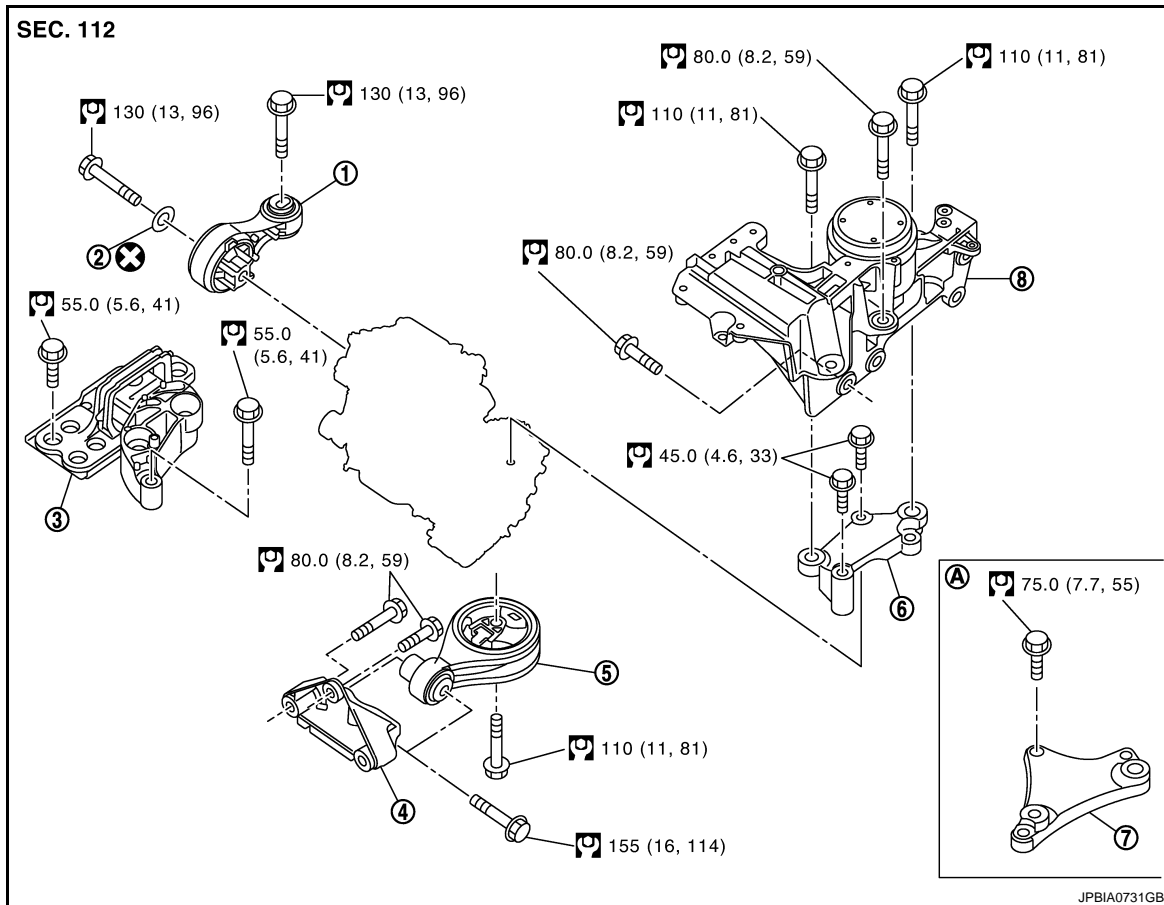
P

## REMOVAL AND INSTALLATION

### ENGINE ASSEMBLY

#### Exploded View

INFOID:000000001277909



- |  |                                   |  |
|--|-----------------------------------|--|
| 1. Upper torque rod                          | 2. Washer                         | 3. Engine mounting insulator (RH)            |
| 4. Rear engine mounting bracket              | 5. Rear torque rod                | 6. Engine mounting bracket (LH) (M/T models) |
| 7. Engine mounting bracket (LH) (A/T models) | 8. Engine mounting insulator (LH) |  |
| A. A/T models                                |                                   |  |

Refer to [GI-4. "Components"](#) for symbols in the figure.

#### Removal and Installation

INFOID:000000001277910

#### WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.

#### 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.
- 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-33. "Garage Jack and Safety Stand and 2-Pole Lift"](#).

# ENGINE ASSEMBLY

[M9R]

## < REMOVAL AND INSTALLATION >

### REMOVAL

#### Outline

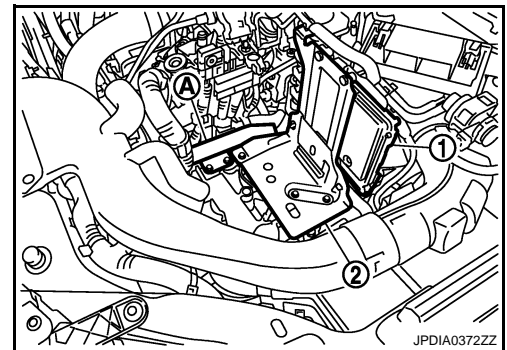
Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

#### Preparation

1. Drain engine coolant from radiator. Refer to [CO-68, "Draining"](#).  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belt.
2. Remove the following parts.
  - Engine undercover
  - Engine cover: Refer to [EM-265, "Exploded View"](#).
  - Front fender protector (RH and LH): Refer to [EXT-21, "Exploded View"](#).
  - Road wheels tire (RH and LH): Refer to [WT-4, "Road Wheel"](#).
  - Battery and battery tray: Refer to [PG-133, "Exploded View"](#).
  - Air inlet tubes and air inlet hoses: Refer to [EM-266, "Exploded View"](#).
  - Air duct (inlet) and air duct/air cleaner case assembly: Refer to [EM-263, "Exploded View"](#).
  - Radiator hose (upper and lower) and cooling fan assembly: Refer to [CO-73, "Exploded View"](#).
  - Exhaust front tube: Refer to [EX-14, "Exploded View"](#).

#### Engine Room LH

1. Remove ECM (1) and bracket (2) as a set.
2. Remove harness bracket (A) from engine mounting insulator (LH).



3. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness into the engine side.  
**CAUTION:**  
**Protect connectors using a resin bag against foreign materials during the operation.**
4. Disconnect fuel hoses from fuel pump. Refer to [EM-288, "Exploded View"](#).
5. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining. Refer to [CO-83, "Exploded View"](#).
6. Disconnect control cable (A/T models) or shift cable/select cable (M/T models) from transaxle. Refer to [TM-343, "Exploded View"](#) (A/T models) or [TM-21, "Exploded View"](#) (M/T models).
7. Remove ground cable from transaxle side.
8. Disconnect vacuum hose from brake booster. Refer to [EM-284, "Exploded View"](#).

#### Engine Room RH

1. Remove fuel filter. Refer to [FL-16, "Exploded View"](#).
2. Remove ground cable.
3. Disconnect reservoir tank hose (lower) from water suction pipe. Refer to [CO-73, "Exploded View"](#).
4. Remove alternator. Refer to [CHG-23, "M9R MODELS : Exploded View"](#).
5. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [HA-47, "M9R : Exploded View"](#).

#### Vehicle Underbody

1. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-67, "FRONT WHEEL SENSOR : Exploded View"](#).

