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# SECTION **EM**

## ENGINE MECHANICAL

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# PRECAUTIONS

## PRECAUTIONS

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### Precautions for Draining Engine Coolant

ABS0046W

- Drain engine coolant when engine is cooled.

### Precautions for Disconnecting Fuel Piping

ABS0046X

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

### Precautions for Removal and Disassembly

ABS00DAH

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and assembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used where noted in the step.

### Precautions for Inspection, Repair and Replacement

ABS0046Z

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

### Precautions for Assembly and Installation

ABS00470

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

# PRECAUTIONS

## Parts Requiring Angular Tightening

ABS00471

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

## Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

ABS004S2

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

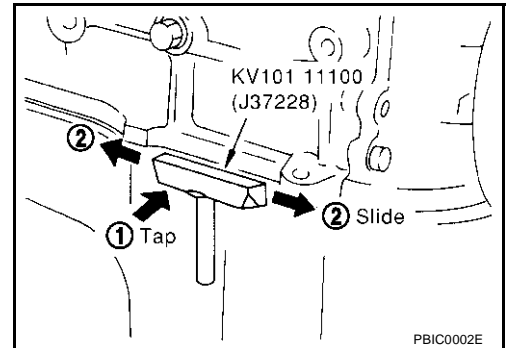
### CAUTION:

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

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the areas where the liquid gasket is applied.

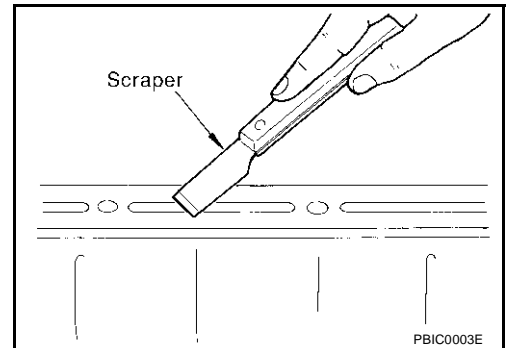
### CAUTION:

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

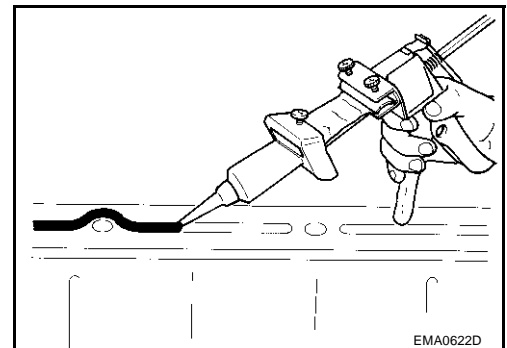


## LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
  - Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface removing any adhering moisture, grease and foreign material.



3. Attach the liquid gasket tube to the tube presser [special service tool: WS39930000 ( — )].  
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
  - If there is a groove for the liquid gasket application, apply the gasket to the groove.

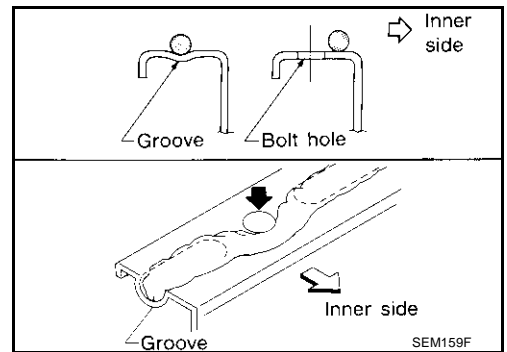


## PRECAUTIONS

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

**CAUTION:**

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



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# PREPARATION

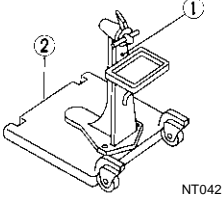
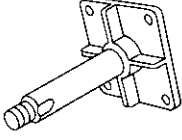
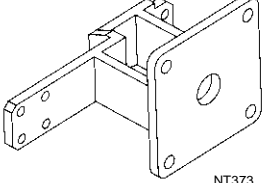
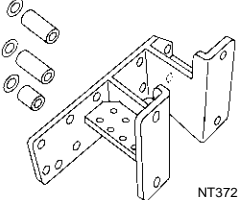
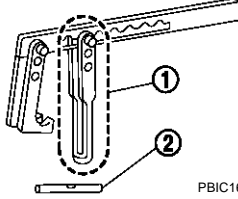
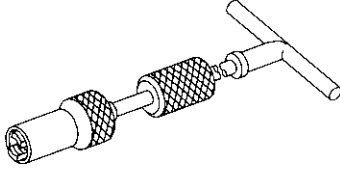
## PREPARATION

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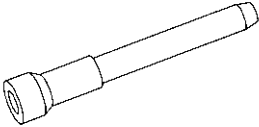
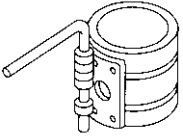
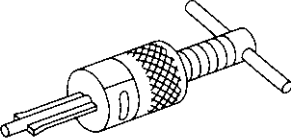
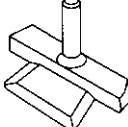
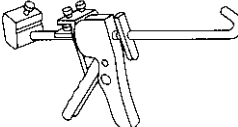
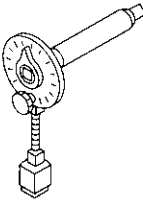
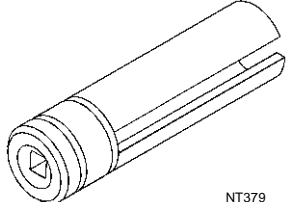
### Special Service Tools

ABS00802

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

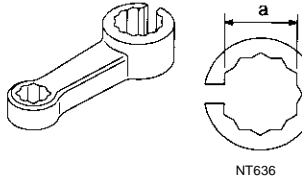
Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 ( — ) Engine stand assembly 1. ST05011000 ( — ) Engine stand 2. ST05012000 ( — ) Base	Disassembling and assembling engine  <p style="text-align: right; font-size: small;">NT042</p>
KV10106500 ( — ) Engine stand shaft	 <p style="text-align: right; font-size: small;">NT028</p>
KV10117000 (J41262) Engine sub-attachment	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).  <p style="text-align: right; font-size: small;">NT373</p>
KV10117001 ( — ) Engine sub-attachment	Installing on the cylinder block  <p style="text-align: right; font-size: small;">NT372</p>
KV10116200 (J26336-A) Valve spring compressor 1. KV10115900 (J26336-20) Attachment 2. KV10109220 ( — ) Adaptor	Disassembling valve mechanism Part (1) is a component of KV10116200 (J26336-A) but part (2) is not so.  <p style="text-align: right; font-size: small;">PBIC1650E</p>
KV10107902 (J38959) Valve oil seal puller	Removing valve oil seal  <p style="text-align: right; font-size: small;">S-NT011</p>

# PREPARATION

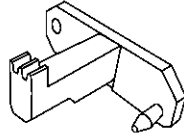
Tool number (Kent-Moore No.) Tool name	Description	
— (J39386) Valve oil seal drift	Installing valve oil seal   NT024	A <b>EM</b> C
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore   NT044	D E
ST16610001 (J23907) Pilot bushing puller	Removing pilot bushing (M/T models) or pilot converter (A/T models)   NT045	F G H
KV10111100 (J37228) Seal cutter	Removing oil pan (lower and upper), front and rear timing chain case, etc.   NT046	I J
WS39930000 ( — ) Tube presser	Pressing the tube of liquid gasket   NT052	K L
KV10112100 (BT8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle   NT014	M
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>   NT379	

# PREPARATION

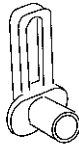
Tool number (Kent-Moore No.) Tool name	Description
KV10114400 (J38365) Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 1 <b>a: 22 mm (0.87 in)</b>
KV10117700 (J44716) Ring gear stopper	Removing and installing crankshaft pulley
— (J-45488) Quick connector release	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)



NT636



NT822

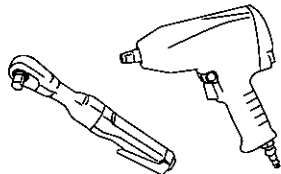


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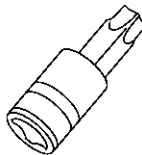
## Commercial Service Tools

ABS00474

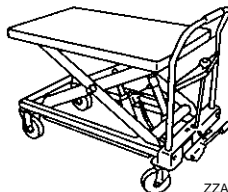
(Kent-Moore No.) Tool name	Description
Power tool	Loosening bolts and nuts
TORX socket	Removing and installing flywheel <b>Size: T55</b>
Manual lift table caddy	Removing and installing engine



PBIC0190E



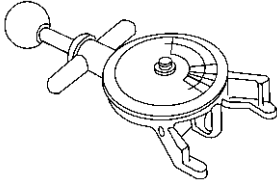
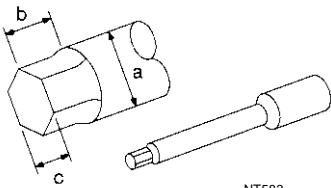
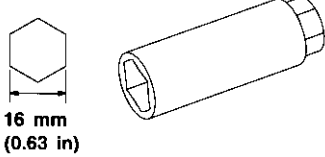
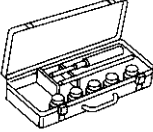
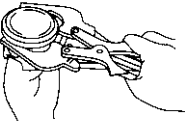
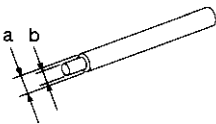
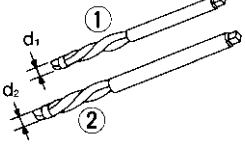
PBIC1113E



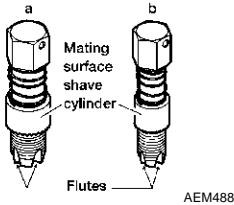

ZZA1210D



# PREPARATION

(Kent-Moore No.) Tool name	Description	A
(BT3373-F) Belt tension gauge   AMA126	Checking drive belt tension	EM  C
(J24239-01) Cylinder head bolt wrench   NT583	Loosening and tightening cylinder head bolt, and used with angle wrench [special service tool: 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)	D  E
Spark plug wrench   NT047	Removing and installing spark plug	F  G
Valve seat cutter set   NT048	Finishing valve seat dimensions	H  I  J
Piston ring expander   NT030	Removing and installing piston ring	K  L
Valve guide drift   NT015	Removing and installing valve guide <b>Intake &amp; Exhaust:</b> <b>a = 9.5 mm (0.374 in) dia.</b> <b>b = 5.5 mm (0.217 in) dia.</b>	M
Valve guide reamer   NT016	(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide <b>Intake &amp; Exhaust:</b> <b>d1 = 6.0 mm (0.236 in) dia.</b> <b>d2 = 10.2 mm (0.402 in) dia.</b>	

# PREPARATION

(Kent-Moore No.) Tool name	Description
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 <p>Reconditioning the exhaust system threads before installing a new 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</b>  <b>b = J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor</b></p>
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 <p>Lubricating heated oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

## NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PPF:00003

### NVH Troubleshooting — Engine Noise

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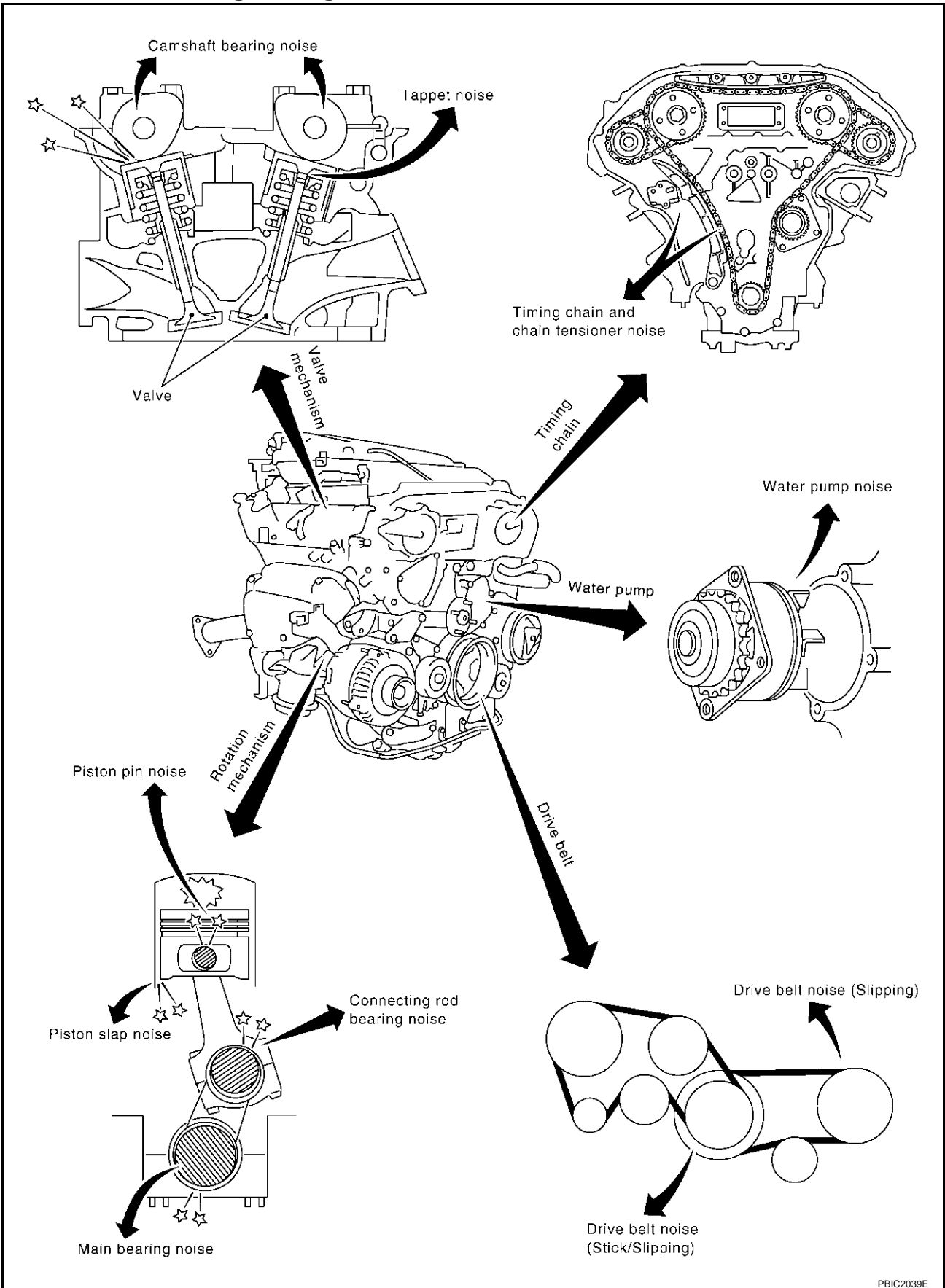
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PBIC2039E

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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

ABS00476

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-78</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal clearance	<a href="#">EM-73</a> <a href="#">EM-73</a>
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	<a href="#">EM-123</a> <a href="#">EM-125</a>
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	<a href="#">EM-127</a> <a href="#">EM-124</a> <a href="#">EM-124</a> <a href="#">EM-124</a>
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	<a href="#">EM-125</a> <a href="#">EM-125</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-130</a> <a href="#">EM-129</a>
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	<a href="#">EM-60</a> <a href="#">EM-54</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	<a href="#">EM-13</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-26</a> <a href="#">"WATER PUMP"</a>

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

# DRIVE BELTS

## DRIVE BELTS

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### Checking Drive Belts

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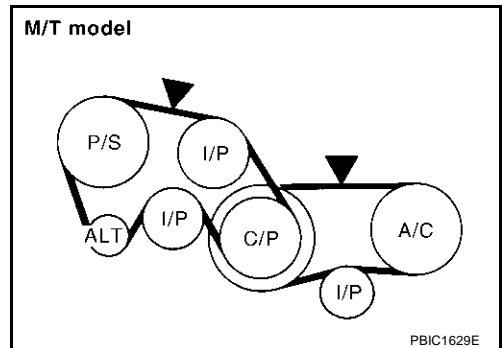
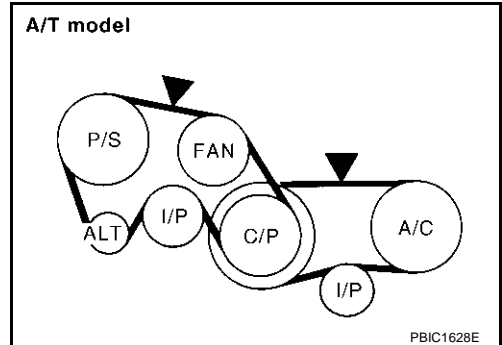
#### WARNING:

Be sure to perform when the engine is stopped.

1. Inspect belts for cracks, fraying, wear and oil. If necessary, replace.
2. Inspect drive belt deflection or tension at a point on the belt mid-way 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 the 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* <sup>1</sup>		Unit: N (kg, lb)
	Used belt			Used belt		
	Limit	After adjustment	New belt	Limit	After adjustment	New belt
Alternator, power steering oil pump and fan belt* <sup>2</sup>	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)
Air conditioner compressor	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)			—		

\*<sup>1</sup> : If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

\*<sup>2</sup> : Alternator and power steering oil pump belt for M/T models

### Tension Adjustment

ABS00478

Portion	Belt tightening method for adjustment
Alternator, power steering oil pump and fan belt*	Adjusting bolt on idler pulley
Air conditioner compressor belt	Adjusting bolt on idler pulley

\* : Alternator and power steering oil pump belt for M/T models

#### 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 “Used belt limit”, adjust it to value for “After adjustment of used belt”.

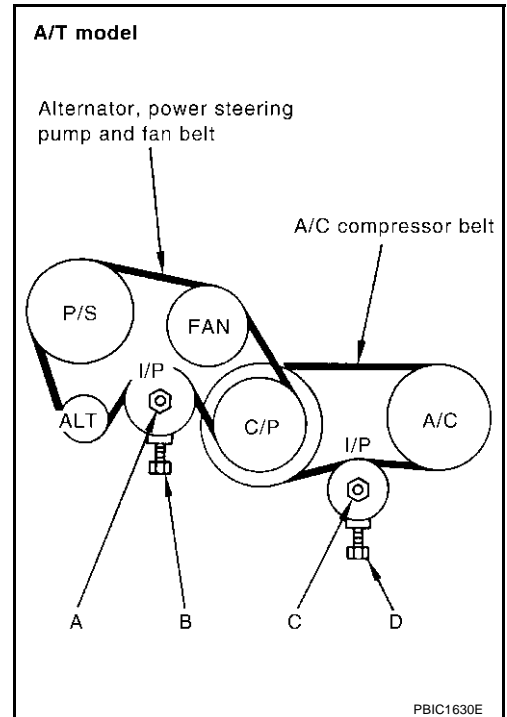
# DRIVE BELTS

- When checking belt deflection or tension immediately after installation, first adjust it to the specified value. Then, after turning the 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.

## ALTERNATOR, POWER STEERING OIL PUMP AND FAN 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-13. "Checking Drive Belts"](#).
3. Tighten nut (A).

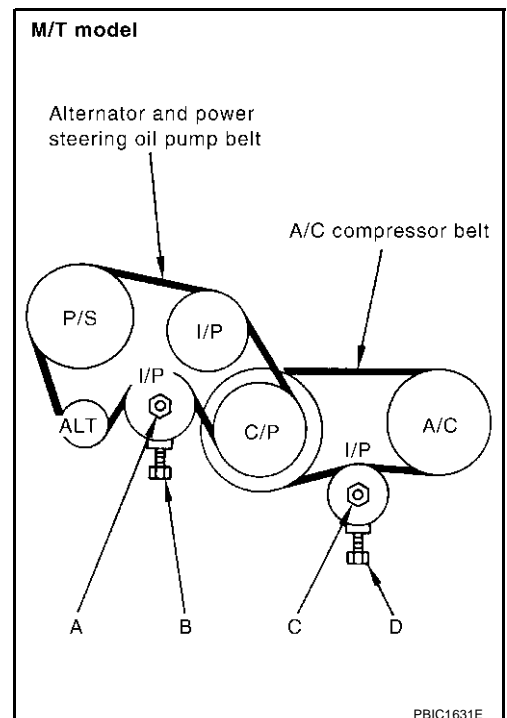
 : 31.4 - 38.2 N·m (3.2 - 3.9 kg·m, 24 - 28 ft·lb)



## AIR CONDITIONER 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-13. "Checking Drive Belts"](#).
3. Tighten nut (C).

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



# DRIVE BELTS

ABS00479

## Removal and Installation

### REMOVAL

1. Remove alternator, power steering oil pump and fan belt (alternator and power steering oil pump belt for M/T models). Refer to [EM-14, "ALTERNATOR, POWER STEERING OIL PUMP AND FAN BELT"](#) .
2. Remove air conditioner compressor belt. Refer to [EM-14, "AIR CONDITIONER COMPRESSOR BELT"](#) .

#### **CAUTION:**

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

### INSTALLATION

1. Install belts to pulley in reverse order of removal.
  - Check that engine oil and engine coolant are not adhered to belt and each pulley groove.
  - Make sure belt is correctly engaged with the pulley groove.
2. Adjust belt tension. Refer to [EM-13, "Tension Adjustment"](#) .
3. Tighten each adjusting bolt and nut to the specified torque.
4. Make sure that tension of each belt is within the standard.

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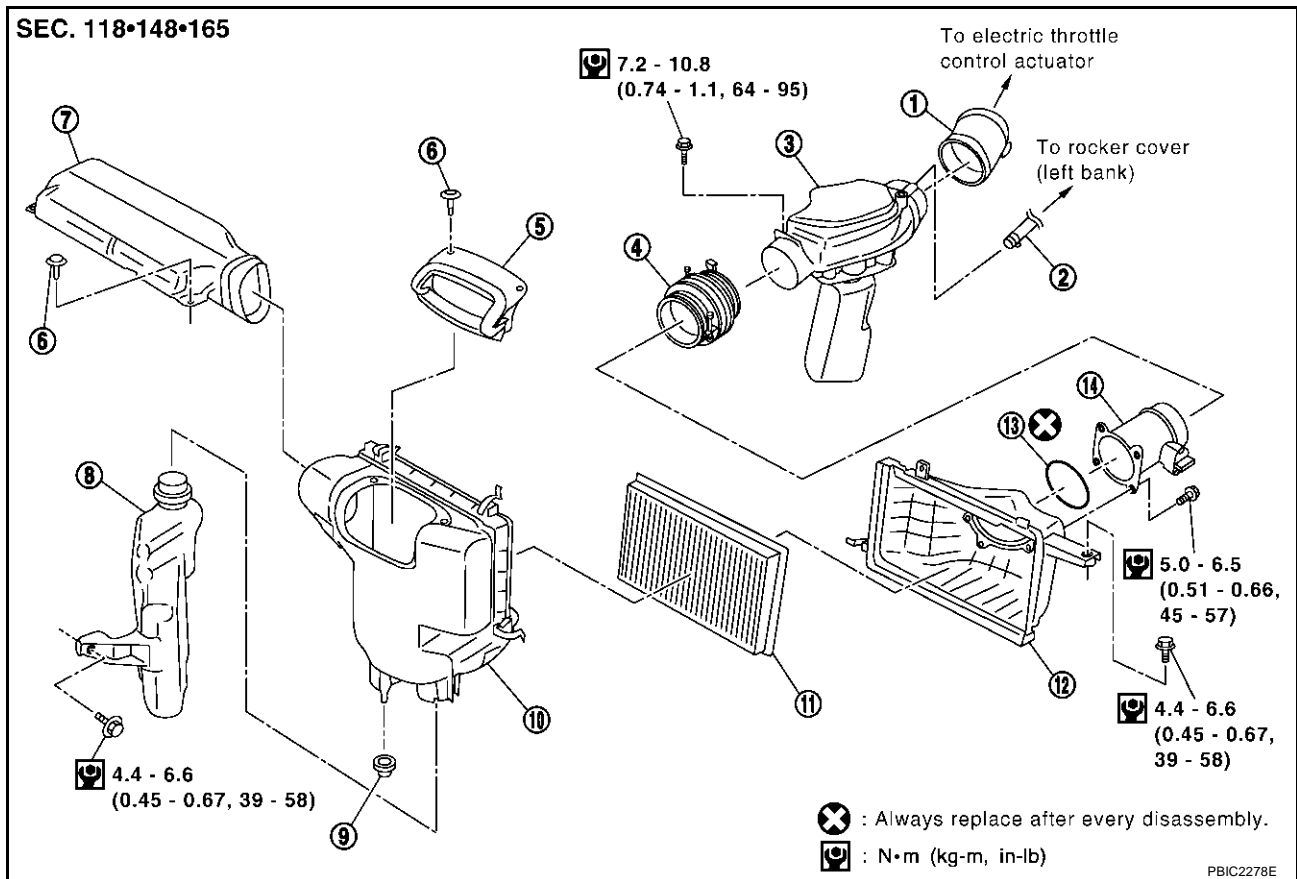
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### Removal and Installation

ABS0047A



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

### REMOVAL

- Remove engine cover with power tool. Refer to [EM-18. "INTAKE MANIFOLD COLLECTOR"](#).
  - This work is unnecessary when parts located forward of mass air flow sensor are removed/installed.
- Remove air duct (inlet).
- Disconnect the harness connector from the mass air flow sensor.
- Remove air cleaner case/mass air flow sensor assembly and air duct/resonator assembly disconnecting their joints.
  - Add marks as necessary for easier installation.
- Remove mass air flow sensor from air cleaner case.

### CAUTION:

**Handle mass air flow sensor with care.**

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

- Remove resonator in the fender, lifting left fender protector.

### INSTALLATION

- Install in the reverse order of removal paying attention to the following.
  - Align marks. Attach each joint. Screw clamps firmly.



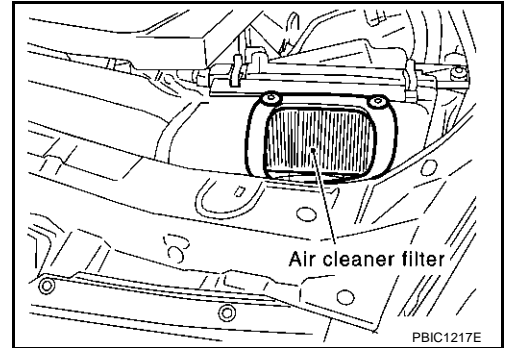
# AIR CLEANER AND AIR DUCT

- To position air cleaner case, refer to [EM-17, "Changing Air Cleaner Filter"](#).

## Changing Air Cleaner Filter INSPECTION

ABS0047B

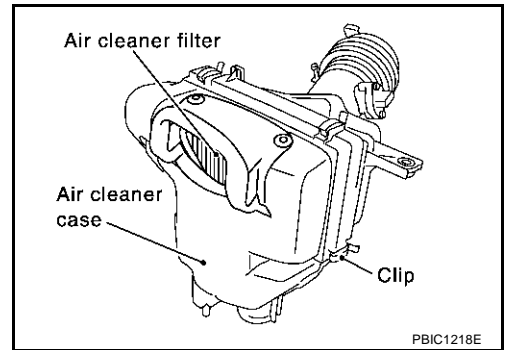
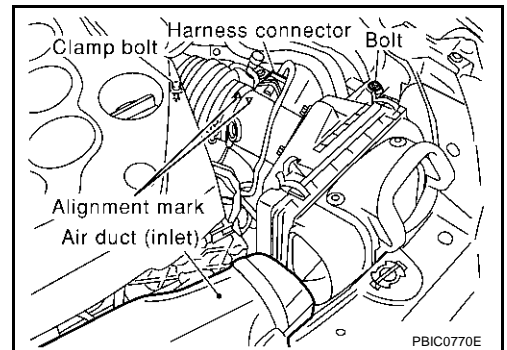
- Check status (fouling, damage, etc.) of air cleaner filter at power duct hole.



## REMOVAL

Removal in the order below.

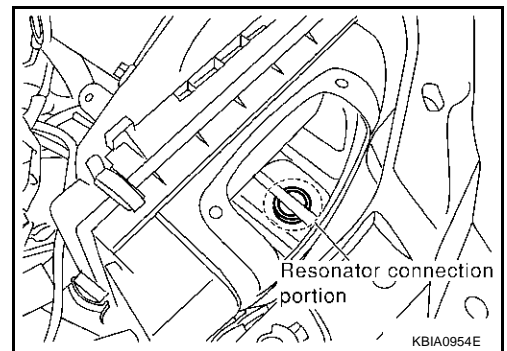
1. Remove air duct (inlet) from air cleaner case.
2. Disconnect harness connector from mass air flow sensor.
3. Loosen clamp bolts of air hose.
4. Remove mounting bolts for air cleaner case. Remove air cleaner case/mass air flow sensor/air hose assembly.
5. Unfasten clips and open air cleaner case, and remove air cleaner filter.



## INSTALLATION

Install in the reverse order of removal paying attention to the following.

- If grommet at bottom of air cleaner case comes off together with air cleaner case, fix it to vehicle before installation.
- Look at internal bottom face through power duct hole, and position air cleaner case with resonator upper end circle and air cleaner case round hole aligned. Then push air cleaner case straight down.
- At this time, check by hand if protrusion at bottom of air cleaner case has been inserted into grommet on vehicle side.
- Clip power duct with bulge on reverse side of lower end engaged with air cleaner case.



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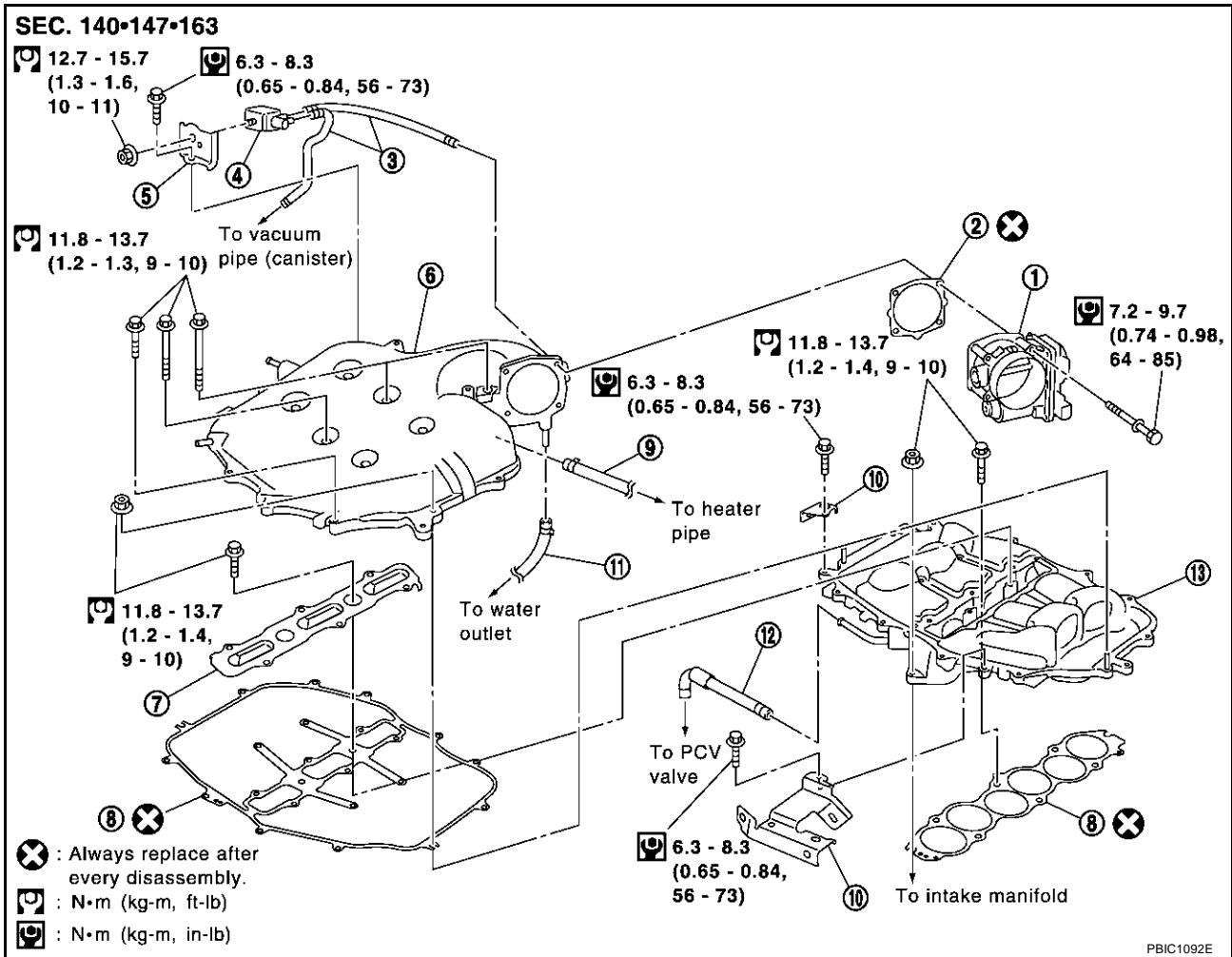
# INTAKE MANIFOLD COLLECTOR

PFP:14003

ABS0047C

## INTAKE MANIFOLD COLLECTOR

### Removal and Installation



- |  |                |                                      |
|--|----------------|--------------------------------------|
| 1. Electric throttle control actuator                | 2. Gasket      | 3. Vacuum hose                       |
| 4. EVAP canister purge volume control solenoid valve | 5. Bracket     | 6. Intake manifold collector (upper) |
| 7. Intake manifold collector cover                   | 8. Gasket      | 9. Water hose                        |
| 10. Bracket  | 11. Water hose | 12. PCV hose                         |
| 13. Intake manifold collector (lower)                |                |                                      |

### REMOVAL

#### WARNING:

- To avoid the danger of being scalded, never drain engine coolant when the engine is hot.
- Gasket for intake manifold collector (upper) is secured together with mounting bolt for intake manifold collector (lower). Thus, even when only gasket for upper side is replaced, gasket for lower side must be also replaced.

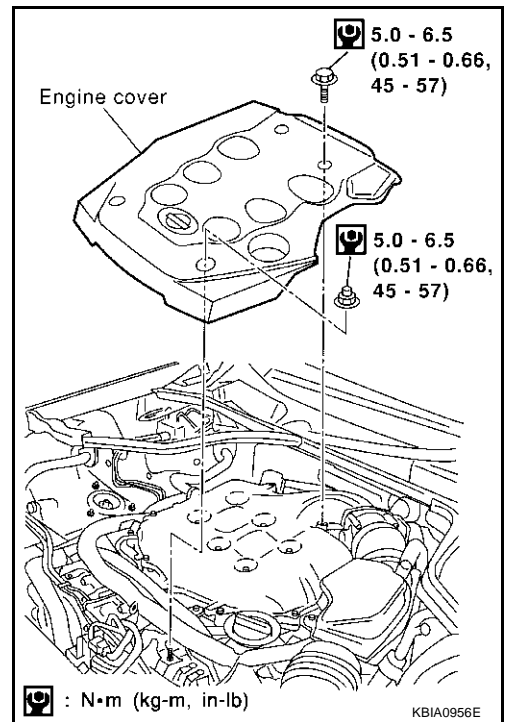
# INTAKE MANIFOLD COLLECTOR

1. Remove engine cover with power tool.
2. Drain engine coolant, or when water hose is disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-11, "Changing Engine Coolant"](#) .

**CAUTION:**

**Perform when engine is cold.**

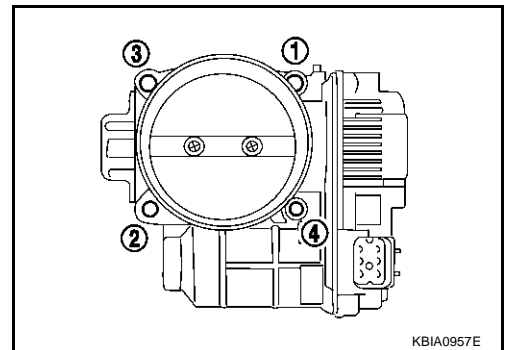
3. Remove air cleaner case and air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#) .



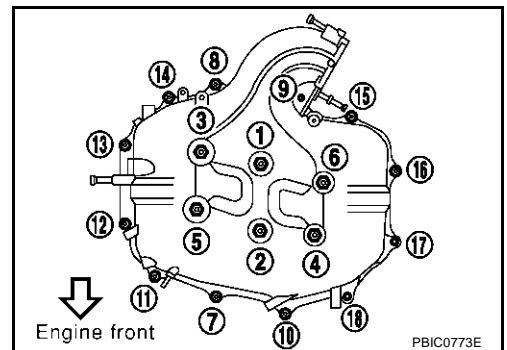
4. Remove electric throttle control actuator.
  - Loosen bolts in the reverse order of that shown in the figure.

**CAUTION:**

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



5. Remove fuel sub-tube mounting bolt to disconnect from rear of intake manifold collector (lower). Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#) .
6. Disconnect vacuum hose and water hose from intake manifold collector (upper).
7. Disconnect EVAP canister purge volume control solenoid valve bracket mounting bolt from intake manifold collector (upper).
8. Loosen bolts in reverse order of illustration to remove intake manifold collector (upper) with power tool.

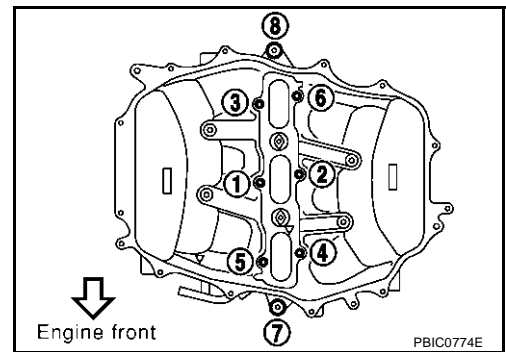


9. Remove PCV hose [between intake manifold collector (upper) and RH rocker cover].

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# INTAKE MANIFOLD COLLECTOR

- Loosen bolts in reverse order of illustration, and remove the intake manifold collector cover, gasket, intake manifold collector (lower) and gasket with power tool.



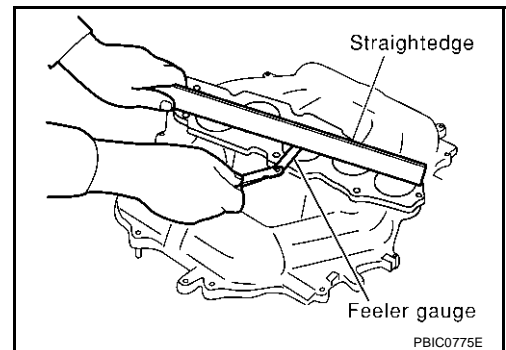
## INSPECTION AFTER REMOVAL

### Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of both the intake manifold collector (upper) and (lower).

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

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

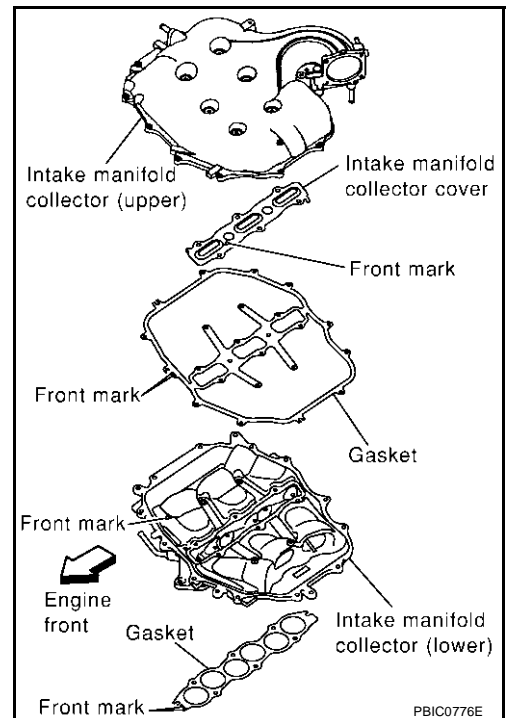


## INSTALLATION

- Install in the reverse order of removal paying attention to the following.

### Indication of Part Installation Direction

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



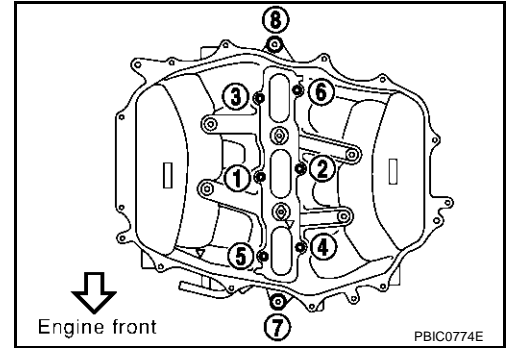
# INTAKE MANIFOLD COLLECTOR

## Installation of Intake Manifold Collector (Lower)

- Tighten 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.



## Installation of Intake Manifold Collector (Upper)

- If stud bolts were removed, install them and tighten to the torque specified 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 bolts while referring to numbers shown below and in figure. (Bolt length does not include pilot portion.)

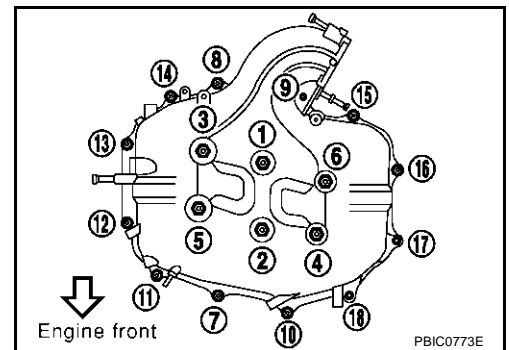
**M6 Nut** : 12, 17

**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

- Tighten in numerical order as shown in the figure.

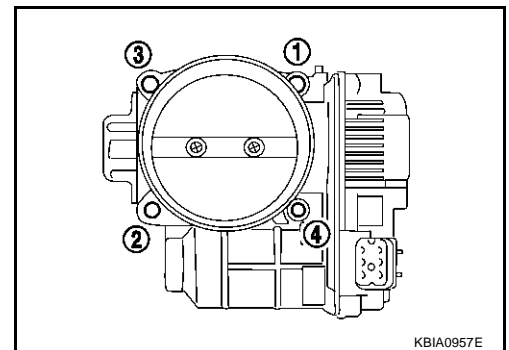


## Installation of Water Hose

- Insert hose by 27 to 32 mm (1.06 to 1.26 in) from connector end.
- Clamp hose at location of 3 to 7 mm (0.12 to 0.28 in) from hose end.

## Installation of Electric Throttle Control Actuator

- Install gasket with three protrusions for installation check facing any direction other than upward.
- Tighten in numerical order as shown in the figure.
- Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to [EC-51, "Throttle Valve Closed Position Learning"](#) (TYPE 1) or [EC-692, "Throttle Valve Closed Position Learning"](#) (TYPE 2).
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when the electric throttle control actuator is replaced. Refer to [EC-51, "Idle Air Volume Learning"](#) (TYPE 1) or [EC-692, "Idle Air Volume Learning"](#) (TYPE 2).



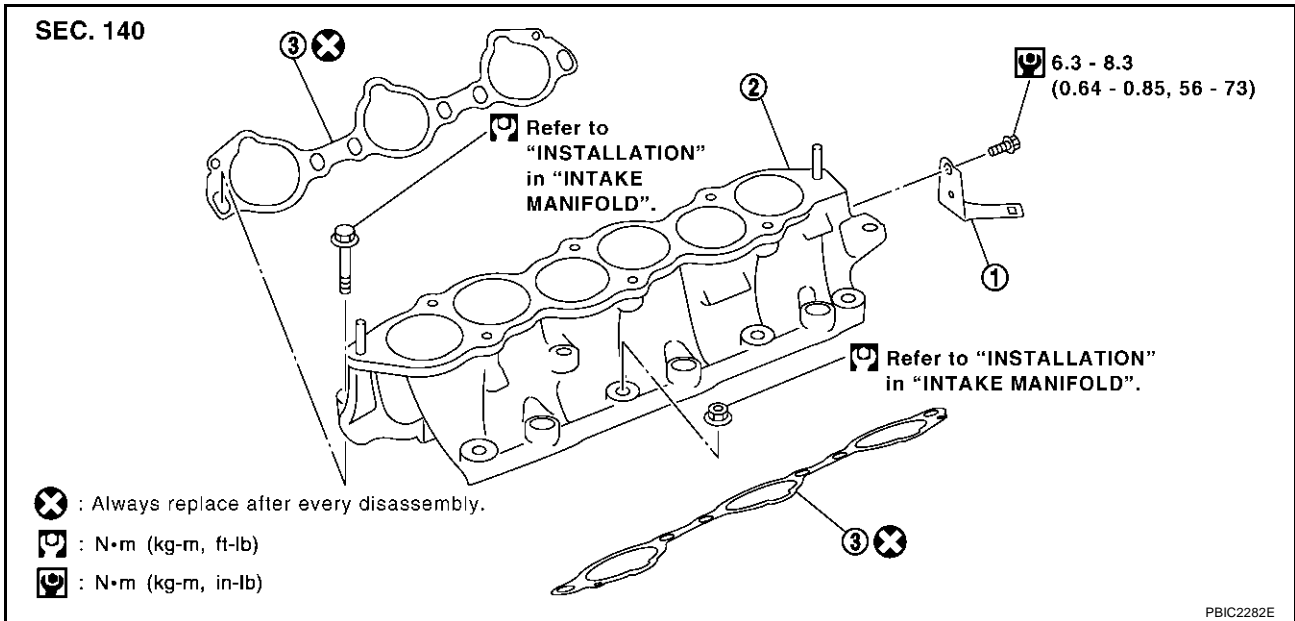
# INTAKE MANIFOLD

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## INTAKE MANIFOLD

### Removal and Installation

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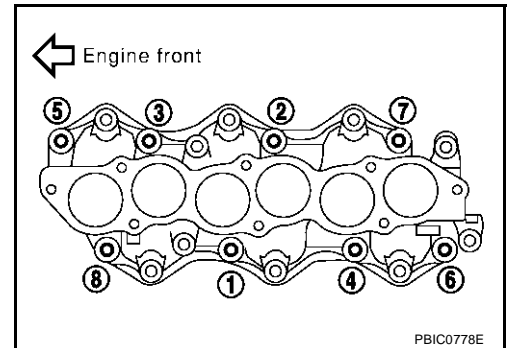
1. Harness bracket

2. Intake manifold

3. Gasket

### REMOVAL

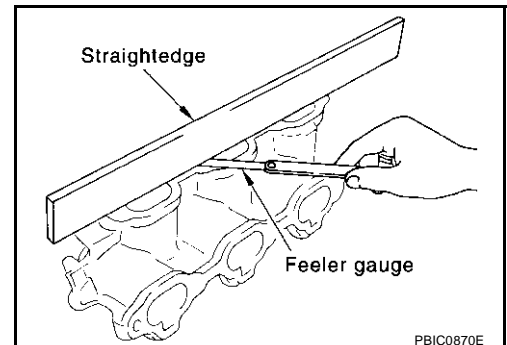
1. Release fuel pressure. Refer to [EC-53, "FUEL PRESSURE RELEASE"](#) (TYPE 1) or [EC-694, "FUEL PRESSURE RELEASE"](#) (TYPE 2).
2. Remove intake manifold collector (upper) and (lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove fuel tube and fuel injector assembly. Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#).
4. Loosen bolts and nuts in reverse order of illustration to remove intake manifold assembly with power tool.



### INSPECTION AFTER REMOVAL

#### Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of each surface on intake manifold.  
**Limit : 0.1 mm (0.004 in)**
- If it exceeds the limit, replace the intake manifold.




# INTAKE MANIFOLD

## INSTALLATION

Install in the reverse order of removal paying attention to the following.

### Installation of Intake Manifold

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

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

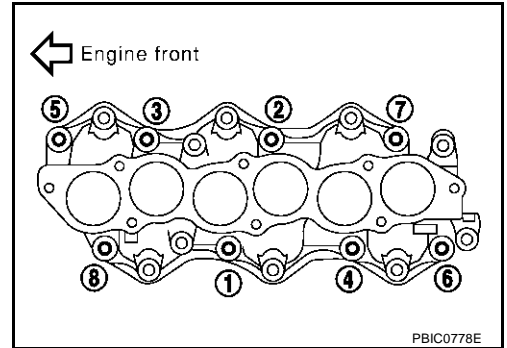
- Tighten all mounting bolts and nuts to specified torque in two or more steps in numerical order shown in figure.

