

# SECTION **EM**

## ENGINE MECHANICAL

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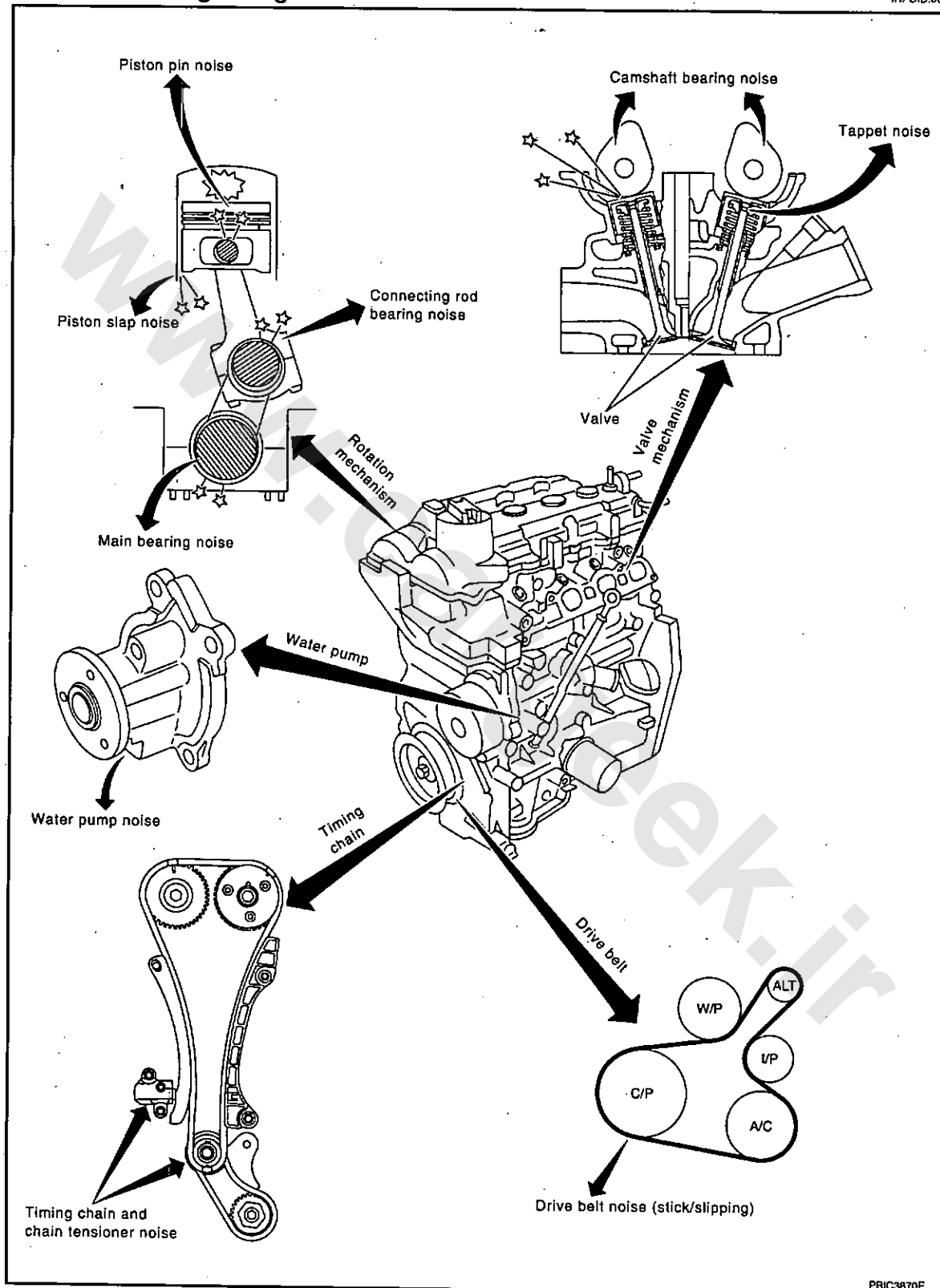
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## SYMPTOM DIAGNOSIS

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

#### NVH Troubleshooting - Engine Noise

INFOID:0000000004899137



PBIC3870E

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR16DE]

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

INFOID:000000004699139

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

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-22
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-117 EM-117
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 small end clearance	EM-121 EM-121
	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	EM-121 EM-121 EM-121 EM-121
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod small end clearance Connecting rod bearing oil clearance	EM-121 EM-124
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-125 EM-121
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	EM-54
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-16
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idle pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-18

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

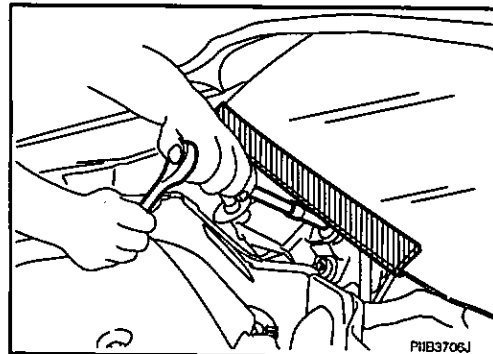
## PRECAUTION

### PRECAUTIONS

#### Precaution for Procedure without Cowl Top Cover

INFOID:000000004899139

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



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

INFOID:000000005022453

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. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the "SRS AIR BAG" 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.
- 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 AIR BAG".
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

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

#### WARNING:

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, DO NOT use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

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

INFOID:000000004948978

#### 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.

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.

# PRECAUTIONS

[HR16DE]

## < PRECAUTION >

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.)

### Draining Engine Coolant

INFOID:0000000004899141

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

### Disconnecting Fuel Piping

INFOID:0000000004899142

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

### Removal and Disassembly

INFOID:0000000004899143

- 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, make sure 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:0000000004899144

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

### Assembly and Installation

INFOID:0000000004899145

- 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:0000000004899146

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

## PRECAUTIONS

### < PRECAUTION >

[HR16DE]

- 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)
- Never use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

### Liquid Gasket

INFOID:000000004899147

#### REMOVAL OF LIQUID GASKET

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

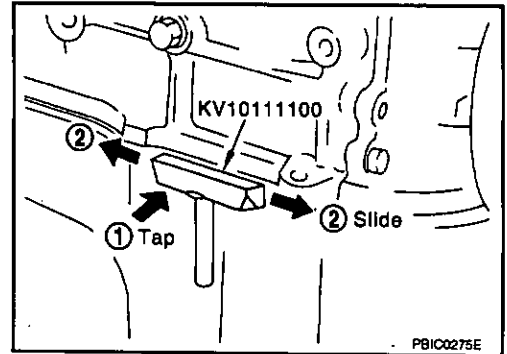
##### CAUTION:

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

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

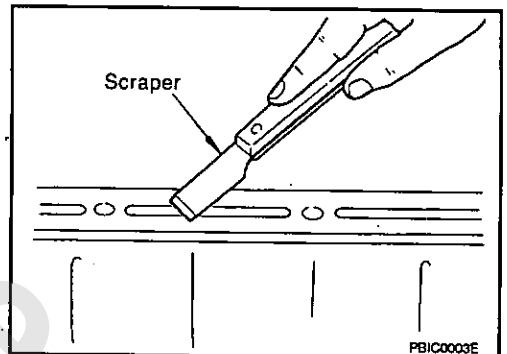
##### CAUTION:

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



#### LIQUID GASKET APPLICATION PROCEDURE

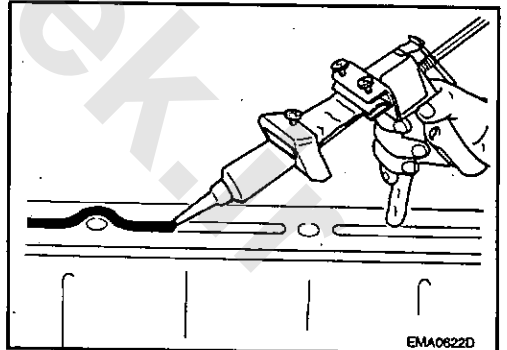
1. Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.
  - Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts and bolt holes.
2. Wipe the liquid gasket application surface and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



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

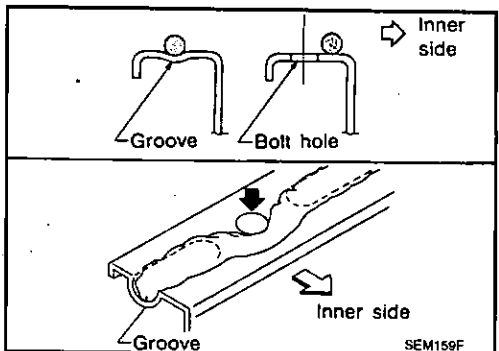
**Use Genuine Liquid Gasket or equivalent.**

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 liquid gasket to the groove.



- As for the bolt holes, normally apply the liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.
- Within 5 minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nut after the installation.
- Wait 30 minutes or more after installation before refilling engine oil and engine coolant.

##### CAUTION:



## PRECAUTIONS

< PRECAUTION >

[HR16DE]

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

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# PREPARATION

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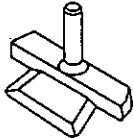
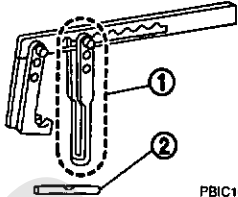
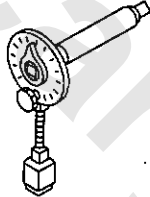
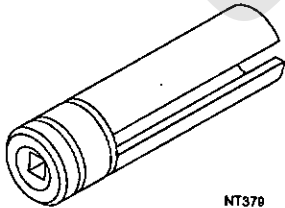
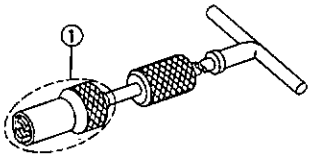
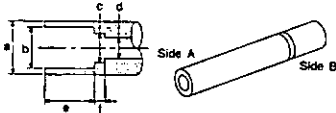
[HR16DE]

## PREPARATION

### PREPARATION

#### Special Service Tools

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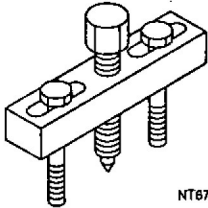
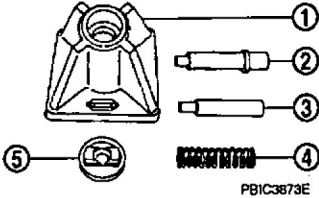
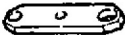
Tool number Tool name		Description
KV10111100 Seal cutter	 S-NT046	Removing oil pan (lower and upper) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	 PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench	 S-NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10117100 Heated oxygen sensor wrench	 NT370	Loosening or tightening heated oxygen sensor 1 For 22 mm (0.87 in) width hexagon nut
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	 SZNT605	Removing valve oil seal
KV10115600 Valve oil seal drift	 S-NT603	Installing valve oil seal Use side A. 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)



# PREPARATION

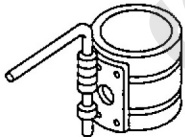

< PREPARATION >

[HR16DE]

Tool number Tool name	Description	
KV11103000 Pulley puller	Removing crankshaft pulley	A
 NT676		EM
KV10110300 Old number:(ST13030020) 1. Press stand: ST13030020 2. Center shaft: KV10114120 3. Drift: KV10109730 4. Spring: ST13030030 5. Center cap: KV10110310	Installing and removing piston pin	C
 PBIC3673E		D
KV11105210 Stopper plate	Fixing drive plate and flywheel	E
 ZZA0006D		F

## Commercial Service Tools

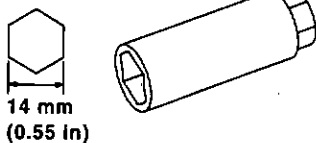

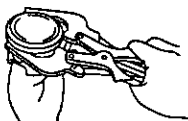

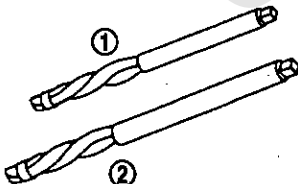
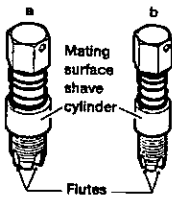

INFOID:0000000004899141

Tool number Tool name	Description	
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore	I
 S-NT044		J
Quick connector release	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)	K
 PBIC0198E		L

# PREPARATION

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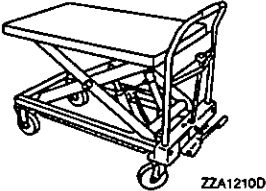
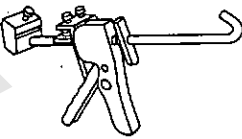
[HR16DE]

Tool name	Description
<p>Spark plug wrench</p>  <p>14 mm (0.55 in)</p> <p>PBIC3874E</p>	<p>Removing and installing spark plug</p>
<p>Valve seat cutter set</p>  <p>S-NT048</p>	<p>Finishing valve seat dimensions</p>
<p>Piston ring expander</p>  <p>S-NT030</p>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p>  <p>PBIC4012E</p>	<p>Removing and installing valve guide</p>
<p>Valve guide reamer</p>  <p>PBIC4013E</p>	<p>1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide</p>
<p>Oxygen sensor thread cleaner</p>  <p>AEM488</p>	<p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) <b>a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor</b> <b>b = 12 mm (0.47 in) dia. for titania heated oxygen sensor</b></p>
<p>Acoustic tension gauge</p>  <p>PBIC3881E</p>	<p>Checking drive belt tension</p>

# PREPARATION

< PREPARATION >

[HR16DE]

Tool name	Description
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Manual lift table caddy  ZZA12100	Removing and installing engine
Tube presser  S-NT052	Pressing the tube of liquid gasket

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## ON-VEHICLE MAINTENANCE

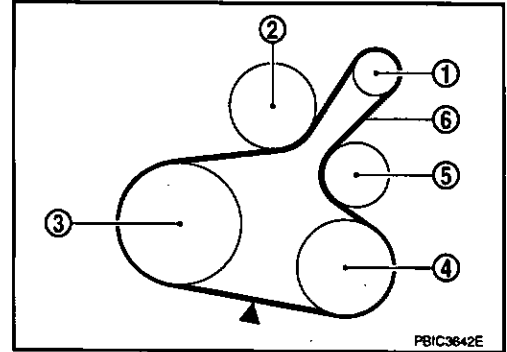
### DRIVE BELTS

#### Checking

INFOID:0000000004899150

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

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



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

#### CAUTION:

- When the tension and frequency are measured, the acoustic tension gauge should be used.
- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.

Belt Deflection / Belt Tension and Frequency:

Refer to EM-116. "Drive Belts".

#### Tension Adjustment

INFOID:0000000004899151

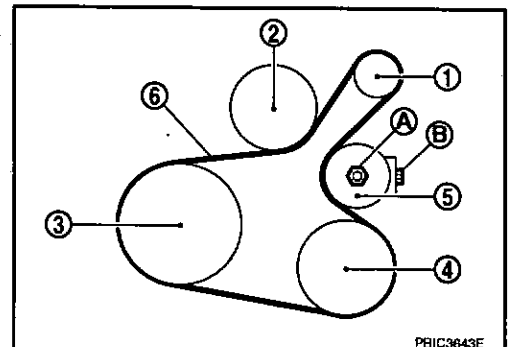
Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

#### CAUTION:

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

1. Remove front fender protector (RH). Refer to EXT-22. "Exploded View".
2. Loosen the idler pulley lock nut (A) from the tightening position with the specified torque by 45 degrees.

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



# DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

[HR16DE]

## CAUTION:

- When the lock nut is loosened excessively, the idler pulley tilts and the correct tension adjustment cannot be performed. Never loosen it excessively (more than 45 degrees).
- Put a matching mark on the lock nut, and check turning angle with a protractor. Never visually check the tightening angle.

3. Adjust the belt tension by turning the adjusting bolt.

## CAUTION:

- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.
- When the tension adjustment is performed, the lock nut should be in the condition at step "2". If the tension adjustment is performed when the lock nut is loosened more than the standard, the idler pulley tilts and the correct tension adjustment cannot be performed.

4. Tighten the lock nut.

 : 34.8 N·m (3.5 kg-m, 26 ft-lb)

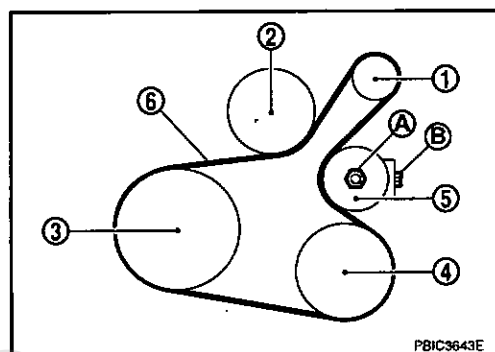
## Removal and Installation

INFOID:000000004899152

### REMOVAL

1. Remove front fender protector (RH). Refer to EXT-22, "Exploded View".
2. Loosen the idler pulley lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

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

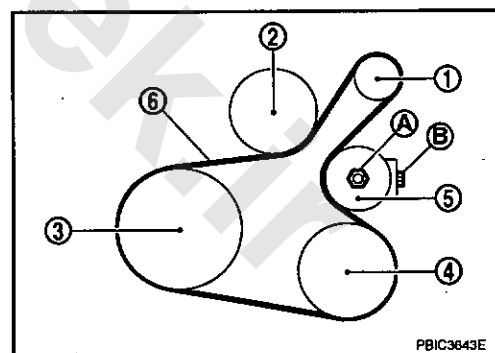



3. Remove drive belt.

### INSTALLATION

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

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



 : 4.4 N·m (0.45 kg-m, 39 in-lb)

## NOTE:

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

2. Install the drive belt to each pulley.

## CAUTION:

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

3. Adjust drive belt tension by turning the adjusting bolt. Refer to EM-16, "Tension Adjustment".

## DRIVE BELTS


< ON-VEHICLE MAINTENANCE >

[HR16DE]

### CAUTION:

- Perform the belt tension adjustment with the lock nut temporarily tightened at the step "1" so as not to tilt the idler pulley.
- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.

4. Tighten the lock nut.

 : 34.8 N·m (3.5 kg-m, 26 ft-lb)

5. Make sure that belt tension of each belt within the standard.

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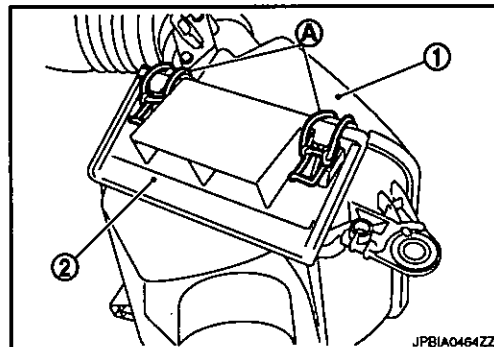
## AIR CLEANER FILTER

### Removal and Installation

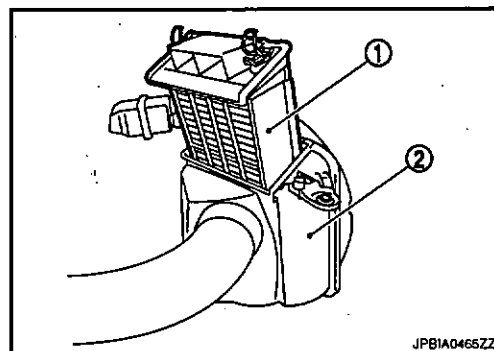
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#### REMOVAL

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.

# SPARK PLUG

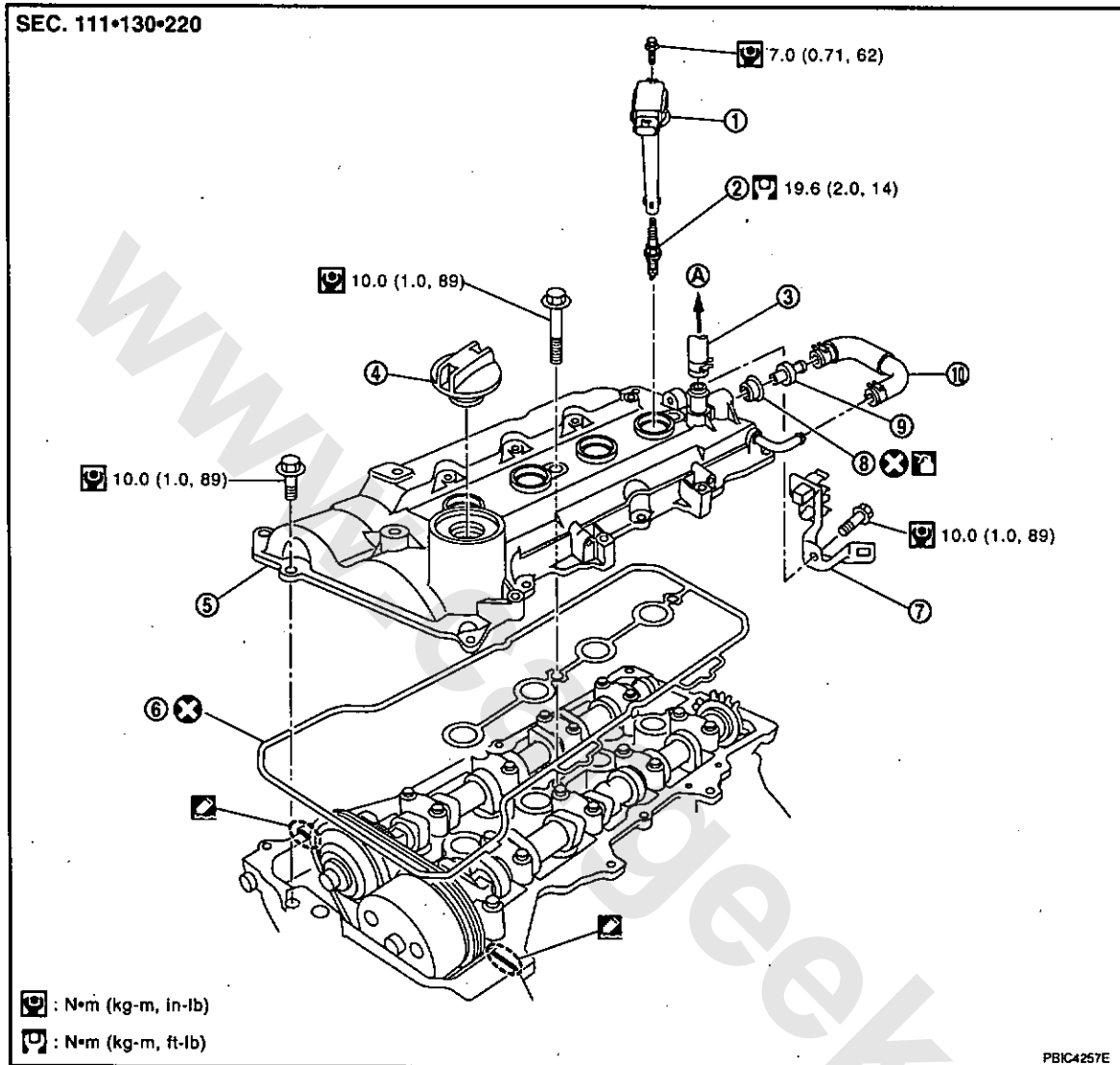
< ON-VEHICLE MAINTENANCE >

[HR16DE]

## SPARK PLUG

### Exploded View

INFOID:000000004899154



- |                   |                 |              |
|-------------------|-----------------|--------------|
| 1. Ignition coil  | 2. Spark plug   | 3. PCV hose  |
| 4. Oil filler cap | 5. Rocker cover | 6. Gasket    |
| 7. Bracket        | 8. Grommet      | 9. PCV valve |
| 10. PCV hose      |                 |              |
| A. To air duct    |                 |              |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899155

### REMOVAL

1. Remove intake manifold. Refer to EM-30, "Exploded View".
2. Remove ignition coil. Refer to EM-44, "Exploded View".

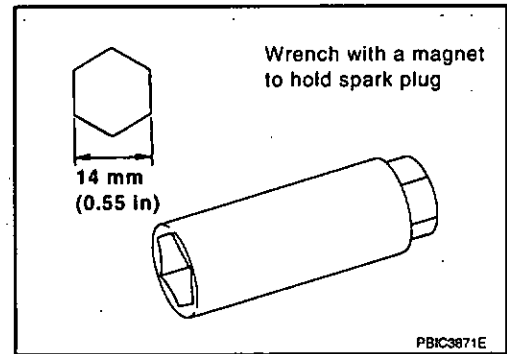


# SPARK PLUG

## < ON-VEHICLE MAINTENANCE >

[HR16DE]

3. Remove spark plug with a spark plug wrench (commercial service tool).



## INSTALLATION

Installation is the reverse order of removal.

## Inspection

INFOID:000000004899156

## INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

Spark plug (Standard type): Refer to EM-117, "Spark Plug".

### CAUTION:

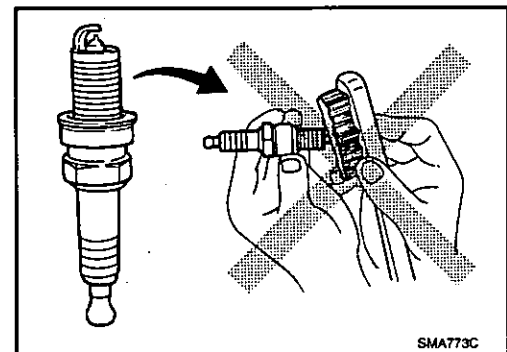
- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure:

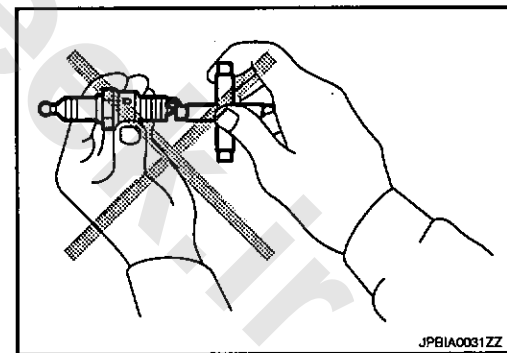
Less than 588 kPa (6 kg/cm<sup>2</sup>, 85 psi)

Cleaning time:

Less than 20 seconds



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



# CAMSHAFT VALVE CLEARANCE

< ON-VEHICLE MAINTENANCE >

[HR16DE]

## CAMSHAFT VALVE CLEARANCE

### Inspection and Adjustment

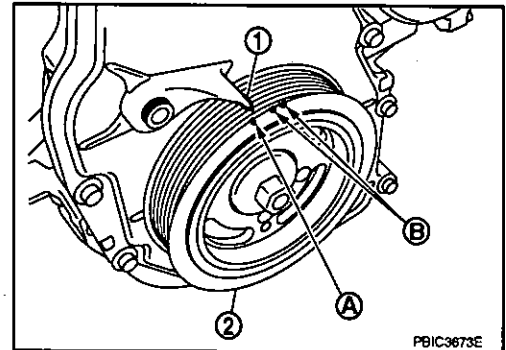
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#### INSPECTION

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

1. Remove rocker cover. Refer to EM-44, "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 (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

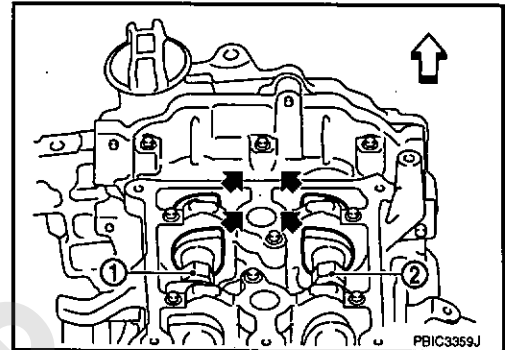
B : White paint mark (Not use for service)



- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face outside as shown in the figure.

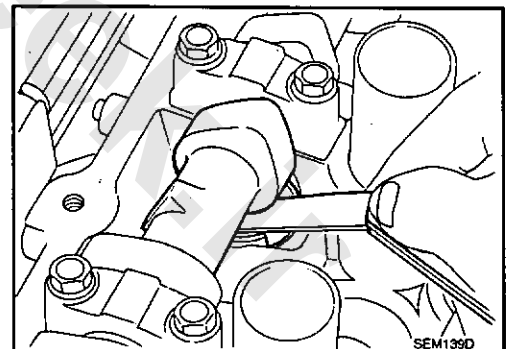
1 : Camshaft (INT)  
2 : Camshaft (EXH)  
⇐ : Engine front

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



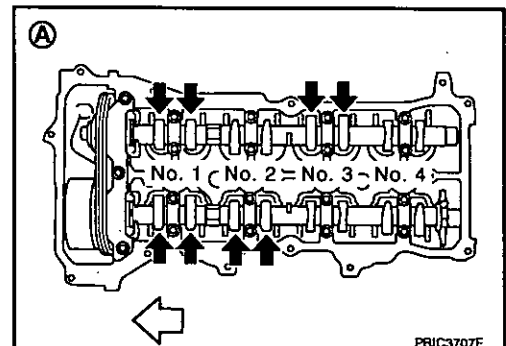
- b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

**Valve Clearance:** Refer to EM-117, "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 : No. 1 cylinder compression TDC  
⇐ : Engine front



# CAMSHAFT VALVE CLEARANCE

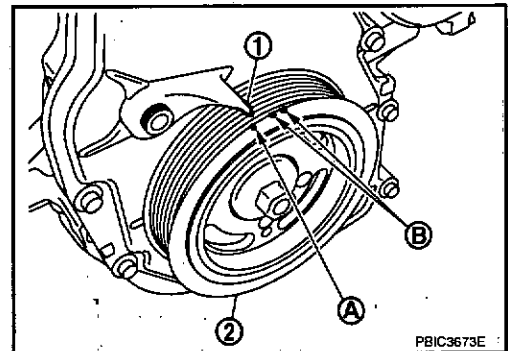
< ON-VEHICLE MAINTENANCE >

[HR16DE]

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
Measurement position	EXH	x		x	
	INT	x	x		

- c. Rotate crankshaft pulley (2) one revolution (360 degrees) and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

B : White paint mark (Not use for service)

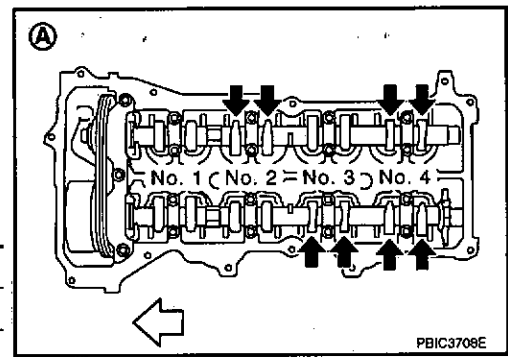


- By referring to the figure, measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (→) in the figure] with a feeler gauge.

A : No. 4 cylinder compression TDC

↶ : Engine front

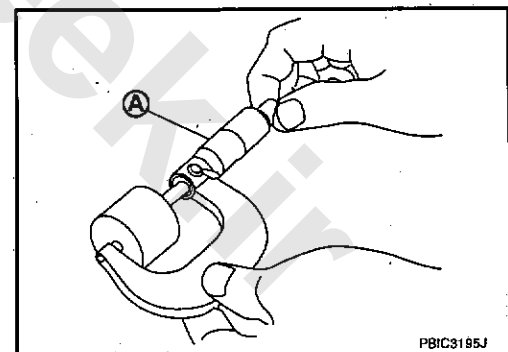
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
Measurement point	EXH		x		x
	INT			x	x



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

## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
- Remove camshaft. Refer to EM-56. "Exploded View".
  - Remove valve lifters at the locations that are out of the standard.
  - Measure the center thickness of the removed valve lifters with a micrometer (A).



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

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

t = Valve lifter thickness to be replaced

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

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

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

Intake : 0.30 mm (0.012 in)

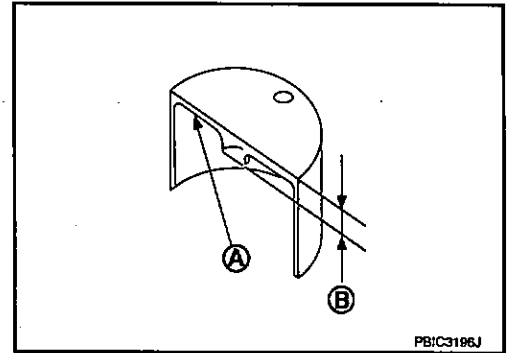
Exhaust : 0.33 mm (0.013 in)

## CAMSHAFT VALVE CLEARANCE

### < ON-VEHICLE MAINTENANCE >

[HR16DE]

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
- Stamp mark "300" indicates 3.00 mm (0.118 in) in thickness.



#### NOTE:

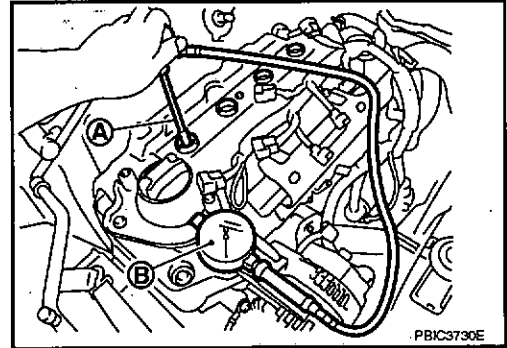
Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.1181 to 0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to EM-117, "Camshaft".

5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-56, "Exploded View".
7. Manually rotate crankshaft pulley a few rotations.
8. Make sure that valve clearances for cold engine are within specifications by referring to the specified values.
9. Install all removed parts in the reverse order of removal.
10. Warm up the engine, and check for unusual noise and vibration.

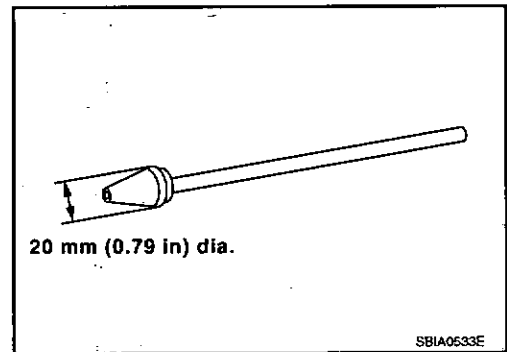
## COMPRESSION PRESSURE

### Inspection

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure.
3. Remove ignition coil and spark plug from each cylinder. Refer to EM-44, "Exploded View".
4. Connect an engine tachometer.
5. Install a compression tester (B) with an adapter (commercial service tool) (A) 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-116, "General Specification".

#### CAUTION:

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

- If the engine speed is out of the 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 recheck it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gasket is leaking. In such a case, replace cylinder head gasket.

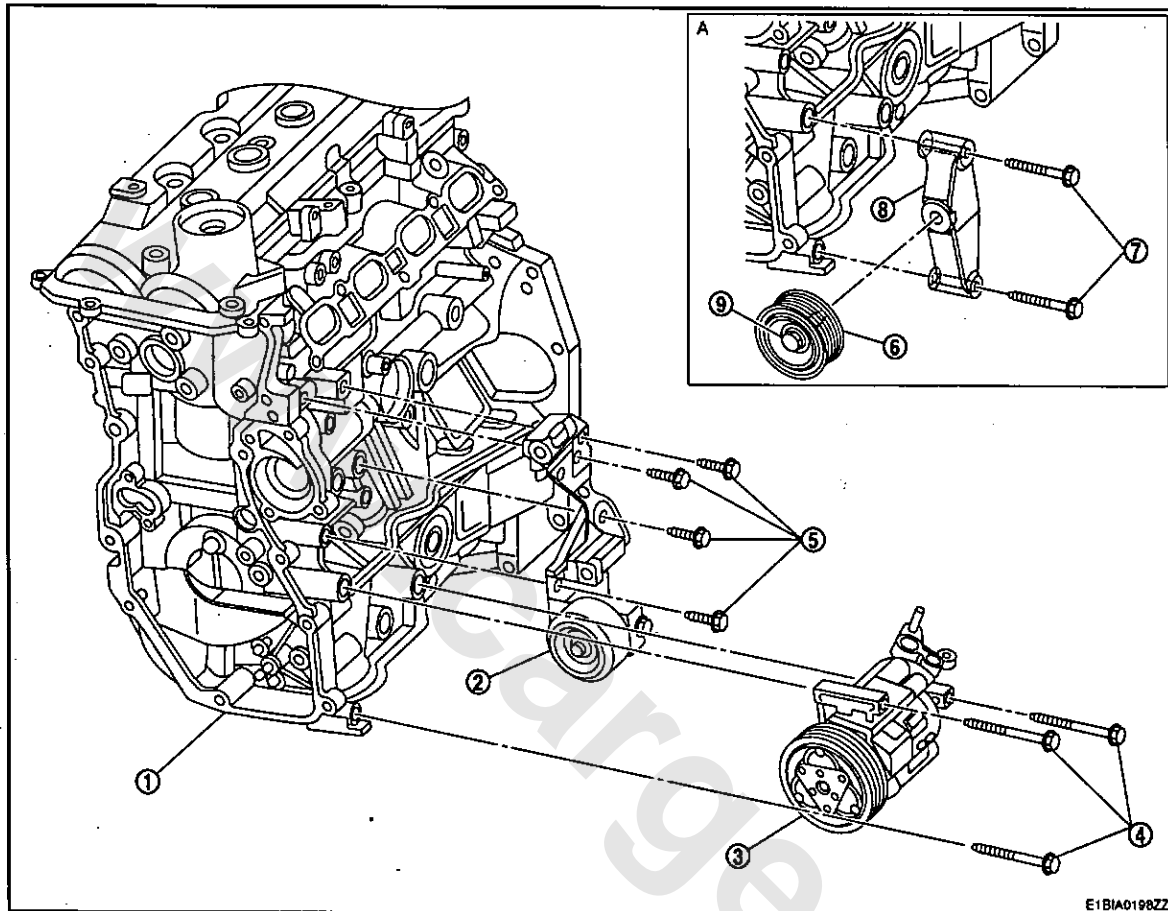
7. After inspection is completed, install removed parts.
8. Start the engine, and confirm that the engine runs smoothly.
9. Perform trouble diagnosis. If DTC appears, erase it.

## ON-VEHICLE REPAIR

### DRIVE BELT IDLER PULLEY

Exploded View

INFOID:000000004899159



E1BIA0198ZZ

- |  |                                   |                                   |
|--|-----------------------------------|-----------------------------------|
| 1. Engine  | 2. Drive belt idler pulley Type 1 | 3. Compressor assembly (With A/C) |
| 4. Fixing bolts                                  | 5. Fixing bolts                   | 6. Drive belt Idler pulley Type 2 |
| 7. Fixing bolts                                  | 8. Bracket idler pulley           | 9. Drive idler pulley fixing bolt |
| A Drive belt idler pulley assembly (without A/C) |                                   |                                   |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899160

### REMOVAL

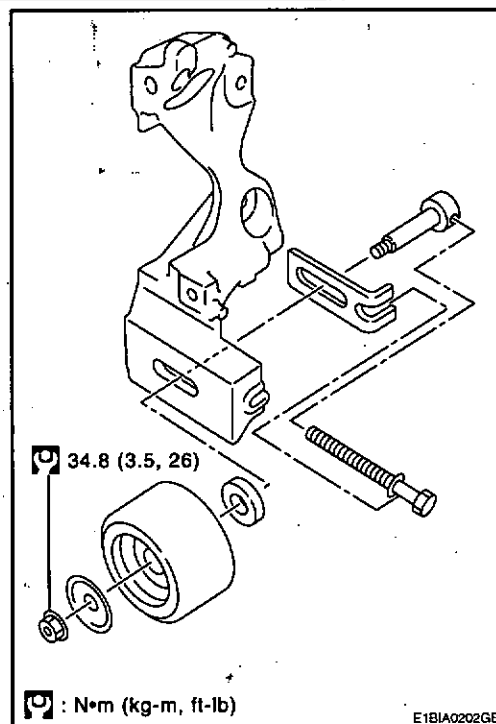
1. Remove drive belt. Refer to EM-17, "Removal and Installation".

# DRIVE BELT IDLER PULLEY .

[HR16DE]

## < ON-VEHICLE REPAIR >

2. Remove the drive belt idler pulley type 1.
  - Remove the lock nut, and then remove the plate, idler pulley, and washer.
  - Remove the center shaft together with the spacer with inserting the adjusting bolt.
3. Remove the drive belt idler pulley type 2. Refer to EM-26, "Exploded View".

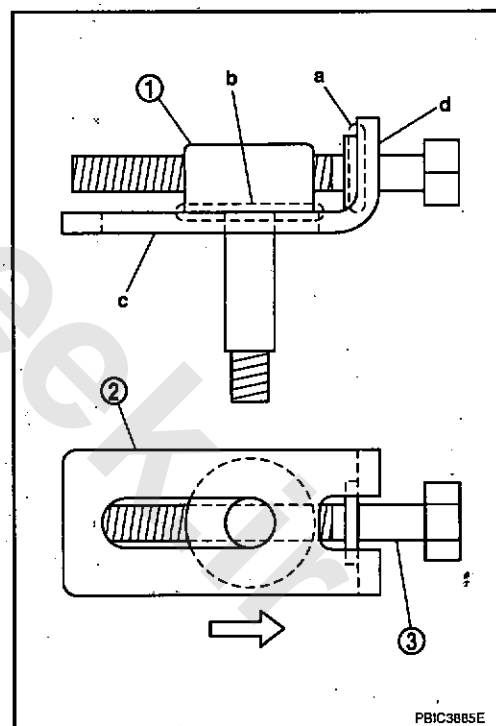


## INSTALLATION

### TYPE 1

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

: 3.9 N·m (0.40 kg-m, 35 in-lb)



### TYPE 2

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

# AIR CLEANER AND AIR DUCT

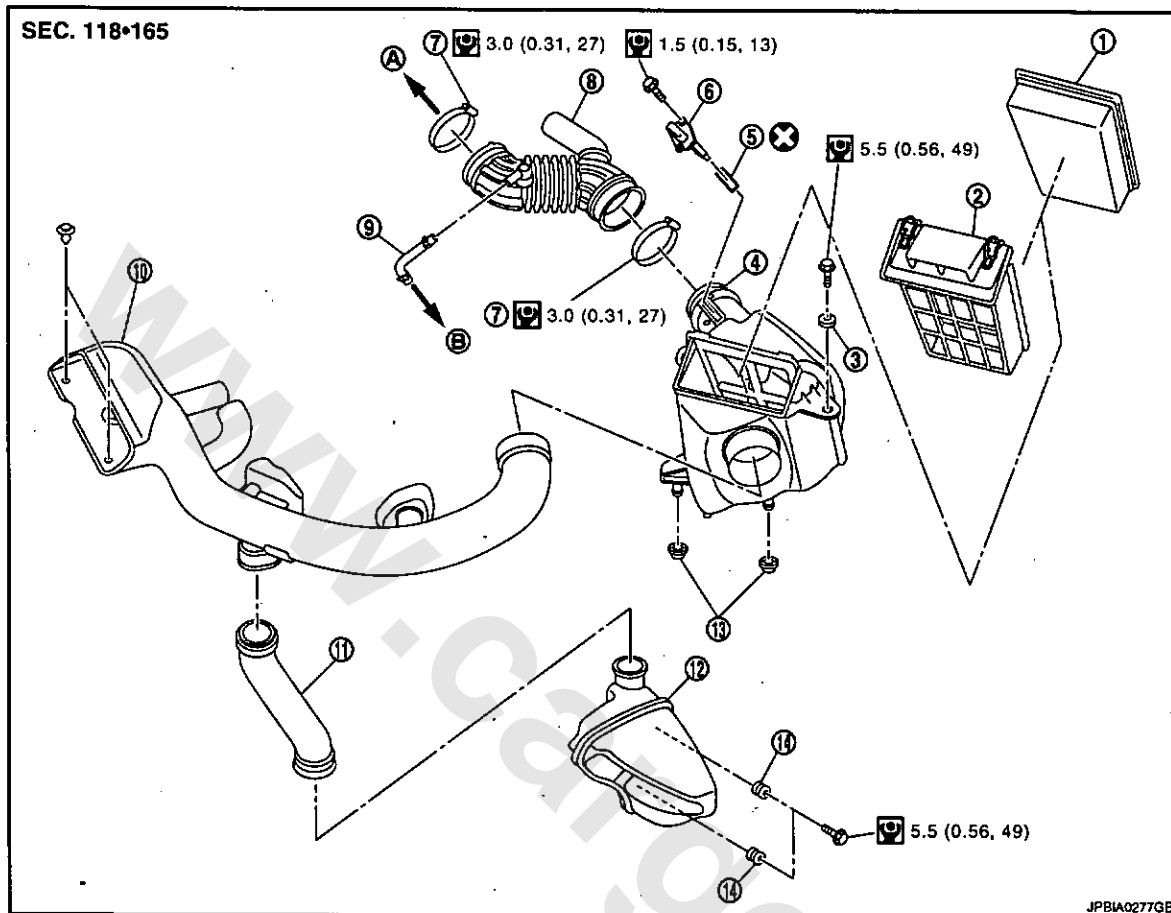
< ON-VEHICLE REPAIR >

[HR16DE]

## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:000000004899161



- |  |                                    |                         |
|--|------------------------------------|-------------------------|
| 1. Air cleaner filter                    | 2. Holder                          | 3. Grommet              |
| 4. Air cleaner case                      | 5. O-ring                          | 6. Mass air flow sensor |
| 7. Clamp                                 | 8. Air duct and resonator assembly | 9. PCV hose             |
| 10. Air duct (inlet)                     | 11. Air duct                       | 12. Resonator           |
| 13. Grommet                              | 14. Grommet                        |                         |
| A. To electric throttle control actuator | B. To rocker cover                 |                         |

Refer to GI-3, "Components" for symbols in the figure.

### Removal and Installation

INFOID:000000004899162

#### REMOVAL

1. Remove the air duct (inlet).
2. Disconnect mass air flow sensor harness connector.
3. Remove the PCV hose.
4. Remove air cleaner case/mass air flow sensor assembly and air duct and resonator assembly disconnecting their joints.
  - Add marks as necessary for easier installation.
5. Remove air cleaner case.
6. Remove the mass air flow sensor from the air cleaner case, if necessary.

#### CAUTION:

- Handle mass air flow sensor carefully and avoid impacts.
- Never touch sensor part.



# AIR CLEANER AND AIR DUCT

< ON-VEHICLE REPAIR >

[HR16DE]

## INSTALLATION

- Note the following, and install in the reverse order of removal.
- Align marks. Attach each joint. Screw clamps firmly.

## Inspection

INFOID:0000000004899163

EM

## 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

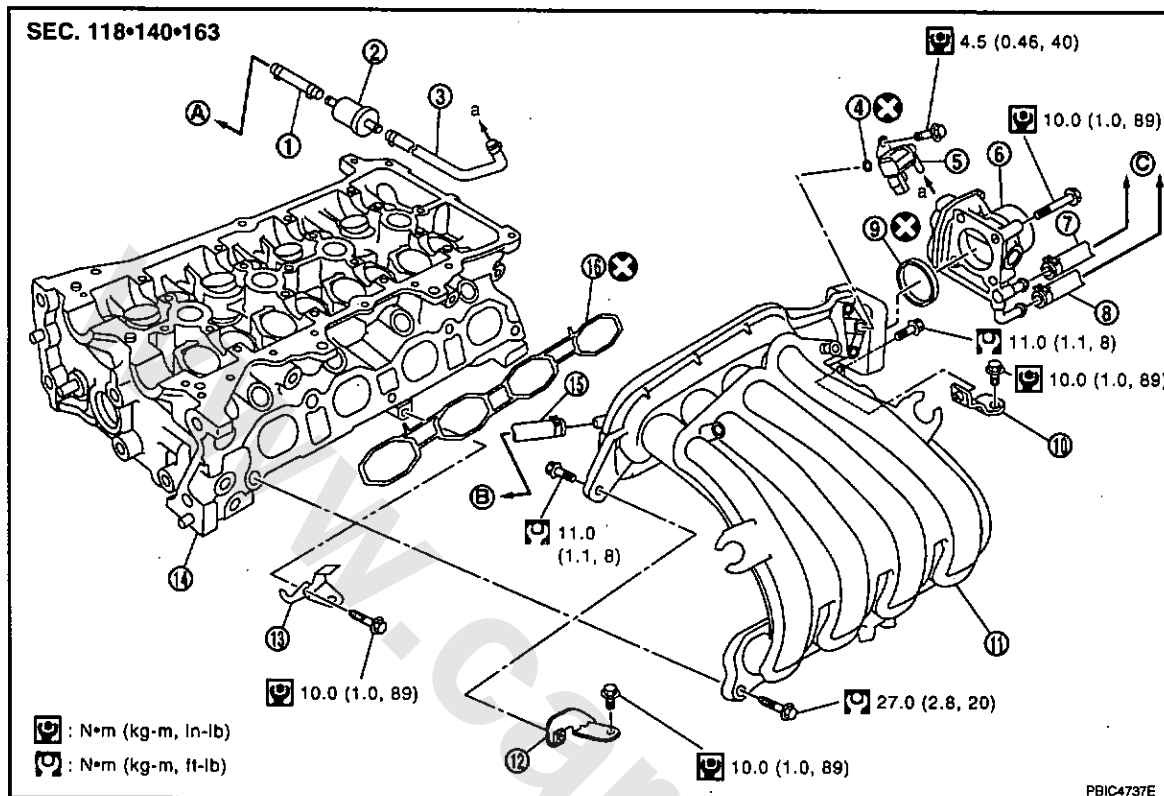
< ON-VEHICLE REPAIR >

[HR16DE]

## INTAKE MANIFOLD

### Exploded View

INFOID:000000004599164



- |  |  |                                       |
|--|--|---------------------------------------|
| 1. EVAP hose                           | 2. Vacuum tank                                       | 3. EVAP hose                          |
| 4. O-ring                              | 5. EVAP canister purge volume control solenoid valve | 6. Electric throttle control actuator |
| 7. Water hose (Northern Europe models) | 8. Water hose (Northern Europe models)               | 9. Gasket                             |
| 10. Intake manifold support (rear)     | 11. Intake manifold                                  | 12. Intake manifold support (front)   |
| 13. Intake manifold support (center)   | 14. Cylinder head                                    | 15. Vacuum hose                       |
| 16. Gasket                             |  |                                       |
| A. To centralized under-floor piping   | B. To brake booster                                  | C. To water outlet                    |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899165

### REMOVAL

- Remove the air duct (inlet) and the air duct and resonator assembly. Refer to EM-28, "Exploded View".
- Disconnect water hoses from electric throttle control actuator, attach blind plug to prevent engine coolant leakage. (Northern Europe models)  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belts.
- Pull out oil level gauge.  
**CAUTION:**

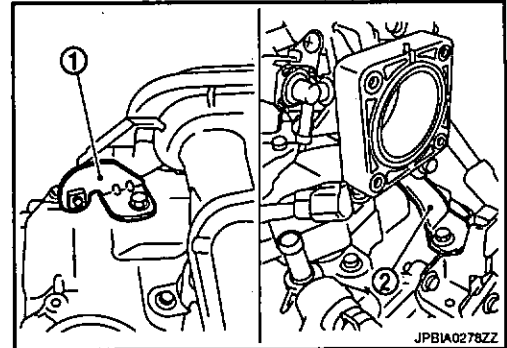
Cover the oil level gauge guide openings to avoid entry of foreign materials.
- Remove electric throttle control actuator.  
**CAUTION:**
  - Handle electric throttle control actuator carefully and avoid impacts.
  - Never disassemble or adjust electric throttle control actuator.

# INTAKE MANIFOLD

[HR16DE]

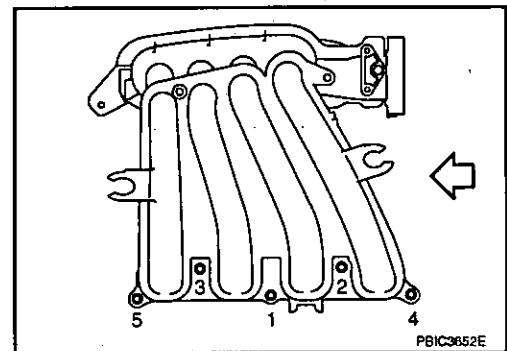
## < ON-VEHICLE REPAIR >

5. Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.
6. Disconnect vacuum hose for brake booster from intake manifold.
7. Remove intake manifold support front (1) and rear (2).



8. Remove intake manifold.
  - Loosen bolts in the reverse of the order shown in the figure.

⇐ : Engine front



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

**CAUTION:**  
Handle EVAP canister purge volume control solenoid valve carefully and avoid impacts.
10. Remove intake manifold support (center) from cylinder head, if necessary.
 

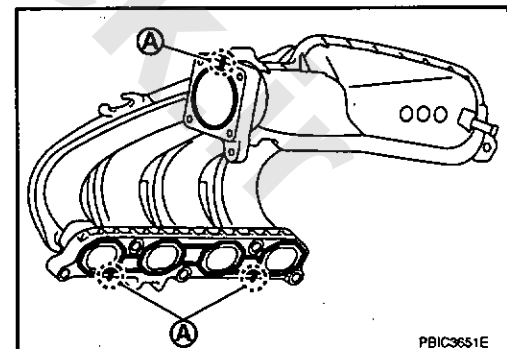
**NOTE:**  
The intake manifold support (center) functions as the guide when the intake manifold is installed.

## INSTALLATION

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

### Intake Manifold

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



2. Place the intake manifold into the installation position.
 

**CAUTION:**  
Make sure that the oil level gauge guide is not disconnected from the fixing clip of water inlet due to interference with intake manifold.

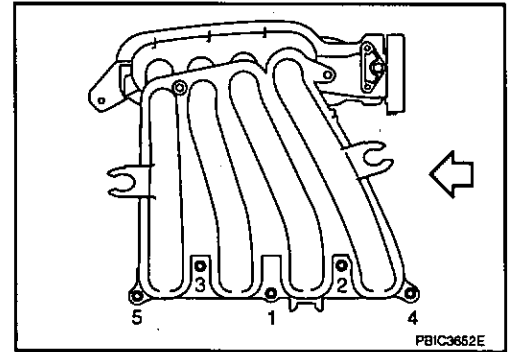
## INTAKE MANIFOLD

< ON-VEHICLE REPAIR >

[HR16DE]

3. Tighten bolts in the numerical order shown in the figure.

⇐ : Engine front



4. Install intake manifold support (front and rear).

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.
- Perform "Throttle Valve Closed Position Learning" and "Idle Air Volume Learning" after repair when replacing electric throttle control actuator.

# EXHAUST MANIFOLD

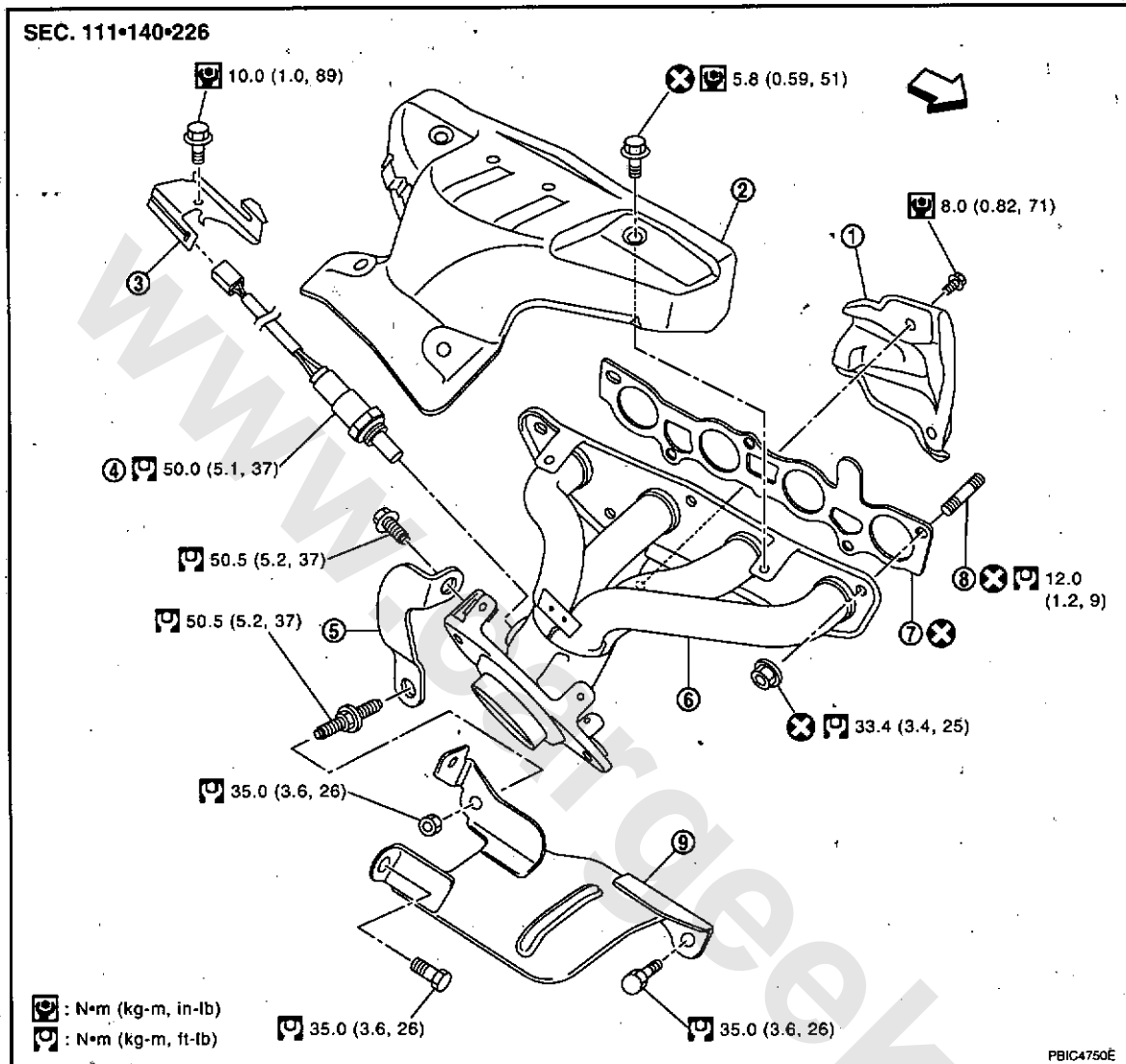
< ON-VEHICLE REPAIR >

[HR16DE]

## EXHAUST MANIFOLD

### Exploded View

INFOID:0000000004899166



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

↶ : Engine front

## Removal and Installation

INFOID:0000000004899167

### REMOVAL

1. Remove exhaust front tube. Refer to EX-5, "Exploded View".
2. Remove the harness bracket of heated oxygen sensor 1 from the cylinder head.
3. Remove exhaust manifold cover.
4. Remove the heated oxygen sensor 1.

# EXHAUST MANIFOLD

## < ON-VEHICLE REPAIR >

[HR16DE]

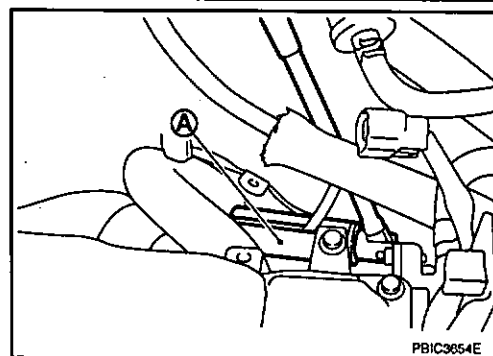
- Using heated oxygen sensor wrench [SST: KV10117100] (A), remove heated oxygen sensor 1.

### CAUTION:

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

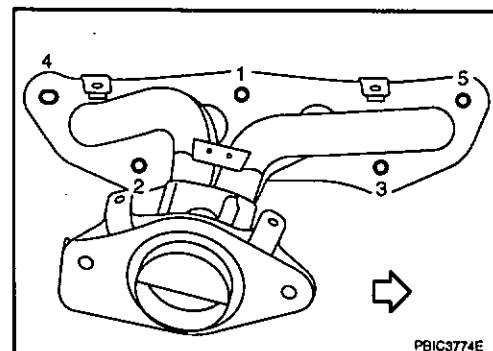
### NOTE:

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



5. Remove exhaust manifold side mounting bolt of exhaust manifold stay.
6. Remove exhaust manifold.
  - Loosen nuts in the reverse of the order shown in the figure.

← : Engine front



7. Remove gasket.

### CAUTION:

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

8. Remove exhaust manifold cover from back of exhaust manifold.

## INSTALLATION

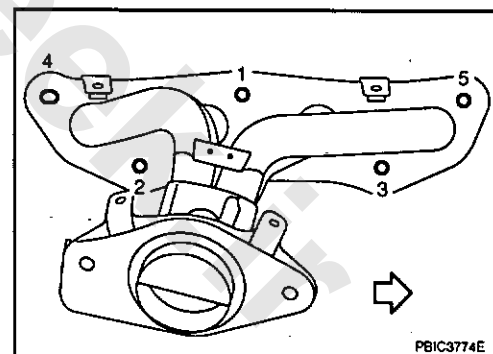
Note the following, and install in the reverse order of removal.

Exhaust Manifold

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

← : Engine front

2. Tighten to the specified torque again.



## Inspection

## INSPECTION AFTER REMOVAL

Mounting Surface Distortion

INFOID:0000000004899168

## EXHAUST MANIFOLD

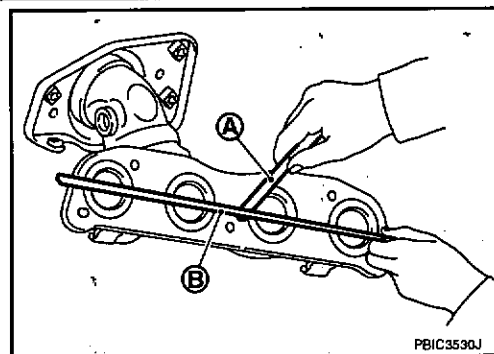
[HR16DE]

### < ON-VEHICLE REPAIR >

- Using a straightedge (B) and feeler gauge (A), check distortion of exhaust manifold mounting surface.

**Limit:** Refer to EM-117, "Exhaust Manifold".

- Replace exhaust manifold if outside the limit.



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## FUEL INJECTOR AND FUEL TUBE

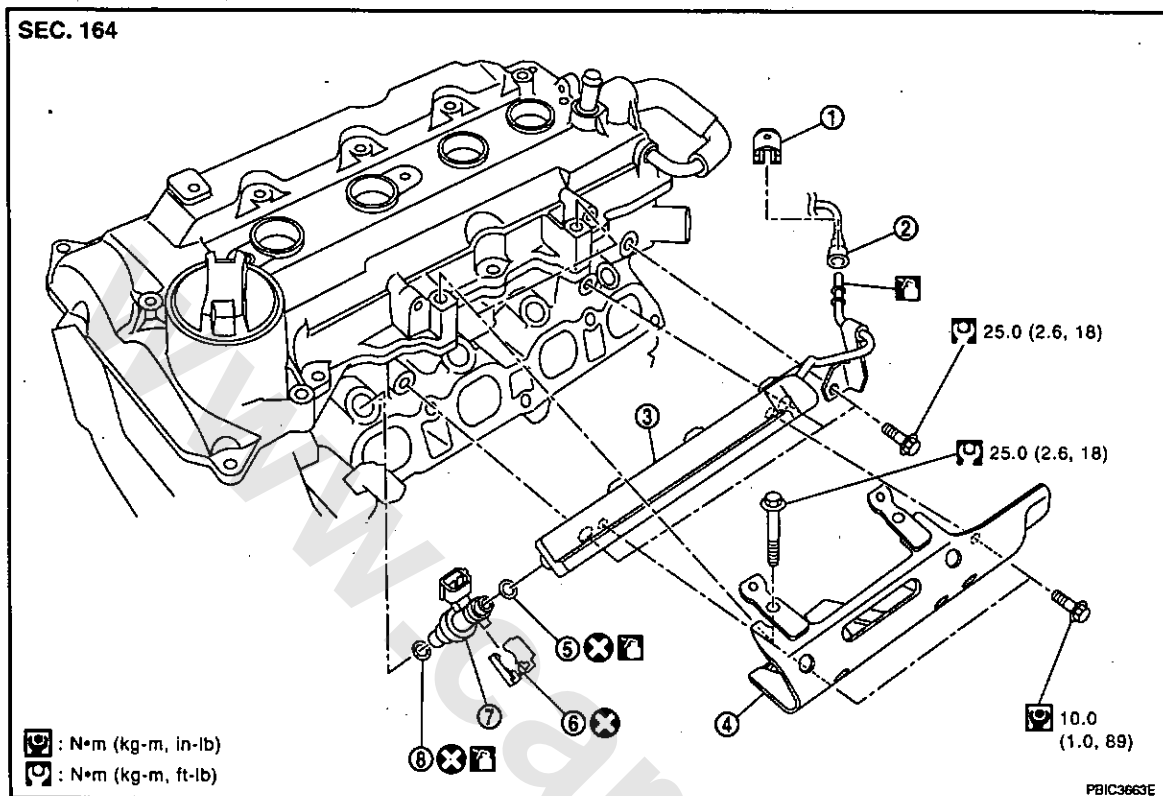
< ON-VEHICLE REPAIR >

[HR16DE]

### FUEL INJECTOR AND FUEL TUBE

#### Exploded View

INFOID:0000000004899169



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

Refer to GI-3, "Components" for symbols in the figure.

#### CAUTION:

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

#### Removal and Installation

INFOID:0000000004899170

#### 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.
2. Remove intake manifold. Refer to EM-30, "Exploded View".



# FUEL INJECTOR AND FUEL TUBE

[HR16DE]

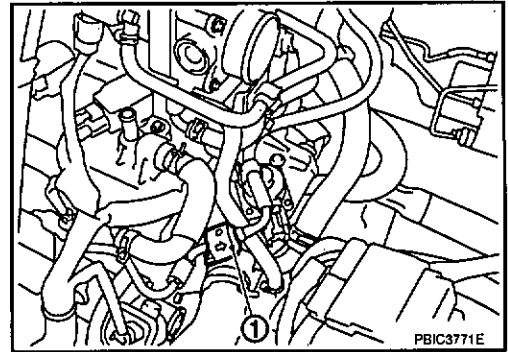
## < ON-VEHICLE REPAIR >

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

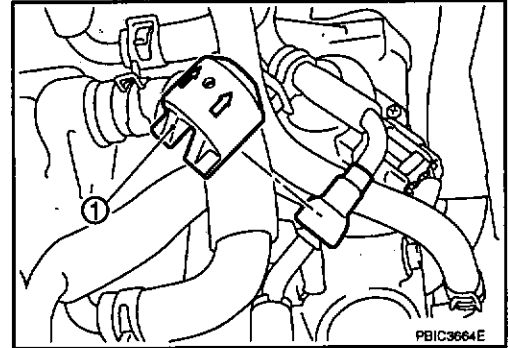
1 : Quick connector cap

### NOTE:

There is no fuel return path.



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



- c. With the sleeve side of quick connector release (SST) 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.

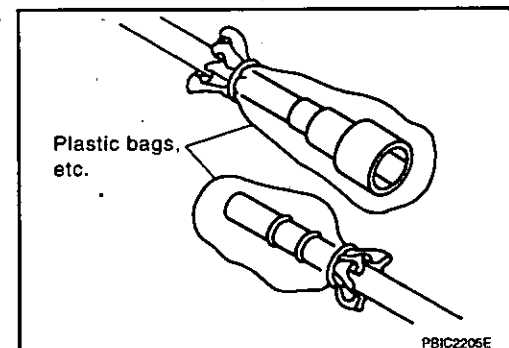
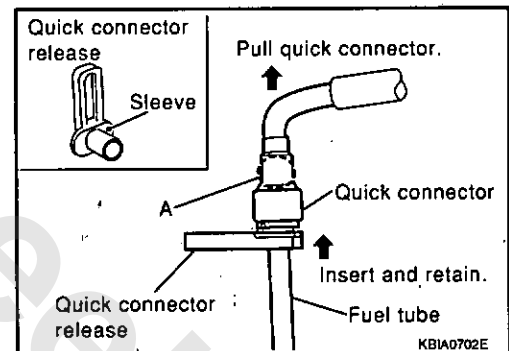
### CAUTION:

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.

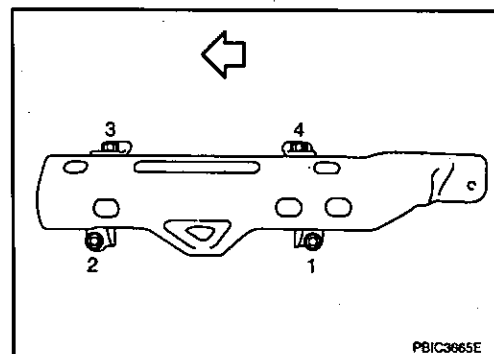
# FUEL INJECTOR AND FUEL TUBE

## < ON-VEHICLE REPAIR >

[HR16DE]

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

⇐ : Engine front

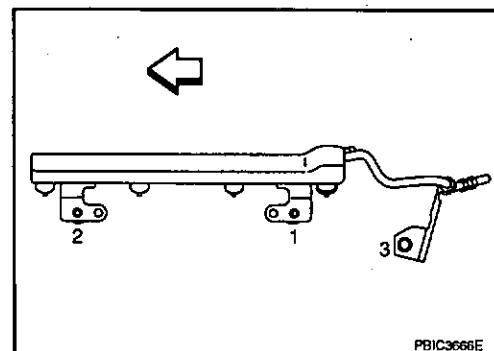


6. Remove the fuel injector and fuel tube assembly.
- Loosen bolts in the reverse of the order shown in the figure.

⇐ : Engine front

### CAUTION:

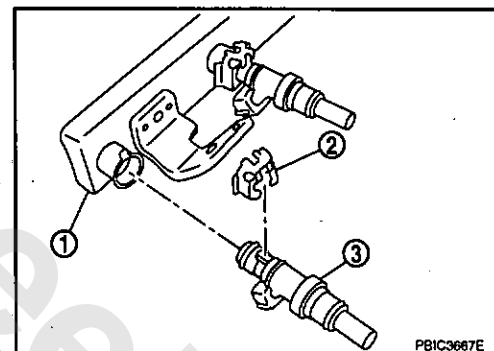
- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leaks from fuel tube.



7. Remove the fuel injector (3) from the fuel tube (1) with the following procedure.
- Open and remove the clip (2).
  - Remove fuel injector from the fuel tube by pulling straight.

### CAUTION:

- Be careful about fuel leakage remaining in fuel tube.
- Be careful not to damage the nozzle of fuel injector.
- Never subject fuel injector to impact by dropping or hitting.
- Never disassemble.



## INSTALLATION

1. Install new the O-ring to the fuel injector, paying attention to the following.

### CAUTION:

- The 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 engine oil.
- Never clean O-ring with solvent.
- Make sure that the O-ring and its mating part are free of foreign material.
- Be careful not to scratch O-ring with tool or fingernails when installing it. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it into fuel tube immediately.
- Insert O-ring straight into fuel tube. Never decenter or twist it.

# FUEL INJECTOR AND FUEL TUBE

[HR16DE]

## < ON-VEHICLE REPAIR >

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

3 : O-ring (Black)

5 : O-ring (Green)

- a. Insert the clips (2) into the clip mounting grooves on the fuel injector.

- Insert clip cut-out (D) into fuel injector protrusion (F).

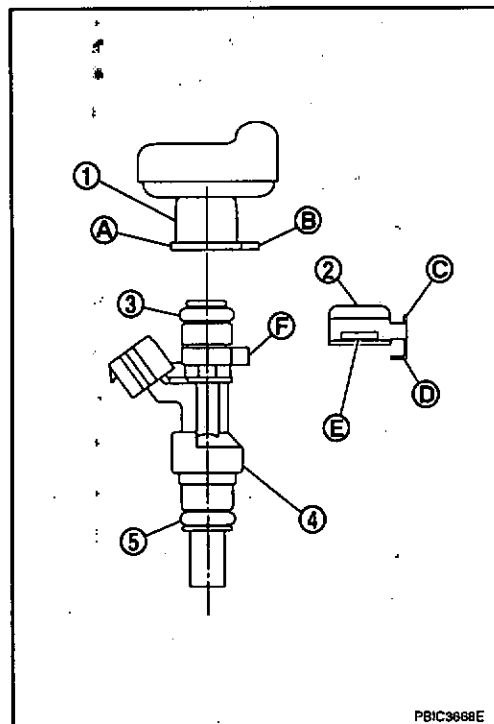
### CAUTION:

- Always replace clip with new one.
- Make sure that the clip does not interfere with the O-ring. If interference occurs, replace the O-ring.

- b. Insert the fuel injector into the fuel tube with clip attached.

- Make sure that the axis is lined up when inserting.
- Insert clip cut-out (C) into fuel tube protrusion (B).
- Make sure that the flange (A) on the fuel tube fits securely in the clip flange fixing groove (E).

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



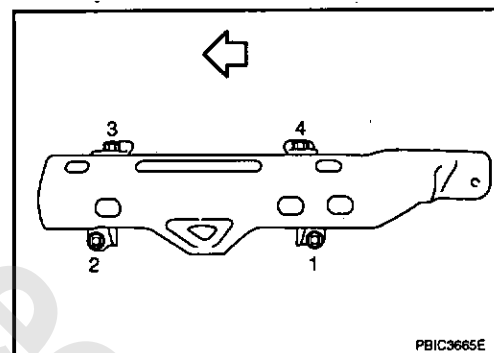
3. Install fuel tube and injector assembly onto cylinder head.

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

← : Engine front

### CAUTION:

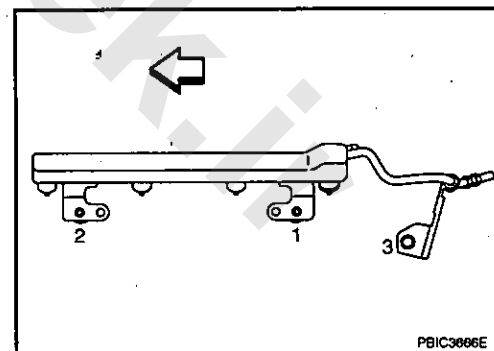
Be careful not to let tip of injector nozzle interfere with other parts.



4. Install fuel tube protector.

- Tighten bolts in the numerical order 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.

# FUEL INJECTOR AND FUEL TUBE

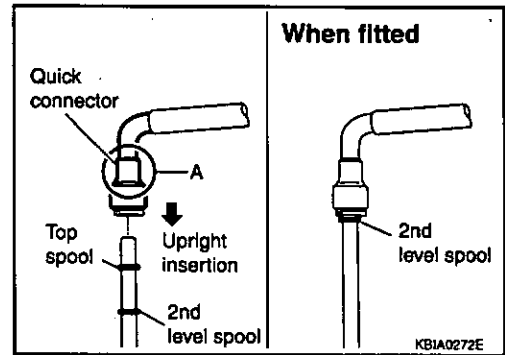
## < ON-VEHICLE REPAIR >

[HR16DE]

- 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:

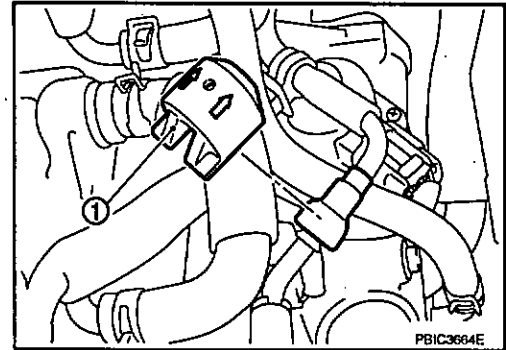
- Hold "A" position in the figure when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert until you hear a "click" sound and actually feel the engagement.
- To avoid misidentification of engagement 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. Make sure it is completely engaged (connected) so that it does not come out from fuel tube.
- e. Install quick connector cap (1) to quick connector connection.
- Install quick connector cap with the side arrow facing quick connector side (fuel feed hose side).

### CAUTION:

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

## Inspection

INFOID:000000004899171

## INSPECTION AFTER INSTALLATION

### Check on Fuel Leakage

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

### CAUTION:

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

# OIL PAN (LOWER)

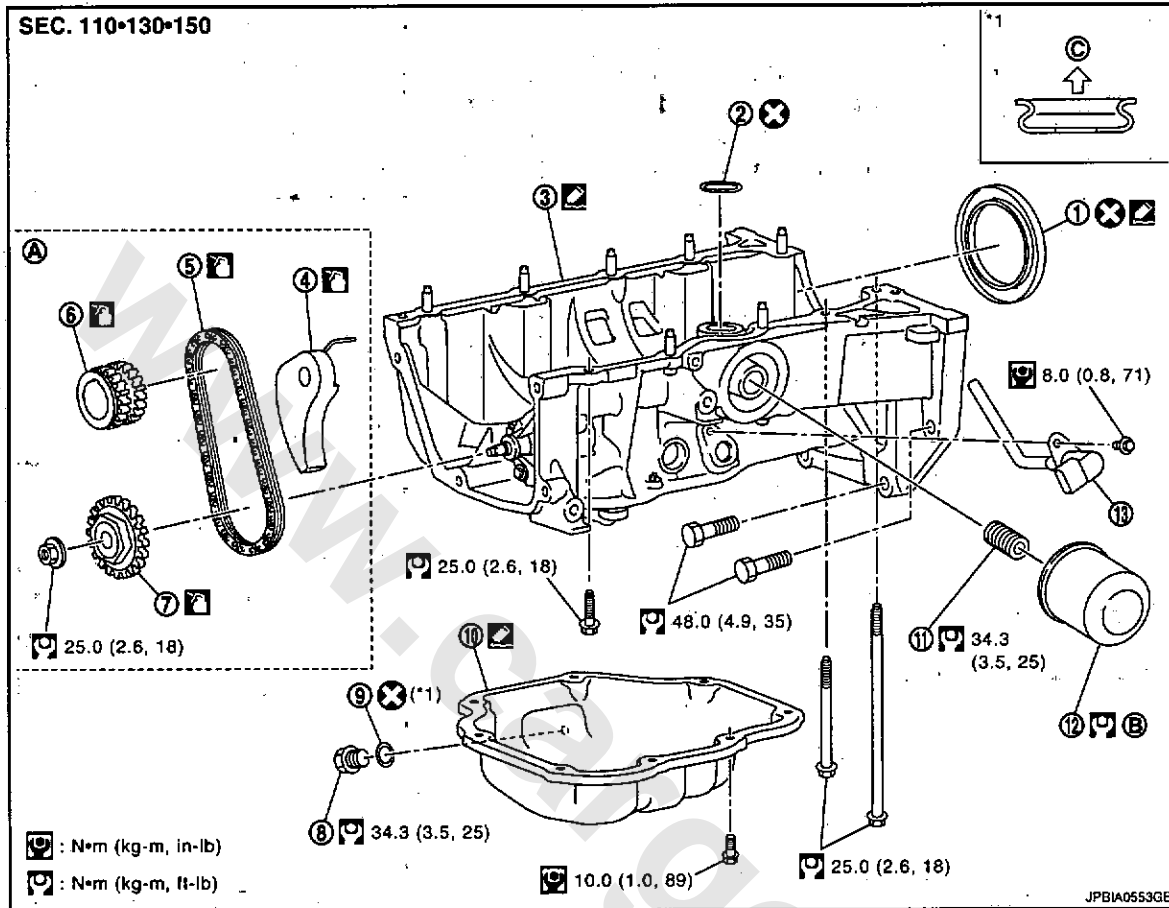
< ON-VEHICLE REPAIR >

[HR16DE]

## OIL PAN (LOWER)

### Exploded View

INFOID:0000000004899172



- |                      |                          |                        |
|----------------------|--------------------------|------------------------|
| 1. Rear oil seal     | 2. O-ring                | 3. Oil pan (upper)     |
| 4. Chain tensioner   | 5. Oil pump drive chain  | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pan drain plug    | 9. Washer              |
| 10. Oil pan (lower)  | 11. Oil filter stud bolt | 12. Oil filter         |
| 13. Oil level sensor |                          |                        |

A. Refer to EM-47

B. Refer to LU-9

C. Oil pan side

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:0000000004899173

### REMOVAL

1. Drain engine oil. Refer to LU-7, "Draining".
2. Remove the oil pan (lower) with the following procedure.

## OIL PAN (LOWER)

### < ON-VEHICLE REPAIR >

[HR16DE]

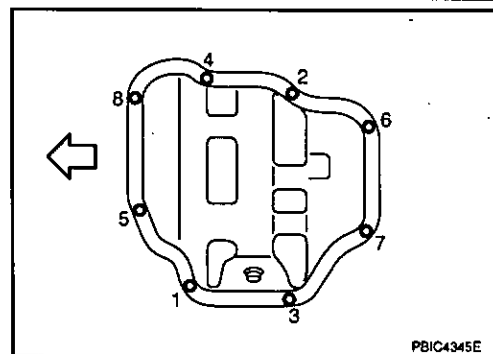
- a. Loosen bolts in the reverse of the order shown in the figure.

⇐ : Engine front

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

**CAUTION:**

- Be careful not to damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a flat-bladed screwdriver, etc.



### INSTALLATION

1. Install oil pan (lower) with the following procedure.
- a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove the 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 surfaces when cleaning off old liquid gasket.**

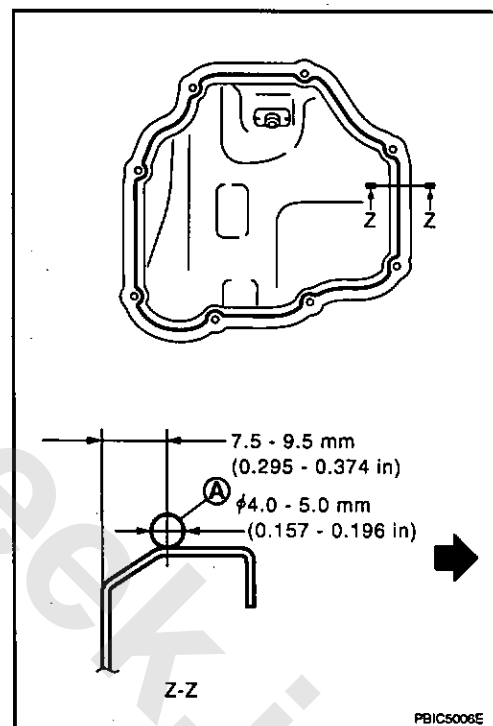
- b. Apply a continuous bead of liquid gasket (A) with the tube presser (commercial service tool) to areas shown in the figure.

⇐ : Engine out side

**Use Genuine Liquid Gasket or equivalent.**

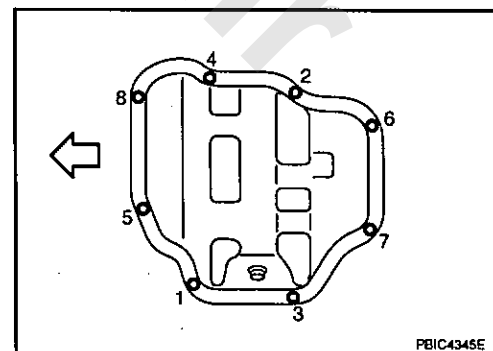
**CAUTION:**

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



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

⇐ : Engine front



2. Install oil pan drain plug.
- For installation direction of washer. Refer to EM-41. "Exploded View".
3. Install in the reverse order of removal, for the rest of parts.

**CAUTION:**

## OIL PAN (LOWER)

< ON-VEHICLE REPAIR >

[HR16DE]

Pour engine oil at least 30 minutes after oil pan is installed.

### Inspection

INFOID:000000004899174

A

### INSPECTION AFTER INSTALLATION

EM

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".

C

D

E

F

G

H

I

J

K

L

M

N

O

P

**[HR16DE]**

### Exploded View

INFOID:0000000004899175



- |                   |                 |              |
|-------------------|-----------------|--------------|
| 1. Ignition coil  | 2. Spark plug   | 3. PCV hose  |
| 4. Oil filler cap | 5. Rocker cover | 6. Gasket    |
| 7. Bracket        | 8. Grommet      | 9. PCV valve |
| 10. PCV hose      |                 |              |
| A. To air duct    |                 |              |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:0000000004899176

## REMOVAL

1. Remove intake manifold. Refer to EM-30, "Exploded View".

2. Remove ignition coil.

**CAUTION:**

- **Handle ignition coil carefully and avoid impacts.**
- **Never disassemble.**

3. Remove grand cable (RH).



# IGNITION COIL, SPARK PLUG AND ROCKER COVER

[HR16DE]

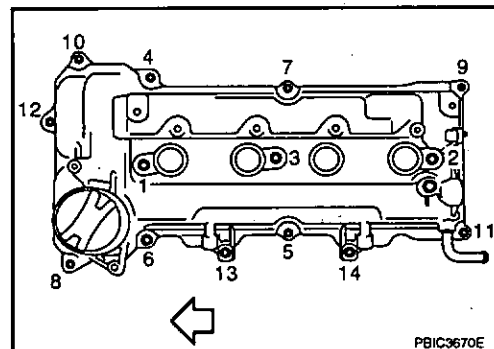
## < ON-VEHICLE REPAIR >

4. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to EM-84. "Exploded View".
5. Remove fuel tube protector.
6. Remove oil filler cap.
7. Remove rocker cover.
  - Loosen bolts in reverse order shown in the figure.

⇐ : Engine front

### NOTE:

13 and 14 shown in the figure are used to tighten the fuel tube protector.



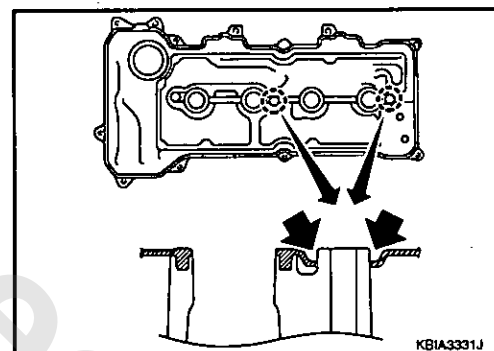
8. Remove rocker cover gasket from rocker cover.
9. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.

### CAUTION:

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

## INSTALLATION

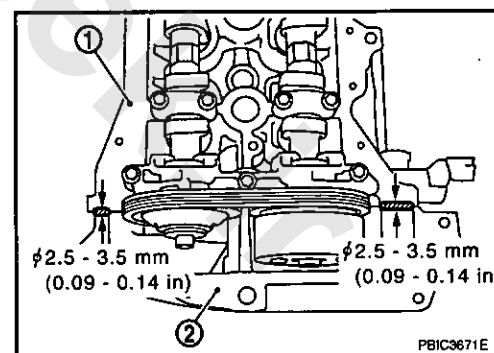
1. Install the rocker cover with the following procedure.
  - a. Install the gasket to the rocker cover.
    - Check for damage or foreign material.
    - Make sure that it is securely inserted in the mounting groove of rocker cover.
    - For the 2 bolt holes shown in the figure, push the gasket into the boss for the rocker cover bolt hole to prevent it from falling.



- b. Apply liquid gasket to the position shown in the figure.

- 1 : Cylinder head
- 2 : Front cover

**Use Genuine Liquid Gasket or equivalent.**



2. Install rocker cover to the cylinder head.
 

**CAUTION:**  
**Make sure the gasket is not dropped.**
3. Install rocker cover.

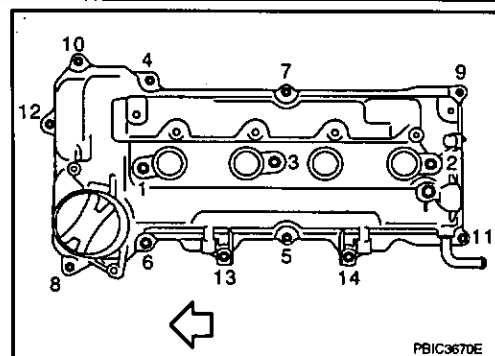
## IGNITION COIL, SPARK PLUG AND ROCKER COVER

< ON-VEHICLE REPAIR >

[HR16DE]

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

⇐ : Engine front



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

# TIMING CHAIN

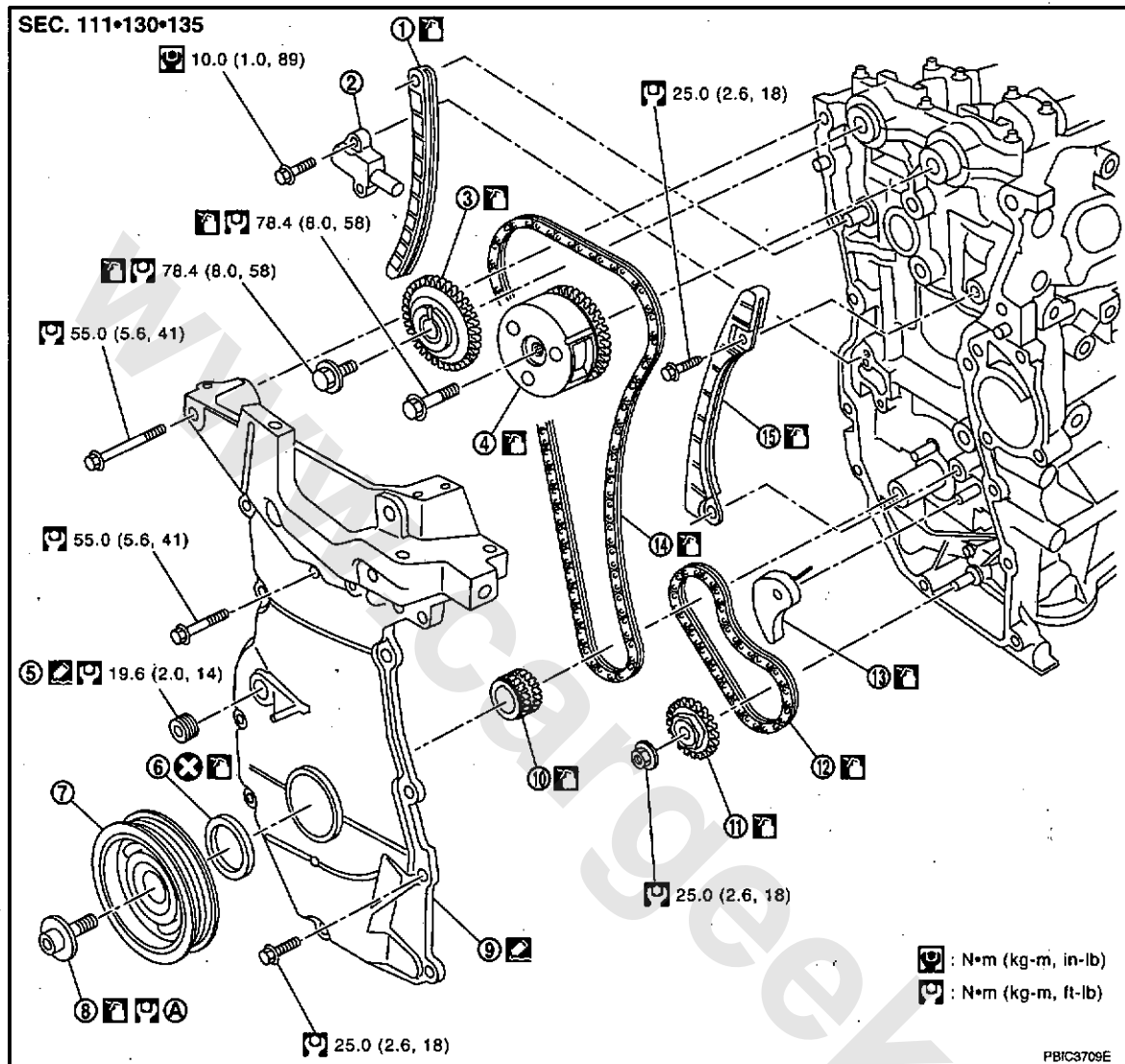
< ON-VEHICLE REPAIR >

[HR16DE]

## TIMING CHAIN

### Exploded View

INFOID:0000000004899177



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

A. Refer to EM-47

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:0000000004899178

### CAUTION:

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

### REMOVAL

1. Remove front wheel (RH). Refer to WT-3, "Road Wheel".
2. Remove front fender protector (RH). Refer to EXT-22, "Exploded View".
3. Drain engine oil. Refer to LU-7, "Draining".

### CAUTION:

# TIMING CHAIN

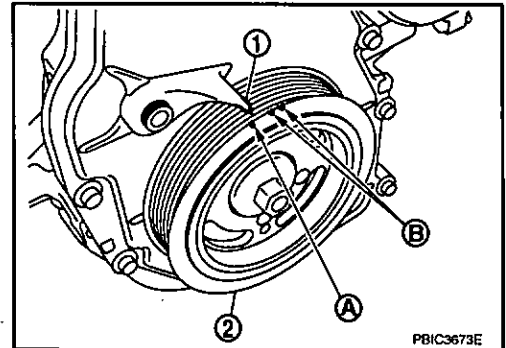
## < ON-VEHICLE REPAIR >

[HR16DE]

**Be sure to perform this step when engine is cold.**

4. Remove the following parts.
  - Intake manifold: Refer to EM-30, "Exploded View".
  - Drive belt: Refer to EM-17, "Removal and Installation".
  - Water pump pulley: Refer to CO-17, "Exploded View".
  - Ground cable (RH)
5. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to EM-84, "Exploded View".
6. Remove rocker cover. Refer to EM-44, "Exploded View".
7. Set No. 1 cylinder at TDC of its compression stroke with the following procedure:
  - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

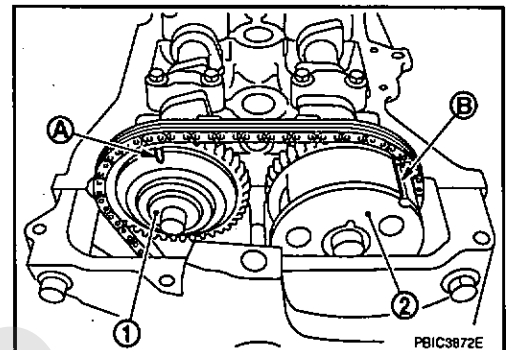
B : White paint mark (Not use for service)



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

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

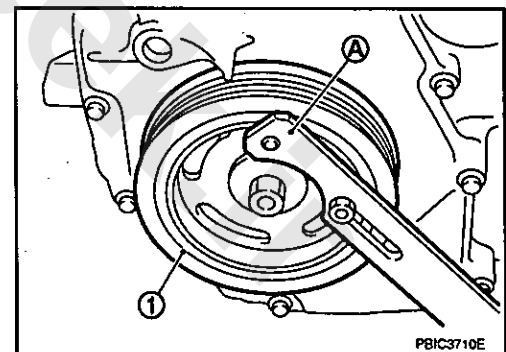
- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.



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

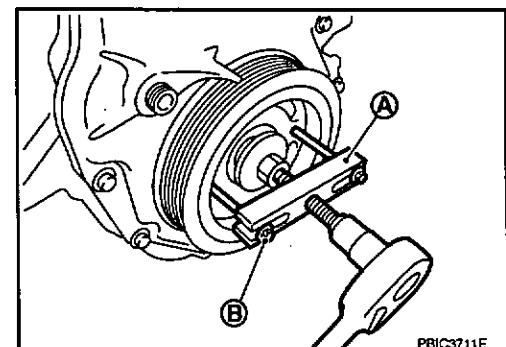
**CAUTION:**

**Never remove the mounting bolts as they are used as a supporting point for the pulley puller.**



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

B : M6 bolt

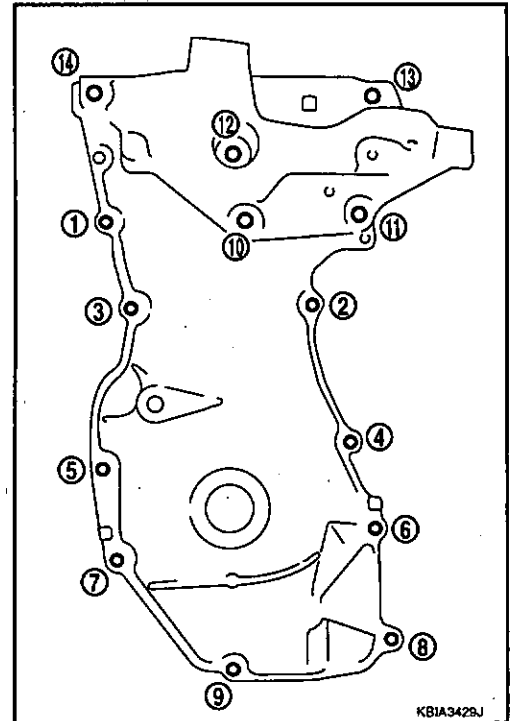


# TIMING CHAIN

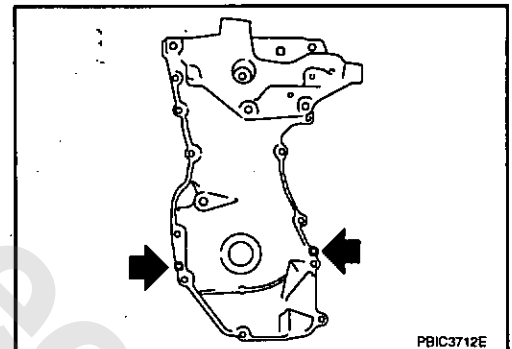
< ON-VEHICLE REPAIR >

[HR16DE]

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



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



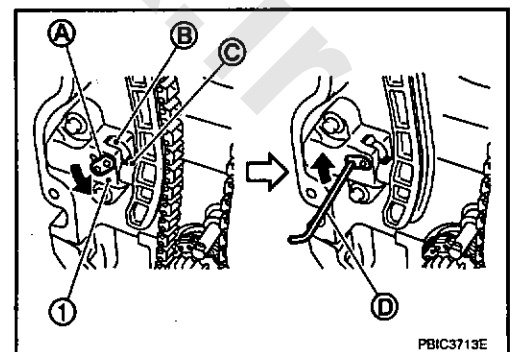
10. Remove front oil seal from front cover.
  - Remove by lifting it up using a suitable tool.

**CAUTION:**

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

11. Remove chain tensioner (1) with the following procedure.

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

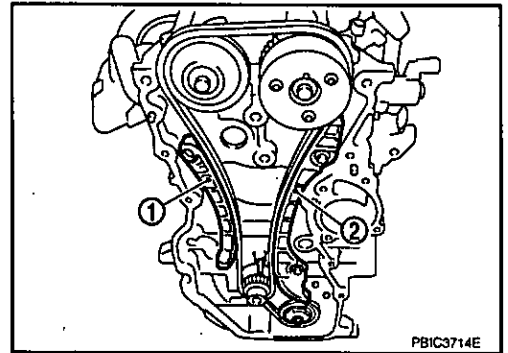


## TIMING CHAIN

### < ON-VEHICLE REPAIR >

[HR16DE]

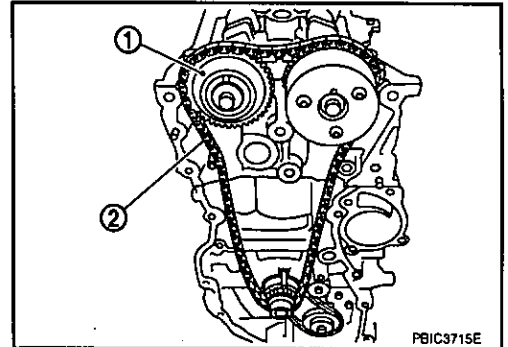
12. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



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

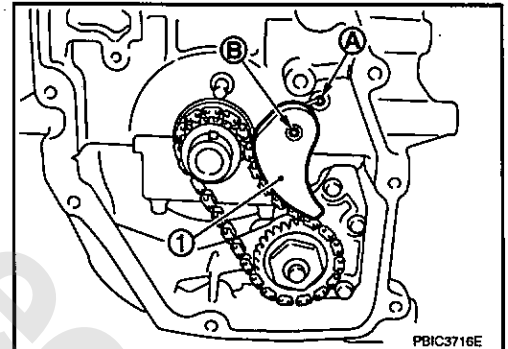
**CAUTION:**

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

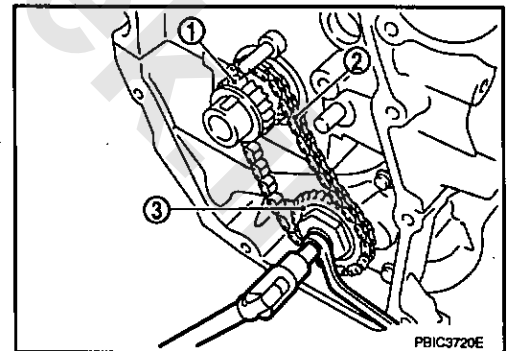


14. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

- a. Remove chain tensioner (1).
- Pull out from the shaft (B) and spring fixing holes (A).



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



### INSTALLATION

#### NOTE:

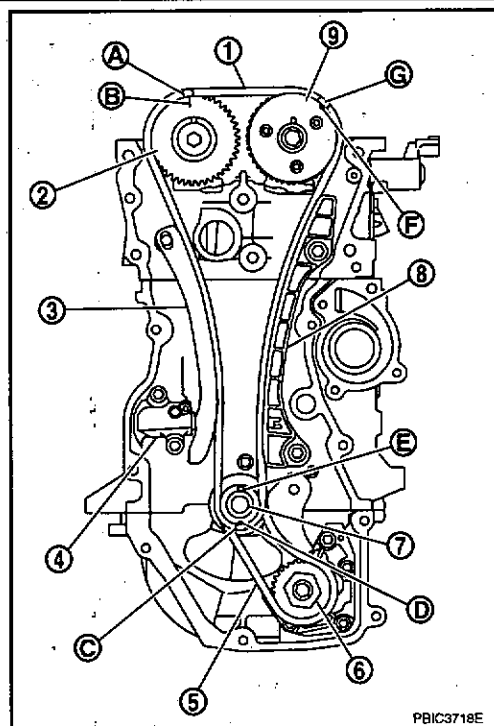
# TIMING CHAIN

## < ON-VEHICLE REPAIR >

[HR16DE]

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

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



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

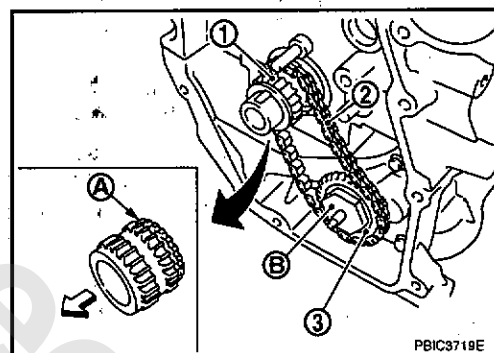
- a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇐ : Engine front

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

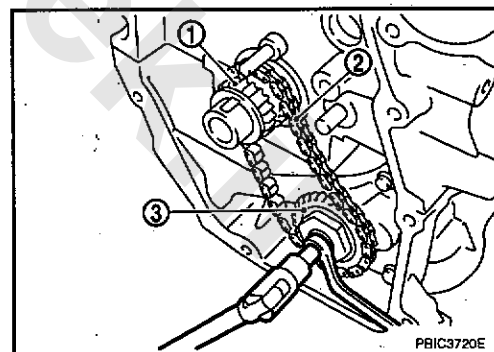
### NOTE:

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



- b. Hold the top of the oil pump shaft using the TORX socket, and then tighten the oil pump sprocket nuts.