# ENGINE ASSEMBLY

[M9R]

## < REMOVAL AND INSTALLATION >

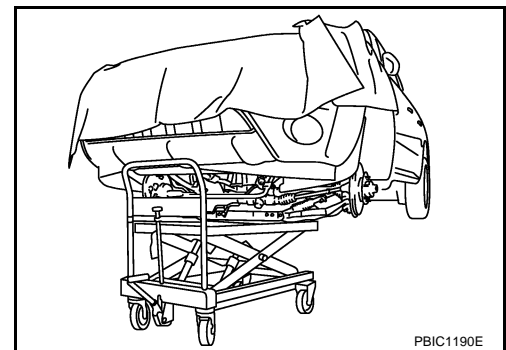
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-42, "BRAKE CALIPER ASSEMBLY : Exploded View"](#).
3. Remove two mounting bolts which fix steering knuckle and strut. Refer to [FSU-20, "Exploded View"](#).
4. Remove rear torque rod.
5. Remove propeller shaft (4WD models). Refer to [DLN-121, "Exploded View"](#).
6. Remove drive shaft (LH and RH). Refer to [FAX-26, "M9R : Exploded View"](#) (2WD models) or [FAX-68, "M9R : Exploded View"](#) (4WD models).
7. Remove stabilizer connecting rod mounting nut and cap at strut side (RH and LH). Refer to [FSU-20, "Exploded View"](#).
8. Disconnect intermediate shaft to steering column assembly. Refer to [ST-10, "Exploded View"](#).
9. Remove turbocharger cooling pump and bracket assembly. Refer to [EM-275, "Exploded View"](#).
10. Remove differential exhaust pressure sensor and bracket assembly. Refer to [EX-14, "Exploded View"](#).
11. Disconnect clutch pipe. Refer to [CL-14, "Exploded View"](#).
12. Remove front suspension member. Refer to [FSU-20, "Exploded View"](#).
13. 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-320, "Exploded View"](#).

### Removal

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

**CAUTION:**

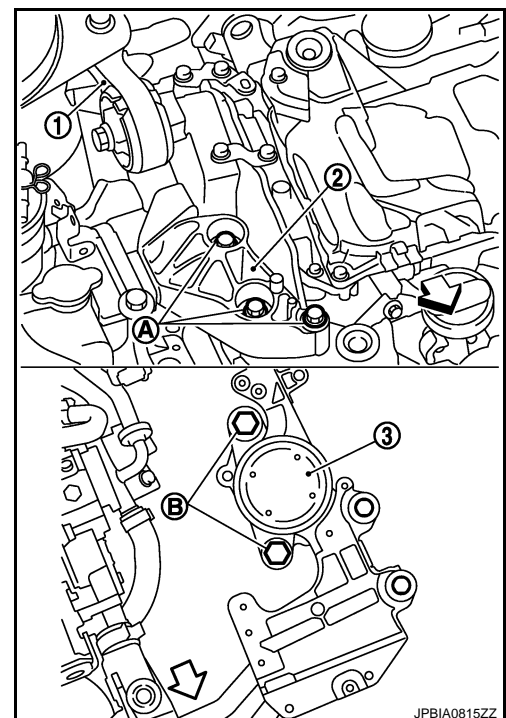
**Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.**



2. Remove upper torque rod (1).

← :Vehicle front

3. Remove three mounting bolts (A) on engine mounting insulator (RH) (2).
4. Remove two mounting bolts (B) on engine mounting insulator (LH) (3).



# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[M9R]

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

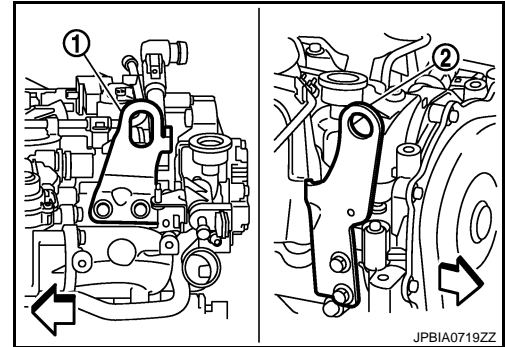
**CAUTION:**

- 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

- Set a hoist to engine slinger (rear side) (1) and engine slinger (front side) (2).

← : Engine front



- Remove starter motor. Refer to [STR-22, "M9R MODELS : Exploded View"](#).
- Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-85, "Exploded View"](#) (M/T models) or [TM-351, "Exploded View"](#) (A/T models).

## INSTALLATION

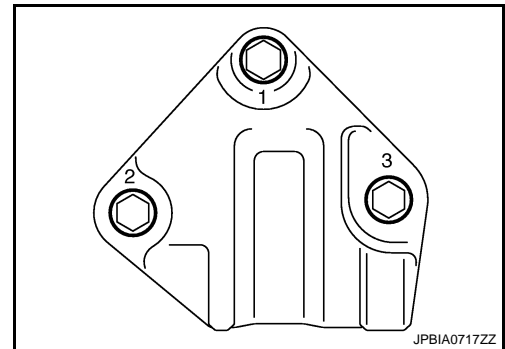
Note the following, and install in the reverse order of removal.

**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.

### Preparation

- Install the engine mounting bracket (rear) to the engine with the following procedure:
  - Tighten the bolt No. 1 as shown in the figure (temporarily).
  - Tighten the bolts No. 2, 3 in numerical order as shown in the figure (specified torque).
  - Tighten the bolt No. 1 as shown in the figure (specified torque).



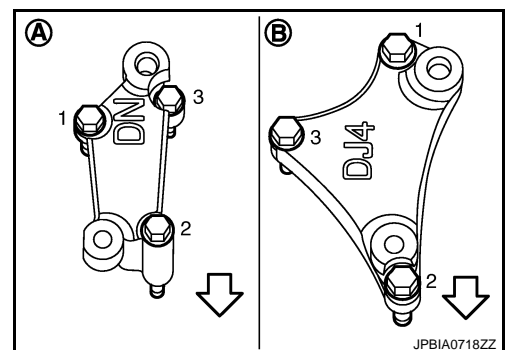
- Install the engine mounting bracket (LH) to the transaxle with the following procedure:

A : M/T models

B : A/T models

← : Vehicle front

- Tighten the bolt No. 1 as shown in the figure (temporarily).
- Tighten the bolts No. 2, 3 in numerical order as shown in the figure (specified torque).
- Tighten the bolt No. 1 as shown in the figure (specified torque).



- Install the engine mounting insulator (LH) to the body with the following procedure:

# ENGINE ASSEMBLY

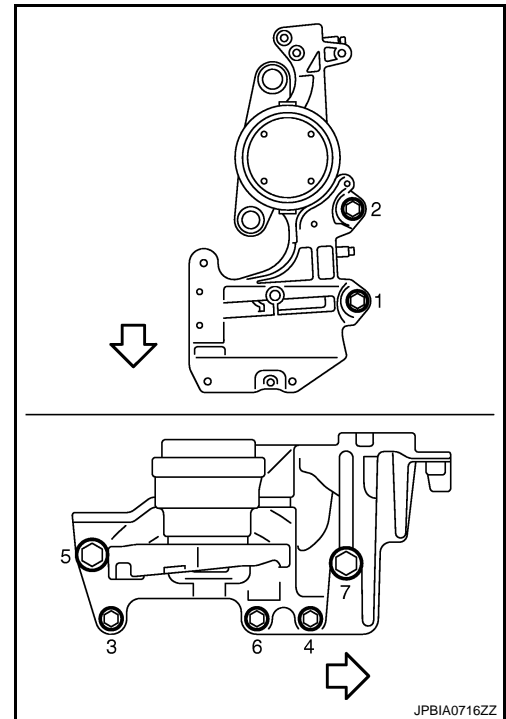
[M9R]

## < REMOVAL AND INSTALLATION >

- a. Tighten the bolt No. 7 as shown in the figure (temporarily).

