

# CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

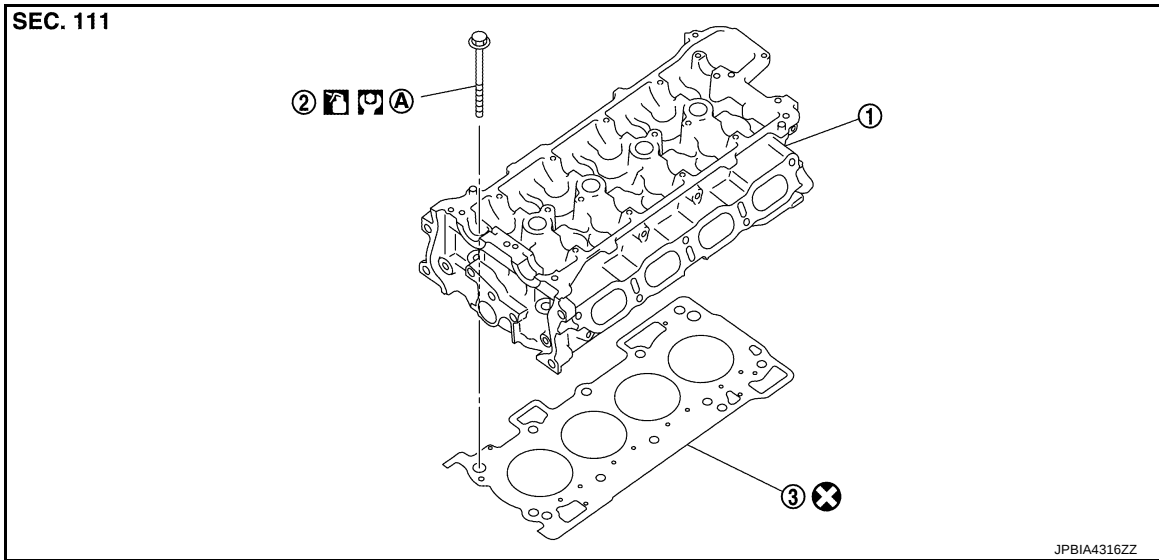
[MR20DD]

## CYLINDER HEAD

### Exploded View

INFOID:000000010783725

### REMOVAL



① Cylinder head assembly

② Cylinder head bolt

③ Cylinder head gasket

Ⓐ Comply with the installation procedure when tightening. Refer to [EM-93](#)

ⓧ : Always replace after every disassembly.

⓪ : N·m (kg-m, ft-lb)

