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# SECTION **EM**

## ENGINE MECHANICAL

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# PRECAUTIONS

## PRECAUTIONS

PPF:00001

### Precautions for Drain Engine Coolant

ABS004RJ

Drain engine coolant when engine is cooled.

### Precautions for Disconnecting Fuel Piping

ABS004RK

- 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

ABS004RL

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

### Precautions for Inspection, Repair and Replacement

ABS004RM

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

### Precautions for Assembly and Installation

ABS004RN

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

### Parts Requiring Angular Tightening

ABS004RO

- Use an angle wrench for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Main bearing cap bolts
  - Connecting rod cap nuts
  - 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

## Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

ABS004RP

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

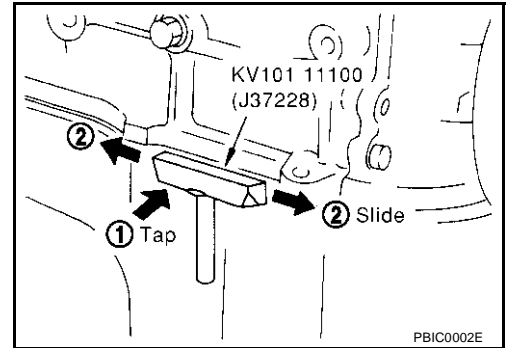
**CAUTION:**

**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.

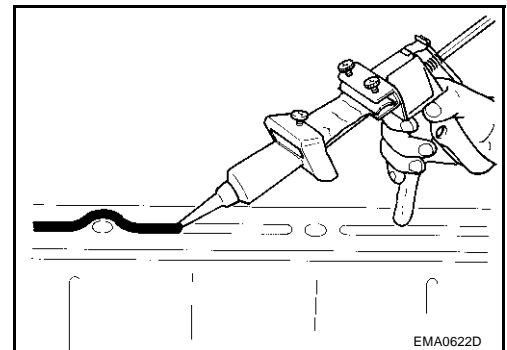
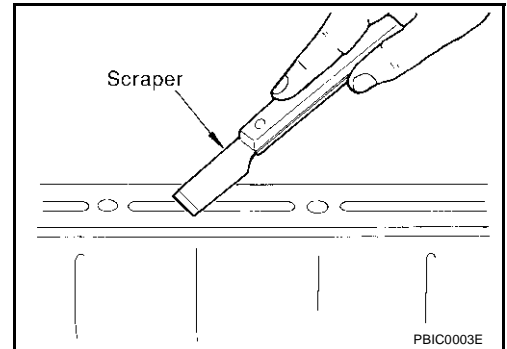
**CAUTION:**

**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

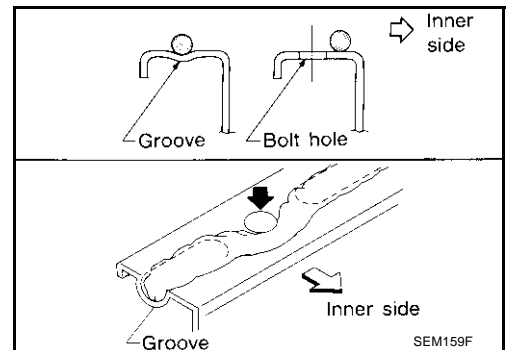
1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
  - Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
3. Attach the liquid gasket tube to the tube presser.  
**Use Genuine RTV silicone sealant or equivalent. Refer to [GI-46, "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 liquid gasket to the groove.



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

**CAUTION:**

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



# PREPARATION

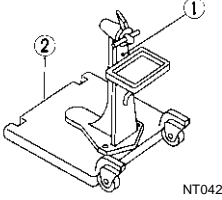
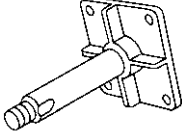
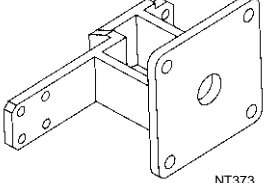
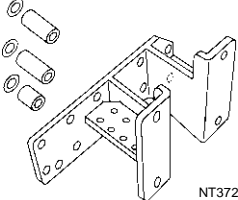
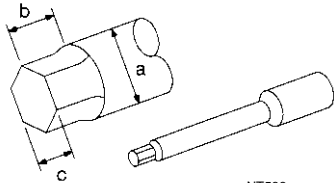
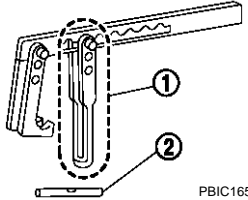
## PREPARATION

PPF:00002

### Special Service Tools

ABS00325

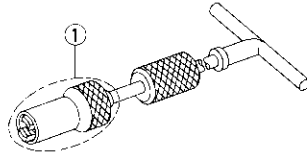
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 ( — ) Engine stand assembly 1. ST05011000 ( — ) Engine stand 2. ST05012000 ( — ) Base	Disassembling and assembling  NT042
KV10106500 ( — ) Engine stand shaft	 NT028
KV10117000 (J41262) Engine sub-attachment	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).  NT373
KV10117001 ( — ) Engine sub-attachment	Installing on the cylinder block  NT372
ST10120000 (J24239-01) Cylinder head bolt wrench	Loosening and tightening cylinder head bolt <b>a: 13 (0.51) dia.</b> <b>b: 12 (0.47)</b> <b>c: 10 (0.39)</b> Unit: mm (in)  NT583
KV10116200 (J26336-B) Valve spring compressor 1. KV10115900 (J26336-20) Attachment 2. KV10109230 ( — ) Adapter	Disassembling valve mechanism  PBIC1650E

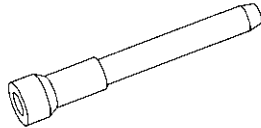
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# PREPARATION

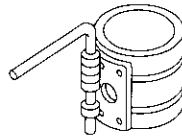
Tool number (Kent-Moore No.) Tool name	Description
KV10107902 (J38959) Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	Removing valve oil seal
(J39386) Valve oil seal drift	Installing valve oil seal
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore
ST16610001 (J23907) Pilot bushing puller	Removing crankshaft pilot bushing
KV10111100 (J37228) Seal cutter	Removing steel oil pan and rear timing chain case
WS39930000 ( — ) Tube presser	Pressing the tube of liquid gasket
KV10112100 (BT8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle



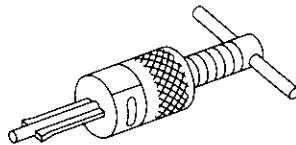
S-NT605



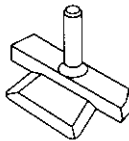
NT024



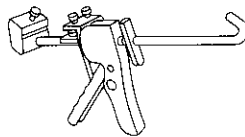
NT044



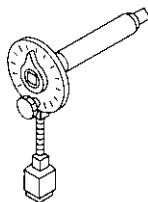
NT045



NT046

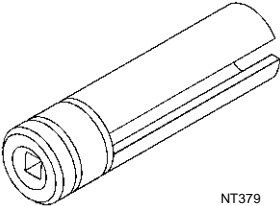
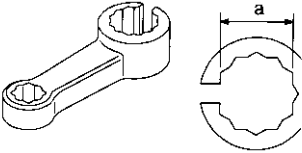
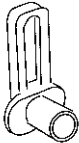


NT052



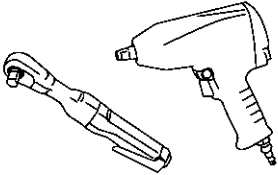
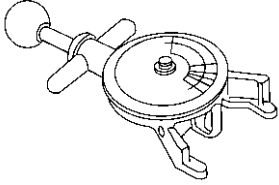
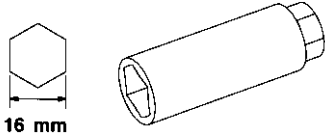
NT014

# PREPARATION


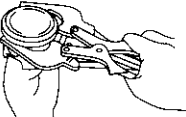
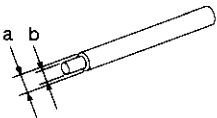
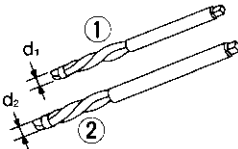
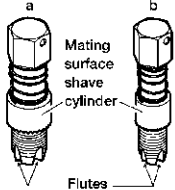
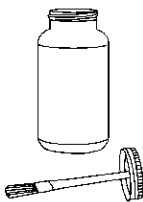
Tool number (Kent-Moore No.) Tool name	Description	
KV10117100 (J3647-A) Heated oxygen sensor wrench   NT379	Loosening or tightening heated oxygen sensor <b>For 22 mm (0.87 in) width hexagon nut</b>	A  <b>EM</b>  C
KV10117200 (J38365) Heated oxygen sensor wrench   NT636	Loosening or tightening rear heated oxygen sensor <b>a: 22 mm (0.87 in)</b>	D  E
— (J-45488) Quick connector release   PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CTALOG: Part No. 16441 6N210)	F  G  H

## Commercial Service Tools

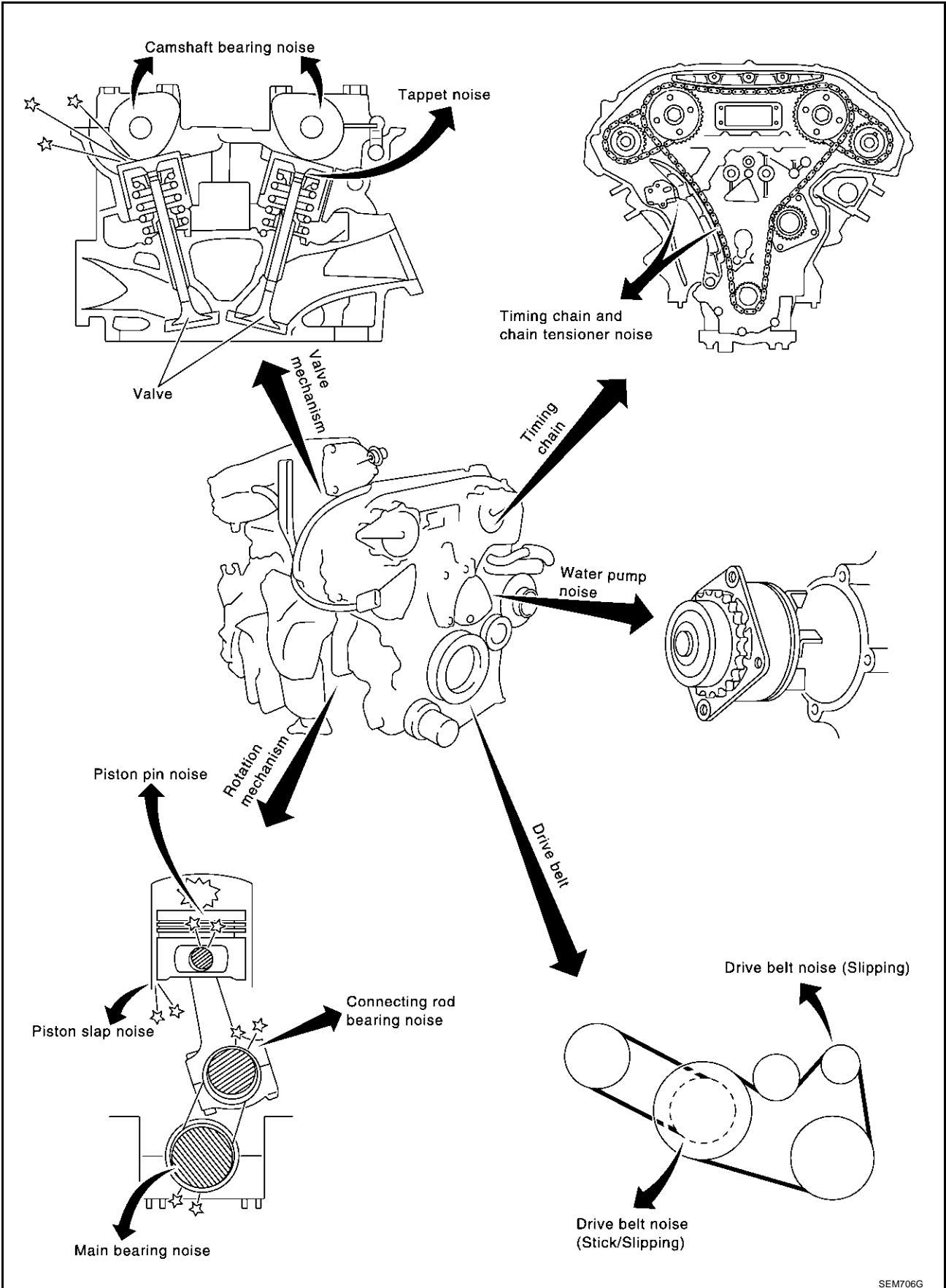
ABS00326

(Kent-Moore No.) Tool name	Description	
Power tool   PBIC0190E	Loosening bolts and nuts	I  J  K
(BT3373-F) Belt tension gauge   AMA126	Checking drive belt tension	L  M
Spark plug wrench   NT047	Removing and installing spark plug	

# PREPARATION

(Kent-Moore No.) Tool name	Description	
Valve seat cutter set   NT048	Finishing valve seat dimensions	
Piston ring expander   NT030	Removing and installing piston ring	
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>	
Valve guide reamer   NT016	Reaming valve guide with 1 or hole for oversize valve guide with 2 <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>	
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 AEM488	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>
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 AEM489	Lubricating heated oxygen sensor thread cleaning tool when reconditioning exhaust system threads





SEM706G

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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

ABS00328

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-77</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal clearance	<a href="#">EM-72</a> <a href="#">EM-72</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-115</a> <a href="#">EM-117</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-119</a> <a href="#">EM-116</a> <a href="#">EM-116</a> <a href="#">EM-116</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-117</a> <a href="#">EM-121</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-122</a> <a href="#">EM-121</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-11</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-20_ "WATER PUMP"</a>

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

# DRIVE BELTS

## DRIVE BELTS

PF0:02117

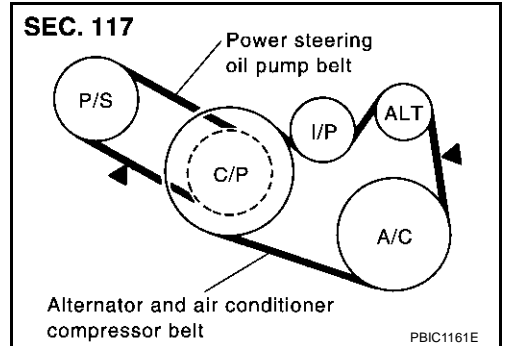
### Checking Drive Belts

ABS00329

#### WARNING:

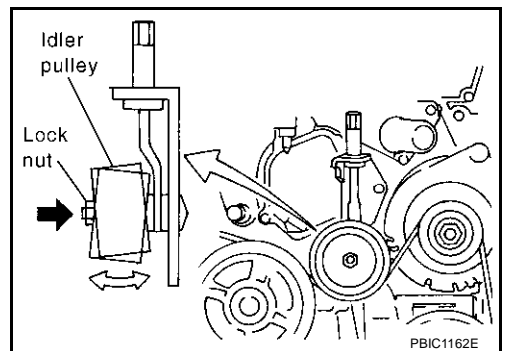
Be sure to perform when the engine is stopped.

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*		Unit: N (kg, lb)
	Used belt			New belt	Used belt	
	Limit	After adjustment	Limit		After adjustment	New belt
Alternator and air conditioner compressor	7 (0.28)	4.2 - 4.6 (0.17 - 0.18)	3.7 - 4.1 (0.15 - 0.16)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Power steering oil pump	11 (0.43)	7.3 - 8 (0.29 - 0.30)	6.5 - 7.2 (0.26 - 0.28)	196 (20, 44)	495 - 583 (50.5 - 59.5, 111 - 131)	603 - 691 (61.5 - 70.5, 135.6 - 155.4)
Applied pushing force	98 N (10 Kg, 22 lb)			—		

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

### Tension Adjustment

ABS0036V

Portion	Belt tightening method for adjustment
Power steering oil pump belt	Adjusting bolt on power steering oil pump
Alternator and air conditioner compressor belt	Adjusting bolt on idler pulley

#### CAUTION:


- When belt is replaced with a new one, adjust it to value for “New belt” to accommodate for insufficient adaptability with pulley grooves.

# DRIVE BELTS


- When deflection or tension of belt being used exceeds "Used belt limit", adjust it to value for "After adjustment of used belt".
- 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.

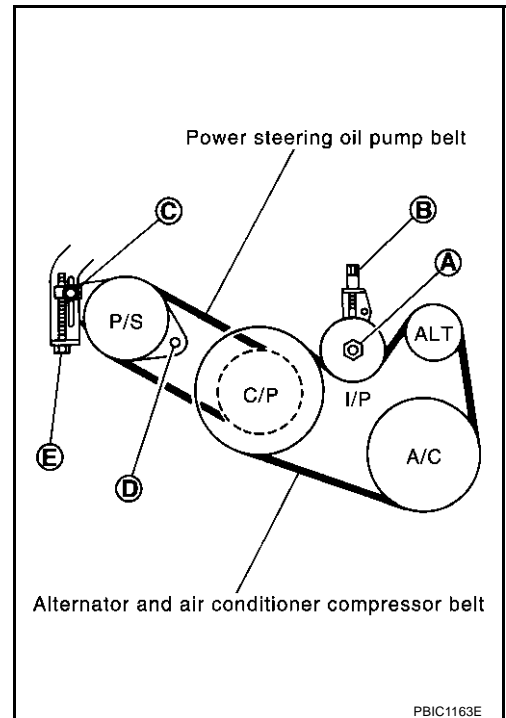
## ALTERNATOR AND AIR CONDITIONER COMPRESSOR BELT

1. Remove splash guard (RH).
2. Loosen idler pulley lock nut (A) and adjust tension by turning adjusting bolt (B).
  - For specified belt tension, refer to [EM-11, "Checking Drive Belts"](#).
3. Tighten lock nut (A).

 : 30.4 - 39.2 N-m (3.1 - 3.9 kg-m, 23 - 28 ft-lb)

4. Tighten adjusting bolt (B).

 : 3.9 - 6.9 N-m (0.4 - 0.7 kg-m, 35 - 61 in-lb)



## POWER STEERING OIL PUMP BELT

1. Remove splash guard (RH).
2. Loosen adjusting bolt (C).
3. Loosen power steering oil pump mounting bolt (D).
  - Bolt head (D) is engine rear side.
4. Adjust by turning adjusting bolt (E).
  - For specified belt tension, refer to [EM-11, "Checking Drive Belts"](#).

### NOTE:

Adjusting bolt (E) is loosened with counter-clockwise rotation.

5. Tighten bolt (C), then bolt (D).

### Tightening torque:

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

**Bolt (D) : 36.3 - 50.0 N-m (3.7 - 5.1 kg-m, 27 - 36 ft-lb)**

## Removal and Installation

### REMOVAL

1. Remove splash guard (RH).
2. Fully loosen each belt by following the guidelines in [EM-11, "Tension Adjustment"](#). Remove alternator and air conditioner compressor belt and then power steering oil pump belt.

### CAUTION:

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

ABS0036W

# DRIVE BELTS

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## INSTALLATION

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

**CAUTION:**

- **Make sure belt is correctly engaged with the pulley groove.**
- **Check for oil and engine coolant on belt and each pulley groove.**

2. Adjust belt tension. Refer to [EM-11, "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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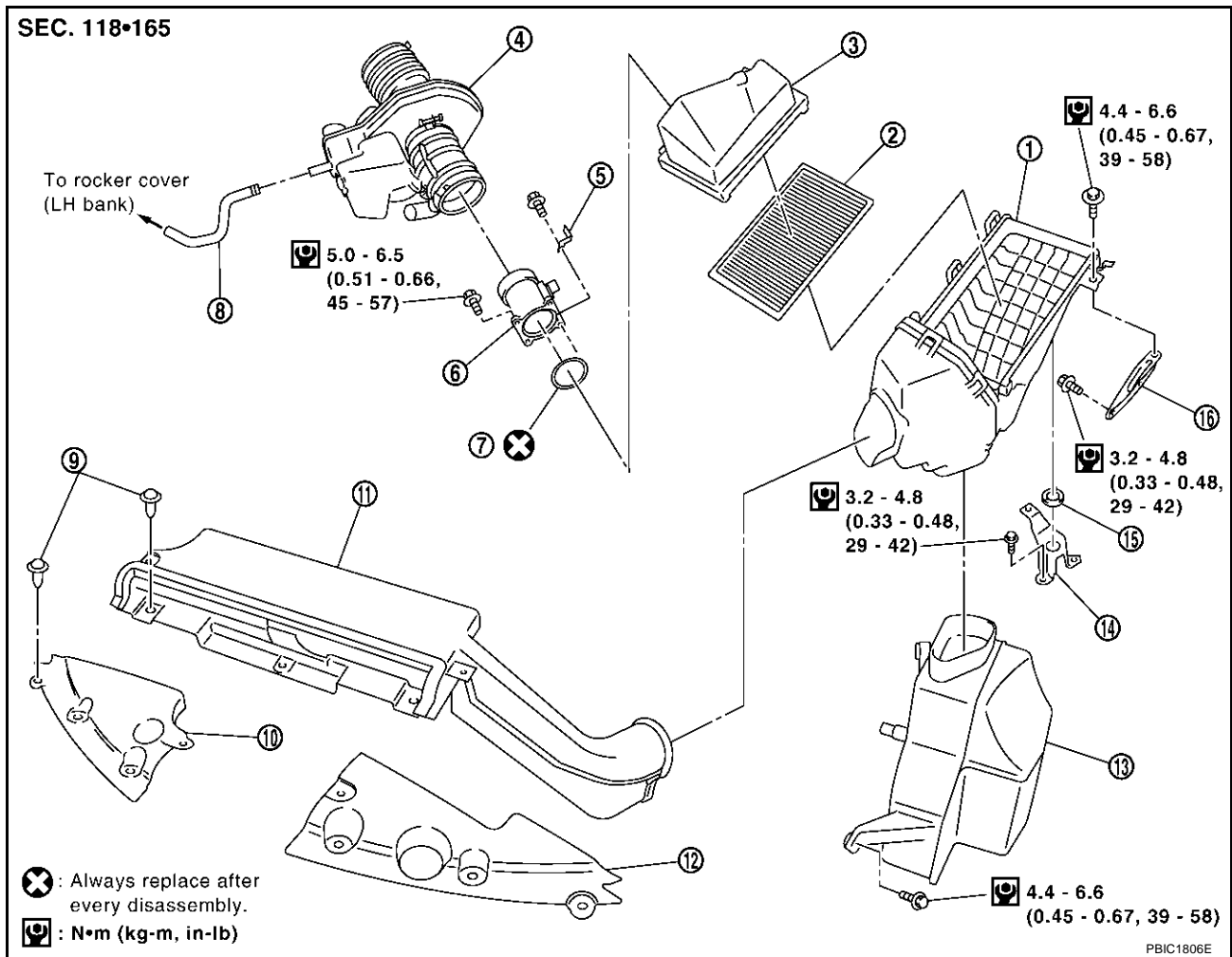
# AIR CLEANER AND AIR DUCT

## AIR CLEANER AND AIR DUCT

PFP:16500

### Removal and Installation

ABS0033C



- |                                    |                       |                                    |
|------------------------------------|-----------------------|------------------------------------|
| 1. Air cleaner case (lower)        | 2. Air cleaner filter | 3. Air cleaner case (upper)        |
| 4. Air duct assembly               | 5. Harness bracket    | 6. Mass air flow sensor            |
| 7. O-ring                          | 8. PCV hose           | 9. Clip                            |
| 10. Radiator cover grill (RH side) | 11. Air duct (inlet)  | 12. Radiator cover grill (LH side) |
| 13. Resonator                      | 14. Bracket           | 15. Grommet                        |
| 16. Bracket                        |                       |                                    |

### REMOVAL

- Remove RH and LH both side radiator cover grills.
- Remove air duct (inlet).
- Disconnect harness connector from the mass air flow sensor.
- Disconnect the tube clamp at the electric throttle control actuator and at the mass air flow sensor.
- Remove PCV hose, air cleaner case (upper) with the mass air flow sensor attached.
- Remove mass air flow sensor from air cleaner case (upper), as necessary.

### 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, as necessary.

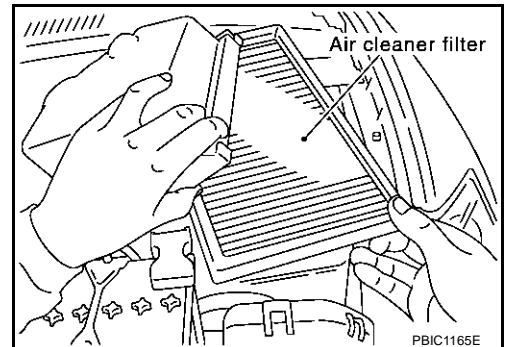
# AIR CLEANER AND AIR DUCT

## INSTALLATION

Installation is in the reverse order of removal.

## CHANGING AIR CLEANER FILTER

1. Unhook the air cleaner case (lower) side clips and lift up the air cleaner case (upper).
2. Remove the air cleaner filter.



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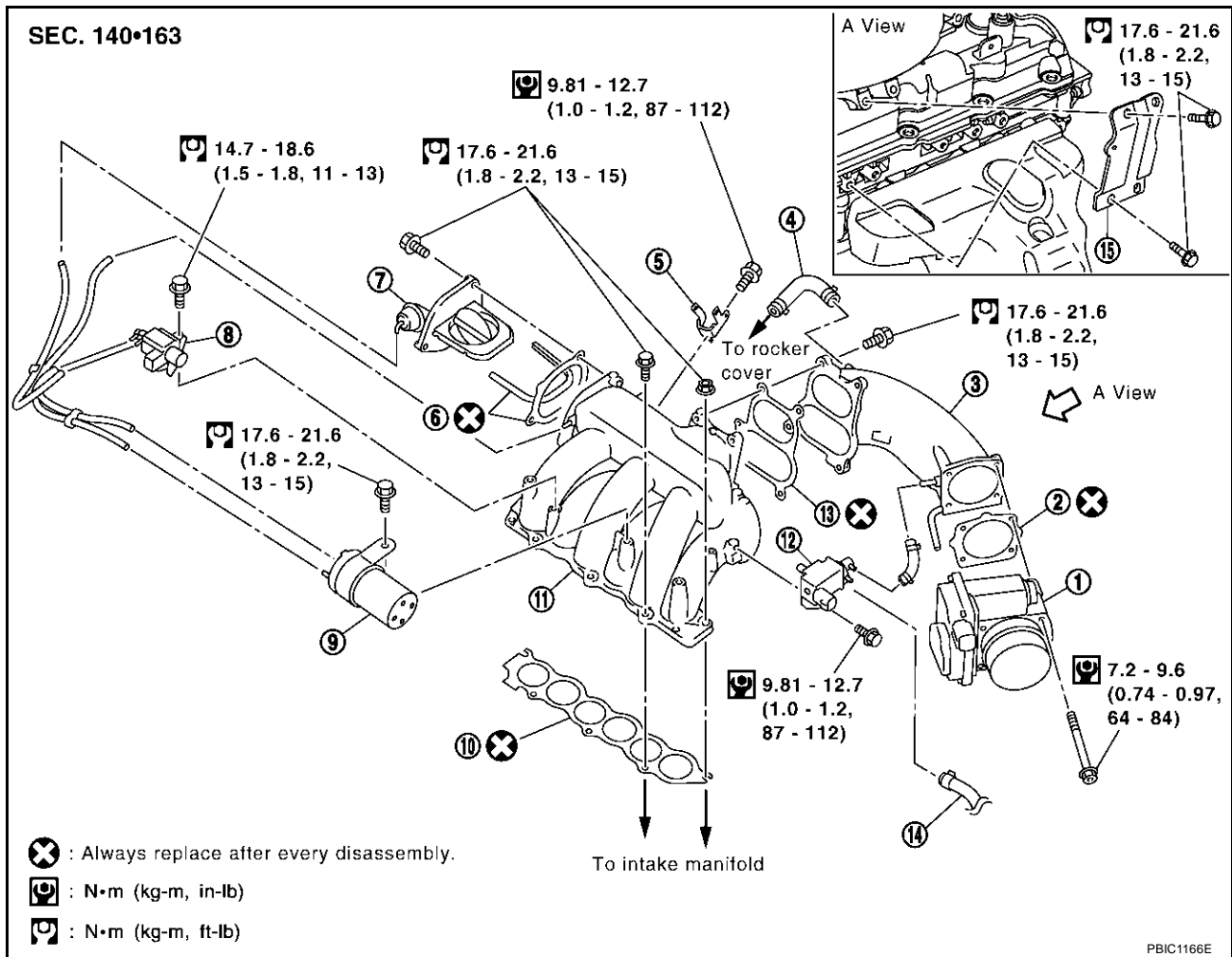
# INTAKE MANIFOLD COLLECTOR

## INTAKE MANIFOLD COLLECTOR

PFP:14003

### Removal and Installation

ABS0032E



- |                                       |                                       |   |
|---------------------------------------|---------------------------------------|---|
| 1. Electric throttle control actuator | 2. Gasket                             | 3. Intake manifold collector (upper)                  |
| 4. PCV hose                           | 5. Harness bracket                    | 6. Gasket   |
| 7. Power valve                        | 8. VIAS control solenoid valve        | 9. Vacuum tank  |
| 10. Gasket                            | 11. Intake manifold collector (lower) | 12. EVAP canister purge volume control solenoid valve |
| 13. Gasket                            | 14. EVAP hose                         | 15. Support bracket                                   |



# INTAKE MANIFOLD COLLECTOR

## REMOVAL

### WARNING:

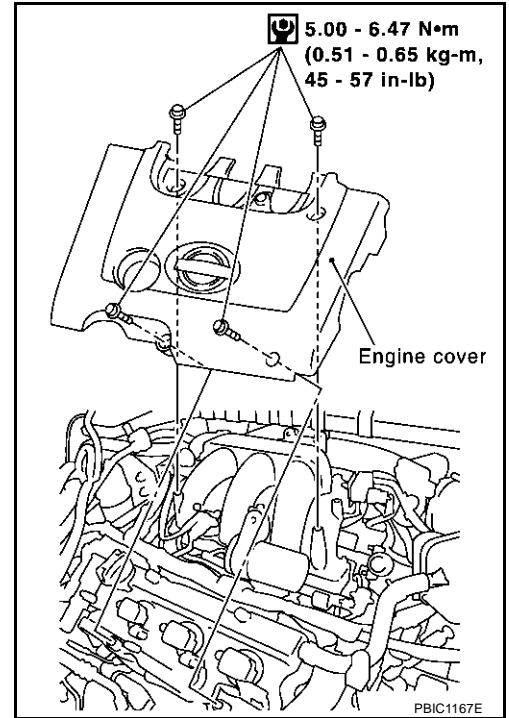
To avoid the danger of being scalded, never drain the coolant when the engine is hot.

1. Remove engine cover.
2. Drain engine coolant, or when water hose is disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-8, "Changing Engine Coolant"](#) .

### CAUTION:

Perform when engine is cold.

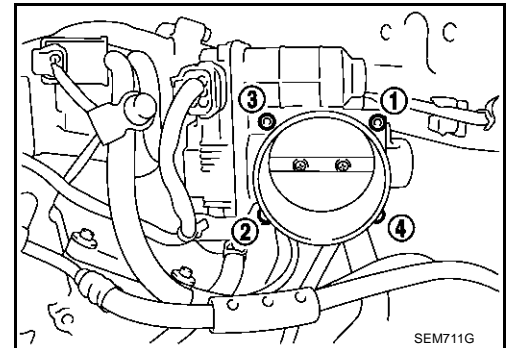
3. Remove air duct. Refer to [EM-14, "AIR CLEANER AND AIR DUCT"](#) .



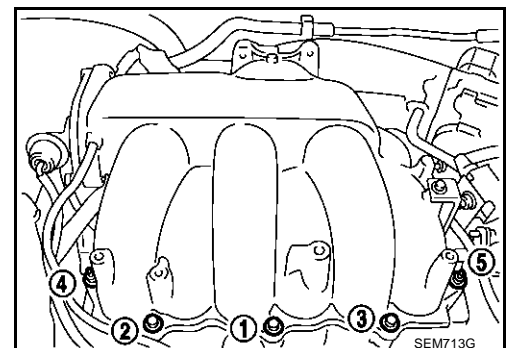
4. Remove electric throttle control actuator.
  - Loosen bolts in the reverse order of that shown in the figure.

### CAUTION:

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

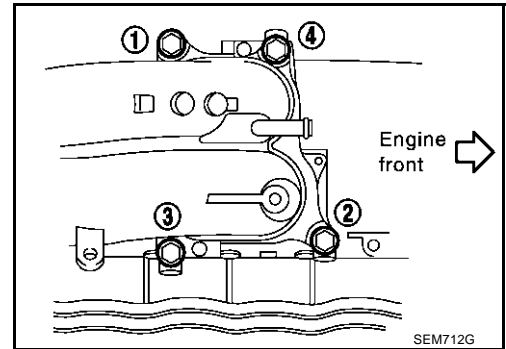


5. Disconnect vacuum hose and water hose from intake manifold collector (upper and lower).
6. Disconnect EVAP canister purge volume control solenoid valve mounting bolt from intake manifold collector (lower).
7. Remove VIAS control solenoid valve and vacuum tank.
8. Remove the RH windshield wiper arm and RH front cowl top cover. Refer to [EI-21, "COWL TOP"](#) .
9. Disconnect the power steering hose bracket.
10. Remove intake manifold collector support bracket.
11. Remove PCV hose [between intake manifold collector (upper) and RH rocker cover].
12. Loosen bolts in reverse order of illustration with power tool, and remove intake manifold collector (upper and lower) assembly with power tool.

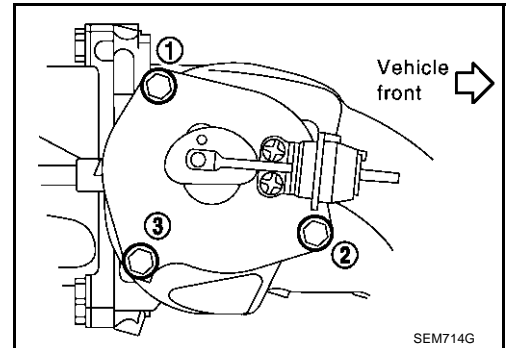


# INTAKE MANIFOLD COLLECTOR

13. Loosen bolts in reverse order of illustration to remove intake manifold collector (upper) with power tool.



14. Remove power valve in reverse order of illustration.



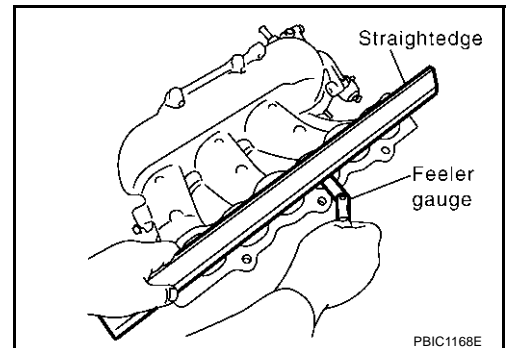
## INSPECTION AFTER REMOVAL

### Surface Distortion

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

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

- If it exceeds the limit, replace the intake manifold collector.



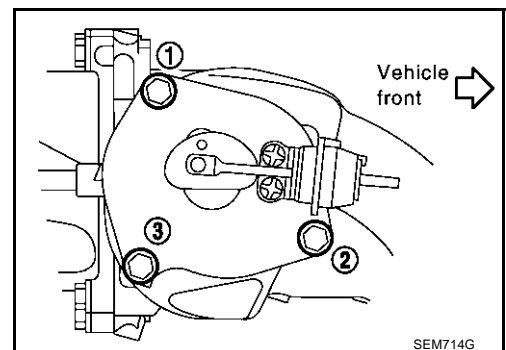
## INSTALLATION

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

### Installation of Power Valve

- Tighten in numerical order as shown in the figure.

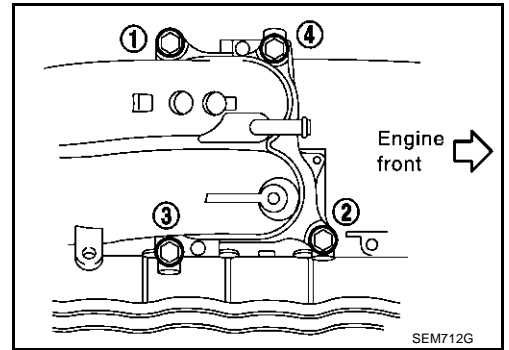
**🔩 : 17.6 - 21.6 N·m (1.8 - 2.2 kg·m, 13 - 15 ft·lb)**



# INTAKE MANIFOLD COLLECTOR

## Installation of Intake Manifold Collector (Upper)

- Tighten in numerical order as shown in the figure.  
🔧 : 17.6 - 21.6 N-m (1.8 - 2.2 kg-m, 13 - 15 ft-lb)

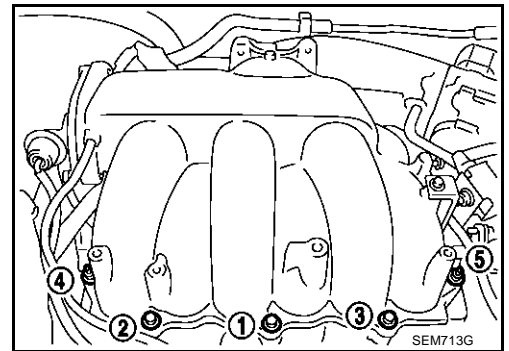


## Installation of Intake Manifold Collector (Lower)

- Tighten in numerical order as shown in the figure.  
🔧 : 17.6 - 21.6 N-m (1.8 - 2.2 kg-m, 13 - 15 ft-lb)

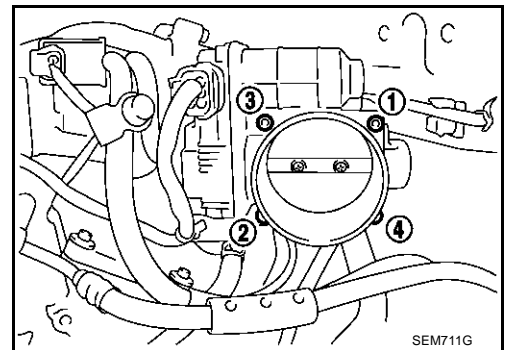
### NOTE:

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



## Installation of Electric Throttle Control Actuator

- Install gasket with three protrusions for installation check facing any direction other than upward or downward.
- Tighten in numerical order as shown in the figure.  
🔧 : 7.2 - 9.6 N-m (0.74 - 0.97 kg-m, 64 - 84 in-lb)
- Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to [EC-64, "Throttle Valve Closed Position Learning"](#).
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when the electric throttle control actuator is replaced. Refer to [EC-64, "Idle Air Volume Learning"](#).



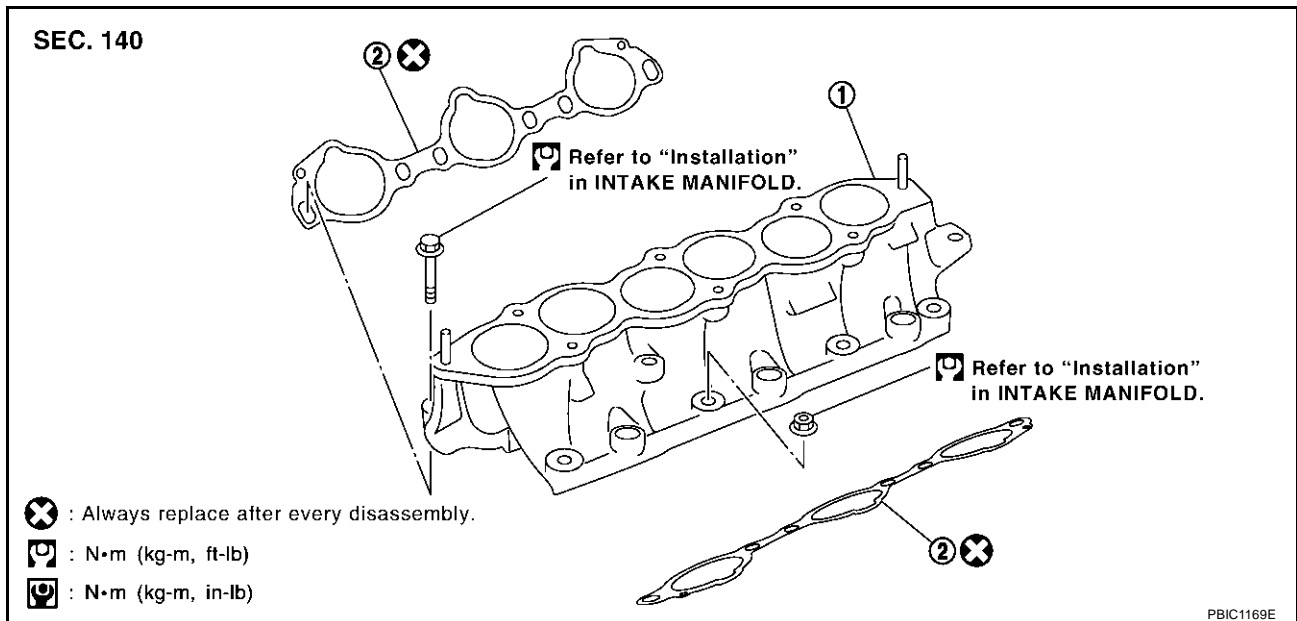
# INTAKE MANIFOLD

## INTAKE MANIFOLD

PFP:14003

### Removal and Installation

ABS0033D

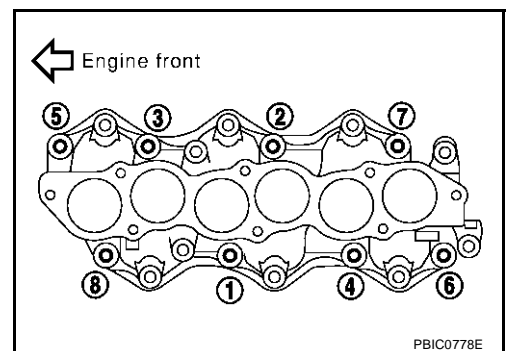


1. Intake manifold

2. Gasket

### REMOVAL

1. Release fuel pressure. Refer to [EC-66, "FUEL PRESSURE RELEASE"](#).
2. Remove intake manifold collector (upper and lower). Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove fuel tube and fuel injector assembly. Refer to [EM-38, "FUEL INJECTOR AND FUEL TUBE"](#).
4. Loosen bolts and nuts in reverse order of illustration to remove intake manifold assembly with power tool.



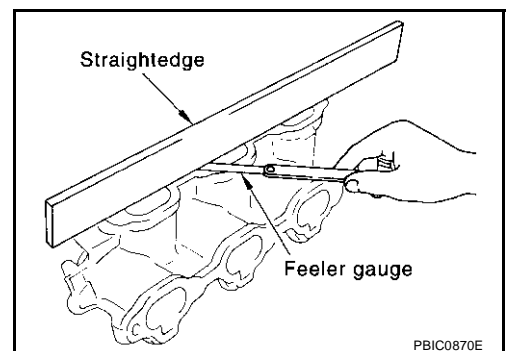
### INSPECTION AFTER REMOVAL

#### Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of each surface on intake manifold.

