SECTION EM
ENGINE MECHANICAL

CONTENTS

SERVICE INFORMATION

PRECAUTIONS

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

INFOID:0000000001702460

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.

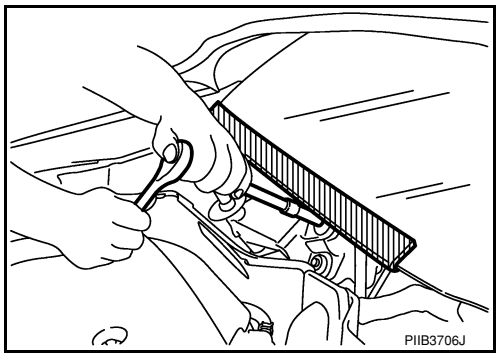
WARNING:

- **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.**

Precaution for Procedure without Cowl Top Cover

INFOID:0000000001702461

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



Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:0000000001702462

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-III 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-III.

Precaution for Drain Coolant

INFOID:0000000001702463

- Drain coolant when engine is cooled.

Precaution for Disconnecting Fuel Piping

INFOID:0000000001702464

- 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:0000000001702465

- 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:0000000001702466

- 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:0000000001702467

- 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:0000000001702468

- 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)

Tool number : KV10112100 (BT-8653-A)

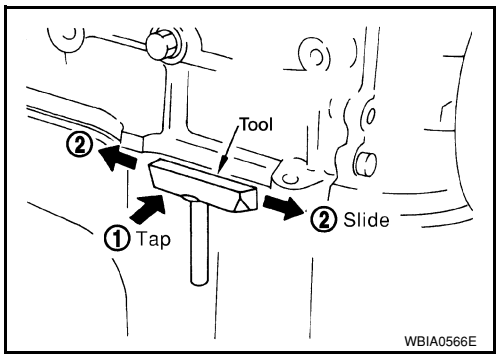
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precaution for Liquid Gasket

INFOID:0000000001702469

REMOVAL OF LIQUID GASKET SEALING

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



Tool number : KV10111100 (J-37228)

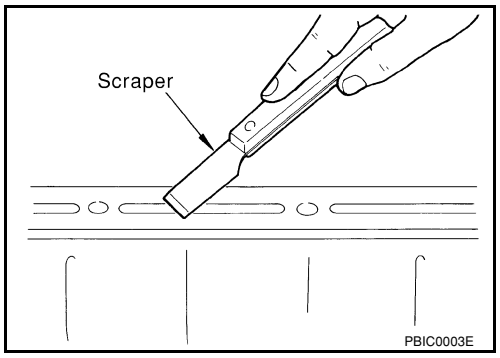
CAUTION:
Be careful not to damage the mating surfaces.

- 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.

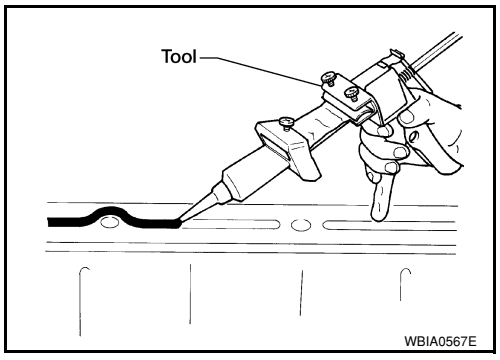
CAUTION:
If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
   - Remove the sealant completely from the groove of the gasket application surface, 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-42, "Recommended Chemical Product and Sealant".



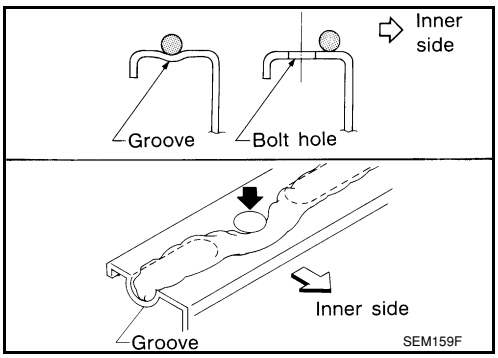
4. Apply the sealant without breaks to the specified location using Tool.



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-10, "Fluids and Lubricants".



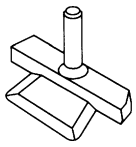
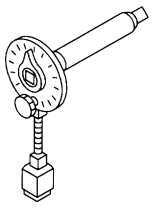
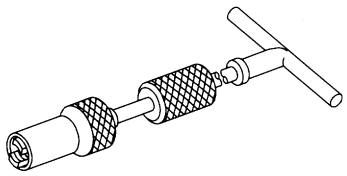
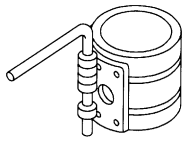
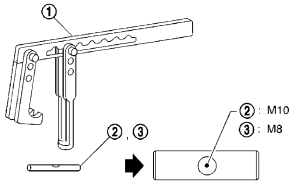
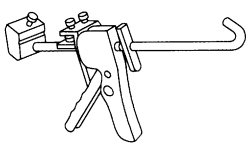
CAUTION:
Follow all specific instructions in this manual.

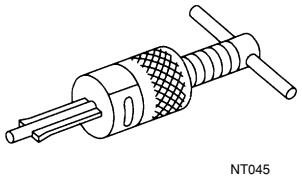
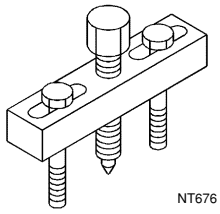
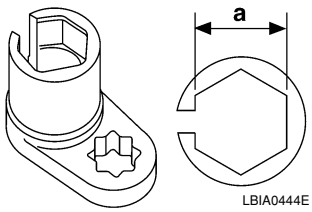
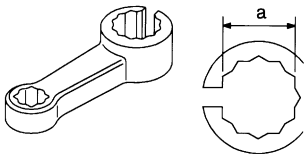
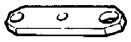
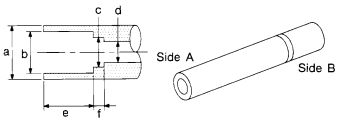
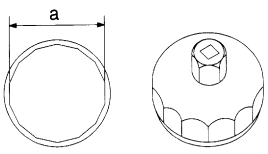
PREPARATION

Special Service Tool

INFOID:0000000001702470

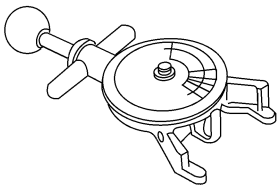
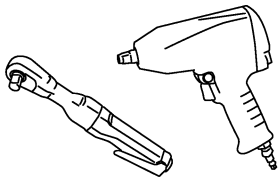
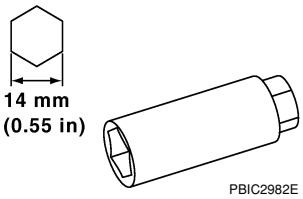
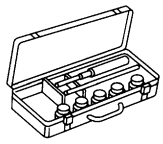
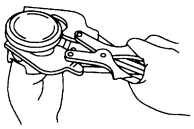
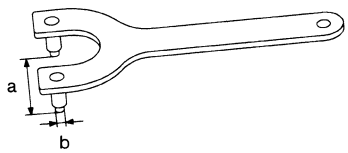
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

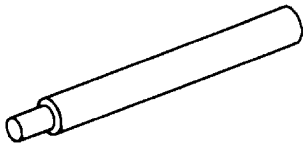
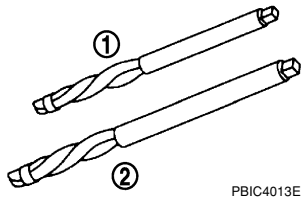
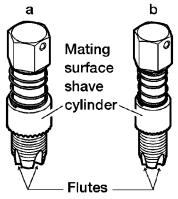
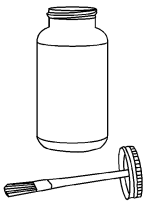
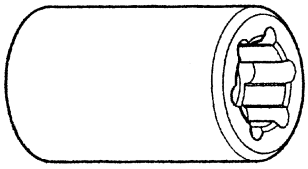
Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter  NT046	Removing steel oil pan and rear timing chain case
KV10112100 (BT-8653-A) Angle wrench  NT014	Tightening bolts for bearing cap, cylinder head, etc.
KV10107902 (J-38959) Valve oil seal puller  S-NT011	Removing valve 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 (Kent-Moore No.) Tool name	Description
ST16610001 (J-23907) Pilot bushing puller  NT045	Removing crankshaft pilot bushing
KV11103000 (—) Pulley puller  NT676	Removing crankshaft pulley
KV991J0050 (J-44626) Air fuel sensor Socket  LBIA0444E	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**
KV10114400 (J-38365) Heated oxygen sensor wrench  NT636	Loosening or tightening rear heated oxygen sensor **a: 22 mm (0.87 in)**
KV11105210 (J-44716) Stopper plate  ZZA0009D	Securing driveplate and flywheel
KV10115600 (J-38958) Valve oil seal drift  S-NT603	Installing valve oil seal **Use side A.** **a: 20 (0.79) dia**. **b: 13 (0.51) dia.** **c: 10.3 (0.406) dia**. **d: 8 (0.31) dia.** **e: 10.7 (0.421)** **f: 5 (0.20)**
KV10115801 (—) Oil filter wrench  S-NT375	Removing and installing oil filter **a: 64.3 mm (2.531 in)**

Commercial Service Tool

INFOID:0000000001702471

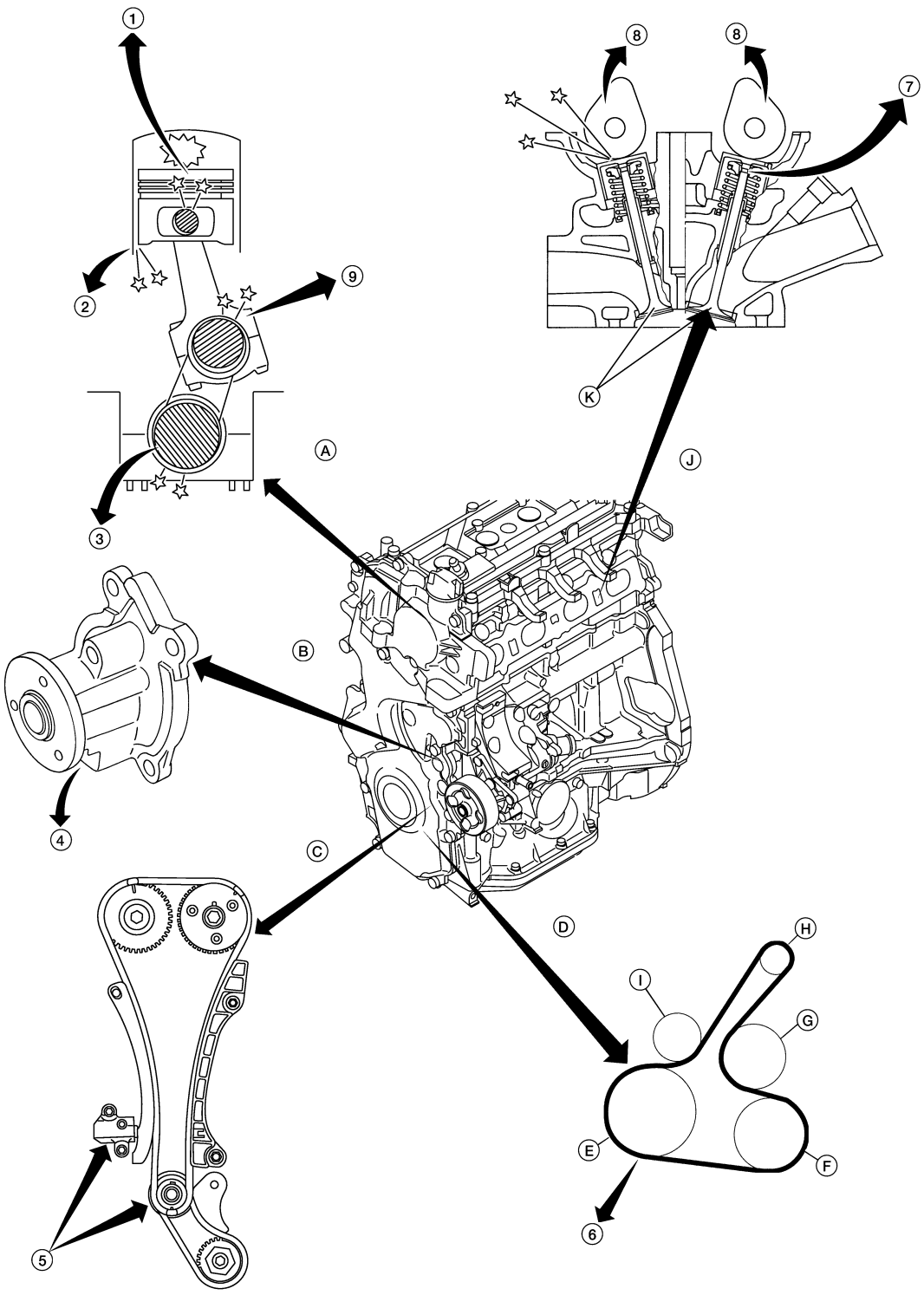
(Kent-Moore No.) Tool name	Description
(BT-3373-F) Belt tension gauge  AMA126	Checking drive belt tension
Power tool  PBIC0190E	Loosening bolts and nuts
Spark plug wrench  PBIC2982E	Removing and installing spark plug
Valve seat cutter set  NT048	Finishing valve seat dimensions
Piston ring expander  NT030	Removing and installing piston ring
KV10109300 (—) Pulley holder  NT628	Removing and installing crankshaft pulley

(Kent-Moore No.) Tool name	Description
KV10111800 Valve guide drift  PBIC4012E	Removing and installing valve guide
Valve guide reamer  PBIC4013E	(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner  AEM488	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **a: J-43897-18 (18 mm dia.) for zirconia oxygen sensor** **b: J-43897-12 (12 mm dia.) for titania 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
E20 Torx® Socket (J-45816)  LBIA0285E	Removing and installing drive plate and flywheel bolts

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:0000000001702472



WBIA0769E

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:0000000001702473

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.

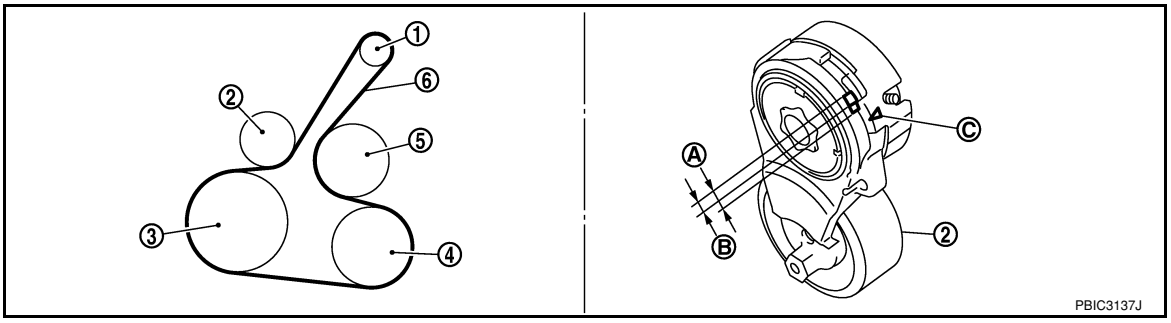
Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-104
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-47 EM-47
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-93 EM-93
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-93 EM-93 EM-93 EM-93
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-93 EM-93
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-93 EM-93
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-38
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-16

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

DRIVE BELTS

Component

INFOID:0000000001702474



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

Checking Drive Belts

INFOID:0000000001702475

WARNING:
Be sure to perform this step 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 (A).
  NOTE:
  - Check the drive belt auto-tensioner indication when the engine is cold.
  - When new drive belt is installed, the indicator (notch on fixed side) should be within the range (B).
- Visually check entire drive belt for wear, damage or cracks.
- If the indicator (notch on fixed side) is out of the possible use range or belt is damaged, replace drive belt.

Tension Adjustment

INFOID:0000000001702476

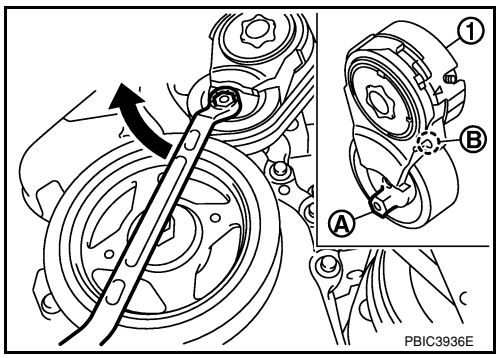
Belt tension is not necessary, as it is automatically adjusted by drive belt auto-tensioner.

Removal and Installation

INFOID:0000000001702477

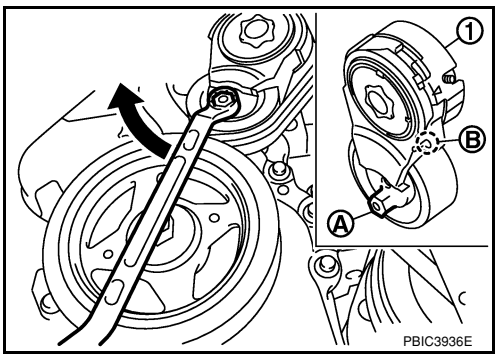
REMOVAL

1. Hold the hexagonal part (A) of drive belt auto-tensioner (1) with a wrench securely. Then move the wrench handle in the direction of arrow (loosening direction of tensioner).
   CAUTION:
   Never place hand in a location where pinching may occur if the holding tool accidentally comes off.
2. Insert a rod such as short-length screwdriver approximately 6 mm (0.24 in) in diameter into the hole (B) of the retaining boss to fix drive belt auto-tensioner.
3. Remove drive belt.



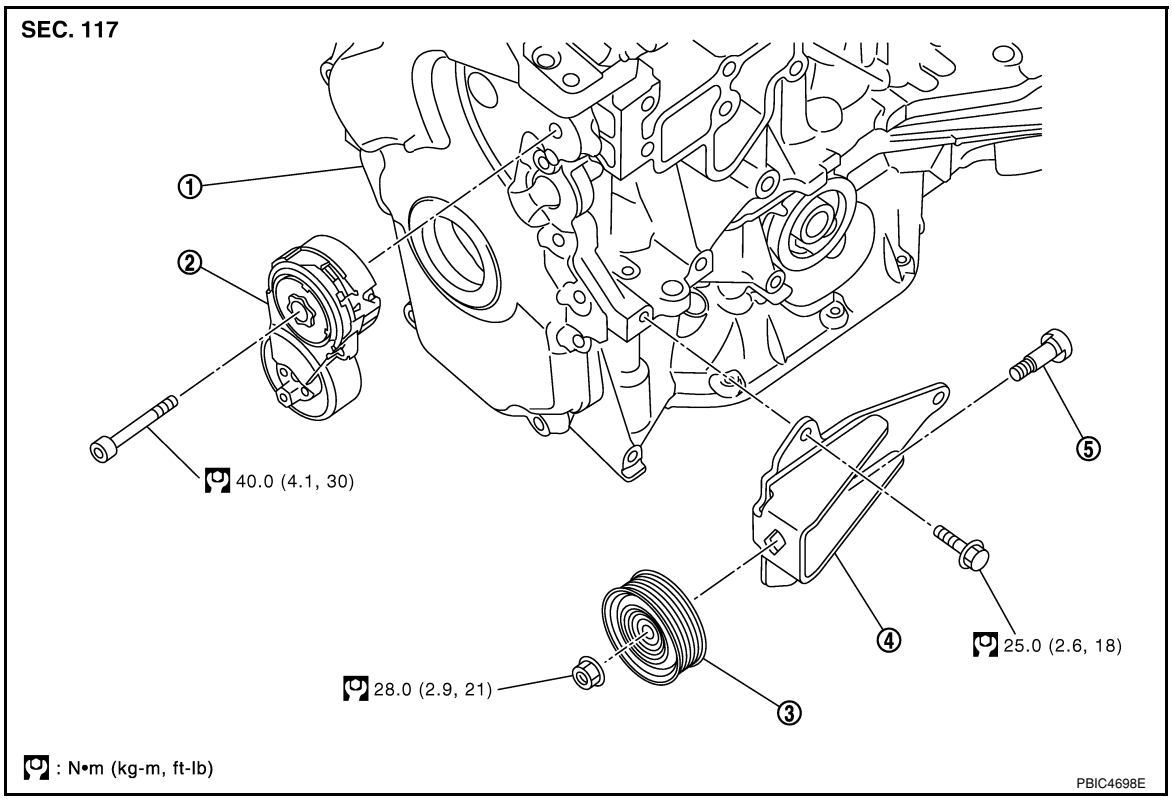
INSTALLATION

1. Hold the hexagonal part (A) of drive belt auto-tensioner (1) with a box wrench securely. Then move the wrench handle in the direction of arrow (loosening direction of tensioner).
   CAUTION:
   Never place hand in a location where pinching may occur if the holding tool accidentally comes off.
2. Insert a rod such as short-length screwdriver approximately 6 mm (0.24 in) in diameter into the hole (B) of retaining boss to fix drive belt auto-tensioner.
3. Install drive belt.
   CAUTION:
   - **Confirm drive belt is completely set to pulleys.**
   - **Check for engine oil, working fluid and engine coolant are not adhered to drive belt and each pulley groove.**
4. Release drive belt auto-tensioner, and apply tension to drive belt.
5. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
6. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to EM-13, "Checking Drive Belts".



Component

INFOID:0000000001702478



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:0000000001702479

REMOVAL

1. Remove drive belt. Refer to EM-13, "Removal and Installation".
2. Release the fixed drive belt auto-tensioner pulley.
3. Loosen bolt and remove drive belt auto-tensioner.
   NOTE:

Use TORX socket (size T50).

4. Remove idler pulley and bracket (models without A/C).

INSTALLATION

Installation is the reverse order of removal.

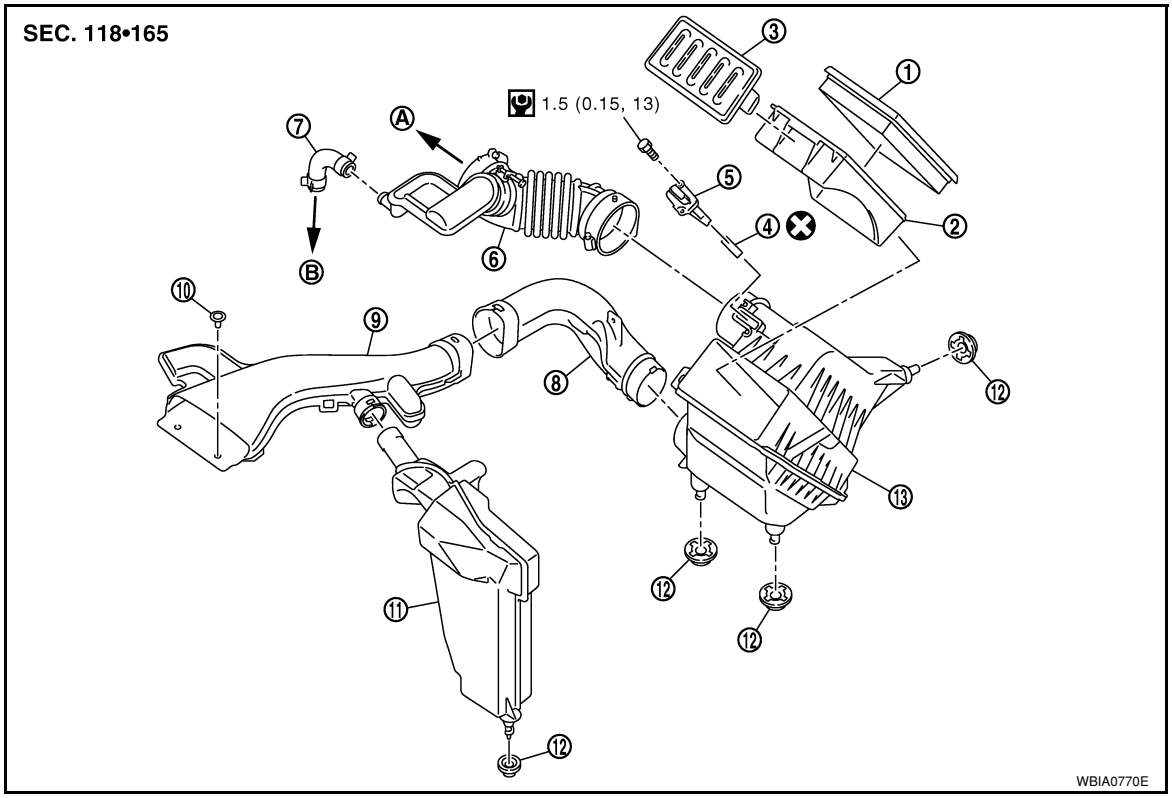
CAUTION:

- **When installing drive belt auto-tensioner, be careful not to interfere with water pump pulley.**
- **If there is damage greater than peeled paint, replace drive belt auto-tensioner and/or idler pulley.**

AIR CLEANER AND AIR DUCT

Component

INFOID:0000000001702480



1. Air cleaner filter
2. Holder
3. Air cleaner cover
4. Seal
5. Mass air flow sensor
6. Air duct
7. PCV hose
8. Air duct (Inlet)
9. Air duct (Front)
10. Clip
11. Resonator
12. Grommet
13. Air cleaner case
A. To electronic throttle control actuator
B. To rocker cover

Removal and Installation

INFOID:0000000001702481

REMOVAL

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

a. Remove battery. Refer to SC-4.
b. Disconnect harness connector from mass air flow sensor.
c. Remove the air cleaner case.

7. Remove the mass air flow sensor from the air cleaner case, if necessary.

CAUTION:
- **Handle it carefully and avoid impacts.**
- **Do not touch sensor part.**

INSTALLATION

Installation is in the reverse order of removal.

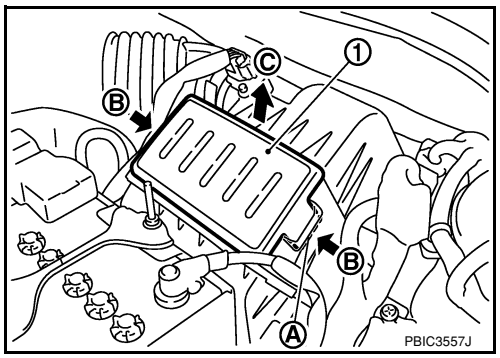
- Align marks.
- Attach each joint securely.
- Screw clamps firmly.

Changing Air Cleaner Filter

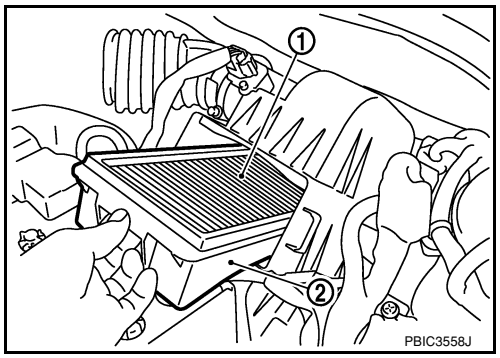
INFOID:0000000001702482

REMOVAL

1. Push the tabs (A) of both ends of the air cleaner cover (1) into the inside (B).
2. Pull up the air cleaner cover forward (C) and remove it.



3. Remove the air cleaner filter (1) and holder (2) assembly from the air cleaner case.
4. Remove the air cleaner filter from the holder.



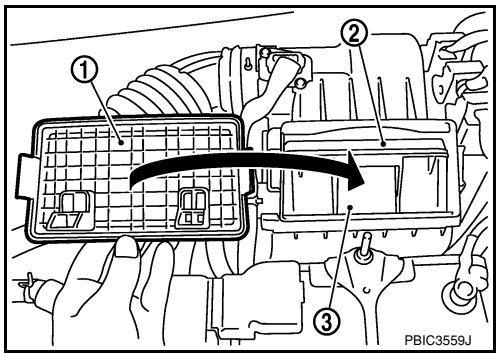
INSPECTION AFTER REMOVAL

It is necessary to replace it at the recommended intervals, more often under dusty driving conditions. Refer to MA-6.

INSTALLATION

Installation is in the reverse order of removal.