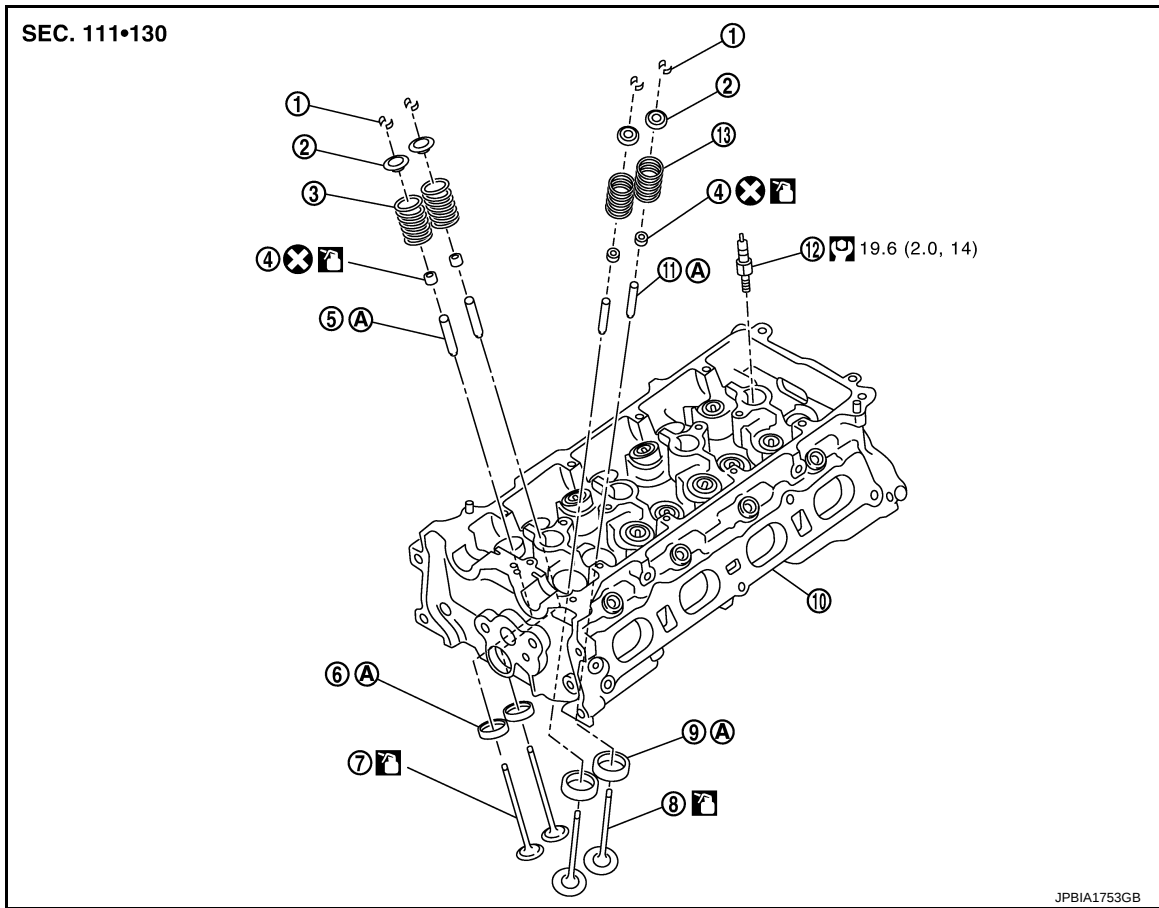
Ⓛ : Should be lubricated with oil.

### DISASSEMBLY

# CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]



- |                  |                         |                                               |
|------------------|-------------------------|-----------------------------------------------|
| ① Valve collet   | ② Valve spring retainer | ③ Valve spring (with valve spring seat) (EXH) |
| 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 (with valve spring seat) (INT)

Ⓐ Comply with the installation procedure when tightening. Refer to [EM-94](#)

⊗ : Always replace after every disassembly.

Ⓜ : N·m (kg·m, ft·lb)

Ⓛ : Should be lubricated with oil.

## Removal and Installation

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### REMOVAL

1. Release fuel pressure. Refer to [EC-152, "Work Procedure"](#).
2. Drain engine coolant and engine oil. Refer to [CO-13, "Draining"](#) and [LU-10, "Draining"](#).
3. Remove the following components and related parts.
  - Intake manifold: Refer to [EM-33, "Exploded View"](#).
  - Exhaust manifold: Refer to [EM-37, "Exploded View"](#).
  - High pressure fuel pump: Refer to [EM-43, "Exploded View"](#).
  - Fuel tube and fuel injector assembly: Refer to [EM-48, "Exploded View"](#).
  - Water outlet: Refer to [CO-28, "Exploded View"](#).
  - Rocker cover: Refer to [EM-54, "Exploded View"](#).
  - Front cover, timing chain: Refer to [EM-67, "Exploded View"](#).

# CYLINDER HEAD

## < UNIT DISASSEMBLY AND ASSEMBLY >

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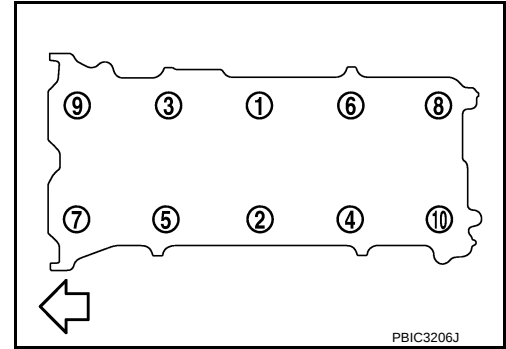
- Camshaft: Refer to [EM-80, "Exploded View"](#).

### 4. Remove cylinder head.

- Loosen cylinder head bolts in the order from 10 to 1 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.