**Limit : 0.1 mm (0.04 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)**

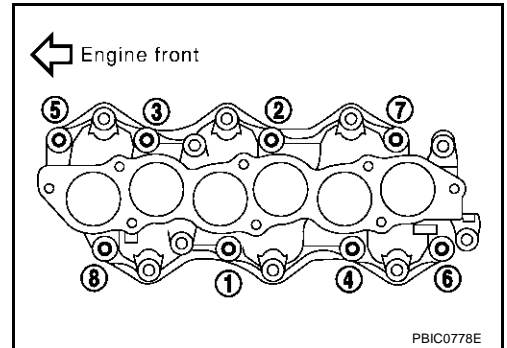
- Tighten all mounting bolts and nuts to specified torque in two or more steps in numerical order shown in figure.

 **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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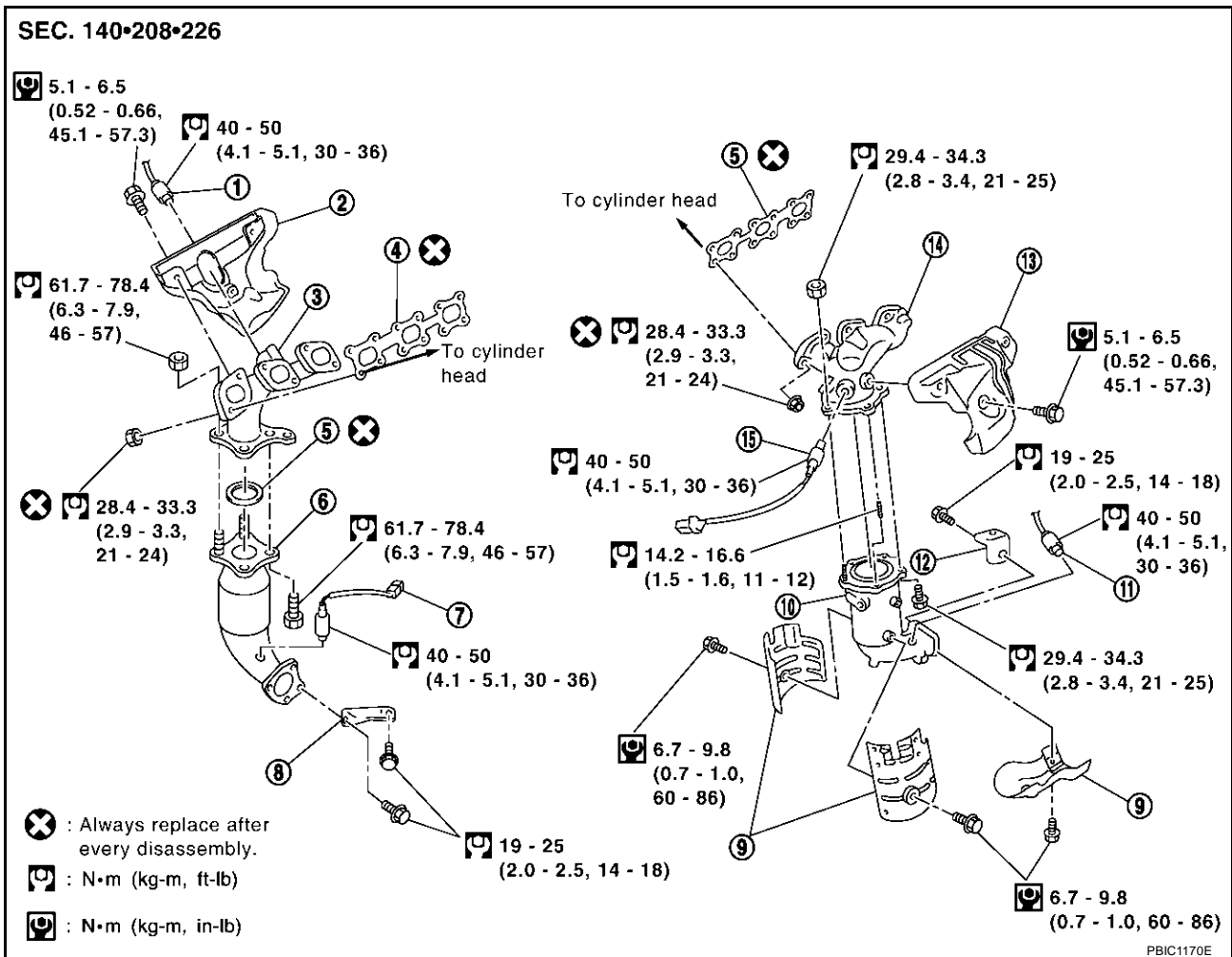
# EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

## EXHAUST MANIFOLD AND THREE WAY CATALYST

### Removal and Installation

ABS0032G



- |   |                                     |  |
|---|-------------------------------------|--|
| 1. Heated oxygen sensor 1 (bank 1)          | 2. Exhaust manifold cover           | 3. Exhaust manifold (RH bank)              |
| 4. Gasket                                   | 5. Gasket                           | 6. Three way catalyst (manifold) (RH bank) |
| 7. Heated oxygen sensor 2 (bank 1)          | 8. Support (RH)                     | 9. Three way catalyst heat shield          |
| 10. Three way catalyst (manifold) (LH bank) | 11. Heated oxygen sensor 2 (bank 2) | 12. Support (LH)                           |
| 13. Exhaust manifold cover                  | 14. Exhaust manifold (LH bank)      | 15. Heated oxygen sensor 1 (bank 2)        |

### REMOVAL

#### WARNING:

- Perform the work when the exhaust and cooling system have completely cooled down.
  - When removing the engine mounting through bolts and nuts, lift the engine up slightly for safety with a transmission jack. Refer to [EM-95, "ENGINE ASSEMBLY"](#).
1. Remove the exhaust front tube. Refer to [EX-3, "Removal and Installation"](#).
  2. Remove rear engine mount insulator (2WD models) (when RH exhaust manifold and three way catalyst is removed). Refer to [EM-95, "ENGINE ASSEMBLY"](#).
  3. Remove the RH windshield wiper arm and RH front cowl top cover (when RH exhaust manifold and three way catalyst is removed). Refer to [EI-21, "COWL TOP"](#).

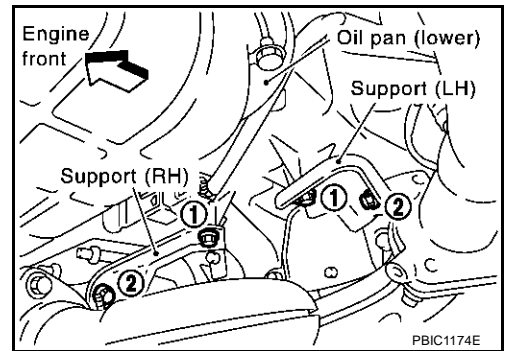
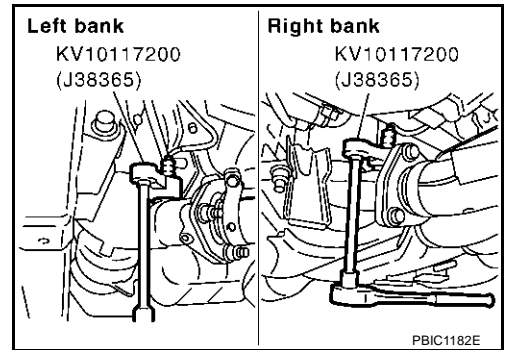
# EXHAUST MANIFOLD AND THREE WAY CATALYST

4. Remove heated oxygen sensor 1 and 2 on both LH and RH bank.
  - a. Remove harness connector of each heated oxygen sensor, and disconnect the harness from the bracket and middle clamp.
  - b. Remove both heated oxygen sensors with heated oxygen sensor wrench [special service tool: KV10117100 (J3647-A) or KV10117200 (J38365)].

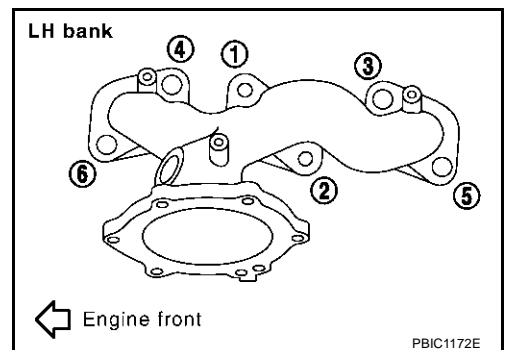
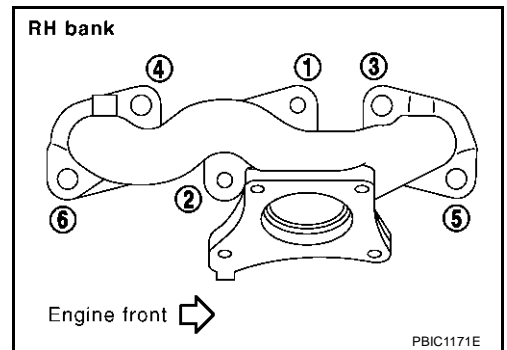
**CAUTION:**

- Be careful not to damage heated oxygen sensor.
- Discard any heated oxygen sensor 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.

5. Remove the exhaust manifold covers and the three way catalyst heat shields.
6. Remove bolts in the reverse order of illustration to remove three way catalyst supports (RH and LH).



7. Remove the three way catalyst (manifold) (RH bank) and three way catalyst (manifold) (LH bank) by loosening the bolts first and then removing the nuts.
8. Remove the exhaust manifolds.
  - Loosen the nuts in the reverse order as shown.



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# EXHAUST MANIFOLD AND THREE WAY CATALYST

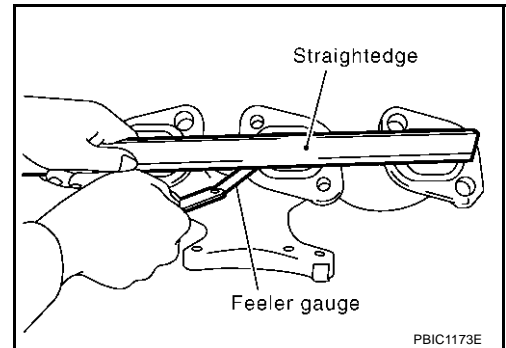
## INSPECTION AFTER REMOVAL

### Surface Distortion

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

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

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



## INSTALLATION

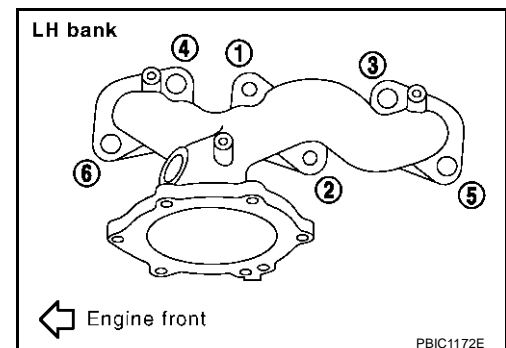
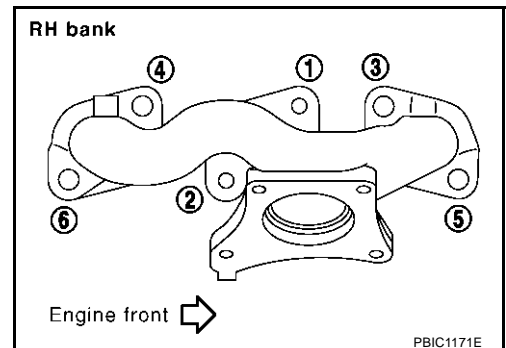
Installation is in the reverse order of removal paying attention to the following.

### CAUTION:

- When using the heated oxygen sensor wrench [special service tool: KV10117200 (J38365)], tighten to the middle of specified torque range, because the length of the tool may increase the actual tightness. Do not tighten to the maximum specified torque range.
- Before installing a heated oxygen sensor, clean the threads on the exhaust manifold using the oxygen sensor thread cleaner tool (commercial service tool), and apply anti-seize lubricant.
- Do not over-torque the heated oxygen sensors. Doing so may cause damage to the heated oxygen sensors.

### Exhaust Manifold

- Install the exhaust manifold nuts in the numerical order as shown.




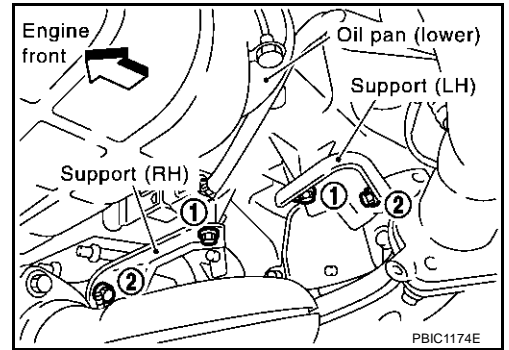


# EXHAUST MANIFOLD AND THREE WAY CATALYST

## Three Way Catalyst Supports

Install in the numerical order as shown.

 : 19 - 25 N·m (2.0 - 2.5 kg·m, 14 - 18 ft·lb)



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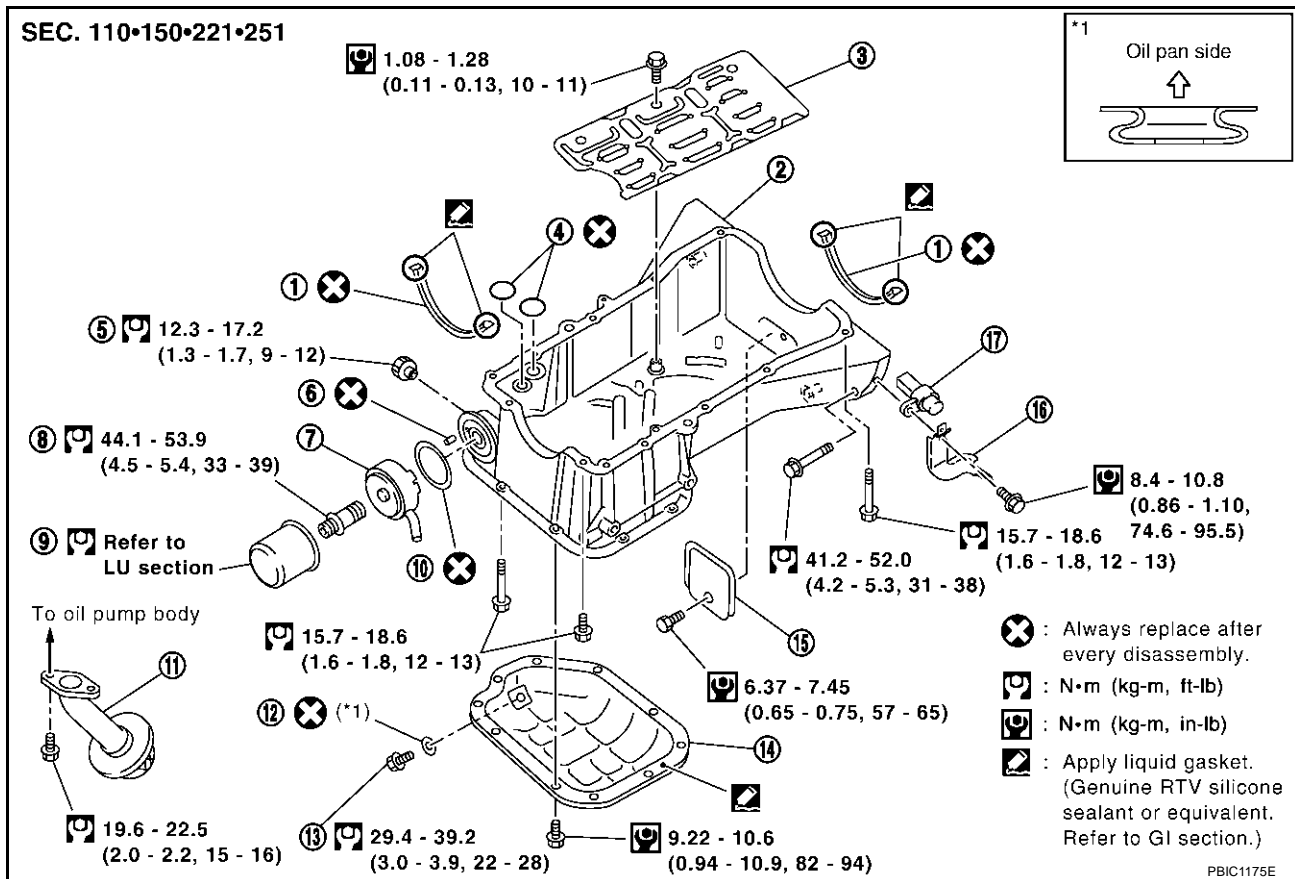
# OIL PAN AND OIL STRAINER

PF11110

ABS0036T

## OIL PAN AND OIL STRAINER

### Removal and Installation



- |  |                                      |                      |
|--|--------------------------------------|----------------------|
| 1. Gasket  | 2. Upper oil pan                     | 3. Baffle plate      |
| 4. O-ring  | 5. Oil pressure switch               | 6. Relief valve      |
| 7. Oil cooler  | 8. Oil cooler connector              | 9. Oil filter        |
| 10. Gasket   | 11. Oil strainer                     | 12. Gasket           |
| 13. Drain plug   | 14. Lower oil pan                    | 15. Rear cover plate |
| 16. Heated oxygen sensor (bank 2) harness clamp (2WD models) | 17. Crankshaft position sensor (POS) |                      |

### REMOVAL

#### 2WD Model

#### WARNING:

Do not remove the oil pan until the exhaust system and cooling system have completely cooled off.

#### CAUTION:

When removing the upper oil pan from the engine, first remove the crankshaft position sensor (POS). Be careful not to damage sensor edges or signal plate teeth.

- Remove splash guard (RH).
- Remove the front RH road wheel and tire with power tool.
- Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
- Drain engine coolant. Refer to [CO-8, "Changing Engine Coolant"](#).

#### CAUTION:

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

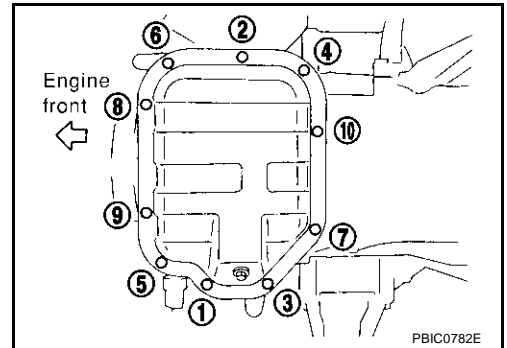
- Remove oil filter. Refer to [LU-9, "OIL FILTER"](#).

#### CAUTION:

Do not spill engine oil on the drive belts.

# OIL PAN AND OIL STRAINER

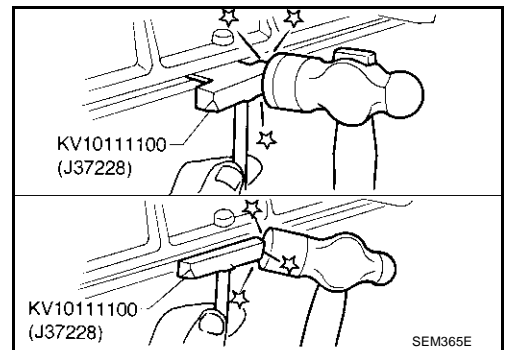
6. Remove oil cooler and water pipes. Refer to [LU-10, "OIL COOLER"](#) .
7. Remove drive belts. Refer to [EM-11, "DRIVE BELTS"](#) .
8. Remove A/C compressor with piping connected, and temporarily secure it aside. Refer to [ATC-151, "Components"](#) .
9. Remove exhaust front tube. Refer to [EX-3, "EXHAUST SYSTEM"](#) .
10. Remove the heated oxygen sensor 2 (bank 2) and remove the three way catalyst (manifold) (bank 2) from the exhaust manifold. Refer to [EM-22, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
11. Loosen lower oil pan bolts with power tool in reverse order of illustration to remove.



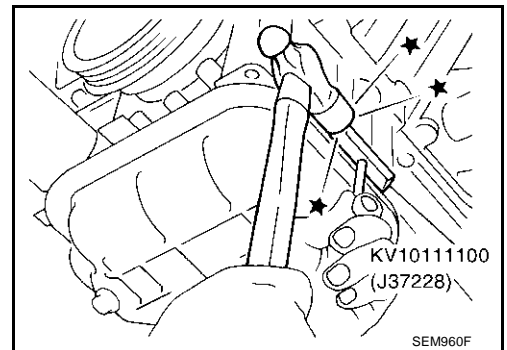
12. Insert a seal cutter (special service tool) between the lower oil pan and the upper oil pan.

**CAUTION:**

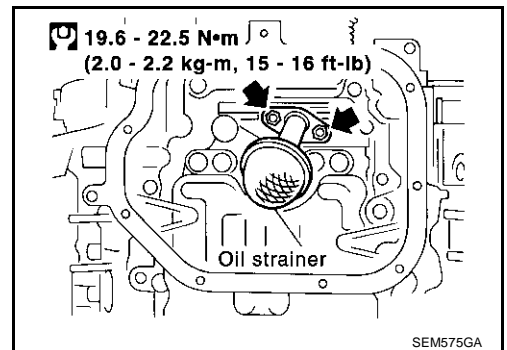
- Be careful not to damage the mating surface.
- Do not insert a screwdriver, this will damage the mating surfaces.



13. Slide seal cutter (special service tool) by tapping on the side of the tool with a hammer. Remove lower oil pan.



14. Remove oil strainer.



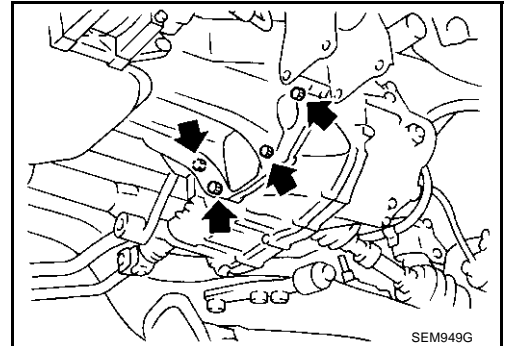
15. Remove the oil pressure switch. Refer to [LU-6, "Inspection"](#) .
16. Remove crankshaft position sensor (POS).

## OIL PAN AND OIL STRAINER

### CAUTION:

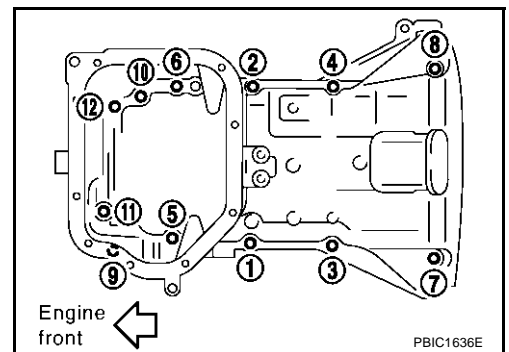
- Handle carefully to avoid dropping and shocks.
- Do not disassemble.
- Do not allow metal powder to adhere to magnetic part at sensor tip.
- Do not place sensors in a location where they are exposed to magnetism.

17. Remove the four engine-to-transaxle bolts.

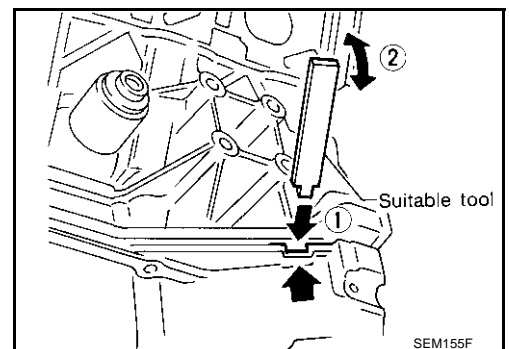


18. Remove upper oil pan.

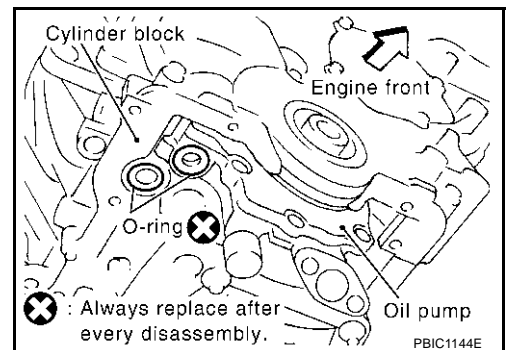
- Loosen bolts in reverse order as shown with power tool.



19. Insert an appropriate size tool into the notch of the upper oil pan as shown (1).  
Pry off the upper oil pan by moving the tool up and down as shown (2).

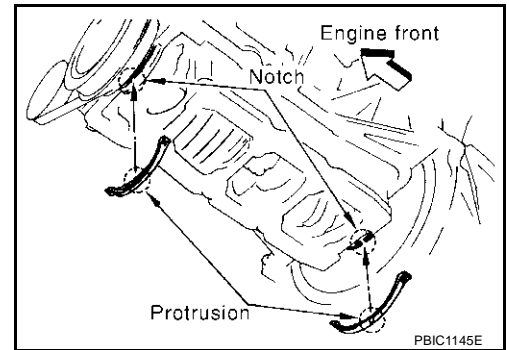


20. Remove O-rings from the bottom of the cylinder block and oil pump body.



# OIL PAN AND OIL STRAINER

21. Remove oil pan gaskets.



## AWD Model

### WARNING:

Do not remove the oil pan until the exhaust system and cooling system have completely cooled off.

### CAUTION:

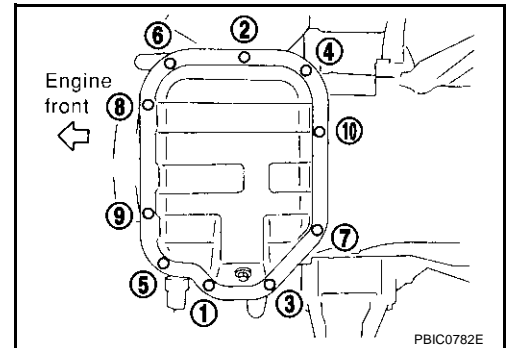
When removing the upper oil pan from the engine, first remove the crankshaft position sensor (POS). Be careful not to damage sensor edges or signal plate teeth.

1. Remove engine assembly from vehicle, and separate front suspension member, transaxle and transfer assembly from engine. Refer to [EM-95, "Removal and Installation"](#).
2. Install engine slingers. Refer to [EM-100, "CYLINDER BLOCK"](#).
3. install engine sub-attachment to right side of cylinder block, then lift engine, and mount it onto the engine stand. Refer to [EM-100, "CYLINDER BLOCK"](#).
4. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
5. Remove oil filter. Refer to [LU-9, "OIL FILTER"](#).

### CAUTION:

Do not spill engine oil on the drive belt.

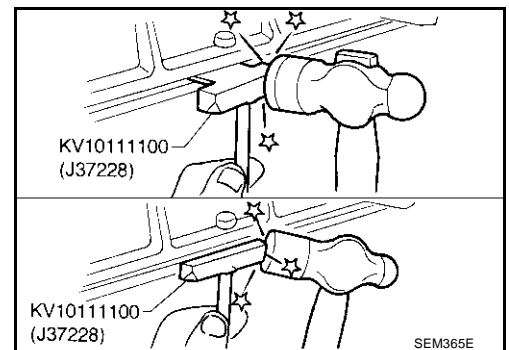
6. Remove oil cooler and water pipes. Refer to [LU-10, "OIL COOLER"](#).
7. Remove the heated oxygen sensor 2 (bank 2) and remove the three way catalyst (manifold) (bank 2) from the exhaust manifold. Refer to [EM-22, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
8. Loosen lower oil pan bolts with power tool in reverse order of illustration to remove.



9. Insert a seal cutter (special service tool) between the lower oil pan and the upper oil pan.

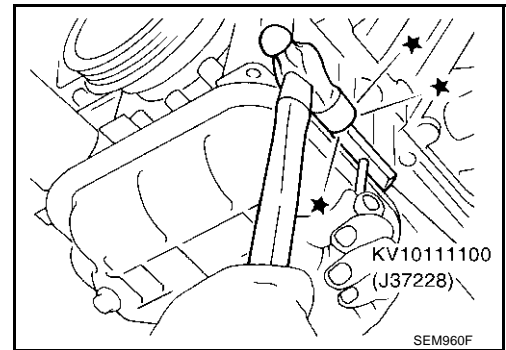
### CAUTION:

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

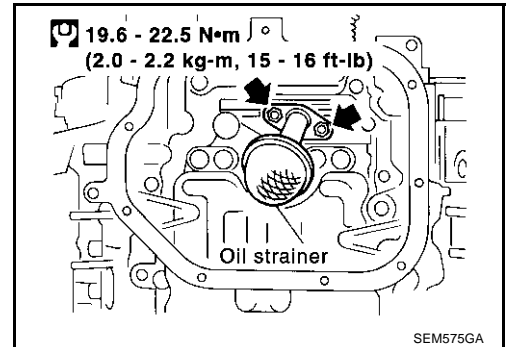


## OIL PAN AND OIL STRAINER

10. Slide seal cutter (special service tool) by tapping on the side of the tool with a hammer. Remove lower oil pan.



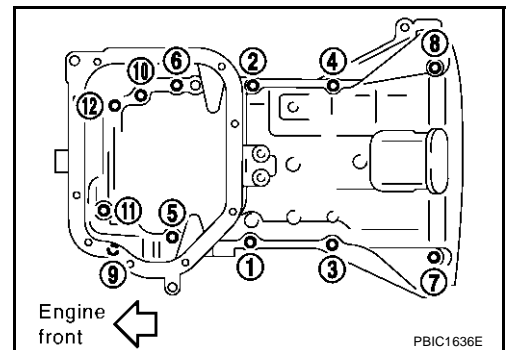
11. Remove oil strainer.



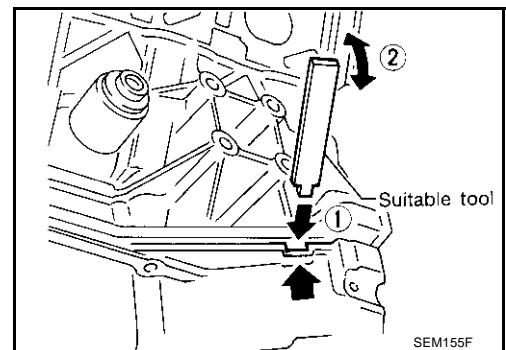
12. Remove the oil pressure switch. Refer to [LU-6, "Inspection"](#).

13. Remove upper oil pan.

- Loosen bolts in reverse order as shown with power tool.

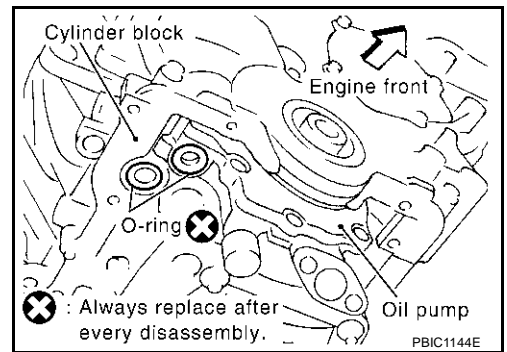


14. Insert an appropriate size tool into the notch of the upper oil pan as shown (1). Pry off the upper oil pan by moving the tool up and down as shown (2).

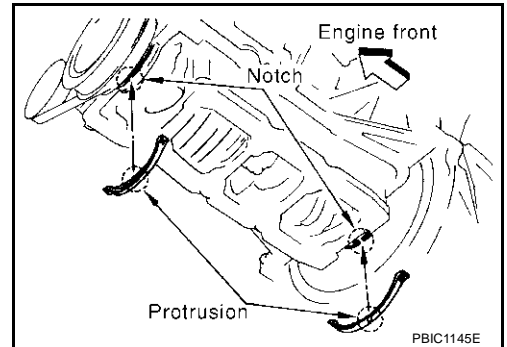


# OIL PAN AND OIL STRAINER

15. Remove O-rings from the bottom of the cylinder block and oil pump body.



16. Remove oil pan gasket.



## INSPECTION AFTER REMOVAL

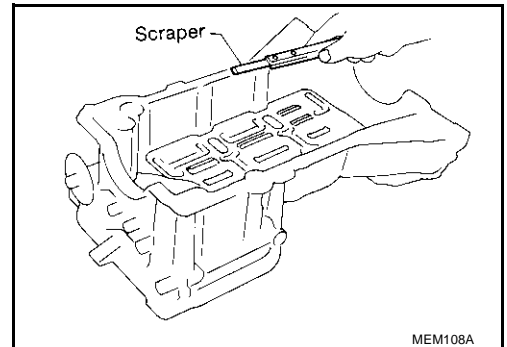
- Clean oil strainer if any object attached.

## INSTALLATION

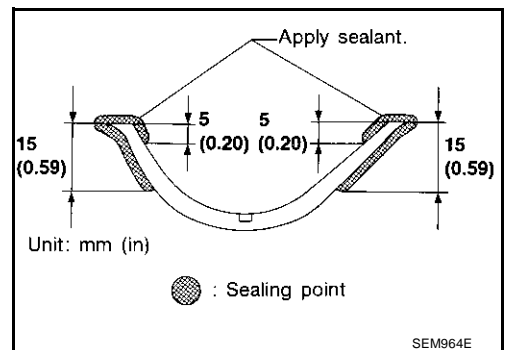
1. Install in the upper oil pan in the order below.
  - a. Use a scraper to remove old liquid gasket from mating surfaces.
    - Also remove the old liquid gasket from mating surface of the cylinder block.
    - Remove the old liquid gasket from the bolt holes and threads.

### CAUTION:

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



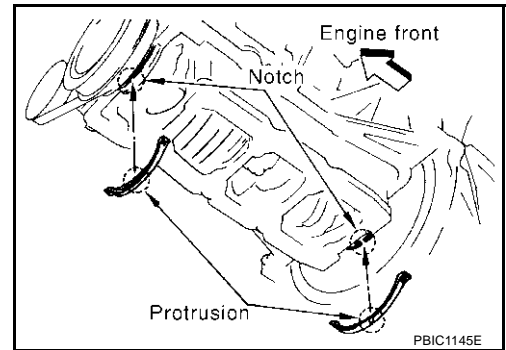
- b. Apply Genuine RTV Silicone Sealant or equivalent, to the front timing chain case gasket and the rear oil seal retainer gasket as shown. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



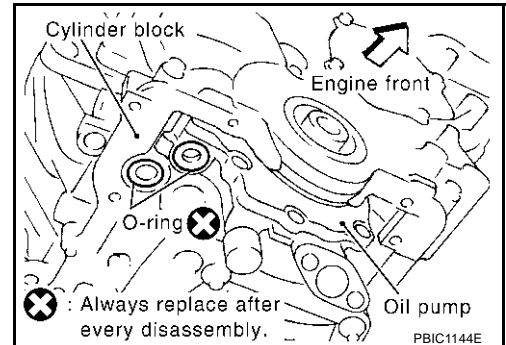
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M

## OIL PAN AND OIL STRAINER

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



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

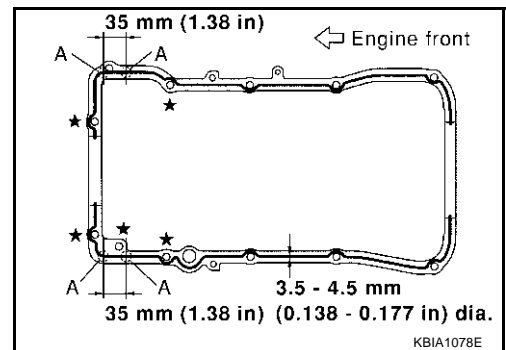


- d. Apply a continuous bead of sealant to the cylinder block mating surface of the upper oil pan to a limited portion as shown.

**Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**

**CAUTION:**

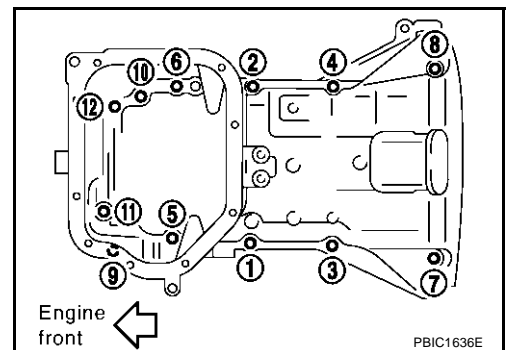
- For bolt holes with ★ marks (5 locations), apply liquid gasket outside the holes.
- Apply a bead of 4.5 to 5.5 mm (0.177 to 0.217 in) diameter to area "A".
- Attaching should be done within 5 minutes after coating.



- 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**

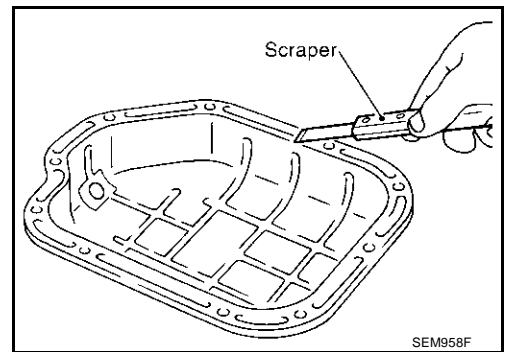


- f. Install the four engine-to-transaxle bolts. (2WD models)  
 g. Install oil strainer to oil pump.  
 2. Install the lower oil pan in the order below.

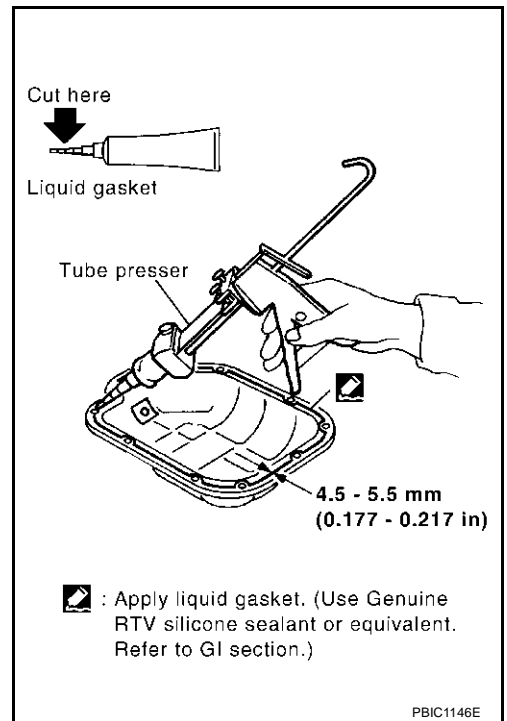


## OIL PAN AND OIL STRAINER

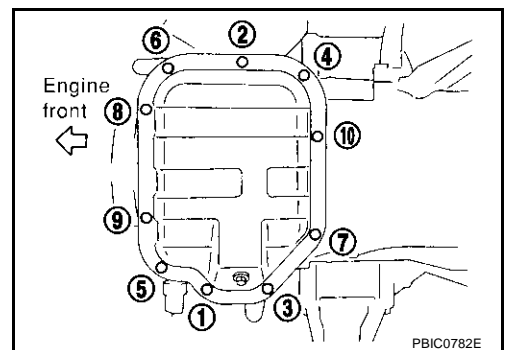
- a. Use a scraper to remove old liquid gasket from mating surfaces.
- Also remove old liquid gasket from mating surface of upper oil pan.



- b. Apply a continuous bead of sealant to the lower oil pan.
- Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "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.



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

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

# OIL PAN AND OIL STRAINER

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## 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 and 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.

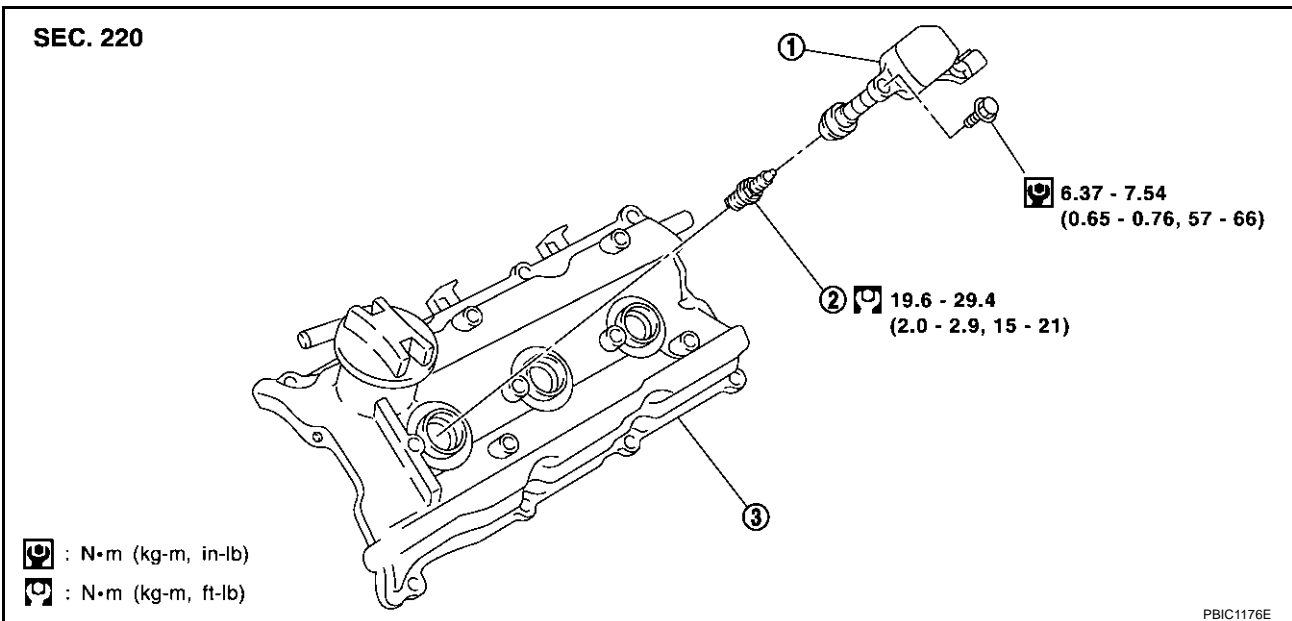
# IGNITION COIL

PF2:22448

## IGNITION COIL

### Removal and Installation

ABS00321



1. Ignition coil

2. Spark plug

3. Rocker cover (left bank)

### REMOVAL

1. Remove the engine cover. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).
2. Disconnect the mass air flow sensor electrical connector and remove the air cleaner and air duct assembly. Refer to [EM-14, "Removal and Installation"](#).
3. Remove the RH windshield wiper arm and the RH front cowl top cover. Refer to [EI-21, "COWL TOP"](#).
4. Remove the intake manifold collector (upper and lower), gasket, and electric throttle control actuator. Refer to [EM-16, "Removal and Installation"](#).  
The intake manifold collector (upper) should be moved aside with water hoses connected.
5. Remove ignition coil.