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



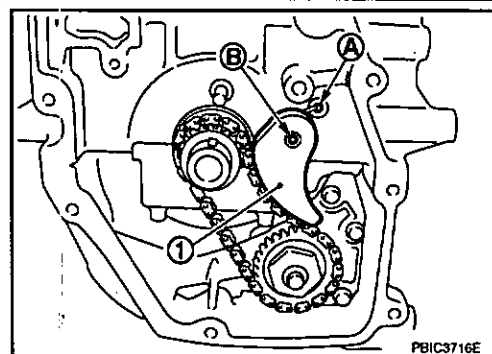
## TIMING CHAIN

### < ON-VEHICLE REPAIR >

[HR16DE]

c. Install chain tensioner (1).

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



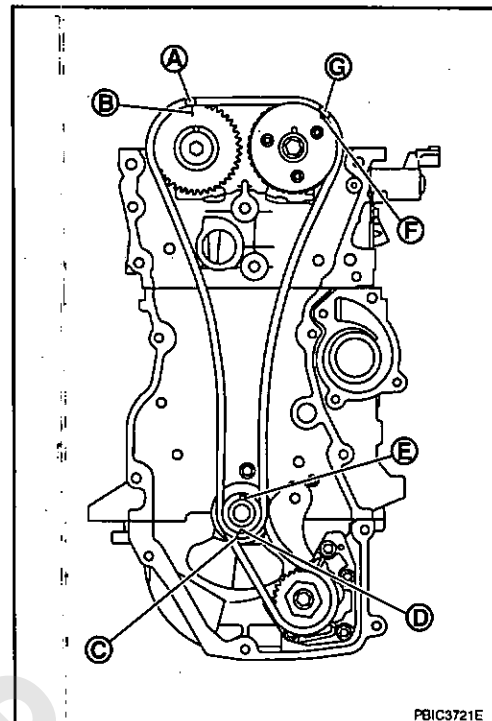
2. Install timing chain with the following procedure.

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

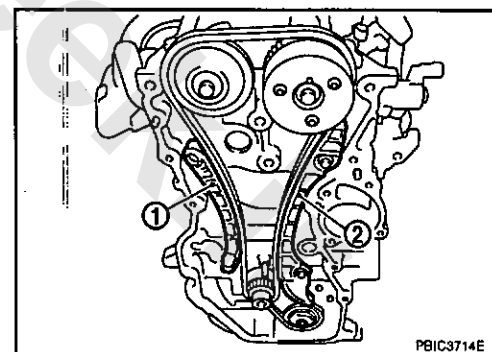
- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

**CAUTION:**

- Check matching mark position of each sprocket and timing chain again after installing the timing chain, keep matching marks aligned by holding them with a hand.
- To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.

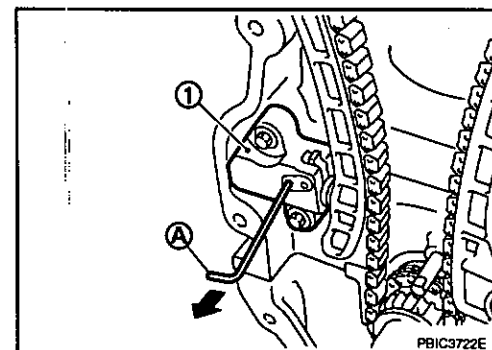


3. Install timing chain tension guide (2) and timing chain slack guide (1).



4. Install chain tensioner (1).

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





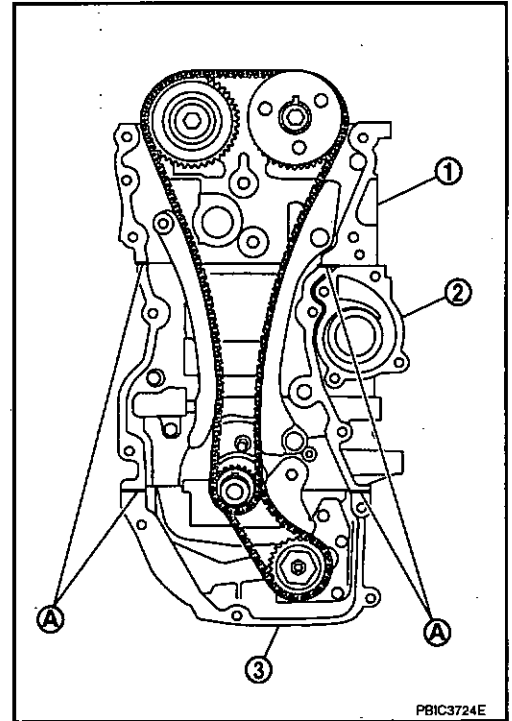
## TIMING CHAIN

[HR16DE]

### < ON-VEHICLE REPAIR >

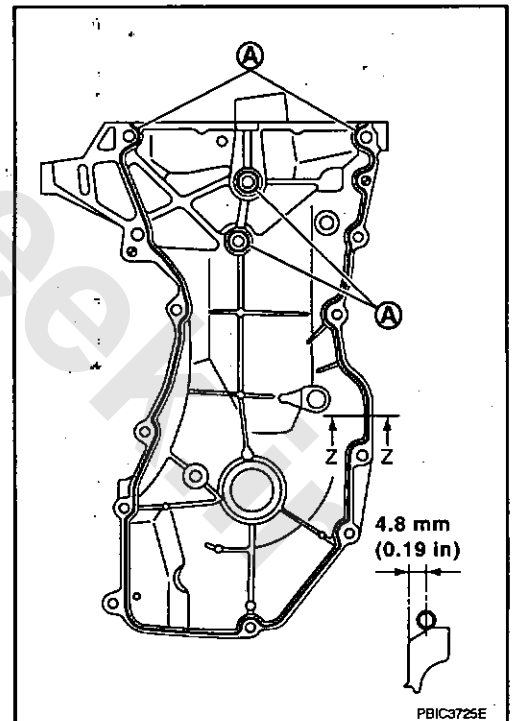
5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to EM-73, "FRONT OIL SEAL : Removal and Installation"
7. Install front cover with the following procedure:
  - a. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure.  
**Use Genuine Liquid Gasket or equivalent.**

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



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

- A : Liquid gasket application area  $\phi$  3.0 - 4.0 mm (0.12 - 0.16 in)



## TIMING CHAIN

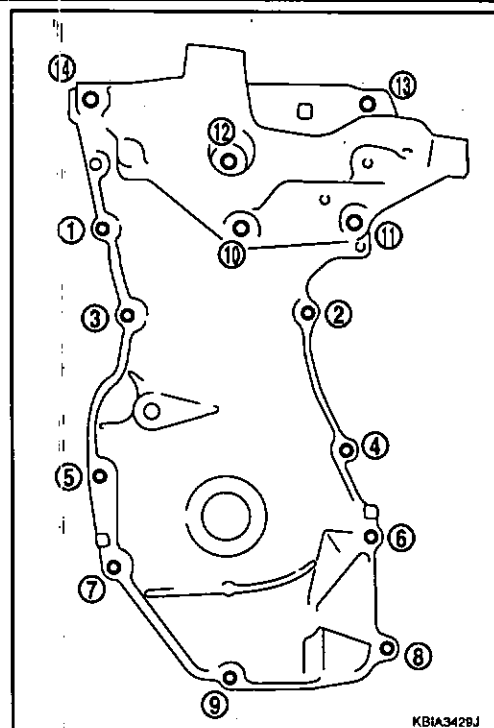
### < ON-VEHICLE REPAIR >

[HR16DE]

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


**CAUTION:**

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

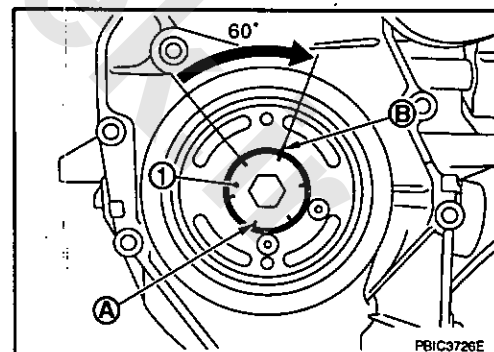


8. Insert crankshaft pulley by aligning with crankshaft key.
  - When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).

**CAUTION:**  
**Never damage front oil seal lip section.**
9. Tighten crankshaft pulley bolt with the following procedure:
  - Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.
  - a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
  - b. Tighten crankshaft pulley bolt.

 : 35.0 N·m (3.6 kg-m, 26 ft-lb)

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



10. Make sure that crankshaft turns smoothly by rotating by hand clockwise.
11. Install in the reverse order of removal, for the rest of parts.

### Inspection

### INSPECTION AFTER REMOVAL

#### Timing Chain

INFOID:000000004899179

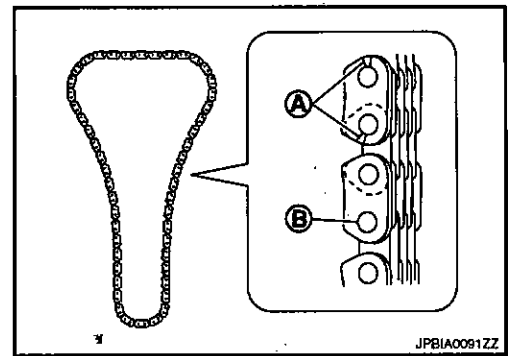
# TIMING CHAIN

[HR16DE]

## < ON-VEHICLE REPAIR >

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

- A : Crack
- B : Wear



## 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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

### NOTE:

If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure 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

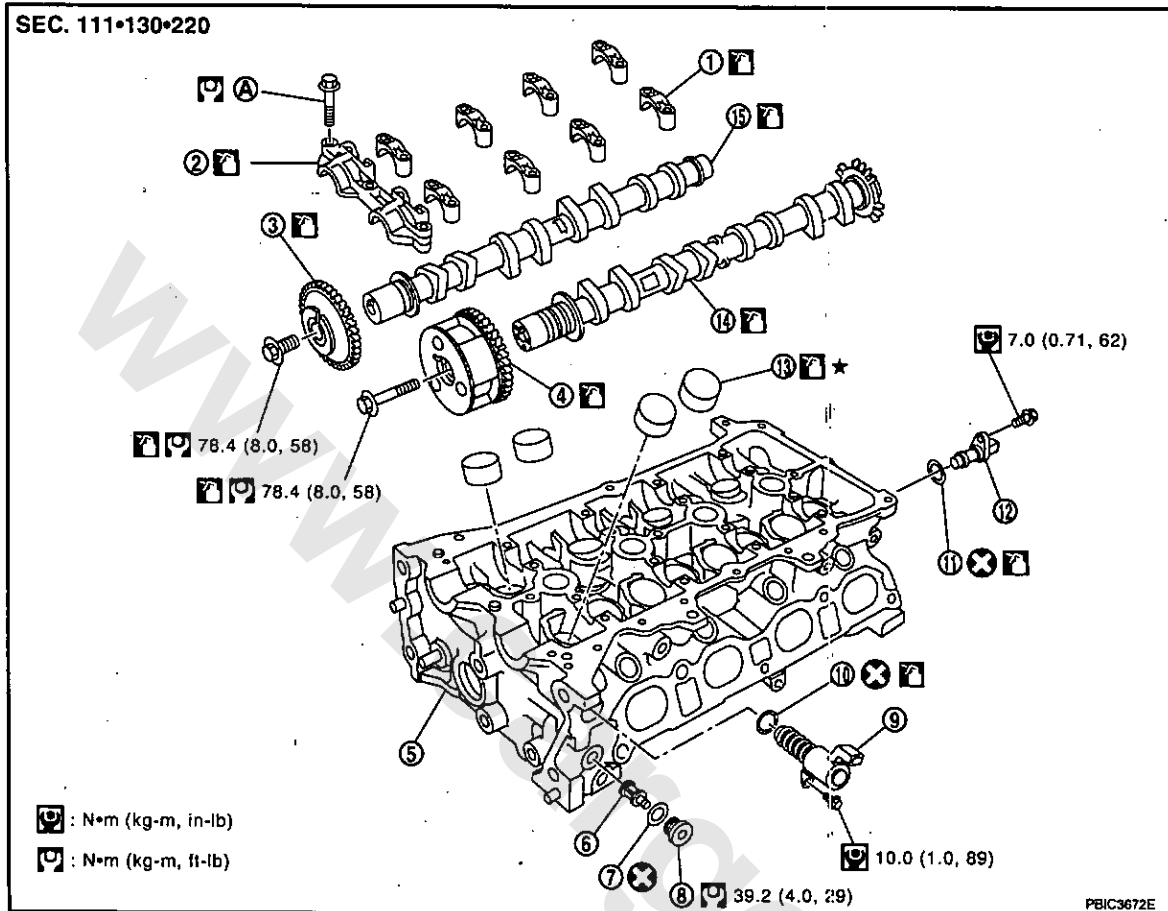
< ON-VEHICLE REPAIR >

[HR16DE]

## CAMSHAFT

### Exploded View

INFOID:000000004899180



- |                                  |                            |   |
|----------------------------------|----------------------------|---|
| 1. Camshaft bracket (No. 2 to 5) | 2. Camshaft bracket (No.1) | 3. Camshaft sprocket (EXH)                      |
| 4. Camshaft sprocket (INT)       | 5. Cylinder head           | 6. Oil filter (for intake valve timing control) |
| 7. Washer                        | 8. Plug                    | 9. Intake valve timing control solenoid valve   |
| 10. O-ring                       | 11. O-ring                 | 12. Camshaft position sensor (PHASE)            |
| 13. Valve lifter                 | 14. Camshaft (INT)         | 15. Camshaft (EXH)                              |

A. Refer to EM-56

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899181

### CAUTION:

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

### REMOVAL

#### NOTE:

This section describes the procedure for removal and installation of camshaft with front cover. If the front cover is removed first, change the following procedure.

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

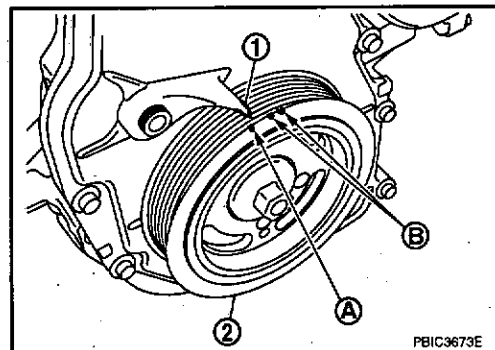
1. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to EM-84, "Exploded View".
2. Remove rocker cover. Refer to EM-44, "Removal and Installation".
3. Remove camshaft position sensor (PHASE) from rear end of cylinder head.

### CAUTION:

**Handle it carefully and avoid impacts.**

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

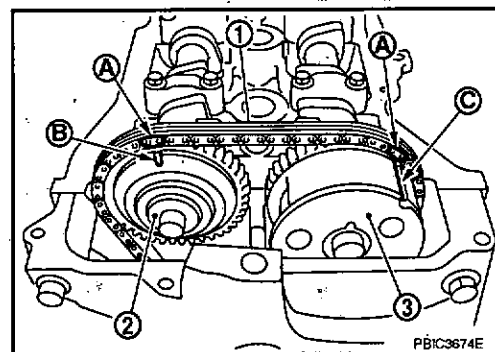
B : White paint mark (Not use for service)



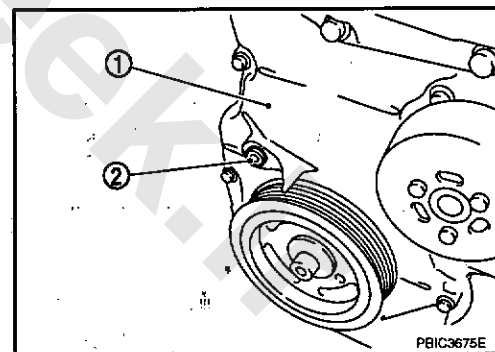
- b. Make sure that the matching marks on each the camshaft sprockets are in the position shown in the figure.

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

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



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



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

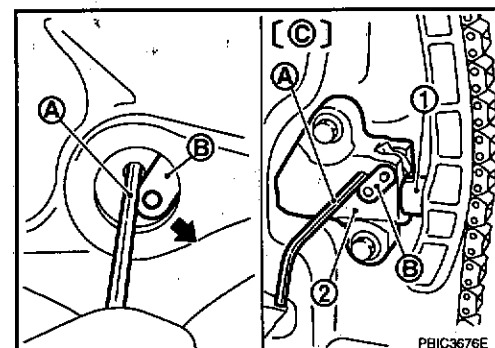
C : Front cover has been omitted

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

### NOTE:

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

### CAUTION:



# CAMSHAFT

< ON-VEHICLE REPAIR >

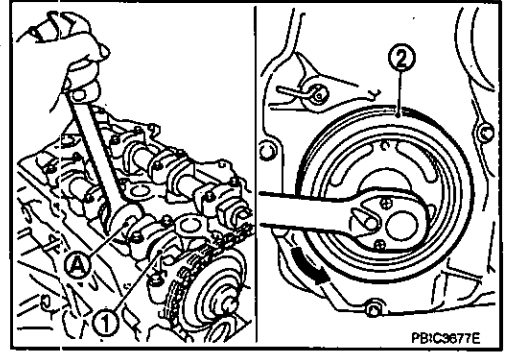
[HR16DE]

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

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

**CAUTION:**

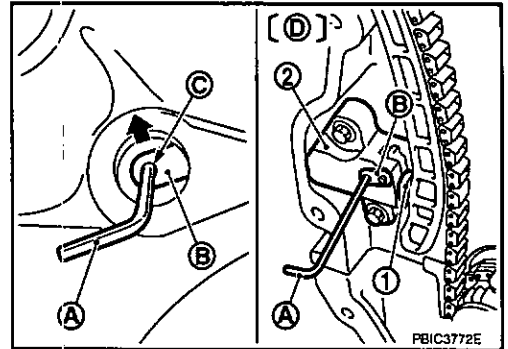
Hold the camshaft hexagonal part (A), and then secure the camshaft.



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

D : Front cover has been omitted

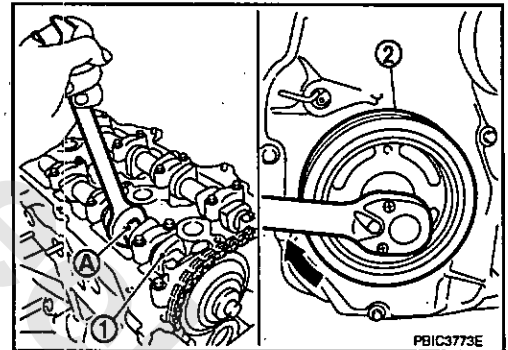
- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



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

**CAUTION:**

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



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

**CAUTION:**

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

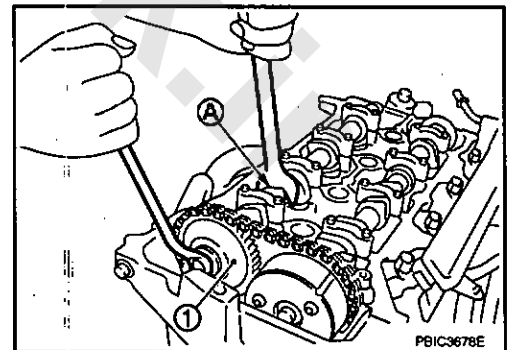
**NOTE:**

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

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

**CAUTION:**

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position for the following reasons.

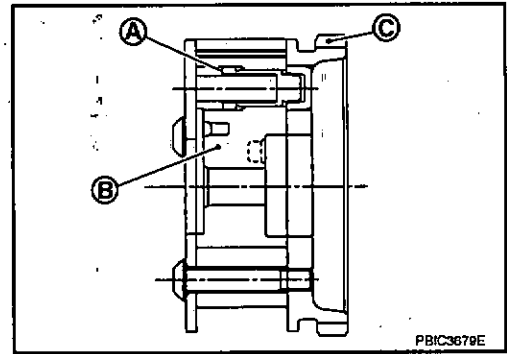


# CAMSHAFT

## < ON-VEHICLE REPAIR >

[HR16DE]

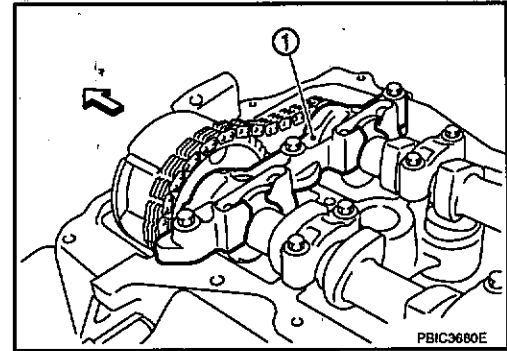
- The sprocket (C) and vane (camshaft coupling) (B) are designed to spin and move within the range of a certain angle.
- With the engine stopped and the vane in the most retarded angle, it will not spin because it is locked to the sprocket side by the internal lock pin (A).
- If the camshaft sprocket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



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

⇐ : Engine front

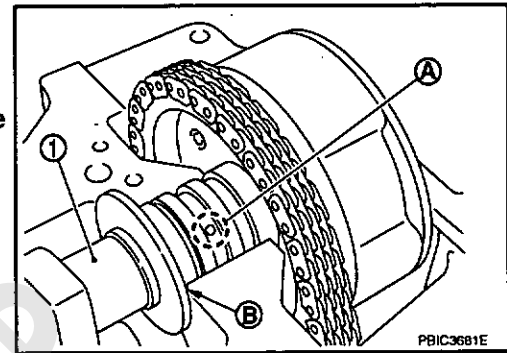
- Loosen the bolts in several steps, and then remove them.



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

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

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



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

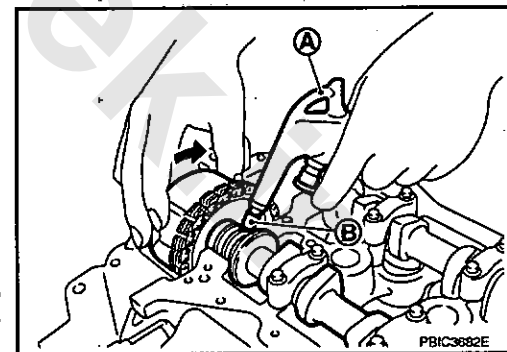
### CAUTION:

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

### NOTE:

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

- c. Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternatively.
- Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (⇐)].
  - Perform the work while applying the air pressure to the oil hole.

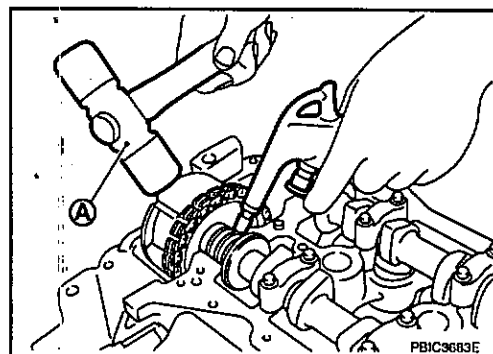


# CAMSHAFT

## < ON-VEHICLE REPAIR >

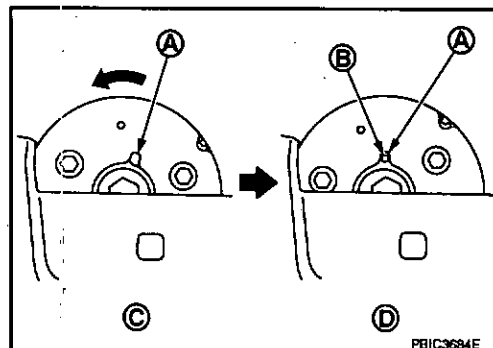
[HR16DE]

- If the lock pin is not released by hands, tap the camshaft sprocket (INT) lightly with a plastic hammer (A).
- If the camshaft sprocket (INT) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.



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

- C : Most retarded angle (lock pin engaged)  
D : Most advanced angle



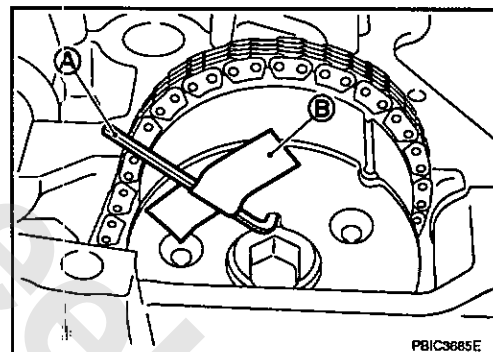
- Keep the air pressure on.
  - If there is no click, as soon as the vane-side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.
  - Make sure that it is in the most advanced angle position by seeing if the stopper pin groove (A) and the stopper pin hole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

### CAUTION:

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

### NOTE:

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

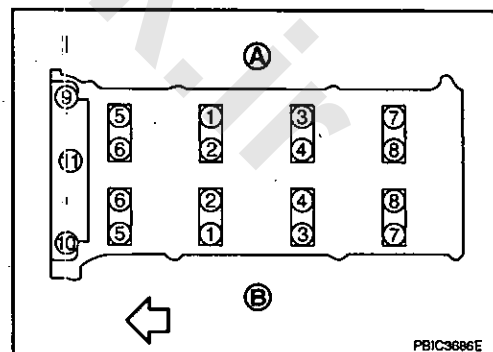


8. Remove camshaft brackets (No. 2 to 5).
- Loosen bolts in several steps in the reverse of the order shown in the figure.

- A : EXH side  
B : INT side  
← : Engine front

### NOTE:

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



9. Remove camshaft (EXH).



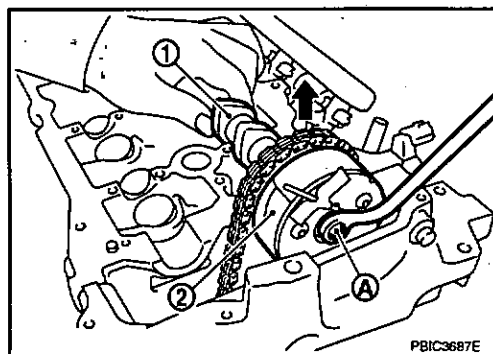
# CAMSHAFT

## < ON-VEHICLE REPAIR >

- [HR16DE]

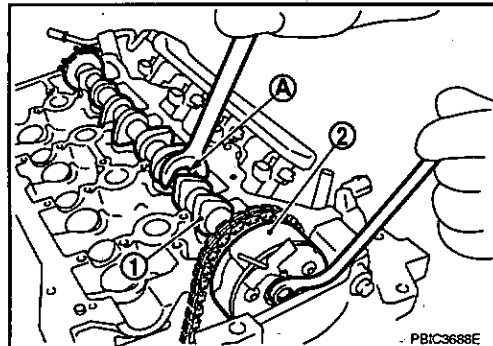
10. Remove the camshaft (INT) (1) and the camshaft sprocket (INT) (2) with the following procedure.

- Lift up the camshaft sprocket (INT), and then set the thin tools (a box wrench, etc.) to the mounting bolt (A).
- Return the camshaft (INT) to the cylinder head journal quietly.

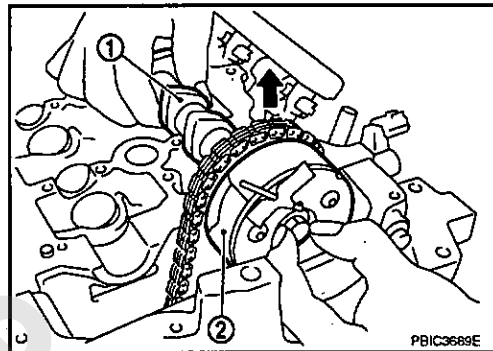


- Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

1 :Camshaft (INT)



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



- Remove camshaft (INT) rearward.

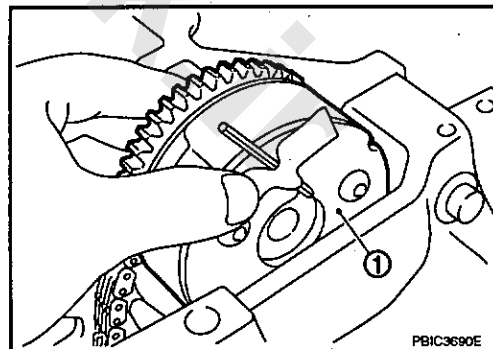
**CAUTION:**

**Never damage the signal plate of rear end.**

- Remove camshaft sprocket (INT) (1).

**CAUTION:**

**Never drop stopper pin.**



**CAUTION:**

# CAMSHAFT

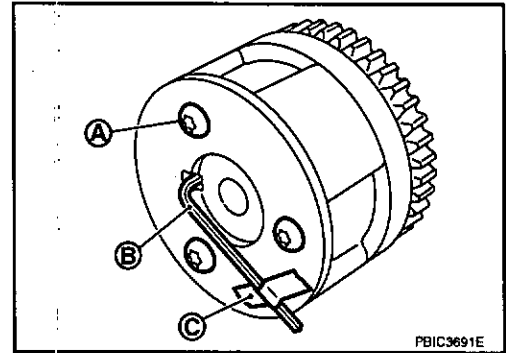
## < ON-VEHICLE REPAIR >

[HR16DE]

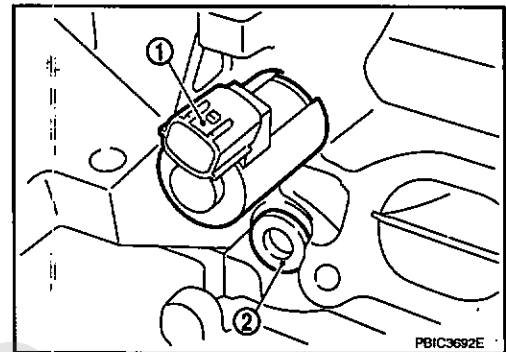
- Tape (C) the stopper pin (B) so it does not come out.
- Never subject it to impact by dropping.
- Never disassemble. [Never loosen the three mounting bolts (A)].

### NOTE:

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

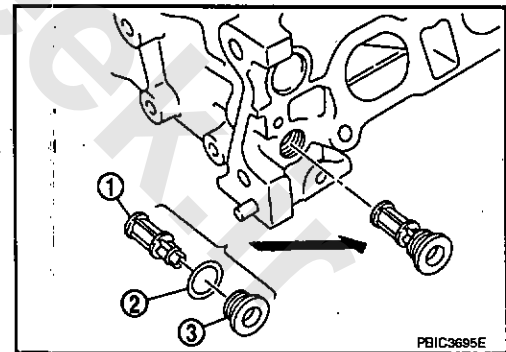


- Install the camshaft (INT) and tighten the mounting bolts enough to prevent air from leaking out.  
**CAUTION:**  
The internal lock pin will get damaged, so keep the torque on the mounting bolts to the minimum required to prevent air from escaping.
  - Apply the air pressure, disengage the lock pin, and turn the vane to the most advanced angle position.
  - Insert the stopper pin.
  - Remove camshaft sprocket (INT) from the camshaft.
- Remove valve lifter.
    - Identify installation positions, and store them without mixing them up.
  - Remove intake valve timing control solenoid valve (1).
  - Remove the alternator and bracket, remove the plug (2), and then remove the oil filter. Refer to CHG-17, "HR16DE MODELS : Exploded View".



## INSTALLATION

- Install the oil filter (1).
  - 2 : Washer
  - The oil filter is assembled to the plug (3), and then install it to the cylinder head.



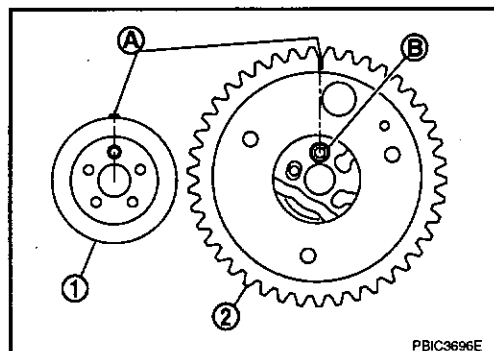
- Install intake valve timing control solenoid valve.
  - Insert it straightly into the cylinder head.
  - Tighten bolts after placing it completely.
- Install valve lifter.
  - If it is reused, install in its original positions.
- Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT) with the following procedure.  
**NOTE:**  
It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (INT).

# CAMSHAFT

## < ON-VEHICLE REPAIR >

[HR16DE]

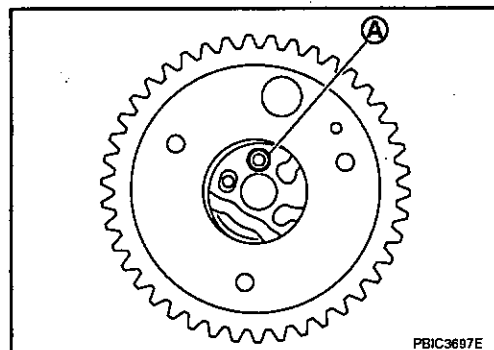
- a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.
  - Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)
- b. Put the matching marks on a line extending from the knock pin hole (B)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



5. Set the camshaft sprocket (INT) to between cylinder head and front cover.
  - Set it with the knock pin hole (A) facing up.

### CAUTION:

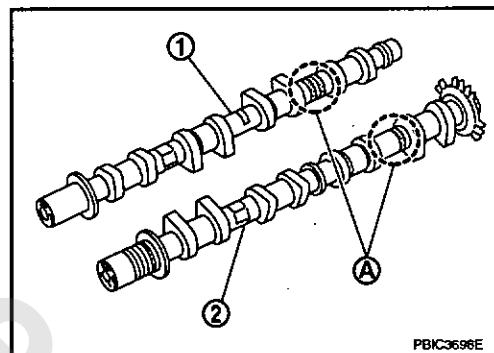
**Make sure the stopper pin is inserted at the most advanced position beforehand.**



6. Install camshaft.

- 1 : Camshaft (EXH)
- 2 : Camshaft (INT)
- A : Identification mark

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

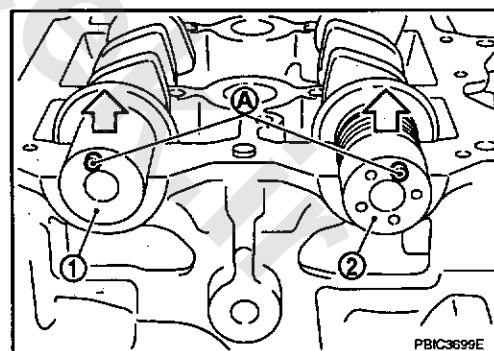


- Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown in the figure.

- 1 : Camshaft (EXH)
- 2 : Camshaft (INT)
- ⇐ : Upper side

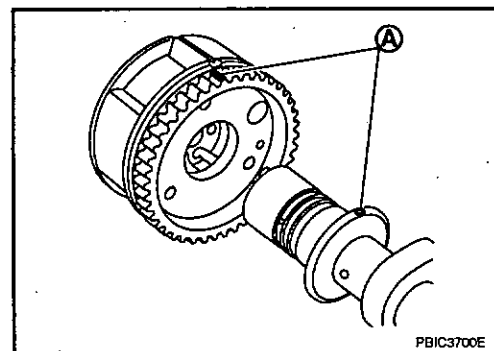
### NOTE:

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



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

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



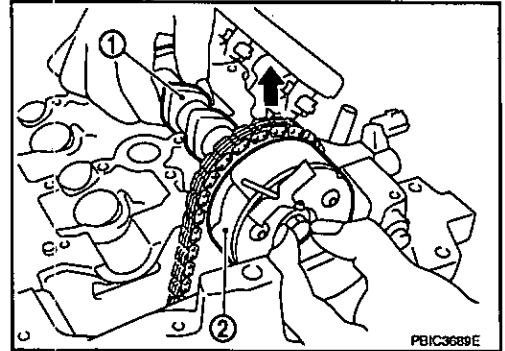
# CAMSHAFT

## < ON-VEHICLE REPAIR >

[HR16DE]

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

2 : Camshaft sprocket (INT)

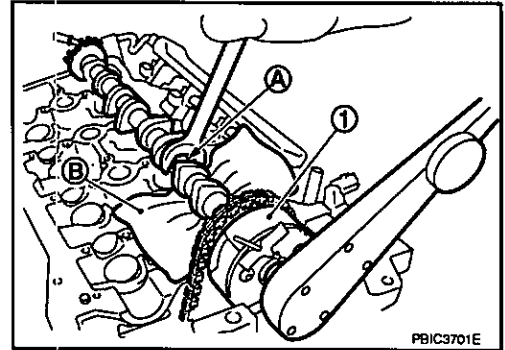


8. Put a thick shop cloth (B) to the lower surface, and then set the tools to the bolt while lifting up the front side of camshaft (INT) (1).

9. Tighten the mounting bolt.

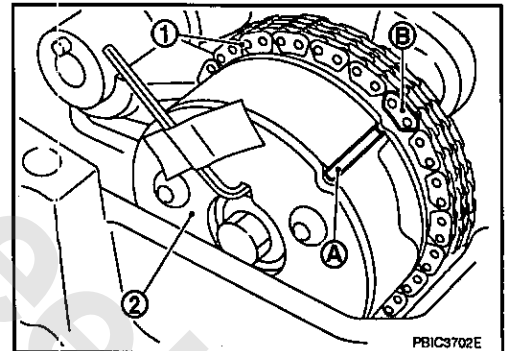
**CAUTION:**

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



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

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



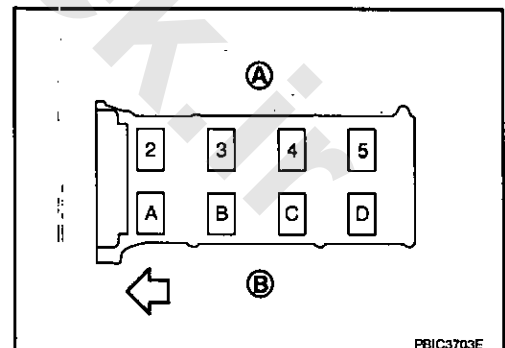
12. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown in the figure.

A : EXH side

B : INT side

← : Engine front

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



# CAMSHAFT


## < ON-VEHICLE REPAIR >

[HR16DE]


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

- A : EXH side
- B : INT side
- ← : Engine front

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

 : 2.0 N·m (0.2 kg-m, 1 ft-lb)


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

 : 2.0 N·m (0.2 kg-m, 1 ft-lb)

- c. Tighten all bolts in numerical order.

 : 5.9 N·m (0.6 kg-m, 4 ft-lb)

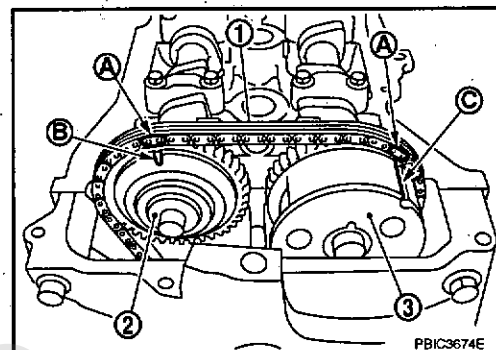
- d. Tighten all bolts in numerical order.

 : 10.4 N·m (1.1 kg-m, 8 ft-lb)

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

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

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

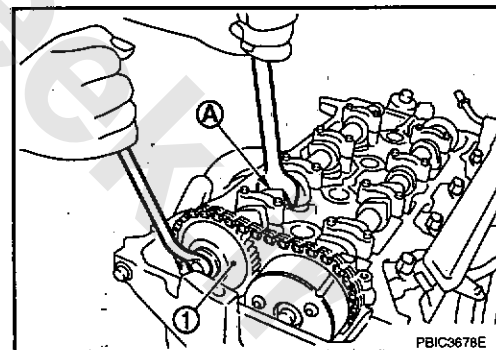


15. Tighten the mounting bolt.

- 1 : Camshaft sprocket (EXH)

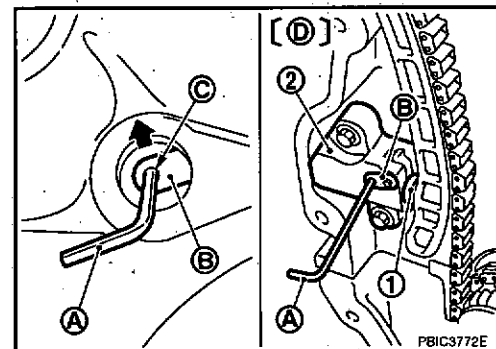
### CAUTION:

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



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

- 1 : Plunger
- 2 : Chain tensioner
- B : Lever
- C : Lever hole
- D : Front cover has been omitted

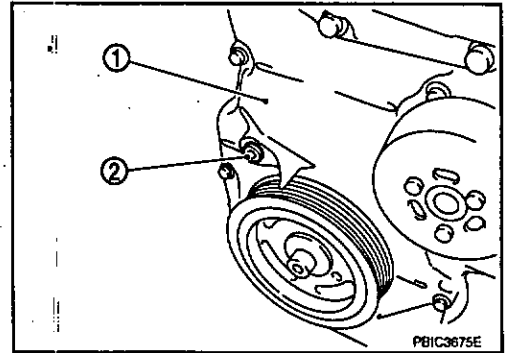


# CAMSHAFT

## < ON-VEHICLE REPAIR >

[HR16DE]

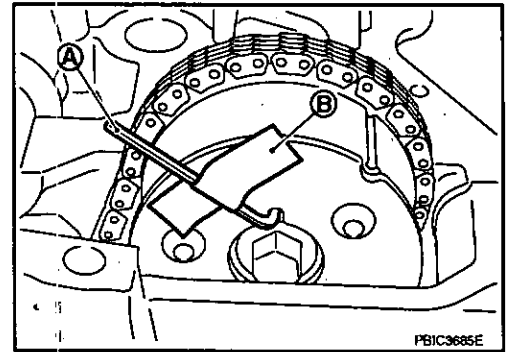
17. Install the plug (2) to the front cover (1).
  - Apply liquid gasket to the threads, and tighten them.
  - Use Genuine Liquid Gasket or equivalent.**



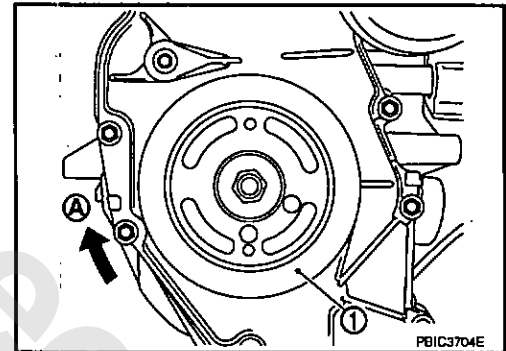
18. Return the camshaft sprocket (INT) in the most retarded position with the following procedure.

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

B : Tape



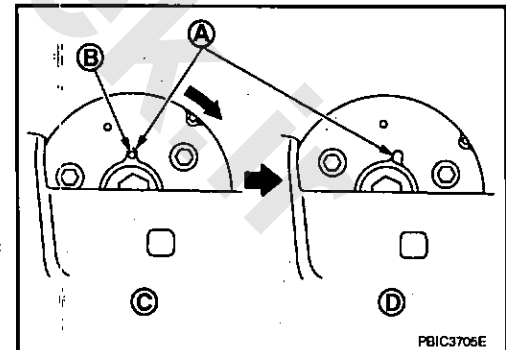
- b. Turn the crankshaft pulley (1) slowly clockwise (A) and return the camshaft sprocket (INT) to the most retarded angle position.



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

B : Stopper pin hole  
C : Most advanced angle  
D : Most retarded angle (lock pin engaged)

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



19. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.
  - Tighten bolts with it seated completely.
20. Check and adjust valve clearance. Refer to EM-22, "Inspection and Adjustment".
21. Install in the reverse order of removal, for the rest of parts.

## Inspection

INFOID:000000004899182

## INSPECTION AFTER REMOVAL

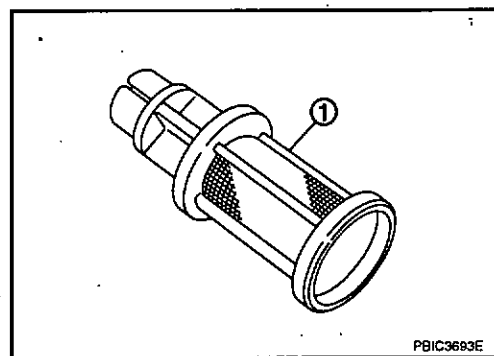
# CAMSHAFT

## < ON-VEHICLE REPAIR >

[HR16DE]

### Oil Filter

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



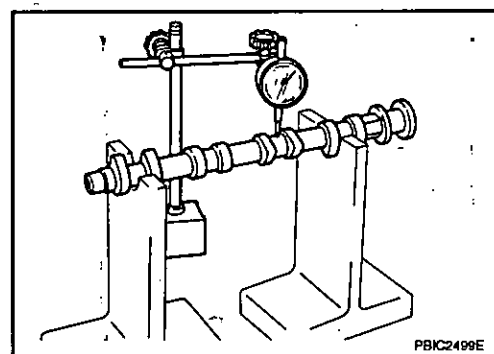
### Camshaft Runout

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

#### CAUTION:

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

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



#### Standard and Limit:

Refer to EM-117, "Camshaft".

4. If it exceeds the limit, replace camshaft.

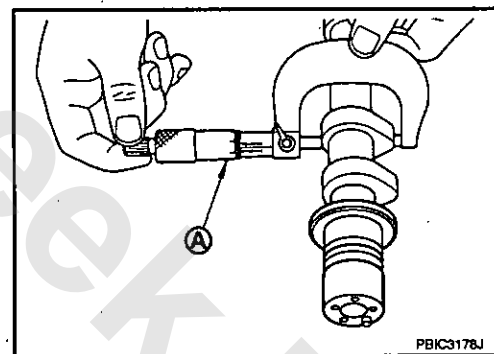
### Camshaft Cam Height

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

#### Standard and Cam wear Limit:

Refer to EM-117, "Camshaft".

2. If wear exceeds the limit, replace camshaft.

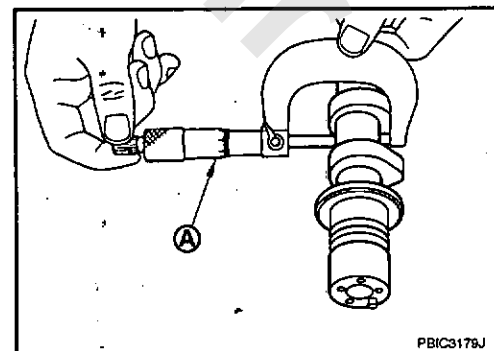


### Camshaft Journal Oil Clearance

#### CAMSHAFT JOURNAL DIAMETER

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

Standard: Refer to EM-117, "Camshaft".



#### CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to EM-56, "Removal and Installation".

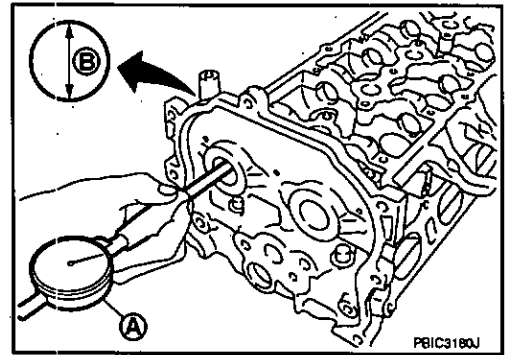
# CAMSHAFT

## < ON-VEHICLE REPAIR >

[HR16DE]

- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

**Standard:** Refer to EM-117, "Camshaft".



### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard and Limit:** Refer to EM-117, "Camshaft".

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

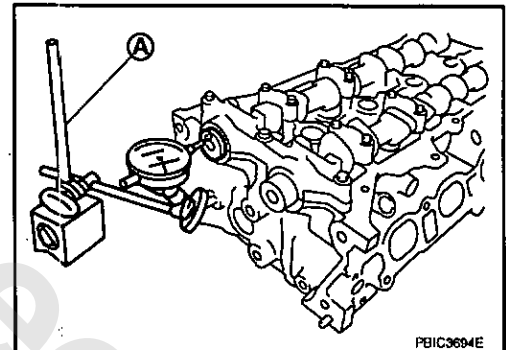
#### NOTE:

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

### Camshaft End Play

1. Install camshaft in cylinder head. Refer to EM-56, "Removal and Installation".
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

**Standard and Limit:** Refer to EM-117, "Camshaft".



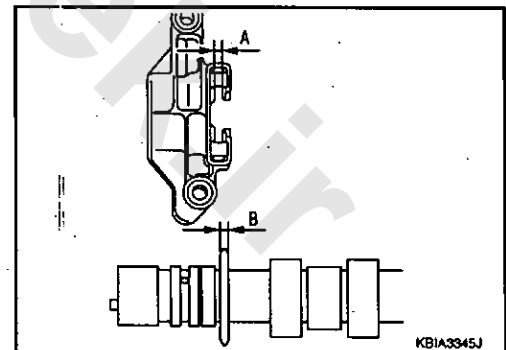
- Measure the following parts if out of the standard.
- Dimension "A" for cylinder head No. 1 journal bearing

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

- Dimension "B" for camshaft thrust

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

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



### Camshaft Sprocket Runout

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

#### CAUTION:

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



# CAMSHAFT

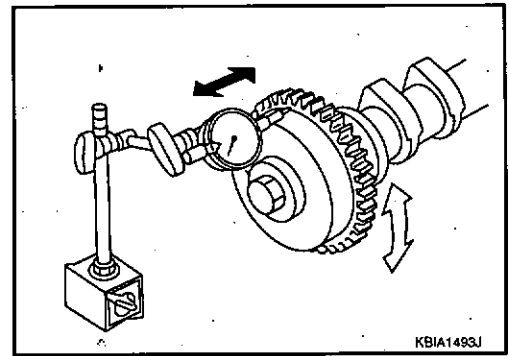
[HR16DE]

## < ON-VEHICLE REPAIR >

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

**Limit:** Refer to EM-117, "Camshaft".

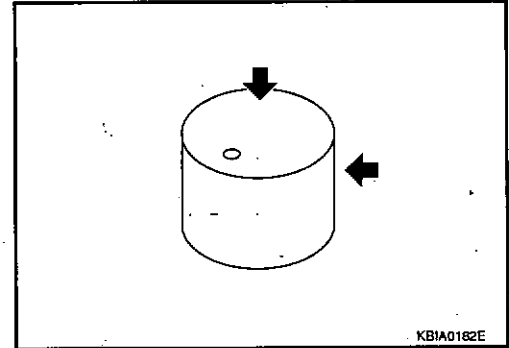
- If it exceeds the limit, replace camshaft sprocket.



### Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-117, "Camshaft".

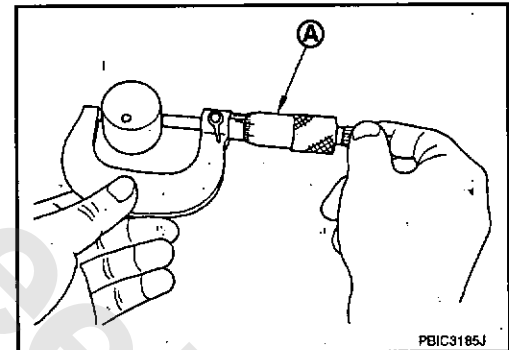


### Valve Lifter Clearance

#### VALVE LIFTER OUTER DIAMETER

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

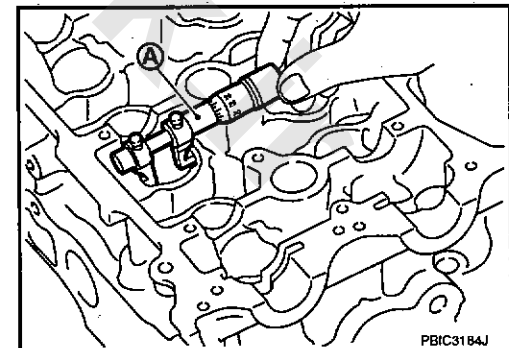
**Standard:** Refer to EM-117, "Camshaft".



#### VALVE LIFTER HOLE DIAMETER

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

**Standard:** Refer to EM-117, "Camshaft".



#### VALVE LIFTER CLEARANCE

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

**Standard:** Refer to EM-117, "Camshaft".

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

## INSPECTION AFTER INSTALLATION

## Inspection for Leaks

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

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

**NOTE:**

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

- Warm up engine thoroughly to make sure there is no leakage of fuel, 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.

## Inspection of Camshaft Sprocket (INT) Oil Groove

**CAUTION:**

- Perform this inspection only when DTC P0011 is detected in self-diagnostic results and it is directed according to inspection procedure of EC section.
- Check when engine is cold so as to prevent burns from 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.
  - b. Remove intake manifold. Refer to EM-30, "Exploded View".
  - c. Disconnect ignition coil and injector harness connectors. Refer to EM-44, "Exploded View".
3. Remove intake valve timing control solenoid valve. Refer to EM-56, "Exploded View".
4. Crank engine, and then make sure that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.

1 : Plug

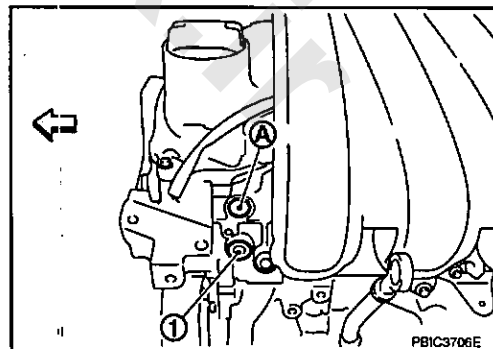
⇐ : Engine front

**WARNING:**

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

**CAUTION:**

- Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.
  - Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belts, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.
5. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.



## CAMSHAFT

[HR16DE]

### < ON-VEHICLE REPAIR >

- Remove oil filter, and then clean it. Refer to EM-66, "Inspection".
  - 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".
6. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
- Clean oil groove if necessary. Refer to LU-3, "Engine Lubrication System" and LU-3, "Engine Lubrication System Schematic".
7. After inspection, install removed parts in the reverse order.

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

## OIL SEAL

## VALVE OIL SEAL

## VALVE OIL SEAL : Removal and Installation

INFOID:000000004899183

## REMOVAL

1. Remove camshafts. Refer to EM-56, "Exploded View".
2. Remove valve lifters. Refer to EM-56, "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.

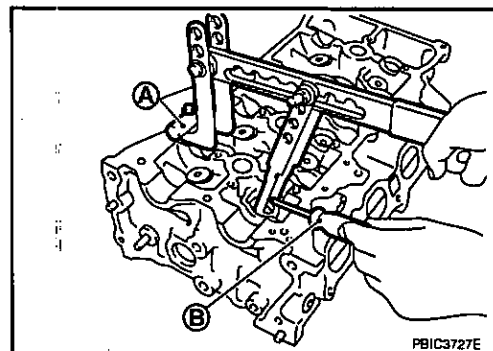
**CAUTION:**

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

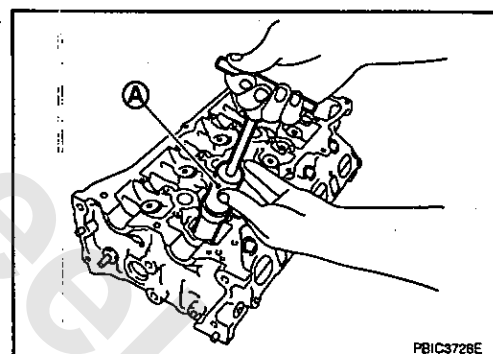
4. Remove valve collet.
  - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand (B).

**CAUTION:**

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



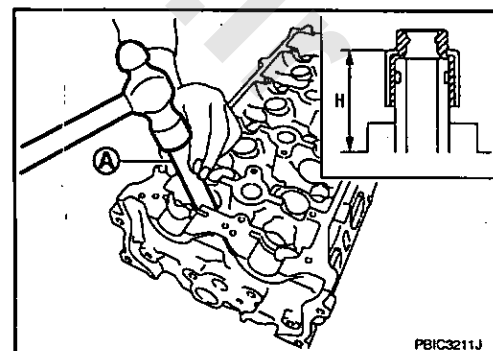
5. Remove valve spring retainer, valve spring and valve spring seat. Refer to EM-75, "Exploded View".
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



## INSTALLATION

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

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



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

## FRONT OIL SEAL

## FRONT OIL SEAL : Removal and Installation

INFOID:0000000004899184

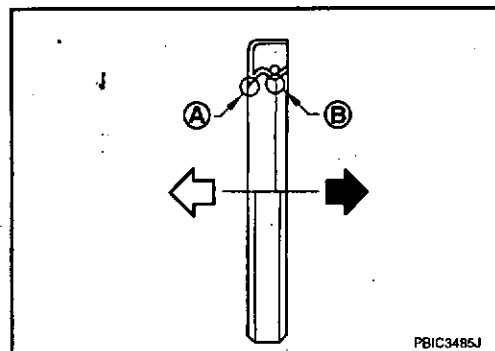
## REMOVAL

- Remove the following parts:
    - Front fender protector (RH): Refer to EXT-22, "Exploded View".
    - Drive belt: Refer to EM-17, "Removal and Installation".
    - Crankshaft pulley: Refer to EM-47, "Exploded View".
  - Remove front oil seal using a suitable tool.
- CAUTION:**  
Be careful not to damage front timing chain case and crankshaft.

## INSTALLATION

- Apply new engine oil to both oil seal lip and dust seal lip of new front oil seal.
  - Install front oil seal.
- 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



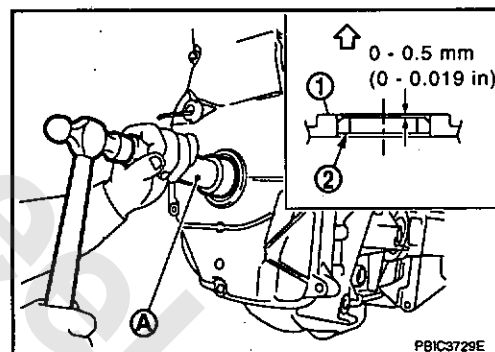
- Using a suitable drift, press-fit until the height of front oil seal (2) is level with the mounting surface.

- 1 : Front cover  
 ⇐ : Engine outside

- Suitable drift (A): outer diameter 50 mm (1.97 in), inner diameter 44 mm (1.73 in).
- Make sure the garter spring is in position and seal lips not inverted

**CAUTION:**

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



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

## REAR OIL SEAL

## REAR OIL SEAL : Removal and Installation

INFOID:0000000004899185

## REMOVAL

- Remove transaxle assembly.
- Remove clutch cover and clutch disk.
- Remove flywheel. Refer to EM-94, "Exploded View".
- Remove rear oil seal with a suitable tool.

**CAUTION:**

- Be careful not to damage crankshaft and cylinder block.

## INSTALLATION

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

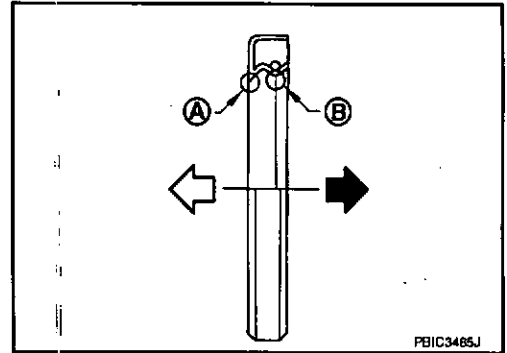
## OIL SEAL

### < ON-VEHICLE REPAIR >

[HR16DE]

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

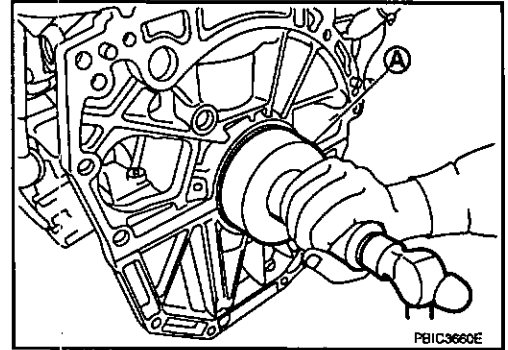
- A : Dust seal lip  
B : Oil seal lip  
⇐ : Engine outside  
➡ : Engine inside



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

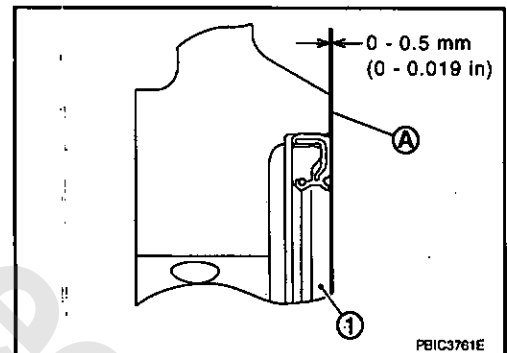
#### CAUTION:

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

# CYLINDER HEAD

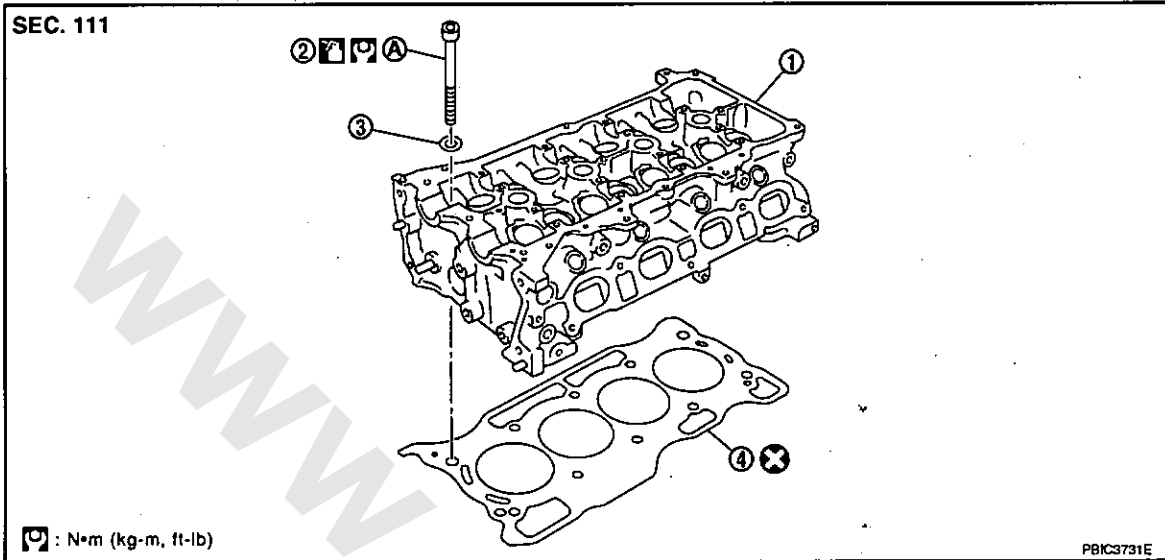
< ON-VEHICLE REPAIR >

[HR16DE]

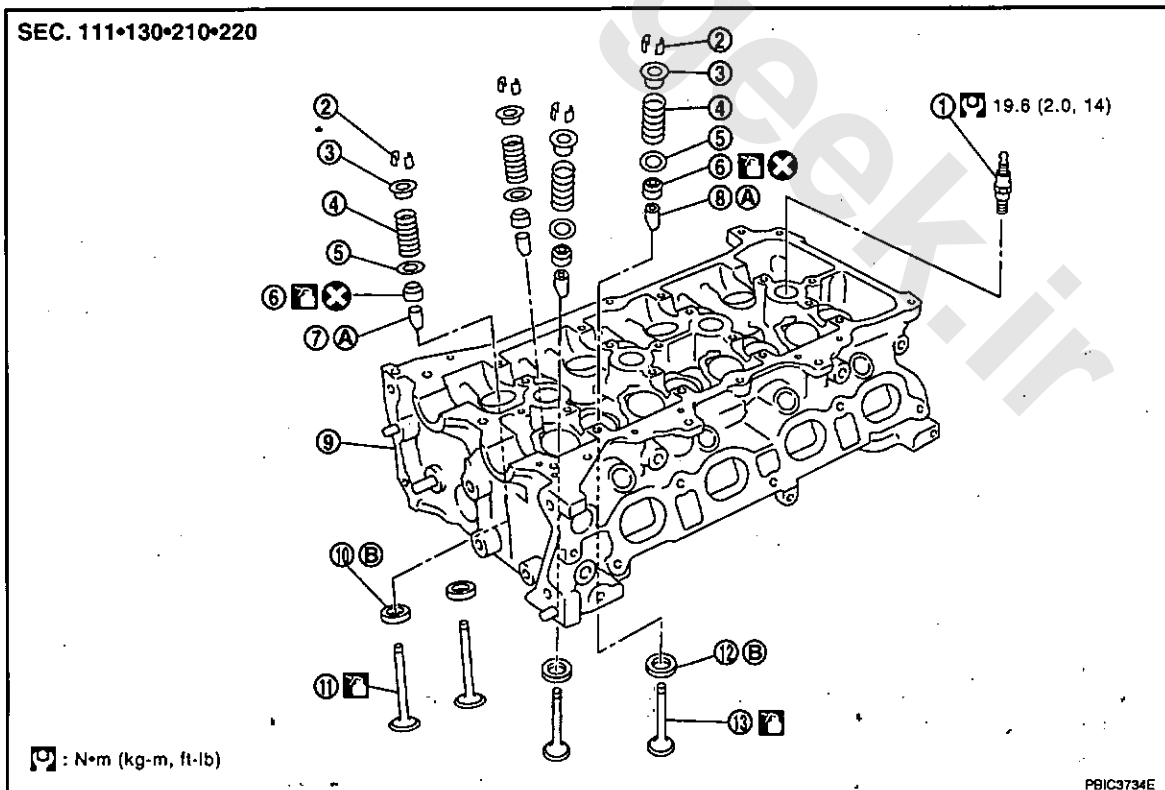
## CYLINDER HEAD

Exploded View

REMOVAL



DISASSEMBLY



# CYLINDER HEAD

< ON-VEHICLE REPAIR >

[HR16DE]

- |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|
| 1. Spark plug            | 2. Valve collet          | 3. Valve spring retainer |
| 4. Valve spring          | 5. Valve spring seat     | 6. Valve oil seal        |
| 7. Valve guide (EXH)     | 8. Valve guide (INT)     | 9. Cylinder head         |
| 10. Valve seat (EXH)     | 11. Valve (EXH)          | 12. Valve seat (INT)     |
| 13. Valve (INT)          |                          |                          |
| A. Refer to <u>EM-77</u> | B. Refer to <u>EM-77</u> |                          |

Refer to GI-3, "Components" for symbols in the figure.

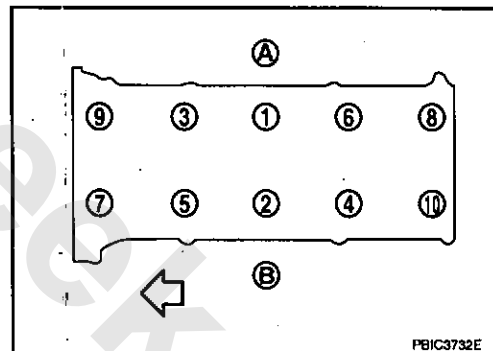
## Removal and Installation

INFOID:0000000004899187

### REMOVAL

1. Release fuel pressure.
2. Drain engine coolant and engine oil. Refer to CO-9, "Draining" and LU-7, "Draining".  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant and engine oil on drive belt.
3. Remove the following components and related parts.
  - Front fender protector (RH): Refer to EXT-22, "Exploded View".
  - Alternator: Refer to CHG-17, "HR16DE MODELS : Exploded View".
  - Exhaust front tube: Refer to EX-5, "Exploded View".
  - Exhaust manifold: Refer to EM-33, "Exploded View".
  - Intake manifold: Refer to EM-30, "Exploded View".
  - Fuel tube and fuel injector: Refer to EM-36, "Exploded View".
  - Water outlet: Refer to CO-21, "Exploded View".
  - Drive belt: Refer to EM-17, "Removal and Installation".
  - Front cover: Refer to EM-47, "Exploded View".
  - Camshaft: Refer to EM-56, "Exploded View".
4. Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

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



5. Remove cylinder head gasket.

### INSTALLATION

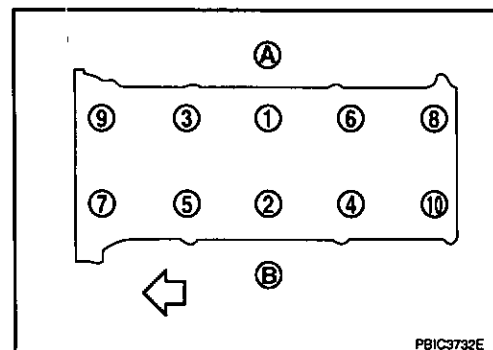
1. Install new cylinder head gasket.
2. Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.

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

#### CAUTION:

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

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






# CYLINDER HEAD

< ON-VEHICLE REPAIR >

[HR16DE]

: 66.7 N·m (6.8 kg-m, 49 ft-lb)


- c. 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.

- d. Tighten all bolts.

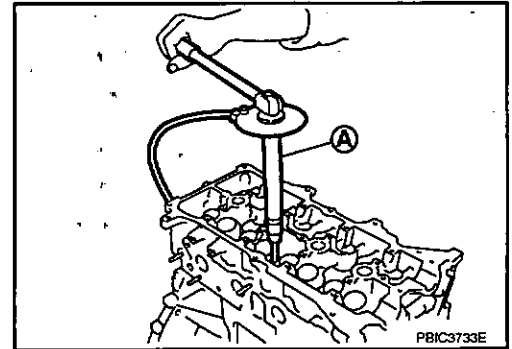
: 40.0 N·m (4.1 kg-m, 30 ft-lb)

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

## CAUTION:

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

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



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

## Disassembly and Assembly

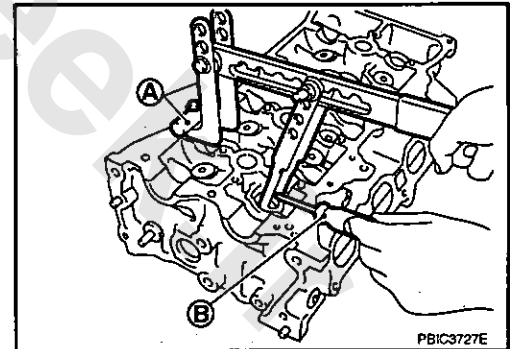
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### DISASSEMBLY

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

## CAUTION:

Be careful not to damage valve lifter holes.



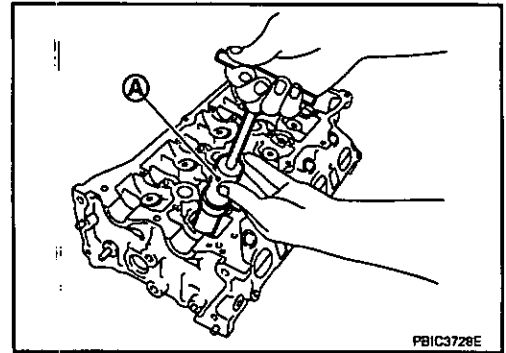
4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
  - Identify installation positions, and store them without mixing them up.

# CYLINDER HEAD

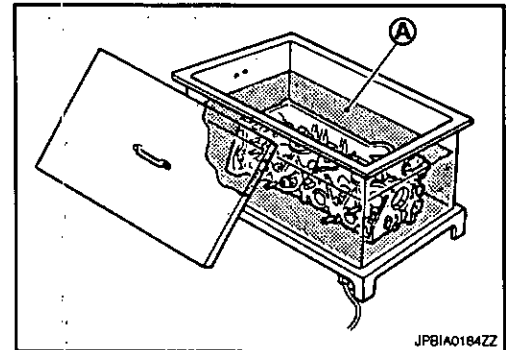
## < ON-VEHICLE REPAIR >

[HR16DE]

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



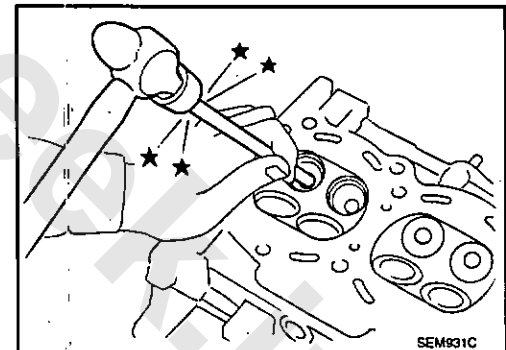
7. Remove valve spring seat.
8. Remove valve seat, if valve seat must be replaced.
- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
- CAUTION:**  
**Never bore excessively to prevent cylinder head from scratching.**
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 a hammer and the valve guide drift (commercial service tool).

**WARNING:**

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

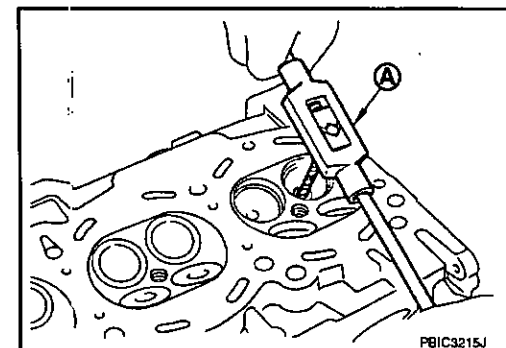


## ASSEMBLY

1. When valve guide is removed, install it.
- CAUTION:**  
**Replace with oversize [0.2 mm (0.008 in)] valve guide.**
- a. Using the valve guide reamer (commercial service tool) (A), ream cylinder head valve guide hole.

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

**Refer to EM-119, "Cylinder Head".**

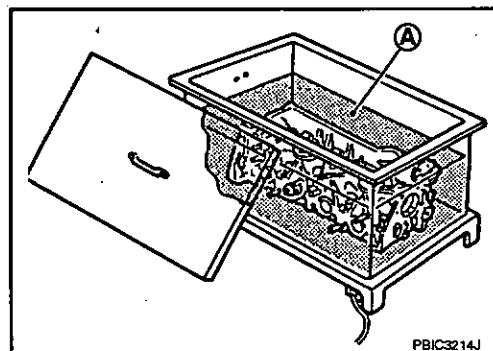


# CYLINDER HEAD

## < ON-VEHICLE REPAIR >

[HR16DE]

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

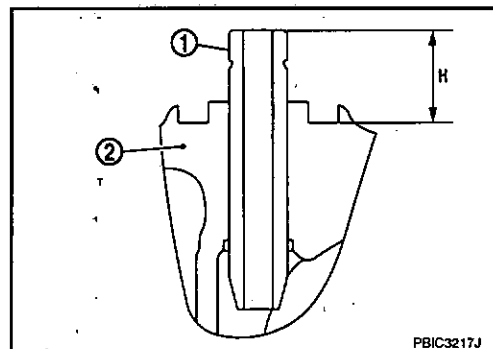


- c. Using the valve guide drift (commercial service tool), press valve guide (1) from camshaft side to the dimensions as in the figure.

**Projection "H": Refer to EM-119, "Cylinder Head".**

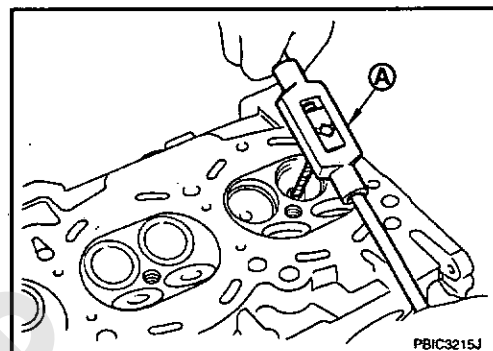
**WARNING:**

**Cylinder head (2) contains heat. Wear protective equipment to avoid getting burned.**



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

**Standard: Refer to EM-119, "Cylinder Head".**



2. When valve seat is removed, install it.

**CAUTION:**

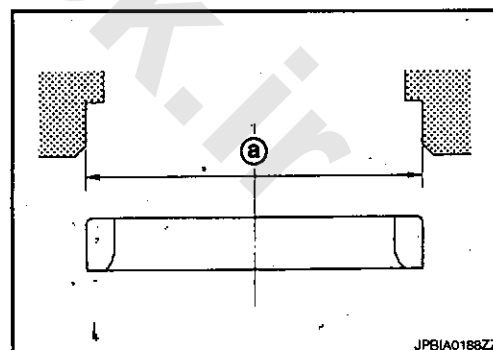
**Replace with oversize [0.5 mm (0.020 in)] valve seat.**

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

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

**Refer to EM-119, "Cylinder Head".**

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

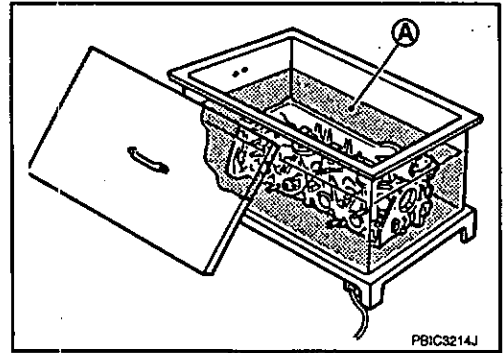


## CYLINDER HEAD

### < ON-VEHICLE REPAIR >

[HR16DE]

- 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. Force fit valve seat into cylinder head.

**WARNING:**

Cylinder head contains heat. Wear protective equipment to avoid getting burned.

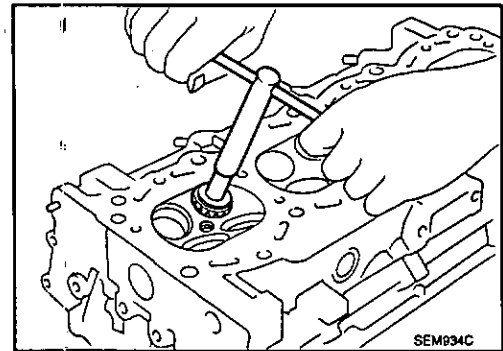
**CAUTION:**

Avoid directly touching cold valve seats.

- d. Using the valve seat cutter set (commercial service tool) or valve seat grinder, finish seat to the specified dimensions. Refer to EM-119, "Cylinder Head".

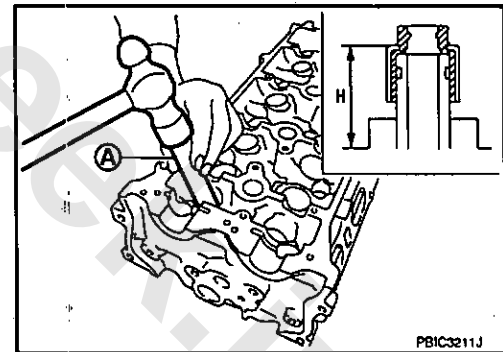
**CAUTION:**

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



- e. Using compound, grind to adjust valve fitting.  
f. Check again for normal contact. Refer to EM-81, "Inspection".  
3. Install valve oil seal.  
• Install with the valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.

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



4. Install valve spring seat.  
5. Install valve.  
• Install larger diameter to intake side.  
6. Install valve spring.  
**NOTE:**  
It can be installed in either direction.  
7. Install valve spring retainer.  
8. Install valve collet.

# CYLINDER HEAD

## < ON-VEHICLE REPAIR >

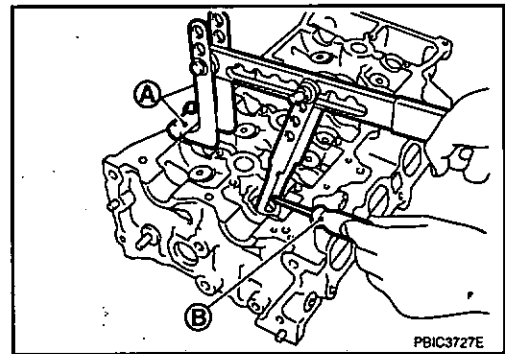
[HR16DE]

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

### CAUTION:

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

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



A

EM

C

D

E

9. Install valve lifter.

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

## Inspection

INFOID:0000000004899189

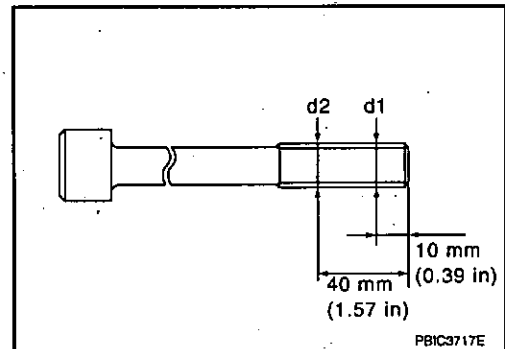
## INSPECTION AFTER REMOVAL

### 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.



F

G

H

I

### Cylinder Head Distortion

#### NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to EM-102, "Inspection".

- 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 engine coolant.**

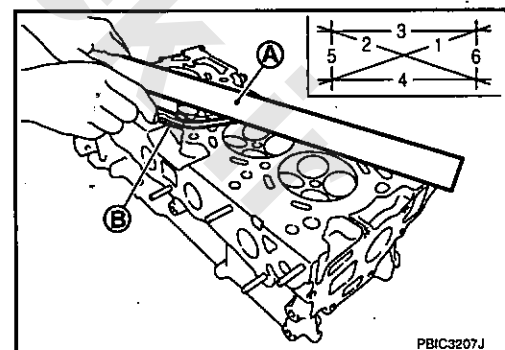
- At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

A : Straightedge

B : Feeler gauge

**Limit : Refer to EM-119, "Cylinder Head".**

- If it exceeds the limit, replace cylinder head.



J

K

L

M

N

O

## INSPECTION AFTER DISASSEMBLY

### Valve Dimensions

- Check the dimensions of each valve. For the dimensions, refer to EM-119, "Cylinder Head".
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

### Valve Guide Clearance

### Valve Stem Diameter

P

# CYLINDER HEAD

## < ON-VEHICLE REPAIR >

[HR16DE]

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

**Standard** : Refer to EM-119, "Cylinder Head".

### Valve Guide Inner Diameter

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

**Standard** : Refer to EM-119, "Cylinder Head".

### Valve Guide Clearance

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

**Standard and Limit** : Refer to EM-119, "Cylinder Head".

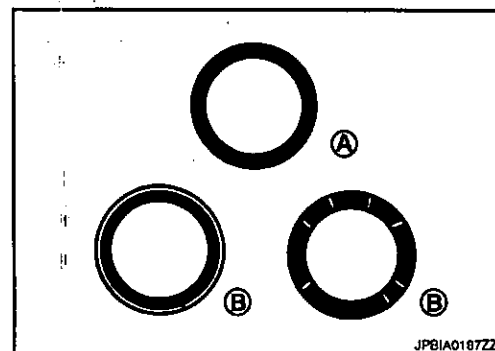
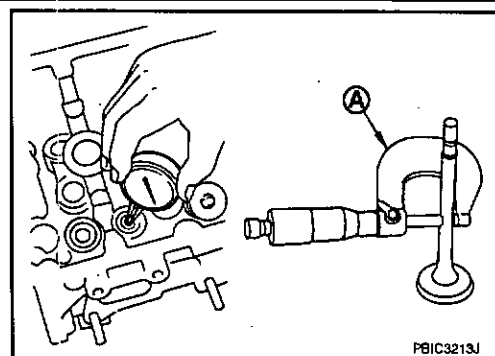
- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced, refer to "VALVE GUIDE REPLACEMENT".

### Valve Seat Contact

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace valve seat. Refer to EM-77, "Disassembly and Assembly".

A : OK

B : NG



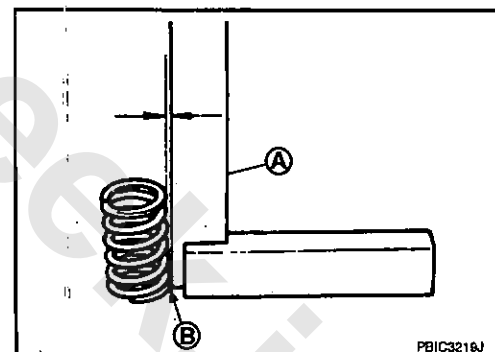
### Valve Spring Squareness

- 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-119, "Cylinder Head".

- If it exceeds the limit, replace valve spring.

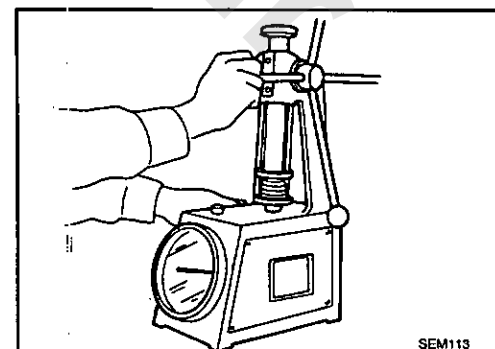


### Valve Spring Dimensions and Valve Spring Pressure Load

- Check the valve spring pressure at specified spring height.

**Standard** : Refer to EM-119, "Cylinder Head".

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



## 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-13, "Fluids and Lubricants".

# CYLINDER HEAD

[HR16DE]

## < ON-VEHICLE REPAIR >

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

Summary of the inspection items:

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	—

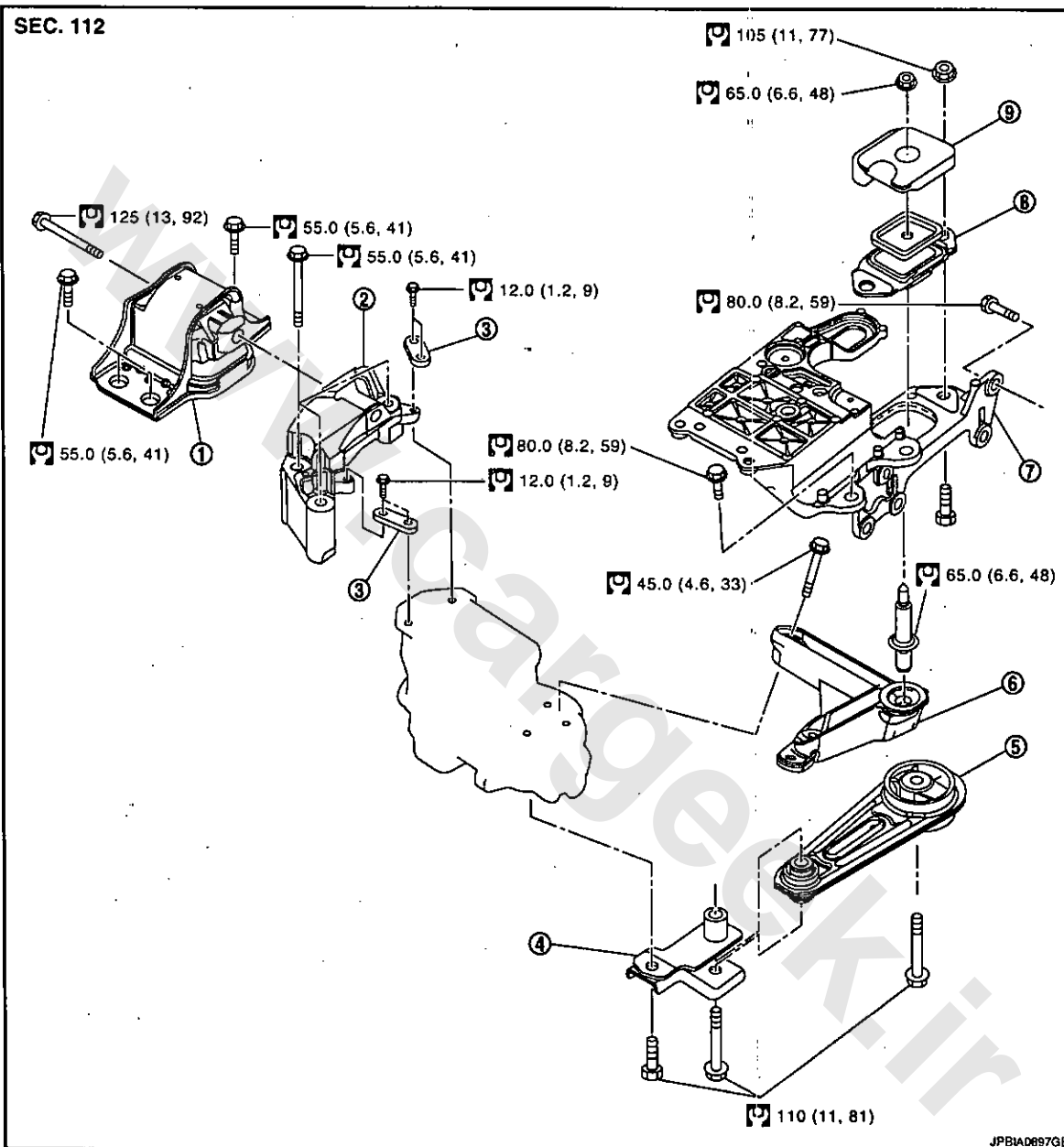
\*: Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

## REMOVAL AND INSTALLATION

### ENGINE ASSEMBLY

#### Exploded View

INFOID:000000004899190



- |                                   |                                   |                                 |
|-----------------------------------|-----------------------------------|---------------------------------|
| 1. Engine mounting insulator (RH) | 2. Engine mounting bracket (RH)   | 3. Engine mounting stay         |
| 4. Rear engine mounting bracket   | 5. Rear torque rod                | 6. Engine mounting bracket (LH) |
| 7. Engine mounting bracket (LH)   | 8. Engine mounting insulator (LH) | 9. Mass dumber                  |

Refer to GI-3, "Components" for symbols in the figure.

#### Removal and Installation

INFOID:000000004899191

#### 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:



# ENGINE ASSEMBLY

[HR16DE]

## < REMOVAL AND INSTALLATION >

- 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-32, "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.
2. Drain engine coolant from radiator. Refer to CO-9, "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 fender protector (RH and LH): Refer to EXT-22, "Exploded View".
  - Front road wheels and tires: Refer to WT-3, "Road Wheel".
  - Battery and battery tray: Refer to PG-89, "Exploded View".
  - Drive belt: Refer to EM-17, "Removal and Installation".
  - Air duct and air cleaner case assembly: Refer to EM-28, "Exploded View".
  - Radiator hose (upper and lower): Refer to CO-13, "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.**
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-21, "Exploded View".
4. Disconnect control linkage from transaxle.
5. Remove ground cable at transaxle side.

### Engine Room RH

1. Remove ground cable between front cover and vehicle.
2. Alternator and alternator bracket; Refer to CHG-17, "HR16DE MODELS : Exploded View".
3. Disconnect reservoir tank hose. Refer to CO-13, "Exploded View".
4. 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. (with A/C models) Refer to HA-38, "Exploded View".

### Vehicle Underbody

1. Remove front wheel sensor (RH and LH) for ABS from steering knuckle. Refer to BRC-42, "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-37, "BRAKE CALIPER ASSEMBLY : Exploded View".
3. Remove stabilizer connecting rod. Refer to FSU-20, "Exploded View".
4. Remove steering knuckle mounting nuts and bolts. Refer to FSU-20, "Exploded View".
5. Disconnect steering outer socket. Refer to ST-14, "Exploded View".

# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[HR16DE]

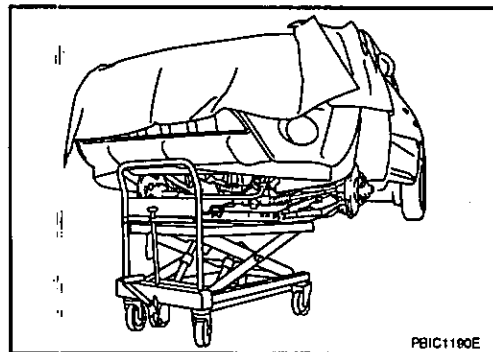
6. Remove drive shafts (RH and LH) and center bearing cover bracket. Refer to FAX-18, "HR16DE MODELS : Exploded View".
7. Disconnect intermediate shaft to steering column assembly. Refer to ST-10, "Exploded View".
8. Remove rear torque rod.
9. Remove front suspension member. Refer to FSU-20, "Exploded View".
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-41, "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:

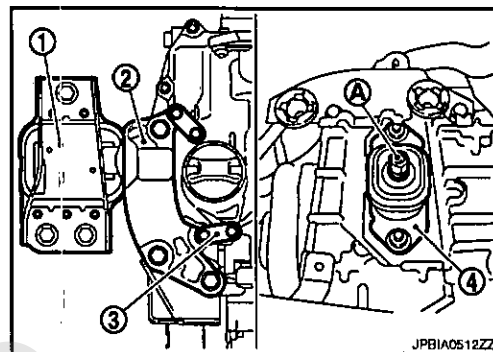
**Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.**



2. Remove engine mounting insulator (RH) (1), engine mounting bracket (RH) (2) and engine mounting stay (3).

4 : Engine mounting insulator (LH)

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



4. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly.

#### CAUTION:

- Make sure 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.

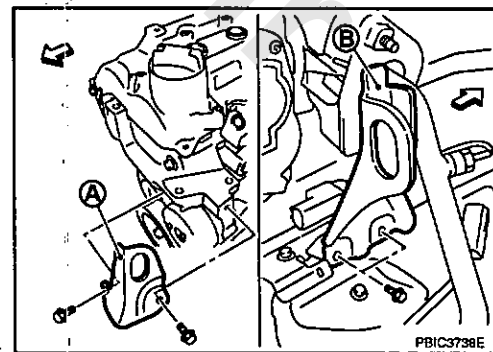
### Separation

1. Install engine slinger to cylinder head front left side (A) and rear right side (B).

⇐ : Engine front

#### Slinger bolts

⊗ : 25.5 N·m (2.6 kg-m, 19 ft-lb)



2. Remove starter motor. Refer to STR-13, "HR16DE MODELS : Exploded View".
3. Lift with a hoist and separate the engine from the transaxle assembly.

### INSTALLATION

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

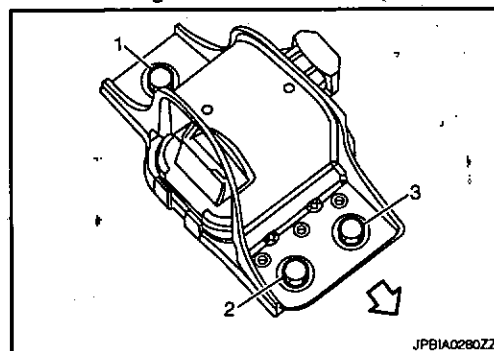
# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[HR16DE]

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Make sure that each mounting insulator is seated properly, and tighten mounting nuts and bolts.
- Tighten engine mounting insulator (RH) bolts in the numerical order shown in the figure.

⇐ : Vehicle front



## Inspection

INFOID:0000000004899192

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

### Summary of the inspection items:

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

INFOID:0000000004899183

#### NOTE:

Explained here is how to disassemble with engine stand supporting transmission 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-84, "Exploded View".
2. Remove clutch cover and clutch disc.
3. Remove flywheel.
  - Secure flywheel with a stopper plate [SST: KV11105210], and remove mounting bolts.

#### CAUTION:

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

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

#### CAUTION:

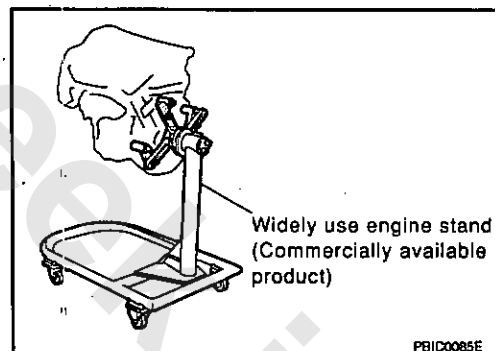
- **Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to EM-30, "Exploded View".
  - Exhaust manifold: Refer to EM-33, "Exploded View".
  - Rocker cover: Refer to EM-44, "Exploded View".

#### NOTE:

The figure shows an example of widely use engine stand that can support mating surface of transaxle with flywheel removed.

#### CAUTION:

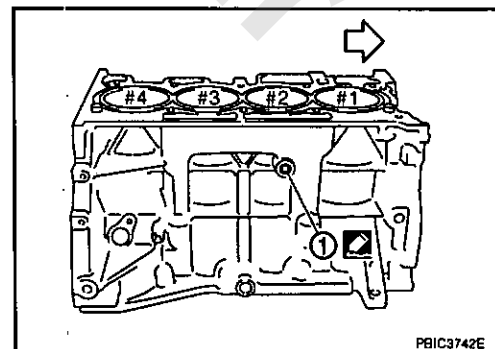
**Before removing the hanging chains, make sure the engine stand is stable and there is no risk of overturning.**



5. Drain engine oil. Refer to LU-7, "Draining".
6. Drain engine coolant by removing water drain plug (1) from inside of the engine.

↔ : Engine front

**Use Genuine Liquid Gasket or equivalent.**



## ENGINE UNIT

## Disassembly

INFOID:0000000004899184

1. Remove intake manifold. Refer to EM-30, "Exploded View".
2. Remove exhaust manifold. Refer to EM-33, "Exploded View".
3. Remove oil pan (lower). Refer to EM-41, "Exploded View".
4. Remove ignition coil, spark plug and rocker cover. Refer to EM-44, "Exploded View".
5. Remove fuel injector and fuel tube. Refer to EM-36, "Exploded View".
6. Remove timing chain. Refer to EM-47, "Exploded View".
7. Remove camshaft. Refer to EM-56, "Exploded View".
8. Remove cylinder head. Refer to EM-75, "Exploded View".

## Assembly

INFOID:0000000004899185

Assembly is the reverse order of disassembly.

A

EM

C

D

E

F

G

H

I

J

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P

# OIL PAN (UPPER)

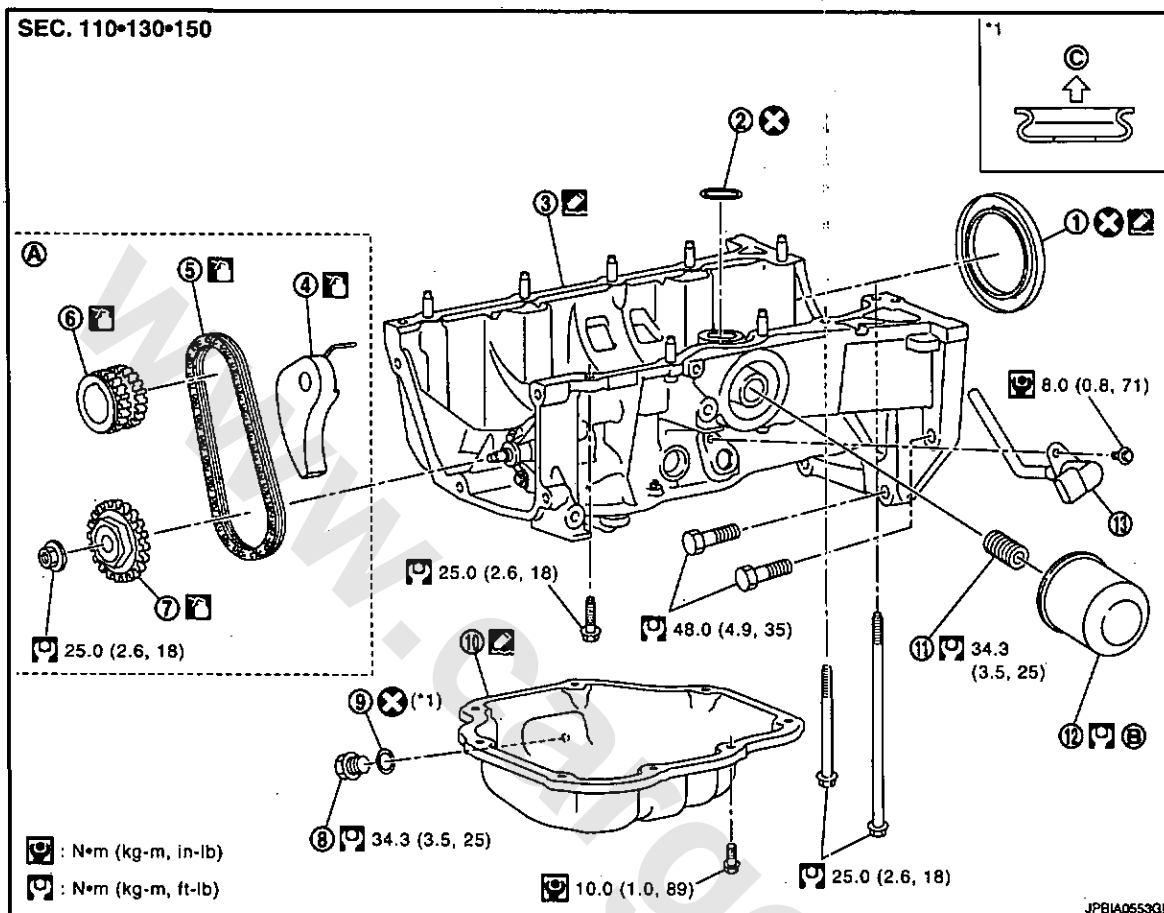
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

## OIL PAN (UPPER)

### Exploded View

INFOID:000000004899196



- |                      |                          |                        |
|----------------------|--------------------------|------------------------|
| 1. Rear oil seal     | 2. O-ring                | 3. Oil pan (upper)     |
| 4. Chain tensioner   | 5. Oil pump drive chain  | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pan drain plug    | 9. Washer              |
| 10. Oil pan (lower)  | 11. Oil filter stud bolt | 12. Oil filter         |
| 13. Oil level sensor |                          |                        |
| A. Refer to EM-47    | B. Refer to LU-9         | C. Oil pan side        |

Refer to Gl-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899197

### NOTE:

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

### REMOVAL

1. Remove the oil pan (lower). Refer to EM-41, "Exploded View".
2. Remove front cover and timing chain. Refer to EM-47, "Exploded View".
3. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to EM-47, "Exploded View".
4. Remove oil pan (upper) with the following procedure.