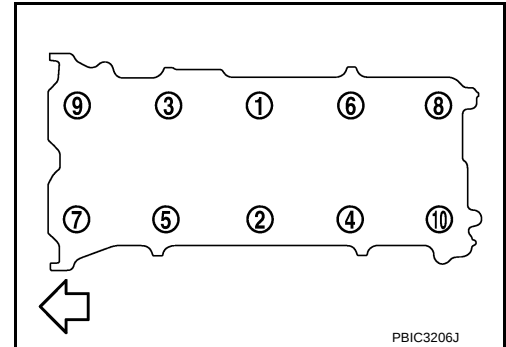
### 2. Install cylinder head, and tighten cylinder head bolts in the order from 1 to 10 as shown in the figure with the following procedure.

⇐ : Engine front

#### CAUTION:

If cylinder head bolts are reused, check their outer diameters before installation. Refer to [EM-99, "Inspection"](#).

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



: 40.0 N·m (4.1 kg-m, 30 ft-lb)

### c. Turn all cylinder head bolts 100 degrees clockwise (angle tightening).

#### CAUTION:

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100] <sup>Ⓐ</sup> 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 cylinder head bolts in reverse order that indicated in the figure.

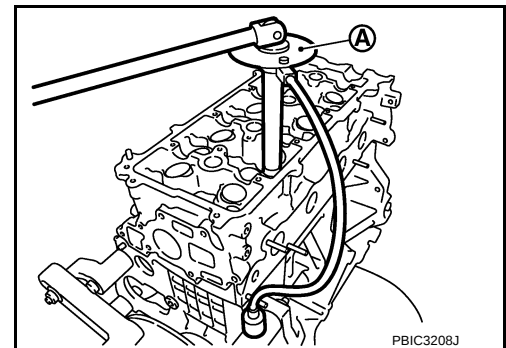
### e. Tighten all cylinder head bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

### f. Turn all cylinder head bolts 95 degrees clockwise (angle tightening).

### g. Turn all cylinder head bolts 95 degrees clockwise again (angle tightening).

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



## Disassembly and Assembly

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## DISASSEMBLY

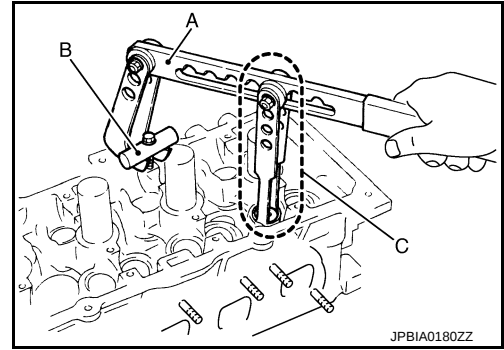
- Remove spark plug with spark plug wrench (commercial service tool).
- Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.

## CYLINDER HEAD

### < UNIT DISASSEMBLY AND ASSEMBLY >

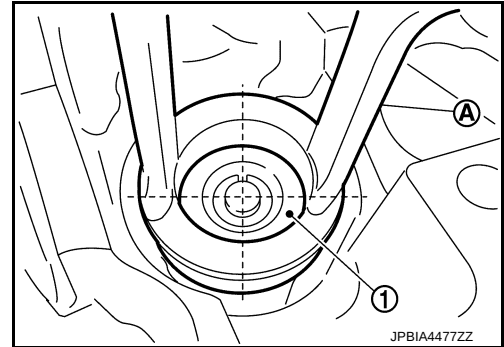
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3. Remove valve collet.
  - Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Remove valve collet with a magnet hand.



#### CAUTION:

- Be careful not to damage valve lifter holes.
- Fit the attachment [SST: KV10115900 (J-26336-20)] (A) in the center of valve spring retainer ① to press it.