 **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)**



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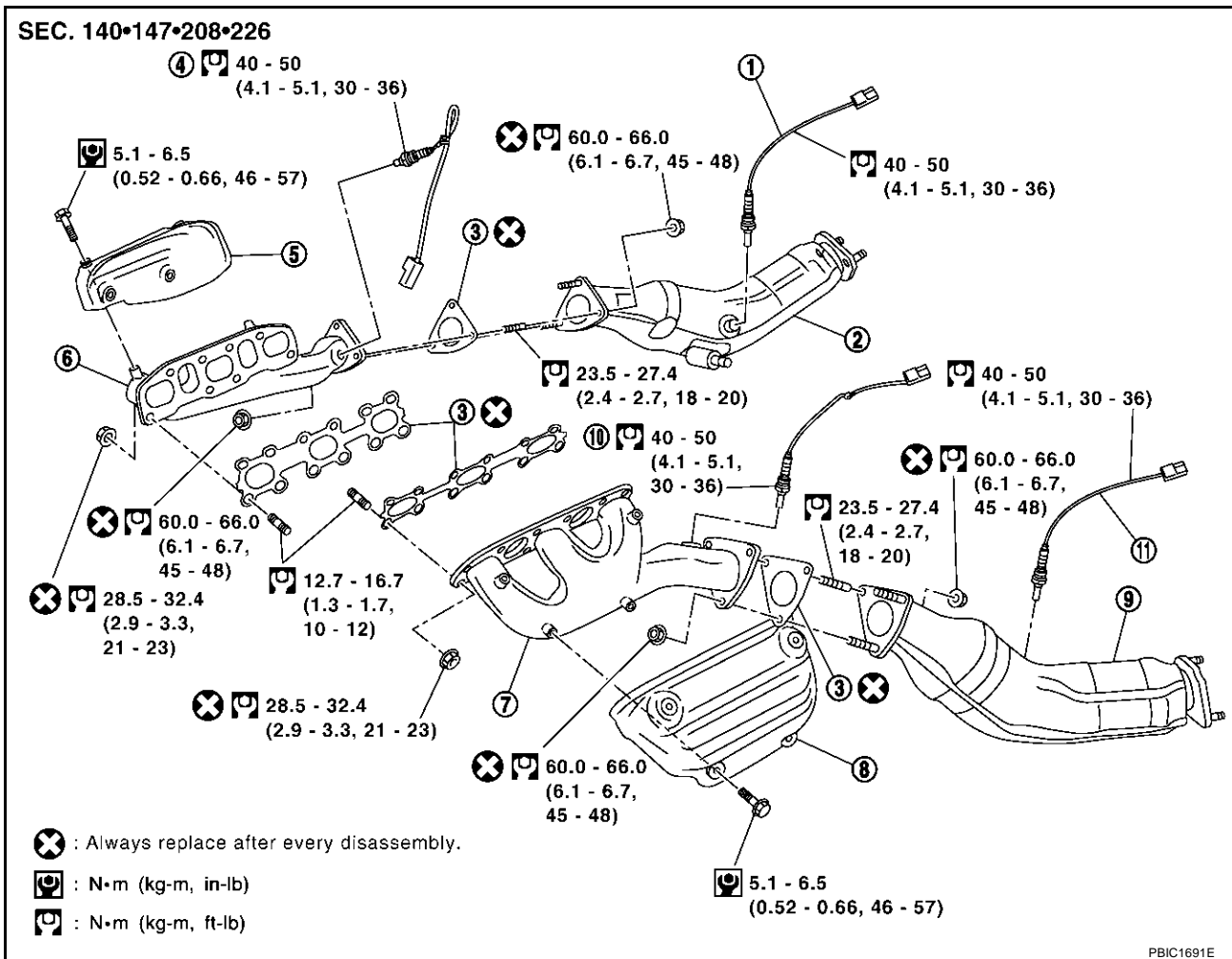
# EXHAUST MANIFOLD AND THREE WAY CATALYST

## EXHAUST MANIFOLD AND THREE WAY CATALYST

PF14004

### Removal and Installation

ABS0047E



- |                                     |                                     |                                 |
|-------------------------------------|-------------------------------------|---------------------------------|
| 1. Heated oxygen sensor 2 (bank 1)  | 2. Three way catalyst (RH bank)     | 3. Gasket                       |
| 4. Heated oxygen sensor 1 (bank 1)  | 5. Exhaust manifold cover (RH bank) | 6. Exhaust manifold (RH bank)   |
| 7. Exhaust manifold (LH bank)       | 8. Exhaust manifold cover (LH bank) | 9. Three way catalyst (LH bank) |
| 10. Heated oxygen sensor 1 (bank 2) | 11. Heated oxygen sensor 2 (bank 2) |                                 |

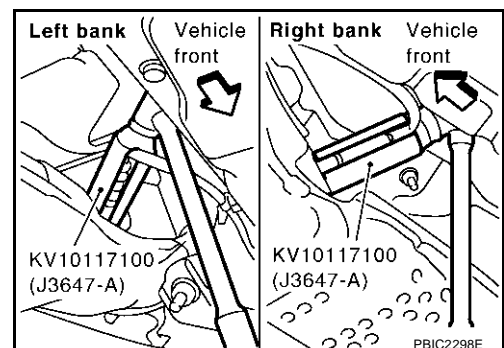
### REMOVAL

- Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
- Remove air cleaner case and air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#).
- Remove undercover with power tool.
- Using heated oxygen sensor wrench (special service tool), remove heated oxygen sensor 2 on both banks.

- 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 from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.



- Remove bracket between right/left catalytic converter and transmission. Refer to [EX-3, "EXHAUST SYSTEM"](#).

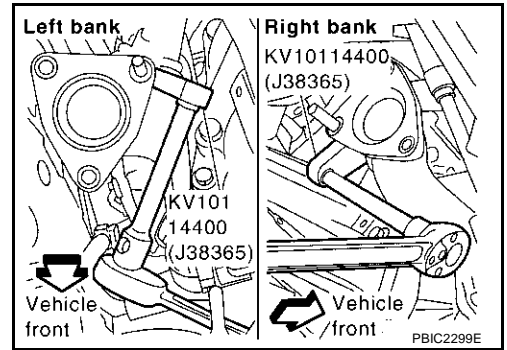


# EXHAUST MANIFOLD AND THREE WAY CATALYST

6. Remove three way catalyst.
7. Using heated oxygen sensor wrench (special service tool), remove heated oxygen sensor 1 on both banks.
  - Put marks to identify installation positions of each heated oxygen sensor 1.

**CAUTION:**

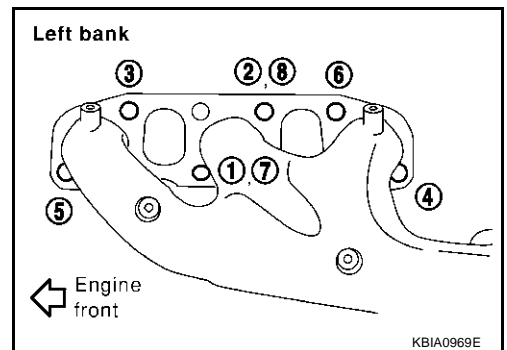
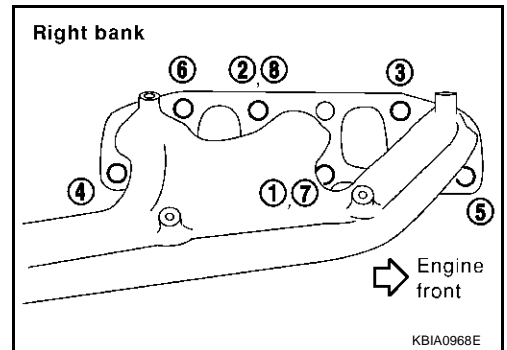
- Be careful not to damage heated oxygen sensor 1.
- Discard any heated oxygen sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.



8. Remove water pipes on both RH and LH side. Refer to [CO-32, "WATER OUTLET AND WATER PIPING"](#).
9. Remove exhaust manifold cover.
10. Loosen nuts in the reverse order of illustration to remove exhaust manifold with power tool.

**CAUTION:**

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



11. Remove exhaust manifold gaskets.

**CAUTION:**

Cover engine openings to avoid entry of foreign materials.

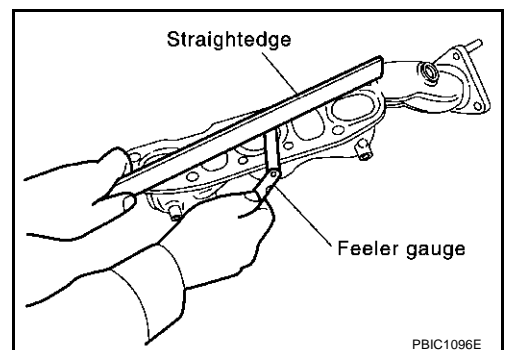
## INSPECTION AFTER REMOVAL

### Surface Distortion

- Use a reliable straightedge and feeler gauge to check the flatness of exhaust manifold fitting surface.

**Limit : 0.3 mm (0.012 in)**

- If it exceeds the limit, replace the exhaust manifold.



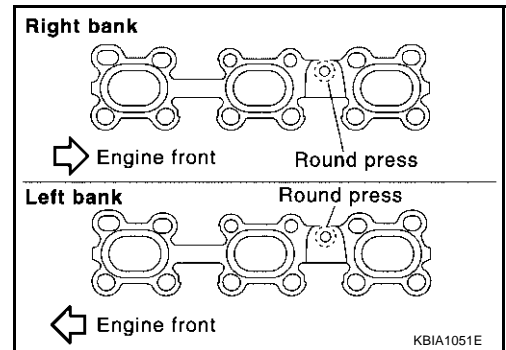
# EXHAUST MANIFOLD AND THREE WAY CATALYST

## INSTALLATION

- Install in the reverse order of removal paying attention to the following.


### Installation of 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.

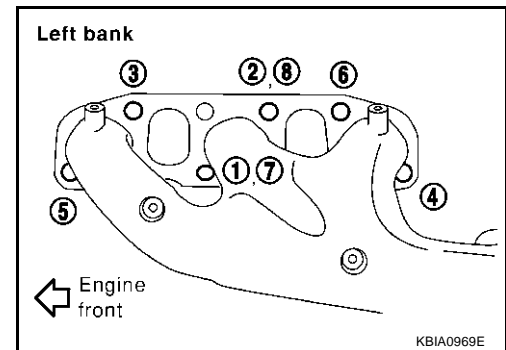
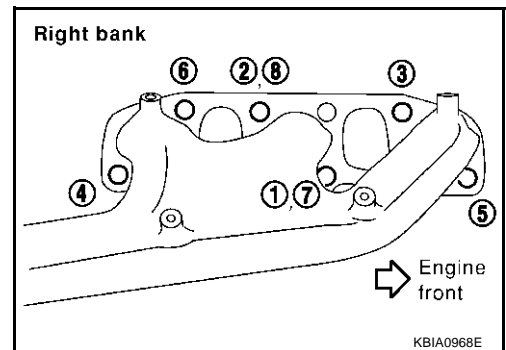


### Installation of Exhaust Manifold

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

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

- Install exhaust manifold in the numerical order as shown in the figure.
- Tighten nuts No. 1 and No. 2 in two steps. The numerical order No. 7 and No. 8 shows second step.



### Installation of Heated Oxygen Sensor

- Install heated oxygen sensors in the original position.
- Install referring the following if the installation positions cannot be identified.

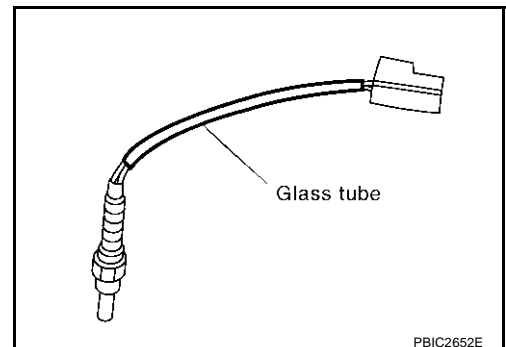
#### Glass tube color

Heated oxygen sensor 1\* : Black

Heated oxygen sensor 2 (bank 1) : White

Heated oxygen sensor 2 (bank 2) : White

\*: Heated oxygen sensor 1 are same parts both bank 1 and bank 2.



## EXHAUST MANIFOLD AND THREE WAY CATALYST

---

### CAUTION:

- When using heated oxygen sensor wrench [special service tool: KV10114400 (J38365)], tighten to the middle of specified torque because length of tool may induce slight indication increase. Do not tighten to the maximum specified torque.
- Before installing a new heated oxygen sensor, clean exhaust system threads using heated 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 the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the “MIL” coming on.

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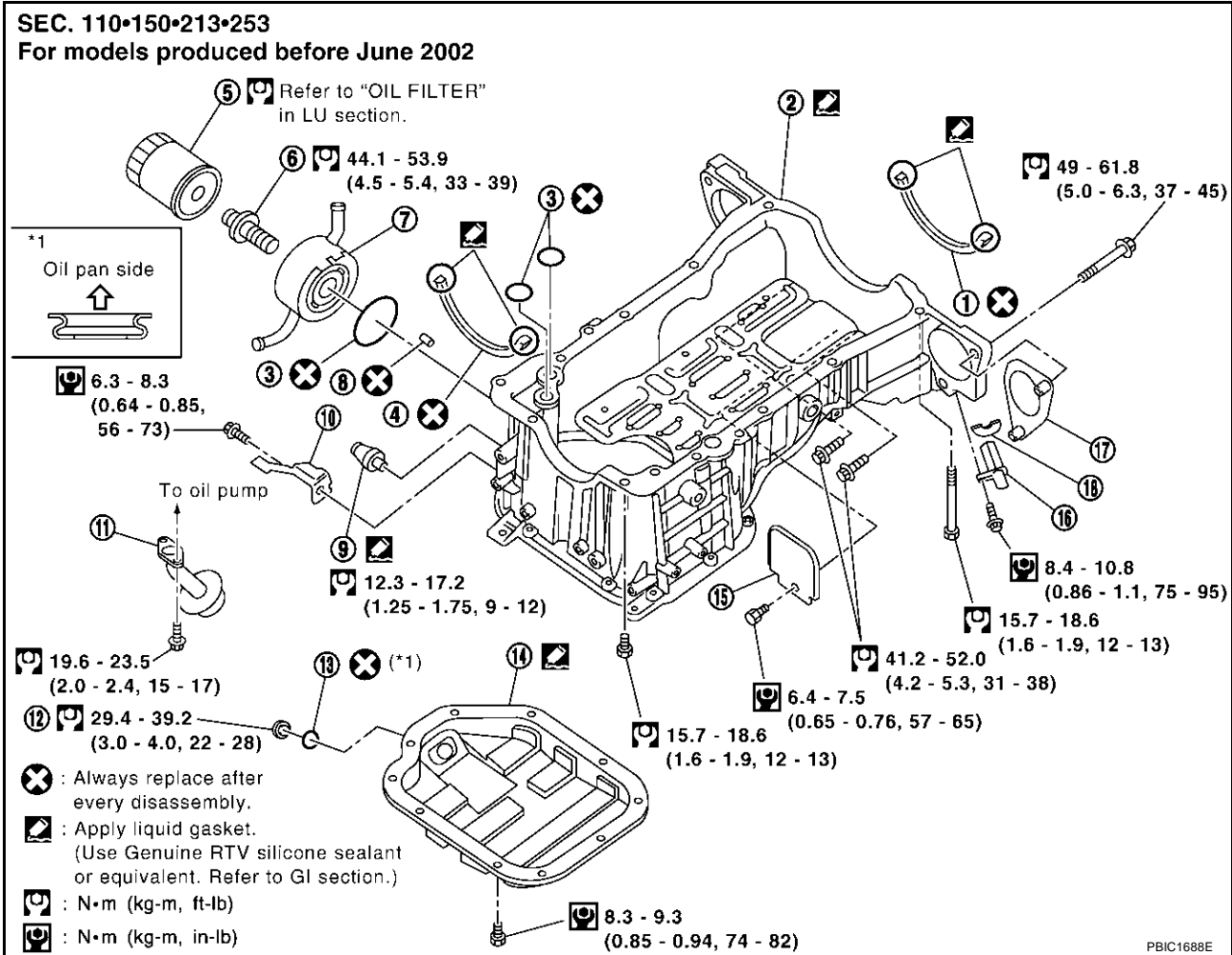
# OIL PAN AND OIL STRAINER

PFP:11110

ABS0002D

## OIL PAN AND OIL STRAINER

### Removal and Installation



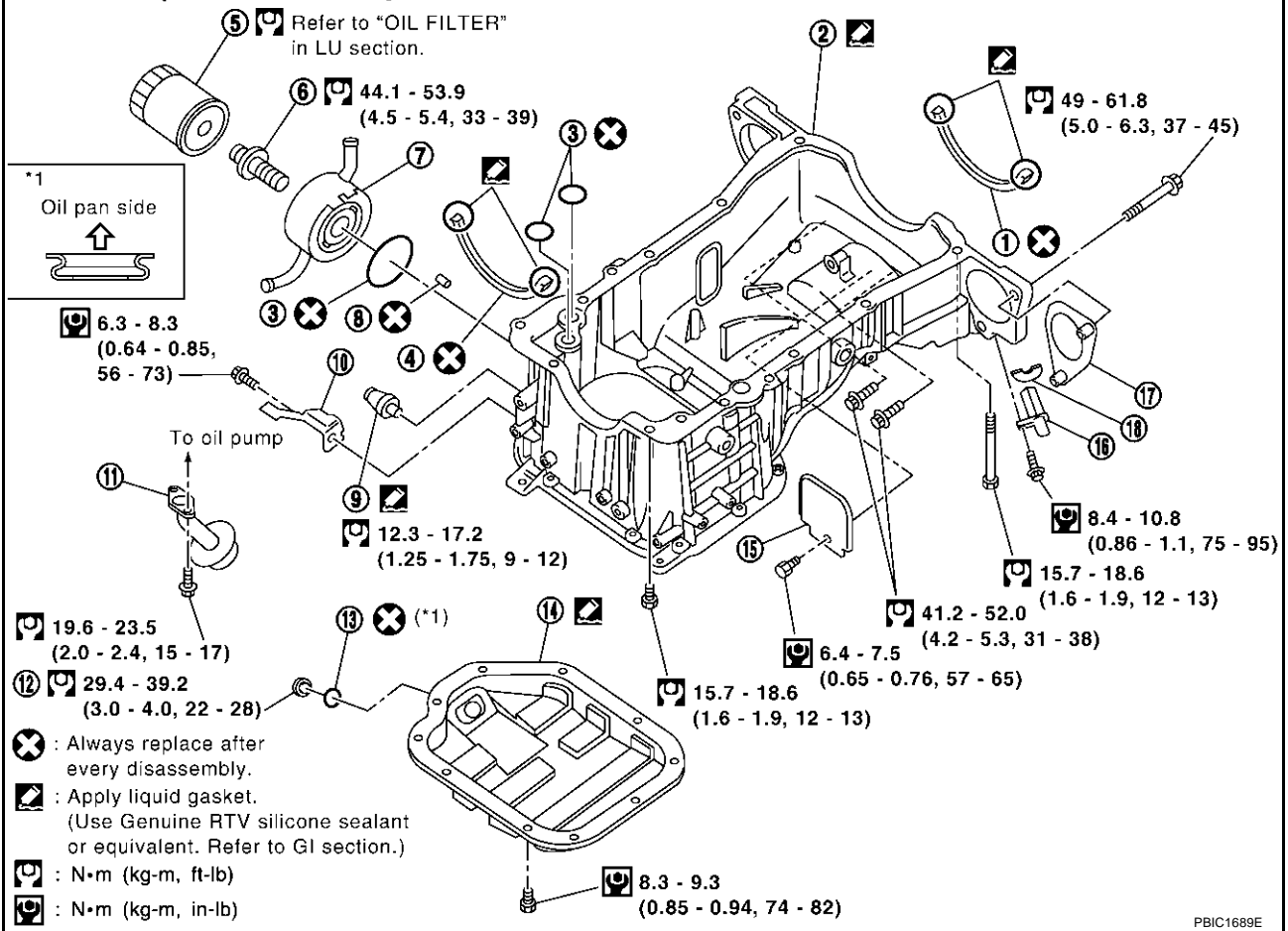
PBIC1688E

- |                                      |                      |                              |
|--------------------------------------|----------------------|------------------------------|
| 1. Oil pan gasket                    | 2. Oil pan (upper)   | 3. O-ring                    |
| 4. Oil pan gasket                    | 5. Oil filter        | 6. Connector bolt            |
| 7. Oil cooler                        | 8. Relief valve      | 9. Oil pressure switch       |
| 10. Bracket                          | 11. Oil strainer     | 12. Drain plug               |
| 13. Drain plug washer                | 14. Oil pan (lower)  | 15. Rear plate               |
| 16. Crankshaft position sensor (POS) | 17. Rear cover plate | 18. Seal rubber (A/T models) |

# OIL PAN AND OIL STRAINER

SEC. 110•150•213•253

For models produced after July 2002



- |                                      |                      |                              |
|--------------------------------------|----------------------|------------------------------|
| 1. Oil pan gasket                    | 2. Oil pan (upper)   | 3. O-ring                    |
| 4. Oil pan gasket                    | 5. Oil filter        | 6. Connector bolt            |
| 7. Oil cooler                        | 8. Relief valve      | 9. Oil pressure switch       |
| 10. Bracket                          | 11. Oil strainer     | 12. Drain plug               |
| 13. Drain plug washer                | 14. Oil pan (lower)  | 15. Rear plate               |
| 16. Crankshaft position sensor (POS) | 17. Rear cover plate | 18. Seal rubber (A/T models) |

## REMOVAL

### WARNING:

To avoid the danger of being scalded, never drain the engine oil when the engine is hot.

### NOTE:

To remove oil pan (lower) only, take step 4, then step 17. Step 1 to 3 and 5 to 16 are unnecessary.

1. Remove engine hood and undercover with power tool.
2. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove air duct. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#).
4. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
5. Drain engine coolant. Refer to [CO-11, "Changing Engine Coolant"](#).

### CAUTION:

- Perform this step when engine is cold.
  - Do not spill engine coolant on drive belts.
6. Install engine slinger and sling engine assembly for keeping the original position. Refer to [EM-98, "ENGINE ASSEMBLY"](#).
  7. Remove front suspension member. Refer to [FSU-14, "FRONT SUSPENSION MEMBER"](#).
  8. Remove belt for alternator, power steering oil pump and fan. Refer to [EM-15, "Removal and Installation"](#).

# OIL PAN AND OIL STRAINER

9. Remove alternator. Refer to [SC-31, "Removal and Installation"](#) .
10. Remove starter motor. Refer to [SC-19, "Removal and Installation"](#) .
11. Remove idler pulley and bracket assembly. Refer to [EM-54, "TIMING CHAIN"](#) .
12. Disconnect oil cooler water hoses, and remove oil cooler water pipe mounting bolt. Refer to [LU-10, "OIL COOLER"](#) .
13. Disconnect A/T fluid cooler hoses, and remove A/T fluid cooler tube (A/T models). Refer to [AT-329, "TRANSMISSION ASSEMBLY"](#) .
14. 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.

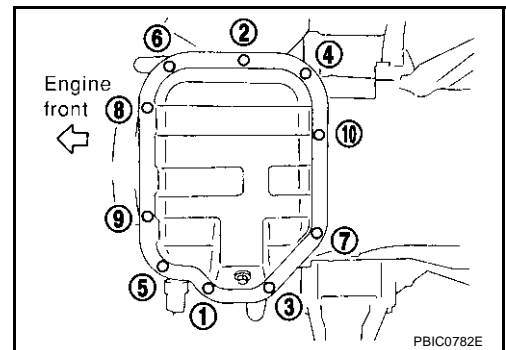
15. Remove oil filter, as necessary. Refer to [LU-9, "OIL FILTER"](#) .
16. Remove oil cooler, as necessary. Refer to [LU-10, "OIL COOLER"](#) .
17. Loosen oil pan (lower) bolts with power tool in reverse order of illustration to remove.

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

**CAUTION:**

**Exercise care not to damage mating surface.**

18. Remove oil strainer.
19. Remove transmission joint bolts which pierce oil pan (upper). Refer to [AT-329, "Removal and Installation"](#) (A/T models) or [MT-19, "Removal and Installation from Vehicle"](#) (M/T models).
20. Remove rear cover plate.

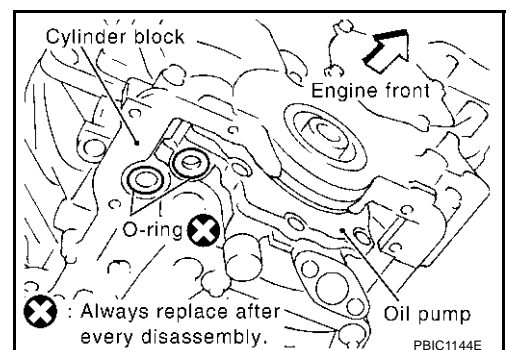
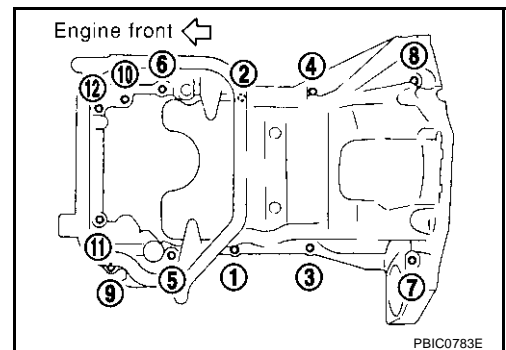


21. Loosen oil pan (upper) bolts with power tool in reverse order of illustration to remove.
- Insert seal cutter [special service tool: KV10111100 (J37228)] between oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of the tool with a hammer. Remove oil pan (upper).

**CAUTION:**

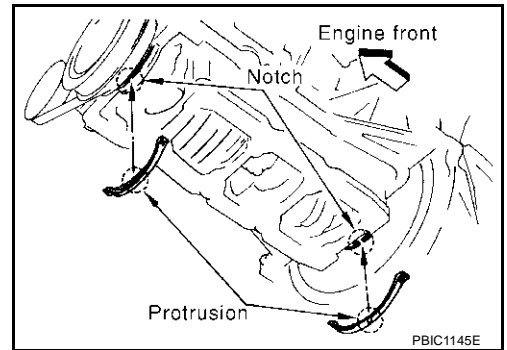
**Exercise care not to damage mating surface.**

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



# OIL PAN AND OIL STRAINER

23. Remove oil pan gaskets.



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## INSPECTION AFTER REMOVAL

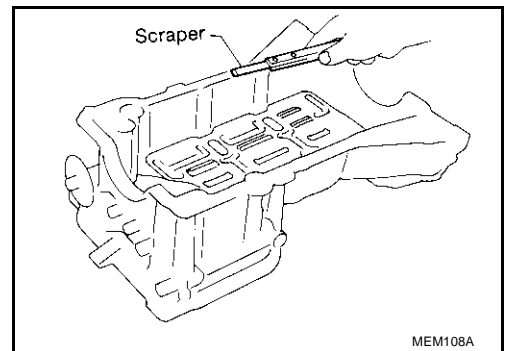
- Clean oil strainer if any object attached.

## INSTALLATION

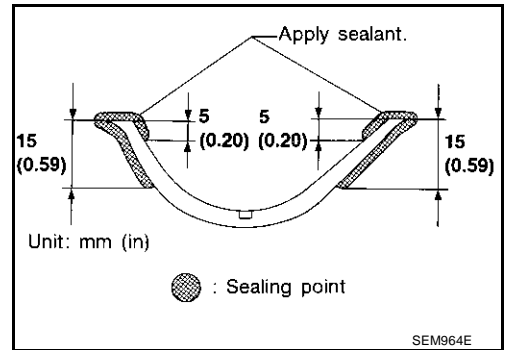
1. Install in the upper oil pan in the order below.
  - a. Use a scraper to remove old liquid gasket from mating surfaces.
    - Also remove the old liquid gasket from mating surface of the cylinder block.
    - Remove the old liquid gasket from the bolt holes and threads.

### CAUTION:

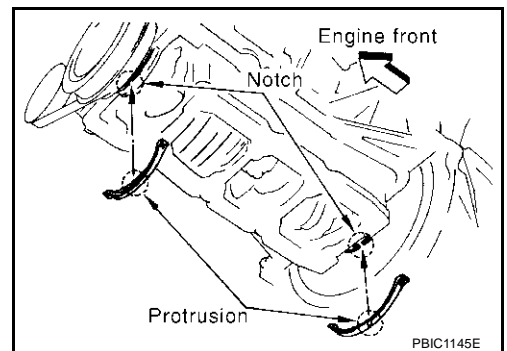
Do not scratch or damage the mating surfaces when cleaning off the old liquid gasket.



- 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"](#).

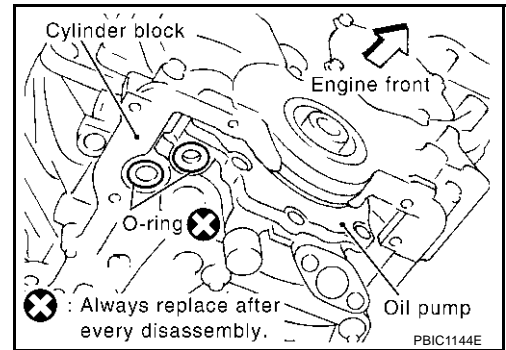


- To install, align protrusion of oil pan gasket with notches of front timing chain case and rear oil seal retainer.
- Install oil pan gasket with smaller arc to front timing chain case side.



## OIL PAN AND OIL STRAINER

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

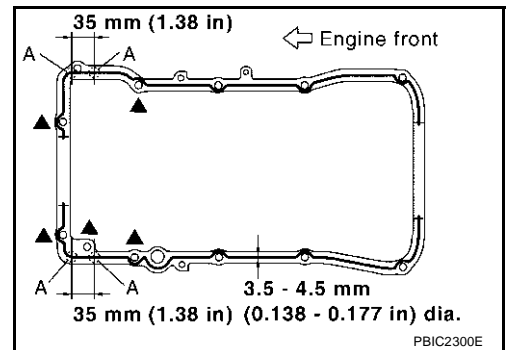


- d. Apply a continuous bead of sealant to the cylinder block mating surface of the upper oil pan to a limited portion as shown.

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

**CAUTION:**

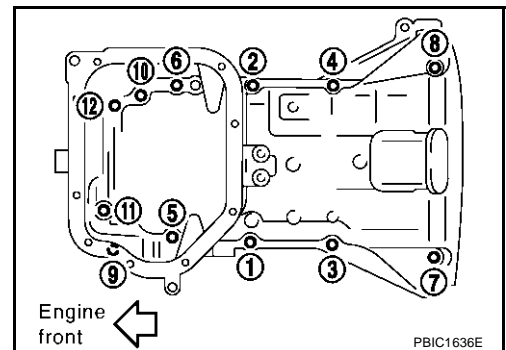
- For bolt holes with ▲ marks (5 locations), apply liquid gasket outside the holes.
- Apply a bead of 4.5 to 5.5 mm (0.177 to 0.217 in) diameter to area "A".
- Attaching should be done within 5 minutes after coating.



- e. Install the upper oil pan.

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

- M8 × 100 mm (3.97 in) : 5, 7, 8, 11**  
**M8 × 25 mm (0.98 in) : Except the above**

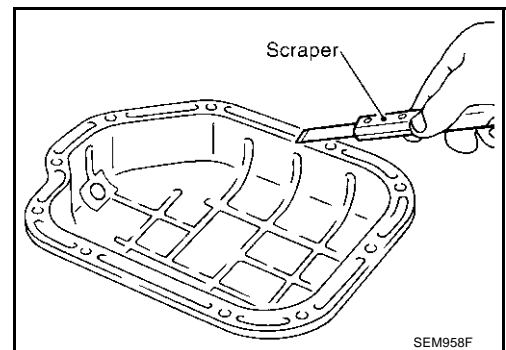


- f. Tighten transmission joint bolts. Refer to [AT-331, "INSTALLATION"](#) (A/T models) or [MT-21, "INSTALLATION"](#) (M/T models).

2. Install oil strainer to oil pump.
3. Install oil pan (lower) in the order below.

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

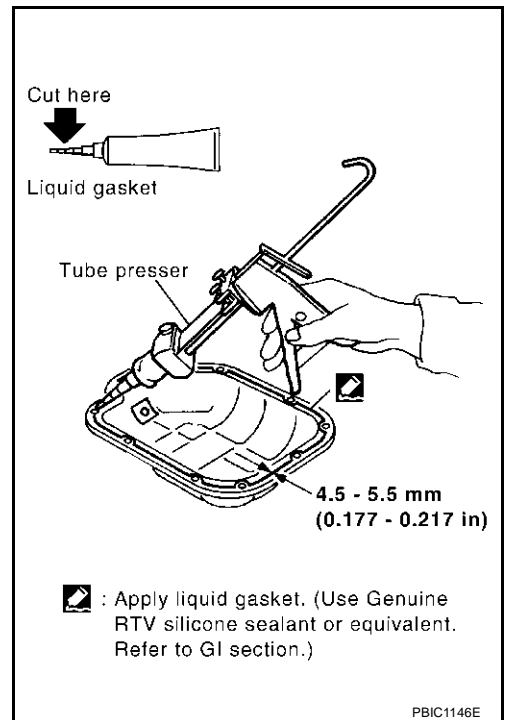
- Also remove old liquid gasket from mating surface of upper oil pan.



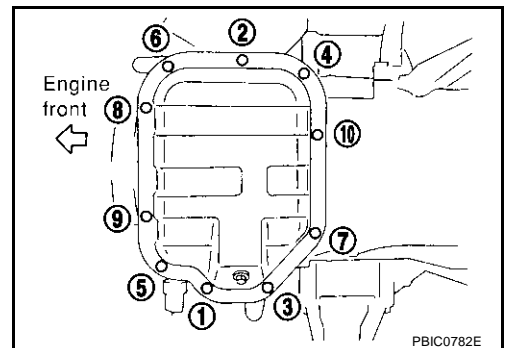


## OIL PAN AND OIL STRAINER

- b. Apply a continuous bead of sealant to the lower oil pan.
- Use **Genuine RTV Silicone Sealant** or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
  - Be sure the sealant is **4.5 - 5.5 mm (0.177 - 0.217 in)** wide.
  - Attaching should be done within **5 minutes** after coating.



- c. Install lower oil pan.
- Tighten the bolts in the numerical order as shown.



4. Install oil pan drain plug.
- Refer to illustration of components of former page for installation direction of washer.
5. Install in the reverse order of removal after this step.

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

### INSPECTION AFTER INSTALLATION

1. Check engine oil level and add engine oil. Refer to [LU-6, "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-6, "ENGINE OIL"](#).

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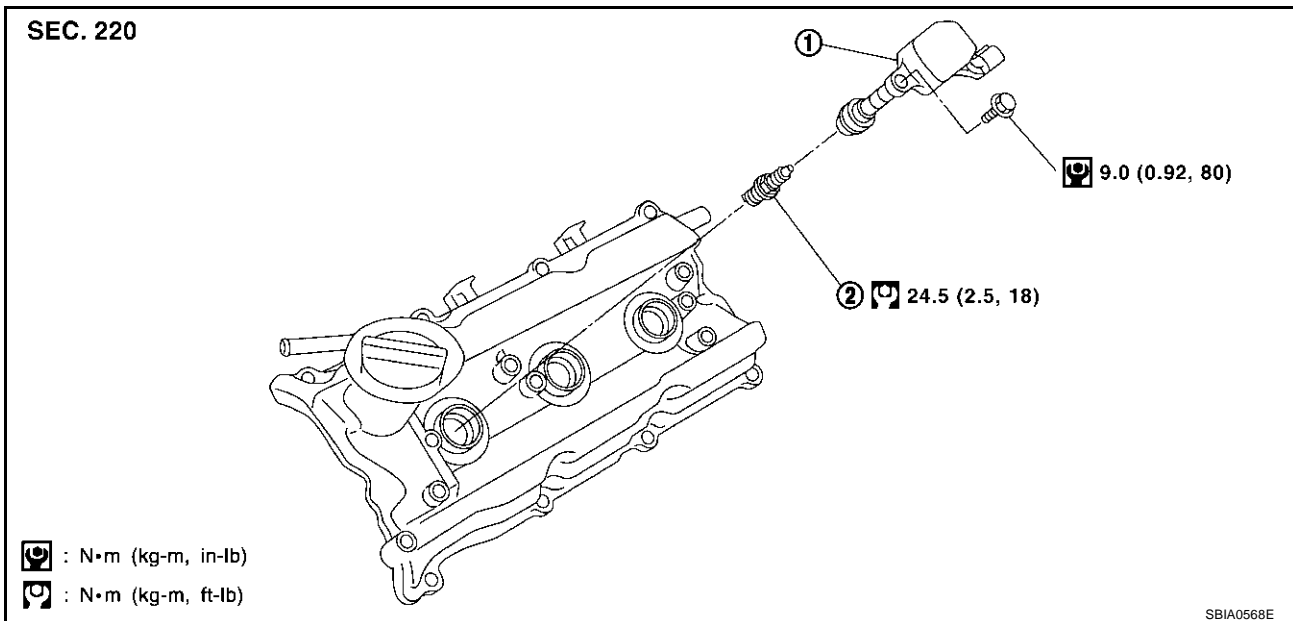
# IGNITION COIL

PFP:22448

## IGNITION COIL

### Removal and Installation

ABS0000H



1. Ignition coil

2. Spark plug

### REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air cleaner case and air duct (for ignition coil of LH bank side). 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.**

6. Using spark plug wrench (commercial service tool), remove spark plug. Refer to [EM-35, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#).

### INSTALLATION

1. Install in the reverse order of removal.

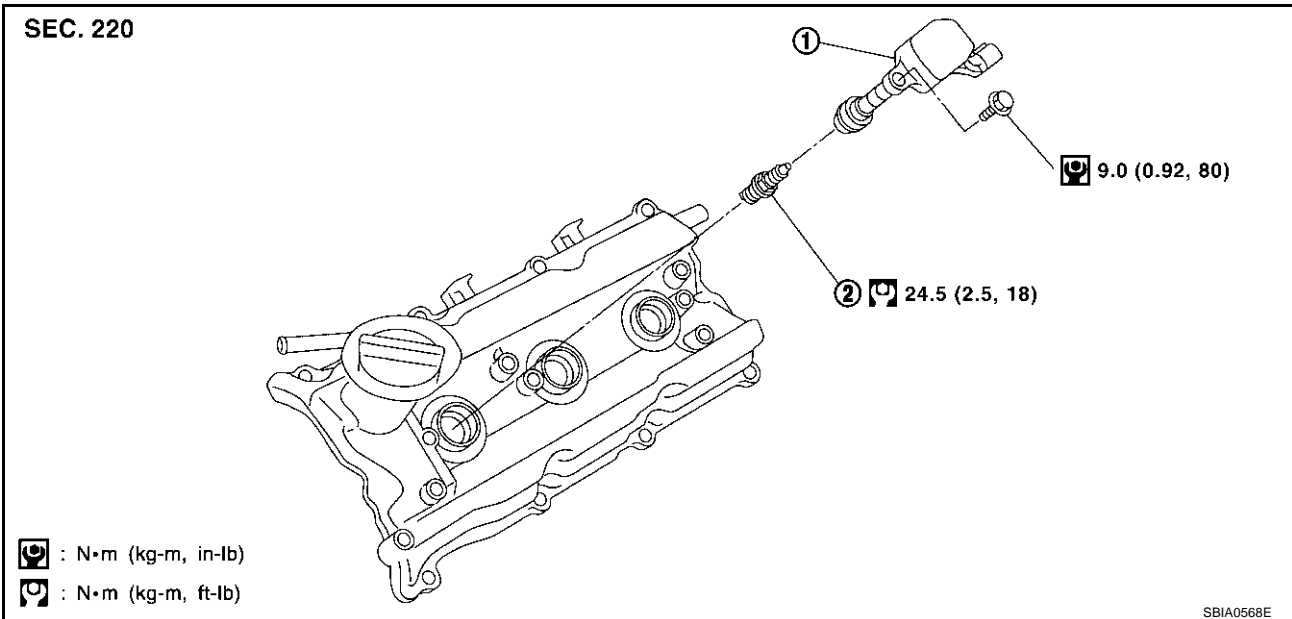
# SPARK PLUG (PLATINUM-TIPPED TYPE)

PF22401

## SPARK PLUG (PLATINUM-TIPPED TYPE)

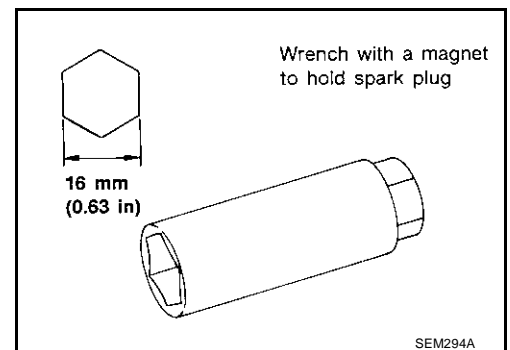
### Removal and Installation

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### REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "Removal and Installation"](#).
2. Remove ignition coil. Refer to [EM-34, "IGNITION COIL"](#).
3. Remove spark plug using spark plug wrench (commercial service tool).



### INSPECTION AFTER REMOVAL

- Use standard type spark plug for normal condition.

The hot type spark plug is suitable when fouling occurs with the standard type spark plug under conditions such as:

- Frequent engine starts
- Low ambient temperatures

The cold type spark plug is suitable when spark plug knock occurs with the 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:

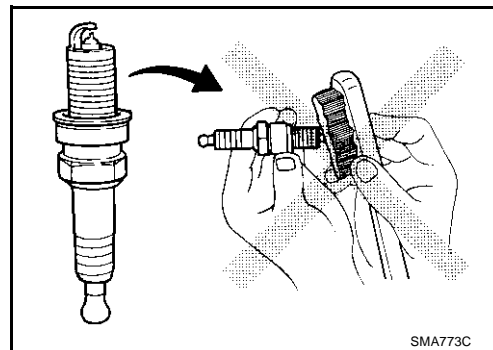
- Do not drop or shock spark plug.
- Do not use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure:

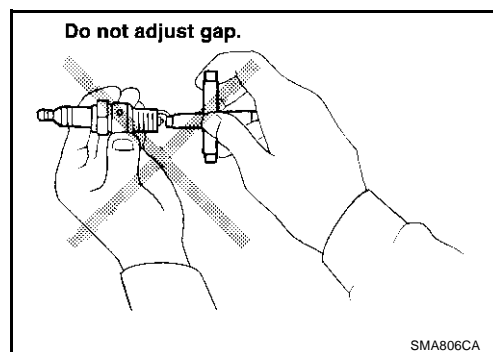
Less than 588 kPa (6 kg/cm<sup>2</sup> , 85 psi)

Cleaning time:

Less than 20 seconds



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



### INSTALLATION

Install in the reverse order of removal.

# FUEL INJECTOR AND FUEL TUBE

PFP:16600

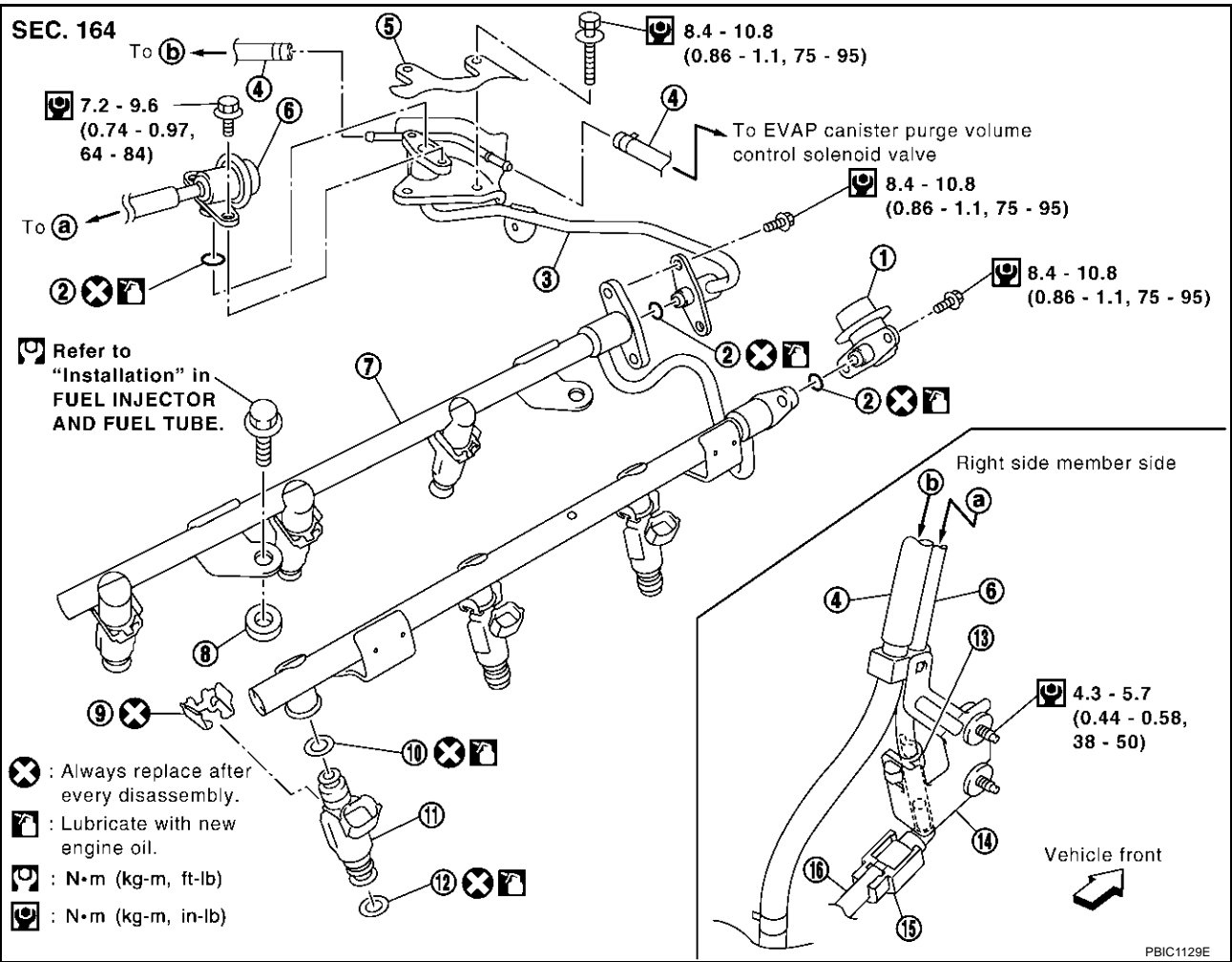
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## FUEL INJECTOR AND FUEL TUBE

### Removal and Installation

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|------------------------------------|--|---------------------------------|
| 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 (black)                 | 11. Fuel injector                                      | 12. O-ring (green)              |
| 13. Hose clamp                     | 14. Bracket  | 15. Quick connector cap         |
| 16. Centralized under-floor piping |  |                                 |

#### CAUTION:

- Apply new engine oil when installing the parts that specified to do so in the figure.
- Do not remove or disassemble parts unless instructed as shown in the figure.

# FUEL INJECTOR AND FUEL TUBE

## REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Release fuel pressure. Refer to [EC-53, "FUEL PRESSURE RELEASE"](#) (TYPE 1) or [EC-694, "FUEL PRESSURE RELEASE"](#) (TYPE 2).
3. Drain engine coolant, or when water hoses are disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-11, "Changing Engine Coolant"](#) and [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .

### CAUTION:

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

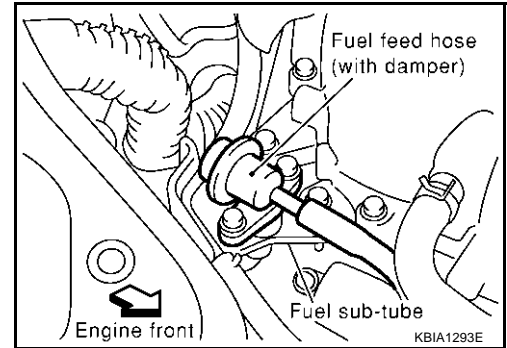
4. Remove fuel feed hose (with damper) from fuel sub-tube.

### NOTE:

There is no fuel return route.

