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# SECTION **EM**

## ENGINE MECHANICAL

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# PRECAUTIONS

## PRECAUTIONS

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### Precautions for Supplemental Restraint System (SRS) “AIR BAG” and “SEAT BELT PRE-TENSIONER”

EBS00M8F

The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the SRS and SB section of this Service Manual.

#### **WARNING:**

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the SRS section.
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

### Precautions for Drain Coolant

EBS00M8G

- Drain coolant when engine is cooled.

### Precautions for Disconnecting Fuel Piping

EBS00M8H

- 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

EBS00M8I

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

### Precautions for Inspection, Repair and Replacement

EBS00M8J

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

### Precautions for Assembly and Installation

EBS00M8K

- 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 oil or coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route after draining coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.

# PRECAUTIONS

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

## Parts Requiring Angular Tightening

EBS00M8L

- 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 for Liquid Gasket

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### REMOVAL OF LIQUID GASKET SEALING

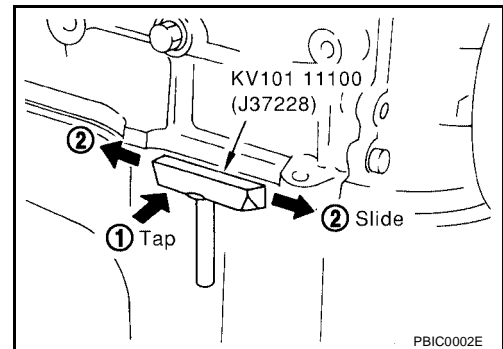
- After removing the mounting bolts and nuts, separate the mating surface using Tool and remove the liquid gasket sealing.

**Tool number** : KV10111100 (J37228)

#### 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 (1) the cutter where the Silicone RTV Sealant is applied. Use a plastic hammer to slide the cutter (2) by tapping on the side.

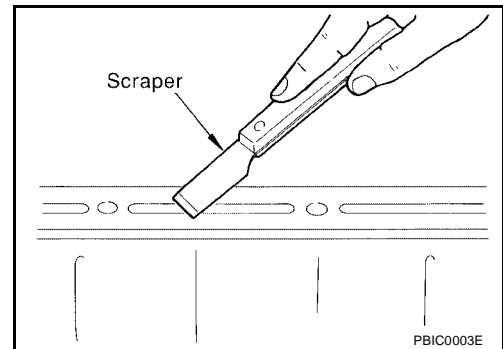


#### CAUTION:

**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

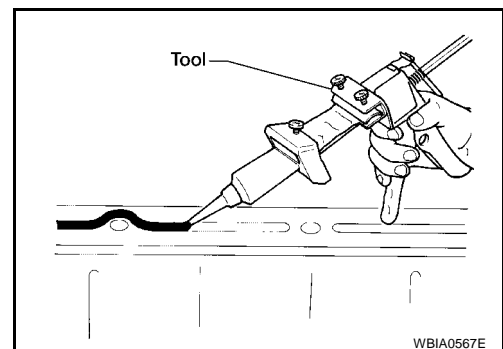
1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
  - Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.  
**Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**



4. Apply the sealant using Tool without breaks to the specified location.

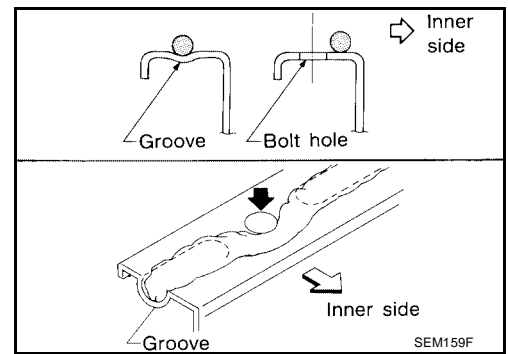
**Tool number** : WS39930000 ( - )

- If there is a groove for the sealant application, apply the sealant to the groove.
- As for the bolt holes, normally apply the sealant inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of the sealant application, install the mating component.
- If the sealant protrudes, wipe it off immediately.
- Do not retighten after the installation.



## PRECAUTIONS

- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to [MA-9](#), "[RECOMMENDED FLUIDS AND LUBRICANTS](#)".



**CAUTION:**  
Follow all specific instructions in this manual.

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# PREPARATION

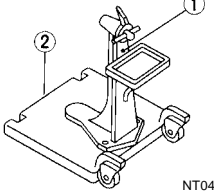
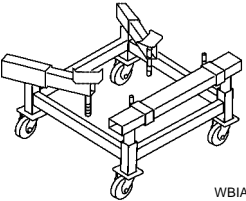
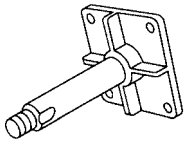
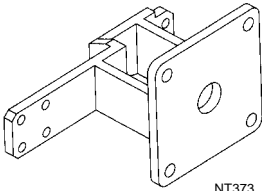
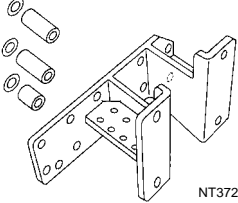
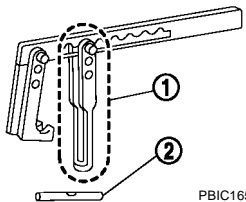
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## PREPARATION

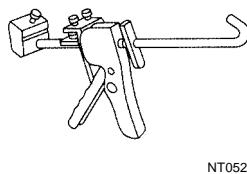
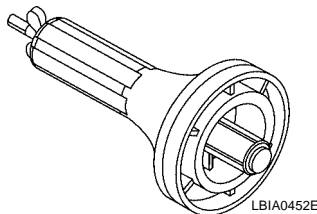
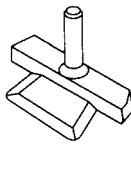
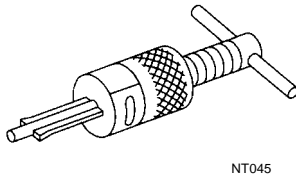
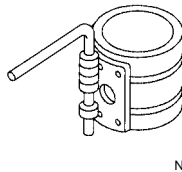
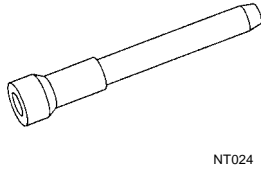
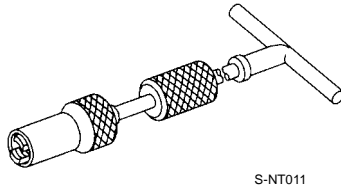
### Special Service Tools

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

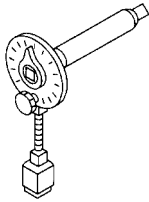
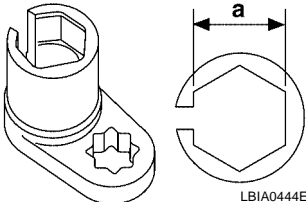
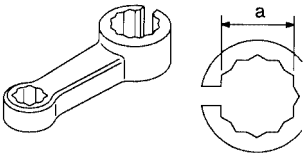
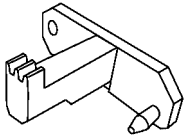
| Tool number<br>(Kent-Moore No.)<br>Tool name   | Image   | Description   |
|--|---|---|
| ST0501S000<br>(      —      )<br>Engine stand assembly<br>1 ST05011000<br>(      —      )<br>Engine stand<br>2 ST05012000<br>(      —      )<br>Base |  <p style="text-align: right; font-size: small;">NT042</p>       | Disassembling and assembling  |
| KV101J0010<br>(J-47242)<br>Engine support table  |  <p style="text-align: right; font-size: small;">WBIA0658E</p>   | Engine and transmission assembly removal  |
| KV10106500<br>(      —      )<br>Engine stand shaft  |  <p style="text-align: right; font-size: small;">NT028</p>      | Disassembling and assembling  |
| KV10117000<br>(J41262)<br>Engine sub-attachment  |  <p style="text-align: right; font-size: small;">NT373</p>     | KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable). |
| KV10117001<br>(      —      )<br>Engine sub-attachment   |  <p style="text-align: right; font-size: small;">NT372</p>     | Installing on the cylinder block  |
| KV10116200<br>(J26336-B)<br>Valve spring compressor<br>1 KV10115900<br>(J26336-20)<br>Attachment<br>2 KV1019230<br>(      —      )                   |  <p style="text-align: right; font-size: small;">PBIC1650E</p> | Disassembling valve mechanism<br>Part (1) is a component of KV10116200 (J26336-B, but Part (2) is not.  |

# PREPARATION

| Tool number<br>(Kent-Moore No.)<br>Tool name    | Description                                       | A           |
|---|---|-------------|
| KV10107902<br>(J38959)<br>Valve oil seal puller | Removing valve oil seal                           | EM          |
| (J39386)<br>Valve oil seal drift                | Installing valve oil seal                         | C<br>D<br>E |
| EM03470000<br>(J8037)<br>Piston ring compressor | Installing piston assembly into cylinder bore     | F<br>G      |
| ST16610001<br>(J23907)<br>Pilot bushing puller  | Removing crankshaft pilot bushing                 | H<br>I<br>J |
| KV10111100<br>(J37228)<br>Seal cutter           | Removing steel oil pan and rear timing chain case | K<br>L      |
| KV991J0120<br>(J-47128)<br>Seal installer       | Installing rear main seal                         | M           |
| WS39930000<br>( — )<br>Tube presser             | Pressing the tube of liquid gasket                |             |

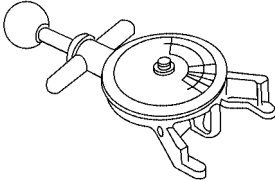
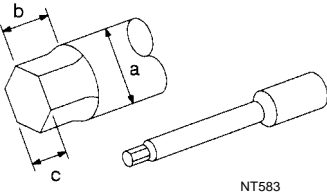
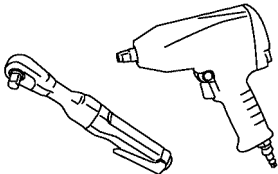


# PREPARATION

| Tool number<br>(Kent-Moore No.)<br>Tool name  | Description  |
|---|--|
| KV10112100<br>(BT8653-A)<br>Angle wrench<br> <p style="text-align: right;">NT014</p>               | Tightening bolts for bearing cap, cylinder head, etc.                          |
| KV991J0050<br>(J-44626)<br>Air fuel sensor Socket<br> <p style="text-align: right;">LBI A0444E</p> | Loosening or tightening air fuel ratio A/F sensor<br><b>a: 22 mm (0.87 in)</b> |
| KV10114400<br>(J38365)<br>Heated oxygen sensor wrench<br> <p style="text-align: right;">NT636</p>  | Loosening or tightening rear heated oxygen sensor<br><b>a: 22 mm (0.87 in)</b> |
| KV10117700<br>(J44716)<br>Ring gear stopper<br> <p style="text-align: right;">NT822</p>          | Removing and installing crankshaft pulley                                      |

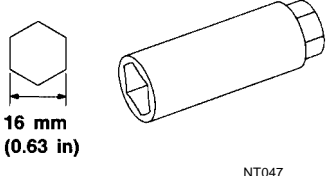
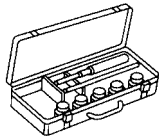
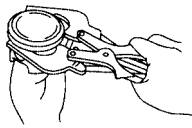
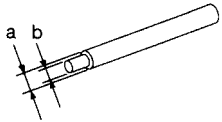
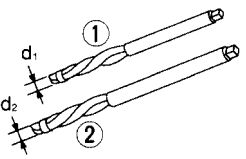
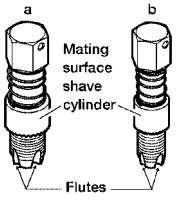
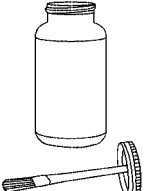
## Commercial Service Tools

EBS00JAG

| (Kent-Moore No.)<br>Tool name   | Description  |
|---|--|
| (BT3373-F)<br>Belt tension gauge<br> <p style="text-align: right;">AMA126</p>        | Checking drive belt tension  |
| (J24239-01)<br>Cylinder head bolt wrench<br> <p style="text-align: right;">NT583</p> | Loosening and tightening cylinder head bolt<br><b>a: 13 (0.51) dia.</b><br><b>b: 12 (0.47)</b><br><b>c: 10 (0.39)</b><br>Unit: mm (in) |
| Power tool<br> <p style="text-align: right;">PBIC0190E</p>                           | Loosening bolts and nuts   |



# PREPARATION

| (Kent-Moore No.)<br>Tool name   | Description   |                     |
|---|---|---------------------|
| Spark plug wrench<br><br> <p style="text-align: center;">16 mm<br/>(0.63 in)</p> <p style="text-align: right;">NT047</p>                   | Removing and installing spark plug  | A<br><b>EM</b><br>C |
| Valve seat cutter set<br><br> <p style="text-align: right;">NT048</p>  | Finishing valve seat dimensions   | D<br>E              |
| Piston ring expander<br><br> <p style="text-align: right;">NT030</p>   | Removing and installing piston ring   | F<br>G              |
| Valve guide drift<br><br> <p style="text-align: right;">NT015</p>   | Removing and installing valve guide<br><b>Intake &amp; Exhaust:</b><br><b>a = 9.5 mm (0.374 in) dia.</b><br><b>b = 5.5 mm (0.217 in) dia.</b>   | H<br>I<br>J         |
| Valve guide reamer<br><br> <p style="text-align: right;">NT016</p>   | Reaming valve guide 1 or hole for oversize valve guide 2<br><b>Intake &amp; Exhaust:</b><br><b>d1 = 6.0 mm (0.236 in) dia.</b><br><b>d2 = 10.2 mm (0.402 in) dia.</b>   | K<br>L              |
| (J-43897-18)<br>(J-43897-12)<br>Oxygen sensor thread cleaner<br><br> <p style="text-align: right;">AEM488</p>                            | Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.)<br><b>a = J-43897-18 (18 mm dia.) for zirconia oxygen sensor</b><br><b>b = J-43897-12 (12 mm dia.) for titania oxygen sensor</b> | M                   |
| Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)<br><br> <p style="text-align: right;">AEM489</p> | Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads   |                     |

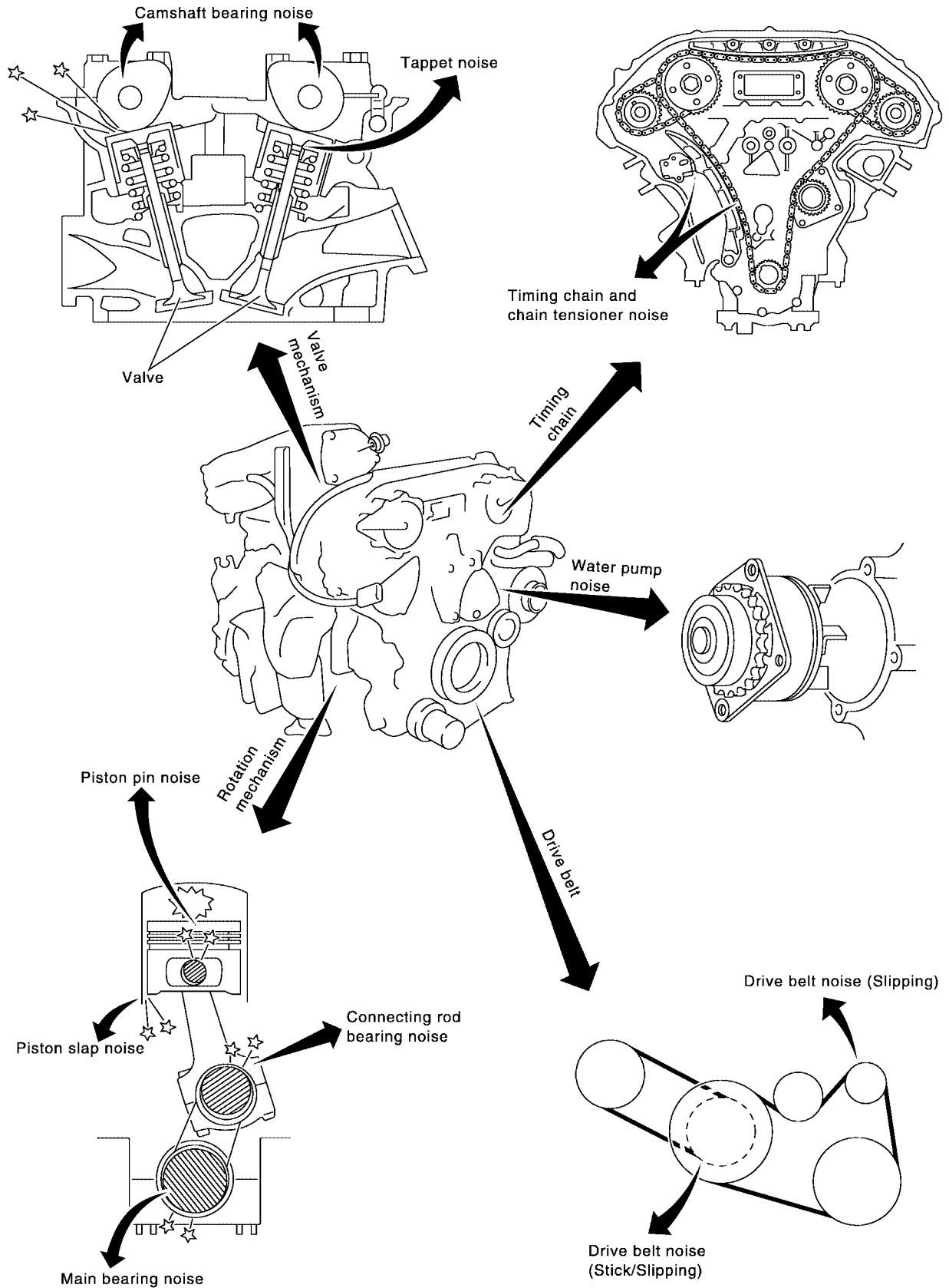
# NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

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

PFP:00003

### NVH Troubleshooting — Engine Noise

EBS00JAH



SEM706G

# NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

EBS00JAI

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

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. Repair or replace the identified part as necessary.

| 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<br>Rocker cover<br>Cylinder head                  | Ticking or clicking  | C                             | A             | —             | A           | B           | —             | Tappet noise                           | Valve clearance  | <a href="#">EM-93</a>  |
|   | Rattle               | C                             | A             | —             | A           | B           | C             | Camshaft bearing noise                 | Camshaft journal clearance<br>Camshaft runout  | <a href="#">EM-83</a>  |
| Crankshaft pulley<br>Cylinder block (Side of engine)<br>Oil pan | Slap or knock        | —                             | A             | —             | B           | B           | —             | Piston pin noise                       | Piston and piston pin clearance<br>Connecting rod bushing clearance  | <a href="#">EM-101</a> |
|   | Slap or rap          | A                             | —             | —             | B           | B           | A             | Piston slap noise                      | Piston-to-bore clearance<br>Piston ring side clearance<br>Piston ring end gap<br>Connecting rod bend and torsion | <a href="#">EM-122</a> |
|   | Knock                | A                             | B             | C             | B           | B           | B             | Connecting rod bearing noise           | Connecting rod bushing clearance (Small end)<br>Connecting rod bearing clearance (Big end)                       | <a href="#">EM-122</a> |
|   | Knock                | A                             | B             | —             | A           | B           | C             | Main bearing noise                     | Main bearing oil clearance<br>Crankshaft runout  | <a href="#">EM-122</a> |
| Front of engine<br>Timing chain cover                           | Tapping or ticking   | A                             | A             | —             | B           | B           | B             | Timing chain and chain tensioner noise | Timing chain cracks and wear<br>Timing chain tensioner operation   | <a href="#">EM-58</a>  |
| Front of engine   | Squeaking or fizzing | A                             | B             | —             | B           | —           | C             | Drive belts (Sticking or slipping)     | Drive belts deflection   | <a href="#">EM-12</a>  |
|   | Creaking             | A                             | B             | A             | B           | A           | B             | Drive belts (Slipping)                 | Idler pulley bearing operation   |                        |
|   | Squall<br>Creak      | A                             | B             | —             | B           | A           | B             | Water pump noise                       | Water pump operation   | <a href="#">CO-19</a>  |

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

# DRIVE BELTS

## DRIVE BELTS

PDF:02117

### Checking Drive Belts

EBS00JAJ

#### **WARNING:**

Be sure to perform when the engine is not running.

1. Inspect belt for cracks, fraying, wear or oil adhesion. If necessary, replace with a new one.
2. Inspect drive belt deflections by applying 98 N (10kg, 22lb) on the belt midway between pulleys as shown.
3. Measure the belt tension using Tool at the locations shown.

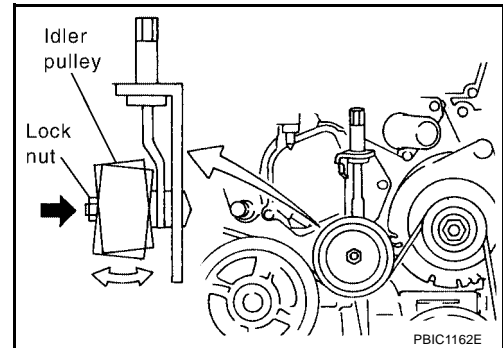
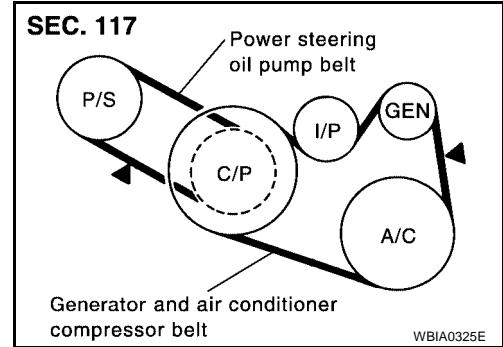
**Tool number** : BT3373-F

#### **NOTE:**

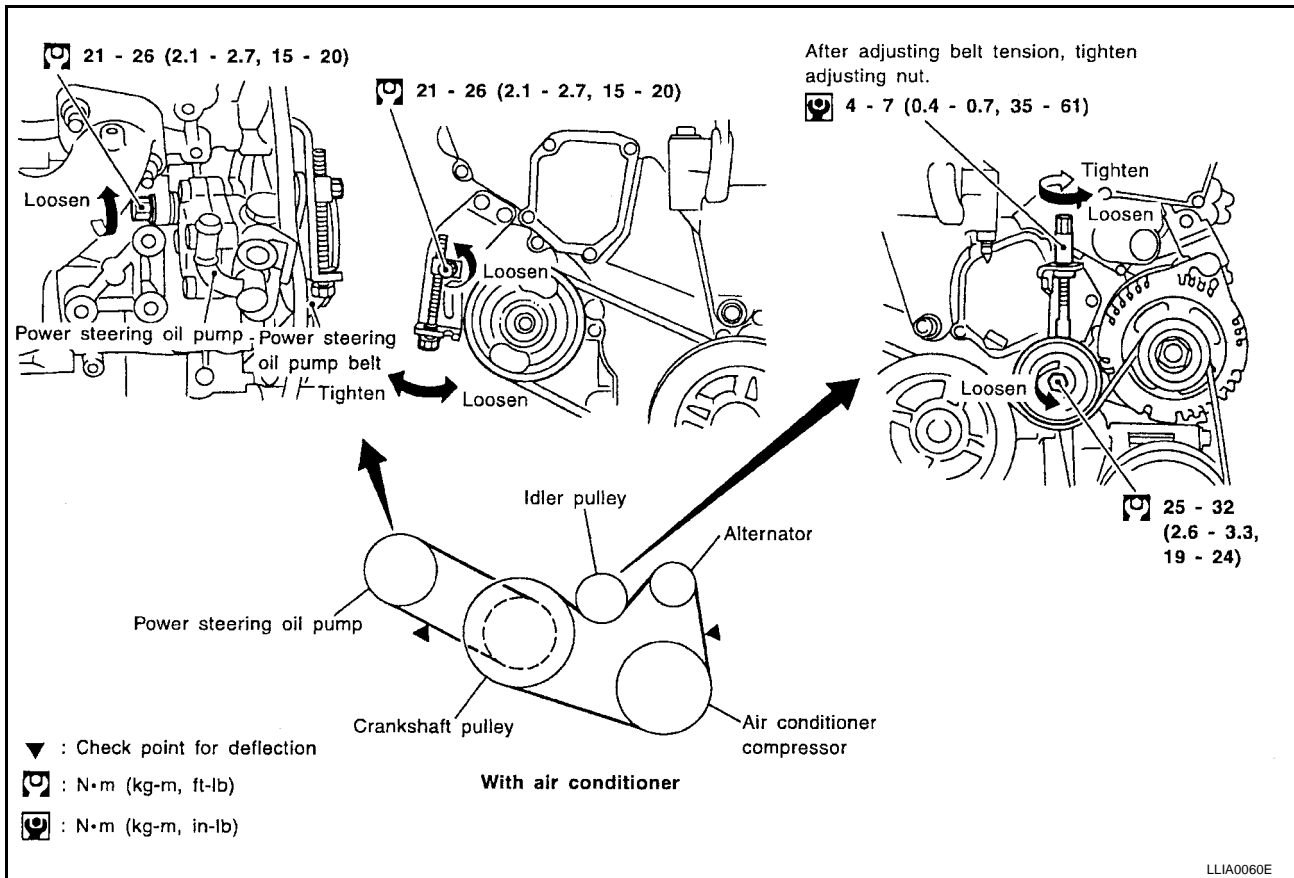
- Inspect drive belt deflection or tension when engine is cold.
- Adjust if belt deflections exceed the limit or if belt tension is not within specifications.

#### **CAUTION:**

- **When checking belt deflection or tension immediately after installation, first adjust it to the specification value. Then, after turning the crankshaft two turns or more, readjust 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.**



# DRIVE BELTS



## Belt Deflection and Tension

|   | Deflection adjustment |                         | Unit: mm (in)           | Tension adjustment* |                                    | Unit: N (kg, lb)                       |
|---|-----------------------|-------------------------|-------------------------|---------------------|------------------------------------|--|
|   | Used belt             |                         | New belt                | Used belt           |                                    | New belt                               |
|   | Limit                 | After adjustment        |                         | Limit               | After adjustment                   |  |
| Generator 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 pump                       | 11 (0.43)             | 7.3 - 8.0 (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                     | 98N (10kg, 22lb)      |                         |                         | —                   |                                    |  |

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

## Tension Adjustment

EBS00JAK

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

### CAUTION:

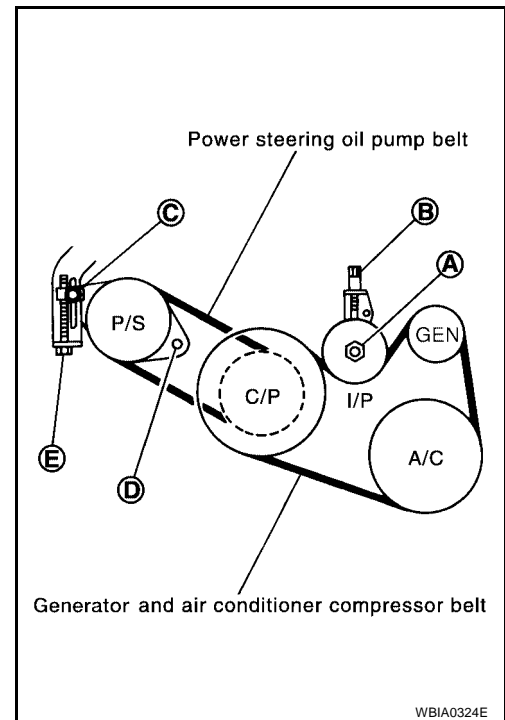
- When belt is replaced with a new one, adjust it to value for "New belt" to accommodate for insufficient adaptability with pulley grooves.
- When deflection or tension of belt being used exceeds "Used belt limit" adjust it to value for "Used belt".
- When checking belt deflection or tension immediately after installation, first adjust it to the specification value. Then, after turning the crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.

# DRIVE BELTS

- 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.

## GENERATOR AND AIR CONDITIONER COMPRESSOR BELT

1. Remove engine undercover.
2. Loosen idler pulley lock nut (A) and adjust by turning adjusting bolt (B).
  - For specified belt tension, refer to [MA-11, "CHECKING DRIVE BELTS"](#).
3. Tighten lock nut (A) refer to [EM-12, "Checking Drive Belts"](#).
4. Tighten adjusting bolt (B) refer to [EM-12, "Checking Drive Belts"](#).



# DRIVE BELTS

## POWER STEERING OIL PUMP BELT

1. Remove engine undercover.
2. Loosen adjusting bolt (C).
3. Loosen power steering oil pump bolt (D).

### NOTE:

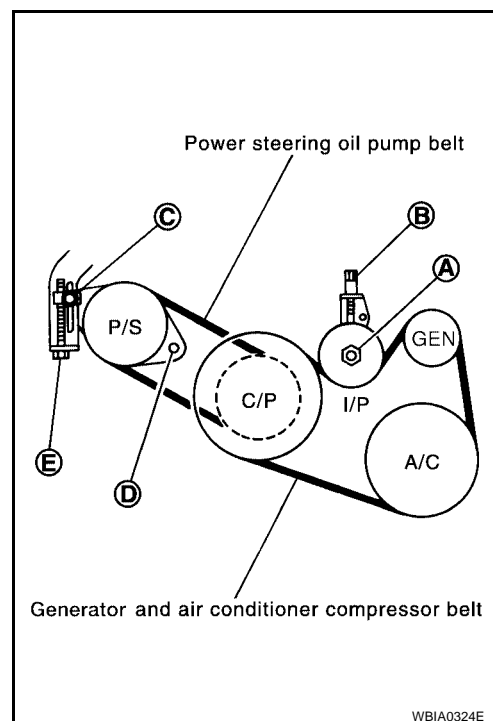
Bolt head (D) is at the engine rear side.

4. Adjust by turning the adjusting bolt (E).
  - For specified belt tension, refer to [MA-11, "CHECKING DRIVE BELTS"](#).

### NOTE:

Adjusting bolt (E) is loosened with counterclockwise rotation.

5. Tighten adjusting bolt (C) refer to [EM-12, "Checking Drive Belts"](#).
6. Tighten power steering oil pump bolt (D) refer to [EM-12, "Checking Drive Belts"](#).



## Removal and Installation

### REMOVAL

1. Remove engine undercover.
2. Fully loosen each belt. Refer to [MA-13, "Power steering oil pump belt"](#). Remove generator 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 belts.

### INSTALLATION

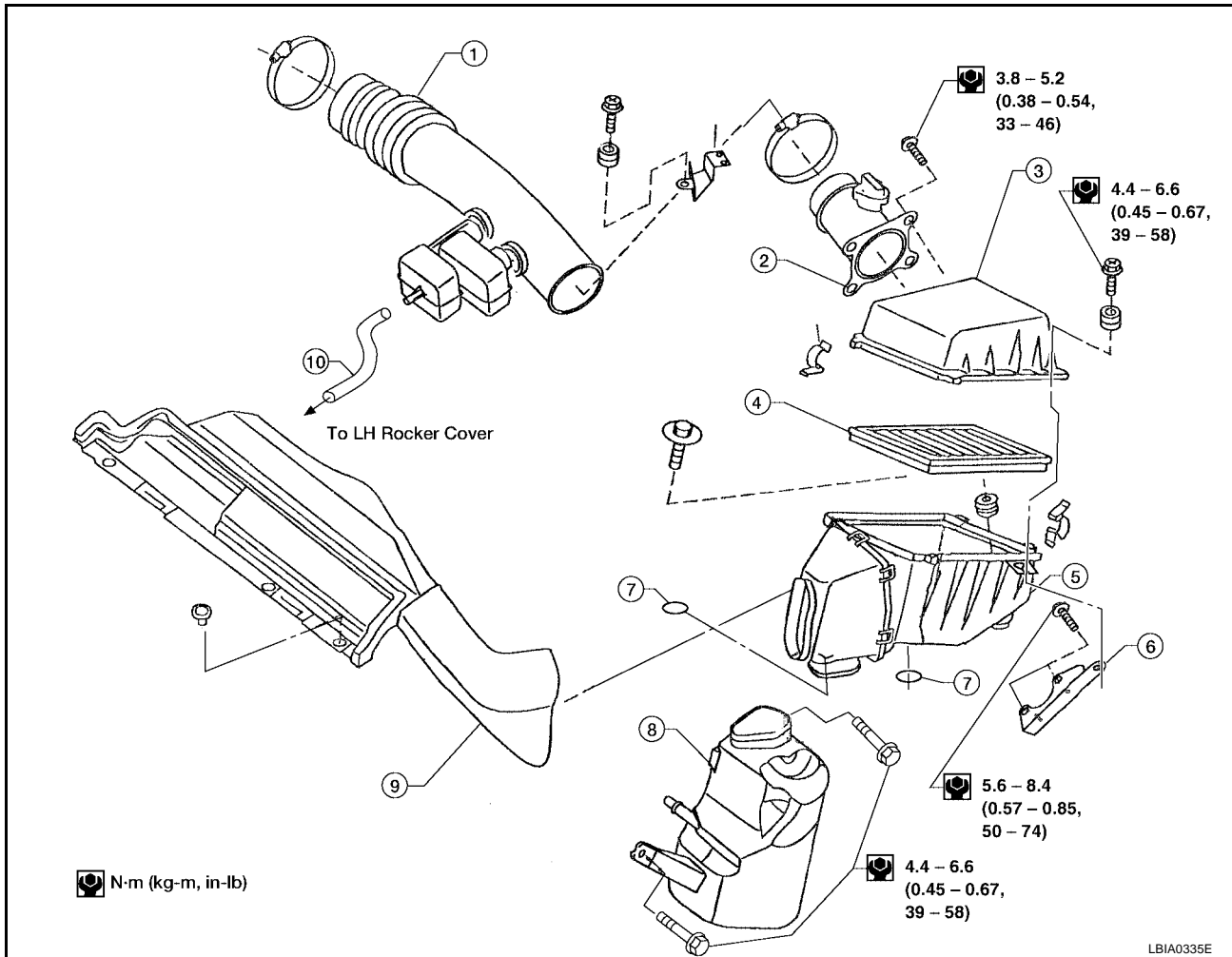
1. Installation is in the reverse order of removal.

### CAUTION:

- Make sure belts are correctly engaged with the pulley groove.
  - Clean off any for oil and coolant on belts and each pulley groove.
2. Adjust belt tension. Refer to [MA-13, "Power steering oil pump belt"](#).

### Removal and Installation

EBS00JAM



- |   |                             |                             |
|---|-----------------------------|-----------------------------|
| 1. Air cleaner to electric throttle control actuator tube | 2. Mass air flow sensor     | 3. Air cleaner case (upper) |
| 4. Air cleaner filter                                     | 5. Air cleaner case (lower) | 6. Air cleaner case bracket |
| 7. Grommet  | 8. Resonator (in fender)    | 9. Fresh air duct           |
| 10. PCV hose  |                             |                             |

### REMOVAL

1. Remove the grille top cover.
2. Remove the fresh air duct.
3. Disconnect the harness connector from the mass air flow sensor.
4. Disconnect the tube clamp at the electric throttle control actuator.
5. Remove air cleaner to electric throttle control actuator tube, air cleaner case (upper) with the mass air flow sensor attached.
6. 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.

7. Remove the air cleaner case (lower).
8. 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.

A

## CHANGING AIR CLEANER FILTER

1. Disconnect the tube clamp at the electric throttle control actuator and mass air flow sensor.
2. Separate the mass air flow sensor from the air cleaner to electric throttle control actuator tube.
3. Unhook the air cleaner case side clips and remove the air cleaner case (upper).
4. Remove the air cleaner filter.
5. Install a new air cleaner filter.
6. Installation is in the reverse order of removal.

EM

C

D

E

F

G

H

I

J

K

L

M



# INTAKE MANIFOLD COLLECTOR

- |   |                                      |  |
|---|--------------------------------------|--|
| 1. Electric throttle control actuator                 | 2. Intake manifold collector (upper) | 3. EVAP canister purge volume control solenoid valve |
| 4. Intake manifold collector (lower)                  | 5. Power valve                       | 6. VIAS control solenoid valve                       |
| 7. Vacuum tank  | 8. Service port                      | 9. Fuel hose   |
| 10. Gasket  | 11. EGR temperature sensor           | 12. EGR tube (to lower intake manifold collector)    |
| 13. EGR volume control valve                          | 14. EGR tube (to exhaust manifold)   | 15. EGR volume control valve bracket                 |
| 16. Intake manifold collector (lower) support bracket |                                      |  |

## REMOVAL

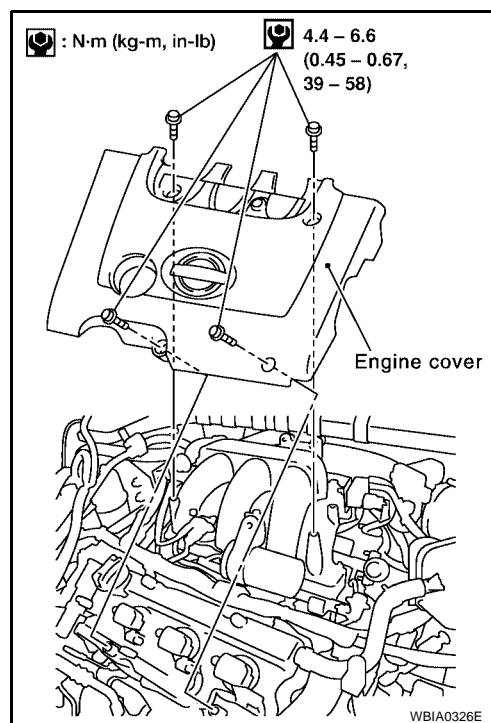
### WARNING:

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

1. Remove the cowl top. Refer to [EI-19, "Removal and Installation"](#).
2. Remove the windshield wiper assembly. Refer to [WW-23, "Removal and Installation of Wiper Motor and Linkage"](#).
3. Remove the engine cover using power tool.
4. Remove air cleaner case lid and mass air flow sensor, and air intake tube as an assembly. Refer to [EM-16, "Removal and Installation"](#).
5. Partially drain the coolant when the engine is cool. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).
6. Disconnect the following:
  - Power brake booster vacuum hose
  - Coolant hoses from the intake manifold collector
  - Swirl control vacuum lines to power valve and intake manifold collector upper
  - Fuel injector electrical connectors
  - PCV hose
  - Electric throttle control actuator electrical connector
  - EVAP canister purge hose
  - EGR temperature sensor electrical connector

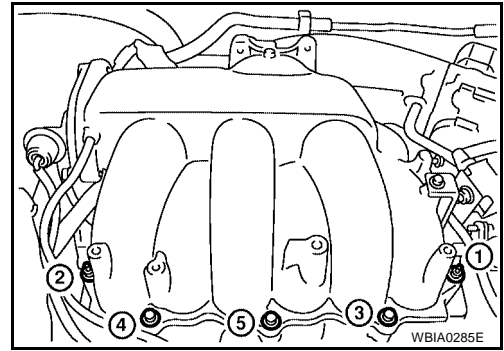
### CAUTION:

- Cover any engine openings to avoid the entry of any foreign material.
7. Remove the EGR tube (to lower intake manifold collector) nuts.
  8. Disconnect the power steering hose bracket from the rear of the intake manifold collector.
  9. Remove the EVAP canister purge volume solenoid valve bracket bolt. Position the valve aside.
  10. Remove the VIAS control solenoid valve bracket bolt. Position the valve aside.
  11. Remove the vacuum tank.
  12. Remove the intake manifold collector support bracket from the back of the intake manifold collector using power tool.



# INTAKE MANIFOLD COLLECTOR

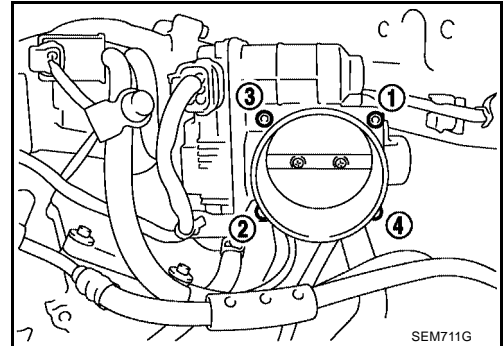
13. Loosen the intake manifold collector bolts in the order shown using power tool, and remove the intake manifold collector and gasket.



14. If necessary, remove the electric throttle control actuator bolts in the order shown and remove the electric throttle control actuator.

**CAUTION:**

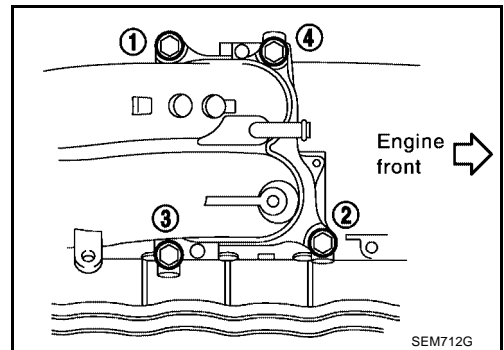
- Handle carefully to avoid any shock to the electric throttle control actuator.
- Do not disassemble.



15. If necessary, remove the intake manifold collector (upper) bolts in the order shown, using power tool and remove the intake manifold collector.

**CAUTION:**

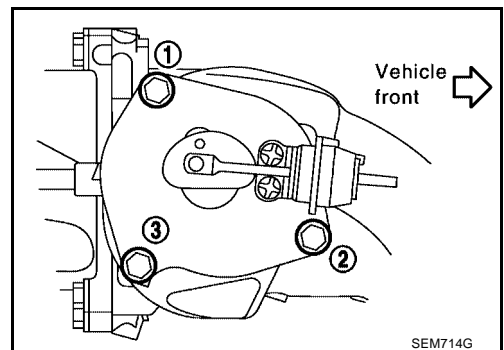
- Handle carefully to avoid any shock to the electric throttle control actuator, if installed.



16. If necessary, remove power valve bolts in the order shown and remove the power valve.

17. If necessary remove the following components:

- Vacuum tank
- VIAS control solenoid valve
- EVAP canister purge volume control solenoid valve



## INSTALLATION

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

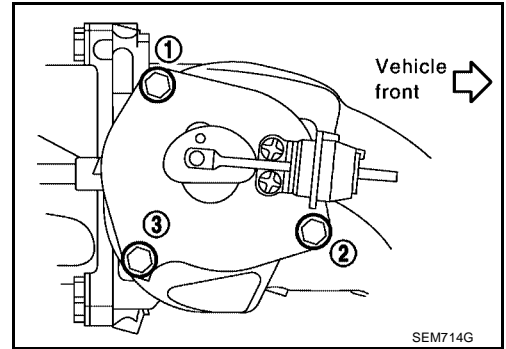
**NOTE:**

After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

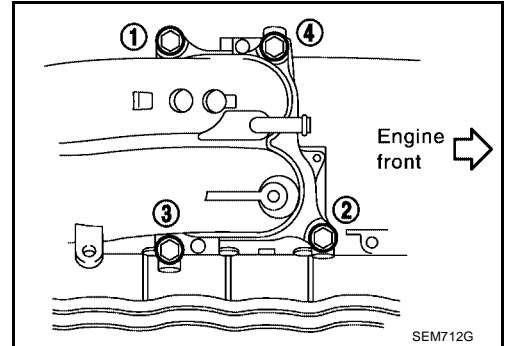
1. Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to [EC-90, "Throttle Valve Closed Position Learning"](#) .
2. Perform the "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to [EC-91, "Idle Air Volume Learning"](#) .

# INTAKE MANIFOLD COLLECTOR

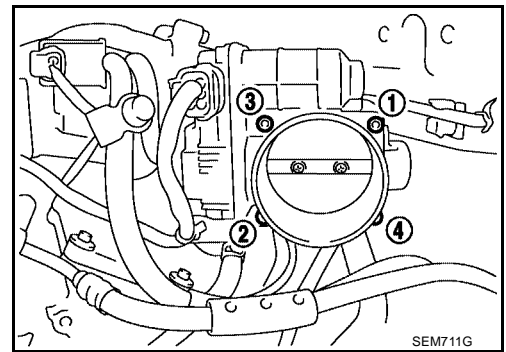
- If necessary, install power valve bolts in the order shown refer to [EM-18, "Removal and Installation"](#) .



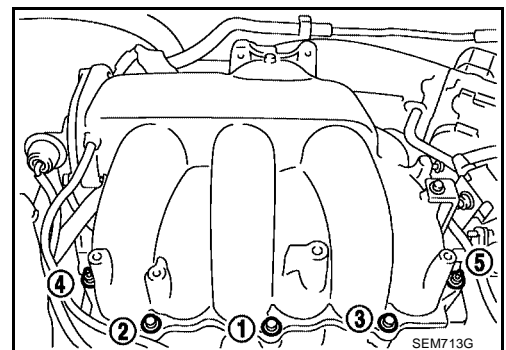
- If necessary, tighten the intake manifold collector pipe bolts in the order shown refer to [EM-18, "Removal and Installation"](#) .



- If necessary, install the electric throttle control actuator bolts in the order shown. Install gasket with three protrusions facing down refer to [EM-18, "Removal and Installation"](#) .



- Install the intake manifold collector bolts in the order shown refer to [EM-18, "Removal and Installation"](#) .



A  
EM  
C  
D  
E  
F  
G  
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I  
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L  
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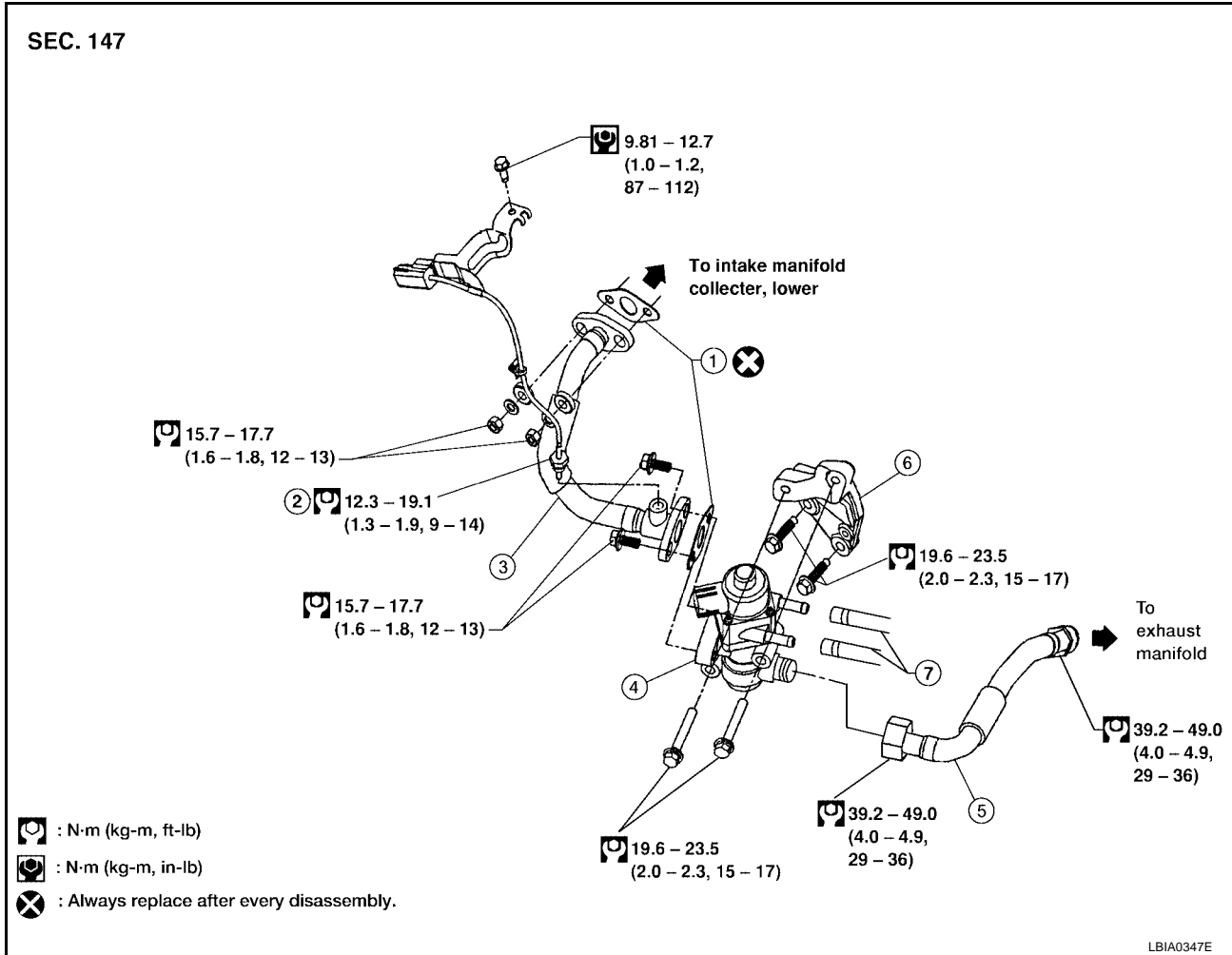
# EGR VOLUME CONTROL VALVE

## EGR VOLUME CONTROL VALVE

PF14710

### Removal and Installation

EBS00JA0



- |                             |                                   |  |
|-----------------------------|-----------------------------------|--|
| 1. Gasket                   | 2. EGR temperature sensor         | 3. EGR tube (to lower intake manifold collector) |
| 4. EGR volume control valve | 5. EGR tube (to exhaust manifold) | 6. EGR volume control valve bracket              |
| 7. Coolant lines            |                                   |  |

# EGR VOLUME CONTROL VALVE

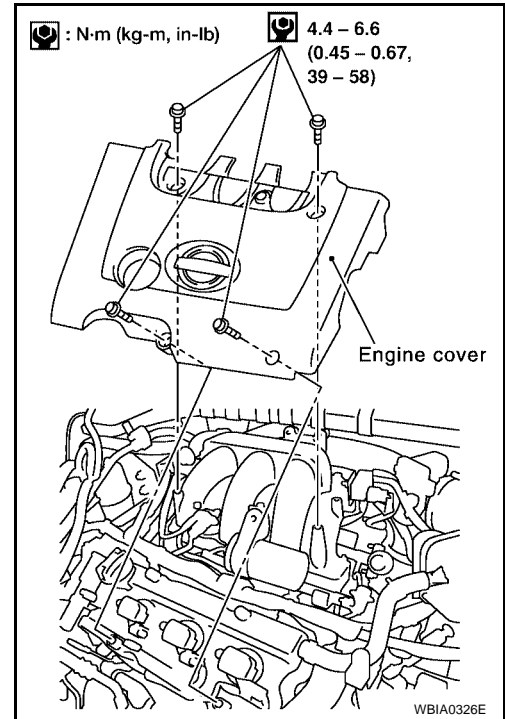
## REMOVAL

1. Remove the engine cover using power tool.
2. Remove air cleaner case lid and mass air flow sensor, and air intake tube as an assembly. Refer to [EM-16, "Removal and Installation"](#).
3. Partially drain the coolant when the engine is cool. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).

### CAUTION:

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

4. Disconnect the EGR temperature sensor electrical connector and bracket.
5. If necessary, remove the EGR temperature sensor.
6. Disconnect the EGR volume control valve electrical connector.
7. Remove the EGR tube (to intake manifold collector) bolts at the intake manifold collector.
8. Remove the EGR tube (to intake manifold collector) bolts at the EGR volume control valve and remove the tube.
9. Loosen the EGR tube (to exhaust manifold) to EGR volume control valve fitting.
10. If necessary remove the EGR tube (to exhaust manifold) as follows:
  - a. Remove the front cowl grille. Refer to [EI-19, "Removal and Installation"](#).
  - b. Remove the windshield wiper assembly. Refer to [WW-23, "Removal and Installation of Wiper Motor and Linkage"](#).
  - c. Remove the EGR tube (to exhaust manifold) to EGR volume control valve fitting.
  - d. Disconnect the air fuel ratio (A/F) sensor 1 (bank 1).
  - e. Remove the RH heat shield.
  - f. Remove the EGR tube (to exhaust manifold) to exhaust manifold fitting.
11. Disconnect the coolant lines at the EGR volume control valve.
12. Remove the EGR volume control valve bolts and the valve.



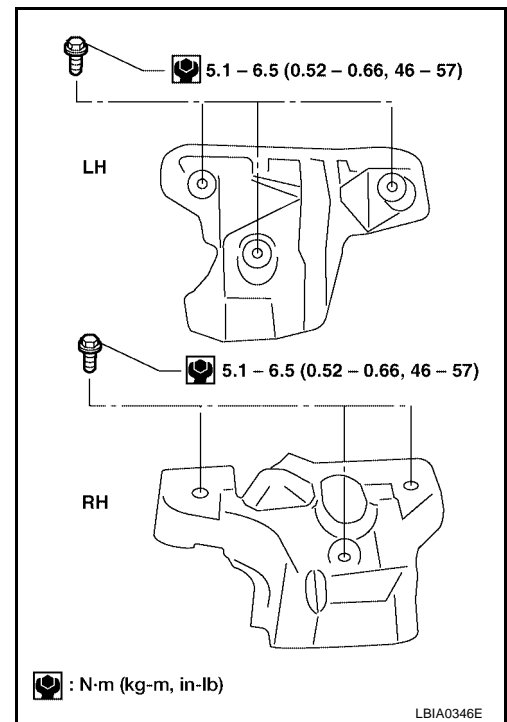
## INSTALLATION

Installation is in the reverse order of removal.

# EGR VOLUME CONTROL VALVE

- Install the RH heat shield bolts.

**RH heat shield bolts** : 5.1 - 6.5 N-m (0.52 - 0.66 kg-m, 46 - 57 in-lb)





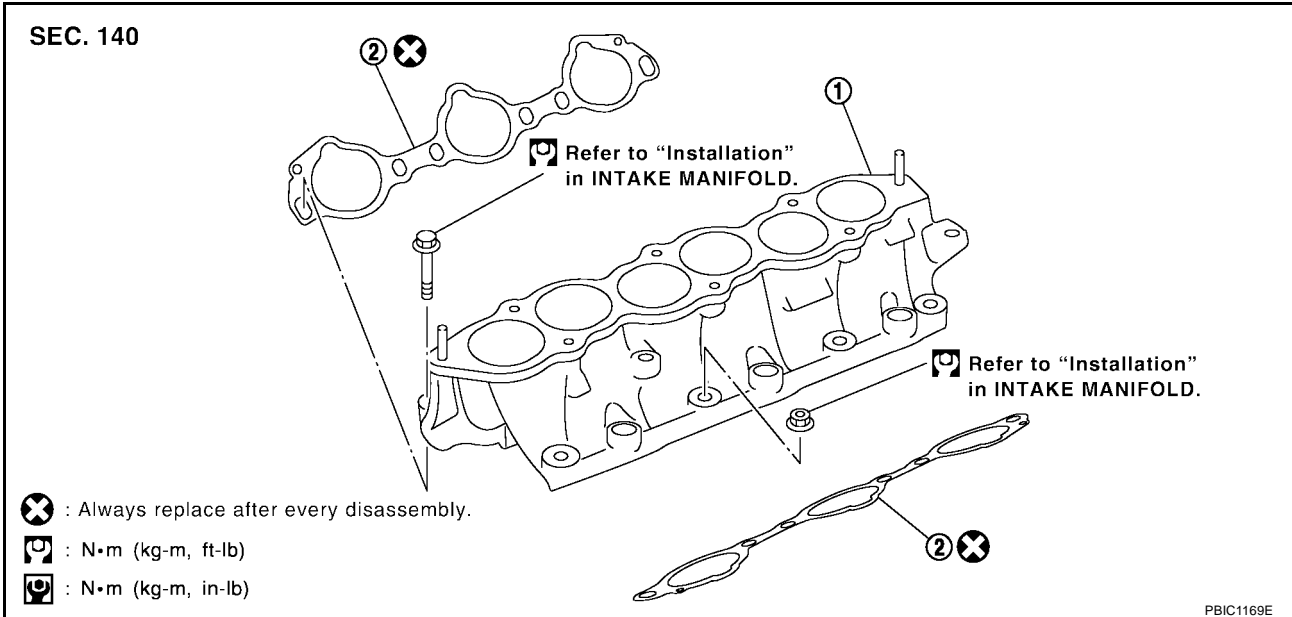
# INTAKE MANIFOLD

PFP:14003

EBS00JAP

## INTAKE MANIFOLD

### Removal and Installation

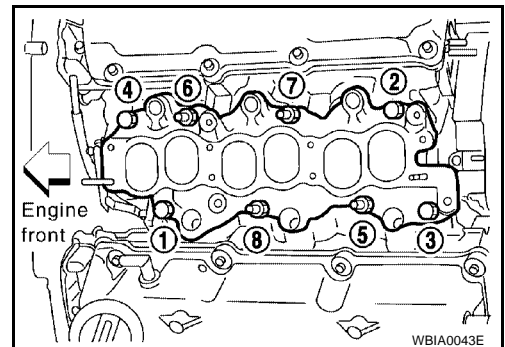


1. Intake manifold

2. Gasket

### REMOVAL

1. Release the fuel pressure. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#).
2. Remove the intake manifold collector. Refer to [EM-18, "Removal and Installation"](#).
3. Remove the fuel rail with the fuel injectors. Refer to [EM-40, "Removal and Installation"](#).
4. Loosen the intake manifold nuts and bolts in the order shown using power tool, and remove the intake manifold.



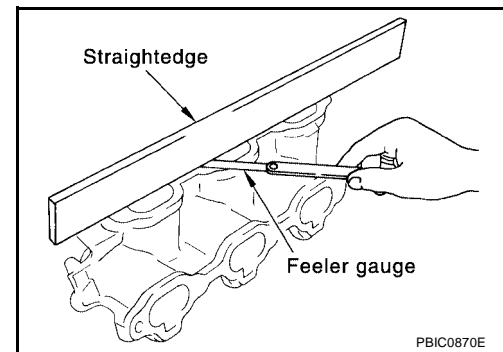
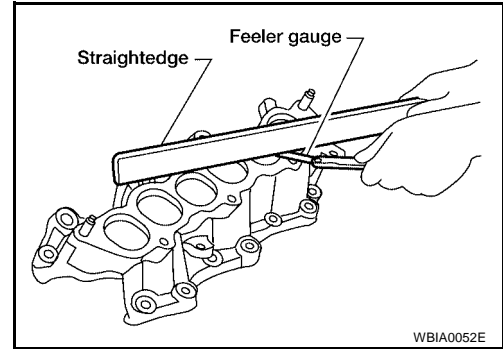
# INTAKE MANIFOLD

## INSPECTION AFTER REMOVAL

### Surface Distortion

Using straightedge and feeler gauge, inspect the surface distortion of both the intake manifold and the intake manifold collector.

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



## INSTALLATION

Installation is in the reverse order of removal.

- If necessary, install the stud bolts.

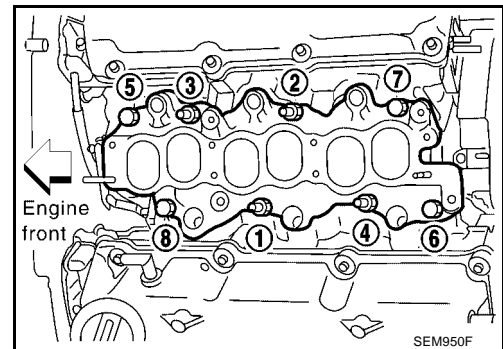
**Stud bolts : 9.8 - 11.8 N·m (1.0 - 1.2 kg·m, 87 - 104 in·lb)**

- Install intake manifold bolts in three steps in the order shown.

