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# SECTION **EM**

## ENGINE MECHANICAL

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# PRECAUTIONS

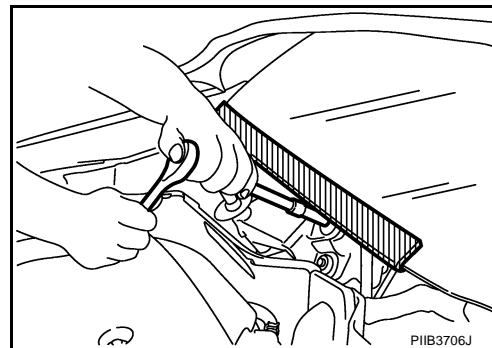
## PRECAUTIONS

PFP:00001

### Precautions for Procedures without Cowl Top Cover

NBS003FC

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



### Precautions for Battery Service

NBS003FD

Before disconnecting the battery, lower both the driver and passenger windows. This will prevent any interference between the window edge and the vehicle when the door is opened/closed. During normal operation, the window slightly raises and lowers automatically to prevent any window to vehicle interference. The automatic window function will not work with the battery disconnected.

### Precautions for Drain Engine Coolant and Engine Oil

NBS00002

Drain engine coolant and engine oil when engine is cooled.

### Precautions for Disconnecting Fuel Piping

NBS00003

- 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.

### Precautions for Removal and Disassembly

NBS00004

- When instructed to use special service tools, 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.
- Cover openings of engine system with 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 bolts and nuts, 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.

### Precautions for Inspection, Repair and Replacement

NBS00005

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

### Precautions for Assembly and Installation

NBS00006

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening bolts and nuts, 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.
- Dowel pins are used for several parts alignment. When replacing and reassembling with dowel pins, make sure that dowel pins are installed in the original portion.
- 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.

# PRECAUTIONS

- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

## Parts Requiring Angle Tightening

NBS00007

- Use angle wrench [SST: KV10112100 (BT8653-A)] for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Main bearing cap bolts
  - Connecting rod cap bolts
  - Crankshaft pulley 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.

## Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

NBS00008

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

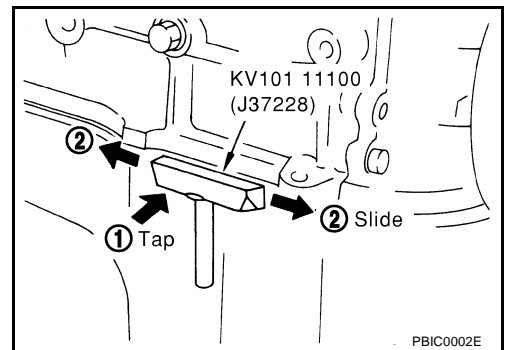
### CAUTION:

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

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

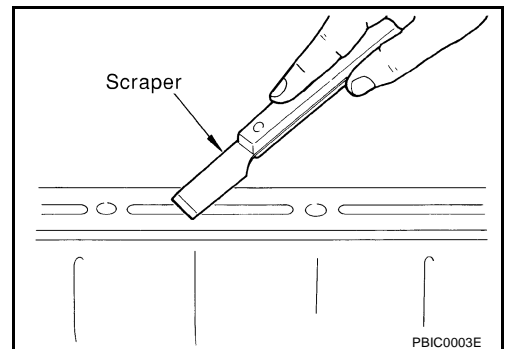
### CAUTION:

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



## LIQUID GASKET APPLICATION PROCEDURE

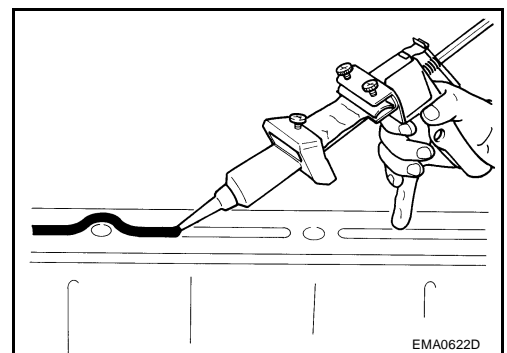
1. Using scraper, remove old liquid gasket adhering to the gasket application surface and the mating surface.
  - Remove liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with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



3. Attach liquid gasket tube to tube presser [SST: WS39930000 ( — )].

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

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.

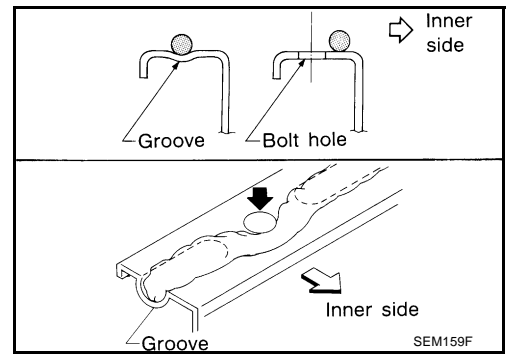


## PRECAUTIONS

- 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.**



# PREPARATION

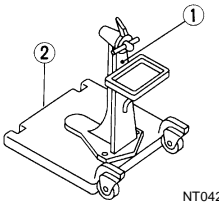
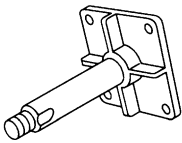
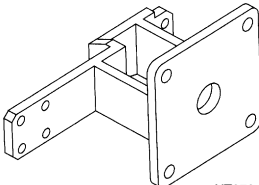
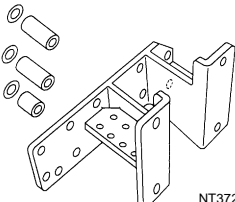
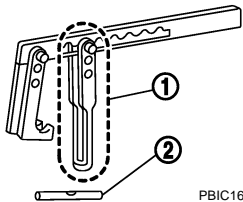
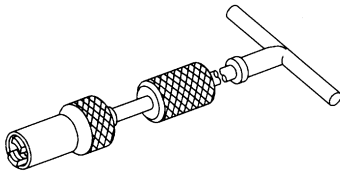
## PREPARATION

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### Special Service Tools

NBS00009

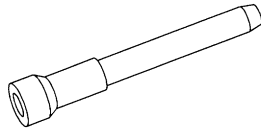
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 ( — ) Engine stand assembly 1. ST05011000 ( — ) Engine stand 2. ST05012000 ( — ) Base	Disassembling and assembling engine  NT042
KV10106500 ( — ) Engine stand shaft	 NT028
KV10117000 (J41262) Engine sub-attachment	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).  NT373
KV10117001 ( — ) Engine sub-attachment	Installing on cylinder block  NT372
KV10116200 (J26336-A) Valve spring compressor 1. KV10115900 (J26336-20) Attachment 2. KV10109220 ( — ) Adapter	Disassembling valve mechanism Part (1) is a component of KV10116200 (J26336-A), but Part (2) is not so.  PBIC1650E
KV10107902 (J38959) Valve oil seal puller	Replacing valve oil seal  NT011

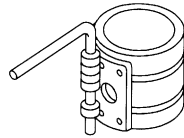
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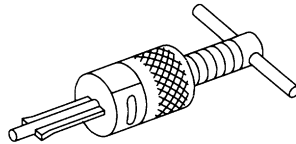
Tool number (Kent-Moore No.) Tool name	Description
— (J39386) Valve oil seal drift	Installing valve oil seal
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore
ST16610001 (J23907) Pilot bushing puller	Removing pilot bushing (M/T models) or pilot converter (A/T models)
KV10111100 (J37228) Seal cutter	Removing oil pan (lower and upper), front and rear timing chain case, etc.
WS39930000 ( — ) Tube presser	Pressing the tube of liquid gasket
KV10112100 (BT8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10117100 (J3647-A) Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 2 <b>For 22 mm (0.87 in) width hexagon nut</b>



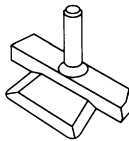
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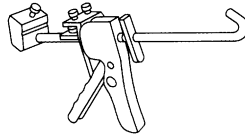
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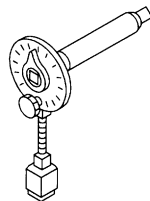
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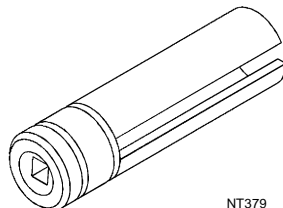
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NT052



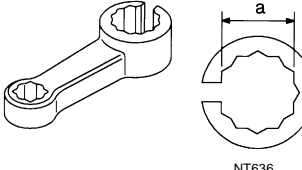
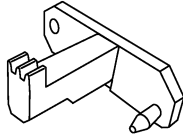

NT014



NT379

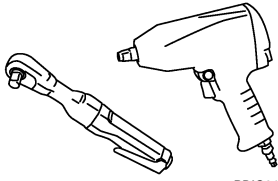
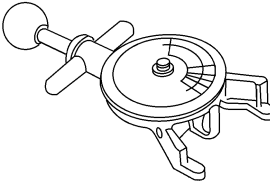
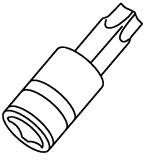


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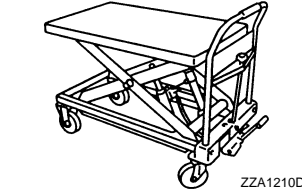
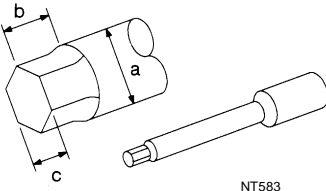
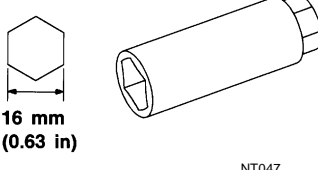

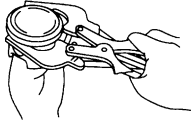
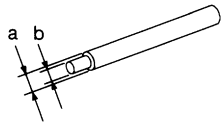
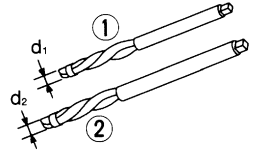
Tool number (Kent-Moore No.) Tool name	Description	
KV10114400 (J38365) Heated oxygen sensor wrench <div style="text-align: center;">  <p>NT636</p> </div>	Loosening or tightening air fuel ratio sensor 1 <b>a: 22 mm (0.87 in)</b>	EM
KV10117700 (J44716) Ring gear stopper <div style="text-align: center;">  <p>NT822</p> </div>	Removing and installing crankshaft pulley	D
— (J-45488) Quick connector release <div style="text-align: center;">  <p>PBIC0198E</p> </div>	Removing fuel tube quick connectors in engine room	F

## Commercial Service Tools

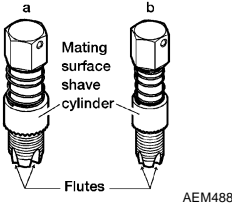

NBS0000A

(Kent-Moore No.) Tool name	Description	
( — ) Power tool <div style="text-align: center;">  <p>PBIC0190E</p> </div>	Loosening bolts and nuts	J
(BT3373-F) Belt tension gauge <div style="text-align: center;">  <p>AMA126</p> </div>	Checking drive belt tension	L
( — ) TORX socket <div style="text-align: center;">  <p>PBIC1113E</p> </div>	Removing and installing flywheel <b>Size: T55</b>	M

# PREPARATION

(Kent-Moore No.) Tool name	Description
( — ) Manual lift table caddy	Removing and installing engine
 ZZA1210D	
(J24239-01) Cylinder head bolt wrench	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100 (BT8653-A)] <b>a: 13 (0.51) dia.</b> <b>b: 12 (0.47)</b> <b>c: 10 (0.39)</b> Unit: mm (in)
 NT583	
( — ) Spark plug wrench	Removing and installing spark plug
 16 mm (0.63 in) NT047	
( — ) Valve seat cutter set	Finishing valve seat dimensions
 NT048	
( — ) Piston ring expander	Removing and installing piston ring
 NT030	
( — ) Valve guide drift	Removing and installing valve guide <b>Intake and Exhaust:</b> <b>a: 9.5 mm (0.374 in) dia.</b> <b>b: 5.5 mm (0.217 in) dia.</b>
 NT015	
( — ) Valve guide reamer	(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide <b>Intake and Exhaust:</b> <b>d1 : 6.0 mm (0.236 in) dia.</b> <b>d2 : 10.2 mm (0.402 in) dia.</b>
 NT016	

# PREPARATION

(Kent-Moore No.) Tool name	Description	A
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 <p>Reconditioning the exhaust system threads before installing a new air fuel ratio sensor and heated oxygen sensor (Use with anti-seize lubricant shown below.)  <b>a: J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor and air fuel ratio sensor</b>  <b>b: J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor</b></p>	EM
( — ) Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 <p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>	D

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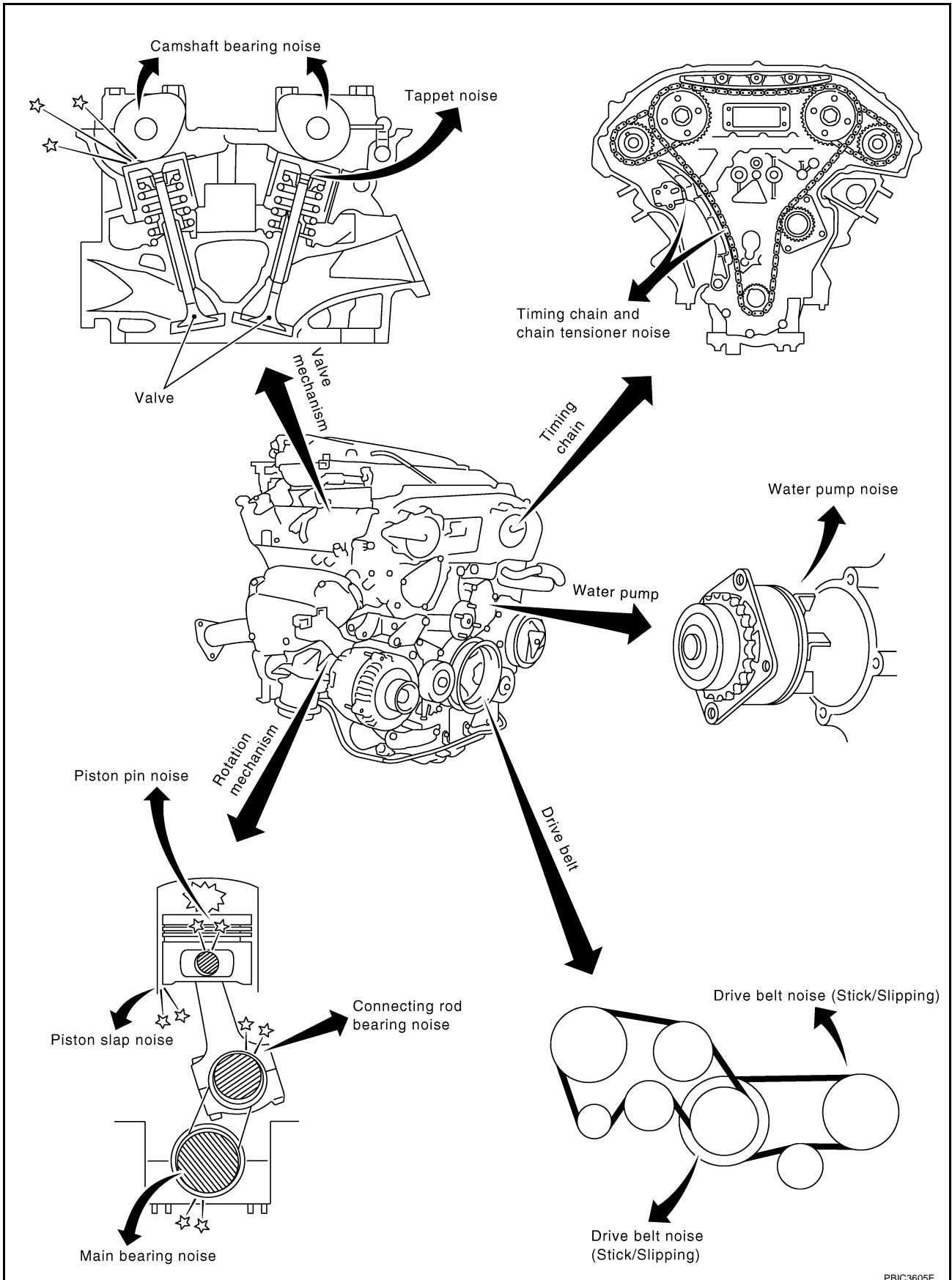
# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

## NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

### NVH Troubleshooting — Engine Noise

NBS0000B



PBIC3605E

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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

NBS0000C

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	<a href="#">EM-111</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal oil clearance	<a href="#">EM-102</a> <a href="#">EM-103</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	<a href="#">EM-156</a> <a href="#">EM-159</a>
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	<a href="#">EM-161</a> <a href="#">EM-157</a> <a href="#">EM-158</a> <a href="#">EM-158</a>
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	<a href="#">EM-159</a> <a href="#">EM-163</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-164</a> <a href="#">EM-163</a>
Front of engine Timing chain case	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	<a href="#">EM-67</a> <a href="#">EM-59</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	<a href="#">EM-14</a>
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	<a href="#">CO-24</a> , <a href="#">"WATER PUMP"</a>

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

# DRIVE BELTS

## DRIVE BELTS

PFP:02117

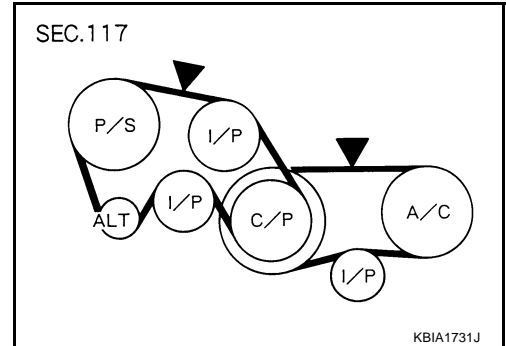
### Checking Drive Belts

NBS0000D

#### WARNING:

Be sure to perform when engine is stopped.

1. Inspect belts for cracks, fraying, wear and oil. If necessary, replace.
2. Inspect drive belt deflection at a point on the belt midway between pulleys.
  - Inspection should be done only when engine is cold, or over 30 minutes after engine is stopped.
  - Measure belt tension with tension gauge (BT3373-F or equivalent) at points marked ▼ shown in the figure.
  - When measuring deflection, apply 98 N (10 kg, 22 lb) at the ▼ marked point.
  - Adjust if belt deflection exceeds the limit or if belt tension is not within specifications.



#### CAUTION:

- When checking belt deflection or tension 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.
- Tighten idler pulley lock nut by hand and measure deflection or tension without looseness.

#### Belt deflection and tension

	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and power steering oil pump belt	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
A/C compressor belt	12 (0.47)	9 - 10 (0.35 - 0.39)	8 - 9 (0.31 - 0.35)	196 (20, 44)	348 - 436 (35.5 - 44.5, 78 - 98)	470 - 559 (48 - 57, 106 - 126)
Applied pushing force	98 N (10 kg, 22 lb)			—		

\*: If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on belt.

### Tension Adjustment

NBS0000E

Portion	Belt tightening method for adjustment
Alternator and power steering oil pump belt	Adjusting bolt on idler pulley
A/C compressor belt	Adjusting bolt on idler pulley


#### CAUTION:

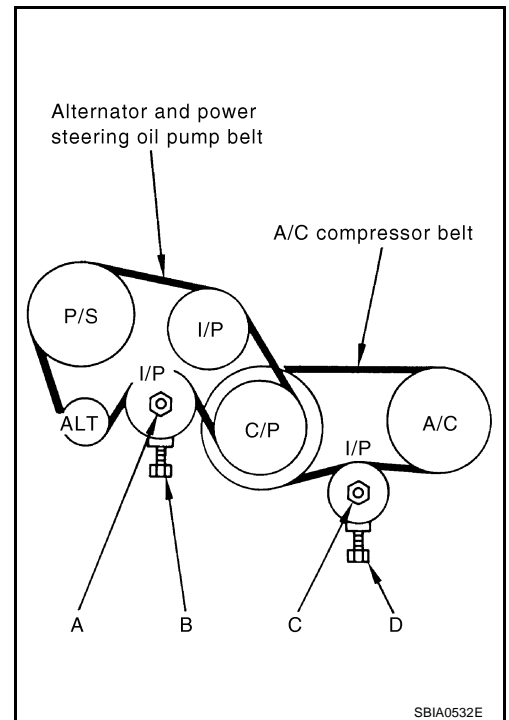
- When belt is replaced with a new one, adjust it to value for “New belt” to accommodate for insufficient adaptability with pulley grooves.
- When deflection or tension of belt being used exceeds “Limit”, adjust it to value for “After adjustment”.
- When checking belt deflection or tension immediately 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 installing belt, make sure that it is correctly engaged with pulley groove.
- Keep oil and water away from belt.
- Do not twist or bend belt excessively.

# DRIVE BELTS

## ALTERNATOR AND POWER STEERING OIL PUMP BELT


1. Remove undercover with power tool.
2. Loosen idler pulley lock nut (A) and adjust tension by turning adjusting bolt (B).
  - For specified belt tension, refer to [EM-14, "Checking Drive Belts"](#).
3. Tighten nut (A).

: 31.4 - 38.2 N-m (3.2 - 3.9 kg-m, 24 - 28 ft-lb)



## A/C COMPRESSOR BELT

1. Remove undercover with power tool.
2. Loosen idler pulley lock nut (C) and adjust tension by turning adjusting bolt (D).
  - For specified belt tension, refer to [EM-14, "Checking Drive Belts"](#).
3. Tighten nut (C).

: 30.4 - 39.2 N-m (3.1 - 4.0 kg-m, 23 - 28 ft-lb)

## Removal and Installation

### REMOVAL

1. Remove undercover with power tool.
2. Remove alternator and power steering oil pump belt. Refer to [EM-15, "ALTERNATOR AND POWER STEERING OIL PUMP BELT"](#).
3. Remove A/C compressor belt. Refer to [EM-15, "A/C COMPRESSOR BELT"](#).

### CAUTION:

Grease is applied to idler pulley adjusting bolt. Be careful to keep grease away from belt.

### INSTALLATION

1. Install belts to pulley in the reverse order of removal.

### CAUTION:

- Make sure belt is correctly engaged with the pulley groove.
  - Check for engine oil and engine coolant are not adhered belt and each pulley groove.
2. Adjust belt tension. Refer to [EM-14, "Tension Adjustment"](#).
  3. Tighten each nuts and bolts and nut to the specified torque.
  4. Make sure that tension of each belt is within the standard.

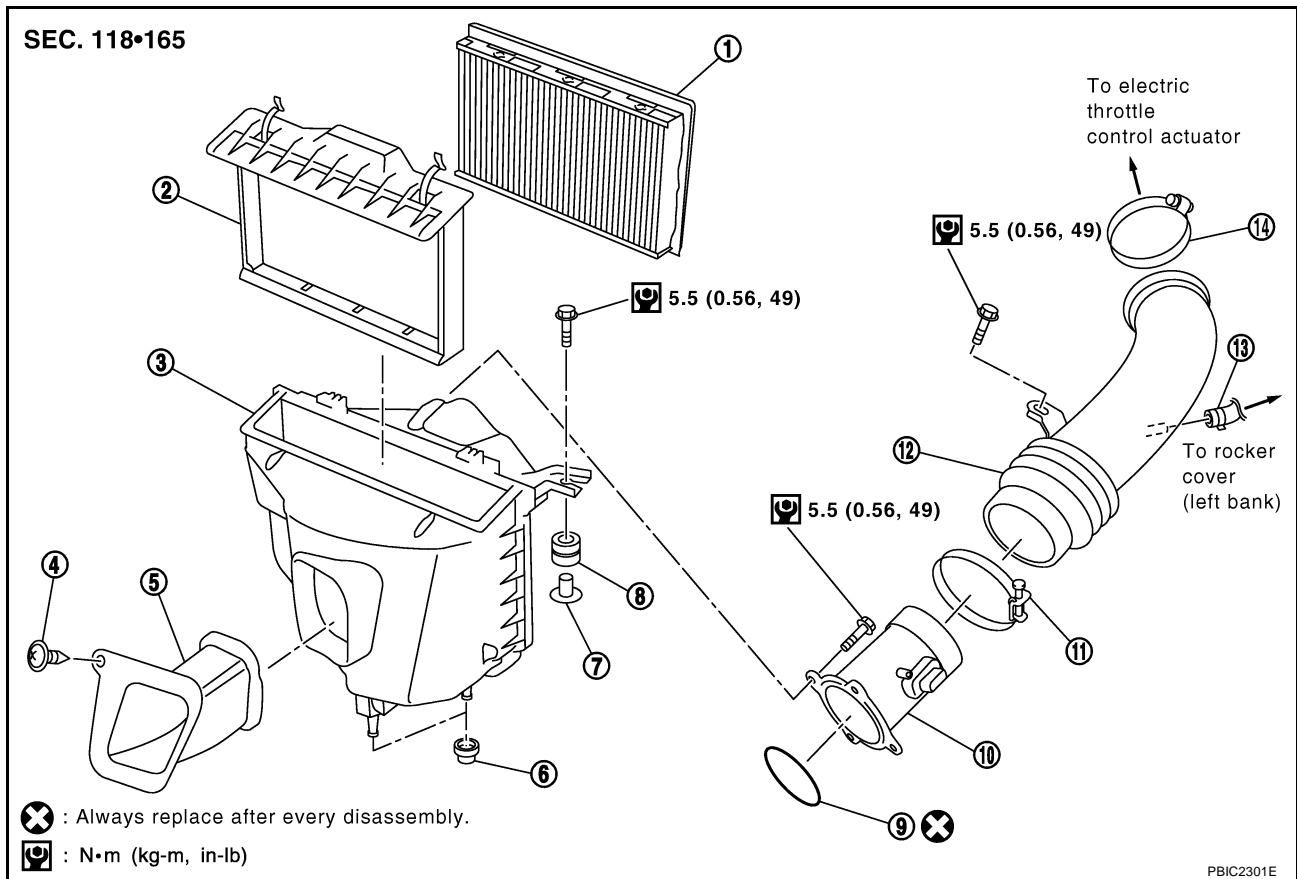
# AIR CLEANER AND AIR DUCT

## AIR CLEANER AND AIR DUCT

PFP:16500

### Removal and Installation

NBS0000G



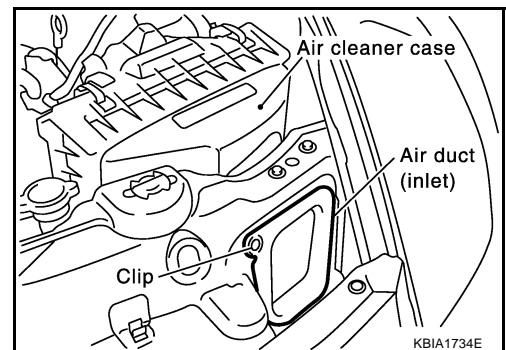
- |                          |                     |                     |
|--------------------------|---------------------|---------------------|
| 1. Air cleaner filter    | 2. Holder           | 3. Air cleaner case |
| 4. Clip                  | 5. Air duct (inlet) | 6. Grommet          |
| 7. Collar                | 8. Grommet          | 9. O-ring           |
| 10. Mass air flow sensor | 11. Clamp           | 12. Air duct        |
| 13. PCV hose             | 14. Clamp           |                     |

### REMOVAL

1. Remove clips, and slide air duct (inlet) frontward, disengage clips and air cleaner case.

#### NOTE:

When removing air duct (inlet), remove front bumper and bumper fascia stay radiator core support center. Refer to [EI-14. "FRONT BUMPER"](#) and [BL-19. "RADIATOR CORE SUPPORT"](#)



2. Disconnect harness connector from mass air flow sensor.
3. Disconnect PCV hose.
4. Remove air cleaner case/mass air flow sensor assembly and air duct assembly disconnecting their joints.
  - Add marks as necessary for easier installation.
5. Remove mass air flow sensor from air cleaner case.

#### CAUTION:

Handle mass air flow sensor with care.

- Do not shock it.



# AIR CLEANER AND AIR DUCT

- Do not disassemble it.
- Do not touch its sensor.

## INSPECTION AFTER REMOVAL

Inspect air duct for crack or tear.

- If anything found, replace air duct.

## INSTALLATION

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

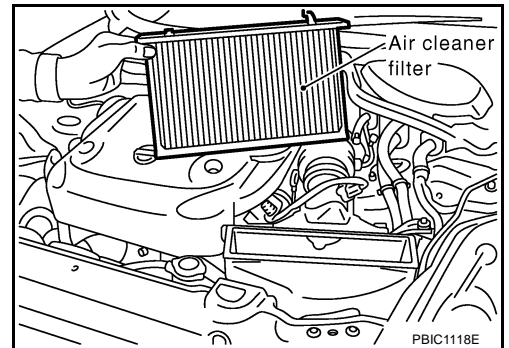
- Align marks. Attach each joint. Screw clamps firmly.

## Changing Air Cleaner Filter

### REMOVAL

1. Unhook clips, and lift holder.
2. Remove air cleaner filter.

NBS0000H



## INSTALLATION

Installation is the reverse order of removal.

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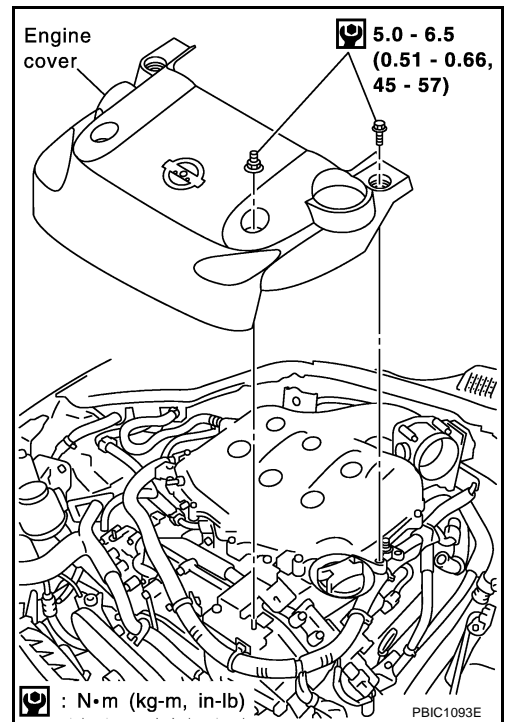


# INTAKE MANIFOLD COLLECTOR

2. Remove engine cover with power tool.

**CAUTION:**

When removing/installing engine cover with tower bar installed, remove and install carefully in order to prevent damage to top surface.



3. Drain engine coolant, or when water hose is disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-10, "Changing Engine Coolant"](#).

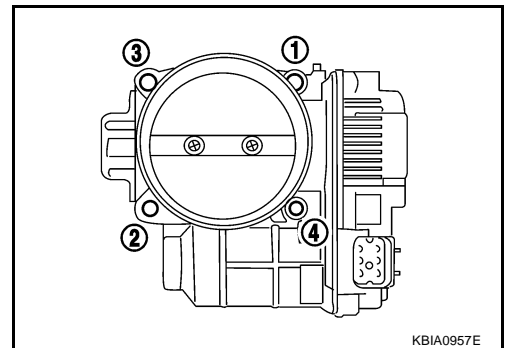
**CAUTION:**

- Perform this step when engine is cold.
- Do not spill engine coolant on drive belts.

4. Remove air cleaner case and air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#).
5. Remove electric throttle control actuator as follows:
  - a. Disconnect harness connector.
  - b. Loosen mounting bolts in reverse order as shown in the figure.

**CAUTION:**

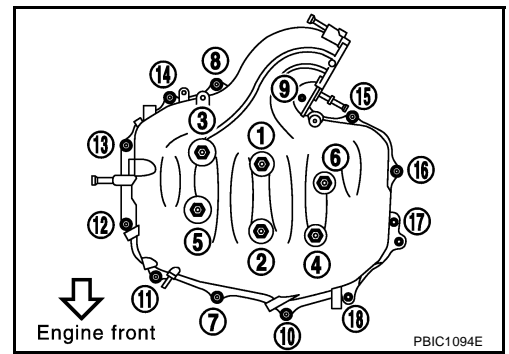
- Handle carefully to avoid any shock to electric throttle control actuator.
- Do not disassemble.



6. Remove fuel sub-tube mounting bolt to disconnect from rear of intake manifold collector (lower). Refer to [EM-38, "FUEL INJECTOR AND FUEL TUBE"](#).
7. Disconnect vacuum hose and water hose from intake manifold collector (upper).
8. Remove EVAP canister purge volume control solenoid valve bracket mounting bolt from intake manifold collector (upper).

# INTAKE MANIFOLD COLLECTOR

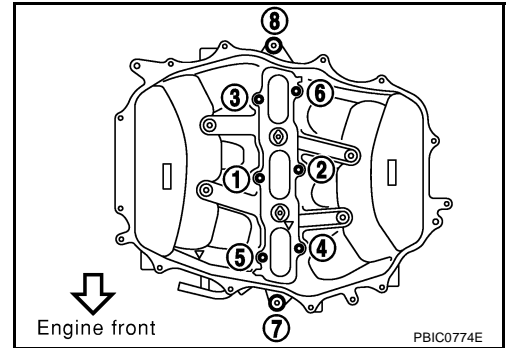
9. Loosen mounting bolts with power tool in reverse order as shown in the figure to remove intake manifold collector (upper).



10. Remove PCV hose [between intake manifold collector (lower) and rocker cover (right bank)].
11. Loosen mounting bolts with power tool in reverse order as shown in the figure, and remove the intake manifold collector cover, gasket, intake manifold collector (lower) and gasket.

**CAUTION:**

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



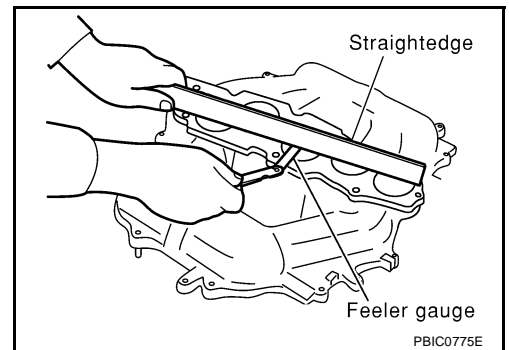
## INSPECTION AFTER REMOVAL

### Surface Distortion

- Check the surface distortion of both the intake manifold collector (upper and lower) mating surfaces with straightedge and feeler gauge.

**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace intake manifold collector (upper and/or lower).



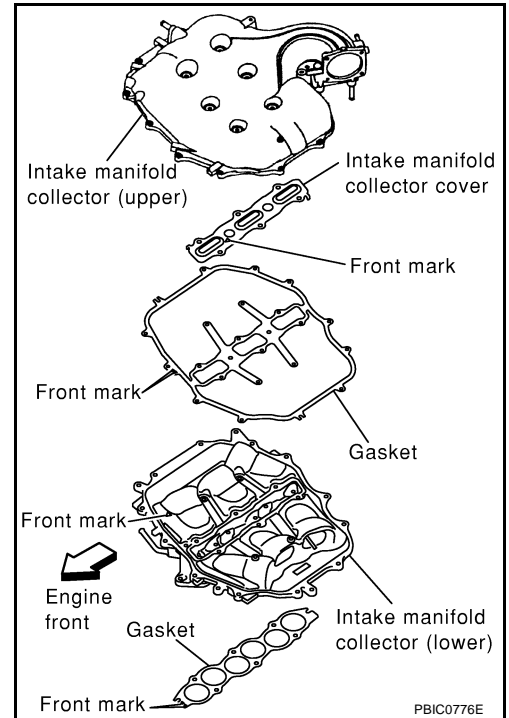
# INTAKE MANIFOLD COLLECTOR

## INSTALLATION

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

### Part Installation Direction

Referring to front marks, install parts shown in the figure.

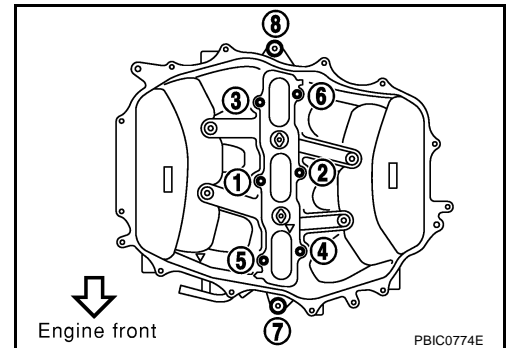


### Intake Manifold Collector (Lower)

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


#### NOTE:

Tighten mounting bolts to secure gasket (lower), intake manifold collector (lower), gasket (upper), and intake manifold collector cover.



### Intake Manifold Collector (Upper)

- If stud bolts were removed, install them and tighten to the specified torque below.

: 4.9 - 6.9 N·m (0.5 - 0.7 kg-m, 44 - 61 in-lb)

- Shank length under bolt head varies with bolt location. Install mounting bolts while referring to numbers shown below and in the figure. (Bolt length does not include pilot portion.)

#### Bolt

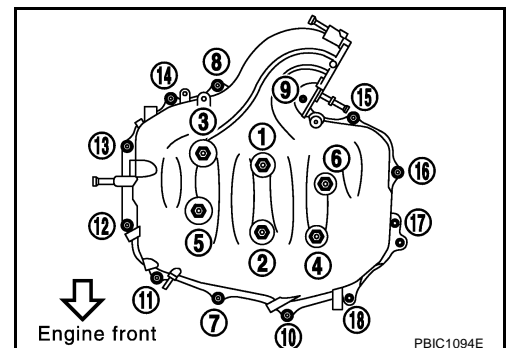
**M6 × 25 mm (0.98 in)** : 7, 8, 10, 11, 13, 14, 15, 16, 18

**M6 × 45 mm (1.77 in)** : 2, 4, 5

**M6 × 60 mm (2.36 in)** : 1, 3, 6, 9

**M6 Nut** : 12, 17

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



### Water Hose

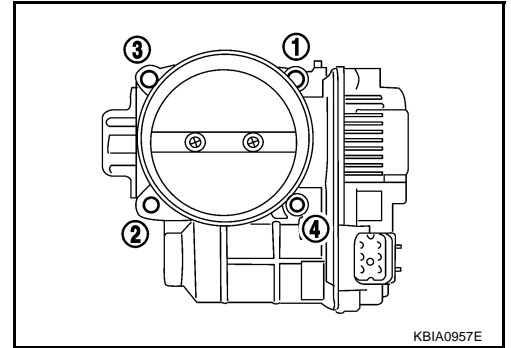
- Insert hose by 27 to 32 mm (1.06 to 1.26 in) from connector end.

# INTAKE MANIFOLD COLLECTOR

- Clamp hose at location of 3 to 7 mm (0.12 to 0.28 in) from hose end.

## Electric Throttle Control Actuator

- Install gasket with positioning no-protrusion surface upward or downward.
- Tighten mounting bolts in numerical order as shown in the figure.
- Perform the “Throttle Valve Closed Position Learning” when harness connector of electric throttle control actuator is disconnected. Refer to [EC-79, "Throttle Valve Closed Position Learning"](#).
- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when electric throttle control actuator is replaced. Refer to [EC-79, "Idle Air Volume Learning"](#).



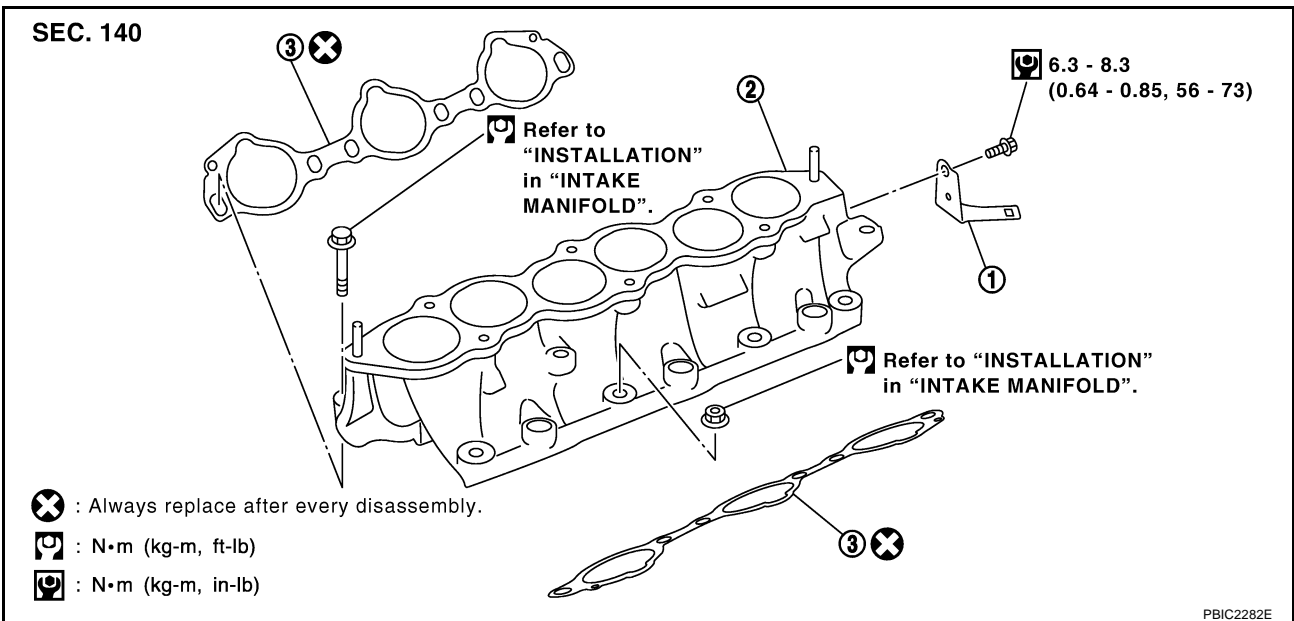
# INTAKE MANIFOLD

PFP:14003

## INTAKE MANIFOLD

### Removal and Installation

NBS0000J



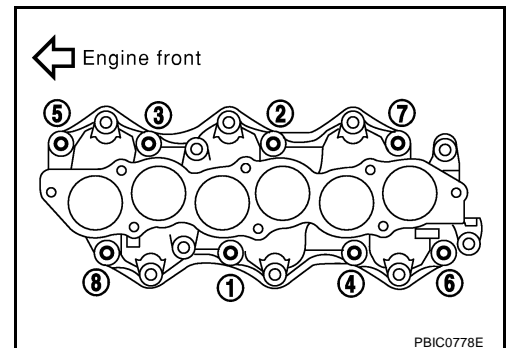
1. Harness bracket

2. Intake manifold

3. Gasket

### REMOVAL

1. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
2. Remove intake manifold collectors (upper and lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove fuel tube and fuel injector assembly. Refer to [EM-38, "FUEL INJECTOR AND FUEL TUBE"](#).
4. Loosen mounting nuts and bolts with power tool in reverse order as shown in the figure to remove intake manifold.



5. Remove gaskets.

### CAUTION:

Cover engine openings to avoid entry of foreign materials.

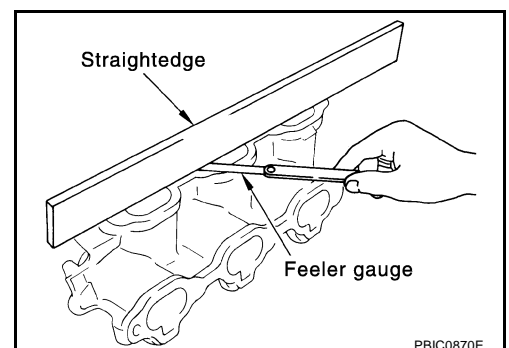
### INSPECTION AFTER REMOVAL

#### Surface Distortion

- Check the surface distortion of the intake manifold mating surface with straightedge and feeler gauge.

**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace intake manifold.




# INTAKE MANIFOLD

## INSTALLATION

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

### Intake Manifold

- If stud bolts were removed, install them and tighten to the specified torque below.

: **9.8 - 11.8 N·m (1.0 - 1.2 kg·m, 87 - 104 in·lb)**

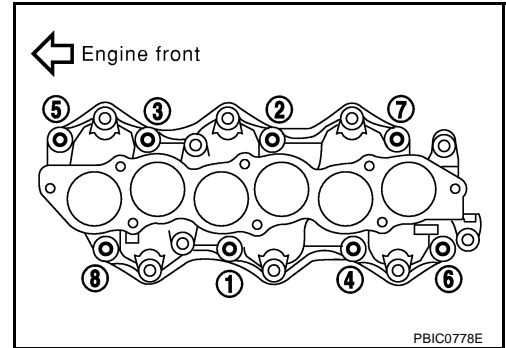
- Tighten all mounting nuts and bolts to the specified torque in two or more steps in numerical order shown in the figure.

 **1st step**

: **4.9 - 9.8 N·m (0.5 - 1.0 kg·m, 4 - 7 ft·lb)**

 **2nd step and after**

: **26.5 - 31.4 N·m (2.7 - 3.2 kg·m, 20 - 23 ft·lb)**





# EXHAUST MANIFOLD AND THREE WAY CATALYST

PF14004

A

## EXHAUST MANIFOLD AND THREE WAY CATALYST

NBS0000K

### Removal and Installation

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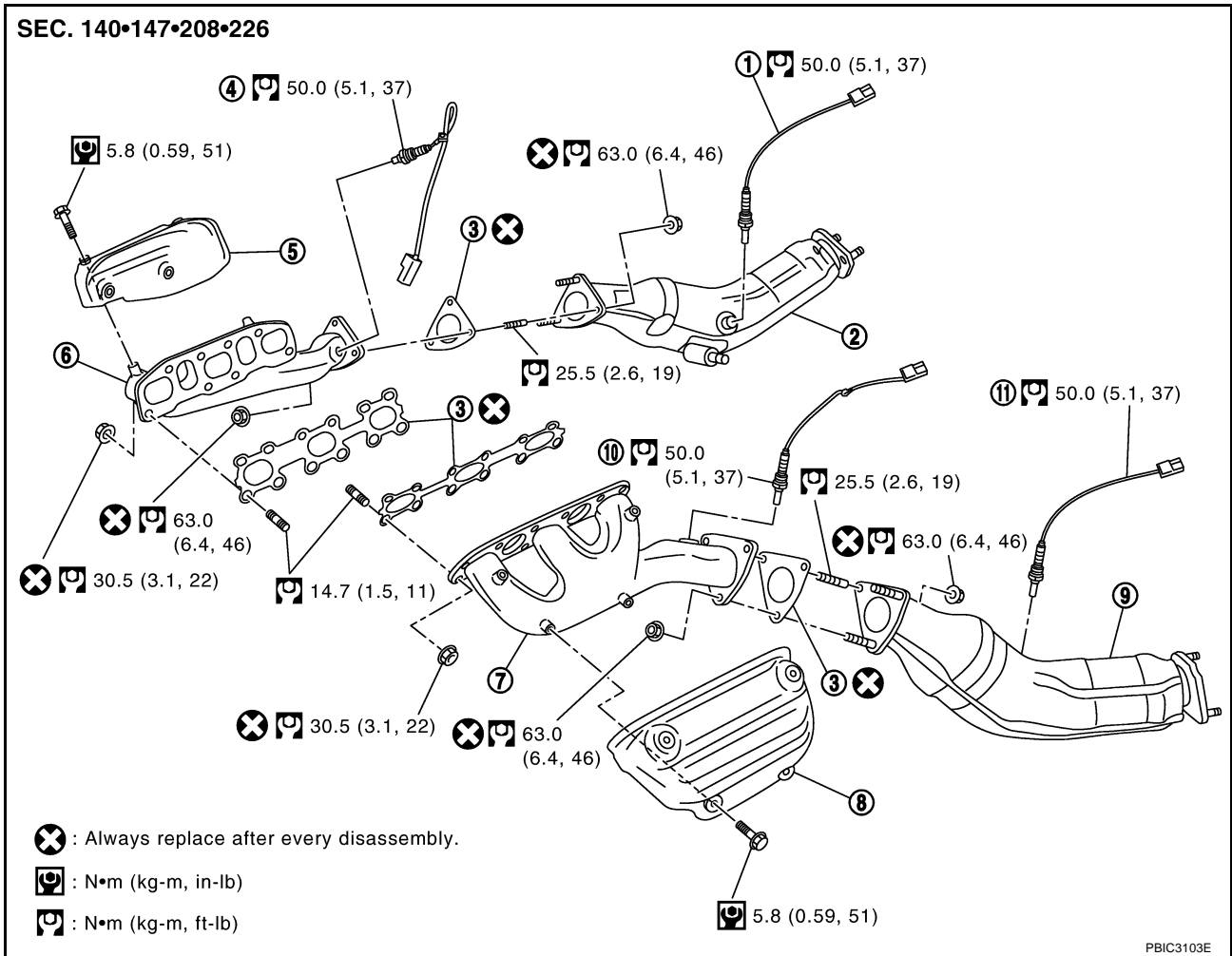
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- |                                      |  |                                   |
|--------------------------------------|--|-----------------------------------|
| 1. Heated oxygen sensor 2 (bank 1)   | 2. Three way catalyst (right bank)     | 3. Gasket                         |
| 4. Air fuel ratio sensor 1 (bank 1)  | 5. Exhaust manifold cover (right bank) | 6. Exhaust manifold (right bank)  |
| 7. Exhaust manifold (left bank)      | 8. Exhaust manifold cover (left bank)  | 9. Three way catalyst (left bank) |
| 10. Air fuel ratio sensor 1 (bank 2) | 11. Heated oxygen sensor 2 (bank 2)    |                                   |

### REMOVAL

#### WARNING:

Perform the work when the exhaust and cooling system have completely cooled down.

1. Remove tower bar. Refer to [FSU-20, "TOWER BAR"](#).
2. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
3. Drain engine coolant. Refer to [CO-10, "Changing Engine Coolant"](#).

#### CAUTION:

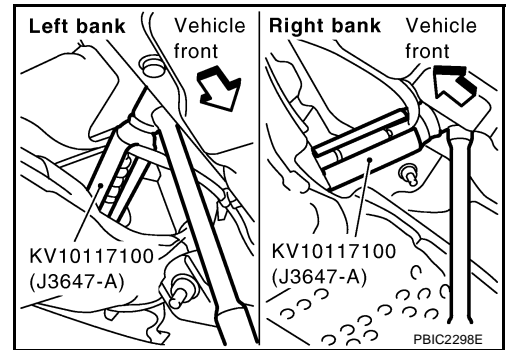
- Perform this step when engine is cold.
  - Do not spill engine coolant on drive belts.
4. Remove air cleaner case and air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#).
  5. Remove undercover with power tool.

## EXHAUST MANIFOLD AND THREE WAY CATALYST

6. Disconnect harness connector and remove heated oxygen sensor 2 on both banks using heated oxygen sensor wrench (SST).
- Put marks to identify installation positions of each heated oxygen sensor 2.

**CAUTION:**

- Be careful not to damage heated oxygen sensor 2.
- Discard any heated oxygen sensor 2 which has been dropped onto a hard surface such as a concrete floor. Replace with a new sensor.



7. Remove exhaust mounting bracket between three way catalysts (right and left bank) and transmission. Refer to [EX-3, "EXHAUST SYSTEM"](#).

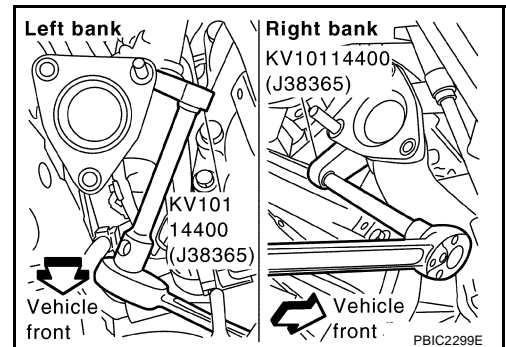
8. Remove three way catalyst.

9. Disconnect harness connector and remove air fuel ratio sensor 1 on both banks using heated oxygen sensor wrench (SST).

- Put marks to identify installation positions of each air fuel ratio sensor 1.

**CAUTION:**

- Be careful not to damage air fuel ratio sensor 1.
- Discard any air fuel ratio sensor 1 which has been dropped onto a hard surface such as a concrete floor. Replace with a new sensor.



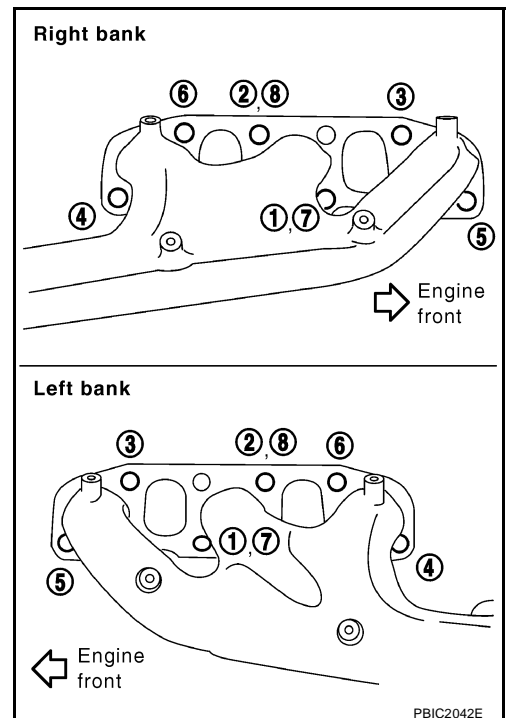
10. Remove water pipe and heater pipe on both right and left side. Refer to [CO-31, "WATER OUTLET AND WATER PIPING"](#).

11. Remove exhaust manifold cover.

12. Loosen mounting nuts with power tool in reverse order as shown in the figure to remove exhaust manifold.

**NOTE:**

Disregard the numerical order No. 7 and 8 in removal.



13. Remove gaskets.

**CAUTION:**

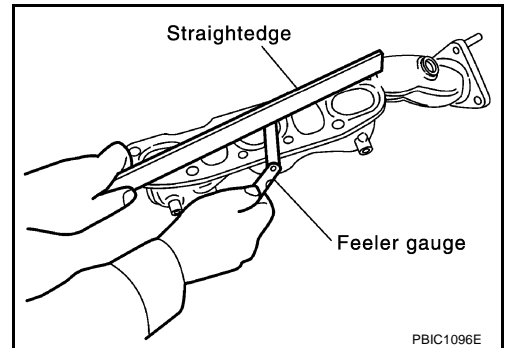
Cover engine openings to avoid entry of foreign materials.

# EXHAUST MANIFOLD AND THREE WAY CATALYST

## INSPECTION AFTER REMOVAL

### Surface Distortion

- Check the surface distortion of the exhaust manifold mating surface with straightedge and feeler gauge.
- **Limit : 0.3 mm (0.012 in)**
- If it exceeds the limit, replace exhaust manifold.

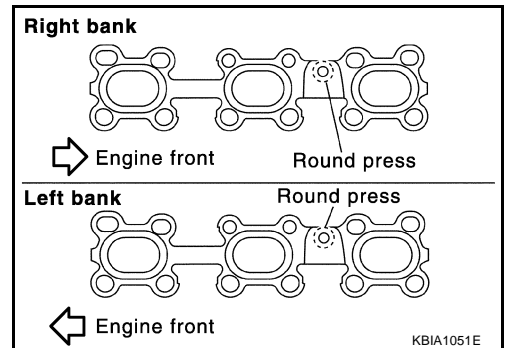


## INSTALLATION

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


### Exhaust Manifold Gasket

- Install in direction shown below. (Follow same procedure for both banks.)
- Locate thick side of port connecting part on right side from technician's view.
- Locate round press in thick side of port connecting part above center level line of port.



### Exhaust Manifold

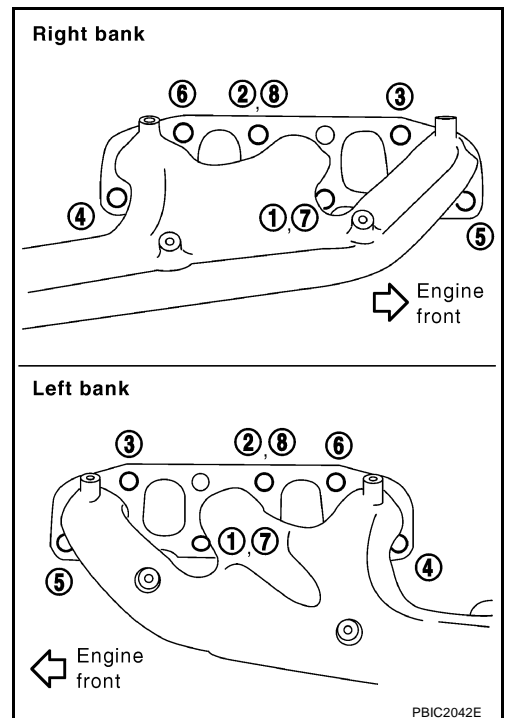
- If stud bolts were removed, install them and tighten to the specified torque below.

: **12.7 - 16.7 N·m (1.3 - 1.7 kg·m, 10 - 12 ft·lb)**

- Install mounting exhaust manifold in numerical order as shown in the figure.

#### NOTE:

Tighten nuts No. 1 and 2 in two steps. The numerical order No. 7 and 8 shown second step.



# EXHAUST MANIFOLD AND THREE WAY CATALYST

## Air Fuel Ratio Sensor 1 and Heated Oxygen Sensor 2

- Install air fuel ratio sensor 1 and heated oxygen sensor 2 in the original position.
- Install referring to the following if the installation positions cannot be identified.

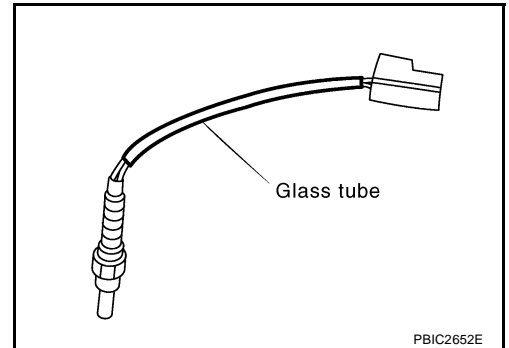
### Glass tube color

Air fuel ratio sensor 1*	: Black
Heated oxygen sensor 2 (bank 1)	: White
Heated oxygen sensor 2 (bank 2)	: White

\*: Air fuel ratio sensor 1 is the same for both bank 1 and bank 2.

### CAUTION:

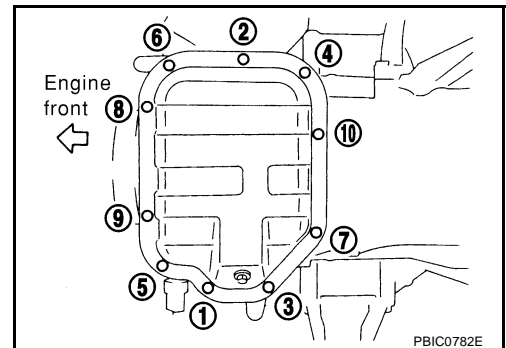
- Before installing a new air fuel ratio sensor 1 and heated oxygen sensor 2, clean exhaust system threads using oxygen sensor thread cleaner (commercial service tool: J-43897-18 or J-43897-12) and apply anti-seize lubricant (commercial service tool).
- Do not over torque air fuel ratio sensor 1 and heated oxygen sensor 2. Doing so may cause damage to air fuel ratio sensor 1 and heated oxygen sensor 2, resulting in the "MIL" coming on.





