SECTION EM
ENGINE MECHANICAL

CONTENTS

MR16DDT

HR16DE

K9K

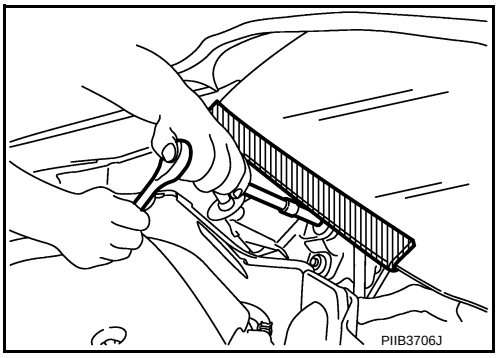
PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

INFOID:0000000006337221

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



Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:0000000006337222

NOTE:
- Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.
If turning the steering wheel is required with the battery disconnected or discharged, follow the operation 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. Turn the ignition switch to ACC position.
   (At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT-III.

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

INFOID:0000000006337223

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 AIR BAG” and “SEAT BELT” 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 that 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 "SRS AIR BAG".**
- **Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

- **When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.**
- **When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.**

Draining Engine Coolant

INFOID:0000000006337224

Drain engine coolant and engine oil when the engine is cooled.

Disconnecting Fuel Piping

INFOID:0000000006337225

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

Precaution for Handling High Pressure Fuel System

INFOID:0000000006337226

- High pressure fuel system components are between high pressure fuel pump and fuel injector.
- Always release fuel pressure and never start the engine when performing removal and installation.
- When removing or installing parts without releasing fuel pressure, fuel may be splashed and, if fuel contacts skin or eyes, it may cause inflammation.

Removal and Disassembly

INFOID:0000000006337227

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- 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 in the step.

Inspection, Repair and Replacement

INFOID:0000000006337228

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

Assembly and Installation

INFOID:0000000006337229

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.

- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

Parts Requiring Angle Tightening

INFOID:0000000006337230

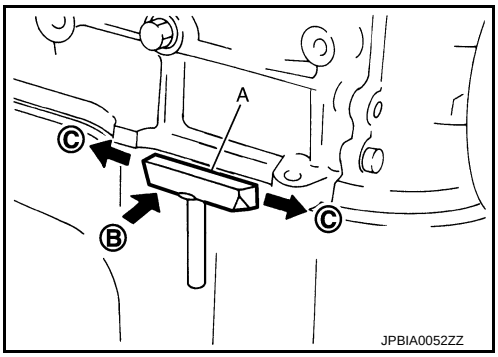
- Use the angle wrench [SST: KV10112100 (BT8653-A)] for the final tightening of the following engine parts:
- Camshaft sprocket (INT) bolt
- Cylinder head bolts
- Main bearing cap bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket

INFOID:0000000006337231

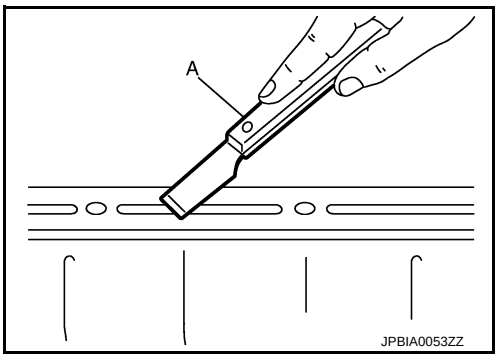
REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100 (J-37228)] (A) and remove old liquid gasket sealing.
  CAUTION:
  Be careful not to damage the mating surfaces.
- Tap the seal cutter [SST: KV10111100 (J-37228)] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100 (J-37228)] is difficult to use, lightly tap the parts using a plastic hammer to remove it.
  CAUTION:
  If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.

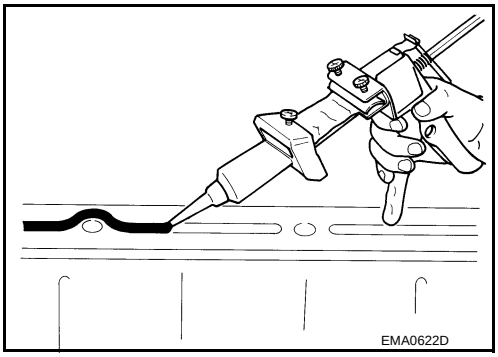


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
   - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



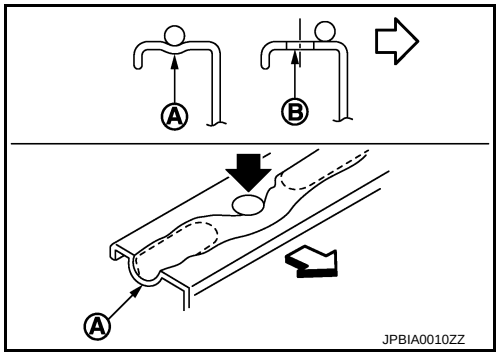
3. Attach liquid gasket tube to the tube presser (commercial service tool).
   Use Genuine Liquid Gasket or equivalent.
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

A : Groove

⇦ : Inside



- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

CAUTION:

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

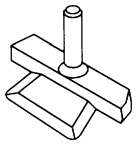
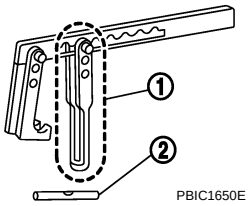
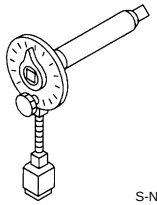
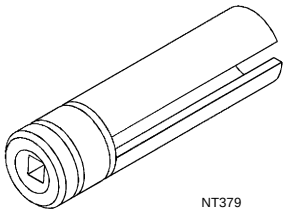
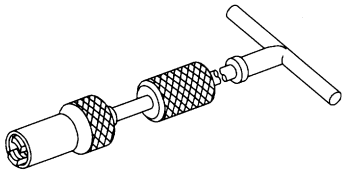
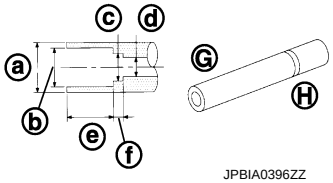
PREPARATION

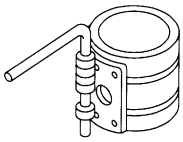
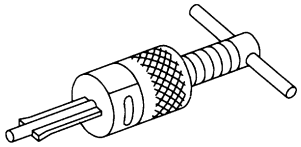
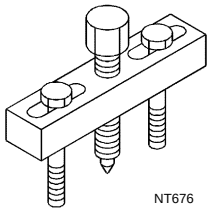
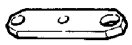
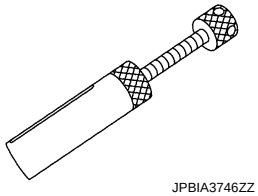
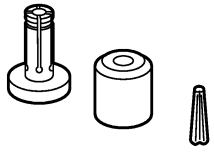
PREPARATION

Special Service Tools

INFOID:0000000006337232

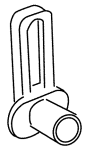
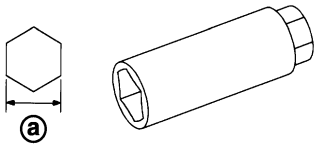
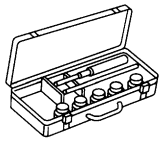
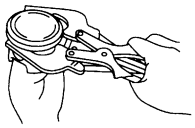
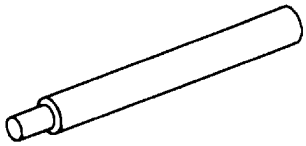
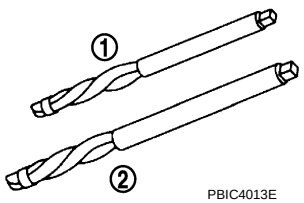
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

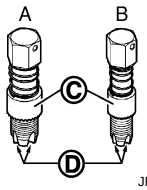
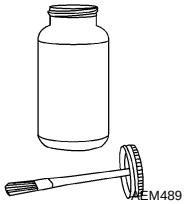
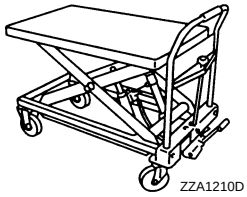
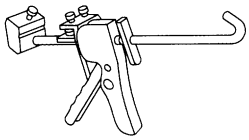
Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter  S-NT046	Removing oil pan (upper and lower) etc.
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter  PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200 (J-26336-A), but Part (2) is not so.
KV10112100 (BT8653-A) Angle wrench  S-NT014	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 (J-3647-A) Heated oxygen sensor wrench  NT379	Loosening or tightening air fuel ratio sensor 1 **For 22 mm (0.87 in) width hexagon nut**
KV10107902 (J-38959) Valve oil seal puller  NT011	Removing valve oil seal
KV10115600 (J-38958) Valve oil seal drift  JPBIA0396ZZ	Installing valve oil seal **Use side A (G).** **a: 20 (0.79) dia.** **d: 8 (0.31) dia.** **b: 13 (0.51) dia.** **e: 10.7 (0.421)** **c: 10.3 (0.406) dia.** **f: 5 (0.20)** **H: Side B** Unit: mm (in)

Tool number (Kent-Moore No.) Tool name	Description
EM03470000 (J-8037) Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 (J-23907) Pilot bushing puller  S-NT045	Removing pilot converter
KV11103000 (—) Pulley puller  NT676	Removing crankshaft pulley
KV11105210 (J-44716) Stopper plate  ZZA0009D	Fixing drive plate
KV10119600 (—) Injector remover  JPBIA3746ZZ	Removing fuel injector
KV101197S0 (—) Injector seal drift set  JPBIA3281ZZ	Installing fuel injector seal ring

Commercial Service Tools

INFOID:0000000006337233

(Kent-Moore No.) Tool name	Description
(J-45488) Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room
(—) Spark plug wrench  JPBIA0399ZZ	Removing and installing spark plug a: 14 mm (0.55 in)
(—) Pulley holder  ZZA1010D	Crankshaft pulley removing and installing
(—) Valve seat cutter set  S-NT048	Finishing valve seat dimensions
(—) Piston ring expander  S-NT030	Removing and installing piston ring
(—) 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

(Kent-Moore No.) Tool name		Description
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 JPBIA0238ZZ	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor (Use with anti-seize lubricant shown below.) **A: J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor** **B: J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor** C: Mating surface shave cylinder D: Flutes
(—) 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
(—) Manual lift table caddy	 ZZA1210D	Removing and installing engine
(—) Tube presser	 S-NT052	Pressing the tube of liquid gasket

BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

Inspection and Adjustment

INFOID:0000000006337234

INSPECTION

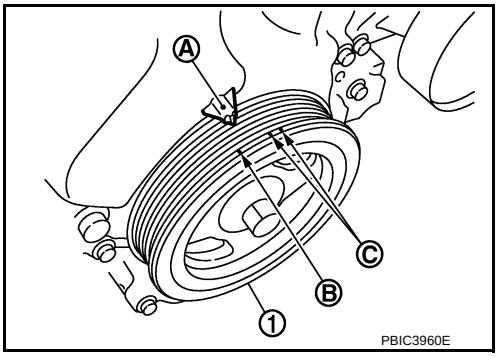
Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to EM-53, "Exploded View".
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.

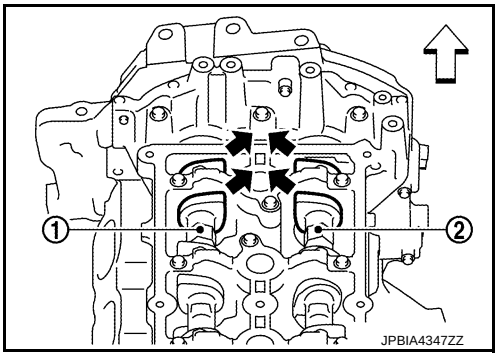
C : White paint mark (Not use for service)



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

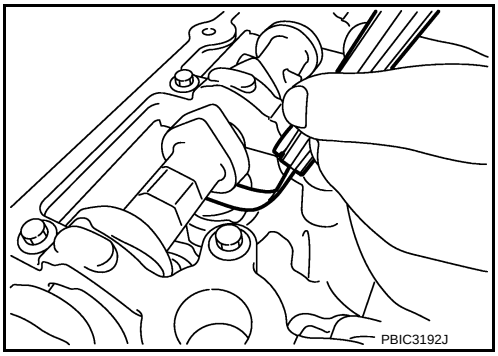
1 : Camshaft (INT)
2 : Camshaft (EXH)
⇦ : Engine front

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



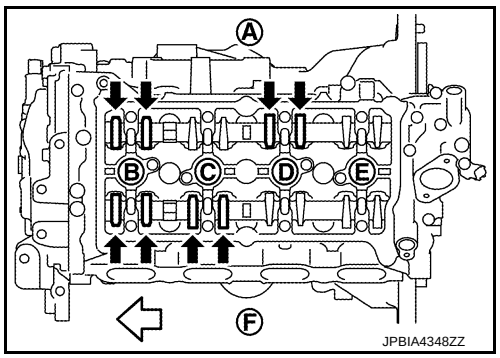
b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

Valve clearance : Refer to EM-130, "Camshaft".



- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below [locations indicated with black arrow (⬅) in the figure] with a feeler gauge.

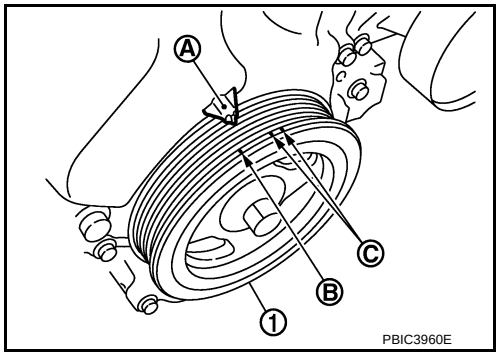
A : Exhaust side
B : No. 1 cylinder
C : No. 2 cylinder
D : No. 3 cylinder
E : No. 4 cylinder
F : Intake side
⇦ : Engine front



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

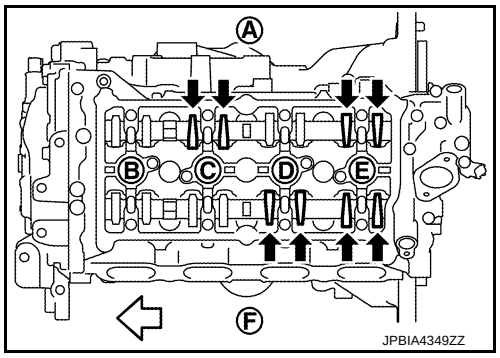
c. Set No. 4 cylinder at TDC of its compression stroke.
- Rotate crankshaft pulley (1) one revolution (360 degrees) and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

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 (⬅) in the figure] with a feeler gauge.

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



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

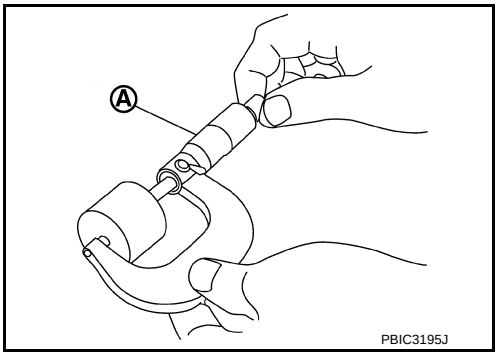
3. If out of standard, perform adjustment. Refer to "ADJUSTMENT".

ADJUSTMENT

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

1. Remove camshaft. Refer to EM-78, "Exploded View".
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

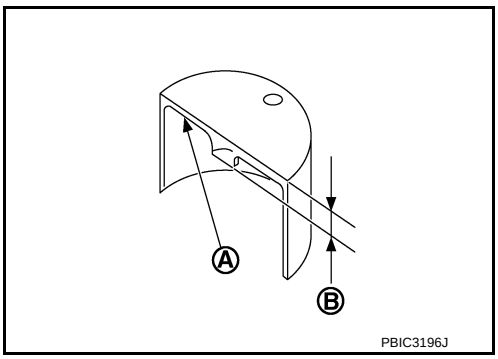
C_1 = Measured valve clearance

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-130, "Camshaft".

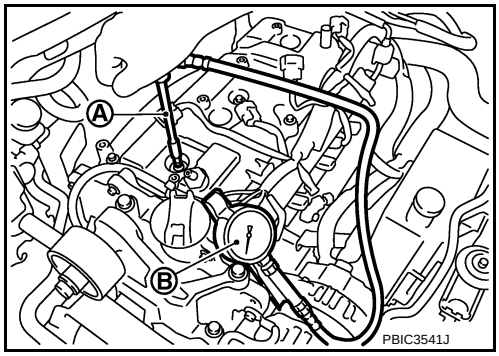
5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-78, "Exploded View".
7. Install timing chain and related parts. Refer to EM-67, "Exploded View".
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to “INSPECTION”.
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

Inspection

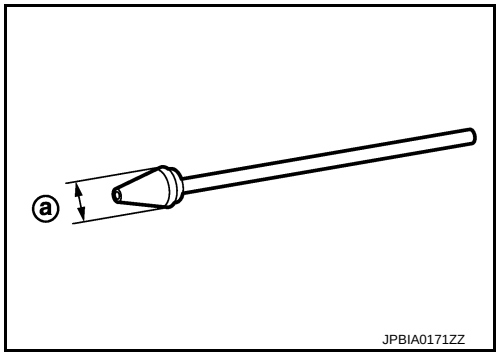
INFOID:0000000006337235

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-551, "Work Procedure".
3. Remove ignition coil and spark plug from each cylinder. Refer to EM-53, "Exploded View".
4. Connect engine tachometer (not required in use of CONSULT-III).
5. Install compression gauge (B) with an adapter (A) (commercial service tool) 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.

a : 20 mm (0.79 in)



6. 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 : Refer to EM-129, "General Specification".

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 the 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, and cylinder head gasket). After the checking, measure 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 recheck 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 gaskets are leaking. In such a case, replace cylinder head gaskets.

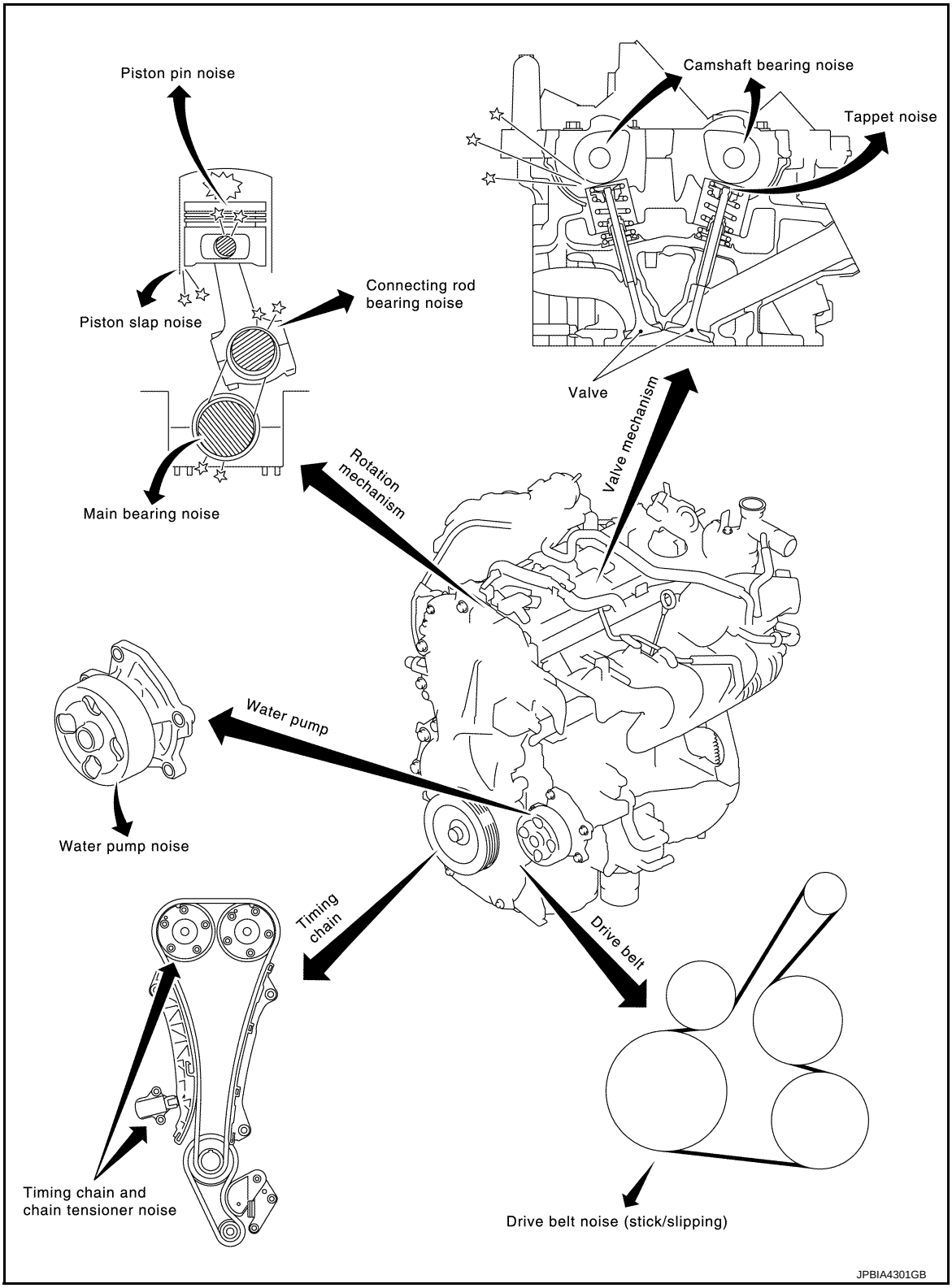
7. After inspection is completed, install removed parts.
8. Start the engine, and check that the engine runs smoothly.
9. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-147, "Description".

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH troubleshooting Chart

INFOID:0000000006337236



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-14
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-130
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-134
	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-134
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-134 EM-138
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-138 EM-134
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-76 EM-67
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-20
	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-22

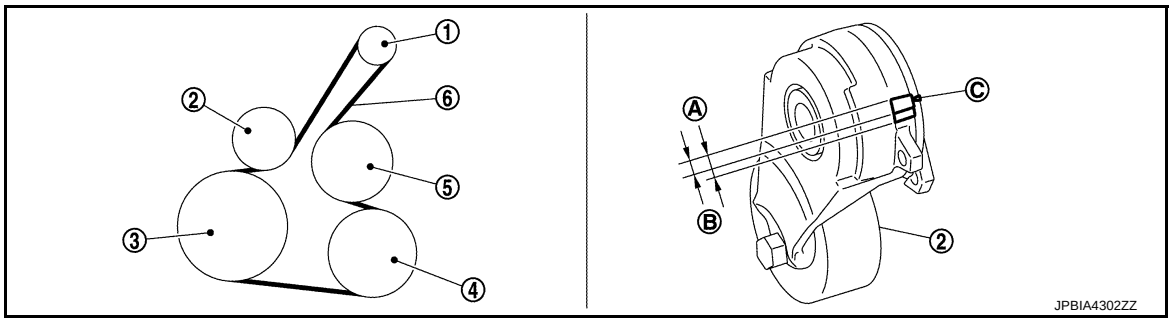
A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

DRIVE BELT

Exploded View

INFOID:0000000006337237



1.	Alternator	2.	Drive belt auto-tensioner	3.	Crankshaft pulley
4.	A/C compressor	5.	Water pump	6.	Drive belt
A.	Possible use range	B.	Range when new drive belt is installed	C.	Indicator

Checking

INFOID:0000000006337238

WARNING:
Perform this step when engine is stopped.

- Check that the indicator (C) (notch on fixed side) of drive belt auto-tensioner is within the possible use range (A) in the figure.
  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) in the figure.
- 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:0000000006337239

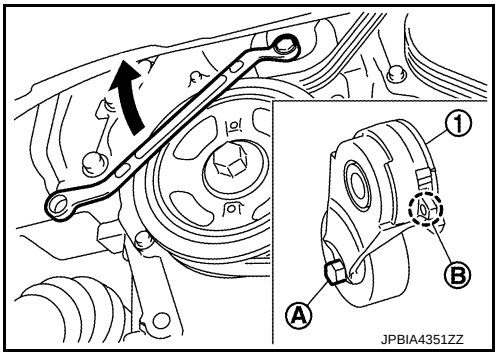
Refer to : EM-129, "Drive Belt".

Removal and Installation

INFOID:0000000006337240

REMOVAL

1. Turn the steering wheel to the right.
2. Remove the front fender protector (RH) front side bolts and clips. And keep a service area. Refer to EXT-22, "Exploded View".
3. 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:
   Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.



4. Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole (B) of the retaining boss to fix drive belt auto-tensioner.
   - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.
5. Remove drive belt.

INSTALLATION

1. 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.**
2. Release drive belt auto-tensioner, and apply tension to drive belt.
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to EM-20, "Exploded View".

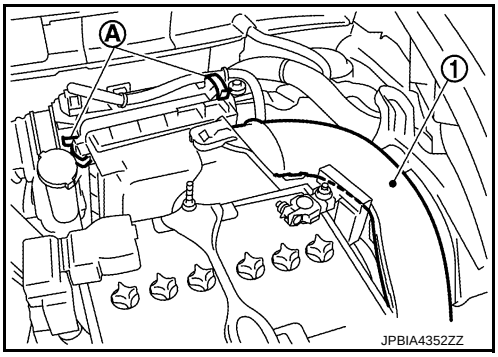
AIR CLEANER FILTER

Removal and Installation

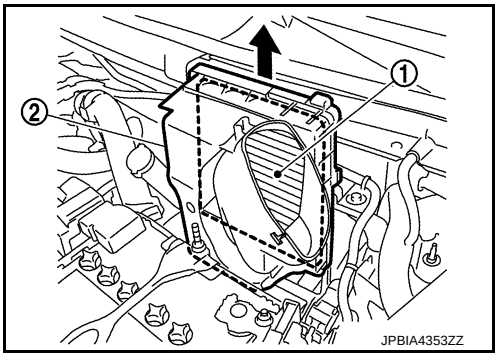
INFOID:0000000006337241

REMOVAL

1. Remove air duct assembly (duct side) (1).
2. Unhook the tabs (A) of both ends of the air cleaner cover.



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



INSTALLATION

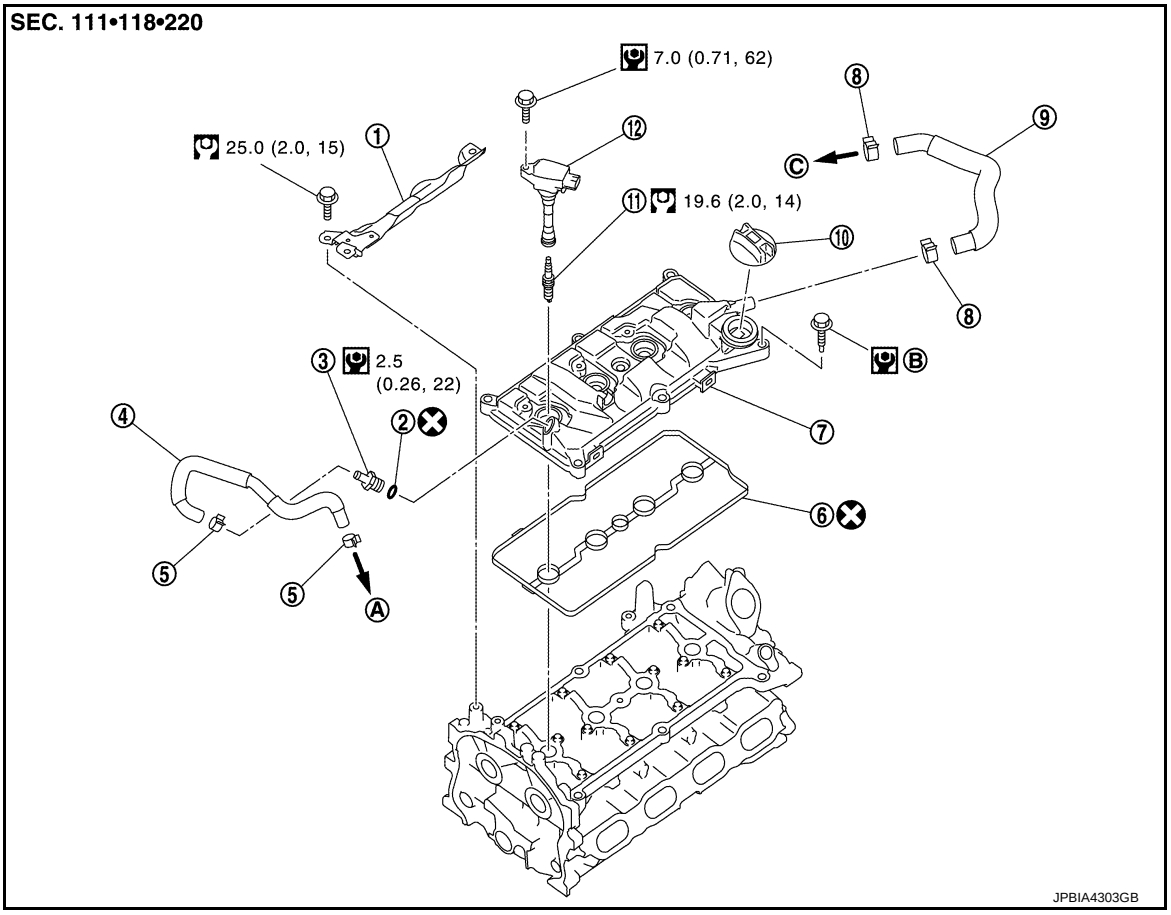
Note the following, and install in the reverse order of removal.

- Fixing clips shall be fixed after inserting air cleaner body protrusion to air cleaner case notch hole.
- Make sure that whether air cleaner body has been firmly installed by shaking it.

SPARK PLUG

Exploded View

INFOID:0000000006430455



1.	Rocker cover protector	2.	O-ring	3.	PCV valve
4.	PCV hose	5.	Clamp	6.	Rocker cover gasket
7.	Rocker cover	8.	Clamp	9.	PCV hose
10.	Oil filler cap	11.	Spark plug	12.	Ignition coil
A.	To air duct assembly	B.	Tightening must be done following the installation procedure. Refer to EM-53	C.	To intake manifold

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

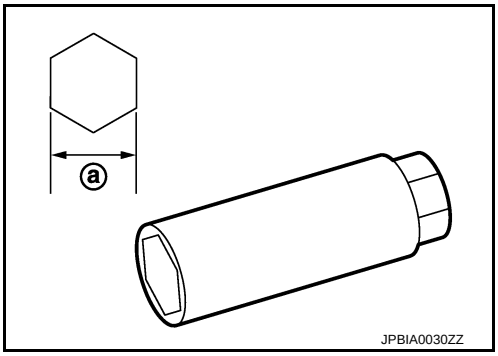
INFOID:0000000006337243

REMOVAL

1. Remove engine cover. Refer to EM-25, "Exploded View".
2. Remove air inlet tube assembly. Refer to EM-31, "Exploded View".
3. Remove ignition coil.

4. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)



CAUTION:
Never drop or shock spark plug.

INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:0000000006337244

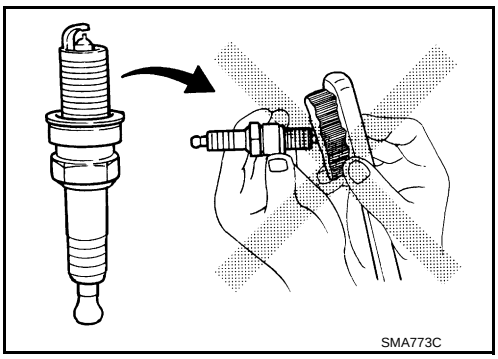
INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

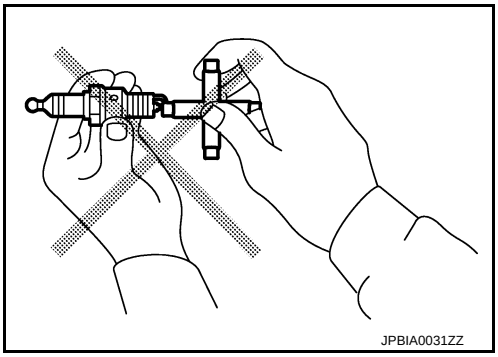
Spark plug (Standard type) : Refer to EM-129, "Spark Plug".