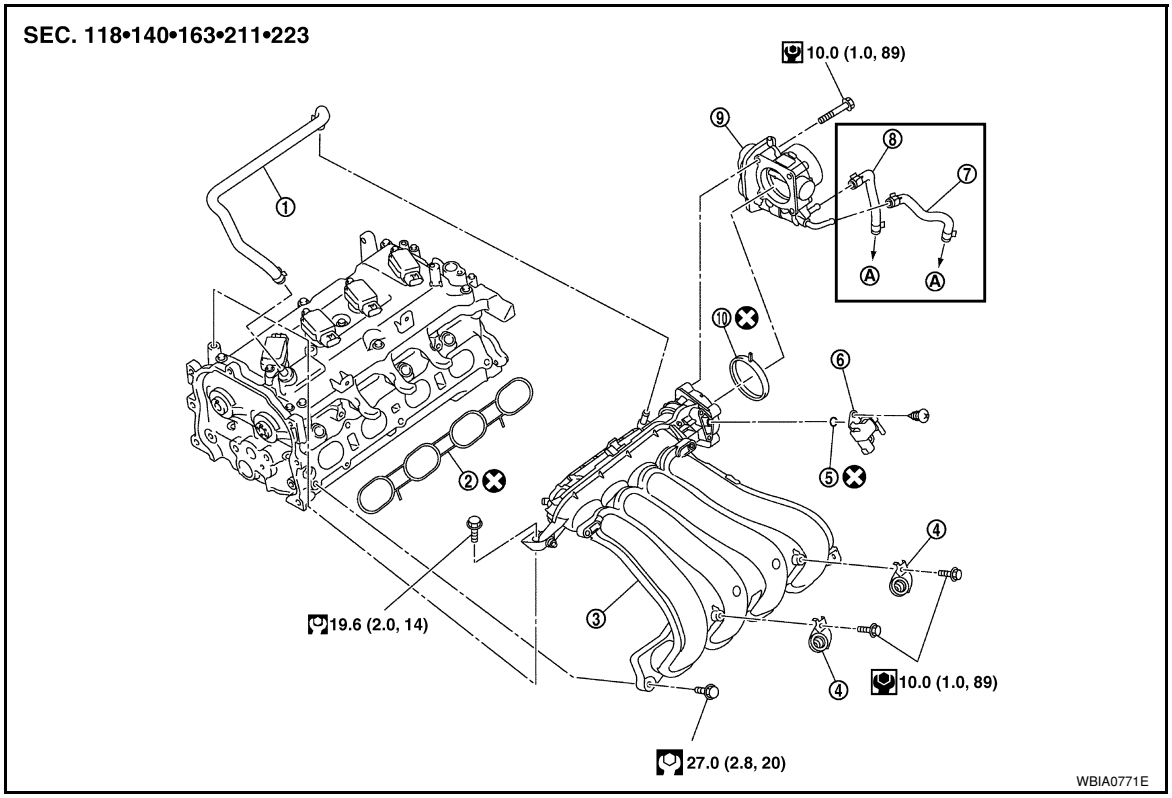
- Install the air cleaner cover (1) in the direction shown.
- Air cleaner filter (2)
- Holder (3)



INTAKE MANIFOLD

Component

INFOID:0000000001702483



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. Electronic throttle control actuator
10. Gasket
A. To water outlet

Removal and Installation

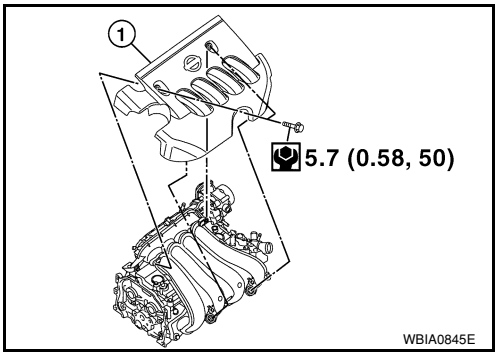
INFOID:0000000001702484

REMOVAL

1. Remove engine cover (1).
2. Drain engine coolant. Refer to CO-8, "Changing Engine Coolant".
   CAUTION:
   Perform this step when engine is cold.
   NOTE:
   This step is unnecessary when putting plugs to water hoses (to electronic throttle control actuator)

a. Disconnect water hoses from electronic throttle control actuator.

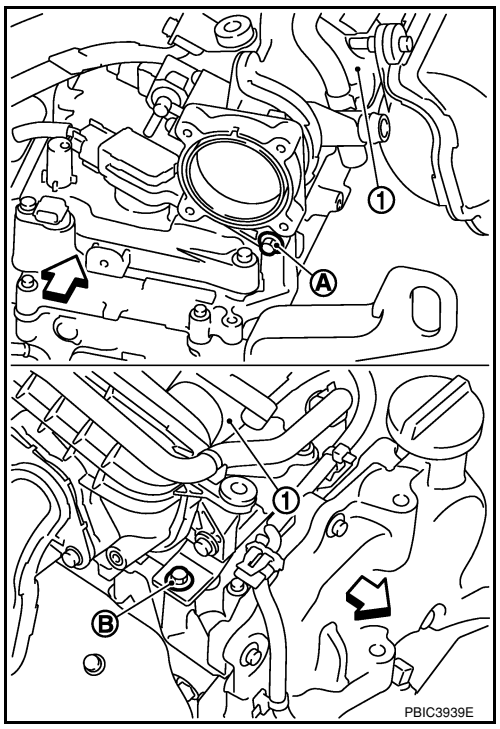
b. Remove electronic throttle control actuator.
   CAUTION:
   - **Handle carefully to avoid any shock to electronic throttle control actuator.**
   - **Never disassemble.**



3. Remove oil level gauge.
   CAUTION:
   Cover the oil level gauge guide openings to avoid entry of foreign materials.

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

⇦ : Engine front

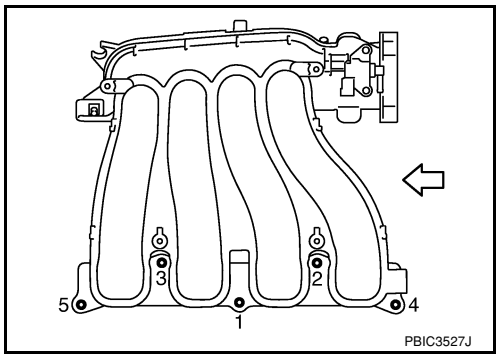


5. Loosen bolts in reverse order as shown.

⇦ : Engine front

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

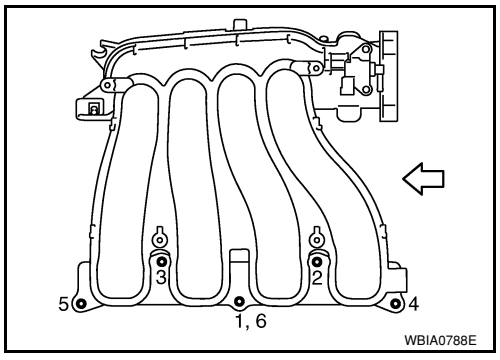
6. Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.
CAUTION:
Handle it carefully and avoid impacts.
7. Remove intake manifold.



INSTALLATION

1. Install intake manifold.
NOTE:
Be sure the intake manifold gasket is seated correctly in groove of intake manifold.
2. Tighten bolts in numerical order as shown.

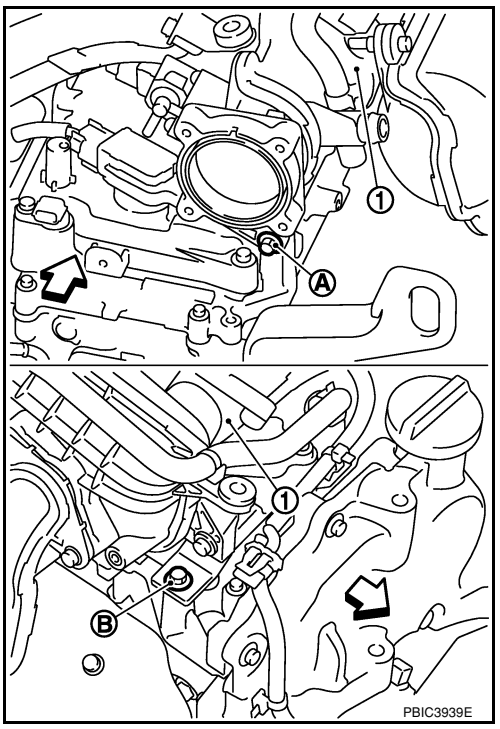
⇦ : Engine front



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

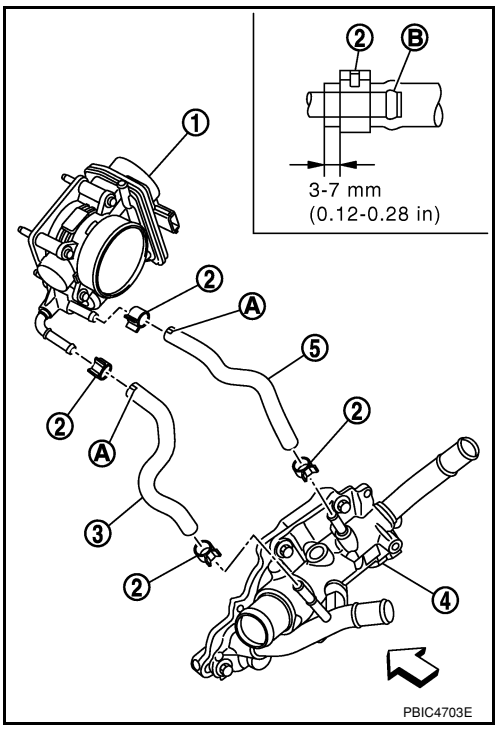
1 : Intake manifold

⇦ : Engine front



4. Install electronic throttle control actuator
5. Install water hoses (3), (5) to electronic throttle control actuator as shown.

1 : Electronic throttle control actuator
2 : Clamp
4 : Water outlet
A : Paint Mark
B : The clamp shall not interfere with the bulged section.



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

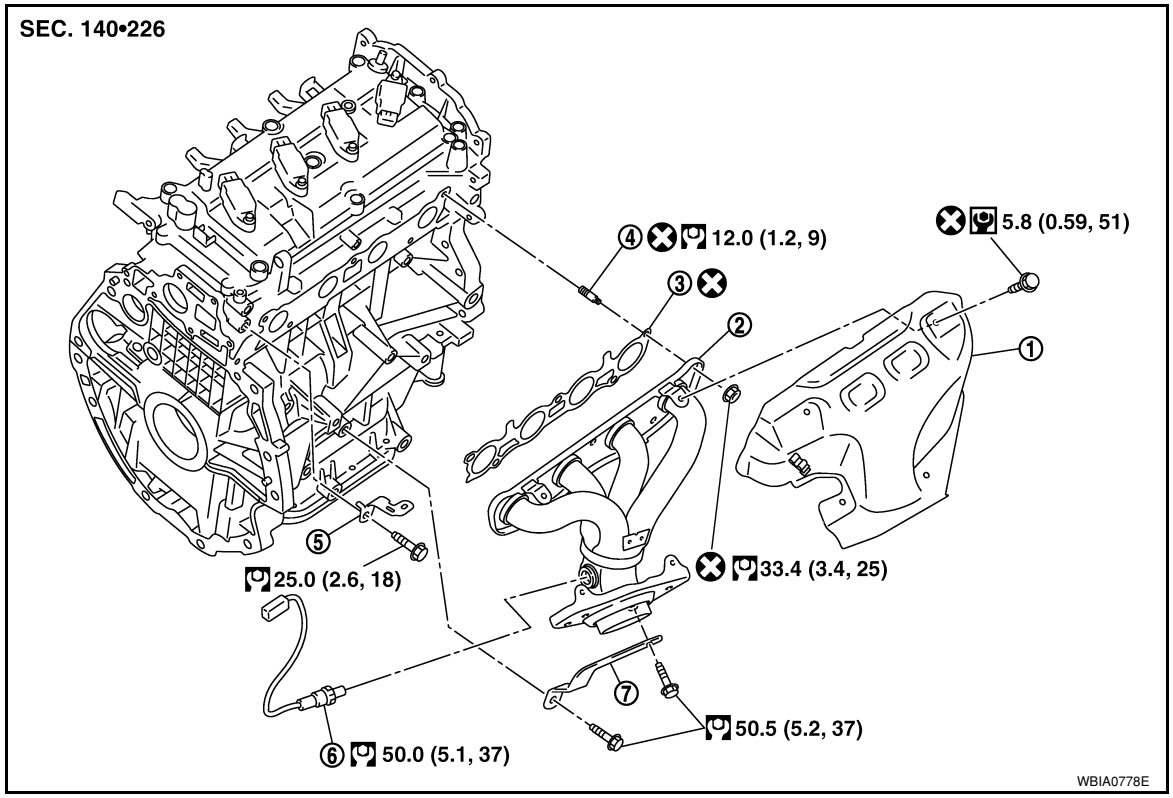
INSPECTION AFTER INSTALLATION

- Check for leaks of engine coolant. Refer to CO-8, "Inspection".
- Start and warm up the engine. Visually check for engine coolant leaks.

EXHAUST MANIFOLD

Component

INFOID:0000000001702485



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

Removal and Installation

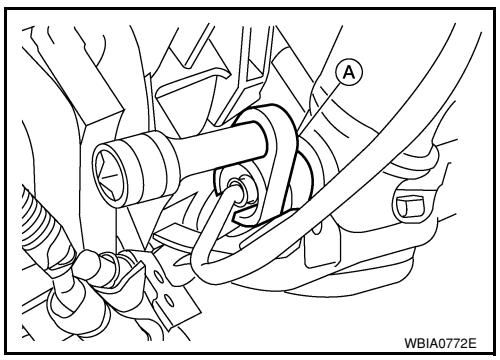
INFOID:0000000001702486

REMOVAL

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

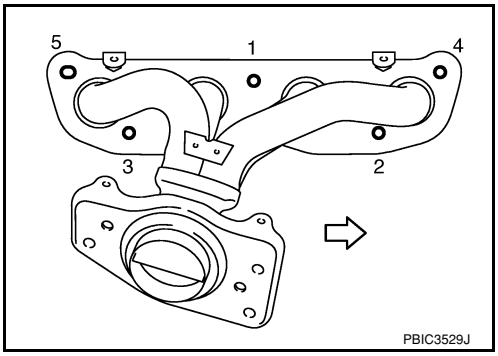
Tool number :KV991J0050 (J-44626)

CAUTION:
Handle it carefully and avoid impacts.



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

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



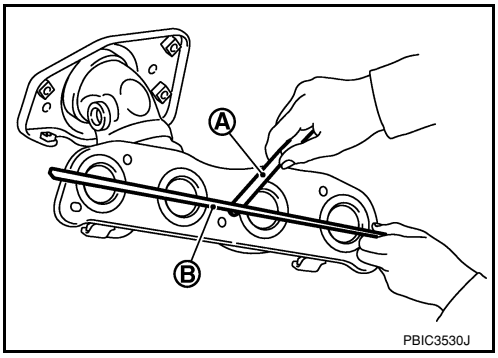
⇦ : Engine front

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.



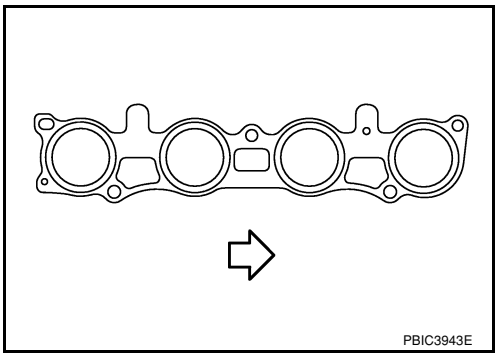
Limit:

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.

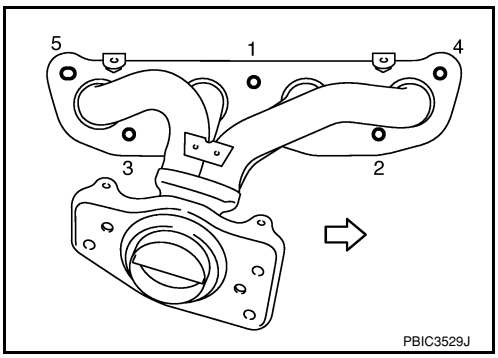
INSTALLATION

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



⇦ : Engine front

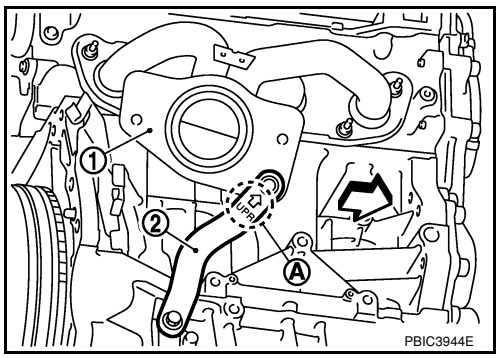
2. Tighten exhaust manifold nuts to specification in two stages in the numerical order as shown.



⇦ : Engine front

3. Install exhaust manifold stay (2) in the direction as shown.

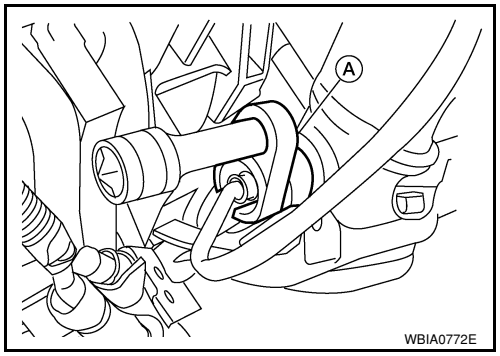
1 : Exhaust manifold
A : Upper mark
⇦ : Engine front



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

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.**



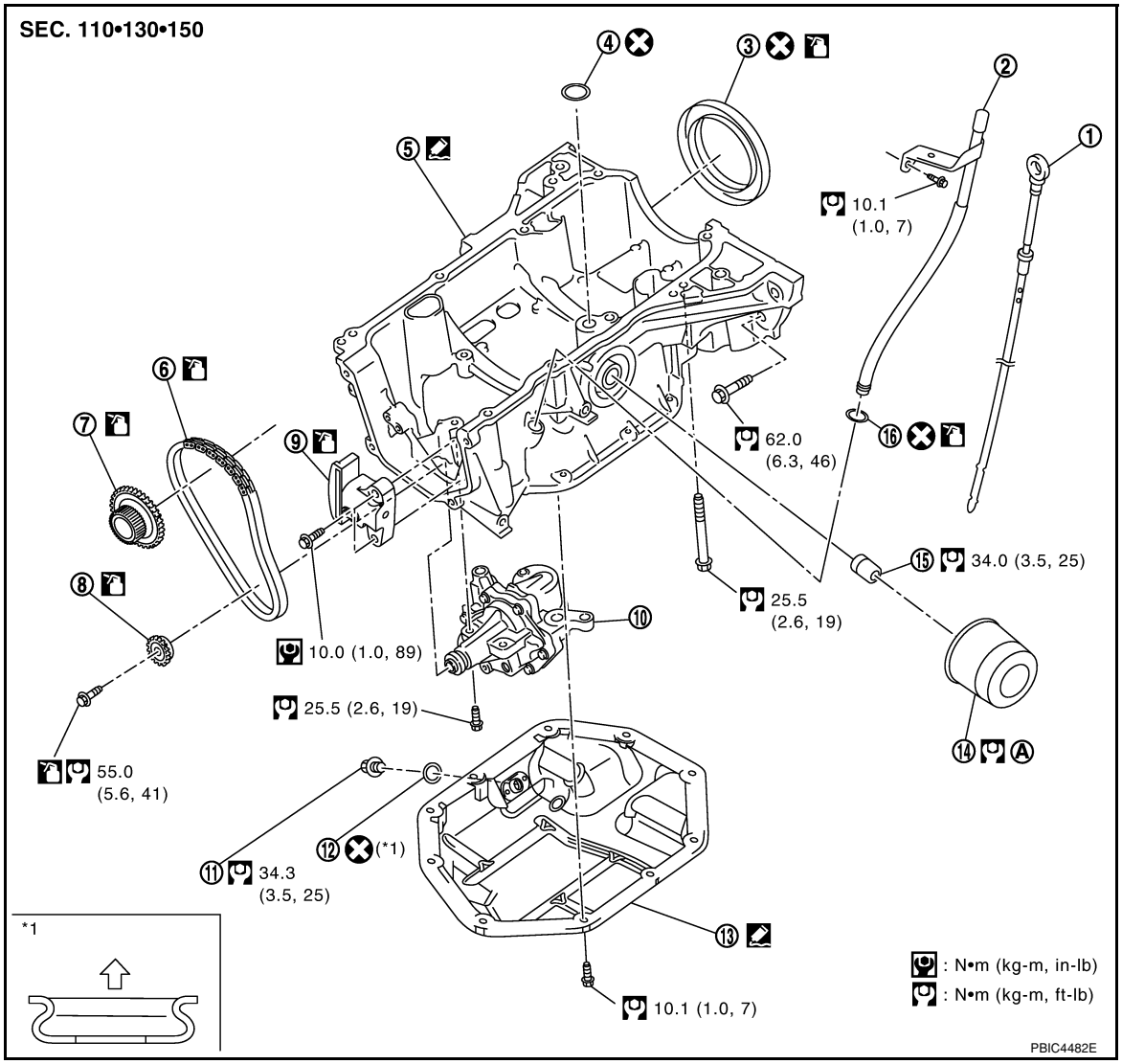
Tool number : — (J-43897-12)
Tool number : — (J-43897-18)

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

OIL PAN

Component

INFOID:0000000001702487



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. Oil pump
11. Drain plug
12. Drain plug washer
13. Oil pan (lower)
14. Oil filter
15. Connector bolt
16. O-ring
A. Refer to EM-24

⇦ : Oil pan side

Removal and Installation

INFOID:0000000001702488

REMOVAL

WARNING:

- **Be careful not to burn yourself, as the engine oil 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.**

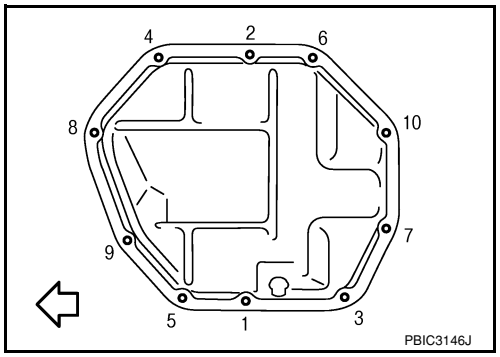
1. Drain engine oil. Refer to LU-6.
2. Remove engine and transaxle assembly. Refer to EM-72.
3. Remove oil filter using Tool.

Tool number : KV10115801 (—)

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

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

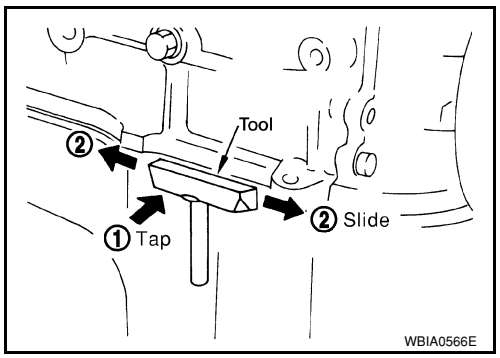
⇦ : Engine front



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

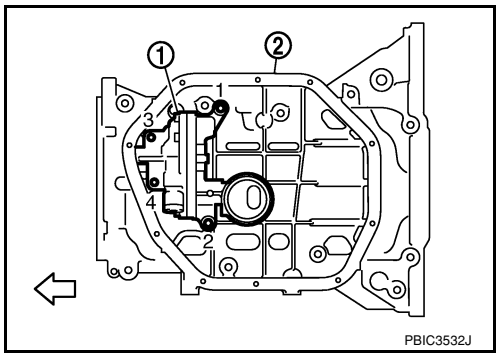
Tool number : KV10111100 (J-37228)

CAUTION:
Be careful not to damage the mating surfaces.



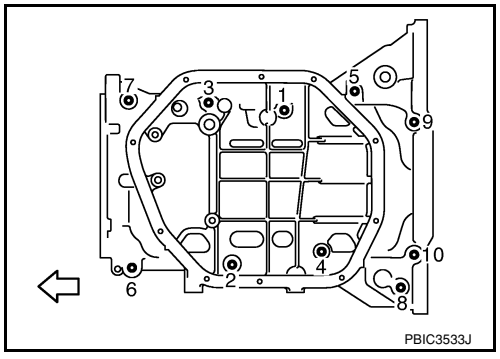
6. Remove the following parts:
   - Flywheel (M/T models) or drive plate (A/T or CVT models); Refer to EM-76.
   - Front cover, timing chain, oil pump drive chain; Refer to EM-37.
7. Remove oil pump.
   - Loosen bolts in reverse order as shown.

1 : Oil pump
2 : Oil pan (upper)
⇦ : Engine front

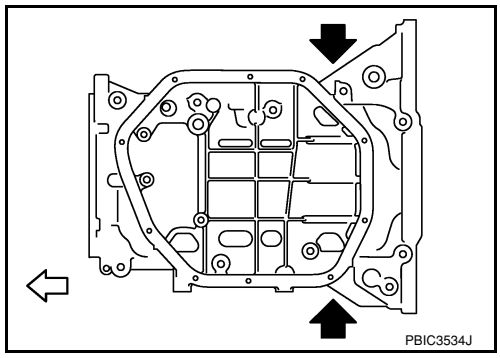


8. Remove oil pan (lower) bolts in reverse order as shown.

⇦ : Engine front



9. Insert a screwdriver shown by the arrow (⇦) and open up a crack between oil pan (upper) and cylinder block.



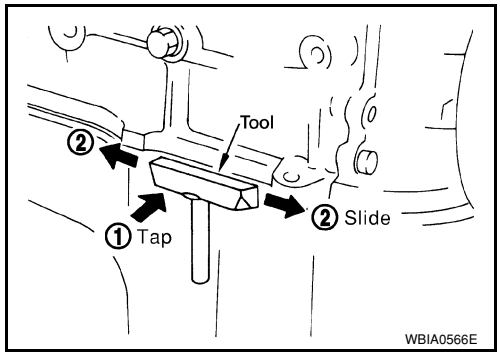
⇦ : Engine front

CAUTION:
A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.

10. 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 lower oil pan from the upper oil pan.



CAUTION:
Be careful not to damage the mating surfaces.

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

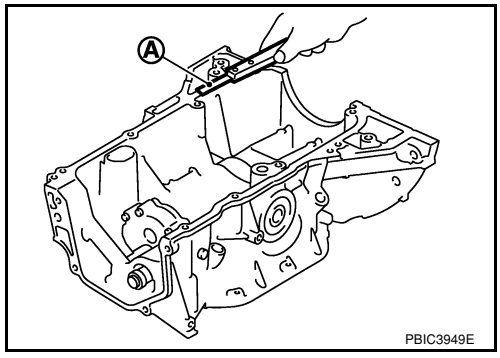
INSPECTION AFTER REMOVAL

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.



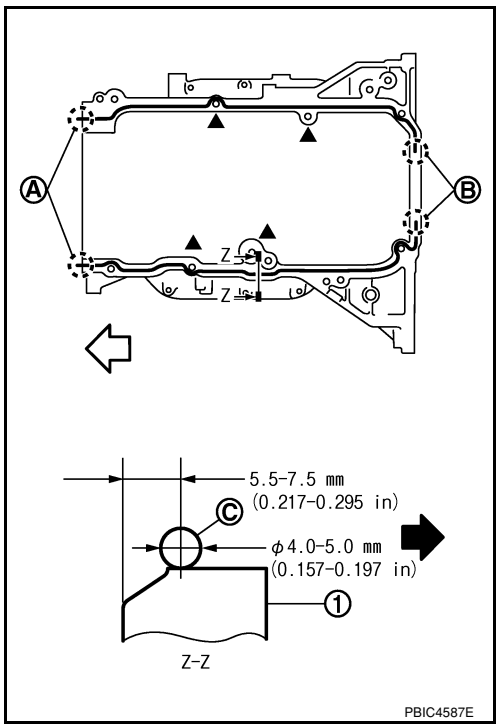
CAUTION:
Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

2. Apply the sealant without breaks to the specified location using Tool.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "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
⇦ : Engine front
⬅ : Engine outside

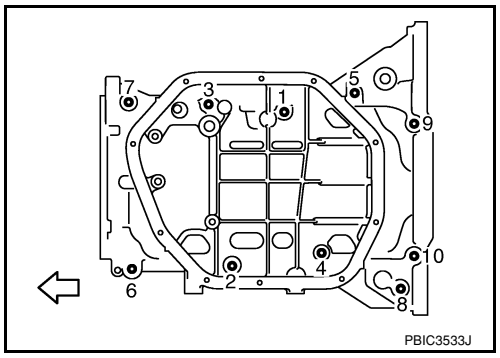
CAUTION:
Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.



3. Install new O-ring at cylinder block side.
CAUTION:
Install avoiding misalignment of O-ring.

4. Tighten bolts in numerical order as shown.

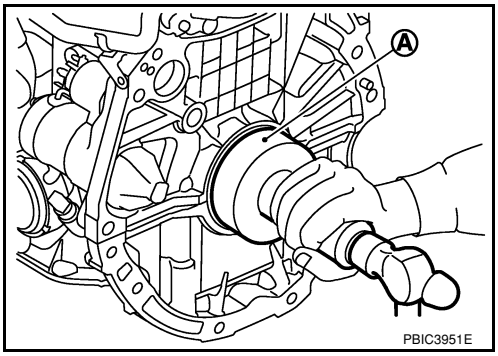
⇦ : Engine front



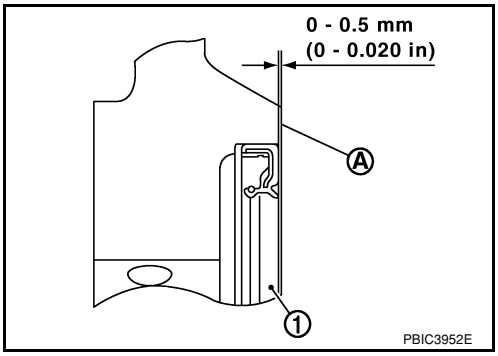
5. Install rear oil seal with the following procedure.
CAUTION:
- **The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).**
- **Always replace rear oil seal with new one.**
- **Never touch oil seal lip.**

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) (commercial service tool).



- Press-fit to the specified dimensions as shown.