# OIL PAN AND OIL STRAINER

1. Remove hood assembly. Refer to [BL-13, "HOOD"](#) .
2. Remove tower bar. Refer to [FSU-20, "TOWER BAR"](#) .
3. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
4. Remove air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#) .
5. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#) .  
**CAUTION:**
  - Perform this step when engine is cold.
  - Do not spill engine oil on drive belts.
6. Drain engine coolant. Refer to [CO-10, "Changing Engine Coolant"](#) .  
**CAUTION:**
  - Perform this step when engine is cold.
  - Do not spill engine coolant on drive belts.
7. Remove undercover with power tool.
8. Install engine slinger to sling engine assembly for positioning. Refer to [EM-131, "ENGINE ASSEMBLY"](#) .
9. Remove front suspension member. Refer to [FSU-19, "FRONT SUSPENSION MEMBER"](#) .
10. Remove drive belts. Refer to [EM-14, "DRIVE BELTS"](#) .
11. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#) .
12. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#) .
13. Remove idler pulley and bracket assembly. Refer to [EM-59, "TIMING CHAIN"](#) .
14. Disconnect oil cooler water hoses, and remove oil cooler water pipe mounting bolt. Refer to [LU-11, "OIL COOLER"](#) .
15. Disconnect A/T fluid cooler hoses, and remove A/T fluid cooler tube (A/T models). Refer to [AT-274, "TRANSMISSION ASSEMBLY"](#) .
16. Remove crankshaft position sensor (POS).  
**CAUTION:**
  - Handle carefully to avoid dropping and shocks.
  - Do not disassemble.
  - Do not allow metal powder to adhere to magnetic part at sensor tip.
  - Do not place sensors in a location where they are exposed to magnetism.
17. Remove oil filter, as necessary. Refer to [LU-10, "OIL FILTER"](#) .
18. Remove oil cooler, as necessary. Refer to [LU-11, "OIL COOLER"](#) .
19. Remove oil temperature sensor, as necessary. (M/T models)
20. Remove oil pan (lower) as follows:
  - a. Loosen mounting bolts with power tool in reverse order as shown in the figure to remove.

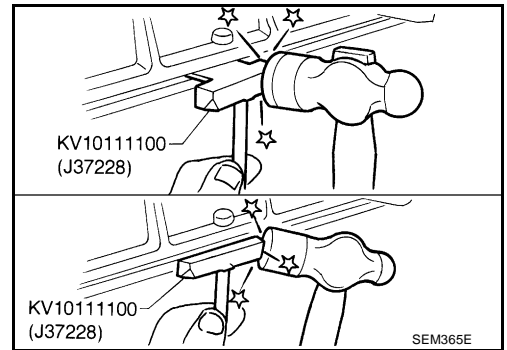


# OIL PAN AND OIL STRAINER

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

**CAUTION:**

- Be careful not to damage the mating surfaces.
- Do not insert screwdriver, this will damage the mating surface.

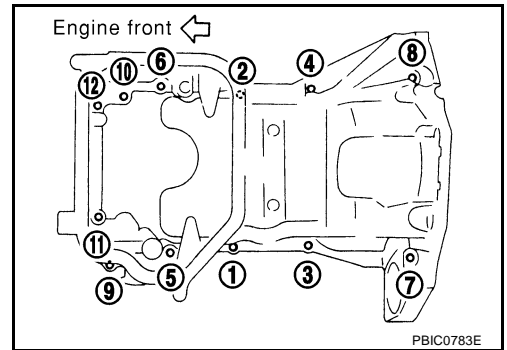


21. Remove baffle plate.
22. Remove oil strainer.
23. Remove transmission joint bolts which pierce oil pan (upper). Refer to [MT-18, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
24. Remove rear cover plate.
25. Loosen mounting bolts with power tool in reverse order as shown in the figure to remove oil pan (upper).

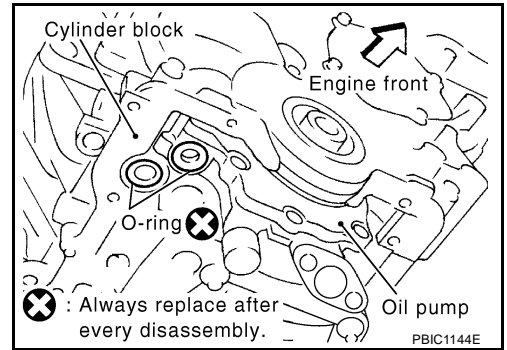
- Insert seal cutter [SST: KV10111100 (J37228)] between oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of tool with hammer. Remove oil pan (upper).

**CAUTION:**

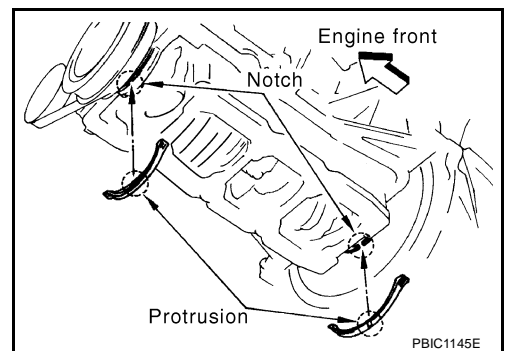
Be careful not to damage mating surface.



26. Remove O-rings from bottom of cylinder block and oil pump.



27. Remove oil pan gaskets.



## INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

# OIL PAN AND OIL STRAINER

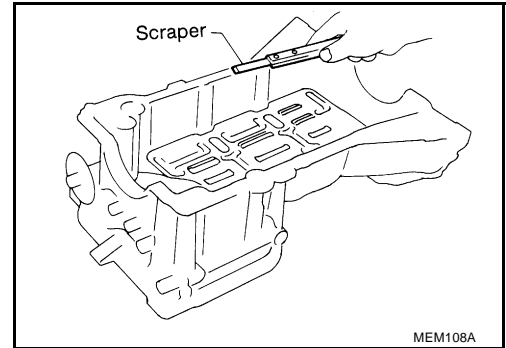
## INSTALLATION

1. Install oil pan (upper) as follows:

- 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.

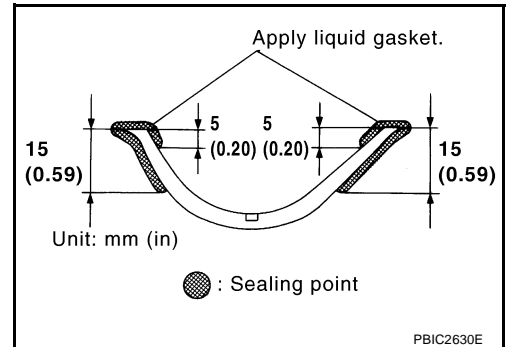
**CAUTION:**

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

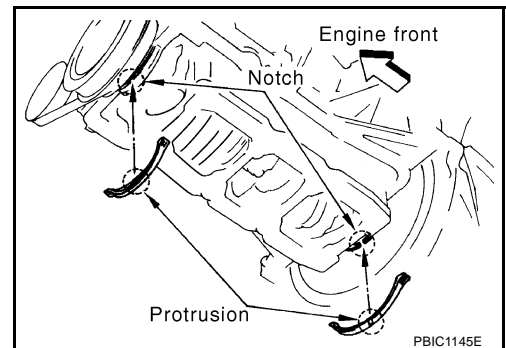


b. Install new oil pan gaskets.

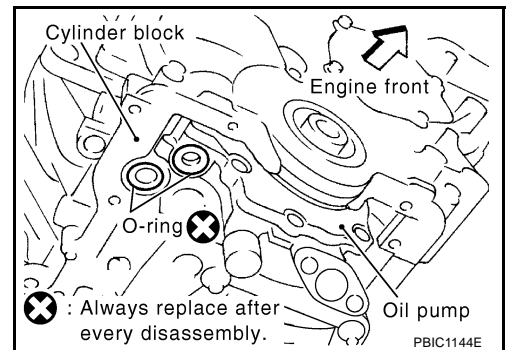
- Apply liquid gasket to oil pan gaskets as shown in the figure. **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**



- To install, align protrusion of oil pan gasket with notches of front timing chain case and rear oil seal retainer.
- Install oil pan gasket with smaller arc to front timing chain case side.



c. Install new O-rings on the bottom of cylinder block and oil pump.





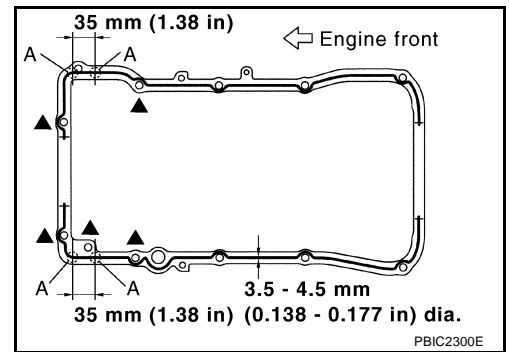
## OIL PAN AND OIL STRAINER

- d. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to the cylinder block mating surface of oil pan (upper) to a limited portion as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

**CAUTION:**

- For bolt holes with ▲ marks (5 locations), apply liquid gasket outside the holes.
- Apply a bead of 4.5 to 5.5 mm (0.177 to 0.217 in) in diameter to area "A".
- Attaching should be done within 5 minutes after coating.



- e. Install oil pan (upper).

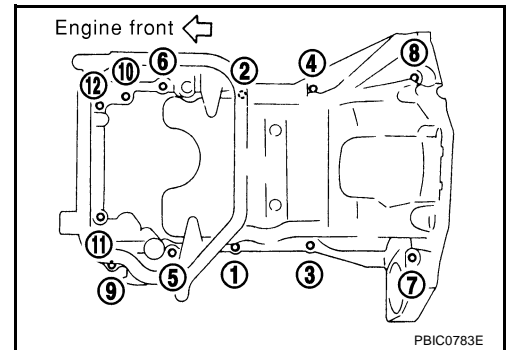
**CAUTION:**

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

- Tighten mounting bolts in numerical order as shown in the figure.
- There are two types of mounting bolts. Refer to the following for locating bolts.

**M8 × 100 mm (3.94 in) : 5, 7, 8, 11**

**M8 × 25 mm (0.98 in) : Except the above**



- f. Tighten transmission joint bolts. Refer to [MT-18, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).

2. Install oil strainer to oil pump.

3. Install baffle plate.

- Apply locking sealant to the thread of mounting bolts.

**Use Genuine High Strength Thread Locking Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

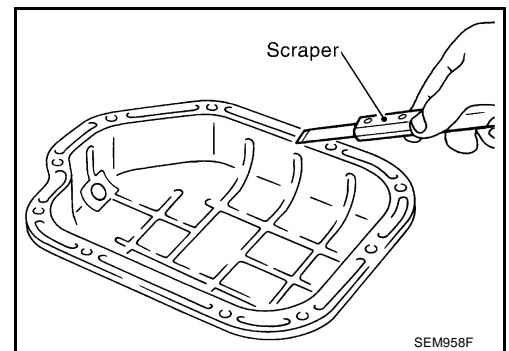
4. Install oil pan (lower) as follows:

- a. Use scraper to remove old liquid gasket from mating surfaces.

- Also remove old liquid gasket from mating surface of oil pan (upper).
- Remove old liquid gasket from the bolt holes and thread.

**CAUTION:**

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



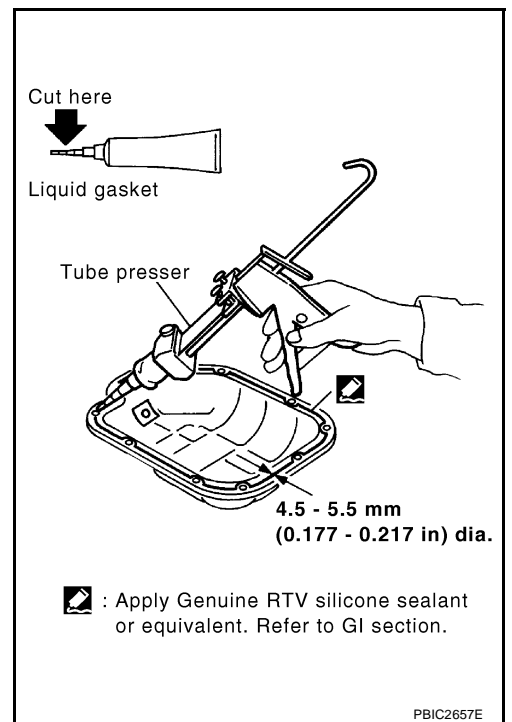
## OIL PAN AND OIL STRAINER

- b. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to the oil pan (lower) as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**

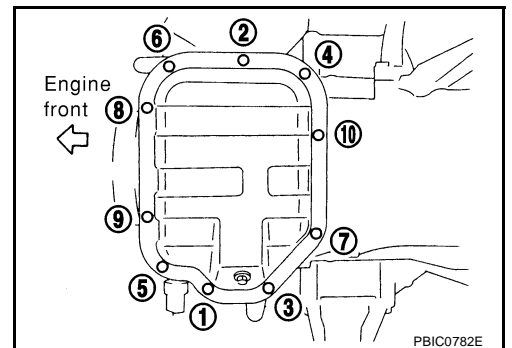
**CAUTION:**

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



- c. Install oil pan (lower).

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



5. Install oil pan drain plug.

- Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-29, "Removal and Installation"](#) .

6. Install in the reverse order of removal after this step.

**NOTE:**

At least 30 minutes after oil pan is installed, pour engine oil.

### INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-7, "ENGINE OIL"](#) .
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-7, "ENGINE OIL"](#) .

# IGNITION COIL

## IGNITION COIL

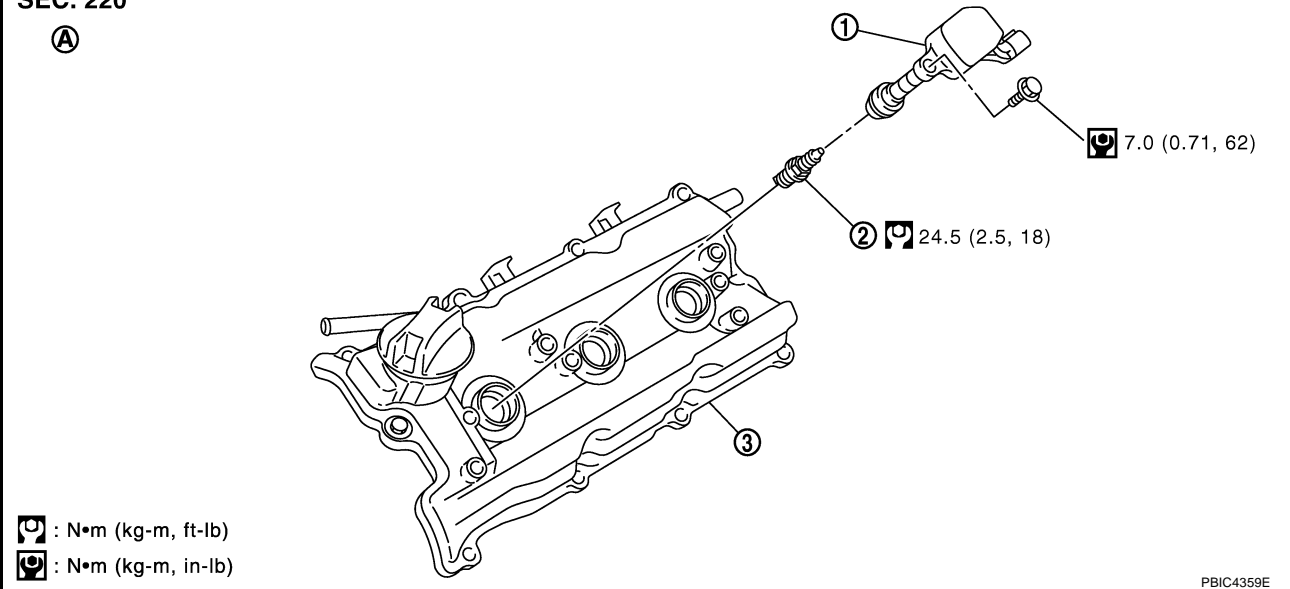
PFP:22448

### Removal and Installation

NBS0000M

SEC. 220

A



1. Ignition coil

2. Spark plug

3. Rocker cover

A. Left bank

### REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove air cleaner case and air duct. (At the left bank side, remove ignition coil) Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#) .
3. Move aside harness, harness bracket, and hoses located above ignition coil.
4. Disconnect harness connector from ignition coil.
5. Remove ignition coil.

**CAUTION:**  
Do not shock it.

### INSTALLATION

Installation is the reverse order of removal.

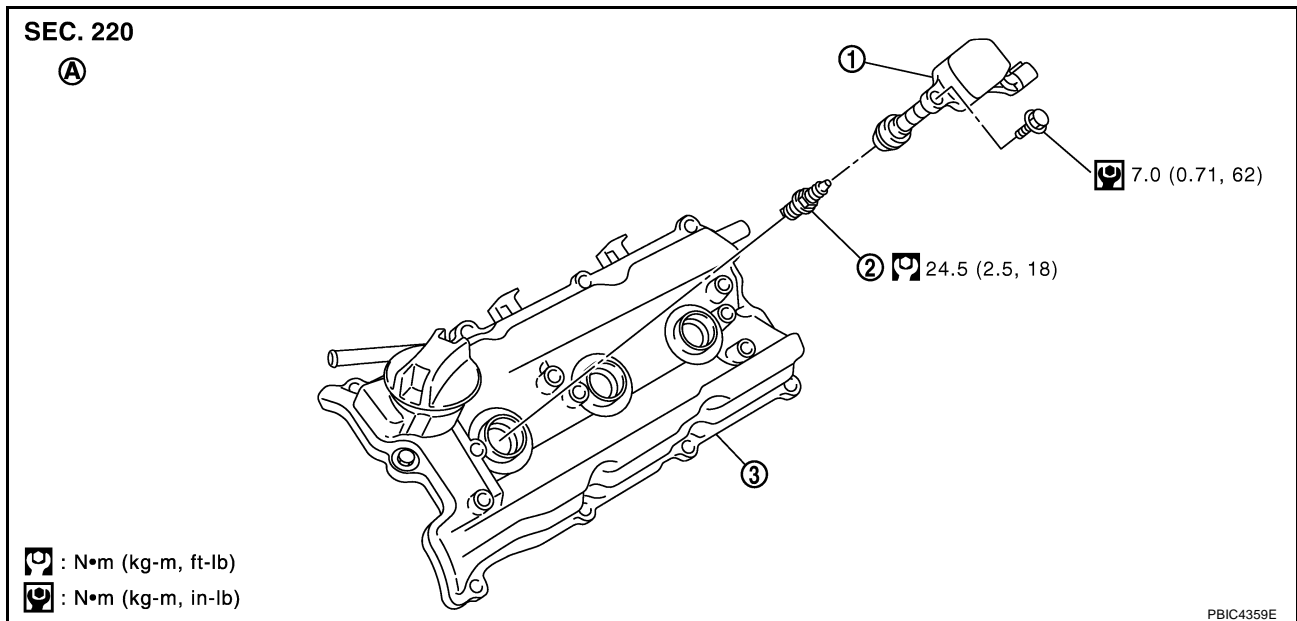
# SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

## SPARK PLUG (PLATINUM-TIPPED TYPE)

### Removal and Installation

NBS0000N



1. Ignition coil

2. Spark plug

3. Rocker cover

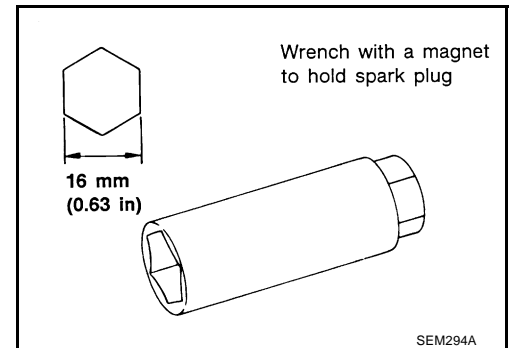
A. Left bank

### REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove ignition coil. Refer to [EM-35, "IGNITION COIL"](#).
3. Remove spark plug using spark plug wrench (commercial service tool).

#### CAUTION:

Do not drop or shock it.



### INSPECTION AFTER REMOVAL

Use standard type spark plug for normal condition.

Hot type spark plug is suitable when fouling occurs with standard type spark plug under conditions such as:

- Frequent engine starts
- Low ambient temperatures

Cold type spark plug is suitable when spark plug knock occurs with standard type spark plug under conditions such as:

- Extended highway driving
- Frequent high engine revolution

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11

Gap (Nominal) : 1.1 mm (0.043 in)

# SPARK PLUG (PLATINUM-TIPPED TYPE)

## CAUTION:

- Do not drop or shock spark plug.
- Do not use wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

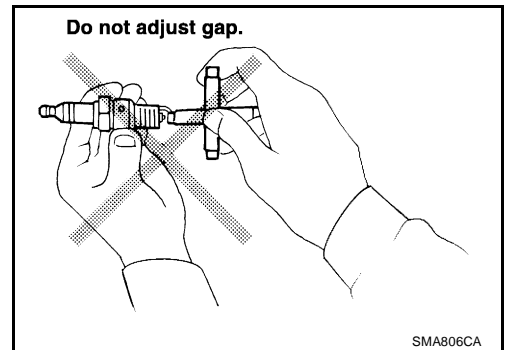
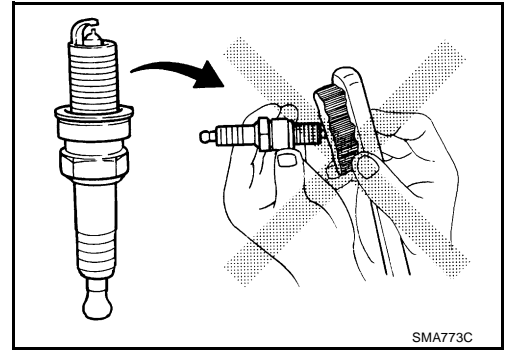
Cleaner air pressure:

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

Cleaning time:

Less than 20 seconds

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



## INSTALLATION

Installation is the reverse order of removal.

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

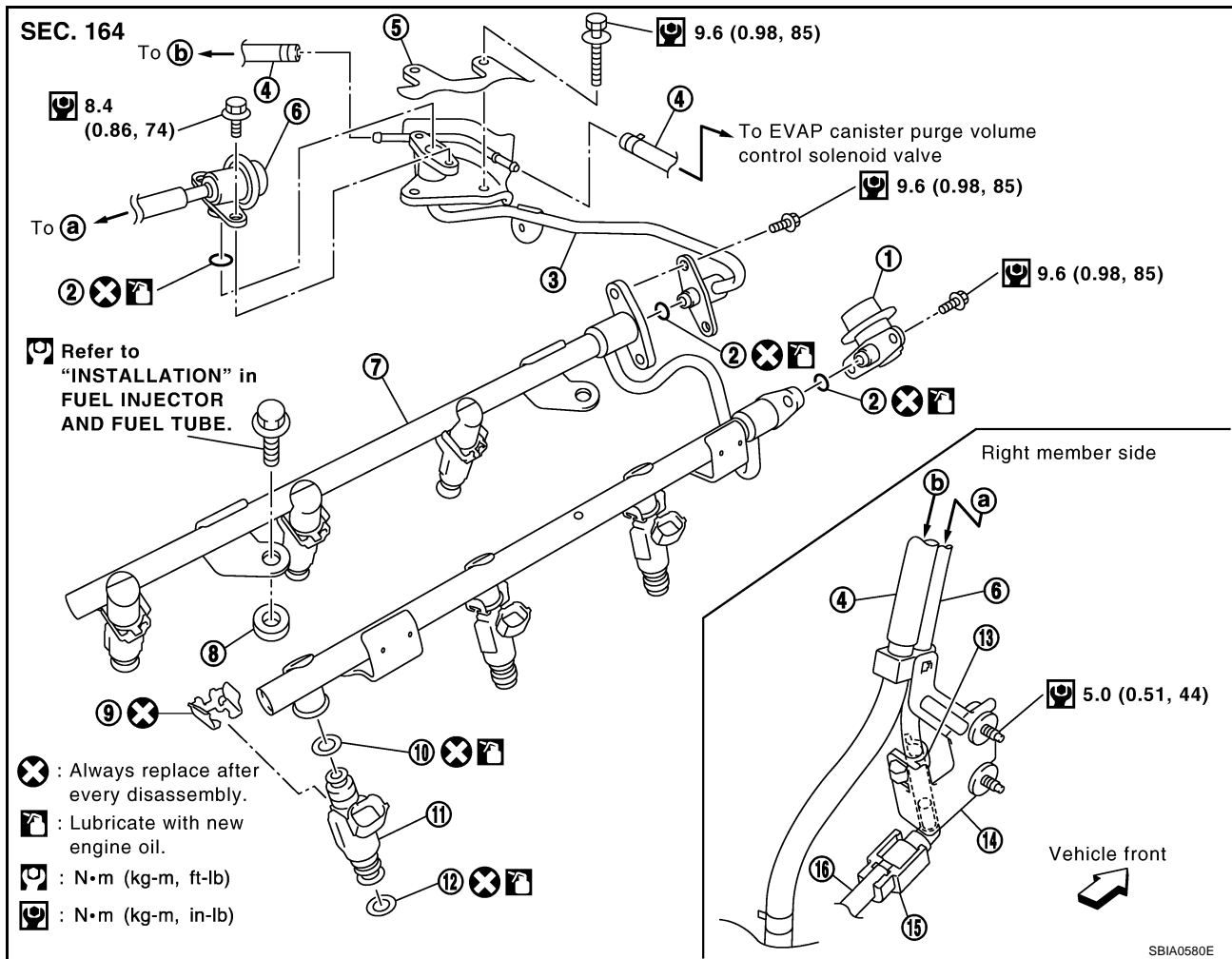
# FUEL INJECTOR AND FUEL TUBE

PFP:16600

NBS00000

## FUEL INJECTOR AND FUEL TUBE

### Removal and Installation



- |                                    |  |                                 |
|------------------------------------|--|---------------------------------|
| 1. Fuel damper                     | 2. O-ring  | 3. Fuel sub-tube                |
| 4. EVAP hose                       | 5. Intake manifold collector (lower) rear right side | 6. Fuel feed hose (with damper) |
| 7. Fuel tube                       | 8. Spacer  | 9. Clip                         |
| 10. O-ring (blue)                  | 11. Fuel injector                                    | 12. O-ring (brown)              |
| 13. Hose clamp                     | 14. Bracket  | 15. Quick connector cap         |
| 16. Centralized under-floor piping |  |                                 |

### CAUTION:

Do not remove or disassemble parts unless instructed as shown in the figure.

### REMOVAL

#### 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.
  - Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.
  - To avoid the danger of being scalded, do not drain engine coolant when engine is hot.
1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
  2. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
  3. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-10, "Changing Engine Coolant"](#) and [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).

### CAUTION:

Perform this step when engine is cold.

## FUEL INJECTOR AND FUEL TUBE

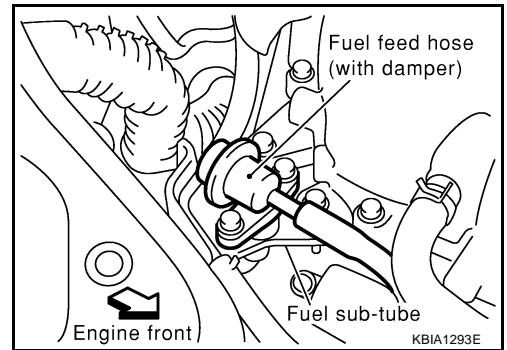
4. Remove fuel feed hose (with damper) from fuel sub-tube.

**NOTE:**

There is no fuel return route.

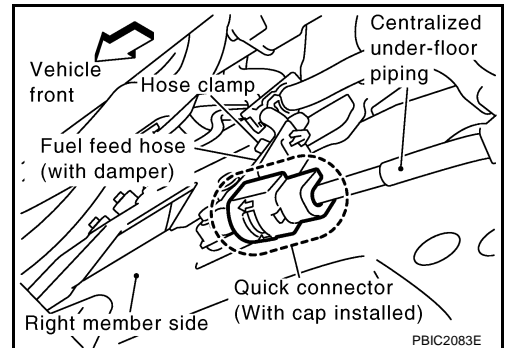
**CAUTION:**

- While hoses are disconnected, plug them to prevent fuel from draining.
- Do not separate fuel damper and fuel feed hose.



5. When separating fuel feed hose (with damper) and centralized under-floor piping connection, disconnect quick connector as follows:

- Remove quick connector cap from quick connector connection on right member side.
- Disconnect fuel feed hose (with damper) from bracket hose clamp.



- Disconnect quick connector from centralized under-floor piping as follows:

**CAUTION:**

**Disconnect quick connector by using quick connector release [SST: — (J-45488)], not by picking out retainer tabs.**

- With the sleeve side of quick connector release facing quick connector, install quick connector release onto centralized under-floor piping.
- 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.**

- Draw and pull out quick connector straight from centralized under-floor piping.

**CAUTION:**

- Pull quick connector holding "A" position as shown in the figure.

- Do not pull with lateral force applied. O-ring inside quick connector may be damaged.

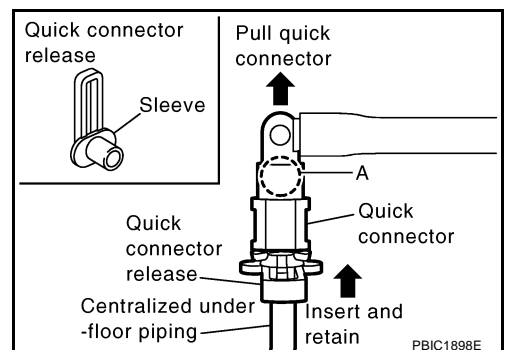
- Prepare container and cloth beforehand as fuel will leak out.

- Avoid fire and sparks.

- Keep parts away from heat source. Especially, be careful when welding is performed around them.

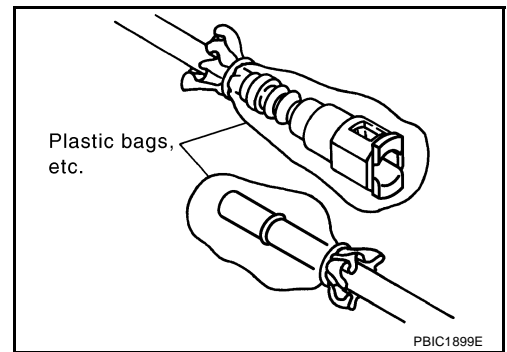
- Do not expose parts to battery electrolyte or other acids.

- Do not bend or twist connection between quick connector and fuel feed hose (with damper) during installation/removal.



## FUEL INJECTOR AND FUEL TUBE

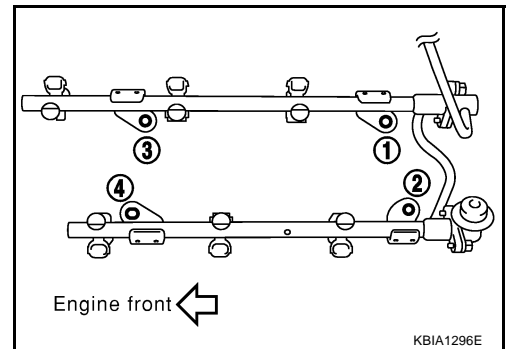
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



6. Remove intake manifold collectors (upper and lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
7. Disconnect harness connector from fuel injector.
8. Loosen mounting bolts in reverse order as shown in the figure, and remove fuel tube and fuel injector assembly.

**CAUTION:**

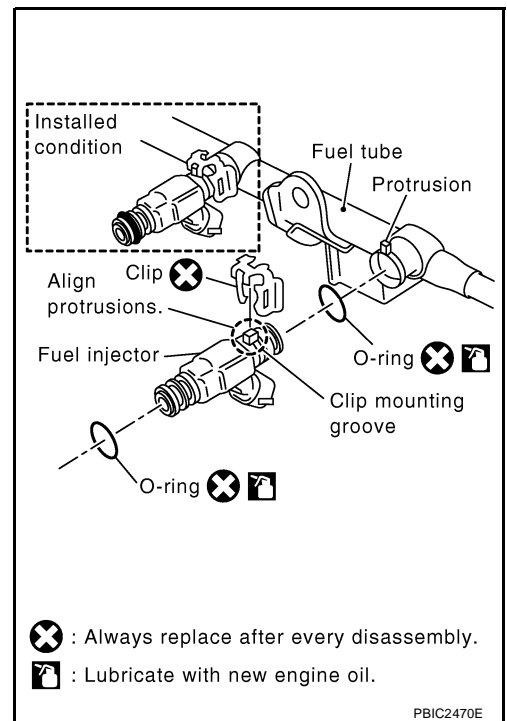
Do not tilt it, or remaining fuel in pipes may flow out from pipes.



9. Remove spacers on intake manifold.
10. Remove fuel injector from fuel tube as follows:
  - a. Open and remove clip.
  - 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 injector nozzles during removal.
- Do not bump or drop fuel injector.
- Do not disassemble fuel injector.



11. Remove fuel sub-tube and fuel damper.

### INSTALLATION

1. Install fuel damper and fuel sub-tube.
  - When handling new O-rings, be careful of the following caution:
 

**CAUTION:**

    - Handle O-ring with bare hands. Do not wear gloves.



# FUEL INJECTOR AND FUEL TUBE

- Lubricate O-ring with new engine oil.
  - Do not 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 was stretched while it was being attached, do not insert it quickly into fuel tube.
  - Insert O-ring straight into fuel tube. Do not decenter or twist it.
- Insert fuel damper and fuel sub-tube straight into fuel tube.
  - Tighten mounting bolts evenly in turn.
  - After tightening mounting bolts, make sure that there is no gap between flange and fuel tube.
2. Install O-rings to fuel injector, paying attention to the following.

**CAUTION:**

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

Fuel tube side : Blue

Nozzle side : Brown

- Handle O-ring with bare hands. Do not wear gloves.
- Lubricate O-ring with new engine oil.
- Do not 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 was stretched while it was being attached, do not insert it quickly into fuel tube.
- Insert O-ring straight into fuel injector. Do not decenter or twist it.

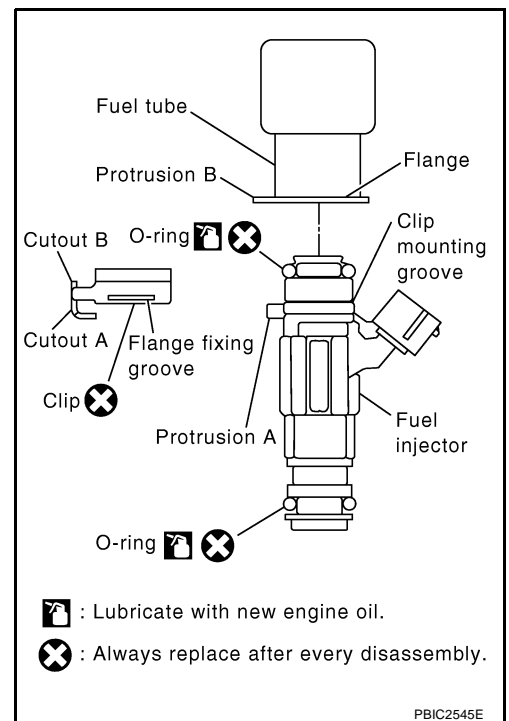
3. Install fuel injector to fuel tube as follows:

- a. Insert clip into clip mounting groove on fuel injector.
- Insert clip so that protrusion "A" of fuel injector matches cutout "A" of clip.

**CAUTION:**

- Do not reuse clip. Replace it with a new one.
- Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.

- b. Insert fuel injector into fuel tube with clip attached.
- Insert it while matching it to the axial center.
  - Insert fuel injector so that protrusion "B" of fuel tube matches cutout "B" of clip.
  - Make sure that fuel tube flange is securely fixed in flange fixing groove on clip.
- c. Make sure that installation is complete by checking that fuel injector does not rotate or come off.
- Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.





4. Install spacers on intake manifold.
5. Install fuel tube and fuel injector assembly to intake manifold.

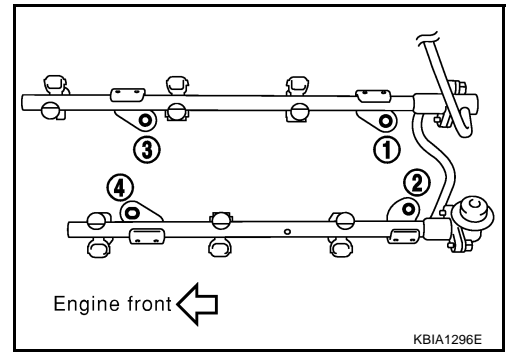
**CAUTION:**

Be careful not to let tip of injector nozzle come in contact with other parts.

## FUEL INJECTOR AND FUEL TUBE

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

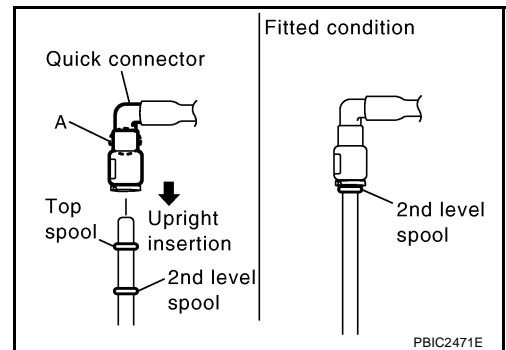
-  **1st step**  
: 9.3 - 10.8 N-m (0.95 - 1.1 kg-m, 6.9 - 7.9 ft-lb)
-  **2nd step**  
: 20.6 - 26.5 N-m (2.1 - 2.7 kg-m, 16 - 19 ft-lb)



6. Connect fuel injector harness connector.
7. Install intake manifold collectors (upper and lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
8. Install fuel sub-tube on rear end of intake manifold collector (lower).
9. Connect fuel feed hose (with damper).
  - Handling procedure of O-ring is the same as that of fuel damper and fuel sub-tube.
  - Insert fuel damper straight into fuel sub-tube.
  - Tighten mounting bolts evenly in turn.
  - After tightening mounting bolts, make sure that there is no gap between flange and fuel sub-tube.
10. Connect quick connector between fuel feed hose (with damper) and centralized under-floor piping connection as follows:
  - a. Make sure no foreign substances are deposited in and around centralized under-floor piping and quick connector, and no damage on them.
  - b. Thinly apply new engine oil around centralized under-floor piping from tip end to spool end.
  - c. Align center to insert quick connector straightly into centralized under-floor piping.
    - Insert quick connector to centralized under-floor piping until top spool is completely inside quick connector, and 2nd level spool exposes right below quick connector.

### CAUTION:

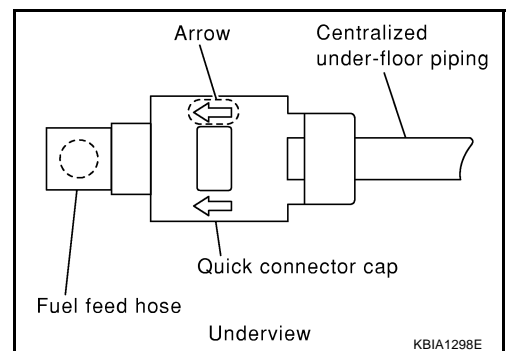
- Hold "A" position as shown in the figure when inserting centralized under-floor piping into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert until you hear a "click" sound and actually feel the engagement.
- To avoid misidentification of engagement with a similar sound, be sure to perform the next step.



- d. Pull quick connector by hand holding "A" position. Make sure it is completely engaged (connected) so that it does not come out from centralized under-floor piping.
- e. Install quick connector cap to quick connector connection.
  - Install quick connector cap with arrow on surface facing in direction of quick connector (fuel feed hose side).

### CAUTION:

If cap cannot be installed smoothly, quick connector may have not been installed correctly. Check connection again.



11. Install in the reverse order of removal after this step.

# FUEL INJECTOR AND FUEL TUBE

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## INSPECTION AFTER INSTALLATION

### Check on Fuel Leakage

1. Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.

**NOTE:**

Use mirrors for checking at points out of clear sight.

2. Start engine. With engine speed increased, check again for fuel leakage at connection points.

**CAUTION:**

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

A

EM

C

D

E

F

G

H

I

J

K

L

M

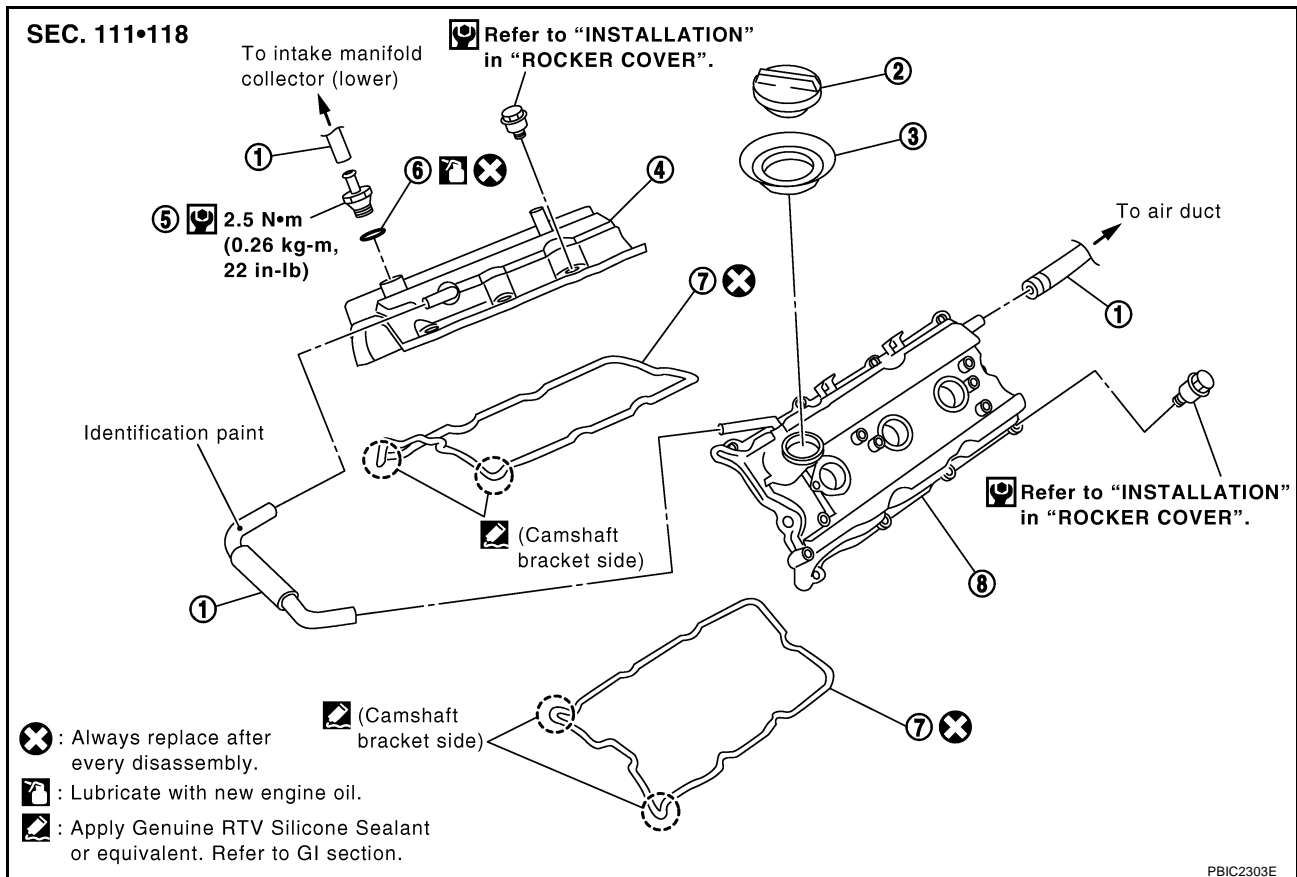
# ROCKER COVER

## ROCKER COVER

PFP:13264

### Removal and Installation

NBS0000P



- |                              |                             |                |
|------------------------------|-----------------------------|----------------|
| 1. PCV hose                  | 2. Oil filler cap           | 3. Oil catcher |
| 4. Rocker cover (right bank) | 5. PCV valve                | 6. O-ring      |
| 7. Rocker cover gasket       | 8. Rocker cover (left bank) |                |

### REMOVAL

1. Remove engine cover. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Release the fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
3. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-10, "Changing Engine Coolant"](#) and [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).

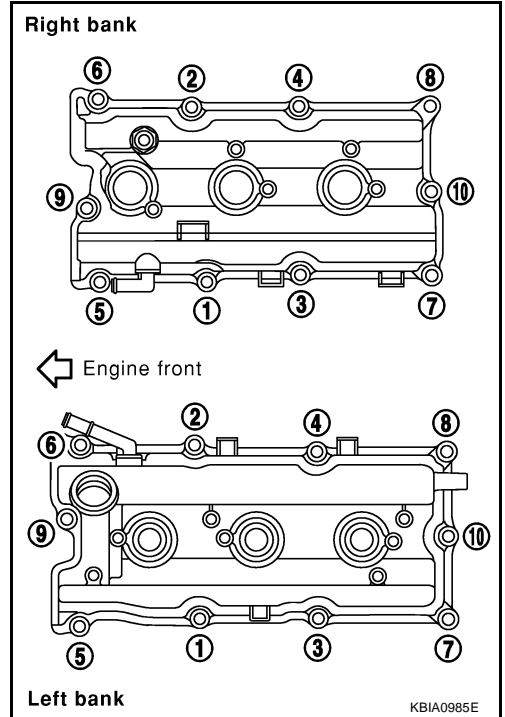
#### CAUTION:

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

4. Remove intake manifold collectors (upper and lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
5. Separate engine harness removing their brackets from rocker covers.
6. Remove ignition coil. Refer to [EM-35, "IGNITION COIL"](#).
7. Remove PCV hoses from rocker covers.
8. Remove PCV valve and O-ring from rocker cover (right bank), if necessary.
9. Remove oil filler cap from rocker cover (left bank), if necessary.

# ROCKER COVER

10. Loosen mounting bolts with power tool in reverse order as shown in the figure.



11. Remove rocker cover gaskets from rocker covers.  
 12. Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

**CAUTION:**

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

**INSTALLATION**

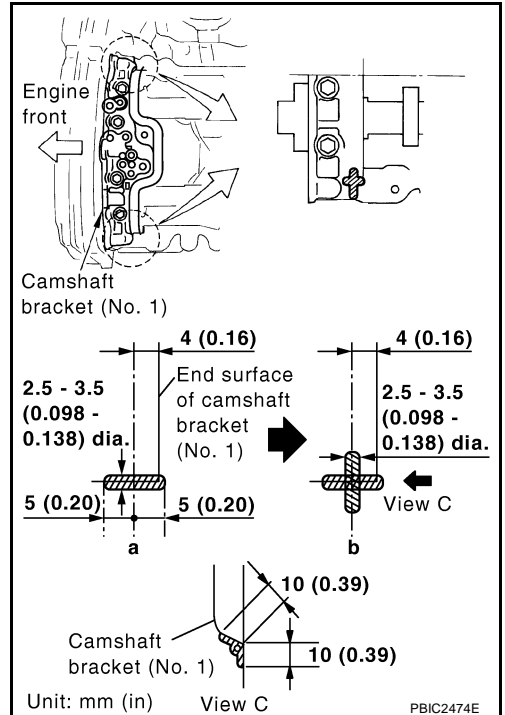
1. Apply liquid gasket with tube presser [SST: WS39930000 ( — )] to joint part among rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

**NOTE:**

The figure shows an example of left bank side [zoomed in shows camshaft bracket (No. 1)].


- a. Refer to the figure "a" to apply liquid gasket to joint part of camshaft bracket (No. 1) and cylinder head.  
 b. Refer to the figure "b" to apply liquid gasket to the figure "a" squarely.




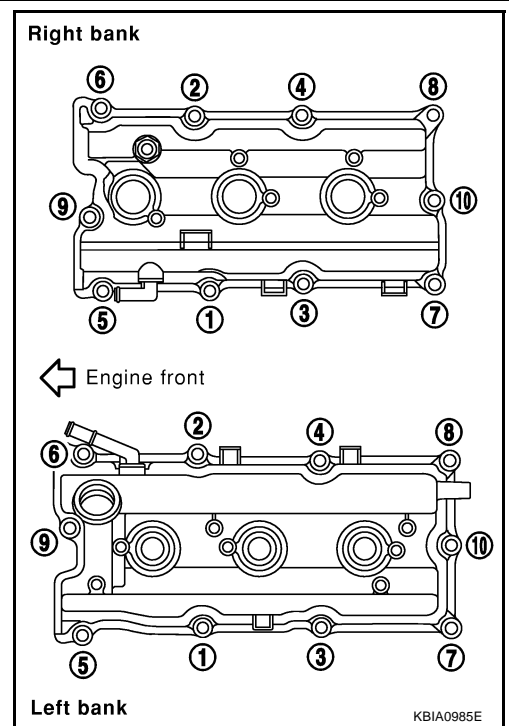
2. Install new rocker cover gasket to rocker cover.  
 3. Install rocker cover.  
 • Check if rocker cover gasket is not dropped from installation groove of rocker cover.

# ROCKER COVER

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

 **1st step**  
: 0.96 - 2.96 N·m (0.10 - 0.30 kg·m, 9 - 26 in·lb)

 **2nd step**  
: 7.33 - 9.33 N·m (0.75 - 0.95 kg·m, 65 - 82 in·lb)



5. Install oil filler cap to rocker cover (left bank), if removed.
6. Install new O-ring and PCV valve to rocker cover (right bank), if removed.
7. Install PCV hose.
- Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
  - When installing, be careful not to twist or come in contact with other parts.
  - Install PCV hose between right and left rocker covers with its identification paint facing upward (right rocker cover side). Refer to component figure in [EM-44, "Removal and Installation"](#).
8. Install in the reverse order of removal after this step.

# FRONT TIMING CHAIN CASE

## FRONT TIMING CHAIN CASE

PFP:13599

### Removal and Installation

NBS00000

#### NOTE:

- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in the reverse order of removal. Refer to [EM-59, "TIMING CHAIN"](#) .
- Refer to [EM-59, "TIMING CHAIN"](#) for component parts location.

#### REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove undercover with power tool.
3. Release the fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#) .
4. Disconnect the battery cable from the negative terminal.
5. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#) .

#### CAUTION:

- Perform this step when engine is cold.
- Do not spill engine oil on drive belts.

6. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#) .

#### CAUTION:

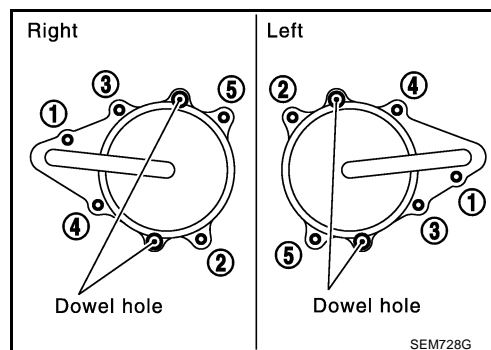
- Perform this step when engine is cold.
- Do not spill engine coolant on drive belts.

7. Remove radiator cooling fan assembly. Refer to [CO-22, "COOLING FAN"](#) .
8. Separate engine harnesses removing their brackets from front timing chain case.
9. Remove drive belts. Refer to [EM-14, "DRIVE BELTS"](#) .
10. Remove power steering oil pump from bracket with piping connected, and temporarily secure it to aside. Refer to [PS-29, "POWER STEERING OIL PUMP"](#) .
11. Remove power steering oil pump bracket. Refer to [PS-29, "POWER STEERING OIL PUMP"](#) .
12. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#) .
13. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
14. Remove right and left intake valve timing control covers. (A/T models)

- Loosen mounting bolts in reverse order as shown in the figure.
- Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

#### CAUTION:

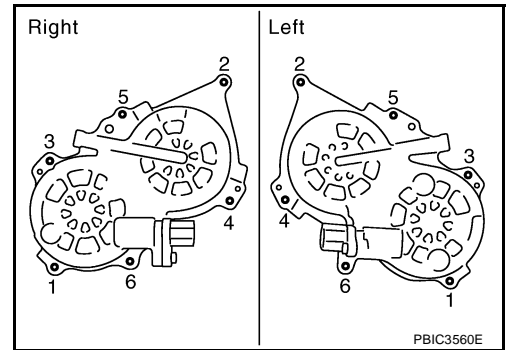
Shaft is internally jointed with camshaft sprocket (INT) center hole. When removing, keep it horizontal until it is completely disconnected.



15. Remove left and right valve timing control covers (including magnet retarder and cover) with the following procedure. (M/T models)

## FRONT TIMING CHAIN CASE

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

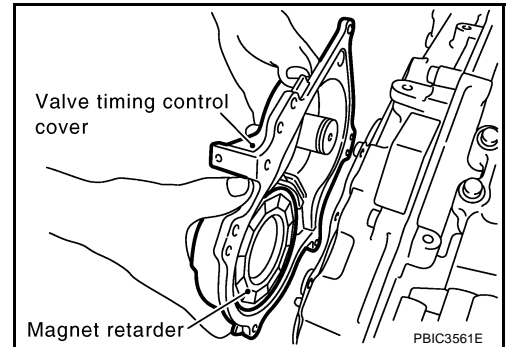


- b. Shaft is engaged with intake side camshaft sprocket center hole on inside. Pull straight out so as not to tilt until the joint is disengaged.

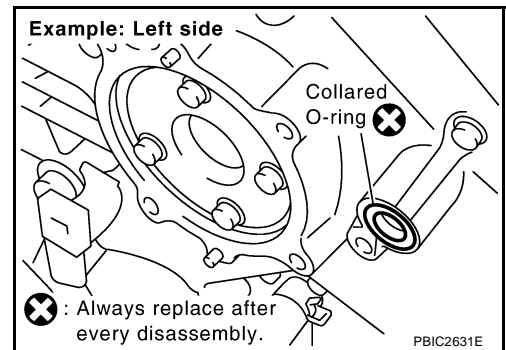
- The mating surface of magnet retarder may be fitted with the exhaust side camshaft sprocket via the engine oil. Open valve timing control cover carefully.
- If the mating surface of magnet retarder is fitted with the camshaft sprocket, open the cover within the range that the load is not applied to the harness. And then, remove it so as to prevent magnet retarder from dropping.

**CAUTION:**

- Be careful not to damage magnet retarder.
- When carrying valve timing control cover, face the magnet retarder side up to prevent the cover from falling from magnet retarder.
- Do not remove magnet retarder from valve timing control cover. (Disassembly prohibited parts)



16. Remove collared O-ring from front timing chain case (left and right side). (A/T models)



17. Remove rocker covers (right and left banks). Refer to [EM-44, "ROCKER COVER"](#) .

**NOTE:**

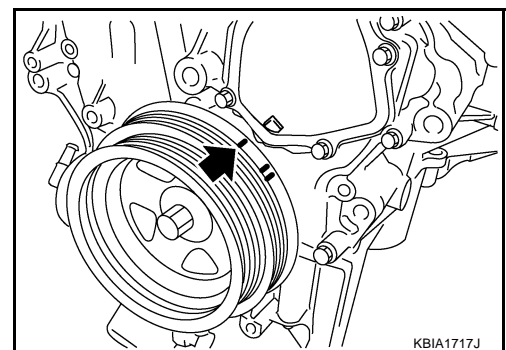
When only timing chain (primary) is removed, rocker cover does not need to be removed.

18. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

**NOTE:**

When timing chain is not removed/installed, this step is not required.

- a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



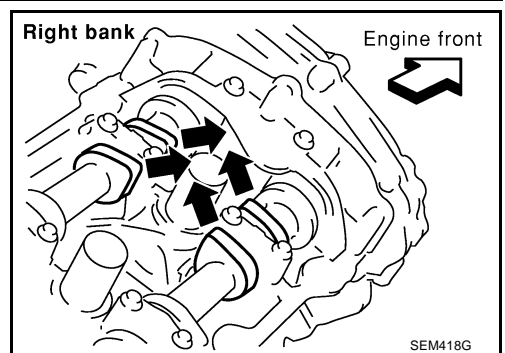


## FRONT TIMING CHAIN CASE

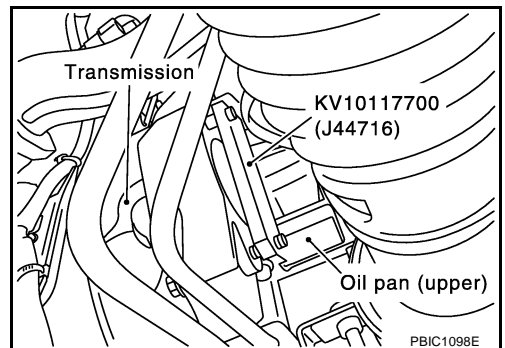
- b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.

**NOTE:**

When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to [EM-68, "INSTALLATION"](#) (A/T models) or [EM-88, "INSTALLATION"](#) (M/T models).



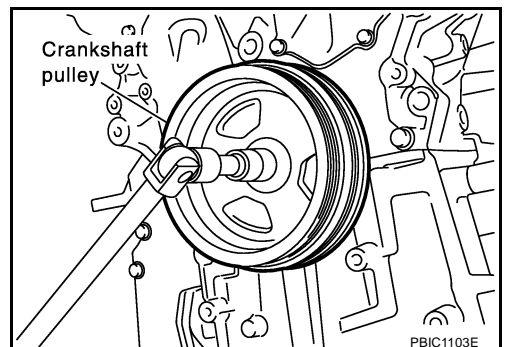
19. Remove crankshaft pulley as follows:
- a. Remove starter motor and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10, "STARTING SYSTEM"](#).



- b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

**CAUTION:**

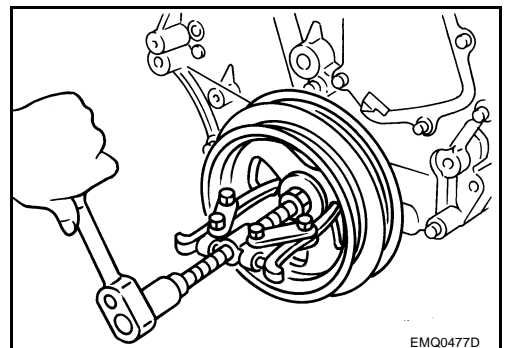
**Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.**



- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

**CAUTION:**

**Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.**

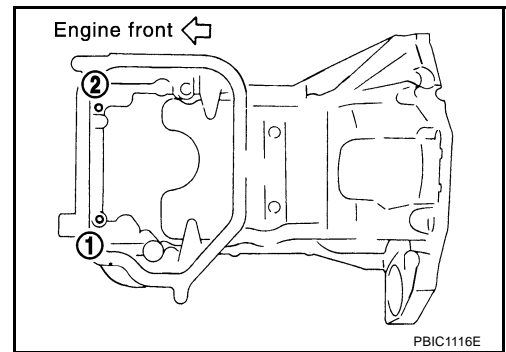


20. Remove oil pan (lower). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#).

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## FRONT TIMING CHAIN CASE

21. Loosen two mounting bolts in front of oil pan (upper) in reverse order as shown in the figure.

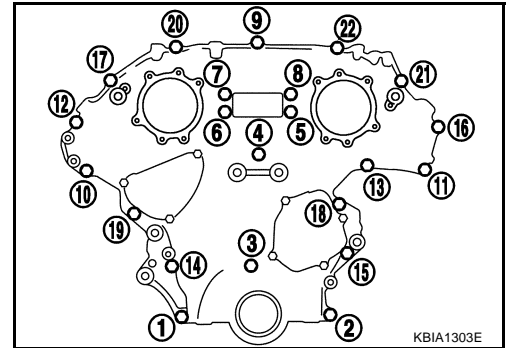


22. Remove front timing chain case as follows:

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

**NOTE:**

Figure shows A/T models.



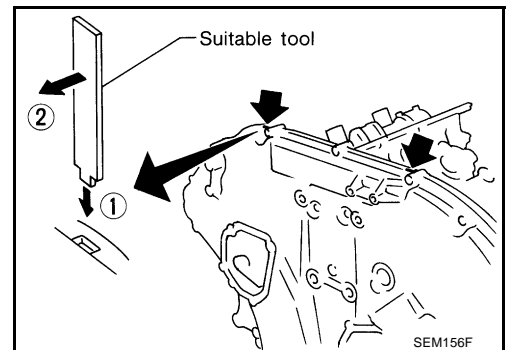
- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).

- c. Pry off case by moving tool as shown (2).

- Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

**CAUTION:**

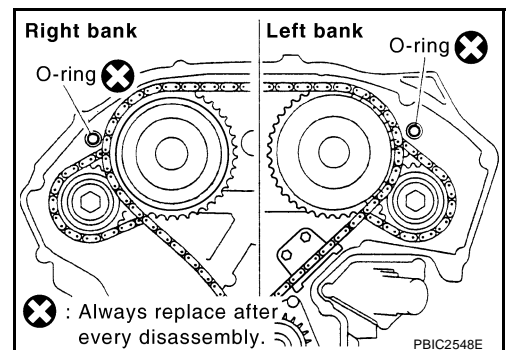
- Do not use screwdriver or something similar.
- After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.