**Step 1 : 4.9 - 9.8 N·m (0.5 - 0.99 kg·m, 44 - 86 in·lb)**

**Step 2 : 26.5 - 31.4 N·m (2.7 - 3.2 kg·m, 20 - 23 ft·lb)**

**Step 3 : 26.5 - 31.4 N·m (2.7 - 3.2 kg·m, 20 - 23 ft·lb)**



# EXHAUST MANIFOLD AND THREE WAY CATALYST

## EXHAUST MANIFOLD AND THREE WAY CATALYST

### Removal and Installation

PF14004

EBS00JAQ

A

EM

C

D

E

F

G

Engine front

H

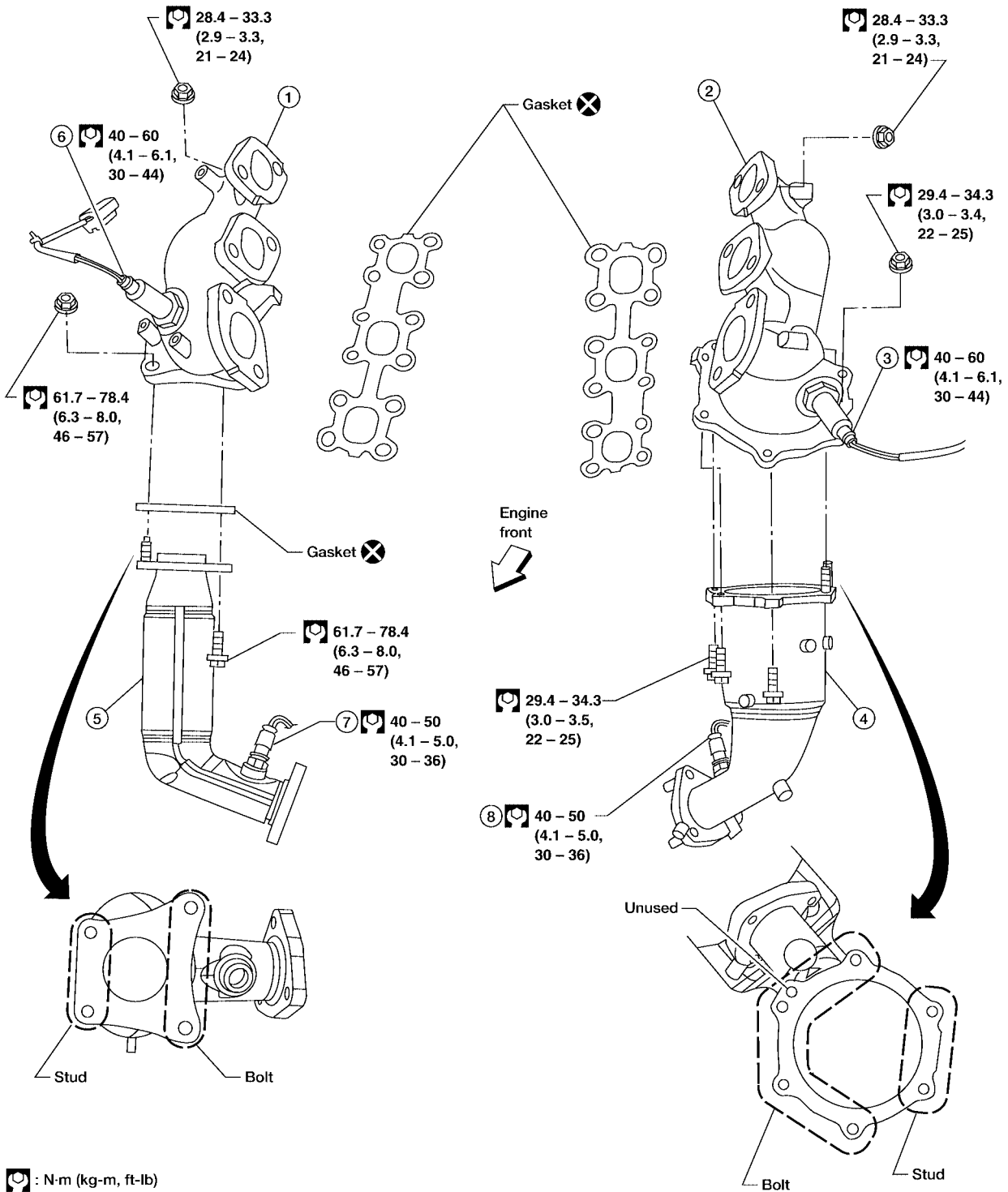
I

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WBIA0267E

- |  |  |   |
|--|--|---|
| 1. Exhaust manifold (RH bank)              | 2. Exhaust manifold (LH bank)              | 3. Air fuel ratio (A/F) sensor 1 (bank 2) |
| 4. Three way catalyst (manifold) (bank 2)  | 5. Three way catalyst (manifold) (bank 1)  | 6. Air fuel ratio (A/F) sensor 1 (bank 1) |
| 7. Heated oxygen sensor 2 (front) (bank 1) | 8. Heated oxygen sensor 2 (front) (bank 2) |   |

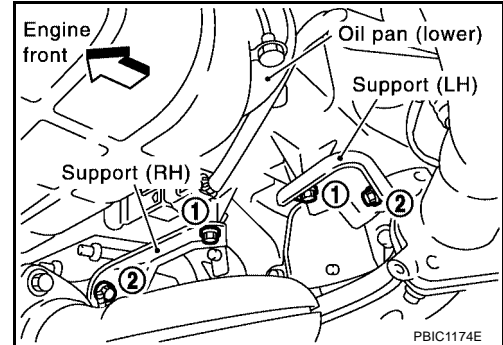
# EXHAUST MANIFOLD AND THREE WAY CATALYST

## REMOVAL

### WARNING:

- Perform the work when the exhaust and cooling system have completely cooled down.
- When removing the front and rear engine mounting through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to [EM-117, "REMOVAL"](#) .

1. Remove the front wheel and tires using power tool.
2. Remove the engine undercover.
3. Remove the inner wheel well splash shields.
4. Remove the radiator and cooling fan assembly. Refer to [CO-12, "REMOVAL"](#) .
5. Remove the front exhaust tube. Refer to [EX-3, "Removal and Installation"](#) .
6. Remove the front suspension member. Refer to [FSU-15, "Removal and Installation"](#) .
7. Remove the RH and LH three way catalyst support bolts in the order shown.

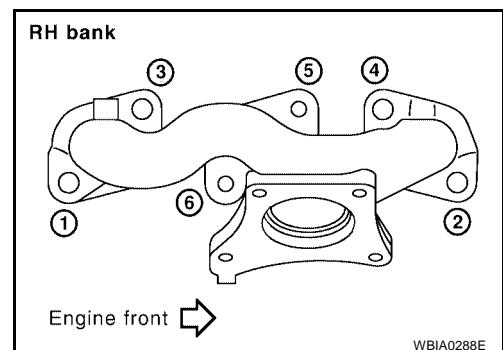


8. Remove heated oxygen sensor 2 (bank 1), heated oxygen sensor 2 (bank 2), air fuel ratio (A/F) sensor 1 (bank 1) and air fuel ratio (A/F) sensor 1 (bank 2).
  - a. Remove harness connector of each sensor, and disconnect the harness from the bracket and middle clamp.
  - b. Remove both heated oxygen sensors and air fuel ratio (A/F) sensors using Tool.

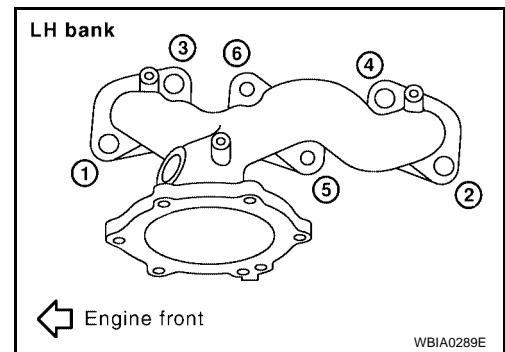
**Tool numbers** : KV10114400 (J-38365)  
: KV991J0050 (J-44626)

### CAUTION:

- Be careful not to damage heated oxygen sensors or air fuel ratio (A/F) sensors.
  - 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.
9. Remove exhaust manifold and three way catalyst heat shields with power tool.
  10. Remove the three way catalyst (manifold) (bank 1) and three way catalyst (manifold) (bank 2) by loosening the bolts first and then removing the nuts and through bolts.
  11. Remove the exhaust manifolds. Loosen the exhaust manifold nuts in the order shown.



# EXHAUST MANIFOLD AND THREE WAY CATALYST

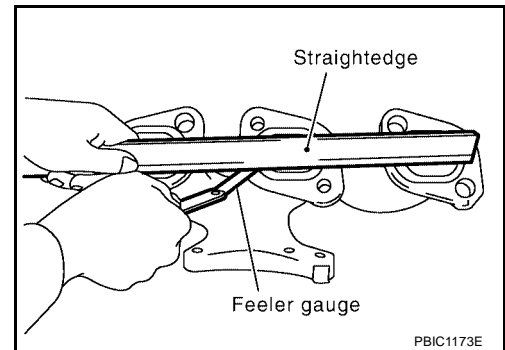


## INSPECTION AFTER REMOVAL

### 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)**



## INSTALLATION

Installation is in the reverse order of removal.

- Install the exhaust manifold nuts in the order shown.

**Exhaust manifold nuts : 28.4 - 33.3 N-m (2.9 - 3.3 kg-m, 21 - 24 lb-ft)**

### CAUTION:

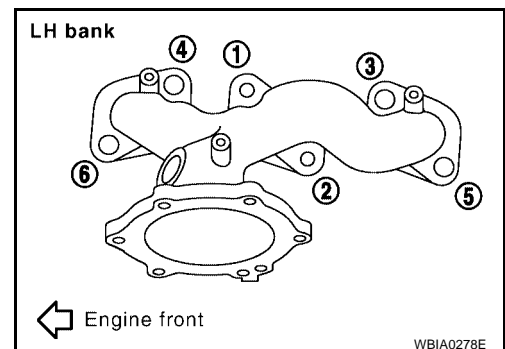
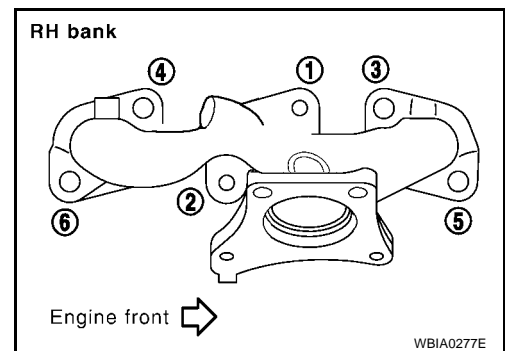
- When using the heated oxygen sensor wrench, tighten to the middle of specified torque range, because the length of the Tool may increase the actual tightness. Do not tighten to the maximum specified torque range.

**Tool numbers : KV10114400 (J-38365)  
: KV991J0050 (J-44626)**

- Before installing a heated oxygen sensor or air fuel ratio (A/F) sensor, clean the exhaust manifold threads using the oxygen sensor thread cleaner tool, and apply anti-seize lubricant.

**Tool numbers : J-43897-18  
: J-43897-12**

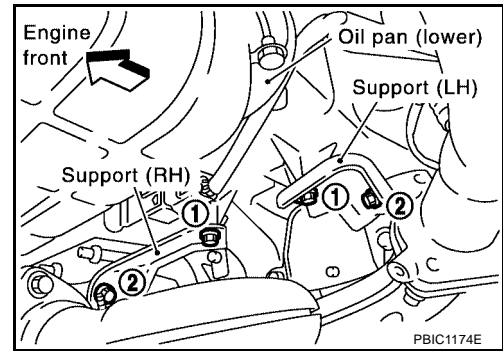
- Do not over-tighten the air fuel ratio (A/F) sensor or heated oxygen sensors. Doing so may cause damage.



# EXHAUST MANIFOLD AND THREE WAY CATALYST

- Install the RH and LH three way catalyst support bolts in the order shown.

**Three way catalyst support bolts** : 19 - 28 N·m (2.0 - 2.5 kg·m, 14 - 18 ft·lb)

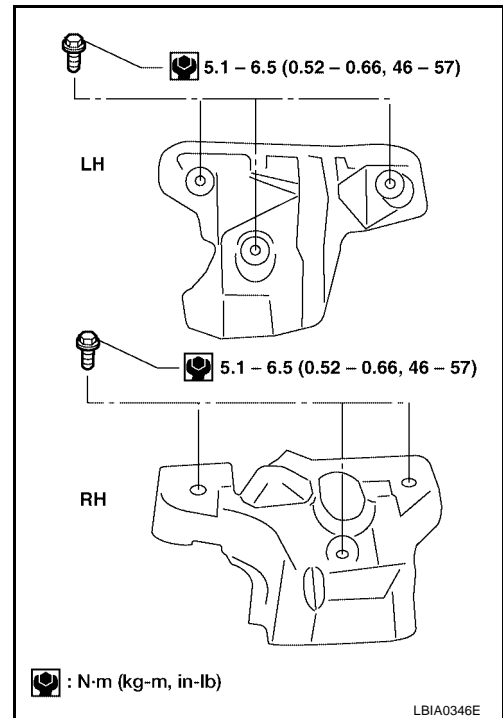


- Install the exhaust manifold heat shield bolts.

**Exhaust manifold heat shield bolts** : 5.1 - 6.5 N·m (0.52 - 0.66 kg·m, 46 - 57 in·lb)

- Install the three way catalyst heat shield bolts.

**Three way catalyst heat shield bolts** : 6.7 - 9.8 N·m (0.69 - 0.99 kg·m, 60 - 86 in·lb)



# OIL PAN AND OIL STRAINER

PF:11110

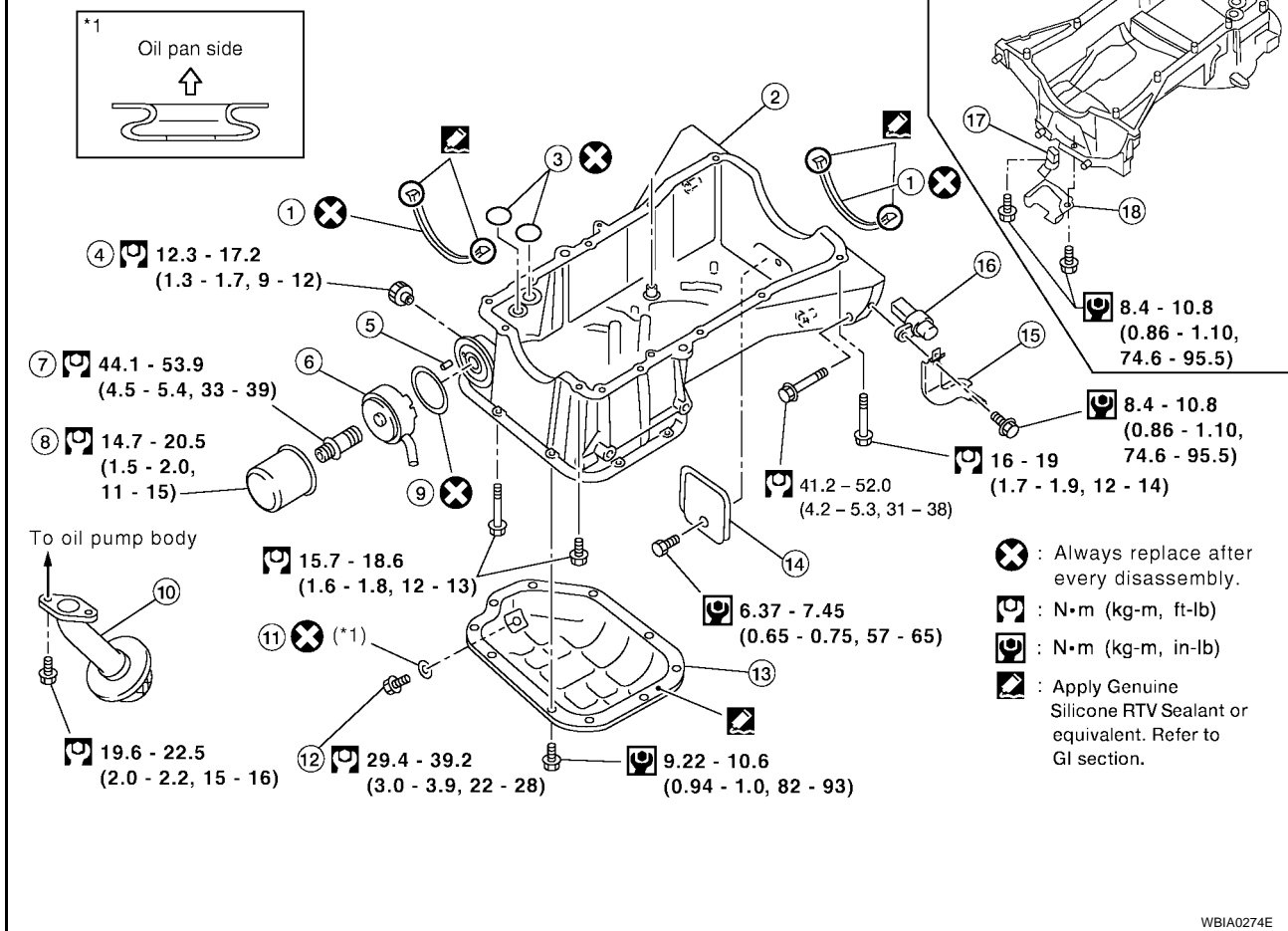
EBS00JAR

## OIL PAN AND OIL STRAINER

### Removal and Installation

SEC. 110•150•221•251

5 A/T



- |  |  |   |
|--|--|---|
| 1. Gasket  | 2. Upper oil pan                             | 3. O-ring   |
| 4. Oil pressure switch                             | 5. Relief valve                              | 6. Oil cooler                                       |
| 7. Oil cooler connection                           | 8. Oil filter                                | 9. Gasket   |
| 10. Oil strainer                                   | 11. Gasket                                   | 12. Drain plug                                      |
| 13. Lower oil pan                                  | 14. Rear plate cover                         | 15. Heated oxygen sensor (bank 2) harness clamp     |
| 16. Crankshaft position sensor (POS) (4 A/T & M/T) | 17. Crankshaft position sensor (POS) (5 A/T) | 18. Crankshaft position sensor (POS) (5 A/T) shield |

### REMOVAL

#### WARNING:

- You should not remove the oil pan until the exhaust system and cooling system have completely cooled off.
- When removing the front and rear engine mounting through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to step 37 in [EM-117, "REMOVAL"](#).

#### 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 the front RH wheel and tire using power tool. Refer to [WT-4, "WHEEL AND TIRE ASSEMBLY"](#).
- Disconnect the battery negative terminal.
- Remove the oil dipstick.
- Drain the engine coolant. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).

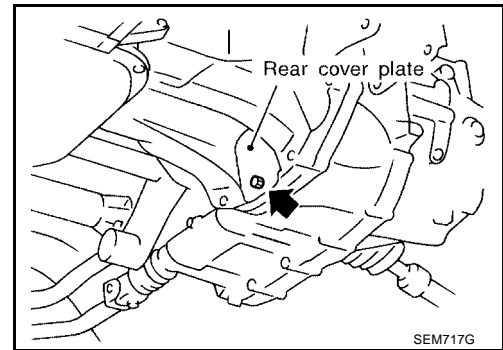
## OIL PAN AND OIL STRAINER

5. Remove the engine undercover.
6. Remove the RH inner fender splash shield.
7. Remove the A/C drive belt. Refer to [EM-15, "REMOVAL"](#) .
8. Remove the front exhaust tube. Refer to [EX-3, "Removal and Installation"](#) .
9. Remove coolant pipe bolts.
10. Remove the A/C compressor with piping attached, and position it out of the way securely with wire.

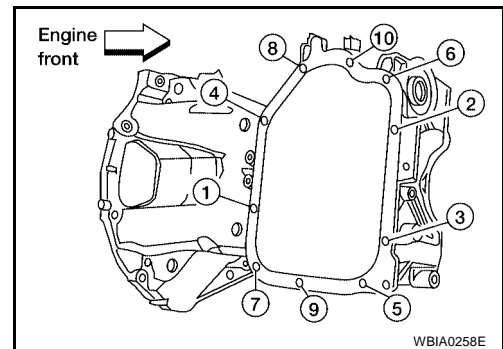
**CAUTION:**

**Do not pull on or crimp the A/C lines and hoses.**

11. Disconnect the coolant lines from the engine oil cooler and plug them to prevent coolant loss.
12. Remove the oil filter and engine oil cooler from the upper oil pan.
13. Remove the oil pressure switch, and the crankshaft position sensor (POS) from the upper oil pan.
14. Remove the front drive shafts. Refer to [FAX-11, "Removal and Installation"](#) .
15. Remove the front suspension member. Refer to [FSU-15, "Removal and Installation"](#) .
16. Disconnect the heated oxygen sensors and air flow ratio (A/F) sensors and remove the two catalytic converters from the exhaust manifolds using power tool. Refer to [EX-3, "Removal and Installation"](#) .
17. Remove the rear plate cover from the upper oil pan.



18. Loosen the lower oil pan bolts using power tool in order shown.

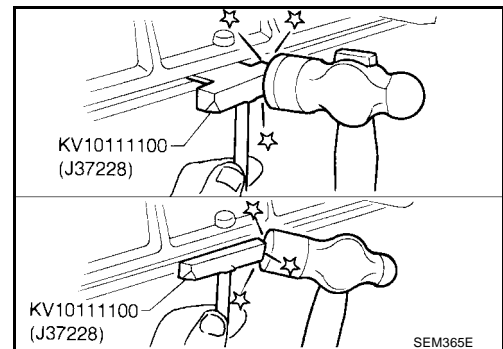


19. Remove the lower oil pan.
  - a. Insert Tool between the lower oil pan and the upper oil pan.

**Tool number : KV10111100 (J37228)**

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

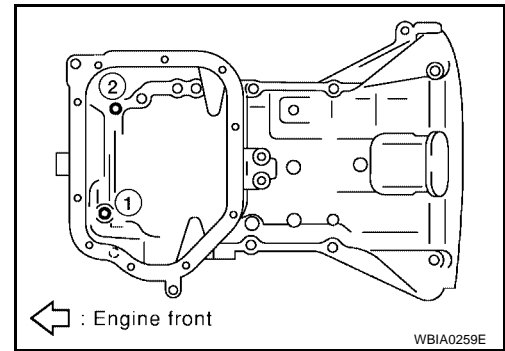
- b. Slide the Tool by tapping its side with a hammer to remove the lower oil pan from the upper oil pan.



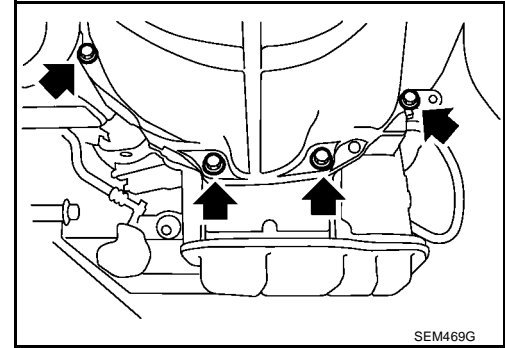


# OIL PAN AND OIL STRAINER

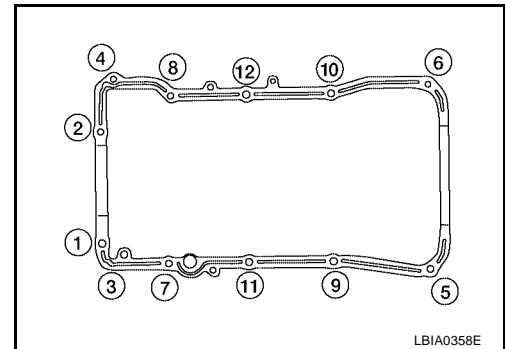
20. Loosen upper oil pan front bolts in the order shown.



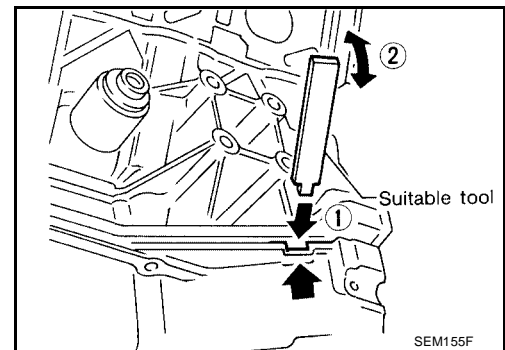
21. Remove the four upper oil pan to transaxle bolts.



22. Loosen the bolts in the order shown, using power tool.



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

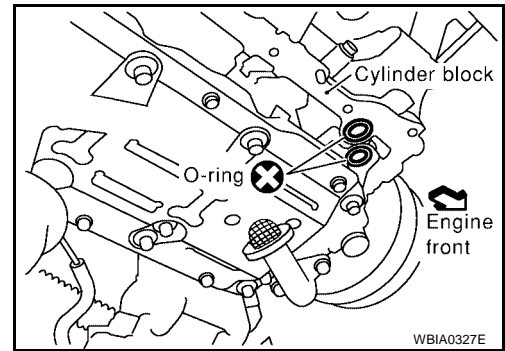


23. Remove the upper oil pan.

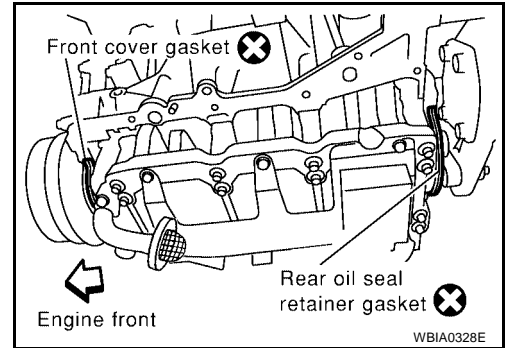
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# OIL PAN AND OIL STRAINER

24. Remove the O-ring seals from the bottom of the cylinder block and oil pump housing, use new O-rings for installation.



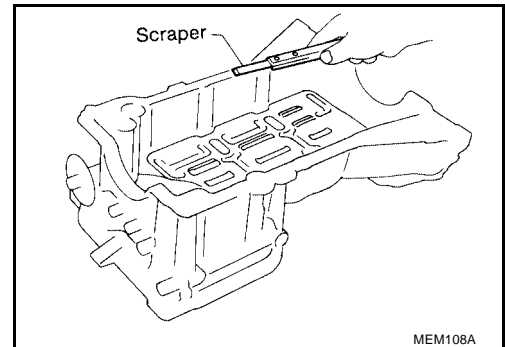
25. Remove front cover gasket and rear oil seal retainer gasket.  
26. Remove the oil strainer.



27. If re-installing the original oil pan, remove the old sealant from the mating surfaces using a scraper.
- Also remove the old sealant from mating surface of the cylinder block.
  - Remove the old sealant from the bolt holes and threads.

**CAUTION:**

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



## INSPECTION AFTER REMOVAL

Clean oil strainer if any object is attached.

## INSTALLATION

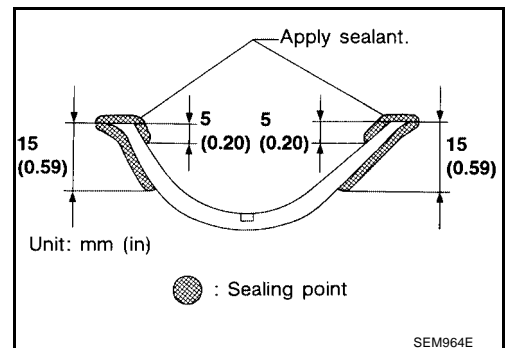
**CAUTION:**

**Wait at least 30 minutes before refilling the engine with oil.**

1. Install oil strainer.

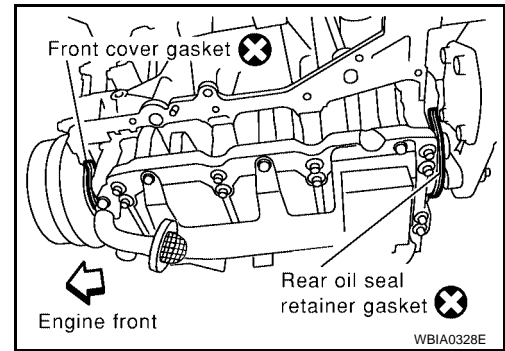
**Oil strainer bolts : 19.6 - 22.5 N·m (2.0 - 2.2 kg·m, 15 - 16 ft·lb)**

2. Apply Genuine Silicone RTV Sealant or equivalent, to the front cover gasket and the rear oil seal retainer gasket as shown. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



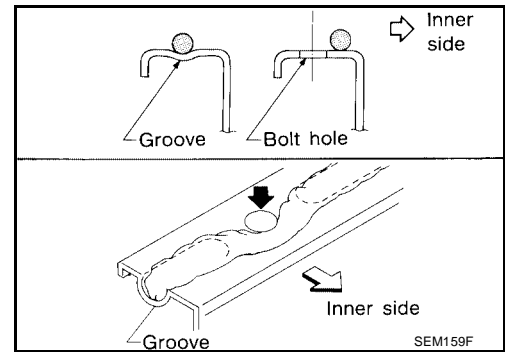
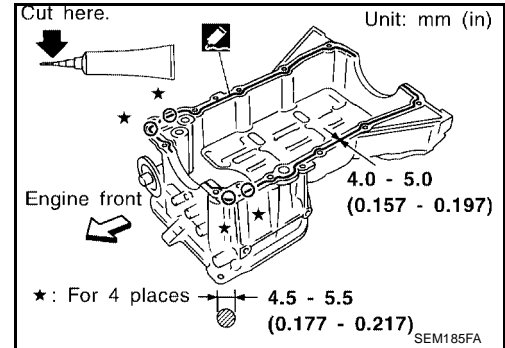
# OIL PAN AND OIL STRAINER

3. Install the front cover gasket and rear oil seal retainer gasket as shown.

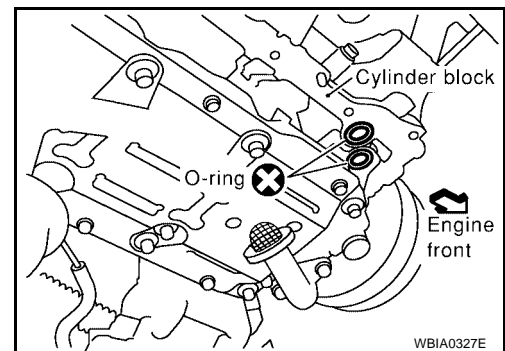


4. Apply a bead of sealant to the cylinder block mating surface of the upper oil pan to a limited portion as shown.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
- Be sure the sealant is applied to a limited portion as shown, and the sealant is 4.0 - 5.0 mm (0.157 - 0.197 in) or 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
- Attaching should be done within 5 minutes after coating.

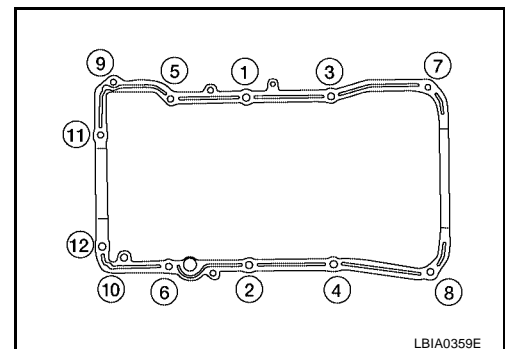


5. Install new O-rings on the cylinder block and oil pump body.



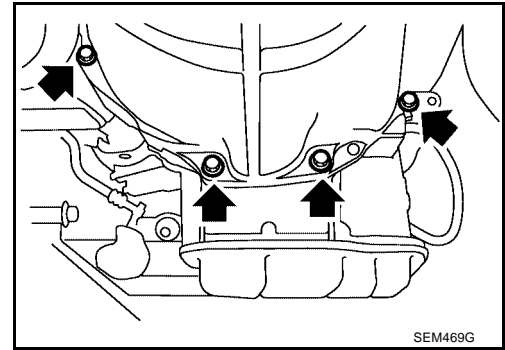
6. Install the upper oil pan.

- Tighten upper oil pan bolts in the order shown refer to [EM-31, "Removal and Installation"](#).
- Wait at least 30 minutes before refilling the engine with oil.

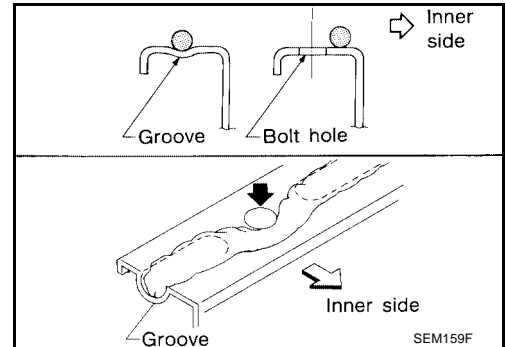


## OIL PAN AND OIL STRAINER

7. Install the four upper oil pan to transaxle bolts. Refer to [EM-120, "INSTALLATION"](#).



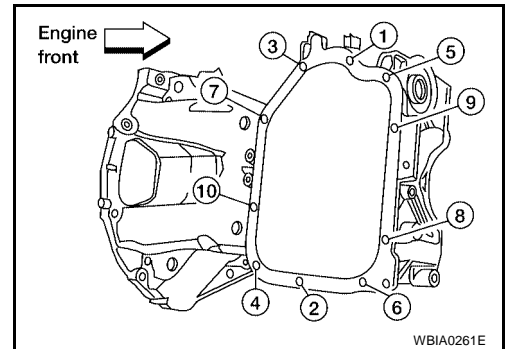
8. Apply a continuous bead of sealant to the lower oil pan.
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
  - Be sure the sealant is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
  - Installation must be done within 5 minutes after applying sealant.



9. Install the lower oil pan. Tighten the lower oil pan bolts in order shown.

**Lower oil pan bolts : 9.22 - 10.6 N-m (0.94 - 1.00 kg-m, 82 - 93 in-lb)**

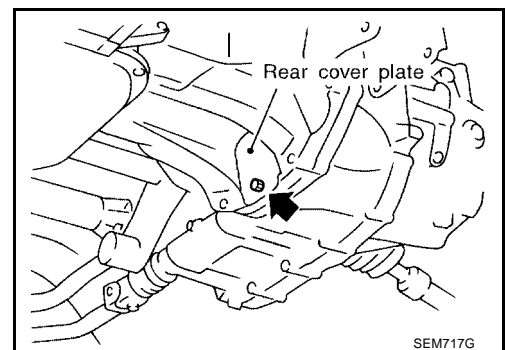
- Wait at least 30 minutes before refilling the engine with oil.



10. Install rear plate cover.

**Rear plate cover bolt : 6.37 - 7.45 N-m (0.65 - 0.75 kg-m, 57 - 65 in-lb)**

11. Installation of the remaining components is in the reverse order of removal.



### INSPECTION AFTER INSTALLATION

- Start the engine and check for leaks. Refer to [MA-16, "Changing Engine Oil"](#).
- Inspect the engine oil level. Refer to [MA-16, "Changing Engine Oil"](#).

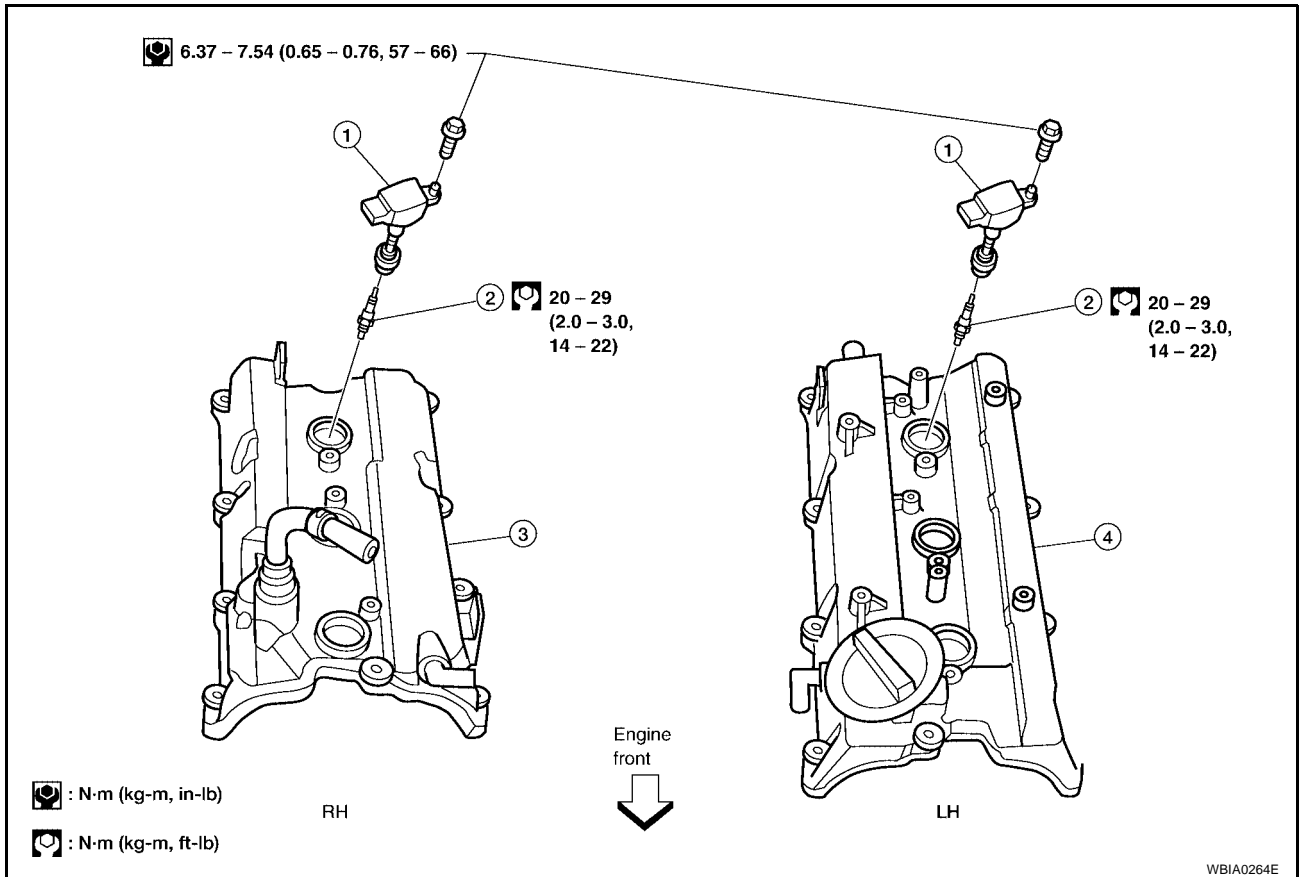
# IGNITION COIL

PF22448

EBS00JAS

## IGNITION COIL

### Removal and Installation



1. Ignition coil
2. Spark plug
3. Rocker cover (right bank)
4. Rocker cover (left bank)

### REMOVAL

1. Remove the engine cover using power tool.
2. Drain engine coolant. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).
3. Disconnect the mass air flow sensor electrical connector and remove the air cleaner assembly and air intake tubes. Refer to [EM-16, "Removal and Installation"](#).
4. Remove the intake manifold collector, gasket, and electric throttle control actuator. Refer to [EM-18, "Removal and Installation"](#).
5. Remove the six ignition coils.

#### CAUTION:

Do not shock it.

### INSTALLATION

Installation is in the reverse order of removal.

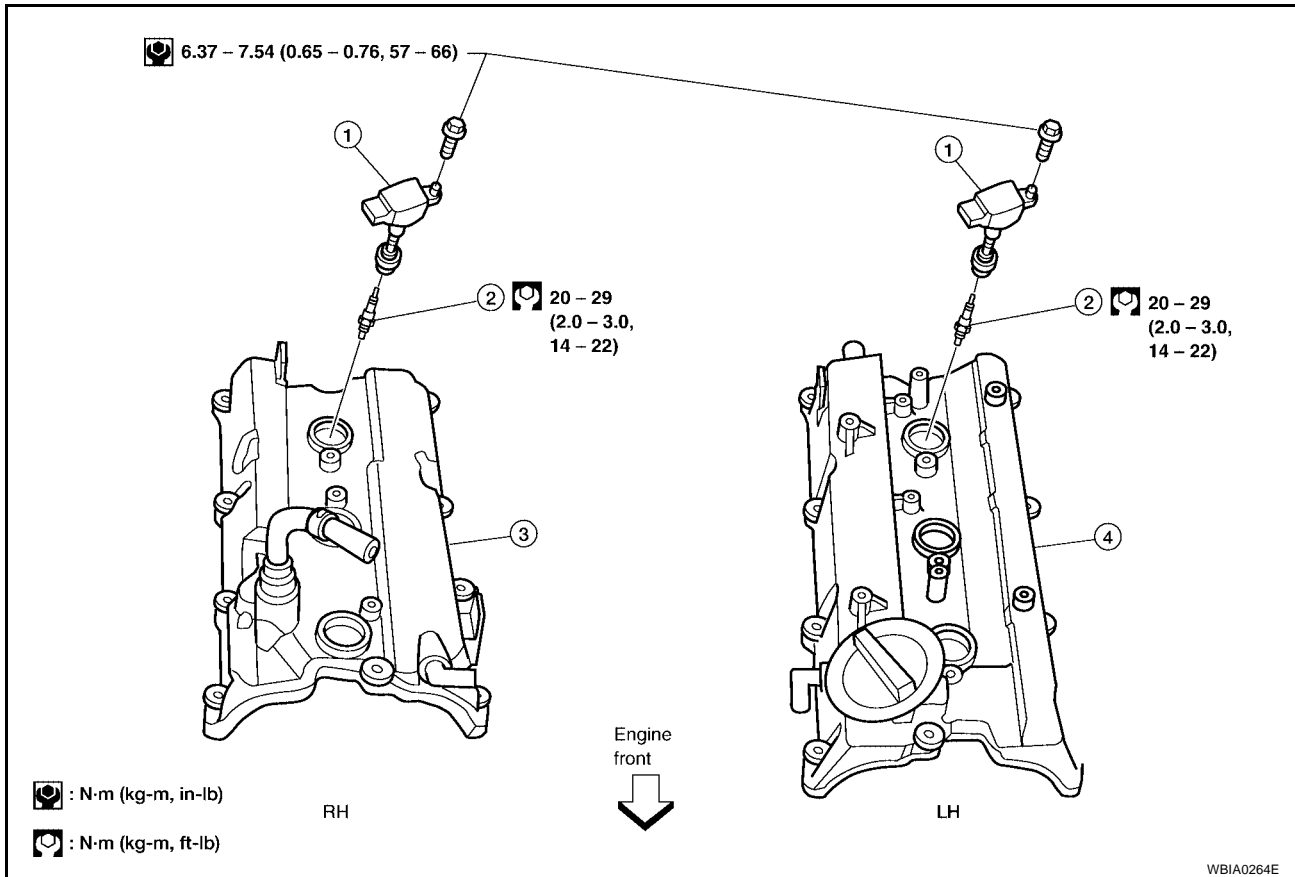
# SPARK PLUG (PLATINUM-TIPPED TYPE)

## SPARK PLUG (PLATINUM-TIPPED TYPE)

PF22401

### Removal and Installation

EBS00JAT



1. Ignition coil
2. Spark plug
3. Rocker cover (right bank)
4. Rocker cover (left bank)

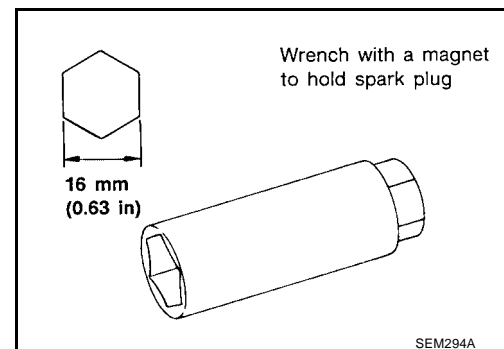
### REMOVAL

1. Remove the engine cover, using power tool.
2. Drain engine coolant. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).
3. Disconnect the mass air flow sensor electrical connector and remove the air cleaner assembly and air intake tubes. Refer to [EM-16, "Removal and Installation"](#).
4. Remove the intake manifold collector, gasket, and electric throttle control actuator. Refer to [EM-18, "Removal and Installation"](#).
5. Remove the six ignition coils.

#### CAUTION:

**Do not shock it.**

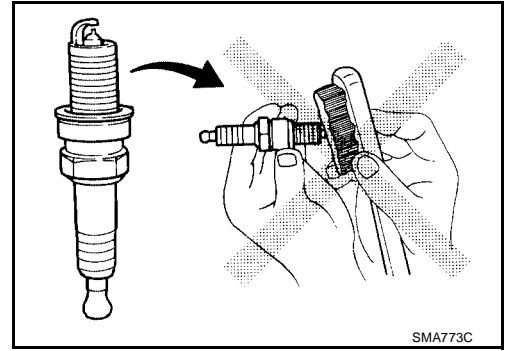
6. Remove the six spark plugs using a suitable tool.
  - If replacing the spark plugs use the correct spark plug for maximum performance. Refer to [MA-18, "Changing Spark Plugs \(Platinum - Tipped Type\)"](#).



# SPARK PLUG (PLATINUM-TIPPED TYPE)

## INSPECTION AFTER REMOVAL

Do not use a wire brush for cleaning.

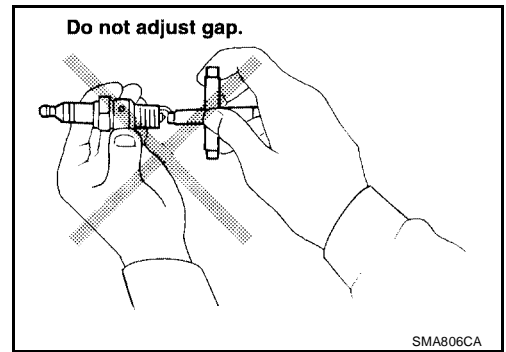


**Cleaner air pressure** : less than 588 kPa (6 kg/cm<sup>2</sup> , 85 psi)  
**Cleaning time** : less than 20 seconds

If plug tip is covered with carbon, a spark plug cleaner may be used.

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

**Gap (nominal)** : 1.1 mm (0.043 in)



## INSTALLATION

Installation is in the reverse order of removal.

Use standard type spark plug for normal driving conditions. Refer to [EM-151, "SPARK PLUG"](#).

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 engine spark knock occurs with the standard type spark plug under conditions such as:

- Extended highway driving
- Frequent high engine revolution

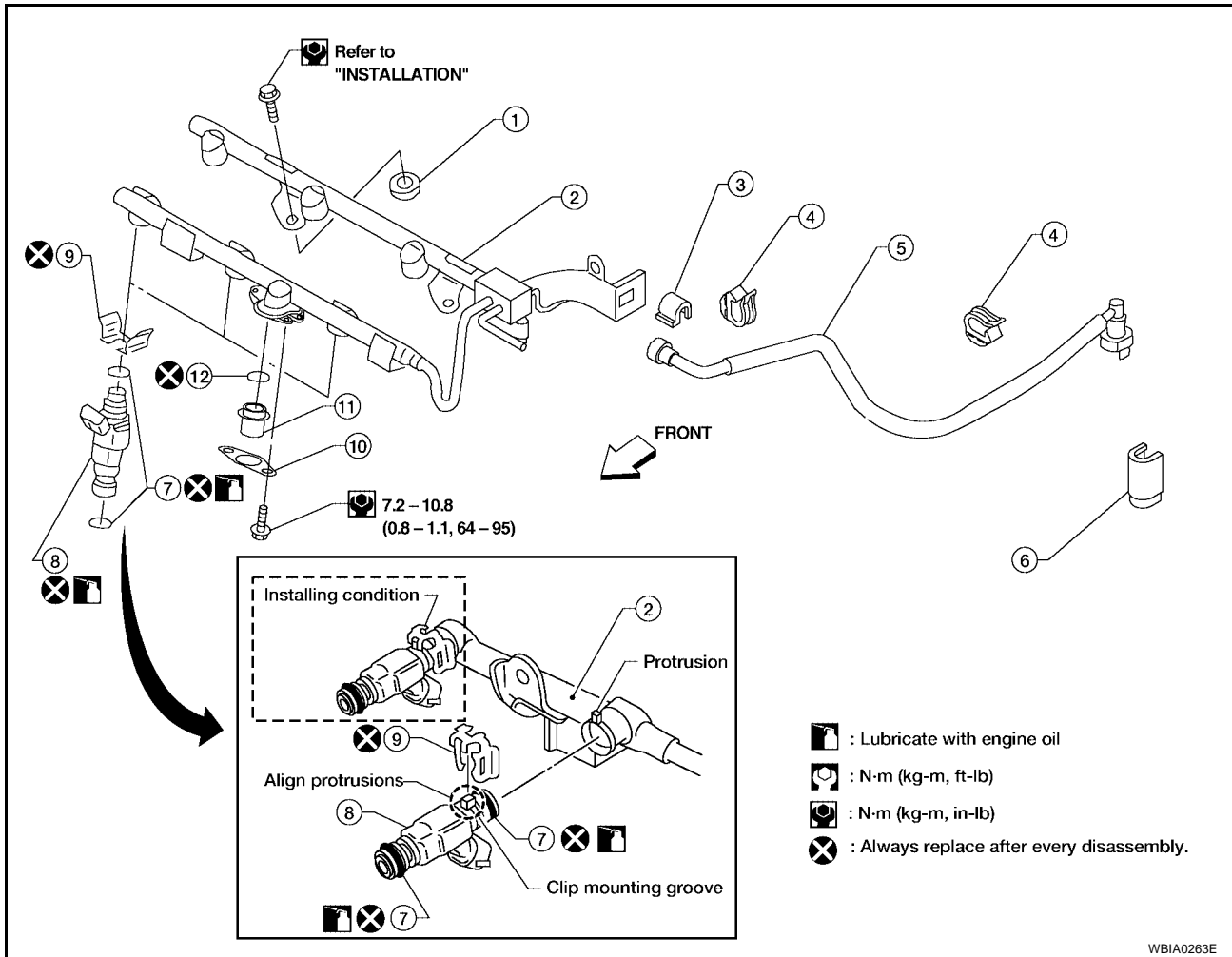
# FUEL INJECTOR AND FUEL TUBE

PF16600

## FUEL INJECTOR AND FUEL TUBE

### Removal and Installation

EBS00JAU



WBIA0263E

- |                 |                          |                  |
|-----------------|--------------------------|------------------|
| 1. Insulator    | 2. Fuel tube assembly    | 3. Connector cap |
| 4. Clip         | 5. Fuel hose             | 6. Connector cap |
| 7. O-ring       | 8. Fuel injector         | 9. Clip          |
| 10. Fuel damper | 11. Fuel damper retainer | 12. O-ring       |

#### CAUTION:

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

#### REMOVAL

1. Remove the intake manifold collector. Refer to [EM-18. "Removal and Installation"](#).
2. To remove the quick connector cap, hold the sides of the connector, push in the tabs and pull out the tube.

#### NOTE:

If the connector and the tube are stuck together, push and pull several times until they start to move. Then disconnect them by pulling.

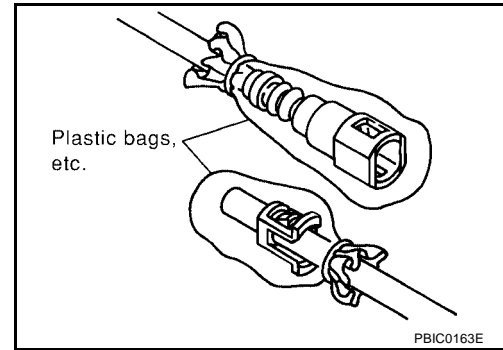
#### CAUTION:

- The tube can be removed when the tabs are completely depressed. Do not twist it more than necessary.
- Do not use any tools to remove the quick connector.
- Keep the resin tube away from heat. Be especially careful when welding near the tube.
- Prevent acid liquids such as battery electrolyte, etc. from getting on the resin tube.
- Do not bend or twist the tube during removal or installation.
- Do not remove the remaining retainer on the tube.



# FUEL INJECTOR AND FUEL TUBE

- When the tube is replaced, also replace the retainer with a new one.
  - To keep the connecting portion clean and to avoid damage and foreign materials entering, cover the ends of the fuel tubes with plastic bags or something similar.
3. Remove the fuel rail with the fuel injectors attached, from the intake manifold. Remove the fuel injector O-rings and use new O-rings for installation.
  4. If necessary, remove fuel damper bolts and the fuel dampers. Remove fuel damper O-rings and use new O-rings for installation.



## INSTALLATION

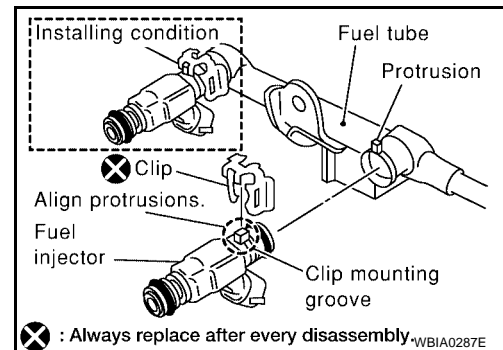
1. If necessary, Install fuel damper bolts. Use new O-rings for installation.

**Fuel damper bolts : 7.2 - 10.8 (0.8 - 1.1 kg-m, 64 - 95 in-lb)**

2. Install the fuel rails with fuel injectors attached.

### NOTE:

- Carefully install new O-rings.
- Lubricate O-rings by lightly coating with new engine oil.
- Be careful not to damage the O-rings and surfaces for O-ring sealing surfaces. Do not expand or twist O-rings.
- Discard old clips; replace with new ones.
- Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.
- Position clips in grooves on the fuel injectors.
- Align the protrusions of the fuel tube assembly with those of the fuel injectors.
- After properly inserting the fuel injectors onto the fuel tube assembly, check that the fuel tube protrusions are engaged with those of fuel injectors, and the flanges of the fuel tube assembly are fully engaged with the clips.



3. Tighten fuel tube assembly bolts in the order shown, in two steps:

### Fuel tube assembly bolts

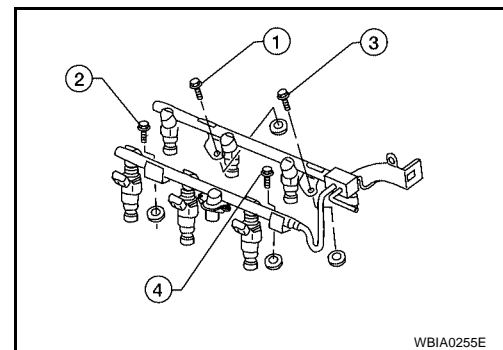
**Step 1 : 9.3 - 10.8 N-m (0.95 - 1.1 kg-m, 6.2 - 7.9 ft-lb)**

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

### CAUTION:

- After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leakage.

4. Install the quick connector as follows:
  - a. Make sure no foreign substances are deposited in and around the fuel tube and quick connector and that there is no damage.
  - b. Align the center to insert the quick connector straight onto the fuel tube.
  - c. Insert the fuel tube until a click is heard.
5. Installation of the remaining components is in the reverse of removal.



## INSPECTION AFTER INSTALLATION

Make sure there is no fuel leakage at connections as follows:

1. Apply fuel pressure to fuel lines by turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
2. Start the engine and rev it up and check for fuel leaks at connections.

## FUEL INJECTOR AND FUEL TUBE

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**NOTE:**

Use mirrors for checking on connections out of the direct line of sight.

**CAUTION:**

**Do not touch engine immediately after stopping as engine is extremely hot.**

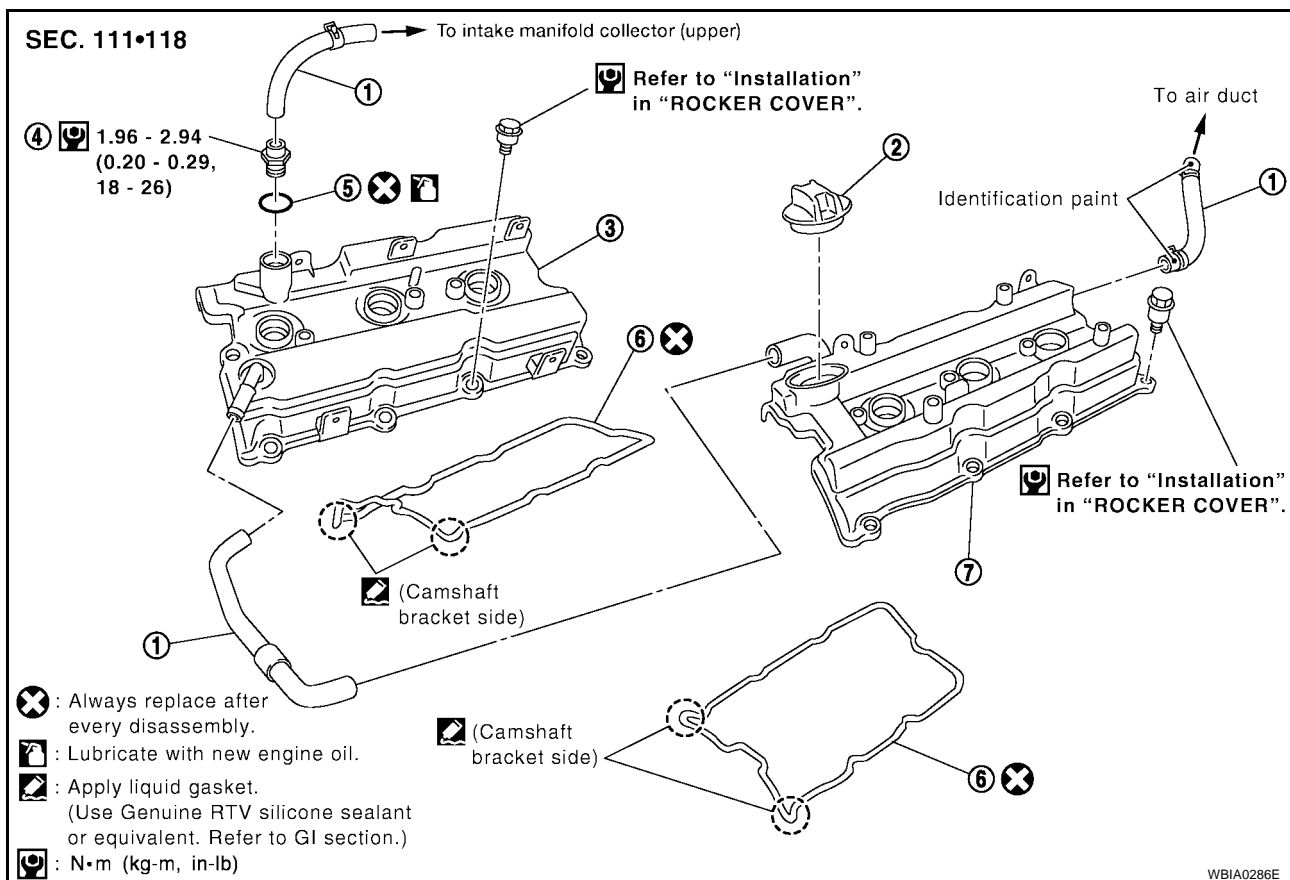
# ROCKER COVER

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## ROCKER COVER

### Removal and Installation



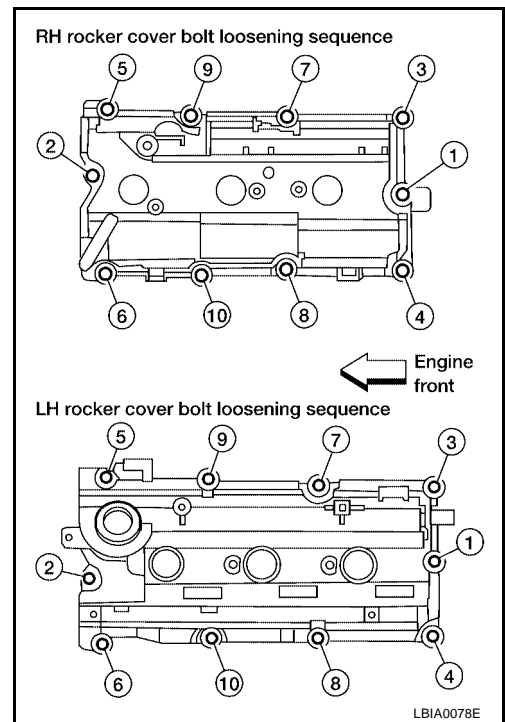
- |                      |                   |                        |
|----------------------|-------------------|------------------------|
| 1. PCV hose          | 2. Oil filler cap | 3. Rocker cover (RH)   |
| 4. PCV valve         | 5. O-ring         | 6. Rocker cover gasket |
| 7. Rocker cover (LH)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

### REMOVAL

- Remove the engine cover using power tool. Remove side engine covers.
- If removing RH rocker cover, disconnect the mass air flow sensor electrical connector and remove the air cleaner to electric throttle control actuator tube and air cleaner lid. Refer to [EM-16, "Removal and Installation"](#).
- If removing RH rocker cover, remove the front cowl panel. Refer to [EI-19, "Removal and Installation"](#).
- If removing RH rocker cover, remove the windshield wiper arms and motor assembly. Refer to [WW-23, "Removal and Installation of Wiper Motor and Linkage"](#).
- If removing RH rocker cover, remove the intake manifold collector. Refer to [EM-18, "Removal and Installation"](#).
- If removing LH rocker cover, disconnect the air fuel (A/F) ratio sensor.
- Remove the ignition coils. Refer to [EM-37, "Removal and Installation"](#).
- Position engine harness aside.
- Disconnect PCV hose.
- Remove dipstick.