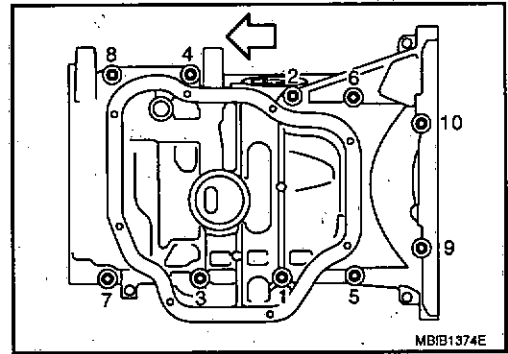
## OIL PAN (UPPER)

[HR16DE]

### < DISASSEMBLY AND ASSEMBLY >

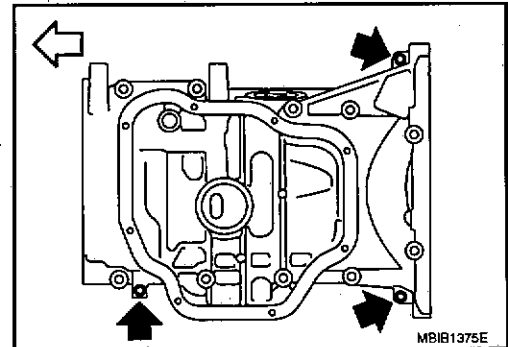
- a. Loosen oil pan (upper) mounting bolts in the reverse of the order shown in the figure.

↩ : Engine front



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

↩ : Engine front



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

#### CAUTION:

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

5. Remove oil level sensor, if necessary.  
6. Remove rear oil seal from crankshaft.

### INSTALLATION

1. Install the oil pan (upper) in the following procedure.
- a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove the old liquid gasket from mating surface of cylinder block.
  - Remove old liquid gasket from the bolt holes and threads.
- CAUTION:**  
Never scratch or damage the mating surfaces when cleaning off old liquid gasket.
- b. Install O-ring to the cylinder block.

## OIL PAN (UPPER)

### < DISASSEMBLY AND ASSEMBLY >

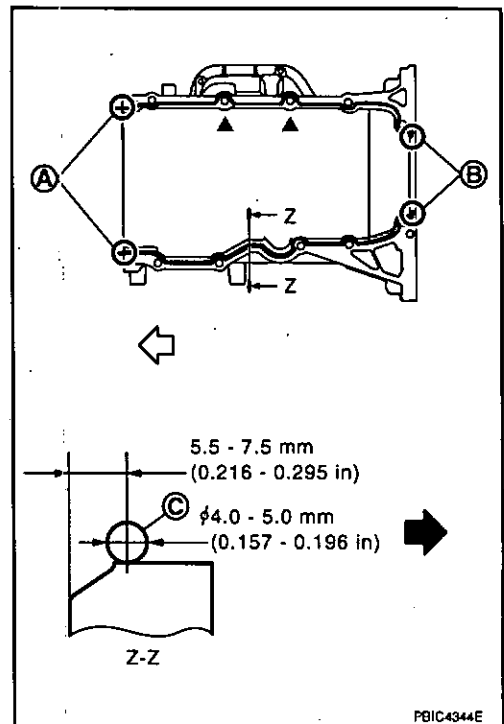
[HR16DE]

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

- A : 2 mm (0.08 in) protruded to outside  
B : 2 mm (0.08 in) protruded to rear oil seal mounting side  
⇐ : Engine front  
➡ : Oil pan out side

**CAUTION:**

Attaching should be done within 5 minutes after coating.



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

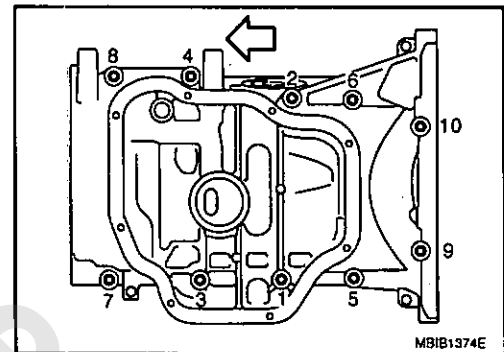
- ⇐ : Engine front

**CAUTION:**

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

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

- |                       |                     |
|-----------------------|---------------------|
| M8 × 179 mm (7.05 in) | : No. 9, 10         |
| M8 × 25 mm (0.98 in)  | : No. 4, 7, 8       |
| M8 × 90 mm (3.54 in)  | : No. 1, 2, 3, 5, 6 |

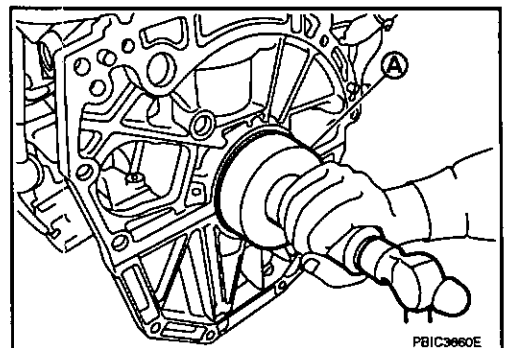


2. Install rear oil seal.

**CAUTION:**

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

- Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a spatula.
- Apply the liquid gasket lightly to entire outside area of new rear oil seal.  
**Use Genuine Liquid Gasket or equivalent.**
- Press-fit the rear oil seal using a drift with outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).





## OIL PAN (UPPER)

[HR16DE]

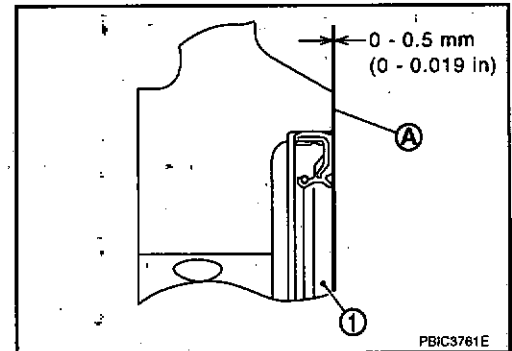
### < DISASSEMBLY AND ASSEMBLY >

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

1. Rear oil seal
- A. Rear end surface of cylinder block

#### 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 make sure that oil seal does not curl or tilt.



- d. After press-fitting the rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.
3. Install crankshaft sprocket, oil pump sprocket, oil pump drive chain, and chain tensioner. Refer to EM-47, "Exploded View".
4. Install timing chain and related parts. Refer to EM-47, "Exploded View".
5. Install front cover and related parts. Refer to EM-47, "Exploded View".
6. Install in the reverse order of removal, for the rest of parts.

#### CAUTION:

Pour engine oil at least 30 minutes after oil pan is installed.

### Inspection

INFOID:0000000004899198

### 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".

# CYLINDER BLOCK

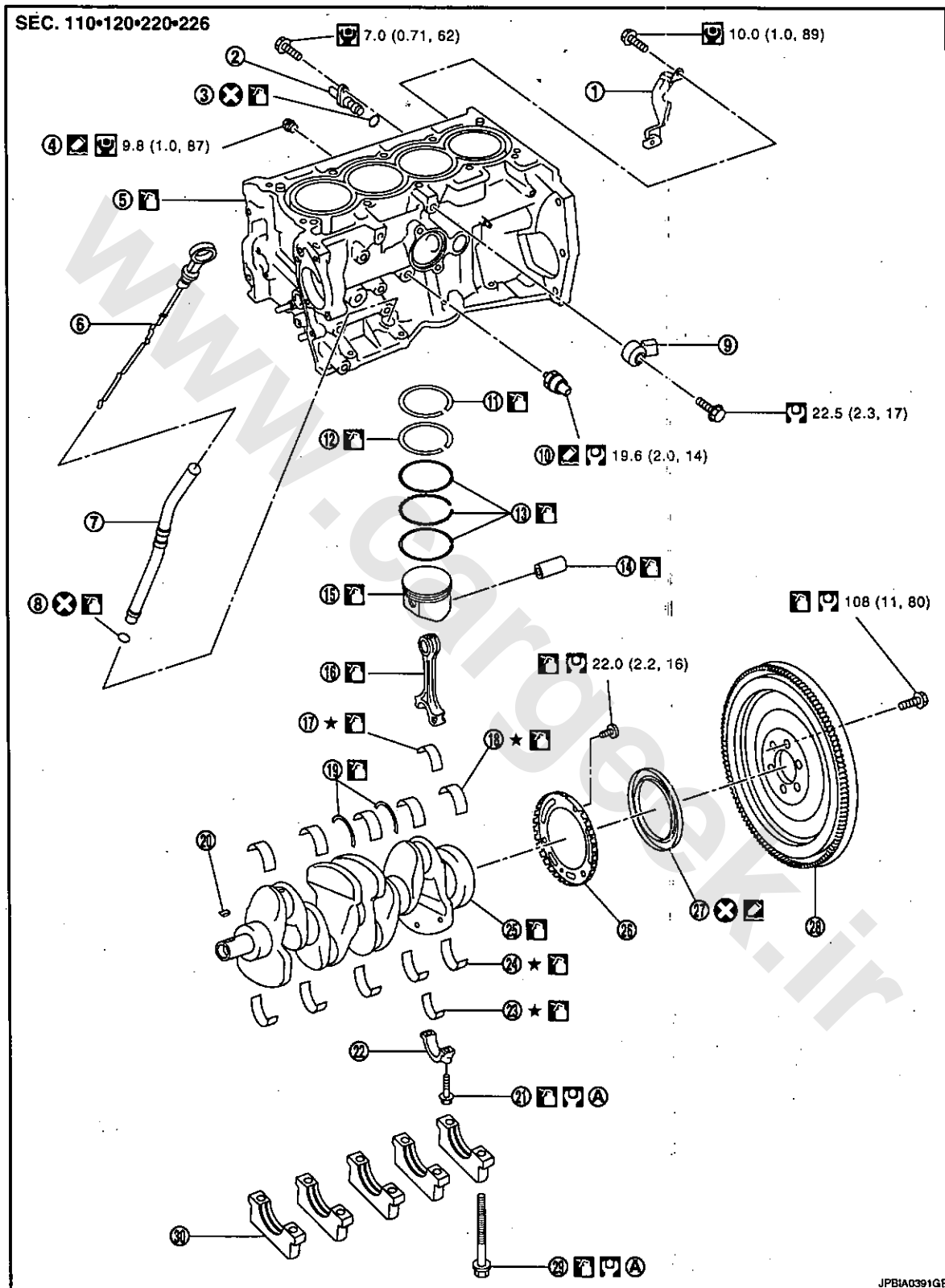
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

## CYLINDER BLOCK

Exploded View

INFOID:000000004899199



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

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

- |                         |                                    |                             |
|-------------------------|------------------------------------|-----------------------------|
| 10. Oil pressure switch | 11. Top ring                       | 12. Second ring             |
| 13. Oil ring            | 14. Piston pin                     | 15. Piston                  |
| 16. Connecting rod      | 17. Connecting rod bearing (upper) | 18. Main bearing (upper)    |
| 19. Thrust bearing      | 20. Crankshaft key                 | 21. Connecting rod cap bolt |
| 22. Connecting rod cap  | 23. Connecting rod bearing (lower) | 24. Main bearing (lower)    |
| 25. Crankshaft          | 26. Signal plate                   | 27. Rear oil seal           |
| 28. Flywheel            | 29. Main bearing cap bolt          | 30. Main bearing cap        |

A. Refer to [EM-95](#)

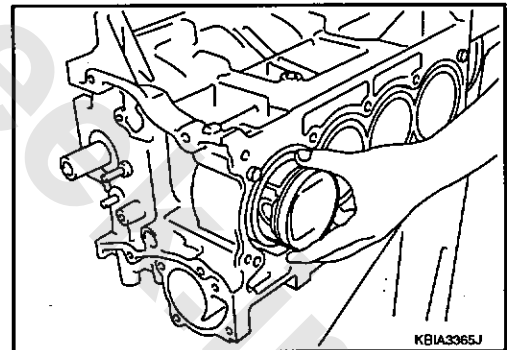
Refer to [GI-3, "Components"](#) for symbols in the figure.

## Disassembly and Assembly

INFOID:000000004899200

### DISASSEMBLY

1. Remove oil pan (upper). Refer to [EM-90, "Exploded View"](#).
2. Remove cylinder head. Refer to [EM-75, "Exploded View"](#).
3. Remove knock sensor.  
**CAUTION:**  
**Carefully handle knock sensor avoiding shocks.**
4. Remove crankshaft position sensor (POS) and cover.  
**CAUTION:**
  - Avoid impacts such as a dropping.
  - Never disassemble.
  - Keep it away from metal particles.
  - Never place the sensor where it is exposed to magnetism.
5. 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.
6. Remove connecting rod bearings.  
**CAUTION:**  
**Identify installation positions, and store them without mixing up.**
7. Remove piston rings from piston.
  - Before removing piston rings, check the piston ring side clearance. Refer to [EM-102, "Inspection"](#).



# CYLINDER BLOCK

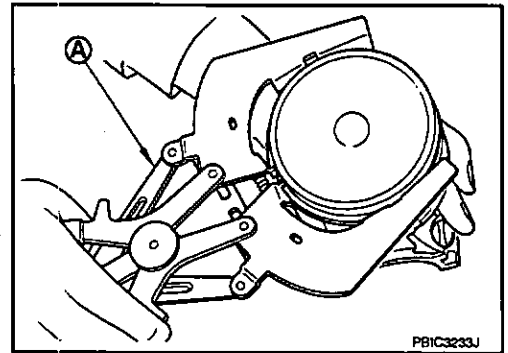
## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

- 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.



8. Remove piston from connecting rod.

- Use a piston pin press stand (SST) and a press to remove the piston pin.

A : Drift [KV10109730]

B : Center cap [KV10110310]

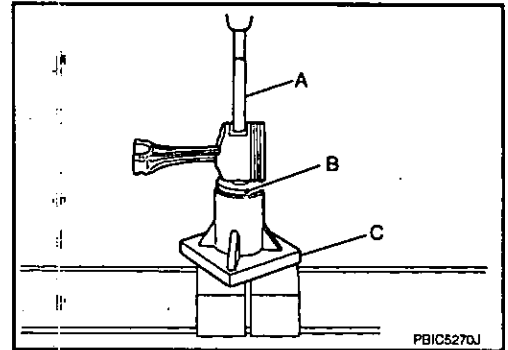
C : Press stand [ST13030020]

### CAUTION:

Be careful not to damage the piston and connecting rod.

### NOTE:

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



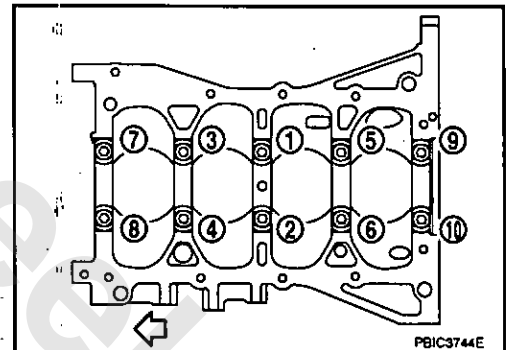
9. Remove the main bearing cap in the following procedure.

- Measure crankshaft end play before loosening main bearing cap bolts. Refer to EM-102, "Inspection"

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

← : Engine front

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



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

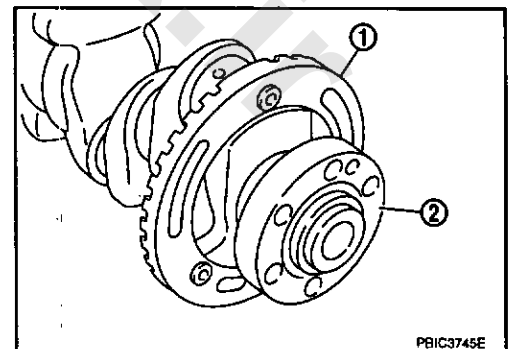
10. Remove crankshaft (2).

### CAUTION:

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

### NOTE:

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



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

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

### CAUTION:

Identify installation positions, and store them without mixing up.

## ASSEMBLY

# CYLINDER BLOCK

[HR16DE]

## < DISASSEMBLY AND ASSEMBLY >

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

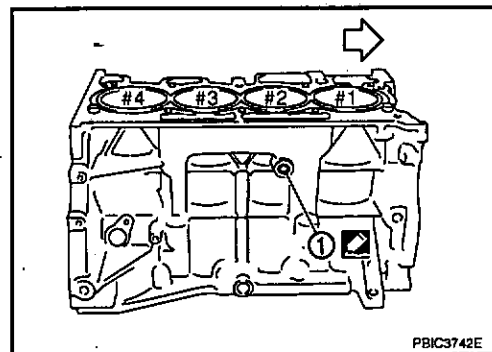
### CAUTION:

**Use a goggles to protect eyes.**

2. Install water drain plug (1) to cylinder block as shown in the figure.

↔ : Engine front

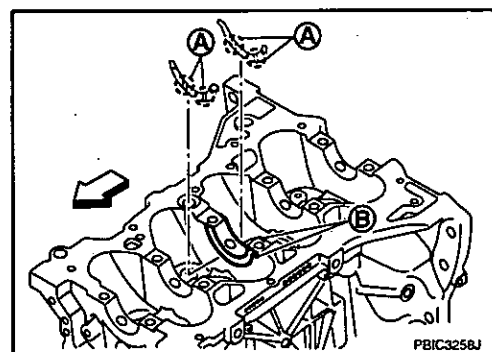
**Use Genuine Liquid Gasket or equivalent.**



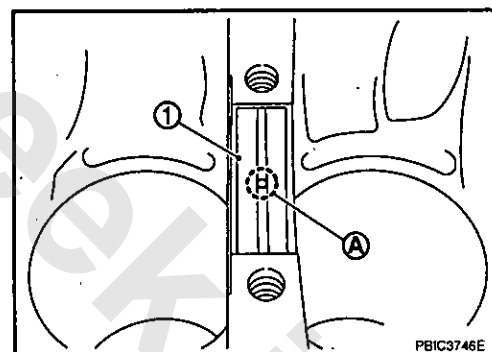
3. Install main bearings and thrust bearings with the following procedure:
  - a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block.
  - b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

↔ : Engine front

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



- c. Install the main bearings (1) paying attention to the direction.
  - Install the one with oil holes (A) onto cylinder block and the one without oil holes onto main bearing cap.
  - Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
  - Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.

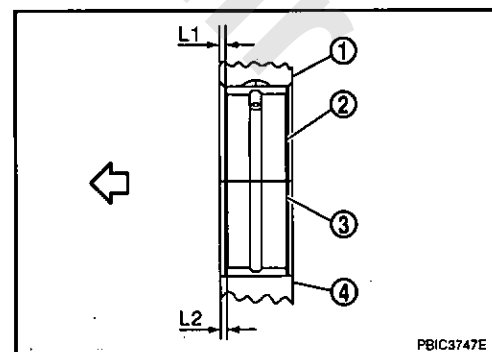


- Install the main bearing in the position shown in the figure.

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

### NOTE:

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



Journal position	No. 1	No. 2	No. 3	No. 4	No. 5
------------------	-------	-------	-------	-------	-------

# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

L1 [Unit: mm (in)]	1.65–2.05 (0.065–0.081)	1.25–1.65 (0.049–0.065)	2.30–2.70 (0.091–0.106)	1.25–1.65 (0.049–0.065)	1.60–2.00 (0.063–0.079)
L2 [Unit: mm (in)]	1.30–1.70 (0.051–0.067)	1.30–1.70 (0.051–0.067)	2.30–2.70 (0.091–0.106)	1.30–1.70 (0.051–0.067)	1.30–1.70 (0.051–0.067)

## CAUTION:

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

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

A : Dowel pin hole

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

## NOTE:

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

- c. Remove dowel pin.

## CAUTION:

Be sure to remove dowel pin.

5. Install crankshaft to cylinder block.
  - Make sure that crankshaft turns smoothly by hand.

## CAUTION:

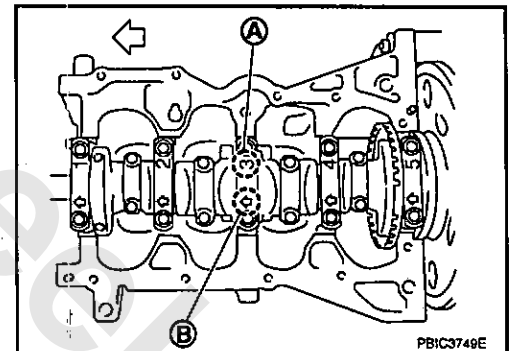
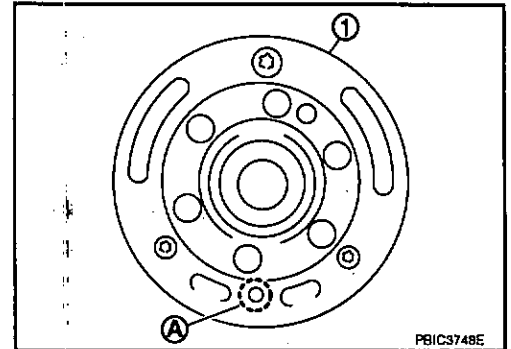
Never install rear oil seal yet.

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

⇐ : Engine front

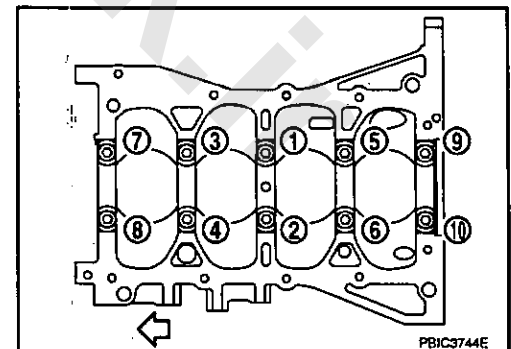
## NOTE:

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



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

⇐ : Engine front



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

Ⓒ: 32.4 N·m (3.3 kg-m, 24 ft-lb)

# CYLINDER BLOCK

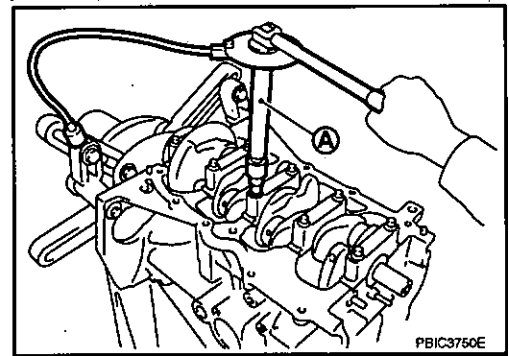
## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

### CAUTION:

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



- After installing the mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to EM-102. "Inspection".

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

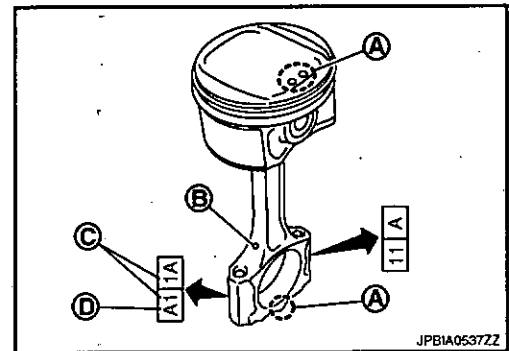
- a. Set so that the front mark (A) on the piston head and the cylinder number (C) are in the position shown in the figure.

B : Oil hole

D : Connecting rod big end grade

### NOTE:

The symbols without notes are for management.



- b. Press-fit the piston pin using the piston pin press stand (SST).

A : Drift [KV10109730]

B : Center cap [KV10110310]

C : Press stand [ST13030020]

D : Center shaft [KV10114120]

E : Spring [ST13030030]

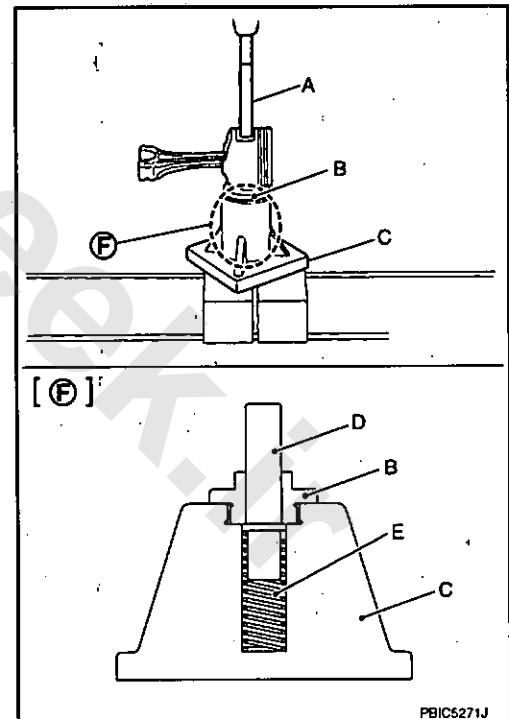
F : For detail

### CAUTION:

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

### NOTE:

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



# CYLINDER BLOCK

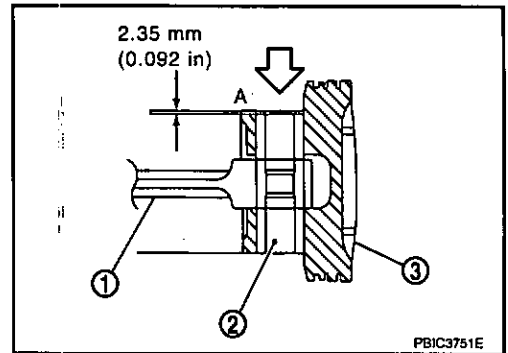
## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

1 : Connecting rod  
 ⇐ : Press-fit direction

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



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

### CAUTION:

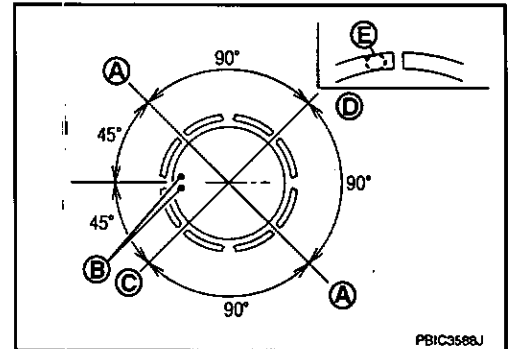
- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark (B).

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

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

Stamped mark:

Second ring : R



- Install connecting rod bearings to connecting rod and connecting rod cap.

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

### NOTE:

There is no stopper tab.

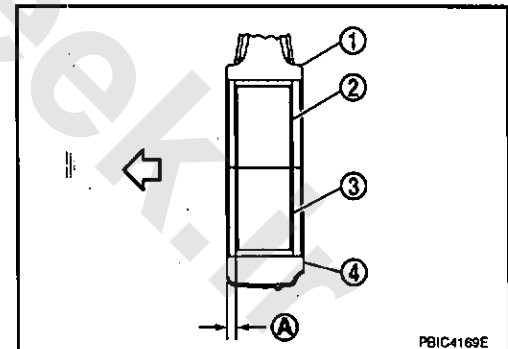
- Make sure that the oil holes on connecting rod and connecting rod bearing are aligned.
- Install the connecting rod in the dimension shown in the figure.

1 : Connecting rod  
 2 : Connecting rod bearing (upper)  
 3 : Connecting rod bearing (lower)  
 4 : Connecting rod cap  
 ⇐ : Engine front

Dimension "A" : 1.7 - 2.1 mm (0.067 - 0.083 in)

### NOTE:

Install the connecting rod bearing in the center position with the dimension 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.
- 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.



# CYLINDER BLOCK

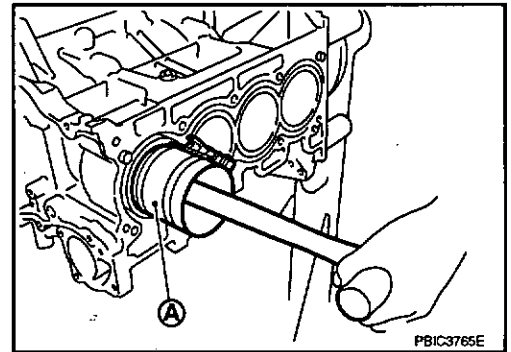
## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

### CAUTION:

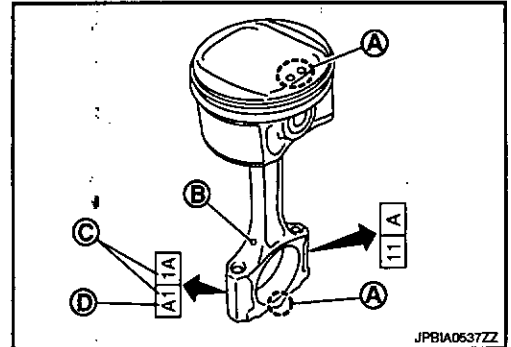
- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



### 12. Install connecting rod cap.

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

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



### 13. Inspect outer diameter of connecting rod cap bolts. Refer to EM-102, "Inspection".

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

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

: 27.5 N·m (2.8 kg-m, 20 ft-lb)

### c. Completely loosen bolts.

: 0 N·m (0 kg-m, 0 ft-lb)

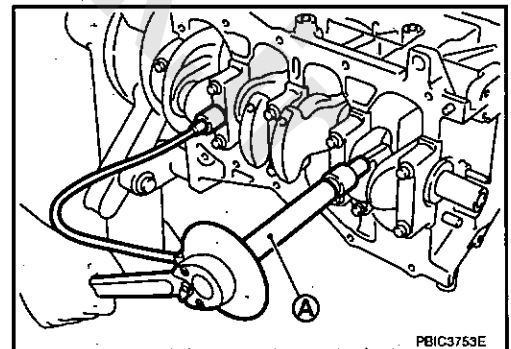
### d. Tighten bolts in several steps.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

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

### CAUTION:

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



- After tightening connecting rod bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-102, "Inspection".

### 15. Install oil pan (upper). Refer to EM-90, "Exploded View".

### NOTE:

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

### 16. Install rear oil seal. Refer to EM-73, "REAR OIL SEAL : Removal and Installation".

### 17. Install flywheel.

## CYLINDER BLOCK

### < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

#### 18. Install knock sensor (1).

⇐ : Engine front

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

#### CAUTION:

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

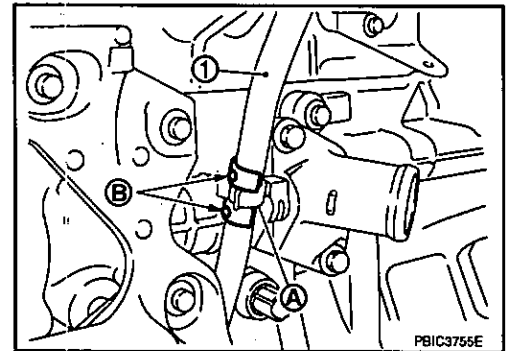
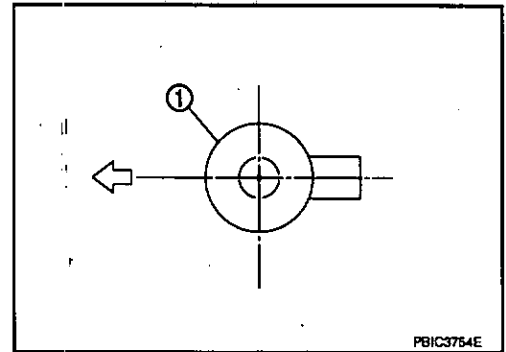
#### NOTE:

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

#### 19. Install crankshaft position sensor (POS) and cover.

- Tighten bolts with it seated completely.

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



#### 21. Assemble in the reverse order of disassembly after this step.

### Inspection

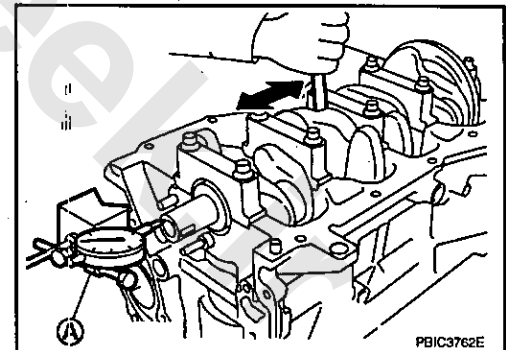
INFOID:0000000004899201

#### 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-121, "Cylinder Block".**

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

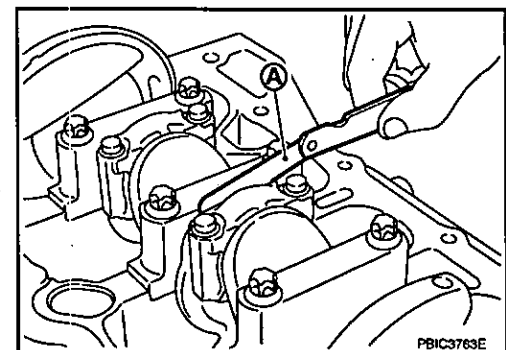


#### CONNECTING ROD SIDE CLEARANCE

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

**Standard : Refer to EM-121, "Cylinder Block".**

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



# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

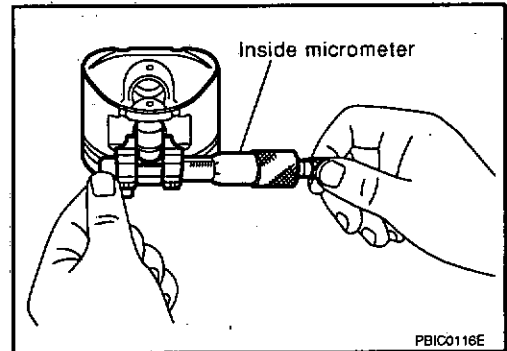
[HR16DE]

### PISTON TO PISTON PIN OIL CLEARANCE

#### Piston Pin Hole Diameter

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

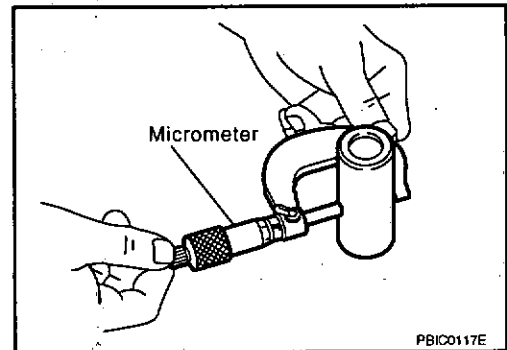
**Standard** : Refer to EM-121, "Cylinder Block".



#### Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

**Standard** : Refer to EM-121, "Cylinder Block".



#### Piston to Piston Pin Oil Clearance

$(\text{Piston to piston pin oil clearance}) = (\text{Piston pin hole diameter}) - (\text{Piston pin outer diameter})$

**Standard** : Refer to EM-121, "Cylinder Block".

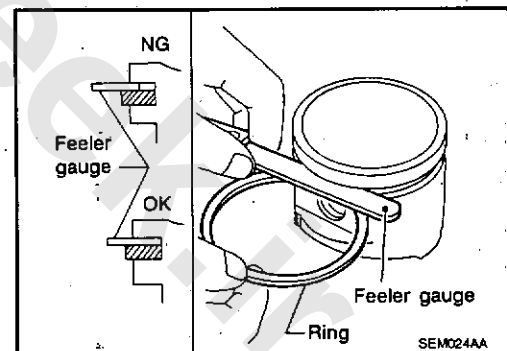
- If oil clearance is out of the standard, replace piston and piston pin assembly.

### 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-121, "Cylinder Block".

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

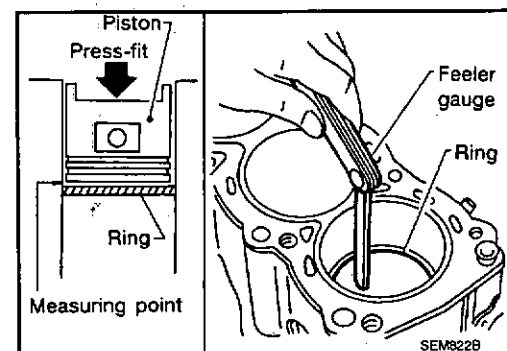


### PISTON RING END GAP

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

**Standard and Limit** : Refer to EM-121, "Cylinder Block".

- If the measured value exceeds the limit, replace piston ring.



### CONNECTING ROD BEND AND TORSION

## CYLINDER BLOCK

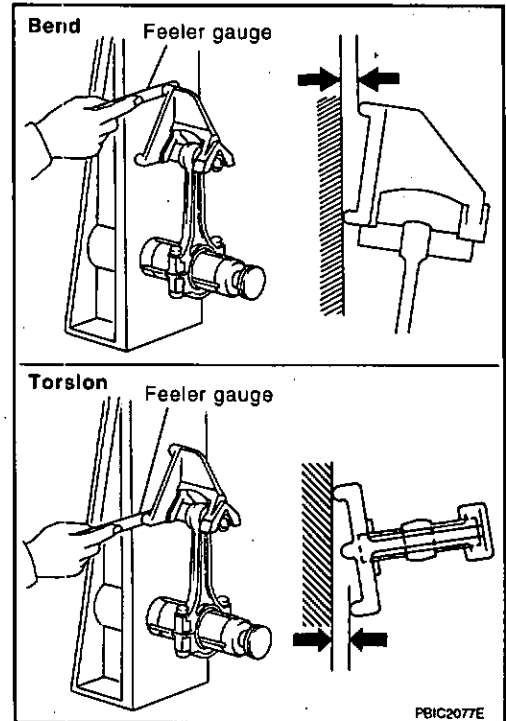
### < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

- Check with a connecting rod aligner.

**Limit** : Refer to EM-121, "Cylinder Block".

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

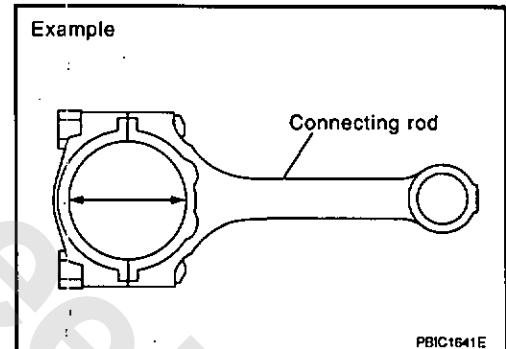


### CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".
- Measure the inner diameter of connecting rod big end with an inside micrometer.

**Standard** : Refer to EM-121, "Cylinder Block".

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

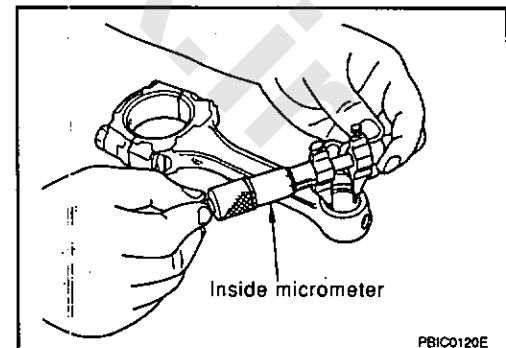


### CONNECTING ROD SMALL END CLEARANCE

Connecting Rod Small End Inner Diameter

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

**Standard** : Refer to EM-121, "Cylinder Block".



Piston Pin Outer Diameter

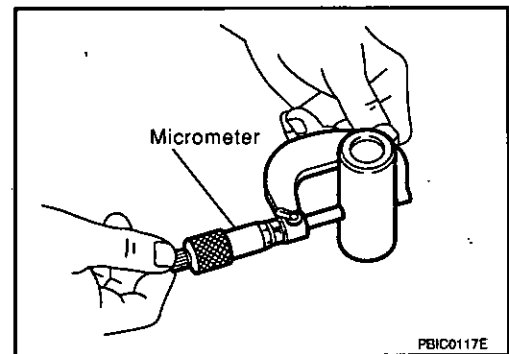
# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

Measure the outer diameter of piston pin with a micrometer.

**Standard** : Refer to EM-121, "Cylinder Block".



Connecting Rod Small End Clearance

(Connecting rod small end clearance) = (Connecting rod small end inner diameter) – (Piston pin outer diameter)

**Standard** : Refer to EM-121, "Cylinder Block".

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing connecting rod assembly, refer to "CONNECTING ROD BEARING OIL CLEARANCE" to select 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.

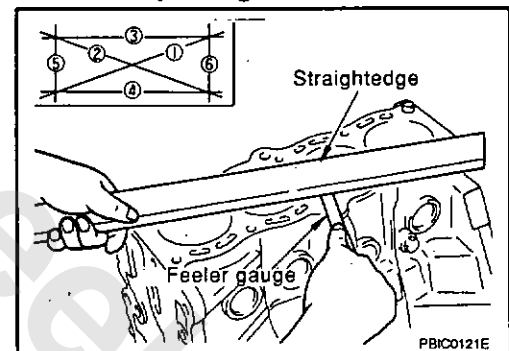
### CAUTION:

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

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

**Limit** : Refer to EM-121, "Cylinder Block".

- If it exceeds the limit, replace cylinder block.



## MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".
- Measure the position shown in the figure [5 mm (0.196 in) rearward from main bearing housing front side end surface) in the 2 directions as shown in the figure. The smaller one is the measured value.

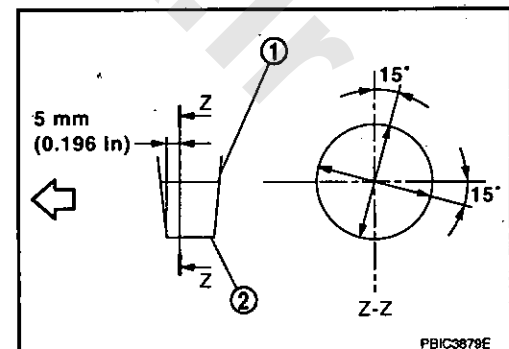
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

**Standard** : Refer to EM-121, "Cylinder Block".

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

### NOTE:

These components cannot be replaced as a single unit, because they were processed together.



## PISTON TO CYLINDER BORE CLEARANCE

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

### Cylinder Bore Inner Diameter

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

A : Unit: mm (in)

#### NOTE:

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

#### Standard:

Cylinder bore inner diameter

: Refer to EM-121, "Cylinder Block".

#### Limit:

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

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

: Refer to EM-121, "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.

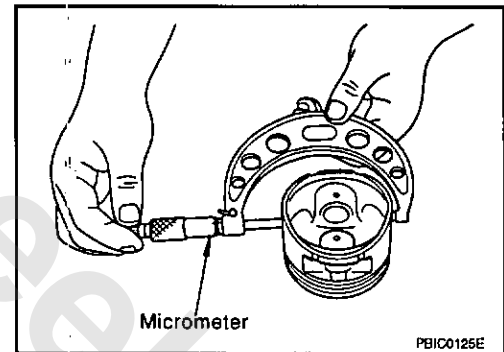
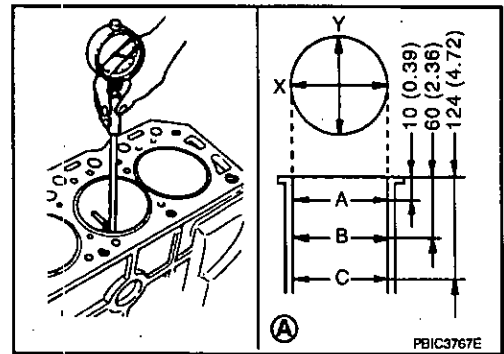
#### NOTE:

There is no service setting for oversized piston.

### Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer.

Standard : Refer to EM-121, "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-121, "Cylinder Block".

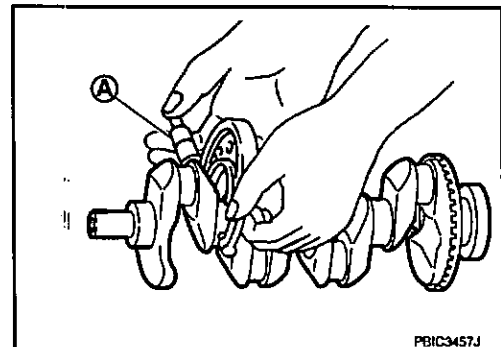
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block.

### CRANKSHAFT MAIN JOURNAL DIAMETER

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

Standard : Refer to EM-121, "Cylinder Block".

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to "MAIN BEARING OIL CLEARANCE".



# CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

## CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard** : Refer to EM-121, "Cylinder Block".

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to "CONNECTING ROD BEARING OIL CLEARANCE".

## OUT-OF-ROUND AND TAPER OF CRANKSHAFT

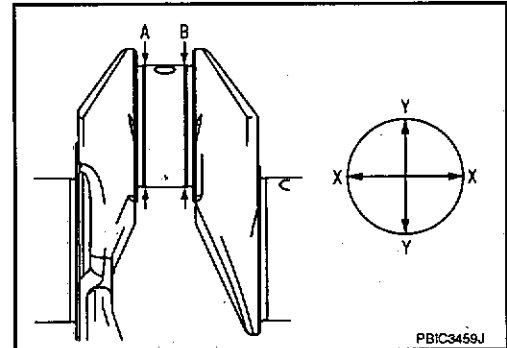
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in dimension between "A" and "B" at "X"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

**Limit:**

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

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

: Refer to EM-121, "Cylinder Block".



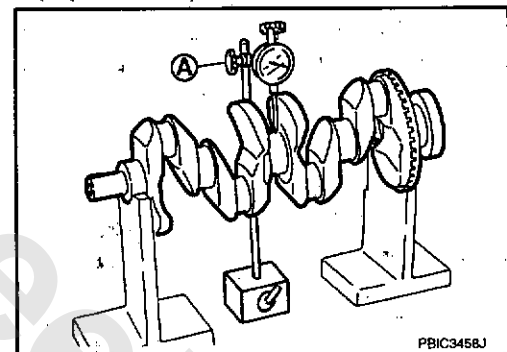
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to "MAIN BEARING OIL CLEARANCE" and/or "CONNECTING ROD BEARING OIL CLEARANCE".

## CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of 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)

**Limit** : Refer to EM-121, "Cylinder Block".

- If it exceeds the limit, replace crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

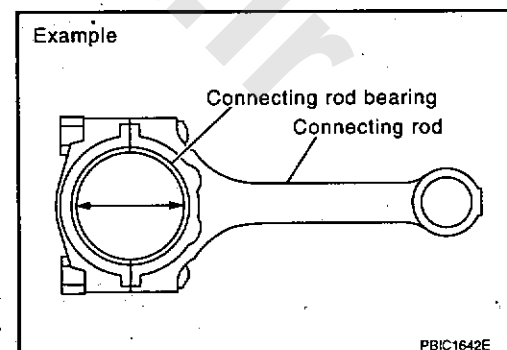
Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".
- Measure the inner diameter of connecting rod bearing with an inside micrometer.  
 $(\text{Bearing oil clearance}) = (\text{Connecting rod bearing inner diameter}) - (\text{Crankshaft pin journal diameter})$

**Standard and Limit**

: Refer to EM-124, "Connecting Rod Bearing".

- If the clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to EM-111, "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.

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".

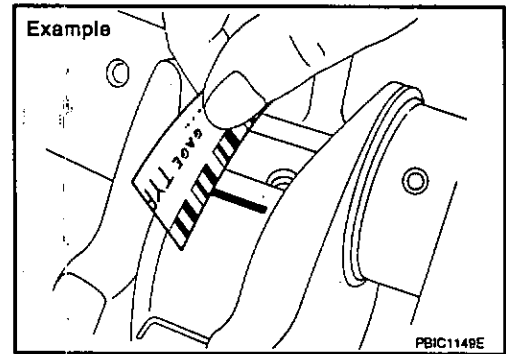
### CAUTION:

**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".



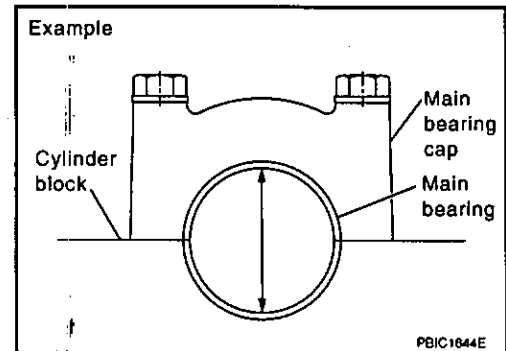
## MAIN BEARING OIL CLEARANCE

### Method by Calculation

- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".
- Measure the inner diameter of main bearing with a bore gauge.  
 $(\text{Bearing oil clearance}) = (\text{Main bearing inner diameter}) - (\text{Crankshaft main journal diameter})$

**Standard** : Refer to EM-125, "Main Bearing".

- If the clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain the specified bearing oil clearance. Refer to EM-113, "Main Bearing".



### Method of Using Plastigage

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

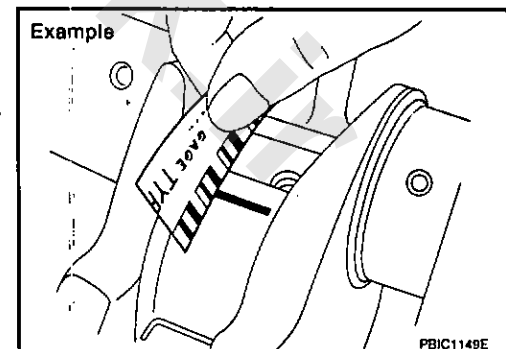
### CAUTION:

**Never rotate crankshaft.**

- Remove main bearing cap 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



# CYLINDER BLOCK

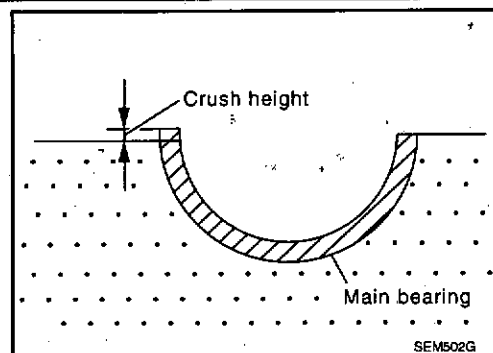
## < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

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

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

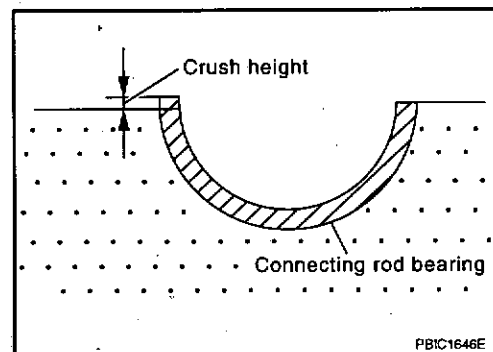


## CONNECTING ROD BEARING CRUSH HEIGHT

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

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

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

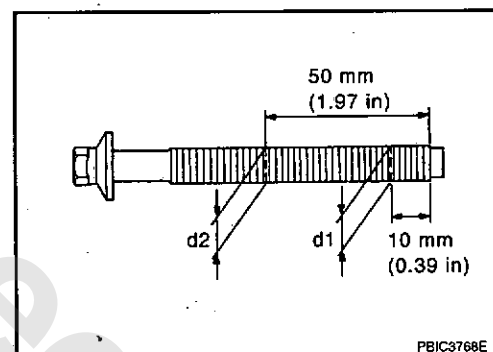


## MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters ("d1", "d2") at two positions as shown in the figure.
- If reduction appears in a position other than "d2", regard it as "d2".

**Limit ("d1"—"d2"): 0.2 mm (0.008 in)**

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

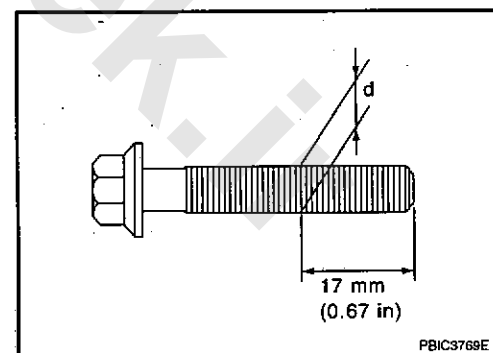


## CONNECTING ROD CAP BOLT OUTER DIAMETER

- 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" falls below the limit (when it becomes thinner), replace connecting rod cap bolt with a new one.



## FLYWHEEL DEFLECTION

## CYLINDER BLOCK

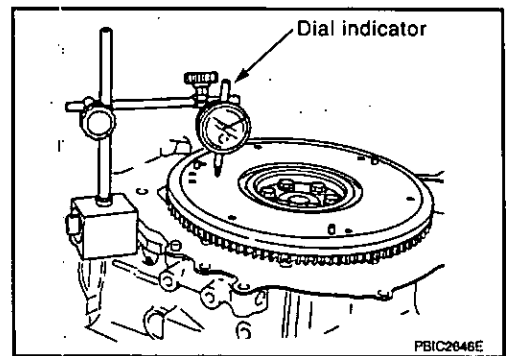
### < DISASSEMBLY AND ASSEMBLY >

[HR16DE]

- Measure the deflection of flywheel contact surface to clutch with a dial indicator.

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

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



# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:000000004899202

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.

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

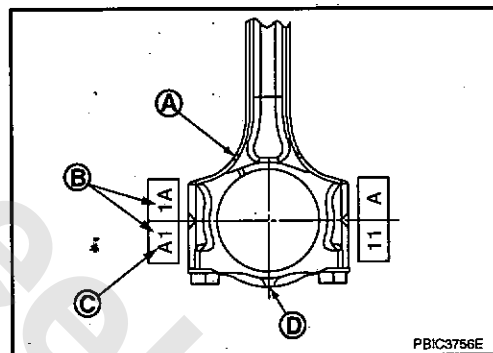
### Connecting Rod Bearing

INFOID:000000004899203

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

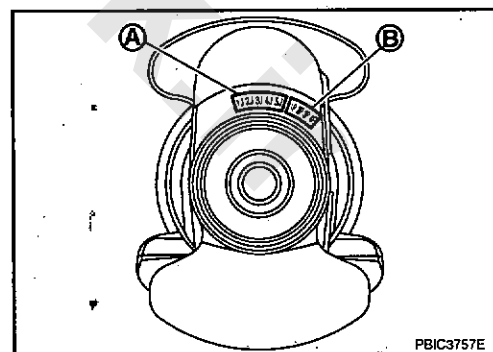
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

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



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

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



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

#### WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-102, "Inspection".

# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

PBIC3758E

Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to EM-124, "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

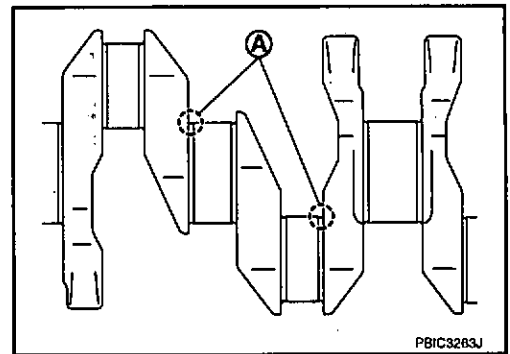
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

Bearing undersize table:

Refer to EM-124, "Connecting Rod Bearing".



INFOID:0000000004899204

## Main Bearing

### HOW TO SELECT MAIN BEARING

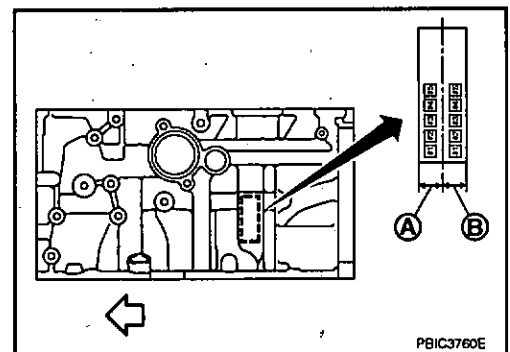
When New Cylinder Block and Crankshaft Are Used

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

A : Basic stamp mark

↔ : Engine front

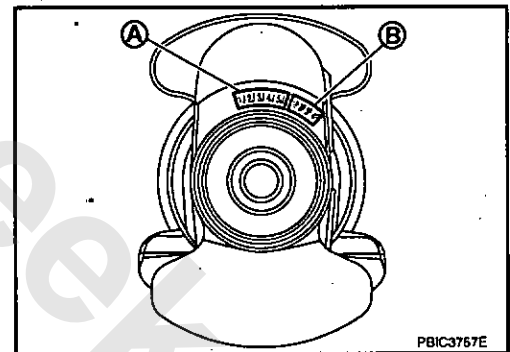
- If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



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

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

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



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

#### NOTE:

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

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to EM-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".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

Main Bearing Selection Table

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

PBIC3759E

Main Bearing Grade Table

Main Bearing Grade Table : Refer to EM-125. "Main Bearing".

Use Undersize Bearing Usage Guide

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

**CAUTION:**

## HOW TO SELECT PISTON AND BEARING

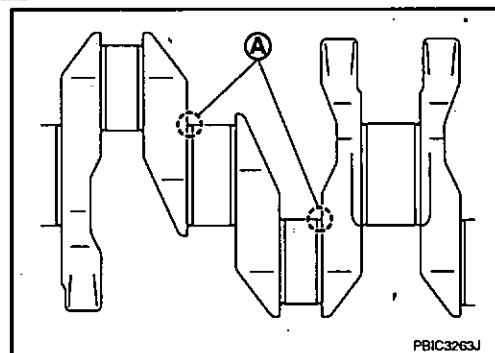
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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

Bearing undersize table:

Refer to EM-125, "Main Bearing".



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

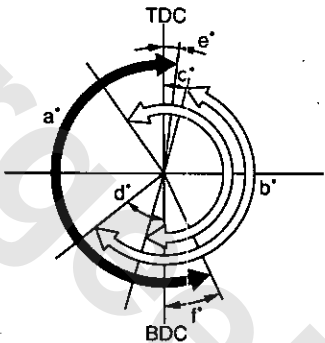
## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification

INFOID:0000000004899205

#### GENERAL SPECIFICATIONS

Engine type		HR16DE			
Cylinder arrangement		In-line 4			
Displacement cm <sup>3</sup> (cu in)		1,598 (97.51)			
Bore and stroke mm (in)		78.0 x 83.6 (3.071 x 3.291)			
Valve arrangement		DOHC			
Firing order		1-3-4-2			
Number of piston rings	Compression	2			
	Oil	1			
Number of main bearings		4			
Compression ratio		10.7			
Compression pressure kPa (bar, kg/cm <sup>2</sup> , psi)/200 rpm	Standard	1,500 (15.0, 15.3, 217.5)			
	Minimum	1,471 (14.7, 15.0, 213.3)			
	Differential limit between cylinders	6.2 (0.06, 0.06, 0.9)			
Valve timing (Intake valve timing control - "ON")	 JPBIA0552ZZ				
Unit: degree					
a	b	c	d	e	f
208	228	-11 (24)	59 (24)	4	24

#### Drive Belts

INFOID:0000000004899206

#### BELT DEFLECTION:

Location		Deflection adjustment *		Unit: mm (in)
		Used belt		New belt
		Limit	After adjusted	
Drive belt	With A/C models	7.9 (0.31)	4.8 - 5.3 (0.19 - 0.21)	4.2 - 4.5 (0.17 - 0.18)
	Without A/C models	7.1 (0.28)	4.3 - 4.7 (0.17 - 0.19)	3.6 - 3.9 (0.14 - 0.15)
Applied pushing force		98 N (10 kg, 22 lb)		

\*: When engine is cold.

#### BELT TENSION AND FREQUENCY:



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Location		Tension adjustment *		Unit: N (kg, lb)	Frequency adjustment *		Unit: Hz
		Used belt		New belt	Used belt		New belt
		Limit	After adjusted		Limit	After adjusted	
Drive belt	With A/C models	500 (51.0, 112)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	163	216 - 225	238 - 246
	Without A/C models	500 (51.0, 112)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	183	242 - 252	266 - 276

\*: When engine is cold.

## Spark Plug

INFOID:0000000004899207

### SPARK PLUG (PLATINUM-TIPPED TYPE)

Unit: mm (in)

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

## Exhaust Manifold

INFOID:0000000004899208

### EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Exhaust manifold	0.3 (0.012)

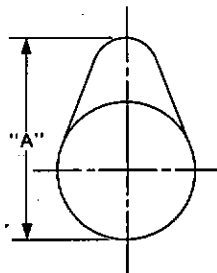
## Camshaft

INFOID:0000000004899209

### CAMSHAFT

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.004)



SEM671

Camshaft cam height "A"	Intake	41.705 - 41.895 (1.6419 - 1.6494)	—
	Exhaust	40.175 - 40.365 (1.5817 - 1.5892)	—
Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9823 - 0.9831)	—
Camshaft 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 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)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

## < SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Items	Standard	Limit
Camshaft end play	0.075 - 0.153 (0.0030 - 0.0060)	0.2 (0.008)
Camshaft sprocket runout [TIR*]	—	0.15 (0.0059)

\*: Total indicator reading

## VALVE LIFTER

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.977 - 29.987 (1.1802 - 1.1806)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

## VALVE CLEARANCE

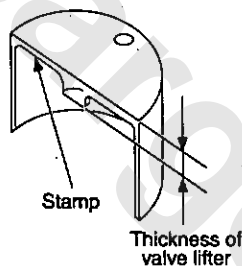
Unit: mm (in)

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

\*: Approximately 80°C (176°F)

## AVAILABLE VALVE LIFTER

Thickness mm (in)	Identification mark
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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

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Thickness mm (in)	Identification mark
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

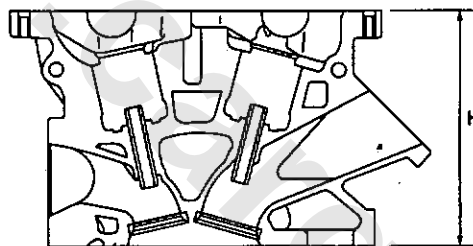
## Cylinder Head

INFOID:0000000004699210

## CYLINDER HEAD

Unit: mm (in)

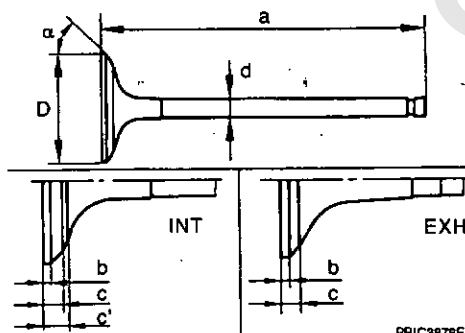
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	125.0 (4.92)	—



PB1C0924E

## VALVE DIMENSIONS

Unit: mm (in)



PB1C3676E

Valve head diameter "D"	Intake	31.0 - 31.3 (1.220 - 1.232)
	Exhaust	25.3 - 25.6 (0.996 - 1.008)
Valve length "a"	Intake	101.65 (4.002)
	Exhaust	102.46 (4.034)
"b"	Intake	1.0 (0.039)
	Exhaust	

# SERVICE DATA AND SPECIFICATIONS (SDS)

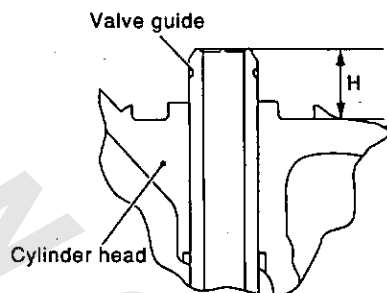
< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

"c"	Intake	2.1 - 2.8 (0.083 - 0.110)
	Exhaust	2.3 - 3.0 (0.091 - 0.118)
"c"	Intake	3.0 (0.118)
	Exhaust	—
Valve stem diameter "d"	Intake	4.965 - 4.980 (0.1955 - 0.1961)
	Exhaust	4.955 - 4.970 (0.1951 - 0.1957)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	

## VALVE GUIDE

Unit: mm (in)

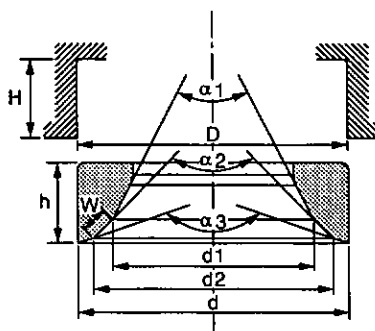


PBIC2187E

Items		Standard	Oversize (service) [0.2 (0.008)]
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3557)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1969 - 0.1976)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3542)	9.175 - 9.196 (0.3612 - 0.3620)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
Projection length "H"		11.4 - 11.8 (0.449 - 0.465)	

## VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (service) [0.5 (0.02)]
Cylinder head seat recess diameter "D"	Intake	31.400 - 31.416 (1.2362 - 1.2368)	31.900 - 31.916 (1.2559 - 1.2565)
	Exhaust	25.900 - 25.916 (1.0197 - 1.0203)	26.400 - 26.416 (1.0394 - 1.0400)
Valve seat outer diameter "d"	Intake	31.497 - 31.513 (1.2400 - 1.2407)	31.997 - 32.013 (1.2597 - 1.2604)
	Exhaust	25.997 - 26.013 (1.0235 - 1.0241)	26.497 - 26.513 (1.0432 - 1.0438)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust		
Diameter "d1"*1	Intake	29.0 (1.142)	
	Exhaust	23.0 (0.906)	
Diameter "d2"*2	Intake	30.3 - 30.8 (1.193 - 1.213)	
	Exhaust	24.6 - 25.1 (0.969 - 0.988)	
Angle "α1"	Intake	60°	
	Exhaust	45°	
Angle "α2"	Intake	88°45' - 90°15'	
	Exhaust		
Angle "α3"	Intake	120°	
	Exhaust		
Contacting width "W"*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height "h"	Intake	6.0 (0.236)	5.45 (0.215)
	Exhaust		5.43 (0.214)
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	Standard
Free height	42.26 mm (1.6638 in)
Installation height	32.40 mm (1.2756 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)

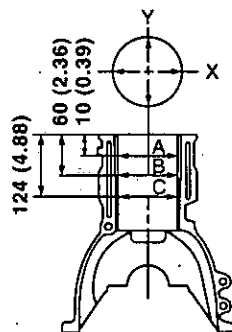
Items	Limit
Valve spring squareness	1.8 mm (0.071 in)

## Cylinder Block

INFOID:0000000004899211

## CYLINDER BLOCK

Unit: mm (in)



PBIC3924E

Cylinder block top surface distortion	Limit	0.1 (0.004)
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# SERVICE DATA AND SPECIFICATIONS (SDS)

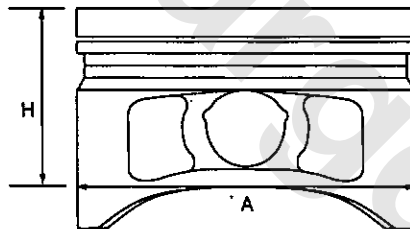
## < SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Cylinder bore inner diameter	Standard	78.000 - 78.015 (3.0709 - 3.0715)
Out-of-round	Limit	0.015 (0.0006)
Taper		0.010 (0.0004)
Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0473)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0474)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0475)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0476)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0477)
	Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)
	Grade No. S	52.012 - 52.013 (2.0477 - 2.0478)
	Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)
	Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)
	Grade No. V	52.015 - 52.016 (2.0478 - 2.0479)
	Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

## AVAILABLE PISTON

Unit: mm (in)



PBIC0188E !!

Item	Standard	Limit
Piston skirt diameter "A"	77.965 - 77.980 (3.0695 - 3.0701)	—
Measure point "H"	37.1 (1.461)	—
Piston pin hole diameter	19.006 - 19.012 (0.7483 - 0.7485)	—
Piston to cylinder bore clearance	0.020 - 0.050 (0.0008 - 0.0020)	0.09 (0.0035)

## PISTON RING

Unit: mm (in)

Items		Standard	Limit
Piston ring side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil (rail ring)	0.045 - 0.125 (0.0018 - 0.0049)	—
Piston ring end gap	Top	0.20 - 0.30 (0.0079 - 0.0118)	0.50 (0.0197)
	2nd	0.35 - 0.50 (0.0138 - 0.0197)	0.66 (0.0260)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.92 (0.0362)

## PISTON PIN

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Unit: mm (in)

Piston pin outer diameter		18.996 - 19.002 (0.7479 - 0.7481)
Piston to piston pin oil clearance	Standard	0.008 - 0.012 (0.0003 - 0.0005)

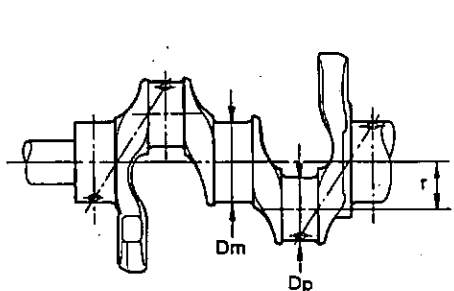
## CONNECTING ROD

Unit: mm (in)

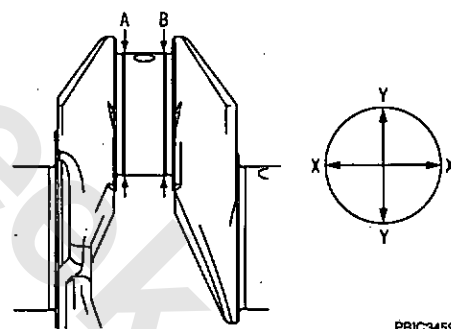
Center distance		129.84 - 129.94 (5.11 - 5.12)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end clearance	Standard	-0.018 - -0.044 (-0.0007 - -0.0017)
Connecting rod small end inner diameter	Standard	18.958 - 18.978 (0.7464 - 0.7472)
Connecting rod side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0139)
Connecting rod big end diameter	Grade No. A	43.000 - 43.001 (1.6929 - 1.6929)
	Grade No. B	43.001 - 43.002 (1.6929 - 1.6930)
	Grade No. C	43.002 - 43.003 (1.6930 - 1.6930)
	Grade No. D	43.003 - 43.004 (1.6930 - 1.6931)
	Grade No. E	43.004 - 43.005 (1.6931 - 1.6931)
	Grade No. F	43.005 - 43.006 (1.6931 - 1.6931)
	Grade No. G	43.006 - 43.007 (1.6931 - 1.6932)
	Grade No. H	43.007 - 43.008 (1.6932 - 1.6932)
	Grade No. J	43.008 - 43.009 (1.6932 - 1.6933)
	Grade No. K	43.009 - 43.010 (1.6933 - 1.6933)
	Grade No. L	43.010 - 43.011 (1.6933 - 1.6933)
	Grade No. M	43.011 - 43.012 (1.6933 - 1.6934)
	Grade No. N	43.012 - 43.013 (1.6934 - 1.6934)

## CRANKSHAFT

Unit: mm (in)



SEM845



PBIC3459J

Center distance "r"		41.68 - 41.76 (1.6409 - 1.6441)
Out-of-round	Limit	0.003 (0.0001)
Taper	Limit	0.004 (0.0002)
Runout [TIR*]	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.098 - 0.260 (0.0039 - 0.0102)
	Limit	* 0.35 (0.0138)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Crankshaft pin journal diameter grade. "Dp"	Grade No. A	39.971 - 39.970 (1.5737 - 1.5736)
	Grade No. B	39.970 - 39.969 (1.5736 - 1.5736)
	Grade No. C	39.969 - 39.968 (1.5736 - 1.5735)
	Grade No. D	39.968 - 39.967 (1.5735 - 1.5735)
	Grade No. E	39.967 - 39.966 (1.5735 - 1.5735)
	Grade No. F	39.966 - 39.965 (1.5735 - 1.5734)
	Grade No. G	39.965 - 39.964 (1.5734 - 1.5734)
	Grade No. H	39.964 - 39.963 (1.5734 - 1.5733)
	Grade No. J	39.963 - 39.962 (1.5733 - 1.5733)
	Grade No. K	39.962 - 39.961 (1.5733 - 1.5733)
	Grade No. L	39.961 - 39.960 (1.5733 - 1.5732)
	Grade No. M	39.960 - 39.959 (1.5732 - 1.5732)
	Grade No. N	39.959 - 39.958 (1.5732 - 1.5731)
	Grade No. P	39.958 - 39.957 (1.5731 - 1.5731)
	Grade No. R	39.957 - 39.956 (1.5731 - 1.5731)
	Grade No. S	39.956 - 39.955 (1.5731 - 1.5730)
	Grade No. T	39.955 - 39.954 (1.5730 - 1.5730)
	Grade No. U	39.954 - 39.953 (1.5730 - 1.5729)
Crankshaft main journal diameter grade. "Dm"	Grade No. A	47.979 - 47.978 (1.8889 - 1.8889)
	Grade No. B	47.978 - 47.977 (1.8889 - 1.8889)
	Grade No. C	47.977 - 47.976 (1.8889 - 1.8888)
	Grade No. D	47.976 - 47.975 (1.8888 - 1.8888)
	Grade No. E	47.975 - 47.974 (1.8888 - 1.8887)
	Grade No. F	47.974 - 47.973 (1.8887 - 1.8887)
	Grade No. G	47.973 - 47.972 (1.8887 - 1.8887)
	Grade No. H	47.972 - 47.971 (1.8887 - 1.8886)
	Grade No. J	47.971 - 47.970 (1.8886 - 1.8886)
	Grade No. K	47.970 - 47.969 (1.8886 - 1.8885)
	Grade No. L	47.969 - 47.968 (1.8885 - 1.8885)
	Grade No. M	47.968 - 47.967 (1.8885 - 1.8885)
	Grade No. N	47.967 - 47.966 (1.8885 - 1.8884)
	Grade No. P	47.966 - 47.965 (1.8884 - 1.8884)
	Grade No. R	47.965 - 47.964 (1.8884 - 1.8883)
	Grade No. S	47.964 - 47.963 (1.8883 - 1.8883)
	Grade No. T	47.963 - 47.962 (1.8883 - 1.8883)
	Grade No. U	47.962 - 47.961 (1.8883 - 1.8882)
	Grade No. V	47.961 - 47.960 (1.8882 - 1.8882)
	Grade No. W	47.960 - 47.959 (1.8882 - 1.8881)

\*: Total indicator reading

## Connecting Rod Bearing

INFOID:000000004899212

### CONNECTING ROD BEARING GRADE TABLE

Unit: mm (in)

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



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

## UNDERSIZE TABLE

Unit: mm (in)

Item	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.627 - 1.635 (0.0641 - 0.0644)	Grind so that bearing clearance is the specified value.

## CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

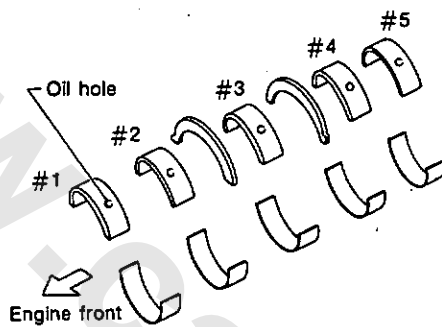
Connecting rod bearing oil clearance	Standard	0.029 - 0.039 (0.0011 - 0.0015)
	Limit	0.10 (0.0039)

## Main Bearing

INFOID:0000000004899213

## MAIN BEARING GRADE TABLE

Unit: mm (in)



SEM685D

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	
01	UPR	1.996 - 1.999 (0.0786 - 0.0787)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
	LWR	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
	LWR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
45	UPR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
	LWR	2.011 - 2.014 (0.0792 - 0.0793)	Pink	

## UNDERSIZE TABLE

Unit: mm (in)

Items	Thickness	Main journal diameter
- 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)

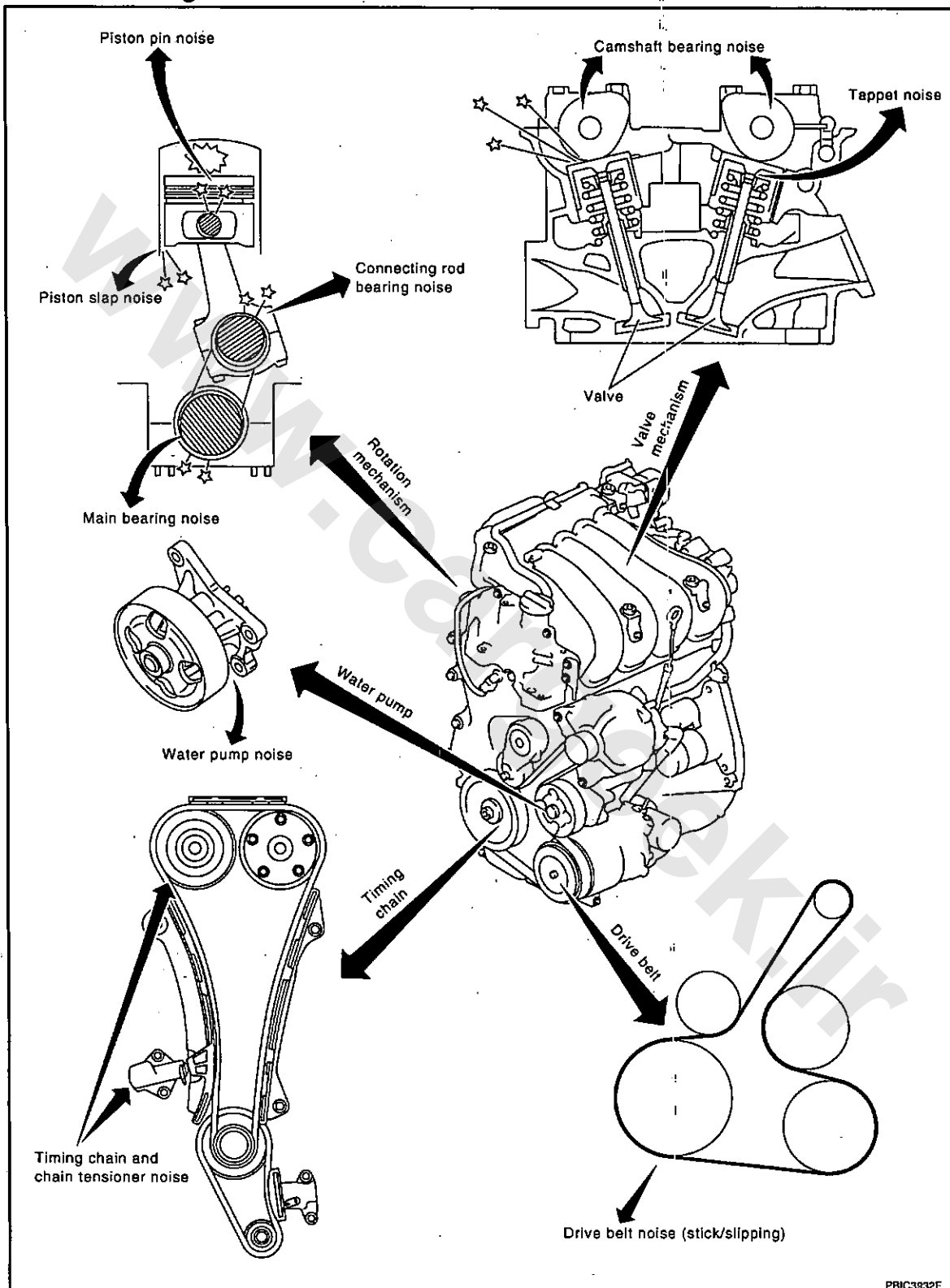
Main bearing oil clearance	Standard	0.024 - 0.034 (0.0009 - 0.0013)
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## SYMPTOM DIAGNOSIS

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

#### NVH troubleshooting Chart

INFOID:000000004899214



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	EM-141
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-239 EM-239
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	EM-243 EM-243
	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	EM-243 EM-243 EM-243 EM-243
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-243 EM-246
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-247 EM-243
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	EM-173 EM-164
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-136
	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	CO-39

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

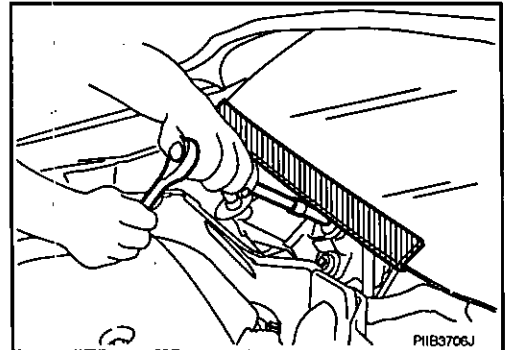
## PRECAUTION

### PRECAUTIONS

#### Precaution for Procedure without Cowl-Top Cover

INFOID:000000004899215

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



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

INFOID:000000005022454

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. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the "SRS AIR BAG" 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.
- 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 AIR BAG".
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

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

#### WARNING:

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, DO NOT use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

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

INFOID:000000004948836

#### 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.

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.

## PRECAUTIONS

[MR20DE]

### < PRECAUTION >

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.)

#### Draining Engine Coolant

INFOID:000000004899217

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

#### Disconnecting Fuel Piping

INFOID:000000004899218

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

#### Removal and Disassembly

INFOID:000000004899219

- 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, make sure 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:000000004899220

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

#### Assembly and Installation

INFOID:000000004899221

- 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:000000004899222

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
  - Camshaft sprocket (INT) bolt

## PRECAUTIONS

[MR20DE]

### < PRECAUTION >

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

## Liquid Gasket

INFOID:0000000004899223

### 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.

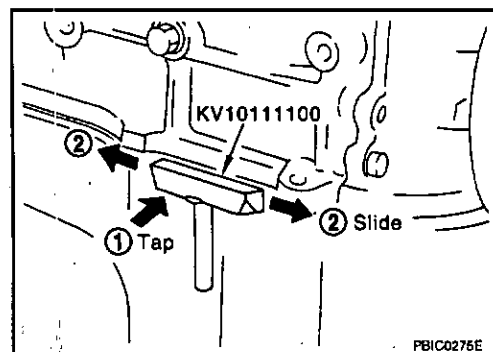
#### CAUTION:

**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.

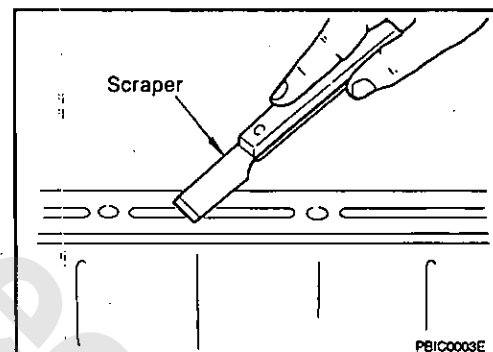
#### CAUTION:

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

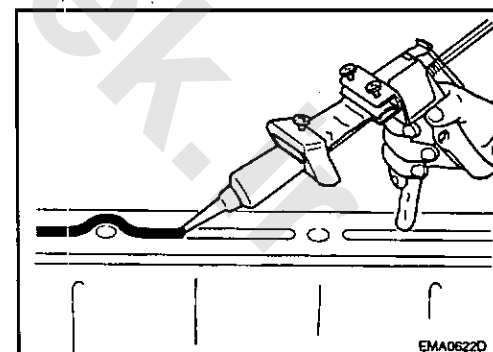


### LIQUID GASKET APPLICATION PROCEDURE

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.



## PRECAUTIONS

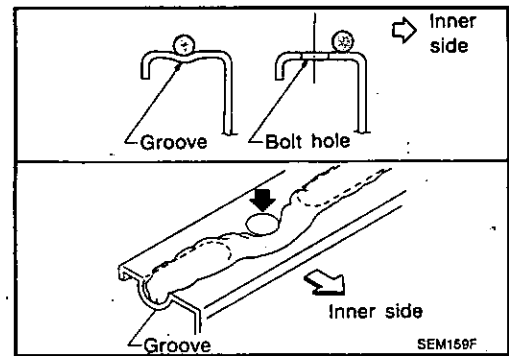
[MR20DE]

### < PRECAUTION >

- As for bolt holes, normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of liquid gasket application, install the mating component.
- If 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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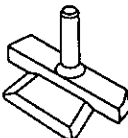
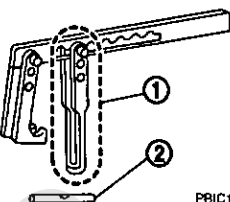
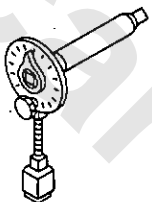
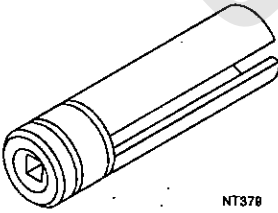
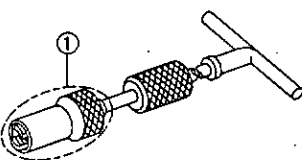
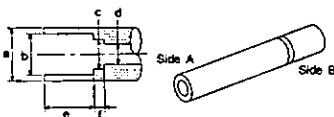
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## PREPARATION

## PREPARATION

### Special Service Tools

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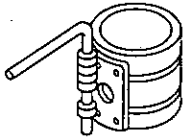

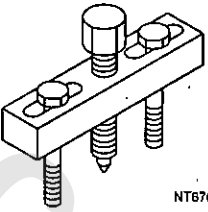


Tool number Tool name		Description
KV1011100 Seal cutter	 S-NT046	Removing oil pan (upper and lower) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	 PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench	 S-NT014	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 Heated oxygen sensor wrench	 NT378	Loosening or tightening heated oxygen sensor 1 For 22 mm (0.87 in) width hexagon nut
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	 S-NT605	Removing valve oil seal
KV10115600 Valve oil seal drift	 S-NT603	Installing valve oil seal Use side A. 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)



# PREPARATION

< PREPARATION >

[MR20DE]

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

Commercial Service Tools

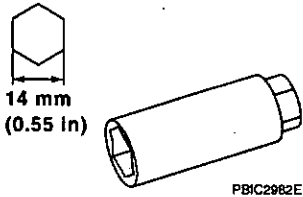




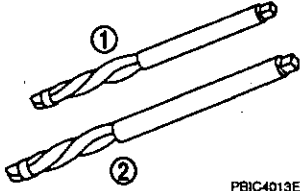
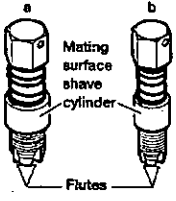
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# PREPARATION

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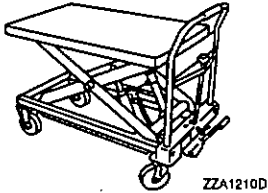
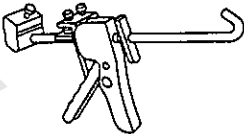
[MR20DE]

Tool name	Description
<p>Spark plug wrench</p>  <p>14 mm (0.55 in)</p> <p>PBIC2982E</p>	<p>Removing and installing spark plug</p>
<p>Pulley holder</p>  <p>ZZA1010D</p>	<p>Crankshaft pulley removing and installing</p>
<p>Valve seat cutter set</p>  <p>S-NT048</p>	<p>Finishing valve seat dimensions</p>
<p>Piston ring expander</p>  <p>S-NT030</p>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p>  <p>PBIC4012E</p>	<p>Removing and installing valve guide</p>
<p>Valve guide reamer</p>  <p>PBIC4013E</p>	<p>1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide</p>
<p>Oxygen sensor thread cleaner</p>  <p>Flutes</p> <p>Mating surface shave cylinder</p> <p>ADM488</p>	<p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor b = 12 mm (0.47 in) dia. for titania heated oxygen sensor</p>

# PREPARATION

< PREPARATION >

[MR20DE]

Tool name	Description
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Manual lift table caddy  ZZA1210D	Removing and installing engine
Tube presser  S-NT052	Pressing the tube of liquid gasket

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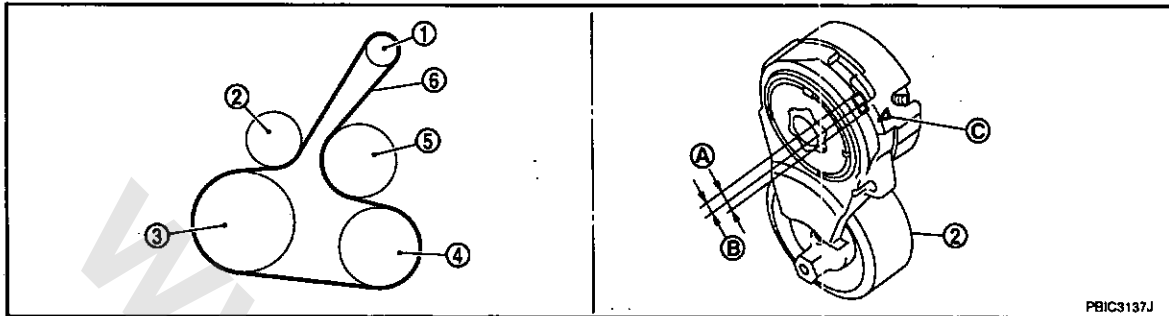
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## ON-VEHICLE MAINTENANCE

### DRIVE BELTS

#### Exploded View

INFOID:000000004899226



- |  |   |                      |
|--|---|----------------------|
| 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:000000004899227

##### WARNING:

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

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

##### 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:000000004899228

Refer to : **EM-238. "Drive Belt".**

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

#### Removal and Installation

INFOID:000000004899229

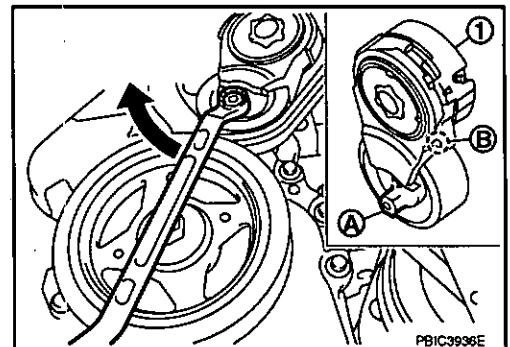
##### REMOVAL

- 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.**

- 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.
- Remove drive belt.



##### INSTALLATION

## DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

[MR20DE]

1. Install drive belt.

**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-136, "Exploded View".

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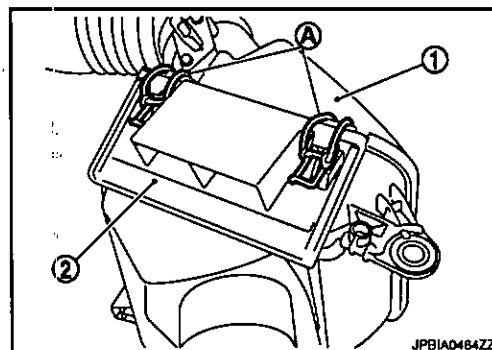
## AIR CLEANER FILTER

### Removal and Installation

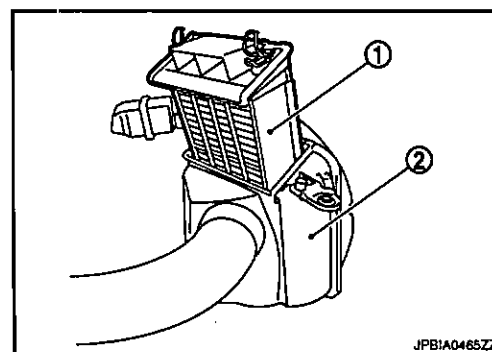
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#### REMOVAL

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.

# SPARK PLUG

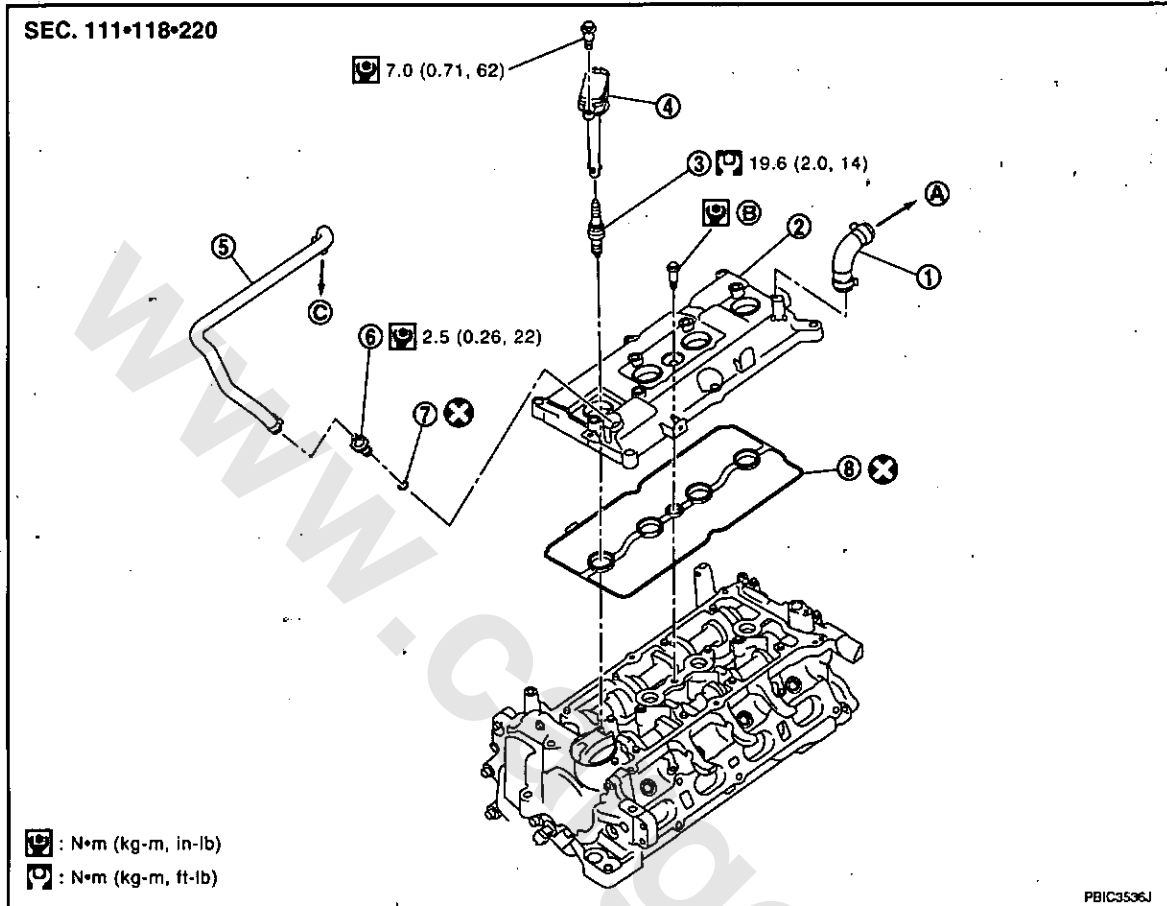
< ON-VEHICLE MAINTENANCE >

[MR20DE]

## SPARK PLUG

### Exploded View

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- |                  |                    |                       |
|------------------|--------------------|-----------------------|
| 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 EM-162 | C. To intake manifold |

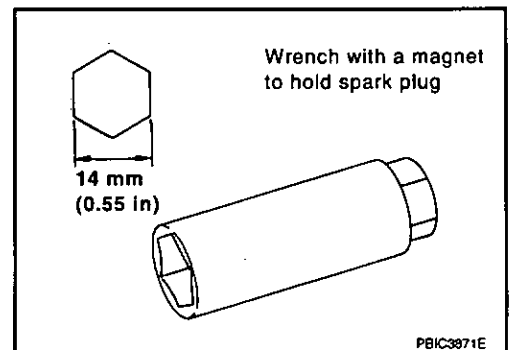
Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899232

### REMOVAL

1. Remove ignition coil.
2. Remove spark plug with a spark plug wrench (commercial service tool).



### INSTALLATION

# SPARK PLUG

< ON-VEHICLE MAINTENANCE >

[MR20DE]

Installation is the reverse order of removal.

## Inspection

INFOID:0000000004899233

### INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

Spark plug (standard) : Refer to EM-238, "Spark Plug".

#### CAUTION:

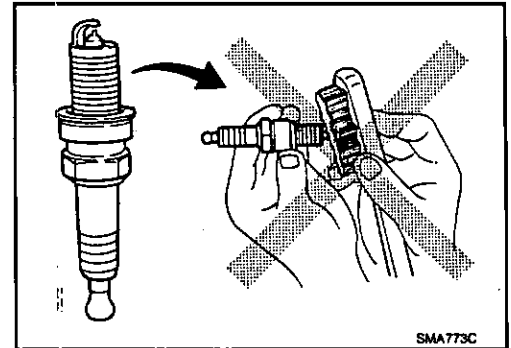
- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure:

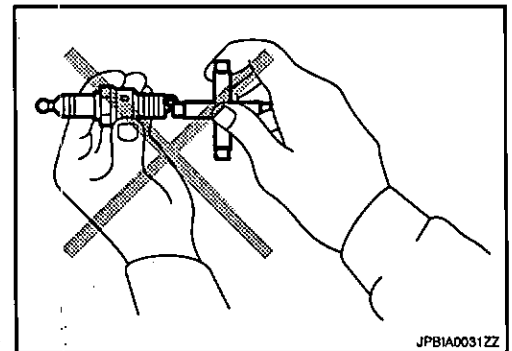
Less than 588 kPa (6 kg/cm<sup>2</sup>, 85 psi)

Cleaning time:

Less than 20 seconds



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





## CAMSHAFT VALVE CLEARANCE

## Inspection and Adjustment

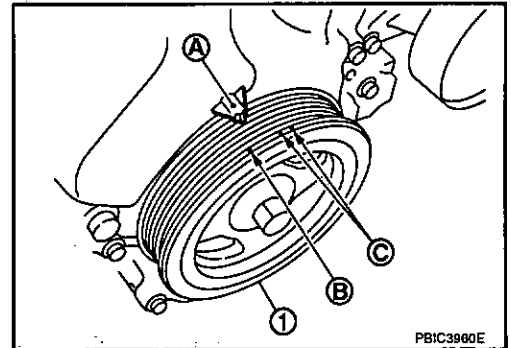
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## INSPECTION

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

1. Remove rocker cover. Refer to EM-162, "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.

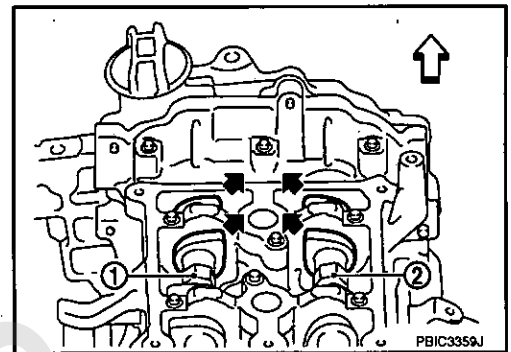
C : White paint mark (Not use for service)



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

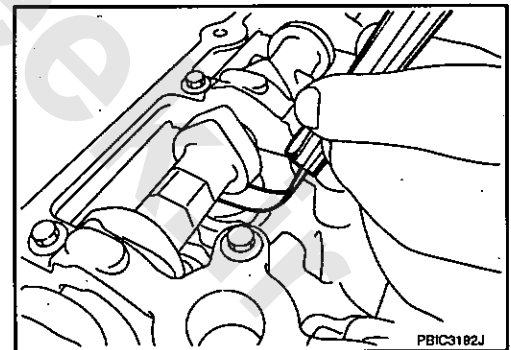
- 1 : Camshaft (INT)  
 2 : Camshaft (EXH)  
 ← : Engine front

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



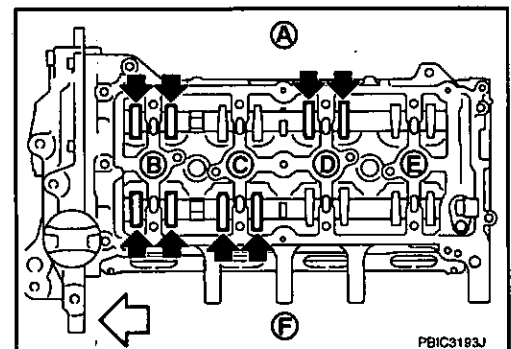
- b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

Valve clearance : Refer to EM-239, "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

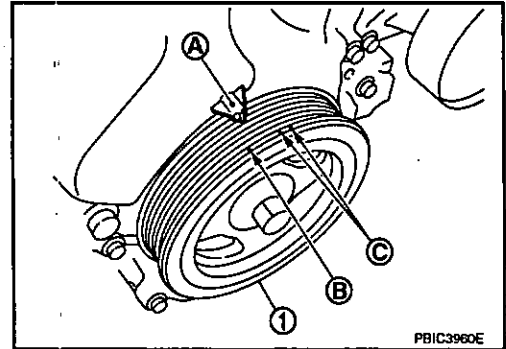
⇐ : Engine front

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

c. Set No.4 cylinder at TDC of its compression stroke.

- Rotate crankshaft pulley (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)



- 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

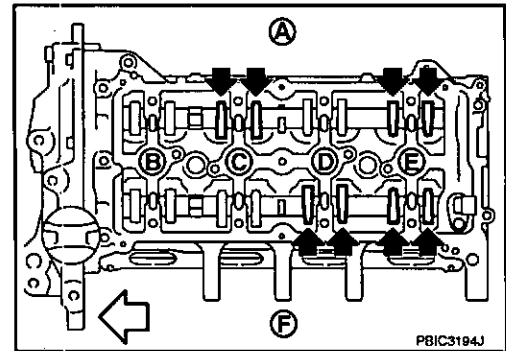
C : No.2 cylinder

D : No.3 cylinder

E : No.4 cylinder

F : Intake side

⇨ : Engine front



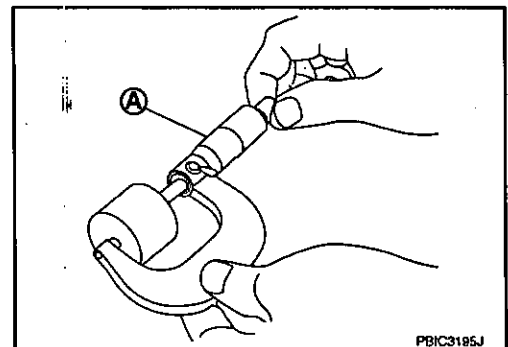
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	EXH		x		x
	INT			x	x

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

## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.

1. Remove camshaft. Refer to EM-175, "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

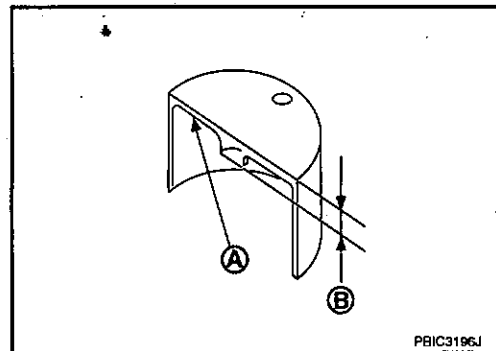
C<sub>1</sub> = Measured valve clearance

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 (0.118 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-239, "Camshaft".