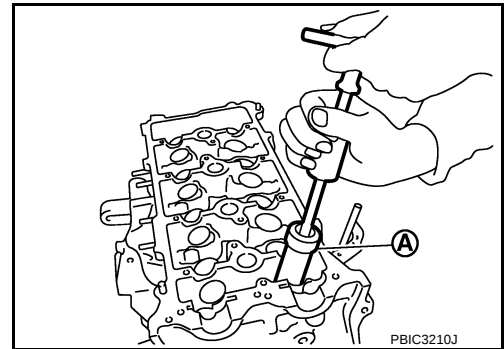


4. Remove valve spring retainer and valve spring (with valve spring seat).

#### 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).



7. When 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-135, "Cylinder Head"](#).
8. When valve guide must be replaced.

#### CAUTION:

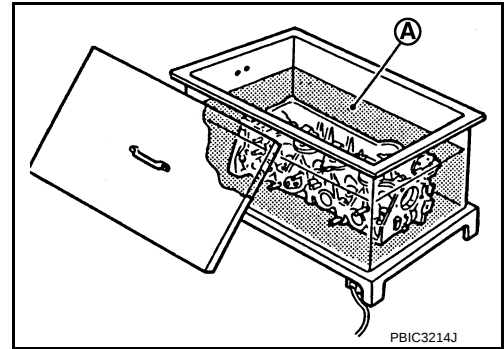
**Never bore excessively to prevent cylinder head from scratching.**

## CYLINDER HEAD

### < UNIT DISASSEMBLY AND ASSEMBLY >

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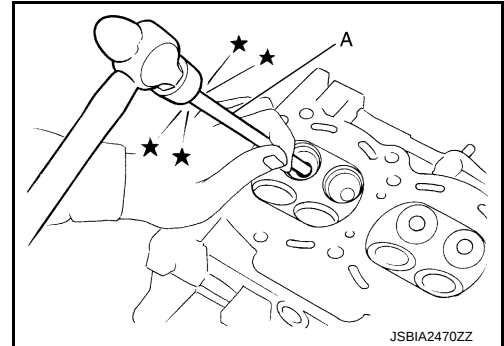
- a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



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

**CAUTION:**

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



### ASSEMBLY

1. When valve guide is removed, install it.

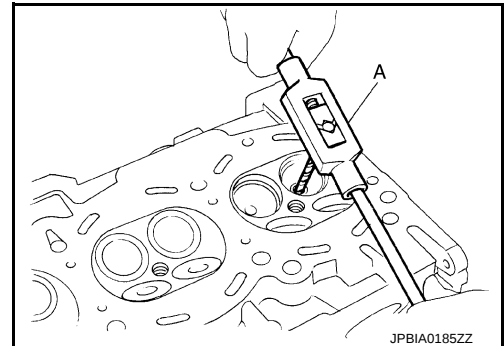
**CAUTION:**

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

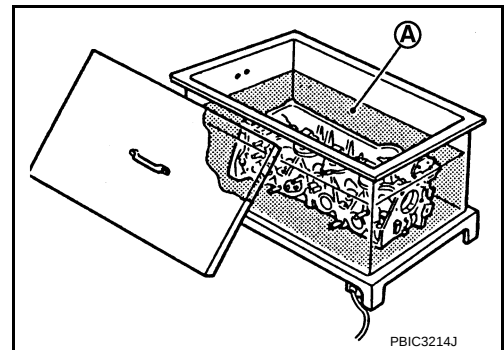
- a. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool) (A).

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

**Refer to [EM-135, "Cylinder Head"](#).**



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



# CYLINDER HEAD

## < UNIT DISASSEMBLY AND ASSEMBLY >

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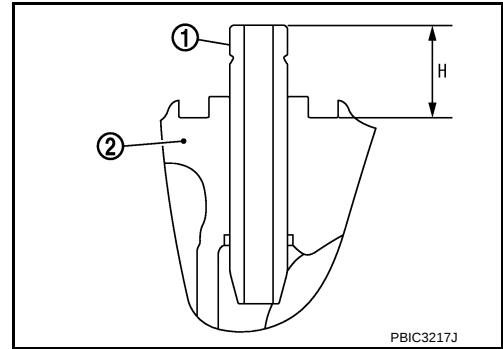
- c. Press valve guide ① from camshaft side to dimensions as shown in the figure.

