# SECTION EM
# ENGINE MECHANICAL



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# SERVICE INFORMATION

## PRECAUTIONS

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

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The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted.
Information necessary to service the system safely is included in the SRS 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 WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

**WARNING:**

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

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

INFOID:0000000007401828

**NOTE:**

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the ″LOCK″ position.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.
For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.
If steering wheel rotation is required when battery power is interrupted, follow the procedure below before starting the repair operation.

#### OPERATION PROCEDURE

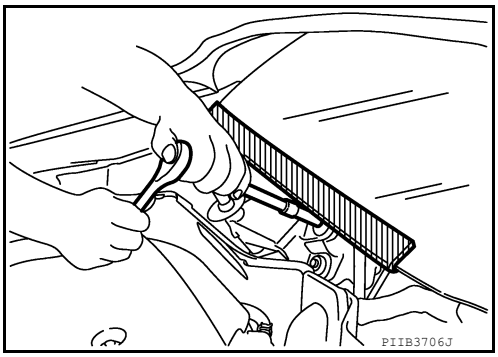
1. Connect both battery cables.
   **NOTE:**
   Supply power using jumper cables if battery is discharged.
2. Use the Intelligent Key or mechanical key to turn the ignition switch to the ″ACC″ position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.

5. When the repair work is completed, return the ignition switch to the ″LOCK″ position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT.

## Precaution for Procedure without Cowl Top Cover

INFOID:0000000007401829

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




## Precaution for Drain Coolant

INFOID:0000000007401830

- Drain coolant when engine is cooled.

## Precaution for Disconnecting Fuel Piping

INFOID:0000000007401831

- 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.

## Precaution for Removal and Disassembly

INFOID:0000000007401832

- 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.

## Precaution for Inspection, Repair and Replacement

INFOID:0000000007401833

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

## Precaution for Assembly and Installation

INFOID:0000000007401834

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

## Parts Requiring Angular Tightening

INFOID:0000000007401835

- Use an angle wrench for the final tightening of the following engine parts:
- Cylinder head bolts
- Camshaft sprocket (INT)
- 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.

## Precaution for Liquid Gasket

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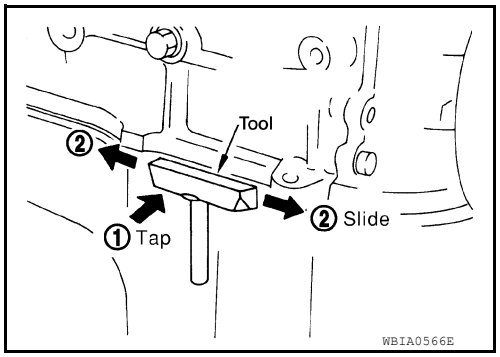
### REMOVAL OF LIQUID GASKET SEALANT

- After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

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

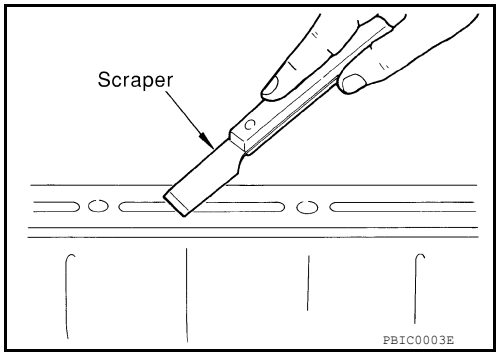
**CAUTION:**
**Be careful not to damage the mating surfaces.**

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the RTV Silicone Sealant is applied. Use a plastic hammer to slide the cutter (2) by tapping on the side.




### LIQUID GASKET APPLICATION PROCEDURE

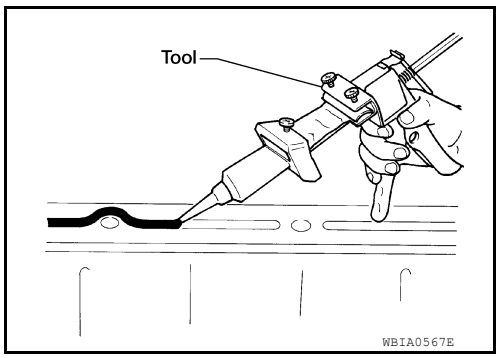
1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
   - Remove the sealant completely from the groove of the gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating surface 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-44, "Recommended Chemical Product and Sealant".**



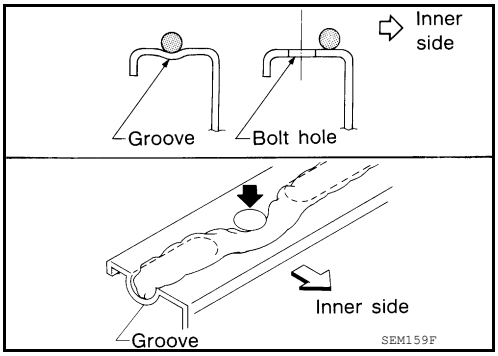

4. Apply the sealant without breaks to the specified location using Tool.

**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.



- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to MA-15, "MR20DE".



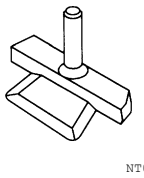
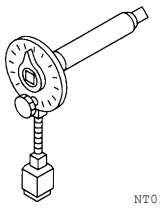
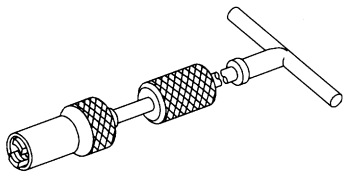
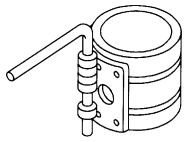
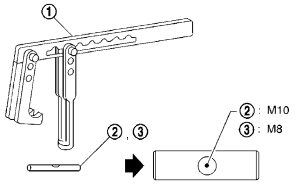
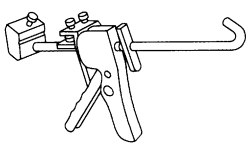

**CAUTION:**
**Carefully follow all of the warnings, cautions, notes, and procedures contained in this manual.**

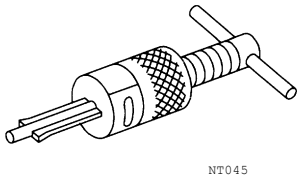
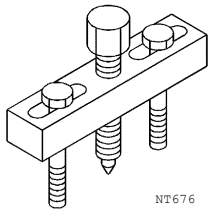
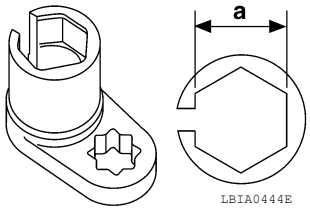
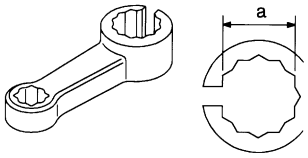
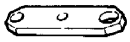
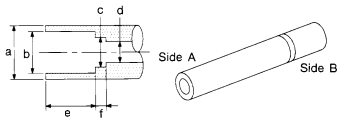
# PREPARATION

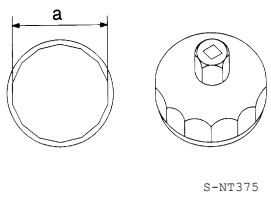
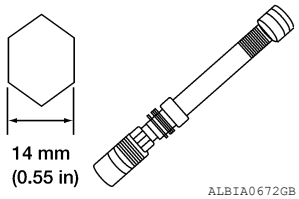
## Special Service Tool

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

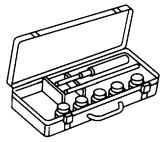
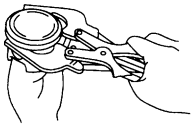
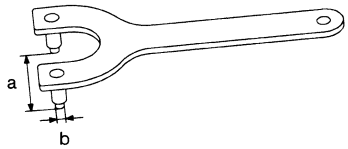
| Tool number (Kent-Moore No.) Tool name | Description |
|---|---|
| KV10111100 (J-37228) Seal cutter  NT046 | Removing steel oil pan and rear timing chain case |
| KV10112100 (BT-8653-A) Angle wrench  NT014 | Tightening bolts for bearing cap, cylinder head, etc. |
| KV10107902 (J-38959) Valve oil seal puller  S-NT011 | Removing valve oil seal |
| EM03470000 (J-8037) Piston ring compressor  NT044 | Installing piston assembly into cylinder bore |
| KV101092S0 (J-26336-B) Valve spring compressor 1 KV10109210 (J-26336-20) Attachment 2 KV10109220 ( — ) 3. KV10109230 Adapter (M8)   NT718 | Disassembling and assembling valve mechanism |
| WS39930000 ( — ) Tube presser  NT052 | Pressing the tube of liquid gasket |

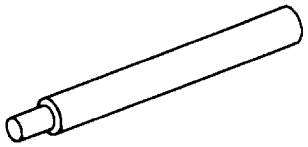
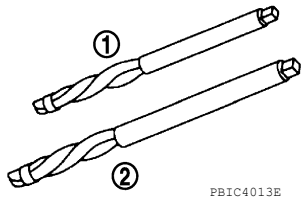
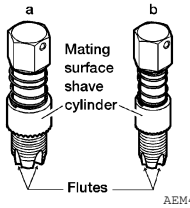
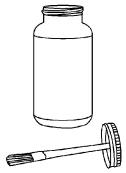
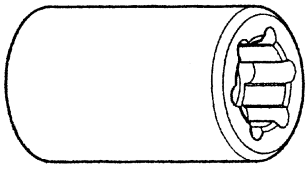
| Tool number<br>(Kent-Moore No.)<br>Tool name | Description |
|---|---|
| ST16610001<br>(J-23907)<br>Pilot bushing puller<br><br>NT045 | Removing crankshaft pilot bushing |
| KV11103000<br>( — )<br>Pulley puller<br><br>NT676 | Removing crankshaft pulley |
| KV991J0050<br>(J-44626)<br>Air fuel sensor Socket<br><br><br>LBIA0444E | Loosening or tightening air fuel ratio A/F sensor<br>**a: 22 mm (0.87 in)** |
| KV10114400<br>(J-38365)<br>Heated oxygen sensor wrench<br><br><br>NT636 | Loosening or tightening rear heated oxygen sensor<br>**a: 22 mm (0.87 in)** |
| KV11105210<br>(J-44716)<br>Stopper plate<br><br>ZZA0009D | Securing drive plate and flywheel |
| KV10115600<br>(J-38958)<br>Valve oil seal drift<br><br><br>S-NT603 | Installing valve oil seal<br>**Use side A.**<br>**a: 20 (0.79) dia**<br>**b: 13 (0.51) dia.**<br>**c: 10.3 (0.406) dia**<br>**d: 8 (0.31) dia.**<br>**e: 10.7 (0.421)**<br>**f: 5 (0.20)** |

| Tool number (Kent-Moore No.) Tool name | Description |
|---|---|
| KV10115801 ( — ) Oil filter wrench   S-NT375 | Removing and installing oil filter **a: 64.3 mm (2.531 in)** |
| — (J-48891) Spark plug socket   ALBIA0672GB | Removing and installing spark plug |

## Commercial Service Tool

INFOID:0000000007401838

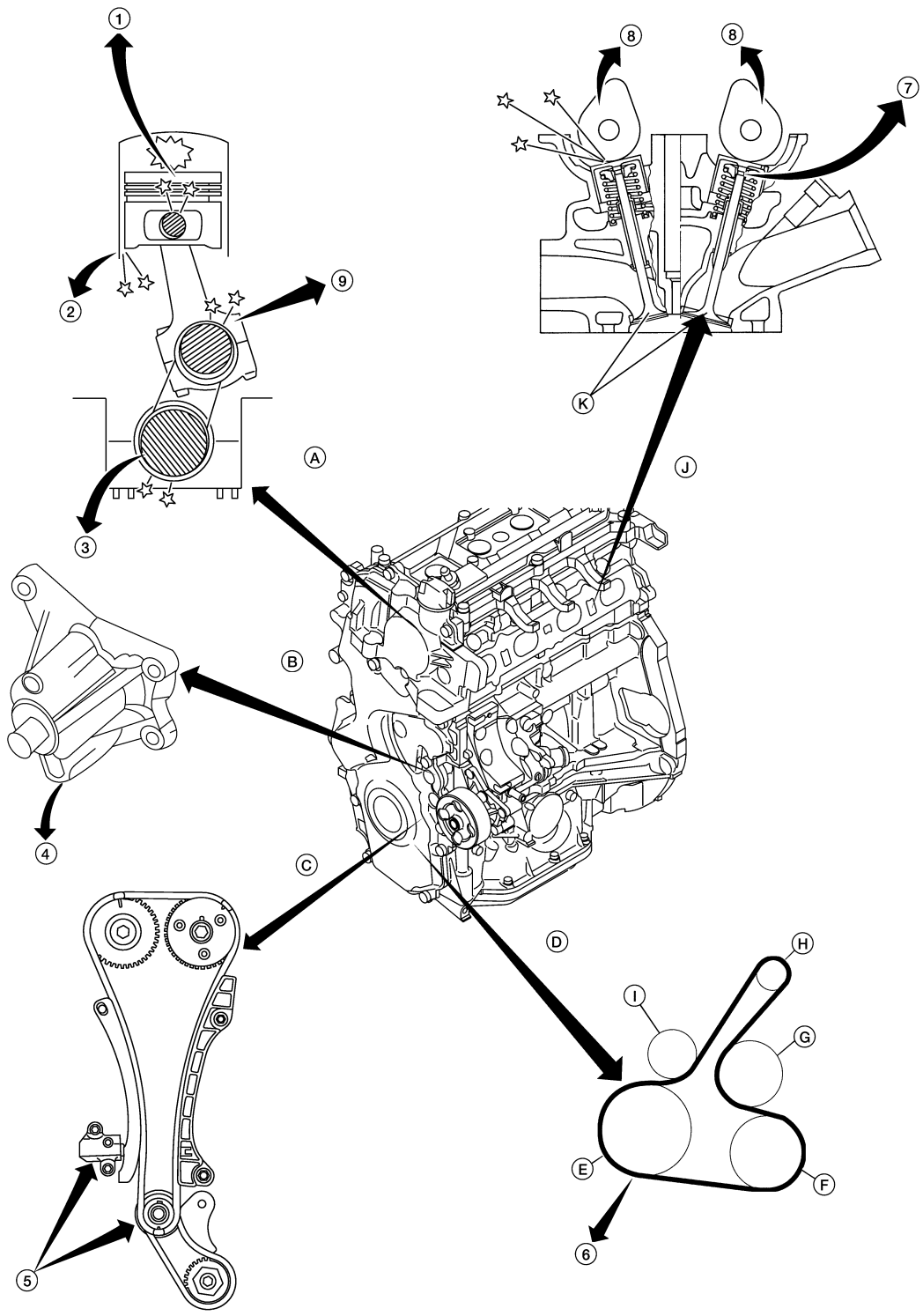
| (Kent-Moore No.) Tool name | Description |
|---|---|
| Power tool  PIIB1407E | Loosening nuts, screws and bolts |
| Valve seat cutter set  NT048 | Finishing valve seat dimensions |
| Piston ring expander  NT030 | Removing and installing piston ring |
| KV10109300 ( — ) Pulley holder   NT628 | Removing and installing crankshaft pulley |

| (Kent-Moore No.)<br>Tool name | Description |
|---|---|
| KV10111800<br>Valve guide drift<br><br>PBIC4012E | Removing and installing valve guide |
| Valve guide reamer<br><br>PBIC4013E | (1): Reaming valve guide inner hole<br>(2): Reaming hole for oversize valve guide |
| (J-43897-18)<br>(J-43897-12)<br>Oxygen sensor thread cleaner<br><br><br>AEM488 | Reconditioning the exhaust system threads before installing a new oxygen sensor and Air Fuel ratio sensor (Use with anti-seize lubricant shown below.)<br>**a: J-43897-18 (18 mm dia.) Air Fuel ratio sensors**<br>**b: J-43897-12 (12 mm dia.) Air Fuel ratio sensors** |
| Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)<br><br>AEM489 | Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads |
| E20 Socket<br>(J-45816)<br><br>LBIA0285E | Removing and installing drive plate and flywheel bolts |

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

## NVH Troubleshooting - Engine Noise

INFOID:0000000007401839




WBIA0822E

1. Piston pin noise
2. Piston slap noise
3. Main bearing noise
4. Water pump noise
5. Timing chain and tensioner noise
6. Drive belt noise (stick/slipping)
7. Tappet noise
8. Camshaft bearing noise
9. Connecting rod noise
A. Rotational mechanism
B. Water pump
C. Timing chain

D. Drive belt
E. Crankshaft pulley
F. A/C compressor
G. Water pump
H. Generator
I. Tension pulley
J. Valve mechanism
K. Valves

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

INFOID:0000000007401840

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

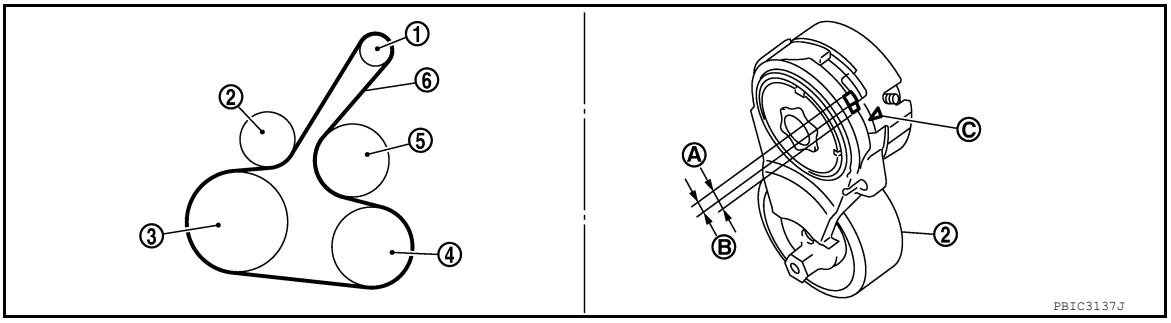
| Location of noise | Type of noise | Operating condition of engine | | | | | | Source of noise | Check item | Reference page |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Before warm-up | After warm-up | When starting | When idling | When racing | While driving | | | |
| Top of engine Rocker cover Cylinder head | Ticking or clicking | C | A | — | A | B | — | Tappet noise | Valve clearance | EM-58 |
| | Rattle | C | A | — | A | B | C | Camshaft bearing noise | Camshaft journal oil clearance<br>Camshaft runout | EM-50<br>EM-50 |
| Crankshaft pulley Cylinder block (Side of engine) Oil pan | Slap or knock | — | A | — | B | B | — | Piston pin noise | Piston to piston pin oil clearance<br>Connecting rod bushing oil clearance | EM-97<br>EM-97 |
| | Slap or rap | A | — | — | B | B | A | Piston slap noise | Piston to cylinder bore clearance<br>Piston ring side clearance<br>Piston ring end gap<br>Connecting rod bend and torsion | EM-97<br>EM-97<br>EM-97<br>EM-97 |
| | Knock | A | B | C | B | B | B | Connecting rod bearing noise | Connecting rod bushing oil clearance<br>Connecting rod bearing oil clearance | EM-97<br>EM-97 |
| | Knock | A | B | — | A | B | C | Main bearing noise | Main bearing oil clearance<br>Crankshaft runout | EM-97<br>EM-97 |
| Front of engine Front 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 | EM-41 |
| Front of engine | Squeaking or fizzing | A | B | — | B | — | C | Drive belt (Sticking or slipping) | Drive belt deflection | EM-13 |
| | Creaking | A | B | A | B | A | B | Drive belt (Slipping) | Idler pulley bearing operation | |
| | Squall Creak | A | B | — | B | A | B | Water pump noise | Water pump operation | CO-21 |

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

# DRIVE BELTS

## Component

INFOID:0000000007401841




| | | | | | |
|---|---|---|---|---|---|
| 1. | Generator | 2. | Drive belt auto–tensioner | 3. | Crankshaft pulley |
| 4. | A/C compressor pulley (Idler pulley on models without A/C) | 5. | Water pump | 6. | Drive belt |
| A. | Allowable use range | B. | Range when new drive belt is installed | C. | Indicator |

## Checking Drive Belts

INFOID:0000000007401842

**WARNING:**
**Inspect the drive belt only when the engine is stopped.**

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

**NOTE:**

- On vehicles not equipped with A/C, there is an idler pulley in the position for the drive belt routing.
- Check the drive belt auto-tensioner indicator (notch) when the engine is cold.
- When the new drive belt is installed, the range of possible use should be as shown.
- Visually check entire belt for wear, damage or cracks.
- If the indicator is out of allowable use range or belt is damaged, replace the drive belt.

## Tension Adjustment

INFOID:0000000007401843

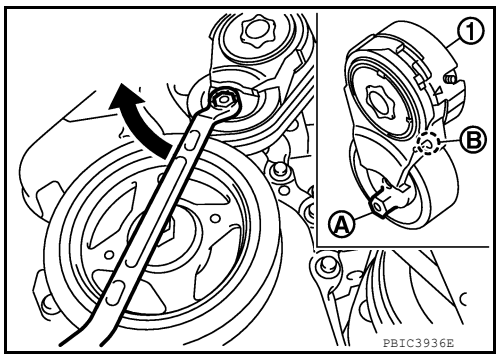
Belt tension is not manually adjustable, it is automatically adjusted by the drive belt auto-tensioner.

## Removal and Installation

INFOID:0000000007401844

### REMOVAL

1. Remove the splash shield RH. Refer to EI-23, "Component".
2. Securely hold the hexagonal part (A) of drive belt auto-tensioner (1) with a suitable tool. Then move the tool in the direction of arrow (loosening direction of tensioner).




**WARNING:**
**Never place hand in a location where pinching may occur if the holding tool accidentally comes off.**
**CAUTION:**

- **Do not loosen the auto-tensioner pulley bolt.**
- **Do not turn the auto-tensioner pulley bolt counterclockwise.**
- **If the auto-tensioner pulley bolt is turned counterclockwise for any reason, the auto-tensioner and pulley must be replaced as a unit.**

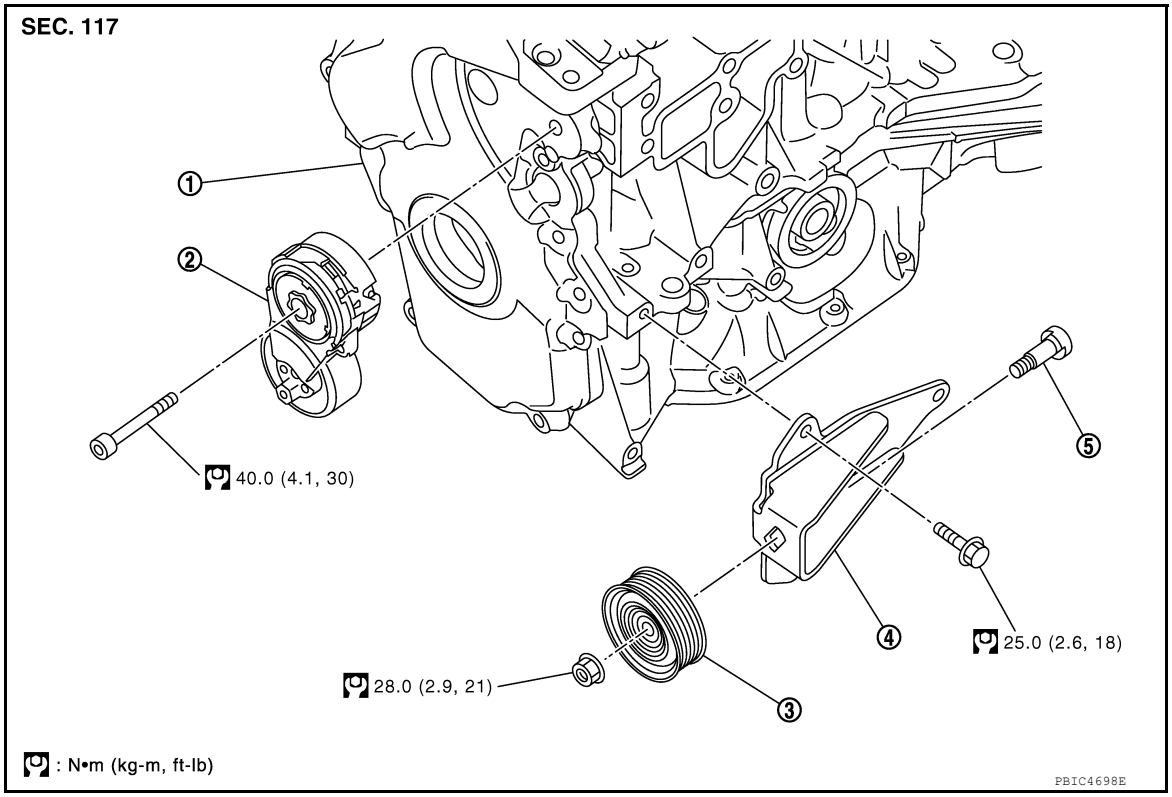
3. Insert a rod approximately 6 mm (0.24 in) in diameter into the hole (B) of the retaining boss to lock drive belt auto-tensioner.
   - Leave tensioner pulley arm locked until belt is installed again.
4. Remove drive belt.

INSTALLATION

1. Install drive belt.
   **CAUTION:**
   **Confirm drive belt is set completely and correctly on all of the pulleys.**
2. Release drive belt auto-tensioner, and apply tension to drive belt.
   **WARNING:**
   **Never place hand in a location where pinching may occur if the holding tool accidentally comes off.**
   **CAUTION:**
   **Ensure the drive belt and each groove on the pulley are free from all engine oil, coolant and other contaminants.**
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm tension of drive belt at indicator is within the allowable use range. Refer to EM-13, "Checking Drive Belts".
5. Install the splash shield RH. Refer to EI-23, "Component".

## Component

INFOID:0000000007401845




1. Front cover
2. Drive belt auto–tensioner
3. Idler pulley (models without A/C)
4. Bracket (models without A/C)
5. Shaft (models without A/C)

## Removal and Installation of Drive Belt Auto-Tensioner

INFOID:0000000007401846

REMOVAL

**CAUTION:**
**The complete auto-tensioner must be replaced as a unit, including the pulley.**

1. Remove front air duct. Refer to EM-16, "Component".
2. Disconnect battery negative terminal. Refer to SC-7, "Removal and Installation (MR20DE Battery)".
3. Remove drive belt. Refer to EM-13, "Removal and Installation".
4. Support the engine and remove the torque rod (RH), engine mounting insulator (RH) and engine mounting bracket (RH). Refer to EM-75, "Component".

5. Release the fixed drive belt auto-tensioner pulley.
6. Loosen bolt and remove drive belt auto-tensioner.
   **NOTE:**
   Use socket (size T50).
7. Remove idler pulley and bracket (models without A/C).
   **CAUTION:**
   - **Do not loosen the auto-tensioner pulley bolt.**
   - **Do not turn the auto-tensioner pulley bolt counterclockwise.**
   - **If the auto-tensioner pulley bolt is turned counterclockwise for any reason, the auto-tensioner and pulley must be replaced as a unit.**

## INSTALLATION

Installation is in the reverse order of removal.

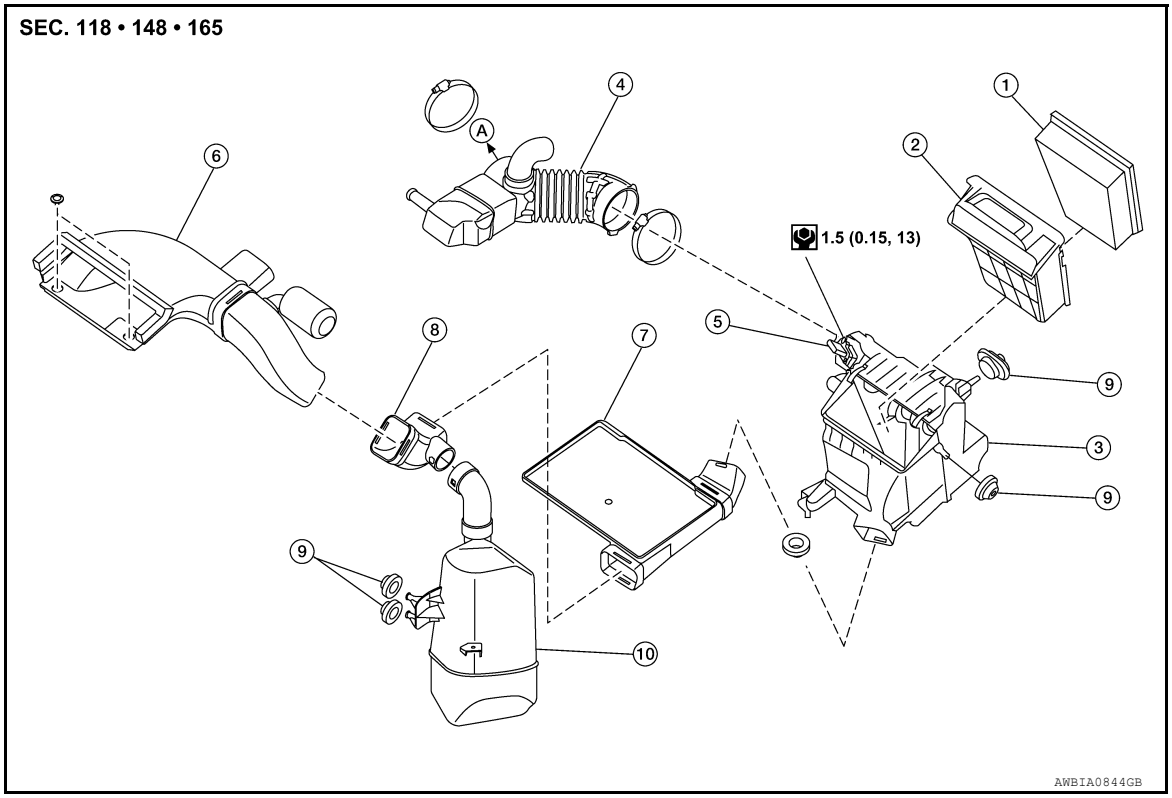
**CAUTION:**

- **If there is damage greater than peeled paint, replace drive belt auto-tensioner units**
- **Install the drive belt auto-tensioner carefully so as to not damage the water pump pulley.**
- **Do not swap the pulley between the new and old auto-tensioner units.**
- **The auto-tensioner and pulley must be replaced as a unit.**

# AIR CLEANER AND AIR DUCT

## Component

INFOID:0000000007401847




1. Air cleaner filter
2. Air cleaner holder
3. Air cleaner case
4. Air duct
5. Mass air flow sensor
6. Air duct (Inlet)
7. Air duct/battery tray
8. Air duct
9. Grommet
10. Resonator
A. To electric throttle control actuator

## Removal and Installation

INFOID:0000000007401848

### REMOVAL

1. Remove the engine room cover.
2. Remove the air duct (inlet).
3. Remove the air cleaner filter from the air cleaner case. Refer to EM-17, "Changing Air Cleaner Filter".
4. Remove the air duct [between air duct (inlet) and air cleaner case] from the air cleaner case.
5. Remove the PCV hose.
6. Remove the air duct (between air cleaner case and electric throttle control actuator).
   • Add marks as necessary for easier installation.
7. Remove air cleaner case with the following procedure.

a. Remove battery. Refer to SC-7, "Removal and Installation (MR20DE Battery)".
b. Disconnect the brake fluid level sensor.
c. Disconnect and remove the ECM.
d. Disconnect harness connector from mass air flow sensor.
e. Remove the air cleaner case.

8. Remove the mass air flow sensor from the air cleaner case, as necessary.

**CAUTION:**
**Handle the mass air flow sensor with care:**
**• Do not shock it.**

- **Do not disassemble it.**
- **Do not touch the internal sensor.**

INSTALLATION

Installation is in the reverse order of removal.

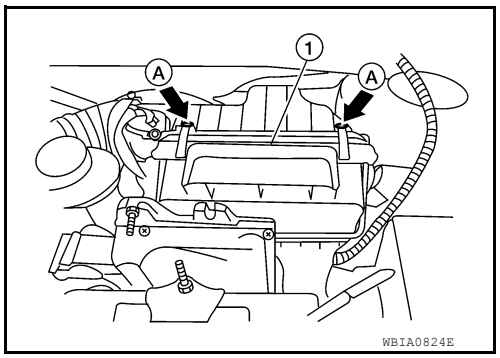
- Align marks.
- Attach each joint securely.
- Screw clamps firmly.

## Changing Air Cleaner Filter

INFOID:0000000007401849

REMOVAL

1. Unclip the tabs (A) of both ends of the air cleaner cover (1).




2. Remove the air cleaner filter and holder assembly from the air cleaner case.
3. Remove the air cleaner filter from the holder.

INSPECTION AFTER REMOVAL

It is necessary to replace it at the recommended intervals, more often under dusty driving conditions. Refer to MA-9.

INSTALLATION

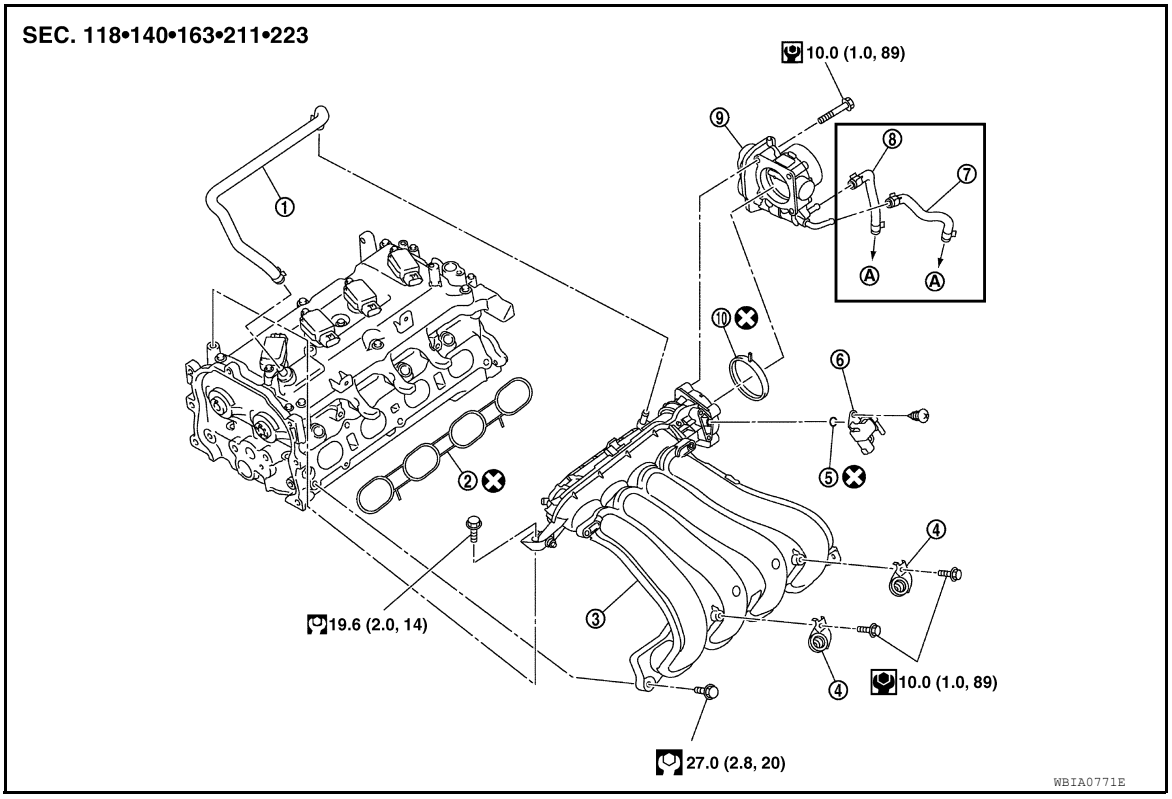
Installation is in the reverse order of removal.

# INTAKE MANIFOLD

## Component

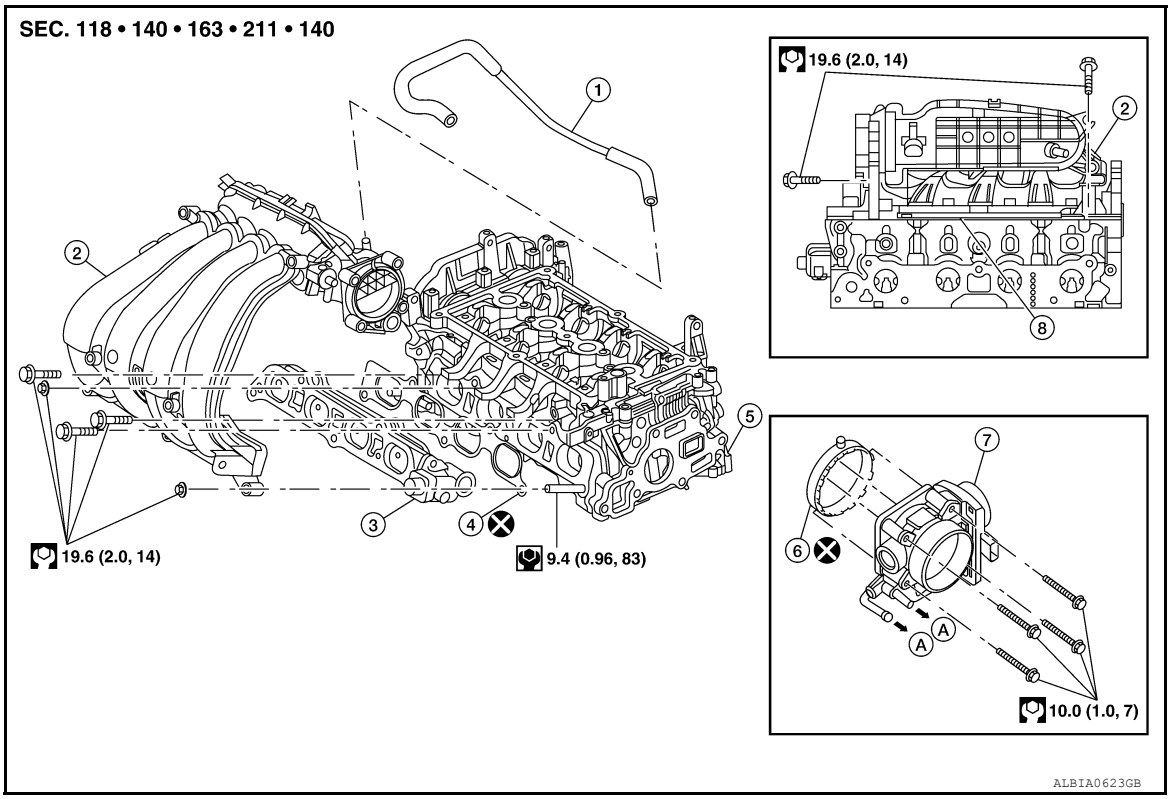
INFOID:0000000007401850

Except For California




1. PCV hose
2. Gasket
3. Intake manifold
4. Bracket
5. O-ring
6. EVAP canister purge volume control solenoid valve
7. Water hose
8. Water hose
9. Electric throttle control actuator
10. Gasket
A. To water outlet

For California




1. PCV hose
2. Intake manifold
3. Intake manifold adapter
4. Gasket
5. Cylinder head
6. Gasket
7. Electric throttle control actuator
8. Camshaft bracket
A. To water outlet

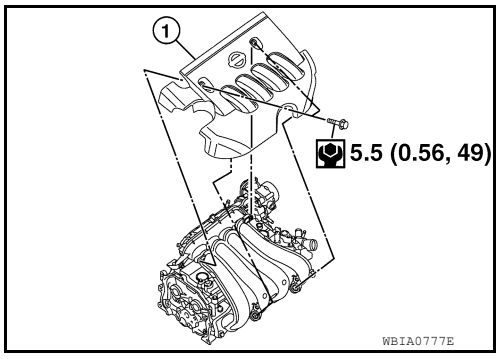
## Removal and Installation

INFOID:0000000007401851

### REMOVAL

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

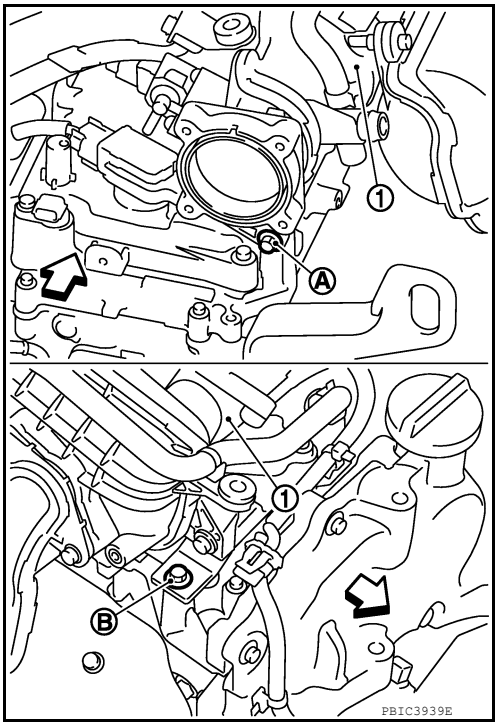
1. Remove engine room cover (1).
2. Remove the air duct (inlet) and air ducts. Refer to EM-16, "Component".
3. Disconnect the EVAP canister purge volume control solenoid valve.
4. Partially drain engine coolant from the radiator. Refer to CO-12, "Changing Engine Coolant".
   **CAUTION:**
   **Perform this step when engine is cold.**
   **NOTE:**
   This step is unnecessary when putting plugs to water hoses (to electric throttle control actuator)




a. Disconnect water hoses from electric throttle control actuator.
b. Remove electric throttle control actuator.
   **CAUTION:**
   - **Handle carefully to avoid any shock to electric throttle control actuator.**
   - **Never disassemble.**
5. Remove the PCV hose and the vacuum hose.
6. Remove oil level gauge.
   **CAUTION:**
   **Cover the oil level gauge guide openings to avoid entry of foreign materials.**

7. Loosen and remove intake manifold (1) bolts (A) (B).

⇦ : Engine front

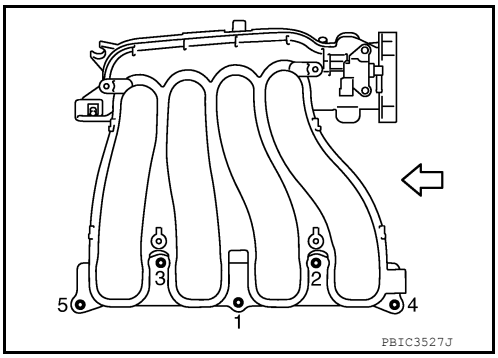



8. Loosen bolts in reverse order as shown.

⇦ : Engine front

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

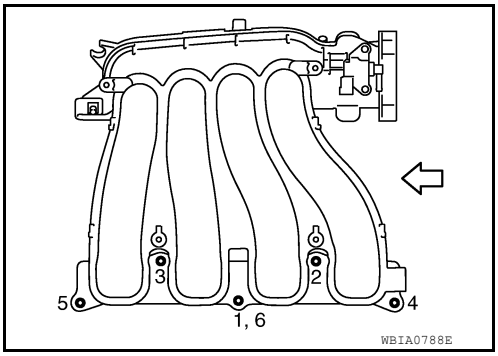
9. Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.
**CAUTION:**
**Handle it carefully and avoid impacts.**
10. Remove intake manifold.
11. Remove intake manifold adapter (for California).




## INSTALLATION

1. Install intake manifold adapter (for California).
**NOTE:**
Be sure the intake manifold adapter gasket is seated correctly in groove of intake manifold adapter (for California).
2. Install intake manifold.
**NOTE:**
Be sure the intake manifold gasket is seated correctly in groove of intake manifold (except for California).
3. Tighten bolts in numerical order as shown.

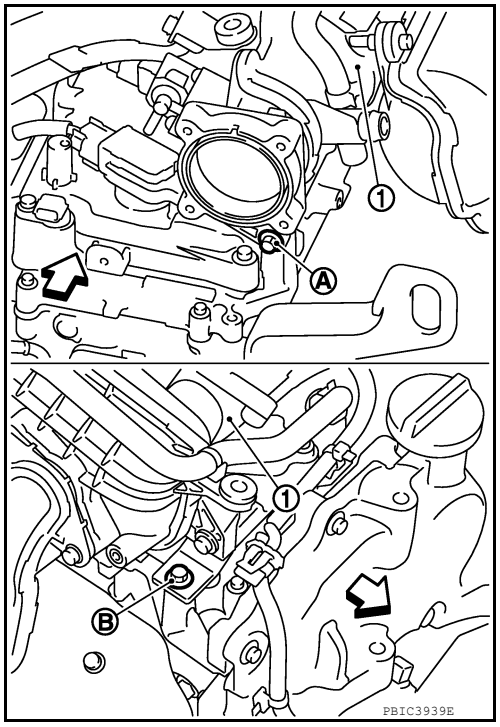
⇦ : Engine front



4. Tighten intake manifold bolt (A). Then tighten intake manifold bolt (B).

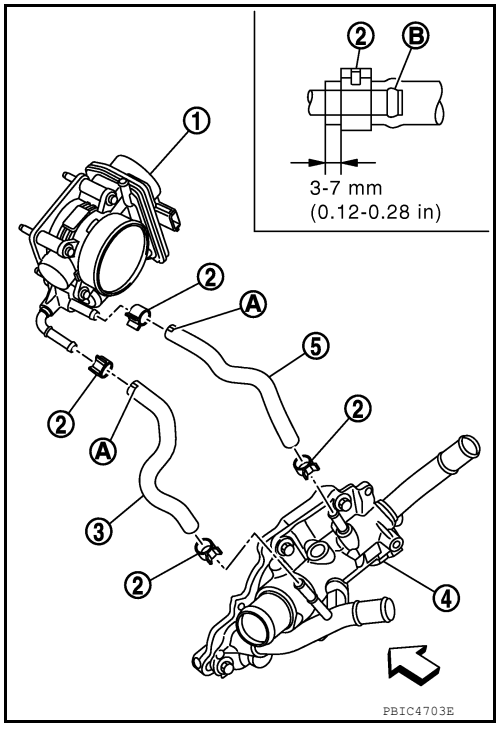
1 : Intake manifold
⇦ : Engine front

**Intake manifold bolt (A) : 19.6 N·m (2.0 kg-m, 14 ft-lb)**
**Intake manifold bolt (B) : 19.6 N·m (2.0 kg-m, 14 ft-lb)**



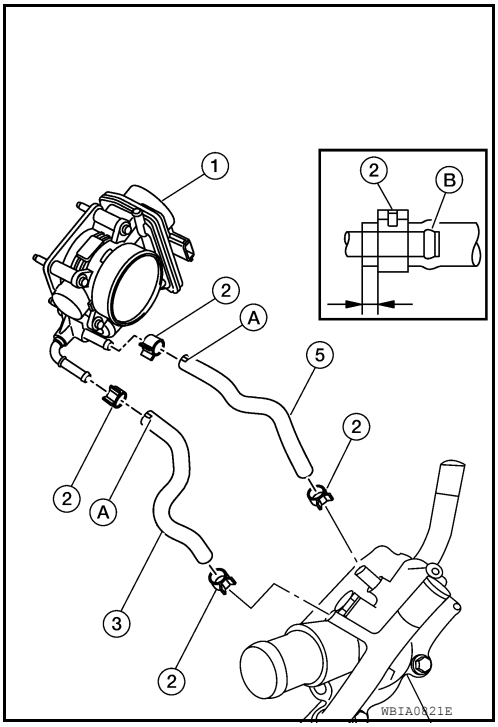

5. Install electric throttle control actuator.
6. Install water hoses (3), (5) to electric throttle control actuator as shown (M/T models).
**NOTE:**
The clamp (2) shall not interfere with the bulged section (B).

1 : Electric throttle control actuator
4 : Water outlet
A : Paint Mark
⇦ : Engine front



7. Install water hoses (3), (5) to electric throttle control actuator as shown (CVT models).
**NOTE:**
The clamp (2) shall not interfere with the bulged section (B).

1 : Electric throttle control actuator
4 : Water outlet
A : Paint Mark
⇦ : Engine front




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

## INSPECTION AFTER INSTALLATION

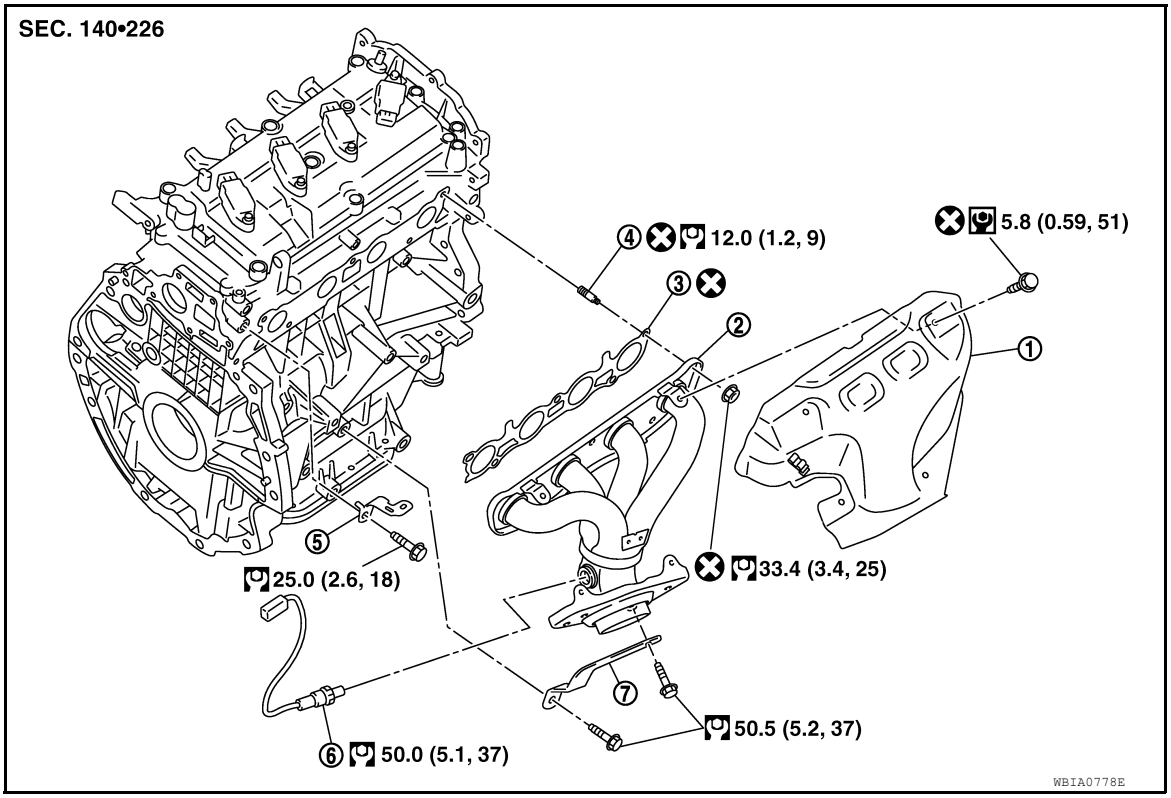
- Check for engine coolant leaks. Refer to CO-11, "Inspection".
- Start and warm up the engine. Visually check for engine coolant leaks.

# EXHAUST MANIFOLD

## Component

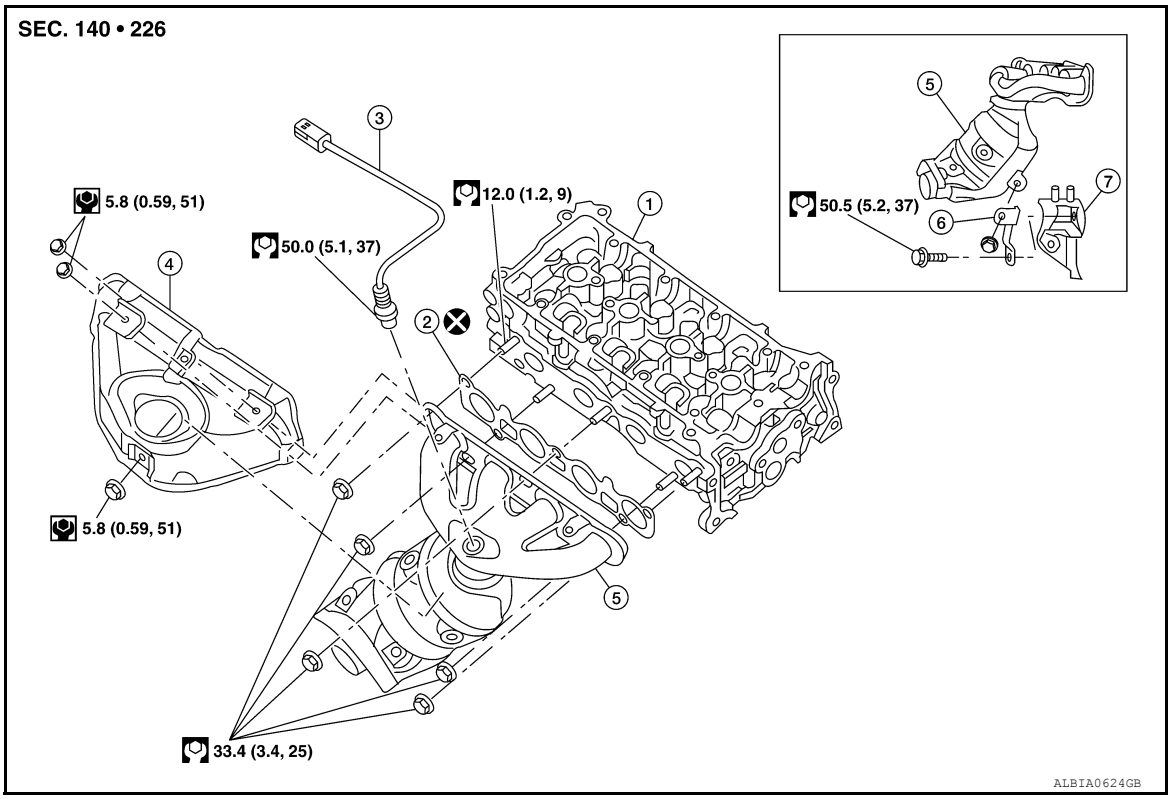
INFOID:0000000007401852

Except for California




1. Exhaust manifold cover
2. Exhaust manifold
3. Gasket
4. Stud bolt
5. Bracket
6. A/F ratio sensor 1
7. Exhaust manifold stay

For California




1. Cylinder head
2. Gasket
3. A/F ratio sensor 1
4. Exhaust manifold cover
5. Exhaust manifold
6. Exhaust manifold stay
7. Oil pan

## Removal and Installation

INFOID:0000000007401853

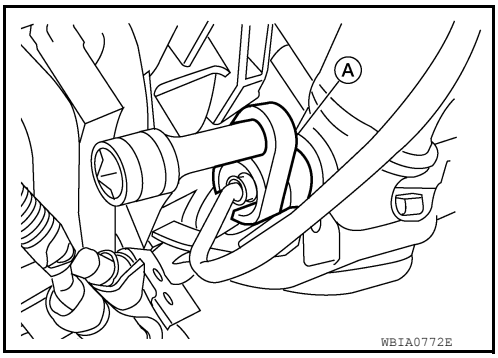
### REMOVAL

1. Remove cowl top. Refer to EI-21, "Removal and Installation".
2. Remove exhaust front tube. Refer to EX-5, "Component".
3. Remove exhaust manifold cover.
4. Remove the A/F ratio sensor 1, using Tool (A).

**Tool number : KV991J0050 (J-44626)**

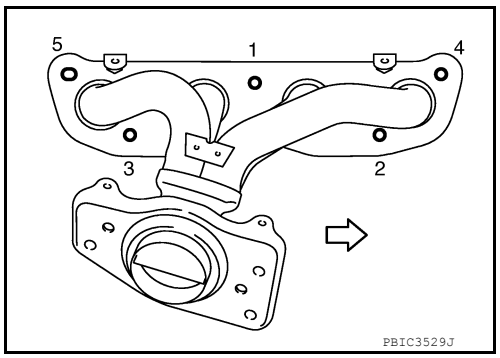
**CAUTION:**

- **Be careful not to damage heated oxygen sensor or air fuel ratio (A/F) sensor.**
- **Discard any heated oxygen sensor or air fuel ratio (A/F) 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; use a new one.**




5. Remove exhaust manifold side bolt of exhaust manifold stay.

6. Loosen nuts in reverse order as shown and remove exhaust manifold.



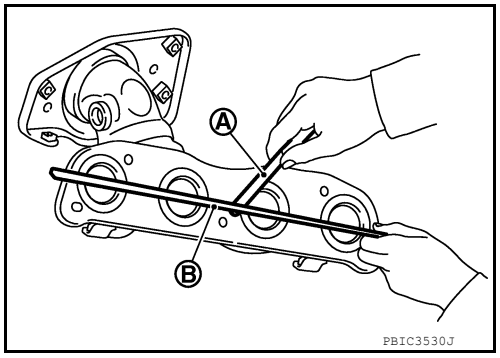

⇦ : Engine front

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

## INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge (B) and feeler gauge (A), check the surface distortion of exhaust manifold mating surface in each exhaust port and entire part.



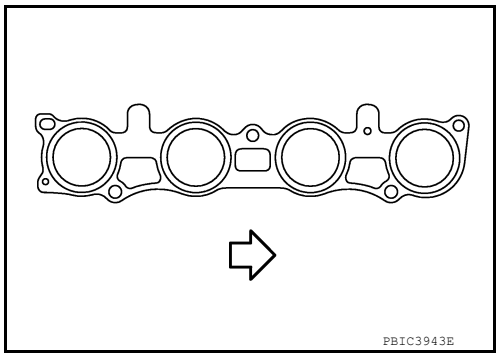

**Limit:**

| | |
|---|---|
| **Each exhaust port** | **: 0.3 mm (0.012 in)** |
| **Entire part** | **: 0.7 mm (0.028 in)** |

- If it exceeds the limit, replace exhaust manifold.

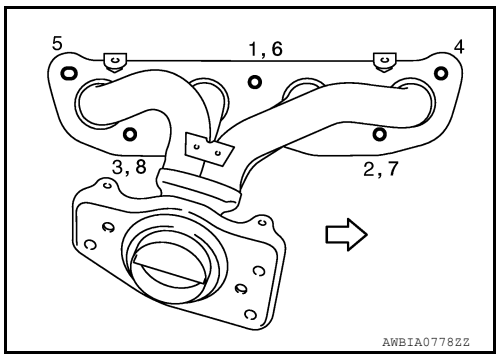
## INSTALLATION

1. Install exhaust manifold gasket to cylinder head as shown.




⇦ : Engine front

2. Tighten exhaust manifold nuts to specification in two stages in the numerical order as shown.

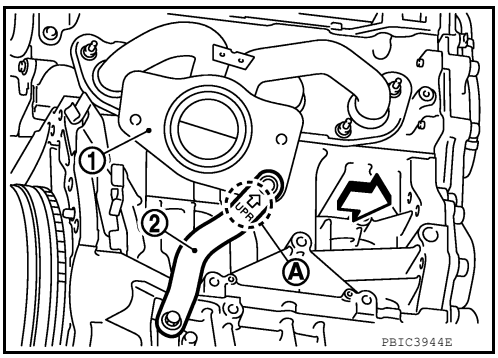



⇦ : Engine front

3. Install exhaust manifold stay.

- Install exhaust manifold stay (2) in the direction as shown (except for California).

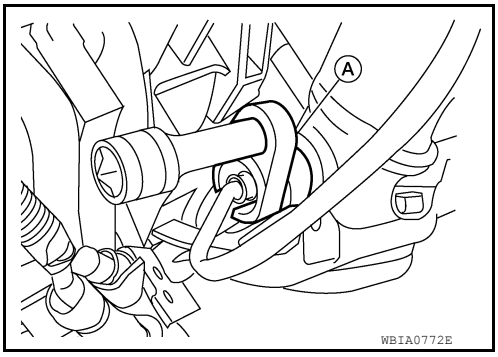
1 : Exhaust manifold
A : Upper mark
⇦ : Engine front




4. Install the A/F ratio sensor 1, using Tool (A).

**Tool number : KV991J0050 (J-44626)**

**CAUTION:**
- **Handle it carefully and avoid impacts.**
- **Before installing a new A/F ratio sensor, clean the exhaust tube threads using suitable tool and approved anti-seize lubricant.**
- **Do not over-tighten the A/F ratio sensor. Doing so may damage the A/F ratio sensor, resulting in the MIL coming on.**



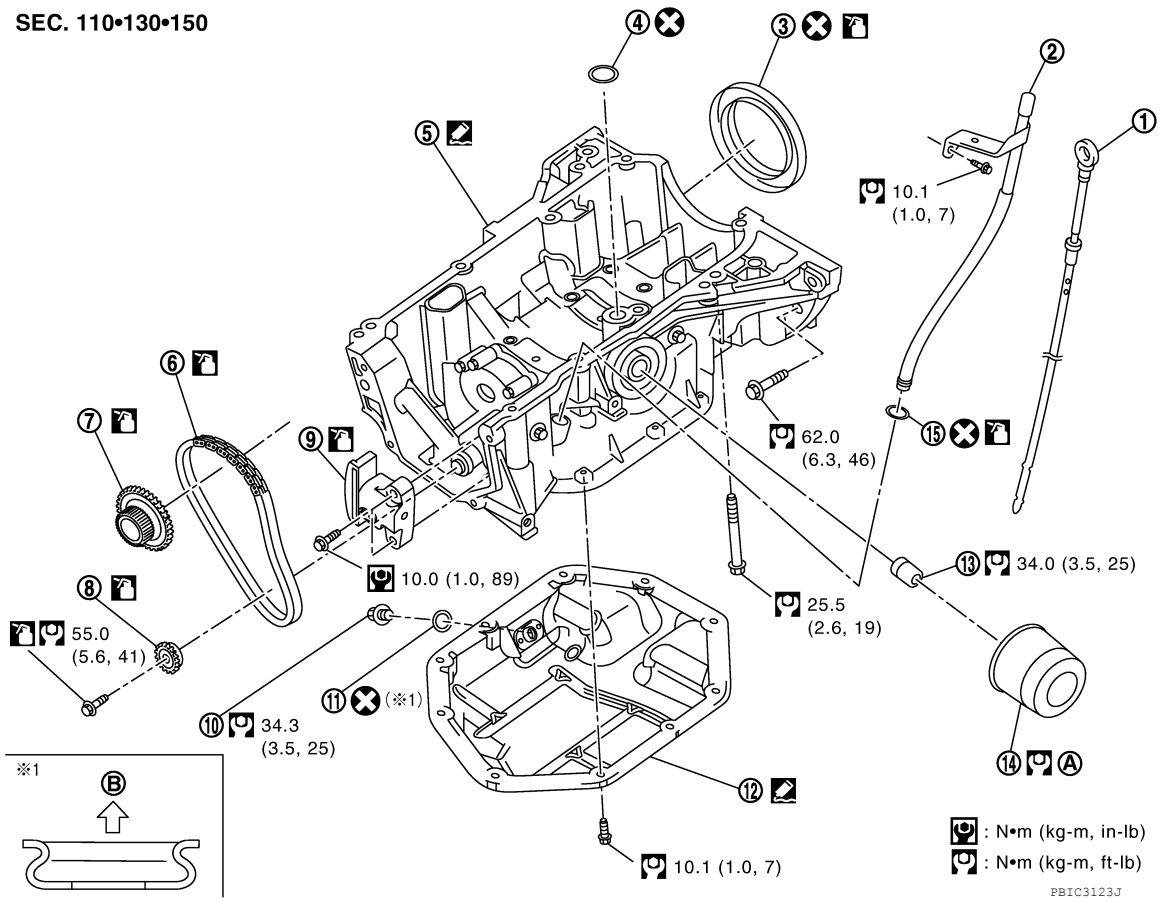

**Oxygen sensor thread cleaner : (J-43897-12)**
**Oxygen sensor thread cleaner : (J-43897-18)**

5. Installation of the remaining parts is in the reverse order of removal.

# OIL PAN

## Component

INFOID:0000000007401854




1. Oil level gauge
2. Oil level gauge guide
3. Rear oil seal
4. O-ring
5. Oil pan (upper)
6. Oil pump drive chain
7. Crankshaft sprocket
8. Oil pump sprocket
9. Timing chain tensioner (for oil pump)
10. Drain plug
11. Drain plug washer
12. Oil pan (lower)
13. Connector bolt
14. Oil filter
15. O-ring
A. Refer to LU-9
B. Oil pan side

**CAUTION:**
**Never disassemble balancer and oil pump and oil pan (upper) because they are integral unit.**

## Removal and Installation

INFOID:0000000007401855

### REMOVAL

**WARNING:**
- **To avoid the danger of being scalded, never drain the engine oil when the engine is hot.**
- **Prolonged and repeated contact with used engine oil may cause skin cancer; try to avoid direct skin contact with used oil. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.**

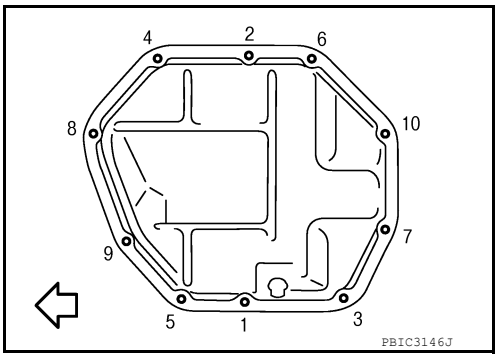
1. Drain engine oil. Refer to LU-7, "Changing Engine Oil".
2. Remove engine and transaxle assembly. Refer to EM-76, "Removal and Installation".
3. Remove flywheel (M/T models) or drive plate (CVT models).
4. Mount engine on suitable stand.
5. Remove oil filter using Tool.

**Tool number : KV10115801 ( — )**

**CAUTION:**
**When removing, prepare a shop cloth to absorb any engine oil leakage or spillage.**

6. Remove the oil pan (lower) bolts in reverse order as shown.

⇦ : Engine front

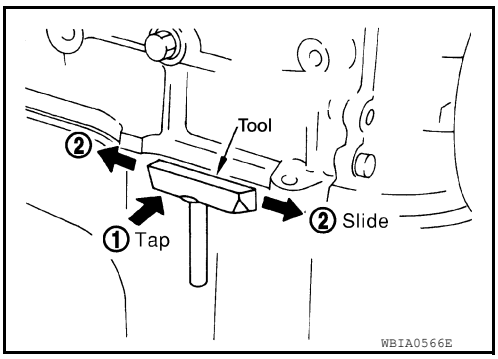



7. After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

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

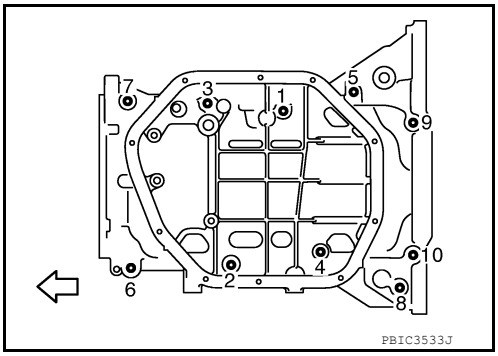
- Slide (1) the Tool by tapping (2) its side with a hammer to remove the lower oil pan from the upper oil pan.

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




8. Remove the following parts:
   - Front cover, timing chain, oil pump drive chain; Refer to EM-40.
   - Oil level gauge guide.
9. Remove oil pan (upper) bolts in reverse order as shown.

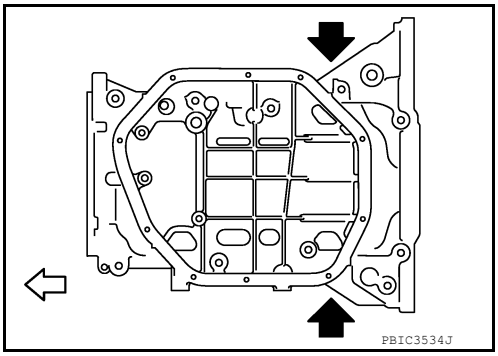
⇦ : Engine front




10. Insert a suitable tool at the position shown by the arrow (⬅) and open up a crack between oil pan (upper) and cylinder block.

⇦ : Engine front

**CAUTION:**
**The liquid gasket used at the factory is very strong. Apply pressure only in the locations shown in the illustration.**

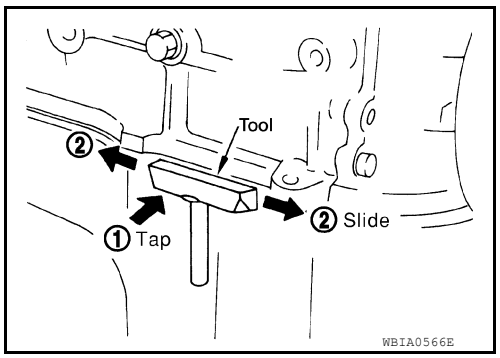


11. After removing the bolts, separate the mating surface and remove the sealant using Tool.

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

- Slide (1) the Tool by tapping (2) its side with a hammer to remove the upper oil pan from the cylinder block.

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




12. Remove O-ring between cylinder block and oil pan (upper).

**CAUTION:**
**Do not reuse O-ring.**

## INSPECTION AFTER REMOVAL

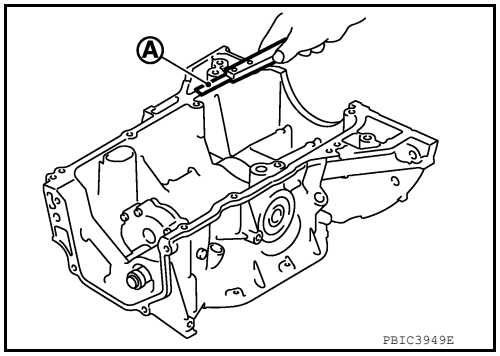
Oil Filter

Clean oil strainer portion (part of the oil pump) if any object attached.

## INSTALLATION

1. Use a scraper (A) to remove old liquid gasket from mating surfaces.
   - Remove the old liquid gasket from mating surface of cylinder block.
   - Remove old liquid gasket from the bolt holes and threads.

**CAUTION:**
**Never scratch or damage the mating surfaces when cleaning off old liquid gasket.**

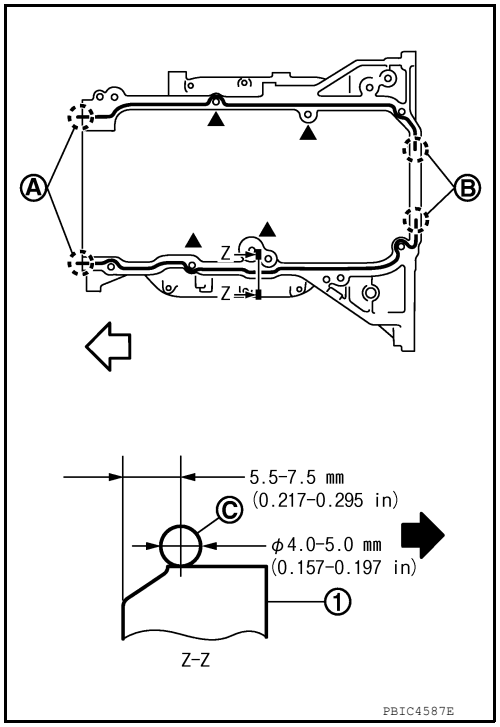



2. Apply the sealant without breaks to the specified location using Tool.
**Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**

**Tool number WS39930000 ( – )**

1 : Oil pan (upper)
A : 2 mm protruded to outside
B : 2 mm protruded to rear oil seal mounting side
C : Liquid gasket
⇦ : Engine front
⬅ : Engine outside

**CAUTION:**
- **Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.**
- **The components must be installed within 5 minutes of the liquid gasket application.**
- **Then allow 30 minutes for the liquid gasket to set before operating the engine.**

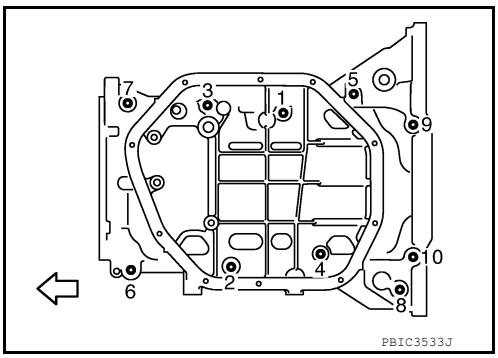



3. Install new O-ring at cylinder block side.

**CAUTION:**
- **Install avoiding misalignment of O-ring.**
- **Do not reuse O-ring.**

4. Tighten the oil pan (upper) bolts in numerical order as shown.

⇦ : Engine front



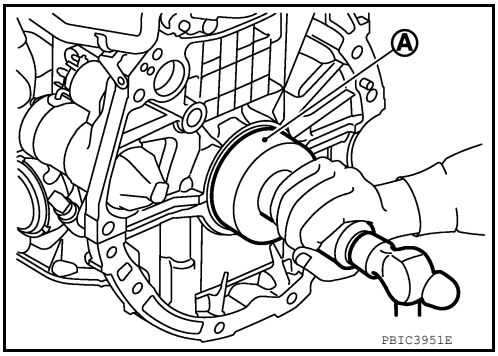

5. Install rear oil seal with the following procedure.

**CAUTION:**
- **The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).**
- **Always replace rear oil seal with new one.**
- **Never touch oil seal lip.**

a. Wipe off liquid gasket protruding to the rear oil seal mating part of oil pan (upper) and cylinder block using a scraper.

b. Apply engine oil to entire outside area of rear oil seal.

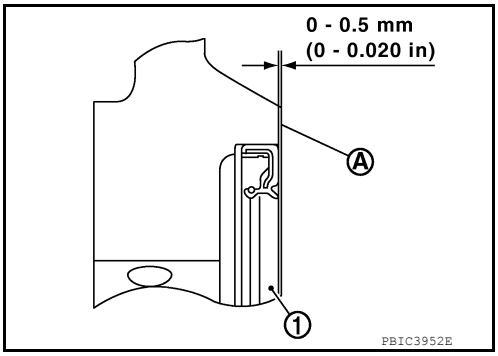
c. Press-fit the rear oil seal using a drift with outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in) (A).




- Press-fit to the specified dimensions as shown.

1 : Rear oil seal

A : Cylinder block rear end surface

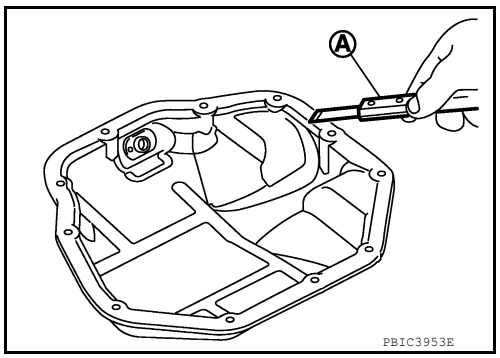



**CAUTION:**
- **Never touch the grease applied to the oil seal lip.**
- **Be careful not to damage the rear oil seal mounting part of oil pan (upper) and cylinder block or the crankshaft.**
- **Press-fit straight, making sure that rear oil seal does not curl or tilt.**

**NOTE:**
The standard surface of the dimension is the rear end surface of cylinder block.

6. Install oil pump sprocket, oil pump drive chain and other related parts if removed.

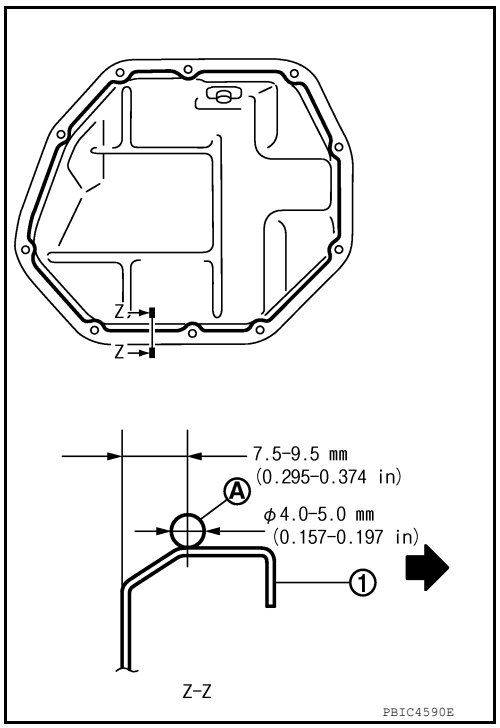
7. Use a scraper (A) to remove old liquid gasket from mating surfaces.
   - Also remove old liquid gasket from mating surface of oil pan (upper).
   - Remove old liquid gasket from the bolt holes and threads.




8. Apply the sealant (A) without breaks to the specified location using Tool.
   **Use Genuine Silicone RTV Sealant or equivalent. Refer to** **GI-44, "Recommended Chemical Product and Sealant"**

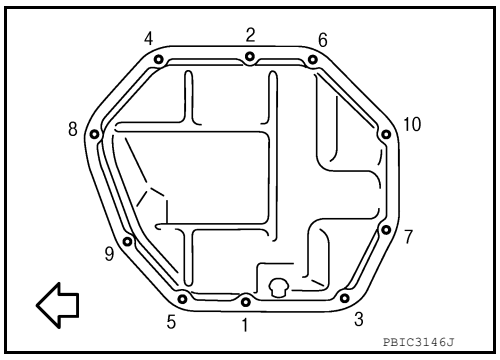
   **Tool number WS39930000 ( – )**

   1 : Oil pan (lower)
   ⬅ : Engine outside




9. Tighten bolts in numerical order as shown.

   ⇦ : Engine front




10. Install oil filter with the following procedure:

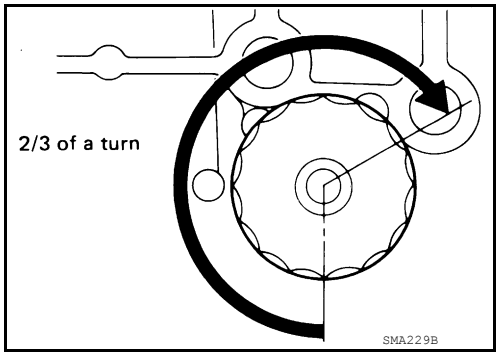
a. Remove foreign materials adhering to the oil filter installation surface.

b. Apply new engine oil to the oil seal contact surface of new oil filter.

c. Screw oil filter manually until it touches the installation surface, then tighten it by 2/3 turn. Or tighten to specification.

   **Oil filter: : 17.7 N·m (1.8 kg-m, 13 ft-lb)**

   **Tool number: : KV10115801 (J-38956)**



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

## 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-15, "MR20DE".
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
  **NOTE:**
  If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust 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:

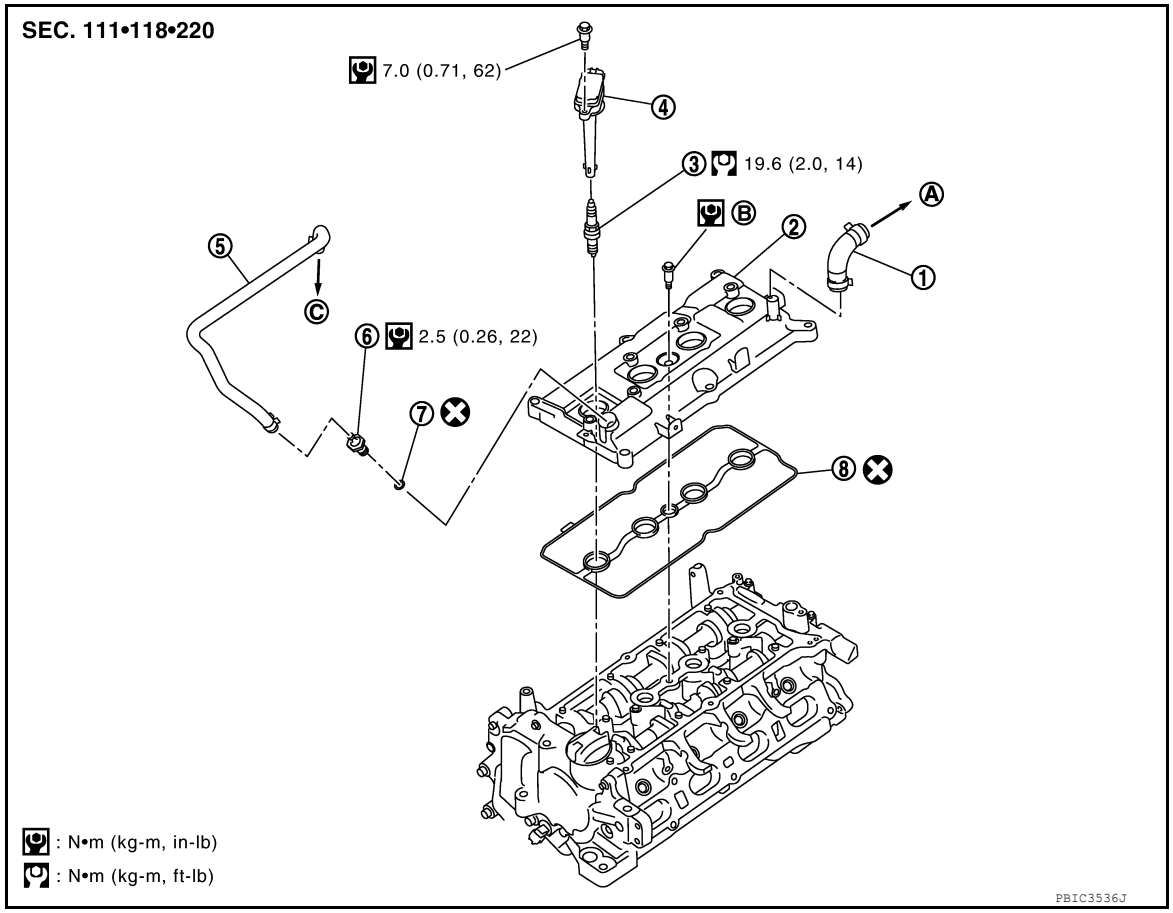
| Item | | Before starting engine | Engine running | After engine stopped |
|---|---|---|---|---|
| Engine coolant | | Level | Leakage | Level |
| Engine oil | | Level | Leakage | Level |
| Transmission/ transaxle fluid | A/T and CVT Models | Leakage | Level/Leakage | Leakage |
| | M/T Models | Level/Leakage | Leakage | Level/Leakage |
| Other oils and fluids* | | Level | Leakage | Level |
| Fuel | | Leakage | Leakage | Leakage |
| Exhaust gas | | — | Leakage | — |

*Power steering fluid, brake fluid, etc.