⇐ :Vehicle front

- b. Tighten the bolts in numerical order as shown in the figure (specified torque).



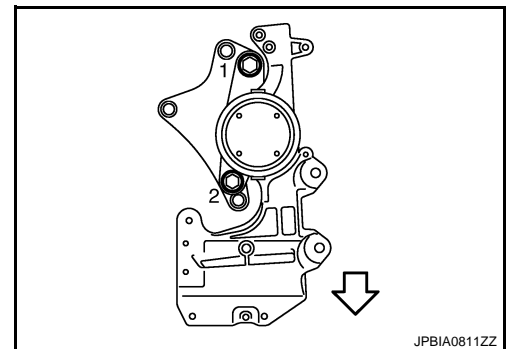
4. Install the engine mounting insulator (RH) and upper torque rod to the body (temporarily).

### Installation

1. Tighten the mounting bolt of rear torque rod (specified torque).
2. Install the engine mounting insulator (LH) to the transaxle side with the following procedure:

⇐ :Vehicle front

- a. Tighten the bolt No. 1 as shown in the figure (temporary).
- b. Tighten the bolt No. 2 as shown in the figure (temporary).
- c. Tighten the bolt No. 1 to the specified torque.
- d. Tighten the bolt No. 2 to the specified torque.

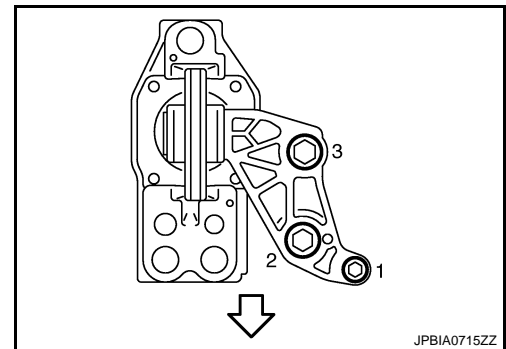


3. Install the engine mounting insulator (RH) to the engine side.

- a. Tighten the bolt No. 3 as shown in the figure (temporarily).

⇐ :Vehicle front

- b. Tighten the bolts in numerical order as shown in the figure (specified torque).



4. Tighten mounting bolts of engine mounting insulator (RH) to the body (specified torque).
5. Tighten mounting bolts of upper torque rod (specified torque).

### Inspection

INFOID:000000001277911

### INSPECTION AFTER INSTALLATION



# ENGINE ASSEMBLY

[M9R]

## < REMOVAL AND INSTALLATION >

### Inspection for Leaks

- 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-22. "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
- 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:

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

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

A  
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**DISASSEMBLY AND ASSEMBLY****ENGINE STAND SETTING****Setting**

INFOID:000000001277877

**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-312, "Exploded View"](#).

2. Install engine to engine stand with the following procedure:

a. Remove flywheel (M/T models) or drive plate (A/T models).

- Secure crankshaft using a crankshaft pulley locking tool [SST: — (Mot.1770)], and remove mounting bolts.

**CAUTION:**

**Never disassemble them.**

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 225 kg (496 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-270, "Exploded View"](#).

- Exhaust manifold: Refer to [EM-278, "Exploded View"](#).

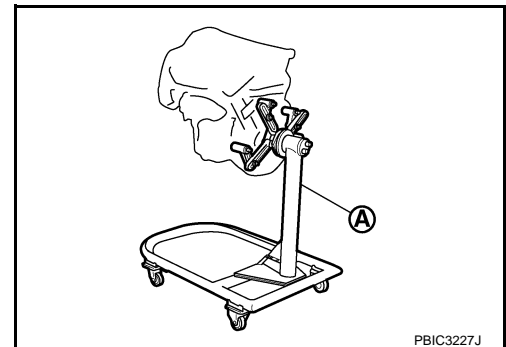
- Oil separator: Refer to [EM-286, "Exploded View"](#).

**NOTE:**

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

**CAUTION:**

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



PBIC3227J

3. Drain engine oil. Refer to [LU-29, "Draining"](#).

**CAUTION:**

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

## ENGINE UNIT

### Disassembly

INFOID:000000001277878

1. Remove multifunction support bracket. Refer to [EM-261, "Exploded View"](#).
2. Remove intake manifold. Refer to [EM-270, "Exploded View"](#).
3. Remove exhaust manifold. Refer to [EM-278, "Exploded View"](#).
4. Remove oil pan (lower). Refer to [EM-280, "Exploded View"](#).
5. Remove oil cooler. Refer to [LU-31, "Exploded View"](#).
6. Remove vacuum pump. Refer to [EM-284, "Exploded View"](#).
7. Remove fuel pump. Refer to [EM-291, "Exploded View"](#).
8. Remove timing chain. Refer to [EM-293, "Exploded View"](#).
9. Remove cylinder head housing. Refer to [EM-304, "Exploded View"](#).
10. Remove water suction pipe. Refer to [CO-81, "Exploded View"](#).
11. Remove water outlet and thermostat assembly. Refer to [CO-83, "Exploded View"](#).

### Assembly

INFOID:000000001277879

Assembly is the reverse order of disassembly.

A  
EM  
C  
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# OIL PAN (UPPER)