② : Cylinder head

**Projection (H)** : Refer to [EM-135, "Cylinder Head"](#).

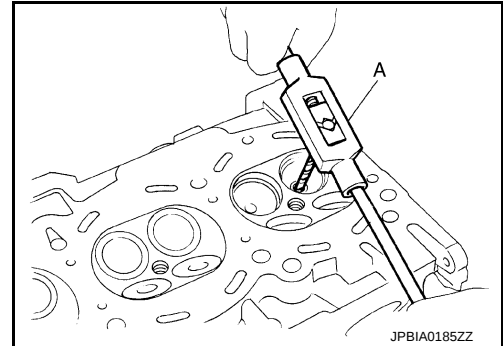
**CAUTION:**

Cylinder head contains heat, 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-135, "Cylinder Head"](#).



2. When valve seat is removed, install it.

**CAUTION:**

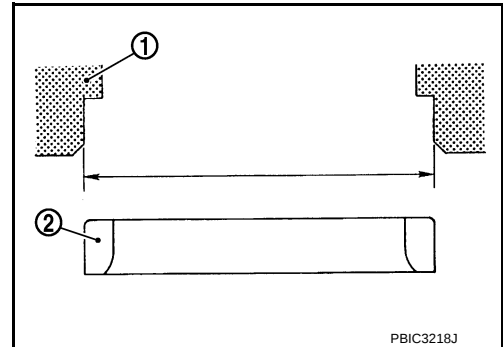
**Replace with oversize [0.5 mm (0.020 in)] valve seat.**

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

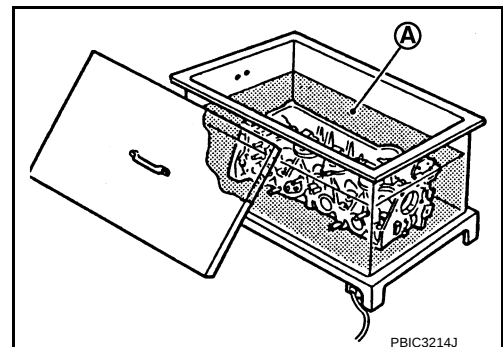
**For service parts: Oversize [0.5 mm (0.020 in)]**

**Refer to [EM-135, "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:**

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

## CYLINDER HEAD

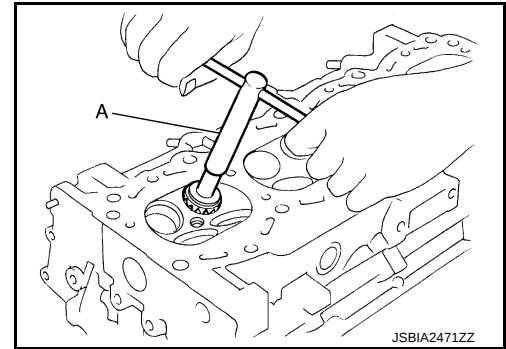
### < UNIT DISASSEMBLY AND ASSEMBLY >

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- d. Using valve seat cutter set (commercial service tool) (A) or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to [EM-135, "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.

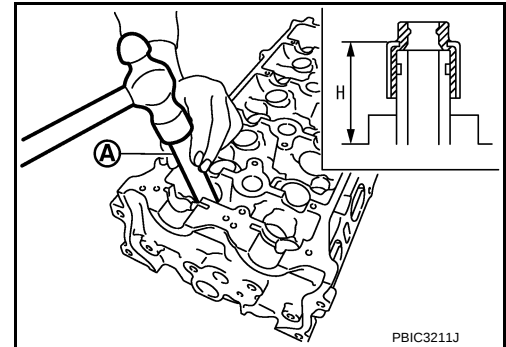


- e. Using compound, grind to adjust valve fitting.  
f. Check again for normal contact. Refer to [EM-99, "Inspection"](#).  
3. Install valve oil seal.  
• Install with a valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.

**NOTE:**

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

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

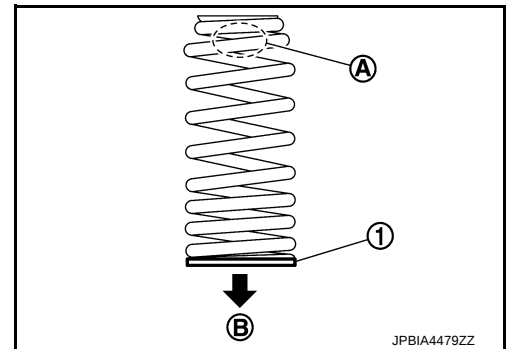


4. Install valve.  
• Install larger diameter to intake side.  
5. Install valve spring (with valve spring seat).  
• Install smaller pitch (valve spring seat side) to cylinder head side (B).