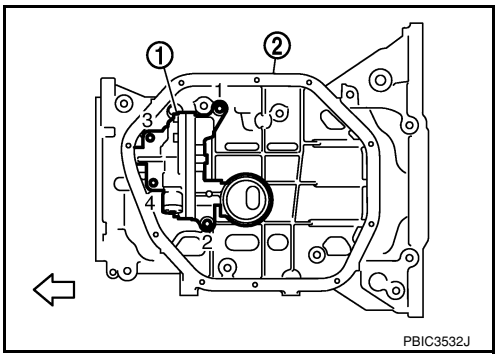


1 : Rear oil seal
A : Cylinder block rear end surface

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.

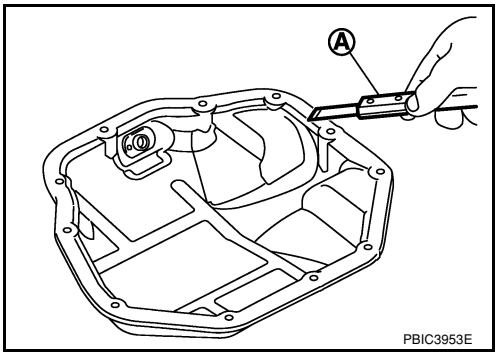
6. Install oil pump.
- Tighten bolts in numerical order as shown.



1 : Oil pump
2 : Oil pan (upper)
⇦ : Engine front

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

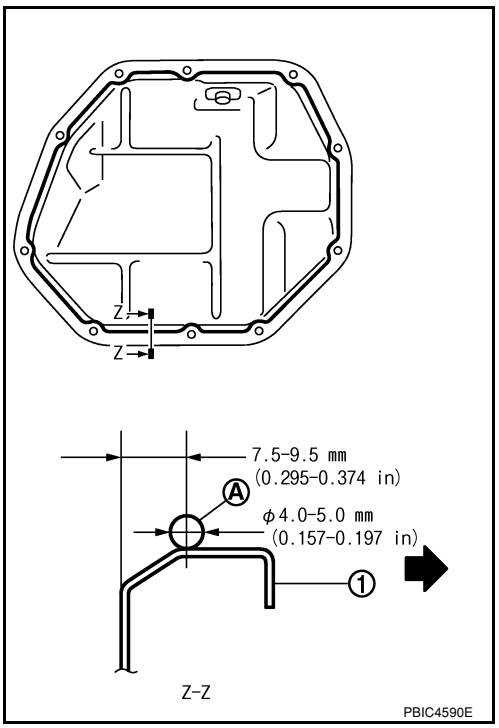
8. Use a scraper (A) to remove old liquid gasket from mating surfaces.
- Also remove old liquid gasket from mating surface of oil pan (upper).
- Remove old liquid gasket from the bolt holes and threads.



9. Apply the sealant without breaks to the specified location using Tool.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".

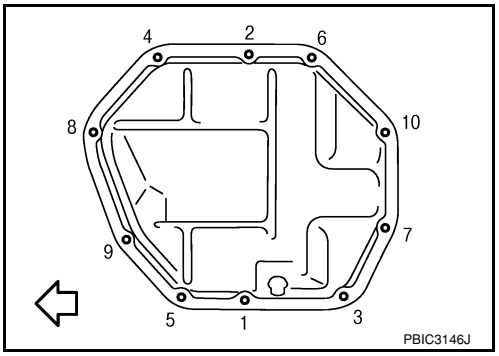
Tool number WS39930000 (–)

1 : Oil pan (lower)
⬅ : Engine outside



10. Tighten bolts in numerical order as shown.

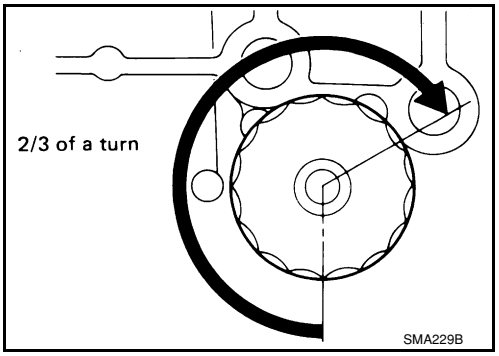
⇦ : Engine front



11. 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)

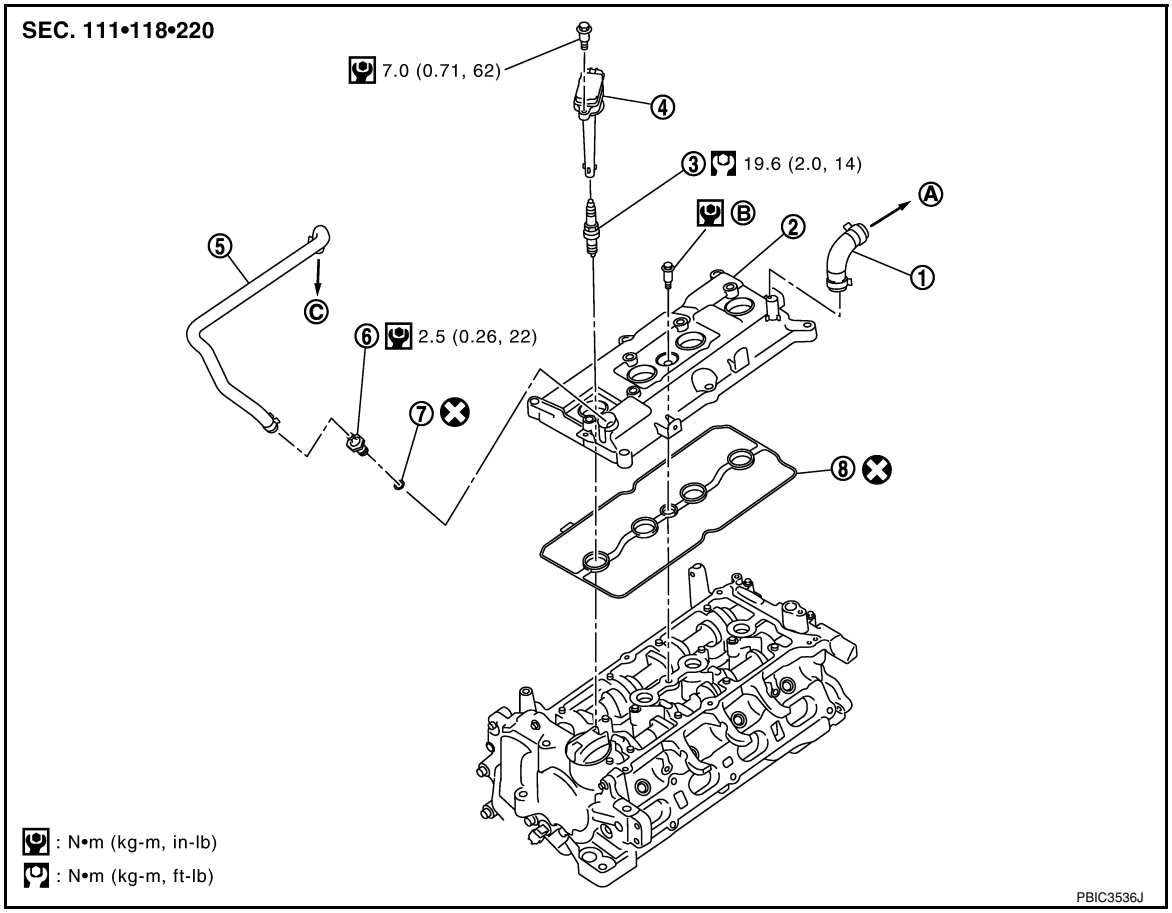


12. Installation of the remaining components is in the reverse order of removal.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Component

INFOID:0000000001702489



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-30.
C. To intake manifold

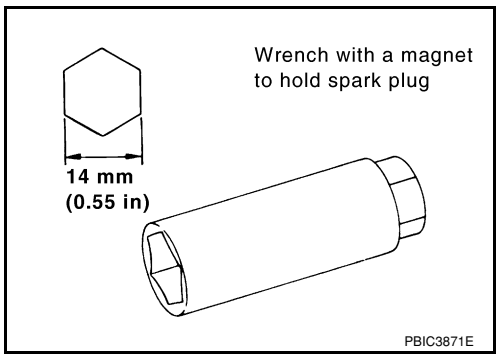
Removal and Installation

INFOID:0000000001702490

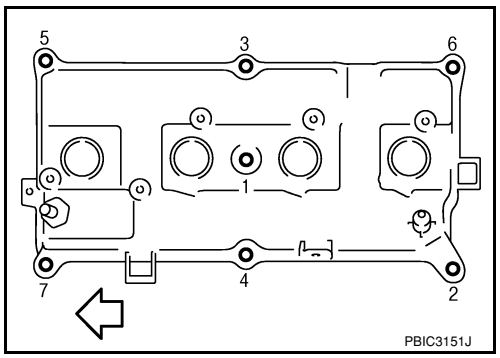
REMOVAL

1. Remove intake manifold. Refer to EM-18.
2. Remove ignition coil.
   CAUTION:
   - **Handle it carefully and avoid impacts.**
   - **Never disassemble.**

3. Remove spark plug using suitable tool.
CAUTION:
Never drop or shock it.

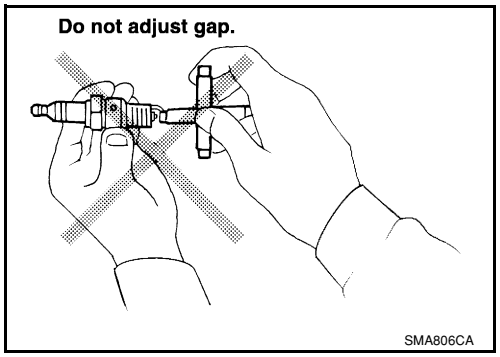


4. Remove rocker cover.
- Loosen bolts in reverse order as shown.
- ⇦ Engine front



INSPECTION AFTER REMOVAL

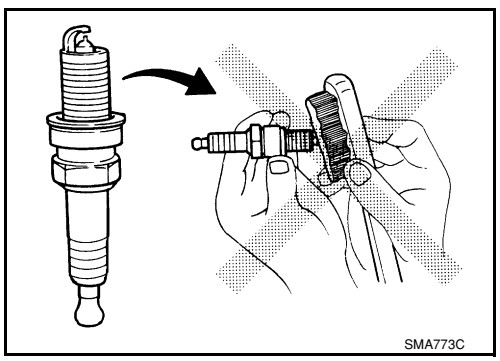
CAUTION:
- **Never drop or shock spark plug.**
- **Checking and adjusting spark plug gap is not required between change intervals.**



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

Cleaner air pressure	**: Less than 588 kPa (5.88 bar, 6 kg/cm^2, 85 psi)**
Cleaning time	**: Less than 20 seconds**

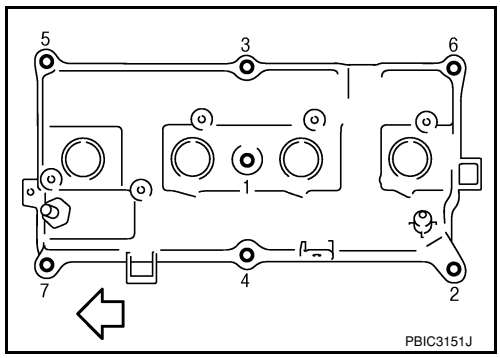
- **Never use wire brush for cleaning spark plug.**



INSTALLATION

1. Install rocker cover gasket to rocker cover.

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

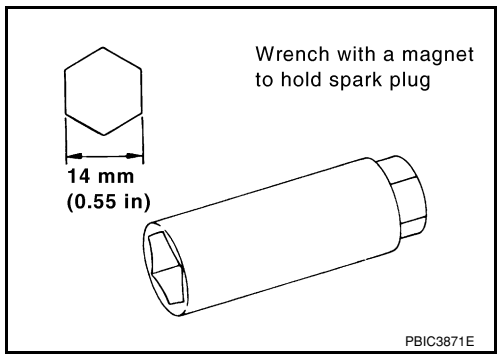


   1st step : 1.96 N·m (0.20 kg-m, 17 in-lb)
   2nd step : 8.33 N·m (0.85 kg-m, 73 in-lb)

   - ⇦ Engine front

   CAUTION:
   Check if rocker cover gasket is not dropped from the installation groove of rocker cover.

3. Install spark plug using suitable tool.



   Plug type : Iridium tipped
   Make : DENSO
   Part number : FXE20HR11
   Gap (nominal) : 1.1 mm (0.043 in)

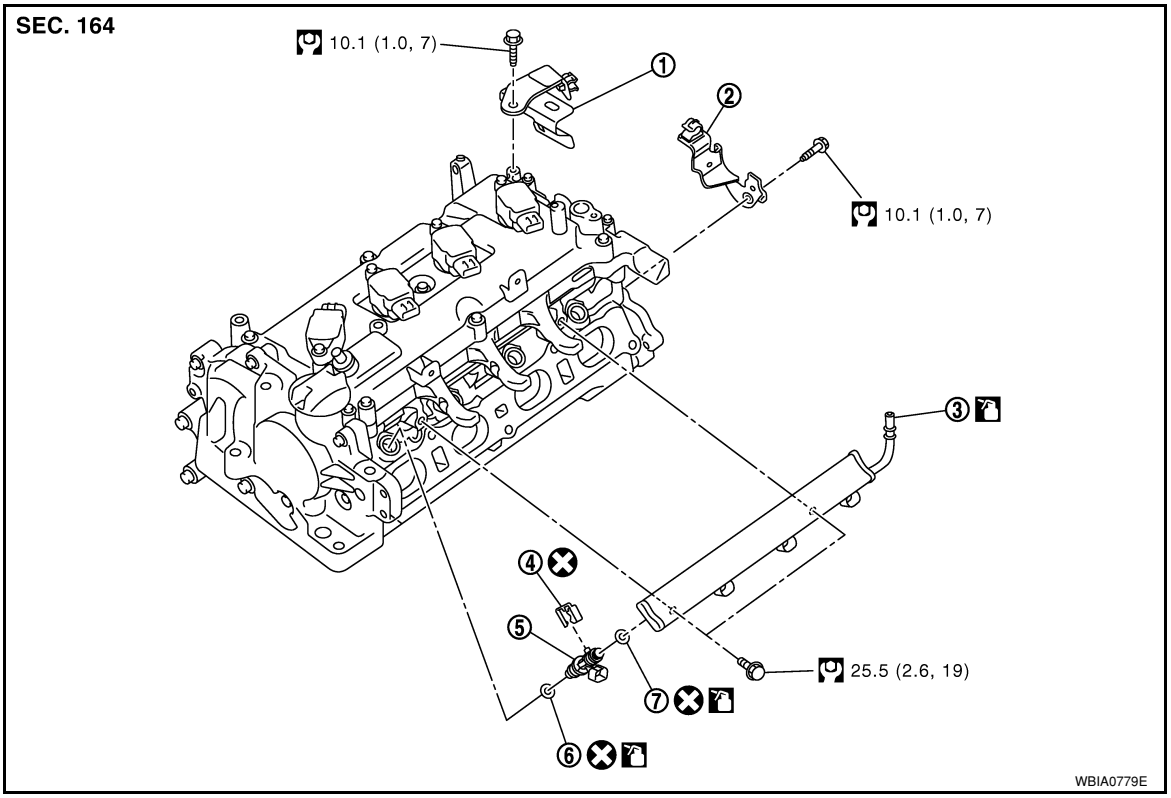
   CAUTION:
   Never drop or shock it.

4. Install ignition coil.
   CAUTION:
   - **Handle it carefully and avoid impacts.**
   - **Never disassemble.**
5. Install intake manifold. Refer to EM-18.

FUEL INJECTOR AND FUEL TUBE

Component

INFOID:0000000001702491



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

Removal and Installation

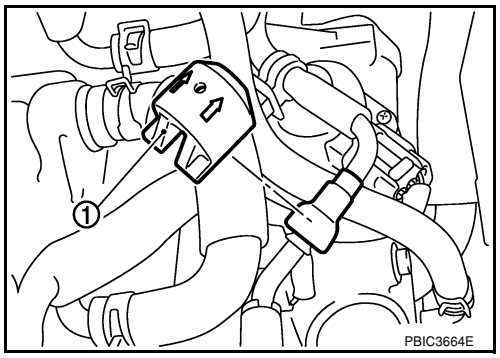
INFOID:0000000001702492

REMOVAL

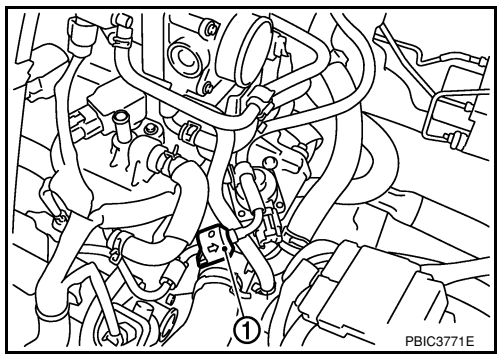
WARNING:

- **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. Release the fuel pressure. Refer to EC-78, "Fuel Pressure Check".
2. Remove quick connector cap (1) from quick connector connection.



3. Disconnect fuel feed hose from hose clamp.



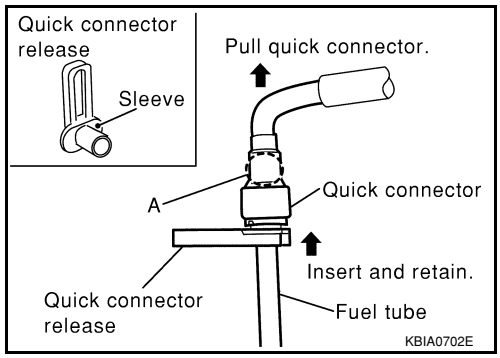
1 : Quick connector cap

NOTE:
There is no fuel return path.

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

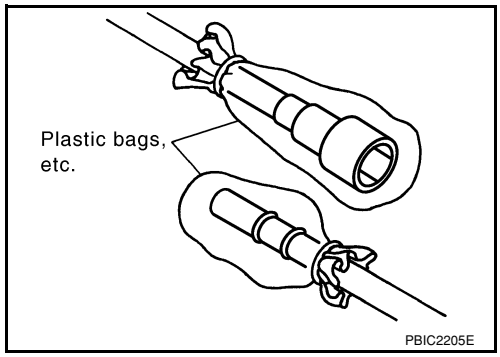
5. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

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



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

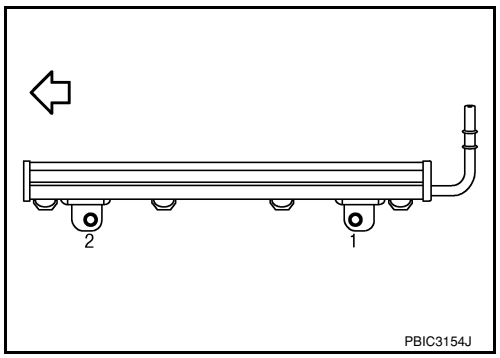
CAUTION:
- **Pull quick connector holding "A" position.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful 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.**



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

8. Remove fuel tube.
   • Loosen bolts in reverse order as shown.

   ⇦ : Engine front



9. 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.**
10. 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. Note the following, and install O-rings to fuel injector.
   CAUTION:
   • **Upper and lower O-rings are different. Be careful not to confuse them.**

Fuel tube side	: Black
Nozzle side	: Green

   • **Handle O-ring with bare hands. Never wear gloves.**
   • **Lubricate O-ring with new engine oil.**
   • **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 it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, never insert it quickly into fuel tube.**
   • **Insert O-ring straight into fuel tube. Never twist it.**

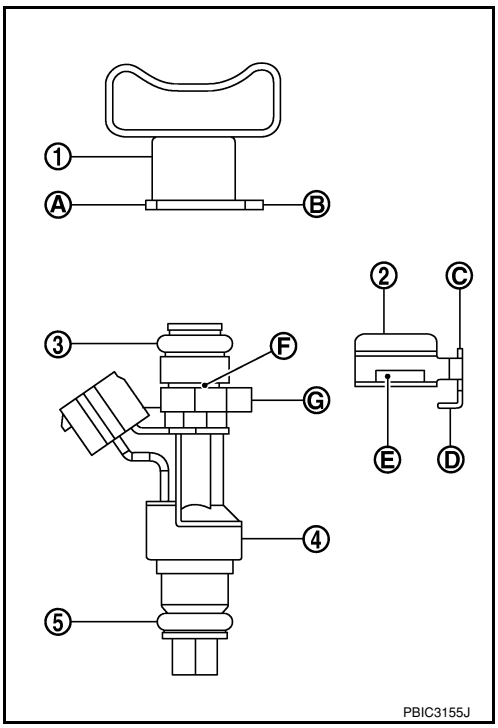
2. Install fuel injector (4) to fuel tube (1) with the following procedure:

   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:
   • **Never reuse clip. Replace it with a new one.**
   • **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**

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

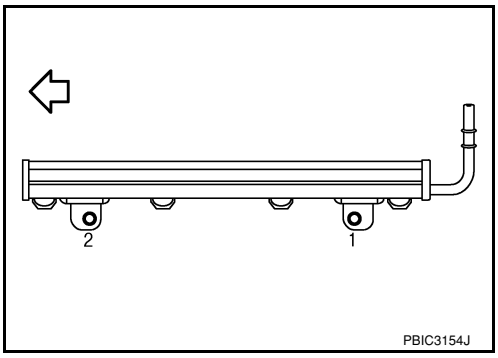
c. Make sure that installation is complete by making sure that fuel injector does not rotate or come off.



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

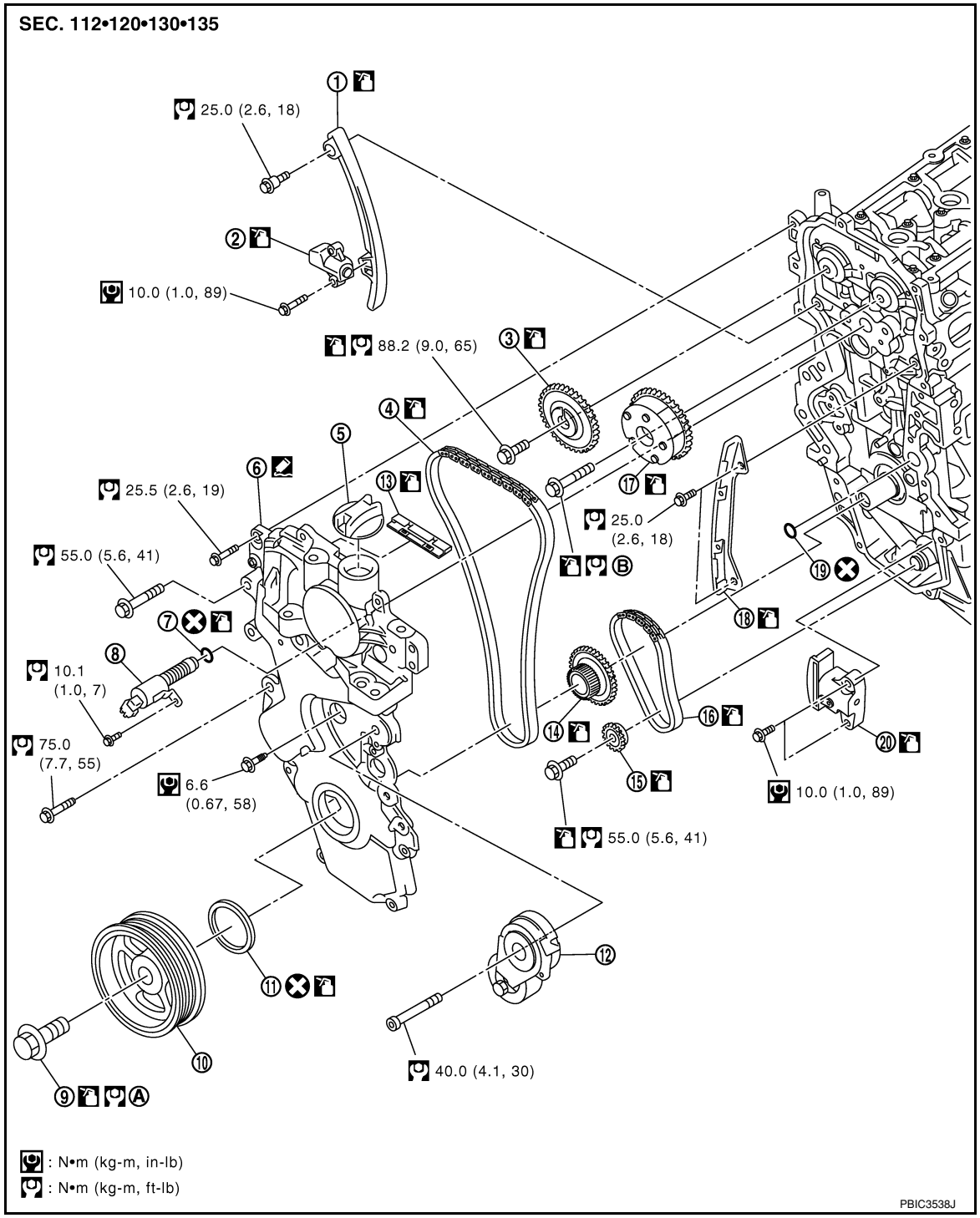


5. Installation of the remaining components is in the reverse order of removal.

TIMING CHAIN

Component

INFOID:0000000001702493



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-38
B. Refer to EM-47

Removal and Installation

INFOID:0000000001844926

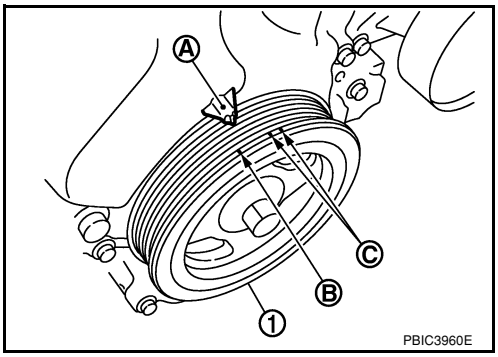
CAUTION:
The rotating direction indicated in the text indicates all directions seen from the engine front.

REMOVAL

1. Remove front RH wheel. Refer to WT-6, "Rotation".
2. Remove front fender protector (RH). Refer to EI-23, "Removal and Installation".
3. Drain engine oil. Refer to LU-7, "Changing Engine Oil".
   NOTE:
   Perform this step when engine is cold.
4. Remove the following parts.
   - Rocker cover: Refer to EM-30, "Component".
   - Drive belt: Refer to EM-13, "Removal and Installation".
   - Water pump pulley: Refer to CO-16, "Component".
   - Ground cable (between engine bracket (RH) and radiator core support)
5. Support the bottom surface of engine using a transmission jack, and then remove the engine bracket and insulator (RH). Refer to EM-72, "Component".
6. 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.

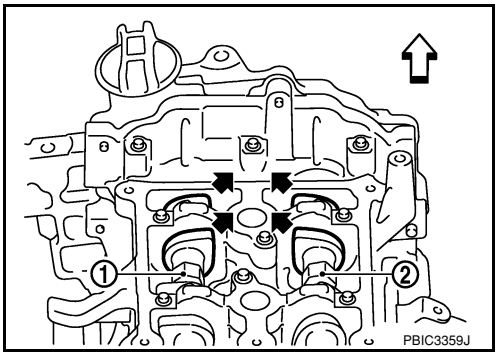
C : White paint mark (Not use for service)



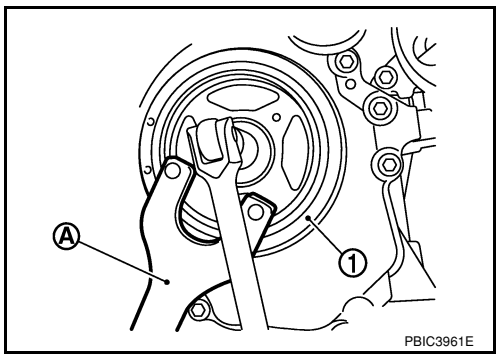
b. At the same time, make sure that the cam noses of the No.1 cylinder are located (⬅) as shown.

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

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

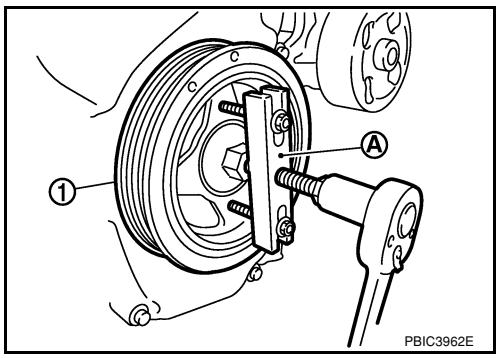


7. Hold crankshaft pulley (1) using suitable tool (A) loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.
CAUTION:
Never remove the crankshaft pulley bolt as it will be used as a supporting point for the pulley puller.