### INSTALLATION

1. Installation is in the reverse order of removal.

# SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

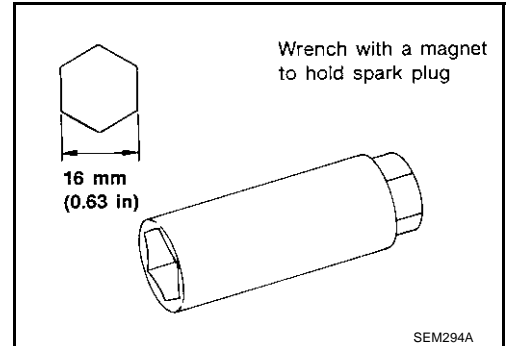
## SPARK PLUG (PLATINUM-TIPPED TYPE)

### Removal and Installation

#### REMOVAL

ABS0033P

1. Remove engine cover. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove ignition coil. Refer to [EM-35, "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)**

#### CAUTION:

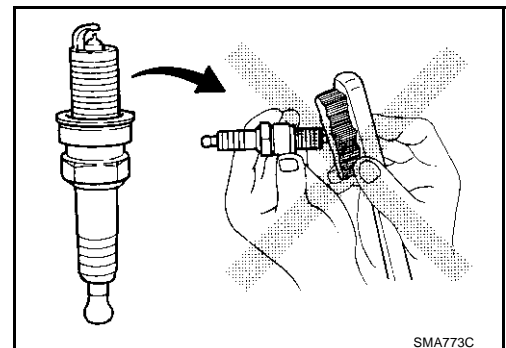
- Do not drop or shock spark plug.
- Do not use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

**Cleaner air pressure:**

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

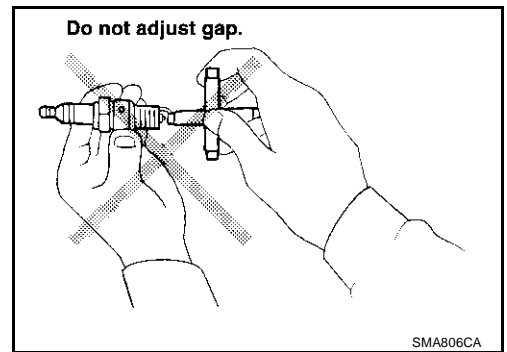
**Cleaning time:**

**Less than 20 seconds**



## SPARK PLUG (PLATINUM-TIPPED TYPE)

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



A

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### INSTALLATION

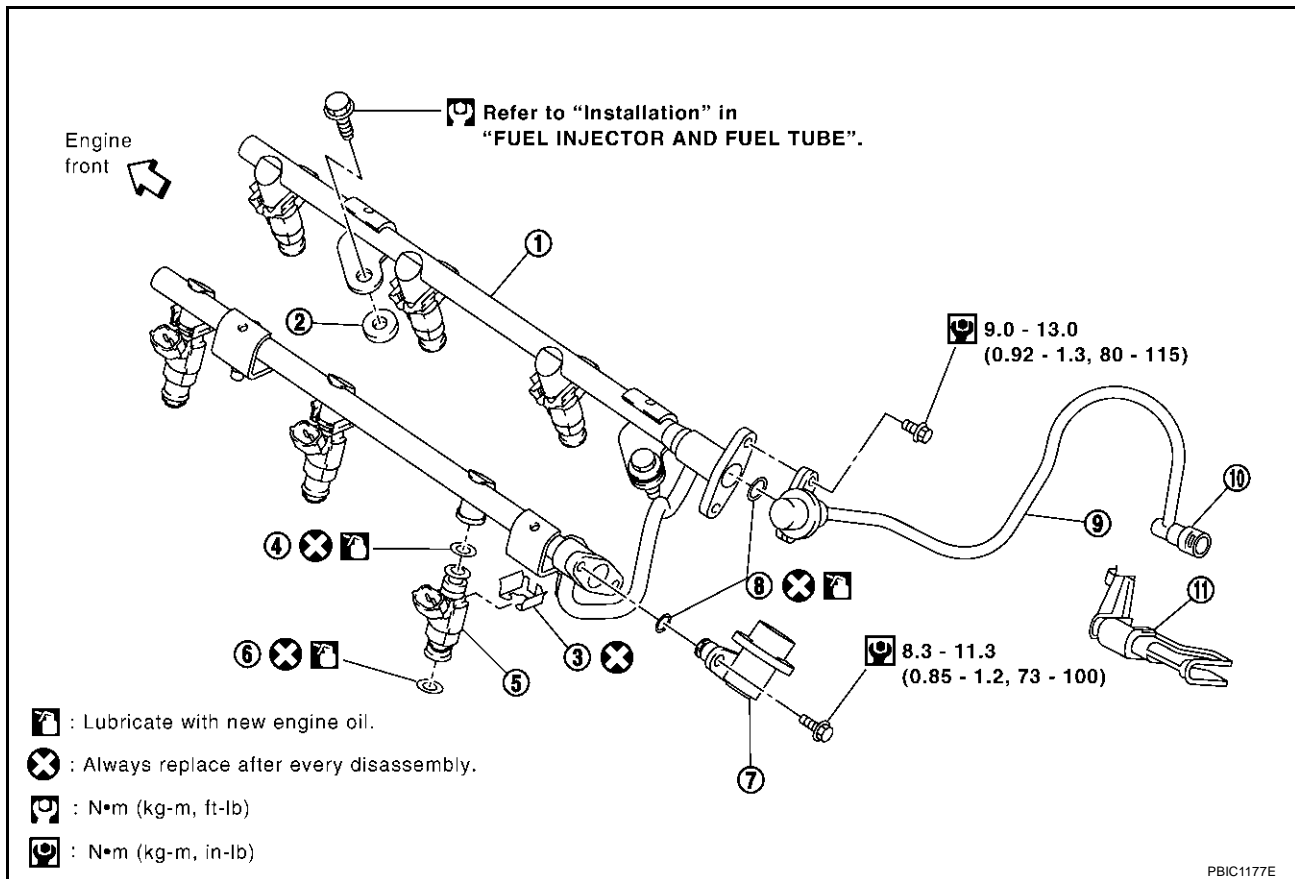
- Install in the reverse order of removal.

## FUEL INJECTOR AND FUEL TUBE

PFP:16600

### Removal and Installation

ABS0032K



- |                     |                         |                                 |
|---------------------|-------------------------|---------------------------------|
| 1. Fuel tube        | 2. Insulator            | 3. Clip                         |
| 4. O-ring (black)   | 5. Fuel injector        | 6. O-ring (green)               |
| 7. Fuel damper      | 8. O-ring               | 9. Fuel feed hose (with damper) |
| 10. Quick connector | 11. Quick connector cap |                                 |

#### CAUTION:

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

#### REMOVAL

#### WARNING:

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

1. Remove the engine cover. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).
2. Release the fuel pressure. Refer to [EC-66, "FUEL PRESSURE RELEASE"](#).
3. Remove the RH windshield wiper arm and the RH cowl top cover. Refer to [EI-21, "Removal and Installation"](#).
4. Remove radiator cover grille, air duct (inlet), air cleaner case, air duct assembly and mass air flow sensor. Refer to [EM-14, "AIR CLEANER AND AIR DUCT"](#).
5. Disconnect electric throttle control actuator and engine coolant hoses.

#### CAUTION:

Handle carefully to avoid any shock to the electric throttle control actuator.

6. Disconnect vacuum hose, fuel injectors electrical connectors, and PCV hose.

#### CAUTION:

Cover any engine openings to avoid the entry of any foreign material.

7. Remove the vacuum tank from intake manifold collector (lower).
8. Disconnect the power steering hose bracket.

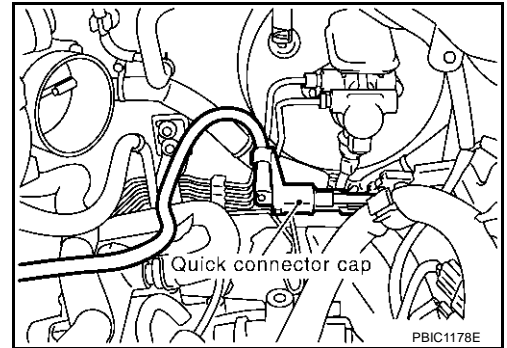
# FUEL INJECTOR AND FUEL TUBE

9. Remove the intake manifold collector (upper and lower). Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).  
The intake manifold collector (upper) should be moved aside with water hoses connected.
10. Remove fuel feed hose (with damper) from fuel tube.

**CAUTION:**

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

11. Disconnect fuel feed hose (with damper) quick connector at vehicle piping side. When separating fuel feed hose and centralized under-floor piping connection, disconnect quick connector with the following procedure.
- a. Remove quick connector cap from quick connector.

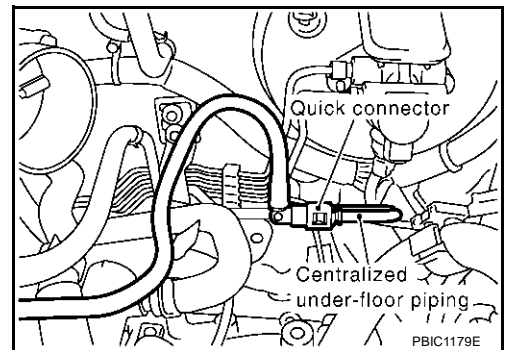


- b. Disconnect quick connector from centralized under-floor piping as follows:

**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 fuel tube.



- ii. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

**CAUTION:**

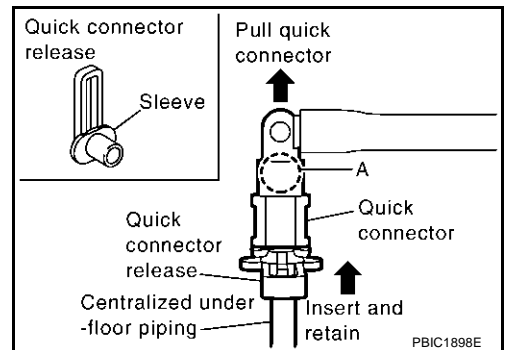
**Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.**

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

**CAUTION:**

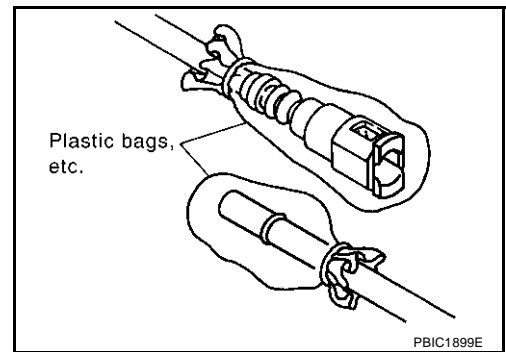
- Pull quick connector holding "A" position as shown in the figure.

- 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.
- 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 hose (with damper) during installation/removal.



## FUEL INJECTOR AND FUEL TUBE

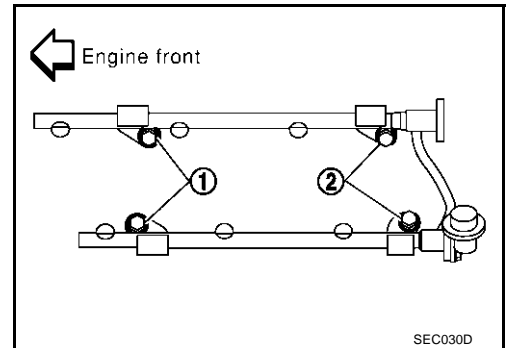
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



12. Remove harness connector from fuel injector.
13. Loosen mounting bolts in numerical order in the figure, and remove fuel tube and fuel injector assembly.

**CAUTION:**

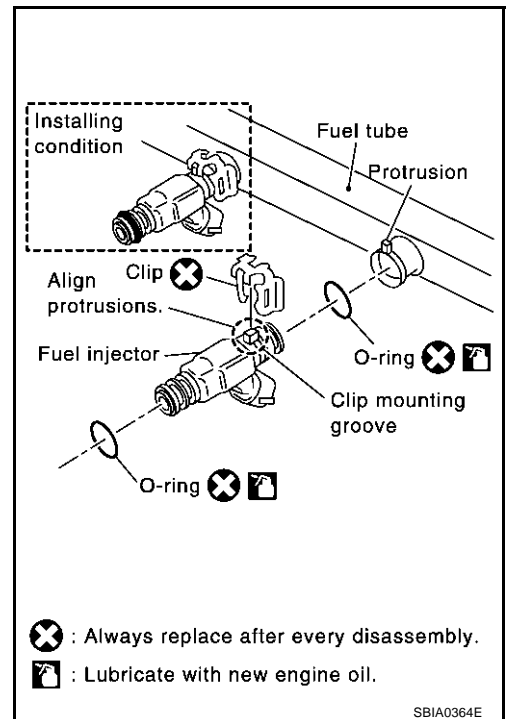
Do not tilt it, or remaining fuel in pipes may flow out from pipes.



14. Remove fuel injector from fuel tube with following procedure.
  - a. Open and remove clip.
  - b. 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.



15. Remove fuel damper from fuel tube.

### INSTALLATION

1. Install fuel damper.
  - 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.



## FUEL INJECTOR AND FUEL TUBE

- 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 fuel damper 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 tube. 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.

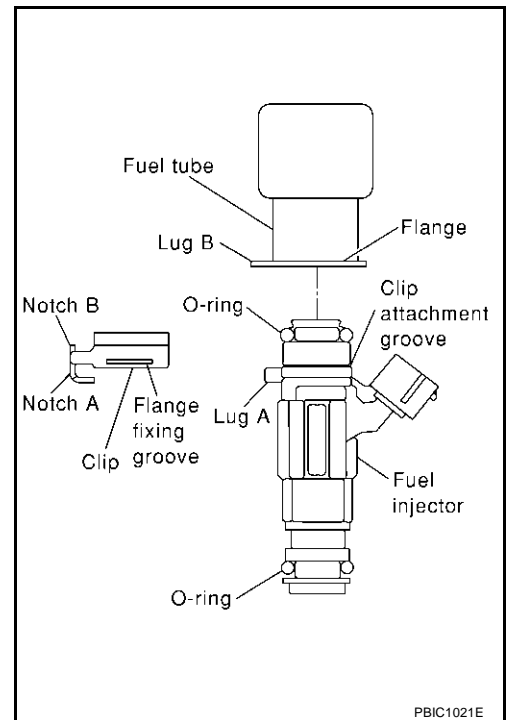
### CAUTION:

- 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. 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)**

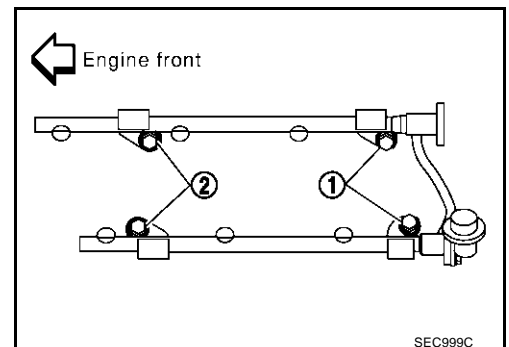
 **2nd step : 20.6 - 26.5 N-m (2.1 - 2.7 kg-m, 16 - 19 ft-lb)**

### CAUTION:

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

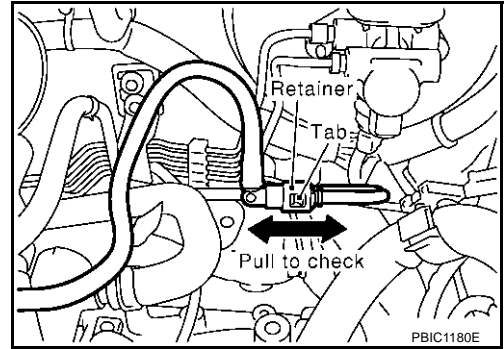
5. Connect fuel injector harness.

6. Install intake manifold collector (upper and lower). Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).



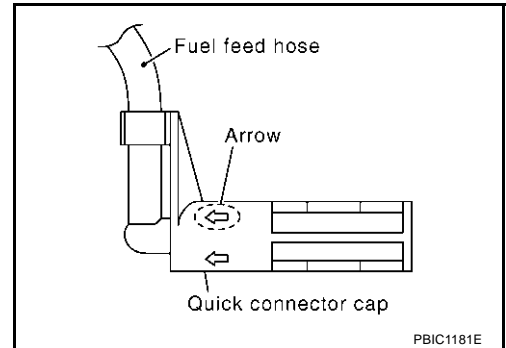
## FUEL INJECTOR AND FUEL TUBE

7. Connect quick connector between fuel feed hose (with damper) and centralized under-floor piping connection with the following procedure:
  - a. Check the connection for damage and foreign materials.
  - b. Align the quick connector with the tube, then insert the connector straight into the tube until a click is heard.
  - c. After connecting the quick connector, use the following method to make sure it is full connected.
    - Visually confirm that the two retainer tabs are connected to the connector.
    - Pull the tube and the connector to make sure they are securely connected.
  - d. Install quick connector cap to quick connector connection.
    - Install quick connector cap with arrow on surface facing in direction of quick connector.



### **CAUTION:**

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



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

## **INSPECTION AFTER INSTALLATION**

### **Check on Fuel Leakage**

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

### **NOTE:**

Use mirrors for checking at points out of clear sight.

### **CAUTION:**

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

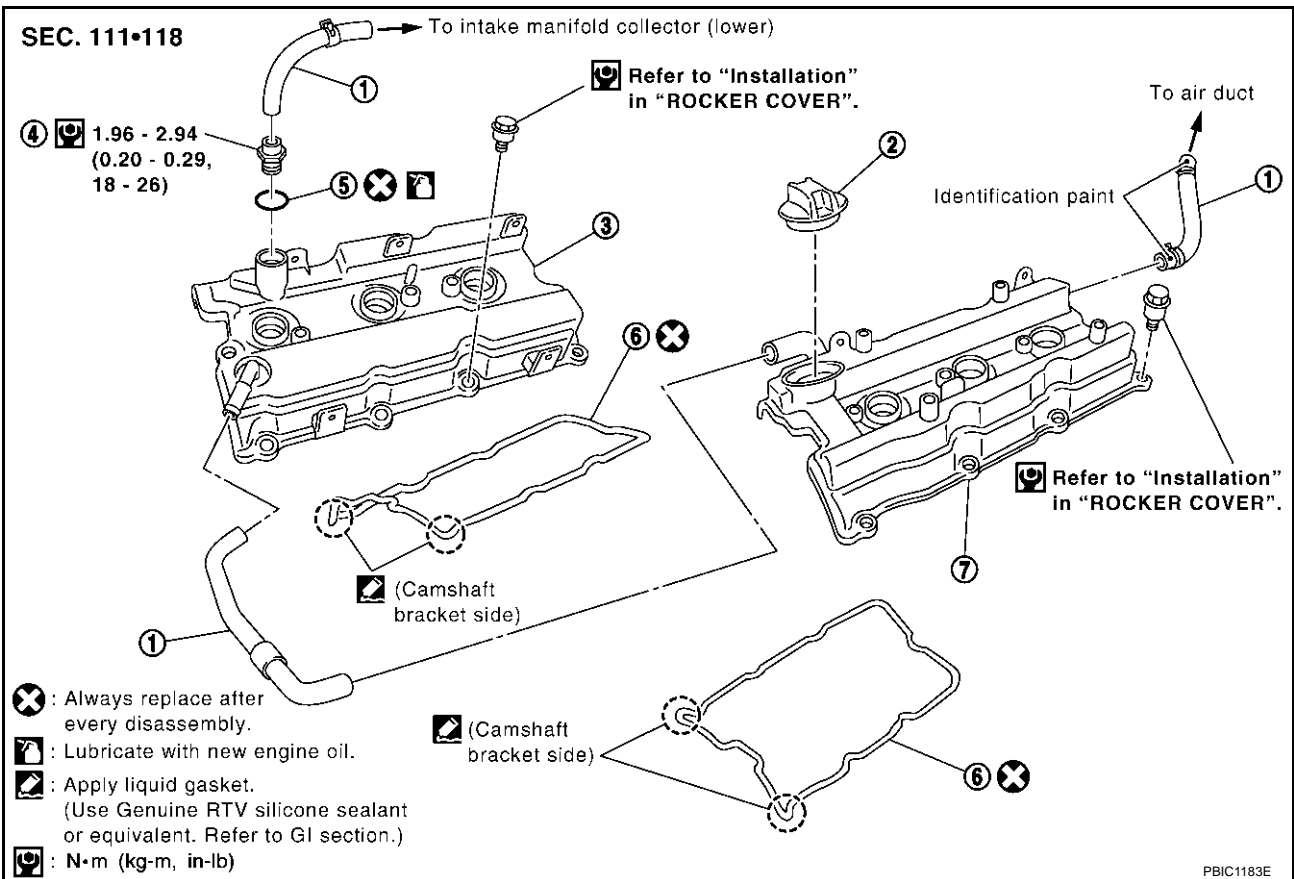
# ROCKER COVER

PFP:13264

## ROCKER COVER

### Removal and Installation

ABS0034R



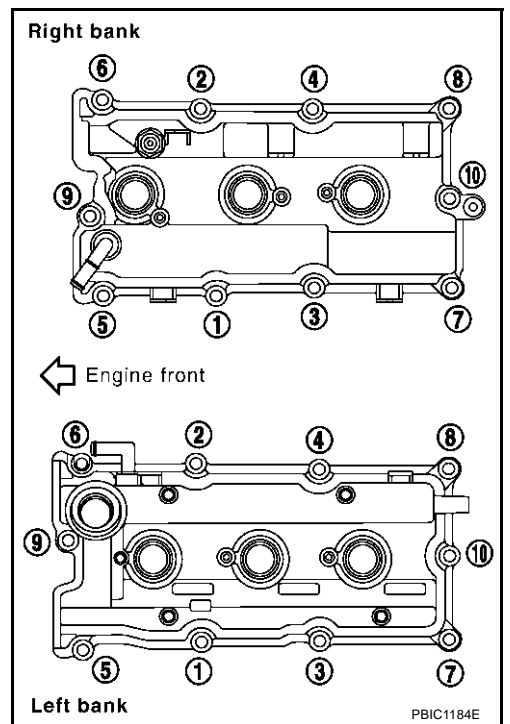
- |                           |                   |                           |
|---------------------------|-------------------|---------------------------|
| 1. PCV hose               | 2. Oil filler cap | 3. Rocker cover (RH bank) |
| 4. PCV valve              | 5. O-ring         | 6. Rocker cover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

### REMOVAL

1. Remove the intake manifold collector (upper and lower) with power tool. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove the ignition coil. Refer to [EM-35, "IGNITION COIL"](#) .
3. Remove PCV hoses from rocker covers.

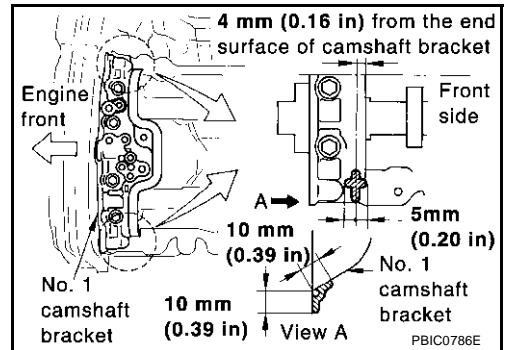
# ROCKER COVER

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



## INSTALLATION



- Apply liquid gasket of 3.0 mm (0.12 in) diameter to position shown in the figure (both edges of No.1 camshaft bracket) (on both banks).
  - First, apply it to engine longitudinal direction [5.0 mm (0.197 in) + 5.0 mm (0.197 in) side in figure].
  - Use Genuine Thread Sealant or equivalent. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

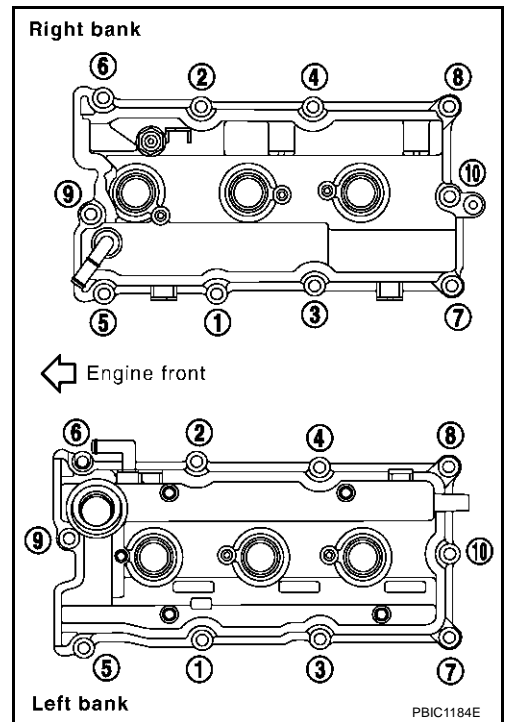


- Install rocker cover.
  - Check if rocker cover gasket is dropped from installation groove of rocker cover.

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

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

# FRONT TIMING CHAIN CASE

PFP:13599

## FRONT TIMING CHAIN CASE

### Removal and Installation

ABS0032M

#### NOTE:

- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing upper oil pan on vehicle.
- When upper oil pan needs to be removed or installed, or when rear timing chain case is removed or installed, remove lower and upper oil pans 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. Place vehicle onto lift.
2. Disconnect battery ground cable.
3. Remove engine cover. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).
4. Remove radiator cover grilles, air duct (inlet), air cleaner case assembly and air duct. Refer to [EM-14, "AIR CLEANER AND AIR DUCT"](#).
5. Remove RH and LH rocker covers. Refer to [EM-43, "ROCKER COVER"](#).

#### NOTE:

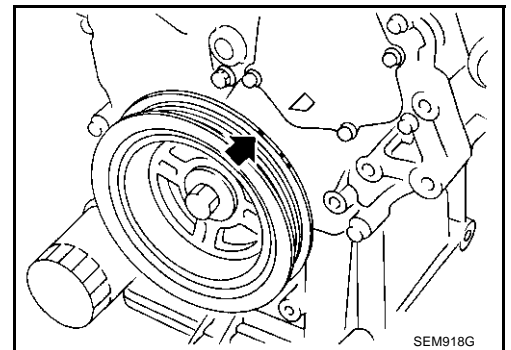
When only primary timing chain is removed, rocker cover does not need to be removed.

6. Remove splash guard (RH).
7. Drain engine coolant from radiator. Refer to [CO-8, "Changing Engine Coolant"](#).
8. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
9. Remove engine harnesses.
10. Remove A/C compressor from bracket with piping connected, and temporarily secure it aside. Refer to [ATC-152, "Removal and Installation of Compressor"](#).
11. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-28, "Removal and Installation"](#).
12. Remove power steering oil pump bracket. Refer to [PS-28, "Removal and Installation"](#).
13. Remove alternator. Refer to [SC-27, "Removal and Installation"](#).
14. Remove idler pulley and bracket. Refer to [EM-54, "TIMING CHAIN"](#).
15. Obtain compression TDC of No.1 cylinder as follows:

#### NOTE:

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

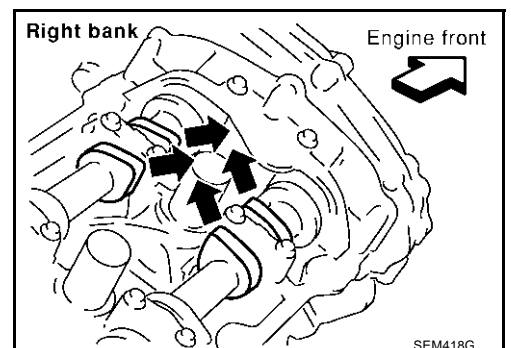
- a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



- 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"](#).

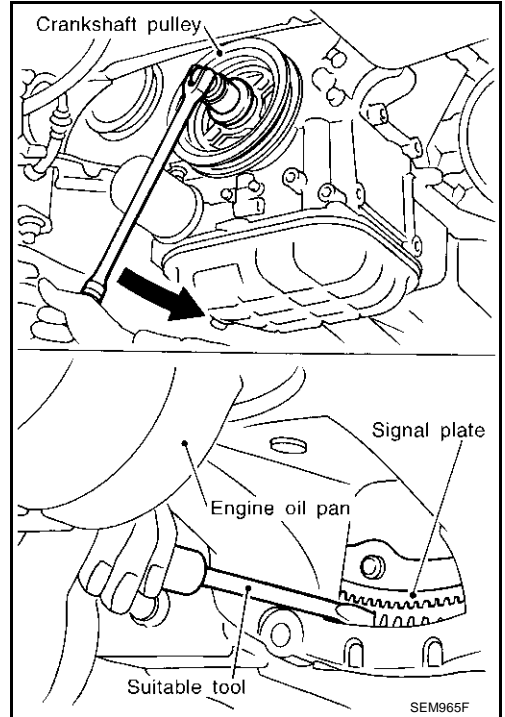


# FRONT TIMING CHAIN CASE

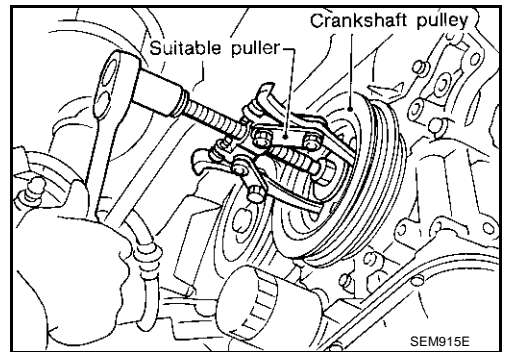
16. Loosen crankshaft pulley bolt. (At this time remove oil pan rear cover plate and set a suitable tool to ring gear so that crankshaft cannot rotate.)

**CAUTION:**

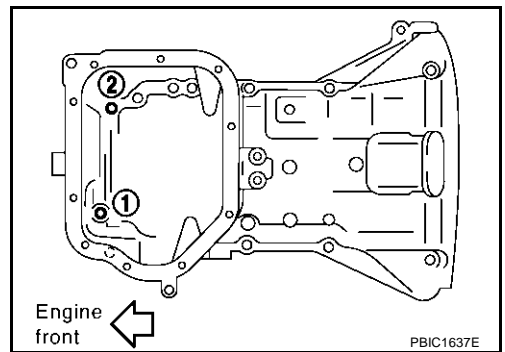
Exercise care not to damage signal plate.



17. Remove crankshaft pulley with a suitable puller.  
 18. Remove lower oil pan. Refer to [EM-26, "OIL PAN AND OIL STRAINER"](#).



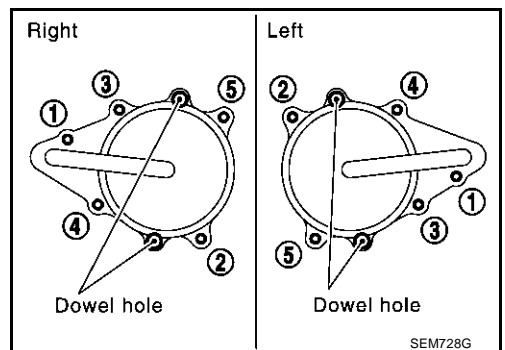
19. Loosen bolts in reverse order shown in figure, and remove installation bolts at the front of upper oil pan.  
 20. Install lower oil pan temporarily.  
 21. Support the lower oil pan bottom with a transmission jack.
- Perform following operations with engine front-side supported with jack.



22. 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.

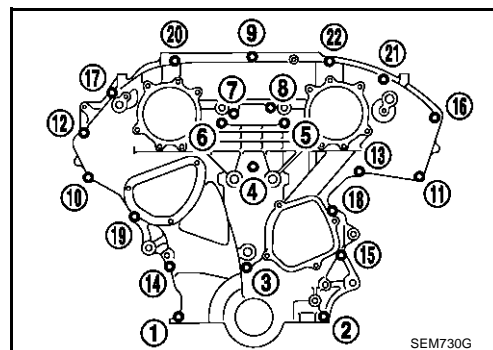
**CAUTION:**

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



## FRONT TIMING CHAIN CASE

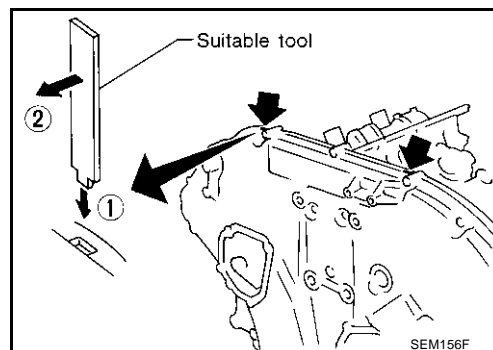
23. Remove right side engine mounting, mounting bracket and nuts. Refer to [EM-95, "ENGINE ASSEMBLY"](#).
24. Raise engine front-side with jack. (This secures workspace to remove front timing chain case.)
25. Remove front timing chain case.
  - a. Loosen mounting bolts in reverse order as shown.



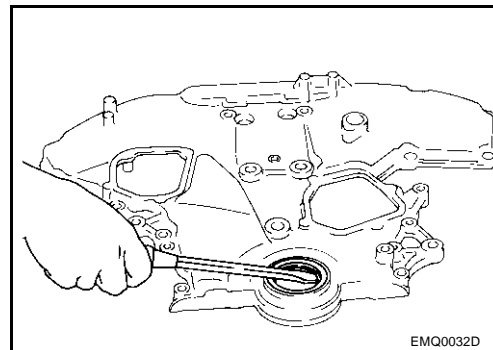
- b. Insert the appropriate size tool into the notch at the top of the front timing chain case as shown (1).
    - c. Pry off the case by moving the tool as shown (2).
      - Use seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.

### CAUTION:

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



26. 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.
        27. 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.



28. Remove timing chain and related parts. Refer to [EM-54, "TIMING CHAIN"](#) starting from step 11. (Disregard the procedures for removing front timing chain case and upper oil pan.)
        29. Remove residual gasket from front timing chain case and liquid gasket mating surface.

### CAUTION:

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

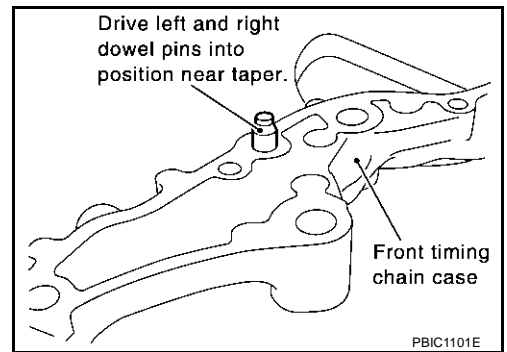
## INSTALLATION

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



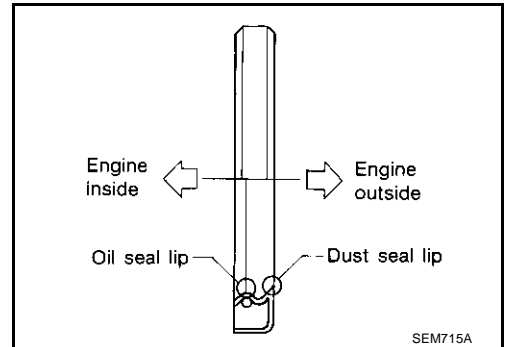
## FRONT TIMING CHAIN CASE

2. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.

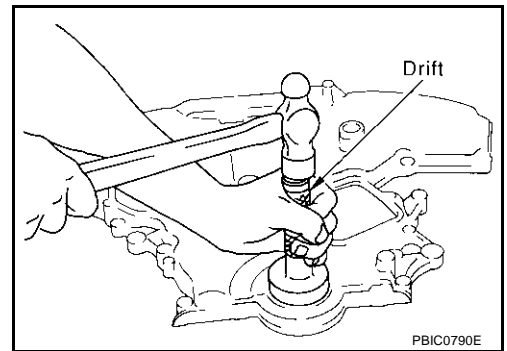


3. Install the front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.

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

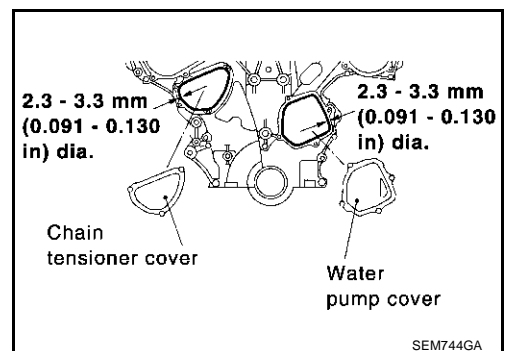


- Using a suitable drift, press-fit oil seal until it becomes flush with timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



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

- Apply RTV Silicone Sealant or equivalent. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

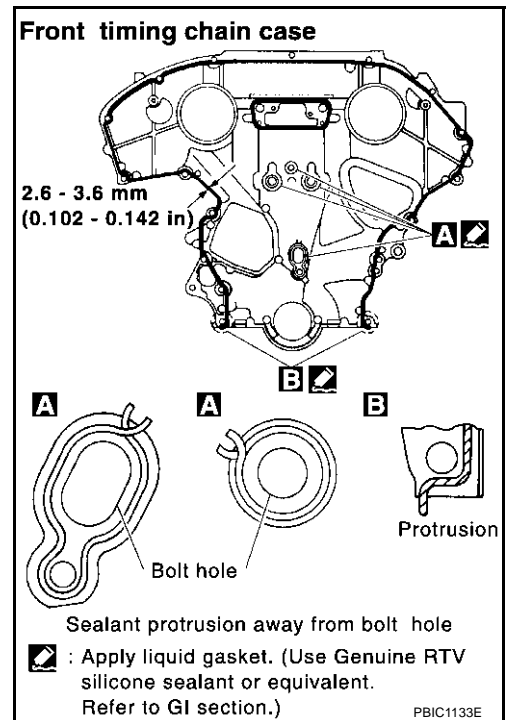


# FRONT TIMING CHAIN CASE

5. Install front timing chain case as follows:

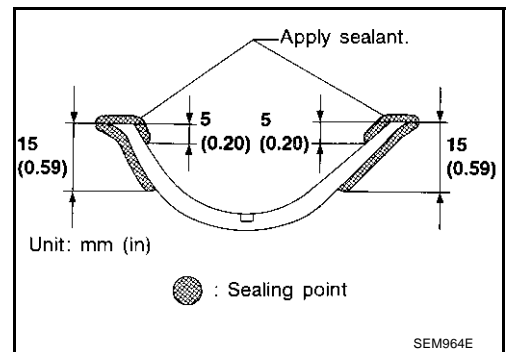
a. Apply liquid gasket to front timing chain case back side as shown.

- Apply RTV Silicone Sealant or equivalent. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

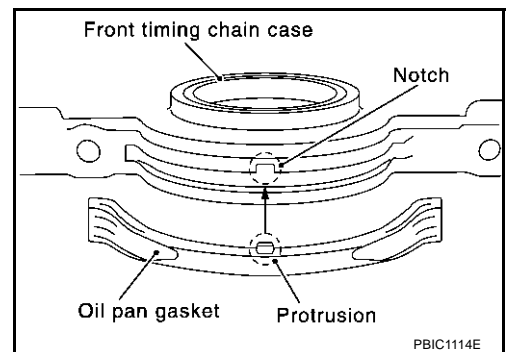


b. Install oil pan gasket.

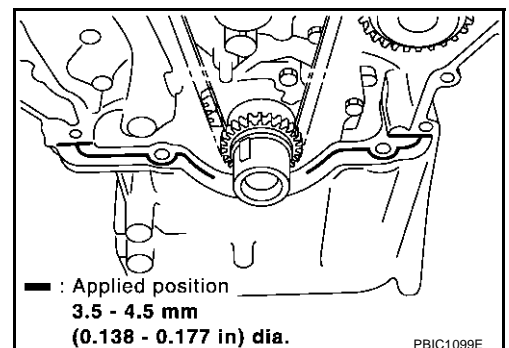
- Apply RTV Silicone Sealant or equivalent. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



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



- Apply liquid gasket to top surface of upper oil pan as shown in figure.
- Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

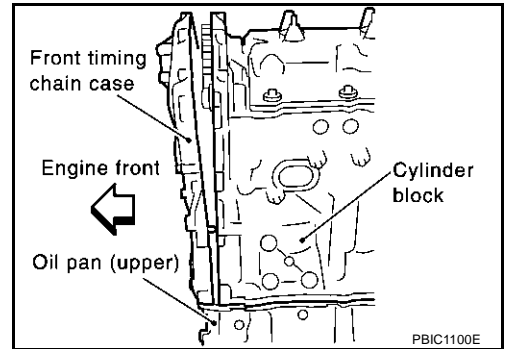


# FRONT TIMING CHAIN CASE

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

**CAUTION:**

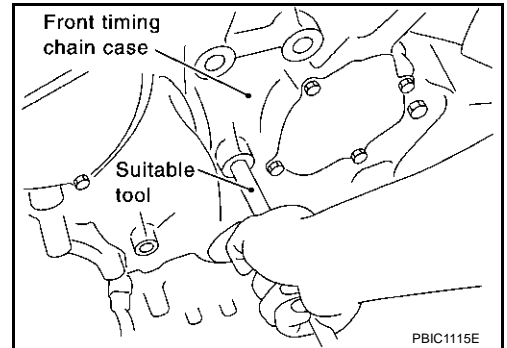
**Be careful that oil pan gasket is in place.**



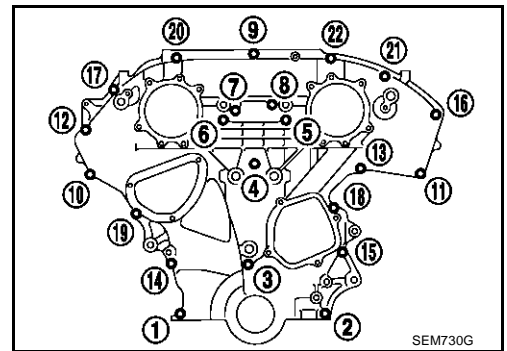
- ii. While pressing front timing chain case from its front and top as shown in figure, hammer dowel pin until the outer end becomes flush with surface.
- iii. Install bolts and temporarily tighten them.

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


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



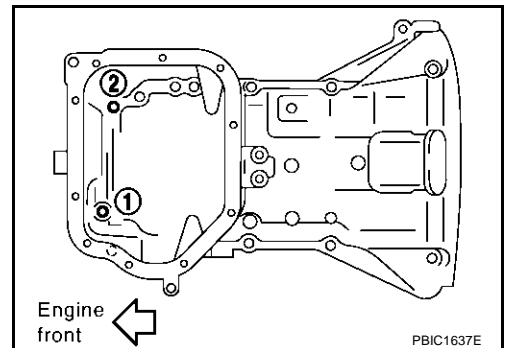
- 6. Tighten bolts to the specified torque in order shown in the figure.
  - After tightening, retighten them to specified torque in numerical order shown in figure.