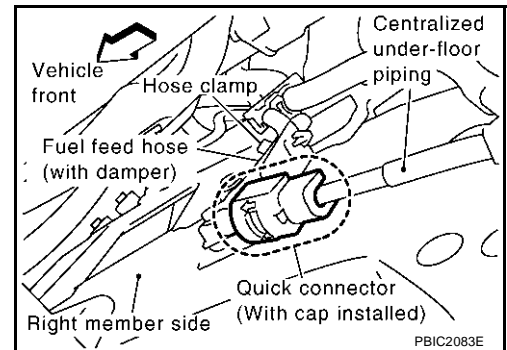
### CAUTION:

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



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

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



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

### CAUTION:

**Disconnect quick connector by using quick connector release (special service tool: J-45488), not by picking out retainer tabs.**

- i. With the sleeve side of quick connector release facing quick connector, install quick connector release onto centralized under-floor piping.
- ii. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

### CAUTION:

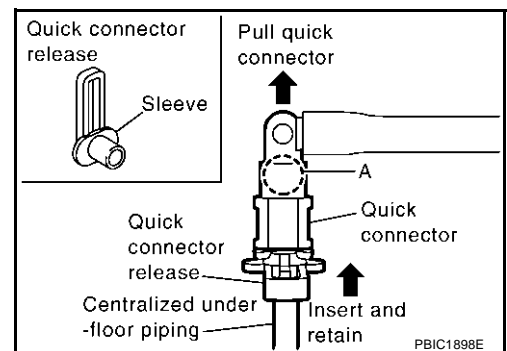
**Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.**

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

### CAUTION:

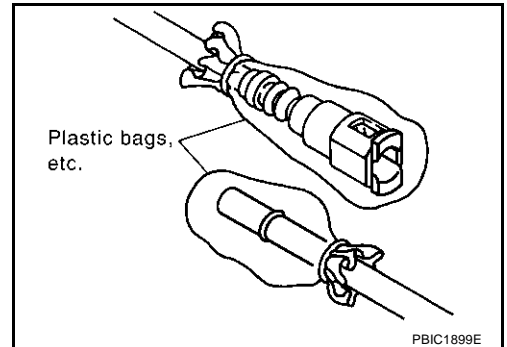
- Pull quick connector holding "A" position as shown in the figure.

- 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.



## FUEL INJECTOR AND FUEL TUBE

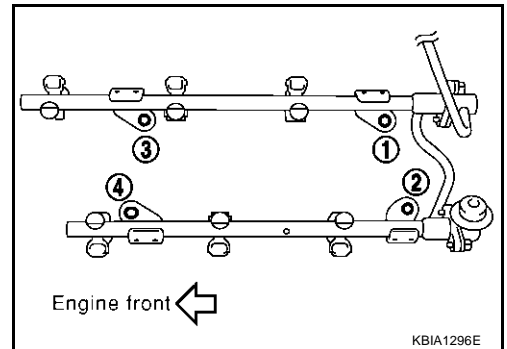
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Do not expose parts to battery electrolyte or other acids.
- Do not bend or twist connection between quick connector and fuel feed hose (with damper) during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



- Remove intake manifold collector (upper) and (lower). Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
- Disconnect harness connector from fuel injector.
- Loosen mounting bolts in the reverse order 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.

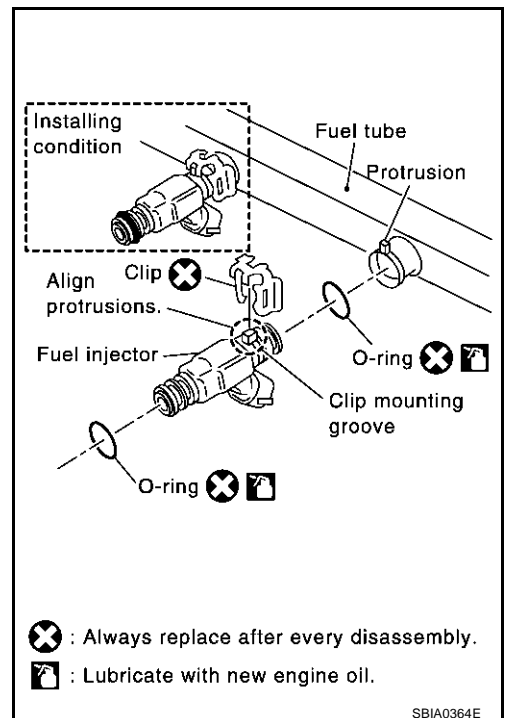


- Remove spacers on intake manifold.
- Remove fuel injector from fuel tube with following procedure.
  - Open and remove clip.
  - Remove fuel injector from the fuel tube by pulling straight.

**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 injectors.
- Do not disassemble fuel injectors.

- Remove fuel sub-tube and fuel damper.



### INSTALLATION

- Install fuel damper and fuel sub-tube.

## FUEL INJECTOR AND FUEL TUBE

- When handling O-rings, be careful of the following:

### CAUTION:

- Handle O-ring with bare hands. Never 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 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 items below.

### CAUTION:

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

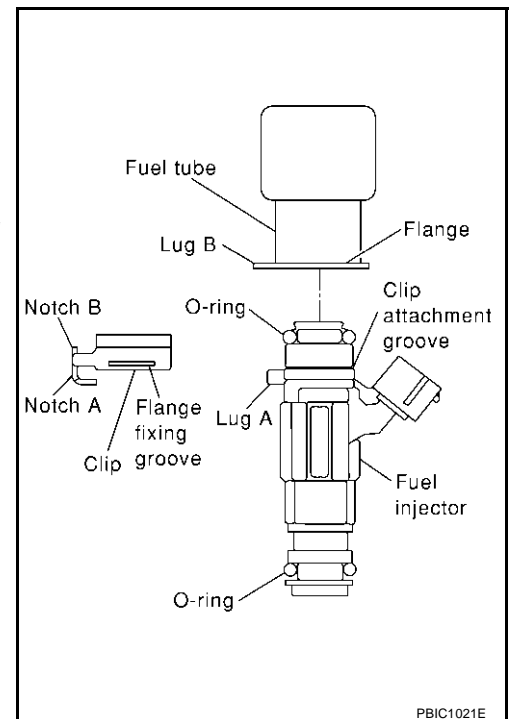
Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Never wear gloves.
  - Lubricate O-ring with new engine oil.
  - 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 with the following procedure.
- a. Insert clip into clip mounting groove on fuel injector.
- Insert clip so that lug "A" of fuel injector matches notch "A" of the 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 lug "B" of fuel tube matches notch "B" of the 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.



4. Install spacers on intake manifold.




## FUEL INJECTOR AND FUEL TUBE

5. Install fuel tube and fuel injector assembly to intake manifold.

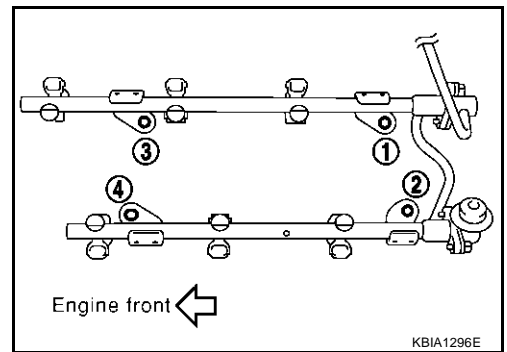
**CAUTION:**

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

- Tighten mounting bolts in two steps in numerical order shown in 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 sub-harness.

7. Install intake manifold collector (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.

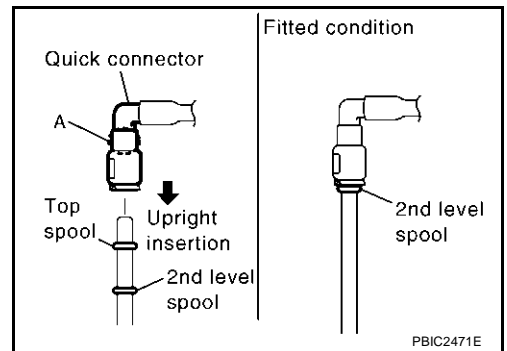
**CAUTION:**

- 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.



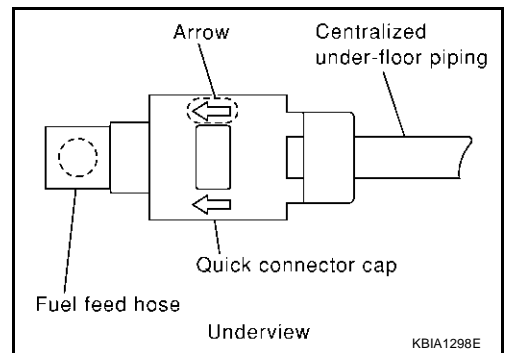
- d. Pull quick connector by hand holding "A" position. Make sure it is completely engaged (connected) so that it does not come out from centralized under-floor piping.

- 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.

### INSPECTION AFTER INSTALLATION

- Check for fuel leakage with the following procedure.

## FUEL INJECTOR AND FUEL TUBE

---

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.**

# ROCKER COVER

PFP:13264

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## ROCKER COVER

### Removal and Installation

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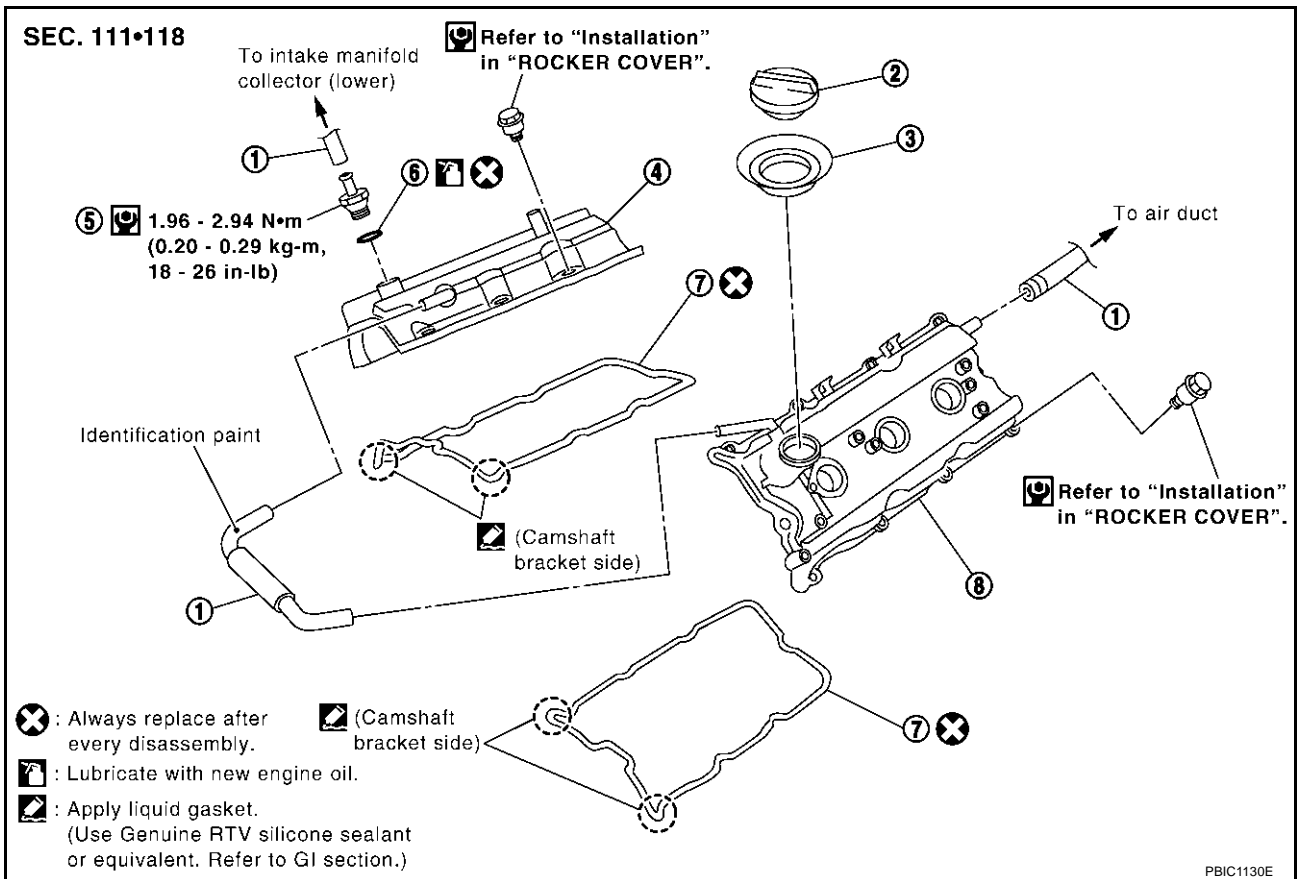
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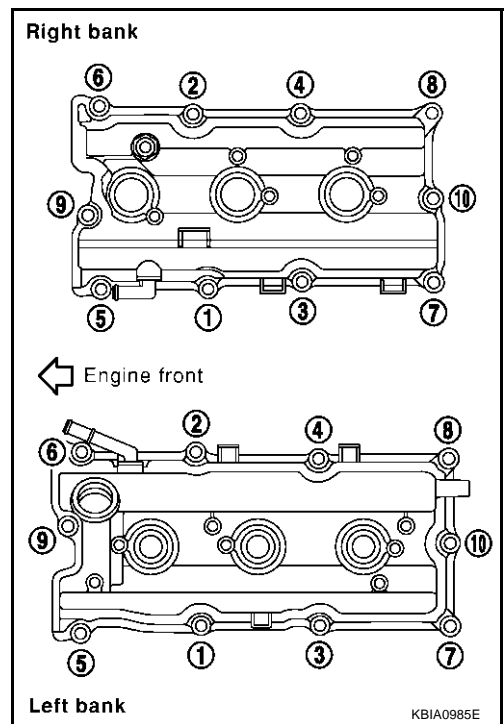
- |                           |                           |                |
|---------------------------|---------------------------|----------------|
| 1. PCV hose               | 2. Oil filler cap         | 3. Oil catcher |
| 4. Rocker cover (RH bank) | 5. PCV valve              | 6. O-ring      |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

### REMOVAL

1. Remove the intake manifold collector (upper) and (lower) with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove the ignition coil. Refer to [EM-34, "IGNITION COIL"](#).
3. Remove PCV hoses from rocker covers.

# ROCKER COVER

4. Loosen bolts in the reverse order shown in the figure (with power tool).



## INSTALLATION

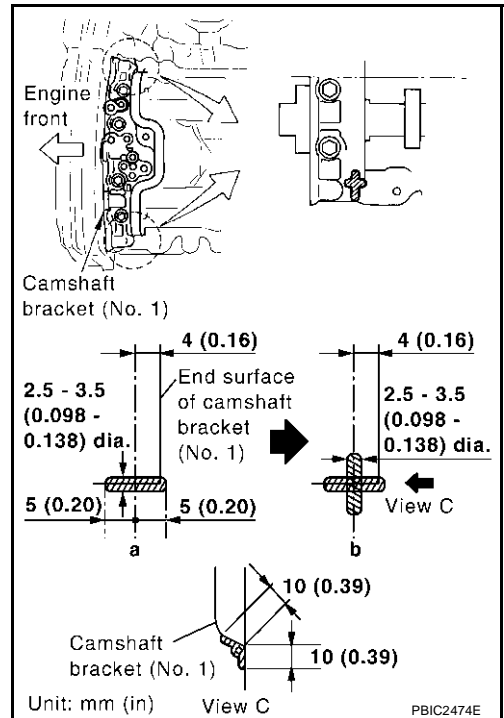
1. Apply liquid gasket with tube presser [special service tool: WS39930000 ( — )] to joint part among rocker cover, cylinder head and camshaft bracket (No. 1) as follows:

**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.




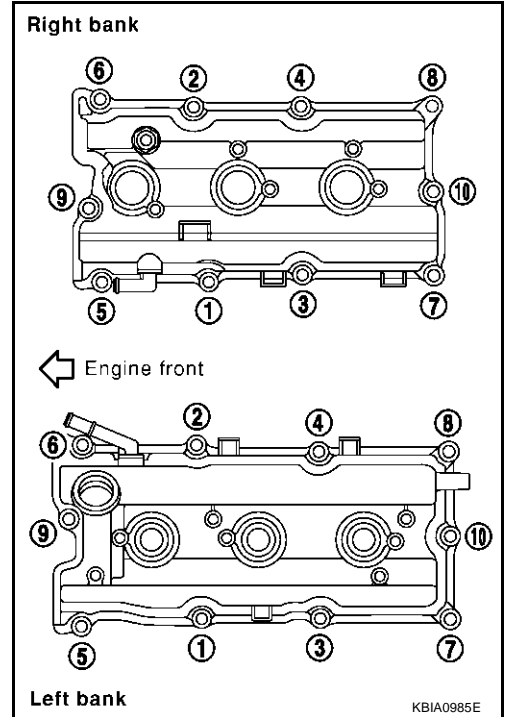
2. Install rocker cover.
  - Check if rocker cover gasket is not dropped from installation groove of rocker cover.

## ROCKER COVER

3. Tighten bolts two steps separately in order numbers in illustration.

 **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)



4. 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-43, "Removal and Installation"](#) .
5. Install in the reverse order of removal after this step.

# FRONT TIMING CHAIN CASE

## FRONT TIMING CHAIN CASE

PFP:13599

### Removal and Installation

ABS008GR

#### NOTE:

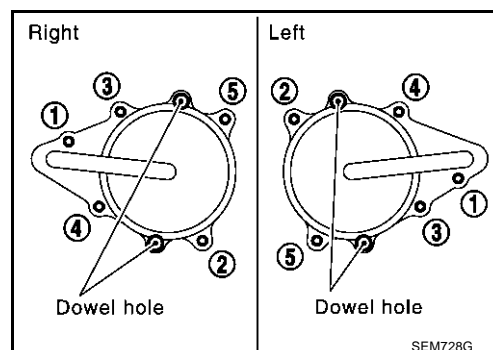
- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in reverse order of removal. Refer to [EM-54, "TIMING CHAIN"](#).
- Refer to [EM-54, "TIMING CHAIN"](#) for component parts location.

#### REMOVAL

1. Remove engine cover with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
2. Drain engine coolant from radiator. Refer to [CO-11, "Changing Engine Coolant"](#).
3. Separate engine harnesses removing their brackets from front timing chain case.
4. Remove cooling fan (A/T models). Refer to [CO-22, "Removal and Installation \(Crankshaft Driven Type\) \(A/T Models\)"](#).
5. Remove radiator cooling fan assembly (M/T models). Refer to [CO-24, "Removal and Installation \(Motor Driven\) \(M/T Models\)"](#).
6. Remove drive belts. Refer to [EM-13, "DRIVE BELTS"](#).
7. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-24, "Removal and Installation"](#).
8. Remove power steering oil pump bracket. Refer to [PS-24, "Removal and Installation"](#).
9. Remove alternator. Refer to [SC-31, "Removal and Installation"](#).
10. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
11. Remove the RH and LH intake valve timing control covers.
  - Loosen bolts in reverse order as shown.
  - Use seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.

#### CAUTION:

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



12. Remove RH and LH rocker covers with power tool. Refer to [EM-43, "ROCKER COVER"](#).

#### NOTE:

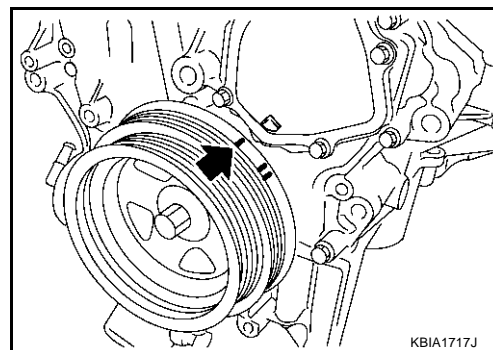
When secondary timing chain is not removed/installed, this step is not required.

13. Obtain compression TDC of No.1 cylinder 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.

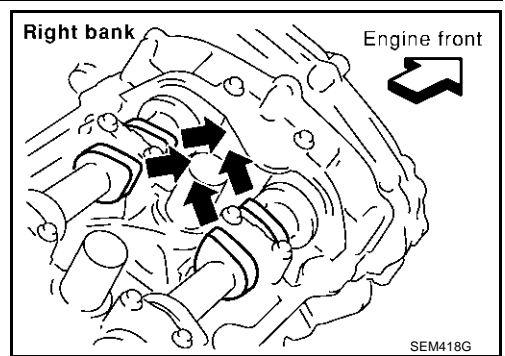


## FRONT TIMING CHAIN CASE

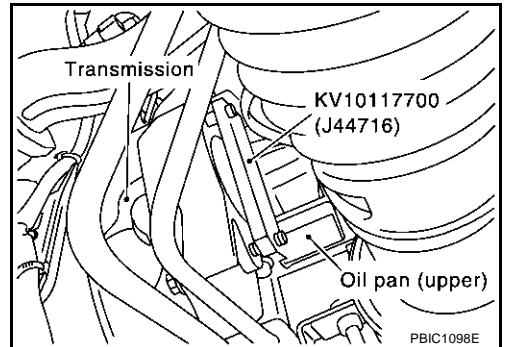
- b. Check that intake and exhaust cam noses on No. 1 cylinder (engine front side of RH bank) are located as shown.
- If not, turn the crankshaft one revolution (360°) and align as shown.

**NOTE:**

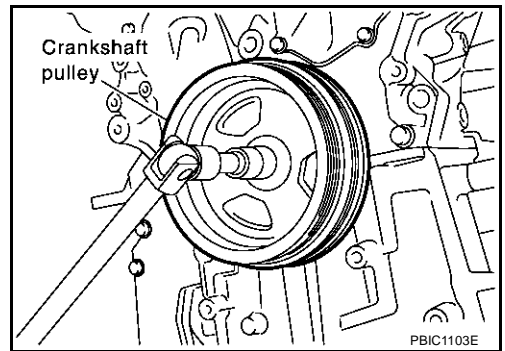
When only primary timing chain is removed, rocker cover does not need to be removed. To confirm that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to [EM-54, "TIMING CHAIN"](#).



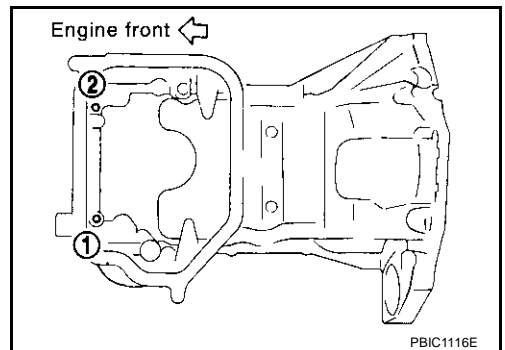
14. Remove starter motor and set ring gear stopper (special service tool) as shown. Refer to [SC-19, "Removal and Installation"](#).



15. Remove crankshaft pulley.



16. Remove oil pan (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).
17. Loosen two mounting bolts in front of oil pan (upper) in reverse order shown in figure.

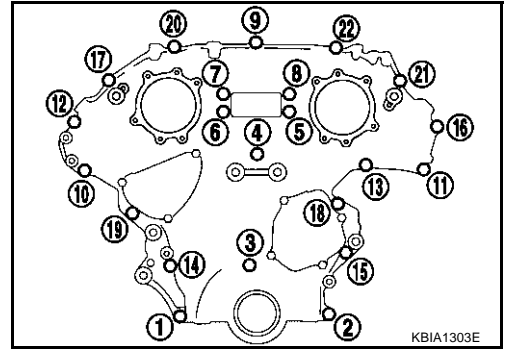


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## FRONT TIMING CHAIN CASE

18. Remove front timing chain case.

a. Loosen mounting bolts in reverse order as shown.



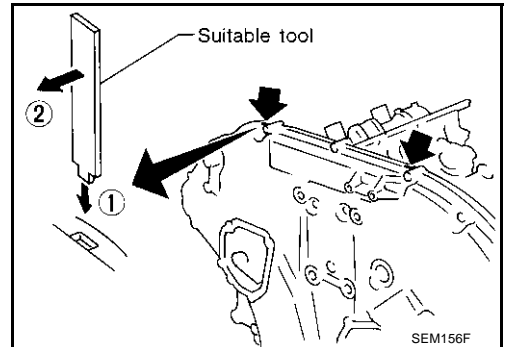
b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).

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

- Use seal cutter (special service tool) or an equivalent tool to cut liquid gasket for removal.

**CAUTION:**

- Do not use screwdrivers or something similar.
- After removal, handle it carefully so it does not tilt, cant, or warp under a load.

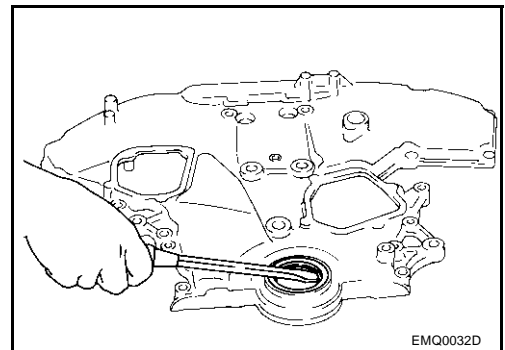


19. Remove water pump cover and chain tensioner cover from front timing chain case.

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

20. Remove the front oil seal from the front timing chain case using a suitable tool.

- Use screwdriver for removal.
- Exercise care not to damage front timing chain case.

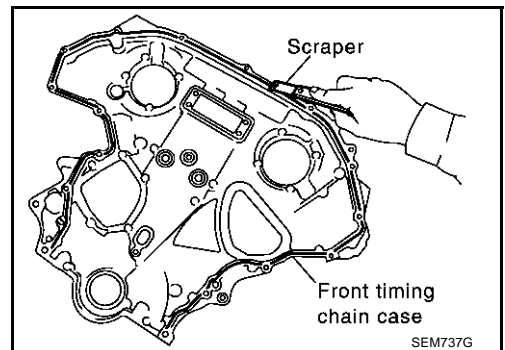


21. Remove timing chain and related parts. Refer to [EM-54, "TIMING CHAIN"](#).

22. 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:**

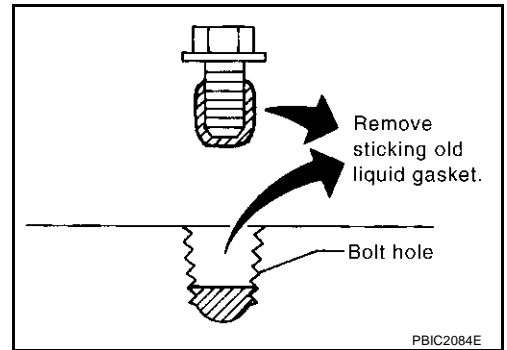
**Be careful not to allow gasket fragments to enter oil pan.**





# FRONT TIMING CHAIN CASE

- Remove old liquid gasket from bolt hole and thread.



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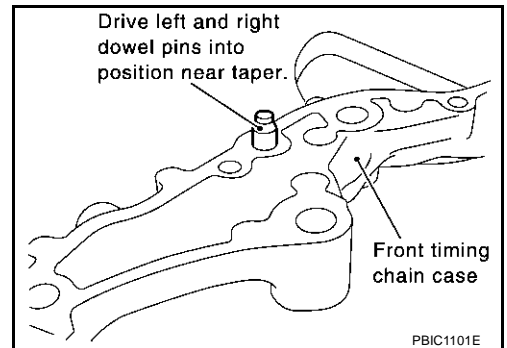
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## INSTALLATION

1. Install timing chain and related parts. Refer to [EM-54, "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.



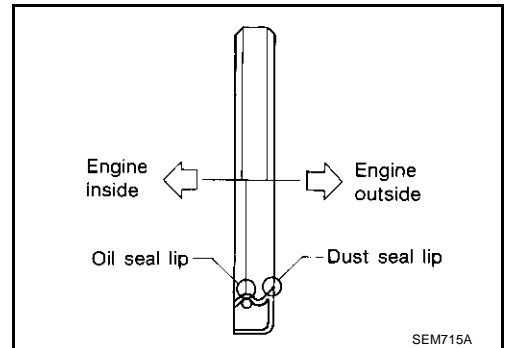
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3. Install the front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.
  - Install it so that each seal lip is oriented as shown in figure.



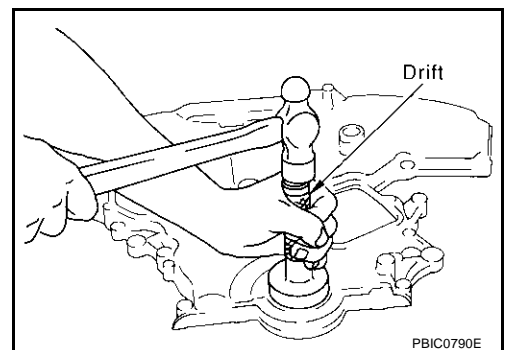
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- Using a suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



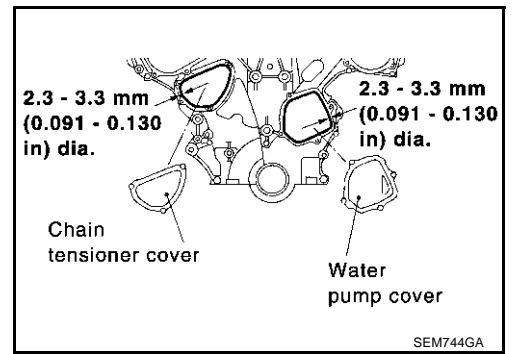
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4. Install the water pump cover and the chain tensioner cover to front timing chain case.

# FRONT TIMING CHAIN CASE

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

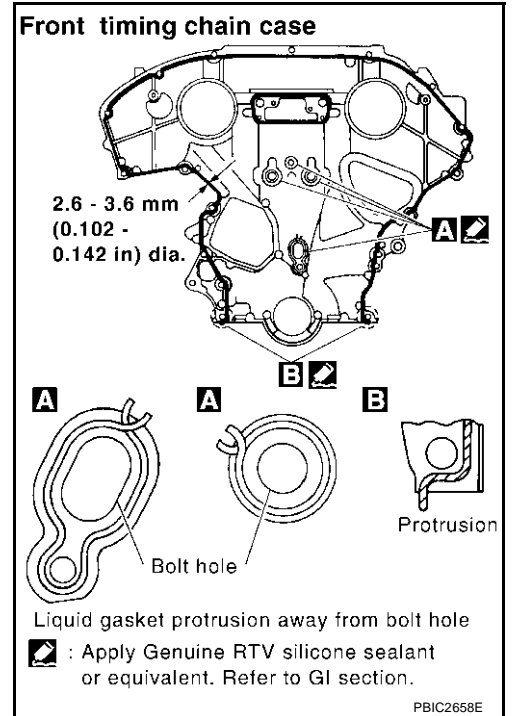
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



5. Install front timing chain case as follows:

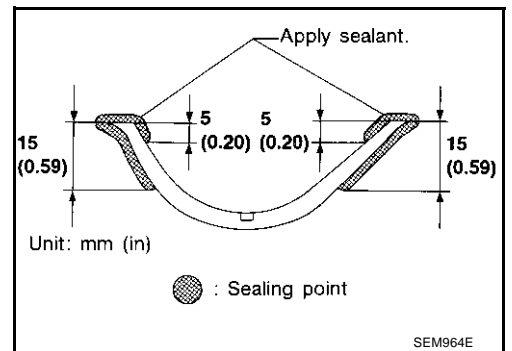
- a. Apply a continuous bead of liquid gasket with tube presser [special service tool: WS39930000 ( — )] to front timing chain case back side as shown in the figure.

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



- b. Install oil pan gasket.

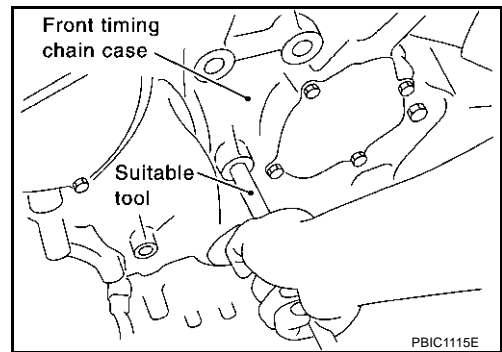
- Apply liquid gasket to oil pan gasket as shown in the figure. **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**





## FRONT TIMING CHAIN CASE

- ii. While pressing front timing chain case from its front and top as shown in figure, install bolts and temporarily tighten them. For bolt size and positions, refer to the step 6.
- iii. Hammer dowel pin until the outer end becomes flush with surface.

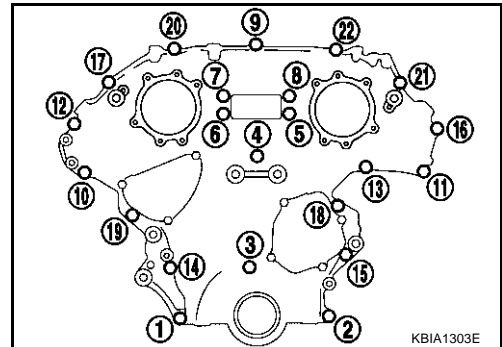


6. Tighten bolts to the specified torque in order shown in the figure.

**8 mm (0.31 in) dia. bolts : 1, 2**

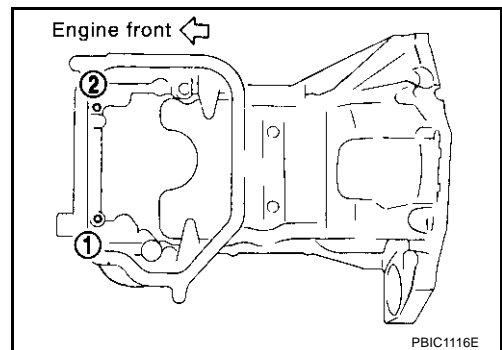
**6 mm (0.24 in) dia. bolts : Except the above**

- After tightening, retighten them to specified torque in numerical order shown in figure.



7. Install two mounting bolts in front of oil pan (upper) in numerical order shown in figure.

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



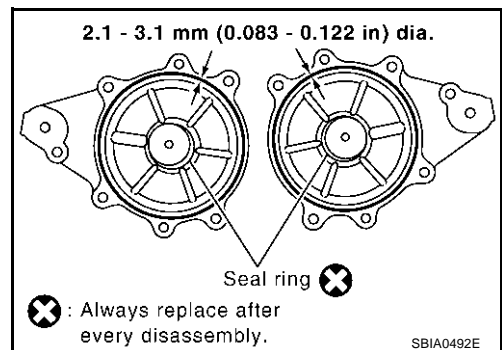
8. Install oil pan (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .

9. Install RH and LH intake valve timing control covers as follows:

- a. Install seal rings in shaft grooves.

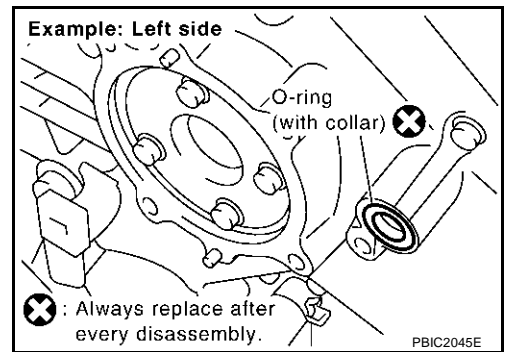
- b. Apply a continuous bead of liquid gasket with tube presser [special service tool: WS39930000 ( — )] to intake valve timing control covers as shown in the figure.

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

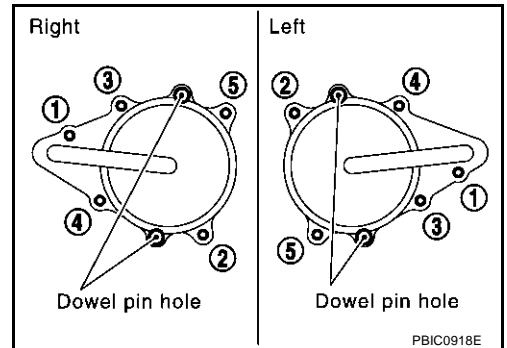


## FRONT TIMING CHAIN CASE

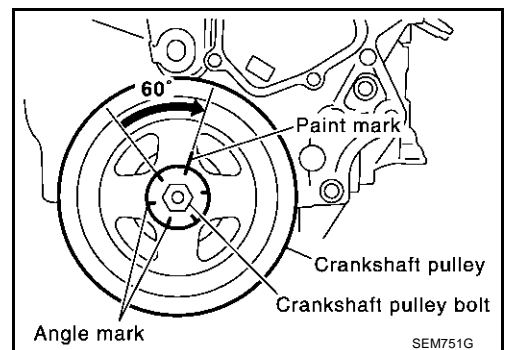
- c. Install collared O-ring in front timing chain case oil hole (LH and RH sides).



- d. Being careful not to move the seal ring from the installation groove, align the dowel pins on the front timing chain case with the holes to install the intake valve timing control covers.
- e. Tighten bolts in the numerical order as shown.



10. Install crankshaft pulley as follows:
- Fix crankshaft using ring gear stopper [special service tool: KV10117700 (J44716)].
  - Install crankshaft pulley, taking care not to damage front oil seal.
    - When press-fitting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
  - Tighten bolt to 39.2 to 49.0 N·m (4.0 to 5.0 kg·m, 29 to 36 ft·lb).
  - Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by 60 to 66 degrees [Target: 60 degrees (equivalent to one graduation)].



11. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
12. For the following operations, perform steps in the reverse order of removal.

### NOTE:

If hydraulic pressure inside 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.



# 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. Chain tensioner cover   |
| 16. Intake valve timing control cover | 17. Water hose clamp                  | 18. Cooling fan pulley bracket (A/T models),<br>Idler pulley bracket (M/T models) |
| 19. Idler pulley                      | 20. Crankshaft pulley                 | 21. Front oil seal  |
| 22. Water pump cover                  | 23. Idler pulley                      | 24. A/C compressor bracket  |
| 25. Front timing chain case           | 26. Bracket                           | 27. Rear timing chain case  |
| 28. O-ring                            | 29. Tension guide                     | 30. Water drain plug  |

## NOTE:

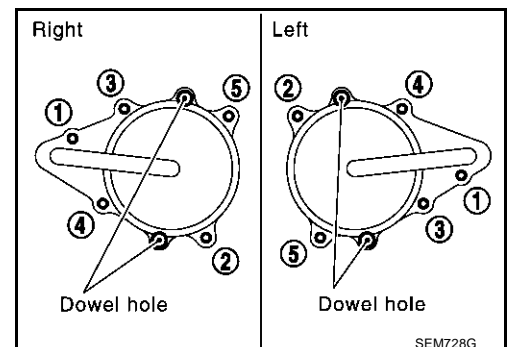
- This section describes procedures for removing/installing front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.
- To remove/install front timing chain case, timing chain, and its related parts without removing oil pan (upper), refer to [EM-46, "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. Drain engine coolant from radiator. Refer to [CO-11, "Changing Engine Coolant"](#).
5. Drain engine oil from oil pan. Refer to [LU-8, "Changing Engine Oil"](#).
6. Separate engine harnesses removing their brackets from front timing chain case.
7. Remove intake manifold collector (upper) and (lower) with power tool. Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#).
8. Remove radiator cooling fan assembly (M/T models). Refer to [CO-24, "Removal and Installation \(Motor Driven\) \(M/T Models\)"](#).
9. Remove cooling fan (A/T models). Refer to [CO-22, "Removal and Installation \(Crankshaft Driven Type\) \(A/T Models\)"](#).
10. Remove radiator. Refer to [CO-14, "RADIATOR"](#).
11. Remove drive belts. Refer to [EM-13, "DRIVE BELTS"](#).
12. Remove A/C compressor from bracket with piping connected, and temporarily secure it aside. Refer to [ATC-154, "Removal and Installation of Compressor"](#).
13. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-24, "Removal and Installation"](#).
14. Remove power steering oil pump bracket. Refer to [PS-24, "Removal and Installation"](#).
15. Remove alternator. Refer to [SC-31, "Removal and Installation"](#).
16. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
17. Remove oil pan (upper) and (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).
18. Remove the RH and LH intake valve timing control covers.
  - Loosen bolts in reverse order as shown.
  - Use seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.

## CAUTION:

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

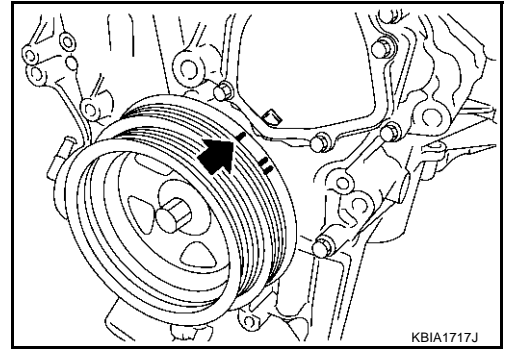


19. Remove RH and LH rocker covers with power tool. Refer to [EM-43, "ROCKER COVER"](#).

# TIMING CHAIN

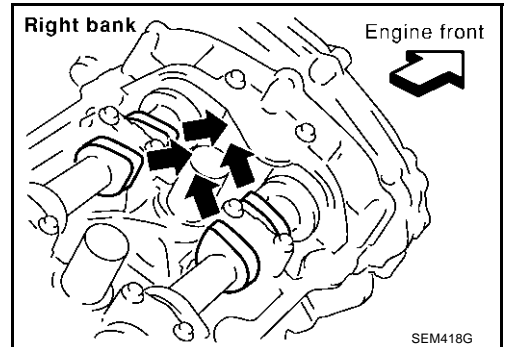
20. Obtain compression TDC of No.1 cylinder as follows:

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

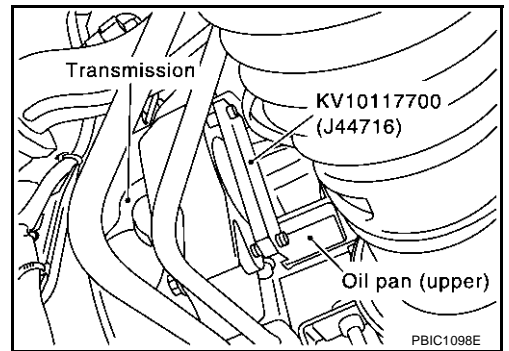


- b. Check that intake and exhaust cam noses on No. 1 cylinder (engine front side of RH bank) are located as shown.

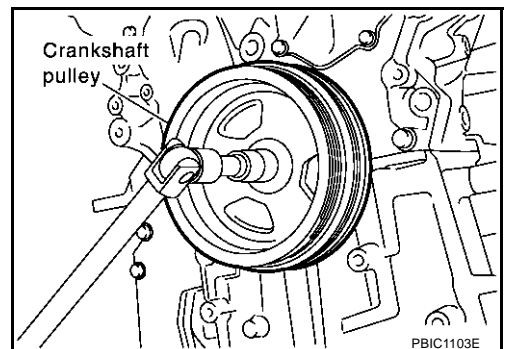
- If not, turn the crankshaft one revolution (360°) and align as shown.



- c. Remove starter motor and set ring gear stopper (special service tool) as shown. Refer to [SC-19, "Removal and Installation"](#) .

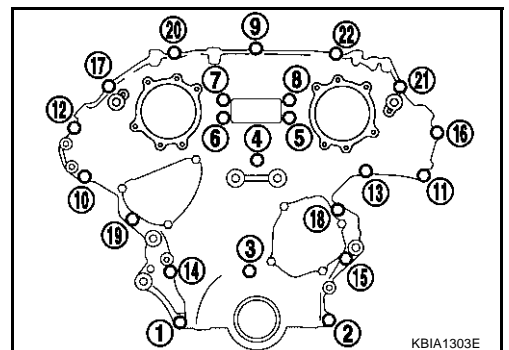


21. Remove crankshaft pulley.



22. Remove front timing chain case.

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



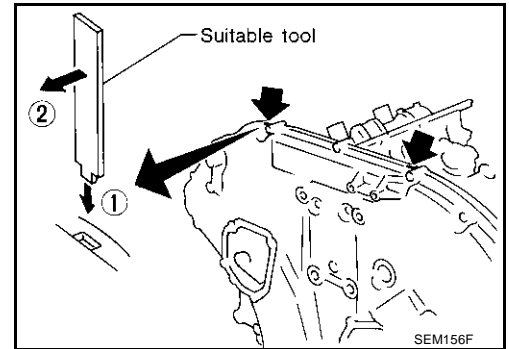


## TIMING CHAIN

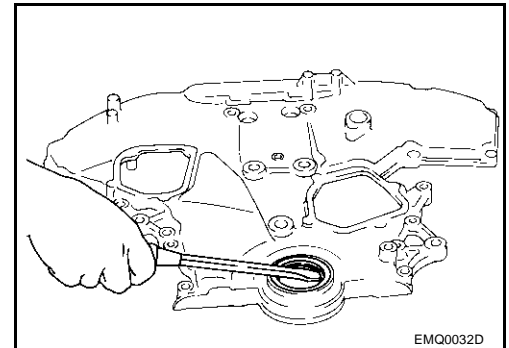
- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).
- c. Pry off the case by moving the tool as shown (2).
- Use seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.

**CAUTION:**

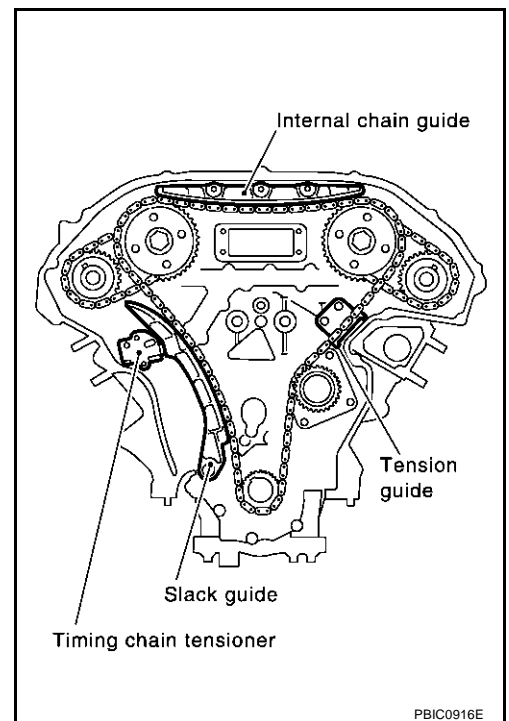
- Do not use screwdrivers or something similar.
- After removal, handle it carefully so it does not tilt, cant, or warp under a load.



23. Remove water pump cover and chain tensioner cover from front timing chain case.
- Use seal cutter (special service tool) or an equivalent tool to cut liquid gasket for removal.
24. Remove the front oil seal from the front timing chain case using a suitable tool.
- Use screwdriver for removal.
  - Exercise care not to damage front timing chain case.



25. Remove internal chain guide, timing chain tensioner, tension guide and slack guide.



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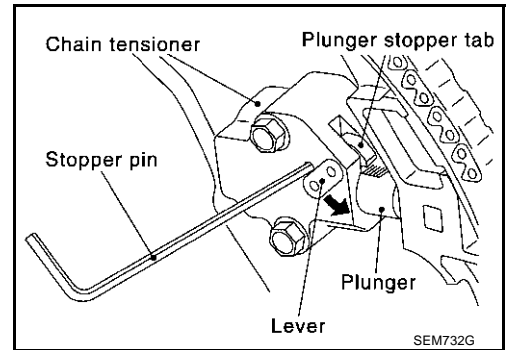
## TIMING CHAIN

- Remove timing chain tensioner as follows:

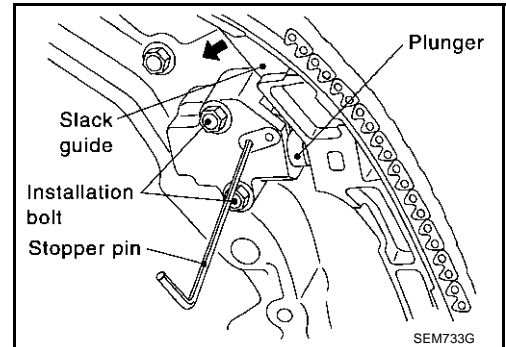
- Pull lever down and release plunger stopper tab.
  - Plunger stopper tab can be pushed up to release (coaxial structure with lever).
- Insert stopper pin into tensioner body hole to hold lever, and keep the tab released.

**NOTE:**

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



- Insert plunger into tensioner body by pressing the slack guide.
- Keep the slack guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.
- Remove the mounting bolts and remove the timing chain tensioner.



- Remove timing chain (primary) and crankshaft sprocket.

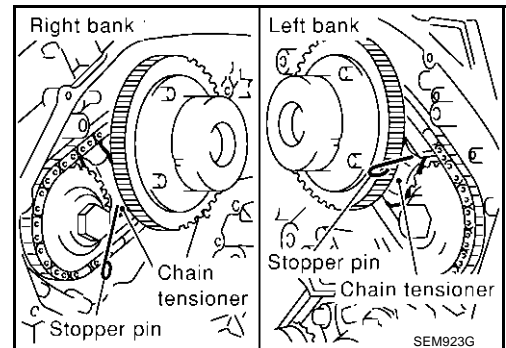
**CAUTION:**

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

- Attach a suitable stopper pin to the RH and LH secondary timing chain tensioners.