23. Remove O-rings from rear timing chain case.

**NOTE:**

Figure shows A/T models.



24. Remove oil pan gasket. Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#) .

25. Remove water pump cover and chain tensioner cover from front timing chain case.

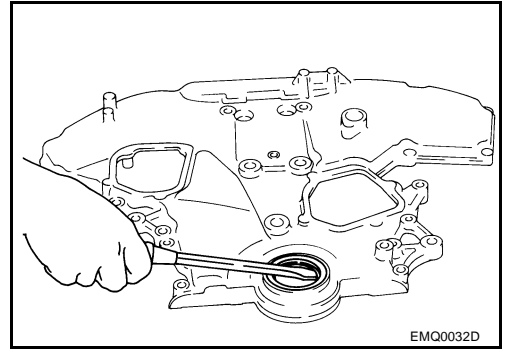
- Use seal cutter [SST: KV10111100 (J37228)] or equivalent tool to cut liquid gasket for removal.

# FRONT TIMING CHAIN CASE

26. Remove front oil seal from front timing chain case using suitable tool.
- Use screwdriver for removal.

**CAUTION:**

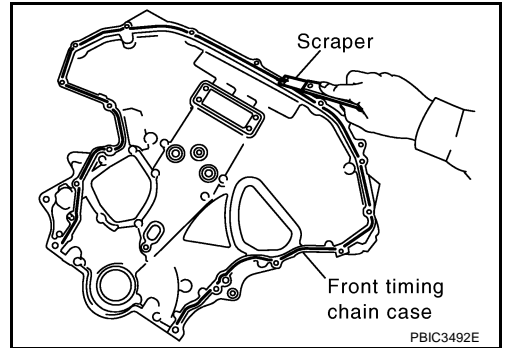
**Be careful not to damage front timing chain case.**



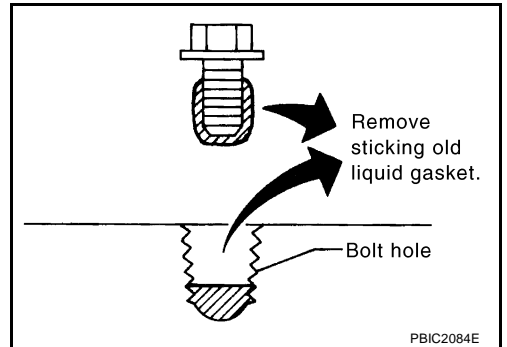
27. Remove timing chain and related parts. Refer to [EM-59, "TIMING CHAIN"](#).
28. Use scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

**CAUTION:**

**Be careful not to allow gasket fragments to enter oil pan.**

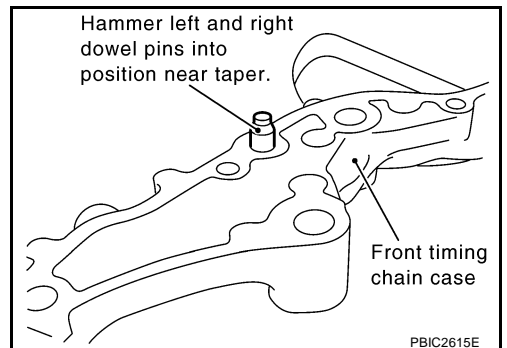


- Remove old liquid gasket from bolt hole and thread.



## INSTALLATION

1. Install timing chain and related parts. Refer to [EM-59, "TIMING CHAIN"](#).
2. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.



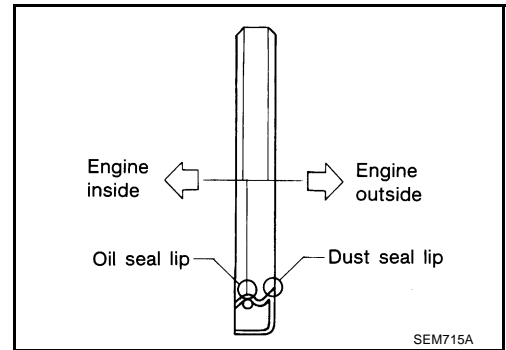
3. Install new front oil seal on the front timing chain case.
  - Apply new engine oil to both oil seal lip and dust seal lip.

## FRONT TIMING CHAIN CASE

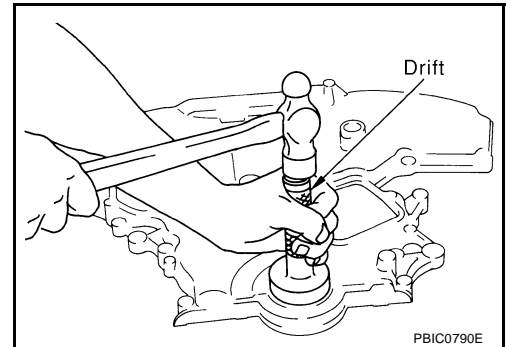
- Install it so that each seal lip is oriented as shown in the figure.

**CAUTION:**

**Be careful not to scratch or make burrs on circumference of oil seal.**



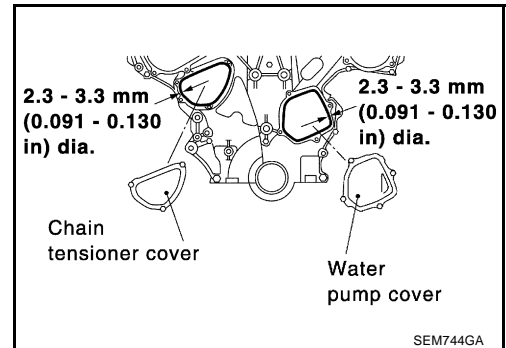
- Using suitable drift [outer diameter: 60 mm (2.36 in)], press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



4. Install water pump cover and chain tensioner cover to front timing chain case.

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to front timing chain case as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



5. Install front timing chain case as follows:

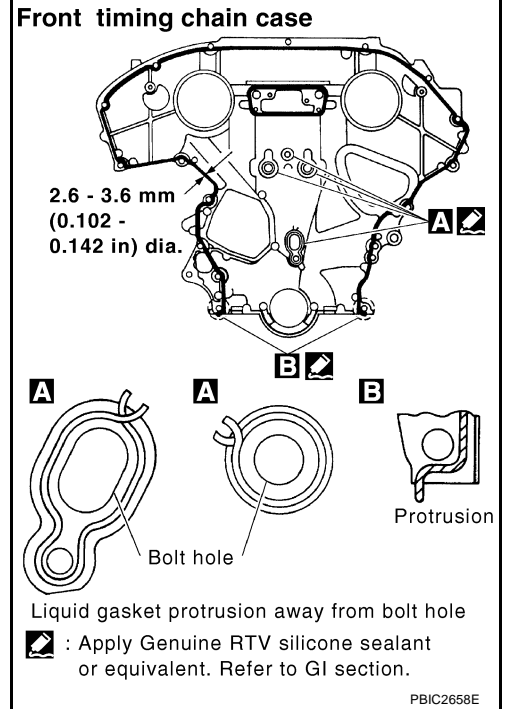
# FRONT TIMING CHAIN CASE

- a. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to front timing chain case back side as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

**NOTE:**

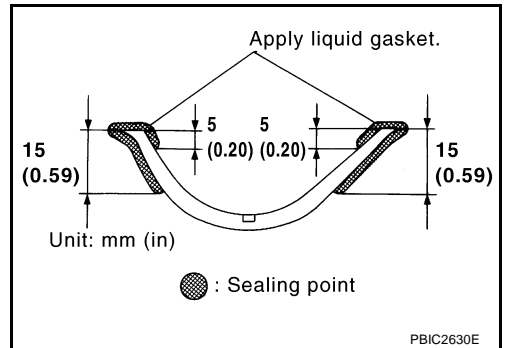
Figure shows A/T models.



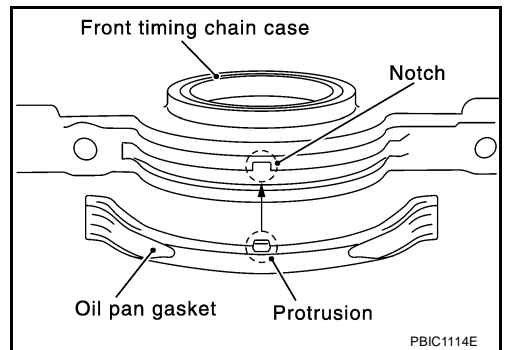
- b. Install new oil pan gasket.

- Apply liquid gasket to oil pan gasket as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**



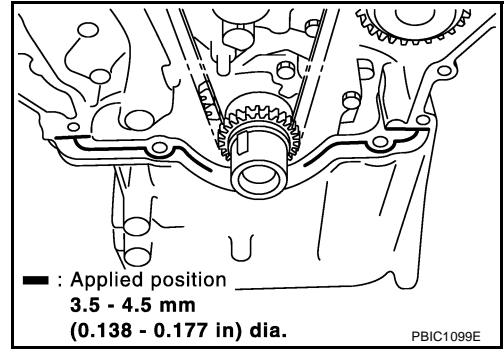
- Align notch of front timing chain case with protrusion of oil pan gasket.



## FRONT TIMING CHAIN CASE

- Apply liquid gasket with tube presser [SST: WS39930000 ( — )] to top surface of oil pan (upper) as shown in the figure.

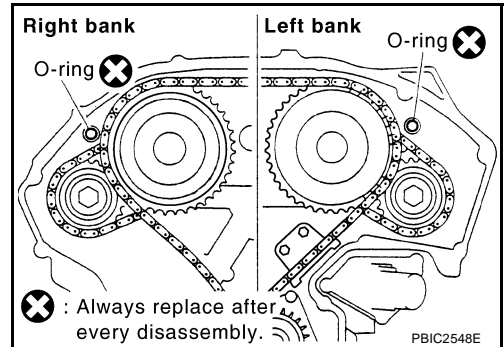
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



- c. Install new O-rings on rear timing chain case.

**NOTE:**

Figure shows A/T models.

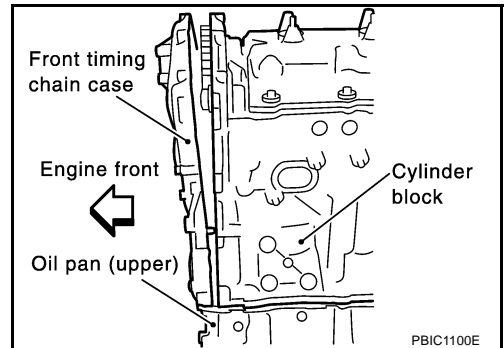


- d. Assemble front timing chain case as follows:

- i. Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.

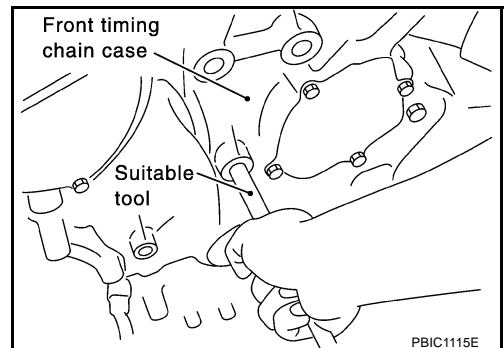
**CAUTION:**

**Be careful that oil pan gasket is in place.**



- ii. Since front timing chain case is offset for difference of bolt holes, tight bolts temporarily with holding front timing chain case from front and top as shown in the figure.


- iii. Same as the step ii, insert dowel pin with holding front timing chain case from front and top completely.




# FRONT TIMING CHAIN CASE

- e. Tighten mounting bolts to the specified torque in numerical order as shown in the figure.
- There are two types of mounting bolts. Refer to the following for locating bolts.

**M8 bolts** : 1, 2

: 25.5 - 31.3 N·m (2.6 - 3.2 kg·m, 19 - 23 ft·lb)


**M6 bolts** : Except the above

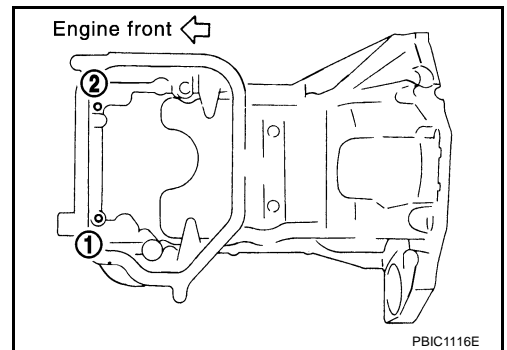
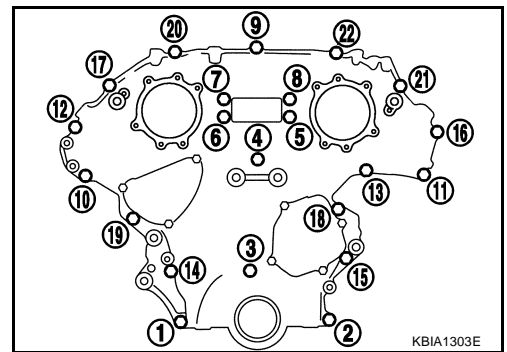
: 11.7 - 13.7 N·m (1.2 - 1.4 kg·m, 9 - 10 ft·lb)

**NOTE:**

Figure shows A/T models.

- f. After all bolts tightened, retighten them to the specified torque in numerical order as shown in the figure.
6. Install two mounting bolts in front of oil pan (upper) in numerical order as shown in the figure.

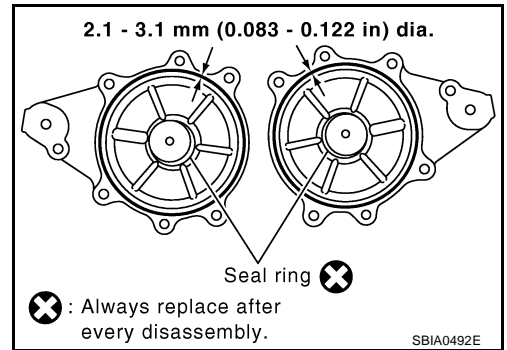
: 15.7 - 18.6 N·m (1.6 - 1.9 kg·m, 12 - 13 ft·lb)



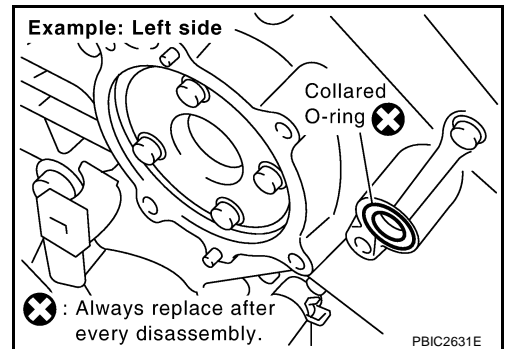
7. Install oil pan (lower). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#) .
8. Install right and left intake valve timing control covers as follows. (A/T models)
- a. Install new seal rings in shaft grooves.

- b. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to intake valve timing control covers as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



- c. Install new collared O-rings in front timing chain case oil hole (left and right sides).

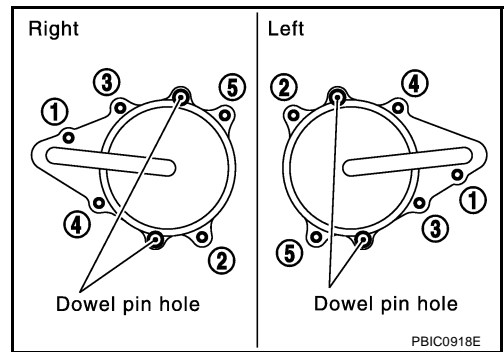


- d. Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.

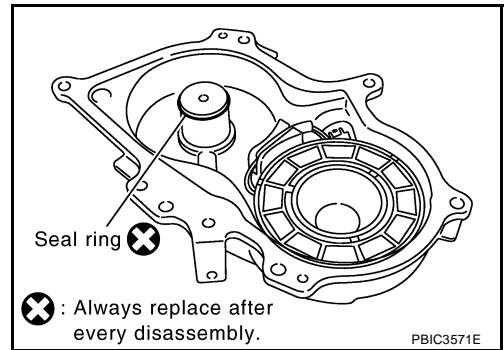
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## FRONT TIMING CHAIN CASE

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



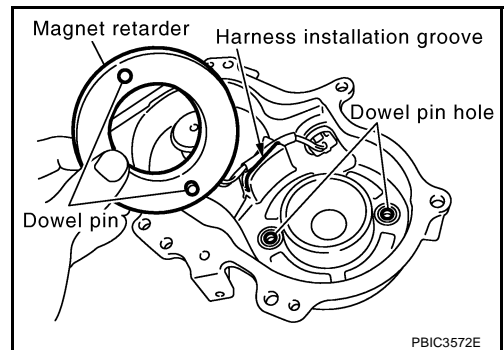
9. Install right and left valve timing control covers as follows. (M/T models)  
 a. Install new seal rings in shaft grooves.



- b. Install magnet retarder aligning the dowel pins of the back with the cover side dowel pin holes securely. Simultaneously insert the harness into the installation groove securely.

**NOTE:**

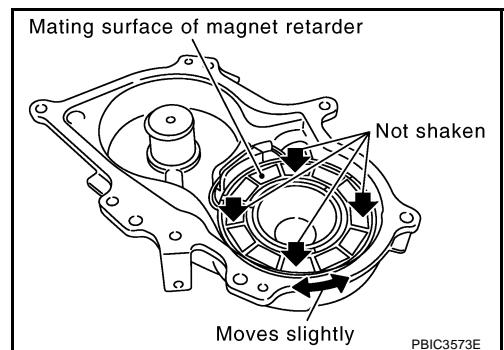
Figure shows the structure of the parts. Therefore, magnet retarder is being removed from the cover in this figure. But, if magnet retarder is in the correct position, omit step “b” and perform step “c”.



- c. To check the joint between dowel pins and dowel pin holes, check the looseness in the axle direction by pushing the mating surface of magnet retarder at several places and the circumferential looseness (between dowel pins and dowel pin holes) by twisting in the circumferential direction.

**CAUTION:**

**Always perform this procedure when removing because the gap between dowel pins and dowel pin holes may not be caused on purpose.**



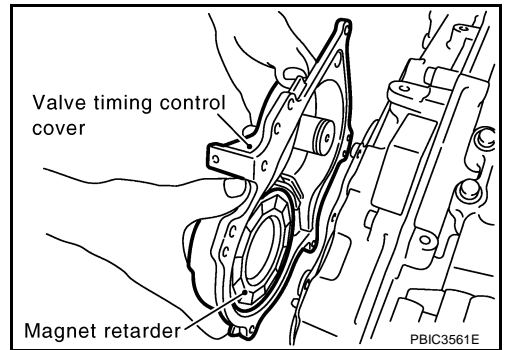


# FRONT TIMING CHAIN CASE

d. Install valve timing control cover to front timing chain case.

**CAUTION:**

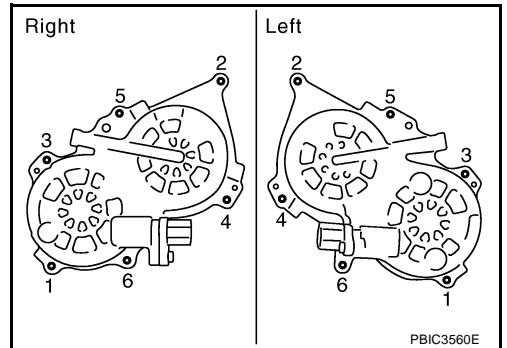
- Do not face the magnet retarder side down to prevent magnet retarder from dropping.
- Check the mating surface of magnet retarder and the drum of exhaust side camshaft sprocket for foreign materials.
- Align the center of both shaft holes of the shaft and the intake side camshaft sprocket, and then insert them.
- Be careful not to drop the seal ring from the shaft groove.
- When setting the valve timing control cover in position by hand, if valve timing control cover is not contacting with the front timing chain case, the dowel pin of magnet retarder may not be aligned with the dowel pin holes of cover. In this case, return to step "b".



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

**CAUTION:**

Completely tighten the mounting bolts with the seat surface of valve timing control cover contacting with front timing chain case.

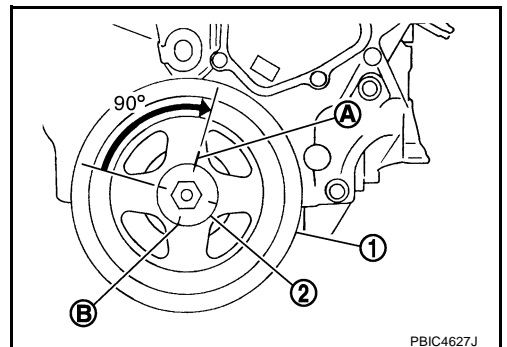


10. Install crankshaft pulley as follows:

- Fix crankshaft using ring gear stopper [SST: KV10117700 (J44716)].
- Install crankshaft pulley, taking care not to damage front oil seal.
  - When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).
- Tighten crankshaft pulley bolt.

: 44.1 N·m (4.5 kg-m, 33 ft-lb)

d. Place a paint mark (A) on crankshaft pulley (1) aligning with the angle mark (B) on crankshaft pulley bolt (2). Tighten the bolt 90 degrees (angle tightening).



- Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
- Install in the reverse order of removal after this step.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-12, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Run engine to check for unusual noise and vibration.

## FRONT TIMING CHAIN CASE

---

**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 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

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

# TIMING CHAIN

PFP:13028

A

## TIMING CHAIN

### Removal and Installation (A/T Models)

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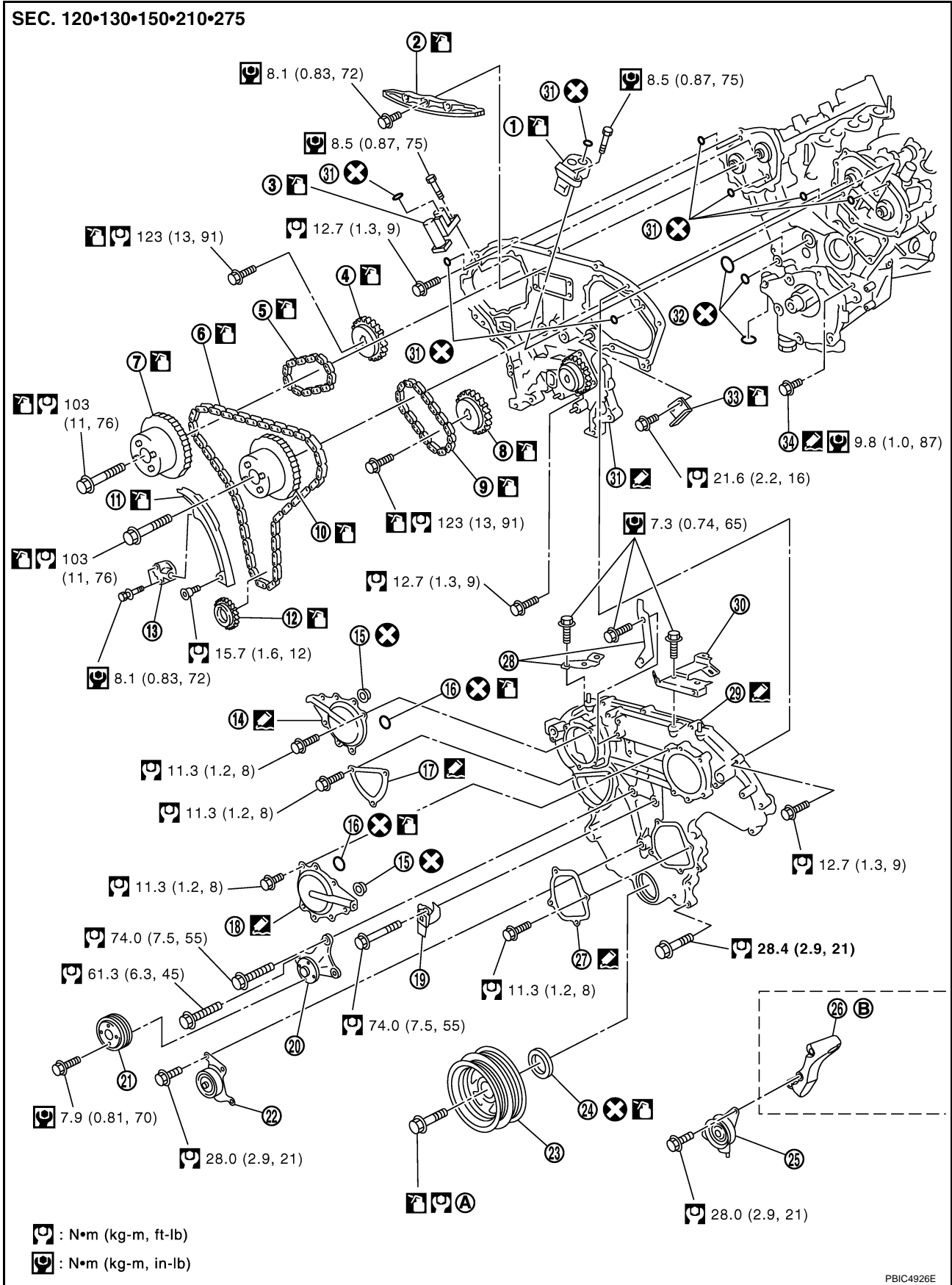
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# TIMING CHAIN

- 
- |                                       |                                       |                                       |
|---------------------------------------|---------------------------------------|---------------------------------------|
| 1. Timing chain tensioner (secondary) | 2. Internal chain guide               | 3. Timing chain tensioner (secondary) |
| 4. Camshaft sprocket (EXH)            | 5. Timing chain (secondary)           | 6. Timing chain (primary)             |
| 7. Camshaft sprocket (INT)            | 8. Camshaft sprocket (EXH)            | 9. Timing chain (secondary)           |
| 10. Camshaft sprocket (INT)           | 11. Slack guide                       | 12. Crankshaft sprocket               |
| 13. Timing chain tensioner (primary)  | 14. Intake valve timing control cover | 15. Collared O-ring                   |
| 16. Seal ring                         | 17. Chain tensioner cover             | 18. Intake valve timing control cover |
| 19. Water hose clamp                  | 20. Idler pulley bracket              | 21. Idler pulley                      |
| 22. Idler pulley                      | 23. Crankshaft pulley                 | 24. Front oil seal                    |
| 25. Idler pulley                      | 26. A/C compressor bracket            | 27. Water pump cover                  |
| 28. Bracket                           | 29. Front timing chain case           | 30. Bracket                           |
| 31. Rear timing chain case            | 32. O-ring                            | 33. Tension guide                     |
| 34. Water drain plug (front)          |                                       |                                       |
- A. Refer to [EM-68](#)                      B. Refer to [ATC-128](#)

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## NOTE:

- This section describes procedures for removing/installing front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.
- To remove/install front timing chain case, timing chain, and its related parts without removing oil pan (upper), refer to [EM-47, "FRONT TIMING CHAIN CASE"](#).

## REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air cleaner case assembly. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#).
3. Remove undercover with power tool.
4. Release the fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
5. Disconnect the battery cable from the negative terminal.
6. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#).

### CAUTION:

- Perform this step when engine is cold.
- Do not spill engine coolant on drive belts.

7. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#).

### CAUTION:

- Perform this step when engine is cold.
- Do not spill engine oil on drive belts.

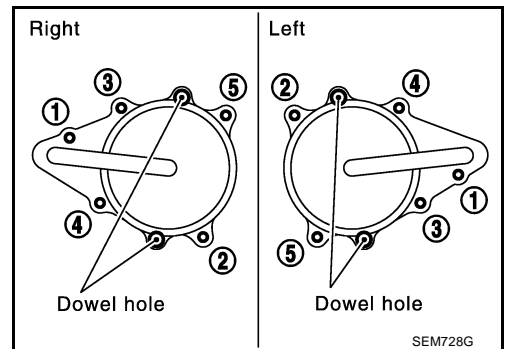
8. Separate engine harnesses removing their brackets from front timing chain case.
9. Remove intake manifold collectors (upper and lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
10. Remove radiator cooling fan assembly. Refer to [CO-22, "COOLING FAN"](#).
11. Remove drive belts. Refer to [EM-14, "DRIVE BELTS"](#).
12. Remove A/C compressor from bracket with piping connected, and temporarily secure it aside. Refer to [ATC-128, "Components"](#).
13. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
14. Remove power steering oil pump bracket. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
15. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#).
16. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
17. Remove right and left intake valve timing control covers.

## TIMING CHAIN

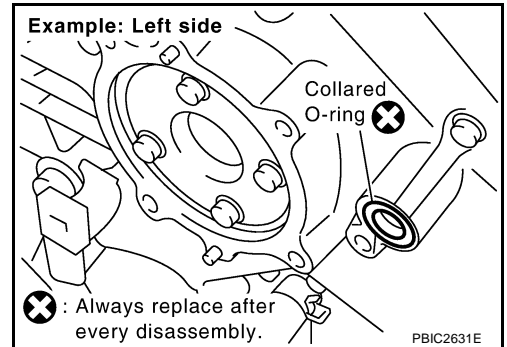
- Loosen mounting bolts in reverse order as shown in the figure.
- Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

### CAUTION:

Shaft is internally jointed with camshaft sprocket (INT) center hole. When removing, keep it horizontal until it is completely disconnected.



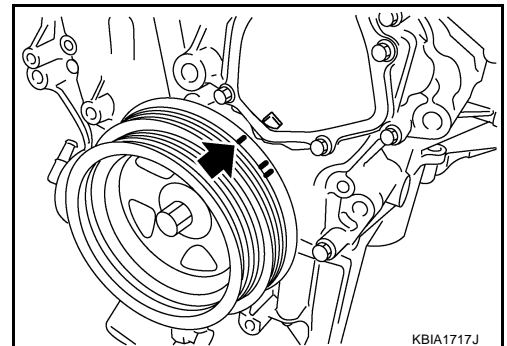
18. Remove collared O-ring from front timing chain case (left and right side).



19. Remove rocker covers (right and left banks). Refer to [EM-44, "ROCKER COVER"](#) .

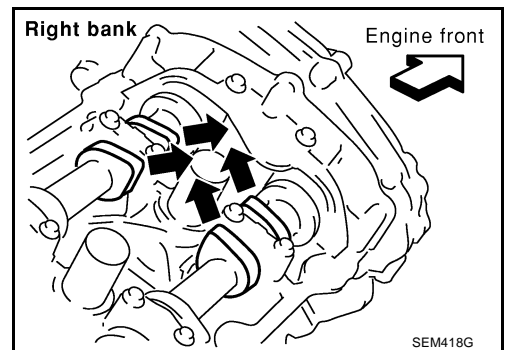
20. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

- a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



- b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.

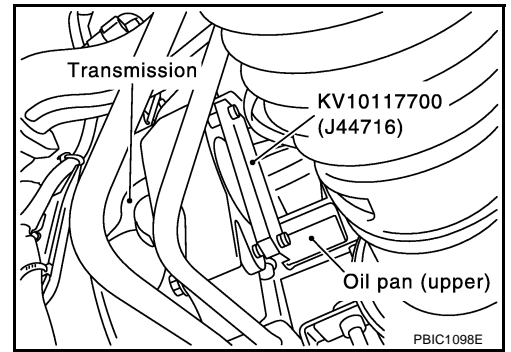
- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.



21. Remove crankshaft pulley as follows:

# TIMING CHAIN

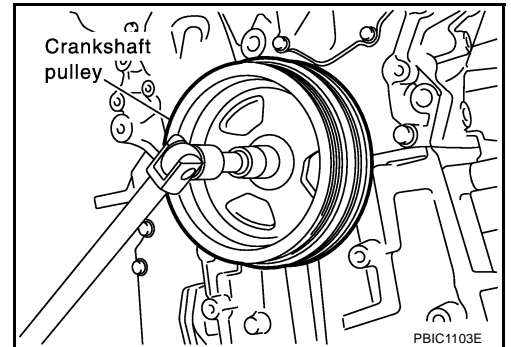
- a. Remove starter motor and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10, "STARTING SYSTEM"](#).



- b. Loosen crankshaft pulley bolt and rotate bolt seating surface at 10 mm (0.39 in) from its original position.

**CAUTION:**

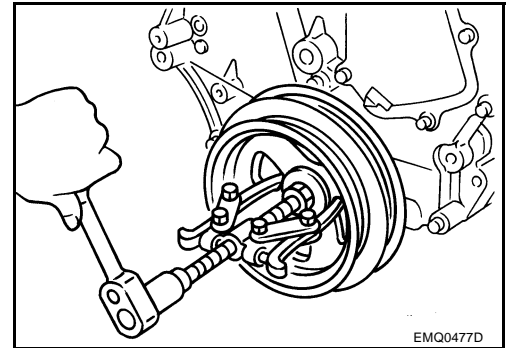
**Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.**



- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

**CAUTION:**

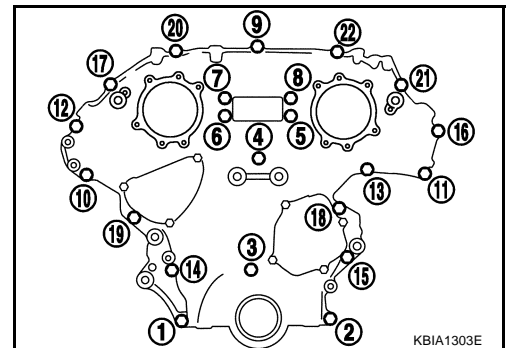
**Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.**



22. Remove oil pans (upper and lower). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#).

23. Remove front timing chain case as follows:

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

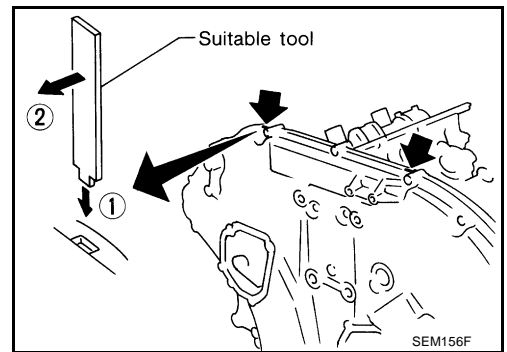


# TIMING CHAIN

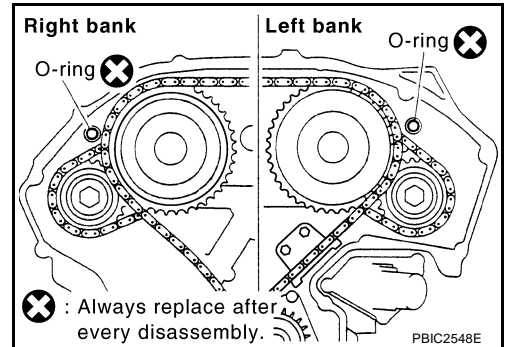
- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).
- c. Pry off case by moving the tool as shown (2).
  - Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

**CAUTION:**

- Do not use screwdriver or something similar.
- After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.



24. Remove O-rings from rear timing chain case.



25. Remove water pump cover and chain tensioner cover from front timing chain case.

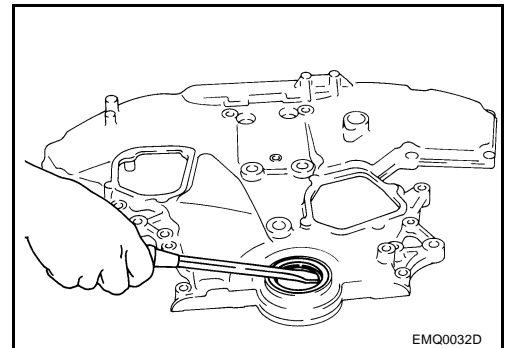
- Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

26. Remove front oil seal from front timing chain case using suitable tool.

- Use screwdriver for removal.

**CAUTION:**

**Be careful not to damage front timing chain case.**



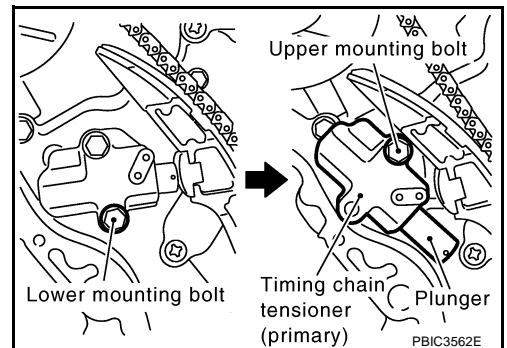
27. Remove timing chain tensioner (primary) as follows:

- a. Remove lower mounting bolt.
- b. Loosen upper mounting bolt slowly, and then turn timing chain tensioner (primary) on the mounting bolt so that plunger is fully expanded.

**NOTE:**

Even if plunger is fully expanded, it is not dropped from the body of timing chain tensioner (primary).

- c. Remove upper mounting bolt, and then remove timing chain tensioner (primary).



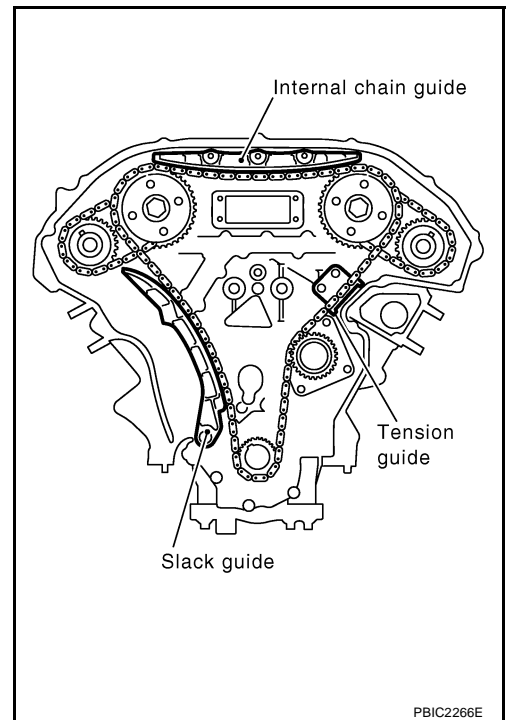
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## TIMING CHAIN

28. Remove internal chain guide, tension guide and slack guide.

**NOTE:**

Tension guide can be removed after removing timing chain (primary).



29. Remove timing chain (primary) and crankshaft sprocket.

**CAUTION:**

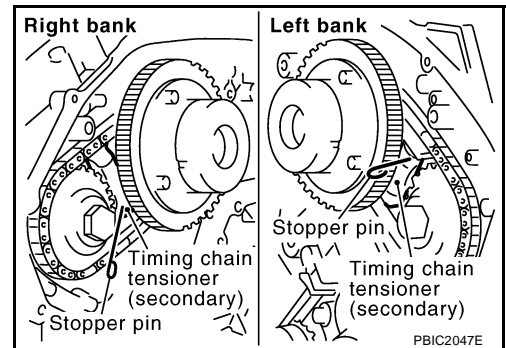
After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.

30. Remove timing chain (secondary) and camshaft sprockets as follows:

- a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).

**NOTE:**

- Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.
- For removal of timing chain tensioner (secondary), refer to [EM-100, "CAMSHAFT"](#). [Removing camshaft bracket (No. 1) is required.]

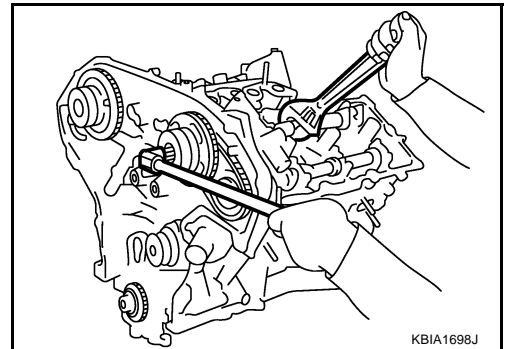


- b. Remove intake and exhaust camshaft sprocket bolts.

- Secure the hexagonal portion of camshaft using wrench to loosen mounting bolts.

**CAUTION:**

Do not loosen mounting bolts with securing anything other than the camshaft hexagonal portion or with tensioning the timing chain.



- c. Remove timing chain (secondary) together with camshaft sprockets.

- Turn camshaft slightly to secure slackness of timing chain on timing chain tensioner (secondary) side.



# TIMING CHAIN

- Insert 0.5 mm (0.020 in)-thick metal or resin plate between timing chain and timing chain tensioner plunger (guide). Remove timing chain (secondary) together with camshaft sprockets with timing chain loose from guide groove.

**CAUTION:**

**Be careful of plunger coming-off when removing timing chain (secondary). This is because plunger of timing chain tensioner (secondary) moves during operation, leading to coming-off of fixed stopper pin.**

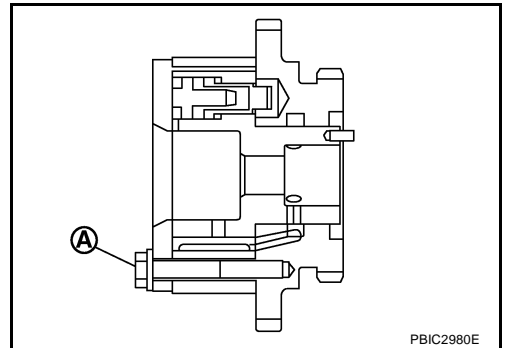
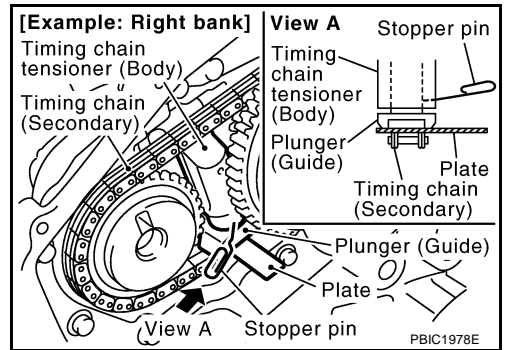
**NOTE:**

Camshaft sprocket (INT) is two-for-one structure of primary and secondary sprockets.

- When handling camshaft sprocket (INT), be careful of the following caution:

**CAUTION:**

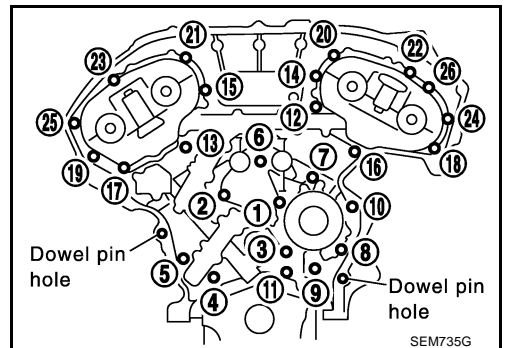
- Handle carefully to avoid any shock to camshaft sprocket.
- Do not disassemble. (Do not loosen bolts "A" as shown in the figure.)



31. Remove water pump. Refer to [CO-24. "WATER PUMP"](#) .

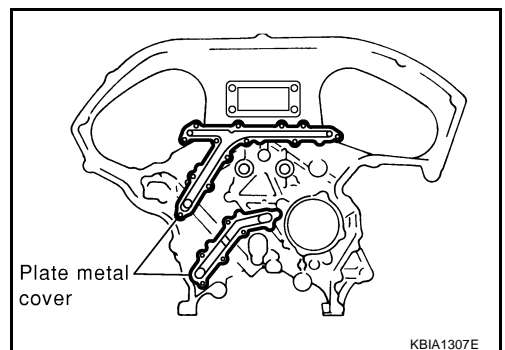
32. Remove rear timing chain case as follows:

- Loosen and remove mounting bolts in reverse order as shown in the figure.
- Cut liquid gasket using seal cutter [SST: KV10111100 (J37228)] and remove rear timing chain case.



**CAUTION:**

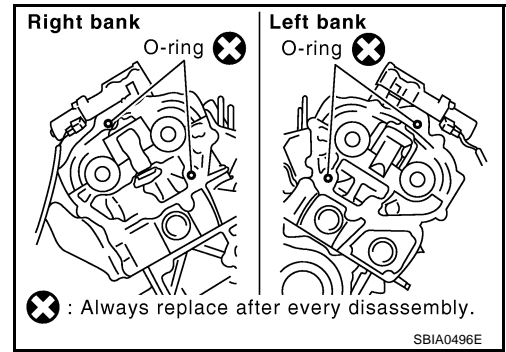
- Do not remove plate metal cover of oil passage.
- After removal, handle rear timing chain case carefully so it does not tilt, cant, or warp under a load.



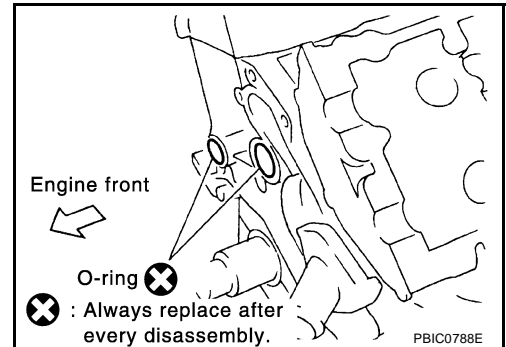
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# TIMING CHAIN

33. Remove O-rings from cylinder head.



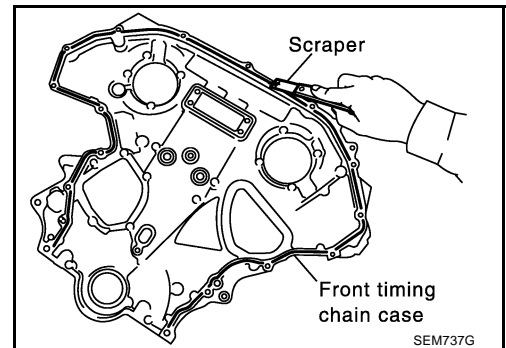
34. Remove O-rings from cylinder block.



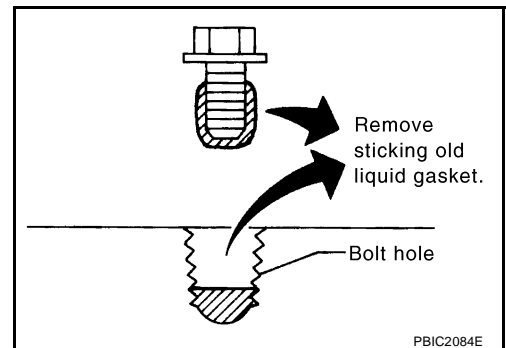
35. Remove timing chain tensioners (secondary) from cylinder head as follows, if necessary.

- a. Remove camshaft brackets (No. 1). Refer to [EM-101, "REMOVAL"](#).
- b. Remove timing chain tensioners (secondary) with stopper pin attached.

36. Use scraper to remove all traces of old liquid gasket from front and rear timing chain cases, and opposite mating surfaces.

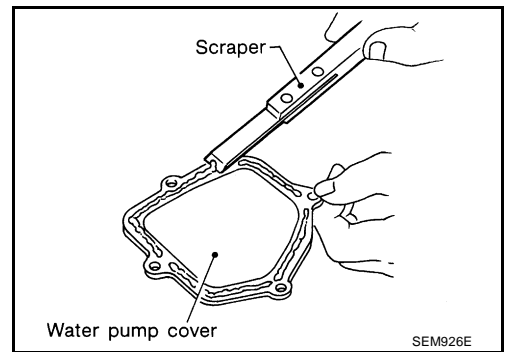


- Remove old liquid gasket from bolt hole and thread.



# TIMING CHAIN

37. Use scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.



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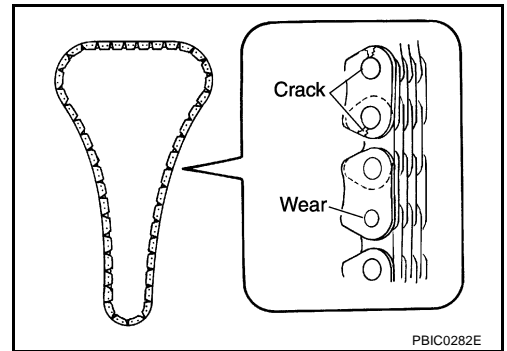
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## INSPECTION AFTER REMOVAL

### Timing Chain

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



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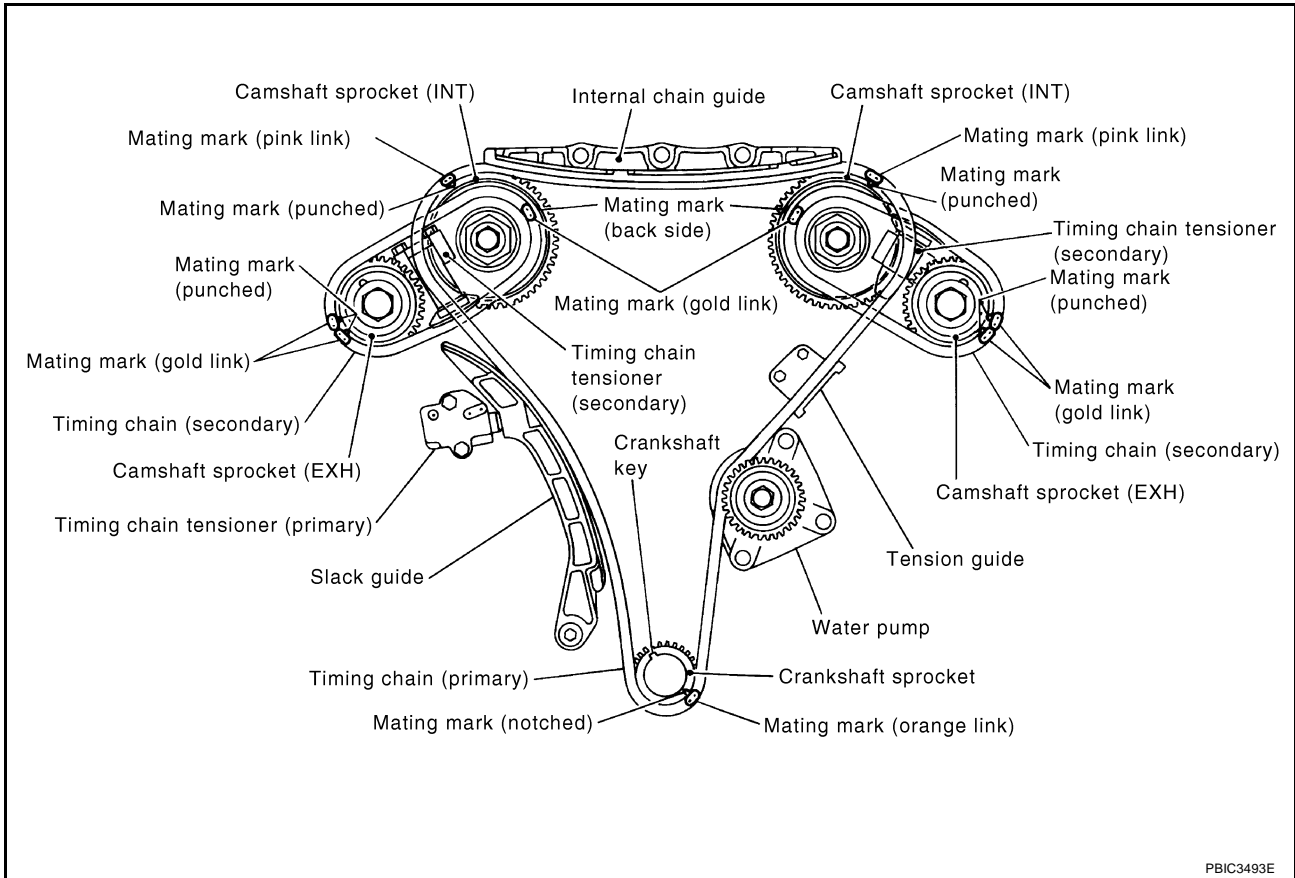
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# TIMING CHAIN

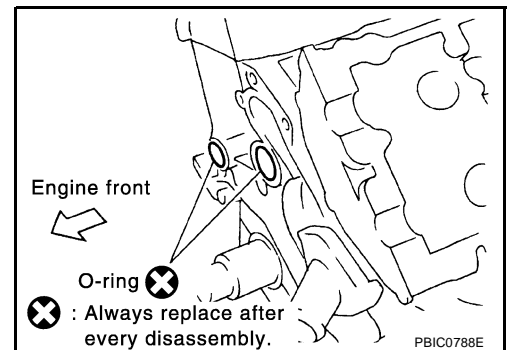
## INSTALLATION

### NOTE:

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

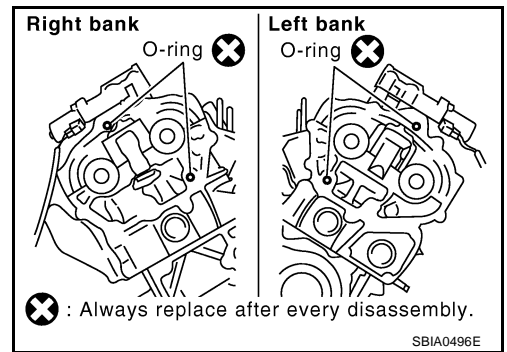


1. Install timing chain tensioners (secondary) to cylinder head as follows if removed. Refer to [EM-105, "INSTALLATION"](#).
  - a. Install timing chain tensioners (secondary) with stopper pin attached and new O-ring.
  - b. Install camshaft brackets (No. 1). Refer to [EM-105, "INSTALLATION"](#).
2. Install rear timing chain case as follows:
  - a. Install new O-rings onto cylinder block.



## TIMING CHAIN

- b. Install new O-rings to cylinder head.



- c. Apply liquid gasket with tube presser [SST: WS39930000 ( — )] to rear timing chain case back side as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**

**CAUTION:**

- For "A" in the figure, completely wipe out liquid gasket extended on a portion touching at engine coolant.

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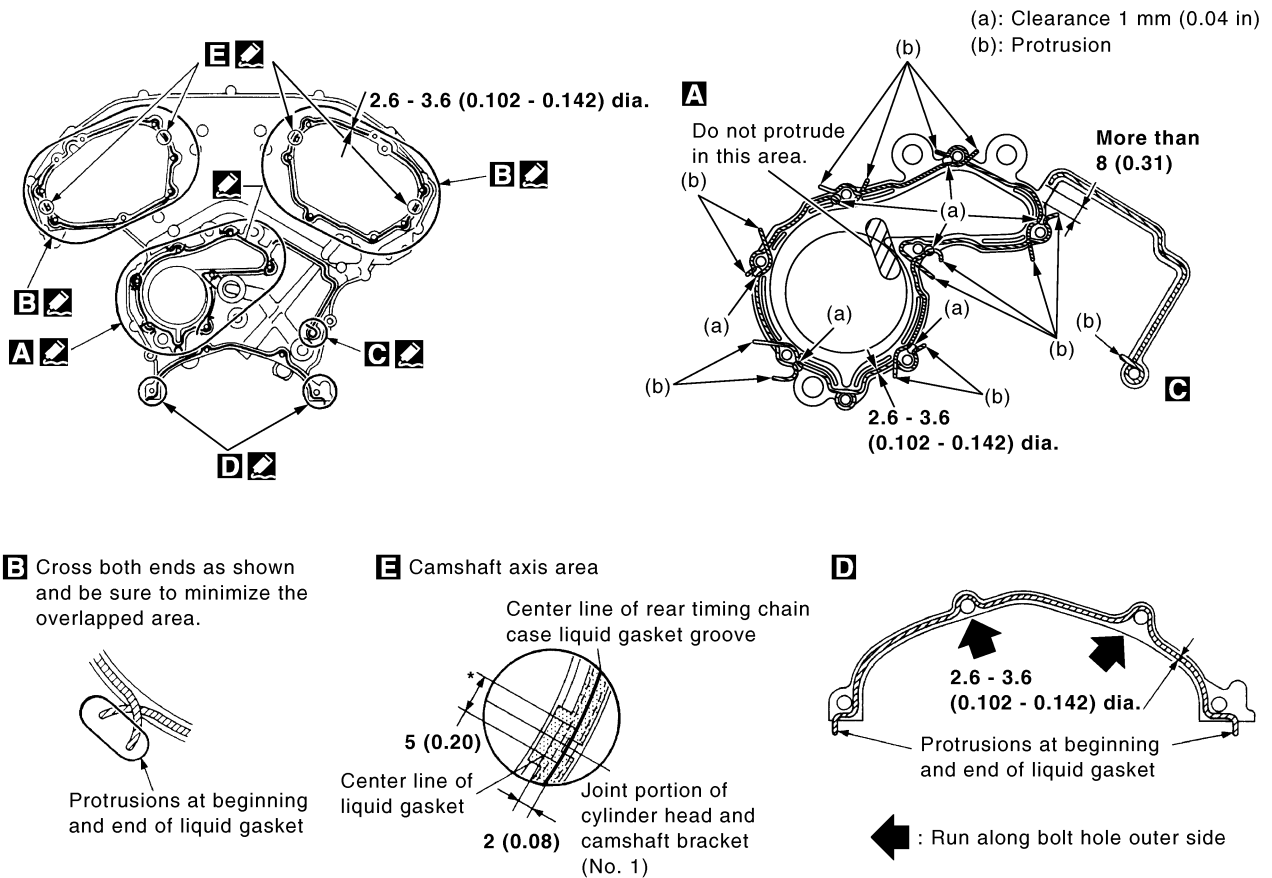
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# TIMING CHAIN

- Apply liquid gasket on installation position of water pump and cylinder head very completely.

## Rear timing chain case: Back side



\*: Apply liquid gasket to the chamfered surface between camshaft bracket (No. 1) and cylinder head.

☒ : Apply Genuine RTV Silicone Sealant or equivalent. Refer to GI section.

Unit: mm (in)

PBIC2659E

- Align rear timing chain case and water pump assembly with dowel pins (right and left) on cylinder block and install rear timing chain case.
  - Make sure O-rings stay in place during installation to cylinder block and cylinder head.
- Tighten mounting bolts in numerical order as shown in the figure.
  - There are two types of mounting bolts. Refer to the following for locating bolts.

### Bolt length:

20 mm (0.79 in)

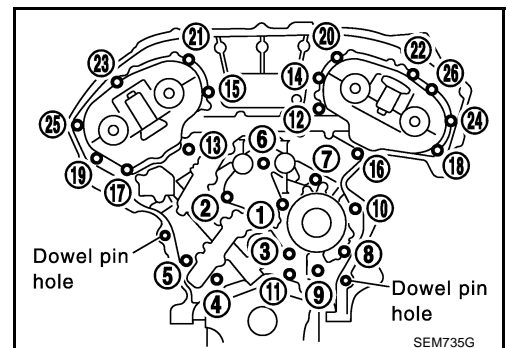
16 mm (0.63 in)

### Bolt position

: 1, 2, 3, 6, 7, 8, 9, 10

: Except the above

☒ : 11.7 - 13.7 N·m (1.2 - 1.4 kg·m, 9 - 10 ft·lb)



# TIMING CHAIN

- f. After all bolts are tightened, retighten them to the specified in numerical order shown in the figure.
- If liquid gasket protrudes, wipe it off immediately.

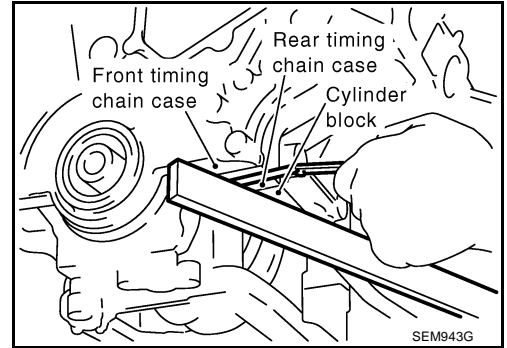
- g. After installing rear timing chain case, check the surface height difference between following parts on oil pan (upper) mounting surface.

## Standard

### Rear timing chain case to cylinder block:

**-0.24 to 0.14 mm (-0.0094 to 0.0055 in)**

- If not within standard, repeat the installation procedure.



3. Install water pump with new O-rings. Refer to [CO-24, "WATER PUMP"](#).
4. Make sure that dowel pin hole, dowel pin and crankshaft key are located as shown in the figure. (No. 1 cylinder at compression TDC)

### NOTE:

Though camshaft does not stop at the position 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.