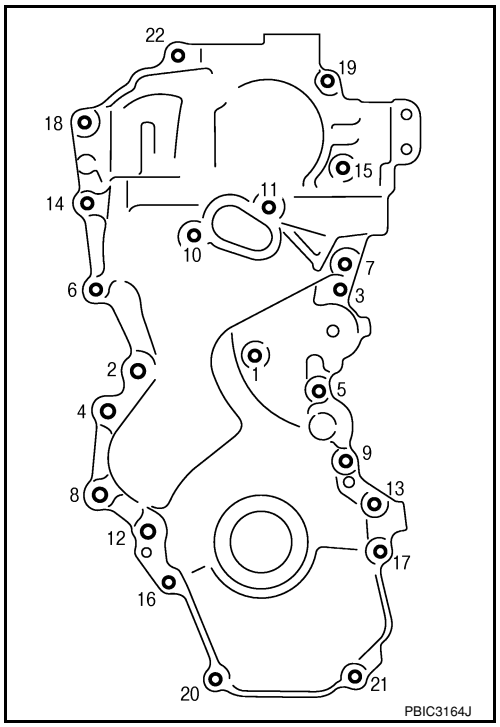


8. Attach a pulley puller (A) in the M6 thread hole on crankshaft pulley (1), and remove crankshaft pulley.

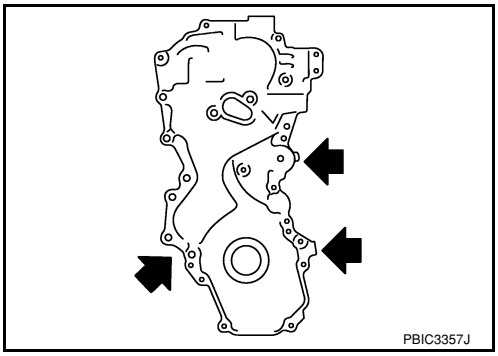
Tool number : KV11103000 (—)



9. Remove oil pan (lower). Refer to EM-24, "Component".
NOTE:
When crankshaft sprocket, oil pump sprocket and other related parts are not removed, this step is unnecessary.
10. Remove intake valve timing control solenoid valve.
11. Remove drive belt auto-tensioner.
12. Loosen bolts in reverse order as shown.

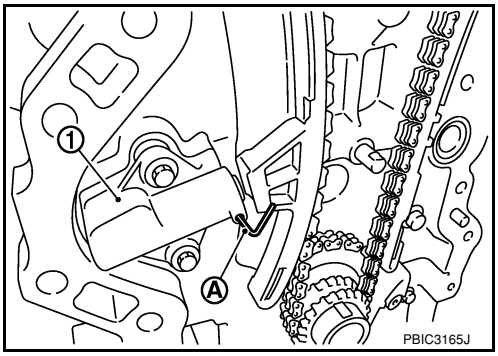


13. Cut liquid gasket by prying the position (⬅) shown, and then remove the front cover.
    CAUTION:
    - **Be careful not to damage the mating surface.**
    - **A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.**

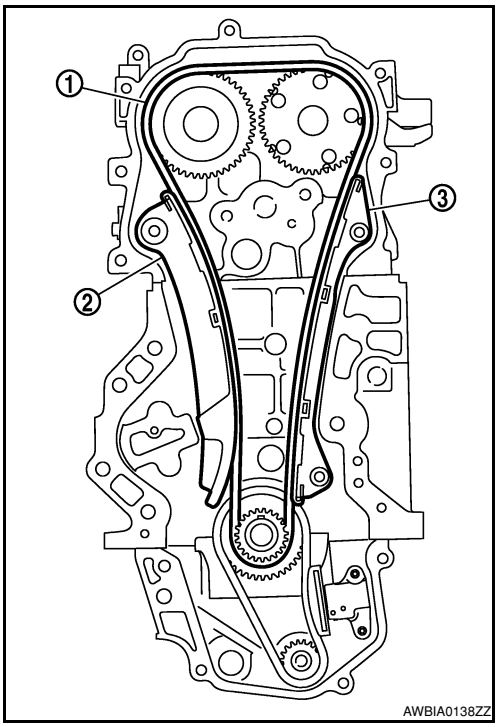


14. Remove front oil seal from front cover.
    - Lift up front oil seal using a suitable tool.

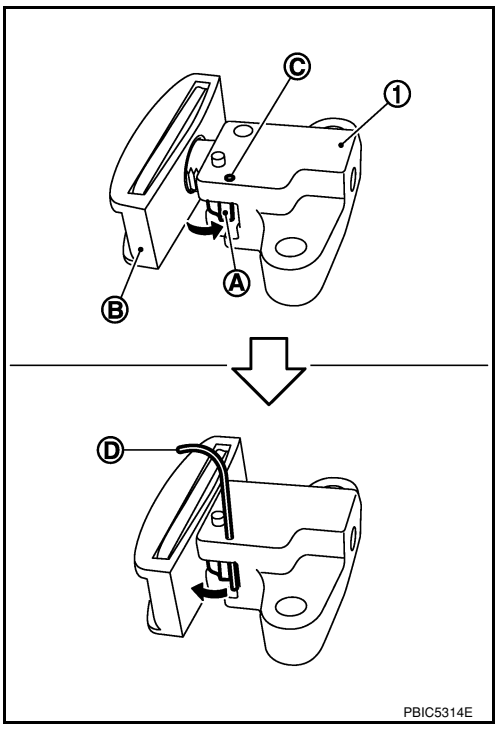
    CAUTION:
    Be careful not to damage front cover.
15. Push in timing chain tensioner plunger.
16. Insert a stopper pin (A) into the body hole to retain the plunger in collapsed position.
    NOTE:
    Use approximately 1.5 mm (0.059 in) diameter. hard metal pin as a stopper pin.
17. Remove timing chain tensioner (1).



18. 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.



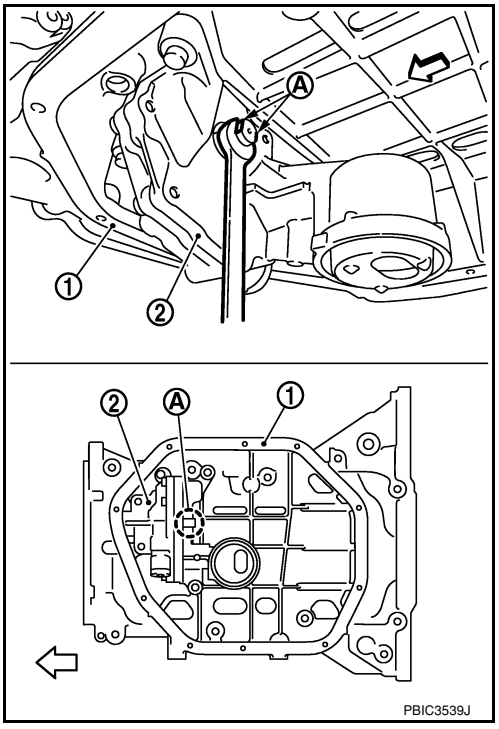
19. Press stopper tab (A) in the direction shown to push the timing chain slack guide (B) toward timing chain tensioner (for oil pump) (1).
    - The slack guide (B) is released by pressing the stopper tab (A). As a result, the slack guide (B) can be moved.
20. Insert stopper pin (D) into tensioner body 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.
21. Remove timing chain tensioner (for oil pump).



22. Hold the WAF part of oil pump shaft (A), and then loosen the oil pump sprocket bolt and remove them.

    1 : Oil pan (upper)
    2 : Oil pump
    ⇦ : Engine front

    CAUTION:
    - **Secure the oil pump shaft with the WAF part.**
    - **Never loosen the oil pump sprocket bolt by tightening the oil pump drive chain.**

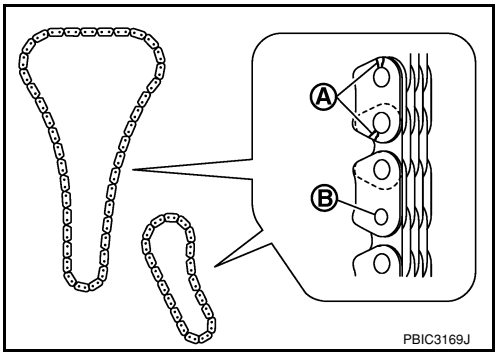


23. Remove crankshaft sprocket, oil pump sprocket and oil pump drive chain as a set.
24. Remove timing chain tension guide (front cover side) from front cover if necessary.

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.

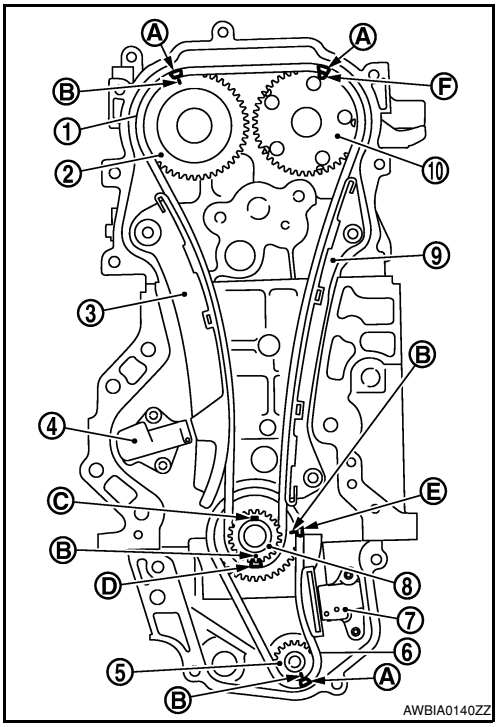


INSTALLATION

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 are aligned.



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 (gold link)
E : Matching mark (orange link)
F : Matching mark (outer groove*)

NOTE:

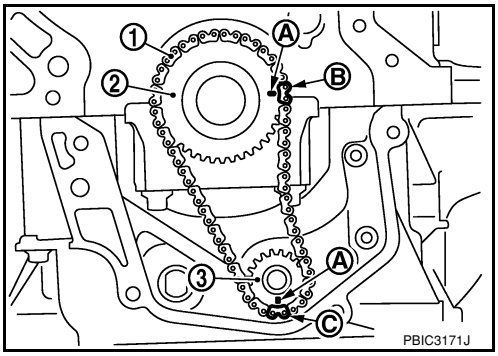
*: There are two outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

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.

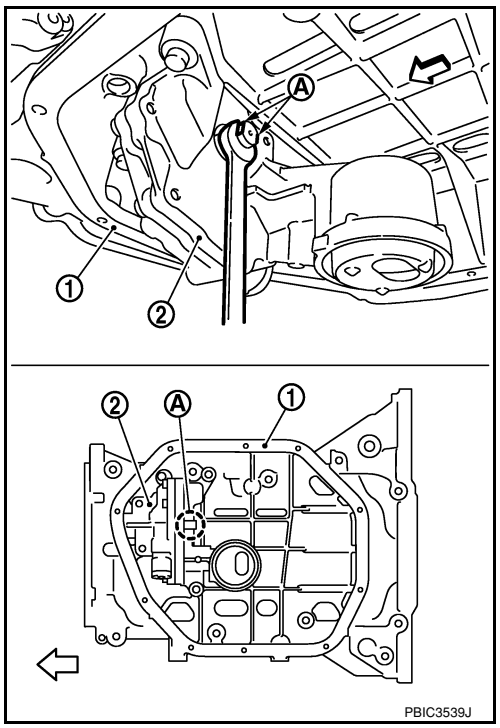
CAUTION:

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

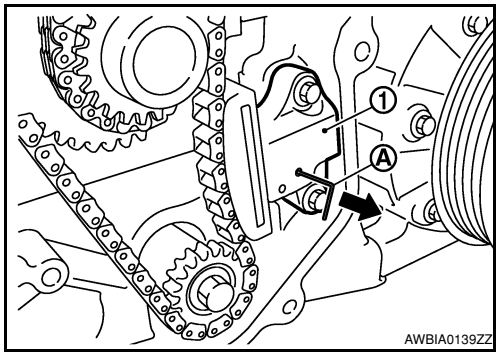
4. Hold the WAF part of oil pump shaft (A), and then tighten the oil pump sprocket bolt.

1 : Oil pan (upper)
2 : Oil pump
⇦ : Engine front

CAUTION:
- **Secure the oil pump shaft with the WAF part.**
- **Never loosen the oil pump sprocket bolt by tightening the oil pump drive chain.**



5. Install chain tensioner (for oil pump) (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 chain tensioner (for oil pump).
   3. Check matching mark position of oil pump drive chain and each sprocket again.

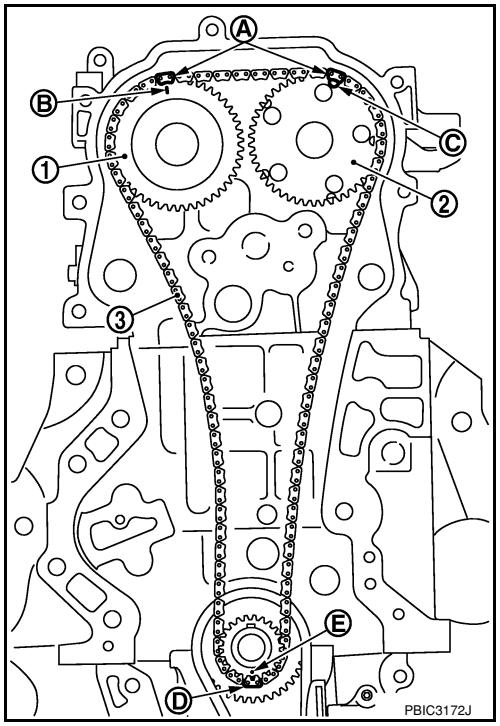


6. Align the matching marks of each sprocket with the matching marks of timing chain.

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 (gold link)
E : Matching mark (stamping)

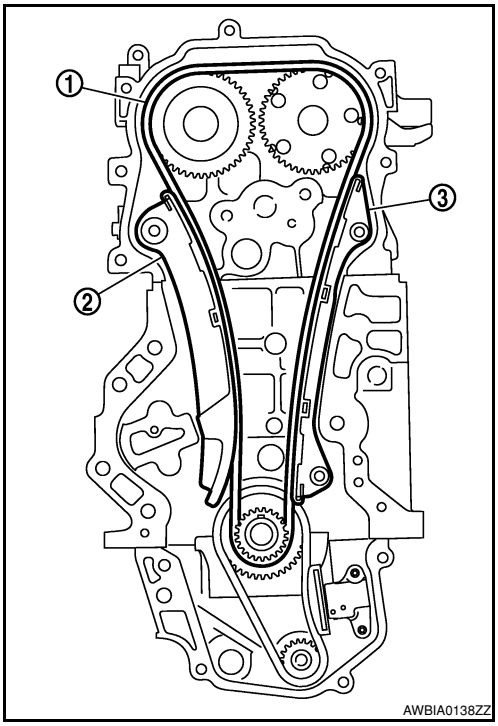
NOTE:
*: There are 2 outer grooves in camshaft sprocket (INT). The wider one is a matching mark.
- If these matching marks are not aligned, rotate the camshaft slightly by holding the hexagonal portion to correct the position.

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

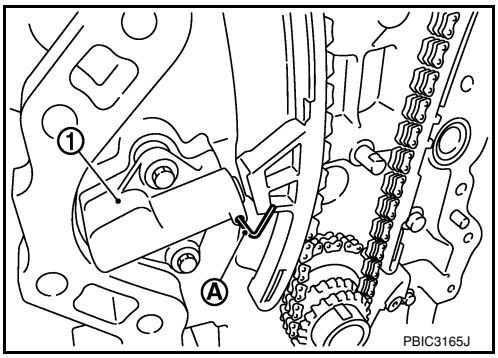


7. Install the timing chain tension guide (3) and the timing chain slack guide (2).

1 : Timing chain

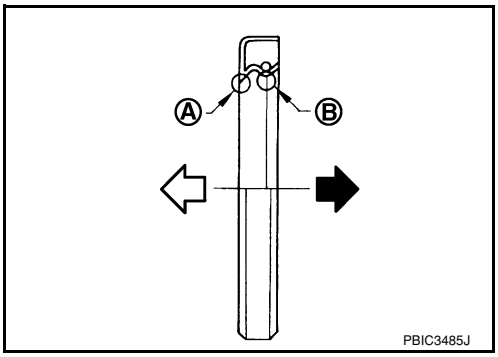


8. Install timing chain tensioner (1).
   1. Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
   2. Securely pull out the stopper pin after installing the timing chain tensioner.



9. Check matching mark position of timing chain and each sprocket again.
10. Apply new engine oil to new front oil seal joint surface.
11. 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.**

12. Install new O-ring to cylinder block.
CAUTION:

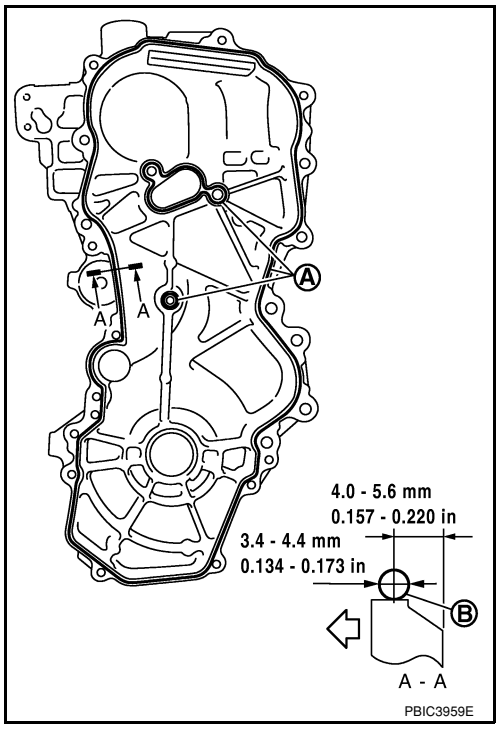
Be sure O-rings a aligned properly.

13. Apply the sealant without breaks to the specified location using Tool.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".

Tool number WS39930000 (–)

A : Liquid gasket application area

⇦ : Engine outside

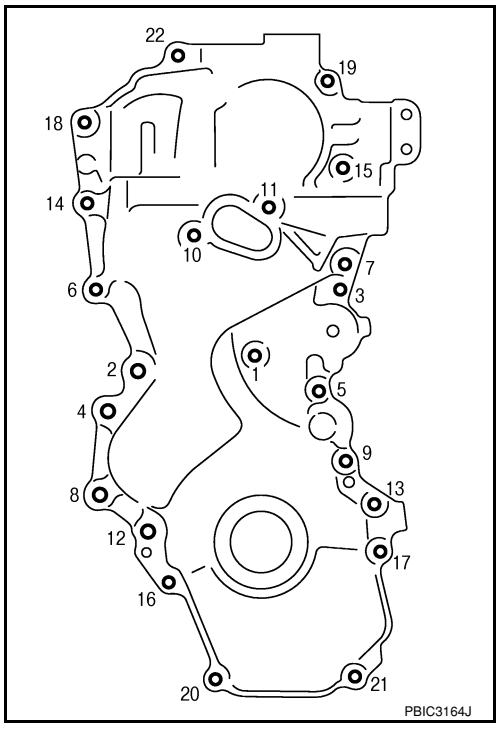


14. Make sure that matching marks of timing chain and each sprocket are still aligned.
CAUTION:
- **Make sure O-ring on cylinder block is correctly installed.**
- **Be careful not to damage front oil seal by interference with front end of crankshaft.**

15. Install front cover, and tighten bolts in numerical order as shown.
CAUTION:
Attaching should be done within 5 minutes after liquid gasket application.
NOTE:
Installation position of bolts is as shown.

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

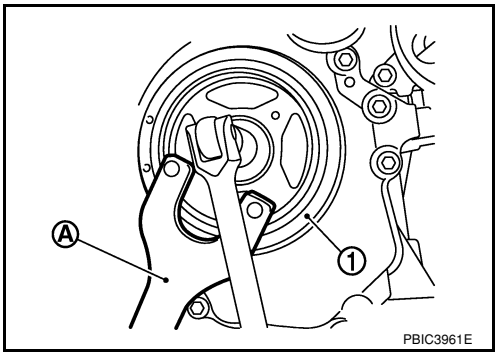
16. Tighten all bolts are in two stages to specified torque in numerical order as shown.
CAUTION:
Be sure to wipe off any excessive liquid gasket leaking.



17. 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.**

18. Secure crankshaft pulley (1) using Tool (A).

Tool Number (A) : KV10109300 (—)

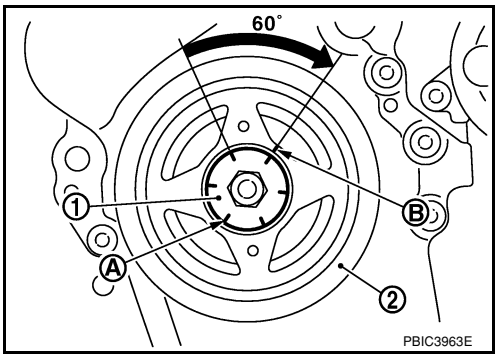


19. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
20. Tighten crankshaft pulley bolt in three steps.

Step 1 : 68.6 N·m (7.0 kg-m, 51 ft-lb)
Step 2 : 0 N·m (0 kg-m, 0 ft-lb)
Step 3 : 29.4 N·m (3.0 kg-m, 22 ft-lb)

21. 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 flange (1).
22. Turn another 60 degrees clockwise (angle tightening) using Tool.
    • Check the tightening angle with movement of one angle mark.

Tool number : KV10112100 (BT-8653-A)

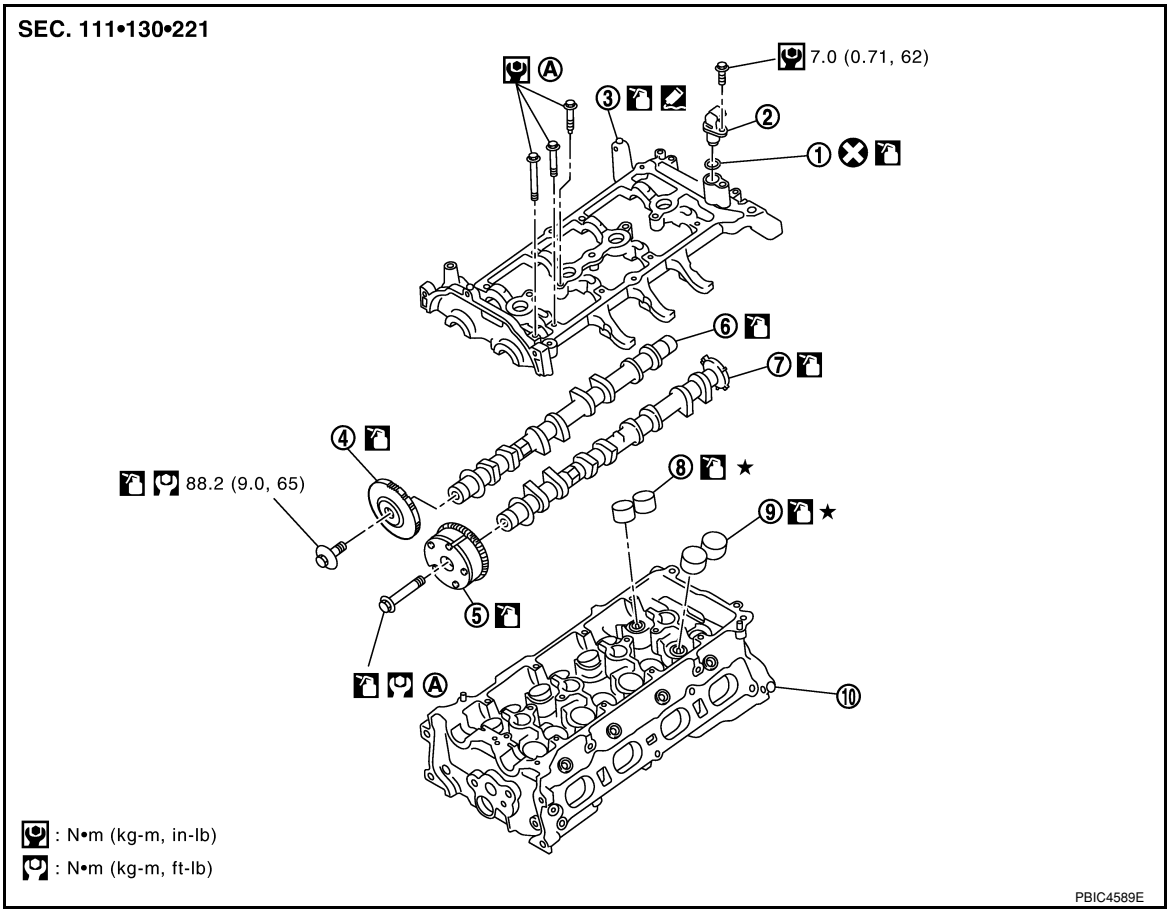


23. Make sure that crankshaft rotates clockwise smoothly.
24. Installation of the remaining components is in the reverse order of removal.

CAMSHAFT

Component

INFOID:0000000001702495



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-47.

Removal and Installation

INFOID:0000000001702496

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. Release the fuel pressure. Refer to EC-78, "Fuel Pressure Check".
2. Disconnect negative battery cable. Refer to SC-6, "Removal and Installation".
3. Remove front RH wheel. Refer to WT-6.
4. Remove front fender protector (RH). Refer to EI-23.
5. Drain engine coolant. Refer to CO-8.
   NOTE:
   Perform this step when engine is cold.
6. Remove the following parts.
   - Intake manifold; Refer to EM-18.
   - Rocker cover; Refer to EM-30.

- Fuel tube and fuel injector assembly; Refer to EM-33.
- Front cover, timing chain and related parts; Refer to EM-37.

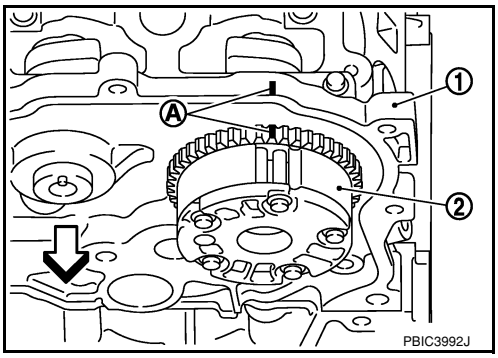
7. Remove camshaft position sensor (PHASE) from camshaft bracket.

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.

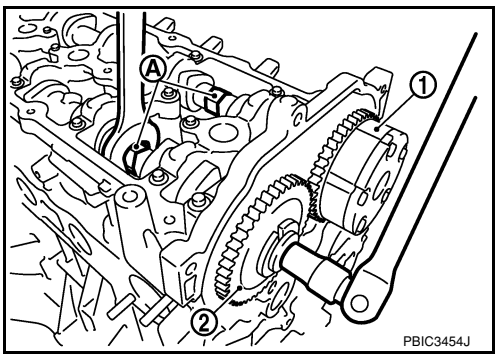
⇦ : Engine front

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



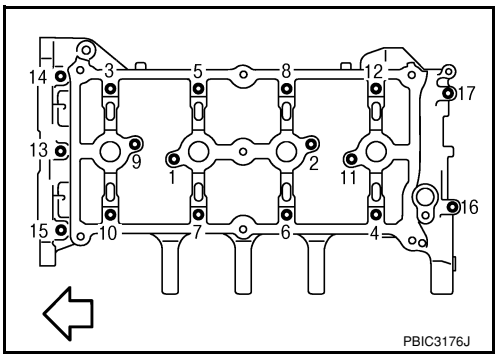
9. Remove camshaft sprockets (INT) (1) and (EXH) (2).
- Secure hexagonal part (A) of camshaft with a wrench. Loosen camshaft sprocket bolts and remove camshaft sprocket.

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.

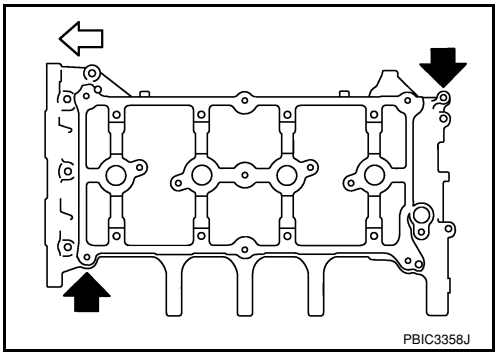
⇦ : Engine front



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.**
- **A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.**



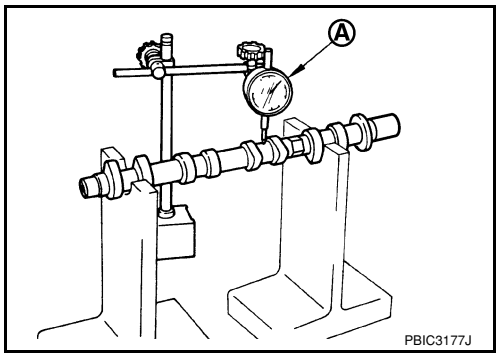
12. Remove camshafts.

13. Remove valve lifters.
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)

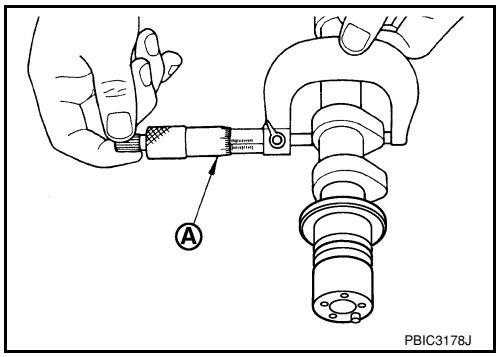


Standard : Less than 0.02 mm (0.0008 in).
Limit : 0.05 mm (0.0020 in)

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)

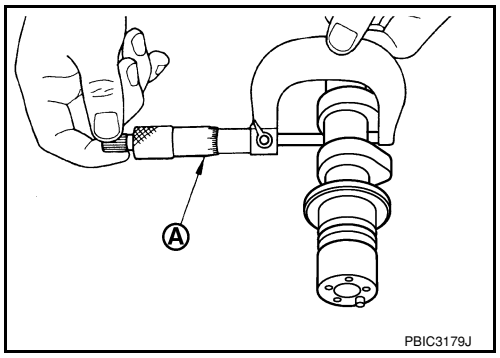
Limit:
Intake : 44.405 mm (1.7482 in)
Exhaust : 42.975 mm (1.6919 in)

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).