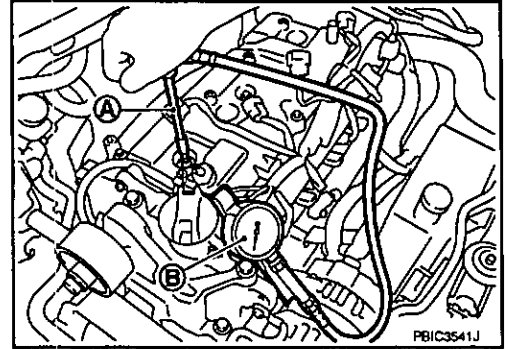
5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-175, "Exploded View".
7. Install timing chain and related parts. Refer to EM-164, "Exploded View".
8. Manually rotate crankshaft pulley a few rotations.
9. Make sure that the valve clearances is within the standard. Refer to "INSPECTION".
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

## COMPRESSION PRESSURE

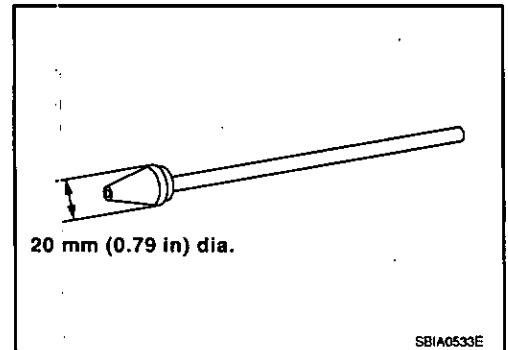
### Inspection

INFOID:000000004699235

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-287, "Inspection".
3. Remove ignition coil and spark plug from each cylinder. Refer to EM-162, "Exploded View".
4. Connect engine tachometer.
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-238, "General Specification".

#### CAUTION:

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

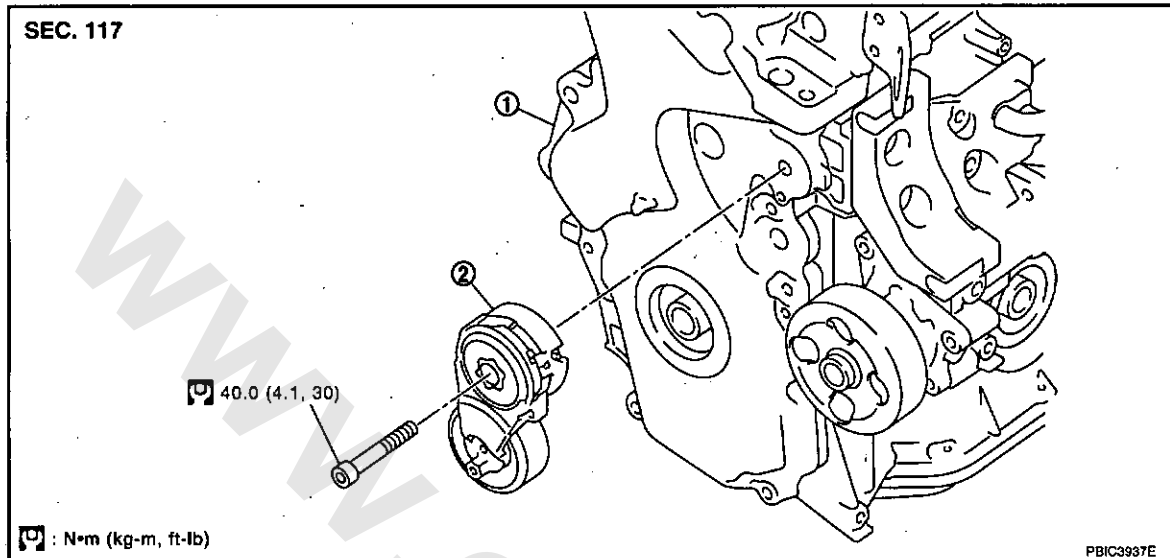
- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the engine speed again with normal battery gravity.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston 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 recheck it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
  - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
7. After inspection is completed, install removed parts.
  8. Start the engine, and make sure that the engine runs smoothly.
  9. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-73, "Diagnosis Description".

## ON-VEHICLE REPAIR

### DRIVE BELT AUTO-TENSIONER

#### Exploded View

INFOID:0000000004899236



1. Front cover

2. Drive belt auto-tensioner

#### Removal and Installation

INFOID:0000000004899237

##### Removal

1. Remove drive belt. Refer to [EM-136, "Removal and Installation"](#).
  - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.
2. Remove front fender protector (RH). Refer to [EXT-22, "Exploded View"](#).
3. 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-196, "M/T : Exploded View"](#) (M/T models) or [EM-201, "CVT : Exploded View"](#) (CVT models).
4. 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.

##### 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

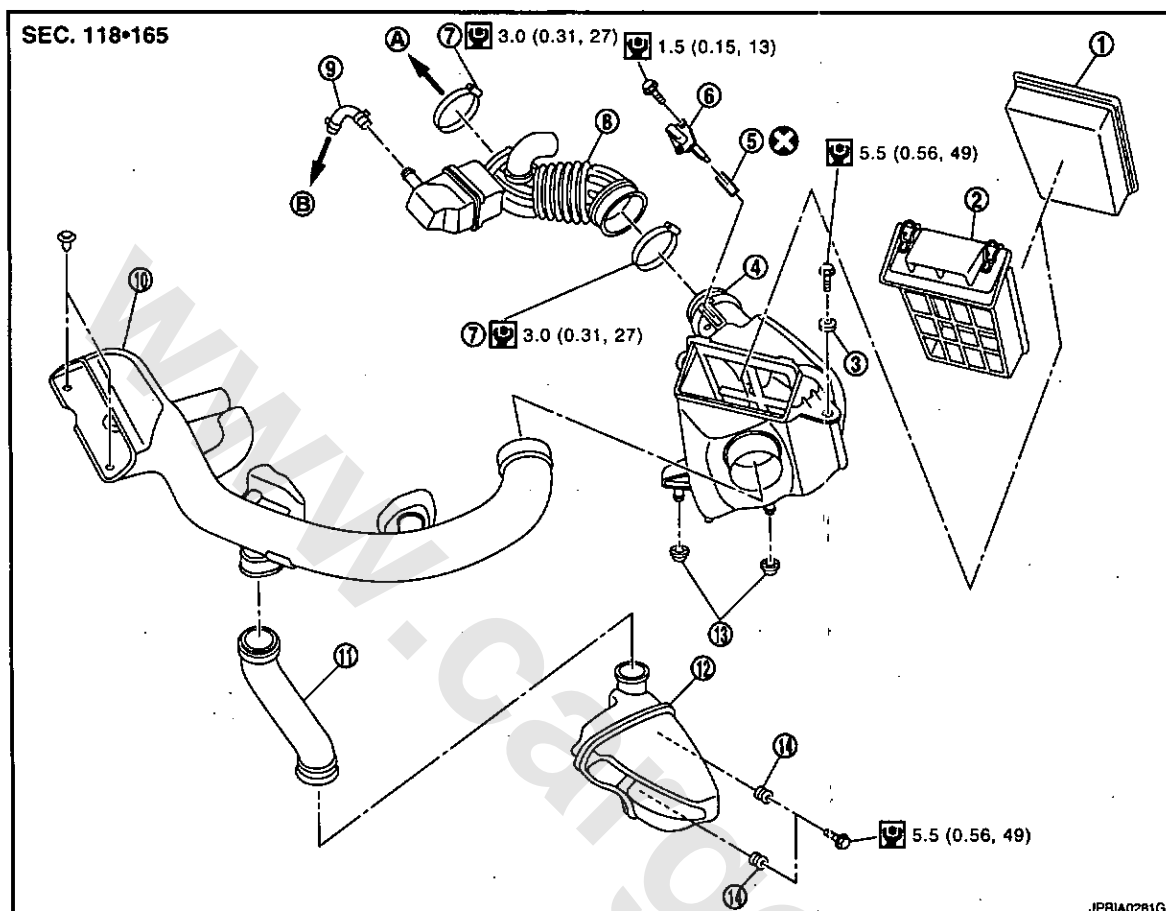
< ON-VEHICLE REPAIR >

[MR20DE]

## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:000000004899238



JPBIA0281GB

- |  |                                    |                         |
|--|------------------------------------|-------------------------|
| 1. Air cleaner filter                    | 2. Holder                          | 3. Grommet              |
| 4. Air cleaner case                      | 5. O-ring                          | 6. Mass air flow sensor |
| 7. Clamp                                 | 8. Air duct and resonator assembly | 9. PCV hose             |
| 10. Air duct (inlet)                     | 11. Air duct                       | 12. Resonator           |
| 13. Grommet                              | 14. Grommet                        |                         |
| A. To electric throttle control actuator | B. To rocker cover                 |                         |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899239

### REMOVAL

1. Remove air duct (inlet).
2. Remove engine cover. Refer to EM-148, "Exploded View".
3. Disconnect mass air flow sensor harness connector.
4. Disconnect PCV hose.
5. Remove the battery stay, and then move the battery.
6. Remove air cleaner case/mass air flow sensor assembly 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:

- Never shock mass air flow sensor.

# AIR CLEANER AND AIR DUCT

< ON-VEHICLE REPAIR >

[MR20DE]

- Never disassemble 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

## INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

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

A

EM

INFOID:0000000004899240

C

D

E

F

G

H

I

J

K

L

M

N

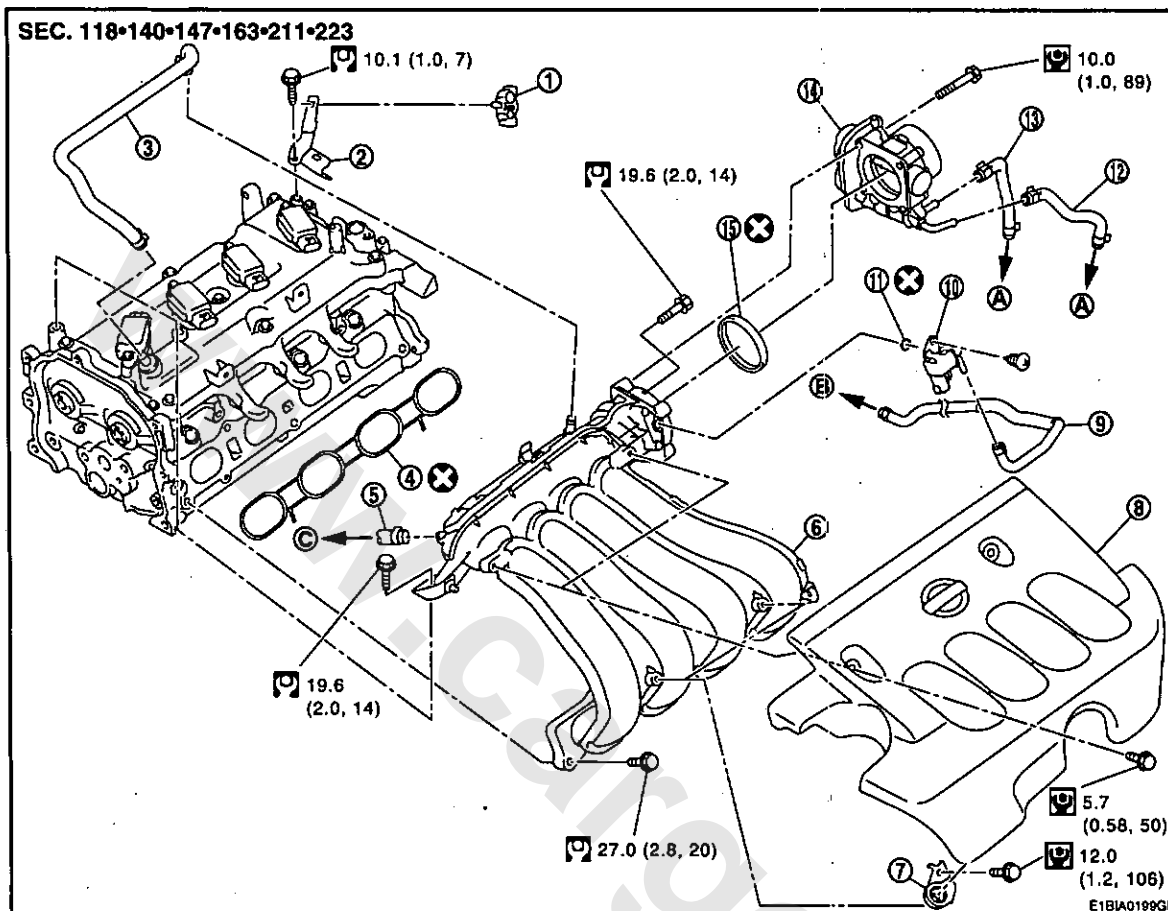
O

P

## INTAKE MANIFOLD

### Exploded View

INFOID:000000004899241



- |   |  |                     |
|---|--|---------------------|
| 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 |
| N.m (Kg-m, in-lb)                                     | N.m (Kg-m, ft-lb)                      |                     |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899242

### 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.
4. Remove air duct and resonator assembly. Refer to EM-146, "Exploded View".
5. Disconnect vacuum hose from intake manifold. Refer to EM-148, "Exploded View".
6. Disconnect water hoses from electric throttle control actuator, attach blind plug to prevent engine coolant leakage.



# INTAKE MANIFOLD

< ON-VEHICLE REPAIR >

[MR20DE]

## CAUTION:

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

7. Remove electric throttle control actuator.

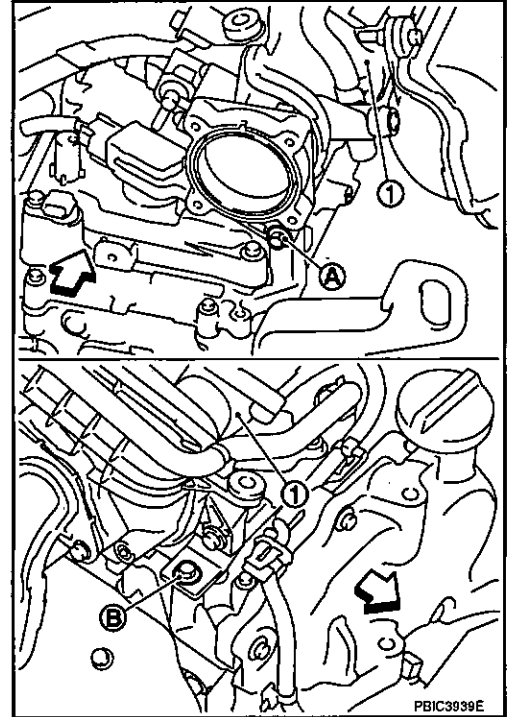
## CAUTION:

- 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:

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

⇐ : Engine front

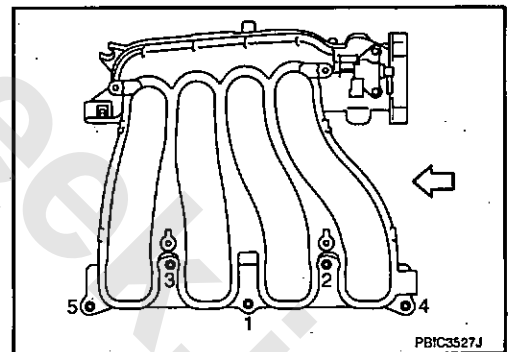


- b. Loosen mounting bolts in reverse order as shown in the figure.

⇐ : 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:

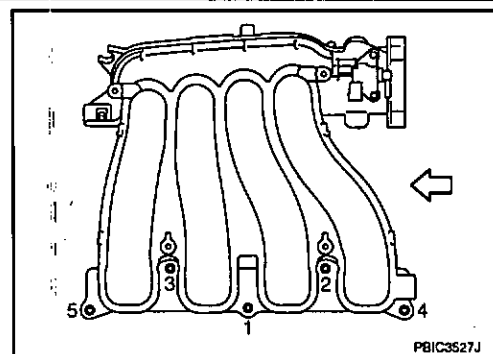
## INTAKE MANIFOLD

### < ON-VEHICLE REPAIR >

[MR20DE]

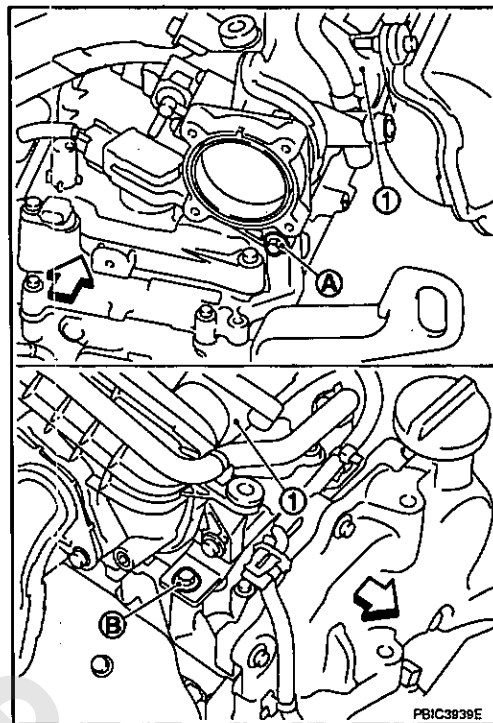
- a. Tighten in numerical order as shown in the figure.

⇐ : Engine front



- b. Tighten intake manifold (1) mounting bolt (A). Then tighten intake manifold mounting bolt (B).

⇐ : 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 EC-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 EC-14, "THROTTLE VALVE CLOSED POSITION LEARNING : Description" and EC-15, "IDLE AIR VOLUME LEARNING : Description".

# EXHAUST MANIFOLD

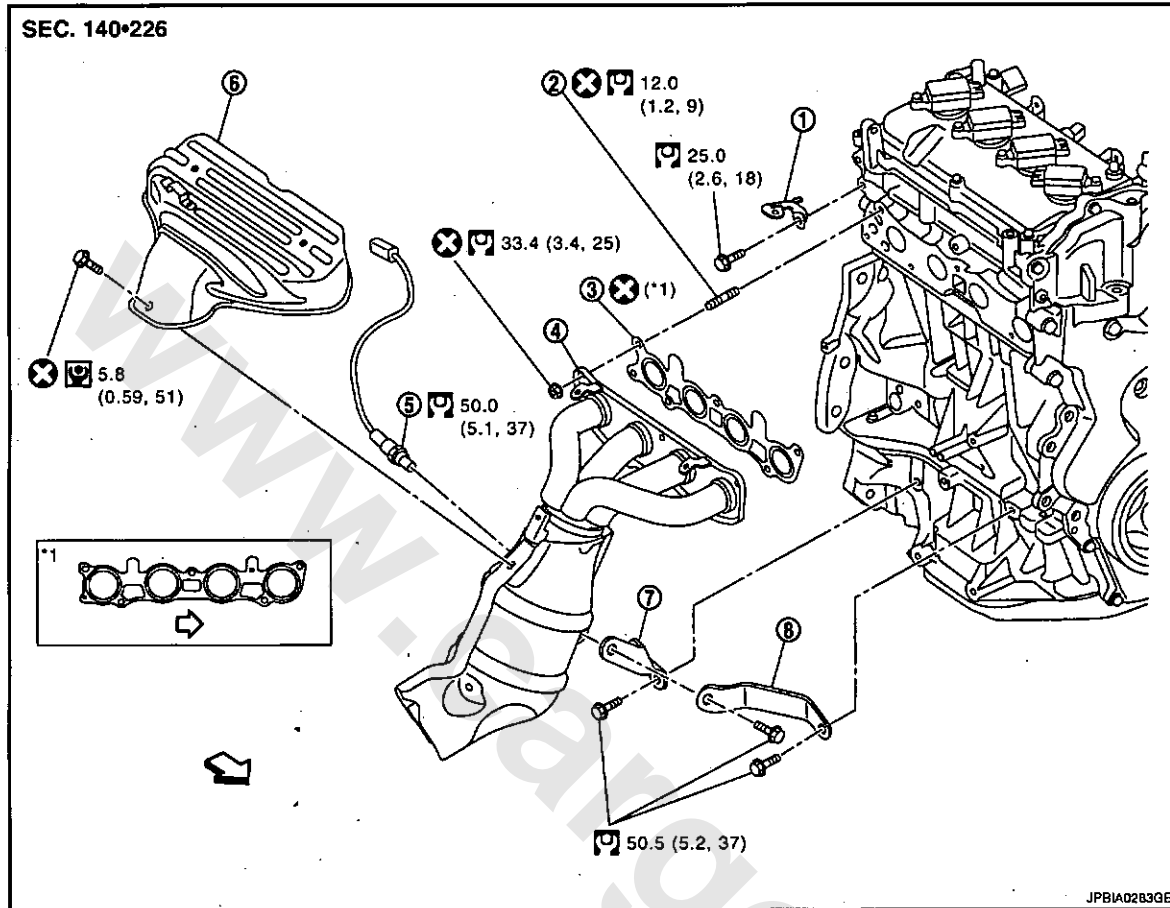
< ON-VEHICLE REPAIR >

[MR20DE]

## EXHAUST MANIFOLD

### Exploded View

INFOID:0000000004699243



- |                                       |                                       |                           |
|---------------------------------------|---------------------------------------|---------------------------|
| 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-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:0000000004699244

### REMOVAL

1. Remove exhaust front tube. Refer to EX-10, "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-26, "MR20DE MODELS: Exploded View".
5. Remove exhaust manifold stay.
6. Remove exhaust manifold.

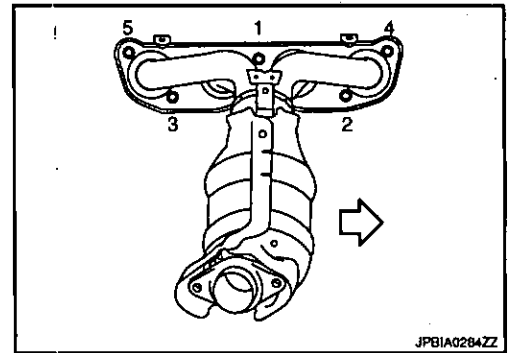
# EXHAUST MANIFOLD

## < ON-VEHICLE REPAIR >

[MR20DE]

- Loosen nuts in reverse order as shown in the figure

⇐ : Engine front



- Remove gasket.

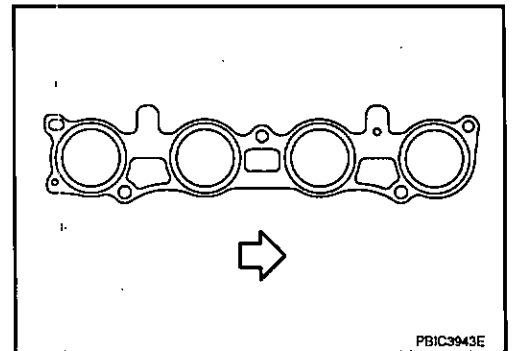
### CAUTION:

Cover engine openings to avoid entry of foreign materials.

## INSTALLATION

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

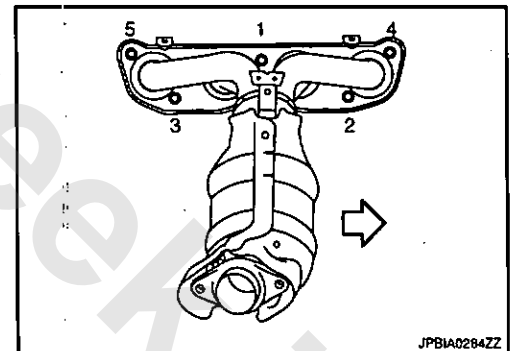
⇐ : Engine front



- 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.

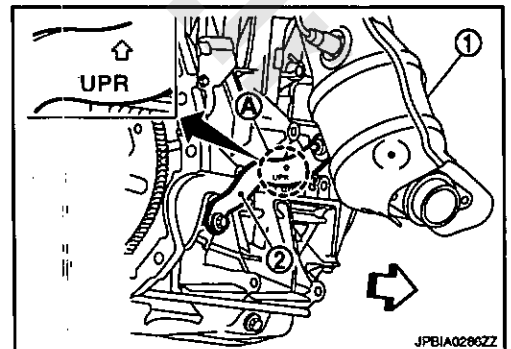
1 : Exhaust manifold

A : Upper mark

⇐ : Engine front

### NOTE:

This figure shows 2WD models as an example.



- Install remaining parts in the reverse order of removal.

## Inspection

## INSPECTION AFTER REMOVAL

INFOID:000000004899245

# EXHAUST MANIFOLD

< ON-VEHICLE REPAIR >

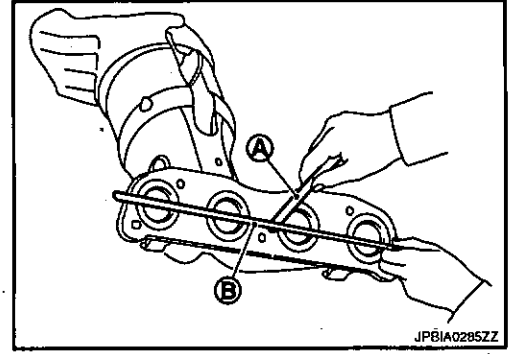
[MR20DE]

## 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-238, "Exhaust Manifold".

- If it exceeds the limit, replace exhaust manifold.



A

EM

C

D

E

F

G

H

I

J

K

L

M

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O

P

# OIL PAN (LOWER)

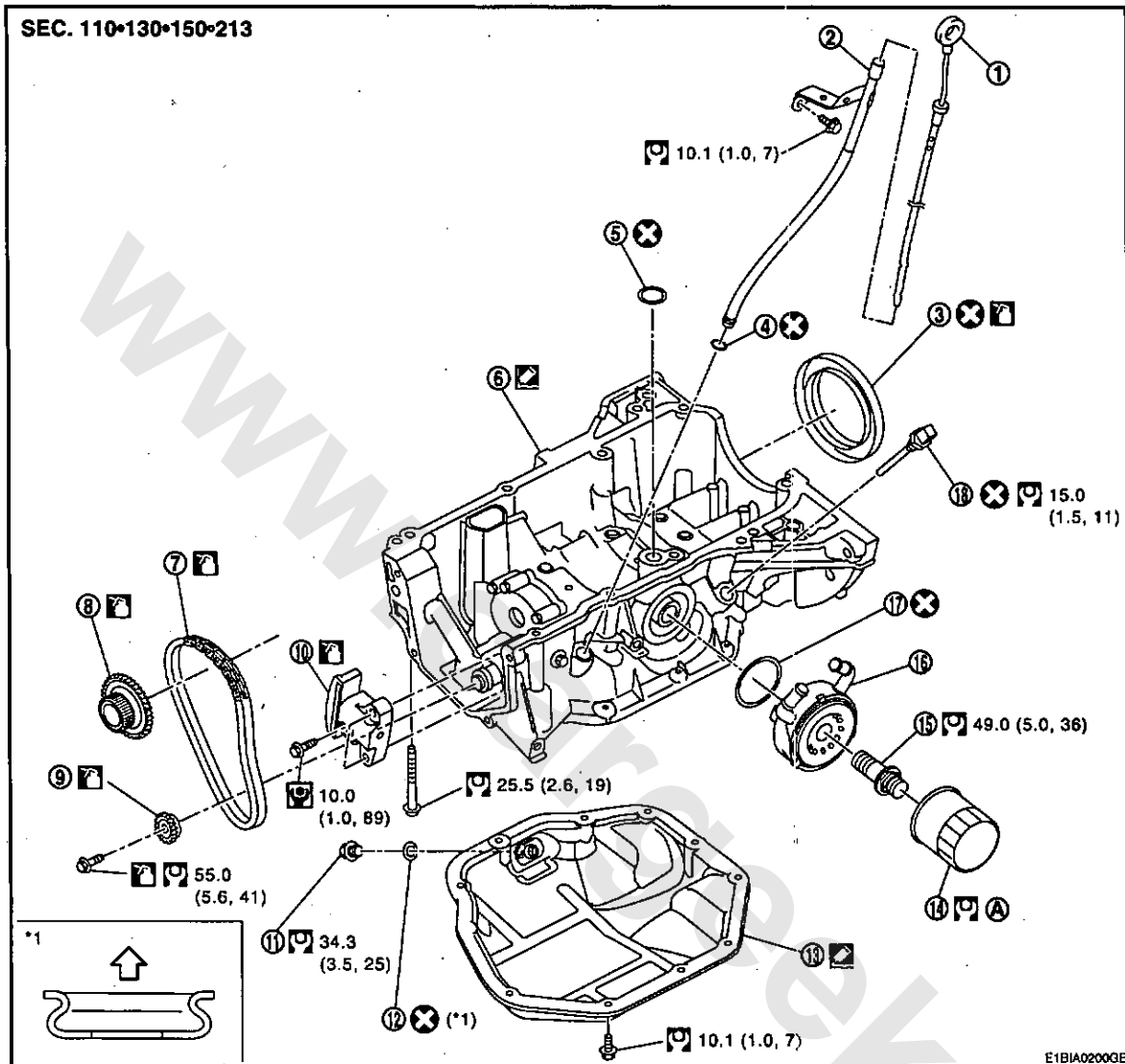
< ON-VEHICLE REPAIR >

[MR20DE]

## OIL PAN (LOWER)

Exploded View

INFOID:000000004899245



- |  |                          |                           |
|--|--------------------------|---------------------------|
| 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-17                        | N.m (Kg-m, in-lb)        | N.m (Kg-m, ft-lb)         |

← : Oil pan side

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899247

### REMOVAL

1. Remove engine undercover.
2. Drain engine oil. Refer to LU-15, "Draining".
3. Remove oil pan (lower) with the following procedure:

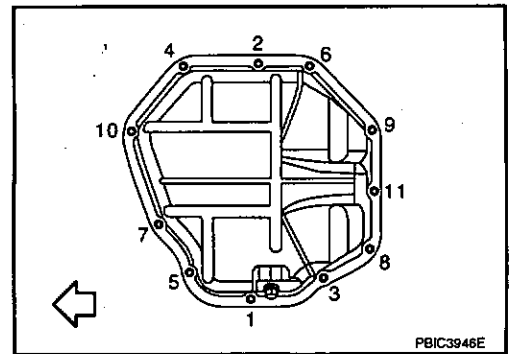
## OIL PAN (LOWER)

### < ON-VEHICLE REPAIR >

[MR20DE]

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

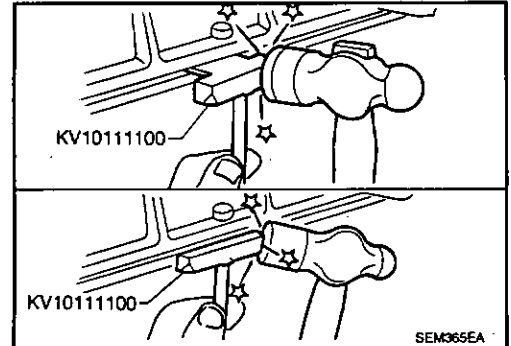
← : Engine front



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

**CAUTION:**

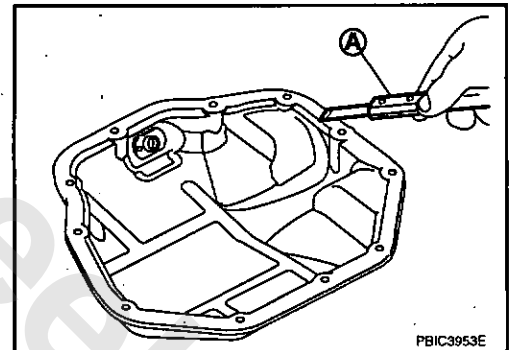
**Be careful not to damage the mating surface.**



### 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.



## OIL PAN (LOWER)

### < ON-VEHICLE REPAIR >

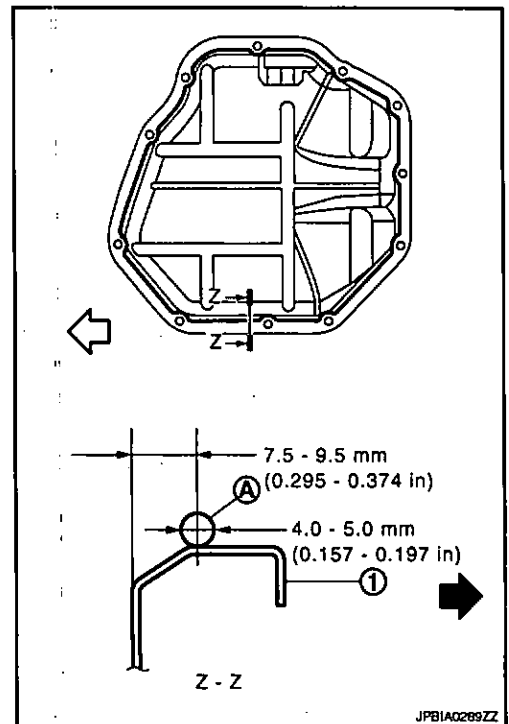
[MR20DE]

- 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)

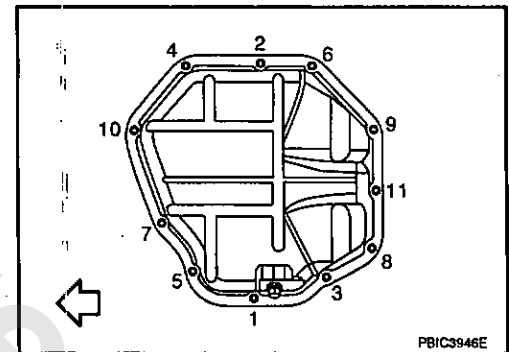
← : Engine outside

Use Genuine Liquid Gasket or equivalent.



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

↺ : Engine front



## Inspection

INFOID:000000004899248

### 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-14, "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-14, "Inspection".



# FUEL INJECTOR AND FUEL TUBE

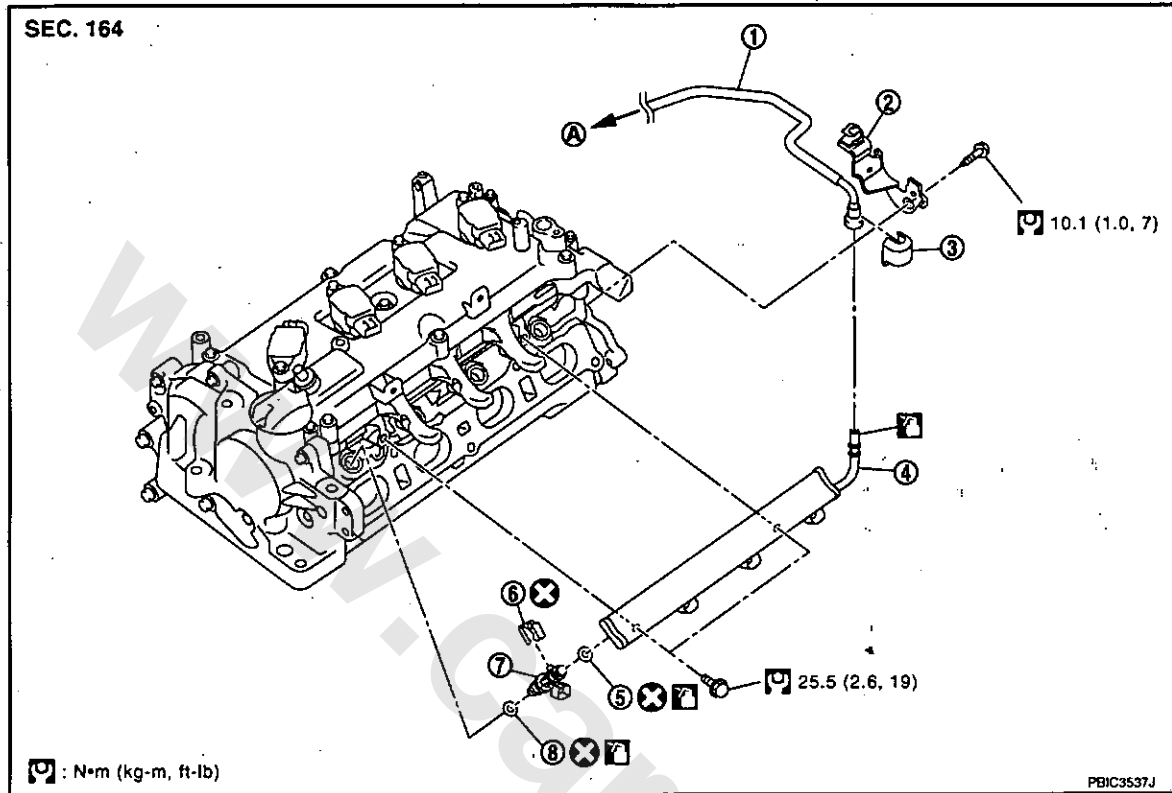
< ON-VEHICLE REPAIR >

[MR20DE]

## FUEL INJECTOR AND FUEL TUBE

### Exploded View

INFOID:0000000004899249



- |                                      |                   |                        |
|--------------------------------------|-------------------|------------------------|
| 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-3, "Components" for symbols in the figure.

### CAUTION:

Never remove or disassemble parts unless instructed in the figure.

### Removal and Installation

INFOID:0000000004899250

### 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 EC-287, "Inspection".
2. Remove intake manifold. Refer to EM-148, "Exploded View".

# FUEL INJECTOR AND FUEL TUBE

## < ON-VEHICLE REPAIR >

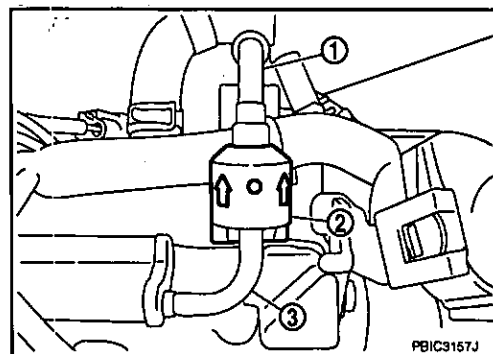
[MR20DE]

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.

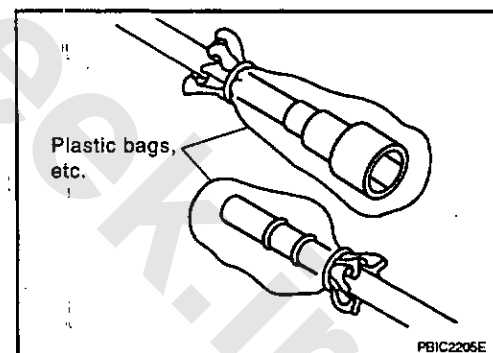
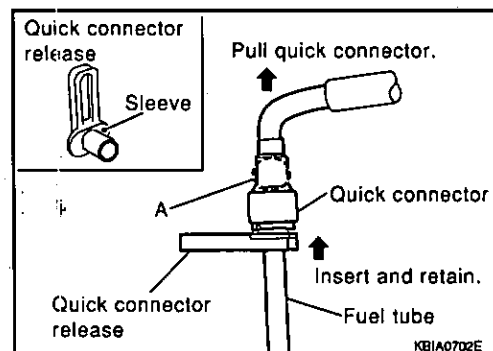
**CAUTION:**

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.

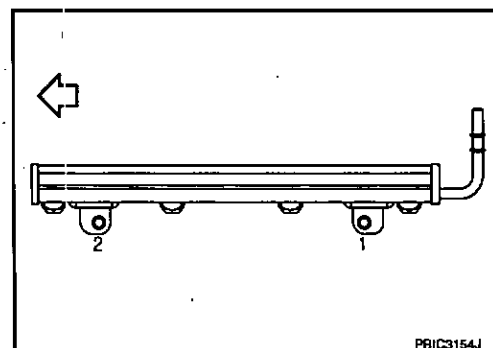


4. Disconnect harness connector from fuel injector.
5. Remove fuel tube and fuel injector assembly.
  - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : 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

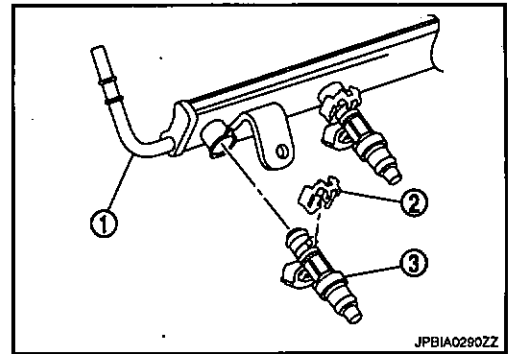
[MR20DE]

## < ON-VEHICLE REPAIR >

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.
- Make sure that O-ring and its mating part are free of foreign material.
- When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it quickly into fuel tube.
- Insert O-ring straight into fuel tube. Never decenter or twist it.

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

3 : O-ring (black)

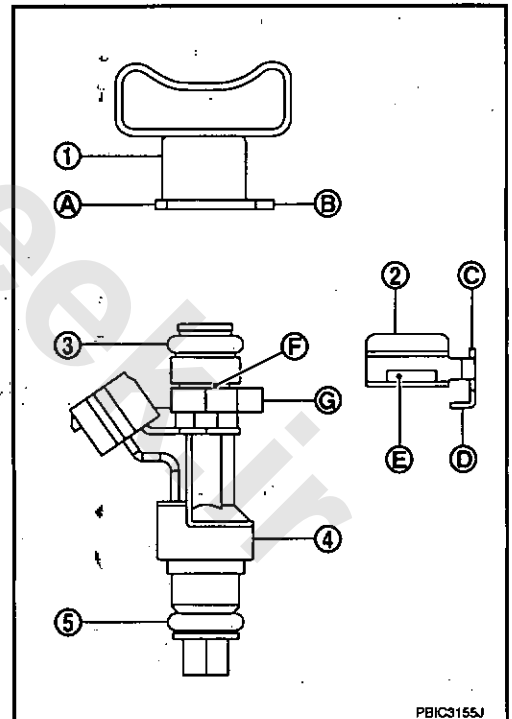
5 : O-ring (green)

- 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.
  - Make sure that fuel tube flange (A) is securely fixed in flange fixing groove (E) on clip.
- c. Make sure 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.

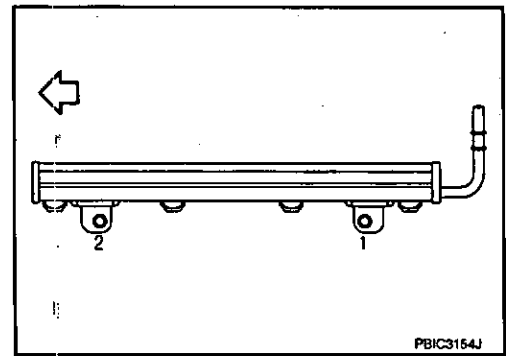
# FUEL INJECTOR AND FUEL TUBE

## < ON-VEHICLE REPAIR >

[MR20DE]

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

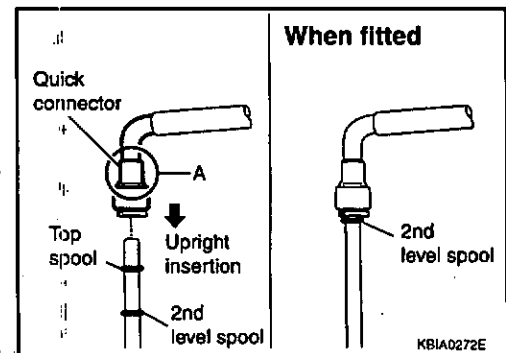
↔ : Engine front



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.



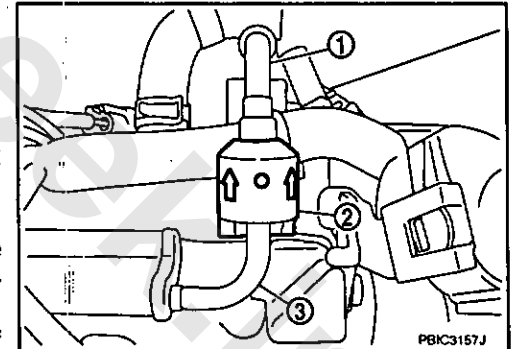
- d. Before clamping fuel feed hose with hose clamp, pull quick connector hard by hand holding "A" position. Make sure it is completely engaged (connected) so that it does not come out from fuel tube.
- e. Install quick connector cap (2) to quick connector connection.

1. Fuel feed hose
3. Fuel tube

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

### CAUTION:

- Make sure 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:0000000004899251

## INSPECTION AFTER INSTALLATION

### Check on Fuel Leakage

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

### NOTE:

Use mirrors for checking at points out of clear sight.

## FUEL INJECTOR AND FUEL TUBE

< ON-VEHICLE REPAIR >

[MR20DE]

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

**CAUTION:**

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

A

EM

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P

# IGNITION COIL , SPARK PLUG AND ROCKER COVER

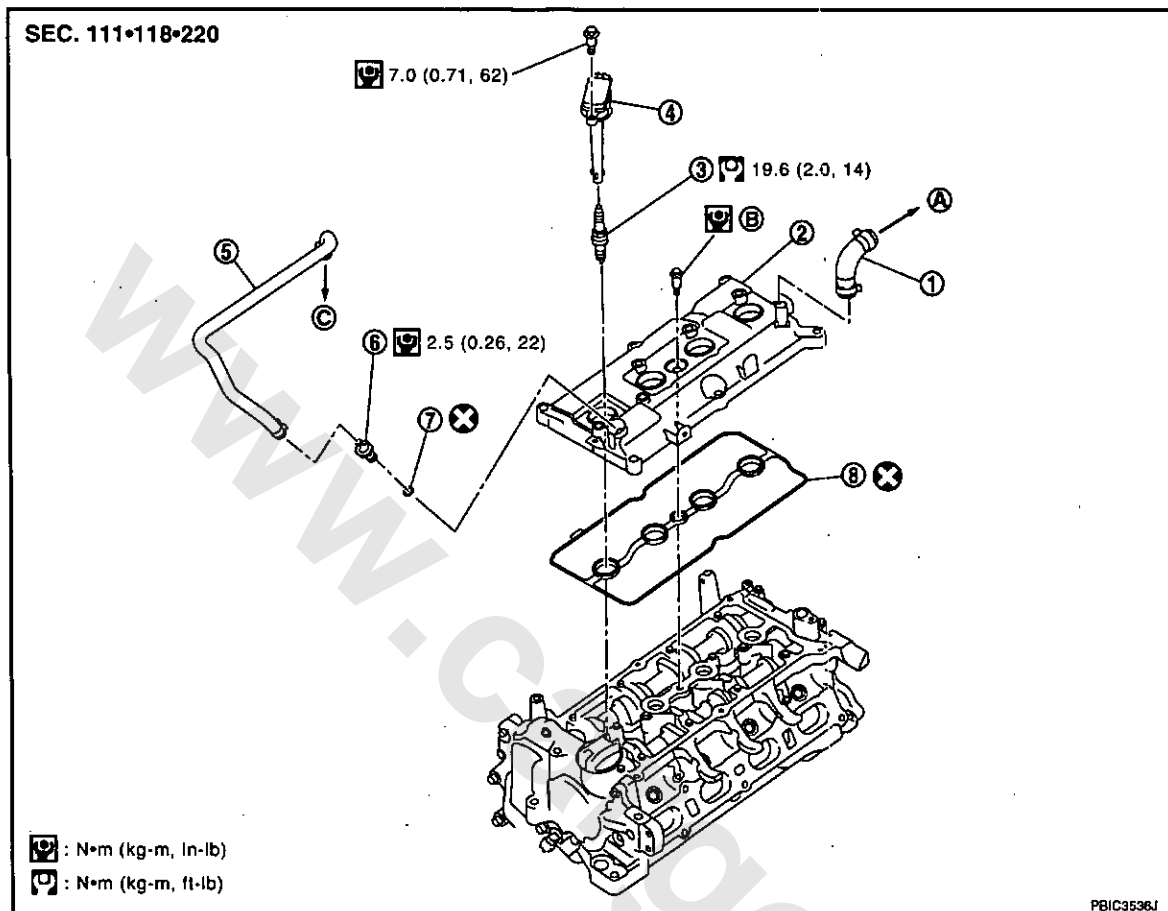
< ON-VEHICLE REPAIR >

[MR20DE]

## IGNITION COIL , SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:0000000004899252



- |                  |                                    |                       |
|------------------|------------------------------------|-----------------------|
| 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-162</a> | C. To intake manifold |

Refer to [GI-3, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:0000000004899253

### REMOVAL

1. Remove intake manifold. Refer to [EM-148, "Removal and Installation"](#).
2. Remove ignition coil.  
**CAUTION:**
  - Handle ignition coil carefully and avoid impacts.
  - Never disassemble ignition coil.
3. Remove rocker cover.

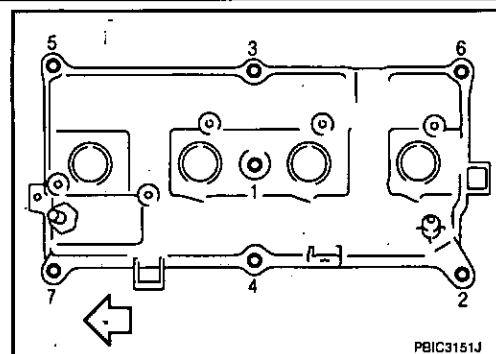
# IGNITION COIL , SPRAK PLUG AND ROCKER COVER

< 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:**  
Make sure 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

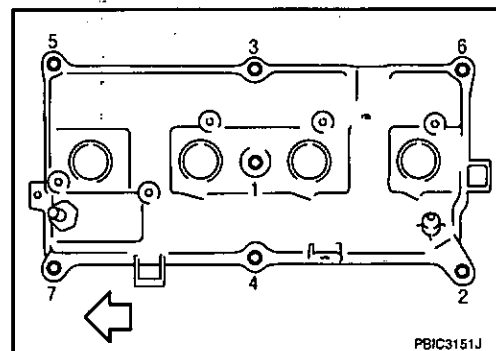
🔧 1st step

: 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

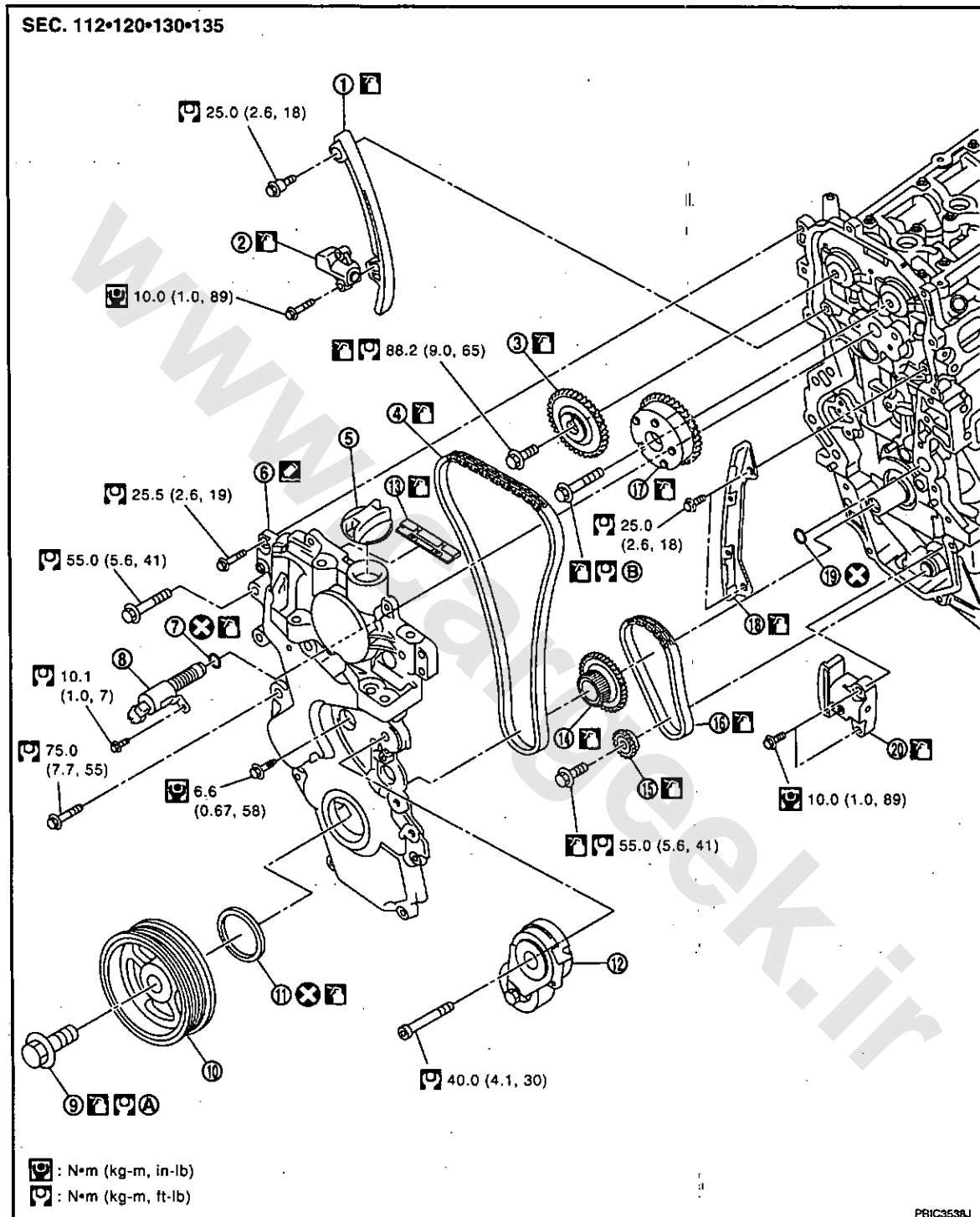
< ON-VEHICLE REPAIR >

[MR20DE]

## TIMING CHAIN

### Exploded View

INFOID:0000000004899254





# 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 <u>EM-165</u>      | B. Refer to <u>EM-175</u>                |                                |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:0000000004899255

### REMOVAL

#### CAUTION:

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

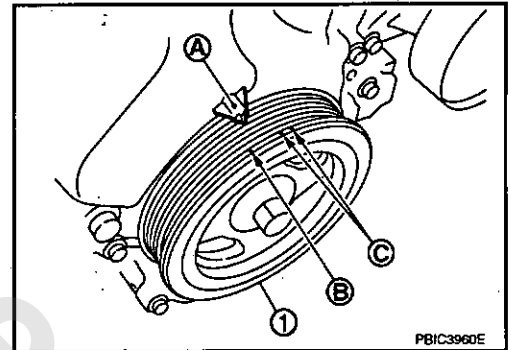
1. Remove front wheel (RH). Refer to WT-3, "Road Wheel".
2. Remove front fender protector (RH). Refer to EXT-22, "Exploded View".
3. Drain engine oil. Refer to LU-15, "Draining".

#### CAUTION:

Perform this step when engine is cold.

4. Remove the following parts.
  - Intake manifold: Refer to EM-148, "Exploded View".
  - Rocker cover: Refer to EM-162, "Exploded View".
  - Drive belt: Refer to EM-136, "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.

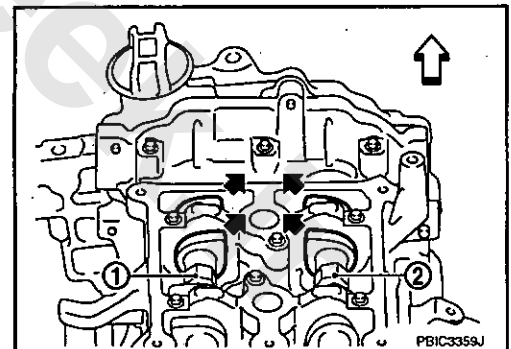
C : White paint mark (Not use for service)



- b. At the same time, make sure 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:

## TIMING CHAIN

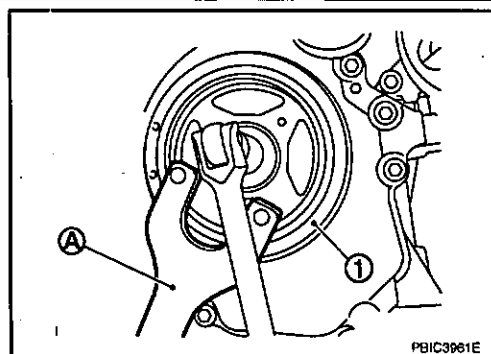
### < ON-VEHICLE REPAIR >

[MR20DE]

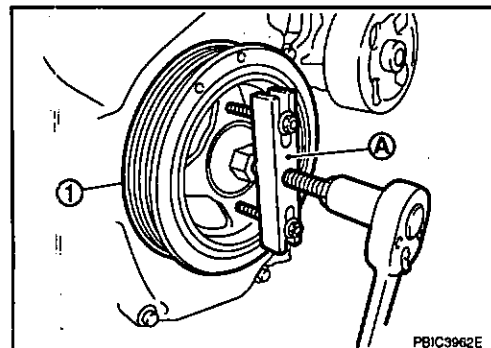
- a. Fix crankshaft pulley (1) with a pulley holder (A) (commercial service tool), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.

**CAUTION:**

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



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



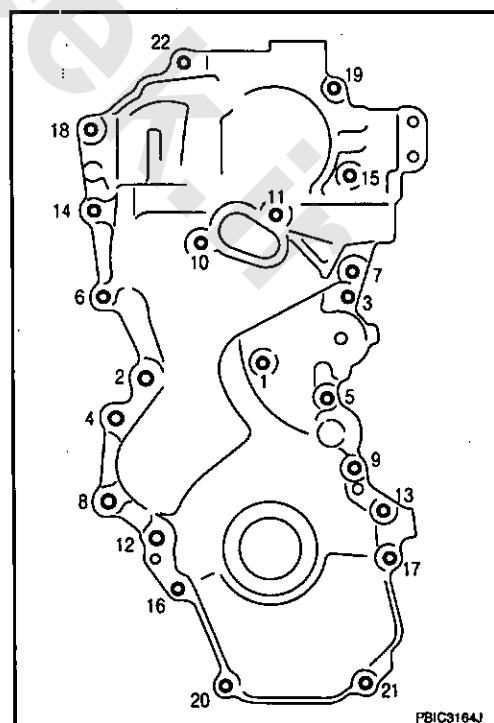
7. Remove rear torque rod. Refer to EM-196, "M/T : Exploded View" (M/T models) or EM-201, "CVT : Exploded View" (CVT models).
8. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting stay and the engine mounting insulator (RH). Refer to EM-196, "M/T : Exploded View" (M/T models) or EM-201, "CVT : Exploded View" (CVT models).

9. Remove oil pan (lower). Refer to EM-154, "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.



## TIMING CHAIN

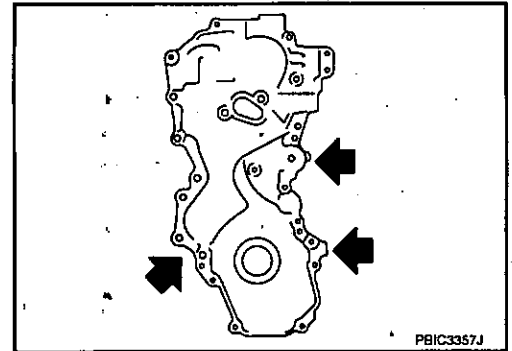
< ON-VEHICLE REPAIR >

[MR20DE]

- 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.



A

EM

C

D

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13. Remove front oil seal from front cover.  
• Lift up front oil seal using a screwdriver.

**CAUTION:**

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

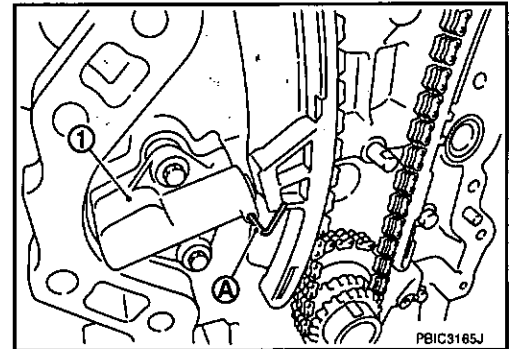
14. Remove timing chain tensioner with the following procedure:

- a. Push in timing chain tensioner plunger.  
b. 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.

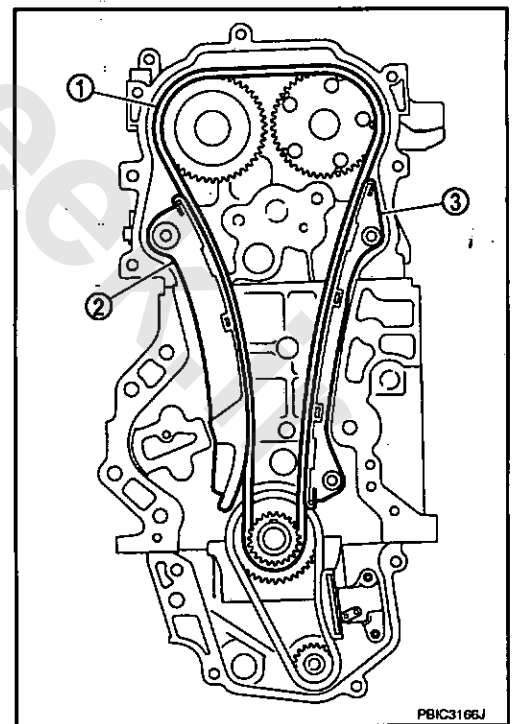
- c. Remove timing chain tensioner (1).



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

### < ON-VEHICLE REPAIR >

[MR20DE]

- a. Fully lift up lever (A), and push the timing chain slack guide (B) into the inside of balancer unit timing chain tensioner (1).
  - The slack guide is released by fully lifting the lever up. As the result, the slack guide can be moved.
- b. Matching the hole on lever with the hole on tensioner body, insert a stopper pin (C) to secure the slack guide.

**NOTE:**

Use approximately 1.0 mm (0.04 in) diameter, hard metal pin as a stopper pin.

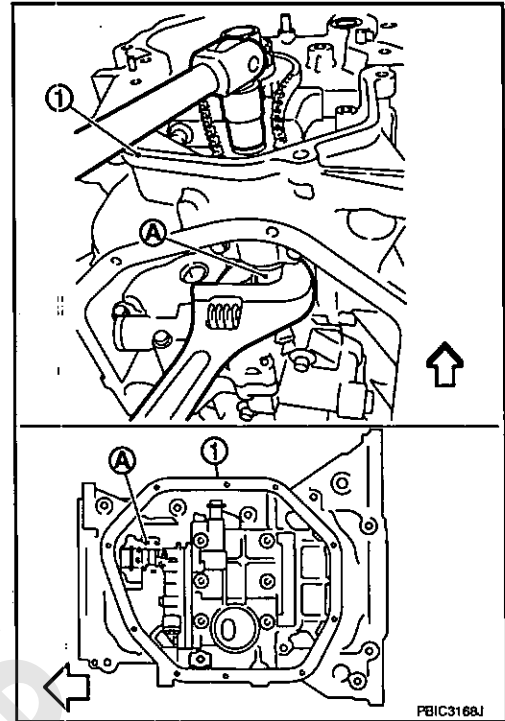
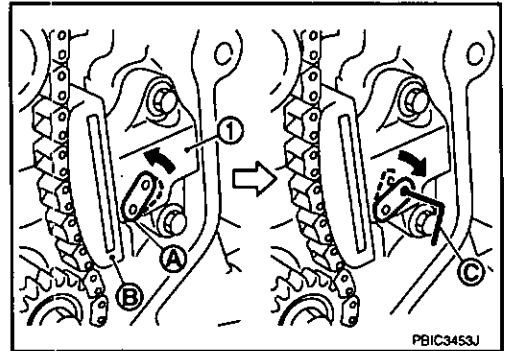
- c. Remove balancer unit timing chain tensioner.
  - When the holes on lever and tensioner body cannot be aligned, align these holes by slightly moving the slack guide.
- d. Hold the WAF part of balancer shaft [WAF:19.0 mm (0.75 in)] (A), and then loosen the balancer unit sprocket bolt.

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

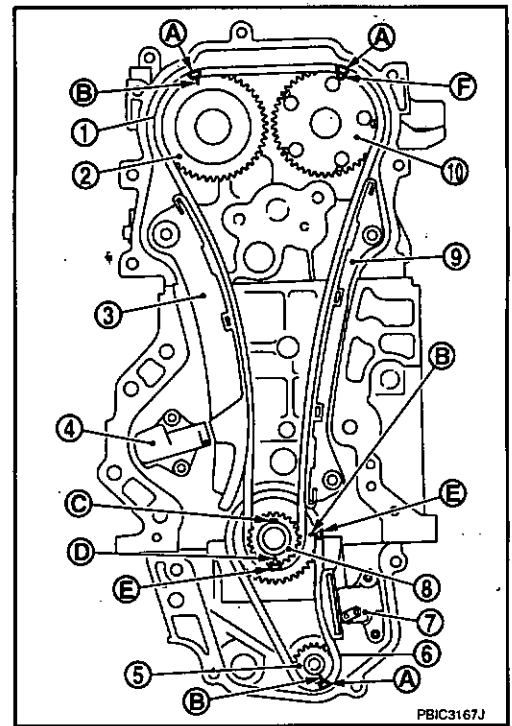
[MR20DE]

## < 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. Make sure 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.**

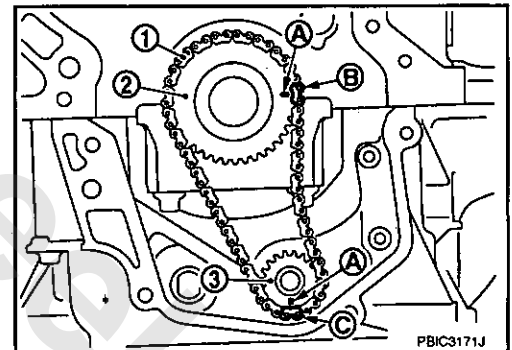
3. Install crankshaft sprocket (2), balancer unit sprocket (3) and balancer unit timing chain (1).

- 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

### < ON-VEHICLE REPAIR >

[MR20DE]

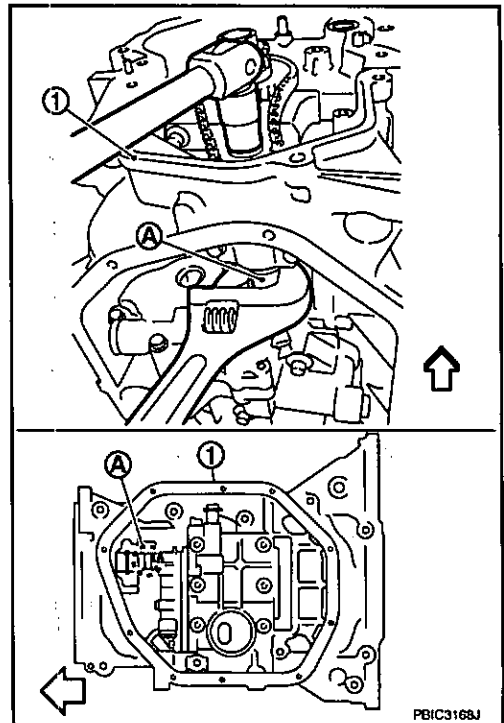
4. Hold the WAF part of balancer unit shaft [WAF: 19.0 mm (0.75 in)] (A), and then tighten the balancer shaft sprocket bolt.

1 : Oil pan (upper)

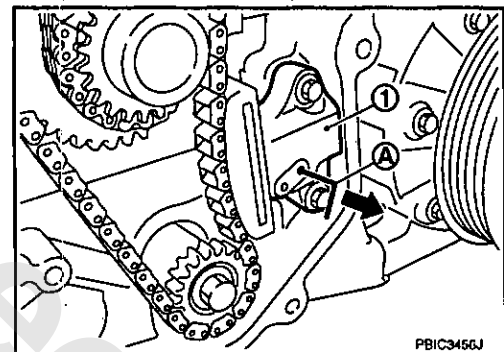
⇐ : Engine front

#### 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.



# TIMING CHAIN

[MR20DE]

## < ON-VEHICLE REPAIR >

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

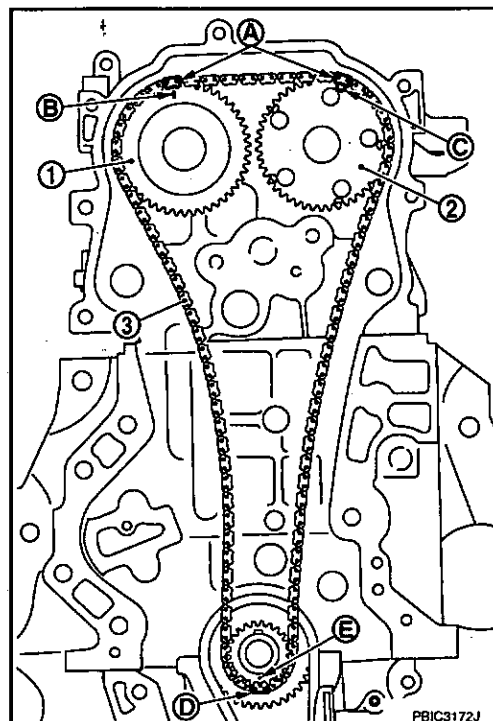
- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- 3 : Timing chain
- A : Matching mark (dark blue link)
- B : Matching mark (stamping)
- C : Matching mark (outer groove\*)
- D : Matching mark (orange link)
- E : Matching mark (stamping)

\*: 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.

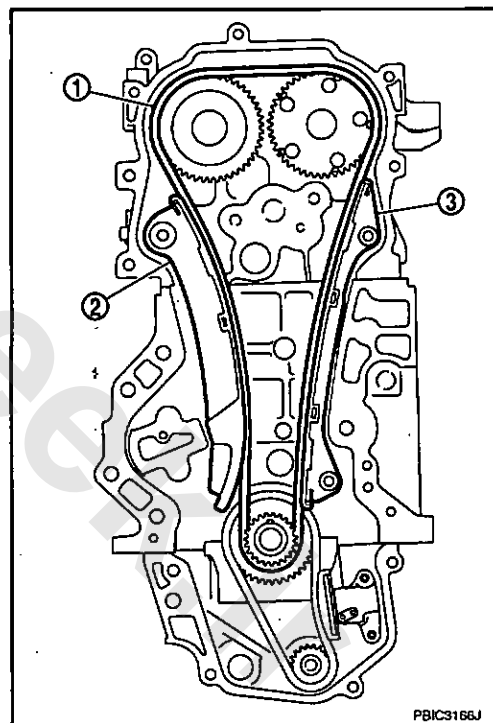
### CAUTION:

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



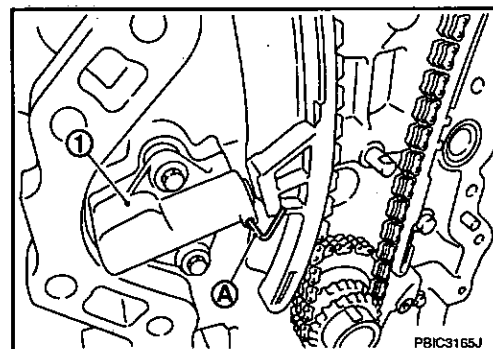
7. Install the timing chain tension guide (3) and the timing chain slack guide (2).

- 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-185, "FRONT OIL SEAL ; Removal and Installation".
11. Install front cover with the following procedure:
  - a. Install new O-ring to cylinder block.

### CAUTION:

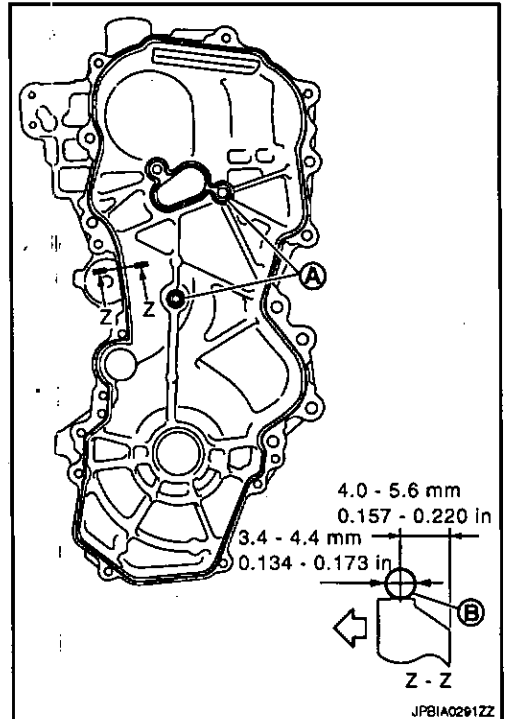
**Never misalign O-ring.**

- 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. Make sure that matching marks of timing chain and each sprocket are still aligned. Then install front cover.
- CAUTION:**
- Make sure 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

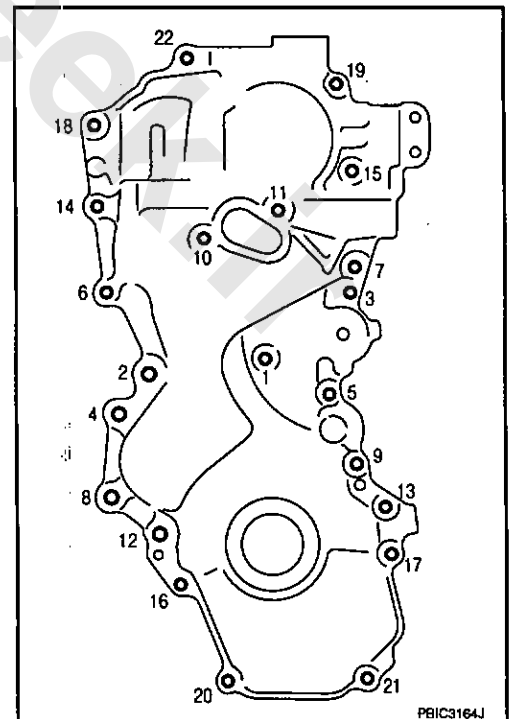
### CAUTION:

**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

## < ON-VEHICLE REPAIR >


[MR20DE]

- 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)

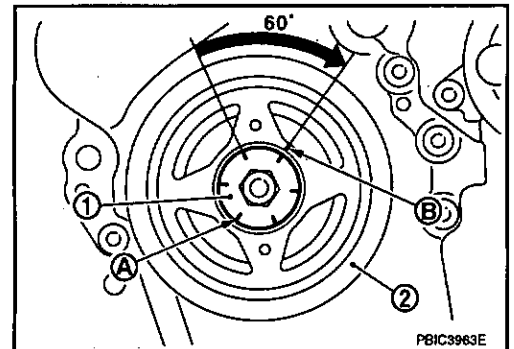
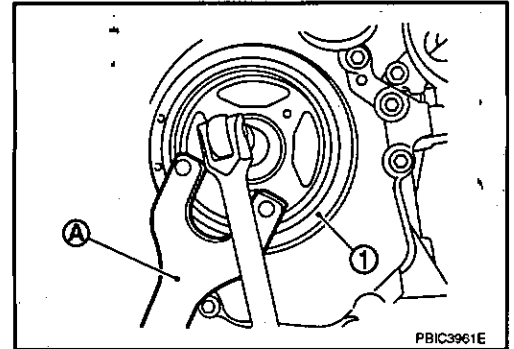
- e. Completely loosen.

 : 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. Make sure that crankshaft rotates clockwise smoothly.

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

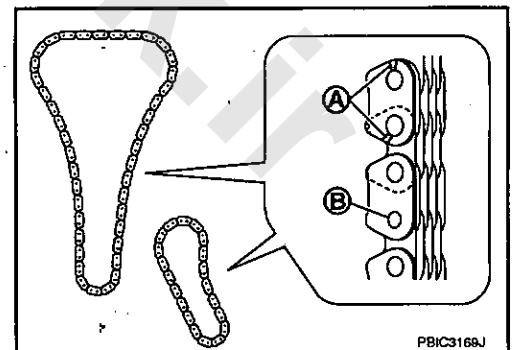
## Inspection

INFOID:0000000004899256

### 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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-13, "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.

## TIMING CHAIN

### < ON-VEHICLE REPAIR >

[MR20DE]

- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

#### NOTE:

If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure 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:

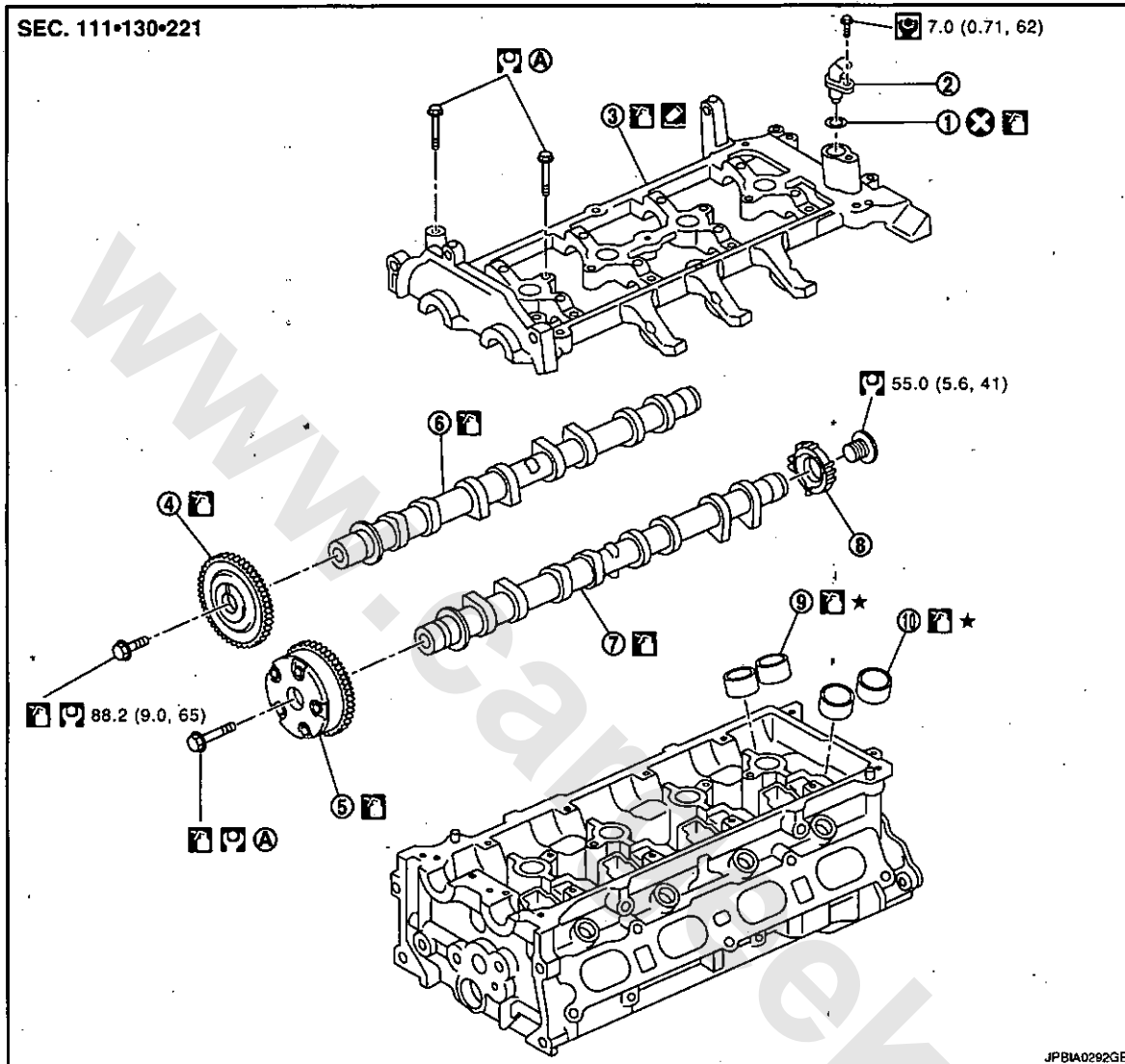
Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

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

## CAMSHAFT

## Exploded View

INFOID:0000000004899257



- |                            |                                     |                       |
|----------------------------|-------------------------------------|-----------------------|
| 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-175](#)

Refer to [GI-3, "Components"](#) for symbols shown in the figure.

## Removal and Installation

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**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-148, "Exploded View"](#).
  - Rocker cover: Refer to [EM-162, "Exploded View"](#).
  - Front cover and timing chain related parts: Refer to [EM-164, "Exploded View"](#).

**NOTE:**

# CAMSHAFT

## < ON-VEHICLE REPAIR >

[MR20DE]

Removal of balancer unit related part is not necessary.

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

### CAUTION:

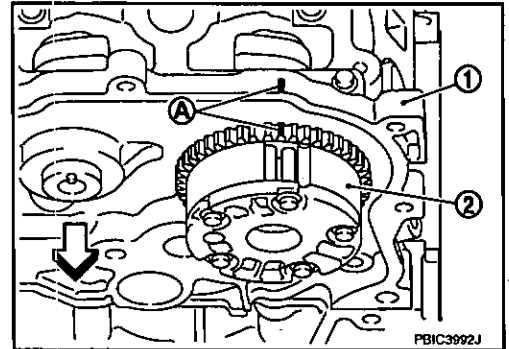
- Handle camshaft position sensor (PHASE) carefully and avoid impacts.
- Never disassemble camshaft position sensor (PHASE).
- Never place sensor where it is exposed to magnetism.

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).

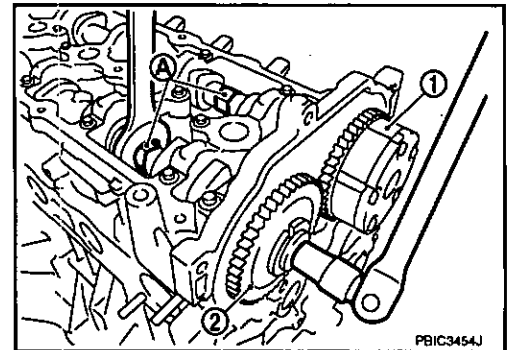


4. Remove camshaft sprockets (INT) (1) and (EXH) (2).

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

### CAUTION:

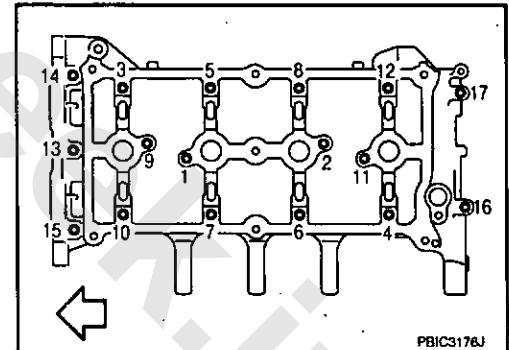
- Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.
- Never loosen the mounting bolts with securing anything other than the camshaft hexagonal part or with tensioning the timing chain.



5. Remove camshaft bracket with the following procedure:

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

⇐ : Engine front

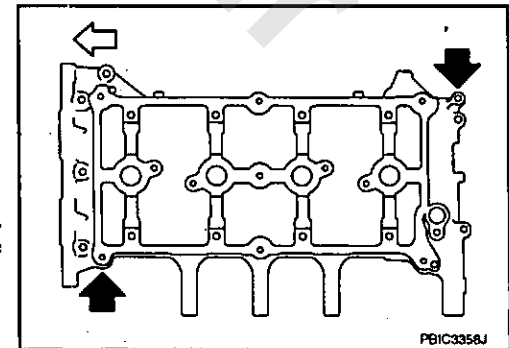


- b. Cut liquid gasket by prying the position (⇐) shown in the figure, and then remove the camshaft bracket.

⇐ : 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.

# CAMSHAFT

## < ON-VEHICLE REPAIR >

[MR20DE]

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)

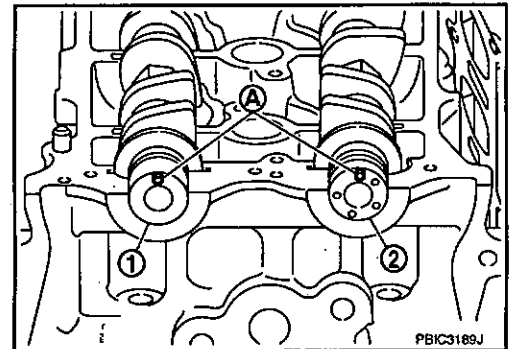
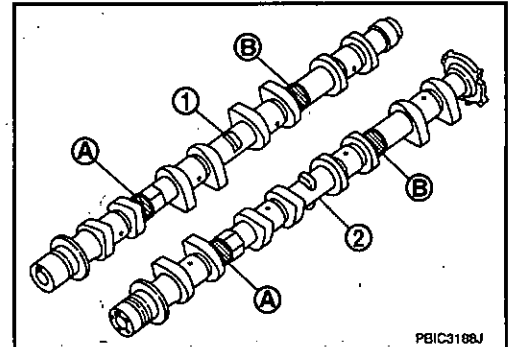
Identification color	A	B
Camshaft (EXH)	—	Yellow
Camshaft (INT)	Yellow	—

- 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:

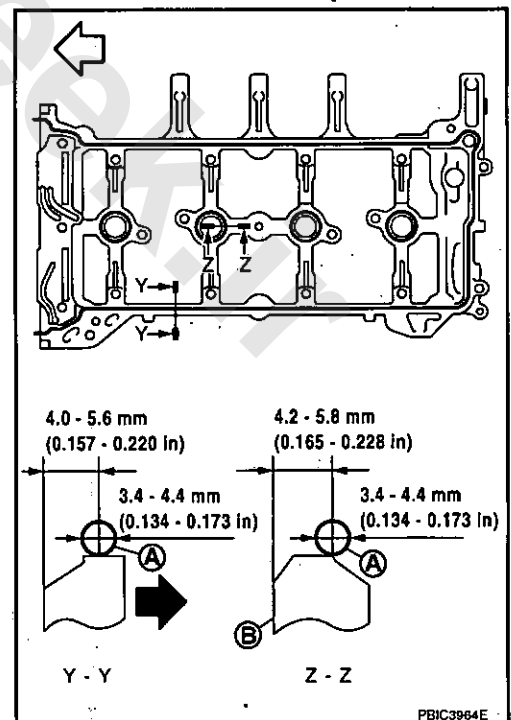
Though camshaft does not stop at the positions as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.



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

## < ON-VEHICLE REPAIR >

[MR20DE]

- 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:

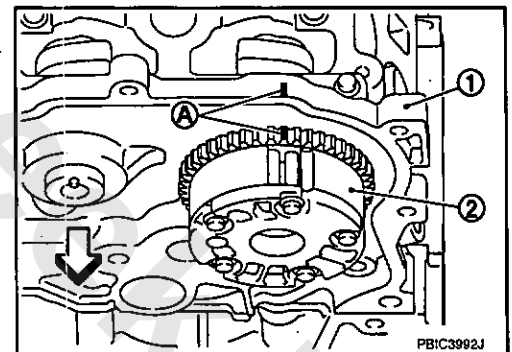
After tightening mounting bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the mating surface of cylinder head.

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)

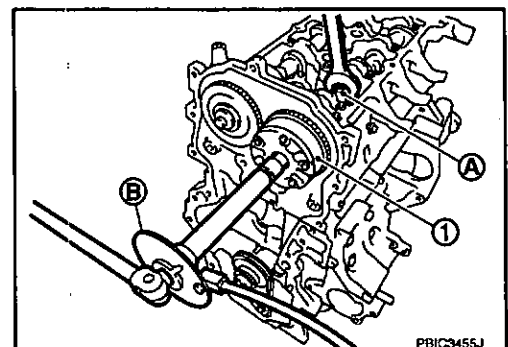
- ii. Turn 67 degrees clockwise (angle tightening).

1 : Camshaft sprocket (INT)

A : Camshaft (INT) hexagonal part

### CAUTION:

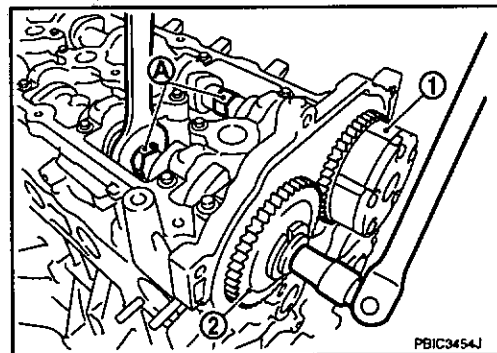
Check the tightening angle by using an angle wrench [SST: KV10112100] (B) or protractor. Never judge by visual inspection without an angle wrench.



### 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-164, "Exploded View".
7. Inspect and adjust valve clearance. Refer to EM-141, "Inspection and Adjustment".
8. Install remaining parts in the reverse order of removal.

## Inspection

INFOID:000000004899259

### INSPECTION AFTER REMOVAL

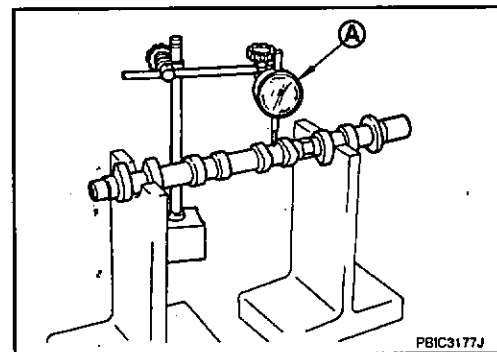
#### Camshaft Runout

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)



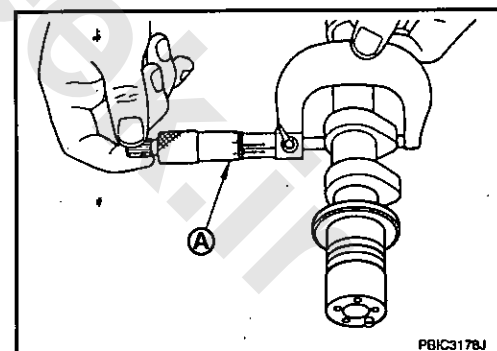
**Standard and Limit : Refer to EM-239, "Camshaft".**

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-239, "Camshaft".**



2. If it exceeds the limit, replace camshaft.

#### Camshaft Journal Oil Clearance

### CAMSHAFT JOURNAL OUTER DIAMETER

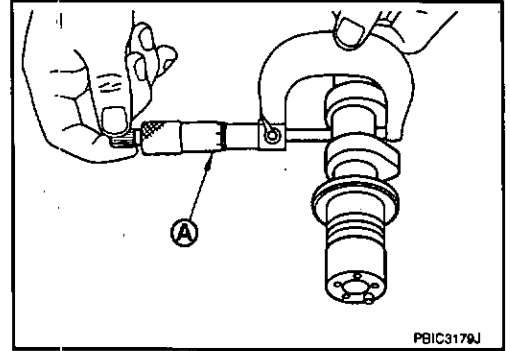
# CAMSHAFT

## < ON-VEHICLE REPAIR >

[MR20DE]

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

**Standard** : Refer to EM-239, "Camshaft".

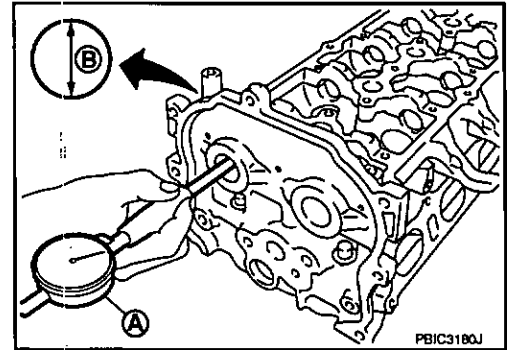


### CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque. Refer to EM-175, "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-239, "Camshaft".



### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard and Limit** : Refer to EM-239, "Camshaft".

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

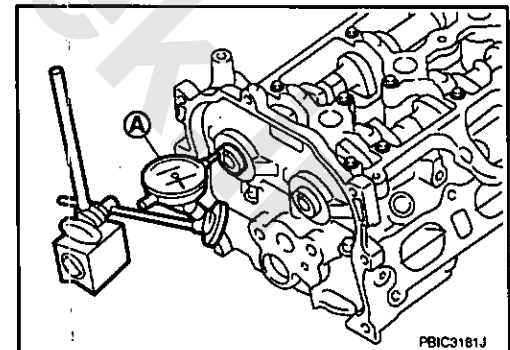
#### NOTE:

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-175, "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-239, "Camshaft".





# CAMSHAFT

[MR20DE]

## < ON-VEHICLE REPAIR >

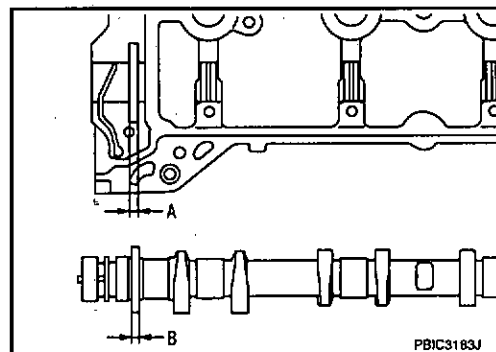
- Measure the following parts if out of the standard.
- Dimension "A" for groove of cylinder head No. 1 journal

**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.

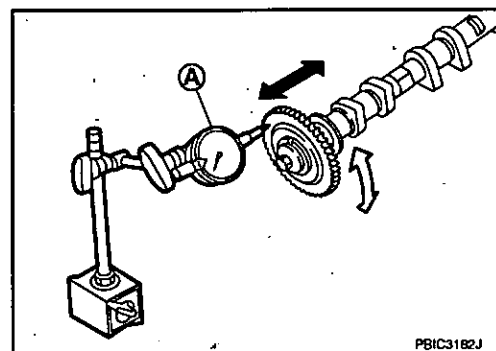
### CAUTION:

**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-239. "Camshaft".**

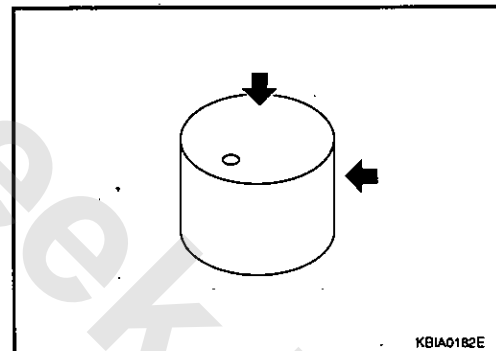
- If it exceeds the limit, replace camshaft sprocket.



## Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-239. "Camshaft".

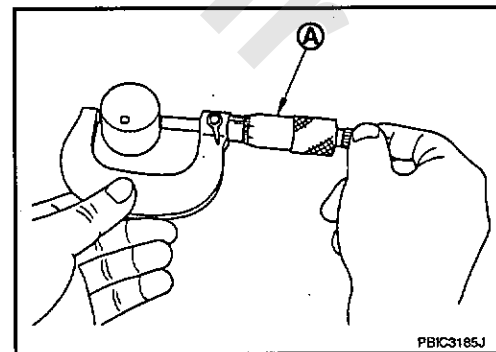


## Valve Lifter Clearance

### VALVE LIFTER OUTER DIAMETER

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

**Standard : Refer to EM-239. "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).

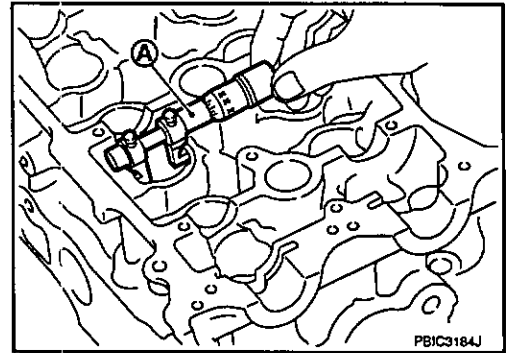
**Standard** : Refer to EM-239, "Camshaft".

### VALVE LIFTER CLEARANCE

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

**Standard** : Refer to EM-239, "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

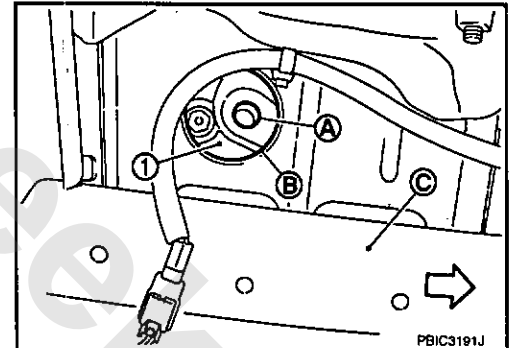
Inspection of Camshaft Sprocket (INT) Oil Groove

#### CAUTION:

- Perform this inspection only when DTC P0011 is detected in self-diagnostic results and it is directed according to inspection procedure of EC section. Refer to EC-89, "DTC Logic".
- Check when engine is cold so as to prevent burns by the splashing engine oil.

1. Check engine oil level. Refer to LU-14, "Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
  - a. Release the fuel pressure. Refer to EC-287, "Inspection".
  - b. Remove intake manifold. Refer to EM-148, "Exploded View".
  - c. Disconnect ignition coil and injector harness connectors.
3. Remove intake valve timing control solenoid valve. Refer to EM-164, "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 waste 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.
    - Remove oil filter (for intake valve timing control solenoid), and then clean it. Refer to EM-212, "Exploded View".

## CAMSHAFT

### < ON-VEHICLE REPAIR >

[MR20DE]

- Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to LU-11, "Engine Lubrication System" and LU-11, "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-11, "Engine Lubrication System" and LU-11, "Engine Lubrication System Schematic".
- 9. After inspection, install removed parts in the reverse order.

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

## OIL SEAL

## VALVE OIL SEAL

## VALVE OIL SEAL : Removal and Installation

INFOID:000000004899260

## REMOVAL

1. Remove camshafts. Refer to EM-175, "Exploded View".
2. Remove valve lifters. Refer to EM-175, "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.

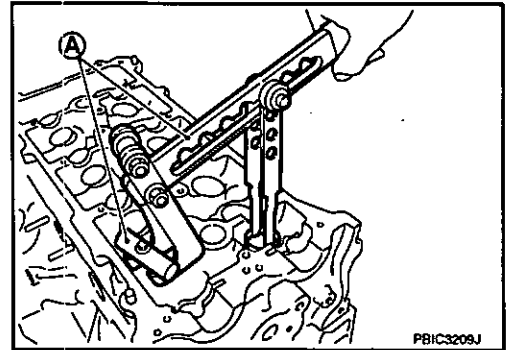
**CAUTION:**

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

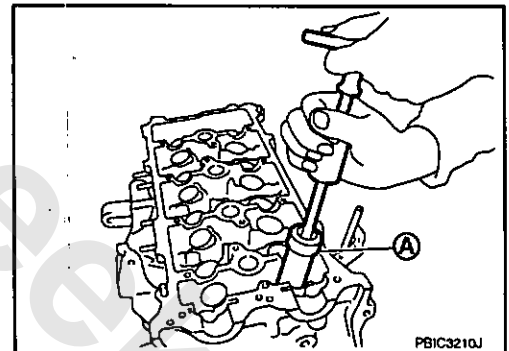
4. Remove valve collet.
  - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A).

**CAUTION:**

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



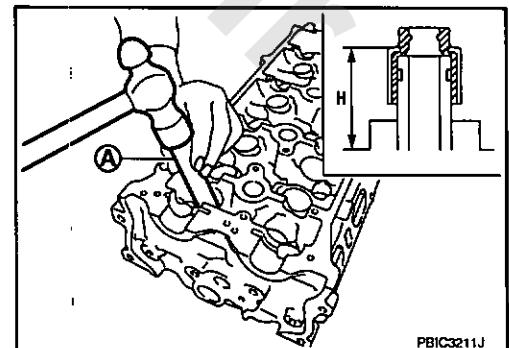
5. Remove valve spring retainer, valve spring and valve spring seat.
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



## 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

# OIL SEAL

< ON-VEHICLE REPAIR >

[MR20DE]

## FRONT OIL SEAL : Removal and Installation

INFOID:000000004899261

### REMOVAL

1. Remove the following parts.
  - Front fender protector (RH): Refer to EXT-22, "Exploded View".
  - Drive belt: Refer to EM-136, "Exploded View".
  - Crankshaft pulley: Refer to EM-164, "Exploded View".

2. Remove front oil seal with a suitable tool.

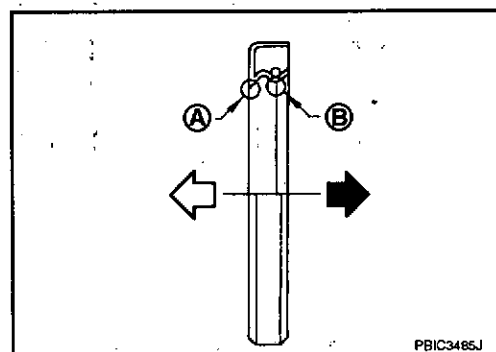
#### CAUTION:

**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:000000004899262

### REMOVAL

1. Remove transaxle assembly. Refer to TM-105, "2WD : Exploded View" or TM-109, "4WD : Exploded View" (CVT models).
2. Remove clutch cover and clutch disk (M/T models).
3. Remove drive plate (CVT models) or flywheel (M/T models). Refer to EM-212, "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.**

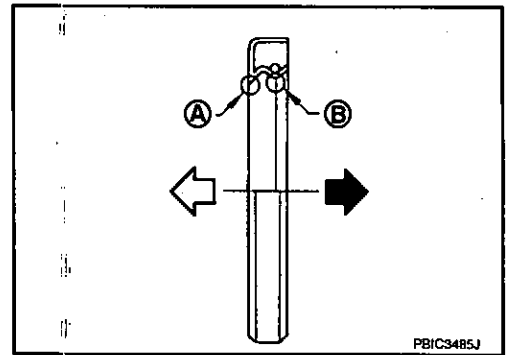
## OIL SEAL

### < ON-VEHICLE REPAIR >

[MR20DE]

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

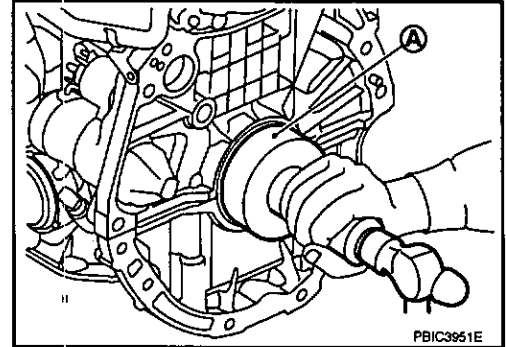
- A : Dust seal lip  
B : Oil seal lip  
⇐ : Engine outside  
➡ : Engine inside



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

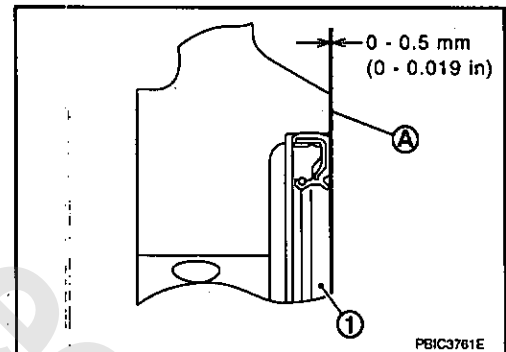
**CAUTION:**

- 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.