# IGNITION COIL, SPARK PLUG AND ROCKER COVER

## Component

INFOID:0000000007401856




| | | |
|---|---|---|
| 1. PCV hose | 2. Rocker cover | 3. Spark plug |
| 4. Ignition coil | 5. PCV hose | 6. PCV valve |
| 7. O-ring | 8. Gasket | |
| A. To air duct | B. Refer to EM-33, "Removal and Installation". | C. To intake manifold |

## Removal and Installation

INFOID:0000000007401857

### REMOVAL

1. Remove intake manifold. Refer to EM-19, "Removal and Installation".
2. Remove the four ignition coils.

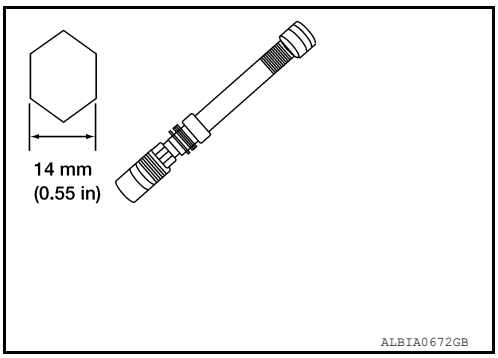
**CAUTION:**

- **Handle the ignition coils carefully and avoid impacts.**
- **Never disassemble the ignition coils.**

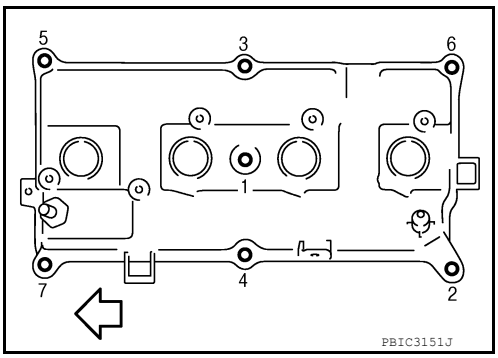
3. Remove the four spark plugs using Tool.

**Tool number : — (J-48891)**

**CAUTION:**
**Never drop or shock it the spark plugs.**

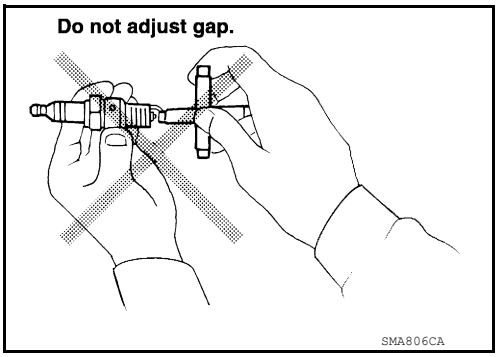



4. Remove rocker cover.
   - Loosen bolts in reverse order as shown.
   - ⇦ Engine front




## INSPECTION AFTER REMOVAL

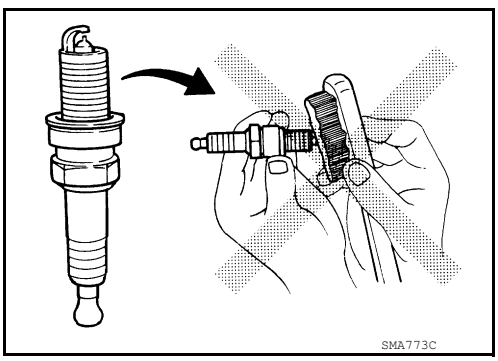
**CAUTION:**
- **Never drop or shock spark plug.**
- **Checking and adjusting spark plug gap is not required between change intervals.**




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

**Cleaner air pressure : Less than 588 kPa (6 kg/cm$^2$, 85 psi)**
**Cleaning time : Less than 20 seconds**

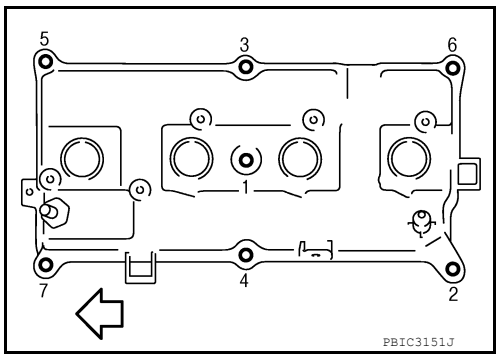
- **Never use wire brush for cleaning spark plug.**




## INSTALLATION

1. Install rocker cover gasket to rocker cover.

2. Install rocker cover.
   - Tighten bolts in two steps separately in numerical order as shown.



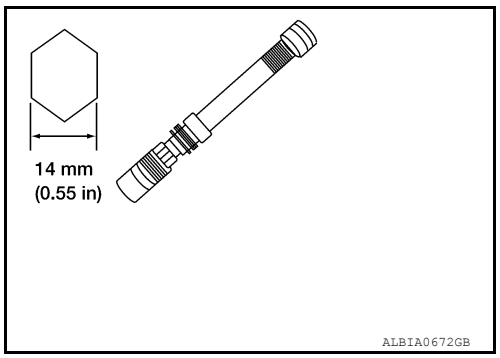

**1st step : 1.96 N·m (0.20 kg-m, 17 in-lb)**
**2nd step : 8.33 N·m (0.85 kg-m, 73 in-lb)**

   - ⇦ Engine front

**CAUTION:**
**Ensure that the rocker cover gasket remains in the rocker cover groove prior to rocker cover installation.**

3. Install the four spark plugs using Tool.

**Tool number : — (J-48891)**




**CAUTION:**
**Never drop or shock it the spark plugs.**

| Application | Except for California | For California |
|---|---|---|
| Make | NGK | Denso |
| Part number* | PLZKAR6A-11 | FXE20HR-11 |
| Gap (nominal) | 1.1 mm (0.043 in) | 1.1 mm (0.043 in) |

*: Always check with the Parts Department for the latest parts information.

4. Install the four ignition coils.

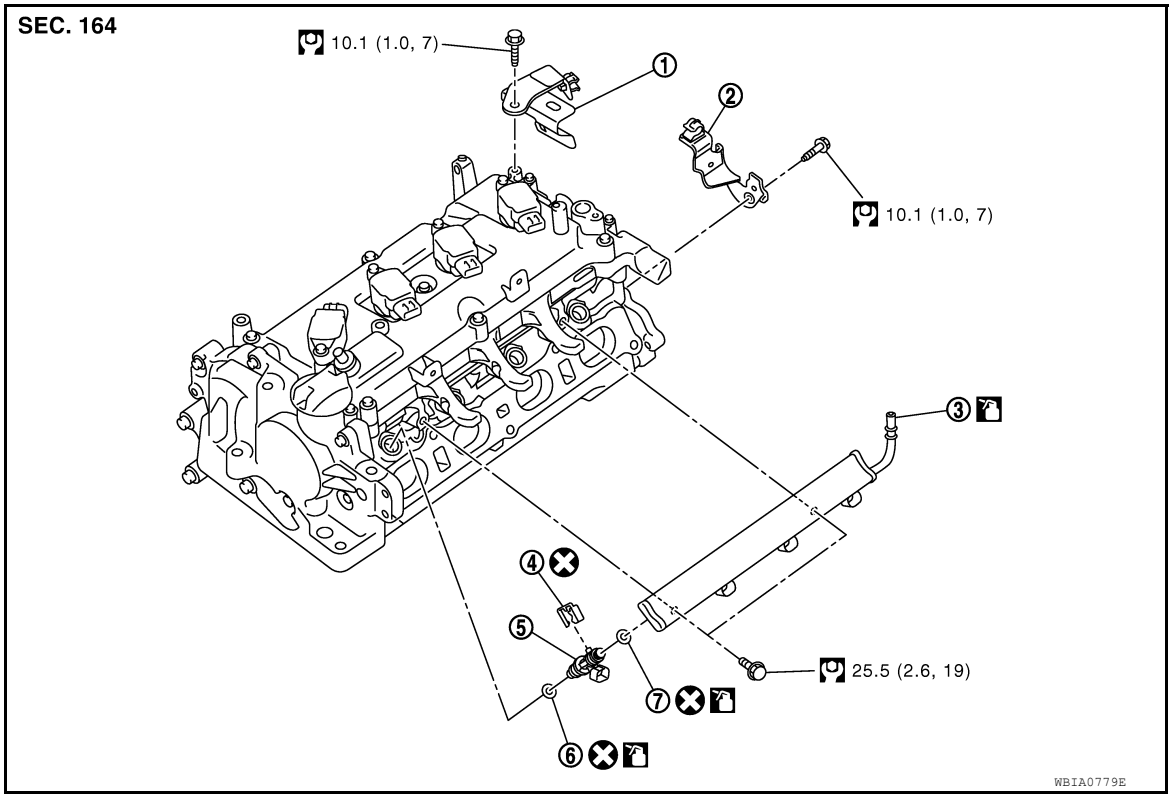
**CAUTION:**
- **Handle the ignition coils carefully and avoid impacts.**
- **Never disassemble the ignition coils.**

5. Install intake manifold. Refer to EM-19, "Removal and Installation".

# FUEL INJECTOR AND FUEL TUBE

## Component

INFOID:0000000007401858




1. Bracket
2. Bracket
3. Fuel tube
4. Clip
5. Fuel injector
6. O-ring (green)
7. O-ring (black)

## Removal and Installation

INFOID:0000000007401859

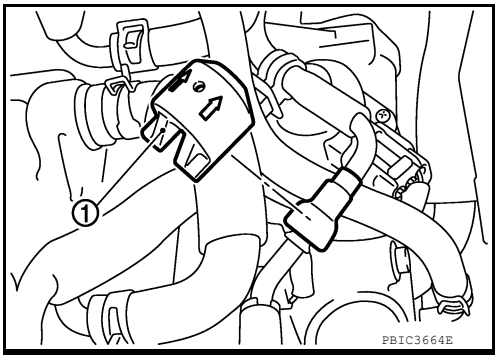
**WARNING:**
- **Put a "CAUTION: FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a $CO_2$ fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**

**CAUTION:**
- **Apply new engine oil to parts before installing the parts, as shown above.**
- **Do not remove or disassemble parts unless instructed as shown.**

### REMOVAL

1. Release the fuel pressure. Refer to EC-102, "Fuel Pressure Check" (for California) or EC-662, "Fuel Pressure Check" (except for California).
2. Disconnect the battery negative terminal. Refer to SC-7, "Removal and Installation (MR20DE Battery)".

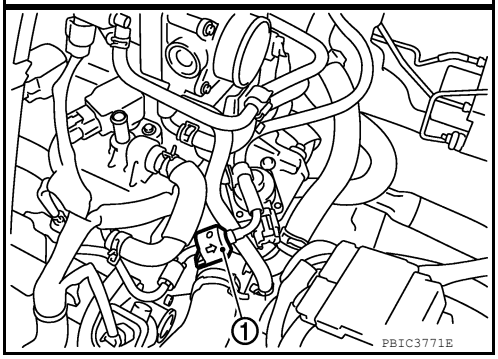
3. Remove quick connector cap (1) from quick connector connection.




4. Disconnect fuel feed hose from hose clamp.

1 : Quick connector cap

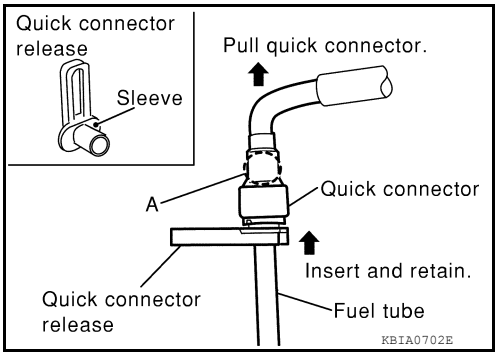
**NOTE:**
There is no fuel return path.




5. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.

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

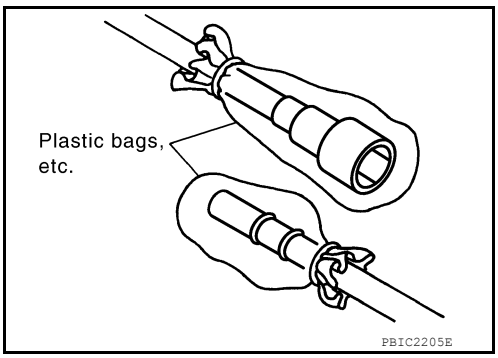
**CAUTION:**
**Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.**




7. Draw and pull out quick connector straight from fuel tube.

**CAUTION:**
- **Pull quick connector holding “A” position.**
- **Do not reuse O-ring.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Do not expose parts to battery electrolyte or other acids.**
- **Do not bend or twist connection between quick connector and fuel feed hose during installation/ removal.**

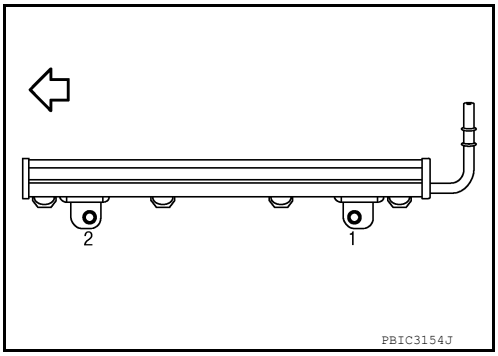
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.**




8. Remove intake manifold. Refer to EM-18.

9. Remove fuel tube.
   - Loosen bolts in reverse order as shown.

   ⇦ : Engine front




10. Remove the fuel tube and fuel injector assembly.
    **CAUTION:**
    - **When removing, be careful to avoid any interference with fuel injector.**
    - **Use a shop cloth to absorb any fuel leaks from fuel tube.**
11. Remove fuel injector from fuel tube with the following procedure:

a. Open and remove clip.

b. Remove fuel injector from fuel tube by pulling straight.
   **CAUTION:**
   - **Be careful with remaining fuel that may go out from fuel tube.**
   - **Be careful not to damage fuel injector nozzle during removal.**
   - **Never bump or drop fuel injector.**
   - **Never disassemble fuel injector.**

## INSTALLATION

1. Install new O-rings on the fuel injector.
   - Fuel tube side: Black
   - Nozzle side: Green

   **CAUTION:**
   - **Do not reuse O-rings.**
   - **Upper and lower O-rings are different. Be careful to install them in the correct location.**
   - **Handle O-ring with bare hands. Never wear gloves.**
   - **Lubricate O-ring with new engine oil.**
   - **Never clean O-ring with solvent.**
   - **Make sure that O-ring and its mating part are free of foreign material.**
   - **When installing O-ring, be careful not to scratch or nick it.**
   - **Also be careful not to twist or stretch O-ring. If O-ring was stretched, allow it time to return to an unstretched condition prior to installation.**
   - **Insert O-ring straight into fuel tube. Never twist it.**
   - **Never insert the O-ring quickly into fuel tube.**

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

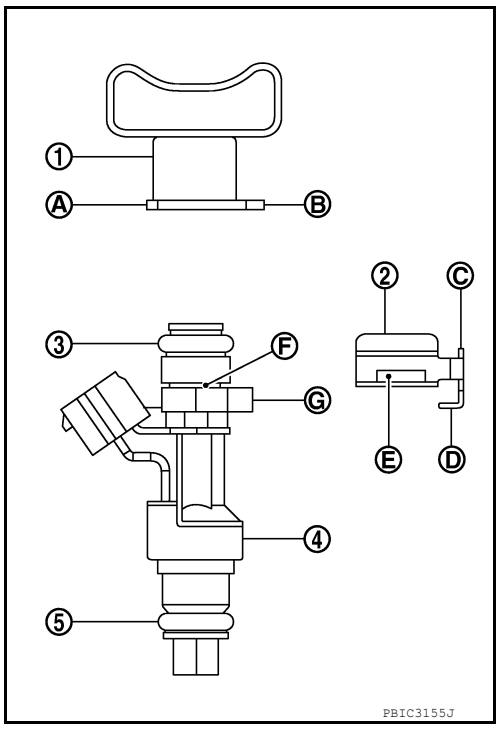
3 : O–ring (black)
5 : O–ring (green)

a. Insert clip (2) into clip groove (F) on fuel injector.
- Insert clip so that protrusion (G) of fuel injector matches cut-out (D) of clip.

**CAUTION:**
- **Do not reuse O-rings.**
- **Never reuse clip. Replace it with a new one.**
- **Be careful to keep clip from interfering with O-ring.**
- **If interference occurs during installation replace the O-ring.**

b. Insert fuel injector into fuel tube with clip attached.
- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion (B) of fuel tube matches cut-out (C) of clip.
- Make sure that fuel tube flange (A) is securely fixed in flange fixing groove (E) on clip.

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

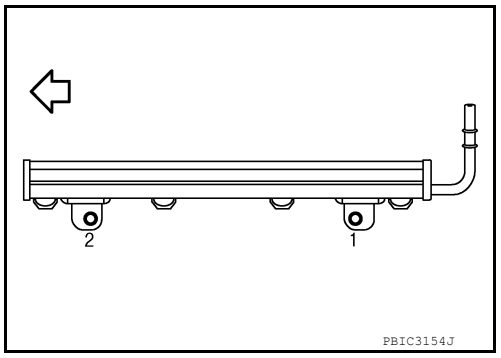



3. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

**CAUTION:**
**For installation, be careful not to interfere with fuel injector nozzle.**

4. Tighten bolts in numerical order as shown.

⇦ : Engine front




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

## INSPECTION AFTER INSTALLATION

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

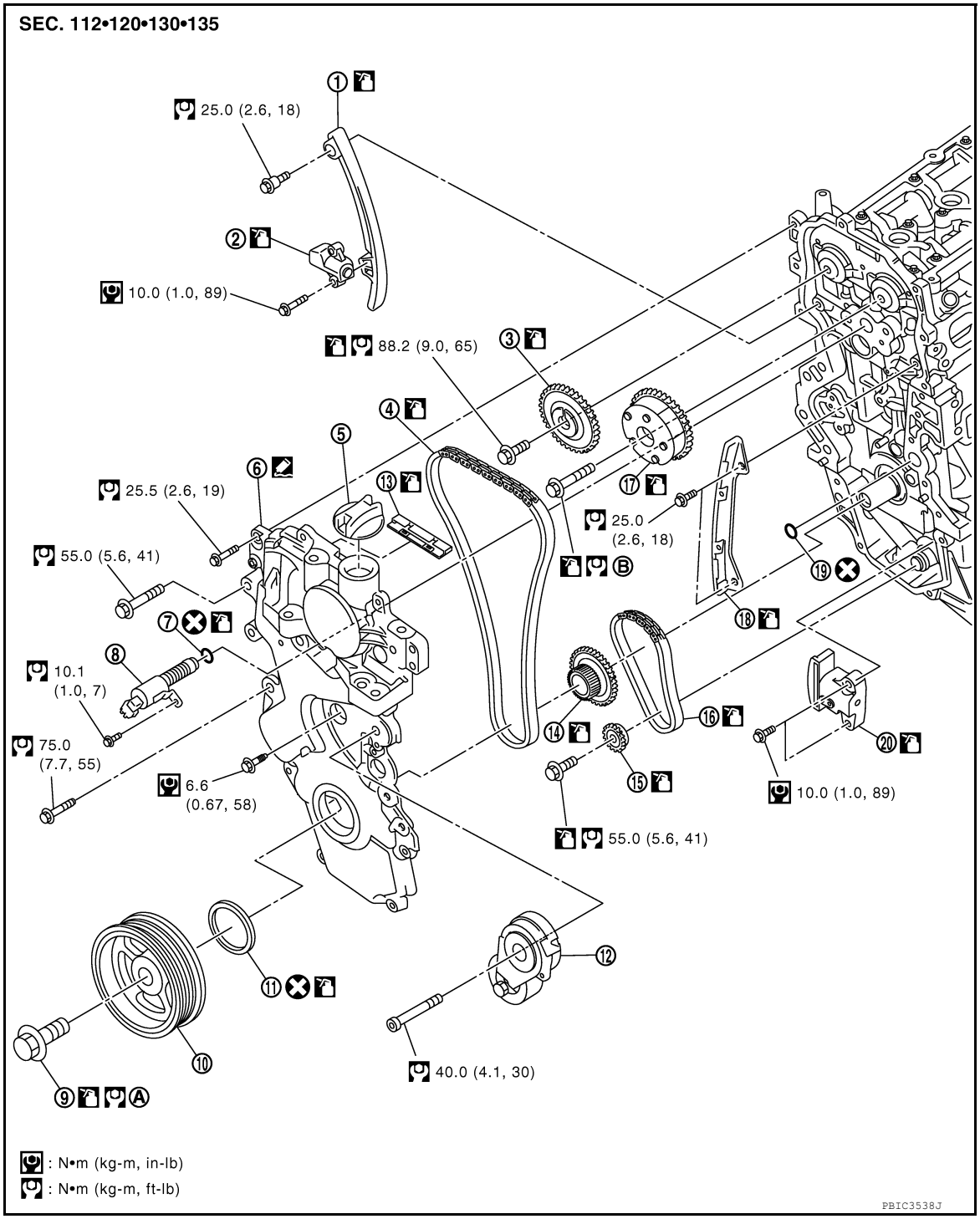
1. Apply fuel pressure to fuel lines by turning ignition switch ON (with engine stopped). Then check for fuel leaks at connections.
2. Start the engine and rev it up and check for fuel leaks at connections.

**CAUTION:**
**Do not touch engine immediately after stopping as engine is extremely hot.**
**NOTE:**
Use mirrors for checking on connections out of the direct line of sight.
- Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to EC-100, "Throttle Valve Closed Position Learning" (except for California) or EC-660, "Throttle Valve Closed Position Learning" (for California).
- If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to EC-100, "Idle Air Volume Learning" (except for California) or EC-660, "Idle Air Volume Learning" (for California).

# TIMING CHAIN

## Component

INFOID:0000000007401860




| | | | | | |
|---|---|---|---|---|---|
| 1. | Timing chain slack guide | 2. | Timing chain tensioner | 3. | Camshaft sprocket (EXH) |
| 4. | Timing chain | 5. | Oil filler cap | 6. | Front cover |
| 7. | O-ring | 8. | Intake valve timing control solenoid valve | 9. | Crankshaft pulley bolt |
| 10. | Crankshaft pulley | 11. | Front oil seal | 12. | Drive belt auto-tensioner |
| 13. | Timing chain tension guide (front cover side) | 14. | Crankshaft sprocket | 15. | Oil pump sprocket |

16. Oil pump drive chain
17. Camshaft sprocket (INT)
18. Timing chain tension guide
19. O-ring
20. Chain tensioner (for oil pump)
A. Refer to EM-41
B. Refer to EM-50

## Removal and Installation

INFOID:0000000007401861

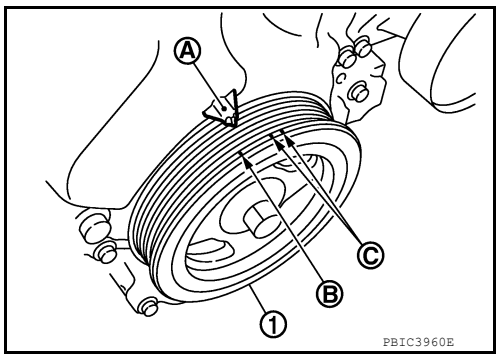
**CAUTION:**
**The rotating direction indicated in the text indicates all directions seen from the engine front.**

### REMOVAL

1. Disconnect the battery negative terminal. Refer to SC-7, "Removal and Installation (MR20DE Battery)".
2. Drain engine oil. Refer to LU-7, "Changing Engine Oil".
   **NOTE:**
   Perform this step when engine is cold.
3. Partially drain engine coolant from the radiator. Refer to CO-12, "Changing Engine Coolant".
4. Remove front RH wheel. Refer to WT-7, "Adjustment".
5. Remove splash shield (RH). Refer to EI-23.
6. Remove the following parts.
   - Rocker cover: Refer to EM-33, "Component".
   - Drive belt: Refer to EM-13, "Component".
   - Water pump pulley: Refer to CO-21, "Component".
   - Ground cable (between engine bracket (RH) and radiator core support)
7. Support the bottom surface of engine using a transmission jack, and then remove the torque rod (RH), engine mounting bracket and insulator (RH). Refer to EM-75.
8. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:

a. Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

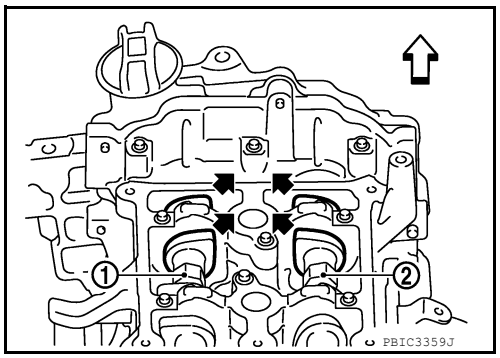
C : White paint mark (Not use for service)



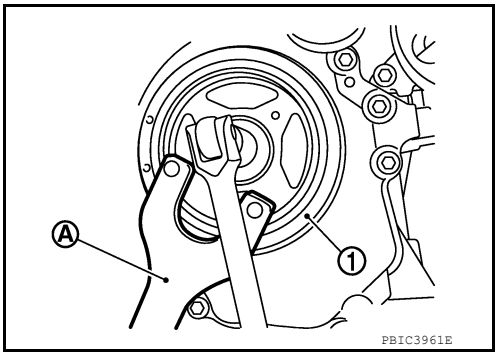

b. At the same time, make sure that the cam noses of the No.1 cylinder are located (⬅) as shown.

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

- If not, rotate crankshaft pulley one revolution (360 degrees) and align as shown.

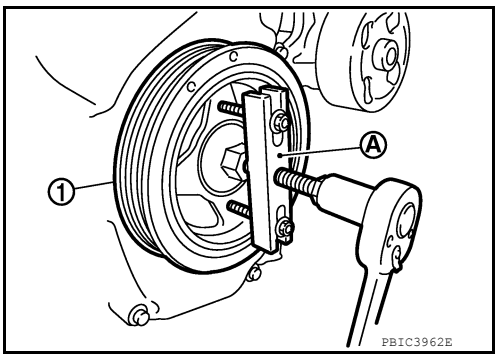


9. Hold crankshaft pulley (1) using suitable tool (A) loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.
**CAUTION:**
**Never remove the crankshaft pulley bolt as it will be used as a supporting point for the pulley puller.**

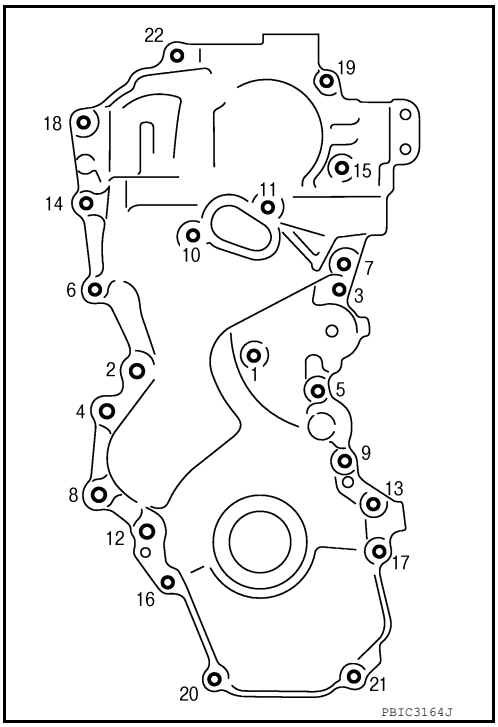



10. Attach Tool (A) in the M6 thread hole on crankshaft pulley (1), and remove crankshaft pulley.

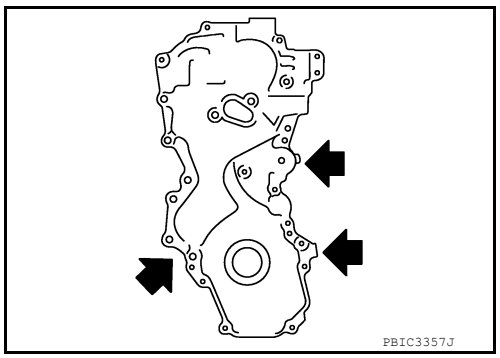
**Tool number : KV11103000 ( — )**




11. Remove oil pan (lower). Refer to EM-27.
**NOTE:**
When crankshaft sprocket, oil pump sprocket and other related parts are not removed, this step is unnecessary.
12. Remove intake valve timing control solenoid valve.
13. Remove drive belt auto-tensioner.
14. Loosen bolts in reverse order as shown.



15. Cut liquid gasket by prying the position (⬅) shown, and then remove the front cover.
**CAUTION:**
- **Be careful not to damage the mating surface.**
- **The liquid gasket used at the factory is very strong.**
- **Pry the front cover only in the spots shown in the illustration.**

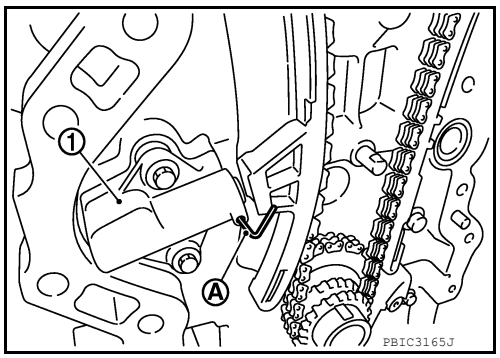



16. Remove front oil seal from front cover.
- Lift up front oil seal using a suitable tool.

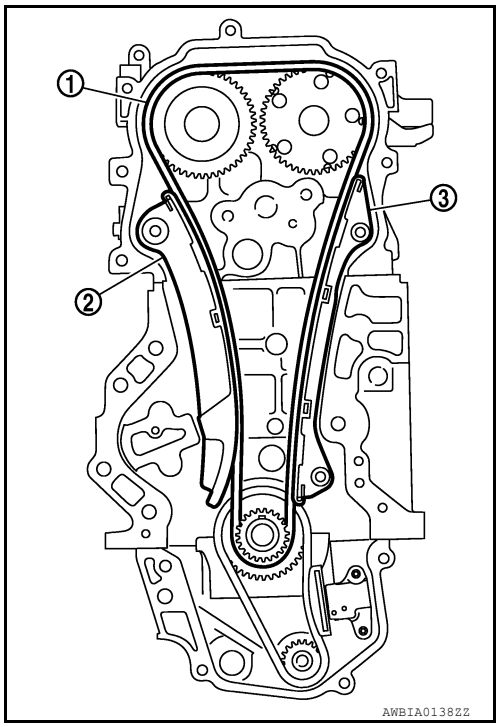
**CAUTION:**
**Be careful not to damage front cover.**

17. Push in timing chain tensioner plunger.
18. Insert a stopper pin (A) into the body hole to retain the plunger in collapsed position.
**NOTE:**
Use approximately 1.5 mm (0.059 in) diameter. hard metal pin as a stopper pin.

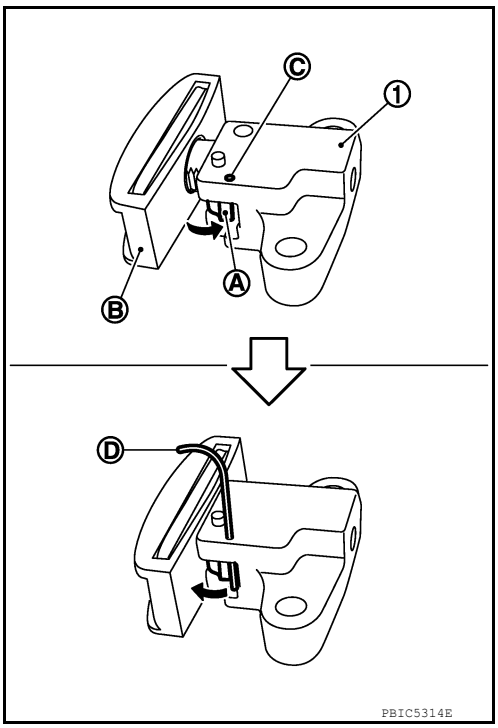
19. Remove timing chain tensioner (1).




20. Remove timing chain slack guide (2), timing chain tension guide (3) and timing chain (1).
**CAUTION:**
**Never rotate each crankshaft and camshaft individually while timing chain is removed. It causes interference between valve and piston.**



21. Press stopper tab (A) in the direction shown to push the timing chain slack guide (B) toward timing chain tensioner (for oil pump) (1).
    - The slack guide (B) is released by pressing the stopper tab (A). As a result, the slack guide (B) can be moved.
22. Insert stopper pin (D) into tensioner body hole (C) to secure timing chain slack guide (B).
    **NOTE:**
    Use a hard metal pin with a diameter of approximately 1.2 mm (0.047 in) as a stopper pin.
23. Remove chain tensioner (for oil pump), if necessary.

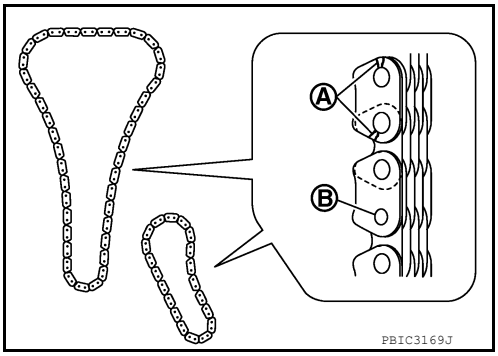



24. Remove crankshaft sprocket, oil pump sprocket and oil pump drive chain as a set, if necessary.
25. Remove timing chain tension guide (front cover side) from front cover, if necessary.

## INSPECTION AFTER REMOVAL

Timing Chain

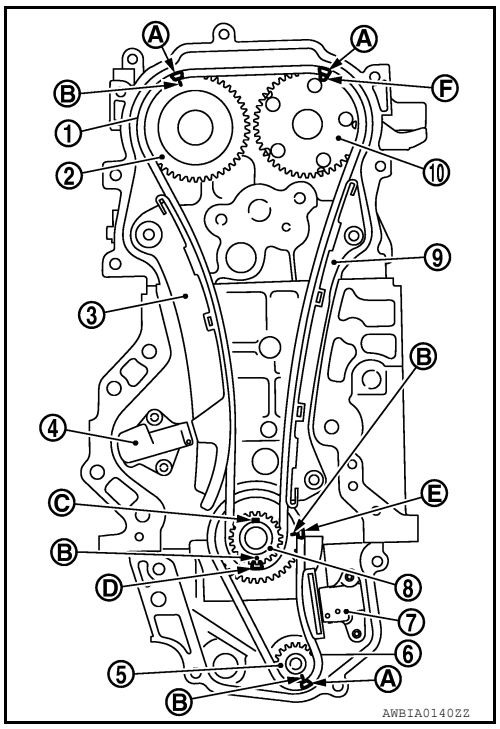
- Check timing chain and oil pump drive chain for cracks (A) and any excessive wear (B) at the roller links of timing chain.
- Replace timing chain and/or oil pump drive chain, if necessary.




## INSTALLATION

**NOTE:**

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

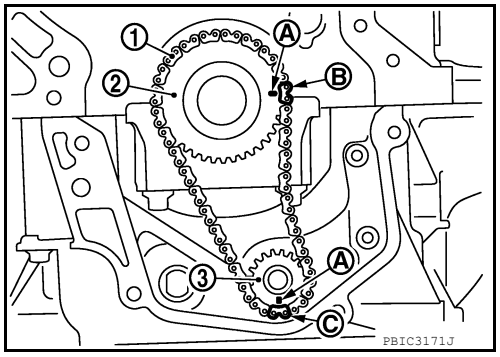



1. Make sure that crankshaft key points straight up.

1 : Timing chain
2 : Camshaft sprocket (EXH)
3 : Timing chain slack guide
4 : Timing chain tensioner
5 : Oil pump sprocket
6 : Oil pump drive chain
7 : Chain tensioner (for oil pump)
8 : Crankshaft sprocket
9 : Timing chain tension guide
10 : Camshaft sprocket (INT)
A : Matching mark (dark blue link)
B : Matching mark (stamping)
C : Crankshaft key position (straight up)
D : Matching mark (orange link)
E : Matching mark (orange link)
F : Matching mark (outer groove*)

**NOTE:**
*: There are two outer grooves in camshaft sprocket (INT). The larger one is a matching mark.

2. If the timing chain tension guide (front cover side) is removed, install it to the front cover.
**CAUTION:**
**Check the joint condition by sound or feeling.**

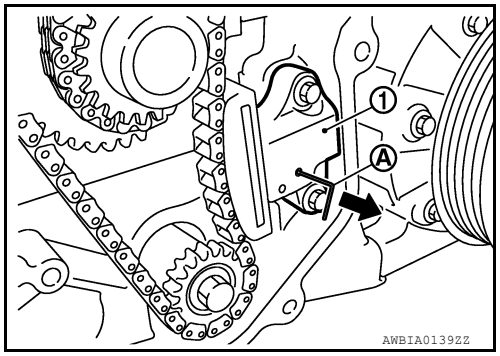



3. Install crankshaft sprocket (2), oil pump sprocket (3) and oil pump drive chain (1).

A : Matching mark (stamping)
B : Matching mark (orange link)
C : Matching mark (dark blue link)

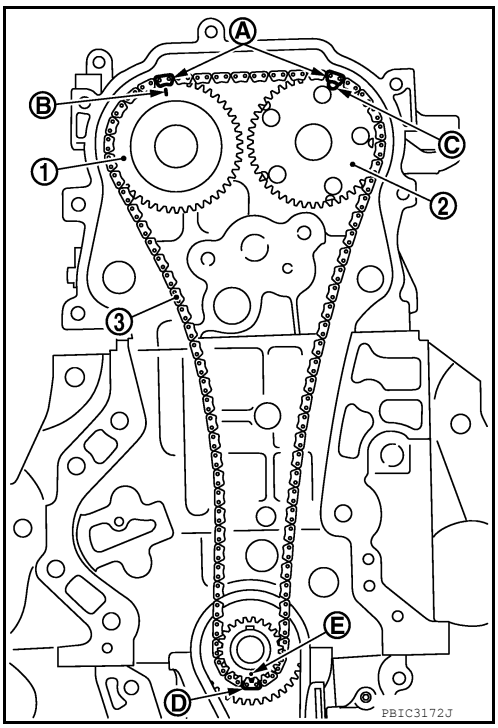
- Install it by aligning matching marks on each sprocket and oil pump drive chain.
- If these matching marks are not aligned, rotate the oil pump shaft slightly to correct the position.

**CAUTION:**
**Check matching mark position of each sprocket after installing the oil pump drive chain.**




4. Install chain tensioner (for oil pump) (1).
- Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
- Securely pull out (⬅) the stopper pin after installing the chain tensioner (for oil pump).
- Check matching mark position of oil pump drive chain and each sprocket again.

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

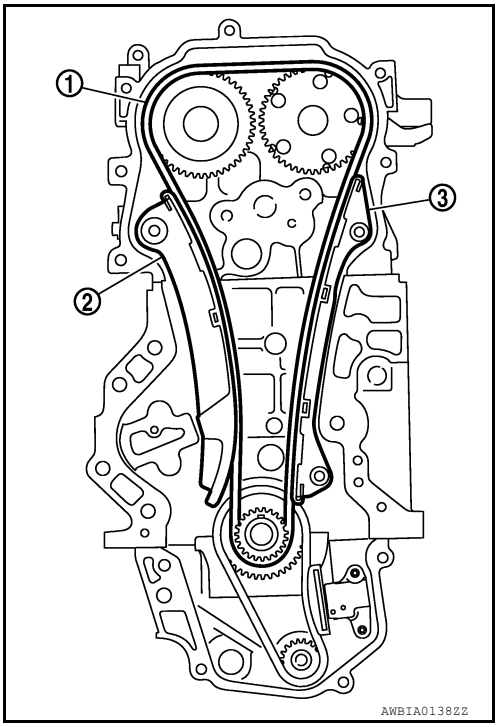



1 : Camshaft sprocket (EXH)
2 : Camshaft sprocket (INT)
3 : Timing chain
A : Matching mark (dark blue link)
B : Matching mark (stamping)
C : Matching mark (outer groove*)
D : Matching mark (orange link)
E : Matching mark (stamping)

**NOTE:**
*: There are 2 outer grooves in camshaft sprocket (INT). The larger one is a matching mark.
- If these matching marks are not aligned, rotate the camshaft slightly by holding the hexagonal portion to correct the position.

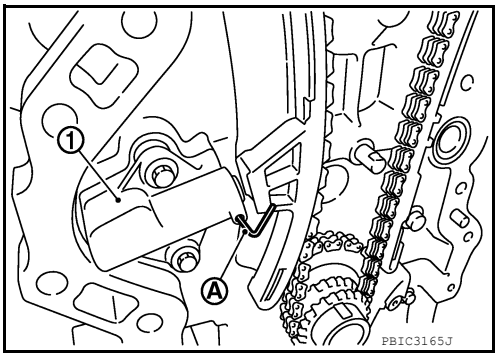
**CAUTION:**
**Check matching mark position of each sprocket and timing chain again after installing the timing chain.**

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



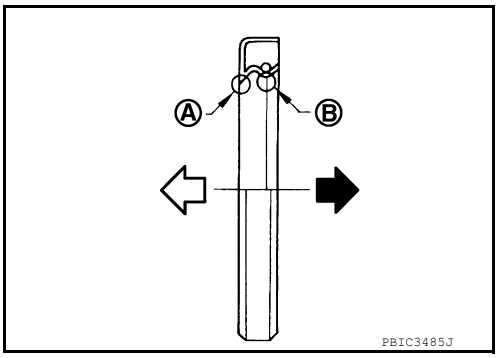

1 : Timing chain

7. Install timing chain tensioner (1).
   - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
   - Securely pull out the stopper pin after installing the timing chain tensioner.



8. Check matching mark position of timing chain and each sprocket again.
9. Apply new engine oil to new front oil seal joint surface.
10. Using a suitable tool install front oil seal so that each seal lip is oriented as shown.

A : Dust seal lip
B : Oil seal lip
⇦ : Engine front
⬅ : Engine rear




- Press-fit front oil seal until it is flush with front end surface of front cover as shown below with a suitable tool.

**Within 0.3 mm (0.012 in) toward engine front**
**Within 0.5 mm (0.020 in) toward engine rear**

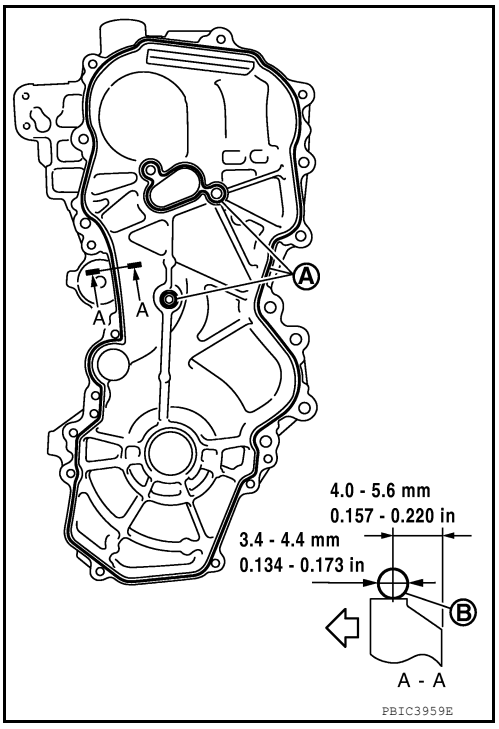
**CAUTION:**
- **Be careful not to damage front cover and crankshaft.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Never touch grease applied onto oil seal lip.**

11. Install new O-ring to cylinder block.
**CAUTION:**
- **Be sure O-rings are aligned properly.**
- **Do not reuse O-rings.**

12. Apply the sealant without breaks to the specified location using Tool.
**Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**
**CAUTION:**
**The components must be installed within 5 minutes of the liquid gasket application. Then allow 30 minutes for the liquid gasket to set before operating the engine.**

**Tool number WS39930000 ( – )**

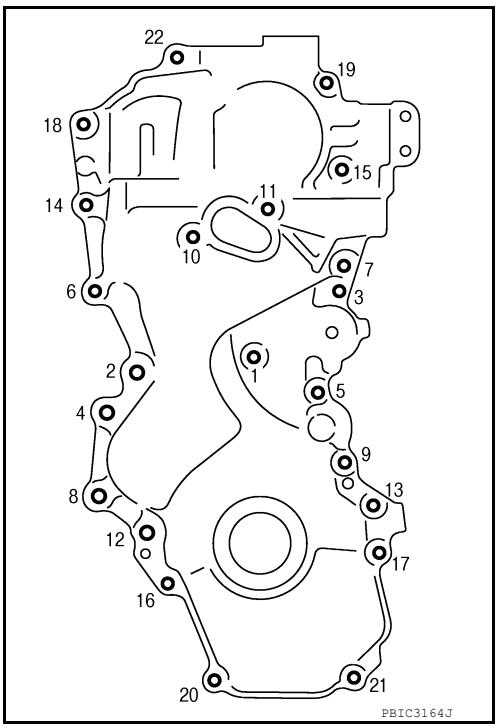
A : Liquid gasket application area
B : Liquid gasket
⇦ : Engine outside




13. Make sure that matching marks of timing chain and each sprocket are still aligned.
**CAUTION:**
- **Make sure O-ring on cylinder block is correctly installed.**
- **Do not reuse O-ring.**
- **Be careful not to damage front oil seal by interference with front end of crankshaft.**

14. Install front cover, and tighten bolts in numerical order as shown.
**CAUTION:**
**Attaching should be done within 5 minutes after liquid gasket application.**
**NOTE:**
Use the following for the installation position of bolts.

| | | |
|---|---|---|
| M6 bolts | : | No. 1 |
| M10 bolts | : | No. 6, 7, 10, 11, 14 |
| M12 bolts | : | No. 2, 4, 8, 12 |
| M8 bolts | : | Except the above |




15. Tighten all bolts are in two stages to specified torque in numerical order as shown.
**CAUTION:**
**Be sure to wipe off excess liquid gasket.**

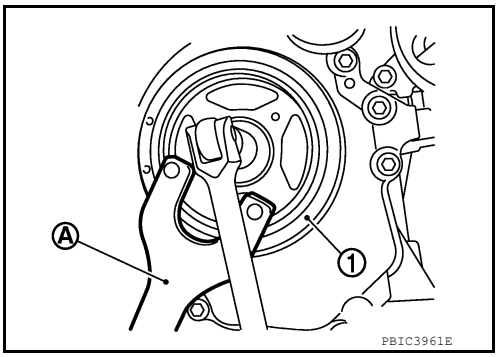
16. Install crankshaft pulley using the following procedure.

a. Install crankshaft pulley.
**CAUTION:**
- **Never damage front oil seal lip section.**
- **If needed use a plastic hammer, tap on its center portion (not circumference) to seat crankshaft pulley.**

b. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.

c. Secure crankshaft pulley (1) using suitable tool (A).

**Tool number : KV10109300 ( — )**

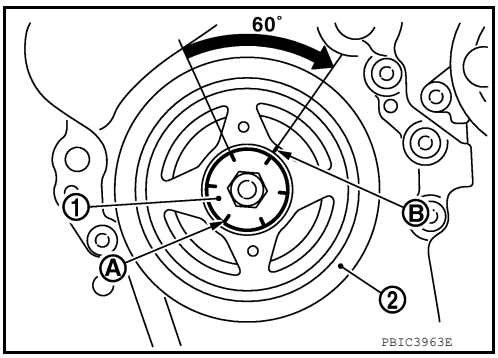



d. Tighten crankshaft pulley bolt in two steps.

**Step 1 : 29.4 N·m (3.0 kg-m, 22 ft-lb)**
**Step 2 : 60° clockwise**

- For angle tightening, put a paint mark (B) on crankshaft pulley (2), matching with any one of six easy to recognize angle marks (A) on crankshaft pulley bolt (1) flange.
- Turn 60 degrees clockwise (angle tightening).
- Check the tightening angle with movement of one angle mark.

e. Make sure that crankshaft rotates clockwise smoothly.

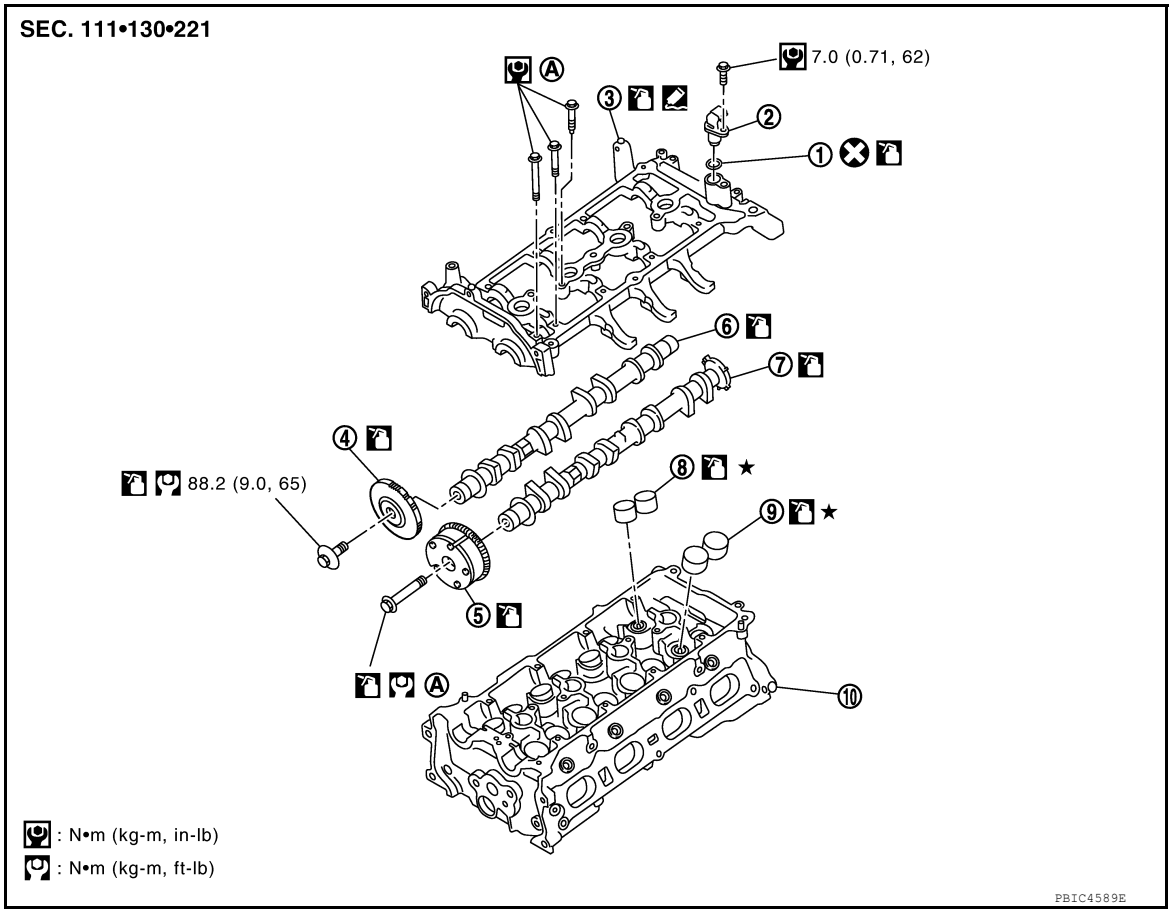


17. Installation of the remaining components is in the reverse order of removal.

# CAMSHAFT

## Component

INFOID:0000000007401862




1. O-ring
2. Camshaft position sensor (PHASE)
3. Camshaft bracket
4. Camshaft sprocket (EXH)
5. Camshaft sprocket (INT)
6. Camshaft (EXH)
7. Camshaft (INT)
8. Valve lifter (EXH)
9. Valve lifter (INT)
10. Cylinder head

A. Refer to EM-50.

## Removal and Installation

INFOID:0000000007401863

### REMOVAL

**WARNING:**

- **Put a "CAUTION: FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**

1. Release the fuel pressure. Refer to EC-102, "Fuel Pressure Check" (for California) or EC-662, "Fuel Pressure Check" (except for California).
2. Disconnect battery negative terminal. Refer to SC-7, "Removal and Installation (MR20DE Battery)".
3. Remove front RH wheel. Refer to WT-7, "Adjustment".
4. Remove splash shield (RH). Refer to EI-23.
5. Partially drain engine coolant. Refer to CO-11.
   **NOTE:**
   Perform this step when engine is cold.
6. Remove the following parts.
   - Intake manifold; Refer to EM-18.

- Rocker cover; Refer to EM-33.
- Front cover, timing chain and related parts; Refer to EM-40.
- Generator; Refer to SC-41, "Removal and Installation MR20DE".

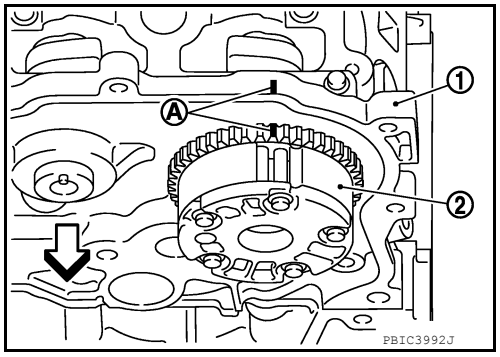
7. Remove camshaft position sensor (PHASE) from camshaft bracket.

**CAUTION:**
- **Handle carefully to avoid dropping and shocks.**
- **Never disassemble.**
- **Never allow metal powder to adhere to magnetic part at sensor tip.**
- **Never place sensor in a location where it is exposed to magnetism.**

8. Put the matching mark (A) on the camshaft sprocket (INT) (2) and the camshaft bracket (1) as shown.

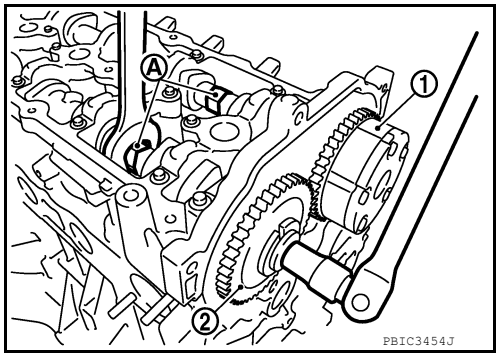
⇦ : Engine front

**NOTE:**
It prevents the knock pin of the camshaft (INT) from engaging with the incorrect pin hole when installing the camshaft sprocket (INT).



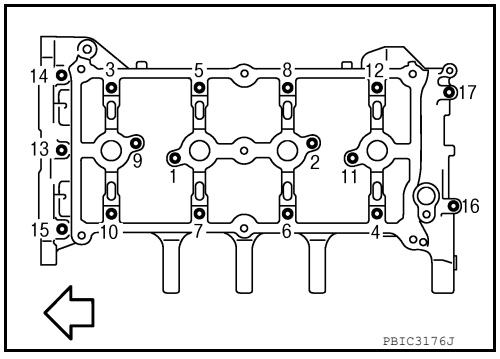

9. Remove camshaft sprockets (INT) (1) and (EXH) (2).
- Secure hexagonal part (A) of camshaft with a wrench. Loosen camshaft sprocket bolts and remove camshaft sprocket.

**CAUTION:**
- **Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.**
- **Never loosen the bolts with securing anything other than the camshaft hexagonal part or with tensioning the timing chain.**




10. Loosen bolts in reverse order as shown.

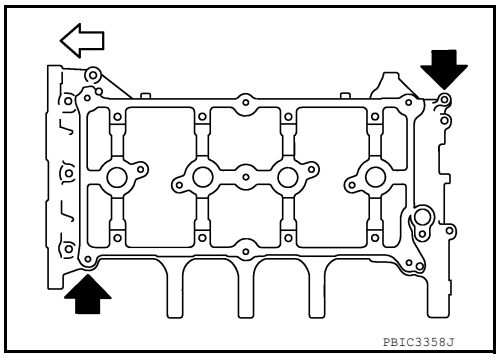
⇦ : Engine front




11. Cut liquid gasket by prying the position (⬅) shown, and then remove the camshaft bracket.

⇦ : Engine front

**CAUTION:**
- **Be careful not to damage the mating surface.**
- **The liquid gasket used at the factory is very strong.**
- **Pry only in the locations shown in the illustration.**



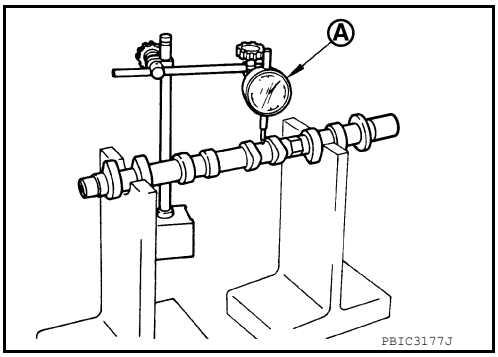

12. Remove camshafts.

13. Remove valve lifters, if necessary.
**NOTE:**
Identify installed positions, and store them without mixing them up.

## INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 5 journal of camshaft.
**CAUTION:**
**Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.**
2. Set dial indicator (A) vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on dial indicator. (Total indicator reading)

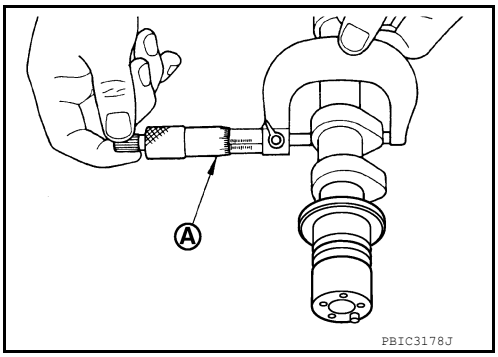



**Standard : Less than 0.02 mm (0.0008 in).**
**Limit : 0.05 mm (0.0020 in)**

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

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




**Standard:**
**Intake : 44.605 - 44.795 mm (1.7560 - 1.7635 in)**
**Exhaust : 43.175 - 43.365 mm (1.6997 - 1.7072 in)**

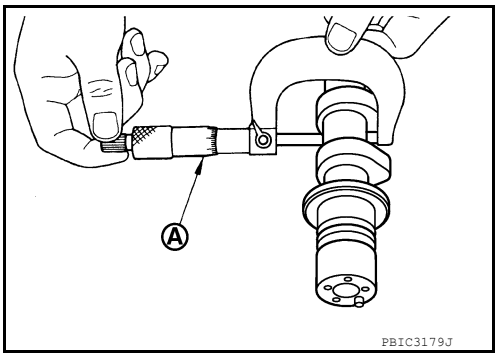
**Limit:**
**Intake : 44.405 mm (1.7482 in)**
**Exhaust : 42.975 mm (1.6919 in)**

2. If it exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

**CAMSHAFT JOURNAL OUTER DIAMETER**

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

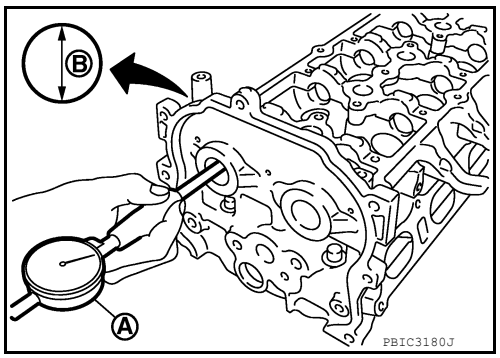



**Standard:**
**No. 1 : 27.935 - 27.955 mm (1.0998 - 1.1006 in)**
**No. 2, 3, 4, 5 : 24.950 - 24.970 mm (0.9823 - 0.9831 in)**

**CAMSHAFT BRACKET INNER DIAMETER**

- Tighten camshaft bracket bolts with specified torque. Follow the "INSTALLATION" tightening procedure.

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




B : Measuring direction of inner diameter

**Standard:**

**No. 1 : 28.000 - 28.021 mm (1.1024 - 1.1032 in)**

**No. 2, 3, 4, 5 : 25.000 - 25.021 mm (0.9843 - 0.9851 in)**

**CAMSHAFT JOURNAL OIL CLEARANCE**

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

**Standard:**

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

**No. 2, 3, 4, 5 : 0.030 - 0.071 mm (0.0012 - 0.0028 in)**

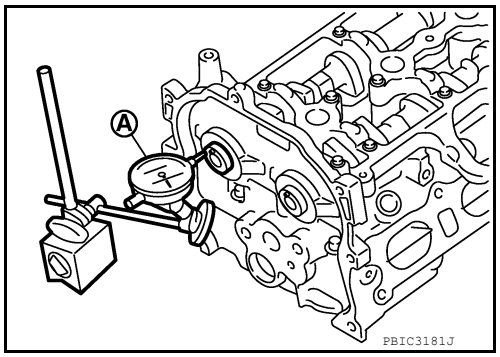
**Limit:**

**: 0.15 mm (0.0059 in)**

- If it exceeds the limit, replace camshaft or cylinder head, or both.
  **NOTE:**
  Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Follow the "INSTALLATION" tightening procedure.
2. Install dial indicator in thrust direction on front end of camshaft. Read the end play of dial indicator (A) when camshaft is moved forward/backward (in direction to axis).




**Standard : 0.075 - 0.153 mm (0.0030 - 0.0060 in)**

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

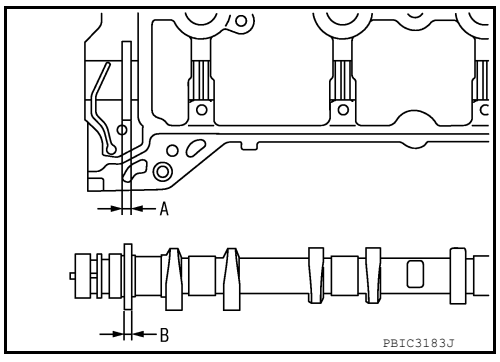
- Measure the following parts if out of the standard.
  - Dimension “A” for groove of cylinder head No. 1 journal

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

  - Dimension “B” for camshaft flange

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

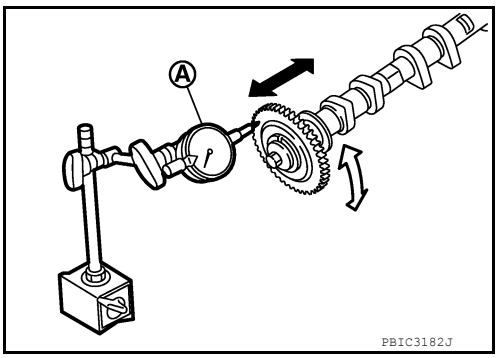
- Use the standards above, and then replace camshaft and/or cylinder head.




Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.
   **CAUTION:**
   **Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.**

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



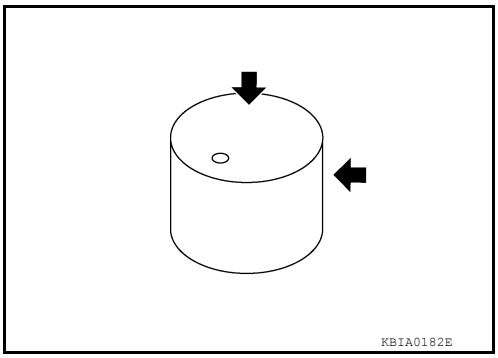

**Limit : 0.15 mm (0.0059 in)**

- If it exceeds the limit, replace camshaft sprocket.

Valve Lifter

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

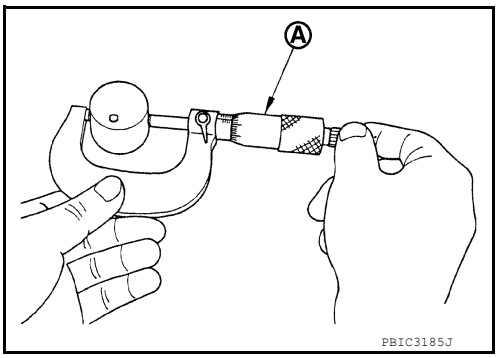
- If anything above is found, replace valve lifter. Refer to EM-58, "Valve Clearance".




Valve Lifter Clearance

**VALVE LIFTER OUTER DIAMETER**

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



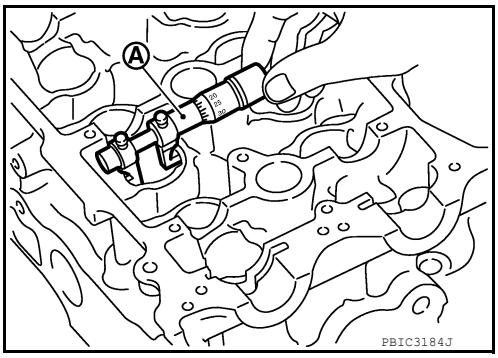

**Standard:**

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

**Exhaust : 29.977 - 29.987 mm (1.1802 - 1.1806 in)**

**VALVE LIFTER HOLE DIAMETER**

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




**Standard:**

**Intake : 34.000 - 34.021 mm (1.3386 - 1.3394 in)**

**Exhaust : 30.000 - 30.021 mm (1.1811 - 1.1819 in)**

**VALVE LIFTER CLEARANCE**

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

**Standard: 0.013 - 0.044 mm (0.0005 - 0.0017 in)**

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

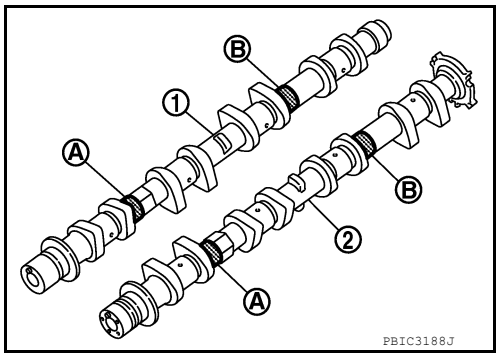
## INSTALLATION

1. Install valve lifters.
   - Install them in the original positions.
2. Install camshafts.

- Clean camshaft journal to remove any foreign material.
- Distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft or using the identification colors (A) and (B).

1 : Camshaft (EXH)
2 : Camshaft (INT)

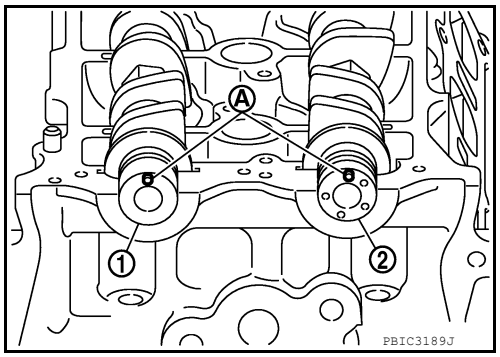
| Identification color | A | B |
|---|---|---|
| Camshaft (EXH) | — | Yellow |
| Camshaft (INT) | Yellow | — |




- Install camshafts so that camshaft dowel pins (A) on the front side are positioned as shown.

1 : Camshaft (EXH)
2 : Camshaft (INT)

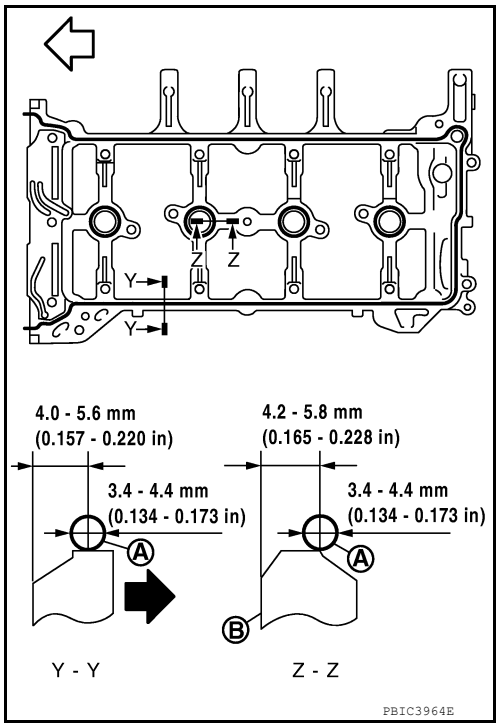
**NOTE:**
Though camshaft does not stop at the positions as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction as shown.



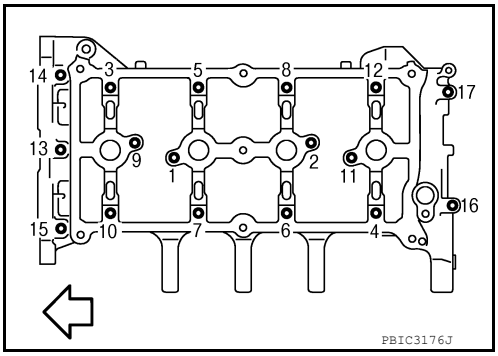

3. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
4. Apply liquid gasket (A) to camshaft bracket as shown.
**Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**
**CAUTION:**
**The components must be installed within 5 minutes of the liquid gasket application. Then allow 30 minutes for the liquid gasket to set before operating the engine.**

**Tool number WS39930000 ( – )**

B : Plug hole inner wall
⇦ : Engine front
⬅ : Engine outside



5. Install camshaft bracket bolts in three stage in numerical order as shown in numerical order as shown.




⇦ : Engine front

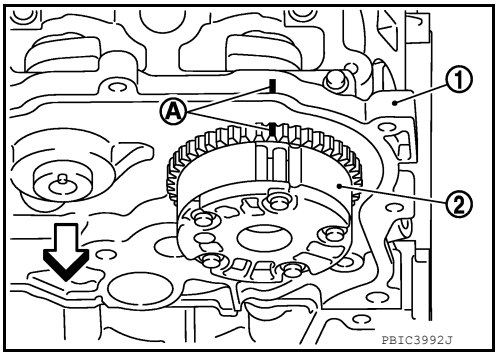
- There are two types of bolts. Use the following to locate bolts.

**M6 bolts [thread length: 57.5 mm (2.264 in)]**
**: 13, 14 and 15**
**M6 bolts [thread length: 35.00 mm (1.378 in)]**
**: Except the above**

6. Tighten all bolts in numerical order in three steps.

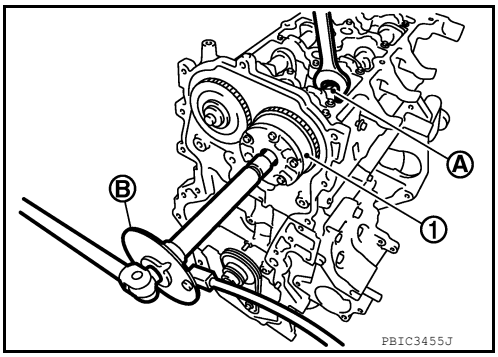
**Step 1 : 1.96 N·m (0.20 kg-m, 17 in-lb)**
**Step 2 : 5.88 N·m (0.60 kg-m, 52 in-lb)**
**Step 3 : 9.5 N·m (0.97 kg-m, 84 in-lb)**

7. Install the camshaft sprocket (INT) to the camshaft (INT).
**NOTE:**
When the camshaft sprocket (INT) (2) is removed, align the paint mark (A) put according to step “8”. Securely align the knock pin and the pin hole, and then install them.




1 : Camshaft bracket
⇦ : Engine front

8. Install camshaft (INT) sprocket bolt. with the following steps.




1 : Camshaft (INT) sprocket
A : Camshaft (INT) hexagonal part

**Step 1 : 35.0 N·m (3.6 kg-m, 26 ft-lb)**
**Step 2 : Turn clockwise 67 degrees (angle tightening) using Tool (B).**

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

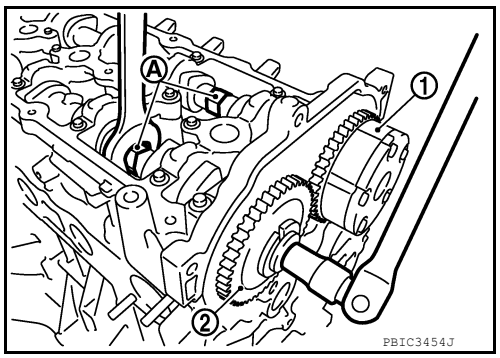
**CAUTION:**
**Never judge by visual inspection without an angle wrench.**
**NOTE:**
Secure the hexagonal part of camshaft (INT) using wrench to tighten bolt.

9. Install camshaft (EXH) sprocket (2).

1 : Camshaft (INT) sprocket

**Camshaft (EXH) sprocket bolt : 88.2 N·m (9.0 kg-m, 65 ft-lb)**

**NOTE:**
Secure the hexagonal part (A) of camshaft (EXH) using wrench to tighten bolt.




10. Install timing chain and related parts. Refer to EM-40.
11. Inspect and adjust valve clearance. Refer to EM-58, "Valve Clearance".
12. Installation of the remaining components is in the reverse order of removal.

## 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-22, "ENGINE OIL : Inspection".
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
  **NOTE:**
  If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust 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 |
| Transmission/ transaxle fluid | A/T and CVT Models | Leakage | Level/Leakage | Leakage |
| | M/T Models | Level/Leakage | Leakage | Level/Leakage |
| Other oils and fluids* | | Level | Leakage | Level |
| Fuel | | Leakage | Leakage | Leakage |
| Exhaust gas | | — | Leakage | — |

*Power steering fluid, brake fluid, etc.

Inspection of Camshaft Sprocket (INT) Oil Groove

**CAUTION:**

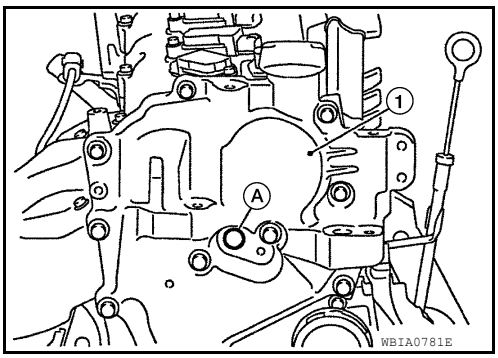
- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to EC-620, "Introduction".**
- **Check when engine is cold so as to prevent burns from the splashing engine oil.**

1. Check engine oil level. Refer to MA-22, "ENGINE OIL : Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Remove intake manifold. Refer to EM-19, "Removal and Installation".
b. Disconnect ignition coil and injector harness connectors.

3. Remove intake valve timing control solenoid valve. Refer to EM-41, "Removal and Installation".

4. Clean the mating area of intake valve timing control solenoid valve. Insert a clean shop cloth (with no oil adhesion) into the oil hole (A) of the cylinder head.




1 : Front cover

⇦ :Vehicle front

5. Install engine mounting bracket (RH), engine mounting insulator, and torque rod (RH) under the Step 4 condition. (With intake valve timing control solenoid valve removed, and a shop cloth inserted into the oil hole.)
6. Crank engine, and then make sure that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.
   • Check engine oil leakage by oil amount adhered to the waste inserted into the oil hole.

**WARNING:**
**Be careful not to touch rotating parts (drive belts, idler pulley, and crankshaft pulley, etc.).**
**CAUTION:**
- **Do not perform cranking without installing right engine mount bracket, right engine mount insulator, and right torque rod.**
- **Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.**
- **Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belts, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.**

7. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.
   • Remove oil filter (for intake valve timing control), and then clean it. Refer to EM-40, "Component".
   • Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to EM-41, "Removal and Installation".
8. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
   • Clean oil groove if necessary. Refer to LU-5, "Lubrication Circuit".
9. Installation of the remaining components is in the reverse order of removal

## Valve Clearance

INFOID:0000000007401864

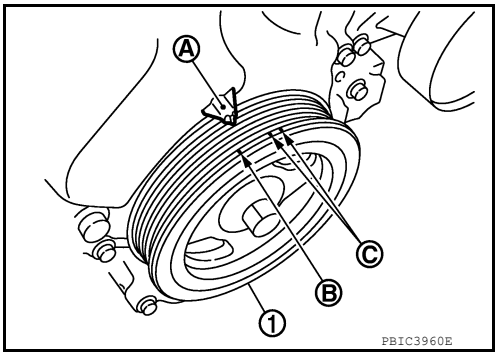
### INSPECTION

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

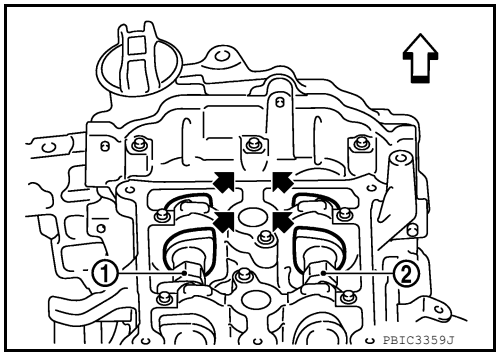
1. Remove rocker cover. Refer to EM-33.
2. Measure the valve clearance with the following procedure:

a. Set No. 1 cylinder at TDC of its compression stroke.
   • Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

C : White paint mark (Not use for service)



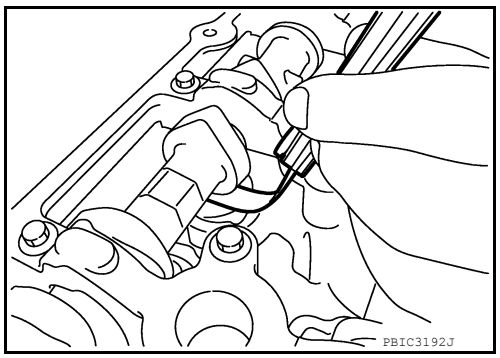
- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face inside (⬅) as shown.




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

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

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



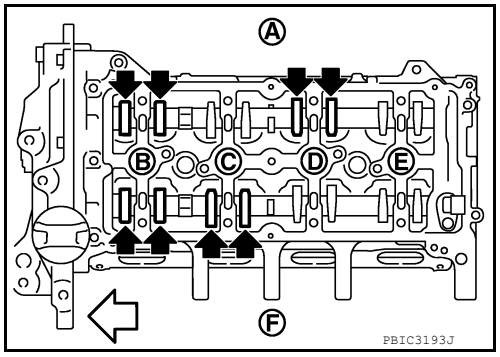

Valve clearance:

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)

- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below [locations indicated with black arrow (⬅)] with a feeler gauge.
- No. 1 cylinder compression TDC



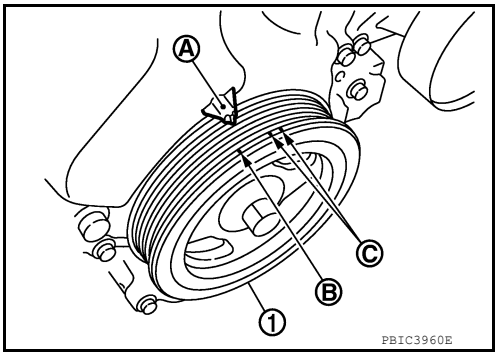

| Measuring position | | No. 1 CYL. | No. 2 CYL. | No. 3 CYL. | No. 4 CYL. |
|---|---|---|---|---|---|
| No. 1 cylinder at compression TDC | EXH | × | | × | |
| | INT | × | × | | |

A : Exhaust side
B : No.1 cylinder
C : No.2 cylinder
D : No.3 cylinder
E : No.4 cylinder
F : Intake side
⇦ : Engine front

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

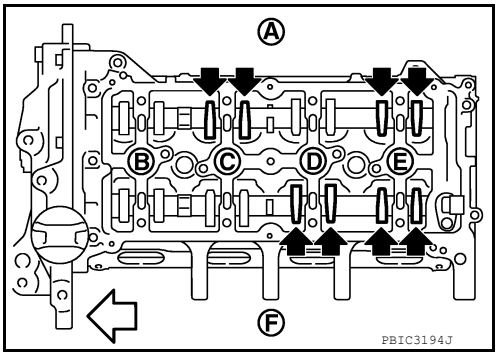
- Rotate crankshaft pulley (1) one revolution (360 degrees) and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

C : White paint mark (Not use for service)




- By referring to the figure, measure the valve clearance at locations marked "×" as shown in the table below [locations indicated with black arrow (⬅)] with a feeler gauge.
- No. 4 cylinder compression TDC

| Measuring position | | No. 1 CYL. | No. 2 CYL. | No. 3 CYL. | No. 4 CYL. |
|---|---|---|---|---|---|
| No. 4 cylinder at compression TDC | EXH | | × | | × |
| | INT | | | × | × |



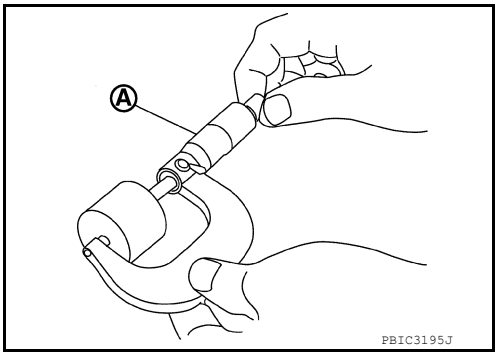

A : Exhaust side
B : No.1 cylinder
C : No.2 cylinder
D : No.3 cylinder
E : No.4 cylinder
F : Intake side
⇦ : Engine front

3. If out of standard, perform adjustment.

ADJUSTMENT

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

1. Remove camshaft. Refer to EM-50, "Removal and Installation".
2. Remove valve lifters at the locations that are out of the standard.
3. Measure the center thickness of the removed valve lifters with a micrometer (A).