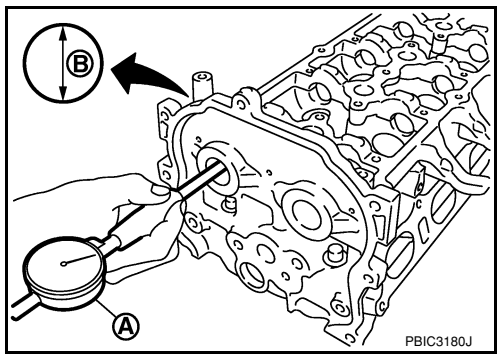
Standard:
No. 1 : 27.935 - 27.955 mm (1.0998 - 1.1006 in)
No. 2, 3, 4, 5 : 24.950 - 24.970 mm (0.9823 - 0.9831 in)

CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque.

- 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)

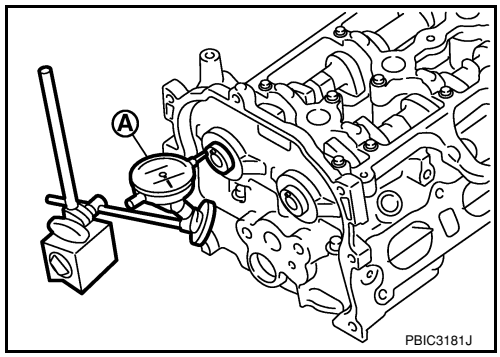
- If it exceeds the limit, replace camshaft or cylinder head, or both.

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.
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)

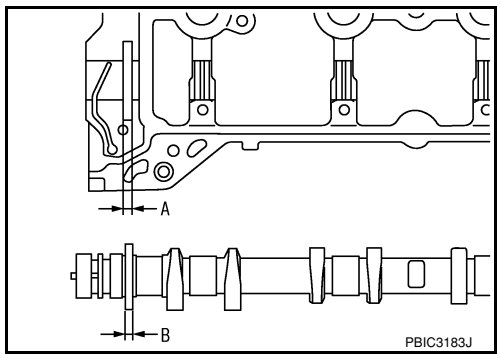
- Measure the following parts if out of the standard.
  - Dimension “A” for groove of cylinder head No. 1 journal

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)

- Apply the standards above, and then replace camshaft and/or cylinder head, if necessary.



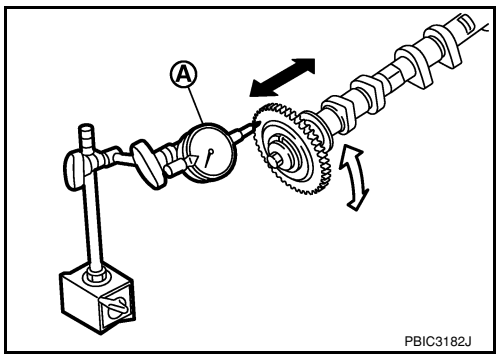
Camshaft Sprocket Runout

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)



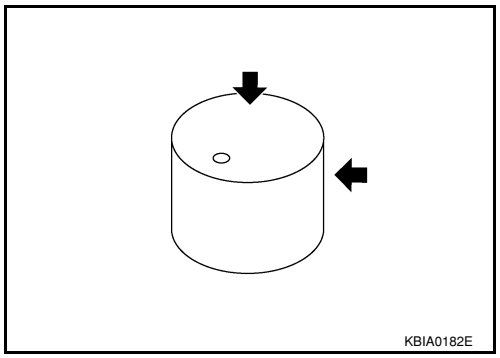
Limit : 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.

Valve Lifter

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

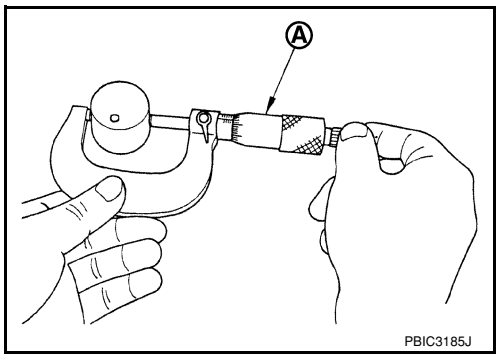
- If anything above is found, replace valve lifter. Refer to EM-55, "Valve Clearance".



Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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



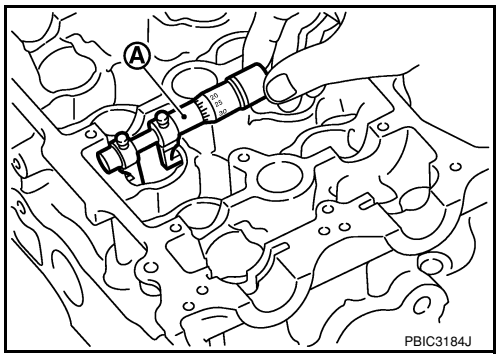
Standard:

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)

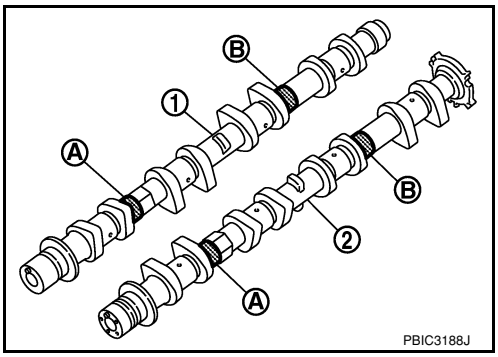
- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

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)

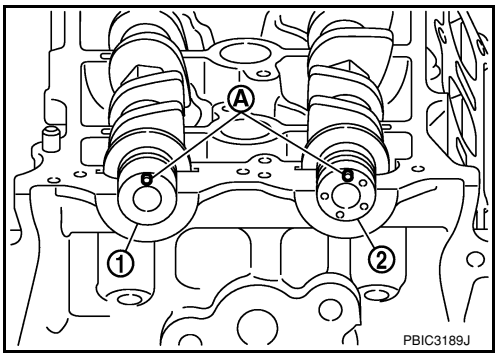


Identification color	A	B
Camshaft (EXH)	—	Yellow
Camshaft (INT)	Yellow	—

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

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

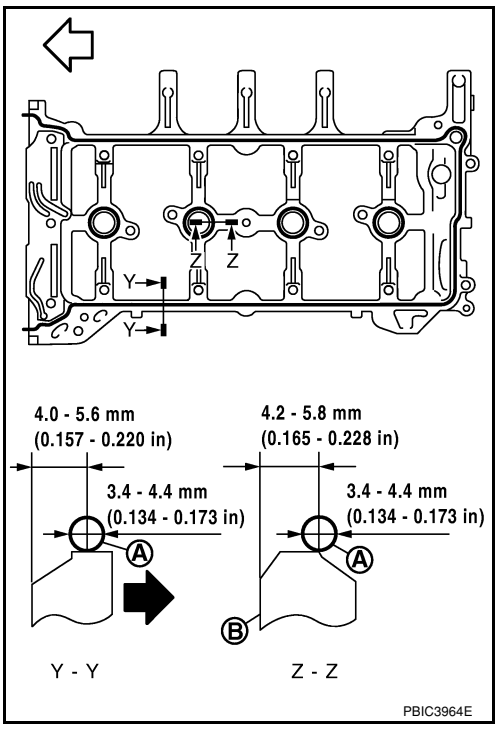
NOTE:
Though camshaft does not stop at the positions as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction as shown.



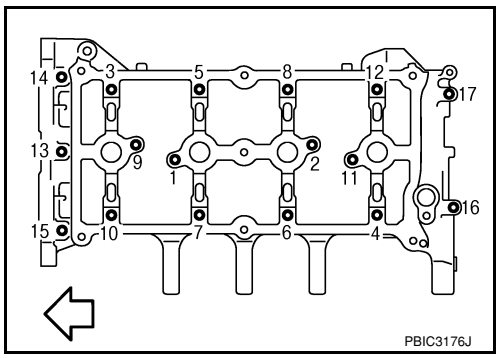
3. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
4. Apply liquid gasket (A) to camshaft bracket as shown.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".

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

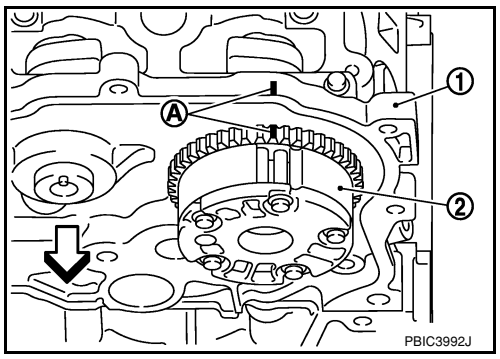
- There are two types of bolts. Locate the bolts as shown.

M6 bolts [thread length: 57.5 mm (2.264 in)]
: 13, 14 and 15 as shown
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 “3”. Securely align the knock pin and the pin hole, and then install them.



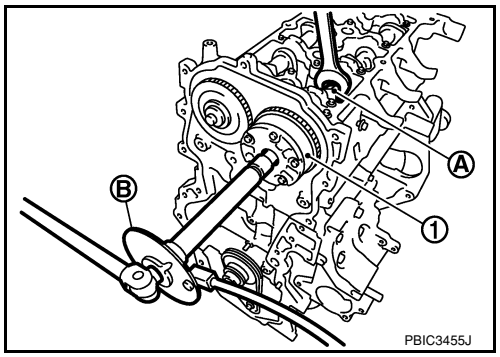
1 : Camshaft bracket
⇦ : Engine front

8. Tighten camshaft (INT) sprocket bolt.

Camshaft sprocket bolt (INT) : 35.0 N·m (3.6 kg-m, 26 ft-lb)

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

9. Turn 67 degrees clockwise (angle tightening) using Tool.

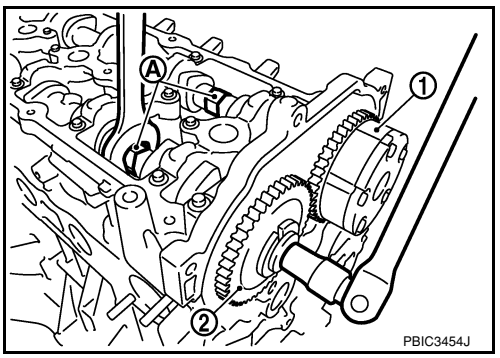


1 : Camshaft sprocket (INT)
A : Camshaft (INT) hexagonal part

CAUTION:
Never judge by visual inspection without an angle wrench.

Tool number : KV10112100 (BT-8653-A)

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



1 : Camshaft sprocket (INT)

Camshaft sprocket bolt (EXH) : 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.

11. Install timing chain and related parts. Refer to EM-37.
12. Inspect and adjust valve clearance. Refer to EM-55, "Valve Clearance".
13. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to GI-42, "Recommended Chemical Product and Sealant".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

  NOTE:
  If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

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

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

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:

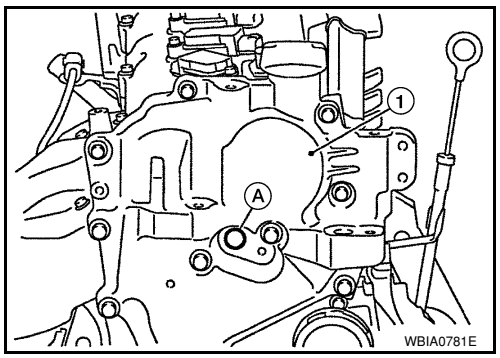
- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-III and it is directed according to inspection procedure of EC section. Refer to EC-46.**
- **Check when engine is cold so as to prevent burns from the splashing engine oil.**

1. Check engine oil level. Refer to LU-6, "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-18, "Component".
b. Disconnect ignition coil and injector harness connectors.

3. Remove intake valve timing control solenoid valve. Refer to EM-37, "Component".

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.) Refer to EM-72, "Component".
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-76, "Component".
   • Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to LU-5.
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.
9. Installation of the remaining components is in the reverse order of removal

Valve Clearance

INFOID:0000000001702497

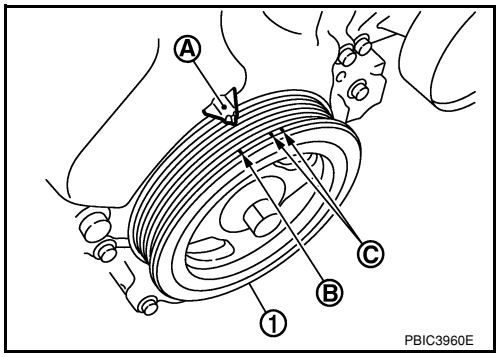
INSPECTION

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-30.
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.

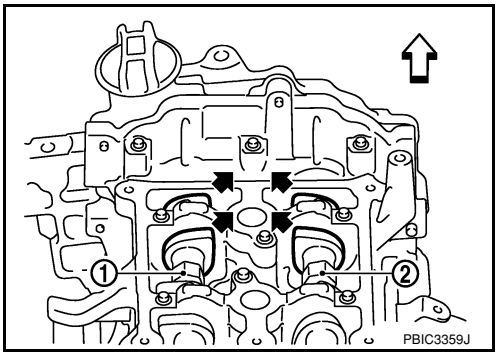
C : White paint mark (Not use for service)



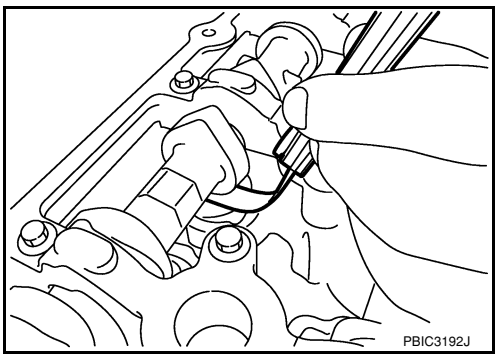
- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face inside (⬅) as shown.

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:

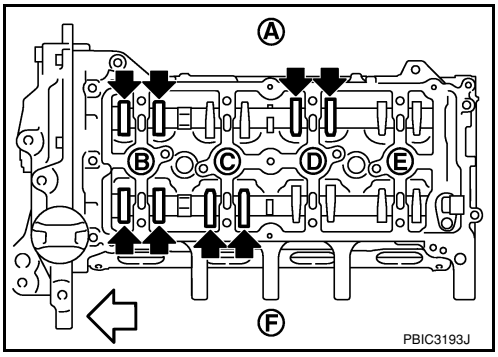
Unit: mm (in)

	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	×	×		

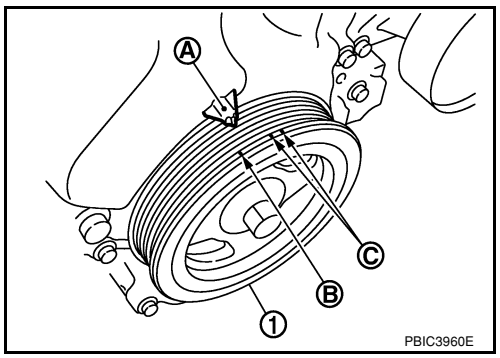


A : Exhaust side
B : No.1 cylinder
C : No.2 cylinder
D : No.3 cylinder
E : No.4 cylinder
F : Intake side
⇦ : Engine front

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

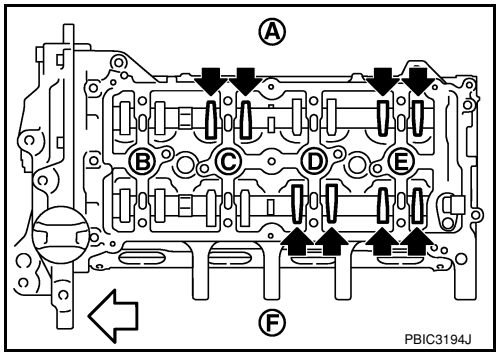
- Rotate crankshaft pulley (1) one revolution (360 degrees) and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

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			×	×



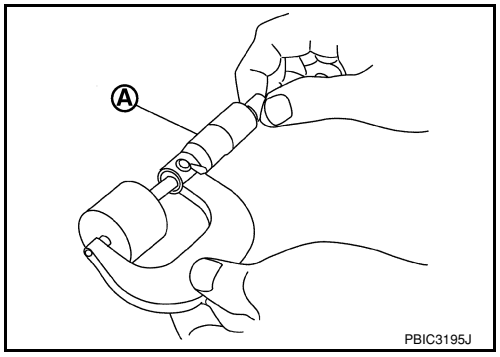
A : Exhaust side
B : No.1 cylinder
C : No.2 cylinder
D : No.3 cylinder
E : No.4 cylinder
F : Intake side
⇦ : Engine front

3. If out of standard, perform adjustment.

ADJUSTMENT

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

1. Remove camshaft. Refer to EM-47, "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).



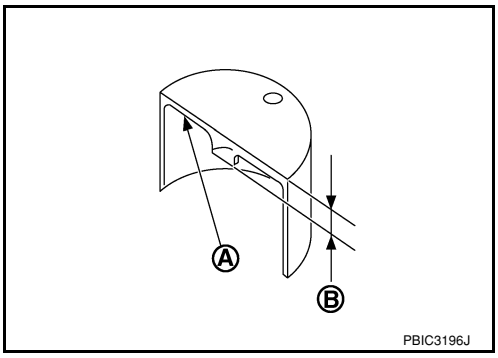
4. Use the equation below to calculate valve lifter thickness for replacement.

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-104, "Standard and Limit".

5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-47, "Removal and Installation".
7. Install timing chain and related parts. Refer to EM-37.
8. Manually rotate crankshaft pulley a few rotations.
9. Make sure that the valve clearances is within the standard.
10. Installation of the remaining components is in the reverse order of removal.

OIL SEAL

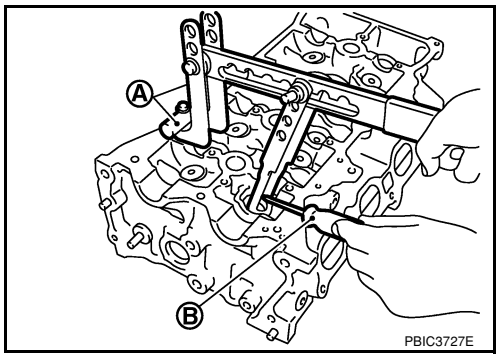
Removal and Installation of Valve Oil Seal

INFOID:0000000001702498

REMOVAL

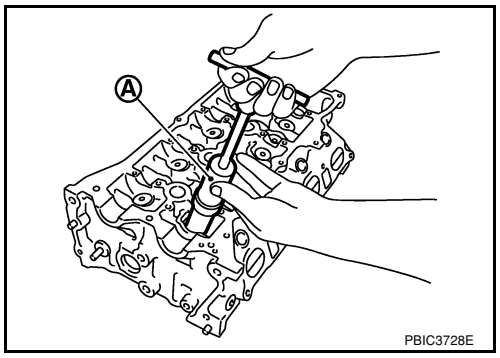
1. Remove camshafts. Refer to EM-47, "Component".
2. Remove valve lifters. Refer to EM-47.
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.
   CAUTION:
   When rotating crankshaft, be careful to avoid scarring front 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)

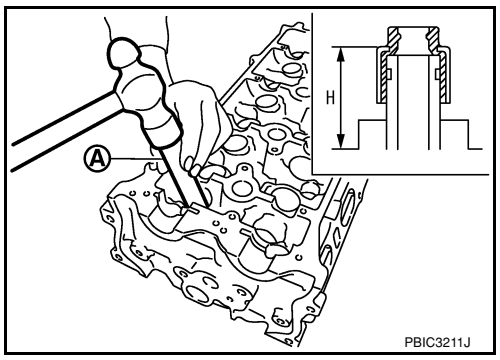


INSTALLATION

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 (—)



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

Removal and Installation of Front Oil Seal

INFOID:0000000001702499

REMOVAL

1. Remove the following parts.
   • Front fender protector (RH); Refer to EI-23.

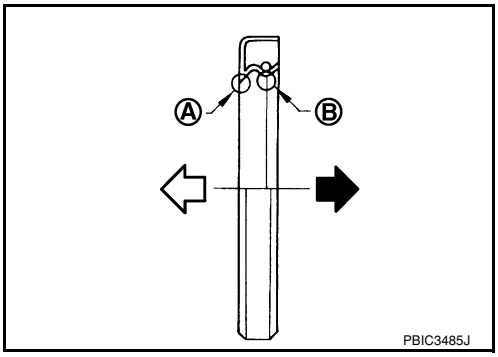
- Drive belt; Refer to EM-13, "Component".
- Crankshaft pulley; Refer to EM-37, "Component".

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.

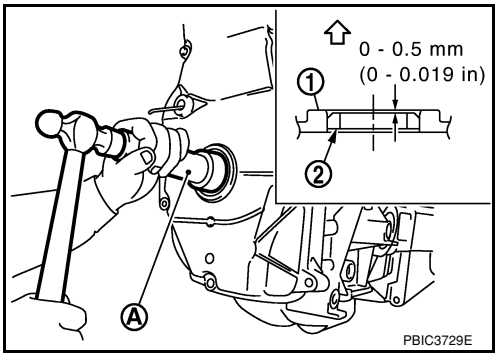
A : Dust seal lip
B : Oil seal lip
⇦ : Engine outside
⬅ : Engine inside



- 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.

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.**
- **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:0000000001702500

REMOVAL

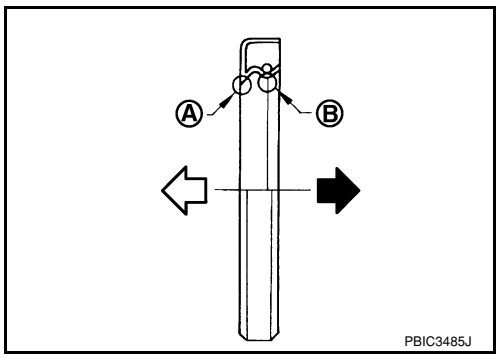
1. Remove transaxle assembly. Refer to MT-16 (M/T models), AT-226 (A/T models) or CVT-178 (CVT models).
2. Remove clutch cover and clutch disk (M/T models). Refer to CL-13.
3. Remove drive plate (A/T or CVT models) or flywheel (M/T models). Refer to EM-76, "Component".
4. Remove rear oil seal with a 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-42, "Recommended Chemical Product and Sealant".

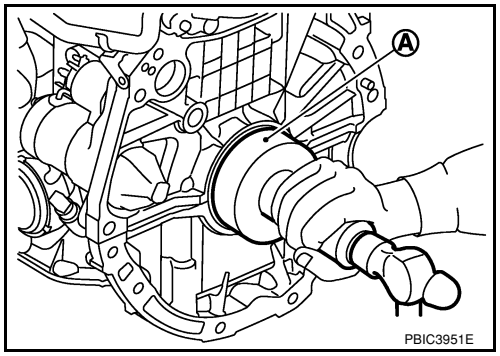
2. Install rear oil seal so that each seal lip is oriented as shown.

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).

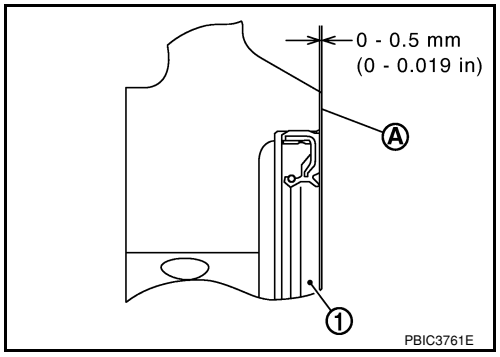
CAUTION:
- **Be careful not to damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Do not touch grease applied onto oil seal lip.**



- 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

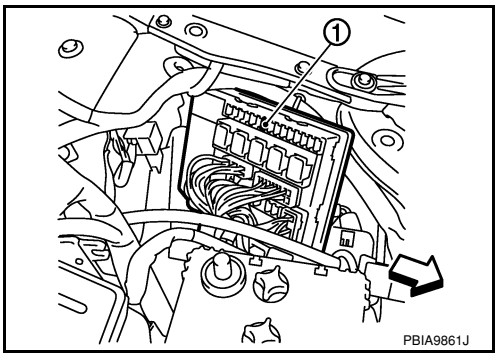
On-Vehicle Service

INFOID:0000000001702501

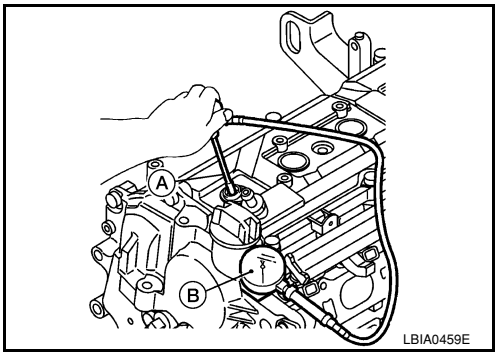
CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-78, "Fuel Pressure Check".
3. Disconnect fuel pump fuse (1) to avoid fuel injection during measurement.

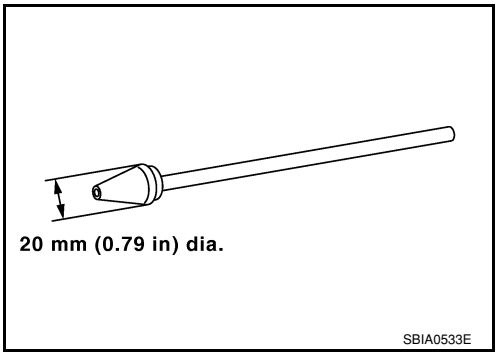
⇦ : Vehicle front



4. Remove engine cover. Refer to EM-18, "Component".
5. Remove ignition coil and spark plug from each cylinder. Refer to EM-30.
6. Connect an engine tachometer (not required in use of CONSULT-III).
7. Install a suitable compression tester with an adapter onto spark plug hole.



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



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

Compression pressure:

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

Standard	Minimum	Differential limit between cylinders
1,500 (15.0, 15.3, 217.6) / 200	1,200 (12.0, 12.2, 174) / 200	100 (1, 1, 15) / 200

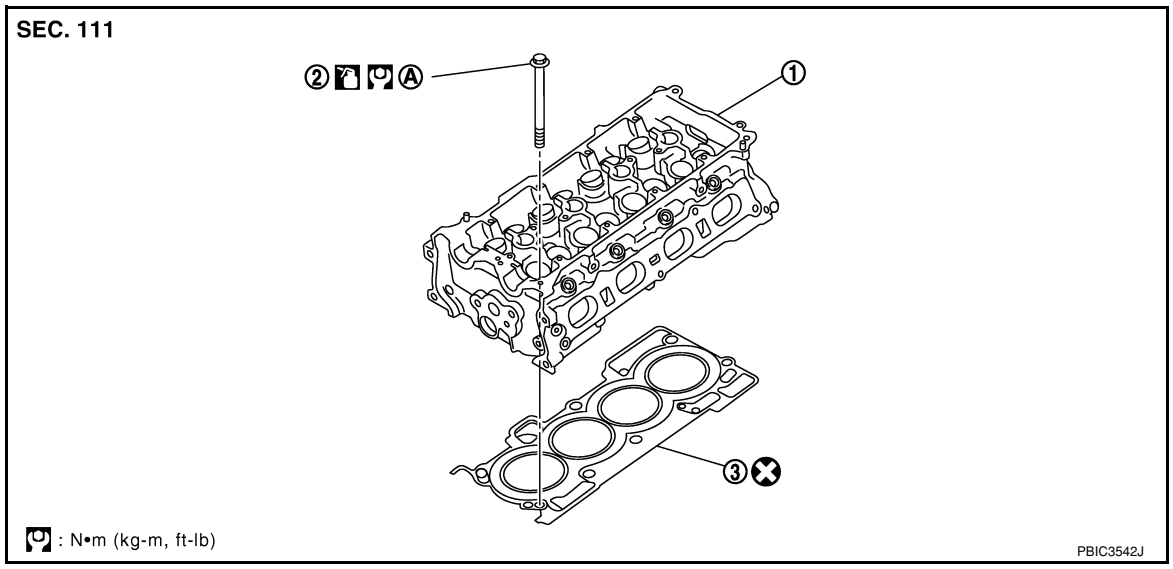
CAUTION:
Always use a fully charged battery to obtain the specified engine speed.

- 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-81.

Component

INFOID:0000000001702502



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

A. Refer to EM-63

Removal and Installation

INFOID:0000000001702503

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.**

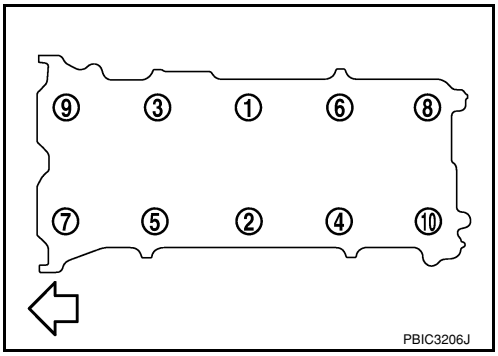
1. Release the fuel pressure. Refer to EC-78, "Fuel Pressure Check".
2. Drain engine coolant and engine oil. Refer to CO-8 and LU-6.
3. Remove front fender protector (RH). Refer to EI-23.
4. Remove drive belt. Refer to EM-13, "Removal and Installation".
5. Remove the following components and related parts.
   - Exhaust manifold; Refer to EM-21.
   - Intake manifold; Refer to EM-18.
   - Fuel tube and fuel injector assembly; Refer to EM-33.