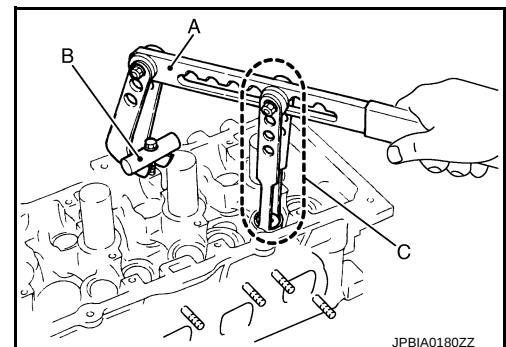
① : Valve spring seat (Do not remove from valve spring.)

- Confirm identification color (A) of valve spring.

**Intake : White**  
**Exhaust : Orange**



6. Install valve spring retainer.  
7. Install valve collet.  
• Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Install valve collet with a magnet hand.



**CAUTION:**

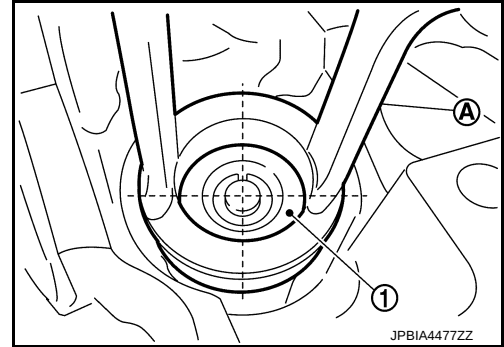
- Be careful not to damage valve lifter holes.

# CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Fit the attachment [SST: KV10115900 (J-26336-20)] ① in the center of valve spring retainer ① to press it.
- 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.
9. Install spark plug with spark plug wrench (commercial service tool).

## Inspection

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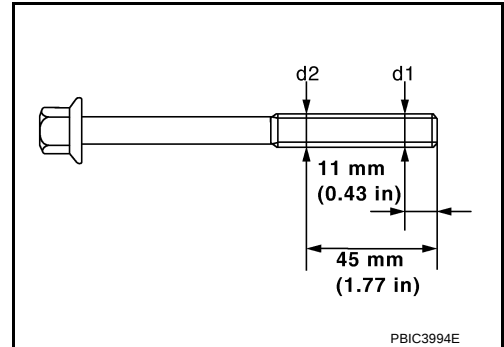
### INSPECTION AFTER REMOVAL

#### 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-115, "Inspection"](#).

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

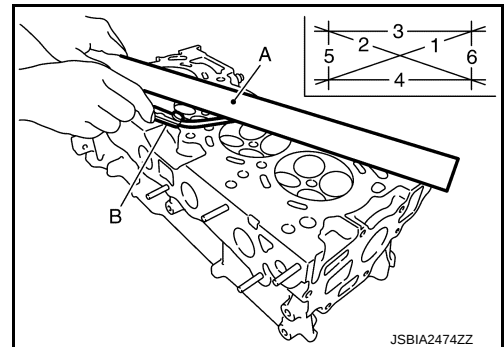
##### CAUTION:

**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-135, "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-135, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