# ROCKER COVER

11. Remove rocker covers bolts in the order shown.



## INSTALLATION

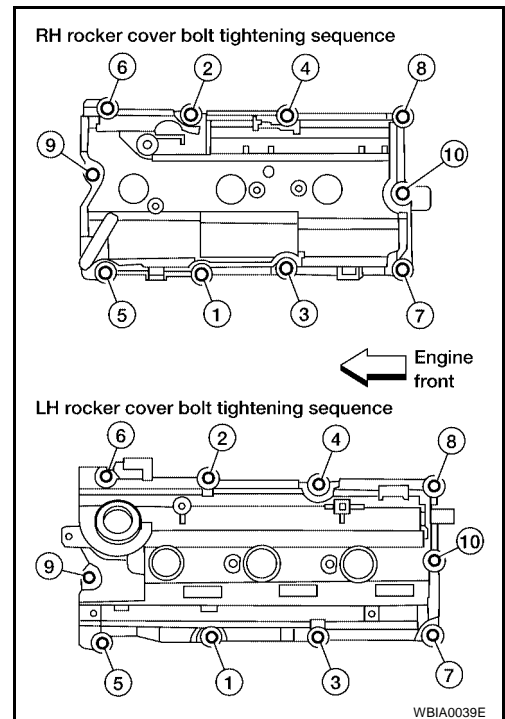
Installation is in the reverse order of removal.

- Apply sealant to the areas on the front corners. Refer to [EM-117, "Removal and Installation"](#).
- Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
- Tighten the rocker cover bolts in two steps in the order shown.

### Rocker cover bolts

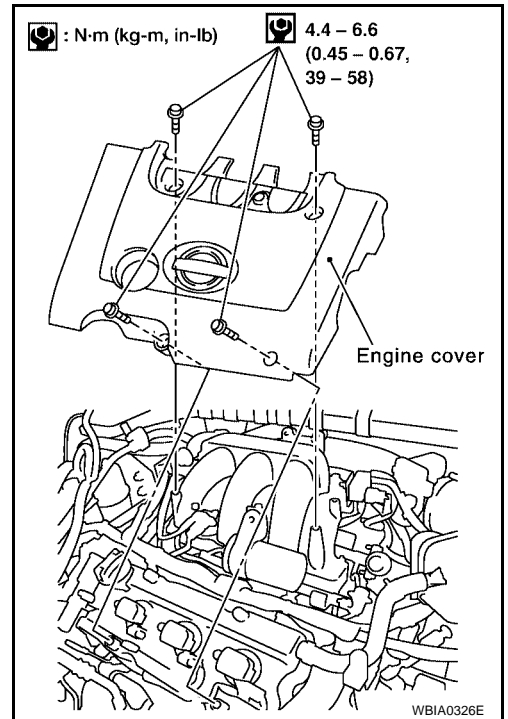
**Step 1** : 0.96 - 2.96 N·m (0.10 - 0.30 kg·m, 9 - 26 in·lb)

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



# ROCKER COVER

- Install engine cover.



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# FRONT TIMING CHAIN CASE

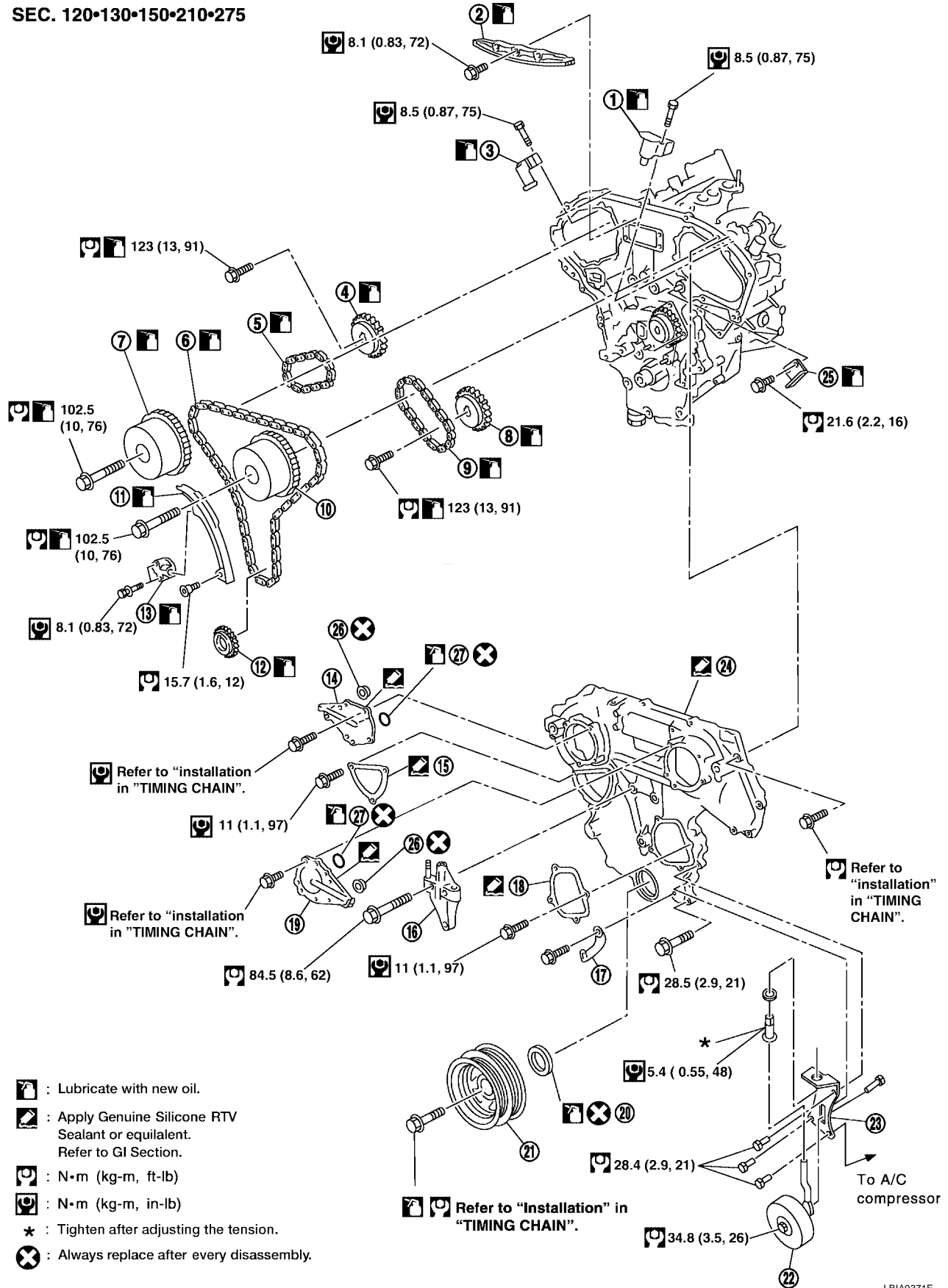
FPF:13599

EBS00JAW

## FRONT TIMING CHAIN CASE

### Removal and Installation

SEC. 120•130•150•210•275



- : Lubricate with new oil.
- : Apply Genuine Silicone RTV Sealant or equivalent. Refer to GI Section.
- : N•m (kg-m, ft-lb)
- : N•m (kg-m, in-lb)
- \* : Tighten after adjusting the tension.
- : Always replace after every disassembly.

LBIA0371E

# FRONT TIMING CHAIN CASE

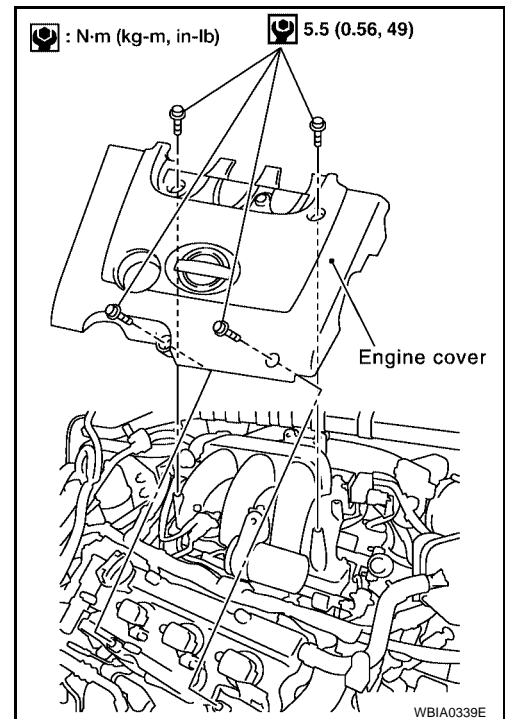
- |                                       |                                     |                                       |
|---------------------------------------|-------------------------------------|---------------------------------------|
| 1. Timing chain tensioner (secondary) | 2. Internal chain 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. IVT control valve cover - right | 15. Chain tensioner cover             |
| 16. RH engine mounting bracket        | 17. Water hose clamp                | 18. Water pump cover                  |
| 19. IVT control valve cover - left    | 20. Front oil seal                  | 21. Crankshaft pulley                 |
| 22. Idler pulley                      | 23. Idler pulley bracket            | 24. Front timing chain case           |
| 25. Timing tension guide              | 26. Collared O-ring                 | 27. Seal ring                         |

## NOTE:

- This section describes procedures for removal/installation procedure of the front timing chain case and timing chain related parts without removing the oil pan (upper) from the vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in reverse order of removal. Refer to [EM-58, "TIMING CHAIN"](#).
- Refer to [EM-58, "TIMING CHAIN"](#) for component parts location.

## REMOVAL

1. Release the fuel pressure. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#).
2. Disconnect the battery negative terminal.
3. Drain the engine cooling system. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).
4. Drain engine oil. Refer to [MA-16, "Changing Engine Oil"](#).
5. Remove engine cover using power tool. Remove side engine covers.
6. Remove the intake air duct with the air cleaner case lid and mass air flow sensor. Refer to [EM-16, "REMOVAL"](#).
7. Remove the engine coolant reservoir. Refer to [CO-12, "RADIATOR"](#).



## FRONT TIMING CHAIN CASE

8. Disconnect the fuel rail quick connector at the vehicle piping side. Refer to [EM-40, "REMOVAL"](#) .
9. Remove the cowl top. Refer to [EI-19, "Removal and Installation"](#) .
10. Remove the windshield wiper assembly. Refer to [WW-23, "REMOVAL"](#) .
11. Remove the IPDM E/R and position aside. Remove the bracket.
12. Remove the front RH wheel and tire using power tool. Refer to [WT-4, "WHEEL AND TIRE ASSEMBLY"](#) .
13. Remove the engine undercover.
14. Remove the RH inner fender splash shield.
15. Remove the drive belts and idler pulley. Refer to [EM-15, "REMOVAL"](#) .
16. Recover the A/C system R134a and remove the A/C compressor. Refer to [ATC-119, "Evacuating System and Charging Refrigerant"](#) .
17. Remove engine oil cooler pipe bolts.
18. Remove the power steering oil pump and reservoir tank with lines attached and position them aside.
19. Remove the lower oil pans. Refer to [EM-31, "REMOVAL"](#) .
20. Remove the generator. Refer to [SC-31, "REMOVAL"](#) .
21. Disconnect the engine harness and position aside.
22. Remove A/C low pressure line. Refer to [ATC-125, "Removal and Installation for Low-pressure Flexible Hose"](#) .
23. Support the engine and remove the RH engine mounting insulator, mount and bracket. Refer to [EM-117, "Removal and Installation"](#) .
24. Remove the water pump cover and chain tensioner cover from the front timing chain case using Tool.

**Tool number : KV1011100 (J37228)**

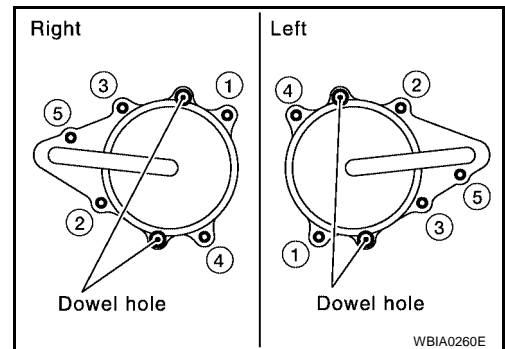
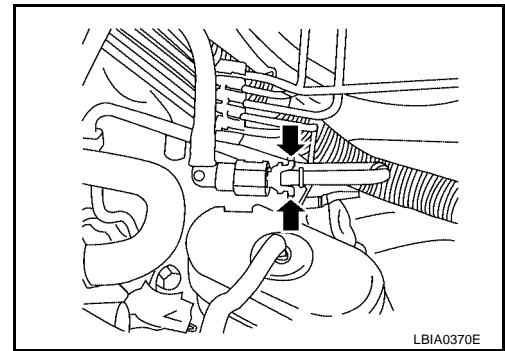
- Be careful not to damage the mating surface.
- Do not insert a screwdriver, this will damage the mating surfaces.

25. Remove the IVT control covers, right and left. Loosen the IVT control cover bolts in the order shown.

**NOTE:**

The shaft in the cover is inserted into the center hole of the intake camshaft sprocket. Remove the cover by pulling straight out until the cover disengages from the camshaft sprocket.

26. On A/T vehicles, remove the starter motor. Refer to [SC-18, "5-Speed A/T Models"](#) .
27. Remove the intake manifold collector. Refer to [EM-19, "REMOVAL"](#) .





# FRONT TIMING CHAIN CASE

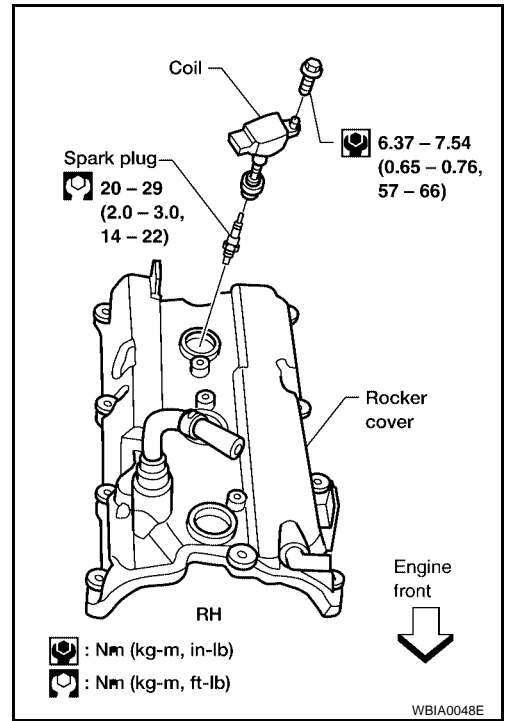
28. Remove the six ignition coils.

**NOTE:**

Note locations for installation.

29. Remove the six spark plugs.

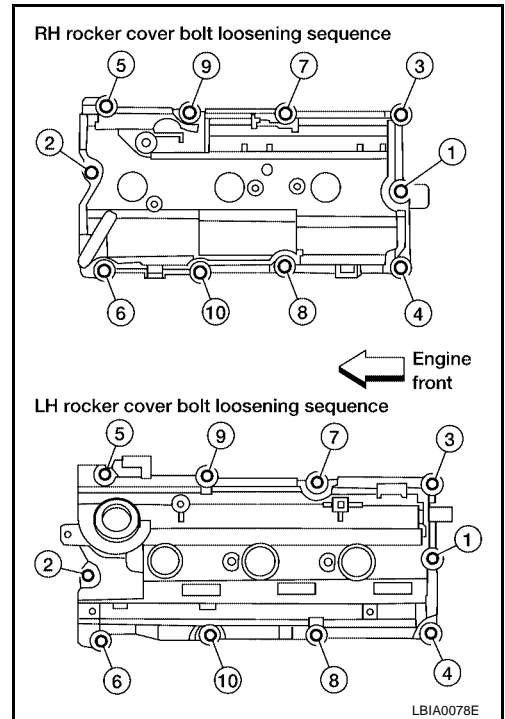
30. Remove the engine oil dipstick.



31. If necessary, remove the rocker covers. Loosen the rocker covers bolts in the order shown.

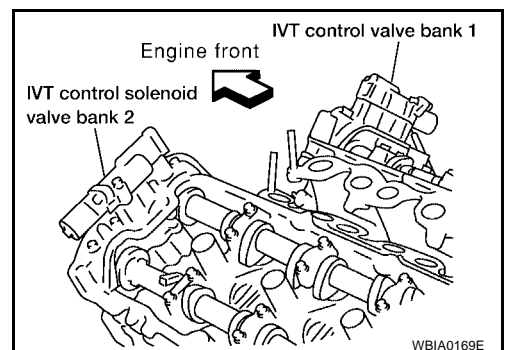
**NOTE:**

Necessary only when removing secondary timing chains.



32. Remove the IVT control solenoid valves.

- Discard the gaskets and use new gaskets for installation.

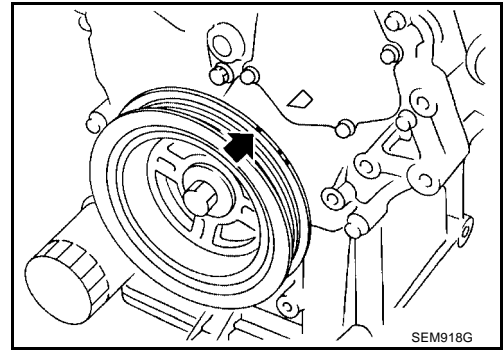


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## FRONT TIMING CHAIN CASE

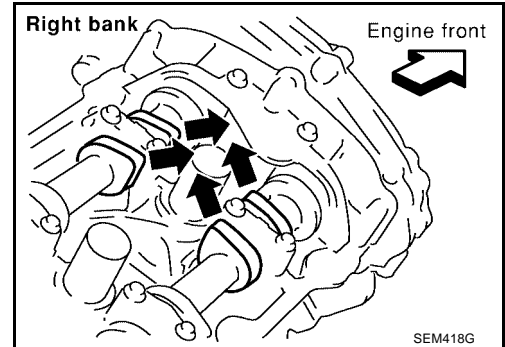
33. Obtain compression TDC of No. 1 cylinder as follows:

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



- b. Check that intake and exhaust camshaft lobes on No. 1 cylinder (right bank of engine) are located as shown.

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

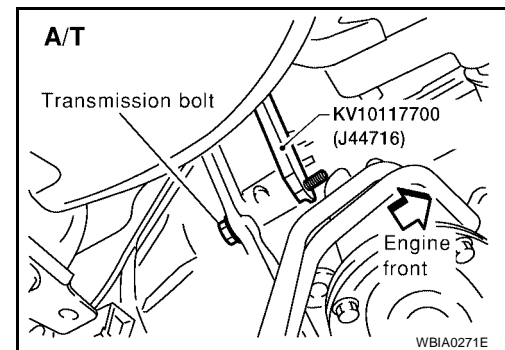
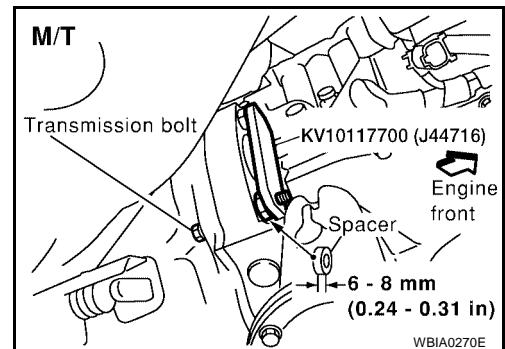


34. Install Tool as shown.

**Tool number : KV10117700 (J-44716)**

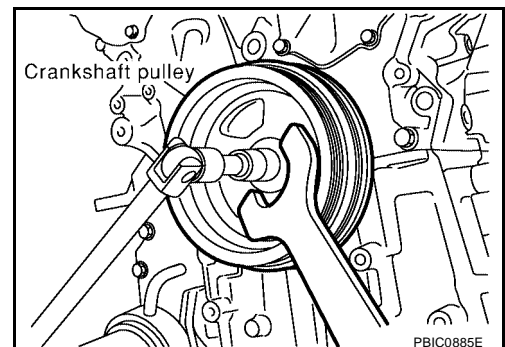
**CAUTION:**

**Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting the stopper.**



35. Remove the crankshaft pulley as follows:

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

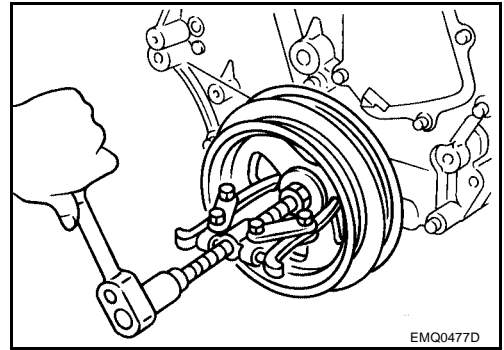


# FRONT TIMING CHAIN CASE

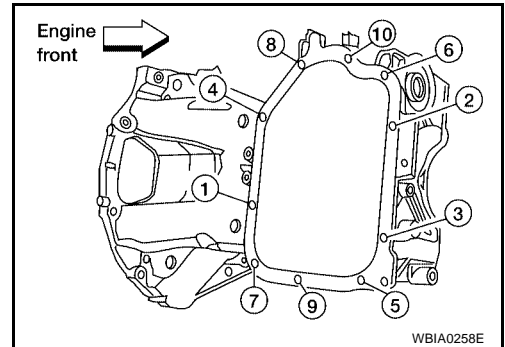
- b. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.

**CAUTION:**

Do not use a puller claw on crankshaft pulley periphery.



36. Loosen the lower oil pan bolts using power tool in order shown.

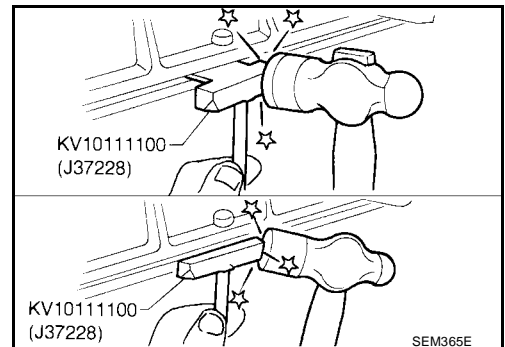


37. Remove the lower oil pan.

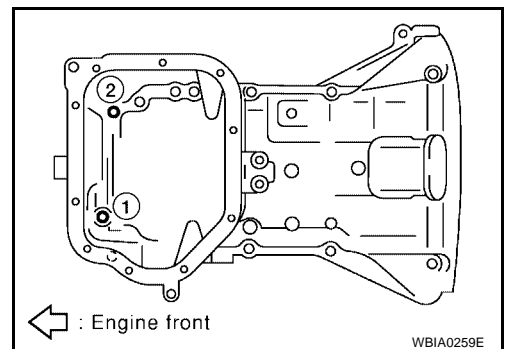
- a. Insert Tool between the lower oil pan and the upper oil pan.

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

- b. Slide the Tool by tapping its side with a hammer to remove the lower oil pan from the upper oil pan.

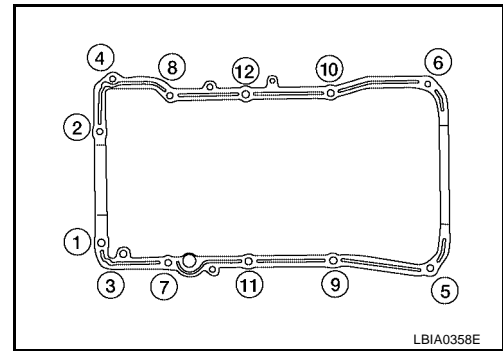


38. Loosen upper oil pan front bolts in the order shown.

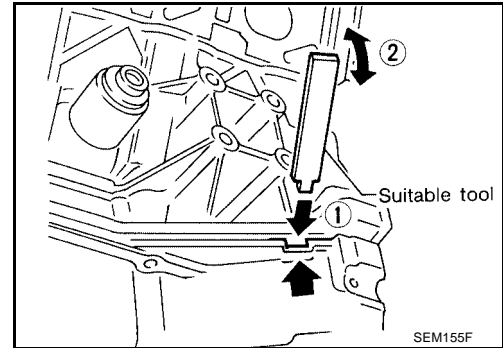


## FRONT TIMING CHAIN CASE

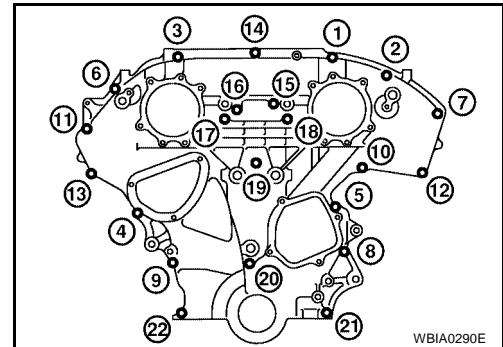
39. Loosen the bolts in the order shown, using power tool.



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



40. Temporarily install lower oil pan.
41. Support front of engine under oil pan using a jack.
42. Remove the front timing chain case.
  - a. Loosen the front timing chain case bolts in the order shown.

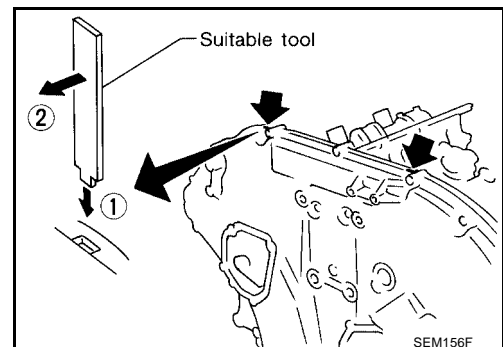


- b. Insert the appropriate size tool into the notch (1) at the top of the front timing chain case as shown.
- c. Pry off the case by moving the suitable tool (2) as shown.
  - Cut liquid gasket for removal using Tool.

**Tool number : KV10111100 (J37228)**

**CAUTION:**

- Do not use a screwdriver or similar tool.
- After removal, handle carefully so it does not bend, or warp under a load.

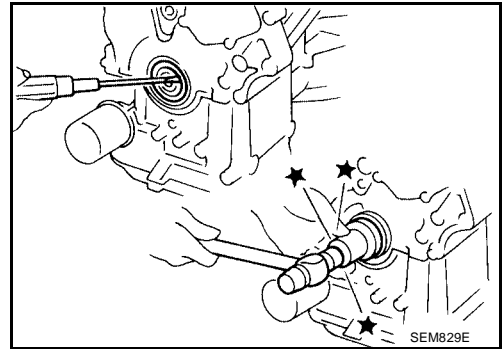


# FRONT TIMING CHAIN CASE

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

**CAUTION:**

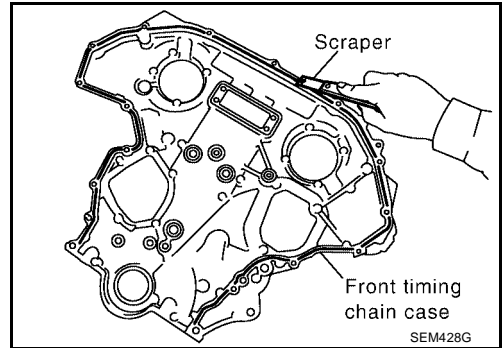
**Do not damage the front cover.**



44. Use a scraper to remove all of the old Silicone RTV Sealant from the front timing chain case and opposite mating surfaces.

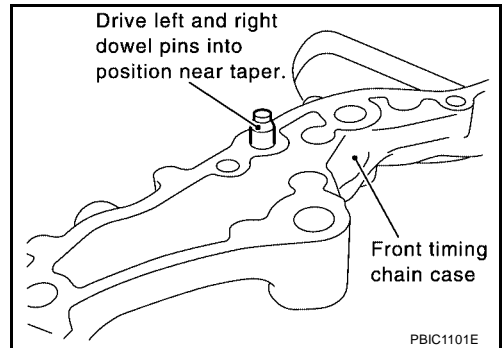
**CAUTION:**

**Do not damage the mating surfaces.**

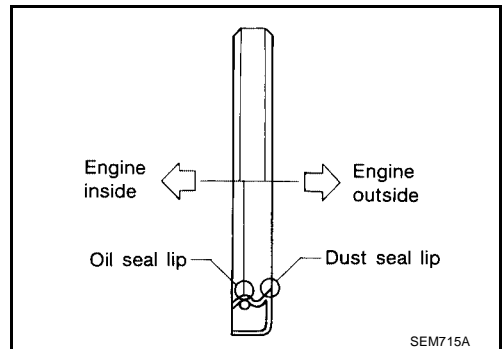


## INSTALLATION

1. Install timing chain and related parts. Refer to [EM-70, "INSTALLATION"](#).
2. Install dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.

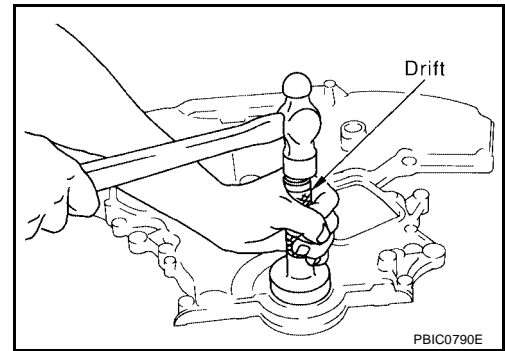


3. Install the front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.
  - Install it so that each seal lip is oriented as shown.

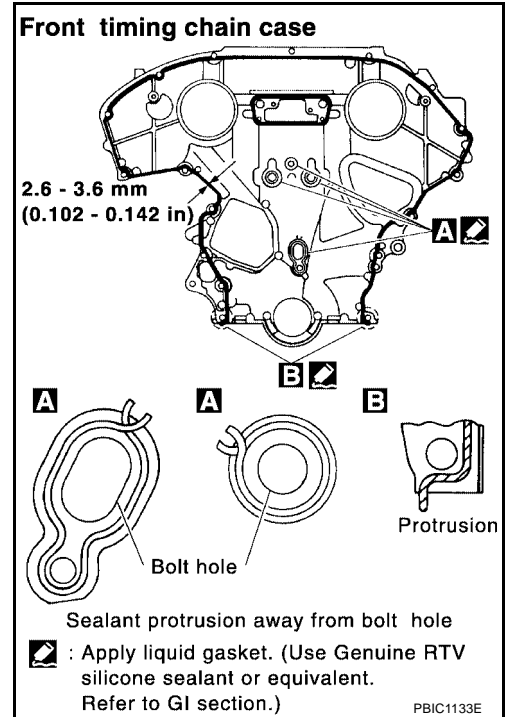


## FRONT TIMING CHAIN CASE

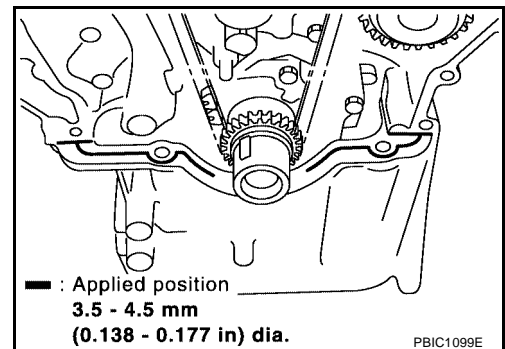
- Make sure the garter spring is in position and seal lip is not inverted.



4. Apply Silicone RTV Sealant to front timing chain case as shown.
  - Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
  - Before installation, wipe off the protruding sealant.
  - Install dowel pin on the rear timing chain case into dowel pin hole in front timing chain case.



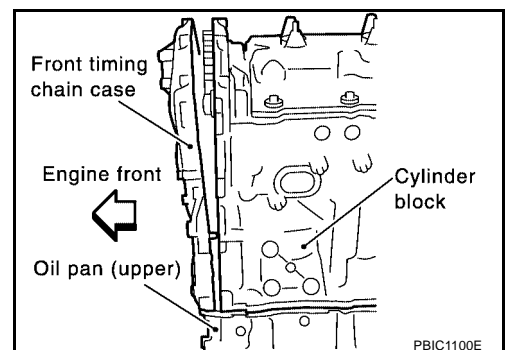
5. Apply Silicone RTV Sealant to top surface of oil pan (upper) as shown.
  - Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).



6. Install front timing chain case.
  - a. Install lower end of front timing chain case tightly onto top surface of oil pan (upper).

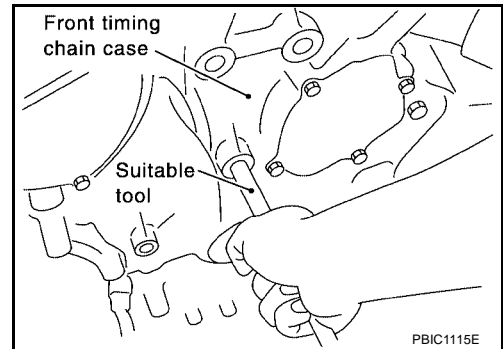
**CAUTION:**

Be careful that oil pan gasket is in place.



## FRONT TIMING CHAIN CASE

- b. While pressing front timing chain case from its front and top shown, hammer dowel pin until the outer end becomes flush with surface.



7. Loosely install the front timing chain case bolts.

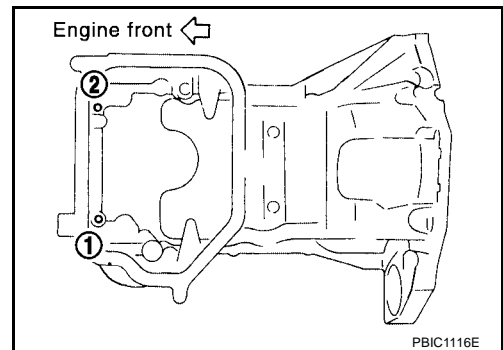
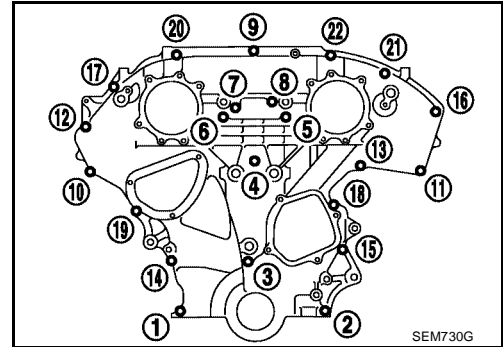
| Bolt position | Bolt diameter    |
|---------------|------------------|
| 1, 2          | : 8 mm (0.31 in) |
| 3 – 22        | : 6 mm (0.24 in) |

8. Tighten the front timing chain case bolts in the order shown.

| Bolt position | Tightening specification        |
|---------------|---------------------------------|
| 1, 2          | : 28.5 N·m (2.9 kg·m, 21 ft·lb) |
| 3 – 22        | : 12.8 N·m (1.3 kg·m, 9 ft·lb)  |

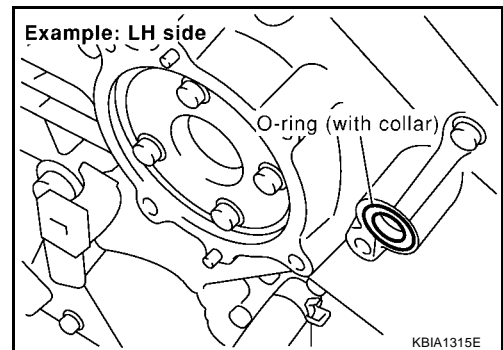
- Retighten the front timing chain case bolts in the order shown.

9. Install the upper oil pan front bolts in the order shown refer to [EM-31, "Removal and Installation"](#).



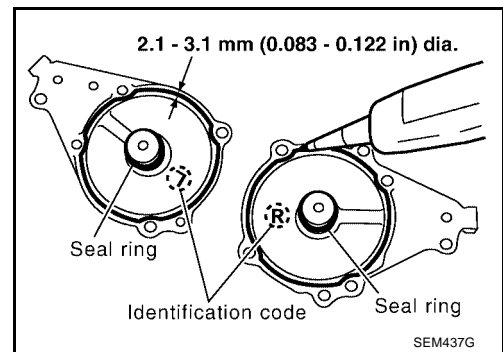
10. Install IVT control valve covers as follows:

- a. Install new collared O-rings in front cover oil hole (LH and RH sides).

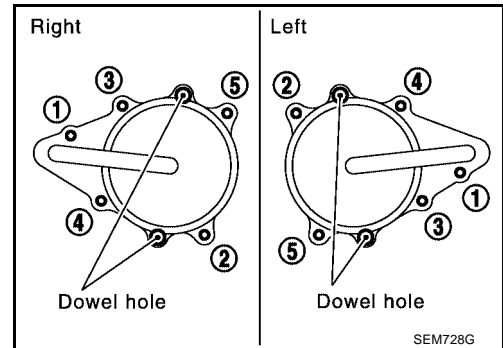


## FRONT TIMING CHAIN CASE

- b. Install new seal rings on the IVT control covers.
- c. Apply Silicone RTV Sealant to the IVT control covers.
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

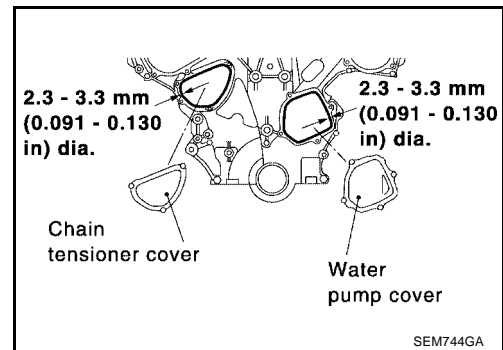


- Being careful not to move the seal ring from the installation groove, align the dowel pins on the chain case with the holes to install the IVT control covers.
- Tighten the intake valve timing control cover bolts in the order shown refer to [EM-46, "Removal and Installation"](#).



11. Apply liquid gasket and install the water pump cover and the chain tensioner cover refer to [EM-46, "Removal and Installation"](#).

- Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

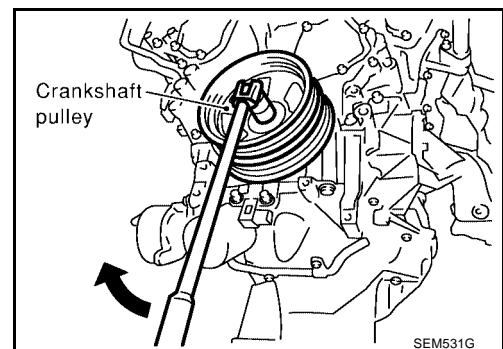


12. Install crankshaft pulley and tighten the bolt in two steps.
- Lubricate thread and seat surface of the bolt with new engine oil.
  - For the second step of angle tightening use Tool.

**Step 1 : 39 - 49 N·m (4.0 - 5.0 kg·m, 29 - 36 ft·lb)**

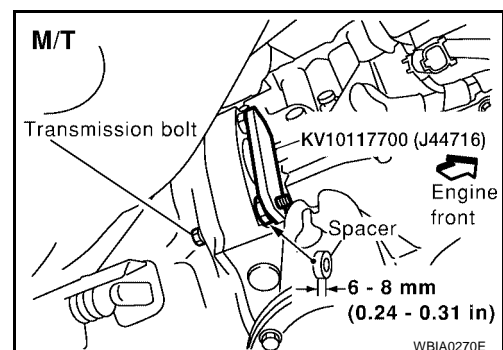
**Step 2 : 84° - 90° degrees clockwise**

**Tool number : KV10112100 (BT-8653-A)**



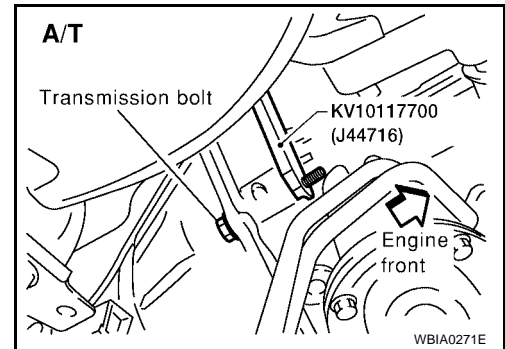
13. Remove Tool.

**Tool number : KV10117700 (J-44716)**





## FRONT TIMING CHAIN CASE



14. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
15. Installation of the remaining components is 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. This is normal. Noise will stop after hydraulic pressure rises.

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# TIMING CHAIN

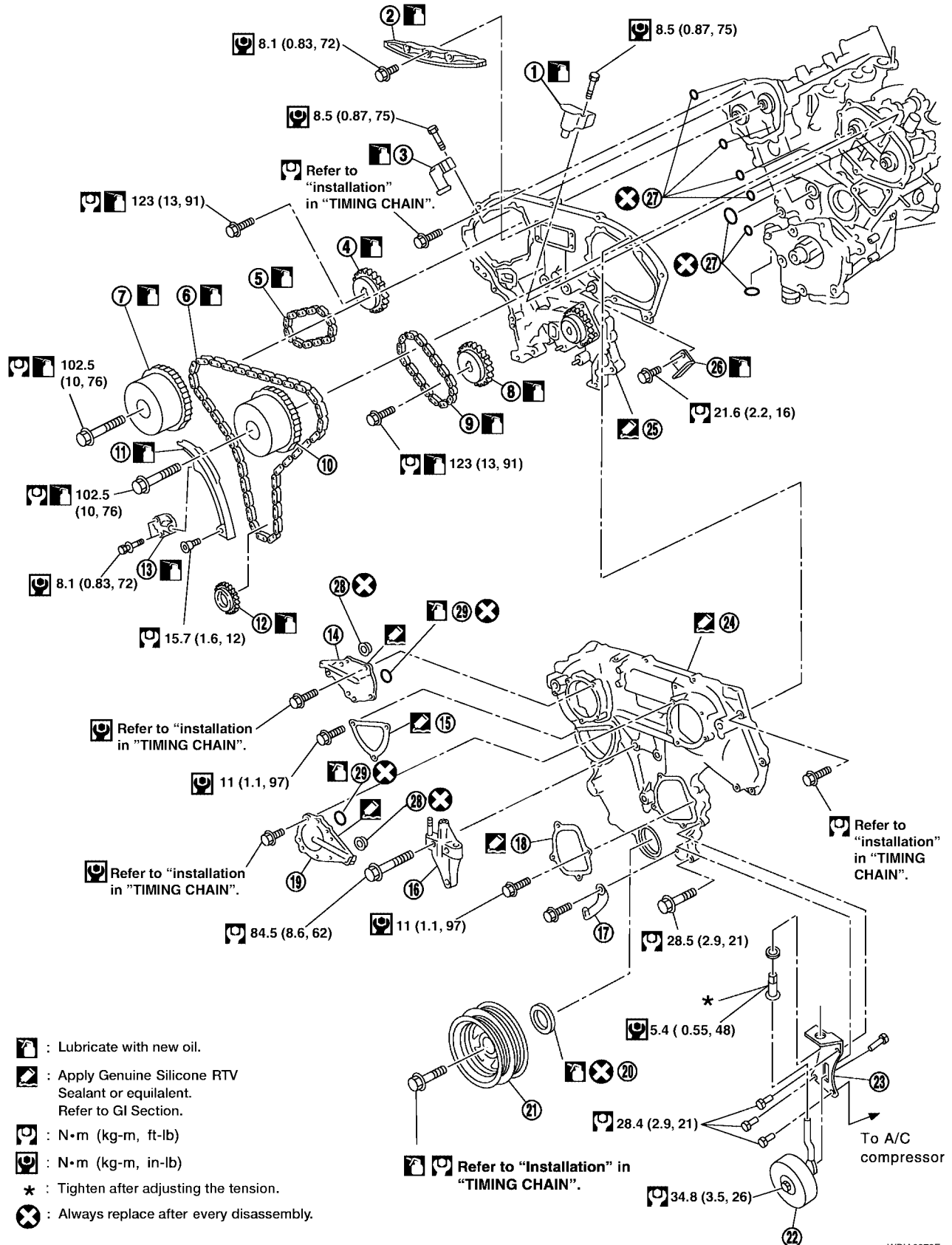
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## TIMING CHAIN

### Removal and Installation

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# TIMING CHAIN

- |                                    |                                     |                             |
|------------------------------------|-------------------------------------|-----------------------------|
| 1. Timing chain tensioner          | 2. Internal chain guide             | 3. Timing chain tensioner   |
| 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         | 14. IVT control valve cover - right | 15. Chain tensioner cover   |
| 16. RH engine mounting bracket     | 17. Water hose clamp                | 18. Water pump cover        |
| 19. IVT control valve cover - left | 20. Front oil seal                  | 21. Crankshaft pulley       |
| 22. Idler pulley                   | 23. Idler pulley bracket            | 24. Front timing chain case |
| 25. Rear timing chain case         | 26. Timing tension guide            | 27. O-ring                  |
| 28. Collared O-ring                | 29. Seal ring                       |                             |

## CAUTION:

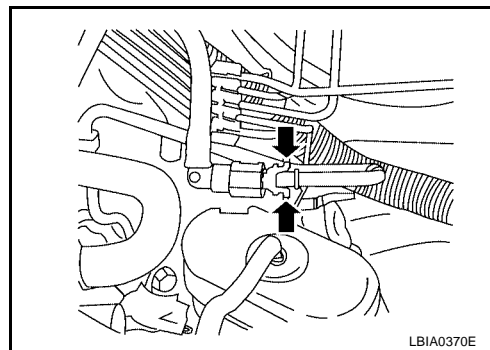
- After removing timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets, camshaft brackets, and crankshaft pulley.
- Before disconnecting fuel hose, release fuel pressure. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#).
- Before removing the upper oil pan, remove the crankshaft position sensor (POS).
- Be careful not to damage sensor edges.
- Do not spill engine oil or coolant on drive belts.

## NOTE:

- This section describes procedures for removal/installation procedure of the 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, "Removal and Installation"](#).

## REMOVAL

1. Release the fuel pressure. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#).
2. Disconnect the battery negative terminal.
3. Drain the engine cooling system. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).
4. Drain engine oil. Refer to [MA-16, "Changing Engine Oil"](#).
5. Remove engine cover using power tool.
6. Remove side engine covers.
7. Remove the intake air duct with the air cleaner case lid and mass air flow sensor. Refer to [EM-16, "Removal and Installation"](#).
8. Remove the engine coolant reservoir.
9. Disconnect the fuel rail quick connector at the vehicle piping side.
10. Remove the cowl top. Refer to [EI-19, "Removal and Installation"](#).
11. Remove the windshield wiper assembly. Refer to [WW-23, "Removal and Installation of Wiper Motor and Linkage"](#).
12. Remove the IPDM E/R and position aside. Remove the bracket.
13. Remove the front RH wheel and tire using power tool.
14. Remove the engine undercover.
15. Remove the RH inner fender splash shield.
16. Remove the drive belts and idler pulley. Refer to [EM-15, "Removal and Installation"](#).
17. Recover the A/C system R134a and remove the A/C compressor. Refer to [ATC-119, "Evacuating System and Charging Refrigerant"](#).



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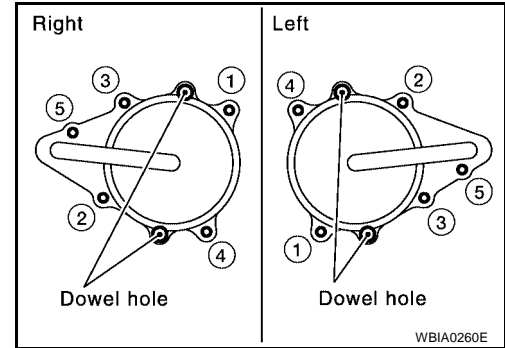
# TIMING CHAIN

18. Remove engine oil cooler pipe bolts.
19. Remove the power steering oil pump and reservoir tank with lines attached and position them aside.
20. Remove the upper and lower oil pans. Refer to [EM-31, "Removal and Installation"](#) .
21. Remove the generator. Refer to [SC-31, "Removal and Installation"](#) .
22. Disconnect the engine harness and position aside.
23. Remove the A/C low pressure line. Refer to [ATC-125, "Removal and Installation for Low-pressure Flexible Hose"](#) .
24. Support the engine and remove the RH engine mounting insulator, mount and bracket. Refer to [EM-117, "Removal and Installation"](#) .
25. Remove the chain tensioner cover and water pump cover.
26. Remove the IVT control covers, right and left. Loosen the IVT control cover bolts in the order shown.

**NOTE:**

The shaft in the cover is inserted into the center hole of the intake camshaft sprocket. Remove the cover by pulling straight out until the cover disengages from the camshaft sprocket.

27. On A/T vehicles, remove the starter motor. Refer to [SC-18, "5-Speed A/T Models"](#) .
28. Remove the intake manifold collector. Refer to [EM-19, "REMOVAL"](#) .

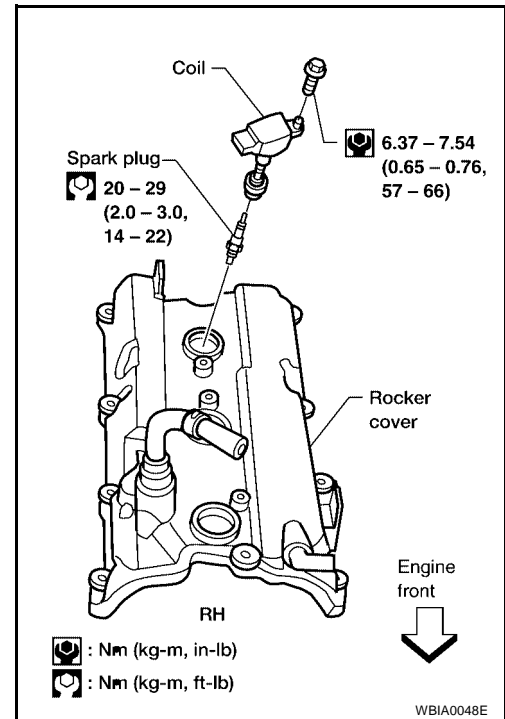


29. Remove the six ignition coils.

**NOTE:**

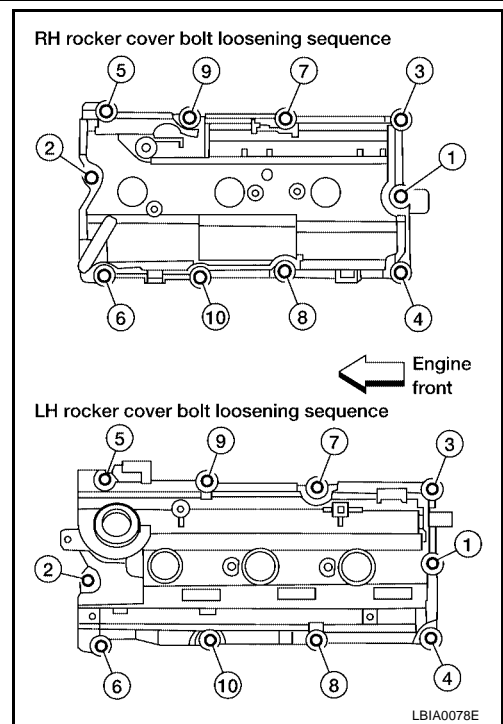
Note locations for installation.

30. Remove the six spark plugs.
31. Remove the engine oil dipstick.

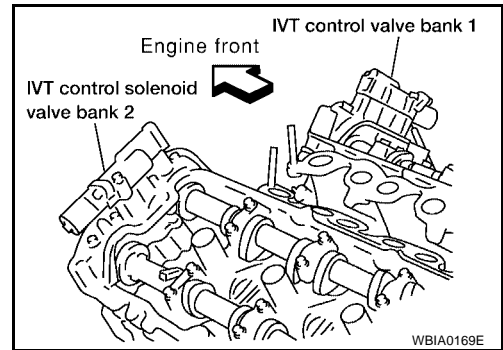


# TIMING CHAIN

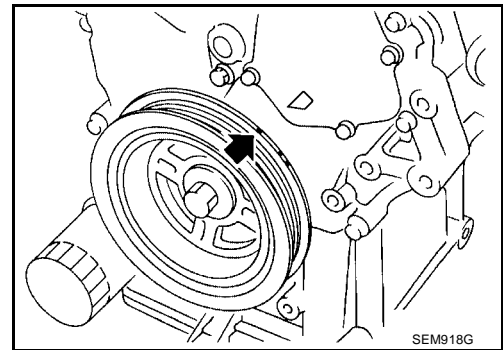
32. Remove the rocker covers. Loosen the rocker covers bolts in the order shown.



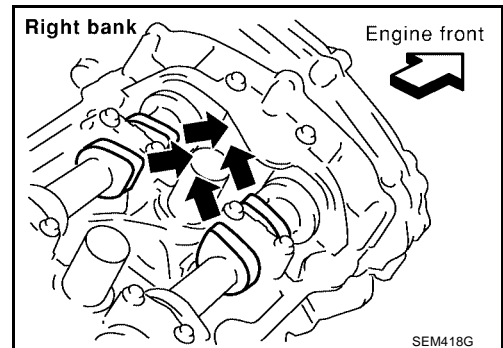
33. Remove the IVT control solenoid valves.
- Discard the gaskets and use new gaskets for installation.



34. Obtain compression TDC of No. 1 cylinder as follows:
- Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



- Check that intake and exhaust camshaft lobes on No. 1 cylinder (right bank of engine) are located as shown.
  - If not, turn the crankshaft one revolution (360°) and align as shown.



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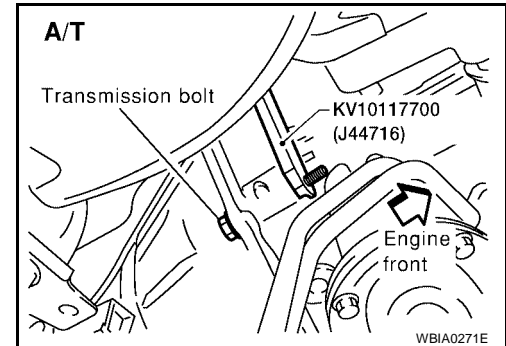
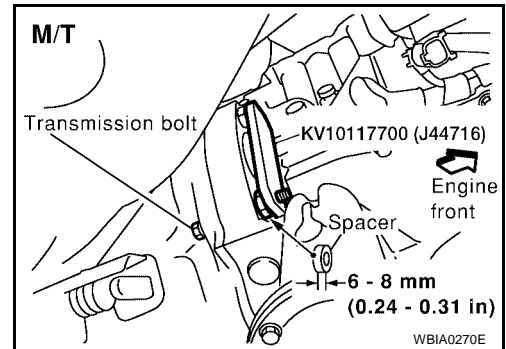
# TIMING CHAIN

35. Install Tool as shown.

**Tool number : KV10117700 (J-44716)**

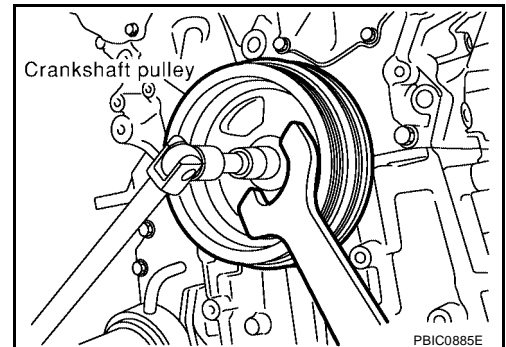
**CAUTION:**

**Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting the stopper.**



36. Remove the crankshaft pulley as follows:

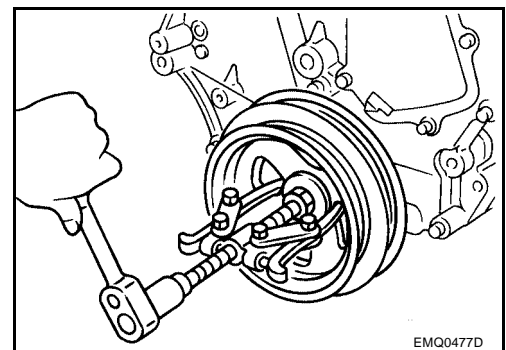
a. Loosen crankshaft pulley mounting bolt using pulley holder and locate bolt seating surface at 10 mm (0.39 in) from its original position.



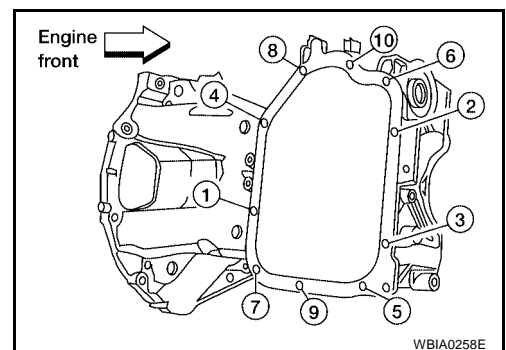
b. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.

**CAUTION:**

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



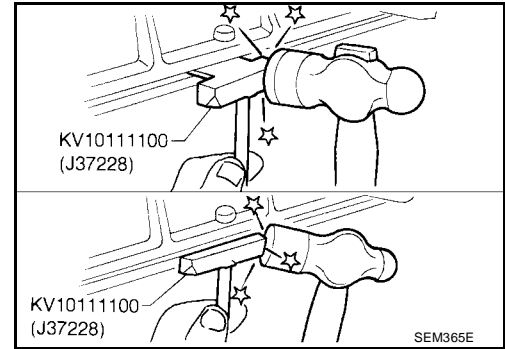
37. Loosen the lower oil pan bolts using power tool in order shown.