- Water outlet; Refer to CO-19.
- Rocker cover; Refer to EM-30.
- Front cover, timing chain; Refer to EM-37.
- Camshaft; Refer to EM-47.

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

     ⇦ : Engine front

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



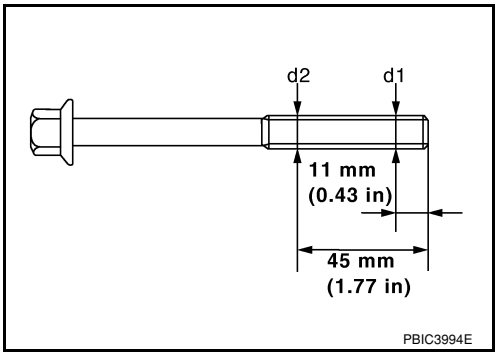
INSPECTION AFTER REMOVAL

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

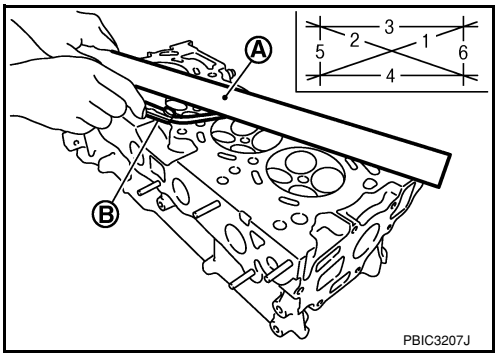
NOTE:

When performing this inspection, cylinder block distortion should be also checked. Refer to EM-93, "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 passages for engine oil or water.
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.

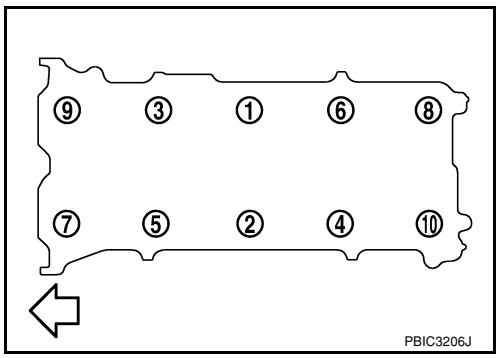


INSTALLATION

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.

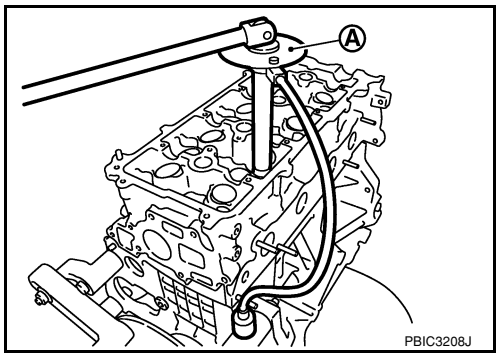
Step a : 40 N·m (4.1 kg-m, 30 ft-lb)
Step b : 100° clockwise
Step c : Loosen to 0 N·m in the reverse order of tightening.
Step d : 40 N·m (4.1 kg-m, 30 ft-lb)
Step e : 100° clockwise
Step f : 100° clockwise



⇦: 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

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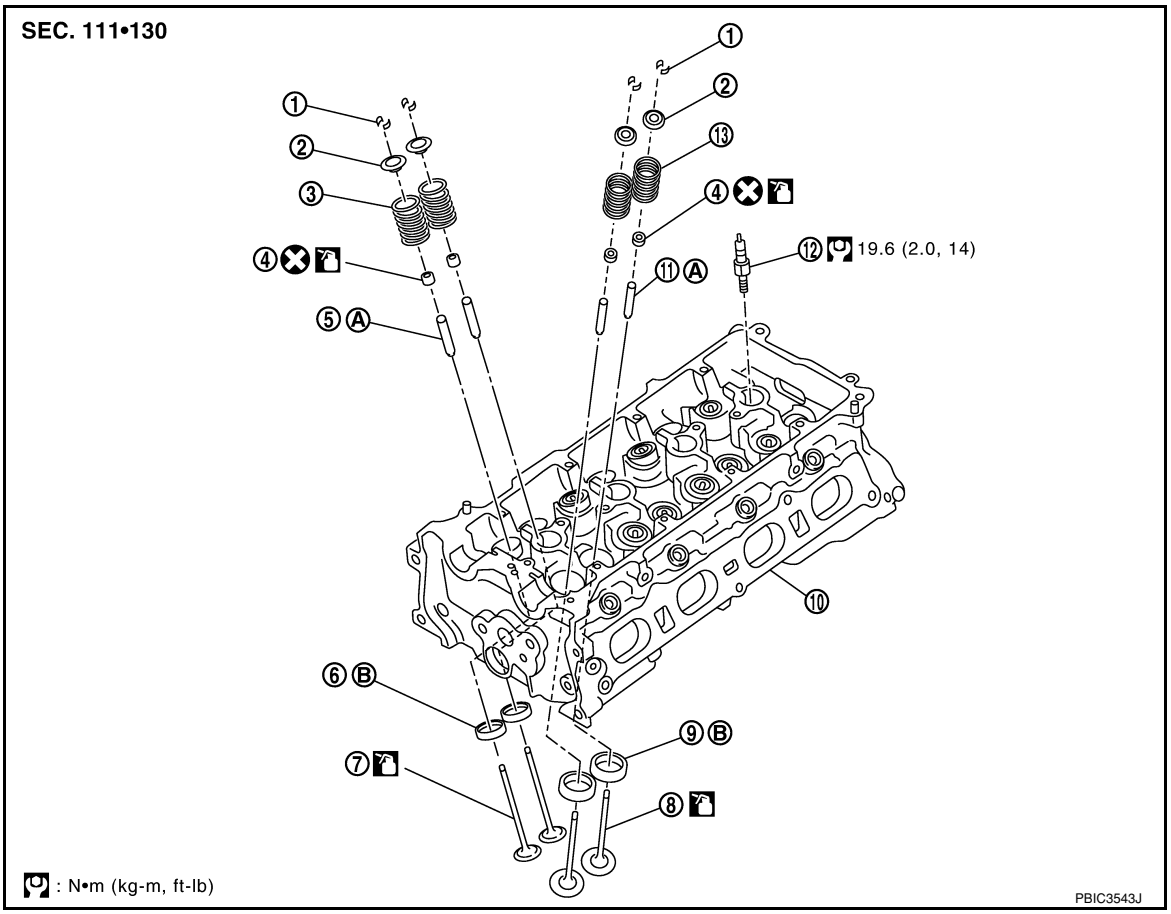

1. Valve collet
2. Valve spring retainer
3. Valve spring (EXH) (with valve spring seat)
4. Valve oil seal
5. Valve guide (EXH)
6. Valve seat (EXH)
7. Valve (EXH)
8. Valve (INT)
9. Valve seat (INT)
10. Cylinder head
11. Valve guide (INT)
12. Spark plug
13. Valve spring (INT) (with valve spring seat)

A. Refer to EM-67
B. Refer to EM-67

Disassembly and Assembly

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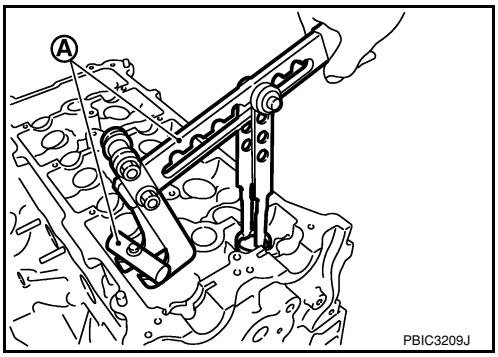
DISASSEMBLY

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.

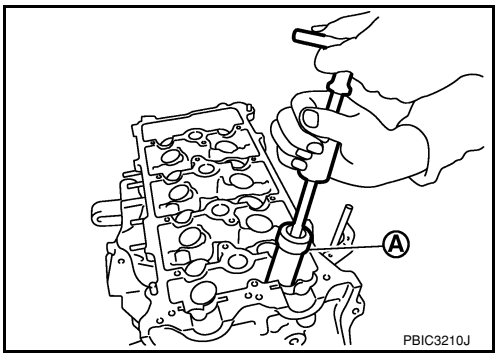
   CAUTION:
   When working, be careful not to damage valve lifter holes.

   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-67, "Inspection After Disassembly" to removal.
8. When valve guide must be replaced, refer to EM-67, "Inspection After Disassembly" to removal.

ASSEMBLY

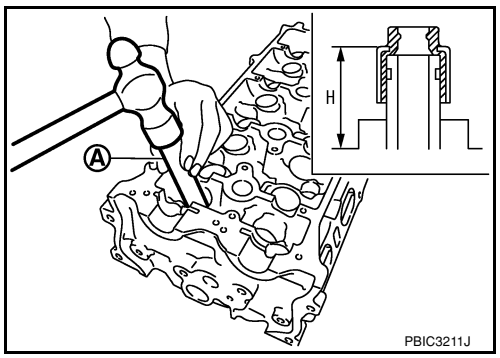
1. Install valve guide if removed. Refer to EM-67, "Inspection After Disassembly".
2. Install valve seat if removed. Refer to EM-67, "Inspection After Disassembly".

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)

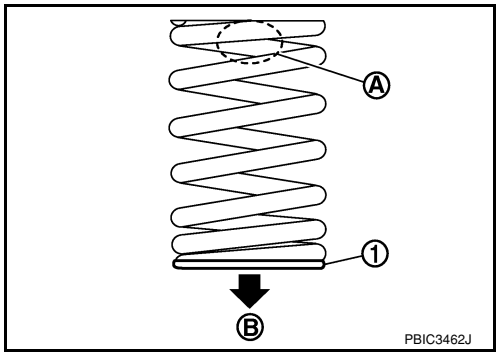


4. Install valve.
   • Install larger diameter to intake side.

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.)

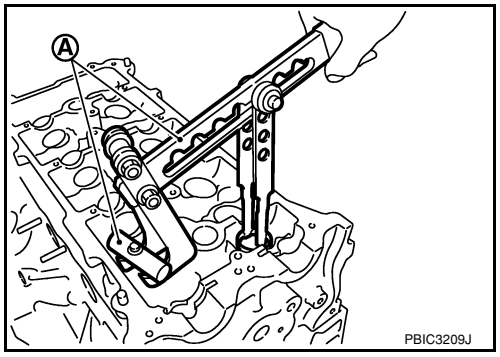
   Intake : White
   Exhaust : Orange



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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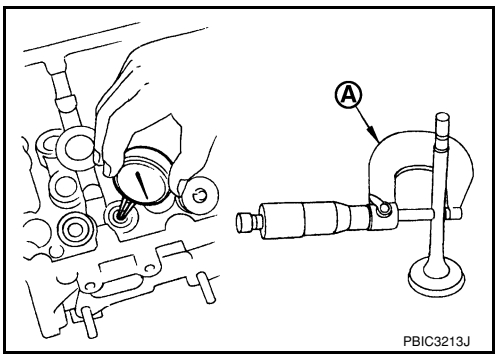
VALVE DIMENSIONS

• Check dimensions of each valve. For dimensions, refer to EM-104, "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

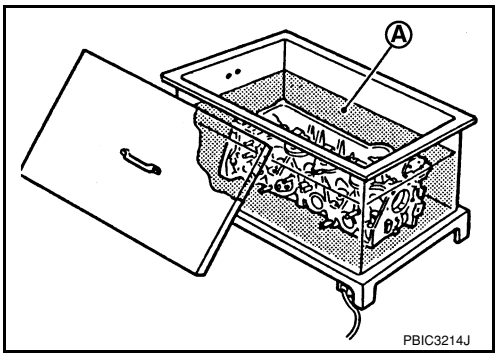
: 0.1 mm (0.004 in)

- 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.

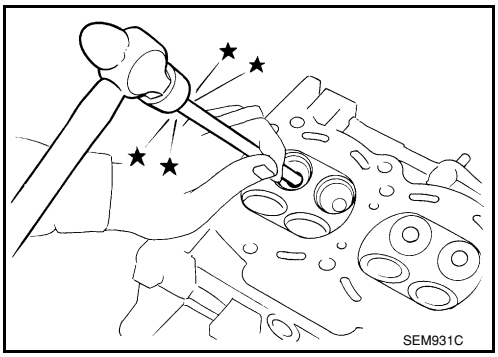
1. To remove valve guide, heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil (A).



2. Drive out valve guide using suitable tools.

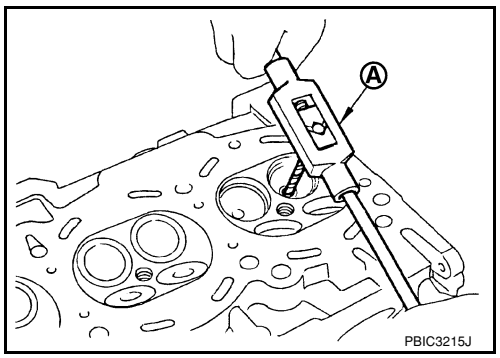
CAUTION:

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

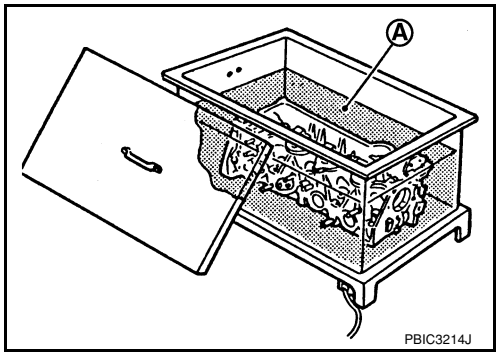


3. Ream cylinder head valve guide hole using suitable tool (A).

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).

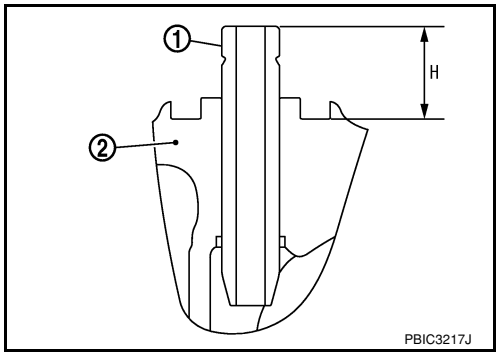


5. Press valve guide (1) from camshaft side to dimensions as shown.

2 : Cylinder head

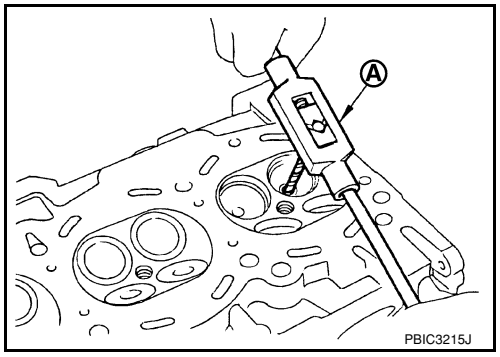
Projection "H" : 13.35 - 13.65 mm (0.526 - 0.537 in)

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).

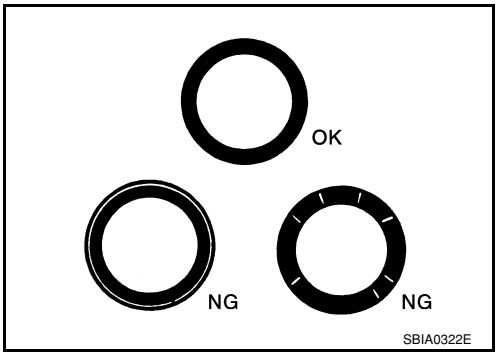
Standard
: 5.500 - 5.518 mm (0.2165 - 0.2172 in)



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

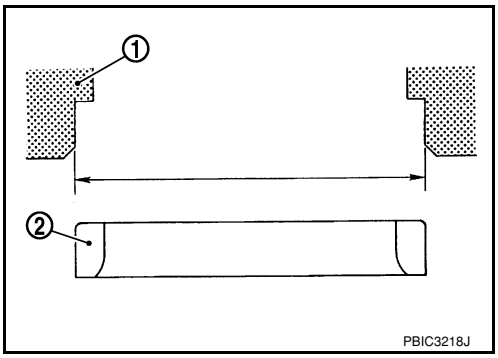
When valve seat is removed, replace with oversized [0.5 mm (0.020 in)] valve seat.

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-104, "Standard and Limit".
2. Ream cylinder head (1) recess diameter for service valve seat.

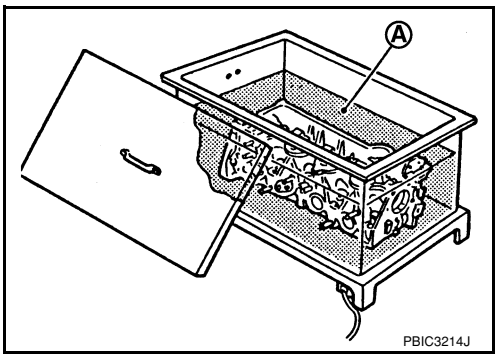
   2 : Valve seat

   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)

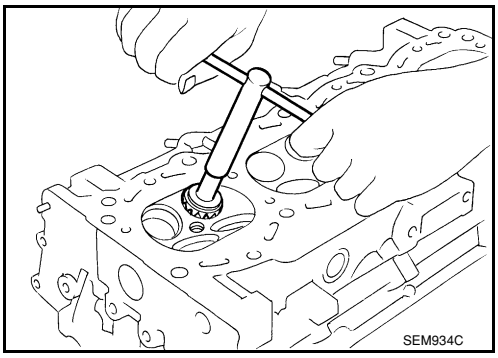
   - Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.



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-104, "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.

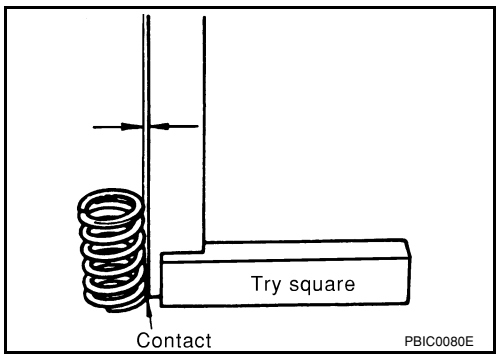


6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Follow the "VALVE SEAT CONTACT" procedure.

VALVE SPRING SQUARENESS

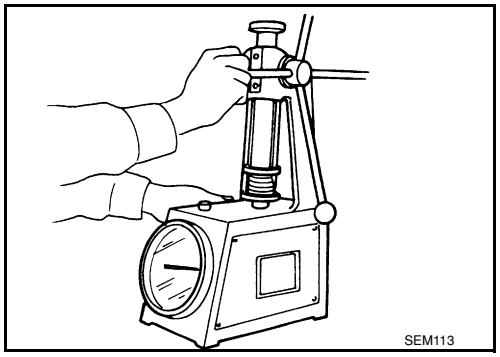
- Set try square along the side of valve spring and rotate the spring. Measure the maximum clearance between the top of valve spring and try square.
  CAUTION:
  Never remove valve spring seat from valve spring.

  Limit: 1.9 mm (0.075 in)
- If it exceeds the limit, replace valve spring (with valve spring seat).



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- 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

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

ENGINE ASSEMBLY

Component

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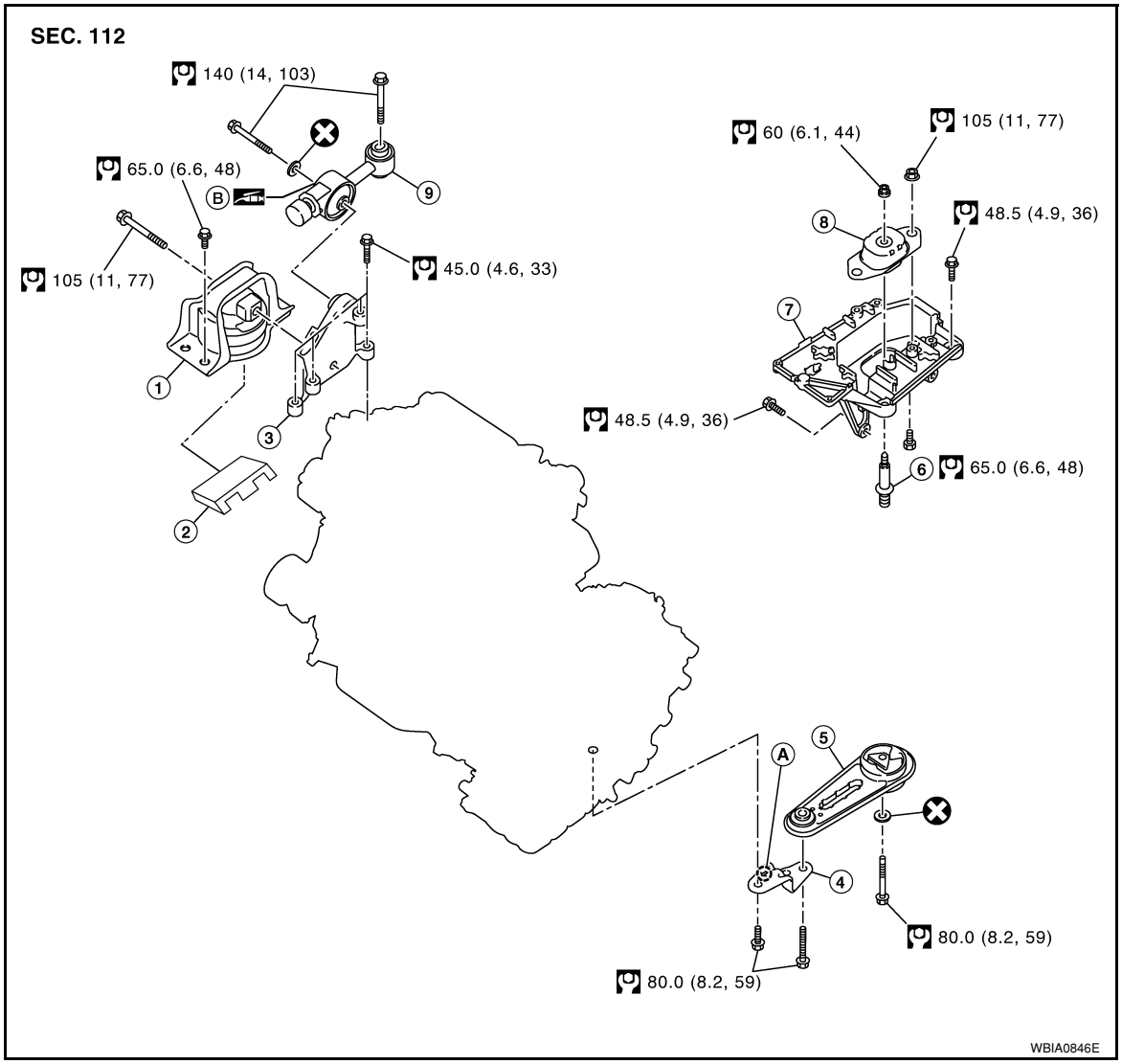

1. Engine mounting Insulator (RH)
2. Engine mounting shim (RH) (if equipped)
3. Engine mounting bracket (RH)
4. Bracket
5. Rear torque rod
6. Engine through bolt
7. Engine mounting bracket (LH)
8. Engine mounting insulator (LH)
9. Torque rod (RH)

A. Front mark
B. Silicone lubricant

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:

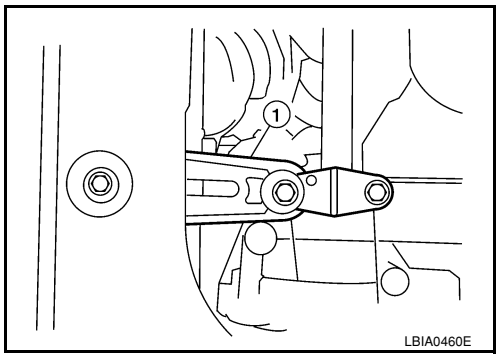
- **Always be careful to work safely, avoid forceful or uninstructed operations.**
- **Do not start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine section, follow the applicable procedures.**
- **Always use the support point specified 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-38, "Garage Jack and Safety Stand and 2-Pole Lift".**

REMOVAL

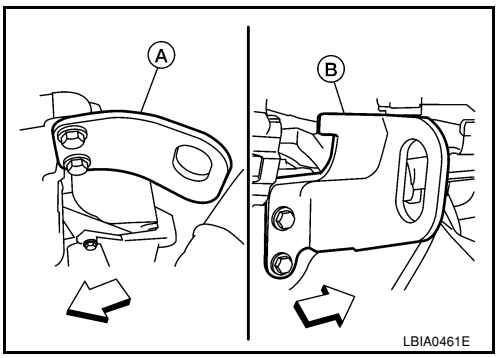
Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

1. Remove engine undercover
2. Drain engine coolant from radiator. Refer to CO-8, "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-23.
4. Remove exhaust front tube; Refer to EX-4.
5. Remove drive shafts (LH and RH) from steering knuckle. Refer to FAX-8.
6. Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to AT-226 (A/T models), CVT-178 (CVT) or MT-16 (M/T models).
7. Remove rear torque rod (1).
   NOTE:
   A/T model shown CVT and M/T models similar.



8. Remove hood assembly. Refer to BL-13.
9. Remove cowl top cover and cowl top extension assembly. Refer to EI-21.
10. Release fuel pressure. Refer to EC-78, "Fuel Pressure Check".
11. Remove battery and battery tray; Refer to SC-4.
12. Remove drive belt; Refer to EM-13, "Component".
13. Remove air duct and air cleaner case assembly; Refer to EM-16.
14. Remove cooling fan assembly.
15. Remove radiator hose (upper and lower). Refer to CO-11.
16. Disconnect A/T, CVT fluid cooler hoses. Refer to CO-11.
17. 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.
18. Disconnect fuel feed hose at engine side. Refer to EM-33, "Component".
19. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining. Refer to CO-19, "Component".
20. Disconnect control cable from transaxle. Refer to CVT-167 (CVT) or AT-203 (A/T), MT-13 (MT).
21. Remove ground cable at transaxle side.
22. Remove ground cable between front cover and vehicle.
23. Remove generator. Refer to SC-20.
24. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to MTC-78, "Removal and Installation of Compressor".
25. Remove the intake manifold to prevent the hanging chain from interfering. Refer to EM-18, "Component".

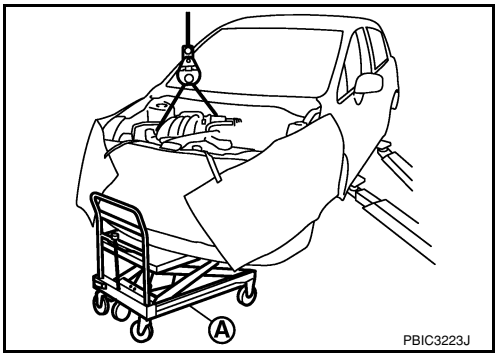
26. Install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.



⇦ : Engine front

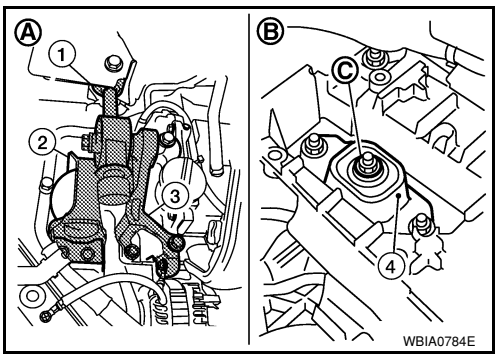
Slinger bolts : 25.5 N·m (2.6 kg-m, 19 ft-lb)

27. Support engine and transaxle assembly with a hoist and secure the engine in appropriate position.
28. 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.

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



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

30. Remove engine through bolt-securing nut (C).
31. 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.**

32. When the engine hoisting is not performed simultaneously, install engine slinger to cylinder head front left side and rear right side. Refer to EM-72, "Component".
33. Remove starter motor. Refer to SC-8.
34. Lift with a hoist and position above engine.
35. Separate the engine and the transaxle. Refer to AT-226 (A/T models), CVT-178 (CVT models) or MT-16 (M/T models).

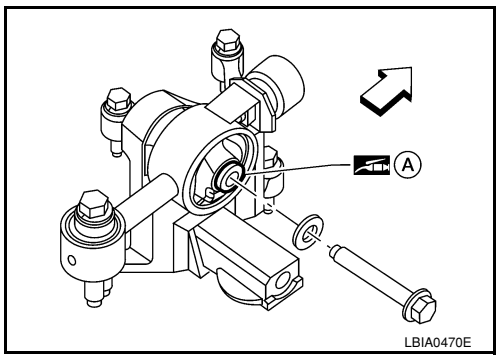
INSTALLATION

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-72, "Component".
- Prior to installing the upper torque rod, apply a light coat of silicone lubricant (A) to the washer facing side of the bushing inner tube as shown.

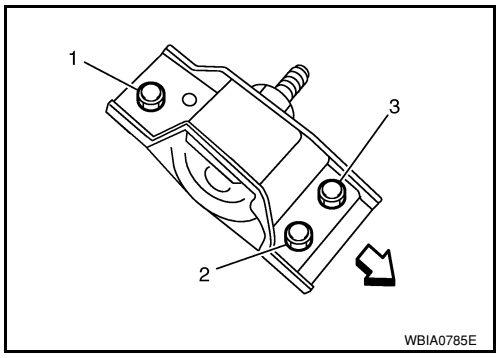
NOTE:
- Apply silicone lubricant (A) by dabbing the outward facing tube surface with a sponge or suitable tool.
- Do not apply excess lubricant.