- 7. Install right side engine mounting, mounting bracket and nuts. Refer to [EM-95, "ENGINE ASSEMBLY"](#).
- 8. Remove lower oil pan.
- 9. Install two mounting bolts in front of upper oil pan in numerical order shown in figure.

 : **15.7 - 18.6 N-m (1.6 - 1.9 kg-m, 12 - 14 ft-lb)**

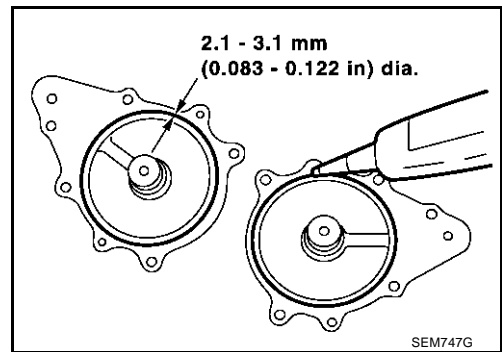
- 10. Install lower oil pan . Refer to [EM-26, "OIL PAN AND OIL STRAINER"](#) .



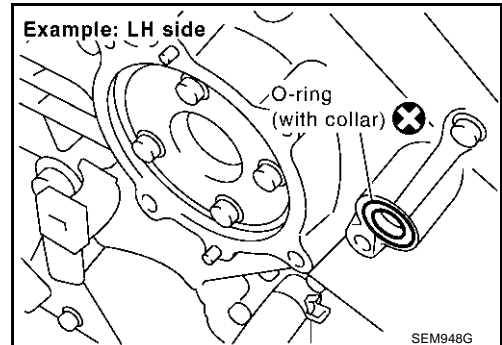
## FRONT TIMING CHAIN CASE

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

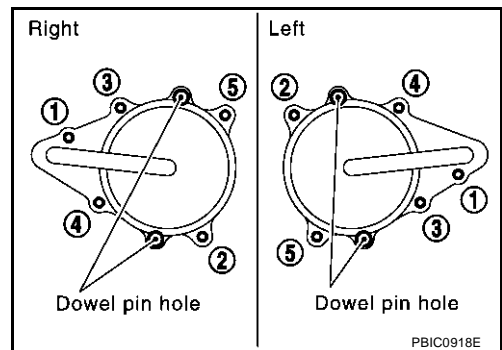
- a. Install seal rings in shaft grooves.
- b. Apply liquid gasket to the intake valve timing control covers.
  - Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46. "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



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

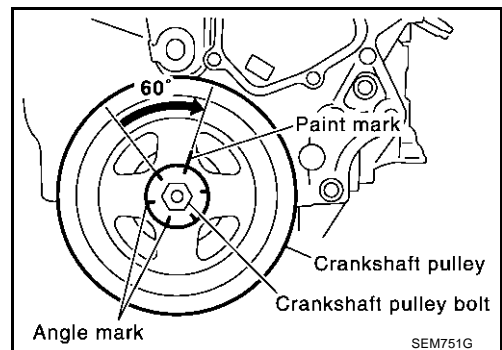


- d. Being careful not to move the seal ring from the installation groove, align the dowel pins on the chain case with the holes to install the intake valve timing control covers.
- e. Tighten bolts in the numerical order as shown.



12. Install crankshaft pulley as follows:

- a. Fix crankshaft using a suitable tool.
- b. 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).
- c. Tighten bolt to 39.2 to 49.0 N·m (4.0 to 5.0 kg·m, 29 to 36 ft·lb).
- d. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by 60 to 65 degrees [Target: 60 degrees (equivalent to one graduation)].



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

14. For the following operations, perform steps in the reverse order of removal.

# FRONT TIMING CHAIN CASE

**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.

A

**EM**

C

D

E

F

G

H

I

J

K

L

M

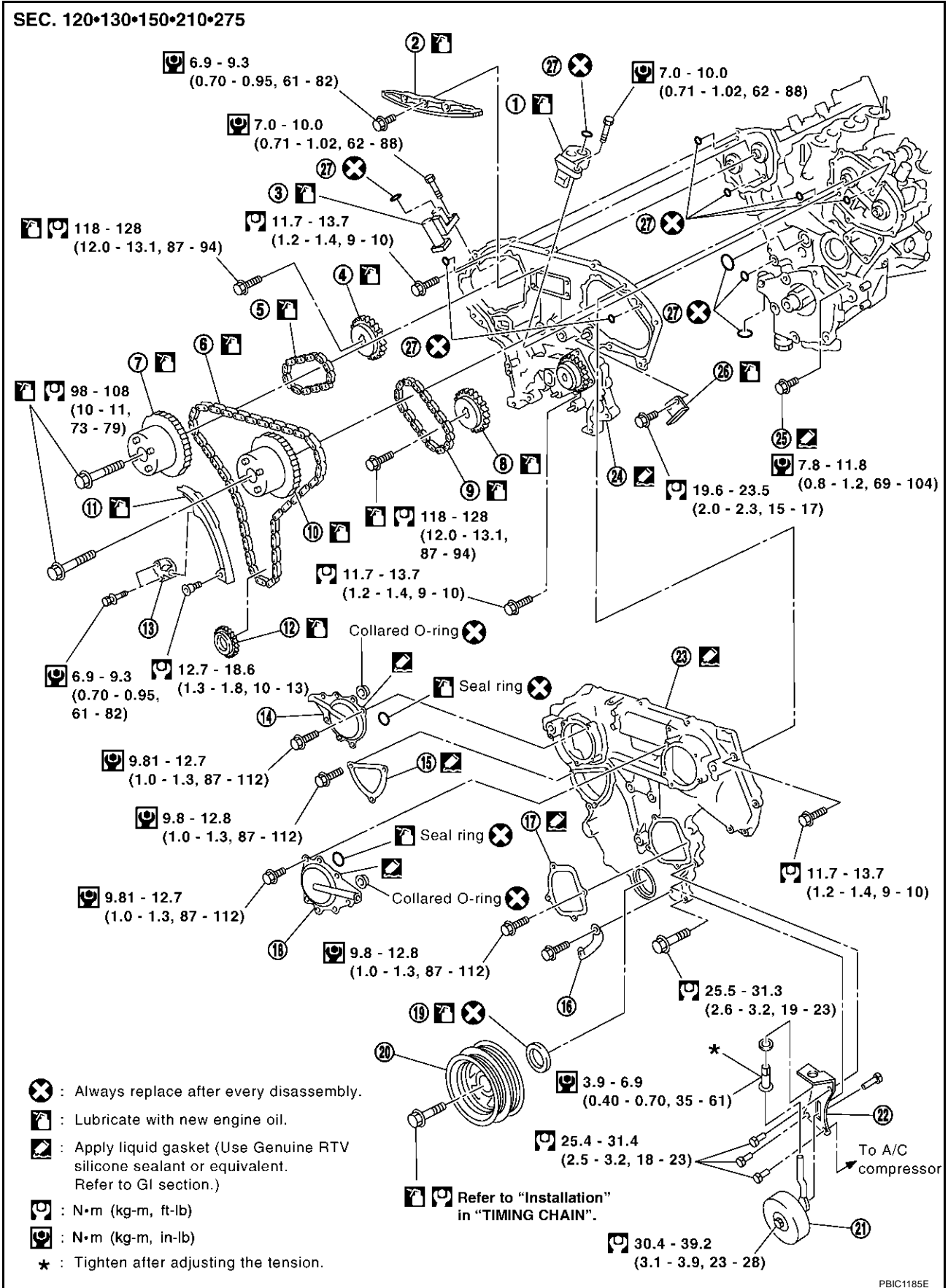
# TIMING CHAIN

PFP:13028

## TIMING CHAIN

### Removal and Installation

ABS00330



# 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. Water hose clamp                  | 17. Water pump cover                  | 18. Intake valve timing control cover |
| 19. Front oil seal                    | 20. Crankshaft pulley                 | 21. Idler pulley                      |
| 22. Idler pulley bracket              | 23. Front timing chain case           | 24. Rear timing chain case            |
| 25. Water drain plug                  | 26. Tension guide                     | 27. O-ring                            |

## CAUTION:

- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets, camshaft brackets, and crankshaft pulley.

## 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 assembly from vehicle, and separate front suspension member, transaxle and transfer (AWD models) assembly from engine. Refer to [EM-95, "Removal and Installation"](#).
2. Install engine slingers. Refer to [EM-95, "ENGINE ASSEMBLY"](#).
3. Install engine sub-attachment to right side of cylinder block, then lift engine, and mount it onto the engine stand. Refer to [EM-100, "CYLINDER BLOCK"](#).
4. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
5. Remove engine harnesses.
6. Remove water hoses.
7. Remove EVAP canister purge volume control solenoid valve. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).
8. Remove drive belts and idler pulley bracket.
9. Remove power steering oil pump assembly. Refer to [PS-28, "Removal and Installation"](#).
10. Remove alternator. Refer to [SC-27, "Removal and Installation"](#).
11. Remove RH and LH rocker covers with power tool. Refer to [EM-43, "ROCKER COVER"](#).
12. Remove crankshaft position sensor (POS).

## CAUTION:

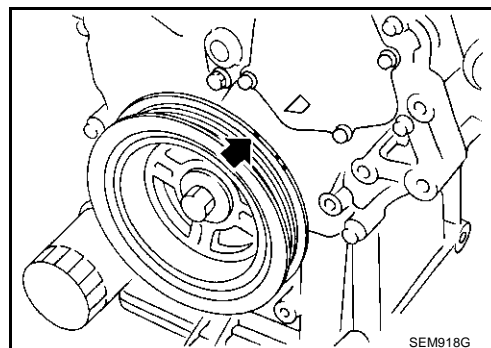
- Handle carefully to avoid dropping and shocks.
- Do not disassemble.
- Do not allow metal powder to adhere to magnetic part at sensor tip.
- Do not place sensors in a location where they are exposed to magnetism.

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.



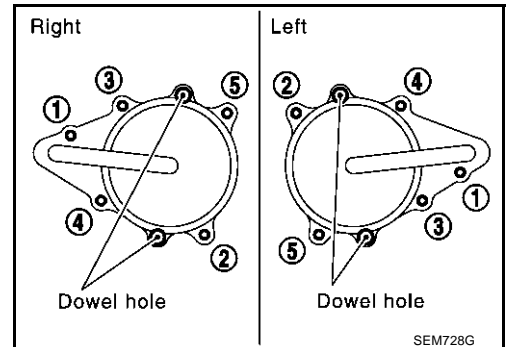
## TIMING CHAIN

14. Remove lower and upper oil pans. Refer to [EM-26, "OIL PAN AND OIL STRAINER"](#).
15. Remove crankshaft pulley as follows:
  - a. Lock crankshaft with a hammer handle or similar tool to loosen fixing bolts.
  - b. Remove crankshaft pulley with a suitable puller.

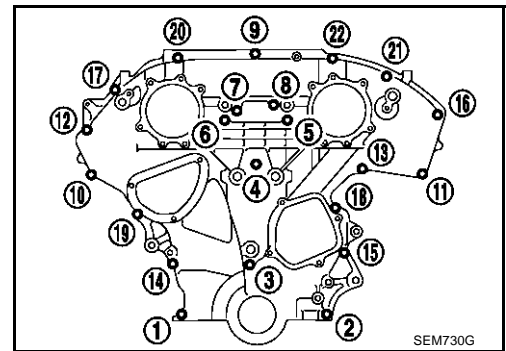
16. Remove the RH and LH intake valve timing control covers.
  - Loosen bolts in reverse order as shown.
  - Use seal cutter [special service tool: KV10111100 (j37228)] or an equivalent tool to cut liquid gasket for removal.

**CAUTION:**

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



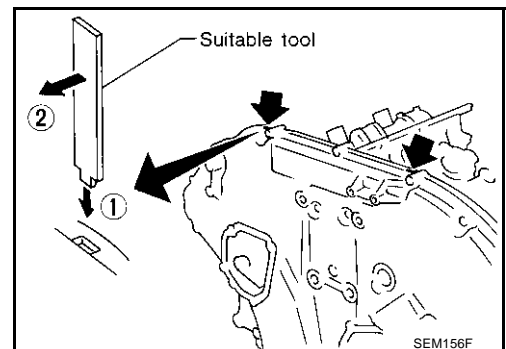
17. Remove RH engine mounting bracket. Refer to [EM-95, "ENGINE ASSEMBLY"](#).
18. Remove front timing chain case.
  - a. Loosen mounting bolts in reverse order as shown.



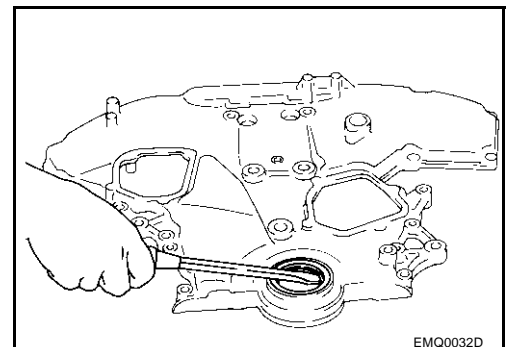
- b. Insert the appropriate size tool into the notch at the top of the front timing chain case as shown (1).
    - c. Pry off the case by moving the tool as shown (2).
- Use seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.

**CAUTION:**

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



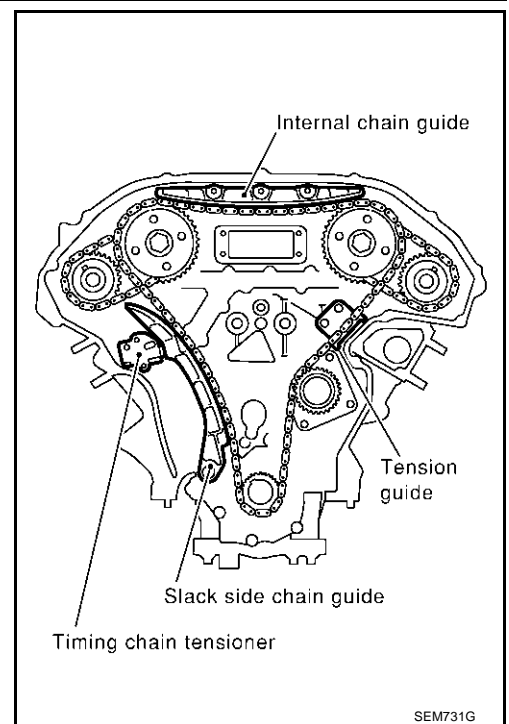
19. Remove water pump cover and chain tensioner cover from front timing chain case.
  - Use seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.
20. Remove the front oil seal from the front timing chain case using a suitable tool.
  - Use screwdriver for removal.
  - Exercise care not to damage front timing chain case.





## TIMING CHAIN

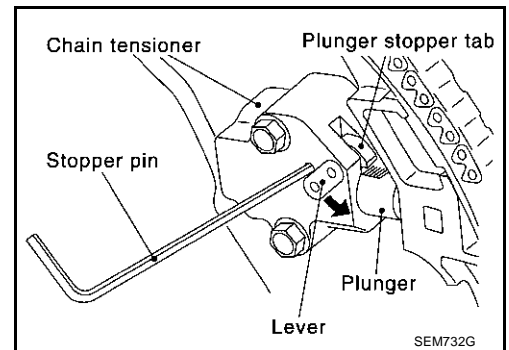
21. Remove internal chain guide, timing chain tensioner, tension guide and slack guide.



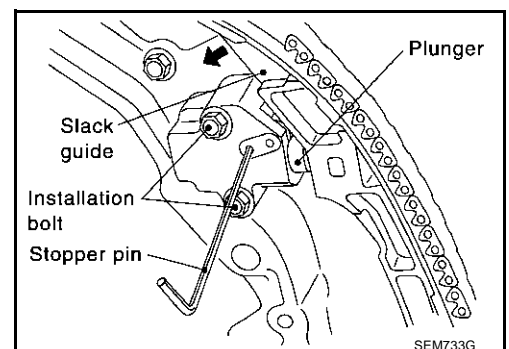
- Remove timing chain tensioner as follows:
- a. Pull lever down and release plunger stopper tab.
    - Plunger stopper tab can be pushed up to release (coaxial structure with lever).
  - b. Insert stopper pin into tensioner body hole to hold lever, and keep the tab released.

**NOTE:**

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



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



22. 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.

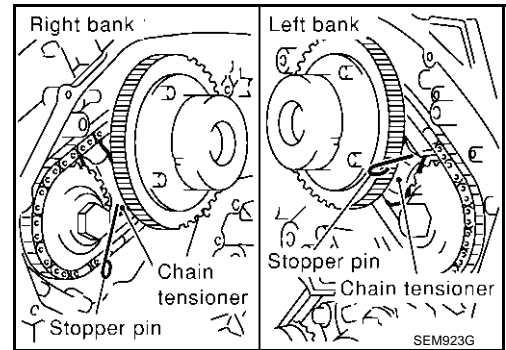
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## TIMING CHAIN

23. Attach a suitable stopper pin to the RH and LH camshaft chain tensioners (for secondary timing chains).

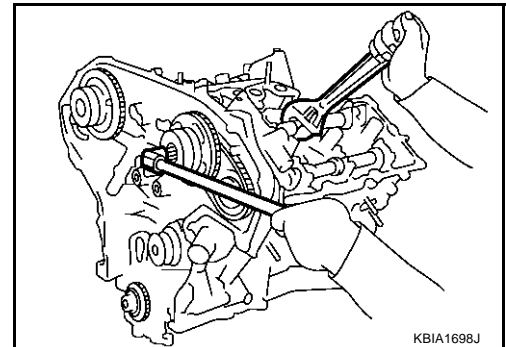
**NOTE:**

For removal and installation of secondary chain tensioner, refer to [EM-70, "CAMSHAFT"](#) . (Removing No. 1 camshaft bracket is required.)



24. Remove intake and exhaust camshaft sprocket bolts.

- Apply paint to timing chain and camshaft sprockets for alignment during installation.
- Secure the hexagonal portion of the camshaft using a wrench to loosen the mounting bolts.



25. 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.

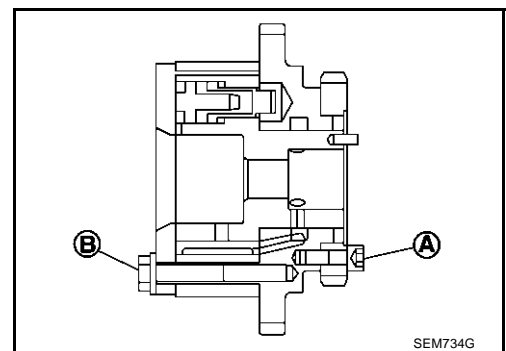
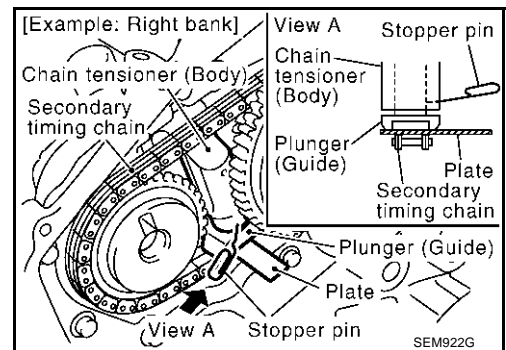
**NOTE:**

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).

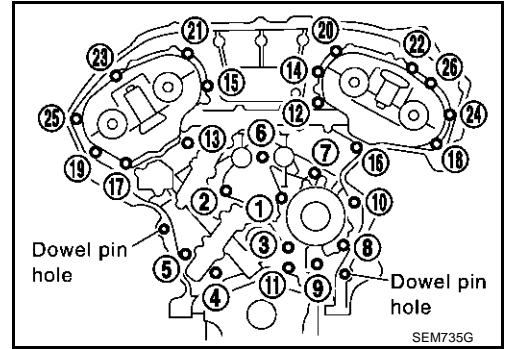


26. Remove chain tension guide.

# TIMING CHAIN

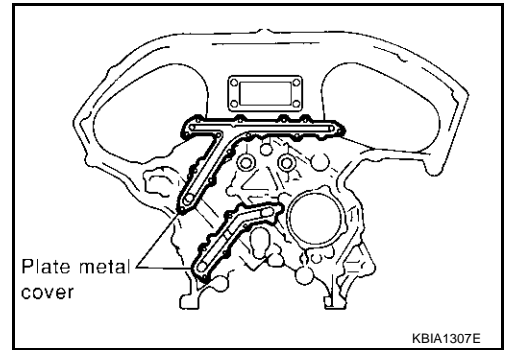
27. Remove rear timing chain case as follows:

- a. Loosen and remove mounting bolts in reverse order as shown.
- b. Cut the sealant using a seal cutter [special service tool: KV10111100 (J37228)] or an equivalent tool and remove rear timing chain case.



**CAUTION:**

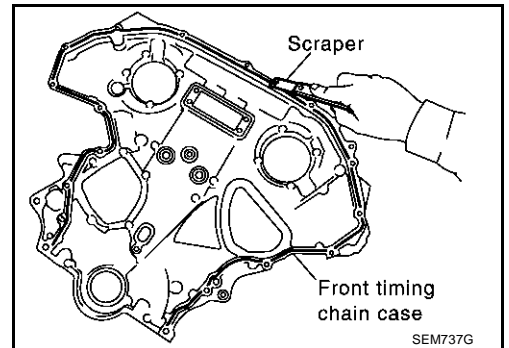
- Do not remove plate metal cover of oil passage.
- After removing chain case, do not apply any load which affects flatness.



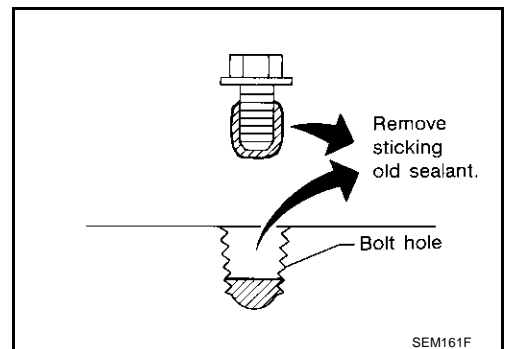
28. Remove RH and LH camshaft chain tensioners from cylinder head as follows if necessary.

- a. Remove No.1 camshaft brackets. Refer to [EM-71, "REMOVAL"](#).
- b. Remove secondary chain tensioners with stopper pin attached.

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



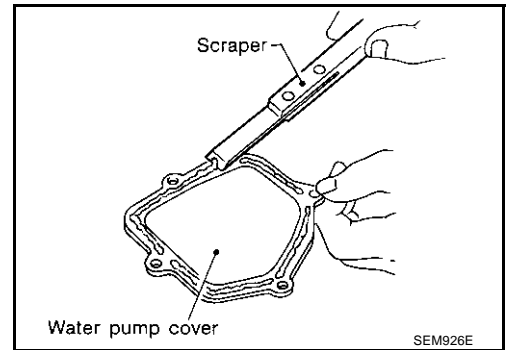
- Remove old liquid gasket from the bolt hole and thread.



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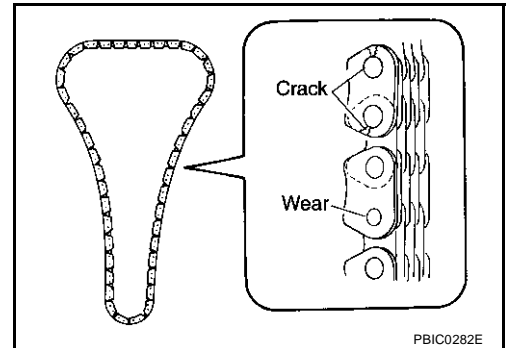
# TIMING CHAIN

30. 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

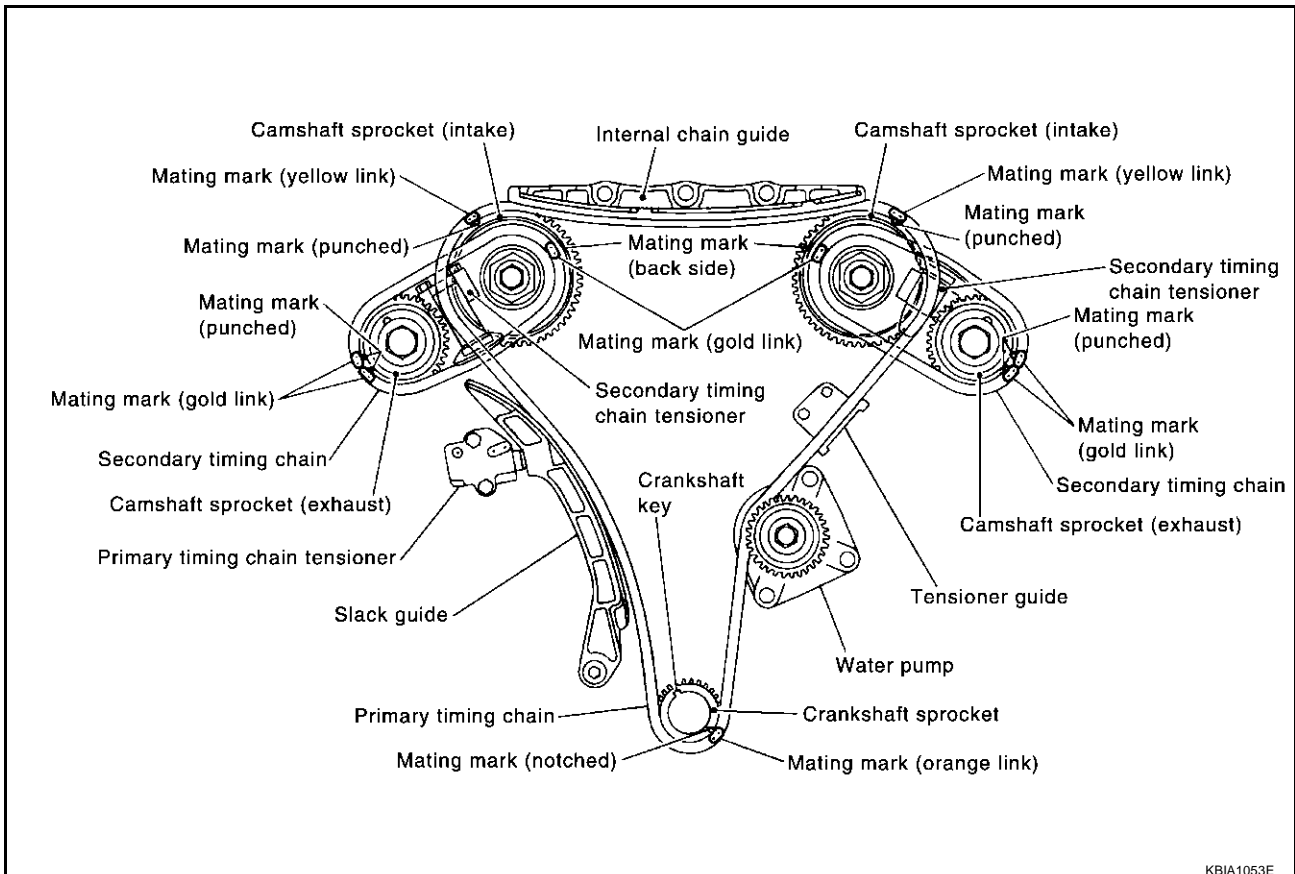
Check for cracks and any excessive wear at the roller links of the timing chain. Replace the timing chain as necessary.



## 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 camshaft chain tensioners to cylinder head as follows if removed. Refer to [EM-74](#), "[INSTALLATION](#)".

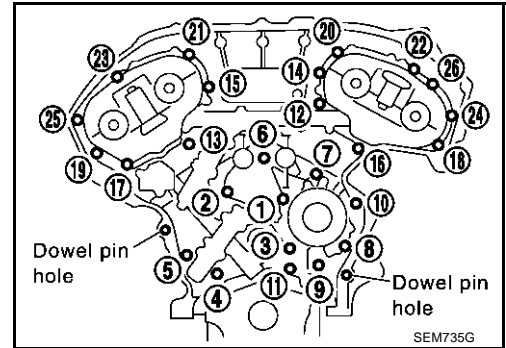


## TIMING CHAIN

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

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



- 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

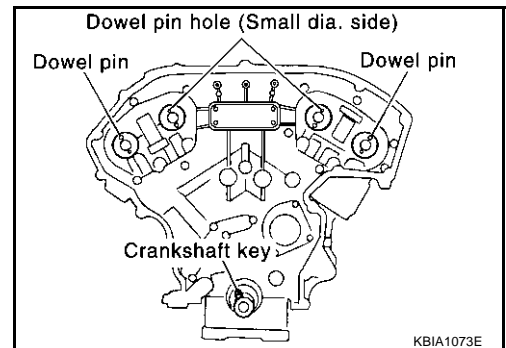
**Rear timing chain case to cylinder block:**  
 -0.24 to 0.14 mm (-0.0094 to 0.0055 in)

- 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.

**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:

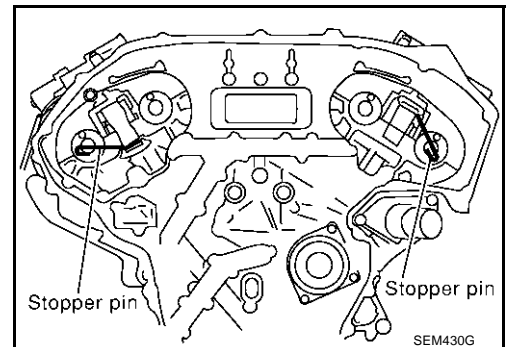
Hole on small dia. side must be used for intake side dowel pin hole. Do not misidentify (ignore big dia. side).

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 chain tensioner and keep it pressed in with a stopper pin.



# TIMING CHAIN

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.

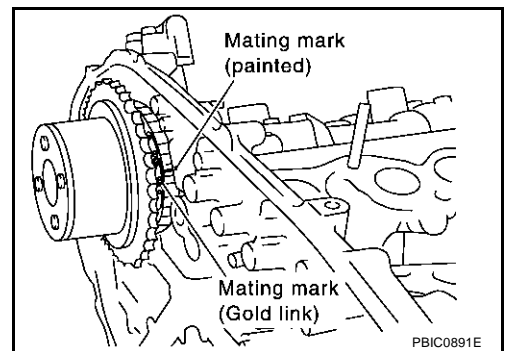
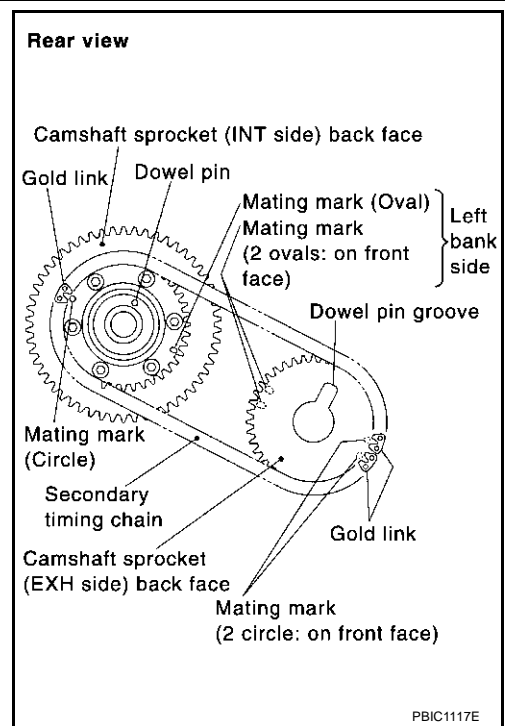
**NOTE:**

- 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.**

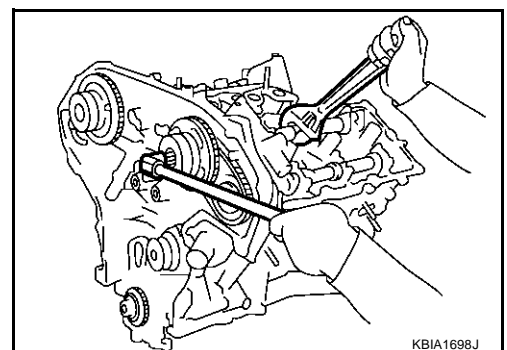
**LH bank : use oval type.**

- 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.
- 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.

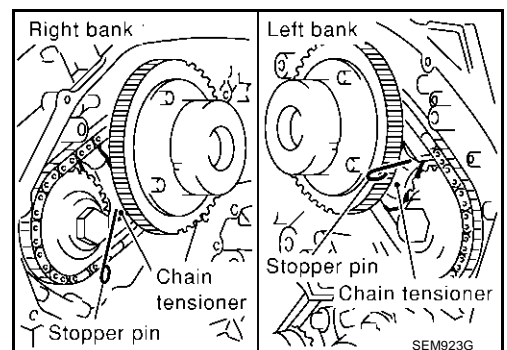


10. After confirming the mating marks are aligned, tighten the camshaft sprocket mounting bolts.

- 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.



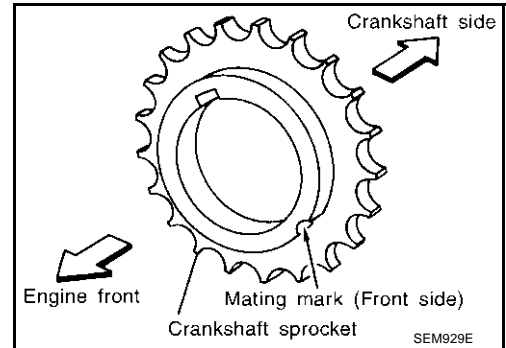
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## TIMING CHAIN

12. Install the primary timing chain as follows:

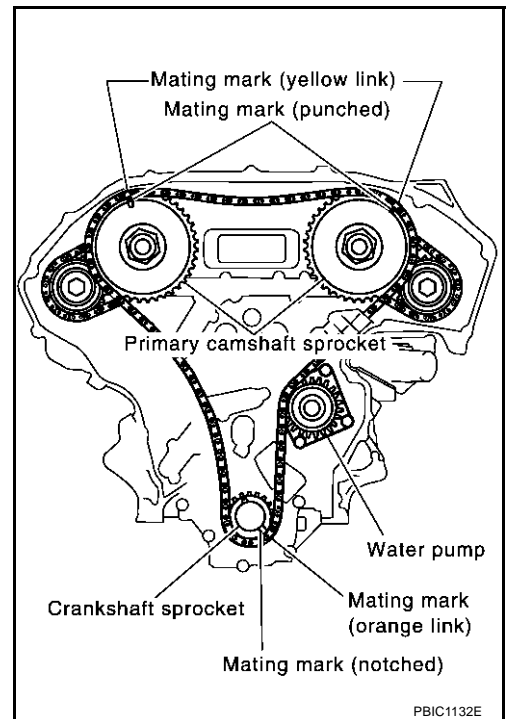
a. Install the crankshaft sprocket.

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



b. Install the primary timing chain.

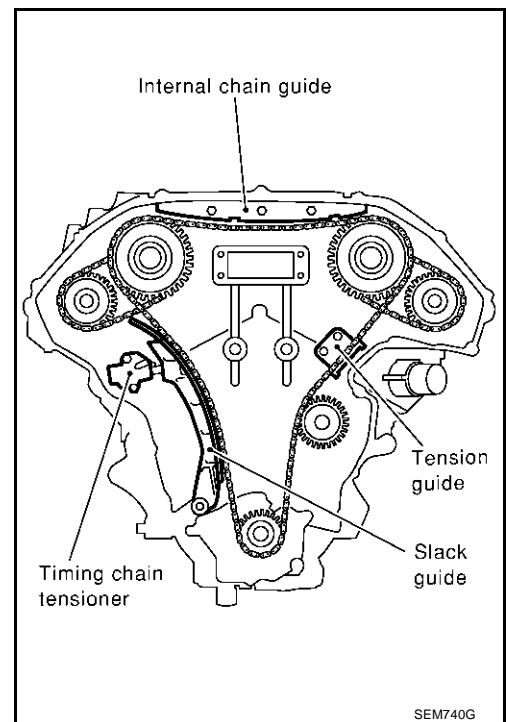
- Install primary timing chain so the mating mark (punched) on camshaft sprocket is aligned with the yellow link on the timing chain, while the mating mark (notched) on the crankshaft sprocket is aligned with the orange one on the timing chain, as shown.
- When it is difficult to align mating marks of 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.



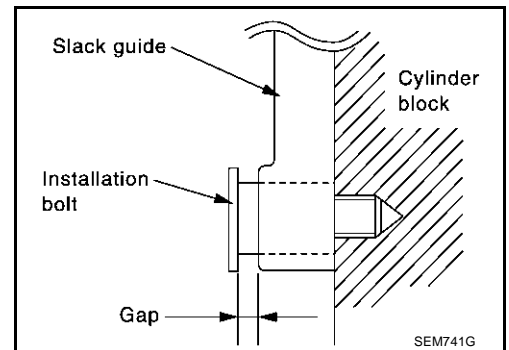


## TIMING CHAIN

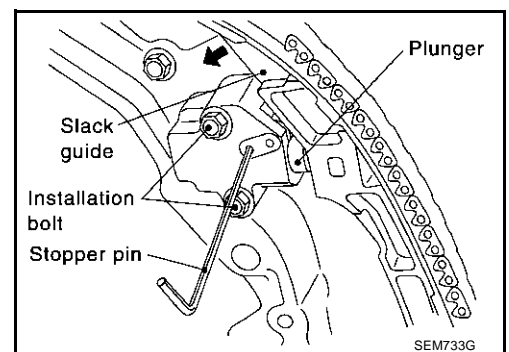
13. Install the internal chain guide and tension guide.
14. Install slack guide.



- 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.



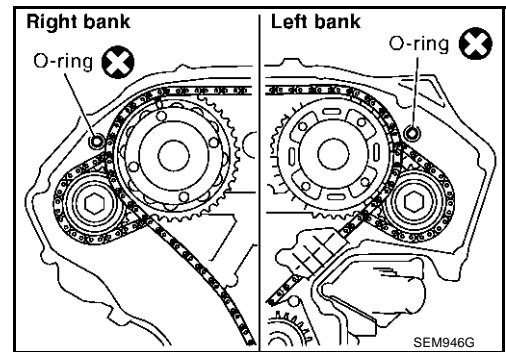
15. Install chain tensioner for slack guide.
  - When installing the chain tensioner, push in the sleeve and keep it pressed in with the stopper pin.
  - Remove any dirt and foreign materials completely from the back and the mounting surfaces of the chain tensioner.
  - After installation, pull out the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



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

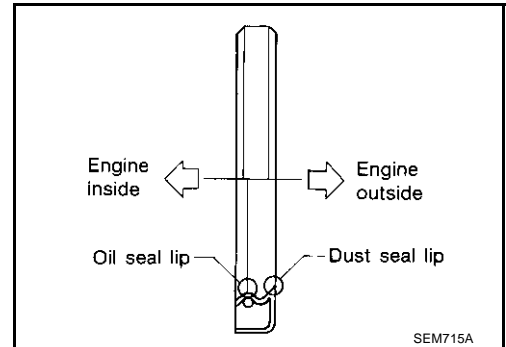
# TIMING CHAIN

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

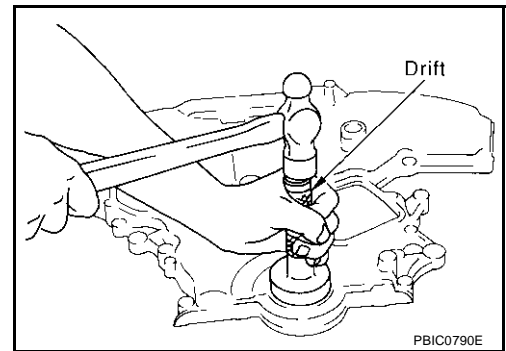


18. Install the front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.

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

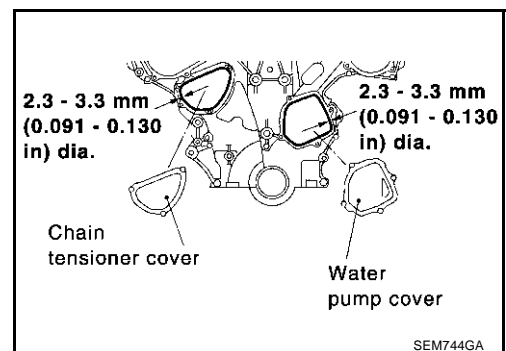


- Using a suitable drift, press-fit oil seal until it becomes flush with timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



19. Install the water pump cover and the chain tensioner cover to front cover.

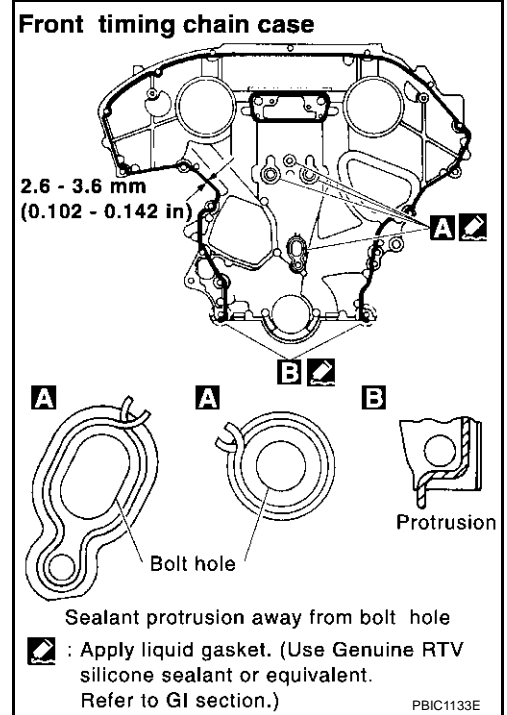
- Apply RTV Silicone Sealant or equivalent. Refer to [GI-46](#). "[RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS](#)".



# TIMING CHAIN

20. Install front timing chain case as follows:

- Apply liquid gasket to front timing chain case back side as shown.
- 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.

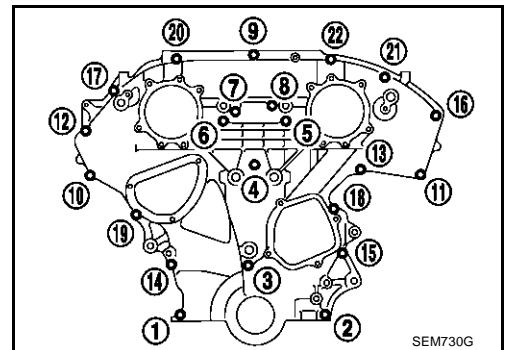
**8 mm (0.31 in) dia. bolts : 1, 2**

: **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.



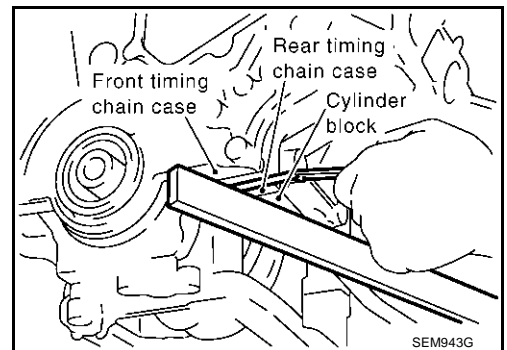
21. After installing the front timing chain case, check the surface height difference between the following parts on the oil pan mounting surface.