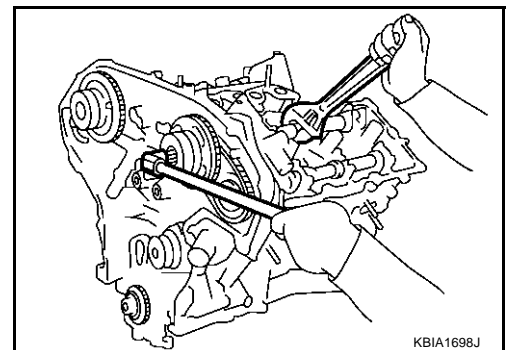
**NOTE:**

For removal and installation of secondary timing chain tensioner, refer to [EM-71, "CAMSHAFT"](#) . (Removing No. 1 camshaft bracket is required.)



- Remove intake and exhaust camshaft sprocket bolts.

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



## TIMING CHAIN

29. Remove secondary timing chain together with camshaft sprockets.

- Turn camshaft slightly to secure slackness of timing chain on chain tensioner side.
- Insert 0.5 mm (0.020 in)-thick metal or resin plate between timing chain and chain tensioner plunger (guide). Remove secondary timing chain together with camshaft sprockets with timing chain loose from guide groove.

**CAUTION:**

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

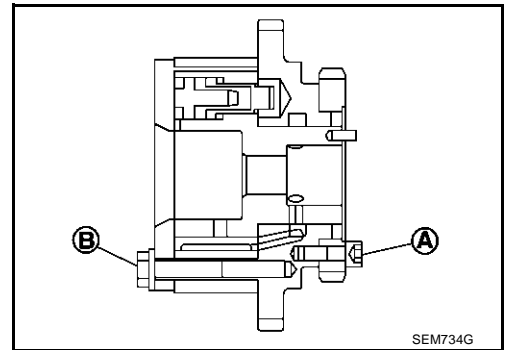
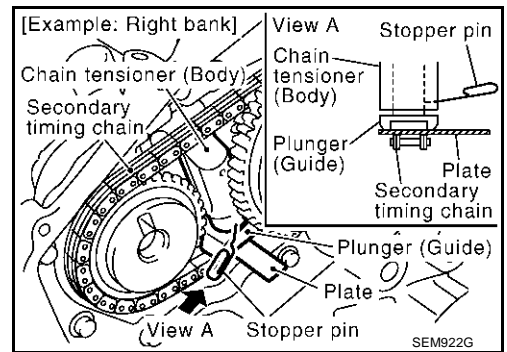
**NOTE:**

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

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

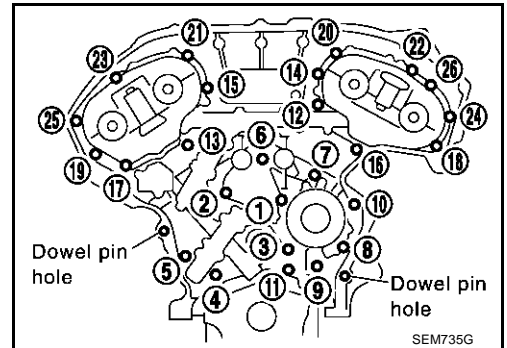
**CAUTION:**

- Handle carefully to avoid any shock to camshaft sprocket.
- Do not disassemble. (Never loosen bolts "A" and "B" as shown).



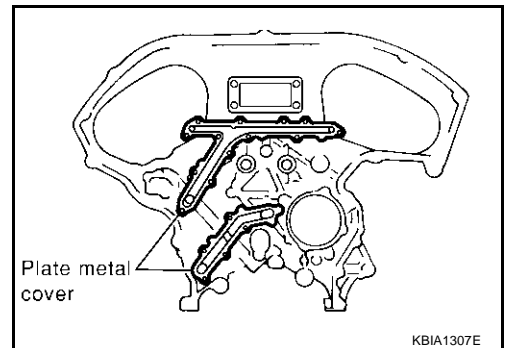
30. Remove rear timing chain case as follows:

- Loosen and remove mounting bolts in reverse order as shown.
- Cut the sealant using a seal cutter [special service tool: KV10111100 (J37288)] or an equivalent tool and remove rear timing chain case.



**CAUTION:**

- Do not remove plate metal cover of oil passage.
- After removing chain case, do not apply any load which affects flatness.

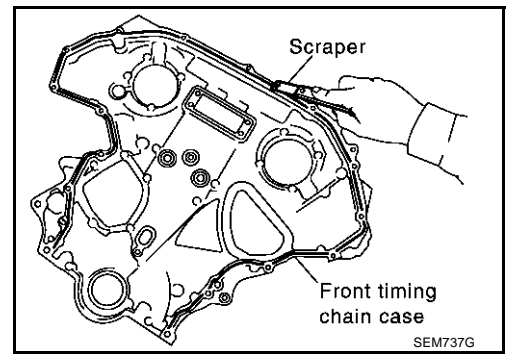


31. Remove RH and LH secondary timing chain tensioners from cylinder head as follows if necessary.

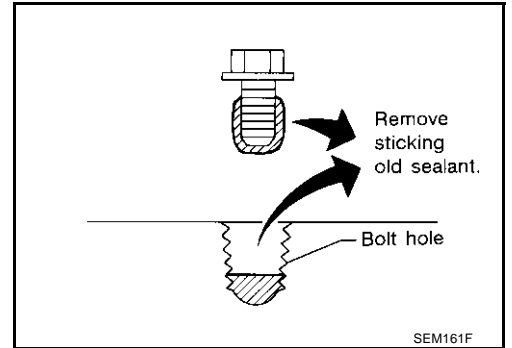
- Remove No.1 camshaft brackets. Refer to [EM-72, "REMOVAL"](#).
- Remove secondary timing chain tensioners with stopper pin attached.

## TIMING CHAIN

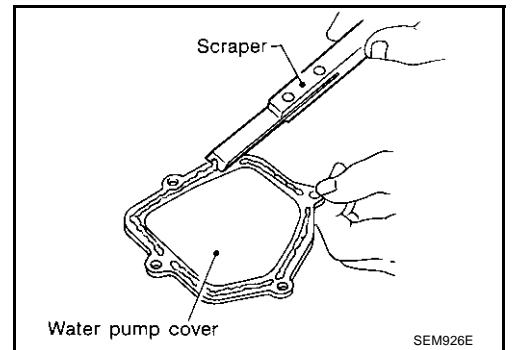
32. Use a scraper to remove all traces of liquid gasket from front and rear timing chain cases, and opposite mating surfaces.



- Remove old liquid gasket from the bolt hole and thread.

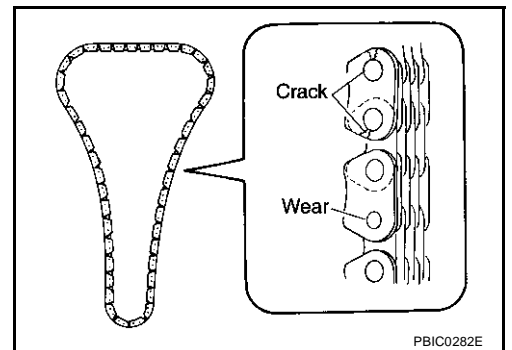


33. Use a scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.



### INSPECTION AFTER REMOVAL

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

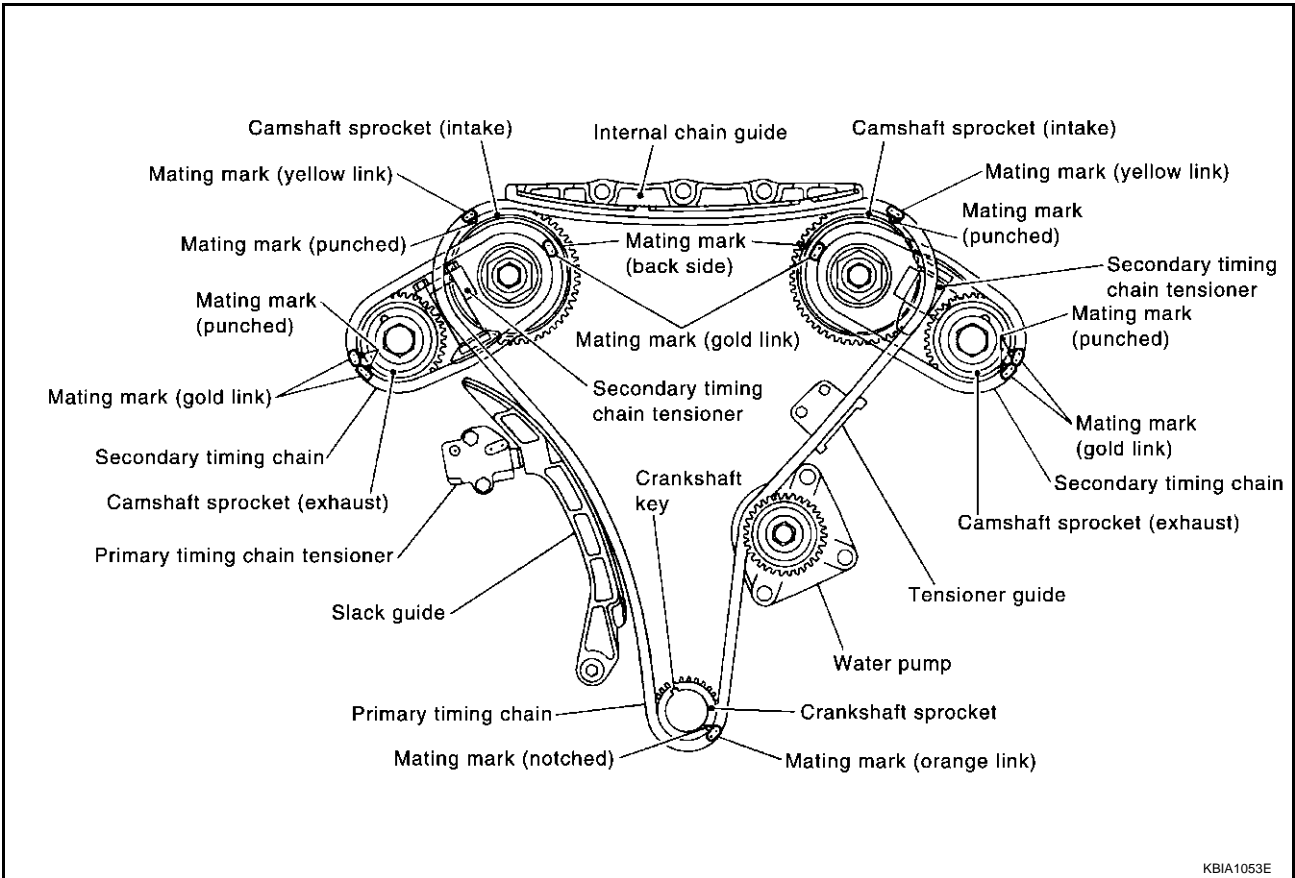


# TIMING CHAIN

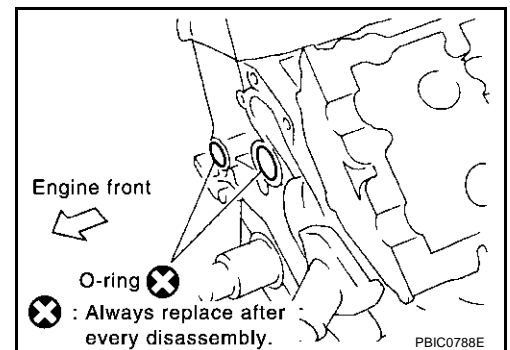
## INSTALLATION

### 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.

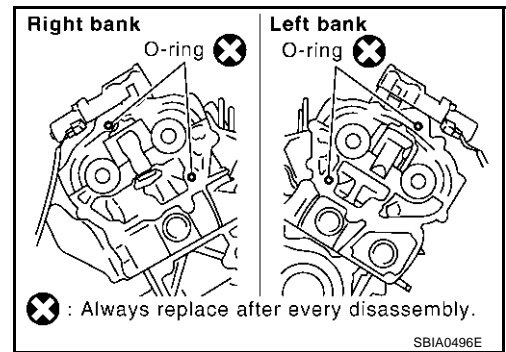


1. Install RH and LH secondary timing chain tensioners to cylinder head as follows if removed. Refer to [EM-76, "INSTALLATION"](#) .
  - a. Install secondary timing chain tensioners with stopper pin attached and new O-ring.
  - b. Install No.1 camshaft brackets. Refer to [EM-76, "INSTALLATION"](#) .
2. Install O-rings onto cylinder block.



# TIMING CHAIN

3. Install O-rings to cylinder head.



4. Apply liquid gasket to rear timing chain case back side as shown. Use **Genuine RTV Silicone Sealant** or equivalent. Refer to **GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"**.

**Rear timing chain case: Back side**

(a) Clearance 1 mm (0.04 in)  
(b) Protrusion

**A** Do not protrude in this area.

More than 8 (0.31)

2.6 - 3.6 (0.102 - 0.142) dia.

**B** Cross both ends as shown and be sure to minimize the overlapped area.

**E** Camshaft axis area

Center line of rear timing chain case liquid gasket groove

5 (0.20)

Center line of liquid gasket

2 (0.08)

Joint portion of cylinder head and camshaft bracket (No. 1)

**D**

2.6 - 3.6 (0.102 - 0.142) dia.

Protrusions at beginning and end of liquid gasket

: Run along bolt hole outer 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

## TIMING CHAIN

5. Align the rear timing chain case and water pump assembly with the dowel pins (RH and LH) on the cylinder block and install the case.
  - Make sure the O-rings stay in place during installation to cylinder block and cylinder head.
- a. Tighten the mounting bolts in the numerical order as shown.
  - There are two bolt lengths used. Follow the below for proper bolt length specifications.

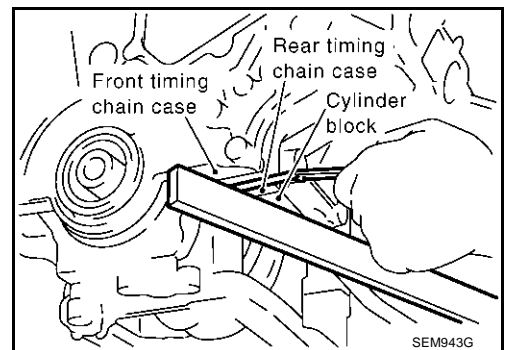
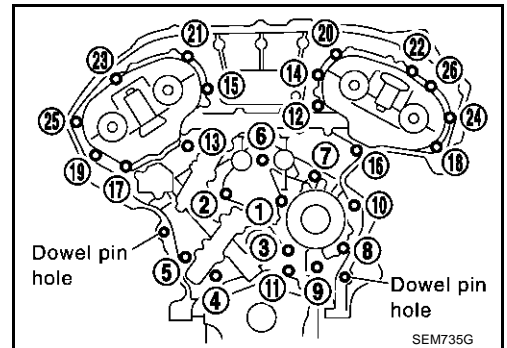
Bolt length:	Bolt position
20 mm (0.79 in)	: 1, 2, 3, 6, 7, 8, 9, 10
16 mm (0.63 in)	: Except the above

- b. After all bolts are temporarily tightened, retighten them to the specification in the numerical order as shown.
  - If the RTV Silicone Sealant protrudes, wipe it off immediately.
6. After installing rear timing chain case, check surface height difference between following parts on oil pan 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 above installation procedure.



7. Install chain tension guide.
8. Position the crankshaft so No. 1 piston is set at TDC on the compression stroke.
  - Make sure that the dowel pin hole, dowel pin and crankshaft key are located as shown.

### NOTE:

Though camshafts are not stopped at the positions as shown in the figure for the cam nose locations, it is appropriate in this step that camshafts are stopped at the basically same direction of the figure.

### Camshaft dowel pin hole (intake side)

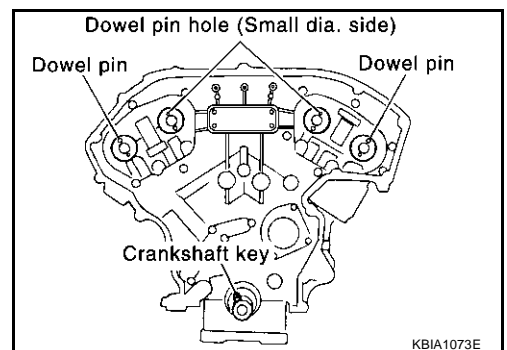
: At cylinder head upper face side in each bank.

### Camshaft dowel pin (exhaust side)

: At cylinder head upper face side in each bank.

### Crankshaft key

: At cylinder head side of RH bank.



### CAUTION:

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

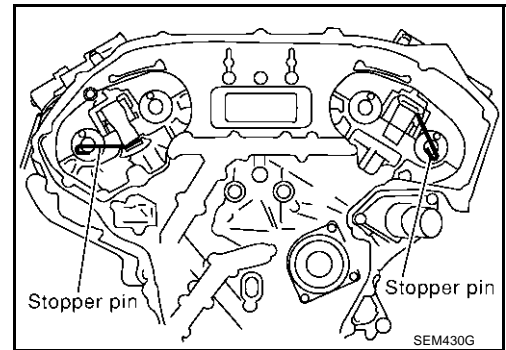
## TIMING CHAIN

9. Install the timing chains (secondary) and camshaft sprockets.

**CAUTION:**

**Matching marks between the timing chain and sprockets slip easily. Confirm all matching mark positions repeatedly during the installation process.**

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



- b. Install secondary timing chains and camshaft sprockets.

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

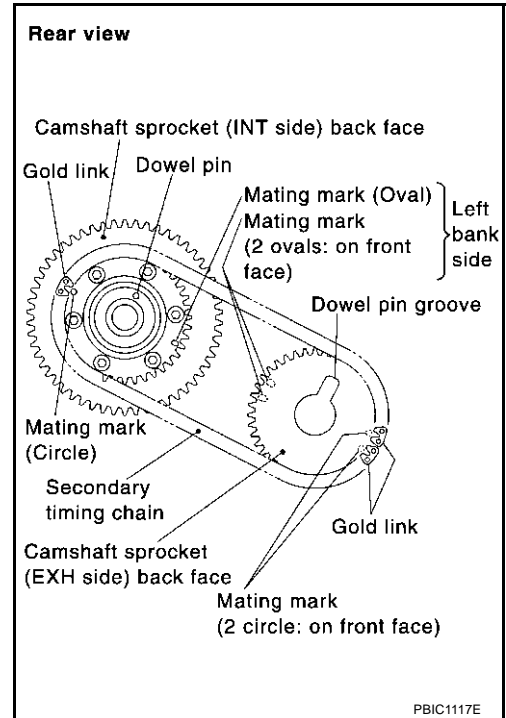
**NOTE:**

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

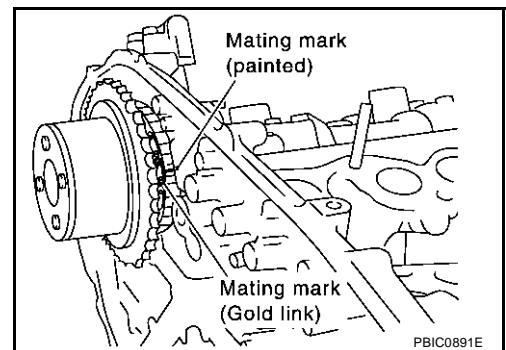
**RH bank : use circle type.**

**LH bank : use oval type.**

- Align the dowel pin and pin hole on the camshaft with the groove and dowel pin on the sprocket, and install them.
- On the intake side, align the pin hole on the small diameter side of the camshaft front end with the dowel pin on the back side of the camshaft sprocket, and install them.
- On the exhaust side, align the dowel pin on the camshaft front end with the pin groove on the camshaft sprocket, and install them.



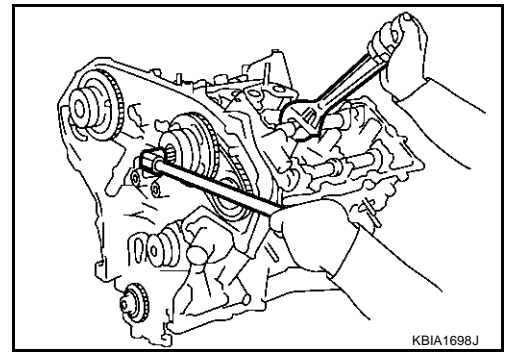
- In cases that positions of each mating mark and each dowel pin are not fit on mating parts, make fine adjustment to the position holding the hexagonal part of camshaft with a wrench or the equivalent.
- Mounting bolts for the camshaft sprockets must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of the 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.



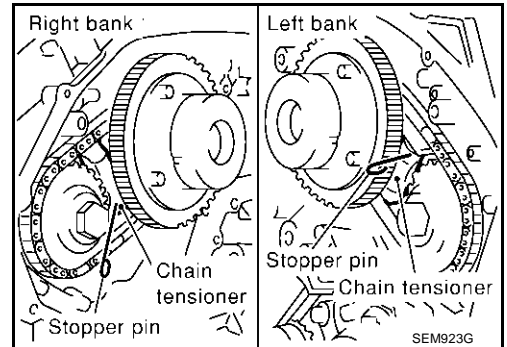


# TIMING CHAIN

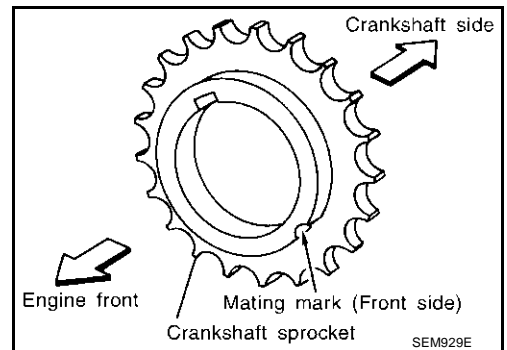
10. After confirming the mating marks are aligned, tighten the camshaft sprocket mounting bolts.
  - Secure the camshaft using a wrench at the hexagonal portion to tighten the mounting bolts.



11. Pull the stopper pins out from the secondary timing chain tensioners.



12. Install the primary timing chain as follows:
  - a. Install the crankshaft sprocket.
    - Make sure the mating marks on the crankshaft sprocket face the front of the engine.

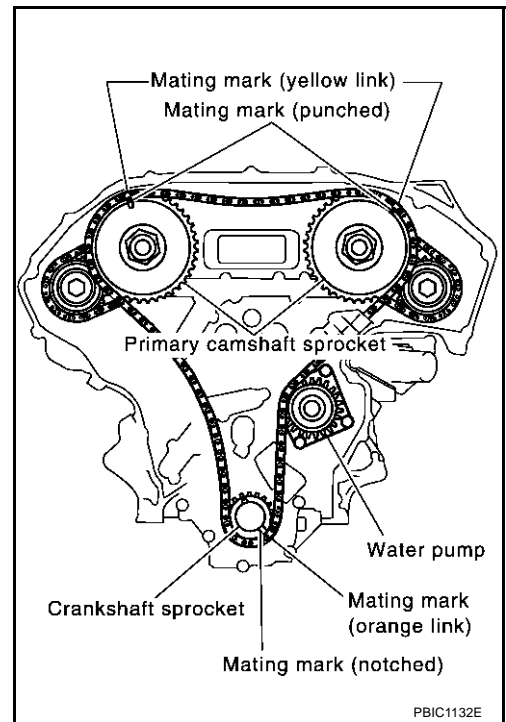


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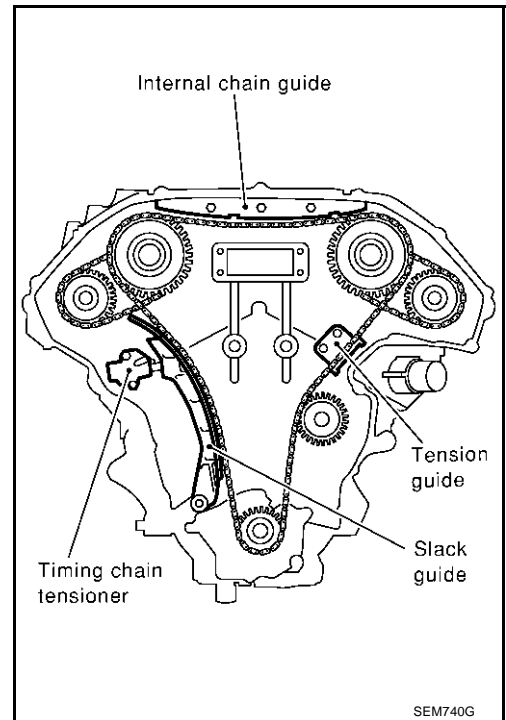
# TIMING CHAIN

b. Install the primary timing chain.

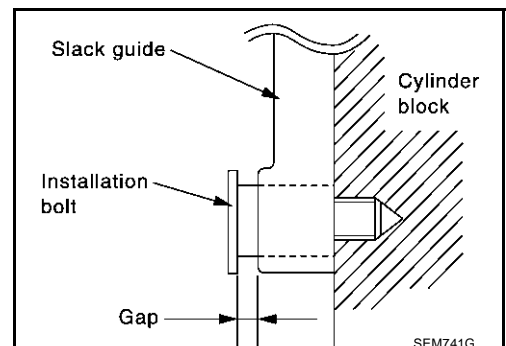
- Install primary timing chain so the mating mark (punched) on camshaft sprocket is aligned with the yellow link on the timing chain, while the mating mark (notched) on the crankshaft sprocket is aligned with the orange one on the timing chain, as shown.
- When it is difficult to align mating marks of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



13. Install the internal chain guide and slack guide.



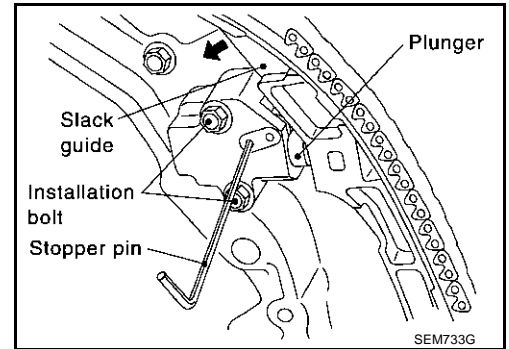
- Do not overtighten the slack guide mounting bolts. It is normal for a gap to exist under the bolt seats when the mounting bolts are tightened to specification.



## TIMING CHAIN

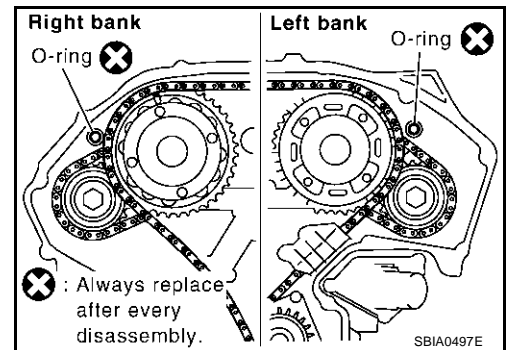
### 14. Install chain tensioner for slack guide.

- When installing the chain tensioner, push in the sleeve and keep it pressed in with the stopper pin.
- Remove any dirt and foreign materials completely from the back and the mounting surfaces of the chain tensioner.
- After installation, pull out the stopper pin by pressing the slack guide.



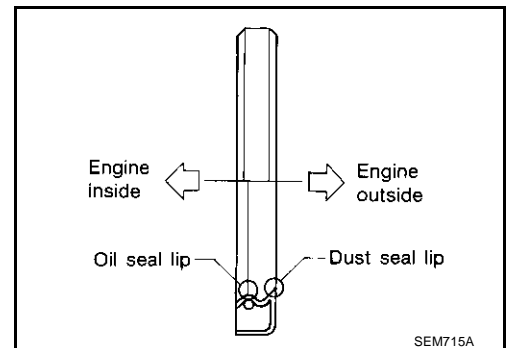
### 15. Reconfirm that the mating marks on the sprockets and the timing chain have not slipped out of alignment.

### 16. Install new O-rings on the rear timing chain case.

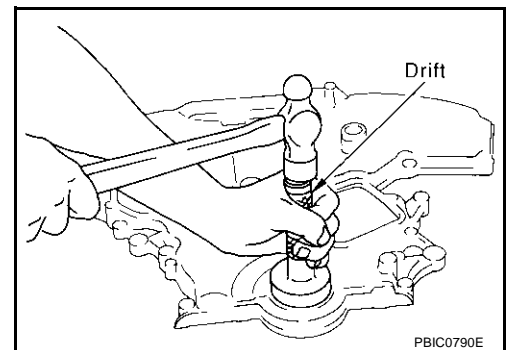


### 17. Install the front oil seal on the front timing chain case.

- 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 figure.



- Using a 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.

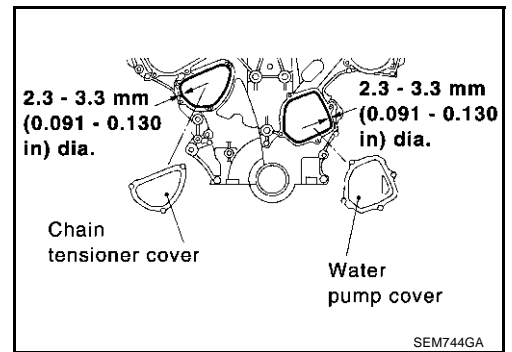


### 18. Install the water pump cover and the chain tensioner cover to front timing chain case.

## TIMING CHAIN

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

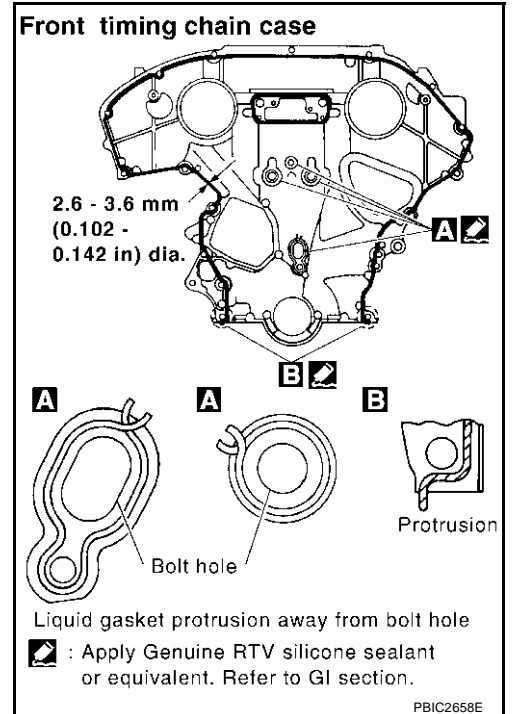
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



19. Install front timing chain case as follows:

- a. Apply a continuous bead of liquid gasket with tube presser [special service tool: 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 dowel pin on the rear timing chain case into dowel pin hole on front timing chain case.
- c. Tighten bolts to the specified torque in order shown in the figure.

**8 mm (0.31 in) dia. bolts : 1, 2**

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

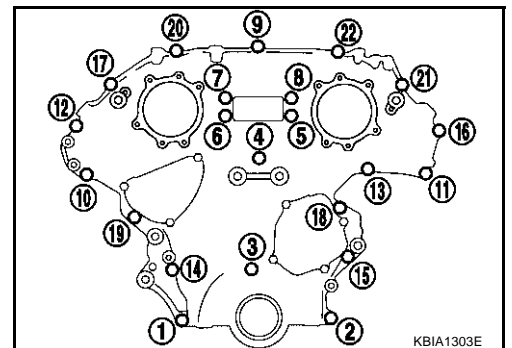
**6 mm (0.24 in) dia. bolts : Except the above**

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

- d. After tightening, retighten them to specified torque in numerical order shown in figure.

**CAUTION:**

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



## TIMING CHAIN

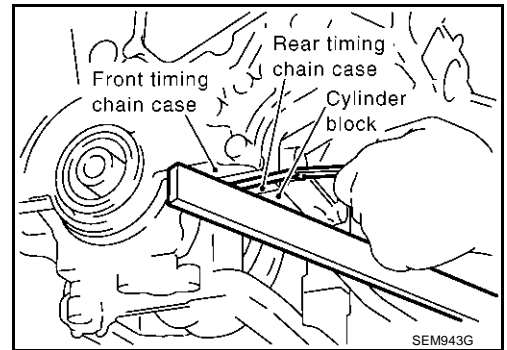
20. After installing the front timing chain case, check the surface height difference between the following parts on the oil pan mounting surface.

### Standard

#### Front timing chain case to rear timing chain case:

−0.14 to 0.14 mm (−0.005 to 0.0055 in)

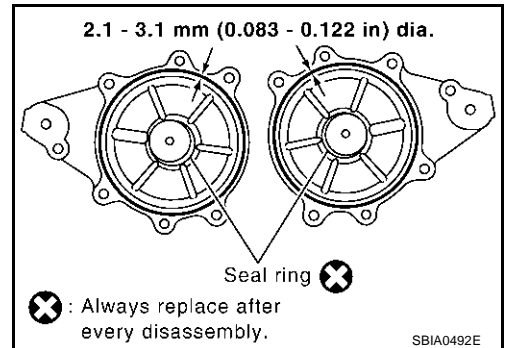
- If not within specification, repeat the installation procedure.



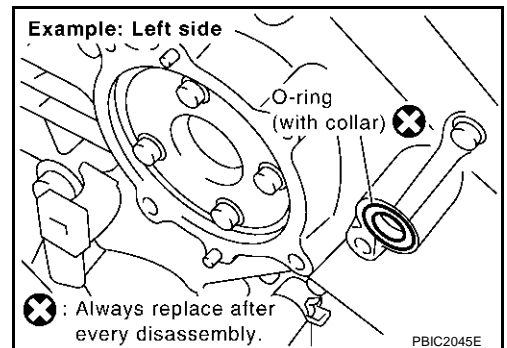
21. Install RH and LH intake valve timing control covers as follows:

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

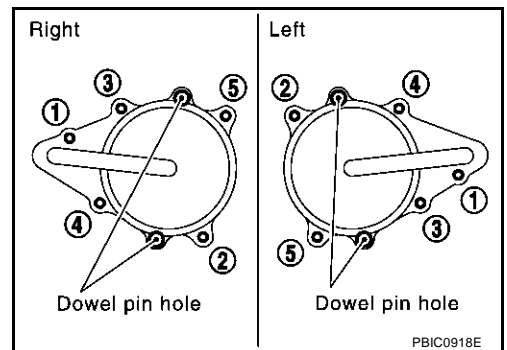
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**



- Install collared O-ring in the oil hole of the front timing chain case (LH and RH sides).



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

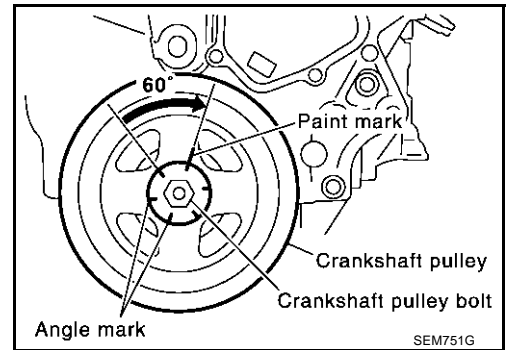


22. Install crankshaft pulley as follows:

- Fix crankshaft using ring gear stopper [special service tool: KV10117700 (J44716)].
- Install crankshaft pulley, taking care not to damage front oil seal.
  - When press-fitting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
- Tighten bolt to 39.2 to 49.0 N·m (4.0 to 5.0 kg·m, 29 to 36 ft·lb).

## TIMING CHAIN

- d. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by 60 to 66 degrees [Target: 60 degrees (equivalent to one graduation)].



23. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
24. For the following operations, perform steps in the reverse order of removal.

**NOTE:**

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

# CAMSHAFT

PPF:13001

## CAMSHAFT

### Removal and Installation

ABS0002F

A

EM

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H

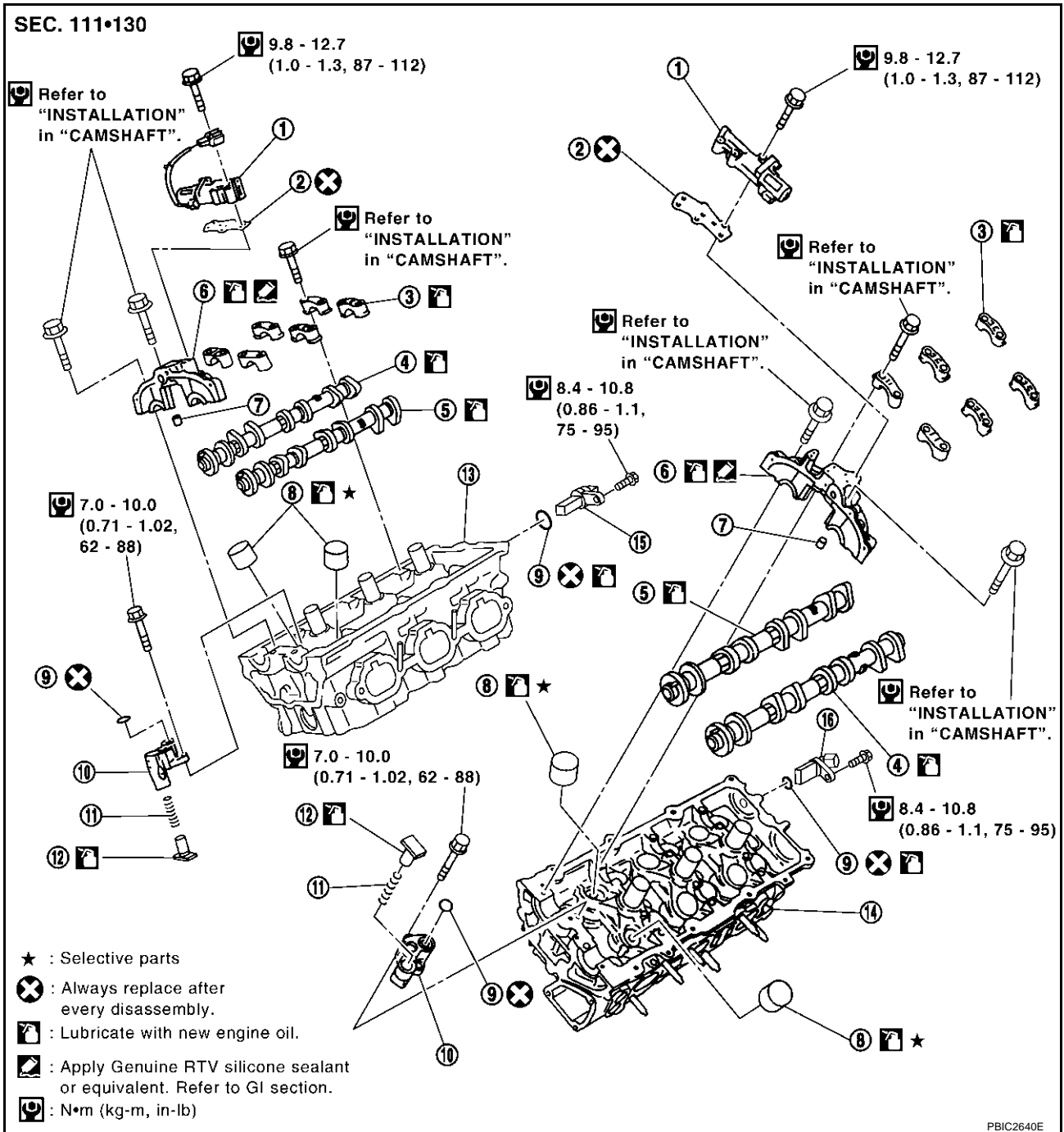
I

J

K

L

M



- |  |                             |  |
|--|-----------------------------|--|
| 1. Intake valve timing control valve           | 2. Gasket                   | 3. Camshaft bracket (No.2 to No.4)             |
| 4. Camshaft (EXH)                              | 5. Camshaft (INT)           | 6. Camshaft bracket (No.1)                     |
| 7. Dowel pin                                   | 8. Valve lifter             | 9. O-ring                                      |
| 10. Chain tensioner                            | 11. Spring                  | 12. Plunger                                    |
| 13. Cylinder head (RH bank)                    | 14. Cylinder head (LH bank) | 15. Camshaft position sensor (PHASE) (RH bank) |
| 16. Camshaft position sensor (PHASE) (LH bank) |                             |  |

# CAMSHAFT

## REMOVAL

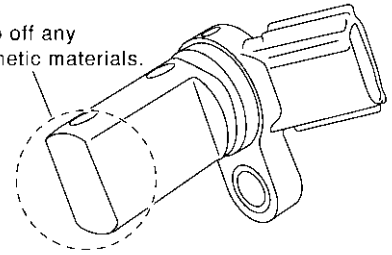
1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [EM-54, "TIMING CHAIN"](#).
2. If necessary, remove camshaft position sensor (PHASE) (RH and LH bank) from cylinder head back side.

### 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.

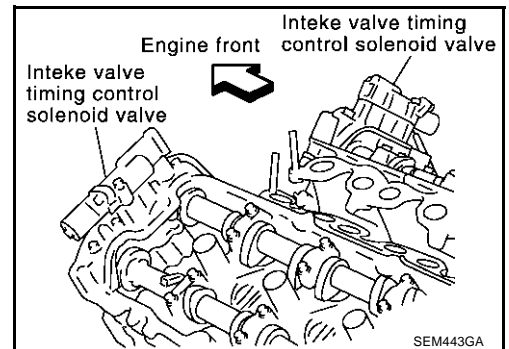
Example: Left bank

Keep off any magnetic materials.



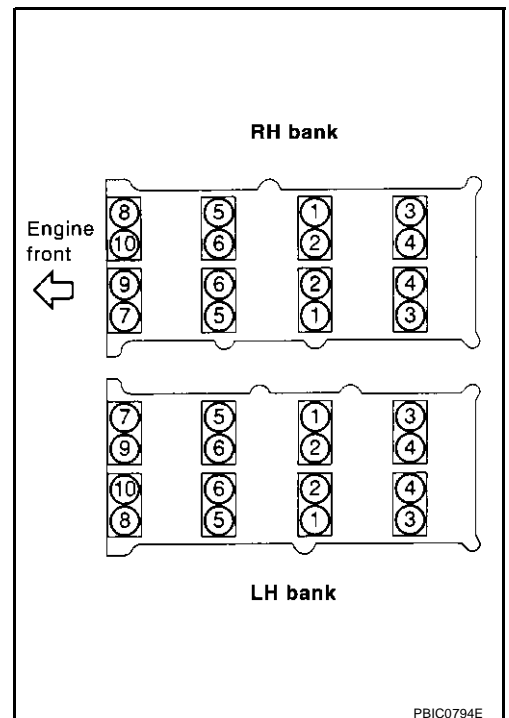
KBIA1046E

3. Remove intake valve timing control solenoid valve from No.1 camshaft bracket on both banks.



SEM443GA

4. Remove the intake and exhaust camshaft brackets.
  - Mark the camshafts, camshaft brackets, and bolts so they are placed in the same position and direction for installation.
  - Equally loosen the camshaft bracket bolts in several steps in the reverse order as shown.



PBIC0794E

5. Remove camshaft.
6. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.



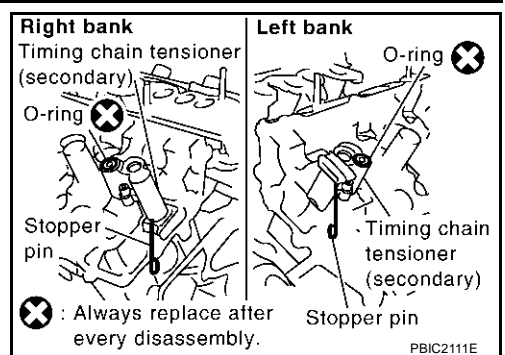
# CAMSHAFT

7. Remove secondary timing chain tensioner from cylinder head.

- Remove chain tensioner with its stopper pin attached.

**NOTE:**

Stopper pin was attached when secondary timing chain was removed.



## INSPECTION AFTER REMOVAL

### Camshaft Runout

1. Put V block on precise flat bed, and support No. 2 and No. 4 journal of camshaft.

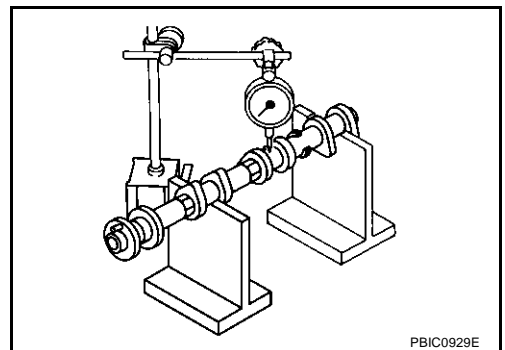
**CAUTION:**

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

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

**Limit : 0.05 mm (0.0020 in)**

4. If it exceed the limit, replace camshaft.



### Camshaft Cam Height

1. Measure camshaft cam height.

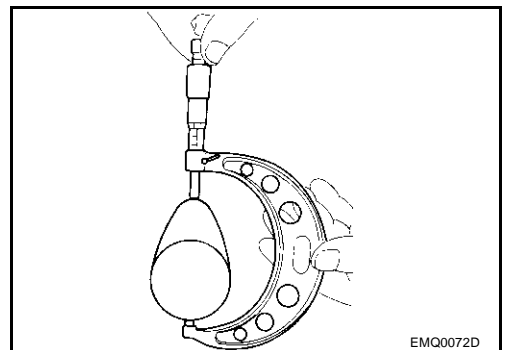
**Standard cam height (intake and exhaust)**

**: 44.865 - 45.055 mm (1.7663 - 1.7738 in)**

**Cam wear limit**

**: 0.2 mm (0.008 in)**

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



### Camshaft Journal Clearance

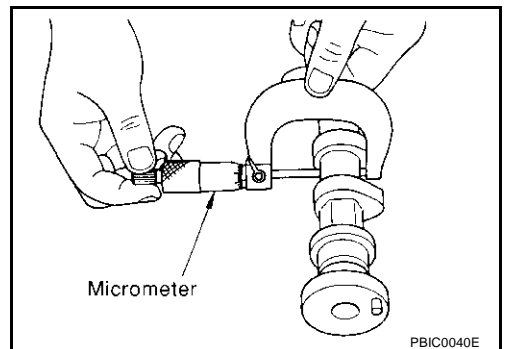
#### Outer Diameter of Camshaft Journal

- Measure outer diameter of camshaft journal.

**Standard outer diameter:**

**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

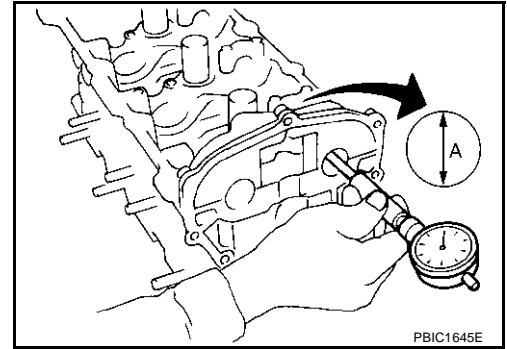
## Inner Diameter of Camshaft Bracket

- Tighten camshaft bracket bolt with specified torque.
- Using inside micrometer, measure inner diameter "A" of camshaft bracket.

### Standard inner diameter:

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)



## Calculation of Camshaft Journal Clearance

(Journal clearance) = (inner diameter of camshaft bracket) – (outer diameter of camshaft journal).

### 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)

- When out of the limit, replace either or both camshaft and cylinder head.

### NOTE:

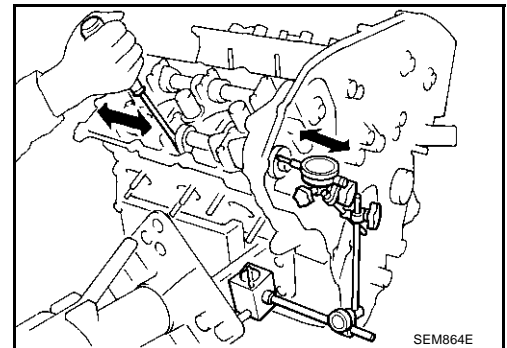
Inner diameter of camshaft bracket is manufactured together with cylinder head. Replace the whole cylinder head assembly.

## Camshaft End Play

- Install dial gauge in thrust direction on front end of camshaft. Measure end play of dial gauge 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.