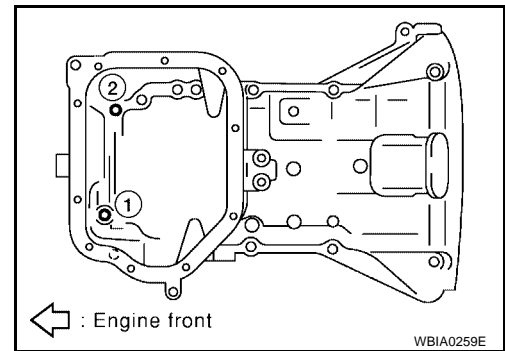
# TIMING CHAIN

38. Remove the lower oil pan.

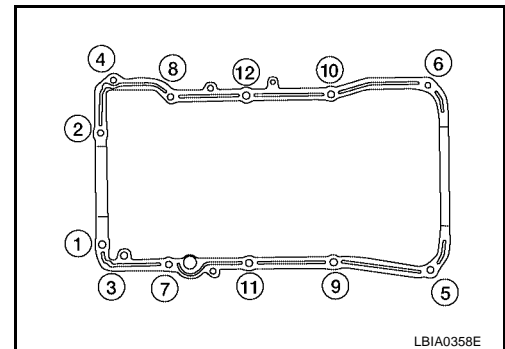
- a. Insert Tool between the lower oil pan and the upper oil pan.
  - Be careful not to damage the mating surface.
  - Do not insert a screwdriver, this will damage the mating surfaces.
- b. Slide the Tool by tapping its side with a hammer to remove the lower oil pan from the upper oil pan.



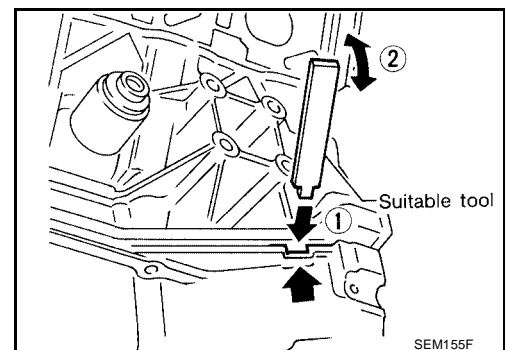
39. Loosen upper oil pan front bolts in the order shown.



40. Loosen the bolts in the order shown, using power tool.



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



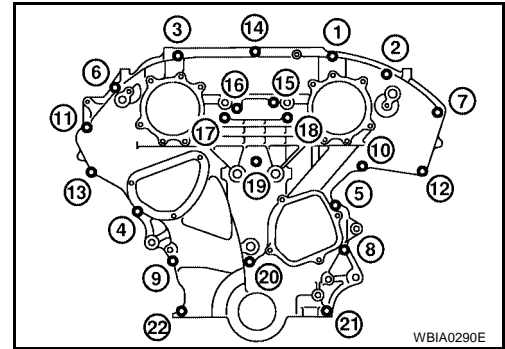
41. Temporarily install lower oil pan.

42. Support front of engine under oil pan using a jack.

## TIMING CHAIN

43. Remove the front timing chain case.

a. Loosen the front timing chain case bolts in the order shown.



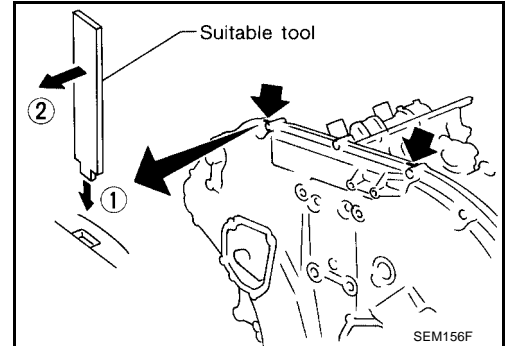
b. Insert the appropriate size tool into the notch (1) at the top of the front timing chain case as shown.

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

- Use seal cutter or an equivalent tool to cut liquid gasket for removal.

**CAUTION:**

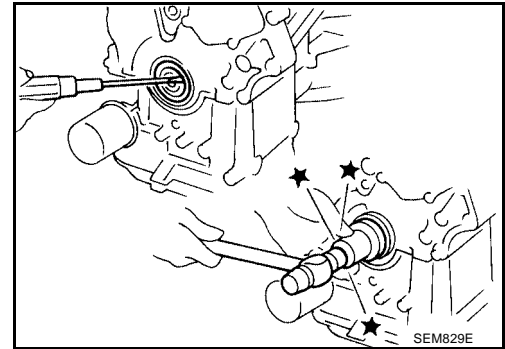
- Do not use a screwdriver or similar tool.
- After removal, handle carefully so it does not bend, or warp under a load.



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

**CAUTION:**

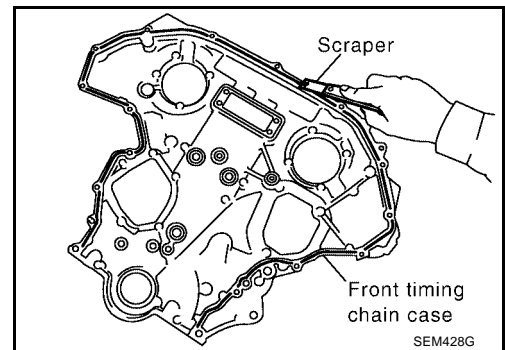
Do not damage the front cover.



45. Use a scraper to remove all of the old Silicone RTV Sealant from the front timing chain case and opposite mating surfaces.

**CAUTION:**

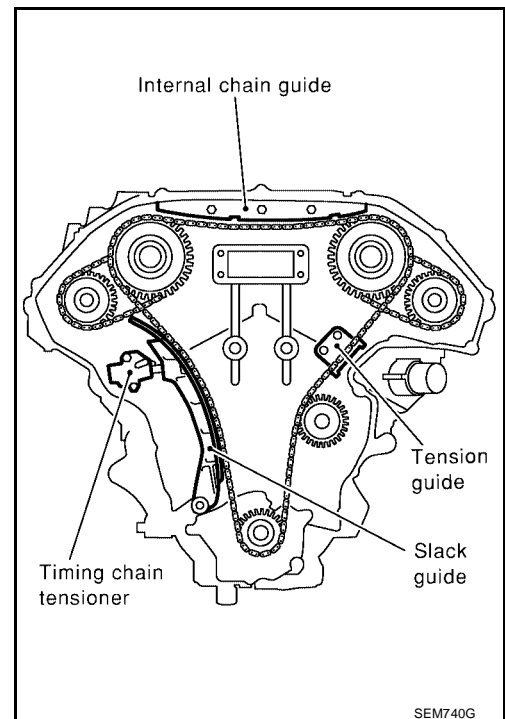
Do not damage the mating surfaces.





# TIMING CHAIN

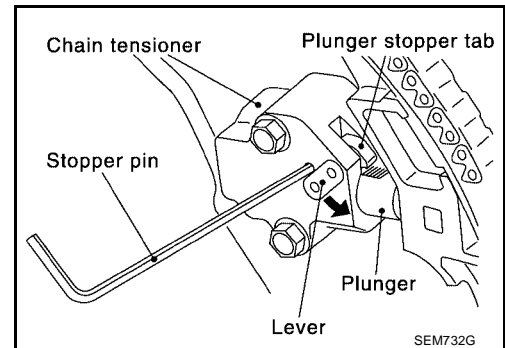
46. Remove the internal chain guide.



47. Remove the timing chain tensioner and slack guide.

- Place paint marks on the timing chain and sprockets to indicate the correct position of the components for installation.

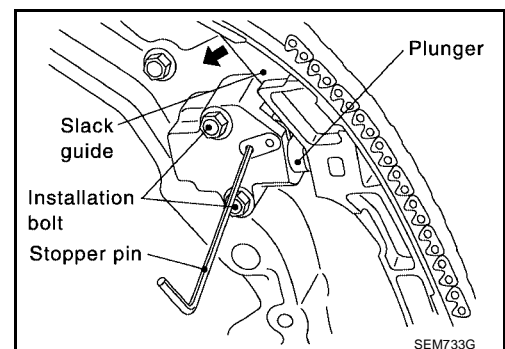
- Pull lever down and release plunger stopper tab. Plunger stopper tab can be pushed up to release (coaxial structure with lever).
- Insert stopper pin into tensioner body hole to hold lever, and keep the tab released. An Allen wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.
- Insert plunger into tensioner body by pressing the slack side chain guide.



- Keep the slack side chain guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.
  - Remove the timing chain tensioner installation bolts and remove the timing chain tensioner.
  - Remove slack guide installation bolt and the slack guide.
48. Remove primary timing chain and crankshaft sprocket.

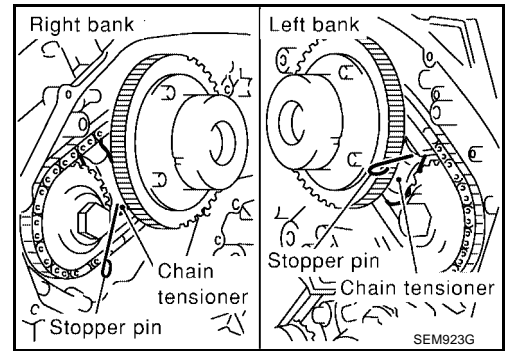
**CAUTION:**

**After removing timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.**

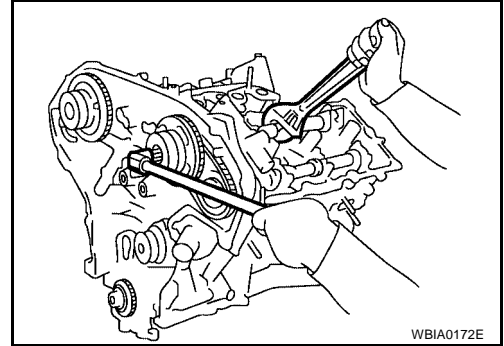


## TIMING CHAIN

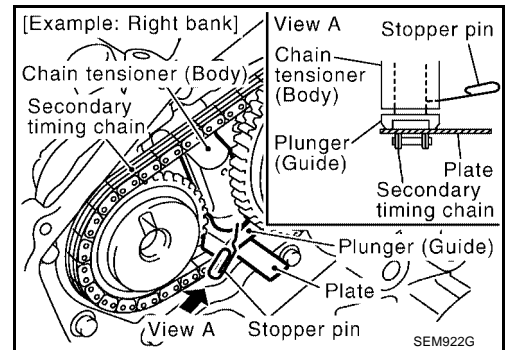
49. Attach a suitable stopper pin to the right and left camshaft chain tensioners (for secondary timing chains).



50. Remove the intake and exhaust camshaft sprocket bolts.
- Apply paint to the timing chain and camshaft sprockets for alignment during installation.
  - Secure the hexagonal portion of the camshaft using a wrench to loosen the bolts as shown.

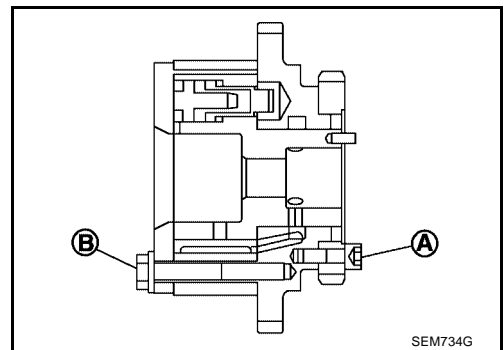


51. Remove the secondary timing chains with camshaft sprockets.
- Rotate camshaft slightly, and slacken timing chain of timing chain tensioner side.
  - Insert metal or resin plate [0.5 mm (0.020 in)] into guide between timing chain and chain tensioner plunger. Remove cam sprocket and secondary timing chain with timing chain removed from guide groove.
    - Intake camshaft sprocket is two-for-one structure of primary and secondary sprockets.
    - Handle the intake sprockets as an assembly.



**CAUTION:**

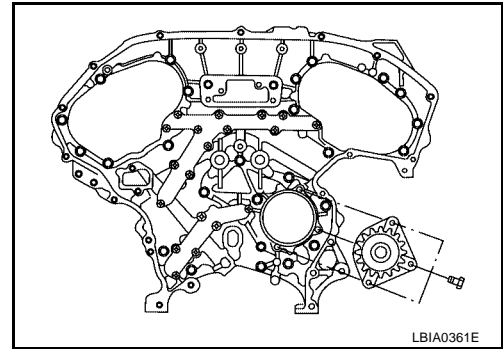
- Chain tensioner plunger can move while stopper pin is inserted in tensioner. Plunger can come out of tensioner when timing chain is removed. Use caution during removal.
- Avoid impact or dropping the intake sprockets.
- Do not disassemble the intake sprockets (never loosen bolts A and B as shown).



52. Remove the timing chain tension guide.

# TIMING CHAIN

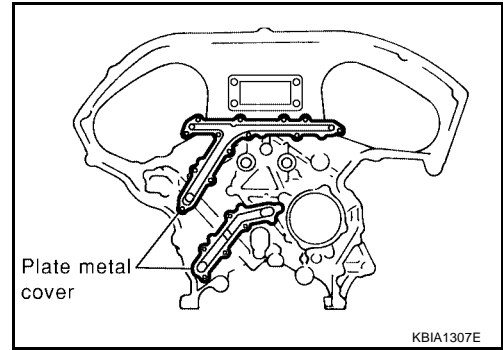
53. If necessary remove the water pump.



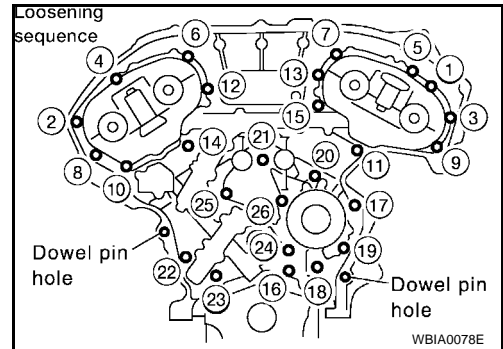
54. Remove the rear timing chain case.

**CAUTION:**

- Do not remove the plate metal cover for the oil passage.
- After removing the chain case, do not apply any load to the case that might bend it.

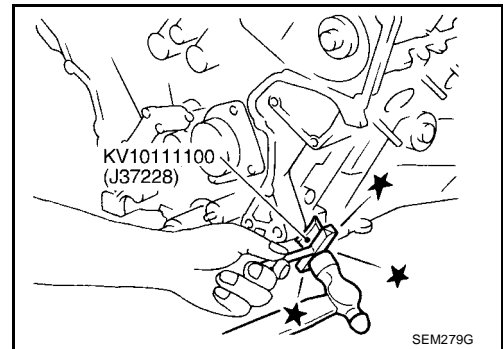


a. Loosen and remove the rear timing chain case bolts in the order shown.



b. Cut the sealant using Tool and remove the rear timing chain case.

**Tool number : KV10111100 (J-37228)**

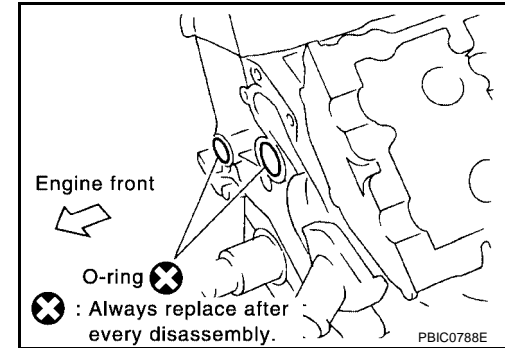
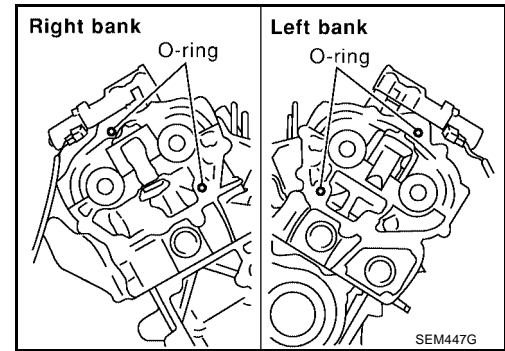


55. Disconnect the inlet coolant hose.

56. Remove the inlet coolant housing, gasket and thermostat.

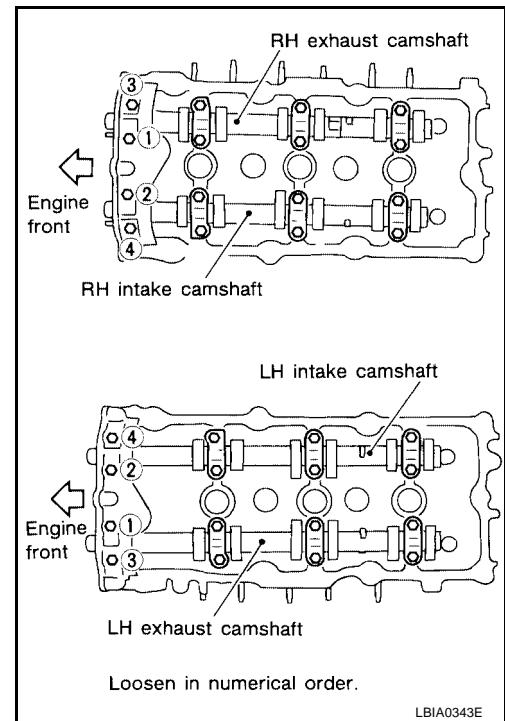
# TIMING CHAIN

57. Remove O-rings on the cylinder head and cylinder block.



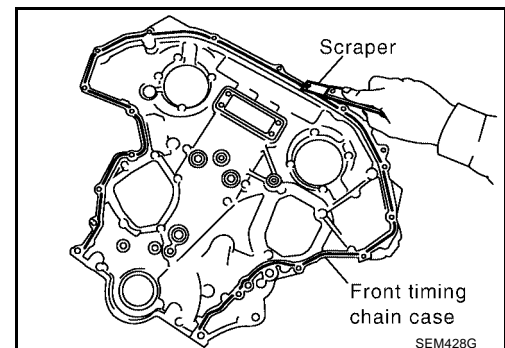
58. Loosen the No. 1 camshaft bracket bolts in several steps in the order shown and remove No. 1 camshaft brackets.

59. Remove the camshaft chain tensioners (for secondary timing chains).



60. Use a scraper to remove all of the old Silicone RTV Sealant from the front and rear timing chain case and opposite mating surfaces.

**CAUTION:**  
Do not damage the mating surfaces.

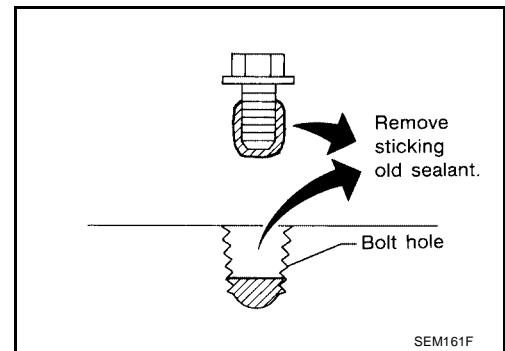


# TIMING CHAIN

61. Remove all old Silicone RTV Sealant from all the bolt holes and bolts.

**CAUTION:**

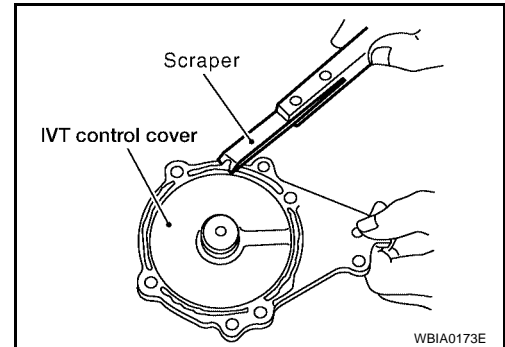
**Do not damage the threads or mating surfaces.**



62. Use a scraper to remove all the old Silicone RTV Sealant from the water pump cover, chain tensioner cover and IVT control covers.

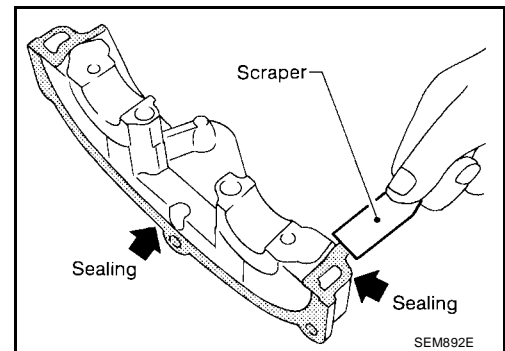
**CAUTION:**

**Do not damage the mating surfaces.**



63. Remove the old Silicone RTV Sealant from the camshaft No. 1 bracket mating surface using a scraper.

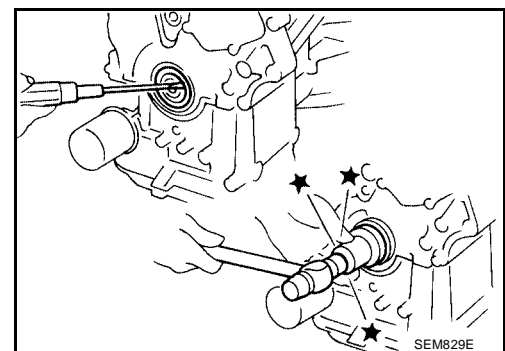
- Do not scratch or damage the mating surface.



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

**CAUTION:**

**Do not damage the front cover.**

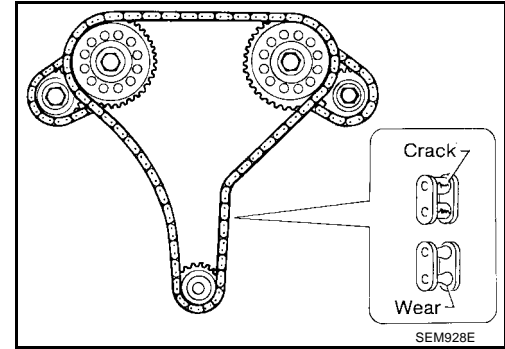


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# TIMING CHAIN

## INSPECTION AFTER REMOVAL

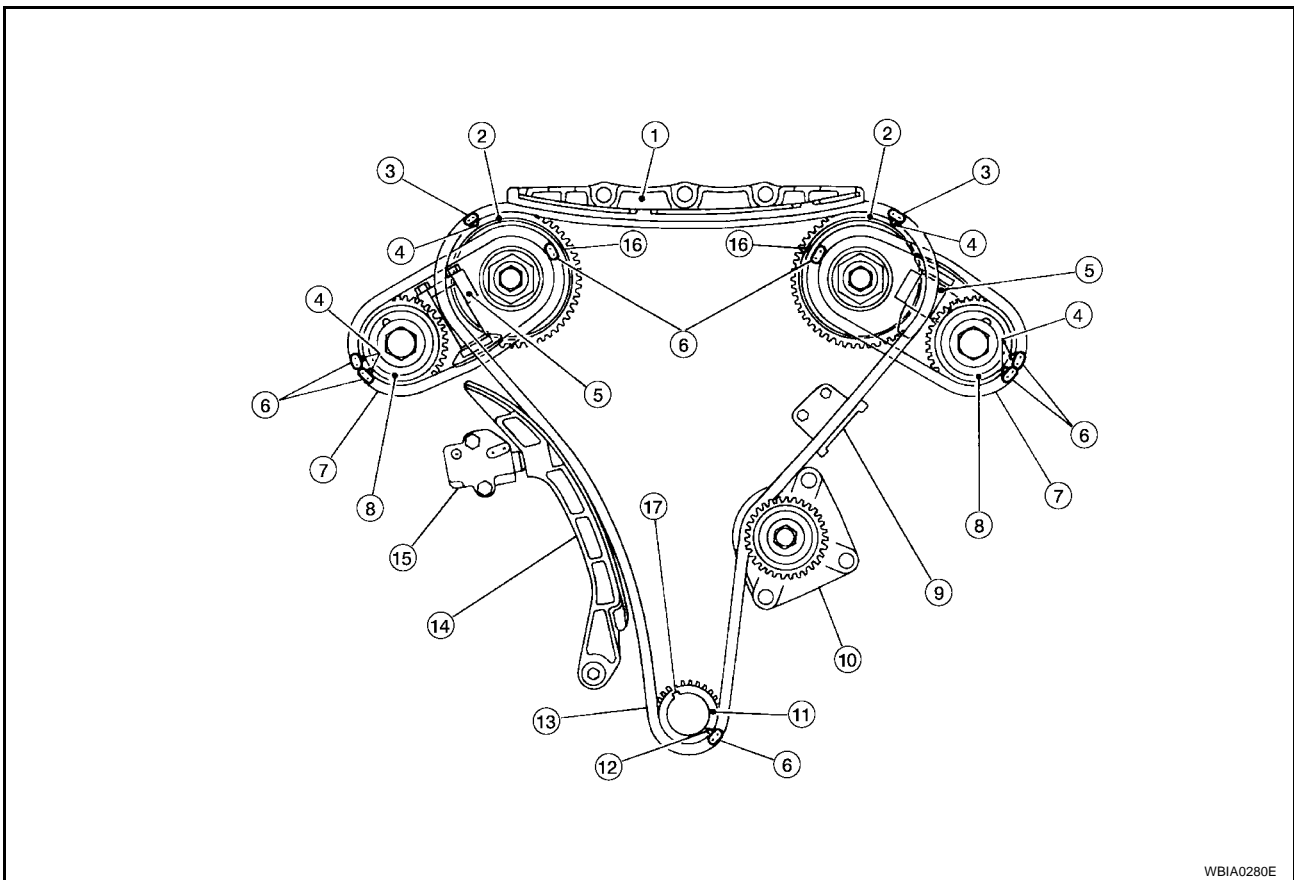
Check for cracks and any excessive wear at the roller links of the timing chain. Replace the timing chain as necessary.



## INSTALLATION

### NOTE:

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

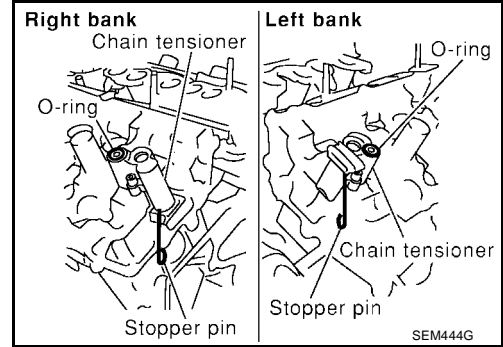


- |                             |                                       |                                      |
|-----------------------------|---------------------------------------|--------------------------------------|
| 1. Internal chain guide     | 2. Camshaft sprocket (INT)            | 3. Mating mark (copper link)         |
| 4. Mating mark (punched)    | 5. Timing chain tensioner (secondary) | 6. Mating mark (yellow link)         |
| 7. Timing chain (secondary) | 8. Camshaft sprocket (EXH)            | 9. Tensioner guide                   |
| 10. Water pump              | 11. Crankshaft sprocket               | 12. Mating mark (notched)            |
| 13. Timing chain (primary)  | 14. Slack guide                       | 15. Timing chain tensioner (primary) |
| 16. Mating mark (back side) | 17. Crankshaft key                    |                                      |

# TIMING CHAIN

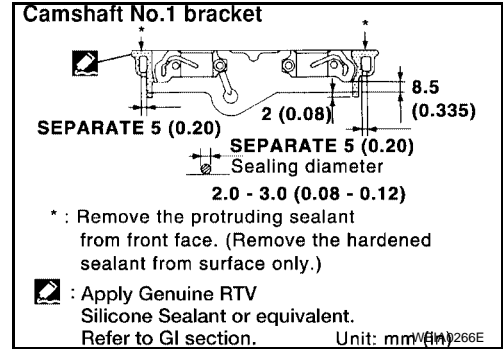
1. Install the camshaft chain tensioners (for secondary timing chains).

**Camshaft chain tensioner bolts : 8.5 N-m (0.87 kg-m, 75 in-lb)**



2. Before installing No. 1 camshaft bracket, apply sealant to mating surface.

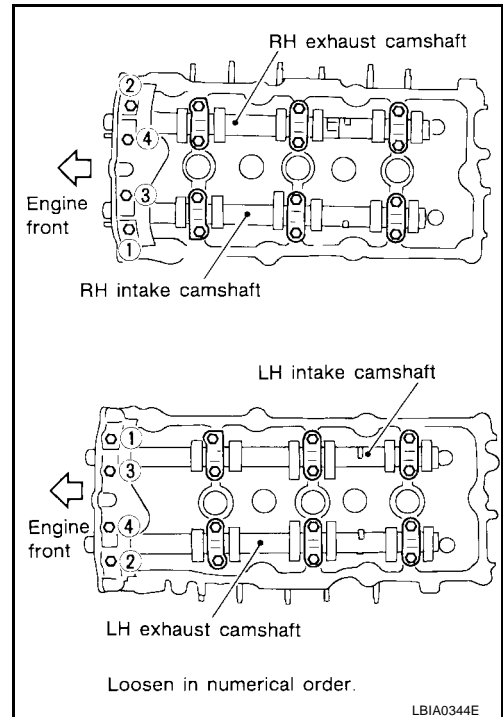
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
- Before installation, wipe off any protruding sealant.
- Refer to [EM-4, "LIQUID GASKET APPLICATION PROCEDURE"](#).



3. Tighten the No. 1 camshaft bracket in three steps, in the order shown.

**Camshaft bracket bolts**

- Step 1 (bolts 7 - 10) : 1.96 N-m (0.2 kg-m, 17 in-lb)**
- Step 2 (bolts 1 - 6) : 1.96 N-m (0.2 kg-m, 17 in-lb)**
- Step 3 : 5.88 N-m (0.6 kg-m, 52 in-lb)**
- Step 4 (bolts 1 - 6) : 10.4 N-m (1.1 kg-m, 92 in-lb)**



4. Install the thermostat, gasket and engine coolant inlet and thermostat assembly.

**Coolant inlet housing bolts : 8.4 - 11.2 N-m (0.86 - 1.14 kg-m, 74.6 - 99.0 in-lb)**





# TIMING CHAIN

- Before installation, wipe off the protruding sealant.

7. Align the rear timing chain case 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.

a. Loosely install the rear timing chain case in the order shown. There are two bolt lengths used. Follow the chart below for proper bolt length specifications.

| Bolt position           | Bolt length     |
|-------------------------|-----------------|
| 1, 2, 3, 6, 7, 8, 9, 10 | 20 mm (0.79 in) |
| 4, 5, 11 - 26           | 16 mm (0.63 in) |

b. After all bolts are initially tightened, retighten them in the order shown.

**Rear timing chain case** : 12 - 13 N·m (1.2 - 1.4 kg·m, 9 - 10 ft·lb)

8. After installing rear timing chain case, check surface height difference between the rear timing chain case to cylinder block.

**Standard** : - 0.24 - 0.14 mm (-0.0094 - 0.0055 in)

- If not within standard, repeat above installation procedure.

9. Install the timing chain tension guide.

**Timing chain tension guide bolts** : 19.6 - 23.5 N·m (2.0 - 2.3 kg·m, 15 - 17 ft·lb)

10. Position the crankshaft so No. 1 piston is set at TDC on the compression stroke.

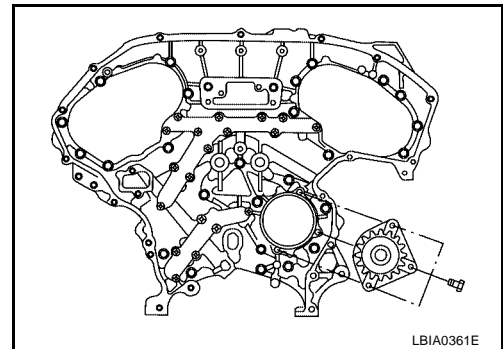
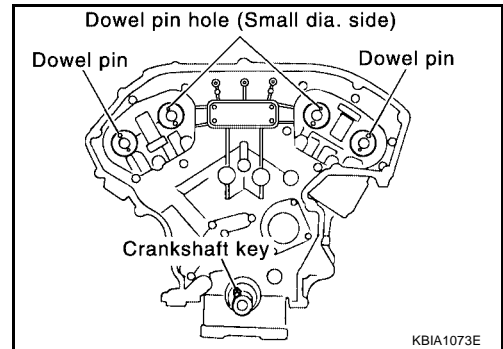
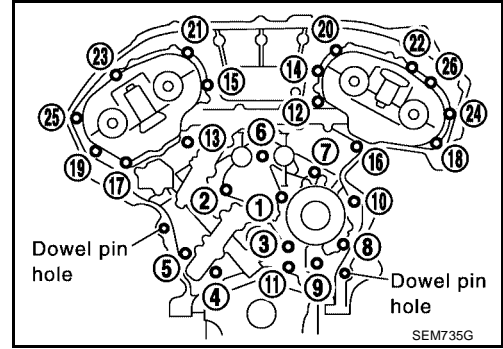
- Make sure that the dowel pin hole, dowel pin and crankshaft key are located as shown.  
 Camshaft dowel pin hole (intake side): at cylinder head upper face side in each bank.  
 Camshaft dowel pin (exhaust side): at cylinder head upper face side in each bank.  
 Crankshaft key: at cylinder head side of RH bank.

**CAUTION:**

**Hole on small diameter side must be used for intake camshaft sprocket dowel pin. Do not misidentify (ignore big diameter side).**

11. If necessary, install the water pump and water pump bolts.

**Water pump bolts** : 8.5 - 10.7 N·m (0.86 - 1.10 kg·m, 75-95 in·lb)



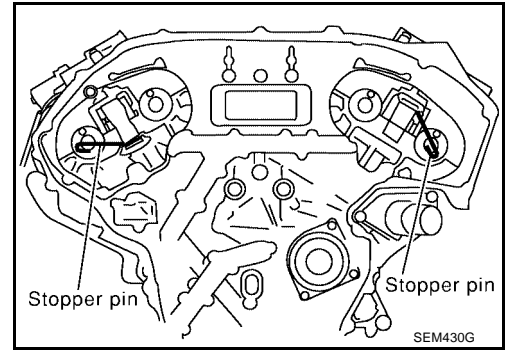
# TIMING CHAIN

12. Install the secondary timing chains and camshaft sprockets.

**CAUTION:**

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

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



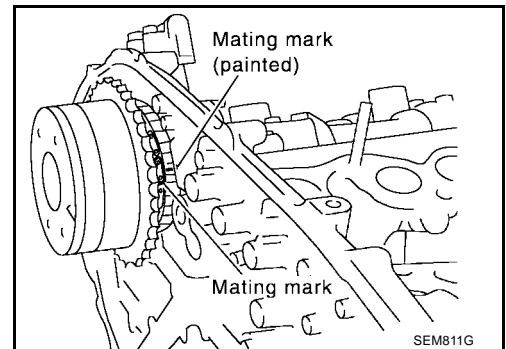
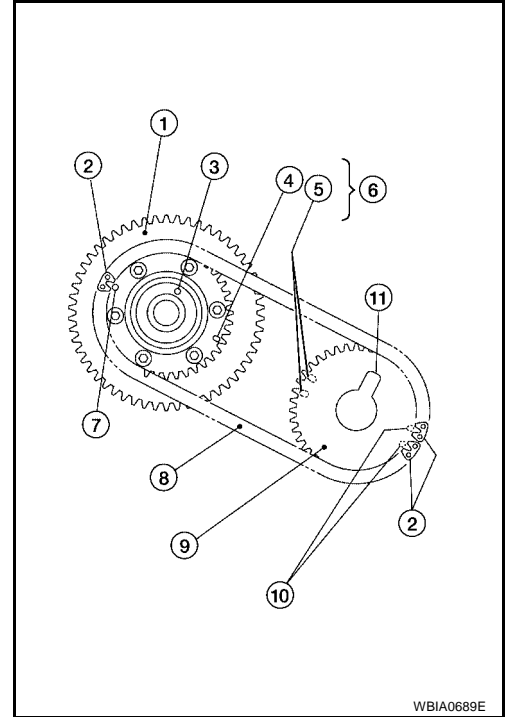
a. Align the matching marks (4), (5), (7) and (10) on the secondary timing chain (8) [yellow link (2)] with the ones on the intake and exhaust sprockets (stamped), and install them.

- Illustration shows RH (rear view)
- Matching marks for the intake sprocket are on the back side of the secondary sprocket.
- There are two types of matching marks, round (7) and (10) and oval (4) and (5) types. They should be used for the RH and LH banks, respectively.  
RH bank: use round type (7) and (10).  
LH (6) bank: use oval type (4) and (5).

b. Align the dowel pin (3) with the pin hole on the camshaft sprocket INT side (1), and the dowel pin groove (11) with the dowel pin on the camshaft EXH side, 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 (3) on the back side of the camshaft sprocket (1), and install them.
- On the exhaust side, align the dowel pin on the camshaft front end with the dowel pin groove (11) on the camshaft sprocket (9), and install them.
- Camshaft sprocket bolts must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of the dowel pin (3) and dowel pin groove (11).

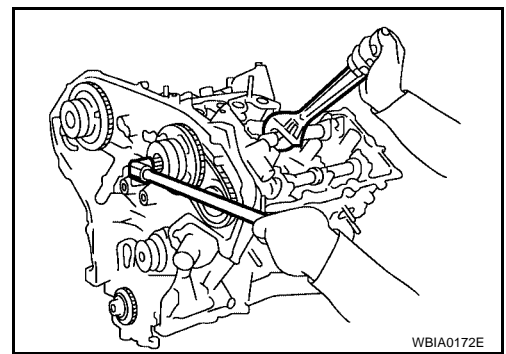
- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the sprocket teeth in advance with paint.



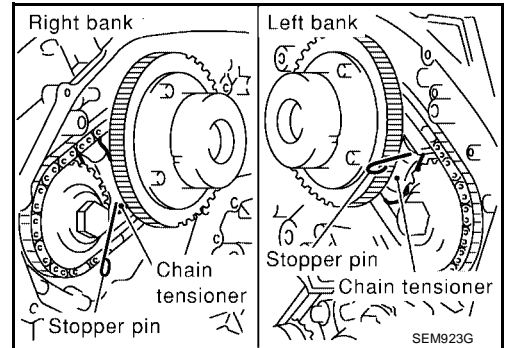
# TIMING CHAIN

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

**Camshaft sprocket bolts : 102.5 N-m (10 kg-m, 76 ft-lb)**

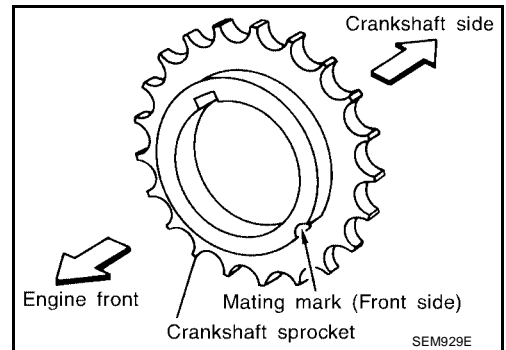


14. Pull the stopper pins out from the timing chain tensioners (for secondary timing chains).



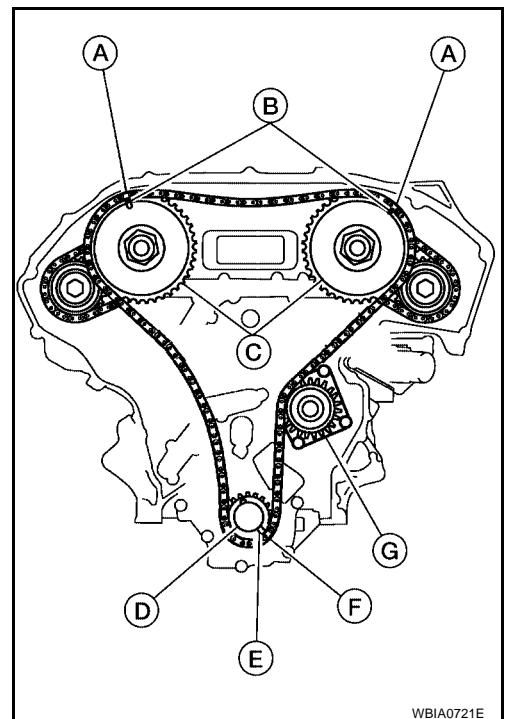
15. Install the crankshaft sprocket on the crankshaft.

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



16. Install the primary timing chain.

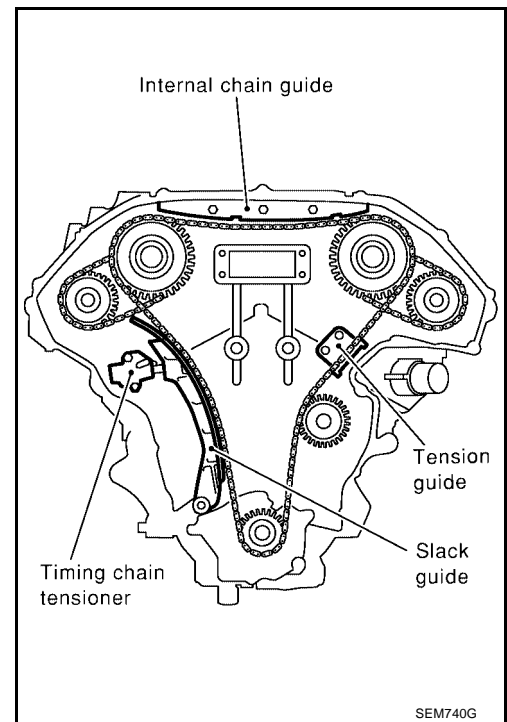
- Water pump (G).
- Install primary timing chain so the mating mark punched (B) on camshaft sprocket is aligned with the copper link (A) on the timing chain, while the mating mark notched (E) on the crankshaft sprocket (D) is aligned with the yellow link (F) on the timing chain, as shown.
- When it is difficult to align mating marks (A) with (B) and (E) with (F) 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

17. Install the internal chain guide.

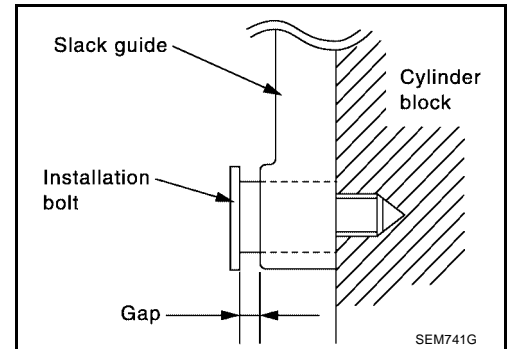
**Internal chain guide bolts : 8.1 N-m (0.83 kg-m, 72 in-lb)**



18. Install the slack guide.

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

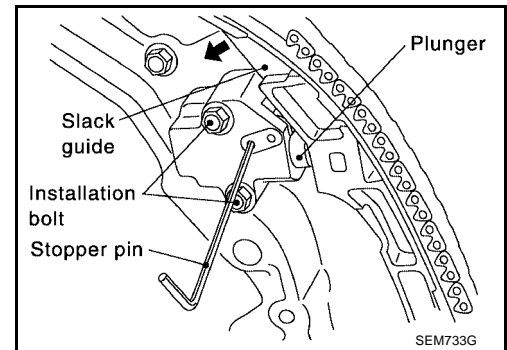
**Slack guide bolt : 15.7 N-m (1.6 kg-m, 12 ft-lb)**



19. Install the timing chain tensioner for the slack guide.

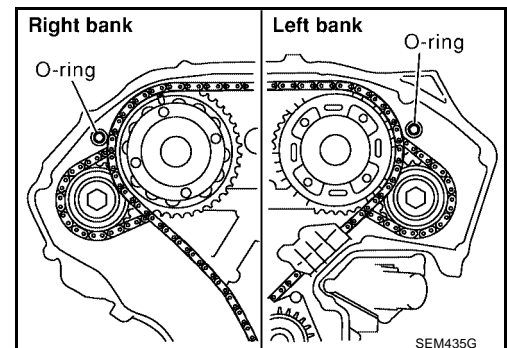
**Timing chain tensioner bolts : 8.1 N-m (0.83 kg-m, 72 in-lb)**

- 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.



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

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



# TIMING CHAIN

22. Install the front oil seal on the front timing chain case using a suitable tool. Apply clean engine oil to the oil seal edges.

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

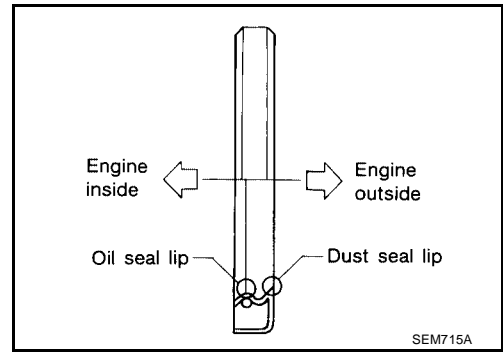
**Suitable drift**

**Outer diameter : 59 mm (2.32 in)**

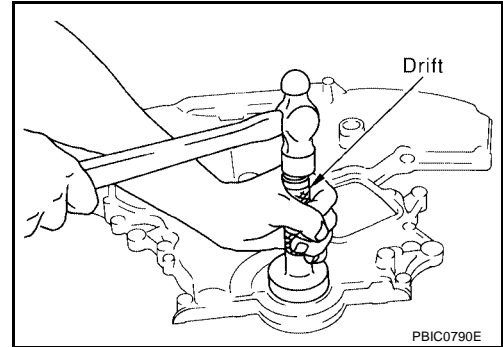
**Inner diameter : 49 mm (1.93 in)**

**CAUTION:**

**Press fit straight and avoid causing burrs or tilting the oil seal.**

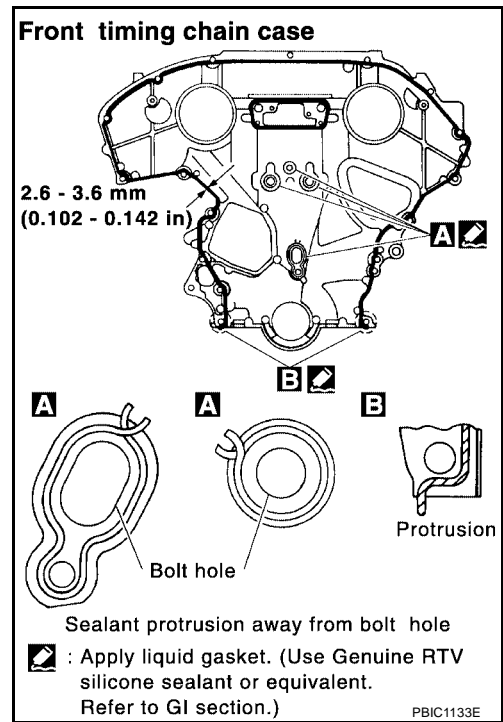


- Using a suitable drift, press-fit oil seal until it becomes flush with timing chain case end face.
- Make sure the garter spring in the oil seal is in position and seal lip is not inverted.



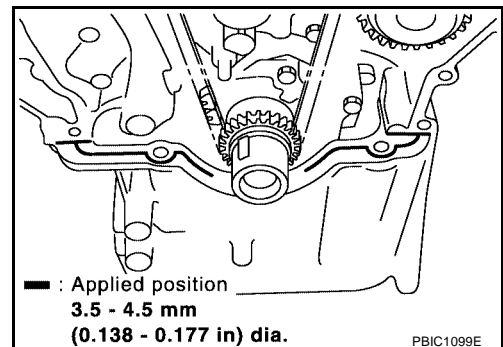
23. Apply Silicone RTV Sealant to front timing chain case as shown.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Before installation, wipe off the protruding sealant.
- Install dowel pin on the rear timing chain case into dowel pin hole in front timing chain case.



24. Apply Silicone RTV Sealant to top surface of oil pan (upper) as shown.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).



A  
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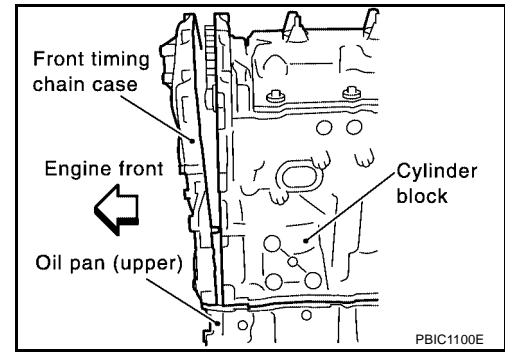
# TIMING CHAIN

25. Install front timing chain case.

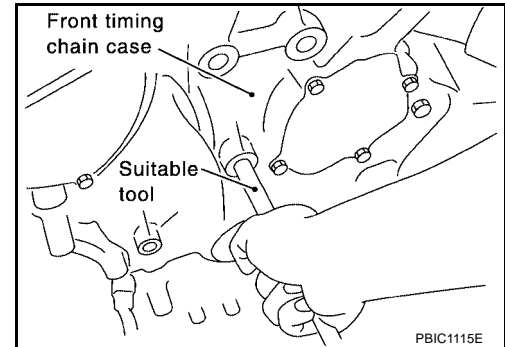
- a. Install lower end of front timing chain case tightly onto top surface of oil pan (upper).

**CAUTION:**

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

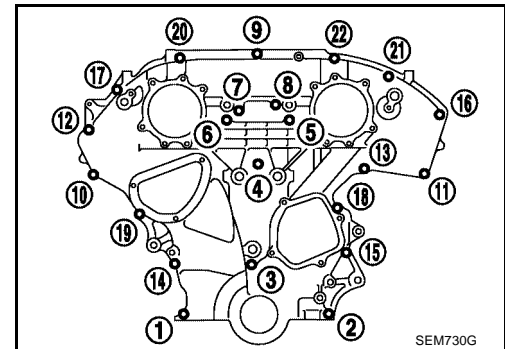


- b. While pressing front timing chain case from its front and top using suitable tool, hammer dowel pin until the outer end becomes flush with surface.



26. Loosely install the front timing chain case bolts.

| Bolt position | Bolt diameter    |
|---------------|------------------|
| 1, 2          | : 8 mm (0.31 in) |
| 3 – 22        | : 6 mm (0.24 in) |



27. Tighten the front timing chain case bolts in the order shown.

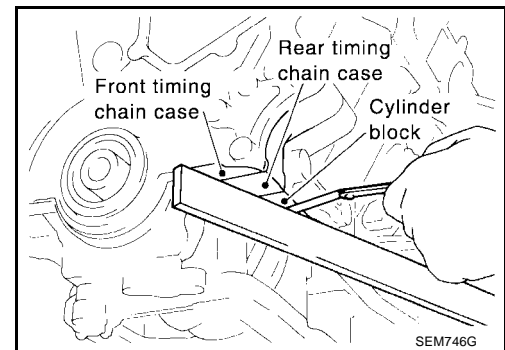
- Retighten the front timing chain case bolts in the order shown.

| Bolt position | Tightening specification        |
|---------------|---------------------------------|
| 1, 2          | : 28.5 N·m (2.9 kg·m, 21 ft·lb) |
| 3 – 22        | : 12.8 N·m (1.3 kg·m, 9 ft·lb)  |

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

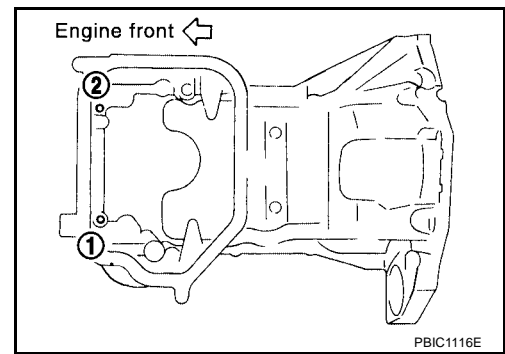
- If not within specification, repeat the installation procedure.

|   |   |
|---|---|
| Front timing chain case to rear timing chain case | : (-0.14) - 0.14 mm [(-0.0055) - 0.0055 in]       |
| Oil pump to cylinder block                        | : (-0.36) - (-0.10) mm [(-0.0142) - (-0.0039) in] |



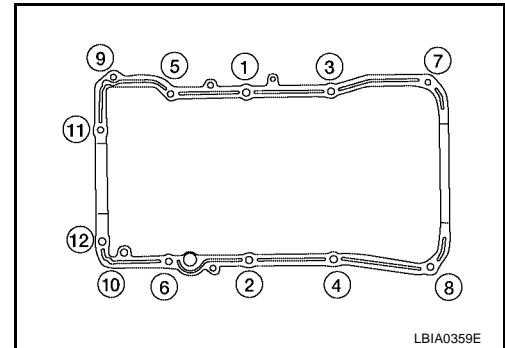
# TIMING CHAIN

29. Install the upper oil pan front bolts in the order shown refer to [EM-31, "Removal and Installation"](#) .

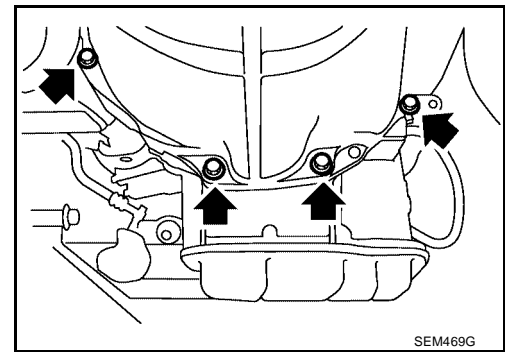


30. Install the upper oil pan.

- Tighten upper oil pan bolts in the order shown refer to [EM-31, "Removal and Installation"](#) .
- Wait at least 30 minutes before refilling the engine with oil.

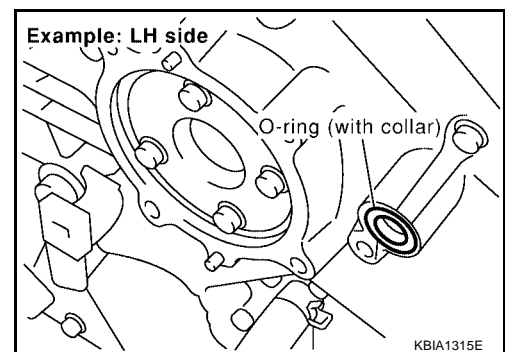


31. Install the four upper oil pan to transaxle bolts. Refer to [EM-120, "INSTALLATION"](#) .

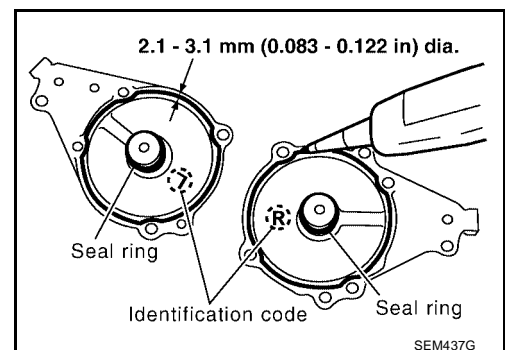


32. Install IVT control valve covers as follows:

- a. Install new collared O-rings in front cover oil hole (LH and RH sides).



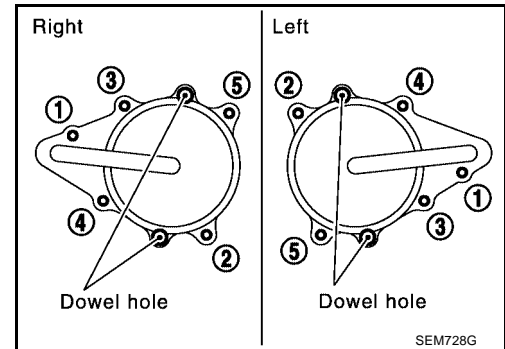
- b. Install new seal rings on the IVT control covers.  
 c. Apply Silicone RTV Sealant to the IVT control covers.  
 ● Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .



# TIMING CHAIN

- 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 IVT control covers.
- Tighten the intake valve timing control cover bolts in the order shown.

**Intake valve timing control cover bolts : 11.3 N-m (1.2 kg-m, 8 ft-lb)**

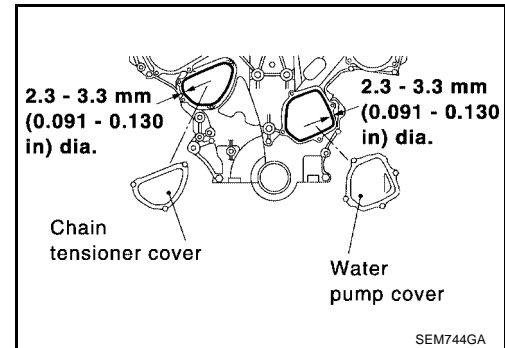


33. Apply liquid gasket and install the water pump cover and the chain tensioner cover.

**Water pump cover bolts : 11 N-m (1.1 kg-m, 97 in-lb)**

**Chain tensioner cover bolts : 11 N-m (1.1 kg-m, 97 in-lb)**

- Use Genuine Silicone RTV Sealant or equivalent. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).

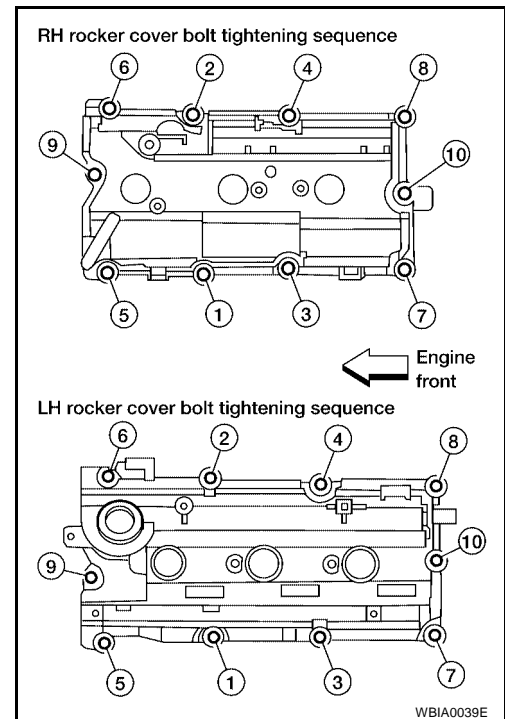


34. Install the RH engine mounting insulator, mount and bracket. Refer to [EM-117, "Removal and Installation"](#).

35. Install the RH and LH rocker covers. Tighten the rocker cover bolts in two steps in the order shown.

**Step 1 : 0.96 - 2.96 N-m (0.1 - 0.3 kg-m, 9 - 26 in-lb)**

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



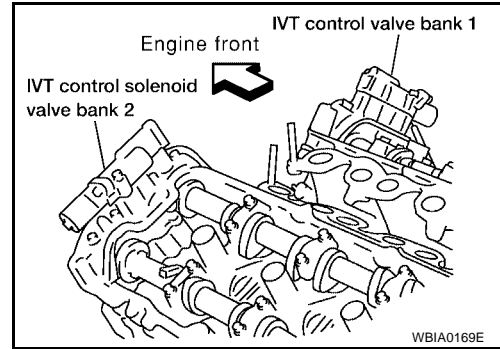


# TIMING CHAIN

36. Install the IVT control solenoid valve bank 1 and bank 2.

**IVT control solenoid valve bolts** : 9.81 - 12.70 N·m (1.0 - 1.2 kg·m, 87 - 112 in·lb)

37. Install the engine oil dipstick.



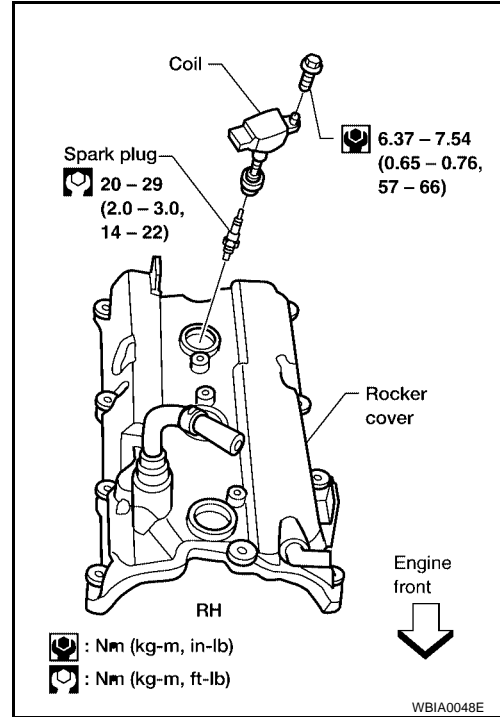
38. Install the six spark plugs in their original positions.