CAUTION:
- **Never drop or shock spark plug.**
- **Never use a wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used.**

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



- **Spark plug gap adjustment is not required between replacement intervals.**
- **Measure spark plug gap. when it exceeds the limit, replace spark plug even if it is with in the specified replacement mileage. Refer to EM-129, "Spark Plug".**

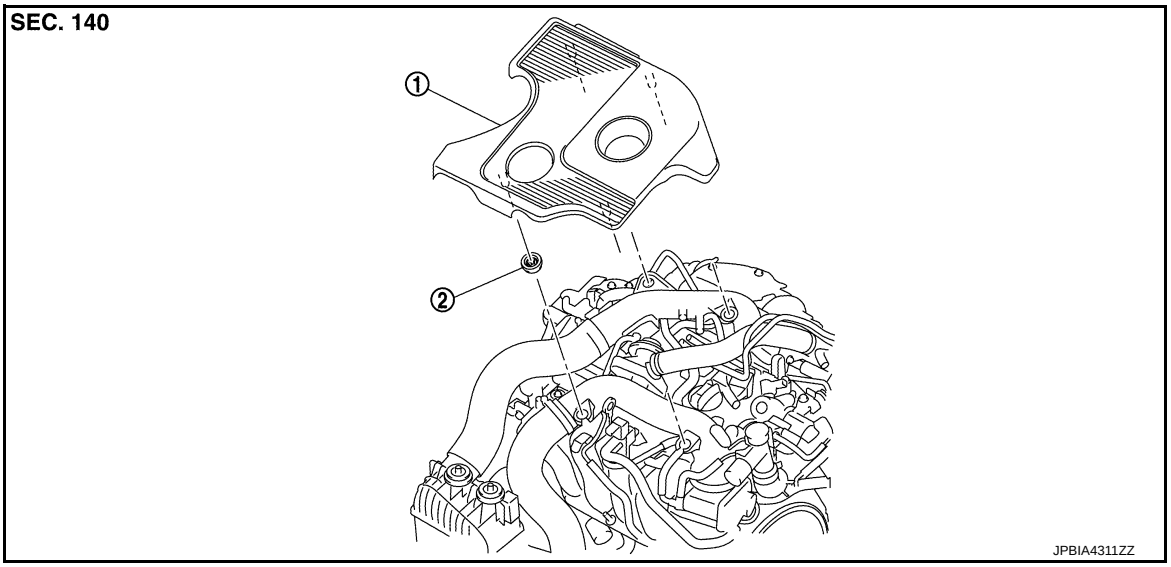


REMOVAL AND INSTALLATION

ENGINE COVER

Exploded View

INFOID:0000000006337245



1. Engine cover
2. Mounting rubber

Removal and Installation

INFOID:0000000006337246

REMOVAL

Remove engine cover.

CAUTION:

Never damage or scratch engine cover when installing or removing.

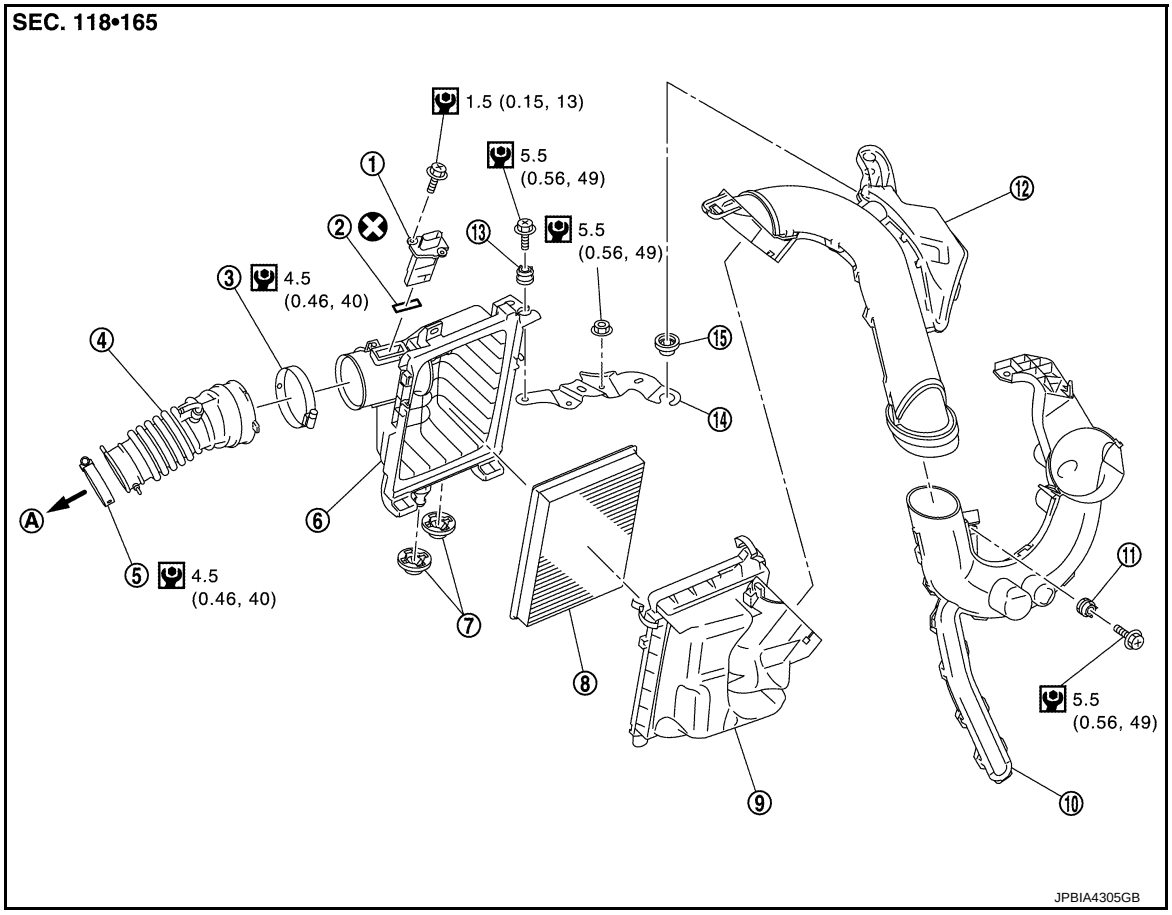
INSTALLATION

Install in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:0000000006337249



1. Mass air flow sensor
2. Gasket
3. Clamp
4. Air duct (suction side)
5. Clamp
6. Air cleaner cover assembly
7. Mounting rubber
8. Air cleaner filter
9. Air cleaner body assembly
10. Air duct with resonator
11. Grommet
12. Air duct (duct side)
13. Grommet
14. Bracket
15. Mounting rubber
A. To turbocharger

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006337250

REMOVAL

NOTE:

Mass air flow sensor is removable under the car-mounted condition.

1. Remove air duct (duct side).
2. Remove engine cover. Refer to EM-25, "Exploded View".
3. Remove the air cleaner filter from the air cleaner case.
4. Disconnect mass air flow sensor harness connector, and remove harness clamp from air cleaner body.
5. Remove air cleaner body assembly.
6. Remove the air duct (between air cleaner case assembly and turbocharger air duct).
   - Add matching marks if necessary for easier installation.

7. Remove air cleaner cover assembly.
8. Remove mass air flow sensor from air cleaner cover, if necessary.
   CAUTION:
   Handle the mass air flow sensor with following cares.
   - **Never shock the mass air flow sensor.**
   - **Never disassemble the mass air flow sensor.**
   - **Never touch the sensor of the mass air flow sensor.**
9. Remove air duct with resonator with the following procedure.

a. Remove fender protector (LH). Refer to EXT-22, "Exploded View".
b. Remove air duct with resonator.

INSTALLATION

Note the following, and install in the reverse order of removal.
- Align marks. Attach each joint. Screw clamps firmly.
- Fixing clips shall be fixed after inserting air cleaner body assembly protrusion to air cleaner case botch hole.
- Make sure whether air cleaner body has been firmly installed by shaking it.

Inspection

INFOID:0000000006337251

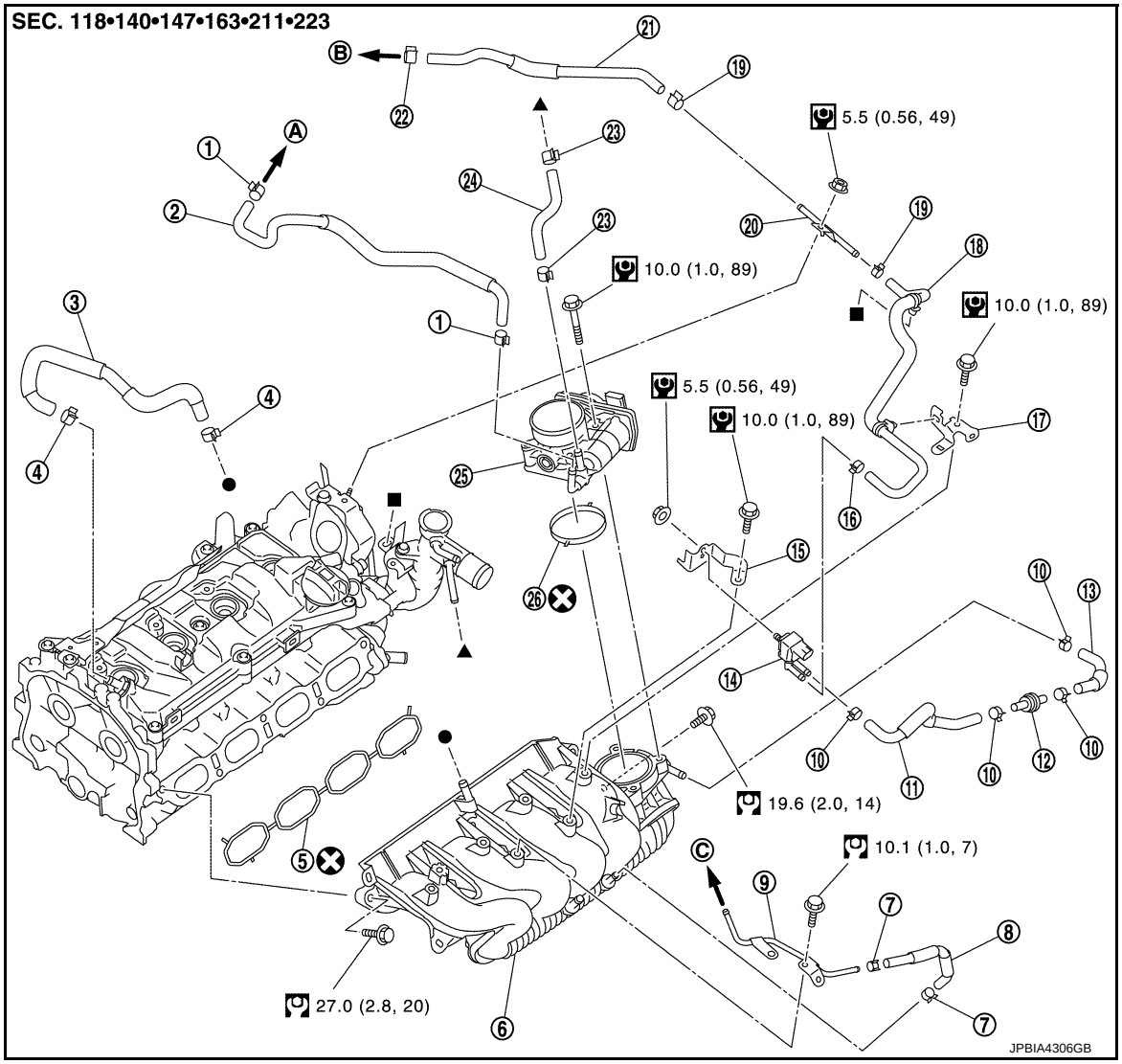
INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.
- If anything found, replace air duct and resonator assembly.

INTAKE MANIFOLD

Exploded View

INFOID:0000000006337252



1.	Clamp	2.	Water hose	3.	PCV hose
4.	Clamp	5.	Gasket	6.	Intake manifold
7.	Clamp	8.	Vacuum hose	9.	Vacuum gallery assembly
10.	Clamp	11.	EVAP hose	12.	EVAP service port valve
13.	EVAP hose	14.	EVAP canister purge volume control solenoid valve	15.	Bracket
16.	Clamp	17.	Bracket	18.	EVAP hose
19.	Clamp	20.	EVAP tube	21.	EVAP hose
22.	Clamp	23.	Clamp	24.	Water hose
25.	Electric throttle control actuator	26.	Gasket		
A.	To turbocharger	B.	To centralized under-floor piping	C.	To recirculation valve hose

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

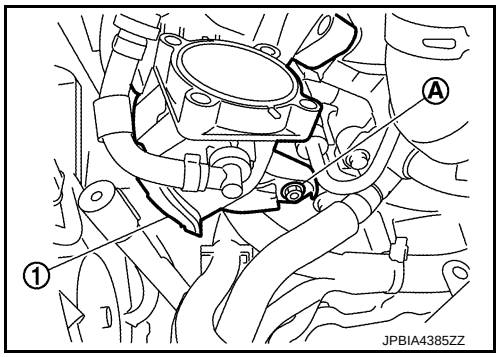
: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006337253

REMOVAL

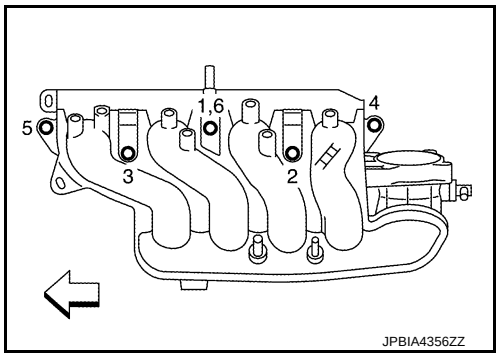
1. Remove engine cover. Refer to EM-25, "Exploded View".
2. Pull out oil level gauge.
   CAUTION:
   Cover the oil level gauge guide openings to avoid entry of foreign materials.
3. Disconnect turbocharger boost sensor (with intake air temperature sensor 2) harness connector. Refer to EM-31, "Exploded View".
4. Remove air inlet tube assembly. Refer to EM-31, "Exploded View".
5. Disconnect water hoses from electric throttle control actuator as follows:
   - Attach plug to prevent engine coolant leakage when engine coolant is not drained. Refer to CO-11, "Draining".
   CAUTION:
   Perform this step when the engine is cold.
   NOTE:
   This step is not required when removing only intake manifold.
6. Disconnect electric throttle control actuator harness connector.
7. Remove electric throttle control actuator.
   CAUTION:
   - **Handle carefully to avoid any shock to electric throttle control actuator.**
   - **Never disassemble electric throttle control actuator.**
8. Disconnect EVAP canister purge volume control solenoid valve harness connector, and them remove bracket with EVAP canister purge volume control solenoid valve.
9. Remove vacuum gallery.
10. Disconnect PCV hose (intake manifold side).
11. Remove intake manifold (1) with the following procedure.
    - Loosen and remove intake manifold mounting bolt (A).



- Loosen mounting bolts in reverse order as shown in the figure.

⇦ : Engine front

NOTE:
Disregard the numerical order No.6 in removal.
CAUTION:
Cover engine openings to avoid entry of foreign materials.



INSTALLATION

Note the following, and install in the reverse order of removal.

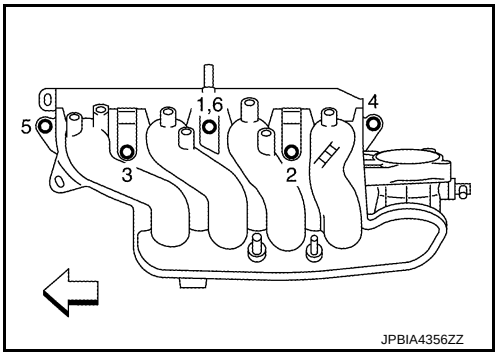
Intake Manifold

1. Check if gasket is not dropped from the installation groove of intake manifold.
2. Install intake manifold with the following procedure:

a. Tighten in numerical order as shown in the figure.

⇦ : Engine front

NOTE:
- Tighten bolt the No.1 in two steps.
- The numerical order No.6 shows the second step.



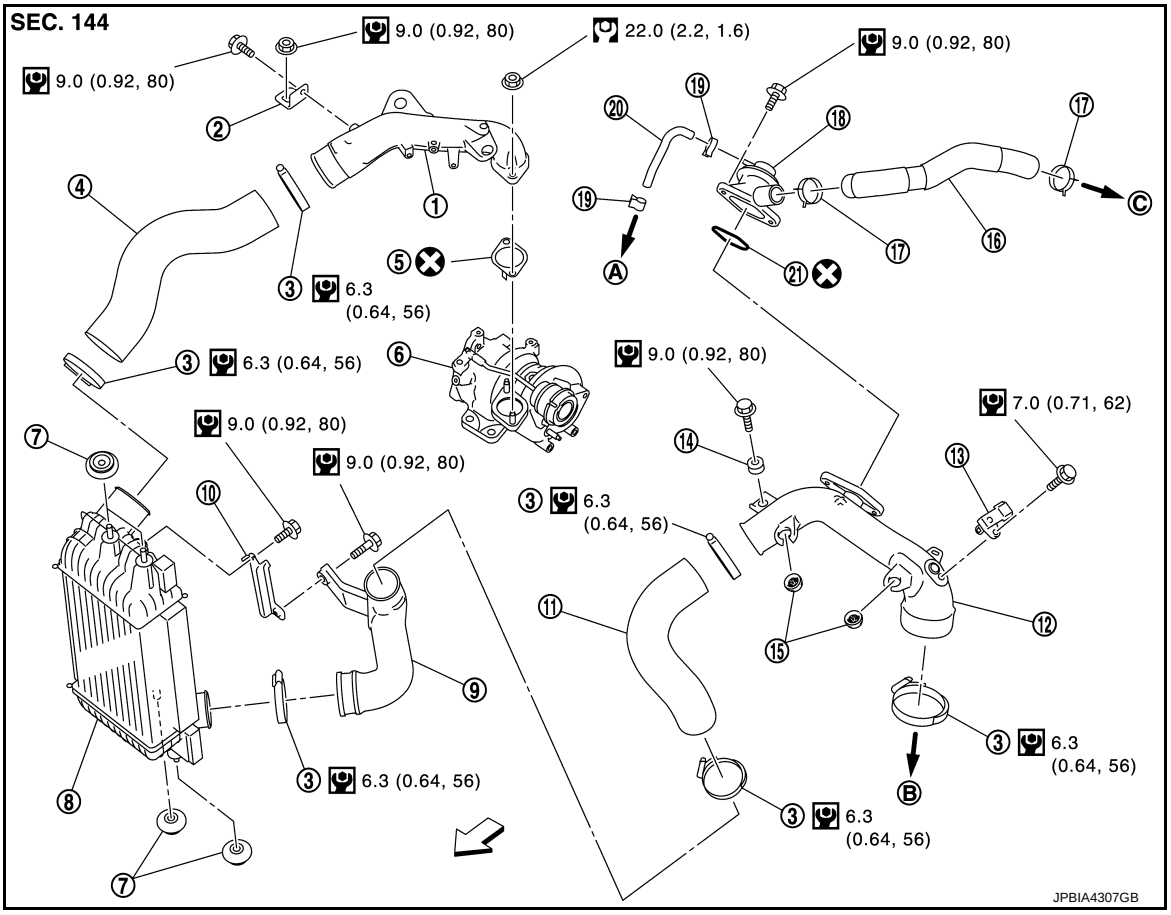
3. Install in the reverse order of removal after this step.

Electric Throttle Control Actuator
- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform “Throttle Valve Closed Position Learning” after repair when removing harness connector of the electric throttle control actuator. Refer to EC-135, "Work Procedure".
- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer to EC-135, "Work Procedure" and EC-136, "Work Procedure".

CHARGE AIR COOLER

Exploded View

INFOID:0000000006337254



1.	Air inlet tube assembly	2.	Air inlet tube bracket	3.	Clamp
4.	Air inlet hose	5.	Gasket	6.	Turbocharger
7.	Mounting rubber	8.	Charge air cooler	9.	Air inlet tube assembly
10.	Air inlet tube bracket	11.	Air inlet hose	12.	Air inlet tube assembly
13.	Turbochager boost sensor (with intake air temperture sensor 2)	14.	Grommet	15.	Grommet
16.	Air inlet hose	17.	Clamp	18.	Recirculation valve
19.	Clamp	20.	Vacuum hose	21.	Gasket
A.	To vacuum gallery assembly	B.	To electric throttle control actuator	C.	To turbocharger

⇦ : Vehicle front

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

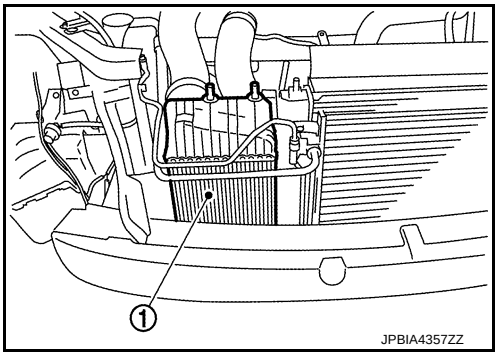
Removal and Installation

INFOID:0000000006337255

REMOVAL

1. Remove front bumper. Refer to EXT-12, "Exploded View".
2. Remove radiator core support upper. Refer to DLK-149, "MR16DDT : Exploded View".
3. Remove air inlet hose between air inlet tube and charge air cooler.

4. Remove charge air cooler (1).
   CAUTION:
   - **Avoid interference between the charge air cooler and radiator.**
   - **When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.**



INSTALLATION

Install in the reverse order of removal paying attention to the following points:
- Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
- Pay attention to identification mark and direction.
- When installing air inlet hoses and tubes. Refer to EM-31, "Removal and Installation".

Inspection

INFOID:0000000006337256

INSPECTION AFTER REMOVAL

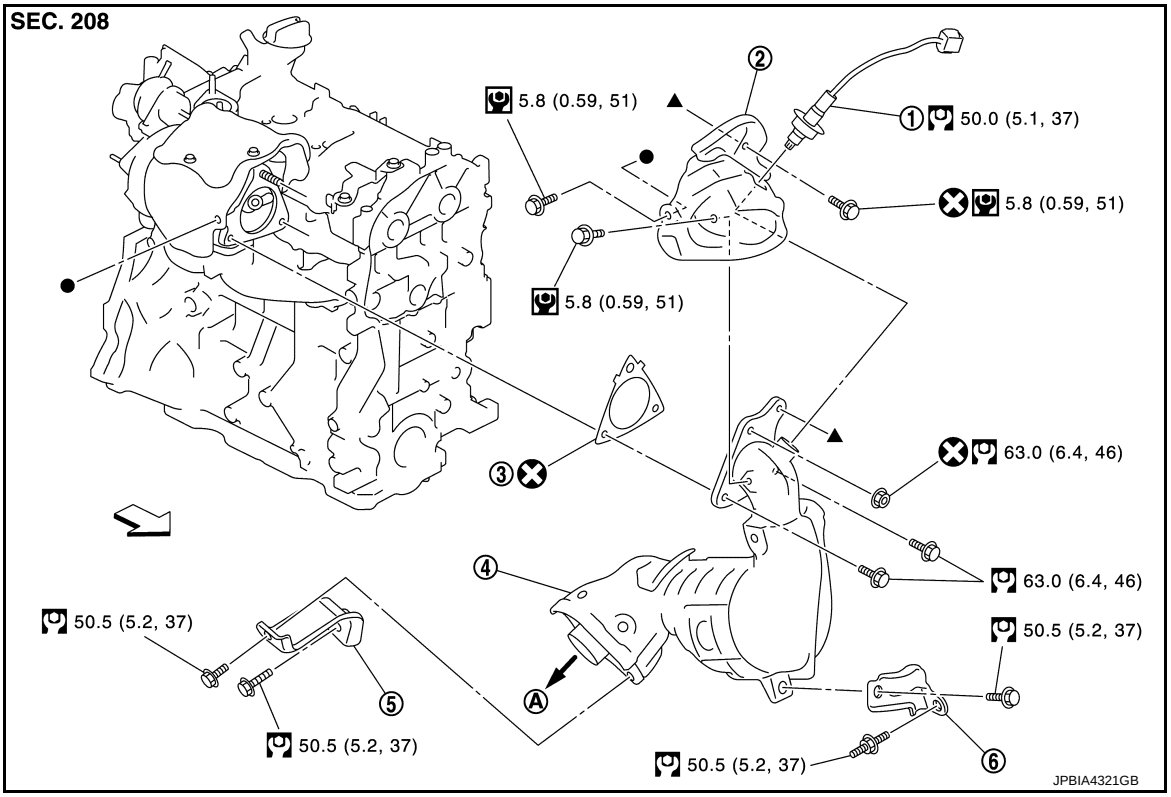
1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler in necessary.
   - Be careful not to deform core fins.
   - For cleaning procedure of charge air cooler core, refer to CO-19, "Inspection".

CATALYST

2WD

2WD : Exploded View

INFOID:0000000006430453



1. A/F sensor 1
2. Catalyst convertor shroud upper
3. Gasket
4. Catalyst
5. Catalyst convertor support bracket rear
6. Catalyst convertor bracket (RH)

A. To exhaust system

⇦ Engine front

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

2WD : Removal and Installation

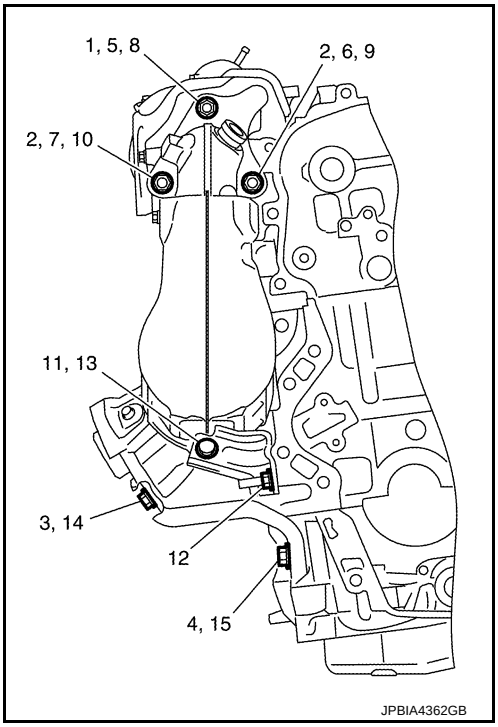
INFOID:0000000006430454

REMOVAL

1. Remove engine cover. Refer to EM-25, "Exploded View".
2. Remove cowl top extension. Refer to EXT-20, "Exploded View".
3. Remove front tube. Refer to EX-5, "Exploded View".
4. Remove A/F sensor 1.
   - Using heated oxygen sensor wrench [SST: KV10117100], remove A/F sensor 1.
   CAUTION:
   Handle A/F sensor 1 carefully and avoid impacts.
5. Remove catalyst convertor shroud upper.
6. Remove bolts and nut of catalyst convertor turbocharger side.
7. Remove support bracket (RH).
8. Remove drive shaft insulator. Refer to
9. Remove catalyst convertor.

INSTALLATION

1. Install catalyst convertor with the following procedure.
   - Tighten in numerical order as shown in the figure.
   - Install catalyst convertor (base on stud position 1).
   - Temporary assemble 2 (no priority).
   - Temporary assemble 3, 4.
   - Tightening 5, 6 and 7.
   - Tightening again 8, 9 and 10.
   - Temporary assemble 11.
   - Tightening 12,13,14,and 15.

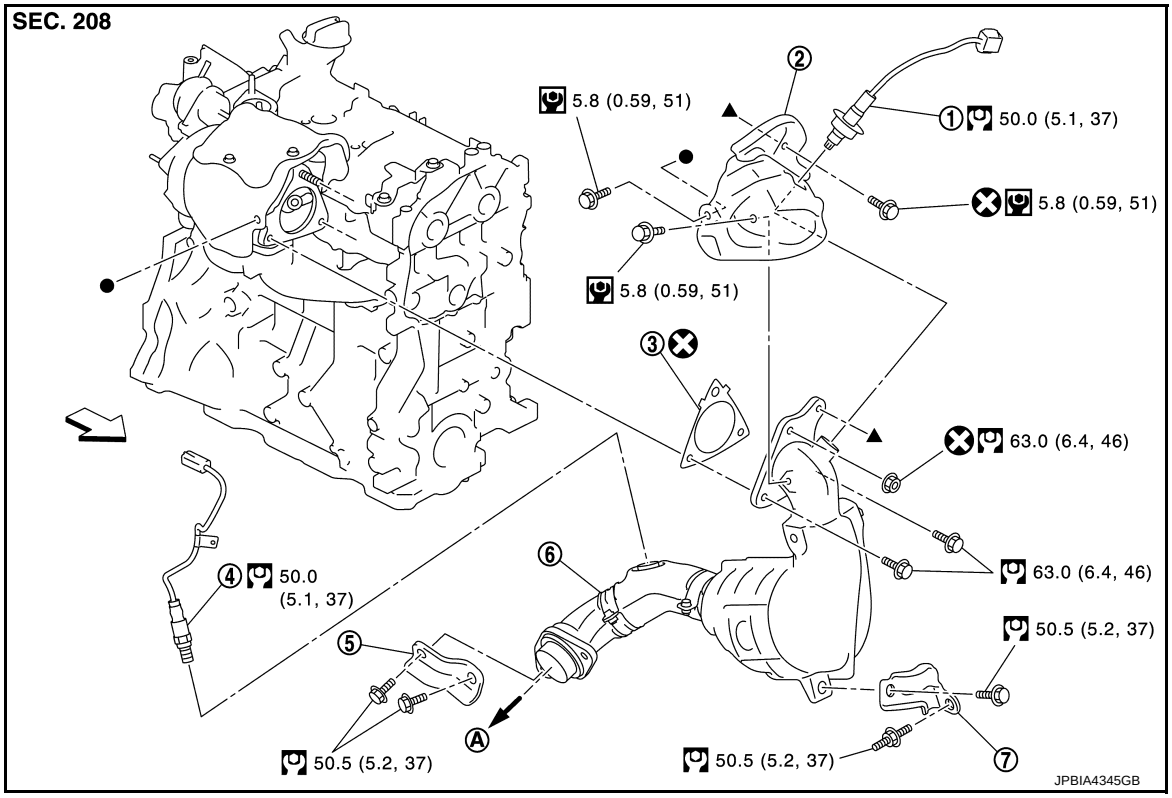


2. Install in the reverse order of removal after this step.

4WD

4WD : Exploded View

INFOID:0000000006430461



1. A/F sensor 1
2. Catalyst convertor shroud upper
3. Gasket
4. Heated oxygen sensor 2
5. Catalyst convertor upport bracket rear
6. Catalyst convertor
7. Catalyst convertor support bracket (RH)

A. To exhaust system

⇦ Engine front

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

4WD : Removal and Installation

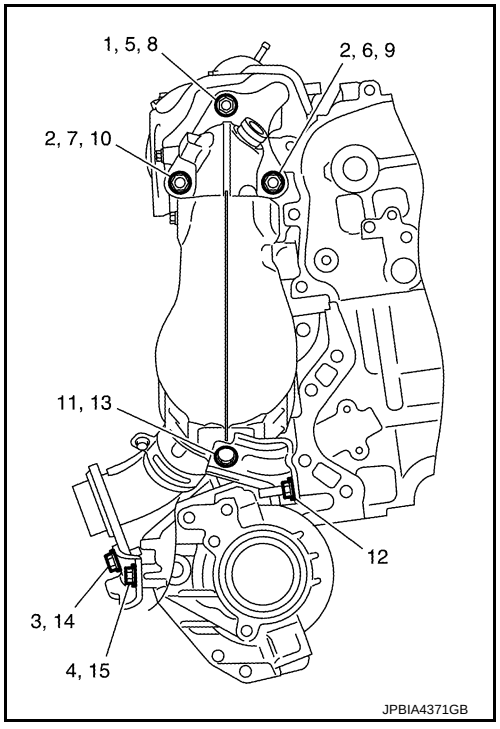
INFOID:0000000006430462

REMOVAL

1. Drain engine coolant. Refer to CO-11, "Draining".
2. Remove engine cover. Refer to EM-25, "Exploded View".
3. Remove cowl top extension. Refer to EXT-20, "Exploded View".
4. Remove front tube. Refer to EX-5, "Exploded View"
5. Remove A/F sensor 1.
6. Remove catalyst convertor shroud upper.
7. Remove bolts and nut of catalyst convertor turbocharger side.
8. Remove drive shaft insulator.
9. Remove support bracket (RH).
10. Move catalyst convertor.
11. Remove turbocharger. Refer to EM-36, "Exploded View".
12. Remove catalyst convertor.