- If not within specification, repeat the installation procedure.

**Standard**

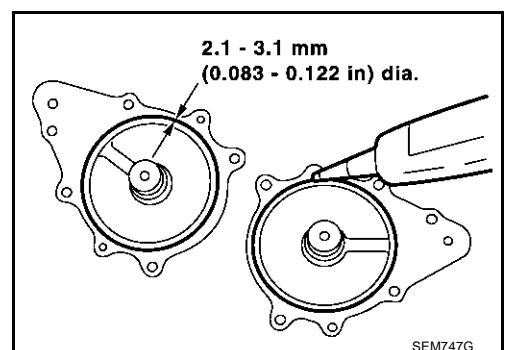
**Front timing chain case to rear timing chain case:**

**-0.14 to 0.14 mm (-0.005 to 0.0055 in)**



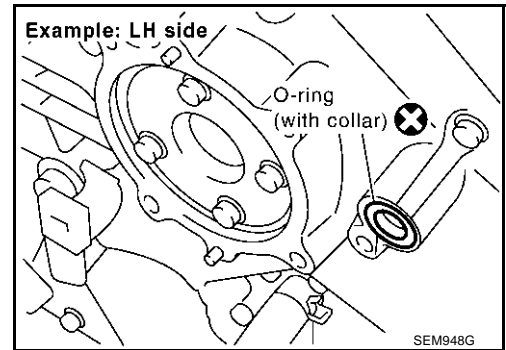
22. Install RH and LH intake valve timing control covers as follows:

- Install seal rings in shaft grooves.
- Apply liquid gasket to the intake valve timing control covers.
  - Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

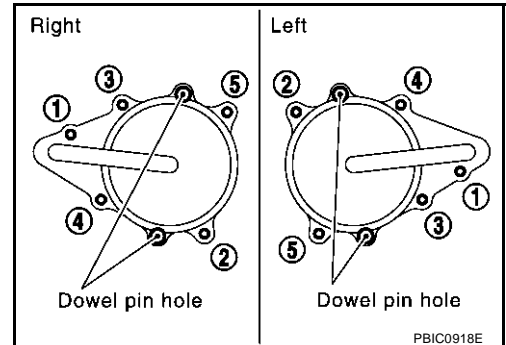


## TIMING CHAIN

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



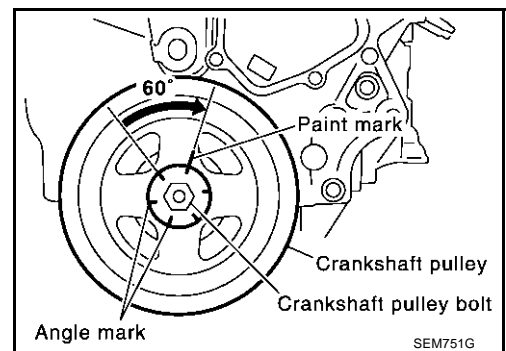
- d. Being careful not to move the seal ring from the installation groove, align the dowel pins on the chain case with the holes to install the intake valve timing control covers.
- e. Tighten bolts in the numerical order as shown.



23. Install RH and LH rocker covers. Refer to [EM-43, "ROCKER COVER"](#) .

24. Install crankshaft pulley as follows:

- Fix crankshaft using a hammer shaft or an equivalent tool.
- 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 65 degrees [Target: 60 degrees (equivalent to one graduation)].



25. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
26. 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.

# TIMING CHAIN

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## INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of engine coolant, lubrications and working oils. 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, lubricants, working oil, 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, lubricants, oil, and fluid. Refill to specified level, if necessary.

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# CAMSHAFT

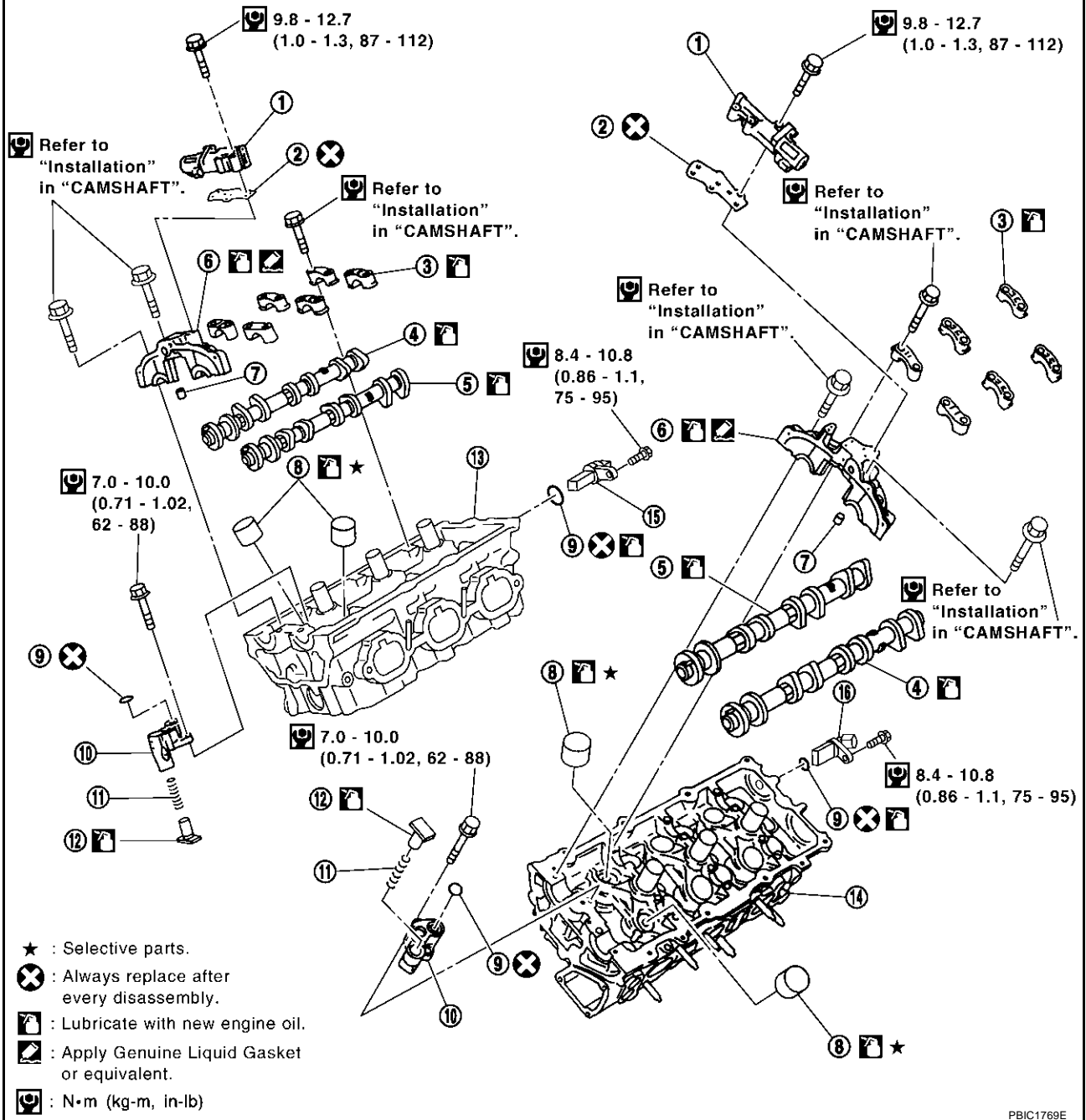
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## CAMSHAFT

### Removal and Installation

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- |  |                             |  |
|--|-----------------------------|--|
| 1. Intake valve timing control solenoid 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 (Secondary)                | 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) |                             |  |

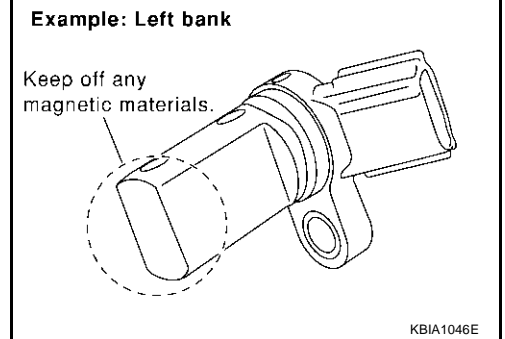
# CAMSHAFT

## REMOVAL

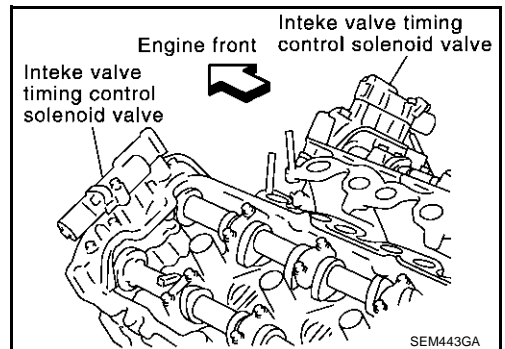
1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [EM-54, "TIMING CHAIN"](#).
2. If necessary, remove camshaft position sensor (PHASE) (RH and LH banks) from cylinder head back side.

### CAUTION:

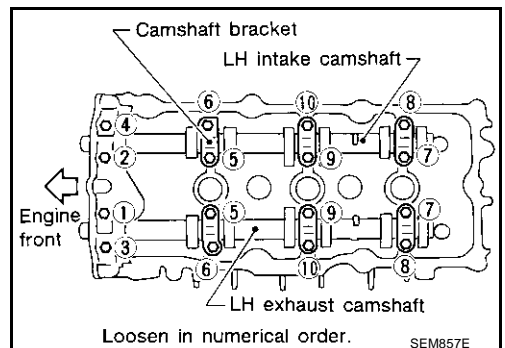
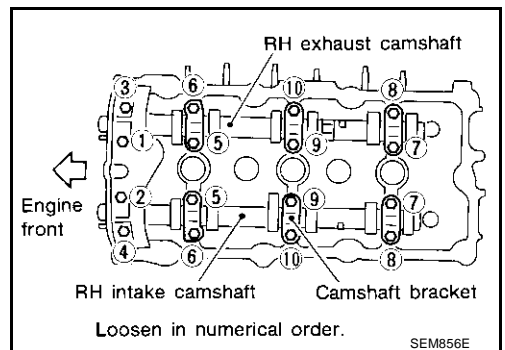
- Handle carefully to avoid dropping and shocks.
- Do not disassemble.
- Do not allow metal powder to adhere to magnetic part at sensor tip.
- Do not place sensors in a location where they are exposed to magnetism.



3. Remove the intake valve timing control solenoid valves.
  - Discard the intake valve timing control solenoid valve gaskets and use new gaskets for installation.



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 numerical order shown.



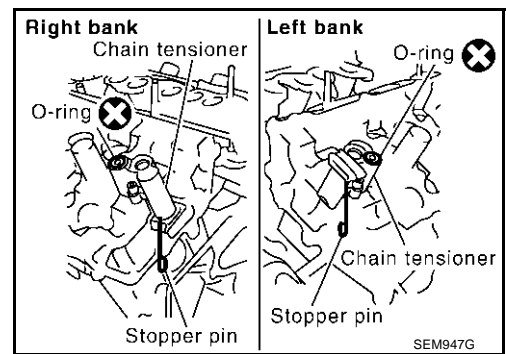
5. Remove camshaft.
6. Remove valve lifter.
  - Identify installation positions, and store them without mixing them up.

# CAMSHAFT

- Remove secondary timing chain tensioner from cylinder head.
  - Remove secondary chain tensioner with its stopper pin attached.

**NOTE:**

Stopper pin was attached when secondary timing chain was removed.



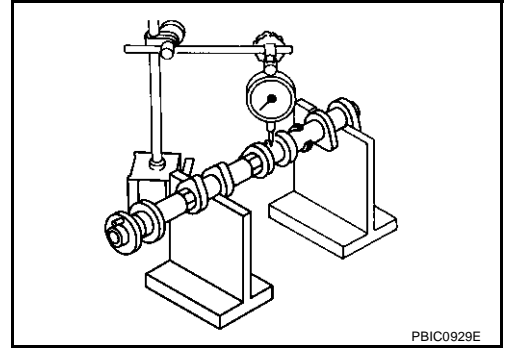
## INSPECTION AFTER REMOVAL

### Camshaft Runout

- Put V block on precise flat bed, and support No. 2 and No. 4 journal of camshaft.
- Set dial gauge vertically to No. 3 journal.
- Turn camshaft to one direction with hands, and measure camshaft runout on dial gauge. (Total indicator reading)

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

- If it exceeds the limit, replace camshaft.



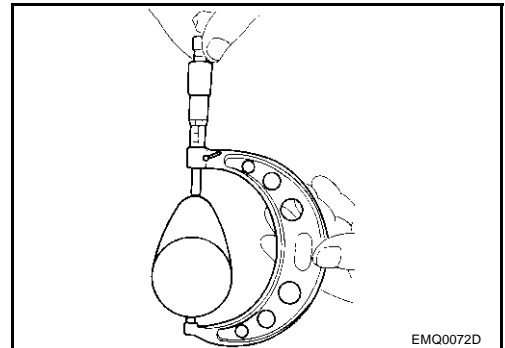
### Camshaft Cam Height

- 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)**

- If wear is beyond the limit, replace camshaft.



### Camshaft Journal Clearance

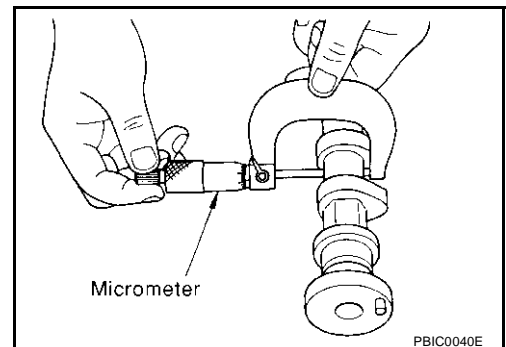
#### Outer Diameter of Camshaft Journal

- 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.

### NOTICE:

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)**

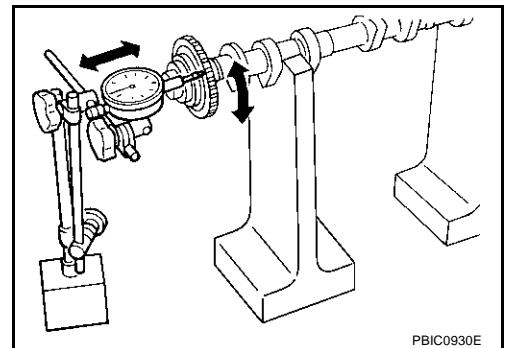
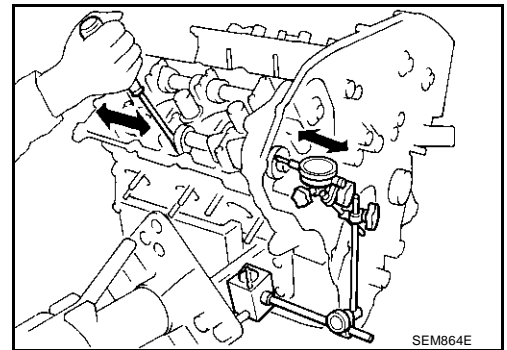
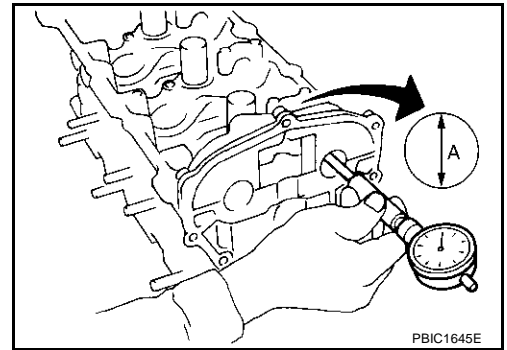
- When out of the limit, replace with new camshaft and measure again.
- When out of the limit again, replace with new cylinder head.

## Camshaft Sprocket Runout

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



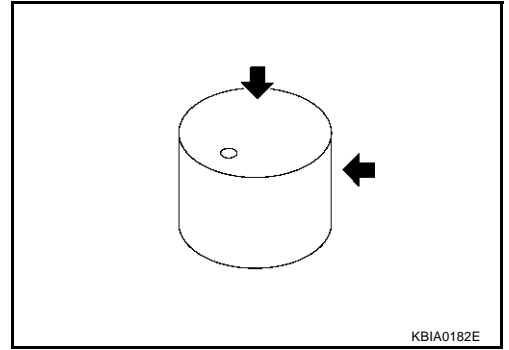
A  
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# CAMSHAFT

## Valve Lifter

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

- If anything above is found, replace valve lifter.

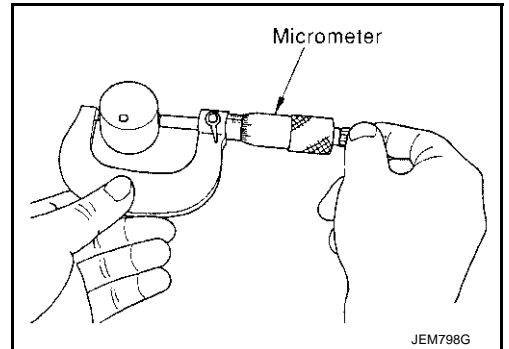


## Valve Lifter Clearance

### Outer Diameter of Valve Lifter

- Measure outer diameter of valve lifter.

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



### Valve Lifter Hole Diameter

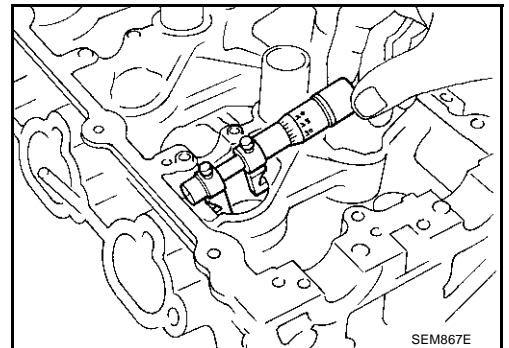
- Using inside micrometer, measure diameter of valve lifter hole of cylinder head.

**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)**

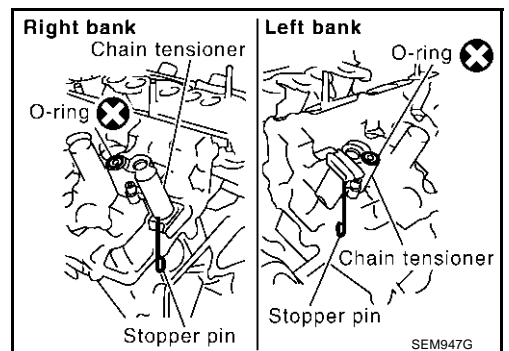


- When out of specified range, referring to each specification of outer and inner diameter, replace either or both valve lifter and cylinder head.

## 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.

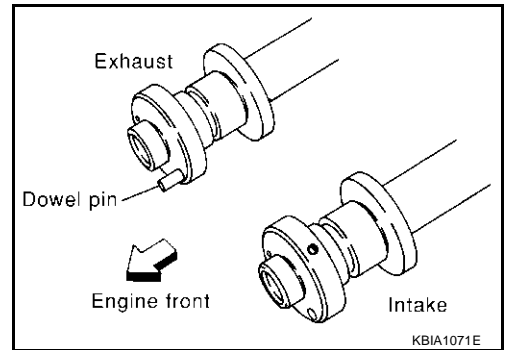


2. Install valve lifter.
  - Install it in the original position.

# CAMSHAFT

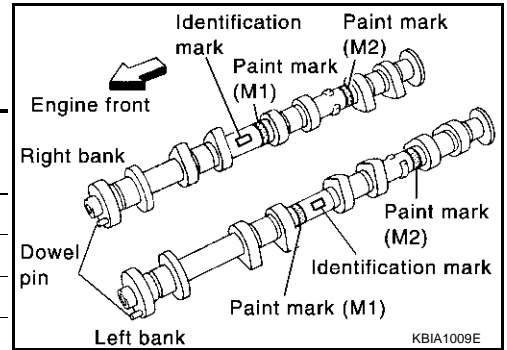
## 3. Install camshafts.

- 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.

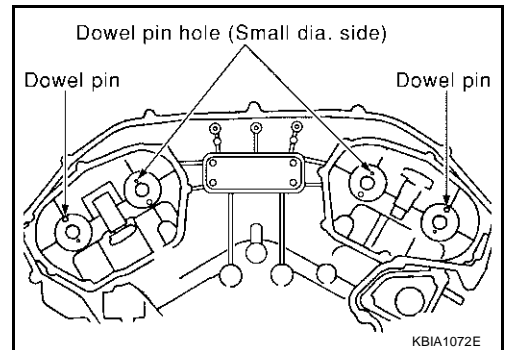
Bank	INT/EXH	Dowel pin	Paint marks		ID mark
			M1	M2	
RH	INT	No	Pink	No	RE
	EXH	Yes	No	Orange	RE
LH	INT	No	Pink	No	LH
	EXH	Yes	No	Orange	LH



- 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)

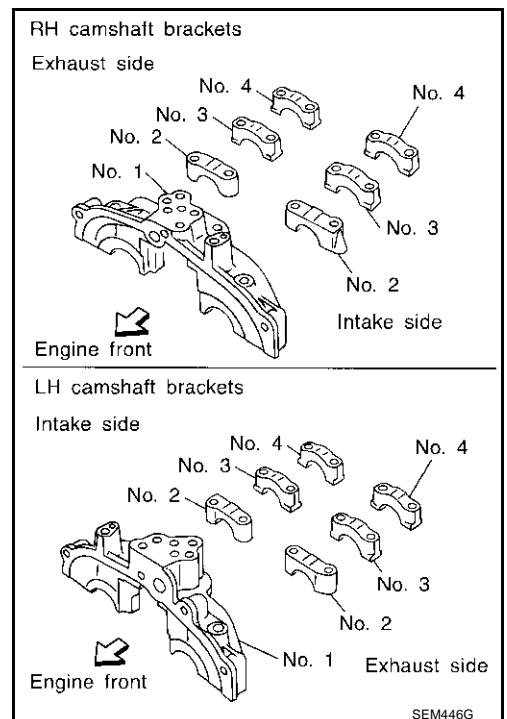
**NOTE:**

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).



## 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.

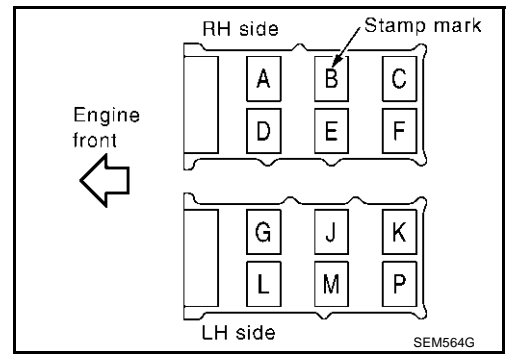


# CAMSHAFT

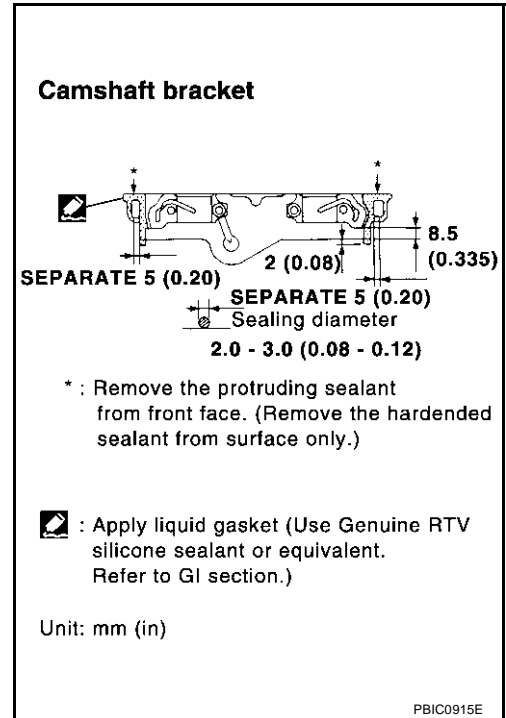
- Install No.2 to 4 camshaft brackets aligning the stamp marks as shown.

**NOTE:**

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



- Apply sealant to mating surface of No.1 camshaft bracket as shown on RH and LH banks.
- Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46](#). "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS".



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.

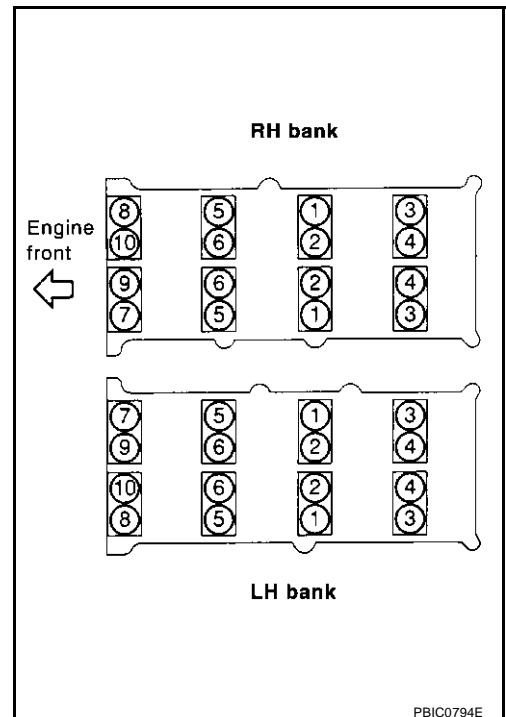
☒ : 1.96 N·m (0.2 kg-m, 17 in-lb)

- b. Tighten all bolts in the numerical order as shown.

☒ : 5.88 N·m (0.6 kg-m, 52 in-lb)

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

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

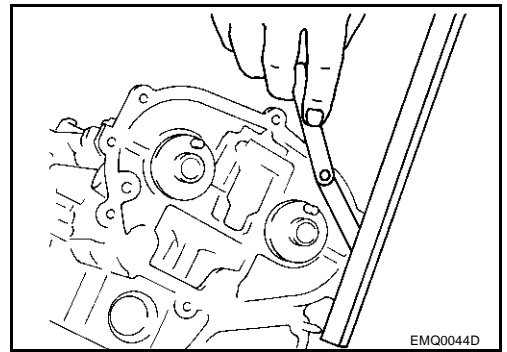


# CAMSHAFT

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.

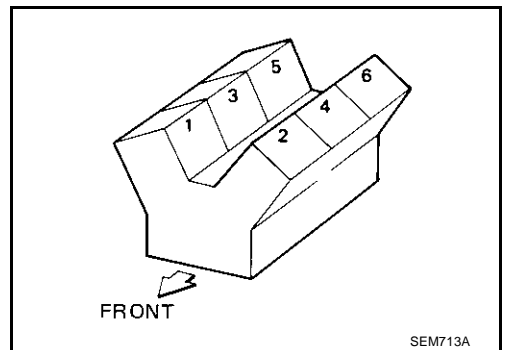


7. Inspect and adjust valve clearance. Refer to [EM-77, "Valve Clearance"](#).
8. Install in the reverse order of removal after this step.

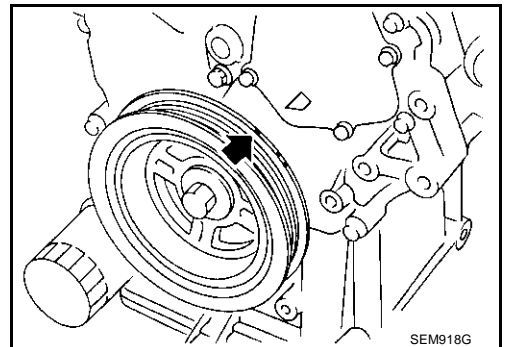
## Valve Clearance INSPECTION

ABS003MI

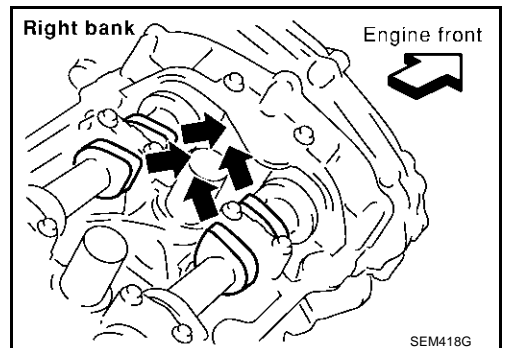
- Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.



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



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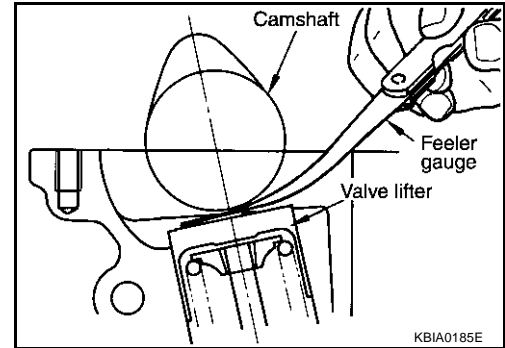
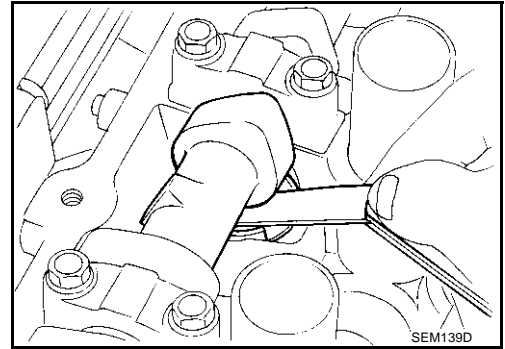
# CAMSHAFT

b. Using a feeler gauge, measure valve clearance.

**Valve clearance standard:**

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

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

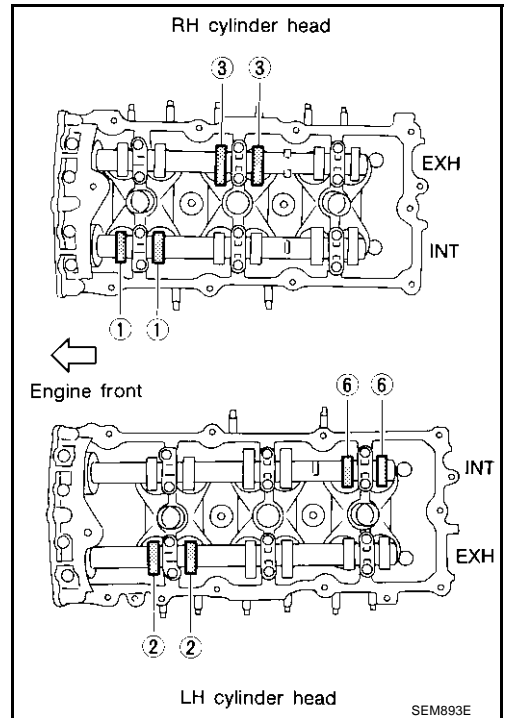


● No.1 cylinder at compression TDC

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:**

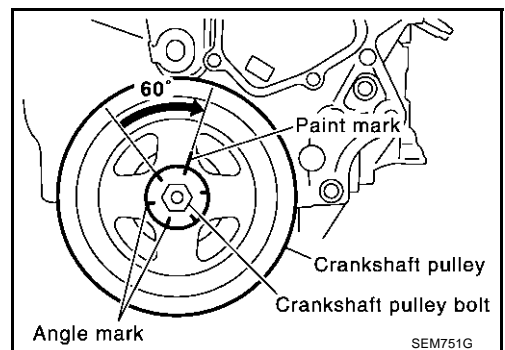
If inspection was carried out with cold engine, check that values with fully warmed up engine are still within specifications.



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

**NOTE:**

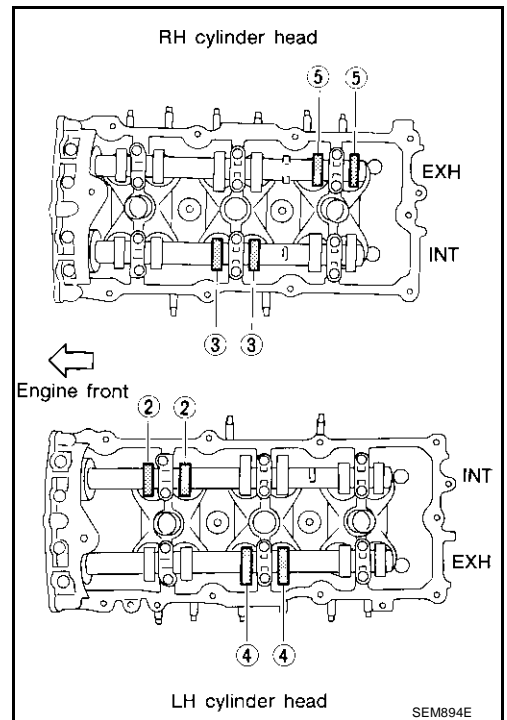
Crankshaft pulley mounting bolt flange has a stamped line every 60°. They can be used as a guide to rotation angle.



# CAMSHAFT

- No.3 cylinder at compression TDC

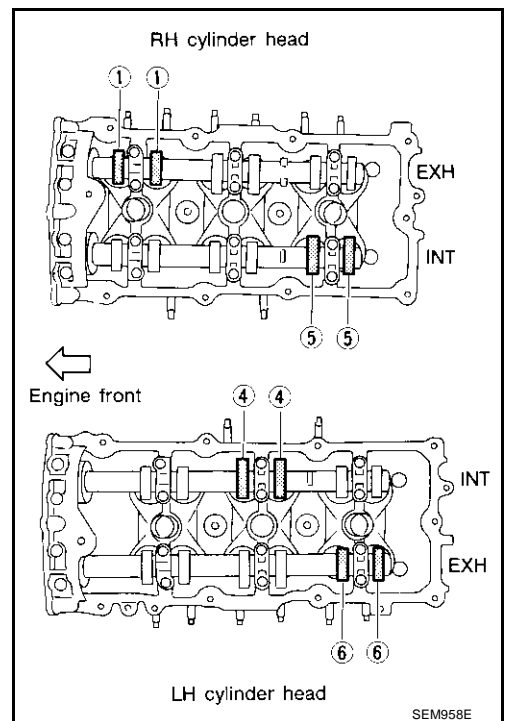
Measuring position (RH bank)		No.1 CYL.	No.3 CYL.	No.5 CYL.
No.3 cylinder at TDC	EXH			×
	INT		×	
Measuring position (LH bank)		No.2 CYL.	No.4 CYL.	No.6 CYL.
No.3 cylinder at TDC	INT	×		
	EXH		×	



- 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 below.

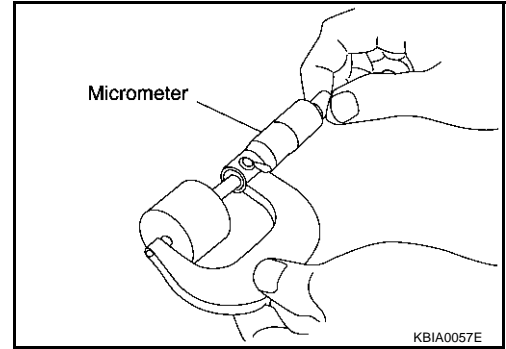


## ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
  - The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use the specifications for hot engine condition to adjust.
1. Remove camshaft. Refer to [EM-70, "Removal and Installation"](#).
  2. Remove the valve lifters at the locations that are outside the standard.

# CAMSHAFT

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.

**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)\*

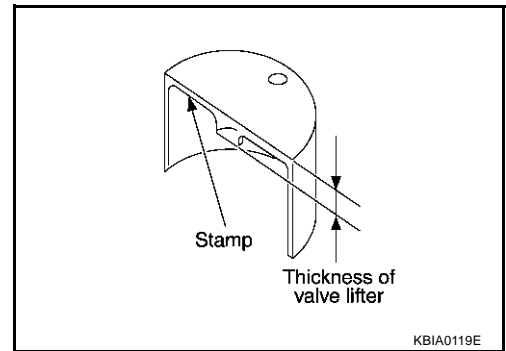
**Exhaust** : 0.33 mm (0.013 in)\*

\*: Approximately 20°C (68°F)

- Thickness of a 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:**

2 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).

5. Install the selected valve lifter.
6. Install camshaft.
7. Manually turn crankshaft pulley a few turns.
8. Check that valve clearances for cold engine are within specifications by referring to the specified values.
9. 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

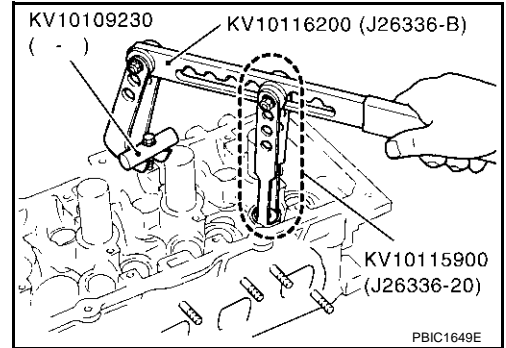
## OIL SEAL

PF0:00100

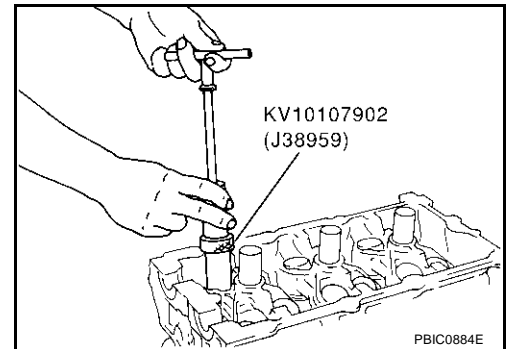
### Removal and Installation of Valve Oil Seal REMOVAL

ABS003MJ

1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-70, "CAMSHAFT"](#) .
2. Remove valve lifters. Refer to [EM-70, "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

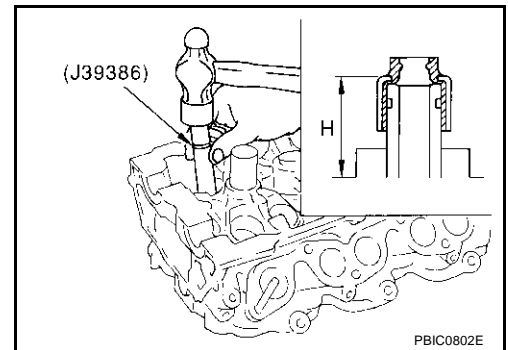
1. Apply engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift (special service tool), press fit valve seal to height "H" shown in figure.

#### 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.



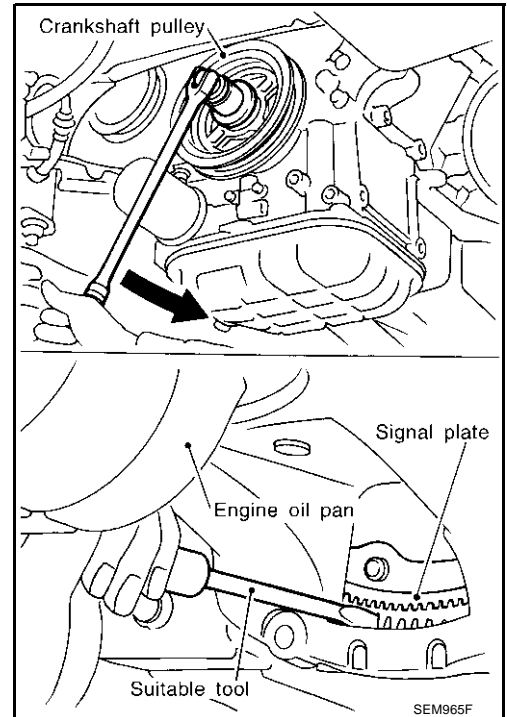
# OIL SEAL

ABS003MK

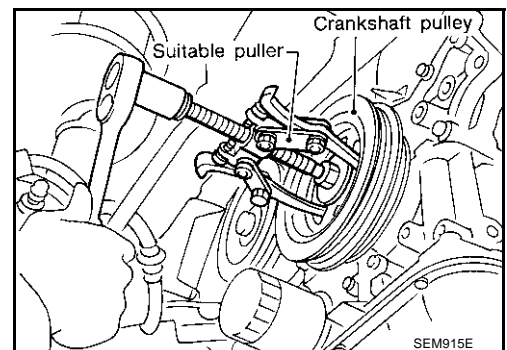
## Removal and Installation of Front Oil Seal REMOVAL

1. Remove the following parts:
  - Splash guard (RH)
  - Front RH road wheel and engine side cover
  - Drive belts; Refer to [EM-11, "DRIVE BELTS"](#).
  - Rear cover plate; Refer to [EM-26, "OIL PAN AND OIL STRAINER"](#)
2. Remove crankshaft pulley as follows:
  - a. Loosen crankshaft pulley mounting bolt.

**CAUTION:**  
Exercise care not to damage signal plate.

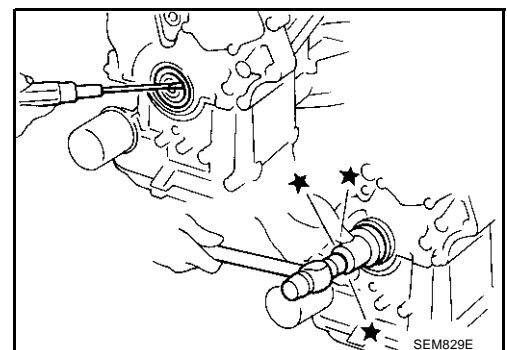


- b. Locate bolt seating surface at 10 mm (0.39 in) from its original position. Remove crankshaft pulley.



3. Remove front oil seal using a suitable tool.

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



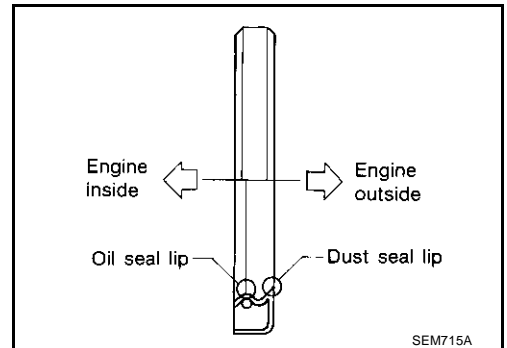
# OIL SEAL

## 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).

### CAUTION:

- 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

ABS003ML

### REMOVAL

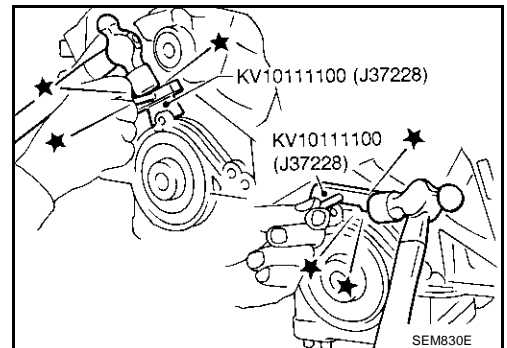
1. Remove engine assembly from vehicle, and separate front suspension member, transaxle and transfer (AWD models) assembly from engine. Refer to [EM-95, "Removal and Installation"](#) .
2. Install engine slingers. Refer to [EM-95, "ENGINE ASSEMBLY"](#) .
3. install engine sub-attachment to right side of cylinder block, then lift engine, and mount it onto the engine stand. Refer to [EM-100, "CYLINDER BLOCK"](#) .
4. Remove drive plate.
5. Remove upper oil pan. Refer to [EM-26, "OIL PAN AND OIL STRAINER"](#) .
6. 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.