### Camshaft dowel pin hole (intake side)

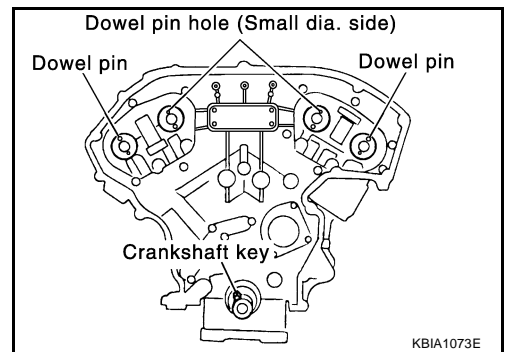
: At cylinder head upper face side in each bank.

### Camshaft dowel pin (exhaust side)

: At cylinder head upper face side in each bank.

### Crankshaft key

: At cylinder head side of right bank.



### CAUTION:

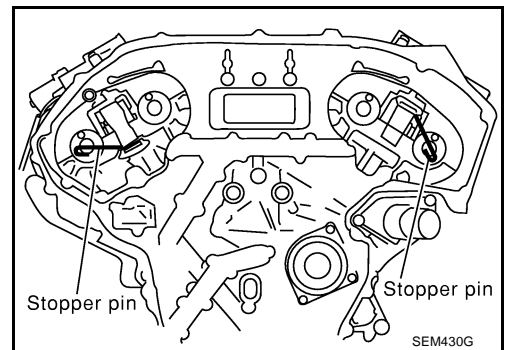
Hole on small dia. side must be used for intake side dowel pin hole. Do not misidentify (ignore big dia. side).

5. Install timing chains (secondary) and camshaft sprockets as follows:

### CAUTION:

Mating marks between timing chain and sprockets slip easily. Confirm all mating mark positions repeatedly during the installation process.

- a. Push plunger of timing chain tensioner (secondary) and keep it pressed in with stopper pin.



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## TIMING CHAIN

b. Install timing chains (secondary) and camshaft sprockets.

- Align the mating marks on timing chain (secondary) (gold link) with the ones on intake and exhaust camshaft sprockets (punched), and install them.

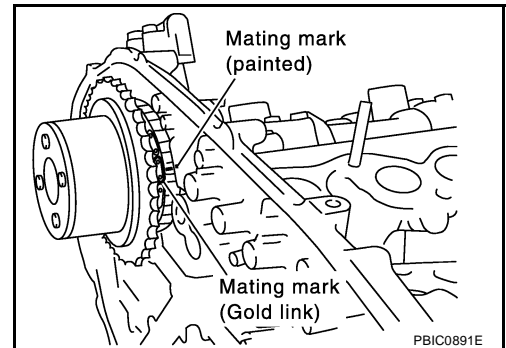
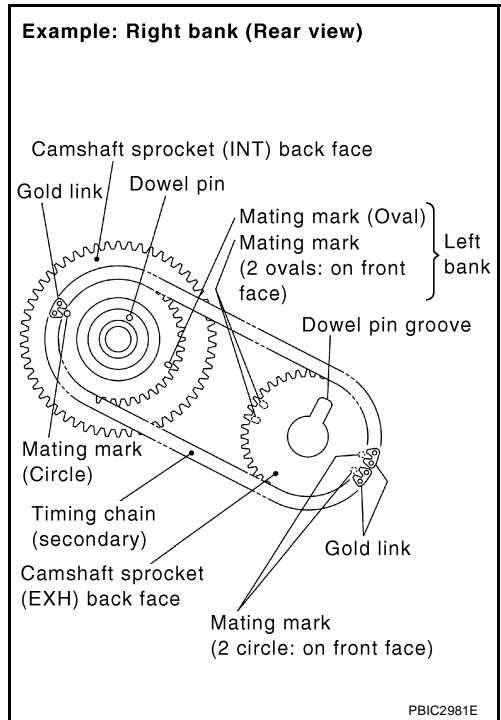
**NOTE:**

- Mating marks for intake camshaft sprocket are on the back side of camshaft sprocket (secondary).
- There are two types of mating marks, circle and oval types. They should be used for the right and left banks, respectively.

**Right bank : Use circle type.**

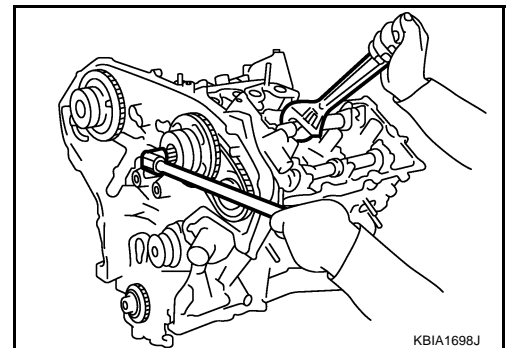
**Left bank : Use oval type.**

- Align dowel pin and pin hole on camshafts with the groove and dowel pin on sprockets, and install them.
- On the intake side, align pin hole on the small diameter side of the camshaft front end with dowel pin on the back side of camshaft sprocket, and install them.
- On the exhaust side, align dowel pin on camshaft front end with pin groove on camshaft sprocket, and install them.
- In case that positions of each mating mark and each dowel pin are not fit on mating parts, make fine adjustment to the position holding the hexagonal portion on camshaft with wrench or equivalent.
- Mounting bolts for camshaft sprockets must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of dowel pins.
- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the top of sprocket teeth and its extended line in advance with paint.



c. After confirming the mating marks are aligned, tighten camshaft sprocket mounting bolts.

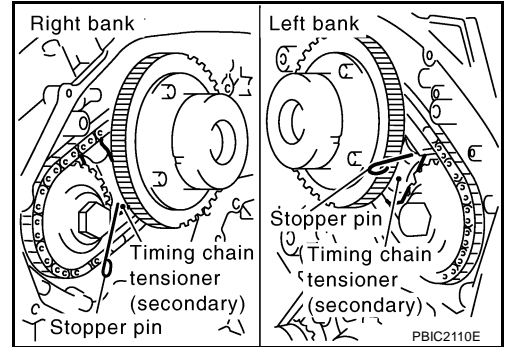
- Secure camshaft using wrench at the hexagonal portion to tighten mounting bolts.





# TIMING CHAIN

d. Pull stopper pins out from timing chain tensioners (secondary).

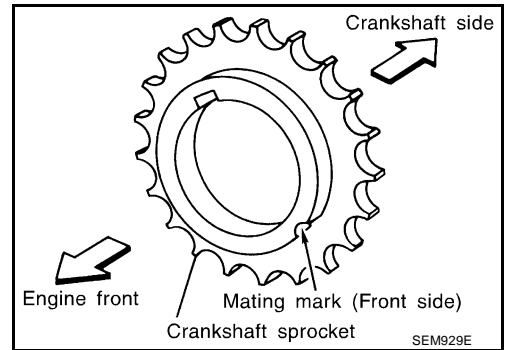


6. Install tension guide.

7. Install timing chain (primary) as follows:

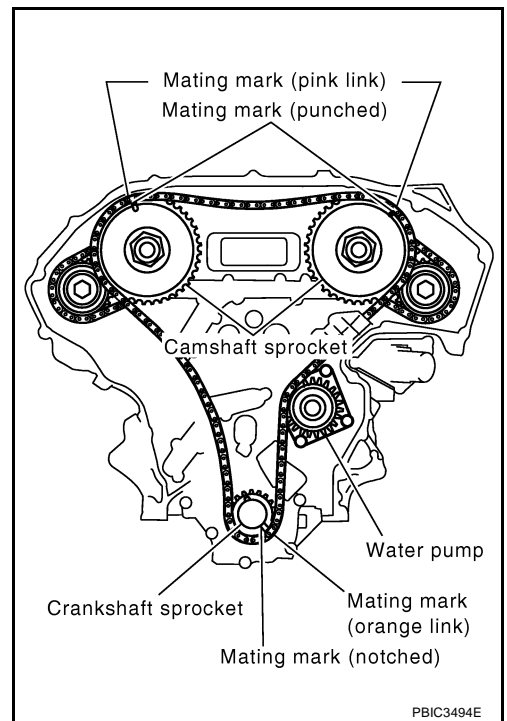
a. Install crankshaft sprocket.

- Make sure the mating marks on crankshaft sprocket face the front of engine.



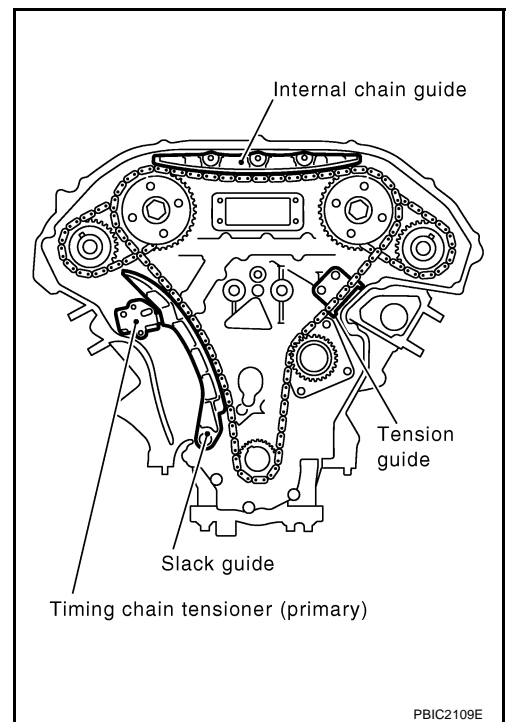
b. Install timing chain (primary).

- Install timing chain (primary) so the mating mark (punched) on camshaft sprocket is aligned with the pink link on timing chain, while the mating mark (notched) on crankshaft sprocket is aligned with the orange one on timing chain, as shown in the figure.
- When it is difficult to align mating marks of timing chain (primary) with each sprocket, gradually turn camshaft using wrench on the hexagonal portion to align it with the mating marks.
- During alignment, be careful to prevent dislocation of mating mark alignments of timing chains (secondary).



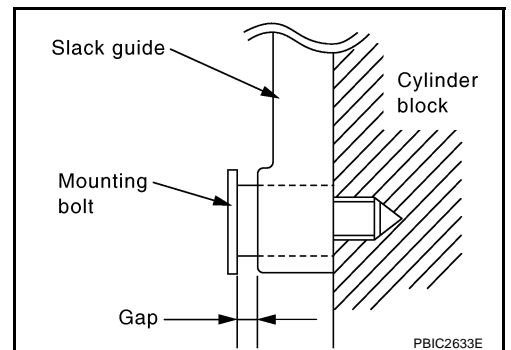
## TIMING CHAIN

8. Install internal chain guide, slack guide and timing chain tensioner (primary).



### CAUTION:

Do not overtighten slack guide mounting bolts. It is normal for a gap to exist under the bolt seats when mounting bolts are tightened to specification.



9. Install the timing chain tensioner (primary) with the following procedure:

- a. Pull plunger stopper tab up (or turn lever downward) so as to remove plunger stopper tab from the ratchet of plunger.

### NOTE:

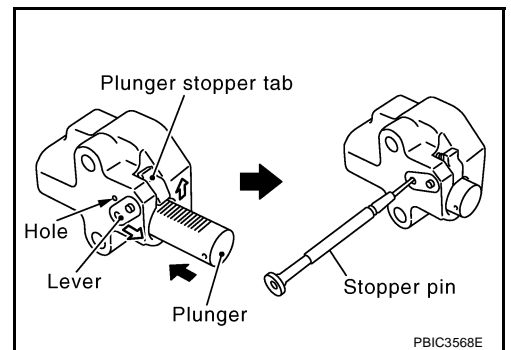
Plunger stopper tab and lever are synchronized.

- b. Push plunger into the inside of tensioner body.
- c. Hold plunger in the fully compressed position by engaging plunger stopper tab with the tip of ratchet.
- d. To secure lever, insert stopper pin through hole of lever into tensioner body hole.

- The lever parts and the tab are synchronized. Therefore, the plunger will be secured under this condition.

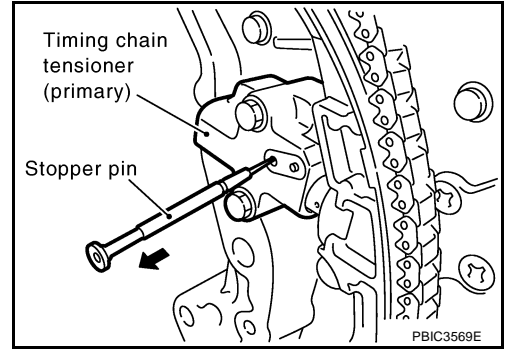
### NOTE:

Figure shows the example of 1.2 mm (0.047 in) diameter thin screwdriver being used as the stopper pin.

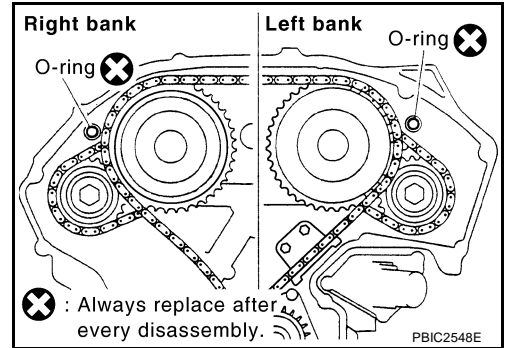


# TIMING CHAIN

- e. Install timing chain tensioner (primary).
  - Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner (primary).
- f. Pull out stopper pin after installing, and then release plunger.



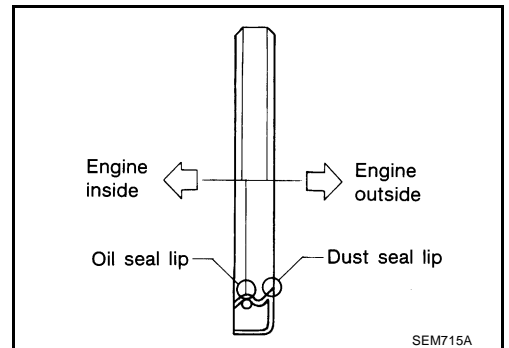
- 10. Make sure again that the mating marks on sprockets and timing chain have not slipped out of alignment.
- 11. Install new O-rings on rear timing chain case.



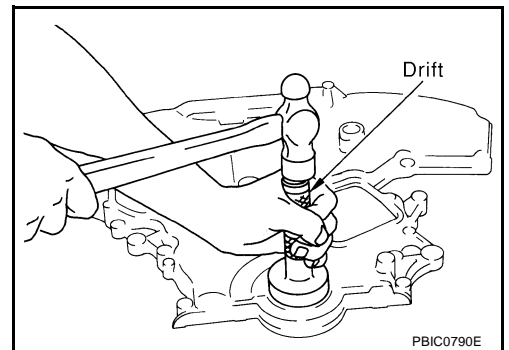
- 12. Install new front oil seal on front timing chain case.
  - Apply new engine oil to both oil seal lip and dust seal lip.
  - Install it so that each seal lip is oriented as shown in the figure.

**CAUTION:**

**Be careful not scratch or make burrs on circumference of oil seal.**



- Using suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



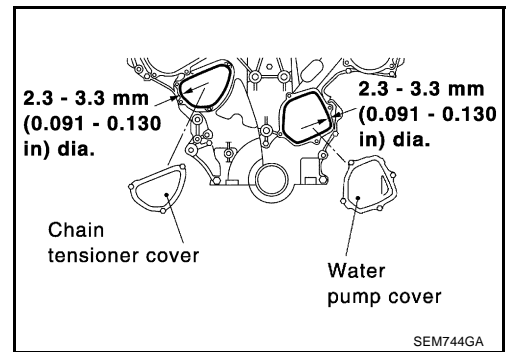
- 13. Install water pump cover and chain tensioner cover to front timing chain case.

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# TIMING CHAIN

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to front timing chain case as shown in the figure.

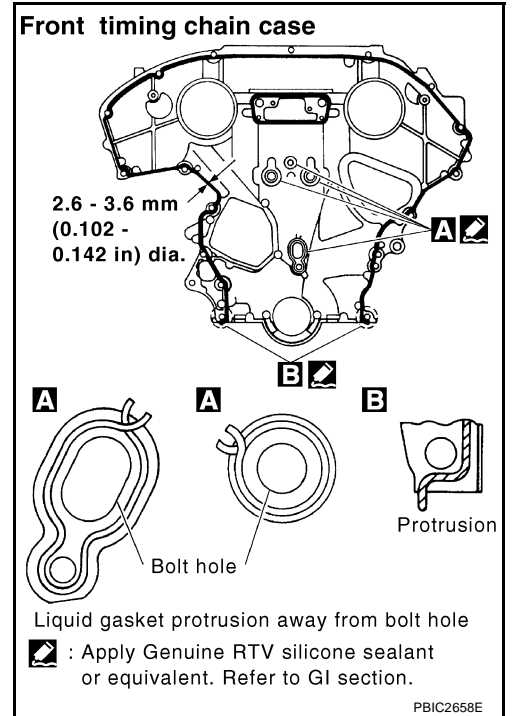
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



14. Install front timing chain case as follows:

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to front timing chain case back side as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



- Install front timing chain case as to fit its dowel pin hole together dowel pin on rear timing chain case.

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

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

**M8 bolts : 1, 2**

: 25.5 - 31.3 N-m (2.6 - 3.2 kg-m, 19 - 23 ft-lb)

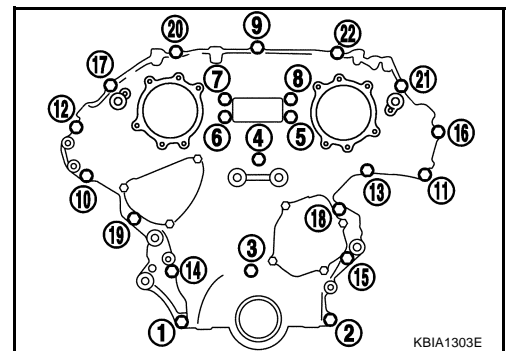
**M6 bolts : Except the above**

: 11.7 - 13.7 N-m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

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

**CAUTION:**

**Be sure to wipe off any excessive liquid gasket leaking on surface mating with oil pan (upper).**



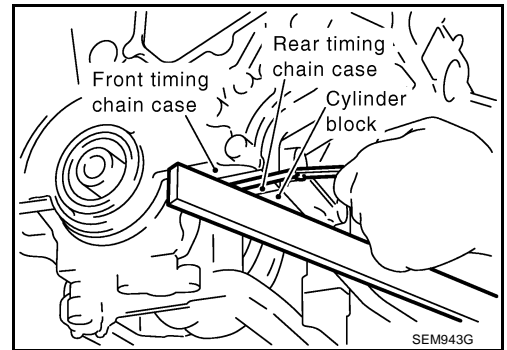
# TIMING CHAIN

- e. After installing front timing chain case, check the surface height difference between the following parts on the oil pan (upper) mounting surface.

## Standard

**Front timing chain case to rear timing chain case:  
-0.14 to 0.14 mm (-0.0055 to 0.0055 in)**

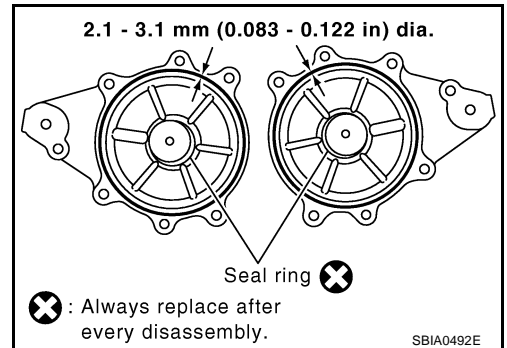
- If not within standard, repeat the installation procedure.



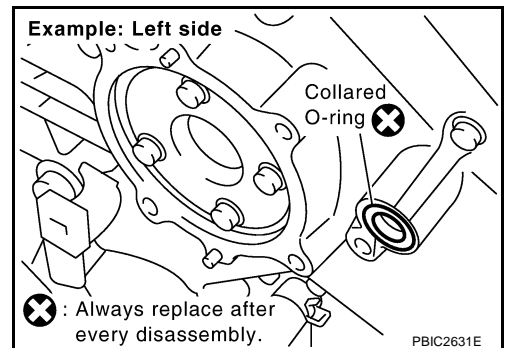
15. Install right and left intake valve timing control covers as follows:

- Install new seal rings in shaft grooves.
- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to intake valve timing control covers as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

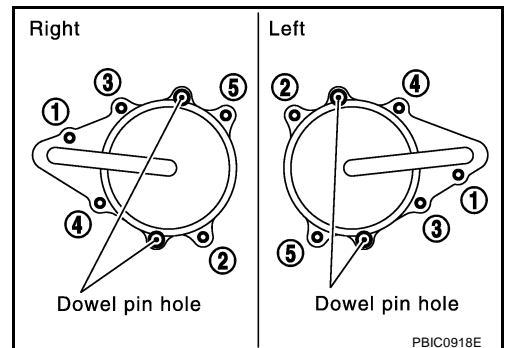


- Install new collared O-rings in front timing chain case oil hole (left and right sides).



- Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with holes to install intake valve timing control covers.

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



16. Install oil pans (upper and lower). Refer to [EM-29. "OIL PAN AND OIL STRAINER"](#).

17. Install rocker covers (right and left banks). Refer to [EM-44. "ROCKER COVER"](#).

18. Install crankshaft pulley as follows:

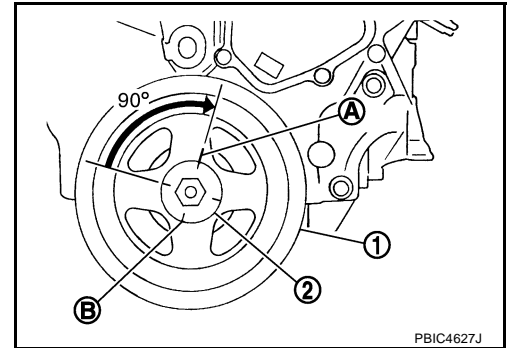
- Fix crankshaft using ring gear stopper [SST: KV10117700 (J44716)].
- Install crankshaft pulley, taking care not to damage front oil seal.
  - When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).

# TIMING CHAIN

c. Tighten crankshaft pulley bolt.

: 44.1 N-m (4.5 kg-m, 33 ft-lb)

d. Place a paint mark (A) on crankshaft pulley (1) aligning with the angle mark (B) on crankshaft pulley bolt (2). Tighten the bolt 90 degrees (angle tightening).



19. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.

20. Install in the reverse order of removal after this step.

**NOTE:**

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

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-12, "RECOMMENDED 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, 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	—

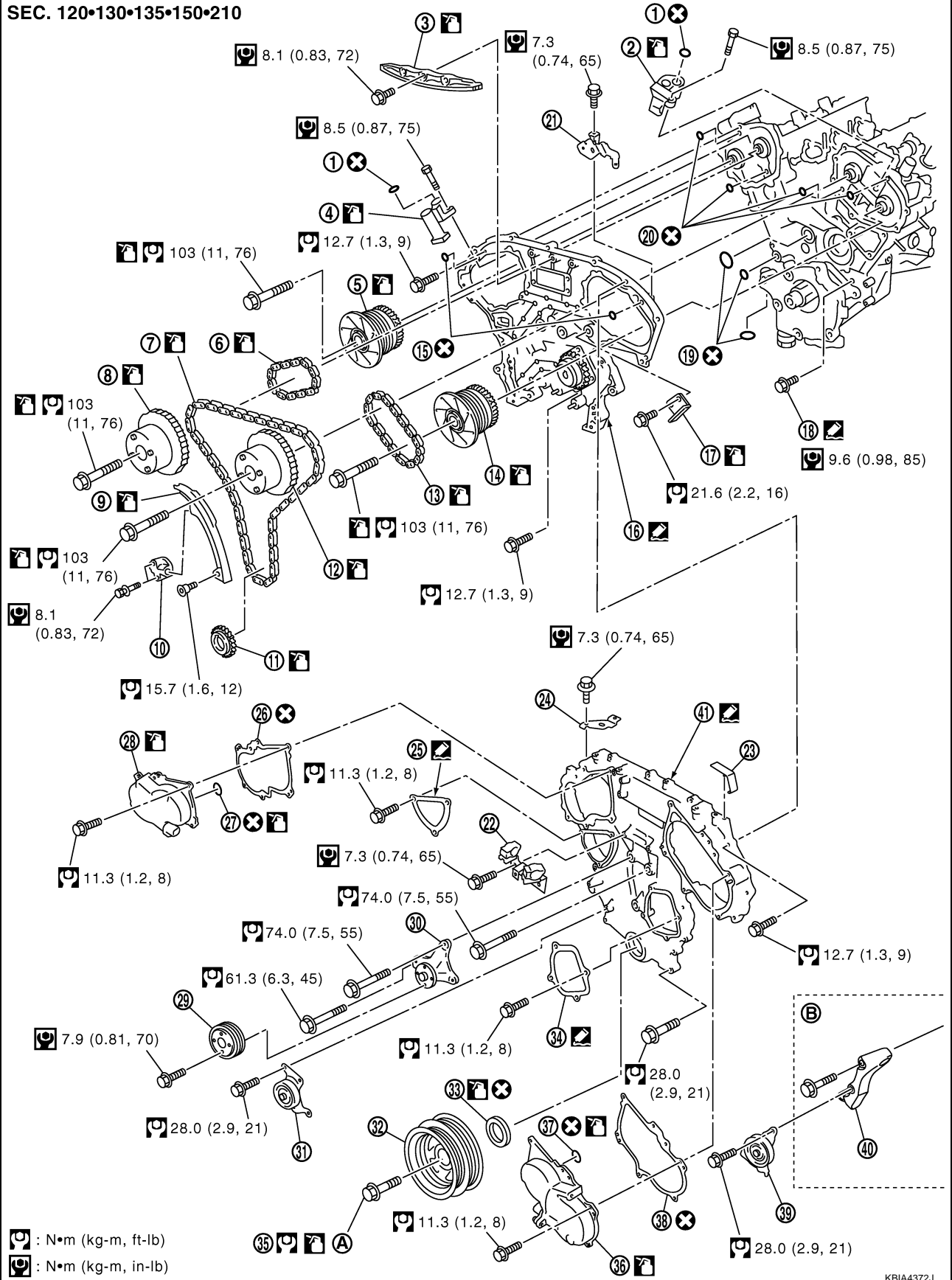
\* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

# TIMING CHAIN

## Removal and Installation (M/T Models)

NBS0000S

SEC. 120•130•135•150•210



☐ : N•m (kg-m, ft-lb)  
 ☐ : N•m (kg-m, in-lb)

- |                                       |                                       |                             |
|---------------------------------------|---------------------------------------|-----------------------------|
| 1. O-ring                             | 2. Timing chain tensioner (secondary) | 3. Internal chain guide     |
| 4. Timing chain tensioner (secondary) | 5. Camshaft sprocket (EXH)            | 6. Timing chain (secondary) |

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# TIMING CHAIN

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7. Timing chain (primary)	8. Camshaft sprocket (INT)	9. Slack guide
10. Timing chain tensioner (primary)	11. Crankshaft sprocket	12. Camshaft sprocket (INT)
13. Timing chain (secondary)	14. Camshaft sprocket (EXH)	15. O-ring
16. Rear timing chain case	17. Tension guide	18. Water drain plug (front)
19. O-ring	20. O-ring	21. Bracket
22. Bracket	23. Clip	24. Bracket
25. Chain tensioner cover	26. Gasket	27. Seal ring
28. Valve timing control cover	29. Idler pulley	30. Idler pulley bracket
31. Idler pulley	32. Crankshaft pulley	33. Front oil seal
34. Water pump cover	35. Crankshaft pulley bolt	36. Valve timing control cover
37. Seal ring	38. Gasket	39. Idler pulley
40. A/C compressor bracket	41. Front timing chain case	
A. Refer to <a href="#">EM-88</a>	B. Refer to <a href="#">ATC-128</a>	

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## NOTE:

- This section describes procedures for removing/installing front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.
- To remove/install front timing chain case, timing chain, and its related parts without removing oil pan (upper), refer to [EM-47, "FRONT TIMING CHAIN CASE"](#).

## REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air cleaner case assembly. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#).
3. Remove undercover with power tool.
4. Release the fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
5. Disconnect the battery cable from the negative terminal.
6. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#).

### CAUTION:

- Perform this step when engine is cold.
- Do not spill engine coolant on drive belts.

7. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#).

### CAUTION:

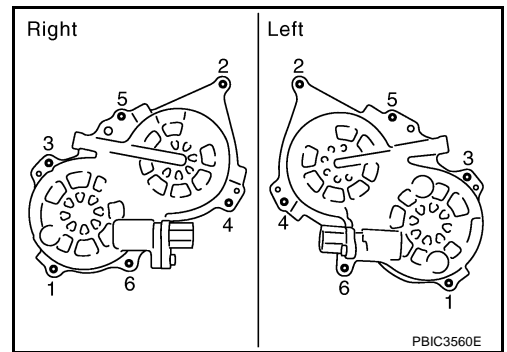
- Perform this step when engine is cold.
- Do not spill engine oil on drive belts.

8. Separate engine harnesses removing their brackets from front timing chain case.
9. Remove intake manifold collectors (upper and lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
10. Remove radiator cooling fan assembly. Refer to [CO-22, "COOLING FAN"](#).
11. Remove drive belts. Refer to [EM-14, "DRIVE BELTS"](#).
12. Remove A/C compressor from bracket with piping connected, and temporarily secure it aside. Refer to [ATC-128, "Components"](#).
13. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
14. Remove power steering oil pump bracket. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
15. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#).
16. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
17. Remove left and right valve timing control covers (including magnet retarder and cover) with the following procedure.



# TIMING CHAIN

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

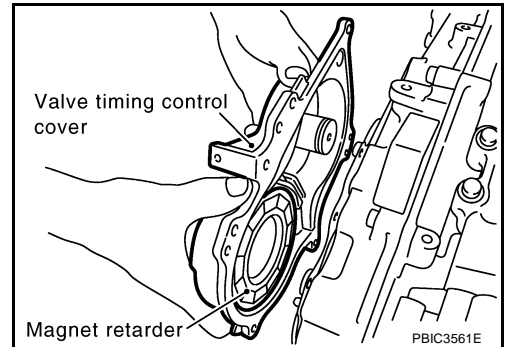


- b. Shaft is engaged with intake side camshaft sprocket center hole on inside. Pull straight out so as not to tilt until the joint is disengaged.

- The mating surface of magnet retarder may be fitted with the exhaust side camshaft sprocket via the engine oil. Open valve timing control cover carefully.
- If the mating surface of magnet retarder is fitted with the camshaft sprocket, open the cover within the range that the load is not applied to the harness. And then, remove it so as to prevent magnet retarder from dropping.

**CAUTION:**

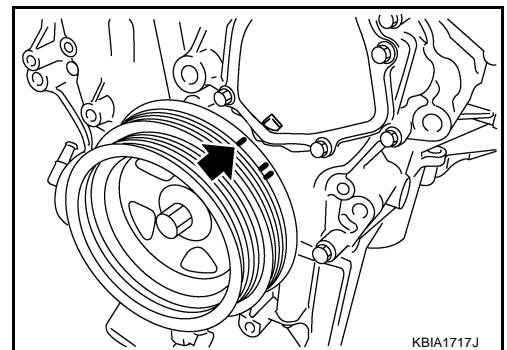
- **Be careful not to damage magnet retarder.**
- **When carrying valve timing control cover, face the magnet retarder side up to prevent the cover from falling from magnet retarder.**
- **Do not remove magnet retarder from valve timing control cover. (Disassembly prohibited parts)**



18. Remove rocker covers (right and left banks). Refer to [EM-44, "ROCKER COVER"](#) .

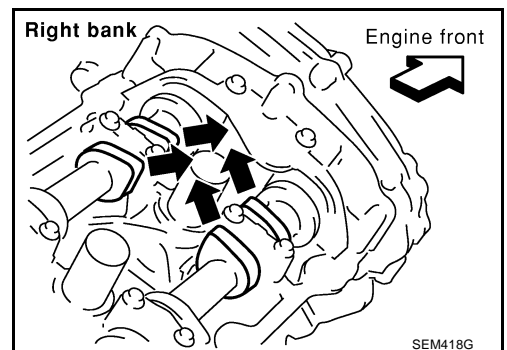
19. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

- a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



- b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.

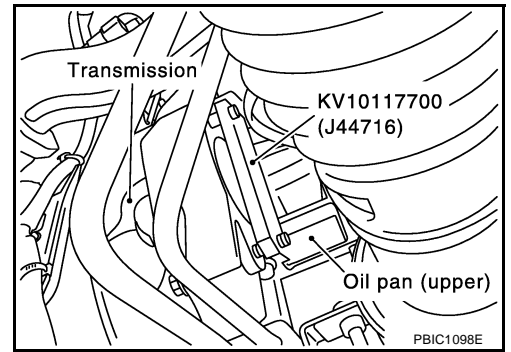
- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.



20. Remove crankshaft pulley as follows:

# TIMING CHAIN

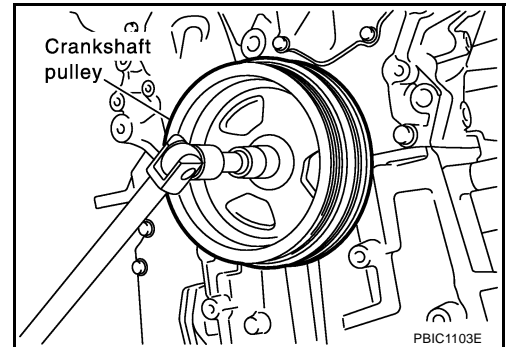
- a. Remove starter motor and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10, "STARTING SYSTEM"](#).



- b. Loosen crankshaft pulley bolt and rotate bolt seating surface at 10 mm (0.39 in) from its original position.

**CAUTION:**

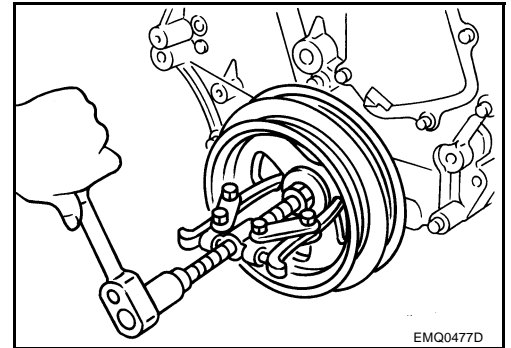
**Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.**



- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

**CAUTION:**

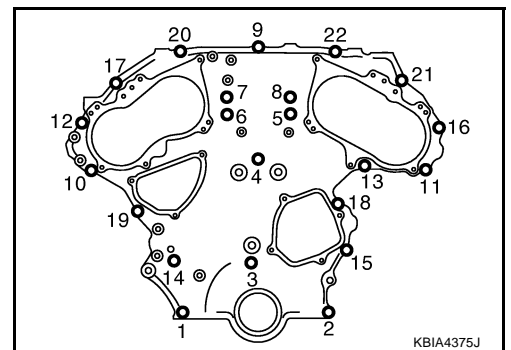
**Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.**



21. Remove oil pans (upper and lower). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#).

22. Remove front timing chain case as follows:

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

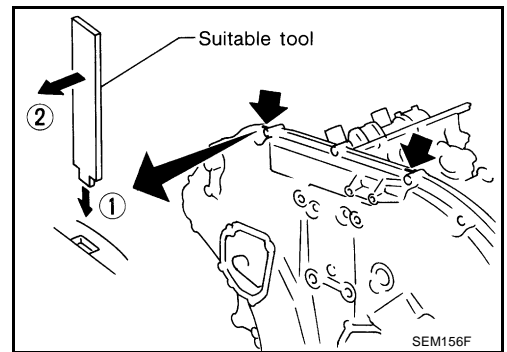


## TIMING CHAIN

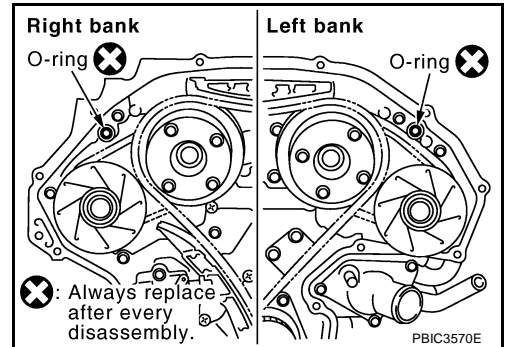
- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).
- c. Pry off case by moving the tool as shown (2).
  - Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

**CAUTION:**

- Do not use screwdriver or something similar.
- After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.



23. Remove O-rings from rear timing chain case.



24. Remove water pump cover and chain tensioner cover from front timing chain case.

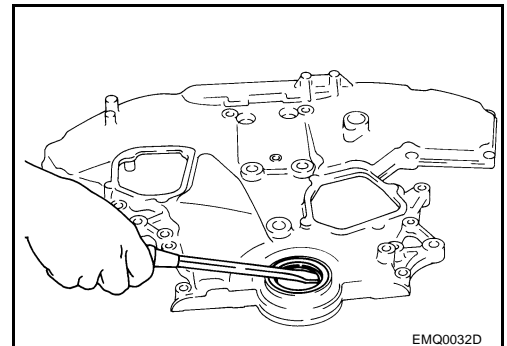
- Use seal cutter [SST: KV10111100 (J37228)] to cut liquid gasket for removal.

25. Remove front oil seal from front timing chain case using suitable tool.

- Use screwdriver for removal.

**CAUTION:**

Be careful not to damage front timing chain case.



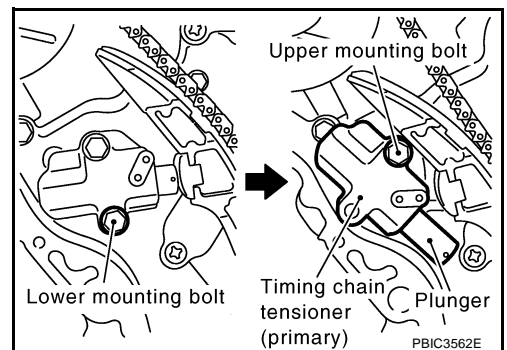
26. Remove timing chain tensioner (primary) as follows:

- a. Remove lower mounting bolt.
- b. Loosen upper mounting bolt slowly, and then turn timing chain tensioner (primary) on the mounting bolt so that plunger is fully expanded.

**NOTE:**

Even if plunger is fully expanded, it is not dropped from the body of timing chain tensioner (primary).

- c. Remove upper mounting bolt, and then remove timing chain tensioner (primary).



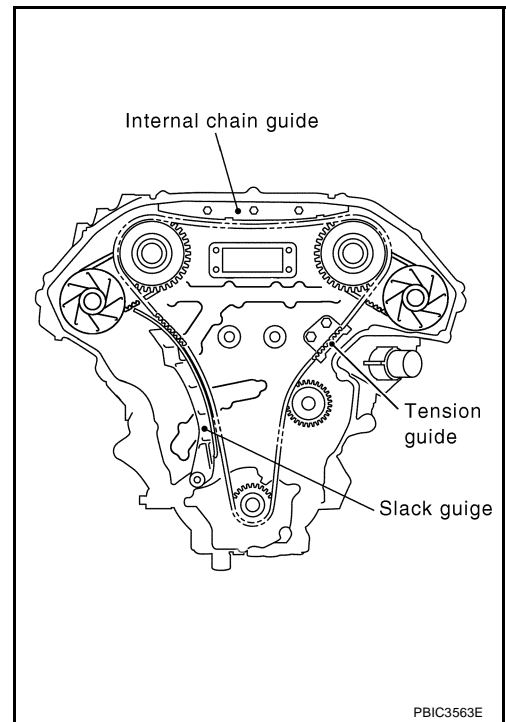
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## TIMING CHAIN

27. Remove internal chain guide, tension guide and slack guide.

**NOTE:**

Tension guide can be removed after removing timing chain (primary).



28. Remove timing chain (primary) and crankshaft sprocket.

**CAUTION:**

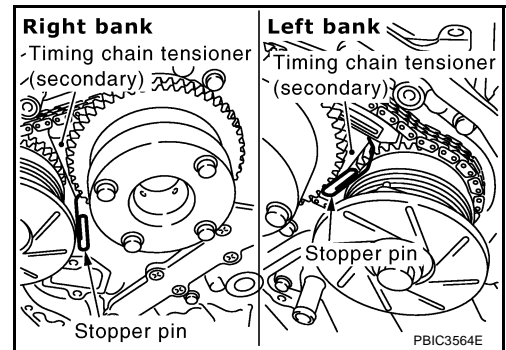
After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.

29. Remove timing chain (secondary) and camshaft sprockets as follows:

- a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).

**NOTE:**

- Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.
- For removal of timing chain tensioner (secondary), refer to [EM-100, "CAMSHAFT"](#) . [Removing camshaft bracket (No. 1) is required.]

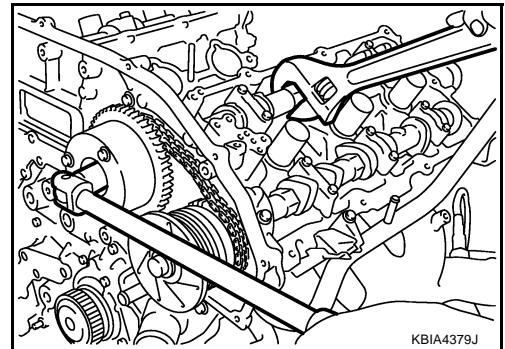


- b. Remove intake and exhaust camshaft sprocket bolts.

- Secure the hexagonal portion of camshaft using wrench to loosen mounting bolts.

**CAUTION:**

Do not loosen mounting bolts with securing anything other than the camshaft hexagonal portion or with tensioning the timing chain.



- c. Remove timing chain (secondary) together with camshaft sprockets.

**CAUTION:**

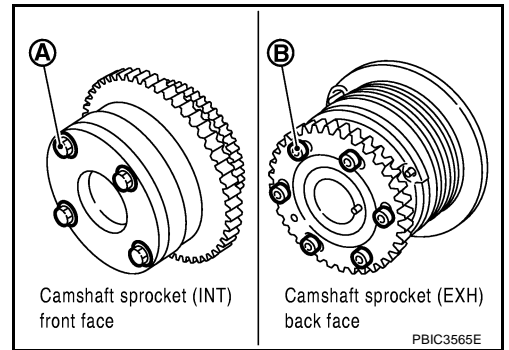
- Handle carefully to avoid any shock to camshaft sprocket.

# TIMING CHAIN

- Do not disassemble. (Do not loosen bolts "A" and "B" as shown in the figure.)

**NOTE:**

Camshaft sprocket (INT) is two-for-one structure of primary and secondary sprockets.



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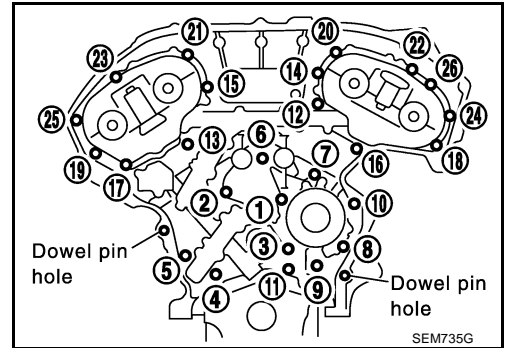
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30. Remove water pump. Refer to [CO-24, "WATER PUMP"](#) .

31. Remove rear timing chain case as follows:

- Loosen and remove mounting bolts in reverse order as shown in the figure.
- Cut liquid gasket using seal cutter [SST: KV10111100 (J37228)] and remove rear timing chain case.



E

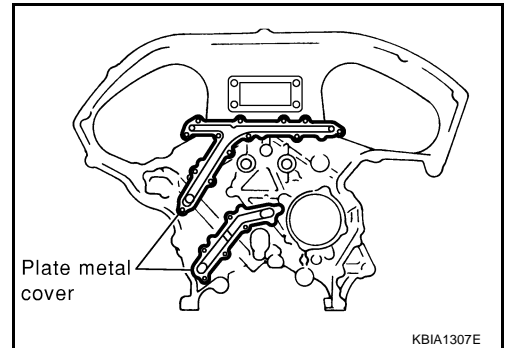
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**CAUTION:**

- Do not remove plate metal cover of oil passage.
- After removal, handle rear timing chain case carefully so it does not tilt, cant, or warp under a load.



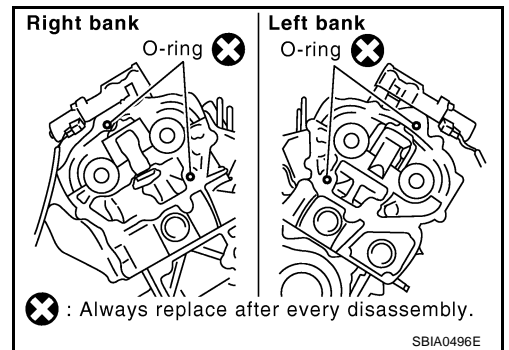
I

J

K

L

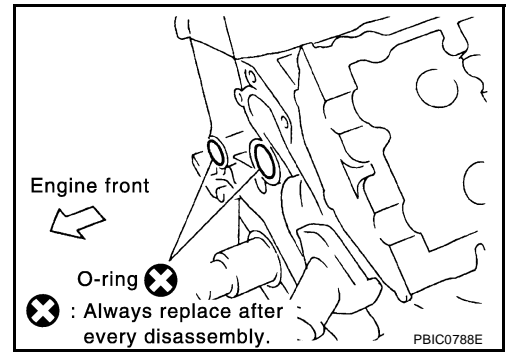
32. Remove O-rings from cylinder head.



M

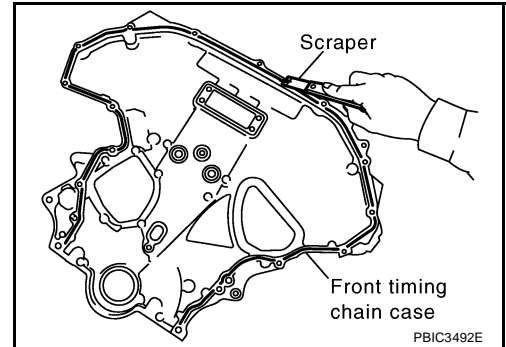
# TIMING CHAIN

33. Remove O-rings from cylinder block.

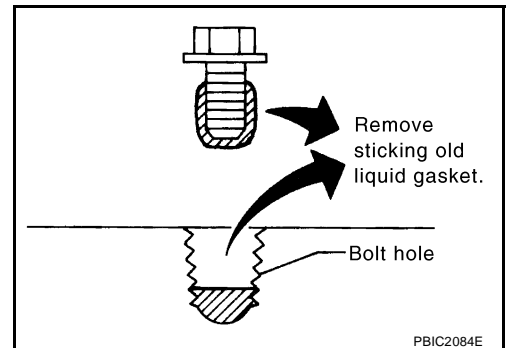


34. Remove timing chain tensioners (secondary) from cylinder head as follows, if necessary.

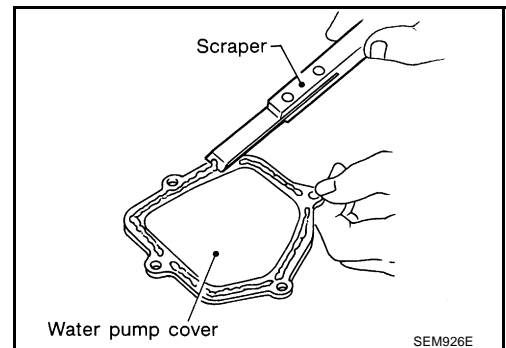
- a. Remove camshaft brackets (No. 1). Refer to [EM-101, "REMOVAL"](#).
  - b. Remove timing chain tensioners (secondary) with stopper pin attached.
35. Use scraper to remove all traces of old liquid gasket from front and rear timing chain cases, and opposite mating surfaces.



- Remove old liquid gasket from bolt hole and thread.



36. Use scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and valve timing control covers.

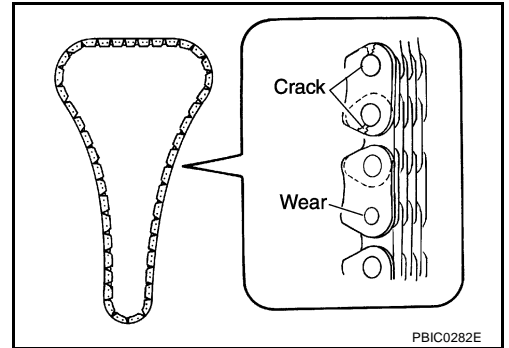


# TIMING CHAIN

## INSPECTION AFTER REMOVAL

### Timing Chain

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



A

EM

C

D

E

F

G

H

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L

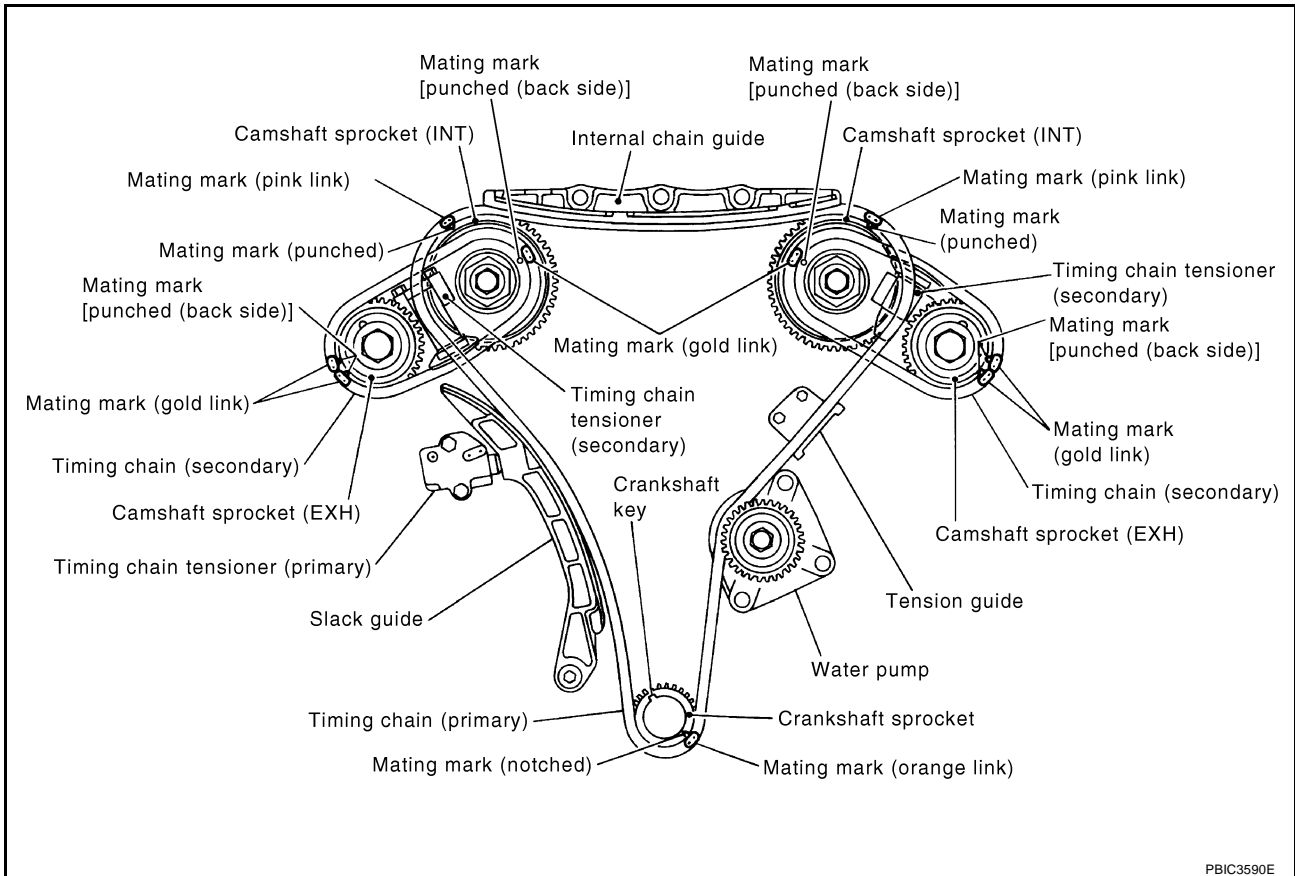
M

# TIMING CHAIN

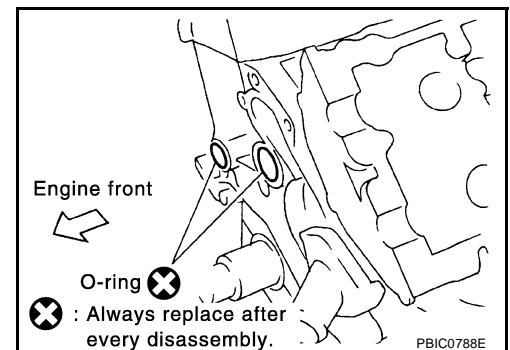
## INSTALLATION

### NOTE:

- The below figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.
- In this figure, the drum of exhaust side camshaft sprocket has been omitted.



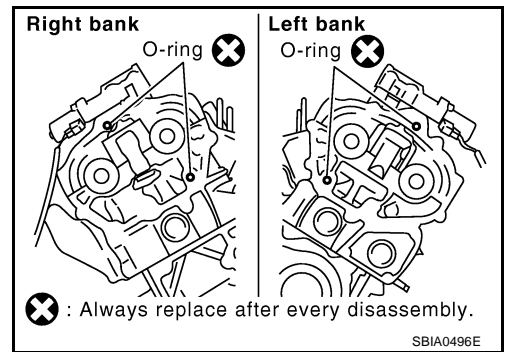
1. Install timing chain tensioners (secondary) to cylinder head as follows if removed. Refer to [EM-105, "INSTALLATION"](#) .
  - a. Install timing chain tensioners (secondary) with stopper pin attached and new O-ring.
  - b. Install camshaft brackets (No. 1). Refer to [EM-105, "INSTALLATION"](#) .
2. Install rear timing chain case as follows:
  - a. Install new O-rings onto cylinder block.





## TIMING CHAIN

- b. Install new O-rings to cylinder head.



- c. Apply liquid gasket with tube presser [SST: WS39930000 ( — )] to rear timing chain case back side as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**

**CAUTION:**

- For "A" in the figure, completely wipe out liquid gasket extended on a portion touching at engine coolant.

A

EM

C

D

E

F

G

H

I

J

K

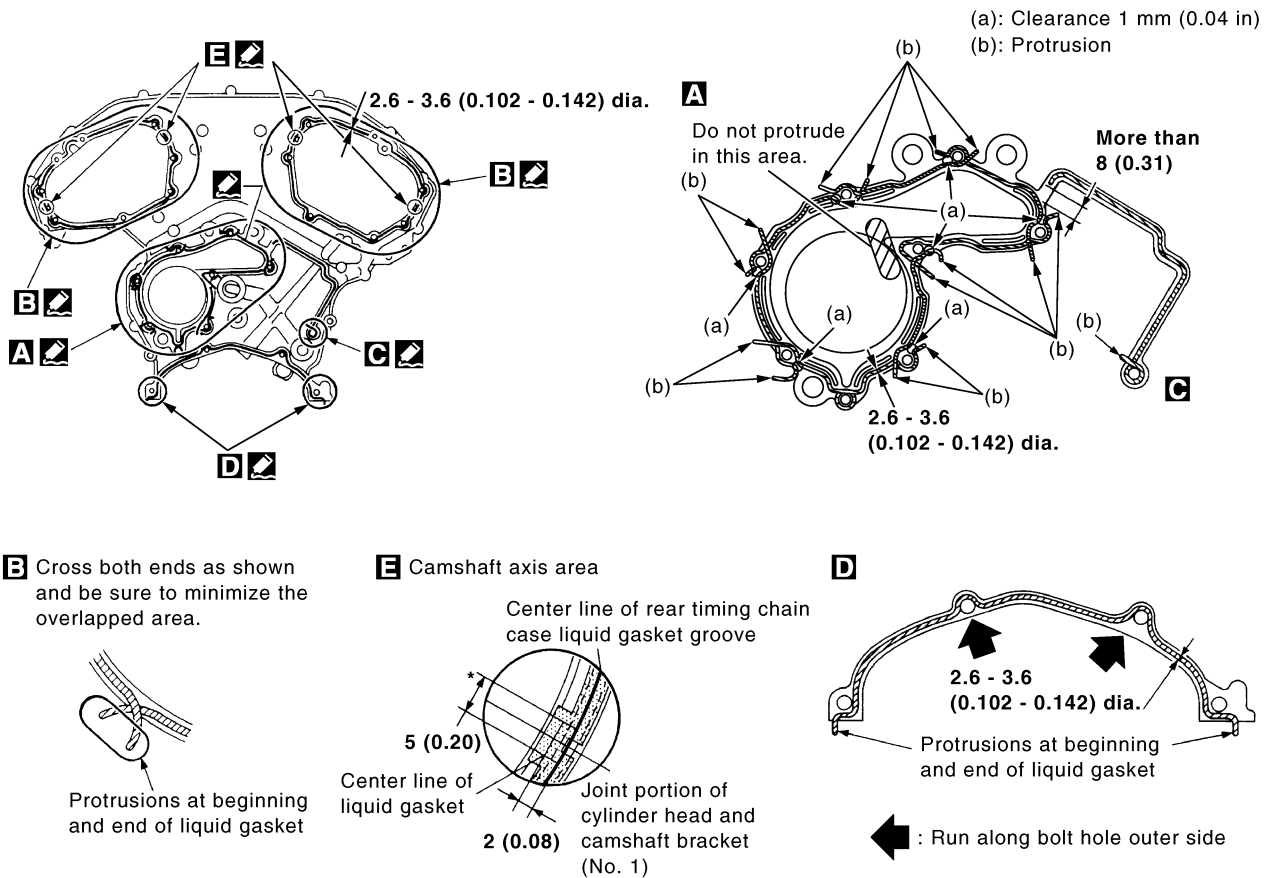
L

M

# TIMING CHAIN

- Apply liquid gasket on installation position of water pump and cylinder head very completely.

## Rear timing chain case: Back side



\*: Apply liquid gasket to the chamfered surface between camshaft bracket (No. 1) and cylinder head.

: Apply Genuine RTV Silicone Sealant or equivalent. Refer to GI section.

Unit: mm (in)

PBIC2659E

- Align rear timing chain case and water pump assembly with dowel pins (right and left) on cylinder block and install rear timing chain case.
  - Make sure O-rings stay in place during installation to cylinder block and cylinder head.
- Tighten mounting bolts in numerical order as shown in the figure.
  - There are two types of mounting bolts. Refer to the following for locating bolts.

### Bolt length:

20 mm (0.79 in)

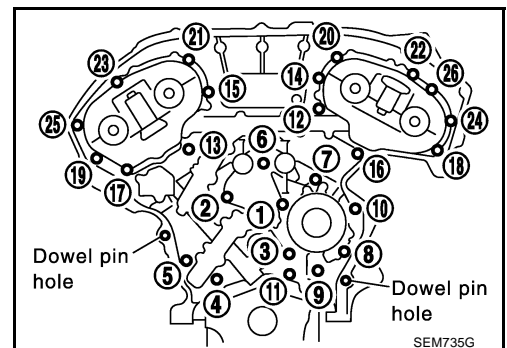
16 mm (0.63 in)

### Bolt position

: 1, 2, 3, 6, 7, 8, 9, 10

: Except the above

: 11.7 - 13.7 N·m (1.2 - 1.4 kg·m, 9 - 10 ft·lb)



# TIMING CHAIN

- f. After all bolts are tightened, retighten them to the specified in numerical order shown in the figure.
- If liquid gasket protrudes, wipe it off immediately.

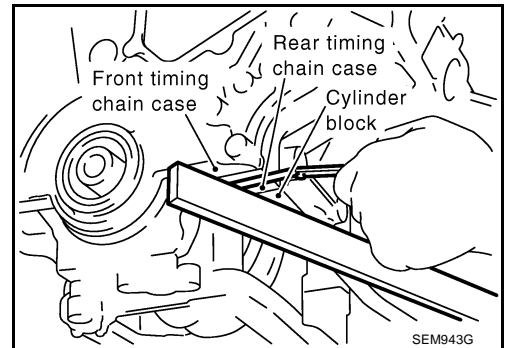
- g. After installing rear timing chain case, check the surface height difference between following parts on oil pan (upper) mounting surface.