# CYLINDER HEAD

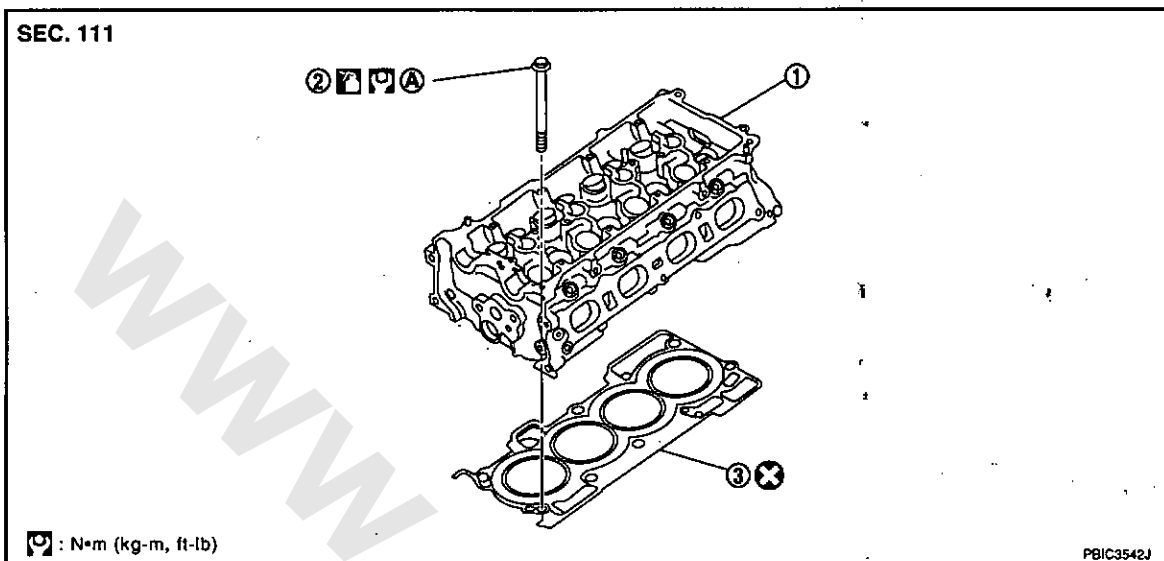
< ON-VEHICLE REPAIR >

[MR20DE]

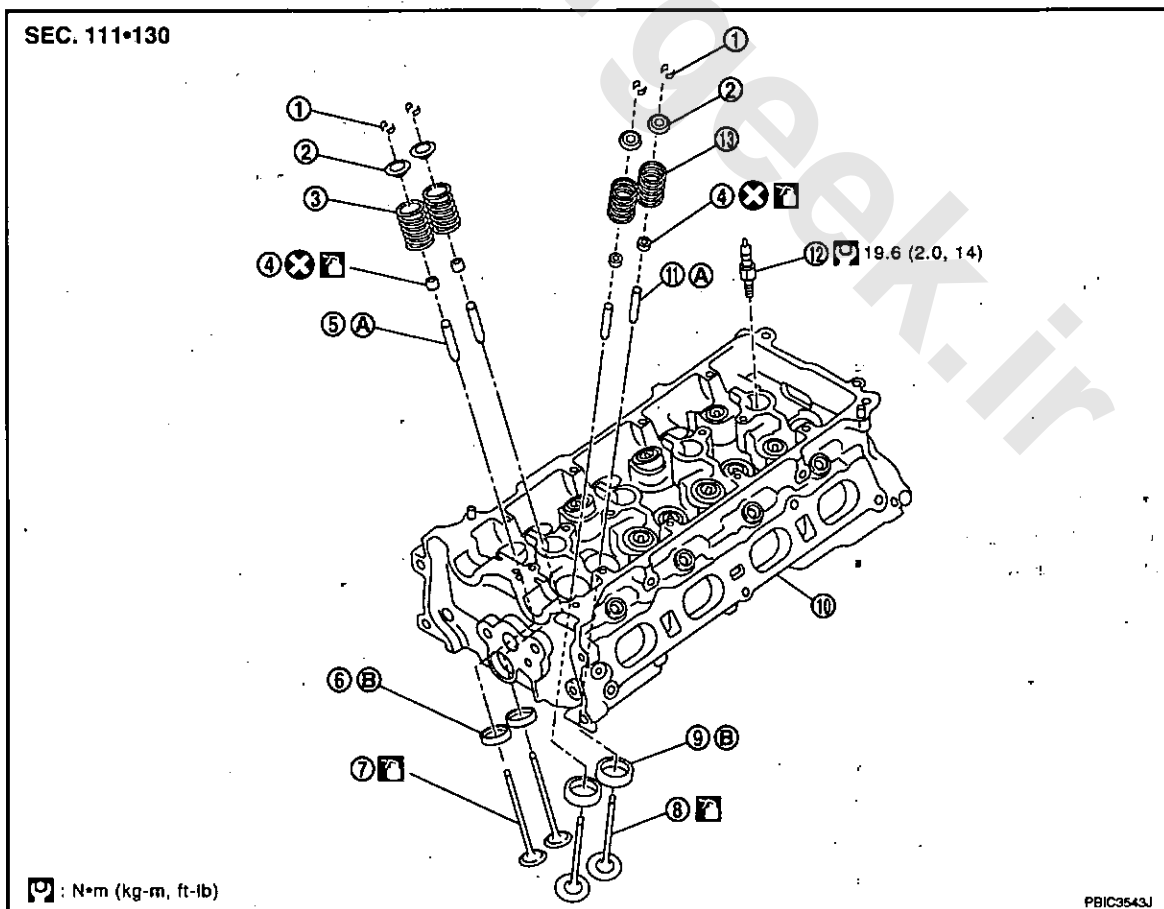
## CYLINDER HEAD

Exploded View

REMOVAL



DISSASSEMBLY



# CYLINDER HEAD

< ON-VEHICLE REPAIR >

[MR20DE]

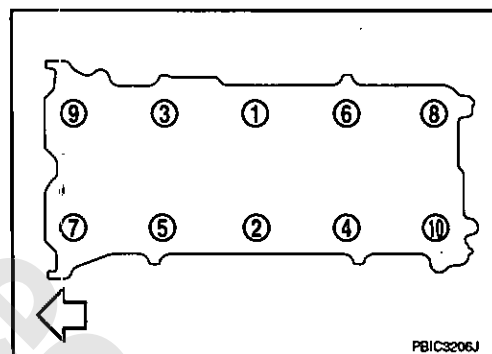
- |  |                           |   |
|--|---------------------------|---|
| 1. Valve collet                                    | 2. Valve spring retainer  | 3. Valve spring (EXH)<br>(with valve spring seat) |
| 4. Valve oil seal                                  | 5. Valve guide (EXH)      | 6. Valve 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 <u>EM-189</u>                          | B. Refer to <u>EM-189</u> |   |
- Refer to GI-3, "Components" for symbols shown in the figure.

## Removal and Installation

INFOID:000000004899264

### REMOVAL

1. Release fuel pressure. Refer to EC-287, "Inspection".
  2. Drain engine coolant and engine oil. Refer to CO-30, "Draining" and LU-15, "Draining".
  3. Remove the following components and related parts.
    - Exhaust manifold: Refer to EM-151, "Exploded View".
    - Intake manifold: Refer to EM-148, "Exploded View".
    - Fuel tube and fuel injector assembly: Refer to EM-157, "Exploded View".
    - Water outlet: Refer to CO-44, "Exploded View".
    - Rocker cover: Refer to EM-162, "Exploded View".
    - Front cover, timing chain: Refer to EM-164, "Exploded View".
    - Camshaft: Refer to EM-175, "Exploded View".
  4. Remove cylinder head.
    - Loosen mounting bolts in reverse order as shown in the figure.
- ⇐ : Engine front
- Using TORX socket, loosen cylinder head bolts.



5. Remove cylinder head gasket.

### INSTALLATION

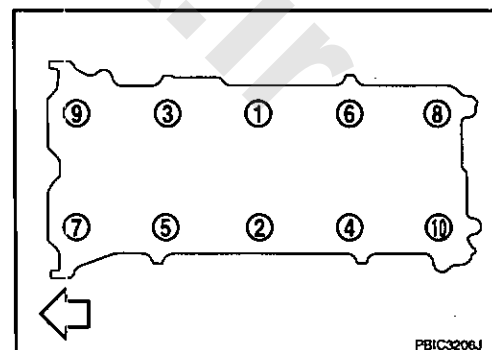
1. Install cylinder head gasket.
2. Install cylinder head, and tighten cylinder head bolts in numerical order as shown in figure with the following procedure.

⇐ : Engine front

#### CAUTION:

If cylinder head bolts are re-used, check their outer diameters before installation. Refer to EM-193, "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

## < ON-VEHICLE REPAIR >

[MR20DE]

- 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)

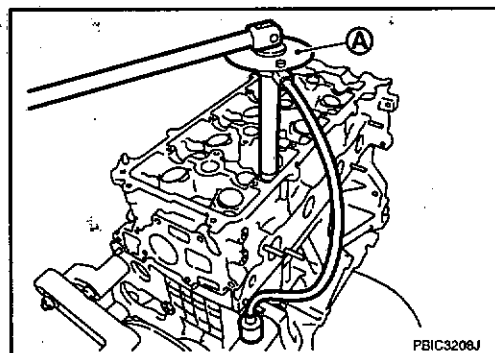
**CAUTION:**

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.



## Disassembly and Assembly

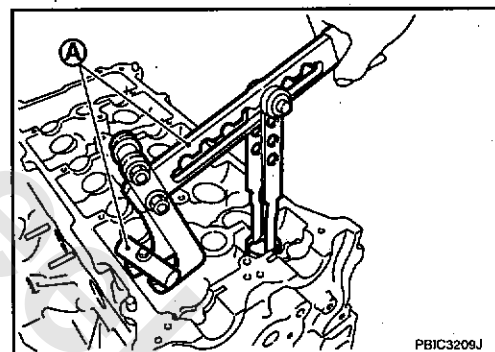
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### Disassembly

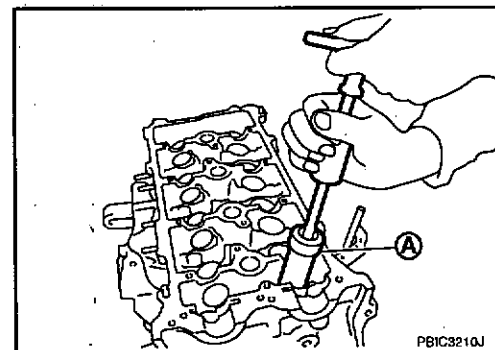
1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
  - Compress valve spring with valve spring compressor, attachment and adapter [SST: KV10116200] (A). Remove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

**CAUTION:**

Be careful not to damage valve lifter holes.



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.

## CYLINDER HEAD

### < ON-VEHICLE REPAIR >

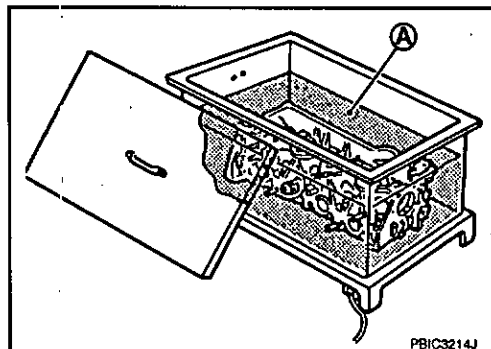
[MR20DE]

- 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-240, "Cylinder Head".

#### CAUTION:

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

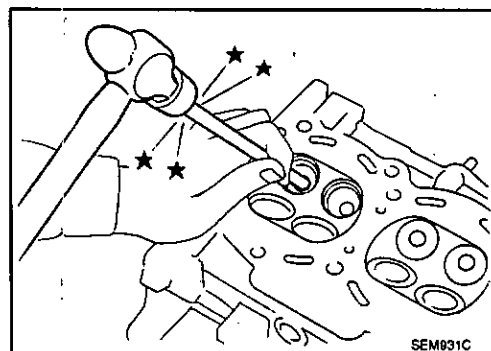
8. When valve guide must be replaced:
  - a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



- 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.**

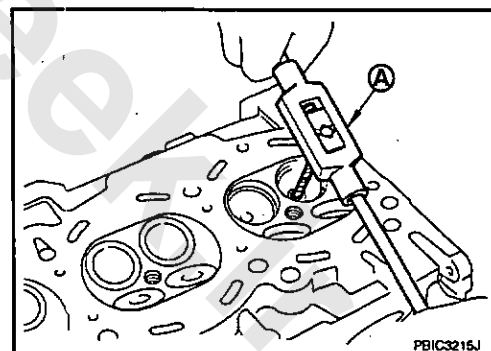


### Assembly

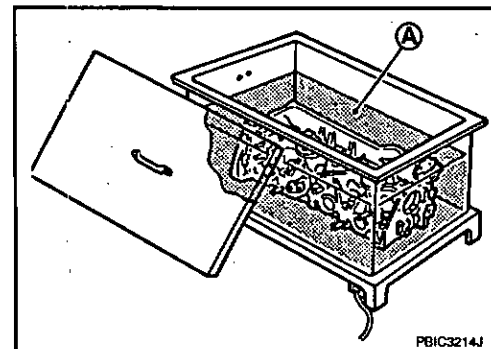
1. When valve guide is removed, install it.  
**CAUTION:**  
**Replace with oversize [0.2 mm (0.008 in)] valve guide.**
  - a. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool) (A).

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

**Refer to EM-240, "Cylinder Head".**



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



# CYLINDER HEAD

[MR20DE]

## < ON-VEHICLE REPAIR >

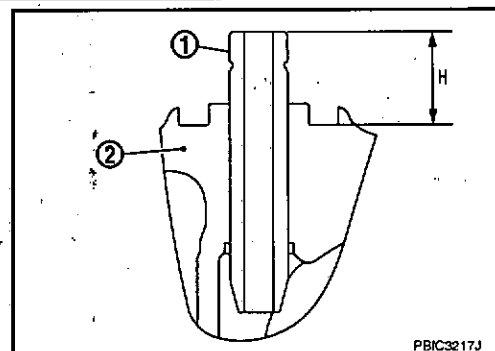
- c. Press valve guide (1) from camshaft side to dimensions, as shown in the figure.

2 : Cylinder head

Projection "H" : Refer to EM-240, "Cylinder Head".

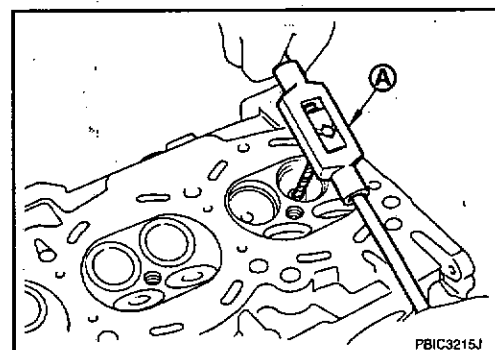
### CAUTION:

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-240, "Cylinder Head".



2. When valve seat is removed, install it.

### CAUTION:

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

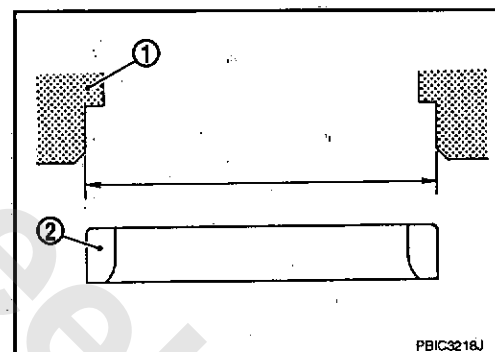
- a. Ream cylinder head (1) recess diameter for service valve seat.

2 : Valve seat

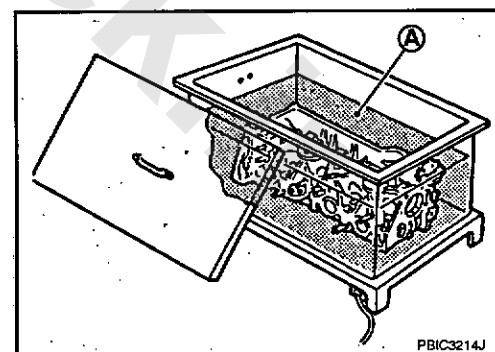
For service parts: Oversize [0.5 mm (0.020 in)]

Refer to EM-240, "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

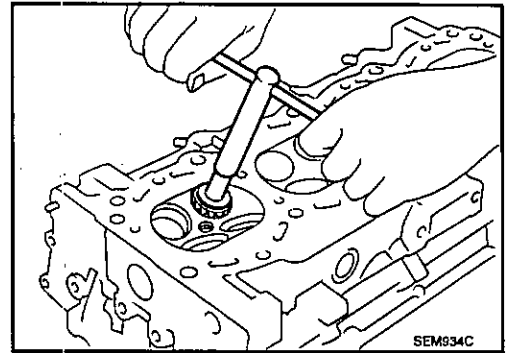
## < ON-VEHICLE REPAIR >

[MR20DE]

- 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-240, "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-193, "Inspection".

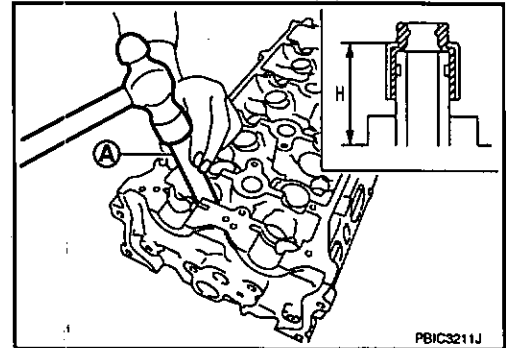
3. Install valve oil seal.

- 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.

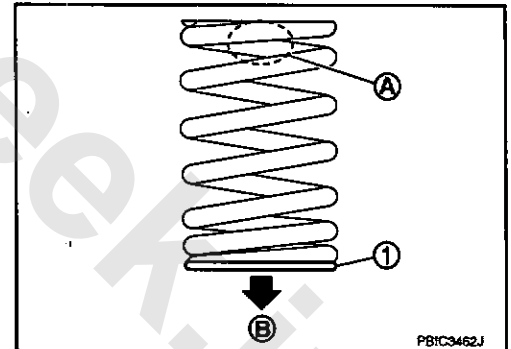
5. Install valve spring (with valve spring seat).  
• Install smaller pitch (valve spring seat side) to cylinder head side (B).

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.

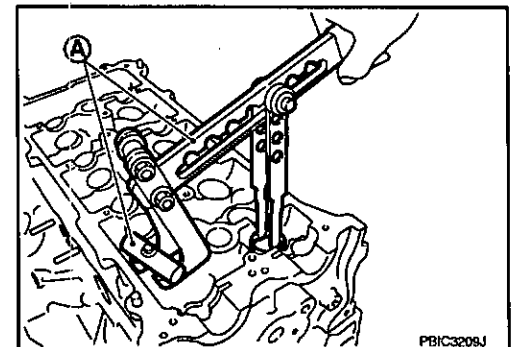
7. Install valve collet.

- 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

< ON-VEHICLE REPAIR >

[MR20DE]

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

## Inspection

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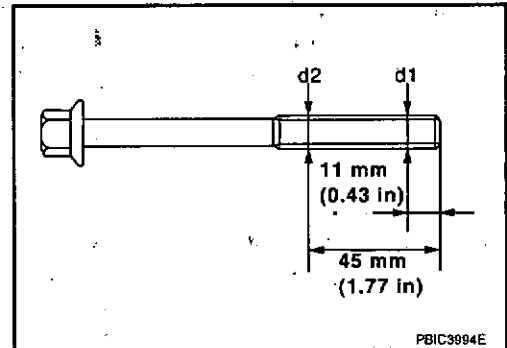
### INSPECTION AFTER REMOVAL

#### 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-221, "Inspection".

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

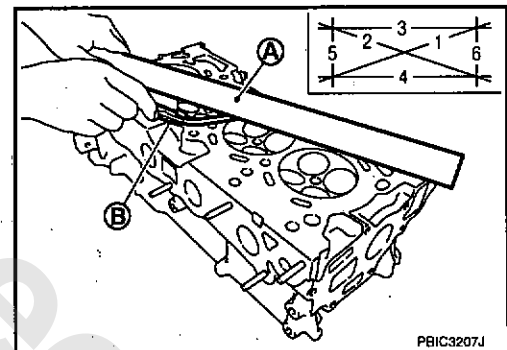
##### CAUTION:

**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-240, "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-240, "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-240, "Cylinder Head".**

##### Valve Guide Inner Diameter

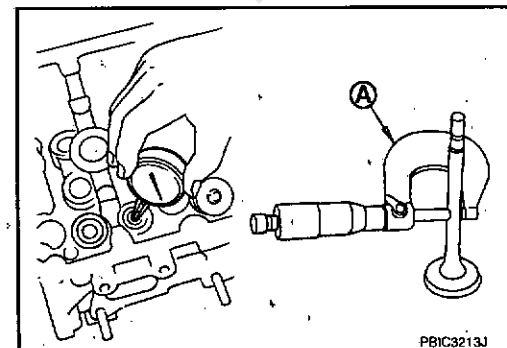
- Measure the inner diameter of valve guide with bore gauge.

**Standard : Refer to EM-240, "Cylinder Head".**

##### Valve Guide Clearance

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

**Standard and Limit : Refer to EM-240, "Cylinder Head".**



# CYLINDER HEAD

## < ON-VEHICLE REPAIR >

[MR20DE]

- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to EM-189, "Disassembly and Assembly".

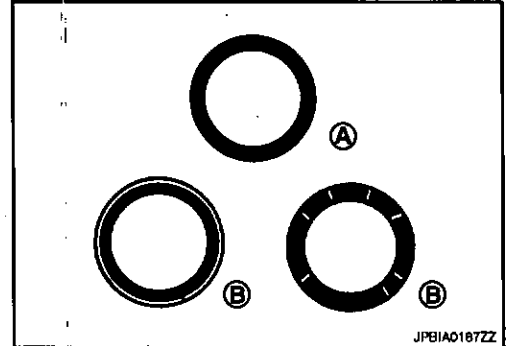
### VALVE SEAT CONTACT

- 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-189, "Disassembly and Assembly".



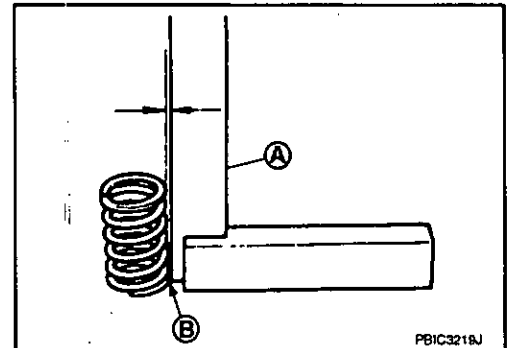
### VALVE SPRING SQUARENESS

- 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-240, "Cylinder Head".

- If it exceeds the limit, replace valve spring.



### VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

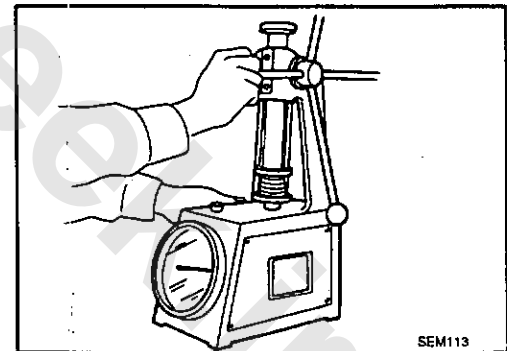
- Check valve spring pressure with valve spring seat installed at the specified spring height.

#### CAUTION:

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

**Standard** : Refer to EM-240, "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

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

# CYLINDER HEAD

< ON-VEHICLE REPAIR >

[MR20DE]

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

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

## REMOVAL AND INSTALLATION

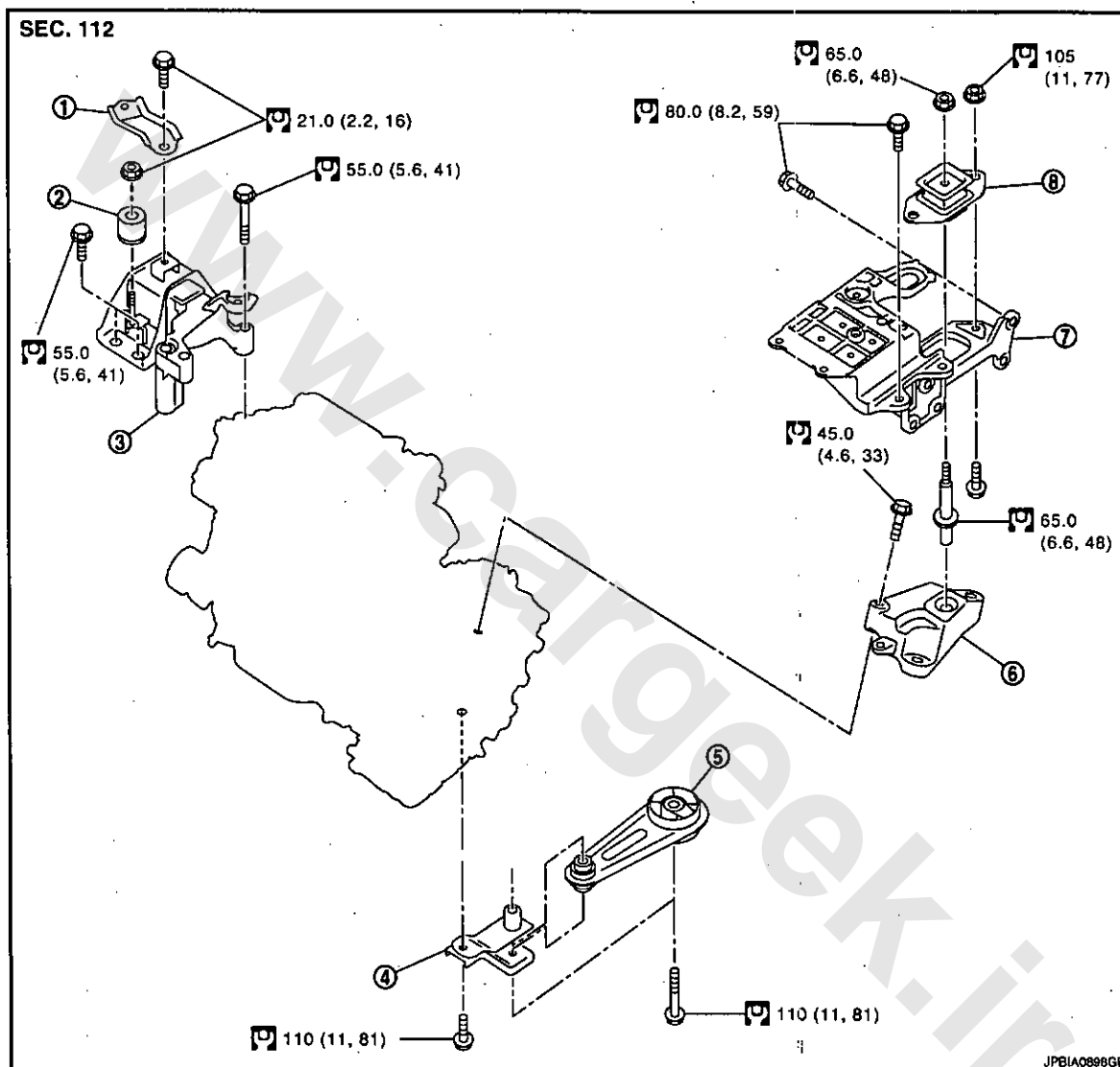
## ENGINE ASSEMBLY

M/T

M/T : Exploded View

INFOID:0000000004899267

2WD models



- |                                 |                                   |                                   |
|---------------------------------|-----------------------------------|-----------------------------------|
| 1. Engine mounting stay         | 2. Dynamic damper                 | 3. Engine mounting insulator (RH) |
| 4. Rear engine mounting bracket | 5. Rear torque rod                | 6. Engine mounting bracket (LH)   |
| 7. Engine mounting bracket (LH) | 8. Engine mounting insulator (LH) | 9. Mass damper. (If equipped)     |

Refer to GI-3, "Components" for symbols in the figure.

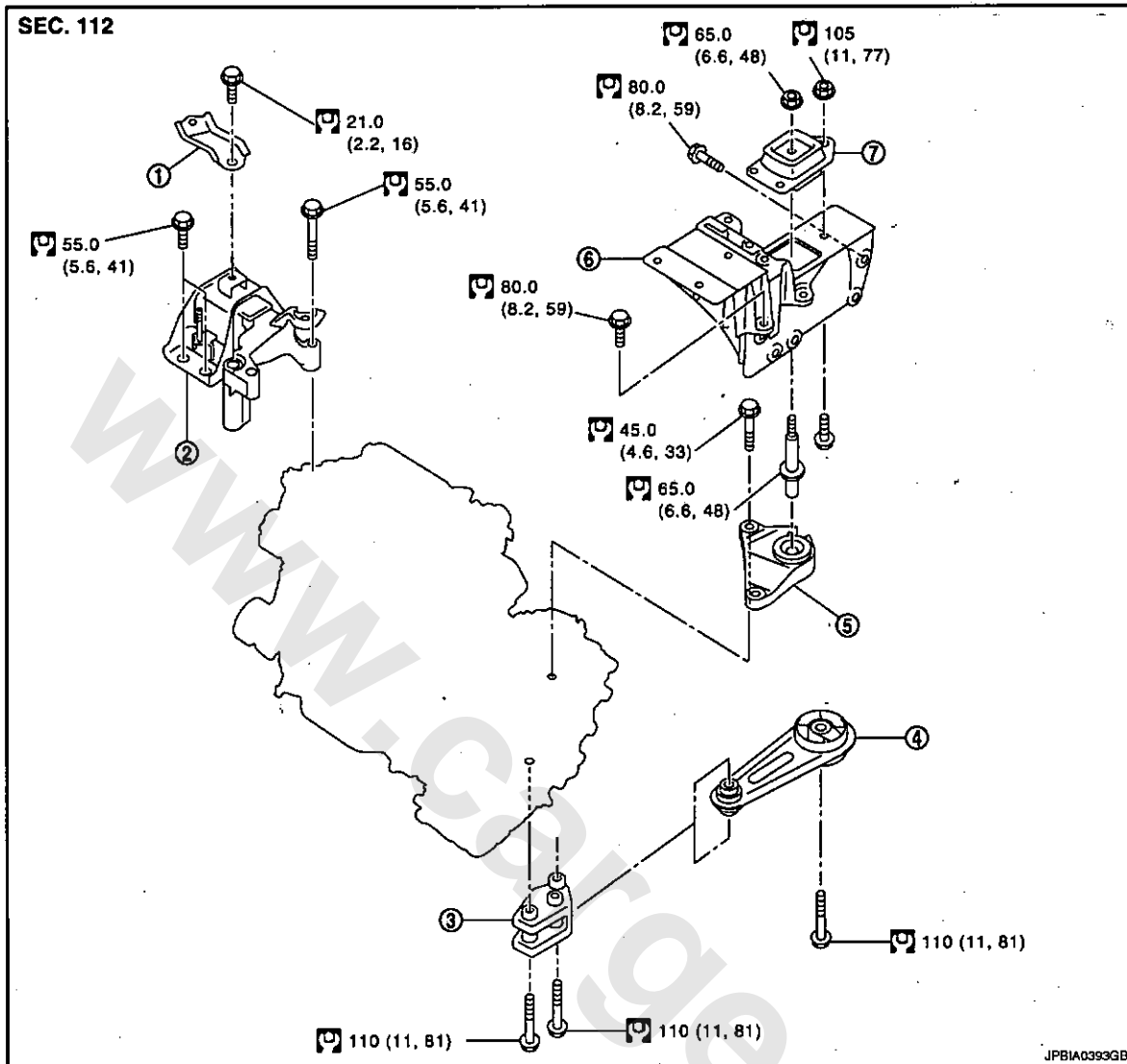
4WD models



# 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 (LH) |
| 7. Engine mounting insulator (LH) |                                   |                                 |

Refer to GI-3, "Components" for symbols in the figure.

## M/T : Removal and Installation

INFOID:000000004899268

### 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-32, "Garage Jack and Safety Stand and 2-Pole Lift".

## REMOVAL

# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[MR20DE]

### 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 EC-287, "Inspection".
2. Drain engine coolant from radiator. Refer to CO-30, "Draining".  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belt.
3. Remove the following parts.
  - Engine undercover
  - Engine cover: Refer to EM-148, "Exploded View".
  - Front fender protector (RH and LH): Refer to EXT-22, "Exploded View".
  - Front road wheels and tires: Refer to WT-3, "Road Wheel".
  - Battery and battery tray: Refer to PG-89, "Exploded View".
  - Air duct and air cleaner case assembly: Refer to EM-146, "Exploded View".
  - Radiator hose (upper and lower) and cooling fan assembly: Refer to CO-34, "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-157, "Exploded View".
3. Disconnect heater hoses. Refer to CO-44, "Exploded View".
4. Disconnect control linkage from transaxle.
5. Remove ground cable at transaxle side.

### Engine Room RH

1. Disconnect vacuum hose from intake manifold. Refer to EM-148, "Exploded View".
2. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope (with A/C models). Refer to HA-38, "Exploded View".
3. Disconnect reservoir tank hoses. Refer to CO-34, "Exploded View".

### Vehicle Underbody

1. Remove front wheel sensor (RH and LH) for ABS from steering knuckle. Refer to BRC-42, "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-37, "BRAKE CALIPER ASSEMBLY ; Exploded View".
3. Disconnect steering outer sockets from steering knuckle. Refer to ST-14, "Exploded View".
4. Remove rear torque rod.
5. Remove drive shafts (RH and LH). Refer to FAX-18, "HR16DE MODELS ; Exploded View" (2WD models) or FAX-60, "MR20DE MODELS ; Exploded View" (4WD models).
6. Remove propeller shaft (4WD models). Refer to DLN-105, "Exploded View".
7. Remove stabilizer connecting rod. Refer to FSU-20, "Exploded View".
8. Disconnect intermediate shaft to steering column assembly. Refer to ST-10, "Exploded View".
9. Remove front suspension member. Refer to FSU-20, "Exploded View".
10. Preparation for the separation work of transaxle is as follows:
  - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side.

### Removal

# ENGINE ASSEMBLY

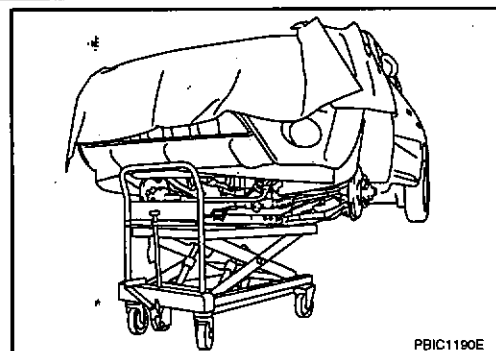
## < REMOVAL AND INSTALLATION >

[MR20DE]

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:

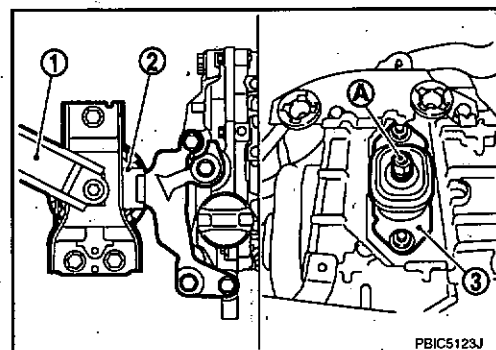
Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



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

3 : Engine mounting insulator (LH)

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



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

### CAUTION:

- Make sure 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

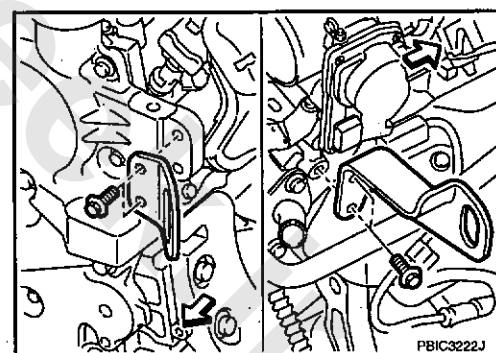
1. Install engine slinger to front cover front left side and cylinder head rear right side.

← : 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)



2. Remove starter motor. Refer to STR-18, "MR20DE MODELS : Exploded View".
3. Lift with a hoist and separate the engine from the transaxle assembly.

### 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.
- Make sure that each mounting insulator is seated properly, and tighten mounting nuts and bolts.

Engine Mounting Insulator (RH)

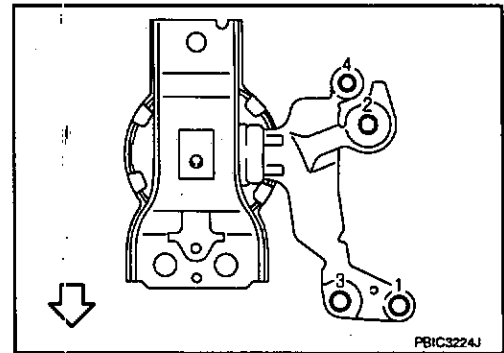
# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[MR20DE]

1. Temporarily tighten the bolt "4" shown in the figure.
2. Tighten bolts to the specified torque according to the numerical order shown in the figure.

← : Vehicle front



## M/T : Inspection

INFOID:0000000004899269

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

### Summary of the inspection items:

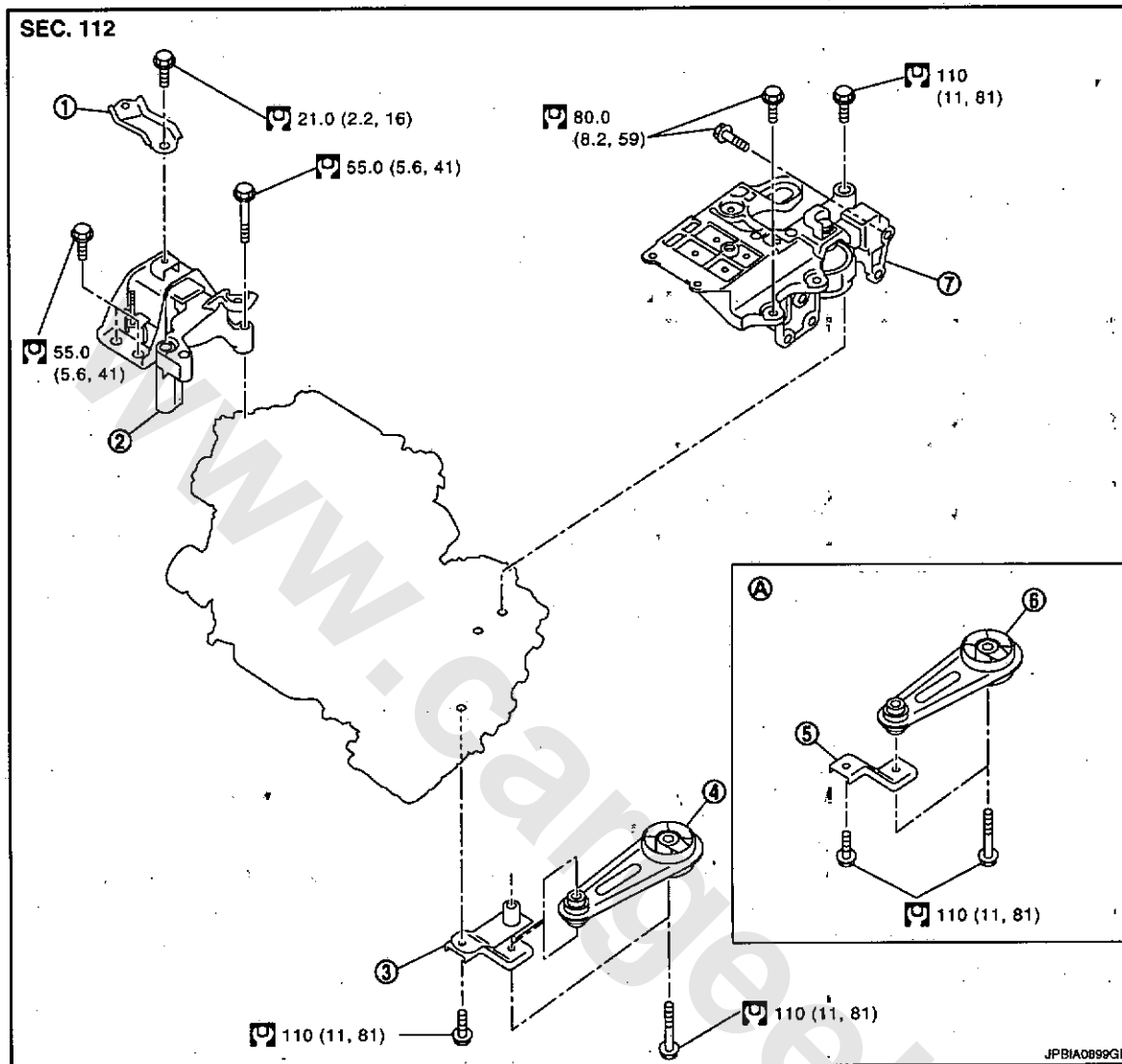
Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

CVT

## CVT : Exploded View

INFOID:000000004899270



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

Refer to GI-3, "Components" for symbols in the figure.

## CVT : Removal and Installation

INFOID:000000004899271

### 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 >

[MR20DE]

- For supporting points for lifting and jacking point at rear axle, refer to GI-32, "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 EC-287, "Inspection".
2. Drain engine coolant from radiator. Refer to CO-30, "Draining".  
**CAUTION:**
  - Perform this step when the engine is cold.
  - Never spill engine coolant on drive belt.
3. Remove the following parts.
  - Engine undercover
  - Engine cover: Refer to EM-148, "Exploded View".
  - Front fender protector (RH and LH): Refer to EXT-22, "Exploded View".
  - Front road wheels and tires: Refer to WT-3, "Road Wheel".
  - Battery and battery tray: Refer to PG-89, "Exploded View".
  - Air duct and air cleaner case assembly: Refer to EM-146, "Exploded View".
  - Radiator hose (upper and lower), CVT fluid cooler hose and cooling fan assembly: Refer to CO-34, "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-157, "Exploded View".
3. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining. Refer to CO-44, "Exploded View".
4. Disconnect control cable from transaxle. Refer to TM-80, "Exploded View".
5. Remove ground cable at transaxle side.

### Engine Room RH

1. Disconnect vacuum hose from intake manifold. Refer to EM-148, "Exploded View".
2. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope (with A/C models). Refer to HA-38, "Exploded View".
3. Disconnect reservoir tank hoses. Refer to CO-34, "Exploded View".

### Vehicle Underbody

1. Remove front wheel sensor (RH and LH) for ABS from steering knuckle. Refer to BRC-42, "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-37, "BRAKE CALIPER ASSEMBLY : Exploded View".
3. Disconnect steering outer sockets from steering knuckle. Refer to ST-14, "Exploded View".
4. Remove rear torque rod.
5. Remove drive shafts (RH and LH). Refer to FAX-26, "MR20DE MODELS : Exploded View" (2WD models) or FAX-60, "MR20DE MODELS : Exploded View" (4WD models).
6. Remove propeller shaft (4WD models). Refer to DLN-105, "Exploded View".
7. Remove stabilizer connecting rod. Refer to FSU-20, "Exploded View".
8. Disconnect intermediate shaft to steering column assembly. Refer to ST-10, "Exploded View".
9. Remove front suspension member. Refer to FSU-20, "Exploded View".
10. Preparation for the separation work of transaxle is as follows:

# ENGINE ASSEMBLY

[MR20DE]

## < REMOVAL AND INSTALLATION >

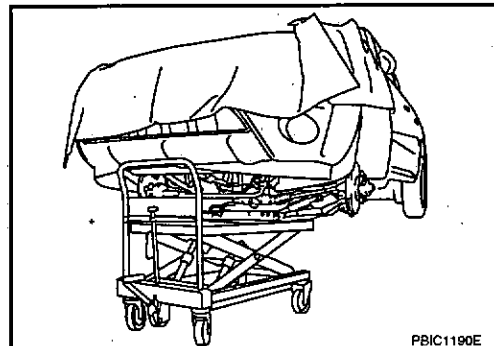
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to EM-154, "Exploded View".

### 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.

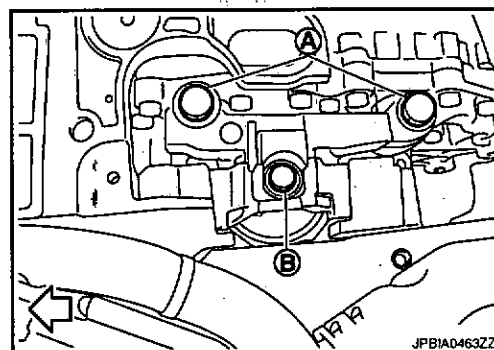


- Remove four mounting bolts on engine mounting insulator (RH) (front cover side).
- Remove two mounting bolts (A) on engine mounting insulator (LH) (transaxle side).

← : 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:

- Make sure 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

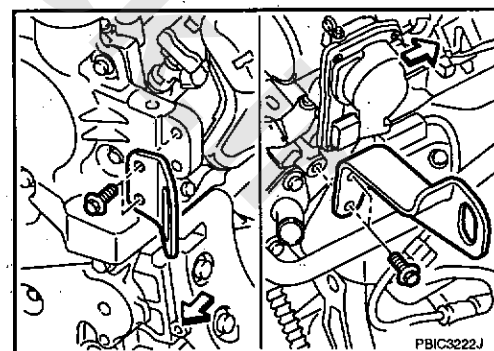
- Install engine slinger to front cover front left side and cylinder head rear right side.

← : 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-18, "MR20DE MODELS : Exploded View".
- Lift with a hoist and separate the engine from the transaxle assembly. Refer to TM-105, "2WD : Exploded View" (2WD models) or TM-109, "4WD : 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.

# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[MR20DE]

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

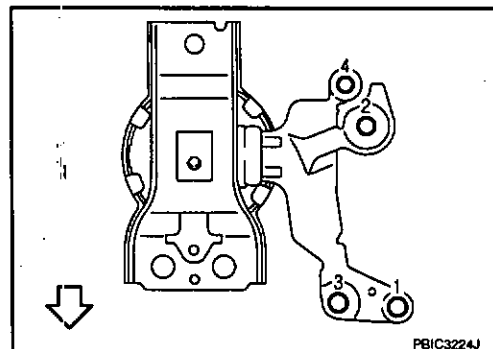
Engine mounting insulator (RH)

- Install engine mounting insulator (RH) to the engine side according to the following procedure.

1. Temporarily tighten mounting bolts the engine mounting insulator (RH) and the engine.

⇐ :Vehicle front

2. Tighten mounting bolts in the numerical order shown in the figure.



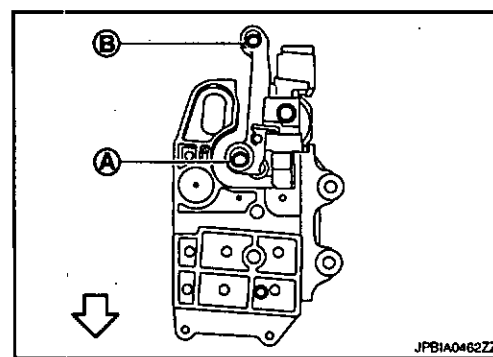
Engine mounting insulator (LH)

- Install engine mounting insulator (LH) to the transaxle side according to the following procedure.

1. Temporarily tighten the mounting bolt (A).

⇐ :Vehicle front

2. Tighten mounting bolt (B) to the specified torque.
3. Tighten mounting bolt (A) to the specified torque.



## CVT : Inspection

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

Summary of the inspection items:

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

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



## DISASSEMBLY AND ASSEMBLY

## ENGINE STAND SETTING

## Setting

INFOID:0000000004899273

**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-196, "M/T : Exploded View" (M/T models) or EM-201, "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. Lift the engine with a hoist to install it onto widely use engine stand.

**CAUTION:**

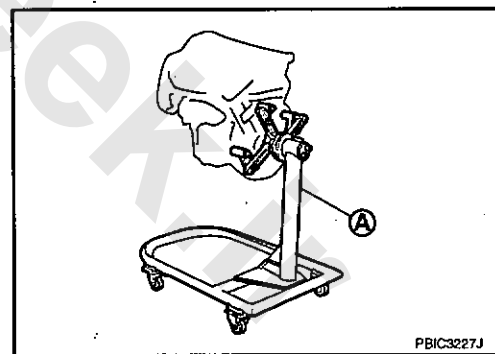
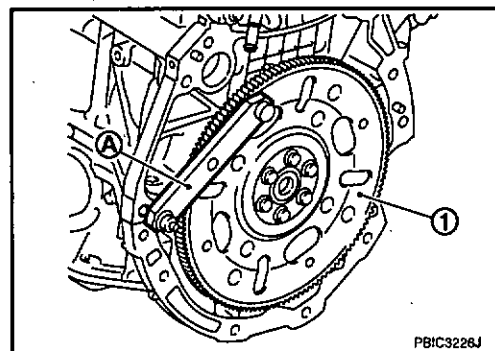
- **Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to EM-148, "Exploded View".
  - Exhaust manifold: Refer to EM-151, "Exploded View".
  - Rocker cover: Refer to EM-162, "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, make sure the engine stand is stable and there is no risk of overturning.**



3. Drain engine oil. Refer to LU-15, "Draining".

**CAUTION:**

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

## ENGINE STAND SETTING

### < DISASSEMBLY AND ASSEMBLY >

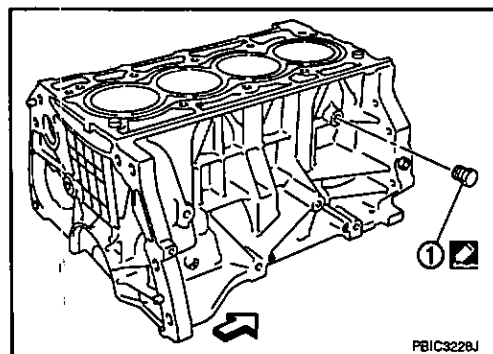
[MR20DE]

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

↔ : Engine front

**Tightening torque** : Refer to EM-213, "Disassembly and Assembly"

**Use Genuine Liquid Gasket or equivalent.**



## ENGINE UNIT

## Disassembly

INFOID:0000000004899274

1. Remove intake manifold. Refer to EM-148, "Exploded View".
2. Remove exhaust manifold. Refer to EM-151, "Exploded View".
3. Remove oil pan (lower). Refer to EM-154, "Exploded View".
4. Remove oil cooler. Refer to LU-18, "Exploded View".
5. Remove ignition coil, spark plug and rocker cover. Refer to EM-162, "Exploded View".
6. Remove fuel injector and fuel tube. Refer to EM-157, "Exploded View".
7. Remove timing chain. Refer to EM-164, "Exploded View".
8. Remove camshaft. Refer to EM-175, "Exploded View".
9. Remove water inlet. Refer to CO-41, "Exploded View".
10. Remove water outlet. Refer to CO-44, "Exploded View".
11. Remove cylinder head. Refer to EM-187, "Exploded View".

## Assembly

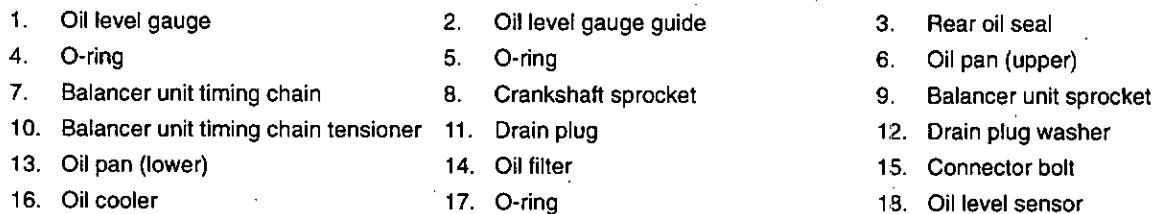
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Assembly is the reverse order of disassembly.

## < DISASSEMBLY AND ASSEMBLY >

## OIL PAN (UPPER)

(NEQID:0000000024899276)



← : Oil pan side

**EM-208**

# OIL PAN (UPPER)

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

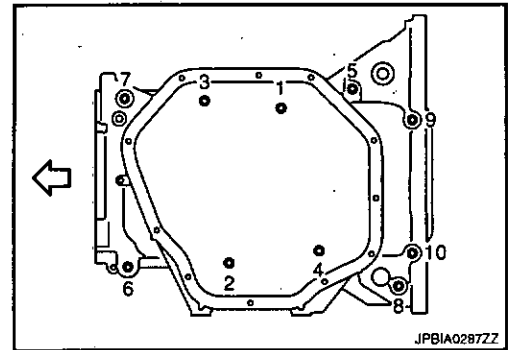
## Removal and Installation

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### REMOVAL

1. Remove oil pan (lower). Refer to EM-154, "Exploded View".
2. Remove oil cooler and oil filter. Refer to LU-18, "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-164, "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

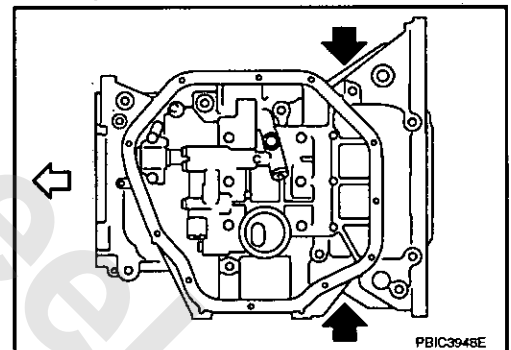


- b. Insert a screwdriver shown by the arrow (→) in the figure and open up a crack between oil pan (upper) and cylinder block.

← : 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)

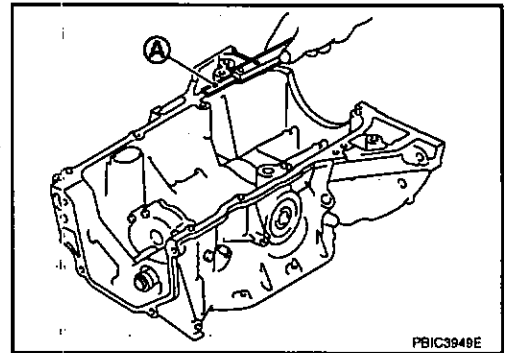
### < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- 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.**



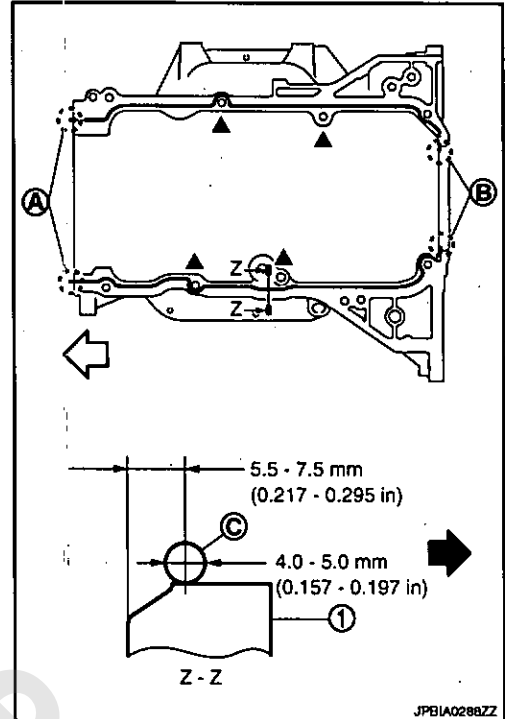
- b. Apply a continuous bead of liquid gasket (C) with a tube presser (commercial service tool) as shown in the figure.

- 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.**

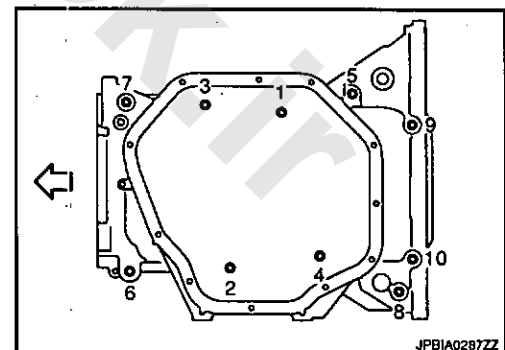
#### CAUTION:

**Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.**



- 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:**

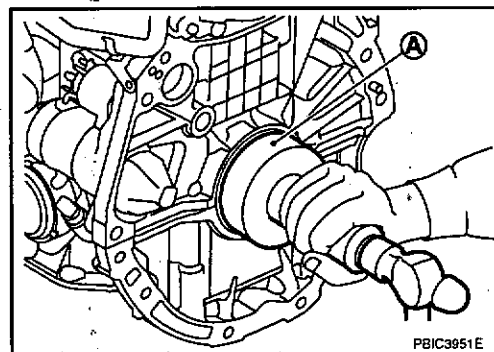
  - The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
  - Always replace rear oil seal with new one.
  - Never touch oil seal lip.
- a. Wipe off liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using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

## OIL PAN (UPPER)

### < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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



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

1 : Rear oil seal

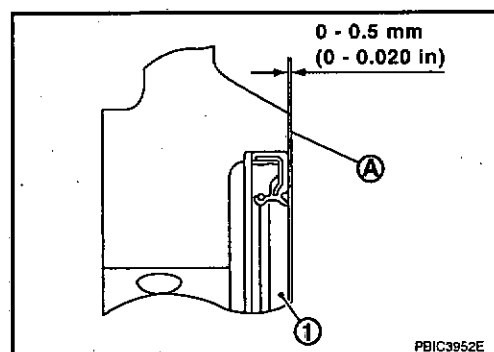
A : Cylinder block rear end surface

#### 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

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#### INSPECTION AFTER REMOVAL

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

# CYLINDER BLOCK

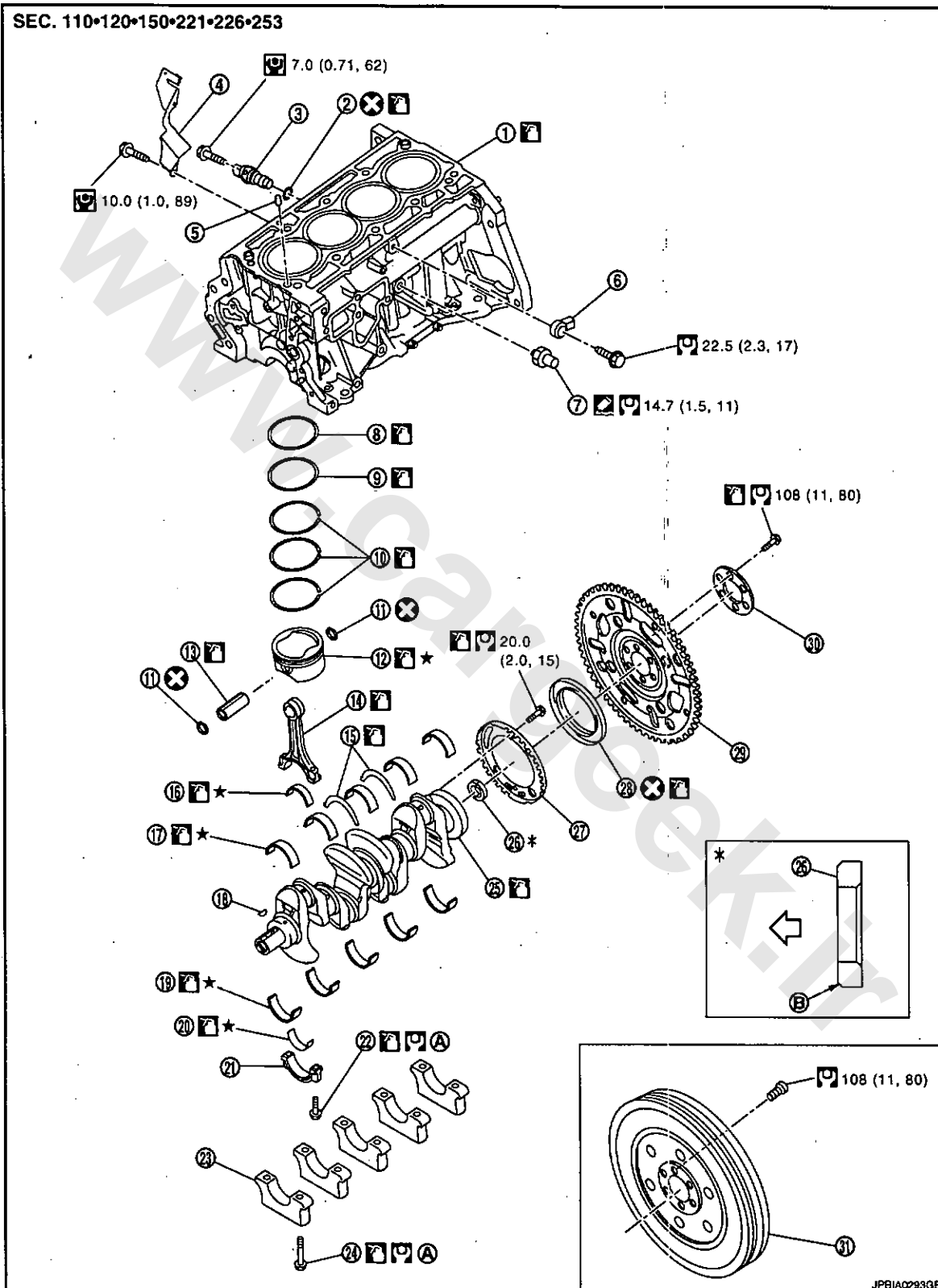
< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

## CYLINDER BLOCK

Exploded View

INFOID:000000004899279



- |   |   |                                     |
|---|---|-------------------------------------|
| 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

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- |                                    |                                    |                                      |
|------------------------------------|------------------------------------|--------------------------------------|
| 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-213](#) B. Chamfered

↶ : Crankshaft side

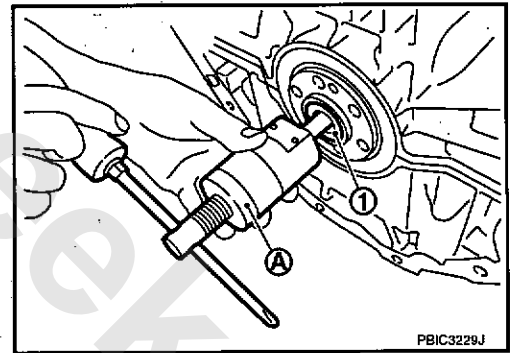
Refer to [GI-3, "Components"](#) for symbols shown in the figure.

## Disassembly and Assembly

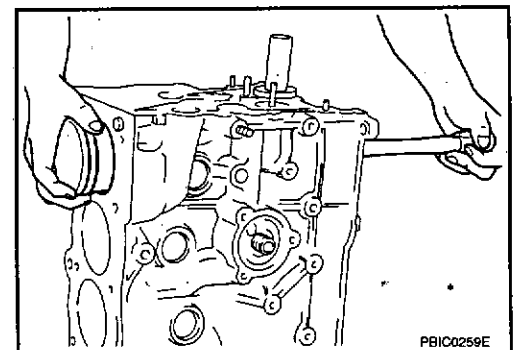
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### Disassembly

- Remove oil pan (upper). Refer to [EM-208, "Exploded View"](#).
- Remove thermostat housing. Refer to [CO-41, "Exploded View"](#).
- Remove knock sensor.  
**CAUTION:**  
**Handle it carefully and avoid impacts.**
- 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.
- Remove oil filter (for intake valve timing control).
- Remove pilot converter (1) using pilot bushing puller [SST: ST16610001] (A) or suitable tool. (CVT models)  
**NOTE:**  
M/T models have no pilot converter.



- 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-221, "Inspection"](#).
- Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- Remove connecting rod cap.
- 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.



- Remove connecting rod bearings.

## CYLINDER BLOCK

### < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

#### CAUTION:

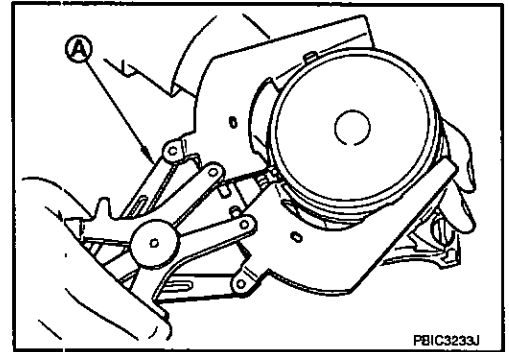
When removing them, note the installation position. Keep them in the correct.

9. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to EM-221, "Inspection".
- Use a piston ring expander (commercial service tool) (A).

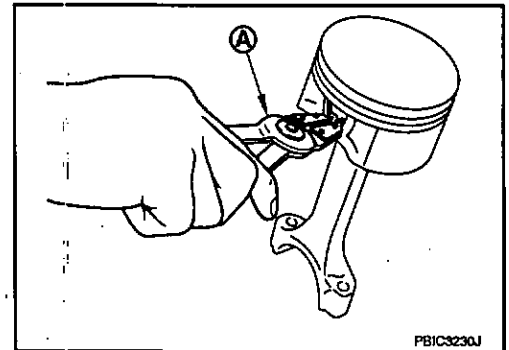
#### CAUTION:

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

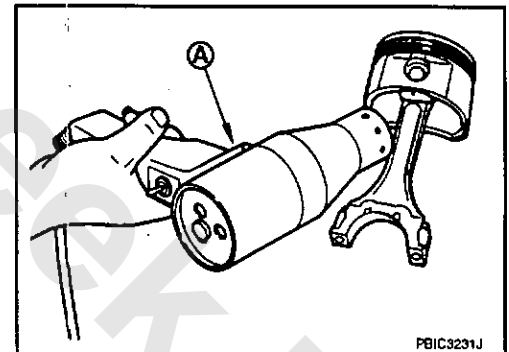


10. Remove piston from connecting rod with the following procedure:

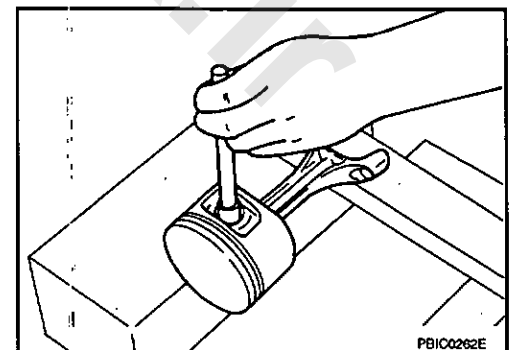
- a. Using snap ring pliers (A), remove snap rings.



- 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).



11. Remove main bearing cap mounting bolts.

- Measure crankshaft end play before loosening main bearing cap mounting bolts. Refer to EM-221, "Inspection".

# CYLINDER BLOCK

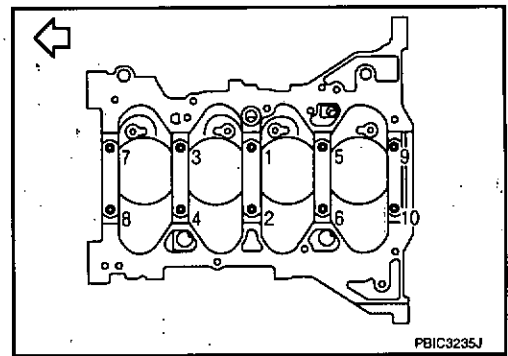
[MR20DE]

## < 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.**

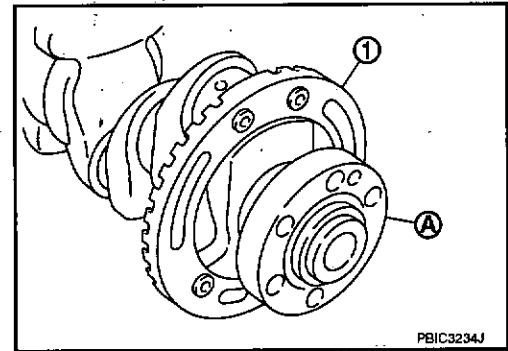
- Remove crankshaft.

### 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.

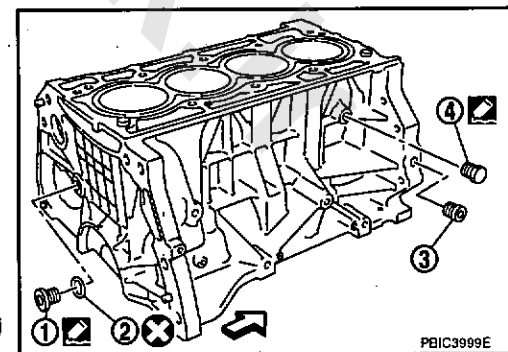
2 : Washer

⇐ : 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  
1

Washer  
Yes

Tightening torque  
54.0 N·m (5.5 kg·m, 40 ft·lb)

# **CYLINDER BLOCK**

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

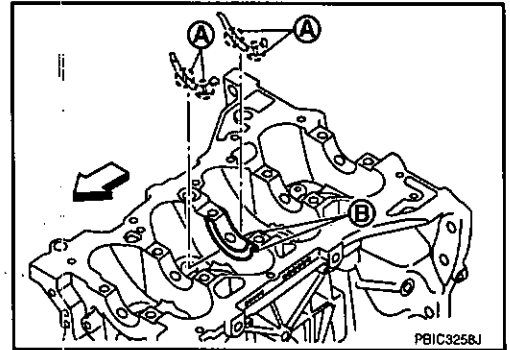
Part	Washer	Tightening torque
3	No	19.6 N·m (2.0 kg-m, 14 ft-lb)
4	No	9.8 N·m (1.0 kg-m, 87 in-lb)

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

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

↔ : Engine front

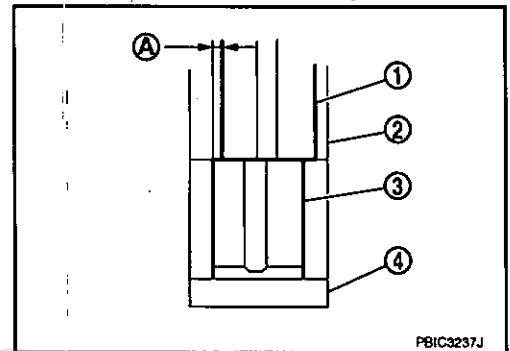
- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).



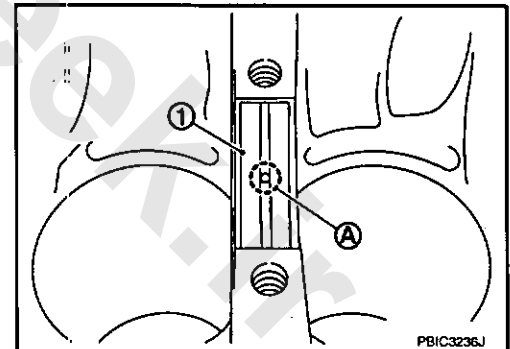
c. Install the main bearings paying attention to the direction.

- 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 (0.033 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.

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

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- 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:

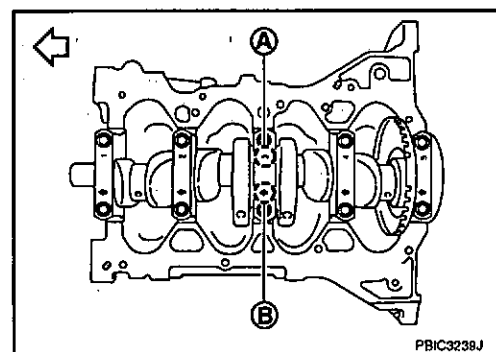
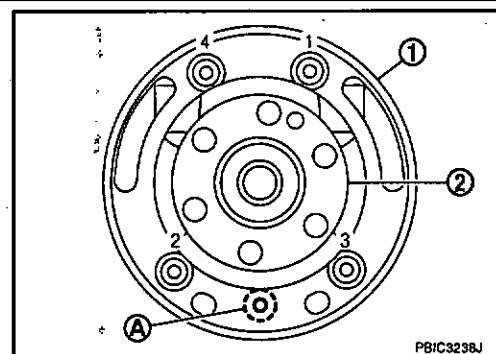
**Be sure to remove dowel pin.**

5. Install crankshaft to cylinder block.  
• While turning crankshaft by hand, make sure 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.

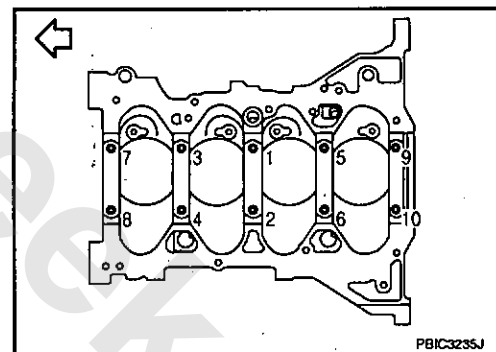


- b. Tighten main bearing cap bolts in numerical order as shown in the figure with the following procedure:

← : Engine front

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

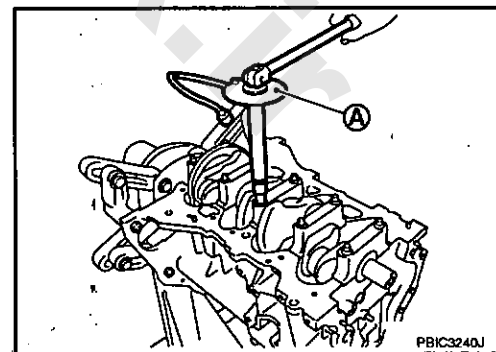
: 34.3 N·m (3.5 kg-m, 25 ft-lb)



- 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.**



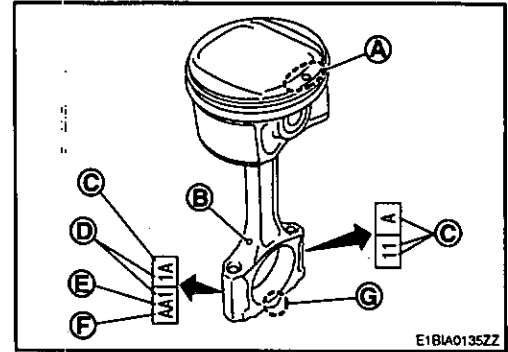
- After installing mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
  - Check crankshaft end play. Refer to EM-221, "Inspection".
7. Install piston to connecting rod with the following procedure:  
a. Using snap ring pliers, install new snap ring to the groove of the piston 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.



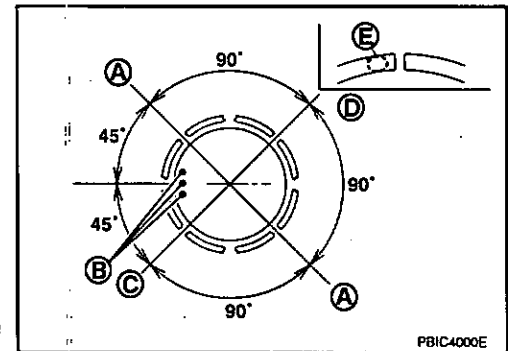
- C : Management code
- E : Big end diameter grade
- F : Small end diameter grade
- G : Front mark (connecting rod cap)

- Install new snap ring to the groove of the piston front side.
  - Insert it fully into groove to install.
  - After installing, make sure 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.

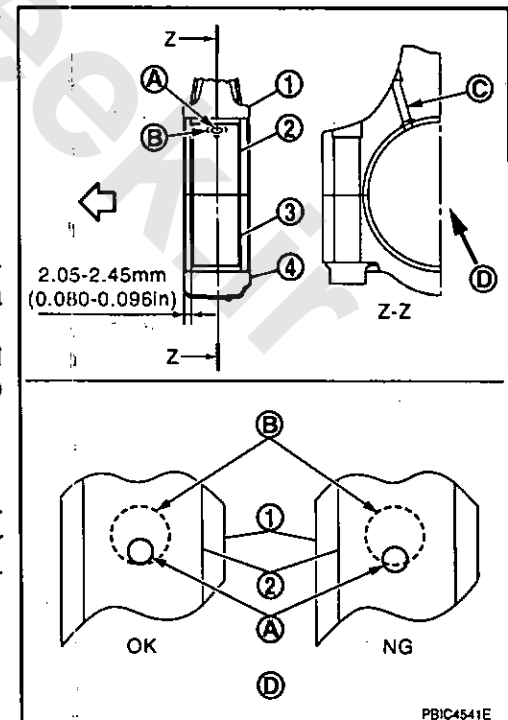
- Install connecting rod bearing upper (2) and lower (3) to connecting rod (1) and connecting rod cap (4).

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

- Install the connecting rod in the dimension shown in the figure.
- Make sure 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.

# CYLINDER BLOCK

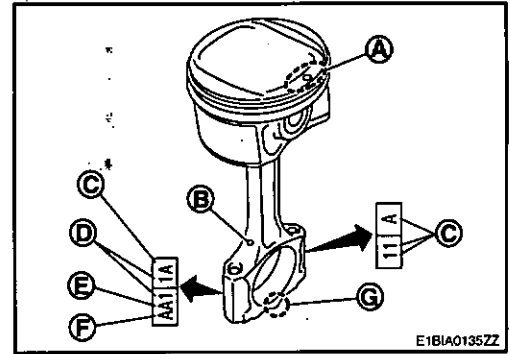
## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

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

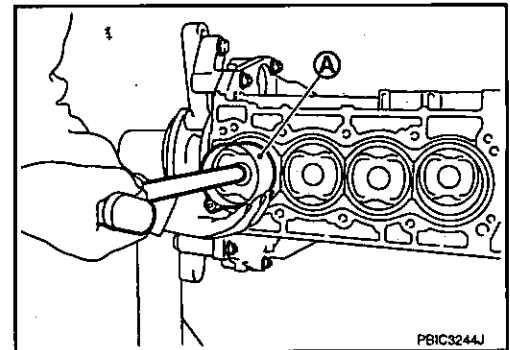
- Install so that front mark (A) on the piston head faces the front of engine.



- 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:

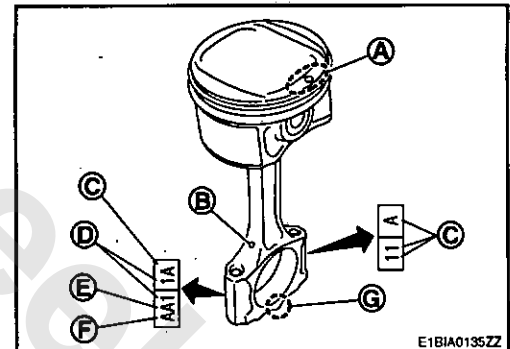
Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



## 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:

- Make sure 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-221. "Inspection".

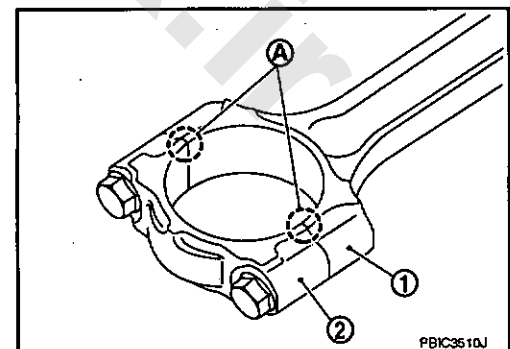
- Apply new engine oil to the threads and seats of connecting rod cap bolts.
- Tighten bolts.

: 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.



## CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

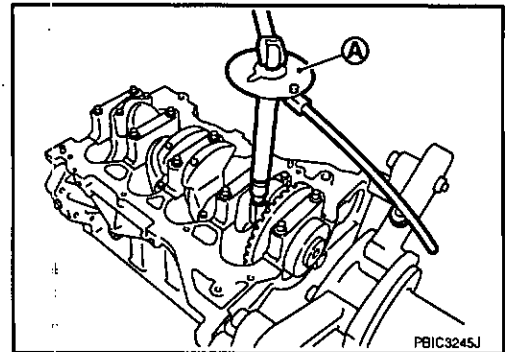
[MR20DE]

: 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, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-221, "Inspection".

13. Install oil pan (upper). Refer to EM-208, "Exploded View".

**NOTE:**

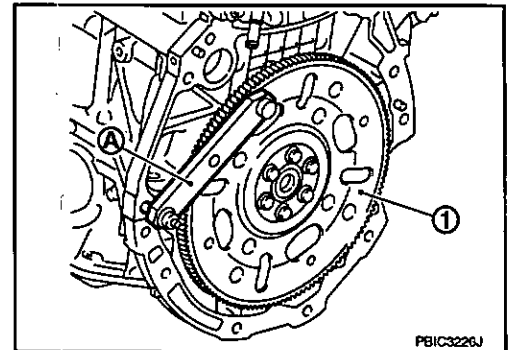
Install the rear oil seal after installing the oil pan (upper).

14. Install rear oil seal. Refer to EM-185, "REAR OIL SEAL : Removal and Installation".

15. Install drive plate (1) (CVT models) or flywheel (M/T models).

**Drive plate**

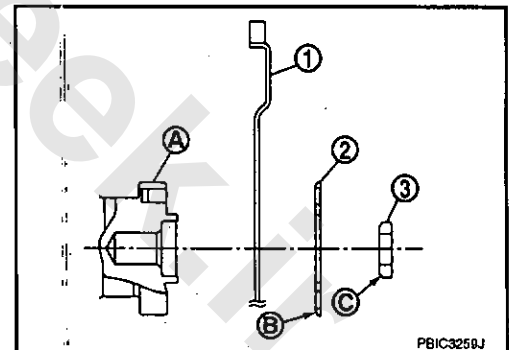
- Secure crankshaft with a stopper plate [SST: KV11105210] (A), and tighten mounting bolts crosswise over several times.



- 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

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

A : Cylinder block left side

⇐ : Engine front

### CAUTION:

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

### NOTE:

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

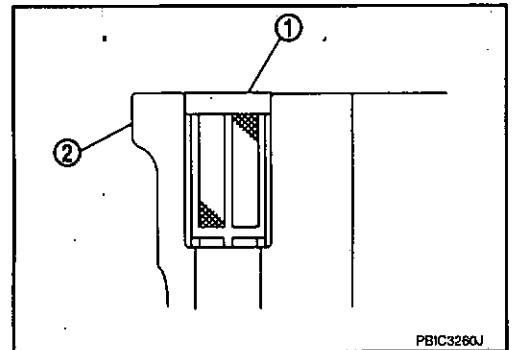
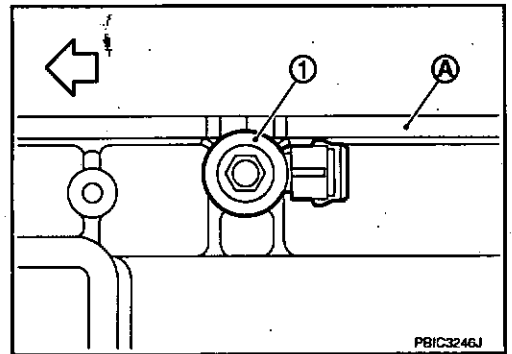
17. Install crankshaft position sensor (POS) and crankshaft position sensor (POS) cover.

### 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.

- Make sure 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

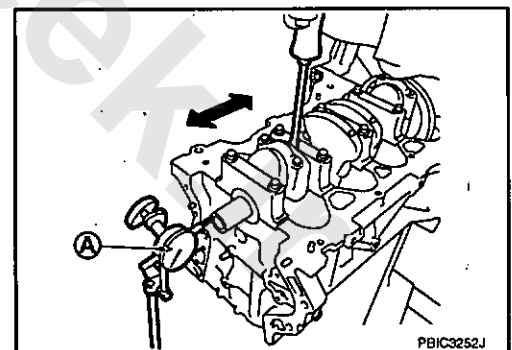
INFOID:0000000004899281

### 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-243, "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

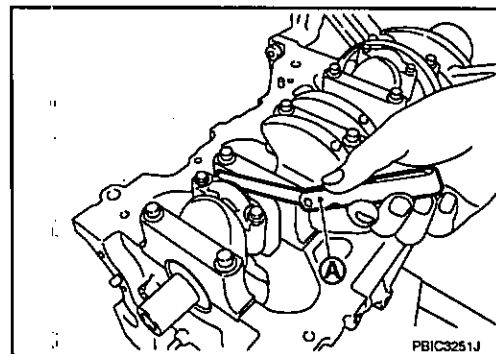
### < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

**Standard and Limit** : Refer to EM-243, "Cylinder Block".

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

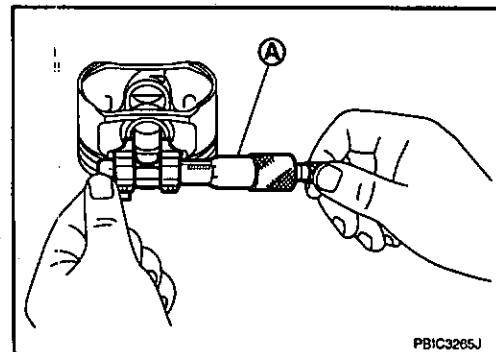


### PISTON TO PISTON PIN OIL CLEARANCE

#### Piston Pin Hole Diameter

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

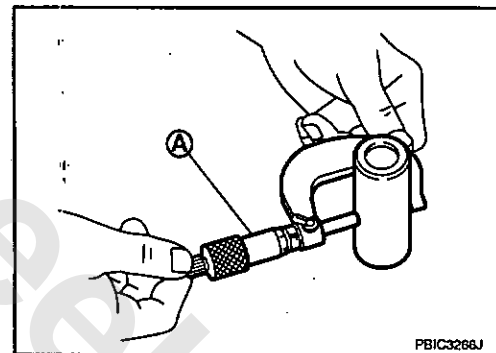
**Standard** : Refer to EM-243, "Cylinder Block".



#### Piston Pin Outer Diameter

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

**Standard** : Refer to EM-243, "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-243, "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-231, "Piston".

#### NOTE:

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

### PISTON RING SIDE CLEARANCE

# CYLINDER BLOCK

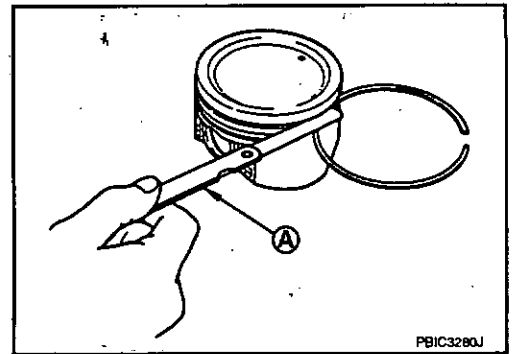
## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

**Standard and Limit** : Refer to EM-243. "Cylinder Block".

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

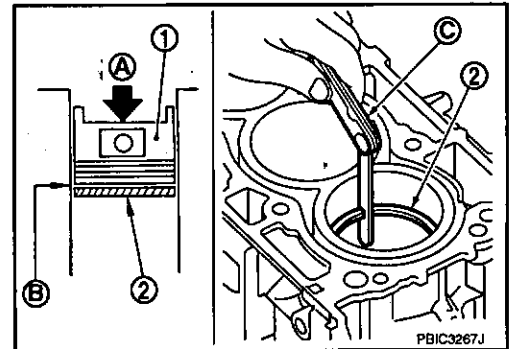


## PISTON RING END GAP

- Make sure 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-243. "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.



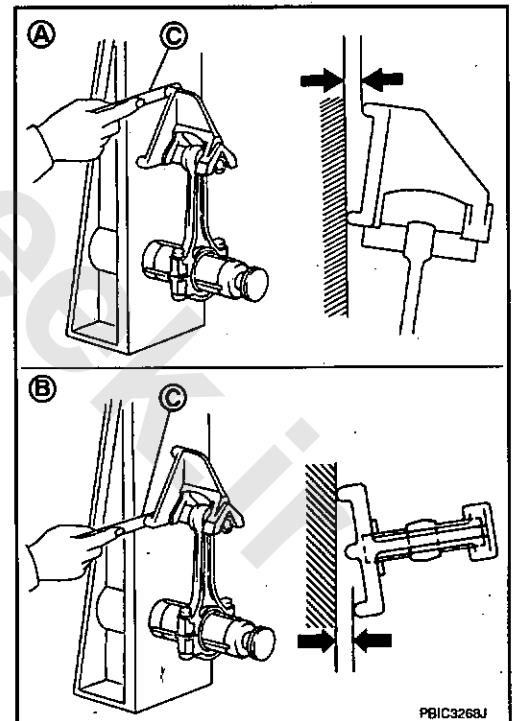
## CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

A : Bend  
B : Torsion  
C : Feeler gauge

**Limit** : Refer to EM-243. "Cylinder Block".

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



## CONNECTING ROD BIG END DIAMETER

## CYLINDER BLOCK

### < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to EM-213, "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-243, "Cylinder Block".

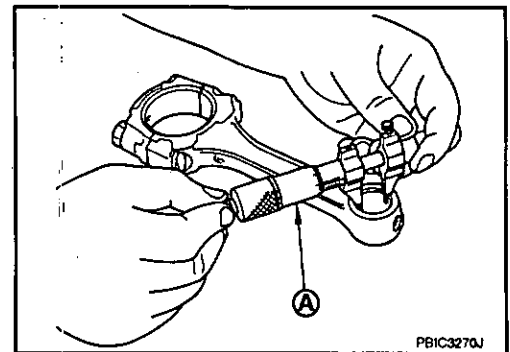
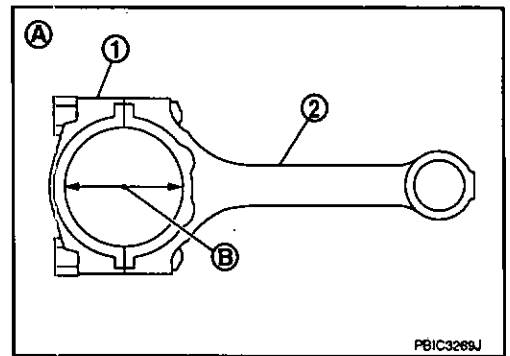
- If out of the standard, replace connecting rod assembly.

### CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

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

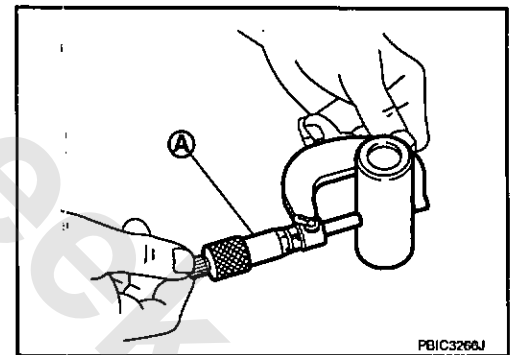
**Standard** : Refer to EM-243, "Cylinder Block".



Piston Pin Outer Diameter

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

**Standard** : Refer to EM-243, "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-243, "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-231, "Piston".
- If replacing connecting rod assembly. Refer to EM-232, "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

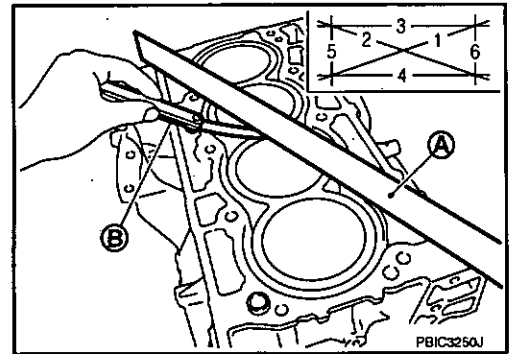
[MR20DE]

## < 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-243, "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-213, "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.

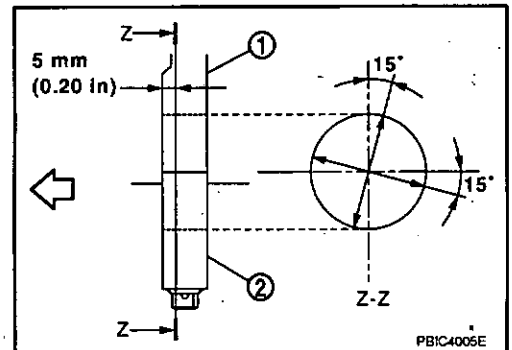
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

**Standard** : Refer to EM-243, "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-243, "Cylinder Block".

### Limit:

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

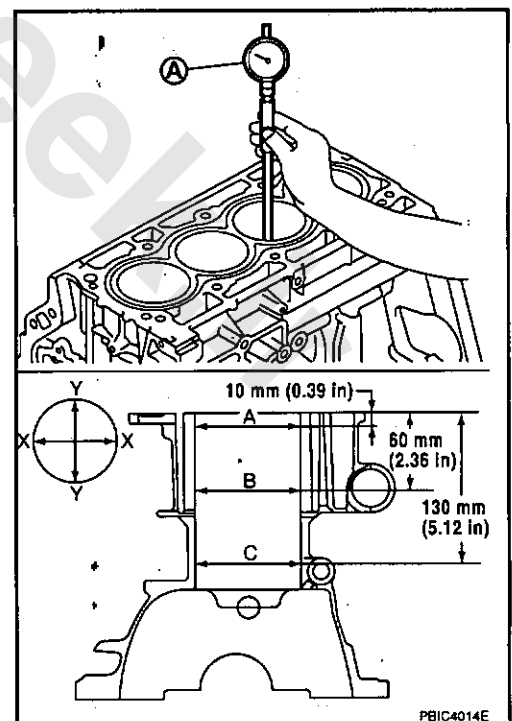
**Taper (Difference between "A" and "B")**

: Refer to EM-243, "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

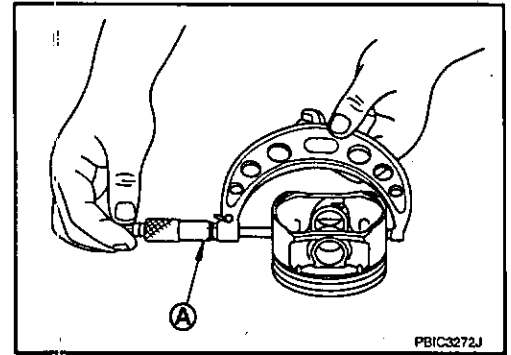
# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

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

**Standard** : Refer to EM-243, "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-243, "Cylinder Block".

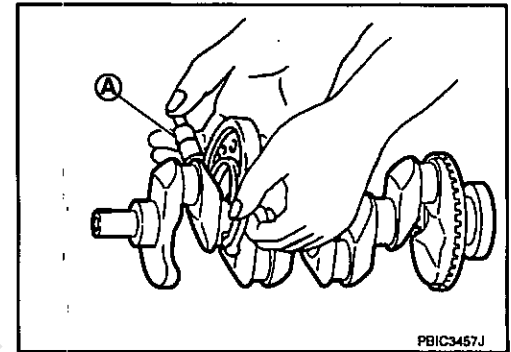
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to EM-231, "Piston".

### CRANKSHAFT MAIN JOURNAL DIAMETER

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

**Standard** : Refer to EM-243, "Cylinder Block".

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-234, "Main Bearing".



### CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard** : Refer to EM-243, "Cylinder Block".

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-232, "Connecting Rod Bearing".

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

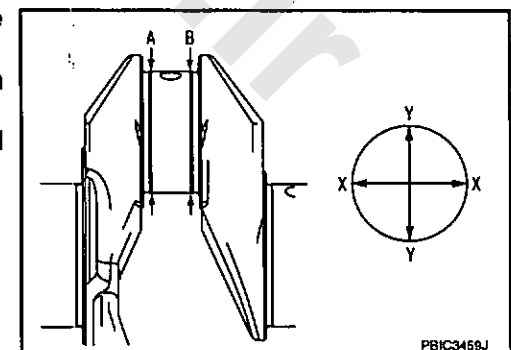
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in dimension between "A" and "B" at "X"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

**Limit:**

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

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

: Refer to EM-243, "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-232, "Connecting Rod Bearing" and/or EM-234, "Main Bearing".

### CRANKSHAFT RUNOUT

# CYLINDER BLOCK

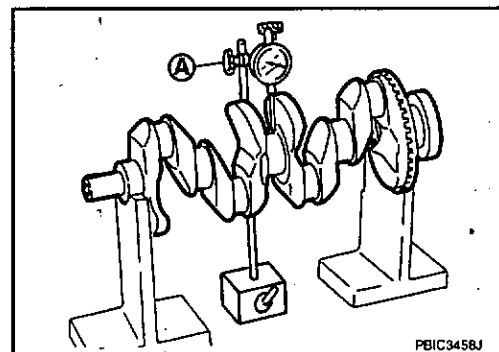
## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- 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-243, "Cylinder Block".

- If it exceeds the limit, replace crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

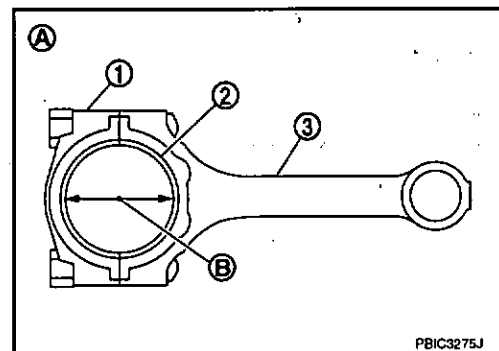
### Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to EM-213, "Disassembly and Assembly".

A : Example

B : Inner diameter measuring direction

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



**Standard and Limit** : Refer to EM-246, "Connecting Rod Bearing".

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to EM-232, "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-213, "Disassembly and Assembly".

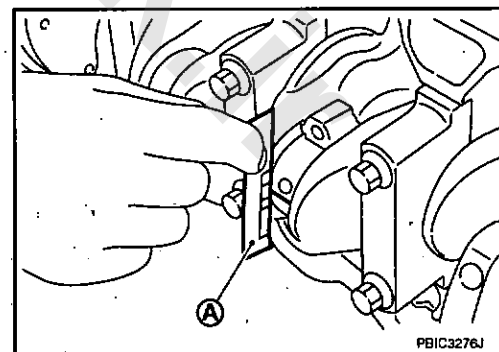
### CAUTION:

**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".



## MAIN BEARING OIL CLEARANCE

### Method by Calculation

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

- 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-213, "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-247, "Main Bearing".

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to EM-234, "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-213, "Disassembly and Assembly".

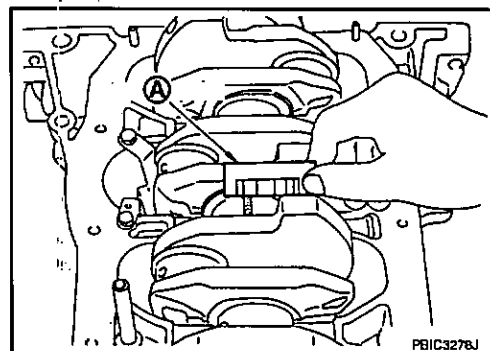
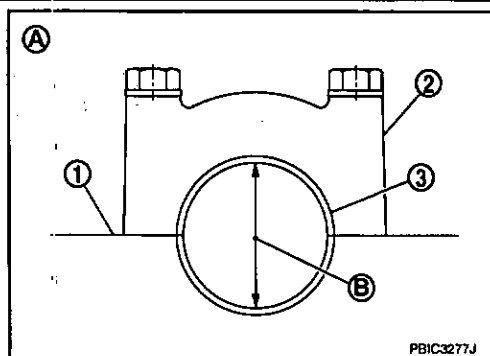
### CAUTION:

**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".



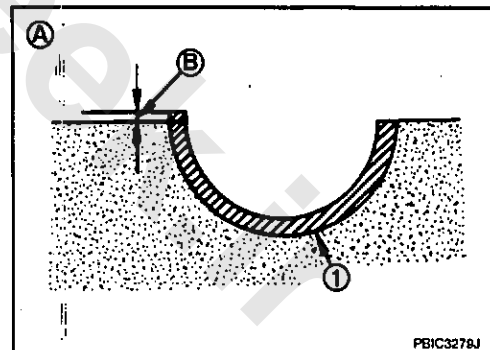
## MAIN BEARING CRUSH HEIGHT

- 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-213, "Disassembly and Assembly".

A : Example

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

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



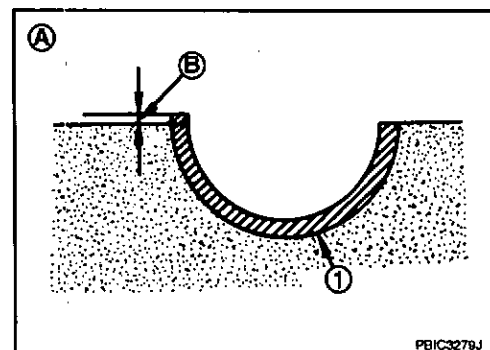
## CONNECTING ROD BEARING CRUSH HEIGHT

- 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-213, "Disassembly and Assembly".

A : Example

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

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





# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[MR20DE]

### MAIN BEARING CAP BOLT OUTER DIAMETER

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

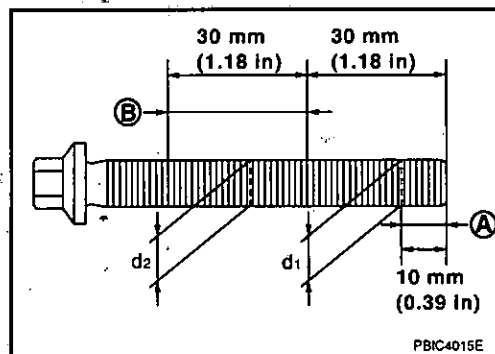
A : "d1" measuring position

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.

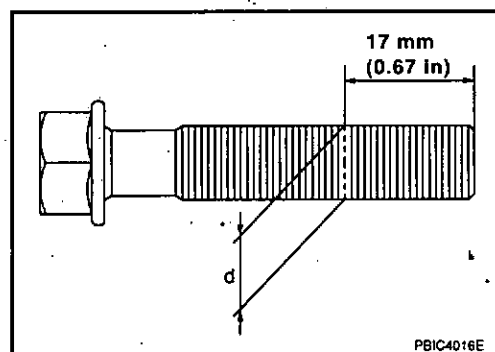


### CONNECTING ROD CAP BOLT OUTER DIAMETER

- 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".

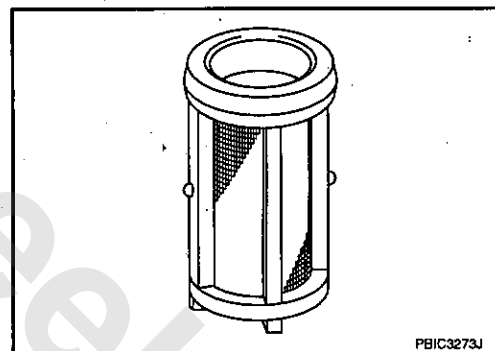
**Limit: 7.75 mm (0.3051 in)**

- 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)

- Make sure 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.