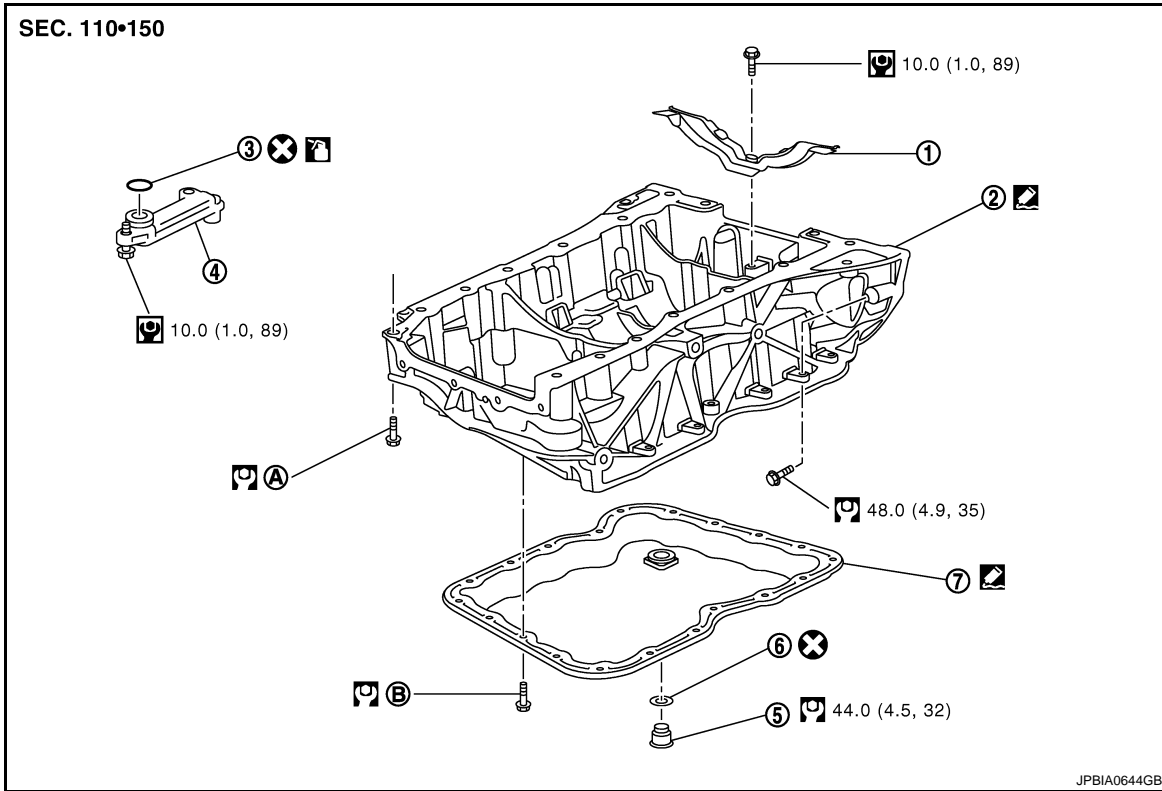
< DISASSEMBLY AND ASSEMBLY >

[M9R]

## OIL PAN (UPPER)

Exploded View

INFOID:000000001283058



- |                                    |                                    |           |
|------------------------------------|------------------------------------|-----------|
| 1. Baffle plate                    | 2. Oil pan (upper)                 | 3. O-ring |
| 4. Oil strainer                    | 5. Oil pan drain plug              | 6. Gasket |
| 7. Oil pan (lower)                 |                                    |           |
| A. Refer to <a href="#">EM-320</a> | B. Refer to <a href="#">EM-280</a> |           |

Refer to [GI-4, "Components"](#) for symbols in the figure.

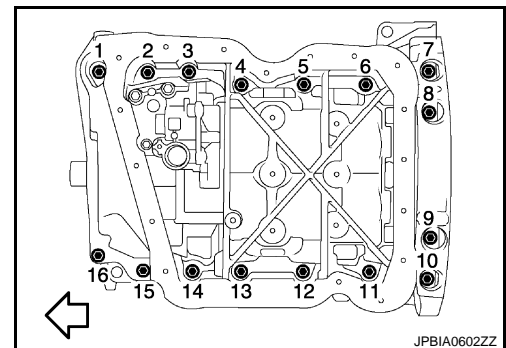
## Removal and Installation

INFOID:000000001283059

### REMOVAL

1. Remove oil pan (lower) and oil strainer. Refer to [EM-280, "Removal and Installation"](#).
2. Remove rear oil seal retainer. Refer to [EM-310, "REAR OIL SEAL : Removal and Installation"](#).
3. Remove oil pan (upper) with the following procedure:
  - a. Loosen mounting bolts in reverse order as shown in the figure.

↶ : Engine front



# OIL PAN (UPPER)

[M9R]

## < DISASSEMBLY AND ASSEMBLY >

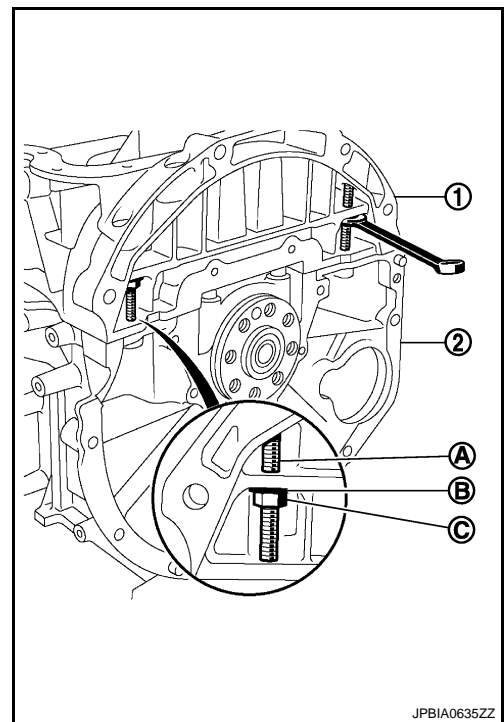
- b. Set two stud bolts (A), two washers (B) and two nuts (C) in place of the oil pan (upper) mounting bolts.

- 1 : Oil pan (upper)  
2 : Cylinder block

### NOTE:

Use M8 × 90 mm (3.54 in) long stud bolt.

- c. Detach the oil pan (upper) from the cylinder block by gradually tightening the nuts. Remove oil pan (upper).



4. Remove oil pump related parts.

## INSTALLATION

1. Install oil pump and oil pump baffle plate with the following procedure:

- a. Install oil pump (1), oil pump baffle plate (2), oil pump drive chain and oil pump sprocket.  
b. Tighten oil pump mounting bolts (A) in two steps.

**1st step: 5.0 N·m (0.51 kg-m, 4 ft-lb)**

**2nd step: 25.0 N·m (2.6 kg-m, 18 ft-lb)**

- c. Tighten oil pump baffle plate mounting bolt (B).

**8.0 N·m (0.82 kg-m, 71 in-lb)**

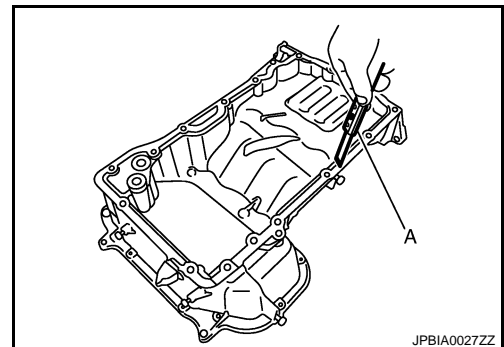
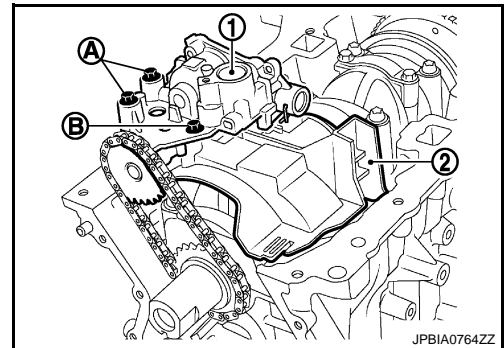
2. Install oil pan (upper) with the following procedure:

- a. Use a scraper (A) to remove old liquid gasket from mating surfaces.

### CAUTION:

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

- Also remove old liquid gasket from mating surface of cylinder block.
- Remove old liquid gasket from the bolt holes and threads.