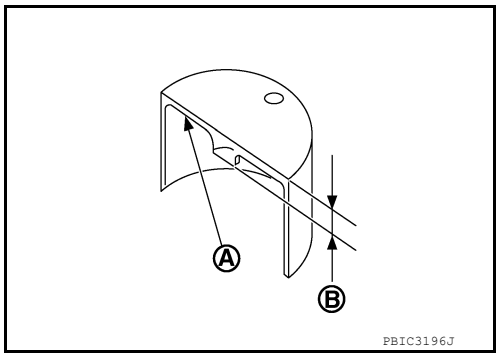

4. Use the equation below to calculate valve lifter thickness for replacement.

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

**$t$ = Valve lifter thickness to be replaced**
**$t_1$ = Removed valve lifter thickness**
**$C_1$ = Measured valve clearance**
**$C_2$ = Standard valve clearance:**

**Intake : 0.30 mm (0.012 in)**
**Exhaust : 0.33 mm (0.013 in)**

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
  Stamp mark “302” indicates 3.02 mm (0.1189 in) in thickness.




**NOTE:**
Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.1181 to 0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to EM-108, "Standard and Limit".

5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-50, "Removal and Installation".
7. Install timing chain and related parts. Refer to EM-40.
8. Manually rotate crankshaft pulley a few rotations.
9. Make sure that the valve clearances are within the standard.
10. Installation of the remaining components is in the reverse order of removal.

# OIL SEAL

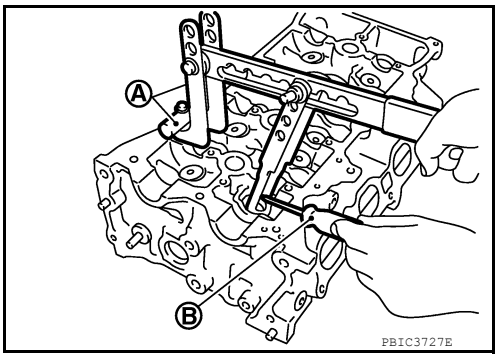
## Removal and Installation of Valve Oil Seal

INFOID:0000000007401865

### REMOVAL

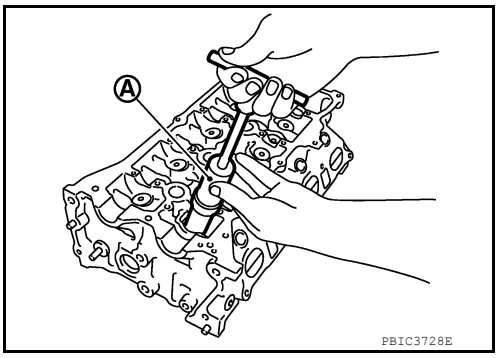
1. Remove camshafts. Refer to EM-50, "Component".
2. Remove valve lifters. Refer to EM-50.
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.
   **CAUTION:**
   **When rotating crankshaft, be careful to avoid scarring front cover with timing chain.**
4. Remove valve collet.
   • Compress valve spring using Tool, the attachment and the adapter (A). Remove valve collet with a suitable magnet hand (B).
   **CAUTION:**
   **When working, be careful not to damage valve lifter holes.**

   **Tool number : KV101092S0 (J-26336-B)**




5. Remove valve spring retainer, valve spring and valve spring seat.
6. Remove valve oil seal using Tool (A).

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

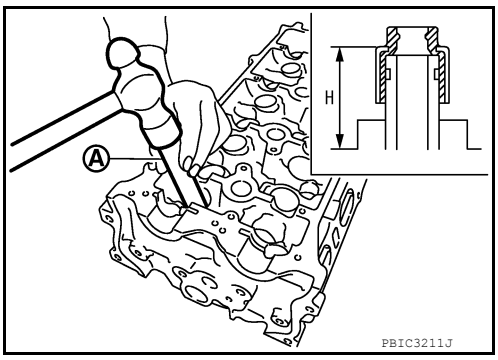



### INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height “H” shown using Tool (A).

   **Height “H” : 15.1 - 15.7 mm (0.594 - 0.618 in)**

   **Tool number : KV10115600 (J-38958)**




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

## Removal and Installation of Front Oil Seal

INFOID:0000000007401866

### REMOVAL

1. Remove the following parts.
   • RH front wheel and tire; Refer to WT-7, "Adjustment".

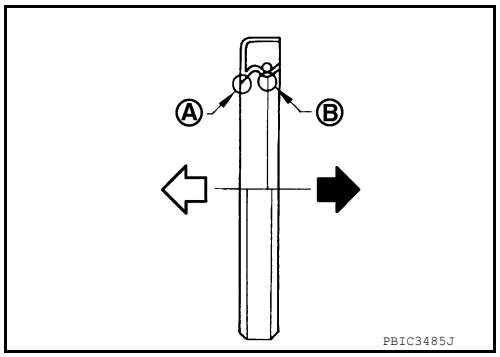
- Splash shield (RH); Refer to EI-23.
- Drive belt; Refer to EM-13, "Component".
- Crankshaft pulley; Refer to EM-40, "Component".

2. Remove front oil seal using a suitable tool.
**CAUTION:**
**Be careful not to damage front cover and crankshaft.**

INSTALLATION

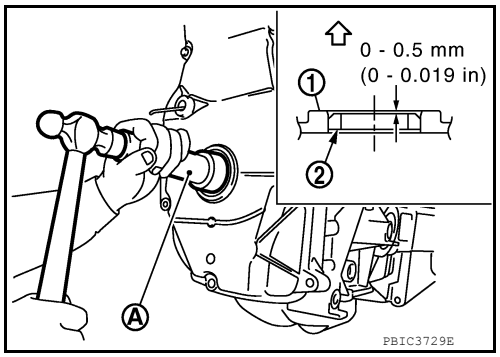
1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown.

A : Dust seal lip
B : Oil seal lip
⇦ : Engine outside
⬅ : Engine inside




- Install front oil seal (2) using a suitable tool with outer diameter 57 mm (2.24 in) and inner diameter 45 mm (1.77 in) (A) to the dimension as shown.

**1: Front cover**
**⇦: Front**
**Within 0.3 mm (0.012 in) toward engine front**
**Within 0.5 mm (0.019 in) toward engine rear**




**CAUTION:**
- **Be careful not to damage front cover and crankshaft.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Do not touch grease applied on oil seal lip.**

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

## Removal and Installation of Rear Oil Seal

INFOID:0000000007401867

REMOVAL

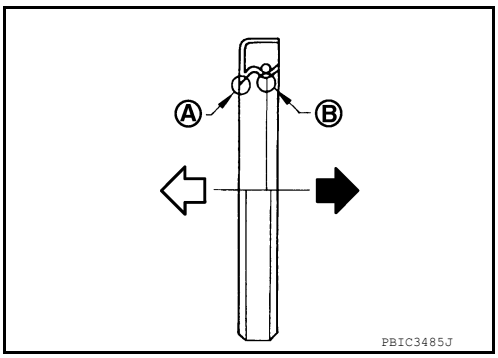
1. Remove engine assembly. Refer to EM-76, "Removal and Installation".
2. Remove clutch cover and clutch disc (M/T models). Refer to CL-15.
3. Remove drive plate (CVT models) or flywheel (M/T models). Refer to EM-80, "Component".
4. Remove rear oil seal with a suitable tool.
**CAUTION:**
**Be careful not to damage crankshaft and cylinder block.**

INSTALLATION

1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
**Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**

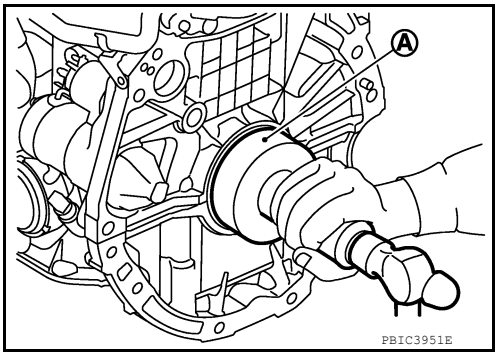
2. Install rear oil seal so that each seal lip is oriented as shown.

A : Dust seal lip
B : Oil seal lip
⇦ : Engine outside
⬅ : Engine inside




- Install rear oil seal with a suitable tool with an outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in) (A).

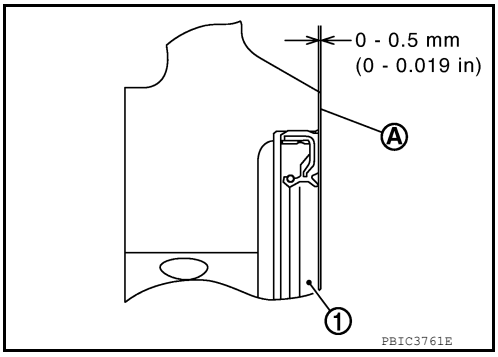
**CAUTION:**
- **Be careful not to damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Do not touch grease applied onto oil seal lip.**




- Install rear oil seal (1) to the position as shown.

A : Rear end surface of cylinder block

**NOTE:**
The standard surface of the dimension is the rear end surface of cylinder block.




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

# CYLINDER HEAD

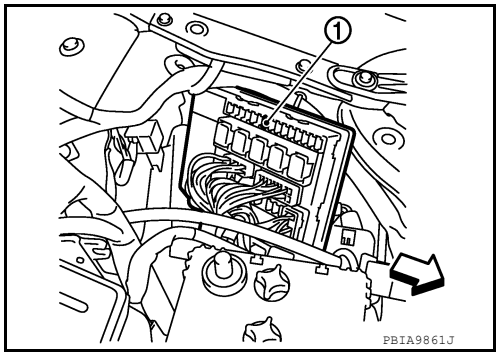
## On-Vehicle Service

INFOID:0000000007401868

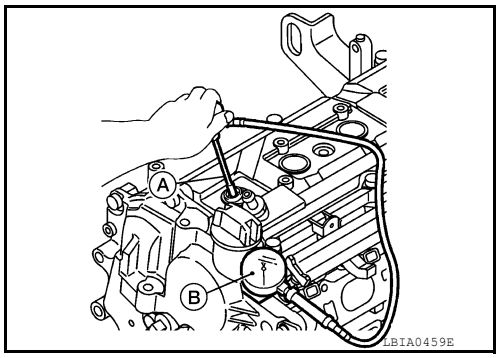
### CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-102, "Fuel Pressure Check" (for California) or EC-662, "Fuel Pressure Check" (except for California).
3. Disconnect fuel pump fuse (1) to avoid fuel injection during measurement.

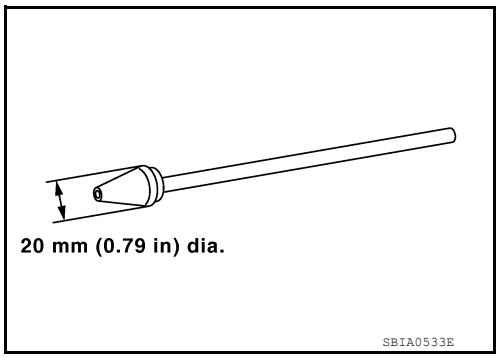
⇦ : Vehicle front




4. Remove engine cover.
5. Remove ignition coil and spark plug from each cylinder. Refer to EM-33.
6. Connect an engine tachometer (not required in use of CONSULT).
7. Install a suitable compression tester (B) with an adapter (A) onto spark plug hole.




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




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

Compression pressure:

Unit: kPa (kg/cm$^2$ psi) /rpm

| Standard | Minimum | Differential limit between cylinders |
|---|---|---|
| 1,390 (14.2, 202) / 250 | 1,140 (11.6, 165) / 250 | 100 (1.0, 15) / 250 |

**CAUTION:**

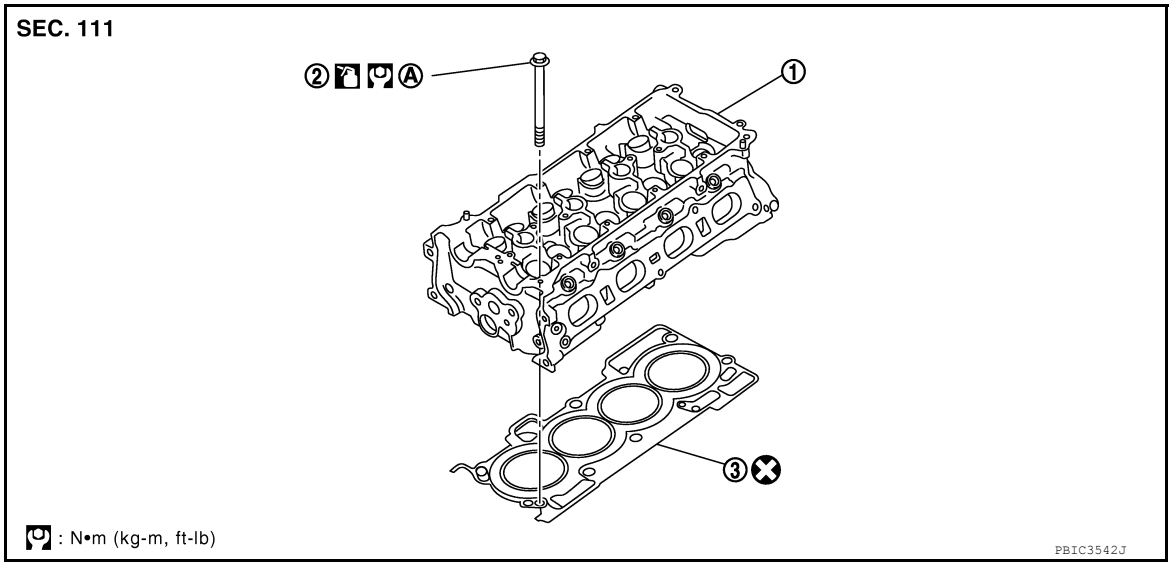
**Always use fully a charged battery to obtain the specified engine speed.**

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.
- If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gasket is leaking. In such a case, replace cylinder head gasket.

9. After inspection is completed, install removed parts.
10. Start the engine, and confirm that the engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-665, "Trouble Diagnosis Introduction" (for California) or EC-665, "Trouble Diagnosis Introduction" (except for California).

## Component

INFOID:0000000007401869




1. Cylinder head assembly
2. Cylinder head bolt
3. Cylinder head gasket

A. Refer to EM-66

## Removal and Installation

INFOID:0000000007401870

### REMOVAL

**WARNING:**

- **Put a "CAUTION: FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a $CO_2$ fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**

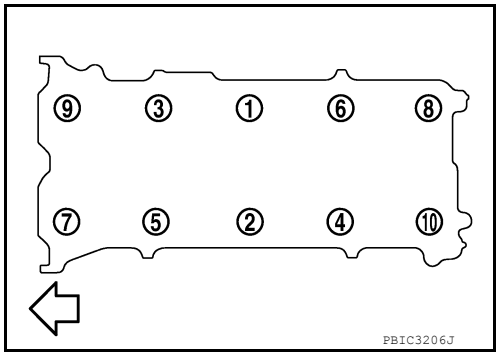
1. Drain engine coolant and engine oil. Refer to CO-11 and LU-7, "Changing Engine Oil".
2. Remove the following components and related parts.
   - Exhaust manifold. Refer to EM-23.
   - Intake manifold. Refer to EM-18.
   - Fuel tube and fuel injector assembly. Refer to EM-36.
   - Water inlet and thermostat. Refer to CO-24, "Removal and Installation" .
   - Water outlet. Refer to CO-26.

- Rocker cover. Refer to EM-33.
- Front cover and timing chain. Refer to EM-40.
- Camshaft. Refer to EM-50.

3. Remove cylinder head.
   - Loosen bolts in reverse order as shown.

   ⇦ : Engine front

   - Using socket (size E18), loosen cylinder head bolts.
4. Remove cylinder head gasket.



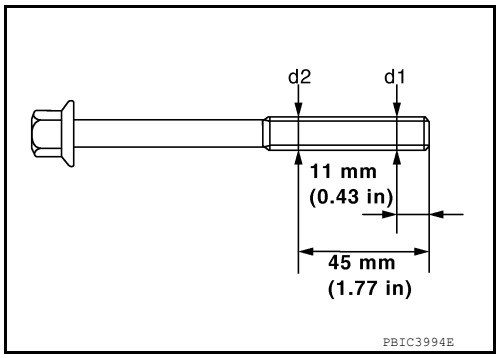

## INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between “d1” and “d2” exceeds the limit, replace them with a new one.

**Limit (“d1”–“d2”): 0.15 mm (0.0059 in)**

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



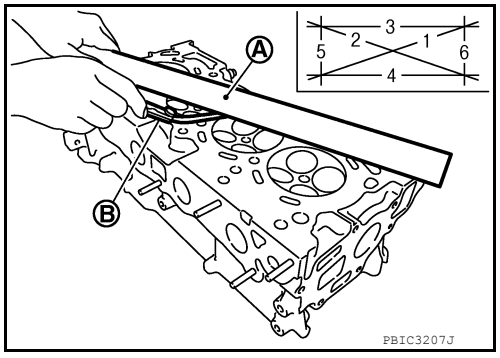

Cylinder Head Distortion

**NOTE:**
When performing this inspection, cylinder block distortion should be also checked. Refer to EM-97, "Inspection After Disassembly".

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.
   **CAUTION:**
   **Use utmost care not to allow gasket debris to enter engine oil or coolant passages.**
2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions using straightedge (A) and feeler gauge (B).

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

- If it exceeds the limit, replace cylinder head.

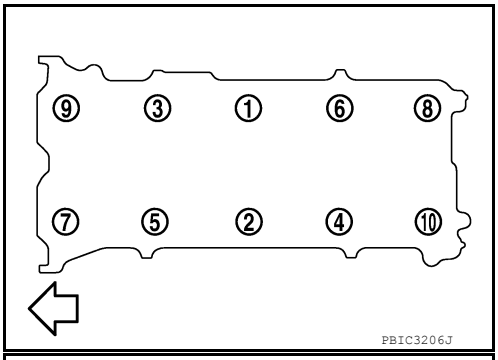



## INSTALLATION

1. Install cylinder head gasket.
2. Apply new engine oil to threads and seating surface of bolts.
   **CAUTION:**
   **If cylinder head bolts re-used, check their outer diameters before installation. Follow the "Cylinder Head Bolts Outer Diameter" procedure.**

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

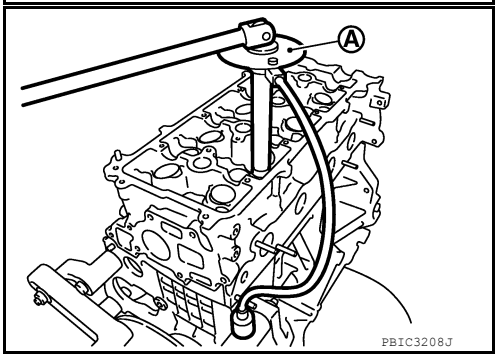
**Step a : 40 N·m (4.1 kg-m, 30 ft-lb)**
**Step b : 100° clockwise**
**Step c : Loosen to 0 N·m**
**Step d : 40 N·m (4.1 kg-m, 30 ft-lb)**
**Step e : 100° clockwise**
**Step f : 100° clockwise**




⇦: Engine front

**CAUTION:**
**Check and confirm the tightening angle by using Tool (A) or protractor. Never judge by visual inspection without the tool.**

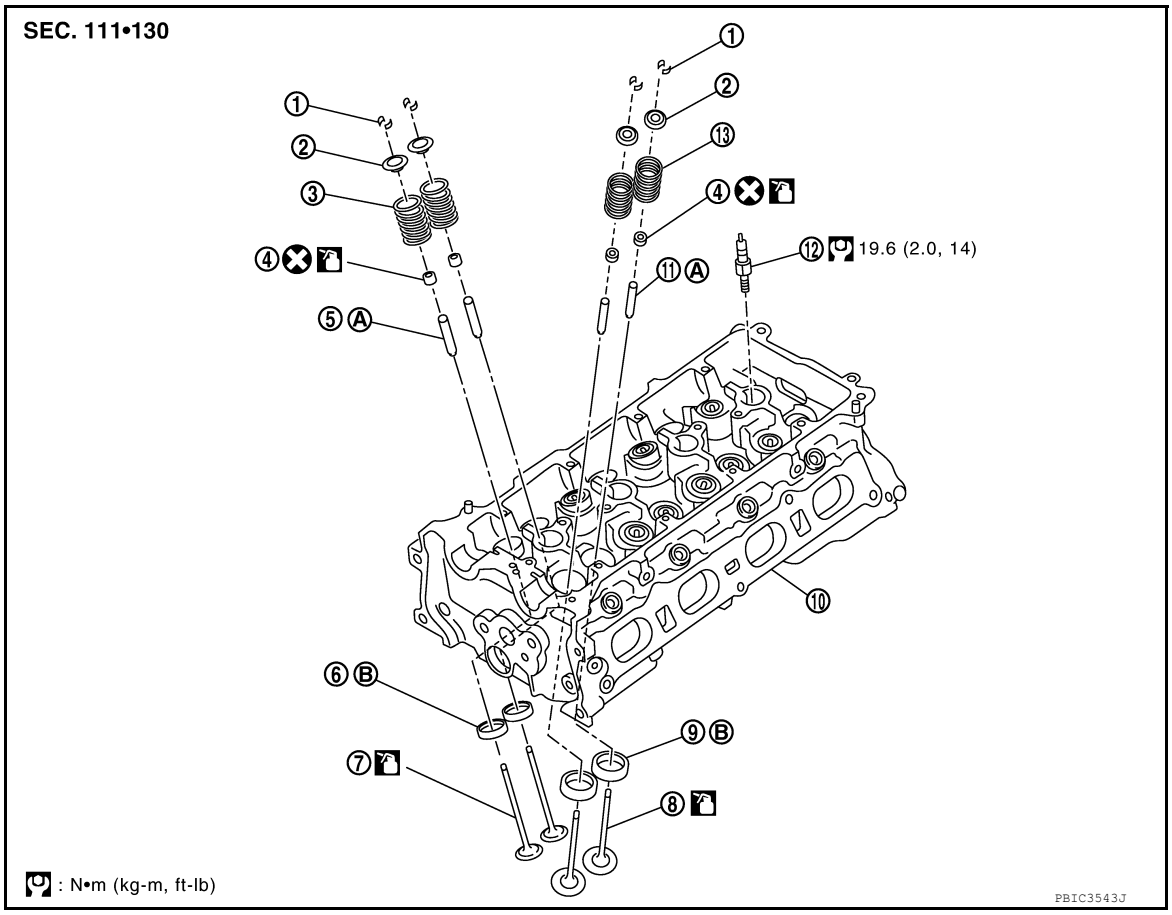
**Tool number : KV10112100 (BT-8653-A)**




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

## Component

INFOID:0000000007401871



1. Valve collet
2. Valve spring retainer
3. Valve spring (EXH) (with valve spring seat)
4. Valve oil seal
5. Valve guide (EXH)
6. Valve seat (EXH)
7. Valve (EXH)
8. Valve (INT)
9. Valve seat (INT)
10. Cylinder head
11. Valve guide (INT)
12. Spark plug
13. Valve spring (INT) (with valve spring seat)

A. Refer to EM-70
B. Refer to EM-70

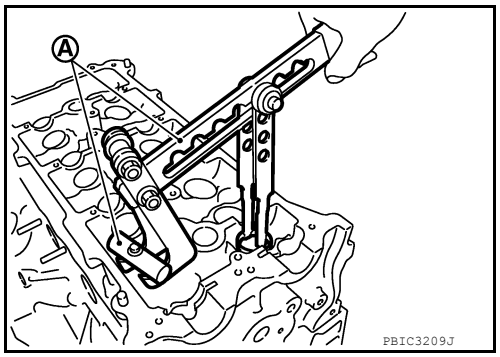
## Disassembly and Assembly

INFOID:0000000007401872

### DISASSEMBLY

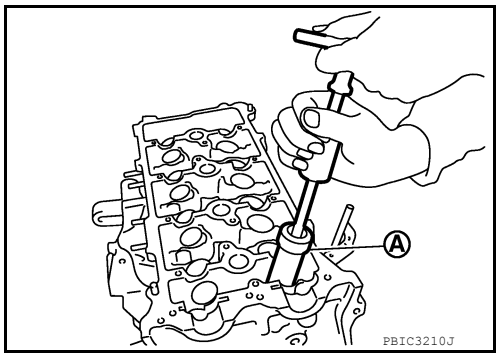
1. Remove spark plug using suitable tool.
2. Remove valve lifter.
   • Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
   • Compress valve spring using Tool, attachment and adapter (A). Remove valve collet using a suitable magnet hand.
   **CAUTION:**
   **When working, be careful not to damage valve lifter holes.**

   **Tool number : KV101092S0 (J-26336-B)**




4. Remove valve spring retainer and valve spring (with valve spring seat).
   **CAUTION:**
   **Never remove valve spring seat from valve spring.**
5. Push valve stem to combustion chamber side, and remove valve.
   **NOTE:**
   Identify installed positions, and store them without mixing them up.
6. Remove valve oil seal using Tool (A).

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




7. When valve seat must be replaced, refer to EM-70, "Inspection After Disassembly" to removal.
8. When valve guide must be replaced, refer to EM-70, "Inspection After Disassembly" to removal.

### ASSEMBLY

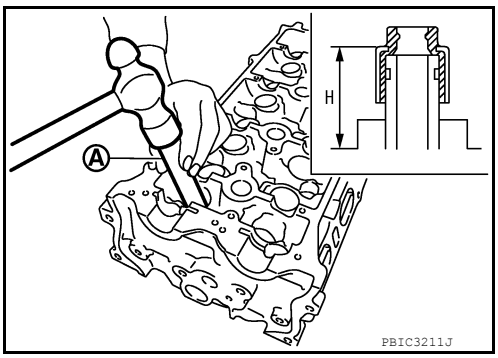
1. Install valve guide if removed. Refer to EM-70, "Inspection After Disassembly".
2. Install valve seat if removed. Refer to EM-70, "Inspection After Disassembly".

3. Install valve oil seal.
   - Install with a valve oil seal using Tool (A) to match dimension as shown.

   **Tool number : KV10115600 (J-38958)**

   **NOTE:**
   Dimension “H” is height that measured before installing valve spring (with valve spring seat).

   **Height “H” : 15.1 - 15.7 mm (0.594 - 0.618 in)**

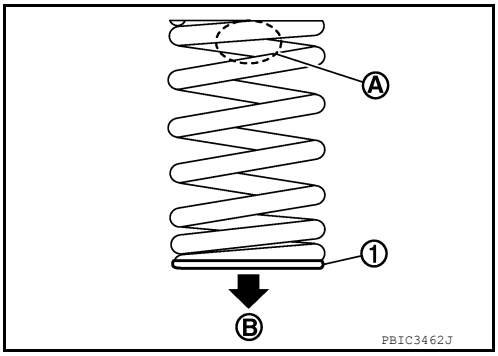



4. Install valve.
   - Install larger diameter to intake side.

5. Install valve spring (with valve spring seat).
   - Install smaller pitch (valve spring seat side) to cylinder head side (B).
   - Confirm identification color (A) of valve spring.

   1 : Valve spring seat (Do not remove from valve spring.)

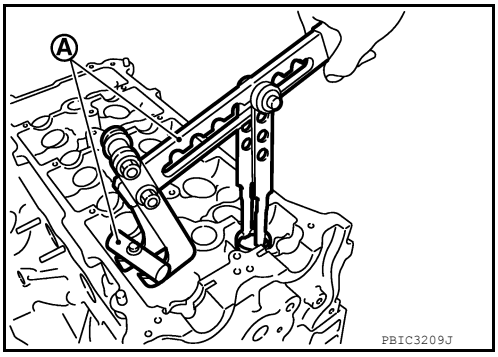
   **Intake : White**
   **Exhaust : Orange**




6. Install valve spring retainer.
7. Install valve collet.
   - Compress valve spring using Tool (A). Install valve collet with a magnet hand.

   **Tool number : KV101092S0 (J-26336 B)**

   **CAUTION:**
   **When working, be careful not to damage valve lifter holes.**
   - Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.




8. Install valve lifter.
   - Install it in the original position.
9. Install spark plug using suitable tool.

## Inspection After Disassembly

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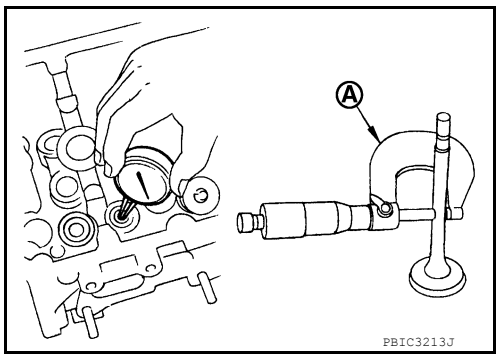
### VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to EM-108, "Standard and Limit".
- If dimensions are out of the standard, replace valve.

### VALVE GUIDE CLEARANCE

Valve Stem Diameter

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




**Standard**

**Intake : 5.465 - 5.480 mm (0.2152 - 0.2157 in)**

**Exhaust : 5.455 - 5.470 mm (0.2148 - 0.2154 in)**

Valve Guide Inner Diameter

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

**Standard**

**: 5.500 - 5.518 mm (0.2165 - 0.2172 in)**

Valve Guide Clearance

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

**Valve guide clearance:**

**Standard**

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

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

**Limit**

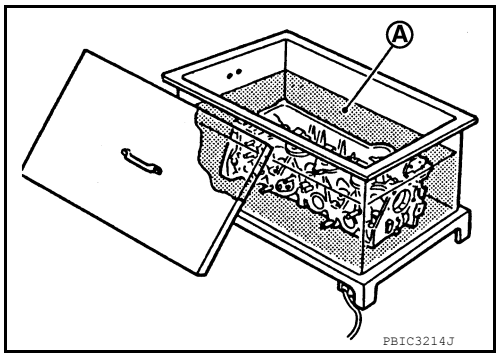
**: 0.1 mm (0.004 in)**

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

## VALVE GUIDE REPLACEMENT

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

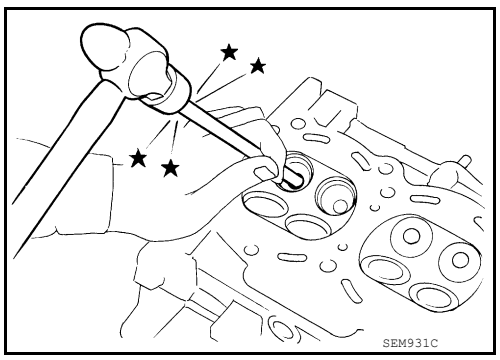
1. To remove valve guide, heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil (A).




2. Drive out valve guide using suitable tools.

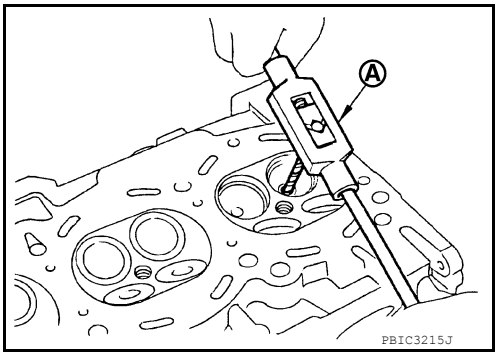
**CAUTION:**

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

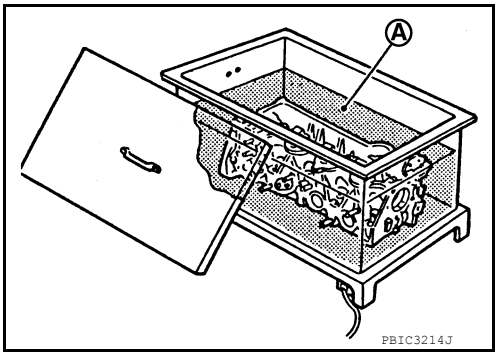


3. Ream cylinder head valve guide hole using suitable tool (A).

**Valve guide hole diameter (for service parts):**
**: 9.675 - 9.696 mm (0.3809 - 0.3817 in)**




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

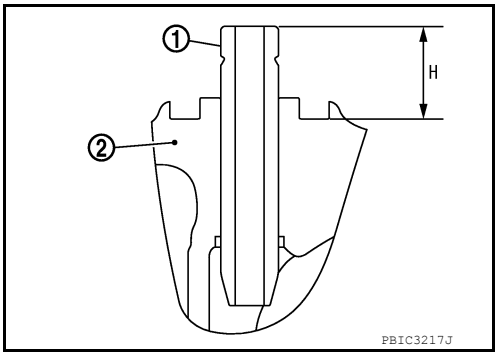



5. Press valve guide (1) from camshaft side to dimensions as shown.

2 : Cylinder head

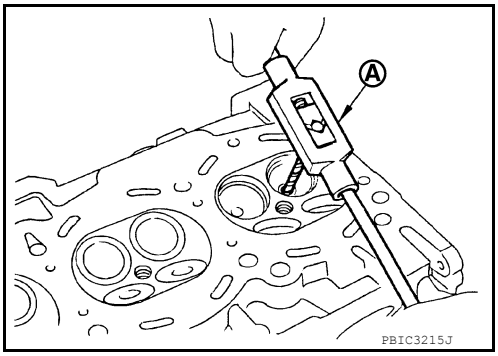
**Projection "H" : 13.35 - 13.65 mm (0.526 - 0.537 in)**

**CAUTION:**
**Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.**




6. Apply reamer finish to valve guide using suitable tool (A).

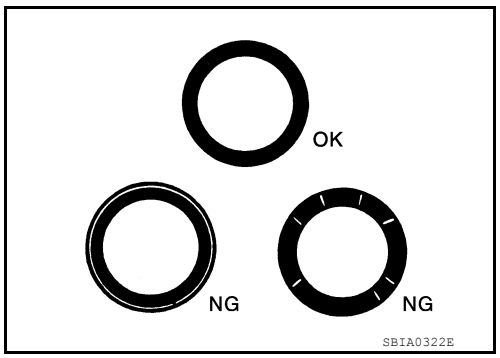
**Standard**
**: 5.500 - 5.518 mm (0.2165 - 0.2172 in)**




VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.

- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace valve seat.




## VALVE SEAT REPLACEMENT

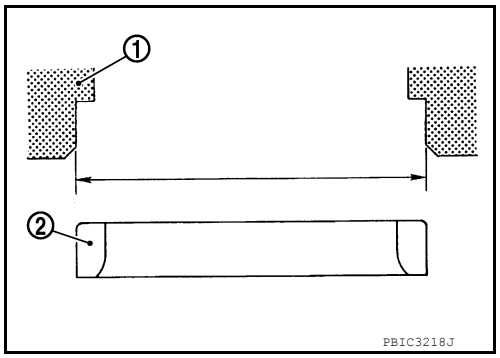
When valve seat is removed, replace with oversized [0.5 mm (0.020 in)] valve seat.

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to EM-108, "Standard and Limit".
2. Ream cylinder head (1) recess diameter for service valve seat.

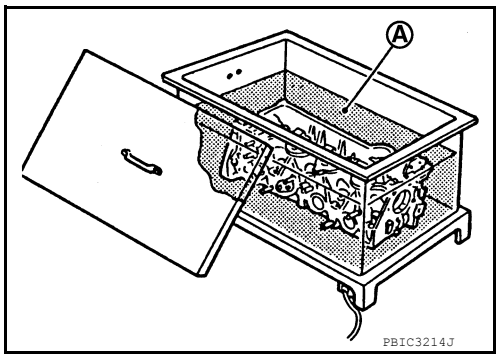
   2 : Valve seat

   **Oversize [0.5 mm (0.020 in)]**
   **Intake : 35.200 - 35.227 mm (1.3858 - 1.3869 in)**
   **Exhaust : 29.200 - 29.227 mm (1.1496 - 1.1507 in)**

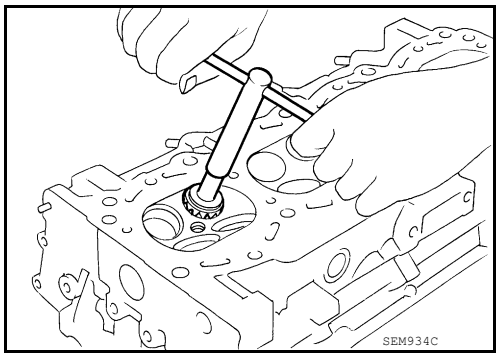
   - Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.




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




4. Provide valve seats cooled well with dry ice. Press-fit valve seat into cylinder head.
   **CAUTION:**
   - **Never touch cold valve seats directly.**
   - **Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.**
5. Using valve seat cutter set or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to EM-108, "Standard and Limit".
   **CAUTION:**
   **When using valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.**



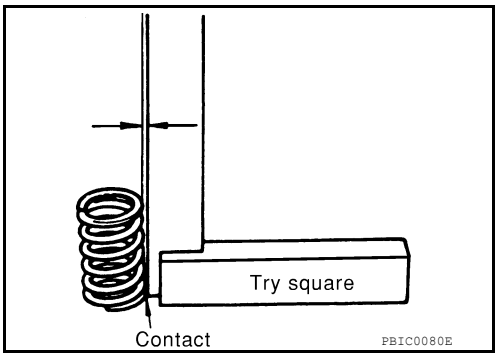

6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Use the "VALVE SEAT CONTACT" procedure.

## VALVE SPRING SQUARENESS

1. Set try square along the side of valve spring and rotate the spring. Measure the maximum clearance between the top of valve spring and try square.
**CAUTION:**
**Never remove valve spring seat from valve spring.**

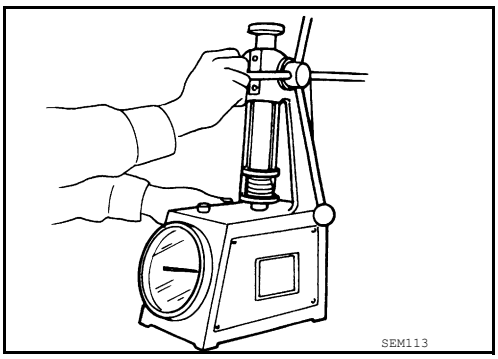
**Limit: 1.9 mm (0.075 in)**

2. If the measurement exceeds the limit, replace valve spring and the valve spring seat as a unit.




## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

1. Check valve spring pressure with valve spring seat installed at the specified spring height.
**CAUTION:**
**Never remove valve spring seat from valve spring.**




Standard:

| Items | Intake | Exhaust |
|---|---|---|
| Free height | 44.90 - 45.10 mm (1.7677 - 1.7755 in) | 45.74 - 45.94 mm (1.8007 - 1.8086 in) |
| Installation height | 35.30 mm (1.390 in) | 35.30 mm (1.390 in) |
| Installation load | 153 - 173 N (15.6 - 17.6 kg, 34 - 39 lb) | 139 - 157 N (14.2 - 16 kg, 10 - 35 lb) |
| Height during valve open | 26.36 mm (1.0377 in) | 27.80 mm (1.0944 in) |
| Load with valve open | 335 - 377 N (34.2 - 38.5 kg, 75 - 85 lb) | 266 - 297 N (27.1 - 3.03 kg, 60 - 67 lb) |
| Identification color | White | Orange |

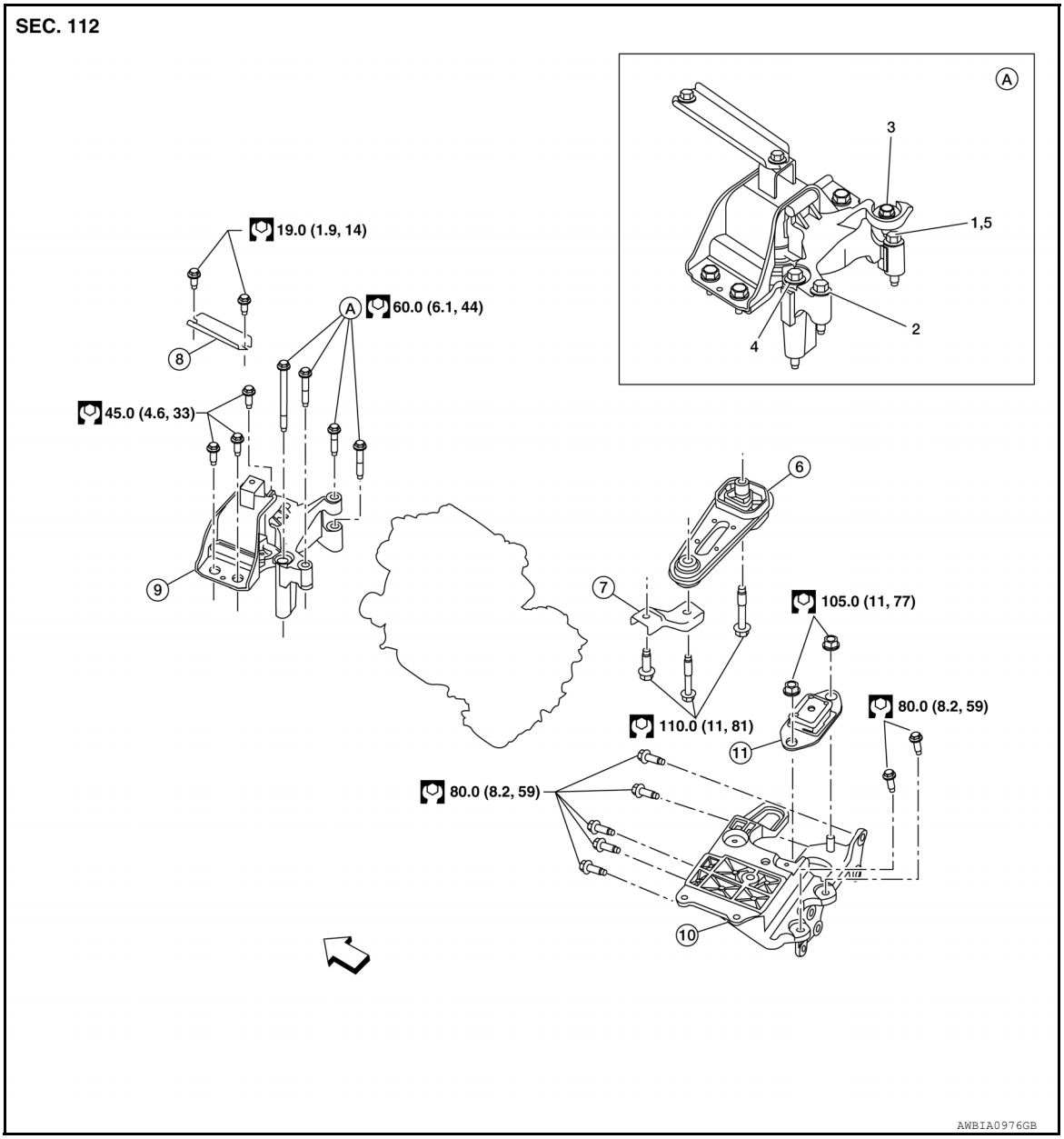
2. If the installation load or load with valve open is out of the specification range replace the valve spring and the valve spring seat as a unit.

# ENGINE ASSEMBLY

## Component

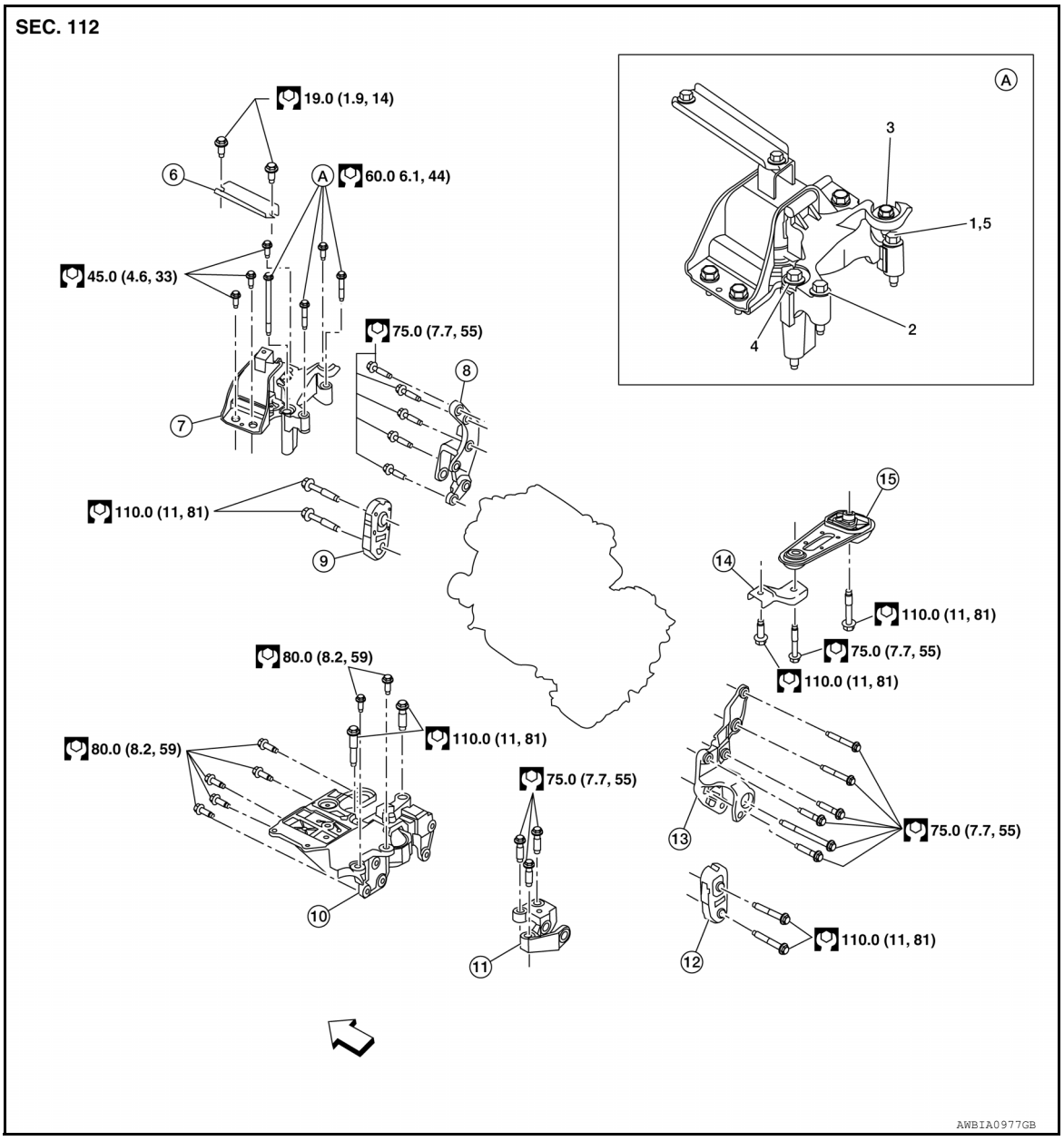
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M/T Models




| | | | | | |
|---|---|---|---|---|---|
| 6. | Rear torque rod | 7. | Bracket | 8. | Torque rod (RH) |
| 9. | Engine mounting Insulator and bracket (RH) | 10. | Engine mounting bracket (LH) | 11. | Engine mounting insulator (LH) |
| A. | Tightening order (1-5) | ⇦ | Engine front | | |

CVT Models




| | | | | | |
|---|---|---|---|---|---|
| 6. | Torque rod (RH) | 7. | Engine mounting Insulator and bracket (RH) | 8. | Engine mounting bracket (RH) |
| 9. | Pull down rod (RH) | 10. | Engine mounting bracket (LH) | 11. | Engine mounting support (LH) |
| 12. | Pull down rod (LH) | 13. | Pull down bracket (LH) | 14. | Bracket |
| 15. | Rear torque rod | A. | Tightening order (1-5) | ⇦ | Engine front |

## Removal and Installation

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**WARNING:**
- **Situate the vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.**

**CAUTION:**
- **Always be careful to work safely, avoid forceful or uninstructed operations.**
- **Do not start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine section, follow the applicable procedures.**
- **Always use the support point specified for lifting.**

- **Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to GI-39, "Garage Jack and Safety Stand and 2-Pole Lift".**

**NOTE:**
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

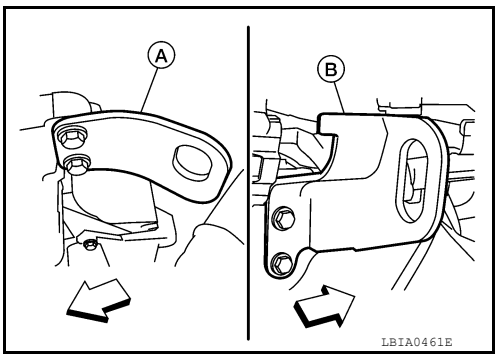
## REMOVAL

### Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

1. Remove engine undercover. Refer to EI-15, "Removal and Installation".
2. Drain engine coolant from radiator. Refer to CO-12, "Changing Engine Coolant".
   **CAUTION:**
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belt.**
3. Remove front fender protector (RH and LH). Refer to EI-24, "Removal and Installation".
4. Remove exhaust front tube. Refer to EX-5.
5. Remove drive shafts (LH and RH) from steering knuckle. Refer to FAX-9, "Removal and Installation (LH)" and FAX-11, "Removal and Installation (RH)".
6. Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to CVT-195, "Removal and Installation (MR20DE)" (CVT models) or MT-19, "Removal and Installation" (M/T models).
7. Remove front suspension member. Refer to FSU-10, "Removal and Installation".
8. Remove hood assembly. Refer to BL-14.
9. Remove cowl top cover and cowl top extension assembly. Refer to EI-21.
10. Release fuel pressure. Refer to EC-102, "Fuel Pressure Check" (for California) or EC-662, "Fuel Pressure Check" (except for California).
11. Remove battery and battery tray. Refer to SC-7, "Removal and Installation (MR20DE Battery)".
12. Remove drive belt. Refer to EM-13, "Component".
13. Remove engine room cover.
14. Disconnect transmission control module (TCM) (CVT models).
15. Disconnect ECM and brake fluid level sensor.
16. Remove ECM.
17. Remove air duct and air cleaner case assembly. Refer to EM-16.
18. Remove radiator hose (upper and lower). Refer to CO-16.
19. Disconnect CVT fluid cooler hoses (CVT models). Refer to CO-16.
20. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness into the engine side.
    **CAUTION:**
    **Protect connectors using a resin bag to protect against foreign materials during the operation.**
21. Disconnect fuel feed hose at engine side. Refer to EM-36, "Component".
22. Disconnect heater hoses. Refer to CO-26, "Component".
23. Disconnect control cables from transaxle. Refer to CVT-171 (CVT models), MT-16, "Removal and Installation" (M/T models).
24. Remove ground cable at transaxle side.
25. Remove ground cable between front cover and vehicle.
26. Remove A/C compressor with piping connected from the engine (if equipped). Temporarily secure it on the vehicle side. Refer to MTC-89, "Removal and Installation for Compressor - MR20DE".
27. Remove the intake manifold to prevent the hanging chain from interfering. Refer to EM-18, "Component".

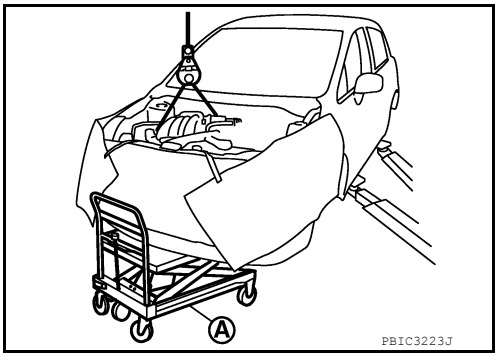
28. Install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.




⇦ : Engine front

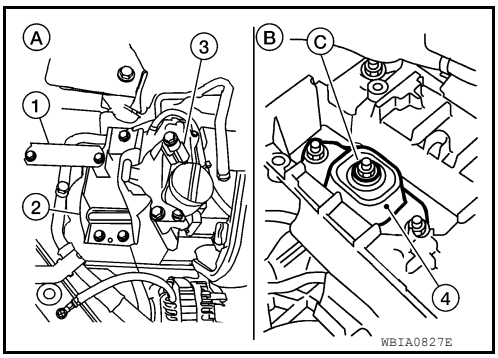
**Slinger bolts (front) : 32.9 N·m (3.3 kg-m, 24.2 ft-lb)**
**Slinger bolts (rear) : 25.0 N·m (2.5 kg-m, 18.4 ft-lb)**

29. Support engine and transaxle assembly with a hoist and secure the engine in appropriate position.
30. Use a manual lift table caddy (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle, and simultaneously adjust hoist tension.




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

31. Remove torque rod (RH) (1), engine mounting insulator (RH) (2) and engine mounting bracket (3).




4 : Engine insulator (LH)
A : Engine front side
B : Transaxle side

32. Remove pull down rod (RH) (CVT models).
33. Remove pull down rod (LH) (CVT models).
34. Remove engine through bolt-securing nut (C).
35. Remove the engine and the transaxle assembly from the vehicle downward by carefully operating supporting tools.

**CAUTION:**
- **During the operation, make sure that no part interferes with the vehicle side.**
- **Before and during this lifting, always check if any harnesses are left connected.**
- **During the removal operation, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.**
- **If necessary, support the vehicle by setting jack or suitable tool at the rear.**
- **During operation, securely support the engine by placing a piece of wood under the engine oil pan and transaxle oil pan. Securely support the engine slingers with a hoist.**

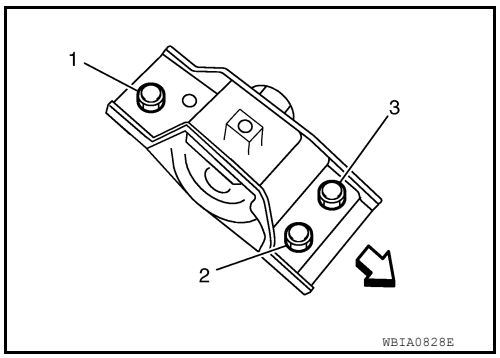
36. Remove starter motor. Refer to SC-11.
37. Separate the engine and the transaxle. Refer to CVT-195, "Removal and Installation (MR20DE)" (CVT models) or MT-19, "Removal and Installation"(M/T models).

## INSTALLATION

Note the following, and install in the reverse order of removal.
- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- When installation directions are specified, install parts according to the directions. Refer to EM-75, "Component".
- Make sure that each mounting insulator is seated properly, and tighten nuts and bolts.

- Tighten engine mounting insulator (RH) bolts in the numerical order shown.

⇦ : Vehicle front




## 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-15, "MR20DE".
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

  **NOTE:**

  If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust 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:

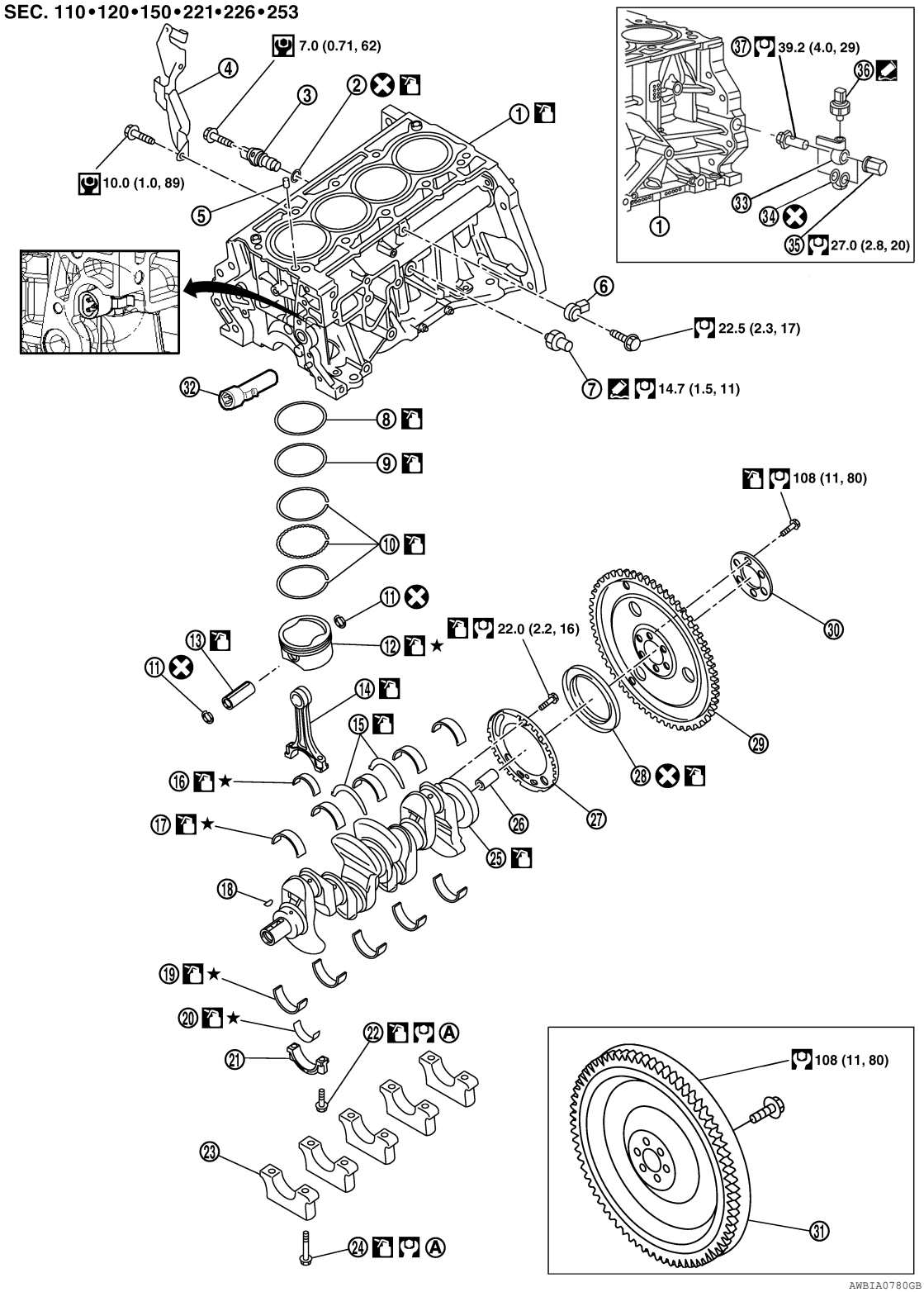
| Item | | Before starting engine | Engine running | After engine stopped |
|---|---|---|---|---|
| Engine coolant | | Level | Leakage | Level |
| Engine oil | | Level | Leakage | Level |
| Transmission/ transaxle fluid | A/T and CVT Models | Leakage | Level/Leakage | Leakage |
| | M/T Models | Level/Leakage | Leakage | Level/Leakage |
| Other oils and fluids* | | Level | Leakage | Level |
| Fuel | | Leakage | Leakage | Leakage |
| Exhaust gas | | — | Leakage | — |

*Power steering fluid, brake fluid, etc.

# CYLINDER BLOCK

## Component

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1. Cylinder block
2. O-ring
3. Crankshaft position sensor (POS)
4. Crankshaft position sensor (POS) cover
5. Oil filter (for intake valve timing control)
6. Knock sensor

7. Oil temperature sensor
8. Top ring
9. Second ring
10. Oil ring
11. Snap ring
12. Piston
13. Piston pin
14. Connecting rod
15. Thrust bearing
16. Connecting rod bearing upper
17. Main bearing upper
18. Crankshaft key
19. Main bearing lower
20. Connecting rod bearing lower
21. Connecting rod bearing cap
22. Connecting rod bolt
23. Main bearing cap
24. Main bearing cap bolt
25. Crankshaft
26. Pilot converter (CVT models)
27. Signal plate
28. Rear oil seal
29. Drive plate (CVT models)
30. Reinforcement plate (CVT models)
31. Flywheel (M/T models)
32. Block heater (Canada only)
33. Oil pressure switch connector
34. Gasket
35. Nut
36. Oil pressure switch
37. Cylinder block connector
A. Refer to EM-81

## Disassembly and Assembly

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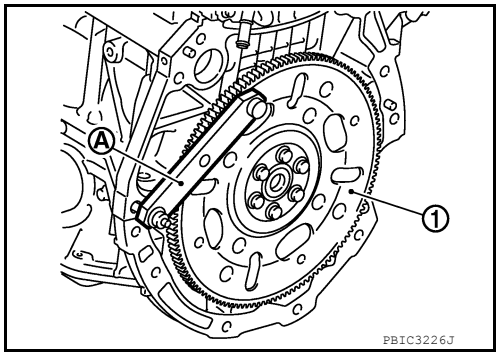
### DISASSEMBLY

1. Remove engine and transaxle assembly from vehicle, separate transaxle from engine. Refer to EM-75.
2. Install engine to engine stand as follows;

a. Remove flywheel (M/T models) or drive plate (1) (CVT models).
- Secure flywheel (M/T models) or drive plate (CVT models) using Tool (A), and remove bolts.

**Tool number : KV 11105210 (J-44716)**

**CAUTION:**
**Be careful not to damage or scratch drive plate (CVT models) and contact surface for clutch disc of flywheel (M/T models).**
**NOTE:**
Figure shows drive plate (CVT models)

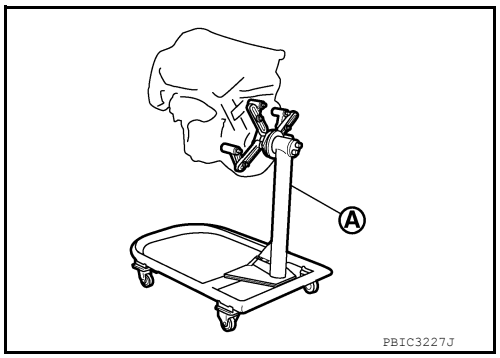



b. Lift the engine with a hoist to install it onto widely use engine stand.

**CAUTION:**
- **Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
- Exhaust manifold; Refer to EM-23.
- Rocker cover; Refer to EM-33.

**NOTE:**
The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel (M/T models) or drive plate (CVT models) removed.

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



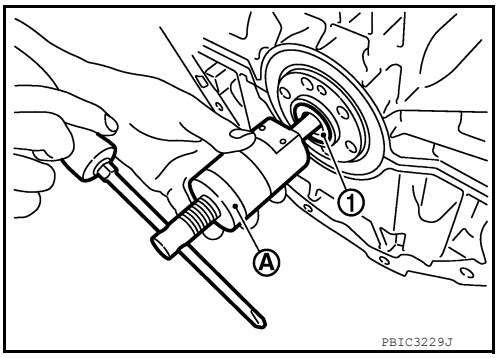

3. Remove oil pan (upper and lower). Refer to EM-27.
4. Remove cylinder head. Refer to EM-65.
5. Remove thermostat housing. Refer to CO-23.
6. Remove knock sensor.
**CAUTION:**
**Carefully handle knock sensor avoiding shocks.**
7. Remove crankshaft position sensor (POS) cover and crankshaft position sensor (POS).

**CAUTION:**
- **Avoid impacts such as a dropping.**
- **Never disassemble.**
- **Keep it away from metal particles.**
- **Never place sensor in a location where it is exposed to magnetism.**

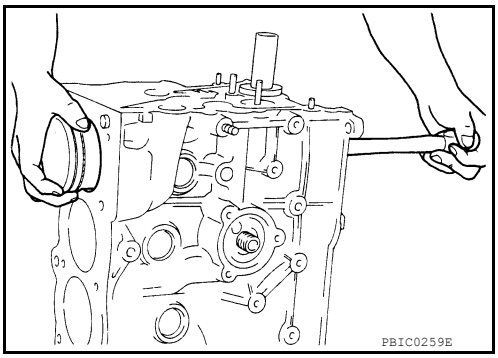
8. Remove oil filter (for intake valve timing control).
9. Remove pilot converter (1) using Tool (A). (CVT models)

**Tool number :ST16610001 (J-23907)**

**NOTE:**
M/T models have no pilot converter.

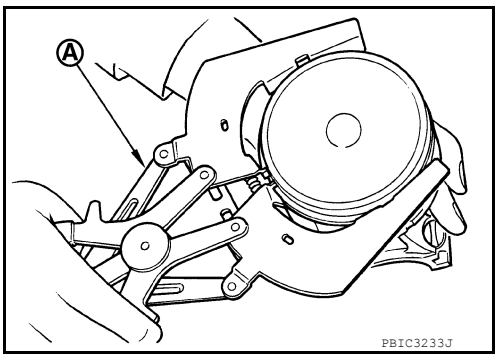



10. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
**NOTE:**
Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-97, "Inspection After Disassembly".
11. Remove connecting rod cap.
12. Using a suitable tool, push piston and connecting rod assembly out to the cylinder head side.
**CAUTION:**
- **Be careful not to damage matching surface with connecting rod cap.**
- **Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**

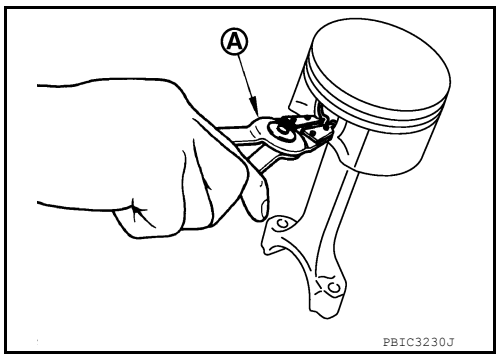



13. Remove connecting rod bearings.
**CAUTION:**
**When removing them, note the installation position. Keep them in the correct order.**
14. Remove piston rings from piston.
- Before removing piston rings, check the piston ring side clearance. Refer to EM-97, "Inspection After Disassembly".

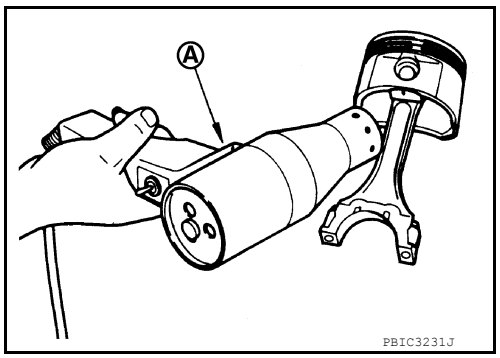
15. Using a suitable tool (A) remove piston rings.
**CAUTION:**
- **When removing piston rings, be careful not to damage the piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



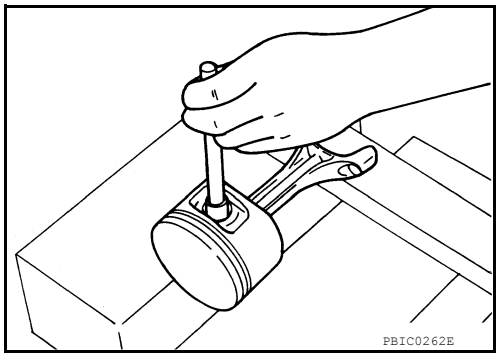
16. Using snap ring pliers (A), remove snap rings.



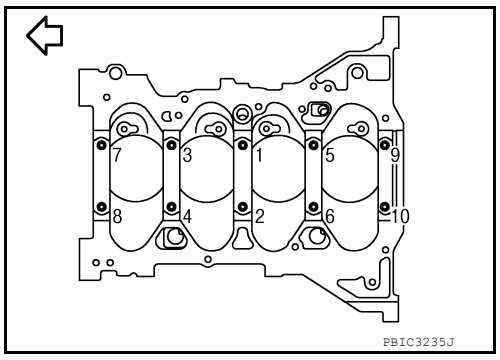

17. Heat piston to 60° to 70°C (140° to 158°F) using a suitable tool (A).




18. Push out piston pin using a suitable tool of an outer diameter approximately 18 mm (0.71 in).




19. Loosen main bearing cap bolts in reverse order as shown, and remove them.
**NOTE:**
Before loosening main bearing cap bolts, measure crankshaft end play. Refer to EM-97, "Inspection After Disassembly".



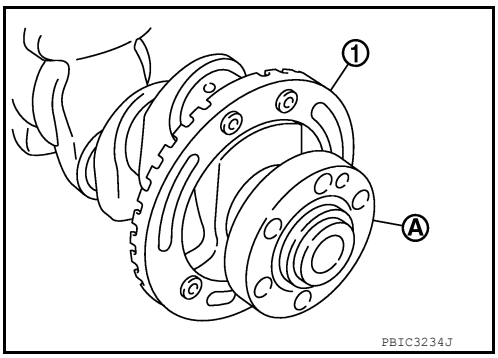

⇦ : Engine front

20. Remove main bearing caps.
- Tap main bearing caps lightly using a suitable tool for removal.

**CAUTION:**
**Be careful not to damage the mounting surface.**

21. Remove crankshaft.
**CAUTION:**

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




22. Pull rear oil seal out from rear end of crankshaft.
23. Remove main bearings and thrust bearings from cylinder block and main bearing caps.
    **CAUTION:**
    **Identify installation positions, and store them without mixing them up.**

## ASSEMBLY

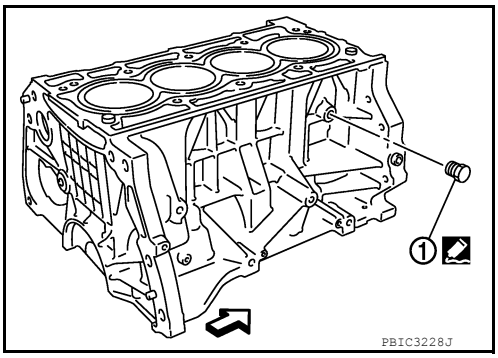
1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.
   **CAUTION:**
   **Use goggles to protect your eyes.**
2. Install water drain plug (1) to cylinder block.

   ⇦ : Engine front

   - Apply liquid gasket to the drain plug thread.

   **Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**

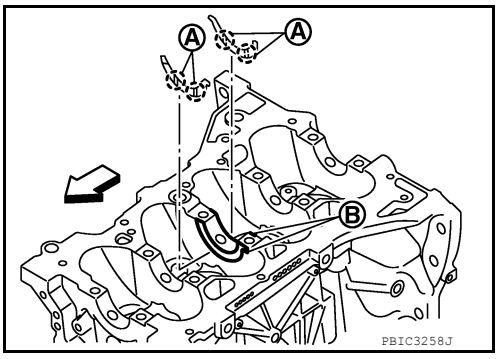
   **9.8 N·m (1.0 kg-m, 87 in-lb)**




3. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and main bearing cap.
4. Install thrust bearings to both sides of the No. 3 journal housing (B) on cylinder block.

   ⇦ : Engine front

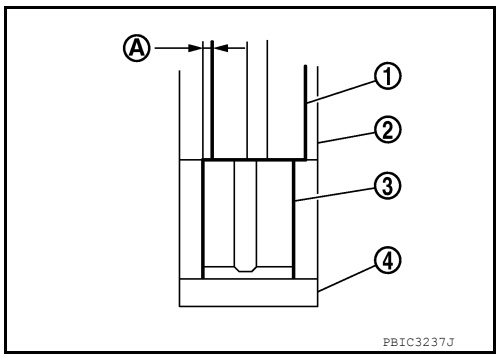
   - Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).



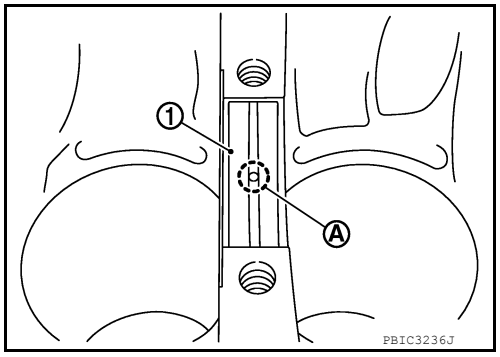

5. Install the main bearings paying attention to the direction.
   **CAUTION:**
   - **Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.**
   - **When installing, align main bearing to the center position of cylinder block and main bearing cap.**

- **The difference (A) between main bearing upper (1) and main bearing lower (3) should be 0.85 mm (0.033 in) or less when installing.**

2 : Cylinder block
4 : Main bearing cap



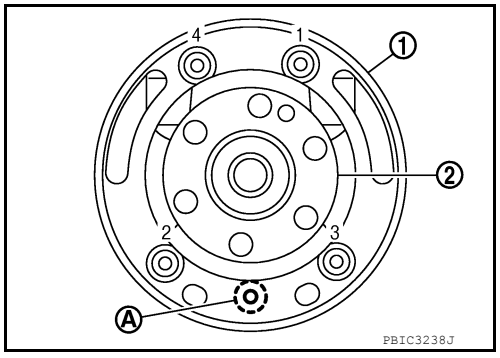

- **Ensure the oil holes on cylinder block and oil holes (A) on the main bearings (1) are aligned.**




6. Install signal plate to crankshaft if removed.
7. Set the signal plate with the flange facing toward the counter weight side (engine front side) to the crankshaft rear surface.
8. Apply new engine oil to threads and seat surfaces of bolts.
9. Position crankshaft (2) and signal plate (1) using a dowel pin (service part), and tighten bolts in numerical order as shown.

A : Dowel pin hole

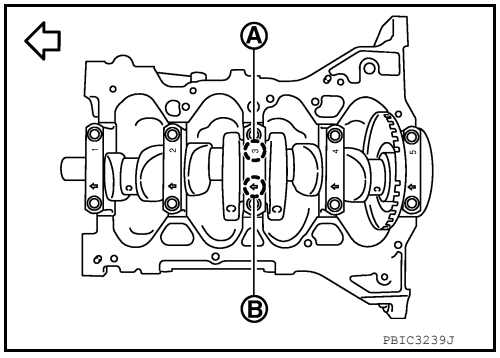
**NOTE:**
Dowel pin of crankshaft and signal plate is provided as a set for each.




10. Tighten bolts in numerical order as shown.
11. Remove dowel pin. (service parts)
**CAUTION:**
**Be sure to remove dowel pin.**
12. Install crankshaft to cylinder block.
• While turning crankshaft by hand, make sure that it turns smoothly.
13. Install main bearing caps referring to the journal No. stamp (A) and front mark (B) as shown.

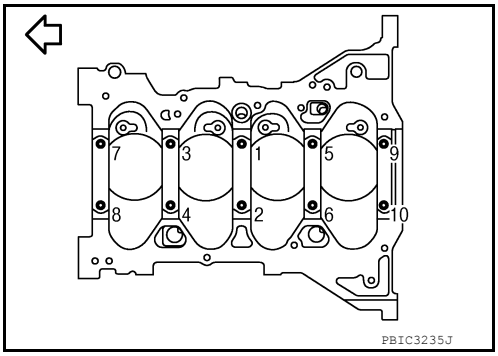
⇦ : Engine front

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



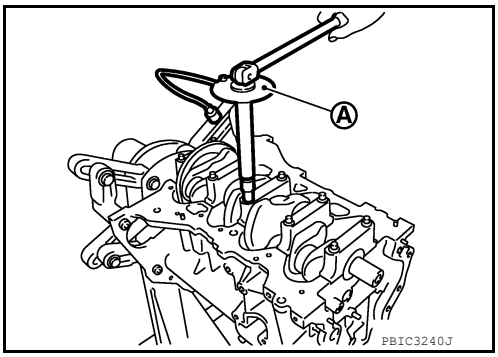

14. Apply new engine oil to threads and seat surfaces of bolts.

15. Tighten main bearing cap bolts in two steps in numerical order as shown.
    - ⇦: Engine front



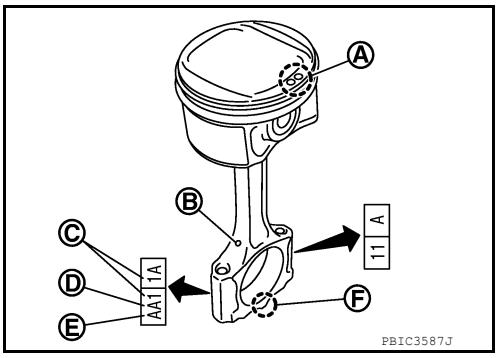

**CAUTION:**
**Measure the angle in Step 2 using Tool (A). Do not measure visually.**

| | |
|---|---|
| **Step 1** | **: 34.3 N·m (3.5 kg-m, 25 ft-lb)** |
| **Step 2** | **: 60° clockwise** |
| **Tool number** | **: KV10112100 (BT-8653-A)** |




- After installing bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to EM-97, "Inspection After Disassembly".

16. Using snap ring pliers, install new snap ring to the groove of the piston rear side.
    - Insert it fully into groove to install.
17. Assemble piston to connecting rod.
    - Using a suitable tool, heat the piston until the piston pin can be pushed in by hand without excess force [approximately 60° to 70 °C (140° to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.
    - Assemble so that the front mark (A) on the piston head and the oil hole (B) and the cylinder number (C) on connecting rod are positioned as shown.

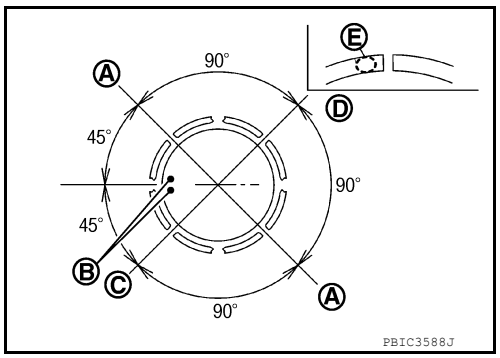



D : Big end diameter grade
E : Small end diameter grade
F : Front mark (connecting rod bearing cap)

18. Install new snap ring to the groove of the piston front side.
    - Insert it fully into groove to install.
    - After installing, make sure that connecting rod moves smoothly.
19. Using a suitable tool, install piston rings.
    **CAUTION:**
    - **Be careful not to damage piston.**
    - **Be careful not to damage piston rings by expanding them excessively.**

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

A : Oil ring upper or lower rail gap
B : Front mark
C : Second ring and oil ring spacer gap
D : Top ring gap
E : Stamped mark




**CAUTION:**
**Never contact the rail end gap under the oil ring with the oil drain cast groove of piston.**

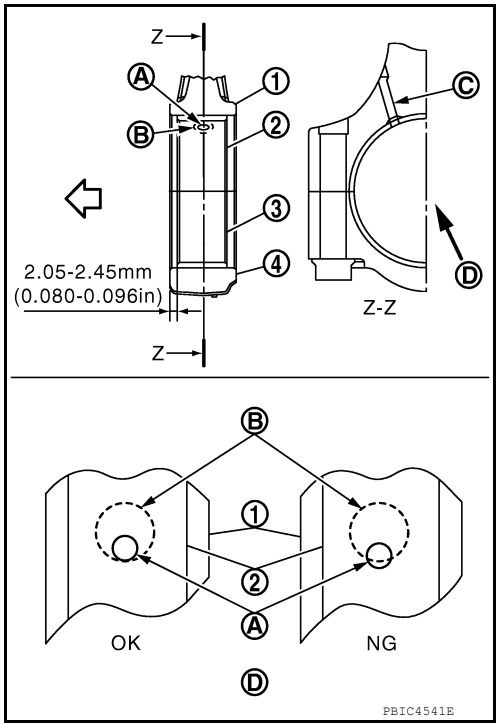
- Install second ring with the stamped surface facing upward.