INSTALLATION

1. Install catalyst convertor with the following procedure.
   - Tighten in numerical order as shown in the figure.
   - Install catalyst convertor (base on stud position 1).
   - Temporary assemble 2 (no priority).
   - Temporary assemble 3, 4.
   - Tightening 5, 6 and 7.
   - Tightening again 8, 9 and 10.
   - Temporary assemble 11.
   - Tightening 12,13,14,and 15.

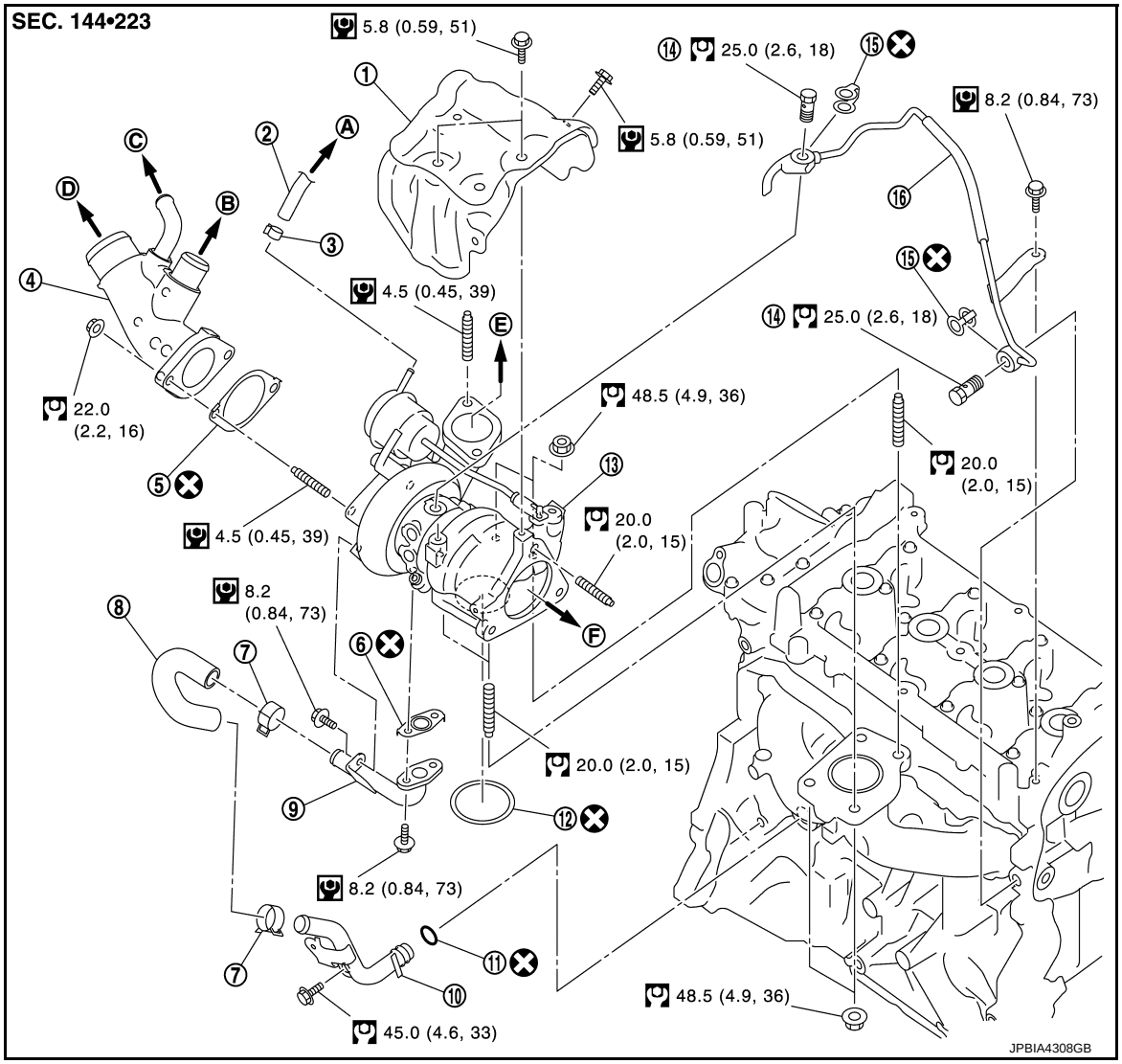


2. Install in the reverse order of removal after this step.

TURBOCHARGER

Exploded View

INFOID:0000000006337257



1.	Heat insulator	2.	Actuator hose	3.	Clamp
4.	Turbocharger inlet tube	5.	Gasket	6.	Gasket
7.	Clamp	8.	Oil outlet hose	9.	Oil return pipe
10.	Oil supply tube	11.	O-ring	12.	O-ring
13.	Turbocharger	14.	Eye bolt	15.	Gasket
16.	Oil supply tube				
A.	To EVAP canister purge volume control solenoid valve	B.	To air inlet hose	C.	To PCV hose
D.	To air duct	E.	To air inlet tube assembly	F.	To catalyst convertor

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006337258

REMOVAL

1. Drain engine coolant. Refer to CO-11, "Draining".
2. Remove engine cover. Refer to EM-25, "Exploded View".
3. Remove air cleaner cover assembly and air cleaner body assembly. Refer to EM-26, "Exploded View".
4. Remove air inlet tube assembly. Refer to EM-31, "Exploded View".
5. Remove cowl top extension. Refer to EXT-20, "Exploded View".
6. Disconnect heated oxygen sensor 2 harness connector.
7. Remove front tube. Refer to EX-5, "Exploded View".
8. Remove catalyst convertor. Refer to EM-33, "2WD : Exploded View" (2WD models) or EM-34, "4WD : Exploded View" (4WD models).
9. Remove turbocharger assembly as follows:

a. Remove heat insulator.
b. Remove oil supply tube.
c. Remove mounting nuts of turbocharger.

CAUTION:
Be careful not to deform each turbocharger piping when pulling out the assembly.

INSTALLATION

Install in the reverse order of removal.

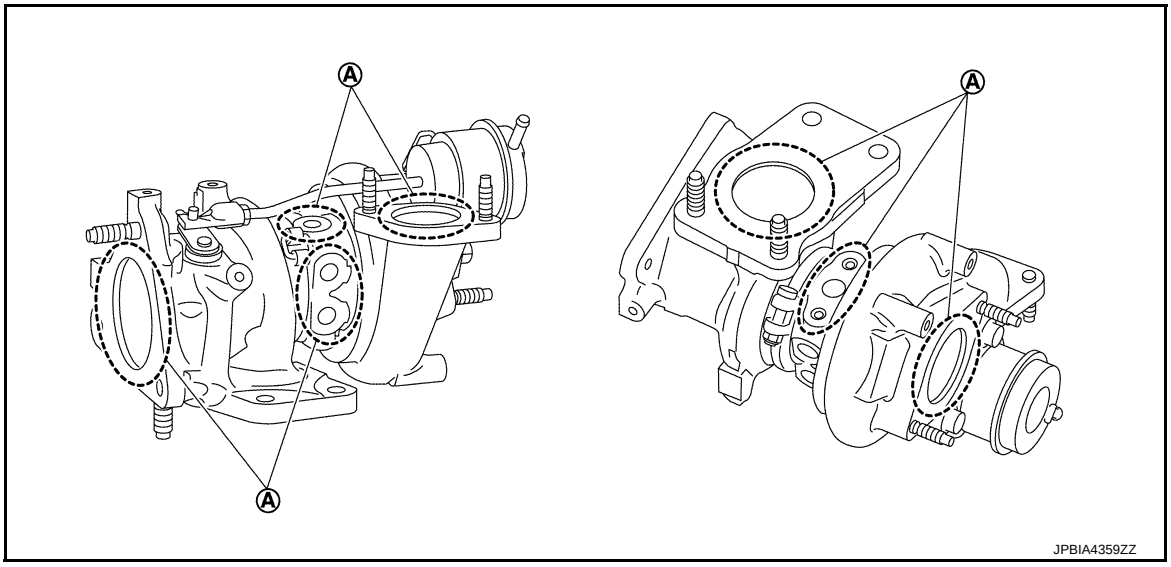
NOTE:
Apply LOCTITE FRENETANCH or equivalent to the threads of the turbocharger oil inlet pipe union to the cylinder head.

Inspection

INFOID:0000000006337259

INSPECTION AFTER REMOVAL

Turbocharger



A. Check for leakage

CAUTION:
When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and air cleaner
Exhaust side : Between turbocharger and outlet duct

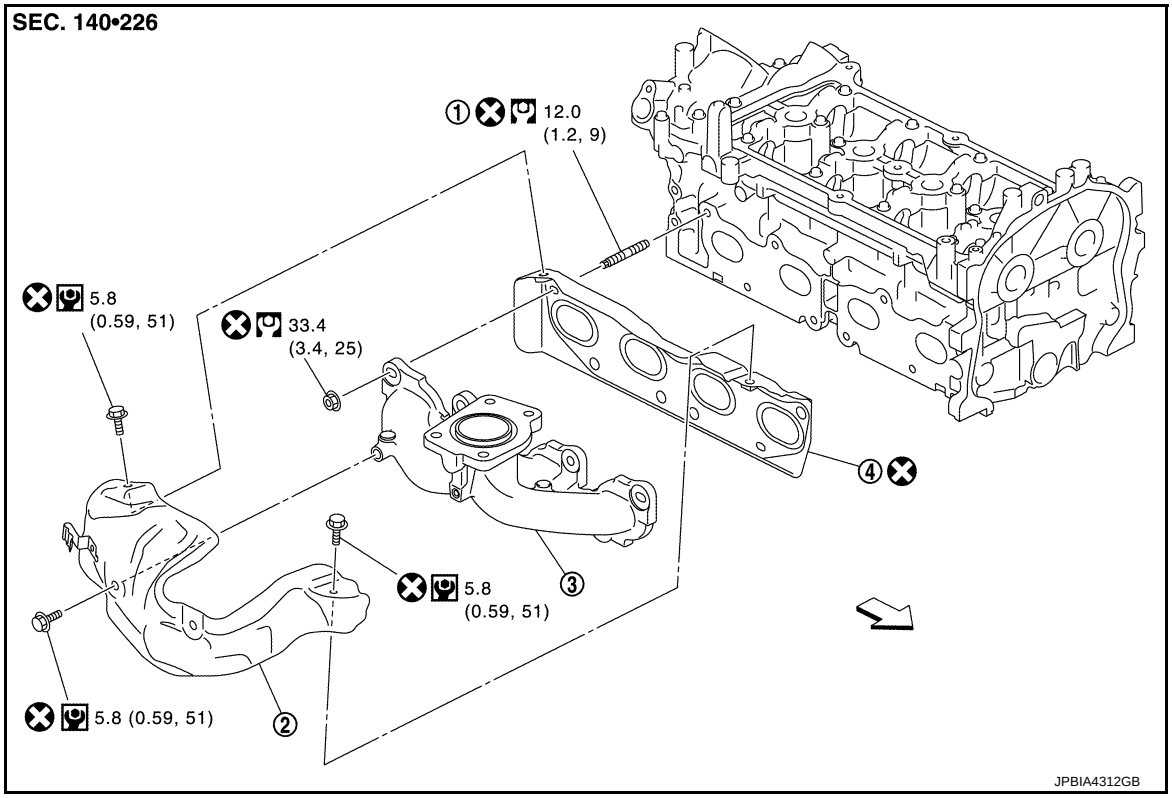
INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

EXHAUST MANIFOLD

Exploded View

INFOID:0000000006337260



1. Stud bolt
2. Exhaust manifold cover
3. Exhaust manifold
4. Gasket

⇦ Engine front

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006337261

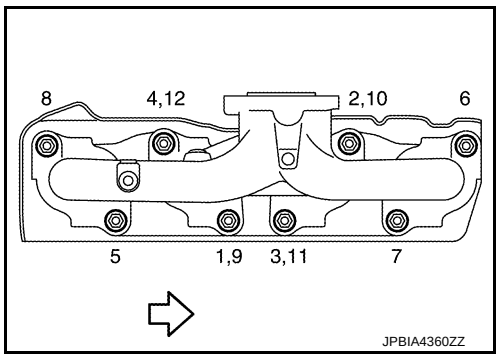
REMOVAL

1. Drain engine coolant. Refer to CO-11, "Draining".
2. Remove turbocharger. Refer to EM-36, "Exploded View".
3. Remove catalyst convertor. Refer to EM-33, "2WD : Exploded View" (2WD models) or EM-34, "4WD : Exploded View" (4WD models).
4. Remove exhaust manifold cover.
5. Remove exhaust manifold.

- Loosen nuts in reverse order as shown in the figure.

⇦ : Engine front

NOTE:
Disregard the numerical order No. 9 to 12 in removal.



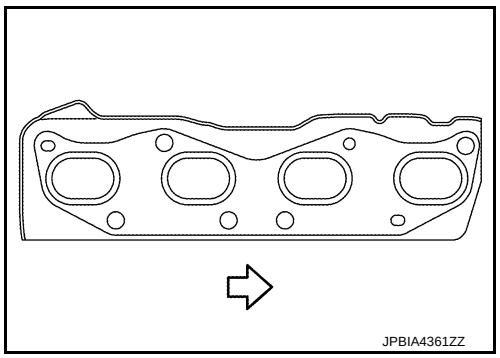
6. Remove gasket.

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

INSTALLATION

1. Install gasket to cylinder head as shown in the figure.

⇦ : Engine front

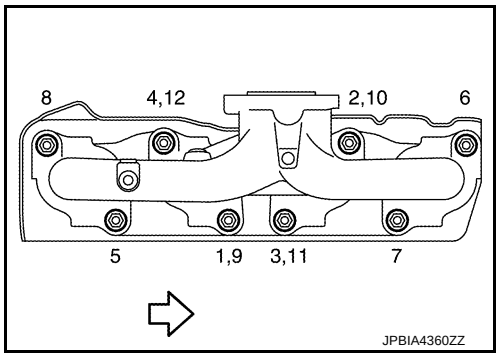


2. Install exhaust manifold with the following procedure:

a. Tighten nuts in numerical order as shown in the figure.

⇦ : Engine front

NOTE:
- Tighten nuts the No.1 to No.4 in two steps.
- The numerical order No.9 to No.12 shows the second step.



3. Install remaining parts in the reverse order of removal.

Inspection

INFOID:0000000006337262

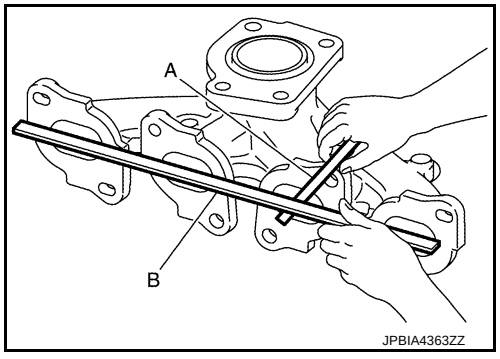
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : Refer to EM-130, "Exhaust Manifold".

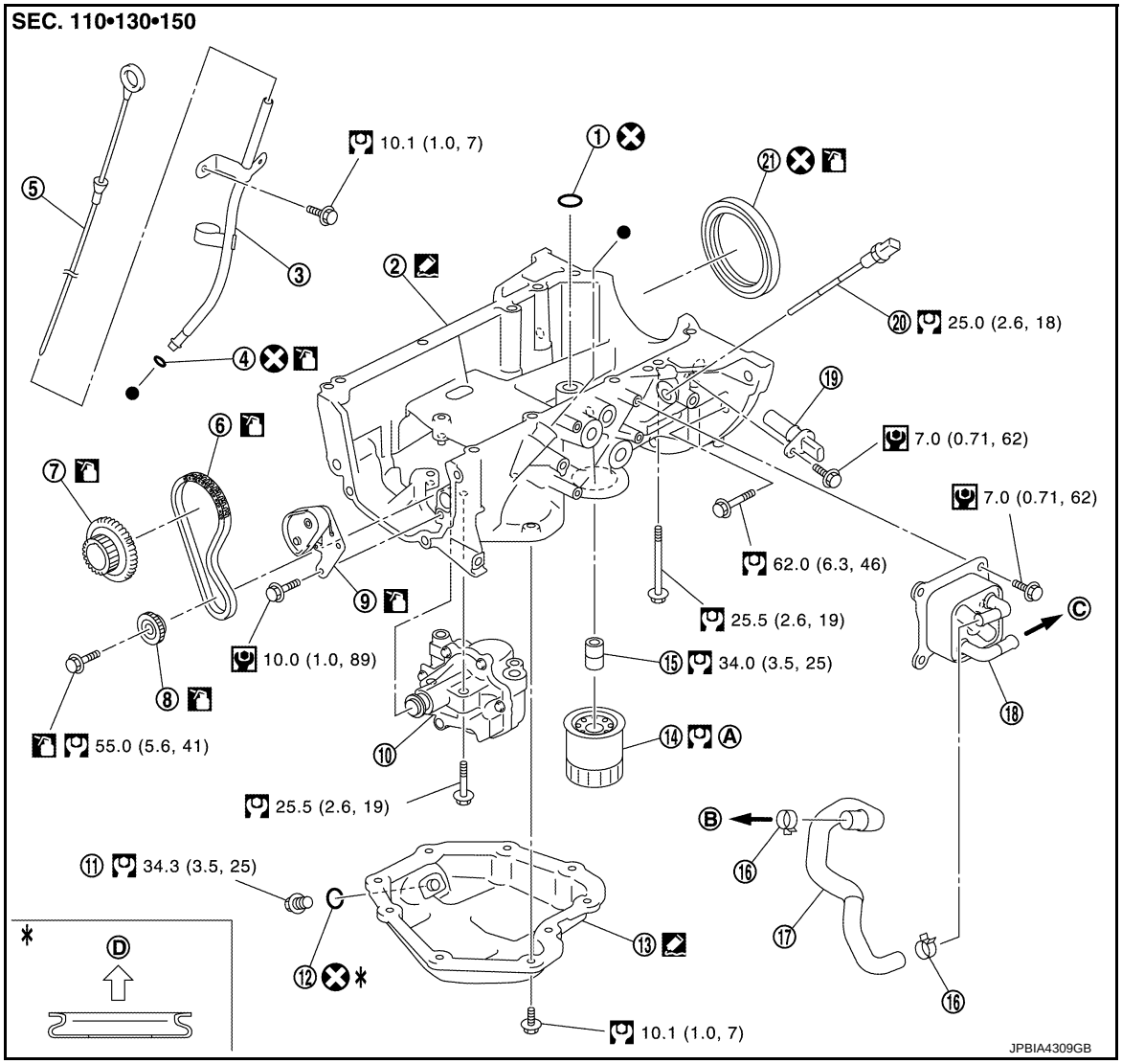
- If it exceeds the limit, replace exhaust manifold.



OIL PAN (LOWER)

Exploded View

INFOID:0000000006430456



1. O-ring
2. Oil pan (upper)
3. Oil level gauge guide
4. O-ring
5. Oil level gauge
6. Oil pump drive chain
7. Crankshaft sprocket
8. Oil pump sprocket
9. Oil pump chain tensioner
10. Oil pump
11. Drain plug
12. Drain plug washer
13. Oil pan (lower)
14. Oil filter
15. Connector bolt
16. Clamp
17. Water hose
18. Oil cooler
19. Crankshaft position sensor
20. Oil level sensor
21. Rear oil seal

A. Refer to LU-11
B. Oil pan side
C. To thermostat housing (M/T models)
To CVT oil warmer (CVT models)
D. Oil pan side

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Sealing point

: Should be lubricated with oil.

Removal and Installation

INFOID:0000000006337264

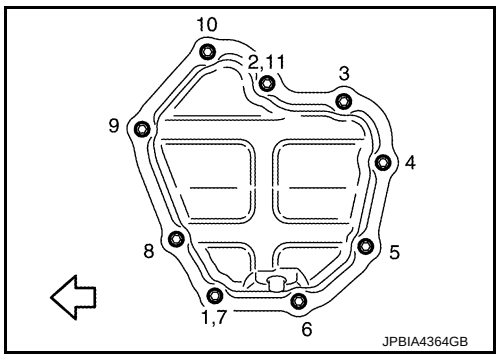
REMOVAL

1. Drain engine oil. Refer to LU-9, "Draining".
2. Remove oil pan (lower) with the following procedure:

a. Loosen mounting bolts in reverse order as shown in the figure.

: Engine front

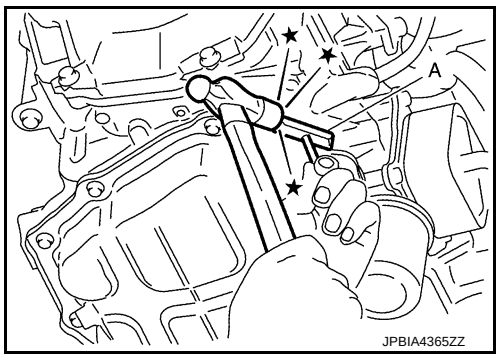
NOTE:
Disregard the numerical order No.7 and No.11 in removal.



b. Insert seal cutter [SST: KV10111100 (J-37228)] (A) between oil pan (upper) and oil pan (lower).
CAUTION:
- **Be careful not to damage the mating surface.**
- **Never insert a screwdriver. This damages the mating surfaces.**

c. Slide the seal cutter [SST: KV10111100 (J-37228)] by tapping on the side of tool with a hammer.

d. Remove oil pan (lower).

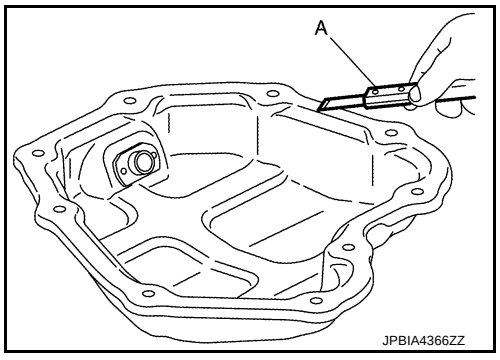


INSTALLATION

1. Install oil pan (lower) as follows:

a. 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.

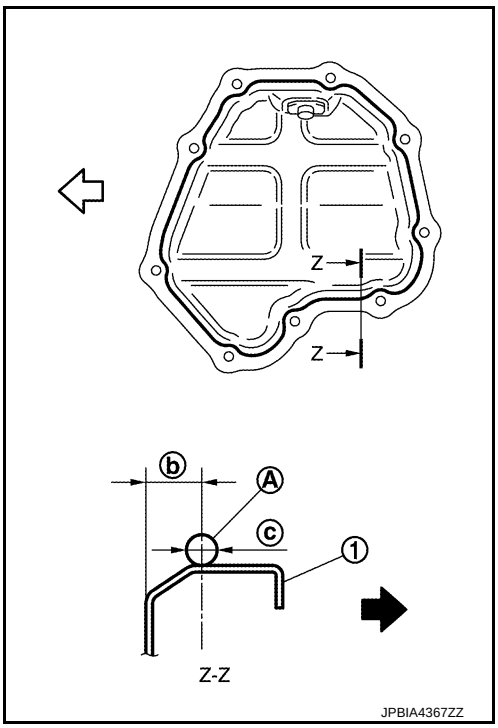
CAUTION:
Never scratch or damage the mating surface when cleaning off old liquid gasket.



b. Apply a continuous bead of liquid gasket (A) with a tube presser (commercial service tool) as shown in the figure.

1 : Oil pan (lower)
b : 7.5-9.5mm (0.295 - 0.374 in)
c : ϕ 4.0 - 5.0 mm (0.157 - 0.197 in)
⬅ : Engine outside

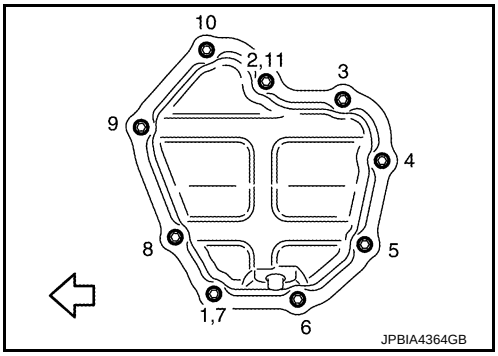
Use Genuine Liquid Gasket or equivalent.
CAUTION:
Attaching should be done within 5 minutes after liquid gasket application.



c. Tighten bolts in numerical order as shown in the figure.

⇦ : Engine front

NOTE:
- Tighten bolts the No.1 and No.2 in two steps.
- The numerical order No.7 and No.11 shows the second steps.



2. Install oil pan drain plug.
   - Refer to the figure of components of former page for installation direction of drain plug washer. Refer to EM-99, "Exploded View".
3. Install in the reverse order of removal after this step.

Inspection

INFOID:0000000006337265

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSPECTION AFTER INSTALLATION

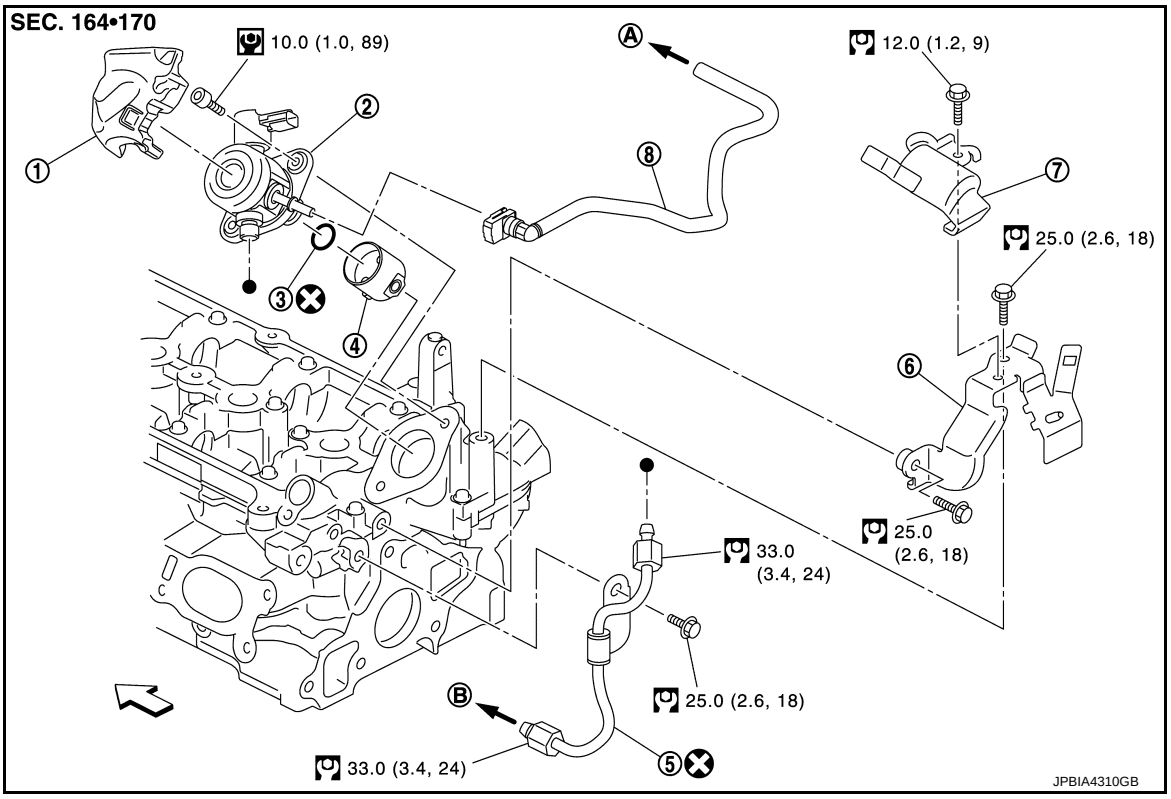
1. Check the engine oil level and adjust engine oil. Refer to LU-8, "Inspection".
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to LU-8, "Inspection".

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

Exploded View

INFOID:0000000006337266

CAUTION:
Never remove or disassemble parts unless instructed as shown in the figure.



1. High pressure fuel pump insulator
2. High pressure fuel pump
3. O-ring
4. Valve lifter
5. Fuel tube assembly
6. Bracket
7. Fuel pump connector protector
8. Fuel feed hose
A. To centralized under-floor piping
B. To fuel tube assembly

⇦ : Engine front

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006337267

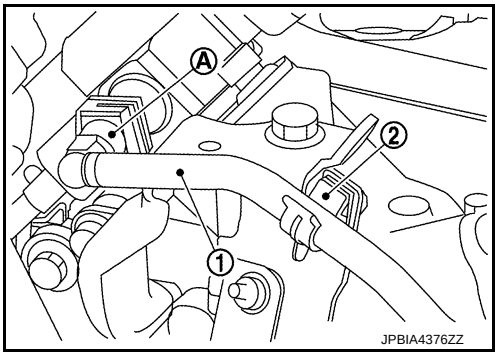
REMOVAL

WARNING:
- **Be sure to read EM-7, "Precaution for Handling High Pressure Fuel System" when working on the high pressure fuel system.**
- **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.**
- **Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.**
- **To avoid the danger of being scalded, never drain engine coolant when engine is hot.**

1. Release fuel pressure. Refer to EC-140, "Work Procedure".
2. Remove engine cover. Refer toEM-25, "Exploded View".
3. Remove fuel pump connector protector, and remove high pressure fuel pump insulator.

4. Disconnect harness connector (A) with the following procedure.

a. Disconnect fuel feed hose (1) from clamp (2).



b. Disengage (A) and pull up (B) the pawl of the fuel feed hose conector retainer (C) to disconnect the fuel feed tube from high pressure fuel pump.

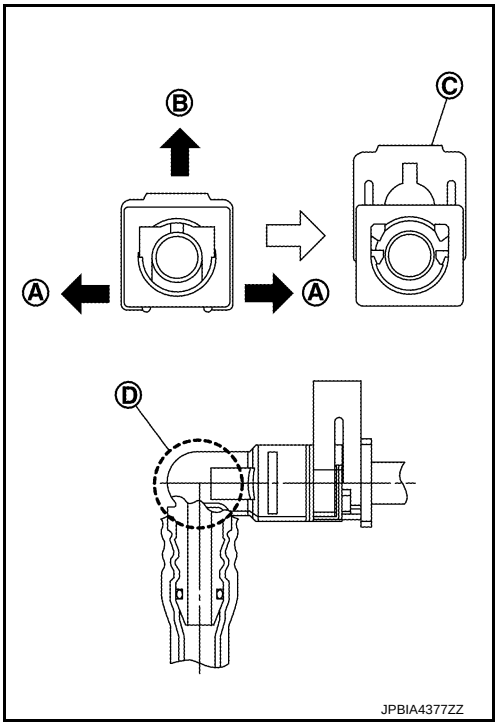
NOTE:

If the fuel feed hose is stuck, hold the fuel pipe by hand and disconnect it by pusing and pulling.