## OIL PAN (UPPER)

[M9R]

### < DISASSEMBLY AND ASSEMBLY >

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

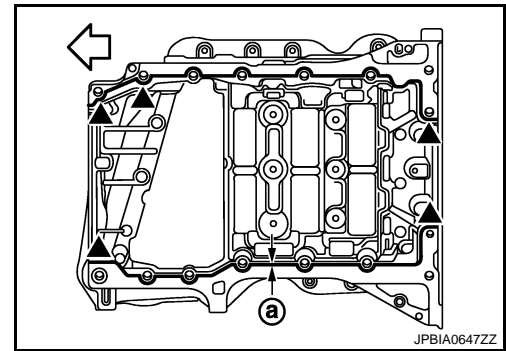
a : 3.0 - 7.0 mm (0.118 - 0.276 in)

← : Engine front

**Use Genuine Liquid Gasket or equivalent**

**CAUTION:**

- At the 5 bolt holes marked (▲), liquid gasket should be applied inside holes.
- Attaching should be done within 5 minutes after coating.

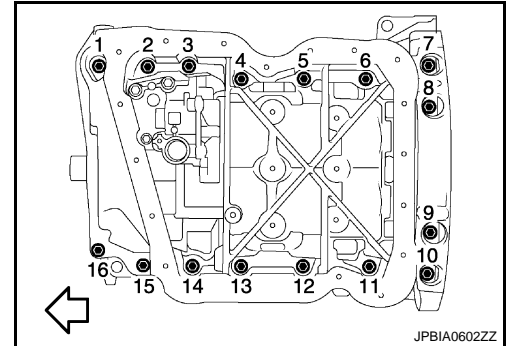


- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

← : Engine front

 **1st step: 10.0 N·m (1.0 kg·m, 7 ft-lb)**

 **2nd step: 25.0 N·m (2.6 kg·m, 18 ft-lb)**



3. Install rear oil seal retainer. Refer to [EM-310. "REAR OIL SEAL : Removal and Installation"](#).
4. Install in the reverse order of removal, for the rest of parts.

**NOTE:**

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

# CYLINDER HEAD

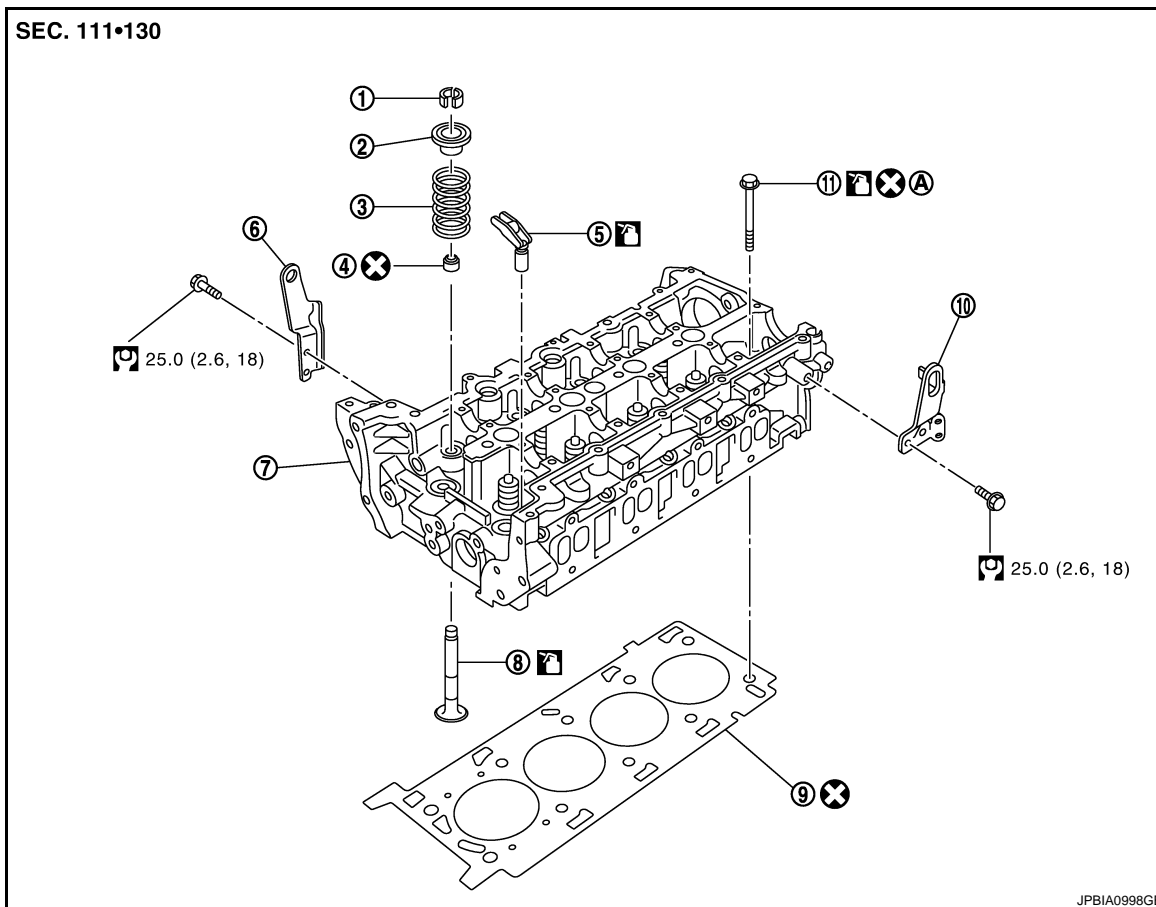
< DISASSEMBLY AND ASSEMBLY >

[M9R]

## CYLINDER HEAD

### Exploded View

INFOID:000000001277905



- |                                |                          |                                |
|--------------------------------|--------------------------|--------------------------------|
| 1. Valve collet                | 2. Valve spring retainer | 3. Valve spring                |
| 4. Valve oil seal              | 5. Hydraulic tappet      | 6. Engine slinger (front side) |
| 7. Cylinder head               | 8. Valve                 | 9. Cylinder head gasket        |
| 10. Engine slinger (rear side) | 11. Cylinder head bolt   |                                |

A. Refer to [EM-323](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

### Disassembly and Assembly

INFOID:000000001277907

#### DISASSEMBLY

- Remove the following components and related parts.
  - Turbocharger: Refer to [EM-275, "Exploded View"](#).
  - Intake manifold: Refer to [EM-270, "Exploded View"](#).
  - Exhaust manifold: Refer to [EM-278, "Exploded View"](#).
  - Water outlet and thermostat assembly: Refer to [CO-83, "Exploded View"](#).
  - Front cover, timing chain: Refer to [EM-293, "Exploded View"](#).
  - Cylinder head housing: Refer to [EM-304, "Exploded View"](#).