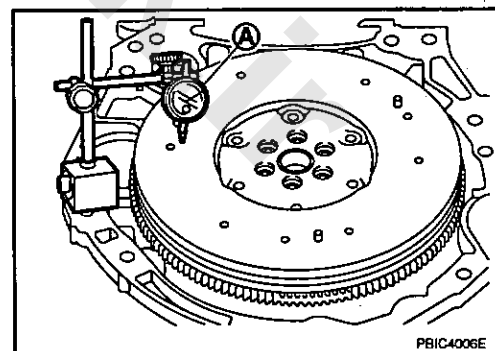
### MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

#### 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]

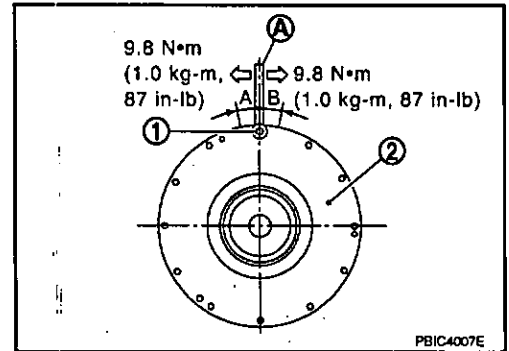
**Standard : 1.8 mm (0.071 in) or less**

- 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.**

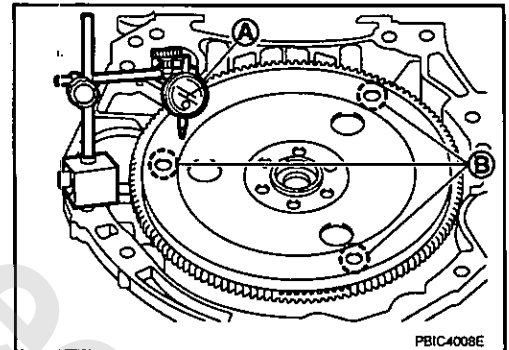
- If measured value is out of the standard, replace flywheel.

### 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.



# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[MR20DE]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:0000000004899282

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

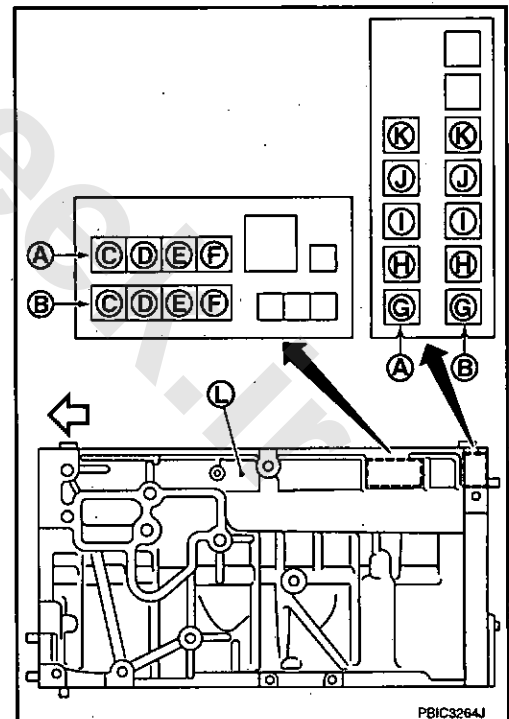
INFOID:0000000004899283

#### 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-221, "Inspection".
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".

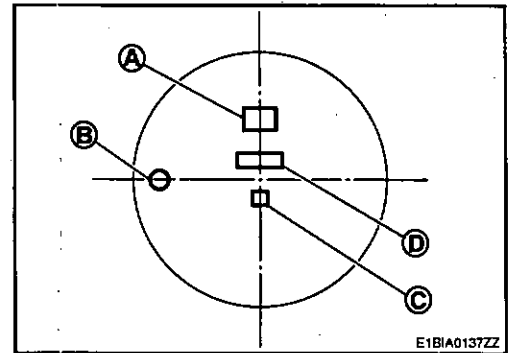
# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[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.

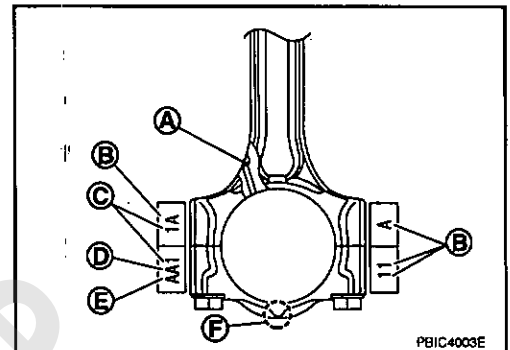
## Connecting Rod Bearing

INFOID:0000000004899284

### WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

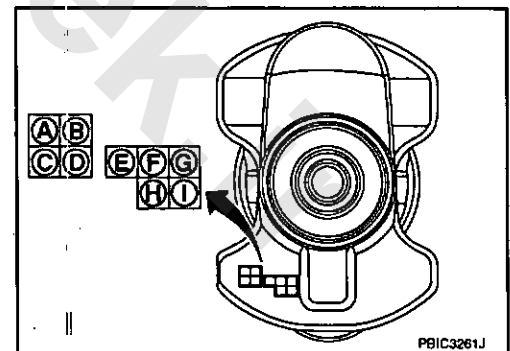
1. Apply connecting rod big end diameter grade stamped on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

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



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

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



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

### WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-221, "Inspection".

# HOW TO SELECT PISTON AND BEARING

[MR20DE]

< DISASSEMBLY AND ASSEMBLY >

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

## CONNECTING ROD BEARING SELECTION TABLE

<div> <div>Connecting rod big end diameter Unit: mm (in)</div> <div>Crankshaft pin journal diameter Unit: mm (in)</div> </div>		Mark		A	B	C	D	E	F	G	H	J	K	L	M	N
		Hole diameter		47.000 - 47.001 (1.8504 - 1.8504)	47.001 - 47.002 (1.8504 - 1.8505)	47.002 - 47.003 (1.8505 - 1.8505)	47.003 - 47.004 (1.8505 - 1.8505)	47.004 - 47.005 (1.8505 - 1.8506)	47.005 - 47.006 (1.8506 - 1.8506)	47.006 - 47.007 (1.8506 - 1.8507)	47.007 - 47.008 (1.8507 - 1.8507)	47.008 - 47.009 (1.8507 - 1.8507)	47.009 - 47.010 (1.8507 - 1.8508)	47.010 - 47.011 (1.8508 - 1.8508)	47.011 - 47.012 (1.8508 - 1.8509)	47.012 - 47.013 (1.8509 - 1.8509)
Mark	Axle diameter															
A	43.970 - 43.971 (1.7311 - 1.7311)	0	0	0	0	0	0	0	0	0	0	1	1	1	12	12
B	43.969 - 43.970 (1.7311 - 1.7311)	0	0	0	0	0	0	0	0	0	1	1	1	12	12	12
C	43.968 - 43.969 (1.7310 - 1.7311)	0	0	0	0	0	0	0	0	1	1	1	1	12	12	2
D	43.967 - 43.968 (1.7310 - 1.7310)	0	0	0	0	0	0	0	1	1	1	1	1	12	12	2
E	43.966 - 43.967 (1.7309 - 1.7310)	0	0	0	0	0	0	1	1	1	1	1	1	12	12	2
F	43.965 - 43.966 (1.7309 - 1.7309)	0	0	0	0	1	1	1	1	1	1	1	1	12	12	2
G	43.964 - 43.965 (1.7309 - 1.7309)	0	0	1	1	1	1	1	1	1	1	1	1	12	12	2
H	43.963 - 43.964 (1.7308 - 1.7309)	0	1	1	1	1	1	1	1	1	1	1	1	12	12	2
J	43.962 - 43.963 (1.7308 - 1.7308)	1	1	1	1	1	1	1	1	1	1	1	1	12	12	2
K	43.961 - 43.962 (1.7307 - 1.7308)	1	1	1	1	1	1	1	1	1	1	1	1	12	12	2
L	43.960 - 43.961 (1.7307 - 1.7307)	1	1	1	1	1	1	1	1	1	1	1	1	12	12	2
M	43.959 - 43.960 (1.7307 - 1.7307)	1	1	1	1	1	1	1	1	1	1	1	1	12	12	2
N	43.958 - 43.959 (1.7306 - 1.7307)	1	1	1	1	1	1	1	1	1	1	1	1	12	12	2
P	43.957 - 43.958 (1.7306 - 1.7306)	1	1	1	1	1	1	1	1	1	1	1	1	12	12	2
R	43.956 - 43.957 (1.7305 - 1.7306)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
S	43.955 - 43.956 (1.7305 - 1.7305)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
T	43.954 - 43.955 (1.7305 - 1.7305)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
U	43.953 - 43.954 (1.7304 - 1.7305)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

PBIC4077E

## CONNECTING ROD BEARING GRADE TABLE

Connecting rod bearing grade table : Refer to EM-246, "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

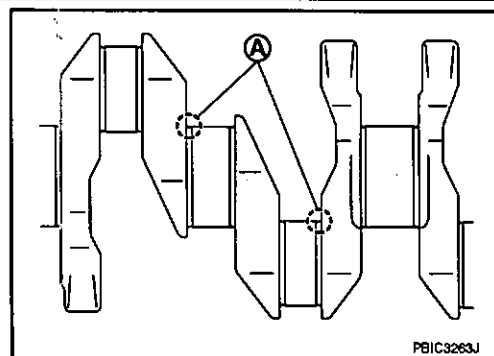
< DISASSEMBLY AND ASSEMBLY >

[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-246. "Connecting Rod Bearing"



INFOID:000000004899285

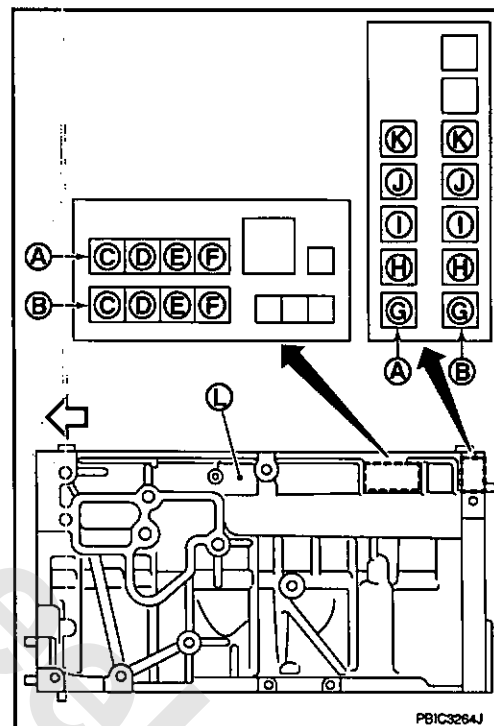
## Main Bearing

### 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).

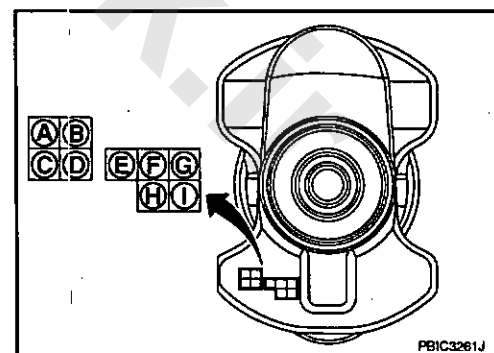
- A : Correction stamp
- B : Standard stamp
- C : Cylinder No. 1 bore grade
- D : Cylinder No. 2 bore grade
- E : Cylinder No. 3 bore grade
- F : Cylinder No. 4 bore grade
- G : No. 1 main bearing housing grade
- H : No. 2 main bearing housing grade
- I : No. 3 main bearing housing grade
- J : No. 4 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-221, "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)

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

**[MR20DE]**

Crankshaft main journal diameter Unit: mm (in)	Cylinder block main bearing housing inner 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)	1	12	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45				
B	51.977 - 51.978 (2.0463 - 2.0464)	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45				
C	51.976 - 51.977 (2.0463 - 2.0463)	12	12	2	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				
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				
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	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	5	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	5	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	5	56	56	56	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	5	56	56	56	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	5	56	56	56	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	5	56	56	56	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	5	56	56	56	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	5	56	56	56	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	67	67	67	7	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	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														

PBIC4079E

**Main bearing grade table (All journals) : Refer to EM-247, "Main Bearing".**

- 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.

**EM-236**



# HOW TO SELECT PISTON AND BEARING

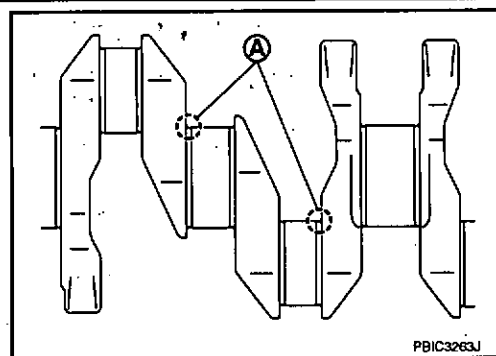
< DISASSEMBLY AND ASSEMBLY >

[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-247. "Main Bearing".



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

#### General Specification

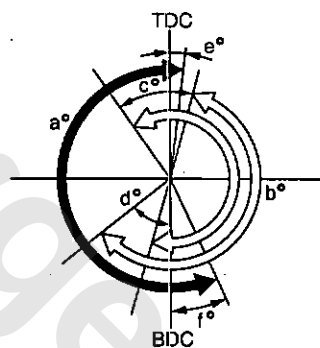
INFOID:0000000004899286

#### 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)

#### Valve timing

( ) : Valve timing control "ON"



PBIC4542E

Unit: degree					
a	b	c	d	e	f
212	224	-8 (32)	52 (12)	7	25

#### Drive Belt

INFOID:0000000004899287

#### DRIVE BELT

Tension of drive belt	Auto adjustment by auto-tensioner
-----------------------	-----------------------------------

#### Spark Plug

INFOID:0000000004899288

#### SPARK PLUG

Unit: mm (in)

Make	NGK
Standard type	PLZKAR6A-11, PLZKAR7A-11, PLZKAR5A-11
Gap (Nominal)	1.1 (0.043)

#### Exhaust Manifold

INFOID:0000000004899289

#### EXHAUST MANIFOLD

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Unit: mm (in)

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

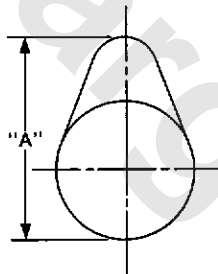
## Camshaft

INFOID:0000000004899290

## 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)	44.405 (1.748)
	Exhaust	43.775 - 43.965 (1.7234 - 1.7309)	43.165 (1.699)
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)
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)

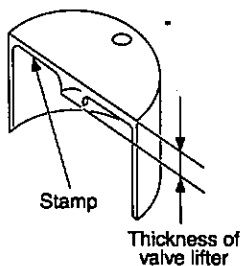
## AVAILABLE VALVE LIFTER

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

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:000000004899291

## CYLINDER HEAD

Unit: mm (in)

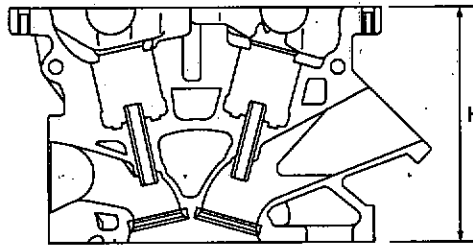
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

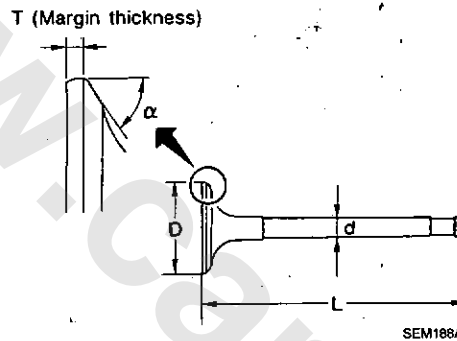
Items	Standard	Limit
Normal cylinder head height "H"	130.9 (5.15)	—



PBIC0924E

## VALVE DIMENSIONS

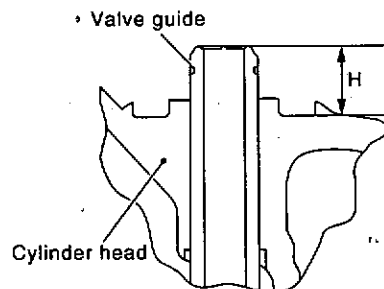
Unit: mm (in)



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 (4.184)
	Exhaust	105.26 (4.144)
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

Unit: mm (in)



PBIC2187E

Items	Standard	Oversize (service) [0.2 (0.008)]
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# SERVICE DATA AND SPECIFICATIONS (SDS)

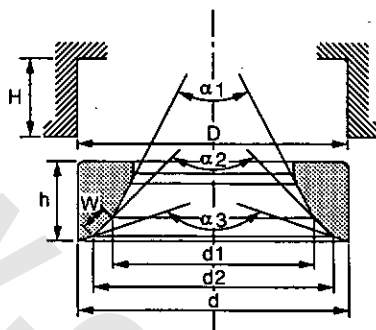
< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

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 (0.526 - 0.537)	

## VALVE SEAT

Unit: mm (in)



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°	
Contacting width "W"*3	Intake	1.0 - 1.4 (0.039 - 0.055)	
	Exhaust	1.2 - 1.6 (0.047 - 0.063)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.03 - 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

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Items	Standard	
	Intake	Exhaust
Free height	45.59 - 46.96 mm (1.7949 - 1.8488 in)	45.13 - 46.40 mm (1.7768 - 1.8268 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

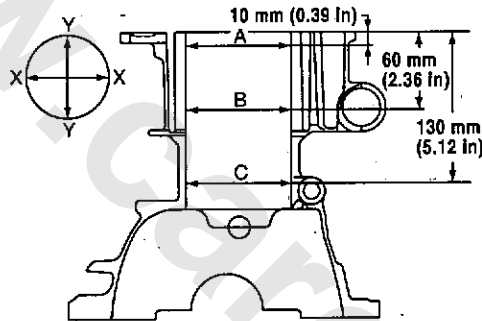
Items	Limit
Valve spring squareness	1.9 mm (0.075 in)

## Cylinder Block

INFOID:000000004899292

## CYLINDER BLOCK

Unit: mm (in)



PBIC4017E

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

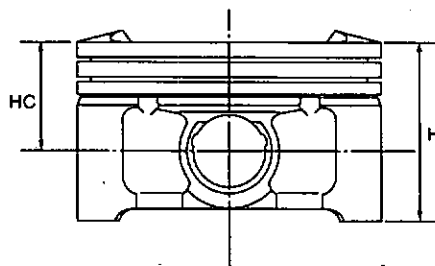
AVAILABLE PISTON

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

Unit: mm (in)



E18IA0136ZZ

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)
Comp height (HC)			31.13 (1.226)
Measure point "H"			49.63 (1.954)
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 (0.002 - 0.003)	0.11 (0.0043)
	2nd	0.03 - 0.07 (0.001 - 0.003)	0.10 (0.0039)
	Oil ring	0.015 - 0.185 (0.001 - 0.007)	—
Piston ring end gap	Top	0.20 - 0.30 (0.008 - 0.012)	0.51 (0.020)
	2nd	0.50 - 0.65 (0.020 - 0.026)	0.83 (0.033)
	Oil (rail ring)	0.15 - 0.45 (0.006 - 0.018)	0.78 (0.031)

## PISTON PIN

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 (5.471 - 5.475)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*	Standard	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)



# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

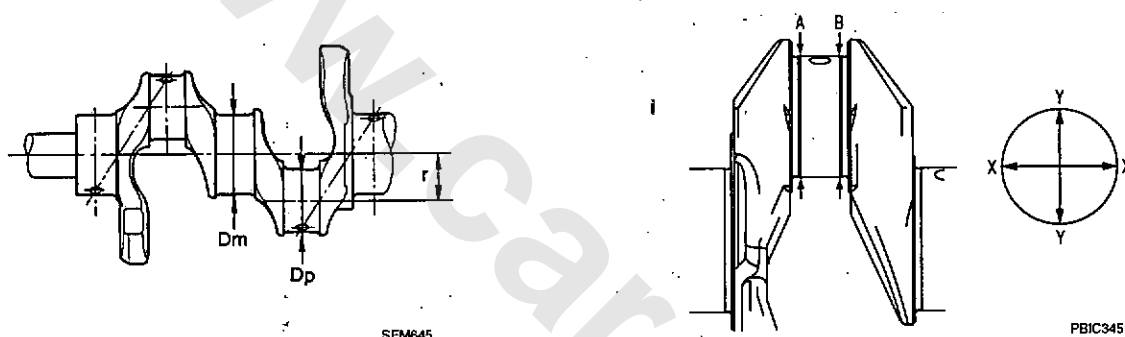
[MR20DE]

Connecting rod side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)
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 (1.8507 - 1.8508)
	Grade No. L	47.010 - 47.011 (1.8508 - 1.8508)
	Grade No. M	47.011 - 47.012 (1.8508 - 1.8509)
	Grade No. N	47.012 - 47.013 (1.8509 - 1.8509)

\*: After installing in connecting rod

## CRANKSHAFT

Unit: mm (in)



Center distance "r"		44.89 - 44.97 (1.7673 - 1.7705)
Out-of-round	Limit	0.0035 (0.0001)
	Limit	0.0035 (0.0001)
Taper	Limit	0.05 (0.0020)
	Limit	0.10 (0.0039)
Runout [TIR*]	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.012)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (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)
	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:000000004899293

### 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.
		1.497 - 1.500 (0.0589 - 0.0591)	Brown	
		1.500 - 1.503 (0.0591 - 0.0592)	Green	
		1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
		1.506 - 1.509 (0.0593 - 0.0594)	Blue	
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
	LWR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
23	UPR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
	LWR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
34	UPR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
	LWR	1.506 - 1.509 (0.0593 - 0.0594)	Blue	

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DE]

## UNDERSIZE TABLE

Unit: mm (in)

Item	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:0000000004899294

## 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)

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

## MAIN BEARING OIL CLEARANCE

Unit: mm (in)

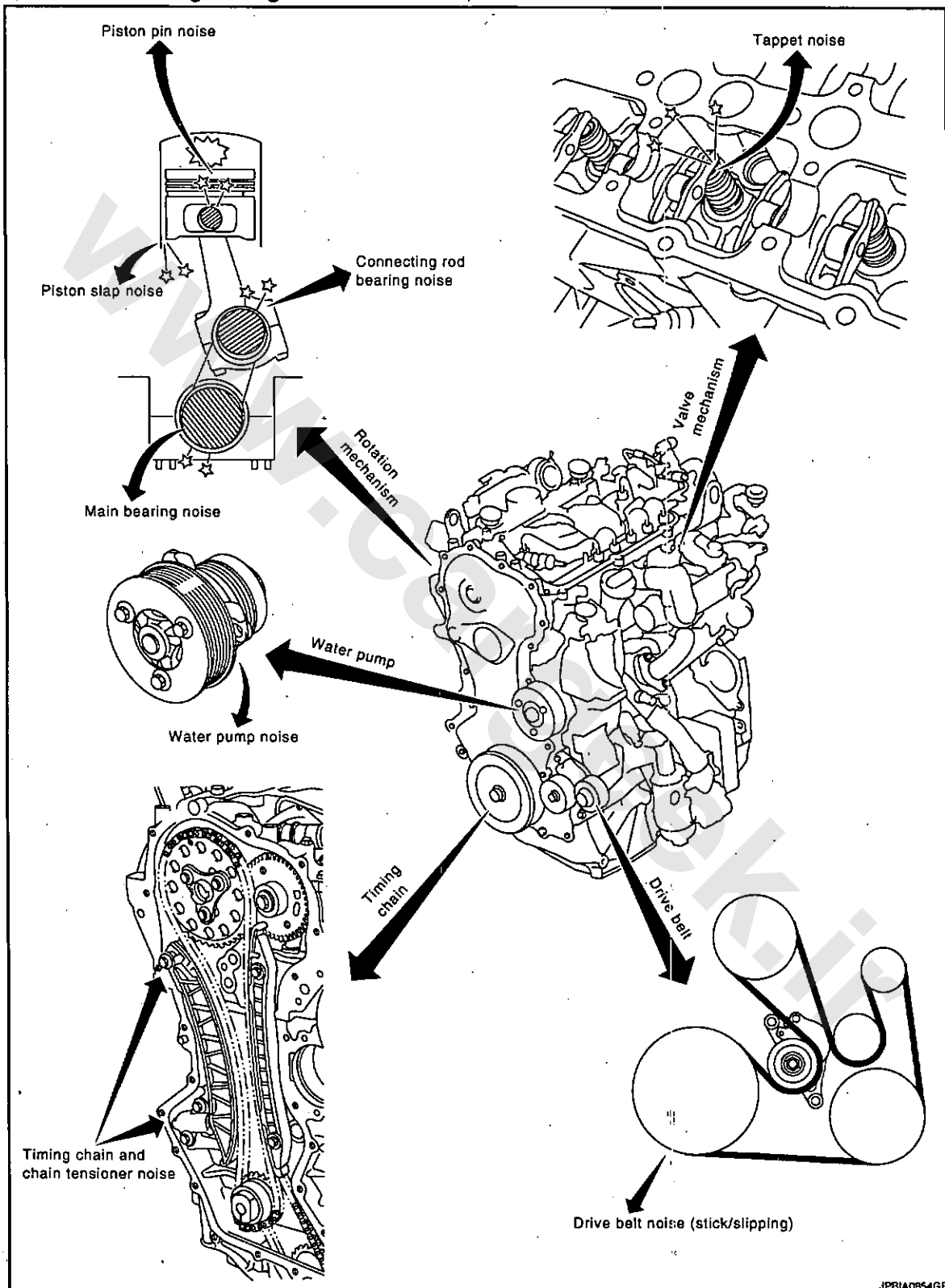
Main bearing oil clearance	Standard	No. 1, 4 and 5	0.024 - 0.034 (0.0009 - 0.0013)
		No. 2 and 3	0.012 - 0.022 (0.0005 - 0.0009)
	Limit		0.065 (0.0026)

## SYMPTOM DIAGNOSIS

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

#### NVH Troubleshooting - Engine Noise

INFOID:00000000489295



# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[M9R]

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

INFOID:0000000004899296

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	EM-290
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance	EM-311
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	EM-347
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring side clearance Piston ring end gap	EM-347
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-347
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance	EM-347
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	EM-306
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-259
	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	CO-67

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

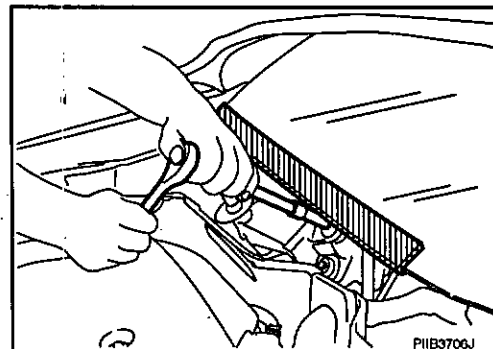
## PRECAUTION

### PRECAUTIONS

#### Precaution for Procedure without Cowl Top Cover

INFOID:0000000004899297

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



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

INFOID:0000000005022599

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. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the "SRS AIR BAG" 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.
- 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 AIR BAG".
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

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

#### WARNING:

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, DO NOT use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

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

INFOID:0000000004948635

#### 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.

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.

# PRECAUTIONS

[M9R]

## < PRECAUTION >

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.)

### Precaution for Drain Coolant

INFOID:0000000004899299

Drain coolant when engine is cooled.

### Precaution for Disconnecting Fuel Piping

INFOID:0000000004899300

- 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:0000000004899301

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

### Precaution for Inspection, Repair and Replacement

INFOID:0000000004899302

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

### Precaution for Assembly and Installation

INFOID:0000000004899303

- 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.

### Parts Requiring Angular Tightening

INFOID:0000000004899304

- 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

# PRECAUTIONS

## < PRECAUTION >

[M9R]

- 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.

## Precaution for Liquid Gasket

INFOID:000000004899305

### 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.

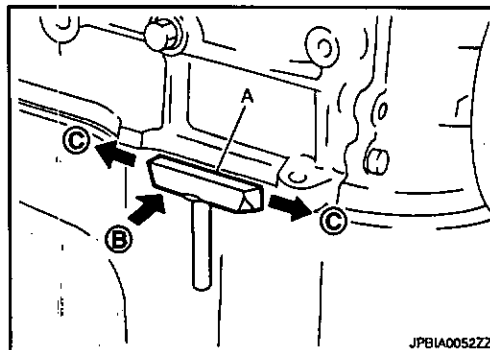
#### CAUTION:

**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.

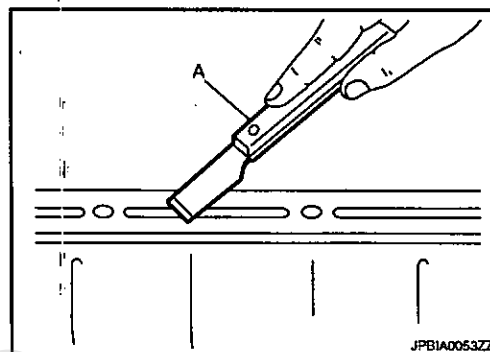
#### CAUTION:

**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

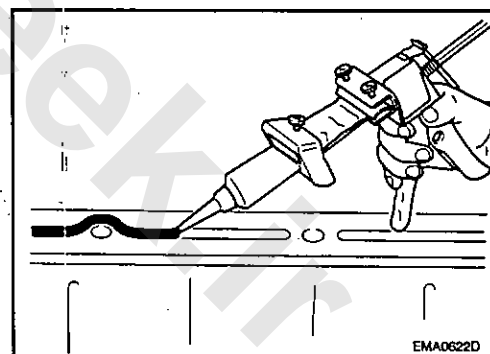
1. Using a scraper (A), remove the old liquid gasket adhering to the gasket application surface and the mating surface.
  - Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts and bolt holes.
2. Wipe the gasket application surface and the mating surface 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.**

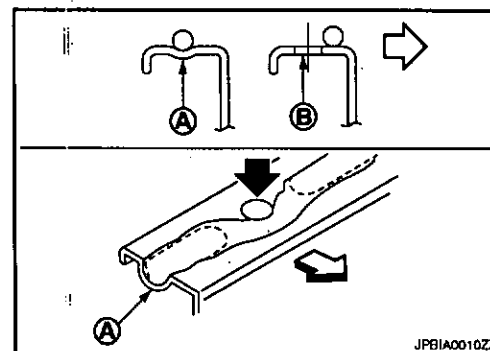
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for the liquid gasket application, apply the gasket to the groove.



- 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.





# PRECAUTIONS

< PRECAUTION >

[M9R]

## CAUTION:

If there are instructions in this manual, observe them.

## Precaution for Diesel Equipment

INFOID:0000000004899306

## 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
  - 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 towlettes 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.

# PRECAUTIONS

## < PRECAUTION >

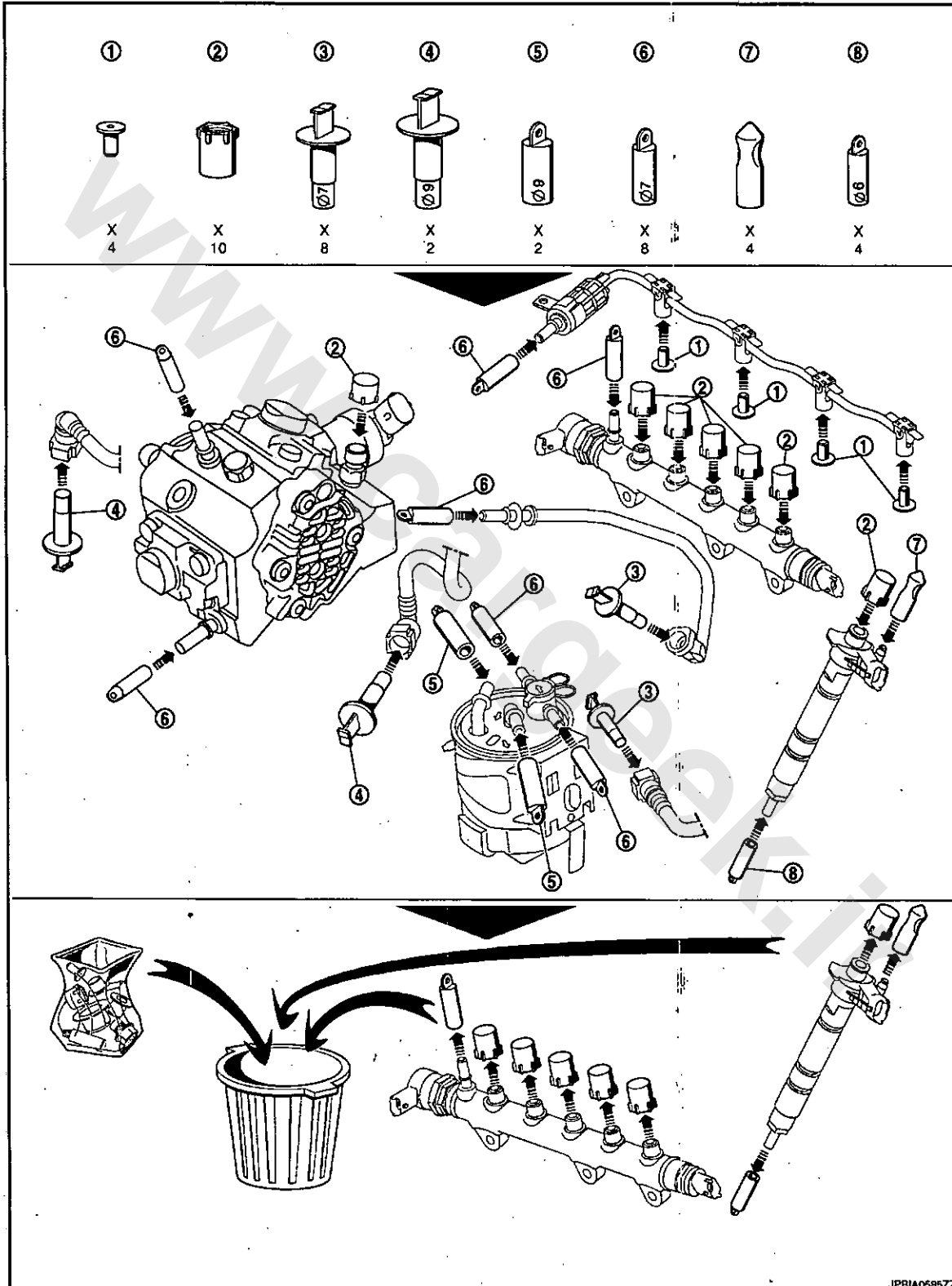
[M9R]

- 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

(Renault part No. 77 01 209 062)



JPBIA0585ZZ

## SPECIAL FEATURES

### CAUTION:

## PRECAUTIONS

[M9R]

### < PRECAUTION >

- The engine must not operate with:
- Use diesel fuel required by the regulations for cetane number. Refer to GI-31, "Fuel".
- Petrol, even in tiny quantities
- 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.

# PREPARATION

< PREPARATION >

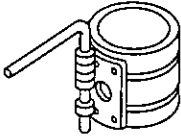
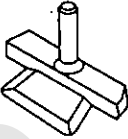
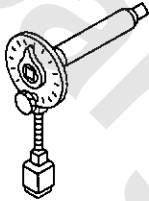
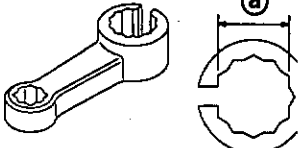
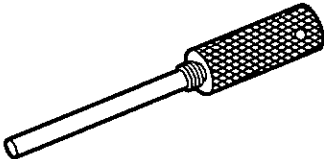
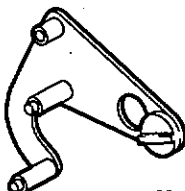
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## PREPARATION

## PREPARATION

### Special Service Tools

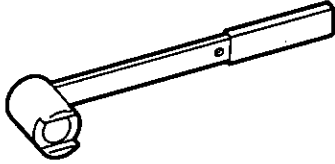
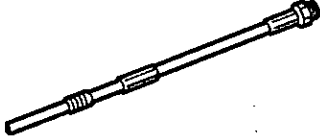
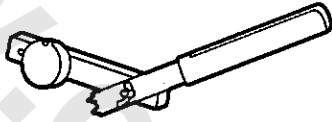
INFOID:000000004899307

NISSAN tool number (RENAULT tool No.) Tool name	Description
EM03470000 ( — ) Piston ring compressor	Installing piston assembly into cylinder bore
 NT044	
KV10111100 ( — ) Seal cutter	Removing oil pan and front cover, etc
 NT046	
KV10112100 ( — ) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
 NT014	
KV10114400 ( — ) Heated oxygen sensor wrench	Loosening or tightening air fuel ratio sensor a: 22 mm (0.87 in)
 JPBIA0397ZZ	
— (Mot. 1766) TDC set pin	To lock engine at TDC
 JPBIA0629ZZ	
— (Mot. 1769) Camshaft timing tool	To lock camshaft when changing timing chain
 JPBIA0628ZZ	

# PREPARATION

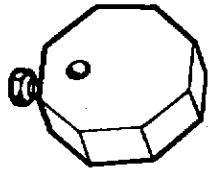
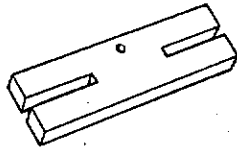
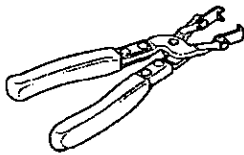
## < PREPARATION >

[M9R]

NISSAN tool number (RENAULT tool No.) Tool name	Description	
— (Mot. 1770) Crankshaft pulley locking tool	To lock crankshaft pulley	A EM
 JPBIA0630ZZ		C
— (Mot. 1772) Compression gauge adapter	Connecting compression gauge and glow plug hole	D
 JPBIA0626ZZ		E F
— (Mot. 1773) Positioning tool	To position the gear and apply for the right clearance (wear compensation gear)	G H
 JPBIA0625ZZ		

## Commercial Service Tools

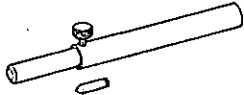
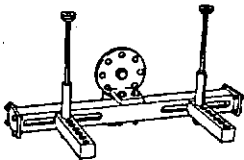
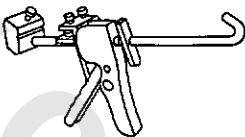
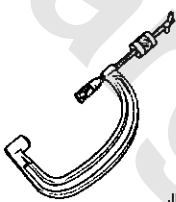
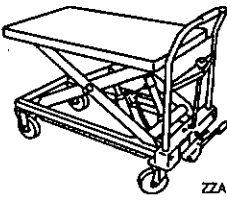
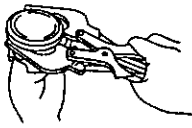
INFOID:000000004899308

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)	J K
 MBIB0360E		L
KV113B0050 (Mot. 252-01) Dial indicator stand set	Thrust plate for measuring the protrusion of piston used with KV113B0040 (Mot. 251-01)	M N
 MBIB0361E		O
KV113B0090 (Mot. 1335) Valve seal remover	Tool for removing valve oil seals	P
 MBIB0370E		

# PREPARATION

## < PREPARATION >

[M9R]

NISSAN tool number (RENAULT tool No.) Tool name		Description
KV113B0180 (Mot. 1511-01) Valve seal drift	 MB1B0378E	Tool for installing valve oil seals
KV113B0200 (Mot. 1573) Cylinder head stand	 MB1B0390E	Cylinder head and cylinder head housing support
Tube presser	 NT052	Pressing the tube of liquid gasket
Valve spring compressor	 JPB1A0770ZZ	Disassembling valve mechanism
Manual lift table caddy	 ZZA1210D	Removing and installing engine
Piston ring expander	 NT030	Removing and installing piston ring

# DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

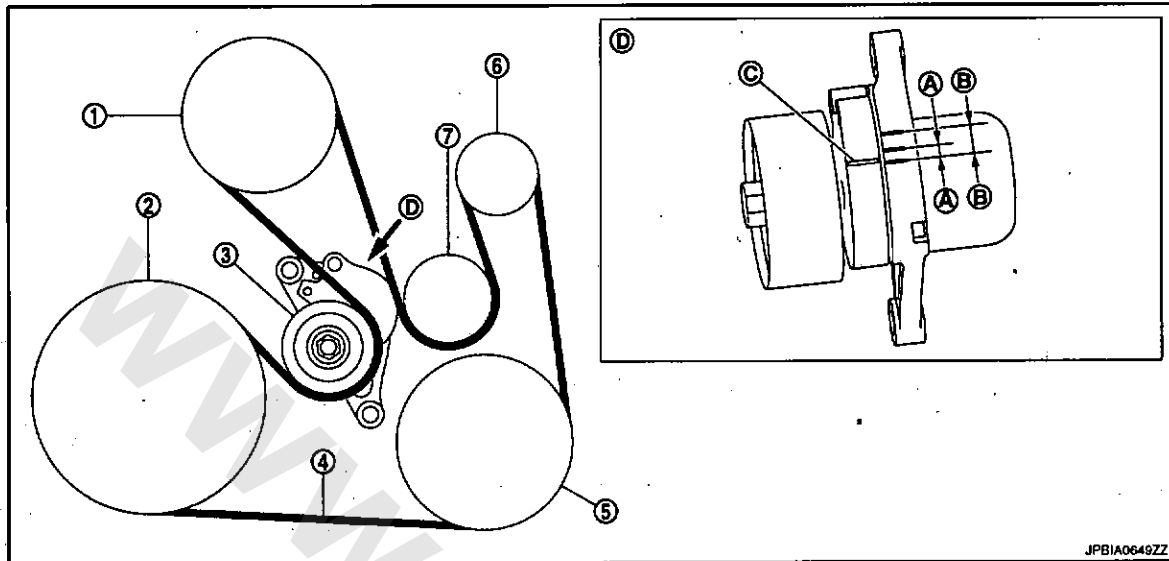
[M9R]

## ON-VEHICLE MAINTENANCE

### DRIVE BELTS

#### Exploded View

INFOID:0000000004899309



- |   |                       |                              |
|---|-----------------------|------------------------------|
| 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 D                                 |                       |                              |

#### Checking

INFOID:0000000004899310

##### 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:0000000004899311

Refer to EM-356, "Drive Belts".

#### Removal and Installation

INFOID:0000000004899312

##### 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

- Remove front fender protector (RH). Refer to EXT-22, "Exploded View".

## DRIVE BELTS

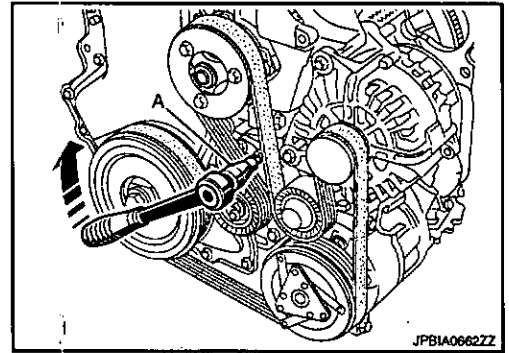
### < ON-VEHICLE MAINTENANCE >

[M9R]

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.**

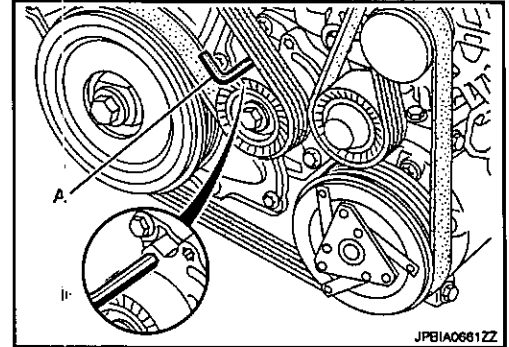


3. Insert a stopper pin (A) in diameter such as short-length screw-driver into the hole of the retaining boss to fix drive belt auto-tensioner pulley.

- 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-259, "Exploded View".



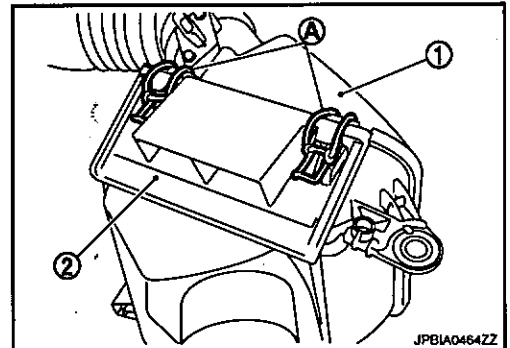
## AIR CLEANER FILTER

### Removal and Installation

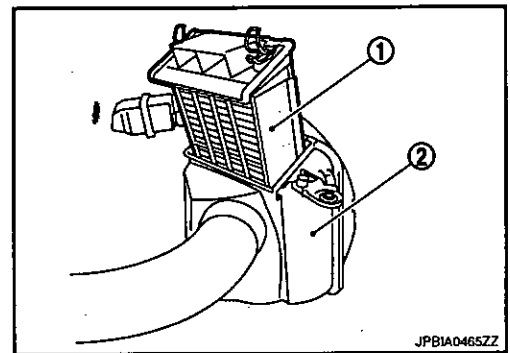
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#### REMOVAL

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

Install in the reverse order of removal.

## COMPRESSION PRESSURE

### Inspection

INFOID:0000000004899314

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-356. "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 recheck it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
  - If two adjacent cylinders have respectively low compression pressure and their compression 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.

# DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

< ON-VEHICLE REPAIR >

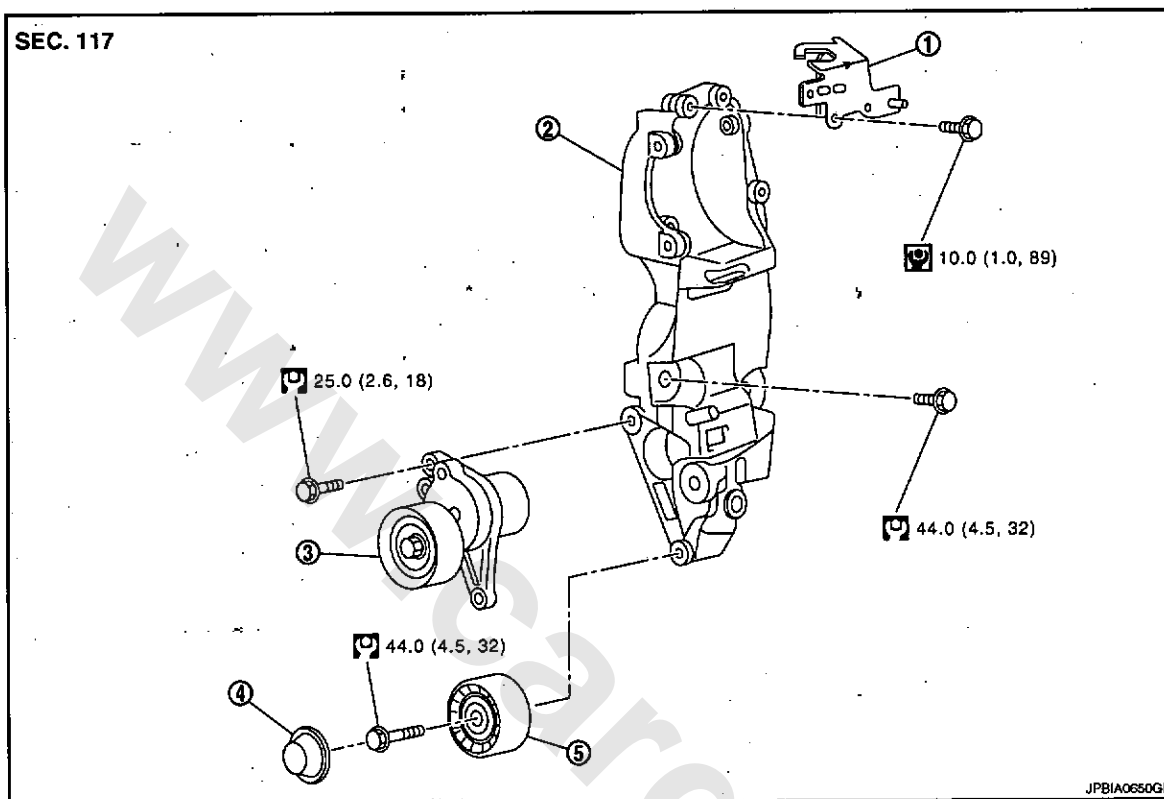
[M9R]

## ON-VEHICLE REPAIR

### DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

#### Exploded View

INFOID:0000000004899315



1. Harness bracket
2. Multifunction support bracket
3. Drive belt auto-tensioner
4. Cover
5. Idler pulley

Refer to GI-3, "Components" for symbols in the figure.

#### Removal and Installation

INFOID:0000000004899316

##### 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 drive belt. Refer to EM-259, "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 cooling fan assembly. Refer to CO-57, "Exploded View".
  - c. Remove alternator. Refer to CHG-24, "M9R MODELS : Exploded View".
  - d. 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-38, "Exploded View".
  - e. Remove multifunction support bracket.

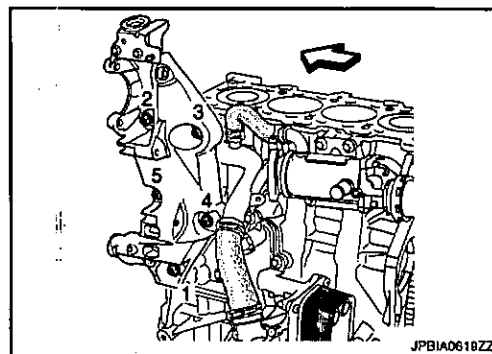
## DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

### < ON-VEHICLE REPAIR >

[M9R]

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

⇐ : Engine front



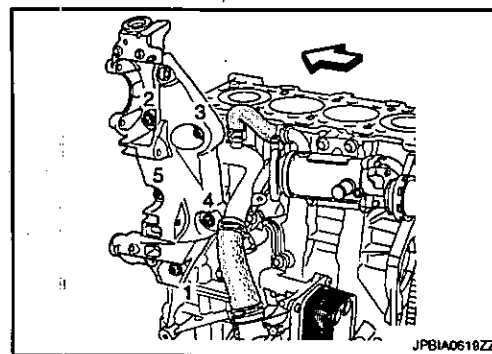
### INSTALLATION

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.

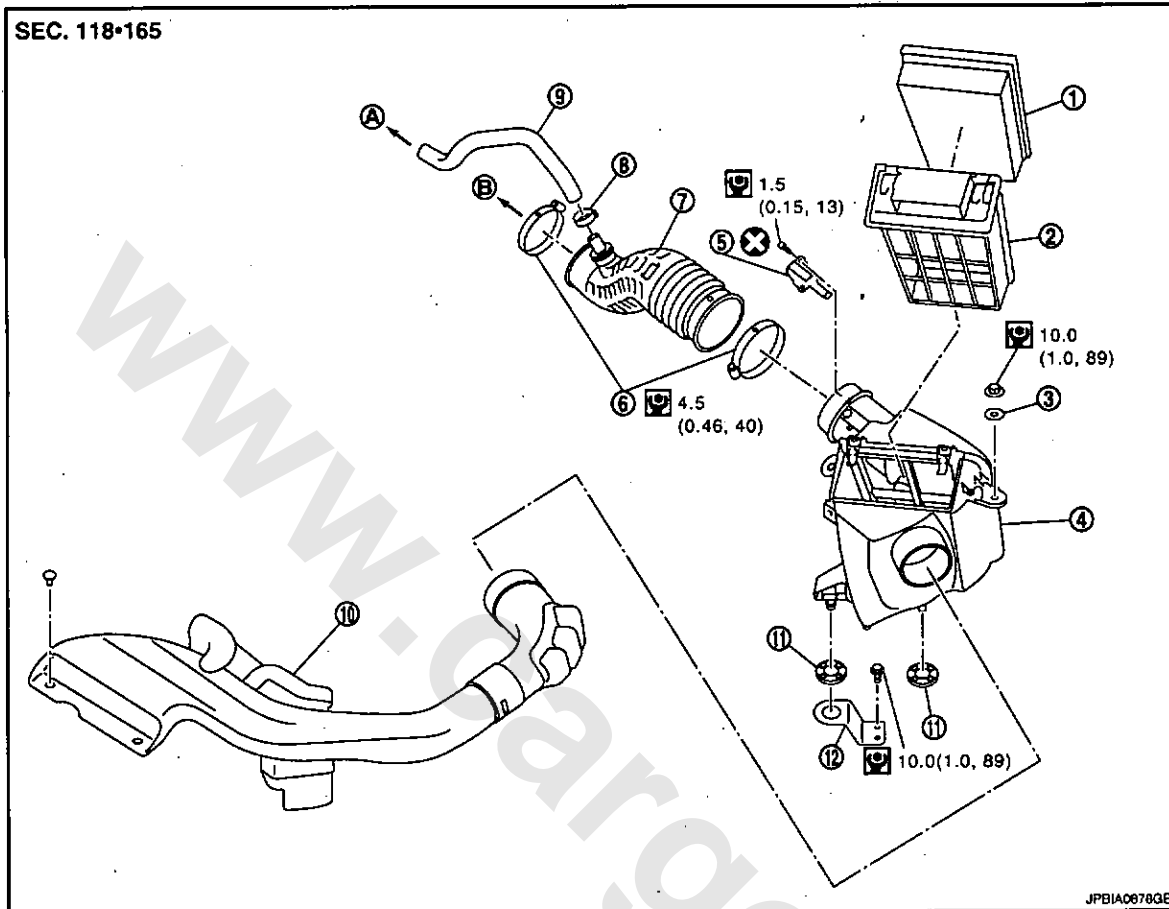
⇐ : Engine front



## AIR CLEANER AND AIR DUCT

### Exploded View

INFOID:0000000004899317



- |                       |                         |             |
|-----------------------|-------------------------|-------------|
| 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-3, "Components" for symbols in the figure.

### Removal and Installation

INFOID:0000000004899318

#### REMOVAL

1. Remove battery. Refer to PG-89, "Exploded View".
2. Disconnect ECM harness connectors and remove ECM and ECM bracket.
3. Remove engine cover. Refer to EM-267, "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.
- Never touch mass air flow sensor.

## AIR CLEANER AND AIR DUCT

< ON-VEHICLE REPAIR >

[M9R]

### INSTALLATION

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

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

### Inspection

INFOID:000000004899319

### INSPECTION AFTER REMOVAL

Inspect air duct assembly for crack or tear.

- If anything found, replace air duct assembly.

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# ENGINE COVER

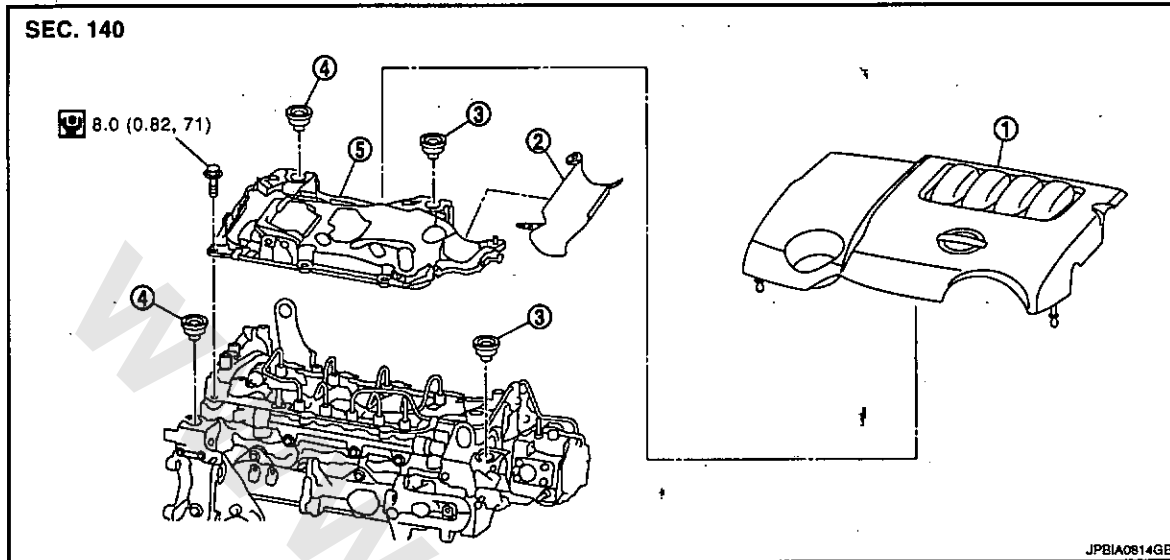
< ON-VEHICLE REPAIR >

[M9R]

## ENGINE COVER

### Exploded View

INFOID:000000004899320



- |                            |                         |                            |
|----------------------------|-------------------------|----------------------------|
| 1. Engine cover            | 2. Air inlet tube cover | 3. Mounting rubber (brown) |
| 4. Mounting rubber (black) | 5. Fuel injection cover |                            |

Refer to GI-3, "Components" for symbols in the figure.\*

### Removal and Installation

INFOID:000000004899321

#### 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-268, "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.

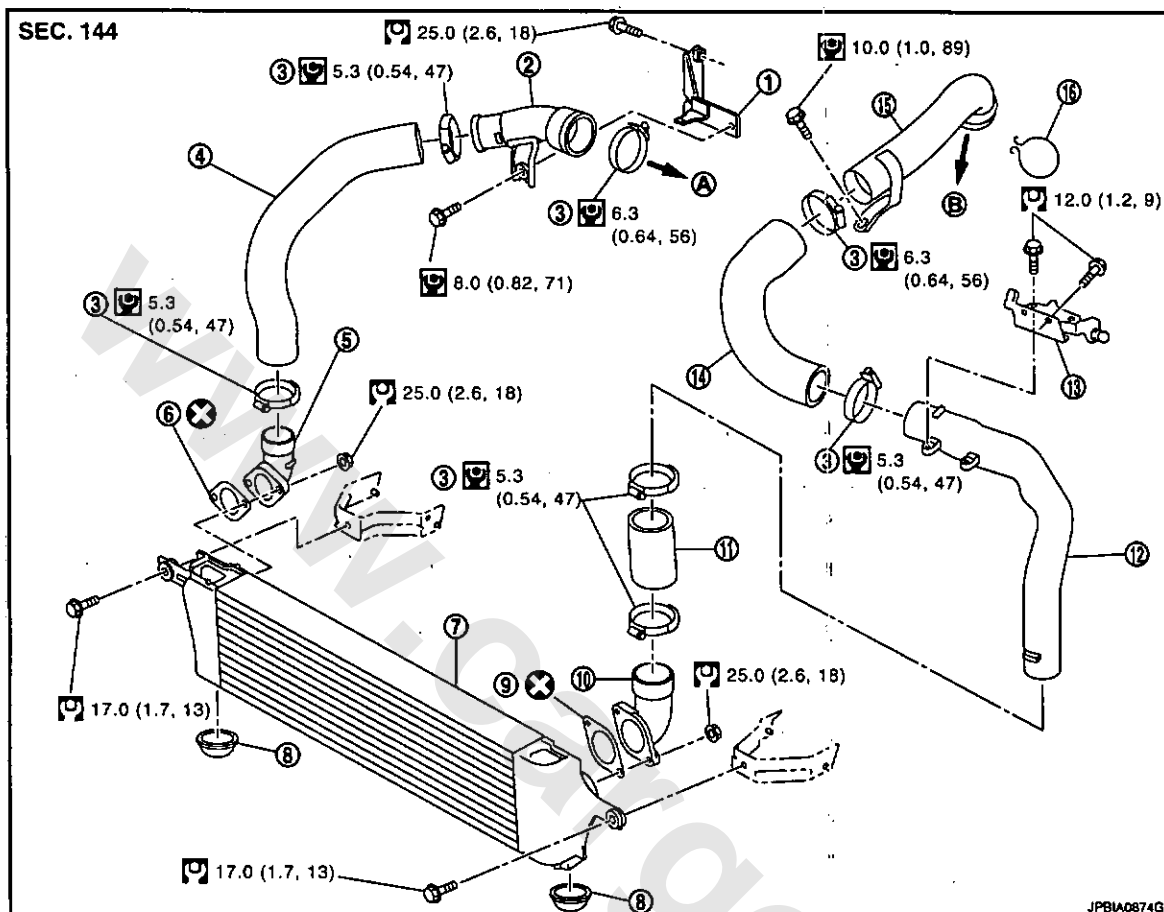
#### **CAUTION:**

**When installing, push the engine cover at the position on the pins.**

## CHARGE AIR COOLER

### Exploded View

INFOID:000000004899322



- |                            |                    |                    |
|----------------------------|--------------------|--------------------|
| 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-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899323

### REMOVAL

1. Remove engine cover. Refer to EM-267, "Exploded View".
2. Remove air duct (inlet). Refer to EM-265, "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-11, "Exploded View".
5. Remove charge air cooler.

### INSTALLATION



# CHARGE AIR COOLER

< ON-VEHICLE REPAIR >

[M9R]

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:0000000004899324

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-56, "RADIATOR : Inspection".

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# EGR SYSTEM

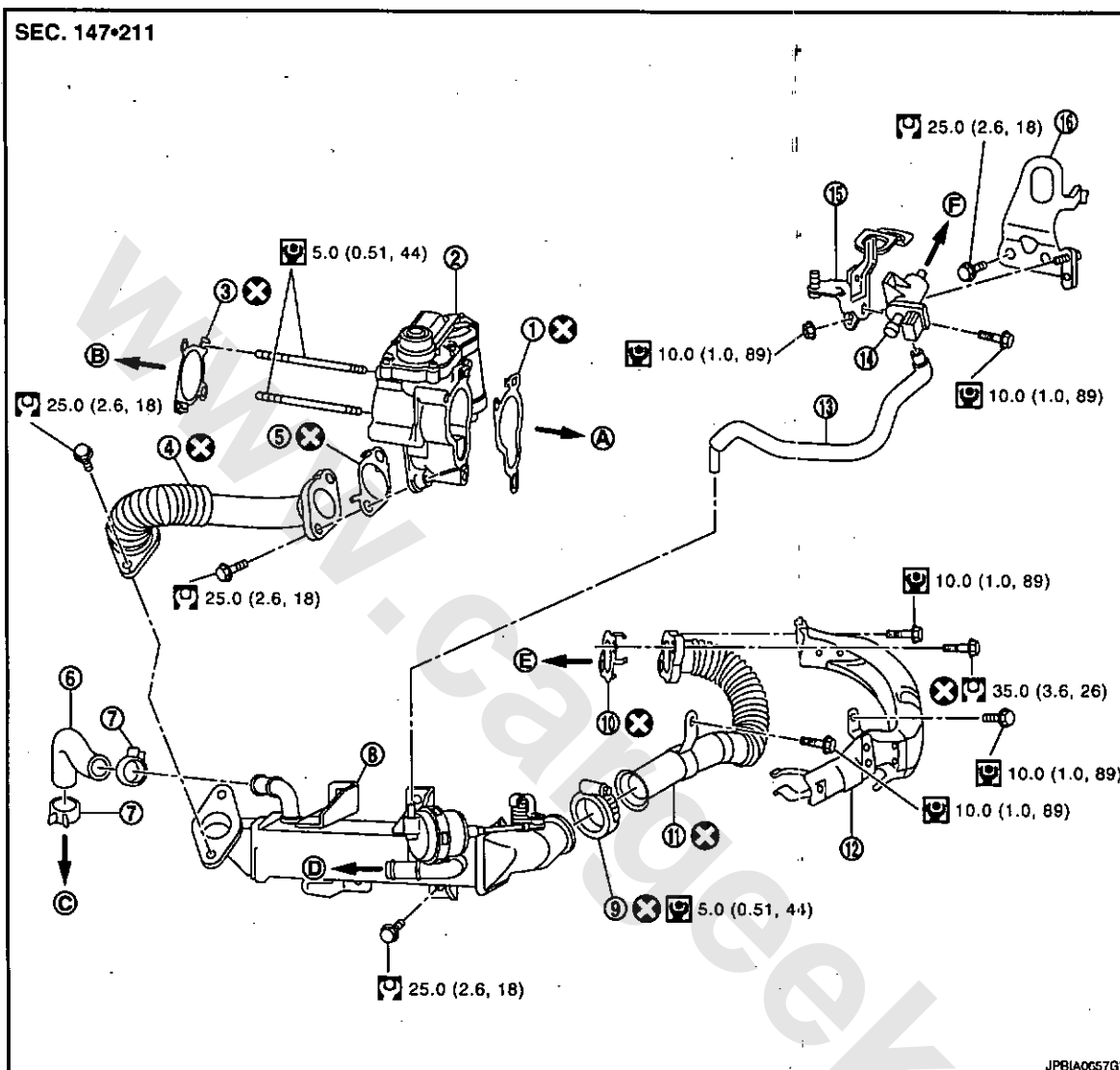
< ON-VEHICLE REPAIR >

[M9R]

## EGR SYSTEM

### Exploded View

INFOID:000000004899325



- |                           |  |                          |
|---------------------------|--|--------------------------|
| 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-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899326

### REMOVAL

1. Drain engine coolant. Refer to CO-53, "Draining".  
**CAUTION:**  
Perform this step when the engine is cold.

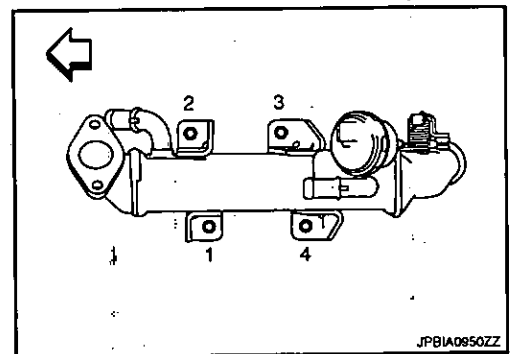
# EGR SYSTEM

[M9R]

## < ON-VEHICLE REPAIR >

2. Remove battery. Refer to PG-89, "Exploded View".
3. Remove electric throttle control actuator and turbocharger boost sensor housing. Refer to EM-272, "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-63, "Exploded View"
10. Remove water pipe, bracket and heater pipe. Refer to CO-63, "Exploded View"
11. Remove EGR tube (rear).
12. Remove starter motor. Refer to STR-23, "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.

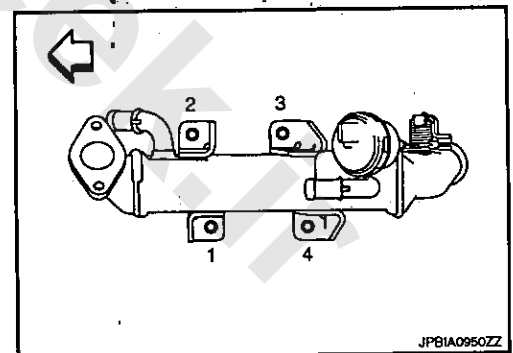
### CAUTION:

Clean each joint surface before installation.

#### EGR Cooler Tube

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

⇐ : Engine front



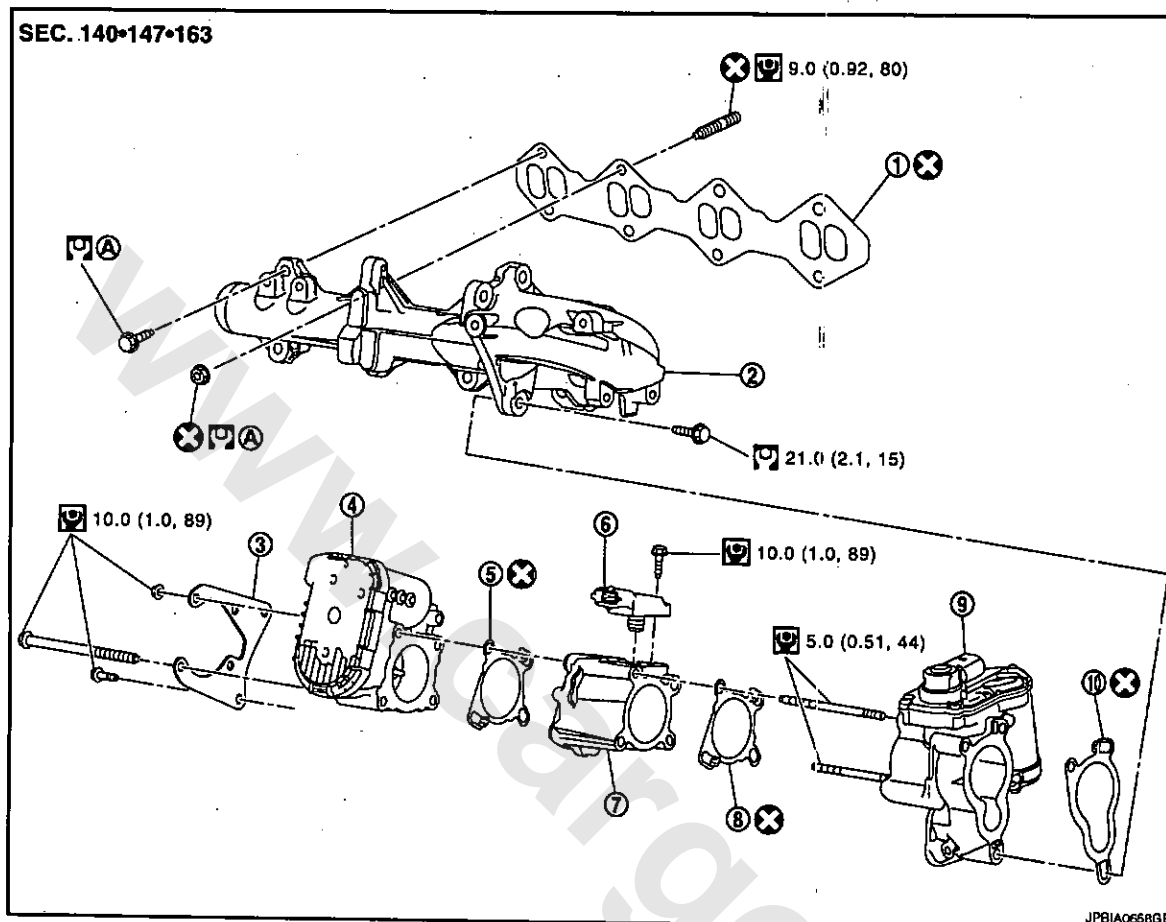
#### EGR Volume Control Valve

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.

## INTAKE MANIFOLD

### Exploded View

INFOID:000000004899327



- |                                       |                    |  |
|---------------------------------------|--------------------|--|
| 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-272](#)

Refer to [GI-3, "Components"](#) for symbols in the figure.

## Removal and Installation

INFOID:000000004899328

### REMOVAL

1. Remove engine cover. Refer to [EM-267, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-265, "Exploded View"](#).
3. Remove air inlet hose and air inlet tube. Refer to [EM-268, "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

## < ON-VEHICLE REPAIR >

[M9R]

8. Loosen water pipe mounting bolts from intake manifold. Refer to CO-63, "Exploded View".
9. Remove EGR volume control valve and EGR tube (front) assembly. Refer to EM-270, "Exploded View".

### 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-263, "Exploded View".
11. Remove bracket from intake manifold. Refer to CO-63, "Exploded View".
12. Remove intake manifold with the following procedure:

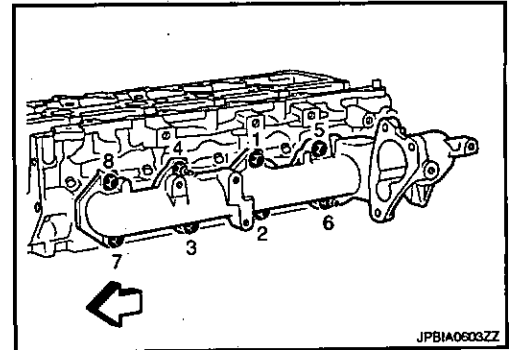
- a. Loosen mounting bolts and nuts in reverse order as shown in the figure.

⇐ : 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.

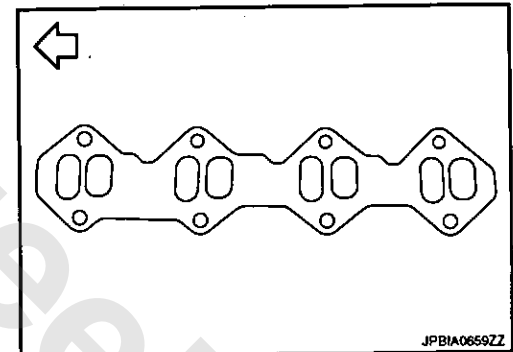
### CAUTION:

Clean each joint surface before installation.

#### Intake Manifold

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

⇐ : Engine front

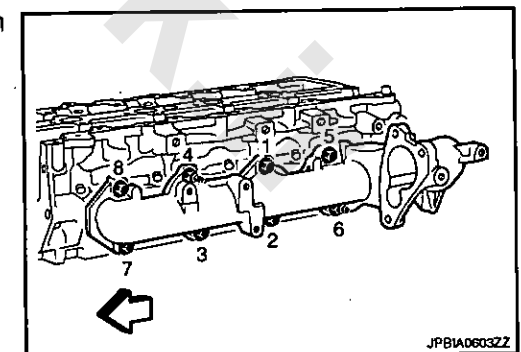


2. Install intake manifold.
  - Tighten mounting bolts and nuts in two steps separately in numerical order as shown in the figure.

⇐ : 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.

## Inspection

## INSPECTION AFTER REMOVAL

## INTAKE MANIFOLD

< ON-VEHICLE REPAIR >

[M9R]

### Surface Distortion

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

**Standard** : Refer to EM-356. "Intake Manifold".

- If it exceeds the standard, replace intake manifold.

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# CATALYST

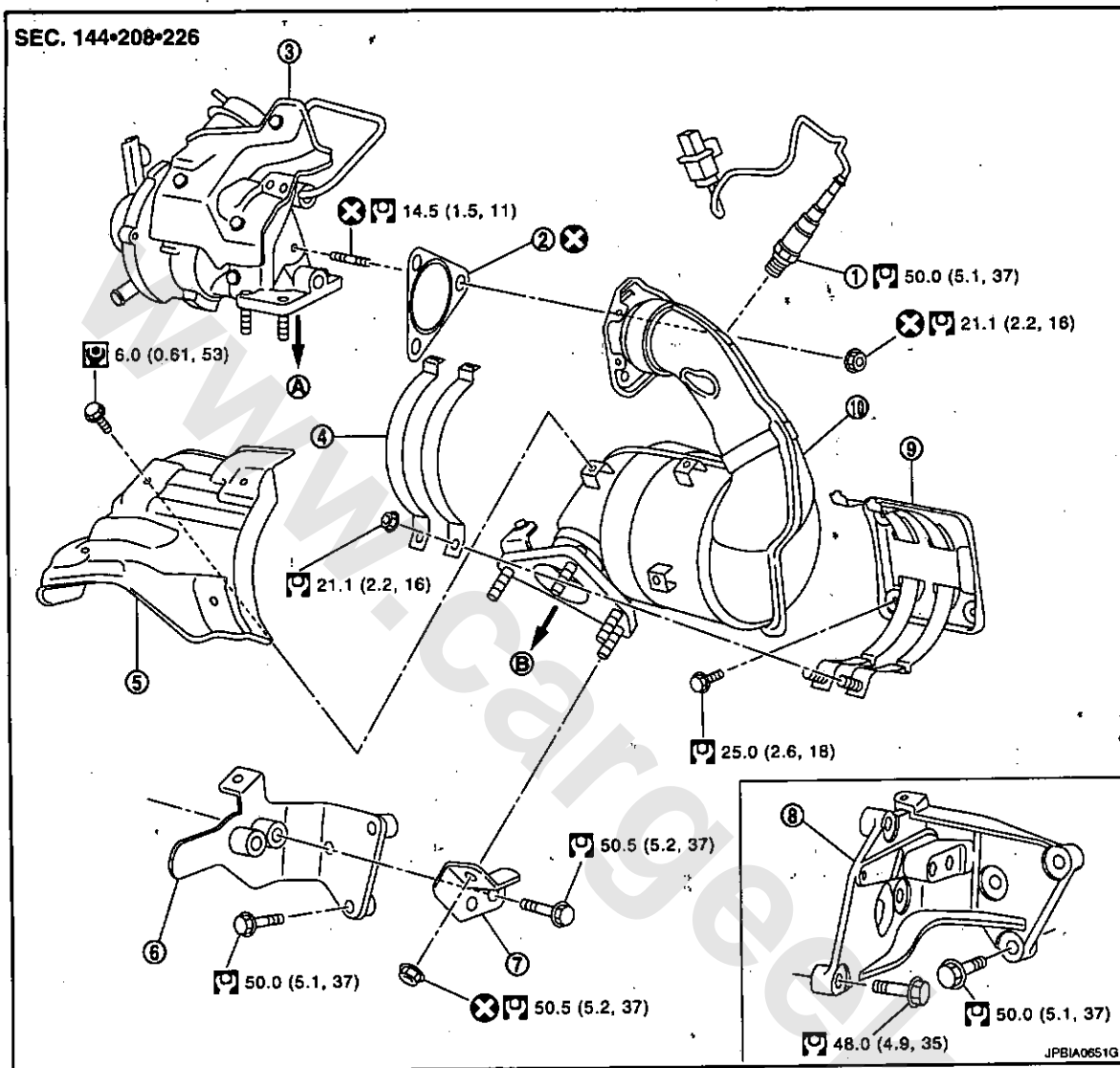
< ON-VEHICLE REPAIR >

[M9R]

## CATALYST

### Exploded View

INFOID:000000004899330



- |                             |                          |                             |
|-----------------------------|--------------------------|-----------------------------|
| 1. Air fuel ratio sensor    | 2. Gasket                | 3. Turbocharger             |
| 4. Catalyst support (upper) | 5. Catalyst insulator    | 6. Bracket (2WD models)     |
| 7. Catalyst bracket         | 8. Gusset (4WD models)   | 9. Catalyst support (lower) |
| 10. Catalyst                |                          |                             |
| A. To exhaust manifold      | B. To exhaust front tube |                             |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899331

### REMOVAL

1. Remove engine undercover.
2. Remove cowl top cover and extension cowl top. Refer to EXT-20, "Exploded View".
3. Disconnect air fuel ratio sensor harness connector.

# CATALYST

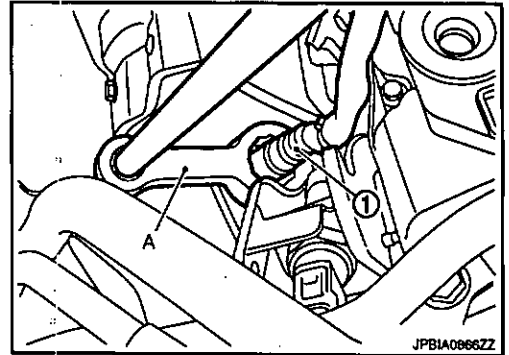
## < ON-VEHICLE REPAIR >

[M9R]

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-277, "Exploded View".
6. Loosen mounting nuts and remove stud bolts from turbocharger.
7. Remove exhaust front tube. Refer to EX-15, "Exploded View".
8. Remove right side drive shaft and support bearing bracket. Refer to FAX-34, "M9R MODELS : 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:0000000004899332

## INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.



# TURBOCHARGER

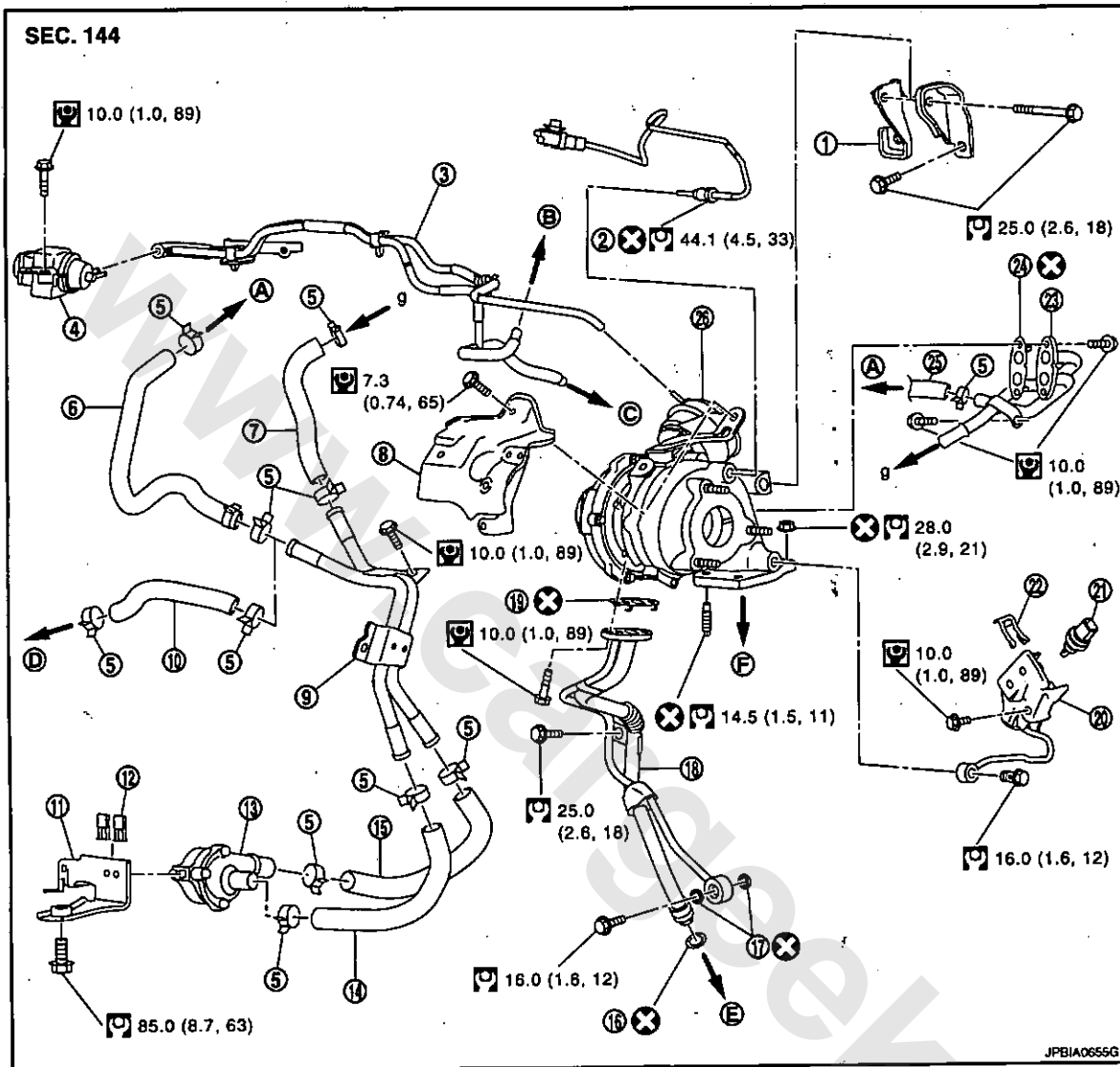
< ON-VEHICLE REPAIR >

[M9R]

## TURBOCHARGER

### Exploded View

INFOID:000000004899333



JPBIA0655GB

- |  |                                     |  |
|--|-------------------------------------|--|
| 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-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899334

### REMOVAL

# TURBOCHARGER

## < ON-VEHICLE REPAIR >

[M9R]

1. Drain engine coolant. Refer to CO-53, "Draining".  
**CAUTION:**  
**Perform this step when the engine is cold.**
2. Remove air inlet tube from turbocharger. Refer to EM-268, "Exploded View".
3. Remove air duct assembly. Refer to EM-265, "Exploded View".
4. Remove cowl top cover and extension cowl top. Refer to EXT-20, "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-15, "Exploded View".
8. Remove catalyst. Refer to EM-275, "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:

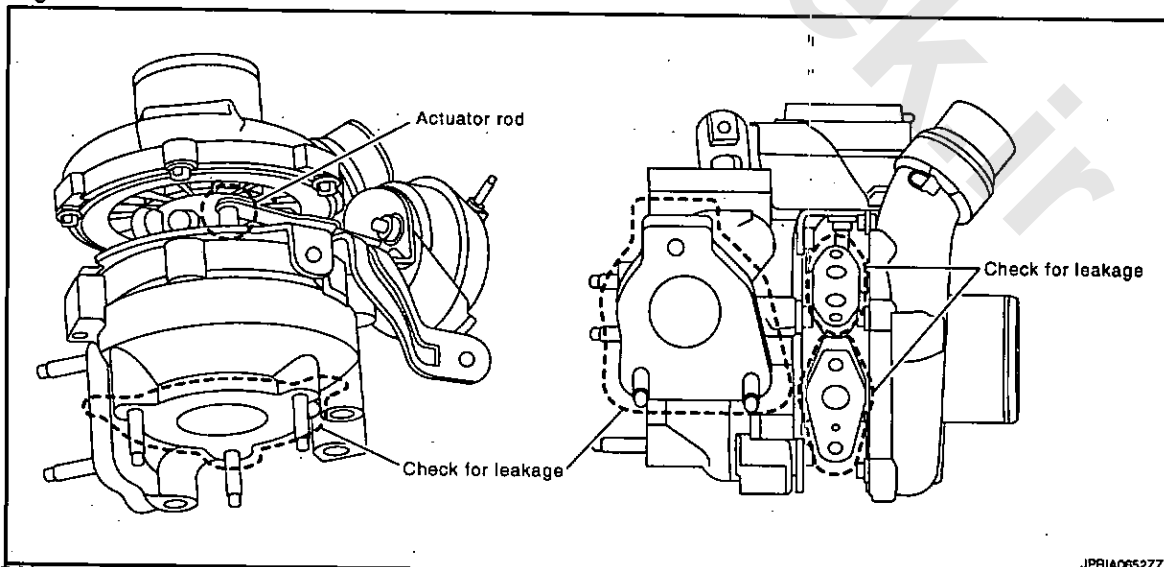
- Before installing a new exhaust gas temperature sensor, clean turbocharger thread.
- Be careful not to impact or damage exhaust gas temperature sensor 1.
- When installing, never use such tools as an air impact wrench.

## Inspection

INFOID:0000000004899335

## 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:

# TURBOCHARGER

< ON-VEHICLE REPAIR >

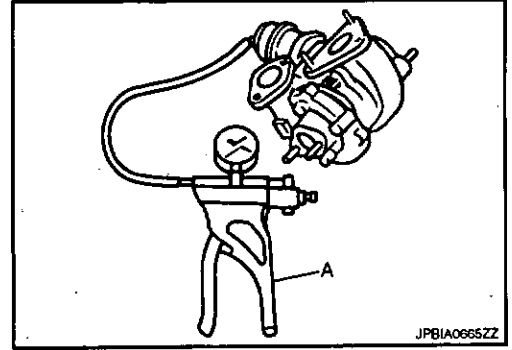
[M9R]

- Suction side:** Between turbocharger and air cleaner  
Between turbocharger and charge air cleaner
- Exhaust side:** Between turbocharger and catalyst  
Between turbocharger and exhaust manifold

## Turbocharger Boost Control

- Connect the handy vacuum pump (A) to the actuator, and check that the rod strokes smoothly in compliance with the following pressure.

**Standard (value of vacuum/value of rod moving):**  
Refer to EM-357, "Turbocharger".



## INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

# EXHAUST MANIFOLD

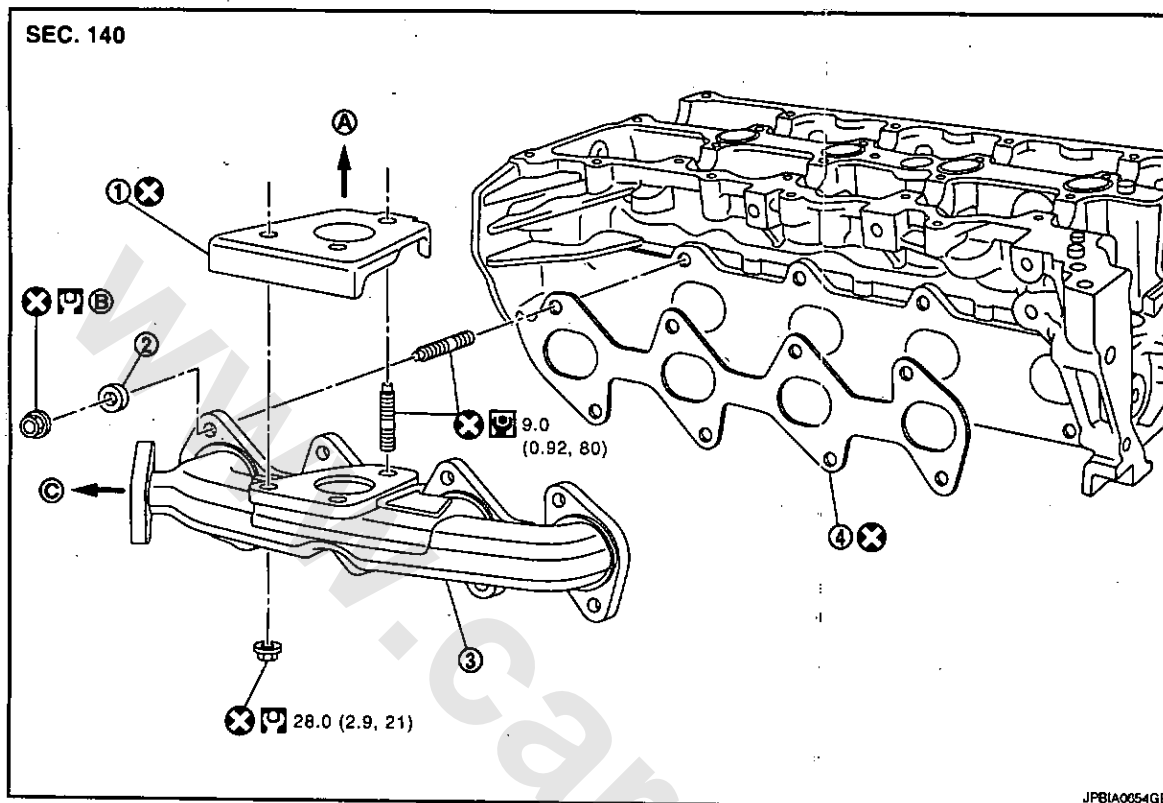
< ON-VEHICLE REPAIR >

[M9R]

## EXHAUST MANIFOLD

### Exploded View

INFOID:0000000004899336



## Removal and Installation

INFOID:0000000004899337

### REMOVAL

1. Drain engine coolant. Refer to CO-53, "Draining".  
**CAUTION:**  
**Perform this step when the engine is cold.**
2. Remove catalyst. Refer to EM-275, "Exploded View".
3. Remove turbocharger. Refer to EM-277, "Exploded View".
4. Remove air cleaner case. Refer to EM-265, "Exploded View".
5. Remove EGR tube (rear) from exhaust manifold. Refer to EM-270, "Exploded View".
6. Remove exhaust manifold and spacers.

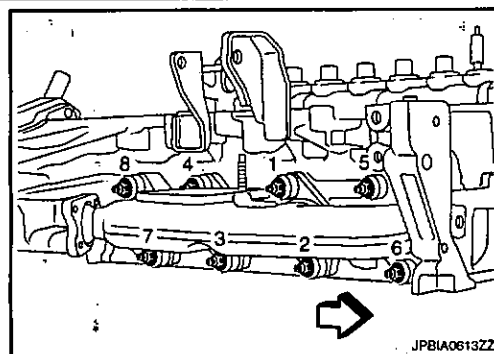
# EXHAUST MANIFOLD

## < ON-VEHICLE REPAIR >

[M9R]

- Loosen mounting nuts in the reverse order as shown in the figure.

⇐ : Engine front



- Remove gasket.

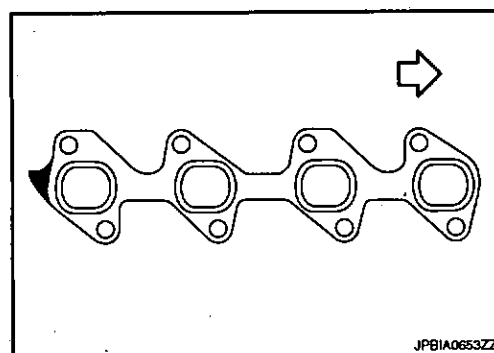
### CAUTION:

Cover engine openings to avoid entry of foreign materials.

## INSTALLATION

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

⇐ : Engine front



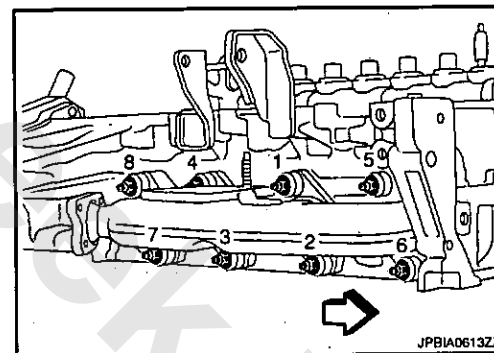
- Install exhaust manifold.

- 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:0000000004896338

## 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-356. "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

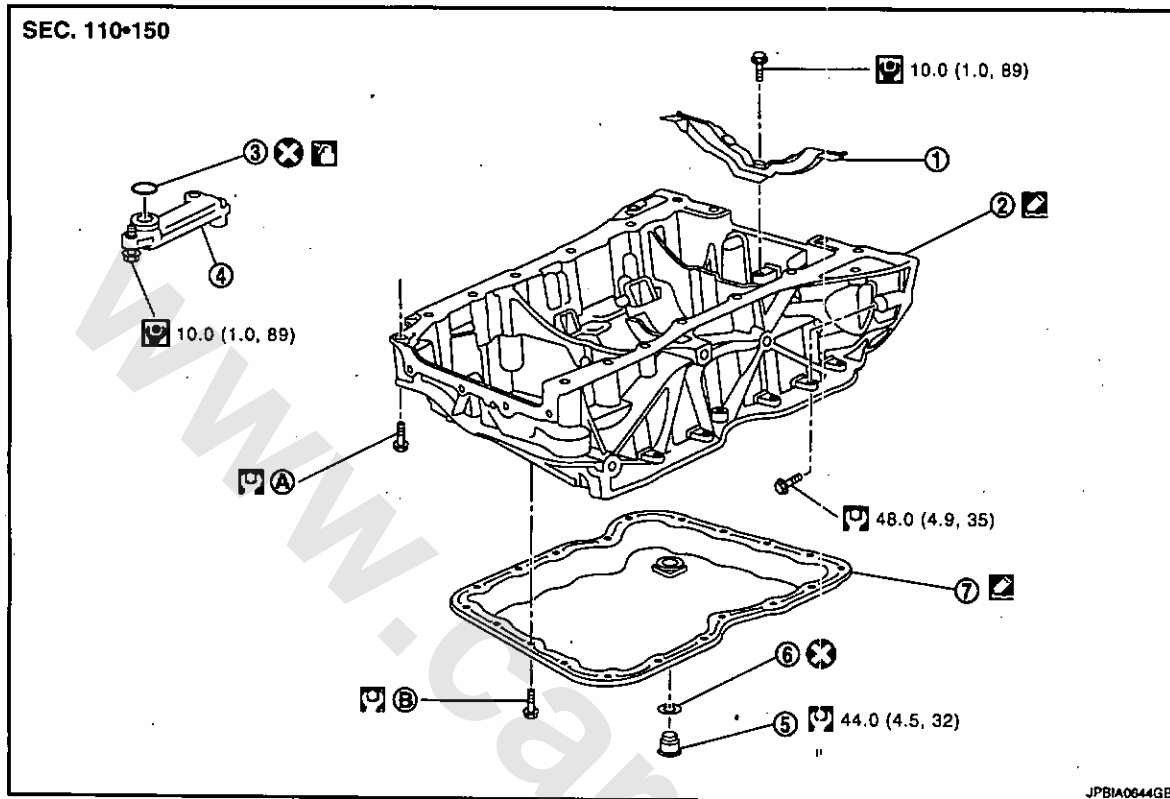
< ON-VEHICLE REPAIR >

[M9R]

## OIL PAN (LOWER) AND OIL STRAINER

Exploded View

INFOID:000000000489339



- |                                    |                                    |           |
|------------------------------------|------------------------------------|-----------|
| 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-323</a> | B. Refer to <a href="#">EM-282</a> |           |

Refer to [GI-3](#), "Components" for symbols in the figure.

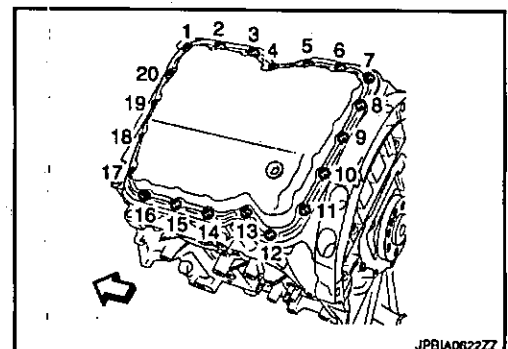
## Removal and Installation

INFOID:000000000489340

### REMOVAL

1. Remove engine undercover.
2. Drain engine oil. Refer to [LU-24](#), "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

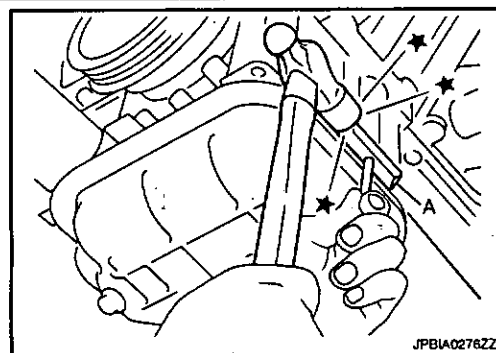
### < ON-VEHICLE REPAIR >

[M9R]

- 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.

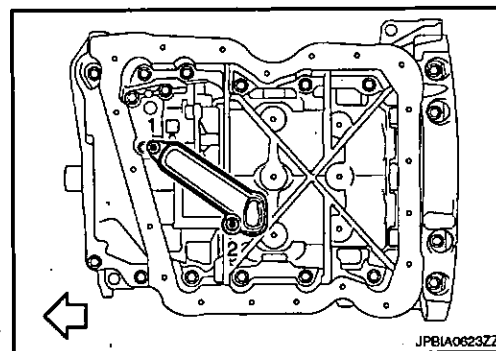
#### CAUTION:

- 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.

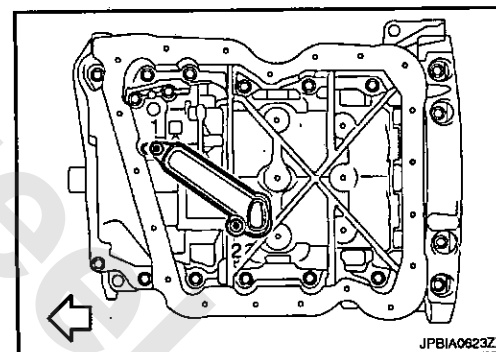
⇐ : Engine front



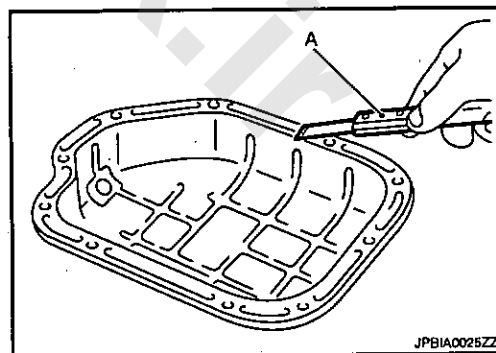
### INSTALLATION

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.



## OIL PAN (LOWER) AND OIL STRAINER

### < ON-VEHICLE REPAIR >

[M9R]

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

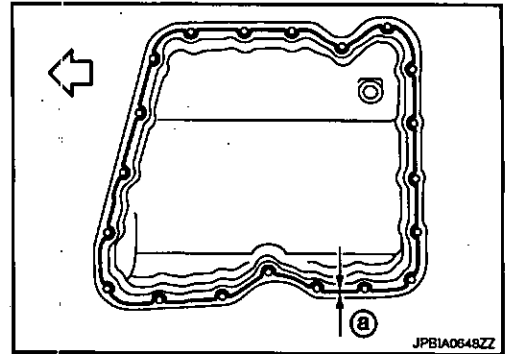
a : 3.0 - 7.0 mm (0.118 - 0.276 in)

↶ : Engine front

**Use Genuine Liquid Gasket or equivalent**

**CAUTION:**

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

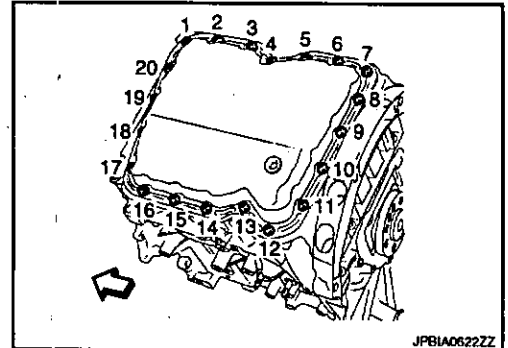


- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

↶ : 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:0000000004899341

#### INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

#### INSPECTION AFTER INSTALLATION

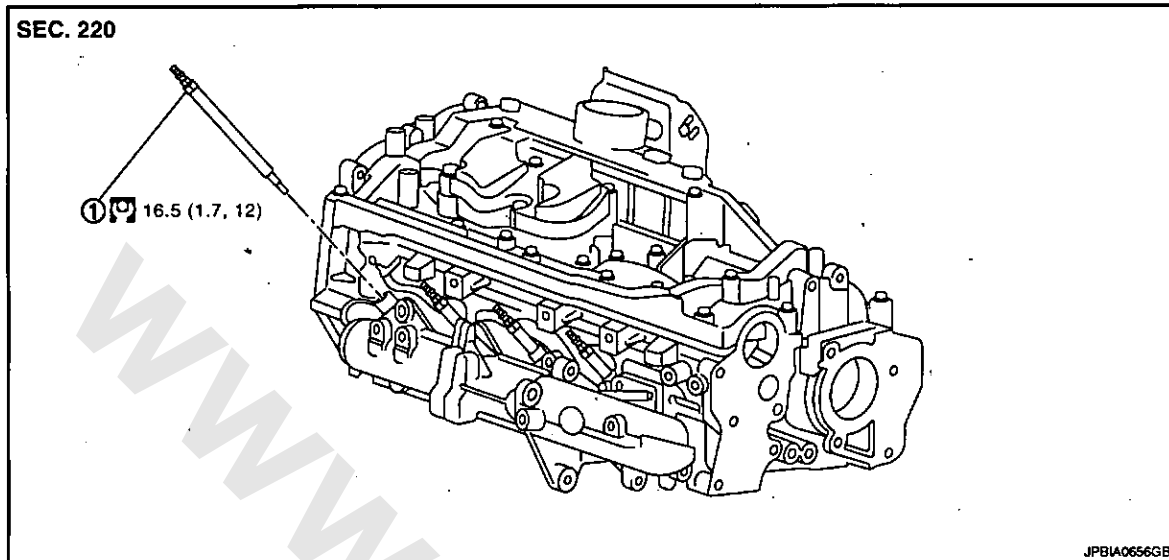
1. Check the engine oil level and adjust engine oil. Refer to LU-23, "Inspection".
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to LU-23, "Inspection".