⇦ : Vehicle front



- 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

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.
- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-10.
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

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

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

CYLINDER BLOCK

Component

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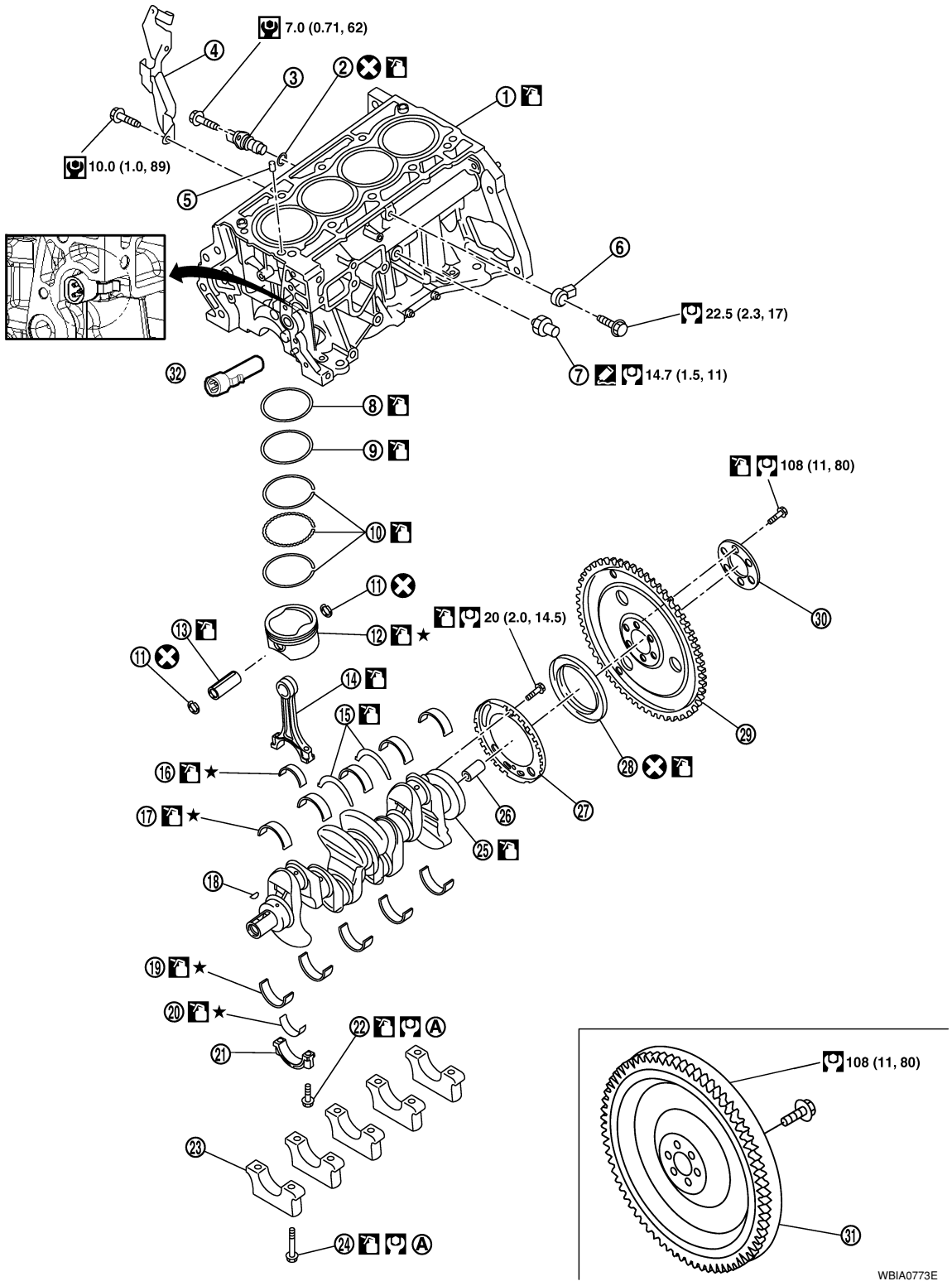


1. Cylinder block
2. O-ring
3. Crankshaft position sensor (POS)
4. Crankshaft position sensor (POS) cover
5. Oil filter (for intake valve timing control)
6. Knock sensor

7. Oil pressure switch	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 (A/T or CVT models)	27. Signal plate
28. Rear oil seal	29. Drive plate (A/T or CVT models)	30. Reinforcement plate (A/T or CVT models)
31. Flywheel (M/T models)	32. Block heater (Canada only)	A. Refer to EM-77

Disassembly and Assembly

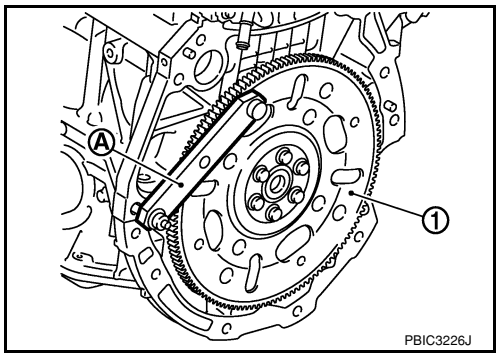
INFOID:0000000001702510

DISASSEMBLY

1. Remove engine and transaxle assembly from vehicle, separate transaxle from engine. Refer to EM-72.
2. Install engine to engine stand as follows;

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

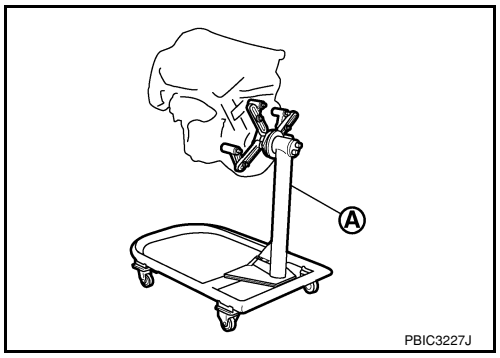
Tool number : KV 11105210 (J-44716)



CAUTION:
Be careful not to damage or scratch drive plate (A/T or CVT models) and contact surface for clutch disc of flywheel (M/T models).
NOTE:
Figure shows drive plate (A/T or 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-21.
- Rocker cover; Refer to EM-30.

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 (A/T or CVT models) removed.



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

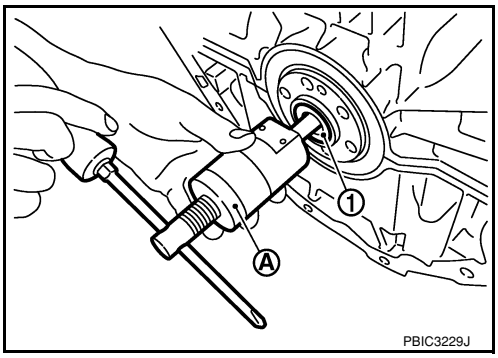
3. Remove oil pan (upper and lower). Refer to EM-24.
4. Remove cylinder head. Refer to EM-62.
5. Remove thermostat housing. Refer to CO-17.
6. Remove knock sensor.
CAUTION:
Carefully handle knock sensor avoiding shocks.
7. Remove crankshaft position sensor (POS) cover and crankshaft position sensor (POS).

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.**

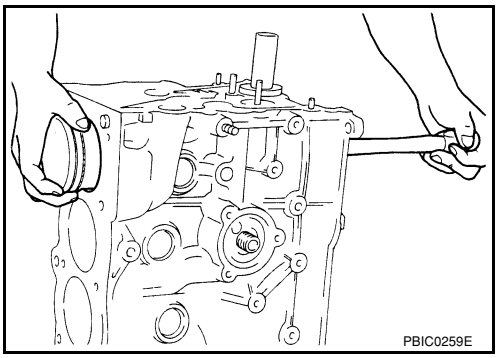
8. Remove oil filter (for intake valve timing control).
9. Remove pilot converter (1) using Tool (A). (A/T or CVT models)

Tool number :ST16610001 (J-23907)

NOTE:
M/T models have no pilot converter.

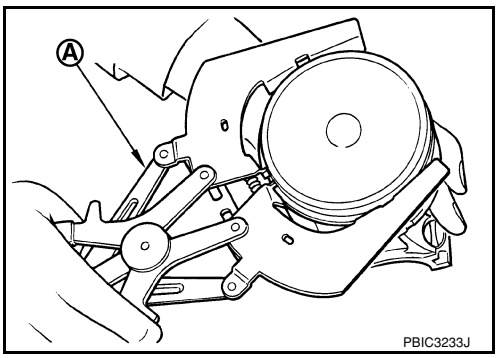


10. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
NOTE:
Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-93, "Inspection After Disassembly".
11. Remove connecting rod cap.
12. Using a suitable 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.**

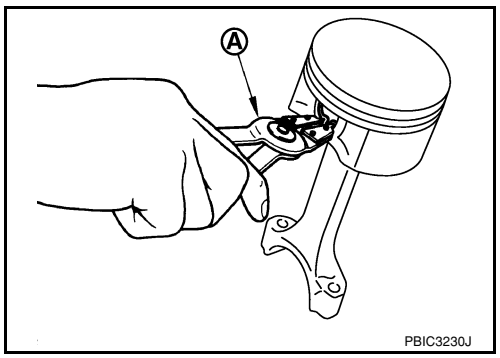


13. Remove connecting rod bearings.
CAUTION:
When removing them, note the installation position. Keep them in the correct order.
14. Remove piston rings form piston.
- Before removing piston rings, check the piston ring side clearance. Refer to EM-93, "Inspection After Disassembly".

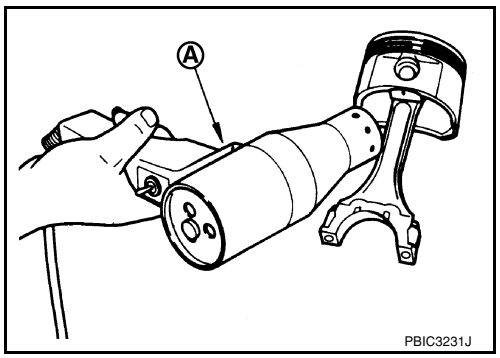
15. Using a suitable tool (A) remove piston rings.
CAUTION:
- **When removing piston rings, be careful not to damage the piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



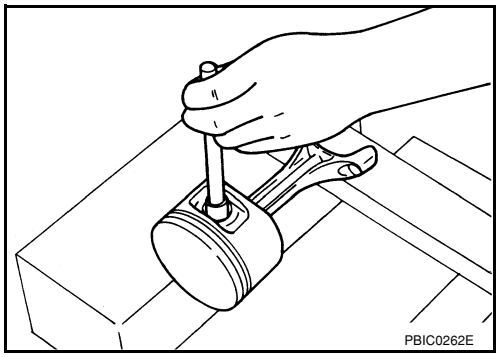
16. Using snap ring pliers (A), remove snap rings.



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

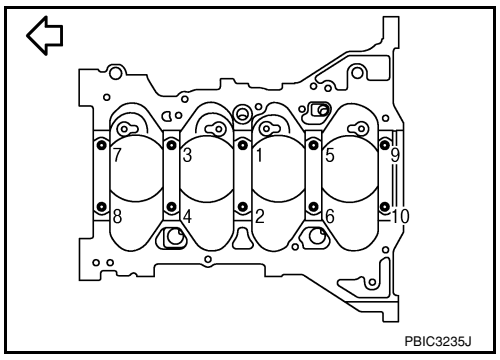


18. Push out piston pin using a suitable tool of an outer diameter approximately 18 mm (0.71 in).



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-93, "Inspection After Disassembly".

⇦ : Engine front

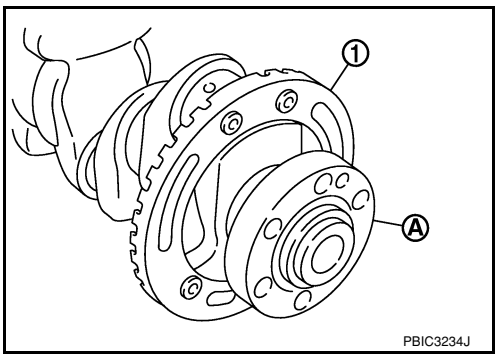


20. Remove main bearing caps.
- Tap main bearing caps lightly using a suitable tool for removal.

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

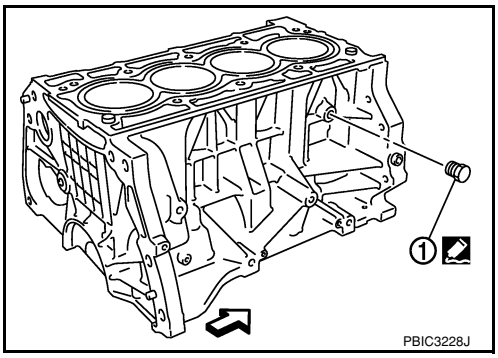
1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.
   CAUTION:
   Use a goggles to protect your eye.
2. Install water drain plug (1) to cylinder block.

   ⇦ : Engine front

   - Apply liquid gasket to the drain plug thread.

   Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".

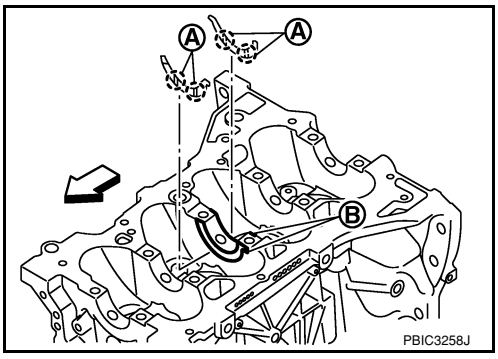
   9.8 N·m (1.0 kg-m, 87 in-lb)



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

   ⇦ : Engine front

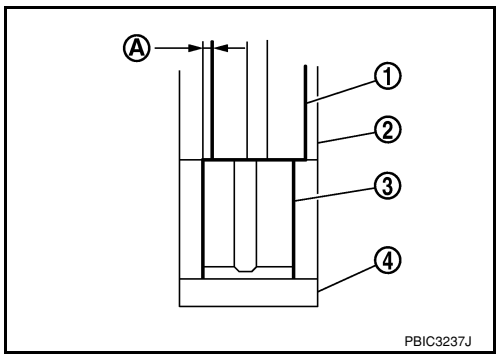
   - Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).



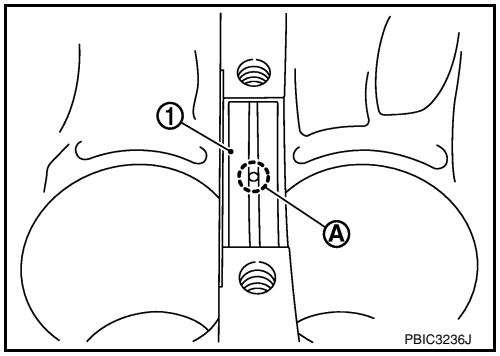
5. Install the main bearings paying attention to the direction.
   CAUTION:
   - **Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.**
   - **When installing, align main bearing to the center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

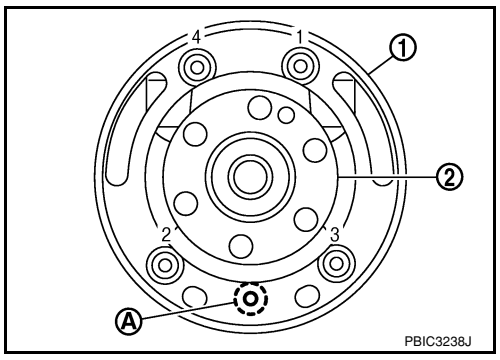


6. Install signal plate to crankshaft if removed.
7. Set the signal plate with the flange facing toward the counter weight side (engine front side) to the crankshaft rear surface.
8. Apply new engine oil to threads and seat surfaces of bolts.
9. Position crankshaft (2) and signal plate (1) using a dowel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

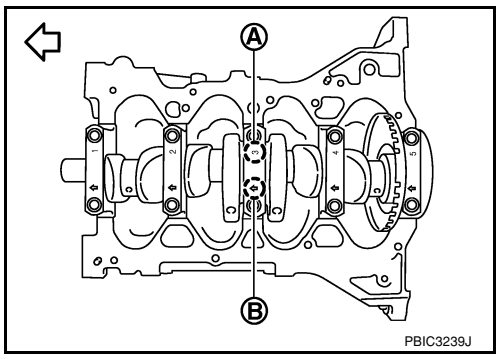


12. Install crankshaft to cylinder block.
- While turning crankshaft by hand, make sure that it turns smoothly.

13. Install main bearing caps referring to the journal No. stamp (A) and front mark (B) as shown.

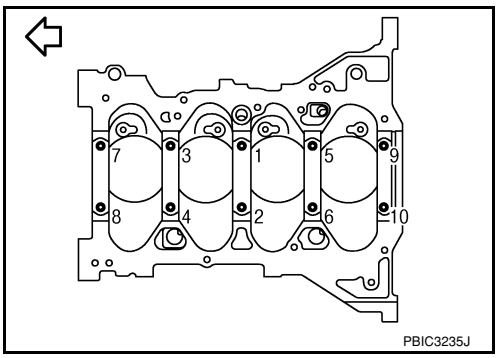
⇦ : Engine front

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.

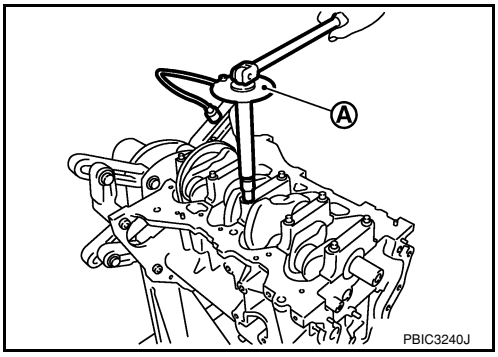
15. Tighten main bearing cap bolts in two steps.
NOTE:
Tighten main bearing cap bolts in numerical order as shown:



⇦ : Engine front

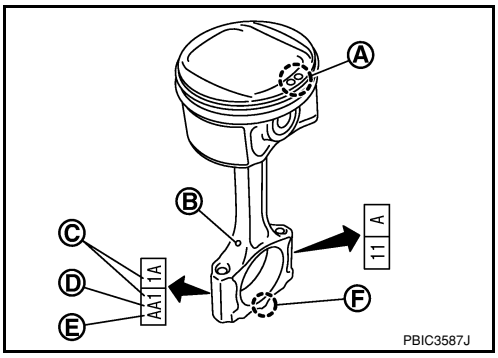
Step 1 : 34.3 N·m (3.5 kg-m, 25 ft-lb)
Step2 60° clockwise

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-93, "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.

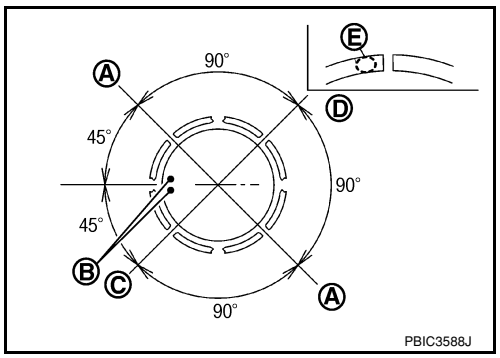


D : Big end diameter grade
E : Small end diameter grade
F : Front mark (connecting rod bearing cap)

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.

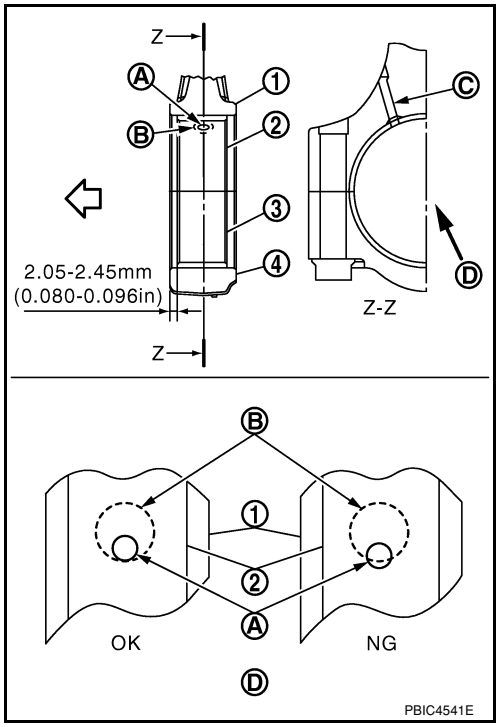
- Install second ring with the stamped surface facing upward.

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.

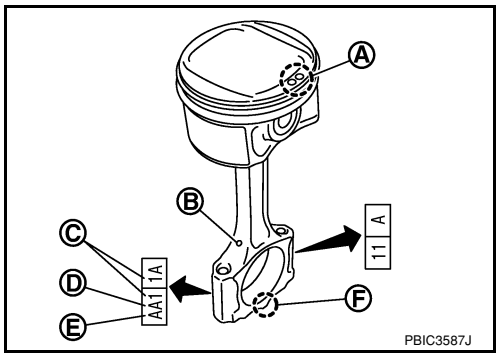
NOTE:
- There is no positioning tab.
- Install the connecting rod bearings in the center of connecting rod and connecting rod bearing cap as shown. For service operation, the center position can be checked, visually.



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.

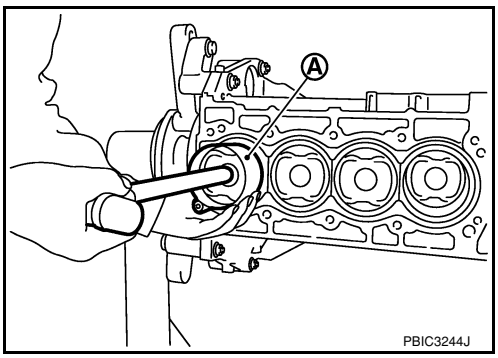
B : Oil hole
D : Big end diameter grade
E : Small end diameter grade
F : Front mark (connecting rod bearing cap)

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



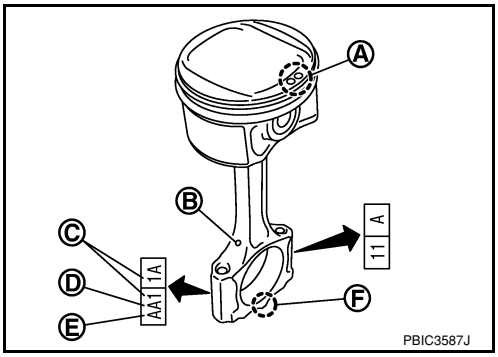
- Using a piston ring compressor [SST: EM03470000 (J-8037)] (A) or suitable tool, install piston with the front mark on the piston head facing the front of the engine.

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



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

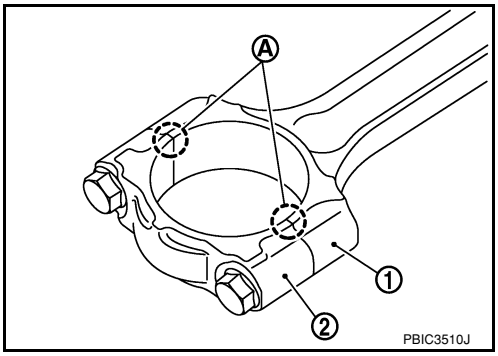
A : Front mark (piston)
B : Oil hole
D : Big end diameter grade
E : Small end diameter grade
F : Front mark (connecting rod bearing cap)



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-93, "Inspection After Disassembly".**

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



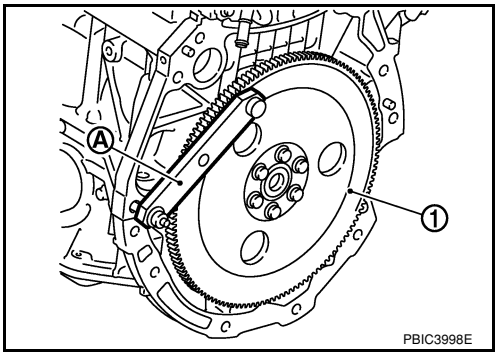
Step 1 : 27.4 N·m (2.8 kg-m, 20 ft-lb)
Step 2 : 0 N·m (0 kg-m, 0 ft-lb)
Step 3 : 19.6 N·m (2.0 kg-m, 14 ft-lb)

- After tightening connecting rod bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-93, "Inspection After Disassembly".

26. Install oil pan (upper). Refer to EM-24.
    NOTE:
    Install the rear oil seal after installing the oil pan (upper).
27. Install rear oil seal. Refer to EM-24.
28. Install flywheel (M/T models) or drive plate (1) (A/T or CVT models).
    - Secure crankshaft using Tool. (A), and tighten bolts crosswise over several times.

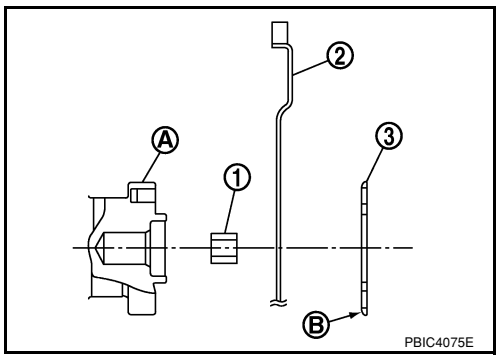
Tool number : KV11105210 (J-44716)

NOTE:
A/T model shown CVT and M/T similar.



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

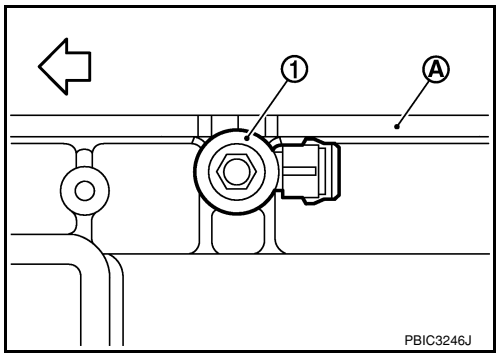
A : Crankshaft rear end
B : R



- Using a suitable tool of 33 mm. (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops (A/T or 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

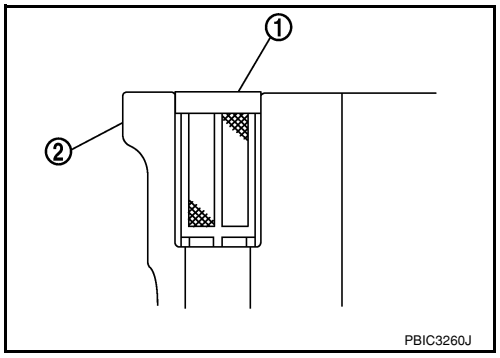


CAUTION:
- **Never tighten bolts while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

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. Assemble in the reverse order of disassembly.

How to Select Piston and Bearing

INFOID:0000000001702511

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)

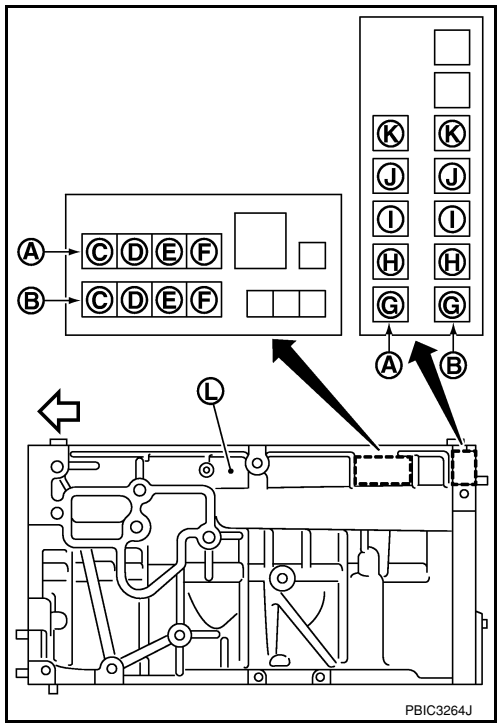
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.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

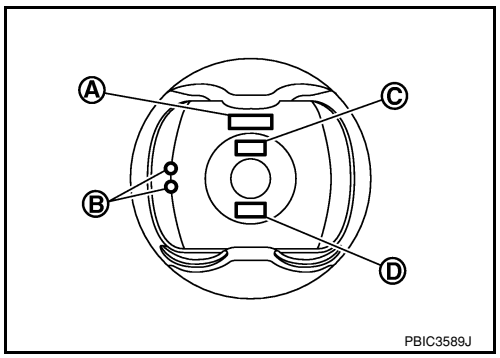


- If there is a correction stamp mark on the cylinder block, use it as a correct reference.