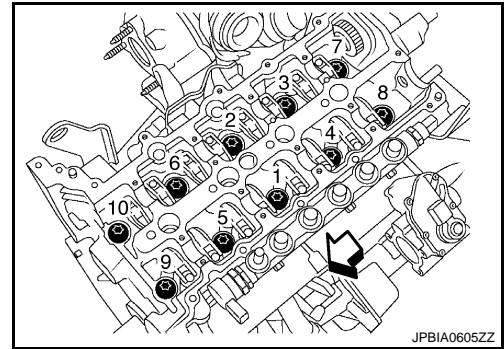
# CYLINDER HEAD

< DISASSEMBLY AND ASSEMBLY >

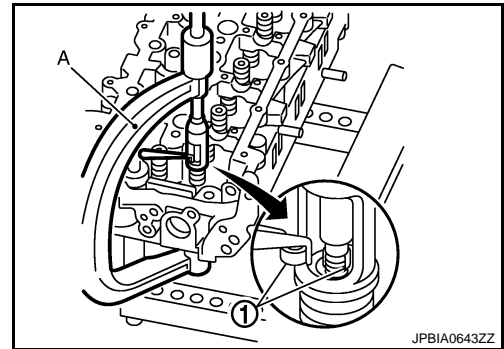
[M9R]

2. Remove cylinder head.
  - Loosen mounting bolts in reverse order as shown in the figure.

↶ : Engine front



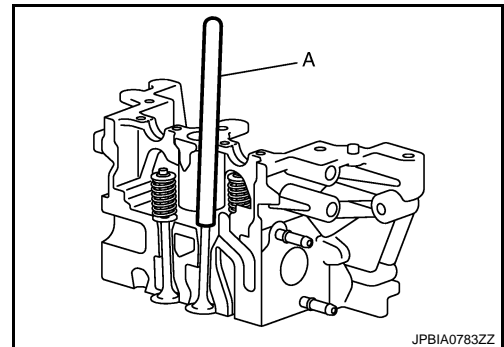
3. Remove cylinder head gasket.
4. Set the cylinder head assembly to the cylinder head support [commercial service tool: KV113B0200 (Mot.1573)].
5. Remove hydraulic tappet.  
**CAUTION:**  
**Be sure to immerse the hydraulic tappets in a bath of engine oil to ensure no air enters.**
6. Remove valve collet (1).
  - Compress valve spring with valve spring compressor (commercial service tool) (A).



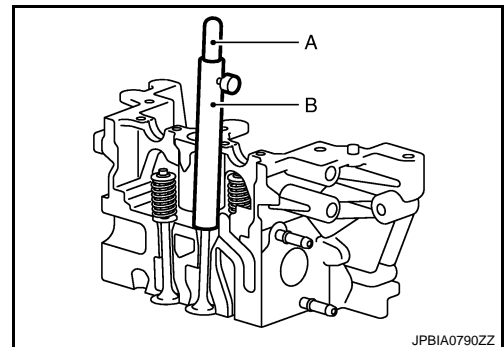
7. Remove valve spring retainer and valve spring.
8. Check dimension of valve oil seal mounting position before removing valve and valve oil seal with the following procedure:
  - a. Install the push rod (A) of valve seal drift [commercial service tool: KV113B0180 (Mot.1511-01)] on the valve oil seal.

**NOTE:**

The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve oil seal.



- b. Install the guide tube (B) over the push rod (A) until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
    - Remove the guide tube assembly plus push rod, being careful not to loosen the knurled wheel.



9. Push valve stem to combustion chamber side, and remove valve.



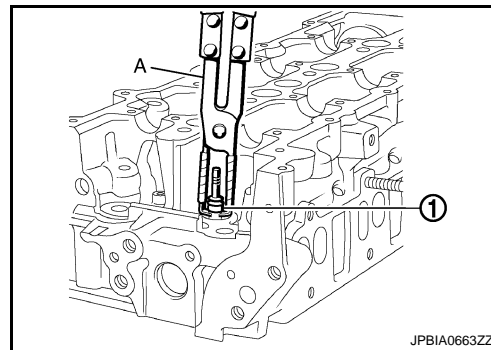
# CYLINDER HEAD

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

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

10. Remove valve oil seal (1) with a valve oil seal puller [commercial service tool: KV113B0090 (Mot.1335)] (A).



## ASSEMBLY

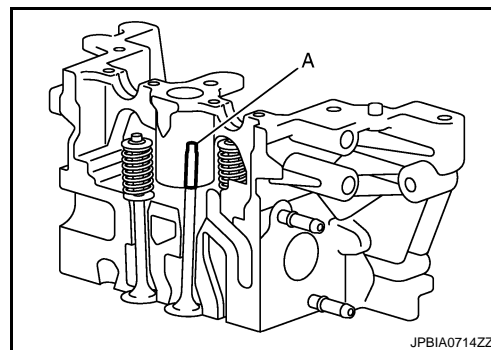
1. Install valve.

**NOTE:**

Install larger diameter to intake side.

2. Install valve oil seal with the following procedure:

- a. Position the protector (A) of valve seal drift [commercial service tool: KV113B0180 (Mot.1511-01)] on the valve.



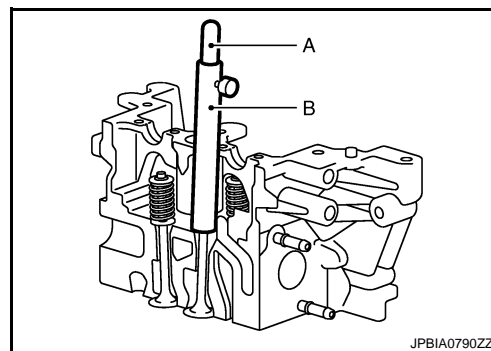
- b. Position a valve oil seal on the protector. Move the valve oil seal past the protector.

**CAUTION:**

**Never lubricate valve oil seal.**

- c. Remove the protector.

- d. Push in the push rod (A) of valve seal drift [commercial service tool: KV113B0180 (Mot. 1511-01)] with palm of the hand until the guide tube (B) makes contact with the cylinder head.



3. Install valve spring.

**NOTE:**

The intake and exhaust valve springs are identical.

4. Install valve spring retainer.

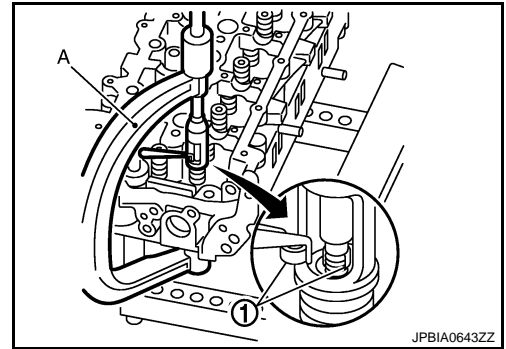
5. Install valve collet (1).

# CYLINDER HEAD

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

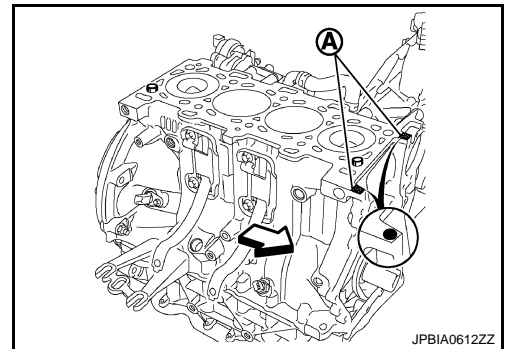
- Compress valve spring with a valve spring compressor (commercial service tool) (A).
- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



6. Install hydraulic tappet.
  - Check that the tappets are filled with oil before refitting them.
7. Install cylinder head gasket with the following procedure:  
**CAUTION:**  
**Before installing cylinder head, inspect piston protrusion.**
- a. Apply liquid gasket to position (A) shown in the figure.