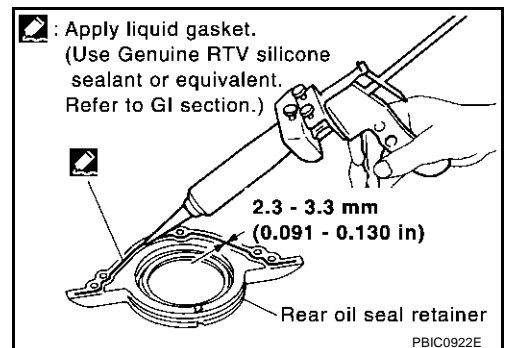
### NOTE:

Rear oil seal and retainer form a single part and are handled as an assembly.



## INSTALLATION

1. Remove old liquid gasket on mating surface of cylinder block and oil pan using scraper.
2. Apply liquid gasket to rear oil seal retainer using tube presser (special service tool) as shown in the figure.
  - Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .
  - Assembly should be done within 5 minutes after coating.



3. Install rear oil seal retainer to cylinder block.
4. Perform steps in the reverse order of removal for the following operations.

# CYLINDER HEAD

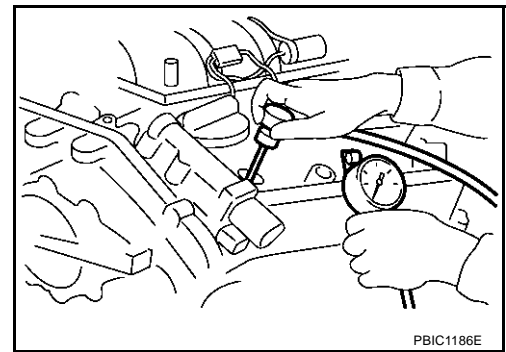
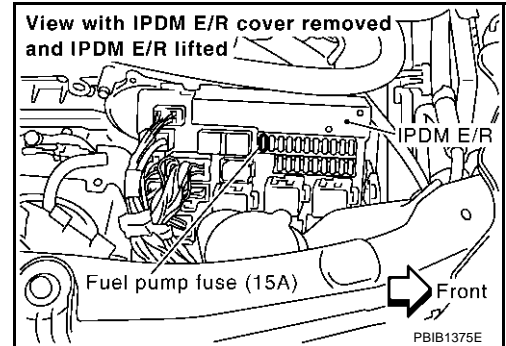
## CYLINDER HEAD

PFP:11041

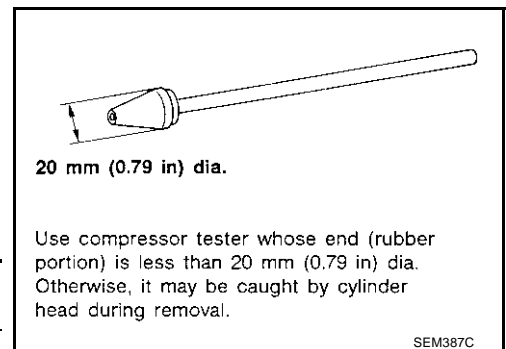
### On-Vehicle Service CHECKING COMPRESSION PRESSURE

ABS003MM

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-66, "FUEL PRESSURE RELEASE"](#).
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.
4. Remove engine cover. Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#).
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-35, "IGNITION COIL"](#) and [EM-36, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#).
6. Connect engine tachometer (not required in use of CONSULT-II).
7. Install compression tester with adapter onto spark plug hole.



- Use 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	Deference 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.

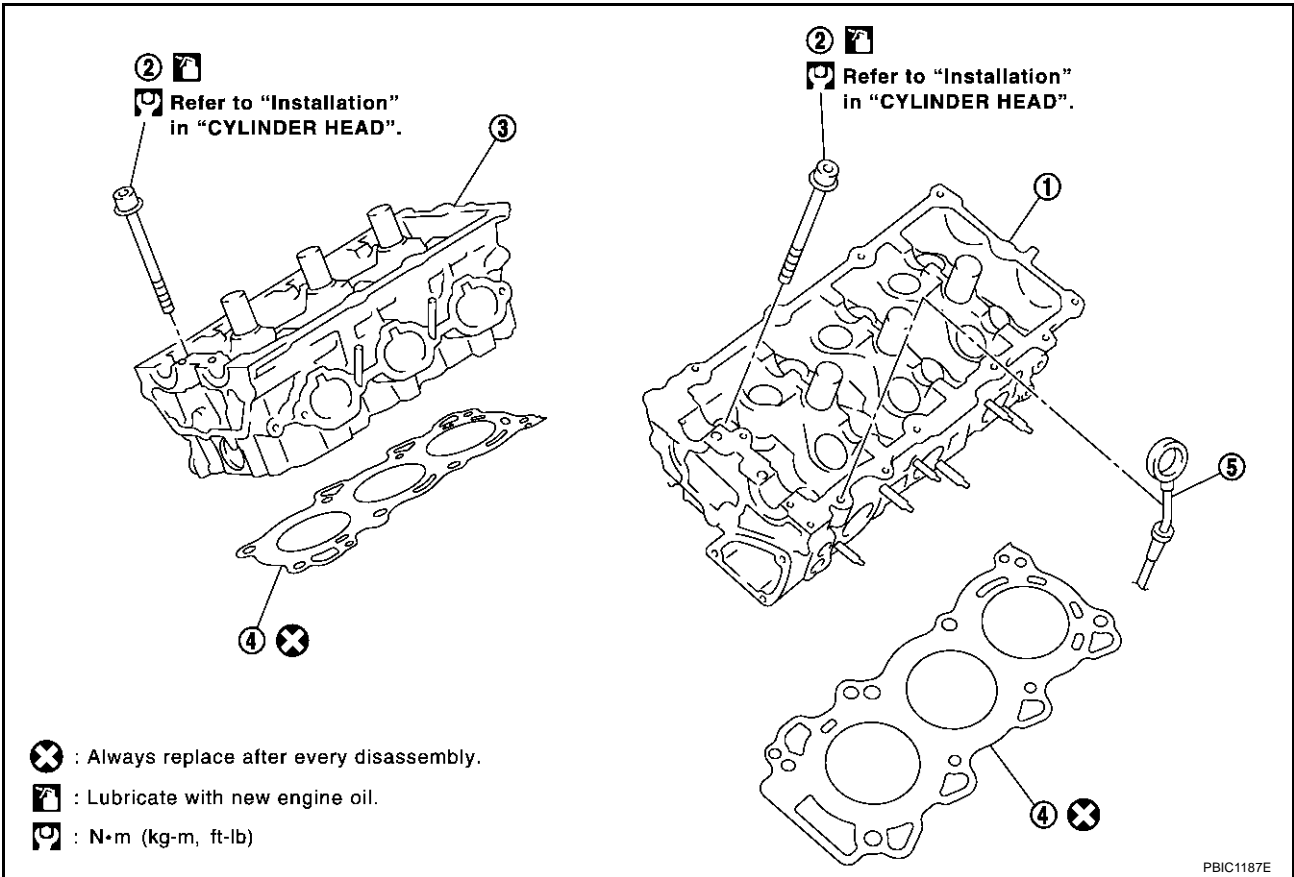
# CYLINDER HEAD

- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the gaskets are leaking. In such a case, replace the cylinder head gaskets.

9. After inspection is completed, install removed parts.

## Removal and Installation

ABS003MN



1. Cylinder head (LH bank)

2. Cylinder head bolt

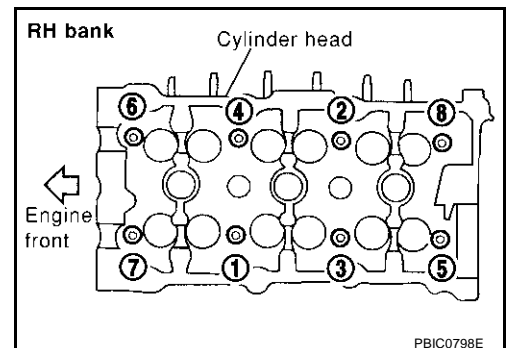
3. Cylinder head (RH bank)

4. Cylinder head gasket

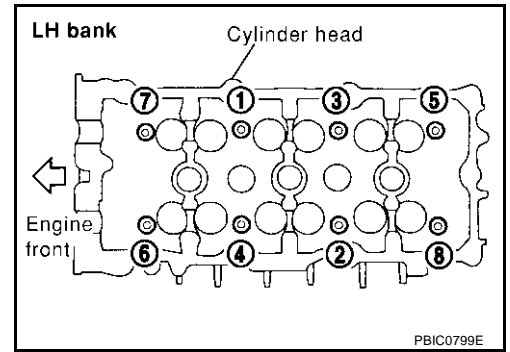
5. Oil level gauge

## REMOVAL

1. Remove the following components and related parts:
  - Fuel tube and fuel injector assembly. Refer to [EM-38, "FUEL INJECTOR AND FUEL TUBE"](#).
  - Intake manifold. Refer to [EM-20, "INTAKE MANIFOLD"](#).
  - Exhaust manifold. Refer to [EM-22, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
  - Water inlet and thermostat assembly. Refer to [CO-24, "THERMOSTAT AND THERMOSTAT HOUSING"](#).
  - Water outlet and water piping. Refer to [CO-26, "WATER OUTLET AND WATER PIPING"](#).
2. Remove camshaft. Refer to [EM-70, "CAMSHAFT"](#).
3. Remove cylinder head loosening bolts in reverse order shown in the figure.



# CYLINDER HEAD



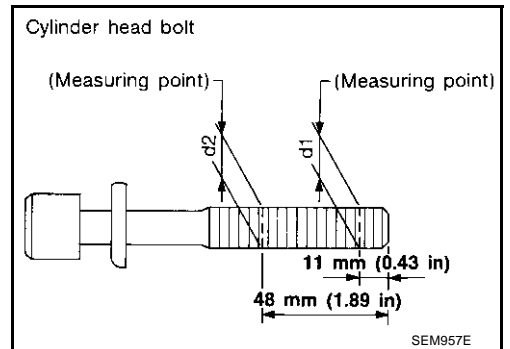
## INSPECTION AFTER REMOVAL

### 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.

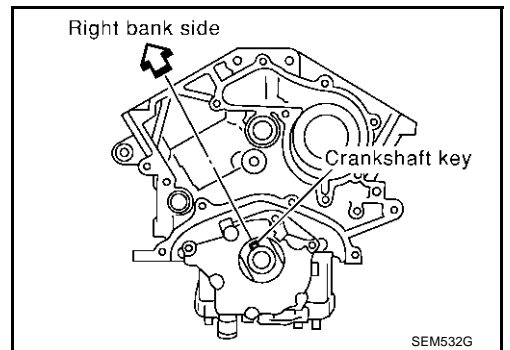
**Limit (d1 - d2) : 0.11 mm (0.0043 in)**

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



## INSTALLATION

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

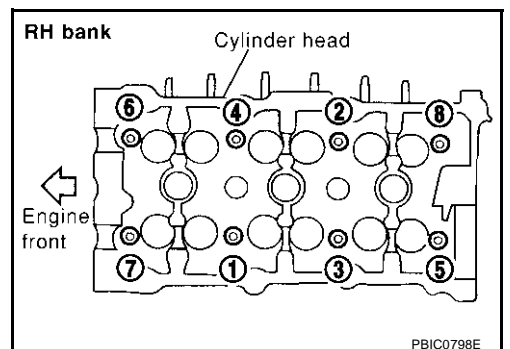


3. Install cylinder head follow the steps below to tighten cylinder head bolts in the order shown in figure.
  - a. Tighten all bolts to 98.1 N·m (10 kg-m, 72 ft-lb).
  - b. Completely loosen to 0 N·m (0 kg-m, 0 ft-lb).

### 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)].

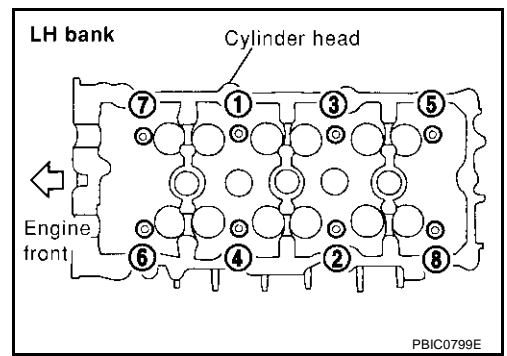


# CYLINDER HEAD

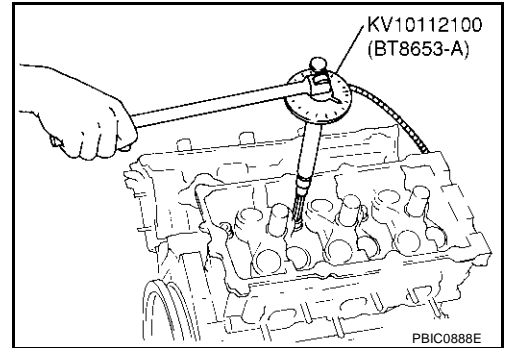
- e. Turn all bolts 90 to 95 degrees clockwise again [target: 90 degrees (angle tightening)].

**CAUTION:**

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



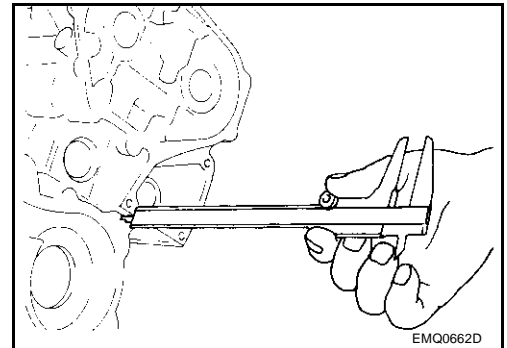
- Check tightening angle indicated on the angle wrench indicator plate.



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.

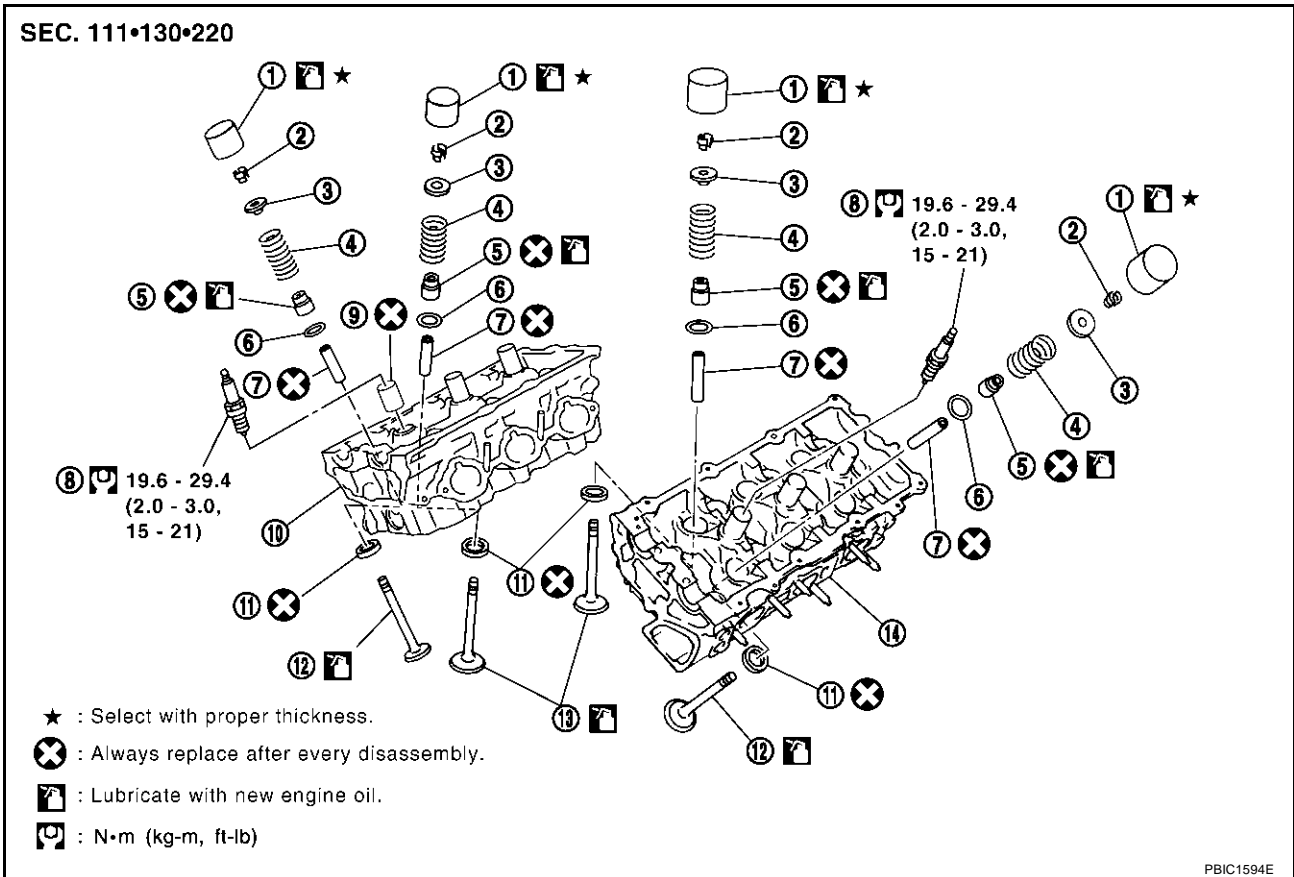


5. Perform steps in reverse order of removal for the following operations.

# CYLINDER HEAD

## Disassembly and Assembly

ABS003MO

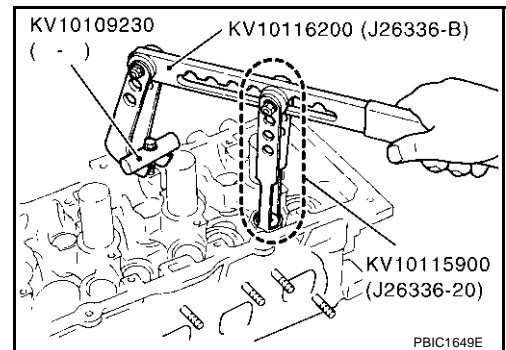


- |                             |                             |                          |
|-----------------------------|-----------------------------|--------------------------|
| 1. Valve lifter             | 2. Valve collet             | 3. Valve spring retainer |
| 4. Valve spring             | 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

- Remove spark plug with spark plug wrench (commercial service tool).
- Remove valve lifter.
  - Mark position on valve lifter for assembly.
- Remove valve collet.
  - Compress valve spring with valve spring compressor (special service tool). Remove valve collet with magnet hand.

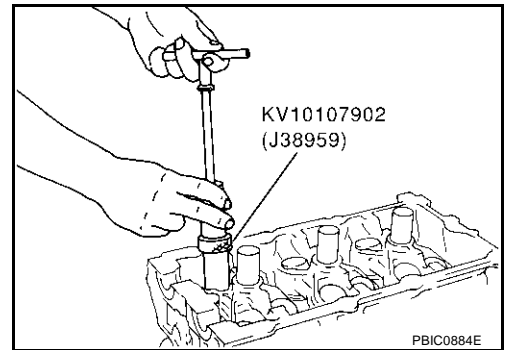
**CAUTION:**  
**When working, take care not to damage valve lifter holes.**
- Remove valve spring retainer and valve spring.
- Push valve stem to combustion chamber side, and remove valve.
  - Inspect valve guide clearance before removal. Refer to [EM-89. "VALVE GUIDE CLEARANCE"](#).
  - Mark position on valve for assembly.





# CYLINDER HEAD

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-92, "VALVE SEAT REPLACEMENT"](#).
9. If valve guide must be replaced, refer to [EM-90, "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.

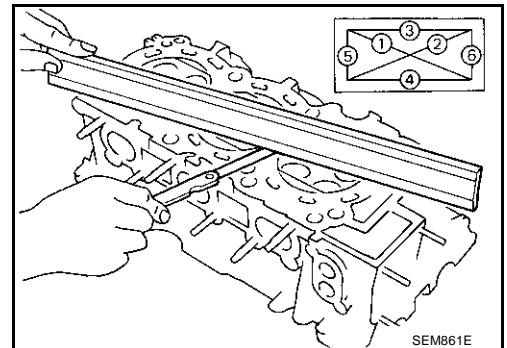
## Inspection After Disassembly CYLINDER HEAD DISTORTION

ABS003MP

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

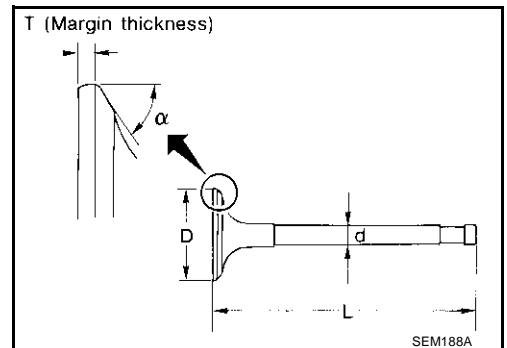
**Limit : 0.1mm (0.004 in)**

- If it exceeds the limit, replace cylinder head.



## VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [EM-126, "VALVE"](#).



## VALVE GUIDE CLEARANCE

### Valve Guide Stem Diameter

- Measure outer diameter of valve stem with micrometer.

#### Standard

**Intake : 59.65 - 59.80 mm (0.2348 - 0.2354 in)**

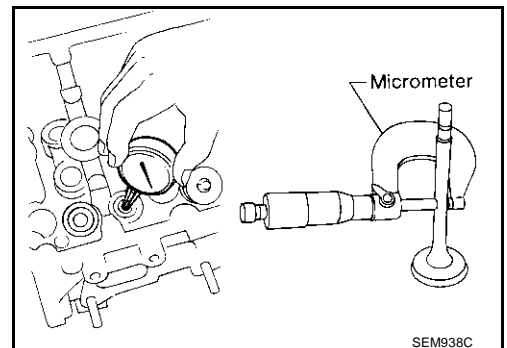
**Exhaust : 59.55 - 59.70 mm (0.2344 - 0.2350 in)**

### 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)**



# CYLINDER HEAD

## 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)

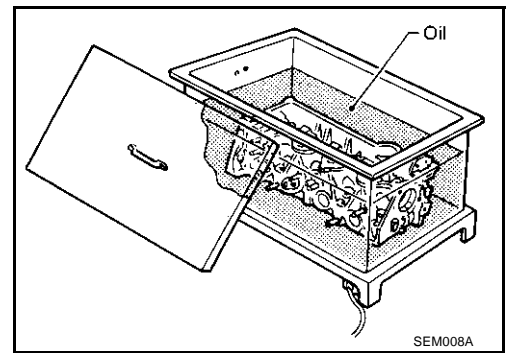
Exhaust : 0.09 mm (0.004 in)

- If it exceeds the limit, replace valve guide.

## VALVE GUIDE REPLACEMENT

When valve guide is removed, replace with oversized (0.2 mm, 0.008 in) valve guide.

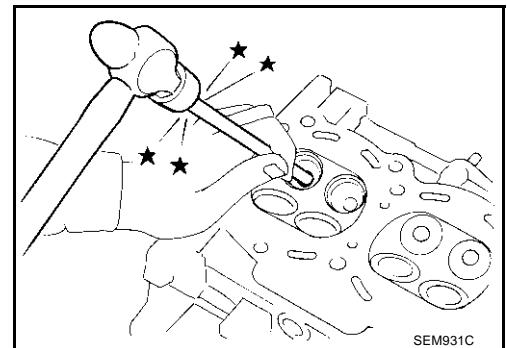
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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.

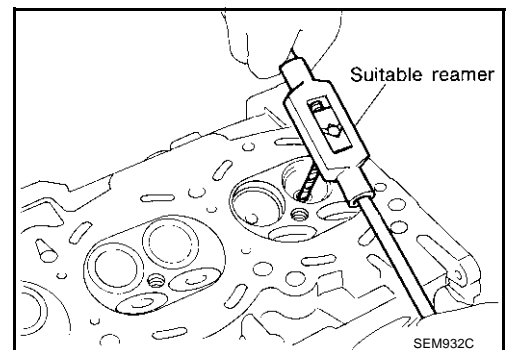


3. Using valve guide reamer, ream cylinder head valve guide hole.

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

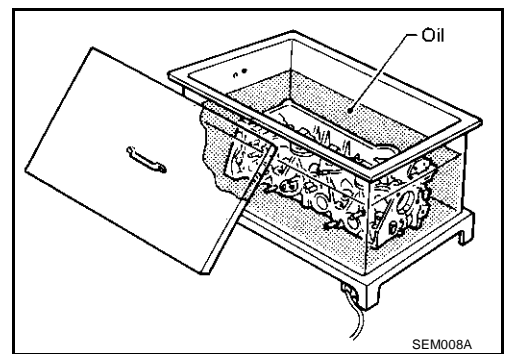
#### Intake and exhaust

: 10.175 - 10.196 mm (0.4006 - 0.4014 in)



# CYLINDER HEAD

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.

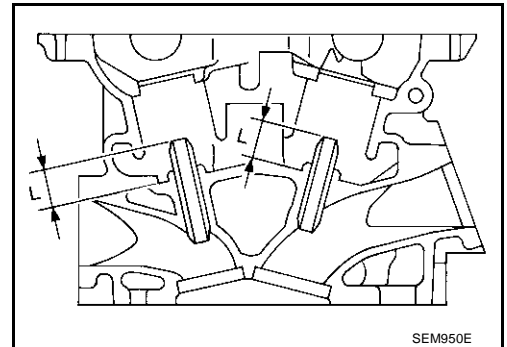
### Projection "L"

#### 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.

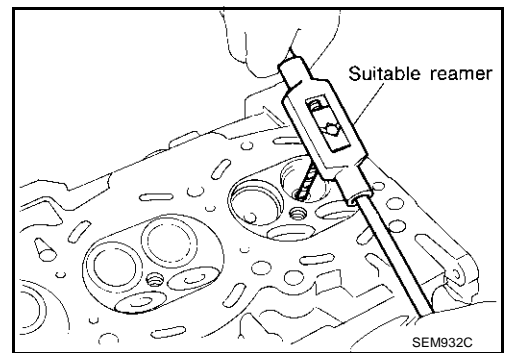


6. Using valve guide reamer, apply reamer finish to valve guide.

### Standard:

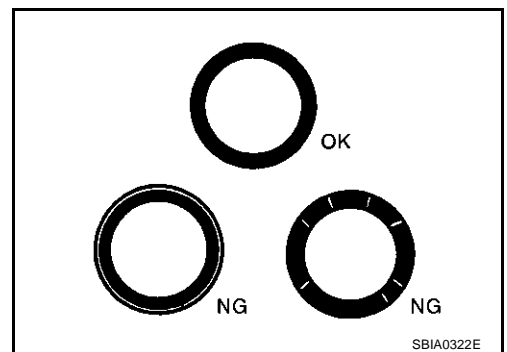
#### Intake and exhaust

: 6.000 - 6.018 mm (0.2362 - 0.2369 in)



## 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.



A  
EM  
C  
D  
E  
F  
G  
H  
I  
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L  
M

# CYLINDER HEAD

## VALVE SEAT REPLACEMENT

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

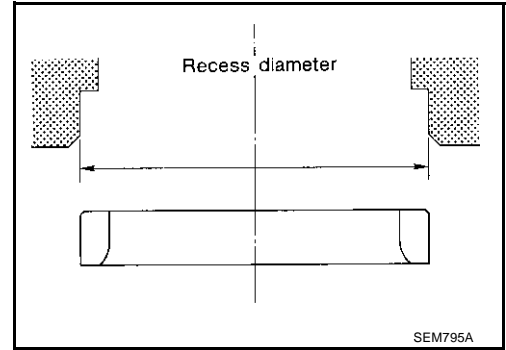
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess diameter for service valve seat.

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

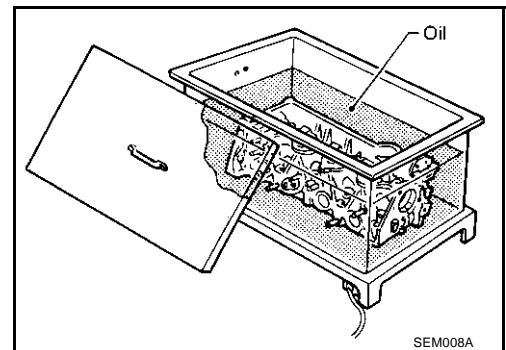
**Intake : 38.500 - 38.516 mm (1.5157 - 1.5164 in)**

**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.

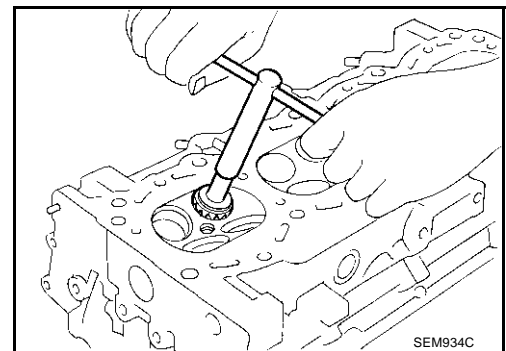
**CAUTION:**

- 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.



Grind to obtain the dimensions indicated in figure.

**Standard :**

**D1 dia. : 35 mm (1.38 in)\*1**

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

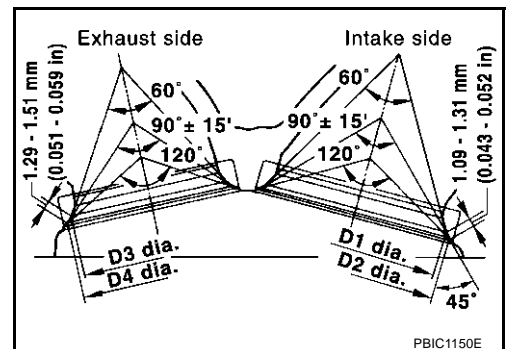
**D3 dia. : 28.7 mm (1.130 in)\*1**

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

\*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.



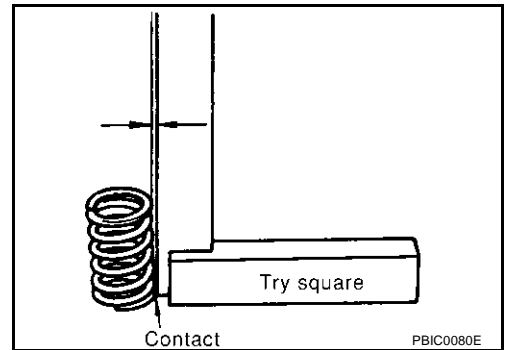
# CYLINDER HEAD

7. Check again for normal 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)**



## 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:

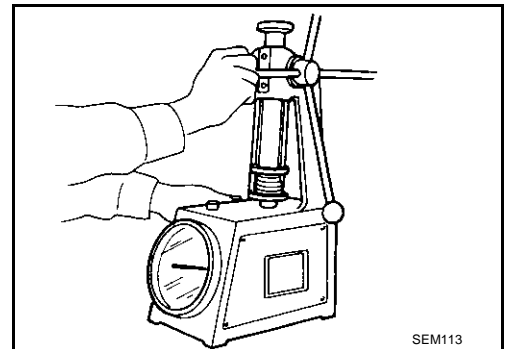
**184 - 208 N (18.8 - 21.2 kg, 41.4 - 46.8 lb)**

##### 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)**



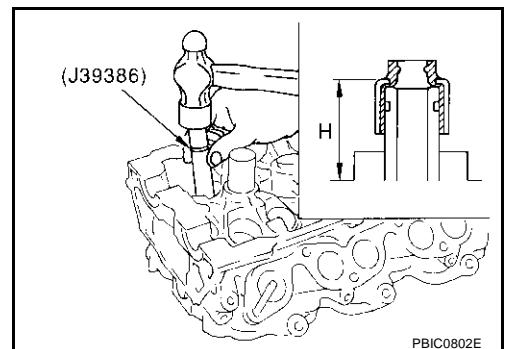
## ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-90, "VALVE GUIDE REPLACEMENT"](#).
2. When valve seat is removed, install it. Refer to [EM-92, "VALVE SEAT REPLACEMENT"](#).
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)**

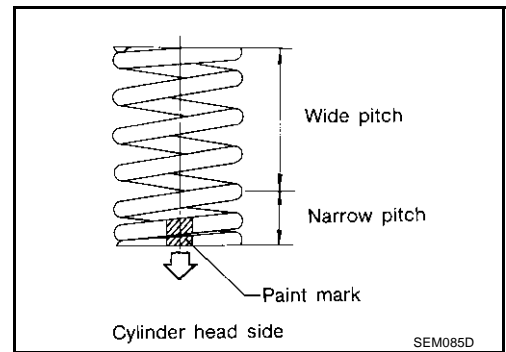
4. Install valve spring seat.



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

# CYLINDER HEAD

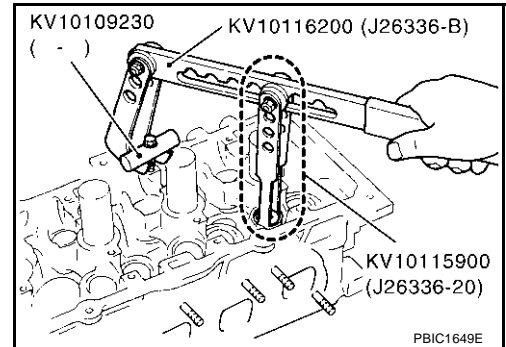
6. Install valve spring (uneven pitch type).
  - Install smaller pitch end (paint mark) to cylinder head side (valve spring seat side).
7. Install valve spring retainer.



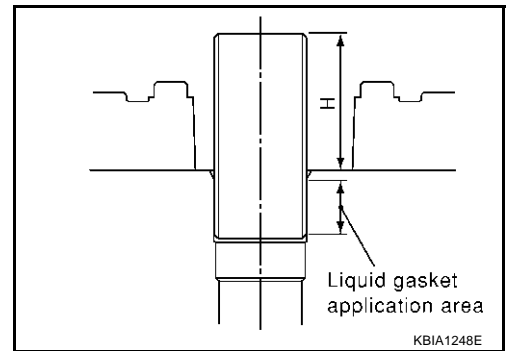
8. Install valve collet.
  - Compress valve spring with valve spring compressor (special service tool). Install valve collet with magnet hand.

**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 RTV Silicone Sealant or equivalent. Refer to [GI-46. "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" :**  
**: 38.55 - 38.65 mm (1.5177 - 1.5217 in)**

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

11. Install spark plug.

# ENGINE ASSEMBLY

PFP:10001

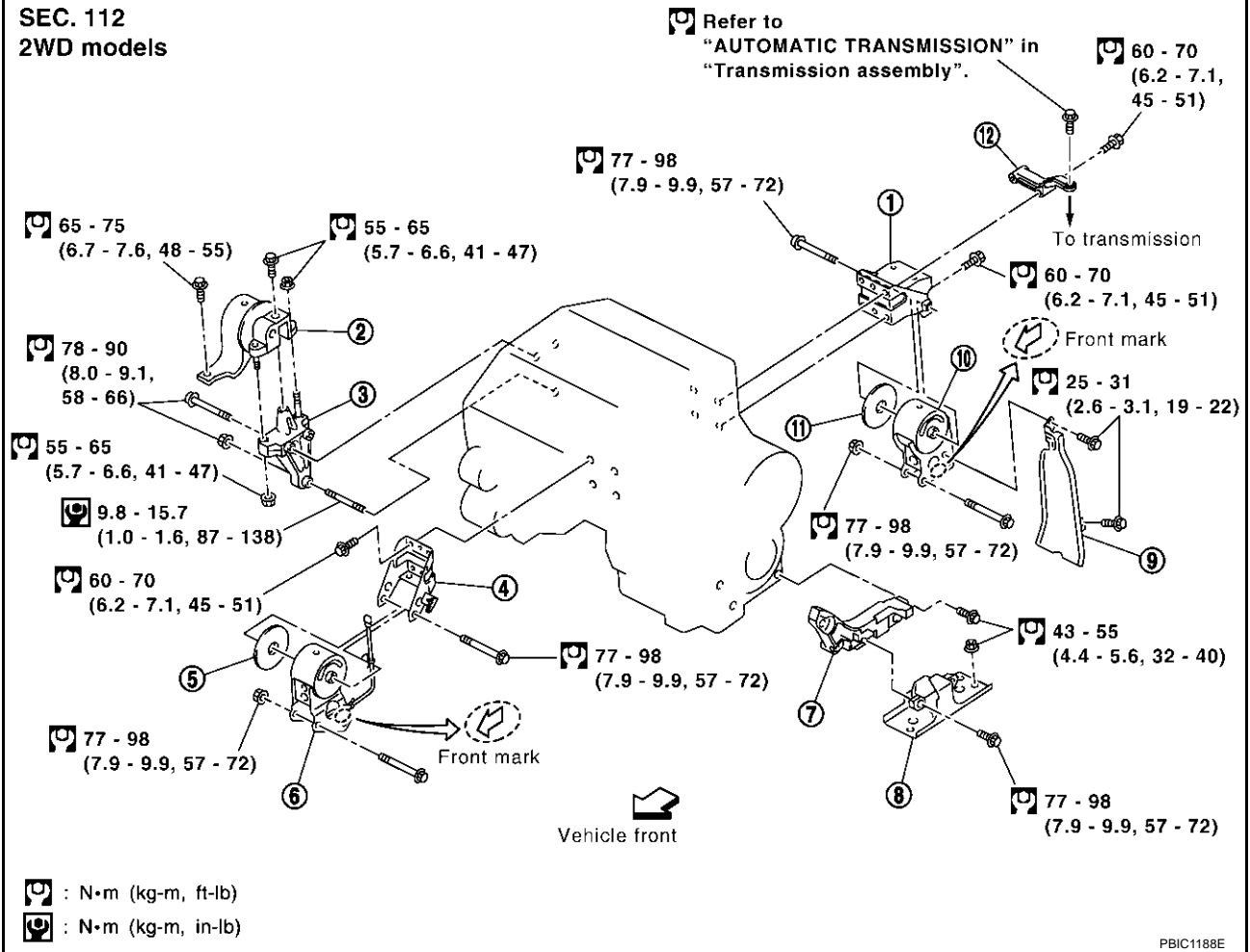
ABS00330

## ENGINE ASSEMBLY

### Removal and Installation

#### SEC. 112

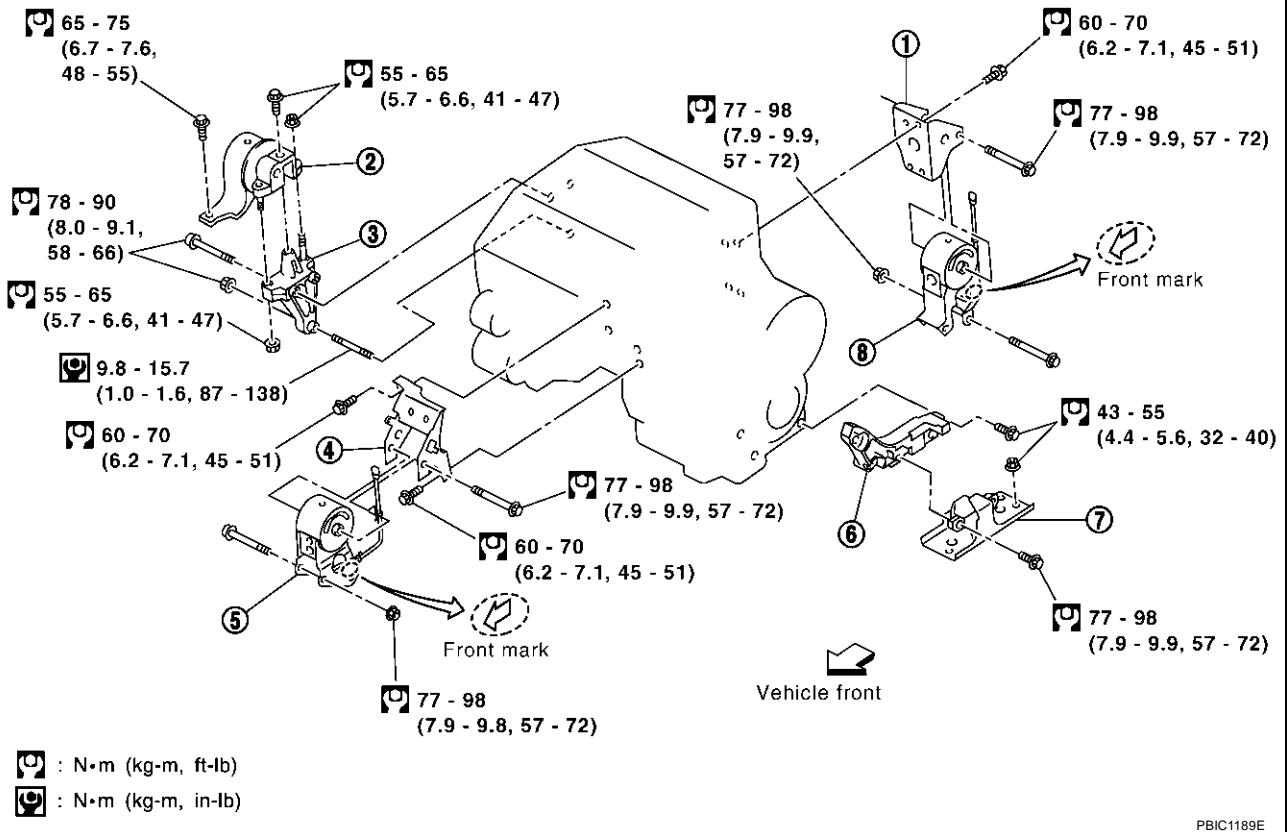
2WD models



- |                                    |                                 |                                    |
|------------------------------------|---------------------------------|------------------------------------|
| 1. Rear engine mounting bracket    | 2. RH engine mounting insulator | 3. RH engine mounting bracket      |
| 4. Front engine mounting bracket   | 5. Stopper                      | 6. Front engine mounting insulator |
| 7. LH engine mounting bracket      | 8. LH engine mounting insulator | 9. Engine mounting air guide       |
| 10. Rear engine mounting insulator | 11. Stopper                     | 12. Bracket                        |

# ENGINE ASSEMBLY

## SEC. 112 AWD models



- |                                  |                                    |                               |
|----------------------------------|------------------------------------|-------------------------------|
| 1. Rear engine mounting bracket  | 2. RH engine mounting insulator    | 3. RH engine mounting bracket |
| 4. Front engine mounting bracket | 5. Front engine mounting insulator | 6. LH engine mounting bracket |
| 7. LH engine mounting insulator  | 8. Rear engine mounting insulator  |                               |

### WARNING:

- Place chocks at front and back of rear road wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts as described in the NISSAN Parts Catalog.