**Spark plugs** : 20 - 29 N·m (2.0 - 3.0 kg·m, 14 - 22 ft·lb)

39. Install the six ignition coils in their original positions.

**Ignition coils** : 6.37 - 7.54 N·m (0.65 - 0.76 kg·m, 57 - 66 in·lb)

40. Install the intake manifold collector. Refer to [EM-20, "INSTALLATION"](#).



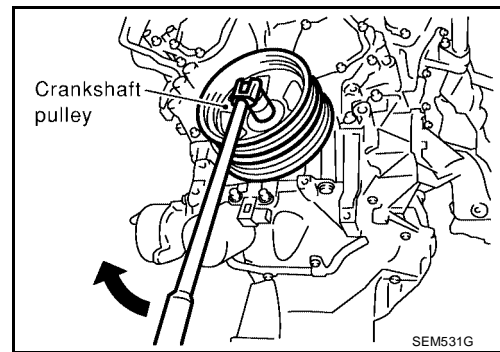
41. Install crankshaft pulley and tighten the bolt in two steps.

- Lubricate thread and seat surface of the bolt with new engine oil.
- For the second step of angle tightening use Tool.

**Step 1** : 39 - 49 N·m (4.0 - 5.0 kg·m, 29 - 36 ft·lb)

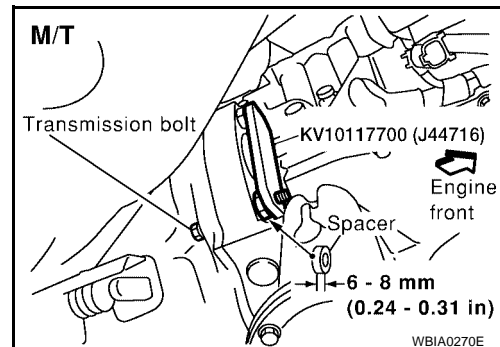
**Step 2** : 84° - 90° degrees clockwise

**Tool number** : KV10112100 (BT-8653-A)

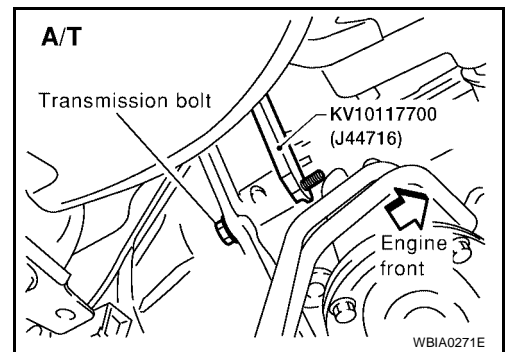


42. Remove Tool.

**Tool number** : KV10117700 (J-44716)



## TIMING CHAIN



43. Install the starter motor. Refer to [SC-17, "Removal and Installation"](#) .
44. Install the RH engine mounting insulator, mount and bracket. Refer to [EM-117, "Removal and Installation"](#) .
45. Reposition and reconnect the engine harness.
46. Install the generator. Refer to [SC-31, "INSTALLATION"](#) .
47. Install the upper and lower oil pans. Refer to [EM-34, "INSTALLATION"](#) .
48. Install the power steering pump. Refer to [PS-26, "INSTALLATION"](#) .
49. Install the A/C compressor and recharge the system. Refer to [ATC-122, "Removal and Installation for Compressor"](#) .
50. Install the idler pulley and the drive belts. Refer to [EM-15, "Removal and Installation"](#) .
51. Install the inner fender splash shield and the engine undercover.
52. Connect the inlet coolant hose.
53. Install the IPDM E/R and bracket.
54. Install the RH wheel and tire. Refer to [WT-4, "WHEEL AND TIRE ASSEMBLY"](#) .
55. Install the windshield wiper assembly. Refer to [WW-23, "INSTALLATION"](#) .
56. Install the cowl top grille. Refer to [EI-19, "Removal and Installation"](#) .
57. Install the fuel hose quick connector to the fuel tube at the vehicle piping side. Refer to [EM-41, "INSTALLATION"](#) .
58. Install the engine coolant reservoir.
59. Install the intake air duct with the air cleaner case lid and mass air flow sensor. Refer to [EM-17, "INSTALLATION"](#) .
60. Install engine cover.
61. Refill the coolant. Refer to [MA-14, "REFILLING ENGINE COOLANT"](#) .

**CAUTION:**

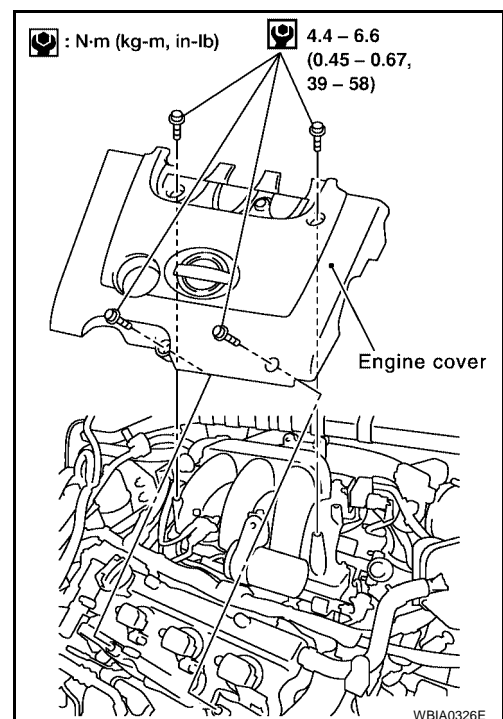
**Wait at least 30 minutes for the Silicone RTV Sealant to set before filling the engine with fluids to avoid leaks.**

62. Refill the engine oil. Refer to [MA-16, "Changing Engine Oil"](#) .

**CAUTION:**

**Wait at least 30 minutes for the Silicone RTV Sealant to set before filling the engine with fluids to avoid leaks.**

63. Connect the battery negative terminal.
64. Activate the fuel system. Check for any leaks when the system is repressurized and correct as necessary.
65. Start the engine and check all systems for leaks or improper operation. Correct as necessary.
  - After starting engine, keep idling for three minutes. Then rev engine up to 3,000 rpm under no load to purge air from the high-pressure oil chamber of the chain tensioners. The engine may produce a rattling noise. This indicates that air still remains in the chamber and is not a matter of concern.



# CAMSHAFT

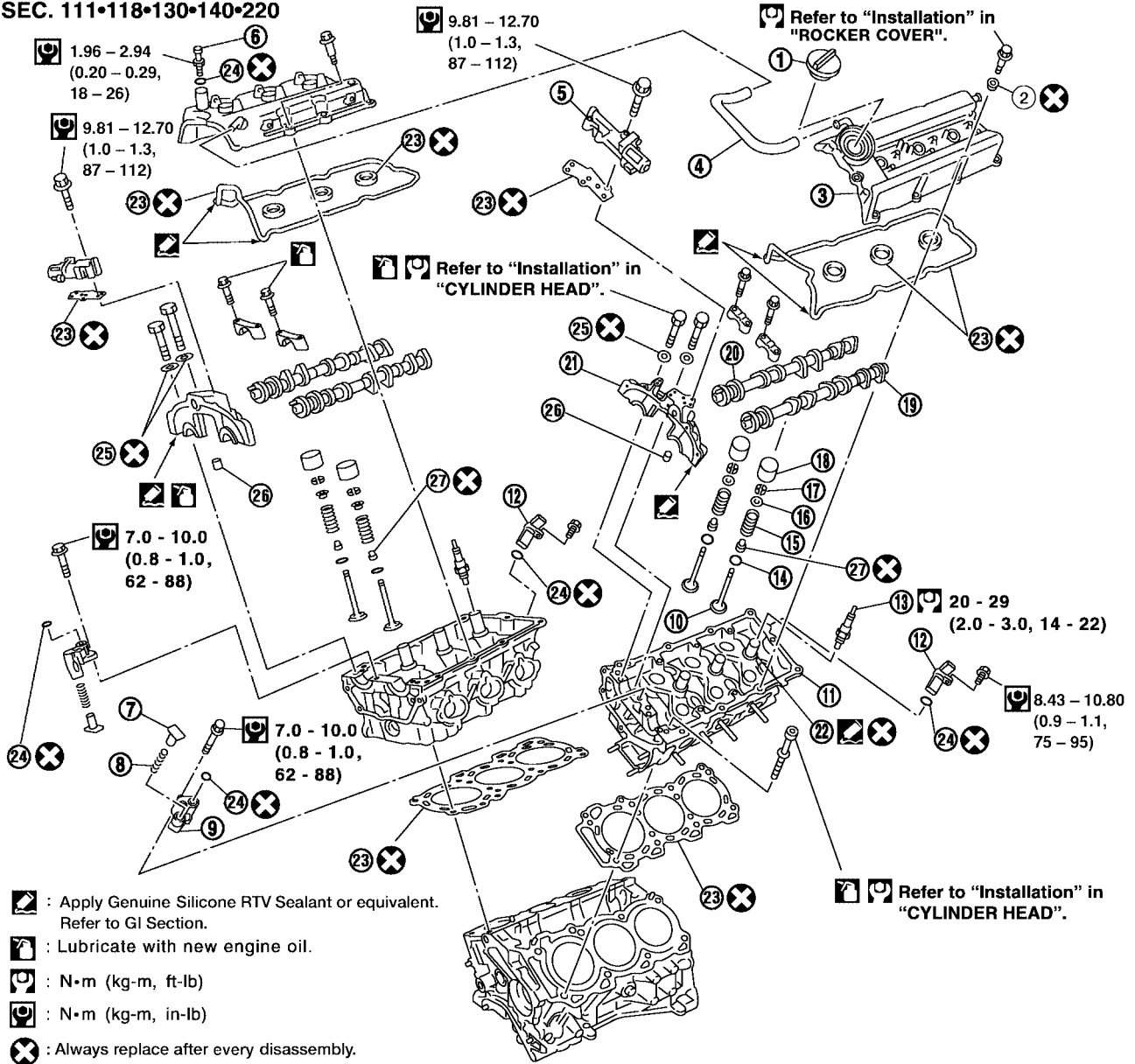
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## CAMSHAFT

### Removal and Installation

SEC. 111•118•130•140•220



- |                           |                               |                                      |
|---------------------------|-------------------------------|--------------------------------------|
| 1. Oil filler cap         | 2. Washer                     | 3. Rocker cover                      |
| 4. PCV hose               | 5. IVT control solenoid valve | 6. PCV valve                         |
| 7. Tensioner sleeve       | 8. Tensioner spring           | 9. Camshaft chain tensioner          |
| 10. Valve                 | 11. Cylinder head             | 12. Camshaft position sensor (PHASE) |
| 13. Spark plug            | 14. Valve spring seat         | 15. Valve spring                     |
| 16. Valve spring retainer | 17. Valve collet              | 18. Valve lifter                     |
| 19. Camshaft (EXH)        | 20. Camshaft (INT)            | 21. Camshaft bracket                 |
| 22. Spark plug tube       | 23. Gasket                    | 24. O-ring                           |
| 25. Seal washer           | 26. Dowel pin                 | 27. Valve oil seal                   |

WBIA0275E

# CAMSHAFT

## CAUTION:

Apply new engine oil to parts marked in illustration before installation.

## REMOVAL

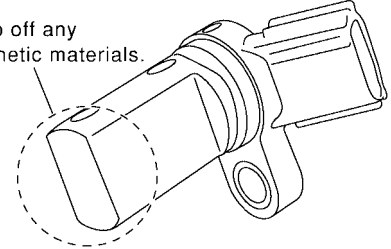
1. Remove the timing chains. Refer to [EM-59, "REMOVAL"](#).
2. If necessary, remove camshaft position sensor (PHASE) (right and left bank) from cylinder head back side.

## CAUTION:

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

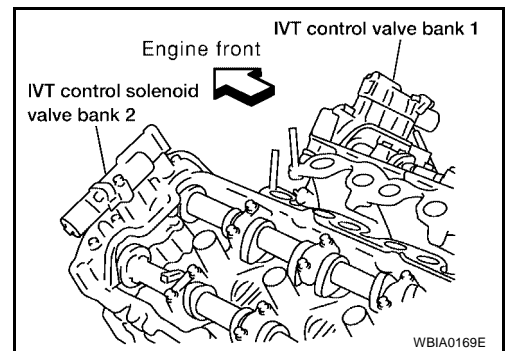
Example: Left bank

Keep off any magnetic materials.



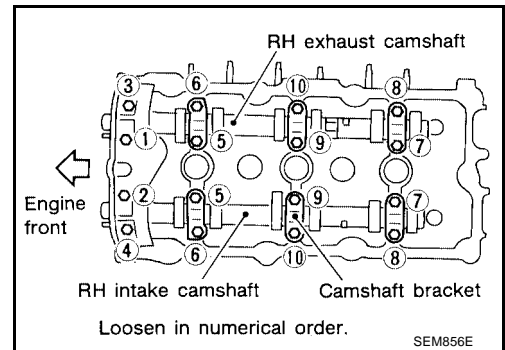
KBIA1046E

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

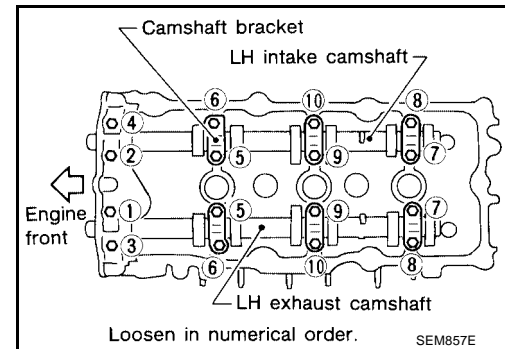


WBIA0169E

4. Remove the intake and exhaust camshaft brackets and the camshafts.
  - 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 order shown.



SEM856E



SEM857E

5. Remove valve lifters.

## NOTE:

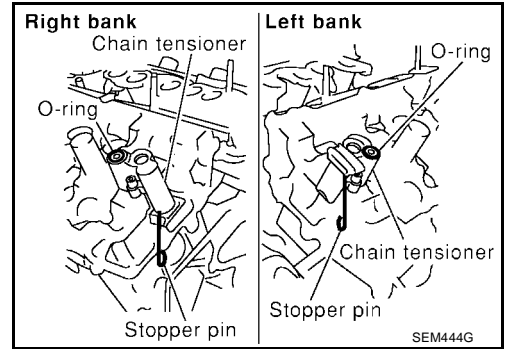
Identify installation positions to ensure proper installation.

# CAMSHAFT

- Remove camshaft timing chain tensioner from cylinder head with the stopper pin inserted.

**NOTE:**

Stopper pin was installed when secondary timing chain was removed.



A  
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# CAMSHAFT

## INSPECTION AFTER REMOVAL

### Camshaft Visual Check

Check camshaft for scratches, seizure and wear. Replace if necessary.

### Camshaft Runout

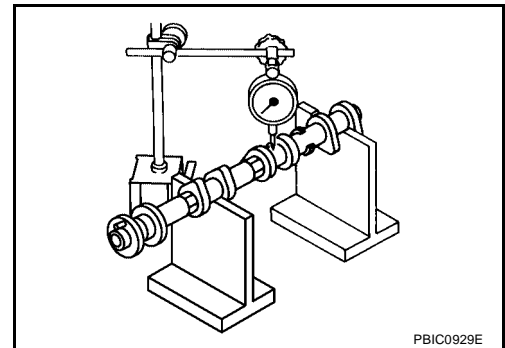
1. Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
2. Set dial gauges vertically to No. 3 journal as shown.
3. Turn camshaft in one direction slowly by hand, measure the camshaft runout on the dial gauges.
  - Runout is the largest indicator reading after one full revolution.

#### Camshaft Runout

**Standard : Less than 0.02 mm (0.0008 in)**

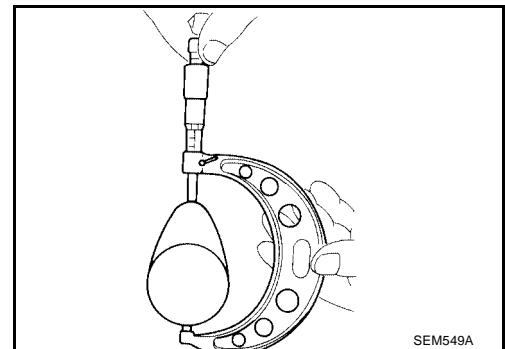
**Limit : 0.05 mm (0.0020 in)**

4. If actual runout exceeds the limit, replace the camshaft.



### Camshaft Cam Lobe Height

1. Measure camshaft cam lobe height as shown. Refer to [EM-156, "CAMSHAFT AND CAMSHAFT BEARING"](#).
2. If wear has reduced the lobe height below specifications, replace the camshaft.



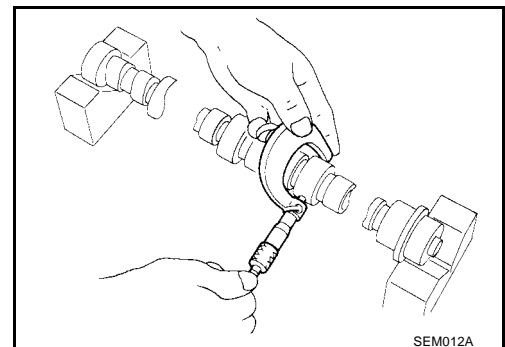
### Camshaft Journal Clearance

#### Outer Diameter of Camshaft Journal

- Measure outer diameter of camshaft journal as shown.

**Standard outer diameter, No.1 : 25.935 - 25.955 mm (1.0211 - 1.0218 in)**

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

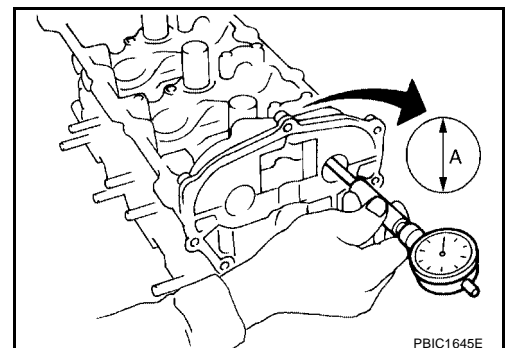


#### Inner Diameter of Camshaft Bracket

1. Tighten camshaft bracket bolts to specified torque. Refer to [EM-88, "INSTALLATION"](#).
2. Using inside micrometer, measure inner diameter "A" of camshaft bearing.

**Standard inner diameter No.1 : 26.000 - 26.021 mm (1.0236 - 1.0244 in)**

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



# CAMSHAFT

## 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)

**Standard 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 specified range, 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.

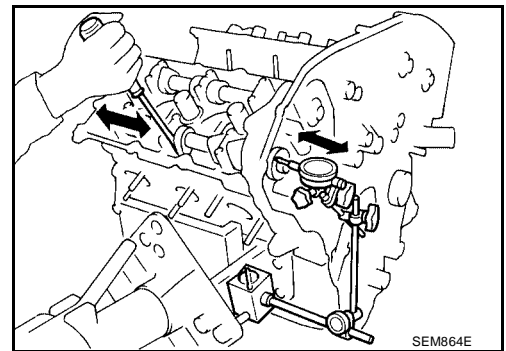
## Camshaft End Play

- Install the camshaft in the cylinder head. Refer to [EM-88, "INSTALLATION"](#).
- Install dial gauge in thrust direction on front end of camshaft. Measure end play when camshaft is moved forward/backward (in direction to axis) as shown.

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

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

- If out of the specified range, replace with new camshaft and measure again.
- If out of the specified range again, replace with new cylinder head.

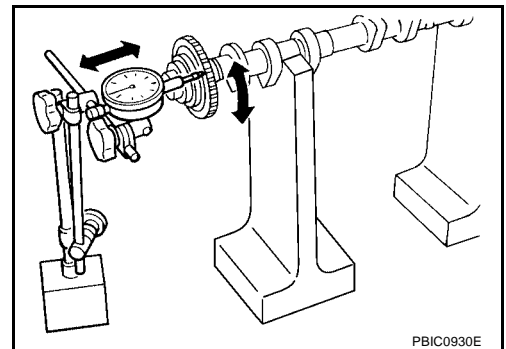


## Camshaft Sprocket Runout

- Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
- Install camshaft sprocket on camshaft.
- Measure camshaft sprocket runout.

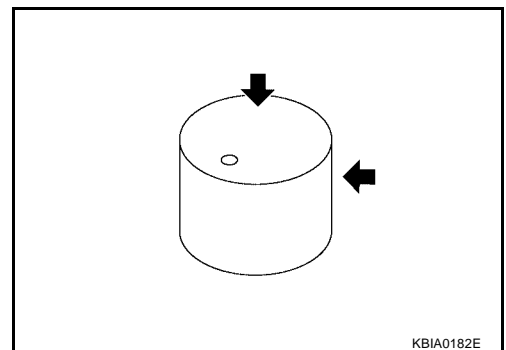
**Limit** : 0.15 mm (0.0059 in)

- If sprocket runout exceeds the limit, replace camshaft sprocket.



## Valve Lifter

- Check if the surface of the valve lifter has any excessive wear or cracks, replace as necessary.

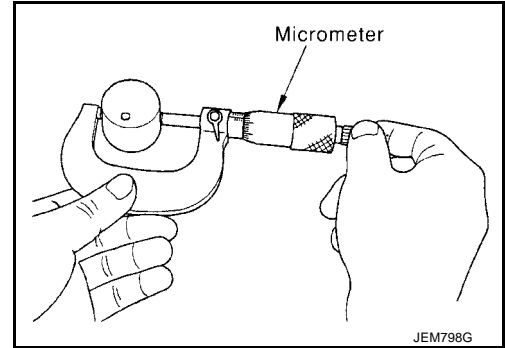


# CAMSHAFT

## Valve Lifter Clearance

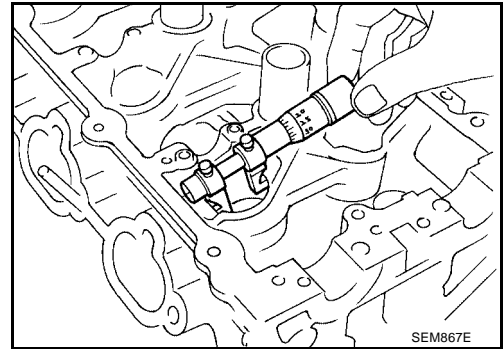
### Outer Diameter of Valve Lifter

- Measure the outer diameter of the valve lifter. Refer to [EM-153, "Valve Lifter"](#).
- If out of the specified range, replace the valve lifter.



### Valve Lifter Bore Diameter

- Using inside micrometer, measure diameter of valve lifter bore of cylinder head. Refer to [EM-153, "Valve Lifter"](#).
- If out of the specified range, replace the cylinder head assembly.



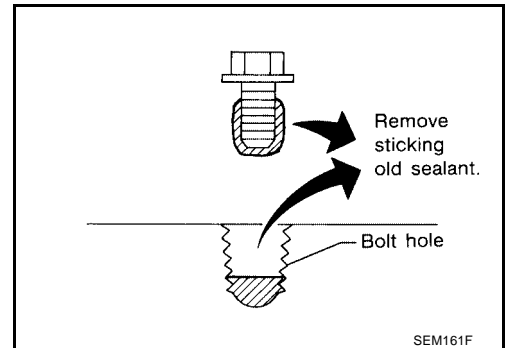
### Calculation of Valve Lifter Clearance

- (Valve lifter clearance) = (hole diameter for valve lifter) – (outer diameter of valve lifter). Refer to [EM-153, "Valve Lifter"](#).
- If out of specified range, replace either or both valve lifter and cylinder head assembly.

## INSTALLATION

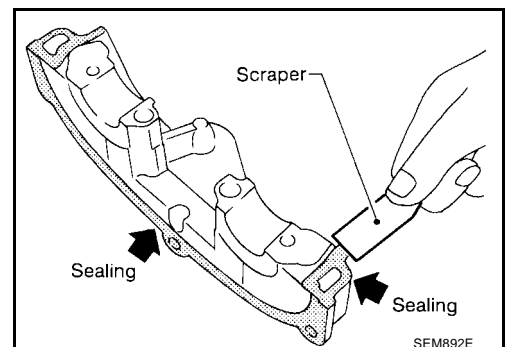
1. Before installation, remove any old Silicone RTV Sealant from component mating surfaces using a scraper.

- Remove the old Silicone RTV Sealant from the bolt holes and threads.
- Do not scratch or damage the mating surfaces.



2. Before installing the No. 1 camshaft bracket, remove the old Silicone RTV Sealant from the mating surface using a scraper.

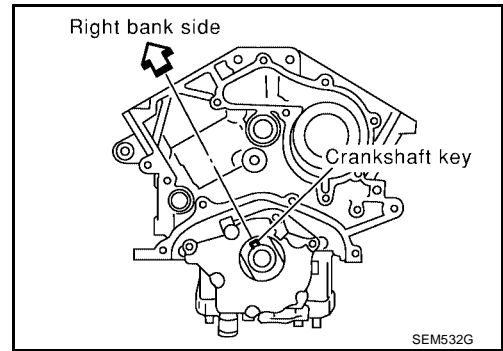
- Do not scratch or damage the mating surface.





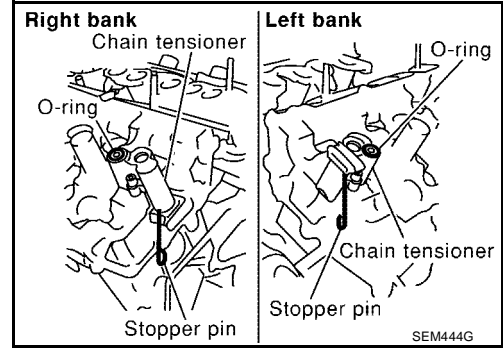
# CAMSHAFT

3. 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.



4. Install camshaft chain tensioners on both sides of cylinder head.

**Camshaft chain tensioner bolts : 7 - 10 N·m (0.8 - 1.0 kg-m, 62 - 88 in-lb)**



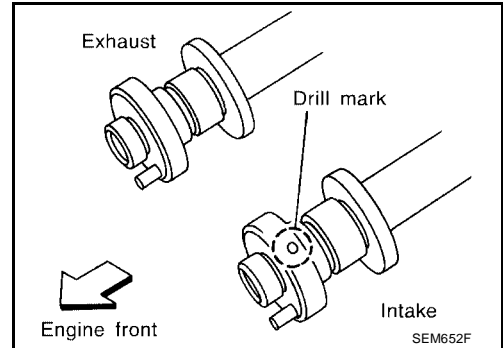
5. Install valve lifters.

**NOTE:**

Install them in original positions.

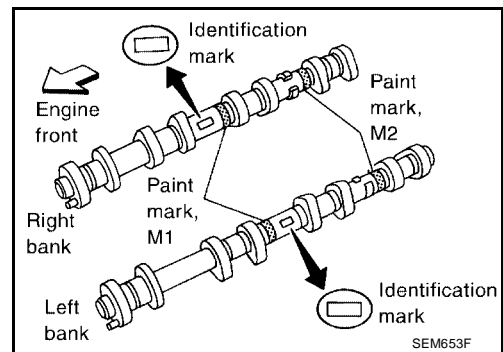
6. Install exhaust and intake camshafts and camshaft brackets.

- Intake camshaft has a drill mark on camshaft sprocket mounting flange.



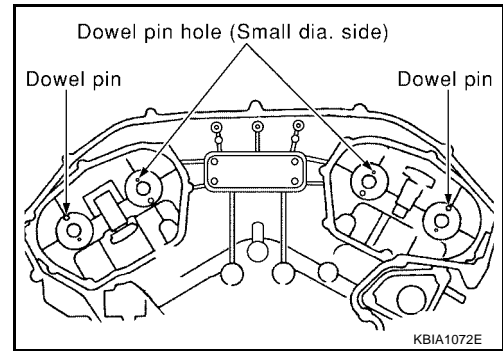
- Follow your identification marks made during removal, or follow the identification marks that are present on the new camshafts components for proper placement and direction of the components.

| Bank | INT/EXH | ID mark | Drill mark | Paint marks |     |
|------|---------|---------|------------|-------------|-----|
|      |         |         |            | M1          | M2  |
| RH   | INT     | RE      | Yes        | Yes         | No  |
|      | EXH     | RE      | No         | No          | Yes |
| LH   | INT     | LH      | Yes        | Yes         | No  |
|      | EXH     | LH      | No         | No          | Yes |



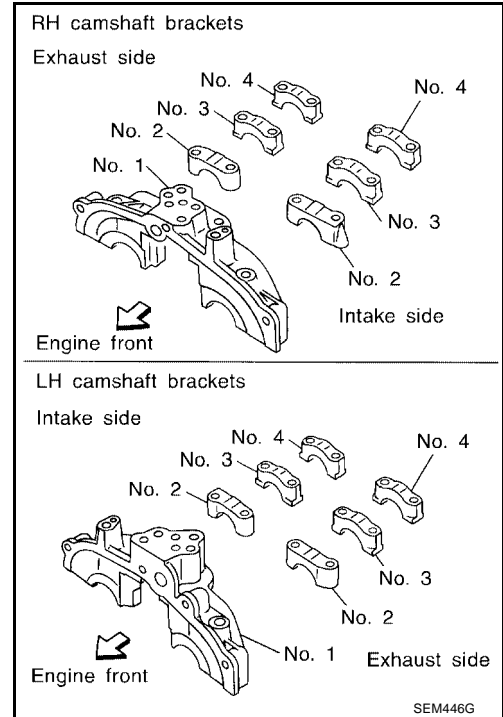
# CAMSHAFT

- Position the camshafts:  
RH exhaust camshaft dowel pin at about 10 o'clock.  
LH exhaust camshaft dowel pin at about 2 o'clock.

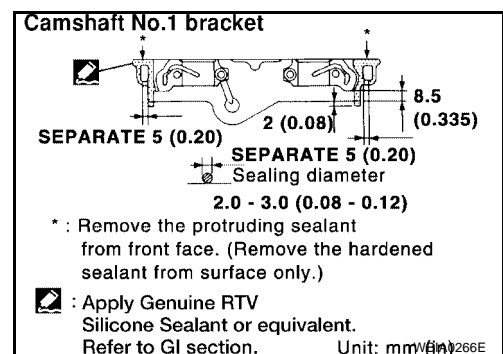


7. Before installing camshaft brackets, apply sealant to mating surface of No. 1 camshaft bracket.

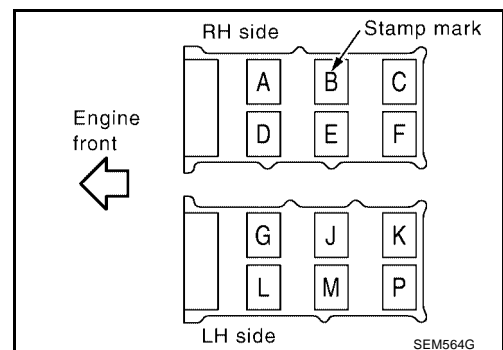
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



- Before installation, wipe off any protruding sealant.
- Refer to [EM-4, "LIQUID GASKET APPLICATION PROCEDURE"](#).



- Install camshaft brackets in their original positions and direction. Align the stamp marks as shown.
- If checking and adjusting any part of valve assembly or camshaft, check valve clearance according to the reference data. Refer to [EM-93, "Valve Clearance"](#).



# CAMSHAFT

8. Tighten the camshaft brackets in the four steps, in the order shown.

**NOTE:**

Lubricate the threads and seat surfaces of the camshaft bracket bolts with new engine oil before installation.

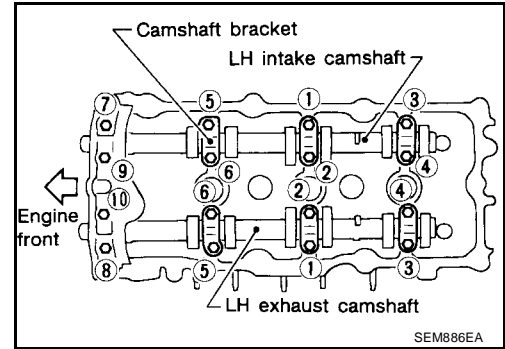
**Camshaft bracket bolts**

**Step 1 (bolts 7 - 10) : 1.96 N-m (0.2 kg-m, 17 in-lb)**

**Step 2 (bolts 1 - 6) : 1.96 N-m (0.2 kg-m, 17 in-lb)**

**Step 3 : 5.88 N-m (0.6 kg-m, 52 in-lb)**

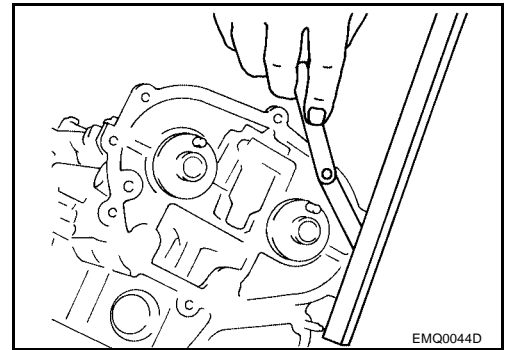
**Step 4 (bolts 1 - 6) : 10.4 N-m (1.1 kg-m, 92 in-lb)**



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

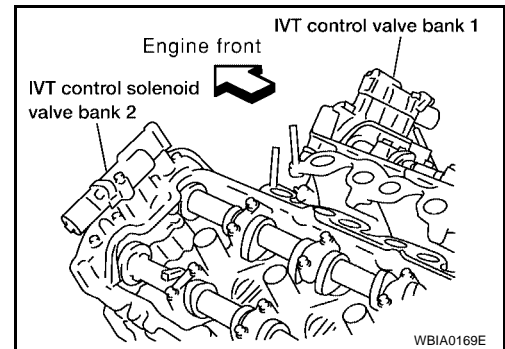
**Standard : - 0.14 (- 0.0055 in)**

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



10. Install the IVT control solenoid valves with new gaskets.

**IVT control solenoid valve bolts : 9.81 - 12.7 N-m (1.0 - 1.2 kg-m, 87 - 112 in-lb)**



11. If necessary, install camshaft position sensor (PHASE) (RH and LH bank.)

**Camshaft position sensor (PHASE) bolt : 8.4 - 10.8 N-m (0.9 - 1.1 kg-m, 75 - 95 in-lb)**

12. Install the timing chains. Refer to [EM-70, "INSTALLATION"](#) .
13. Install the LH and RH rocker cover refer to [EM-44, "INSTALLATION"](#) .
14. Install the fuel rail and injectors. Refer to [EM-40, "Removal and Installation"](#) .
15. Installation of the remaining components is in the reverse order of removal.

# CAMSHAFT

EBS00M6V

## INSPECTION AFTER INSTALLATION

### INSPECTION OF CAMSHAFT SPROCKET (INT) OIL GROOVE

#### CAUTION:

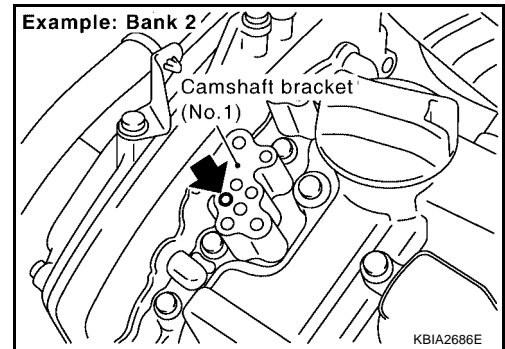
- Perform this inspection only when DTC P0011 and/or DTC0021 are detected in self-diagnostic results of CONSULT II and it is directed according to inspection procedure of EC section. Refer to [EC-175, "DTC P0011, P0021 IVT CONTROL"](#) .
  - Check when engine is cold so as to prevent burns from any splashing engine oil.
1. Check engine oil level. Refer to [LU-7, "ENGINE OIL"](#) .
  2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
    - a. Release fuel pressure. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#) .
    - b. Disconnect ignition coil and injector harness connectors if practical.
  3. Remove IVT control solenoid valve. Refer to [EM-83, "CAMSHAFT"](#) .
  4. Crank engine, and then make sure that engine oil comes out from IVT control cover oil hole. End cranking after checking.

#### WARNING:

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

#### CAUTION:

- Engine oil may squirt from IVT control solenoid valve installation hole during cranking. Use a shop cloth to prevent engine oil from splashing on worker, engine components and vehicle.
  - Do not allow engine oil to get on rubber components such as drive belts or engine mount insulators. Immediately wipe off any splashed engine oil.
5. Clean oil groove between oil strainer and IVT control solenoid valve if engine oil does not come out from IVT control cover (No. 1) oil hole. Refer to [LU-5, "LUBRICATION SYSTEM"](#) .
  6. Remove components between IVT control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
    - Clean oil groove if necessary. Refer to [LU-5, "LUBRICATION SYSTEM"](#) .



# CAMSHAFT

EBS00JAZ

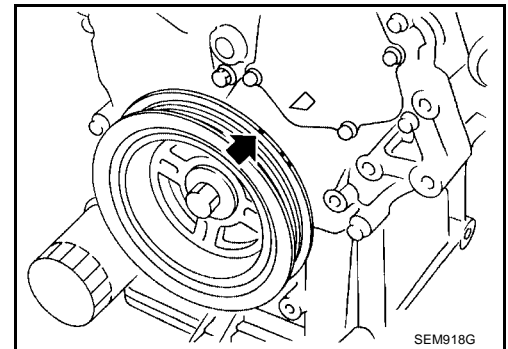
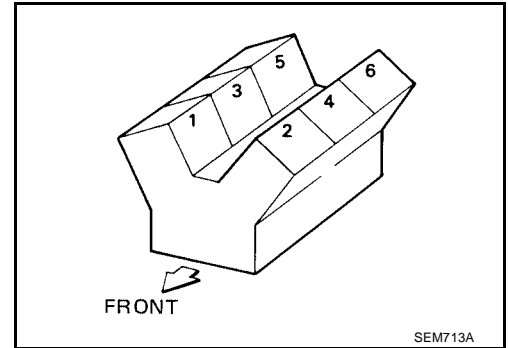
## Valve Clearance CHECKING

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.

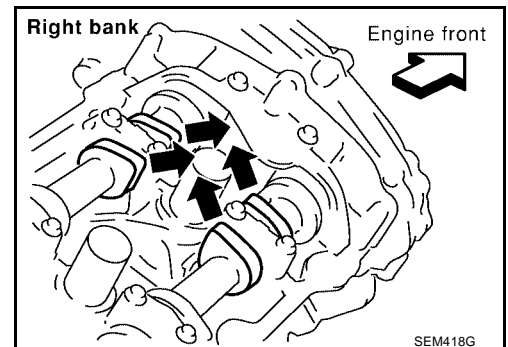
### NOTE:

Check valve clearance while engine is cold and not running.

1. Remove the intake manifold collectors. Refer to [EM-19, "REMOVAL"](#).
2. Remove the ignition coils. Refer to [EM-37, "REMOVAL"](#).
3. Remove the spark plugs. Refer to [EM-38, "REMOVAL"](#).
4. Remove the rocker covers. [EM-43, "REMOVAL"](#).
5. Set No.1 cylinder at TDC on its compression stroke.
  - Align pointer with TDC mark on crankshaft pulley.



- Check that the valve lifters on No.1 cylinder are loose and valve lifters on No.4 are tight. If not, turn the crankshaft one full revolution (360°) and align as shown.



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# CAMSHAFT

6. Check only the valves as shown.

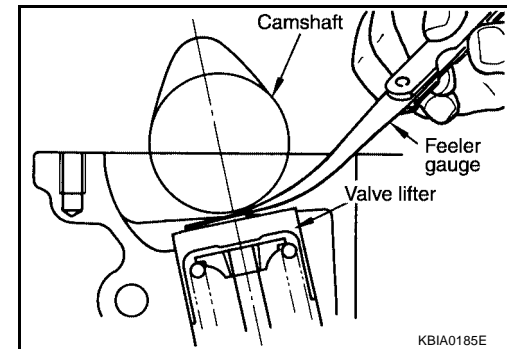
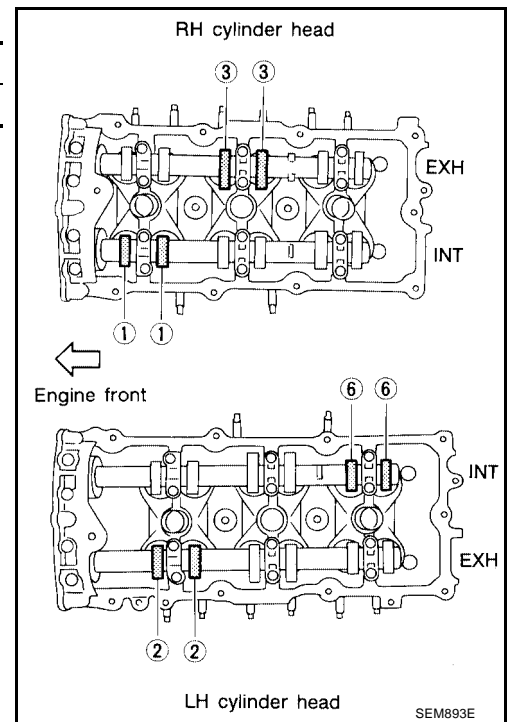
| Crank Position | Valve No. 1 | Valve No. 2 | Valve No. 3 | Valve No. 6 |
|----------------|-------------|-------------|-------------|-------------|
| No. 1 TDC      | Intake      | Exhaust     | Exhaust     | Intake      |

- Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
- Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement lifter size.

### Valve Clearance for Checking (cold)

**Intake** : 0.26 - 0.34 mm (0.010 - 0.013 in)

**Exhaust** : 0.29 - 0.37 mm (0.011 - 0.015 in)



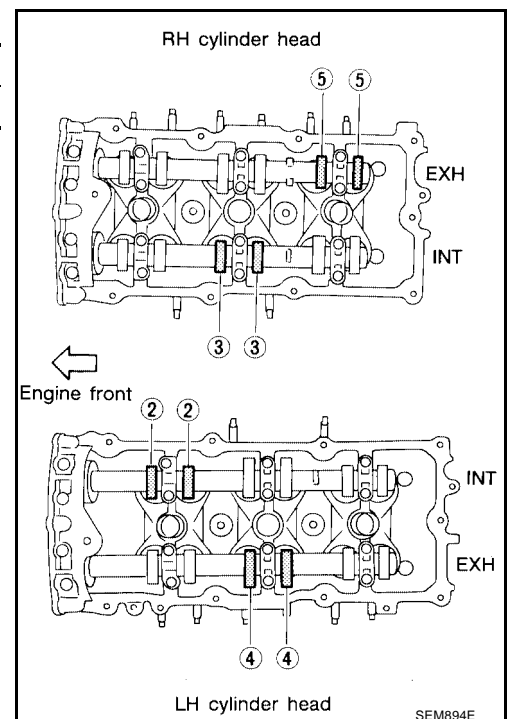
7. Turn crankshaft 240°.
8. Set No.3 cylinder at TDC on its compression stroke.
9. Check only those valves as shown.

| Crank Position | Valve No. 2 | Valve No. 3 | Valve No. 4 | Valve No. 5 |
|----------------|-------------|-------------|-------------|-------------|
| No. 3 TDC      | Intake      | Intake      | Exhaust     | Exhaust     |

### Valve Clearance for Checking (cold)

**Intake** : 0.26 - 0.34 mm (0.010 - 0.013 in)

**Exhaust** : 0.29 - 0.37 mm (0.011 - 0.015 in)



# CAMSHAFT

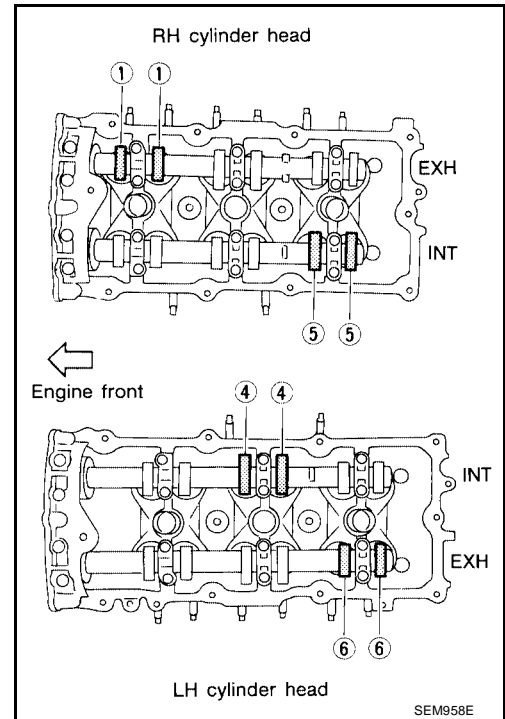
10. Turn the crankshaft 240° and align as above.
11. Set No.5 cylinder at TDC on its compression stroke.
12. Check only those valves as shown.

| Crank Position | Valve No. 1 | Valve No. 4 | Valve No. 5 | Valve No. 6 |
|----------------|-------------|-------------|-------------|-------------|
| No. 5 TDC      | Exhaust     | Intake      | Intake      | Exhaust     |

## Valve Clearance for Checking (cold)

**Intake** : 0.26 - 0.34 mm (0.010 - 0.013 in)

**Exhaust** : 0.29 - 0.37 mm (0.011 - 0.015 in)



13. If all valve clearances are within specification, install the following components. If the valve clearances are out of specification, adjust the valve clearances.

- Rocker covers. Refer to [EM-44, "INSTALLATION"](#) .
- All spark plugs. Refer to [EM-39, "INSTALLATION"](#) .
- All ignition coils. Refer to [EM-37, "INSTALLATION"](#) .
- Intake manifold collectors. Refer to [EM-20, "INSTALLATION"](#) .

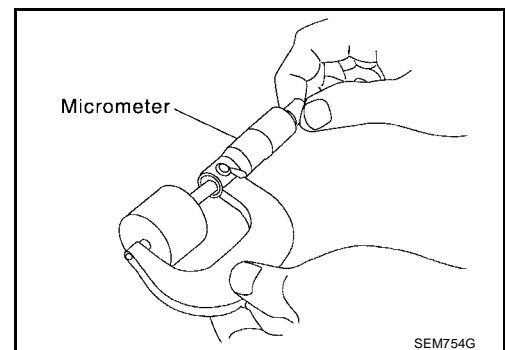
## VALVE ADJUSTING

### CAUTION:

Adjust valve clearance while engine is cold.

### NOTE:

- Perform adjustment by selecting the correct head thickness of the valve lifter (adjusting shims are not used).
  - The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use specifications for hot engine condition to confirm valve clearances.
1. Remove the camshaft. Refer to [EM-84, "REMOVAL"](#) .
  2. Remove the valve lifter that was measured as being outside the standard specifications.
  3. Measure the center thickness of the removed lifter with a micrometer as shown.



# CAMSHAFT

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

Valve lifter thickness calculation equation:  $t = t1 + (C1 - C2)$

t = thickness of the replacement lifter

t1 = thickness of the removed lifter

C1 = measured valve clearance

C2 = standard valve clearance

- The thickness of the new valve lifter can be identified by the stamped mark on the reverse side (inside the lifter).
- Available thickness of the valve lifter (factory setting): 7.88 - 8.40 mm (0.3102 - 0.3307 in), in 0.02 mm (0.0008 in) increments, in 27 sizes (intake / exhaust). Refer to [EM-153, "Valve Lifter"](#).

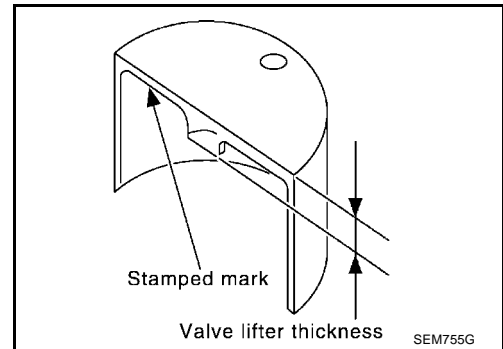
**NOTE:**

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

**Value lifter thickness**

**Intake : 0.30 mm (0.012 in)**

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



5. Install the selected replacement valve lifter.
6. Install the camshaft. Refer to [EM-88, "INSTALLATION"](#).
7. Rotate the crankshaft a few turns by hand.
8. Confirm that the valve clearances are within specification.
9. After the engine has been run to full operating temperature, confirm that the valve clearances are within specification.

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

\* Approximately 80°C (176°F)



## OIL SEAL

PFP:00100

### Removal and Installation of Valve Oil Seal

EBS00JB0

#### REMOVAL

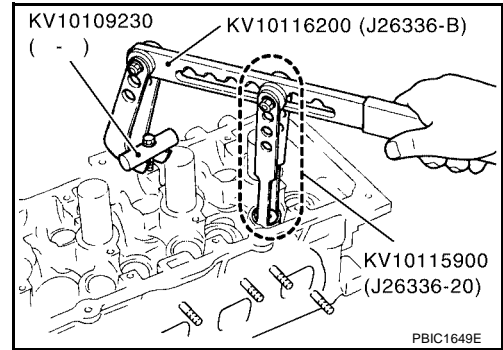
1. Remove camshaft and valve lifter relating to valve oil seal to be removed. Refer to [EM-83, "Removal and Installation"](#).
2. Rotate crankshaft, and set piston whose oil seal is to be removed to top dead center. This prevents valve from dropping inside cylinder.

**CAUTION:**

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

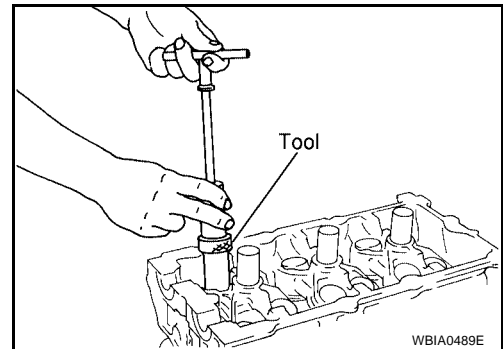
3. Remove valve collet, valve spring retainer and valve spring using Tool.

**Tool numbers** : KV10116200 (J-26336-A)  
                   : KV10115900 (J-26336-20)  
                   : KV10109230 ( - )



4. Remove valve oil seal using Tool.

**Tool number** : KV10107902 (J-38959)



#### INSTALLATION

1. Apply new engine oil to new valve oil seal joint surface and seal lip.
2. Press in valve oil seal to height "H" using Tool to specified height.

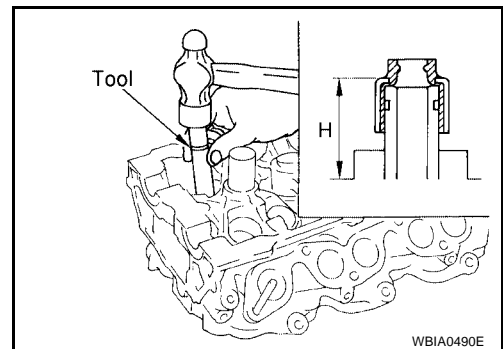
**Tool number** : (J-39386)

**NOTE:**

Dimension "H": height measured before valve spring seat installation.

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

3. Installation of the remaining components is in the reverse order of removal.



### Removal and Installation of Front Oil Seal

EBS00JB1

#### REMOVAL

1. Remove the following parts:
  - Engine undercover.
  - Drive belts. Refer to [EM-12, "DRIVE BELTS"](#).
  - Radiator fan. Refer to [CO-12, "REMOVAL"](#).
2. Remove the crankshaft pulley as follows:
  - a. Remove the starter motor. Refer to [SC-17, "M/T MODELS"](#) or [SC-18, "5-Speed A/T Models"](#).

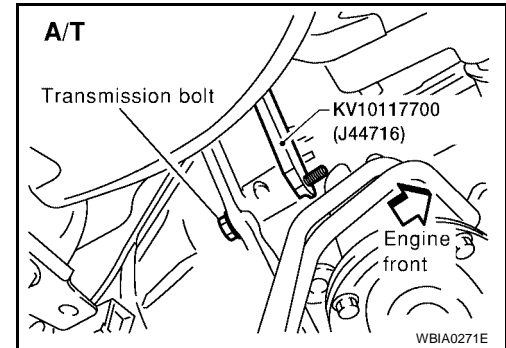
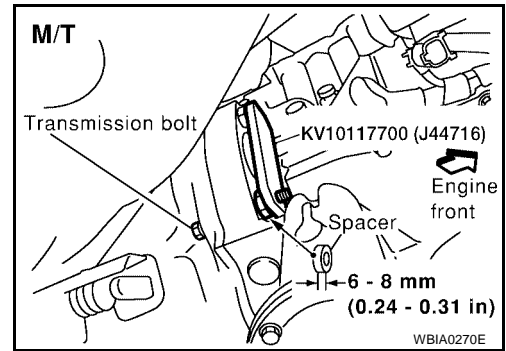
# OIL SEAL

b. Install Tool as shown.

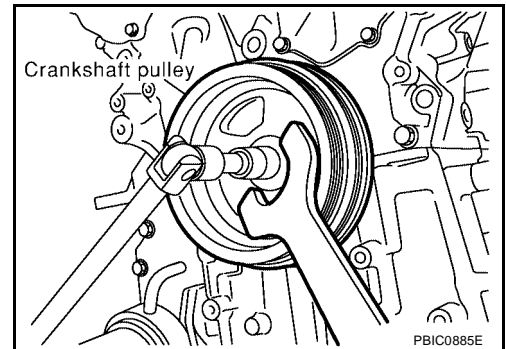
**Tool number : KV10117700 (J-44716)**

**CAUTION:**

**Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear when setting the stopper.**



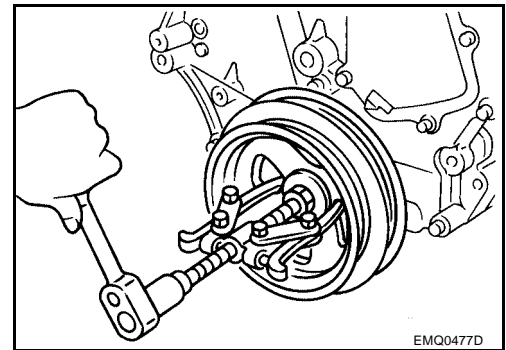
c. Loosen crankshaft pulley bolt using pulley holder and locate bolt seating surface at 10 mm (0.39 in) from its original position.



d. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.

**CAUTION:**

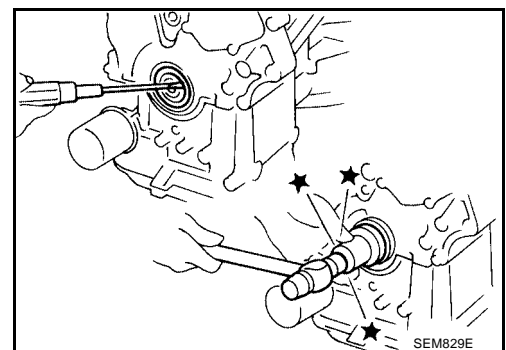
**Do not use a puller claw on crankshaft pulley periphery.**



3. Remove front oil seal from front timing chain case.

**CAUTION:**

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



# OIL SEAL

## INSTALLATION

1. Apply new engine oil to new oil seal and install it flush with front of mounting surface using a suitable tool.
  - Install new oil seal in the direction shown.

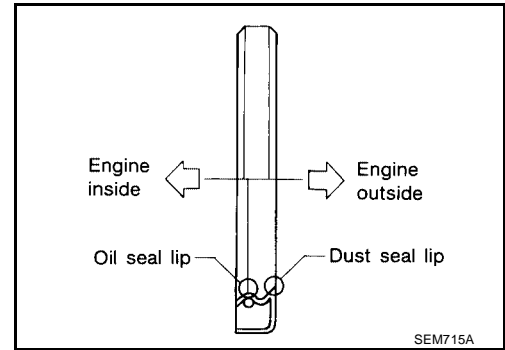
### Suitable drift

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.

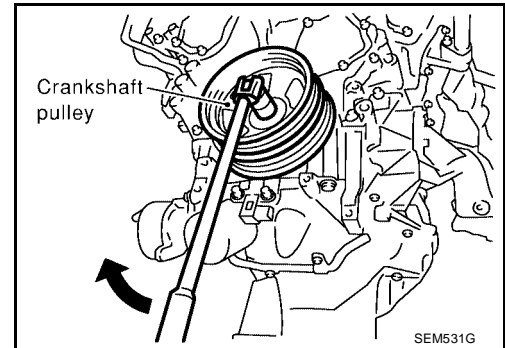


2. Install crankshaft pulley and tighten the bolt in two steps.
  - Lubricate thread and seat surface of the bolt with new engine oil.
  - Apply a paint mark for the second step of angle tightening.

Step 1 : 39 - 49 N-m (4.0 - 5.0 kg-m, 29 - 36 ft-lb)

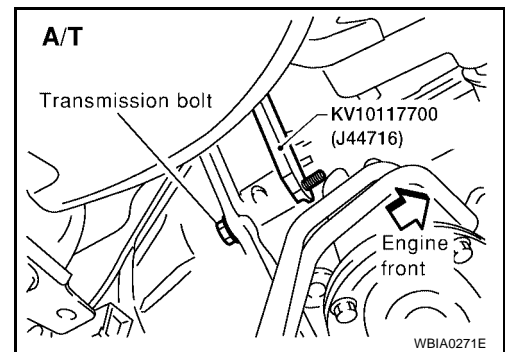
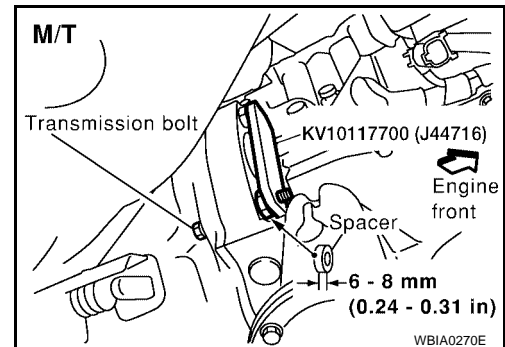
Step 2 : 84° - 90° degrees clockwise

Tool number : KV10112100 (BT-8653-A)



3. Remove Tool.

Tool number : KV10117700 (J-44716)



4. Installation of the remaining components is in reverse order of removal.

## Removal and Installation of Rear Oil Seal

### REMOVAL

EBS00JB2

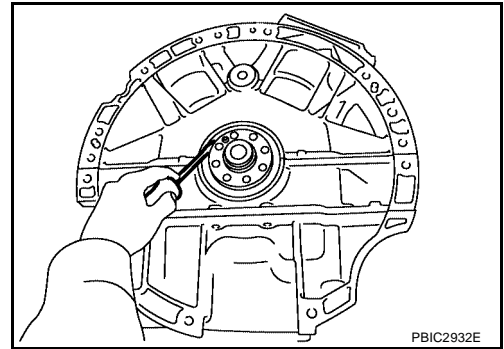
1. Remove transaxle, refer to [MT-16, "REMOVAL"](#) (MT), [AT-243, "REMOVAL"](#) (5 AT).
2. Remove flywheel or drive plate. Refer to [EM-122, "Disassembly and Assembly"](#), [EM-123, "DISASSEMBLY"](#) (M/T), [EM-117, "REMOVAL"](#), [AT-243, "REMOVAL"](#) (5 AT).