⇐ : Engine front

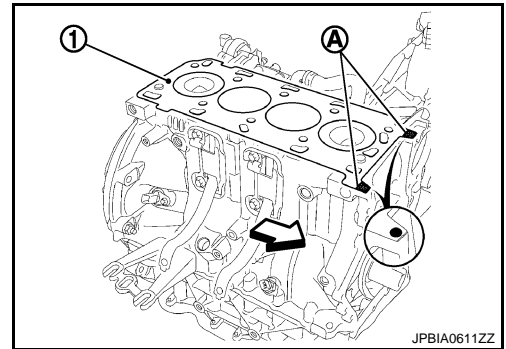
**Use Genuine Liquid Gasket or equivalent.**



- b. Install cylinder head gasket (1), and apply liquid gasket to position (A) shown in the figure.

⇐ : Engine front

**Use Genuine Liquid Gasket or equivalent.**



8. Install cylinder head, and tighten mounting bolts in numerical order as shown in figure with the following procedure:

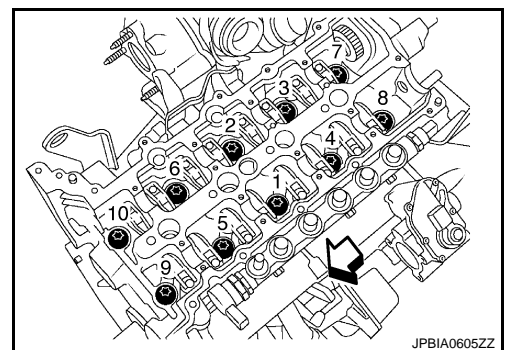
⇐ : Engine front

- a. Tighten all bolts.

: **5.0 N·m (0.51 kg·m, 4 ft·lb)**

- b. Tighten all bolts.

: **30.0 N·m (3.1 kg·m, 22 ft·lb)**



# CYLINDER HEAD

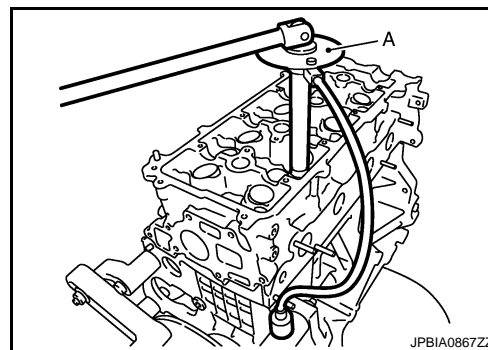
< DISASSEMBLY AND ASSEMBLY >

[M9R]

- c. Turn all bolts 300 degrees clockwise (angle tightening).

**CAUTION:**

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100 ( — )] (A) or protractor. Never judge by visual inspection without the tool.



9. Assemble in the reverse order of disassembly, for the rest of parts.

## Inspection

INFOID:0000000001277908

### INSPECTION AFTER DISASSEMBLY

#### Cylinder Head Distortion

**NOTE:**

When performing this inspection, cylinder block distortion should be also checked.

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

**CAUTION:**

Never allow gasket debris to enter passages for engine oil or water.

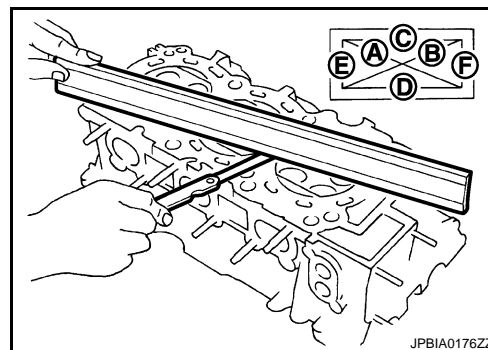
2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions (A - F).

**Standard:** Refer to [EM-330, "Cylinder Head"](#).

- If it exceeds the standard, replace cylinder head and cylinder head housing.

**NOTE:**

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



#### VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-330, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact.

#### VALVE GUIDE CLEARANCE

##### Valve Stem Diameter

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

**Standard :** Refer to [EM-330, "Cylinder Head"](#).

##### Valve Guide Inner Diameter

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

**Standard :** Refer to [EM-330, "Cylinder Head"](#).

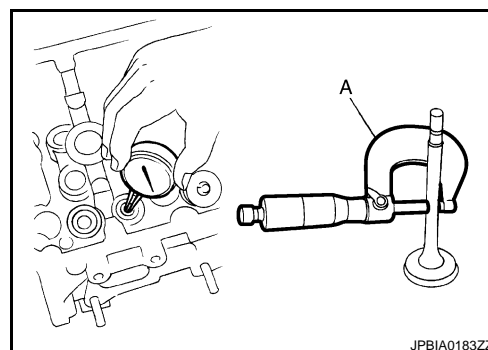
##### Valve Guide Clearance

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

**Standard :** Refer to [EM-330, "Cylinder Head"](#).

- If it exceeds the standard, replace valve and/or cylinder head and cylinder head housing.

#### VALVE SEAT CONTACT



# CYLINDER HEAD

## < DISASSEMBLY AND ASSEMBLY >

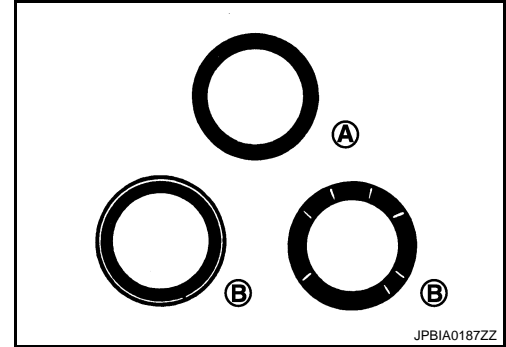
[M9R]

- 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

B : NG

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace cylinder head and cylinder head housing.

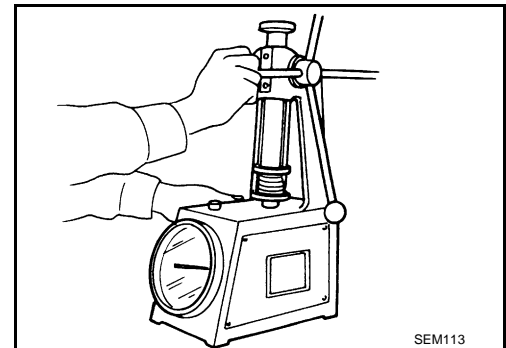


## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

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

**Standard** : Refer to [EM-330, "Cylinder Head"](#).

- If the pressure height is out of the standard, replace valve spring.