### CAUTION:

- Do not start working until exhaust system and engine coolant are cool.
- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Use the correct supporting points for lifting and jacking. Refer to [GI-40. "LIFTING POINT"](#).
- In removing the drive shafts, be careful not to damage any transaxle grease seals.
- Before separating the engine and transaxle, remove the crankshaft position sensor (POS).
- Do not damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.

## 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-66. "FUEL PRESSURE RELEASE"](#).
2. Drain engine coolant. Refer to [CO-8. "Changing Engine Coolant"](#).
3. Remove the following parts:



# ENGINE ASSEMBLY

- Engine cover; Refer to [EM-16, "INTAKE MANIFOLD COLLECTOR"](#) .
  - Engine hood; Refer to [BL-13, "HOOD"](#) .
  - Front road wheel and tires
  - Engine undercover and splash guards
  - Battery and tray using power tools; Refer to [SC-4, "BATTERY"](#) .
  - Air duct (inlet); Refer to [EM-14, "AIR CLEANER AND AIR DUCT"](#) .
  - Air duct and air cleaner case (upper) assembly with mass air flow sensor; Refer to [EM-14, "AIR CLEANER AND AIR DUCT"](#) .
  - Drive belts; Refer to [EM-11, "DRIVE BELTS"](#) .
  - Radiator assembly, coolant reservoir, and system hoses. Refer to [CO-12, "Removal and Installation"](#) .
  - Windshield wiper arms and front cowl top covers. Refer to [WW-47, "Removal and Installation of Front Wiper Arms, Adjustment of Wiper Arms Stop Location"](#) and [EI-21, "COWL TOP"](#) .
4. Disconnect engine room harness at the ECM side.

## CAUTION:

**To keep clean harness connector and avoid damage and foreign materials, cover them completely with plastic bags or something similar.**

## Engine Room

1. Disconnect heater hoses.
  - Install plug to avoid leakage of engine coolant.
2. Remove EVAP hose.
3. Disconnect fuel hose quick connector at centralized under-floor piping side. Refer to [EM-38, "Removal and Installation"](#) .
  - Install plug to avoid leakage of fuel.
4. Disconnect transaxle shift control cable.
5. Disconnect power brake booster vacuum hose at engine side.
6. Remove alternator. Refer to [SC-18, "CHARGING SYSTEM"](#) .
7. Remove A/C compressor with piping connected, and temporarily secure it aside. Refer to [ATC-151, "Components"](#) .
8. Disconnect reservoir tank for power steering from engine compartment bracket and position it aside.

## Vehicle Underbody

1. Remove LH and RH front drive shafts. Refer to [FAX-7, "FRONT DRIVE SHAFT"](#) .
2. Remove front exhaust tube using power tools. Refer to [EX-3, "EXHAUST SYSTEM"](#) .
3. Disconnect power steering gear from steering lower joint. Refer to [PS-14, "POWER STEERING GEAR AND LINKAGE"](#) .
4. Disconnect stabilizer connecting rod. Refer to [FSU-14, "STABILIZER BAR"](#) .
5. Remove propeller shaft (AWD models). Refer to [PR-4, "REAR PROPELLER SHAFT"](#) .
6. Disconnect power steering piping from power steering oil cooler. Refer to [PS-34, "HYDRAULIC LINE"](#) .
  - Install plug to avoid leakage of power steering fluid.
7. 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.**

# ENGINE ASSEMBLY

## Removal Work

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

### CAUTION:

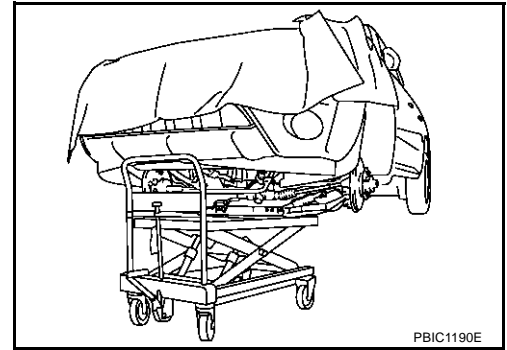
**Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.**

2. Remove RH engine mounting insulator and RH engine mounting bracket.
3. Remove mounting bolt between transverse link and front suspension member with power tool.
4. Remove front suspension member mounting nuts and bolts. Refer to [FSU-5, "FRONT SUSPENSION ASSEMBLY"](#).

5. Carefully lower engine, transaxle, transfer (AWD models) and front suspension member assembly with manual lift table caddy, avoiding interference with the vehicle body.

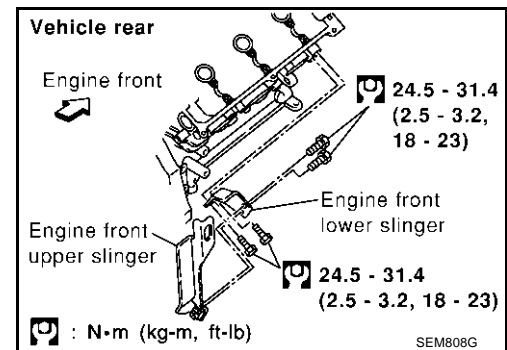
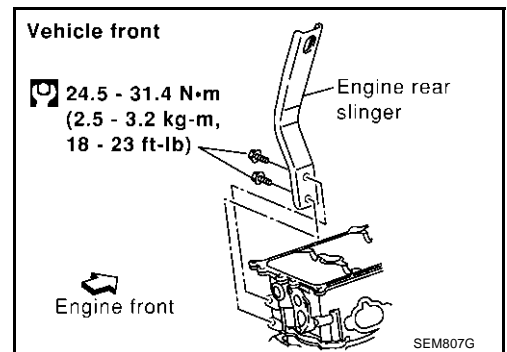
### CAUTION:

- **Confirm there is no interference with vehicle.**
- **Make sure 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.**



## Separation Work

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



2. Remove power steering oil pump, power steering piping and power steering bracket from engine, transaxle and transfer (AWD models) assembly. Refer to [PS-34, "HYDRAULIC LINE"](#).
3. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#).
4. Disconnect harness connector of front engine mounting insulator and rear engine mounting insulator.
5. Lift with hoist and separate engine, transaxle and transfer (AWD models) 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.**

6. Separate engine, transaxle and transfer (AWD models) assembly. Refer to [CVT-197, "TRANSAXLE ASSEMBLY"](#).

# ENGINE ASSEMBLY

## INSTALLATION

Installation is in the reverse order of removal.

## 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	–

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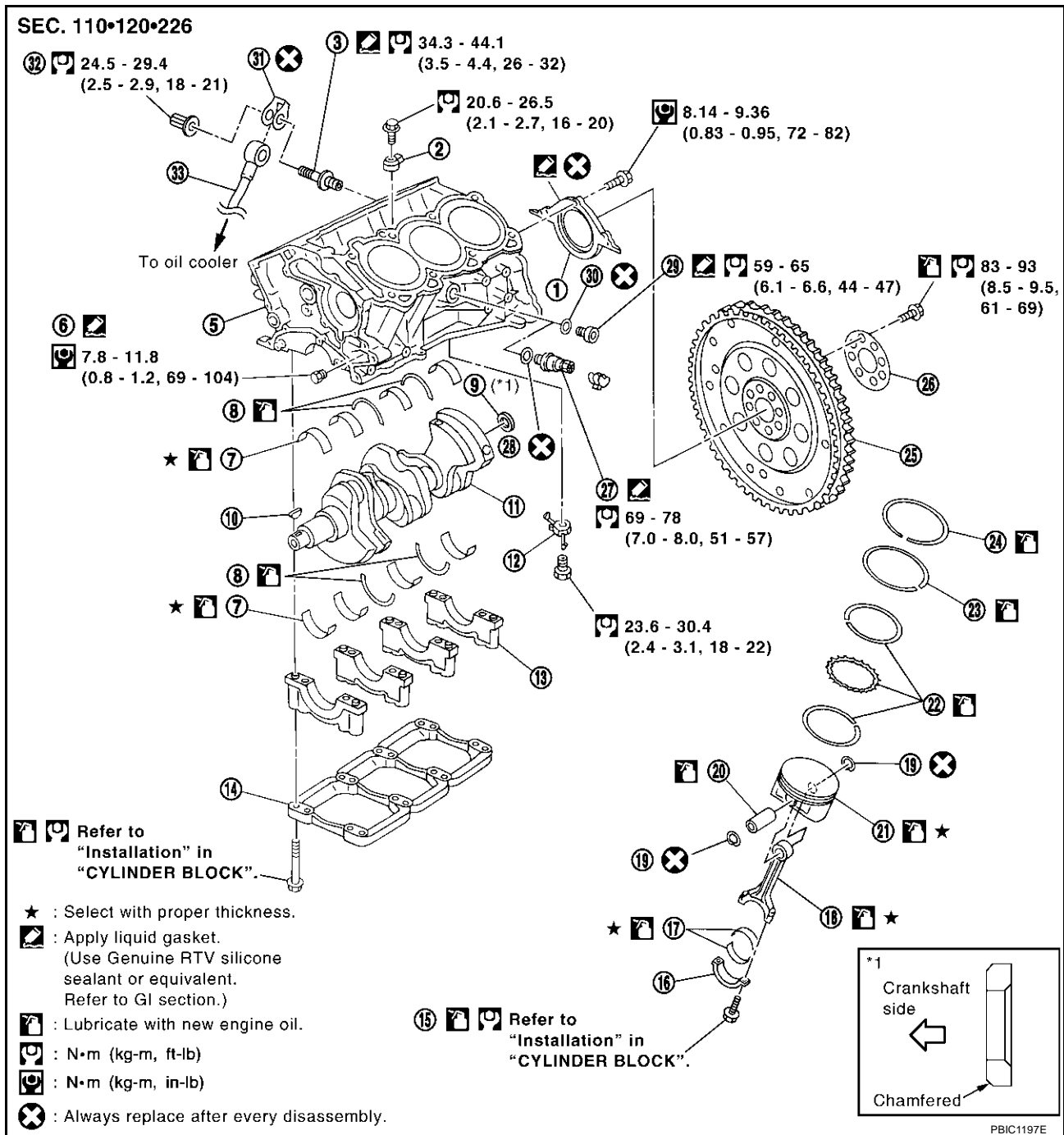
# CYLINDER BLOCK

PFP:11010

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## CYLINDER BLOCK

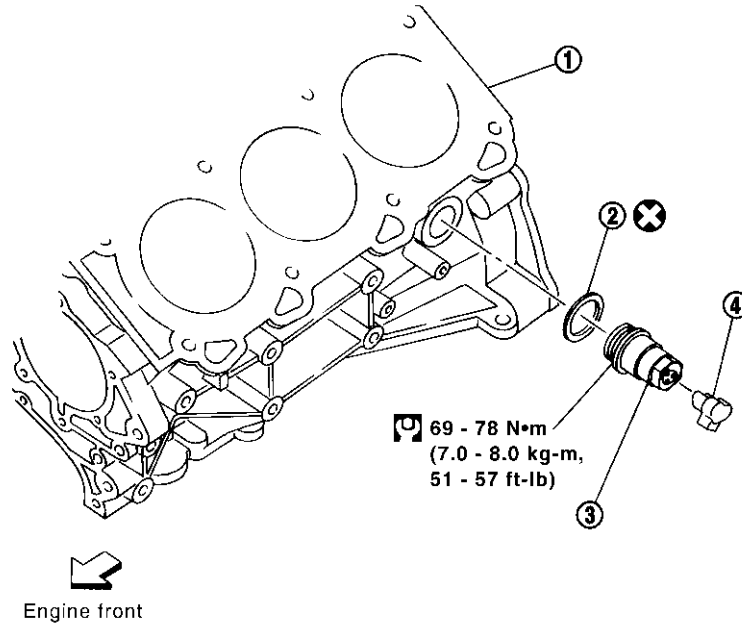
### Disassembly and Assembly



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

# CYLINDER BLOCK

For Canada  
SEC. 110



⊗ : Always replace after every disassembly.

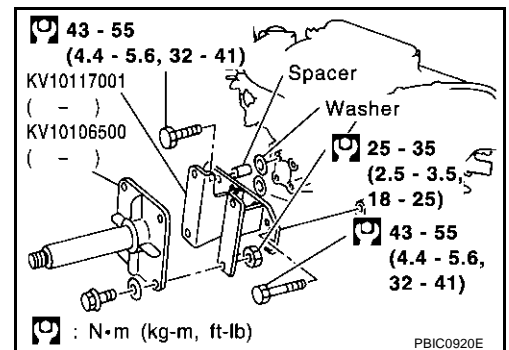
- Remove liquid gasket completely after removing cylinder block heater.
- Install cylinder block heater with heater part downward as shown in the figure.
- Apply engine coolant to O-ring when installing cylinder block heater.

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- |                            |           |                          |
|----------------------------|-----------|--------------------------|
| 1. Cylinder block          | 2. O-ring | 3. Cylinder block heater |
| 4. Connector protector cap |           |                          |

## DISASSEMBLY

1. Remove engine assembly from vehicle, and separate front suspension member, transaxle and transfer (AWD models) assembly from engine. Refer to [EM-95, "Removal and Installation"](#) .
2. Remove rear engine mounting bracket. Refer to [EM-95, "ENGINE ASSEMBLY"](#) .
3. Remove RH exhaust manifold. Refer to [EM-22, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
4. Install engine sub-attachment to right side of cylinder block.
  - Use spacer to engine rear side.

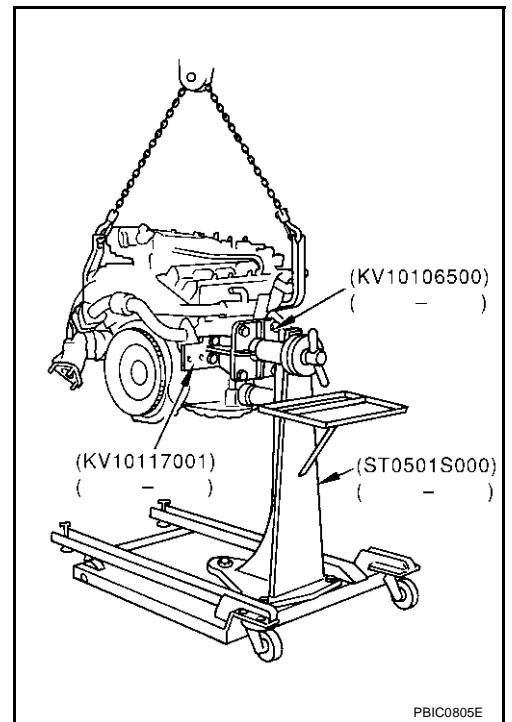


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# CYLINDER BLOCK

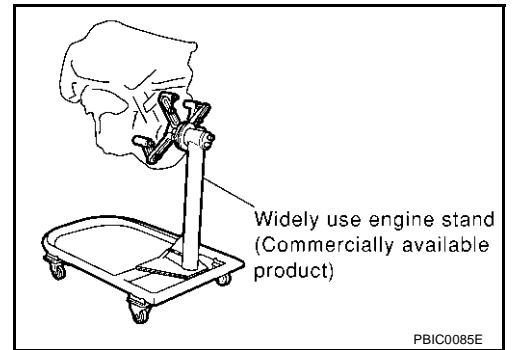
5. Lift engine, and mount it onto the engine stand.



- A commercial engine stand can be used.

**NOTE:**

- This example is an engine stand for holding at transaxle mounting side with the drive plate removed.



6. Drain engine oil and engine coolant from inside of engine.
7. Remove cylinder head. Refer to [EM-85, "Removal and Installation"](#).
8. Remove knock sensor.

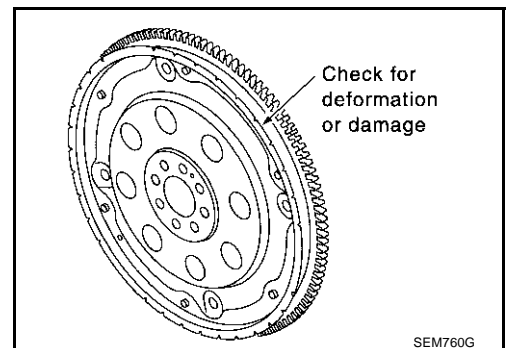
**CAUTION:**

**Carefully handle the sensor avoiding shocks.**

9. Remove drive plate.
  - Loosen mounting bolts in diagonal order.

**CAUTION:**

- Do not disassemble drive plate.
- Never place the 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.



# CYLINDER BLOCK

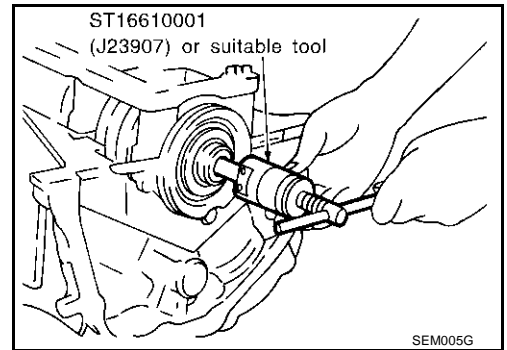
10. Remove pilot converter using pilot bushing puller (special service tool) or suitable tool as necessary.
11. Remove rear oil seal retainer.
  - Remove by inserting a screwdriver between main bearing cap and rear oil seal retainer.

**CAUTION:**

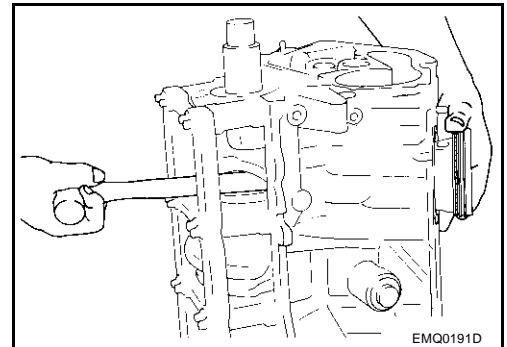
**If rear oil seal retainer is removed, replace it with a new one.**

**NOTE:**

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



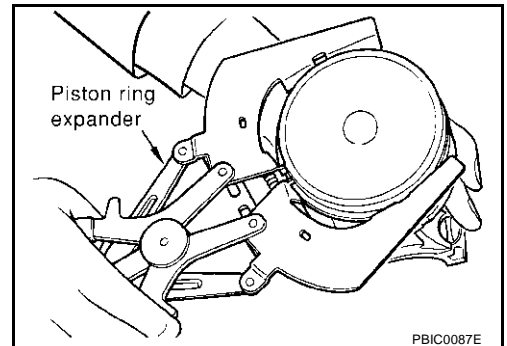
12. Remove the piston and connecting rod assembly.
    - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-115, "CONNECTING ROD SIDE CLEARANCE"](#).
  - a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the 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.
13. Remove the connecting rod bearings from connecting rod and connecting rod cap.



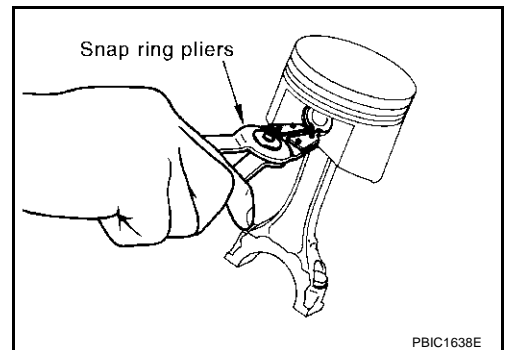
**CAUTION:**

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

14. 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.**



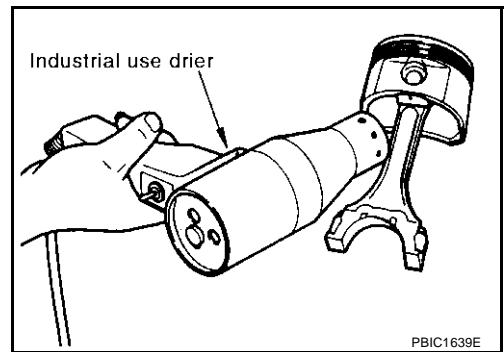
15. Remove the piston from the connecting rod as follows.
  - a. Using a snap ring pliers, remove the snap ring.



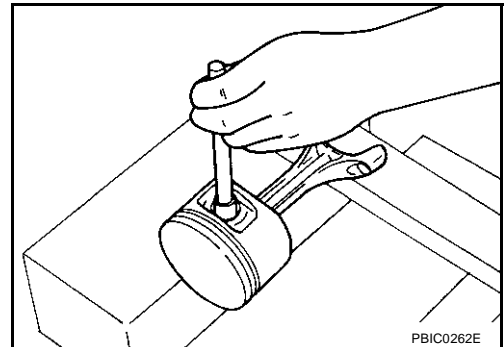
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# CYLINDER BLOCK

- 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).

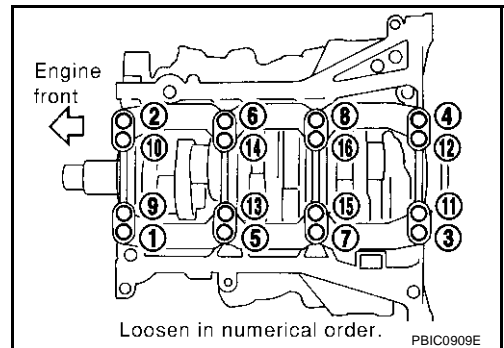


16. Remove main bearing cap bolt.

**NOTE:**

Use TORX socket (size E14).

- Before loosening main bearing cap bolts, measure crankshaft side clearance. Refer to [EM-115, "CRANKSHAFT SIDE CLEARANCE"](#).
- Loosen them in the numerical order shown in the figure in several different steps.



17. Remove main bearing beam.

18. Remove main bearing cap.

- Using main bearing cap bolts, remove main bearing cap while shaking it back-and-forth.

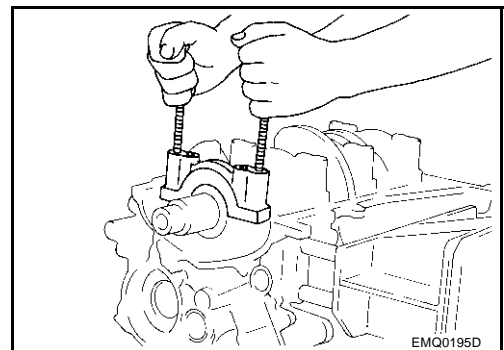
19. Remove crankshaft.

20. Remove main bearings and thrust bearings from cylinder block and main bearing cap.

**CAUTION:**

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

21. 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.**

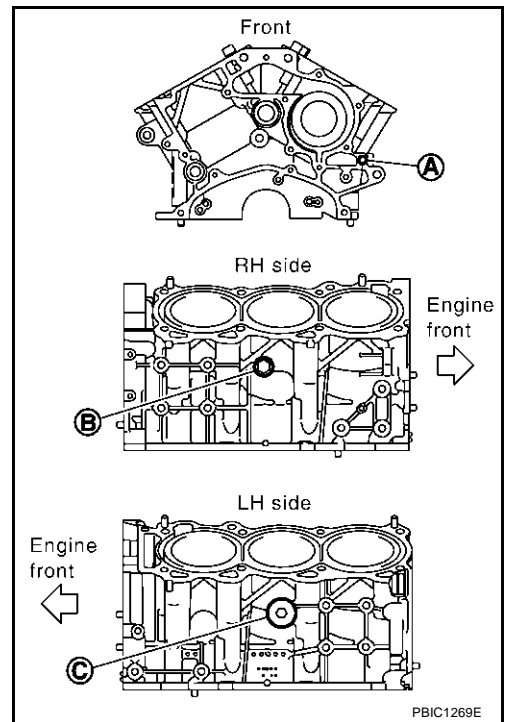


# CYLINDER BLOCK

2. Install each plug to the cylinder block.

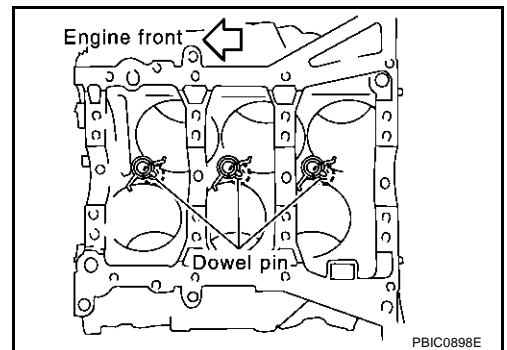
- Apply liquid gasket.  
Use Genuine Thread Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

Part	Washer	Tightening torque
A	No	7.8 - 11.8 N·m (0.8 - 1.2 kg-m, 69 - 104 in-lb)
B	Yes	24.5 - 29.4 N·m (2.5 - 2.9 kg-m, 18 - 21 ft-lb)
C	Yes	59 - 65 N·m (6.1 - 6.7 kg-m, 44 - 48 ft-lb)



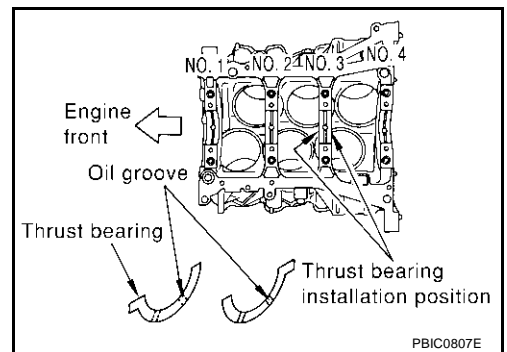
3. Install oil jet.

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



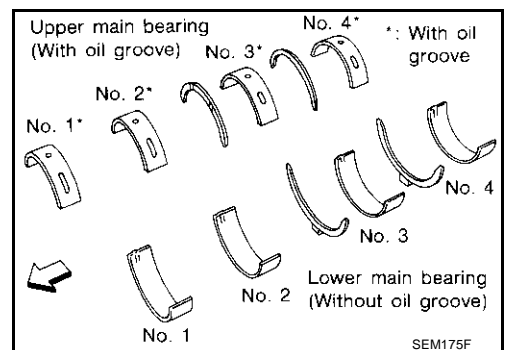
4. Install the main bearings and the thrust bearings.

- Remove dust, dirt, and oil on the bearing mating surfaces of the cylinder block and the main bearing cap.
- 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.



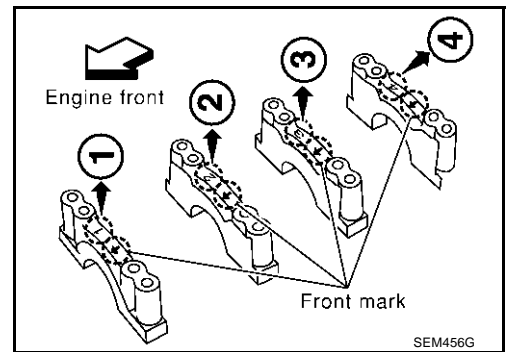
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## CYLINDER BLOCK

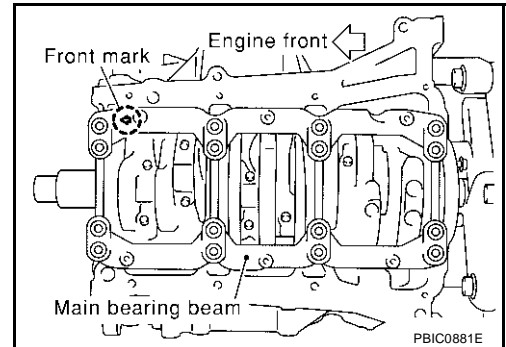
5. Install the crankshaft to the cylinder block.
  - While turning the crankshaft by hand, check that it turns smoothly.
6. Install main bearing cap.
  - Main bearing caps are identified by identification mark cast on them. For installation, face front mark to front side.

**NOTE:**

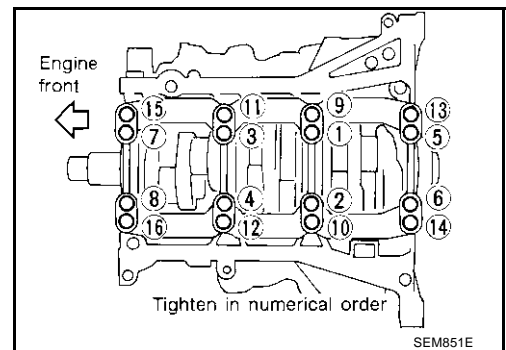
Main bearing cap cannot be replaced as a single part, because it is machined together with cylinder block.



7. Install main bearing beam.
  - Install main bearing beam with front mark facing downward (oil pan side).
  - Install main bearing beam with front mark facing front of engine.
8. Inspect outer diameter of main bearing cap bolt. Refer to [EM-123. "OUTER DIAMETER OF MAIN BEARING CAP BOLT"](#).



9. 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) in several different steps.

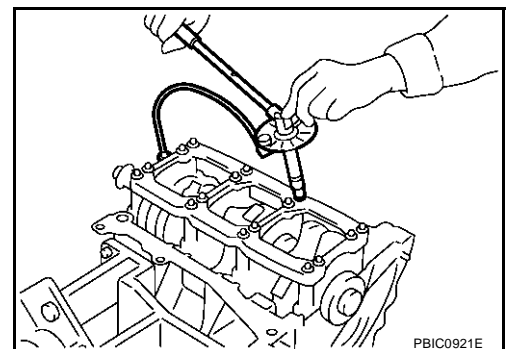


- c. Turn all bolts another 90 to 95 degrees clockwise [Target: 90 degrees (Angle tightening)].

**CAUTION:**

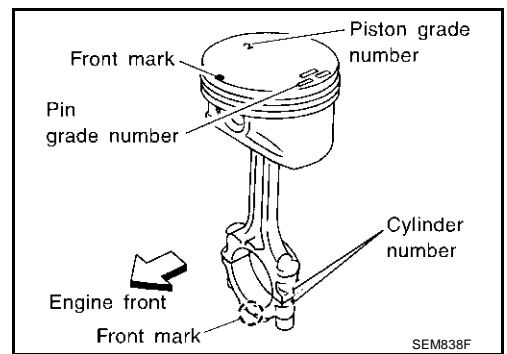
Use an angle wrench [special service tool: KV10112100 (BT8653-A)] to check tightening angle. Do not make judgment by visual inspection.

- After installing mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
  - Check crankshaft side clearance. Refer to [EM-115. "CRANK-SHAFT SIDE CLEARANCE"](#).
10. Inspect outer diameter of connecting rod bolt. Refer to [EM-123. "OUTER DIAMETER OF CONNECTING ROD BOLT"](#).
  11. 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.



# CYLINDER BLOCK

- 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.



12. 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:**

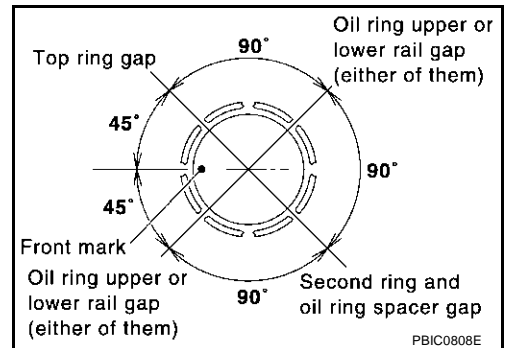
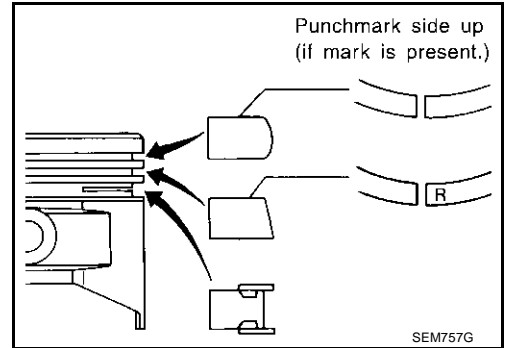
**Top ring** : —

**Second ring** : R

**CAUTION:**

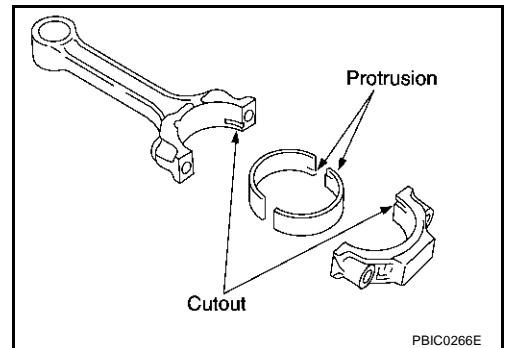
**Be careful not to damage the piston.**

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



13. 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.

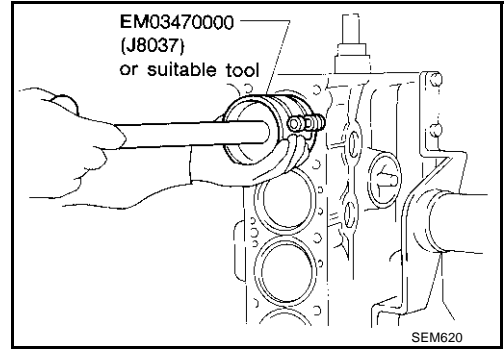


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# CYLINDER BLOCK

14. 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.

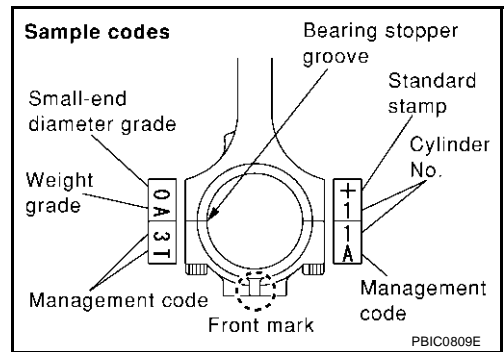


**CAUTION:**

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

15. 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.



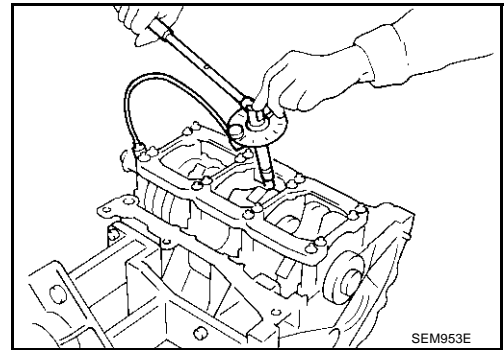
16. Tighten the connecting rod bolt as follows.

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

**CAUTION:**

**Always use an angle wrench [special service tool: KV10112100 (BT8653-A)]. 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-115, "CONNECTING ROD SIDE CLEARANCE"](#)



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

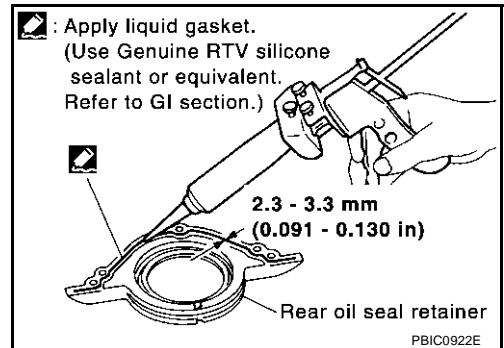
- Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

**CAUTION:**

**Replace with the new parts.**

**NOTE:**

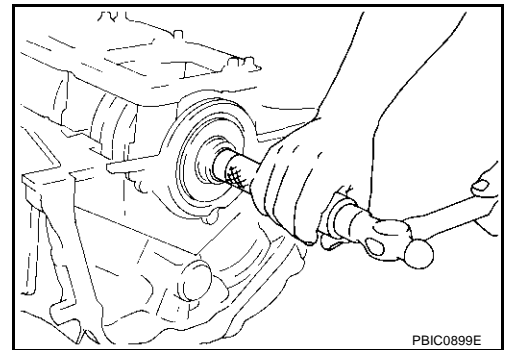
Rear oil seal with rear oil seal retainer.



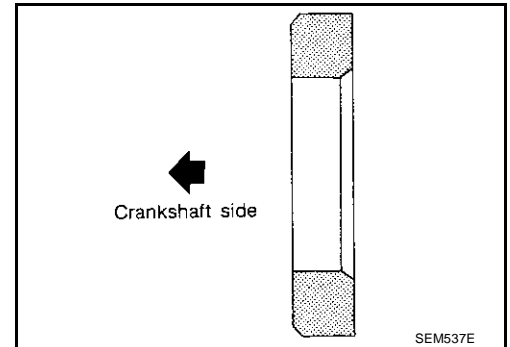
# CYLINDER BLOCK

18. Install pilot converter using suitable tool.

- Outer diameter of drift  
**Pilot converter : Approx. 33 mm (1.30 in)**
- Press-fit pilot converter with its chamfer facing crankshaft.

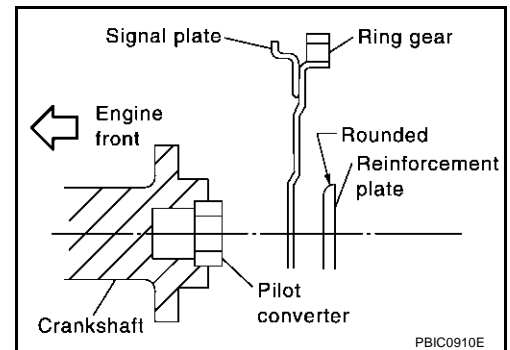


- Install pilot converter as shown.



19. Install drive plate.

- Install drive plate and reinforcement plate as shown in figure.
- Secure the crankshaft using a suitable ring gear stopper or an alternative manner.
- Tighten the installation bolts crosswise over several times.



20. Install knock sensor.

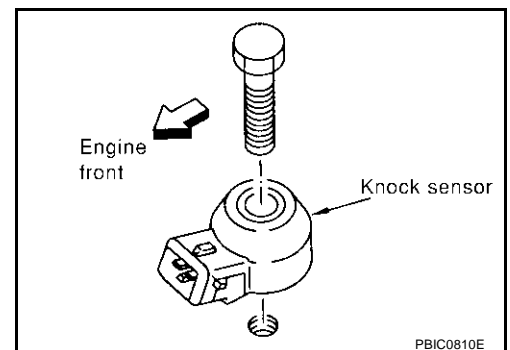
- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
- Install knock sensor so that connector faces front of engine.
- Do not tighten the mounting bolts while holding the connector.
- Make sure that the knock sensor does not interfere with other parts.

**CAUTION:**

**If any impact by dropping is applied to the knock sensor, replace it with new one.**

- After installing knock sensor, connect sub-harness, and lay it out to rear of engine.

21. Install followings in reverse order of removal.



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# CYLINDER BLOCK

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## How to Select Piston and Bearing DESCRIPTION

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	—	—	—

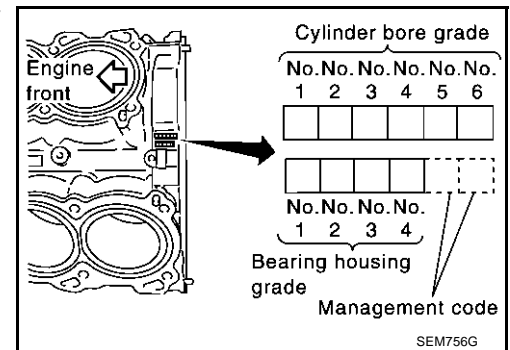
\*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

- 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.

## HOW TO SELECT PISTON

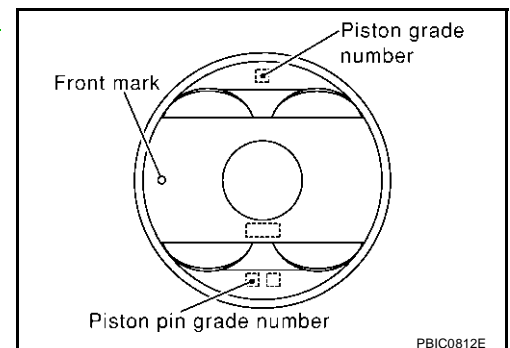
### When New Cylinder Block is Used

- 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-119, "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.



# CYLINDER BLOCK

## 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 bore) 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.

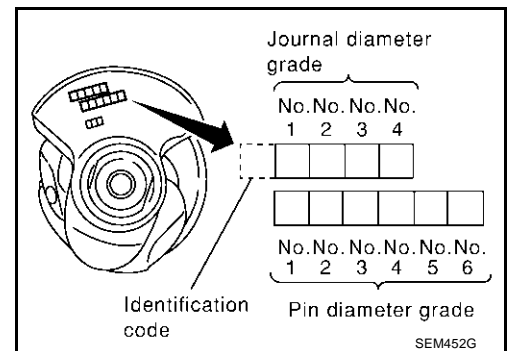
## HOW TO SELECT CONNECTING ROD BEARING

### 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.



### 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. Refer to [EM-117, "CONNECTING ROD BEARING HOUSING DIAMETER \(BIG END\)"](#) and [EM-120, "OUTER DIAMETER OF CRANKSHAFT PIN"](#).
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 inner diameter (Standard value)		55.000 - 55.013 (2.1654 - 2.1659)
Crankshaft pin outer diameter	Grade (Mark)	— (No grade)
51.968 - 51.974 (2.0460 - 2.0462)	0	Bearing grade No. STD 0 Bearing thickness range: 1.500 - 1.503 (0.00591 - 0.0592) Color: Black
51.962 - 51.968 (2.0457 - 2.0460)	1	Bearing grade No. STD 1 Bearing thickness range: 1.503 - 1.506 (0.0592 - 0.0593) Color: Brown
51.956 - 51.962 (2.0455 - 2.0457)	2	Bearing grade No. STD 2 Bearing thickness range: 1.506 - 1.509 (0.0593 - 0.0594) Color: Green

## Undersize Bearings Usage Guide

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

# CYLINDER BLOCK

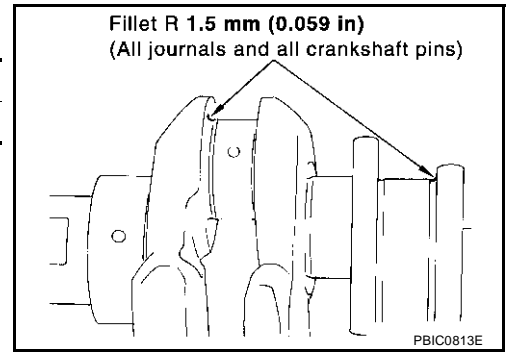
## Bearing undersize table

Unit: mm (in)

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

### CAUTION:

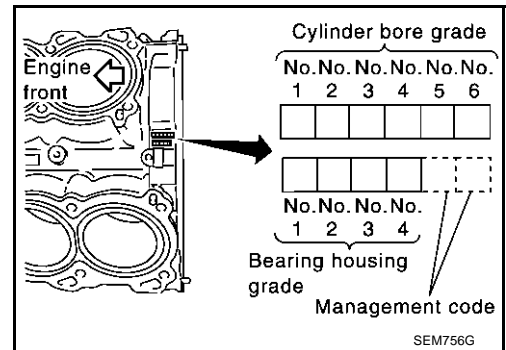
In grinding the crankshaft pin to use undersize bearings, keep the fillet R (All crankshaft pins).