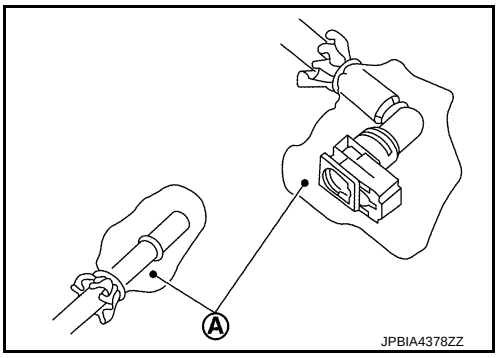
CAUTION:

- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Never expose parts to battery electrolyte or other acids.**
- **Never bent or twist connection between quick connector and fuel feed hose (with damper) during installation/ removal.**
- **Pull quick connector holding (D).**
- **Do not remove the retainer.**
- **Prepare container and colth beforehand as fuel will leak out.**
- **Never pull with lateral force applied. O-ring inside quick connector may be damaged.**

Retainer color : Red



- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags (A), etc. or a similar item.**

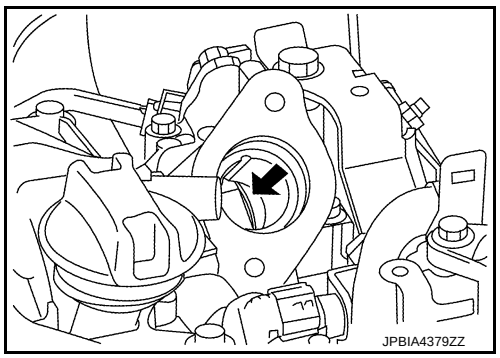


5. Remove intake manifold. Refer to EM-29, "Removal and Installation".
6. Remove fuel feed tube.
7. Remove high pressure fuel pump and lifter.

INSTALLATION

1. Install high pressure pump with the following procedure.

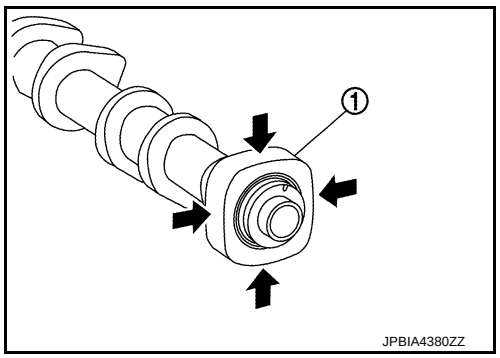
a. Check the orientation of oil pump cam from the mounting area (view arrow) of high pressure fuel pump.



b. Aim oil pump cam at the BTC area (arrow position).

1 : Camshaft (EXH)

NOTE:
For BTC area, anywhere whithin the area indicated by arrow can be accepted.



c. Install O-ring to high pressure fuel pump. When handing new O-ring, paying attention to the following caution items:

CAUTION:
- **Handle O-ring with bare hands. Never wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Never clean O-ring with solvent.**
- **Check 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 new O-ring straight into fuel rail. Never decenter or twist it.**

d. Install valve lifter.

e. Apply oil to the fitting area of high pressure O-ring and cam shaft bracket side to install high pressure pump.

2. Connect fuel feed hose with the following procedure, and them install the fuel feed hose.

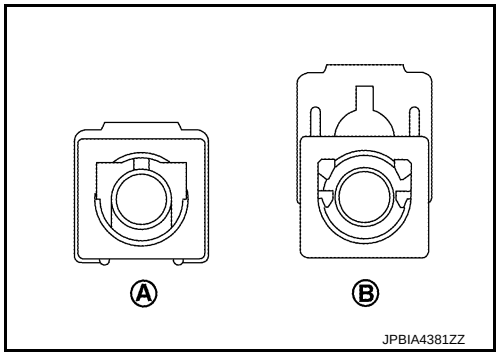
a. Check no foreign substances are deposited in and around matching pipe and quick connector.

b. Quick connector shall be inserted gradually, aligning with the axis of the matching pipe.

c. Insert the retainer until it clicks and check the retainer is locked. After insertion, pull the connector and check that the connector is locked.

A : Lock position
B : Unlock position

CAUTION:
If retainer cannot be installed smoothly, quick connector may be have not been installed correctly. Check connection again.



d. After attaching the quick connector and fix the hose to the clamp.

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

Inspection

INFOID:0000000006337268

INSPECTION AFTER INSTALLATION

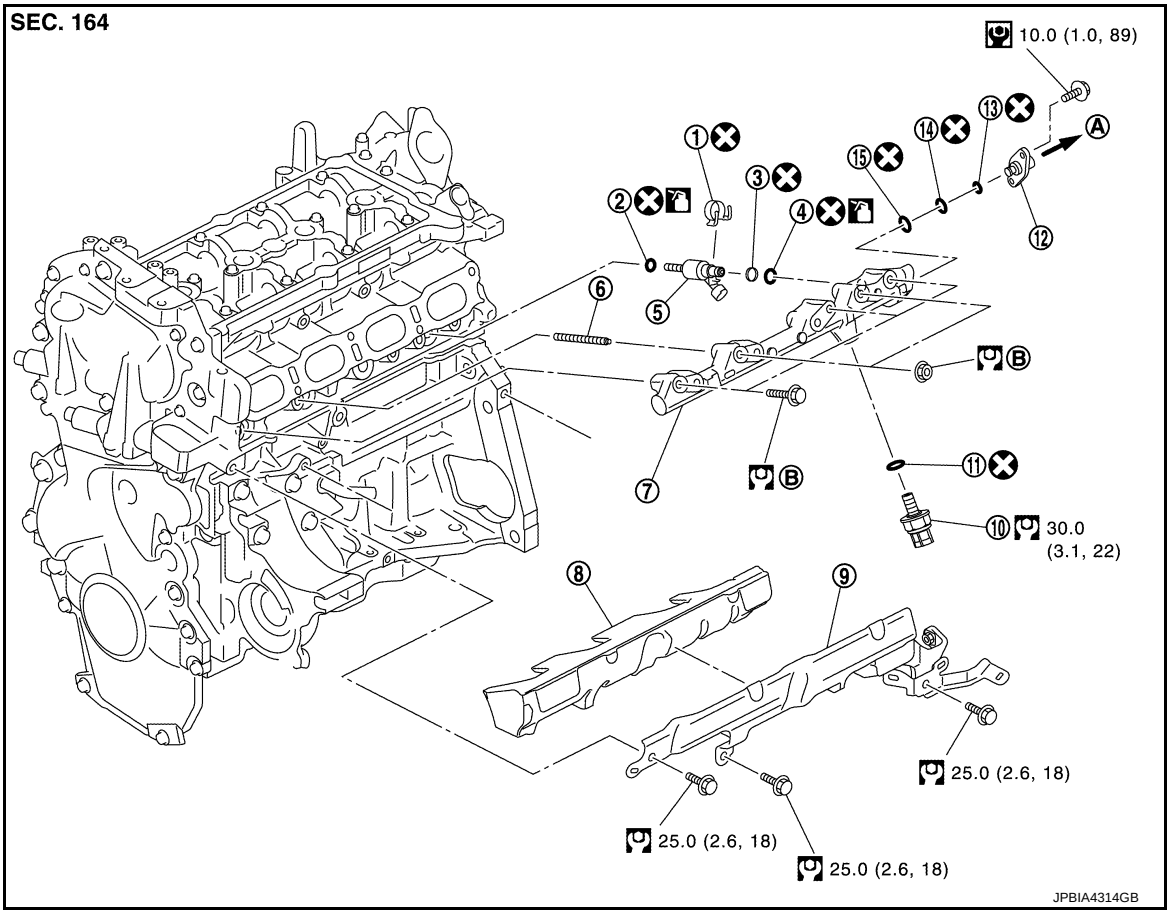
Check for Fuel Leakage

1. Turn ignition switch “ON” (with the engine stopped). With fuel pressure applied to fuel piping, check that there is no fuel leakage at connection points.
   NOTE:
   Use mirrors for checking at points out of clear sight.
2. Start the engine. With engine speed increased, check again that there is no fuel leakage at connection points.
   CAUTION:
   Never touch the engine immediately after it is stopped because the engine is extremely hot.

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:0000000006337269



1.	Holder	2.	Seal ring (white)	3.	Backup ring
4.	O-ring (blue)	5.	Fuel injector	6.	Stud bolt
7.	Fuel tube assembly	8.	Fuel tube insulator	9.	Fuel tube protector
10.	Fuel pressure sensor	11.	O-ring	12.	Fuel tube adaptor
13.	Backup ring (white)	14.	Backup ring (brown)	15.	O-ring (black)
A.	To fuel tube				
B.	Tighting must be done following the installation procedure. Refer to EM-47				

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.

Removal and Installation

INFOID:0000000006337270

WARNING:

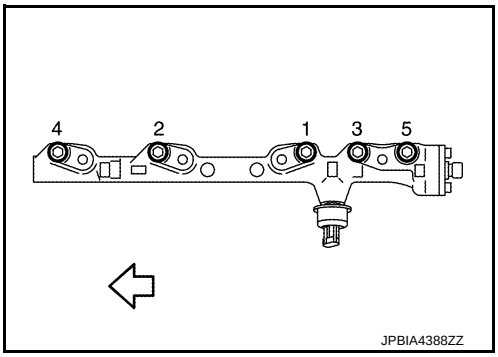
- **Be sure to read EM-7, "Precaution for Handling High Pressure Fuel System" when working on the high pressure fuel system.**
- **Put a “CAUTION: FLAMMABLE” sign in the workshop.**

- **Be sure to work in a well ventilated area and furnish workshop with a CO_2 fire extinguisher.**
- **Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.**
- **To avoid the danger of being scalded, never drain engine coolant when engine is hot.**

REMOVAL

1. Release the fuel pressure. Refer to EC-140, "Work Procedure".
2. Remove front bumper. Refer to EXT-12, "Exploded View"
3. Remove charge are cooler. Refer to EM-31, "Exploded View".
4. Remove oil level gauge. Refer to EM-40, "Exploded View".
5. Remove intake manifold. Refer to EM-28, "Exploded View".
6. Remove alternator. Refer to CHG-30, "MR16DDT : Exploded View"
7. Remove oil level gauge guide. Refer to EM-40, "Exploded View".
8. Remove fuel tube protector, and them remove fuel tube insulator.
9. Remove high pressure pump insulator. Refer to EM-43, "Exploded View".
10. Remove fuel tube. Refer to EM-43, "Exploded View".
11. Disconnect fuel pressure sensor harness connector.
12. Disconnect fuel injector harness connector.
13. Remove fuel tube.
    - Loosen mounting bolts in reverse order as shown in the figure.

    ⇦ : Engine front



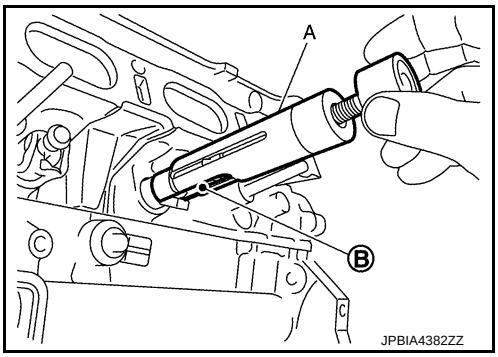
CAUTION:
- **When removing, be careful to avoid any interference with fuel injector.**
- **Use a shop cloth to absorb any fuel leakage from fuel tube.**

14. Remove fuel pressure sensor and fuel tube adaptor, if necessary.
15. Remove fuel injector from cylinder head as per the following.

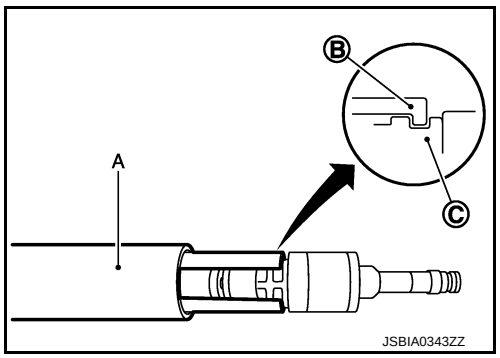
    CAUTION:
    - **Be careful with remaining fuel that may go out from fuel tube.**
    - **Be careful no to damage injector nozzles during removal.**
    - **Never bump or drop fuel injector.**
    - **Never disassemble fuel injector.**

a. Remove injector holder.

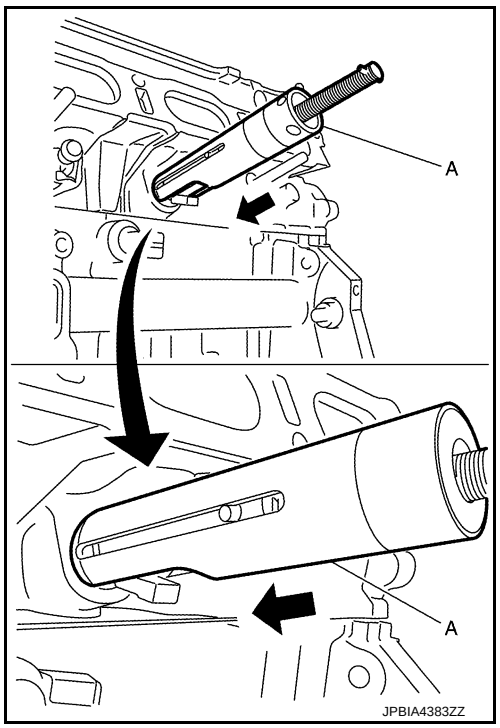
b. Install an remover [SST: KV10119600] (A) to the injector connector side so that cutout (B) of injector remover faces the injector connector side.



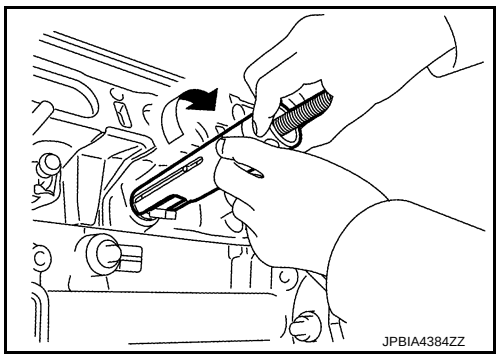
- Hook pawl portion (B) of injector remover [SST: KV10119600] (A) to groove portion (C) of injector



c. Press down body portion (A) of injector remover [SST: KV10119600] until it contacts cylinder head.

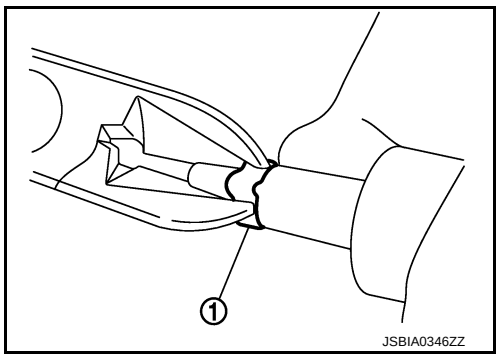


d. Tighten injector remover [SST: KV10119600] clockwise and remove injector from cylinder head.



e. Cut teflon seal (1) while pinching it. Be careful not to damage injector.

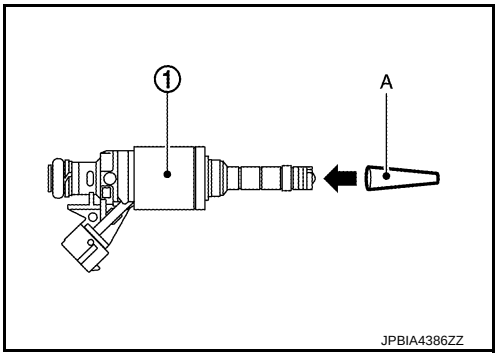
f. Remove insulator from mounting hole of fuel injector of cylinder head.



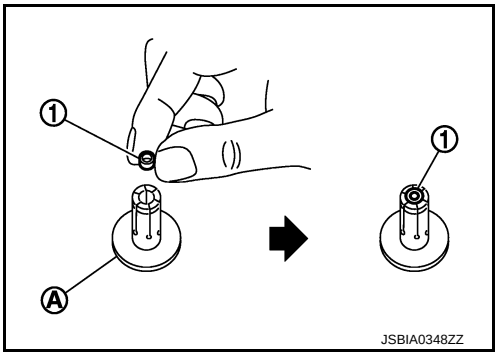
INSTALLATION

1. Install seal ring to fuel injector as per the following:
   CAUTION:
   - **Handle seal ring with bare hands. Never wear gloves.**
   - **Never apply engine oil to seal ring.**
   - **Never clean seal ring with solvent.**

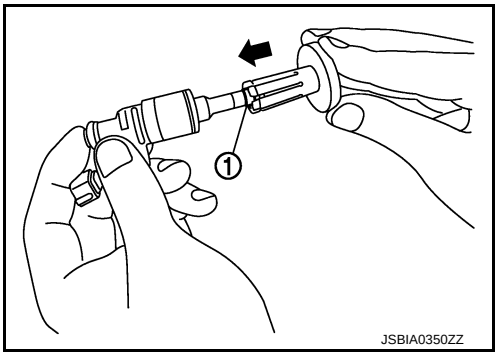
a. Install an injector seal drift set [SST: KV101197S0 (—)] (A) to fuel injector (1).



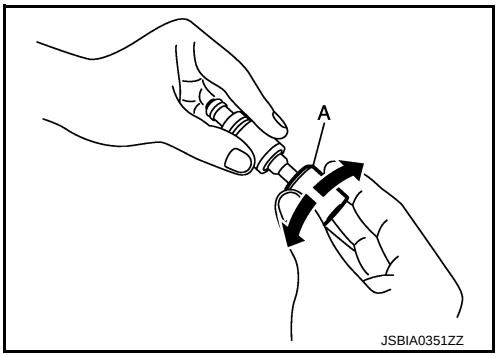
b. Set seal ring (1) to injector seal drift set [SST: KV101197S0 (—)] (A).



c. Straightly insert seal ring (1), which is set in step 2, to fuel injector as shown in the figure and install.
   CAUTION:
   Be careful that seal ring does not exceed the groove portion of fuel injector.

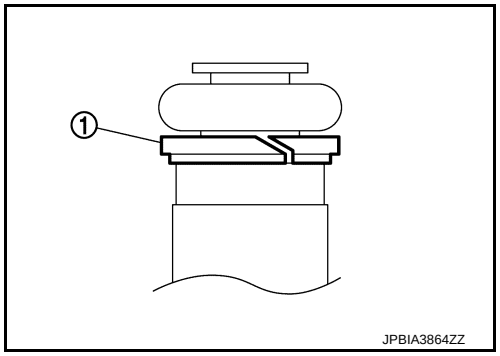


d. Insert injector seal drift set [SST: KV101197S0 (—)] (A) to injector and rotate clockwise and counterclockwise by 90° while pressing seal ring to fit it.
   NOTE:
   Compress seal ring, because this operation is for rectifying stretch of seal ring caused by installation and for preventing sticking when inserting injector into cylinder head.



2. Install O-ring and backup ring to fuel injector. When handing new O-ring and backup ring, paying attention to the following caution items:
   CAUTION:
   - **Handle O-ring with bare hands. Never wear gloves.**
   - **Lubricate O-ring with new engine oil.**

- **Never clean O-ring with solvent.**
- **Check 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 new O-ring straight into fuel rail. Never decenter or twist it.**
- **Always install the back up ring (1) in the right direction as instructed.**



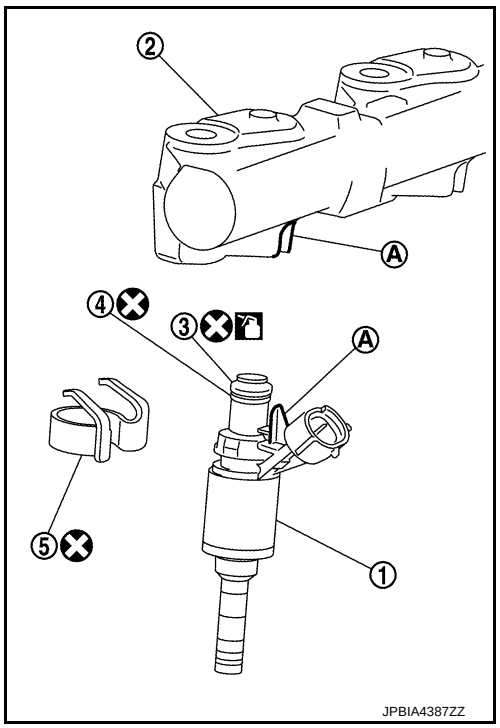
3. Install fuel injector (1) to fuel rail (2) as per the following:

   3 : O-ring (blue)
   4 : Backup ring

a. Install fuel injector holder (5) to fuel injector.
CAUTION:
- **Never reuse injector holder. Replace it with a new one.**
- **Be careful to keep fuel injector holder from interfering with O-ring. If interference occurs, replace O-ring.**

b. Insert fuel injector into fuel rail with fuel injector holder attached.
- Insert it while matching it to the axial center.
- Insert so that protrusion (A) of fuel injector is aligned to cutout (B).

c. Check that installation is complete by checking that fuel injector does not rotate or come off.
- Check that protrusions of fuel injectors and fuel rail are aligned with cutouts of clips after installation.

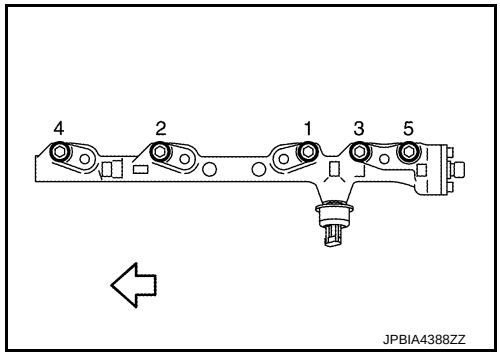


4. Insert insulator into mounting hole of fuel injector of cylinder head.
5. Install fuel pressure sensor, if removed.
6. Install fuel tube adaptor, if removed.
   - Install O-ring and backup ring to fuel tube adaptor. When handing new O-ring and backup ring, paying attention to the following caution items:

CAUTION:
- **Handle O-ring with bare hands. Never wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Never clean O-ring with solvent.**
- **Check 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 new O-ring straight into fuel rail. Never decenter or twist it.**
- **Always install the back up ring in the right direction as instructed.**

- **Since the cross sections of fuel tube adapter and back up ring are tapered, be careful with the mounting direction.**

7. Install fuel rail and fuel injector assembly to cylinder head.
   - Tighten mounting bolts and nuts in two steps in numerical order as shown in the figure.



⇦ : Engine front

1st step : 10.0 N·m (1.0 kg-m, 89 in-lb)

2nd step : 20.5 N·m (2.1 kg-m, 15 ft-lb)

8. Connect injector harness connector.
9. Install in the reverse order of removal after this step.

Inspection

INFOID:0000000006337271

INSPECTION AFTER INSTALLATION

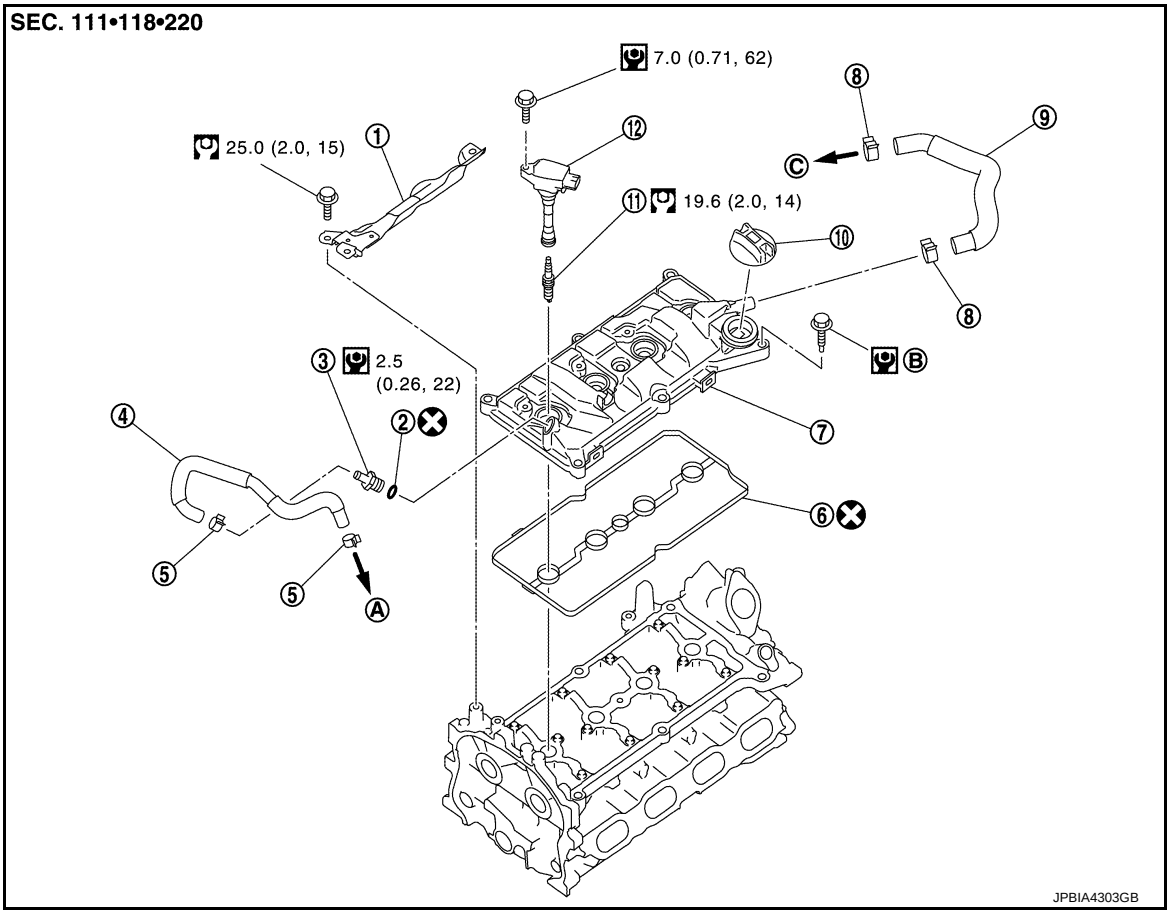
Check on Fuel Leakage

1. Turn ignition switch “ON” (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.
   NOTE:
   Use mirrors for checking at points out of clear sight.
2. Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.
   CAUTION:
   Never touch the engine immediately after stopped, as the engine becomes extremely hot.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:0000000006337242



1.	Rocker cover protector	2.	O-ring	3.	PCV control valve
4.	PCV hose	5.	Clamp	6.	Rocker cover gasket
7.	Rocker cover	8.	Clamp	9.	PCV hose
10.	Oil filler cap	11.	Spark plug	12.	Ignition coil
A.	To air duct assembly	B.	Tightening must be done following the installation procedure. Refer to EM-53	C.	To turbocharger inlet tube

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006337273

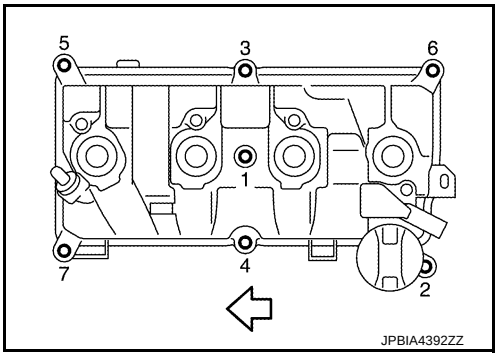
REMOVAL

1. Drain engine coolant. Refer to CO-11, "Draining".
2. Remove engine cover. Refer to EM-25, "Exploded View".
3. Remove intake manifold. Refer to EM-28, "Exploded View".
4. Remove air inlet tube assembly. Refer to EM-31, "Exploded View".
5. Remove PCV hose.
6. Remove rocker cover protector.
7. Disconnect ignition coil harness connector, and them remove ignition coil.

CAUTION:
- **Never drop or shock ignition coil.**
- **Never disassemble ignition coil.**

8. Move ignition harness.
9. Remove rocker cover.
   - Loosen bolts in reverse order shown in the figure.

⇦ : Engine front



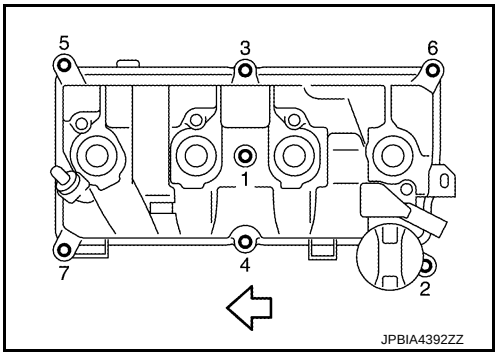
10. Remove PCV valve and PCV hose, if necessary.
11. Remove rocker cover gasket from rocker cover.

INSTALLATION

1. Install the rocker cover gasket to rocker cover.
   CAUTION:
   Check the gasket is not dropped.
2. Install rocker cover.
   - Tighten bolts in two steps separately in numerical order as shown in the figure.

⇦ : Engine front

1st step : 1.96 N·m (0.20 kg-m, 17 in-lb)
2nd step : 8.33 N·m (0.85 kg-m, 74 in-lb)



3. Install in the reverse order of removal, for the rest of parts.

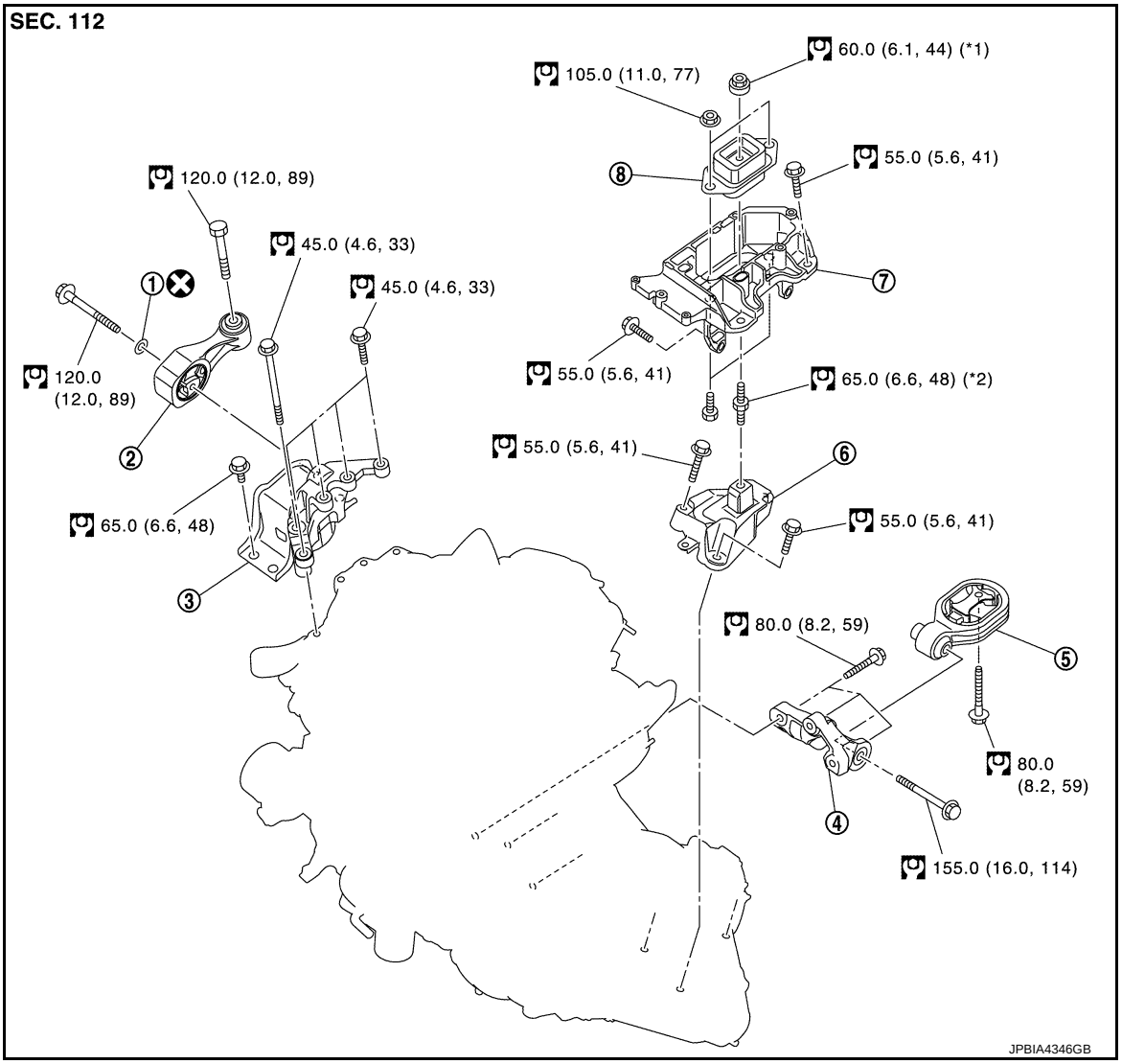
UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

2WD

2WD : Exploded View

INFOID:0000000006337287



1. Washer
2. Upper torque rod (RH)
3. Engine mounting insulator (RH)
4. Rear torque rod bracket
5. Rear torque rod
6. Engine mounting insulator (LH)
7. Engine mounting frame support (LH)
8. Engine mounting bracket (LH)

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

CAUTION:

Check that the stud bolt (*2) is tight at the specified torque before tightening the mounting nut (*1) shown in the figure. [Stud bolt (*2) may be loosened after loosening the mounting nut (*1)]

2WD : Removal and Installation

INFOID:0000000006337288

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.**
- **Never start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine section, refer to the applicable sections.**
- **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-36, "Garage Jack and Safety Stand and 2-Pole Lift".**

REMOVAL

Outline

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

Preparation

1. Release fuel pressure. Refer to EC-140, "Work Procedure".
2. Drain engine coolant from radiator. Refer to CO-11, "Draining".
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Never spill engine coolant on drive belts.**
3. Remove the following parts.
   - Engine undercover
   - Front road wheels and tires
   - Front fender protector (RH and LH): Refer to EXT-22, "Exploded View".
   - Drive belt: Refer to EM-20, "Removal and Installation".
   - Engine cover: Refer to EM-25, "Exploded View".
   - Battery and battery tray: Refer to PG-124, "Exploded View".
   - Air duct, and air cleaner case assembly and air cleaner body assembly: Refer to EM-26, "Exploded View".
   - Radiator hose (upper and lower): Refer to CO-17, "Exploded View".
   - Exhaust front tube: Refer to EX-5, "Exploded View".
   - Radiator cooling fan assembly: Refer to CO-20, "Exploded View".
   - Charger air cooler: Refer to EM-31, "Exploded View".
   - Alternator: Refer to CHG-30, "MR16DDT : Exploded View".

Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.
   CAUTION:
   Protect connectors using a resin bag against foreign materials during the operation.
2. Disconnect fuel feed hose quick connector. Refer to EM-43, "Exploded View".
3. Disconnect heater hoses. Refer to CO-26, "Exploded View".
4. Disconnect control linkage from transaxle. Refer to TM-78, "Exploded View".
5. Remove EVAP hoses. Refer to EM-28, "Exploded View".
6. Disconnect clutch tube on transaxle side from clutch damper. Refer to CL-24, "Exploded View".

Engine Room RH

1. Disconnect vacuum hose from intake manifold. Refer to EM-28, "Exploded View".
2. Remove A/C compressor. Refer to HA-86, "Exploded View".
3. Remove ground cable at engine side.

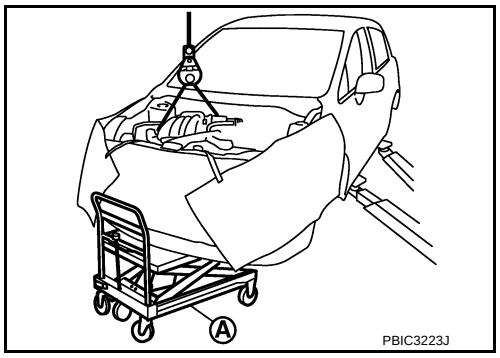
Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove drive shafts (RH and LH). Refer to FAX-21, "Exploded View".
3. Remove rear torque rod.
4. Remove stabilizer connecting rod. Refer to FSU-16, "Exploded View".

5. Remove front suspension member. Refer to FSU-18, "Exploded View".
6. Preparation for the separation work of transaxle is as follows:
   - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to EM-99, "Exploded View".

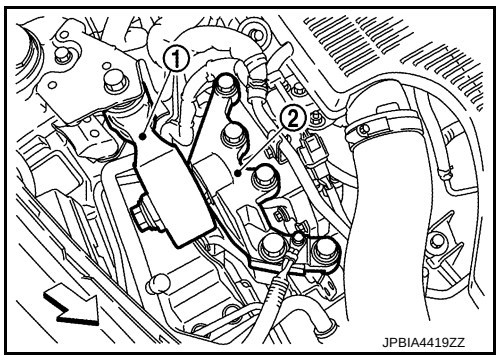
Removal

1. Use a manual lift table caddy (commercial service tool) (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.
   CAUTION:
   Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



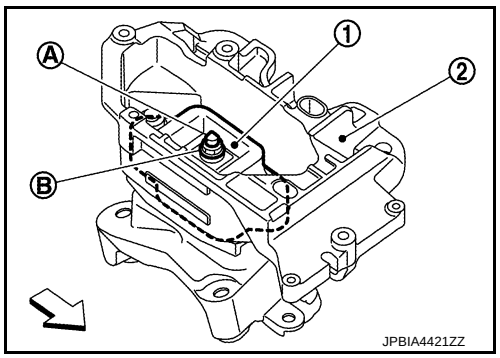
2. Remove upper torque rod (1), and engine mounting insulator (RH) (2).

   ⇦ : Vehicle front



3. Remove engine mounting bracket (LH) through bolt-securing nut (B).

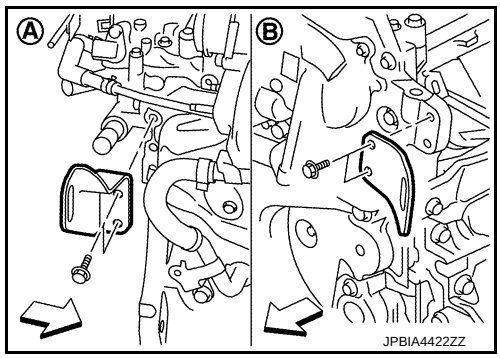
   1 : Engine mounting insulator (LH)
   2 : Engine mounting bracket support (LH)
   A : Through not
   ⇦ : Vehicle front



4. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.
   CAUTION:
   - **Check that no part interferes with the vehicle side.**
   - **Before and during this lifting, always check if any harnesses are left connected.**
   - **During the removal, 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.**

Separation

1. Install engine slinger to front cover front left side (A) and cylinder head rear right side (B).



⇦ : Engine front

Slinger bolts

Front cover front left side: **: 32.9 N·m (3.4 kg-m, 24 ft-lb)**

Cylinder head rear right side: **: 25.0 N·m (2.6 kg-m, 18 ft-lb)**

2. Remove starter motor. Refer to STR-27, "MR16DDT : Exploded View".
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to TM-84, "MR16DDT : Exploded View".

INSTALLATION

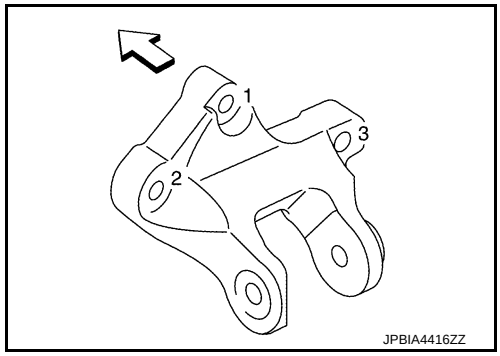
Note the following, and install in the reverse order of removal.

CAUTION:

- **Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.**
- **Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.**
- **When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to EM-55, "2WD : Exploded View".**

Rear torque rod bracket

1. Temporarily tighten mounting bolts in the numerical order as shown in the figure.



⇦ : Vehicle front

2. Tighten mounting bolts to the specified torque in the numerical order as shown in the figure.

2WD : Inspection

INFOID:0000000006709022

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- 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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check 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:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level

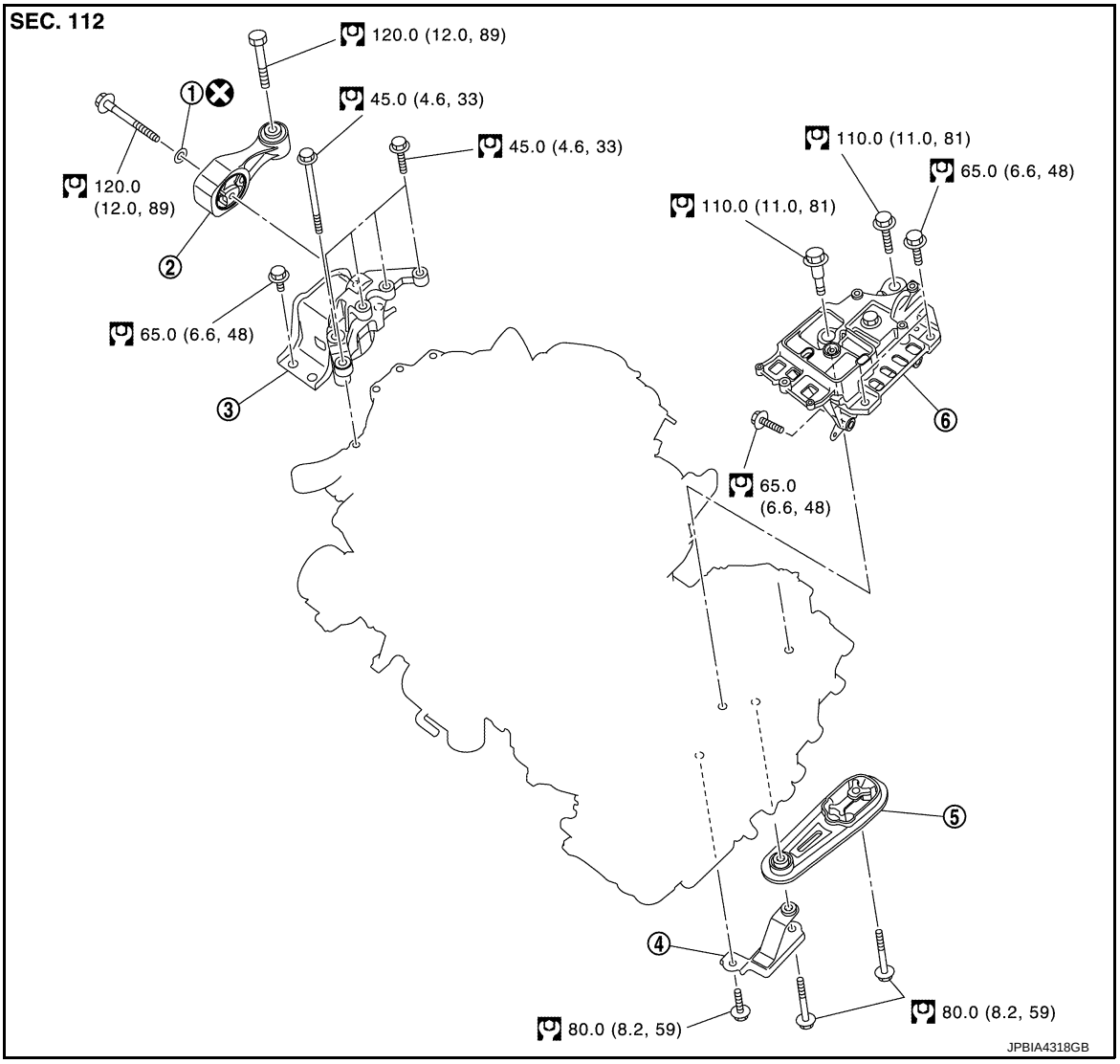
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

4WD

4WD : Exploded View

INFOID:0000000006430457



1. Washer
2. Upper torque rod (RH)
3. Engine mounting insulator (RH)
4. Rear engine mounting bracket
5. Rear torque rod
6. Engine mounting insulator (LH)

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

4WD : Removal and Installation

INFOID:0000000006430458

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.**
- **Never start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine section, refer to the applicable sections.**
- **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-36, "Garage Jack and Safety Stand and 2-Pole Lift".**

REMOVAL

Outline

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

Preparation

1. Release fuel pressure. Refer to EC-140, "Work Procedure".
2. Drain engine coolant from radiator. Refer to CO-11, "Draining".
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Never spill engine coolant on drive belts.**
3. Remove the following parts.
   - Engine undercover
   - Front road wheels and tires
   - Front fender protector (RH and LH): Refer to EXT-22, "Exploded View".
   - Drive belt: Refer to EM-20, "Removal and Installation".
   - Engine cover: Refer to EM-25, "Exploded View".
   - Battery and battery tray: Refer to PG-124, "Exploded View".
   - Air duct, air cleaner case assembly and air cleaner body assembly: Refer to EM-26, "Exploded View".
   - Radiator hose (upper and lower): Refer to CO-17, "Exploded View".
   - Radiator cooling fan assembly: Refer toCO-20, "Exploded View".
   - Exhaust front tube: Refer to EX-5, "Exploded View".
   - Alternator: Refer to CHG-30, "MR16DDT : Exploded View".

Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.
   CAUTION:
   Protect connectors using a resin bag against foreign materials during the operation.
2. Disconnect fuel feed hose quick connector. Refer to EM-43, "Exploded View".
3. Disconnect heater hoses. Refer to CO-26, "Exploded View".
4. Disconnect control cable from transaxle. Refer to TM-273, "Exploded View".
5. Remove EVAP hoses. Refer to EM-28, "Exploded View".

Engine Room RH

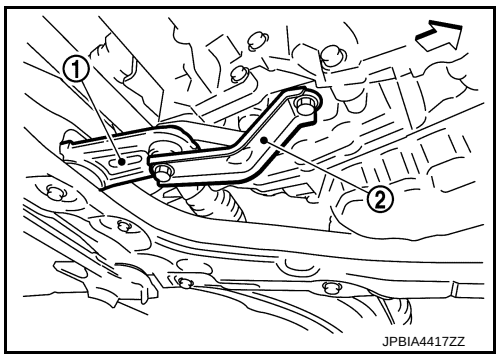
1. Disconnect vacuum hose from intake manifold. Refer to EM-28, "Exploded View".
2. Remove A/C compressor. Refer to HA-86, "Exploded View".
3. Remove ground cable at engine side.

Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove rear propeller shaft. Refer to DLN-121, "Exploded View".
3. Remove drive shafts (RH and LH). Refer to FAX-21, "Exploded View".

4. Remove rear torque rod (1).

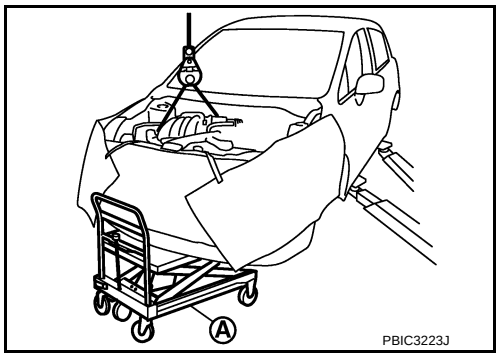
2 : Rear engine mounting bracket
⇦ : Vehicle front



5. Remove stabilizer connecting rod. Refer to FSU-16, "Exploded View".
6. Rear front suspension member. Refer to FSU-18, "Exploded View".
7. Preparation for the separation work of transaxle is as follows:
   - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to EM-40, "Exploded View".

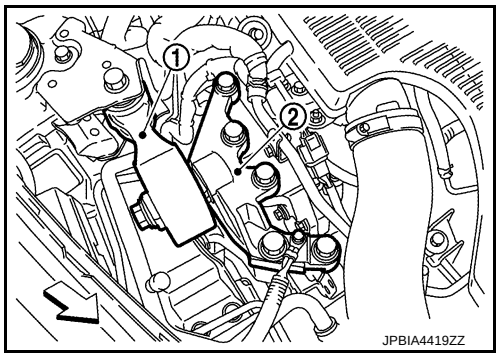
Removal

1. Use a manual lift table caddy (commercial service tool) (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.
   CAUTION:
   Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



2. Remove upper torque rod (1) and engine mounting insulator (RH) (2).

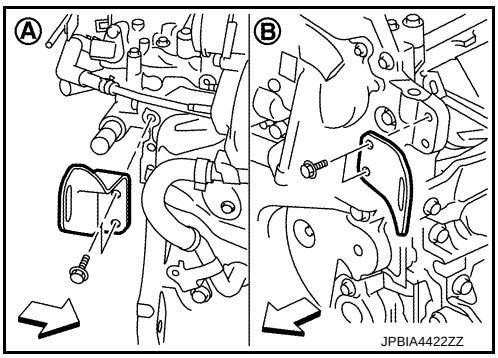
⇦ : Vehicle front



3. Remove engine mounting bracket (LH).
4. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.
   CAUTION:
   - **Check that no part interferes with the vehicle side.**
   - **Before and during this lifting, always check if any harnesses are left connected.**
   - **During the removal, 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.**

Separation

1. Install engine slinger to front cover front left side (A) and cylinder head rear right side (B).



⇦ : Engine front

Slinger bolts

Front cover front left side: **: 32.9 N·m (3.4 kg-m, 24 ft-lb)**

Cylinder head rear right side: **: 25.0 N·m (2.6 kg-m, 18 ft-lb)**

2. Remove starter motor. Refer to STR-27, "MR16DDT : Exploded View".
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to TM-301, "Exploded View" (CVT models).

INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

- **Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.**
- **Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.**
- **When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to EM-59, "4WD : Exploded View".**

4WD : Inspection

INFOID:0000000006337289

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- 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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check 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:

Items	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.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:0000000006337290

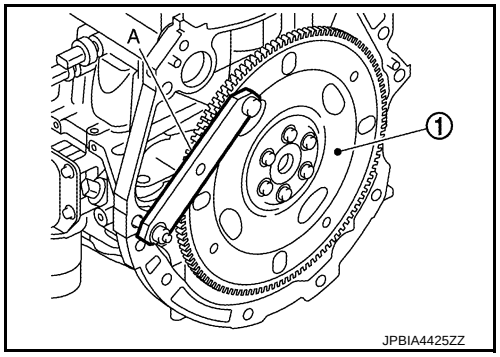
NOTE:
Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine.
2. Install engine to engine stand with the following procedure:

a. Remove flywheel (M/T models) or drive plate (CVT models).
- Secure flywheel (M/T models) or drive plate (CVT models) (1) with a stopper plate [SST: KV11105210 (J-44716)] (A), and remove mounting bolts.

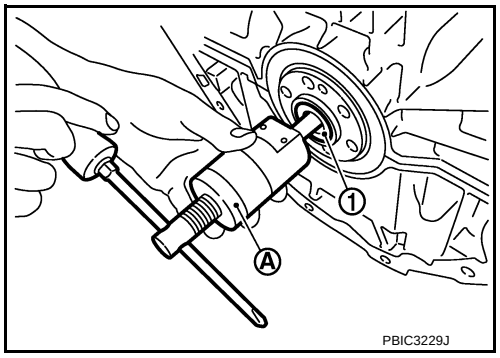
CAUTION:
- **Never disassemble them.**
- **Never place them with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch them.**
- **Handle signal plate in a manner that prevents them from becoming magnetized.**

NOTE:
This figure shows CVT models as an example.



b. Remove pilot converter (1) using pilot bushing puller [SST: ST16610001 (J-23907)] (A) or suitable tool. (CVT models)

NOTE:
M/T models have no pilot bushing.



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

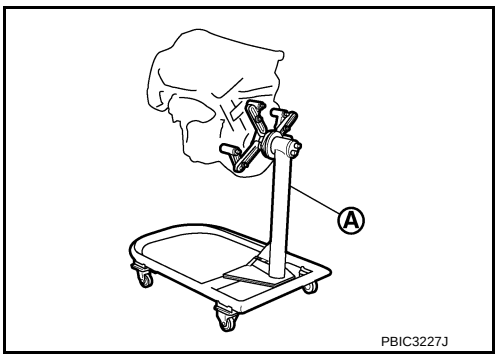
CAUTION:
- **Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
- Intake manifold: Refer to EM-28, "Exploded View".
- catalyst convertor: Refer to EM-33, "2WD : Exploded View" (2WD models) or EM-34, "4WD : Exploded View" (4WD models).
- Rocker cover: Refer to EM-53, "Exploded View".

NOTE:

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

CAUTION:

Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.

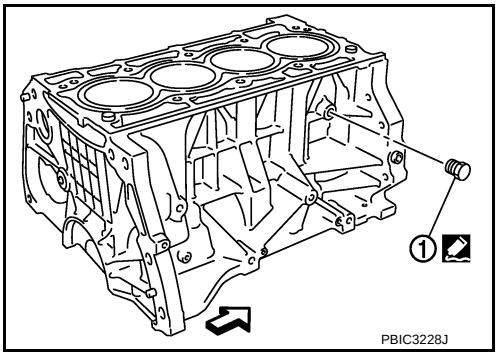


3. Drain engine oil. Refer to LU-9, "Draining".

CAUTION:

Be sure to clean drain plug and install with new drain plug washer.

4. Drain engine coolant by removing water drain plug (1) from inside of the engine.



⇦ : Engine front

Tightening torque : Refer to EM-104, "Disassembly and Assembly".

Use Genuine Liquid Gasket or equivalent.

ENGINE UNIT

Disassembly

INFOID:0000000006337291

1. Remove intake manifold. Refer to EM-28, "Exploded View".
2. Remove catalyst convertor. Refer to EM-33, "2WD : Exploded View" (2WD models) or EM-34, "4WD : Exploded View" (4WD models).
3. Remove turbocharger. Refer to EM-36, "Exploded View".
4. Remove exhaust manifold. Refer to EM-38, "Exploded View".
5. Remove oil pan (lower). Refer to EM-99, "Exploded View".
6. Remove ignition coil, spark plug, and rocker cover. Refer to EM-23, "Exploded View".
7. Remove fuel injector and fuel tube. Refer to EM-47, "Exploded View".
8. Remove timing chain. Refer to EM-67, "Exploded View".
9. Remove camshaft. Refer to EM-78, "Exploded View".
10. Remove water inlet. Refer to CO-24, "Exploded View".
11. Remove water outlet. Refer to CO-26, "Exploded View".
12. Remove cylinder head. Refer to EM-90, "Exploded View".

Assembly

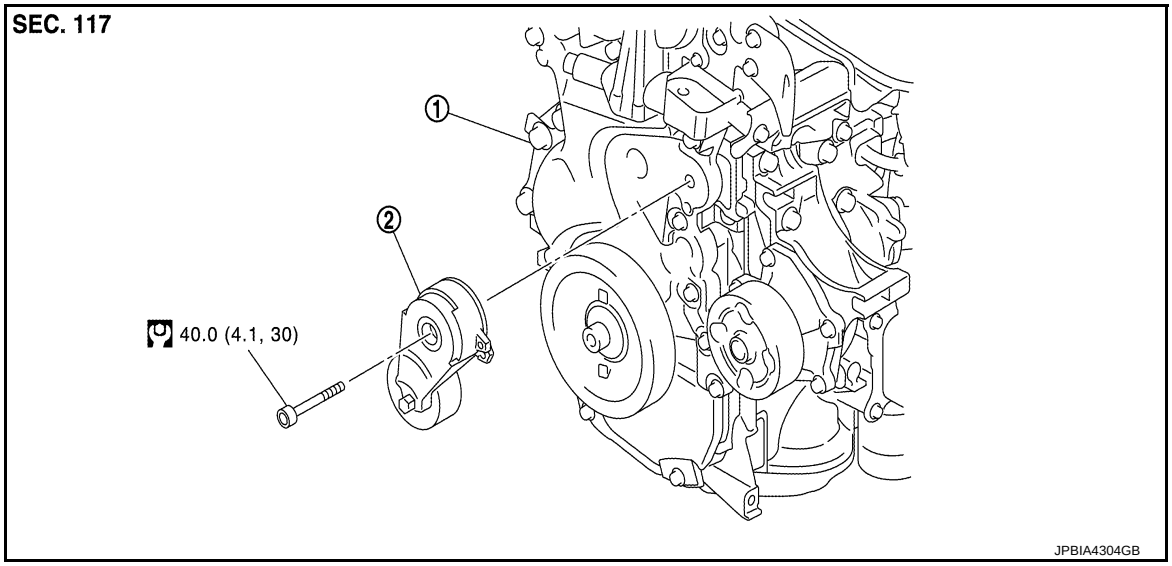
INFOID:0000000006337292

Assemble in the reverse order of disassembly.

DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

Exploded View

INFOID:0000000006337247



1. Front cover
2. Drive belt auto-tensioner

: N·m (kg-m, ft-lb)

Removal and Installation

INFOID:0000000006337248

Removal

1. Loosen mounting bolt and remove drive belt auto-tensioner.

Installation

Install in the reverse order of removal.

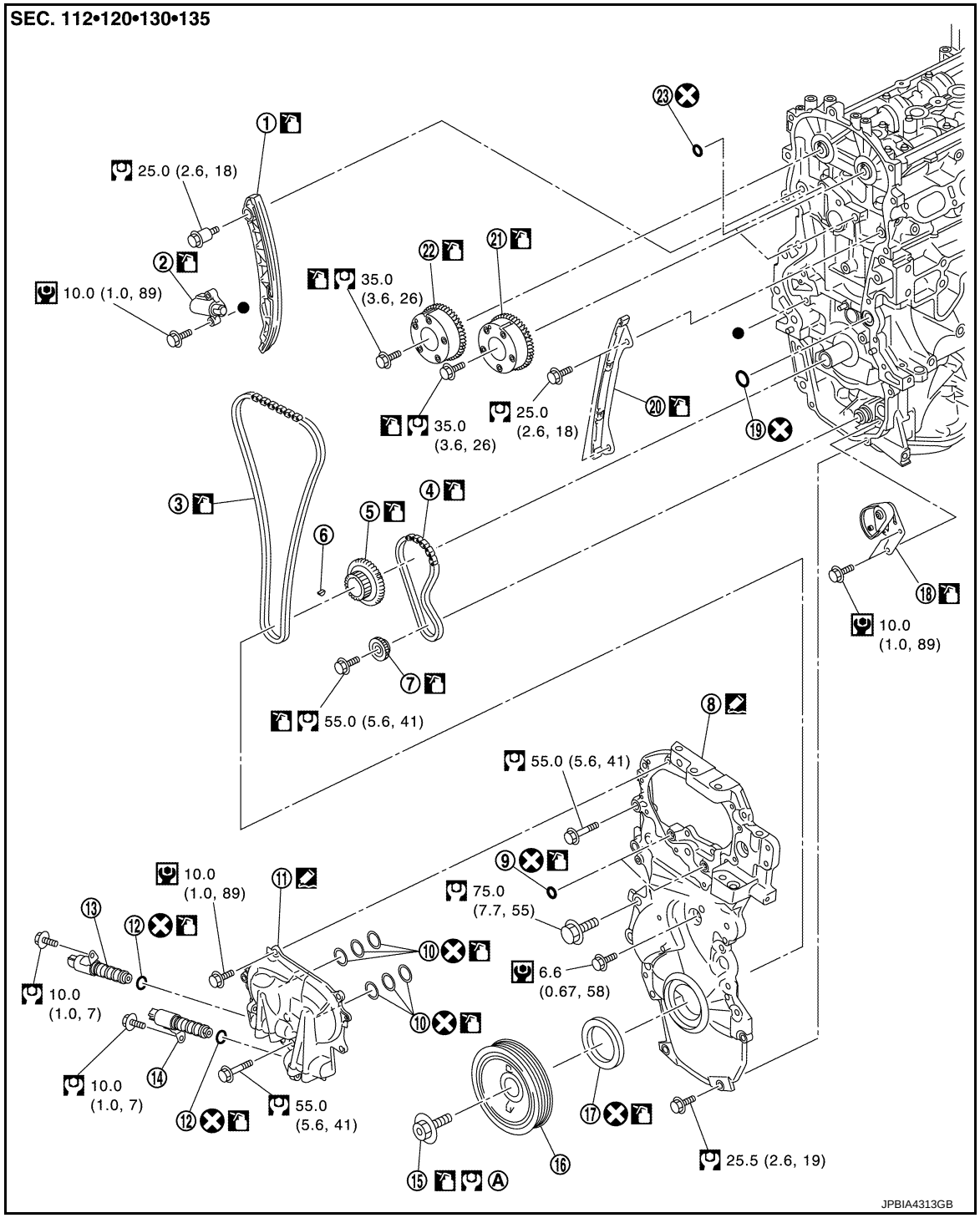
CAUTION:

When installing drive belt auto-tensioner, be careful not to interfere with water pump pulley.

TIMING CHAIN

Exploded View

INFOID:0000000006337274



1. Timing chain slack guide
2. Timing chain tensioner
3. Timing chain
4. Oil pump drive chain
5. Crankshaft sprocket
6. Crankshaft key
7. Oil pump sprocket
8. Front cover
9. O-ring
10. O-ring
11. Oil control valve cover
12. O-ring
13. Oil control valve (EXH)
14. Oil control valve (INT)
15. Crankshaft pulley bolt
16. Crankshaft pulley
17. Front oil seal
18. Oil pump drive chain tensioner
19. O-ring
20. Timing chain tension guide
21. Camshaft spsocket (INT)

22. Camshaft sprocket (EXH) 23. O-ring

A. Tightening must be done following the installation procedure. Refer to EM-68

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

Removal and Installation

INFOID:0000000006337275

REMOVAL

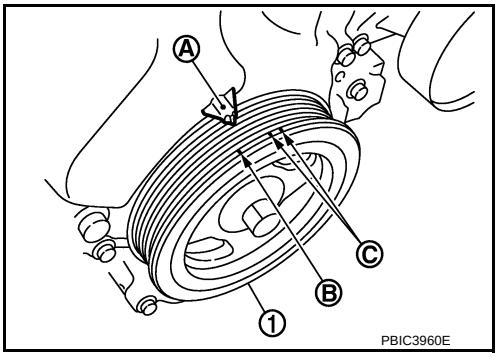
CAUTION:

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

1. Drain engine oil. Refer to LU-9, "Draining".
   CAUTION:
   Perform this step when engine is cold.
2. Remove the following parts:
   - Intake manifold: Refer to EM-28, "Exploded View".
   - Rocker cover: Refer to EM-23, "Exploded View".
3. 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.

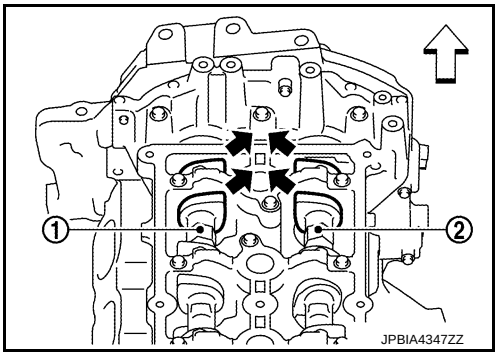
C : White paint mark (Not use for service)



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

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

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

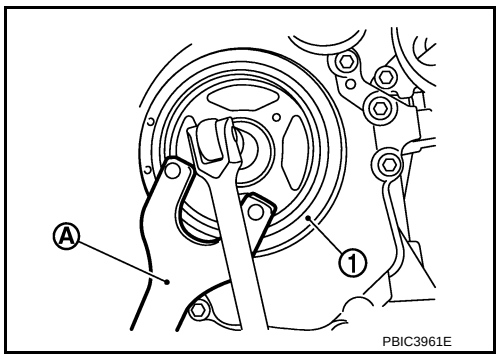


4. Remove crankshaft pulley with the following procedure:

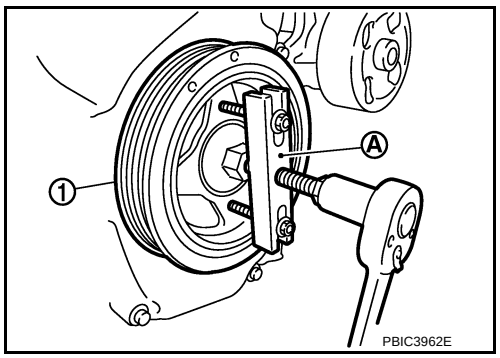
a. Fix crankshaft pulley (1) with a pulley holder (commercial service tool) (A), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.