## Standard

### Rear timing chain case to cylinder block:

−0.24 to 0.14 mm (−0.0094 to 0.0055 in)

- If not within standard, repeat the installation procedure.



3. Install water pump with new O-rings. Refer to [CO-24, "WATER PUMP"](#).
4. Make sure that dowel pin holes (small dia. side) and crankshaft key are located as shown in the figure. (No. 1 cylinder at compression TDC)

### NOTE:

Though camshaft does not stop at the position 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.

### Camshaft dowel pin hole (intake side)

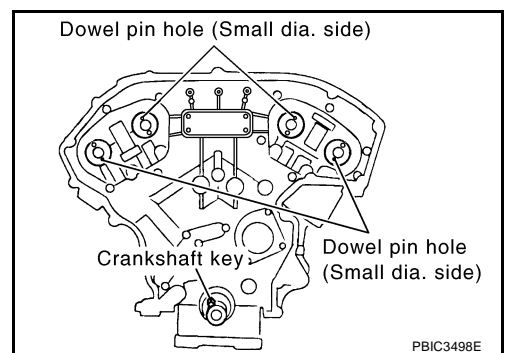
: At cylinder head upper face side in each bank.

### Camshaft dowel pin hole (exhaust side)

: At cylinder head lower face side in each bank.

### Crankshaft key

: At cylinder head side of right bank.



### CAUTION:

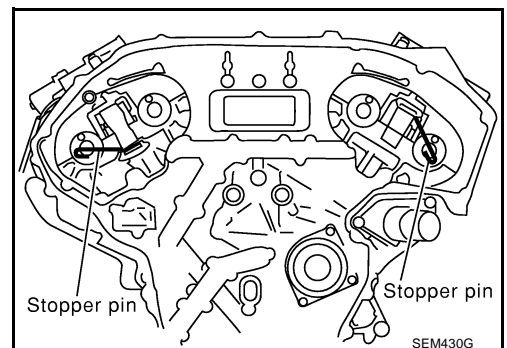
The small dia. side of camshaft dowel pin holes should be used. (The large dia. side is not used.)

5. Install timing chains (secondary) and camshaft sprockets as follows:

### CAUTION:

- When replacing camshaft sprocket (EXH), replace valve timing control cover (including magnet retarder and cover).
- Mating marks between timing chain and sprockets slip easily. Confirm all mating mark positions repeatedly during the installation process.

- a. Push plunger of timing chain tensioner (secondary) and keep it pressed in with stopper pin.



## TIMING CHAIN

b. Install timing chains (secondary) and camshaft sprockets.

- Align the mating marks on timing chain (secondary) (gold link) with the ones on intake and exhaust camshaft sprockets (punched), and install them.

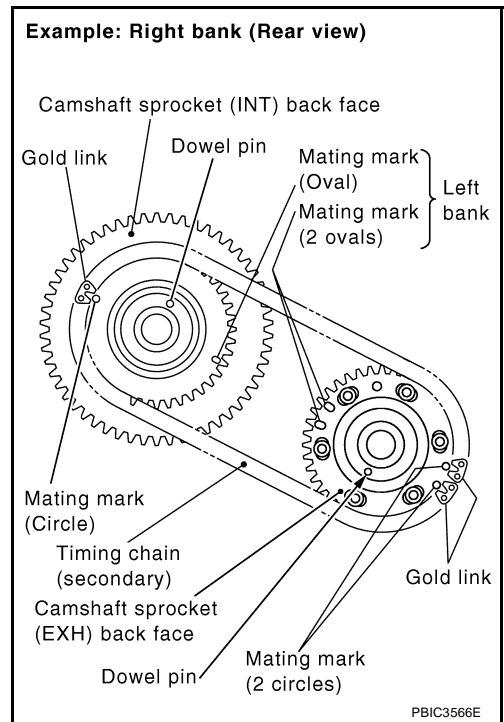
**NOTE:**

- Mating marks for intake camshaft sprocket are on the back side of camshaft sprocket (secondary).
- There are two types of mating marks, circle and oval types. They should be used for the right and left banks, respectively.

**Right bank : Use circle type.**

**Left bank : Use oval type.**

- Align dowel pin hole on the small diameter side of the camshaft front end with dowel pin on the back side of camshaft sprockets, and install them.
- In case that positions of each mating mark and each dowel pin are not fit on mating parts, make fine adjustment to the position holding the hexagonal portion on camshaft with wrench or equivalent.
- Mounting bolts for camshaft sprockets must be tightened in the step "d". Tightening them by hand is enough to prevent the dislocation of dowel pins.

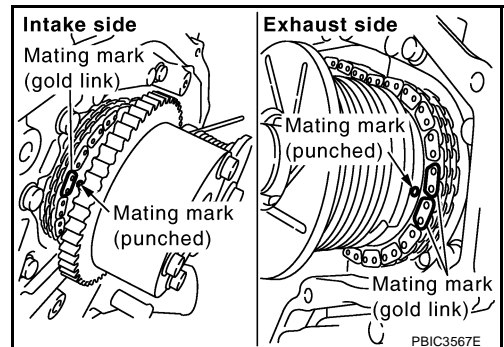


c. Make sure that timing chain (secondary) is not loose from each camshaft sprocket.

- Make sure the mating marks (punched) on each camshaft sprocket are positioned on the mating marks (gold link) on timing chain (secondary).

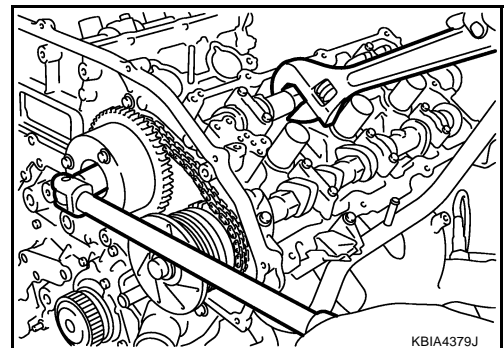
**NOTE:**

Mating mark (punched) in the figure is for checking loose at this step.



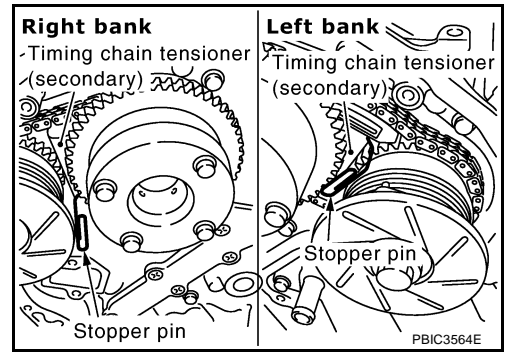
d. Tighten camshaft sprocket mounting bolts.

- Secure camshaft using wrench at the hexagonal portion to tighten mounting bolts.

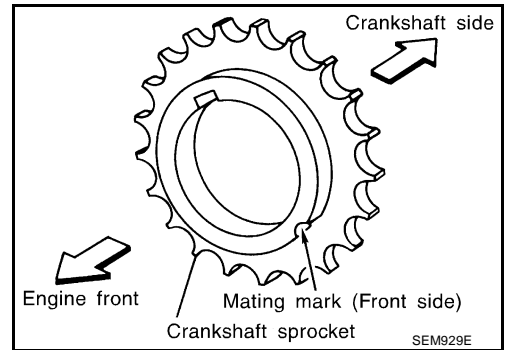


# TIMING CHAIN

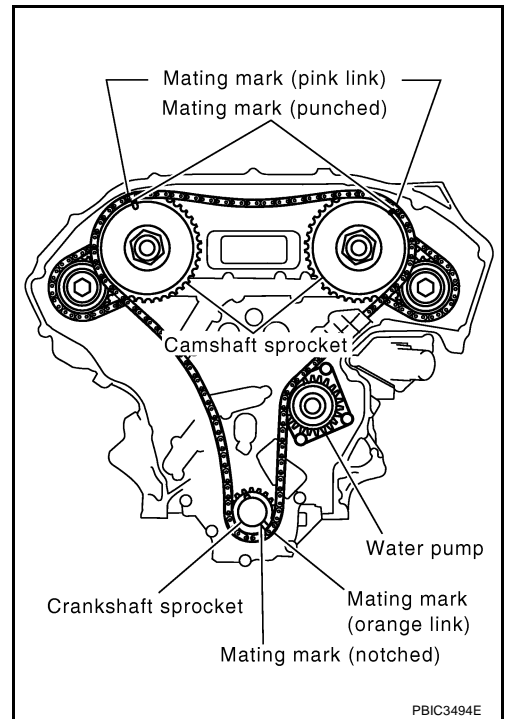
e. Pull stopper pins out from timing chain tensioners (secondary).



- 6. Install tension guide.
- 7. Install timing chain (primary) as follows:
  - a. Install crankshaft sprocket.
    - Make sure the mating marks on crankshaft sprocket face the front of engine.

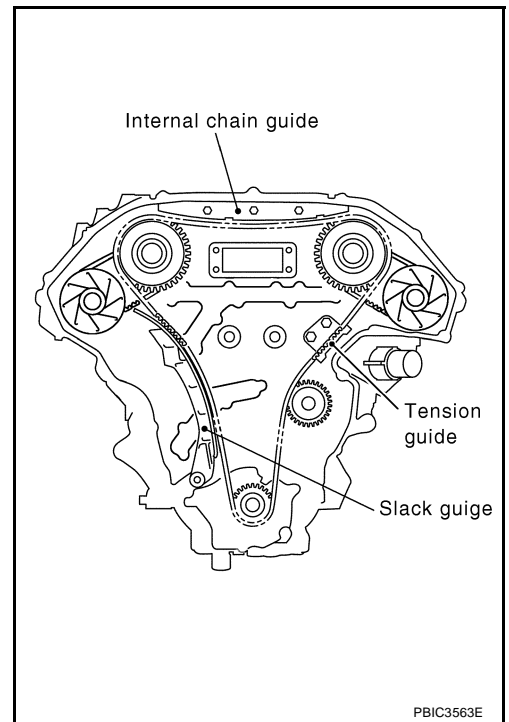


- b. Install timing chain (primary).
  - Install timing chain (primary) so the mating mark (punched) on camshaft sprocket is aligned with the pink link on timing chain, while the mating mark (notched) on crankshaft sprocket is aligned with the orange one on timing chain, as shown in the figure.
  - When it is difficult to align mating marks of timing chain (primary) with each sprocket, gradually turn camshaft using wrench on the hexagonal portion to align it with the mating marks.
  - During alignment, be careful to prevent dislocation of mating mark alignments of timing chains (secondary).



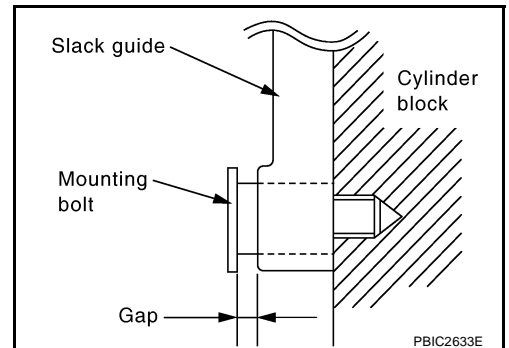
## TIMING CHAIN

8. Install internal chain guide, slack guide and timing chain tensioner (primary).



### CAUTION:

Do not overtighten slack guide mounting bolts. It is normal for a gap to exist under the bolt seats when mounting bolts are tightened to specification.



9. Install the timing chain tensioner (primary) with the following procedure:

- a. Pull plunger stopper tab up (or turn lever downward) so as to remove plunger stopper tab from the ratchet of plunger.

### NOTE:

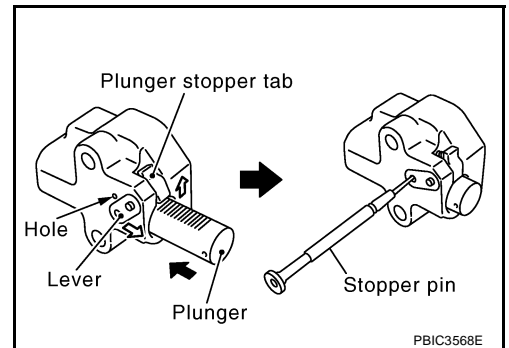
Plunger stopper tab and lever are synchronized.

- b. Push plunger into the inside of tensioner body.
- c. Hold plunger in the fully compressed position by engaging plunger stopper tab with the tip of ratchet.
- d. To secure lever, insert stopper pin through hole of lever into tensioner body hole.

- The lever parts and the tab are synchronized. Therefore, the plunger will be secured under this condition.

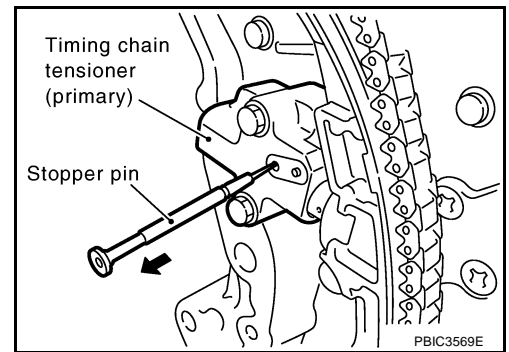
### NOTE:

Figure shows the example of 1.2 mm (0.047 in) diameter thin screwdriver being used as the stopper pin.

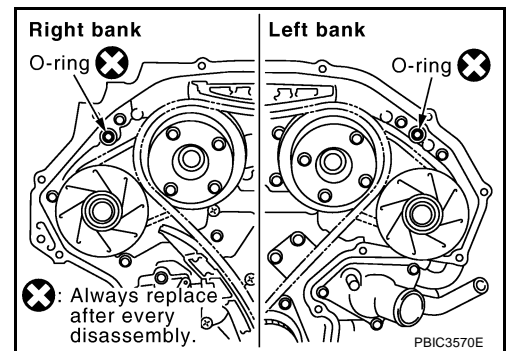


# TIMING CHAIN

- e. Install timing chain tensioner (primary).
  - Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner (primary).
- f. Pull out stopper pin after installing, and then release plunger.



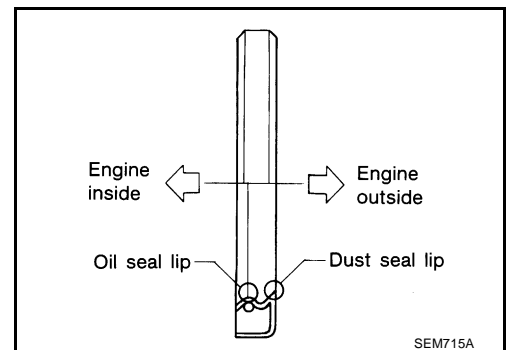
- 10. Make sure again that the mating marks on sprockets and timing chain have not slipped out of alignment.
- 11. Install new O-rings on rear timing chain case.



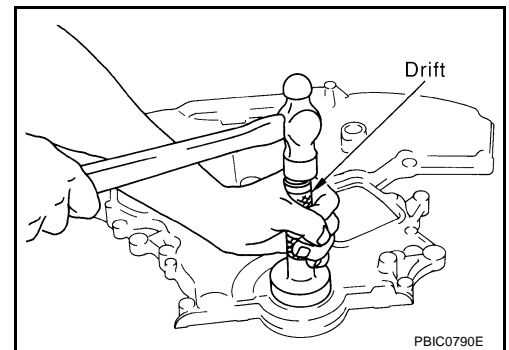
- 12. Install new front oil seal on front timing chain case.
  - Apply new engine oil to both oil seal lip and dust seal lip.
  - Install it so that each seal lip is oriented as shown in the figure.

**CAUTION:**

**Be careful not to scratch or make burrs on circumference of oil seal.**



- Using suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.

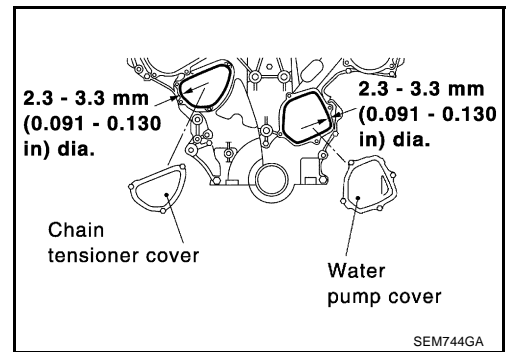


- 13. Install water pump cover and chain tensioner cover to front timing chain case.

# TIMING CHAIN

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to front timing chain case as shown in the figure.

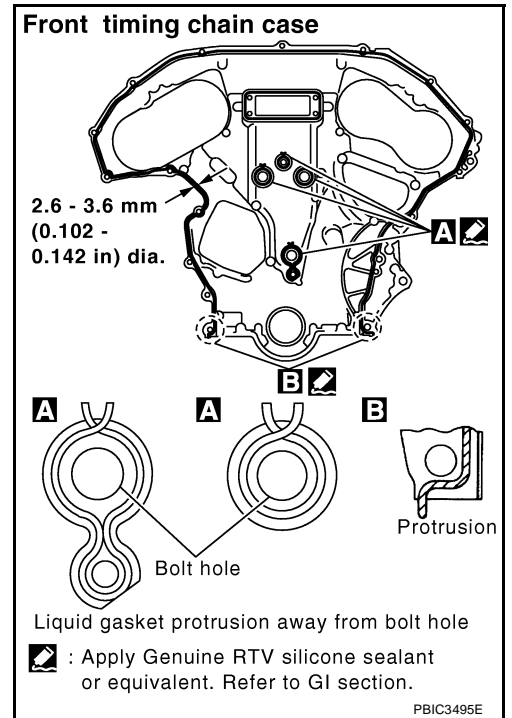
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



14. Install front timing chain case as follows:

- a. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to front timing chain case back side as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



- b. Install front timing chain case as to fit its dowel pin hole together dowel pin on rear timing chain case.

- c. Tighten mounting bolts to the specified torque in numerical order as shown in the figure.

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

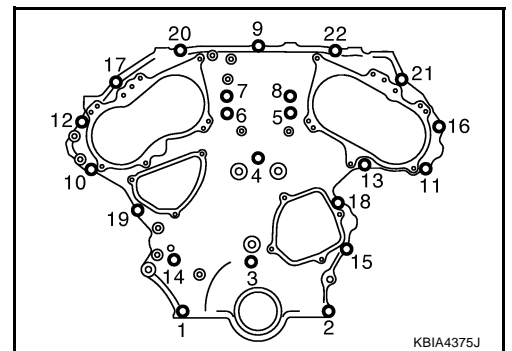
**M8 bolts : 1, 2**

: **25.5 - 31.3 N-m (2.6 - 3.2 kg-m, 19 - 23 ft-lb)**

**M6 bolts : Except the above**

: **11.7 - 13.7 N-m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)**

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



**CAUTION:**

**Be sure to wipe off any excessive liquid gasket leaking on surface mating with oil pan (upper).**



# TIMING CHAIN

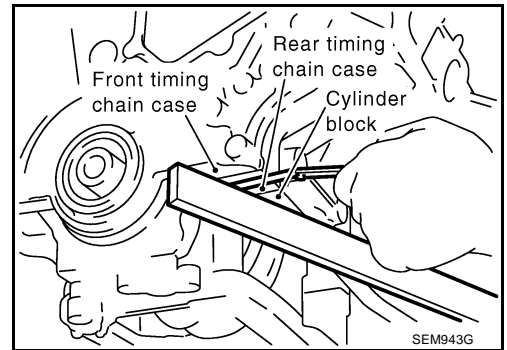
- e. After installing front timing chain case, check the surface height difference between the following parts on the oil pan (upper) mounting surface.

## Standard

Front timing chain case to rear timing chain case:

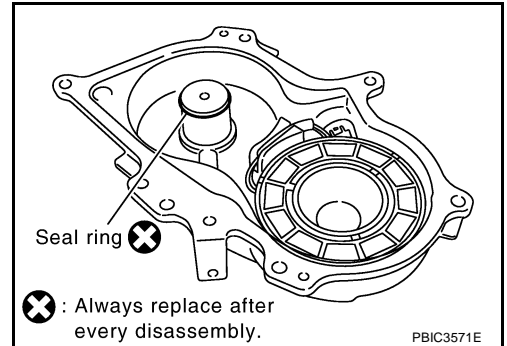
-0.14 to 0.14 mm (-0.0055 to 0.0055 in)

- If not within standard, repeat the installation procedure.



15. Install right and left valve timing control covers as follows:

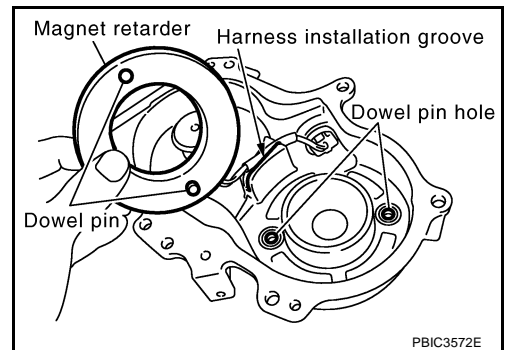
- a. Install new seal rings in shaft grooves.



- b. Install magnet retarder aligning the dowel pins of the back with the cover side dowel pin holes securely. Simultaneously insert the harness into the installation groove securely.

### NOTE:

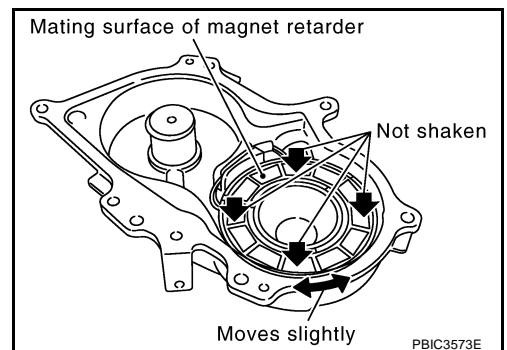
Figure shows the structure of the parts. Therefore, magnet retarder is being removed from the cover in this figure. But, if magnet retarder is in the correct position, omit step "b" and perform step "c".



- c. To check the joint between dowel pins and dowel pin holes, check the looseness in the axle direction by pushing the mating surface of magnet retarder at several places and the circumferential looseness (between dowel pins and dowel pin holes) by twisting in the circumferential direction.

### CAUTION:

Always perform this procedure when removing because the gap between dowel pins and dowel pin holes may not be caused on purpose.



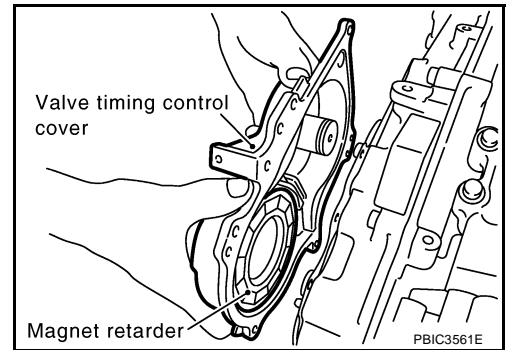
A  
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M

## TIMING CHAIN

- d. Install valve timing control cover to front timing chain case.

**CAUTION:**

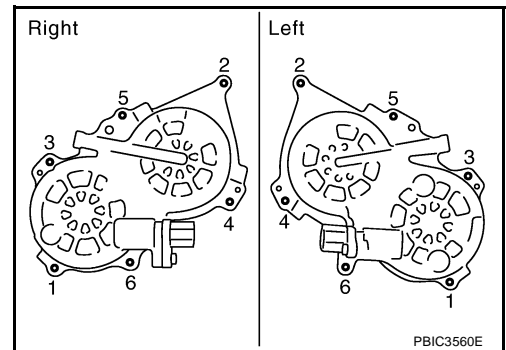
- Do not face the magnet retarder side down to prevent magnet retarder from dropping.
- Check the mating surface of magnet retarder and the drum of exhaust side camshaft sprocket for foreign materials.
- Align the center of both shaft holes of the shaft and the intake side camshaft sprocket, and then insert them.
- Be careful not to drop the seal ring from the shaft groove.
- When setting the valve timing control cover in position by hand, if valve timing control cover is not contacting with the front timing chain case, the dowel pin of magnet retarder may not be aligned with the dowel pin holes of cover. In this case, return to step "b".



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

**CAUTION:**

Completely tighten the mounting bolts with the seat surface of valve timing control cover contacting with front timing chain case.



16. Install oil pans (upper and lower). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#) .

17. Install rocker covers (right and left banks). Refer to [EM-44, "ROCKER COVER"](#) .

18. Install crankshaft pulley as follows:

- a. Fix crankshaft using ring gear stopper [SST: KV10117700 (J44716)].

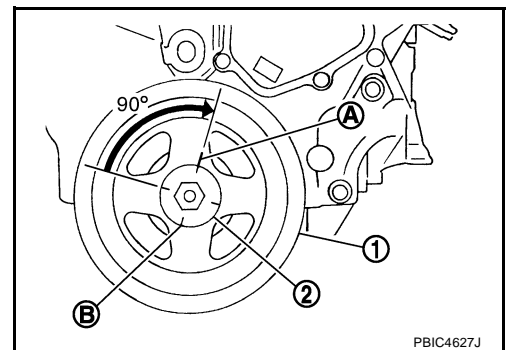
- b. Install crankshaft pulley, taking care not to damage front oil seal.

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

- c. Tighten crankshaft pulley bolt.

: 44.1 N·m (4.5 kg·m, 33 ft·lb)

- d. Place a paint mark (A) on crankshaft pulley (1) aligning with the angle mark (B) on crankshaft pulley bolt (2). Tighten the bolt 90 degrees (angle tightening).



19. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.

20. Install in the reverse order of removal after this step.

# TIMING CHAIN

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-12, "RECOMMENDED 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, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

#### Summary of the inspection items:

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

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

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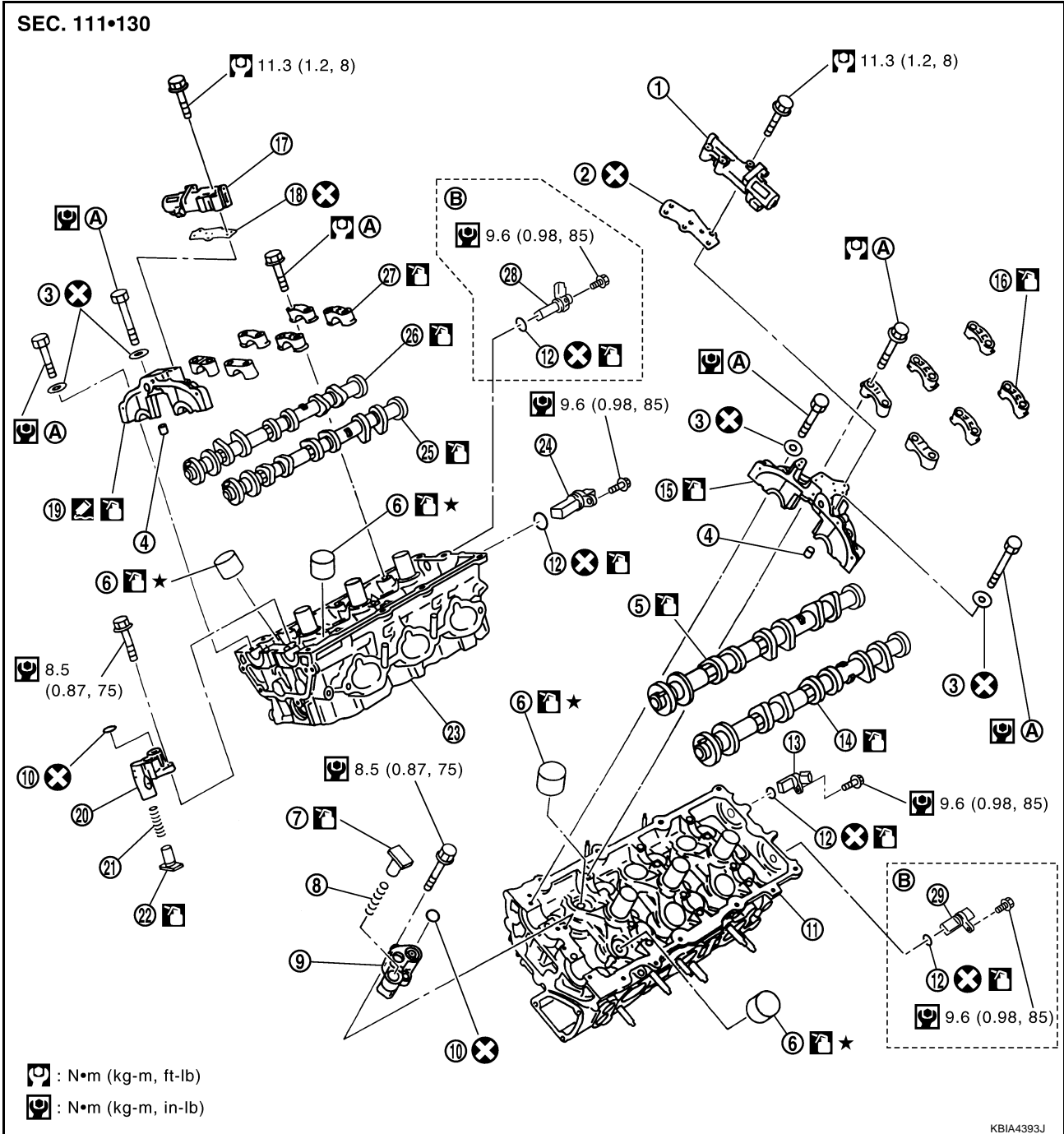
# CAMSHAFT

PFP:13001

## CAMSHAFT

### Removal and Installation

NBS0000T



- |  |  |   |
|--|--|---|
| 1. Intake valve timing control solenoid valve    | 2. Gasket                                      | 3. Seal washer                                    |
| 4. Dowel pin                                     | 5. Camshaft (INT)                              | 6. Valve lifter                                   |
| 7. Plunger                                       | 8. Spring                                      | 9. Timing chain tensioner (Secondary)             |
| 10. O-ring                                       | 11. Cylinder head (left bank)                  | 12. O-ring  |
| 13. Camshaft position sensor (PHASE) (left bank) | 14. Camshaft (EXH)                             | 15. Camshaft bracket (No. 1)                      |
| 16. Camshaft bracket (No. 2 to 4)                | 17. Intake valve timing control solenoid valve | 18. Gasket  |
| 19. Camshaft bracket (No. 1)                     | 20. Timing chain tensioner (Secondary)         | 21. Spring  |
| 22. Plunger                                      | 23. Cylinder head (left bank)                  | 24. Camshaft position sensor (PHASE) (right bank) |

# CAMSHAFT

- |   |  |                                   |
|---|--|-----------------------------------|
| 25. Camshaft (INT)  | 26. Camshaft (EXH)   | 27. Camshaft bracket (No. 2 to 4) |
| 28. Exhaust valve timing control position sensor (right bank) | 29. Exhaust valve timing control position sensor (left bank) |                                   |
| A. Refer to <a href="#">EM-105</a>                            | B. M/T models  |                                   |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

## REMOVAL

1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [EM-59, "TIMING CHAIN"](#).

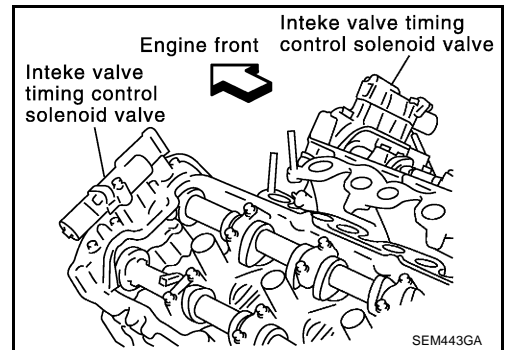
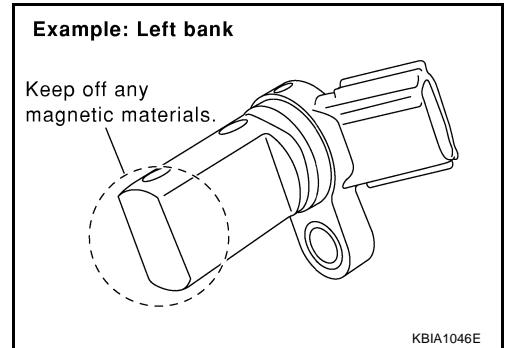
2. Remove camshaft position sensor (PHASE) (right and left banks) and exhaust valve timing control position sensor (right and left banks) (M/T models) from cylinder head back side.

### CAUTION:

- Handle carefully to avoid dropping and shocks.
- Do not disassemble.
- Do not allow metal powder to adhere to magnetic part at sensor tip.
- Do not place sensors in a location where they are exposed to magnetism.

3. Remove intake valve timing control solenoid valves.

- Discard intake valve timing control solenoid valve gaskets and use new gaskets for installation.

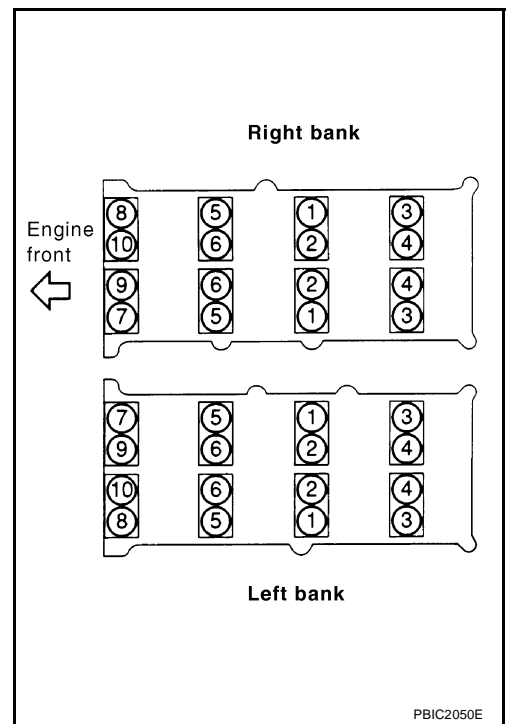


4. Remove intake and exhaust camshaft brackets.

- Mark camshafts, camshaft brackets and bolts so they are placed in the same position and direction for installation.

# CAMSHAFT

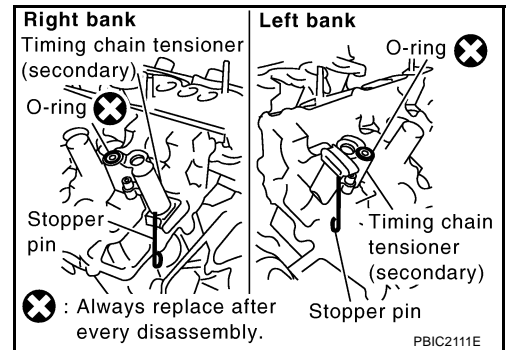
- Equally loosen camshaft bracket bolts in several steps in reverse order as shown in the figure.



- Remove camshaft.
- Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.
- Remove timing chain tensioner (secondary) from cylinder head.
  - Remove timing chain tensioner (secondary) with its stopper pin attached.

**NOTE:**

Stopper pin was attached when timing chain (secondary) was removed.



## INSPECTION AFTER REMOVAL

### Camshaft Runout

- Put V-block on precise flat table, and support No. 2 and 4 journals of camshaft.

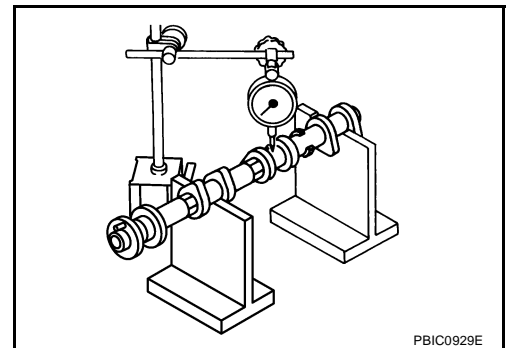
**CAUTION:**

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

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

**Standard** : Less than 0.02 mm (0.0008 in)  
**Limit** : 0.05 mm (0.0020 in)

- If it exceeds the limit, replace camshaft.



# CAMSHAFT

## Camshaft Cam Height

1. Measure the camshaft cam height with a micrometer.

### Standard cam height:

#### Intake

##### A/T models

: 44.865 - 45.055 mm (1.7663 - 1.7738 in)

##### M/T models

: 45.865 - 46.055 mm (1.8057 - 1.8132 in)

#### Exhaust

##### A/T models

: 44.865 - 45.055 mm (1.7663 - 1.7738 in)

##### M/T models

: 45.875 - 46.065 mm (1.8061 - 1.8136 in)

### Cam wear limit

: 0.2 mm (0.008 in)

2. If wear is beyond the limit, replace camshaft.

## Camshaft Journal Oil Clearance

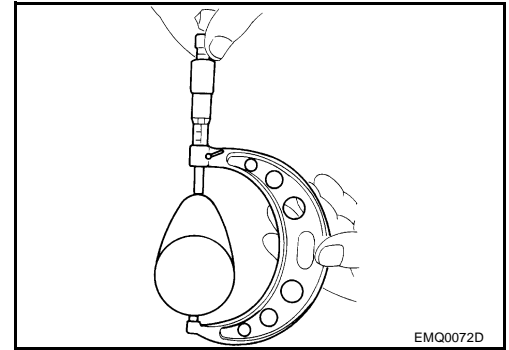
### CAMSHAFT JOURNAL DIAMETER

- Measure the outer diameter of camshaft journal with a micrometer.

### Standard:

No. 1 : 25.935 - 25.955 mm (1.0211 - 1.0218 in)

No. 2, 3, 4 : 23.445 - 23.465 mm (0.9230 - 0.9238 in)



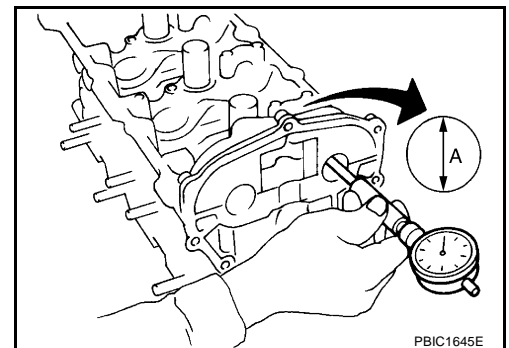
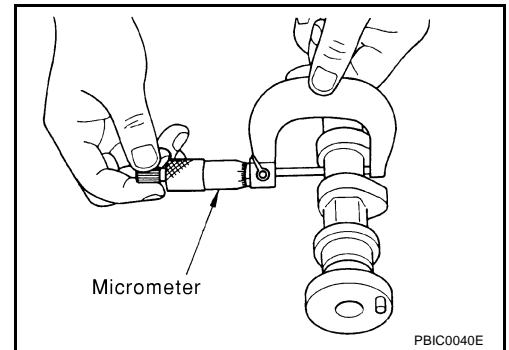
### CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolt with the specified torque. Refer to [EM-105, "INSTALLATION"](#) for the tightening procedure.
- Measure the inner diameter "A" of camshaft bracket with a bore gauge.

### Standard:

No. 1 : 26.000 - 26.021 mm (1.0236 - 1.0244 in)

No. 2, 3, 4 : 23.500 - 23.521 mm (0.9252 - 0.9260 in)



### CAMSHAFT JOURNAL OIL CLEARANCE

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

### Standard:

No. 1 : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

No. 2, 3, 4 : 0.035 - 0.076 mm (0.0014 - 0.0030 in)

Limit : 0.15 mm (0.0059 in)

# CAMSHAFT

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

## NOTE:

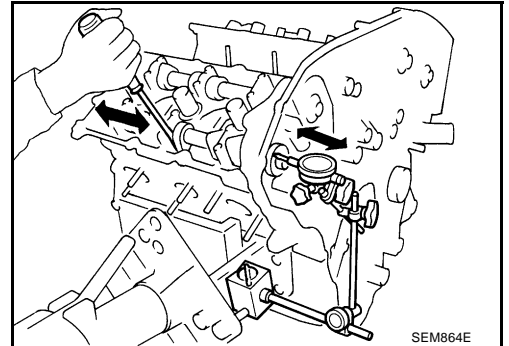
Camshaft brackets cannot be replaced as single parts, because there are machined together with cylinder head. Replace whole cylinder head assembly.

## Camshaft End Play

- Install a dial indicator in thrust direction on front end of camshaft. Measure the end play of a dial indicator when camshaft is moved forward/backward (in direction to axis).

**Standard** : 0.115 - 0.188 mm (0.0045 - 0.0074 in)

**Limit** : 0.24 mm (0.0094 in)



- Measure the following parts if out of the limit.

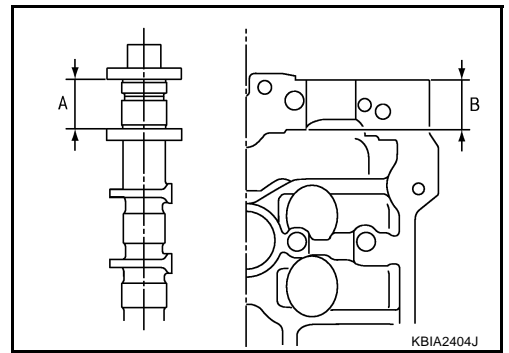
- Dimension "A" for camshaft No. 1 journal

**Standard** : 27.500 - 27.548 mm (1.0827 - 1.0846 in)

- Dimension "B" for cylinder head No. 1 journal bearing

**Standard** : 27.360 - 27.385 mm (1.0772 - 1.0781 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 4 journal of camshaft.

### CAUTION:

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

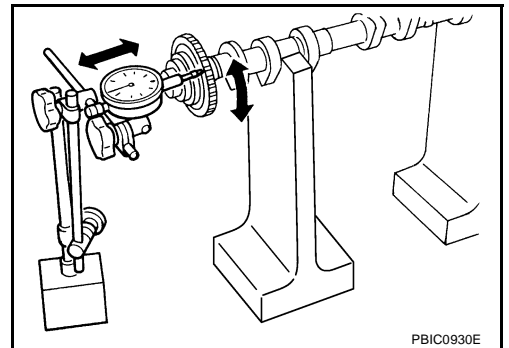
2. Measure the camshaft sprocket runout with a dial indicator. (Total indicator reading)

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

- If it exceeds the limit, replace camshaft sprocket.

### CAUTION:

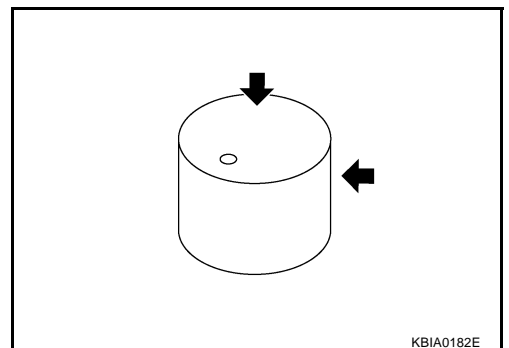
**When replacing camshaft sprocket (EXH), replace valve timing control cover (including magnet retarder and cover). (M/T models)**



## Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-170](#), "[Available Valve Lifter](#)".





# CAMSHAFT

## Valve Lifter Clearance

### VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter at 1/2 height of valve lifter with a micrometer since valve lifter is in barrel shape.

#### Standard

**Intake : 33.977 - 33.987 mm (1.3377 - 1.3381 in)**

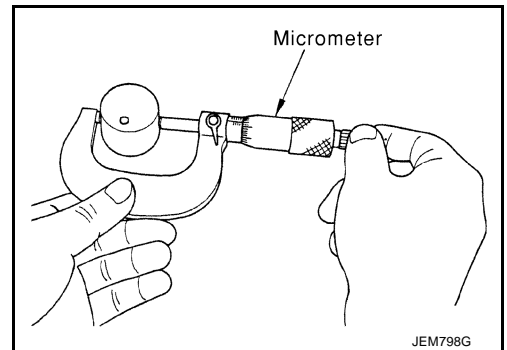
#### Exhaust

**Identification (stamped) mark "R"**

**: 33.977 - 33.987 mm (1.3377 - 1.3381 in)**

**Identification (stamped) mark "V"**

**: 33.980 - 33.990 mm (1.3378 - 1.3382 in)**

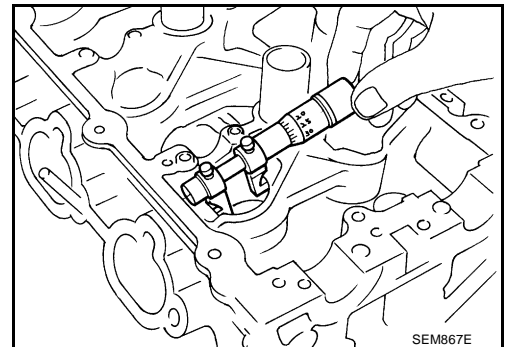


### VALVE LIFTER HOLE DIAMETER

- Measure the inner diameter of valve lifter hole of cylinder head with an inside micrometer.

#### Standard (Intake and exhaust)

**: 34.000 - 34.016 mm (1.3386 - 1.3392 in)**



### VALVE LIFTER CLEARANCE

- $(\text{Valve lifter clearance}) = (\text{Valve lifter hole diameter}) - (\text{Valve lifter outer diameter})$

#### Standard

**Intake : 0.013 - 0.039 mm (0.0005 - 0.0015 in)**

#### Exhaust

**Identification (stamped) mark "R"**

**: 0.013 - 0.039 mm (0.0005 - 0.0015 in)**

**Identification (stamped) mark "V"**

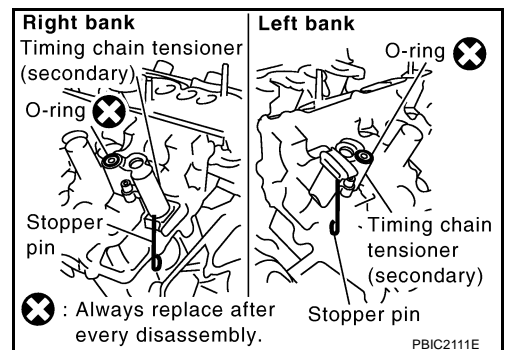
**: 0.010 - 0.036 mm (0.0004 - 0.0014 in)**

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

## INSTALLATION

1. Install timing chain tensioners (secondary) on both sides of cylinder head.

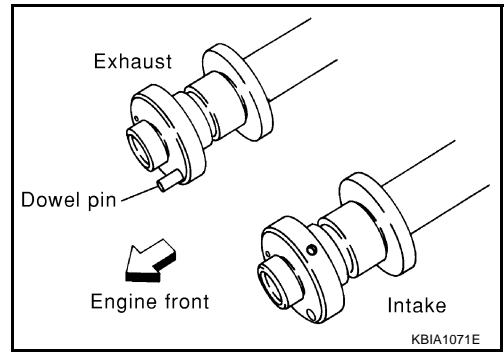
- Install timing chain tensioner with its stopper pin attached.
- Install timing chain tensioner with sliding part facing downward on right-side cylinder head, and with sliding part facing upward on left-side cylinder head.
- Install new O-ring as shown in the figure.



2. Install valve lifter.
  - Install it in the original position.
3. Install camshafts. (A/T models)

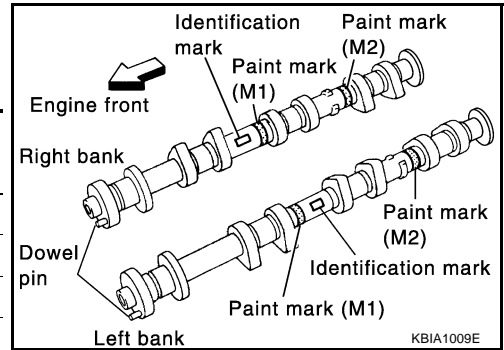
# CAMSHAFT

- Install camshaft with dowel pin attached to its front end face on the exhaust side.



- Follow your identification marks made during removal, or follow the identification marks that are present on new camshafts for proper placement and direction.

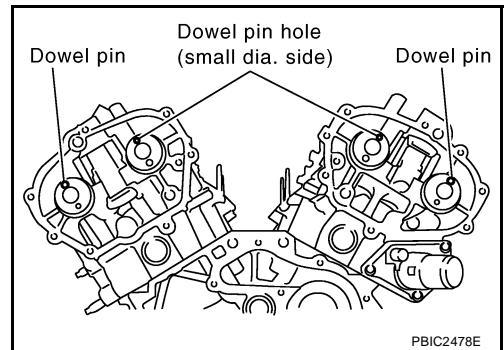
Bank	INT/EXH	Dowel pin	Paint marks		Identification mark
			M1	M2	
RH	INT	No	Pink	No	RE
	EXH	Yes	No	Orange	RE
LH	INT	No	Pink	No	LH
	EXH	Yes	No	Orange	LH



- Install camshaft so that dowel pin hole and dowel pin on front end face are positioned as shown in the figure. (No. 1 cylinder TDC on its compression stroke)

**NOTE:**

- Large and small pin holes are located on front end face of camshaft (INT), at intervals of 180 degrees. Face small dia. side pin hole upward (in cylinder head upper face direction).
- 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.

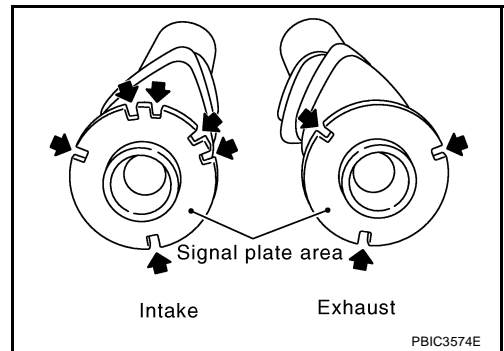


4. Install camshafts. (M/T models)

- The distinguishing between intake and exhaust depends on the difference of the shape (the number of the notch) of the signal plate area on rear end of camshaft.

**Intake : 6 notches**

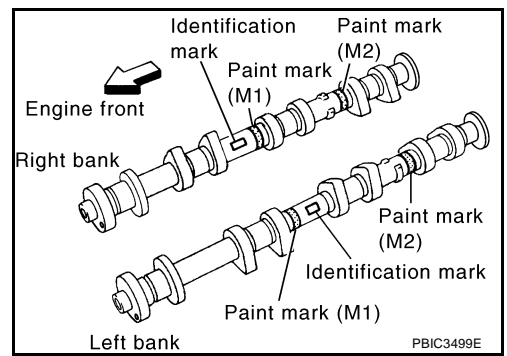
**Exhaust : 3 notches**



# CAMSHAFT

- Follow your identification marks made during removal, or follow the identification marks that are present on new camshafts for proper placement and direction.

Bank	INT/EXH	Paint marks		Identification mark
		M1	M2	
RH	INT	Brown	No	RE
	EXH	No	Brown	RE
LH	INT	Brown	No	LH
	EXH	No	Brown	LH

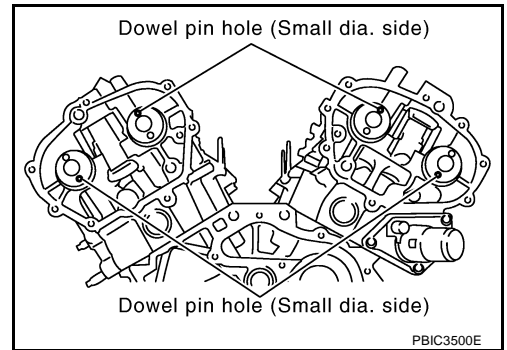


- Install camshaft so that dowel pin hole (small dia. side) front end face are positioned as shown in the figure. (No. 1 cylinder TDC on its compression stroke)

**Intake** : On cylinder head upper surface  
**Exhaust** : On cylinder head lower surface

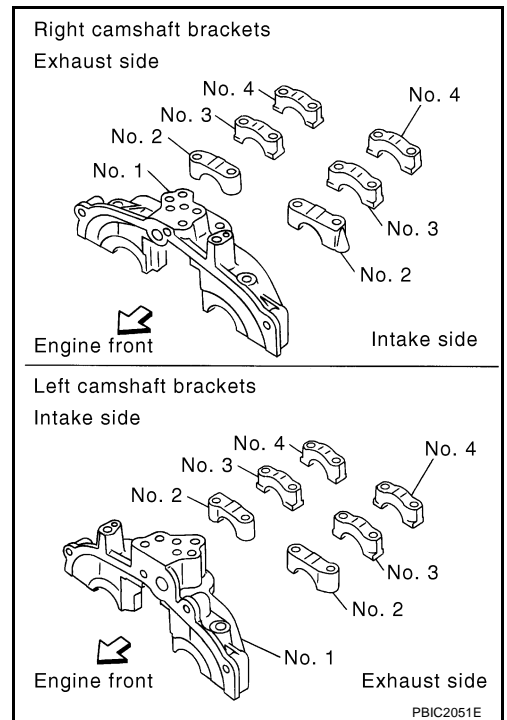
**NOTE:**

- Large and small dowel pin holes are located on the front end of camshaft at 180 degree intervals. Only the small dowel pin hole position is described in this text because the large dowel pin hole is not used for assembly of engine.
- 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.



5. Install camshaft brackets.

- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Install camshaft bracket in original position and direction as shown in the figure.

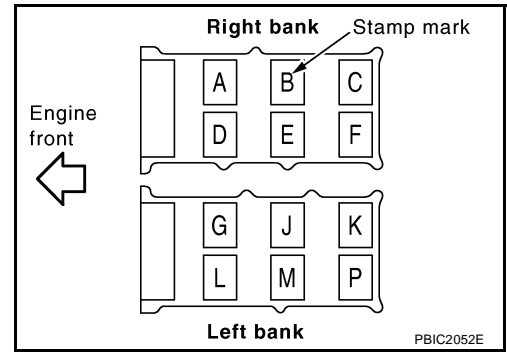


# CAMSHAFT

- Install camshaft brackets (No. 2 to 4) aligning the stamp marks as shown in the figure.

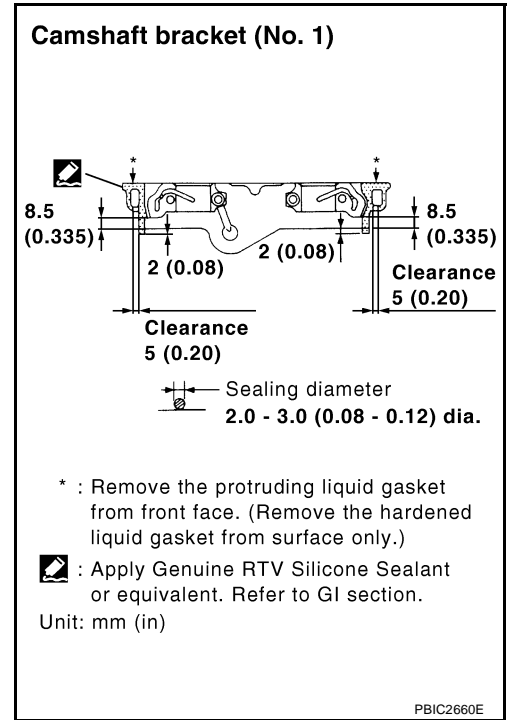
**NOTE:**

There are no identification marks indicating left and right for camshaft bracket (No. 1).



- Apply liquid gasket to mating surface of camshaft bracket (No. 1) as shown on right and left banks.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**



6. Tighten camshaft bracket bolts in the following steps, in numerical order as shown in the figure.

- a. Tighten No. 7 to 10 in numerical order as shown.

: 1.96 N·m (0.2 kg-m, 17 in-lb)

- b. Tighten No. 1 to 6 in numerical order as shown.

: 1.96 N·m (0.2 kg-m, 17 in-lb)

- c. Tighten No. 1 to 10 in numerical order as shown.

: 5.88 N·m (0.6 kg-m, 52 in-lb)

- d. Tighten No. 1 to 6 in numerical order as shown.

: 9.02 - 11.8 N·m (0.92 - 1.20 kg-m, 80 - 104 in-lb)

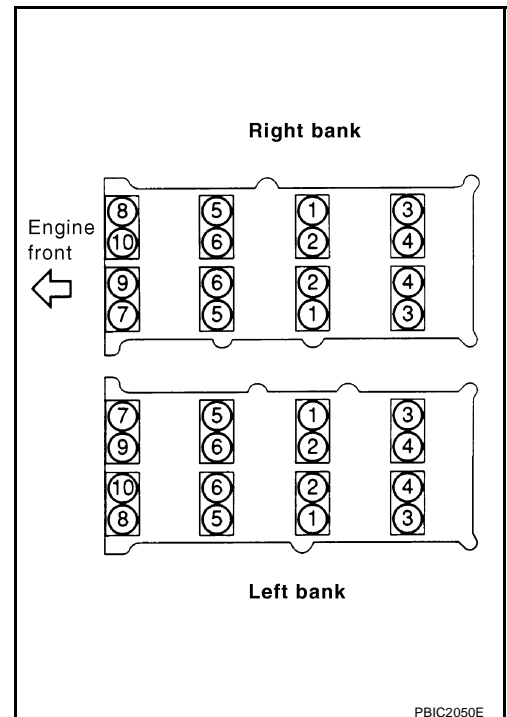
- e. Tighten No. 7 to 10 in numerical order as shown.

: 8.3 - 10.3 N·m (0.85 - 1.0 kg-m, 74 - 91 in-lb)

**CAUTION:**

After tightening mounting bolts of camshaft brackets (No. 1), be sure to wipe off excessive liquid gasket from the parts list below.

- Mating surface of rocker cover



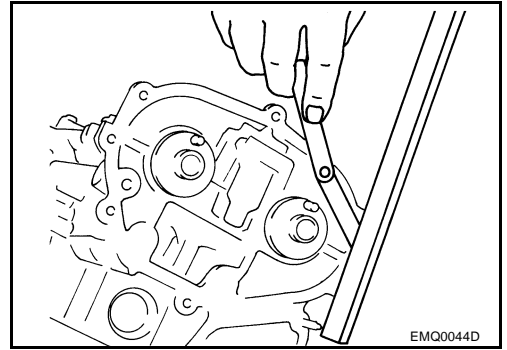
# CAMSHAFT

- **Mating surface of rear timing chain case**

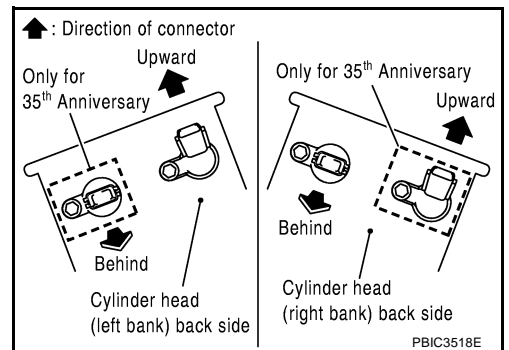
7. Measure difference in levels between front end faces of camshaft bracket (No. 1) and cylinder head.

**Standard : -0.14 to 0.14 mm (-0.0055 to 0.0055 in)**

- Measure two positions (both intake and exhaust side) for a single bank.
- If the measured value is out of the standard, re-install camshaft bracket (No. 1).



8. Inspect and adjust the valve clearance. Refer to [EM-111, "Valve Clearance"](#).
9. Install camshaft position sensor (PHASE) (right and left banks) and exhaust valve timing control position sensor (right and left banks) (M/T models) to the cylinder head back side.
- Install them in the position shown in the figure.



10. Install in the reverse order of removal after this step.

# CAMSHAFT

## INSPECTION AFTER INSTALLATION

### Inspection of Camshaft Sprocket (INT) Oil Groove

#### CAUTION:

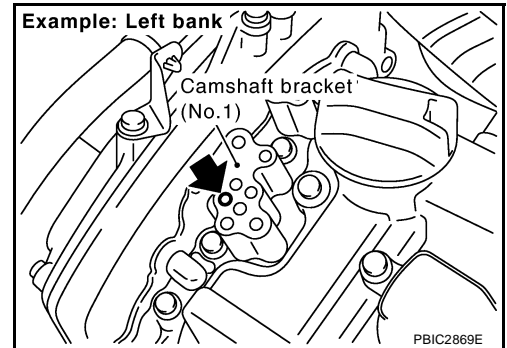
- Perform this inspection only when DTC P0011 or P0021 are detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to [EC-83, "TROUBLE DIAGNOSIS"](#).
- Check when engine is cold so as to prevent burns from any splashing engine oil.
  1. Check the engine oil level. Refer to [LU-7, "ENGINE OIL"](#).
  2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
    - a. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
    - b. Disconnect ignition coil and injector harness connectors.
  3. Remove intake valve timing control solenoid valve. Refer to [EM-100, "CAMSHAFT"](#).
  4. Crank the engine, and then make sure that engine oil comes out from camshaft bracket (No. 1) oil hole. End crank after checking.