20. Install connecting rod bearing upper (2) and lower (3) to connecting rod (1) and connecting rod cap (4).

C : Oil hole (connecting rod)
D : Arrow view
⇦ : Engine front

- Install the connecting rod in the dimension shown.
- Make sure that connecting rod bearing oil hole (A) is completely in the inside of connecting rod oil hole chamfered area (B).
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.

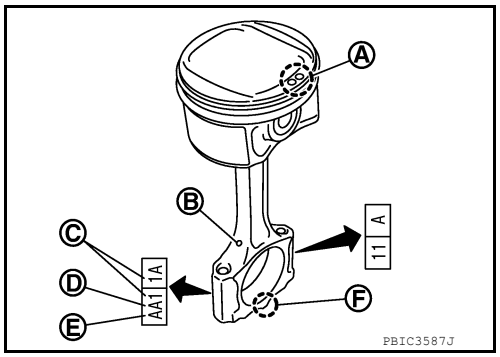
**NOTE:**
- There is no positioning tab.
- Install the connecting rod bearings in the center of connecting rod and connecting rod bearing cap as shown. For service operation, the center position can be checked, visually.




21. Install piston and connecting rod assembly to crankshaft.
- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number (C) on connecting rod to install.

B : Oil hole
D : Big end diameter grade
E : Small end diameter grade
F : Front mark (connecting rod bearing cap)

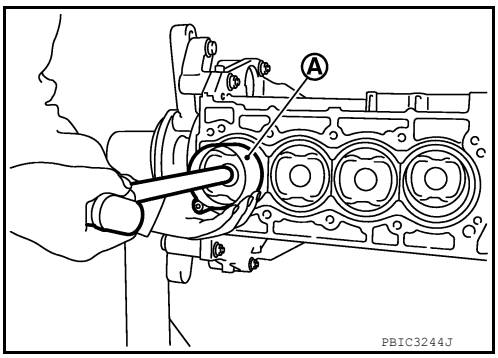
- Install so that front mark (A) on the piston head faces the front of engine.



- Using Tool (A), install piston with the front mark on the piston head facing the front of the engine.

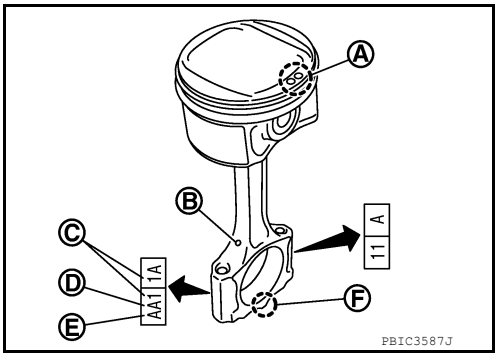
**CAUTION:**
**Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**

**Tool number : EM03470000 (J-8037)**




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

A : Front mark (piston)
B : Oil hole
D : Big end diameter grade
E : Small end diameter grade
F : Front mark (connecting rod bearing cap)



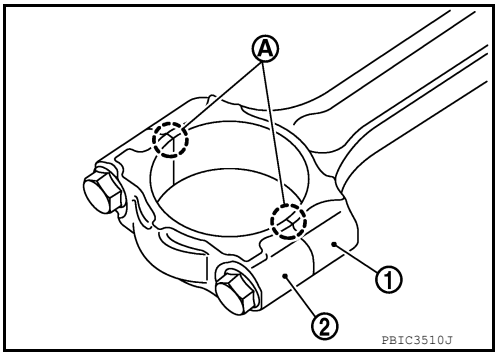

23. Tighten connecting rod bolt with the following procedure:

**CAUTION:**
- **Make sure that there is no gap in the thrust surface (A) of the joint between connecting rod (1) and connecting rod bearing cap (2) and that these parts are in the correct position. And then, tighten the connecting rod bolts.**
- **If the connecting rod bolts are reused, measure the outer diameter. Refer to EM-97, "Inspection After Disassembly".**

24. Apply new engine oil to the threads and seats of connecting rod bolts.
25. Tighten connecting rod bolts in two steps using Tool.

**Step 1 : 19.6 N·m (2.0 kg-m, 14 ft-lb)**
**Step 2 : 60° clockwise**

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

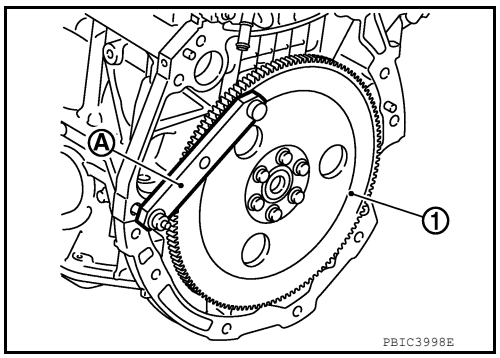



- After tightening connecting rod bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-97, "Inspection After Disassembly".

26. Install oil pan (upper). Refer to EM-27.
**NOTE:**
Install the rear oil seal after installing the oil pan (upper).
27. Install rear oil seal. Refer to EM-27.

28. Install flywheel (M/T models) or drive plate (1) (CVT models).
    - Secure crankshaft using Tool. (A), and tighten bolts crosswise over several times.

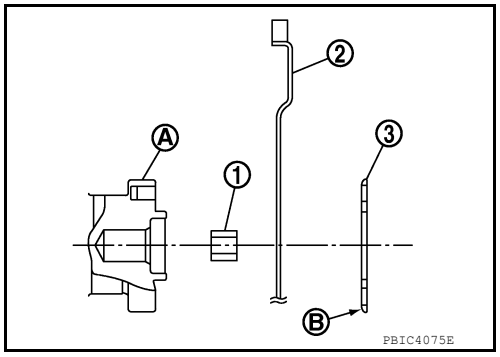
    **Tool number : KV11105210 (J-44716)**




    - Install pilot converter (1), drive plate (2) and reinforcement plate (3) as shown (CVT models).

      A : Crankshaft rear end
      B : R

    - Using a suitable tool of 33 mm. (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops (CVT models).
      **NOTE:**
      M/T models have no pilot converter and reinforcement plate.

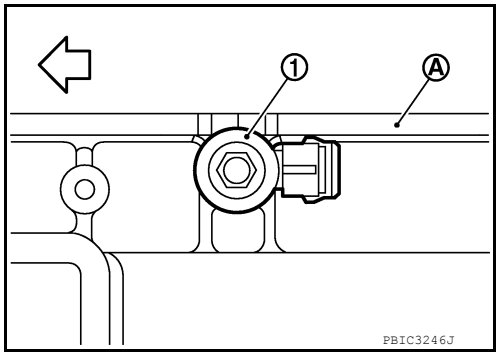



29. Install knock sensor (1) with connector facing toward the rear of engine.

      A : Cylinder block left side
      ⇦ : Engine front

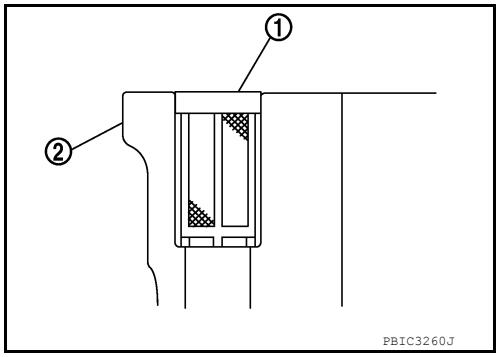
    **CAUTION:**
    - **Never tighten bolts while holding the connector.**
    - **If any impact by dropping is applied to knock sensor, replace it with a new one.**

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




30. Install crankshaft position sensor (POS) and crankshaft position sensor (POS) cover.
    **CAUTION:**
    - **Avoid impacts such as a dropping.**
    - **Keep it away from metal particles.**
    - **Never place sensor in a location where it is exposed to magnetism.**

31. Install oil filter (for intake valve timing control) (1) in the direction shown.
    - Make sure that the oil filter does not protrude from the upper surface of cylinder block (2) after installation.




32. Assembly is in the reverse order of disassembly.

# How to Select Piston and Bearing

INFOID:0000000007401878

## DESCRIPTION

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

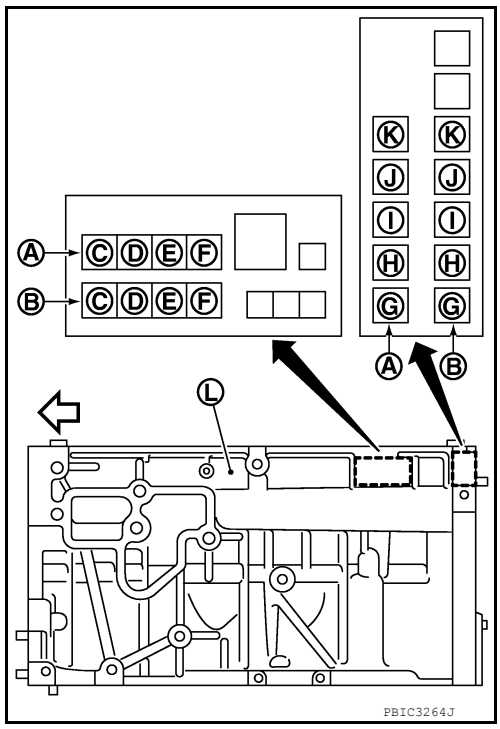
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

## HOW TO SELECT PISTON

When New Cylinder Block is Used

- Check the cylinder bore grade on rear left side of cylinder block (L), and select piston of the same grade.

A : Correction stamp
B : Standard stamp
C : Cylinder No. 1 bore grade
D : Cylinder No. 2 bore grade
E : Cylinder No. 3 bore grade
F : Cylinder No. 4 bore grade
G : No. 1 main bearing housing grade
H : No. 2 main bearing housing grade
I : No. 3 main bearing housing grade
J : No. 4 main bearing housing grade
K : No. 5 main bearing housing grade
⇦ : Engine front

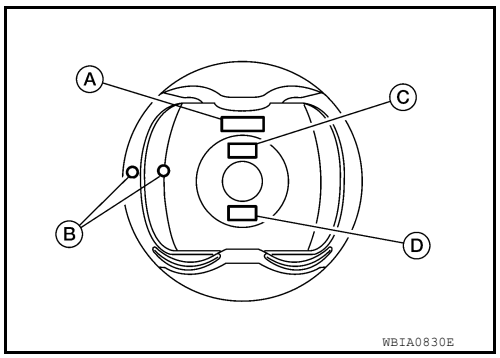



- If there is a correction stamp mark on the cylinder block, use it as a correct reference.

**When Cylinder Block is Reused**

1. Measure the cylinder bore inner diameter. Refer to EM-97, "Inspection After Disassembly".
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the “Piston Selection Table”.

3. Select piston of the same grade.




A : Identification code
B : Front mark
C : Piston grade number
D : Pin grade number

Piston Selection Table

Unit: mm (in)

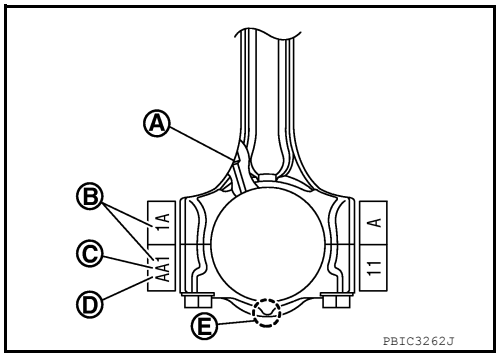
| Grade number (Mark) | 1 | 2 [or no mark (piston only)] |
|---|---|---|
| Cylinder bore Inner diameter | 84.000 - 84.010 (3.3071 - 3.3075) | 84.010 - 84.020 (3.3075 - 3.3079) |
| Piston skirt diameter | 83.970 - 83.980 (3.3059 - 3.3063) | 83.980 - 83.990 (3.3063 - 3.3067) |

**NOTE:**
- Piston is available together with piston pin as an assembly.
- There is no piston pin (piston pin hole) grade.

## HOW TO SELECT CONNECTING ROD BEARING

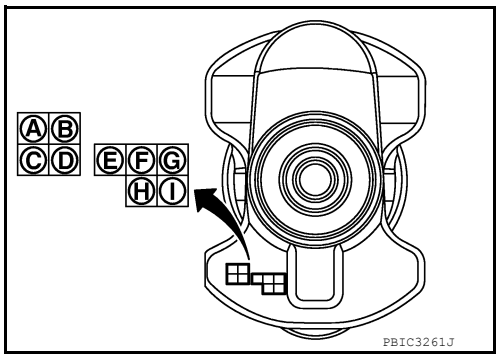
**When New Connecting Rod and Crankshaft are Used**

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




A : Oil hole
B : Cylinder number
D : Small end diameter grade
E : Front mark

2. Apply crankshaft pin journal diameter grade stamped on crankshaft front side to the column in the “Connecting Rod Bearing Selection Table”.




A : No. 1 pin journal diameter grade
B : No. 2 pin journal diameter grade
C : No. 3 pin journal diameter grade
D : No. 4 pin journal diameter grade
E : No. 1 main journal diameter grade
F : No. 2 main journal diameter grade
G : No. 3 main journal diameter grade
H : No. 4 main journal diameter grade
I : No. 5 main journal diameter grade

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

**When Crankshaft and Connecting Rod are Reused**

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-97, "Inspection After Disassembly" and EM-97, "Inspection After Disassembly".

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

Connecting Rod Bearing Selection Table

| Crankshaft pin journal diameter Unit: mm (in) / Connecting rod big end diameter Unit: mm (in) | | Mark | A | B | C | D | E | F | G | H | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | Axle diameter | Hole diameter | 47.000 - 47.001 (1.8504 - 1.8504) | 47.001 - 47.002 (1.8504 - 1.8505) | 47.002 - 47.003 (1.8505 - 1.8505) | 47.003 - 47.004 (1.8505 - 1.8505) | 47.004 - 47.005 (1.8505 - 1.8506) | 47.005 - 47.006 (1.8506 - 1.8506) | 47.006 - 47.007 (1.8506 - 1.8507) | 47.007 - 47.008 (1.8507 - 1.8507) | 47.008 - 47.009 (1.8507 - 1.8507) | 47.009 - 47.010 (1.8507 - 1.8508) | 47.010 - 47.011 (1.8508 - 1.8508) | 47.011 - 47.012 (1.8508 - 1.8509) | 47.012 - 47.013 (1.8509 - 1.8509) |
| A | 43.970 - 43.971 (1.7311 - 1.7311) | | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 |
| B | 43.969 - 43.970 (1.7311 - 1.7311) | | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 |
| C | 43.968 - 43.969 (1.7310 - 1.7311) | | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 |
| D | 43.967 - 43.968 (1.7310 - 1.7310) | | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 |
| E | 43.966 - 43.967 (1.7309 - 1.7310) | | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 |
| F | 43.965 - 43.966 (1.7309 - 1.7309) | | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 |
| G | 43.964 - 43.965 (1.7309 - 1.7309) | | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 |
| H | 43.963 - 43.964 (1.7308 - 1.7309) | | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 |
| J | 43.962 - 43.963 (1.7308 - 1.7308) | | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 |
| K | 43.961 - 43.962 (1.7307 - 1.7308) | | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 |
| L | 43.960 - 43.961 (1.7307 - 1.7307) | | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 |
| M | 43.959 - 43.960 (1.7307 - 1.7307) | | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 |
| N | 43.958 - 43.959 (1.7306 - 1.7307) | | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 |
| P | 43.957 - 43.958 (1.7306 - 1.7306) | | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 |
| R | 43.956 - 43.957 (1.7305 - 1.7306) | | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 |
| S | 43.955 - 43.956 (1.7305 - 1.7305) | | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 |
| T | 43.954 - 43.955 (1.7305 - 1.7305) | | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 |
| U | 43.953 - 43.954 (1.7304 - 1.7305) | | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 4 |

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Connecting Rod Bearing Grade Table

Unit: mm (in)

| Grade number | Thickness | Identification color | Remarks |
|---|---|---|---|
| 0 | 1.494 - 1.497 (0.0588 - 0.0589) | Black | Grade and color are the same for upper and lower bearings. |
| 1 | 1.497 - 1.500 (0.0589 - 0.0591) | Brown | |
| 2 | 1.500 - 1.503 (0.0591- 0.0592) | Green | |
| 3 | 1.503 - 1.506 (0.0592 - 0.0593) | Yellow | |
| 4 | 1.506 - 1.509 (0.0593 - 0.0594) | Blue | |

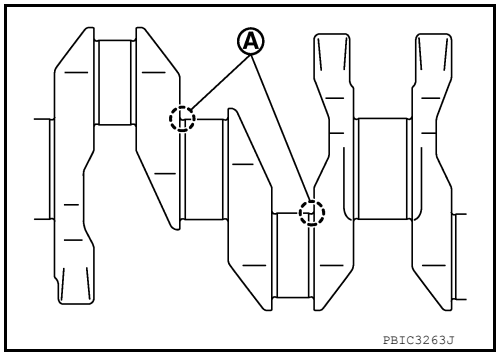
| Grade number | | Thickness | Identification color | Remarks |
|---|---|---|---|---|
| 01 | UPR | 1.494 - 1.497 (0.0588 - 0.0589) | Black | Grade and color are different between upper and lower bearings. |
| | LWR | 1.497 - 1.500 (0.0589 - 0.0591) | Brown | |
| 12 | UPR | 1.497 - 1.500 (0.0589 - 0.0591) | Brown | |
| | LWR | 1.500 - 1.503 (0.0591 - 0.0592) | Green | |
| 23 | UPR | 1.500 - 1.503 (0.0591 - 0.0592) | Green | |
| | LWR | 1.503 - 1.506 (0.0592 - 0.0593) | Yellow | |
| 34 | UPR | 1.503 - 1.506 (0.0592 - 0.0593) | Yellow | |
| | LWR | 1.506 - 1.509 (0.0593 - 0.0594) | Blue | |

Undersize Bearings Usage Guide

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

**CAUTION:**

**In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)] (A).**




Bearing undersize table

Unit: mm (in)

| Size | Thickness |
|---|---|
| US 0.25 (0.0098) | 1.623 - 1.631 (0.0639 - 0.0642) |

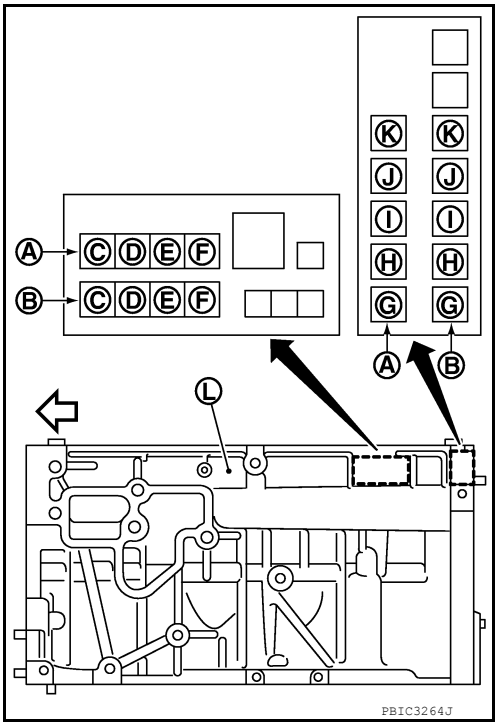
## HOW TO SELECT MAIN BEARING

**When New Cylinder Block and Crankshaft are Used**

1. “Main Bearing Selection Table” rows correspond to main bearing housing grade on rear left side of cylinder block (L).

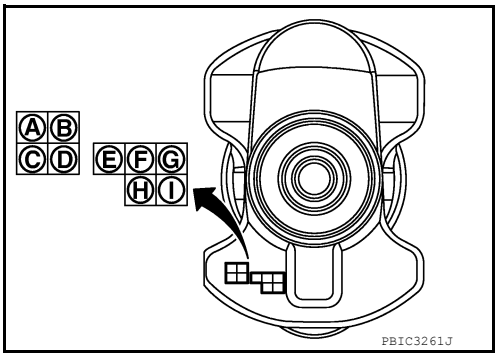
A : Correction stamp
B : Standard stamp
C : Cylinder No. 1 bore grade
D : Cylinder No. 2 bore grade
E : Cylinder No. 3 bore grade
F : Cylinder No. 4 bore grade
G : No. 1 main bearing housing grade
H : No. 2 main bearing housing grade
I : No. 3 main bearing housing grade
J : No. 4 main bearing housing grade
K : No. 5 main bearing housing grade
⇦ : Engine front

- If there is a correction stamp mark on cylinder block, use it as a correct reference.




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

A : No. 1 pin journal diameter grade
B : No. 2 pin journal diameter grade
C : No. 3 pin journal diameter grade
D : No. 4 pin journal diameter grade
E : No. 1 main journal diameter grade
F : No. 2 main journal diameter grade
G : No. 3 main journal diameter grade
H : No. 4 main journal diameter grade
I : No. 5 main journal diameter grade




3. Read the symbol at the cross point of selected row and column in the “Main Bearing Selection Table”.
**CAUTION:**
**There are two main bearing selection tables. One is for No. 1, 4 and 5 journals and the other is for No. 2 and 3 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.**
4. Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.
**NOTE:**
Service part is available as a set of both upper and lower.

**When Cylinder Block and Crankshaft are Reused**

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to EM-97, "Inspection After Disassembly" and EM-97, "Inspection After Disassembly".
2. Apply the measured dimension to the “Main Bearing Selection Table”.
3. Read the symbol at the cross point of selected row and column in the “Main Bearing Selection Table”.
**CAUTION:**
**There are two main bearing selection tables. One is for No. 1, 4 and 5 journals and the other is for No. 2 and 3 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.**
4. Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.
**NOTE:**

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

Main Bearing Selection Table (No. 1, 4 and 5 journals)

| Crankshaft main journal diameter Unit: mm (in) / Cylinder block main bearing housing inner diameter Unit: mm (in) | | Mark | A | B | C | D | E | F | G | H | J | K | L | M | N | P | R | S | T | U | V | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hole diameter | 55.997 - 55.998 (2.2046 - 2.2046) | 55.998 - 55.999 (2.2046 - 2.2047) | 55.999 - 56.000 (2.2047 - 2.2047) | 56.000 - 56.001 (2.2047 - 2.2048) | 56.001 - 56.002 (2.2048 - 2.2048) | 56.002 - 56.003 (2.2048 - 2.2048) | 56.003 - 56.004 (2.2048 - 2.2049) | 56.004 - 56.005 (2.2049 - 2.2049) | 56.005 - 56.006 (2.2049 - 2.2050) | 56.006 - 56.007 (2.2050 - 2.2050) | 56.007 - 56.008 (2.2050 - 2.2050) | 56.008 - 56.009 (2.2050 - 2.2051) | 56.009 - 56.010 (2.2051 - 2.2051) | 56.010 - 56.011 (2.2051 - 2.2052) | 56.011 - 56.012 (2.2052 - 2.2052) | 56.012 - 56.013 (2.2052 - 2.2052) | 56.013 - 56.014 (2.2052 - 2.2053) | 56.014 - 56.015 (2.2053 - 2.2053) | 56.015 - 56.016 (2.2053 - 2.2053) | 56.016 - 56.017 (2.2053 - 2.2054) |
| Mark | Axle diameter | | | | | | | | | | | | | | | | | | | | | |
| A | 51.978 - 51.979 (2.0464 - 2.0464) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 |
| B | 51.977 - 51.978 (2.0463 - 2.0464) | | 0 | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 |
| C | 51.976 - 51.977 (2.0463 - 2.0463) | | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 |
| D | 51.975 - 51.976 (2.0463 - 2.0463) | | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 |
| E | 51.974 - 51.975 (2.0462 - 2.0463) | | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 |
| F | 51.973 - 51.974 (2.0462 - 2.0462) | | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 |
| G | 51.972 - 51.973 (2.0461 - 2.0462) | | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 |
| H | 51.971 - 51.972 (2.0461 - 2.0461) | | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 |
| J | 51.970 - 51.971 (2.0461 - 2.0461) | | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 |
| K | 51.969 - 51.970 (2.0460 - 2.0461) | | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 |
| L | 51.968 - 51.969 (2.0460 - 2.0460) | | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 |
| M | 51.967 - 51.968 (2.0459 - 2.0460) | | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 |
| N | 51.966 - 51.967 (2.0459 - 2.0459) | | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 |
| P | 51.965 - 51.966 (2.0459 - 2.0459) | | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 |
| R | 51.964 - 51.965 (2.0458 - 2.0459) | | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 |
| S | 51.963 - 51.964 (2.0458 - 2.0458) | | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 |
| T | 51.962 - 51.963 (2.0457 - 2.0458) | | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 |
| U | 51.961 - 51.962 (2.0457 - 2.0457) | | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 |
| V | 51.960 - 51.961 (2.0457 - 2.0457) | | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 5 |
| W | 51.959 - 51.960 (2.0456 - 2.0457) | | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 5 | 5 |

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Main Bearing Selection Table (No. 2 and 3 journals)

| Crankshaft main journal diameter Unit: mm (in) | | Cylinder block main bearing housing inner diameter Unit: mm (in) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mark | A | B | C | D | E | F | G | H | J | K | L | M | N | P | R | S | T | U | V | W |
| | | Hole diameter | 55.997 - 55.998 (2.2046 - 2.2046) | 55.998 - 55.999 (2.2046 - 2.2047) | 55.999 - 56.000 (2.2047 - 2.2047) | 56.000 - 56.001 (2.2047 - 2.2048) | 56.001 - 56.002 (2.2048 - 2.2048) | 56.002 - 56.003 (2.2048 - 2.2048) | 56.003 - 56.004 (2.2048 - 2.2049) | 56.004 - 56.005 (2.2049 - 2.2049) | 56.005 - 56.006 (2.2049 - 2.2050) | 56.006 - 56.007 (2.2050 - 2.2050) | 56.007 - 56.008 (2.2050 - 2.2050) | 56.008 - 56.009 (2.2050 - 2.2051) | 56.009 - 56.010 (2.2051 - 2.2051) | 56.010 - 56.011 (2.2051 - 2.2052) | 56.011 - 56.012 (2.2052 - 2.2052) | 56.012 - 56.013 (2.2052 - 2.2052) | 56.013 - 56.014 (2.2052 - 2.2053) | 56.014 - 56.015 (2.2053 - 2.2053) | 56.015 - 56.016 (2.2053 - 2.2053) | 56.016 - 56.017 (2.2053 - 2.2054) |
| Mark | Axle diameter | | | | | | | | | | | | | | | | | | | | | | | |
| A | 51.978 - 51.979 (2.0464 - 2.0464) | | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 |
| B | 51.977 - 51.978 (2.0463 - 2.0464) | | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 |
| C | 51.976 - 51.977 (2.0463 - 2.0463) | | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 |
| D | 51.975 - 51.976 (2.0463 - 2.0463) | | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 |
| E | 51.974 - 51.975 (2.0462 - 2.0463) | | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 |
| F | 51.973 - 51.974 (2.0462 - 2.0462) | | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 |
| G | 51.972 - 51.973 (2.0461 - 2.0462) | | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 |
| H | 51.971 - 51.972 (2.0461 - 2.0461) | | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 |
| J | 51.970 - 51.971 (2.0461 - 2.0461) | | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 |
| K | 51.969 - 51.970 (2.0460 - 2.0461) | | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 |
| L | 51.968 - 51.969 (2.0460 - 2.0460) | | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 |
| M | 51.967 - 51.968 (2.0459 - 2.0460) | | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 |
| N | 51.966 - 51.967 (2.0459 - 2.0459) | | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 |
| P | 51.965 - 51.966 (2.0459 - 2.0459) | | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 |
| R | 51.964 - 51.965 (2.0458 - 2.0459) | | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 |
| S | 51.963 - 51.964 (2.0458 - 2.0458) | | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 |
| T | 51.962 - 51.963 (2.0457 - 2.0458) | | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 |
| U | 51.961 - 51.962 (2.0457 - 2.0457) | | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 |
| V | 51.960 - 51.961 (2.0457 - 2.0457) | | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 | 7 |
| W | 51.959 - 51.960 (2.0456 - 2.0457) | | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 | 7 | 7 |

PBIC4079E

Main Bearing Grade Table (All Journals)

Unit: mm (in)

| Grade number | Thickness | Identification color | Remarks |
|---|---|---|---|
| 0 | 1.996 - 1.999 (0.0786 - 0.0787) | Black | Grade and color are the same for upper and lower bearings. |
| 1 | 1.999 - 2.002 (0.0787 - 0.0788) | Brown | |
| 2 | 2.002 - 2.005 (0.0788- 0.0789) | Green | |
| 3 | 2.005 - 2.008 (0.0789 - 0.0791) | Yellow | |
| 4 | 2.008 - 2.011 (0.0791 - 0.0792) | Blue | |
| 5 | 2.011 - 2.014 (0.0792 - 0.0793) | Pink | |
| 6 | 2.014 - 2.017 (0.0793 - 0.0794) | Purple | |
| 7 | 2.017 - 2.020 (0.0794 - 0.0795) | White | |

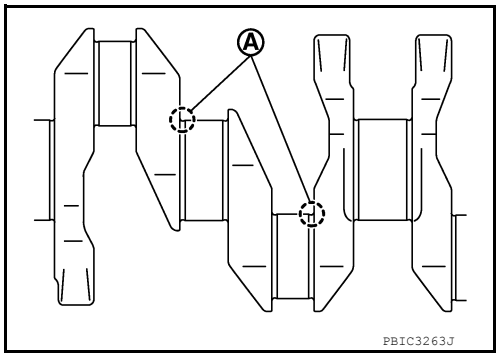
| Grade number | | Thickness | Identification color | Remarks |
|---|---|---|---|---|
| 01 | UPR | 1.996 - 1.999 (0.0786 - 0.0787) | Black | Grade and color are different between upper and lower bearings. |
| | LWR | 1.999 - 2.002 (0.0787 - 0.0788) | Brown | |
| 12 | UPR | 1.999 - 2.002 (0.0787 - 0.0788) | Brown | |
| | LWR | 2.002 - 2.005 (0.0788 - 0.0789) | Green | |
| 23 | UPR | 2.002 - 2.005 (0.0788- 0.0789) | Green | |
| | LWR | 2.005 - 2.008 (0.0789 - 0.0791) | Yellow | |
| 34 | UPR | 2.005 - 2.008 (0.0789 - 0.0791) | Yellow | |
| | LWR | 2.008 - 2.011 (0.0791 - 0.0792) | Blue | |
| 45 | UPR | 2.008 - 2.011 (0.0791 - 0.0792) | Blue | |
| | LWR | 2.011 - 2.014 (0.0792 - 0.0793) | Pink | |
| 56 | UPR | 2.011 - 2.014 (0.0792 - 0.0793) | Pink | |
| | LWR | 2.014 - 2.017 (0.0793 - 0.0794) | Purple | |
| 67 | UPR | 2.014 - 2.017 (0.0793 - 0.0794) | Purple | |
| | LWR | 2.017 - 2.020 (0.0794 - 0.0795) | White | |

Use Undersize Bearing Usage Guide

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

**CAUTION:**

**In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)] (A).**




Bearing undersize table

Unit: mm (in)

| Size | Thickness |
|---|---|
| US 0.25 (0.0098) | 2.126 - 2.134 (0.0837 - 0.0840) |

## Inspection After Disassembly

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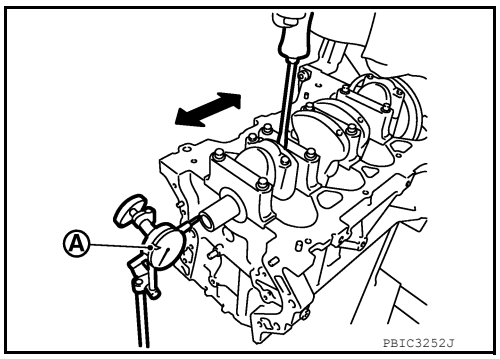
### CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

**Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 in)**

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

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

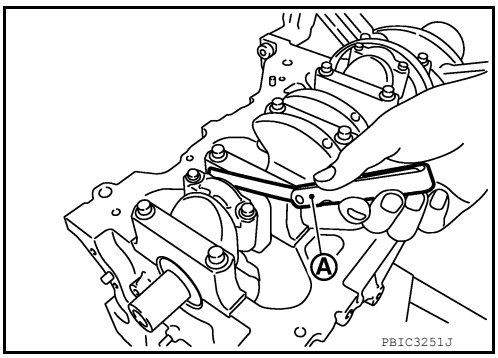



### CONNECTING ROD SIDE CLEARANCE

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

**Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)**
**Limit : 0.40 mm (0.0157 in)**

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

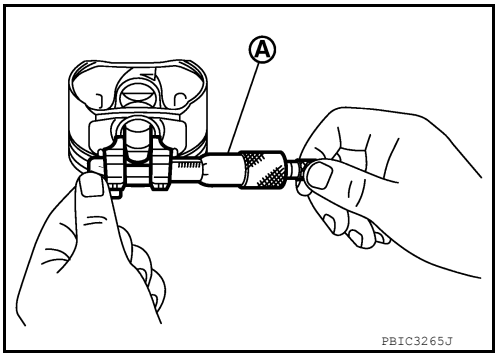



## PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

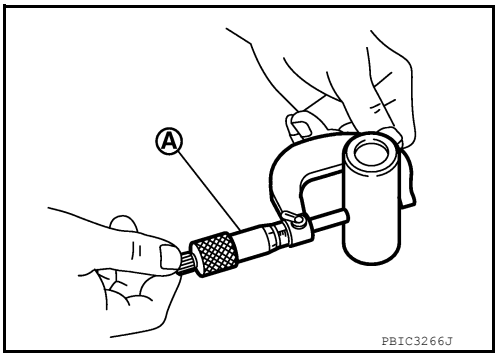
**Standard: 19.993 - 19.999 mm (0.7871 - 0.7874 in)**




Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

**Standard: 19.989 - 19.995 mm (0.7870 - 0.7872 in)**




Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

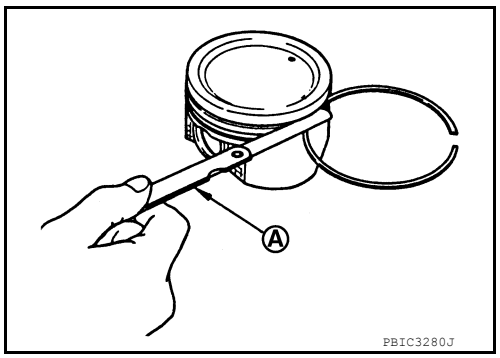
**Standard: 0.002 - 0.006 mm (0.0001 - 0.0002 in)**

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, follow the "Piston to Cylinder Bore Clearance" procedure.

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

## PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).




**Standard:**

| | |
|---|---|
| **Top ring** | **: 0.04 - 0.08 mm (0.002 - 0.003 in)** |
| **2nd ring** | **: 0.03 - 0.07 mm (0.001 - 0.003 in)** |
| **Oil ring** | **: 0.015 - 0.185 mm (0.001 - 0.007 in)** |

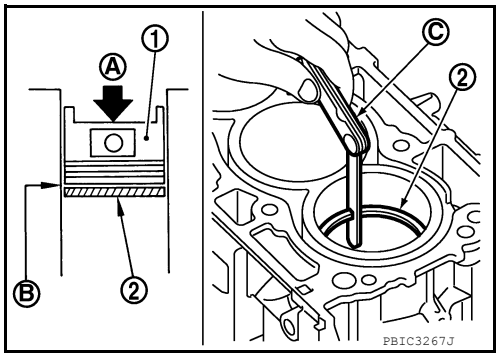
**Limit:**

| | |
|---|---|
| **Top ring** | **: 0.11 mm (0.0043 in)** |
| **2nd ring** | **: 0.10 mm (0.0039 in)** |

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

PISTON RING END GAP

- Make sure that cylinder bore inner diameter is within specification. Follow the "Cylinder Bore Inner Diameter" procedure.
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).




**Standard:**

| | |
|---|---|
| **Top ring** | **: 0.20 - 0.30 mm (0.008 - 0.012 in)** |
| **2nd ring** | **: 0.50 - 0.65 mm (0.020 - 0.026 in)** |
| **Oil ring (rail ring)** | **: 0.15 - 0.45 mm (0.006 - 0.018 in)** |

**Limit:**

| | |
|---|---|
| **Top ring** | **: 0.51 mm (0.020 in)** |
| **2nd ring** | **: 0.83 mm (0.033 in)** |
| **Oil ring (rail ring)** | **: 0.78 mm (0.031 in)** |

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

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

C : Feeler gauge

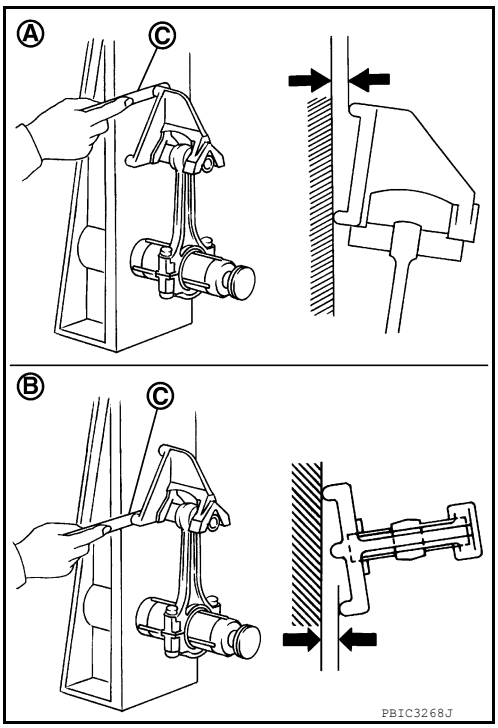
**Bend (A):**

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

**Torsion (B):**

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

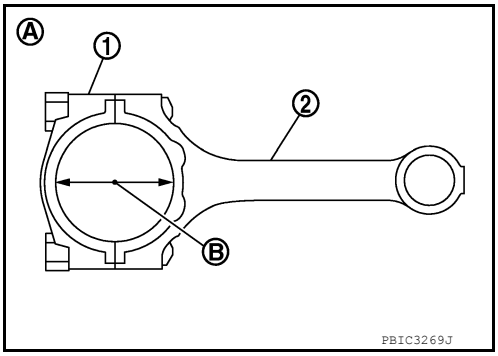
- If it exceeds the limit, replace connecting rod assembly.




## CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to EM-81, "Disassembly and Assembly" for the tightening procedure.

2 : Connecting rod
A : Example
B : Measuring direction of inner diameter




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

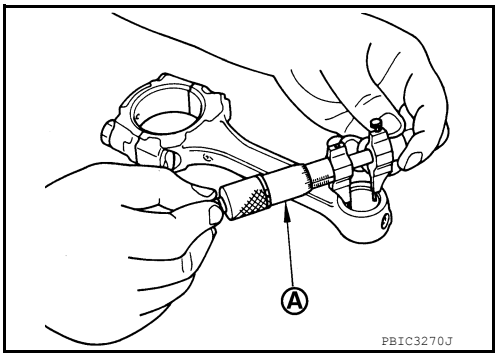
**Standard: 47.000 - 47.013 mm (1.8504 - 1.8509 in)**

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

## CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter
Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

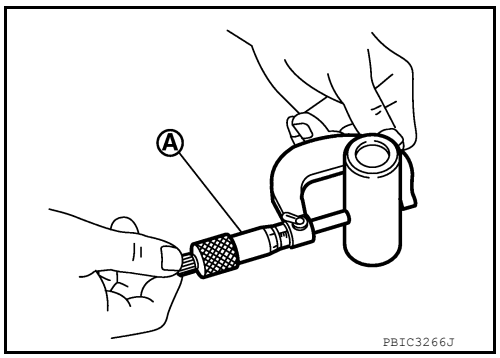
**Standard: 20.000 - 20.012 mm (0.7874 - 0.7879 in)**




Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

**Standard: 19.989 - 19.995 mm (0.7870 - 0.7872 in)**




Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

**Standard : 0.005 - 0.023 mm (0.0002 - 0.0009 in)**
**Limit : 0.03 mm (0.0012 in)**

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, follow the "PISTON TO PISTON PIN OIL CLEARANCE" procedure.
- If replacing connecting rod assembly, follow the "Connecting Rod Bushing Oil Clearance" procedure to select connecting rod bearing.

## CYLINDER BLOCK TOP SURFACE DISTORTION

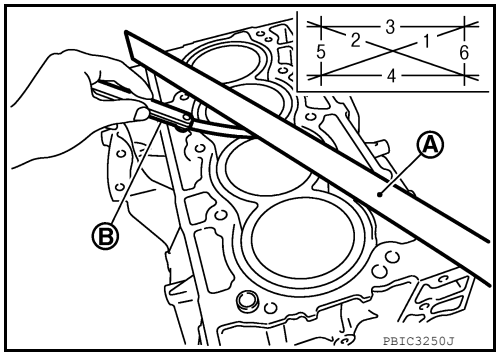
- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

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

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

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

- If it exceeds the limit, replace cylinder block.

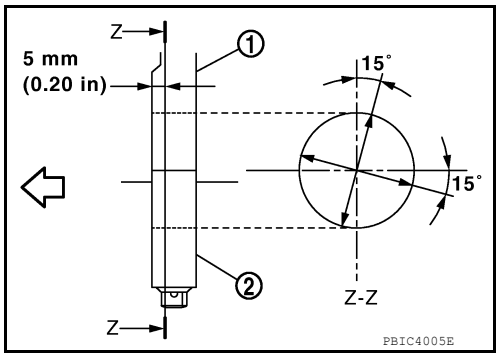



## MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to EM-81, "Disassembly and Assembly" for the tightening procedure.
- Measure the inner diameter of main bearing housing with a bore gauge.
- Measure the position shown [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown. The smaller one is the measured value.

1 : Cylinder block
2 : Main bearing cap
⇦ : Engine front

**Standard: 55.997 - 56.017 mm (2.2046 - 2.2054 in)**




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

**NOTE:**

Main bearing caps cannot be replaced independent from the block because they are machined with the cylinder block.

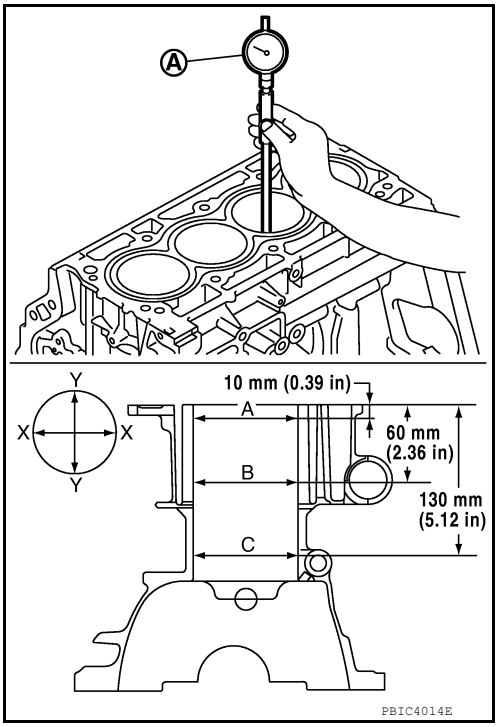
## PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using a bore gauge (A), measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. (“X” and “Y” directions at “A”, “B” and “C”) (“Y” is in longitudinal direction of engine)
  **NOTE:**
  When determining cylinder bore grade, measure the cylinder bore “X” direction at “B” position.

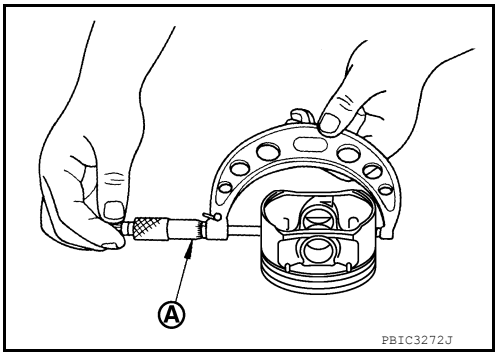
**Standard inner diameter:**
**84.000 - 84.020 mm (3.3071 - 3.3079 in)**
**Out-of-round (Difference between “X” and “Y”):**
**0.015 mm (0.0006 in)**
**Taper limit (Difference between “A” and “C”):**
**0.01 mm (0.0004 in)**

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.
  **NOTE:**
  Oversize piston is not provided.




Piston Skirt Diameter
Measure the outer diameter of piston skirt with a micrometer (A).

**Measure point**
**: Distance from the top 39.9 mm (1.571 in)**
**Standard**
**: 83.970 - 83.990 mm (3.3059 - 3.3067 in)**




Piston to Cylinder Bore Clearance
Calculate by piston skirt diameter and cylinder bore inner diameter (direction “X”, position “B”).
(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

**Standard : 0.020 - 0.040 mm (0.0008 - 0.0016 in)**
**Limit : 0.08 mm (0.0031 in)**

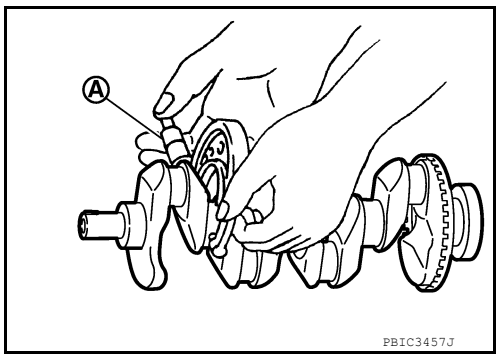
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to EM-90, "How to Select Piston and Bearing".

## CRANKSHAFT MAIN JOURNAL DIAMETER

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

**Standard: 51.959 - 51.979 mm (2.0456 - 2.0464 in) dia.**

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




## CRANKSHAFT PIN JOURNAL DIAMETER

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

**Standard: 43.953 - 43.971 mm (1.7304-1.7311 in) dia.**

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

## OUT-OF-ROUND AND TAPER OF CRANKSHAFT

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

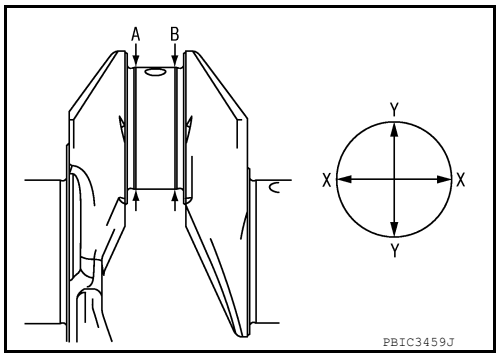
**Limit:**

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

**: 0.0035 mm (0.0001 in)**

**Taper (Difference between “A” and “B”)**

**: 0.0035 mm (0.0001 in)**




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

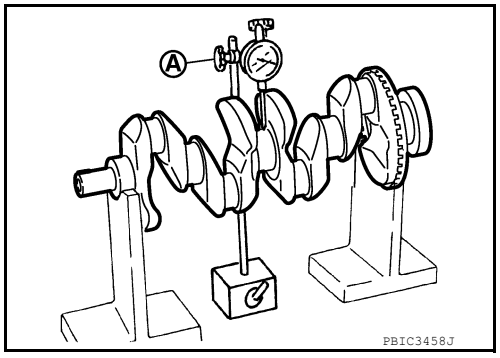
## CRANKSHAFT RUNOUT

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

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

**Limit : 0.10 mm (0.0040 in)**

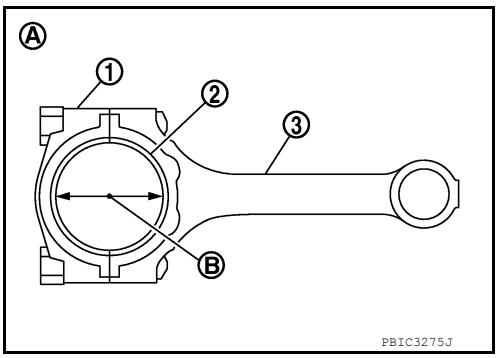
- If it exceeds the limit, replace crankshaft.




## CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod bolts to the specified torque. Refer to EM-81, "Disassembly and Assembly" for tightening procedure.



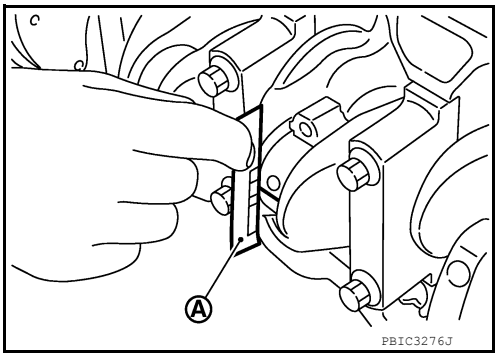

A : Example
B : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

**Standard : 0.037 - 0.047 mm (0.0015 - 0.0019 in)**
**Limit : 0.07 mm (0.0028 in)**

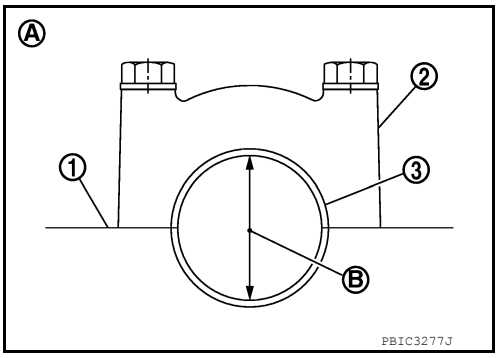
- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to EM-90, "How to Select Piston and Bearing".

Method of Using Plastigage
- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-81, "Disassembly and Assembly" for the tightening procedure.
**CAUTION:**
**Never rotate crankshaft.**
- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.
**NOTE:**
The procedure when the measured value exceeds the limit is same as that described in the “Method by Calculation”.




## MAIN BEARING OIL CLEARANCE

Method by Calculation
- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap bolts to the specified torque. Refer to EM-81, "Disassembly and Assembly" for the tightening procedure.




A : Example
B : Inner diameter measuring direction

- Measure the inner diameter of main bearing with a bore gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

**Standard:**
**No. 1, 4 and 5 journals**
**: 0.024 - 0.034 mm (0.0009 - 0.0013 in)**
**No. 2 and 3 journals**
**: 0.012 - 0.022 mm (0.0005 - 0.0009 in)**
**Limit : 0.065 mm (0.0026 in)**

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to EM-90, "How to Select Piston and Bearing".

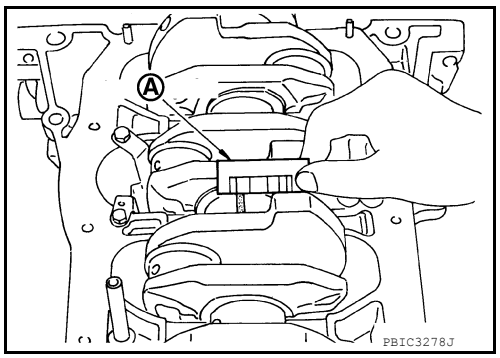
Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap bolts to the specified torque. Refer to EM-81, "Disassembly and Assembly" for the tightening procedure.

**CAUTION:**
**Never rotate crankshaft.**

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

**NOTE:**
The procedure when the measured value exceeds the limit is same as that described in the “Method by Calculation”.



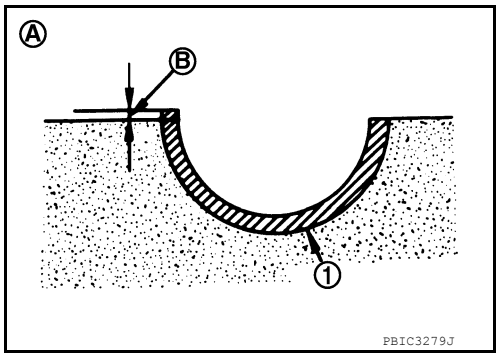

## MAIN BEARING CRUSH HEIGHT

- When main bearing cap is removed after being tightened to the specified torque with main bearings (1) installed, the tip end of bearing must protrude (B). Refer to EM-81, "Disassembly and Assembly" for the tightening procedure.

A : Example

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

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



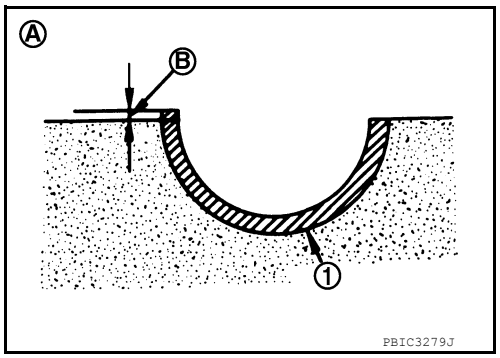

## CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude. Refer to EM-81, "Disassembly and Assembly" for the tightening procedure (B).

A : Example

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

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




## MAIN BEARING CAP BOLT OUTER DIAMETER

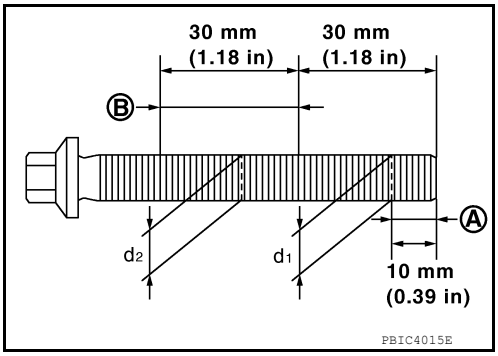
- Measure the outer diameters (“$d_1$”, “$d_2$”) at two positions as shown.

A : “d1” measuring position
B : “d2” measuring position

- If reduction appears in places other than “B” range, regard it as “$d_2$”.

**Limit (“$d_1$”–“$d_2$”): 0.15 mm (0.0059 in)**

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

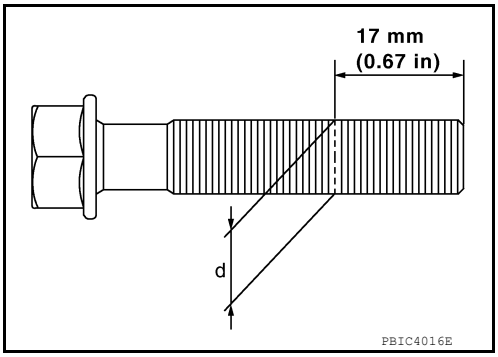



## CONNECTING ROD BOLT OUTER DIAMETER

- Measure the outer diameter “d” at position as shown.
- If reduction appears in a position other than “d”, regard it as “d”.

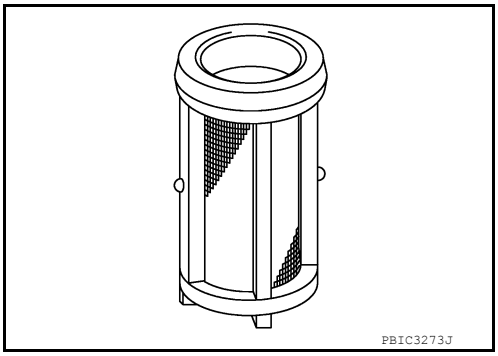
**Limit: 7.75 mm (0.3051 in)**

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




## CLOGGED OR DAMAGED OIL FILTER (FOR INTAKE VALVE TIMING CONTROL)

- Make sure that there is no foreign material on the oil filter and check it for clogging.
- Clean it if necessary.
- Check the oil filter for damage.
- Replace it if necessary.



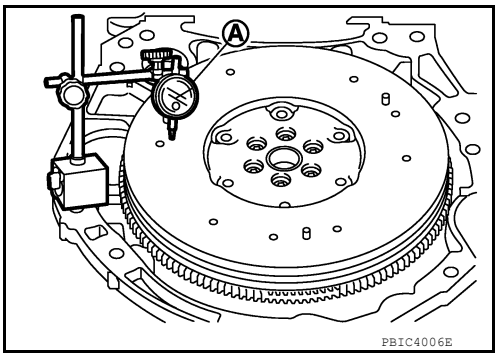

## FLYWHEEL DEFLECTION (M/T MODELS)

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

**Limit : 0.45 mm (0.0177 in) or less.**

- If measured value is out of the standard, replace flywheel.
- If a trace of burn or discoloration is found on the surface, repair it with sandpaper.

**CAUTION:**
**When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.**




## MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)

**CAUTION:**
**Never disassemble double mass flywheel.**

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

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

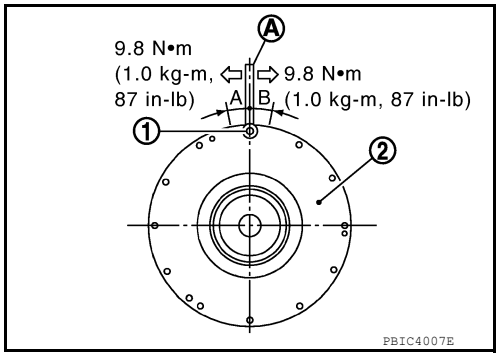
**Standard : 1.8 mm (0.071 in) or less**

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

Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install clutch cover bolt (1) to clutch cover mating hole, and place a torque wrench (A) on the extended line of the flywheel (2) center line.
   - Tighten bolt at a force of 9.8 N·m (1.0 kg-m, 87 in-lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg-m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transaxle side.
4. Measure the dimensions of movement amounts “A” and “B” on circumference of the flywheel on the transaxle side.




**Limit: 33.2 mm (1.307 in) or less.**

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

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Standard and Limit

INFOID:0000000007401880

### GENERAL SPECIFICATIONS

| | | |
|---|---|---|
| Engine type | | MR20DE |
| Cylinder arrangement | | In-line 4 |
| Displacement $cm^3$ (cu in) | | 1,997 (121.86) |
| Bore and stroke mm (in) | | 84.0 x 90.1 (3.307 x 3.547) |
| Valve arrangement | | DOHC |
| Firing order | | 1-3-4-2 |
| Number of piston rings | Compression | 2 |
| | Oil | 1 |
| Compression ratio | | 10.2 |
| Compression pressure kPa (kg/$cm^2$, psi) / 250 rpm | Standard | 1,390 (14.2, 202) |
| | Minimum | 1,140 (11.6, 165) |
| | Differential limit between cylinders | 100 (1.0, 15) |

### DRIVE BELT

| | |
|---|---|
| Tension of drive belt | Auto adjustment by auto-tensioner |

### WATER CONTROL VALVE

| | |
|---|---|
| Valve opening temperature | 93.5 - 96.5°C (200 - 206°F) |
| Full-open valve lift amount | 8 mm/ 108°C (0.315 in/ 226°F) |
| Valve closing temperature | More than 90°C (194°F) |

### EXHAUST MANIFOLD

Unit: mm (in)

| Items | | Limit |
|---|---|---|
| Surface distortion | Each exhaust port | 0.3 (0.012) |
| | Entire part | 0.7 (0.028) |

### THERMOSTAT

| | |
|---|---|
| Valve opening temperature | 80.5 - 83.5°C (177 - 182°F) |
| Full-open valve lift amount | 8 mm/ 95°C (0.315 in/ 203°F) |
| Valve closing temperature | More than 77°C (171°F) |

### SPARK PLUG

Unit: mm (in)

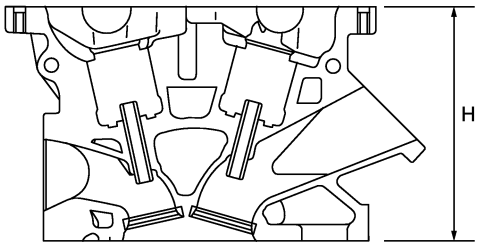
| Application | Except for California | For California |
|---|---|---|
| Make | NGK | Denso |
| Standard type* | PLZKAR6A-11 | FXE20HR-11 |
| Spark plug gap | Nominal: 1.1 (0.043) | |

*: Always check with the Parts Department for the latest parts information.

### CYLINDER HEAD

Unit: mm (in)

| Items | Standard | Limit |
|---|---|---|
| Head surface distortion | — | 0.1 (0.004) |
| Normal cylinder head height “H” | 130.9 (5.15) | — |



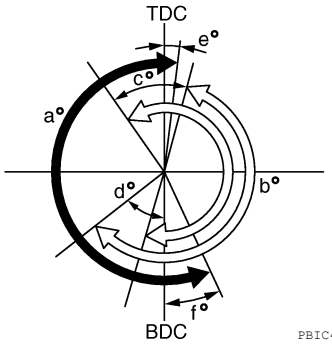

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## VALVE

### Valve Timing

Unit: degree

Valve timing



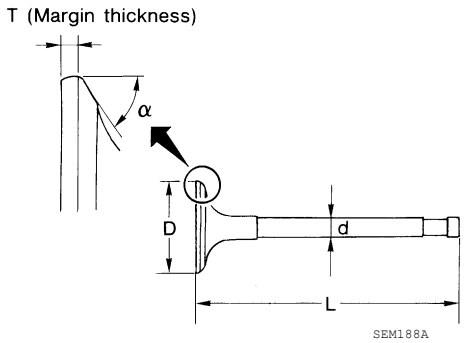

PBIC4542E

| a | b | c | d | e | f |
|---|---|---|---|---|---|
| 212 | 224 | -8 (32) | 52 (12) | 7 | 25 |

( ): Valve timing control “ON”

### Valve Dimensions

Unit: mm (in)




SEM188A

| | | |
|---|---|---|
| Valve head diameter “D” | Intake | 33.8 - 34.1 (1.331 - 1.343) |
| | Exhaust | 27.6 - 27.9 (1.087 - 1.098) |
| Valve length “L” | Intake | 106.27 (4.18) |
| | Exhaust | 105.26 (4.144) |

| | | |
|---|---|---|
| Valve stem diameter “d” | Intake | 5.465 - 5.480 (0.2152 - 0.2157) |
| | Exhaust | 5.455 - 5.470 (0.2148 - 0.2154) |
| Valve seat angle “α” | | 45°15′ - 45°45′ |
| Valve margin “T” | Intake | 1.1 (0.043) |
| | Exhaust | 1.2 (0.047) |

Valve Clearance

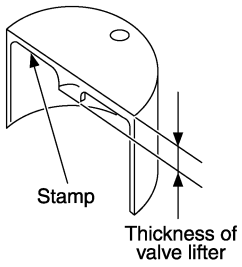
Unit: mm (in)

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

*: Approximately 80°C (176°F)

Available Valve Lifter

| Thickness mm (in) | Identification mark* |
|---|---|




KBIA0119E

| | |
|---|---|
| 3.00 (0.1181) | 300 |
| 3.02 (0.1189) | 302 |
| 3.04 (0.1197) | 304 |
| 3.06 (0.1205) | 306 |
| 3.08 (0.1213) | 308 |
| 3.10 (0.1220) | 310 |
| 3.12 (0.1228) | 312 |
| 3.14 (0.1236) | 314 |
| 3.16 (0.1244) | 316 |
| 3.18 (0.1252) | 318 |
| 3.20 (0.1260) | 320 |
| 3.22 (0.1268) | 322 |
| 3.24 (0.1276) | 324 |
| 3.26 (0.1283) | 326 |
| 3.28 (0.1291) | 328 |
| 3.30 (0.1299) | 330 |
| 3.32 (0.1307) | 332 |
| 3.34 (0.1315) | 334 |
| 3.36 (0.1323) | 336 |
| 3.38 (0.1331) | 338 |
| 3.40 (0.1339) | 340 |
| 3.42 (0.1346) | 342 |

| Thickness mm (in) | Identification mark* |
|---|---|
| 3.44 (0.1354) | 344 |
| 3.46 (0.1362) | 346 |
| 3.48 (0.1370) | 348 |
| 3.50 (0.1378) | 350 |

*: Always check with the Parts Department for the latest parts information.

Valve Spring

| Items | Intake | Exhaust |
|---|---|---|
| Free height | 44.90 - 45.10 mm (1.7677 - 1.7755 in) | 45.74 - 45.94 mm (1.8007 - 1.8086 in) |
| Installation height | 35.30 mm (1.390 in) | 35.30 mm (1.390 in) |
| Installation load | 153 - 173 N (15.6 - 17.6 kg, 34 - 39 lb) | 139 - 157 N (14.2 - 16.0 kg, 31 - 35 lb) |
| Height during valve open | 26.36 mm (1.0377 in) | 27.80 mm (1.0944 in) |
| Load with valve open | 335 - 377 N (34.2 - 38.5 kg, 75 - 85 lb) | 266 - 297 N (27.1 - 30.3 kg, 60 - 67 lb) |
| Identification color | White | Orange |

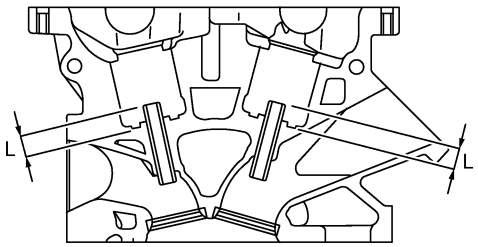
Valve Lifter

Unit: mm (in)

| Items | | Standard |
|---|---|---|
| Valve lifter outer diameter | Intake | 33.977 - 33.987 (1.3377 - 1.3381) |
| | Exhaust | 29.977 - 29.987 (1.1802 - 1.1806) |
| Valve lifter hole diameter | Intake | 34.000 - 34.021 (1.3386 - 1.3394) |
| | Exhaust | 30.000 - 30.021 (1.1811 - 1.1819) |
| Valve lifter clearance | | 0.013 - 0.044 (0.0005 - 0.0017) |

Valve Guide

Unit: mm (in)



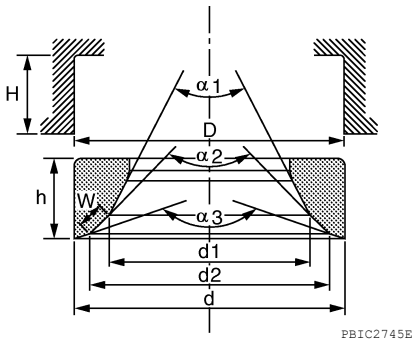

PBIC0184E

| Items | | Standard part | Service part |
|---|---|---|---|
| Valve guide | Outer diameter | 9.523 - 9.534 (0.3749 - 0.3754) | 9.723 - 9.734 (0.3828 - 0.3832) |
| | Inner diameter (Finished size) | 5.500 - 5.518 (0.2165 - 0.2172) | |
| Cylinder head valve guide hole diameter | | 9.475 - 9.496 (0.3730 - 0.3739) | 9.675 - 9.696 (0.3809 - 0.3817) |
| Interference fit of valve guide | | 0.027 - 0.059 (0.0011 - 0.0023) | |

| Items | | Standard | Limit |
|---|---|---|---|
| Valve guide clearance | Intake | 0.020 - 0.053 (0.0008 - 0.0021) | 0.1 (0.004) |
| | Exhaust | 0.030 - 0.063 (0.0012 - 0.0025) | |
| Projection length “L” | | 13.35 - 13.65 (0.526 - 0.537) | |

Valve Seat

Unit: mm (in)




| Items | | Standard | Oversize [0.5 (0.02)] (Service) |
|---|---|---|---|
| Cylinder head seat recess diameter “D” | Intake | 34.700 - 34.727 (1.3661 - 1.3672) | 35.200 - 35.227 (1.3858 - 1.3869) |
| | Exhaust | 28.700 - 28.727 (1.1299 - 1.1310) | 29.200 - 29.227 (1.1496 - 1.1507) |
| Valve seat outer diameter “d” | Intake | 34.808 - 34.824 (1.3704 - 1.3710) | 35.308 - 35.324 (1.3901 - 1.3907) |
| | Exhaust | 28.808 - 28.824 (1.1342 - 1.1348) | 29.308 - 29.324 (1.1539 - 1.1545) |
| Valve seat interference fit | | 0.081 - 0.124 (0.0032 - 0.0049) | |
| Diameter “d1”[1] | Intake | 31.8 (1.252) | |
| | Exhaust | 25.3 (0.996) | |
| Diameter “d2”[2] | Intake | 33.1 - 33.6 (1.303 - 1.323) | |
| | Exhaust | 26.9 - 27.4 (1.059 - 1.079) | |
| Angle “α1” | Intake | 60° | |
| | Exhaust | 45° | |
| Angle “α2” | | 88°45′ - 90°15′ | |
| Angle “α3” | | 120° | |
| Contacting width “W”[3] | Intake | 1.0 - 1.4 (0.039 - 0.055) | |
| | Exhaust | 1.2 - 1.6 (0.047 - 0.063) | |
| Height “h” | Intake | 5.9 - 6.0 (0.232 - 0.236) | 5.03 - 5.13 (0.1980 - 0.2020) |
| | Exhaust | 5.9 - 6.0 (0.232 - 0.236) | 4.95 - 5.05 (0.1949 - 0.1988) |
| Depth “H” | Intake | 6.04 (0.2378) | |
| | Exhaust | 6.05 (0.2382) | |

1: Diameter made by intersection point of conic angles “α1” and “α2”

2: Diameter made by intersection point of conic angles “α2” and “α3”

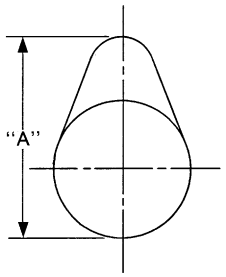
3: Machining data

## CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

| Items | | Standard | Limit |
|---|---|---|---|
| Camshaft journal oil clearance | No. 1 | 0.045 - 0.086 (0.0018 - 0.0034) | 0.15 (0.0059) |
| | No. 2, 3, 4, 5 | 0.030 - 0.071 (0.0012 - 0.0028) | |
| Camshaft bracket inner diameter | No. 1 | 28.000 - 28.021 (1.1024 - 1.1032) | — |
| | No. 2, 3, 4, 5 | 25.000 - 25.021 (0.9843 - 0.9851) | — |
| Camshaft journal outer diameter | No. 1 | 27.935 - 27.955 (1.0998 - 1.1006) | — |
| | No. 2, 3, 4, 5 | 24.950 - 24.970 (0.9823 - 0.9381) | — |
| Camshaft end play | | 0.075 - 0.153 (0.0030 - 0.0060) | 0.24 (0.0094) |
| Camshaft cam height “A” | Intake | 44.605 - 44.795 (1.7560 - 1.7635) | 44.405 (1.7482) |
| | Exhaust | 43.175 - 43.365 (1.6997 - 1.7072) | 42.975 (1.6919) |

| | | |
|---|---|---|
| Camshaft runout [TIR*] | Less than 0.02 (0.0008) | 0.05 (0.0020) |
| Camshaft sprocket runout [TIR*] | — | 0.15 (0.0059) |

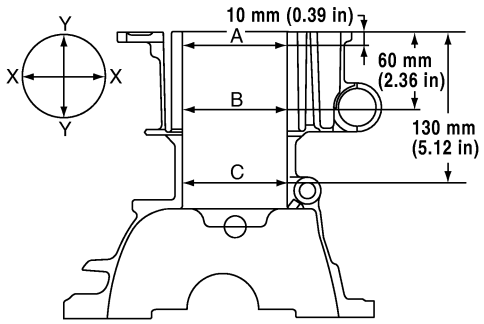



SEM671

*: Total indicator reading

## CYLINDER BLOCK

Unit: mm (in)



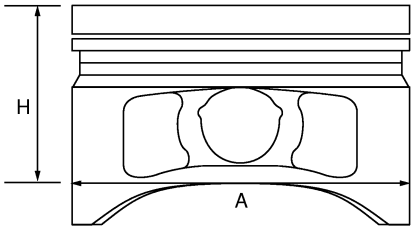

PBIC4017E

| | | | | |
|---|---|---|---|---|
| Top surface distortion | | Limit | | 0.1 (0.004) |
| Cylinder bore | Inner diameter | Standard | Grade No. 1 | 84.000 - 84.010 (3.3071 - 3.3075) |
| | | | Grade No. 2 | 84.010 - 84.020 (3.3075 - 3.3079) |
| Out-of-round (Difference between "X" and "Y") | | Limit | | 0.015 (0.0006) |
| Taper (Difference between "A" and "C") | | | | 0.01 (0.0004) |
| Main bearing housing inner diameter grade | | | Grade No. A | 55.997 - 55.998 (2.2046 - 2.2046) |
| | | | Grade No. B | 55.998 - 55.999 (2.2046 - 2.2047) |
| | | | Grade No. C | 55.999 - 56.000 (2.2047 - 2.2047) |
| | | | Grade No. D | 56.000 - 56.001 (2.2047 - 2.2048) |
| | | | Grade No. E | 56.001 - 56.002 (2.2048 - 2.2048) |
| | | | Grade No. F | 56.002 - 56.003 (2.2048 - 2.2048) |
| | | | Grade No. G | 56.003 - 56.004 (2.2048 - 2.2049) |
| | | | Grade No. H | 56.004 - 56.005 (2.2049 - 2.2049) |
| | | | Grade No. J | 56.005 - 56.006 (2.2049 - 2.2050) |
| | | | Grade No. K | 56.006 - 56.007 (2.2050 - 2.2050) |
| | | | Grade No. L | 56.007 - 56.008 (2.2050 - 2.2050) |
| | | | Grade No. M | 56.008 - 56.009 (2.2050 - 2.2051) |
| | | | Grade No. N | 56.009 - 56.010 (2.2051 - 2.2051) |
| | | | Grade No. P | 56.010 - 56.011 (2.2051 - 2.2052) |
| | | | Grade No. R | 56.011 - 56.012 (2.2052 - 2.2052) |
| | | | Grade No. S | 56.012 - 56.013 (2.2052 - 2.2052) |
| | | | Grade No. T | 56.013 - 56.014 (2.2052 - 2.2053) |
| | | | Grade No. U | 56.014 - 56.015 (2.2053 - 2.2053) |
| | | | Grade No. V | 56.015 - 56.016 (2.2053 - 2.2053) |
| | | | Grade No. W | 56.016 - 56.017 (2.2053 - 2.2054) |

## PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)




PBIC0188E

| | | Grade* | Dimension |
|---|---|---|---|
| Piston skirt diameter “A” | Standard | Grade No. 1 | 83.970 - 83.980 (3.3059 - 3.3063) |
| | | Grade No. 2 | 83.980 - 83.990 (3.3063 - 3.3067) |
| Piston height “H” dimension | | | 39.9 (1.571) |
| Piston pin hole diameter | | | 19.993 - 19.999 (0.7871 - 0.7874) |
| Piston to cylinder bore clearance | | Standard | 0.020 - 0.040 (0.0008 - 0.0016) |
| | | Limit | 0.08 (0.0031) |

*: Always check with the Parts Department for the latest parts information.

### Piston Ring

Unit: mm (in)

| Items | | Standard | Limit |
|---|---|---|---|
| Side clearance | Top | 0.04 - 0.08 (0.002 - 0.003) | 0.11 (0.0043) |
| | 2nd | 0.03 - 0.07 (0.001 - 0.003) | 0.10 (0.0039) |
| | Oil ring | 0.015 - 0.185 (0.001 - 0.007) | — |
| End gap | Top | 0.20 - 0.30 (0.008 - 0.012) | 0.51 (0.020) |
| | 2nd | 0.50 - 0.65 (0.020 - 0.026) | 0.83 (0.033) |
| | Oil (rail ring) | 0.15 - 0.45 (0.006 - 0.018) | 0.78 (0.031) |

### Piston Pin

Unit: mm (in)

| Items | Standard | Limit |
|---|---|---|
| Piston pin outer diameter | 19.989 - 19.995 (0.7870 - 0.7872) | — |
| Piston to piston pin oil clearance | 0.002 - 0.006 (0.0001 - 0.0002) | — |
| Connecting rod bushing oil clearance | 0.005 - 0.023 (0.0002 - 0.0009) | 0.03 (0.0012) |

## CONNECTING ROD

Unit: mm (in)

| | | |
|---|---|---|
| Center distance | | 138.97 - 139.07 (5.47 - 5.48) |
| Bend [per 100 (3.94)] | Limit | 0.15 (0.0059) |
| Torsion [per 100 (3.94)] | Limit | 0.30 (0.0118) |
| Connecting rod bushing inner diameter[1] | | 20.000 - 20.012 (0.7874 - 0.7879) |
| Side clearance | Standard | 0.20 - 0.35 (0.0079 - 0.0138) |
| | Limit | 0.40 (0.0157) |

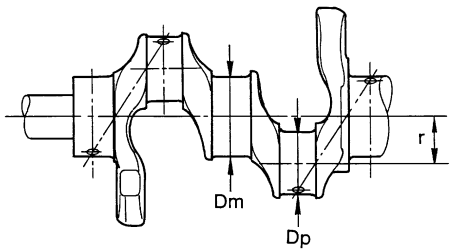
| | | |
|---|---|---|
| | Grade[2] | |
| Connecting rod big end diameter | Grade No. A | 47.000 - 47.001 (1.8504 - 1.8504) |
| | Grade No. B | 47.001 - 47.002 (1.8504 - 1.8505) |
| | Grade No. C | 47.002 - 47.003 (1.8505 - 1.8505) |
| | Grade No. D | 47.003 - 47.004 (1.8505 - 1.8505) |
| | Grade No. E | 47.004 - 47.005 (1.8505 - 1.8506) |
| | Grade No. F | 47.005 - 47.006 (1.8506 - 1.8506) |
| | Grade No. G | 47.006 - 47.007 (1.8506 - 1.8507) |
| | Grade No. H | 47.007 - 47.008 (1.8507 - 1.8507) |
| | Grade No. J | 47.008 - 47.009 (1.8507- 1.8507) |
| | Grade No. K | 47.009 - 47.010 (1.8507- 1.8508) |
| | Grade No. L | 47.010 - 47.011 (1.8508 - 1.8508) |
| | Grade No. M | 47.011 - 47.012 (1.8508 - 1.8509) |
| | Grade No. N | 47.012 - 47.013 (1.8509 - 1.8509) |

[1]: After installing in connecting rod

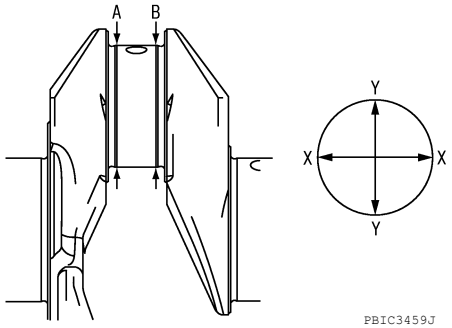
[2]: Always check with the Parts Department for the latest parts information.

## CRANKSHAFT

Unit: mm (in)



SEM645



PBIC3459J

| | | |
|---|---|---|
| Center distance “r” | | 40.41 - 40.49 (1.5909 - 1.5940) |
| Out-of-round (Difference between “X” and “Y”) | Limit | 0.0035 (0.0001) |
| Taper (Difference between “A” and “B”) | Limit | 0.0035 (0.0001) |
| Runout [TIR[1]] | Standard | 0.05 (0.0020) |
| | Limit | 0.10 (0.0040) |
| Crankshaft end play | Standard | 0.10 - 0.26 (0.0039 - 0.0102) |
| | Limit | 0.30 (0.012) |
| | Grade[2] | |

| | | |
|---|---|---|
| Pin journal diameter grade. “Dp” | Grade No. A | 43.970 - 43.971 (1.7311 - 1.7311) |
| | Grade No. B | 43.969 - 43.970 (1.7311 - 1.7311) |
| | Grade No. C | 43.968 - 43.969 (1.7310 - 1.7311) |
| | Grade No. D | 43.967 - 43.968 (1.7310 - 1.7310) |
| | Grade No. E | 43.966 - 43.967 (1.7309 - 1.7310) |
| | Grade No. F | 43.965 - 43.966 (1.7309 - 1.7309) |
| | Grade No. G | 43.964 - 43.965 (1.7309 - 1.7309) |
| | Grade No. H | 43.963 - 43.964 (1.7308 - 1.7309) |
| | Grade No. J | 43.962 - 43.963 (1.7308 - 1.7308) |
| | Grade No. K | 43.961 - 43.962 (1.7307 - 1.7308) |
| | Grade No. L | 43.960 - 43.961 (1.7307 - 1.7307) |
| | Grade No. M | 43.959 - 43.960 (1.7307 - 1.7307) |
| | Grade No. N | 43.958 - 43.959 (1.7306 - 1.7307) |
| | Grade No. P | 43.957 - 43.958 (1.7306 - 1.7306) |
| | Grade No. R | 43.956 - 43.957 (1.7305 - 1.7306) |
| | Grade No. S | 43.955 - 43.956 (1.7305 - 1.7305) |
| | Grade No. T | 43.954 - 43.955 (1.7305 - 1.7305) |
| | Grade No. U | 43.953 - 43.954 (1.7304 - 1.7305) |
| Main journal diameter grade. “Dm” | Grade No. A | 51.978 - 51.979 (2.0464 - 2.0464) |
| | Grade No. B | 51.977 - 51.978 (2.0463 - 2.0464) |
| | Grade No. C | 51.976 - 51.977 (2.0463 - 2.0463) |
| | Grade No. D | 51.975 - 51.976 (2.0463 - 2.0463) |
| | Grade No. E | 51.974 - 51.975 (2.0462 - 2.0463) |
| | Grade No. F | 51.973 - 51.974 (2.0462 - 2.0462) |
| | Grade No. G | 51.972 - 51.973 (2.0461 - 2.0462) |
| | Grade No. H | 51.971 - 51.972 (2.0461 - 2.0461) |
| | Grade No. J | 51.970 - 51.971 (2.0461 - 2.0461) |
| | Grade No. K | 51.969 - 51.970 (2.0460 - 2.0461) |
| | Grade No. L | 51.968 - 51.969 (2.0460 - 2.0460) |
| | Grade No. M | 51.967 - 51.968 (2.0459 - 2.0460) |
| | Grade No. N | 51.966 - 51.967 (2.0459 - 2.0459) |
| | Grade No. P | 51.965 - 51.966 (2.0459 - 2.0459) |
| | Grade No. R | 51.964 - 51.965 (2.0458 - 2.0459) |
| | Grade No. S | 51.963 - 51.964 (2.0458 - 2.0458) |
| | Grade No. T | 51.962 - 51.963 (2.0457 - 2.0458) |
| | Grade No. U | 51.961 - 51.962 (2.0457 - 2.0457) |
| | Grade No. V | 51.960 - 51.961 (2.0457 - 2.0457) |
| | Grade No. W | 51.959 - 51.960 (2.0456 - 2.0457) |

[1]: Total indicator reading.