#### VALVE GUIDE CLEARANCE

# CYLINDER HEAD

## < UNIT DISASSEMBLY AND ASSEMBLY >

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### Valve Stem Diameter

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

**Standard:** Refer to [EM-135, "Cylinder Head"](#).

### Valve Guide Inner Diameter

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

**Standard:** Refer to [EM-135, "Cylinder Head"](#).

### Valve Guide Clearance

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

**Standard and Limit:** Refer to [EM-135, "Cylinder Head"](#).

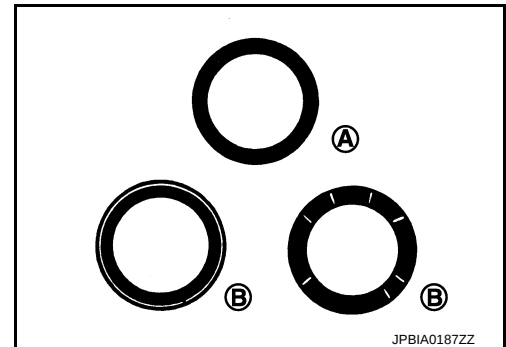
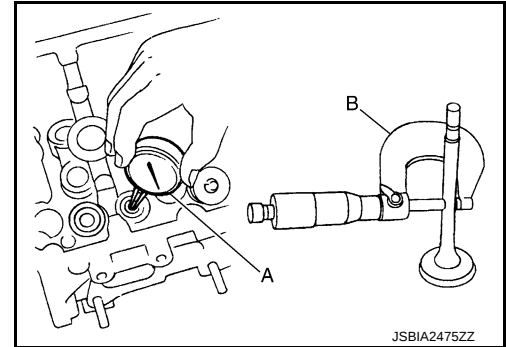
- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to [EM-94, "Disassembly and Assembly"](#).

### 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.

Ⓐ : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions Ⓑ even after the recheck, replace valve seat. Refer to [EM-94, "Disassembly and Assembly"](#).



### VALVE SPRING SQUARENESS

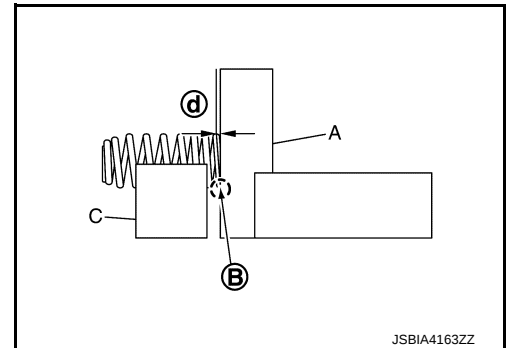
- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance Ⓓ between the top of spring and try square.

Ⓑ : Contact

C : V-block

**Limit :** Refer to [EM-135, "Cylinder Head"](#).

- If it exceeds the limit, replace valve spring.



### VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

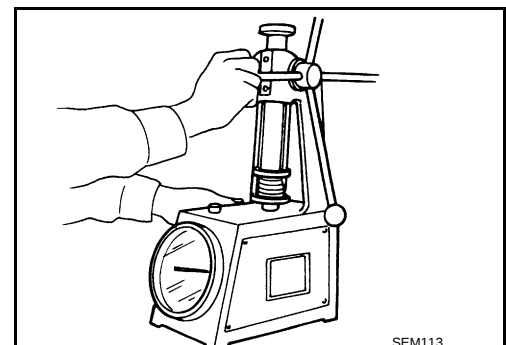
- Check valve spring pressure with valve spring seat installed at the specified spring height.

#### CAUTION:

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

**Standard :** Refer to [EM-135, "Cylinder Head"](#).

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



# CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

## INSPECTION AFTER INSTALLATION

### Inspection for Leakage

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-23. "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                |
| Transmission / transaxle fluid | AT & CVT Models | Leakage                | Level / Leakage | Leakage              |
|                                | MT Models       | Level / Leakage        | Leakage         | Level / Leakage      |
| Other oils and fluids*         |                 | Level                  | Leakage         | Level                |
| Fuel                           |                 | Leakage                | Leakage         | Leakage              |
| Exhaust gases                  |                 | —                      | Leakage         | —                    |