#### WARNING:

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

#### CAUTION:

Engine oil may squirt from intake valve timing control solenoid valve installation hole during cranking. Use a shop cloth to prevent the engine components and the vehicle. Do not allow engine oil to get on rubber components such as drive belt or engine mount insulators. Immediately wipe off any splashed engine oil.



- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from camshaft bracket (No. 1) oil hole. Refer to [LU-4, "LUBRICATION SYSTEM"](#).
- 5. 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-4, "LUBRICATION SYSTEM"](#).
- 6. After inspection, install removed parts.

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-12, "RECOMMENDED 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, 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.

# CAMSHAFT

## 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	—

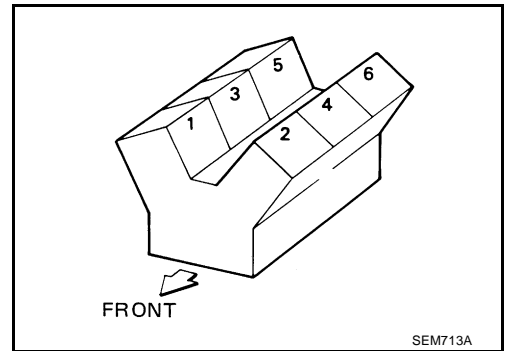
\* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

## Valve Clearance INSPECTION

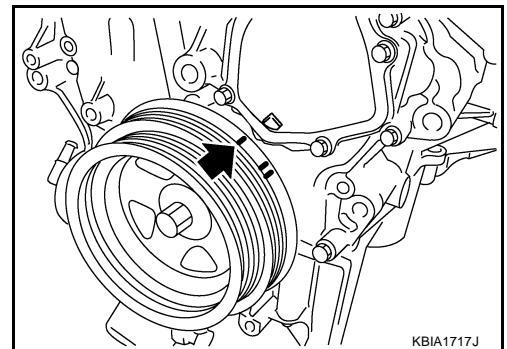
NBS0000U

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.

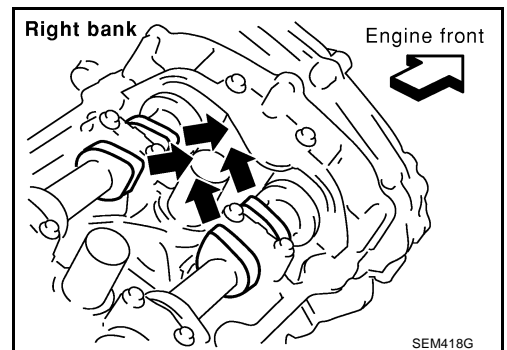
In cases of removing/installing or replacing camshaft and valve-related parts, or of unusual engine conditions due to changes in valve clearance (found malfunctions during starting, idling or causing noise), perform inspection as follows:



1. Remove rocker covers (right and left bank). Refer to [EM-44, "ROCKER COVER"](#).
2. Measure the valve clearance as follows:
  - a. Set No. 1 cylinder at TDC of its compression stroke.
    - Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.

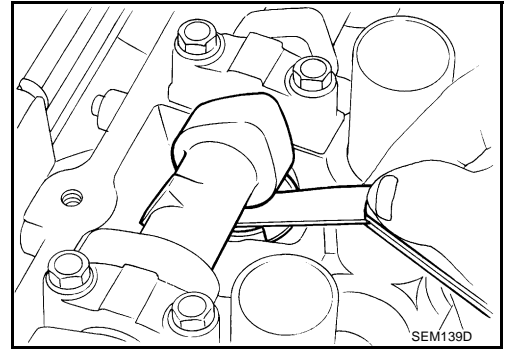


- Make sure that intake and exhaust cam nose on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.



# CAMSHAFT

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



## Valve clearance:

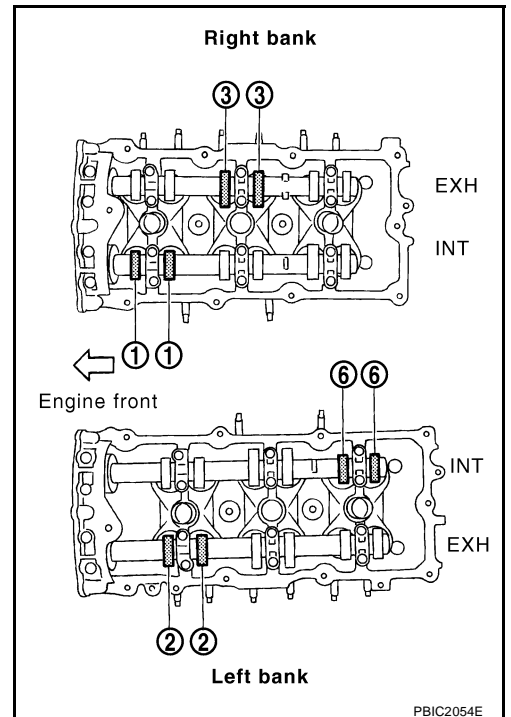
Unit: mm (in)

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)

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure).
- No. 1 cylinder at compression TDC

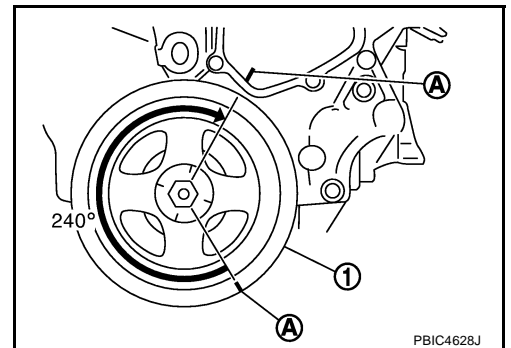
Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 1 cylinder at compression TDC	EXH		x	
	INT	x		
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 1 cylinder at compression TDC	INT			x
	EXH	x		



- c. Rotate crankshaft by 240 degrees clockwise (when viewed from engine front) to align No. 3 cylinder at TDC of its compression stroke.

### NOTE:

- To align cylinder No. 3 with the compression top dead center, place matching marks (A) on the crankshaft pulley (1) side and on the cylinder block side at a point 240° counterclockwise from the compression top dead center using the hex head of the crankshaft pulley bolt as a guide.

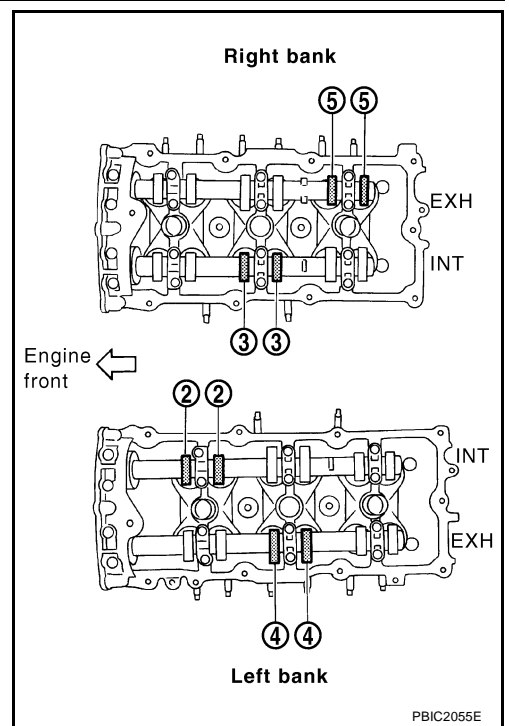




# CAMSHAFT

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure).
- No. 3 cylinder at compression TDC

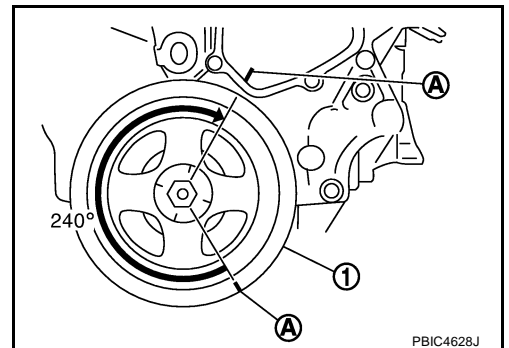
Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 3 cylinder at compression TDC	EXH			x
	INT		x	
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 3 cylinder at compression TDC	INT	x		
	EXH		x	



- d. Rotate crankshaft by 240 degrees clockwise (when viewed from engine front) to align No. 5 cylinder at TDC of its compression stroke.

**NOTE:**

- To align cylinder No. 5 with the compression top dead center, place matching marks (A) on the crankshaft pulley (1) side and on the cylinder block side at a point 240° counterclockwise from the compression top dead center using the hex head of the crankshaft pulley bolt as a guide.

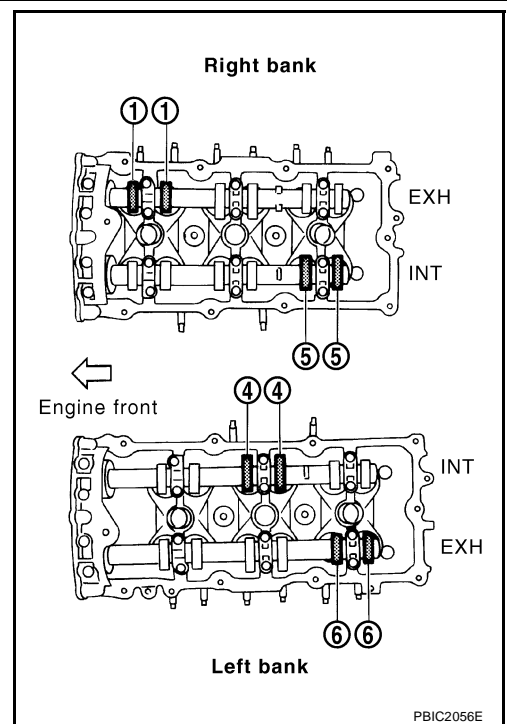


A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

# CAMSHAFT

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure).
- No. 5 cylinder at compression TDC

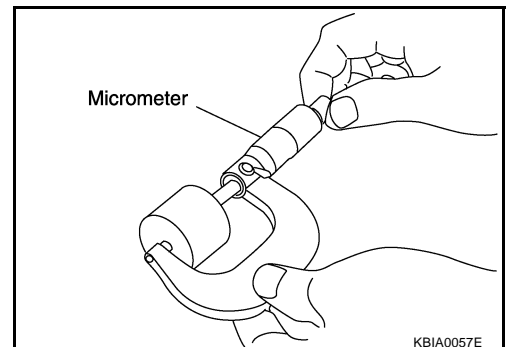
Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 5 cylinder at compression TDC	EXH	x		
	INT			x
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 5 cylinder at compression TDC	INT		x	
	EXH			x



3. If the measured values are out of the standard, perform adjustment. Refer to [EM-114, "ADJUSTMENT"](#) .

## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
1. Measure the valve clearance. Refer to [EM-111, "INSPECTION"](#) .
  2. Remove camshaft. Refer to [EM-101, "REMOVAL"](#) .
  3. Remove valve lifters at the locations that are out of the standard.
  4. Measure the center thickness of removed valve lifters with a micrometer.



5. 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)\***

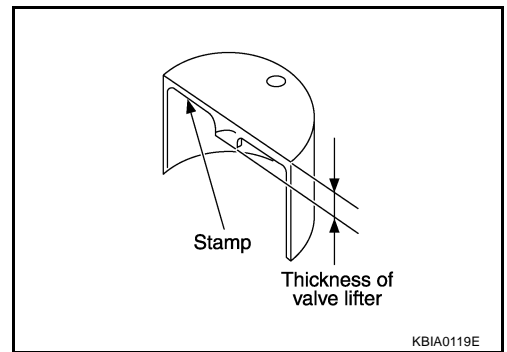
**\*: Approximately 20°C (68°F)**

# CAMSHAFT

- Thickness of new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder). Stamp mark 788U, 788R or 788V indicates 7.88 mm (0.3102 in) in thickness.

**NOTE:**

Three types of stamp marks are used for parallel setting and for manufacturer identification.



Stamp mark			Thickness
INT	EXH		
788U	788R	788V	7.88 mm
790U	790R	790V	7.90 mm
.	.	.	.
.	.	.	.
840U	840R	840V	8.40 mm

Available thickness of valve lifter: 27 sizes with range 7.88 to 8.40 mm (0.3102 to 0.3307 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-170, "Available Valve Lifter"](#) .

**CAUTION:**

- **Install identification letters at each of proper positions.**
- **Never mis-install the valve lifter.**

6. Install selected valve lifter.
7. Install camshaft. Refer to [EM-105, "INSTALLATION"](#) .
8. Manually turn crankshaft pulley a few turns.
9. Make sure that the valve clearances for cold engine are within the specifications by referring to the specified values. Refer to [EM-111, "INSPECTION"](#) .
10. Install all removal parts in the reverse order of removal. Refer to [EM-105, "INSTALLATION"](#) .
11. Warm up the engine, and check for unusual noise and vibration.

# OIL SEAL

## OIL SEAL

PFP:00100

### Removal and Installation of Valve Oil Seal REMOVAL

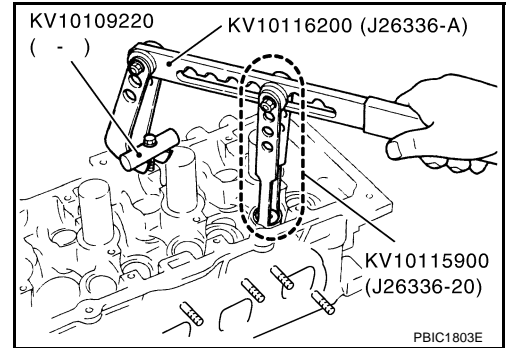
NBS0000V

1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-100, "CAMSHAFT"](#) .
2. Remove valve lifters. Refer to [EM-100, "CAMSHAFT"](#) .
3. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.
4. Remove valve collet.

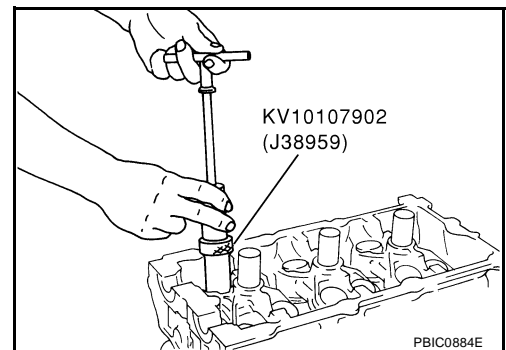
- Compress valve spring with valve spring compressor, attachment, adapter (SST). Remove valve collet with magnet hand.

**CAUTION:**

**When working, take care not to damage valve lifter holes.**



5. Remove valve spring retainer, valve spring and valve spring seat.
6. Remove valve oil seal using valve oil seal puller (SST).



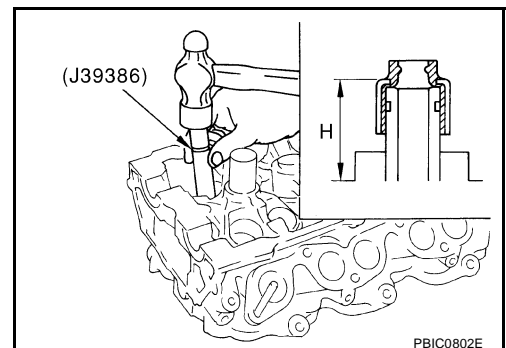
### INSTALLATION

1. Apply engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift (SST), press fit valve oil seal to height "H" shown in the figure.

**NOTE:**

Dimension "H": Height measured before valve spring seat installation

**Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)**



3. Install in the reverse order of removal after this step.

# OIL SEAL

NBS0000W

A

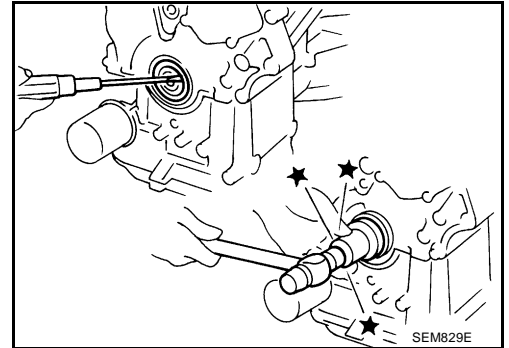
## Removal and Installation of Front Oil Seal

### REMOVAL

1. Remove the following parts:
  - Undercover
  - Drive belts: Refer to [EM-14, "DRIVE BELTS"](#) .
  - Radiator cooling fan assembly: Refer to [CO-22, "COOLING FAN"](#) .
  - Starter motor: Refer to [SC-10, "STARTING SYSTEM"](#) .
  - Crankshaft pulley: Refer to [EM-59, "TIMING CHAIN"](#) .
2. Remove front oil seal using suitable tool.

#### CAUTION:

**Be careful not to damage front timing chain case and crankshaft.**



EM

C

D

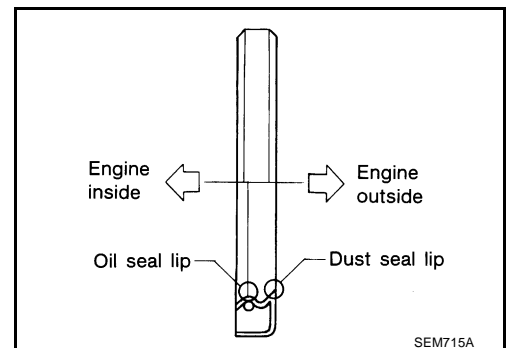
E

F

G

### INSTALLATION

1. Apply engine oil to both oil seal lip and dust seal lip of new front oil seal.
2. Install front oil seal.
  - Install front oil seal so that each seal lip is oriented as shown in the figure.



H

I

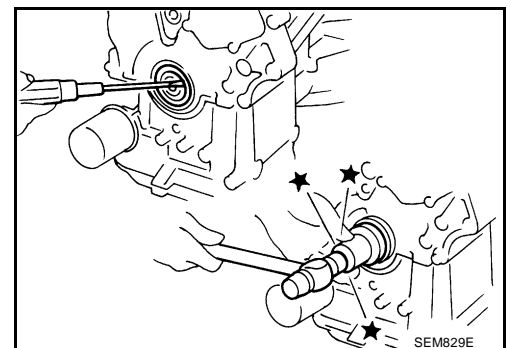
J

K

- Using suitable drift, press-fit until the height of front oil seal is level with the mounting surface.
- Suitable drift: outer diameter 60 mm (2.36 in), inner diameter 50 mm (1.97 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.**



L

M

3. Install in the reverse order of removal after this step.

## Removal and Installation of Rear Oil Seal

NBS0000X

### REMOVAL

1. Remove oil pan (upper). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#) .
2. Remove transmission assembly. Refer to [MT-18, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
3. Remove clutch cover and clutch disk (M/T models). Refer to [CL-16, "CLUTCH DISC, CLUTCH COVER"](#) .
4. Remove flywheel (M/T models) or drive plate (A/T models). Refer to [EM-137, "CYLINDER BLOCK"](#) .

# OIL SEAL

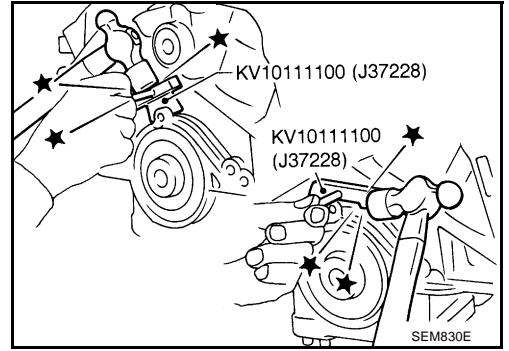
5. Use seal cutter (SST) to cut away liquid gasket and remove rear oil seal retainer.

**CAUTION:**

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

**NOTE:**

Regard both rear oil seal and retainer as an assembly.

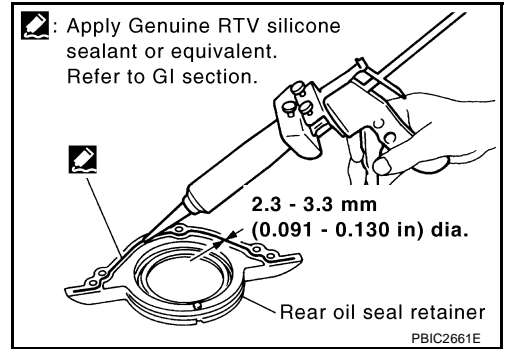


## INSTALLATION

1. Remove old liquid gasket on mating surface of cylinder block and oil pan (upper) using scraper.
2. Apply new engine oil to both oil seal lip and dust seal lip of new rear oil seal retainer.
3. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to rear oil seal retainer as shown in the figure.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**

- Assembly should be done within 5 minutes after coating.



4. Install rear oil seal retainer to cylinder block. Refer to [EM-137, "CYLINDER BLOCK"](#) .
  - Make sure the garter spring is in position and seal lips not inverted.
5. Install in the reverse order of removal after this step.

# CYLINDER HEAD

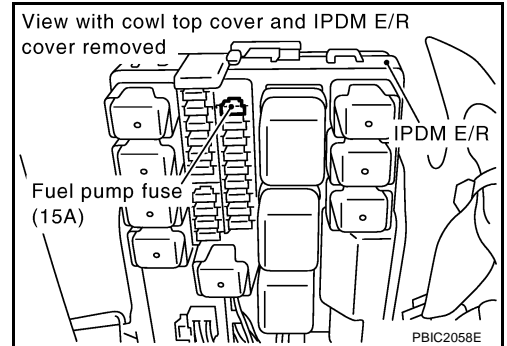
## CYLINDER HEAD

PFP:11041

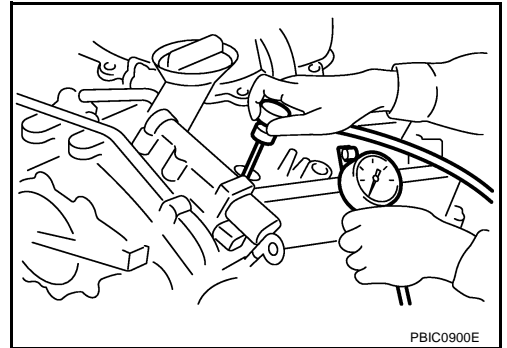
### On-Vehicle Service CHECKING COMPRESSION PRESSURE

NBS0000Y

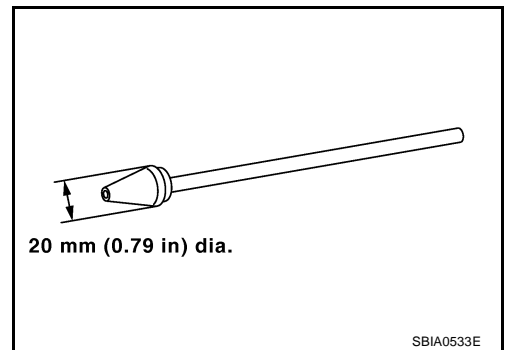
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#) .
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.



4. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-35, "IGNITION COIL"](#) and [EM-36, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#) .
6. Connect engine tachometer (not required in use of CONSULT-II).
7. Install compression tester with adapter onto spark plug hole.



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



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

#### Compression pressure:

Unit: kPa (kg/cm<sup>2</sup> , psi)/rpm

Standard	Minimum	Differential limit between cylinders
1,275 (13.0, 185)/300	981 (10.0, 142)/300	98 (1.0, 14)/300

#### CAUTION:

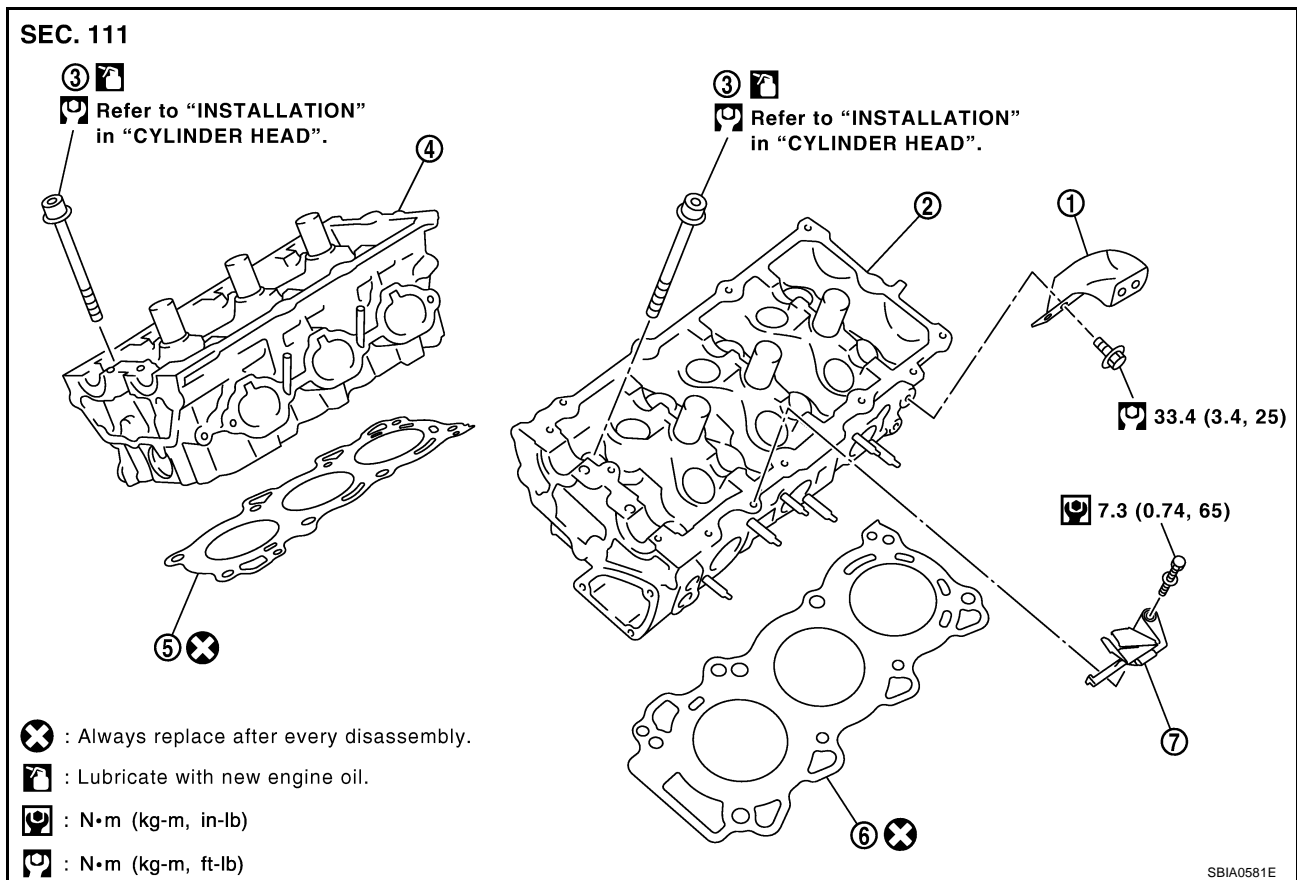
Always use a fully charged battery to obtain specified engine speed.

# CYLINDER HEAD

- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
  - If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
    - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check the 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.
9. After inspection is completed, install removed parts.
10. Start engine, and make sure that engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-83, "TROUBLE DIAGNOSIS"](#) .

## Removal and Installation

NBS0000Z



- |                               |                                      |                                     |
|-------------------------------|--------------------------------------|-------------------------------------|
| 1. Engine rear lower slinger  | 2. Cylinder head (left bank)         | 3. Cylinder head bolt               |
| 4. Cylinder head (right bank) | 5. Cylinder head gasket (right bank) | 6. Cylinder head gasket (left bank) |
| 7. Oil level gauge guide      |                                      |                                     |

## REMOVAL

1. Remove camshaft. Refer to [EM-100, "CAMSHAFT"](#) .

### NOTE:

It is also possible to perform the following steps 2 and 3 just before removing the camshaft.

2. Temporarily fit front suspension member to support engine. Refer to [FSU-19, "FRONT SUSPENSION MEMBER"](#) .



# CYLINDER HEAD

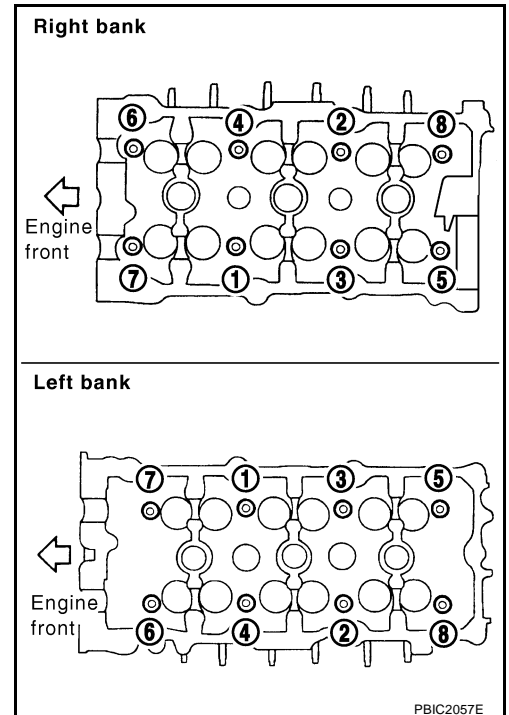
## CAUTION:

Temporary fitting means the status that engine is adequately stable though the hoist is released from hanging.

## NOTE:

At the time of the start of this procedure front suspension member is removed, and cylinder head is hanged by the hoist with engine slinger installed.

3. Release the hoist from hanging, then remove the engine slinger.
4. Remove the following parts:
  - Fuel tube and fuel injector assembly: Refer to [EM-38, "FUEL INJECTOR AND FUEL TUBE"](#) .
  - Intake manifold: Refer to [EM-23, "INTAKE MANIFOLD"](#) .
  - Exhaust manifold: Refer to [EM-25, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
  - Water inlet and thermostat assembly: Refer to [CO-29, "WATER INLET AND THERMOSTAT ASSEMBLY"](#) .
  - Water outlet and water pipe: Refer to [CO-31, "WATER OUTLET AND WATER PIPING"](#) .
5. Remove cylinder head bolts in reverse order as shown in the figure with cylinder head bolt wrench (commercial service tool).



6. Remove cylinder head gaskets.

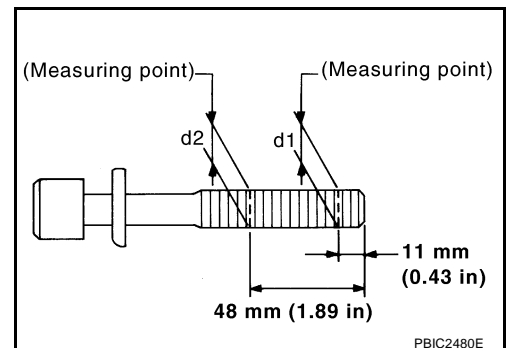
## INSPECTION AFTER REMOVAL

### 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 new one.

**Limit ("d1" – "d2") : 0.11 mm (0.0043 in)**

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



# CYLINDER HEAD

## Cylinder Head Distortion

### NOTE:

When performing this inspection, cylinder block distortion should be also checked. Refer to [EM-160, "CYLINDER BLOCK DISTORTION"](#) .

1. Using scraper, wipe off oil, scale, gasket, sealant and carbon deposits from surface of cylinder head.

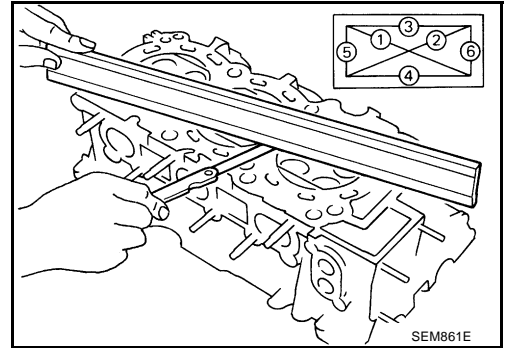
### CAUTION:

**Do not allow gasket fragments to enter engine oil or engine coolant passages.**

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

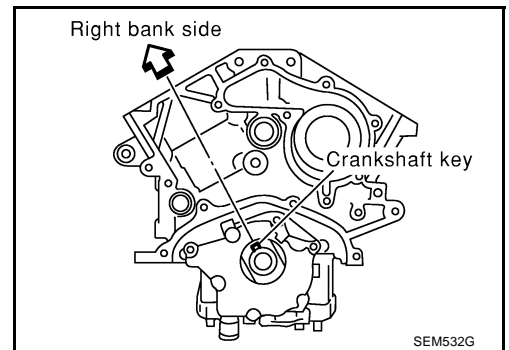
**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace cylinder head.



## INSTALLATION

1. Install new cylinder head gaskets.
2. Turn crankshaft until No. 1 piston is set at TDC.
  - Crankshaft key should line up with the right bank cylinder center line as shown in the figure.



3. Install cylinder head follow the steps below to tighten cylinder head bolts in numerical order as shown in the figure.

### CAUTION:

**If cylinder head bolts re-used, check their outer diameters before installation. Refer to [EM-121, "Cylinder Head Bolts Outer Diameter"](#) .**

- a. Apply new engine oil to threads and seat surfaces of cylinder head bolts.
- b. Tighten all cylinder head bolts.

: **98.1 N-m (10 kg-m, 72 ft-lb)**

- c. Completely loosen all cylinder head bolts.

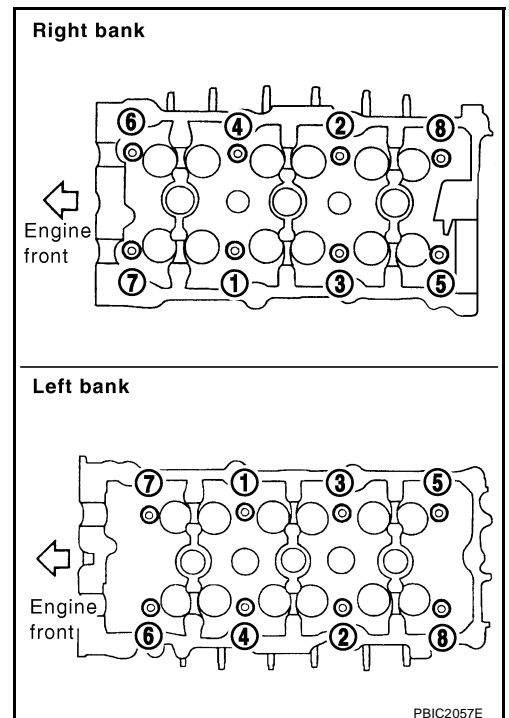
: **0 N-m (0 kg-m, 0 ft-lb)**

### CAUTION:

**In step "c", loosen bolts in reverse order of that indicated in the figure.**

- d. Tighten all cylinder head bolts.

: **34.3 - 44.1 N-m (3.5 - 4.4 kg-m, 26 - 32 ft-lb)**



# CYLINDER HEAD

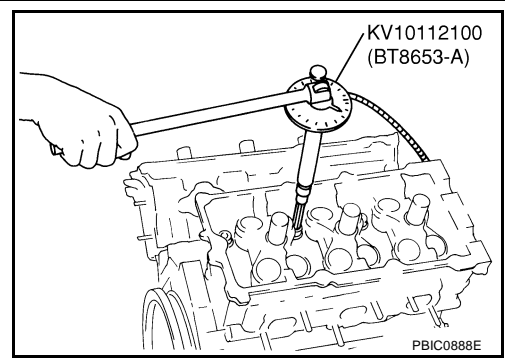
- e. Turn all bolts 90 to 95 degrees clockwise [target: 90 degrees (angle tightening)].

**CAUTION:**

**Check the tightening angle by using angle wrench (SST). Avoid judgment by visual inspection without tool.**

- Check tightening angle indicated on angle wrench (SST) indicator plate.

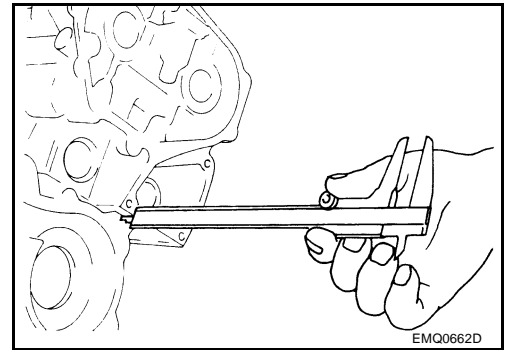
- f. Turn all bolts 90 to 95 degrees clockwise again [target: 90 degrees (angle tightening)].



4. After installing cylinder head, measure distance between front end faces of cylinder block and cylinder head (left and right banks).

**Standard : 14.1 - 14.9 mm (0.555 - 0.587 in)**

- If the measured value is out of the standard, re-install cylinder head.



5. Install in the reverse order of removal after this step.

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-12, "RECOMMENDED 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:

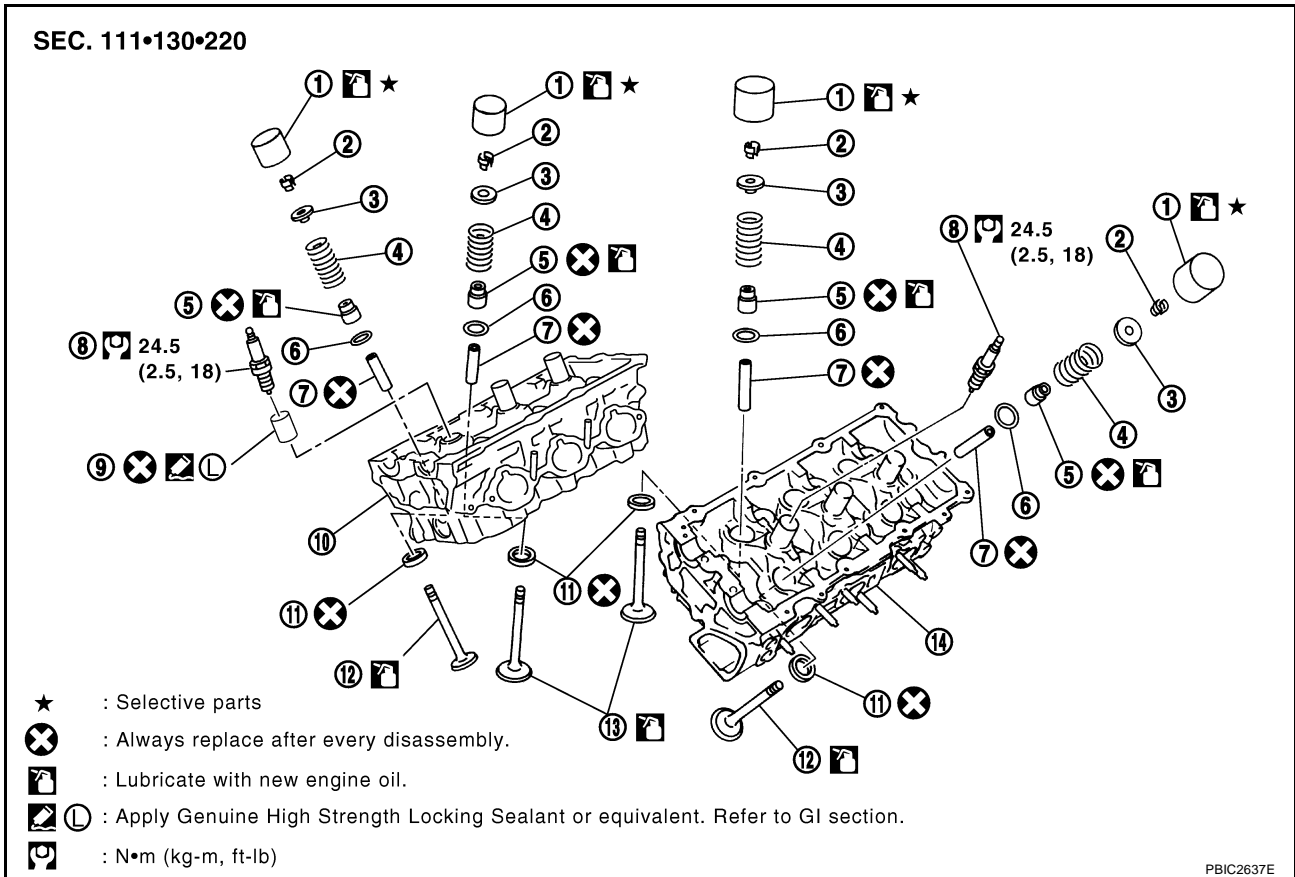
Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

# CYLINDER HEAD

## Disassembly and Assembly

NBS00010



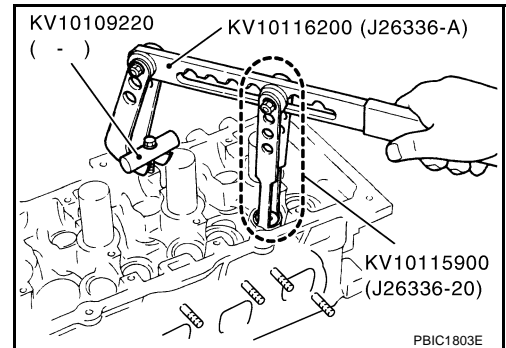
- |                                |                               |                          |
|--------------------------------|-------------------------------|--------------------------|
| 1. Valve lifter                | 2. Valve collet               | 3. Valve spring retainer |
| 4. Valve spring                | 5. Valve oil seal             | 6. Valve spring seat     |
| 7. Valve guide                 | 8. Spark plug                 | 9. Spark plug tube       |
| 10. Cylinder head (right bank) | 11. Valve seat                | 12. Valve (EXH)          |
| 13. Valve (INT)                | 14. Cylinder head (left bank) |                          |

### DISASSEMBLY

- Remove spark plug with spark plug wrench (commercial service tool).
- Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.
- Remove valve collet.
  - Compress valve spring with valve spring compressor, attachment and adapter (SST). Remove valve collet with magnet hand.

### CAUTION:

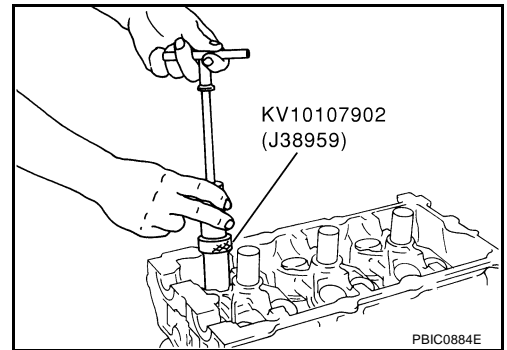
When working, take care not to damage valve lifter holes.



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

# CYLINDER HEAD

6. Remove valve oil seals using valve oil seal puller (SST).



7. If valve seat must be replaced, refer to [EM-129, "VALVE SEAT REPLACEMENT"](#).
8. If valve guide must be replaced, refer to [EM-127, "VALVE GUIDE REPLACEMENT"](#).
9. Remove spark plug tube, as necessary.

- Using pair of pliers, pull spark plug tube out of cylinder head.

**CAUTION:**

- Take care not to damage cylinder head.
- Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.

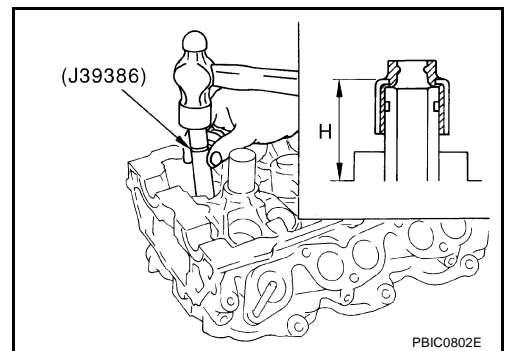
## ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-127, "VALVE GUIDE REPLACEMENT"](#).
2. When valve seat is removed, install it. Refer to [EM-129, "VALVE SEAT REPLACEMENT"](#).
3. Install valve oil seals.

- Install with valve oil seal drift (SST) to match dimension in the figure.

**Height "H" (Without valve spring seat installed)**

**Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)**



4. Install valve spring seat.
5. Install valves.

**NOTE:**

Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type).
  - Install narrow pitch end (paint mark) to cylinder head side (valve spring seat side).

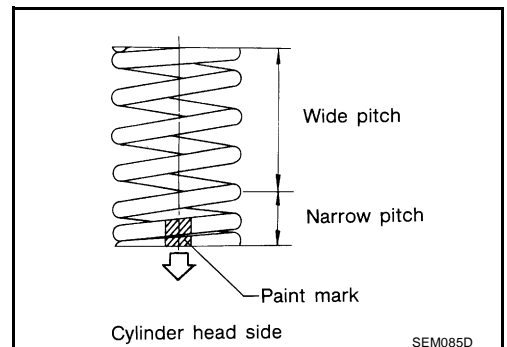
**Paint mark color**

**A/T models**

**: Blue**

**M/T models**

**: Purple**



7. Install valve spring retainer.

# CYLINDER HEAD

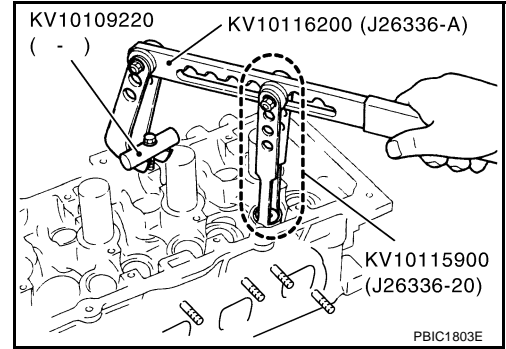
8. Install valve collet.

- Compress valve spring with valve spring compressor, attachment and adapter (SST). Install valve collet with magnet hand.

**CAUTION:**

**When working, take care not to damage valve lifter holes.**

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



9. Install valve lifter.

- Install it in the original position.

10. Install spark plug tube.

- Press-fit spark plug tube as follows:

- Remove old liquid gasket adhering to cylinder head mounting hole.
- Apply liquid gasket to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.

**Use Genuine High Strength Locking Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**

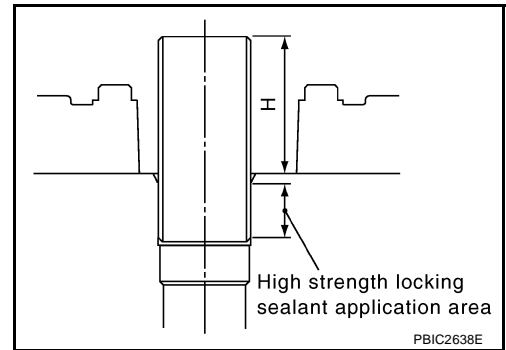
- Using drift, press-fit spark plug tube so that its height "H" is as specified in the figure.

**Standard press-fit height "H":**

**38.1 - 39.1 mm (1.500 - 1.539 in)**

**CAUTION:**

- **When press-fitting, take care not to deform spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.**



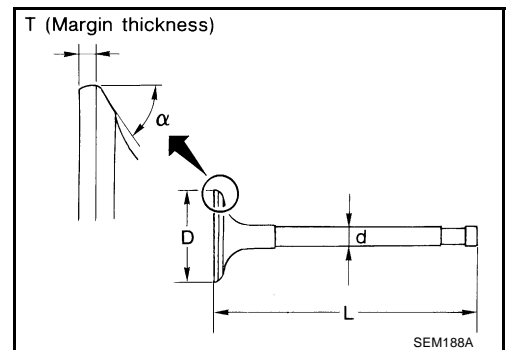
- Install spark plug with spark plug wrench (commercial service tool).

## Inspection After Disassembly

### VALVE DIMENSIONS

NBS00011

- Check dimensions of each valve. For dimensions, refer to [EM-171, "Valve Dimensions"](#) .
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to [EM-129, "VALVE SEAT CONTACT"](#) .



# CYLINDER HEAD

## VALVE GUIDE CLEARANCE

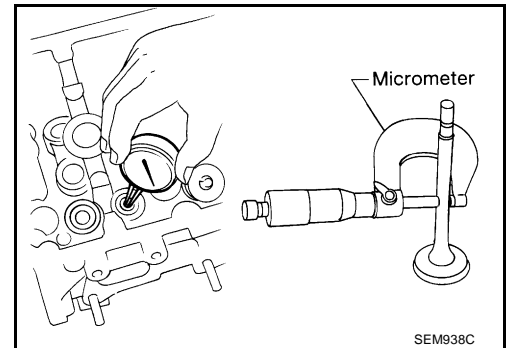
### Valve Stem Diameter

Measure diameter of valve stem with micrometer.

#### Standard

**Intake** : 5.965 - 5.980 mm (0.2348 - 0.2354 in)

**Exhaust** : 5.955 - 5.970 mm (0.2344 - 0.2350 in)



### Valve Guide Inner Diameter

Measure inner diameter of valve guide with inside micrometer.

#### Standard

**Intake and Exhaust** : 6.000 - 6.018 mm (0.2362 - 0.2369 in)

### Valve Guide Clearance

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

#### Valve guide clearance:

##### Standard

**Intake** : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

**Exhaust** : 0.030 - 0.063 mm (0.0012 - 0.0025 in)

##### Limit

**Intake** : 0.08 mm (0.003 in)

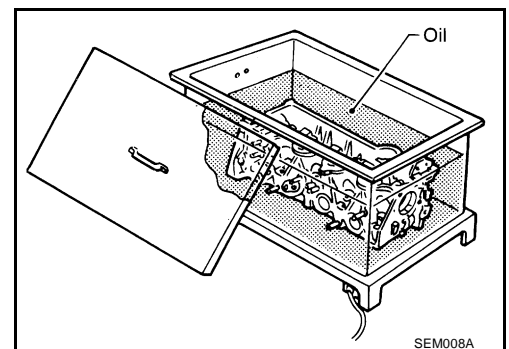
**Exhaust** : 0.09 mm (0.004 in)

- If it exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced, refer to [EM-127, "VALVE GUIDE REPLACEMENT"](#).

## VALVE GUIDE REPLACEMENT

When valve guide is removed, replace with oversize (service) [0.2 mm (0.008 in)] valve guide.

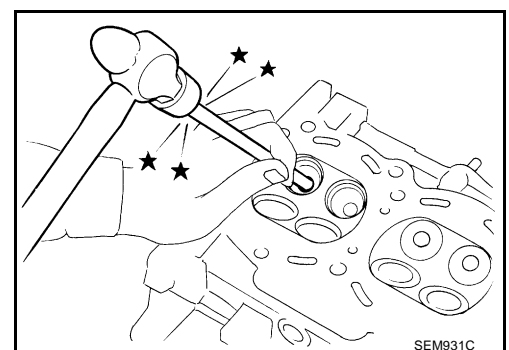
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.

#### **WARNING:**

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





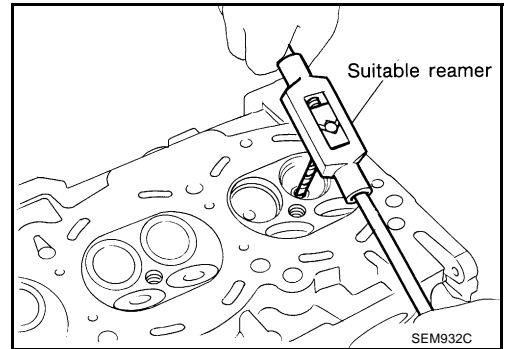
# CYLINDER HEAD

- Using valve guide reamer (commercial service tool), ream cylinder head valve guide hole.

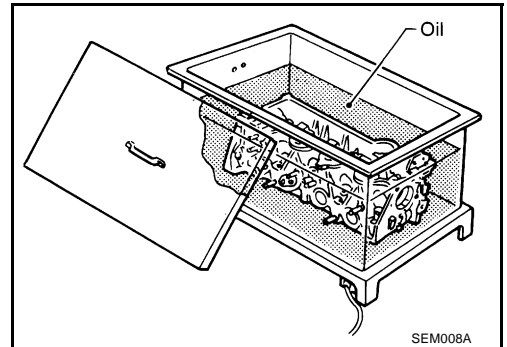
**Valve guide hole diameter (for service parts):**

**Intake and exhaust**

**: 10.175 - 10.196 mm (0.4006 - 0.4014 in)**



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



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

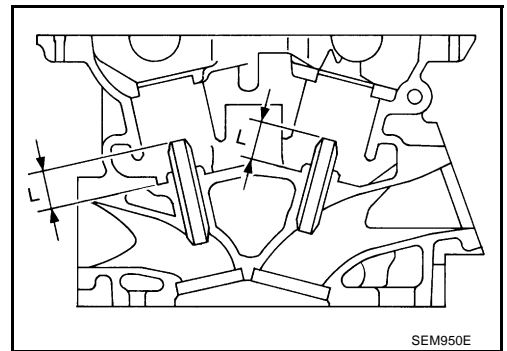
**Projection "L"**

**Intake and exhaust**

**: 12.6 - 12.8 mm (0.496 - 0.504 in)**

**WARNING:**

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

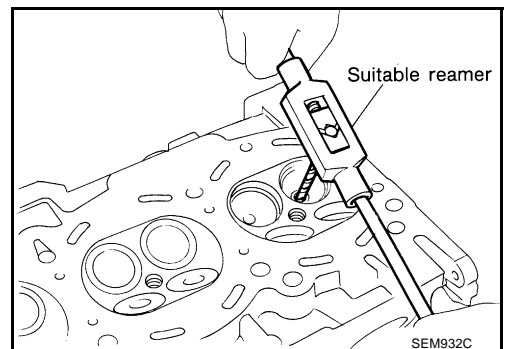


- Using valve guide reamer (commercial service tool), apply reamer finish to valve guide.

**Standard:**

**Intake and exhaust**

**: 6.000 - 6.018 mm (0.2362 - 0.2369 in)**

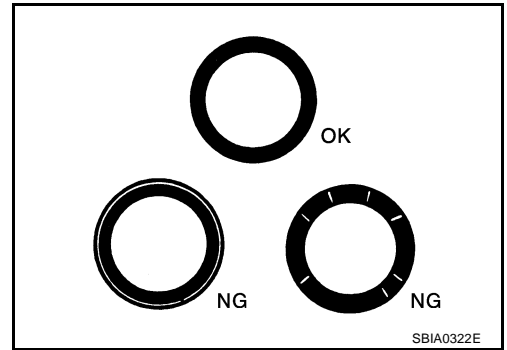




# CYLINDER HEAD

## 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-129, "VALVE SEAT REPLACEMENT"](#).



## VALVE SEAT REPLACEMENT

When valve seat is removed, replace with oversize (service) [0.5 mm (0.020 in)] valve seat.

1. 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-173, "Valve Seat"](#).

### CAUTION:

**Prevent to scratch cylinder head by excessive boring.**

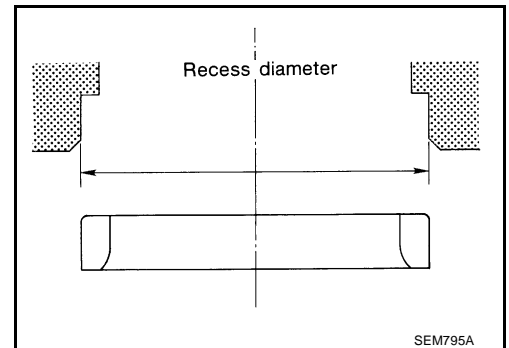
2. Ream cylinder head recess diameter for service valve seat.

### Oversize (Service) [0.5 mm (0.020 in)]

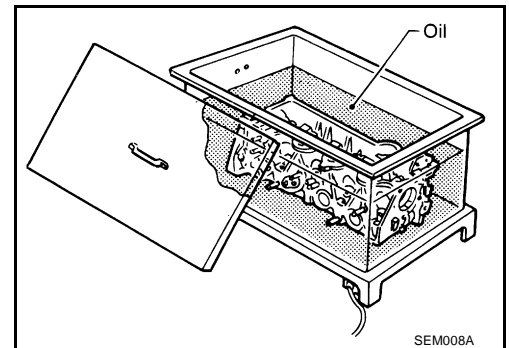
**Intake : 38.500 - 38.516 mm (1.5157 - 1.5164 in)**

**Exhaust : 32.700 - 32.716 mm (1.2874 - 1.2880 in)**

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



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



4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

### WARNING:

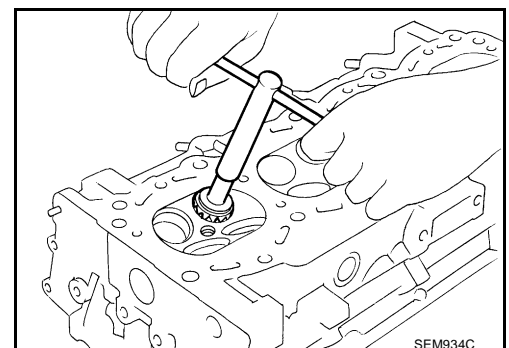
- **Avoid directly touching cold valve seats.**

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

5. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish seat to the specified dimensions. Refer to [EM-173, "Valve Seat"](#).

### CAUTION:

**When using 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.**



# CYLINDER HEAD

6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Refer to [EM-129, "VALVE SEAT CONTACT"](#) .

## VALVE SPRING SQUARENESS

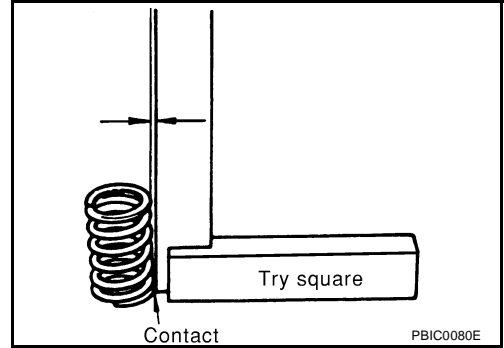
- Set try square along the side of valve spring and rotate spring. Measure the maximum clearance between the top face of spring and try square.

**Limit:**

**A/T models : 2.1 mm (0.083 in)**

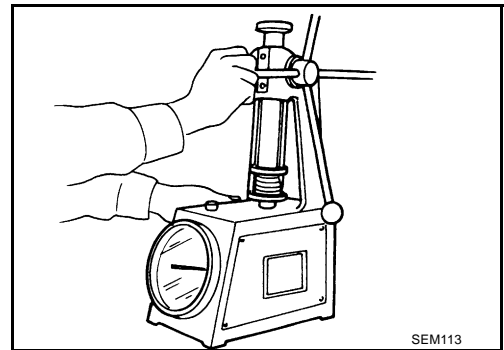
**M/T models : 2.0 mm (0.079 in)**

- If it exceeds the limit, replace valve spring.



## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure at specified spring height.



**Standard:**

Items	A/T models	M/T models
Free height	47.07 mm (1.8531 in)	45.43 mm (1.7886 in)
Installation height	37.00 mm (1.4567 in)	37.00 mm (1.4567 in)
Installation load	166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)	166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)
Height during valve open	27.20 mm (1.071 in)	26.80 mm (1.055 in)
Load with valve open	373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb)	434 - 490 N (44.3 - 50.0 kg, 97.6 - 110.2 lb)
Identification color	Blue	Purple

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



# ENGINE ASSEMBLY

## REMOVAL

### Outline

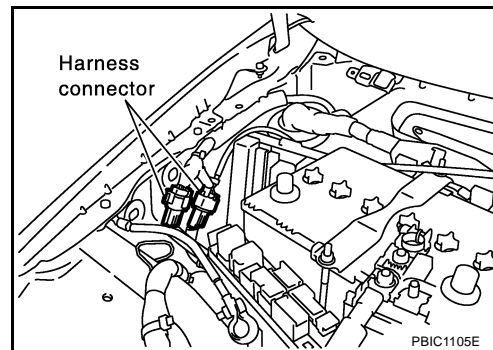
At first, remove engine and transmission assembly with front suspension member from vehicle downward. Then separate engine from transmission.