[2]: Always check with the Parts Department for the latest parts information.

## MAIN BEARING

Unit: mm (in)

| Grade number* | Thickness | Identification color | Remarks |
|---|---|---|---|
| 0 | 1.996 - 1.999 (0.0786 - 0.0787) | Black | Grade and color are the same for upper and lower bearings. |
| 1 | 1.999 - 2.002 (0.0787 - 0.0788) | Brown | |
| 2 | 2.002 - 2.005 (0.0788 - 0.0789) | Green | |
| 3 | 2.005 - 2.008 (0.0789 - 0.0791) | Yellow | |
| 4 | 2.008 - 2.011 (0.0791 - 0.0792) | Blue | |
| 5 | 2.011 - 2.014 (0.0792 - 0.0793) | Pink | |
| 6 | 2.014 - 2.017 (0.0793 - 0.0794) | Purple | |
| 7 | 2.017 - 2.020 (0.0794 - 0.0795) | White | |

| | | | | |
|---|---|---|---|---|
| 01 | UPR | 1.996 - 1.999 (0.0786 - 0.0787) | Black | Grade and color are different between upper and lower bearings. |
| | LWR | 1.999 - 2.002 (0.0787 - 0.0788) | Brown | |
| 12 | UPR | 1.999 - 2.002 (0.0787 - 0.0788) | Brown | |
| | LWR | 2.002 - 2.005 (0.0788 - 0.0789) | Green | |
| 23 | UPR | 2.002 - 2.005 (0.0788 - 0.0789) | Green | |
| | LWR | 2.005 - 2.008 (0.0789 - 0.0791) | Yellow | |
| 34 | UPR | 2.005 - 2.008 (0.0789 - 0.0791) | Yellow | |
| | LWR | 2.008 - 2.011 (0.0791 - 0.0792) | Blue | |
| 45 | UPR | 2.008 - 2.011 (0.0791 - 0.0792) | Blue | |
| | LWR | 2.011 - 2.014 (0.0792 - 0.0793) | Pink | |
| 56 | UPR | 2.011 - 2.014 (0.0792 - 0.0793) | Pink | |
| | LWR | 2.014 - 2.017 (0.0793 - 0.0794) | Purple | |
| 67 | UPR | 2.014 - 2.017 (0.0793 - 0.0794) | Purple | |
| | LWR | 2.017 - 2.020 (0.0794 - 0.0795) | White | |

*: Always check with the Parts Department for the latest parts information.

Undersize

Unit: mm (in)

| Item | Thickness | Main journal diameter |
|---|---|---|
| US 0.25 (0.0098) | 2.126 - 2.134 (0.0837 - 0.0840) | Grind so that bearing clearance is the specified value. |

Bearing Oil Clearance

Unit: mm (in)

| | | | |
|---|---|---|---|
| Main bearing oil clearance | Standard | No. 1, 4 and 5 | 0.024 - 0.034 (0.0009 - 0.0013) |
| | | No. 2 and 3 | 0.012 - 0.022 (0.0005 - 0.0009) |
| | Limit | | 0.065 (0.0026) |

## CONNECTING ROD BEARING

| Grade number* | | Thickness mm (in) | Identification color | Remarks |
|---|---|---|---|---|
| 0 | | 1.494 - 1.497 (0.0588 - 0.0589) | Black | Grade and color are the same for upper and lower bearings. |
| 1 | | 1.497 - 1.500 (0.0589 - 0.0591) | Brown | |
| 2 | | 1.500 - 1.503 (0.0591 - 0.0592) | Green | |
| 3 | | 1.503 - 1.506 (0.0592 - 0.0593) | Yellow | |
| 4 | | 1.506 - 1.509 (0.0593 - 0.0594) | Blue | |
| 01 | UPR | 1.494 - 1.497 (0.0588 - 0.0589) | Black | Grade and color are different between upper and lower bearings. |
| | LWR | 1.497 - 1.500 (0.0589 - 0.0591) | Brown | |
| 12 | UPR | 1.497 - 1.500 (0.0589 - 0.0591) | Brown | |
| | LWR | 1.500 - 1.503 (0.0591 - 0.0592) | Green | |
| 23 | UPR | 1.500 - 1.503 (0.0591 - 0.0592) | Green | |
| | LWR | 1.503 - 1.506 (0.0592 - 0.0593) | Yellow | |
| 34 | UPR | 1.503 - 1.506 (0.0592 - 0.0593) | Yellow | |
| | LWR | 1.506 - 1.509 (0.0593 - 0.0594) | Blue | |

*: Always check with the Parts Department for the latest parts information.

Undersize

Unit: mm (in)

| Item | Thickness | Crank pin journal diameter |
|---|---|---|
| US 0.25 (0.0098) | 1.623 - 1.631 (0.0639 - 0.0642) | Grind so that bearing clearance is the specified value. |

Bearing Oil Clearance

Unit: mm (in)

| | | |
|---|---|---|
| Connecting rod bearing oil clearance | Standard | 0.037 - 0.047 (0.0015 - 0.0019) |
| | Limit | 0.07 (0.0028) |

# SERVICE INFORMATION

## PRECAUTIONS

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

INFOID:0000000007401881

The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted.
Information necessary to service the system safely is included in the SRS 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 WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

**WARNING:**

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

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

INFOID:0000000007401882

**NOTE:**

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the ″LOCK″ position.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.
For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.
If steering wheel rotation is required when battery power is interrupted, follow the procedure below before starting the repair operation.

#### OPERATION PROCEDURE

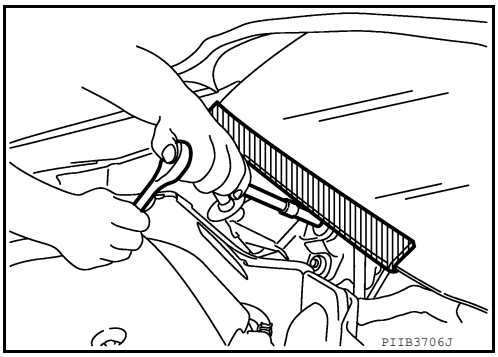
1. Connect both battery cables.
   **NOTE:**
   Supply power using jumper cables if battery is discharged.
2. Use the Intelligent Key or mechanical key to turn the ignition switch to the ″ACC″ position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.

5. When the repair work is completed, return the ignition switch to the ″LOCK″ position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT.

## Precaution for Procedure without Cowl Top Cover

INFOID:0000000007401883

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




## Precaution for Draining Coolant

INFOID:0000000007401884

- Drain coolant when engine is cooled.

## Precaution for Disconnecting Fuel Piping

INFOID:0000000007401885

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

## Precaution for Removal and Disassembly

INFOID:0000000007401886

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful operations.
- Use maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and 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, follow the specifications.

## Precaution for Inspection, Repair and Replacement

INFOID:0000000007401887

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

## Precaution for Assembly and Installation

INFOID:0000000007401888

- Use torque wrench to tighten bolts or nuts.
- 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, follow the specifications.
- Always replace the old with a 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.
- Bleed the air trapped within the system after draining the 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.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage or rattles.

## Parts Requiring Angular Tightening

INFOID:0000000007401889

- Use an angle wrench for the final tightening of the following engine parts.

- Cylinder head bolts
- Lower cylinder block bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)

• Do not use a torque value for final tightening.
• The torque value for these parts are for a preliminary step.
• Ensure thread and seat surfaces are clean and coated with engine oil.

## Precaution for Liquid Gasket

INFOID:0000000007401890

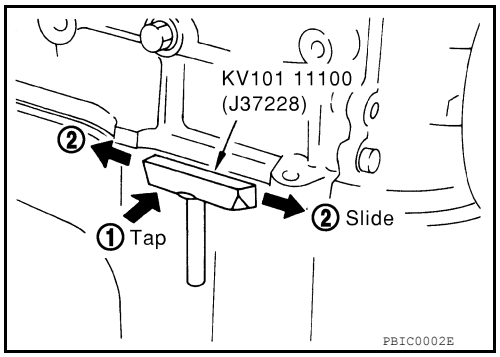
### REMOVAL OF LIQUID GASKET SEALANT

• After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

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

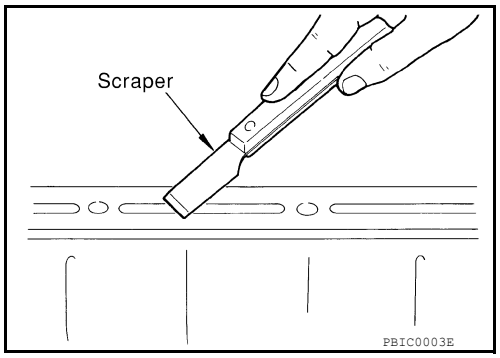
**CAUTION:**
**Be careful not to damage the mating surfaces.**

• In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the RTV Silicone Sealant is applied. Use a plastic hammer to slide the cutter (2) by tapping on the side.




### LIQUID GASKET APPLICATION PROCEDURE

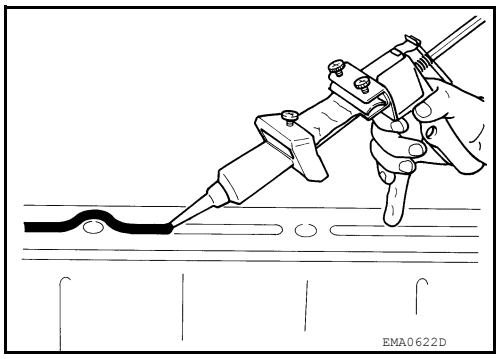
1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
   • Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating 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-44, "Recommended Chemical Product and Sealant".**



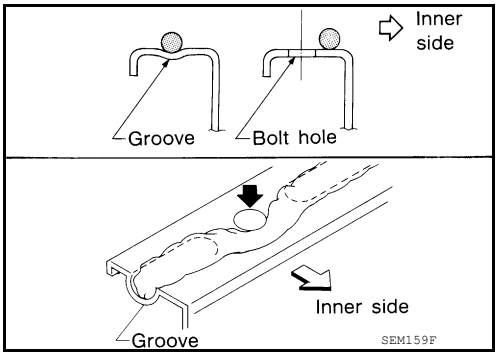

4. Apply the sealant using Tool without breaks to the specified location.

**Tube presser 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.



- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to MA-15.



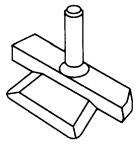
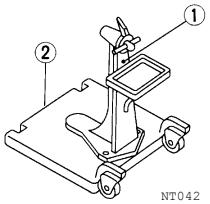
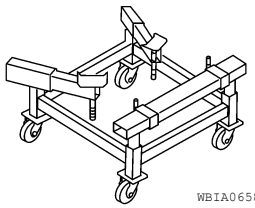
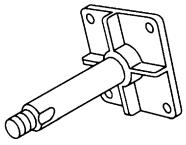
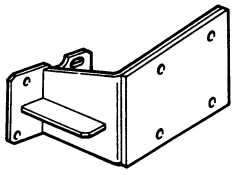
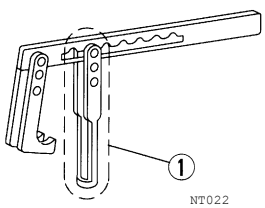

**CAUTION:**
**Carefully follow all of the warnings, cautions, notes, and procedures contained in this manual.**

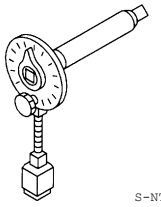
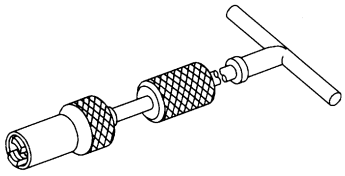
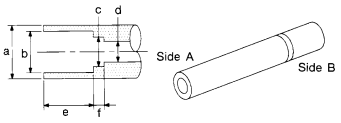
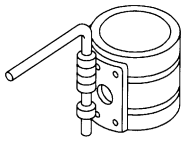
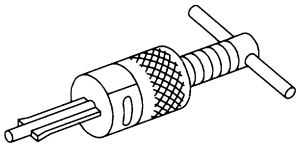
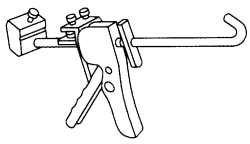
# PREPARATION

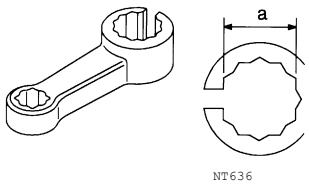
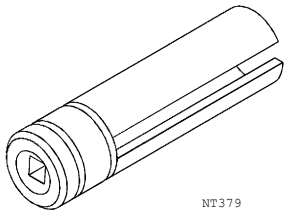
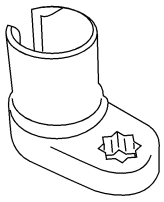
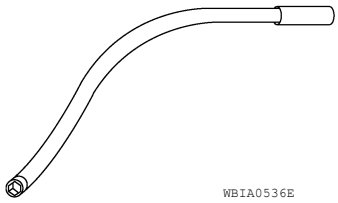
## Special Service Tool

INFOID:0000000007401891

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

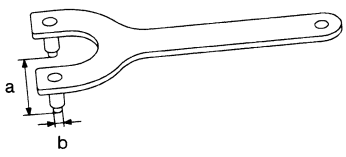
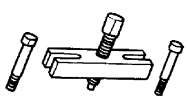
| Tool number<br>(Kent-Moore No.)<br>Tool name | Description |
|---|---|
| KV10111100<br>(J-37228)<br>Seal cutter<br><br>S-NT046 | Removing steel oil pan and rear timing chain case |
| ST0501S000<br>Engine stand assembly<br>1. ST05011000<br>( — )<br>Engine stand<br>2. ST05012000<br>( — )<br>Base<br><br>NT042 | Disassembling and assembling |
| KV101J0010<br>(J-47242)<br>Engine support table<br><br>WBIA0658E | Removal engine and transmission assembly |
| KV10106500<br>( — )<br>Engine stand shaft<br><br>NT028 | |
| KV10115300<br>( — )<br>Engine sub-attachment<br><br>ZZA1078D | |
| KV10116200<br>(J-26336-B)<br>Valve spring compressor<br>1. KV10115900<br>(J-26336-20)<br>Attachment<br><br>NT022 | Disassembling valve mechanism |

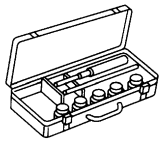
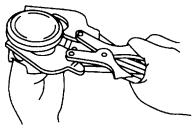
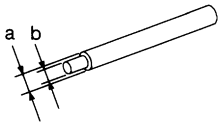
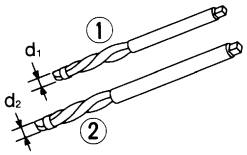
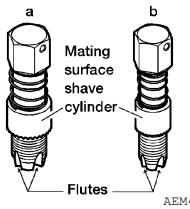
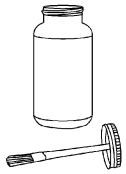
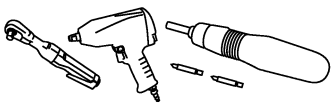
| Tool number (Kent-Moore No.) Tool name | Description |
|---|---|
| KV10112100 (BT-8653-A) Angle wrench  S-NT014 | Tightening bolts for bearing cap, cylinder head, etc. |
| KV10107902 (J-38959) Valve oil seal puller  S-NT011 | Removing valve oil seal |
| KV10115600 (J-38958) Valve oil seal drift   S-NT603 | Installing valve oil seal<br>**Use side A.**<br>**a: 20 (0.79) dia.** **d: 8 (0.31) dia.**<br>**b: 13 (0.51) dia.** **e: 10.7 (0.421) dia.**<br>**c: 10.3 (0.406) dia.** **f: 5 (0.20) dia.**<br>Unit: mm (in) |
| EM03470000 (J-8037) Piston ring compressor  S-NT044 | Installing piston assembly into cylinder bore |
| ST16610001 (J-23907) Pilot bushing puller  S-NT045 | Removing crankshaft pilot bushing |
| WS39930000 ( — ) Tube presser  S-NT052 | Pressing the tube of liquid gasket |
| 16441 6N210 (J-45488) Quick connector release  PBIC0198E | Removing fuel tube quick connectors in engine room<br>(Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210) |

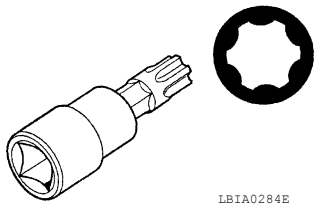
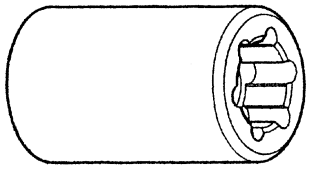
| Tool number (Kent-Moore No.) Tool name | Description |
|---|---|
| KV10114400 (J-38365) Heated oxygen sensor wrench   NT636 | Loosening or tightening rear heated oxygen sensor **a: 22 mm (0.87 in)** |
| KV10117100 (J-36471-A) Heated oxygen sensor wrench  NT379 | Loosening or tightening heated oxygen sensor **For 22 mm (0.87 in) hexagon nut** |
| KV991J0050 (J-44626) Air fuel ratio (A/F) sensor wrench  LEM054 | Loosening or tightening air fuel ratio (A/F) sensor 1 |
| — (J-46535) Drive belt tension releaser  WBIA0536E | Releasing drive belt tension |

## Commercial Service Tool

INFOID:0000000007401892

| Tool number (Kent-Moore No.) Tool name | Description |
|---|---|
| Pulley holder   NT628 | Crankshaft pulley removing and installing **a: 68 mm (2.68 in) dia.** **b: 8 mm (0.31 in) dia.** |
| Crank puller  ZZA0010D | Crankshaft pulley removing |

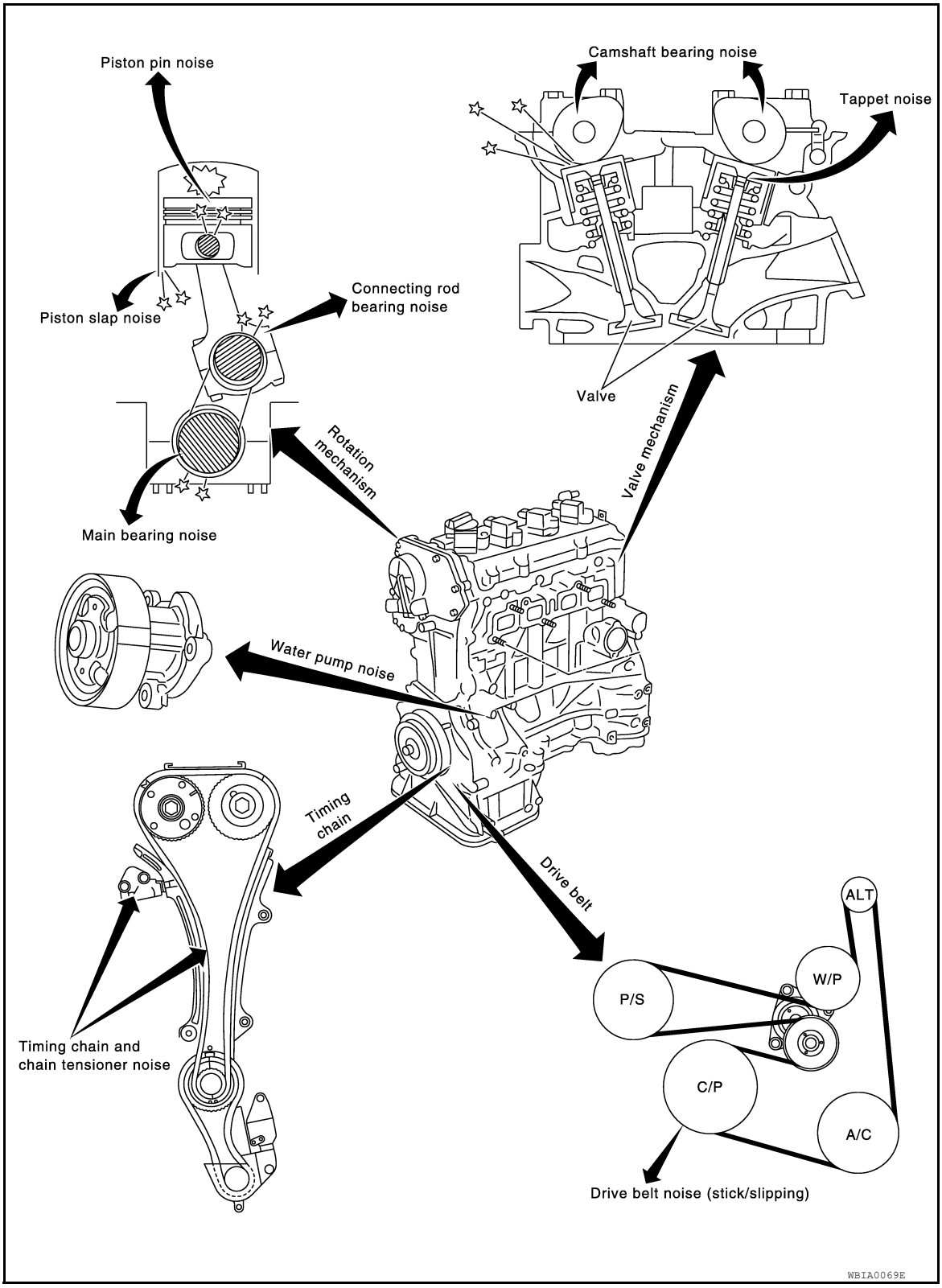
| Tool number (Kent-Moore No.) Tool name | Description |
|---|---|
| Valve seat cutter set  S-NT048 | Finishing valve seat dimensions |
| Piston ring expander  S-NT030 | Removing and installing piston ring |
| Valve guide drift   S-NT015 | Removing and installing valve guide<br>**Intake & Exhaust:**<br>**a: 9.5 mm (0.374 in) dia.**<br>**b: 5.5 mm (0.217 in) dia.** |
| Valve guide reamer   S-NT016 | 1: Reaming valve guide inner hole<br>2: Reaming hole for oversize valve guide<br>**Intake & Exhaust:**<br>**d1: 6.0 mm (0.236 in) dia.**<br>**d2: 10.2 mm (0.402 in) dia.** |
| (J-43897-18)<br>(J-43897-12)<br>Oxygen sensor thread cleaner   AEM488 | Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.)<br>**a: J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor**<br>**b: J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor** |
| Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489 | Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads |
| Power tool  PIIB1407E | Loosening nuts, screws and bolts |

| Tool number<br>(Kent-Moore No.)<br>Tool name | Description |
|---|---|
| TP55 plus Bit<br><br>LBIA0284E | Removing and installing M/T flywheel bolts |
| E20 socket<br>(J-45816)<br><br>LBIA0285E | Removing and installing CVT drive plate bolts |

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

## NVH Troubleshooting - Engine Noise

INFOID:0000000007401893




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

INFOID:0000000007401894

1. Locate the area where noise occurs.
2. Confirm the type of noise.

3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

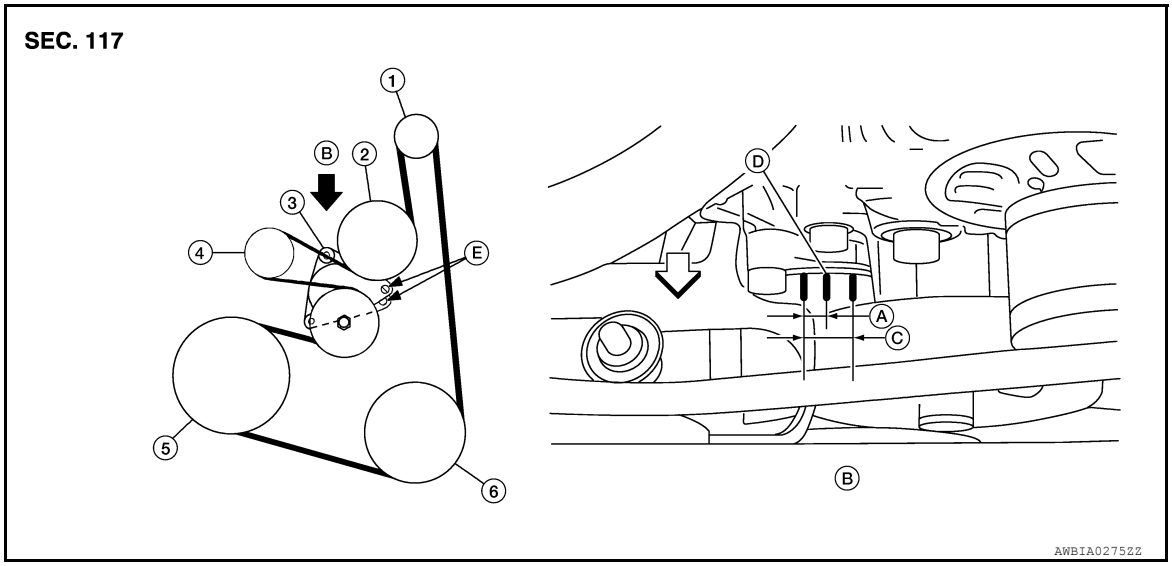
| Location of noise | Type of noise | Operating condition of engine | | | | | | Source of noise | Check item | Reference page |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Before warm-up | After warm-up | When starting | When idling | When racing | While driving | | | |
| Top of engine Rocker cover Cylinder head | Ticking or clicking | C | A | — | A | B | — | Tappet noise | Valve clearance | EM-162 |
| | Rattle | C | A | — | A | B | C | Camshaft bearing noise | Camshaft journal clearance<br>Camshaft runout | EM-154<br>EM-154 |
| Crankshaft pulley Cylinder block (Side of engine) Oil pan | Slap or knock | — | A | — | B | B | — | Piston pin noise | Piston and piston pin clearance<br>Connecting rod bushing clearance | EM-204<br>EM-204 |
| | 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 | EM-204<br>EM-204<br>EM-204<br>EM-204 |
| | Knock | A | B | C | B | B | B | Connecting rod bearing noise | Connecting rod bushing clearance (Small end)<br>Connecting rod bearing clearance (Big end) | EM-204<br>EM-204 |
| | Knock | A | B | — | A | B | C | Main bearing noise | Main bearing oil clearance<br>Crankshaft runout | EM-204<br>EM-204 |
| Front of engine Timing chain cover | Tapping or ticking | A | A | — | B | B | B | Timing chain and chain tensioner noise | Timing chain cracks and wear<br>Timing chain tensioner operation | EM-165 |
| Front of engine | Squeaking or fizzing | A | B | — | B | — | B | Drive belts (Sticking or slipping) | Drive belts deflection | EM-130 |
| | Creaking | A | B | A | B | A | B | Drive belts (Slipping) | Idler pulley bearing operation | |
| | Squall Creak | A | B | — | B | A | B | Water pump noise | Water pump operation | CO-38 |

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

# DRIVE BELTS

## Checking Drive Belts

INFOID:0000000007401895




1. Generator pulley
2. Water pump pulley
3. Drive belt auto-tensioner
4. Idler pulley
5. Crankshaft pulley
6. A/C compressor pulley
A. Allowable use range (new belt)
B. View B
C. Allowable use range
D. Indicator (notch)
E. Temporary retaining boss

**WARNING:**
**Inspect the drive belt only when the engine is stopped.**

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

**NOTE:**
- Check the drive belt auto-tensioner indicator (notch) when the engine is cold.
- When the new drive belt is installed, the range of possible use should be as shown.
- Visually check entire belt for wear, damage or cracks.
- If the indicator is out of allowable use range or belt is damaged, replace the drive belt.

## Tension Adjustment

INFOID:0000000007401896

Belt tension is not manually adjustable, it is automatically adjusted by the drive belt auto-tensioner.

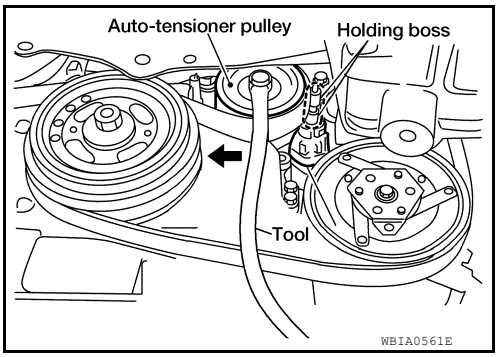
## Removal and Installation

INFOID:0000000007401897

### REMOVAL

1. Remove the splash shield (RH). Refer to EI-23, "Component".
2. Securely hold the hexagonal part in pulley center of drive belt auto-tensioner, move in the direction of arrow (loosening direction of tensioner) using Tool.

**Tool number : — (J-46535)**




**WARNING:**
**Never place hand in a location where pinching may occur if the holding tool accidentally comes off.**

**CAUTION:**
- **Do not loosen the auto-tensioner pulley bolt.**
- **Do not turn the auto-tensioner pulley bolt counterclockwise.**

- **If the auto-tensioner pulley bolt is turned counterclockwise for any reason, the auto-tensioner and pulley must be replaced as a unit.**

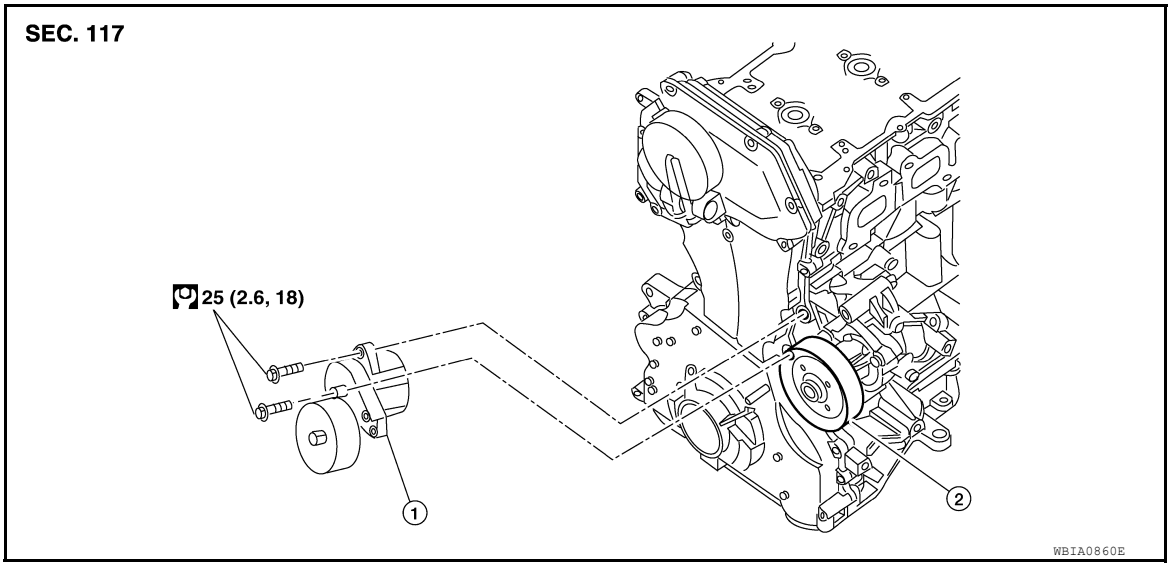
3. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of tensioner into retaining boss to lock tensioner pulley.
   - Leave tensioner pulley arm locked until belt is installed again.
4. Remove drive belt.

## INSTALLATION

1. Install the drive belt onto all of the pulleys except for the water pump pulley. Install the drive belt onto water pump pulley last.
   **CAUTION:**
   **Confirm drive belt is completely set on the pulleys.**
2. Release drive belt auto-tensioner, and apply tension to drive belt.
   **WARNING:**
   **Never place hand in a location where pinching may occur if the holding tool accidentally comes off.**
   **CAUTION:**
   **Ensure the drive belt and each groove on the pulley are free from all engine oil, coolant and other contaminants.**
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm tension of drive belt at indicator is within the allowable use range. Refer to EM-130, "Checking Drive Belts".
5. Install the splash shield (RH). Refer to EI-23, "Component".

# Removal and Installation of Drive Belt Auto-tensioner

INFOID:0000000007401898




1. Drive belt auto-tensioner
2. Water pump pulley

## REMOVAL

**CAUTION:**
**The complete auto-tensioner must be replaced as a unit, including the pulley.**

1. Remove the RH front wheel and tire. Refer to WT-7, "Adjustment".
2. Remove the drive belt EM-130, "Removal and Installation".
3. Remove the engine room cover.
4. Remove the engine coolant reservoir.
5. Support the engine and remove the engine mounting insulator and bracket (RH). Refer to EM-186, "Removal and Installation".
6. Remove the drive belt auto-tensioner.

**CAUTION:**
- **Do not loosen the auto-tensioner pulley bolt.**
- **Do not turn the auto-tensioner pulley bolt counterclockwise.**
- **If the auto-tensioner pulley bolt is turned counterclockwise for any reason, the auto-tensioner and pulley must be replaced as a unit.**

## INSTALLATION

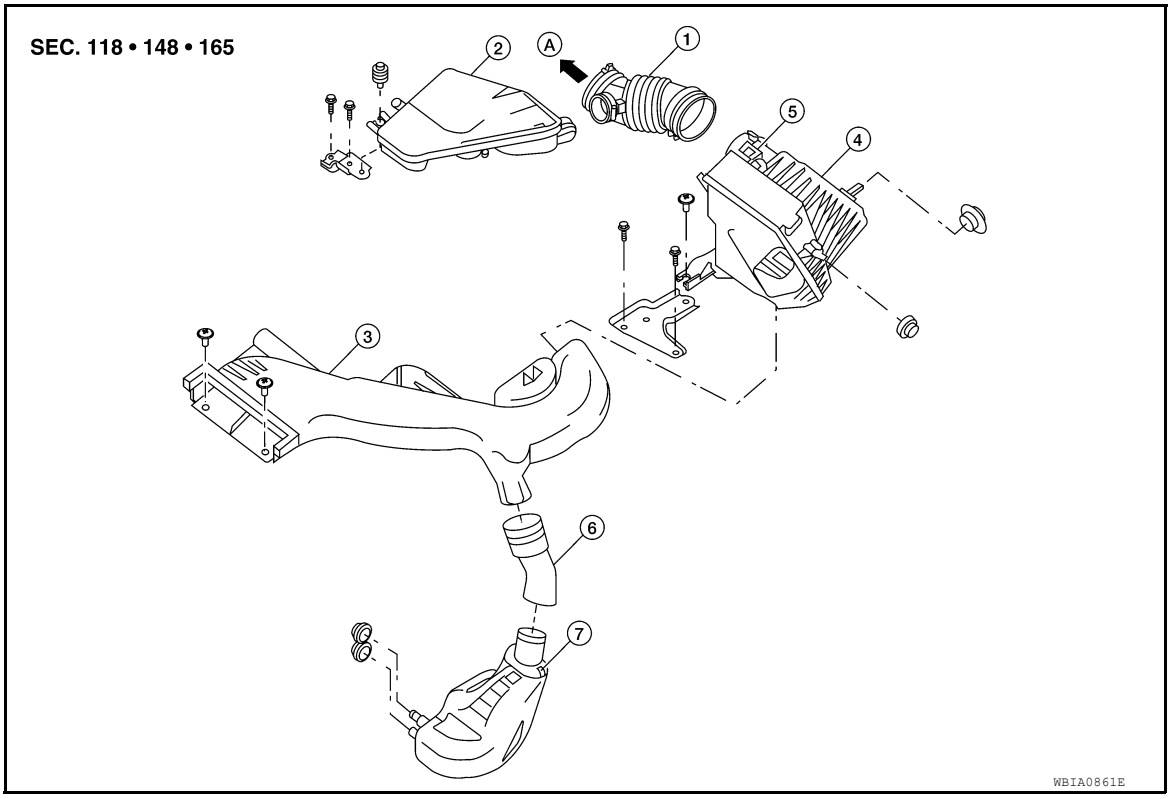
Installation is in the reverse order of removal.

**CAUTION:**
- **If there is damage greater than peeled paint, replace drive belt auto-tensioner units**
- **Install the drive belt auto-tensioner carefully so not to damage the water pump pulley.**
- **Do not swap the pulley between the new and old auto-tensioner units**

# AIR CLEANER AND AIR DUCT

## Removal and Installation

INFOID:0000000007401899




1. Electric throttle control actuator tube
2. Resonator
3. Front air duct
4. Air cleaner case
5. Mass air flow sensor
6. Resonator tube
7. Resonator in fender
A. To electric throttle control actuator

### REMOVAL

1. Remove the battery tray. Refer to SC-9, "Removal and Installation (QR25DE Battery Tray)".
2. Remove the engine room cover.
3. Disconnect the mass air flow sensor electrical connector.
4. Disconnect the tube clamp at the electric throttle control actuator and the fresh air intake tube.
5. Remove air cleaner to electric throttle control actuator tube, air cleaner case, with mass air flow sensor attached.
   • Add marks as necessary for easier installation.
6. Remove mass air flow sensor from air cleaner case, as necessary.
   **CAUTION:**
   **Handle the mass air flow sensor with care:**
   **• Do not shock it.**
   **• Do not disassemble it.**
   **• Do not touch the internal sensor.**
7. Remove the resonator in the fender, if necessary.

a. Remove the left front wheel and tire. Refer to WT-7, "Adjustment".
b. Partially remove the left front fender protector. Refer to EI-24, "Removal and Installation".
c. Remove the left hand side splash shield. Refer to EI-24, "Removal and Installation".
d. Remove the engine undercover. Refer to EI-15, "Removal and Installation".

### INSTALLATION

Installation is in the reverse order of removal.

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

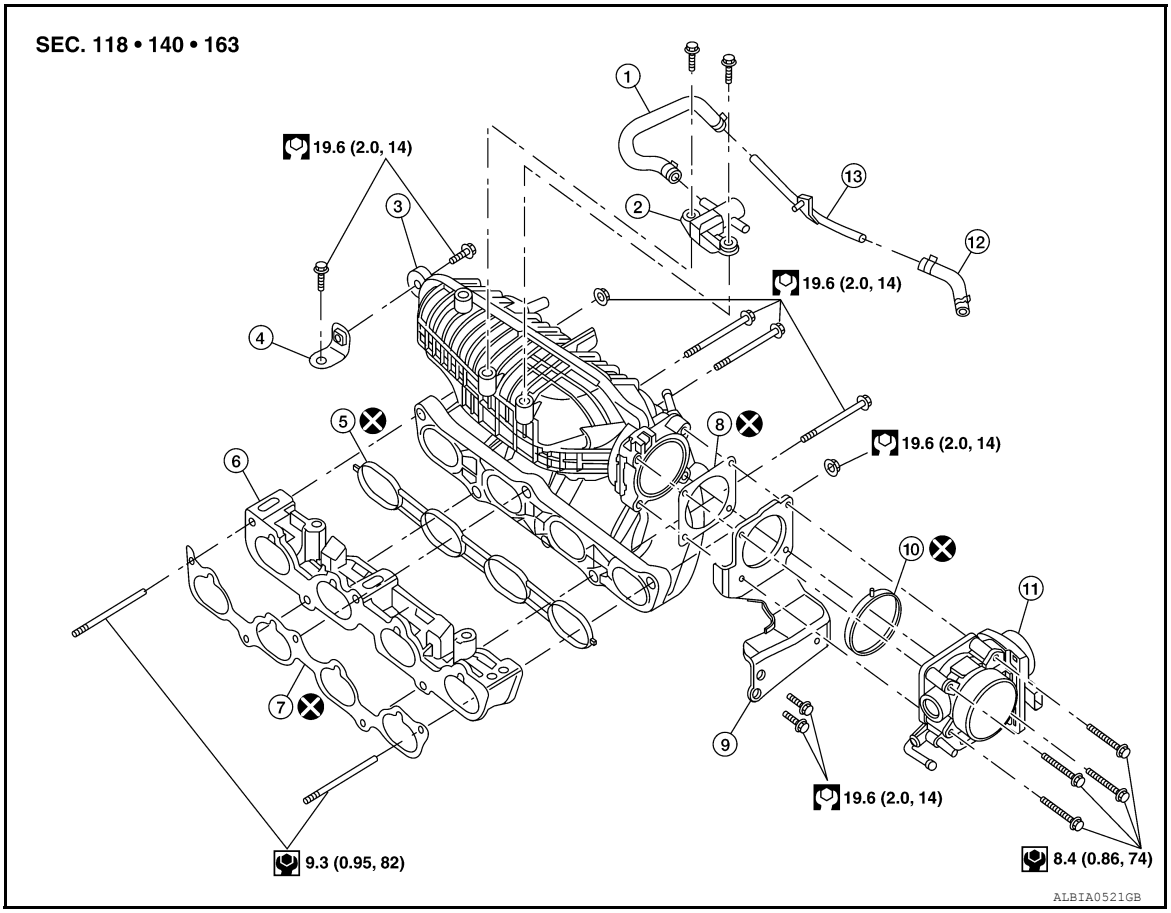
## CHANGING AIR CLEANER FILTER

1. Depress the air cleaner case lid side clips and remove the air cleaner case lid.
2. Remove the air cleaner filter.
3. Install a new air cleaner filter.
4. Installation is in the reverse order of removal.

# INTAKE MANIFOLD

## Removal and Installation

INFOID:0000000007401900




1. EVAP hose
2. EVAP canister purge volume control solenoid
3. Intake manifold
4. Intake manifold support (front)
5. Rubber seal
6. Intake manifold adapter
7. Gasket
8. Gasket
9. Intake manifold support (rear)
10. Rubber seal
11. Electric throttle control actuator
12. PCV hose
13. EVAP tube

### REMOVAL

**WARNING:**

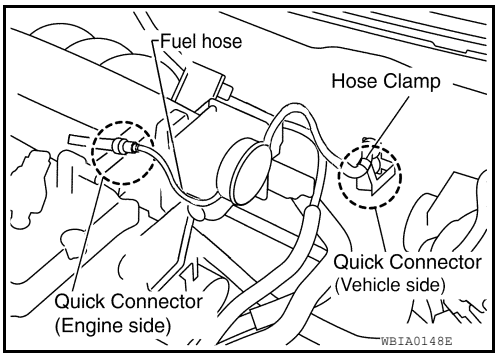
**To avoid the danger of being scalded, never drain the coolant when the engine is hot.**

1. Remove the engine room cover.
2. Release the fuel pressure. Refer to EC-1208, "Fuel Pressure Check".
3. Drain engine coolant from the radiator. Refer to CO-43, "Changing Engine Coolant".
   **CAUTION:**
   **Perform this step when engine is cold.**
   **NOTE:**
   This step necessary only when removing electric throttle control actuator from the vehicle.
4. Remove the battery tray. Refer to SC-9, "Removal and Installation (QR25DE Battery Tray)".
5. Disconnect the MAF sensor electrical connector.
6. Remove air cleaner case and air duct assembly. Refer to EM-133, "Removal and Installation".
7. Remove cowl top. Refer to EI-21, "Removal and Installation".
8. Disconnect the following components at the intake side:
   - PCV hose
   - EVAP canister purge volume control solenoid
   - Electric throttle control actuator

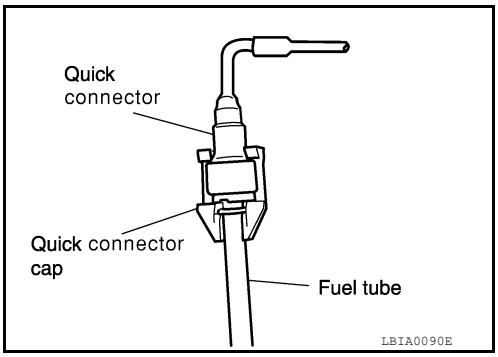
- Brake booster vacuum hose

9. Disconnect the fuel quick connector on the engine side.
   - Using Tool perform the following steps to disconnect the quick connector.

**Tool number : 16441 6N210 (J-45488)**



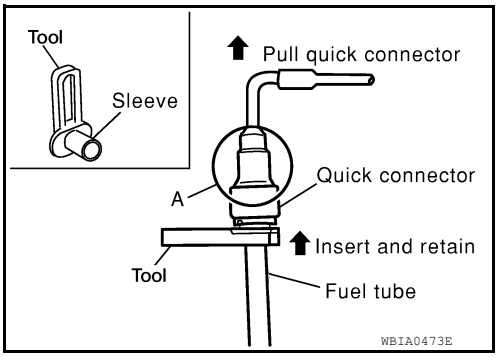

a. Remove quick connector cap.




b. With the sleeve side of Tool facing quick connector, install Tool onto fuel tube.

c. Insert Tool into quick connector until sleeve contacts and goes no further. Hold the Tool on that position.

**CAUTION:**
**Inserting the Tool hard will not disconnect quick connector. Hold Tool where it contacts and goes no further.**



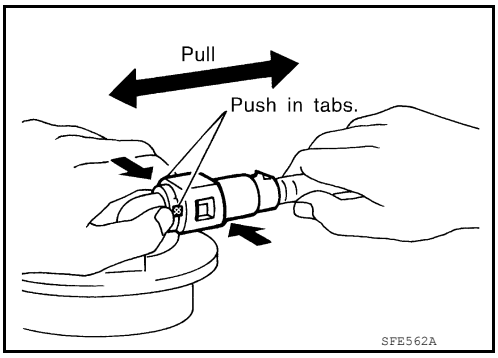

d. Pull the quick connector straight out from the fuel tube.

**CAUTION:**
- **Pull quick connector holding it at the "A" position, as shown.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Do not reuse O-ring.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Be sure to cover openings of disconnected pipes with plug or plastic bag to avoid fuel leakage and entry of foreign materials.**

10. When removing fuel hose quick connector at vehicle piping side, perform as follows.

a. Remove quick connector cap.

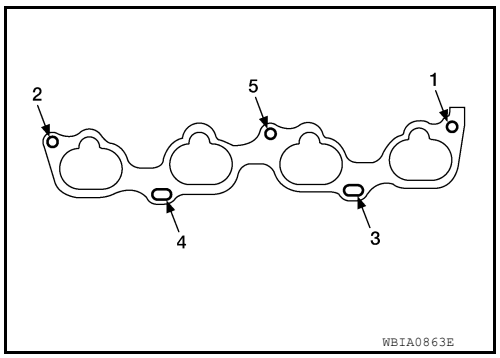
b. Hold the sides of the connector, push in tabs and pull out the tube. (The figure is shown for reference only.)
   - If the connector and the tube are stuck together, push and pull several times until they start to move. Then disconnect them by pulling.




**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 liquid such as battery electrolyte etc. from getting on the resin tube.**
- **Do not bend or twist the tube during installation and removal.**
- **Do not remove the remaining retainer on tube.**

- **When the tube is replaced, also replace the retainer with a new one.**
  **Retainer color: Green.**
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.**

11. Remove EVAP canister purge volume control solenoid valve.
12. Loosen mounting bolts diagonally, reposition the electric throttle control actuator and position aside without disconnecting the coolant hoses.
    **CAUTION:**
    - **Handle carefully to avoid any shock to electric throttle control actuator.**
    - **Never disassemble.**
13. Disconnect intake manifold collector harness, and vacuum hose.
    **CAUTION:**
    **Cover engine openings to avoid entry of foreign materials.**
14. Loosen the bolts in the order shown to remove the intake manifold assembly, using power tools.




## Inspection After Removal

**Surface Distortion**

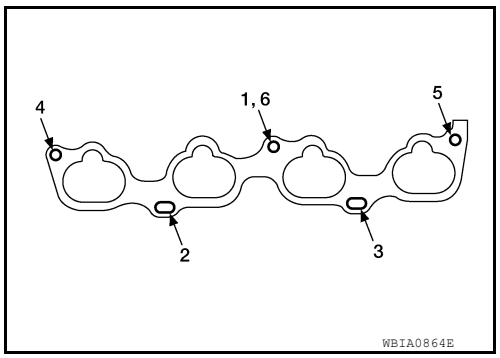
- Using straightedge and feeler gauge, inspect surface distortion of intake manifold adapter and intake manifold surface.

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

## INSTALLATION

Tighten the intake manifold bolts and nuts in the numerical order as shown.

**CAUTION:**
**After tightening No.5, retighten the No.1 bolt to specification.**




Tightening Intake Manifold Support Bolts

- Tighten the intake manifold support bolts following the tightening sequence below.
- Temporarily tighten the intake manifold support (rear) bolts.
- Tighten the electric throttle control actuator bolts.
- Tighten the intake manifold support (rear) bolts.
- Temporarily tighten the intake manifold support (front) bolts (intake manifold side).
- Tighten the intake manifold support (front) bolts (engine side).
- Tighten the intake manifold support (front) bolts (intake manifold side).

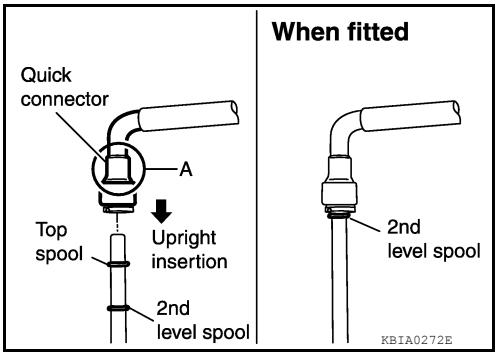
**Installation of Electric Throttle Control Actuator**:

- Tighten the mounting bolts of electric throttle control actuator equally and diagonally in several steps.
- After installation perform procedure in "INSPECTION AFTER INSTALLATION".

CONNECTING QUICK CONNECTOR ON THE FUEL HOSE (ENGINE SIDE)

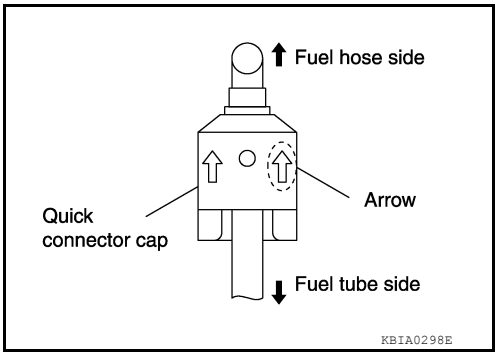
1. Make sure no foreign substances are deposited in and around the fuel tube and quick connector, and there is no damage to them.
2. Thinly apply new engine oil around the fuel tube tip end.
3. Align center to insert quick connector straight into fuel tube.
   - Insert fuel tube into quick connector until the top spool on fuel tubes is inserted completely and the second level spool is positioned slightly below the quick connector bottom end.

   **CAUTION:**
   - **Hold at position "A" as shown, when inserting the fuel tube into the quick connector.**
   - **Carefully align to center to avoid inclined insertion to prevent damage to the O-ring inside the quick connector.**
   - **Do not reuse O-ring.**
   - **Insert the fuel tube until you hear a “click” sound and actually feel the engagement.**
   - **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**



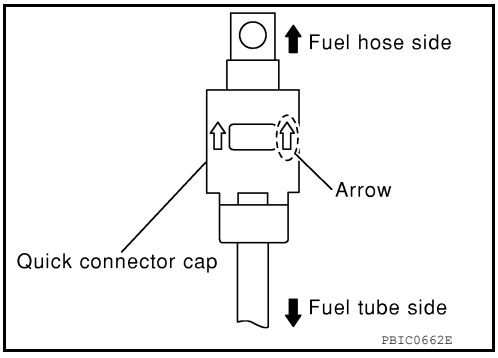

4. Before clamping the fuel hose with the hose clamp, pull the quick connector hard by hand, holding at the "A" position, as shown. Make sure it is completely engaged (connected) so that it does not come off of the fuel tube.

   **NOTE:**
   Recommended pulling force is 50 N (5.1 kg-f, 11.2 lb-f).
5. Install quick connector cap on quick connector joint.
   - Direct arrow mark on quick connector cap to upper side (fuel hose side).
6. Install fuel hose to hose clamp.




CONNECTING QUICK CONNECTOR ON THE FUEL HOSE (VEHICLE PIPING SIDE)

1. Make sure no foreign substances are deposited in and around the fuel tube and quick connector, and there is no damage to them.
2. Align center to insert quick connector straight into fuel tube.
   - Insert fuel tube until a click is heard.
   - Install quick connector cap on quick connector joint. Direct arrow mark on quick connector cap upper side.
   - Install fuel hose to hose clamp.




## 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.

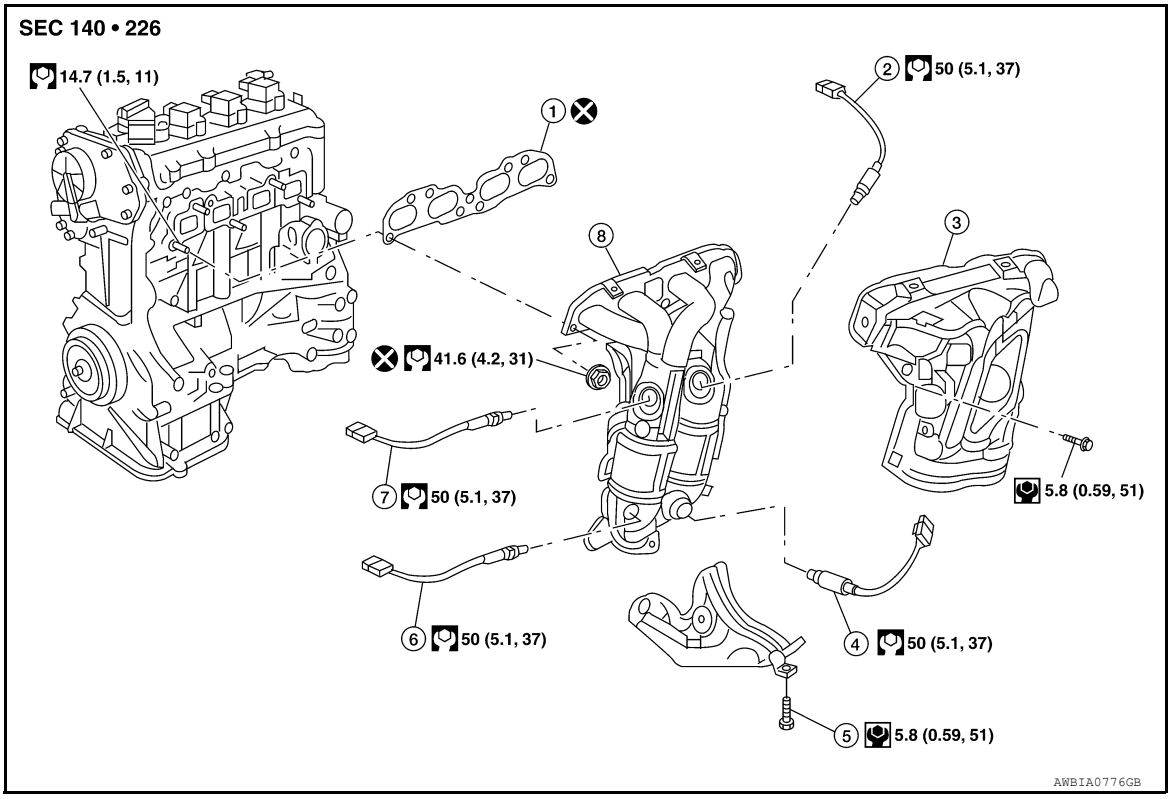
   **CAUTION:**
   **Do not touch engine immediately after stopping as engine is extremely hot.**
   **NOTE:**
   Use mirrors for checking on connections out of the direct line of sight.
   - Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to EC-1206, "Throttle Valve Closed Position Learning".

- If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to EC-1206, "Idle Air Volume Learning".

# EXHAUST MANIFOLD AND THREE WAY CATALYST

## Removal and Installation

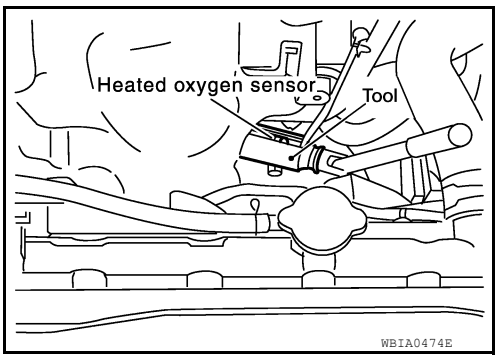
INFOID:0000000007401901




1. Exhaust manifold gasket
2. Heated oxygen sensor 1
3. Exhaust manifold cover (upper and lower)
4. Air fuel ratio (A/F) sensor 1
5. Exhaust manifold cover lower bolt
6. Air fuel ratio (A/F) sensor 2
7. Heated oxygen sensor 2
8. Exhaust manifold assembly

### REMOVAL

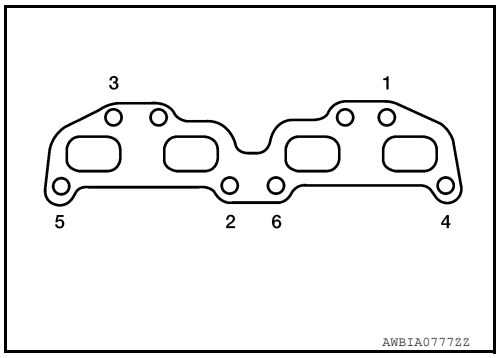
1. Remove the engine undercover. Refer to EI-15, "Removal and Installation".
2. Remove the splash shield (RH). Refer to EI-23, "Component".
3. Remove the front air duct. Refer to EM-133, "Removal and Installation".
4. Remove generator and generator bracket. Refer to SC-42, "Removal and Installation QR25DE".
5. Remove the exhaust front tube. Refer to EX-11, "Component".
6. Remove oil level indicator tube.
7. Disconnect the electrical connector of heated oxygen sensor 1 or air fuel ratio (A/F) sensor 1, and unhook the harness from the bracket and middle clamp on the cover.
8. Remove the heated oxygen sensor 1 or air fuel ratio (A/F) sensor 1 using Tool.




**Tool numbers : KV991J0050 (J-44626)**
**: KV10117100 (J-36471-A)**

**CAUTION:**
- **Be careful not to damage heated oxygen sensor or air fuel ratio (A/F) sensor.**
- **Discard any heated oxygen sensor or air fuel ratio (A/F) 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; use a new one.**

9. Remove the lower exhaust manifold covers.
10. Remove the upper exhaust manifold cover.
11. Loosen the nuts in reverse order as shown, on the exhaust manifold and three way catalyst.
12. Remove the exhaust manifold and three way catalyst assembly and gasket. Discard the gasket.

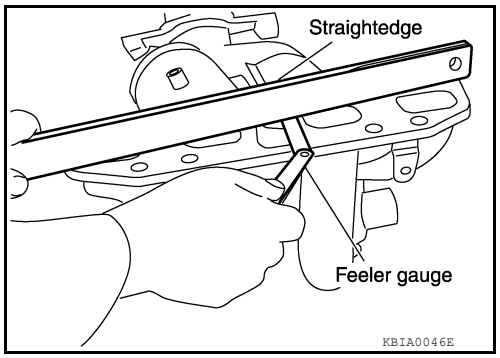



## INSPECTION AFTER REMOVAL

**Surface Distortion**

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

**Limit : 0.7 mm (0.0276 in)**

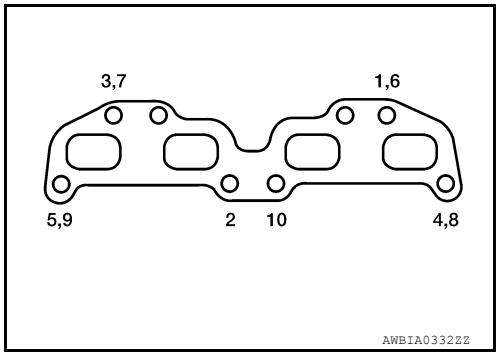



## INSTALLATION

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

**Tightening Exhaust Manifold Nuts**

- Tighten the nuts in the numerical order shown, to specification.




**Installation of A/F Sensors and Heated Oxygen Sensors**

Clean the A/F sensor and heated oxygen sensor threads with the Tool, then apply the anti-seize lubricant to the threads before installing the A/F sensor and heated oxygen sensors.

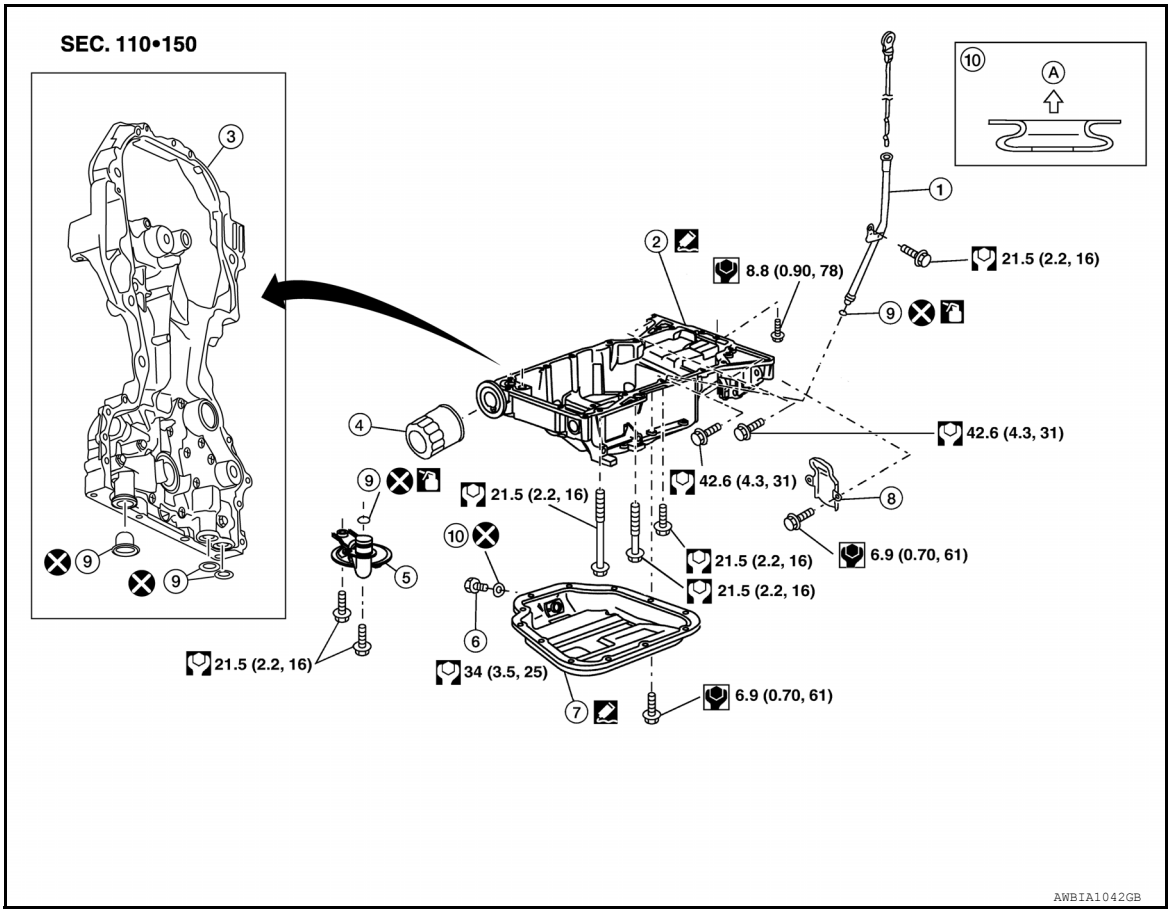
**Oxygen sensor thread cleaner : J-43897 - 18**
**Oxygen sensor thread cleaner : J-43897 - 12**

**CAUTION:**
**Do not over-tighten the A/F sensors and heated oxygen sensors. Doing so may cause damage to the A/F sensors and heated oxygen sensors, resulting in a malfunction and the MIL coming on.**

# OIL PAN AND OIL STRAINER

## Removal and Installation

INFOID:0000000007401902




1. Oil dipstick tube
2. Oil pan (upper)
3. Front cover
4. Oil filter
5. Oil pickup screen
6. Drain plug
7. Oil pan (lower)
8. Rear plate cover
9. O-ring
10. Washer
A. Oil pan side

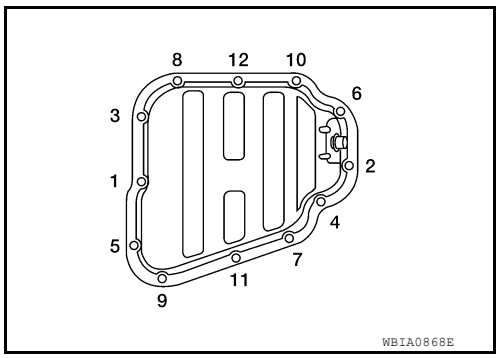
### REMOVAL

**WARNING:**

- **To avoid the danger of being scalded, never drain the engine oil when the engine is hot.**
- **Prolonged and repeated contact with used engine oil may cause skin cancer; try to avoid direct skin contact with used oil. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.**

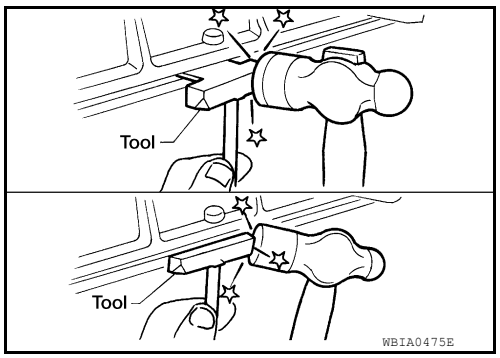
1. Drain engine oil. Refer to LU-19, "Changing Engine Oil".
2. Remove oil dipstick tube and indicator.
3. Remove the front exhaust tube. Refer to EX-11, "Component".
4. Remove A/C compressor bolts and position the A/C compressor aside. Refer to MTC-90, "Removal and Installation for Compressor - QR25DE".
5. Disconnect center drive shaft bearing bracket, without removing the front drive shaft. Refer to FAX-11, "Removal and Installation (RH)".
6. Remove the front suspension member for clearance to remove the oil pan. Refer to FSU-10, "Removal and Installation".

7. Remove the oil pan (lower) bolts in the order shown.



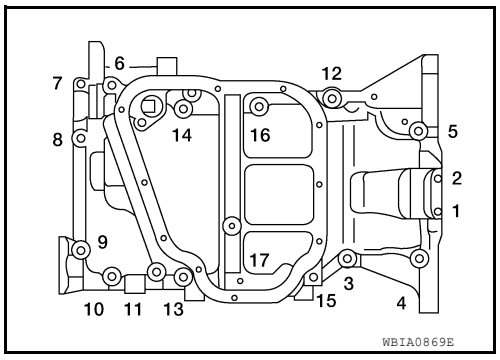

8. Remove the oil pan (lower) using Tool.
**NOTE:**
Tap gently to cut sealant around the pan; do not damage the mating surface using Tool.

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




9. Remove the oil pickup screen.
10. Remove rear plate cover, and four engine-to transaxle bolts, using power tool.

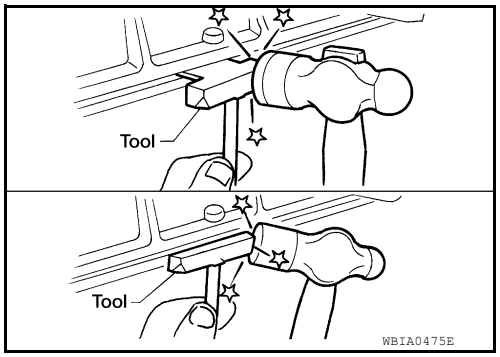
11. Remove the oil pan (upper) bolts in the order shown.




12. Remove oil pan (upper) using Tool.
- Remove the three O-rings from the upper oil pan and front cover. Discard the O-rings.

**CAUTION:**
**Do not reuse O-rings.**
**NOTE:**
Tap gently to cut sealant around the oil pan; do not damage the mating surface using Tool.

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

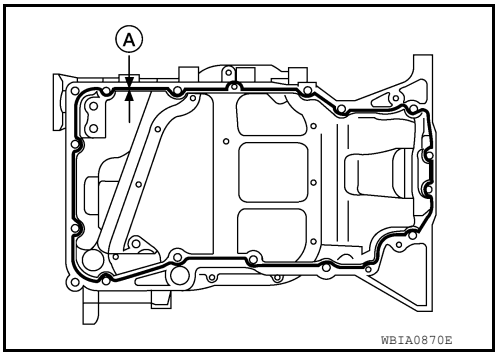



## INSPECTION AFTER REMOVAL
- Clean the oil pickup screen to remove any foreign material.

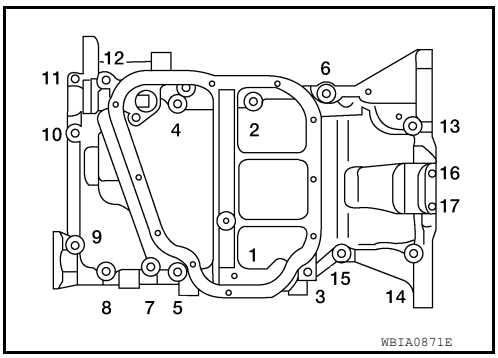
## INSTALLATION
1. Installation is in the reverse order of removal. Paying attention to the following.

a. Apply Genuine Silicone RTV Sealant (A), or equivalent, to the upper oil pan. Refer to GI-44, "Recommended Chemical Product and Sealant", and EM-121, "Precaution for Liquid Gasket".

**CAUTION:**
- **Install two new O-rings in the upper oil pan and a new O-ring in the front cover.**
- **Do not reuse O-rings.**
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the oil pan is installed to allow the sealant to cure**

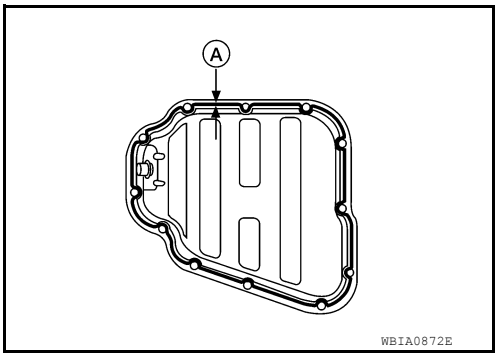



b. Tighten the oil pan (upper) bolts in the order as shown.
- **NOTE:**
  Use the bolt sizes specified below:
  M6 × 20 mm (0.79 in): No.16, 17
  M8 × 25 mm (0.98 in): No.3, 4, 6, 11, 13, 14, 15
  M8 x 60 mm (2.36 in): No.5, 7, 8, 9, 10
  M8 x100 mm (3.97 in): No.1, 2, 12

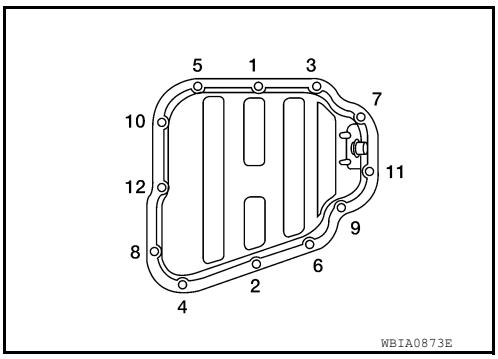



c. Apply Genuine Silicone RTV Sealant (A), or equivalent to the lower oil pan. Refer to GI-44, "Recommended Chemical Product and Sealant", and EM-121, "Precaution for Liquid Gasket"

**CAUTION:**
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the oil pan is installed to allow the sealant to cure**




d. Tighten the oil pan (lower) bolts in the numerical order shown.
- Wait at least 30 minutes after the oil pans are installed before filling the engine with oil.




## 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-15, "QR25DE".
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

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

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

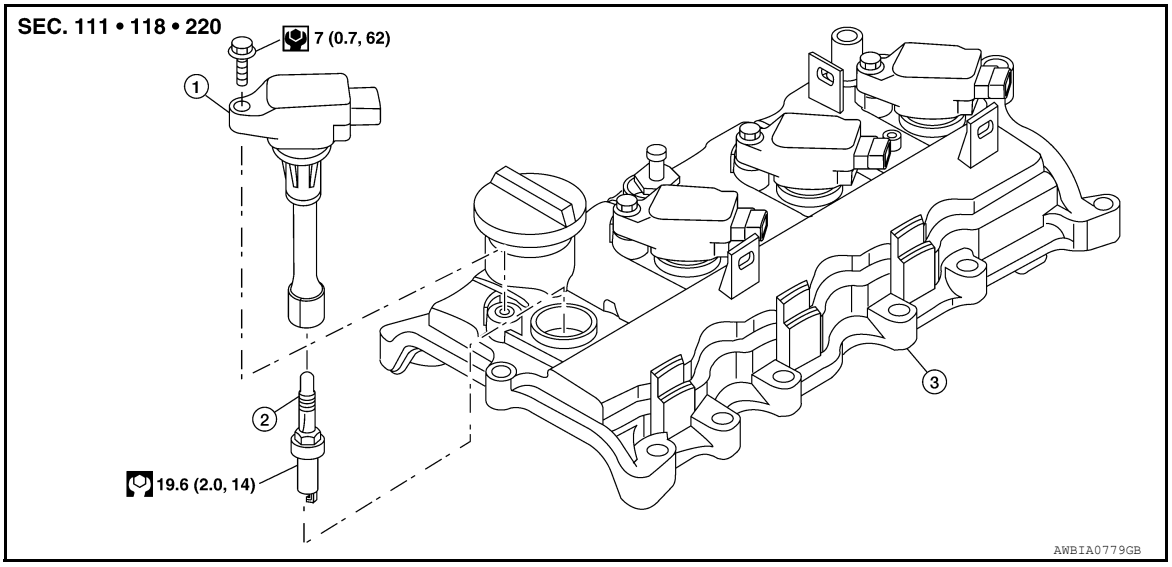
| Item | | Before starting engine | Engine running | After engine stopped |
|---|---|---|---|---|
| Engine coolant | | Level | Leakage | Level |
| Engine oil | | Level | Leakage | Level |
| Transmission/ transaxle fluid | A/T and CVT Models | Leakage | Level/Leakage | Leakage |
| | M/T Models | Level/Leakage | Leakage | Level/Leakage |
| Other oils and fluids* | | Level | Leakage | Level |
| Fuel | | Leakage | Leakage | Leakage |
| Exhaust gas | | — | Leakage | — |

*Power steering fluid, brake fluid, etc.

# IGNITION COIL

## Removal and Installation

INFOID:0000000007401903




1. Ignition coil
2. Spark plug
3. Rocker cover

### REMOVAL

1. Remove the engine room cover.
2. Remove resonator. Refer to EM-133, "Removal and Installation".
3. Disconnect the harness connector from the ignition coil.
4. Remove the ignition coil.
   **CAUTION:**
   **Do not drop or shock it.**

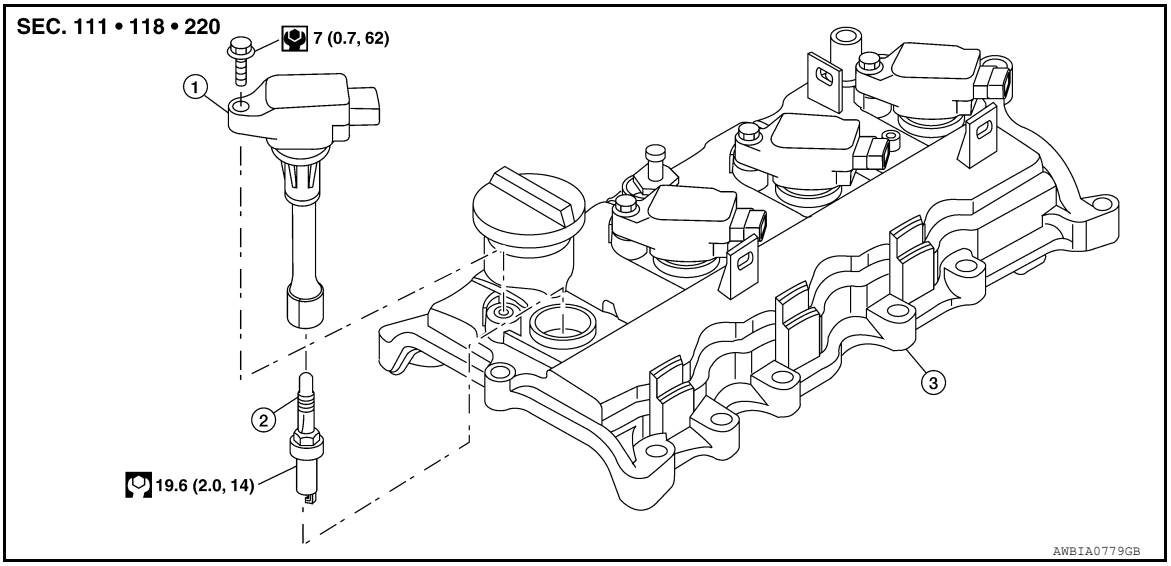
### INSTALLATION

Installation is in the reverse order of removal.

# SPARK PLUG

## Removal and Installation

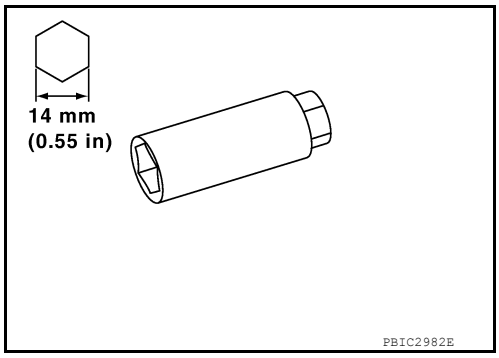
INFOID:0000000007401904




1. Ignition coil
2. Spark plug
3. Rocker cover

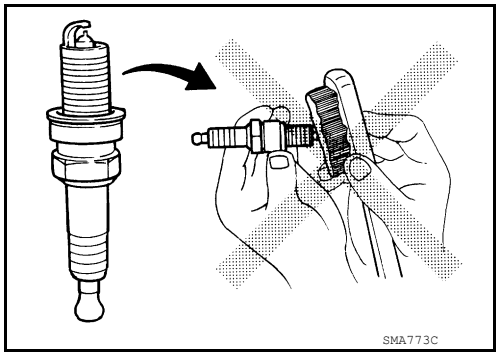
### REMOVAL

1. Remove the ignition coil. Refer to EM-146, "Removal and Installation".
2. Remove the spark plug with a suitable spark plug wrench.




### INSPECTION AFTER REMOVAL

- Do not use a wire brush for cleaning the spark plugs. Replace as necessary.

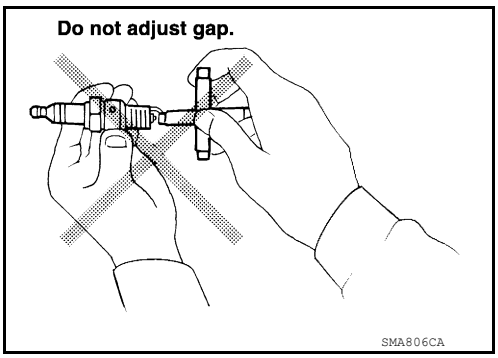



- If plug is covered with carbon, a spark plug cleaner may be used.

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

- Checking and adjusting plug gap is not required between change intervals. If the gap is out of specification, replace the spark plug.

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




## INSTALLATION

Installation is in the reverse order of removal.