CAUTION:

Never remove the crankshaft pulley bolt as they will be used as a supporting point for the pulley puller [SST: KV11103000 (—)].



b. Attach a pulley puller [SST: KV11103000 (—)] (A) in the M6 thread hole on crankshaft pulley (1), and remove crankshaft pulley.



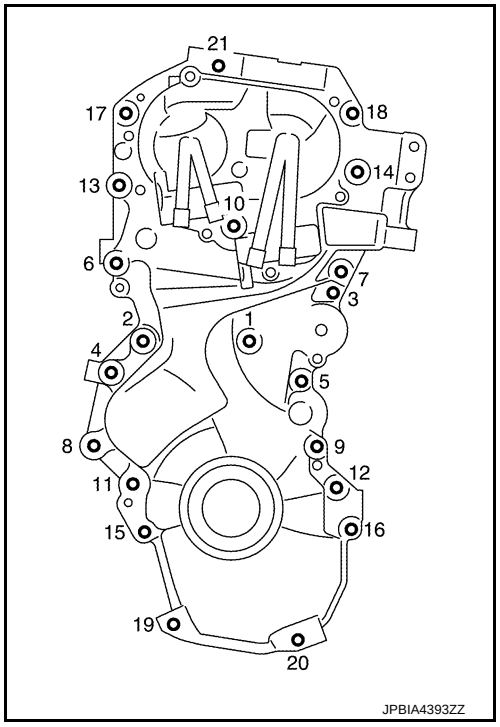
5. Remove oil pan (lower). Refer to EM-99, "Exploded View".

NOTE:

If crankshaft sprocket and oil pump drive component are not removed, this step is unnecessary.

6. Remove intake valve timing control solenoid valve.
7. Remove drive belt auto-tensioner. Refer to EM-66, "Exploded View".
8. Remove front cover with the following procedure:

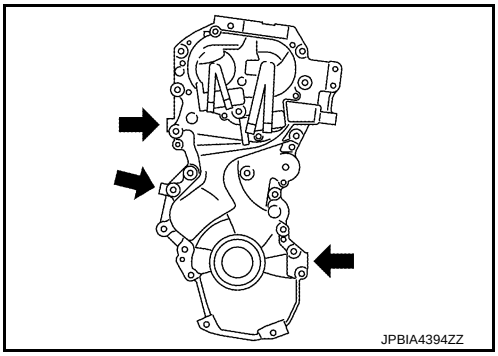
a. Loosen mounting bolts in reverse order as shown in the figure.



b. Cut liquid gasket by prying the position (⬅) shown in the figure, 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.**



9. Remove front oil seal from front cover.

CAUTION:

Be careful not to damage front cover.

- Lift up front oil seal using a screwdriver.

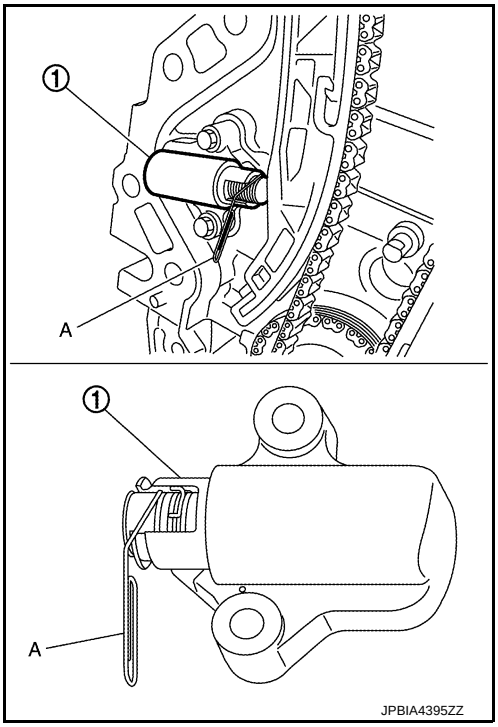
10. Remove timing chain tensioner with the following procedure:

a. Insert a wire (A) (e.g. clip) into the top groove with the timing chain tensioner plunger pressed.

NOTE:

Timing chain tensioner plunger is securely fixed by inserting a wire (e.g. clip).

b. Remove timing chain tensioner (1).



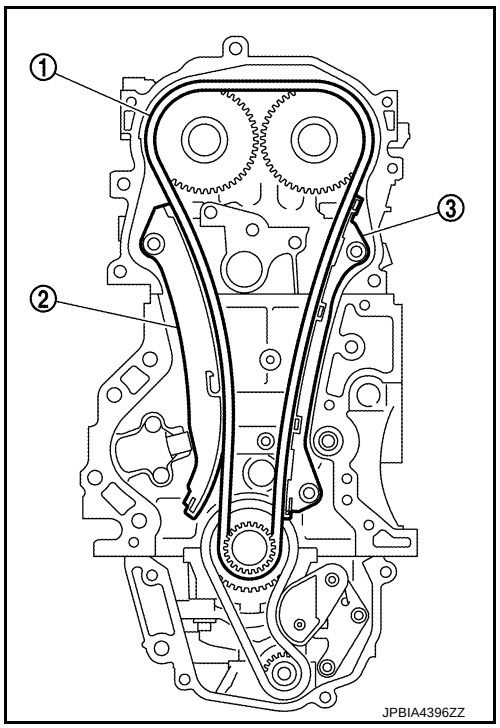
11. Remove slack guide (2), tension guide (3) and timing chain (1).

CAUTION:

Never rotate each crankshaft and camshaft individually while timing chain is removed. It causes interference between valve and piston.

NOTE:

If timing chain is difficult to remove, remove camshaft sprocket (EXH) first to remove timing chain.

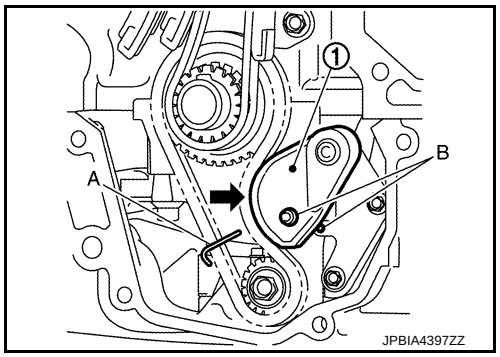


12. Remove crankshaft sprocket and oil pump drive component with the following procedure:

a. Push oil pump drive chain tensioner (1) in the direction show in the figure (A).

b. Insert a stopper pin (A) into the body hole (B).

c. Remove oil pump chain tensioner.
- When the holes on lever and tensioner body cannot be alirned, align these holes by slightly moving the oil pump chain tensioner slack guide.

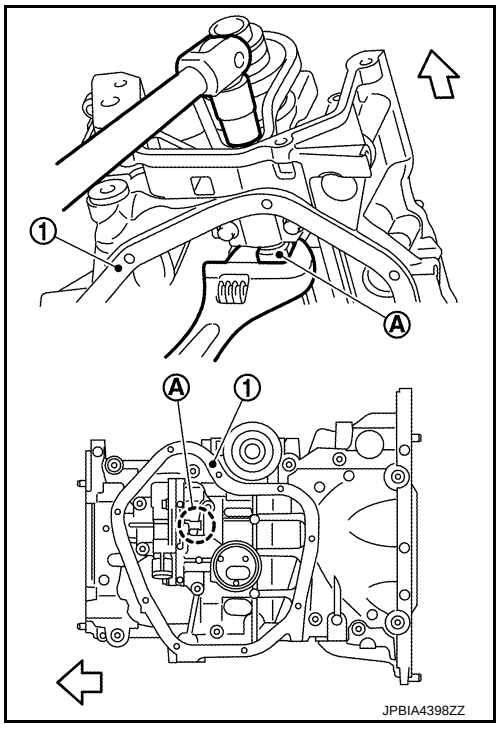


d. Hold the WAF part of oil pump shaft [WAF: 10 mm (0.39 in)] (A), and then loosen the oil pump sprocket bolt and remove it.

1 : Oil pan (upper)

⇦ : 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.**

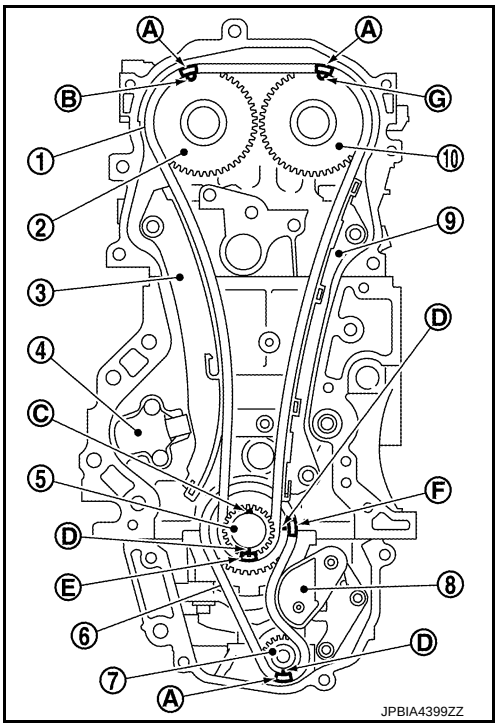


13. Remove tension guide (front cover side) from front cover, if necessary.

INSTALLATION

NOTE:

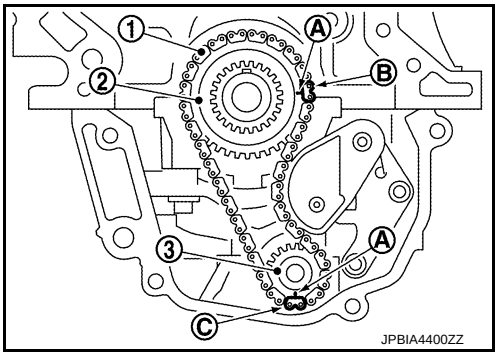
The figure shows the relationship between the matching mark on each timing chain and that on the corresponding sprocket, with the components installed.



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

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

1. Check that crankshaft key points straight up.
2. If the 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 (yellow link)
C : Matching mark (dark blue link)

- Install it by aligning matching marks on each sprockets 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 sprockets after installing the oil pump drive chain.

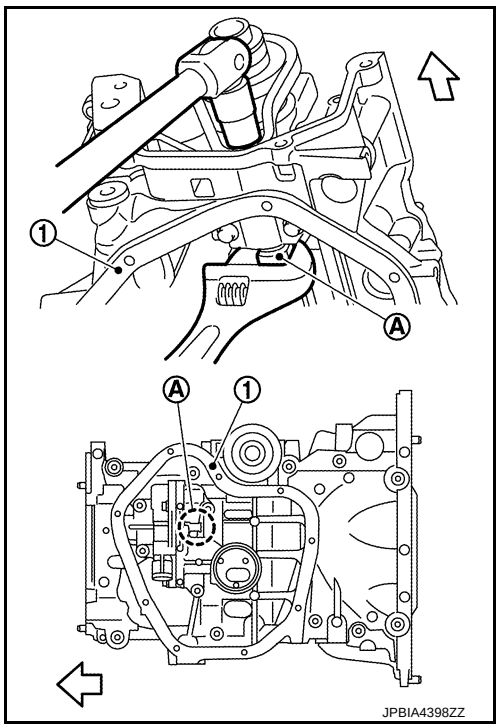
4. Hold the WAF part of oil pump shaft [WAF: 10 mm (0.39 in)] (A), and then tighten the oil pump shaft sprocket bolt.

1 : Oil pan (upper)

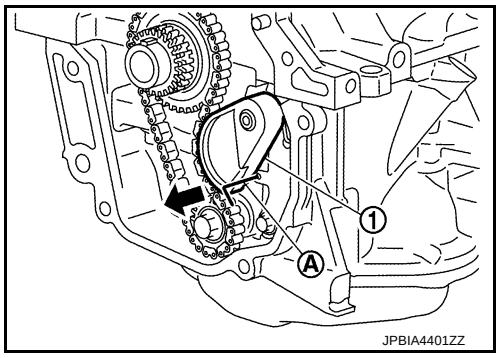
⇦ : Engine front

CAUTION:

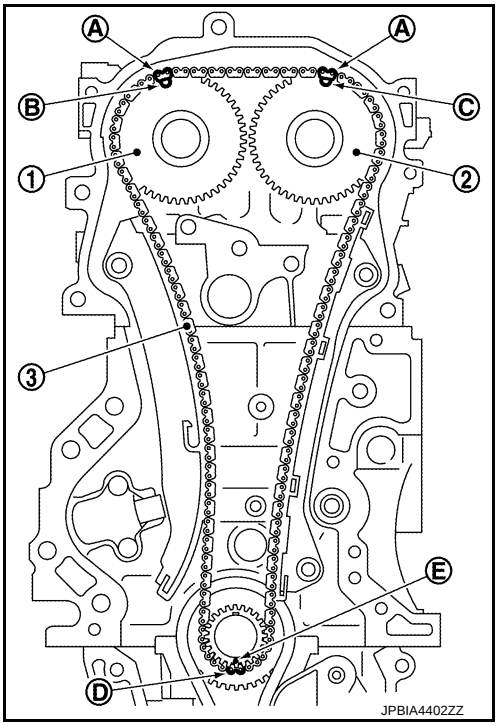
- **Secure the oil pump shaft with the WAF part.**
- **Never loosen the oil pump shaft sprocket bolt by tightening the oil pump drive chain.**



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



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



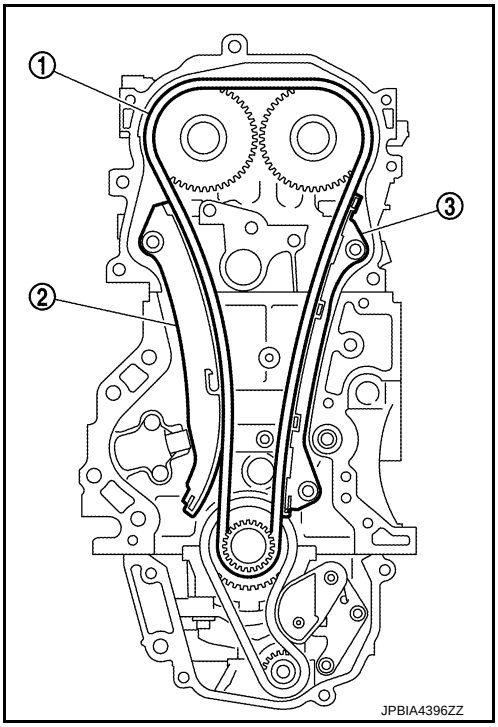
1 : Camshaft sprocket (EXH)
2 : Camshaft sprocket (INT)
3 : Timing chain
A : Matching mark (dark blue link)
B : Matching mark (outer groove*)
C : Matching mark (outer groove)
D : Matching mark (white link)
E : Matching mark (stamping)

*: There are 2 outer grooves in camshaft sprocket (EXH). 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 slack guide (2) and the tension guide (3).



1 : Timing chain

8. Install timing chain tensioner.
   - Fix the plunger at the most compressed position using a stopper pin, and then install it.
   - Securely pull out the stopper pin after installing the timing chain tensioner.
9. Check matching mark position of timing chain and each sprockets again.
10. Install front oil seal. Refer to EM-88, "FRONT OIL SEAL : Removal and Installation".
11. Install front cover with the following procedure:

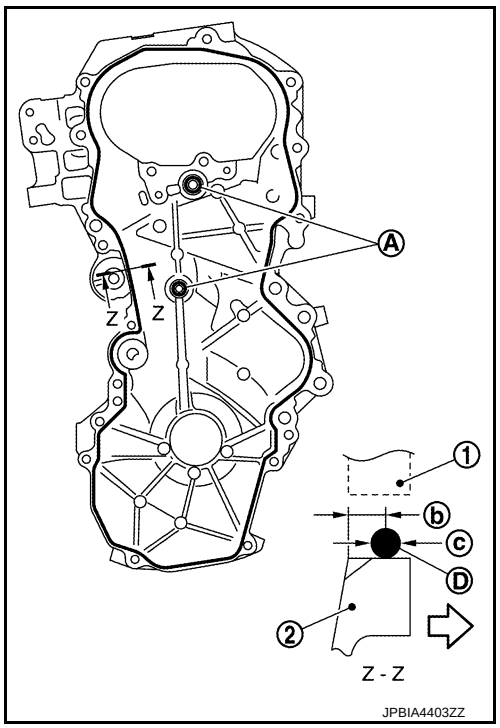
a. Install new O-ring to cylinder block.

CAUTION:
Never misalign O-ring.

b. Apply a continuous bead of liquid gasket (D) with a tube presser (commercial service tool) to front cover as shown in the figure.

1 : Cylinder head
2 : Front cover
A : Liquid gasket application area
b : 4.0 - 5.6 mm (0.157 - 0.220 in)
c : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)
⇦ : Engine outside

Use Genuine Liquid Gasket or equivalent.



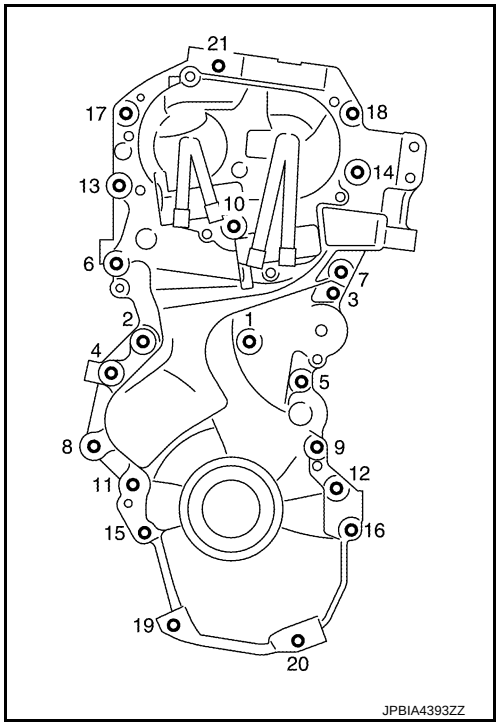
c. Check that matching marks of timing chain and each sprockets are still aligned. Then install front cover.
CAUTION:
- **Check O-ring on cylinder block is correctly installed.**
- **Be careful not to damage front oil seal by interference with front end of crankshaft.**

d. Install front cover, and tighten mounting bolts in numerical order as shown in the figure.
- Refer to the following for the installation position of bolts.

M6 bolt : No. 1
M10 bolts : No. 6, 7, 10, 13, 21
M12 bolts : No. 2, 4, 8, 11
M8 bolts : Except the above

CAUTION:
Attaching should be done within 5 minutes after liquid gasket application.

e. After all bolts are tightened, retighten them to specified torque in numerical order as shown in the figure.
CAUTION:
Be sure to wipe off any excessive liquid gasket leaking.

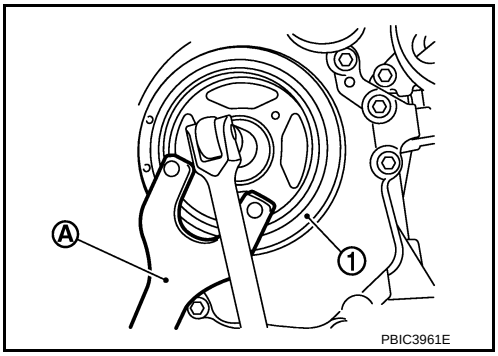


12. Install crankshaft pulley with the following procedure:

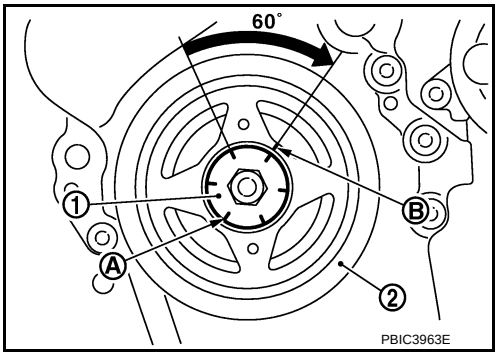
a. When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
CAUTION:
Never damage front oil seal lip section.

b. Secure crankshaft pulley (1) with a pulley holder (commercial service tool) (A).
c. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
d. Tighten crankshaft pulley bolt.

: 29.4 N·m (3.0 kg-m, 22 ft-lb)



e. Put a paint mark (B) on crankshaft pulley (2), matching with any one of six easy to recognize angle marks (A) on crankshaft pulley bolt (1) flange.
f. Turn another 60 degrees clockwise (angle tightening).
• Check the tightening angle with movement of one angle mark.
g. Check that crankshaft rotates clockwise smoothly.



13. Install remaining parts in the reverse order of removal.

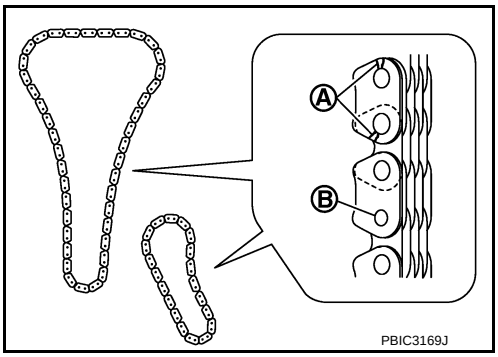
Inspection

INFOID:0000000006337276

INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

• 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-13, "Fluids and Lubricants".
• Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
• Run engine to check for unusual noise and vibration.

NOTE:

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

• Warm up engine thoroughly to check 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:

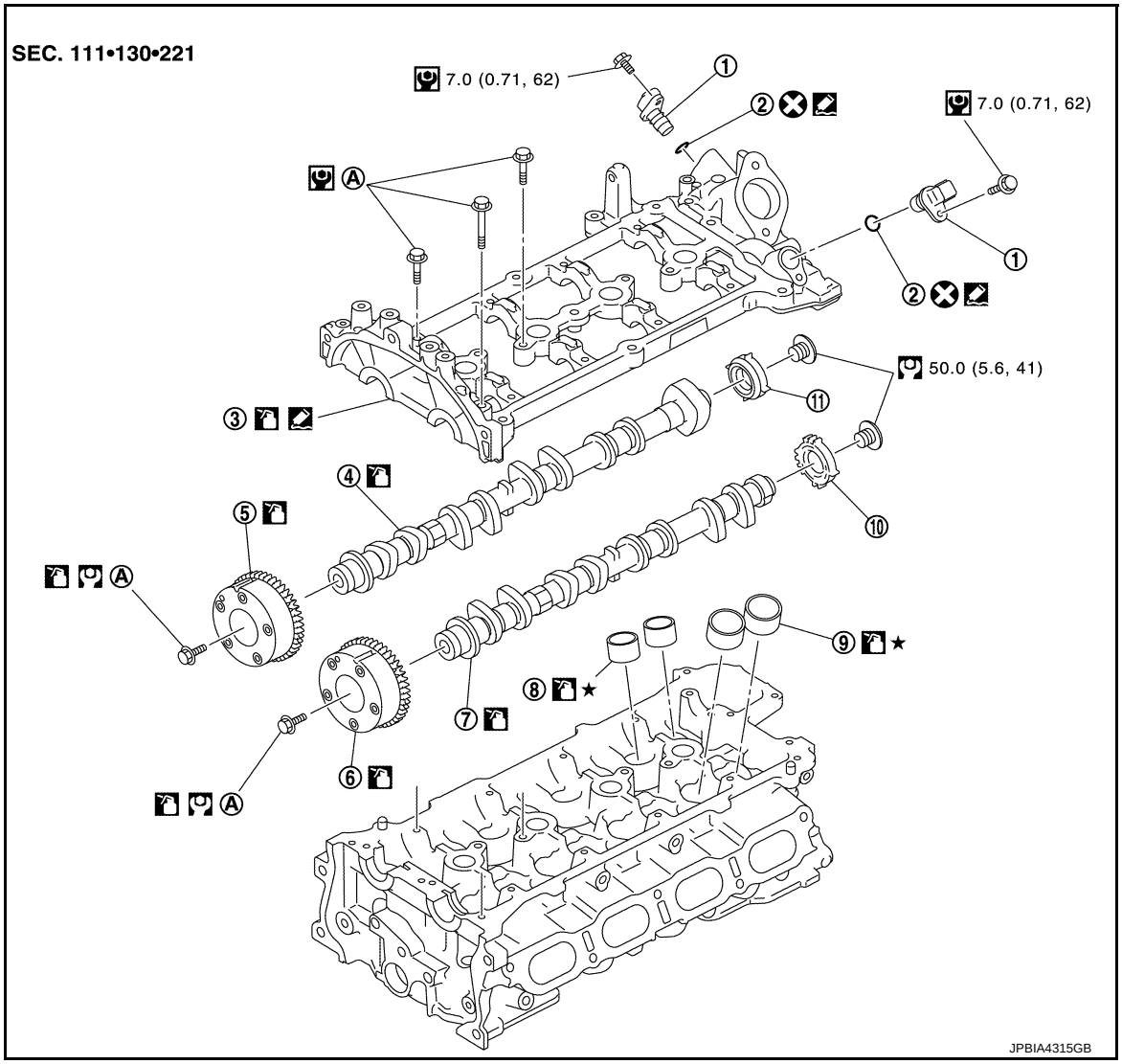
Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

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

CAMSHAFT

Exploded View

INFOID:0000000006337277



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

A. Tightening must be done following the installation procedure. Refer to EM-79

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

★ : Select with proper thickness.

Removal and Installation

INFOID:0000000006337278

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

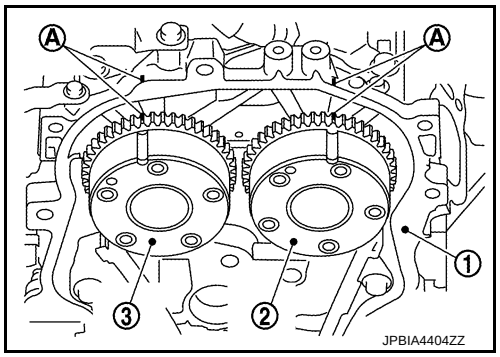
REMOVAL

1. Remove the following parts.
   - Intake manifold: Refer to EM-28, "Exploded View".
   - Rocker cover: Refer to EM-23, "Exploded View".
   - Front cover and timing chain related parts: Refer to EM-67, "Exploded View".

   NOTE:
   Removal of oil pump drive related part is not necessary.
2. Remove camshaft position sensor (PHASE) from camshaft bracket.

   CAUTION:
   - **Handle camshaft position sensor (PHASE) carefully and avoid impacts.**
   - **Never disassemble camshaft position sensor (PHASE).**
   - **Never place sensor where it is exposed to magnetism.**
3. Put the matching mark (A) on the camshaft sprocket (INT) (1), camshaft sprocket (EXH) (2) and the camshaft bracket (1) as shown in the figure.

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

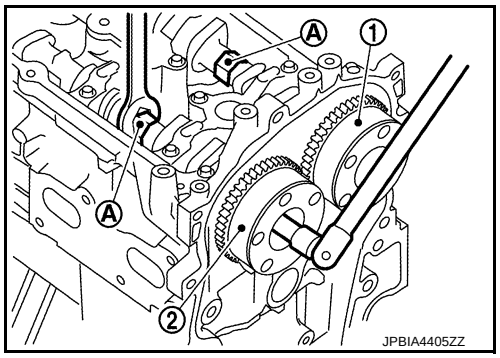


JPBIA4404ZZ

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

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

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

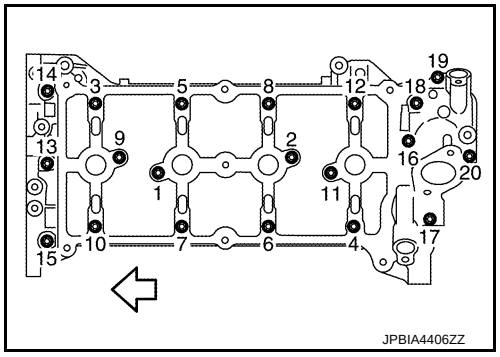


JPBIA4405ZZ

5. Remove camshaft bracket with the following procedure:

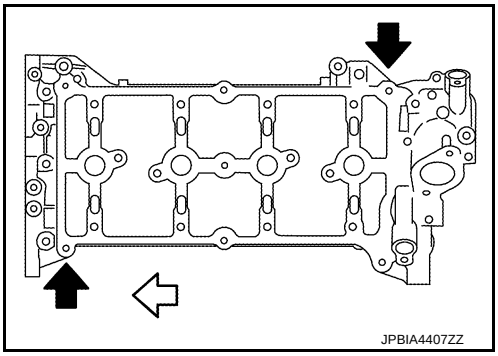
a. Loosen mounting bolts in reverse order as shown in the figure.

⇦ : Engine front



JPBIA4406ZZ

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



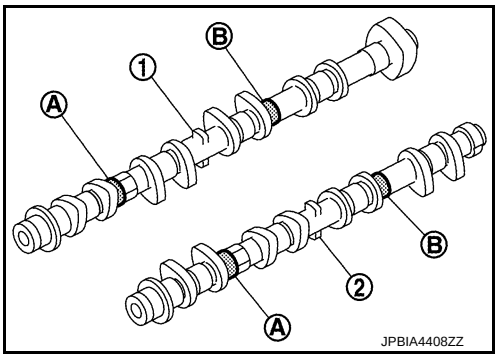
⇦ : Engine front

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.**

6. Remove camshafts.
7. Remove valve lifters.
   - Identify installation positions, and store them without mixing them up.
8. Remove signal plate from camshaft, if necessary.

INSTALLATION

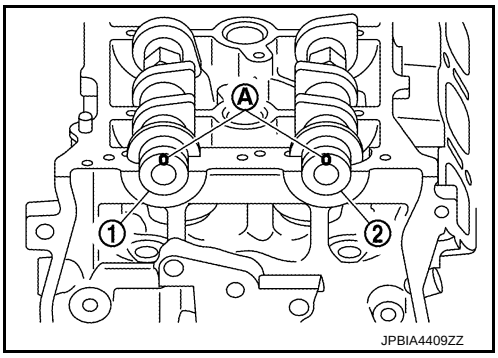
1. Install valve lifters.
   - Install them in the original positions.
2. Install camshafts.
   - Clean camshaft journal to remove any foreign material.
   - Distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft or using the identification 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 in the figure.



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

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

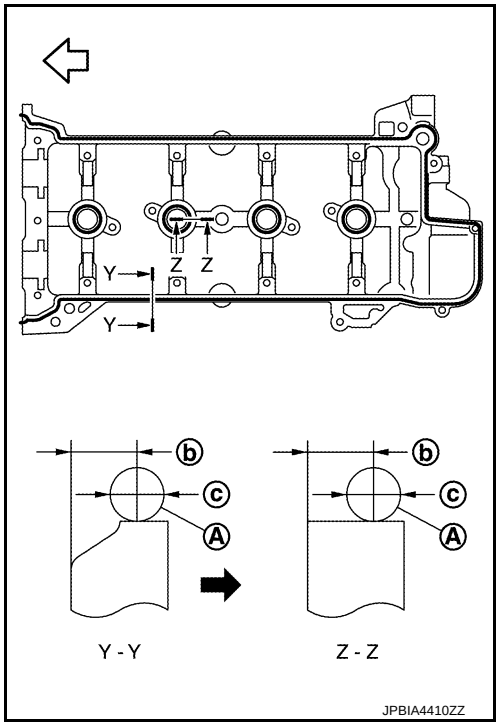
3. Install camshaft bracket with the following procedure:

a. Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.

b. Apply liquid gasket (A) to camshaft bracket as shown in the figure.

b : Plug hole inner wall
c : 3.4 - 4.4mm (0.134 - 0.173 in)
⇦ : Engine front
⬅ : Engine outside

Use Genuine Liquid Gasket or equivalent.