## OIL SEAL

3. Remove rear oil seal with a suitable tool.

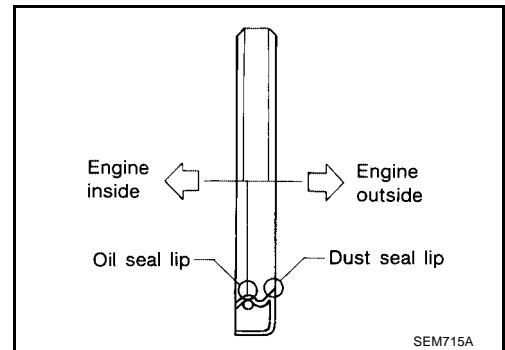
**CAUTION:**

Be careful not to damage crankshaft and cylinder block.

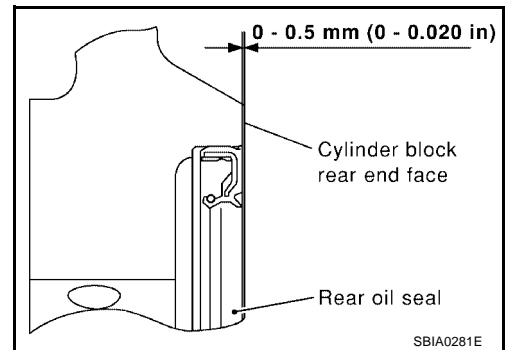


### INSTALLATION

1. Apply new engine oil to new rear oil seal joint surface and seal lip.
2. Install rear oil seal so that each seal lip is oriented as shown.



- Press in rear oil seal to the position as shown.

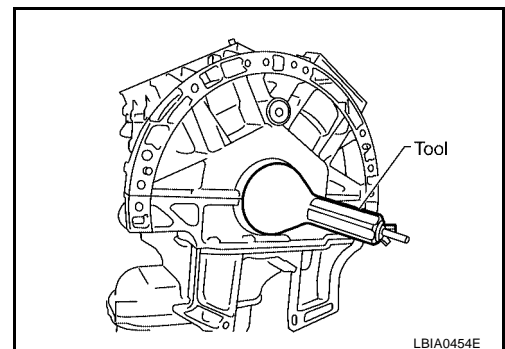


- Install new rear oil seal using Tool.

**Tool number** : KV991J0120 (J-47128)

**CAUTION:**

- Be careful not to damage crankshaft and cylinder block.
- Press-fit oil seal straight to avoid causing burrs or tilting.
- Do not touch grease applied onto oil seal lip.



3. Installation of the remaining components is in the reverse order of removal.

# CYLINDER HEAD

PFP:11041

EBS00JB3

## CYLINDER HEAD

### On-Vehicle Service

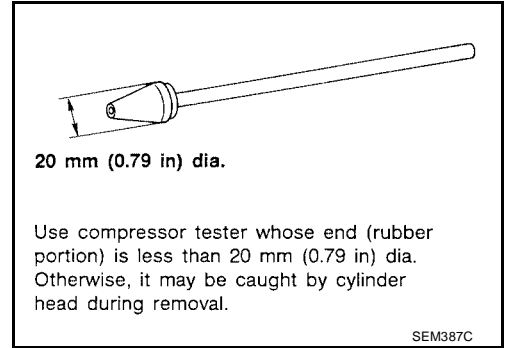
#### CHECKING COMPRESSION PRESSURE

1. Run the engine until it reaches normal operating temperature.
2. Turn the ignition switch to OFF.
3. Release fuel pressure and leave the fuel pump electrically disconnected. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#).
4. Remove all six spark plugs. Refer to [EM-38, "Removal and Installation"](#).
5. Attach a compression tester to No. 1 cylinder.
6. Depress accelerator pedal fully to keep the electric throttle control actuator butterfly-valve wide open to maximize air intake flow.
7. Crank the engine and record the highest gauge indication.
8. Repeat the measurement on each cylinder (steps 5 - 7).

**NOTE:**

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

Unit: kPa (kg/cm<sup>2</sup>, psi)/300 rpm



| Standard          | Minimum         | Difference limit between cylinders |
|-------------------|-----------------|------------------------------------|
| 1,275 (13.0, 185) | 981 (10.0, 142) | 98 (1.0, 14)                       |

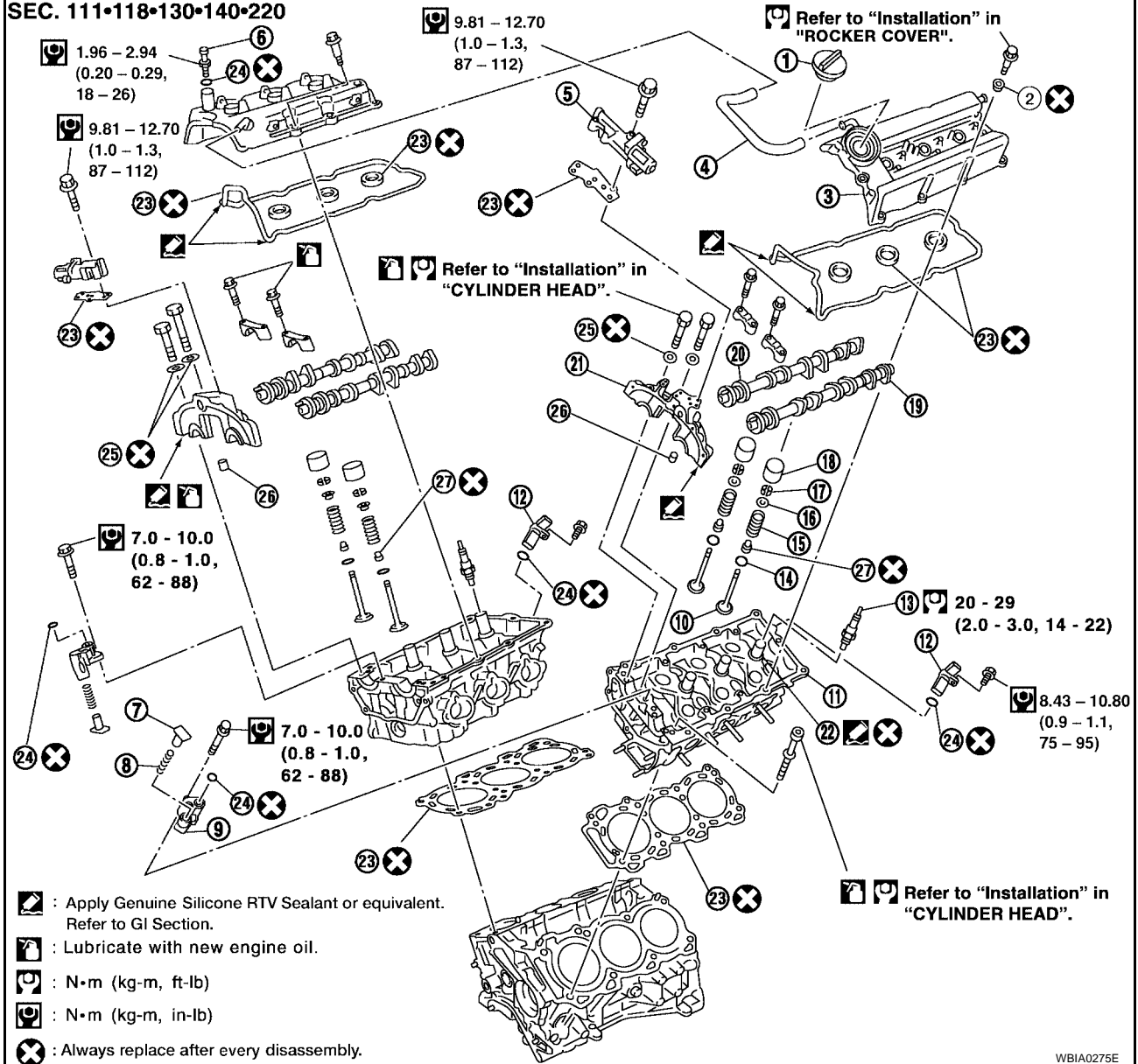
9. If compression in one or more cylinders is low:
  - a. Pour a small amount of engine oil into cylinders through the spark plug holes.
  - b. Retest compression (steps 5 - 8).
    - If adding oil helps raise compression pressure, then the piston rings may be worn or damaged. If so, replace piston rings after checking piston.
    - If the pressure stays low, a valve may be sticking or is seating improperly. Inspect and repair the valve and/or valve seat. Refer to [EM-152, "VALVE"](#). If the valve and/or valve seat is damaged excessively, replace as necessary.
    - If compression stays low in two or more cylinders that are next to each other:
      - The cylinder head gasket may be leaking.
      - Both cylinders may have valve component damage. Inspect and repair as necessary.
10. After inspection is complete, install removed components.
11. Start engine and confirm that engine runs smoothly.
12. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-95, "TROUBLE DIAGNOSIS"](#).

# CYLINDER HEAD

EBS00JB4

## Removal and Installation

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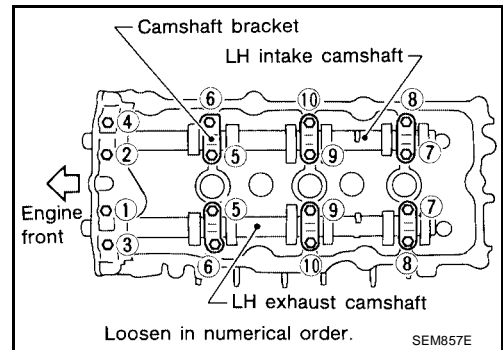
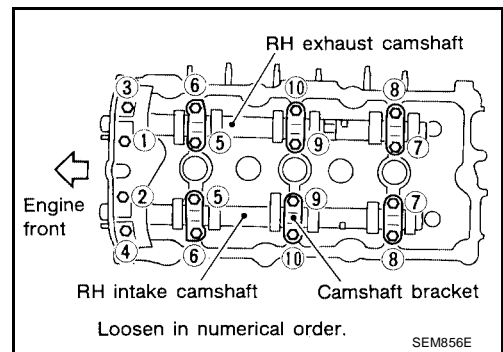
- |                           |                               |                                      |
|---------------------------|-------------------------------|--------------------------------------|
| 1. Oil filler cap         | 2. Washer                     | 3. Rocker cover                      |
| 4. PCV hose               | 5. IVT control solenoid valve | 6. PCV valve                         |
| 7. Tensioner sleeve       | 8. Spring                     | 9. Chain tensioner                   |
| 10. Valve                 | 11. Cylinder head             | 12. Camshaft position sensor (PHASE) |
| 13. Spark plug            | 14. Valve spring seat         | 15. Valve spring                     |
| 16. Valve spring retainer | 17. Valve collet              | 18. Valve lifter                     |
| 19. Camshaft (EXH)        | 20. Camshaft (INT)            | 21. Camshaft bracket                 |
| 22. Spark plug tube       | 23. Gasket                    | 24. O-ring                           |
| 25. Seal washer           | 26. Dowel pin                 | 27. Valve oil seal                   |

### REMOVAL

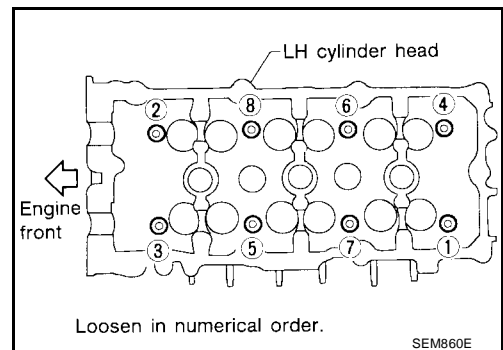
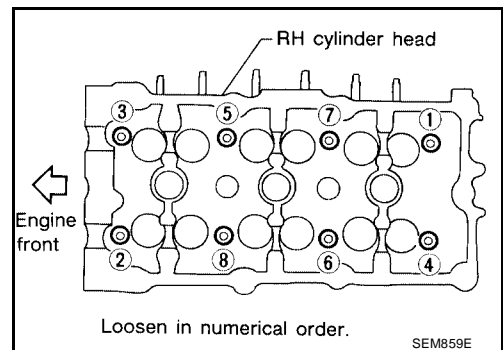
1. Remove the intake manifold. Refer to [EM-25. "REMOVAL"](#) .
2. Remove the timing chains. Refer to [EM-59. "REMOVAL"](#) .
3. Remove the exhaust manifold heat shields and exhaust manifold three way catalyst, Refer to [EM-27. "Removal and Installation"](#) .

# CYLINDER HEAD

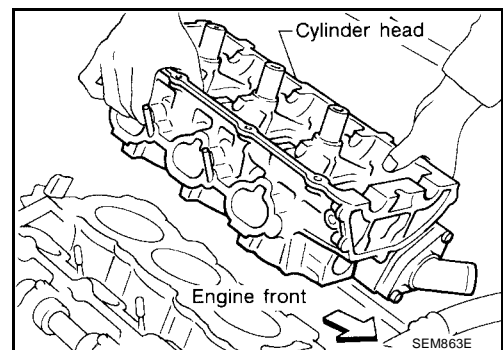
4. Remove the intake and exhaust camshafts and the camshaft brackets.
  - Mark the camshaft brackets so they are placed in the same position and direction for installation.
  - Equally loosen the camshaft bracket bolts in several steps in the order shown.



5. Remove the water outlet. Refer to [CO-26. "REMOVAL"](#).
6. Remove the RH and LH cylinder head bolts, using power tool.
  - The bolts should be loosened gradually in three steps in the order shown.



7. Remove cylinder heads and gaskets.
  - Discard the cylinder head gaskets and use new gaskets for installation.



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# CYLINDER HEAD

## INSPECTION AFTER REMOVAL

### Outer Diameter of Cylinder Head Bolts

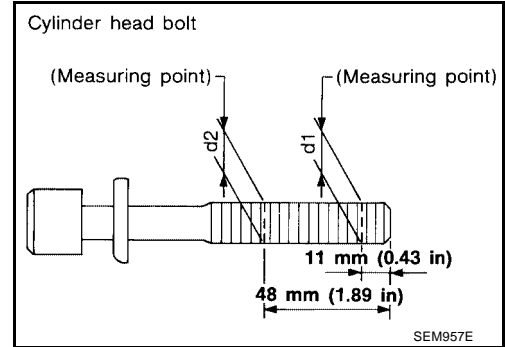
- Inspect the cylinder head bolts before installing the cylinder heads.

**CAUTION:**

Cylinder head bolts are tightened by degree rotation tightening method. Whenever the size difference between d1 and d2 exceeds the limit, replace the bolts with new ones.

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

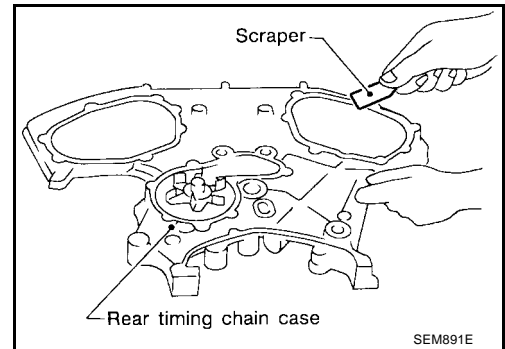
- If a reduction in outer diameter appears in a position other than d2, use it as the d2 measuring point.
- Lubricate threads and seat surfaces of the bolts with new engine oil for installation.



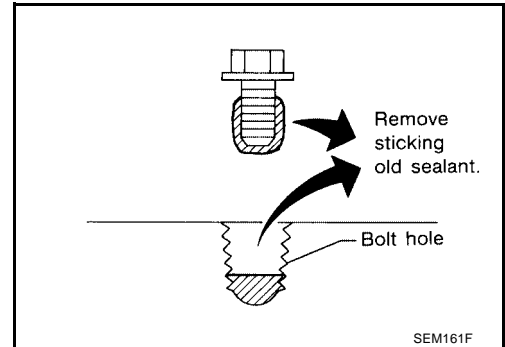
## INSTALLATION

1. Before installing the rear timing chain case, remove the old Silicone RTV Sealant from mating surface using a scraper.

- Also remove old sealant from mating surface of cylinder block.

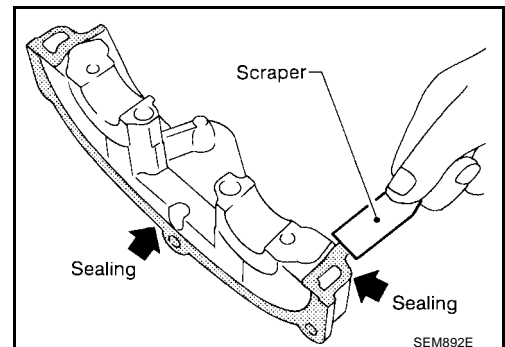


- Remove the old Silicone RTV Sealant from the bolt hole and thread.



2. Before installing the No. 1 camshaft bracket, remove the old Silicone RTV Sealant from the mating surface using a scraper.

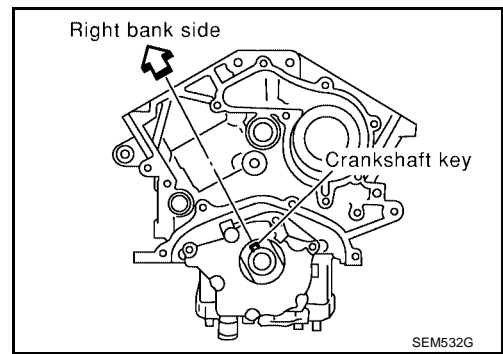
- Do not scratch the mating surface.





# CYLINDER HEAD

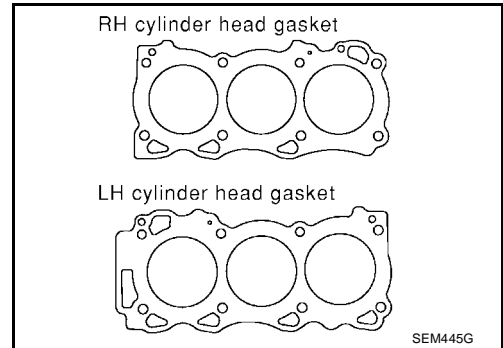
3. Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.
  - The crankshaft key should line up with the right bank cylinder center line as shown.



4. Install new gaskets on the cylinder heads.

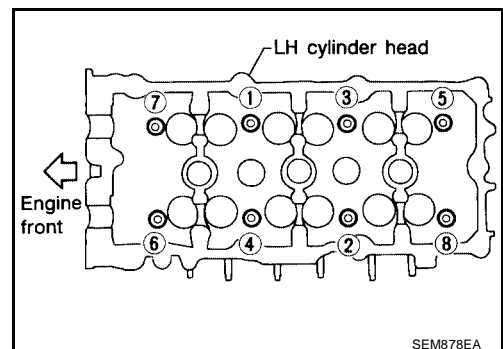
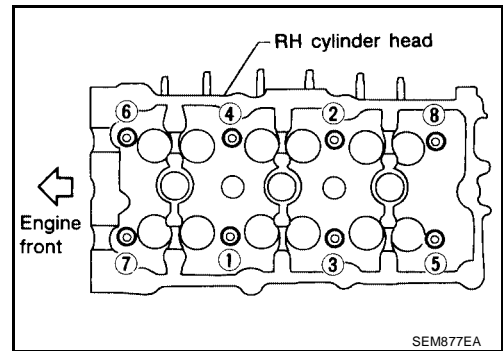
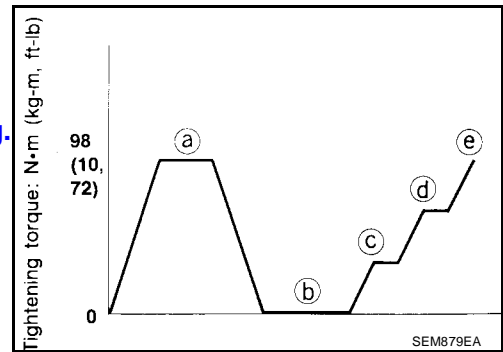
**CAUTION:**

**Do not rotate crankshaft and camshaft separately or valves will strike piston heads.**



5. Install the cylinder heads on the cylinder block. Tighten the cylinder head bolts in five steps in the order shown.

- Step a : 98 N·m (10 kg-m, 72 ft-lb)
- Step b : 0 N·m Loosen in the reverse order of tightening.
- Step c : 39.2 N·m (4.0 kg-m, 29 ft-lb)
- Step d : 90° degrees clockwise
- Step e : 90° degrees clockwise

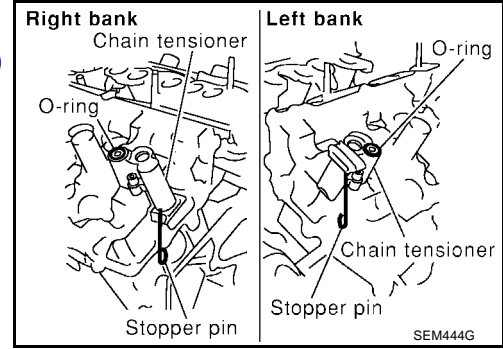


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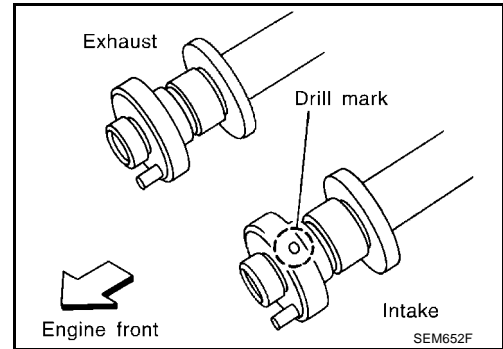
# CYLINDER HEAD

6. Install the water outlet. Refer to [CO-26, "INSTALLATION"](#).
7. Install camshaft chain tensioners on both sides of cylinder head.

**Camshaft chain tensioner bolts : 7 - 10 N·m (0.8 - 1.0 kg-m, 62 - 88 in-lb)**

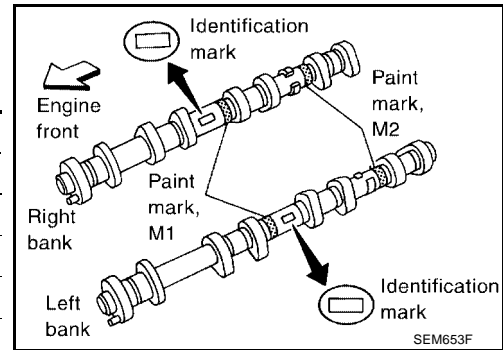


8. Install exhaust and intake camshafts and camshaft brackets.
  - Intake camshaft has a drill mark on camshaft sprocket mounting flange.

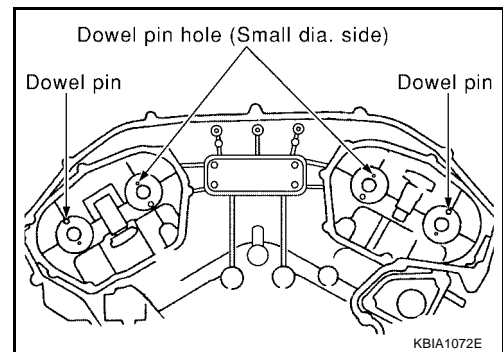


- Follow your identification marks made during removal, or follow the identification marks that are present on the new camshaft components for proper placement.

| Bank | INT/EXH | ID mark | Drill mark | Paint marks |     |
|------|---------|---------|------------|-------------|-----|
|      |         |         |            | M1          | M2  |
| RH   | INT     | RE      | Yes        | Yes         | No  |
|      | EXH     | RE      | No         | No          | Yes |
| LH   | INT     | LH      | Yes        | Yes         | No  |
|      | EXH     | LH      | No         | No          | Yes |

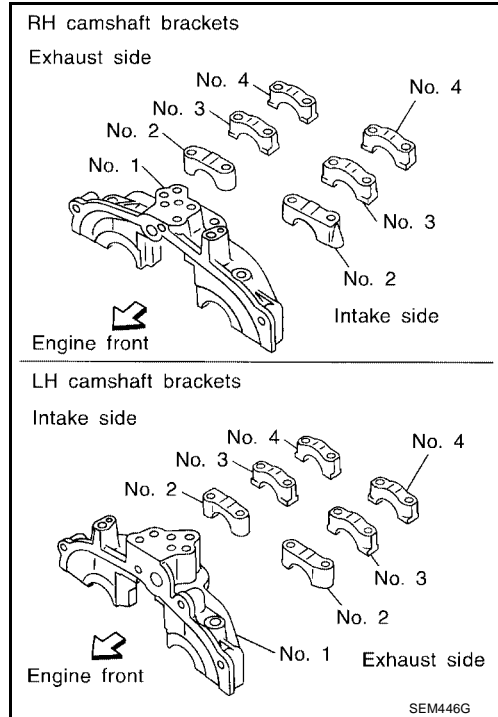


- Position the camshafts:  
 RH exhaust camshaft dowel pin at about 10 o'clock  
 LH exhaust camshaft dowel pin at about 2 o'clock.

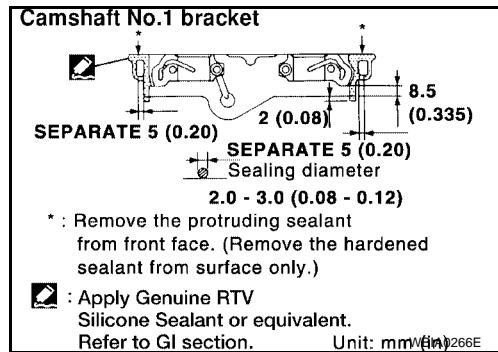


# CYLINDER HEAD

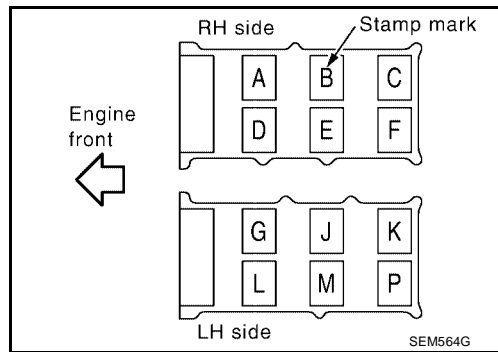
9. Before installing No. 1 camshaft bracket, apply sealant to mating surface.
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



- Before installation, wipe off any protruding sealant.
- Refer to [CO-2, "LIQUID GASKET APPLICATION PROCEDURE"](#).



- Install camshaft brackets in their original positions and directions. Align the stamp marks as shown.
- If any part of the valve assembly or camshaft is replaced, check and adjust the valve clearance. Refer to [EM-93, "Valve Clearance"](#).



# CYLINDER HEAD

10. Tighten the camshaft bracket bolts in five steps in the order shown.

**NOTE:**

Lubricate the threads and seat surfaces of the camshaft bracket bolts with new engine oil before installation.

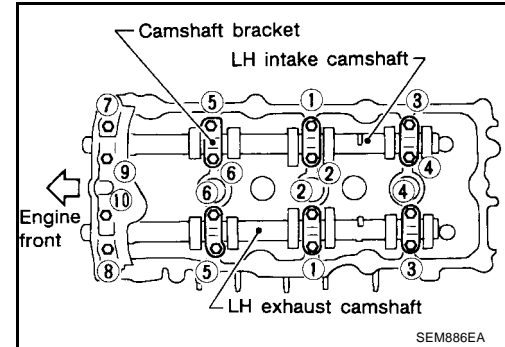
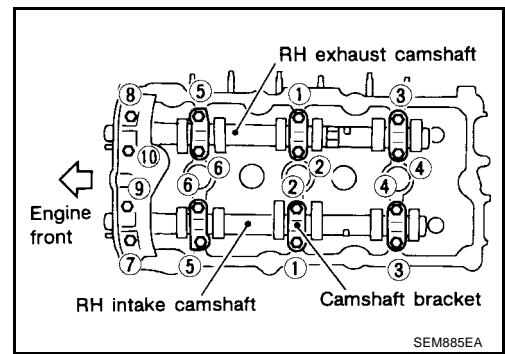
**Camshaft bracket bolts**

**Step 1 (bolts 7 - 10) : 1.96 N·m (0.2 kg-m, 17 in-lb)**

**Step 2 (bolts 1 - 6) : 1.96 N·m (0.2 kg-m, 17 in-lb)**

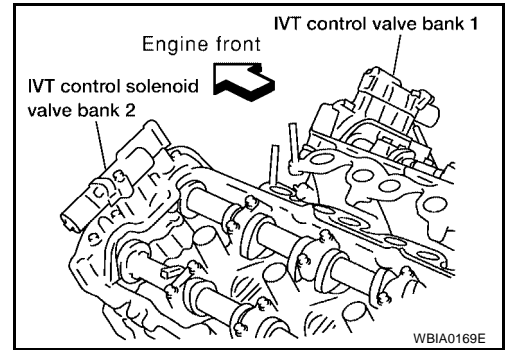
**Step 3 : 5.88 N·m (0.6 kg-m, 52 in-lb)**

**Step 4 (bolts 1 - 6) : 10.4 N·m (1.1 kg-m, 92 in-lb)**

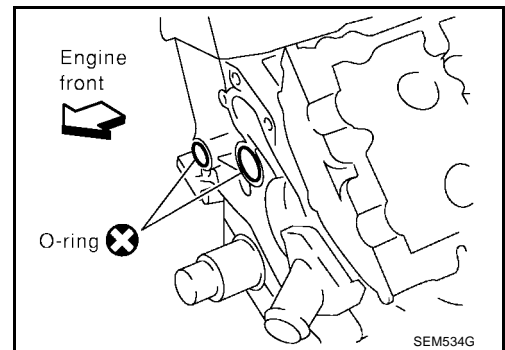


11. Install the IVT control solenoid valves with new gaskets.

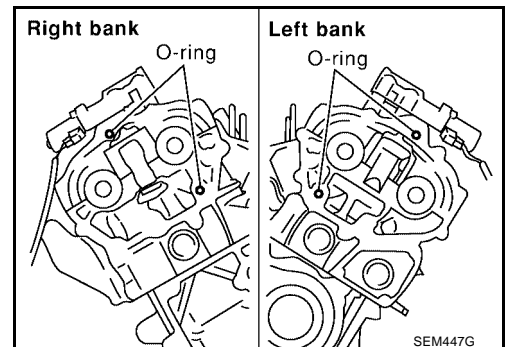
**IVT control solenoid valve bolts : 10 - 12 N·m (1.0 - 1.3 kg-m, 87 - 112 in-lb)**



12. Install the new O-rings on the cylinder block.



13. Install the new O-rings on the cylinder head.



## CYLINDER HEAD

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14. Install the exhaust manifold three way catalysts (manifolds) and exhaust manifold heat shields. Refer to [EM-27, "Removal and Installation"](#) .
15. Install timing chain. Refer to [EM-58, "Removal and Installation"](#) .
16. Install the intake manifold. Refer to [EM-26, "INSTALLATION"](#) .

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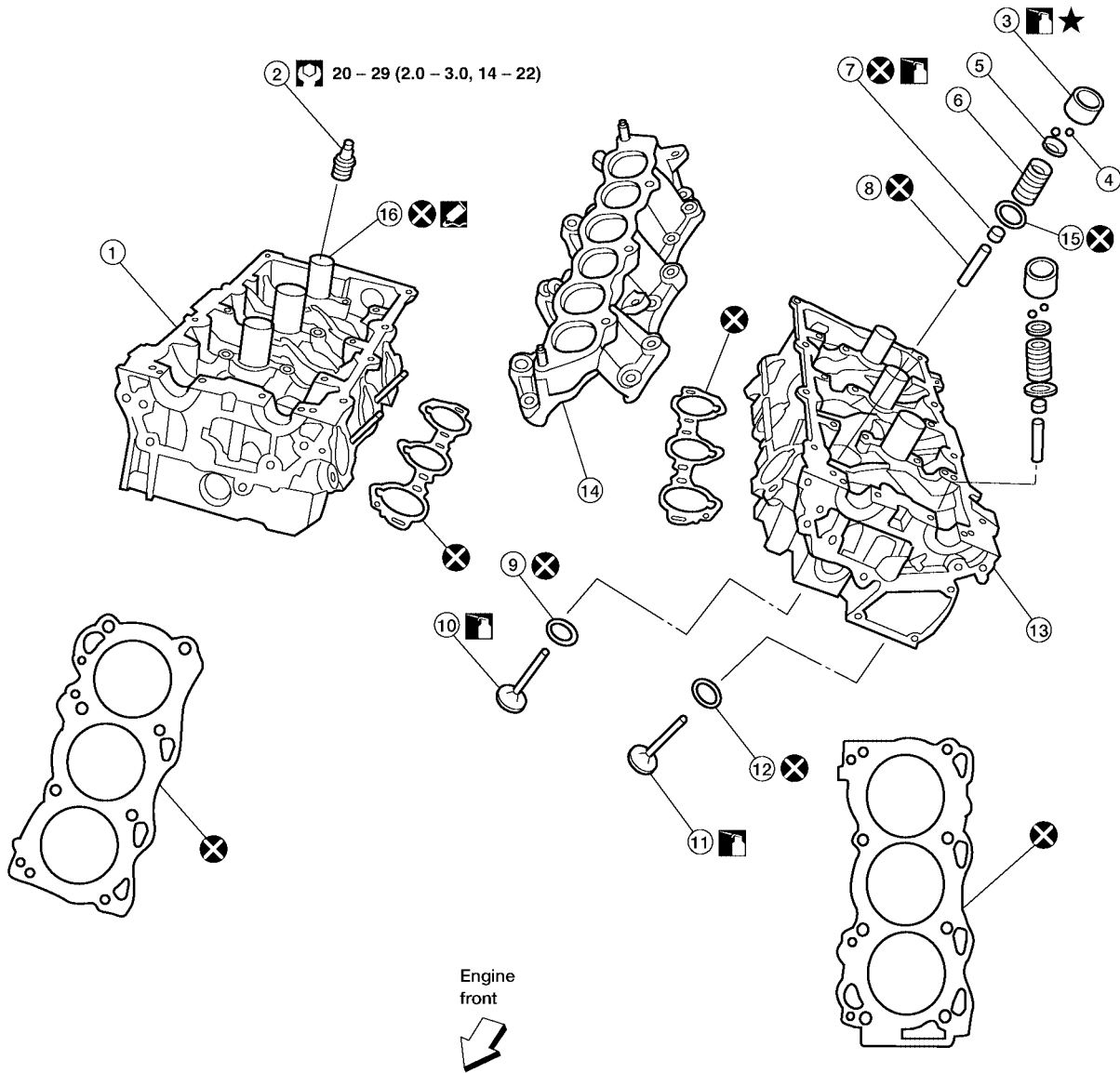
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# CYLINDER HEAD

## Disassembly and Assembly

EBS00JB5



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

: Selectable parts

: Engine oil

: N·m (kg·m, ft·lb)

: Always replace after every disassembly.

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- |                               |                          |                       |
|-------------------------------|--------------------------|-----------------------|
| 1. Cylinder head (right bank) | 2. Spark plug            | 3. Valve lifter       |
| 4. Valve collet               | 5. Valve spring retainer | 6. Valve spring       |
| 7. Valve oil seal             | 8. Valve guide           | 9. Valve seat (INT)   |
| 10. Valve (INT)               | 11. Valve (EXH)          | 12. Valve seat (EXH)  |
| 13. Cylinder head (left bank) | 14. Intake manifold      | 15. Valve spring seat |
| 16. Spark plug tube           |                          |                       |

# CYLINDER HEAD

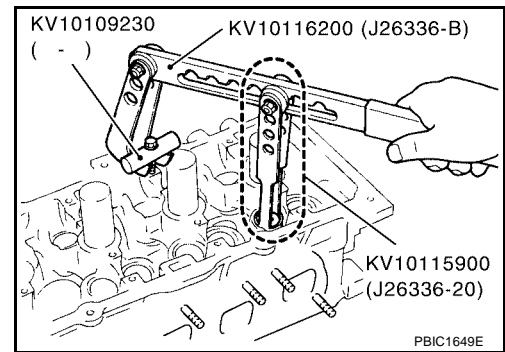
## CAUTION:

- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to threads and seat surface when installing cylinder head, camshaft sprocket, crankshaft pulley, and camshaft bracket.
- Attach tags to valve lifters so as not to mix them up.

## DISASSEMBLY

1. Remove valve lifter.
  - Mark position for installation.
2. Remove valve collet.
  - Compress valve spring using Tool. Remove valve collet with magnet driver.

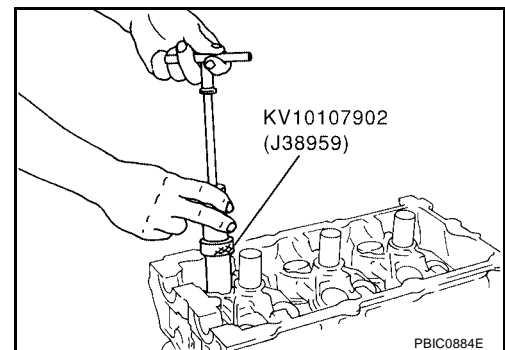
**Tool numbers** : KV10116200 (J26336-B)  
: KV10115900 (J26336-20)  
: KV10109230 ( - )



3. Remove valve spring retainer, valve spring, and valve spring seat.
4. Push valve stem to combustion chamber side, and remove valve, mark for assembly.
  - Inspect valve guide clearance before removal. Refer to [EM-112, "VALVE GUIDE CLEARANCE"](#).
  - Confirm installation point.
5. Remove the valve oil seals using Tool.

**Tool number** : KV10107902 (J38959)

6. If valve seat must be replaced, refer to [EM-114, "VALVE SEAT REPLACEMENT"](#).
7. If valve guide must be replaced, refer to [EM-113, "VALVE GUIDE REPLACEMENT"](#).
8. Remove spark plug with spark plug wrench.
9. Remove spark plug tube, as necessary.
  - Using a pair of pliers, pull spark plug tube out of cylinder head.



## CAUTION:

- Be careful 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.

# CYLINDER HEAD

EBS00JB6

## Inspection After Disassembly CYLINDER HEAD DISTORTION

- Clean the surface of the cylinder head. Use a reliable straightedge and feeler gauge to check the flatness of cylinder head surface.
- Check along six positions as shown.

### Head surface distortion

Limit : 0.1 mm (0.004 in)

- If beyond the specified limit, resurface or replace it.
- The limit for cylinder head resurfacing is determined by the cylinder block resurfacing.

### Resurfacing Limit

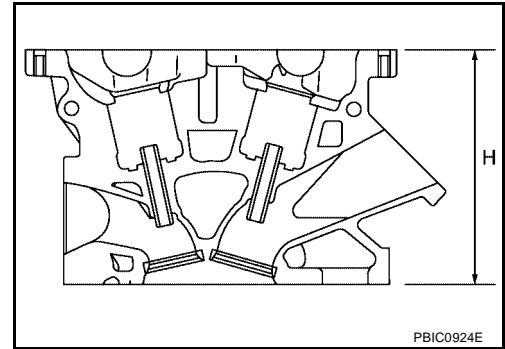
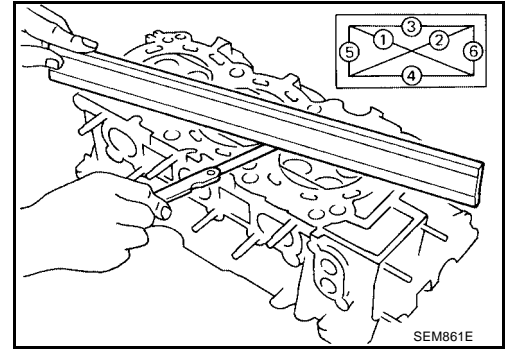
Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

The maximum limit :  $A + B = 0.2 \text{ mm (0.008 in)}$

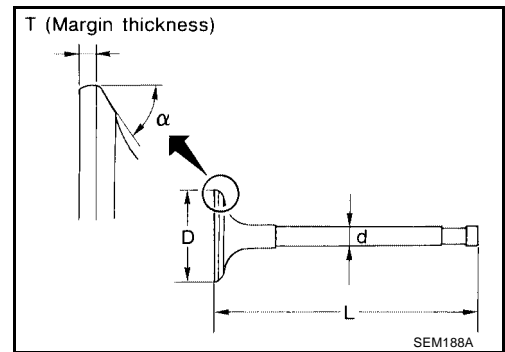
- After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Nominal cylinder head height "H" : 126.3 - 126.5 mm (4.972 - 4.980 in)



## VALVE DIMENSIONS

Check dimensions of each valve, refer to [EM-152, "Valve Dimensions"](#).



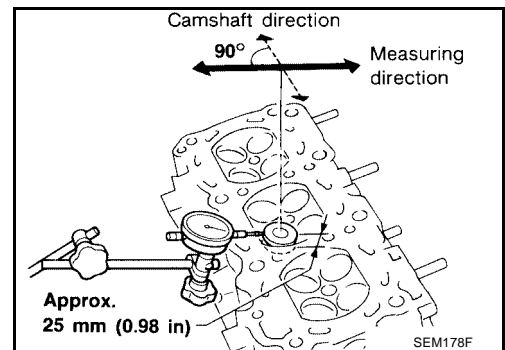
## VALVE GUIDE CLEARANCE

1. Measure valve deflection as shown in the figure. (Valve and valve guide mostly wear in this direction.)

### Valve deflection limit (dial gauge reading)

Intake : 0.24 mm (0.0094 in)

Exhaust : 0.28 mm (0.0110 in)





# CYLINDER HEAD

2. If it exceeds the limit, check valve to valve guide clearance.
  - a. Measure valve stem diameter and valve guide inner diameter.
  - b. Check that clearance is within specification.

### Valve to valve guide clearance standard

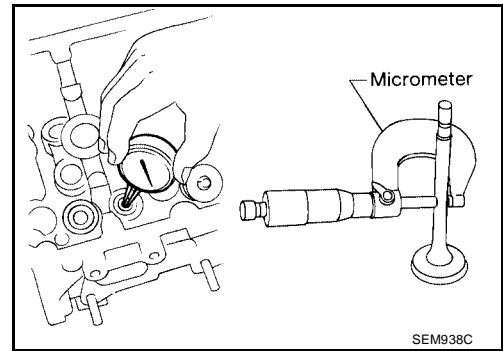
**Intake** : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

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

### Valve to valve guide clearance limit

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

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

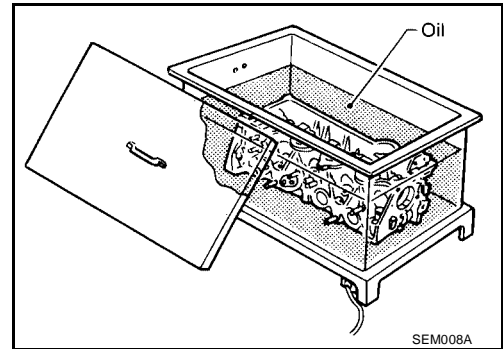


- c. If it exceeds the limit, replace valve or valve guide.

## VALVE GUIDE REPLACEMENT

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

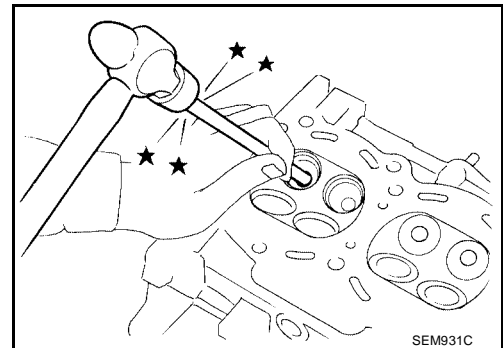
1. To remove valve guide, heat cylinder head to 110° - 130°C (230° - 266°F) by soaking in heated oil.



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

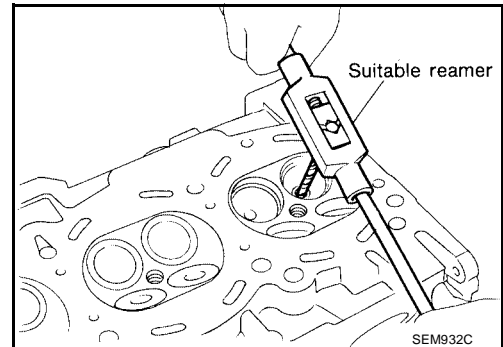
### **WARNING:**

**Cylinder head is hot. Wear protective equipment to prevent getting burned.**



3. Ream cylinder head valve guide hole.

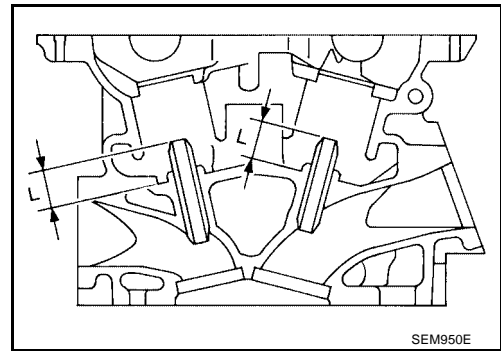
**Valve guide hole diameter (for service parts), intake and exhaust** : 10.175 - 10.196 mm (0.4006 - 0.4014 in)



## CYLINDER HEAD

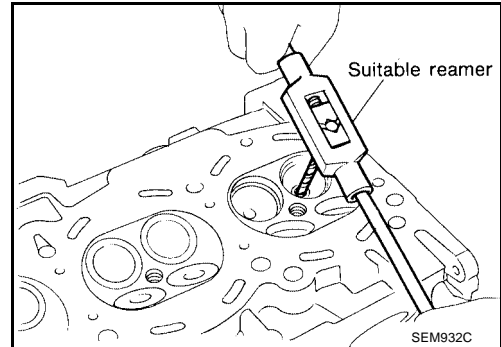
- Heat cylinder head to 110° - 130°C (230° - 266°F) by soaking in heated oil and press new valve guide from camshaft side into the cylinder head to the dimensions as shown.

**Projection "L" : 12.6 - 12.8 mm (0.496 - 0.504 in)**



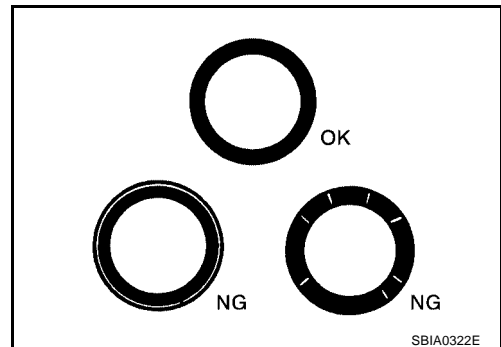
- Using a valve guide reamer, apply a reamer finish to the valve guide.

**Intake and exhaust finished size : 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 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 N.G conditions even after the re-check, replace valve seat.



### VALVE SEAT REPLACEMENT

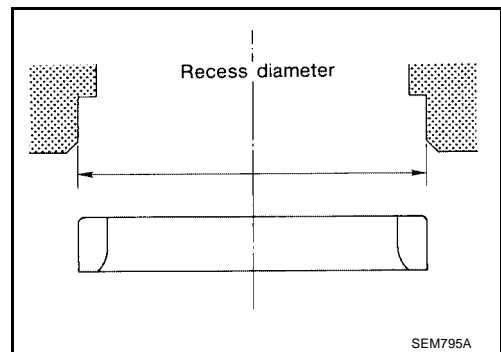
- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
- Ream cylinder head recess for service valve seat.

**Oversize : 0.5 mm (0.020 in)**

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

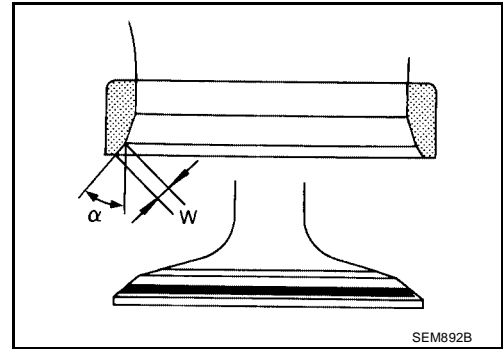
**Exhaust : 32.700 - 32.716 mm (1.2874 - 1.2880 in)**

- Be sure to ream in circles concentric to the valve guide center.
  - This will enable valve seat to fit correctly.
- Heat cylinder head to 110° - 130°C (230° - 266°F) by soaking in heated oil.
  - Press fit valve seat until it seats on the bottom.
  - Cut or grind valve seat using suitable tool to the specified dimensions. Refer to [EM-152, "VALVE"](#).
  - After cutting, lap valve seat with abrasive compound.
  - Check valve seating condition.



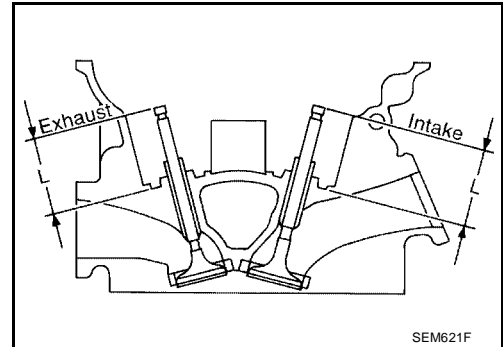
# CYLINDER HEAD

|                                  |   |
|----------------------------------|---|
| Seat face angle “ $\alpha$ ”     | : $45^\circ \pm 0^\circ 15'$<br>degrees/minutes |
| Contacting width “W” for intake  | : $1.2 \pm 0.11$ mm<br>(0.0429 - 0.0516 in)     |
| Contacting width “W” for exhaust | : $1.4 \pm 0.11$ mm<br>(0.0508 - 0.0594 in)     |



8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 to adjust it. If it is longer, replace the valve seat with a new one.

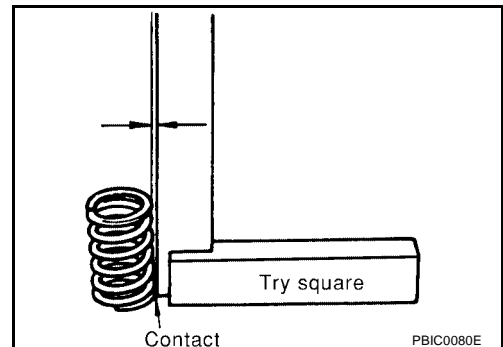
|   |  |
|---|--|
| Valve seat resurface limit “L”<br>intake  | : 41.07 - 41.67 mm<br>(1.6169 - 1.6405 in) |
| Valve seat resurface limit “L”<br>exhaust | : 41.00 - 41.60 mm<br>(1.6142 - 1.6378 in) |



## 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.

**Out-of-square limit** : Less than 2.0 mm (0.079 in)

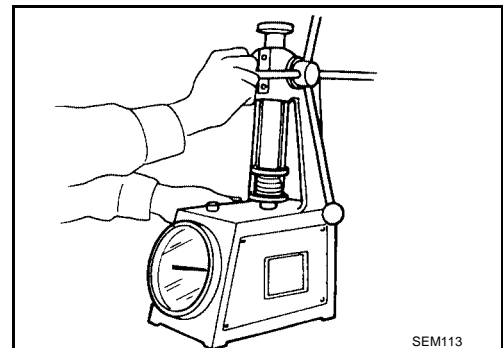


## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure at specified spring height.

|             |  |
|-------------|--|
| Free height | : 46.90 mm (1.8465 in)   |
| Standard    | : 166 - 188 N (16.9 - 19.2 kg, 37.3 - 42.3 lb)<br>at height 37.0 mm (1.457 in) |
| Limit       | : 378 - 426 N (38.6 - 43.5 kg, 85.0 - 95.8 lb)<br>at height 27.8 mm (1.094 in) |

If it is not within specifications, replace the spring.



## ASSEMBLY

1. Install valve guide. Refer to [EM-113, "VALVE GUIDE REPLACEMENT"](#).
2. Install valve seat. Refer to [EM-114, "VALVE SEAT REPLACEMENT"](#).

## CYLINDER HEAD

3. Install new valve spring seats and new valve oil seals using Tool.

**Tool number : (J39386)**

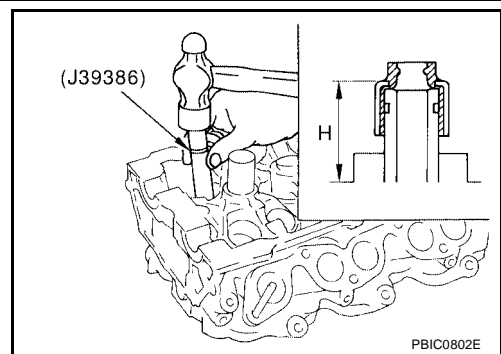
- Install with valve oil seal drift to match dimension in illustration.

**NOTE:**

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

**Height "H"**

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

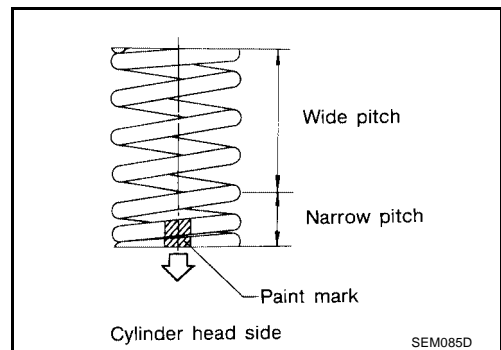


4. Install the valves in their original position, as marked during disassembly.

5. Install valve spring (uneven pitch type).

- Install smaller pitch end (paint mark) to cylinder head side (valve spring seat side).

6. Install valve spring retainer.



7. Install valve collet.

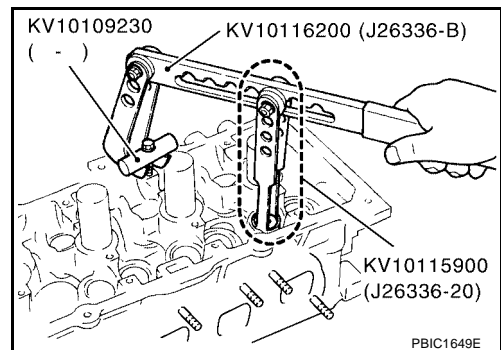
**Tool numbers : KV10116200 (J26336-B)**

**: KV10115900 (J26336-20)**

**: KV10109230 ( - )**

- Compress valve spring using Tool and install valve collet.
- Tap stem edge lightly with plastic hammer after installation to check its installed condition.

8. Install valve lifter refer to [EM-95, "VALVE ADJUSTING"](#) for proper valve lifter selection.



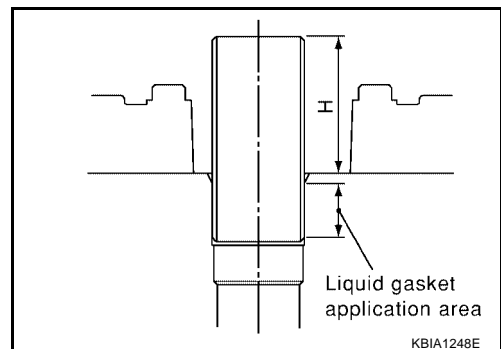
9. Install spark plug tube as follows:

- a. Remove old liquid gasket from 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 [GL-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

- c. Using a drift, press fit the spark plug tube so that it height "H" is as specified.

**Standard press fit height :38.55 - 38.65 mm**  
**"H" (1.5177 - 1.5217 in)**



**CAUTION:**

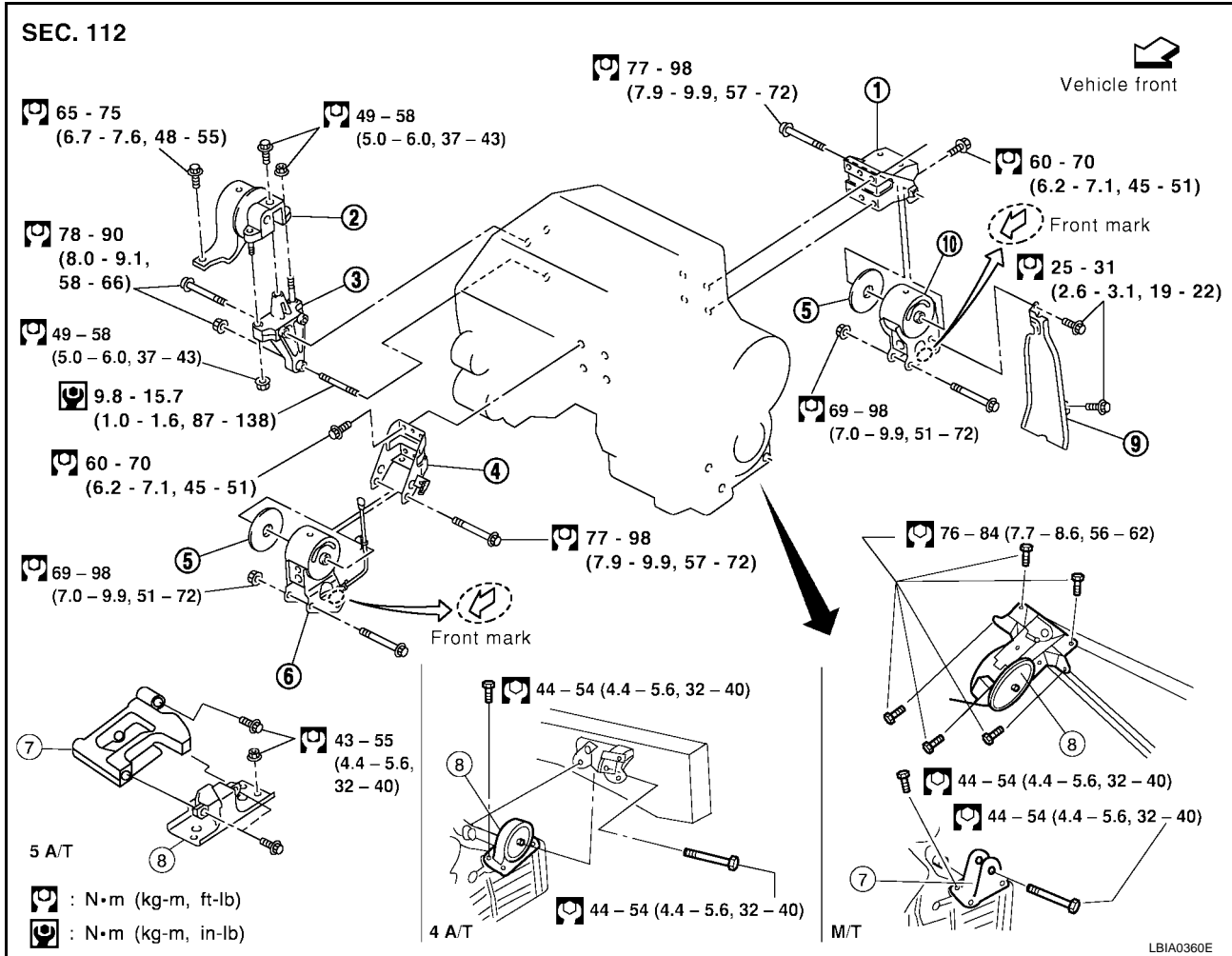
- When press fitting, take care not to deform spark plug tube.
- After press fitting, wipe off liquid gasket protruding onto cylinder head upper face.