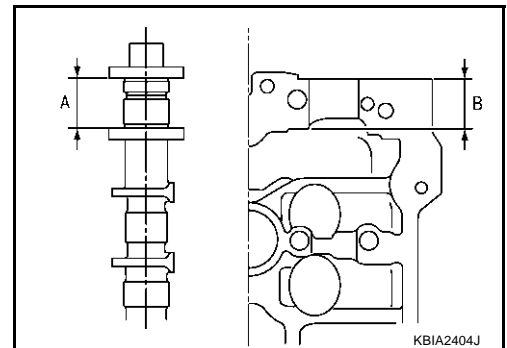
- Dimension "A" for camshaft No. 1 journal

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

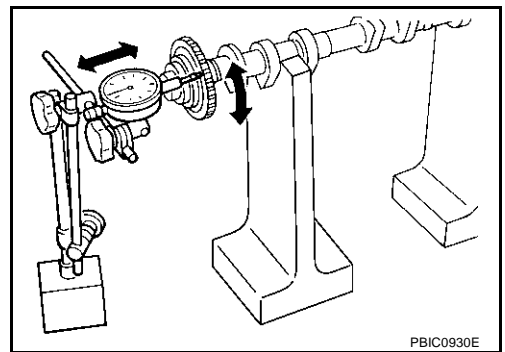
- Put V block on precise flat bed, and support No.2 and No.4 journal of camshaft.

### CAUTION:

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

# CAMSHAFT

- Using dial gauge and measure camshaft sprocket runout. (Total indicator reading)  
**limit : 0.15 mm (0.0059 in)**
- If it exceeds the limit, replace camshaft sprocket.

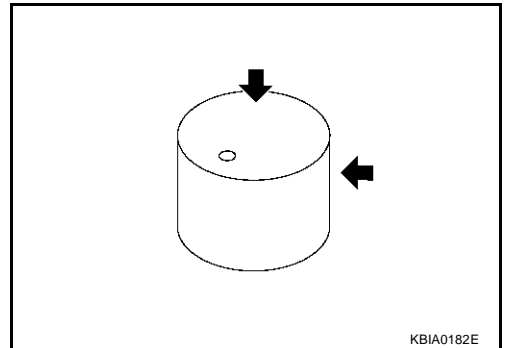


A  
EM  
C

## Valve Lifter

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

- If anything above is found, replace valve lifter.



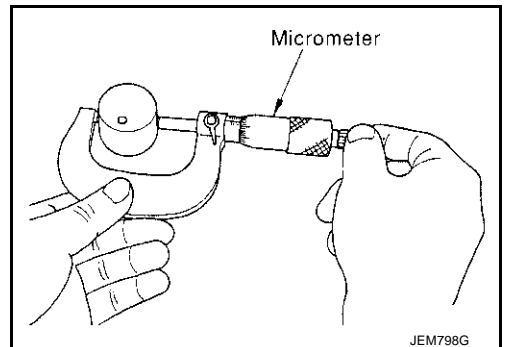
D  
E  
F  
G

## Valve Lifter Clearance

### Outer Diameter of Valve Lifter

- Since valve lifter is in barrel shape, measure outer diameter at 1/2 height of valve lifter.

**Valve lifter outer diameter (Intake and exhaust)**  
**: 33.977 - 33.987mm (1.3377 - 1.3381 in)**



H  
I  
J  
K

### Valve Lifter Hole Diameter

- Using inside micrometer, measure diameter of valve lifter hole of cylinder head.

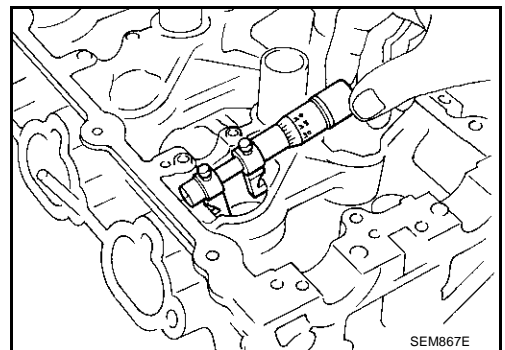
**Standard (Intake and exhaust)**  
**: 34.000 - 34.016 mm (1.3386 - 1.3392 in)**

### Calculation of Valve Lifter Clearance

(Valve lifter clearance) = (hole diameter of valve lifter) – (outer diameter of valve lifter).

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

- When out of specified range, referring to each specification of outer and inner diameter, replace either or both valve lifter and cylinder head.



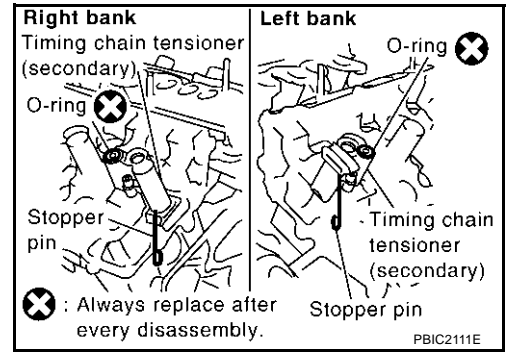
L  
M

# CAMSHAFT

## INSTALLATION

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

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

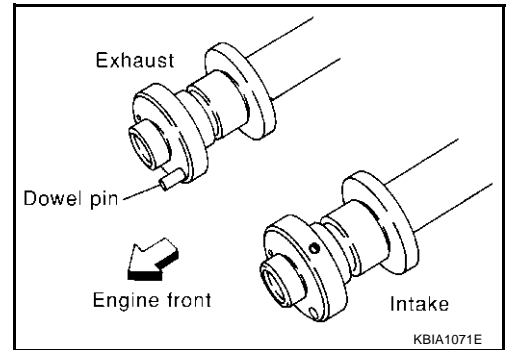


2. Install valve lifter.

- Install it in the original position.

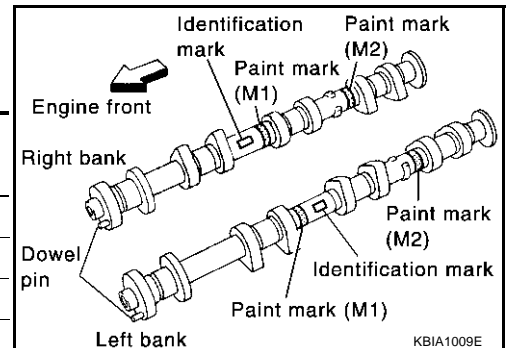
3. Install camshafts.

- 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 the new camshafts for proper placement and direction.

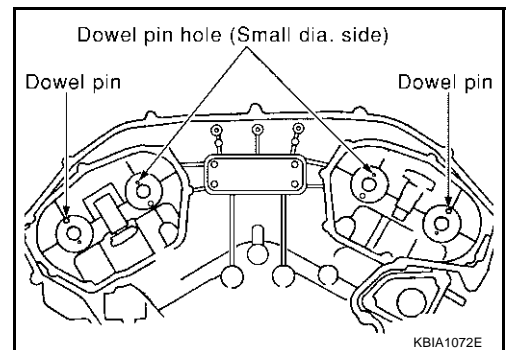
Bank	INT/EXH	Dowel pin	Paint marks		Identification mark
			M1	M2	
RH	INT	No	Pink	No	RE
	EXH	Yes	No	Orange	RE
LH	INT	No	Pink	No	LH
	EXH	Yes	No	Orange	LH



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

### NOTE:

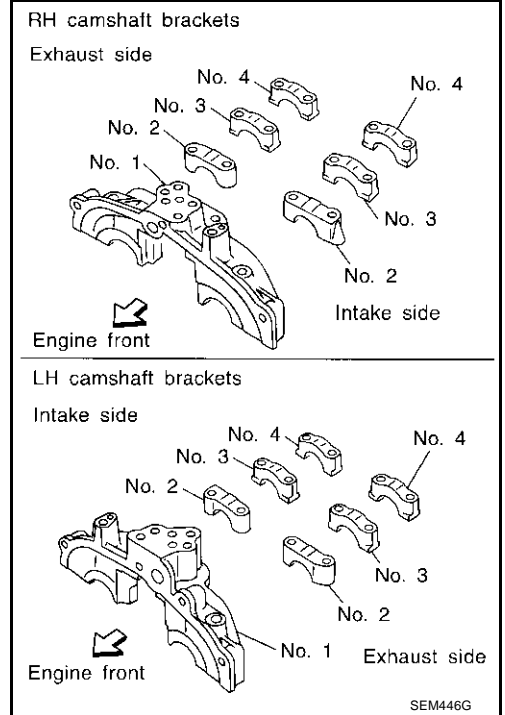
Large- and small-pin holes are located on front end face of intake camshaft, at intervals of 180°. Face small dia. side pin hole upward (in cylinder head upper face direction).



# CAMSHAFT

## 4. Install camshaft brackets.

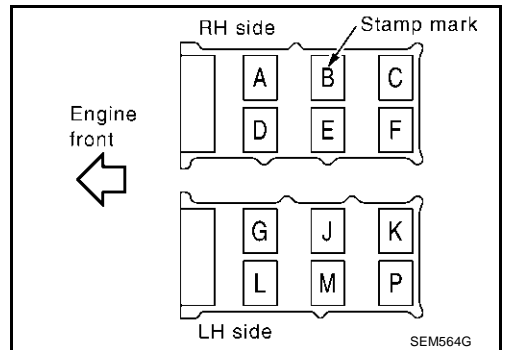
- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Install camshaft bracket in original position and direction as shown in figure.



- Install No.2 to 4 camshaft brackets aligning the stamp marks as shown.

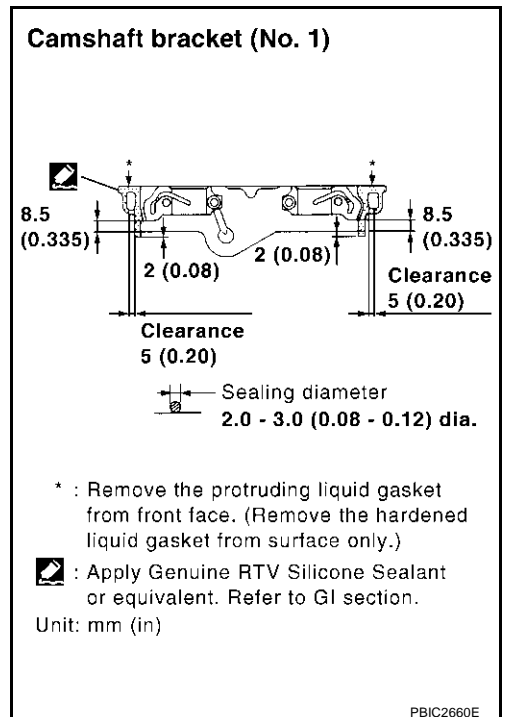
### NOTE:

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



- 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"](#).**



# CAMSHAFT


5. Tighten the camshaft brackets in the following steps, in numerical order as shown.
  - a. Tighten No. 7 to 10, then tighten No.1 to 6 in order as shown.

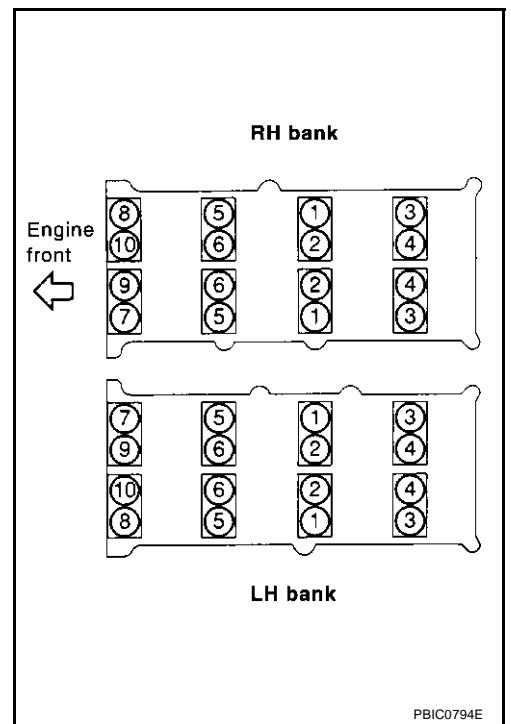
 : 1.96 N·m (0.2 kg·m, 17 in·lb)

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

 : 5.88 N·m (0.6 kg·m, 52 in·lb)

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

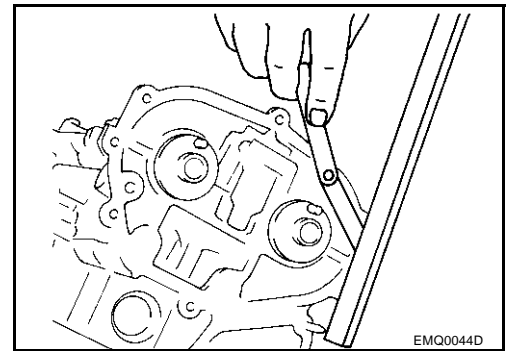
 : 9.02 - 11.8 N·m (0.92 - 1.20 kg·m, 80 - 104 in·lb)



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

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

- If measurement is outside the specified range, re-install camshaft and camshaft bracket.

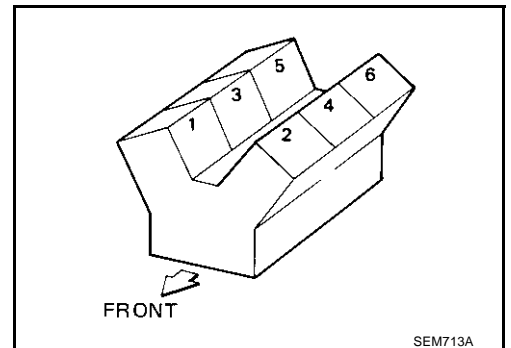


7. Inspect and adjust valve clearance. Refer to [EM-78, "Valve Clearance"](#).
8. Install in the reverse order of removal after this step.

## Valve Clearance INSPECTION

ABS0002M

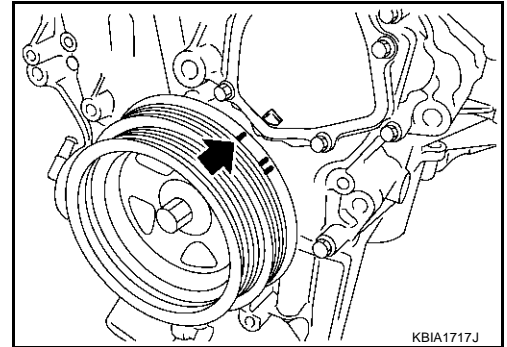
- Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.



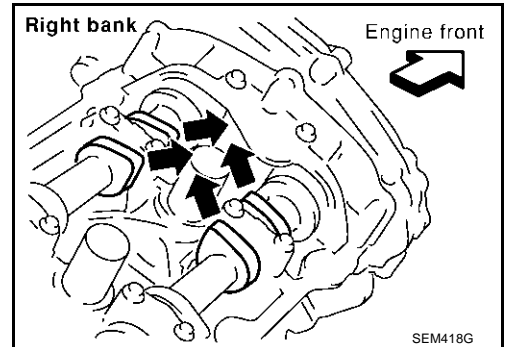
1. Remove RH and LH rocker covers with power tool. Refer to [EM-43, "ROCKER COVER"](#).
2. Measure valve clearance as below:

# CAMSHAFT

- a. Set No.1 cylinder at TDC of its compression stroke.
- Align crankshaft pulley timing mark (grooved line without color) with timing indicator.



- Check that No. 1 cylinder intake and exhaust cam nose is facing in direction shown in figure.
- If not, rotate crankshaft pulley 360° clockwise (when viewed from front).

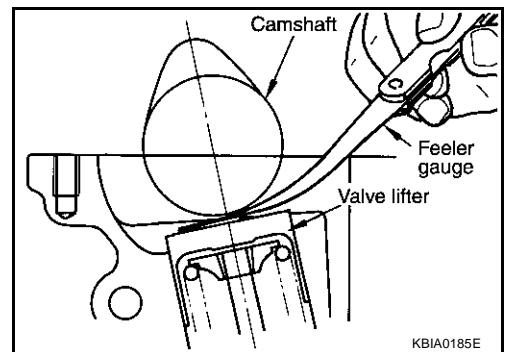
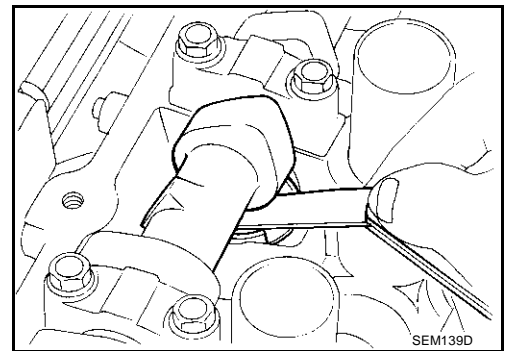


- b. Using a feeler gauge, measure valve clearance.

**Valve clearance standard:**

<b>Cold</b>	<b>Intake</b>	<b>: 0.26 - 0.34 mm (0.010 - 0.013 in)</b>
	<b>Exhaust</b>	<b>: 0.29 - 0.37 mm (0.011 - 0.015 in)</b>
<b>Hot*</b>	<b>Intake</b>	<b>: 0.304 - 0.416 mm (0.012 - 0.016 in)</b>
	<b>Exhaust</b>	<b>: 0.308 - 0.432 mm (0.012 - 0.016 in)</b>

\*: Approximately 80°C (176°F) (Reference data)



A  
EM  
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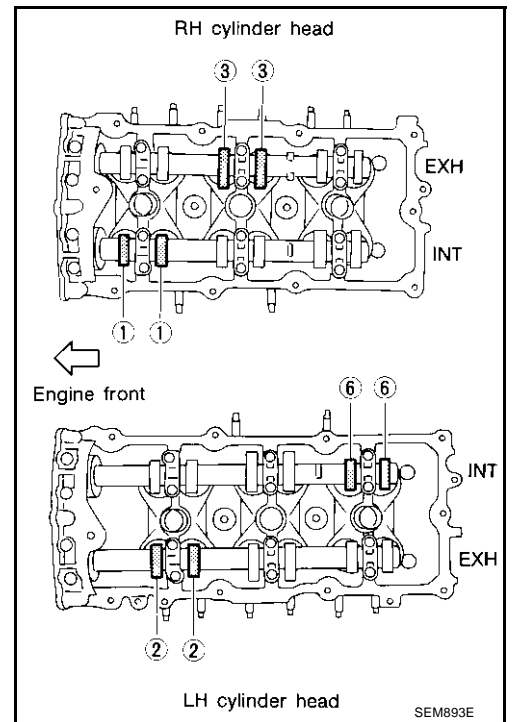
# CAMSHAFT

● No.1 cylinder at compression TDC

Measuring position (RH bank)		No.1 CYL.	No.3 CYL.	No.5 CYL.
No.1 cylinder at TDC	EXH		×	
	INT	×		
Measuring position (LH bank)		No.2 CYL.	No.4 CYL.	No.6 CYL.
No.1 cylinder at TDC	INT			×
	EXH	×		

**CAUTION:**

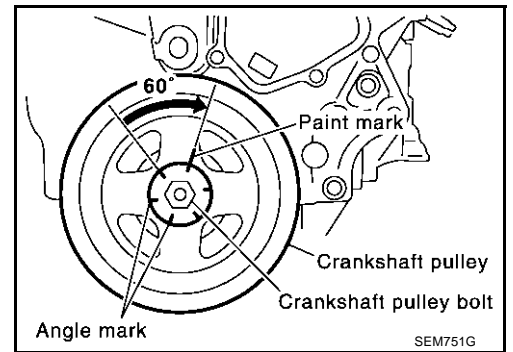
If inspection was carried out with cold engine, check that values with fully warmed up engine are still within specifications.



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

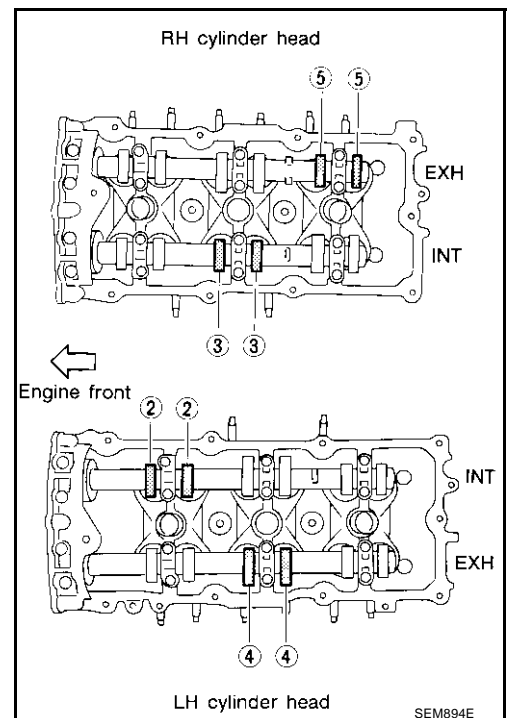
**NOTE:**

Crankshaft pulley mounting bolt flange has a stamped line every 60°. They can be used as a guide to rotation angle.



● No.3 cylinder at compression TDC

Measuring position (RH bank)		No.1 CYL.	No.3 CYL.	No.5 CYL.
No.3 cylinder at TDC	EXH			×
	INT		×	
Measuring position (LH bank)		No.2 CYL.	No.4 CYL.	No.6 CYL.
No.3 cylinder at TDC	INT	×		
	EXH		×	



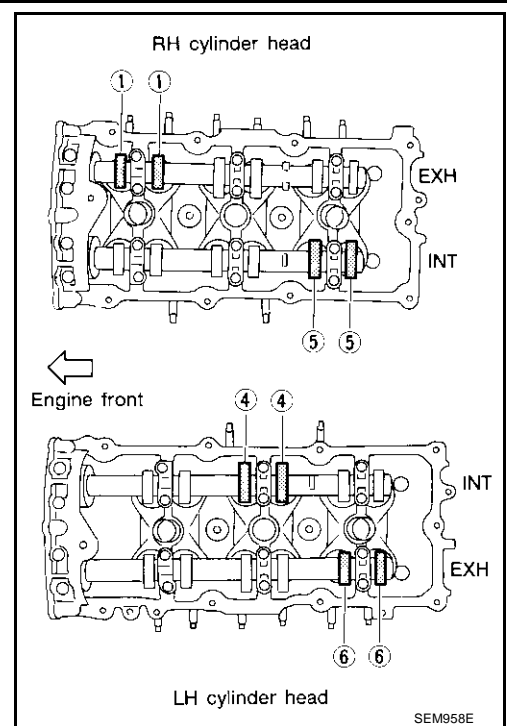


# CAMSHAFT

- d. Turn crankshaft pulley clockwise by 240° from the position of No. 5 cylinder at compression TDC.

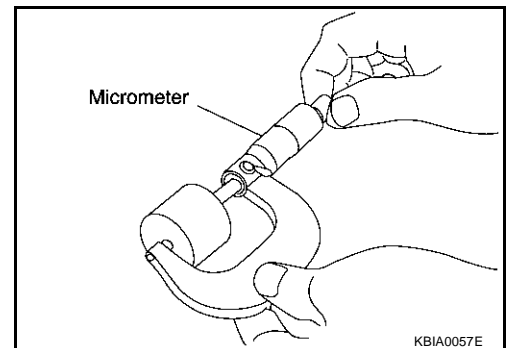
Measuring position (RH bank)		No.1 CYL.	No.3 CYL.	No.5 CYL.
No.5 cylinder at TDC	EXH	×		
	INT			×
Measuring position (LH bank)		No.2 CYL.	No.4 CYL.	No.6 CYL.
No.5 cylinder at TDC	INT		×	
	EXH			×

3. For measurements that are outside the specified range, perform adjustment. Refer to [EM-81, "ADJUSTMENT"](#).



## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
  - The specified valve lifter thickness is the dimension at cold engine condition. Ignore dimensional differences caused by temperature. Use the specifications for hot engine condition to adjust.
1. Remove camshaft. Refer to [EM-72, "REMOVAL"](#).
  2. Remove the valve lifters at the locations that are outside the standard.
  3. Measure the center thickness of the removed valve lifters with a micrometer.



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

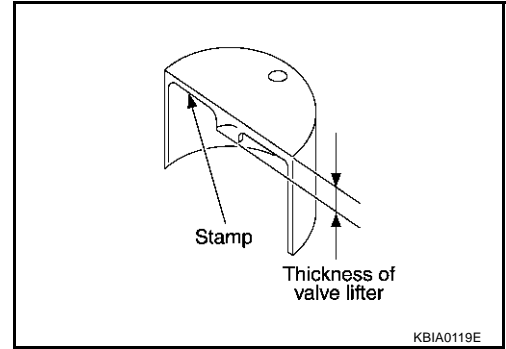
\*: Approximately 20°C (68°F)

# CAMSHAFT

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

**NOTE:**

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



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-136, "Available Valve Lifter"](#) .

6. Install the selected valve lifter.
7. Install camshaft. Refer to [EM-76, "INSTALLATION"](#) .
8. Manually turn crankshaft pulley a few turns.
9. Check that valve clearances for cold engine are within specifications by referring to the specified values.
10. After completing the repair, check valve clearances again with the specifications for warmed engine. Make sure the values are within specifications.

**Valve clearance:**

Unit: mm (in)

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

\*: Approximately 80°C (176°F)

# OIL SEAL

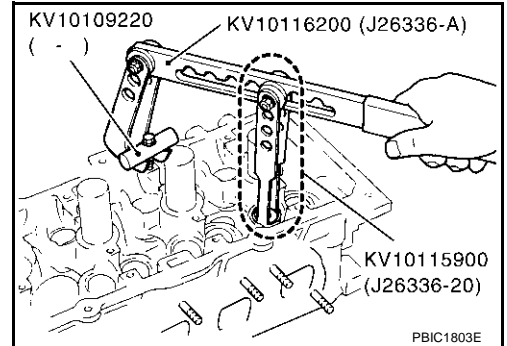
## OIL SEAL

PF0:00100

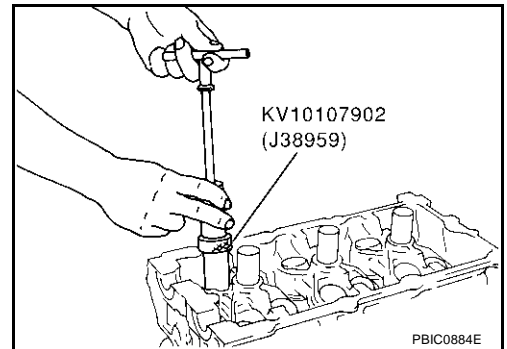
### Removal and Installation of Valve Oil Seal REMOVAL

ABS0002E

1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-71, "CAMSHAFT"](#) .
2. Remove valve lifters. Refer to [EM-71, "CAMSHAFT"](#) .
3. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent the valve from dropping into the cylinder.
4. Using valve spring compressor (special service tool), remove valve collet. Then remove valve spring and valve spring seat.



5. Remove valve oil seal using valve oil seal puller (special service tool).



### INSTALLATION

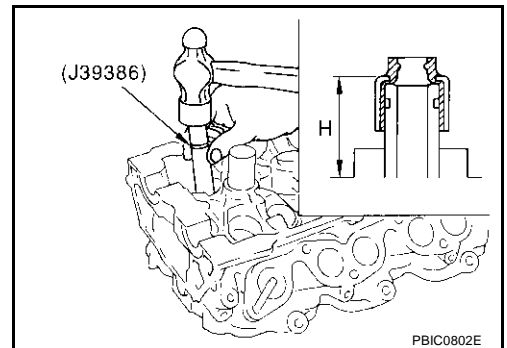
1. Apply engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift (special service tool), press fit valve seal to height "H" shown in figure.

#### NOTE:

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

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

3. Perform steps in the reverse order of removal for the following operations.



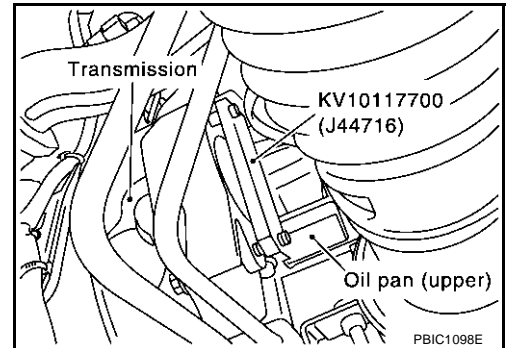
# OIL SEAL

ABS000JQ

## Removal and Installation of Front Oil Seal

### REMOVAL

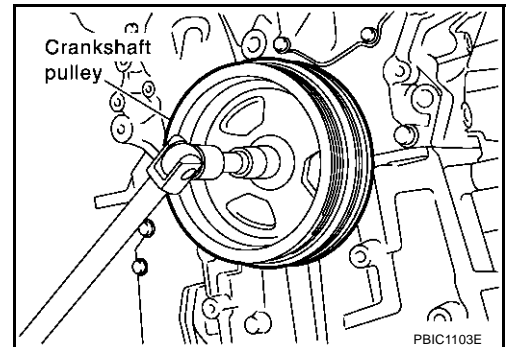
1. Remove the following parts:
  - Undercover
  - Drive belt; Refer to [EM-13, "DRIVE BELTS"](#) .
  - Radiator lower shroud; Refer to [CO-14, "RADIATOR"](#) (A/T models).
  - Cooling fan; Refer to [CO-22, "Removal and Installation \(Crankshaft Driven Type\) \(A/T Models\)"](#) (A/T models).
  - Radiator cooling fan assembly; Refer to [CO-24, "Removal and Installation \(Motor Driven\) \(M/T Models\)"](#) (M/T models).
  - Starter motor; Refer to [SC-19, "Removal and Installation"](#) .
2. Remove crankshaft pulley as follows:
  - a. Set ring gear stopper (special service tool).



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

**CAUTION:**

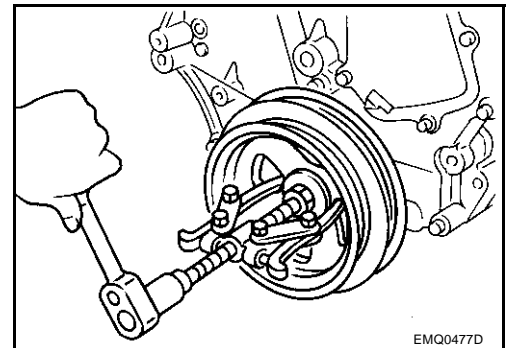
**Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.**



- c. Position a puller (commercial service tool) at recess hole of crankshaft pulley to remove crankshaft pulley.

**CAUTION:**

**Do not use puller claw on crankshaft pulley periphery.**

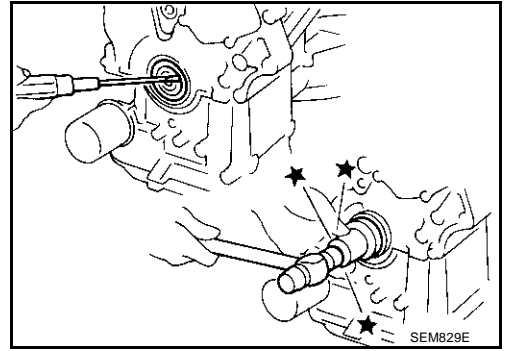


# OIL SEAL

3. Remove front oil seal using a suitable tool.

**CAUTION:**

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

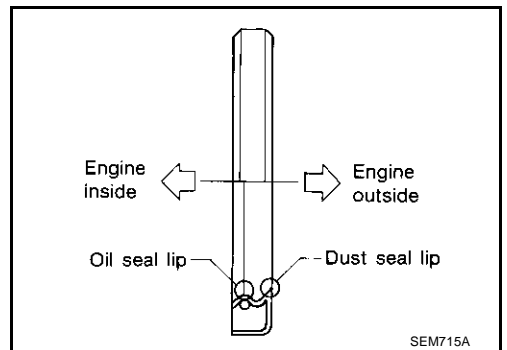


## INSTALLATION

1. Apply engine oil on new front oil seal.
2. Using a suitable drift, press fit until the height of front oil seal is level with the mounting surface.
  - Suitable drift : outer diameter 59 mm (2.32 in), inner diameter 49 mm (1.93 in).
  - Install front oil seal so that each seal lip is oriented as shown in the figure.

**CAUTION:**

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



3. Perform steps in the reverse order of removal for the following operations.

## Removal and Installation of Rear Oil Seal

ABS000JR

### REMOVAL

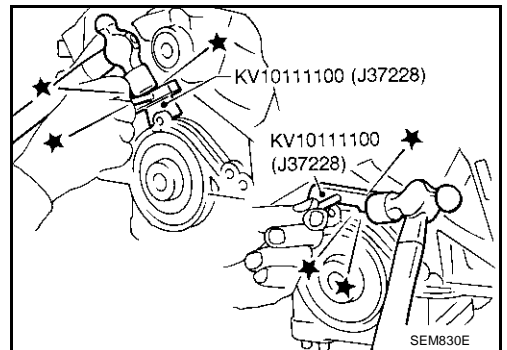
1. Remove oil pan (upper). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).
2. Remove transmission assembly. Refer to [AT-329, "Removal and Installation"](#) (A/T models) or [MT-19, "Removal and Installation from Vehicle"](#) (M/T models).
3. Use a seal cutter (special service tool) to cut away liquid gasket and remove rear oil seal retainer.

**CAUTION:**

Be careful not to damage mounting surface.

**NOTE:**

Regard rear oil seal and retainer as an assembly.



## INSTALLATION

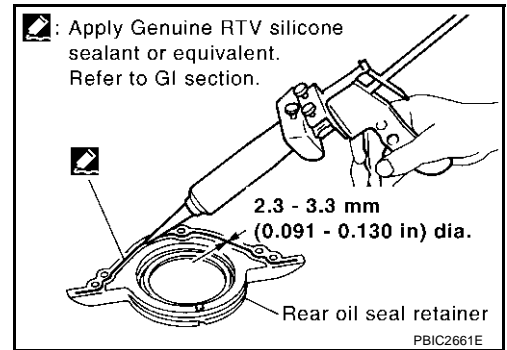
1. Remove old liquid gasket on mating surface of cylinder block and oil pan using scraper.

## OIL SEAL

2. Apply a continuous bead of liquid gasket with tube presser [special service tool: 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.



3. Install rear oil seal retainer to cylinder block. Refer to [EM-103, "CYLINDER BLOCK"](#) .
4. Perform steps in the reverse order of removal for the following operations.

# CYLINDER HEAD

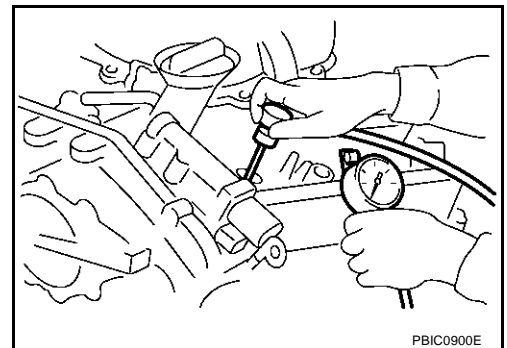
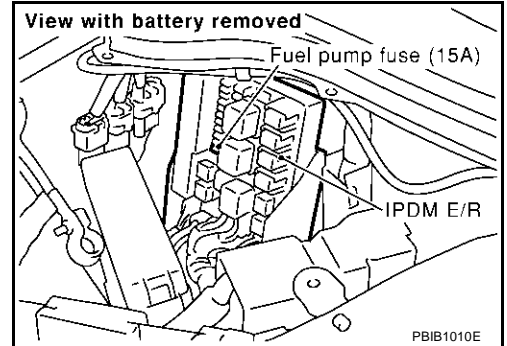
## CYLINDER HEAD

PFP:11041

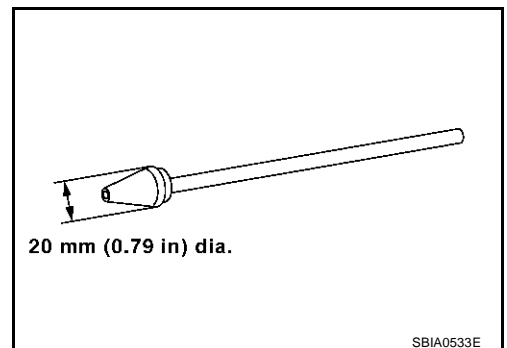
### On-Vehicle Service CHECKING COMPRESSION PRESSURE

ABS0000R

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-53, "FUEL PRESSURE RELEASE"](#) (TYPE 1) or [EC-694, "FUEL PRESSURE RELEASE"](#) (TYPE 2).
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.
4. Remove engine cover with power tool. Refer to [EM-18, "Removal and Installation"](#).
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-34, "IGNITION COIL"](#) and [EM-35, "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 compression gauge 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.



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.**

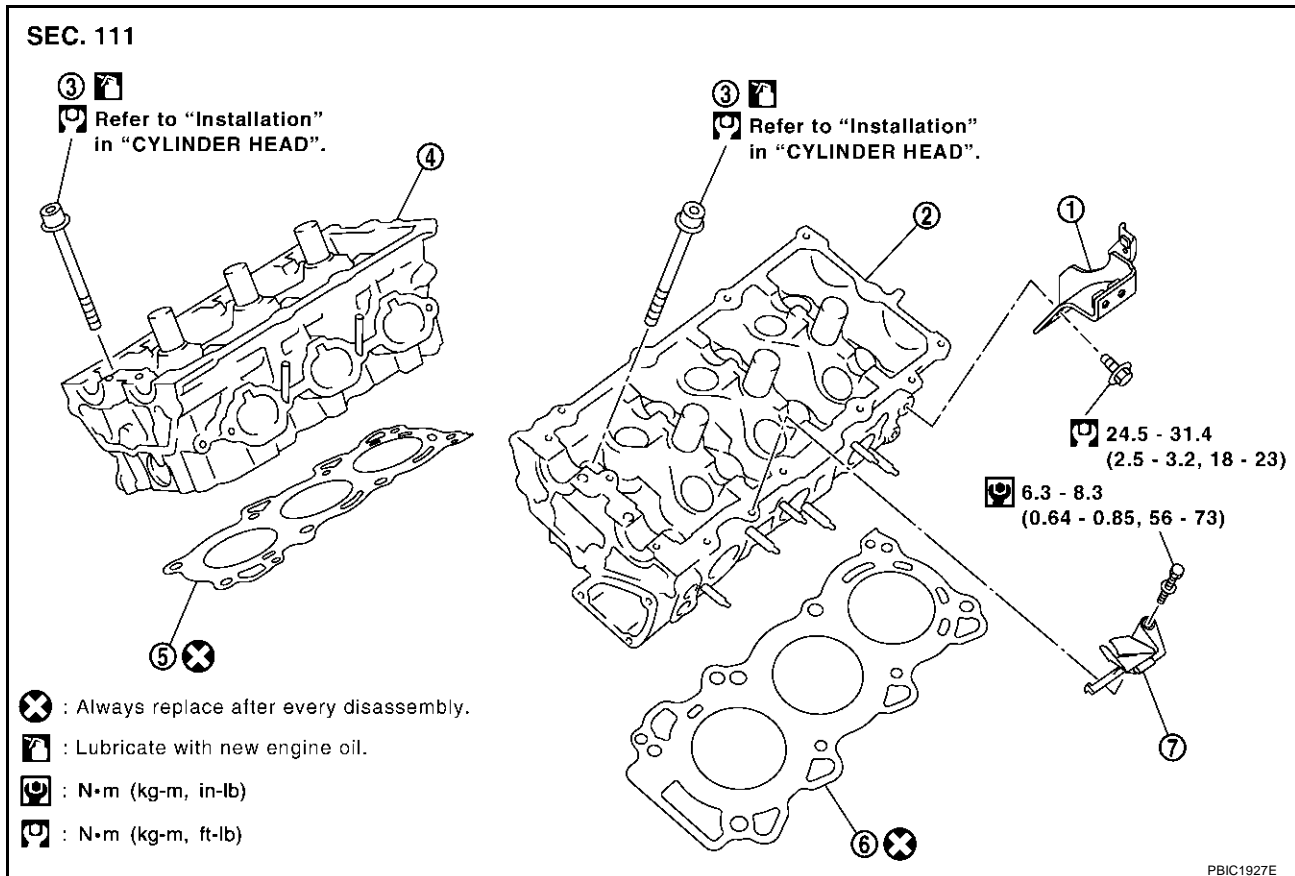
- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
  - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, 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, the 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, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.
9. After inspection is completed, install removed parts.

# CYLINDER HEAD

10. Start engine, and confirm that engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-80, "TROUBLE DIAGNOSIS"](#) (TYPE 1) or [EC-721, "TROUBLE DIAGNOSIS"](#) (TYPE 2).

## Removal and Installation

ABS0000S



1. Engine rear lower slinger
2. Cylinder head (LH bank)
3. Cylinder head bolt
4. Cylinder head (RH bank)
5. Cylinder head gasket (RH bank)
6. Cylinder head gasket (LH bank)
7. Oil level gauge guide

## REMOVAL

1. Remove camshaft. Refer to [EM-71, "CAMSHAFT"](#).

### NOTE:

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

2. Temporarily fit the front suspension member to support the engine. Refer to [FSU-14, "FRONT SUSPENSION MEMBER"](#).

### CAUTION:

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

### NOTE:

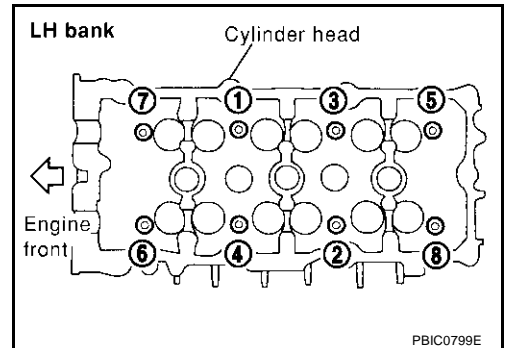
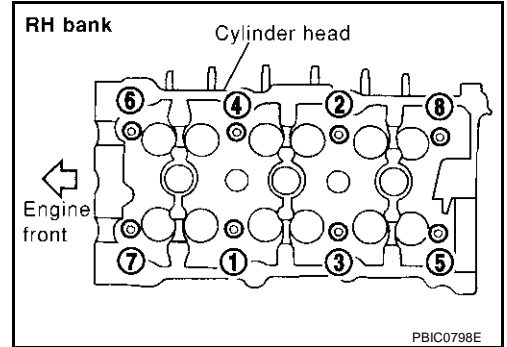
At the time of the start of this procedure the front suspension member is removed, and cylinder head is hanged by the hoist with engine slinger installed.

3. Release the hoist from hanging, then remove the engine slinger.
4. Remove the following components and related parts:
  - Fuel tube and fuel injector assembly. Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#).
  - Intake manifold. Refer to [EM-22, "INTAKE MANIFOLD"](#).
  - Exhaust manifold. Refer to [EM-24, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
  - Water inlet and thermostat housing. Refer to [CO-30, "THERMOSTAT AND THERMOSTAT HOUSING"](#).
  - Water outlet and water piping. Refer to [CO-32, "WATER OUTLET AND WATER PIPING"](#).



# CYLINDER HEAD

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



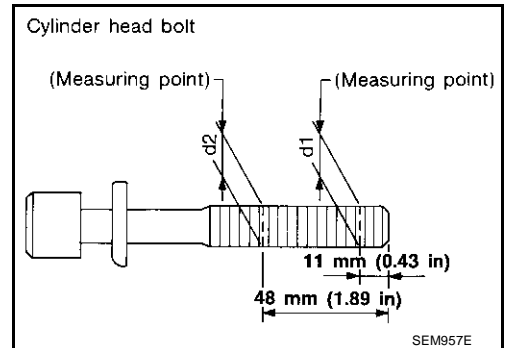
## INSPECTION AFTER REMOVAL

### Outer Diameter of Cylinder Head Bolts

- 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 Distortion

#### NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to [EM-126, "CYLINDER BLOCK DISTORTION"](#).

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

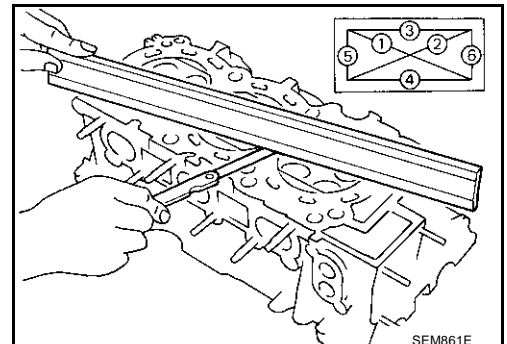
#### CAUTION:

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

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

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

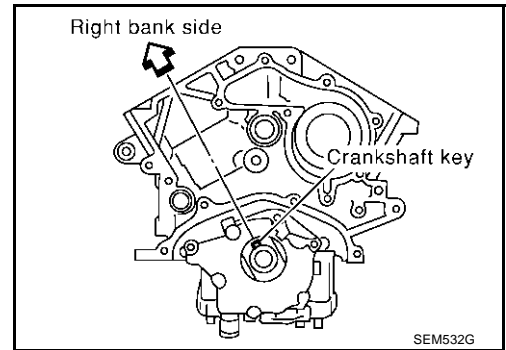
- If it exceeds the limit, replace cylinder head.



# CYLINDER HEAD

## INSTALLATION

1. Install cylinder head gasket.
2. Turn the crankshaft until No. 1 piston is set at TDC.
  - The crankshaft key should line up with the right bank cylinder center line as shown.

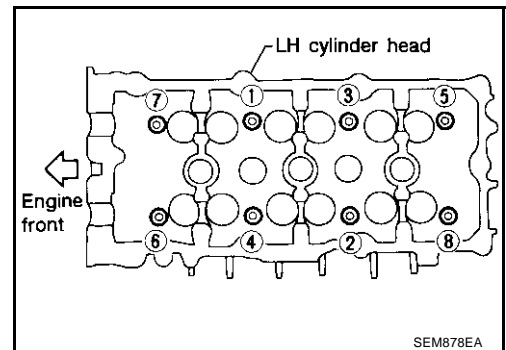
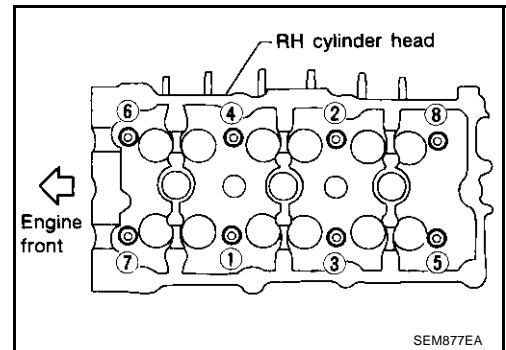


3. Install cylinder head follow the steps below to tighten cylinder head bolts in the order shown in figure.
  - a. Tighten all bolts to 98.1 N·m (10 kg-m, 72 ft-lb).
  - b. Completely loosen to 0 N·m (0 kg-m, 0 ft-lb).

**CAUTION:**

**In step “b”, loosen bolts in the reverse order of that indicated in figure.**

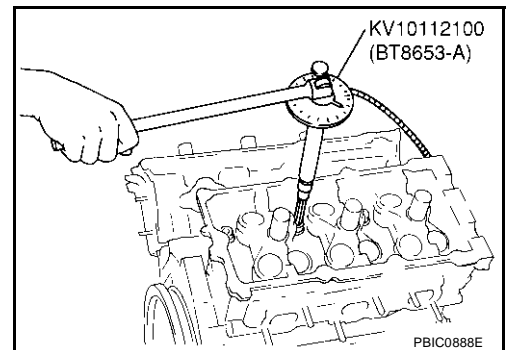
- c. Tighten all bolts to 34.3 to 44.1 N·m (3.5 to 4.4 kg-m, 26 to 32 ft-lb).
- d. Turn all bolts 90 to 95 degrees clockwise [target: 90 degrees (angle tightening)].
- e. Turn all bolts 90 to 95 degrees clockwise again [target: 90 degrees (angle tightening)].



**CAUTION:**

**Check and confirm the tightening angle by using angle wrench (special service tool). Avoid judgment by visual inspection without the tool.**

- Check tightening angle indicated on the angle wrench (special service tool) indicator plate.