### Preparation

1. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#) .
2. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#) .  
**CAUTION:**
  - Perform this step when engine is cold.
  - Do not spill engine coolant on drive belts.
3. Disconnect both battery cables. Refer to [SC-4, "BATTERY"](#) .
4. Remove the following parts:
  - Tower bar: Refer to [FSU-20, "TOWER BAR"](#) .
  - Engine cover: Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
  - Front wiper arm and cowl top cover: Refer to [EI-20, "COWL TOP"](#) .
  - Undercover
  - Drive belts: Refer to [EM-14, "DRIVE BELTS"](#) .
  - Front road wheels and tires
5. Remove air cleaner case and air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#) .
6. Discharge refrigerant from A/C circuit. Refer to [ATC-126, "REFRIGERANT LINES"](#) .
7. Remove radiator cooling fan assembly, reservoir tank and hoses. Refer to [CO-22, "COOLING FAN"](#) and [CO-13, "RADIATOR"](#) .

### Engine Room

1. Disconnect heater hose at engine-side, and fit a plug onto hose end to prevent engine coolant leak.
2. Disconnect ground cable (between vehicle to left cylinder head).
3. Disconnect battery positive cable harness at vehicle side and temporarily fasten it on engine.
4. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope.
5. Remove engine room harness connectors as shown in the figure.



6. Disconnect two body ground cables.
7. Disconnect brake booster vacuum hose.
8. Disconnect fuel feed hose (with damper) and EVAP hose. Refer to [EM-38, "FUEL INJECTOR AND FUEL TUBE"](#) .

#### **CAUTION:**

**Fit plugs onto disconnected hoses to prevent fuel leak.**

9. Remove reservoir tank of power steering oil pump, and piping from vehicle, and temporarily secure them on engine.

#### **CAUTION:**

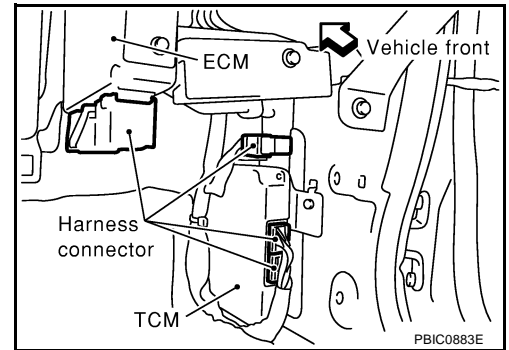
**When temporarily securing, keep the reservoir tank upright to avoid a fluid leak.**

### Passenger Room Side

Follow procedure below to disconnect engine room harness connectors at passenger room side, and temporarily secure them on engine.

# ENGINE ASSEMBLY

1. Remove passenger-side kicking plate inner, dash side finisher, and instrument passenger panel lower. Refer to [EI-35, "BODY SIDE TRIM"](#) and [IP-10, "INSTRUMENT PANEL ASSEMBLY"](#).
2. Disconnect engine room harness connectors at unit sides TCM (A/T models), ECM and other.



3. Disengage intermediate fixing point. Pull out engine room harnesses to engine room side, and temporarily secure them on engine.

### CAUTION:

- When pulling out harnesses, take care not to damage harnesses and connectors.
- After temporarily securing, cover connectors with vinyl or similar material to protect against foreign material adhesion.

## Vehicle Underbody

1. Remove exhaust front tube. Refer to [EX-3, "EXHAUST SYSTEM"](#).
2. Disconnect steering lower joint at power steering gear assembly side, and release steering lower shaft. Refer to [PS-11, "STEERING COLUMN"](#).
3. Remove propeller shaft. Refer to [PR-5, "REAR PROPELLER SHAFT"](#).

### CAUTION:

**Do not impact or damage propeller shaft tube.**

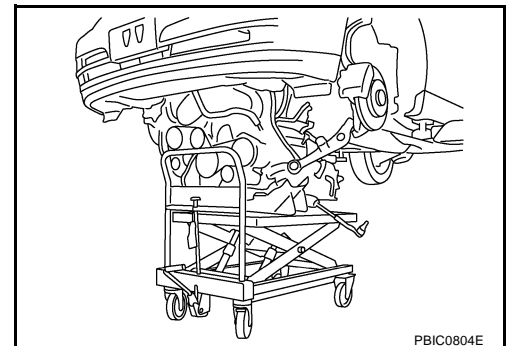
4. Disengage shift lever and clutch operating cylinder (M/T models). Refer to [MT-18, "TRANSMISSION ASSEMBLY"](#) and [CL-11, "OPERATING CYLINDER"](#).
5. Disengage A/T control rod at control device assembly side. Then, temporarily secure it on transmission, so that it does not sag (A/T models). Refer to [AT-236, "SHIFT CONTROL SYSTEM"](#).
6. Remove rear plate cover from oil pan (upper). Then remove bolts fixing drive plate to torque converter (A/T models). Refer to [EM-29, "OIL PAN AND OIL STRAINER"](#) and [AT-274, "TRANSMISSION ASSEMBLY"](#).
7. Remove bolts fixing transmission to lower rear side of oil pan (upper). Refer to [MT-18, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
8. Remove front stabilizer. Refer to [FSU-18, "STABILIZER BAR"](#).
9. Separate steering outer sockets from steering knuckle. Refer to [PS-18, "POWER STEERING GEAR AND LINKAGE"](#).
10. Separate transverse links from suspension member and vehicle body. Refer to [FSU-13, "TRANSVERSE LINK"](#).

## Removal Work

1. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as transmission jack. Securely support bottom of suspension member and transmission.

### CAUTION:

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



2. Remove rear engine mounting member bolts.

# ENGINE ASSEMBLY

3. Remove front suspension member mounting nuts. Refer to [FSU-5, "FRONT SUSPENSION ASSEMBLY"](#) .
4. Carefully lower jack, or raise lift to remove the engine, transmission and front suspension member assembly. When performing work, observe the following caution:


## CAUTION:

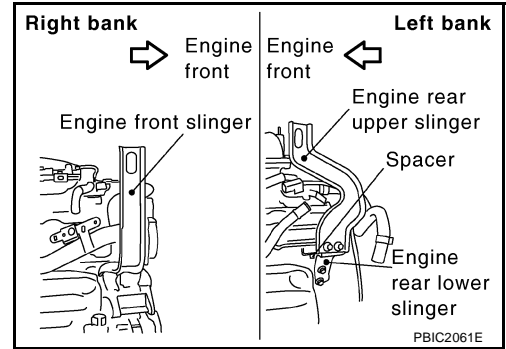
- Confirm there is no interference with the vehicle.
- Make sure that all connection points have been disconnected.
- Keep in mind the center of the vehicle gravity changes. If necessary, use jack(s) to support the vehicle at rear jacking point(s) to prevent it from falling off the lift.

## Separation Work

1. Install engine slingers into front of cylinder head (right bank) and rear of cylinder head (left bank).

### Slinger bolts:

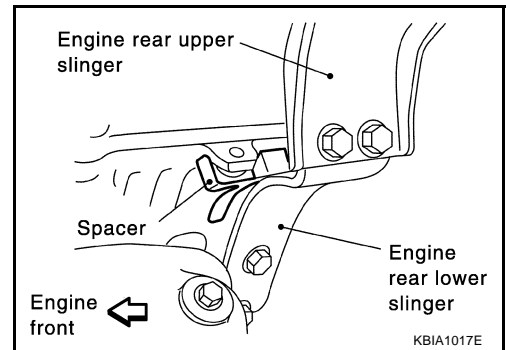
: 24.5 - 31.4 N·m (2.5 - 3.2 kg·m, 18 - 23 ft·lb)



- To protect rocker cover against damage caused by tilting of engine slinger, insert spacer between cylinder head and engine rear lower slinger, in direction shown in the figure.

### NOTE:

Spacer is a component part of engine rear upper slinger assembly.



2. Remove power steering oil pump from engine side. Refer to [PS-29, "POWER STEERING OIL PUMP"](#) .
3. Remove engine mounting insulators (RH and LH) under side nut.
4. Lift with hoist and separate engine and transmission assembly from front suspension member.

## CAUTION:

- Before and during this lifting, always make sure that any harnesses are left connected.
  - Avoid damage to and oil/grease smearing or spills onto engine mounting insulator.
5. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#) .
  6. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#) .
  7. Separate engine from transmission. Refer to [MT-18, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
  8. Remove engine mounting insulators (RH and LH) and brackets (RH and LH) from engine.
  9. Remove rear engine mounting member and engine mounting insulator (rear) from transmission.

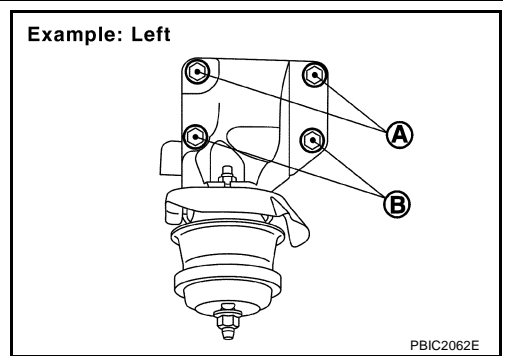
## INSTALLATION

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

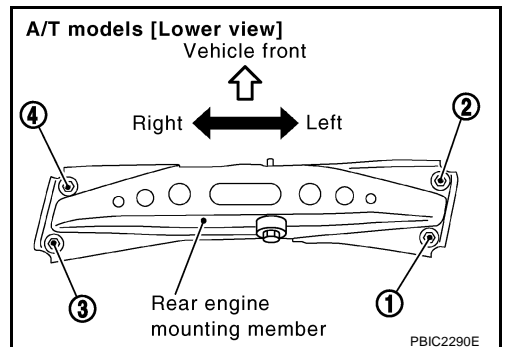
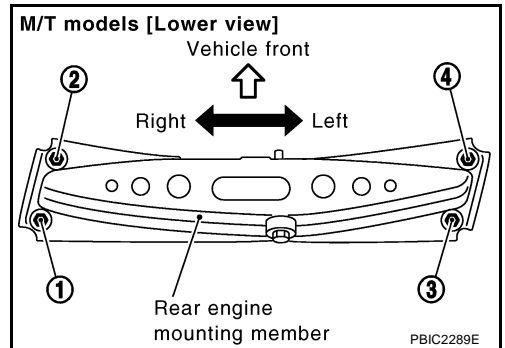
- Do not allow engine mounting insulator to be damaged and careful no engine oil gets on it.
- For a location with a positioning pin, insert it securely into hole of mating part.
- For a part with a specified installation orientation, refer to component figure in [EM-131, "Removal and Installation"](#) .

# ENGINE ASSEMBLY

- When installing engine mounting brackets (RH and LH) on cylinder block, tighten two upper bolts (shown as "A" in the figure) first. Then tighten two lower bolts (shown as "B" in the figure).



- Make sure all engine mounting insulators are seated properly, then tighten mounting nuts.
- Tighten rear engine mounting member bolts in numerical order as shown in the figure.



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

# ENGINE ASSEMBLY

## INSPECTION AFTER INSTALLATION

### Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-12, "RECOMMENDED 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.



# CYLINDER BLOCK

## CYLINDER BLOCK

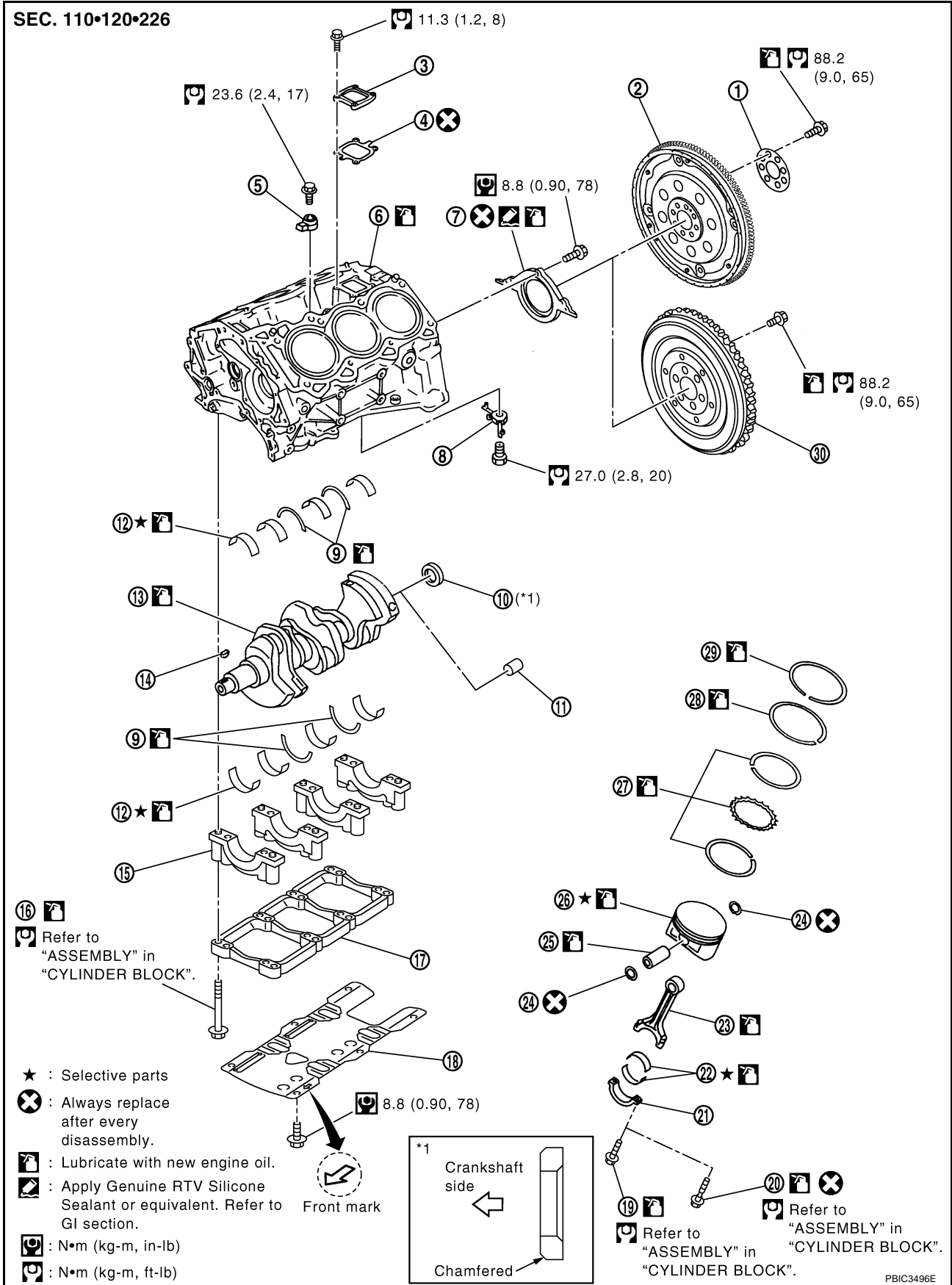
### Disassembly and Assembly

PPF:11010

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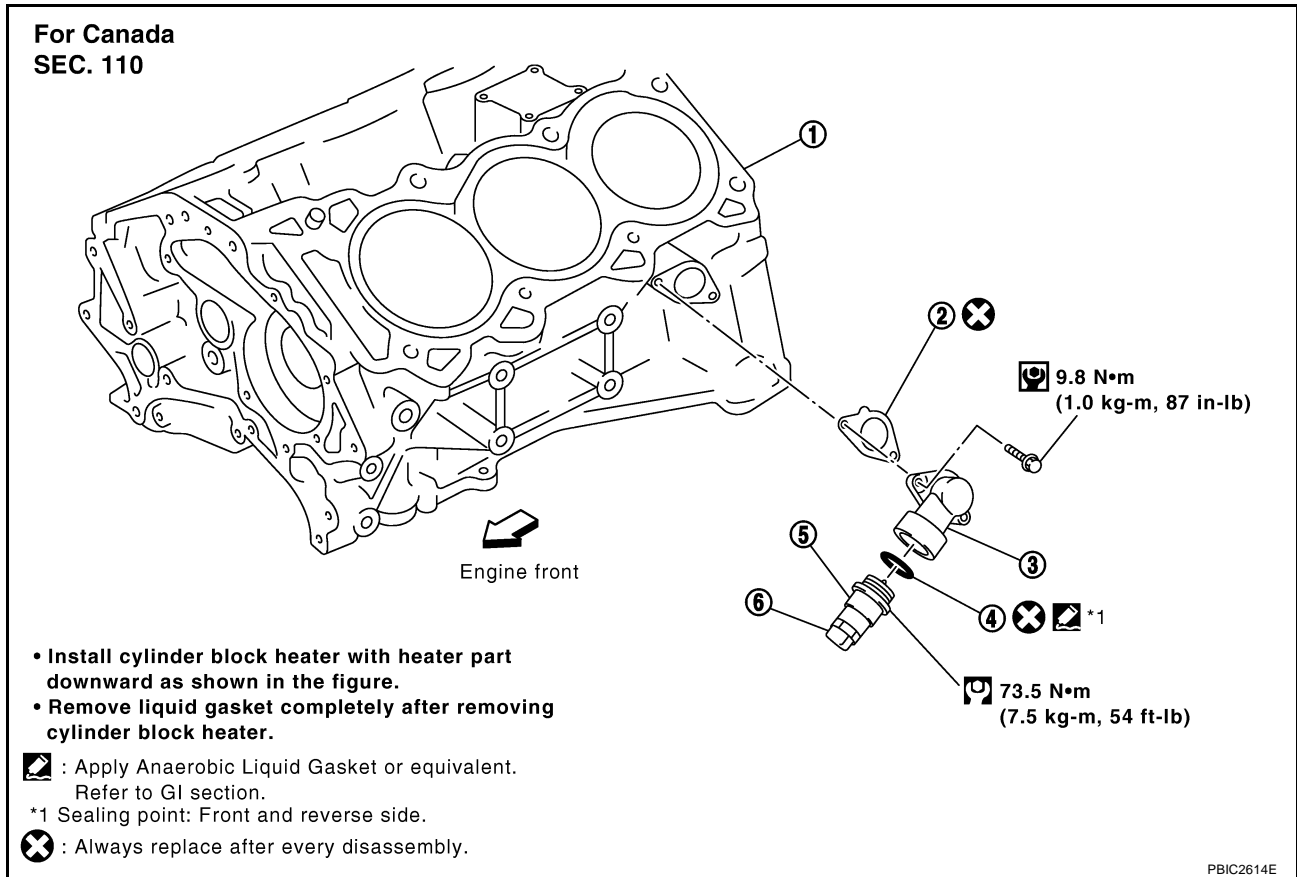
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EM



# CYLINDER BLOCK

- |                                      |                                      |                                |
|--------------------------------------|--------------------------------------|--------------------------------|
| 1. Reinforcement plate               | 2. Drive plate (A/T models)          | 3. Cover                       |
| 4. Gasket                            | 5. Knock sensor                      | 6. Cylinder block              |
| 7. Rear oil seal retainer            | 8. Oil jet                           | 9. Thrust bearing              |
| 10. Pilot converter (A/T models)     | 11. Pilot bushing (M/T models)       | 12. Main bearing               |
| 13. Crankshaft                       | 14. Crankshaft Key                   | 15. Main bearing cap           |
| 16. Main bearing cap bolt            | 17. Main bearing beam                | 18. Baffle plate               |
| 19. Connecting rod bolt (A/T models) | 20. Connecting rod bolt (M/T models) | 21. Connecting rod bearing cap |
| 22. Connecting rod bearing           | 23. Connecting rod                   | 24. Snap ring                  |
| 25. Piston pin                       | 26. Piston                           | 27. Oil ring                   |
| 28. Second ring                      | 29. Top ring                         | 30. Flywheel (M/T models)      |



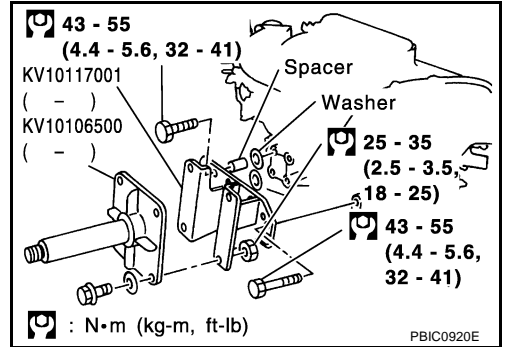
- |                   |                          |                            |
|-------------------|--------------------------|----------------------------|
| 1. Cylinder block | 2. Gasket                | 3. Water connector         |
| 4. Gasket         | 5. Cylinder block heater | 6. Connector protector cap |

## DISASSEMBLY

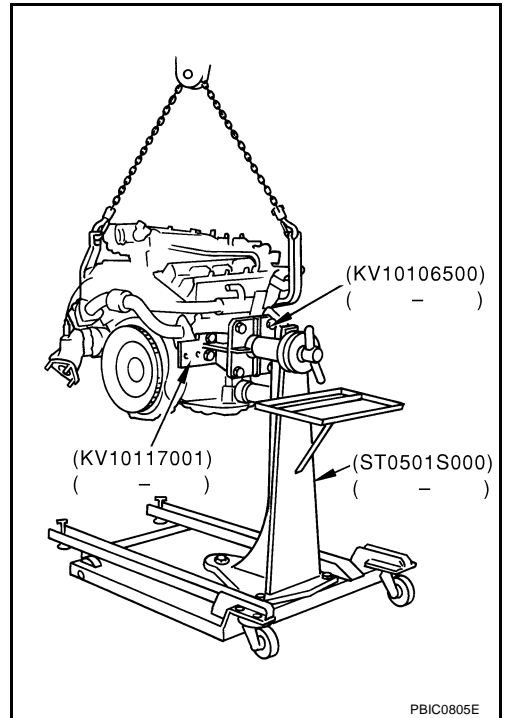
1. Remove engine assembly from vehicle, and separate front suspension member and transmission from engine. Refer to [EM-131, "ENGINE ASSEMBLY"](#).
2. Remove engine mounting brackets (RH and LH). Refer to [EM-131, "ENGINE ASSEMBLY"](#).
3. Remove exhaust manifold (right bank). Refer to [EM-25, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).

# CYLINDER BLOCK

4. Install engine sub-attachment with engine stand shaft (SST) to right side of cylinder block.
  - Use spacer to engine rear side.



5. Lift engine, and mount it onto engine stand (SST).



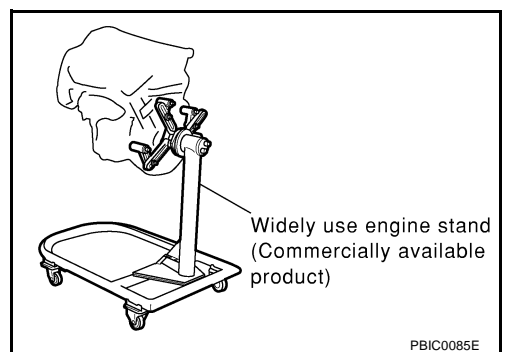
- A widely use engine stand can be used.

**CAUTION:**

Use engine stand that has a load capacity [approximately 220 kg (441 lb) or more] large enough for supporting the engine weight.

**NOTE:**

This example is engine stand for holding at transmission mounting side with flywheel (M/T models) or drive plate (A/T models) removed.

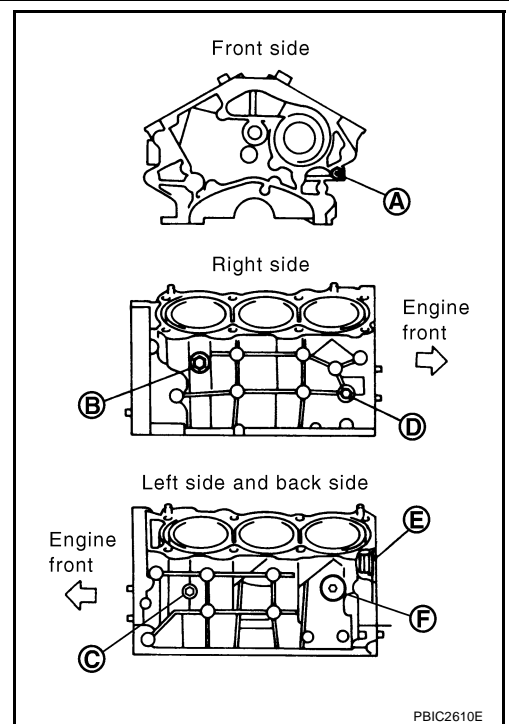


6. Drain engine oil. Refer to [LU-9, "Changing Engine Oil"](#).

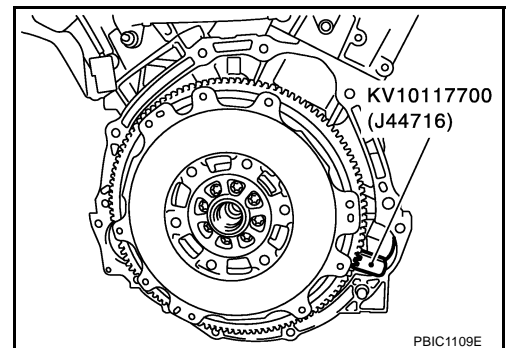
A  
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## CYLINDER BLOCK

7. Drain engine coolant by removing water drain plugs from cylinder block both sides at "B" and "C" and cylinder block front side at "A" as shown in the figure.

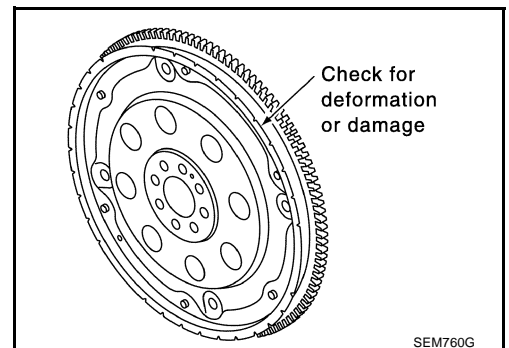


8. Remove clutch cover and clutch disc (M/T models). Refer to [CL-16, "CLUTCH DISC, CLUTCH COVER"](#).
9. Remove flywheel (M/T models) or drive plate (A/T models). Fix crankshaft with ring gear stopper (SST), and remove mounting bolts.
  - Loosen mounting bolts in diagonal order.
  - Use TORX socket for flywheel mounting bolts (size: T55, commercial service tool)



### CAUTION:

- Do not disassemble flywheel (M/T models) and drive plate (A/T models).
- Do not place drive plate (A/T models) 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.



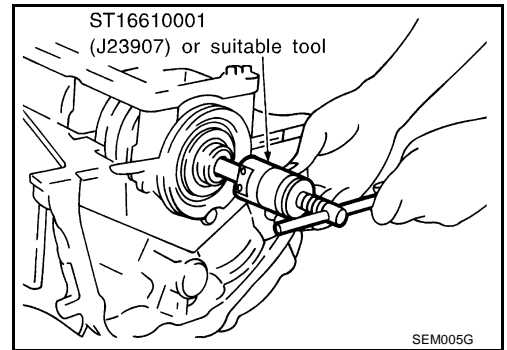
10. Remove cylinder head. Refer to [EM-119, "CYLINDER HEAD"](#).
11. Remove knock sensor.

### CAUTION:

Carefully handle sensor avoiding shocks.

# CYLINDER BLOCK

12. Remove pilot bushing (M/T models) or pilot converter (A/T models) using pilot bushing puller (SST) or suitable tool as necessary.



13. Remove rear oil seal retainer.

- Remove by inserting screwdriver between main bearing cap and rear oil seal retainer.

**CAUTION:**

**If rear oil seal retainer is removed, replace it with new one.**

**NOTE:**

Regard both rear oil seal and retainer as an assembly.

14. Remove baffle plate from main bearing beam.

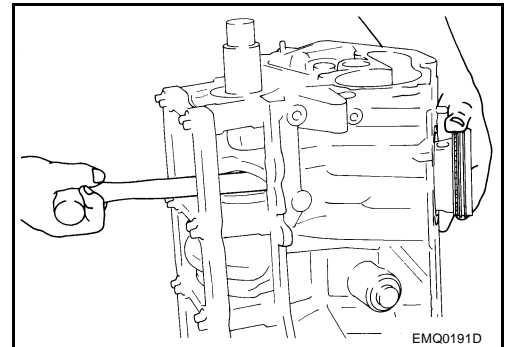
15. Remove piston and connecting rod assembly as follows:

- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-156. "CONNECTING ROD SIDE CLEARANCE"](#).

- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod bearing cap.
- c. Using hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

**CAUTION:**

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



16. Remove connecting rod bearings from connecting rod and connecting rod bearing cap.

**CAUTION:**

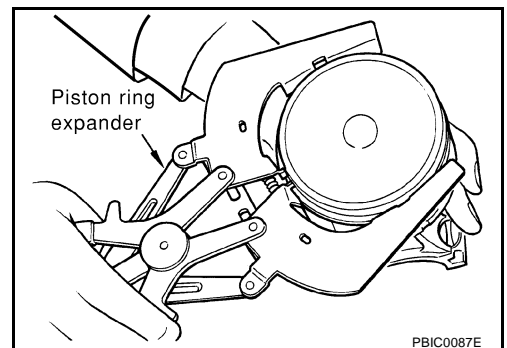
**Identify installation position, and store them without mixing them up.**

17. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to [EM-157. "PISTON RING SIDE CLEARANCE"](#).
- Use piston ring expander (commercial service tool).

**CAUTION:**

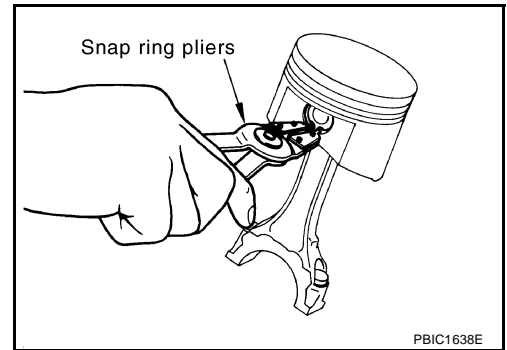
- **When removing piston rings, be careful not to damage piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



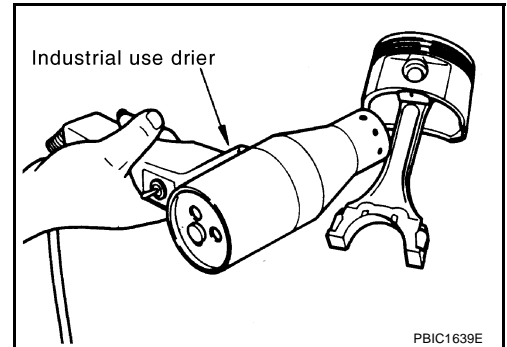
18. Remove piston from connecting rod as follows:

# CYLINDER BLOCK

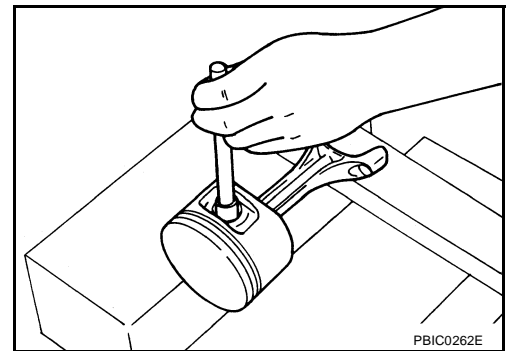
- a. Using snap ring pliers, remove snap ring.



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



- c. Push out piston pin with stick of outer diameter approximately 20 mm (0.79 in).

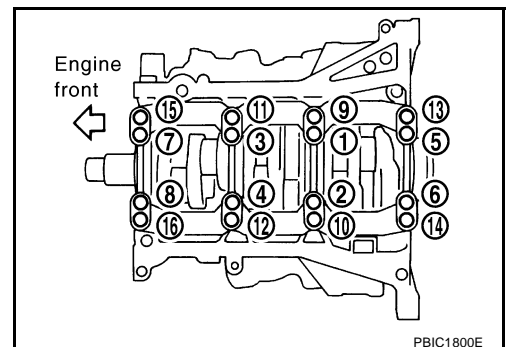


19. Remove main bearing cap bolts.

**NOTE:**

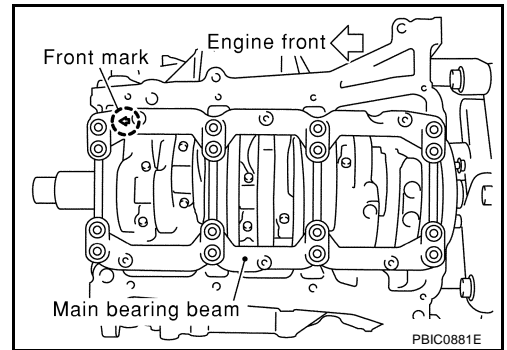
Use TORX socket (size E14).

- Before loosening main bearing cap bolts, measure the crankshaft end play. Refer to [EM-156. "CRANK-SHAFT END PLAY"](#).
- Loosen main bearing cap bolts in reverse order shown in the figure in several different steps.



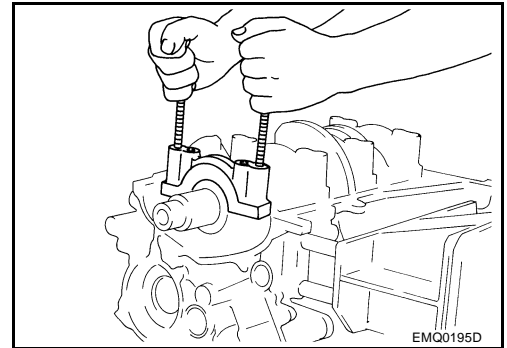
# CYLINDER BLOCK

20. Remove main bearing beam.



21. Remove main bearing caps.

- Using main bearing cap bolts, remove main bearing cap while shaking it back-and-forth.



22. Remove crankshaft.

23. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

**CAUTION:**

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

24. Remove oil jet.

## ASSEMBLY

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

**CAUTION:**

**Use a goggles to protect your eye.**

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

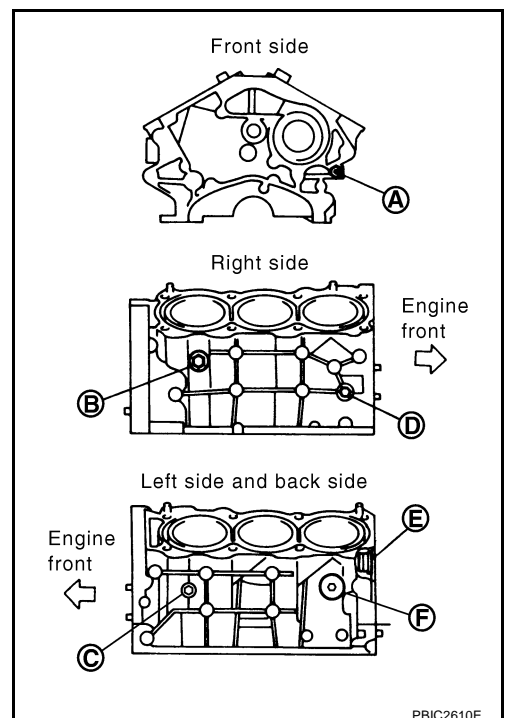
- Apply sealant to the thread of water drain plugs "A", "B" and "C".

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

- Apply sealant to the thread of plugs "D" and "E".  
**Use Genuine High Strength Thread Locking Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

- Apply sealant to the thread of plug "F".  
**Use Anaerobic Liquid Gasket or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

- Replace washers with new one.



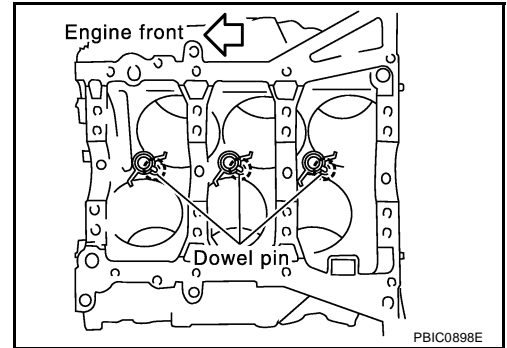
# CYLINDER BLOCK

- Tighten each plug as specified below.

Part	Washer	Tightening torque
A	No	9.8 N-m (1.0 kg-m, 87 in-lb)
B	No	19.6 N-m (2.0 kg-m, 14 ft-lb)
C	No	19.6 N-m (2.0 kg-m, 14 ft-lb)
D	Yes	12.3 N-m (1.3 kg-m, 9 ft-lb)
E	Yes	62.0 N-m (6.3 kg-m, 46 ft-lb)
F	Yes	62.0 N-m (6.3 kg-m, 46 ft-lb)

### 3. Install oil jet.

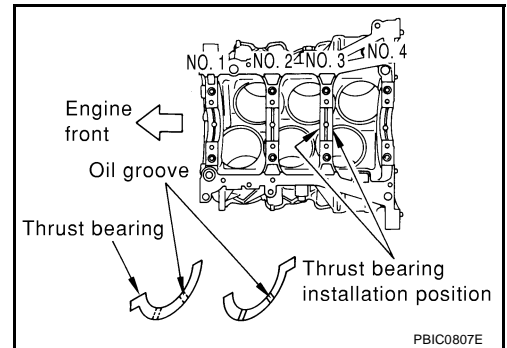
- Insert oil jet dowel pin into cylinder block dowel pin hole, and tighten mounting bolts.



### 4. Install main bearings and thrust bearings as follows:

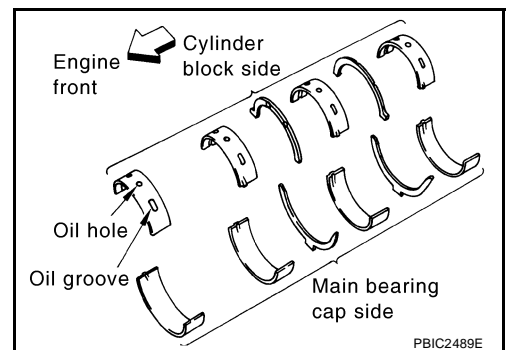
- Remove dust, dirt, and engine oil on bearing mating surfaces of cylinder block and main bearing caps.
- Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block and main bearing cap.

- Install thrust bearings with the oil groove facing crankshaft arm (outside).
- Install thrust bearing with a protrusion on one end on cylinder block, and thrust bearing with a protrusion at center on cap. Align each protrusion with mating notch.



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

- Main bearing with oil hole and groove goes on cylinder block. The one without them goes on main bearing cap.
- Before installing main bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing stopper protrusion to cut-out of cylinder block and main bearing caps.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



### 5. Install crankshaft to cylinder block.

- While turning crankshaft by hand, check that it turns smoothly.

### 6. Install main bearing cap.

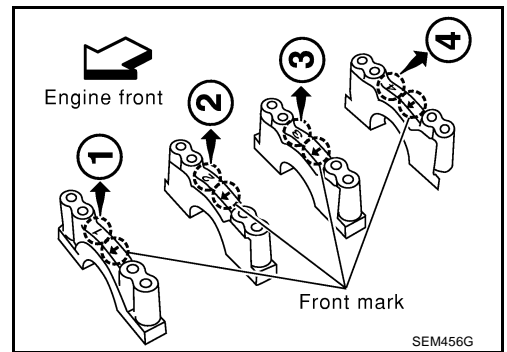


# CYLINDER BLOCK

- Main bearing caps are identified by identification mark cast on them. For installation, face front mark to front side.

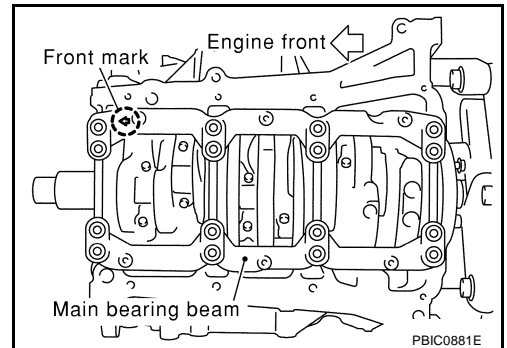
**NOTE:**

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



7. Install main bearing beam.

- Install main bearing beam with front mark facing downward (oil pan side).
- Install main bearing beam with front mark facing front of engine.

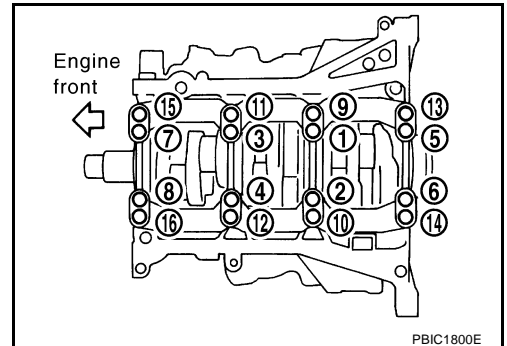


8. Inspect the outer diameter of main bearing cap bolt. Refer to [EM-165, "MAIN BEARING CAP BOLT OUTER DIAMETER"](#).

9. Tighten main bearing cap bolts in numerical order as shown in the figure as follows:

- Apply new engine oil to threads and seat surfaces of main bearing cap bolts.
- Tighten main bearing cap bolts in several different steps.

: **32.3 - 38.3 N·m (3.3 - 3.9 kg-m, 24 - 28 ft-lb)**

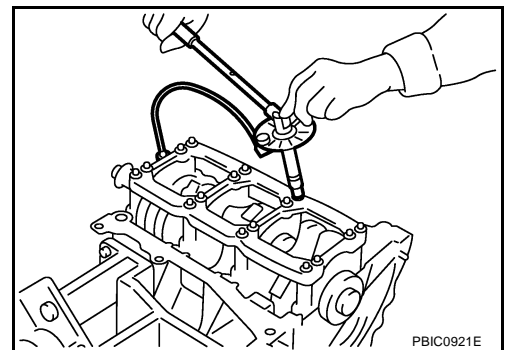


c. Turn all bolts another 90 to 95 degrees clockwise [Target: 90 degrees (angle tightening)].

**CAUTION:**

Use angle wrench [SST: KV10112100 (BT8653-A)] to check tightening angle. Do not make judgment by visual inspection.

- After installing main bearing cap bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check the crankshaft end play. Refer to [EM-156, "CRANKSHAFT END PLAY"](#).



10. Install piston to connecting rod as follows:

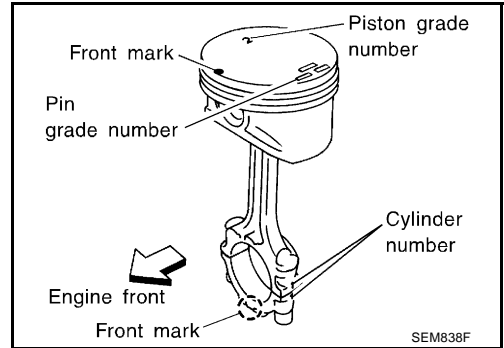
- Using snap ring pliers, install new snap ring to the groove of piston rear side.
  - Insert it fully into groove to install.
- Install piston to connecting rod.

# CYLINDER BLOCK

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

**NOTE:**

Figure shows the piston of A/T models. The front marks of M/T models are 2 punched.

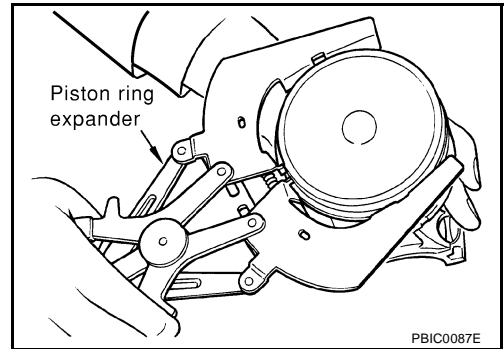


- c. Install new snap ring to the groove of the piston front side.
- Insert it fully into groove to install.
  - After installing, make sure that connecting rod moves smoothly.

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

**CAUTION:**

- When installing piston rings, be careful not to damage piston.
- Be careful not to damage piston rings by expending them excessively.



- Mount second ring with marked (A) side up (A/T models).

**Stamped mark:**

**A/T models (B)**

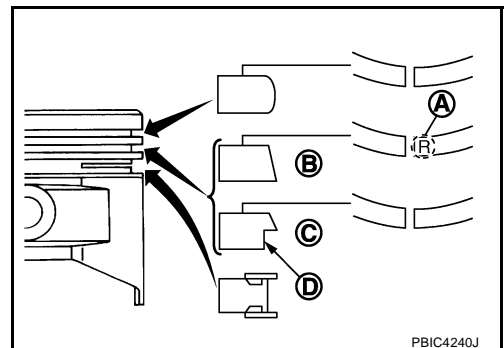
Top ring : —

Second ring : R

**M/T models (C)**

Top ring : —

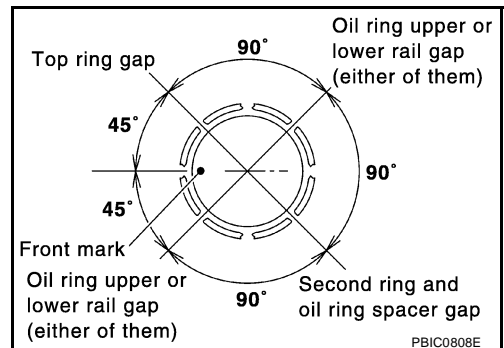
Second ring : —



- Mount second ring with cut out (D) side down (M/T models).
- Position each ring with the gap as shown in the figure referring to the piston front mark.

**NOTE:**

Figure shows the piston of A/T models. The front marks of M/T models are 2 punched.



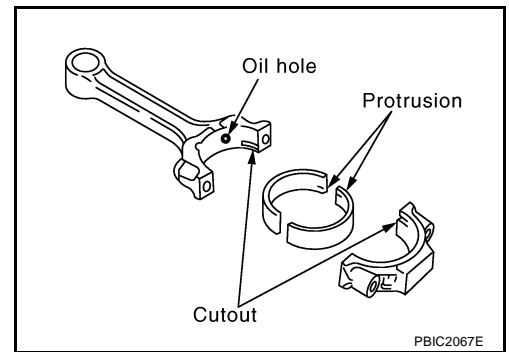
- Check the piston ring side clearance. Refer to [EM-157, "PISTON RING SIDE CLEARANCE"](#).

12. Install connecting rod bearings to connecting rod and connecting rod bearing cap.

- Before installing connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.

# CYLINDER BLOCK

- When installing, align connecting rod bearing stopper protrusion with cutout of connecting rods and connecting rod bearing caps to install.
- Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.

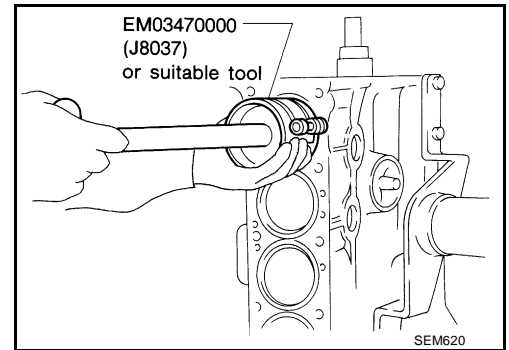


## 13. Install piston and connecting rod assembly to crankshaft.

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin journal.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Be sure that front mark on piston head is facing front of engine.
- Using piston ring compressor (SST) or suitable tool, install piston with the front mark on the piston head facing the front of engine.

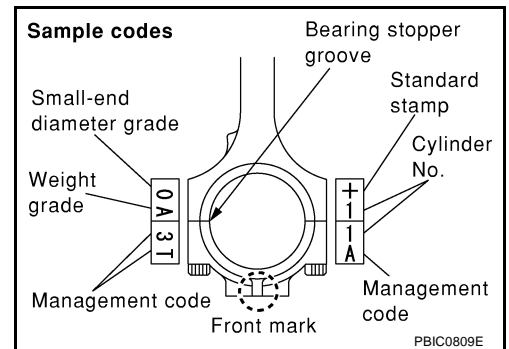
### **CAUTION:**

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



## 14. Install connecting rod bearing cap.

- Match the stamped cylinder number marks on connecting rod with those on connecting rod bearing cap to install.
- Be sure that front mark on connecting rod bearing cap is facing front of engine.




## 15. Inspect the outer diameter of connecting rod bolt. (A/T models) Refer to [EM-165, "CONNECTING ROD BOLT OUTER DIAMETER \(A/T MODELS\)"](#) .

### **CAUTION:**

**Do not reuse connecting rod bolt for M/T models. Replace it with a new one.**

## 16. Tighten connecting rod bolts as follows:

- Apply engine oil to the threads and seats of connecting rod bolts.
- Tighten connecting rod bolts.

: 18.6 - 20.6 N·m (1.9 - 2.1 kg·m, 14 - 15 ft·lb)

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

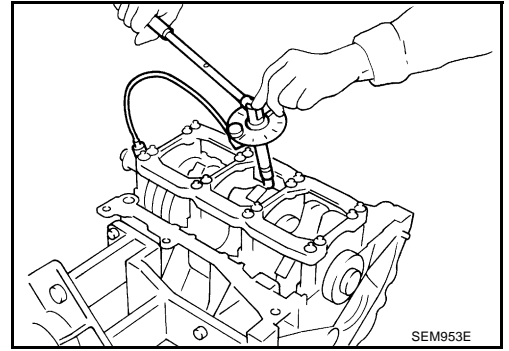
# CYLINDER BLOCK

- c. Then tighten all bolts 90 to 95 degrees clockwise [target: 90 degrees (angle tightening)].

**CAUTION:**

Use angle wrench [SST: KV10112100 (BT8653-A)] to check tightening angle. Do not make judgment by visual inspection.

- After tightening connecting rod bolts, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-156](#), "[CONNECTING ROD SIDE CLEARANCE](#)".



17. Install baffle plate to main bearing beam.
- Install the part shown by the arrow with it facing front of engine.

18. Install new rear oil seal retainer to cylinder block.
- Apply new engine oil to both oil seal lip and dust seal lip.
  - Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 ( — )] to rear oil seal retainer as shown in the figure.

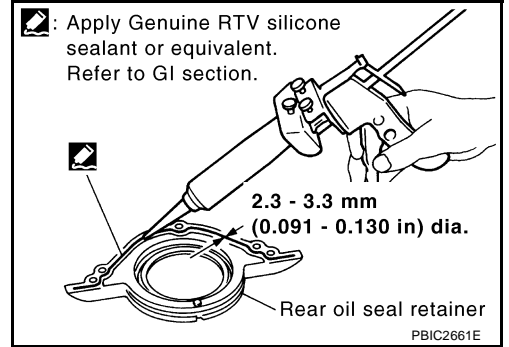
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45](#), "[RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS](#)".

**CAUTION:**

Replace with a new parts.

**NOTE:**

Regard both rear oil seal and retainer as an assembly.

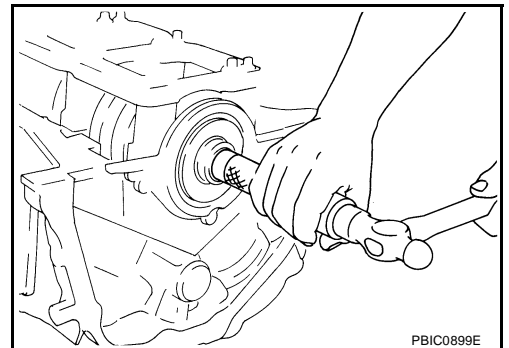


19. Install pilot bushing (M/T models) or pilot converter (A/T models).

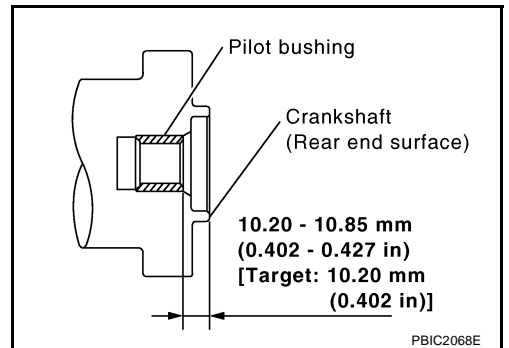
- With drift of the following outer diameter, press-fit as far as it will go.

**Pilot bushing : Approx. 17 mm (0.67 in)**

**Pilot converter : Approx. 33 mm (1.30 in)**

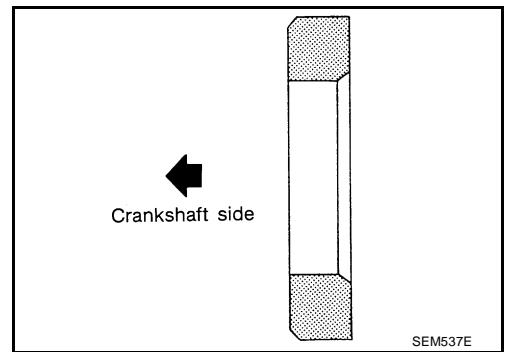


- Press-fit pilot bushing as the dimension in the figure. (M/T models)



# CYLINDER BLOCK

- Press-fit pilot converter with its chamfer facing crankshaft as shown in the figure. (A/T models)



## 20. Install knock sensor.

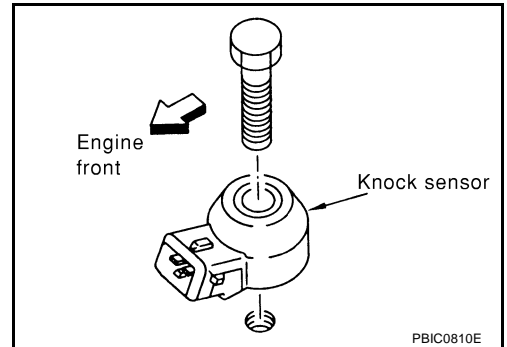
- Install knock sensor so that connector faces front of engine.
- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

### CAUTION:

- Do not tighten mounting bolts while holding connector.
- If any impact by dropping is applied to knock sensor, replace it with 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.



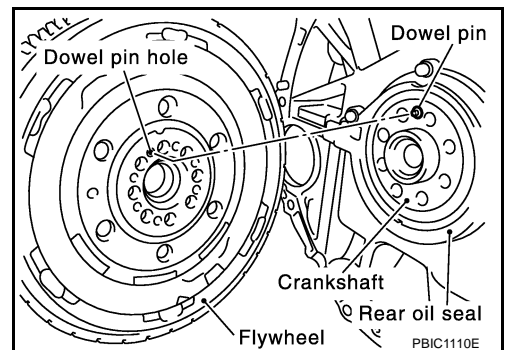
## 21. Note the following, assemble in the reverse order of disassembly after this step.

### Flywheel (M/T models)

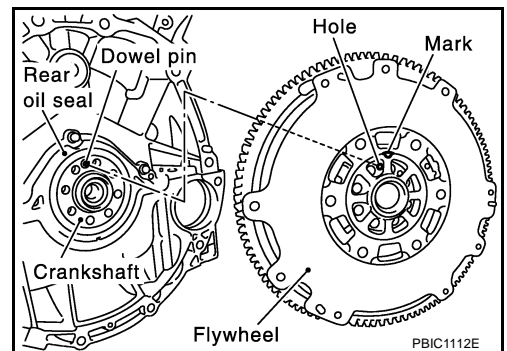
- Ensure the dowel pin is installed in the crankshaft.
- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin hole.

### CAUTION:

If these are not aligned correctly, engine runs roughly and "MIL" turns on.

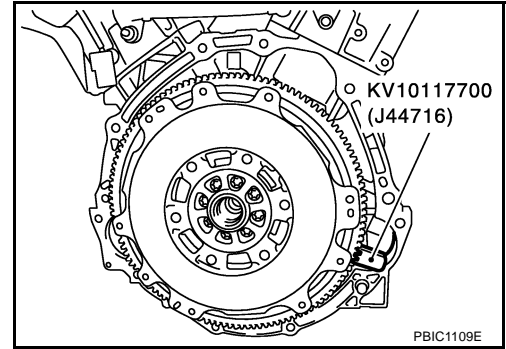


- There is a mating mark on the clutch cover side of flywheel. Refer it during installation.



## CYLINDER BLOCK

- Holding ring gear with ring gear stopper (SST), tighten securing bolts with TORX socket (size: T55, commercial service tool).
- Tighten the mounting bolts crosswise over several times.



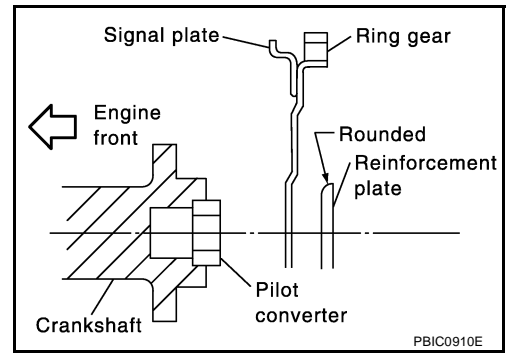
### Drive plate (A/T models)

- When installing drive plate to crankshaft, be sure to correctly align crankshaft side dowel pin and drive plate side dowel pin hole.

#### **CAUTION:**

**If these are not aligned correctly, engine runs roughly and “MIL” turns on.**

- Install drive plate and reinforcement plate as shown in the figure.
- Holding ring gear with ring gear stopper [SST: KV10117700 (J44716)].
- Tighten the mounting bolts crosswise over several times.



# CYLINDER BLOCK

NBS00014

## How to Select Piston and Bearing DESCRIPTION

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to 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 to 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 to piston	Piston and piston pin assembly (Piston is available together with piston pin as assembly.)	Piston grade (piston skirt diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
Between piston to connecting rod*	—	—	—

\*: For the service parts, the grade for fitting cannot be selected between piston pin and connecting rod. (Only "0" grade is available.) The information at the shipment from the plant is described as a reference.

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

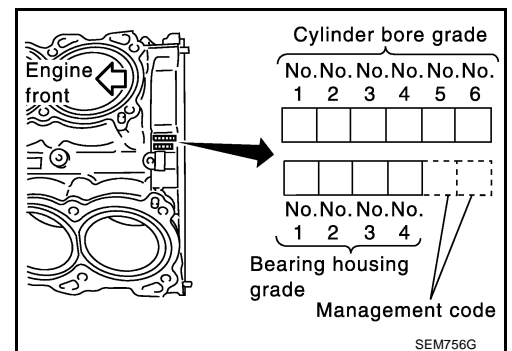
### HOW TO SELECT PISTON

#### When New Cylinder Block is Used

Check the cylinder bore grade ("1", "2" or "3") on rear side of cylinder block, and select piston of the same grade.

#### NOTE:

Piston is available with piston pin as a set for the service part. (Only "0" grade piston pin is available.)

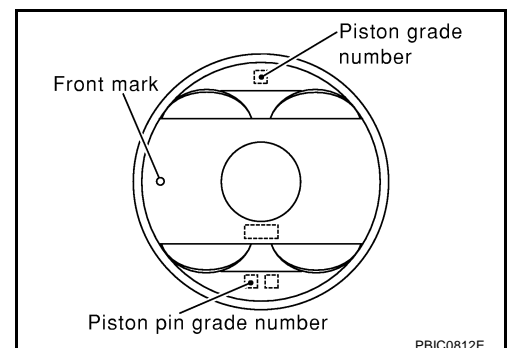


#### When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to [EM-161, "Cylinder Bore Inner Diameter"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".

#### NOTE:

Figure shows the piston of A/T models. The front marks of M/T models are 2 punched.



3. Select piston of the same grade.



# CYLINDER BLOCK

## Piston Selection Table

Unit: mm (in)

Grade	1	2 (or no mark)	3
Cylinder bore inner diameter	95.500 - 95.510 (3.7598 - 3.7602)	95.510 - 95.520 (3.7602 - 3.7606)	95.520 - 95.530 (3.7606 - 3.7610)
Piston skirt diameter	95.480 - 95.490 (3.7590 - 3.7594)	95.490 - 95.500 (3.7594 - 3.7598)	95.500 - 95.510 (3.7598 - 3.7602)

### 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 piston pin grades can be selected. (Only "0" grade is available.)
- No second grade mark is available on piston.