Spark Plug Types

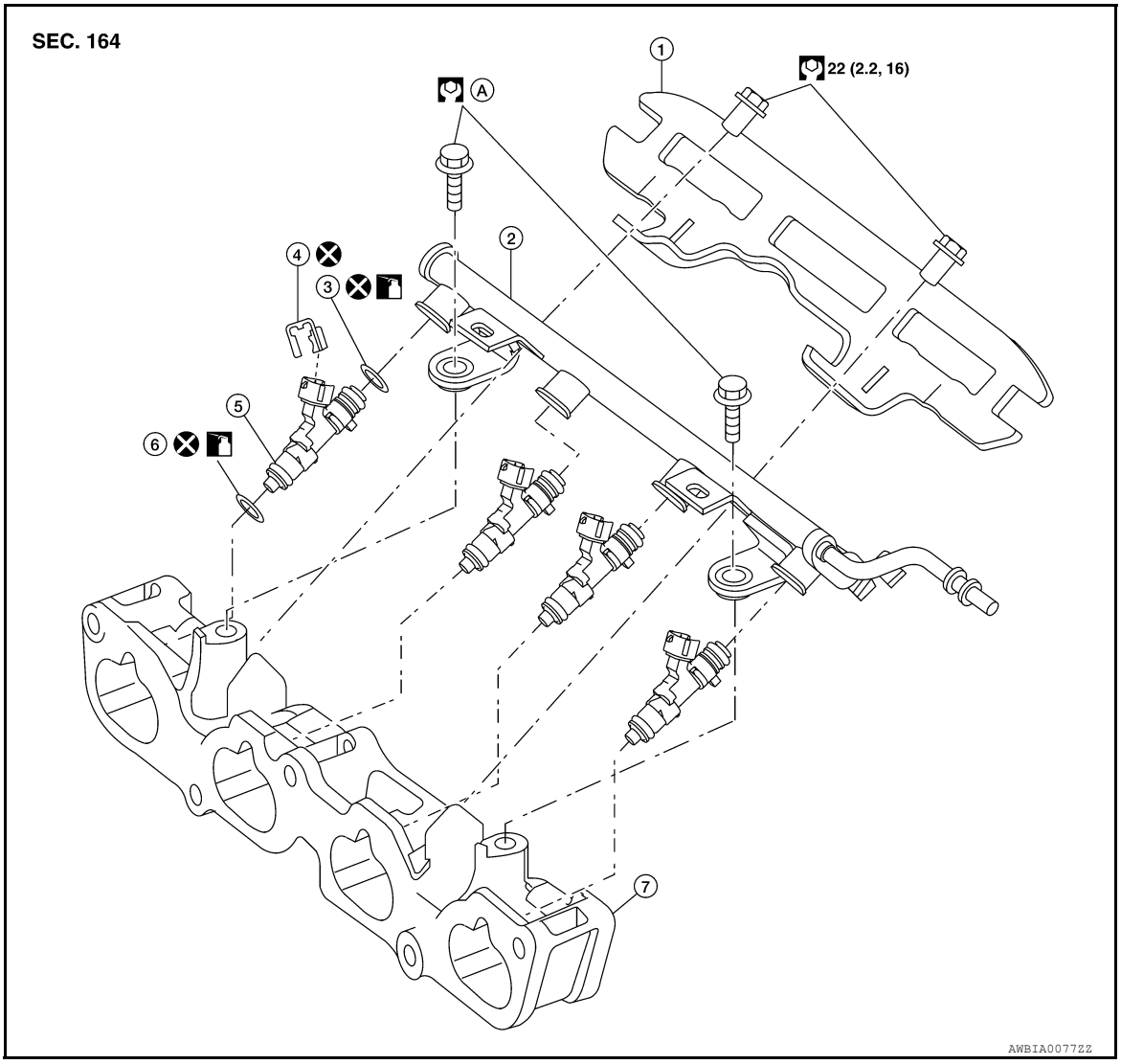
| | |
|---|---|
| Make | NGK |
| Part number* | DILKAR6A-11 |
| Gap (nominal) | 1.1 mm (0.043 in) |

*Always check with the Parts Department for the latest parts information.

# FUEL INJECTOR AND FUEL TUBE

## Removal and Installation

INFOID:0000000007401905




1. Fuel tube protector
2. Fuel tube
3. O-ring (upper)
4. Clip
5. Fuel injector
6. O-ring (lower)
7. Intake manifold adapter
A. Refer to "INSTALLATION" EM-149

**WARNING:**
- **Put a "CAUTION: FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a $CO_2$ fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**

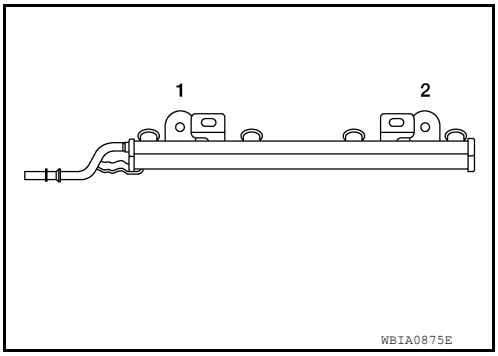
**CAUTION:**
- **Apply new engine oil to parts before installing the parts, as shown above.**
- **Do not remove or disassemble parts unless instructed as shown.**

### REMOVAL

1. Release the fuel pressure. Refer to EC-1208, "Fuel Pressure Check".
2. Remove the cowl top. Refer to EI-21, "Removal and Installation".
3. Remove the front air duct and electric throttle control actuator tube and resonator. Refer to EM-133, "Removal and Installation".
4. Remove the battery tray. Refer to SC-9, "Removal and Installation (QR25DE Battery Tray)".
5. Remove the engine room cover.
6. Remove the air cleaner assembly. Refer to EM-133, "Removal and Installation".

7. Disconnect the fuel hose quick connector at the fuel tube side. Refer to EM-135.
   **CAUTION:**
   - **Prepare a container and shop cloth for catching any spilled fuel.**
   - **While hoses are disconnected seal their openings with vinyl bag or similar material to prevent foreign material from entering them.**
8. Remove the intake manifold. Refer to EM-135.
9. Disconnect sub-harness for injector at engine front side, and remove it from bracket.
10. Loosen the bolts in the order as shown, then remove fuel tube and fuel injectors as an assembly.
11. Remove the fuel injectors from the fuel tube.
    - Release the clip and remove the fuel injector.
    - Pull fuel injector straight out of the fuel tube.

    **CAUTION:**
    - **Be careful not to damage the nozzle.**
    - **Avoid any impact, such as dropping the fuel injector.**
    - **Do not disassemble or adjust the fuel injector.**

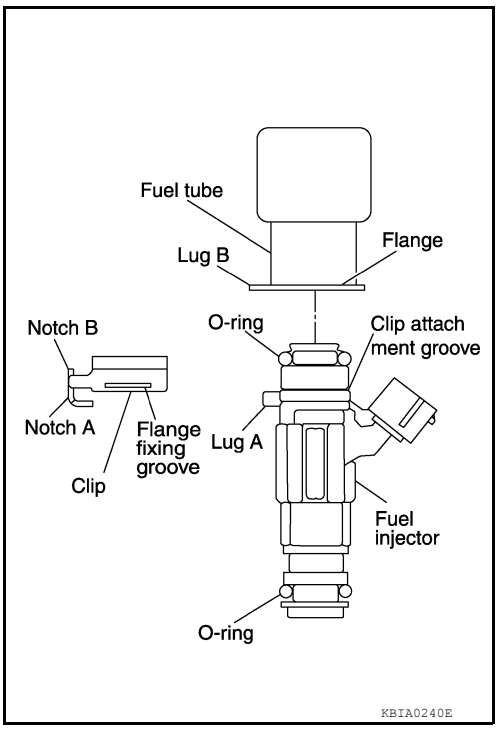



## INSTALLATION

1. Install new O-rings on the fuel injector.
   - Fuel tube side: Black
   - Nozzle side: Green

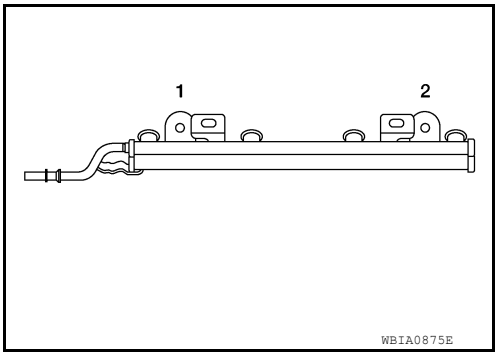
   **CAUTION:**
   - **Do not reuse O-rings.**
   - **Upper and lower O-rings are different. Be careful to install them in the correct location.**
   - **Handle O-ring with bare hands. Never wear gloves.**
   - **Lubricate O-ring with new engine oil.**
   - **Never clean O-ring with solvent.**
   - **Make sure that O-ring and its mating part are free of foreign material.**
   - **When installing O-ring, be careful not to scratch or nick it.**
   - **Also be careful not to twist or stretch O-ring. If O-ring was stretched, allow it time to return to an unstretched condition prior to installation.**
   - **Insert O-ring straight into fuel tube. Never twist it.**
   - **Never insert the O-ring quickly into fuel tube.**
2. Install the fuel injector into the fuel tube with the following procedure:
   - Do not reuse the clip, replace it with a new one.
   - Insert the new clip into the clip attachment groove on fuel injector.
   - Insert the clip so that lug "A" of fuel injector matches notch "A" of the clip.
3. Insert fuel injector into fuel tube with clip attached.
   - Insert it while matching it to the axial center.
   - Insert fuel injector so that lug "B" of fuel injector matches notch "B" of the clip.
   - Make sure that fuel tube flange is securely fixed in flange fixing groove on the clip.
   - Make sure that installation is complete by checking that fuel injector does not rotate or come off.
4. Install fuel tube assembly.

a. Insert the tip of each fuel injector into intake manifold.



b. Tighten the bolts in two steps in the numerical order as shown.

**Fuel tube assembly bolts**
**Step 1 : 10.0 N·m (1.0 kg-m, 7 ft-lb.)**
**Step 2 : 22.0 N·m (2.2 kg-m, 16 ft-lb.)**




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

5. Install the intake manifold. Refer to EM-135.
6. Connect the fuel hose quick connector. Refer to EM-135.
7. Installation of the remaining components is in the reverse order of removal.

## INSPECTION AFTER INSTALLATION

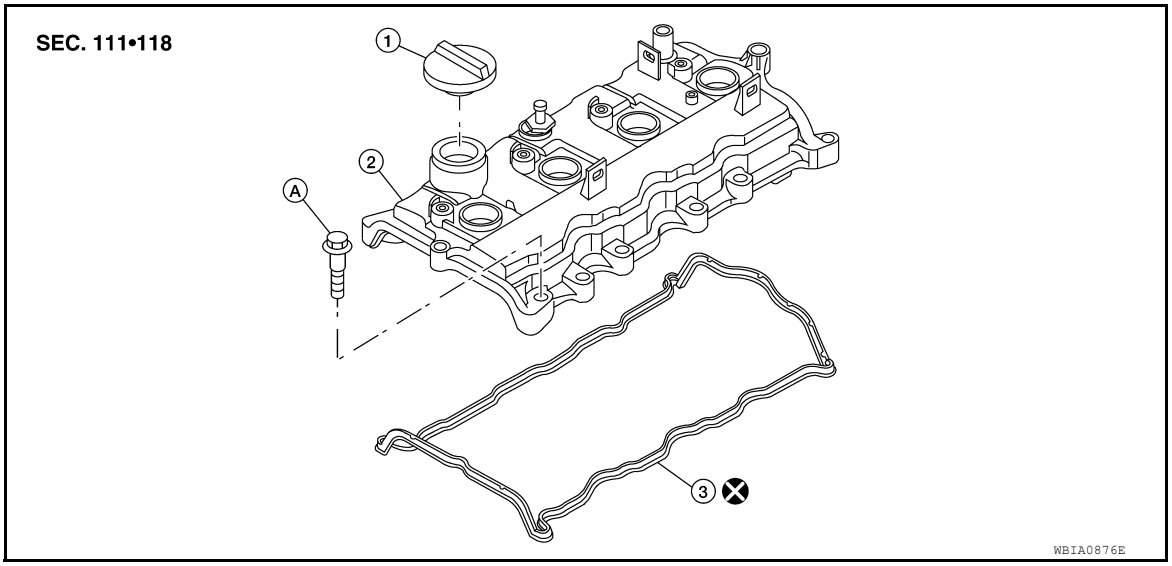
Make sure there are no fuel leaks at the connections.

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.
   **CAUTION:**
   **Do not touch engine immediately after stopping as engine is extremely hot.**
   **NOTE:**
   Use mirrors for checking on connections out of the direct line of sight.
   - Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to EC-1206, "Throttle Valve Closed Position Learning".
   - If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to EC-1206, "Idle Air Volume Learning".

# ROCKER COVER

## Removal and Installation

INFOID:0000000007401906

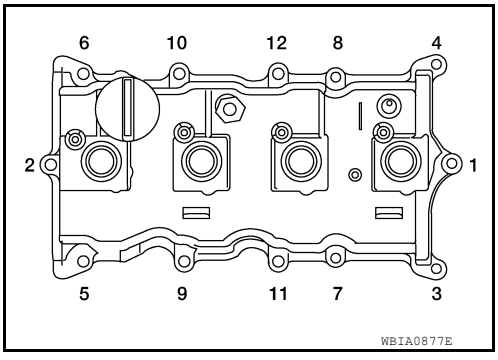



1. Oil filler cap
2. Rocker cover
3. Gasket

A. Follow the installation procedure

### REMOVAL

1. Disconnect the battery negative terminal. Refer to SC-8, "Removal and Installation (QR25DE Battery)".
2. Remove the engine room cover.
3. Remove the engine coolant reservoir.
4. Remove the ignition coils. Refer to EM-146, "Removal and Installation".
5. Install a suitable jack under engine.
6. Remove engine mounting insulator and bracket (RH). Refer to EM-186.
7. Remove PCV hose.
8. Loosen the bolts in the numerical order as shown using power tool.
9. Remove the rocker cover. Remove the oil filler cap and PCV valve if necessary, to transfer to the new rocker cover.




### INSTALLATION

1. Apply RTV Silicone Sealant to the joint part of the cylinder head and camshaft bracket using the following the steps.
   - **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**

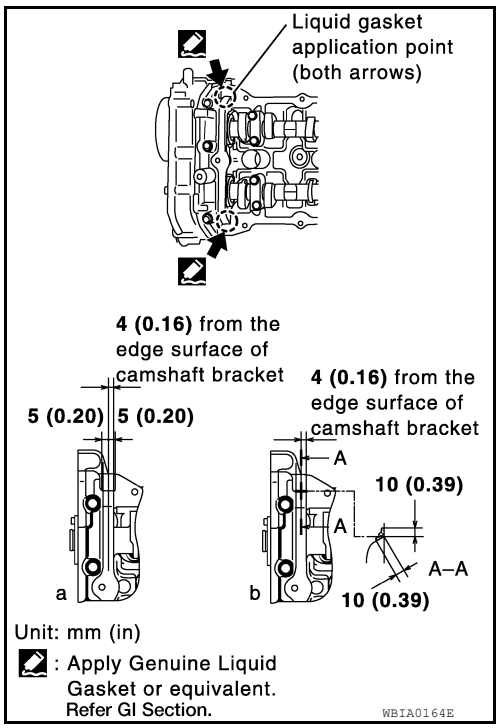
   **CAUTION:**
   - **Installation should be done within 5 minutes after applying liquid gasket.**

- **Do not fill the engine with oil for at least 30 minutes after the rocker cover is installed to allow the sealant to cure.**

a. Follow illustration “a” to apply sealant to joint part of No.1 camshaft bracket and cylinder head.

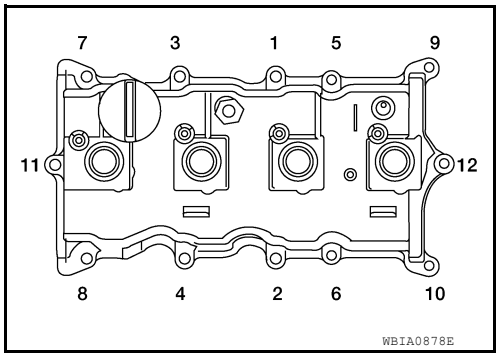
b. Follow illustration “b” to apply sealant in a 90° degree angle to the illustration “a”.

2. Install the rocker cover.
   - The rocker cover gasket must be securely installed in the groove in the rocker cover.




3. Tighten the rocker cover bolts in two steps, in the numerical order as shown.

**Step 1** **: 1.96 N·m (0.20 kg-m, 17 in-lb)**
**Step 2** **: 8.33 N·m (0.85 kg-m, 74 in-lb)**

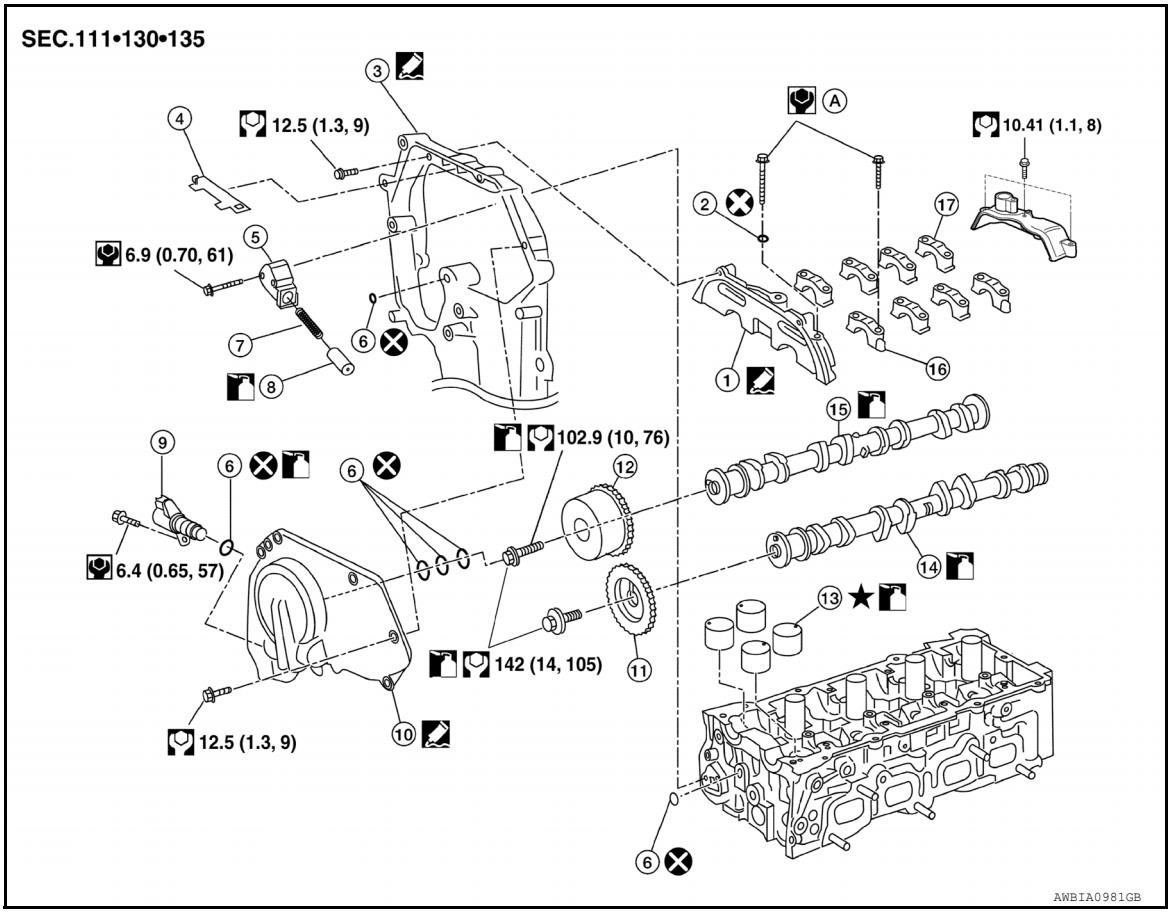



4. Connect the PCV hose and breather hose to the rocker cover. If necessary, install the oil filler cap and PCV valve and lubricate the PCV valve O-ring with new engine oil.
   **CAUTION:**
   **Do not reuse O-ring.**
5. Install the ignition coils. Refer to EM-146, "Removal and Installation".
6. Installation of the remaining components is in the reverse order of removal.

# CAMSHAFT

## Removal and Installation

INFOID:0000000007401907

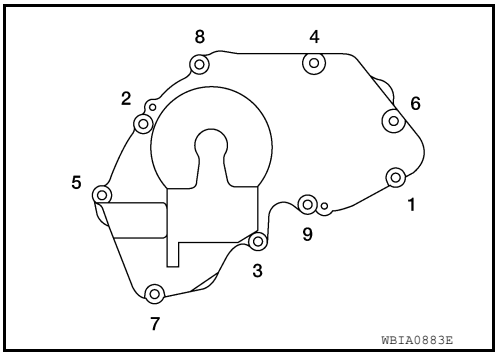



1. Camshaft bracket (No. 1)
2. Washer
3. Front cover (partial view)
4. Chain guide
5. Chain tensioner
6. O-ring(s)
7. Chain tensioner spring
8. Chain tensioner plunger
9. IVT control solenoid valve
10. IVT control cover
11. Camshaft sprocket (EXH)
12. Camshaft sprocket (INT)
13. Valve lifter
14. Camshaft (EXH)
15. Camshaft (INT)
16. Camshaft brackets (EXH)
17. Camshaft brackets (INT)
18. Camshaft sensor bracket
A. Refer to "INSTALLATION"

### REMOVAL

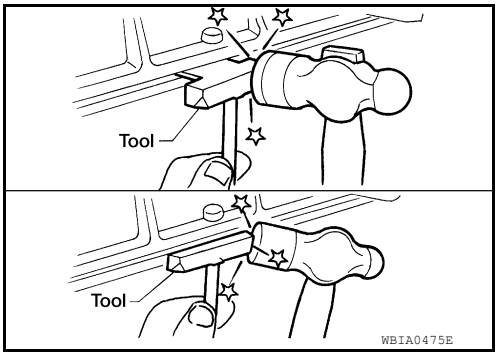
1. Disconnect battery negative terminal. Refer to SC-8, "Removal and Installation (QR25DE Battery)".
2. Remove the rocker cover. Refer to EM-152, "Removal and Installation".
3. Remove the splash shield (RH). Refer to EI-23, "Component".
4. Support the front of the engine using a suitable jack.
5. Remove the torque rod and the engine mounting insulator and bracket (RH). Refer to EM-186, "Removal and Installation".
6. Remove the coolant overflow reservoir tank.
7. Disconnect variable timing control solenoid harness connector.

8. Loosen the IVT control cover bolts in the order as shown.



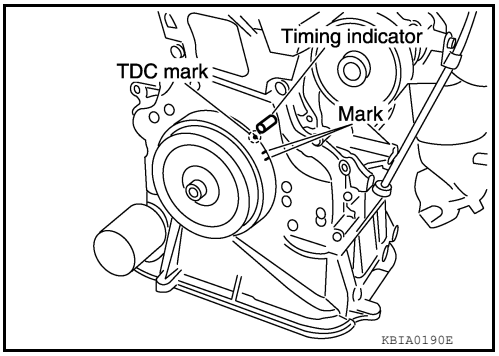

- Remove the IVT control cover by cutting the sealant using Tool.

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

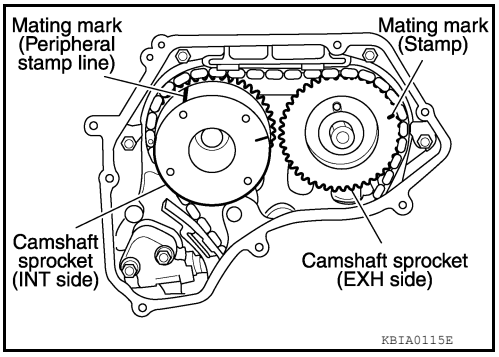



9. Set the No.1 cylinder at TDC on its compression stroke with the following procedure:

a. Rotate crankshaft pulley clockwise, and align mating marks for TDC with timing indicator on front cover, as shown.




b. At the same time, make sure that the mating marks on camshaft sprockets are lined up with the yellow links in the timing chain, as shown.
   - If not, rotate crankshaft pulley one more turn to line up the mating marks to the yellow links, as shown.




10. Disconnect and remove the camshaft position sensor.
11. Pull the timing chain guide out between the camshaft sprockets through front cover.

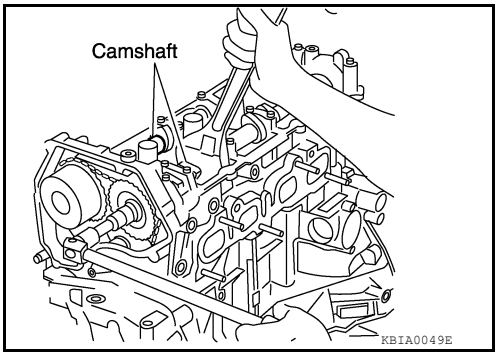
12. Remove camshaft sprockets with the following procedure.

**CAUTION:**

- **Do not rotate the crankshaft or camshaft while the timing chain is removed.**
- **Rotating the crankshaft or the camshaft after the timing chain has been removed causes interference between the valves and pistons.**

**NOTE:**

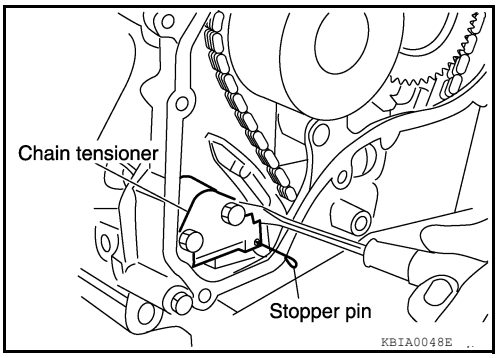
- It is not necessary to hold tension on the timing chain and crankshaft sprocket during this procedure.
- The crankshaft and timing chain cannot become disconnected while the front cover is attached.



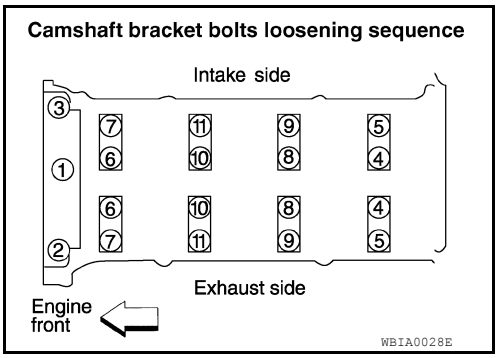

a. Line up the mating marks on camshaft sprockets with the yellow links in the timing chain, and paint an indelible mating mark on the sprocket and timing chain link plate.

b. Push in the tensioner plunger and hold. Insert a stopper pin into the hole on tensioner body to hold the chain tensioner. Remove the timing chain tensioner.
   - Use a wire with 0.5 mm (0.02 in) diameter for a stopper pin.

c. Secure the hexagonal part of camshaft with a suitable tool. Loosen the camshaft sprocket mounting bolts and remove the camshaft sprockets.




13. Loosen the camshaft bracket bolts in the order as shown, and remove the camshaft brackets and camshafts.
    - Remove No.1 camshaft bracket by slightly tapping it with a rubber mallet.
14. Remove the valve lifters, if necessary.
    - Check mounting positions, and set them aside in the order removed.

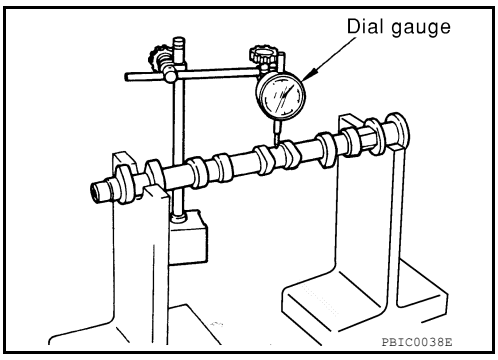



## INSPECTION AFTER REMOVAL

Camshaft Runout

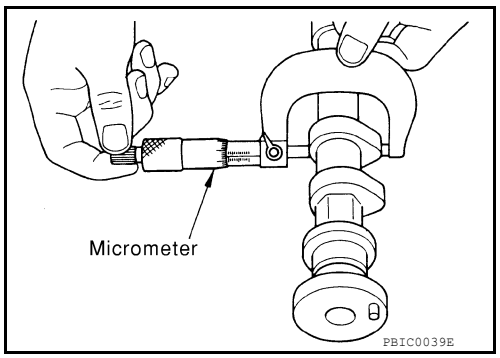
1. Put the camshaft on a V-block supporting the No.2 and No.5 journals.
2. Set the dial gauge vertically on the No.3 journal.
3. Turn camshaft in one direction by hand, and measure the camshaft runout on the dial gauge total indicator reading.

**Standard : Less than 0.04 mm (0.0016 in)**




Camshaft Cam Height

1. Measure the camshaft cam height.




**Standard intake cam height** : **44.815 - 45.005 mm (1.7644 - 1.7718 in)**

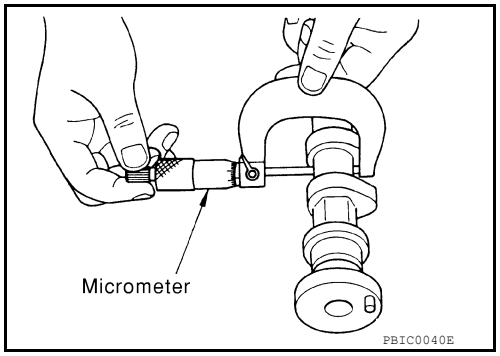
**Standard exhaust cam height** : **43.975 - 44.165 mm (1.7313 - 1.7388 in)**

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

Camshaft Journal Clearance

**Outer Diameter of Camshaft Journal**

- Measure the outer diameter of the camshaft journal.

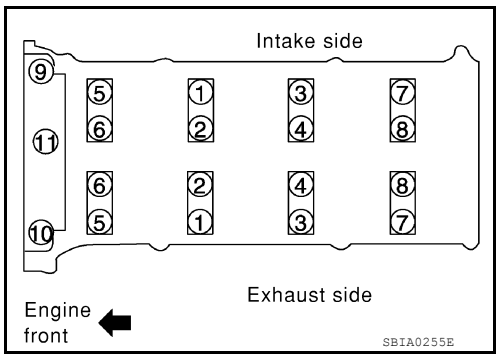



**Standard No.1 outer diameter** : **27.935 - 27.955 mm (1.0998 - 1.1006 in)**

**Standard No.2, 3, 4, 5, outer diameter** : **23.435 - 23.455 mm (0.9226 - 0.9234 in)**

**Inner Diameter of Camshaft Bracket**

- Tighten the camshaft bracket bolts to the specified torque following the tightening pattern as shown.



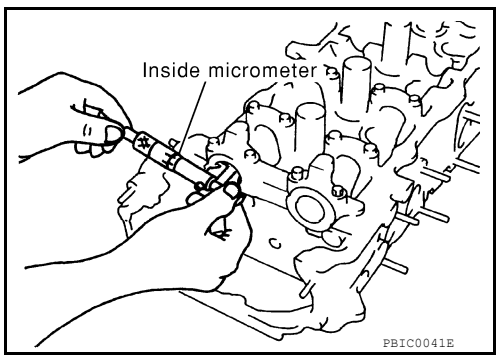

**Step 1 (bolts 9 - 11)** : **1.96 N·m (0.2 kg-m, 17 in-lb)**

**Step 2 (bolts 1 - 8)** : **1.96 N·m (0.2 kg-m, 17 in-lb)**

**Step 3 (bolts 1 - 11)** : **5.88 N·m (0.6 kg-m, 52 in-lb)**

**Step 4 (bolts 1 - 11)** : **10.4 N·m (1.02 kg-m, 92 in-lb)**

- Using inside micrometer, measure inner diameter of camshaft bracket.




**Standard No.1** : **28.000 - 28.021 mm (1.1024 - 1.1032 in)**

**Standard No.2, 3, 4, 5** : **23.500 - 23.521 mm (0.9252 - 0.9260 in)**

**Calculation of Camshaft Journal Clearance**

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

**Standard** : **0.045 - 0.086 mm (0.0018 - 0.0034 in)**

- When out of the specified range above, replace either or both the camshaft and the cylinder head assembly.

**NOTE:**

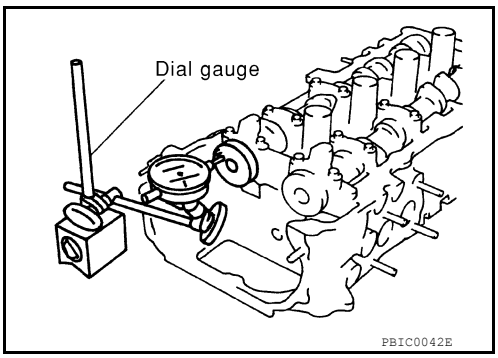
Inner diameter of the camshaft bracket is manufactured together with the cylinder head. If the camshaft bracket is out of specification, replace the whole cylinder head assembly.

Camshaft End Play

1. Install a dial gauge in the thrust direction on the front end of the camshaft. Measure the end play with the dial gauge while moving the camshaft forward and backward (in direction to axis).

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

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

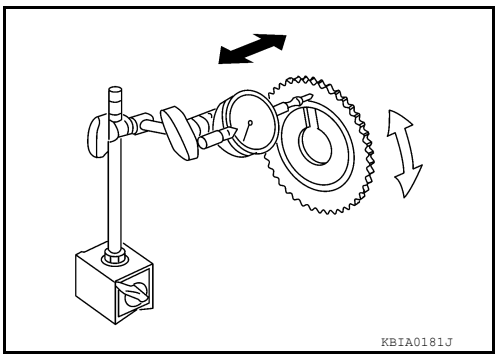



Camshaft Sprocket Runout

1. Install the camshaft in the cylinder head.
2. Install the camshaft sprocket on the camshaft.
3. Measure camshaft sprocket runout while turning the camshaft by hand.

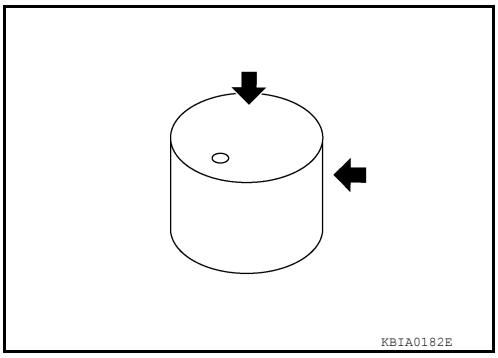
**Runout : Less than 0.15 mm (0.0059 in)**

4. If it exceeds the specification, replace camshaft sprocket.




Valve Lifter

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



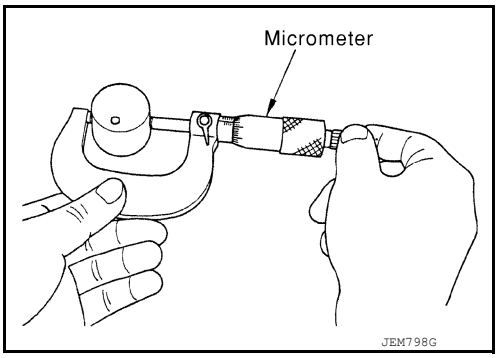

Valve Lifter Clearance

**Outer Diameter of Valve Lifter**

- Measure the outer diameter of the valve lifter.

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

- If out of the specified range, replace the valve lifter.

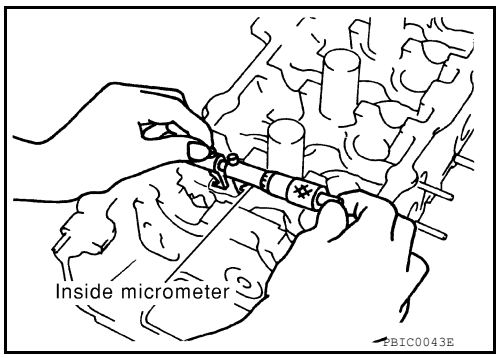


**Valve Lifter Bore Inner Diameter**

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

**Standard : 34.000 - 34.021 mm (1.3386 - 1.3394 in)**

- 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)

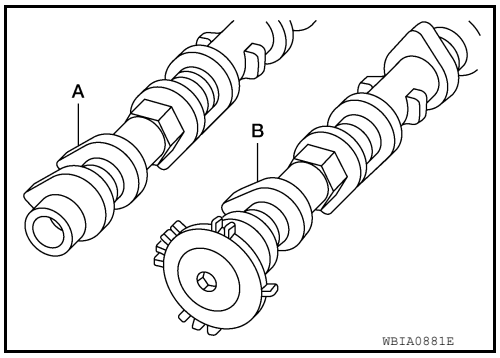
**Standard : 0.013 - 0.044 mm (0.0005 - 0.0017 in)**

- If out of specified range, replace either or both valve lifter and cylinder head assembly.

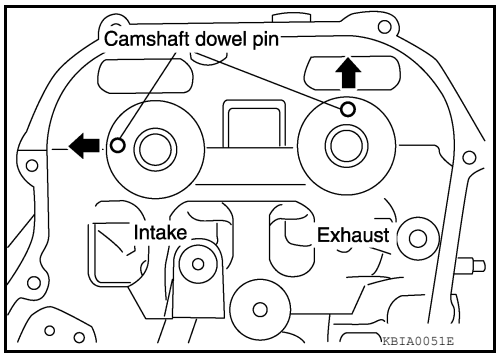
## INSTALLATION

1. Install the valve lifters, if removed.
   - Install them in the same position from which they were removed.
2. Install the camshafts.
   - The distinction between the intake and exhaust camshafts is in a difference of shapes of the back end:

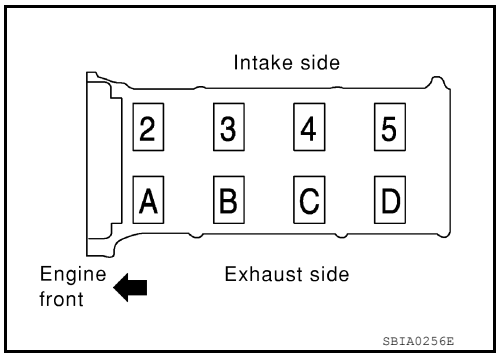
     Intake (B): Signal plate for the camshaft position sensor (PHASE)
     Exhaust (A): Cone end shape




   - Install camshafts so that the dowel pins on the front side are positioned as shown.



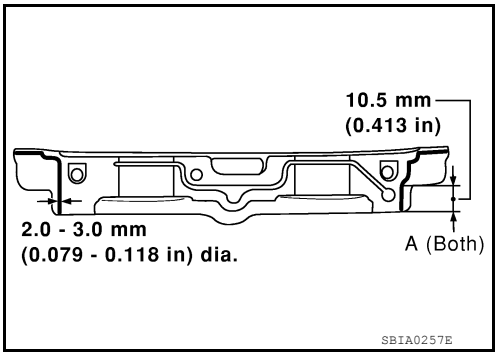

3. Install camshaft brackets.
   - Install by referring to identification mark on upper surface mark.
   - Install so that identification mark can be correctly read when viewed from the exhaust side.



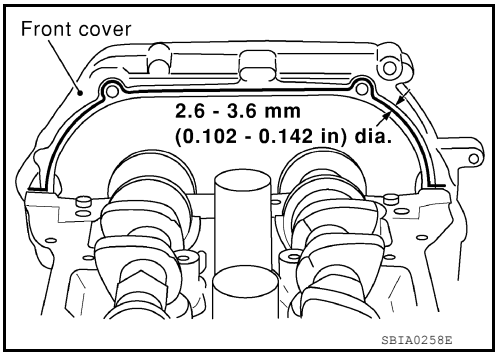
- Install No. 1 camshaft bracket as follows.
- Apply sealant to No.1 camshaft bracket as shown.
- **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**

**CAUTION:**

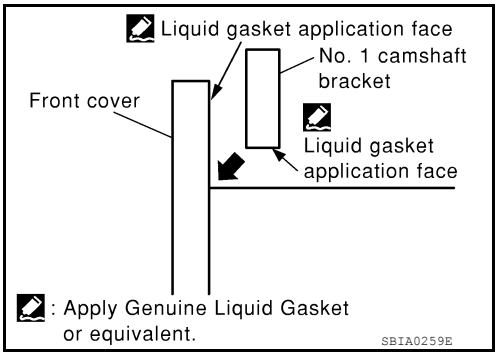
- **After installation, be sure to wipe off any excessive sealant leaking from part "A" (both on right and left sides).**




- Apply sealant to camshaft bracket contact surface on the front cover backside.
- Apply sealant to the outside of bolt hole on front cover.

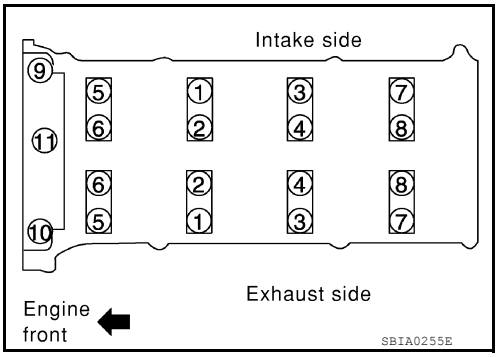



- Position the No.1 camshaft bracket near the mounting position, and install it without disturbing the sealant applied to the surfaces.




4. Tighten camshaft bracket bolts in four steps in the order as shown.

**Step 1 (bolts 9 - 11) : 1.96 N·m (0.2 kg-m, 17 in-lb)**
**Step 2 (bolts 1 - 8) : 1.96 N·m (0.2 kg-m, 17 in-lb)**
**Step 3 (bolts 1 - 11) : 5.88 N·m (0.6 kg-m, 52 in-lb)**
**Step 4 (bolts 1 - 11) : 10.4 N·m (1.02 kg-m, 92 in-lb)**

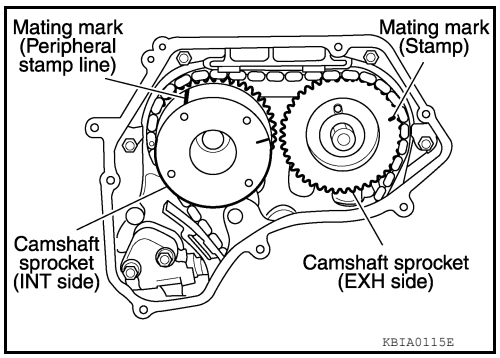



**CAUTION:**
**After tightening camshaft bracket bolts, be sure to wipe off excessive sealant from the parts listed below.**

- **Mating surface of rocker cover.**
- **Mating surface of front cover, when installed without the front cover.**

5. Install camshaft sprockets.
   - Install them by lining up the mating marks on each camshaft sprocket with the ones painted on the timing chain during removal.
   - Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.

   **CAUTION:**
   - **Aligned mating marks could slip. Therefore, after matching them, hold the timing chain in place by hand.**
   - **Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.**




6. Install chain tensioner.

   **CAUTION:**
   - **After installation, pull the stopper pin off completely, and make sure that the tensioner is fully released.**
7. Install chain guide.
8. Install IVT control cover with the following procedure.

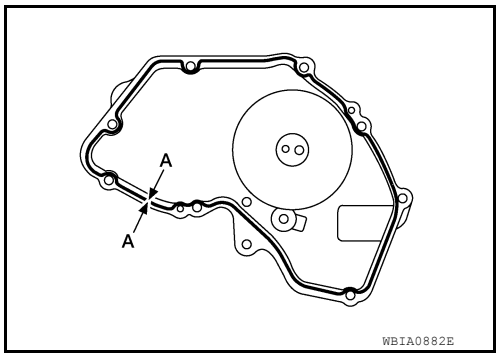
a. Install IVT control solenoid valve to IVT control cover.

b. Install three O-rings to front cover side.

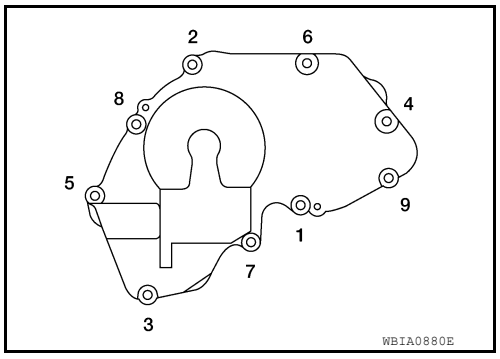
   **CAUTION:**
   **Do not reuse O-rings.**

c. Apply Genuine Silicone RTV Sealant to the positions as shown (A). Refer to GI-44, "Recommended Chemical Product and Sealant".

   **CAUTION:**
   - **Installation should be done within 5 minutes after applying liquid gasket.**
   - **Do not fill the engine with oil for at least 30 minutes after the IVT control cover is installed to allow the sealant to cure.**




d. Install IVT control cover.
   - Tighten the bolts in the numerical order as shown.




9. Check and adjust valve clearances. Refer to EM-162, "Valve Clearance".
10. Installation of the remaining components is in the reverse order of removal.

## Inspection After Installation

INFOID:0000000007401908

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

**CAUTION:**
- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to EC-1272.**
- **Check when engine is cold so as to prevent burns from any splashing engine oil.**

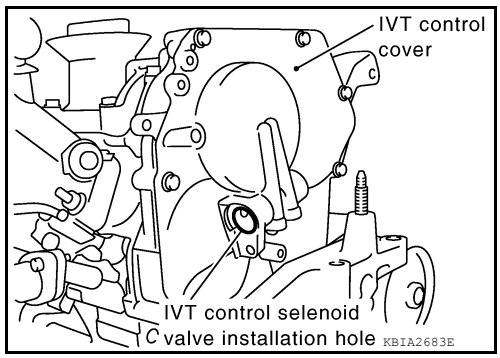
1. Check engine oil level. Refer to LU-18, "Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to EC-1208, "Fuel Pressure Check".

b. Disconnect ignition coil and injector harness connectors if practical.

3. Remove IVT control solenoid valve. Refer to EM-154.

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 oil hole. Refer to LU-16, "Lubrication Circuit".
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-16, "Lubrication Circuit".
7. After inspection, installation of the remaining components is in the reverse order of removal.

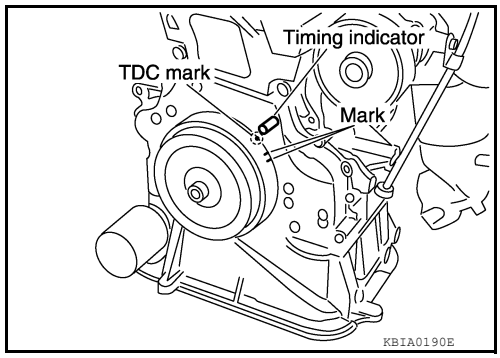
## Valve Clearance

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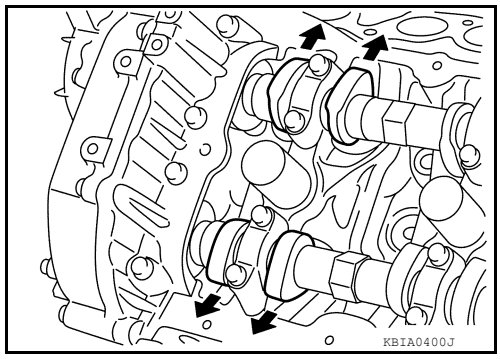
### Inspection

- Perform this inspection as follows after removal, installation, or replacement of the camshaft or any valve-related parts, or if there are any unusual engine conditions due to changes in valve clearance over time (starting, idling, and/or noise).

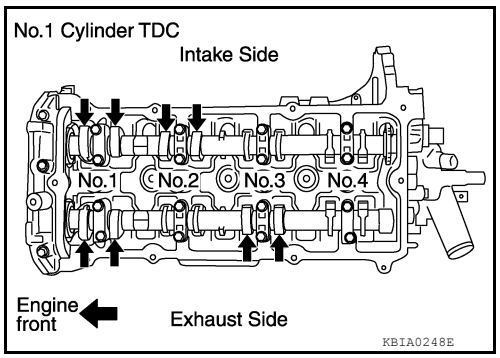
1. Warm up the engine, then stop it.
2. Remove splash shield (RH). Refer to EI-23, "Component".
3. Remove the rocker cover. Refer to EM-152, "Removal and Installation".
4. Turn crankshaft pulley in normal direction (clockwise when viewed from front) to align TDC identification mark (without paint mark) with timing indicator.




5. At this time, check that the both intake and exhaust cam lobes of No. 1 cylinder face outside.
   - If they do not face outside, turn crankshaft pulley once more.

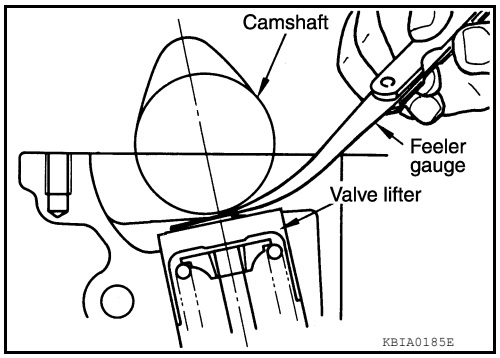


6. By referring to the figure (locations indicated with black arrow), measure valve clearances with a feeler gauge at locations marked X as shown in the table below.
   • No.1 cylinder compression TDC.




| Cylinder | No.1 | | No.2 | | No.3 | | No.4 | |
|---|---|---|---|---|---|---|---|---|
| Valve | INT | EXH | INT | EXH | INT | EXH | INT | EXH |
| Measurable | × | × | × | | | x | | |

   • Use a feeler gauge to measure the clearance between valve and camshaft.



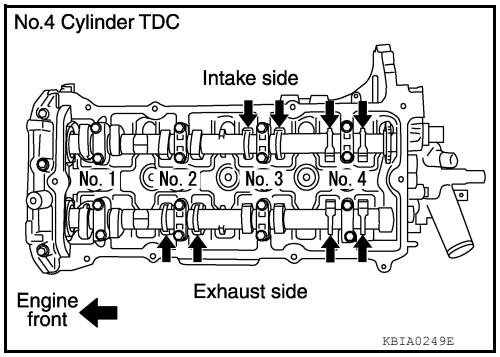

**Valve clearance standard:**

| | | |
|---|---|---|
| **Cold** | **Intake** | **: 0.24 - 0.32 mm (0.009 - 0.013 in)** |
| | **Exhaust** | **: 0.26 - 0.34 mm (0.010 - 0.013 in)** |
| **Hot*** | **Intake** | **: 0.304 - 0.416 mm (0.012 - 0.016 in)** |
| | **Exhaust** | **: 0.308 - 0.432 mm (0.012 - 0.017 in)** |

*Reference data at approximately 80°C (176°F)

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

7. Turn crankshaft one complete revolution (360°) and align mark on crankshaft pulley with pointer.
8. By referring to the figure (locations indicated with black arrow), measure valve clearances with a feeler gauge at locations marked X as shown in the table below.
   • No.4 cylinder compression TDC.




| Cylinder | No.1 | | No.2 | | No.3 | | No.4 | |
|---|---|---|---|---|---|---|---|---|
| Valve | INT | EXH | INT | EXH | INT | EXH | INT | EXH |
| Measurable | | | | x | × | | x | × |

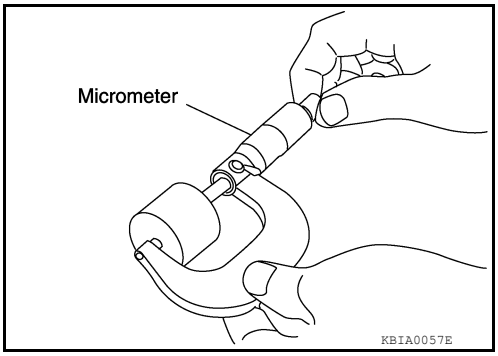
9. If out of specifications, adjust as follows.

## ADJUSTMENT

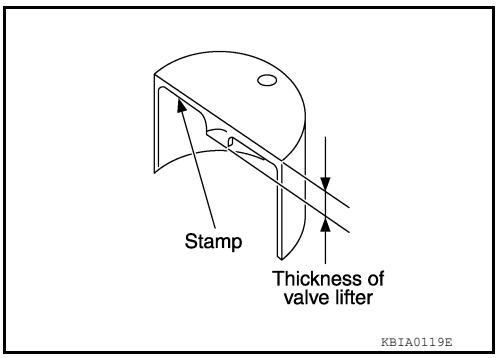
• Perform adjustment depending on selected head thickness of valve lifter.
• The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use the specifications for hot engine condition to adjust.

1. Remove camshaft. Refer to EM-154, "Removal and Installation".
2. Remove the valve lifters at the locations that are outside the standard.

3. Measure the center thickness of the removed valve lifters with a micrometer.




4. Use the equation below to calculate valve lifter thickness for replacement.
   - Valve lifter thickness calculation.
     t = t1 + (C1 - C2)
     t = Thickness of replacement valve lifter.
     t1 = Thickness of removed valve lifter.
     C1 = Measured valve clearance.
     C2 = Standard valve clearance.
   - Thickness of a new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder).
     Stamp mark 696 indicates a thickness of 6.96 mm (0.2740 in)
     **Available thickness of valve lifter: 26 sizes with a range of 6.96 to 7.46 mm (0.2740 to 0.2937 in), in steps of 0.02 mm (0.0008 in), when assembled at the factory.**




5. Install the selected valve lifter.
6. Install camshaft.
7. Manually turn crankshaft pulley a few turns.
8. Check that valve clearances for cold engine are within specifications, by referring to the specified values.
9. After completing the repair, check valve clearances again with the specifications for warmed engine. Use a feeler gauge to measure the clearance between the valve and camshaft. Make sure the values are within specifications.

**Valve clearance standard:**

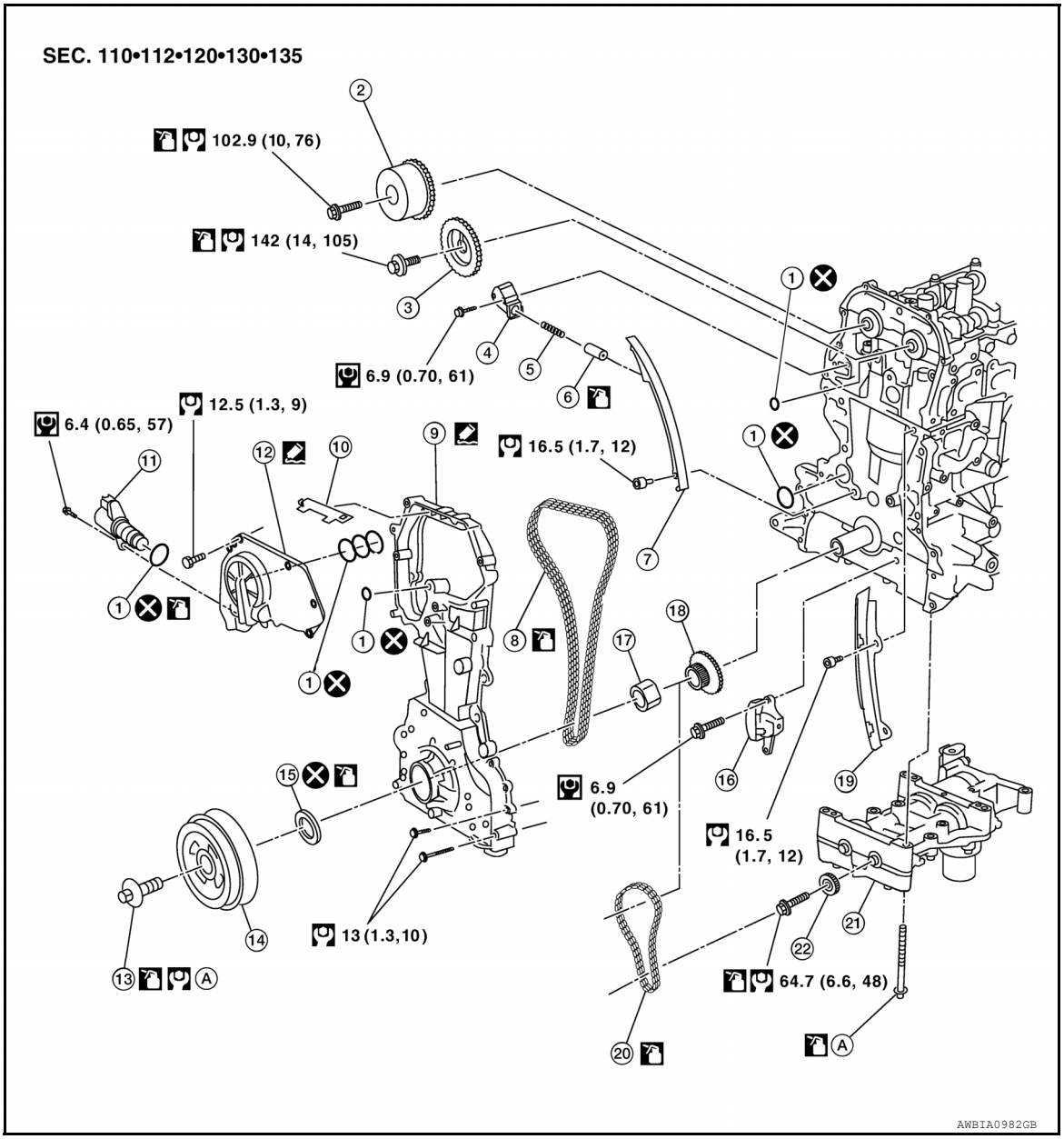
| | | |
|---|---|---|
| **Cold** | **Intake** | **: 0.24 - 0.32 mm (0.009 - 0.013 in)** |
| | **Exhaust** | **: 0.26 - 0.34 mm (0.010 - 0.013 in)** |
| **Hot*** | **Intake** | **: 0.304 - 0.416 mm (0.012 - 0.016 in)** |
| | **Exhaust** | **: 0.308 - 0.432 mm (0.012 - 0.017 in)** |

*: Reference data at approximately 80°C (176°F)

# TIMING CHAIN

## Removal and Installation

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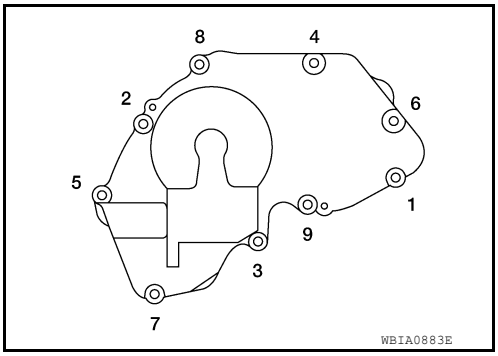

1. O-rings
2. Camshaft sprocket (INT)
3. Camshaft sprocket (EXH)
4. Chain tensioner
5. Spring
6. Chain tensioner plunger
7. Timing chain slack guide
8. Timing chain
9. Front cover
10. Chain guide
11. IVT solenoid valve
12. IVT cover
13. Crankshaft pulley bolt
14. Crankshaft pulley
15. Front oil seal
16. Balancer unit timing chain tensioner
17. Oil pump drive spacer
18. Crankshaft sprocket
19. Timing chain tension guide
20. Balancer unit timing chain
21. Balancer unit
22. Balancer unit sprocket
A. Follow the installation procedure

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

REMOVAL

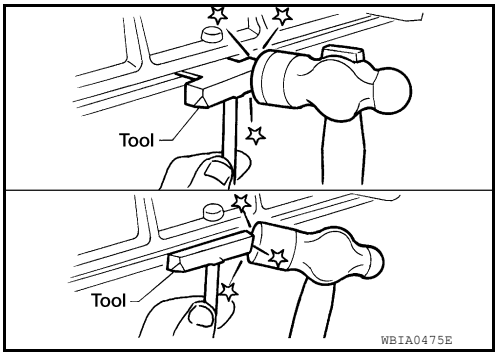
1. Remove the engine from the vehicle. Refer to EM-186, "Removal and Installation".
2. Mount engine to suitable stand.

3. Remove the drive belt auto-tensioner. Refer to EM-131, "Removal and Installation of Drive Belt Auto-tensioner".
4. Remove the A/C compressor. Refer to MTC-90, "Removal and Installation for Compressor - QR25DE".
5. Remove the upper and lower oil pan, and oil strainer. Refer to EM-142, "Removal and Installation".
6. Disconnect variable timing control solenoid harness connector.
7. Remove engine ground.
8. Loosen IVT control cover bolts in the numerical order as shown.



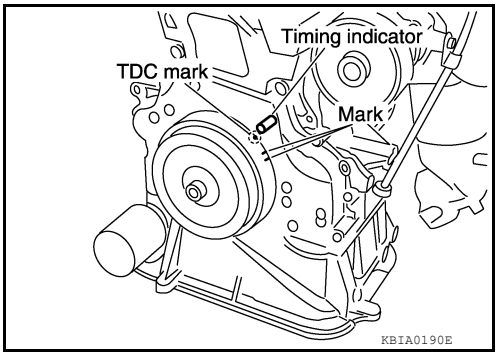

Remove the IVT control cover using Tool.

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

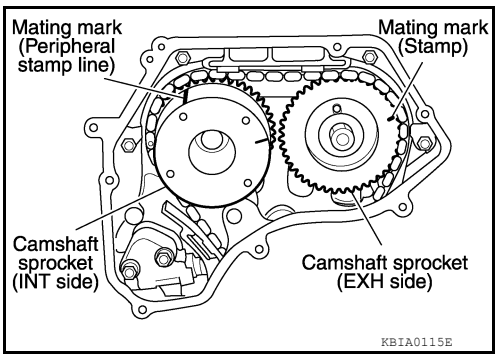



9. Pull chain guide between camshaft sprockets out through front cover.
10. Set the No.1 cylinder at TDC on the compression stroke with the following procedure:

a. Rotate the crankshaft pulley clockwise and align the mating marks to the timing indicator on the front cover.

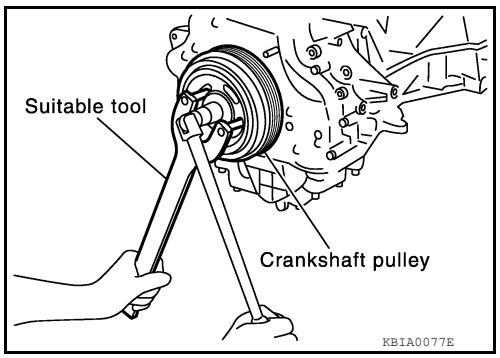



b. At the same time, make sure that the mating marks on the camshaft sprockets are lined up as shown.
   - If not lined up, rotate the crankshaft pulley one more turn to line up the mating marks to the positions as shown.

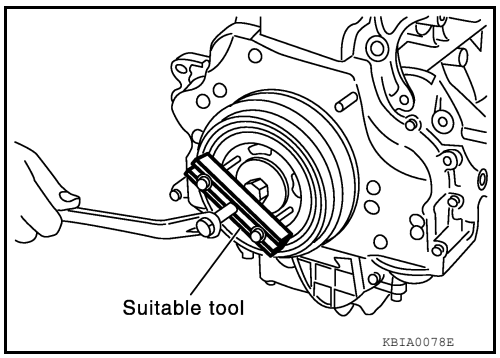


11. Remove crankshaft pulley with the following procedure:

a. Hold the crankshaft pulley using suitable tool, then loosen the crankshaft pulley bolt, and pull the pulley out about 10 mm (0.39 in).




b. Attach suitable pulley puller in the M 6 (0.24 in diameter) thread hole on crankshaft pulley, and remove crankshaft pulley using a suitable puller.




12. Remove the front cover with the following procedure:

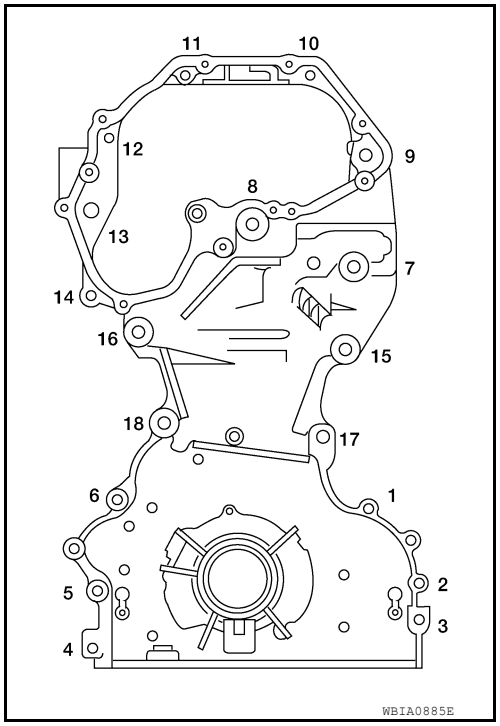
a. Loosen the bolts in the reverse order as shown, and remove them.

b. Remove the front cover.

**CAUTION:**

- **Be careful not to damage the mounting surface.**

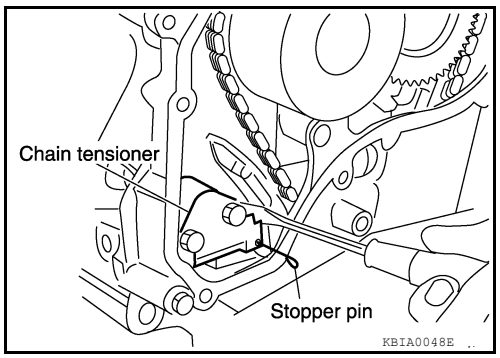
13. If the front oil seal needs to be replaced, lift it out with a suitable tool to remove it.




14. Remove timing chain with the following procedure:

a. Push in the tensioner plunger. Insert a stopper pin into the hole on the tensioner body to hold the chain tensioner.
- Use a wire of 0.5 mm (0.02 in) diameter as a stopper pin.

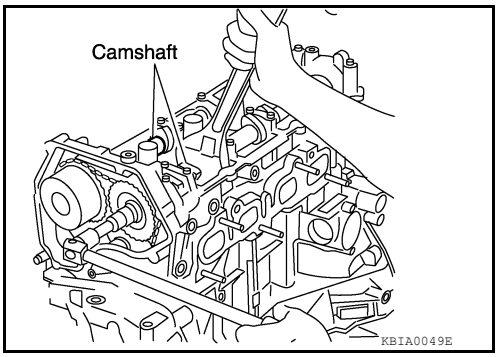
b. Remove the chain tensioner.



c. Secure hexagonal part of the camshaft with a wrench and loosen the camshaft sprocket bolt and remove the camshaft sprocket for both camshafts.

**CAUTION:**

- **Do not rotate the crankshaft or camshaft while the timing chain is removed.**
- **Rotating the crankshaft or the camshaft after the timing chain has been removed causes interference between the valves and pistons.**

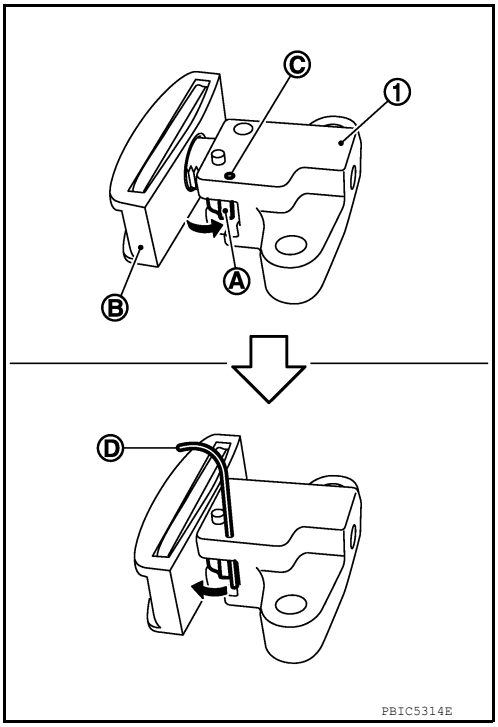



15. Remove the chain slack guide, tension guide, timing chain, and oil pump drive spacer.

16. Press stopper tab (A) in the direction shown to push the timing chain slack guide (B) toward timing chain tensioner (for balancer unit) (1).
    - The slack guide (B) is released by pressing the stopper tab (A). As a result, the slack guide (B) can be moved.
17. Insert stopper pin (D) into tensioner body hole (C) to secure timing chain slack guide (B).

    **NOTE:**

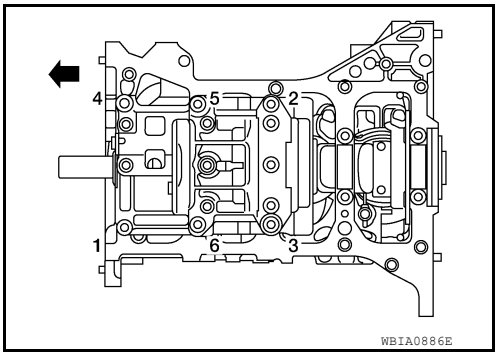
    Use a hard metal pin with a diameter of approximately 1.2 mm (0.047 in) as a stopper pin.
18. Remove timing chain for balancer unit, sprocket for balancer unit and crankshaft sprocket.




19. Loosen bolts in reverse order as shown, and remove balancer unit, if necessary.
    - Use socket (size E14)

**CAUTION:**

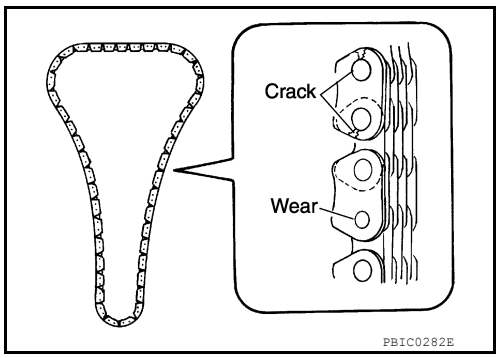
- **Do not disassemble balancer unit.**




## INSPECTION AFTER REMOVAL

Timing Chain

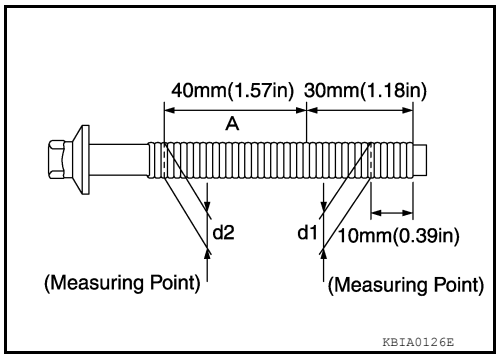
Check the timing chain for cracks or serious wear. If a defect is detected, replace it.




Balancer Unit Bolt Outer Diameter

- Measure outer diameters (d1, d2) at the two positions as shown.
- Measure d2 within the range A.
- If the value difference (d1 - d2) exceeds the limit (a dimension difference is large), replace it with a new one.

**Limit : 0.15 mm (0. 0059 in) or more**




## INSTALLATION

**NOTE:**

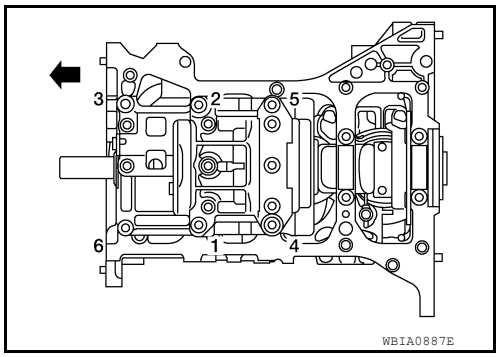
- There may be two color variations of the link marks (link colors) on the timing chain.
- There are 26 links between the blue mating marks on the timing chain; and 64 links between the camshaft sprocket blue link and the crankshaft sprocket orange link, on the timing chain side without the tensioner.

1. Make sure the crankshaft key points straight up.
2. Install the balancer unit and tighten the bolts in the numerical order as shown, if removed:
   - ⬅: Front

**CAUTION:**

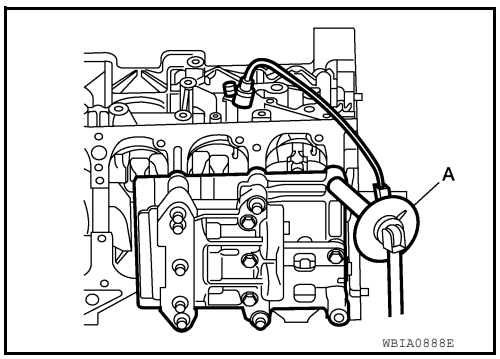
- **When reusing a bolt, check its outer diameter before installation. Follow the "Balancer Unit Bolt Outer Diameter" procedure.**

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



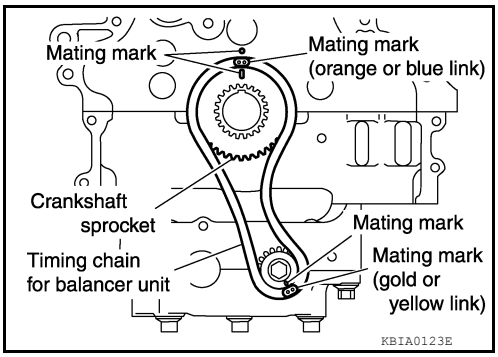

**CAUTION:**

- **Check tightening angle with an angle wrench (A) or a protractor. Do not make judgment by visual check alone.**
- **Apply new engine oil to threads and seating surfaces of bolts.**

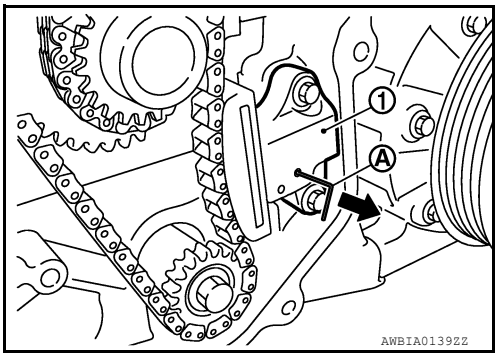


| Balancer Unit Bolts | | |
|---|---|---|
| Step 1 | Bolts 1-5 | : 42 N·m (4.3 kg-m, 31 ft-lb) |
| | Bolt 6 | : 36 N·m (3.7 kg-m, 27 ft-lb) |
| Step 2 | Bolts 1-5 | : 120° + 5° |
| | Bolt 6 | : 90° + 5° |
| Step 3 (Loosen in reverse order of tightening) | Bolts 1-6 | : 0 N·m (0 kg-m, 0 ft-lb) |
| Step 4 | Bolts 1-5 | : 42 N·m (4.3 kg-m, 31 ft-lb) |
| | Bolt 6 | : 36 N·m (3.7 kg-m, 27 ft-lb) |
| Step 5 | Bolts 1-5 | : 120° + 5° |
| | Bolt 6 | : 90° + 5° |

3. Install the crankshaft sprocket and timing chain for the balancer unit.
   - Make sure that the crankshaft sprocket is positioned with mating marks on the block and sprocket meeting at the top.
   - Install it by lining up mating marks on each sprocket and timing chain.

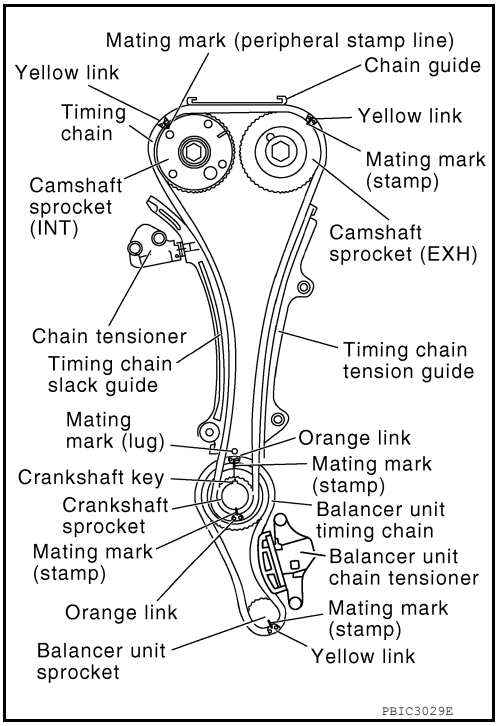



4. Install timing chain tensioner (for balancer unit) (1).
   1. Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
   2. Securely pull out ⬅ the stopper pin after installing the timing chain tensioner (for balancer unit).
   3. Check matching mark position of balancer unit timing chain and each sprocket again.



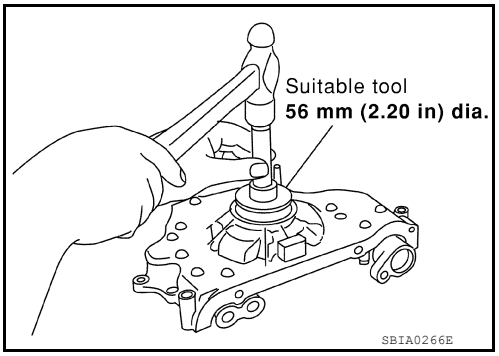
5. Install timing chain and related parts.
   - Install by lining up mating marks on each sprocket and timing chain as shown.

   **CAUTION:**
   **After the mating marks are aligned, keep them aligned by holding them in place.**
   **NOTE:**
   Align the timing marks of each sprocket and the timing chain prior to installing the chain tensioner.
   - Before and after installing chain tensioner, check often to make sure that mating marks have not slipped.
   - After installing chain tensioner, remove stopper pin, and make sure the tensioner moves freely.
   - To avoid skipped teeth, do not move crankshaft and camshaft until front cover is installed.




6. Install new front oil seal to front cover, using suitable tool
   - Install new oil seal in until it is flush with front end surface of front cover.

   **CAUTION:**
   - **Be careful not to cause damage to the oil seal.**




7. Install front cover with the following procedure:

a. Install O-rings to cylinder head and cylinder block.

   **CAUTION:**
   **Do not reuse O-rings.**

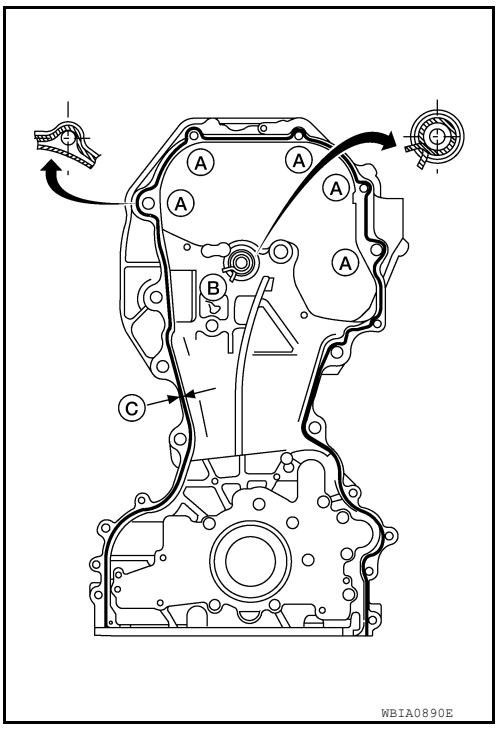
b. Apply Genuine Silicone RTV Sealant or equivalent, to positions specified (A), (B). Refer to GI-44, "Recommended Chemical Product and Sealant".

   **C (Sealant dimension) : 3.9 mm (0.154 in) dia**

   **CAUTION:**
   - **Installation should be done within 5 minutes after applying liquid gasket.**
   - **Do not fill the engine with oil for at least 30 minutes after the front cover is installed to allow the sealant to cure.**

c. Make sure the mating marks on the timing chain and each sprocket are still aligned. Then install the front cover.

   **CAUTION:**
   - **Be careful not to damage the front oil seal on the crankshaft during the front cover installation.**



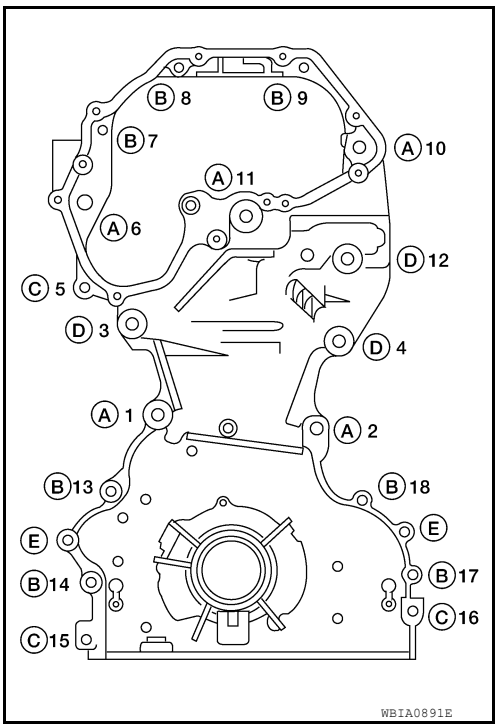
d. Tighten front cover bolts in the numerical order as shown.

e. After all bolts are tightened, retighten them to the specified torque.