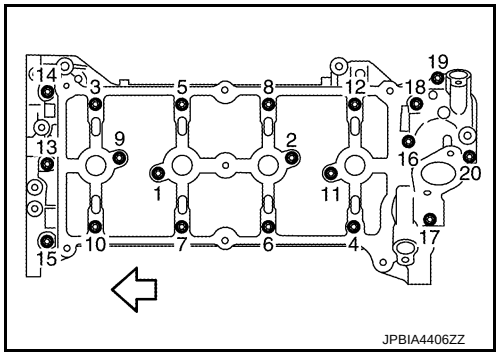


c. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

⇦ : Engine front

- There are two types of mounting bolts. Refer to the following for locating bolts.

M6 bolts [thread length: 57.5 mm (2.264 in)]
: 13, 14, and 15 in the figure
M6 bolts [thread length: 35.0 mm (1.378 in)]
: Except the above



i. Tighten mounting bolts in numerical order.

: 1.96 N·m (0.20 kg-m, 17 in-lb)

ii. Tighten mounting bolts in numerical order.

: 5.88 N·m (0.60 kg-m, 52 in-lb)

iii. Tighten mounting bolts in numerical order.

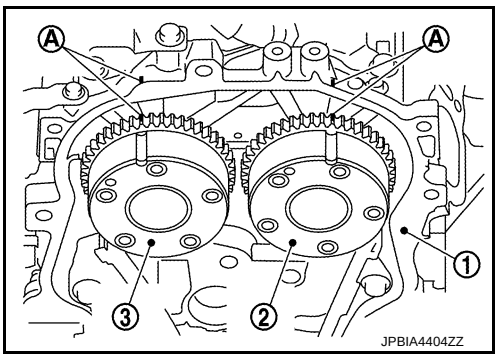
: 9.5 N·m (0.97 kg-m, 84 in-lb)

CAUTION:
After tightening mounting bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the mating surface of cylinder head.

4. Install the camshaft sprocket (INT) to the camshaft (INT) with the following procedure.

a. When the camshaft sprocket (INT) (2) and camshaft sprocket (EXH) (3) is removed, refer to 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



b. Tighten bolts in the following steps.
• Secure the hexagonal part of camshaft (INT) using wrench to tighten mounting bolt.

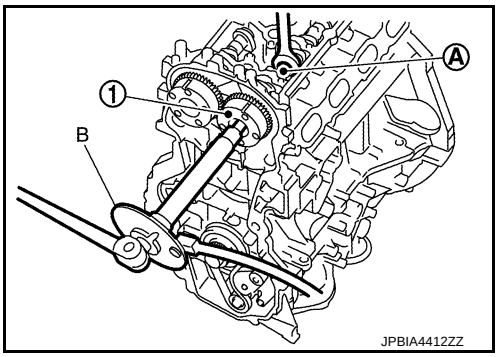
i. Tighten camshaft (INT) mounting bolt.

: 35.0 N·m (3.6 kg-m, 26 ft-lb)

ii. Turn 67 degrees clockwise (angle tightening).

CAUTION:
Check the tightening angle by using an angle wrench [SST: KV10112100 (BT8653-A)] (B) or protractor. Never judge by visual inspection without an angle wrench.

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



5. Install timing chain and related parts. Refer to EM-67, "Exploded View".
6. Inspect and adjust valve clearance. Refer to EM-14, "Inspection and Adjustment".
7. Install remaining parts in the reverse order of removal.

Inspection

INFOID:0000000006337279

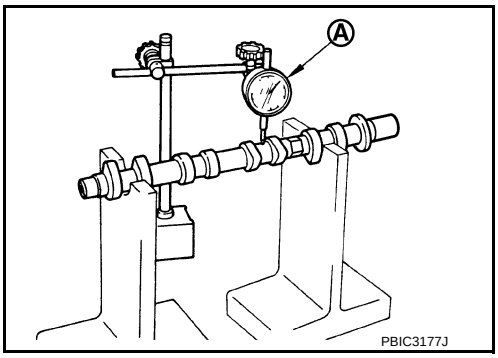
INSPECTION AFTER REMOVAL

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 and Limit : Refer to EM-130, "Camshaft".

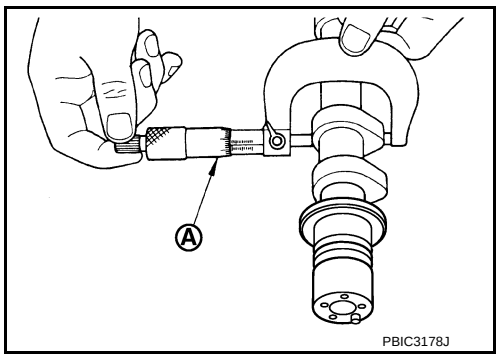
4. If it exceeds the limit, replace camshaft.



Camshaft Cam Height

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

Standard and Limit : Refer to EM-130, "Camshaft".



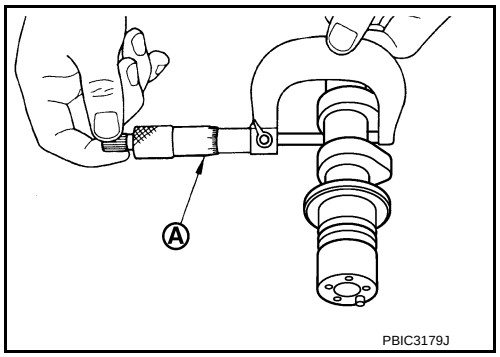
2. If it exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL OUTER DIAMETER

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

Standard : Refer to EM-130, "Camshaft".

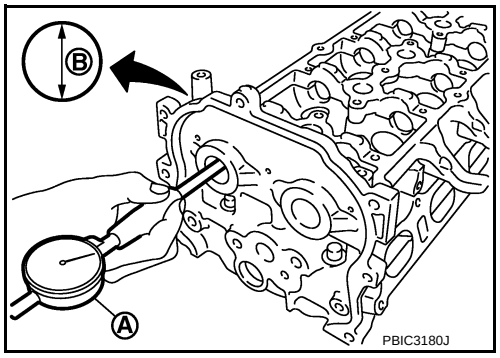


CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque. Refer to EM-79, "Removal and Installation".
- Measure the inner diameter of camshaft bracket with a bore gauge (A).

B : Measuring direction of inner diameter

Standard : Refer to EM-130, "Camshaft".



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard and Limit : Refer to EM-130, "Camshaft".

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

NOTE:

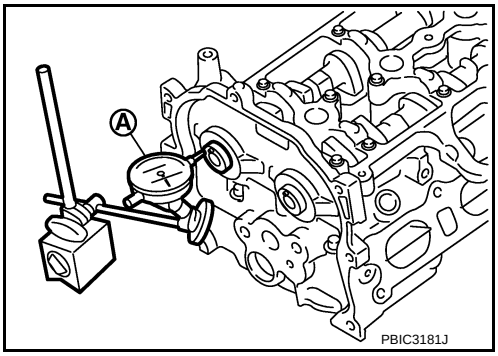
Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to EM-79, "Removal and Installation".

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 and Limit : Refer to EM-130, "Camshaft".



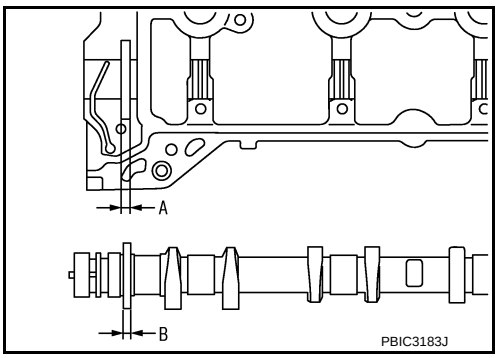
- Measure the following parts if out of the standard.
- Dimension (A) for groove of cylinder head No. 1 journal

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)

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

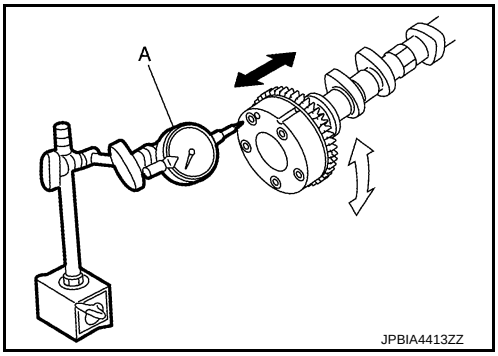


Camshaft Sprocket Runout

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

Limit : Refer to EM-130, "Camshaft".

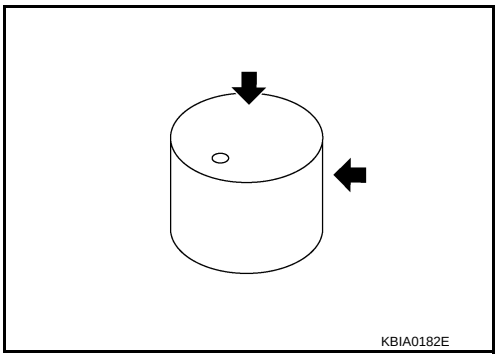
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-130, "Camshaft".

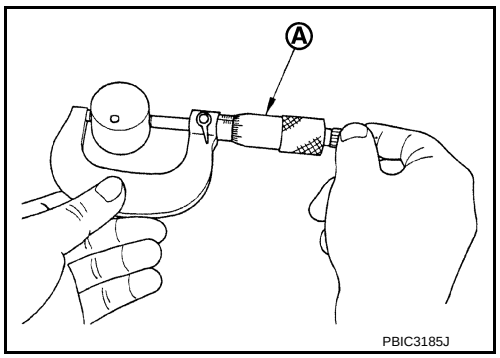


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

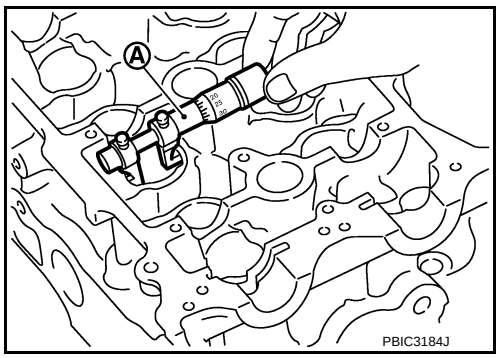
Standard : Refer to EM-130, "Camshaft".



VALVE LIFTER HOLE DIAMETER

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

Standard : Refer to EM-130, "Camshaft".



VALVE LIFTER CLEARANCE

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

Standard : Refer to EM-130, "Camshaft".

- 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.

INSPECTION AFTER INSTALLATION

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-163, "Diagnosis Procedure".**
- **Check when engine is cold so as to prevent burns by the splashing engine oil.**

1. Check engine oil level. Refer to LU-8, "Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release the fuel pressure. Refer to EC-140, "Work Procedure".
b. Remove intake manifold. Refer to EM-28, "Exploded View".
c. Disconnect ignition coil and injector harness connectors.
d. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket (RH) and engine mounting insulator (RH). Refer to EM-55, "2WD : Exploded View".

3. Remove intake valve timing control solenoid valve. Refer to EM-67, "Exploded View".
   - Lift the front side of the engine with a jack base to remove intake valve timing control solenoid valve.
4. Clean the mounting area of intake valve timing control solenoid valve, and then insert a clean waste with no oil adhesion into the oil hole of the cylinder head.
5. Install engine mounting insulator (RH) and engine mounting bracket (RH). (After the removal of intake valve timing control solenoid valve and insertion of a waste into the oil hole.)
6. Perform cranking to check that engine oil comes out from the oil hole (mounting hole of intake valve timing control solenoid valve) of cylinder head.
   - Regarding the engine oil check, judge it by the amount of oil adhered to the wasted inserted into the oil hole.

WARNING:

- **Never insert fingers into the oil hole.**
- **Be careful not to touch rotating parts (drive belt, idler pulleys and crankshaft pulley, etc.).**

CAUTION:

- **Never perform cranking without installing the engine mounting insulator (RH) and engine mounting bracket (RH).**
- **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 belt, 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-103, "Exploded View".
   - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to LU-3, "Engine Lubrication System" and LU-3, "Engine Lubrication System Schematic".
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-3, "Engine Lubrication System" and LU-3, "Engine Lubrication System Schematic".
9. After inspection, install removed parts in the reverse order.

OIL SEAL

VALVE OIL SEAL

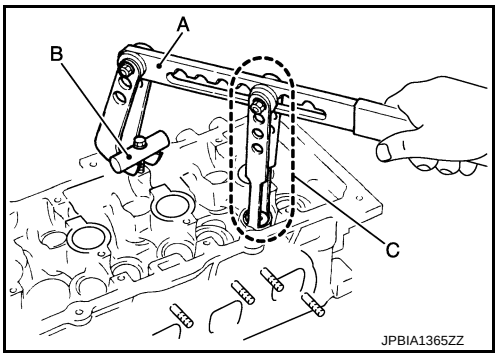
VALVE OIL SEAL : Removal and Installation

INFOID:0000000006337280

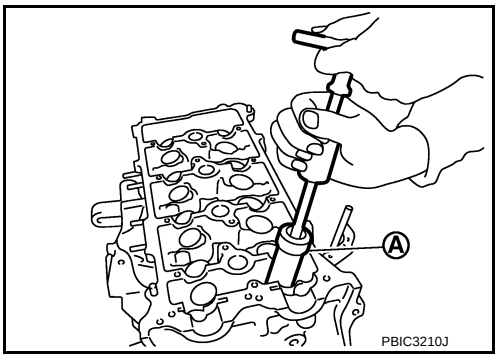
REMOVAL

1. Remove camshafts. Refer to EM-78, "Exploded View".
2. Remove valve lifters. Refer to EM-78, "Exploded View".
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 with the valve spring compressor [SST: KV10116200 (J-26336-A)] (A), the attachment [SST: KV10115900 (J-26336-20)] (C), and the adapter [SST: KV10109220 (—)] (B). Remove valve collet with magnet hand.

   CAUTION:
   Be careful not to damage valve lifter holes.



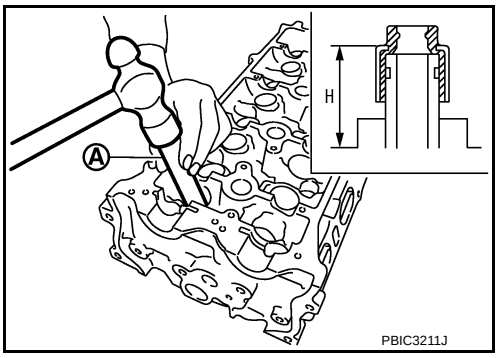
5. Remove valve spring retainer and valve spring (with valve spring seat).
   CAUTION:
   Never remove valve spring seat from valve spring.
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902 (J-38959)] (A).



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 in the figure with the valve oil seal drift [SST: KV10115600 (J-38958)] (A).

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



3. Install in the reverse order of removal, for the rest of parts.

FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:0000000006337281

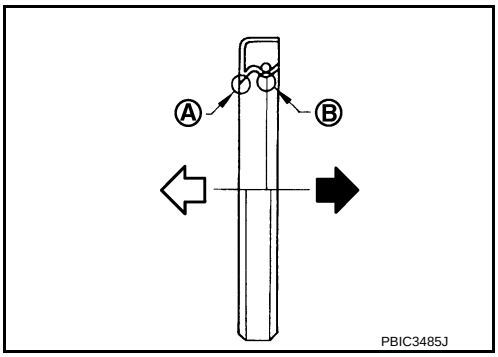
REMOVAL

1. Remove the following parts.
   - Front fender protector (RH): Refer to EXT-22, "Exploded View".
   - Drive belt: Refer to EM-20, "Exploded View".
   - Crankshaft pulley: Refer to EM-67, "Exploded View".
2. Remove front oil seal with 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 in the figure.

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



   - Press-fit front oil seal using a suitable drift with outer diameter 57 mm (2.24 in) and inner diameter 45 mm (1.77 in).

     Within 0.3 mm (0.012 in) toward engine front (crankshaft pulley side)
     Within 0.5 mm (0.020 in) toward engine rear (crankshaft sprocket side)

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

3. Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:0000000006337282

REMOVAL

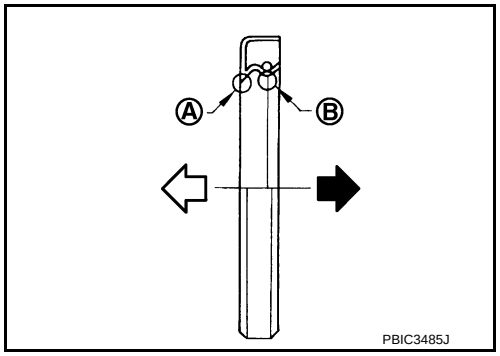
1. Remove transaxle assembly. Refer to TM-301, "Exploded View" (CVT models) or TM-84, "MR16DDT : Exploded View" (M/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to CL-29, "EXCEPT FOR K9K : Exploded View".
3. Remove drive plate (CVT models) or flywheel (M/T models). Refer to EM-103, "Exploded View".
4. Remove rear oil seal with a suitable tool.
   CAUTION:
   Be careful not to damage crankshaft and cylinder block.

INSTALLATION

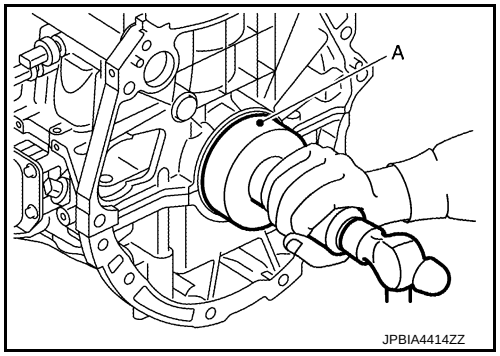
1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
   Use Genuine Liquid Gasket or equivalent.

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

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

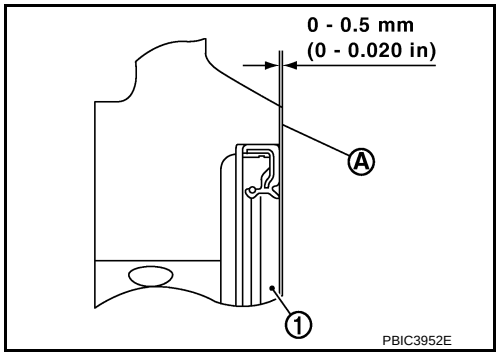


- Press-fit rear oil seal with a suitable drift (A) outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in).
  CAUTION:
  - **Be careful not to damage crankshaft and cylinder block.**
  - **Press-fit oil seal straight to avoid causing burrs or tilting.**
  - **Never touch grease applied onto oil seal lip.**



- Press in rear oil seal (1) to the position as shown in the figure.

A : Rear end surface of cylinder block



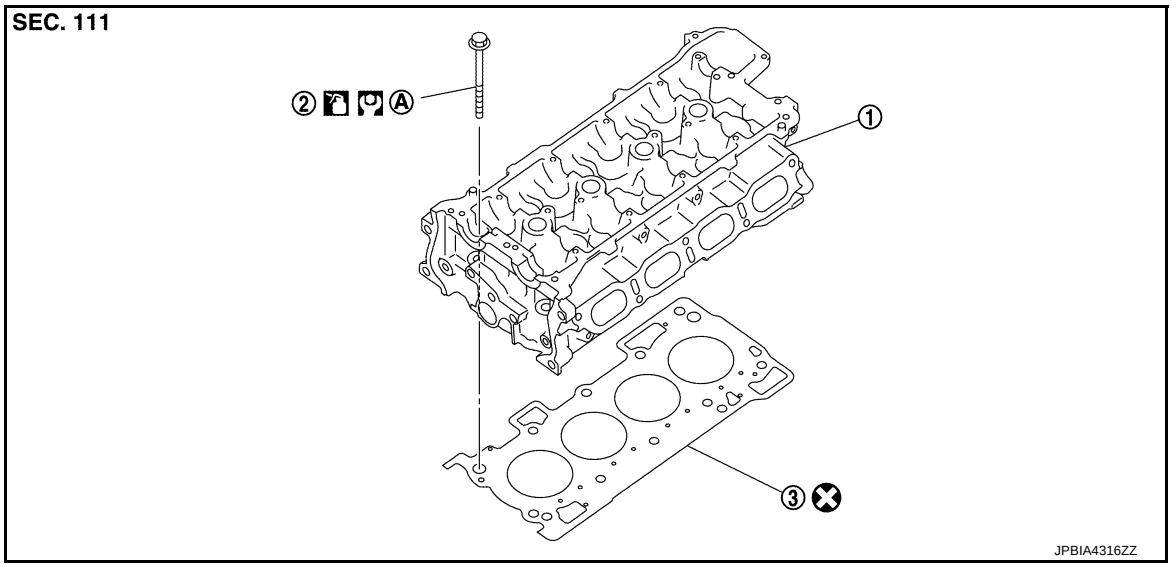
3. Install in the reverse order of removal, for the rest of parts.

CYLINDER HEAD

Exploded View

INFOID:0000000006337283

REMOVAL



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

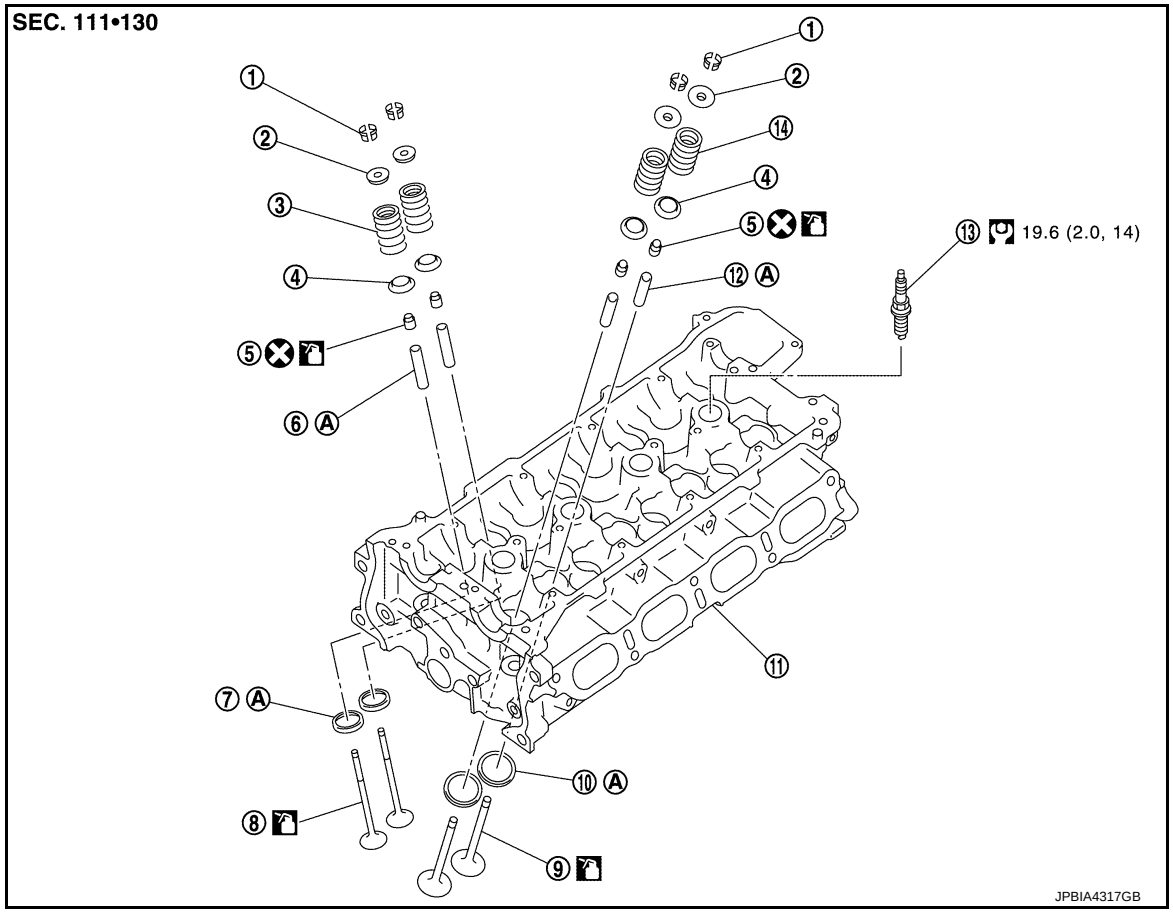
A. Tightening must be done following the installation procedure. Refer to EM-91

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

DISASSEMBLY



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

A. Replacement must be following the disassembly and assembly procedure. Refer to EM-92

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

Removal and Installation

INFOID:0000000006337284

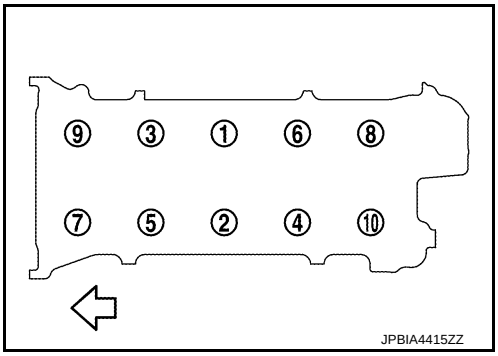
REMOVAL

1. Remove the following components and related parts.
   - Exhaust manifold: Refer to EM-38, "Exploded View".
   - Intake manifold: Refer to EM-28, "Exploded View".
   - Fuel injector and fuel tube assembly: Refer to EM-47, "Exploded View".
   - Water outlet: Refer to CO-26, "Exploded View".
   - Rocker cover: Refer to EM-23, "Exploded View".
   - Front cover, timing chain: Refer to EM-67, "Exploded View".
   - Camshaft: Refer to EM-78, "Exploded View".
2. Remove cylinder head.

- Loosen cylinder head bolts in reverse order as shown in the figure.

⇦ : Engine front

- Using TORX socket, loosen cylinder head bolts.



3. Remove cylinder head gasket.

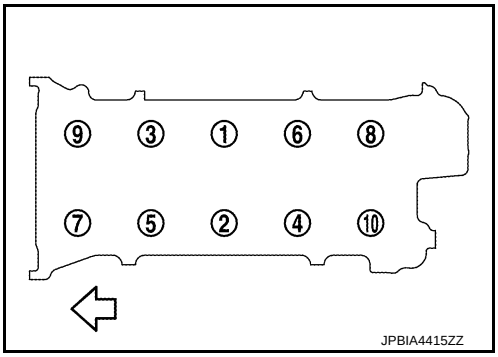
INSTALLATION

1. Install cylinder head gasket.
2. Install cylinder head, and tighten cylinder head bolts in numerical order as shown in the figure with the following procedure.

⇦ : Engine front

CAUTION:
If cylinder head bolts are reused, check their outer diameters before installation. Refer to EM-96, "Inspection".

a. Apply new engine oil to threads and seating surface of mounting bolts.
b. Tighten all cylinder head bolts.



: 40.0 N·m (4.1 kg-m, 30 ft-lb)

c. Turn all cylinder head bolts 100 degrees clockwise (angle tightening).

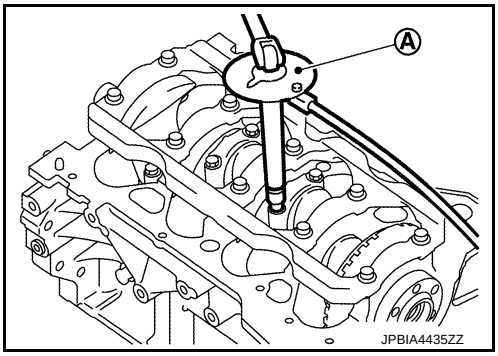
CAUTION:
Check and confirm the tightening angle by using an angle wrench [SST: KV10112100 (BT8653-A)] (A) or protractor. Never judge by visual inspection without the tool.

d. Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:
In this step, loosen cylinder head bolts in reverse order that indicated in the figure.

e. Tighten all cylinder head bolts.



: 40.0 N·m (4.1 kg-m, 30 ft-lb)

f. Turn all cylinder head bolts 95 degrees clockwise (angle tightening).
g. Turn all cylinder head bolts 95 degrees clockwise again (angle tightening).
3. Install in the reverse order of removal, for the rest of parts.

Disassembly and Assembly

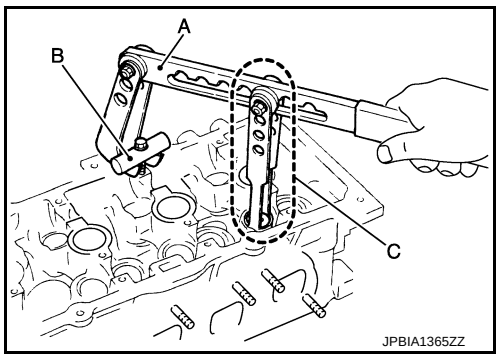
INFOID:0000000006337285

DISASSEMBLY

1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.

- Compress valve spring with the valve spring compressor [SST: KV10116200 (J-26336-A)] (A), the attachment [SST: KV10115900 (J-26336-20)] (C), and the adapter [SST: KV10109220 (—)] (B). Remove valve collet with a magnet hand.

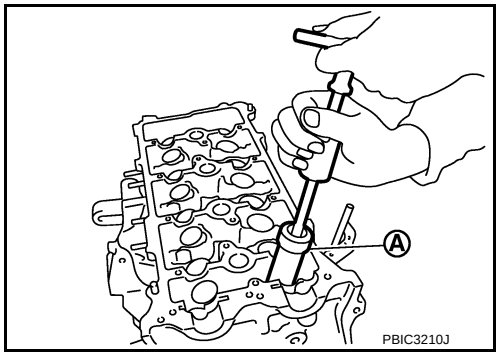
CAUTION:
Be careful not to damage valve lifter holes.



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.
   - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal with a valve oil seal puller [SST: KV10107902 (J-38959)] (A).

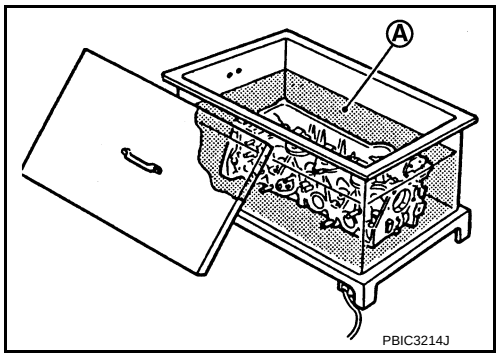


7. When valve seat must be replaced.
   - Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to EM-132, "Cylinder Head".

CAUTION:
Never bore excessively to prevent cylinder head from scratching.

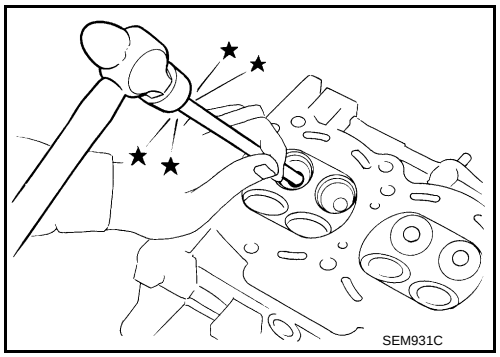
8. When valve guide must be replaced.

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



b. Drive out valve guide with a hammer and valve guide drift (commercial service tool).

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

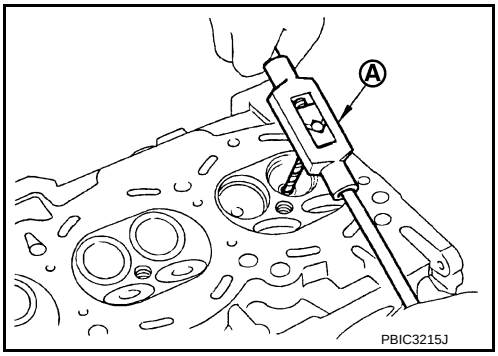


ASSEMBLY

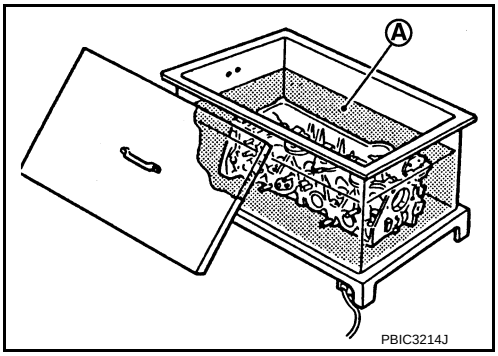
1. When valve guide is removed, install it.
   CAUTION:
   Replace with oversize [0.2 mm (0.008 in)] valve guide.

a. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool) (A).