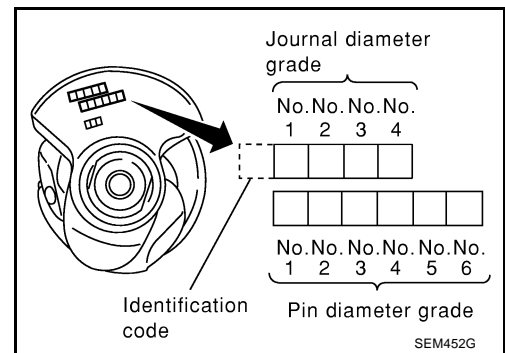
## HOW TO SELECT CONNECTING ROD BEARING

### When New Connecting Rod and Crankshaft are Used

Check pin diameter grade ("0", "1" or "2") on front of crankshaft, and select connecting rod bearing of the same grade.

### NOTE:

There is no grading for connecting rod big end diameter.



### When Crankshaft and Connecting Rod are Reused

1. Measure the connecting rod big end diameter. Refer to [EM-159, "CONNECTING ROD BIG END DIAMETER"](#).
2. Make sure that the connecting rod big end diameter is within the standard value.
3. Measure the crankshaft pin journal diameter. Refer to [EM-162, "CRANKSHAFT PIN JOURNAL DIAMETER"](#).
4. Determine the grade of crankshaft pin diameter grade by corresponding to the measured dimension in "Crankshaft pin journal diameter" column of "Connecting Rod Bearing Selection Table".
5. Select connecting rod bearing of the same grade.

## Connecting Rod Bearing Selection Table

Unit: mm (in)

Connecting rod big end diameter	55.000 - 55.013 (2.1654 - 2.1659)
---------------------------------	-----------------------------------

Unit: mm (in)

Crankshaft		Connecting rod bearing		
Crankshaft pin journal diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
51.962 - 51.968 (2.0457 - 2.0460)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
51.956 - 51.962 (2.0455 - 2.0457)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

## Undersize Bearings Usage Guide

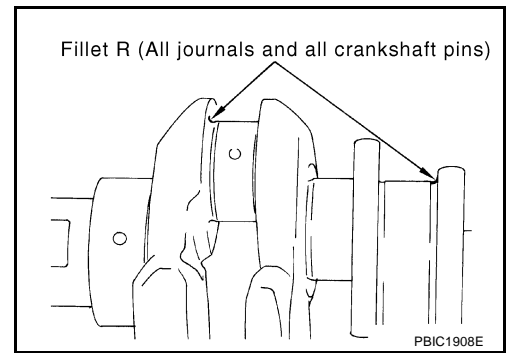
- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind crankshaft pin so that the connecting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



# CYLINDER BLOCK

## CAUTION:

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



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

## Bearing undersize table

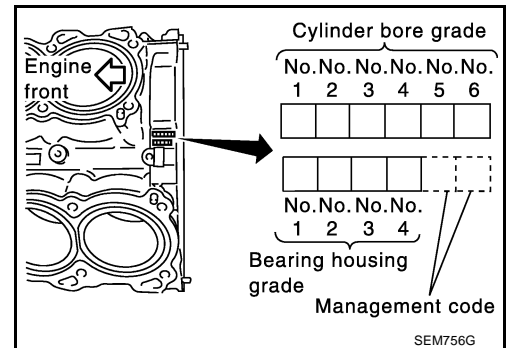
Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

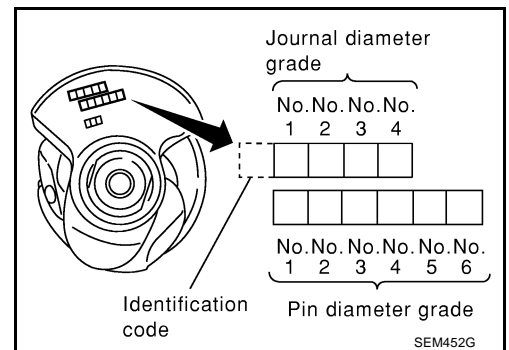
## HOW TO SELECT MAIN BEARING

### When New Cylinder Block and Crankshaft are Used

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



2. "Main Bearing Selection Table" columns correspond to journal diameter grade on front side of crankshaft.



3. Select main bearing grade at the point where selected row and column meet in "Main Bearing Selection Table".

### When Cylinder Block and Crankshaft are Reused

1. Measure cylinder block main bearing housing inner diameter and crankshaft main journal diameter. Refer to [EM-160, "MAIN BEARING HOUSING INNER DIAMETER"](#) and [EM-162, "CRANKSHAFT MAIN JOURNAL DIAMETER"](#).
2. Correspond the measured dimension in "Cylinder block main bearing housing inner diameter" row of "Main Bearing Selection Table".
3. Correspond the measured dimension in "Crankshaft main journal diameter" column of "Main Bearing Selection Table".
4. Select main bearing grade at the point where selected row and column meet in following selection table.

# CYLINDER BLOCK

## Main Bearing Selection Table

Cylinder block main bearing housing inner diameter Unit: mm (in)		Crankshaft main journal diameter Unit: mm (in)		Hole diameter																												
				Mark																												
Mark	Axle diameter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7							
A	59.975 - 59.974 (2.3612 - 2.3612)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34						
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4						
C	59.973 - 59.972 (2.3611 - 2.3611)	0	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4						
D	59.972 - 59.971 (2.3611 - 2.3611)	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4						
E	59.971 - 59.970 (2.3611 - 2.3610)	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45						
F	59.970 - 59.969 (2.3610 - 2.3610)	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45					
G	59.969 - 59.968 (2.3610 - 2.3609)	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45					
H	59.968 - 59.967 (2.3609 - 2.3609)	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	45	45	45	5				
J	59.967 - 59.966 (2.3609 - 2.3609)	1	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	45	45	45	5	5			
K	59.966 - 59.965 (2.3909 - 2.3608)	12	12	12	2	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	45	45	45	5	5	5		
L	59.965 - 59.964 (2.3608 - 2.3608)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	45	45	45	5	5	5		
M	59.964 - 59.963 (2.3608 - 2.3607)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	45	45	45	5	5	5		
N	59.963 - 59.962 (2.3607 - 2.3607)	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	45	45	45	5	5	5	
P	59.962 - 59.961 (2.3607 - 2.3607)	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	45	45	45	5	5	5
R	59.961 - 59.960 (2.3607 - 2.3606)	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
S	59.960 - 59.959 (2.3606 - 2.3606)	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
T	59.959 - 59.958 (2.3606 - 2.3605)	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
U	59.958 - 59.957 (2.3605 - 2.3605)	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
V	59.957 - 59.956 (2.3605 - 2.3605)	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
W	59.956 - 59.955 (2.3605 - 2.3604)	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
X	59.955 - 59.954 (2.3604 - 2.3604)	3	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Y	59.954 - 59.953 (2.3604 - 2.3603)	34	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
4	59.953 - 59.952 (2.3603 - 2.3603)	34	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
7	59.952 - 59.951 (2.3603 - 2.3603)	34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	

PBIC1981E

# CYLINDER BLOCK

## Main Bearing Grade Table (All Journals)

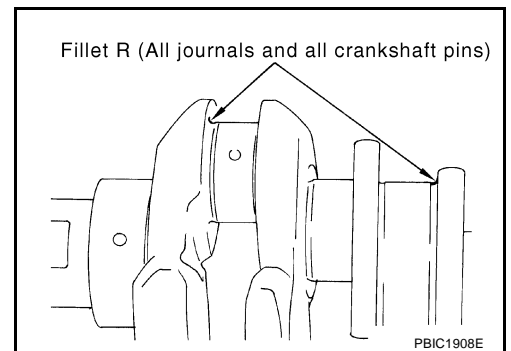
Grade number	Thickness Unit: mm (in)	Width Unit: mm (in)	Identification color	Remarks	
0	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade and color are the same for upper and lower bearings.	
1	2.003 - 2.006 (0.0789 - 0.0790)		Brown		
2	2.006 - 2.009 (0.0790 - 0.0791)		Green		
3	2.009 - 2.012 (0.0791 - 0.0792)		Yellow		
4	2.012 - 2.015 (0.0792 - 0.0793)		Blue		
5	2.015 - 2.018 (0.0793 - 0.0794)		Pink		
6	2.018 - 2.021 (0.0794 - 0.0796)		Purple		
7	2.021 - 2.024 (0.0796 - 0.0797)		White	Grade and color are different for upper and lower bearings.	
01	UPR		2.003 - 2.006 (0.0789 - 0.0790)		Brown
	LWR		2.000 - 2.003 (0.0787 - 0.0789)		Black
12	UPR		2.006 - 2.009 (0.0790 - 0.0791)		Green
	LWR		2.003 - 2.006 (0.0789 - 0.0790)		Brown
23	UPR		2.009 - 2.012 (0.0791 - 0.0792)		Yellow
	LWR		2.006 - 2.009 (0.0790 - 0.0791)		Green
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
	LWR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
	LWR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		
	LWR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White		
	LWR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		

### Undersize Bearing Usage Guide

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

**CAUTION:**

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



### Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)

# CYLINDER BLOCK

NBS00015

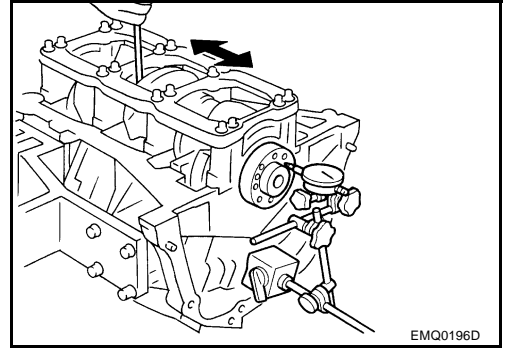
## Inspection After Disassembly CRANKSHAFT END PLAY

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

**Standard : 0.10 - 0.25 mm (0.0040 - 0.0098 in)**

**Limit : 0.30 mm (0.0120 in)**

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



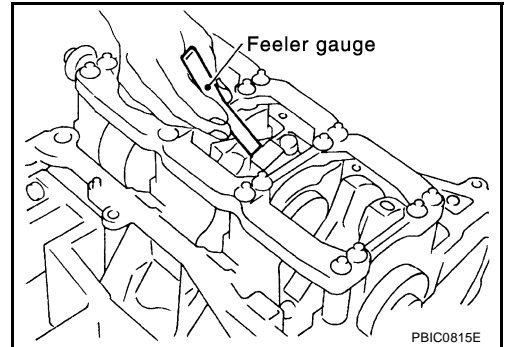
## CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with feeler gauge.

**Standard : 0.20 - 0.35 mm (0.0080 - 0.0138 in)**

**Limit : 0.40 mm (0.0160 in)**

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

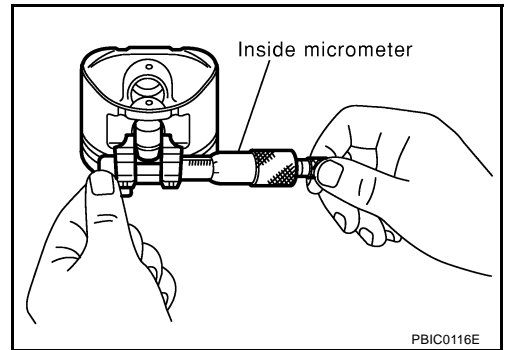


## PISTON TO PISTON PIN OIL CLEARANCE

### Piston Pin Hole Diameter

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

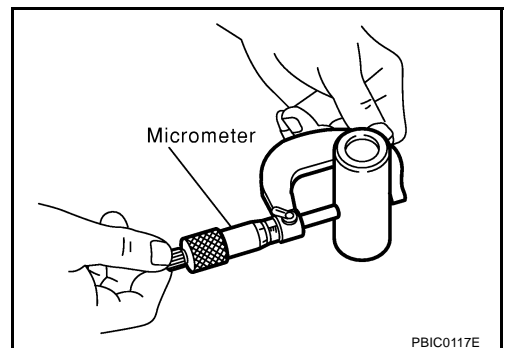
**Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)**



### Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

**Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)**



### Piston to Piston Pin Oil Clearance

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

**Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)**

- If the calculated value is out of the standard, replace piston and piston pin assembly.

# CYLINDER BLOCK

- When replacing piston and piston pin assembly, refer to [EM-151, "HOW TO SELECT 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 piston pin grades can be selected. (Only "0" grade is available.)

## PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with feeler gauge.

### Standard:

#### A/T models

Top ring	: 0.045 - 0.080 mm (0.0018 - 0.0031 in)
2nd ring	: 0.030 - 0.070 mm (0.0012 - 0.0028 in)
Oil ring	: 0.065 - 0.135 mm (0.0026 - 0.0053 in)

#### M/T models

Top ring	: 0.045 - 0.080 mm (0.0018 - 0.0031 in)
2nd ring	: 0.030 - 0.070 mm (0.0012 - 0.0028 in)
Oil ring	: 0.065 - 0.135 mm (0.0026 - 0.0053 in)

### Limit:

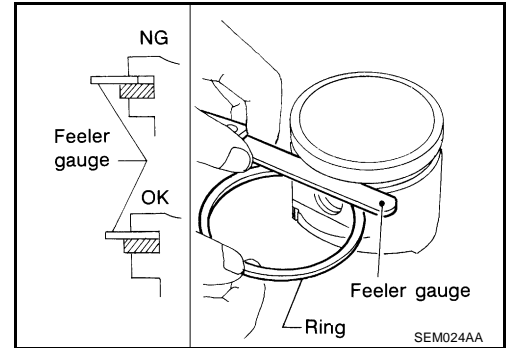
#### A/T models

Top ring	: 0.11 mm (0.0043 in)
2nd ring	: 0.10 mm (0.004 in)
Oil ring	: —

#### M/T models

Top ring	: 0.11 mm (0.0043 in)
2nd ring	: 0.10 mm (0.004 in)
Oil ring	: 0.17 mm (0.0067 in)

- If the measured value exceeds the limit (or exceeding the standard in the case of oil ring of A/T models), replace piston ring, and measure again. If it still exceeds the limit (or exceeding the standard in the case of oil ring of A/T models), replace piston also.



A

EM

C

D

E

F

G

H

I

J

K

L

M

# CYLINDER BLOCK

## PISTON RING END GAP

- Make sure that cylinder bore inner diameter is within the specification. Refer to [EM-161, "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 the piston ring end gap with feeler gauge.

### Standard:

#### A/T models

- Top ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)
- 2nd ring : 0.33 - 0.48 mm (0.0130 - 0.0189 in)
- Oil ring : 0.20 - 0.50 mm (0.008 - 0.020 in)

#### M/T models

- Top ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)
- 2nd ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)
- Oil ring : 0.20 - 0.50 mm (0.008 - 0.020 in)

### Limit:

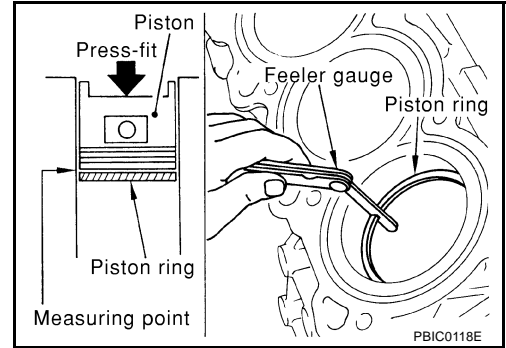
#### A/T models

- Top ring : 0.54 mm (0.0213 in)
- 2nd ring : 0.80 mm (0.0310 in)
- Oil ring : 0.95 mm (0.0374 in)

#### M/T models

- Top ring : 0.54 mm (0.0213 in)
- 2nd ring : 0.53 mm (0.0209 in)
- Oil ring : 0.85 mm (0.0335 in)

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



## CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner.

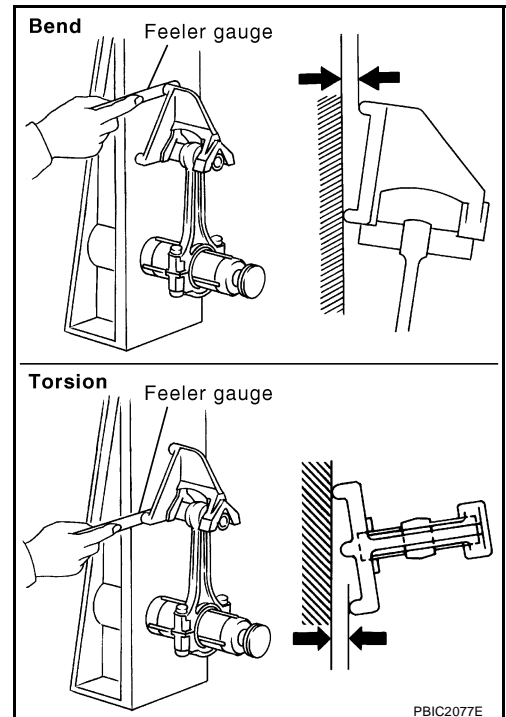
### Bend:

Limit: 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

### Torsion:

Limit: 0.30 mm (0.0120 in) per 100 mm (3.94 in) length

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



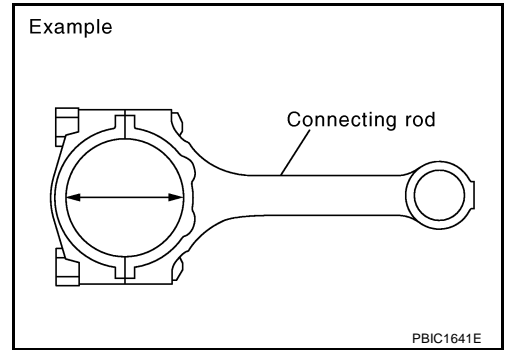
# CYLINDER BLOCK

## CONNECTING ROD BIG END DIAMETER

- Install connecting rod bearing cap without installing connecting rod bearing, and tightening connecting rod bolts to the specified torque. Refer to [EM-143, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of connecting rod big end with inside micrometer.

**Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)**

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

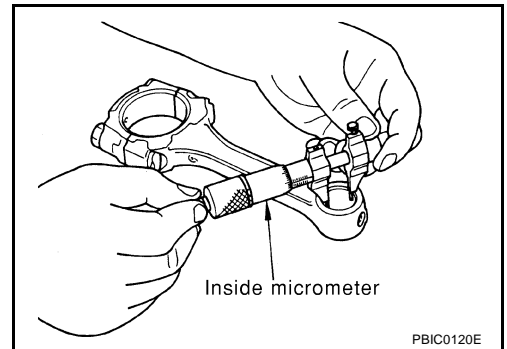


## CONNECTING ROD BUSHING OIL CLEARANCE

### Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with inside micrometer.

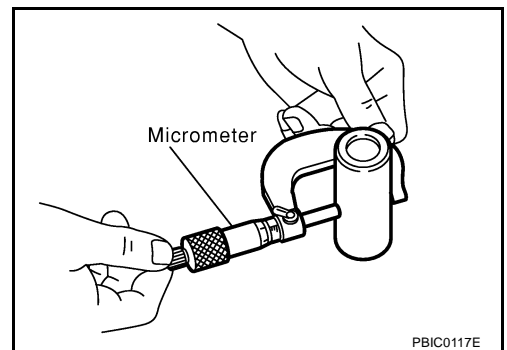
**Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)**



### Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

**Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)**



### Connecting Rod Bushing Oil Clearance

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

**Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**

**Limit : 0.030 mm (0.0012 in)**

- If the measured value exceeds the limit, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to [EM-151, "HOW TO SELECT PISTON"](#) .
- If replacing connecting rod assembly, refer to [EM-163, "CONNECTING ROD BEARING OIL CLEARANCE"](#) to select the connecting rod bearing.

# CYLINDER BLOCK

## Factory installed parts grading:

- Service parts apply only to grade "0".

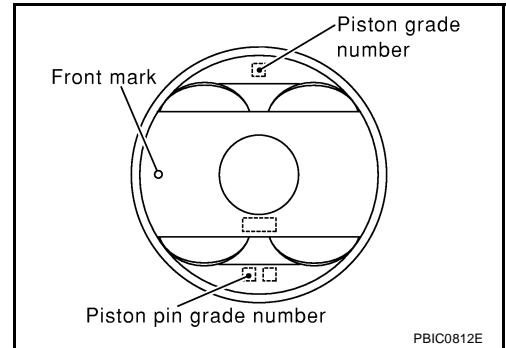
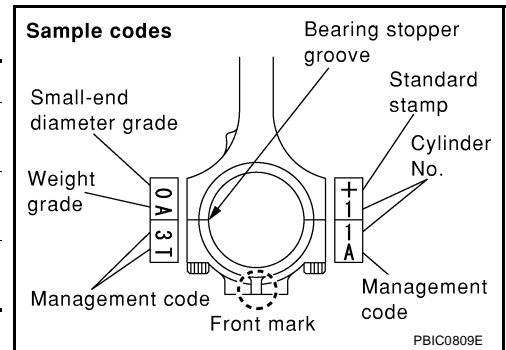
Unit: mm (in)

Grade	0	1
Connecting rod bushing inner diameter *	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)

\*: After installing in connecting rod

### NOTE:

Figure shows the piston of A/T models. The front marks of M/T models are 2 punched.



## CYLINDER BLOCK DISTORTION

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

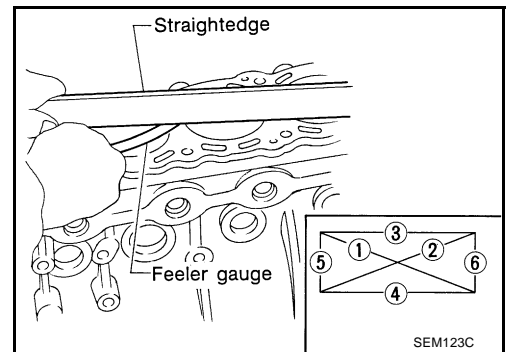
### CAUTION:

**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 straightedge and feeler gauge.

**Limit : 0.1 mm (0.004 in)**

- If it exceeds the limit, replace cylinder block.



## MAIN BEARING HOUSING INNER DIAMETER

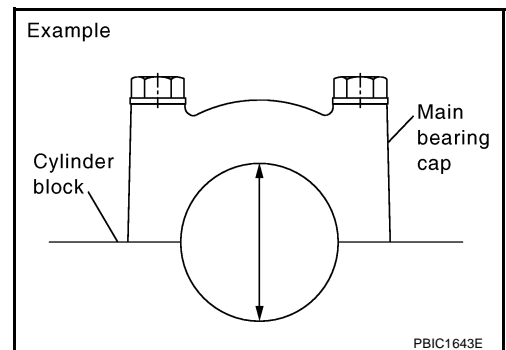
- Install main bearing caps and main bearing beam without installing main bearings, and tighten main bearing cap bolts to the specified torque. Refer to [EM-143, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing housing with bore gauge.

**Standard : 63.993 - 64.017 mm (2.5194 - 2.5203 in)**

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

### NOTE:

Cylinder block cannot be replaced as a single part, because it is machined together with main bearing caps.





# CYLINDER BLOCK

## PISTON TO CYLINDER BORE CLEARANCE

### Cylinder Bore Inner Diameter

- Using bore gauge, measure 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") ("X" is in longitudinal direction of engine)

**Standard inner diameter:**

**95.500 - 95.530 mm (3.7598 - 3.7610 in)**

**Wear limit:**

**0.2 mm (0.008 in)**

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

**0.015 mm (0.0006 in)**

**Taper limit (Difference between "A" and "C"):**

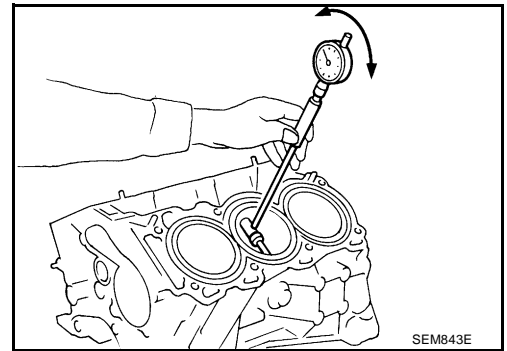
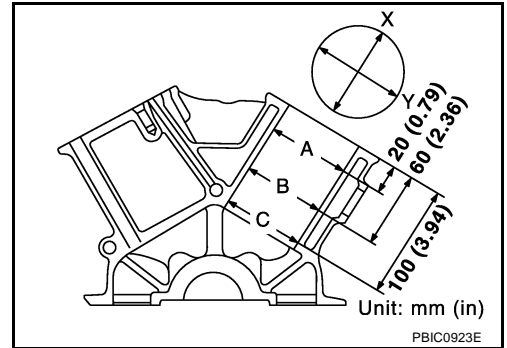
**0.01 mm (0.0004 in)**

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or re-bore the inner wall.
- Oversize piston is provided. When using oversize piston, re-bore cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.

**CAUTION:**

**When using oversize piston, use over size pistons for all cylinders with oversize piston rings.**

**Oversize : 0.2 mm (0.008 in)**



### Piston Skirt Diameter

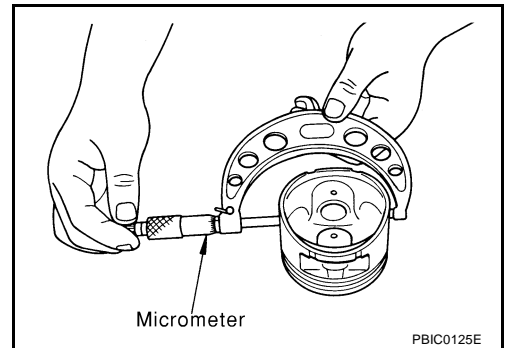
Measure the outer diameter of piston skirt with micrometer.

**Measure point**

**: Distance from the top 41.0 mm (1.614 in)**

**Standard**

**: 95.480 - 95.510 mm (3.7590 - 3.7602 in)**



### Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction "Y", position "B").  
(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter).

**Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)**

**Limit : 0.08 mm (0.0031 in)**

- If calculated value exceeds the limit, replace piston and piston pin assembly. Refer to [EM-151, "HOW TO SELECT PISTON"](#).

### Re-boring Cylinder Bore

- Cylinder bore size is determined by adding piston to cylinder bore clearance to piston skirt diameter.

**Re-bored size calculation:  $D = A + B - C$**

**where,**

**D: Bored diameter**

**A: Piston skirt diameter as measured**

# CYLINDER BLOCK

**B: Piston to cylinder bore clearance (standard value)**

**C: Honing allowance 0.02 mm (0.0008 in)**

2. Install main bearing caps and main bearing beam, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

**NOTE:**

- When any cylinder needs boring, all other cylinders must also be bored.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.

- 4.hone cylinders to obtain the specified piston to cylinder bore clearance.
5. Measure finished cylinder bore for the out-of-round and taper.

**NOTE:**

Measurement should be done after cylinder bore cools down.

## CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with micrometer.

**Standard : 59.951 - 59.975 mm (2.3603 - 2.3612 in) dia.**

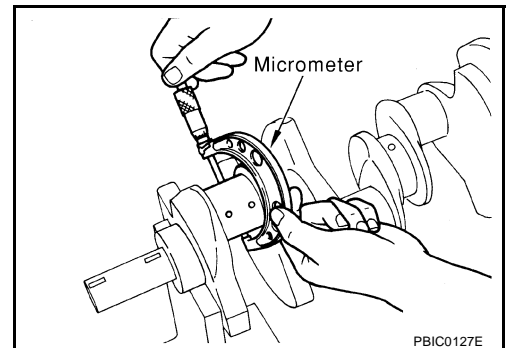
- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-164, "MAIN BEARING OIL CLEARANCE"](#).

## CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard : 51.956 - 51.974 mm (2.0455 - 2.0462 in) dia.**

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-163, "CONNECTING ROD BEARING OIL CLEARANCE"](#).



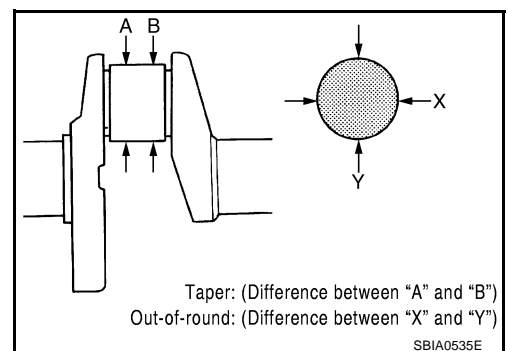
## CRANKSHAFT OUT-OF-ROUND AND TAPER

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

**Limit:**

**Out-of-round (Difference between "X" and "Y")  
: 0.002 mm (0.0001 in)**

**Taper (Difference between "A" and "B")  
: 0.002 mm (0.0001 in)**



- 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 the main bearing and/or connecting rod bearing. Refer to [EM-164, "MAIN BEARING OIL CLEARANCE"](#) and/or [EM-163, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

# CYLINDER BLOCK

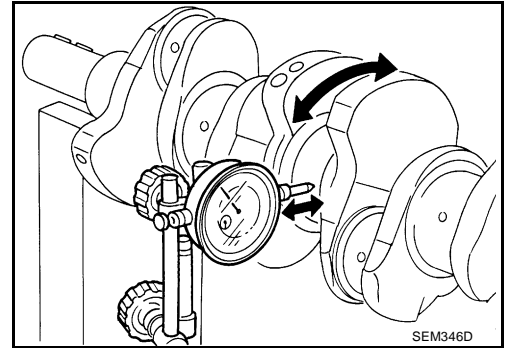
## CRANKSHAFT RUNOUT

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

**Standard** : Less than 0.05 mm (0.0020 in)

**Limit** : 0.10 mm (0.004 in)

- If it exceeds the limit, replace crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

### Method by Calculation

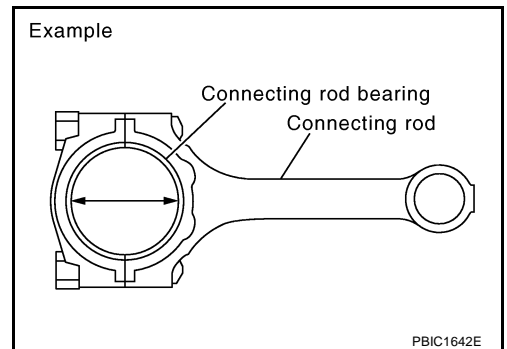
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-143, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of connecting rod bearing with inside micrometer.

(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

**Standard** : 0.034 - 0.059 mm (0.0013 - 0.0023 in)  
(actual clearance)

**Limit** : 0.070 mm (0.0028 in)

- If the calculated value 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-152, "HOW TO SELECT CONNECTING ROD BEARING"](#).



### Method of Using Plastigage

- Remove oil and dust on crankshaft pin journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-143, "ASSEMBLY"](#) for the tightening procedure.

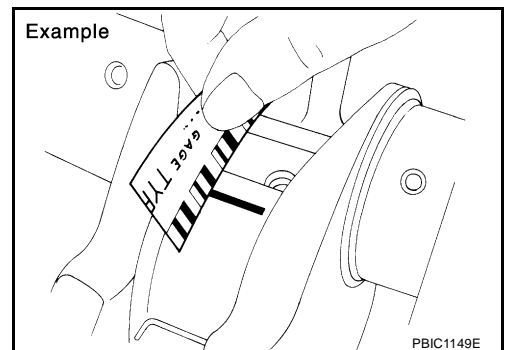
#### CAUTION:

**Do not rotate crankshaft.**

- Remove connecting rod bearing cap and bearing, and using scale on 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".



# CYLINDER BLOCK

## MAIN BEARING OIL CLEARANCE

### Method by Calculation

- Install main bearings to cylinder block and main bearing caps, and tighten main bearing cap bolts with main bearing beam to the specified torque. Refer to [EM-143, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing with bore gauge.  
(Bearing clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

**Standard** : 0.035 - 0.045 mm (0.0014 - 0.0018 in)  
(actual clearance)

**Limit** : 0.065 mm (0.0026 in)

- 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-153, "HOW TO SELECT MAIN BEARING"](#).

### Method of Using Plastigage

- Remove oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut 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 caps, and tighten main bearing bolts with main bearing beam to the specified torque. Refer to [EM-143, "ASSEMBLY"](#) for the tightening procedure.

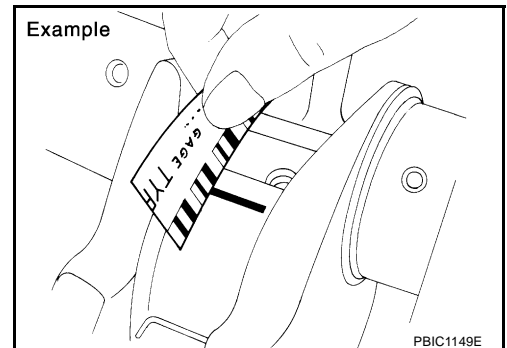
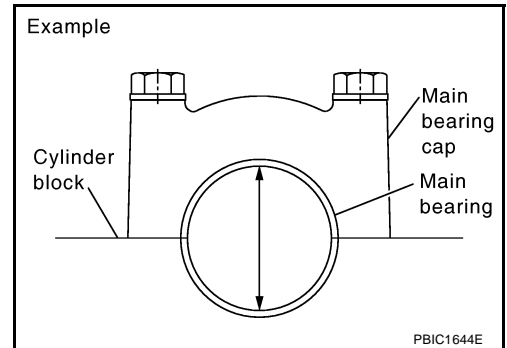
#### CAUTION:

**Do not rotate crankshaft.**

- Remove main bearing caps and bearings, and using scale on 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".

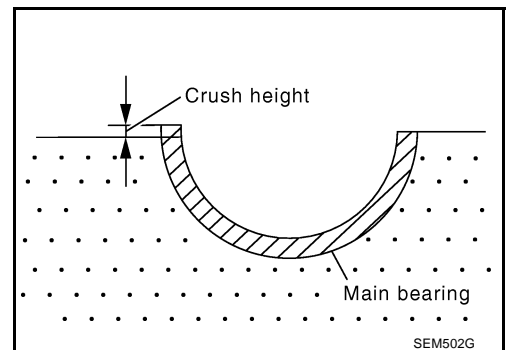


## CRUSH HEIGHT OF MAIN BEARING

- 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-143, "ASSEMBLY"](#) for the tightening procedure.

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

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



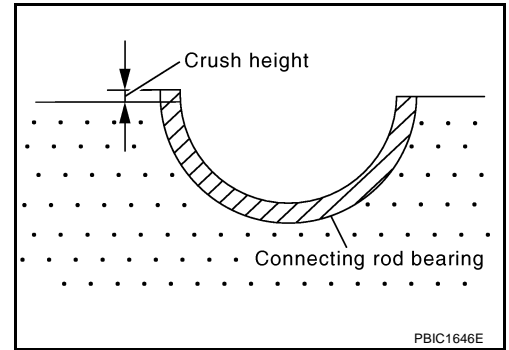
# CYLINDER BLOCK

## CRUSH HEIGHT OF CONNECTING ROD BEARING

- 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-143, "ASSEMBLY"](#) for the tightening procedure.

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

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

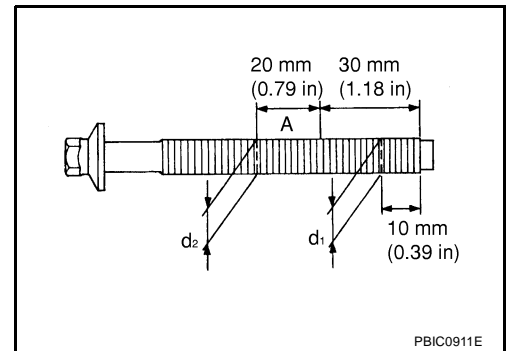


## MAIN BEARING CAP BOLT OUTER DIAMETER

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

**Limit ("d1" - "d2")** : 0.11 mm (0.0043 in)

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



## CONNECTING ROD BOLT OUTER DIAMETER (A/T MODELS)

### CAUTION:

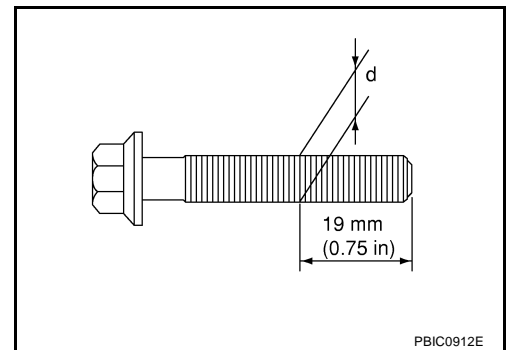
Do not reuse connecting rod bolt for M/T models. Replace it with a new one.

- Measure the outer diameter "d" at position shown in the figure.
- If the reduction appears in a position other than "d", regard it as "d".

**Standard** : 7.90 - 8.00 mm (0.3110 - 0.3150 in)

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

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

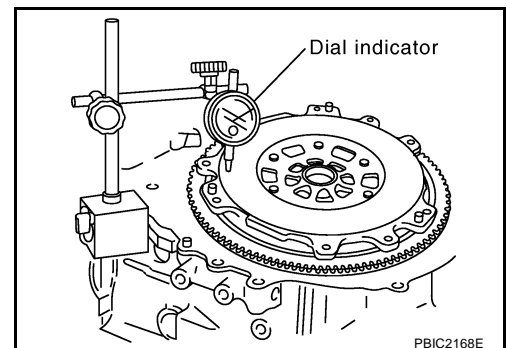


## FLYWHEEL DEFLECTION (M/T MODELS)

- Measure the deflection of flywheel contact surface to clutch with dial indicator.
- Measure the deflection at 210 mm (8.27 in) dia.

**Standard** : 0.45 mm (0.0177 in) or less

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



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

### CAUTION:

Do not disassemble double mass flywheel.

# CYLINDER BLOCK

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

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

**Standard : 1.3 mm (0.051 in) or less**

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

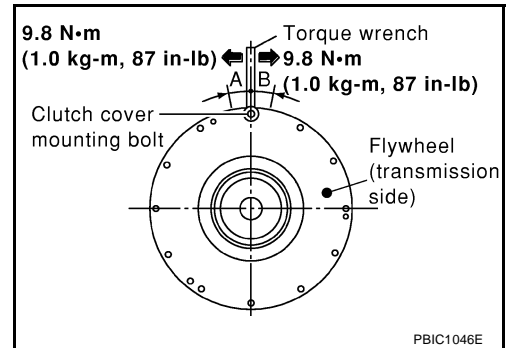
## Movement Amount of Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction as follows:

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

**Standard : 24 mm (0.94 in) or less**

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

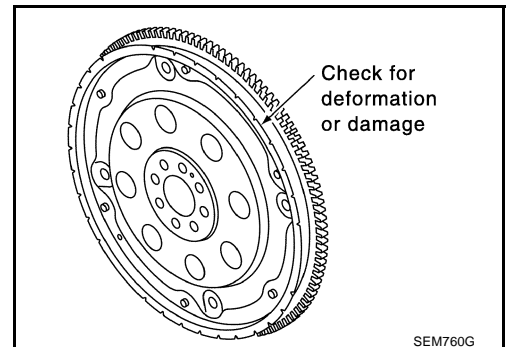


## DRIVE PLATE (A/T MODELS)

- Check drive plate and signal plate for deformation or cracks.

### CAUTION:

- Do not disassemble drive plate.
- Do not place drive plate 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.
- If anything is found, replace drive plate.

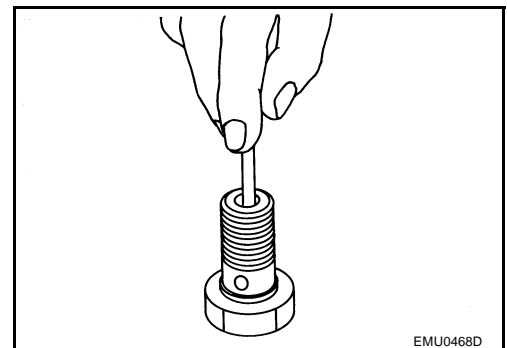


## OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, clean or replace oil jet.

## OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not satisfied, replace oil jet relief valve.



# SERVICE DATA AND SPECIFICATIONS (SDS)

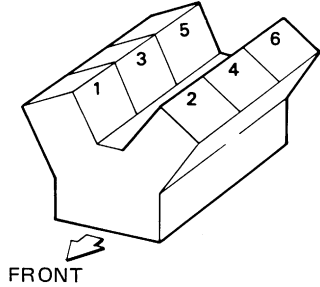
## SERVICE DATA AND SPECIFICATIONS (SDS)

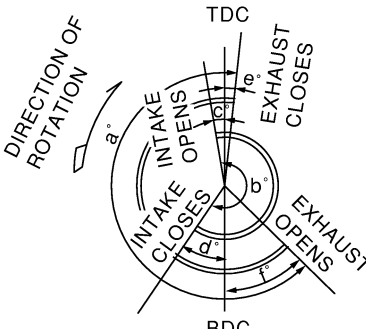
PPF:00100

### Standard and Limit GENERAL SPECIFICATIONS

NBS00016

Cylinder arrangement		V-6
Displacement cm <sup>3</sup> (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3
Compression pressure kPa (kg/cm <sup>2</sup> , psi)/300 rpm	Standard	1,275 (13.0, 185)
	Minimum	981 (10.0, 142)
	Differential limit between cylinders	98 (1.0, 14)

Cylinder number	 <p style="text-align: center;">FRONT</p> <p style="text-align: right; font-size: small;">SEM713A</p>
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Valve timing (Intake valve timing control - "OFF")	 <p style="text-align: right; font-size: small;">PBIC0187E</p>
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Unit: degree

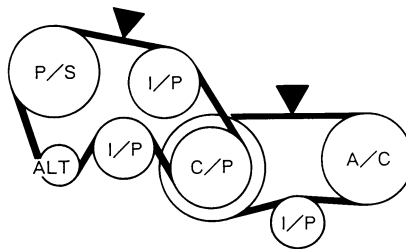
	a	b	c	d	e	f
A/T models	240	238	-6	64	8	52
M/T models	248	248	-2	70	-2	70

# SERVICE DATA AND SPECIFICATIONS (SDS)

## DRIVE BELT

	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and power steering oil pump belt	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
A/C compressor belt	12 (0.47)	9 - 10 (0.35 - 0.39)	8 - 9 (0.31 - 0.35)	196 (20, 44)	348 - 436 (35.5 - 44.5, 78 - 98)	470 - 559 (48 - 57, 106 - 126)
Applied pushing force	98 N (10 kg, 22 lb)			—		

SEC.117



KBIA1731J

\*: If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

## INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit	
Surface distortion	Intake manifold collector (upper)	0.1 (0.004)
	Intake manifold collector (lower)	0.1 (0.004)
	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

## SPARK PLUG

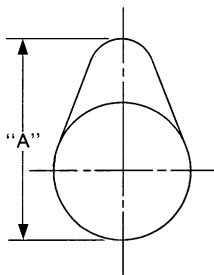
Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (Nominal)	1.1 mm (0.043 in)



# SERVICE DATA AND SPECIFICATIONS (SDS)

## CAMSHAFT AND CAMSHAFT BEARING

			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	0.035 - 0.076 (0.0014 - 0.0030)		
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—	
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—	
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—	
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—	
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)	
Camshaft cam height "A"	A/T models	Intake	0.2 (0.008)*1	
		Exhaust		
	M/T models	Intake		
		Exhaust		
Camshaft runout (TIR*2)		Less than 0.02 (0.0008)	0.05 (0.0020)	
Camshaft sprocket runout (TIR*2)		—	0.15 (0.0059)	



SEM671

\*1 : Cam wear limit

\*2 : Total indicator reading

## Valve Lifter

			Unit: mm (in)	
Items		Standard		
Valve lifter outer diameter	Intake	33.977 - 33.987 (1.3377 - 1.3381)		
	Exhaust	Identification (stamped) mark: "R"	33.977 - 33.987 (1.3377 - 1.3381)	
		Identification (stamped) mark: "V"	33.980 - 33.990 (1.3378 - 1.3382)	
Valve lifter hole diameter		34.000 - 34.016 (1.3386 - 1.3392)		
Valve lifter clearance	Intake	0.013 - 0.039 (0.0005 - 0.0015)		
	Exhaust	Identification (stamped) mark: "R"	0.013 - 0.039 (0.0005 - 0.0015)	
		Identification (stamped) mark: "V"	0.010 - 0.036 (0.0004 - 0.0014)	

## 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)		

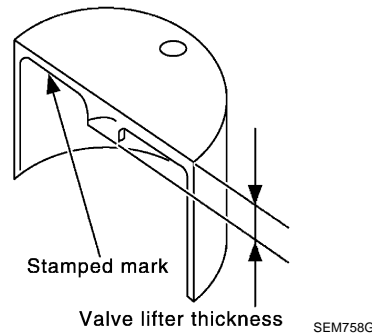
\*: Approximately 80°C (176°F)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Available Valve Lifter

Unit: mm (in)

Identification (stamped) mark			Thickness
Intake	Exhaust		
788U	788R	788V	7.88 (0.3102)
790U	790R	790V	7.90 (0.3110)
792U	792R	792V	7.92 (0.3118)
794U	794R	794V	7.94 (0.3126)
796U	796R	796V	7.96 (0.3134)
798U	798R	798V	7.98 (0.3142)
800U	800R	800V	8.00 (0.3150)
802U	802R	802V	8.02 (0.3157)
804U	804R	804V	8.04 (0.3165)
806U	806R	806V	8.06 (0.3173)
808U	808R	808V	8.08 (0.3181)
810U	810R	810V	8.10 (0.3189)
812U	812R	812V	8.12 (0.3197)
814U	814R	814V	8.14 (0.3205)
816U	816R	816V	8.16 (0.3213)
818U	818R	818V	8.18 (0.3220)
820U	820R	820V	8.20 (0.3228)
822U	822R	822V	8.22 (0.3236)
824U	824R	824V	8.24 (0.3244)
826U	826R	826V	8.26 (0.3252)
828U	828R	828V	8.28 (0.3260)
830U	830R	830V	8.30 (0.3268)
832U	832R	832V	8.32 (0.3276)
834U	834R	834V	8.34 (0.3283)
836U	836R	836V	8.36 (0.3291)
838U	838R	838V	8.38 (0.3299)
840U	840R	840V	8.40 (0.3307)

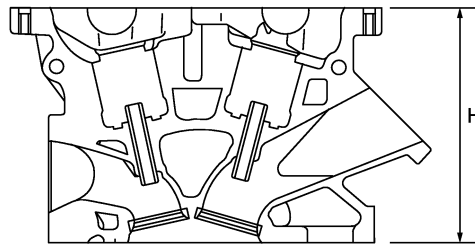


# SERVICE DATA AND SPECIFICATIONS (SDS)

## CYLINDER HEAD

Unit: mm (in)

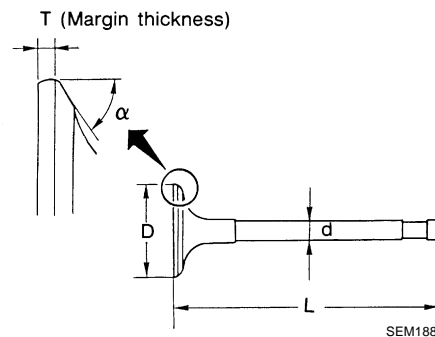
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height "H"	126.3 - 126.5 (4.972 - 4.980)	—



PBIC0924E

## Valve Dimensions

Unit: mm (in)

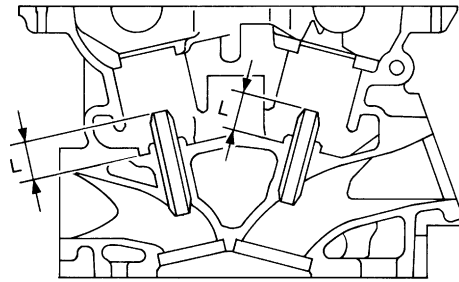


Valve head diameter "D"	Intake	37.0 - 37.3 (1.457 - 1.469)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	96.37 (3.794)
	Exhaust	93.99 (3.700)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)
Valve margin "T" limit		0.5 (0.020)
Valve stem end surface grinding limit		0.2 (0.008)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Guide

Unit: mm (in)



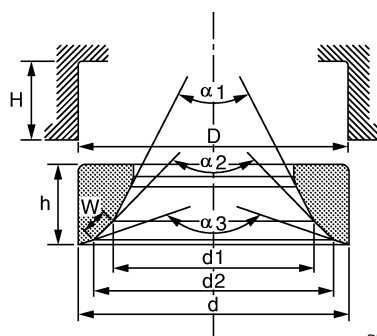
SEM950E

Items		Standard	Oversize (Service) [0.2 (0.008)]
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length "L"		12.6 - 12.8 (0.496 - 0.504)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Seat

Unit: mm (in)



Items		Standard	Oversize (Service) [0.5 (0.02)]
Cylinder head seat recess diameter "D"	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat outer diameter "d"	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter "d1"*1	Intake	35 (1.38)	
	Exhaust	28.7 (1.130)	
Diameter "d2"*2	Intake	36.3 - 36.8 (1.429 - 1.449)	
	Exhaust	30.3 - 30.8 (1.193 - 1.213)	
Angle "alpha1"	Intake	60°	
	Exhaust	60°	
Angle "alpha2"	Intake	88°45' - 90°15'	
	Exhaust	88°45' - 90°15'	
Angle "alpha3"	Intake	120°	
	Exhaust	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)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"		6.0 (0.236)	

\*1 : Diameter made by intersection point of conic angles "alpha1" and "alpha2"

\*2 : Diameter made by intersection point of conic angles "alpha2" and "alpha3"

\*3 : Machining data

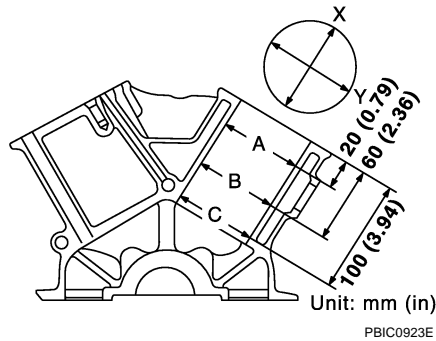
## Valve Spring

Items	A/T models	M/T models
Free height	47.07 mm (1.8531 in)	45.43 mm (1.7886 in)
Installation height	37.00 mm (1.4567 in)	37.00 mm (1.4567 in)
Installation load	166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)	166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)
Height during valve open	27.20 mm (1.071 in)	26.80 mm (1.055 in)
Load with valve open	373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb)	434 - 490 N (44.3 - 50.0 kg, 97.6 - 110.2 lb)
squareness	2.1 mm (0.083 in)	2.0 mm (0.079 in)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## CYLINDER BLOCK

Unit: mm (in)



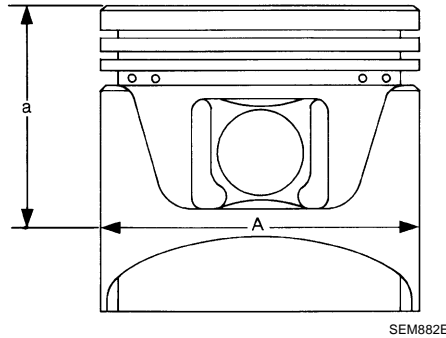
Surface distortion		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Main bearing housing inner diameter		Standard		63.993 - 64.017 (2.5194 - 2.5203)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.2 (0.008)
Out-of-round (Difference between "X" and "Y")		Limit	0.015 (0.0006)	
Taper (Difference between "A" and "C")			0.01 (0.0004)	
Main bearing housing inner diameter (Without bearing)		Grade No. A		63.993 - 63.994 (2.5194 - 2.5194)
		Grade No. B		63.994 - 63.995 (2.5194 - 2.5195)
		Grade No. C		63.995 - 63.996 (2.5195 - 2.5195)
		Grade No. D		63.996 - 63.997 (2.5195 - 2.5196)
		Grade No. E		63.997 - 63.998 (2.5196 - 2.5196)
		Grade No. F		63.998 - 63.999 (2.5196 - 2.5196)
		Grade No. G		63.999 - 64.000 (2.5196 - 2.5197)
		Grade No. H		64.000 - 64.001 (2.5197 - 2.5197)
		Grade No. J		64.001 - 64.002 (2.5197 - 2.5198)
		Grade No. K		64.002 - 64.003 (2.5198 - 2.5198)
		Grade No. L		64.003 - 64.004 (2.5198 - 2.5198)
		Grade No. M		64.004 - 64.005 (2.5198 - 2.5199)
		Grade No. N		64.005 - 64.006 (2.5199 - 2.5199)
		Grade No. P		64.006 - 64.007 (2.5199 - 2.5200)
		Grade No. R		64.007 - 64.008 (2.5200 - 2.5200)
		Grade No. S		64.008 - 64.009 (2.5200 - 2.5200)
		Grade No. T		64.009 - 64.010 (2.5200 - 2.5201)
Grade No. U		64.010 - 64.011 (2.5201 - 2.5201)		
Grade No. V		64.011 - 64.012 (2.5201 - 2.5202)		
Grade No. W		64.012 - 64.013 (2.5202 - 2.5202)		
Grade No. X		64.013 - 64.014 (2.5202 - 2.5202)		
Grade No. Y		64.014 - 64.015 (2.5202 - 2.5203)		
Grade No. 4		64.015 - 64.016 (2.5203 - 2.5203)		
Grade No. 7		64.016 - 64.017 (2.5203 - 2.5203)		
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## PISTON, PISTON RING AND PISTON PIN

### Available Piston

Unit: mm (in)



Items		Standard	Oversize (Service) [0.20 (0.008)]
"a" dimension		41.0 (1.614)	
Piston skirt diameter "A"	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)	—
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)	—
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)	—
	Service	—	95.680 - 95.710 (3.7669 - 3.7681)
Items		Standard	Limit
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	—
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	—
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)	0.08 (0.0031)

### Piston Ring

Unit: mm (in)

Items		Standard		Limit	
		A/T models	M/T models	A/T models	M/T models
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)		0.11 (0.0043)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)		0.10 (0.004)	0.10 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)		—	0.17 (0.0067)
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.23 - 0.33 (0.0091 - 0.0130)	0.80 (0.0315)	0.53 (0.0209)
	Oil (rail ring)	0.20 - 0.50 (0.008 - 0.020)	0.20 - 0.50 (0.008 - 0.020)	0.95 (0.0374)	0.85 (0.0335)

### Piston Pin

Unit: mm (in)

Items		Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
Piston to piston pin oil clearance		0.002 - 0.006 (0.0001 - 0.0002)	—
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

## SERVICE DATA AND SPECIFICATIONS (SDS)

### CONNECTING ROD

Unit: mm (in)

Items	Standard	Limit
Center distance	144.15 - 144.25 (5.6752 - 5.6791)	—
Bend [per 100 (3.94)]	—	0.15 (0.0059)
Torsion [per 100 (3.94)]	—	0.30 (0.0120)
Connecting rod bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end diameter (Without bearing)	55.000 - 55.013 (2.1654 - 2.1659)	—
Side clearance	0.20 - 0.35 (0.0080 - 0.0138)	0.40 (0.0160)

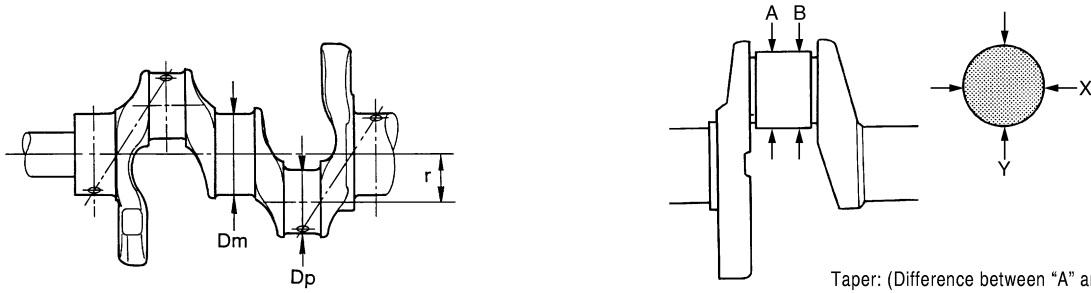
\*: After installing in connecting rod



# SERVICE DATA AND SPECIFICATIONS (SDS)

## CRANKSHAFT

Unit: mm (in)



SEM645

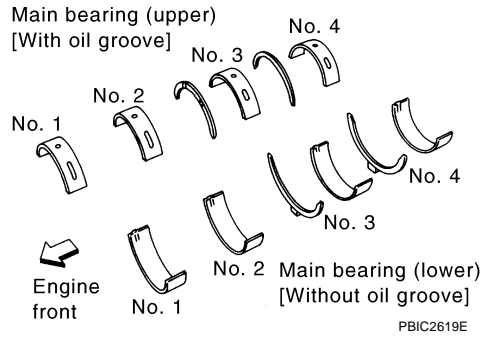
SBIA0535E

Main journal diameter. "Dm"	Standard	Grade No. A	59.974 - 59.975 (2.3612 - 2.3612)
		Grade No. B	59.973 - 59.974 (2.3611 - 2.3612)
		Grade No. C	59.972 - 59.973 (2.3611 - 2.3611)
		Grade No. D	59.971 - 59.972 (2.3611 - 2.3611)
		Grade No. E	59.970 - 59.971 (2.3610 - 2.3611)
		Grade No. F	59.969 - 59.970 (2.3610 - 2.3610)
		Grade No. G	59.968 - 59.969 (2.3609 - 2.3610)
		Grade No. H	59.967 - 59.968 (2.3609 - 2.3609)
		Grade No. J	59.966 - 59.967 (2.3609 - 2.3609)
		Grade No. K	59.965 - 59.966 (2.3608 - 2.3609)
		Grade No. L	59.964 - 59.965 (2.3608 - 2.3608)
		Grade No. M	59.963 - 59.964 (2.3607 - 2.3608)
		Grade No. N	59.962 - 59.963 (2.3607 - 2.3607)
		Grade No. P	59.961 - 59.962 (2.3607 - 2.3607)
		Grade No. R	59.960 - 59.961 (2.3606 - 2.3607)
		Grade No. S	59.959 - 59.960 (2.3606 - 2.3606)
		Grade No. T	59.958 - 59.959 (2.3605 - 2.3606)
Grade No. U	59.957 - 59.958 (2.3605 - 2.3605)		
Grade No. V	59.956 - 59.957 (2.3605 - 2.3605)		
Grade No. W	59.955 - 59.956 (2.3604 - 2.3605)		
Grade No. X	59.954 - 59.955 (2.3604 - 2.3604)		
Grade No. Y	59.953 - 59.954 (2.3603 - 2.3604)		
Grade No. 4	59.952 - 59.953 (2.3603 - 2.3603)		
Grade No. 7	59.951 - 59.952 (2.3603 - 2.3603)		
Pin journal diameter. "Dp"	Standard	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
		Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
		Grade No. 2	51.956 - 51.962 (2.0455 - 2.0457)
Center distance "r"			40.66 - 40.74 (1.6008 - 1.6039)
Out-of-round (Difference between "X" and "Y")	Limit		0.002 (0.0001)
Taper (Difference between "A" and "B")			0.002 (0.0001)
Crankshaft runout (TIR*)	Standard		Less than 0.05 (0.0020)
	Limit		0.10 (0.004)
Crankshaft end play	Standard		0.10 - 0.25 (0.0040 - 0.0098)
	Limit		0.30 (0.0120)

\*: Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

## MAIN BEARING



PBIC2619E

Grade number	UPR/LWR	Thickness mm (in)	Width mm (in)	Identification color	Remarks
0	—	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	—	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
2	—	2.006 - 2.009 (0.0790 - 0.0791)		Green	
3	—	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
4	—	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
5	—	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
6	—	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
7	—	2.021 - 2.024 (0.0796 - 0.0797)		White	Grade is different for upper and lower bearings.
01	UPR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		Black	
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
	LWR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
	LWR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		
	LWR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White		
	LWR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		

### Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

### Main Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Main bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018)*	0.065 (0.0026)

\*: Actual clearance

# SERVICE DATA AND SPECIFICATIONS (SDS)

## CONNECTING ROD BEARING

Grade number	Thickness mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

## Undersize

Unit: mm (in)

Items	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

## Connecting Rod Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.034 - 0.059 (0.0013 - 0.0023)*	0.070 (0.0028)

\*: Actual clearance

# SERVICE DATA AND SPECIFICATIONS (SDS)

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