**Front cover bolt torque**

| | |
|---|---|
| **Bolts A** | **: 49 N·m (5.0 kg-m, 36 ft-lb)** |
| **Bolts B** | **: 12.7 N·m (1.3 kg-m, 9 ft-lb)** |
| **Bolts C** | **: 12.7 N·m (1.3 kg-m, 9 ft-lb)** |
| **Bolts D** | **: 49 N·m (5.0 kg-m, 36 ft-lb)** |
| **E** | **Dowel pins** |

**CAUTION:**
**Wipe off excess sealant after installing the oil pan.**




8. Install the chain guide between the camshaft sprockets.
9. Install IVT cover with the following procedure:

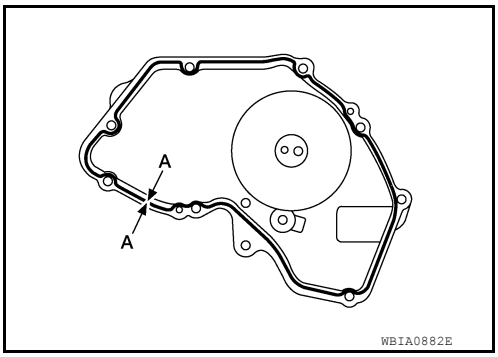
a. Install IVT solenoid valves to IVT cover.

b. Install new oil rings to the intake camshaft sprocket insertion points on IVT control cover backside.
**CAUTION:**
**Do not reuse O-ring.**

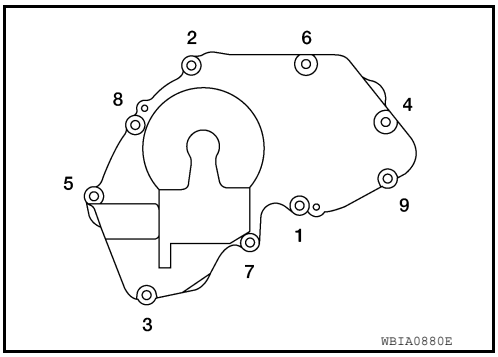
c. Install new O-ring to front cover.
**CAUTION:**
**Do not reuse O-ring.**

d. Apply Silicone RTV Sealant to the IVT cover as shown.
- Apply Genuine Silicone RTV Sealant (A) or equivalent, to positions specified. Refer to GI-44, "Recommended Chemical Product and Sealant".

**CAUTION:**
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the IVT cover is installed to allow the sealant to cure.**




e. Tighten the IVT cover bolts in the numerical order as shown.




10. Insert crankshaft pulley by aligning with crankshaft key.
- Tap its center with a plastic hammer to insert.

- Do not tap the belt hook.

11. Tighten crankshaft pulley bolts.
    - Secure crankshaft pulley with a pulley holder to tighten the bolt.
    - Perform angle tightening with the following procedure:

a. Apply new engine oil to threads and seat surfaces of bolts.

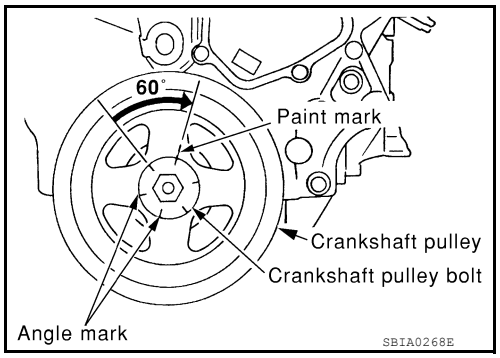
b. Tighten to initial specifications:·

**Crankshaft pulley bolt initial tightening : 37.3 - 47.1 N·m (3.8 - 4.8 kg-m, 28 - 34 ft-lb)**

c. Apply a paint mark on the front cover, mating with any one of six easy to recognize stamp marks on bolt flange.

d. Turn crankshaft pulley bolt another 60° to 66° degrees [Target: 60° degrees].
    - Check vertical mounting angle with movement of one stamp mark.

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



# OIL SEAL

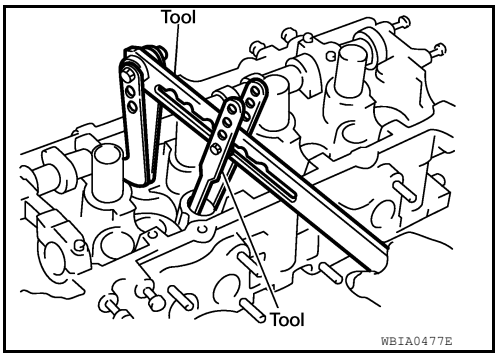
## Removal and Installation of Valve Oil Seal

INFOID:0000000007401911

### REMOVAL

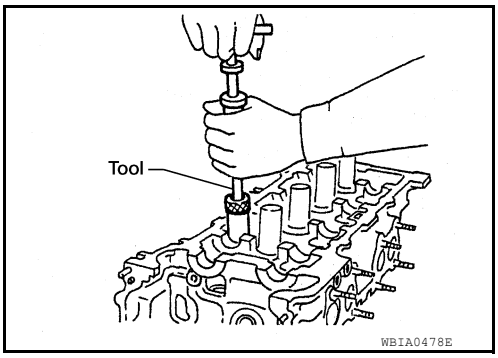
1. Remove camshaft. Refer to EM-154, "Removal and Installation".
2. Remove valve lifter. Refer to EM-154, "Removal and Installation".
3. Rotate crankshaft, and set piston whose oil seal is to removed to top dead center. This prevents valve from dropping inside cylinder.
   **CAUTION:**
   **When rotating crankshaft, be careful to avoid scarring the front cover with the timing chain.**
4. Remove valve collet, valve spring retainer and valve spring using Tool.

**Tool number**
**: KV10116200 (J-26336-B)**
**: KV10115900 (J-26336-20)**




5. Remove valve oil seal using Tool.

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

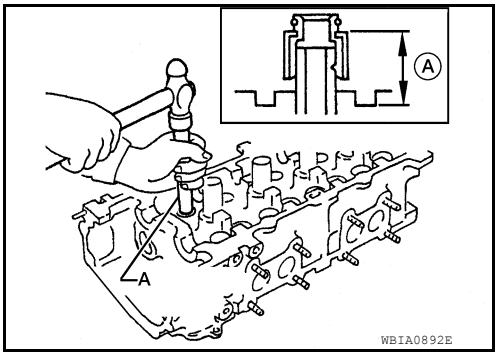



### INSTALLATION

1. Apply new engine oil to new valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the position shown using Tool.

**Oil seal installed height (A) : 12.1 mm (0.476 in)**

**Tool number : KV10115600 (J-38958)**




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

## Removal and Installation of Front Oil Seal

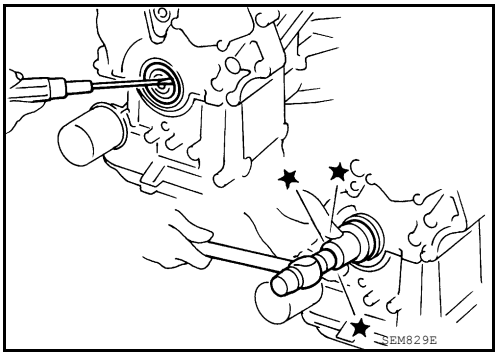
INFOID:0000000007401912

### REMOVAL

1. Remove the following parts:
   • RH front wheel and tire. Refer to WT-7, "Adjustment".

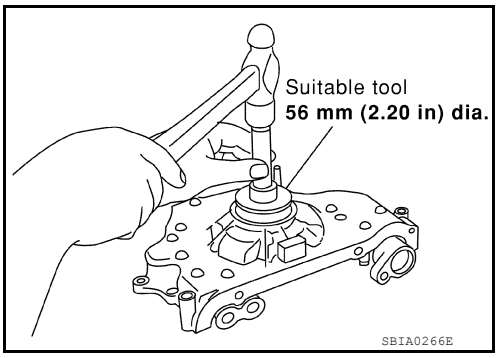
- Splash shield (RH). Refer to EI-23, "Component".
- Drive belt. Refer to EM-130.
- Crankshaft pulley. Refer to EM-165.

2. Remove front oil seal from front cover.
**CAUTION:**
**Be careful not to scratch front cover.**

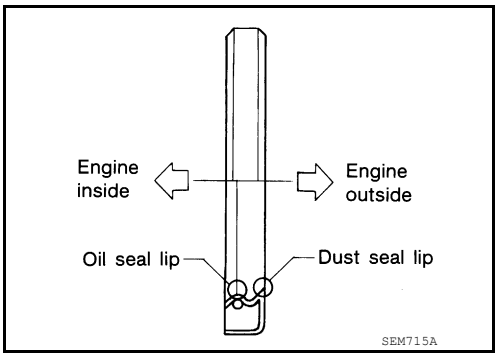



INSTALLATION

1. Apply new engine oil to new oil seal and install it using a suitable tool.
**CAUTION:**
**Do not reuse oil seal.**




- Install new oil seal in the direction shown.




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

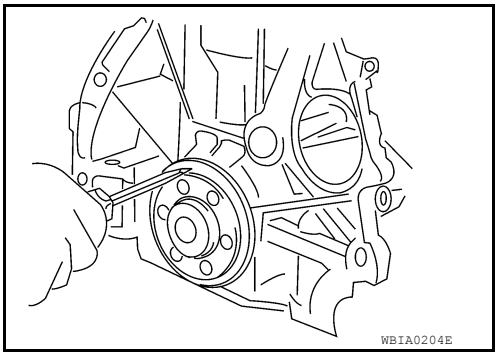
## Removal and Installation of Rear Oil Seal

INFOID:0000000007401913

REMOVAL

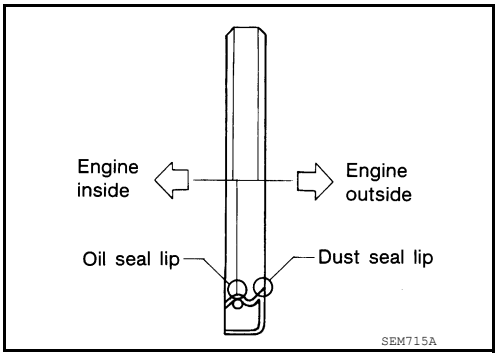
1. Remove the engine assembly. Refer to EM-186, "Removal and Installation".
2. Remove clutch cover and clutch disc (M/T models). Refer to CL-15, "Exploded View".
3. Remove flywheel (M/T models) or drive plate (CVT models). Refer to EM-190, "Disassembly and Assembly".

4. Remove rear oil seal using suitable tool.
**CAUTION:**
**Be careful not to scratch rear oil seal retainer.**

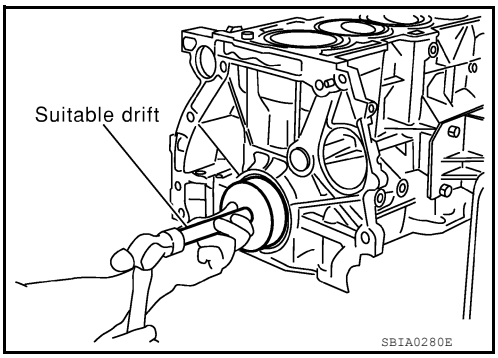



INSTALLATION

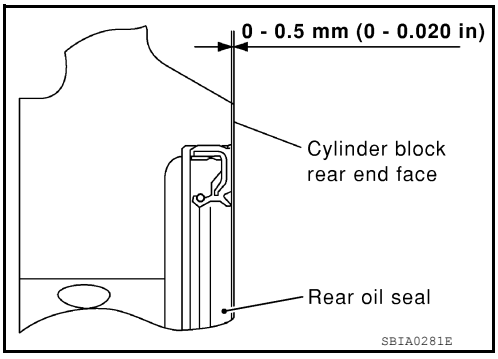
1. Apply new engine oil to new oil seal and install it using a suitable drift.
   - Install new oil seal in the direction shown.
   **CAUTION:**
   **Do not reuse oil seal.**




   - Press fit new oil seal straight using a suitable drift, to avoid causing burrs or tilting.




   - Press in the new oil seal to the specified depth as shown.




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

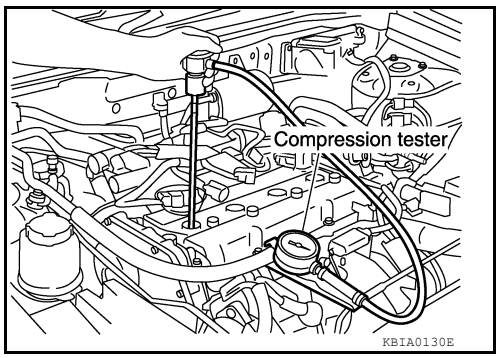
# CYLINDER HEAD

## On-Vehicle Service

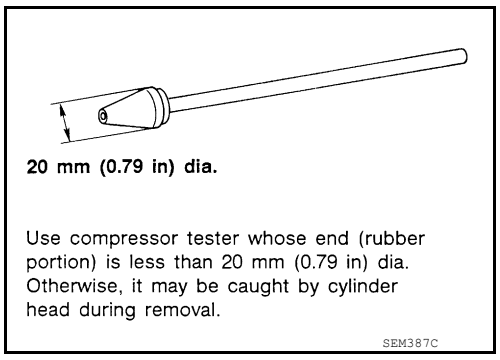
INFOID:0000000007401914

### CHECKING COMPRESSION PRESSURE

1. Warm up the engine to full operating temperature.
2. Release the fuel pressure. Refer to EC-1208, "Fuel Pressure Check".
3. Remove the ignition coil and spark plug from each cylinder.
   Refer to EM-147, "Removal and Installation".
4. Connect engine tachometer (not required in use of CONSULT).
5. Disconnect the fuel injector harness connector to avoid any residual fuel injection during the measurement.
6. Install the compression tester with the adapter into the spark plug hole.




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




7. With the accelerator pedal fully depressed, turn the ignition switch to the “START” position to crank over the engine. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.

Unit: kPa (kg/cm$^2$, psi) / rpm

| Standard | Minimum | Difference limit between cylinders |
|---|---|---|
| 1,250 (12.8, 181.3) / 250 | 1,060 (10.8, 153.7) / 250 | 100 (1.0, 14) / 250 |

**CAUTION:**

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

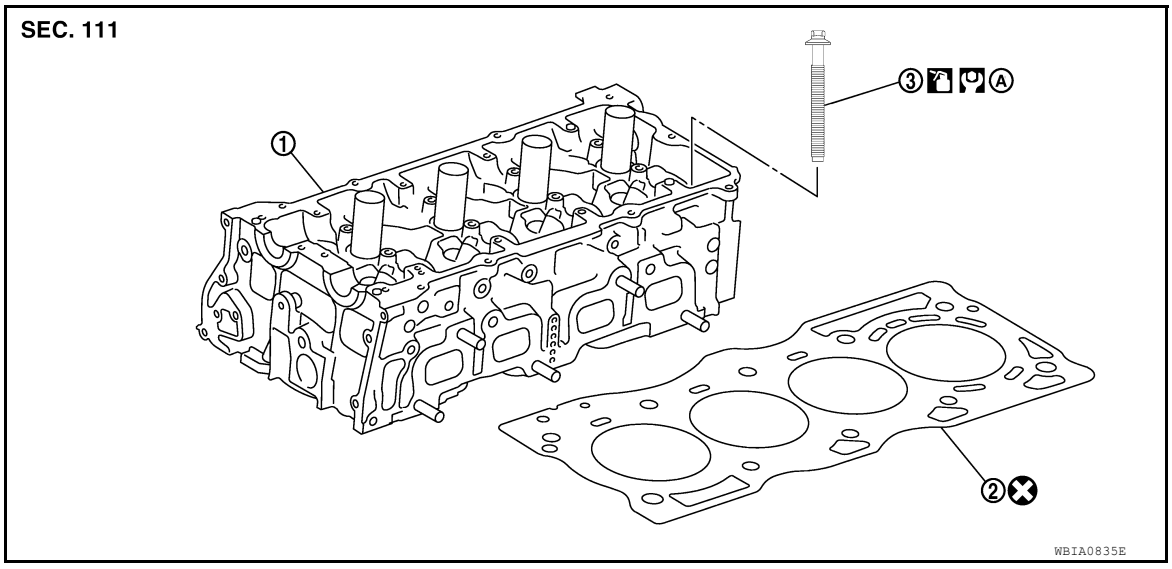
- If the engine speed is out of specified rpm range, check the battery. Check engine speed again with a fully charged battery.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
- If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
- If the added engine oil improves the compression, the piston rings may be worn or damaged. Check the piston rings and replace if necessary.
- If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.

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

8. Install spark plug, ignition coil and harness connectors.

## Removal and Installation

INFOID:0000000007401915

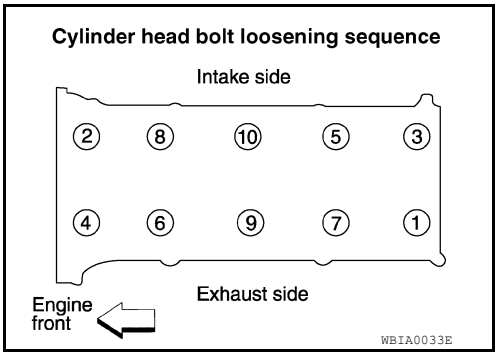



1. Cylinder head assembly
2. Cylinder head gasket
3. Cylinder head bolt

A. Refer to "INSTALLATION" EM-178

### REMOVAL

1. Remove the timing chain. Refer to EM-165, "Removal and Installation".
2. Remove the camshafts. Refer to EM-154.
3. Remove spark plugs. Refer to EM-147, "Removal and Installation".
4. Remove exhaust manifold. Refer to EM-140, "Removal and Installation".
5. Remove cylinder head loosening bolts in the order as shown, using power tool.
6. Remove water outlet, if necessary. Refer to CO-58, "Component".



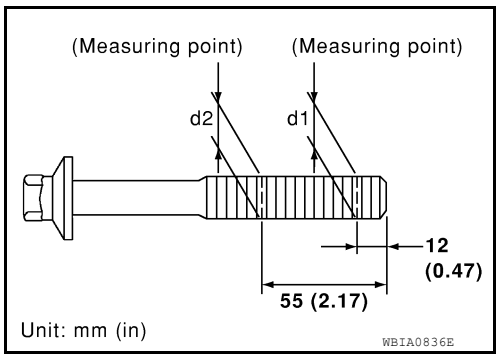

### INSPECTION AFTER REMOVAL

Outer Diameter of Cylinder Head Bolts

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

**Limit (d1 - d2) : 0.23 mm (0.0091 in) or less**

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

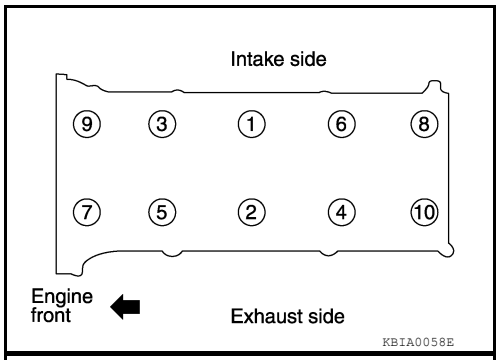


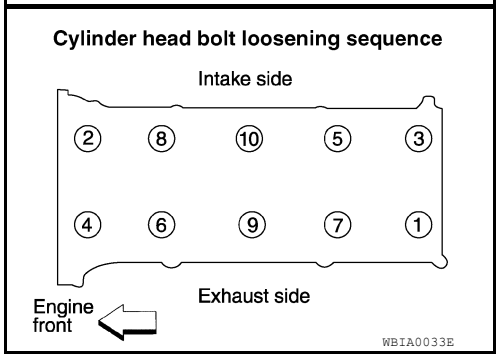

## INSTALLATION

1. Install a new cylinder head gasket.

2. Follow the steps below to tighten the cylinder head bolts using Tool, in the numerical order as shown.
   - Apply new engine oil to the threads and the seating surfaces of bolts.

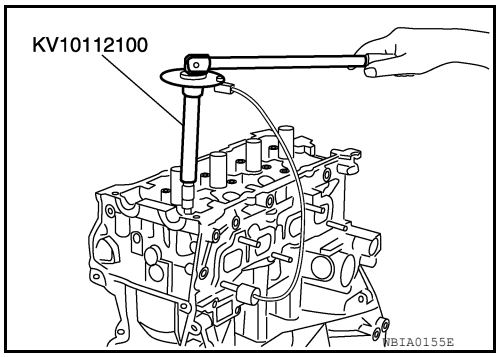
**CAUTION:**
- **If cylinder head bolts are re-used, check their outer diameters before installation. Follow the "Outer Diameter of Cylinder Head Bolts" procedure.**
- **Check and confirm the tightening angle by using angle wrench or protractor. Avoid judgment by visual inspection without the tool.**




**Step a : 55 N·m (5.6 kg-m, 41 ft-lb)**
**Step c : Loosen to 0 N·m in the reverse order of tightening.**
**Step d : 39.2 N·m (4.0 kg-m, 29 ft-lb)**
**Step e : 75° clockwise**
**Step f : 75° clockwise**

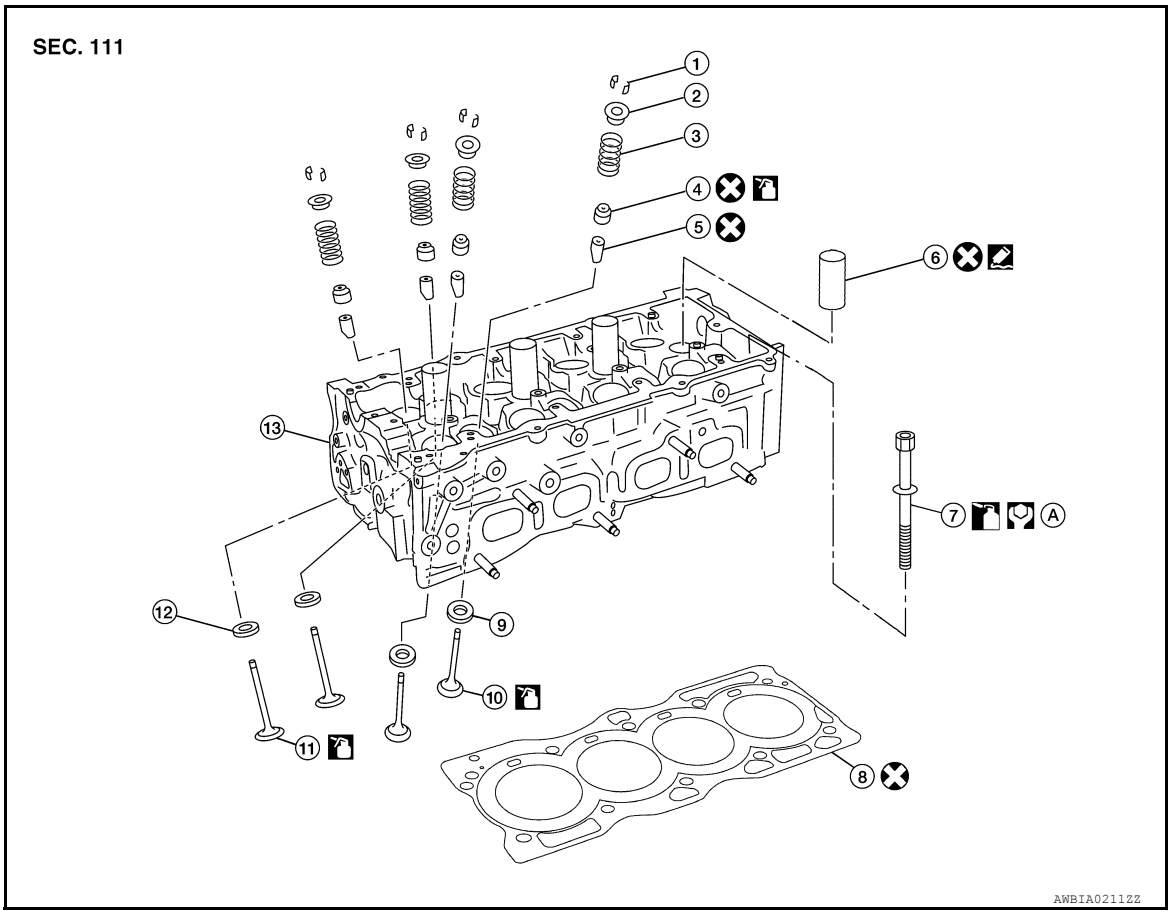
**Tool number : KV10112100 (BT-8653-A)**




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

## Disassembly and Assembly

INFOID:0000000007401916




1. Valve collet
2. Valve spring retainer
3. Valve spring (with valve spring seat)
4. Valve oil seal
5. Valve guide
6. Spark plug tube
7. Head bolt
8. Head gasket
9. Valve seat (EXH)
10. Valve (EXH)
11. Valve (INT)
12. Valve seat (INT)
13. Cylinder head
A. Follow installation procedure

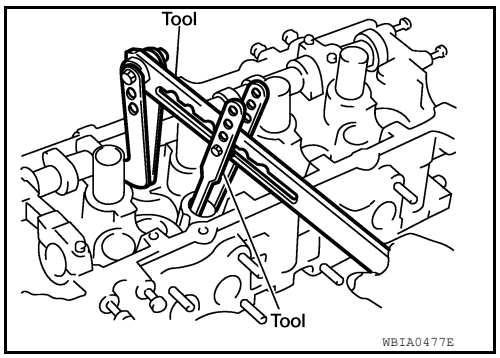
**CAUTION:**

- **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 surfaces when installing the cylinder head, camshaft sprocket, crankshaft pulley and camshaft bracket.**
- **Attach tags to valve lifters so all parts are assembled in their original position.**

### DISASSEMBLY

1. Remove the valve lifter.
   - Confirm installation point.

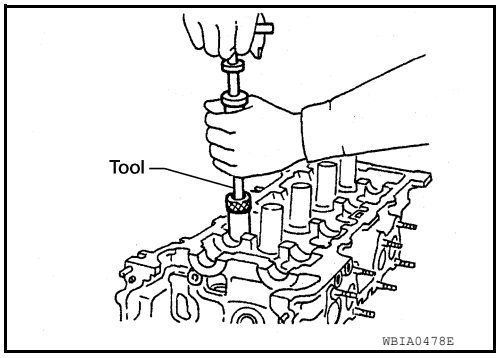
2. Remove the valve collet, valve spring retainer and valve spring using Tool.




**Tool number : KV10116200 (J-26336-B)**
**: KV10115900 (J-26336-20)**

**CAUSTION:**
**Do not remove valve spring seat from valve spring.**

3. Push valve stem to combustion chamber side, and remove valve.
   - Inspect valve guide clearance before removal. Refer to EM-182, "Inspection After Disassembly".
   - Confirm installation point.
4. Remove valve oil seal using Tool.



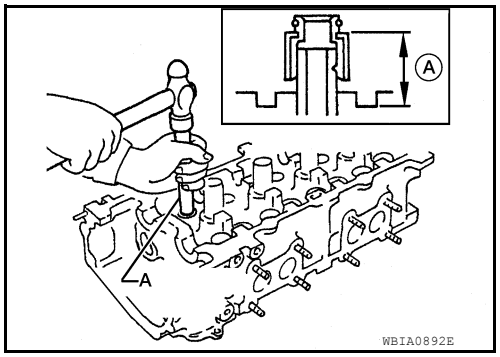

**Tool number : KV10107902 (J-38959)**

5. When valve seat must be replaced, refer to EM-182, "Inspection After Disassembly".
6. When valve guide must be replaced, refer to EM-182, "Inspection After Disassembly".
7. Remove spark plug using suitable tool.
8. Remove spark plug tubes, if necessary using suitable tool.

**CAUTION:**
- **Be careful not to damage cylinder head.**
- **Do not remove spark plug tube if not necessary. Once removed, the spark plug tube cannot be reused because of deformation.**

## ASSEMBLY

1. Install valve guide. Refer to EM-182, "Inspection After Disassembly".
2. Install valve seat. Refer to EM-182, "Inspection After Disassembly".
3. Install new valve oil seal to the specified height as shown, using Tool.

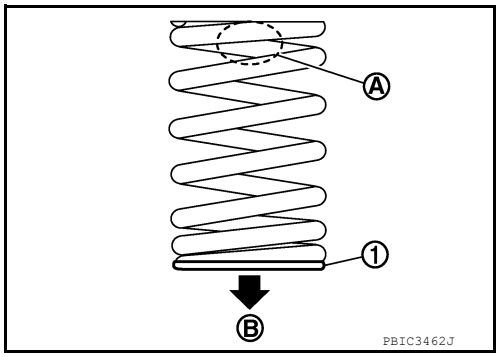



**Oil seal installed height (A) : 12.1 mm (0.476 in)**

**Tool number : KV10115600 (J-38958)**

**CAUSTION:**
**Do not reuse oil seal.**

4. Install valve.
   - Install larger diameter to intake side.
5. Install valve spring [with valve spring seat (1)].
   - A: Identification color
   - B: Cylinder head
   - ⬅: To cylinder head
   - Install smaller pitch spring end (valve spring seat side) to cylinder head side.
   - Confirm the identification color of the valve spring.



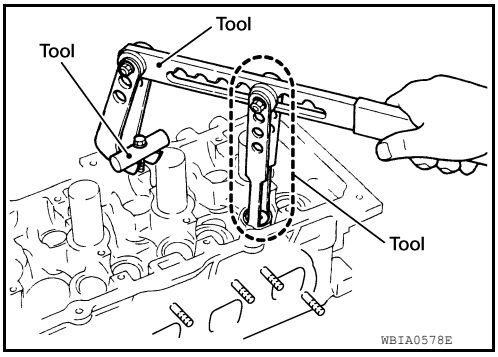

**Intake spring identification color (CVT models) : Pink**

**Exhaust spring identification color (CVT models) : Green**

**Intake spring identification color (M/T models)** : **Blue**

**Exhaust spring identification color (M/T models)** : **Yellow**

6. Install valve spring retainer.
7. Install valve collet using Tool.




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

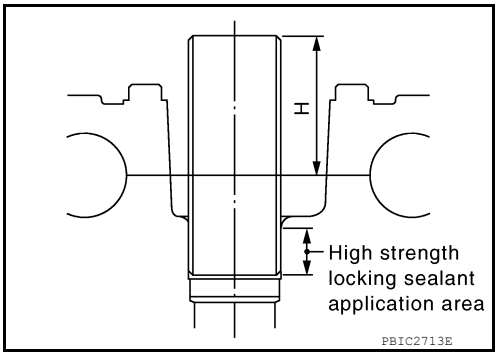
- Install valve collet with a magnet hand.
  **CAUTION:**
  **When working, be careful not to damage valve lifter holes.**
- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.

8. Install valve lifter.
9. Install the spark plug tube, if removed. Press-fit the spark plug tube into the cylinder head using the following procedure:

a. Remove old sealant from cylinder head side installation hole.

b. Apply sealant all round on spark plug tube within approximately 12 mm (0.47 in) width from edge of spark plug tube on the press-fit side.
**Use Genuine High Strength Locking Sealant or equivalent. Refer to** **GI-44, "Recommended Chemical Product and Sealant"**

c. Press-fit the spark plug tube to specified height “H” as shown, using suitable tool.




**Standard press-fit height “H”** : **41.2 - 42.2 mm (1.622 - 1.661 in)**

**CAUTION:**
- **When press-fitting, be careful not to deform spark plug tube.**
- **After press-fitting, wipe off any protruding sealant on top surface of cylinder head.**

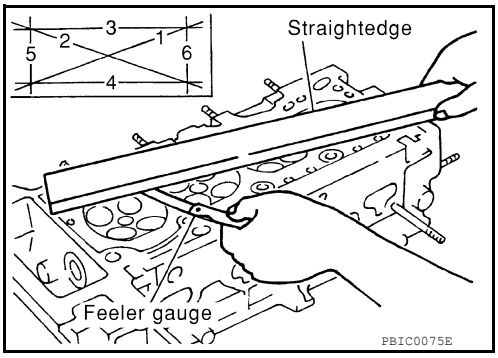
10. Install spark plug. Refer to EM-147.

## Inspection After Disassembly

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### CYLINDER HEAD DISTORTION

1. Wipe off oil and remove water scale deposits, old gasket, old sealer, and carbon with a scraper.
**CAUTION:**
**Use care not to allow gasket debris to enter passages for oil or water.**
2. At each of several locations on bottom surface of cylinder head, measure distortion in six directions. Replace the cylinder head if the distortion exceeds the specification limit.




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

- If it exceeds the limit, replace cylinder head.

### VALVE DIMENSIONS

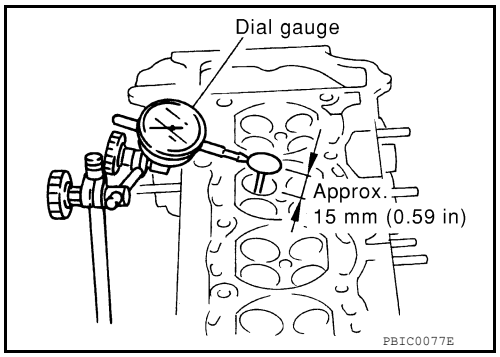
Check dimensions of each valve. Refer to EM-214, "Standard and Limit".

### VALVE GUIDE CLEARANCE

Perform this inspection before removing the valve guide.

1. Make sure that the valve stem diameter is within the specification.
2. Push the valve out by approximately 15 mm (0.59 in) toward the combustion chamber side to measure the valve's run-out volume (in the direction of dial gauge) with dial gauge.
3. Half of the run-out volume accounts for the valve guide clearance.

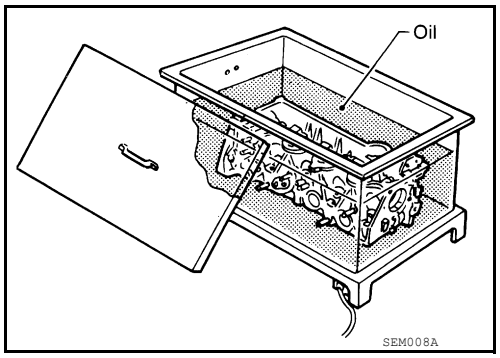
| | |
|---|---|
| **Intake valve guide clearance** | **: 0.020 - 0.053 mm (0.0008 - 0.0021 in) or less** |
| **Exhaust valve guide clearance** | **: 0.030 - 0.063 mm (0.0012 - 0.0025 in) or less** |



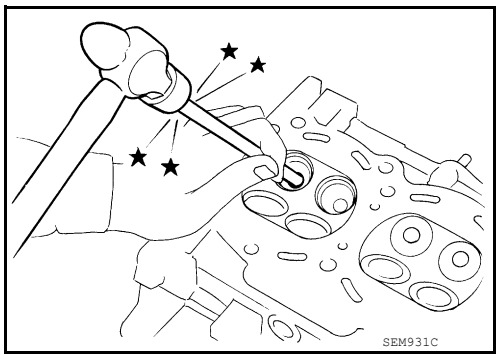

## VALVE GUIDE REPLACEMENT

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

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



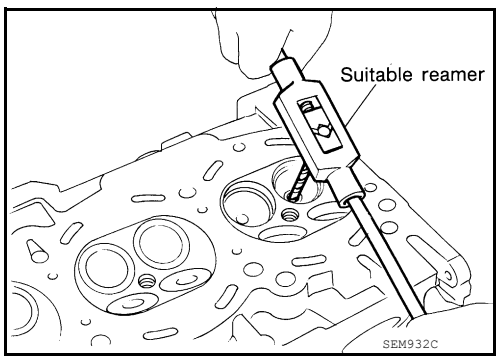

2. Drive out valve guide with a press [under a 20 kN (2.2 ton-force) pressure] or hammer and suitable tool.



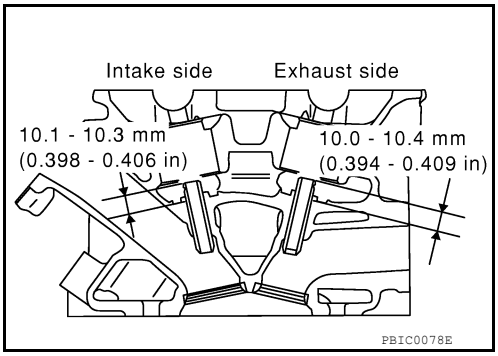

3. Ream cylinder head valve guide hole using suitable reamer.

| | |
|---|---|
| **Intake and exhaust valve guide hole diameter (Standard)** | **: 9.975 - 9.996 mm (0.3927 - 0.3935 in)** |

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

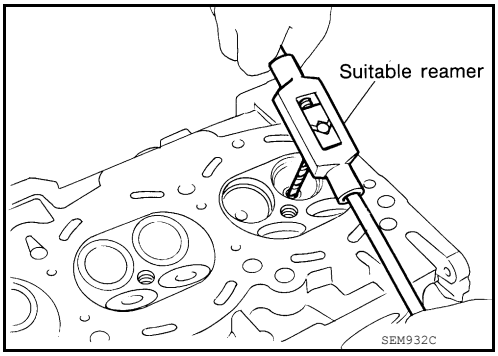


5. Press valve guide from camshaft side to dimensions as shown.




6. Apply finish to valve guide using suitable reamer.

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

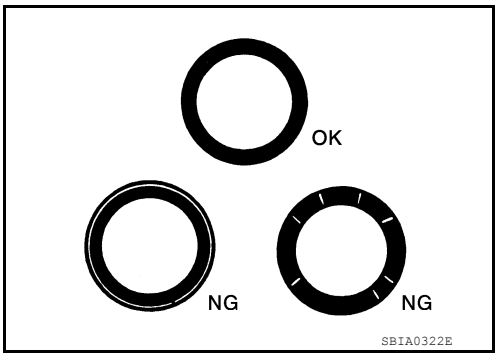



## VALVE SEAT CONTACT

**NOTE:**

After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure:

- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the seat surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace the valve seat.




## VALVE SEAT REPLACEMENT

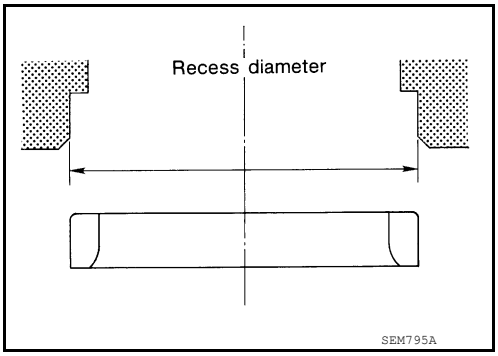
**NOTE:**

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

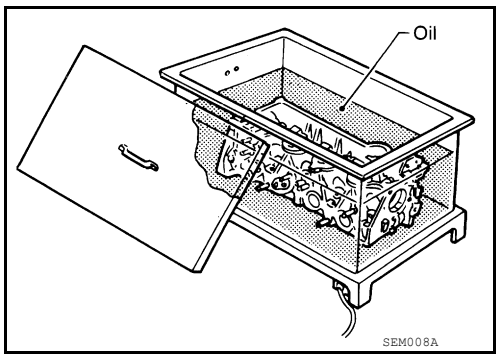
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in the cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess diameter for service valve seat.

**Intake : 37.000 - 37.016 mm (1.4567 - 1.4573 in)**
**Exhaust : 32.000 - 32.016 mm (1.2598 - 1.2605 in)**

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

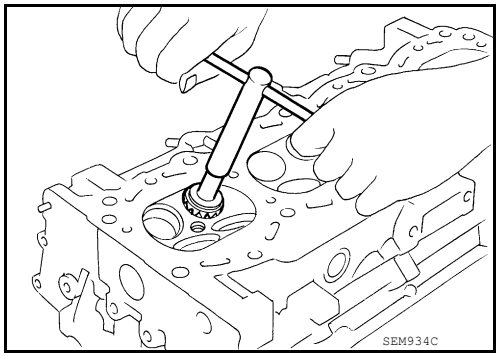


3. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil.




4. Use valve seats cooled well with dry ice. Force fit valve seat into cylinder head.
**CAUTION:**
**Avoid directly touching the cold valve seats.**

5. Finish the seat to the specified dimensions using suitable tool.
**CAUTION:**
**When using valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on the cutter or cutting many different times may result in a defective valve seat.**

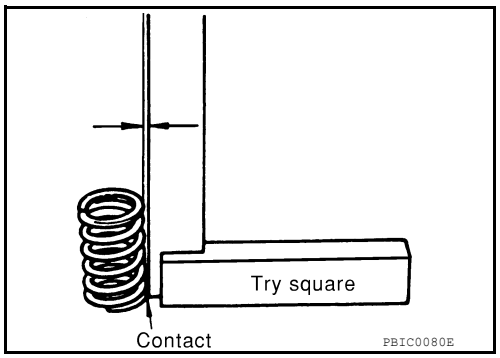



6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact.

## VALVE SPRING SQUARENESS

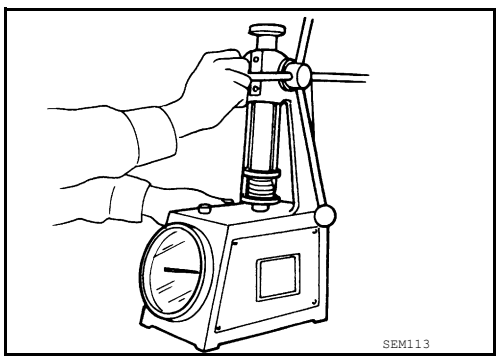
Set try square along the side of the valve spring and rotate the spring. Measure the maximum clearance between the top face of the spring and the try square.

**Limit : 1.9 mm (0.0748 in)**




## VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure with valve spring seat installed at specified spring height. Replace if not within specifications. Refer to EM-214, "Standard and Limit".
**CAUTION:**
**Do not remove the valve spring seat.**

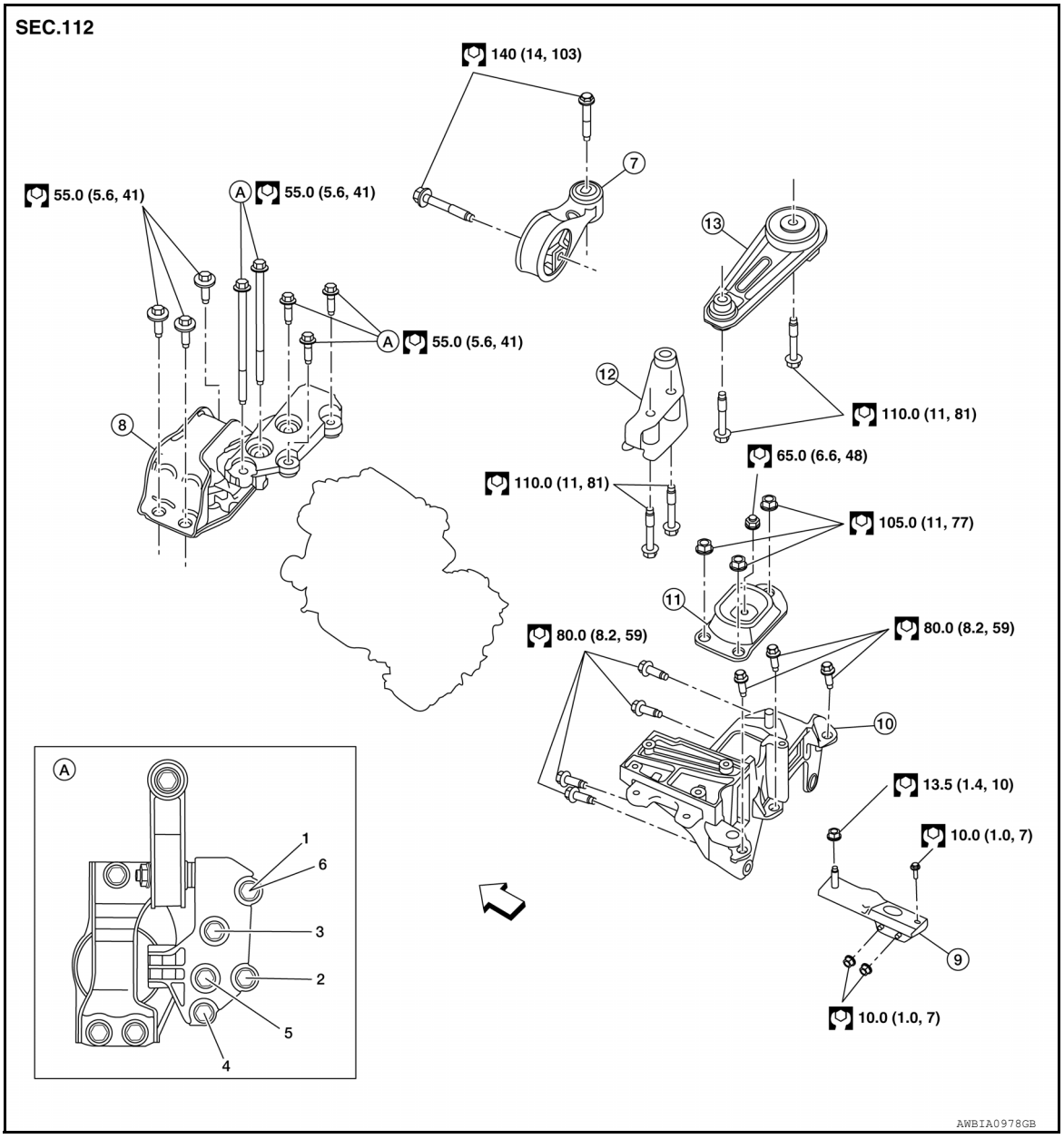


# ENGINE ASSEMBLY

## Removal and Installation

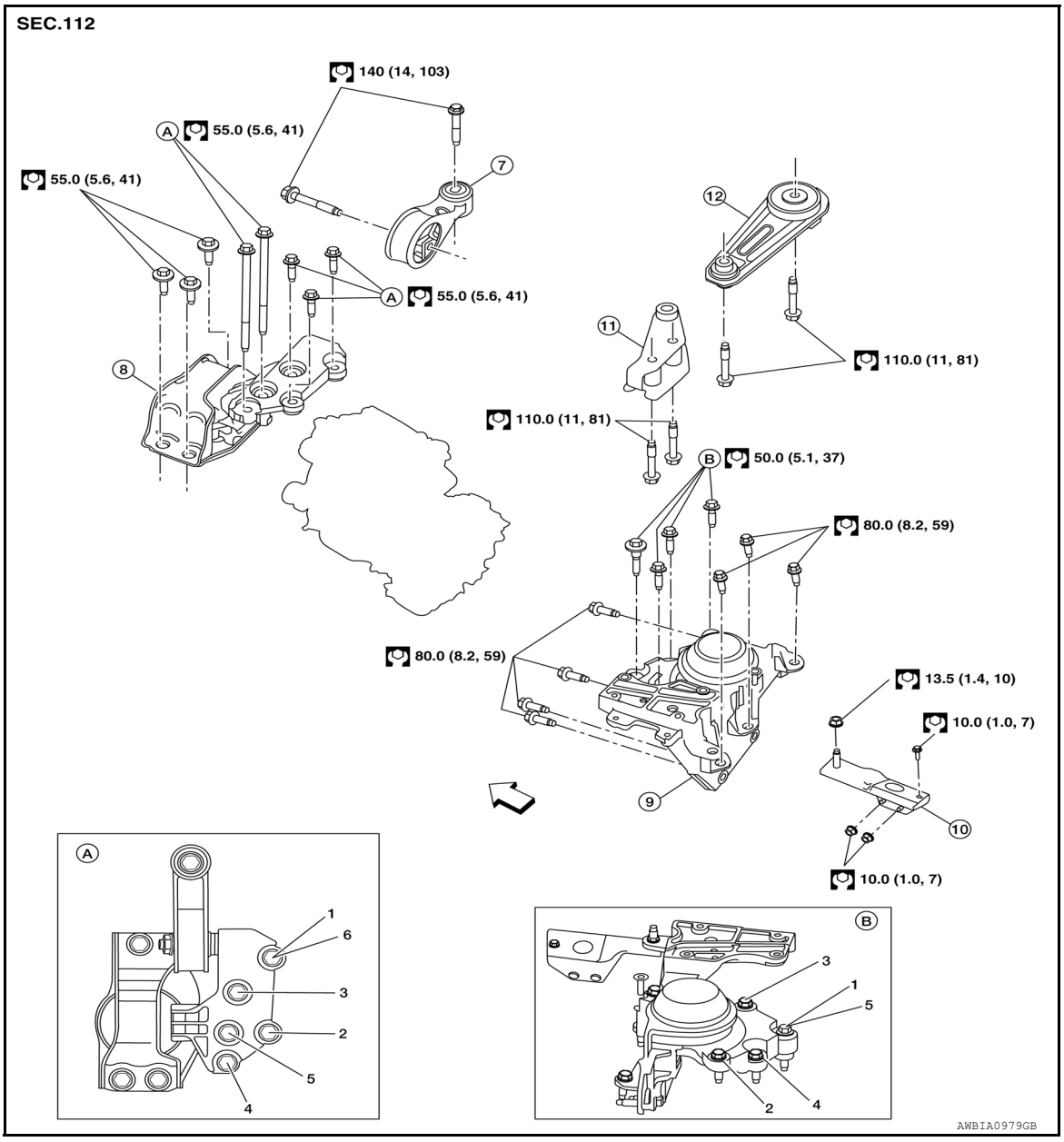
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M/T Models




| | | | | | |
|---|---|---|---|---|---|
| 7. | Torque rod (RH) | 8. | Engine mounting insulator and bracket (RH) | 9. | Support bracket (LH) |
| 10. | Engine mounting bracket (LH) | 11. | Engine mounting insulator (LH) | 12. | Bracket |
| 13. | Rear torque rod | A. | Tightening order (1-6) | ⇦ | Engine front |

CVT Models




| | | | | | |
|---|---|---|---|---|---|
| 7. | Torque rod (RH) | 8. | Engine mounting insulator and bracket (RH) | 9. | Engine mounting bracket (LH) |
| 10. | Support bracket (LH) | 11. | Bracket | 12. | Rear torque rod |
| A. | Tightening order (1-6) | B. | Tightening order (1-5) | ⇦ | Engine front |

**WARNING:**
- **Place chocks at the front and back of the rear wheels.**
- **For engines not equipped with slingers, attach proper slingers and bolts as described in the parts catalog.**

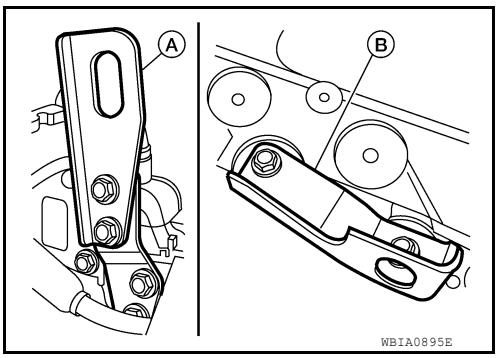
**CAUTION:**
- **Do not start working until the exhaust system and coolant are cool.**
- **If items or work required are not covered by the engine main body section, follow the applicable procedures.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-39.**
- **In removing the drive shaft, be careful not to damage the grease seals on the transaxle.**
- **Before separating the engine and transaxle, remove the crankshaft position sensor (POS) from the assembly.**
- **Be sure not to damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.**

REMOVAL

**NOTE:**
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Release fuel pressure. Refer to EC-1208, "Fuel Pressure Check".
2. Disconnect the fuel rail at the fuel hose quick connector (engine side). Refer to EM-135.
3. Drain the engine coolant. Refer to CO-43, "Changing Engine Coolant".
   **CAUTION:**
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belt.**
4. Remove the engine hood assembly. Refer to BL-15, "Removal and Installation".
5. Remove cowl extension. Refer to EI-21, "Removal and Installation".
6. Remove the battery, battery hold downs, and battery tray. Refer to SC-9, "Removal and Installation (QR25DE Battery Tray)".
7. Disconnect CVT fluid cooler hoses (CVT models).
8. Disconnect the MAF sensor electrical connector.
9. Disconnect brake fluid level sensor.
10. Remove the air duct and air cleaner case assembly. Refer to EM-133, "Removal and Installation".
11. Remove vacuum hose from intake manifold.
12. Disconnect EVAP hose.
13. Disconnect the heater hoses.
14. Remove engine room cover.
15. Remove the engine coolant reservoir tank and radiator hoses (upper) and (lower). Refer to CO-47, "Removal and Installation".
16. Disconnect and set aside the IPDM/ER and remove the IPDM/ER bracket. Refer to PG-29, "Removal and Installation of IPDM E/R".
17. Disconnect ground cable from generator bracket.
18. Disconnect camshaft position sensor.
19. Disconnect A/C piping from compressor and position aside.
20. Disconnect the engine wiring harness retainers and ground strap.
21. Disconnect the transaxle shift controls.
22. Remove transaxle ground strap.
23. Remove front exhaust tube. Refer to EX-11, "Component".
24. Remove the LH and RH drive shafts. Refer to FAX-9, "Removal and Installation (LH)" and FAX-11, "Removal and Installation (RH)".
25. Remove the rear torque rod.
26. Remove the front suspension member. Refer to FSU-10, "Removal and Installation".
27. Install engine slingers into front left cylinder head and rear right cylinder head.
    - Use generator bracket bolt holes for the front slinger.
    - Use the proper slingers and bolts as described in the Parts Catalog.

    **Slinger bolts - front (B) : 48 N·m (4.9 kg-m, 35 ft-lb)**
    **Slinger bolts - rear (A) : 28 N·m (2.8kg-m, 21 ft-lb)**




28. Support engine and transaxle assembly with engine lifting equipment from the top with the vehicle raised on a hoist.
29. Remove the torque rod (RH).
30. Remove engine mounting insulator and bracket (RH).
31. Remove engine mounting bracket (LH) (CVT models).

32. Remove engine mounting insulator (LH) nut.
33. Lower the engine and transaxle assembly from the engine compartment using Tool.
**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.**

**Tool number : KV101J0010 (J-47242)**

34. Remove the starter motor. Refer to SC-28, "Removal and Installation QR25DE".
35. Separate engine and transaxle assembly. Refer to CVT-197, "Removal and Installation (QR25DE)" (CVT models), MT-70, "Removal and Installation" (RS6F52A) or MT-148, "Removal and Installation" (RS6F52H) (M/T models).

## INSTALLATION

Installation is in the reverse order of removal.
Combine engine and transaxle assembly. Refer to CVT-197, "Removal and Installation (QR25DE)" (CVT models), MT-70, "Removal and Installation" (RS6F52A) or MT-148, "Removal and Installation" (RS6F52H) (M/T models).
- Do not allow oil to get on mounting insulators. Be careful not to damage mounting insulators.
- If parts have a direction mark (arrow) this indicates front of the vehicle, and the parts must be installed according to the identification mark.

## 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-15, "QR25DE".
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
**NOTE:**
If hydraulic pressure inside timing chain tensioner drops after removal and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust 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:

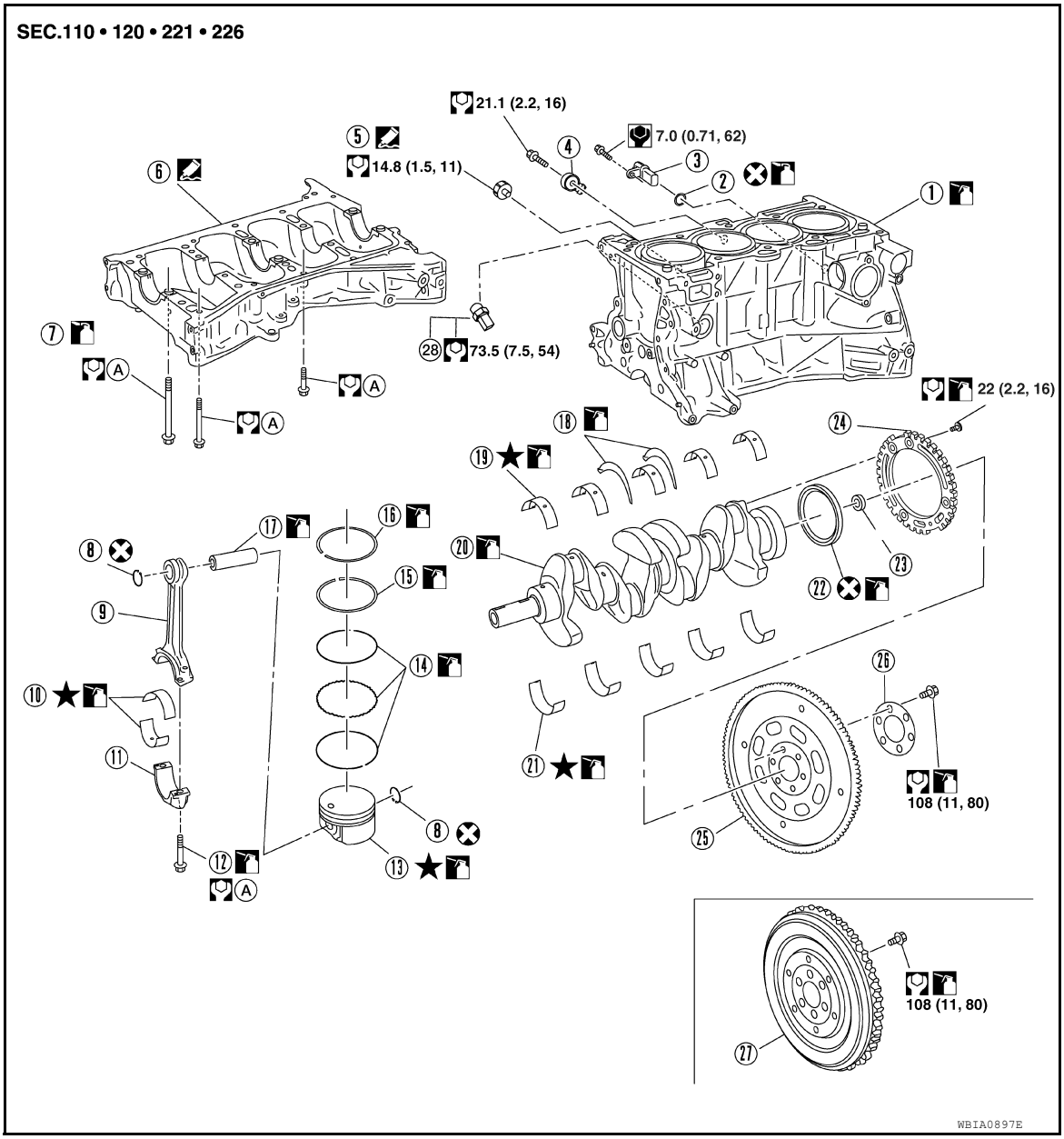
| Item | | Before starting engine | Engine running | After engine stopped |
|---|---|---|---|---|
| Engine coolant | | Level | Leakage | Level |
| Engine oil | | Level | Leakage | Level |
| Transmission/ transaxle fluid | A/T and CVT Models | Leakage | Level/Leakage | Leakage |
| | M/T Models | Level/Leakage | Leakage | Level/Leakage |
| Other oils and fluids* | | Level | Leakage | Level |
| Fuel | | Leakage | Leakage | Leakage |
| Exhaust gas | | — | Leakage | — |

*Power steering fluid, brake fluid, etc.

# CYLINDER BLOCK

## Disassembly and Assembly

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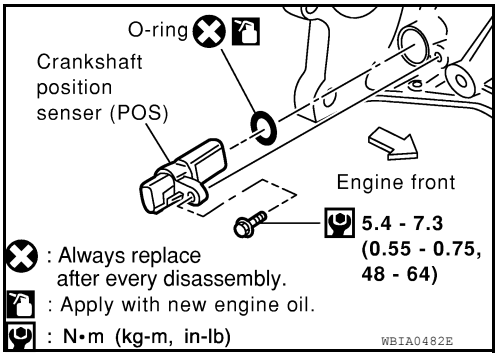



1. Cylinder block
2. O-ring
3. Crankshaft position sensor (POS)
4. Knock sensor
5. Oil pressure sensor
6. Lower cylinder block
7. Lower cylinder block bolt
8. Snap ring
9. Connecting rod
10. Connecting rod bearing
11. Connecting rod bearing cap
12. Connecting rod bearing cap bolt
13. Piston
14. Oil ring
15. Second ring
16. Top ring
17. Piston pin
18. Main thrust bearing
19. Main bearing upper
20. Crankshaft
21. Main bearing lower
22. Crankshaft rear oil seal
23. Pilot converter (CVT only)
24. Crankshaft signal plate
25. Drive plate (CVT)
26. Reinforcement plate (CVT)
27. Flywheel (M/T)
28. Cylinder block heater (if equipped)
A. Refer to "ASSEMBLY" EM-190

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

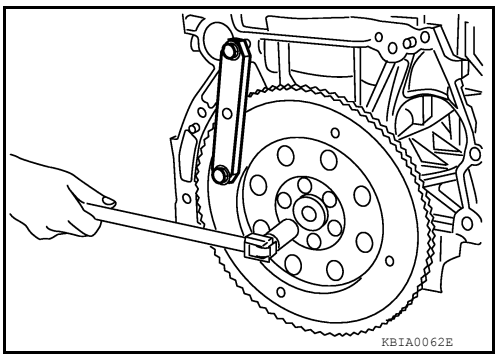
DISASSEMBLY

1. Remove the engine and transaxle as an assembly from the vehicle, and separate the transaxle from the engine. Refer to EM-186, "Removal and Installation".
2. Mount the engine on a suitable engine stand.
3. Drain any remaining engine oil and coolant from the engine.
4. Remove the following components and associated parts.
   - Exhaust manifold and three way catalyst assembly. Refer to EM-140, "Removal and Installation".
   - Intake manifold and fuel tube assembly. Refer to EM-135, "Removal and Installation".
   - Ignition coils. Refer to EM-146, "Removal and Installation".
   - Rocker cover. Refer to EM-152, "Removal and Installation".
   - Front cover, timing chain, and balancer unit. Refer to EM-165, "Removal and Installation".
   - Cylinder head. Refer to EM-178, "Removal and Installation".
5. Remove the knock sensor.
   **CAUTION:**
   **Carefully handle the sensor and do not drop the sensor.**
6. Remove crankshaft position sensor (POS).
   **CAUTION:**
   - **Avoid impacts such as a dropping.**
   - **Do not disassemble.**
   - **Keep it away from metal particles.**
   - **Do not place sensor close to magnetic materials.**



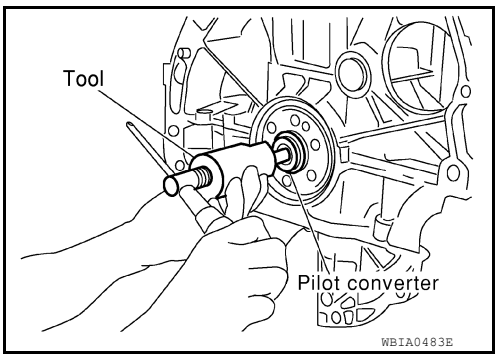

7. Remove the flywheel (M/T models) or drive plate (CVT models). Hold the crankshaft with a stopper plate and use a suitable tool to remove the bolts.
   **CAUTION:**
   - **Be careful not to damage the flywheel contact surface for the clutch disc.**

   **NOTE:**
   - The flywheel two-block construction allows movement in response to transmission side pressure, or when twisted in its rotational direction, therefore, some amount of noise is normal.




8. Remove pilot converter using Tool (CVT models).

   **Tool number : ST16610001 (J-23907)**

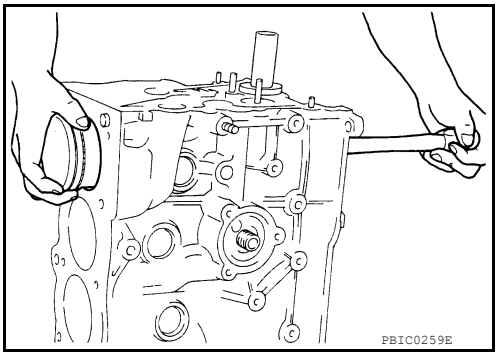


9. Remove the piston and connecting rod assemblies.

a. Position the crankshaft and corresponding connecting rod, to be removed, to the bottom dead center stroke.

b. Remove the connecting rod cap. Number the cap so it can be assembled in the same position.

c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out of the top of the cylinder block. Number the piston and rod so it can be assembled in the same position.
   - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-204, "Inspection After Disassembly".

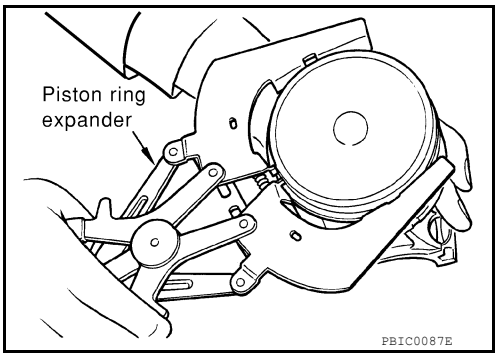



10. Remove the connecting rod bearings. If reusing, number them so they can be assembled in the same position and direction.

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

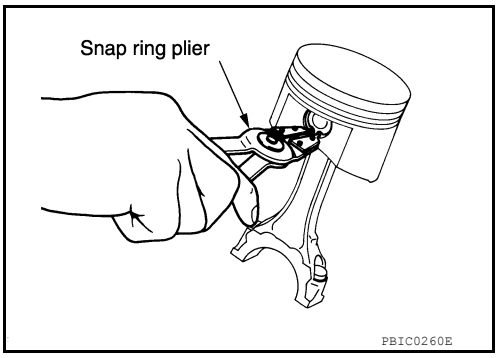
11. Remove the piston rings from the piston.
   - Use a piston ring expander.

**CAUTION:**
- **When removing the piston rings, be careful not to damage the piston.**
- **Be careful not to damage piston rings by expanding them excessively, if reusing them.**
- Before removing the piston rings, check the piston ring side clearance. Refer to EM-204, "Inspection After Disassembly".

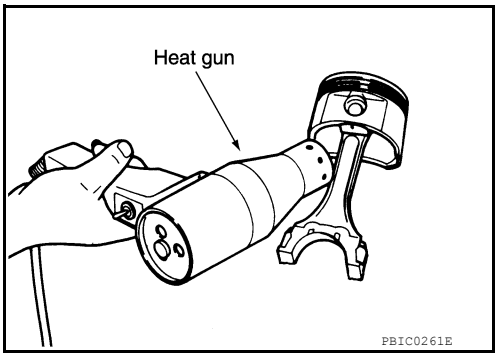



12. Remove the piston from the connecting rod as follows.

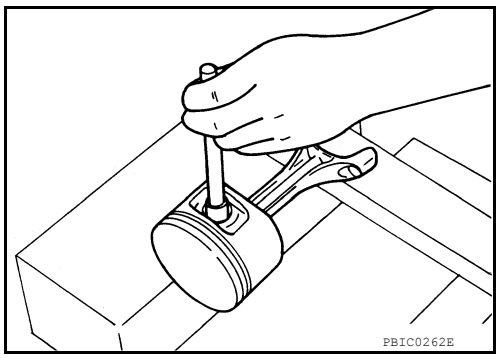
a. Using a snap ring pliers, remove the two snap rings.



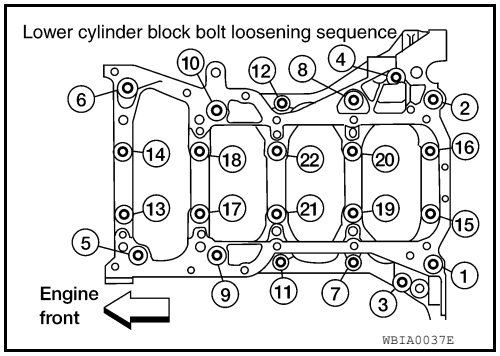

b. Heat the piston to 60° - 70°C (140° - 158°F) with a heat gun, or equivalent.



c. Push out piston pin with a punch of an outer diameter of approximately 19 mm (0.75 in).




13. Remove the lower cylinder block bolts.
    - Before loosening the lower cylinder block bolts, measure the crankshaft side clearance. Refer to EM-204, "Inspection After Disassembly".
    - Loosen them in the order as shown to remove them.



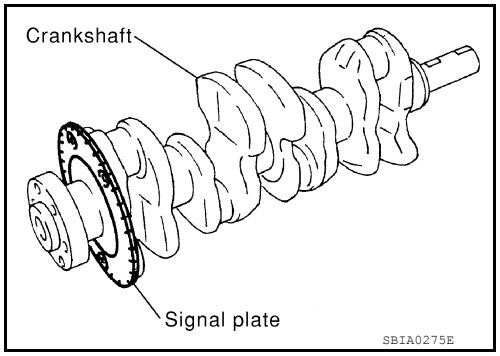

14. Remove the lower cylinder block.
    - Cut the Silicone RTV Sealant and remove the lower cylinder block from the cylinder block, using Tool.

**Seal cutter KV10111100 (J-37228)**

**CAUTION:**
**Be careful not to damage the mounting surface.**

15. Remove the crankshaft.

**CAUTION:**
- **Do not damage or deform the signal plate while mounted on the crankshaft.**
- **When setting the crankshaft on a flat surface, use a block of wood to avoid interference between the signal plate and the surface.**
- **Do not remove signal plate unless it is necessary.**




16. Pull the rear oil seal out of the rear end of the crankshaft.

**CAUTION:**
**Do not to damage the crankshaft or cylinder block when removing the rear oil seal.**

**NOTE:**
When replacing the rear oil seal without removing the cylinder block, use a suitable tool to pull it out from between crankshaft and block.

17. Remove the main bearings and thrust bearings from the cylinder block and lower cylinder block.

**CAUTION:**
**Identify and number the bearings, if reusing them, so that they are assembled in the same position and direction.**

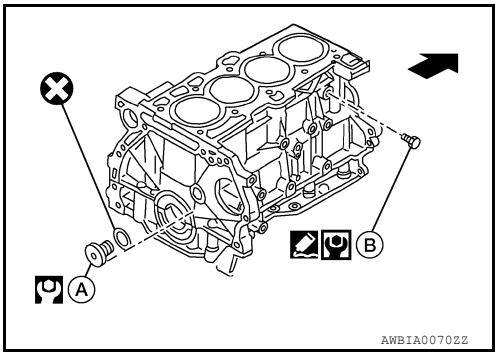
## ASSEMBLY

1. Using compressed air, clean out the coolant and oil passages in the cylinder block, the cylinder bore and the crankcase to remove any foreign material.

**CAUTION:**
**Use approved safety glasses to protect your eyes.**

2. Install the drain plugs on the cylinder block.
   - ⬅: Engine front
   - Apply Silicone RTV Sealant.
     **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".**
     **CAUTION:**
     **Do not reuse copper sealing washers.**

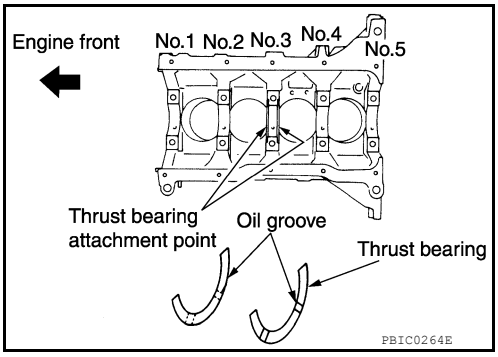
| | |
|---|---|
| **Drain plug (A)** | **: 54 N·m (5.5 kg-m, 40 ft-lb)** |
| **Drain plug (B)** | **: 9.8 N·m (1.0 kg-m, 80 in-lb)** |



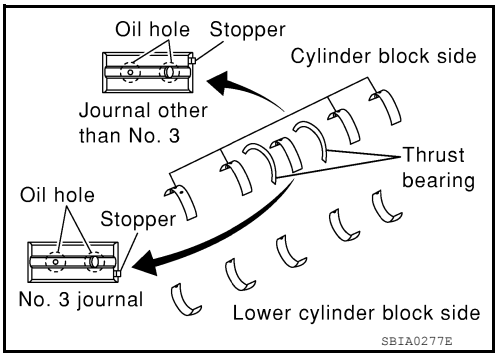

3. Install the main bearings and the thrust bearings.

a. Remove dust, dirt, and oil from the bearing mating surfaces of the cylinder block and lower cylinder block.

b. Install the thrust bearings to both sides of the No. 3 main bearing journal on the cylinder block.
   - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).




c. Install the main bearings paying attention to their position and direction.
   - The main bearing with an oil hole and groove goes on the cylinder block. The one without them goes on the lower cylinder block.
   - Only the main bearing (on the cylinder block) for No. 3 journal has different specifications.
   - Before installing the bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean it.
   - When installing, align the bearing stopper to the notch.
   - Make sure that the oil holes on the cylinder block and those on the corresponding bearing are aligned.

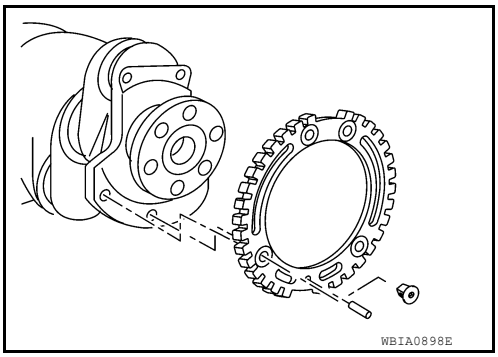



4. Install the signal plate to the crankshaft.

a. Position the crankshaft and signal plate using a positioning dowel pin, and tighten the bolts to specification.

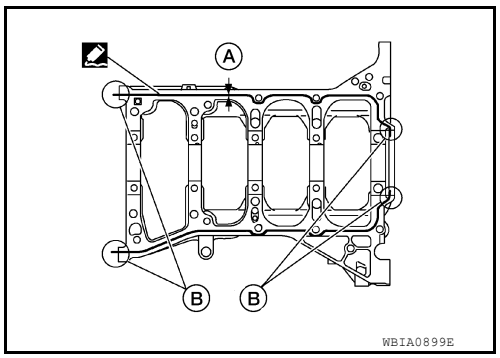
b. Remove the dowel pin.
   **CAUTION:**
   **Be sure to remove dowel pin before installing the crankshaft.**
   **NOTE:**
   Dowel pins for the crankshaft and signal plate are supplied as a set for each.

5. Install the crankshaft onto the cylinder block.
   - While turning the crankshaft by hand, check that it turns smoothly.



6. Install the lower cylinder block.
   - Apply Silicone RTV Sealant to positions as shown (A), (B).
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-44, "Recommended Chemical Product and Sealant".

   **NOTE:**
   Cylinder block and lower cylinder block are machined together. Neither of them can be replaced separately.
   **CAUTION:**
   **After the Silicone RTV Sealant is applied, the lower cylinder block installation must be finished within 5 minutes.**

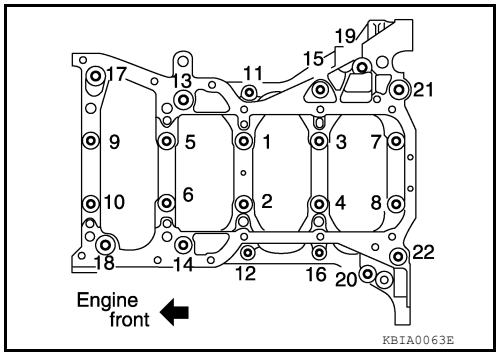



7. Tighten lower cylinder block bolts in the numerical order as shown and according to the following steps:

a. Apply new engine oil to threads and seat surfaces of the bolts.

b. Tighten bolts No. 11 - 22 only in the order as shown, to specification below.

   **Step 1, bolts 11 - 22 only : 25.1 N·m (2.6 kg-m, 19 ft-lb)**



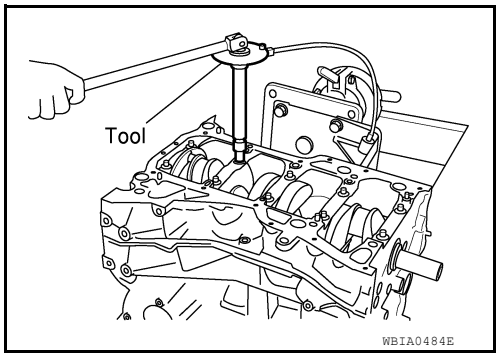

c. Tighten bolts No. 1 - 10 only in the order as shown, to specification below.

   **Step 2, bolts 1 - 10 only : 39.2 N·m (4.0 kg-m, 29 ft-lb)**

d. Tighten bolts No. 1 - 10 only in the order as shown, to specification below using Tool.
   **CAUTION:**
   **Check tightening angle using Tool. Do not make judgment by visual inspection.**

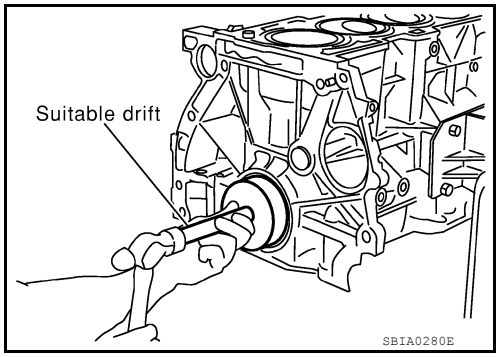
   **Tool number : KV 10112100 (BT-8653-A)**

   **Step 3, bolts 1 - 10 only : 60° degrees rotation**

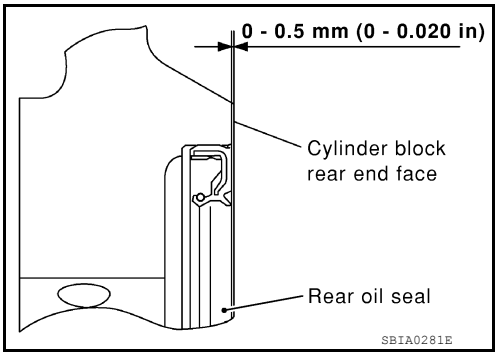



   - Wipe off completely any protruding Silicone RTV Sealant on the exterior of engine.
   - Check crankshaft side clearance. Refer to EM-204, "Inspection After Disassembly".
   - After installing the bolts, make sure that the crankshaft can be rotated smoothly by hand.

8. Install the rear oil seal.
   - Press the oil seal between cylinder block and crankshaft with a suitable drift.
   - Be careful not to touch the grease on the oil seal lip.
   - Be careful not to cause scratches or burrs when pressing in the rear oil seal.
     **CAUTION:**
     **Do not reuse oil seal.**



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

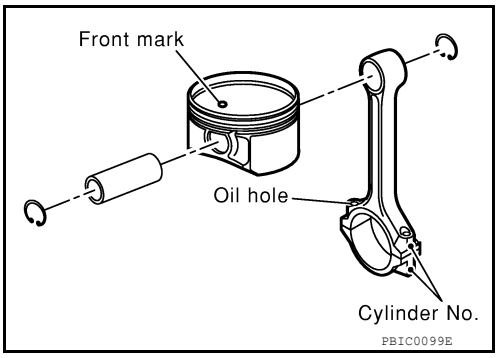



9. Install the piston to the connecting rod. Assemble the components in their original positions.

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

b. Install the piston to the connecting rod.
   - Using a heat gun, heat the piston [approximately 60° - 70 C° (140° - 158 °F)] until the piston pin can be pushed in by hand without excessive force. From the front to the rear, insert the piston pin into the piston and the connecting rod.
   - Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown.

c. Install the piston pin snap ring into the front of the piston.
   - Check that the connecting rod moves smoothly.



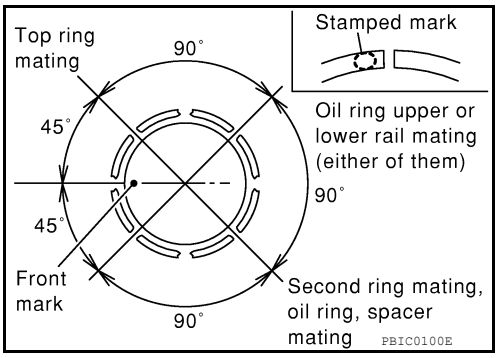

10. Using a piston ring expander, install the piston rings. Assemble the components in their original positions.

**CAUTION:**

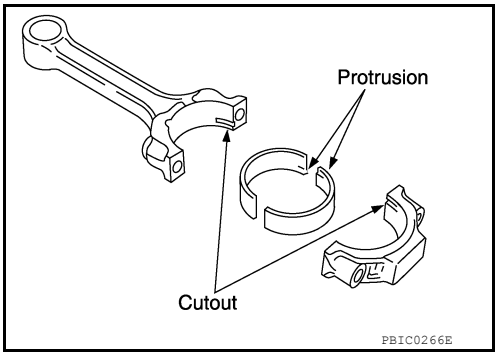
**Be careful not to damage the piston.**

- Position each ring with the gap as shown, referencing the piston front mark as the starting point.
- Install the top ring and the second ring with the stamped surface facing upward.

**Stamped mark** **: 1K (top ring)**
**: 2K (second ring)**



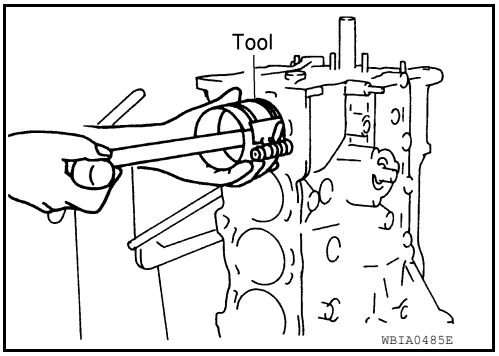

11. Install the connecting rod bearings to the connecting rod and the connecting rod cap. Assemble the components in their original positions.
   - When installing the connecting rod bearings, apply engine oil to the bearing friction surface (inside). Do not apply oil to the back surface, but thoroughly clean the back.
   - When installing, align the connecting rod bearing stopper protrusion with the notch of the connecting rod to install.
   - Check the oil holes on the connecting rod and those on the corresponding bearing are aligned.