## GLOW PLUG

## Exploded View

INFOID:000000004899342



1. Glow plug

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:000000004899343

## 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-267, "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

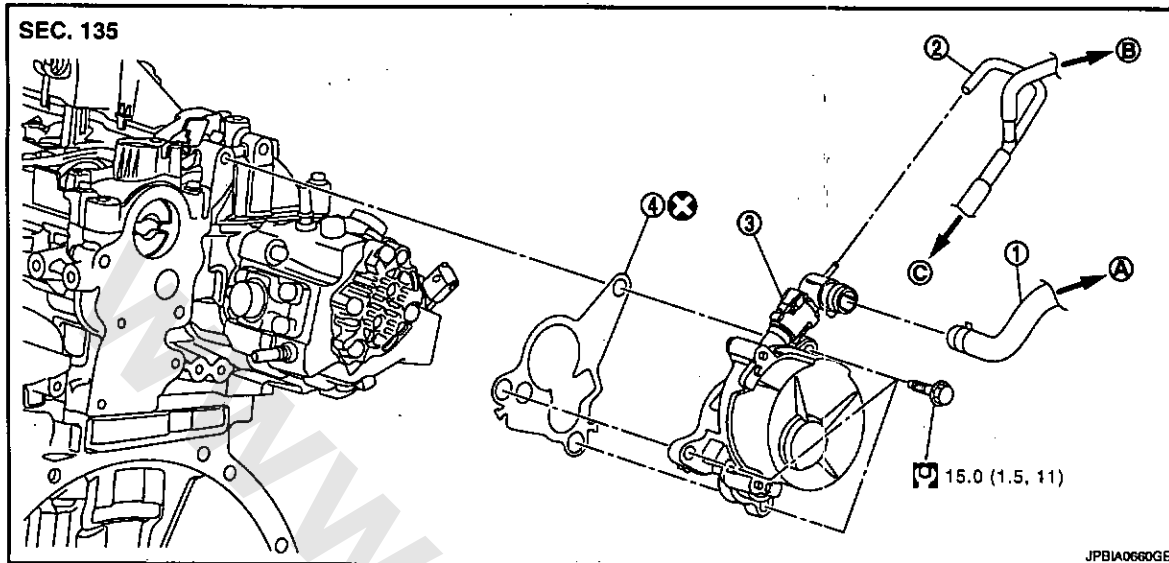
< ON-VEHICLE REPAIR >

[M9R]

## VACUUM PUMP

### Exploded View

INFOID:0000000004699344



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

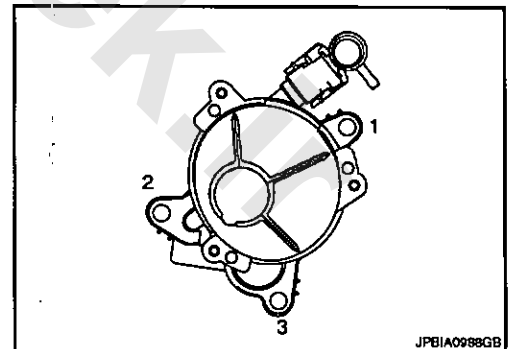
Refer to GI-3, "Components" for symbols in the figure.

### Removal and Installation

INFOID:0000000004898345

#### REMOVAL

1. Remove engine cover. Refer to EM-267, "Exploded View".
2. Remove battery. Refer to PG-89, "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

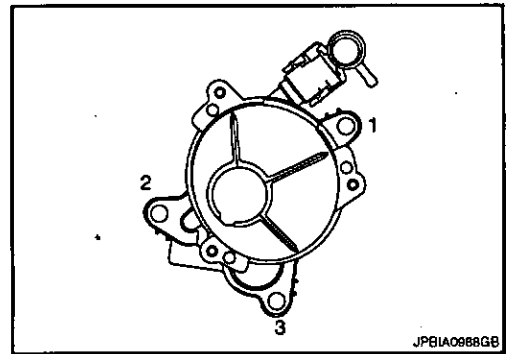
< ON-VEHICLE REPAIR >

[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.



A

EM

C

D

E

F

G

H

I

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K

L

M

N

O

P

# OIL SEPARATOR

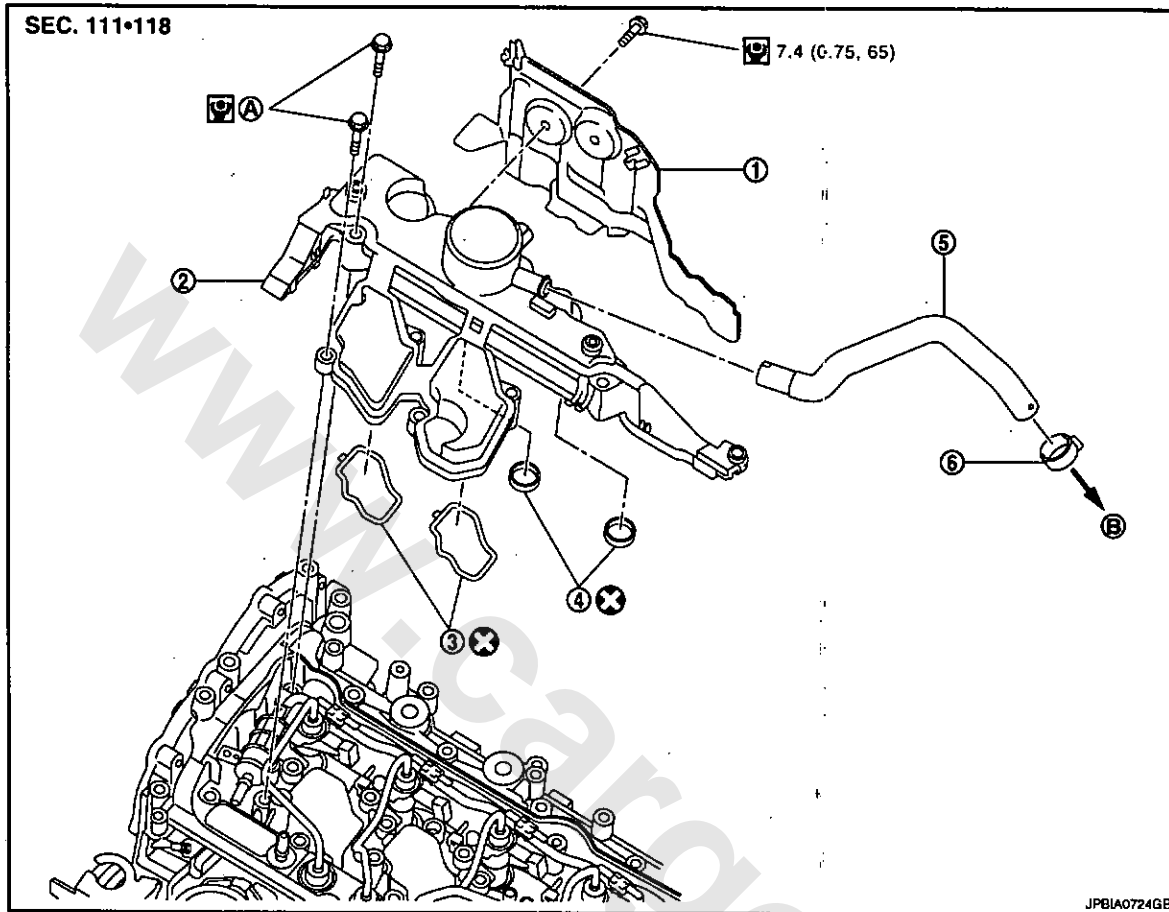
< ON-VEHICLE REPAIR >

[M9R]

## OIL SEPARATOR

### Exploded View

INFOID:0000000004899346



- |                            |                         |           |
|----------------------------|-------------------------|-----------|
| 1. Oil separator insulator | 2. Oil separator        | 3. Gasket |
| 4. Gasket                  | 5. PCV hose             | 6. Clamp  |
| A. Refer to <u>EM-288</u>  | B. To air duct assembly |           |

Refer to GI-3, "Components" for symbols in the figure.

## Removal and Installation

INFOID:0000000004899347

### REMOVAL

1. Remove engine cover and fuel injection cover. Refer to EM-267, "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.

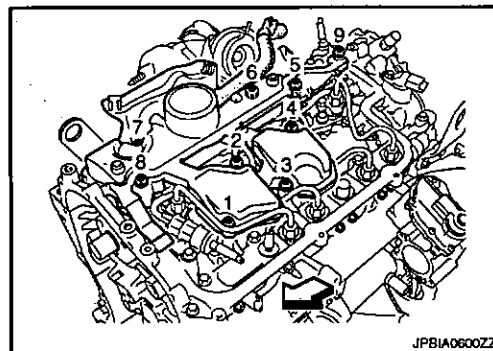
# OIL SEPARATOR

## < ON-VEHICLE REPAIR >

[M9R]

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

⇐ : Engine front



6. Remove oil separator insulator.

### INSTALLATION

1. Install gaskets to oil separator.

#### CAUTION:

**Check the gasket is not dropped.**

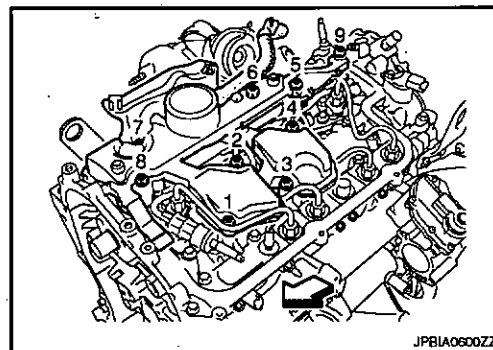
2. Install oil separator.

- 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)



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

# INJECTION TUBE AND FUEL INJECTOR

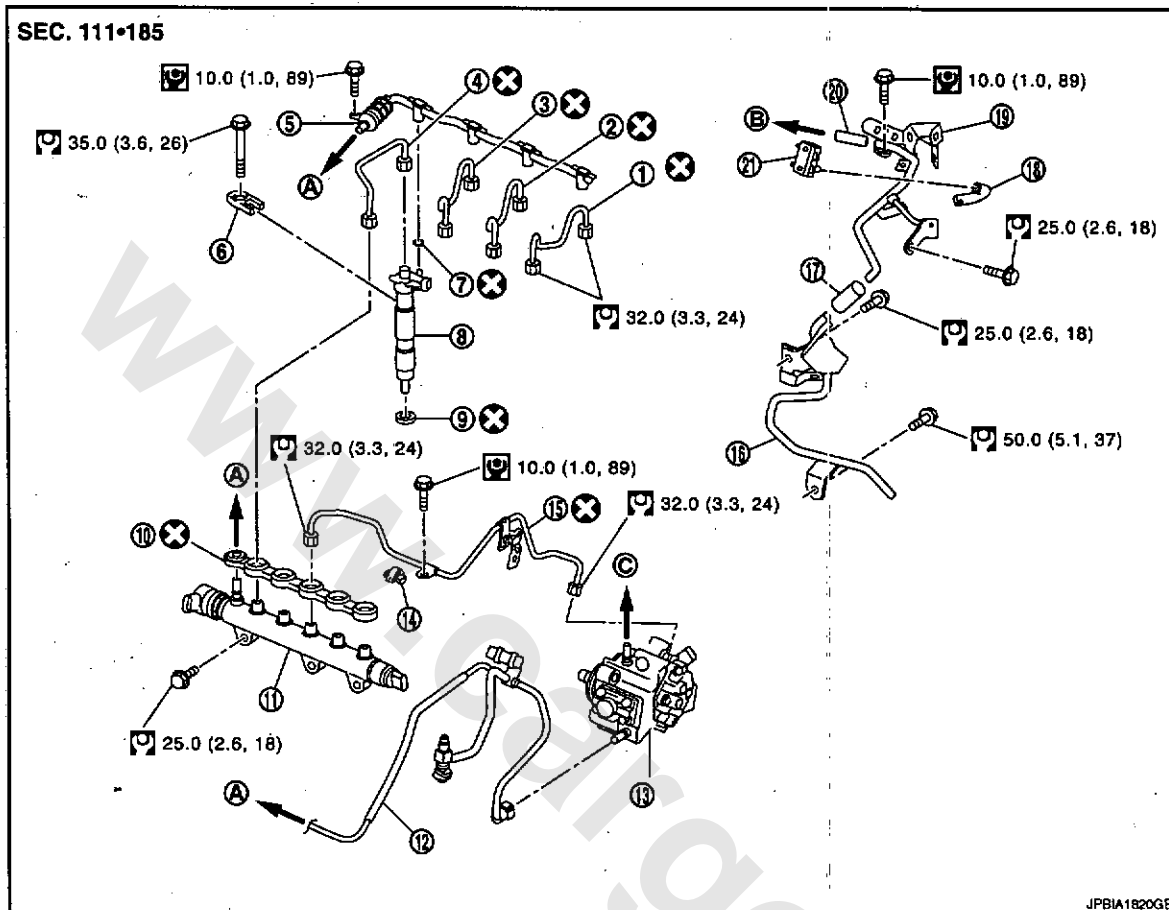
< ON-VEHICLE REPAIR >

[M9R]

## INJECTION TUBE AND FUEL INJECTOR

### Exploded View

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- |                               |                             |                                      |
|-------------------------------|-----------------------------|--------------------------------------|
| 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-3, "Components" for symbols in the figure.

### Removal and Installation

INFOID:000000004899349

#### REMOVAL

##### CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to EM-253, "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.

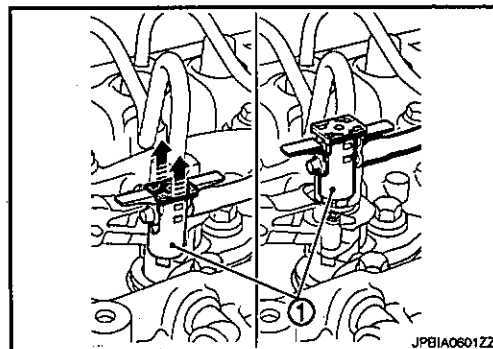
1. Remove the battery. Refer to PG-89, "Exploded View".

# INJECTION TUBE AND FUEL INJECTOR

[M9R]

## < ON-VEHICLE REPAIR >

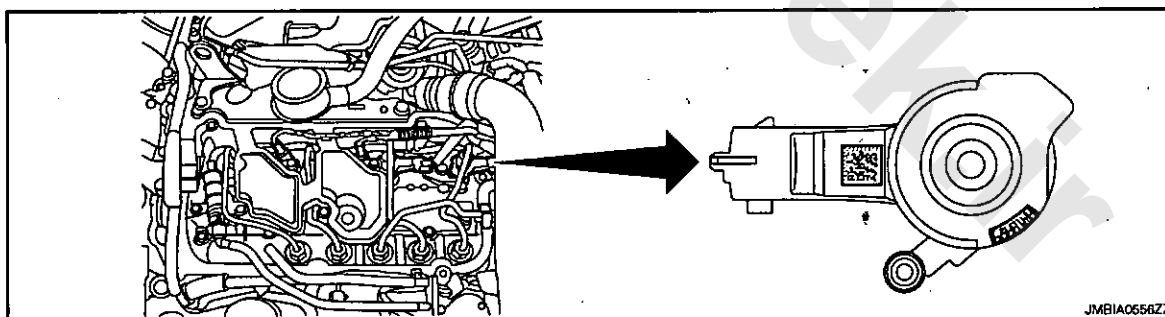
2. Remove oil separator. Refer to EM-288, "Exploded View".
3. Disconnect fuel hose from spill hose.
  - Pinch quick connector square-part with your fingers, and pull out the quick connector by hand.
4. Remove spill hose (1).
  - Lift the movable sections of the injector unions away from the spill hose.



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-270, "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.



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

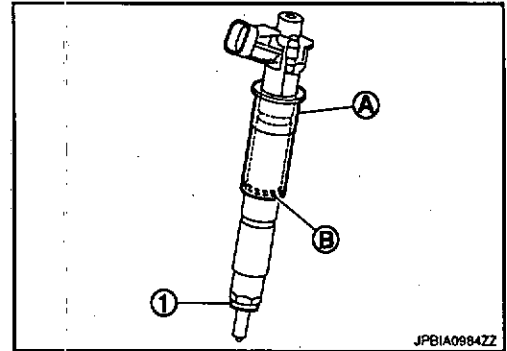
< ON-VEHICLE REPAIR >

[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-23, "Air Bleeding".

**NOTE:**

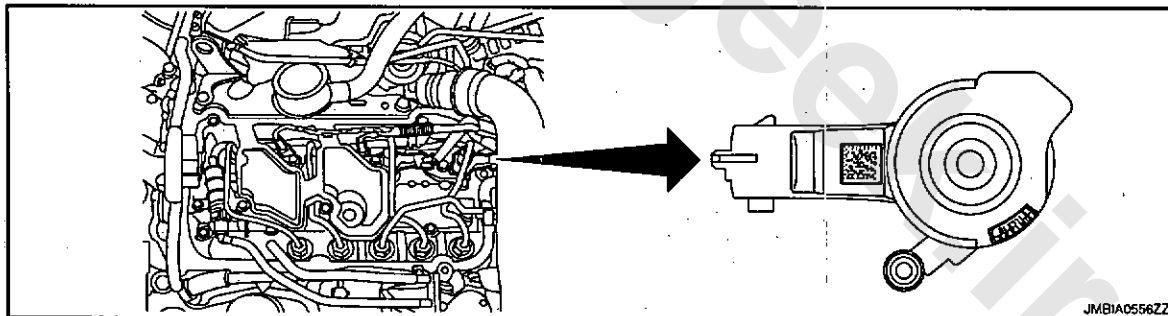
Fill the fuel of at least 60 mℓ (2.11 Imp fl oz).

## Inspection

INFOID:000000004899350

### INSPECTION AFTER INSTALLATION

- Input "INJECTOR ADJUSTMENT VALUE" to ECM after installing to the vehicle when replacing fuel injector.



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-253, "Precaution for Diesel Equipment".**



# FUEL PUMP

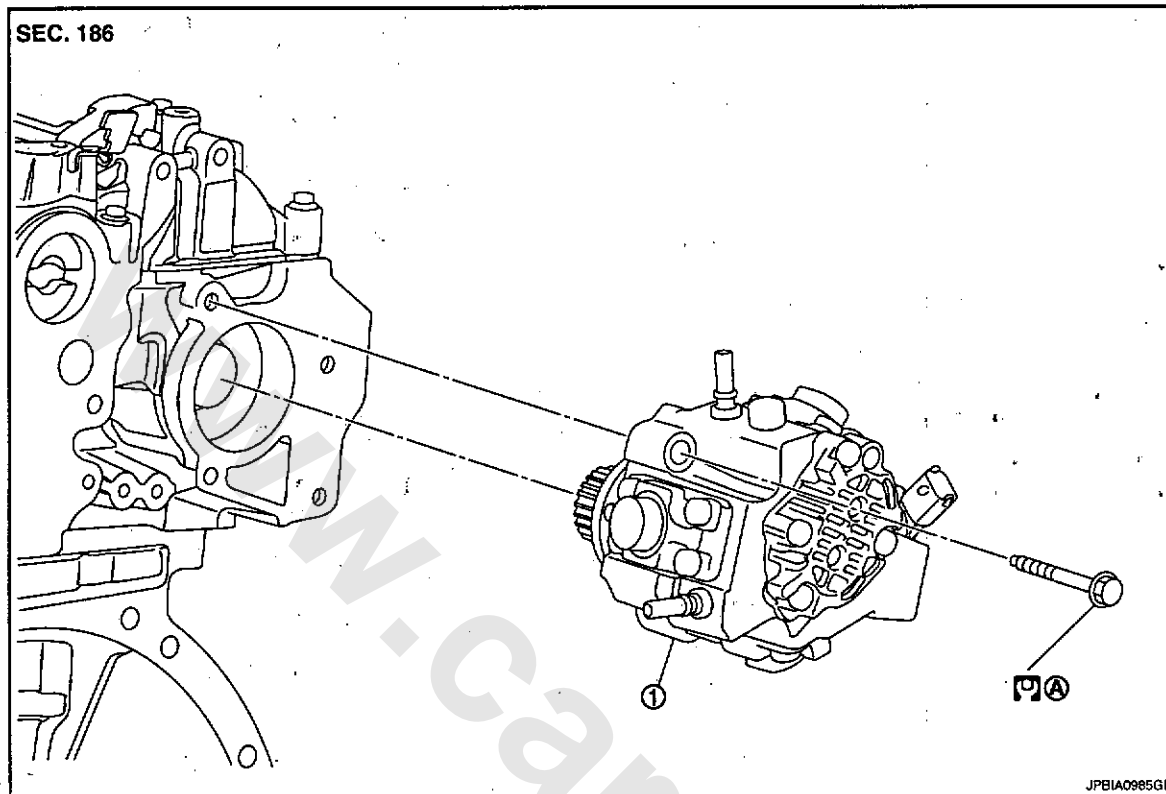
< ON-VEHICLE REPAIR >

[M9R]

## FUEL PUMP

### Exploded View

INFOID:0000000004899351



- 1. Fuel pump
- A. Refer to [EM-293](#)

Refer to [GI-3, "Components"](#) for symbols in the figure.

### Removal and Installation

INFOID:0000000004899352

#### REMOVAL

##### CAUTION:

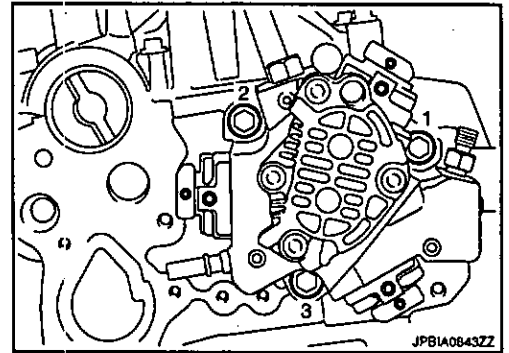
- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-253, "Precaution for Diesel Equipment"](#).
  - Wait until the fuel temperature drops before carrying out any work.
  - Order the special high pressure injection circuit plug kit.
  - Never disassemble or adjust the fuel pump body.
1. Remove the battery. Refer to [PG-89, "Exploded View"](#).
  2. Remove engine cover and fuel injection cover. Refer to [EM-267, "Exploded View"](#).
  3. Remove air duct assembly and air cleaner case. Refer to [EM-265, "Exploded View"](#).
  4. Remove diesel collector. Refer to [EM-290, "Exploded View"](#).
  5. Disconnect fuel hoses from fuel pump. Refer to [EM-290, "Exploded View"](#).
  6. Remove the injection tube (center). Refer to [EM-290, "Exploded View"](#).
  7. Plug all the holes of the injection circuit.
  8. Remove the fuel pump.

# FUEL PUMP

## < ON-VEHICLE REPAIR >

[M9R]

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



9. In case of replacement of the fuel pump you need to install the old fuel pump sprocket on the new fuel pump. Refer to EM-295, "Removal and Installation"

## INSTALLATION

1. Install fuel pump.

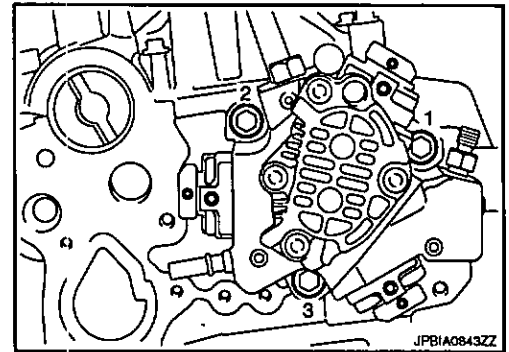
### CAUTION:

**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)



2. Install the injection tube (center) and mounting rubber. Refer to EM-290, "Exploded View".

- Finger tighten until contact the injection tube nuts.

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

- Before starting engine, bleed air from fuel piping. Refer to FL-23, "Air Bleeding".

### NOTE:

Fill the fuel of at least 60 mℓ (2.11 Imp fl oz).

## Inspection

INFOID:000000004899353

## 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-253, "Precaution for Diesel Equipment".**

# FUEL PUMP SPROCKET

< ON-VEHICLE REPAIR >

[M9R]

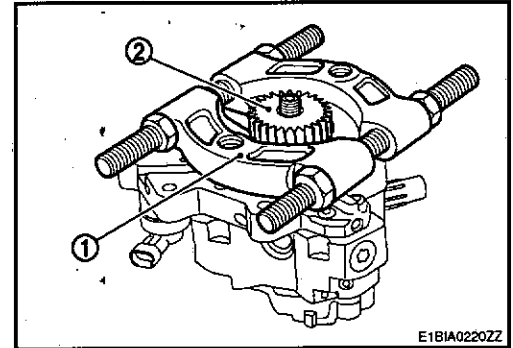
## FUEL PUMP SPROCKET

### Removal and Installation

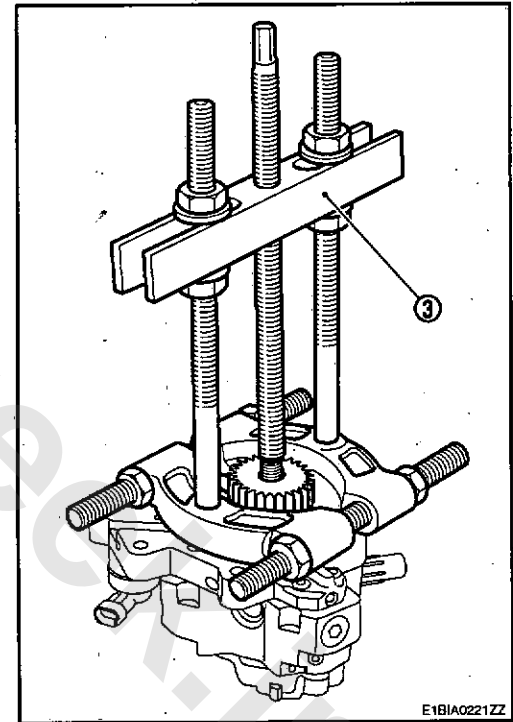
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#### REMOVAL

1. Lock the fuel pump sprocket on the work-bench in a vice with protective jaws.
2. Remove the fuel pump sprocket nut.
3. Fit a separator (1) from the puller kit under the fuel pump sprocket (2).




4. Put the bracket (3) on the separator.



5. Remove the fuel pump sprocket and the puller kit.

#### INSTALLATION

1. Refit the sprocket to the new fuel pump.
2. Screw in the new fuel pump sprocket on the work bench, without tightening it.
3. Lock the fuel pump sprocket on the workbench in a vice with protective jaws.
4. Torque tighten the fuel pump sprocket nut.

: 90 N·m (9.2 kg-m, 66 ft-lb)

# TIMING CHAIN

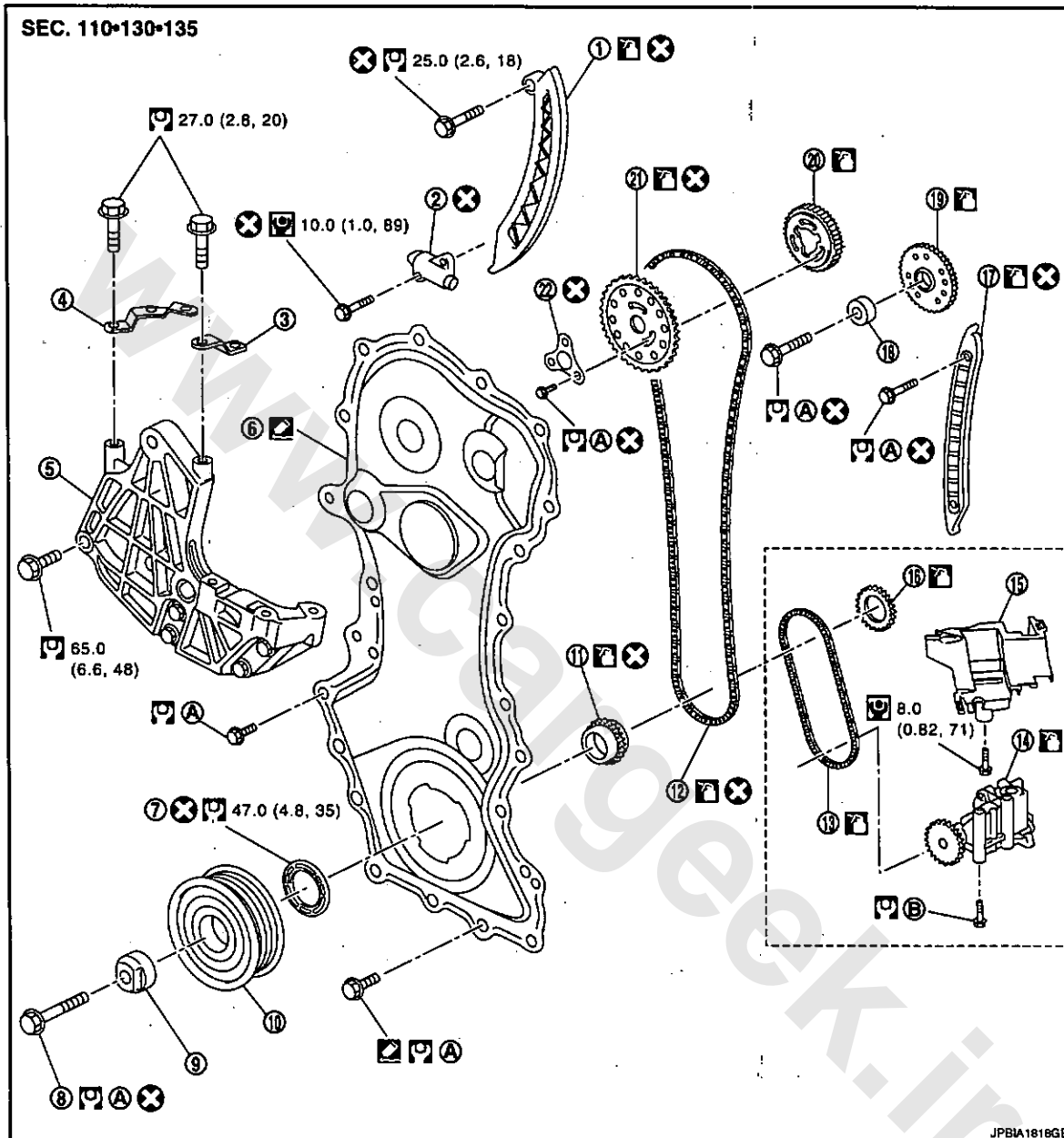
< ON-VEHICLE REPAIR >

[M9R]

## TIMING CHAIN

### Exploded View

INFOID:000000004899355



- |                                |                                |                                   |
|--------------------------------|--------------------------------|-----------------------------------|
| 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-297](#)

B. Refer to [EM-323](#)

Refer to [GI-3](#), "Components" for symbols in the figure.

### NOTE:

# TIMING CHAIN

< ON-VEHICLE REPAIR >

[M9R]

Oil pump related parts cannot be removed with an onboard condition. Refer to EM-323, "Removal and Installation".

## Removal and Installation

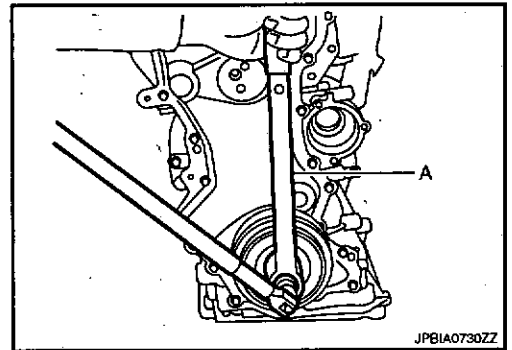
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### REMOVAL

#### CAUTION:

**Never turn the engine in the direction opposite to that of normal operation.**

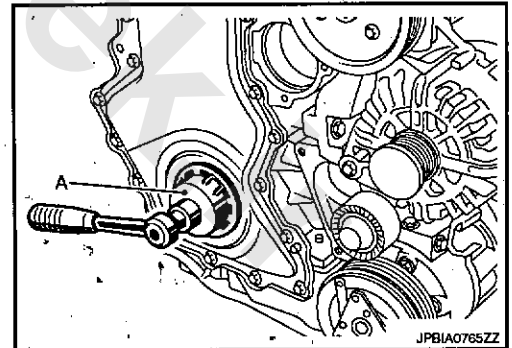
1. Drain engine oil. Refer to LU-24, "Draining".  
**CAUTION:**  
**Perform this step when the engine is cold.**
2. Disconnect the battery cable from the negative terminal.
3. Remove the following parts:
  - Engine undercover
  - Load wheel tire (RH)
  - Fender protector (RH): Refer to EXT-22, "Exploded View".
  - Drive belt: Refer to EM-259, "Removal and Installation".
  - Fuel filter: Refer to FL-22, "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.
- CAUTION:**  
**Be careful not to damage front oil seal lip.**
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.



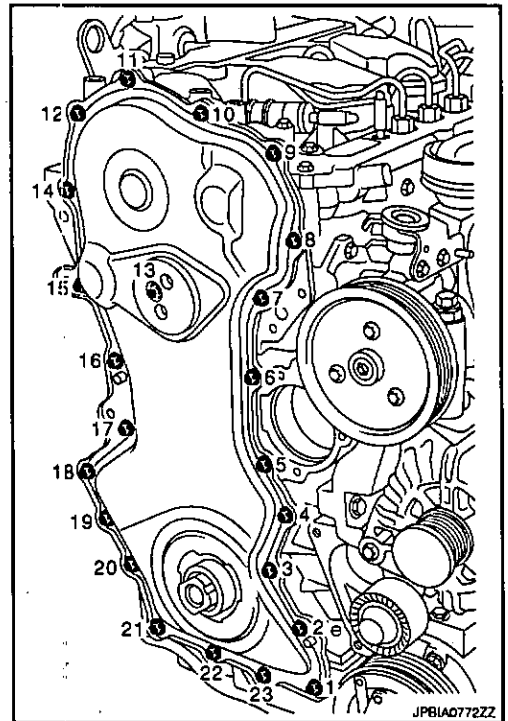
6. Remove the through bolt between lower torque rod and engine mounting bracket (rear), and hold the engine mounting bracket (rear) with a transmission jack. Refer to EM-315, "Exploded View".  
**CAUTION:**  
**Never hold the oil pan (lower).**
7. Remove the upper torque rod and the engine mounting insulator (RH). Refer to EM-315, "Exploded View".
8. Remove engine mounting bracket and engine mounting stay (front and rear).
9. Remove water pump pulley. Refer to CO-66, "Exploded View".
10. Remove front cover with the following procedure:

## TIMING CHAIN

### < ON-VEHICLE REPAIR >

[M9R]

- 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:**

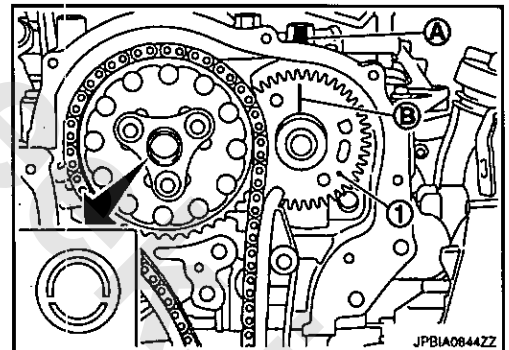
**Never use a screwdriver or something similar.**

**NOTE:**

Unstick the front cover by hand, using a jerking motion to ensure it is not damaged.

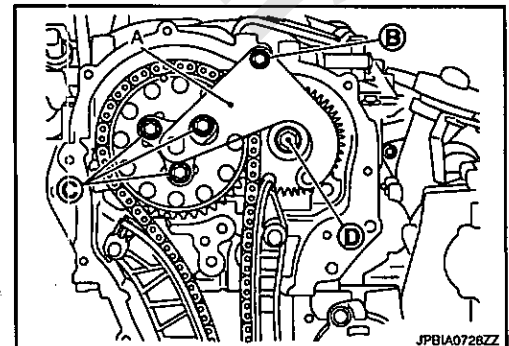
11. Obtain No. 1 cylinder at TDC of its compression. Rotate crankshaft to set it in the position shown in the figure.

- 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:

- Set the camshaft timing tool [SST: — (Mot.1769)] (A), and tighten mounting bolt [M6 × 50 mm (1.97 in)] (B).
- Loosen timing sprocket mounting bolts (C) and wear compensation gear mounting bolt (D).
- Remove the camshaft timing tool.



- Remove the timing chain tensioner.

# 

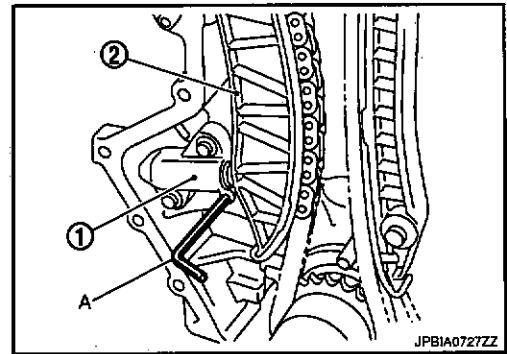
### 

[M9R]

- 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



- Remove timing chain slack guide and timing chain tension guide.
- Remove timing sprocket spacer, timing sprocket (front), crankshaft sprocket and timing chain.

**CAUTION:**

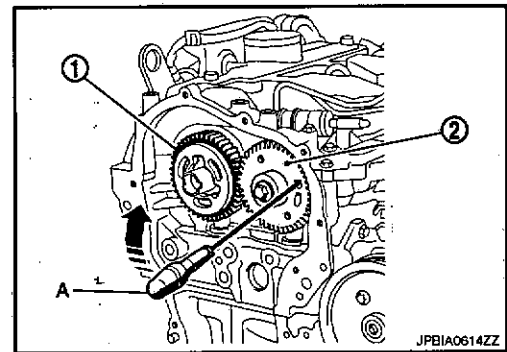
**Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.**

- 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.

- Remove timing sprocket (rear) (1) under the condition shown in Step "g".
- Remove wear compensation gear and spacer.



- Remove oil pump related parts. Refer to EM-323. "Exploded View".

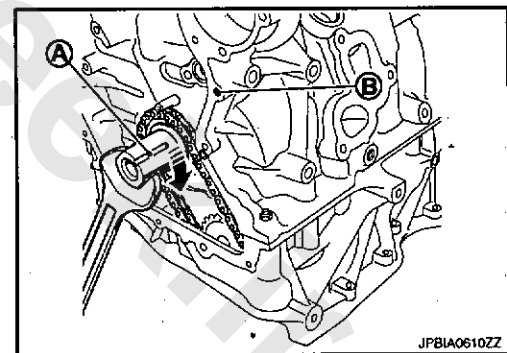
### 

- Obtain No.1 cylinder at TDC of its compression stroke with the following procedure:

- Align the crankshaft groove (A) with the cylinder block hole (B).

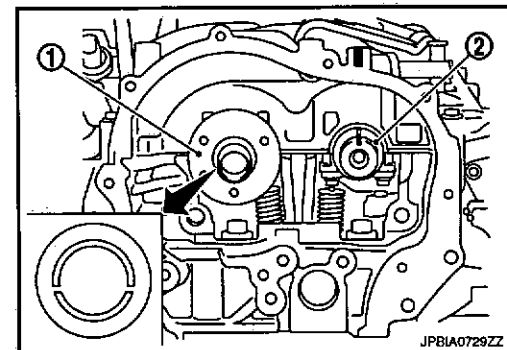
**NOTE:**

This is for the purpose of preventing interferences of valve and piston head.



- 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.

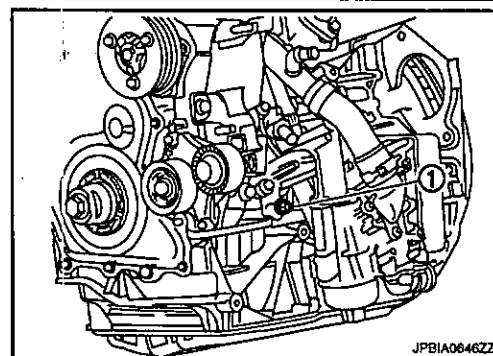


## TIMING CHAIN

### < ON-VEHICLE REPAIR >

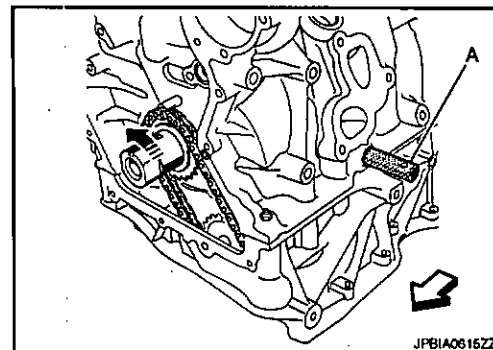
[M9R]

- c. Remove TDC pin plug (1).



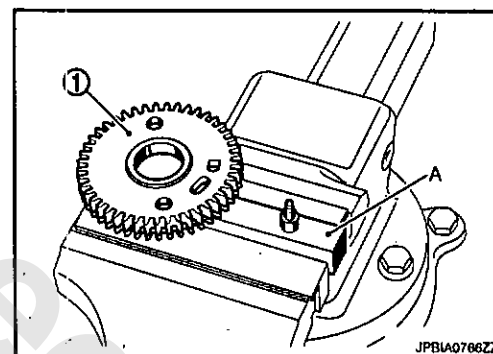
- d. Screw in the TDC set pin [SST: — (Mot. 1766)] (A). Turn the engine counterclockwise until the crankshaft touches the TDC set pin.

⇐ : Engine front



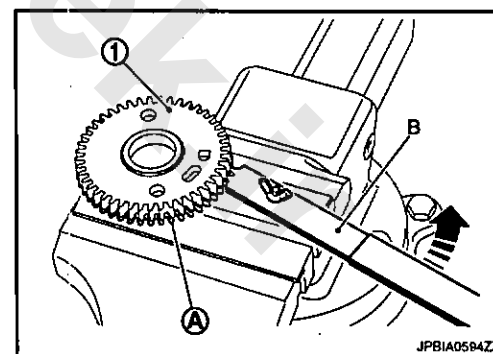
2. Install wear compensation gear with the following procedure:

- 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





# 

### 

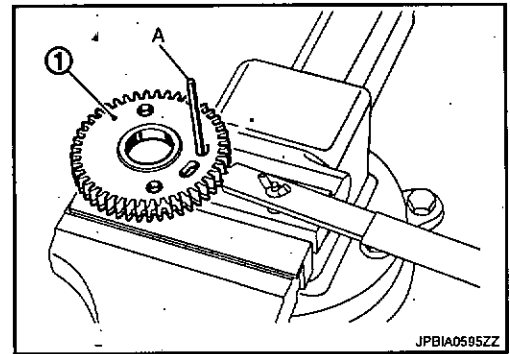
[M9R]

- c. Set a stopper pin (A) in the gear hole.

1 : Wear compensation gear

#### NOTE:

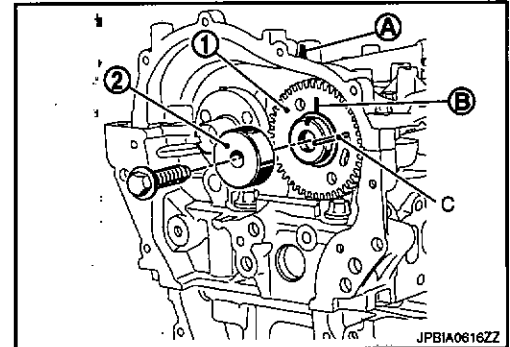
- Use approximately 4.0 mm (0.157 in) dia. hard metal pin as a stopper pin



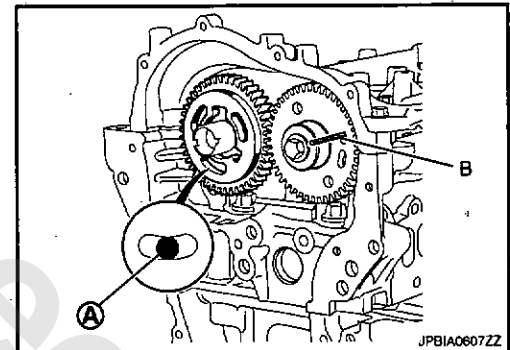
- d. Install wear compensation gear (1) and wear compensation gear spacer (2) to the camshaft (left side).
- e. Align matching mark (B) on wear compensation gear and boss (A) of cylinder head housing.

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

### < ON-VEHICLE REPAIR >

[M9R]

#### 4. Install timing chain tension guide (2).

- A : Matching mark
- B : Matching mark (punched)
- C : Matching mark (notched)
- D : Matching mark

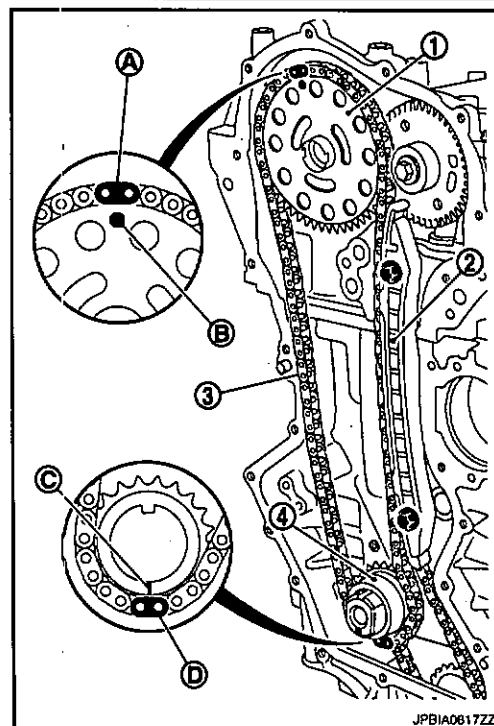
- Tighten timing chain tension guide mounting bolts in two steps.

 **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)**

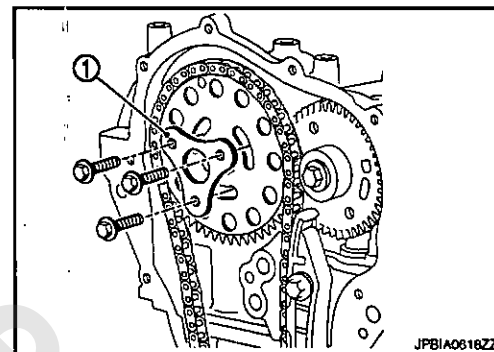
#### 5. Install timing sprocket (front) (1), crankshaft sprocket (4) and timing chain (3).

- 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.

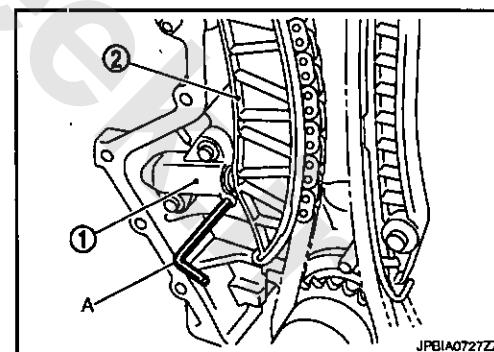
- Allow the timing sprocket to rotate freely.



#### 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

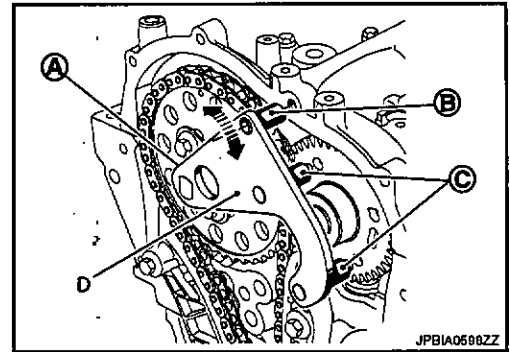
## < ON-VEHICLE REPAIR >

[M9R]

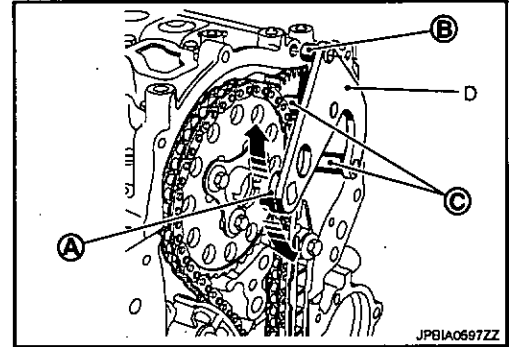
- a. Set the tool collet (A) of the timing adjustment tool [SST: — (Mot. 1769)] (D) in the camshaft groove (right side).

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:**

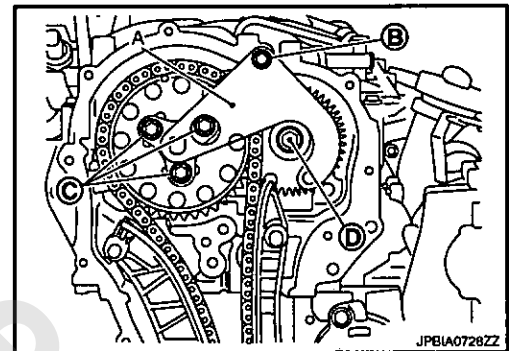
**Check the tightening angle by using an angle wrench [SST: KV10112100 ( — )] or protractor. Never judge by visual inspection without an angle wrench.**

- 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

## < ON-VEHICLE REPAIR >

[M9R]

- 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:**

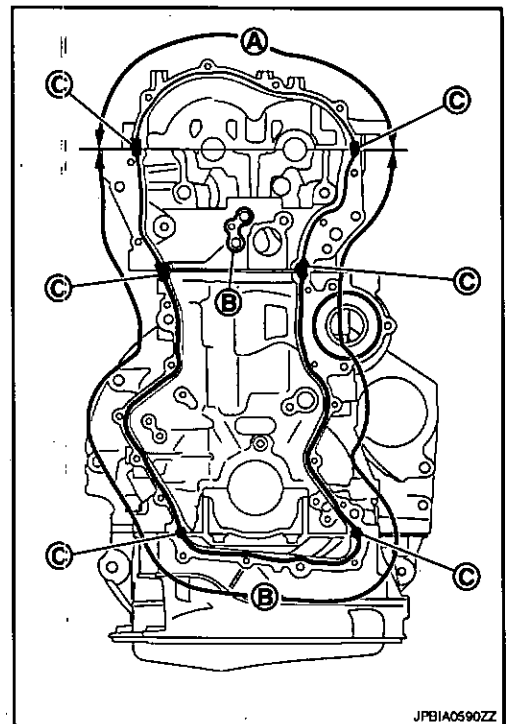
9.0 - 13.0 mm (0.354 - 0.512 in) in diameter and

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)

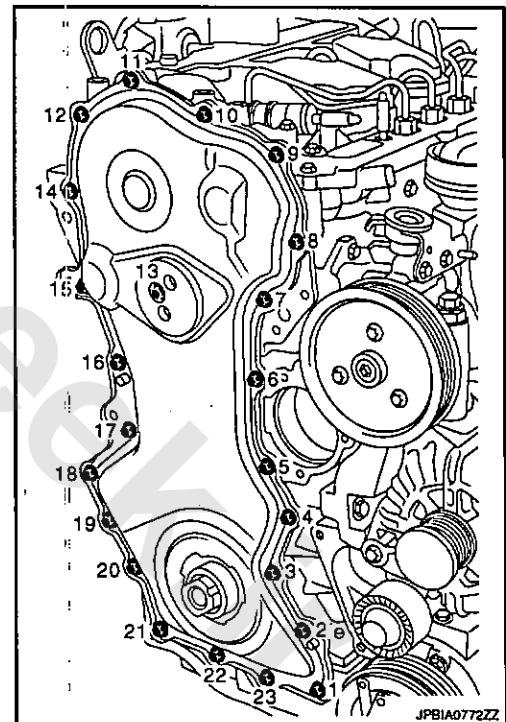
- iii. Tighten No. 23 bolt.

: 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

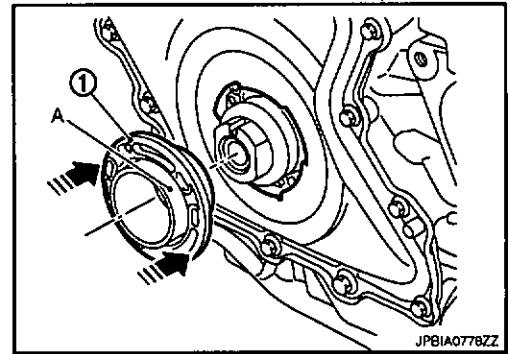
## < ON-VEHICLE REPAIR >

[M9R]

- a. Fit the protector (A) to front oil seal (1).
- Align the front oil seal notches with front cover notches.

**NOTE:**

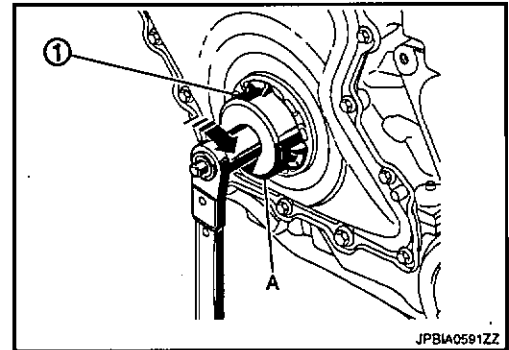
The protector is supplied in the new front oil seal parts kit.



- b. Tighten to front oil seal (1) using service tool (A).

**NOTE:**

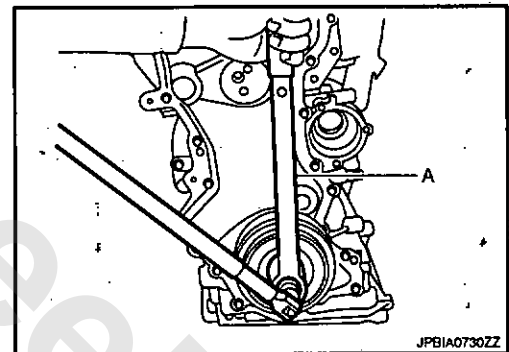
The service tool is supplied in the new front oil seal parts kit.




- 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:

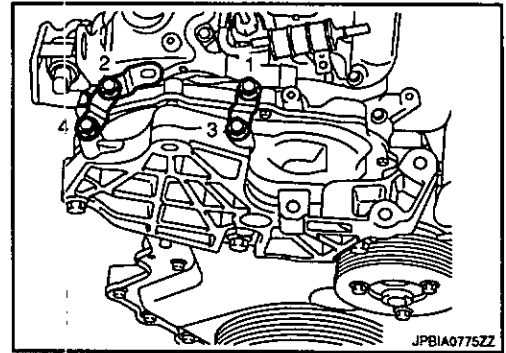
- a. Temporarily tighten engine mounting bracket bolts.  
b. Temporarily tighten engine mounting stay (front and rear) bolts.

# TIMING CHAIN

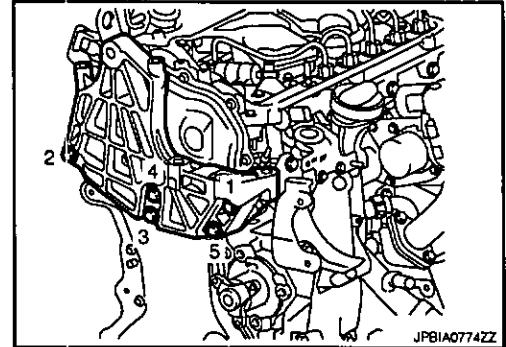
## < ON-VEHICLE REPAIR >

[M9R]

- 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:000000004899357

## 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-13, "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

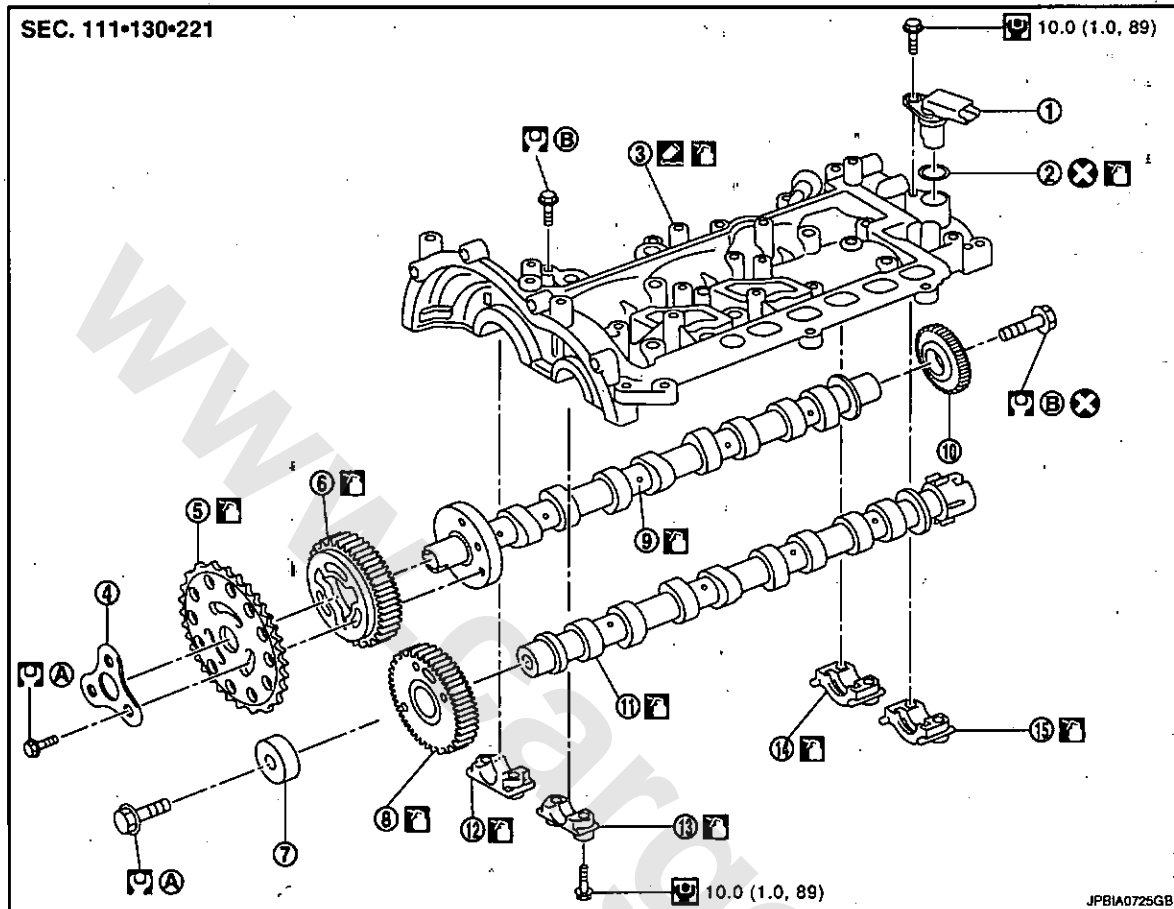
< ON-VEHICLE REPAIR >

[M9R]

## CAMSHAFT

### Exploded View

INFOID:0000000004899358



- |                                       |                            |                           |
|---------------------------------------|----------------------------|---------------------------|
| 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-297](#)

B. Refer to [EM-307](#)

Refer to [GI-3, "Components"](#) for symbols shown in the figure.

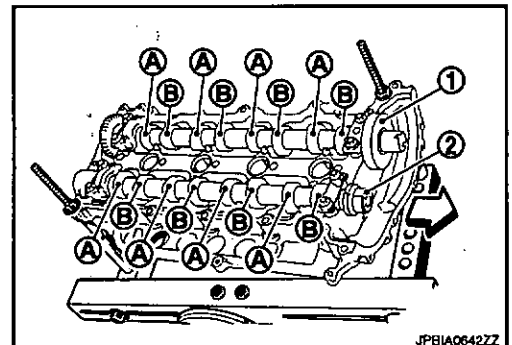
### Removal and Installation

INFOID:0000000004899359

#### 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         |

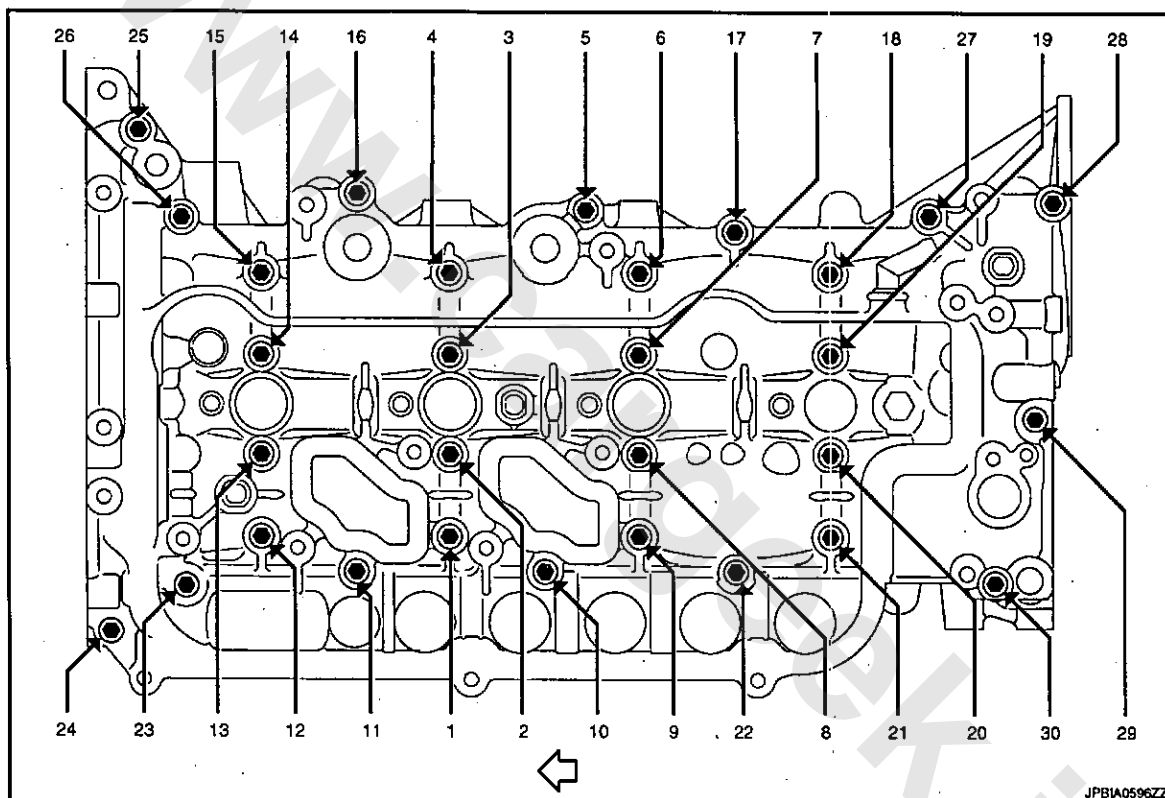


## REMOVAL

1. Remove the following parts.
  - Oil separator: Refer to EM-288, "Exploded View".
  - Fuel injector: Refer to EM-290, "Exploded View".
  - Engine slinger (front side): Refer to EM-326, "Exploded View".
  - Front cover and timing chain related parts: Refer to EM-296, "Exploded View".
  - Fuel pump: Refer to EM-293, "Exploded View".
  - Vacuum pump: Refer to EM-286, "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.



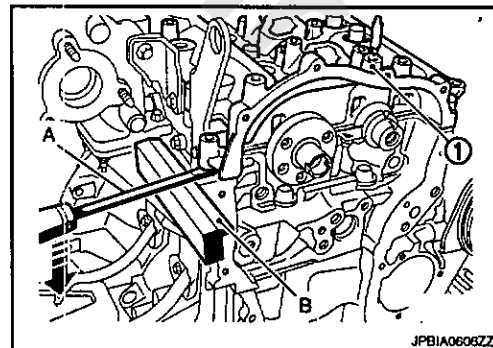
⇐ : Engine front

- 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:

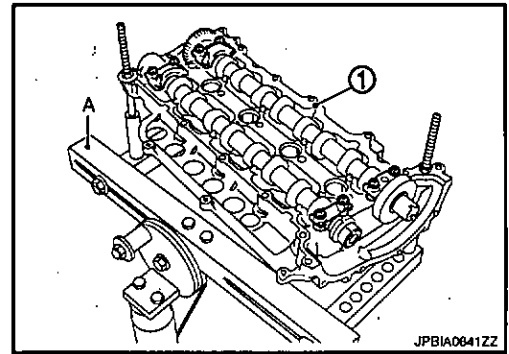


# CAMSHAFT

## < ON-VEHICLE REPAIR >

[M9R]

- 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.

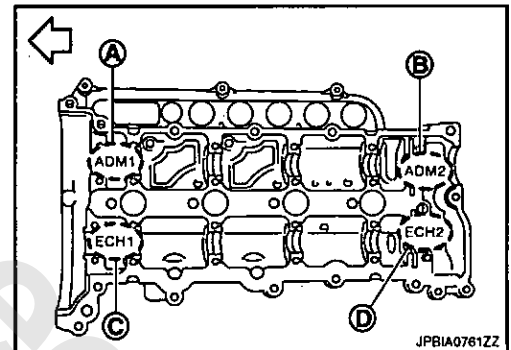
## INSTALLATION

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



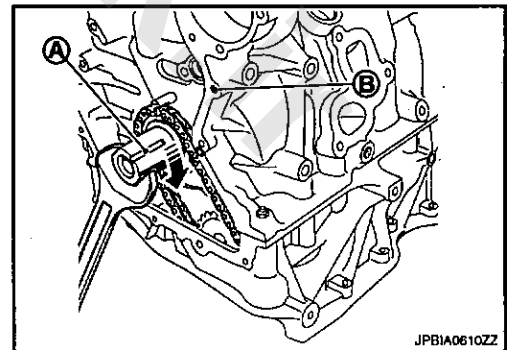
- d. Tighten camshaft bracket mounting bolts.
  - Finger tighten the camshaft bracket mounting bolts, until they just make contact.

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

## < ON-VEHICLE REPAIR >

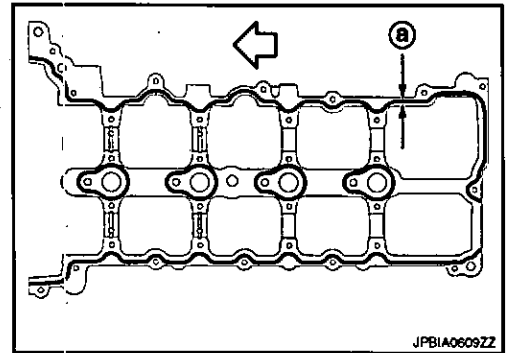
[M9R]

- c. Apply liquid gasket to cylinder head as shown in the figure.

a : 0.5 - 2.5 mm (0.020 - 0.098 in)

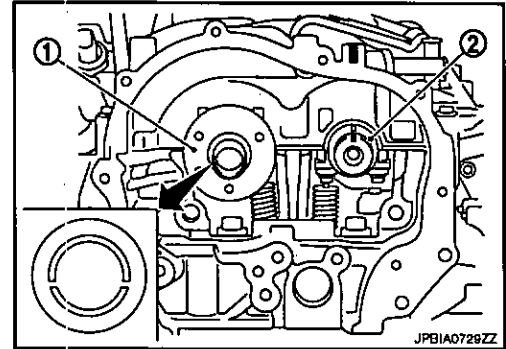
⇐ : Engine front

**Use Genuine Liquid Gasket or equivalent.**

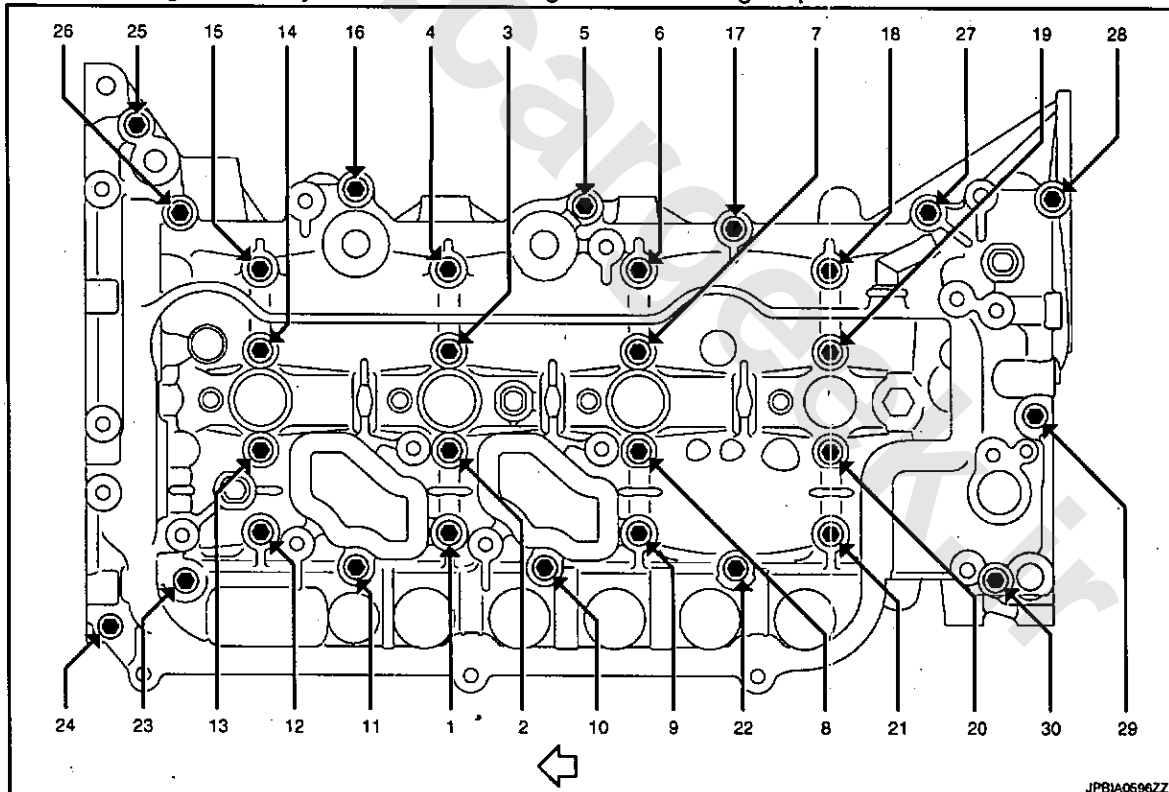


- d. Install so that camshafts are positioned in the directions shown in the figure.

- 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.

: 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-296, "Exploded View".
5. Install in the reverse order of removal, for the rest of parts

## Inspection

INFOID:0000000004899360

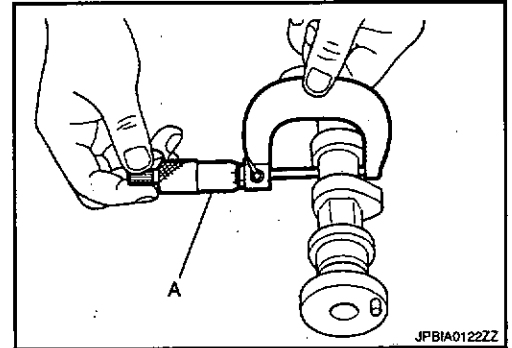
### INSPECTION AFTER REMOVAL

Camshaft Journal oil clearance

#### CAMSHAFT JOURNAL

- Measure the camshaft journal with a micrometer (A).

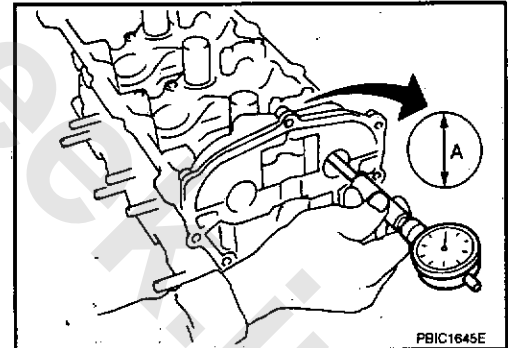
**Standard** : Refer to EM-357, "Camshaft".



#### 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-357, "Camshaft".



#### CAMSHAFT JOURNAL OIL CLEARANCE

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

**Standard** : Refer to EM-357, "Camshaft".

- If it exceeds the standard, replace camshaft or/and 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-13, "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.

## CAMSHAFT

### < ON-VEHICLE REPAIR >

[M9R]

- 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.

## OIL SEAL

## FRONT OIL SEAL

## FRONT OIL SEAL : Removal and Installation

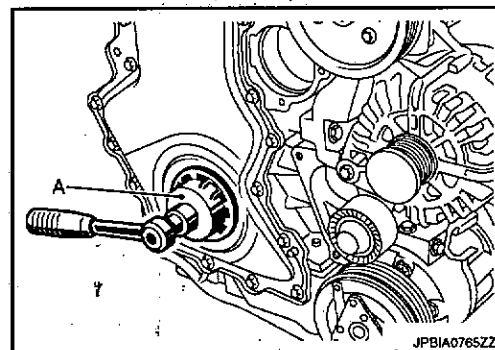
INFOID:000000004899361

## REMOVAL

1. Remove the following parts.
  - Front fender protector (RH): Refer to EXT-22, "Exploded View".
  - Drive belt: Refer to EM-259, "Removal and Installation".
  - Crankshaft pulley: Refer to EM-296, "Exploded View".
2. Remove front oil seal using service tool (A).

**NOTE:**

The service tool is supplied in the new seal parts kit.

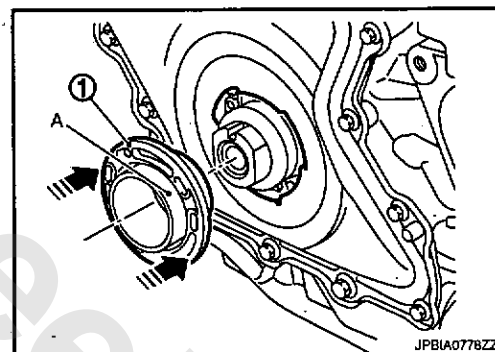


## INSTALLATION

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.

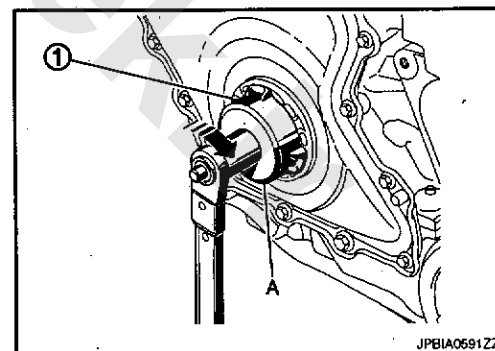


- b. Tighten to front oil seal (1) using service tool (A).

**Tightening torque:** Refer to EM-296, "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:000000004899362

## REMOVAL

1. Remove transaxle assembly.

## OIL SEAL

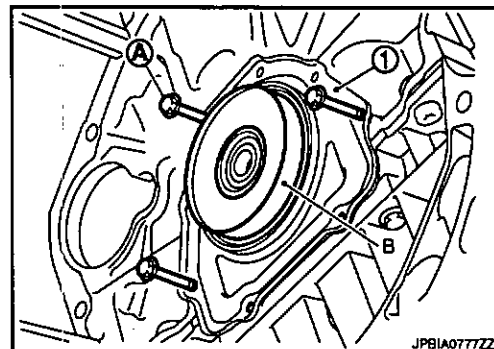
### < ON-VEHICLE REPAIR >

[M9R]

2. Remove clutch cover and clutch disk.
3. Remove flywheel.
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.

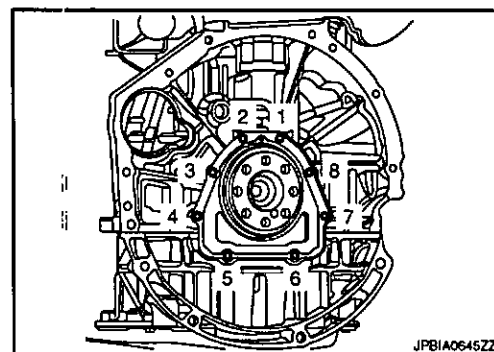


- c. Remove guide bolts and protector.
  - d. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.
  - i. Tighten bolts No. 1 and 5.

: 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.

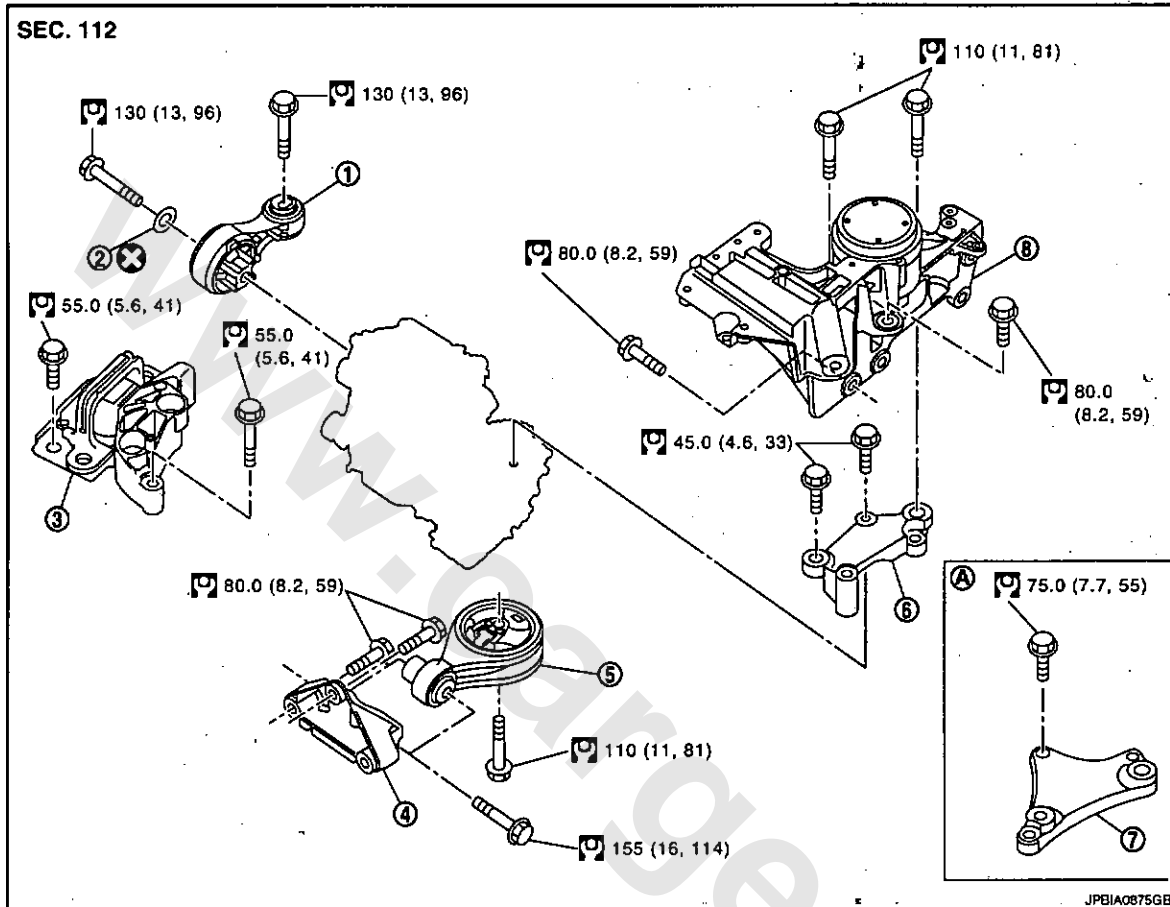
# REMOVAL AND INSTALLATION

## ENGINE ASSEMBLY

### Exploded View

INFOID:000000004899363

EM



- |  |                                   |  |
|--|-----------------------------------|--|
| 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-3, "Components" for symbols in the figure.

### Removal and Installation

INFOID:000000004899364

#### 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-32, "Garage Jack and Safety Stand and 2-Pole Lift".

### REMOVAL

#### Outline

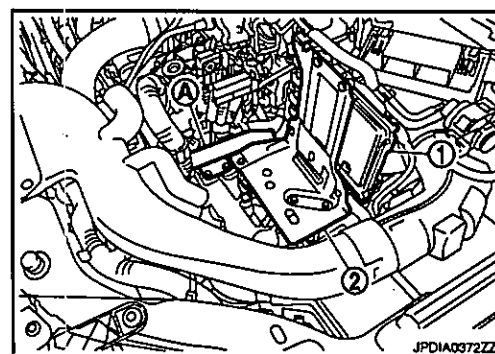
Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

#### Preparation

1. Drain engine coolant from radiator. Refer to CO-53, "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-267, "Exploded View".
  - Front fender protector (RH and LH): Refer to EXT-22, "Exploded View".
  - Road wheels tire (RH and LH): Refer to WT-3, "Road Wheel".
  - Battery and battery tray: Refer to PG-89, "Exploded View".
  - Air inlet tubes and air inlet hoses: Refer to EM-268, "Exploded View".
  - Air duct (inlet) and air duct/air cleaner case assembly: Refer to EM-265, "Exploded View".
  - Radiator hose (upper and lower) and cooling fan assembly: Refer to CO-57, "Exploded View".
  - Exhaust front tube: Refer to EX-15, "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-290, "Exploded View".
5. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining. Refer to CO-63, "Exploded View".
6. Disconnect shift cable/select cable from transaxle.
7. Remove ground cable from transaxle side.
8. Disconnect vacuum hose from brake booster. Refer to EM-286, "Exploded View".

#### Engine Room RH

1. Remove fuel filter. Refer to FL-22, "Exploded View".
2. Remove ground cable.
3. Disconnect reservoir tank hose (lower) from water suction pipe. Refer to CO-61, "Exploded View".
4. Remove alternator. Refer to CHG-24, "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-38, "Exploded View".

#### Vehicle Underbody

1. Remove front wheel sensor (RH and LH) for ABS from steering knuckle. Refer to BRC-42, "FRONT WHEEL SENSOR : Exploded View".



# ENGINE ASSEMBLY

## < REMOVAL AND INSTALLATION >

[M9R]

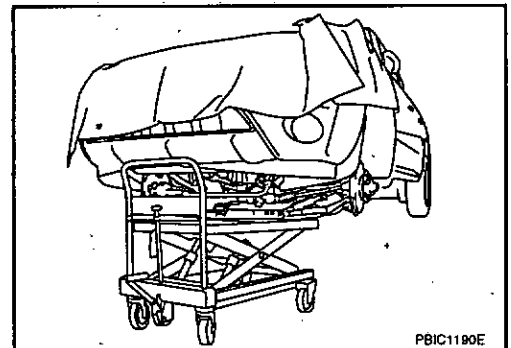
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to BR-37, "BRAKE CALIPER ASSEMBLY : Exploded View" (LHD) or BR-81, "BRAKE CALIPER ASSEMBLY : Exploded View" (RHD).
3. Remove two mounting bolts 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-105, "Exploded View".
6. Remove drive shaft (RH and LH). Refer to FAX-34, "M9R MODELS : Exploded View" (2WD models) or FAX-68, "M9R MODELS : 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-277, "Exploded View".
10. Remove differential exhaust pressure sensor and bracket assembly. Refer to EX-15, "Exploded View".
11. Disconnect clutch pipe.
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-323, "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:

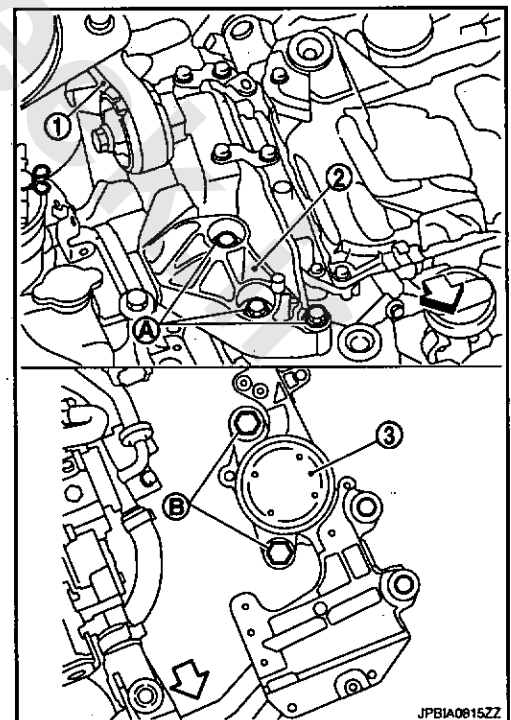
Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



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.

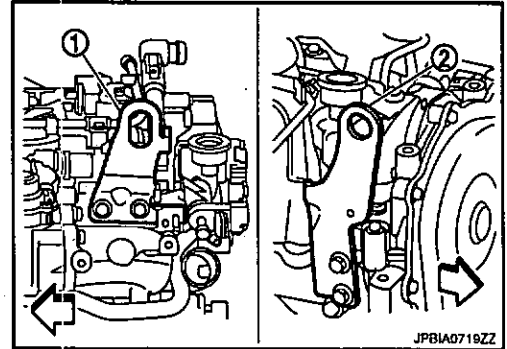
### CAUTION:

- 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-23, "M9R MODELS : Exploded View".
- Lift with a hoist and separate the engine from the transaxle assembly.

## INSTALLATION

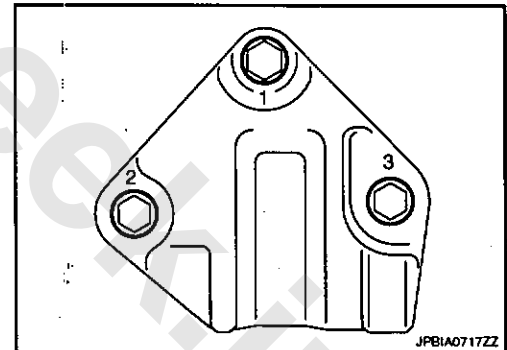
Note the following, and install in the reverse order of removal.

### 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).



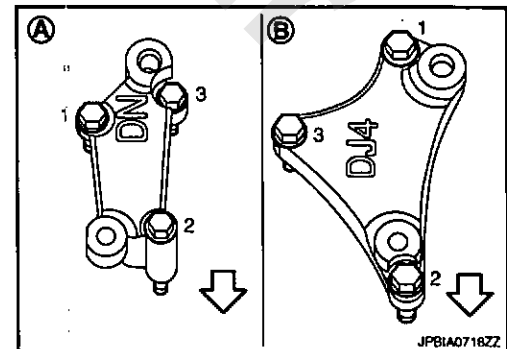
- Install the engine mounting bracket (LH) to the transaxle with the following procedure:

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

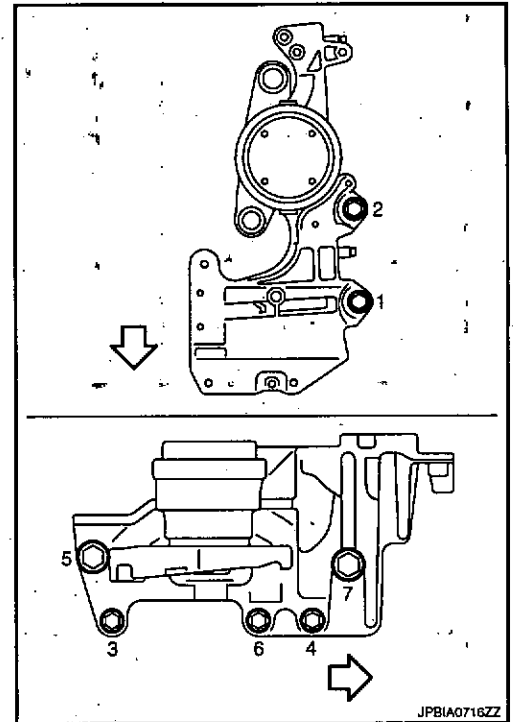
## < REMOVAL AND INSTALLATION >

[M9R]

- 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).



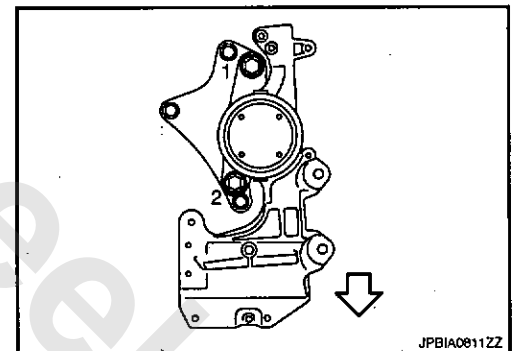
4. Install the engine mounting insulator (RH) and upper torque rod to the body (temporarily).

### 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.

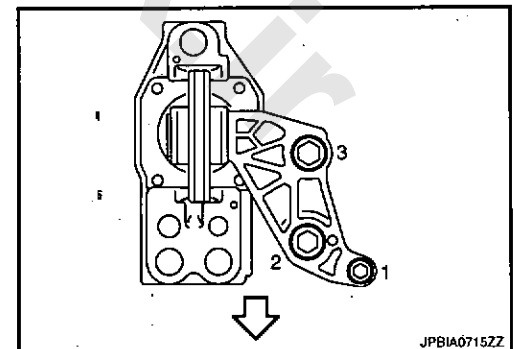


3. Install the engine mounting insulator (RH) to the engine side.

- 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

### INSPECTION AFTER INSTALLATION

INFOID:000000004899365

## ENGINE ASSEMBLY

### < REMOVAL AND INSTALLATION >

[M9R]

#### 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-13, "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.

# DISASSEMBLY AND ASSEMBLY

## ENGINE STAND SETTING

### Setting

INFOID:000000004899366

#### 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-315, "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.**

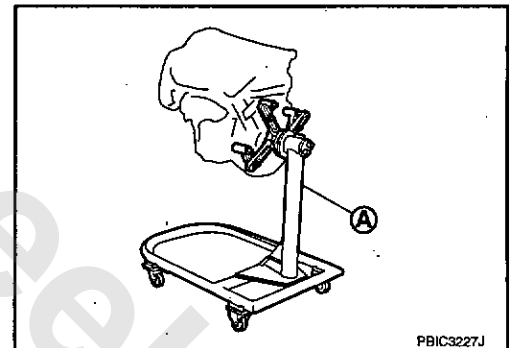
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
  - Intake manifold: Refer to EM-272, "Exploded View".
  - Exhaust manifold: Refer to EM-280, "Exploded View".
  - Oil separator: Refer to EM-288, "Exploded View".

#### 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.**



3. Drain engine oil. Refer to LU-24, "Draining".

#### CAUTION:

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

## ENGINE UNIT

### Disassembly

INFOID:00000000489367

1. Remove multifunction support bracket. Refer to EM-263, "Exploded View".
2. Remove intake manifold. Refer to EM-272, "Exploded View".
3. Remove exhaust manifold. Refer to EM-280, "Exploded View".
4. Remove oil pan (lower). Refer to EM-282, "Exploded View".
5. Remove oil cooler. Refer to LU-27, "Exploded View".
6. Remove vacuum pump. Refer to EM-286, "Exploded View".
7. Remove fuel pump. Refer to EM-293, "Exploded View".
8. Remove timing chain. Refer to EM-296, "Exploded View".
9. Remove cylinder head housing. Refer to EM-307, "Exploded View".
10. Remove water suction pipe. Refer to CO-61, "Exploded View".
11. Remove water outlet and thermostat assembly. Refer to CO-63, "Exploded View".

### Assembly

INFOID:00000000489368

Assembly is the reverse order of disassembly.

# OIL PAN (UPPER)

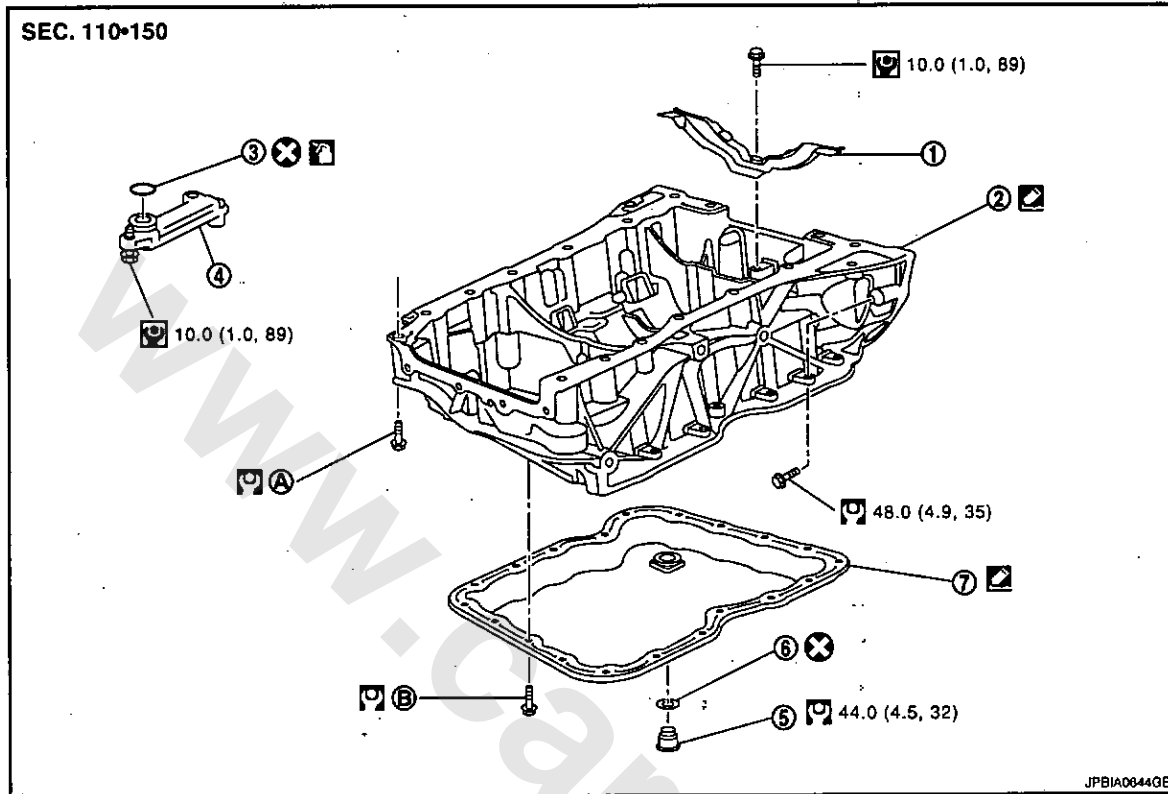
< DISASSEMBLY AND ASSEMBLY >

[M9R]

## OIL PAN (UPPER)

### Exploded View

INFOID:0000000004899369



- |                                    |                                    |           |
|------------------------------------|------------------------------------|-----------|
| 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-323</a> | B. Refer to <a href="#">EM-282</a> |           |

Refer to [GI-3](#), "Components" for symbols in the figure.

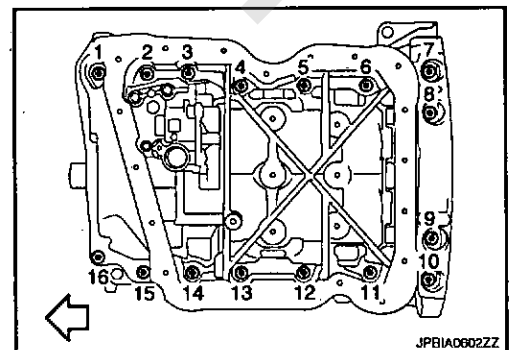
## Removal and Installation

INFOID:0000000004899370

### REMOVAL

1. Remove oil pan (lower) and oil strainer. Refer to [EM-282](#), "Removal and Installation".
2. Remove rear oil seal retainer. Refer to [EM-313](#), "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)

### < DISASSEMBLY AND ASSEMBLY >

[M9R]

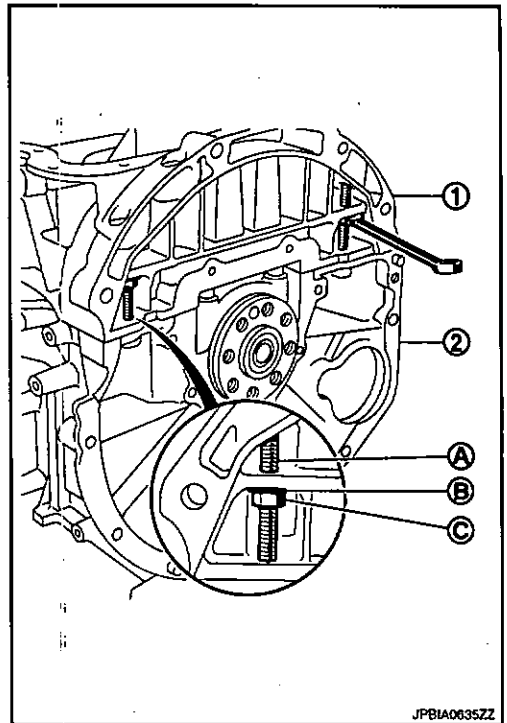
- b. Set two stud bolts (A), two washers (B) and two nuts (C) in place of the oil pan (upper) mounting bolts.

- 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)

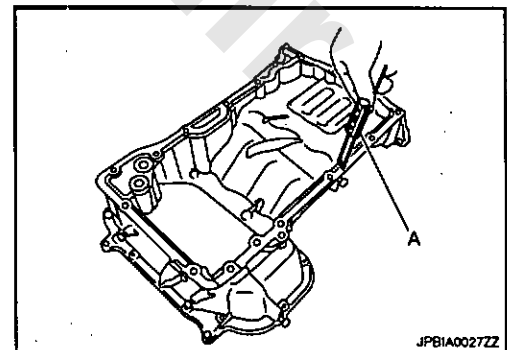
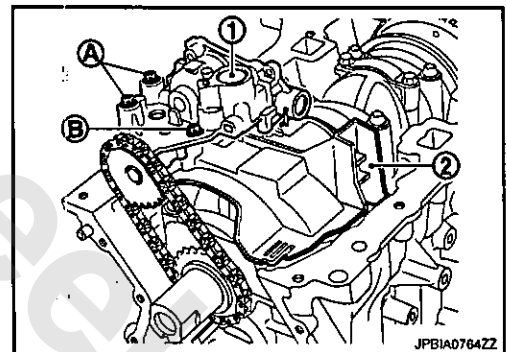
2. Install oil pan (upper) with the following procedure:

- 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)

### < DISASSEMBLY AND ASSEMBLY >

[M9R]

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

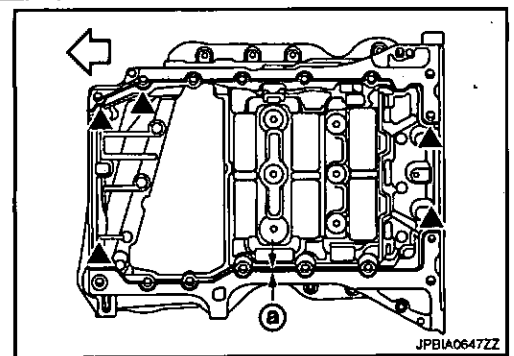
a : 3.0 - 7.0 mm (0.118 - 0.276 in)

↶ : 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.

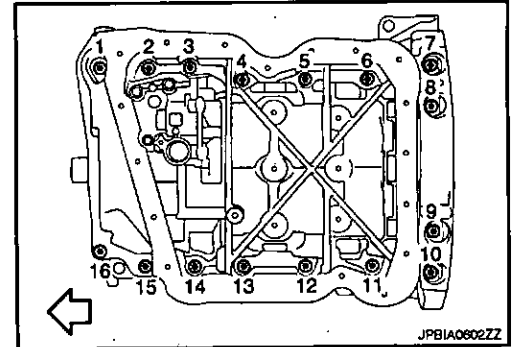


- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

↶ : 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-313, "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

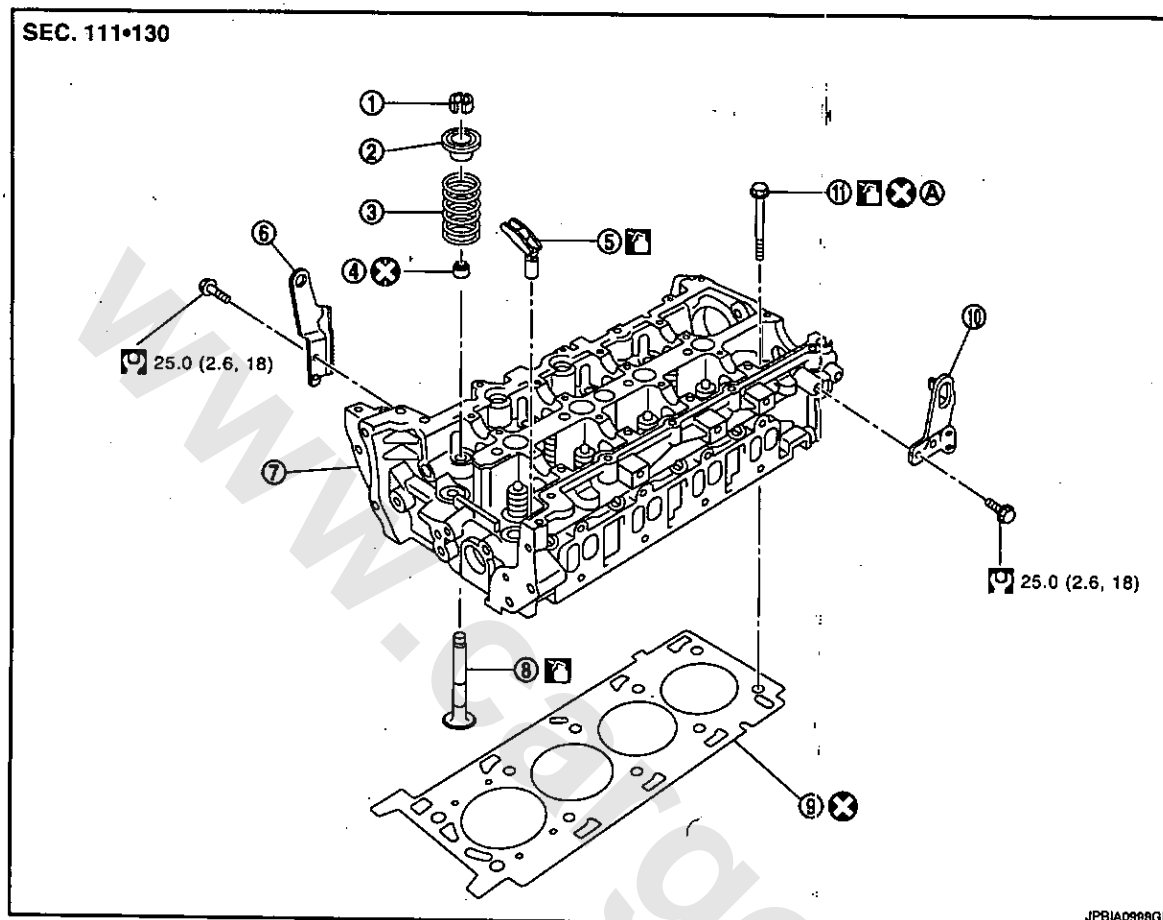
< DISASSEMBLY AND ASSEMBLY >

[M9R]

## CYLINDER HEAD

Exploded View

INFOID:000000004899371



- |                                |                          |                                |
|--------------------------------|--------------------------|--------------------------------|
| 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-326](#)

Refer to [GI-3, "Components"](#) for symbols in the figure.