10. Install spark plug with spark plug wrench.

**Spark plug : 20 - 29 N·m (2.0 - 3.0 kg·m, 14 - 22 ft·lb)**

## ENGINE ASSEMBLY

### Removal and Installation



- |                                    |                                    |                                    |
|------------------------------------|------------------------------------|------------------------------------|
| 1. Rear engine mounting bracket    | 2. RH engine mounting insulator    | 3. RH engine mount                 |
| 4. Front engine mount              | 5. Stopper                         | 6. Front engine mounting insulator |
| 7. LH transaxle mount              | 8. LH transaxle mounting insulator | 9. Air guide (A/T only)            |
| 10. Rear engine mounting insulator |                                    |                                    |

#### WARNING:

- Place chocks at front and back of rear 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 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-38, "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

1. Drain coolant. Refer to [MA-14, "DRAINING ENGINE COOLANT"](#).
2. Remove the front cowl grille. Refer to [EI-19, "Removal and Installation"](#).
3. Remove the windshield wiper assembly. Refer to [WW-23, "Removal and Installation of Wiper Motor and Linkage"](#).

## ENGINE ASSEMBLY

4. Disconnect engine room harness from the engine side and position it aside. Disconnect engine harness ground connections. Access the connector through the glove box opening. Refer to [IP-10, "INSTRUMENT PANEL ASSEMBLY"](#) .
5. Remove the hood. Refer to [BL-13, "Removal and Installation of Hood Assembly"](#) .
6. Remove the battery and battery tray. Refer to [SC-9, "Removal and Installation"](#) .
7. Remove the engine cover using power tool. Remove side engine covers.
8. Disconnect the mass air flow sensor electrical connector.
9. Remove the fresh air intake tube and air cleaner to electric throttle control actuator tube attached to air cleaner lid. Refer to [EM-16, "Removal and Installation"](#) .
10. Disconnect two connectors below mass air flow sensor attached to the shock tower.
11. Release fuel pressure. Refer to [EC-93, "FUEL PRESSURE RELEASE"](#) .
12. Disconnect fuel hose quick connection at vehicle piping side. Refer to [EM-40, "Removal and Installation"](#) .
13. Remove and position aside the IPDM E/R and bracket and position aside. Refer to [PG-27, "Removal and Installation of IPDM E/R"](#) .
14. Remove the radiator assembly, coolant reservoir, and system hoses. Refer to [CO-12, "REMOVAL"](#) .
15. Disconnect the power brake booster vacuum hose from the back of the intake manifold collector.
16. Disconnect heater hoses at the cowl.
17. Disconnect the two fusible link connectors at the battery positive terminal.
18. Disconnect the harness retainers and position the engine harness aside.
19. Remove the ground cable.
20. Remove the clutch operating cylinder with lines attached and position aside. Refer to [CL-11, "Removal and Installation"](#) .
21. Drain engine oil. Refer to [MA-16, "Changing Engine Oil"](#) .
22. Drain A/T oil. Refer to [MA-22, "Changing A/T Fluid"](#) .
23. Drain M/T oil. Refer to [MA-21, "Changing M/T Oil"](#) .
24. Disconnect the transaxle shift controls. Refer to [AT-231, "SHIFT CONTROL SYSTEM"](#) (5 A/T).
25. Disconnect the transmission electrical connectors, harness retainers and position harness aside.
26. Remove exhaust system refer to [EX-5, "REMOVAL"](#) .
27. Remove RH splash shield.
28. Remove the front wheel and tires.
29. Remove the drive belts. Refer to [EM-15, "Removal and Installation"](#) .
30. Remove the front exhaust tube and hanger using power tools. Refer to [EX-3, "Removal and Installation"](#) .
31. Remove engine oil cooler pipe bolts.
32. Remove the idler pulley and idler bracket.
33. Remove the engine undercover.
34. Remove the A/C compressor using power tools. Discharge and recover the R134a refrigerant. Refer to [ATC-119, "HFC-134a \(R-134a\) Service Procedure"](#) .
35. Remove the front drive shafts. Refer to [FAX-11, "Removal and Installation"](#) .
36. Remove the front suspension member. Refer to [FSU-15, "Removal and Installation"](#) .

**CAUTION:**

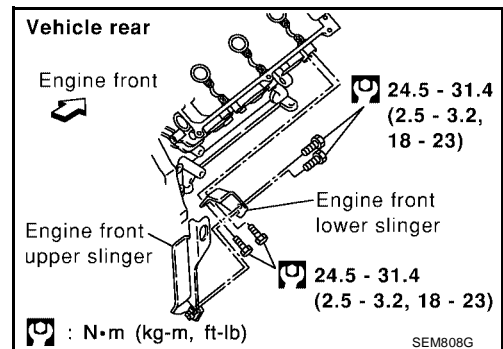
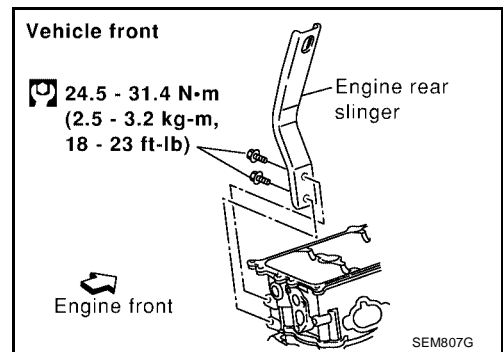
**Make sure to disconnect electrically controlled engine mounting insulator harness clips and power steering line mounts from the front suspension member prior to removal.**

37. Disconnect the power steering pressure switch.
38. Remove the power steering pump, without disconnecting the piping, from the engine and position and secure it aside. Refer to [PS-26, "REMOVAL"](#) .

## ENGINE ASSEMBLY

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

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



40. Secure a hoist to the engine slingers.
41. Remove the LH transaxle mount through bolt.
42. Remove the RH engine mounting insulator nuts and bolt.
43. Carefully lower the engine and transaxle assembly with the hoist avoiding interference with the vehicle body.

### CAUTION:

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

44. Remove the crankshaft position sensor (POS).
45. Remove rear cover plate and bolts securing the torque converter to the drive plate.
46. Remove the starter motor. Refer to [SC-17, "M/T MODELS"](#) , [SC-18, "5-Speed A/T Models"](#) .
47. Separate the engine and transaxle and mount the engine on a suitable engine stand.

# ENGINE ASSEMBLY

## INSTALLATION

Installation is in the reverse order of removal.

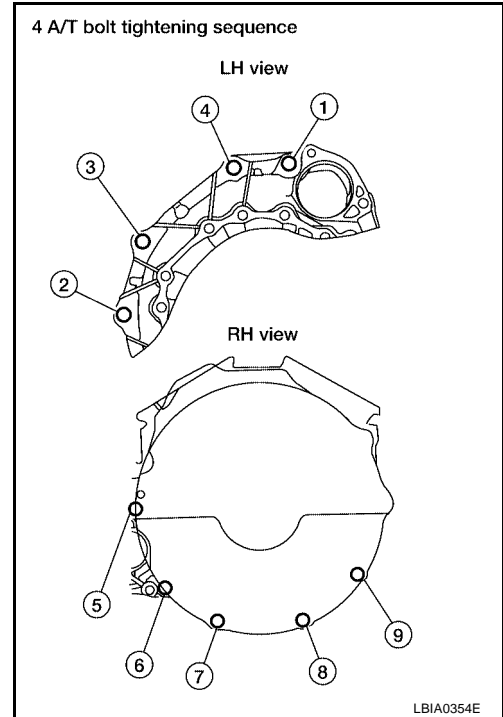
### Manual Transaxle

#### CAUTION:

When installing the transaxle, do not allow the transaxle input shaft to contact the clutch cover.

- When installing the transaxle to the engine, use the specified tightening torque in the order shown.

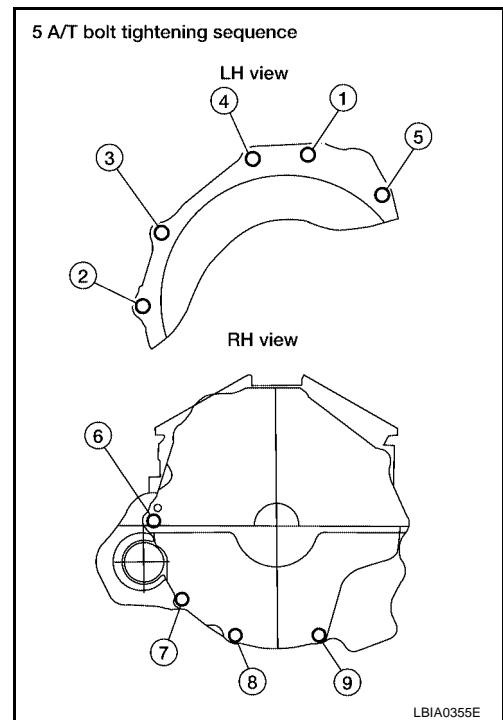
| Bolt No.                                  | 1                            | 2 | 3 | 4 | 5 | 6                            | 7 | 8 | 9 |
|---|------------------------------|---|---|---|---|------------------------------|---|---|---|
| Tightening torque<br>N·m (kg·m,<br>ft·lb) | 70 - 79 (7.1 - 8.1, 52 - 58) |   |   |   |   | 36 - 47 (3.7 - 4.7, 27 - 34) |   |   |   |



### 5 A/T

- When installing the transaxle to the engine, use the specified tightening torque in the numerical sequence as shown.

| Bolt No.                                  | 1                            | 2 | 3 | 4 | 5 | 6                            | 7 | 8 | 9 |
|---|------------------------------|---|---|---|---|------------------------------|---|---|---|
| Tightening torque<br>N·m (kg·m,<br>ft·lb) | 70 - 79 (7.1 - 8.1, 52 - 58) |   |   |   |   | 36 - 47 (3.7 - 4.7, 27 - 34) |   |   |   |



- After installation, check the transaxle oil level, and check for any leaks and any loose mechanisms.
- Install crankshaft position sensor (POS).



# ENGINE ASSEMBLY

**Crankshaft position sensor (POS) bolt** : 8.4 - 10.8 N·m (0.86 - 0.98 kg·m,  
74.6 - 95.5 in·lb)

- Install idler pulley.

**Idler pulley bolts** : 25 - 31 N·m (2.5 - 3.2 kg·m, 18 -  
23 ft·lb)

## INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of Fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. 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                |
| Other oils and fluids* | Level                  | Leakage        | Level                |
| Fuel                   | Leakage                | Leakage        | Leakage              |
| Exhaust gas            | —                      | Leakage        | —                    |

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

# CYLINDER BLOCK

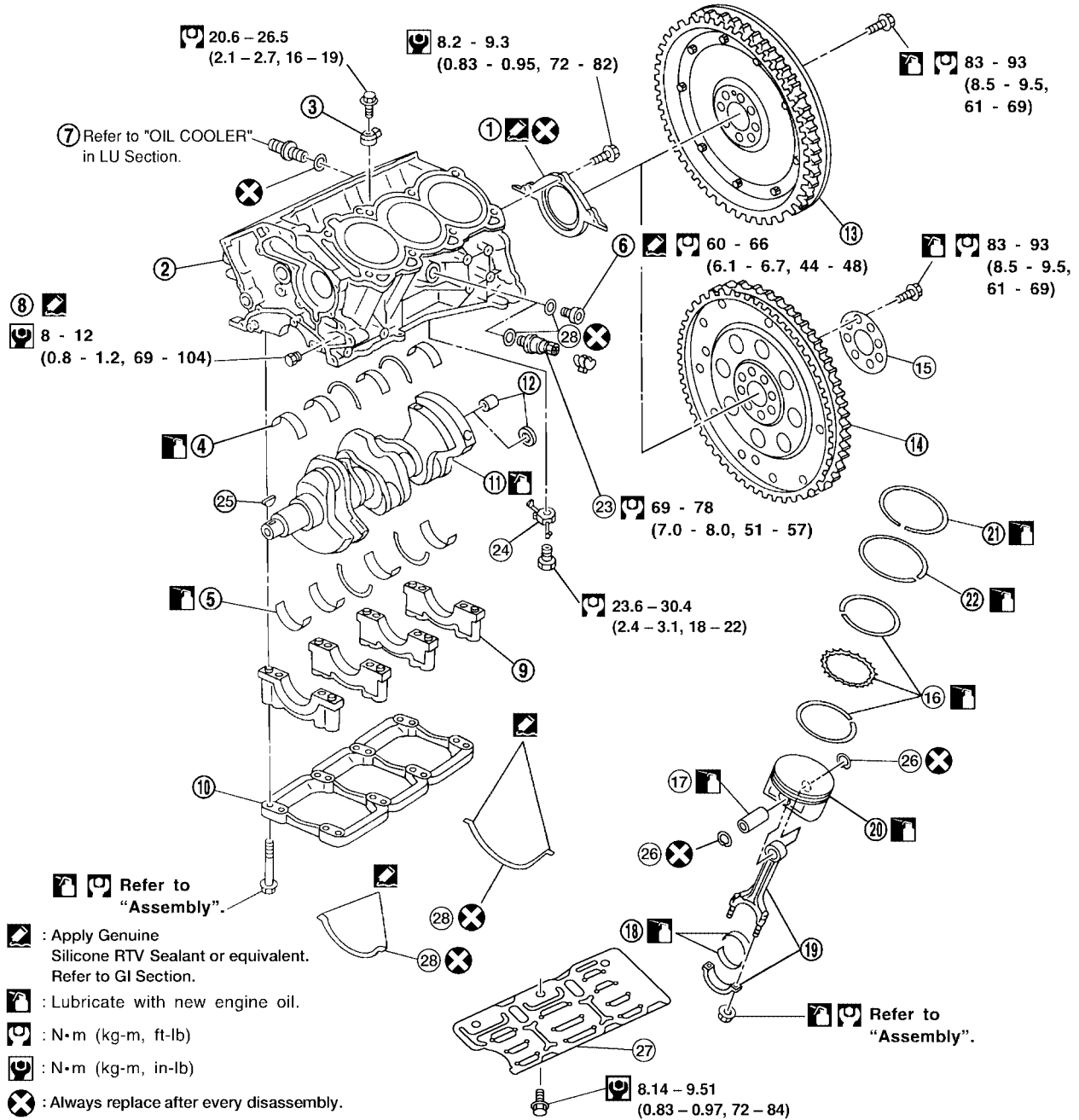
PF1:11010

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## CYLINDER BLOCK

### Disassembly and Assembly

SEC. 110•120•226



WBIA0273E

- |                                      |   |                                      |
|--------------------------------------|---|--------------------------------------|
| 1. Rear oil seal retainer            | 2. Cylinder block                       | 3. Knock sensor                      |
| 4. Upper main bearing                | 5. Lower main bearing                   | 6. Water drain plug (LH side)        |
| 7. Water connector (RH side)         | 8. Water drain plug (water pump side)   | 9. Main bearing cap                  |
| 10. Main bearing beam                | 11. Crankshaft                          | 12. Pilot bushing or pilot converter |
| 13. Flywheel with signal plate (M/T) | 14. Drive plate with signal plate (A/T) | 15. Drive plate reinforcement        |
| 16. Oil ring set                     | 17. Piston pin                          | 18. Connecting rod bearing           |
| 19. Connecting rod                   | 20. Piston                              | 21. Top ring                         |
| 22. Second ring                      | 23. Cylinder block heater (Canada only) | 24. Oil jet                          |
| 25. Key                              | 26. Snap ring                           | 27. Baffle plate                     |
| 28. Gasket                           |   |                                      |

# CYLINDER BLOCK

## CAUTION:

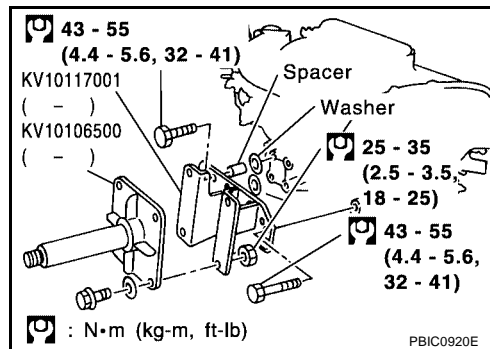
- Apply new engine oil to parts as marked in illustrations before installation.
- Place removed parts such as bearings and bearing caps in their proper order and direction.
- When installing the connecting rod nuts, and main bearing cap bolts, apply new engine oil to the threads and mating surfaces
- Do not allow any magnetic materials to contact the signal plate teeth on the drive plate.

## DISASSEMBLY

1. Remove the engine assembly. Refer to [EM-117, "ENGINE ASSEMBLY"](#) .
2. Install Tools to the right side of cylinder block.

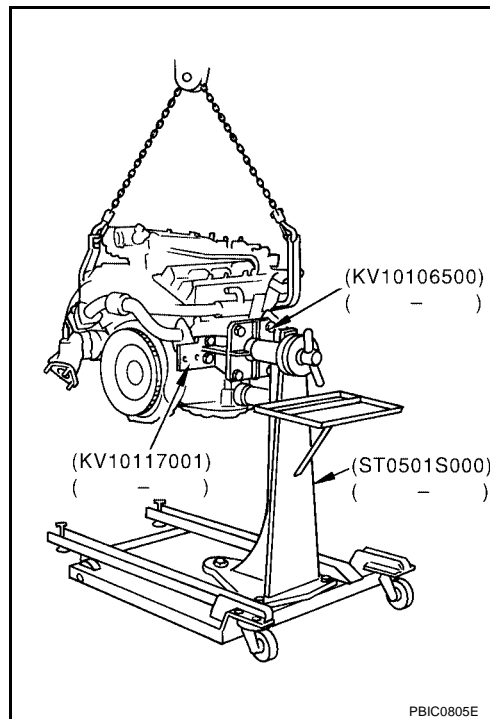
**Tool numbers** : KV10117001 ( - )  
 : KV10106500 ( - )

Use the spacer on the engine rear side.



3. Lift engine and mount it on Tool.

**Tool numbers** : KV10117001 ( - )  
 : KV10106500 ( - )  
 : ST0501S000 ( - )



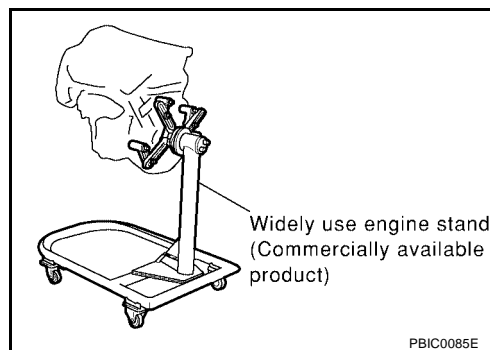
- A commercial engine stand can be used.

## CAUTION:

Use an engine stand that has a load capacity of approximately 220kg (441 lb) or more.

## NOTE:

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



# CYLINDER BLOCK

- Remove the knock sensor.

**CAUTION:**

**Carefully handle sensor avoiding shocking it.**

- Drain the engine of all coolant and oil refer to [MA-14, "DRAINING ENGINE COOLANT"](#) and [MA-16, "Changing Engine Oil"](#).
- Remove the lower and upper oil pans. Refer to [EM-31, "REMOVAL"](#).
- Remove the timing chain. Refer to [EM-59, "REMOVAL"](#).
- Remove oil pump. Refer to [LU-10, "REMOVAL"](#).
- Remove the cylinder heads. Refer to [EM-102, "REMOVAL"](#).
- Lock crankshaft using Tool, and remove drive plate (A/T) or fly-wheel bolts.
  - Loosen the bolts in diagonal order.

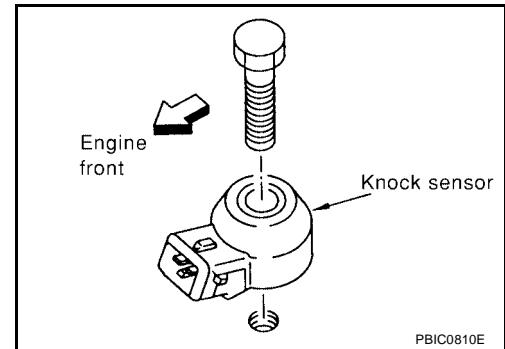
**Tool number** : KV10117700 (J44716)

**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.

- Remove pilot bushing (M/T) or pilot converter (A/T) using Tool.

**Tool number** ST16610001 (J23907)



- Cut away liquid gasket using Tool and remove rear oil seal retainer. Refer to [EM-4, "REMOVAL OF LIQUID GASKET SEALING"](#).

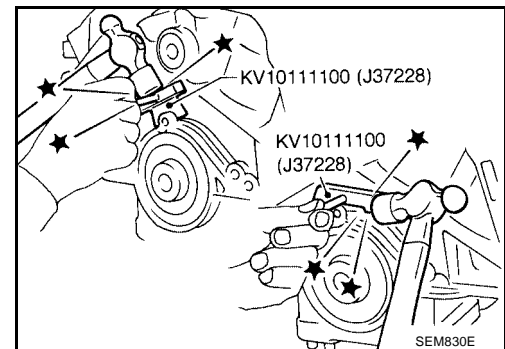
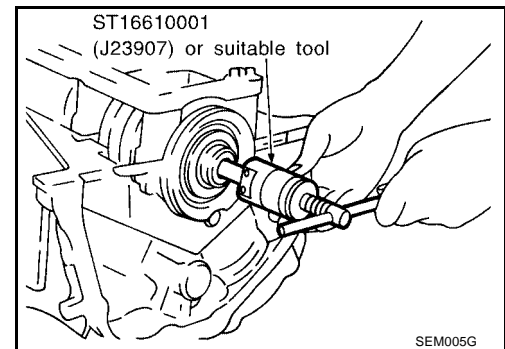
**Tool number** KV10111100 (J37228)

**CAUTION:**

- Be careful not to damage mounting surface.
- If rear oil seal retainer is removed, replace it with a new one.

**NOTE:**

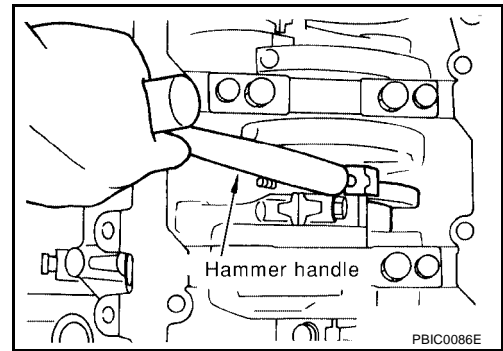
Rear oil seal and retainer form a single part and are handled as an assembly.



- Remove baffle plate from main bearing beam.

# CYLINDER BLOCK

14. Remove the piston and connecting rod assemblies.
  - a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom dead center.
  - b. Remove the connecting rod cap.
  - c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out to the cylinder head side.
    - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-158, "CONNECTING ROD"](#).



15. Remove the connecting rod bearings.

**CAUTION:**

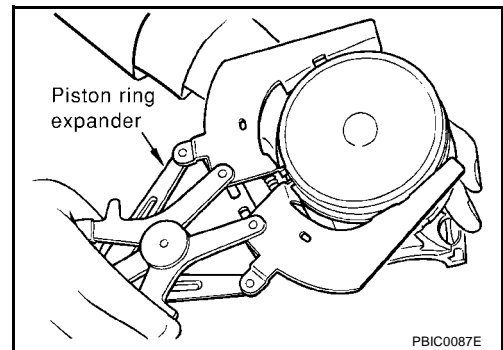
- When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.

16. Remove the piston rings and oil rings from the piston.

- Use a piston ring expander.
- Before removing the piston rings and oil rings, check the piston ring side clearance. Refer to [EM-140, "PISTON RING SIDE CLEARANCE"](#).

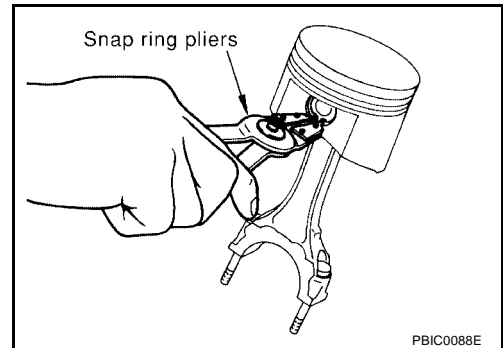
**CAUTION:**

- When removing the piston rings, be careful not to damage the piston. Do not expand the rings excessively.
- Be careful to mark the rings if they are to be reused so they are installed in their original position.

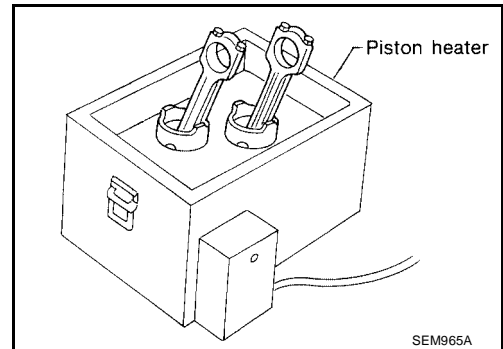


17. Remove the piston from the connecting rod as follows.

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

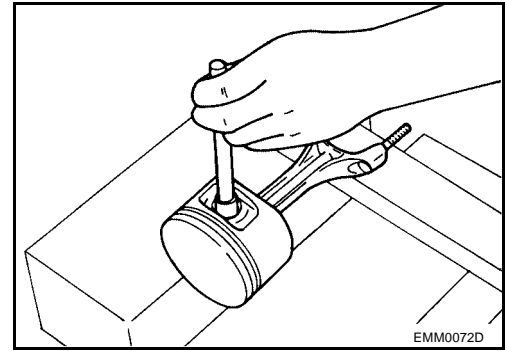


- b. Heat the pistons to 60° - 70°C (140° - 158°F).



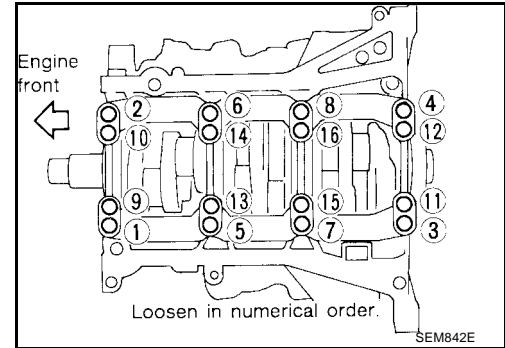
## CYLINDER BLOCK

- c. Push out the piston pin with a suitable tool, with an outer diameter approximately 20 mm (0.8 in).



18. Loosen the main bearing cap bolts in the order shown and remove the main bearing beam, bearing caps and crankshaft.

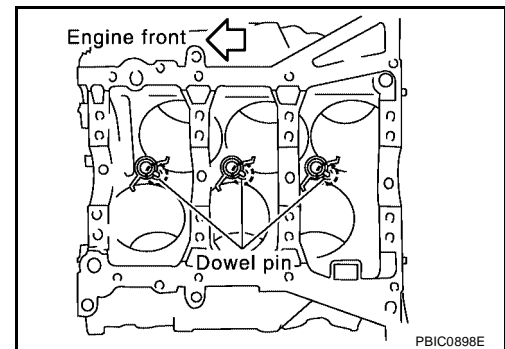
- Before loosening the main bearing cap bolts, measure the crankshaft side clearance. Refer to [EM-145, "OUT-OF-ROUND AND TAPER OF CRANKSHAFT"](#).



19. Remove the oil jets.
20. Remove the main bearings and thrust bearings from the cylinder block and main bearing caps.

**CAUTION:**

When removing them, note their direction and position. Keep them in the correct order for installation.



### ASSEMBLY

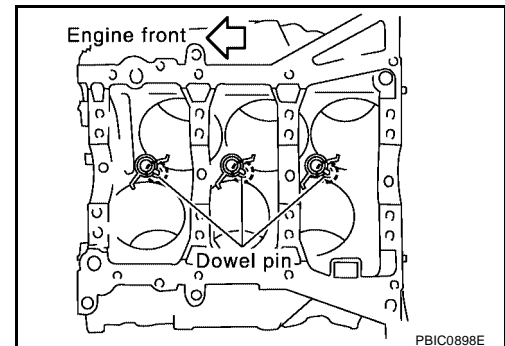
1. Blow out the coolant and oil passages and cylinder bore to remove any foreign materials.

**WARNING:**

Use goggles to protect your eyes.

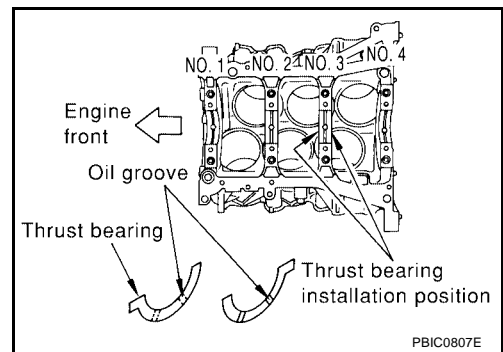
2. Apply liquid gasket and install each water drain plug into the cylinder block.
- Install the cylinder block heater, if equipped.
  - Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
3. Install the oil jets.
- Insert the oil jet dowel pin into the cylinder block dowel pin hole, and tighten the oil jet bolts.

**Oil jet bolts : 23.6 - 30.4 N·m (2.4 - 3.1 kg·m, 18 - 22 ft·lb)**

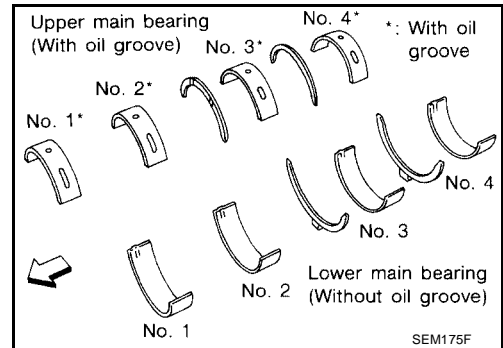


# CYLINDER BLOCK

4. Install the main bearings and the thrust bearings.
  - a. Remove dust, dirt, and oil on the bearing mating surfaces of the cylinder block and the main bearing cap.
  - b. Install the thrust bearings to 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.

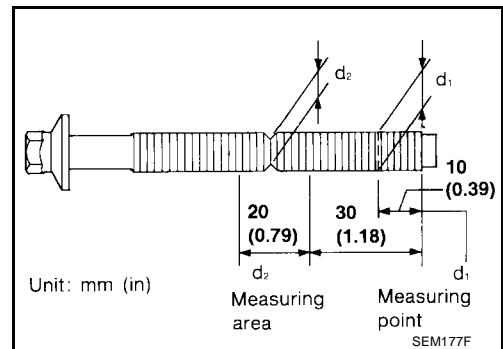


5. Set the upper main bearings in their proper positions on the cylinder block.
  - Confirm the correct main bearings are used. Refer to [EM-143](#), "[PISTON-TO-CYLINDER BORE CLEARANCE](#)".

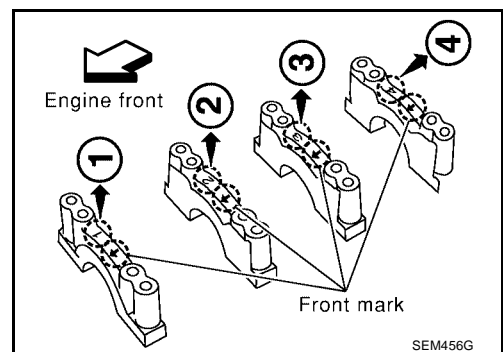


6. Check specifications for the re-use of the main bearing cap bolts.
  - Measure d1 and d2 as shown.
  - For d2, select the minimum diameter in the measuring area.
  - If the difference between d1 and d2 exceeds the limit, replace the bolts for assembly.

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



7. After installing the crankshaft, lower main bearings, main bearing caps, main bearing beam, and bearing cap bolts.
  - a. Make sure that the front marks on the main bearing beam faces the front of the engine.
  - b. Prior to tightening all the bearing cap bolts, place the bearing beam in its proper position by shifting the crankshaft in the axial position.
  - c. After tightening the bearing cap bolts, make sure the crankshaft turns smoothly.
  - d. Lubricate the threads and seat surfaces of the bolts with new engine oil.



# CYLINDER BLOCK

- e. Tighten the bearing cap bolts in two steps in the order shown:

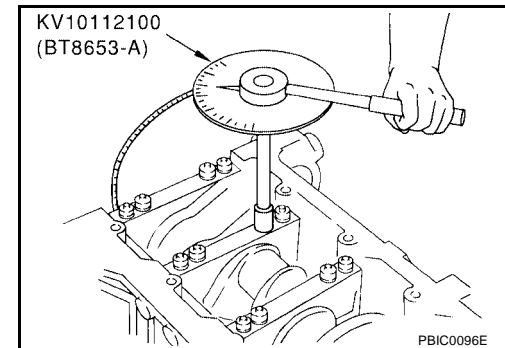
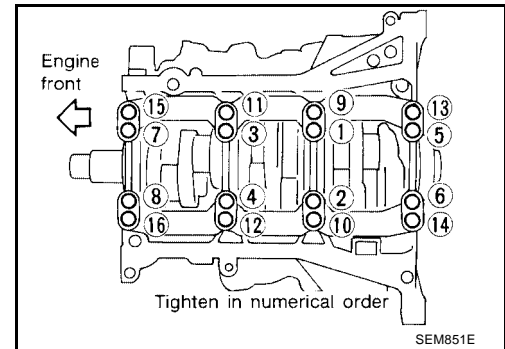
**Bearing cap bolts**

**Step 1 : 32 - 38 N·m (3.3 - 3.9 kg·m, 24 - 28 ft·lb)**

**Step 2 : 90° - 95° degrees clockwise**

**CAUTION:**

Measure the tighten angle with an angle wrench. Do not measure visually.

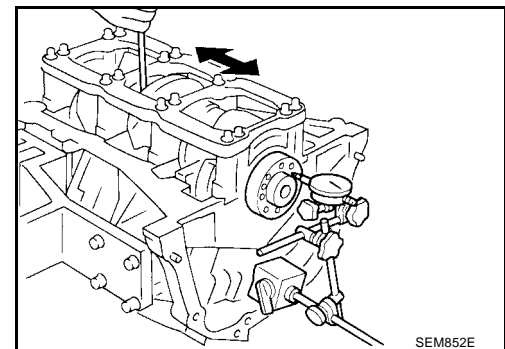


8. Using a dial indicator, measure the clearance between the thrust bearings and the connecting rods when the crankshaft is moved from front to rear.

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

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

- If beyond the limit, replace the thrust bearings and measure again. If still beyond the limit, replace the crankshaft.



9. Install the rear oil seal retainer.

- Apply sealant to rear oil seal retainer using Tool as shown.

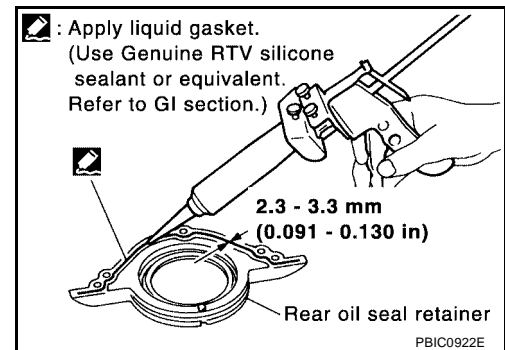
**Tool number : WS39930000 (-)**

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-43, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

**Rear oil seal retainer bolts : 8.2 - 9.3 N·m (0.83 - 0.95 kg·m, 72 - 82 in·lb)**

**CAUTION:**

Rear oil seal is replaced with the rear oil seal retainer and must be replaced as an assembly.

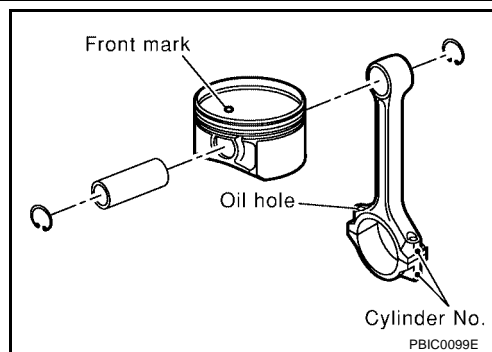




# CYLINDER BLOCK

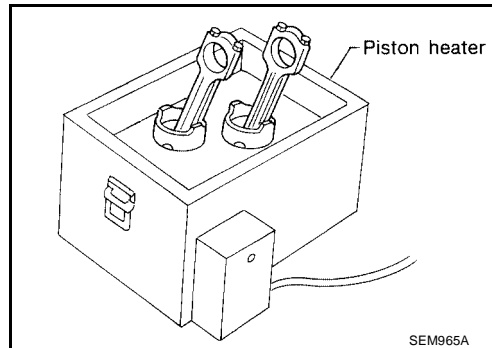
10. Install the piston to the connecting rod.

- a. Using suitable snap ring pliers, install the snap ring into the pin-groove of the piston rear side.
- Insert it fully into groove to install.

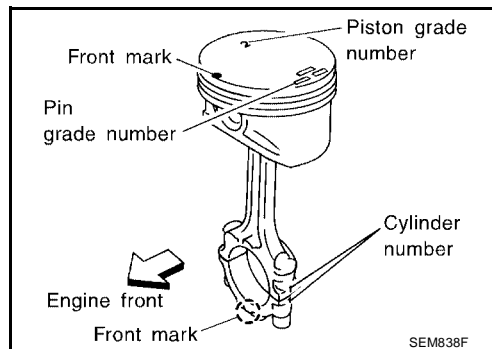


b. Install the piston to the connecting rod.

- Heat the piston until the piston pin can be pushed in by hand without excess force [approx. 60° - 70°C (140° to 158°F)]. From the front to the rear, insert the piston pin into the piston and through the connecting rod.

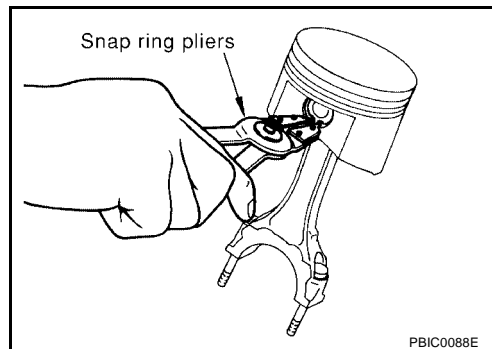


- Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown.



c. Install the snap ring into the front of the piston pin-groove.

- After installing, check that the connecting rod pivots smoothly on the pin.



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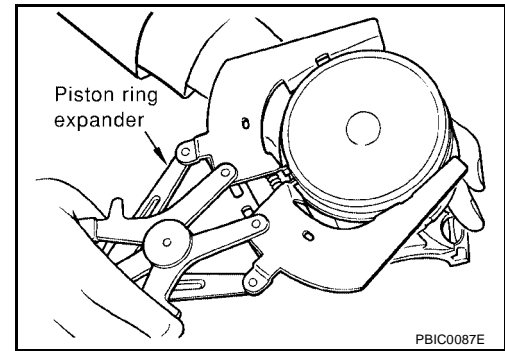
## CYLINDER BLOCK

11. Install the piston rings using a piston ring expander.

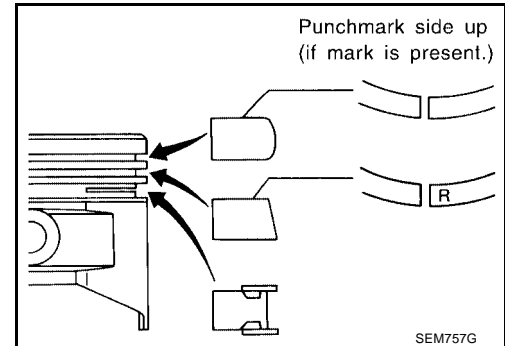
- Install the top ring and the second ring with the stamped surface facing upward. If the ring is not stamped it can face in either direction.

**CAUTION:**

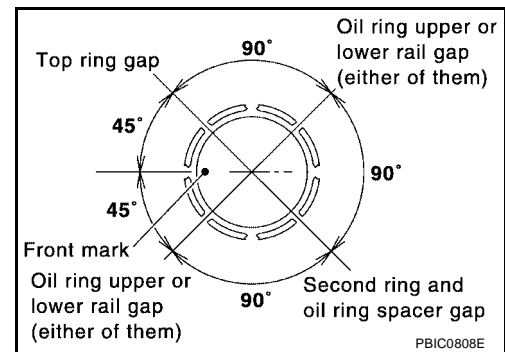
- Be careful not to damage the piston.
- When the piston rings are not replaced, remount the rings in their original positions.



- When replacing the piston rings, those without punchmarks can be mounted either side up.

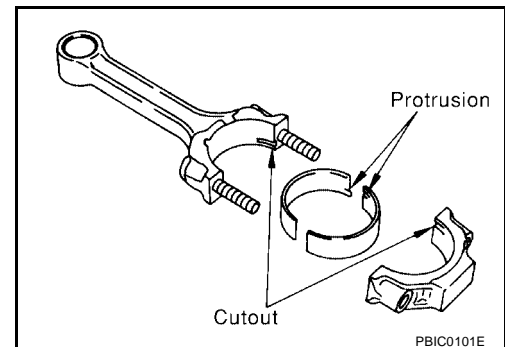


- Position each ring with the gap as shown, referring to the piston front mark.



12. 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 (crankshaft side). Do not apply oil to the back surface (connecting rod and cap side), but thoroughly clean it.
- When installing, align the connecting rod bearing protrusion with the notch of the connecting rod to install.
- Check that the oil holes on the connecting rod and on the corresponding bearing are aligned.



# CYLINDER BLOCK

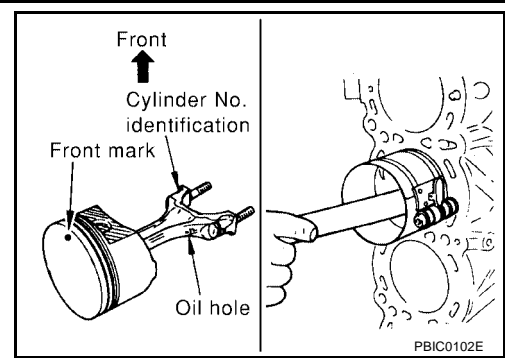
13. Install the piston and connecting rod assembly into the corresponding cylinder.

- 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 No. on the connecting rod to install.
- Install the piston using Tool with the front mark on the piston crown facing the front of the engine.

**Tool number** : EM03470000 (J8037)

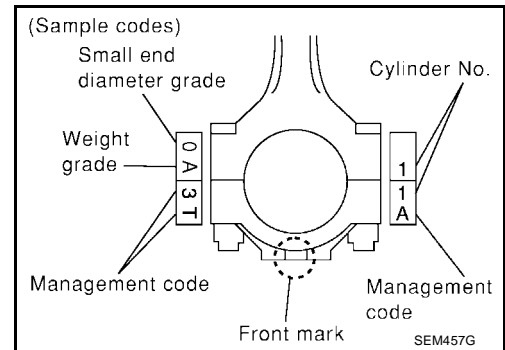
**CAUTION:**

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



14. Install the connecting rod cap.

- Match the stamped cylinder number marks on the connecting rod with those on the cylinder cap for installation.
- Install the piston connecting rod assembly and cap so that the front mark on the cap and piston are facing the front of the engine.
- Lubricate the threads and seat surfaces with new engine oil.



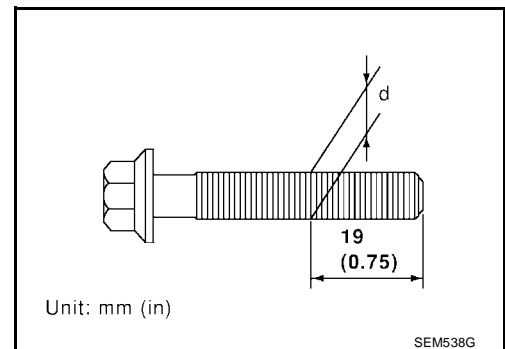
15. Check the connecting rod cap bolts before reusing, then install in their original position in the connecting rod. The bolts should screw in smoothly by hand.

- Measure the outer diameter of the connecting rod cap bolt as shown.

**Outer diameter "d" of the connecting rod bolt**

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

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



16. Tighten the connecting rod nuts in two steps:

**Step 1** : 19 - 21 N·m (1.9 - 2.1 kg·m, 14 - 15 ft·lb)

**Step 2** : 90° - 95° degrees clockwise

**CAUTION:**

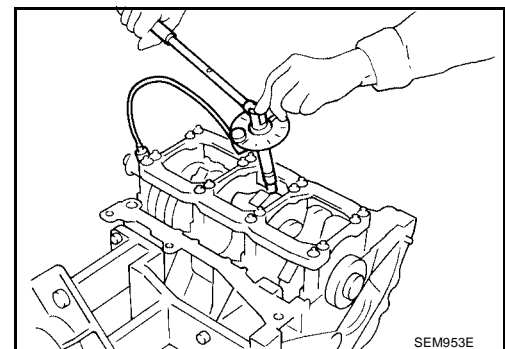
**Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.**

- Apply engine oil to the threads and seats of the connecting rod bolts and nuts.
- After tightening the nuts, make sure that the crankshaft rotates smoothly.
- Check the connecting rod side clearance. If beyond the limit, replace the connecting rod and/or crankshaft.

**Connecting rod side clearance:**

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

**Limit** : 0.40 mm (0.0157 in)



17. Install the baffle plate.

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# CYLINDER BLOCK

**Baffle plate bolts** : 8.14 - 9.51 N·m (0.83 - 0.97 kg-m,  
72 - 84 in-lb)

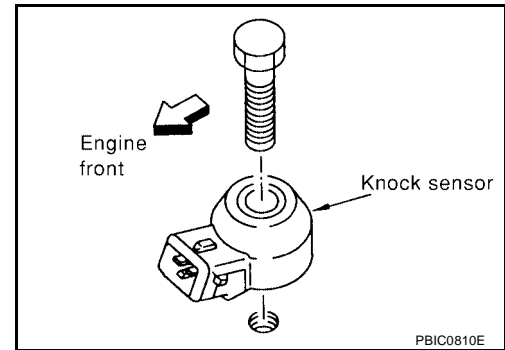
18. Install the knock sensor.

**Knock sensor bolt** : 20.6 - 26.5 N·m (2.1 - 2.7  
kg-m, 16 - 19 in-lb)

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

**CAUTION:**

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

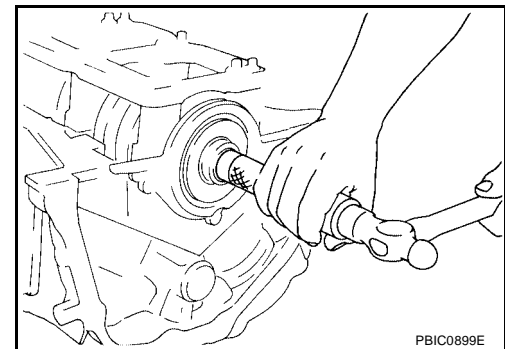


19. Install the pilot bushing (M/T) or pilot converter (A/T) using suitable tool.

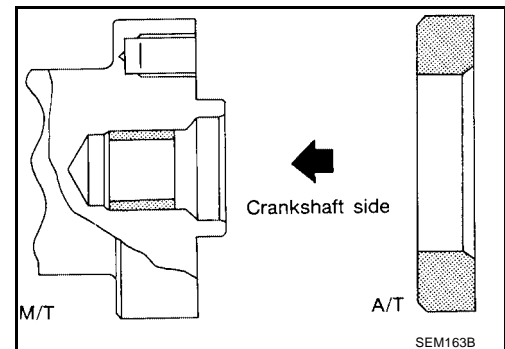
**Outer diameter of drift**

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

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



- Install pilot bushing or pilot converter as shown.

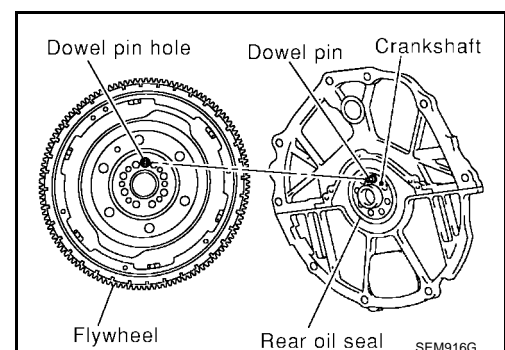


20. Install the flywheel (M/T), if equipped.

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

**Tool number** : KV10117700 (J44716)

**Flywheel bolts** : 83 - 93 N·m (8.5 - 9.5 kg-m, 61 - 69 ft-lb)



# CYLINDER BLOCK

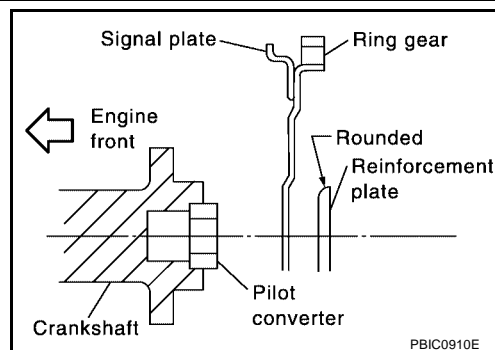
21. Install the drive plate (A/T), if equipped.

- Install the drive plate and reinforce plate in the direction shown.
- Align dowel pins of crankshaft rear and drive plate with pin holes of each part.
- Secure the crankshaft using Tool.

**Tool number : KV10117700 (J44716)**

- Tighten the drive plate bolts in one or two steps.

**Drive plate bolts : 83 - 93 N·m (8.5 - 9.5 kg·m, 61 - 69 ft·lb)**



22. Unlock ring gear or flywheel, remove Tool.

**Tool number : KV10117700 (J44716)**

23. Install the cylinder head. Refer to [EM-102, "Removal and Installation"](#) .

24. Install the oil pump. Refer to [LU-10, "INSTALLATION"](#) .

25. Install the timing chain. Refer to [EM-70, "INSTALLATION"](#) .

26. Install the upper and lower oil pans. Refer to [EM-34, "INSTALLATION"](#) .

27. Remove the engine from the stand and install the engine assembly into the vehicle. Refer to [EM-117, "Removal and Installation"](#) .

28. Assembly of the remaining parts is in the reverse order of disassembly.

29. Fill the engine with the specified oil and coolant. Refer to [MA-9, "Fluids and Lubricants"](#) .

**CAUTION:**

**Wait at least 30 minutes for the sealant to set-up before filling the engine with fluids and running it.**

## How to Select Piston and Bearing DESCRIPTION

EBS00JB9

| Selection points                      | Selection parts   | Selection items                                  | Selection methods   |
|---------------------------------------|---|--|---|
| Between cylinder block and crankshaft | Main bearing  | Main bearing grade (bearing thickness)           | Determined by matching 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.

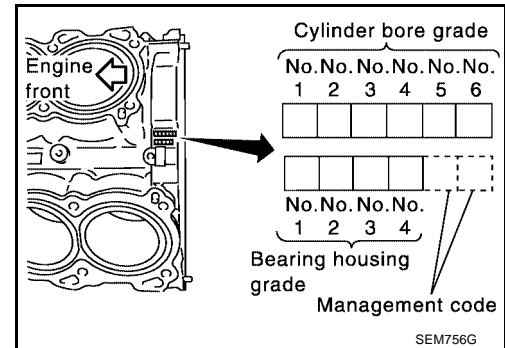
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repair parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values or each selection table.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

# CYLINDER BLOCK

## HOW TO SELECT A PISTON

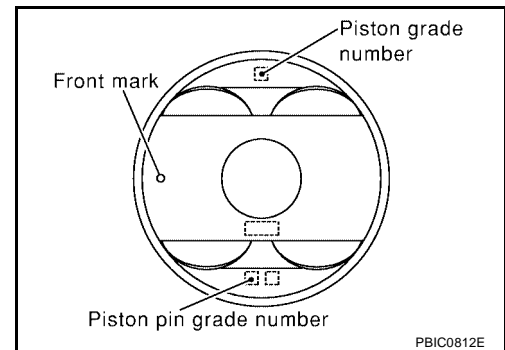
### When New Cylinder Block is Used

- 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.)



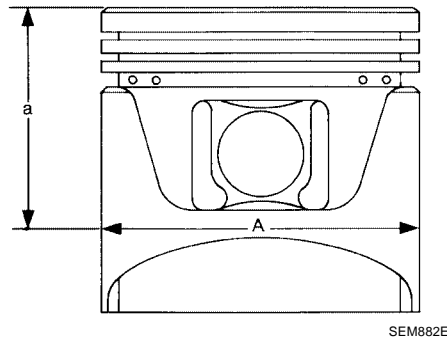
### When Cylinder Block is Reused

1. Measure the cylinder block bore inner diameter.
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the [EM-134](#), "[Piston Selection Table](#)".
3. Select the piston of the same grade.



## Piston Selection Table

Unit: mm (in)



| Grade                           | 1                                 | 2 (or no mark)                    | 3                                 | oversize (service)                |
|---------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| 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) | 95.700 - 95.730 (3.7677 - 3.7689) |
| 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) | 95.680 - 95.710 (3.7669 - 3.7681) |

### 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 grade mark is indicated on 2 grade piston.

# CYLINDER BLOCK

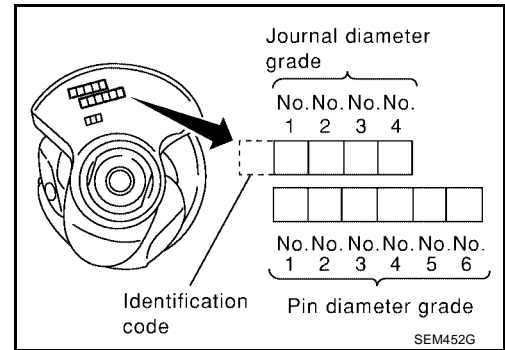
## HOW TO SELECT CONNECTING ROD BEARINGS

### 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.
2. Confirm the big end inner diameter of connecting rod is within the standard value.
3. Apply the measured dimension to the [EM-135, "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 [EM-135, "Connecting Rod Bearing Selection Table"](#).

### Connecting Rod Bearing Selection Table

Unit: mm (in)

| Connecting rod big end inner diameter |              | 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<br>Bearing thickness range: 1.500 - 1.503 (0.00591 - 0.0592)<br>Color: Black |
| 51.962 - 51.968 (2.0457 - 2.0460)     | 1            | Bearing grade No. STD 1<br>Bearing thickness range: 1.503 - 1.506 (0.00592 - 0.0593)<br>Color: Brown |
| 51.956 - 51.962 (2.0455 - 2.0457)     | 2            | Bearing grade No. STD 2<br>Bearing thickness range: 1.506 - 1.509 (0.00593 - 0.0594)<br>Color: Green |

### Undersize Connecting Rod Bearings Usage Guide

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

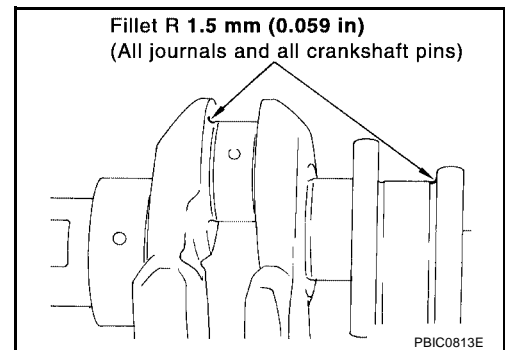
### Connecting Rod Bearing Undersize Table

Unit: mm (in)

| Size          | Thickness                       |
|---------------|---------------------------------|
| 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).

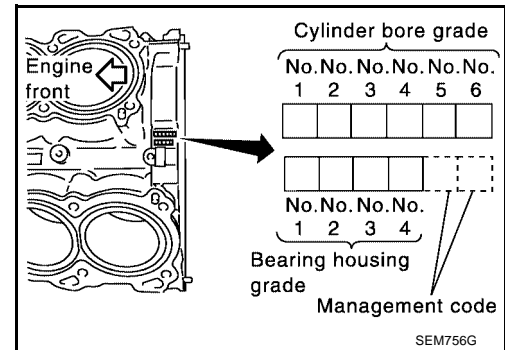


# CYLINDER BLOCK

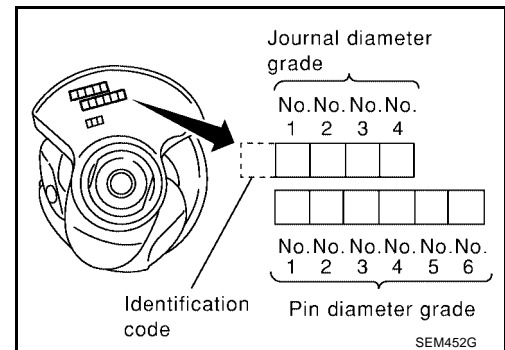
## HOW TO SELECT MAIN BEARINGS

### When New Cylinder Block and Crankshaft are Used

1. [EM-137, "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 column in [EM-137, "Main Bearing Selection Table"](#).
3. Find sign (main bearing grade) at crossing of row and column in [EM-137, "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.
2. Find measured dimension in "Cylinder block bearing housing inner diameter" row of [EM-137, "Main Bearing Selection Table"](#).
3. Find the measured dimension in "Crankshaft main journal diameter" column in [EM-137, "Main Bearing Selection Table"](#).
4. Select main bearing grade at the point where selected row and column intersect.



# CYLINDER BLOCK

## Main Bearing Selection Table

| Cylinder block bearing housing inner diameter<br>Unit: mm (in)<br><br>Crankshaft main journal diameter<br>Unit: mm (in) |                                   | 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 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| B   | 59.974 - 59.973 (2.3612 - 2.3611) | 0             | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| C   | 59.973 - 59.972 (2.3611 - 2.3611) | 0             | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| D   | 59.972 - 59.971 (2.3611 - 2.3611) | 0             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| E   | 59.971 - 59.970 (2.3611 - 2.3610) | 0             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| F   | 59.970 - 59.969 (2.3610 - 2.3610) | 0             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| G   | 59.969 - 59.968 (2.3610 - 2.3609) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| H   | 59.968 - 59.967 (2.3609 - 2.3609) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| J   | 59.967 - 59.966 (2.3609 - 2.3609) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| K   | 59.966 - 59.965 (2.3909 - 2.3608) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| L   | 59.965 - 59.964 (2.3608 - 2.3608) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| M   | 59.964 - 59.963 (2.3608 - 2.3607) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| N   | 59.963 - 59.962 (2.3607 - 2.3607) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| P   | 59.962 - 59.961 (2.3607 - 2.3607) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| R   | 59.961 - 59.960 (2.3607 - 2.3606) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| S   | 59.960 - 59.959 (2.3606 - 2.3606) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| T   | 59.959 - 59.958 (2.3606 - 2.3605) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| U   | 59.958 - 59.957 (2.3605 - 2.3605) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V   | 59.957 - 59.956 (2.3605 - 2.3605) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| W   | 59.956 - 59.955 (2.3605 - 2.3604) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| X   | 59.955 - 59.954 (2.3604 - 2.3604) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Y   | 59.954 - 59.953 (2.3604 - 2.3603) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4   | 59.953 - 59.952 (2.3603 - 2.3603) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7   | 59.952 - 59.951 (2.3603 - 2.3603) | 1             | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

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# CYLINDER BLOCK

**Main Bearing Grade Table (All Journals)**

| Grade number |     | Thickness "T" mm (in)           | Width "W" mm (in)              | Identification color (UPR/LWR) | Remarks  |
|--------------|-----|---------------------------------|--------------------------------|--------------------------------|--|
| 0            |     | 2.000 - 2.003 (0.0787 - 0.0789) | 19.9 - 20.1<br>(0.783 - 0.791) | Black                          | Grade is the same for upper and lower bearings.  |
| 1            |     | 2.003 - 2.006 (0.0789 - 0.0790) |                                | Brown                          |  |
| 2            |     | 2.006 - 2.009 (0.0790 - 0.0791) |                                | Green                          |  |
| 3            |     | 2.009 - 2.012 (0.0791 - 0.0792) |                                | Yellow                         |  |
| 4            |     | 2.012 - 2.015 (0.0792 - 0.0793) |                                | Blue                           |  |
| 5            |     | 2.015 - 2.018 (0.0793 - 0.0794) |                                | Pink                           |  |
| 6            |     | 2.018 - 2.021 (0.0794 - 0.0796) |                                | Purple                         |  |
| 7            |     | 2.021 - 2.024 (0.0796 - 0.0797) |                                | White                          | Grade is different for upper and lower bearings. |
| 01           | UPR | 2.003 - 2.006 (0.0789 - 0.0790) |                                | Brown/Black                    |  |
|              | LWR | 2.000 - 2.003 (0.0787 - 0.0789) |                                |                                |  |
| 12           | UPR | 2.006 - 2.009 (0.0790 - 0.0791) |                                | Green/Brown                    |  |
|              | LWR | 2.003 - 2.006 (0.0789 - 0.0790) |                                |                                |  |
| 23           | UPR | 2.009 - 2.012 (0.0791 - 0.0792) |                                | Yellow/Green                   |  |
|              | LWR | 2.006 - 2.009 (0.0790 - 0.0791) |                                |                                |  |
| 34           | UPR | 2.012 - 2.015 (0.0792 - 0.0793) | Blue/Yellow                    |                                |  |
|              | LWR | 2.009 - 2.012 (0.0791 - 0.0792) |                                |                                |  |
| 45           | UPR | 2.015 - 2.018 (0.0793 - 0.0794) | Pink/Blue                      |                                |  |
|              | LWR | 2.012 - 2.015 (0.0792 - 0.0793) |                                |                                |  |
| 56           | UPR | 2.018 - 2.021 (0.0794 - 0.0796) | Purple/Pink                    |                                |  |
|              | LWR | 2.015 - 2.018 (0.0793 - 0.0794) |                                |                                |  |
| 67           | UPR | 2.021 - 2.024 (0.0796 - 0.0797) | White/Purple                   |                                |  |
|              | LWR | 2.018 - 2.021 (0.0794 - 0.0796) |                                |                                |  |

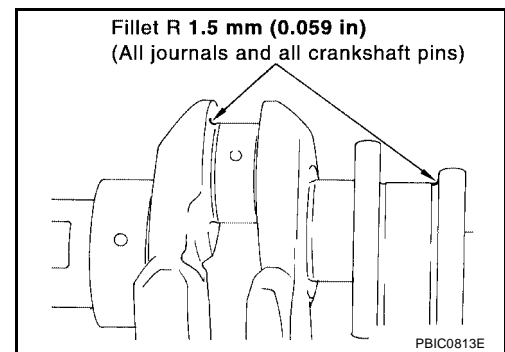
**Undersize Main Bearing Usage Guide**

- Use undersize bearing when oil clearance with standard size main bearing is not within specification.