12. Install the piston and connecting rod assembly to the crankshaft. Assemble the components in their original positions using Tool.

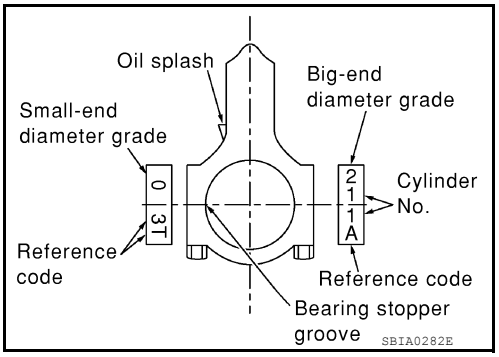
**Tool number : EM03470000**

- Rotate the crankshaft so the pin corresponding to the connecting rod to be installed is at the bottom dead center position.
- Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
- Match the cylinder position number with the cylinder No. on the connecting rod for installation.
- Using tool as shown, install the piston with the front mark on the piston crown facing the front of the engine.




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

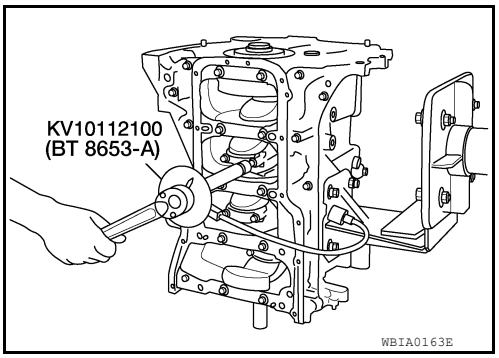
13. Install the connecting rod caps. Assemble the components in their original positions.
    - Match the stamped cylinder number marks on the connecting rod with those on the cap to install.




14. Tighten the connecting rod bolt as follows:
    Apply engine oil to the threads and seats of the connecting rod bolts.

**CAUTION:**
**Check tightening angle using Tool. Do not make judgment by visual inspection.**

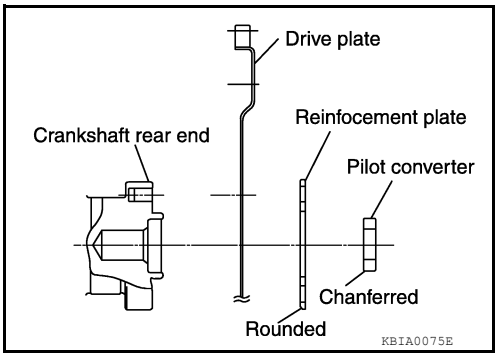
**Tool number : KV10112100 (BT-8653-A)**




**Step 1 : 27.4 N·m (2.8 kg-m, 20 ft-lb) (SE-R), 29.4 (3.0 kg-m, 22 ft-lb) (SE-R Spec V)**
**Step 2 : 0 N·m**
**Step 3 : 19.6 N·m (2.0 kg-m, 14 ft-lb)**
**Stage 2 : Rotate bolts 90° degrees**

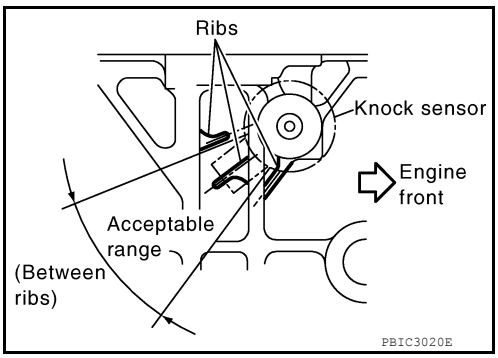
- Check the connecting rod side clearance. Refer to EM-204, "Inspection After Disassembly".
- After tightening the bolts, make sure that the crankshaft rotates smoothly.

15. Install flywheel (M/T Models), or drive plate (CVT Models).
    - Install drive plate, reinforcement plate and pilot converter as shown.
    - Using a drift with 33 mm (1.30 in) diameter, push pilot converter into the end of the crankshaft.



16. Install the knock sensor.
    - Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
    - Install the knock sensor with the connector facing lower left by 45° as shown.
    - Do not tighten the bolts while holding the connector.
    - Make sure that the knock sensor does not interfere with other parts.

    **CAUTION:**
    **If the knock sensor is dropped, replace it with new one.**




17. Install the crankshaft position sensor (POS).
18. Installation of remaining components is in the reverse order of removal.

## How to Select Piston and Bearing

INFOID:0000000007401920

### DESCRIPTION

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

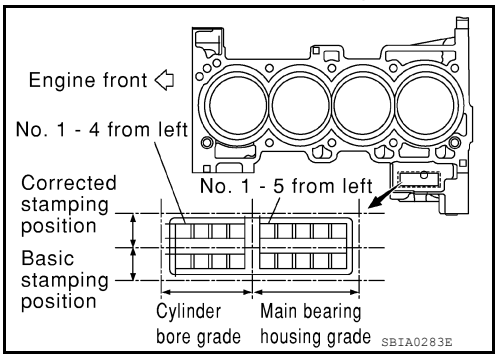
*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

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

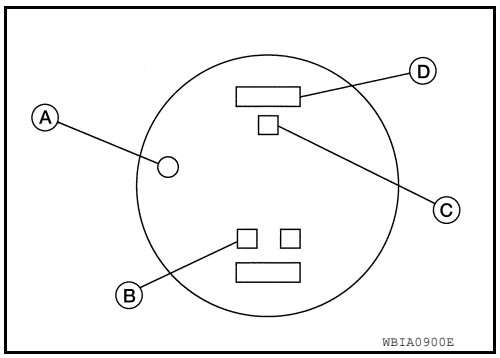
### HOW TO SELECT A PISTON

**When New Cylinder Block** is Used:

- Check the cylinder bore grade on rear left side of cylinder block, and select a piston of the same grade.
- If there is a corrected stamp mark on the cylinder block, use it as a correct reference.



- A: Front mark
- B: Piston pin bore grade
- C: Piston grade I.D. stamp
- D: Piston crown I.D. code stamp




**When a 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 "Piston Selection Table". Select the piston of the same grade.

Piston Selection Table

Unit: mm (in)

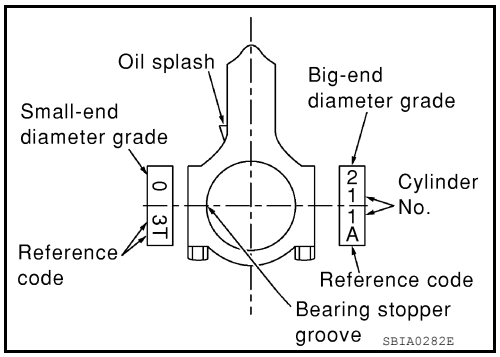
| Grade number (Mark) | 2 (or no mark) | 3 |
|---|---|---|
| Inner diameter of cylinder bore | 89.010-89.020 (3.5043-3.5047) | 89.020-89.030 (3.5047-3.5051) |
| Outer diameter of piston skirt | 88.990-89.000 (3.5035-3.5039) | 89.000-89.010 (3.5039-3.5043) |

**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 grades can be selected. Only 0 grade is available.

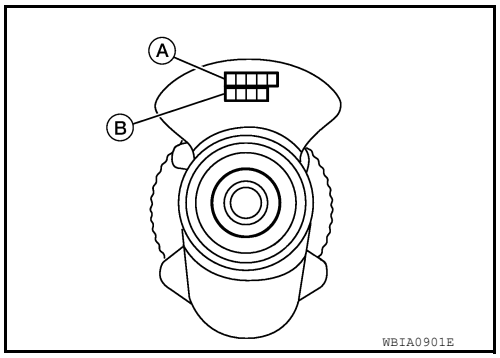
## HOW TO SELECT A CONNECTING ROD BEARING

**When New Connecting Rod and Crankshaft are Used:**

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




2. Apply pin diameter grade stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to connecting rod bearing grade table to select.
   - A: Journal diameter
   - B: Pin 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. Apply the dimension measured to the "Connecting Rod Bearing Selection Table" below.

## Connecting Rod Bearing Selection Table

| Crankshaft pin outer diameter: Mark | Crankshaft pin outer diameter: Outer diameter Unit: mm (in) | Connecting rod blg end. inner diameter: Mark 0 / Inner diameter Unit: mm (in): 48. 000 - 48. 001 (1. 8898 - 1. 8898) | Mark 1 / 48. 001 - 48. 002 (1. 8898 - 1. 8898) | Mark 2 / 48. 002 - 48. 003 (1. 8898 - 1. 8899) | Mark 3 / 48. 003 - 48. 004 (1. 8899 - 1. 8899) | Mark 4 / 48. 004 - 48. 005 (1. 8899 - 1. 8900) | Mark 5 / 48. 005 - 48. 006 (1. 8890 - 1. 8900) | Mark 6 / 48. 006 - 48. 007 (1. 8890 - 1. 8900) | Mark 7 / 48. 007 - 48. 008 (1. 8890 - 1. 8901) | Mark 8 / 48. 008 - 48. 009 (1. 8901 - 1. 8901) | Mark 9 / 48. 009 - 48. 010 (1. 8901 - 1. 8902) | Mark A / 48. 010 - 48. 011 (1. 8902 - 1. 8902) | Mark B / 48. 011 - 48. 012 (1. 8902 - 1. 8902) | Mark C / 48. 012 - 48. 013 (1. 8902 - 1. 8903) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 44. 974 - 44. 973 (1. 7706 - 1. 7706) | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 |
| B | 44. 973 - 44. 972 (1. 7706 - 1. 7705) | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 |
| C | 44. 972 - 44. 971 (1. 7705 - 1. 7705) | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 |
| D | 44. 971 - 44. 970 (1. 7705 - 1. 7705) | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 |
| E | 44. 970 - 44. 969 (1. 7705 - 1. 7704) | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 |
| F | 44. 969 - 44. 968 (1. 7704 - 1. 7704) | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 |
| G | 44. 968 - 44. 967 (1. 7704 - 1. 7704) | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 |
| H | 44. 967 - 44. 966 (1. 7704 - 1. 7703) | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 |
| J | 44. 966 - 44. 965 (1. 7703 - 1. 7703) | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 |
| K | 44. 965 - 44. 964 (1. 7703 - 1. 7702) | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 |
| L | 44. 964 - 44. 963 (1. 7702 - 1. 7702) | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 |
| M | 44. 963 - 44. 962 (1. 7702 - 1. 7702) | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 |
| N | 44. 962 - 44. 961 (1. 7702 - 1. 7701) | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 |
| P | 44. 961 - 44. 960 (1. 7701 - 1. 7701) | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 |
| R | 44. 960 - 44. 959 (1. 7701 - 1. 7700) | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 |
| S | 44. 959 - 44. 958 (1. 7700 - 1. 7700) | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 |
| T | 44. 958 - 44. 957 (1. 7700 - 1. 7700) | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 4 |
| U | 44. 957 - 44. 956 (1. 7700 - 1. 7699) | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 4 | 4 |

AWBIA0021GB

Connecting Rod Bearing Grade Table

Unit: mm (in)

| Grade number | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Thickness | 1.496 - 1.493 (0.0589 - 0.0588) | 1.499 - 1.496 (0.0590 - 0.0589) | 1.502 - 1.499 (0.0591 - 0.0590) | 1.505 - 1.502 (0.0593 - 0.0591) | 1.508 - 1.505 (0.0594 - 0.0593) |
| Identification color | Black | Brown | Green | Yellow | Blue |

Undersize Bearing Usage Guide

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

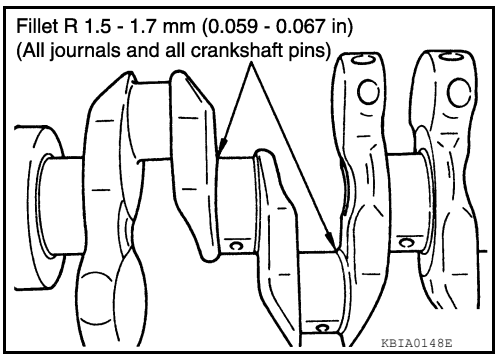
**Bearing Undersize Table**

Unit: mm (in)

| Size U.S. | Thickness |
|---|---|
| 0.25 (0.0098) | 1.622 - 1.630 (0.0639 - 0.0642) |

**CAUTION:**

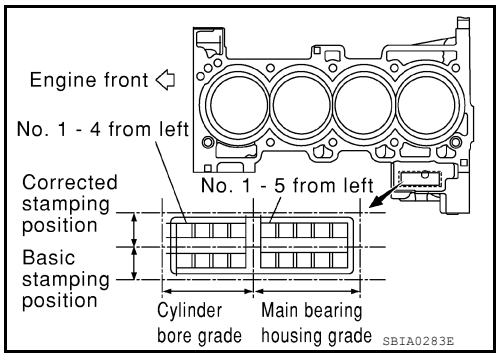
**In grinding the crankshaft pin to use undersize bearings, do not damage the fillet R (All crankshaft pins).**



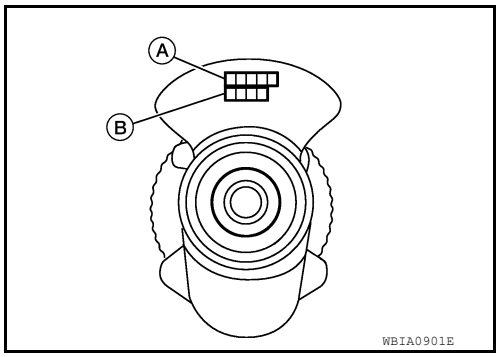
## HOW TO SELECT A MAIN BEARING

**When New Cylinder Block and Crankshaft are Used:**

1. "Main Bearing Selection Table" rows correspond to bearing housing grade on rear left side of cylinder block.
   - If there is a corrected stamp mark on the cylinder block, use it as a correct reference.




2. Apply pin diameter grade (B) stamped on crankshaft front side to column in "Main Bearing Selection Table".
   - A: Journal diameter grade




3. Find value at crossing of row and column in "Main Bearing Selection Table".
   **CAUTION:**
   - **There are two main bearing selection tables. One is for odd-numbered journals (1, 3, and 5) and the other is for even-numbered journals (2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.**
4. Apply the symbol obtained to "Main Bearing Grade Table" to select.
   **NOTE:**
   - Service parts are available as a set of both upper and lower.

**When Cylinder Block and Crankshaft are Reused:**

1. Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal.
2. Apply measurement in above step 1 to the "Main Bearing Selection Table".
3. Follow steps 3 and 4 in "When New Cylinder Block and Crankshaft are Used".

Main Bearing Selection Table (No.1, 3, and No.5 journals)

| Cylinder block main bearing housing inner diameter / Crankshaft journal outer 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Inner diameter Unit: mm (in) | 58.944 – 58.945 (2.3206 – 2.3207) | 58.945 – 58.946 (2.3207 – 2.3207) | 58.946 – 58.947 (2.3207 – 2.3207) | 58.947 – 58.948 (2.3207 – 2.3208) | 58.948 – 58.949 (2.3208 – 2.3208) | 58.949 – 58.950 (2.3208 – 2.3209) | 58.950 – 58.951 (2.3209 – 2.3209) | 58.951 – 58.952 (2.3209 – 2.3209) | 58.952 – 58.953 (2.3209 – 2.3210) | 58.953 – 58.954 (2.3210 – 2.3210) | 58.954 – 58.955 (2.3210 – 2.3211) | 58.955 – 58.956 (2.3211 – 2.3211) | 58.956 – 58.957 (2.3211 – 2.3211) | 58.957 – 58.958 (2.3211 – 2.3212) | 58.958 – 58.959 (2.3212 – 2.3212) | 58.959 – 58.960 (2.3212 – 2.3213) | 58.960 – 58.961 (2.3213 – 2.3213) | 58.961 – 58.962 (2.3213 – 2.3213) | 58.962 – 58.963 (2.3213 – 2.3214) | 58.963 – 58.964 (2.3214 – 2.3214) | 58.964 – 58.965 (2.3214 – 2.3215) | 58.965 – 58.966 (2.3215 – 2.3215) | 58.966 – 58.967 (2.3215 – 2.3215) | 58.967 – 58.968 (2.3215 – 2.3216) |
| Mark | Outer diameter Unit: mm (in) | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 54.979 – 54.978 (2.1645 – 2.1645) | | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 |
| B | 54.978 – 54.977 (2.1645 – 2.1644) | | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 |
| C | 54.977 – 54.976 (2.1644 – 2.1644) | | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 |
| D | 54.976 – 54.975 (2.1644 – 2.1644) | | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 |
| E | 54.975 – 54.974 (2.1644 – 2.1643) | | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 |
| F | 54.974 – 54.973 (2.1643 – 2.1643) | | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 |
| G | 54.973 – 54.972 (2.1643 – 2.1642) | | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 |
| H | 54.972 – 54.971 (2.1642 – 2.1642) | | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 |
| J | 54.971 – 54.970 (2.1642 – 2.1642) | | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 |
| K | 54.970 – 54.969 (2.1642 – 2.1641) | | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 |
| L | 54.969 – 54.968 (2.1641 – 2.1641) | | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 |
| M | 54.968 – 54.967 (2.1641 – 2.1641) | | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 |
| N | 54.967 – 54.966 (2.1641 – 2.1640) | | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 |
| P | 54.966 – 54.965 (2.1640 – 2.1640) | | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 |
| R | 54.965 – 54.964 (2.1640 – 2.1639) | | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 |
| S | 54.964 – 54.963 (2.1639 – 2.1639) | | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 |
| T | 54.963 – 54.962 (2.1639 – 2.1639) | | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 |
| U | 54.962 – 54.961 (2.1639 – 2.1638) | | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 |
| V | 54.961 – 54.960 (2.1638 – 2.1638) | | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 |
| W | 54.960 – 54.959 (2.1638 – 2.1637) | | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 |
| X | 54.959 – 54.958 (2.1637 – 2.1637) | | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 |
| Y | 54.958 – 54.957 (2.1637 – 2.1637) | | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 | 7 |
| 4 | 54.957 – 54.956 (2.1637 – 2.1636) | | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 | 7 | 7 |
| 7 | 54.956 – 54.955 (2.1636 – 2.1636) | | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 | 7 | 7 | 7 | 7 | 7 | 7 |

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Main Bearing Selection Table (No.2,and 4 journals)

| Cylinder block main bearing housing inner diameter / Crankshaft journal outer 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 | Outer diameter Unit: mm (in) | Inner diameter Unit: mm (in) | | | | | | | | | | | | | | | | | | | | | | | |
| | | 58.944 – 58.945 (2.3206 – 2.3207) | 58.945 – 58.946 (2.3207 – 2.3207) | 58.946 – 58.947 (2.3207 – 2.3207) | 58.947 – 58.948 (2.3207 – 2.3208) | 58.948 – 58.949 (2.3208 – 2.3208) | 58.949 – 58.950 (2.3208 – 2.3209) | 58.950 – 58.951 (2.3209 – 2.3209) | 58.951 – 58.952 (2.3209 – 2.3209) | 58.952 – 58.953 (2.3209 – 2.3210) | 58.953 – 58.954 (2.3210 – 2.3210) | 58.954 – 58.955 (2.3210 – 2.3211) | 58.955 – 58.956 (2.3211 – 2.3211) | 58.956 – 58.957 (2.3211 – 2.3211) | 58.957 – 58.958 (2.3211 – 2.3212) | 58.958 – 58.959 (2.3212 – 2.3212) | 58.959 – 58.960 (2.3212 – 2.3213) | 58.960 – 58.961 (2.3213 – 2.3213) | 58.961 – 58.962 (2.3213 – 2.3213) | 58.962 – 58.963 (2.3213 – 2.3214) | 58.963 – 58.964 (2.3214 – 2.3214) | 58.964 – 58.965 (2.3214 – 2.3215) | 58.965 – 58.966 (2.3215 – 2.3215) | 58.966 – 58.967 (2.3215 – 2.3215) | 58.967 – 58.968 (2.3215 – 2.3216) |
| A | 54.979 – 54.978 (2.1645 – 2.1645) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 |
| B | 54.978 – 54.977 (2.1645 – 2.1644) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 |
| C | 54.977 – 54.976 (2.1644 – 2.1644) | 0 | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 |
| D | 54.976 – 54.975 (2.1644 – 2.1644) | 0 | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 |
| E | 54.975 – 54.974 (2.1644 – 2.1643) | 0 | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 |
| F | 54.974 – 54.973 (2.1643 – 2.1643) | 0 | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 |
| G | 54.973 – 54.972 (2.1643 – 2.1642) | 0 | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 |
| H | 54.972 – 54.971 (2.1642 – 2.1642) | 0 | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 |
| J | 54.971 – 54.970 (2.1642 – 2.1642) | 01 | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 |
| K | 54.970 – 54.969 (2.1642 – 2.1641) | 01 | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 |
| L | 54.969 – 54.968 (2.1641 – 2.1641) | 01 | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 |
| M | 54.968 – 54.967 (2.1641 – 2.1641) | 1 | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 |
| N | 54.967 – 54.966 (2.1641 – 2.1640) | 1 | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 |
| P | 54.966 – 54.965 (2.1640 – 2.1640) | 1 | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 |
| R | 54.965 – 54.964 (2.1640 – 2.1639) | 12 | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 |
| S | 54.964 – 54.963 (2.1639 – 2.1639) | 12 | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 |
| T | 54.963 – 54.962 (2.1639 – 2.1639) | 12 | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 |
| U | 54.962 – 54.961 (2.1639 – 2.1638) | 2 | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 |
| V | 54.961 – 54.960 (2.1638 – 2.1638) | 2 | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 |
| W | 54.960 – 54.959 (2.1638 – 2.1637) | 2 | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 |
| X | 54.959 – 54.958 (2.1637 – 2.1637) | 23 | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 |
| Y | 54.958 – 54.957 (2.1637 – 2.1637) | 23 | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 |
| 4 | 54.957 – 54.956 (2.1637 – 2.1636) | 23 | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 |
| 7 | 54.956 – 54.955 (2.1636 – 2.1636) | 3 | 3 | 3 | 34 | 34 | 34 | 4 | 4 | 4 | 45 | 45 | 45 | 5 | 5 | 5 | 56 | 56 | 56 | 6 | 6 | 6 | 67 | 67 | 67 |

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Main Bearing Grade Table (All Journals)

Unit: mm (in)

| Grade number | Thickness | Identification color (UPR / LWR) | Remarks |
|---|---|---|---|
| 0 | 1.973 - 1.976 (0.0777 - 0.0778) | Black | Grade and color are the same for upper and lower bearings. |
| 1 | 1.976 - 1.979 (0.0778 - 0.0779) | Brown | |
| 2 | 1.979 - 1.982 (0.0779- 0.0780) | Green | |
| 3 | 1.982 - 1.985 (0.0780 - 0.0781) | Yellow | |
| 4 | 1.985 - 1.988 (0.0781 - 0.0783) | Blue | |
| 5 | 1.988 - 1.991 (0.0783 - 0.0784) | Pink | |
| 6 | 1.991 - 1.994 (0.0784 - 0.0785) | Purple | |

| | | | | |
|---|---|---|---|---|
| 01 | UPR | 1.973 - 1.976 (0.0777 - 0.0778) | Black / Brown | Grade and color are different for upper and lower bearings. |
| | LWR | 1.976 - 1.979 (0.0778 - 0.0779) | | |
| 12 | UPR | 1.976 - 1.979 (0.0778 - 0.0779) | Brown / Green | |
| | LWR | 1.979 - 1.982 (0.0779 - 0.0780) | | |
| 23 | UPR | 1.979 - 1.982 (0.0779 - 0.0780) | Green / Yellow | |
| | LWR | 1.982 - 1.985 (0.0780 - 0.0781) | | |
| 34 | UPR | 1.982 - 1.985 (0.0780 - 0.0781) | Yellow / Blue | |
| | LWR | 1.985 - 1.988 (0.0781 - 0.0783) | | |
| 45 | UPR | 1.985 - 1.988 (0.0781 - 0.0783) | Blue / Pink | |
| | LWR | 1.988 - 1.991 (0.0783 - 0.0784) | | |
| 56 | UPR | 1.988 - 1.991 (0.0783 - 0.0784) | Pink / Purple | |
| | LWR | 1.991 - 1.994 (0.0784 - 0.0785) | | |
| 67 | UPR | 1.991 - 1.994 (0.0784 - 0.0785) | Purple / White | |
| | LWR | 1.994 - 1.997 (0.0785 - 0.0786) | | |

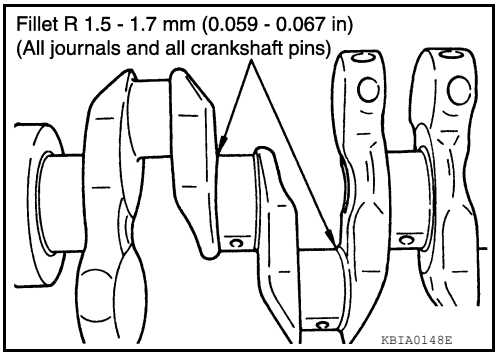
Use Undersize Bearing Usage Guide

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

**Bearing Undersize Table**

Unit: mm (in)

| Size U.S. | Thickness |
|---|---|
| 0.25 (0.0098) | 2.106 - 2.114 (0.0829 - 0.0832) |




**CAUTION:**

**Do not damage fillet R when grinding crankshaft journal in order to use an undersize bearing (all journals).**

## Inspection After Disassembly

INFOID:0000000007401921

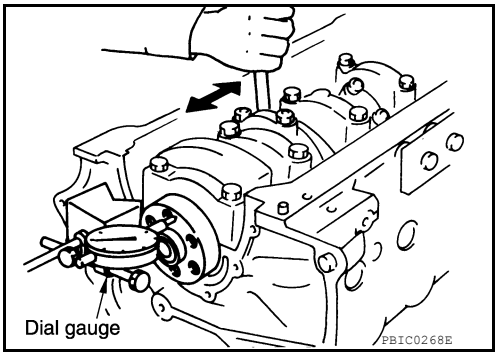
### CRANKSHAFT SIDE CLEARANCE

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

**Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 in)**

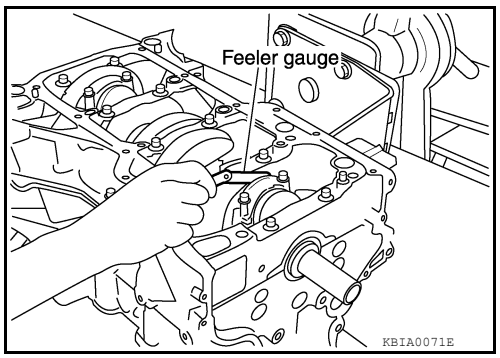
**Limit : 0.30 mm (0.0118 in)**

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




### CONNECTING ROD SIDE CLEARANCE

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



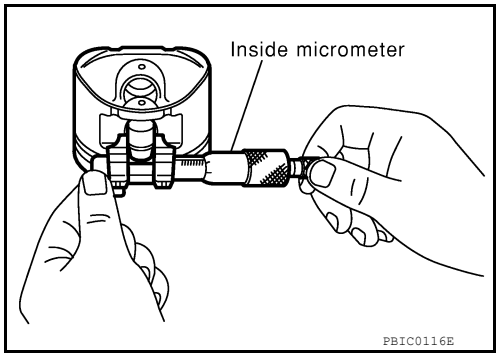

**Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)**
**Limit : 0.50 mm (0.0197 in)**

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

## PISTON AND PISTON PIN CLEARANCE

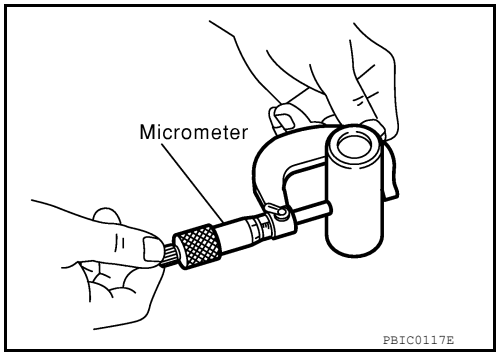
Diameter of Piston Pin Bore

- Measure the diameter of piston pin bore using an inside micrometer. Refer to EM-214, "Standard and Limit".




Outer Diameter of Piston Pin

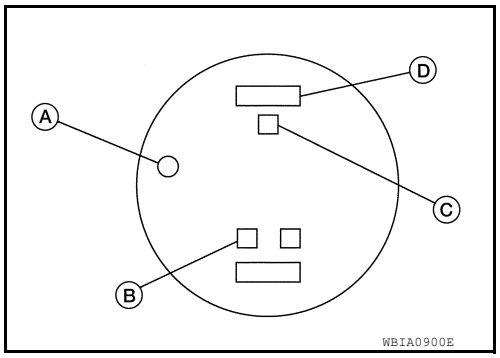
- Measure outer diameter of piston pin using a micrometer. Refer to EM-214, "Standard and Limit".




Piston to Piston Pin Clearance

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

- A: Front mark
- B: Piston pin bore grade
- C: Piston grade I.D. stamp
- D: Piston crown I.D. code stamp

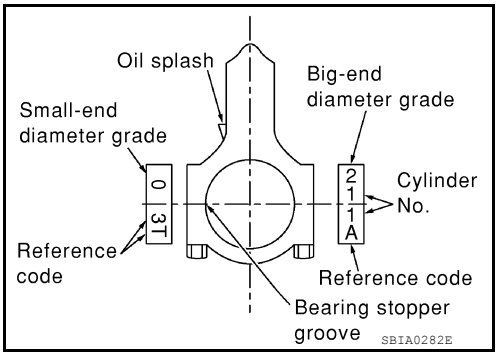



**Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)**

- If clearance exceeds specification, replace either or both of piston/piston pin assembly and connecting rod assembly with reference to specification of each parts.
- Use the piston selection table to replace piston/piston pin assembly. Refer to EM-198, "How to Select Piston and Bearing".
- Use the connecting rod bearing selection table to replace connecting rod. Refer to EM-198, "How to Select Piston and Bearing".

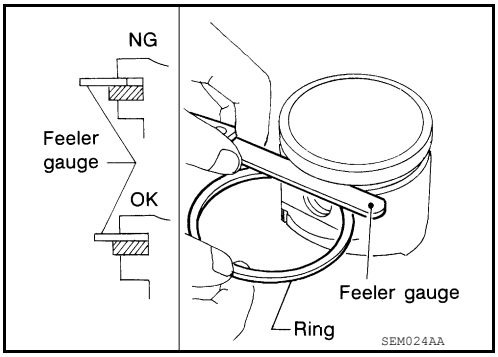
**NOTE:**

- The connecting rod small end grade and piston pin hole (piston pin) grade are provided only for the parts installed at the plant. For service parts, no grades can be selected. Only 0 grade is available.
- Follow the "CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)" for the values for each grade at the plant.
- Regarding marks on piston head, Refer to EM-198, "How to Select Piston and Bearing".



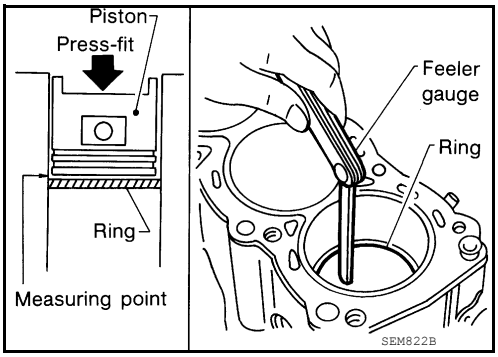

## PISTON RING SIDE CLEARANCE

- Measure side clearance of piston ring and piston ring groove using a feeler gauge. Refer to EM-214, "Standard and Limit".
- If out of specification, replace piston and/or piston ring assembly.



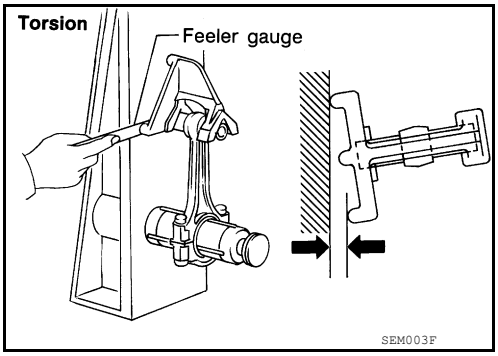

## PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Follow the "PISTON TO CYLINDER BORE CLEARANCE" procedure.
- Insert piston ring until middle of cylinder with piston, and measure gap using a feeler gauge. Refer to EM-214, "Standard and Limit".
- If out of specification, replace piston ring.

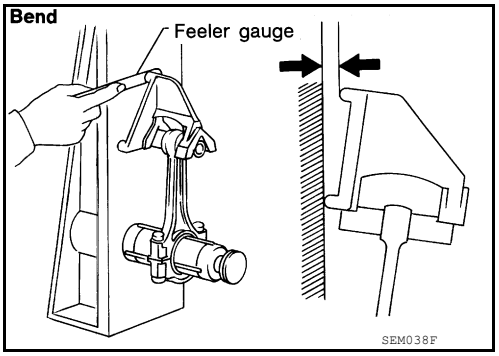



## CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner. Refer to EM-214, "Standard and Limit".

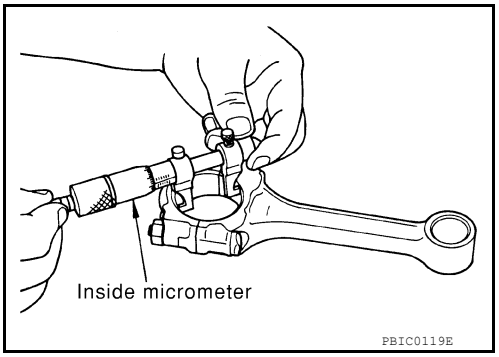


- If it exceeds the limit, replace connecting rod assembly.




## CONNECTING ROD BEARING (BIG END)

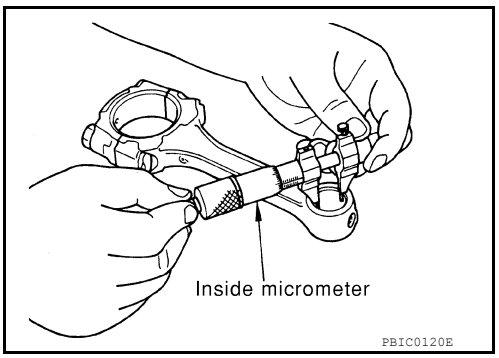
- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod bolt to the specified torque, measure the connecting rod big end inner diameter using an inside micrometer. Refer to EM-214, "Standard and Limit".




## CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

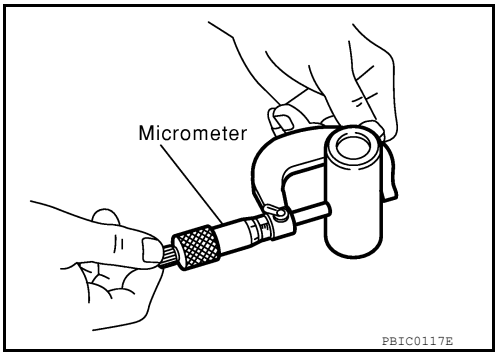
Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of bushing. Refer to EM-214, "Standard and Limit"




Outer Diameter of Piston Pin

- Measure outer diameter of piston pin. Refer to EM-214, "Standard and Limit".

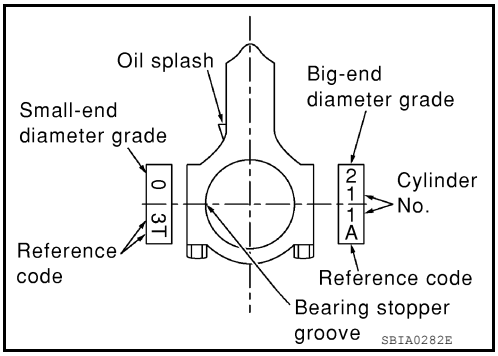



Connecting Rod Bushing Oil Clearance (Small End)

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

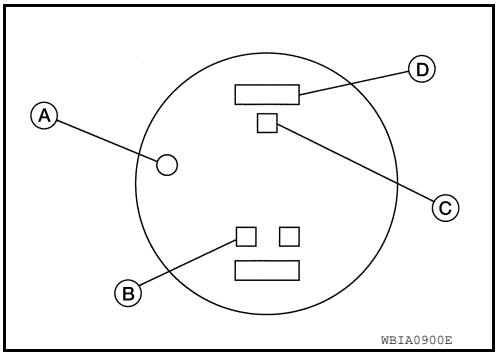
**Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**

- 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, use the "Piston Selection Table" to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to EM-198, "How to Select Piston and Bearing".




**Factory Installed Parts Grading:**

- A: Front mark
- B: Piston pin bore grade
- C: Piston grade I.D. stamp
- D: Piston crown I.D. code stamp
- Service parts apply only to grade 0.




Unit: mm (in)

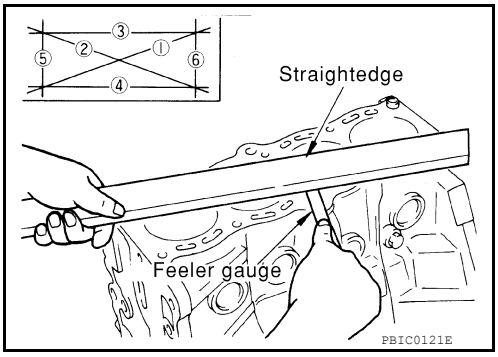
| Grade | 0 | 1 |
|---|---|---|
| Connecting rod small end inner diameter | 20.000 - 20.006 (0.7874 - 0.7876) | 20.006 - 20.012 (0.7876 - 0.7879) |
| Piston pin outer diameter | 19.989 - 19.995 (0.7870 - 0.7872) | 19.995 - 20. 001 (0.7872 - 0.7874) |
| Piston pin bore diameter | 19.993 - 19.999 (0.7871- 0.7874) | 19.999 - 20.005 (0.7874 - 0.7876) |

## CYLINDER BLOCK DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove oil, scale, carbon, or other contamination.
  **CAUTION:**
  **Be careful not to allow gasket debris to enter the oil or coolant passages.**
- Measure the distortion on the block upper face at some different points in 6 directions.

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

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

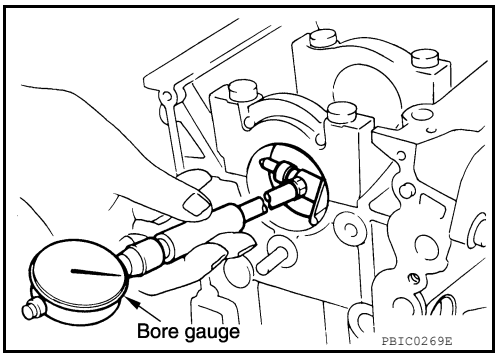



## INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps with the main bearings removed and tighten the bolts to the specified torque. Refer to EM-190, "Disassembly and Assembly".
- Using a bore gauge, measure the inner diameter of the main bearing housing.

**Standard : 58.944 - 58.968 mm (2.3206 - 2.3216 in)**

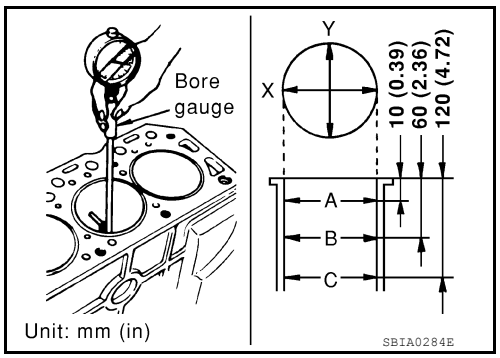
- If out of the standard, replace the cylinder block and lower cylinder block assembly.
  **NOTE:**
  These components cannot be replaced as a single unit because they were processed together.




## PISTON TO CYLINDER BORE CLEARANCE

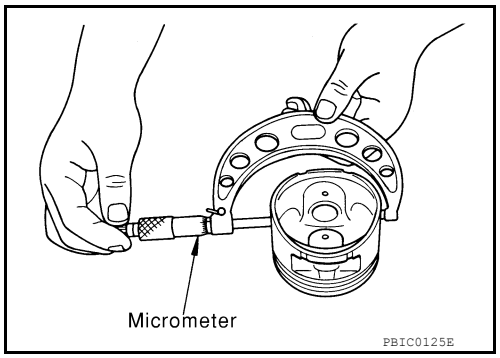
Inner Diameter of Cylinder Bore

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at 6 different points on each cylinder. (X and Y directions at A, B and C). The Y axis is in the longitudinal direction of the engine.
  **NOTE:**
  When determining cylinder bore grade, measure cylinder bore at B position. Refer to EM-214, "Standard and Limit".
- If the measured value rebore exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone the inner wall.




Outer Diameter of Piston

- Measure piston skirt diameter using a micrometer. Refer to EM-214, "Standard and Limit".




- Measure point (distance from the top): 42 mm (1.65 in)

Piston to Cylinder Bore Clearance

- Calculate by outer diameter of piston skirt and inner diameter of cylinder (direction X, position B).

(Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt).

**Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)**
**Limit : 0.08 mm (0.0031 in)**

- If it exceeds the limit, replace piston/piston pin assembly.

Reboring Cylinder Bore

1. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter “A”.

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

**D: Bored diameter**
**A: Piston diameter as measured**
**B: Piston-to-bore clearance (standard value)**
**C: Honing allowance 0.02 mm (0.0008 in)**

2. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

- **When any cylinder needs boring, all other cylinders must also be bored.**
- **Do not cut too much out of cylinder bore at a time.**

4. Hone cylinders to obtain specified piston-to-bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.

- **Measurement should be done after cylinder bore cools down.**

## OUTER DIAMETER OF CRANKSHAFT JOURNAL

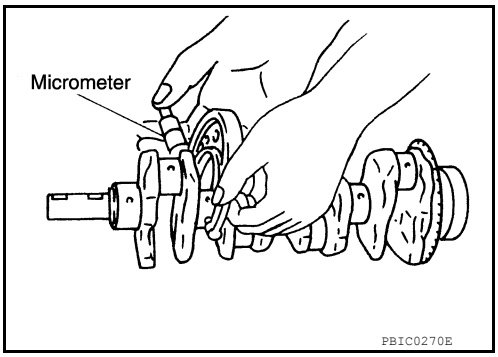
- Measure outer diameter of crankshaft journals.

**Standard : 54.955 - 54.979 mm (2.1636 - 2.1645 in)**

OUTER DIAMETER OF CRANKSHAFT PIN

- Measure outer diameter of crankshaft pin.

**Standard : 44.956 - 44.974 mm (1.7699 - 1.7706 in)**



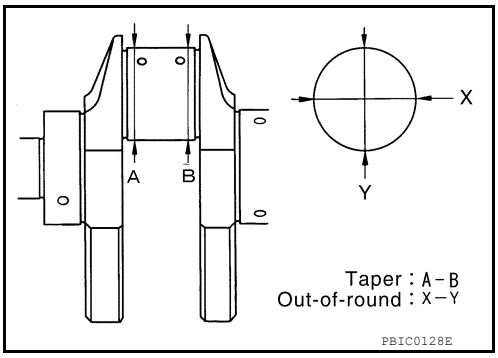

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

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

**Limit**

**Out-of-round (X - Y) : 0.005 mm (0.0002 in)**

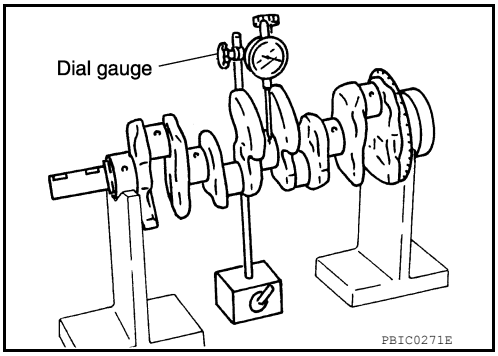
**Taper (A - B) : 0.005 mm (0.0002 in)**




CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on 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, the total indicator reading.

**Limit : Less than 0.05 mm (0.002 in)**



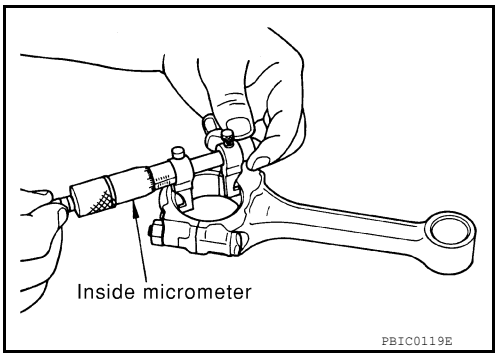

OIL CLEARANCE OF CONNECTING ROD BEARING

Method of Measurement

- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod bolts to the specified torque. Using a inside micrometer measure the inner diameter of connecting rod bearing.
  (Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

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

**Limit : 0.10 mm (0.0039 in)**




- If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to EM-198, "How to Select Piston and Bearing".

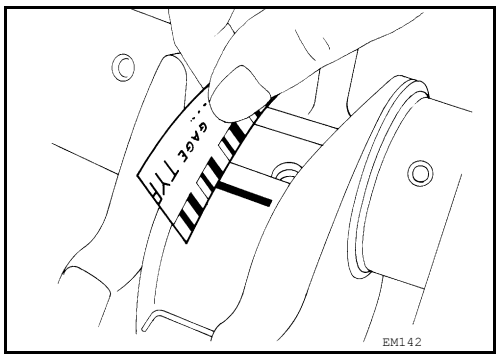
Method of Using Plastigage

- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut the 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 bolts 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 limit is same as that described in the method by calculation.




## OIL CLEARANCE OF MAIN BEARING

Method of Measurement

- Install the main bearings to the cylinder block and bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened to the specified torque.
(Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

**Standard:**

| | |
|---|---|
| **No. 1, 3, and 5 journals** | **: 0.012 - 0.022 mm (0.0005 - 0.0009 in)** |
| **No. 2 and 4 journals** | **: 0.018 - 0.028 mm (0.0007 - 0.0011 in)** |
| **Limit** | **: 0.1 mm (0.004 in)** |

- If the measured value exceeds the limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to EM-198, "How to Select Piston and Bearing".

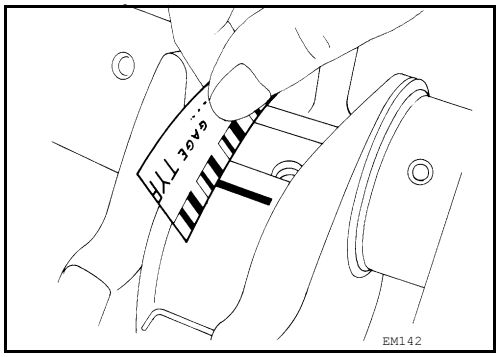
Method of Using Plastigage

- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut the Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts to the specified torque.

**CAUTION:**
**Never rotate the crankshaft.**

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

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

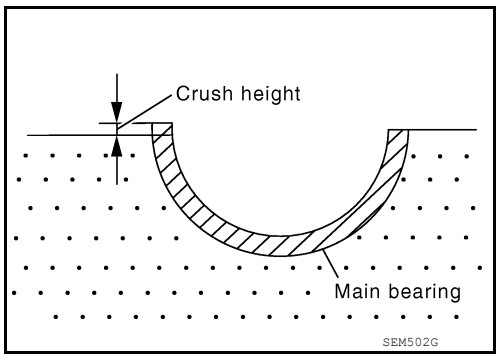



## CRUSH HEIGHT OF MAIN BEARING

- When the bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude.

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

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

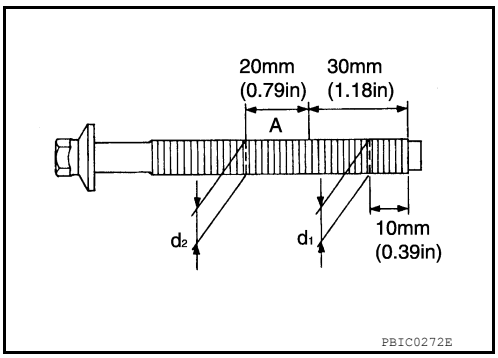



## OUTER DIAMETER OF LOWER CYLINDER BLOCK BOLT

- Perform only with M10 (0.39 in) bolts.
- Measure outer diameters (d1, d2) at two positions as shown.
- Measure d2 at a point within area A as shown.

- When the value of d1- d2 exceeds the limit (a large difference in dimensions), replace the bolt with a new one.

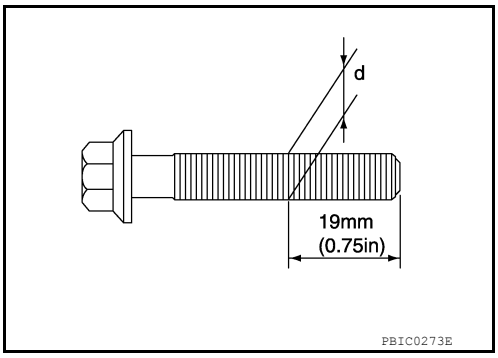
**Limit : 0.13 mm (0.0051 in)**




OUTER DIAMETER OF CONNECTING ROD BOLT

- Measure outer diameter (d) at position as shown.
- When “d” exceeds the limit (when it becomes thinner), replace the bolt with a new one.

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




MOVEMENT AMOUNT OF FLYWHEEL (M/T MODEL)

**NOTE:**

- Inspection for double mass flywheel only.
- Do not disassemble double mass flywheel.

Flywheel Deflection

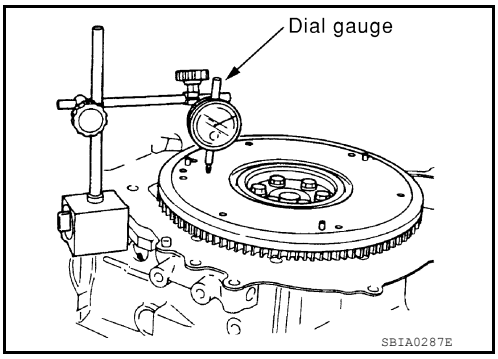
- Measure deflection of flywheel contact surface to the clutch with a dial gauge.
- Measure runout at 210 mm (8.27 in) dia.

**Limit : 0.45 mm (0.0177 in) or less under no load**

- Measure axial displacement at 250 mm (9.84 in) dia.

**Limit : 1.3 mm (0.051 in) or less under 100N (22.48 lb) force**

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



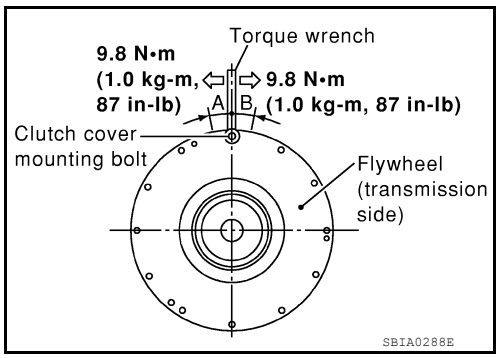

Movement Amount in Rotation Direction

- Check the movement amount in the following procedure.

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.

- Tighten bolt to keep it from loosening at a force of 9.8 N·m (1 kg-m, 87 in-lb).

2. Put a mating mark on circumferences of the two flywheel masses without applying any load (measurement standard points).
3. Apply a force of 9.8 N·m (1 kg-m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure dimensions of movement amounts A and B on circumference of the flywheel on the transmission side.




**Standard : 35 mm (1.38 in) or less**

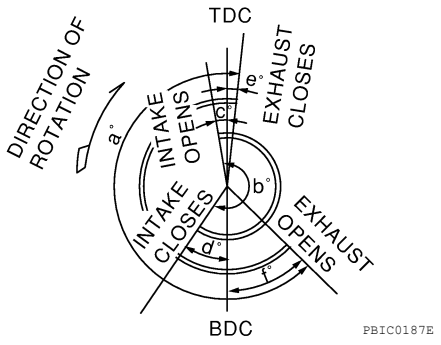
- When measured value is outside the standard, replace flywheel.

# SERVICE DATA AND SPECIFICATIONS (SDS)

## Standard and Limit

INFOID:0000000007401922

### GENERAL SPECIFICATIONS

| Model | | SE-R | SE-R Spec V |
|---|---|---|---|
| Cylinder arrangement | | In-line 4 | |
| Displacement cm$^3$ (in$^3$) | | 2,488 (151.82) | |
| Bore and stroke mm (in) | | 89.0 x 100 (3.50 x 3.94) | |
| Valve arrangement | | DOHC | |
| Firing order | | 1-3-4-2 | |
| Number of piston rings | Compression | 2 | |
| | Oil | 1 | |
| Compression ratio | | 9.5:1 | 10.5:1 |
| Compression pressure kPa (kg/cm$^2$, psi) / 250 rpm | Standard | 1,250 (12.8, 181.3) | |
| | Minimum | 1,060 (10.8, 153.7) | |
| | Differential limit between cylinders | 100 (1.0, 14) | |
| Valve timing |  | | |



Unit: degree

| a | b | c | d | e | f |
|---|---|---|---|---|---|
| 224° | 244° | 0° | 64° | 3° | 41° |

### DRIVE BELTS

| | |
|---|---|
| Tension of drive belts | Auto adjustment by auto-tensioner |

### INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

| | Description | Limit |
|---|---|---|
| Surface distortion | Intake manifold adapter | 0.1 (0.004) |
| | Intake manifold | 0.1 (0.004) |
| | Exhaust manifold | 0.3 (0.012) |

### SPARK PLUG

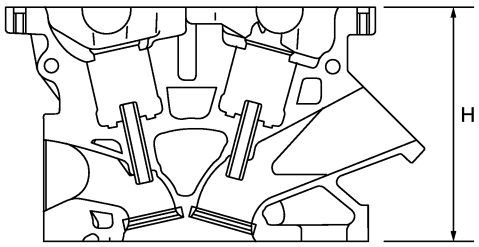
Unit: mm (in)

| Make | | NGK |
|---|---|---|
| Type* | Standard | DILKAR6A-11 |
| Gap (nominal) | | 1.1 (0.043) |

*: Always check with the Parts Department for the latest parts information.

## CYLINDER HEAD

Unit: mm (in)




Nominal cylinder head height:
H = 129.4 mm (5.09 in)

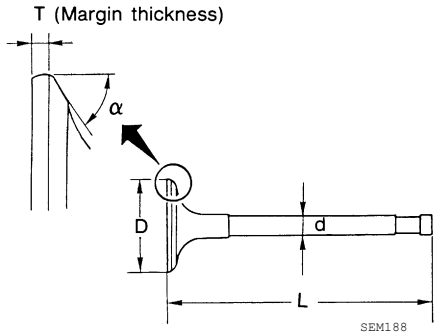
PBIC0283E

| Description | Limit |
|---|---|
| Head surface distortion | 0.1 (0.004) |

## VALVE

### Valve Dimensions

Unit: mm (in)




SEM188

| | | |
|---|---|---|
| Valve head diameter “D” | Intake | 35.5 - 35.8 (1.398 - 1.409) |
| | Exhaust | 30.5 - 30.8 (1.201 - 1.213) |
| Valve length “L” | Intake | 97.16 (3.8252) |
| | Exhaust | 98.82 (3.8905) |
| Valve stem diameter “d” | Intake | 5.965 - 5.980 (0.2348 - 0.2354) |
| | Exhaust | 5.955 - 5.970 (0.2344 - 0.2350) |
| Valve seat angle “α” | Intake | 45°15′ - 45°45′ |
| | Exhaust | |
| Valve margin “T” | Intake | 1.1 (0.043) |
| | Exhaust | 1.3 (0.051) |

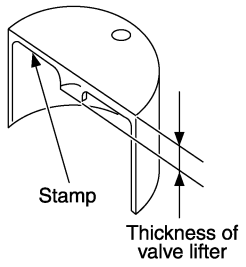
### Valve Clearance

Unit: mm (in)

| | Cold* (reference data) | Hot |
|---|---|---|
| Intake | 0.24 - 0.32 (0.009 - 0.013) | 0.304 - 0.416 (0.012 - 0.016) |
| Exhaust | 0.26 - 0.34 (0.010 - 0.013) | 0.308 - 0.432 (0.012 - 0.017) |

*: Approximately 20°C (68 °F)

### Available Valve Lifter




KBIA0119E

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

*: Always check with the Parts Department for the latest parts information.

Valve Spring

| Specifications* | Intake | Exhaust |
|---|---|---|
| Identification color | Blue (M/T), Pink (CVT) | Yellow (M/T), Green (CVT) |
| Free height | 43.72 - 43.92 mm (1.7213 - 1.7291 in) | 45.29 - 45.49 mm (1.7831 - 1.7909 in) |
| Pressure standard at height 35.30 mm (1.390 in) | 151 - 175 N (15.4 - 17.8 kg-f, 34 - 39 lb-f) | 151 - 175 N (15.4 - 17.8 kg-f, 34 - 39 lb-f) |
| Squareness | 1.9 mm (0.0748 in) | 1.9 mm (0.0748 in) |

| Specifications* | Intake | Exhaust |
|---|---|---|
| Installation height | 35.30 mm (1.390 in) | 35.30 mm (1.390 in) |
| Installation load | 151 - 175 N (15.4 - 17.8 kg-f, 34 - 39 lb-f) | 151 - 175 N (15.4 - 17.8 kg-f, 34 - 39 lb-f) |
| Height during valve open | 25.30 mm (0.996 in) | 26.76 mm (1.0535 in) |
| Load with valve open | 351 - 394 N (35.8 - 40.2 kg-f, 79 - 89 lb-f) | 318 - 362 N (32.4 - 36.9 kg-f, 71 - 81 lb-f) |

*: Always check with the Parts Department for the latest parts information.

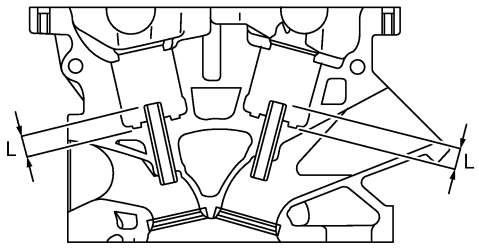
Valve Lifter

Unit: mm (in)

| Description | Standard |
|---|---|
| Valve lifter outer diameter | 33.977 - 33.987 (1.3377 - 1.3381) |
| Lifter lifter bore inner diameter | 34.000 - 34.021 (1.3386 - 1.3394) |
| Clearance between lifter and lifter guide | 0.013 - 0.044 (0.0005 - 0.0017) |

Valve Guide

Unit: mm (in)

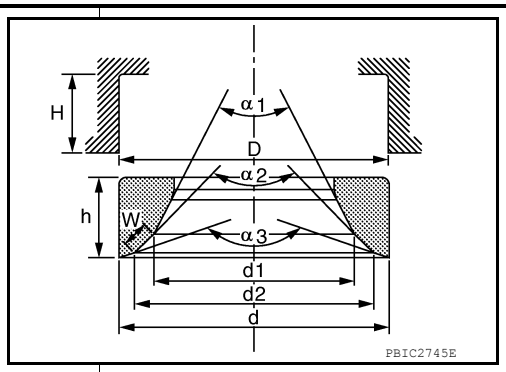



PBIC0184E

| Description | | Standard | Service |
|---|---|---|---|
| Valve guide | Outer diameter | 10.023 - 10.034 (0.3946 - 0.3950) | 10.223 - 10.234 (0.4025 - 0.4029) |
| | Inner diameter (Finished size) | 6.000 - 6.018 (0.2362 - 0.2369) | |
| Intake and exhaust 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 | |
| Valve guide clearance | Intake | 0.020 - 0.053 (0.0008 - 0.0021) or less | |
| | Exhaust | 0.030 - 0.063 (0.0012 - 0.0025) or less | |
| Projection length “L” | Intake | 10.1 - 10.3 (0.398 - 0.406) | |
| | Exhaust | 10.0 - 10.4 (0.394 - 0.409) | |

Valve Seat

Unit: mm (in)



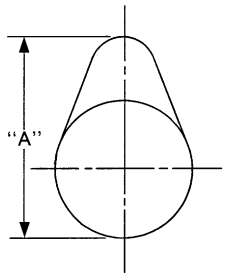

| Description | | Standard | Service |
|---|---|---|---|
| Cylinder head seat recess diameter (D) | Intake | 36.500 - 36.516 (1.4370 - 1.4376) | 37.000 - 37.016 (1.4567 - 1.4573) |
| | Exhaust | 31.500 - 31.516 (1.2402 - 1.2408) | 32.000 - 32.016 (1.2598 - 1.2605) |
| Valve seat interference fit | Intake | 0.081 - 0.113 (0.0032 - 0.0044) | |
| | Exhaust | 0.084 - 0.116 (0.0033 - 0.0046) | |
| Valve seat outer diameter (d) | Intake | 36.597 - 36.613 (1.4408 - 1.4415) | 37.097 - 37.113 (1.4605 - 1.4611) |
| | Exhaust | 31.600 - 31.616 (1.2441 - 1.2447) | 32.100 - 32.116 (1.2638 - 1.2644) |
| Diameter "d1" | Intake | 33.5 (1.319) | |
| | Exhaust | 28.0 (1.102) | |
| Diameter "d2" | Intake | 34.8 - 35.3 (1.3701 - 1.3898) | |
| | Exhaust | 29.6 - 30.1 (1.1654 - 1.1850) | |
| Angle α 1 | Intake | 60° | |
| | Exhaust | 60° | |
| Angle α 2 | Intake | 88° 46' - 90° 14' | |
| | Exhaust | 88° 46' - 90° 14' | |
| Angle α 3 | Intake | 120° | |
| | Exhaust | 120° | |
| Contacting width "W"* | Intake | 0.99 - 1.35 (0.0390 - 0.0531) | |
| | Exhaust | 1.19 - 1.55 (0.0469 - 0.0610) | |

* : Machining data

## CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

| | Standard |
|---|---|
| Camshaft runout [TIR*] | Less than 0.04 (0.0016) |



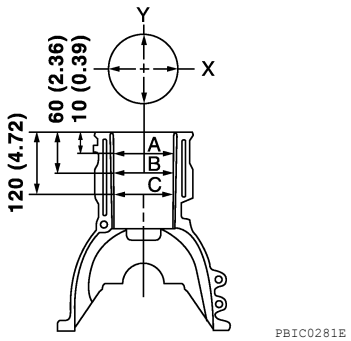

| | | |
|---|---|---|
| Cam height "A" | Intake | 44.815 - 45.005 (1.7644 - 1.7718) |
| | Exhaust | 43.975 - 44.165 (1.7313 - 1.7388) |

| | Standard |
|---|---|
| Outer diameter of camshaft journal | No. 1<br>27.935 - 27.955 (1.0998 - 1.1006)<br>No. 2, 3, 4, 5<br>23.435 - 23.455 (0.9226 - 0.9234) |
| Inner diameter of camshaft bracket | No.1<br>28.000 - 28.021 (1.1024 - 1.1032)<br>No.2, 3, 4, 5<br>23.500 - 23.521 (0.9252 - 0.9260) |
| Camshaft journal clearance | 0.045 - 0.086 (0.0018 - 0.0034) |
| Camshaft end play | 0.115 - 0.188 (0.0045 - 0.0074) |
| Camshaft sprocket runout [TIR*] | Less than 0.15 (0.0059) |

*: Total indicator reading

## CYLINDER BLOCK

Unit: mm (in)



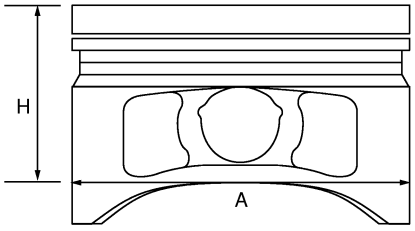

| | | | | |
|---|---|---|---|---|
| Surface distortion | Limit | | | 0.1 (0.004) |
| Cylinder bore | Inner diameter | Standard | Grade No. 2 | 89.010 - 89.020 (3.5043 - 3.5047) |
| | | | Grade No. 3 | 89.020 - 89.030 (3.5047 - 3.5051) |
| | | Wear limit | | 0.2 (0.008) |
| Out-of-round (X – Y) | | | | Less than 0.015 (0.0006) |
| Taper (C – A) | | | | Less than 0.01 (0.0004) |

| | | |
|---|---|---|
| Main journal inner diameter grade (Without bearing) | Grade No. A | 58.944 - 58.945 (2.3206 - 2.3207) |
| | Grade No. B | 58.945 - 58.946 (2.3207 - 2.3207) |
| | Grade No. C | 58.946 - 58.947 (2.3207 - 2.3207) |
| | Grade No. D | 58.947 - 58.948 (2.3207 - 2.3208) |
| | Grade No. E | 58.948 - 58.949 (2.3208 - 2.3208) |
| | Grade No. F | 58.949 - 58.950 (2.3208 - 2.3209) |
| | Grade No. G | 58.950 - 58.951 (2.3209 - 2.3209) |
| | Grade No. H | 58.951 - 58.952 (2.3209 - 2.3209) |
| | Grade No. J | 58.952 - 58.953 (2.3209 - 2.3210) |
| | Grade No. K | 58.953 - 58.954 (2.3210 - 2.3210) |
| | Grade No. L | 58.954 - 58.955 (2.3210 - 2.3211) |
| | Grade No. M | 58.955 - 58.956 (2.3211 - 2.3211) |
| | Grade No. N | 58.956 - 58.957 (2.3211 - 2.3211) |
| | Grade No. P | 58.957 - 58.958 (2.3211 - 2.3212) |
| | Grade No. R | 58.958 - 58.959 (2.3212 - 2.3212) |
| | Grade No. S | 58.959 - 58.960 (2.3212 - 2.3213) |
| | Grade No. T | 58.960 - 58.961 (2.3213 - 2.3213) |
| | Grade No. U | 58.961 - 58.962 (2.3213 - 2.3213) |
| | Grade No. V | 58.962 - 58.963 (2.3213 - 2.3214) |
| | Grade No. W | 58.963 - 58.964 (2.3214 - 2.3214) |
| | Grade No. X | 58.964 - 58.965 (2.3214 - 2.3215) |
| | Grade No. Y | 58.965 - 58.966 (2.3215 - 2.3215) |
| | Grade No. 4 | 58.966 - 58.967 (2.3215 - 2.3215) |
| | Grade No. 7 | 58.967 - 58.968 (2.3215 - 2.3216) |
| Difference in inner diameter between cylinders | Standard | Less than 0.03 (0.0012) |

## PISTON, PISTON RING, AND PISTON PIN

### Available Piston

Unit: mm (in)




PBIC0188E

| | | Grade* | Dimension |
|---|---|---|---|
| Piston skirt diameter “A” | Standard | Grade No. 1 | 88.980 - 88.990 (3.5031 - 3.5035) |
| | | Grade No. 2 | 88.990 - 89.000 (3.5035 - 3.5039) |
| | | Grade No. 3 | 89.000 - 89.010 (3.5039 - 3.5043) |
| “H” dimension | | | 42 (1.65) |
| Piston pin bore diameter | | Grade No. 0 | 19.993 - 19.999 (0.7871 - 0.7874) |
| | | Grade No. 1 | 19.999 - 20.005 (0.7874 - 0.7876) |
| Piston clearance to cylinder bore | | Standard | 0.010 - 0.030 (0.0004 - 0.0012) |
| | | Limit | 0.08 (0.0031) |

*: Always check with the Parts Department for the latest parts information.

### Piston Ring

Unit: mm (in)

| | | Standard | Limit |
|---|---|---|---|
| Side clearance | Top | 0.040 - 0.080 (0.0018 - 0.0031) | 0.11 (0.0043) |
| | 2nd | 0.030 - 0.070 (0.0012 - 0.0028) | 0.10 (0.0039) |
| | Oil ring | 0.045 - 0.125 (0.0018 - 0.0049) | — |
| End gap | Top | 0.21- 0.31 (0.0083 - 0.0122) | 0.54 (0.0213) |
| | 2nd | 0.37 - 0.52 (0.0146 - 0.0205) | 0.67 (0.0264) |
| | Oil (rail ring) | 0.20 - 0.45 (0.0079 - 0.0177) | 0.95 (0.0374) |

Piston Pin

Unit: mm (in)

| | Grade* | Dimension |
|---|---|---|
| Piston pin outer diameter | Grade No.0 | 19.989 - 19.995 (0.7870 - 0.7872) |
| | Grade No.1 | 19.995 - 20.001 (0.7872 - 0.7874) |
| Piston to piston pin clearance (Standard) | | 0.002 - 0.006 (0.0001 - 0.0002) |
| Piston pin to connecting rod bushing clearance | Standard | 0.005 - 0.017 (0.0002 - 0.0007) |

*: Always check with the Parts Department for the latest parts information.

## CONNECTING ROD

Unit: mm (in)

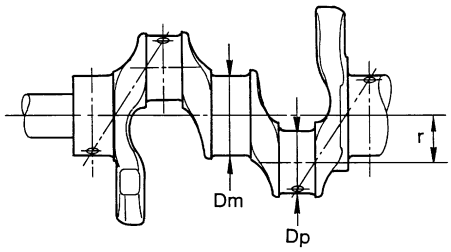
| | Grade[1] | Dimension |
|---|---|---|
| Center distance | | 143.00 - 143.10 (5.63 - 5.63) |
| Bend [per 100 (3.94)] | Limit | 0.15 (0.0059) |
| Torsion [per 100 (3.94)] | Limit | 0.30 (0.0118) |
| Connecting rod small end inner diameter | | 22.000 - 22.012 (0.7874 - 0.7879) |
| Connecting rod small end inner diameter[2] | Grade No. 0 | 20.000 - 20.006 (0.7874 - 0.7876) |
| | Grade No. 1 | 20.006 - 20.012 (0.7876 - 0.7879) |
| Connecting rod big end inner diameter | | 48.000 - 48.013 (1.8898 - 1.8903) |
| Side clearance | Standard | 0.20 - 0.35 (0.0079 - 0.0138) |
| | Limit | 0.50 (0.0197) |
| Connecting rod bearing housing | Grade No. 0<br>Grade No. 1<br>Grade No. 2<br>Grade No. 3<br>Grade No. 4<br>Grade No. 5<br>Grade No. 6<br>Grade No. 7<br>Grade No. 8<br>Grade No. 9<br>Grade No. A<br>Grade No. B<br>Grade No. C | 48.000 - 48.001 (1.8898 - 1.8898)<br>48.001 - 48.002 (1.8898 - 1.8898)<br>48.002 - 48.003 (1.8898 - 1.8899)<br>48.003 - 48.004 (1.8899 - 1.8899)<br>48.004 - 48.005 (1.8899 - 1.8899)<br>48.005 - 48.006 (1.8899 - 1.8900)<br>48.006 - 48.007 (1.8900 - 1.8900)<br>48.007 - 48.008 (1.8900 - 1.8901)<br>48.008 - 48.009 (1.8901 - 1.8901)<br>48.009 - 48.010 (1.8901 - 1.8902)<br>48.010 - 48.011 (1.8902 - 1.8902)<br>48.011 - 48.012 (1.8902 - 1.8902)<br>48.012 - 48.013 (1.8902 - 1.8903) |

[1]: Always check with the Parts Department for the latest parts information.

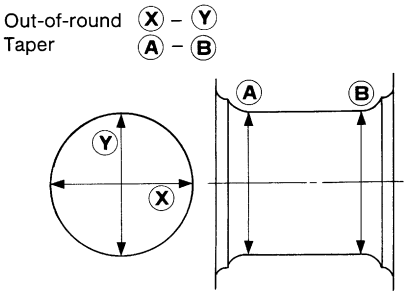
[2]: After installing in connecting rod

## CRANKSHAFT

Unit: mm (in)




SEM645




SEM715

| | Grade[1] | Dimension |
|---|---|---|
| Pin journal dia. “DP” | Grade No. A | 44.974 - 44.973 (1.7706 - 1.7706) |
| | Grade No. B | 44.973 - 44.972 (1.7706 - 1.7705) |
| | Grade No. C | 44.972 - 44.971 (1.7705 - 1.7705) |
| | Grade No. D | 44.971 - 44.970 (1.7705 - 1.7705) |
| | Grade No. E | 44.970 - 44.969 (1.7705 - 1.7704) |
| | Grade No. F | 44.969 - 44.968 (1.7704 - 1.7704) |
| | Grade No. G | 44.968 - 44.967 (1.7704 - 1.7704) |
| | Grade No. H | 44.967 - 44.966 (1.7704 - 1.7703) |
| | Grade No. J | 44.966 - 44.965 (1.7703 - 1.7703) |
| | Grade No. K | 44.965 - 44.964 (1.7703 - 1.7702) |
| | Grade No. L | 44.964 - 44.963 (1.7702 - 1.7702) |
| | Grade No. M | 44.963 - 44.962 (1.7702 - 1.7702) |
| | Grade No. N | 44.962 - 44.961 (1.7702 - 1.7701) |
| | Grade No. P | 44.961 - 44.960 (1.7701 - 1.7701) |
| | Grade No. R | 44.960 - 44.959 (1.7701 - 1.7700) |
| | Grade No. S | 44.959 - 44.958 (1.7700 - 1.7700) |
| | Grade No. T | 44.958 - 44.957 (1.7700 - 1.7700) |
| | Grade No. U | 44.957 - 44.956 (1.7700 - 1.7699) |
| Main journal dia. “Dm” grade | Grade No. A | 54.979 - 54.978 (2.1645 - 2.1645) |
| | Grade No. B | 54.978 - 54.977 (2.1645 - 2.1644) |
| | Grade No. C | 54.977 - 54.976 (2.1644 - 2.1644) |
| | Grade No. D | 54.976 - 54.975 (2.1644 - 2.1644) |
| | Grade No. E | 54.975 - 54.974 (2.1644 - 2.1643) |
| | Grade No. F | 54.974 - 54.973 (2.1643 - 2.1643) |
| | Grade No. G | 54.973 - 54.972 (2.1643 - 2.1642) |
| | Grade No. H | 54.972 - 54.971 (2.1642 - 2.1642) |
| | Grade No. J | 54.971 - 54.970 (2.1642 - 2.1642) |
| | Grade No. K | 54.970 - 54.969 (2.1642 - 2.1641) |
| | Grade No. L | 54.969 - 54.968 (2.1641 - 2.1641) |
| | Grade No. M | 54.968 - 54.967 (2.1641 - 2.1641) |
| | Grade No. N | 54.967 - 54.966 (2.1641 - 2.1640) |
| | Grade No. P | 54.966 - 54.965 (2.1640 - 2.1640) |
| | Grade No. R | 54.965 - 54.964 (2.1640 - 2.1639) |
| | Grade No. S | 54.964 - 54.963 (2.1639 - 2.1639) |
| | Grade No. T | 54.963 - 54.962 (2.1639 - 2.1639) |
| | Grade No. U | 54.962 - 54.961 (2.1639 - 2.1638) |
| | Grade No. V | 54.961 - 54.960 (2.1638 - 2.1638) |
| | Grade No. W | 54.960 - 54.959 (2.1638 - 2.1637) |
| | Grade No. X | 54.959 - 54.958 (2.1637 - 2.1637) |
| | Grade No. Y | 54.958 - 54.957 (2.1637 - 2.1637) |
| | Grade No. 4 | 54.957 - 54.956 (2.1637 - 2.1636) |
| | Grade No. 7 | 54.956 - 54.955 (2.1636 - 2.1636) |
| Center distance “r” | | 49.60 - 50.04 (1.9528 - 1.9701) |
| Out-of-round (X – Y) | Standard | Less than 0.005 (0.0002) |
| Taper (A – B) | Standard | Less than 0.005 (0.0002) |
| Runout [TIR[2]] | Limit | Less than 0.05 (0.002) |

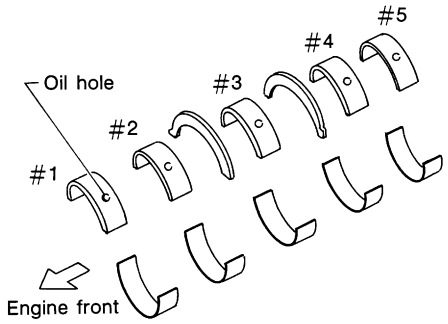
| | | |
|---|---|---|
| Free end play | Standard | 0.10 - 0.26 (0.0039 - 0.0102) |
| | Limit | 0.30 (0.0118) |

1: Always check with the Parts Department for the latest parts information.

2: Total indicator reading

## MAIN BEARING

Unit: mm (in)




SEM685D

| Grade number* | | Thickness | Identification color (UPR / LWR) | Remarks |
|---|---|---|---|---|
| 0 | | 1.973 - 1.976 (0.0777 - 0.0778) | Black | Grade and color are the same for upper and lower bearings. |
| 1 | | 1.976 - 1.979 (0.0778 - 0.0779) | Brown | |
| 2 | | 1.979 - 1.982 (0.0779 - 0.0780) | Green | |
| 3 | | 1.982 - 1.985 (0.0780 - 0.0781) | Yellow | |
| 4 | | 1.985 - 1.988 (0.0781 - 0.0783) | Blue | |
| 5 | | 1.988 - 1.991 (0.0783 - 0.0784) | Pink | |
| 6 | | 1.991 - 1.994 (0.0784 - 0.0785) | Purple | |
| 01 | UPR | 1.973 - 1.976 (0.0777 - 0.0778) | Black / Brown | Grade and color are different for upper and lower bearings. |
| | LWR | 1.976 - 1.979 (0.0778 - 0.0779) | | |
| 12 | UPR | 1.976 - 1.979 (0.0778 - 0.0779) | Brown / Green | |
| | LWR | 1.979 - 1.982 (0.0779 - 0.0780) | | |
| 23 | UPR | 1.979 - 1.982 (0.0779 - 0.0780) | Green / Yellow | |
| | LWR | 1.982 - 1.985 (0.0780 - 0.0781) | | |
| 34 | UPR | 1.982 - 1.985 (0.0780 - 0.0781) | Yellow / Blue | |
| | LWR | 1.985 - 1.988 (0.0781 - 0.0783) | | |
| 45 | UPR | 1.985 - 1.988 (0.0781 - 0.0783) | Blue / Pink | |
| | LWR | 1.988 - 1.991 (0.0783 - 0.0784) | | |
| 56 | UPR | 1.988 - 1.991 (0.0783 - 0.0784) | Pink / Purple | |
| | LWR | 1.991 - 1.994 (0.0784 - 0.0785) | | |
| 67 | UPR | 1.991 - 1.994 (0.0784 - 0.0785) | Purple / White | |
| | LWR | 1.994 - 1.997 (0.0785 - 0.0786) | | |

*: Always check with the Parts Department for the latest parts information.

### Undersize

Unit: mm (in)

| Size U.S. | Thickness | Main journal diameter |
|---|---|---|
| 0.25 (0.0098) | 2.106 - 2.114 (0.0829 - 0.0832) | Grind so that bearing clearance is the specified value. |

### Bearing Clearance

Unit: mm (in)

| | | | |
|---|---|---|---|
| Main bearing oil clearance | Standard | No.1, 3, and 5 | 0.012 - 0.022 (0.0005 - 0.0009) |
| | | No.2 and 4 | 0.018 - 0.028 (0.0007 - 0.0011) |
| | Limit | | 0.1 (0.004) |

## CONNECTING ROD BEARING

| Grade number* | Thickness mm (in) | Identification color |
|---|---|---|
| 0 | 1.493 - 1.496 (0.0588 - 0.0589) | Black |
| 1 | 1.496 - 1.499 (0.0589 - 0.0590) | Brown |
| 2 | 1.499 - 1.502 (0.0590 - 0.0591) | Green |
| 3 | 1.502 - 1.505 (0.0591 - 0.0593) | Yellow |
| 4 | 1.505 - 1.508 (00.593 - 0.0594) | Blue |

*: Always check with the Parts Department for the latest parts information.

### Undersize

Unit: mm (in)

| Size U.S. | Thickness | Crank pin journal diameter |
|---|---|---|
| 0.25 (0.0098) | 1.622 - 1.630 (0.0639 - 0.0642) | Grind so that bearing clearance is the specified value. |

### Bearing Clearance

Unit: mm (in)

| | | |
|---|---|---|
| Connecting rod bearing oil clearance | Standard | 0.035 - 0.045 (0.0014 - 0.0018) |
| | Limit | 0.10 (0.0039) |

## FLYWHEEL

| Items | Standard | Limit |
|---|---|---|
| Deflection of flywheel contact surface at 210 mm (8.27 in) dia. | — | 0.45 mm (0.0177 in) or less under no load |
| Axial displacement at 250 mm (9.84 in) dia. | — | 1.3 mm (0.051 in) or less under 100N (22.48 lb) force |
| Rotation direction movement | 35 mm (1.38 in) or less | — |