## Disassembly and Assembly

INFOID:000000004899372

### DISASSEMBLY

1. Remove the following components and related parts.
  - Turbocharger: Refer to [EM-277, "Exploded View"](#).
  - Intake manifold: Refer to [EM-272, "Exploded View"](#).
  - Exhaust manifold: Refer to [EM-280, "Exploded View"](#).
  - Water outlet and thermostat assembly: Refer to [CO-63, "Exploded View"](#).
  - Front cover, timing chain: Refer to [EM-296, "Exploded View"](#).
  - Cylinder head housing: Refer to [EM-307, "Exploded View"](#).

# CYLINDER HEAD

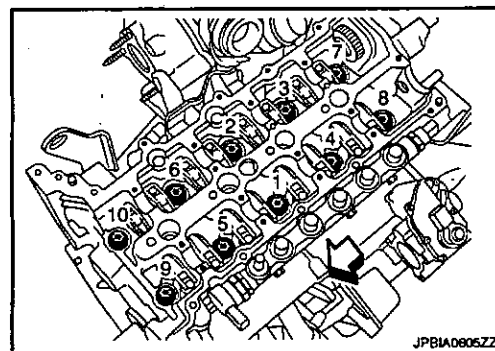
## < DISASSEMBLY AND ASSEMBLY >

[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)].

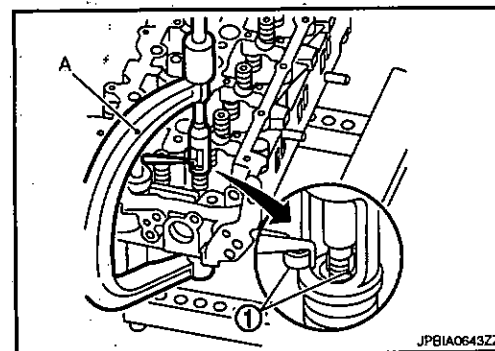
### 5. Remove hydraulic tappet.

#### 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).



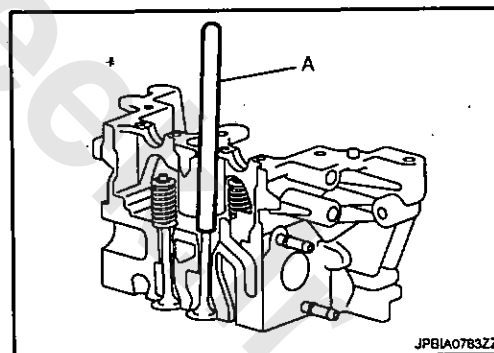
### 7. Remove valve spring retainer and valve spring.

### 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.

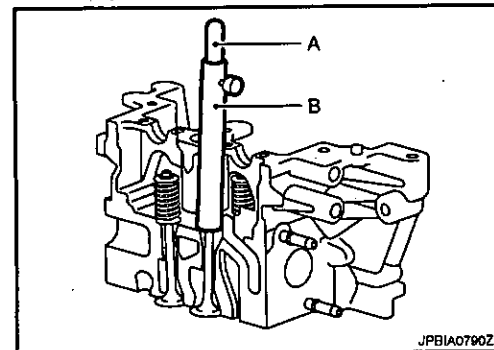
#### NOTE:

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.

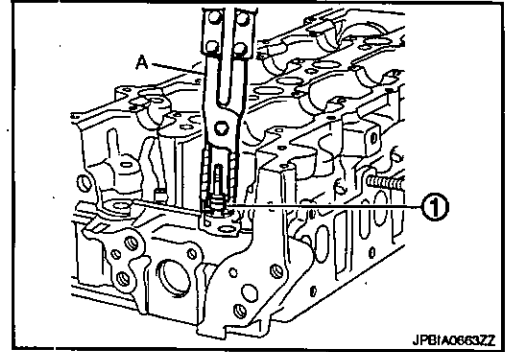
## CYLINDER HEAD

### < 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).



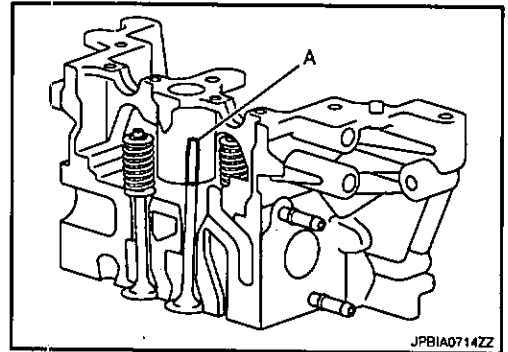
### ASSEMBLY

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.

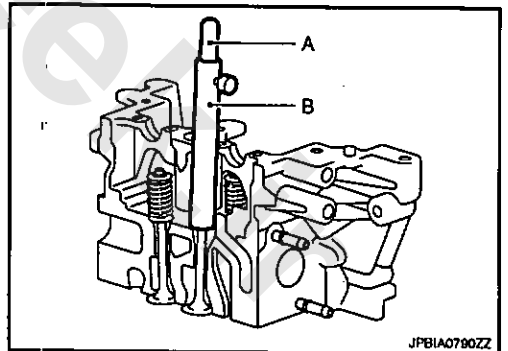


- b. Position a valve oil seal on the protector. Move the valve oil seal past the protector.

#### **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.

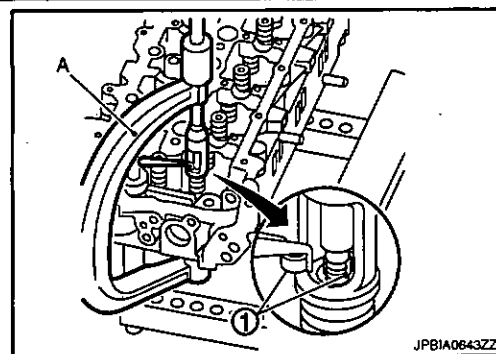
4. Install valve spring retainer.
5. Install valve collet (1).

# 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.



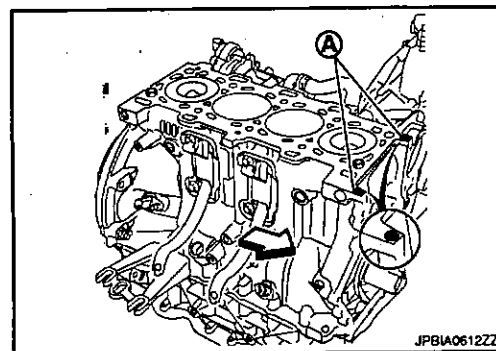
- Install hydraulic tappet.
  - Check that the tappets are filled with oil before refitting them.
- Install cylinder head gasket with the following procedure:
 

**CAUTION:**  
**Before installing cylinder head, inspect piston protrusion.**

  - Apply liquid gasket to position (A) shown in the figure.

↔ : Engine front

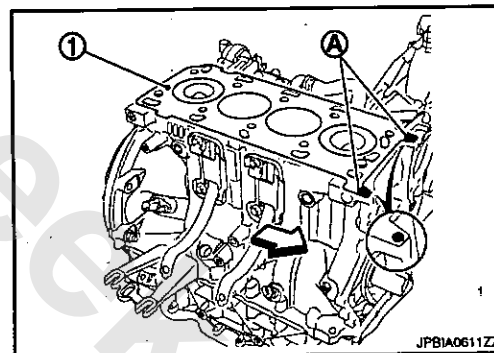
**Use Genuine Liquid Gasket or equivalent.**



- Install cylinder head gasket (1), and apply liquid gasket to position (A) shown in the figure.

↔ : Engine front

**Use Genuine Liquid Gasket or equivalent.**



- Install cylinder head, and tighten mounting bolts in numerical order as shown in figure with the following procedure:

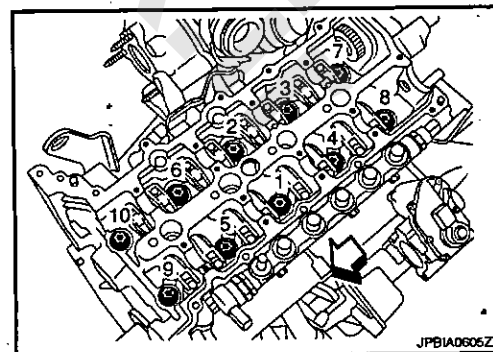
↔ : Engine front

- Tighten all bolts.

☞ : 5.0 N·m (0.51 kg-m, 4 ft-lb)

- Tighten all bolts.

☞ : 30.0 N·m (3.1 kg-m, 22 ft-lb)



# CYLINDER HEAD

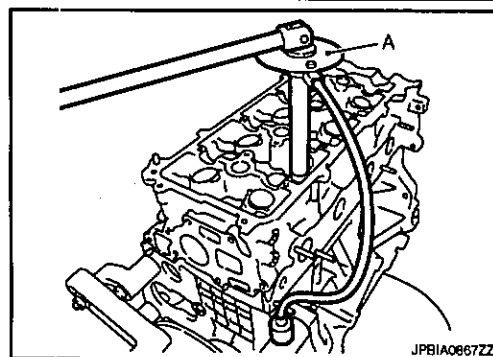
## < DISASSEMBLY AND ASSEMBLY >

[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:000000004898373

## 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.

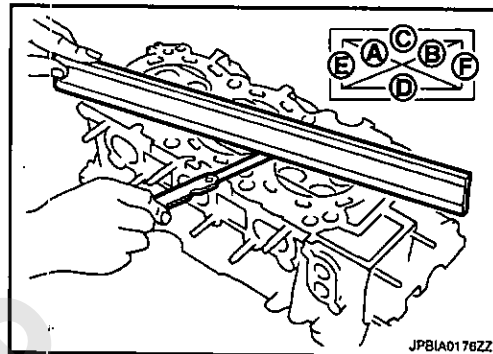
2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions (A - F).

Standard: Refer to EM-357, "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-357, "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-357, "Cylinder Head".

### Valve Guide Inner Diameter

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

Standard : Refer to EM-357, "Cylinder Head".

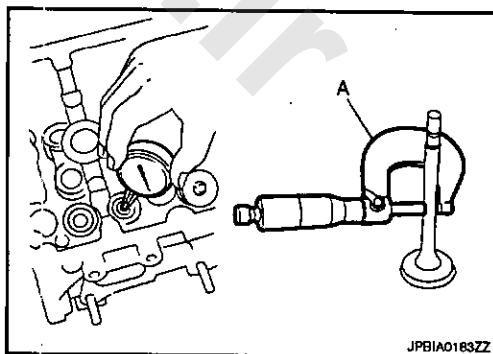
### Valve Guide Clearance

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

Standard : Refer to EM-357, "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 >

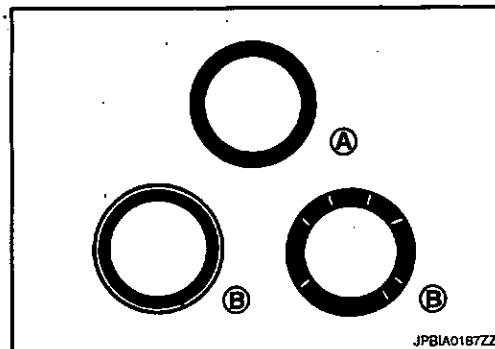
[M9R]

- 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.

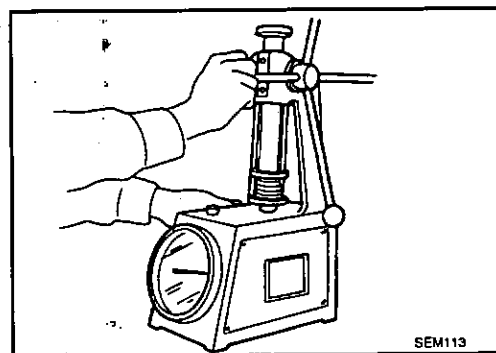


### VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

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

**Standard** : Refer to EM-357, "Cylinder Head".

- If the pressure height is out of the standard, replace valve spring.



# CYLINDER BLOCK

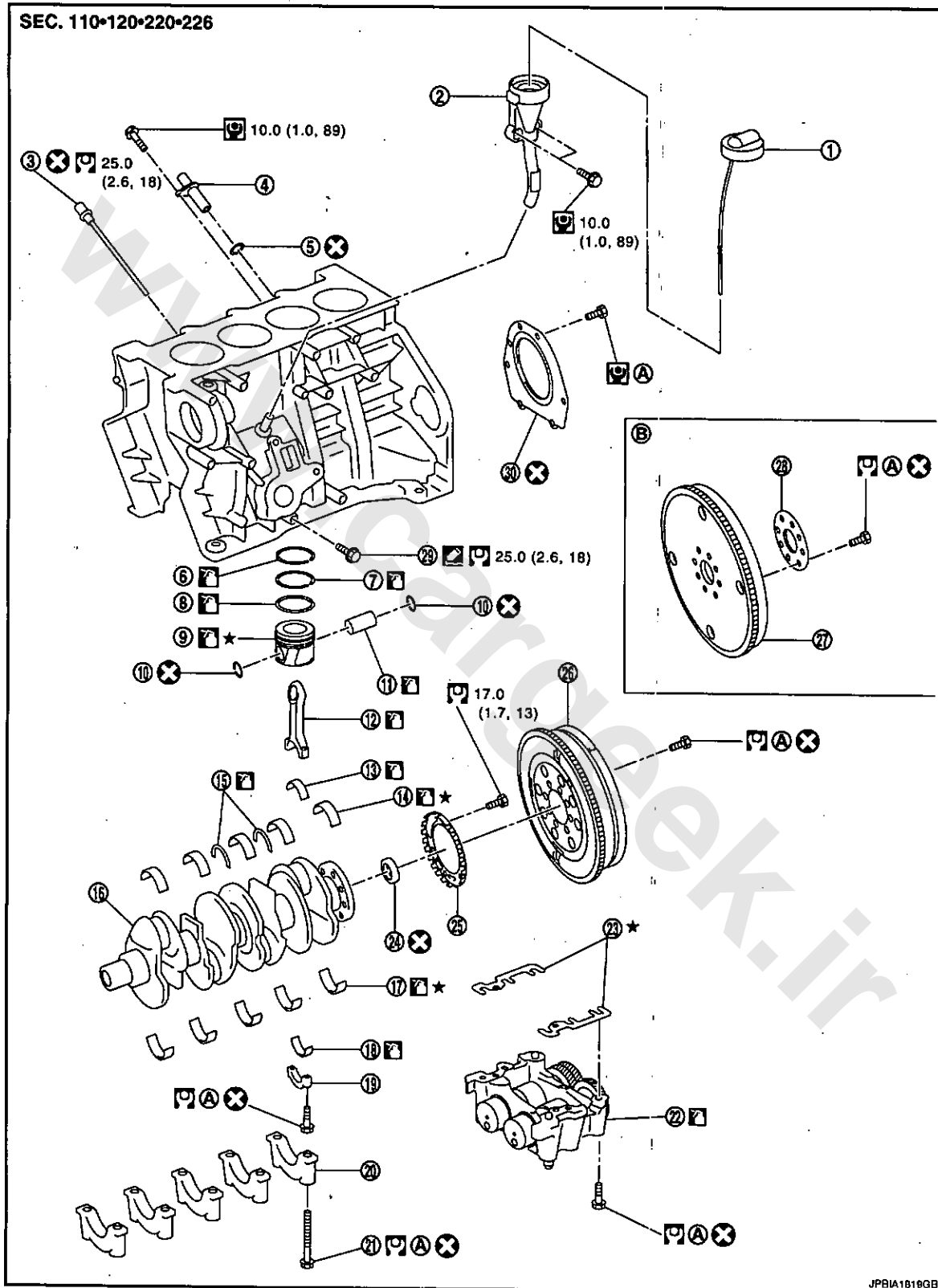
< DISASSEMBLY AND ASSEMBLY >

[M9R]

## CYLINDER BLOCK

Exploded View

INFOID:00000000489374



- |                               |                          |                     |
|-------------------------------|--------------------------|---------------------|
| 1. Oil level gauge            | 2. Oil level gauge guide | 3. Oil level sensor |
| 4. Crankshaft position sensor | 5. O-ring                | 6. Top ring         |
| 7. Second ring                | 8. Oil ring              | 9. Piston           |



# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

- |                                    |                           |                                    |    |
|------------------------------------|---------------------------|------------------------------------|----|
| 10. Snap ring                      | 11. Piston pin            | 12. Connecting rod                 |    |
| 13. Connecting rod bearing (upper) | 14. Main bearing (upper)  | 15. Thrust bearing                 | A  |
| 16. Crankshaft                     | 17. Main bearing (lower)  | 18. Connecting rod bearing (lower) |    |
| 19. Connecting rod cap             | 20. Main bearing cap      | 21. Main bearing cap bolt          | EM |
| 22. Balancer unit                  | 23. Balancer unit shims   | 24. Pilot bushing (M/T models)     |    |
| 25. Signal plate                   | 26. Flywheel (M/T models) | 27. Drive plate                    |    |
| 28. Reinforcement plate            | 29. TDC pin plug          | 30. Rear oil seal retainer         | C  |
| A. Refer to EM-333                 | B. A/T models             |                                    |    |

Refer to GI-3, "Components" for symbols shown in the figure.

## Disassembly and Assembly

INFOID:0000000004898375

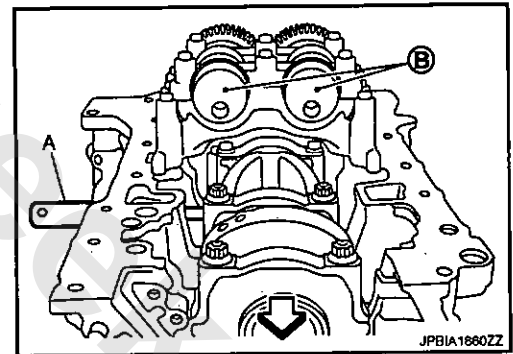
### Disassembly

- Remove oil level sensor.  
**CAUTION:**  
Handle it carefully and avoid impacts.
- Remove crankshaft position sensor.  
**CAUTION:**
  - Handle it carefully and avoid impacts.
  - Never place sensor in a location where it is exposed to magnetism.
- Remove rear oil seal retainer.
- Remove pilot bushing using the pilot bushing puller (commercial service tool), if necessary.
- Remove oil pan (upper). Refer to EM-323, "Exploded View".
- Remove oil pump related parts. Refer to EM-296, "Exploded View".
- Remove balancer unit and balancer unit shims with the following procedure:
  - Obtain No.1 cylinder at TDC of its compression stroke. Refer to EM-297, "Removal and Installation".
  - Screw in the TDC set pin [SST: — (Mot. 1766)] (A).

↔ : Engine front

### CAUTION:

The balancer unit weights (B) must be positioned on the opposite side to the crankshaft.



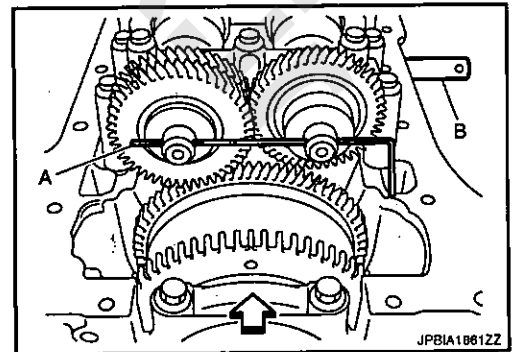
- Lock the balancer unit using the securing pin (A) of [balancer unit position tool (Mot.1802)].

B : TDC set pin [SST: — (Mot. 1766)]

↔ : Engine front

### CAUTION:

Never remove securing pin until balancer unit is installed.

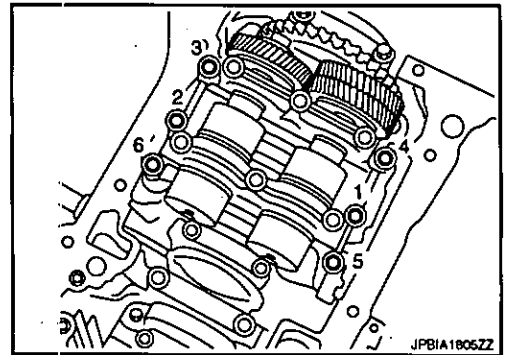


## CYLINDER BLOCK

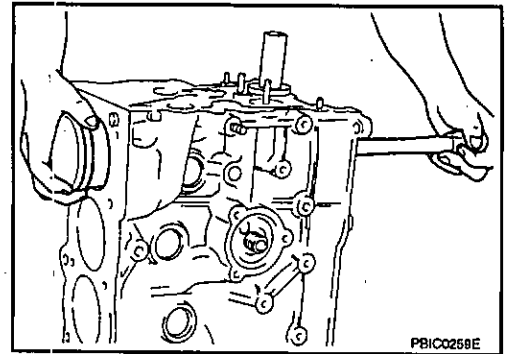
### < DISASSEMBLY AND ASSEMBLY >

[M9R]

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

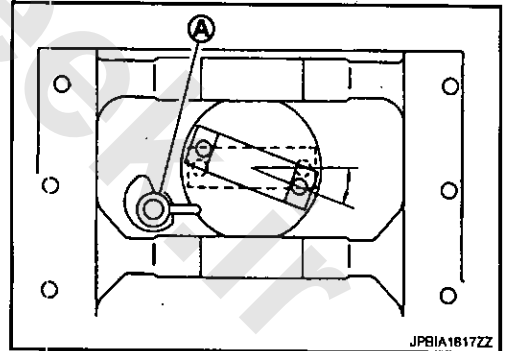


- e. Remove balancer unit and balancer unit shims.  
f. Remove the TDC set pin [SST: — (Mot. 1766)].  
8. Remove piston and connecting rod assembly with the following procedure:  
• Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-347, "Inspection".  
a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.  
b. Remove connecting rod cap.  
• Put a paint mark on cap to identify each cylinder.  
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 oil jets (A), cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.
- Never disassemble oil jets.



9. Remove connecting rod bearings.

#### CAUTION:

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

10. Remove piston rings from piston.

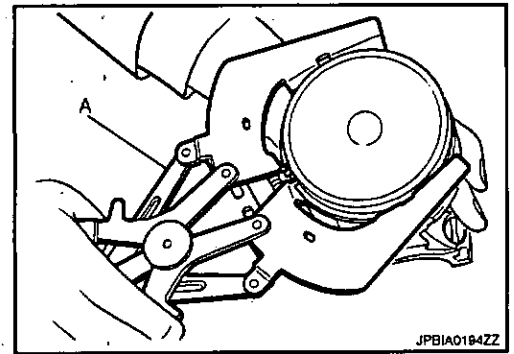
- Before removing piston rings, check the piston ring side clearance. Refer to EM-347, "Inspection".

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

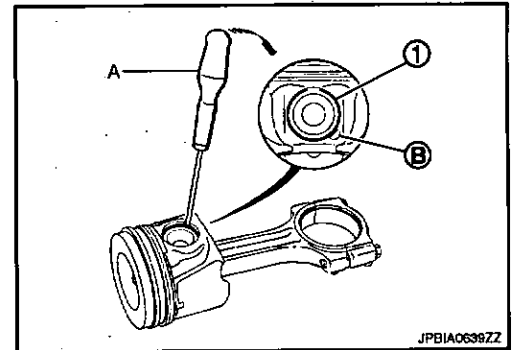
[M9R]

- 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.



11. Remove the snap rings (1) using a screwdriver (A), and then release the piston pin.

B : Channel

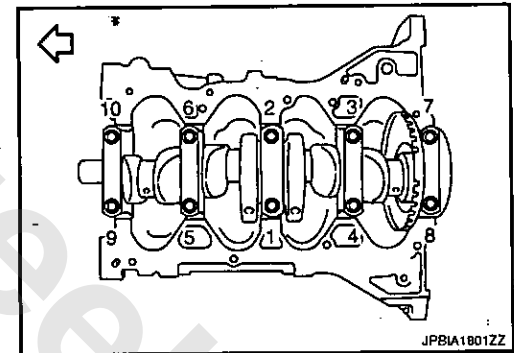


12. Remove main bearing cap mounting bolts with the following procedure:

- Measure crankshaft end play before loosening main bearing cap mounting bolts. Refer to EM-347, "Inspection".

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

⇐ : Engine front



- b. Remove main bearing caps.

- Put a paint mark on main bearing caps to identify each cylinder.
- Remove by rocking bearing cap back and forth while using main bearing cap bolts.

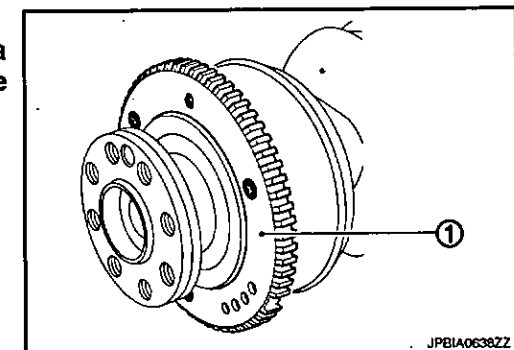
**CAUTION:**

- Be careful not to damage the mounting surface.
- Identify installation positions, and store them without mixing them up.

13. Remove crankshaft.

**CAUTION:**

- Be careful not to damage or deform signal plate (1).
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.



## CYLINDER BLOCK

### < DISASSEMBLY AND ASSEMBLY >

[M9R]

14. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

#### CAUTION:

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

15. Remove signal plate from crankshaft, if necessary.

#### Assembly

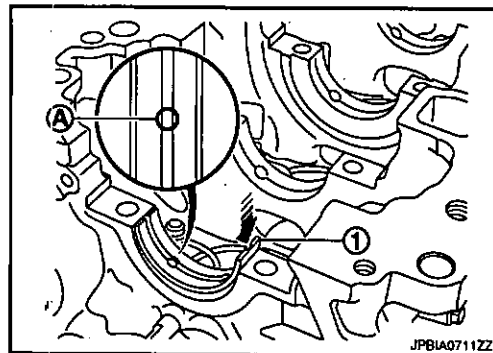
1. Fully air-blow engine coolant and engine oil passages in the cylinder block, cylinder bore and crankcase to remove any foreign matter.

#### CAUTION:

Use a goggles to protect your eye.

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

- a. Remove dust, dirt, and engine oil from the bearing mating surfaces of the cylinder block and main bearing cap.
- b. Install the main bearings paying attention to the direction.
  - Ensure the oil hole on cylinder block and oil hole (A) on the main bearings (upper) (1) are aligned.



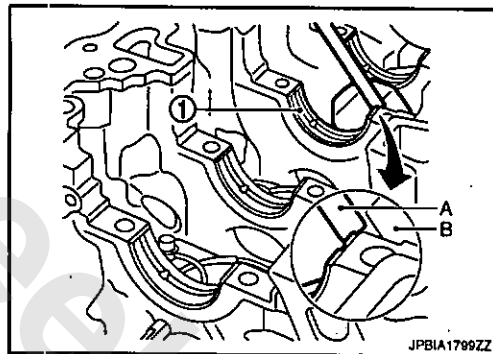
- Adjust the position of the main bearing (1) using a feeler gauge [2.0 mm (0.079 in)] (A).

B : Dial indicator stand set

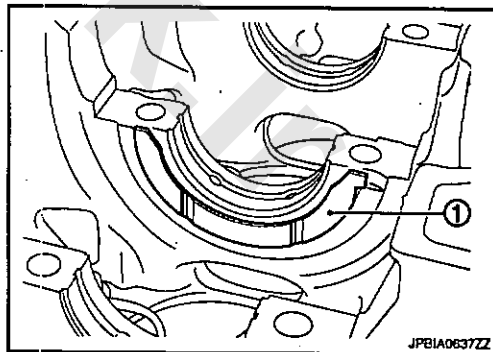
[Commercial service tool: KV113B0040 (Mot.251-01)]

#### NOTE:

Locate the bearing for the main bearing cap side.



- c. Install thrust bearings (1) to both sides of the No. 3 journal housing on the cylinder block.
  - Install thrust bearings with the oil groove facing crankshaft arm (outside).



3. Install signal plate to crankshaft, if removed.
4. Install crankshaft to cylinder block.
  - While turning crankshaft by hand, check that it turns smoothly.
5. Install main bearing caps with the following procedure:

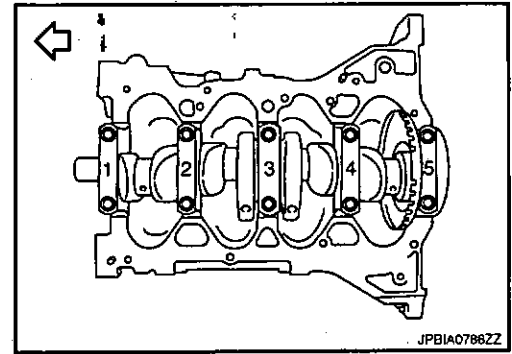
# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

- a. Align the identification number to the journal position to install as shown in the figure.

⇐ : Engine front



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

⇐ : Engine front

- i. Tighten main bearing cap bolts.

Ⓢ: 20.0 N·m (2.0 kg-m, 15 ft-lb)

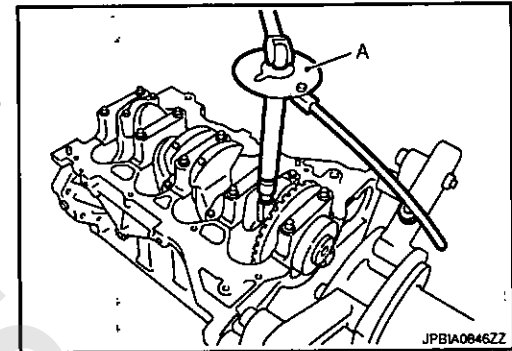
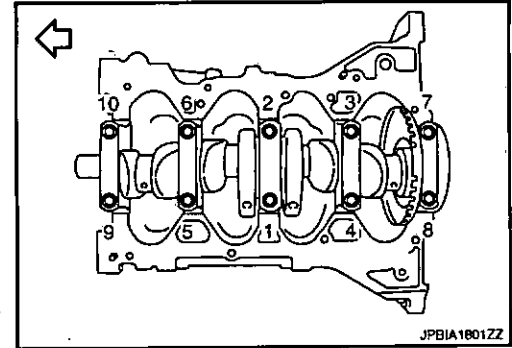
### CAUTION:

Be sure to check that the main bearing cap is in contact with the cylinder block before tightening the bolts.

- ii. Turn bolts 70 degrees clockwise (angle tightening).

### CAUTION:

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



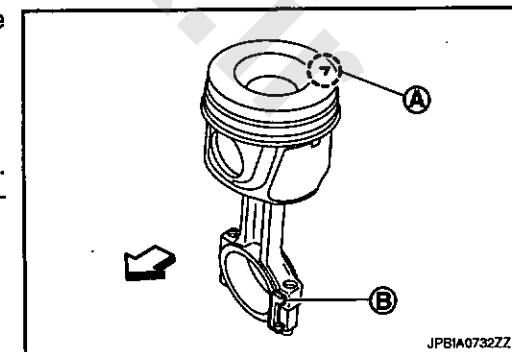
- After installing mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to EM-347, "Inspection".

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

- a. Install snap ring to the groove of the piston rear side.
- Insert it fully into the groove.
- b. Assemble piston to connecting rod.
- Point the mark engraved (A) on the piston head facing and the bosses (B) of the big end as shown in the figure.

⇐ : Engine front

- Piston pin can be pushed in by hand without excessive force. From the front to the rear, insert piston pin into piston and connecting rod.



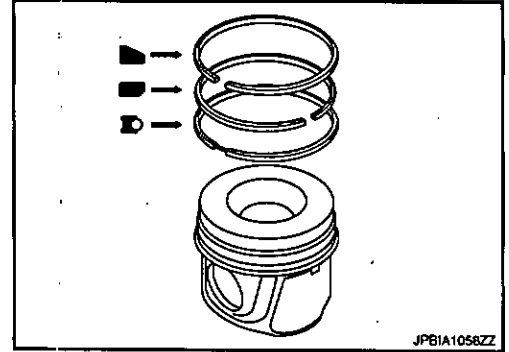
- c. Install snap ring to the groove of the piston front side.
- Insert it fully into the groove.
  - After installing, check that connecting rod moves smoothly.
7. Using a piston ring expander (commercial service tool), install piston rings.
- CAUTION:**

## CYLINDER BLOCK

### < DISASSEMBLY AND ASSEMBLY >

[M9R]

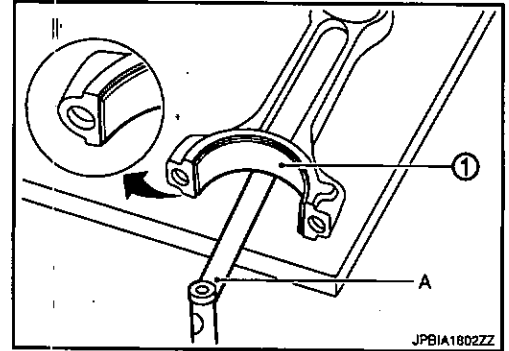
- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark.



8. Install connecting rod bearing (upper) and connecting rod bearing (lower) to connecting rod and connecting rod cap.
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Never apply new engine oil to the back surface, but thoroughly clean the back surface.
  - Adjust the position of the connecting rod bearing (1) using a feeler gauge [2.0 mm (0.079 in)] (A).

**NOTE:**

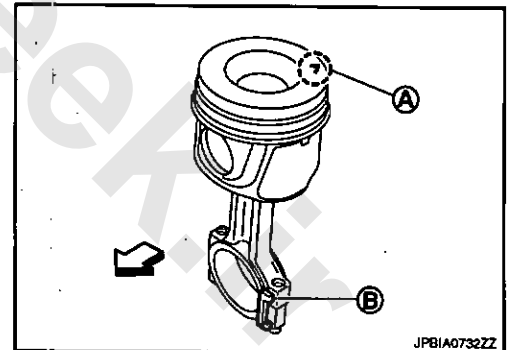
Locate the bearing for the connecting rod cap side.



9. Install piston and connecting rod assembly to crankshaft with the following procedure:
- Install removed parts in the same locations as before.
- a. 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.
- b. Install piston with the mark engraved (A) on the piston head facing the rear of the engine as shown in the figure.

B : Boss of big end

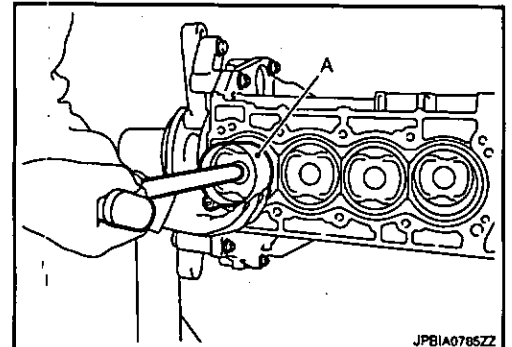
⇐ : Engine front



- c. Using a piston ring compressor [SST: EM03470000 ( — )] (A) or suitable tool.

**CAUTION:**

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



# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >


[M9R]

10. Install connecting rod cap 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 new bolts.

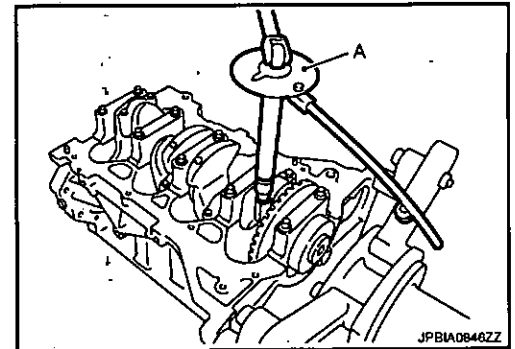
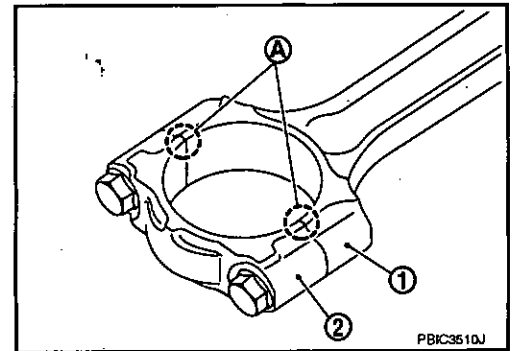
- a. Tighten new connecting rod cap bolts.

: 25.0 N·m (2.6 kg-m, 18 ft-lb)

- b. Turn bolts 55 degrees clockwise (angle tightening).

**CAUTION:**

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-347, "Inspection".
- Check the piston protrusion. Refer to EM-347, "Inspection".

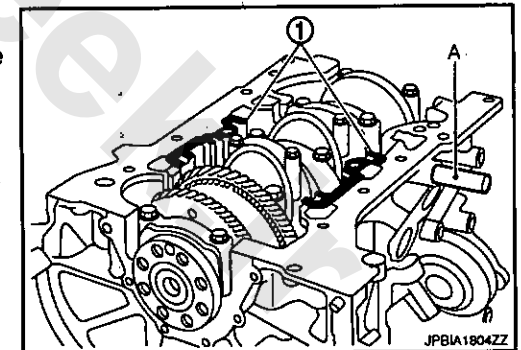
11. Install balancer unit with the following procedure:

**CAUTION:**

When any one of the parts listed below is replaced, adjust backlash of the balancer unit. Refer to EM-341, "Backlash Adjustment".

- Crankshaft
- Cylinder block
- Balancer unit

- a. Obtain No.1 cylinder at the TDC of its compression stroke. Refer to EM-297, "Removal and Installation".
- b. Screw in the TDC set pin [SST: — (Mot. 1766)] (A).
- c. Place balancer unit shims (1), aligning it with the oil hole of the cylinder block.



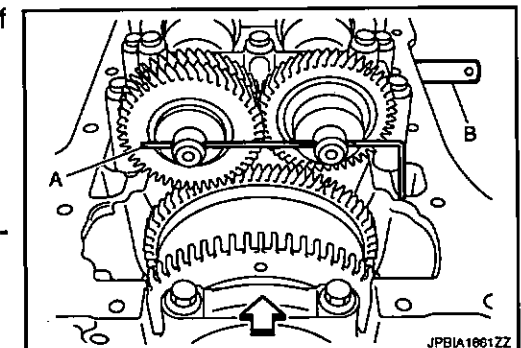
- d. Install balancer unit without removing the securing pin (A) of [balancer unit position tool (Mot.1802)].

B : TDC set pin [SST: — (Mot. 1766)]

: Engine front

**CAUTION:**

The balancer unit weights must be positioned on the opposite side to the crankshaft.

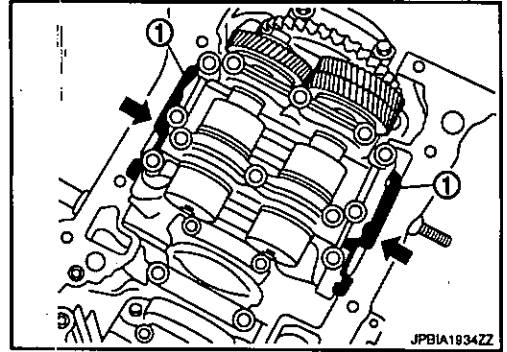


# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

- e. Screw in without tightening the old balancer unit bolts.
- f. Position the balancer unit shims (1) against the balancer unit bolts.



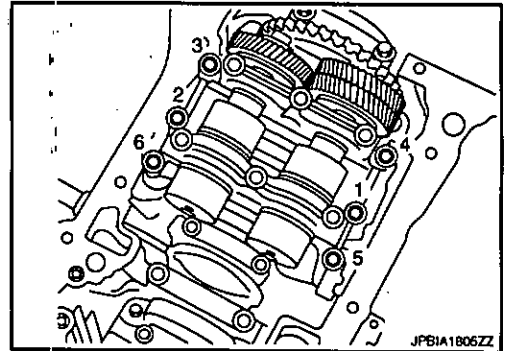
- g. Tighten new balancer unit bolts in numerical order as shown in the figure with the following procedure:
- i. Tighten balancer unit bolts.

: 15.0 N·m (1.5 kg-m, 11 ft-lb)

- ii. Turn bolts 85 degrees clockwise (angle tightening).

### CAUTION:

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



- h. Remove the TDC set pin [SST: — (Mot. 1766)] and securing pin of [balancer unit position tool (Mot.1802)].
12. 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).

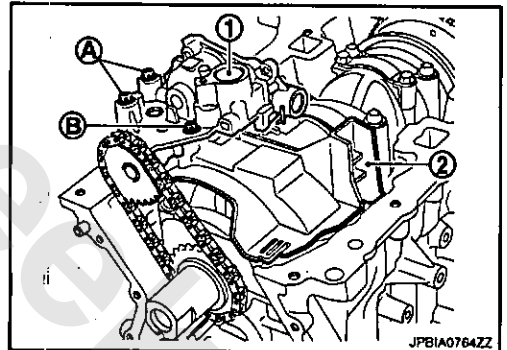
: 5.0 N·m (0.51 kg-m, 4 ft-lb)

- c. Tighten oil pump mounting bolts (A).

: 25.0 N·m (2.6 kg-m, 18 ft-lb)

- d. Tighten oil pump baffle plate mounting bolt (B).

: 8.0 N·m (0.82 kg-m, 71 in-lb)



13. Install oil pan (upper). Refer to EM-323, "Exploded View".

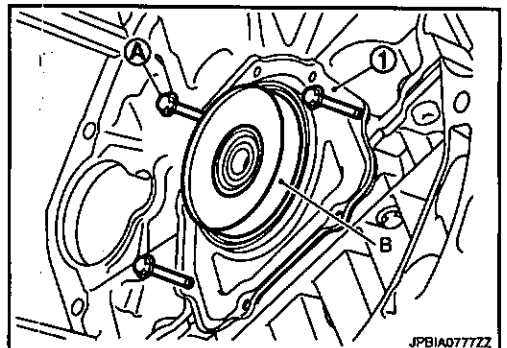
14. Install rear oil seal retainer with the following procedure:

- a. Set guide bolt (A) and protector (B) to rear oil seal retainer (1).

### NOTE:

The protector is supplied in the new oil seal parts kit.

- b. Move the rear oil seal retainer evenly by hand until it makes contact with the cylinder block.





# CYLINDER BLOCK


## < DISASSEMBLY AND ASSEMBLY >

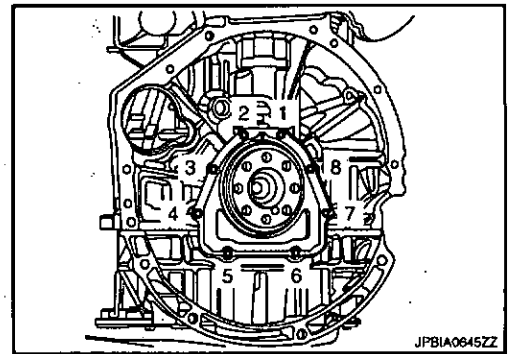
[M9R]

- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.
- i. Tighten mounting bolts No.1 and 5.

: 5.0 N·m (0.51 kg-m, 44 in-lb)

- ii. Tighten mounting bolts No. 1 to 8 in numerical order as shown.

: 12.0 N·m (1.2 kg-m, 106 in-lb)




15. Install pilot bushing (M/T models).
  - Using the drift, force fit the pilot bushing until its front end contacts crankshaft.

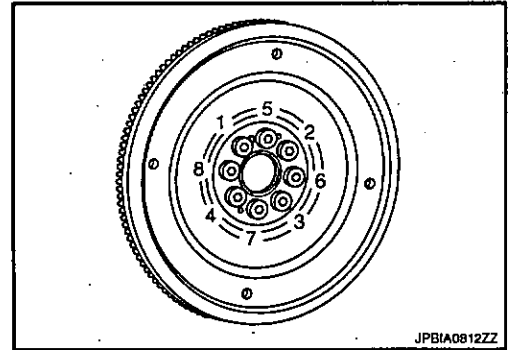
### NOTE:

A/T models have no pilot bushing.


16. Install flywheel (M/T models).
  - a. Fix crankshaft using crankshaft pulley locking tool [SST: — (Mot.1770)].
  - b. Tighten bolts in numerical order as shown in the figure with the following procedure:
    - i. Tighten mounting bolts.

: 25.0 N·m (2.6 kg-m, 18 ft-lb)


- ii. Turn 45 degrees clockwise (angle tightening).



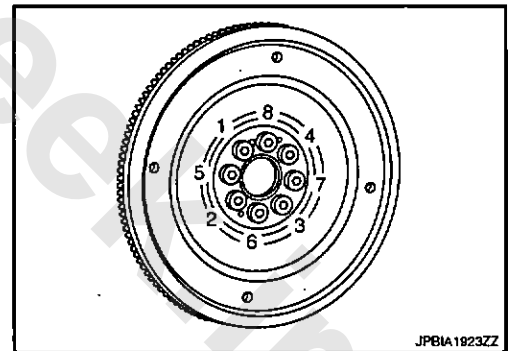
17. Install drive plate (A/T models).
  - a. Fix crankshaft using crankshaft pulley locking tool [SST: — (Mot.1770)].
  - b. Tighten bolts in numerical order as shown in the figure with the following procedure:
    - i. Tighten mounting bolts.

: 30.0 N·m (3.1 kg-m, 22 ft-lb)

- ii. Tighten mounting bolts.

: 35.0 N·m (3.6 kg-m, 26 ft-lb)

- iii. Turn 40 degrees clockwise (angle tightening).



18. Install crankshaft position sensor.

### CAUTION:

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

19. Install oil level sensor.

### CAUTION:

Handle it carefully and avoid impacts.

20. Assemble in the reverse order of disassembly.

## Backlash Adjustment

### CAUTION:

When any one of the parts listed below is replaced, adjust backlash as per the following steps.

- Crankshaft

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# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

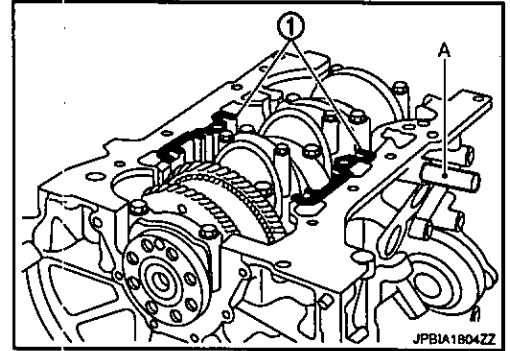
[M9R]

- Cylinder block
- Balancer unit

1. Install balancer unit with the following procedure:
  - a. Obtain No.1 cylinder at the TDC of its compression stroke. Refer to EM-297, "Removal and Installation".
  - b. Screw in the TDC set pin [SST: — (Mot. 1766)] (A).
  - c. Position the 2.80 mm (0.1102 in) thick shims (1) on the cylinder block.

**NOTE:**

The 2.80 mm (0.1102 in) thick shims, that are essential for applying this procedure are not supplied in the balancer positioning tool (Mot. 1802).



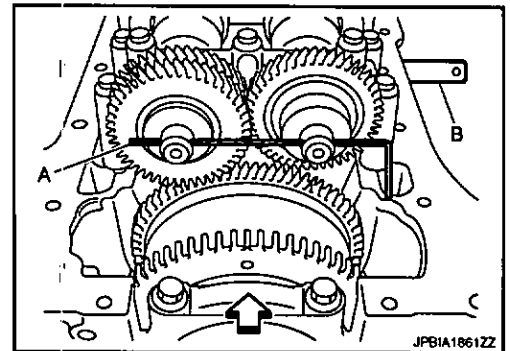
- d. Install balancer unit without removing the securing pin (A) of [balancer unit position tool (Mot.1802)].

B : TDC set pin [SST: — (Mot. 1766)]

↔: Engine front

**CAUTION:**

The balancer unit weights must be positioned on the opposite side to the crankshaft.

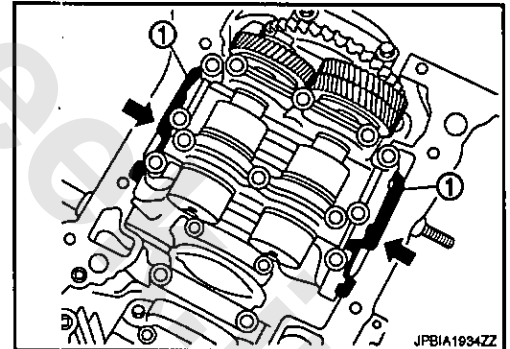


- e. Screw in without tightening the old balancer unit bolts.

**NOTE:**


Reuse bolts when performing inspection.

- f. Position the balancer unit shims (1) against the balancer unit bolts.



- g. Tighten balancer unit bolts in numerical order as shown in the figure with the following procedure:

- i. Tighten balancer unit bolts.

: 15.0 N·m (1.5 kg-m, 11 ft-lb)

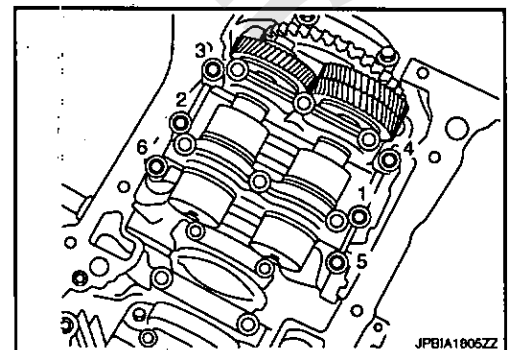
- ii. Turn bolts 85 degrees clockwise (angle tightening).

**CAUTION:**

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

- h. Remove securing pin of [balancer unit position tool (Mot.1802)].

2. Set the balancer unit position tool (Mot.1802), (Mot. 1660) with the following procedure:

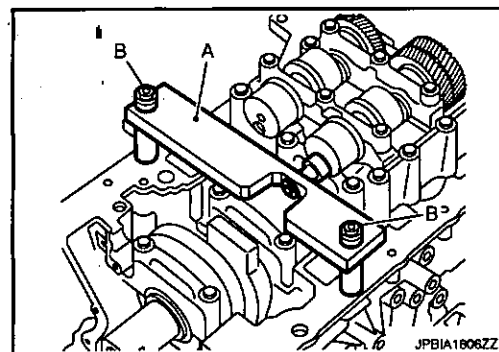


# CYLINDER BLOCK

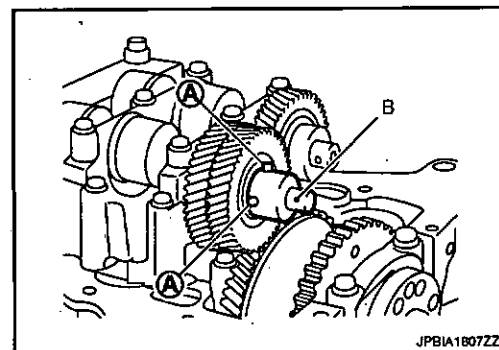
## < DISASSEMBLY AND ASSEMBLY >

[M9R]

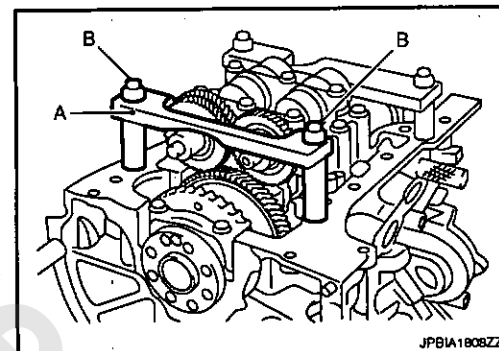
- a. Set axis support (A) of [balancer unit position tool (Mot.1802)].
  - Tighten the spacer bolts (B).



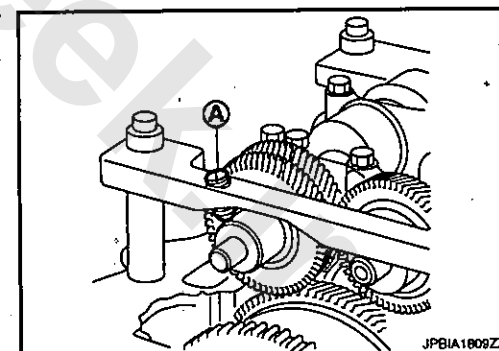
- b. Set adapter (B) of [balancer unit position tool (Mot.1802)].
  - Tighten the adapter bolts (A).



- c. Set radial support (A) of [balancer unit position tool (Mot.1802)].
  - Tighten the spacer bolts (B).



- d. Manually tighten the tension screw (A) until the end and adapter make contact. Turn the tension screw half a turn, using a flat screwdriver.

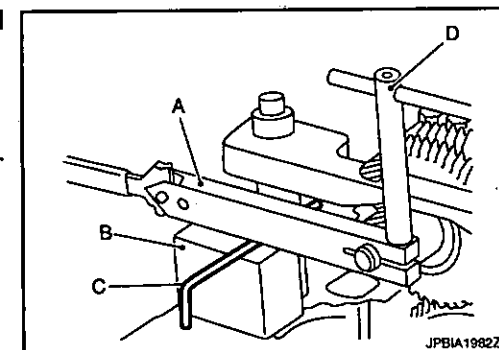


- e. Set shim (B) and securing pin (C) of [balancer unit position tool (Mot. 1802)].

### NOTE:

The shim is 42 mm (1.65 in) high.

- f. Set dial indicator support (A) of [balancer unit position tool (Mot. 1660)].
  - Tighten the dial indicator support bolt (D).



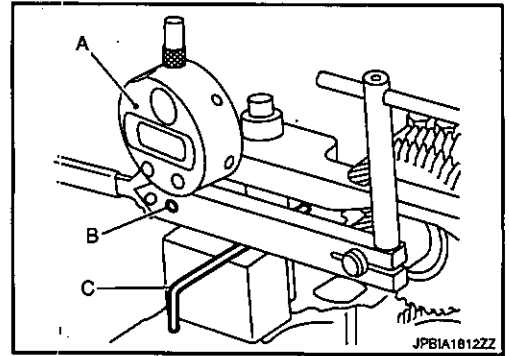
# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

- g. Set the dial indicator (A) of [balancer unit position tool (Mot.1660)] on dial indicator support.
- Moderately tighten the dial indicator support bolt (B).

C : Securing pin

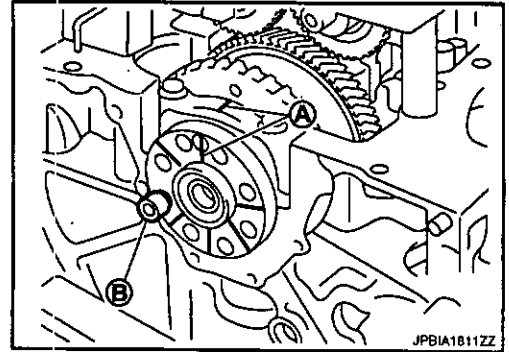


- h. Mark main bearing cap and the back end of crankshaft for positioning.

A : Marking

- Mark the back end of crankshaft side every 60 degrees.

- i. Moderately tighten the mounting bolt (B) to prevent sideways or rotational movement of the crankshaft.

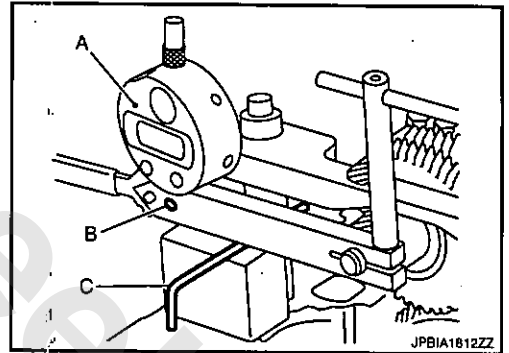


3. Measure backlash with the following procedure:

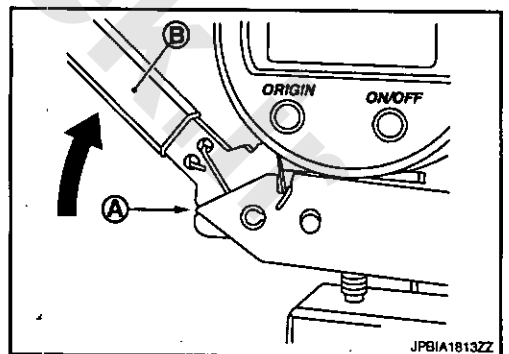
- a. Remove the TDC set pin [SST: — (Mot. 1766)].
- b. Remove the securing pin (C) of [balancer unit position tool (Mot.1802)].

A : Dial indicator

B : Dial indicator support bolt



- c. Press the button "ON/OFF" on the dial indicator.
- d. Pivot the dial indicator support lever (B) upwards to align the lower part of the lever with the index (A).
- e. Without moving the dial indicator support lever, reset the dial indicator using the button "ORIGIN".

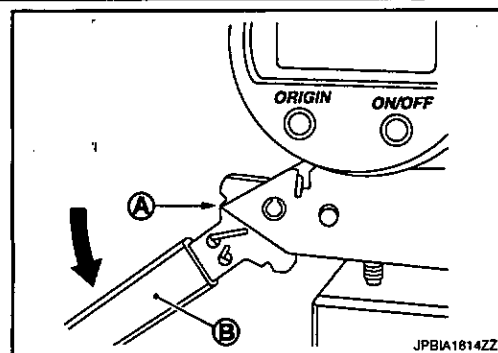


# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

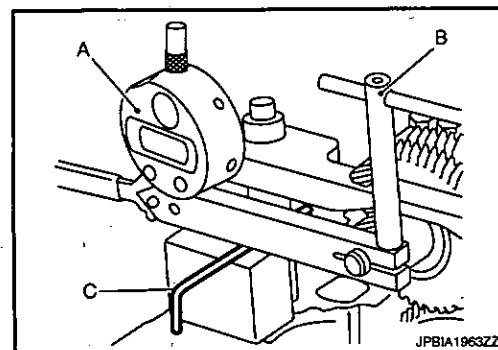
[M9R]

- f. Pivot the dial indicator support lever (B) downwards to align the upper part of the lever with the index (A).
- g. Note the value displayed on the dial indicator.



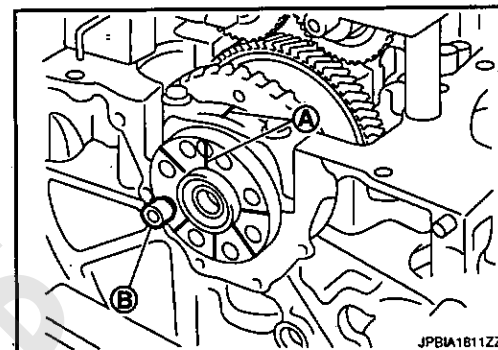
4. Measure the rest of the five points, according to the following steps.
- a. Loosen the dial indicator support bolt (B), and insert the securing pin (C) of [balancer unit position tool (Mot. 1802)] between the dial indicator support and shim.

A :Dial indicator



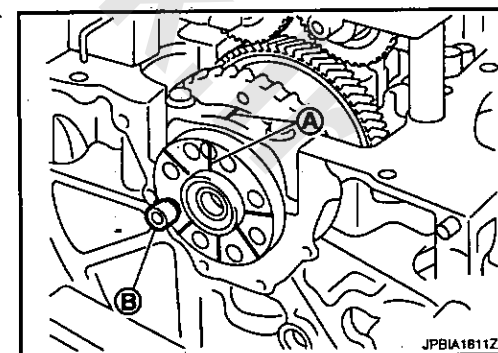
- b. Remove the mounting bolt (B).

A : Marking



- c. Hold the dial indicator support against the securing pin of [balancer unit position tool (Mot.1802)].
- d. Using a spanner, turn the crankshaft 60 degrees in the engine's operating direction to align the fixed marking with the next marking on the crankshaft.
- e. Moderately tighten the mounting bolt (B) to prevent sideways or rotational movement of the crankshaft.

A : Marking



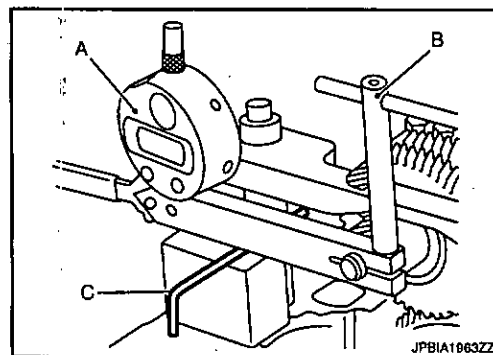
# **CYLINDER BLOCK**

## < DISASSEMBLY AND ASSEMBLY >

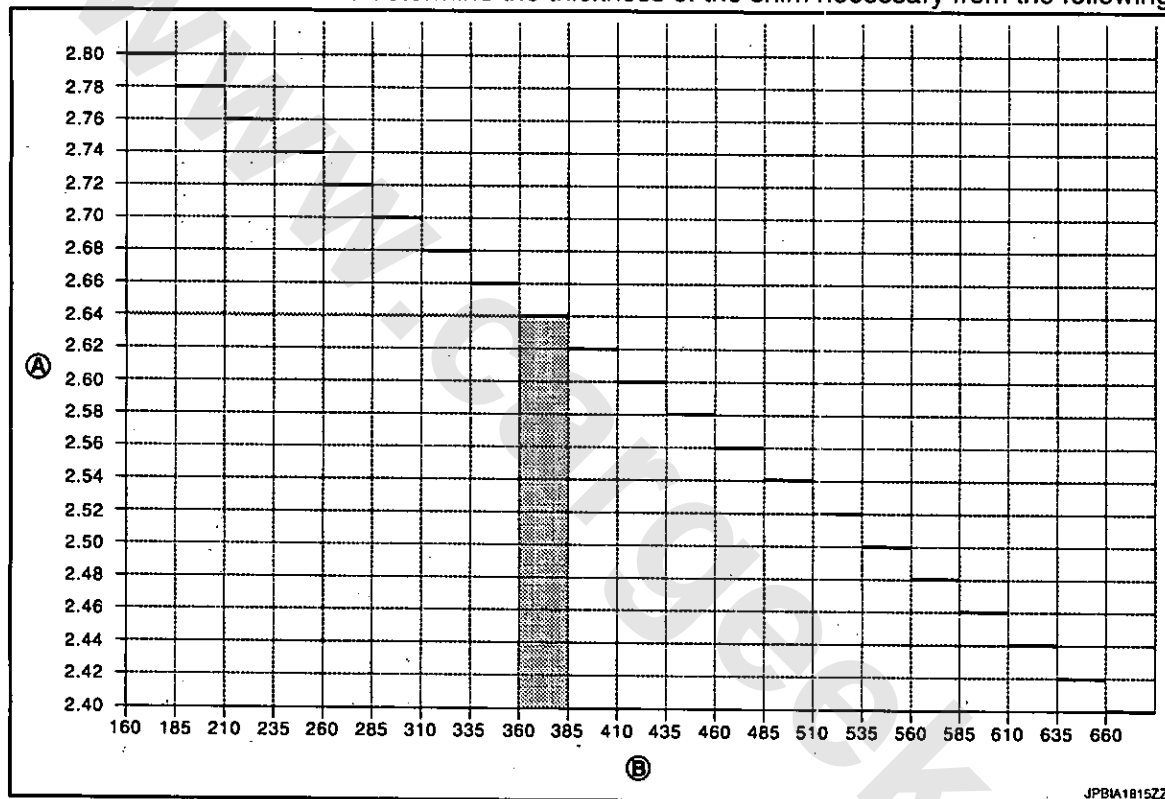
[M9R]

- f. Tighten the dial indicator support bolt (B), and remove the securing pin (C) of [balancer unit position tool (Mot.1802)].

A : Dial indicator



- g. Take a new measurement of the clearance between the teeth.
- h. Repeat the previous operations for the rest of the four points.
5. Use the smallest value noted to determine the thickness of the shim necessary from the following table.



A : Thickness of shims according to clearance measured (unit: mm)

B : Clearance displayed on the dial indicator (unit: microns)

### **NOTE:**

Example: For a measured clearance of between 360 - 385 microns, select 2.64 mm (0.1039 in) thick shims.

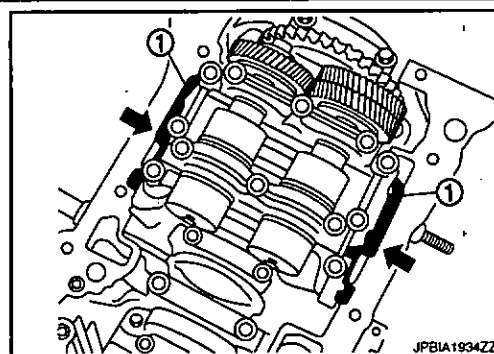
6. Remove the previously placed tools.
7. Loosen the old balancer unit bolts by 2 turns.
8. Remove the 2.80 mm (0.1102 in) thick shims.
9. Position the balancer unit shims of the thickness selected using the table.

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

- Position the balancer unit shims (1) against the balancer unit bolts.



10. Tighten balancer unit bolts in numerical order as shown in the figure with the following procedure:

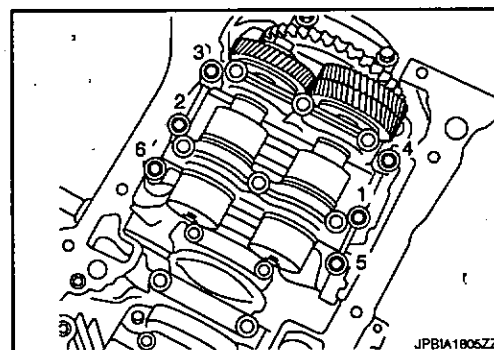
- Replace the old balancer unit bolts with new ones.
- Tighten new balancer unit bolts.

: 15.0 N·m (1.5 kg-m, 11 ft-lb)

- Turn bolts 85 degrees clockwise (angle tightening).

### CAUTION:

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



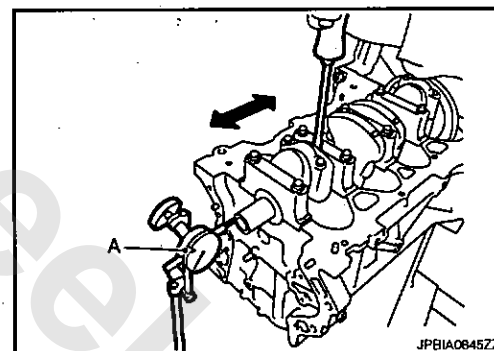
## Inspection

### 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** : Refer to EM-359, "Cylinder Block".

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

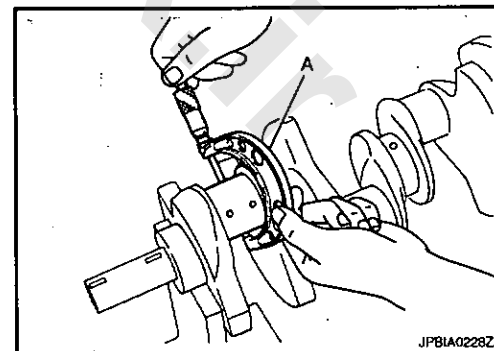


### CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard** : Refer to EM-359, "Cylinder Block".

- If it exceeds the standard, measure the connecting rod bearing oil clearance. Refer to "CONNECTING ROD BEARING OIL CLEARANCE".



### CRANKSHAFT MAIN JOURNAL DIAMETER

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

**Standard** : Refer to EM-359, "Cylinder Block".

- If it exceeds the standard, measure the main bearing oil clearance. Refer to "MAIN BEARING OIL CLEARANCE".

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

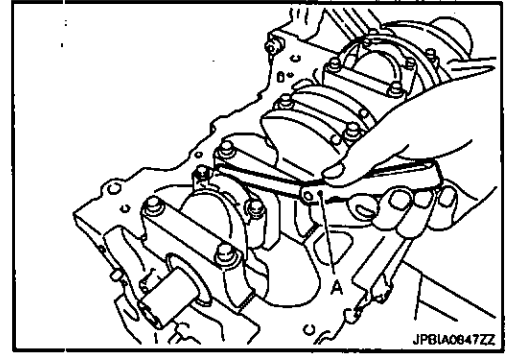
[M9R]

### CONNECTING ROD SIDE CLEARANCE

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

**Standard** : Refer to EM-359, "Cylinder Block".

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



### CONNECTING ROD BIG END DIAMETER

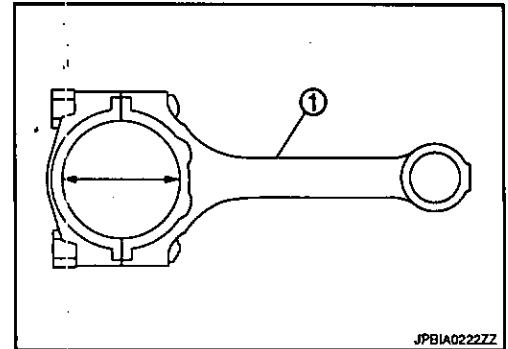
- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to EM-333, "Disassembly and Assembly".

1 : Connecting rod

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

**Standard** : Refer to EM-359, "Cylinder Block".

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

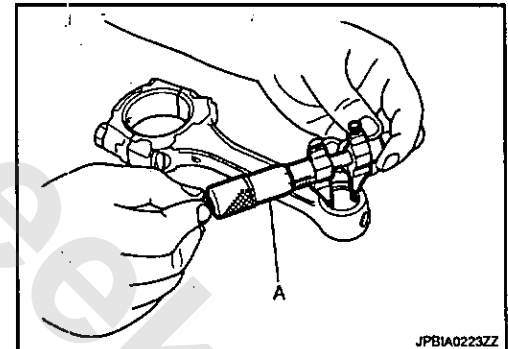


### CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

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

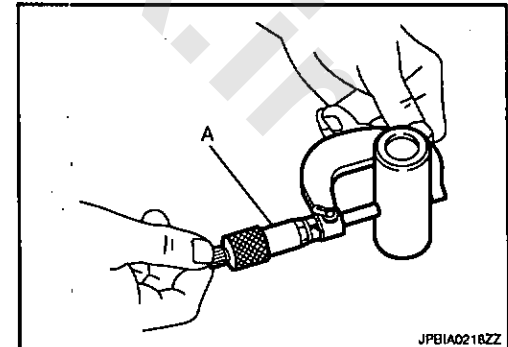
**Standard** : Refer to EM-359, "Cylinder Block".



Piston Pin Outer Diameter

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

**Standard** : Refer to EM-359, "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-359, "Cylinder Block".

- If it exceeds the standard, replace connecting rod assembly and/or piston and piston pin assembly.



# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

- If replacing piston and piston pin assembly. Refer to "PISTON PROTRUSION".

### PISTON PROTRUSION

Measure the protrusion of piston with the following procedure:

1. Set piston at a point close to the TDC. Refer to EM-297, "Removal and Installation".
2. Set the dial indicator stand set [commercial service tool: KV113B0040 (Mot.251-01)] (B) and [commercial service tool: KV113B0050 (Mot.252-01)] (A) at the location as shown in the figure.
3. Set the indicator scale to "0" where the piston protrusion is maximized.
4. Move the dial indicator stand so that the tip of dial indicator can contact the cylinder block. Read the difference.

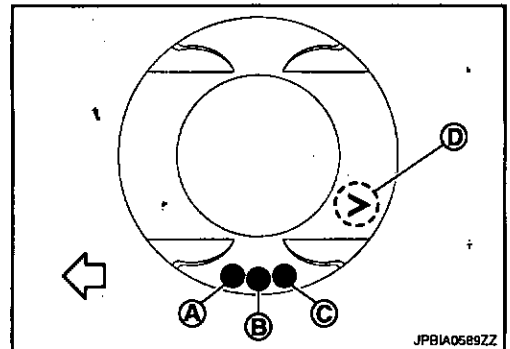
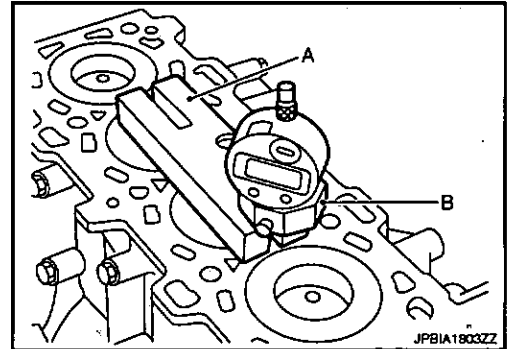
**Standard** : Refer to EM-359, "Cylinder Block".

5. If measured value is out of the standard, replace piston. Select a piston in "Piston Protrusion Grade".

- A : Date of manufacture  
B : Piston grade  
C : Modification in production suffix  
D : Mark engraved  
⇐ : Engine front

#### Piston Protrusion Grade:

Refer to EM-359, "Cylinder Block".

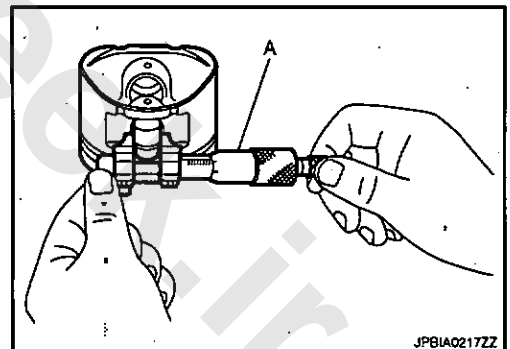


### PISTON TO PISTON PIN OIL CLEARANCE

#### Piston Pin Hole Diameter

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

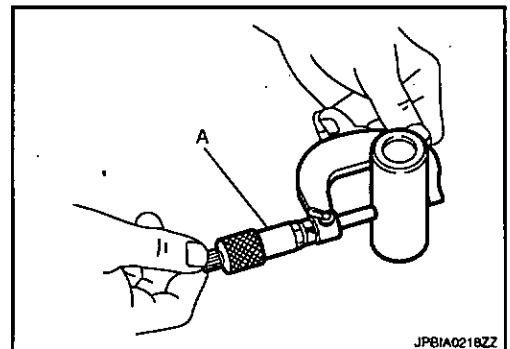
**Standard** : Refer to EM-359, "Cylinder Block".



#### Piston Pin Outer Diameter

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

**Standard** : Refer to EM-359, "Cylinder Block".



Piston to Piston Pin Oil Clearance

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

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

**Standard** : Refer to EM-359. "Cylinder Block".

- If it exceeds the standard, replace piston and piston pin an assembly.

### NOTE:

Piston is available together with piston pin as assembly.

### PISTON RING SIDE CLEARANCE

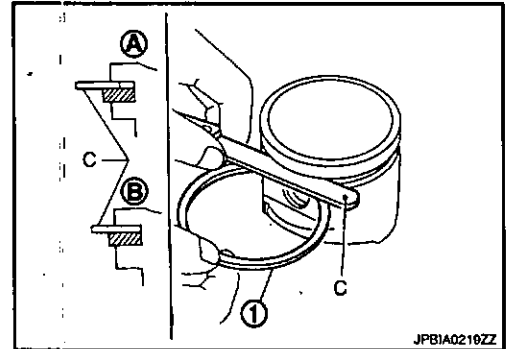
- Measure the side clearance of piston ring (1) and piston ring groove with a feeler gauge (C).

A : OK

B : NG

**Standard** : Refer to EM-359. "Cylinder Block".

- If it exceeds the standard, replace piston ring, and measure again.  
If it still exceeds the standard, also replace piston.



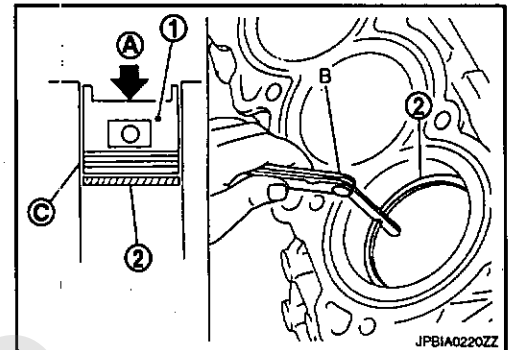
### PISTON RING END GAP

- 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 with piston, and measure piston ring end gap with a feeler gauge (B).

C : Measuring point

**Standard** : Refer to EM-359. "Cylinder Block".

- If it exceeds the standard, replace piston ring, and measure again.  
If it still exceeds the standard, replace cylinder block and piston rings.



### 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.

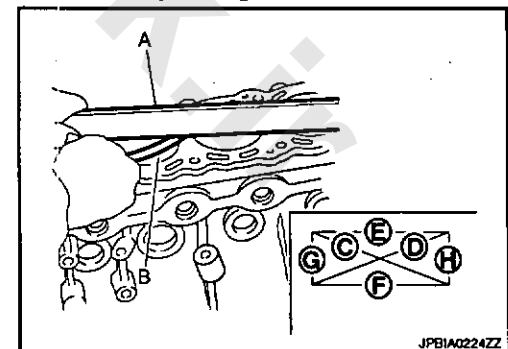
### CAUTION:

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

- Measure the distortion on the cylinder block upper face at different points in six directions (C, D, E, F, G and H) with a straight edge (A) and feeler gauge (B).

**Standard** : Refer to EM-359. "Cylinder Block".

- If it exceeds the standard, 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-333. "Disassembly and Assembly".

# CYLINDER BLOCK

## < DISASSEMBLY AND ASSEMBLY >

[M9R]

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

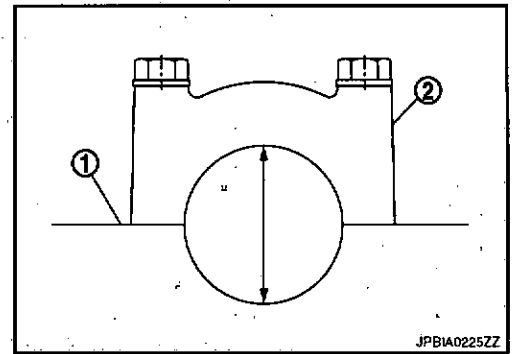
- 1 : Cylinder block  
2 : Main bearing cap

**Standard** : Refer to EM-359, "Cylinder Block".

- If it exceeds the standard, replace cylinder block and main bearing caps assembly.

### NOTE:

Main bearing caps cannot be replaced individually, because it is machined together with the cylinder block.



## PISTON TO CYLINDER BORE CLEARANCE

### Cylinder Bore Inner Diameter

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder.

### Standard:

#### Cylinder bore inner diameter

: Refer to EM-359, "Cylinder Block".

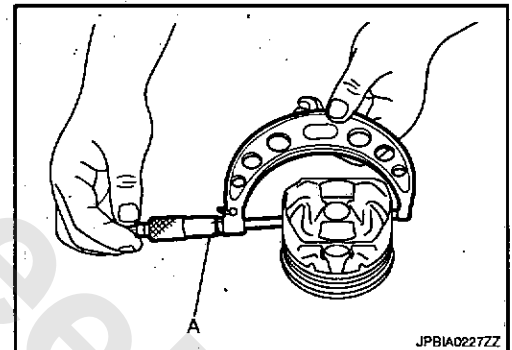
- If it exceeds the standard, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

### Piston Skirt Diameter

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

**Standard** : Refer to EM-359, "Cylinder Block".

**Measure point** : Refer to EM-359, "Cylinder Block".



### Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter.

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

**Standard** : Refer to EM-359, "Cylinder Block".

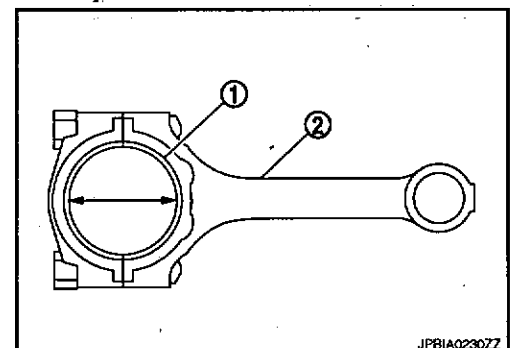
- If it exceeds the standard, replace piston and piston pin assembly and/or cylinder block.

## CONNECTING ROD BEARING OIL CLEARANCE

### Method by Calculation

- Install connecting rod bearings (1) to connecting rod (2) and connecting rod bearing cap, and tighten connecting rod cap bolts to the specified torque. Refer to EM-333, "Disassembly and Assembly".
- 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** : Refer to EM-363, "Connecting Rod Bearing".



## CYLINDER BLOCK

### < DISASSEMBLY AND ASSEMBLY >

[M9R]

- If it exceeds the standard. Replace connecting rod bearing or/and connecting rod.

#### 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-333, "Disassembly and Assembly".

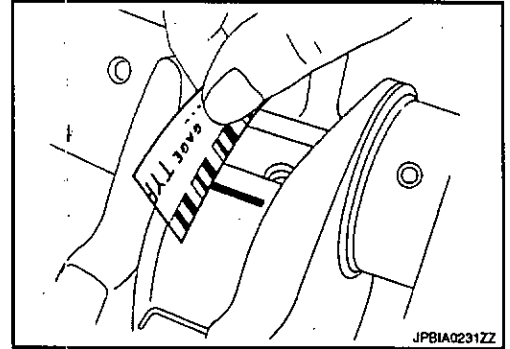
#### CAUTION:

**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 standard is the same as that described in "Method by Calculation".



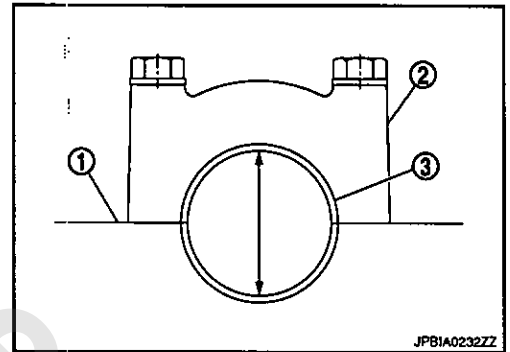
### MAIN BEARING OIL CLEARANCE

#### Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to EM-333, "Disassembly and Assembly".
- Measure the inner diameter of main bearing with a bore gauge.  
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

**Standard** : Refer to EM-363, "Main Bearing".

- If it exceeds the standard, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to EM-353, "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 the 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-333, "Disassembly and Assembly".

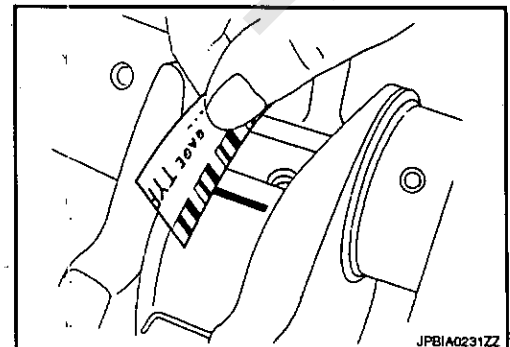
#### CAUTION:

**Never rotate crankshaft.**

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

#### NOTE:

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



# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[M9R]

## HOW TO SELECT PISTON AND BEARING

### Description

INFOID:000000004899378

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)
Piston protrusion	Piston	Piston grade (piston height)	Refer to EM-347, "Inspection".

- 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.

### Main Bearing

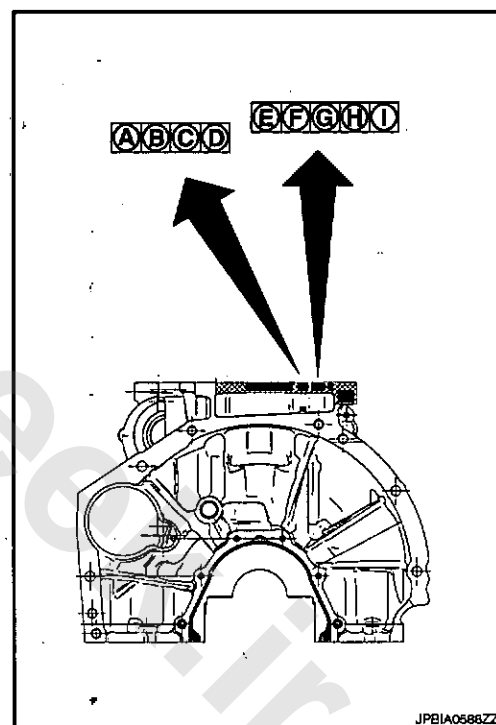
INFOID:000000004899379

#### WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

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

- A : No. 1 cylinder bore grade \*
- B : No. 2 cylinder bore grade \*
- C : No. 3 cylinder bore grade \*
- D : No. 4 cylinder bore grade \*
- E : No. 1 main bearing housing grade
- F : No. 2 main bearing housing grade
- G : No. 3 main bearing housing grade
- H : No. 4 main bearing housing grade
- I : No. 5 main bearing housing grade

- \* This engine only has one cylinder bore grade.



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## HOW TO SELECT PISTON AND BEARING

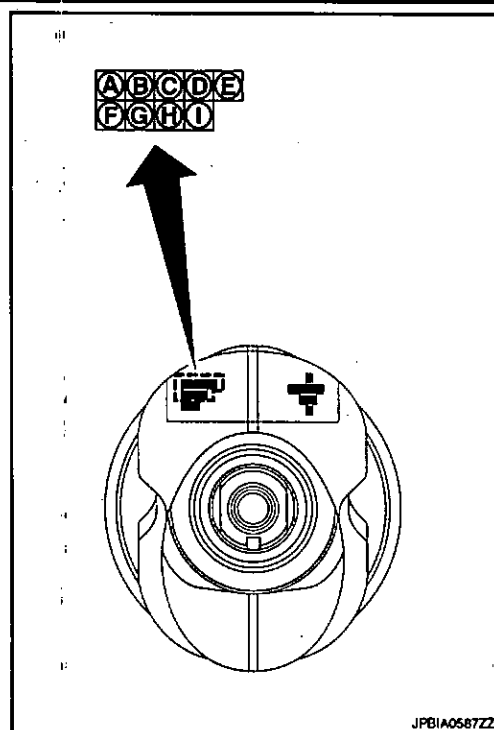
< DISASSEMBLY AND ASSEMBLY >

[M9R]

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

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

- \* This engine only has one pin journal grade.



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

### 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-347, "Inspection".
2. Apply the measured dimension to "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in "Main Bearing Selection Table".
4. Apply the symbol obtained from "Main Bearing Grade Table" to select main bearing.

# HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[M9R]

## MAIN BEARING SELECTION TABLE

Cylinder block main bearing housing inner diameter Unit: mm (in)		Hole diameter	Mark																					
			A	B																				
Crankshaft main journal diameter Unit: mm (in)	Axle diameter	Mark	Hole diameter																					
			A	B	C	E	H	J	K	L	M	P	S	T	U	Z								
A	55.985 (2.2041)	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
B	55.986 (2.2042)	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
C	55.987 (2.2042)	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
D	55.988 (2.2042)	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
E	55.989 (2.2043)	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
F	55.990 (2.2043)	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
G	55.991 (2.2044)	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
H	55.992 (2.2044)	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R	R
I	55.993 (2.2044)	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R	R
J	55.994 (2.2045)	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R	R
K	55.995 (2.2045)	B	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R	R
L	55.996 (2.2046)	Y	B	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R	R
M	55.997 (2.2046)	Y	Y	B	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R	R
N	55.998 (2.2046)	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R	R
O	55.999 (2.2047)	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R	R
P	56.000 (2.2047)	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R	R
Q	56.001 (2.2048)	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R	R
R	56.002 (2.2048)	Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R	R	R
S	56.003 (2.2048)	Y	Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R	R
T	56.004 (2.2049)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R	R
U	56.005 (2.2049)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	R

JPBIA0813C

JPBIA0813GB

## MAIN BEARING GRADE TABLE

Main bearing grade table : Refer to EM-363. "Main Bearing".

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

## SERVICE DATA AND SPECIFICATIONS (SDS)

### SERVICE DATA AND SPECIFICATIONS (SDS)

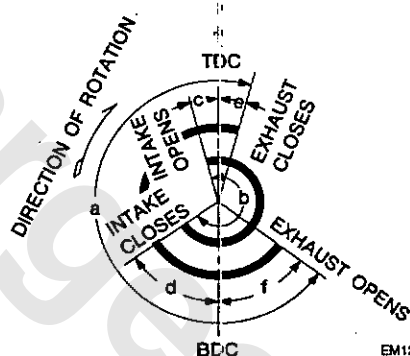
#### General Specification

INFOID:0000000004899380

#### 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	2,599 (26, 26.5, 377)
	Minimum	2,099 (21, 21.4, 304)
	Differential limit between cylinders	500 (5, 5.1, 73)

Valve timing



Unit: degree

a	b	c	d	e	f
198	187	- 11	18	- 17	35

#### Drive Belts

INFOID:0000000004899381

#### DRIVE BELT

Tension of drive belt	Belt tensioning is not necessary, as it is automatically adjusted by drive belt auto-tensioner.
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#### Intake Manifold

INFOID:0000000004899382

#### INTAKE MANIFOLD

Unit: mm (in)

Items	Standard
Surface distortion	0.05 (0.0020)

#### Exhaust Manifold

INFOID:0000000004899383

#### 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:0000000004899384

Value of vacuum	25 kPa (250 mbar, 187.525 mmHg, 7.3825 inHg)	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:0000000004899385

## 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)

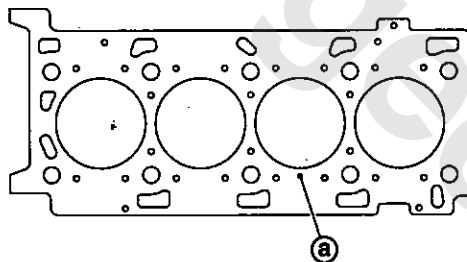
## Cylinder Head

INFOID:0000000004899386

## CYLINDER HEAD

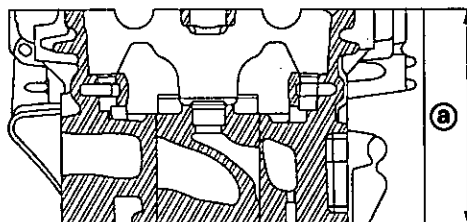
Unit: mm (in)

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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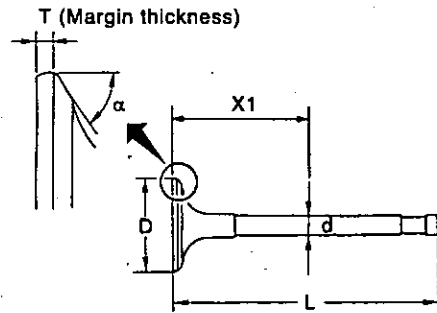
## VALVE DIMENSIONS

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

Unit: mm (in)

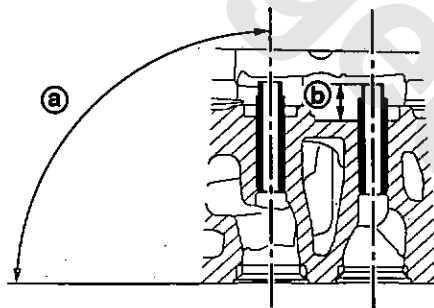


E1BIA0064ZZ

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)



JPBIA0596ZZ

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)

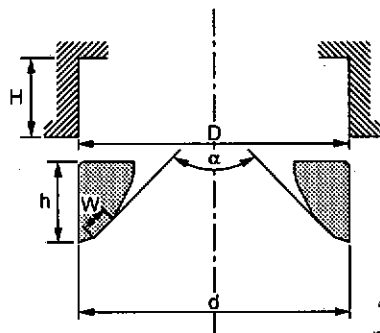
## VALVE SEAT

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

Unit: mm (in)



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)

## Cylinder Block

INFOID:0000000004899387

## CRANKSHAFT

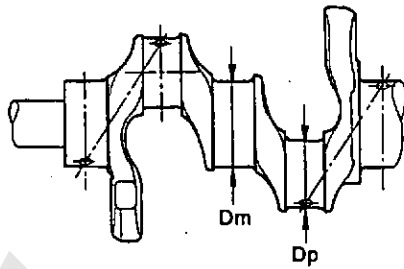
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< SERVICE DATA AND SPECIFICATIONS (SDS)

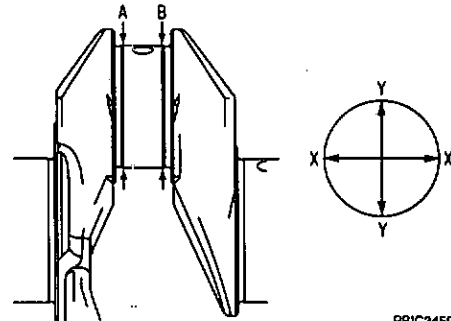
[M9R]

Unit: mm (in)

Item	Standard
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E1BIA0067ZZ



PBIC345BJ

Crankshaft main journal diameter "Dm"

GRADE mark A	55.985 (2.2041)
GRADE mark B	55.986 (2.2042)
GRADE mark C	55.987 (2.2042)
GRADE mark D	55.988 (2.2042)
GRADE mark E	55.989 (2.2043)
GRADE mark F	55.990 (2.2043)
GRADE mark G	55.991 (2.2044)
GRADE mark H	55.992 (2.2044)
GRADE mark I	55.993 (2.2044)
GRADE mark J	55.994 (2.2045)
GRADE mark K	55.995 (2.2045)
GRADE mark L	55.996 (2.2046)
GRADE mark M	55.997 (2.2046)
GRADE mark N	55.998 (2.2046)
GRADE mark O	55.999 (2.2047)
GRADE mark P	56.000 (2.2047)
GRADE mark Q	56.001 (2.2048)
GRADE mark R	56.002 (2.2048)
GRADE mark S	56.003 (2.2048)
GRADE mark T	56.004 (2.2049)
GRADE mark U	56.005 (2.2049)

Crankshaft pin journal diameter "Dp"	52.000 - 52.020 (2.0472 - 2.0480)
Crankshaft end play	0.055 - 0.291 (0.0022 - 0.0115)

## CONNECTING ROD

Unit: mm (in)

Item	Standard
Center distance (big end and small end)	Grade 1 143.460 - 143.475 (5.65 - 5.65)
	Grade 2 143.475 - 143.490 (5.65 - 5.65)
	Grade 3 143.490 - 143.505 (5.65 - 5.65)
	Grade 4 143.505 - 143.520 (5.65 - 5.65)
Connecting rod big end diameter	55.581 - 55.600 (2.1882 - 2.1890)
Connecting rod bushing end diameter	32.020 - 32.032 (1.2606 - 1.2611)
Connecting rod bushing end oil clearance	0.020 - 0.038 (0.0008 - 0.0015)
Connecting rod side clearance	0.015 - 0.477 (0.0006 - 0.0188)

# SERVICE DATA AND SPECIFICATIONS (SDS)

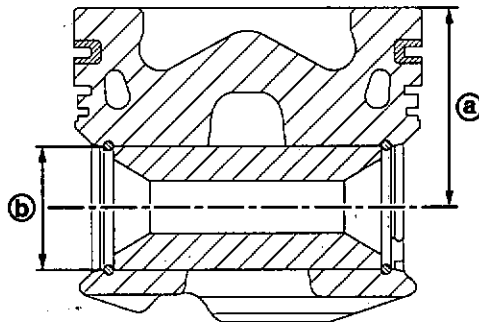
< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

## PISTON PROTRUSION GRADE

Unit: mm (in)

Item	Standard
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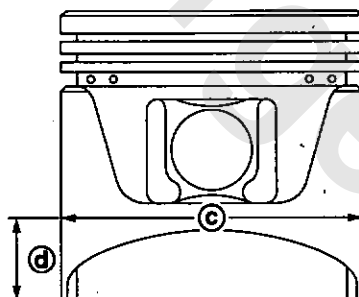


JPBIA0767ZZ

Piston height "a"	Grade F	47.895 - 47.937 (1.8856 - 1.8873)
	Grade G	47.938 - 47.979 (1.8873 - 1.8889)
	Grade H	47.980 - 48.021 (1.8890 - 1.8906)
	Grade J	48.022 - 48.063 (1.8906 - 1.8922)
	Grade K	48.064 - 48.105 (1.8923 - 1.8939)
Piston pin hole diameter "b"		32.012 - 32.017 (1.2603 - 1.2605)
Piston to cylinder bore clearance		0.192 - 0.236 (0.0076 - 0.0093)

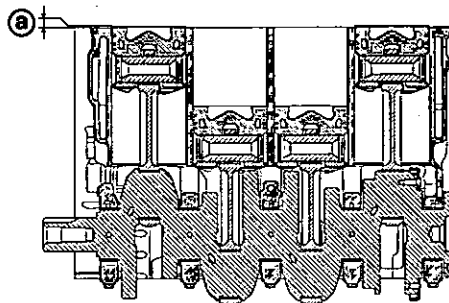
## AVAILABLE PISTON

Item	Standard
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JPBIA0784ZZ

Piston skirt diameter "c"	83.788 - 83.802mm (3.2987 - 3.2993 in)
Measure point "d"	44.0 mm (1.732 in)



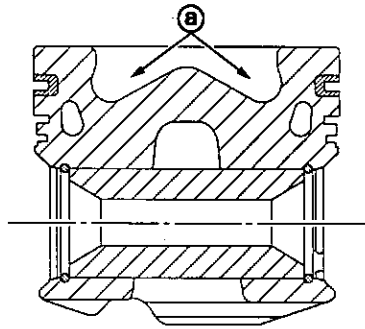
JPBIA0640ZZ

Piston protrusion "a"	0.313 - 0.467 mm (0.0123 - 0.0184 in)
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# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]



JPBIA0633Z2

Capacity of combustion chamber "a"

24.65 - 25.35 cm<sup>3</sup> (1.5041 - 1.546 cu in)

## PISTON RING

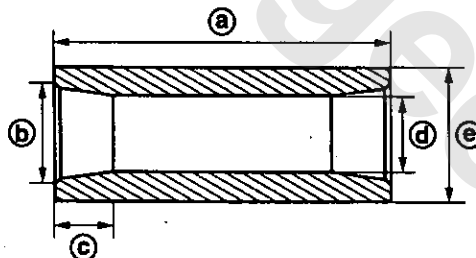
Unit: mm (in)

Items		Standard
Piston ring side clearance	Top	0.09 - 0.13 (0.0035 - 0.0051)
	2nd	0.08 - 0.12 (0.0031 - 0.0047)
	Oil ring	0.03 - 0.07 (0.0012 - 0.0028)
Piston ring end gap	Top	0.23 - 0.38 (0.0091 - 0.0150)
	2nd	0.60 - 0.80 (0.0236 - 0.0315)
	Oil ring	0.25 - 0.50 (0.0098 - 0.0197)

## PISTON PIN

Unit: mm (in)

Items	Standard
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JPBIA0768Z2

Length "a"	64.7 - 65.0 (2.547 - 2.559)
Diameter of chamfer "b"	23.85 - 24.15 (0.9390 - 0.9508)
Length of the chamfer "c"	8.7 (0.343)
Piston pin inner diameter "d"	13.8 - 14.1 (0.543 - 0.555)
Piston pin outer diameter "e"	31.994 - 32.000 (1.2596 - 1.2598)
Piston to piston pin oil clearance	0.012 - 0.023 (0.0005 - 0.0009)

## CYLINDER BLOCK

Unit: mm (in)

Item	Standard
Cylinder block top surface distortion	0.03 (0.0012)
Cylinder bore inner diameter	83.994 - 84.024 (3.3068 - 3.3080)

# SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[M9R]

Cylinder block main bearing housing inner diameter	Grade mark A	59.9975 - 55.9985 (2.3621 - 2.3621)
	Grade mark B	59.9985 - 59.9995 (2.3621 - 2.3622)
	Grade mark C	59.9995 - 60.0005 (2.3622 - 2.3622)
	Grade mark E	60.0005 - 60.0015 (2.3622 - 2.3622)
	Grade mark H	60.0015 - 60.0025 (2.3622 - 2.3623)
	Grade mark J	60.0025 - 60.0035 (2.3623 - 2.3623)
	Grade mark K	60.0035 - 60.0045 (2.3623 - 2.3624)
	Grade mark L	60.0045 - 60.0055 (2.3624 - 2.3624)
	Grade mark M	60.0055 - 60.0065 (2.3624 - 2.3624)
	Grade mark P	60.0065 - 60.0075 (2.3624 - 2.3625)
	Grade mark S	60.0075 - 60.0085 (2.3625 - 2.3625)
	Grade mark T	60.0085 - 60.0095 (2.3625 - 2.3626)
	Grade mark U	60.0095 - 60.0105 (2.3626 - 2.3626)
	Grade mark Z	60.0105 - 60.0115 (2.3626 - 2.3626)

## Main Bearing

INFOID:000000004899388

## MAIN BEARING GRADE TABLE

Marking	Thickness	Identification color
4075 (upper)	1.985 mm (0.0781 in)	Red
4047 (lower)	1.984 mm (0.0781 in)	
4052 (upper)	1.980 mm (0.0780 in)	Blue
4026 (lower)	1.978 mm (0.0779 in)	
7527 (upper)	1.975 mm (0.0778 in)	Yellow
7521 (lower)	1.973 mm (0.0777 in)	

## MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Main bearing oil clearance	Standard	0.035 - 0.065 (0.0014 - 0.0026)
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## Connecting Rod Bearing

INFOID:000000004899389

## CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.053 - 0.093 (0.0021 - 0.0037)
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