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification

INFOID:0000000001277890

A

EM

#### GENERAL SPECIFICATIONS

Engine type	M9R	
Cylinder arrangement	In-line 4	
Displacement	cm <sup>3</sup> (cu in)	1,995 (121.73)
Bore and stroke	mm (in)	84.0 x 90.0 (3.307 x 3.543)
Valve arrangement	DOHC	
Firing order	1-3-4-2	
Number of piston rings	Compression	2
	Oil	1
Compression ratio	15.6	
Compression pressure kPa (bar, kg/cm <sup>2</sup> , psi) / 250 rpm	Standard	
	Minimum	
	Differential limit between cylinders	

C

D

E

F

G

H

I

J

K

L

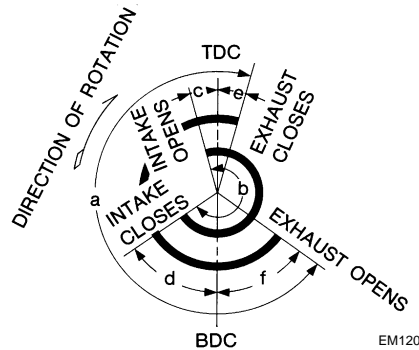
M

N

O

P

Valve timing



Unit: degree

a	b	c	d	e	f
198	187	- 11	18	- 17	35

#### Drive Belts

INFOID:0000000001277891

#### DRIVE BELT

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

#### Intake Manifold

INFOID:0000000001585764

#### INTAKE MANIFOLD

Unit: mm (in)

Items	Standard
Surface distortion	0.05 (0.0020)

#### Exhaust Manifold

INFOID:0000000001585765

#### EXHAUST MANIFOLD

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

Unit: mm (in)

Items	Standard
Surface distortion	0.7 (0.028)

## Turbocharger

INFOID:000000001277912

Value of vacuum	Standard
25 kPa (250 mbar, 187.525 mmHg, 7.3825 inHg)	Valve rod moving length 2.95 - 5.95 mm (0.1161 - 0.2343 in)
More than 60 kPa (600 mbar, 450.06 mmHg, 17.718 inHg)	The rod should not move

## Camshaft

INFOID:000000001277894

### CAMSHAFT

Unit: mm (in)

Items	Standard
Camshaft journal diameter	24.979 - 25.000 (0.9834 - 0.9843)
Cylinder head housing and camshaft bracket inner diameter	25.040 - 25.061 (0.9858 - 0.9867)
Camshaft journal oil clearance	0.040 - 0.082 (0.0016 - 0.0032)

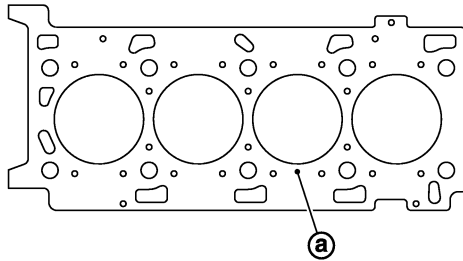
## Cylinder Head

INFOID:000000001277895

### CYLINDER HEAD

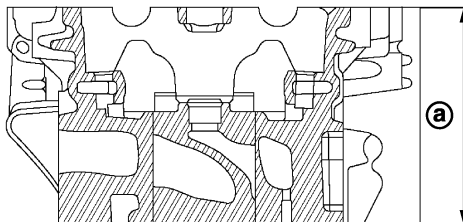
Unit: mm (in)

Items	Standard
Head surface distortion	0.05 (0.0020)



JPBIA0791ZZ

Cylinder head gasket thickness "a"	1.116 - 1.184 (0.0439 - 0.0466)
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JPBIA0792ZZ

Normal cylinder head height "a"	133.6 (5.26)
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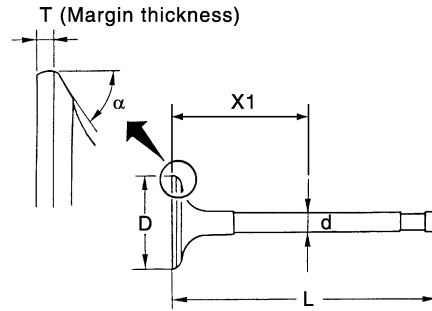
## VALVE DIMENSIONS

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

Unit: mm (in)

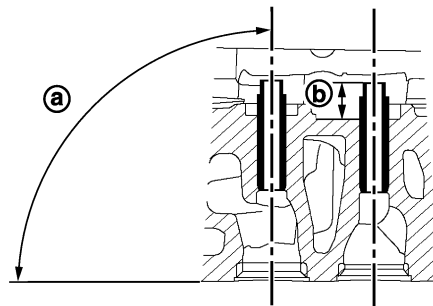


E1BIA0064ZZ

Item		Standard
Valve head diameter "D"	Intake	27.58 - 27.82 (1.0858 - 1.0953)
	Exhaust	25.88 - 26.12 (1.0189 - 1.0283)
Valve length "L"	Intake	103.737 - 104.037 (4.08 - 4.10)
	Exhaust	103.630 - 103.930 (4.08 - 4.09)
Valve stem diameter "d"	Intake	5.970 - 5.985 (0.2350 - 0.2356)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Measuring point "X1"		35.0 (1.378)
Valve seat angle "α"		45° - 45°15'
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	0.94 (0.037)
Valve lift amount		8.0 (0.315)

## VALVE GUIDE

Unit: mm (in)



JPBIA00586ZZ

Items		Standard
Valve guide	Outer diameter	11.033 - 11.044 (0.4344 - 0.4348)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)
Cylinder head valve guide hole diameter		10.987 - 11.013 (0.4326 - 0.4336)
Interference fit of valve guide		0.020 - 0.057 (0.0008 - 0.0022)
Valve guide clearance	Intake	0.015 - 0.048 (0.0006 - 0.0019)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)
Valve guide angle "a"		90°
Projection length "b"		14.0 (0.551)

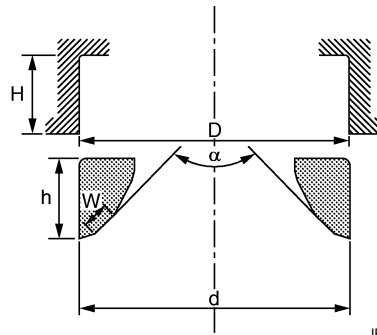
## VALVE SEAT

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

Unit: mm (in)



JPBIA0787ZZ

Items		Standard
Cylinder head seat recess diameter "D"	Intake	28.163 - 28.191 (1.1088 - 1.1099)
	Exhaust	26.986 - 27.014 (1.0624 - 1.0635)
Valve seat outer diameter "d"	Intake	28.276 - 28.292 (1.1132 - 1.1139)
	Exhaust	27.076 - 27.092 (1.0660 - 1.0666)
Valve seat interference fit	Intake	0.085 - 0.129 (0.0033 - 0.0051)
	Exhaust	0.062 - 0.106 (0.0024 - 0.0042)
Angle "α"		89°30'
Contacting width "W"*1	Intake	1.40 (0.0551)
	Exhaust	1.544 (0.0608)
Height "h"	Intake	4.56 - 4.64 (0.1795 - 0.1827)
	Exhaust	4.905 - 4.985 (0.1931 - 0.1963)
Depth "H"	Intake	6.95 (0.2736)
	Exhaust	7.25 (0.2854)

\*1: Machining data

## VALVE SPRING

Free height		46.90 mm (1.8465 in)
Pressure height	200 - 220 N (20.4 - 22.4 kg, 45 - 49 lb)	34.90 mm (1.3740 in)
	353 - 387 N (36.0 - 39.5 kg, 79 - 87 lb)	26.90 mm (1.0591 in)
Full pressed height		24.40 mm (0.9606 in)
Diameter of the wire		2.78 - 2.82 mm (0.1094 - 0.1110 in)
Inner diameter		13.90 - 14.30 mm (0.5472 - 0.5630 in)
Outer diameter		19.50 - 19.90 mm (0.7677 - 0.7835 in)
Valve spring squareness		1.4 mm (0.055 in)