When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to EM-93, "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 : Sub grade number

Piston Selection Table

Unit: mm (in)

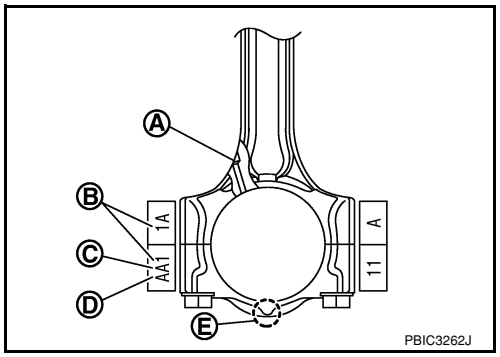
Grade number (Mark)	1	2 [or no mark (piston only)]
Cylinder bore Inner diameter	84.000 - 84.010 (3.3071 - 3.3075)	84.010 - 84.020 (3.3075 - 3.3079)
Piston skirt diameter	83.970 - 83.980 (3.3059 - 3.3063)	83.980 - 83.990 (3.3063 - 3.3067)

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

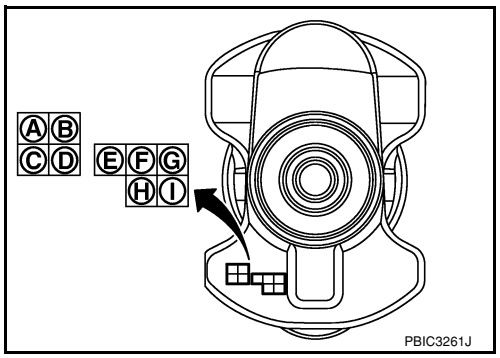
When New Connecting Rod and Crankshaft are Used

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-93, "Inspection After Disassembly" and EM-93, "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	

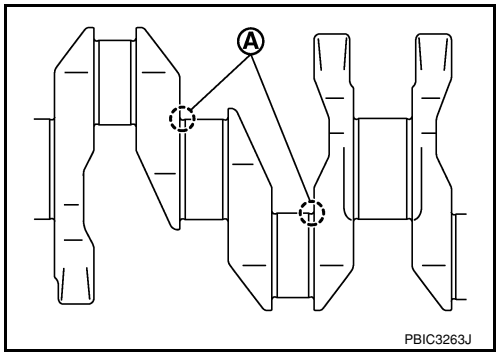
Grade number		Thickness	Identification color	Remarks
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
	LWR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
23	UPR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

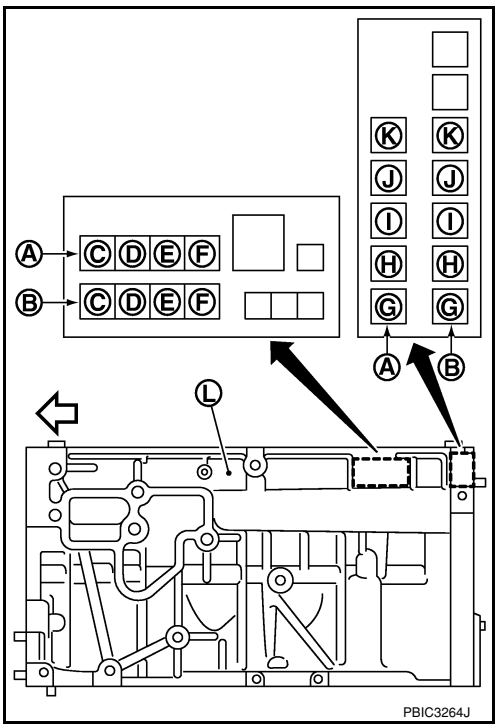
Unit: mm (in)

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

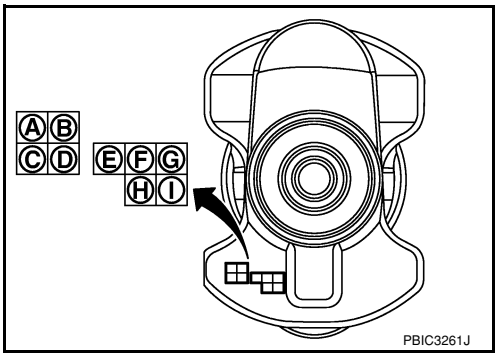
1. “Main Bearing Selection Table” rows correspond to main bearing housing grade on rear left side of cylinder block (L).



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-93, "Inspection After Disassembly" and EM-93, "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) / Mark	Axle diameter	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)
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	

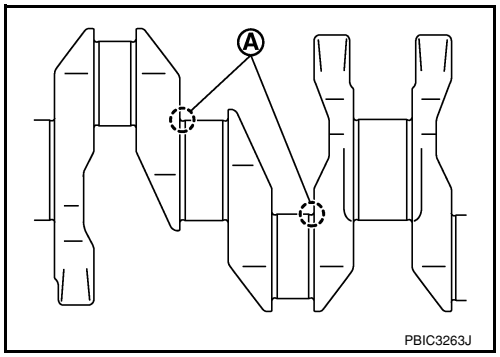
Grade number		Thickness	Identification color	Remarks
01	UPR	1.996 - 1.999 (0.0786 - 0.0787)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR	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

INFOID:0000000001702512

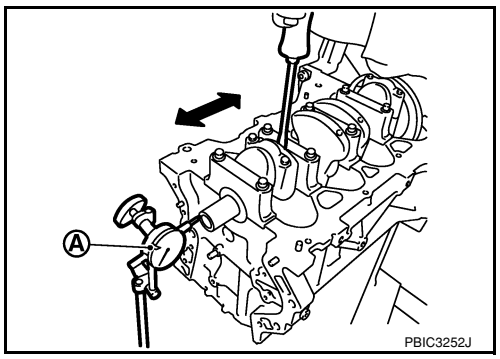
CRANKSHAFT END PLAY

- 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)

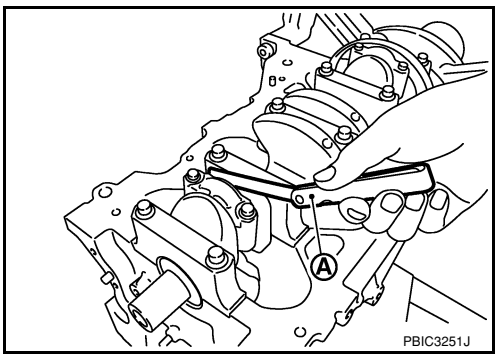
- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.



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)



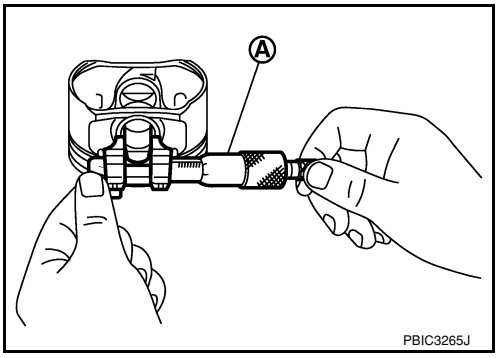
- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

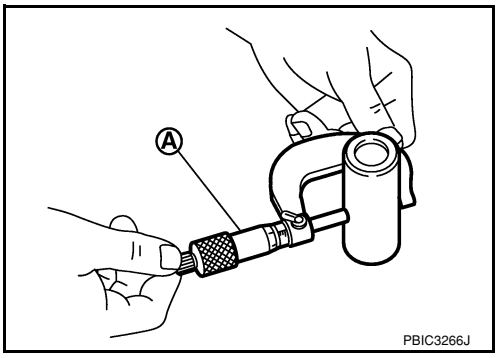
Standard: 19.993 - 19.999 mm (0.7871 - 0.7874 in)



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)

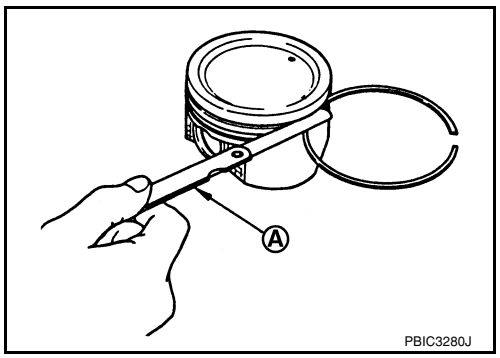
Standard: 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- 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)**

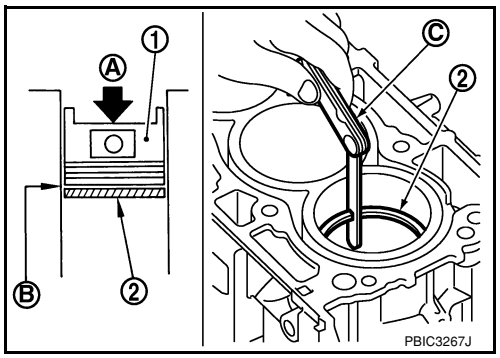
Limit:

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, re-bore cylinder and use oversized piston and piston rings.

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

C : Feeler gauge

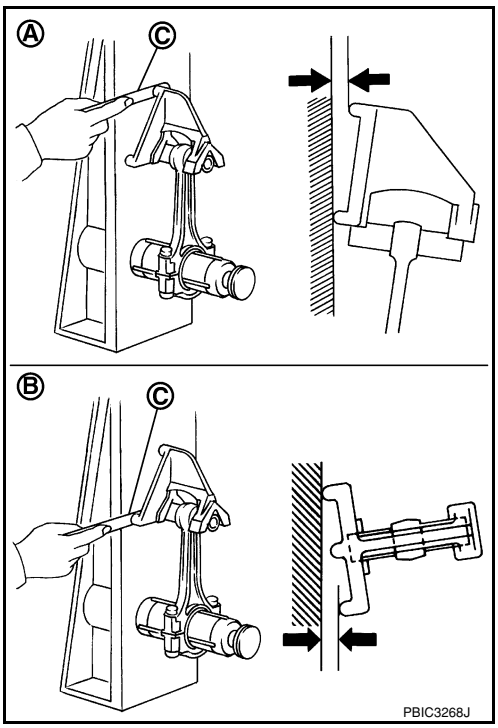
Bend (A):

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

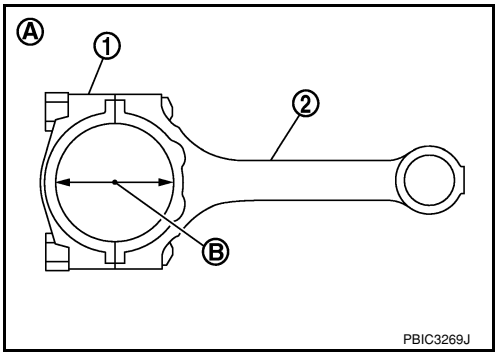
- If it exceeds the limit, replace connecting rod assembly.



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-77, "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.

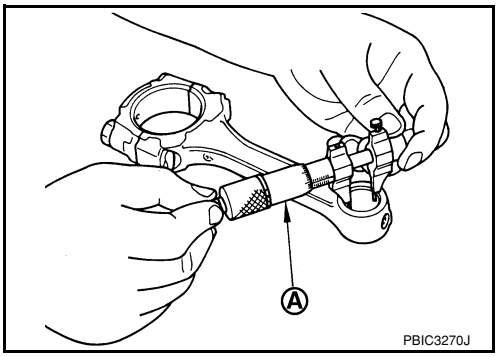
Standard: 47.000 - 47.013 mm (1.8504 - 1.8509 in)

- 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).

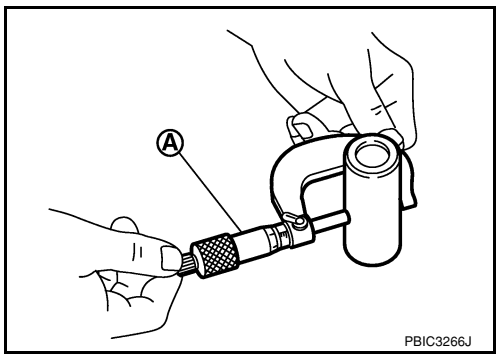
Standard: 20.000 - 20.012 mm (0.7874 - 0.7879 in)



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

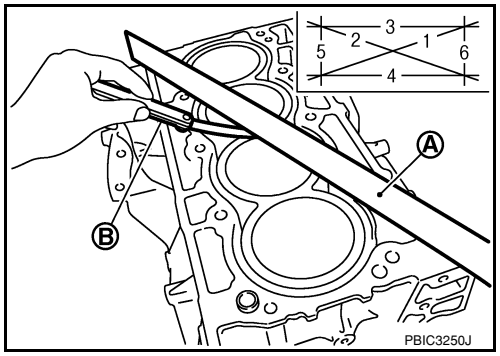
- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

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.

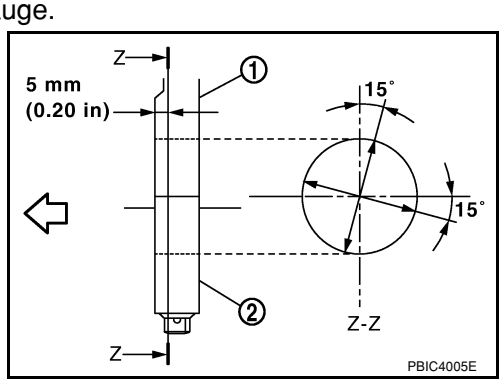


MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to EM-77, "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, replace cylinder block and main bearing caps assembly.

NOTE:

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

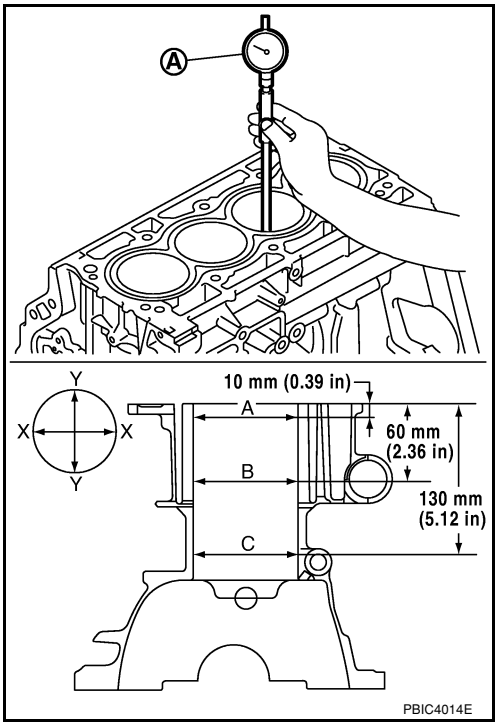
PISTON TO CYLINDER BORE CLEARANCE

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)

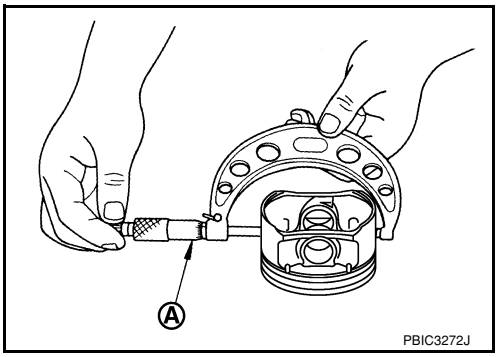
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.
  NOTE:
  Oversize piston is not provided.



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)

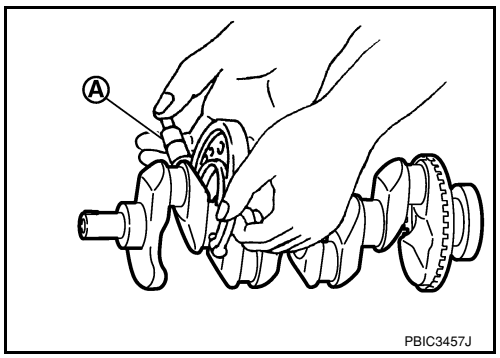
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to EM-85, "How to Select Piston and Bearing".

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”.

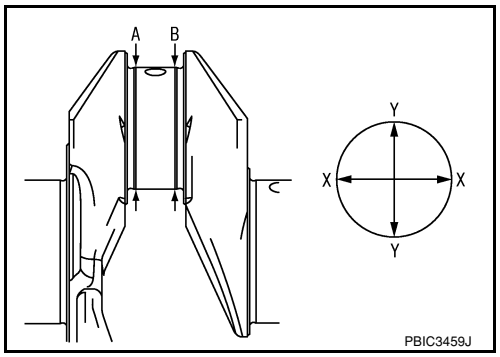
Limit:

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.

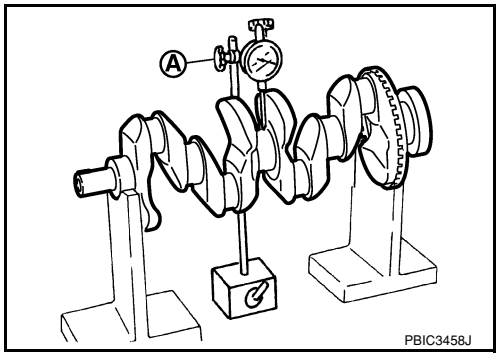
CRANKSHAFT RUNOUT

- 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)

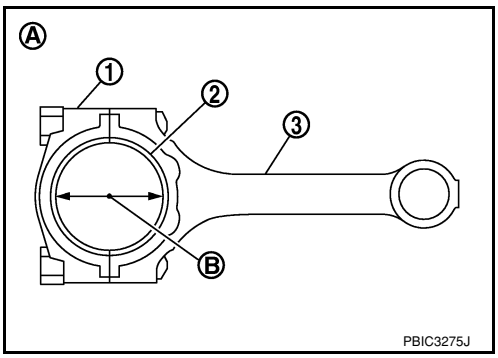
- If it exceeds the limit, replace crankshaft.



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-77, "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)

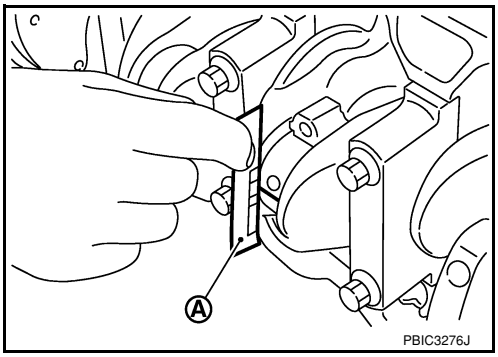
- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to EM-85, "How to Select Piston and Bearing".

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-77, "Disassembly and Assembly" for the tightening procedure.

CAUTION:
Never rotate crankshaft.

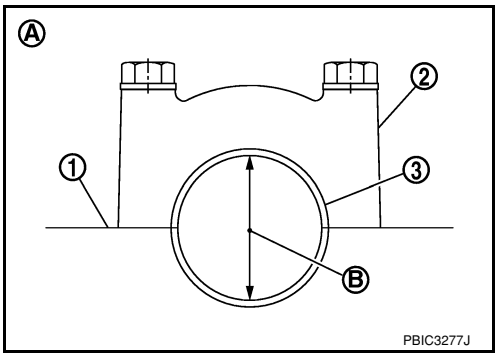
- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.

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-77, "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-85, "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-77, "Disassembly and Assembly" for the tightening procedure.

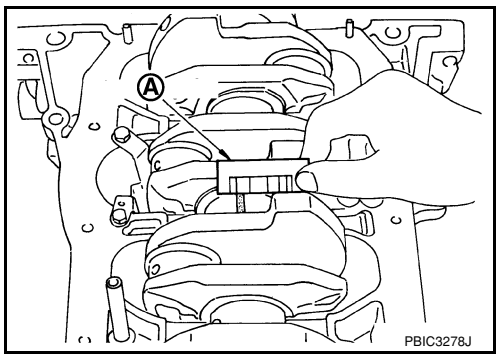
CAUTION:

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”.



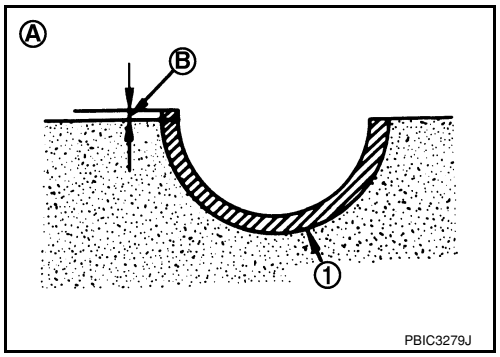
MAIN BEARING CRUSH HEIGHT

- 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-77, "Disassembly and Assembly" for the tightening procedure.

A : Example

Standard : There must be crush height.

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



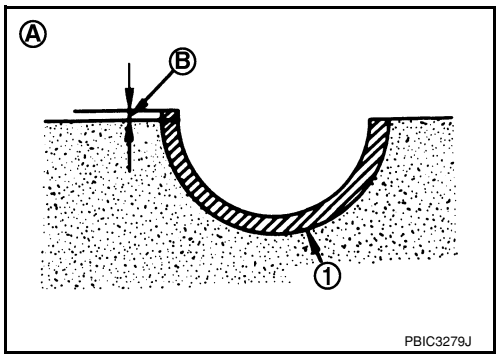
CONNECTING ROD BEARING CRUSH HEIGHT

- 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-77, "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

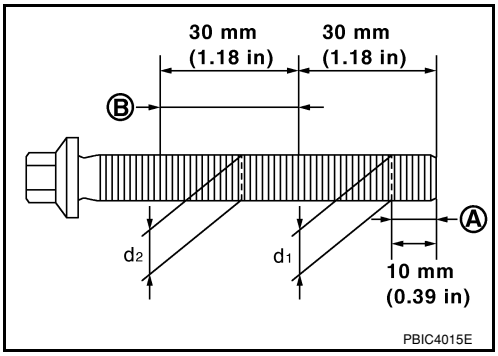
- Measure the outer diameters ("d_1", "d_2") at two positions as shown.

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.

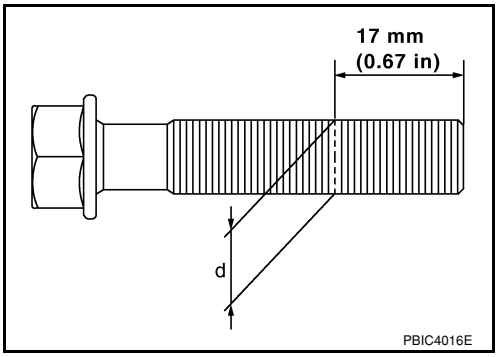


CONNECTING ROD BOLT OUTER DIAMETER

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

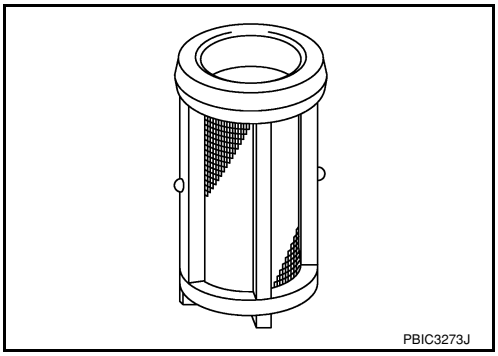
Limit: 7.75 mm (0.3051 in)

- 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.



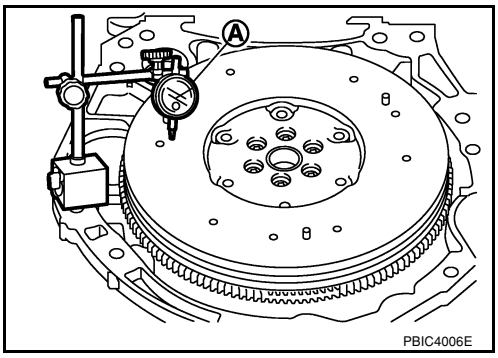
FLYWHEEL DEFLECTION (M/T MODELS)

- 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.

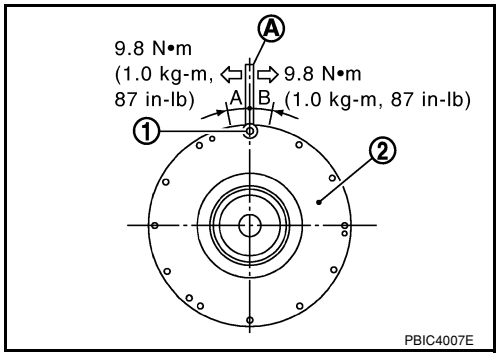
Standard : 1.8 mm (0.071 in) or less

• 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:0000000001702513

GENERAL SPECIFICATIONS

Engine type		MR18DE
Cylinder arrangement		In-line 4
Displacement cm^3 (cu in)		1,797 (109.65)
Bore and stroke mm (in)		84.0 x 81.1 (3.307 x 3.192)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.9
Compression pressure kPa (bar, kg/cm^2 , psi) / 250 rpm	Standard	1,500 (15.0, 15.3, 217.6)
	Minimum	1,200 (12.0, 12.2, 174)
	Differential limit between cylinders	100 (1.0, 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)
Maximum valve lift	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)
Maximum valve lift	8 mm/ 95°C (0.315 in/ 203°F)
Valve closing temperature	More than 77°C (171°F)

SPARK PLUG

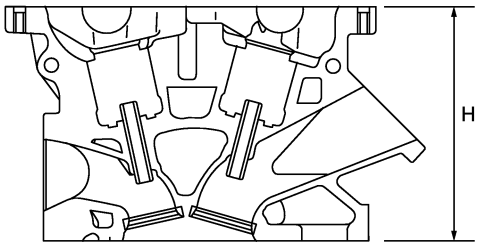
Unit: mm (in)

Plug type	Iridium-tipped TYPE
Make	DENSO
Standard type	FXE20HR11
Spark plug gap	Nominal: 1.1 (0.043)

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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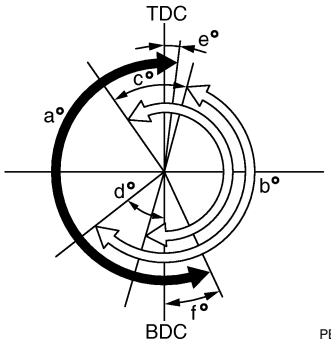
VALVE

Valve Timing

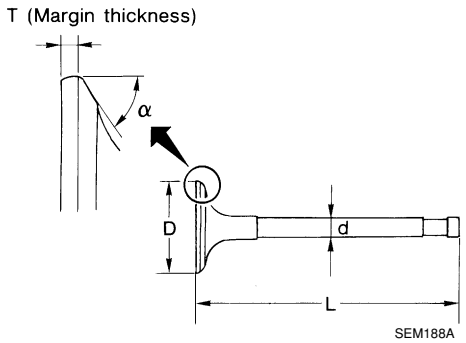
Unit: degree

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 (4.184)
	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

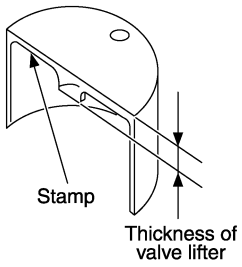
Unit: mm (in)

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

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

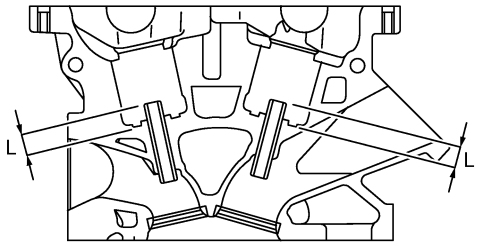
Valve Lifter

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)



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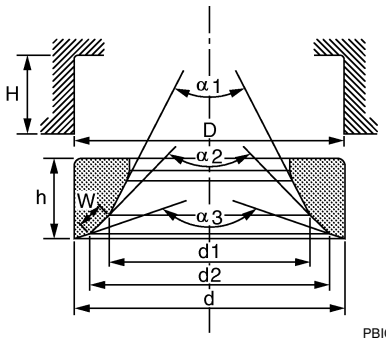
Items		Standard part	Service part
Valve guide	Outer diameter	9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size)	5.500 - 5.518 (0.2165 - 0.2172)	
Cylinder head valve guide hole diameter		9.475 - 9.496 (0.3730 - 0.3739)	9.675 - 9.696 (0.3809 - 0.3817)
Interference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



PBIC2745E

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)	

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

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

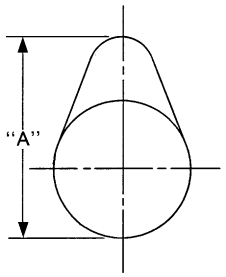
*3 : Machining data

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 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 mm (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]	—	0.15 (0.0059)



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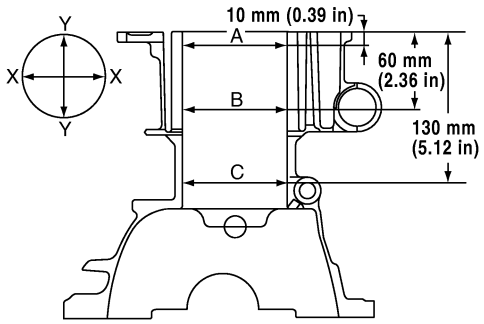
*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



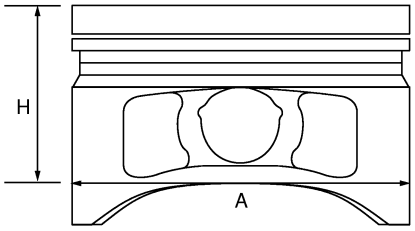
PBIC4017E

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

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)

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)

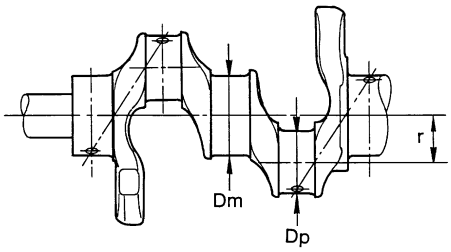
Center distance		143.44 - 143.54 (5.647 - 5.650)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*		20.000 - 20.012 (0.7874 - 0.7879)

Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)
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)

*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



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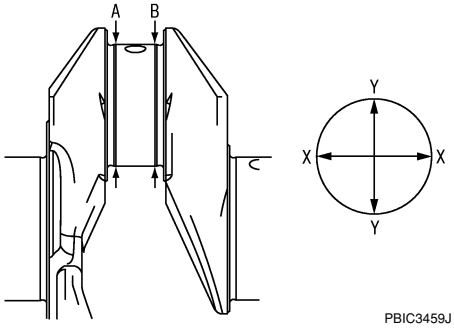

PBIC3459J

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*]	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)

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)

*: Total indicator reading

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	

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	

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)