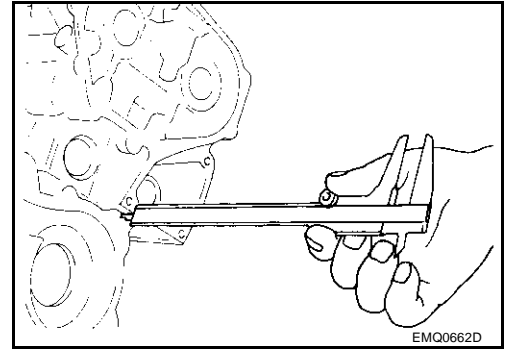


# CYLINDER HEAD

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)**

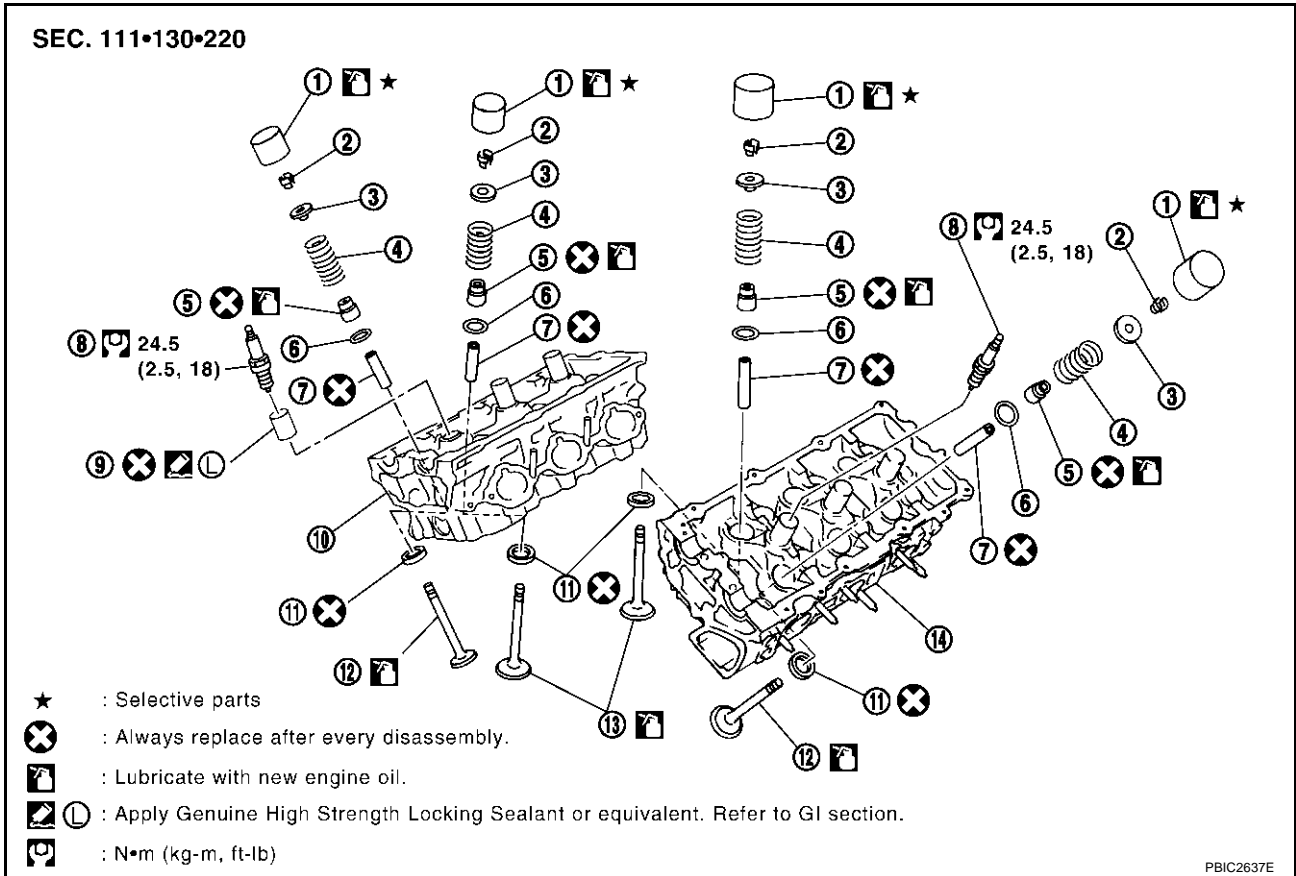
- If measurement is outside the specified range, re-install cylinder head.



5. Perform steps in reverse order of removal for the following operations.

## Disassembly and Assembly

ABS0000T



- |                             |                             |                          |
|-----------------------------|-----------------------------|--------------------------|
| 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 (RH bank) | 11. Valve seat              | 12. Valve (EXH)          |
| 13. Valve (INT)             | 14. Cylinder head (LH bank) |                          |

### DISASSEMBLY

1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove valve lifter.
  - Mark position on valve lifter for assembly.

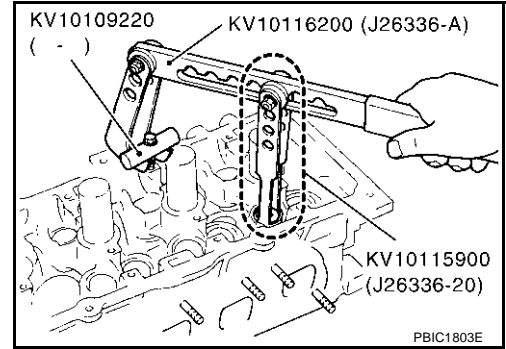
# CYLINDER HEAD

## 3. Remove valve collet.

- Compress valve spring with valve spring compressor (special service tool). Remove valve collet with magnet hand.

### CAUTION:

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



## 4. Remove valve spring retainer and valve spring.

## 5. Push valve stem to combustion chamber side, and remove valve.

- Mark position on valve for assembly.

## 6. Remove valve oil seals using valve oil seal puller (special service tool).

## 7. Remove valve spring seat.

## 8. If valve seat must be replaced, refer to [EM-95, "VALVE SEAT REPLACEMENT"](#).

## 9. If valve guide must be replaced, refer to [EM-93, "VALVE GUIDE REPLACEMENT"](#).

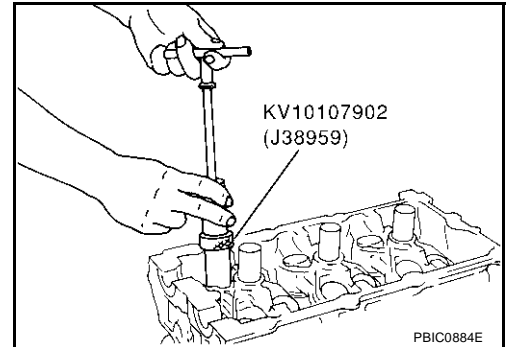
## 10. Remove spark plug tube, as necessary.

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

### CAUTION:

- Take care not to damage cylinder head.

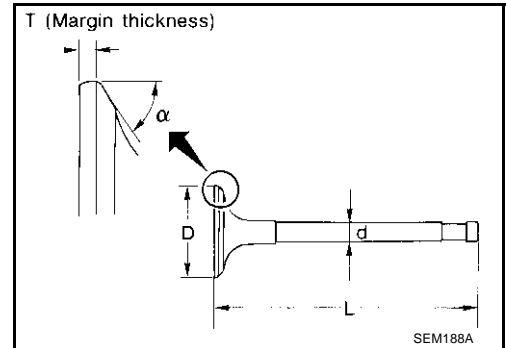
- Once removed, a spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.



## Inspection After Disassembly VALVE DIMENSIONS

ABS0002N

- Check dimensions of each valve. For dimensions, refer to [EM-135, "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact after replacement. Refer to [EM-95, "VALVE SEAT CONTACT"](#).



## VALVE GUIDE CLEARANCE

Measure valve stem diameter and valve guide inner diameter to calculate the clearance.

# CYLINDER HEAD

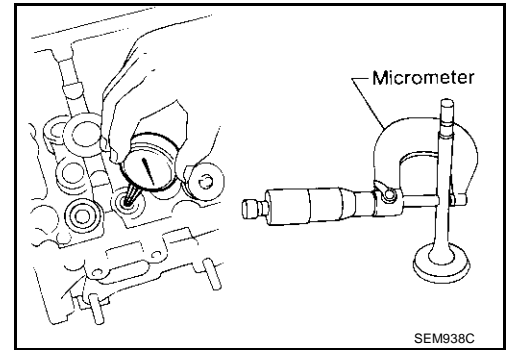
## Valve Stem Diameter

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)

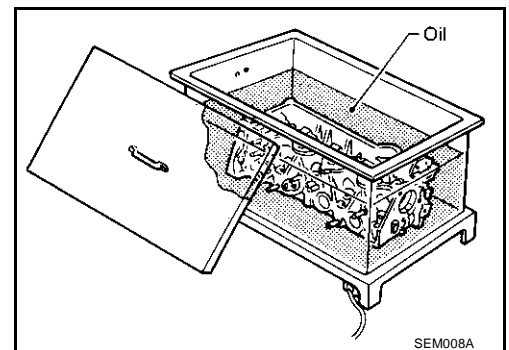
**Exhaust** : 0.09 mm (0.004 in)

- If it exceeds the limit, replace valve and/or valve guide.
- When valve guide must be replaced, refer to [EM-93, "VALVE GUIDE REPLACEMENT"](#).
- If valve replaced, check valve seat contact after replacement. Refer to [EM-95, "VALVE SEAT CONTACT"](#).

## VALVE GUIDE REPLACEMENT

When valve guide is removed, replace with oversized [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.

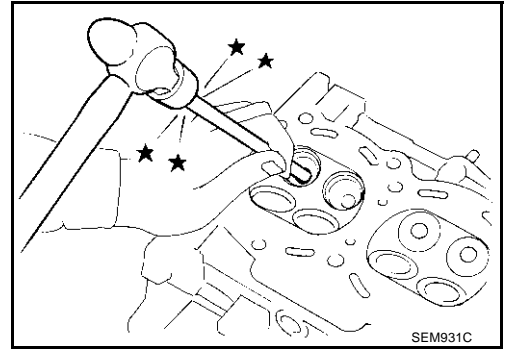


# CYLINDER HEAD

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.

**CAUTION:**

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

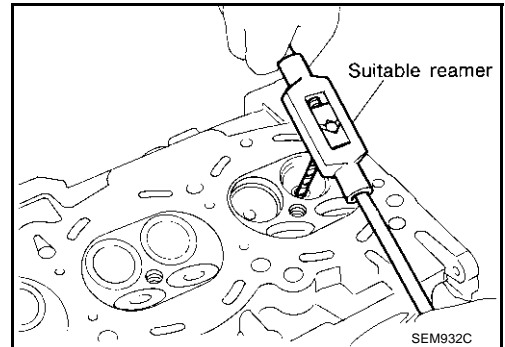


3. Using valve guide reamer (commercial service tool), ream cylinder head valve guide hole.

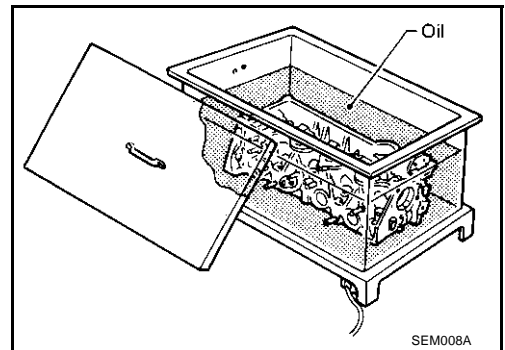
**Valve guide hole diameter (for service parts):**

**Intake and exhaust**

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



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



5. Press valve guide from camshaft side to dimensions as in illustration.

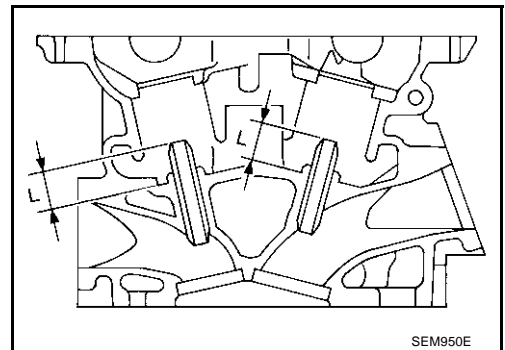
**Projection "L"**

**Intake and Exhaust**

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

**CAUTION:**

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

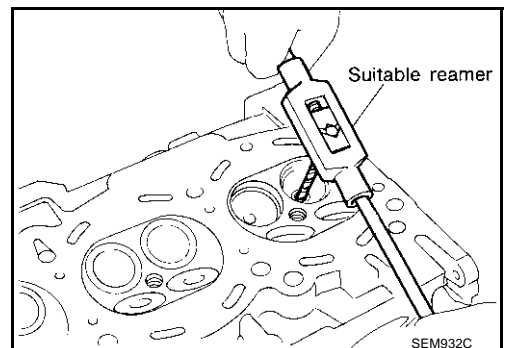


6. Using valve guide reamer (commercial service tool), apply reamer finish to valve guide.

**Standard:**

**Intake and Exhaust**

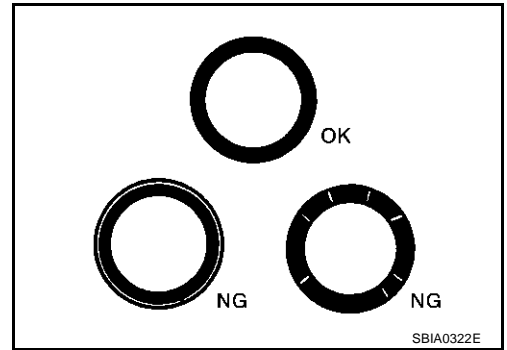
**: 6.000 - 6.018 mm (0.2362 - 0.2369 in)**



# CYLINDER HEAD

## VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within 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-95, "VALVE SEAT REPLACEMENT"](#).



## VALVE SEAT REPLACEMENT

When valve seat is removed, replace with oversized (0.5 mm, 0.020 in) valve seat.

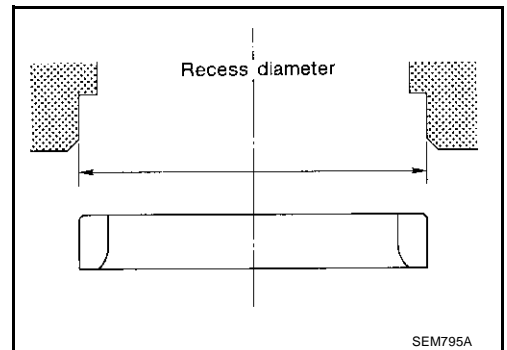
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-138, "Valve Seat"](#).
2. Ream cylinder head recess diameter for service valve seat.

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

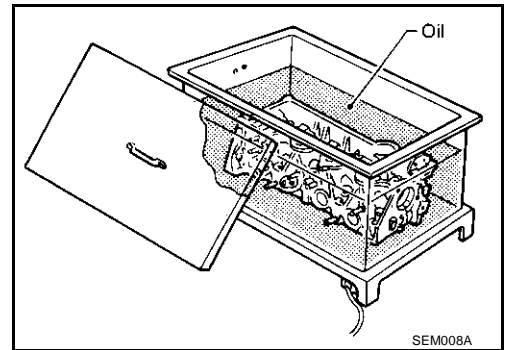
**Intake : 38.500 - 38.516 mm (1.5157 - 1.5164 in)**

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

- Be sure to ream in circles concentric to the 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.

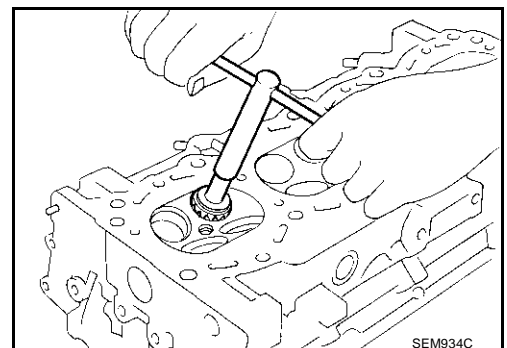
### CAUTION:

- 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 the seat to the specified dimensions.

### CAUTION:

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



# CYLINDER HEAD

Grind to obtain the dimensions indicated in figure.

## Standard :

**D1 dia. : 35 mm (1.38 in)\*<sup>1</sup>**

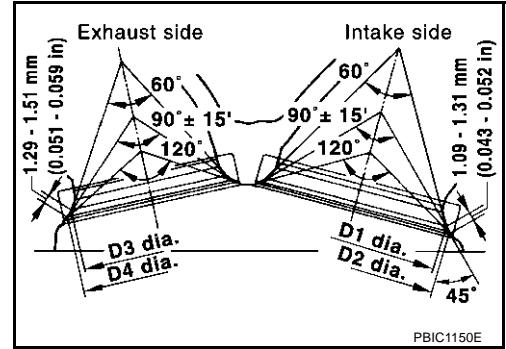
**D2 dia. : 36.6 - 36.8 mm (1.441 - 1.449 in)\*<sup>2</sup>**

**D3 dia. : 28.7 mm (1.130 in)\*<sup>1</sup>**

**D4 dia. : 30.6 - 30.8 mm (1.205 - 1.213 in)\*<sup>2</sup>**

\*1: Diameter made by crossing of conic angles 60° and 90°

\*2: Diameter made by crossing of conic angles 90° and 120°



6. Using compound, grind to adjust valve fitting.

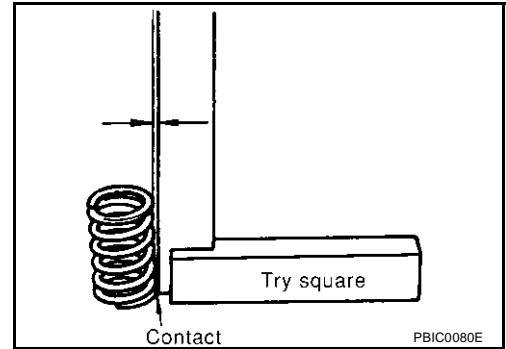
7. Check again for normal contact. Refer to [EM-95, "VALVE SEAT CONTACT"](#) .

## VALVE SPRING SQUARENESS

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

**Limit : 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:

#### Intake and exhaust

#### Free height:

**45.62 mm (1.7961 in)**

#### Installation height:

**37.00 mm (1.4567 in)**

#### Installation load:

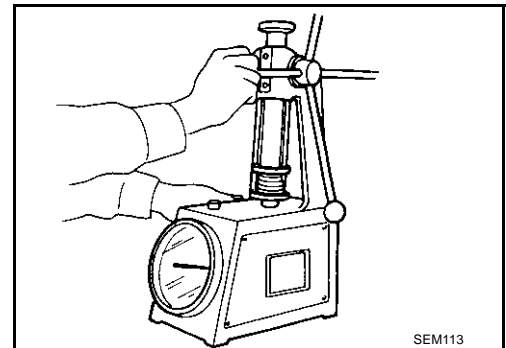
**184 - 208 N (18.8 - 21.2 kg, 41.4 - 46.8 lb)**

#### Height during valve open:

**27.80 mm (1.0945 in)**

#### Load with valve open:

**407 - 459 N (41.5 - 46.8 kg, 91.5 - 103.2 lb)**



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

## ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-93, "VALVE GUIDE REPLACEMENT"](#) .
2. When valve seat is removed, install it. Refer to [EM-95, "VALVE SEAT REPLACEMENT"](#) .

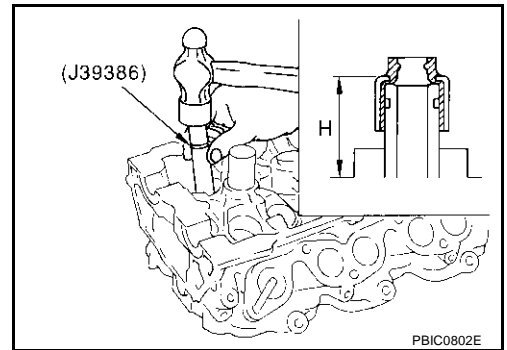


# CYLINDER HEAD

3. Install valve oil seals.
  - Install with valve oil seal drift (special service tool) to match dimension in illustration.

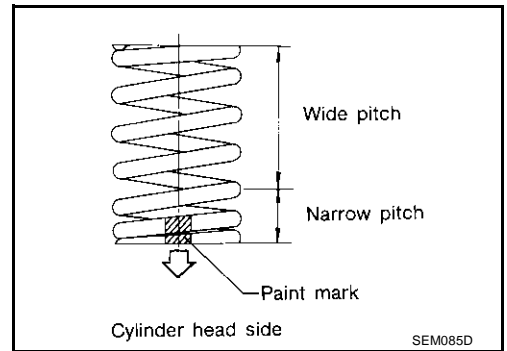
**Height "H" (Without valve spring seat installed)**  
**Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)**

4. Install valve spring seat.



5. Install the valves.
  - Larger diameter valves are for intake side.

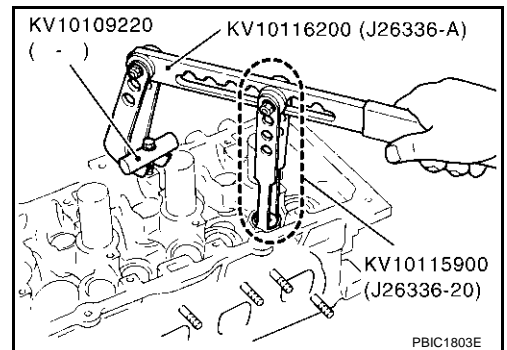
6. Install valve spring (uneven pitch type).
  - Install smaller pitch end (paint mark) to cylinder head side (valve spring seat side).
7. Install valve spring retainer.



8. Install valve collet.
  - Compress valve spring with valve spring compressor (special service tool). 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.

10. Install spark plug tube.
  - Press-fit spark plug tube following procedure below.

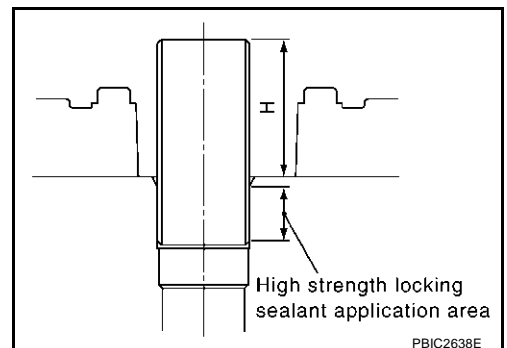
- a. Remove old liquid gasket adhering to cylinder-head mounting hole.
- b. Apply liquid gasket to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.

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

- c. Using a 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 high strength locking sealant protruding onto cylinder-head upper face.



11. Install spark plug.



# ENGINE ASSEMBLY

## REMOVAL

### Outline

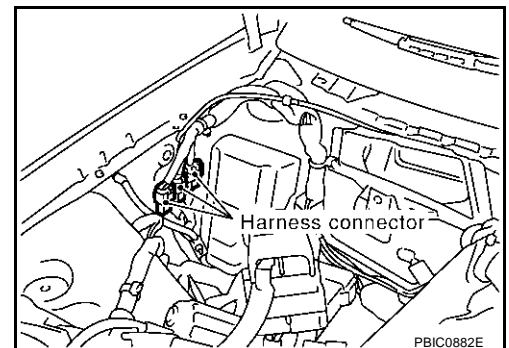
At first, remove engine and transmission assembly with suspension member downward. Then separate engine from transmission.

### Preparation

1. Release fuel pressure. Refer to [EC-53, "FUEL PRESSURE RELEASE"](#) (TYPE 1) or [EC-694, "FUEL PRESSURE RELEASE"](#) (TYPE 2).
2. Disconnect both battery cables. Refer to [SC-4, "BATTERY"](#) .
3. Remove engine hood, engine cover, battery cover, undercover and LH/RH front wheel.
4. Drain engine coolant from radiator drain plug. Refer to [CO-11, "ENGINE COOLANT"](#) .
5. Discharge refrigerant from A/C circuit. Refer to [ATC-152, "REFRIGERANT LINES"](#) .
6. Remove wiper arm and caul top cover. Refer to [EI-21, "COWL TOP"](#) .
7. Remove air duct and air cleaner case assembly. Refer to [EM-16, "AIR CLEANER AND AIR DUCT"](#) .
8. Remove cooling fan (A/T models). Refer to [CO-22, "Removal and Installation \(Crankshaft Driven Type\) \(A/T Models\)"](#) .
9. Remove radiator cooling fan assembly (M/T models). Refer to [CO-24, "Removal and Installation \(Motor Driven\) \(M/T Models\)"](#) .
10. Remove radiator shroud, radiator assembly, reservoir tank and hoses. Refer to [CO-14, "RADIATOR"](#) .

### Engine Room

1. Disconnect heater hose from engine-side, and fit a plug onto hose end to prevent engine coolant leak.
2. Disconnect grounding wire (between vehicle to LH cylinder head).
3. Disconnect battery plus harness at vehicle side and temporarily fasten it on engine.
4. Remove battery.
5. Disconnect engine-room harness connectors shown in the figure.



6. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope.
7. Disconnect two body ground cables.
8. Disconnect brake booster vacuum hose.
9. Disconnect fuel feed hose and EVAP hose. Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#) .

#### **CAUTION:**

**Fit plugs onto disconnected hoses to prevent fuel leak.**

10. Remove power steering oil pump reservoir tank and piping from vehicle, and temporarily secure them on engine.

#### **CAUTION:**

**When temporarily securing, keep them upright to avoid a fluid leak.**

### Passenger Room Side

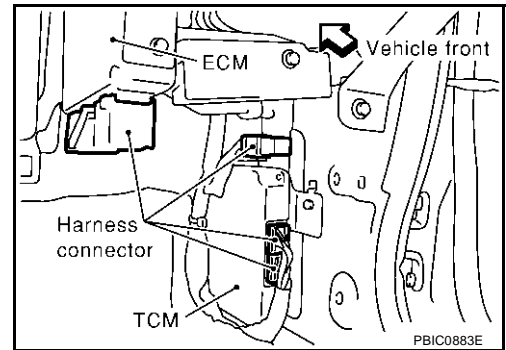
1. Follow procedure below to disconnect engine-room harness connectors at passenger room side, and temporarily secure them on engine.

# ENGINE ASSEMBLY

- a. Remove passenger-side front kick plate, dash side finisher, and glove box. Refer to [EI-39, "BODY SIDE TRIM"](#) and [IP-10, "INSTRUMENT PANEL ASSEMBLY"](#).
- b. Disconnect engine-room harness connectors at unit sides TCM (A/T models), ECM and other.
- c. 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, and release steering shaft. Refer to [PS-9, "STEERING COLUMN"](#).
3. Separate transmission and propeller shaft. Refer to [PR-4, "REAR PROPELLER SHAFT"](#).
4. Disengage shift control linkage at selector lever side. Then, temporarily secure it on transmission, so that it does not sag (A/T models). Refer to [AT-295, "SHIFT CONTROL SYSTEM"](#).
5. Disengage shift lever and clutch operating cylinder (M/T models). Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#).
6. Remove rear plate from upper oil pan. Then, remove bolts fixing drive plate to torque converter (A/T models). Refer to [AT-329, "TRANSMISSION ASSEMBLY"](#).
7. Remove bolts fixing transmission to lower rear side of upper oil pan. Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-329, "TRANSMISSION ASSEMBLY"](#) (A/T models).
8. Remove front stabilizer. Refer to [FSU-13, "STABILIZER BAR"](#).
9. Remove left and right tie rod ends from steering knuckle. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
10. Remove lower ends of left and right struts from lower arms. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
11. Remove left and right lower arms from suspension member. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).

## Removal Work

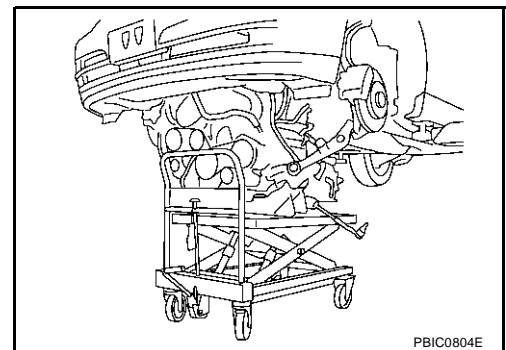
1. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of suspension member and transmission.

## CAUTION:

- Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.
2. Remove rear engine mounting member mounting bolts.
  3. Remove suspension member mounting bolts and nuts. Refer to [FSU-6, "FRONT SUSPENSION ASSEMBLY"](#).
  4. Carefully lower jack, or raise lift to remove engine, transmission, and suspension member assembly. When performing work, observe the following:

## CAUTION:

- Confirm there is no interference with vehicle.
- Check that all connection points have been disconnected.
- Keep in mind the center of vehicle gravity changes. If necessary, use jack(s) to support vehicle at rear jacking point(s) to prevent it from falling off the lift.




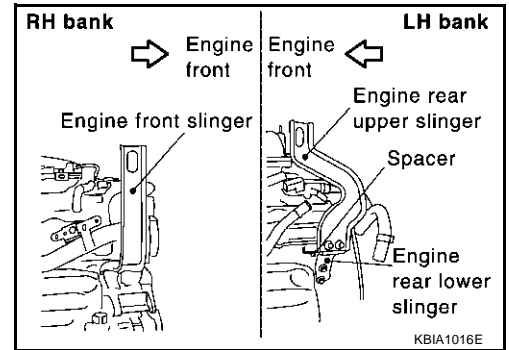
# ENGINE ASSEMBLY

## Separation Work

1. Install engine slingers into front of right bank cylinder head and rear of left bank cylinder head.

### Slinger bolts:

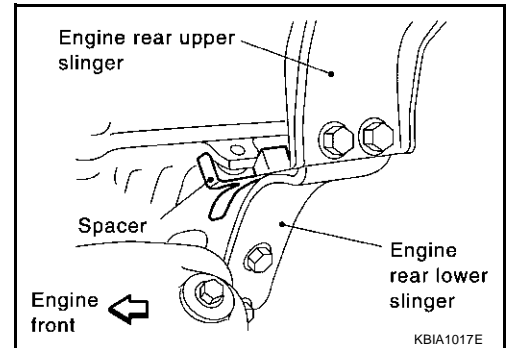
 : 24.5 - 31.4 N·m (2.5 - 3.2 kg·m, 18 - 23 ft·lb)



- 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 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-24, "POWER STEERING OIL PUMP"](#).
3. Remove engine mounting insulators under side nut.
4. Lift with hoist and separate engine and transmission assembly from suspension member.

### CAUTION:

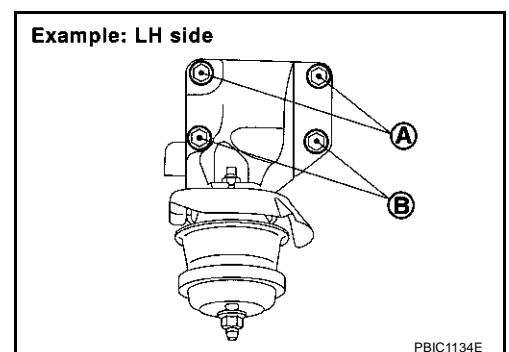
- Before and during this lifting, always check if any harnesses are left connected.
- Avoid damage to and oil/grease smearing or spills onto engine mounting insulator.

5. Remove alternator. Refer to [SC-31, "Removal and Installation"](#).
6. Remove starter motor. Refer to [SC-19, "Removal and Installation"](#).
7. Separate engine from transmission assembly. Refer to [AT-329, "TRANSMISSION ASSEMBLY"](#) (A/T models) or [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models).
8. Remove engine mounting insulator and bracket.

## INSTALLATION

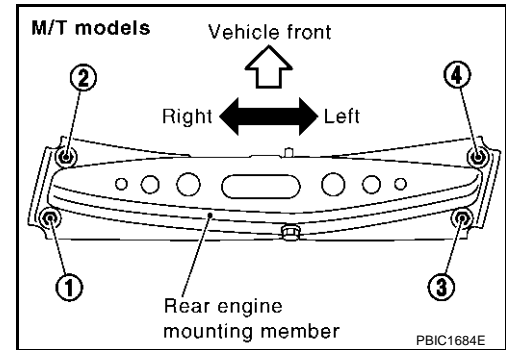
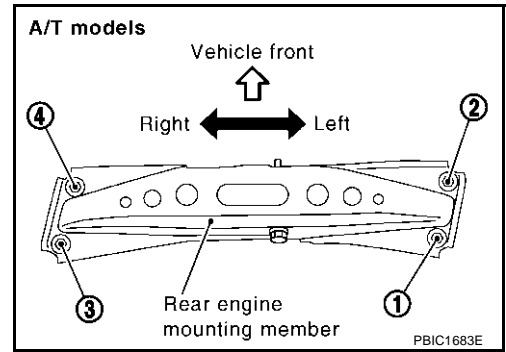
Install in the reverse order of removal paying attention to the following.

- 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-98, "Removal and Installation"](#).
- When installing front engine mounting bracket on cylinder block, tighten two upper bolts (shown as A in figure) first. Then tighten 2 lower bolts (shown as B in figure). (Left and right sides)



# ENGINE ASSEMBLY

- Tighten rear engine mounting member bolts in numerical order shown in figure.



## INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of engine coolant, engine oil and working fluid. If less than required quantity, fill to the specified level.
- 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 engine coolant, engine oil, working fluid, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines, such as in cooling system.
- After cooling down engine, again check amounts of engine coolant, engine oil and working fluid. Refill to specified level, if necessary.
- Summary of the Inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Working fluid	Level	Leakage	Level
Fuel	—	Leakage	—
Exhaust gas	—	Leakage	—

# CYLINDER BLOCK

PPF:11010

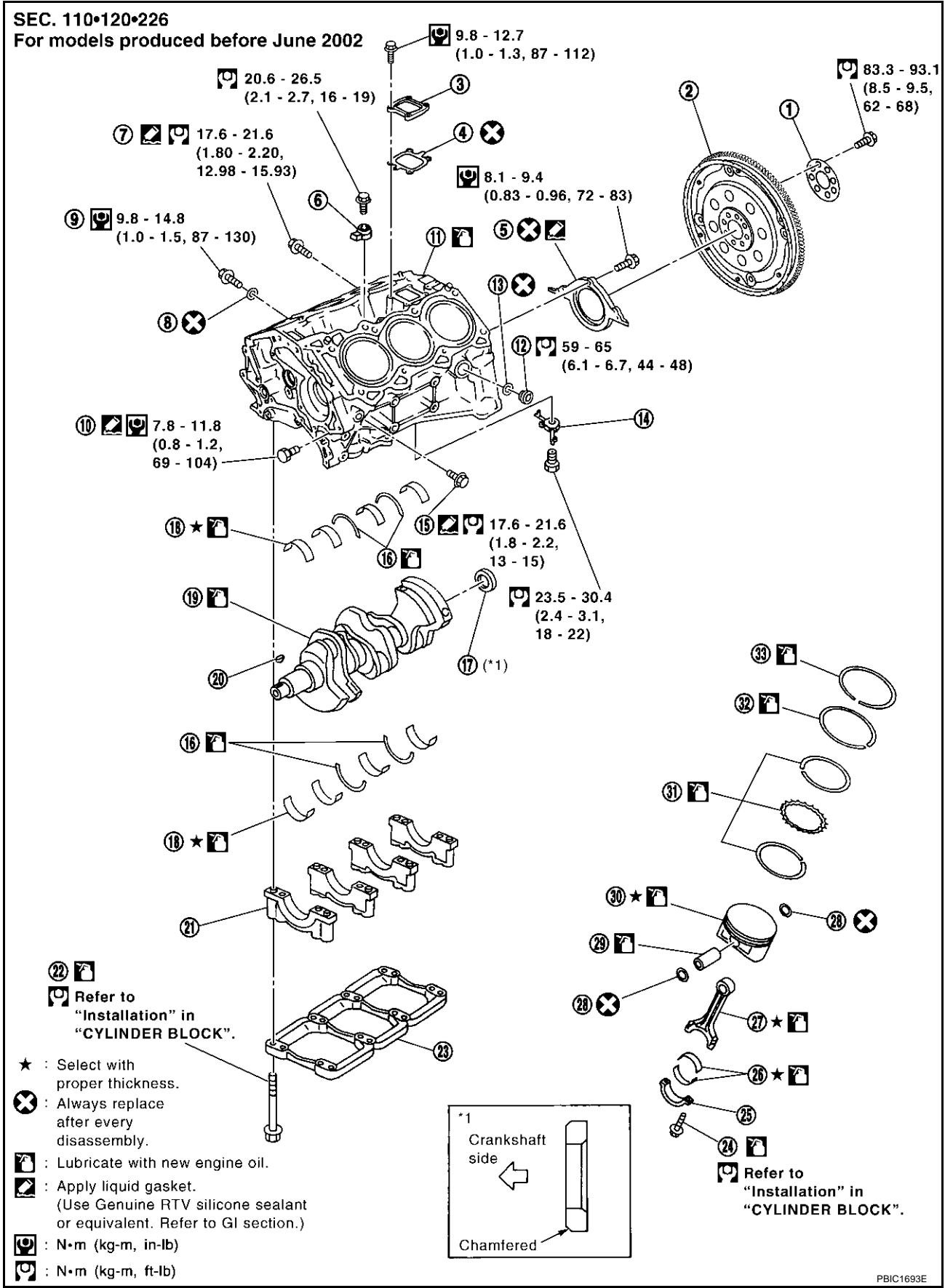
## CYLINDER BLOCK

### Disassembly and Assembly

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PBIC1693E

# CYLINDER BLOCK

---

- |                                |                            |                                |
|--------------------------------|----------------------------|--------------------------------|
| 1. Reinforce plate             | 2. Drive plate             | 3. Cover                       |
| 4. Gasket                      | 5. Rear oil seal retainer  | 6. Knock sensor                |
| 7. Water drain plug (RH side)  | 8. Gasket                  | 9. Plug (RH side)              |
| 10. Water drain plug (Front)   | 11. Cylinder block         | 12. Plug (LH side)             |
| 13. Gasket                     | 14. Oil jet                | 15. Water drain plug (LH side) |
| 16. Thrust bearing             | 17. Pilot convertor        | 18. Main bearing               |
| 19. Crankshaft                 | 20. Key                    | 21. Main bearing cap           |
| 22. Main bearing cap bolt      | 23. Main bearing beam      | 24. Connecting rod bolt        |
| 25. Connecting rod bearing cap | 26. Connecting rod bearing | 27. Connecting rod             |
| 28. Snap ring                  | 29. Piston pin             | 30. Piston                     |
| 31. Oil ring                   | 32. Second ring            | 33. Top ring                   |

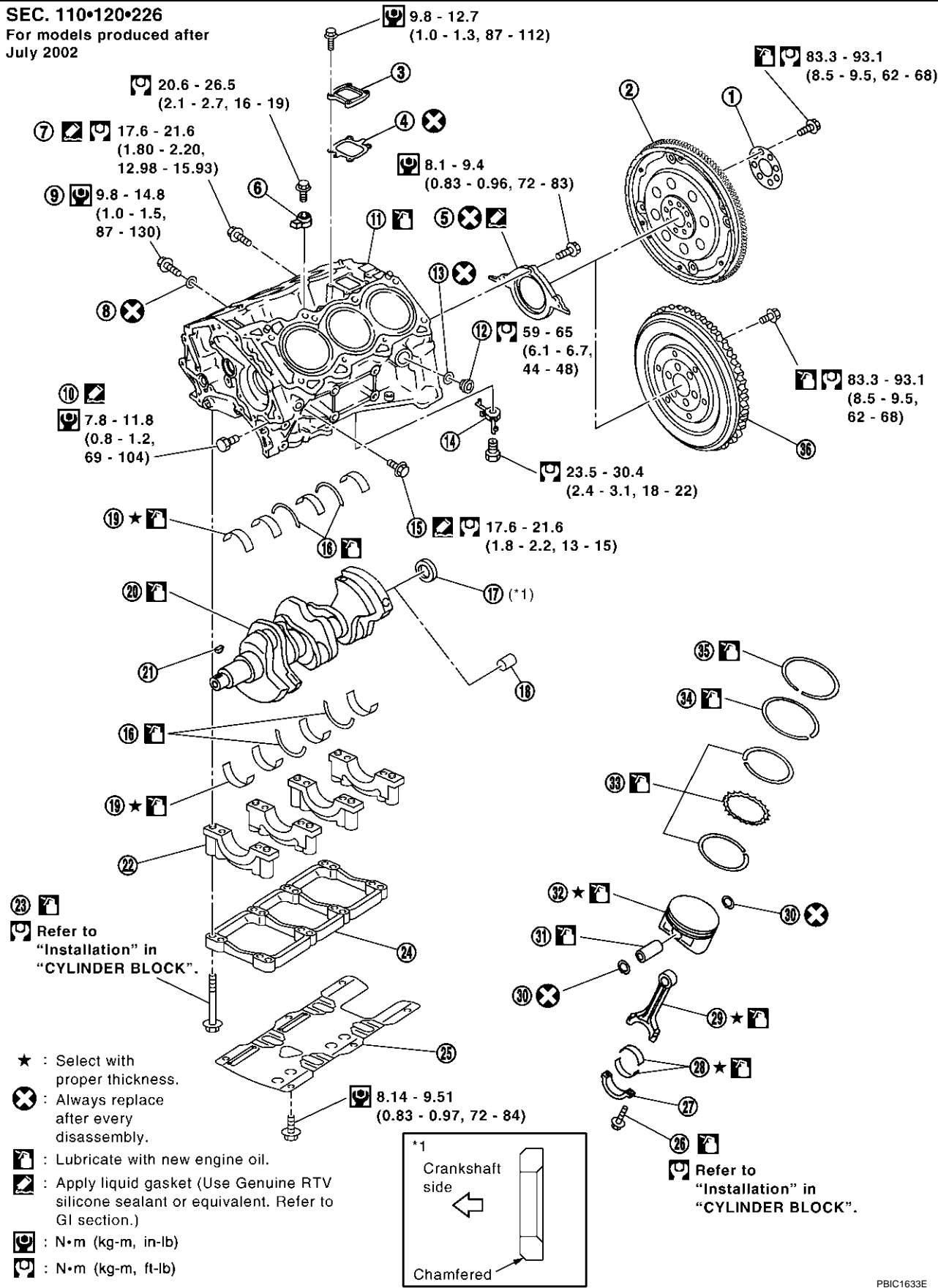


# CYLINDER BLOCK

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## SEC. 110•120•226

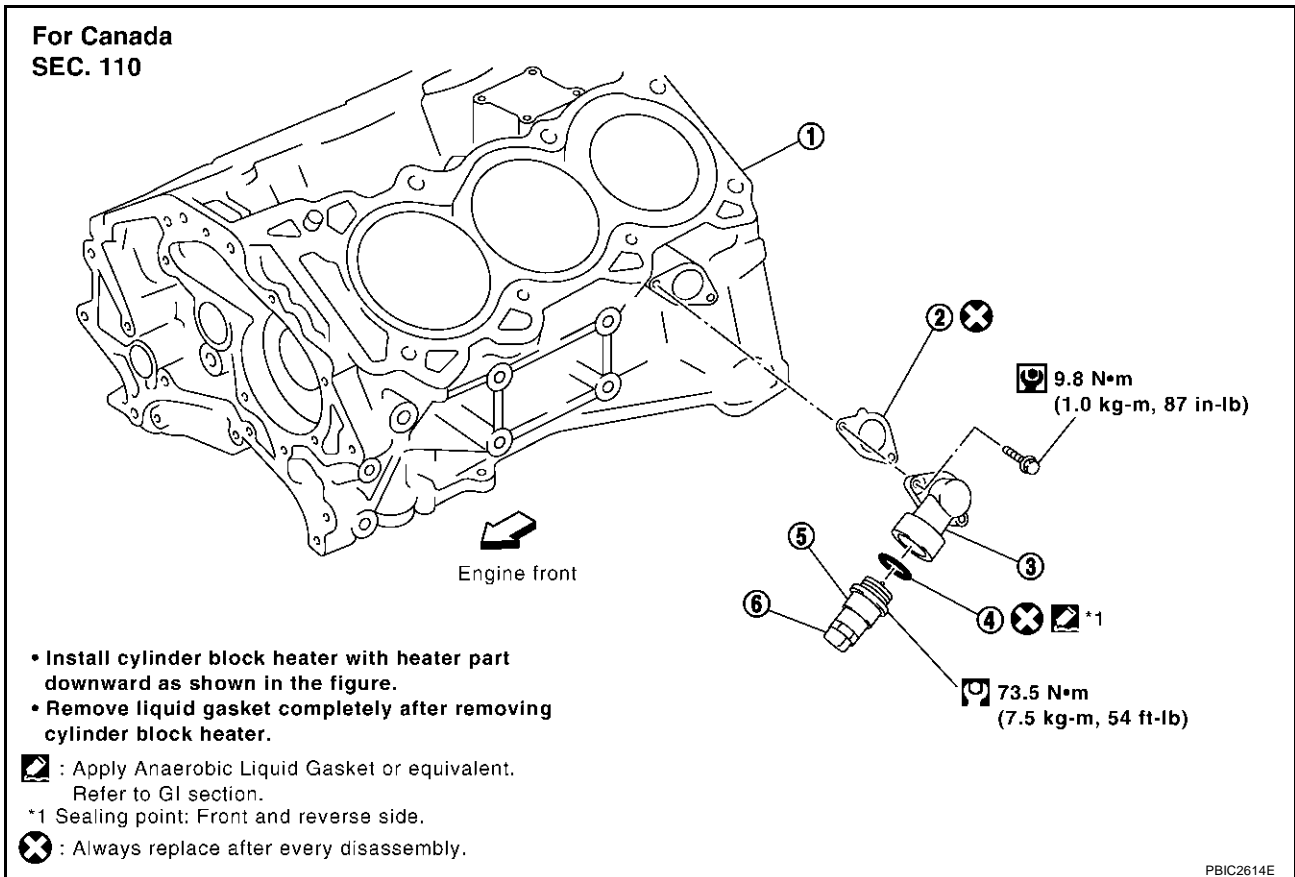
For models produced after July 2002



- |                                     |                             |                   |
|-------------------------------------|-----------------------------|-------------------|
| 1. Reinforcement plate (A/T models) | 2. Drive plate (A/T models) | 3. Cover          |
| 4. Gasket                           | 5. Rear oil seal retainer   | 6. Knock sensor   |
| 7. Water drain plug (RH side)       | 8. Gasket                   | 9. Plug (RH side) |

# CYLINDER BLOCK

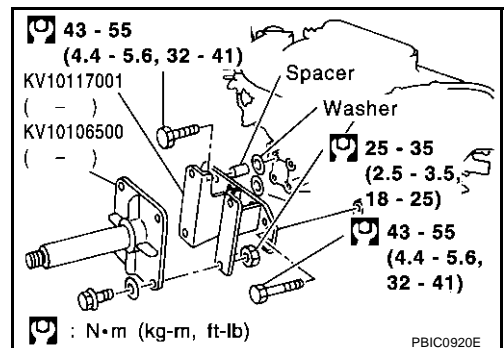
- |                              |                                  |                                |
|------------------------------|----------------------------------|--------------------------------|
| 10. Water drain plug (Front) | 11. Cylinder block               | 12. Plug (LH side)             |
| 13. Gasket                   | 14. Oil jet                      | 15. Water drain plug (LH side) |
| 16. Thrust bearing           | 17. Pilot converter (A/T models) | 18. Pilot bushing (M/T models) |
| 19. Main bearing             | 20. Crankshaft                   | 21. Key                        |
| 22. Main bearing cap         | 23. Main bearing cap bolt        | 24. Main bearing beam          |
| 25. Baffle plate             | 26. Connecting rod bolt          | 27. Connecting rod bearing cap |
| 28. Connecting rod bearing   | 29. Connecting rod               | 30. Snap ring                  |
| 31. Piston pin               | 32. Piston                       | 33. Oil ring                   |
| 34. Second ring              | 35. Top ring                     | 36. Flywheel (M/T models)      |



- |                   |                          |                            |
|-------------------|--------------------------|----------------------------|
| 1. Cylinder block | 2. Gasket                | 3. Water connector         |
| 4. Gasket         | 5. Cylinder block heater | 6. Connector protector cap |

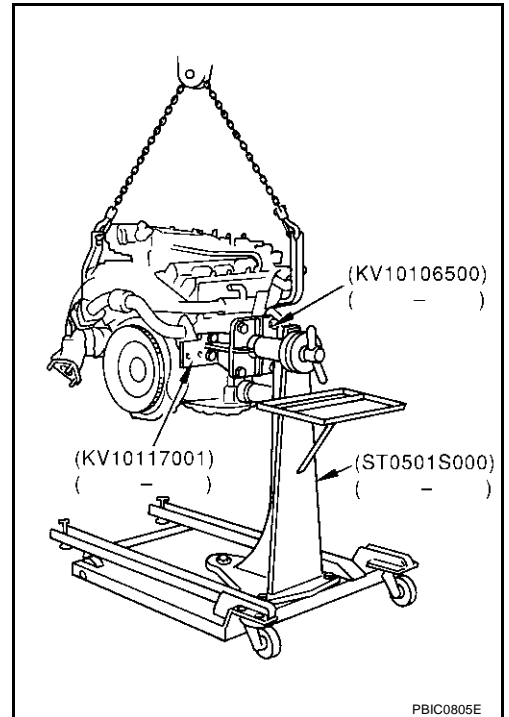
## DISASSEMBLY

- Remove engine assembly from vehicle, and separate transmission from engine. Refer to [EM-98, "ENGINE ASSEMBLY"](#).
- Remove engine mounting bracket. Refer to [EM-98, "ENGINE ASSEMBLY"](#).
- Remove RH exhaust manifold. Refer to [EM-24, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
- Install engine sub-attachment with engine stand shaft (special service tool) to right side of cylinder block.
  - Use spacer to engine rear side.