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

# OIL PAN (UPPER)

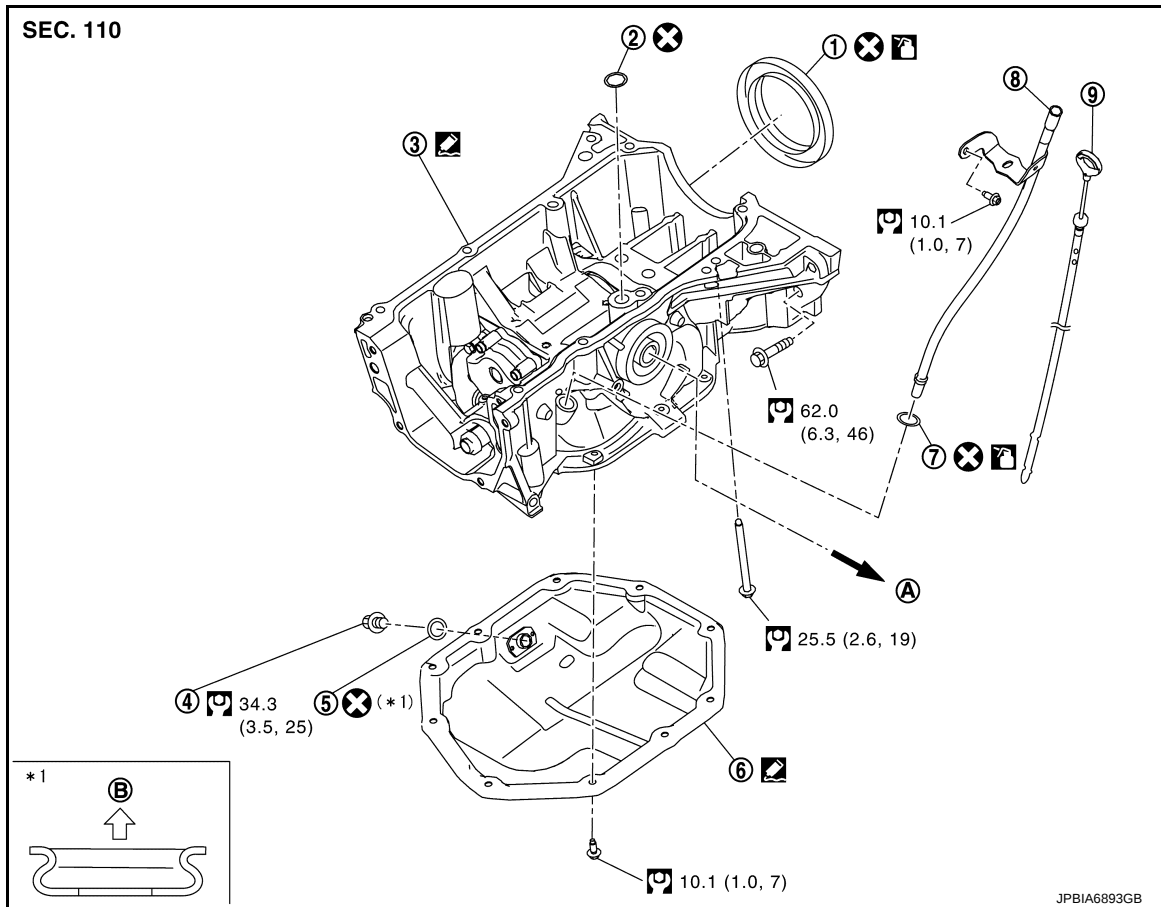
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

## OIL PAN (UPPER)

### Exploded View

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- |                 |                         |                   |
|-----------------|-------------------------|-------------------|
| ① Rear oil seal | ② O-ring                | ③ Oil pan (upper) |
| ④ Drain plug    | ⑤ Drain plug washer     | ⑥ Oil pan (lower) |
| ⑦ O-ring        | ⑧ Oil level gauge guide | ⑨ Oil level gauge |
| Ⓐ To oil cooler | Ⓑ Oil pan (lower) side  |                   |

↶ : Oil pan side

⊗ : Always replace after every disassembly.

Ⓐ : N·m (kg-m, ft-lb)

Ⓐ : Should be lubricated with oil.

Ⓐ : Sealing point

## Removal and Installation

INFOID:000000010783730

### REMOVAL

1. Remove oil pan (lower). Refer to [EM-40, "Exploded View"](#)
2. Remove oil filter. Refer to [LU-12, "Removal and Installation"](#).
3. Remove water hoses of oil cooler.
4. Remove oil level gauge and oil level gauge guide.
5. Remove front cover, timing chain, balancer unit timing chain, and other related parts. Refer to [EM-67, "Exploded View"](#).