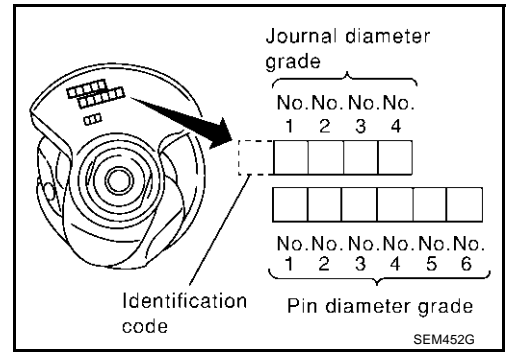
## HOW TO SELECT MAIN BEARING

### When New Cylinder Block and Crankshaft are Used

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



2. Apply journal diameter grade stamped on crankshaft front side to columns 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-118, "INNER DIAMETER OF MAIN BEARING HOUSING"](#) and [EM-120, "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

<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Cylinder block bearing housing inner diameter Unit: mm (in)</p> </div> <div style="text-align: center;"> <p>Crankshaft main journal diameter Unit: mm (in)</p> </div> </div>		Hole diameter																								
		Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
Mark	Axle diameter																									
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	2
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	0	0	1	0	1	1	1	1	1	1	1	2	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	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
D	59.972 - 59.971 (2.3611 - 2.3611)	0	1	0	1	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
E	59.971 - 59.970 (2.3611 - 2.3610)	0	1	0	1	1	1	1	1	1	1	1	1	1	2	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	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	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	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	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	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	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	2
N	59.963 - 59.962 (2.3607 - 2.3607)	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
P	59.962 - 59.961 (2.3607 - 2.3607)	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
R	59.961 - 59.960 (2.3607 - 2.3606)	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
S	59.960 - 59.959 (2.3606 - 2.3606)	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
T	59.959 - 59.958 (2.3606 - 2.3605)	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
U	59.958 - 59.957 (2.3605 - 2.3605)	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
V	59.957 - 59.956 (2.3605 - 2.3605)	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
W	59.956 - 59.955 (2.3605 - 2.3604)	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
X	59.955 - 59.954 (2.3604 - 2.3604)	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Y	59.954 - 59.953 (2.3604 - 2.3603)	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
4	59.953 - 59.952 (2.3603 - 2.3603)	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
7	59.952 - 59.951 (2.3603 - 2.3603)	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4

PBIC0814E

# 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		
01	UPP	2.003 - 2.006 (0.0789 - 0.0790)		19.9 - 20.1 (0.783 - 0.791)	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 Bearing Usage Guide**

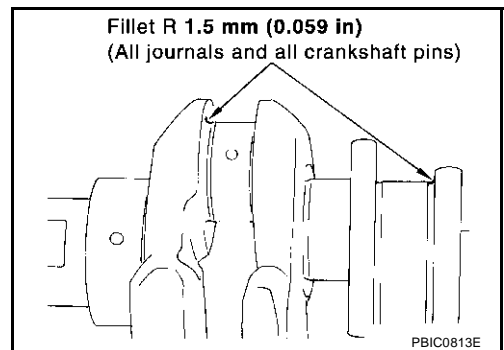
- Use undersize (US) bearing when oil clearance with standard size main bearing is not within specification.
- When using undersize (US) bearing, measure the bearing inner diameter with bearing installed, and grind journal until oil clearance falls within specification.

**Bearing undersize table**

Unit: mm (in)	
Size	Thickness
US 0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)

**CAUTION:**

**Keep fillet R when grinding crankshaft journal in order to use undersize bearing (All journals).**



# CYLINDER BLOCK

ABS0033M

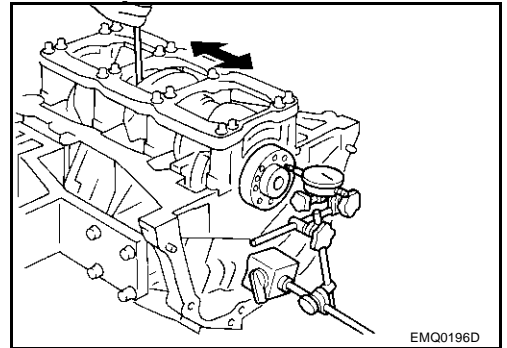
## Inspection After Disassembly CRANKSHAFT SIDE CLEARANCE

- 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.



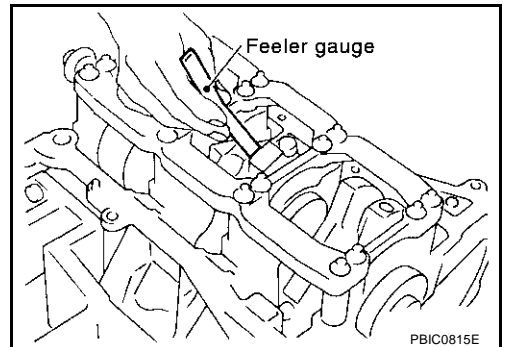
## CONNECTING ROD SIDE CLEARANCE

- 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 (0.0157 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.

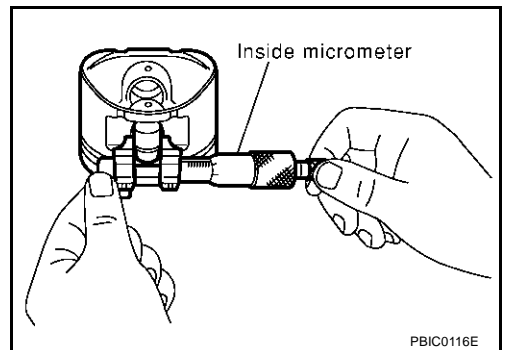


## PISTON AND PISTON PIN CLEARANCE

### Inner Diameter of Piston Pin

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

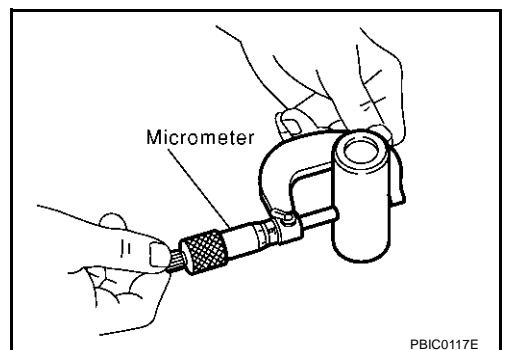
**Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)**



### 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 bore 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.

A  
EM  
C  
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# CYLINDER BLOCK

- When replacing piston/piston pin assembly, refer to [EM-119, "PISTON TO CYLINDER BORE CLEARANCE"](#).

## PISTON RING SIDE CLEARANCE

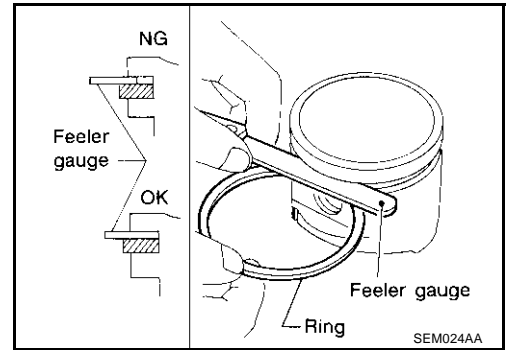
- Measure side clearance of piston ring and piston ring groove with feeler gauge.

### 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

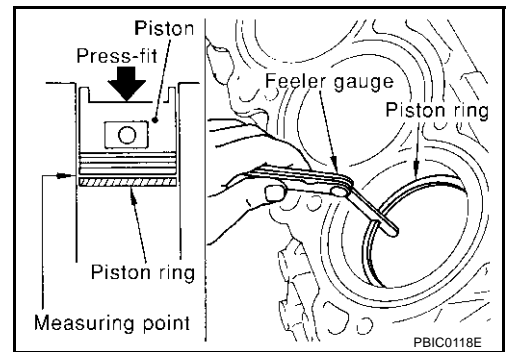
- Check if inner diameter of cylinder bore is within specification. Refer to [EM-119, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Insert piston ring until middle of cylinder with piston, and measure gap.

### 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

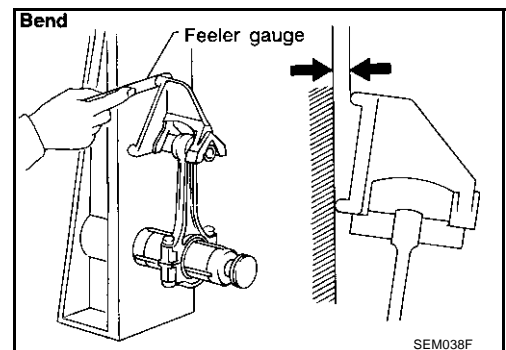
- Check with connecting rod aligner.

### Bend:

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

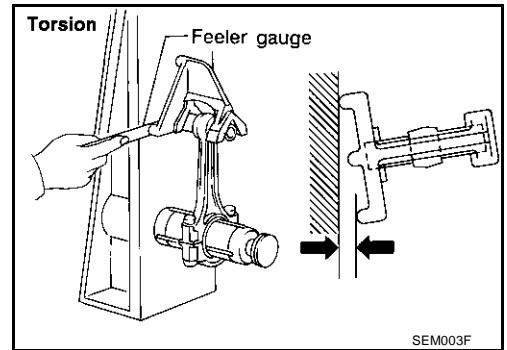
### Torsion:

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.



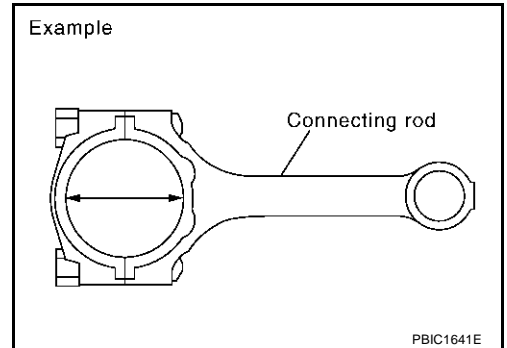
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## CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

- 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-104, "ASSEMBLY"](#) for the tightening procedure.

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

- If it exceeds the standard, replace the connecting rod.

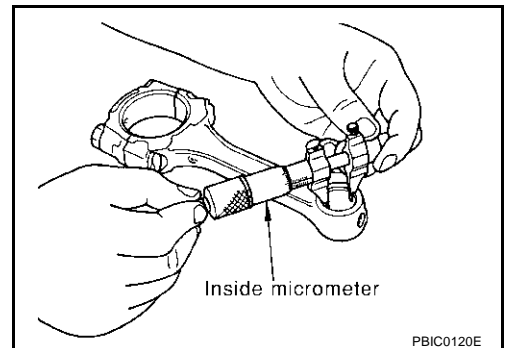


## CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

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

- Measure inner diameter of bushing.

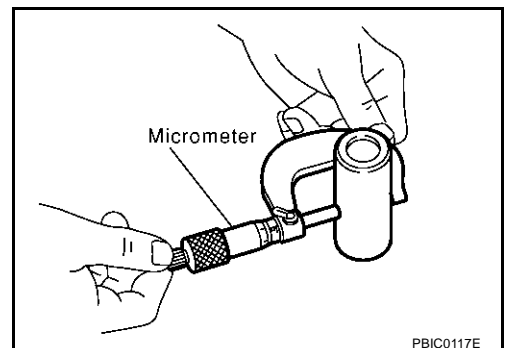
**Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)**



### Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

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



# CYLINDER BLOCK

## 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)**

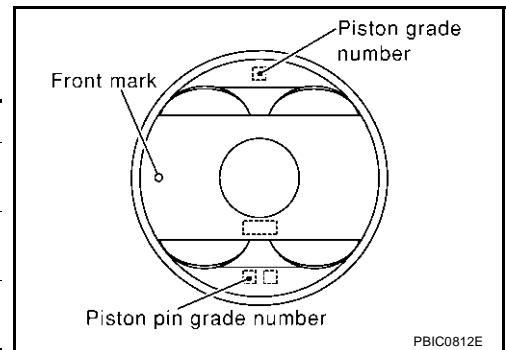
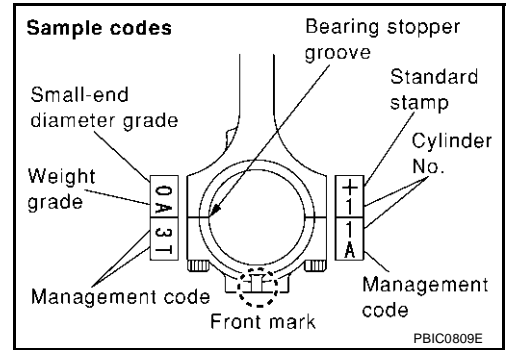
- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to [EM-119, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- If replacing the connecting rod assembly, refer to [EM-121, "OIL CLEARANCE OF CONNECTING ROD BEARING"](#).

### Factory installed parts grading:

- Service parts apply only to grade 0.

Unit: mm (in)

Grade	0	1
Connecting rod small end inner diameter	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin bore 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)



## CYLINDER BLOCK DISTORTION

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

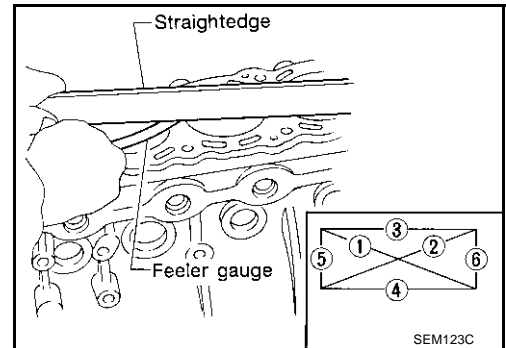
### CAUTION:

**Be careful not to allow gasket flakes to enter the 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

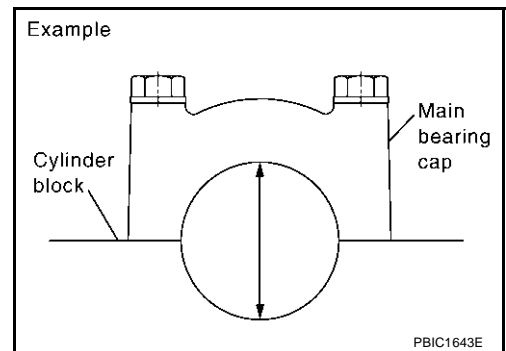
- Install the main bearing caps and main bearing beam with the main bearings removed, and tighten the mounting bolts to the specified torque. Refer to [EM-104, "ASSEMBLY"](#) for the tightening procedure.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

**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) (Y 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):

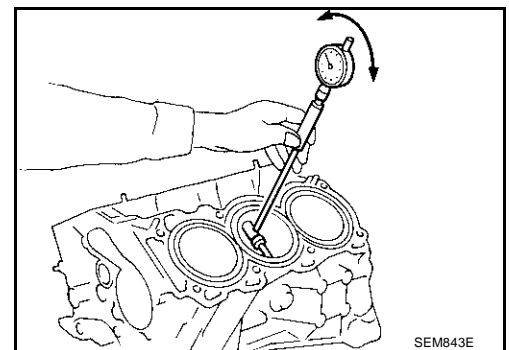
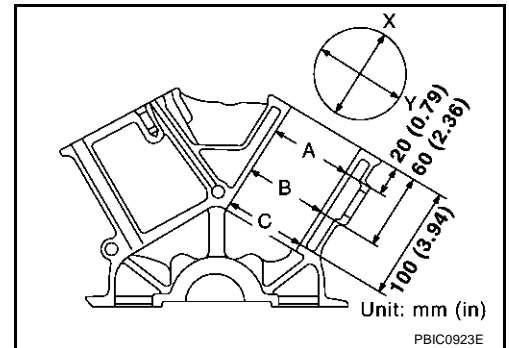
**0.015 mm (0.0006 in)**

#### 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, rebores the cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.

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



### Outer Diameter of Piston

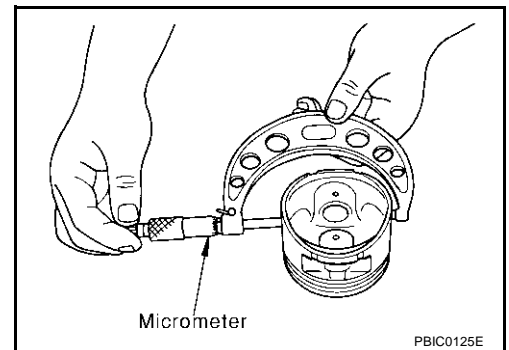
- Measure piston skirt outer diameter using micrometer.

#### 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 X, 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-110, "HOW TO SELECT PISTON"](#).

### Reboring Cylinder Bore

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

**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)**

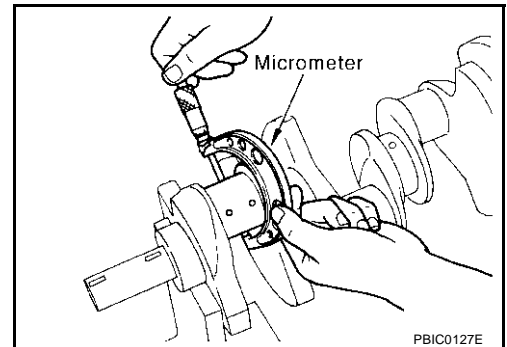
# CYLINDER BLOCK

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 out of the standard, measure the main bearing oil clearance. Then use the undersize bearing. Refer to [EM-122, "OIL CLEARANCE OF MAIN BEARING"](#) .



## OUTER DIAMETER OF CRANKSHAFT PIN

- Measure outer diameter of crankshaft pin.

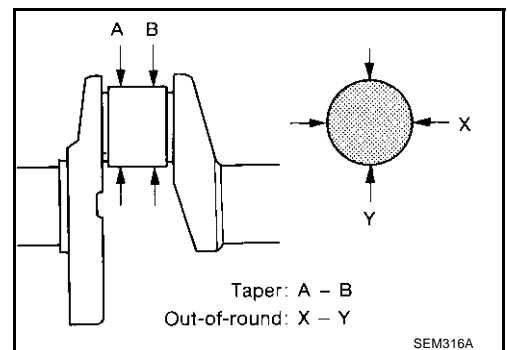
**Standard : 51.956 - 51.974 mm (2.0455 - 2.0462 in) dia.**
- If it out of the standard, measure the connecting rod bearing oil clearance. Then use the undersize bearing. Refer to [EM-121, "OIL CLEARANCE OF CONNECTING ROD BEARING"](#) .

## OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at 4 different points shown in the figure on each journal and pin.
- Out-of-round is indicated by the difference in dimensions between X and Y at A and B.
- Taper is indicated by the difference in dimension between A and B at X and Y.

### Limit:

- Out-of-round (Difference between X and Y) : 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 the 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-122, "OIL CLEARANCE OF MAIN BEARING"](#) or [EM-121, "OIL CLEARANCE OF CONNECTING ROD BEARING"](#) .



# CYLINDER BLOCK

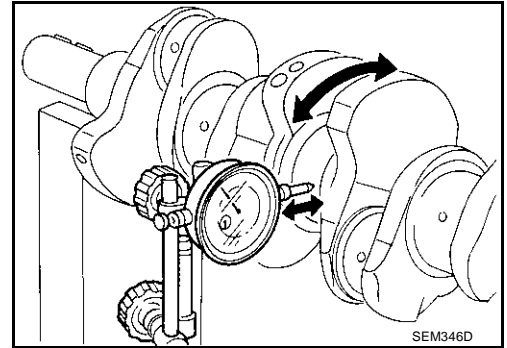
## CRANKSHAFT RUNOUT

- 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 (0.0039 in)**

- If it exceeds the limit, replace the crankshaft.



## OIL CLEARANCE OF CONNECTING ROD BEARING

### Method by Calculation

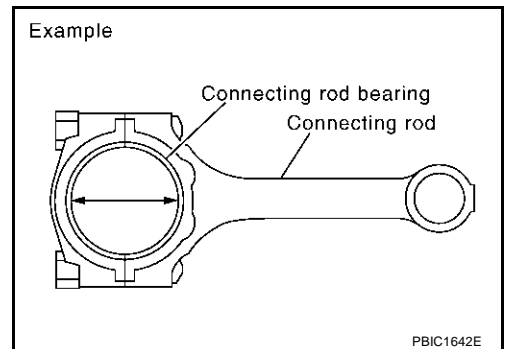
- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Using an inside micrometer measure the inner diameter of connecting rod bearing. Refer to [EM-104, "ASSEMBLY"](#) for the tightening procedure.

(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-111, "HOW TO SELECT CONNECTING ROD BEARING"](#).



### Method of Using Plastigage

- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Refer to [EM-104, "ASSEMBLY"](#) for the tightening procedure.

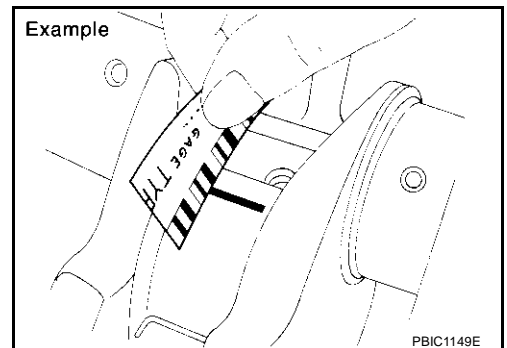
#### **CAUTION:**

**Never rotate the crankshaft.**

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

#### **NOTE:**

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



# CYLINDER BLOCK

## OIL CLEARANCE OF MAIN BEARING

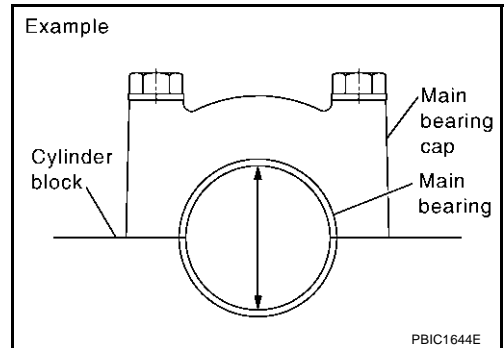
### Method by Calculation

- 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-104, "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-112, "HOW TO SELECT MAIN BEARING"](#).



### Method of Using Plastigage

- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts with main bearing beam to the specified torque. Refer to [EM-104, "ASSEMBLY"](#) for the tightening procedure.

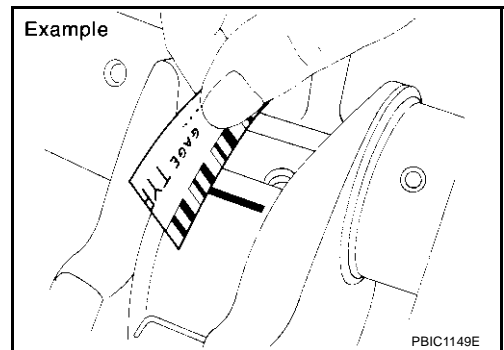
#### CAUTION:

**Never rotate the crankshaft.**

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

#### NOTE:

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

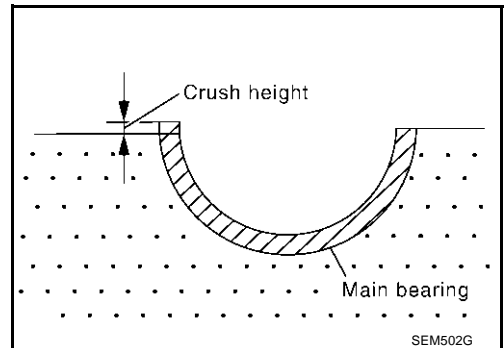


## CRUSH HEIGHT OF MAIN BEARING

- 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-104, "ASSEMBLY"](#) for the tightening procedure.

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

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

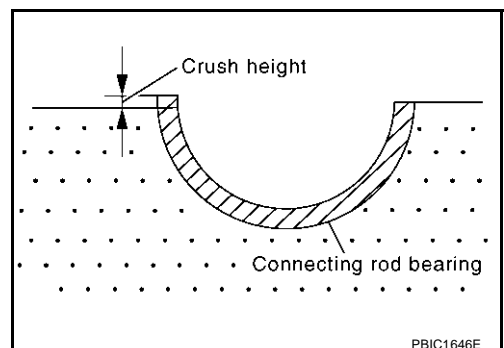


## CRUSH HEIGHT OF CONNECTING ROD BEARING

- 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-104, "ASSEMBLY"](#) for the tightening procedure.

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

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



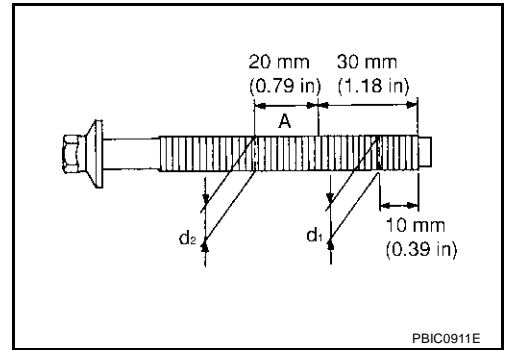
# CYLINDER BLOCK

## OUTER DIAMETER OF MAIN BEARING CAP BOLT

- Measure outer diameters ( $d_1$ ,  $d_2$ ) at two positions shown in the figure.
- Measure  $d_2$  at a point within block A.

**Limit : 0.11 mm (0.0051 in)**

- When the value of  $d_1 - d_2$  exceeds the limit (a large difference in dimensions), replace the bolt with a new one.



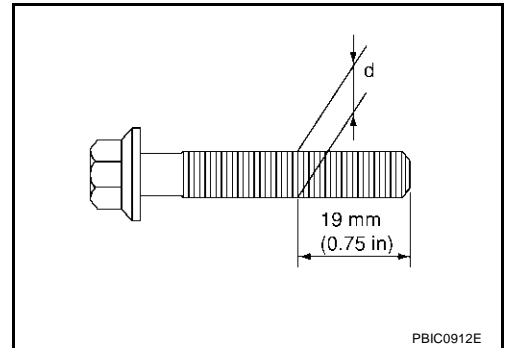
## OUTER DIAMETER OF CONNECTING ROD BOLT

- Measure outer diameter "d" at position shown in the figure.

**Standard : 7.90 - 8.00 mm (0.3110 - 0.3150 in)**

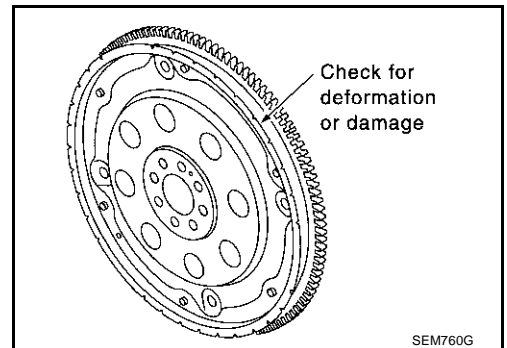
**Limit : 7.75 mm (0.3051 in)**

- When "d" exceeds the limit (when it becomes thinner), replace the bolt with a new one.



## SIGNAL PLATE

- Check the drive plate and signal plate for deformation or cracks.

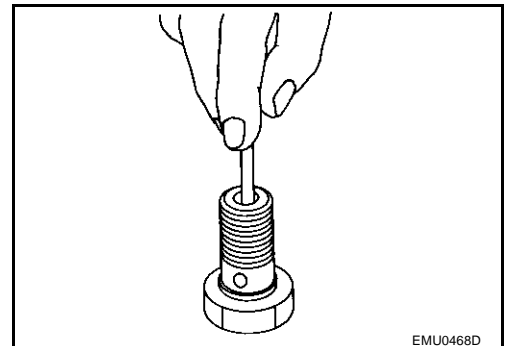


## OIL JET

- 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)

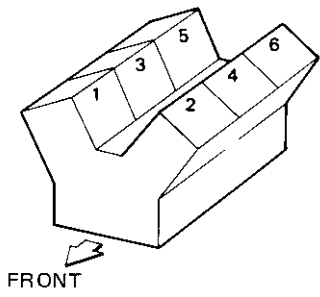
## SERVICE DATA AND SPECIFICATIONS (SDS)

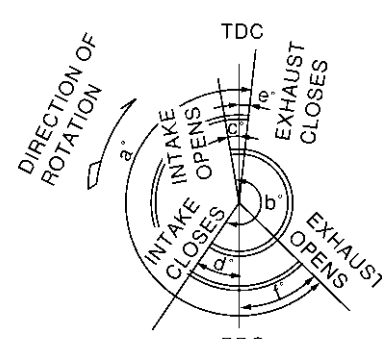
PFP:00100

### Standard and Limit GENERAL SPECIFICATIONS

ABS0033N

Cylinder arrangement		V-6
Displacement cm <sup>3</sup> (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3
Compression pressure kPa (kg/cm <sup>2</sup> , psi)/300 rpm	Standard	1,275 (13.0, 185)
	Minimum	981 (10.0, 142)
	Differential limit between cylinders	98 (1.0, 14)

Cylinder number	 <p style="text-align: right;">SEM713A</p>
-----------------	---

Valve timing (Intake valve timing control - OFF)	 <p style="text-align: right;">PBIC0187E</p>
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Unit: degree					
a	b	c	d	e	f
240	238	- 6	64	8	52

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

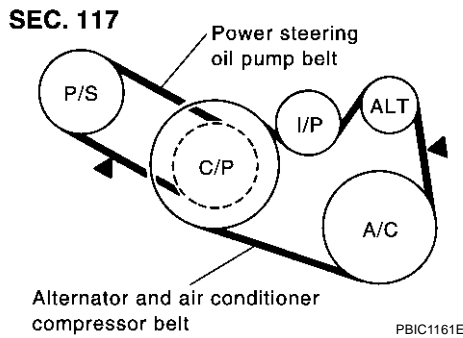
Unit: mm (in)

		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*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and air conditioning compressor	7 (0.28)	4.2 - 4.6 (0.17 - 0.18)	3.7 - 4.1 (0.15 - 0.16)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Power steering oil pump	11 (0.43)	7.3 - 8 (0.29 - 0.30)	6.5 - 7.2 (0.26 - 0.28)	196 (20, 44)	495 - 583 (50.5 - 59.5, 111 - 131)	603 - 691 (61.5 - 70.5, 135.6 - 155.4)
Applied pushing force	98 N (10 kg, 22 lb)			—		



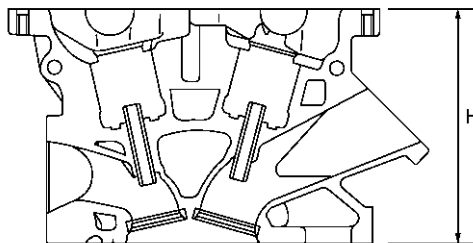
\*: If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

## 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)
	Limit
Head surface distortion	0.1 (0.004)
Normal cylinder head height "H"	126.3 - 126.5 (4.972 - 4.980)



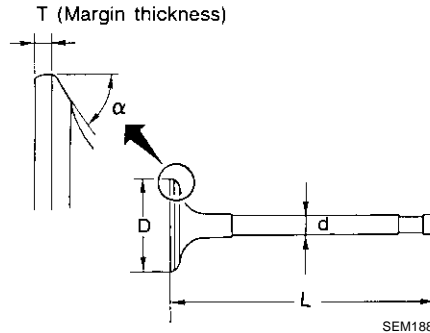
PBIC0924E

# 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)

	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	
Valve open	407 - 459 (41.5 - 46.8, 91.5 - 103.2) at 27.8 (1.0945)	
Out-of-square	mm (in)	Less than 2.0 (0.079)

### Valve Lifter

Unit: mm (in)

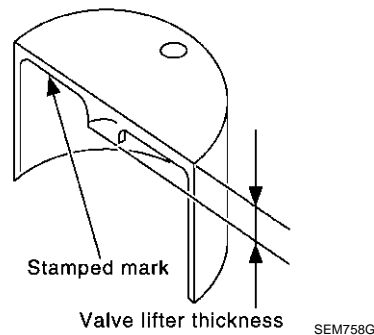
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Lifter guide inner diameter	34.000 - 34.016 (1.3386 - 1.3392)
Clearance between lifter and lifter guide	0.013 - 0.039 (0.0005 - 0.0015)

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Available Valve Lifter

Unit: mm (in)

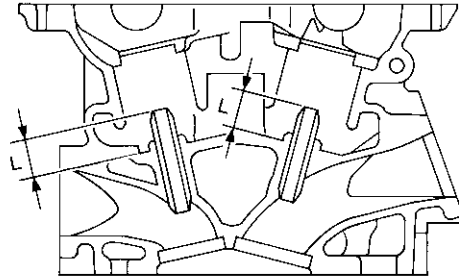
Identification Mark	Thickness
788U or 788R	7.88 (0.3102)
790U or 790R	7.90 (0.3110)
792U or 792R	7.92 (0.3118)
794U or 794R	7.94 (0.3126)
796U or 796R	7.96 (0.3134)
798U or 798R	7.98 (0.3142)
800U or 800R	8.00 (0.3150)
802U or 802R	8.02 (0.3157)
804U or 804R	8.04 (0.3165)
806U or 806R	8.06 (0.3173)
808U 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

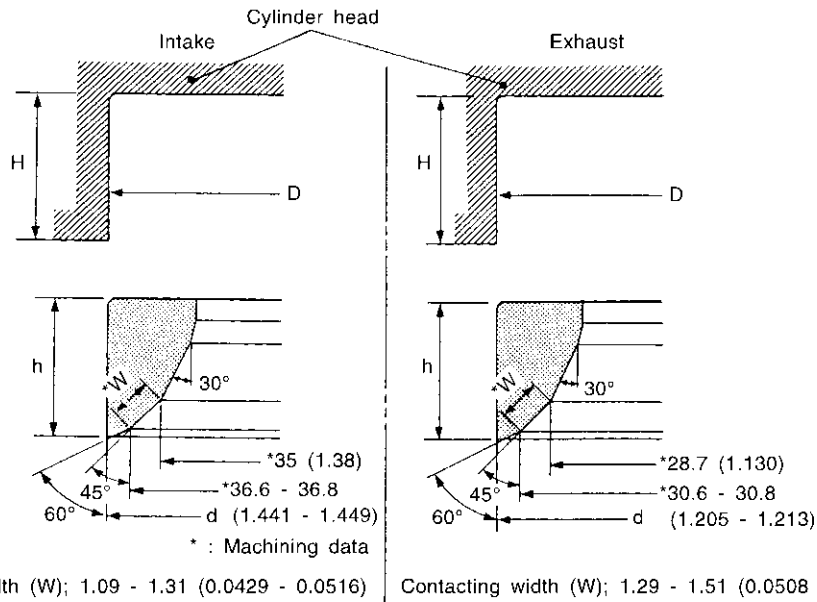
		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Max. tolerance
Stem to 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)	



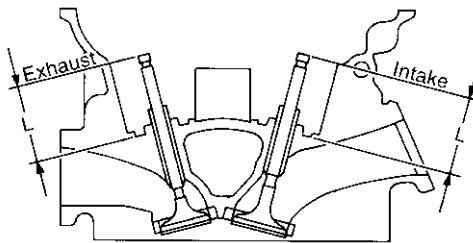
# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Seat

Unit: mm (in)



SEM021EB



SEM621F

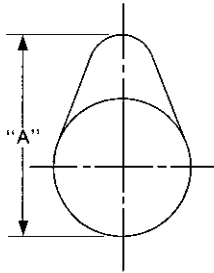
		Standard	Service
Cylinder head seat recess diameter (D)	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 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)

	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)	0.24 (0.0094)



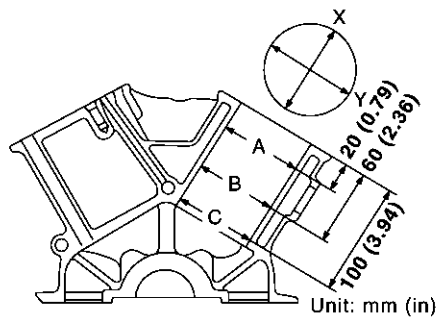
SEM671

Cam height "A"	Intake and exhaust	44.865 - 45.055 (1.7663 - 1.7738)	—
Camshaft runout [TIR*]		Less than 0.05 (0.0020)	—
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)

\*: Total indicator reading

## CYLINDER BLOCK

Unit: mm (in)



PBIC0923E

Surface flatness	Limit	0.10 (0.0039)		
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)		

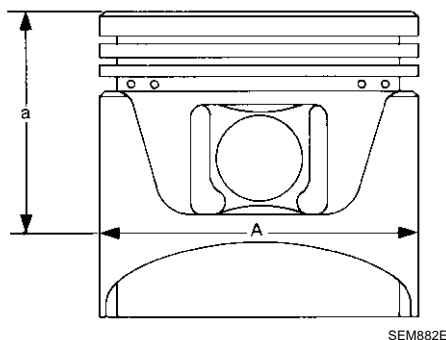
# SERVICE DATA AND SPECIFICATIONS (SDS)

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	95.490 - 95.500 (3.7594 - 3.7598)
		Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)
		0.20 (0.0079) 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	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)

# 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)

## CONNECTING ROD

Unit: mm (in)

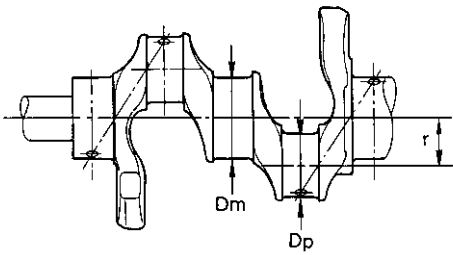
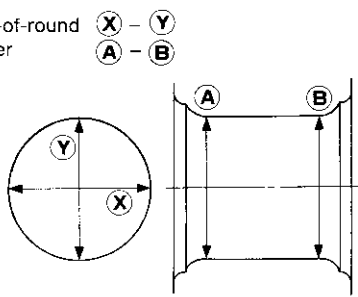
Center distance		144.15 - 144.25 (5.6751 - 5.6791)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - 0.9449)
Piston pin bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end 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)

\*: After installing in connecting rod

# SERVICE DATA AND SPECIFICATIONS (SDS)

## CRANKSHAFT

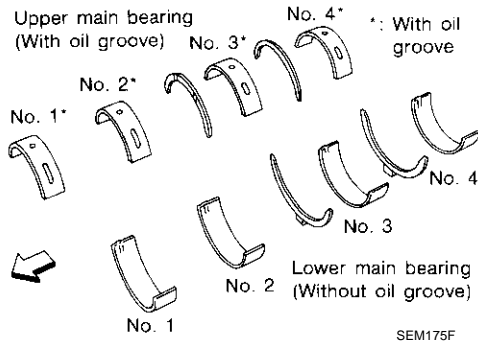
Unit: mm (in)

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)
Runout [TIR*]	Limit	Less than 0.10 (0.0039)
Free end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)
 <p style="text-align: center; font-size: small;">SEM645</p>	<p style="font-size: small;">Out-of-round <math>\text{X} - \text{Y}</math> Taper <math>\text{A} - \text{B}</math></p>  <p style="text-align: right; font-size: small;">SEM715</p>	

\*: 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 CLEARANCE

Unit: mm (in)

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

\*: Actual clearance

## Tightening Torque

ABS00330

\*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

Mass air flow sensor	5.1 - 6.37 (0.52 - 0.64, 46 - 56)*2
Engine cover	5.00 - 6.47 (0.51 - 0.65, 45 - 57)*2
*1 Intake manifold collector (upper)	17.6 - 21.6 (1.8 - 2.2, 13 - 15)
*1 Intake manifold collector (lower)	17.6 - 21.6 (1.8 - 2.2, 13 - 15)
*1 Electric throttle control actuator	7.2 - 9.6 (0.74 - 0.97, 64 - 84)*2
EVAP canister purge volume control solenoid valve	9.81 - 12.7 (1.0 - 1.2, 87 - 112)*2
*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)
Exhaust manifold cover	5.1 - 6.5 (0.52 - 0.66, 46 - 57)*2
*1 Exhaust manifold	28.3 - 33.3 (2.9 - 3.3, 21 - 24)
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)	9.22 - 10.6 (0.94 - 10.9, 82 - 94)*2
*1 Oil pan (upper)	15.7 - 18.6 (1.6 - 1.9, 12 - 14)
Oil strainer	19.6 - 22.5 (2.0 - 2.2, 15 - 16)
Oil pan drain plug	29.4 - 39.2 (3.0 - 4.0, 22 - 29)
Rear plate cover	6.37 - 7.45 (0.65 - 0.75, 57 - 65)*2
Crankshaft position sensor (POS)	8.4 - 10.8 (0.86 - 1.1, 74.6 - 95.5)*2
Ignition coil	6.37 - 7.54 (0.65 - 0.76, 57 - 66)*2
Spark plug	19.6 - 29.4 (2.0 - 2.9, 15 - 21)
Fuel damper	8.3 - 11.3 (0.85 - 1.2, 73 - 100)*2
Fuel feed hose (with damper)	9.0 - 13.0 (0.92 - 1.3, 80 - 115)*2
*1 Fuel tube	1) 9.3 - 10.8 (0.95 - 1.1, 6.9 - 7.9) 2) 20.6 - 26.5 (2.1 - 2.7, 16 - 19)
*1 Rocker cover	1) 0.96 - 2.96 (0.10 - 0.30, 9 - 26)*2 2) 7.33 - 9.33 (0.75 - 0.95, 65 - 82)*2
PCV valve	1.96 - 2.94 (0.20 - 0.29, 18 - 26)*2
*1 Intake valve timing control cover	9.81 - 12.7 (1.0 - 1.3, 87 - 112)*2

## SERVICE DATA AND SPECIFICATIONS (SDS)

Camshaft sprocket (INT)		98 - 108 (10 - 11, 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>
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>
Tension guide		19.6 - 23.5 (2.0 - 2.3, 15 - 17)
Slack guide		12.7 - 18.6 (1.3 - 1.8, 10 - 13)
Crankshaft pulley		1) 39.2 - 49.0 (4.0 - 5.0, 29 - 36)
		2) 60° - 65° (angle tightening)
Chain tensioner cover		9.8 - 12.8 (1.0 - 1.3, 87 - 112)* <sup>2</sup>
Water pump cover		9.8 - 12.8 (1.0 - 1.3, 87 - 112)* <sup>2</sup>
*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)
*1 Camshaft bracket		1) 1.96 (0.2, 17)* <sup>2</sup>
		2) 5.88 (0.6, 52)* <sup>2</sup>
	(No.1 to 6)	3) 9.02 - 11.8 (0.92 - 1.20, 80 - 104)* <sup>2</sup>
	(No.7 to 10)	3) 8.3 - 10.3 (0.85 - 1.0, 74 - 91)* <sup>2</sup>
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)
Oil jet		23.6 - 30.4 (2.4 - 3.1, 18 - 22)
Knock sensor		20.6 - 26.5 (2.1 - 2.7, 16 - 19)
Drive plate		83 - 93 (8.5 - 9.5, 61 - 69)
Rear oil seal retainer		8.14 - 9.36 (0.83 - 0.95, 72 - 82)* <sup>2</sup>