**CAUTION:**

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

- When using undersize bearing, measure the bearing inner diameter with bearing installed, and grind journal until oil clearance falls within specification.



**Main Bearing Undersize Table**

Unit: mm (in)

| Size          | Thickness                       |
|---------------|---------------------------------|
| 0.25 (0.0098) | 2.132 - 2.140 (0.0839 - 0.0843) |

# CYLINDER BLOCK

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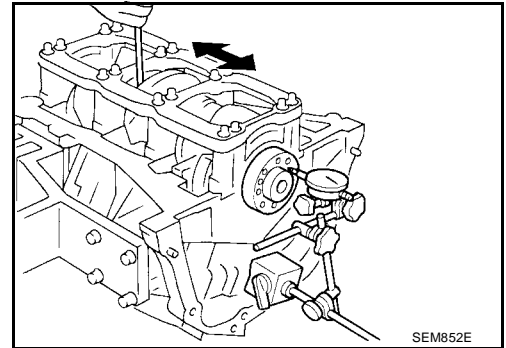
## Inspection After Disassembly CRANKSHAFT END PLAY

- Using a dial indicator, measure the clearance between the thrust bearings and the connecting rods when the crankshaft is moved from front to rear.

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

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

- If beyond the limit, replace the thrust bearings and measure again. If still beyond the limit, replace the crankshaft.



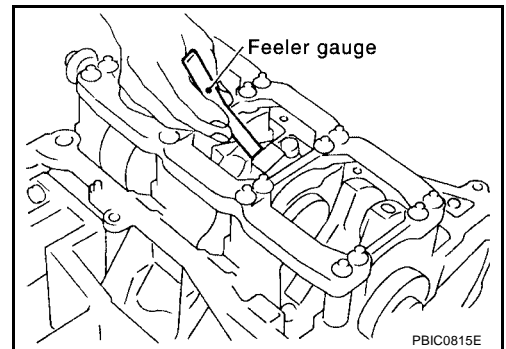
## CONNECTING ROD SIDE CLEARANCE

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

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

**Limit** : 0.40 mm (0.0157 in)

- If beyond the limit, replace the connecting rod and measure again. If still beyond the limit, replace the crankshaft.



## PISTON AND PISTON PIN CLEARANCE

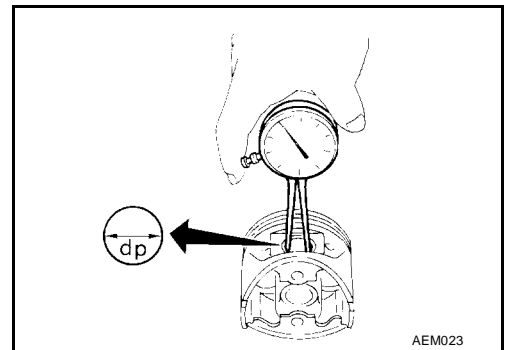
### Inner Diameter of Piston Pin Hole

- Measure the inner diameter of piston pin hole "dp".

**Standard diameter "dp"**

**Grade No. 0** : 21.993 - 21.999 mm (0.8659 - 0.8661 in)

**Grade No. 1** : 21.999 - 22.005 mm (0.8661 - 0.8663 in)



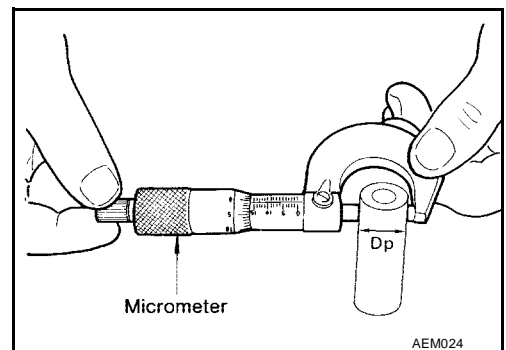
### Outer Diameter of Piston Pin

- Measure outer diameter of piston pin "Dp".

**Standard diameter "Dp"**

**Grade No. 0** : 21.989 - 21.995 mm (0.8657 - 0.8659 in)

**Grade No. 1** : 21.995 - 22.001 mm (0.8659 - 0.8662 in)



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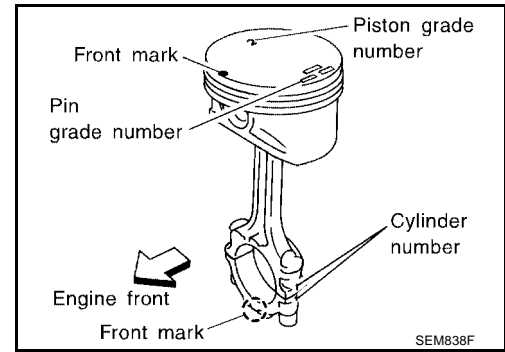
# CYLINDER BLOCK

## Piston and Piston Pin Interference Fit

Standard Interference Fit = "Dp" – "dp"

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

- If clearance exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each part.
- When replacing piston/piston pin assembly, refer to [EM-143](#), "[PISTON-TO-CYLINDER BORE CLEARANCE](#)".



## PISTON RING SIDE CLEARANCE

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

**Standard Side Clearance**

**Top ring : 0.045 - 0.080 mm (0.0018 - 0.0031 in)**

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

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

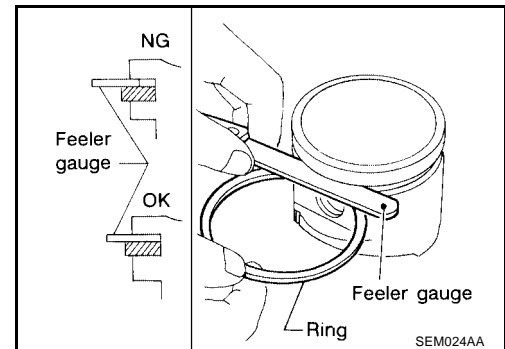
**Maximum Limit**

**Top ring : 0.11 mm (0.0043 in)**

**2nd ring : 0.1 mm (0.004 in)**

**Oil ring : —**

- If out of specification, replace piston ring assembly. If clearance exceeds maximum limit with new rings, replace piston



## PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to [EM-143](#), "[PISTON-TO-CYLINDER BORE CLEARANCE](#)".
- Insert piston ring until it is in the middle of the cylinder bore and measure the end 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)**

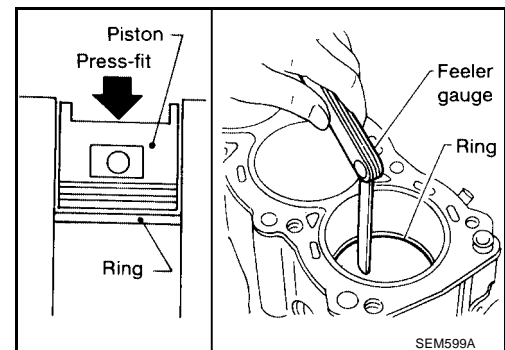
**Limit:**

**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.

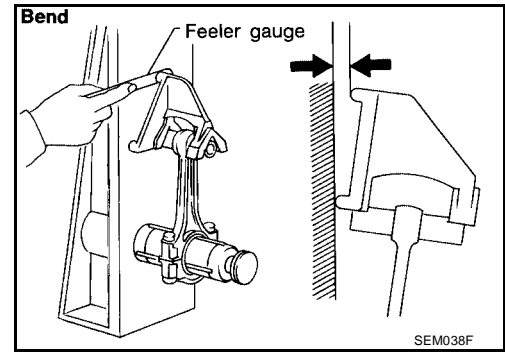


# CYLINDER BLOCK

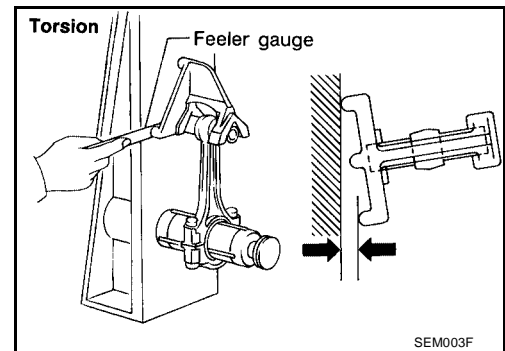
## CONNECTING ROD BEND AND TORSION

**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



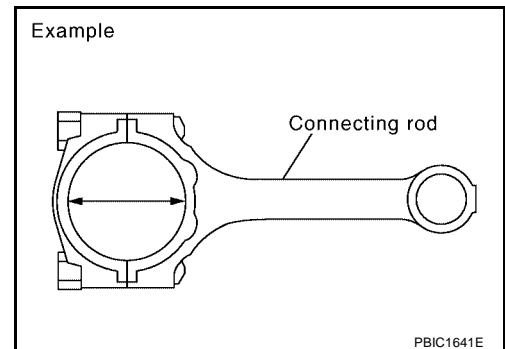
- If it exceeds the limit, replace connecting rod assembly.



## CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod nut to the specified torque, measure the connecting rod bearing housing big end inner diameter using an inside micrometer.

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



## CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

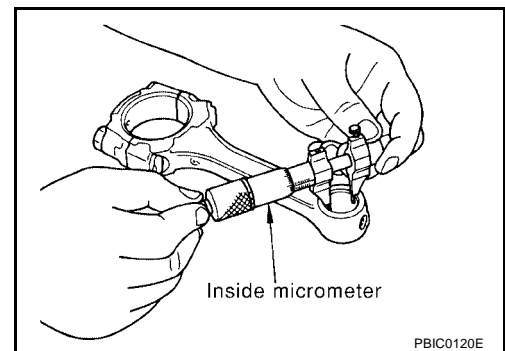
### Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of piston pin bushing.

**Standard**

**Grade No. 0** : 22.000 - 22.006 mm (0.8661 - 0.8664 in)

**Grade No. 1** : 22.006 - 22.012 mm (0.8664 - 0.8666 in)



# CYLINDER BLOCK

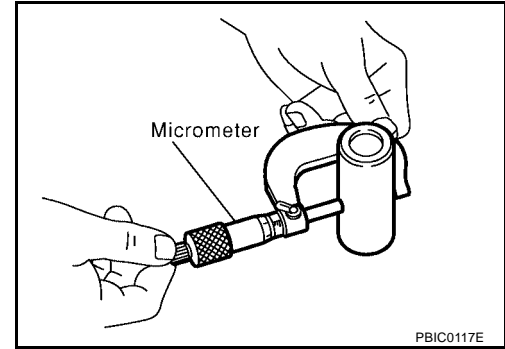
## Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

### Standard

**Grade No. 0** : 21.989 - 21.995 mm (0.8657 - 0.8659 in)

**Grade No. 1** : 21.995 - 22.001 mm (0.8659 - 0.8662 in)



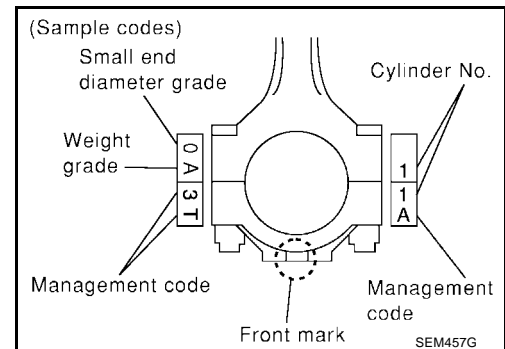
## Connecting Rod Bushing Oil Clearance (Small End)

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

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

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

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to [EM-143, "PISTON-TO-CYLINDER BORE CLEARANCE"](#).
- If replacing the connecting rod assembly, refer to [EM-141, "CONNECTING ROD BUSHING OIL CLEARANCE \(SMALL END\)"](#).

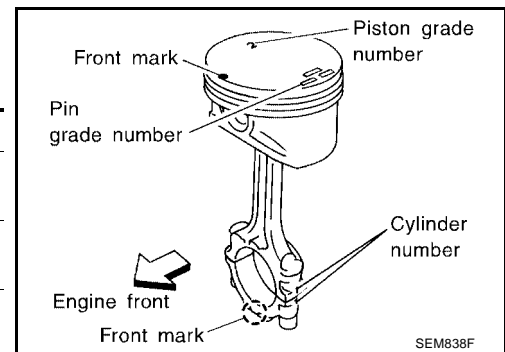


## Factory installed parts grading:

- Service parts apply only to grade 0.

| Grade                              | Unit: mm (in)                        |                                      |
|------------------------------------|--------------------------------------|--------------------------------------|
|                                    | 0                                    | 1                                    |
| Piston pin bushing inner diameter* | 22.000 - 22.006<br>(0.8661 - 0.8664) | 22.006 - 22.012<br>(0.8664 - 0.8666) |
| Piston pin outer diameter          | 21.989 - 21.995<br>(0.8657 - 0.8659) | 21.995 - 22.001<br>(0.8659 - 0.8662) |
| Piston pin hole diameter           | 21.993 - 21.999<br>(0.8659 - 0.8661) | 21.999 - 22.005<br>(0.8661 - 0.8663) |

\*: After installing in connecting rod



## CYLINDER BLOCK DISTORTION

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

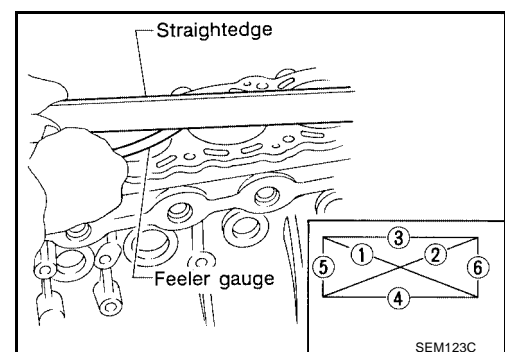
### CAUTION:

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

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

**Distortion limit** : 0.10 mm (0.0039 in)

- If out of specification, resurface the cylinder block. The allowable amount of resurfacing is dependent on the amount of any cylinder head resurfacing. The resurfacing limit is [amount of cylinder head resurfacing] + [amount of cylinder head resurfacing] = 0.2 mm (0.008 in).



# CYLINDER BLOCK

**Cylinder block height : 214.95 - 215.05 mm (8.4626 - 8.4665 in)**

## INNER DIAMETER OF MAIN BEARING HOUSING

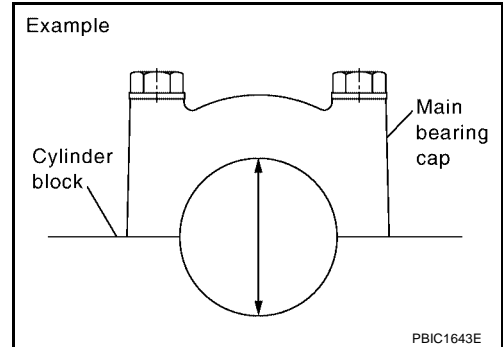
- Install the main bearing caps with the main bearings removed, and tighten the mounting bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

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

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

### NOTE:

These components cannot be replaced individually, since they were processed together.

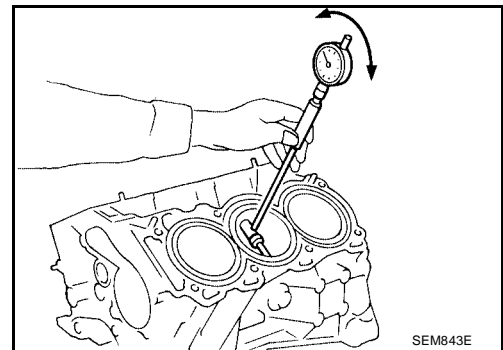


## PISTON-TO-CYLINDER BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper. The X axis is in the longitudinal direction of the engine.

### Cylinder bore inner diameter

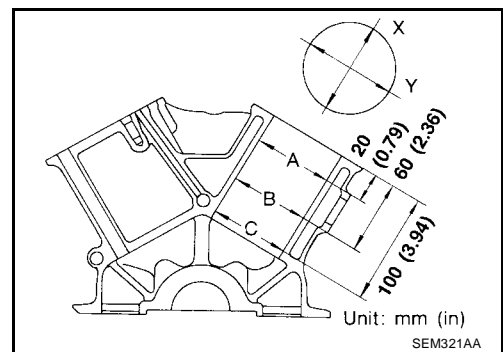
| Grade No. | Standard inner diameter                 | Wear limit          |
|-----------|---|---------------------|
| No. 1     | 95.500 - 95.510 mm (3.7598 - 3.7602 in) | 0.20 mm (0.0079 in) |
| No. 2     | 95.510 - 95.520 mm (3.7602 - 3.7606 in) |                     |
| No. 3     | 95.520 - 95.530 mm (3.7606 - 3.7610 in) |                     |



If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

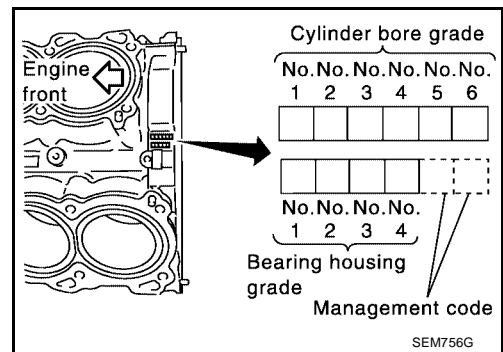
**Out-of-round (Difference between, X - Y) : less than 0.015 mm (0.0006 in)**

**Taper (Difference between, C - A) : less than 0.015 mm (0.0006 in)**



2. Check for scratches and seizure. If seizure is found, hone it.

- If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block rear position. These numbers are punched in either Arabic or Roman numerals.

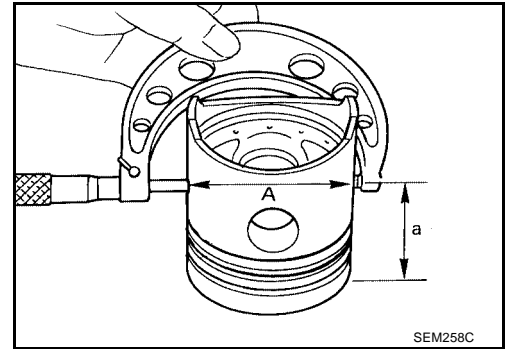


# CYLINDER BLOCK

3. Measure piston skirt diameter.

**Piston diameter "A"** : Refer to [EM-157, "PISTON, PISTON RING AND PISTON PIN"](#) .

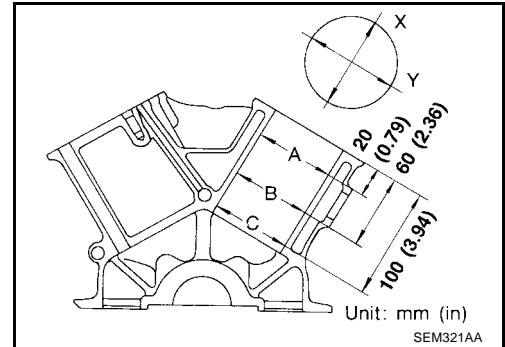
**Measuring point "a"** : 41.0 mm (1.614 in)  
(distance from the top)



4. Check that piston-to-bore clearance is within specification.

**Piston-to-bore clearance at "B"** : 0.010 - 0.030 mm (0.0004 - 0.0012 in)

- The piston-to-bore clearance is measured at the "B" level in the cylinder as shown.



5. Determine piston oversize according to amount of cylinder wear.

- Oversize pistons are available for service.
- If oversize piston is used, use it for all cylinders with oversize piston ring. Refer to [EM-157, "PISTON, PISTON RING AND PISTON PIN"](#) .

6. Cylinder bore size is determined by adding piston-to-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-bore clearance  
**C** : Honing allowance 0.02 mm (0.0008 in)

7. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted after boring.

8. 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.

9. Hone cylinders to obtain specified piston-to-bore clearance.

10. Measure finished cylinder bore for out-of-round and taper.

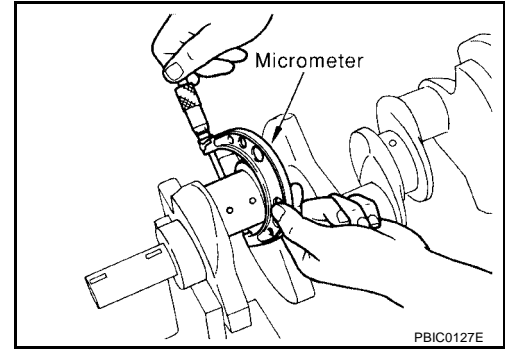
- Measurement should be done after cylinder bore cools down.



# CYLINDER BLOCK

## OUTER DIAMETER OF CRANKSHAFT JOURNAL

Measure outer diameter of crankshaft journals. Refer to [EM-145, "OUT-OF-ROUND AND TAPER OF CRANKSHAFT"](#) .



## OUTER DIAMETER OF CRANKSHAFT PIN

Measure outer diameter of crankshaft pin. Refer to [EM-145, "OUT-OF-ROUND AND TAPER OF CRANKSHAFT"](#) .

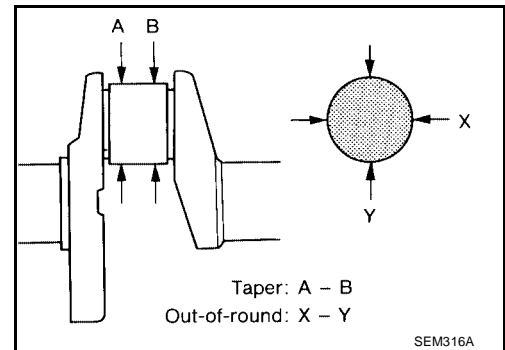
## OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Check the crankshaft main and pin journals for scoring, wear, or cracks.
- Measure the journals for taper and out-of-round.

### Standard

**Out-of-round (difference between, X - Y)** : 0.002 mm (0.0001 in)

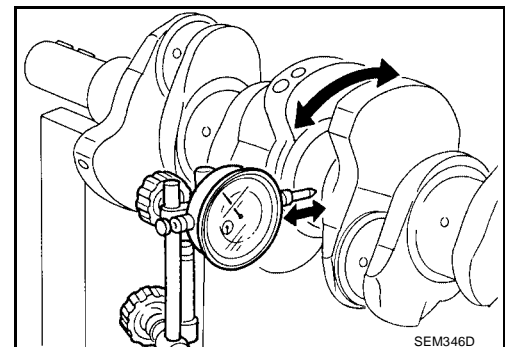
**Taper (difference between, A - B)** : 0.002 mm (0.0001 in)



## CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both ends 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.

**Runout limit (total indicator reading)** : less than 0.10 mm (0.0039 in)



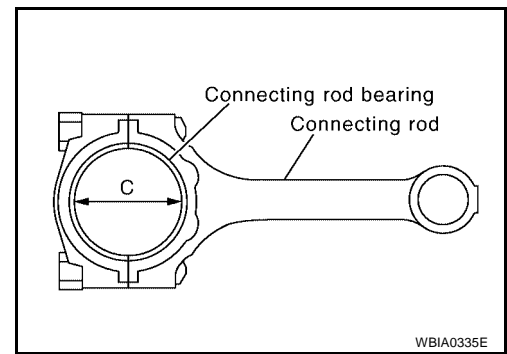
## OIL CLEARANCE OF CONNECTING ROD BEARING

### Method by Calculation

1. Install the connecting rod bearing to the connecting rod and cap.
2. Install the connecting rod cap to the connecting rod. Tighten to specification. Refer to [EM-126, "ASSEMBLY"](#) .

# CYLINDER BLOCK

3. Measure the inner diameter "C" of each connecting rod (big end) as shown.

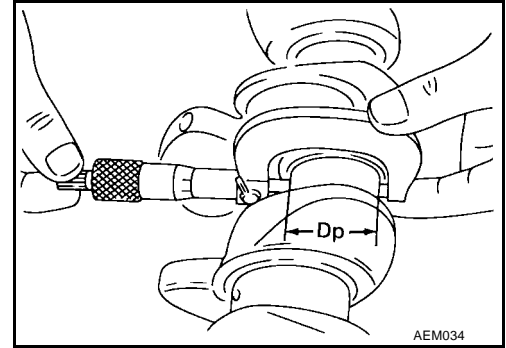


4. Measure the outer diameter "Dp" of each crankshaft pin journal.
5. Calculate the connecting rod bearing clearance.  
Connecting rod bearing clearance = C - Dp

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

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

6. If the clearance cannot be adjusted within the standard of any bearing, grind the crankshaft journal and use undersized bearings. Refer to [EM-135, "HOW TO SELECT CONNECTING ROD BEARINGS"](#).



## 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 cap, and tighten the connecting rod nuts to the specified torque.

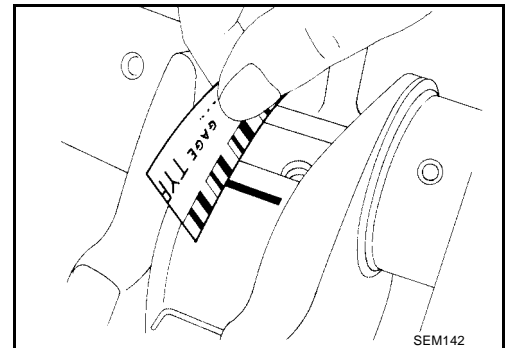
### CAUTION:

**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 repair limit is same as that described in [EM-145, "Method by Calculation"](#).



## OIL CLEARANCE OF MAIN BEARING

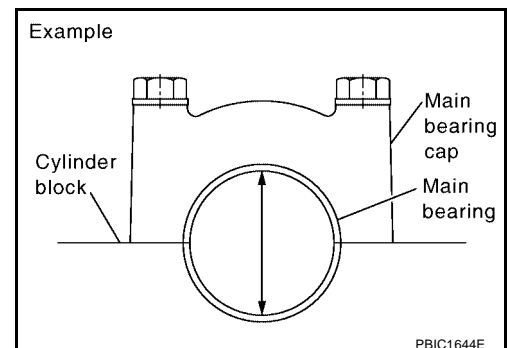
### Method by Calculation

1. Install the main bearings to the cylinder block and bearing cap. Refer to [EM-126, "ASSEMBLY"](#).
2. Calculate the main bearing clearance. (Oil clearance) = (Inner diameter of main bearing) - (Outer diameter of crankshaft journal)

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

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

3. If the calculated clearance exceeds the specified limit, replace the bearings. Refer to [EM-136, "HOW TO SELECT MAIN BEARINGS"](#).



# CYLINDER BLOCK

## 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 main bearings and main bearing caps. Refer to [EM-126, "ASSEMBLY"](#).

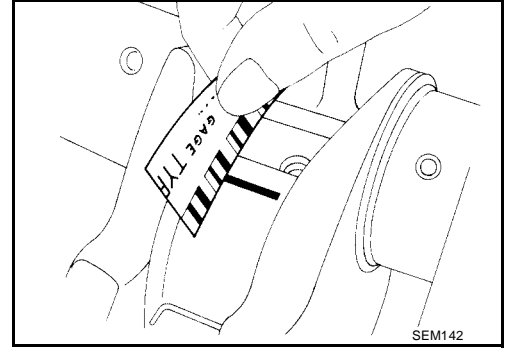
### CAUTION:

**Never rotate the crankshaft.**

- Remove the main bearing caps and bearings, and using the scale on the Plastigage bag, measure the Plastigage width.

### NOTE:

The procedure when the measured value exceeds the repair limit is same as that described in [EM-146, "Method by Calculation"](#).

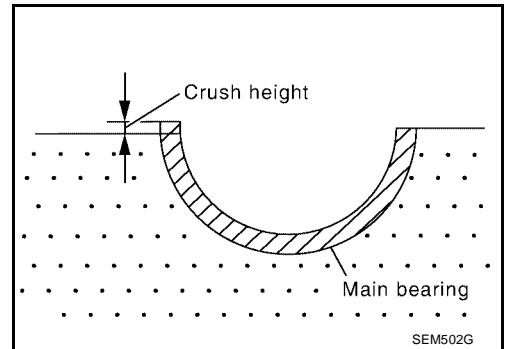


## CRUSH HEIGHT OF MAIN BEARING

- When the bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of the bearing must protrude. Refer to [EM-126, "ASSEMBLY"](#) for tightening procedure.

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

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

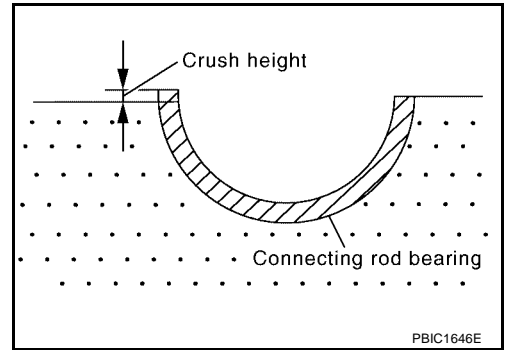


## CRUSH HEIGHT OF CONNECTING ROD BEARING

- When the connecting rod bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of the bearing must protrude. Refer to [EM-126, "ASSEMBLY"](#) for tightening procedure.

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

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

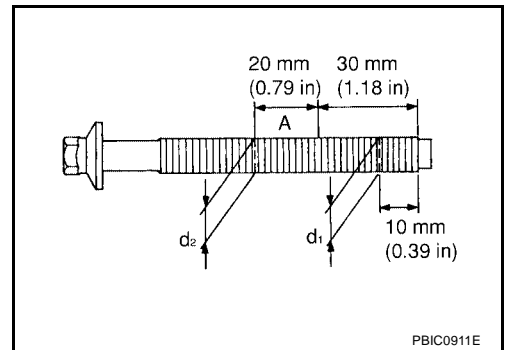


## OUTER DIAMETER OF MAIN BEARING CAP BOLTS

- Measure outer diameters ( $d_1$ ,  $d_2$ ) at two positions as shown.
- Measure  $d_2$  at a point with A.

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

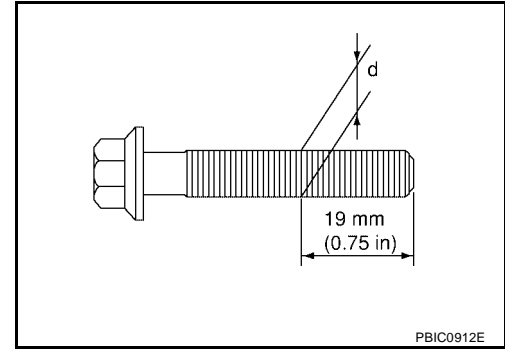
- When the value of  $d_1 - d_2$  exceeds the limit (a large difference in dimensions) replace the bolt with a new one.



# CYLINDER BLOCK

## OUTER DIAMETER OF CONNECTING ROD BOLTS

- Measure outer diameter  $d$  as shown.
  - Standard** : 7.90 - 8.00 mm (0.3110 - 0.3150 in)
  - Limit** : 7.75 mm (0.3051 in)
- When the value of  $d$  exceeds the limit (when it becomes thinner) replace the bolt with a new one.



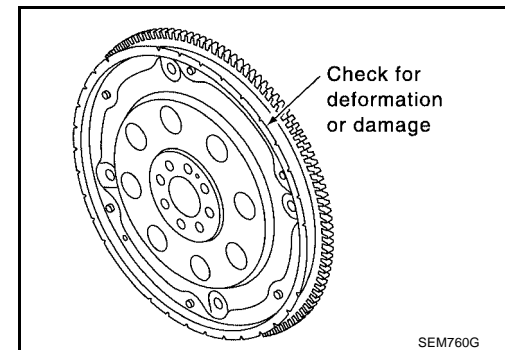
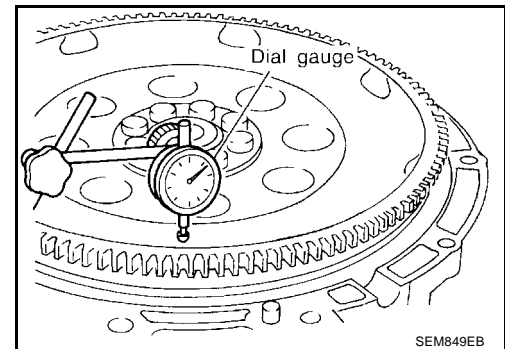
## DRIVE PLATE RUNOUT (A/T)

Runout (Total Indicator Reading):

**Drive plate (A/T)** : less than 0.15 mm (0.0059 in)

### CAUTION:

- The signal plate is built into the drive assembly. Be careful not to damage the signal plate, particularly the teeth.
- Check the drive plate and signal plate for deformation or cracks.
- Keep any magnetized objects away from the signal plate, particularly the teeth.



## FLYWHEEL RUNOUT (M/T)

### NOTE:

- This inspection is for double mass flywheel only.
- Do not disassemble the double mass flywheel.

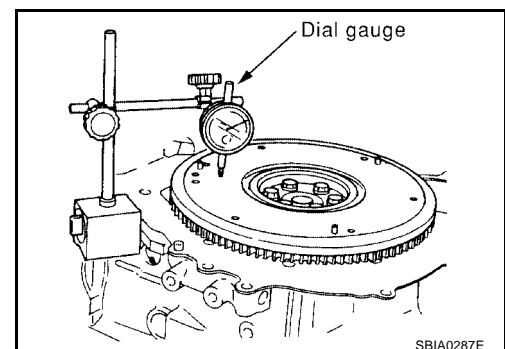
### Flywheel Deflection

- Measure the deflection of the flywheel contact surface to the clutch with a dial gauge.
- Measure the deflection at 210 mm (8.27 in) diameter.

**Standard** : 0.45 mm (0.0177 in) or less

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

- When measured value exceeds the limit, replace the flywheel with a new one.



## Movement Around in Rotation Direction

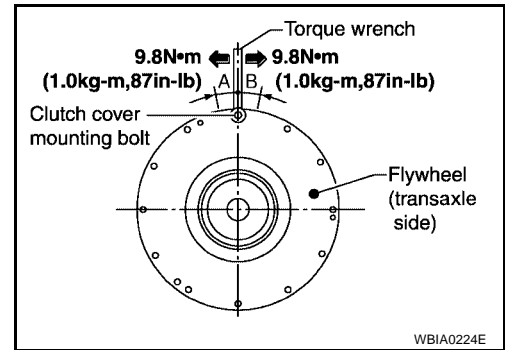
Check the movement amount with the following procedure:

# CYLINDER BLOCK

1. Install a bolt to clutch cover mounting hole and place a torque wrench on the extended line of the flywheel center line.
  - Tighten the bolt at a force of 9.8 N·m (1 kg·m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on the circumference of the two flywheel masses without applying any load (measurement standard points).
3. Apply a force of 9.8 N·m (1 kg·m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transaxle side.
4. Measure dimensions of movement amounts A and B on the circumference of the flywheel on the transaxle side.

**Flywheel movement : 24 mm (0.94 in) or less in rotation direction**

- When the measured value exceeds the standard, replace the flywheel.

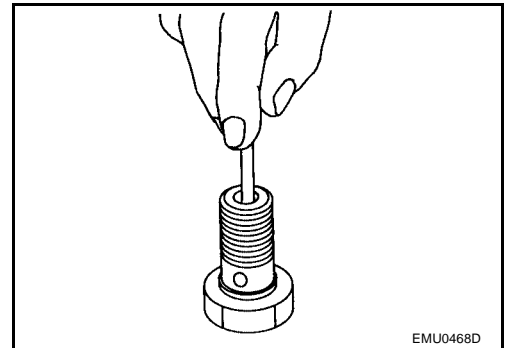


## OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, 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)

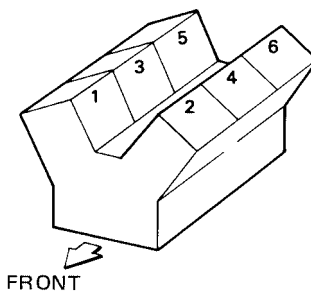
## SERVICE DATA AND SPECIFICATIONS (SDS)

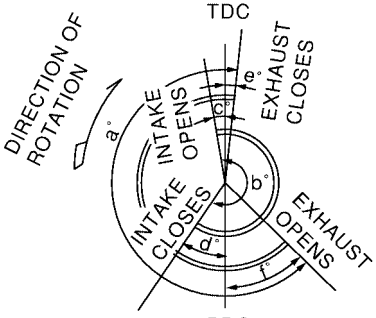
PF0:00100

### Standard and Limit GENERAL SPECIFICATIONS

EBS00JBB

|  |   |                             |
|--|---|-----------------------------|
| 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 (3.760 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  |   | 10.0:1                      |
| Compression pressure<br>kPa (kg/cm <sup>2</sup> , psi)/300 rpm | Standard                                | 1,275 (13.0, 185)           |
|  | Minimum                                 | 981 (10.0, 142)             |
|  | Differential limit<br>between cylinders | 98 (1.0, 14)                |

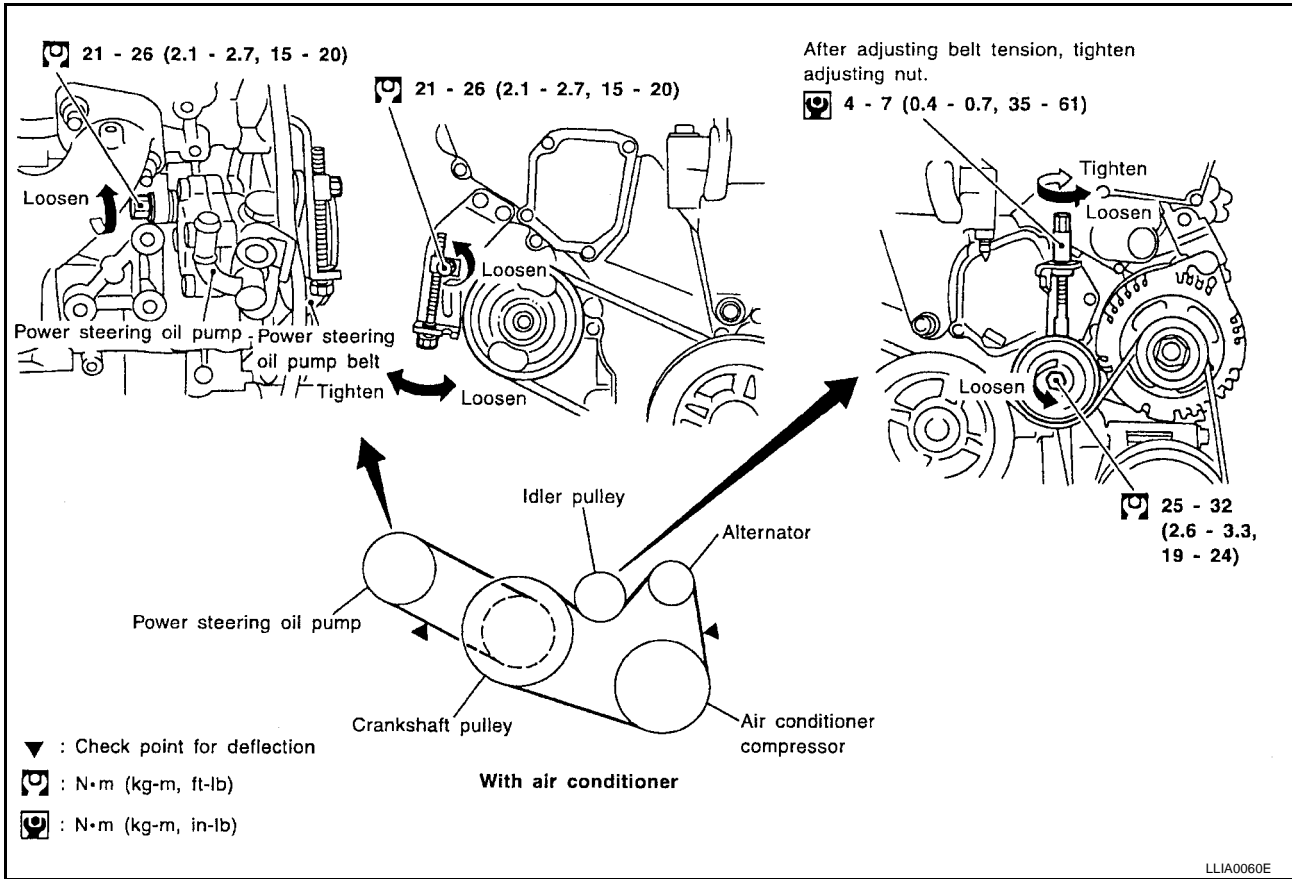
|                 |   |
|-----------------|---|
| Cylinder number |  <p style="text-align: right; margin-top: 10px;">SEM713A</p> |
|-----------------|---|

|                           |  |
|---------------------------|--|
| Valve timing (IVTC - OFF) |  <p style="text-align: right; margin-top: 10px;">PBIC0187E</p> |
|---------------------------|--|

|              |     |     |    |   |    |
|--------------|-----|-----|----|---|----|
| Unit: degree |     |     |    |   |    |
| a            | b   | c   | d  | e | f  |
| 240          | 238 | - 6 | 64 | 8 | 52 |

# 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<br>(0.17 - 0.18) | 3.7 - 4.1<br>(0.15 - 0.16) | 294 (30, 66)        | 730 - 818<br>(74.5 - 83.5,<br>164 - 184) | 838 - 926<br>(85.5 - 94.5,<br>188 - 208)     |
| Power steering pump                        | 11 (0.43)             | 7.3 - 8.0<br>(0.29 - 0.30) | 6.5 - 7.2<br>(0.26 - 0.28) | 196 (20, 44)        | 495 - 583<br>(50.5 - 59.5,<br>111 - 131) | 603 - 691<br>(61.5 - 70.5,<br>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.

## INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

| Item               | Limit                     |             |
|--------------------|---------------------------|-------------|
| Surface distortion | Intake manifold collector | 0.1 (0.004) |
|                    | Intake manifold           | 0.1 (0.004) |
|                    | Exhaust manifold          | 0.3 (0.012) |

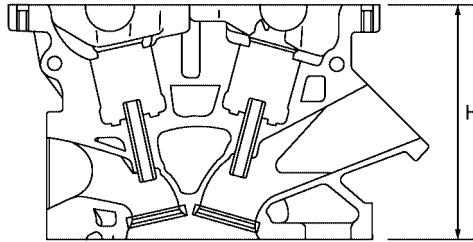
## SPARK PLUG

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

# SERVICE DATA AND SPECIFICATIONS (SDS)

## CYLINDER HEAD

Unit: mm (in)



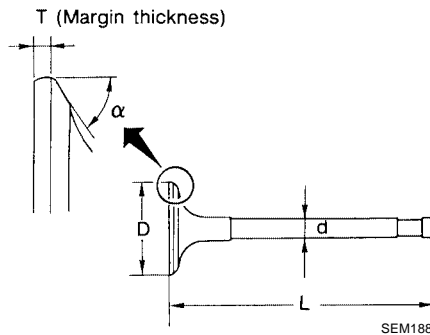
PBIC0924E

|                                  | Standard                      | Limit       |
|----------------------------------|-------------------------------|-------------|
| Head surface distortion          | —                             | 0.1 (0.004) |
| Nominal cylinder head height "H" | 126.3 - 126.5 (4.972 - 4.980) | —           |

## 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                          | 96.21 - 96.71 (3.7878 - 3.8075) |
|                                       | Exhaust                         | 93.74 - 94.24 (3.6905 - 3.7102) |
| Valve stem diameter "d"               | Intake                          | 5.965 - 5.980 (0.2348 - 0.2354) |
|                                       | Exhaust                         | 5.945 - 5.960 (0.2341 - 0.2346) |
| Valve seat angle " $\alpha$ "         | Intake                          | 45°25' - 45°75'                 |
|                                       | Exhaust                         |                                 |
| Valve margin "T"                      | Intake                          | 1.15 - 1.45 (0.0453 - 0.0571)   |
|                                       | Exhaust                         | 1.45 - 1.75 (0.0571 - 0.0689)   |
| Valve margin "T" limit                |                                 | More than 0.5 (0.020)           |
| Valve stem end surface grinding limit |                                 | Less than 0.2 (0.008)           |
| Valve oil seal installation height    | 14.3 14.9 mm (0.563 - 0.587 in) |                                 |

### 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)



# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Spring

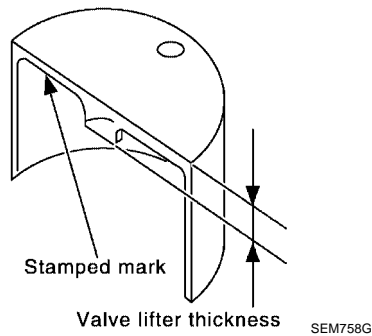
|               |                              |          |  |
|---------------|------------------------------|----------|--|
| Free height   | mm (in)                      |          | 46.90 (1.8465)                                       |
| Pressure      | N (kg, lb) at height mm (in) | Standard | 166 - 188 (16.9 - 19.2, 37.3 - 42.3) at 37.0 (1.457) |
|               |                              | Limit    | 378 - 426 (38.6 - 43.5, 85.0 - 95.8) at 27.8 (1.094) |
| Out-of-square | mm (in)                      |          | Less than 2.0 (0.079)                                |

## Valve Lifter

Unit: mm (in)

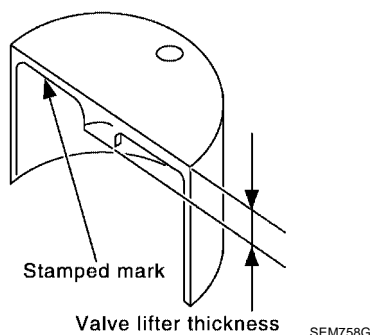
|   |                                   |
|---|-----------------------------------|
| Valve lifter outer diameter               | 33.977 - 33.987 (1.3377 - 1.3381) |
| Lifter lifter bore diameter               | 34.000 - 34.016 (1.3386 - 1.3392) |
| Clearance between lifter and lifter guide | 0.013 -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

## Available Valve Lifter



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

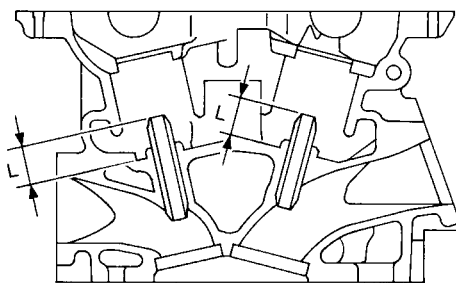
## SERVICE DATA AND SPECIFICATIONS (SDS)



| Identification Mark | Thickness mm (in) |
|---------------------|-------------------|
| 836U or R           | 8.36 (0.3291)     |
| 838U or R           | 8.38 (0.3299)     |
| 840U or R           | 8.40 (0.3307)     |

### Valve Guide

Unit: mm (in)

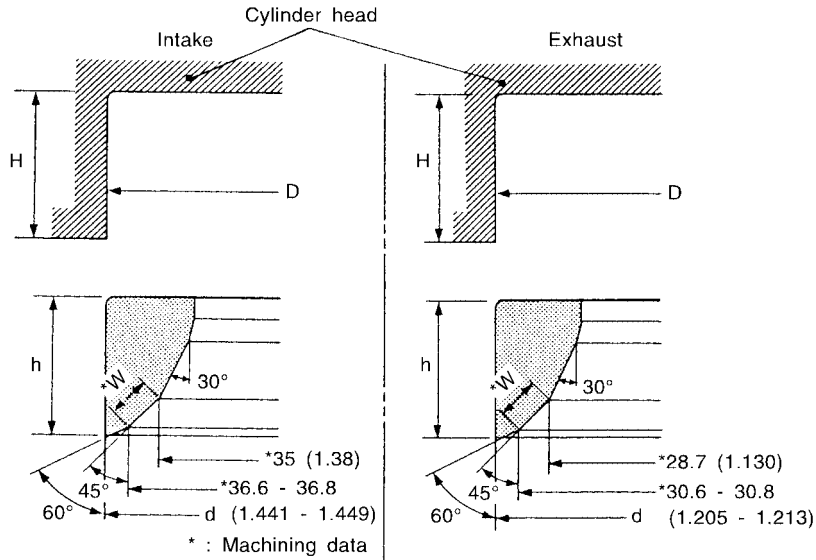


|                                 |                                | Standard                          | Service                           |
|---------------------------------|--------------------------------|-----------------------------------|-----------------------------------|
| Valve guide                     | Outer diameter                 | 10.023 - 10.034 (0.3946 - 0.3950) | 10.223 - 10.234 (0.4025 - 0.4029) |
| Valve guide                     | Inner diameter (Finished size) | 6.000 - 6.018 (0.2362 - 0.2369)   |                                   |
| 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                          | Limit                             |
| Valve to valve guide clearance  | Intake                         | 0.020 - 0.053 (0.0008 - 0.0021)   | 0.08 (0.0031)                     |
|                                 | Exhaust                        | 0.030 - 0.063 (0.0012 - 0.0025)   | 0.09 (0.004)                      |
| Valve deflection                | Intake                         | —                                 | 0.24 (0.0094)                     |
|                                 | Exhaust                        | —                                 | 0.28 (0.0110)                     |
| Projection length "L"           |                                | 12.6 - 12.8 (0.496 - 0.504)       |                                   |

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Valve Seat

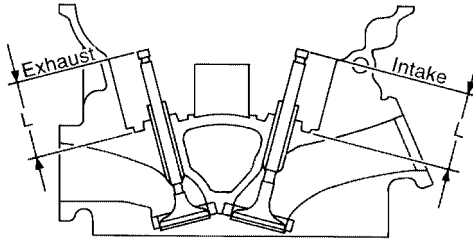
Unit: mm (in)



Contacting width (W); 1.09 - 1.31 (0.0429 - 0.0516)

Contacting width (W); 1.29 - 1.51 (0.0508 - 0.0594)

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)         |                                   |
| Valve seat resurface limit (L)         | Intake  | 41.07 - 41.67 (1.6169 - 1.6405)   |                                   |
|  | Exhaust | 41.00 - 41.60 (1.6142 - 1.6378)   |                                   |

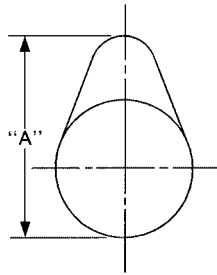
# SERVICE DATA AND SPECIFICATIONS (SDS)

## CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

|                                       | Standard   | Limit         |
|---------------------------------------|--|---------------|
| Camshaft journal to bracket clearance | No. 1<br>0.045 - 0.086 (0.0018 - 0.0034)<br>No. 2, 3, 4<br>0.035 - 0.076 (0.0014 - 0.0030)     | 0.15 (0.0059) |
| Inner diameter of camshaft bracket    | No. 1<br>26.000 - 26.021 (1.0236 - 1.0244)<br>No. 2, 3, 4<br>23.500 - 23.521 (0.9252 - 0.9260) | —             |
| Outer diameter of camshaft journal    | No. 1<br>25.935 - 25.955 (1.0211 - 1.0218)<br>No. 2, 3, 4<br>23.445 - 23.465 (0.9230 - 0.9238) | —             |
| Camshaft runout [TIR*]                | Less than 0.02 (0.0008)  | 0.05 (0.0020) |
| Camshaft sprocket runout [TIR*]       | —  | 0.15 (0.0059) |
| Camshaft end play                     | 0.115 - 0.188 (0.0045 - 0.0074)  | 0.24 (0.0094) |

\*: Total indicator reading

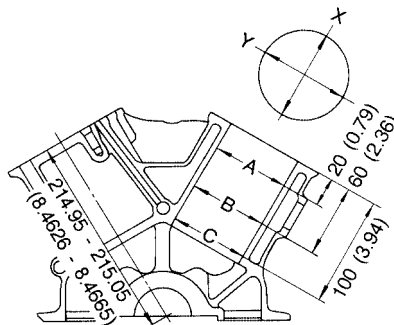


SEM671

|                               |                    |                                   |
|-------------------------------|--------------------|-----------------------------------|
| Cam lobe height "A"           | Intake and exhaust | 44.865 - 45.055 (1.7663 - 1.7738) |
| Wear limit of cam lobe height |                    | 0.2 (0.008)                       |

## CYLINDER BLOCK

Unit: mm (in)



SEM022EA

|   |                |                          |                                   |
|---|----------------|--------------------------|-----------------------------------|
| Surface distortion                      | 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 - Y) |                | Less than 0.015 (0.0006) |                                   |

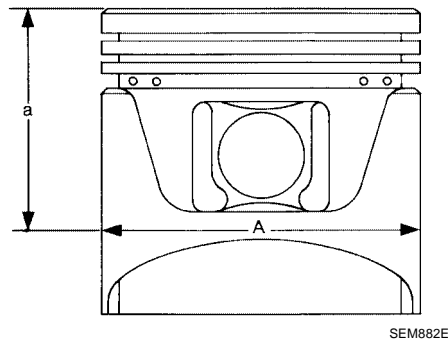
# SERVICE DATA AND SPECIFICATIONS (SDS)

| Taper (Difference between C - A)                       |                                   | Less than 0.015 (0.0006)          |
|--|-----------------------------------|-----------------------------------|
| Main journal inner diameter grade<br>(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) |                                   |

## 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*1                    | 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" measuring point (distance from the top) |               |                                  | 41.0 (1.614)                      |
| Piston pin hole diameter                    | Grade No. 0   |                                  | 21.993 - 21.999 (0.8659 - 0.8661) |
|   | Grade No. 1*2 |                                  | 21.999 - 22.005 (0.8661 - 0.8663) |
| Piston-to-bore clearance to cylinder block  |               |                                  | 0.010 - 0.030 (0.0004 - 0.0012)   |

\*1: There may be no grade number stamp.

\*2: No service parts available

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Piston Ring

Unit: mm (in)

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

## Piston Pin

Unit: mm (in)

|  |              |                                   |
|--|--------------|-----------------------------------|
| Piston pin outer diameter                          | Grade No. 0  | 21.989 - 21.995 (0.8657 - 0.8659) |
|  | Grade No. 1* | 21.995 - 22.001 (0.8659 - 0.8662) |
| Interference fit of piston pin to piston           |              | 0.002 - 0.006 (0.0001 - 0.0002)   |
| Piston pin to connecting rod bushing oil clearance | Standard     | 0.005 - 0.017 (0.0002 - 0.0007)   |
|  | Limit        | 0.030 (0.0012)                    |

\*: No service parts available.

## CONNECTING ROD

Unit: mm (in)

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

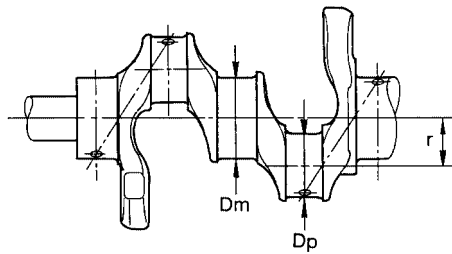
\*: 1: After installing in connecting rod

\*: 2: No service parts available.

# SERVICE DATA AND SPECIFICATIONS (SDS)

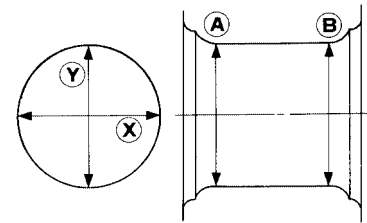
## CRANKSHAFT

Unit: mm (in)



SEM645

Out-of-round  $\textcircled{X} - \textcircled{Y}$   
Taper  $\textcircled{A} - \textcircled{B}$



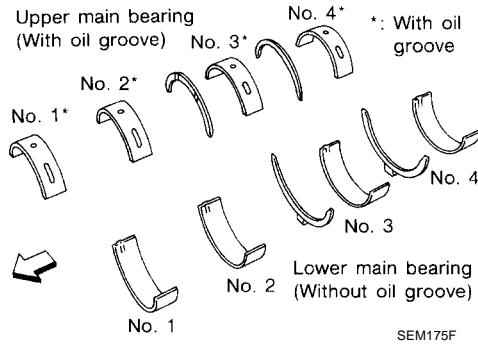
SEM715

|  |                                   |                                   |
|--|-----------------------------------|-----------------------------------|
| 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 - Y) | Standard                          | Less than 0.002 (0.0001)          |
| Taper (Difference between, A - B)        | Standard                          | Less than 0.002 (0.0001)          |
| Runout [TIR*]                            | Limit                             | Less than 0.10 (0.0039)           |
| End play                                 | Standard                          | 0.10 - 0.25 (0.0039 - 0.0098)     |
|  | Limit                             | 0.30 (0.0118)                     |

\*: 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<br>(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           | UPR                             |                                 | 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. |

A

EM

## MISCELLANEOUS COMPONENTS

Unit: mm (in)

|   |                         |
|---|-------------------------|
| Flywheel deflection [TIR]* - Standard   | Less than 0.45 (0.0177) |
| Flywheel deflection [TIR]* - Limit      | 1.3 (0.051)             |
| Drive plate runout [TIR]*               | Less than 0.15 (0.0059) |
| Flywheel movement in rotation direction | Less than 24 (0.94)     |

C

D

\*: Total indicator reading

## BEARING CLEARANCE

Unit: mm (in)

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

E

F

G

\*: Actual clearance

H

I

J

K

L

M

# SERVICE DATA AND SPECIFICATIONS (SDS)

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