# CYLINDER BLOCK

- Lift engine, and mount it onto the engine stand (special service tool).



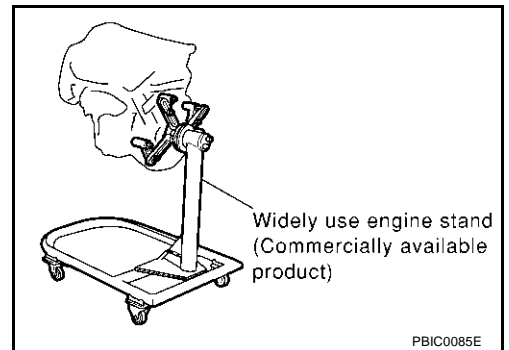
- A commercial engine stand can be used.

**CAUTION:**

Use an engine stand that has a load capacity [approximately 220kg (441 lb) or more] large enough for supporting the engine weight.

**NOTE:**

This example is an engine stand for holding at transmission mounting side with flywheel (M/T models) or drive plate (A/T models) removed.

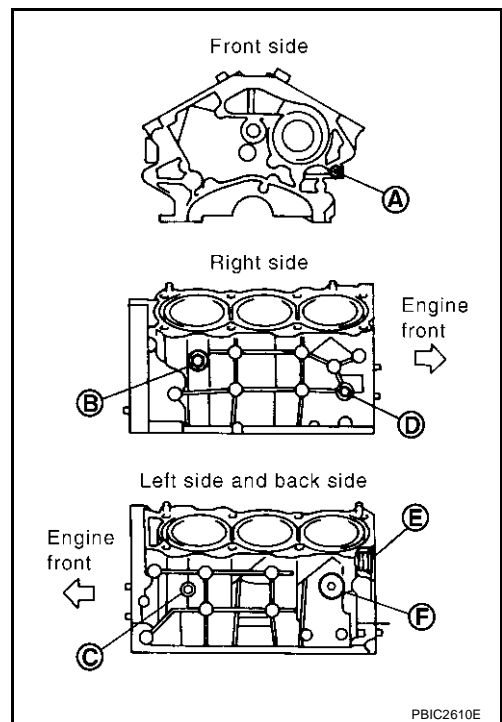


- Drain engine oil. Refer to [CO-11, "Changing Engine Coolant"](#).

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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.

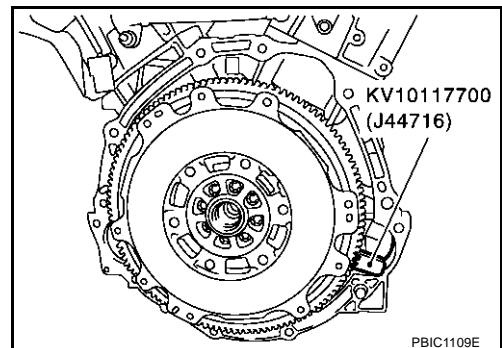


8. Remove the following components and associated parts:
- Intake manifold collector; Refer to [EM-18, "INTAKE MANIFOLD COLLECTOR"](#) .
  - Fuel tube and fuel injector assembly; Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#) .
  - Intake manifold; Refer to [EM-22, "INTAKE MANIFOLD"](#) .
  - Ignition coil; Refer to [EM-34, "IGNITION COIL"](#) .
  - Rocker cover; Refer to [EM-43, "ROCKER COVER"](#) .
  - Thermostat and thermostat housing; Refer to [CO-30, "THERMOSTAT AND THERMOSTAT HOUSING"](#) .
  - Water outlet and water piping; Refer to [CO-32, "WATER OUTLET AND WATER PIPING"](#) .
  - Idler pulley
  - Oil pan (lower) and (upper) and oil strainer; Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .
  - Front timing chain case, timing chain and rear timing chain case; Refer to [EM-54, "TIMING CHAIN"](#) .
  - Camshaft; Refer to [EM-71, "CAMSHAFT"](#) .
  - Cylinder head; Refer to [EM-87, "CYLINDER HEAD"](#) .
9. Remove knock sensor.

**CAUTION:**

**Carefully handle the sensor avoiding shocks.**

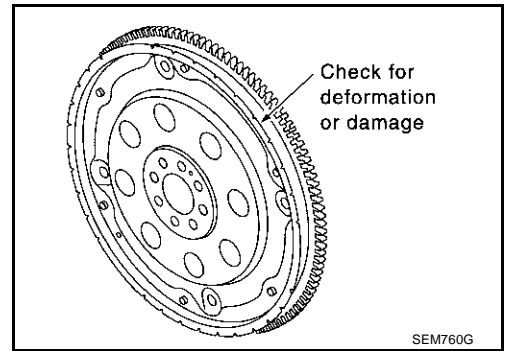
10. Remove clutch cover and clutch disc (M/T models). Refer to [CL-15, "CLUTCH DISC, CLUTCH COVER"](#) .
11. Remove drive plate (A/T models) or flywheel (M/T models). Fix crankshaft with a ring gear stopper (special service tool), and remove mounting bolts.
- Loosen mounting bolts in diagonal order.
  - Use TORX socket for flywheel mounting bolts (size: T55, commercial service tool).



# CYLINDER BLOCK

## CAUTION:

- Do not disassemble flywheel (M/T models) or drive plate (A/T models).
- Never place flywheel (M/T models) or 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.



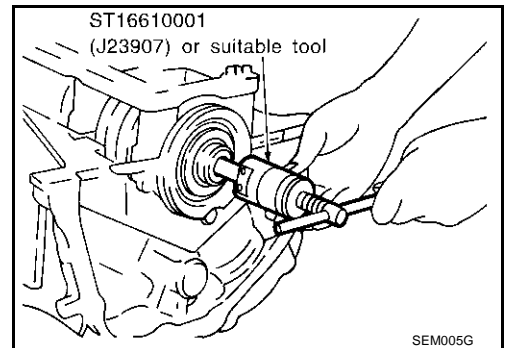
12. Remove pilot converter (A/T models) or pilot bushing (M/T models) using pilot bushing puller (special service tool) or suitable tool as necessary.
13. Remove rear oil seal retainer.
  - Remove by inserting a screwdriver between main bearing cap and rear oil seal retainer.

## CAUTION:

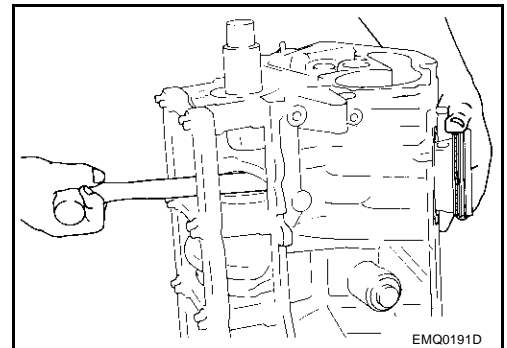
If rear oil seal retainer is removed, replace it with a new one.

## NOTE:

Rear oil seal and retainer make up a single part and are removed as an assembly.



14. Remove baffle plate from main bearing beam (for models produced after July 2002).
15. Remove the piston and connecting rod assembly.
  - a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom dead center.
  - b. Remove the connecting rod cap.
  - c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out to the cylinder head side.
    - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-123, "CONNECTING ROD SIDE CLEARANCE"](#).
16. Remove the connecting rod bearings from connecting rod and connecting rod cap.



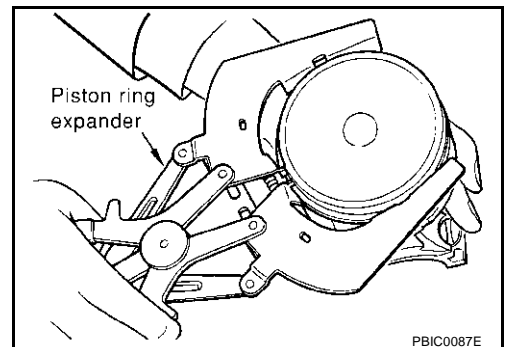
## CAUTION:

- When removing them, note the installation position. Keep them in the correct order.

17. Remove the piston rings from the piston.
  - Use a piston ring expander (commercial service tool).

## CAUTION:

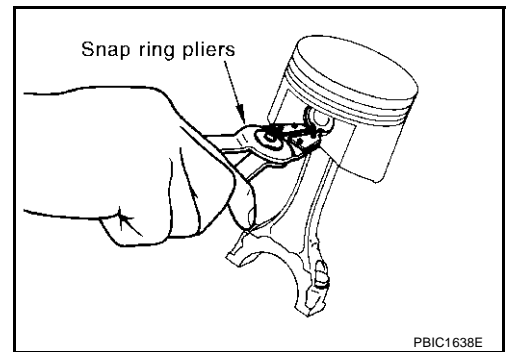
- When removing the piston rings, be careful not to damage the piston.
- Be careful not to damage piston rings by expanding them excessively.



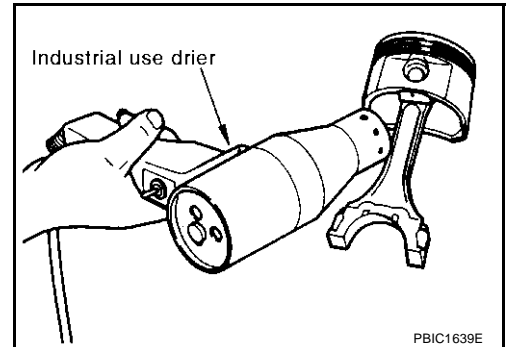
# CYLINDER BLOCK

18. Remove the piston from the connecting rod as follows.

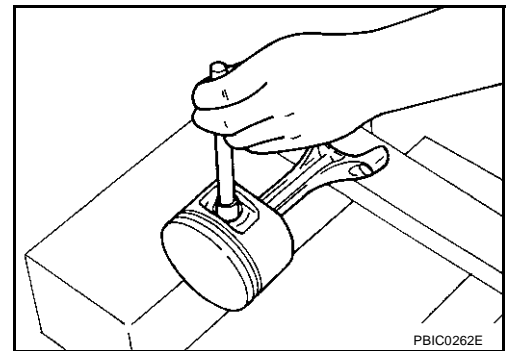
a. Using a snap ring pliers, remove the snap ring.



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



c. Push out piston pin with stick of outer diameter approximately 20 mm (0.79 in).

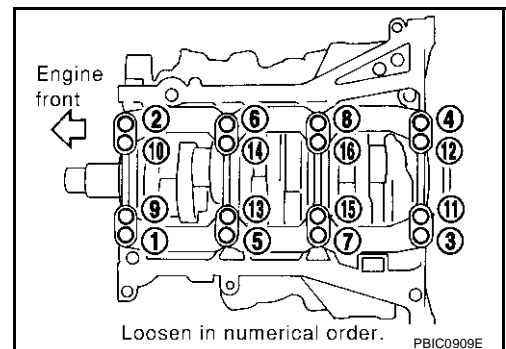


19. Remove main bearing cap bolt.

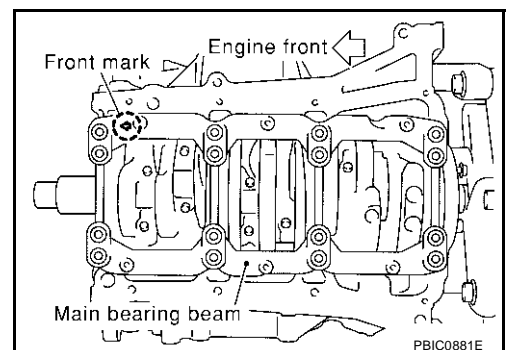
**NOTE:**

Use TORX socket (size E14).

- Before loosening main bearing cap bolts, measure crankshaft end play. Refer to [EM-123, "CRANKSHAFT END PLAY"](#).
- Loosen them in the numerical order shown in the figure in several different steps.



20. Remove main bearing beam.



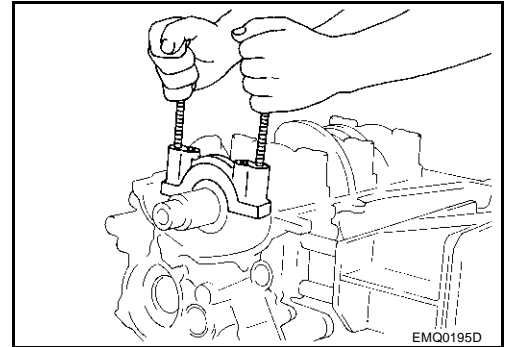
# CYLINDER BLOCK

21. Remove main bearing cap.
  - 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 cap.

**CAUTION:**

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

24. Remove oil jet.



## ASSEMBLY

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

**CAUTION:**

**Use a goggles to protect your eye.**

2. Install each water drain plug to cylinder block as shown in the figure.
  - Apply thread sealant to the thread of water drain plugs.  
**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**
  - Tighten each water drain plug as specified below.

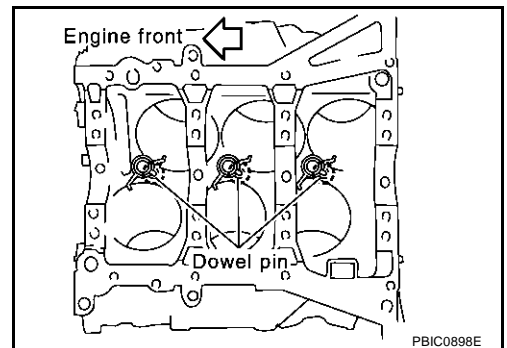
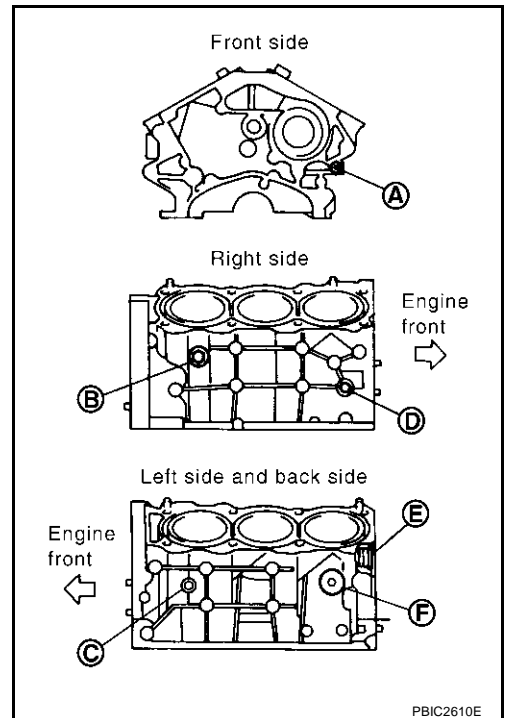
Part	Gasket	Tightening torque
A	No	7.8 - 11.8 N·m (0.8 - 1.2 kg·m, 69 - 104 in·lb)
B	No	17.6 - 21.6 N·m (1.8 - 2.2 kg·m, 13 - 15 ft·lb)
C	No	17.6 - 21.6 N·m (1.8 - 2.2 kg·m, 13 - 15 ft·lb)

3. Install each plug to cylinder block as shown in the figure if removed.

- Apply thread 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 thread sealant to the thread of plug "F".  
**Use Anaerobic Liquid Gasket or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .**
- Tighten each plug as specified below.

Part	Gasket	Tightening torque
D	Yes	9.8 - 14.8 N·m (1.0 - 1.5 kg·m, 87 - 130 in·lb)
E	Yes	59 - 65 N·m (6.1 - 6.6 kg·m, 44 - 47 ft·lb)
F	Yes	59 - 65 N·m (6.1 - 6.6 kg·m, 44 - 47 ft·lb)

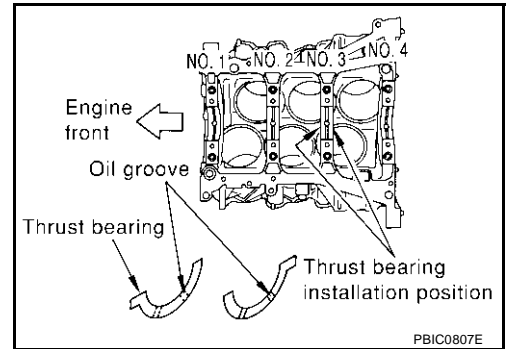
4. Install oil jet.
  - Insert oil jet dowel pin into the cylinder block dowel pin hole, and tighten the mounting bolts.



# CYLINDER BLOCK

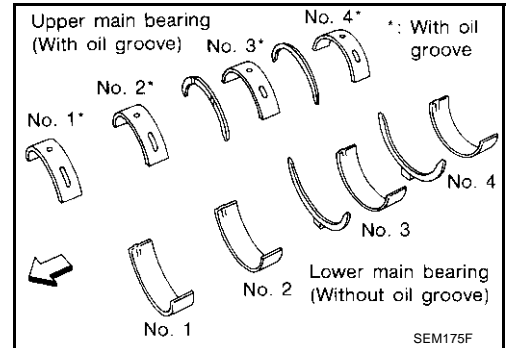
5. Install the main bearings and the thrust bearings.

- a. Remove dust, dirt, and oil on the bearing mating surfaces of the cylinder block and the main bearing cap.
- b. Install the thrust bearings to the both sides of the No. 3 journal housing on the cylinder block and the main bearing cap.
  - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).
  - Install bearing with a projection on one end on cylinder block, and bearing with a projection at center on cap. Align each projection with mating notch.



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

- The main bearing with an oil hole and groove goes on the cylinder block. The one without them goes on the main bearing cap.
- Before installing the bearings, apply engine oil to the bearing surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
- When installing, align the bearing stopper to the notch.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



6. Install the crankshaft to the cylinder block.

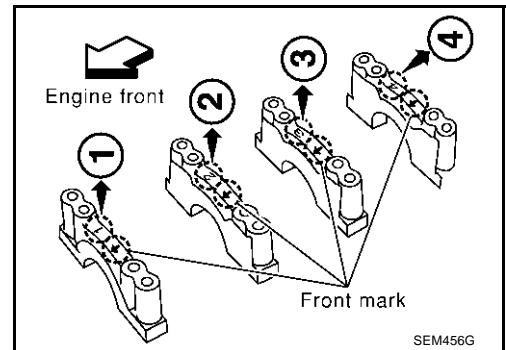
- While turning the crankshaft by hand, check that it turns smoothly.

7. Install main bearing cap.

- Main bearing caps are identified by identification mark cast on them. For installation, face front mark to front side.

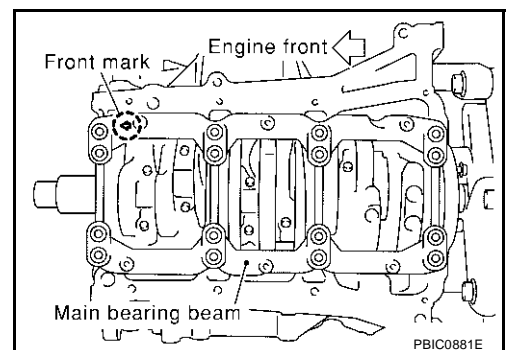
**NOTE:**

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



8. 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.

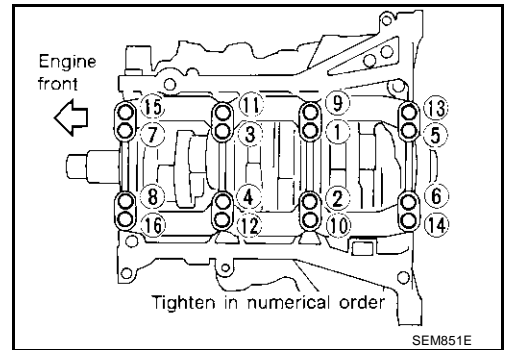


9. Inspect outer diameter of main bearing cap bolt. Refer to [EM-131, "OUTER DIAMETER OF MAIN BEARING CAP BOLT"](#).



# CYLINDER BLOCK

10. Install main bearing cap bolt.
  - a. Apply new engine oil to threads and seat surfaces of mounting bolts.
  - b. Tighten bolts in numerical order with tightening torque 32.3 to 38.3 N·m (3.3 to 3.9 kg·m, 24 to 28 ft·lb).

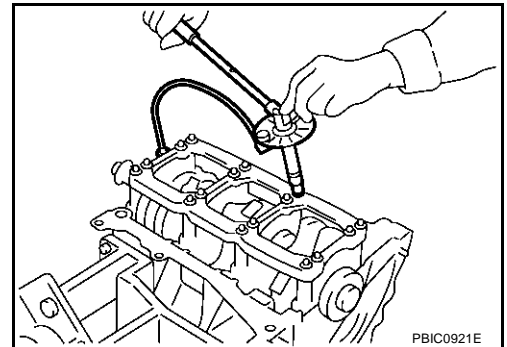


- c. Turn all bolts another 90 to 95 degrees clockwise [Target: 90 degrees (Angle tightening)].

**CAUTION:**

**Use an angle wrench (special service tool) to check tightening angle. Do not make judgment by visual inspection.**

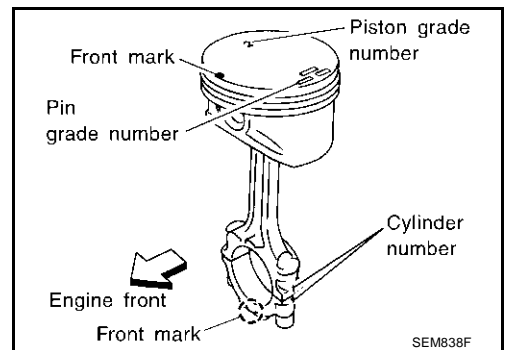
- After installing mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-123, "CRANKSHAFT END PLAY"](#).



11. Inspect outer diameter of connecting rod bolt. Refer to [EM-131, "OUTER DIAMETER OF CONNECTING ROD BOLT"](#).

12. Install the piston to the connecting rod.

- a. Using a snap ring pliers, install a new snap ring to the groove of the piston rear side.
  - Insert it fully into groove to install.
- b. Install the piston to the connecting rod.
  - Using an industrial drier or similar tool, heat the piston until the piston pin can be pushed in by hand without excess force [approx. 60 to 70 °C (140 to 158 °F)]. From the front to the rear, insert the piston pin into the piston and the connecting rod.
  - Assemble so that the front mark on the piston crown and the cylinder number on the connecting rod are positioned as shown in the figure.
- c. Install a new snap ring to the groove of the piston front side.
  - Insert it fully into groove to install.
  - After installing, check that the connecting rod moves smoothly.



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

- If there is stamped mark on ring, mount it with marked side up.

**NOTE:**

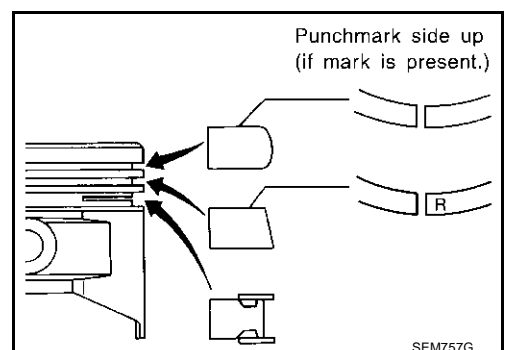
If there is no stamp on ring, no specific orientation is required for installation.

**Stamped mark:**

- Top ring** : —
- Second ring** : R

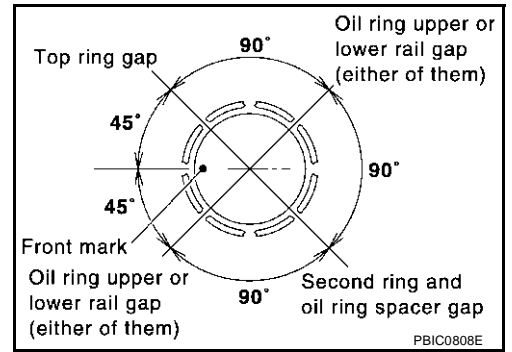
**CAUTION:**

**Be careful not to damage the piston.**

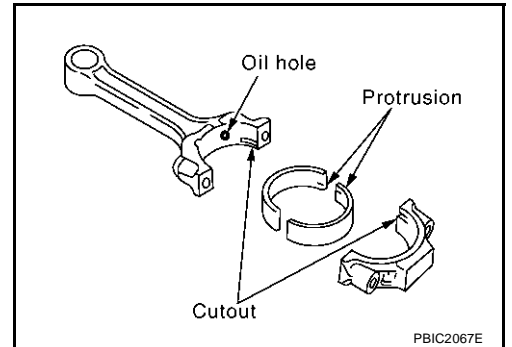


# CYLINDER BLOCK

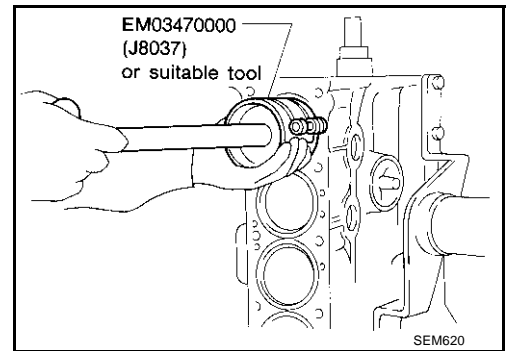
- Position each ring with the gap as shown in the figure referring to the piston front mark.



14. Install the connecting rod bearings to the connecting rod and the connecting rod cap.
  - When installing the connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
  - When installing, align the connecting rod bearing stopper protrusion with the cutout of the connecting rod to install.
  - Check the oil hole on the connecting rod and that on the corresponding bearing are aligned.



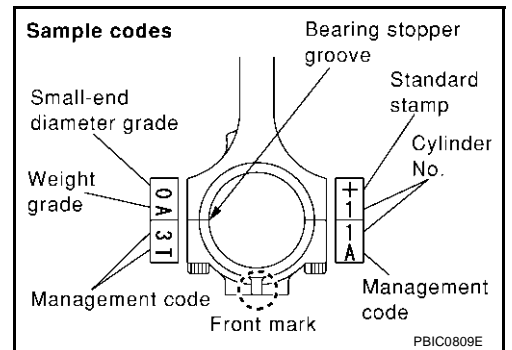
15. Install the piston and connecting rod assembly to the crankshaft.
  - Position the crankshaft pin corresponding to the connecting rod to be installed onto the bottom dead center.
  - Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
  - Match the cylinder position with the cylinder number on the connecting rod to install.
  - Be sure that front mark on piston crown is facing front of engine.
  - Using a piston ring compressor (special service tool) or suitable tool, install the piston with the front mark on the piston crown facing the front of the engine.



## CAUTION:

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

16. Install the connecting rod cap.
  - Match the stamped cylinder number marks on the connecting rod with those on the cap to install.
  - Be sure that front mark on connecting rod cap is facing front of engine.



# CYLINDER BLOCK

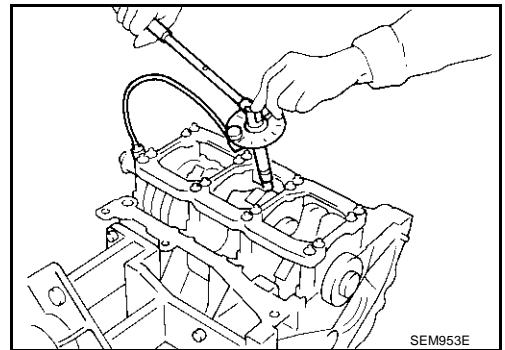
17. Tighten the connecting rod bolt as follows.

- a. Apply engine oil to the threads and seats of the connecting rod bolts.
- b. Tighten bolts to 18.6 to 20.6 N·m (1.9 to 2.1 kg·m, 14 to 15 ft·lb).
- c. Then tighten all bolts 90 to 95 degrees clockwise [target: 90 degrees (Angle tightening)].

**CAUTION:**

**Always use an angle wrench (special service tool). Avoid tightening based on visual check alone.**

- After tightening the bolt, make sure that the crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-123, "CONNECTING ROD SIDE CLEARANCE"](#)



18. Install baffle plate to main bearing beam (models for produced after 2002).

19. Apply liquid gasket and install rear oil seal retainer.

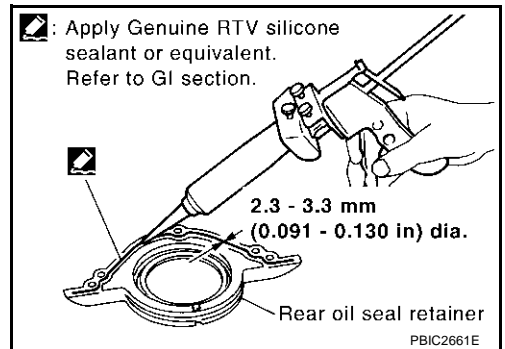
- Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-45, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

**CAUTION:**

**Replace with the new parts.**

**NOTE:**

Regard rear oil seal and retainer as an assembly.

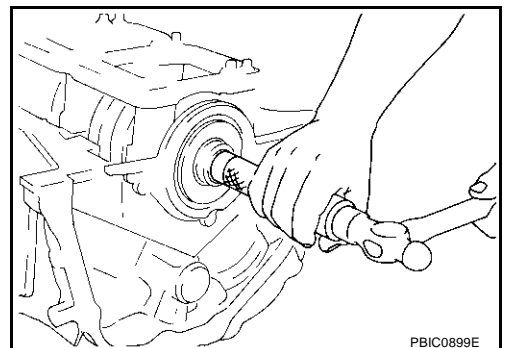


20. Install pilot bushing (M/T models) or pilot converter (A/T models).

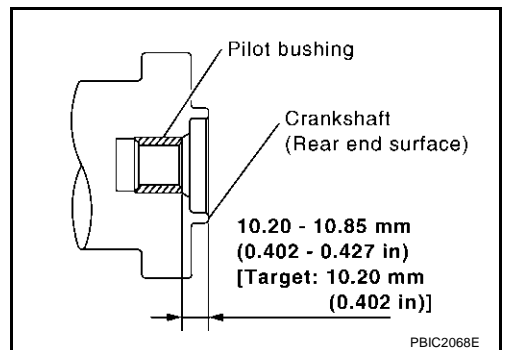
- With drift of the following outer diameter, press-fit as far as it will go.

**Pilot bushing : Approx. 17 mm (0.67 in)**

**Pilot converter : Approx. 33 mm (1.30 in)**



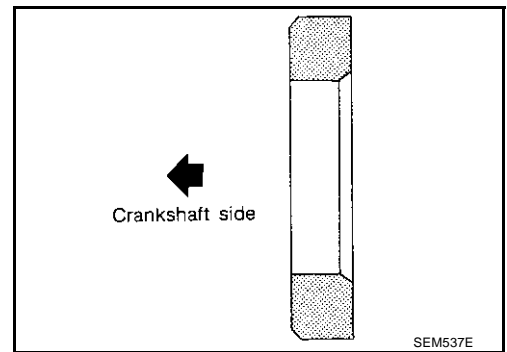
- Press-fit pilot bushing as the dimension in the figure. (M/T models)



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

# CYLINDER BLOCK

- Press-fit pilot converter with its chamfer facing crankshaft as shown in the figure. (A/T models)



## 21. Install knock sensor.

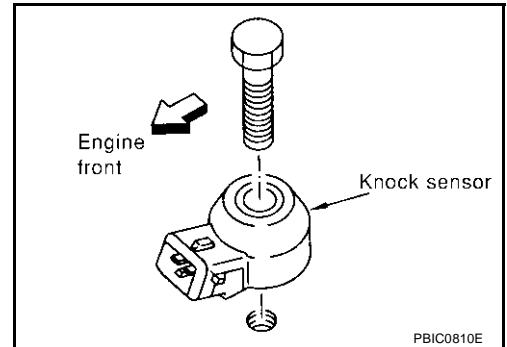
- Install knock sensor so that connector faces front of engine.
- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

### 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:

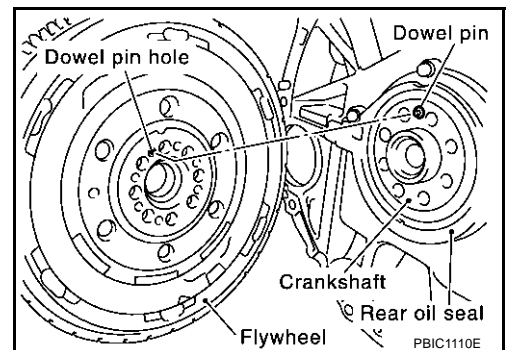
- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Make sure that knock sensor does not interfere with other parts.



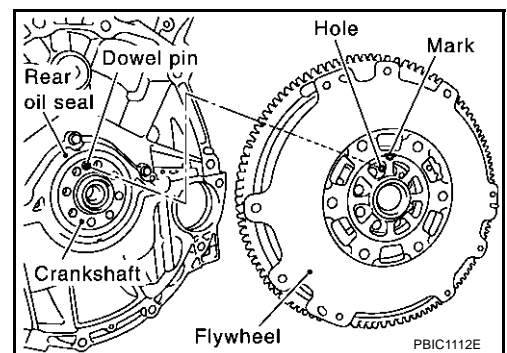
## 22. Note the following, assemble in the reverse order of disassembly after this step.

### Flywheel (M/T models)

- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin hole.

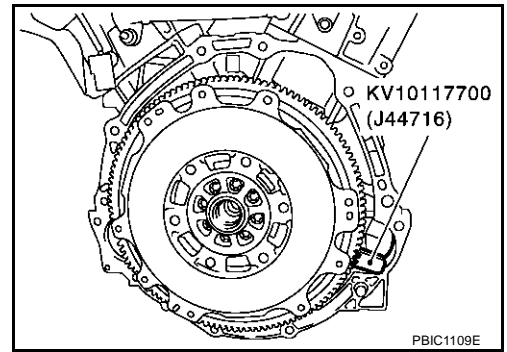


- There is a mating mark on the clutch cover side of flywheel. Refer it during installation.



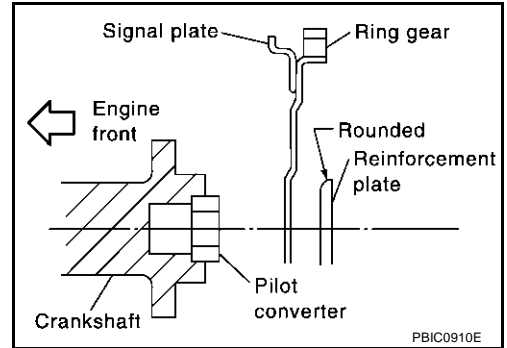
# CYLINDER BLOCK

- Holding ring gear with ring gear stopper [special service tool], tighten securing bolts with TORX socket (size: T55, commercial service tool).
- Tighten the mounting bolts crosswise over several times.



## Drive plate (A/T models)

- Install drive plate and reinforcement plate as shown in the figure.
- Holding ring gear with ring gear stopper [special service tool: KV10117700 (J44716)].
- Tighten the mounting bolts crosswise over several times.



## How to Select Piston and Bearing

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

\*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

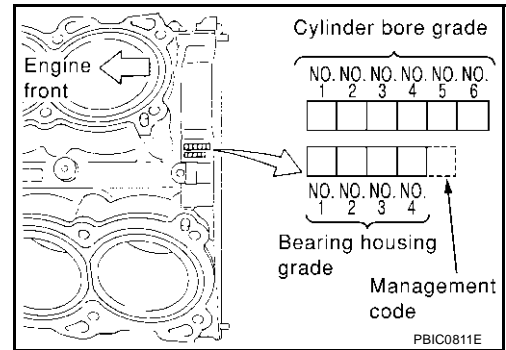
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

# CYLINDER BLOCK

## HOW TO SELECT PISTON

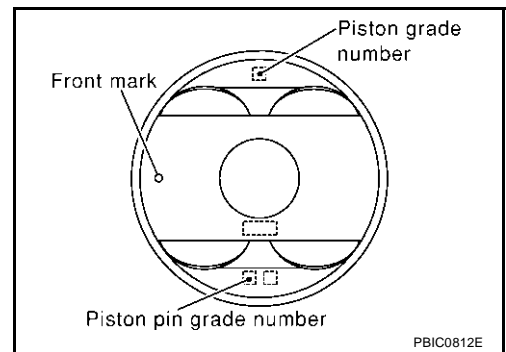
### When New Cylinder Block is Used

- Check the cylinder bore grade (1, 2, or 3) on rear side of cylinder block, and select a piston of the same grade.
- The 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 block bore inner diameter. Refer to [EM-127, "Inner Diameter of Cylinder Bore"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".
3. Select the piston of the same grade.



## Piston Selection Table

Unit: mm (in)

Grade	1	2 (or no mark)	3
Inner diameter of cylinder bore	95.500 / 95.510 (3.7598 / 3.7602)	95.510 / 95.520 (3.7602 / 3.7606)	95.520 / 95.530 (3.7606 / 3.7610)
Outer diameter of piston	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:

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

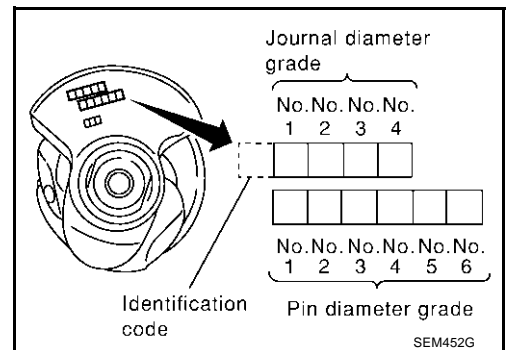
## HOW TO SELECT CONNECTING ROD BEARING

### When New Connecting Rod and Crankshaft are Used

- Check pin diameter grade number (0, 1, or 2) stamped in front of crankshaft, and select connecting rod bearing of same grade number.

### NOTE:

There is no grading for connecting rod big end inner diameter.



# CYLINDER BLOCK

## When Crankshaft and Connecting Rod are Reused

1. Measure dimensions of the big end inner diameter of connecting rod and outer diameter of crankshaft pin individually.
2. Confirm the big end inner diameter of connecting rod is within the standard value.
3. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
4. Determine the grade of crankshaft pin diameter grade by comparing the measurement with the values under the crankshaft pin outer diameter of the "Connecting Rod Bearing Selection Table".
5. Select the 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)

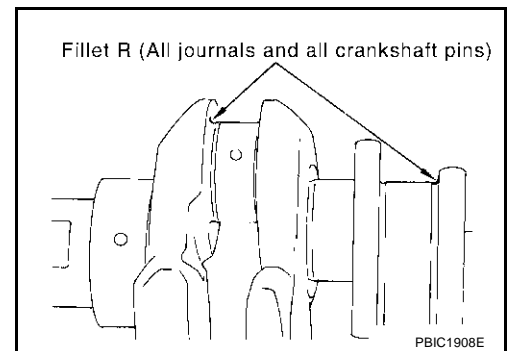
Crankshaft		Connecting rod bearing		
Crankshaft pin journal diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
51.962 - 51.968 (2.0457 - 2.0460)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
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.

### CAUTION:

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



## Bearing undersize table

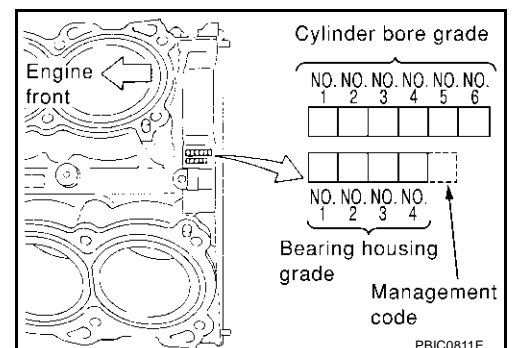
Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

## HOW TO SELECT MAIN BEARING

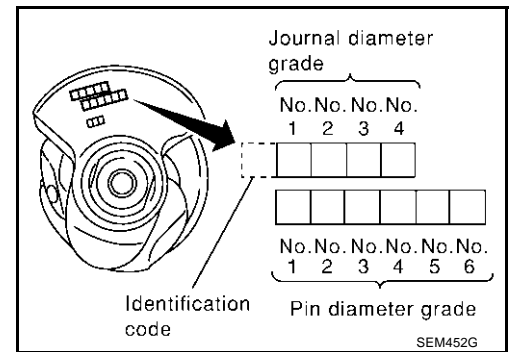
### When New Cylinder Block and Crankshaft are Used

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



# CYLINDER BLOCK

2. Apply journal diameter grade stamped on crankshaft front side to column in "Main Bearing Selection Table".
3. Find sign (main bearing grade) at crossing of row and column in "Main Bearing Selection Table".



## When Cylinder Block and Crankshaft are Reused

1. Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal. Refer to [EM-126, "INNER DIAMETER OF MAIN BEARING HOUSING"](#) and [EM-128, "OUTER DIAMETER OF CRANKSHAFT JOURNAL"](#).
2. Find measured dimension in "Cylinder block bearing housing inner diameter" row of "Main Bearing Selection Table".
3. Find the measured dimension in "Crankshaft main journal diameter" column in the following 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 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	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	0	1	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
C	59.973 - 59.972 (2.3611 - 2.3611)	0	0	1	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
D	59.972 - 59.971 (2.3611 - 2.3611)	0	1	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
E	59.971 - 59.970 (2.3611 - 2.3610)	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
F	59.970 - 59.969 (2.3610 - 2.3610)	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
G	59.969 - 59.968 (2.3610 - 2.3609)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
H	59.968 - 59.967 (2.3609 - 2.3609)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
J	59.967 - 59.966 (2.3609 - 2.3609)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
K	59.966 - 59.965 (2.3909 - 2.3608)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
L	59.965 - 59.964 (2.3608 - 2.3608)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
M	59.964 - 59.963 (2.3608 - 2.3607)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
N	59.963 - 59.962 (2.3607 - 2.3607)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
P	59.962 - 59.961 (2.3607 - 2.3607)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
R	59.961 - 59.960 (2.3607 - 2.3606)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
S	59.960 - 59.959 (2.3606 - 2.3606)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
T	59.959 - 59.958 (2.3606 - 2.3605)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
U	59.958 - 59.957 (2.3605 - 2.3605)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
V	59.957 - 59.956 (2.3605 - 2.3605)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
W	59.956 - 59.955 (2.3605 - 2.3604)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
X	59.955 - 59.954 (2.3604 - 2.3604)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
Y	59.954 - 59.953 (2.3604 - 2.3603)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
4	59.953 - 59.952 (2.3603 - 2.3603)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		
7	59.952 - 59.951 (2.3603 - 2.3603)	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2		

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# CYLINDER BLOCK

## Main Bearing Grade Table (All Journals)

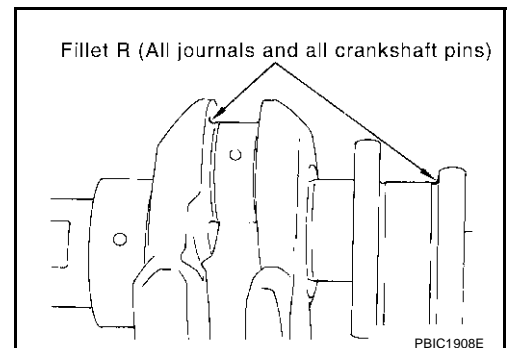
Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color (UPR/LWR)	Remarks	
0	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.	
1	2.003 - 2.006 (0.0789 - 0.0790)		Brown		
2	2.006 - 2.009 (0.0790 - 0.0791)		Green		
3	2.009 - 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	UPP		2.003 - 2.006 (0.0789 - 0.0790)		Brown/Black
	LWR		2.000 - 2.003 (0.0787 - 0.0789)		
12	UPR		2.006 - 2.009 (0.0790 - 0.0791)		Green/Brown
	LWR		2.003 - 2.006 (0.0789 - 0.0790)		
23	UPR		2.009 - 2.012 (0.0791 - 0.0792)		Yellow/Green
	LWR		2.006 - 2.009 (0.0790 - 0.0791)		
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue/Yellow		
	LWR	2.009 - 2.012 (0.0791 - 0.0792)			
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink/Blue		
	LWR	2.012 - 2.015 (0.0792 - 0.0793)			
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple/Pink		
	LWR	2.015 - 2.018 (0.0793 - 0.0794)			
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White/Purple		
	LWR	2.018 - 2.021 (0.0794 - 0.0796)			

### 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

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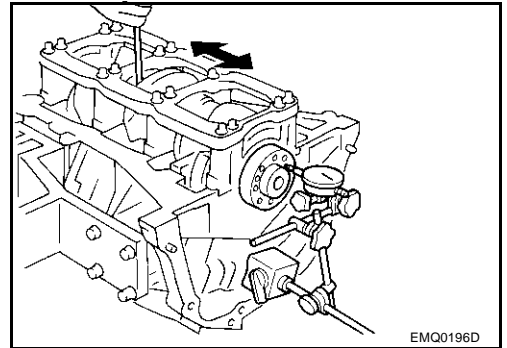
## Inspection After Disassembly CRANKSHAFT END PLAY

- Using a dial gauge, measure the clearance between the thrust bearings and the crankshaft arm when the crankshaft is moved fully forward or backward.

**Standard : 0.10 - 0.25 mm (0.0039 - 0.0098 in)**

**Limit : 0.30 mm (0.0118 in)**

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



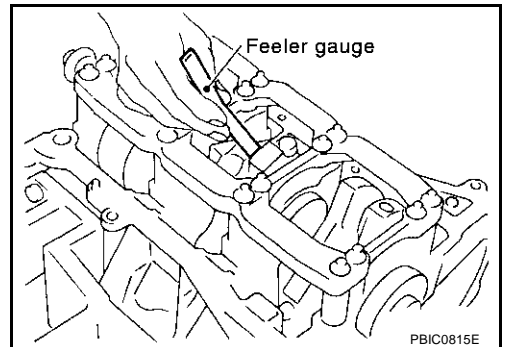
## CONNECTING ROD SIDE CLEARANCE

- Measure side clearance between connecting rod and crankshaft arm with feeler gauge.

**Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)**

**Limit : 0.40 mm (0.016 in)**

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

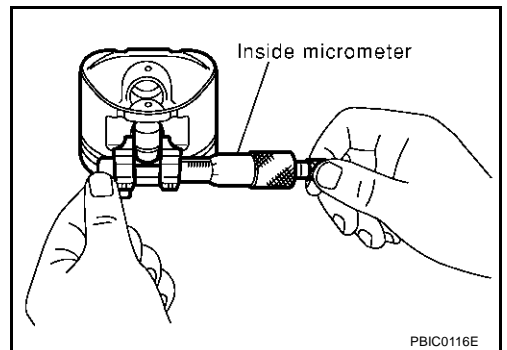


## PISTON AND PISTON PIN CLEARANCE

### Inner Diameter of Piston Pin

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

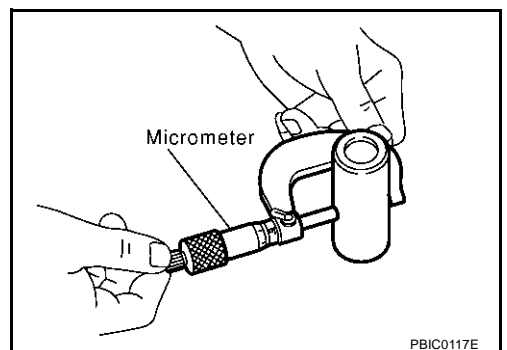
**Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)**



### Outer Diameter of Piston Pin

- Measure outer diameter of piston pin with a micrometer.

**Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)**



### Piston and Piston Pin Clearance

(Piston pin clearance) = (Piston pin hole diameter) – (Outer diameter of piston pin)

**Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)**

- If clearance exceeds specification, replace piston/piston pin assembly with reference to specification of each parts.

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# CYLINDER BLOCK

- When replacing piston/piston pin assembly, refer to [EM-127, "PISTON TO CYLINDER BORE CLEARANCE"](#).

## NOTE:

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

## PISTON RING SIDE CLEARANCE

- Measure side clearance of piston ring and piston ring groove with feeler gauge.

### Standard:

Top ring : 0.045 - 0.080 mm (0.0016 - 0.0031 in)

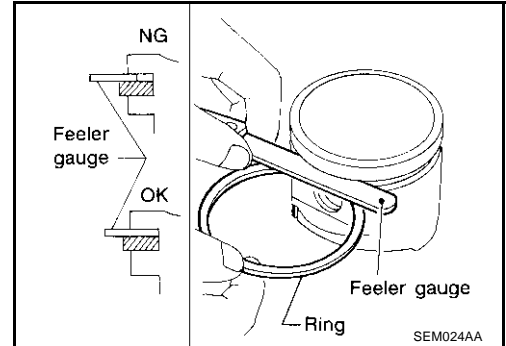
2nd ring : 0.030 - 0.070 mm (0.0012 - 0.0028 in)

Oil ring : 0.065 - 0.135 mm (0.0026 - 0.0053 in)

### Limit:

Top ring : 0.11 mm (0.0043 in)

2nd ring : 0.1 mm (0.004 in)



- If out of specification, replace piston and/or piston ring assembly.

## PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to [EM-127, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Insert piston ring until middle of cylinder with piston, and measure gap.

### Standard:

Top ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)

2nd ring : 0.33 - 0.48 mm (0.0130 - 0.0189 in)

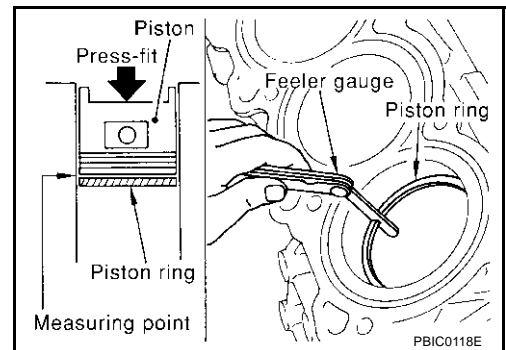
Oil ring : 0.20 - 0.50 mm (0.0079 - 0.0197 in)

### Limit:

Top ring : 0.54 mm (0.0213 in)

2nd ring : 0.80 mm (0.0315 in)

Oil ring : 0.95 mm (0.0374 in)



- If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring.

## CONNECTING ROD BEND AND TORSION

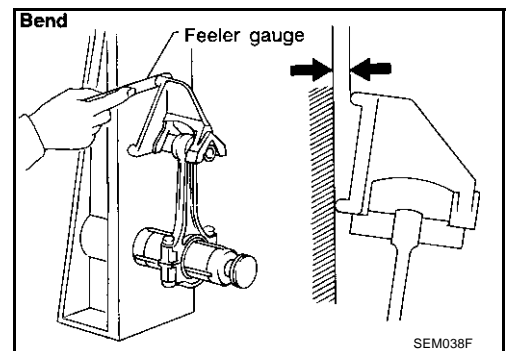
- Check with connecting rod aligner.

### Bend:

Limit : 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

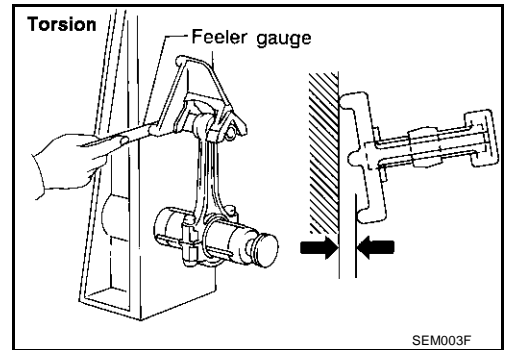
### Torsion:

Limit : 0.30 mm (0.0118 in) per 100 mm (3.94 in) length



# CYLINDER BLOCK

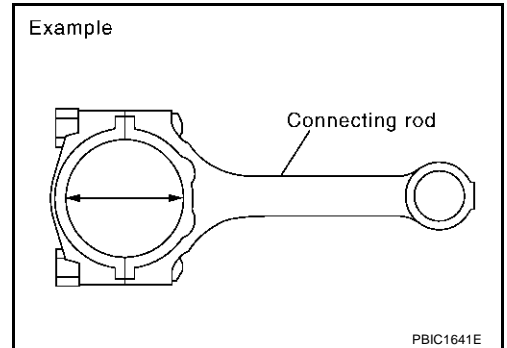
- If it exceeds the limit, replace connecting rod assembly.



## CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod bolt to the specified torque, measure the connecting rod big end inner diameter using an inside micrometer. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

**Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)**

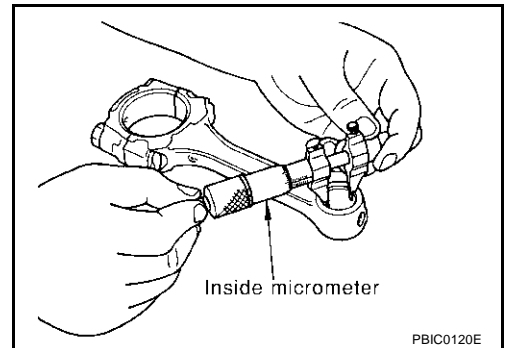


## CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

### Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of bushing.

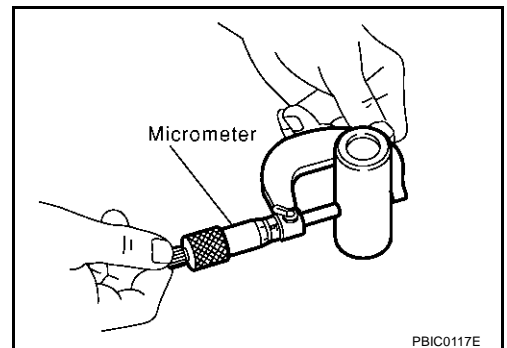
**Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)**



### Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

**Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)**



## Connecting Rod Bushing Oil Clearance (Small End)

(Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin)

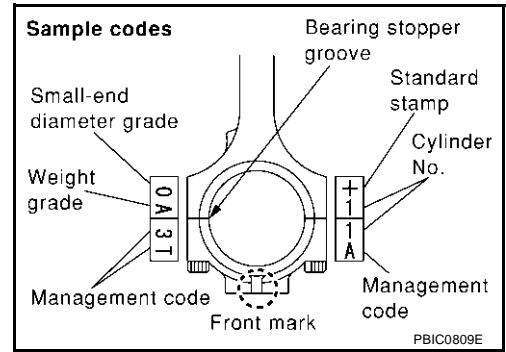
**Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**

**Limit : 0.030 mm (0.0012 in)**

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.

# CYLINDER BLOCK

- If replacing the piston and piston pin assembly, refer to [EM-127, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- If replacing the connecting rod assembly, refer to [EM-129, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

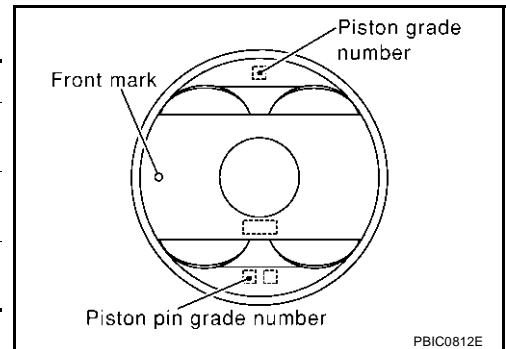


## Factory installed parts grading:

- Service parts apply only to grade 0.

Grade	Unit: mm (in)	
	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



## CYLINDER BLOCK DISTORTION

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

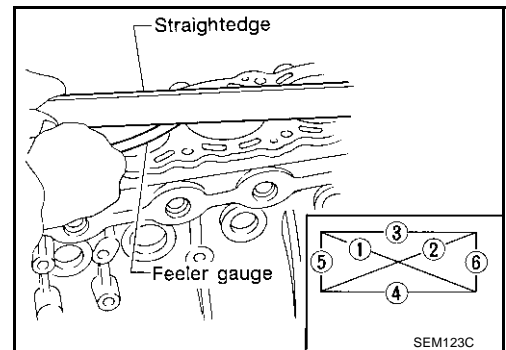
### CAUTION:

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

- Measure the distortion on the block upper face at some different points in 6 directions.

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

- If out of the distortion limit, replace the cylinder block.



## INNER DIAMETER OF MAIN BEARING HOUSING

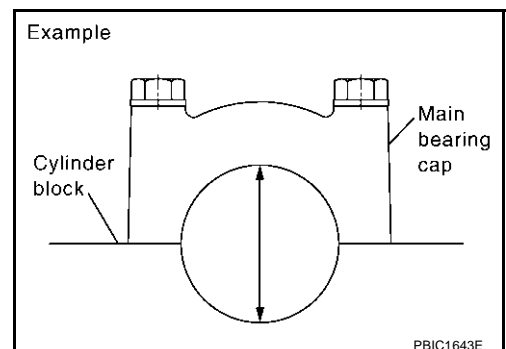
- Install the main bearing caps and main bearing beam with the main bearings removed, and tighten the mounting bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

**Standard : 63.993 - 64.017 mm (2.5194 - 2.5203 in)**

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

### NOTE:

Cylinder block cannot be replaced as a single part because it is machined together with main bearing cap.



# CYLINDER BLOCK

## PISTON TO CYLINDER BORE CLEARANCE

### Inner Diameter of Cylinder Bore

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at 6 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)**

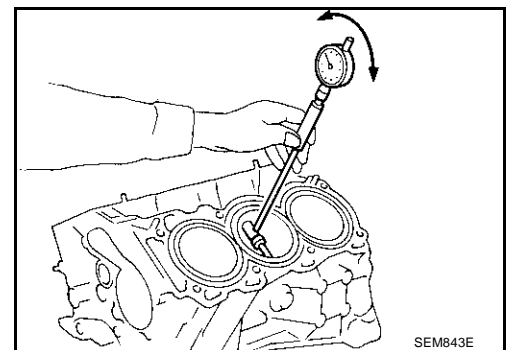
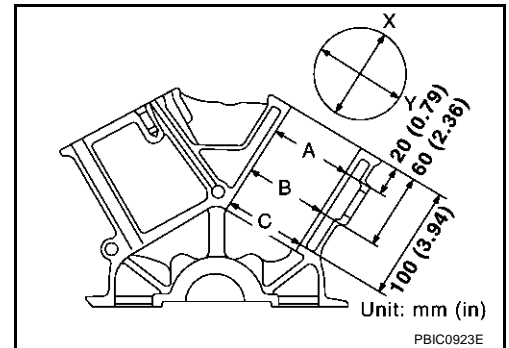
#### Taper limit (Difference between A and C):

**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 rebores the inner wall.
- An oversize piston is provided. When using an oversize piston, rebore the cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.

**Oversize (OS) : 0.2 mm (0.008 in)**

- When using an oversize piston, use oversize pistons for all cylinders with oversize piston rings.



### Outer Diameter of Piston

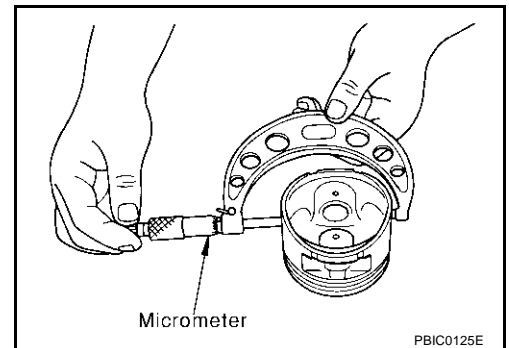
- Measure piston skirt outer diameter using micrometer.

#### 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 outer diameter of piston skirt and inner diameter of cylinder (direction Y, position B).  
(Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt).

**Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)**

**Limit : 0.08 mm (0.0031 in)**

- If it exceeds the limit, replace piston/piston pin assembly. Refer to [EM-118, "HOW TO SELECT PISTON"](#).

### Reboring Cylinder Bore

- Cylinder bore size is determined by adding piston-to-cylinder bore clearance to piston diameter.

**Rebored size calculation:  $D = A + B - C$**

**where,**

**D: Bored diameter**

**A: Piston diameter as measured**

**B: Piston - to - cylinder bore clearance (standard value)**

**C: Honing allowance 0.02 mm (0.0008 in)**

# CYLINDER BLOCK

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.
  - When any cylinder needs boring, all other cylinders must also be bored.
  - Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
4. Hone cylinders to obtain specified piston-to-cylinder bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.
  - Measurement should be done after cylinder bore cools down.

## OUTER DIAMETER OF CRANKSHAFT JOURNAL

- Measure outer diameter of crankshaft journals.

**Standard : 59.951 - 59.975 mm (2.3603 - 2.3612 in) dia.**

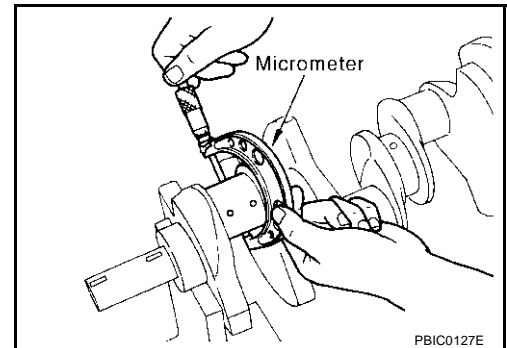
- If it is out of the standard, measure the main bearing oil clearance. Then use the undersize bearing. Refer to [EM-130, "MAIN BEARING OIL CLEARANCE"](#) .

## OUTER DIAMETER OF CRANKSHAFT PIN

- Measure outer diameter of crankshaft pin.

**Standard : 51.956 - 51.974 mm (2.0455 - 2.0462 in) dia.**

- If it is out of the standard, measure the connecting rod bearing oil clearance. Then use the undersize bearing. Refer to [EM-129, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .



## OUT-OF-ROUND AND TAPER OF CRANKSHAFT

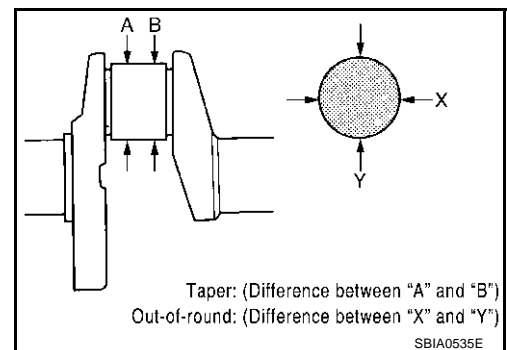
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with micrometer.
- Out-of-round is indicated by the difference in the dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in the dimensions between "A" and "B" 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 journal or pin. Then select the main bearing or connecting rod bearing. Refer to [EM-130, "MAIN BEARING OIL CLEARANCE"](#) or [EM-129, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .





# CYLINDER BLOCK

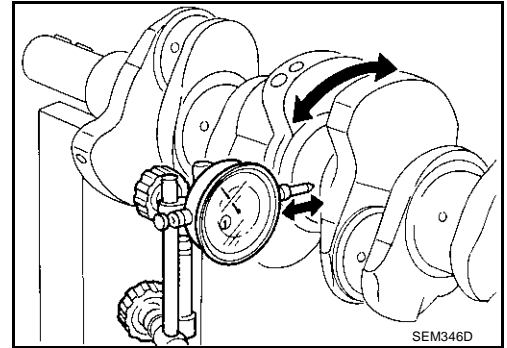
## CRANKSHAFT RUNOUT

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

**Standard : Less than 0.025 mm (0.0010 in)**

**Limit : 0.10 mm (0.004 in)**

- If it exceeds the limit, replace the crankshaft.



## CONNECTING ROD BEARING OIL CLEARANCE

### Method by Calculation

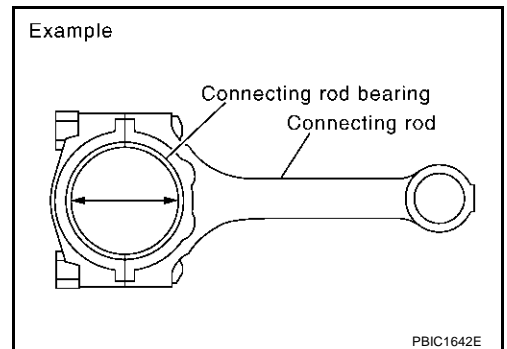
- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Using an inside micrometer measure the inner diameter of connecting rod bearing. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

(Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

**Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 in)**  
**(actual clearance)**

**Limit : 0.070 mm (0.0028 in)**

- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to [EM-118, "HOW TO SELECT CONNECTING ROD BEARING"](#).



### Method of Using Plastigauge

- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigauge slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

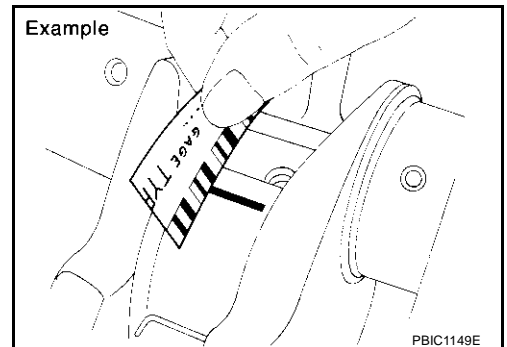
#### **CAUTION:**

**Never rotate the crankshaft.**

- Remove the connecting rod cap and bearings, and using the scale on the plastigauge bag, measure the plastigauge width.

#### **NOTE:**

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".

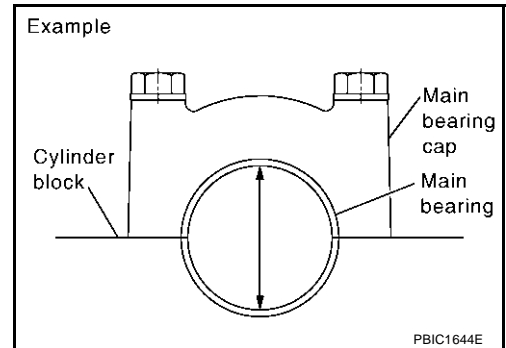


# CYLINDER BLOCK

## MAIN BEARING OIL CLEARANCE

### Method by Calculation

- Install the main bearings to the cylinder block and bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened with main bearing beam to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.  
(Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)



**Standard** : 0.035 - 0.045 mm (0.0014 - 0.0018 in) (actual clearance)

**Limit** : 0.065 mm (0.0026 in)

- If the measured value exceeds the limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to [EM-119, "HOW TO SELECT MAIN BEARING"](#).

### Method of Using Plastigauge

- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut a plastigauge slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts with main bearing beam to the specified torque. Refer to [EM-111, "ASSEMBLY"](#) for the tightening procedure.

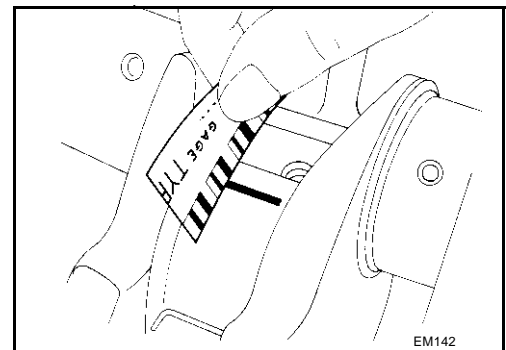
#### **CAUTION:**

**Never rotate the crankshaft.**

- Remove the bearing cap and bearings, and using the scale on the plastigauge bag, measure the plastigauge width.

#### **NOTE:**

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".

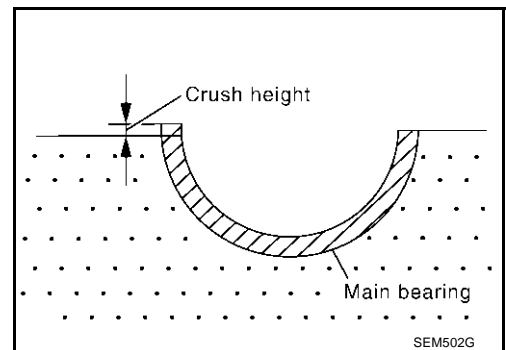


## CRUSH HEIGHT OF MAIN BEARING

- When the 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-111, "ASSEMBLY"](#) for the tightening procedure.

**Standard** : There must be crush height

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



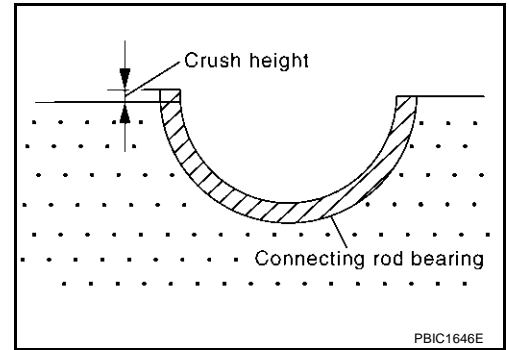
# CYLINDER BLOCK

## CRUSH HEIGHT OF CONNECTING ROD BEARING

- When the 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-111, "ASSEMBLY"](#) for the tightening procedure.

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

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

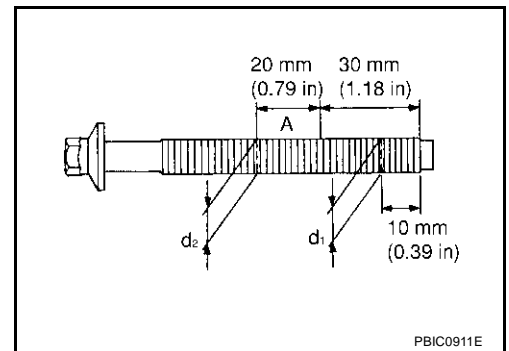


## OUTER DIAMETER OF MAIN BEARING CAP BOLT

- 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 (0.0051 in)

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



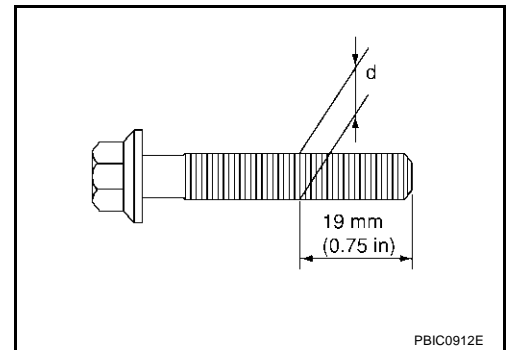
## OUTER DIAMETER OF CONNECTING ROD BOLT

- 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 bolt with new one.

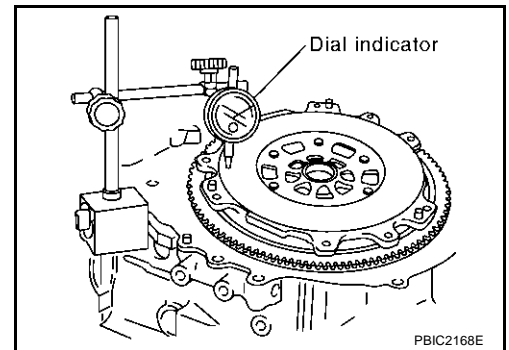


## FLYWHEEL DEFLECTION (M/T MODELS)

- 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.

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

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

# CYLINDER BLOCK

**Standard : 1.3 mm (0.051 in) or less**

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

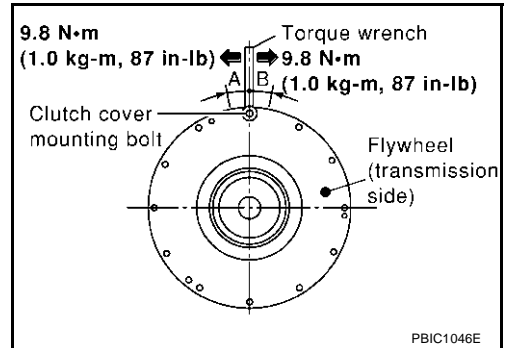
## Movement Amount of Radial (Rotation) Direction

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.

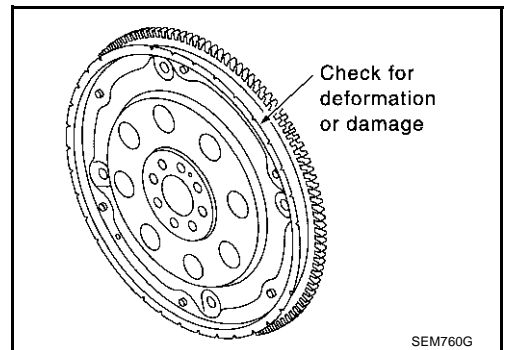


## DRIVE PLATE (A/T MODELS)

- 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.

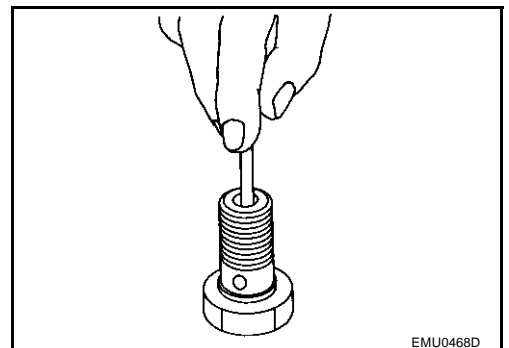


## OIL JET

- 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 a 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)

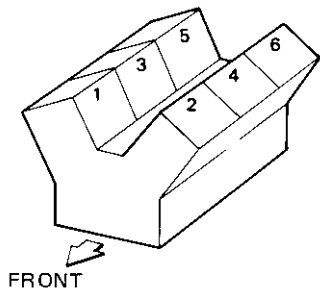
PFP:00100

### Standard and Limit GENERAL SPECIFICATIONS

ABS0000Y

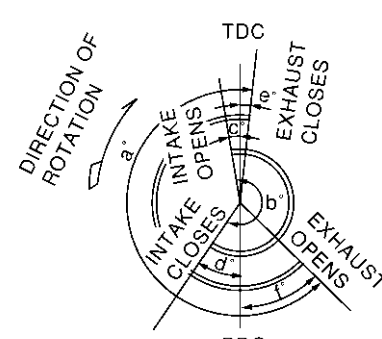
Cylinder arrangement		V-6
Displacement cm <sup>3</sup> (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3
Compression pressure kPa (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



SEM713A

Valve timing  
(Intake valve timing control - OFF)



PBIC0187E

Unit: degree

a	b	c	d	e	f
240	238	- 6	64	8	52

### INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

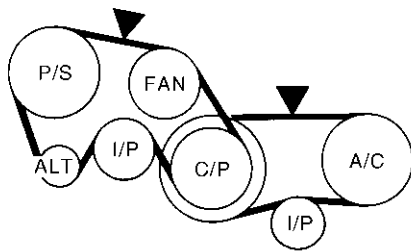
		Limit
Surface distortion	Intake manifold collector upper	0.1 (0.004)
	Intake manifold collector lower	0.1 (0.004)
	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## DRIVE BELT

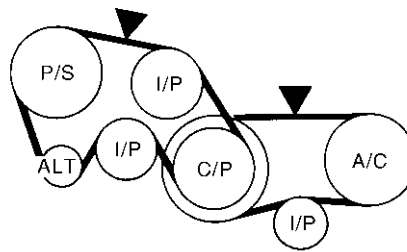
	Deflection adjustment		Unit: mm (in)	Tension adjustment* <sup>1</sup>		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator, power steering oil pump and fan belt* <sup>2</sup>	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Air conditioning compressor	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)			—		

A/T model



PBIC1628E

M/T model



PBIC1629E

\*<sup>1</sup> : If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

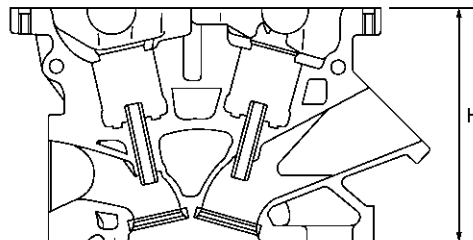
\*<sup>2</sup> : Alternator and power steering oil pump belt for M/T models

## SPARK PLUG

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (nominal)	1.1 mm (0.043 in)

## CYLINDER HEAD

	Unit: mm (in)	
	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	126.3 - 126.5 (4.972 - 4.980)	—



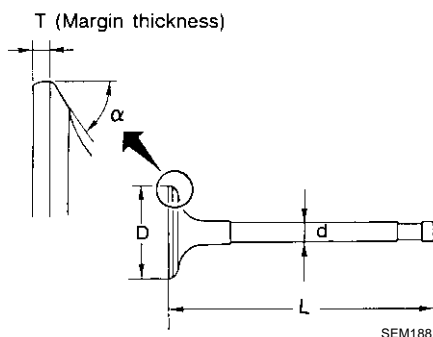
PBIC0924E

# SERVICE DATA AND SPECIFICATIONS (SDS)

## VALVE

### Valve Dimensions

Unit: mm (in)



Valve head diameter "D"	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	96.46 (3.7976)
	Exhaust	93.99 (3.7004)
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		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

### 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)

### Valve Spring

Free height	mm (in)	45.62 (1.7961)
Pressure	N (kg, lb) at height mm (in)	Installation 184 - 208 (18.8 - 21.2, 41.4 - 46.8) at 37.0 (1.457)
		Valve open 407 - 459 (41.5 - 46.8, 91.5 - 103.2) at 27.8 (1.094)
Out-of-square	mm (in)	Less than 2.0 (0.079)

### Valve Lifter

Unit: mm (in)

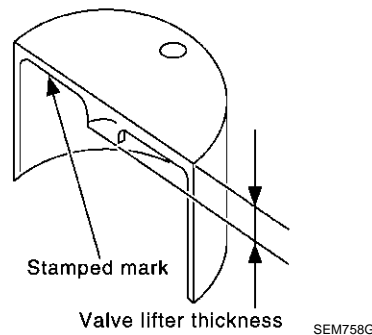
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Lifter guide inner diameter	34.000 - 34.016 (1.3386 - 1.3392)
Clearance between lifter and lifter guide	0.013 - 0.039 (0.0005 - 0.0015)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Available Valve Lifter

Unit: mm (in)

Identification Mark	Thickness
788U or 788R	7.88 (0.3102)
790U or 790R	7.90 (0.3110)
792U or 792R	7.92 (0.3118)
794U or 794R	7.94 (0.3126)
796U or 796R	7.96 (0.3134)
798U or 798R	7.98 (0.3142)
800U or 800R	8.00 (0.3150)
802U or 802R	8.02 (0.3157)
804U or 804R	8.04 (0.3165)
806U or 806R	8.06 (0.3173)
808U or 808R	8.08 (0.3181)
810U or 810R	8.10 (0.3189)
812U or 812R	8.12 (0.3197)
814U or 814R	8.14 (0.3205)
816U or 816R	8.16 (0.3213)
818U or 818R	8.18 (0.3220)
820U or 820R	8.20 (0.3228)
822U or 822R	8.22 (0.3236)
824U or 824R	8.24 (0.3244)
826U or 826R	8.26 (0.3252)
828U or 828R	8.28 (0.3260)
830U or 830R	8.30 (0.3268)
832U or 832R	8.32 (0.3276)
834U or 834R	8.34 (0.3283)
836U or 836R	8.36 (0.3291)
838U or 838R	8.38 (0.3299)
840U or 840R	8.40 (0.3307)

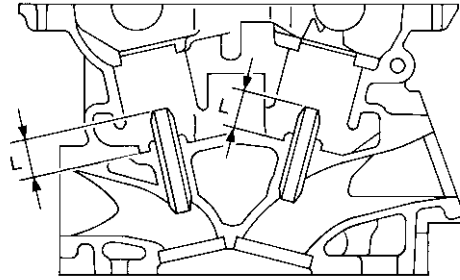




# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Guide

Unit: mm (in)



SEM950E

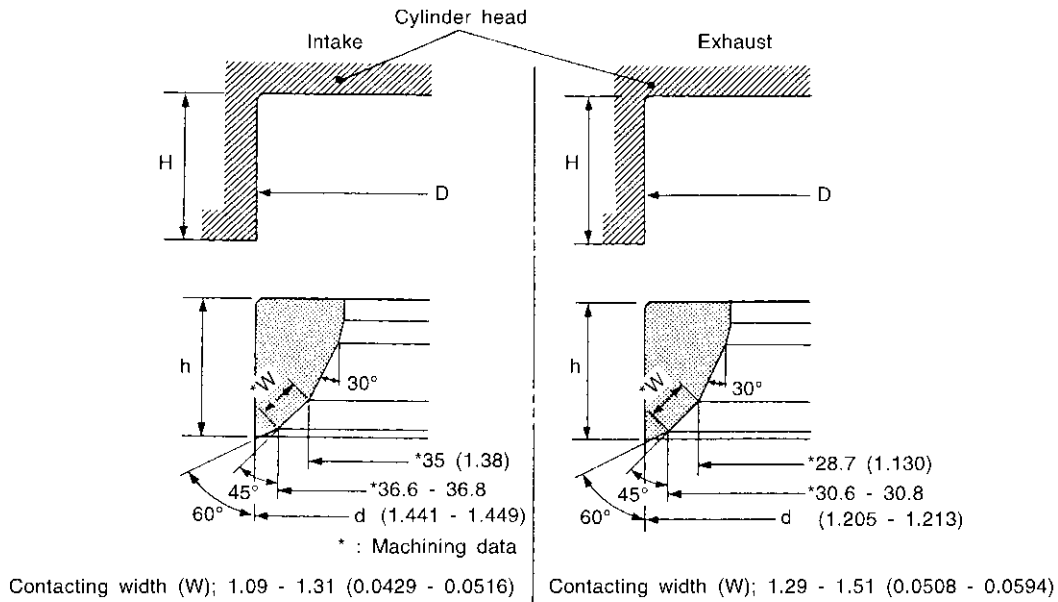
Items		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference 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 (0.0031)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length "L"		12.6 - 12.8 (0.496 - 0.504)	

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

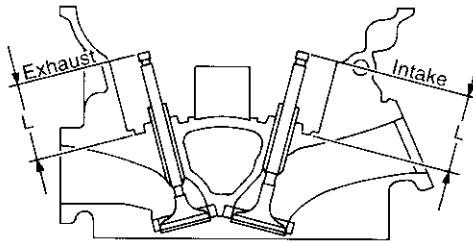
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Seat

Unit: mm (in)



SEM021EB



SEM621F

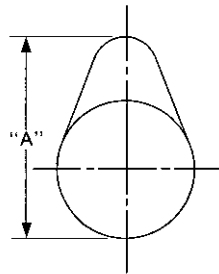
Items		Standard	Service
Cylinder head seat recess diameter (D)	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
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)
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)		5.9 - 6.1 (0.232 - 0.240)	
Depth (L)	Intake	41.07 - 41.67 (1.6169 - 1.6405)	
	Exhaust	41.00 - 41.60 (1.6142 - 1.6378)	

# SERVICE DATA AND SPECIFICATIONS (SDS)

## CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items	Standard	Limit
Camshaft journal to bearing clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)
Inner diameter of camshaft bearing	No. 1	26.000 - 26.021 (1.0236 - 1.0244)
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)
Outer diameter of camshaft journal	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)
Camshaft cam height "A"	Intake and exhaust	44.865 - 45.055 (1.7663 - 1.7738)
Camshaft runout [TIR* <sup>2</sup> ]		Less than 0.02 (0.0010)
Camshaft sprocket runout [TIR* <sup>2</sup> ]		—



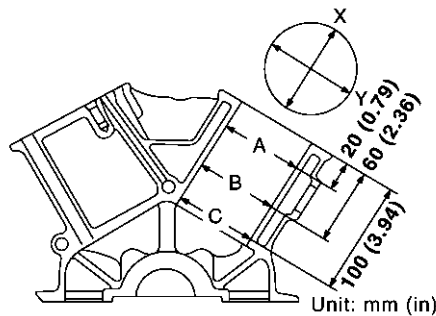
SEM671

\*<sup>1</sup> : Cam wear limit

\*<sup>2</sup> : Total indicator reading

## CYLINDER BLOCK

Unit: mm (in)



PBIC0923E

Surface flatness	Limit	0.1 (0.004)	
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	0.20 (0.0079)	
Out-of-round (Difference between X and Y)		Less than 0.015 (0.0006)	
Taper (Difference between A and C)		Less than 0.010 (0.0004)	

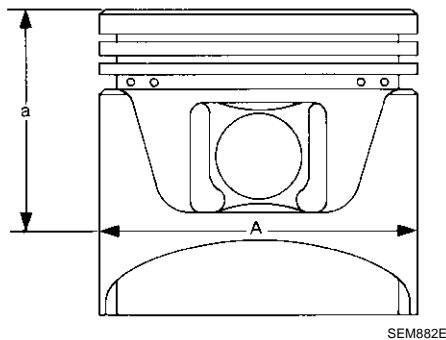
## SERVICE DATA AND SPECIFICATIONS (SDS)

Main journal inner diameter grade (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)

### PISTON, PISTON RING AND PISTON PIN

#### Available Piston

Unit: mm (in)



Piston skirt diameter "A"	Standard	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)
		Grade No. 2* <sup>1</sup>	95.490 - 95.500 (3.7594 - 3.7598)
		Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)
		0.2 (0.008) oversize (Service)	95.680 - 95.710 (3.7669 - 3.7681)
"a" dimension			41.0 (1.614)
Piston pin hole diameter		Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)
		Grade No. 1* <sup>2</sup>	21.999 - 22.005 (0.8661 - 0.8663)
Piston clearance to cylinder block		Standard	0.010 - 0.030 (0.0004 - 0.0012)
		Limit	0.08 (0.0031)

\*1 : No grade number may be stamped on piston.

\*2 : No service parts are available.

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.95 (0.0374)

## Piston Pin

Unit: mm (in)

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)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing oil clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)
	Limit	0.030 (0.0012)

\*: No service parts are available

## CONNECTING ROD

Unit: mm (in)

Center distance		144.15 - 144.25 (5.6752 - 5.6791)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - 0.9449)
Piston pin bushing inner diameter* <sup>1</sup>	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1* <sup>2</sup>	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end inner diameter		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

\*<sup>1</sup> : After installing in connecting rod

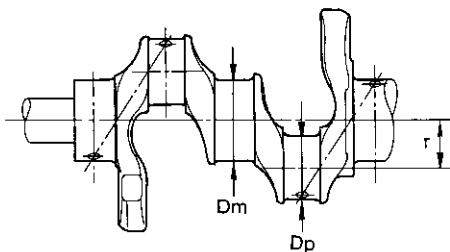
\*<sup>2</sup> : No service parts are available.

# SERVICE DATA AND SPECIFICATIONS (SDS)

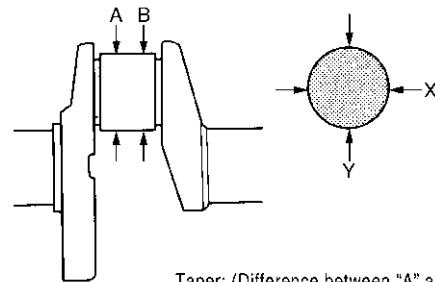
## CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm" grade	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
	Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
	Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
	Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
	Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
	Grade No. F	59.970 - 59.969 (2.3610 - 2.3610)
	Grade No. G	59.969 - 59.968 (2.3610 - 2.3609)
	Grade No. H	59.968 - 59.967 (2.3609 - 2.3609)
	Grade No. J	59.967 - 59.966 (2.3609 - 2.3609)
	Grade No. K	59.966 - 59.965 (2.3609 - 2.3608)
	Grade No. L	59.965 - 59.964 (2.3608 - 2.3608)
	Grade No. M	59.964 - 59.963 (2.3608 - 2.3607)
	Grade No. N	59.963 - 59.962 (2.3607 - 2.3607)
	Grade No. P	59.962 - 59.961 (2.3607 - 2.3607)
	Grade No. R	59.961 - 59.960 (2.3607 - 2.3606)
	Grade No. S	59.960 - 59.959 (2.3606 - 2.3606)
	Grade No. T	59.959 - 59.958 (2.3606 - 2.3605)
	Grade No. U	59.958 - 59.957 (2.3605 - 2.3605)
	Grade No. V	59.957 - 59.956 (2.3605 - 2.3605)
Grade No. W	59.956 - 59.955 (2.3605 - 2.3604)	
Grade No. X	59.955 - 59.954 (2.3604 - 2.3604)	
Grade No. Y	59.954 - 59.953 (2.3604 - 2.3603)	
Grade No. 4	59.953 - 59.952 (2.3603 - 2.3603)	
Grade No. 7	59.952 - 59.951 (2.3603 - 2.3603)	
Pin journal dia. "Dp"	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 (2.0445 - 2.0457)
Center distance "r"		40.36 - 40.44 (1.5890 - 1.5921)
Out-of-round (Difference between "X" and "Y")	Standard	Less than 0.002 (0.0001)
Taper (Difference between "A" and "B")	Standard	Less than 0.002 (0.0001)
Crankshaft runout [TIR*]	Limit	Less than 0.10 (0.0039)
Crankshaft end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)



SEM645



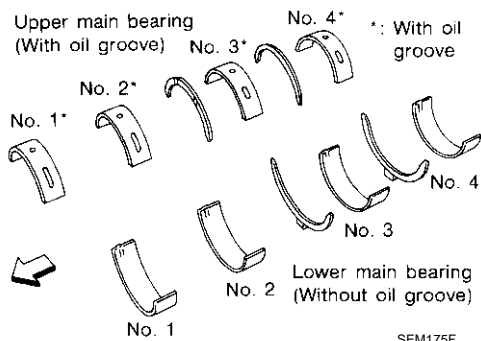
Taper: (Difference between "A" and "B")  
Out-of-round: (Difference between "X" and "Y")

SBIA0535E

\*: Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

## AVAILABLE MAIN BEARING



Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color (UPR/LWR)	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	
01	UPP	2.003 - 2.006 (0.0789 - 0.0790)	Brown/Black	Grade is different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)	Green/Brown	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow/Green	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue/Yellow	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink/Blue	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple/Pink	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White/Purple	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)		

## Undersize

Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

## CONNECTING ROD BEARING

Grade number	Thickness "T" 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

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Undersize

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

## BEARING OIL CLEARANCE

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.034 - 0.059 (0.0013 - 0.0023)*
	Limit	0.070 (0.0028)
Main bearing oil clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)*
	Limit	0.065 (0.0026)

\*: Actual clearance

## MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel deflection [TIR]*	Standard	0.45 (0.0177) or less
Flywheel movement in thrust direction		1.3 (0.051) or less
Flywheel movement in rotation direction		24 (0.94) or less

\*: Total indicator reading

## Tightening Torque

ABS000JH

\*1: Parts to be tightened in particular orders.

1):- Order of tightening when tightening two or more times separately.

Unit: N·m (kg·m, ft·lb)  
Unit: N·m (kg·m, in·lb)\*2

Air duct	7.2 - 10.8 (0.74 - 1.1, 64 - 95)*2
Air cleaner case	4.4 - 6.6 (0.45 - 0.67, 39 - 58)*2
Resonator	4.4 - 6.6 (0.45 - 0.67, 39 - 58)*2
Mass air flow sensor	5.0 - 6.5 (0.51 - 0.66, 45 - 57)*2
Engine cover	5.0 - 6.5 (0.51 - 0.66, 45 - 57)*2
*1 Intake manifold collector (upper)	11.8 - 13.7 (1.2 - 1.3, 9 - 10)
*1 Intake manifold collector (lower)	11.8 - 13.7 (1.2 - 1.3, 9 - 10)
*1 Intake manifold	1) 4.9 - 9.8 (0.50 - 1.0, 4 - 7) 2) 26.5 - 31.4 (2.7 - 3.2, 20 - 23)
*1 Electric throttle control actuator	7.2 - 9.7 (0.74 - 0.98, 64 - 85)*2
EVAP canister purge volume control solenoid valve	12.7 - 15.7 (1.3 - 1.6, 10 - 11)
Exhaust manifold cover	5.1 - 6.5 (0.52 - 0.66, 46 - 57)*2
Exhaust manifold stud	12.7 - 16.7 (1.3 - 1.7, 10 - 12)
*1 Exhaust manifold	28.5 - 32.4 (2.9 - 3.3, 21 - 23)
Heated oxygen sensor 1	40 - 50 (4.1 - 5.1, 30 - 36)
Heated oxygen sensor 2	40 - 50 (4.1 - 5.1, 30 - 36)
*1 Oil pan (lower)	8.3 - 9.3 (0.85 - 0.94, 74 - 82)*2
*1 Oil pan (upper)	15.7 - 18.6 (1.6 - 1.9, 12 - 13)
Oil strainer	19.6 - 23.5 (2.0 - 2.4, 15 - 17)
Oil pan drain plug	29.4 - 39.2 (3.0 - 4.0, 22 - 28)
Rear plate cover	6.4 - 7.5 (0.65 - 0.76, 57 - 65)*2
Crankshaft position sensor (POS)	8.4 - 10.8 (0.86 - 1.1, 75 - 95)*2



## SERVICE DATA AND SPECIFICATIONS (SDS)

Fuel hose clamp bracket (right side member)		4.3 - 5.7 (0.44 - 0.58, 38 - 50)* <sup>2</sup>	A
Fuel feed hose (with damper)		7.2 - 9.6 (0.74 - 0.97, 64 - 84)* <sup>2</sup>	
Fuel sub-tube		8.4 - 10.8 (0.86 - 1.1, 75 - 95)* <sup>2</sup>	
Fuel damper		8.4 - 10.8 (0.86 - 1.1, 75 - 95)* <sup>2</sup>	EM
*1 Fuel tube		1) 9.3 - 10.8 (0.95 - 1.1, 6.9 - 7.9)* <sup>2</sup> 2) 20.6 - 26.5 (2.1 - 2.7, 16 - 19)	C
Ignition coil		9.0 (0.92, 80)* <sup>2</sup>	
Spark plug		24.5 (2.5, 18)	D
*1 Rocker cover		1) 0.96 - 2.96 (0.10 - 0.30, 9 - 26)* <sup>2</sup> 2) 7.33 - 9.33 (0.75 - 0.95, 65 - 82)* <sup>2</sup>	E
PCV valve		1.96 - 2.94 (0.20 - 0.29, 18 - 26)* <sup>2</sup>	
*1 Intake valve timing control cover		9.8 - 12.7 (1.0 - 1.3, 87 - 112)* <sup>2</sup>	F
Camshaft sprocket (INT)		98 - 108 (10.0 - 11.0, 73 - 79)	
Camshaft sprocket (EXH)		118 - 128 (12.0 - 13.1, 87 - 94)	
Timing chain tensioner (primary)		6.9 - 9.3 (0.70 - 0.95, 61 - 82)* <sup>2</sup>	G
Timing chain tensioner (secondary)		7.0 - 10.0 (0.71 - 1.02, 62 - 88)* <sup>2</sup>	
Internal chain guide		6.9 - 9.3 (0.70 - 0.95, 61 - 82)* <sup>2</sup>	H
Tension guide		19.6 - 23.5 (2.0 - 2.3, 15 - 17)	
Slack guide		12.7 - 18.6 (1.3 - 1.9, 10 - 13)	
Crankshaft pulley		1) 39.2 - 49.0 (4.0 - 5.0, 29 - 36) 2) 60° - 66° (angle tightening)	I
Drive belt idler pulley		24.5 - 31.4 (2.5 - 3.2, 18 - 23)	
Chain tensioner cover		9.8 - 12.8 (1.0 - 1.3, 87 - 112)* <sup>2</sup>	J
Water pump cover		9.8 - 12.8 (1.0 - 1.3, 87 - 112)* <sup>2</sup>	
Water hose clamp mounting bolt		68.6 - 79.4 (7.0 - 8.1, 51 - 58)	K
*1 Front timing chain case	M6 bolt	11.7 - 13.7 (1.2 - 1.4, 9 - 10)	
	M8 bolt	25.5 - 31.3 (2.6 - 3.2, 19 - 23)	
*1 Rear timing chain case		11.7 - 13.7 (1.2 - 1.4, 9 - 10)	L
*1 Camshaft bracket		1) 1.96 (0.2, 17)* <sup>2</sup> 2) 5.88 (0.6, 52)* <sup>2</sup> 3) 9.02 - 11.8 (0.92 - 1.20, 80 - 104)* <sup>2</sup>	M
Camshaft position sensor (PHASE)		8.4 - 10.8 (0.86 - 1.1, 75 - 95)* <sup>2</sup>	
Intake valve timing control solenoid valve		9.8 - 12.7 (1.0 - 1.3, 87 - 112)* <sup>2</sup>	
*1 Cylinder head		1) 98.1 (10.0, 72) 2) 0 (0.0, 0) 3) 34.3 - 44.1 (3.5 - 4.4, 26 - 32) 4) 90° - 95° (angle tightening) 5) 90° - 95° (angle tightening)	
*1 Main bearing cap		1) 32.3 - 38.3 (3.3 - 3.9, 24 - 28) 2) 90° - 95° (angle tightening)	
Connecting rod		1) 18.6 - 20.6 (1.9 - 2.1, 14 - 15) 2) 90° - 95° (angle tightening)	

## SERVICE DATA AND SPECIFICATIONS (SDS)

Oil jet	23.5 - 30.4 (2.4 - 3.1, 18 - 22)
Knock sensor	20.6 - 26.5 (2.1 - 2.7, 16 - 19)
Drive plate (A/T models)	83.3 - 93.1 (8.5 - 9.5, 62 - 68)
Flywheel (M/T models)	83.3 - 93.1 (8.5 - 9.5, 62 - 68)
Rear oil seal retainer	8.1 - 9.4 (0.83 - 0.96, 72 - 83)* <sup>2</sup>
Cylinder block heater (for Canada)	73.5 (7.5, 54)
Water connector (for Canada)	9.8 (1.0, 87)* <sup>2</sup>