For service parts: Oversize [0.2 mm (0.008 in)]
Refer to EM-132, "Cylinder Head".



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

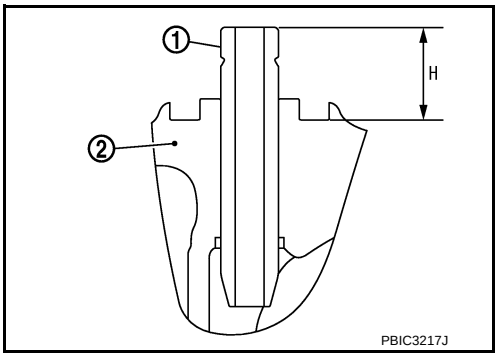


c. Press valve guide (1) from camshaft side to dimensions as shown in the figure.

2 : Cylinder head

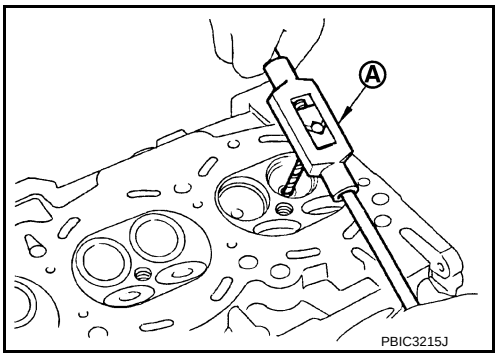
Projection (H) : Refer to EM-132, "Cylinder Head".

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



d. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool) (A).

Standard : Refer to EM-132, "Cylinder Head".



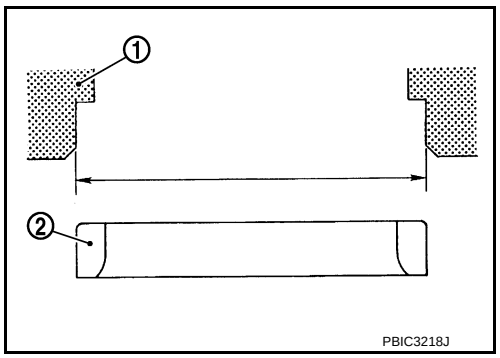
2. When valve seat is removed, install it.
   CAUTION:
   Replace with oversize [0.5 mm (0.020 in)] valve seat.

a. Ream cylinder head (1) recess diameter for service valve seat (2).

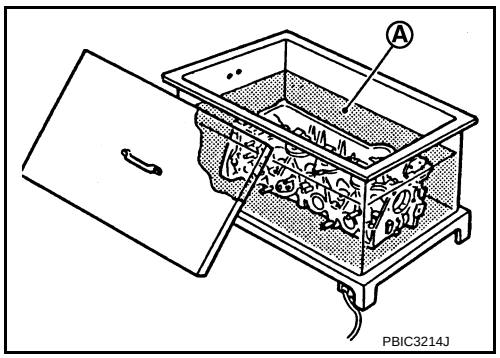
For service parts: Oversize [0.5 mm (0.020 in)]

Refer to EM-132, "Cylinder Head".

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



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



c. Provide valve seats cooled well with dry ice. Press-fit valve seat into cylinder head.

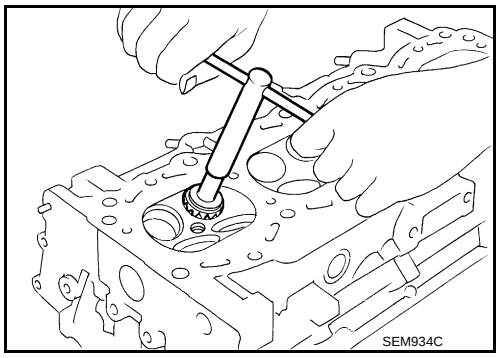
CAUTION:

- **Never touch cold valve seats directly.**
- **Cylinder head contains heat, wear protective equipment to avoid getting burned.**

d. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to EM-132, "Cylinder Head".

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.



e. Using compound, grind to adjust valve fitting.

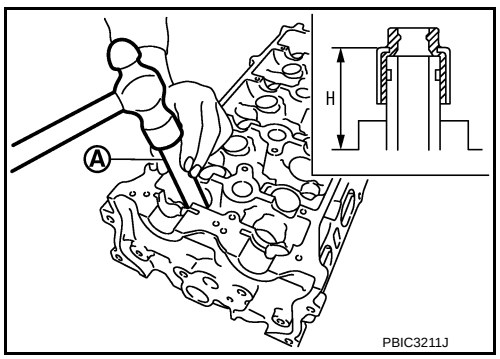
f. Check again for normal contact. Refer to EM-96, "Inspection".

3. Install valve oil seal.
   - Install with a valve oil seal drift [SST: KV10115600 (J-38958)] (A) to match dimension in the figure.

   NOTE:

   Dimension is height that measured before installing valve spring (with valve spring seat).

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



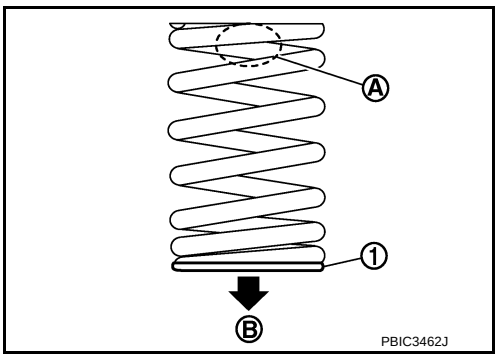
4. Install valve.
   - Install larger diameter to intake side.
5. Install valve spring (with valve spring seat).

- Install smaller pitch (valve spring seat side) to cylinder head side (B).

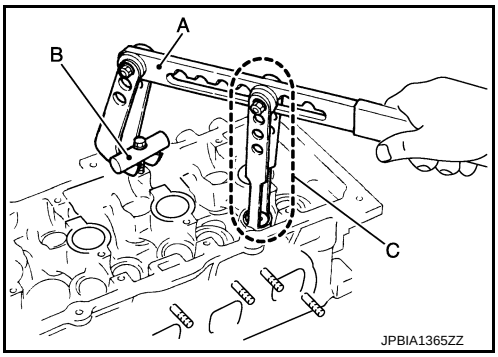
1 : Valve spring seat (Do not remove from valve spring.)

- Confirm identification color (A) of valve spring.

Intake : White
Exhaust : Orange



6. Install valve spring retainer.
7. Install valve collet.
   - Compress valve spring with the valve spring compressor [SST: KV10116200 (J-26336-A)] (A), the attachment [SST: KV10115900 (J-26336-20)] (C), and the adapter [SST: KV10109220 (—)] (B). Install valve collet with a magnet hand.
     CAUTION:
     When working care 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 with spark plug wrench (commercial service tool).

Inspection

INFOID:0000000006337286

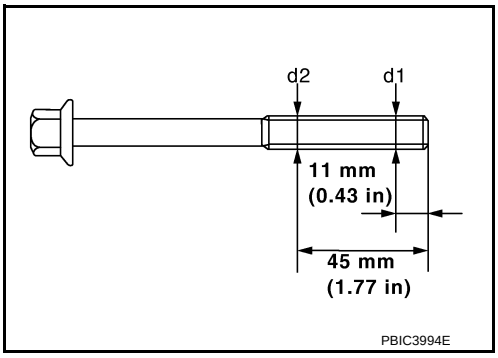
INSPECTION AFTER REMOVAL

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.

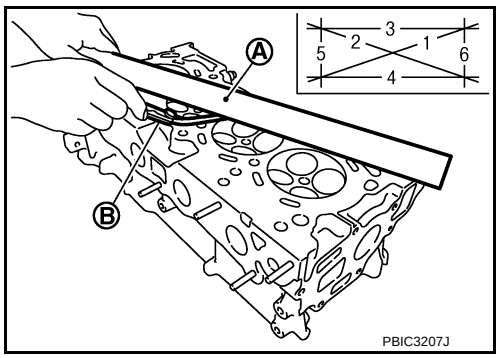


Cylinder Head Distortion

NOTE:
When performing this inspection, cylinder block distortion should be also checked. Refer to EM-112, "Inspection".

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.
   CAUTION:
   Never 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: Refer to EM-132, "Cylinder Head".

- If it exceeds the limit, replace cylinder head.

INSPECTION AFTER DISASSEMBLY

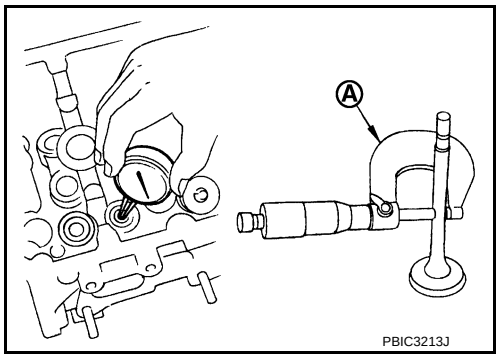
VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to EM-132, "Cylinder Head".
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to “VALVE SEAT CONTACT”.

VALVE GUIDE CLEARANCE

Valve Stem Diameter

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



Standard: Refer to EM-132, "Cylinder Head".

Valve Guide Inner Diameter

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

Standard: Refer to EM-132, "Cylinder Head".

Valve Guide Clearance

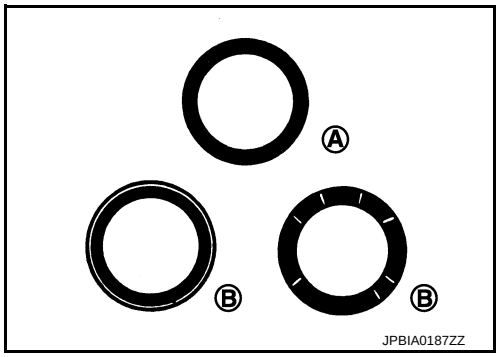
- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

Standard and Limit: Refer to EM-132, "Cylinder Head".

- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to EM-92, "Disassembly and Assembly".

VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the 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.



A : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has “NG” conditions (B) even after the recheck, replace valve seat. Refer to EM-92, "Disassembly and Assembly".

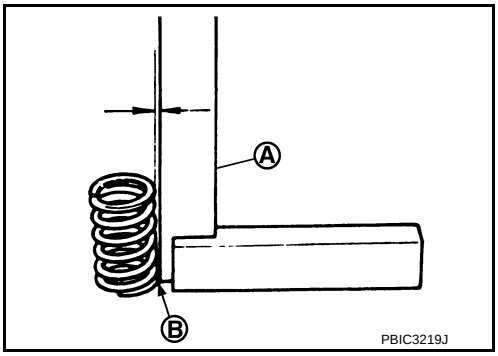
VALVE SPRING SQUARENESS

- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance between the top of spring and try square.

B : Contact

Limit : Refer to EM-132, "Cylinder Head".

- If it exceeds the limit, replace valve spring.



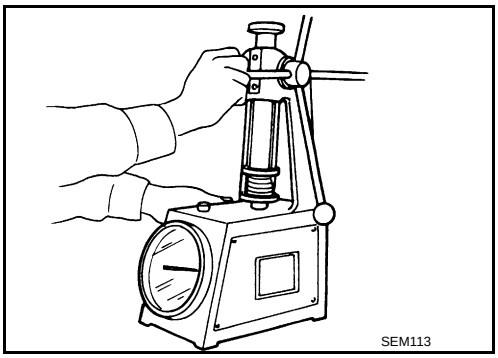
VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure with valve spring seat installed at the specified spring height.

CAUTION:
Never remove valve spring seat from valve spring.

Standard : Refer to EM-132, "Cylinder Head".

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



INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- 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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check 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:

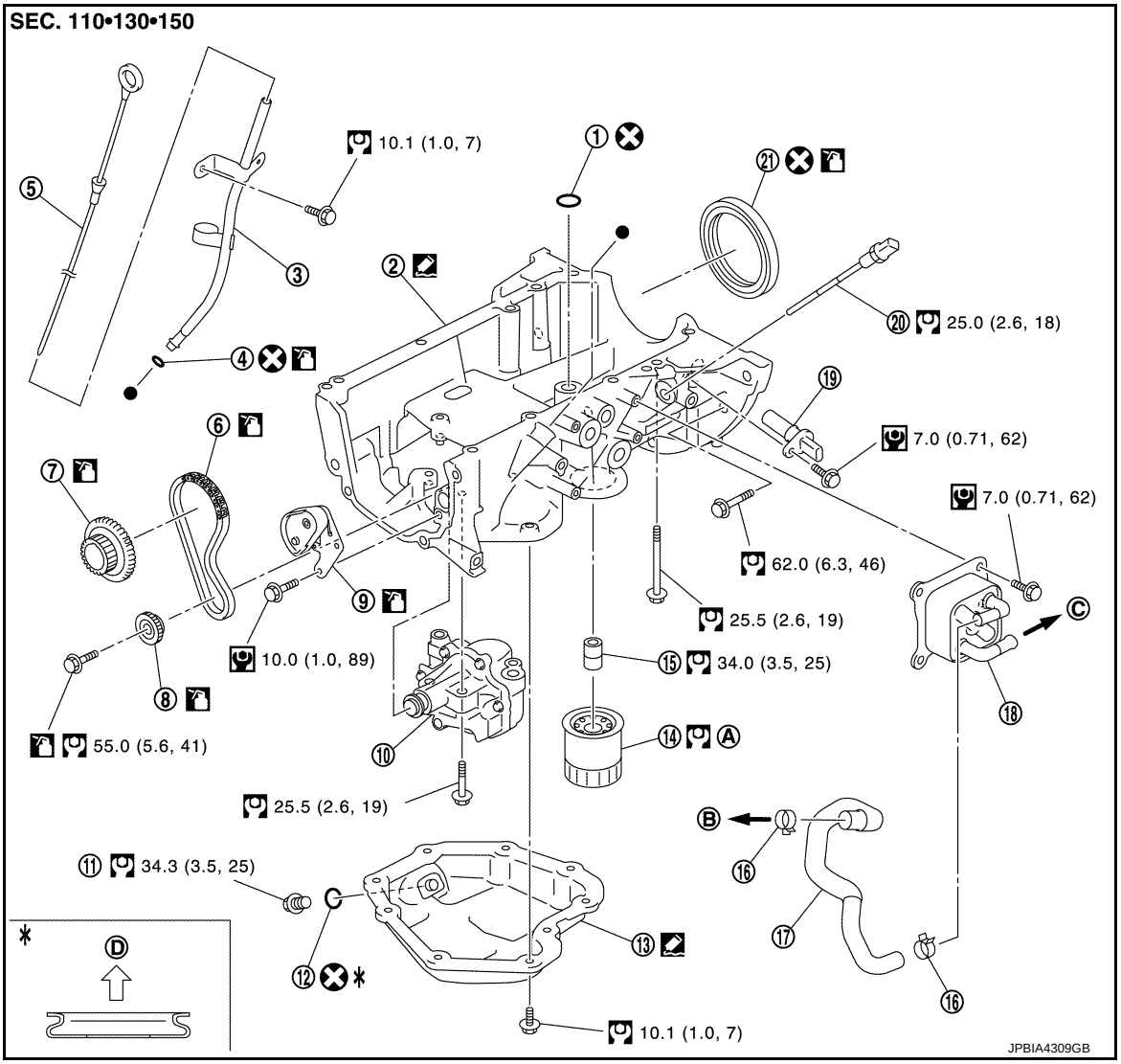
Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

OIL PAN (UPPER)

Exploded View

INFOID:0000000006337263



1. O-ring
2. Oil pan (upper)
3. Oil level gauge guide
4. O-ring
5. Oil level gauge
6. Oil pump drive chain
7. Crankshaft sprocket
8. Oil pump sprocket
9. Oil pump chain tensioner
10. Oil pump
11. Drain plug
12. Drain plug washer
13. Oil pan (lower)
14. Oil filter
15. Connector bolt
16. Clamp
17. Water hose
18. Oil cooler
19. Crankshaft position sensor
20. Oil level sensor
21. Rear oil seal

A. Refer to LU-11
B. Oil pan side
C. To thermostat haosing (M/T models)
To CVT fluid cooler (CVT models)
D. Oil pan side

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

Removal and Installation

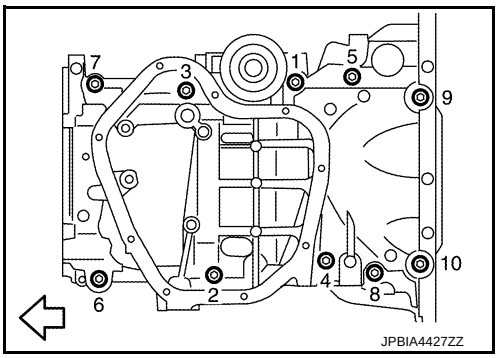
INFOID:0000000006337294

REMOVAL

1. Remove oil pan (lower). Refer to EM-99, "Exploded View".
2. Remove oil filter. Refer to LU-11, "Removal and Installation".
3. Remove front cover, timing chain, oil pump drive chain, and other related parts. Refer to EM-67, "Exploded View".
4. Remove oil level gauge and oil level gauge guide.
5. Remove oil pump. Refer to LU-15, "Exploded View".
   NOTE:
   The oil pan (upper) can be removed and installed without removing the oil pump.
6. Remove oil pan (upper) with the following procedure:

a. Loosen bolts in reverse order as shown in the figure.

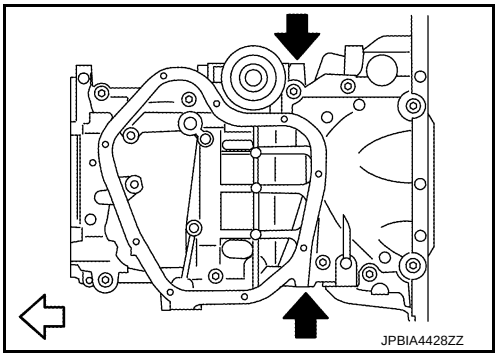
⇦ : Engine front



b. Insert a screwdriver shown by the arrow (⬅) in the figure 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.



c. Insert seal cutter [SST: KV10111100 (J-37228)] between oil pan (upper) and cylinder block, and slide it by tapping on the side of the tool with a hammer.
   CAUTION:
   Be careful not to damage the mating surface.

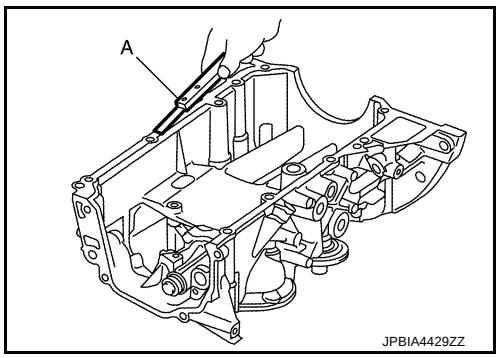
7. Remove O-ring between cylinder block and oil pan (upper).

INSTALLATION

1. Install oil pan (upper) with the following procedure:

a. 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.

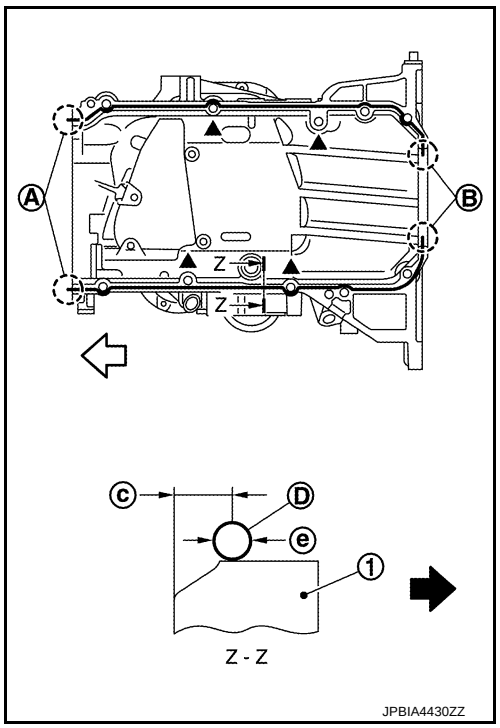


b. Apply a continuous bead of liquid gasket (D) with a tube presser (commercial service tool) as shown in the figure.

1 : Oil pan (upper)
A : 2 mm (0.08 in) protruded to outside
B : 2 mm (0.08 in) protruded to rear oil seal mounting side
c : 5.5 - 7.5 mm (0.217 - 0.295 in)
e : 4.0 - 5.0 mm (0.157 - 0.197 in)
⇦ : Engine front
⬅ : Engine outside

Use Genuine Liquid Gasket or equivalent.

CAUTION:
- **Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.**
- **Attaching should be done within 5 minutes after liquid gasket application.**

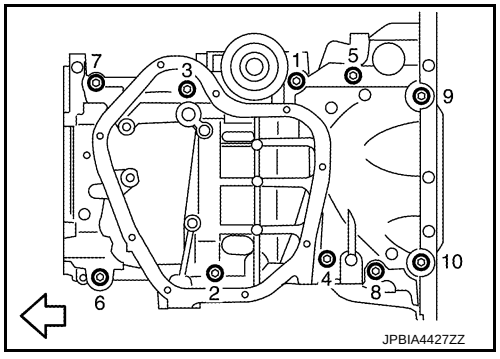


c. Install new O-ring at cylinder block side.

CAUTION:
Install avoiding misalignment of O-ring.

d. Tighten bolts in numerical order as shown in the figure.

⇦ : Engine front



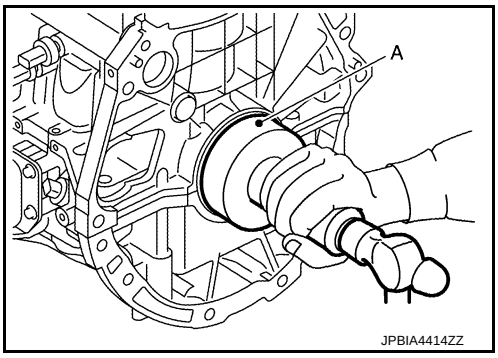
2. Install rear oil seal with the following procedure.

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.**

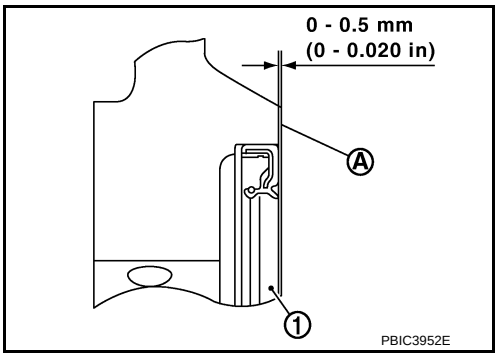
a. Wipe off liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a scraper.

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

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



- Press-fit to the specified dimensions as shown in the figure.



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, checking that rear oil seal does not curl or tilt.**

NOTE:

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

3. Install in the reverse order of removal, for the rest of parts.

Inspection

INFOID:0000000006337295

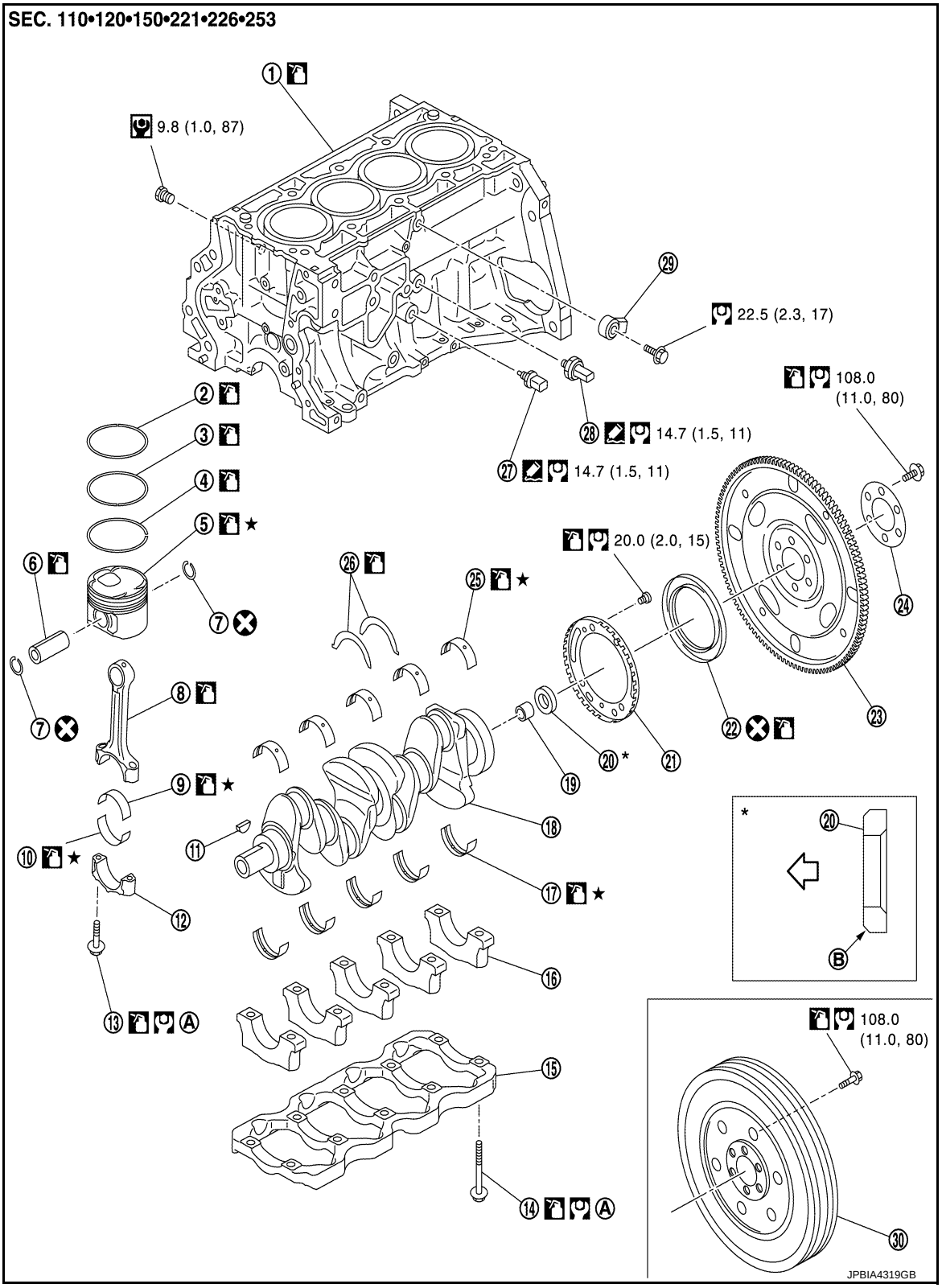
INSPECTION AFTER REMOVAL

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

CYLINDER BLOCK

Exploded View

INFOID:0000000006337296



1. Cylinder block
2. Top ring
3. Second ring
4. Oil ring
5. Piston
6. Piston pin
7. Snap ring
8. Connecting rod
9. Connecting rod bearing (upper)

10. Connecting rod bearing (lower)
11. Crankshaft key
12. Connecting rod cap
13. Connecting rod cap bolt
14. Main bearing cap bolt
15. Main bearing beam
16. Main bearing cap
17. Main bearing (lower)
18. Crankshaft
19. Pilot bush
20. Pilot converter (CVT models)
21. Signal plate
22. Rear oil seal
23. Drive plate (CVT models)
24. Reinforcement plate (CVT models)
25. Main bearing (upper)
26. Thrust bearing
27. Oil temperature sensor
28. Oil pressure sensor
29. Knock sensor
30. Flywheel (M/T models)

A. Tightening must be done following the assembly procedure. Refer to EM-104
B. Chamfered

⇦ : Crankshaft side

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

★ : Select with proper thickness.

Disassembly and Assembly

INFOID:0000000006337297

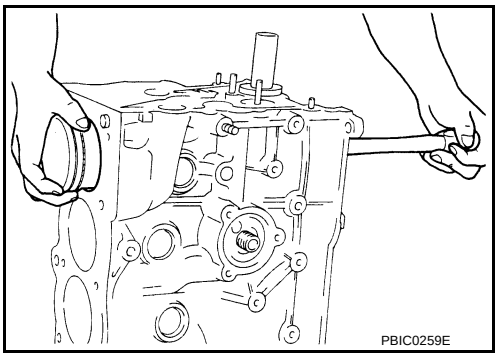
DISASSEMBLY

1. Remove oil pan (upper). Refer to EM-99, "Exploded View".
2. Remove thermostat housing. Refer to CO-24, "Exploded View".
3. Remove knock sensor.
   CAUTION:
   Carefully handle sensor avoiding shocks.
4. Remove piston and connecting rod assembly with the following procedure:
   - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-112, "Inspection".

a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.

b. Remove connecting rod cap.

c. Using a hammer handle or similar 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.**

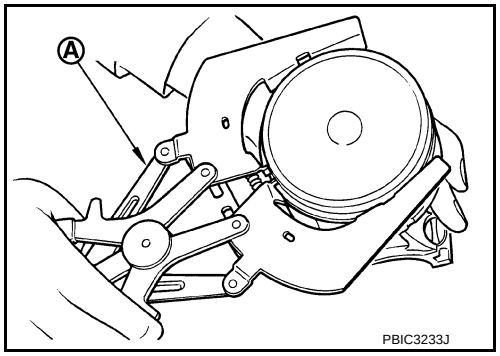


5. Remove connecting rod bearings.
   CAUTION:
   When removing them, note the installation position. Keep them in the correct.
6. Remove piston rings from piston.
   - Before removing piston rings, check the piston ring side clearance. Refer to EM-112, "Inspection".

- Use a piston ring expander (commercial service tool) (A).

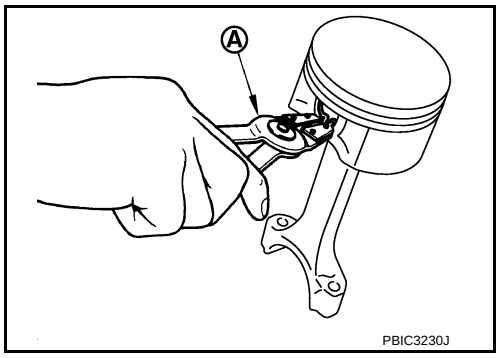
CAUTION:

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

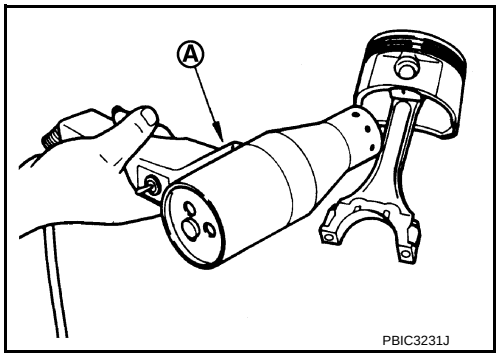


7. Remove piston from connecting rod with the following procedure:

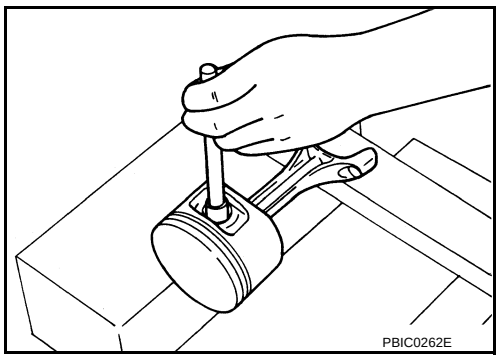
a. Using snap ring pliers (A), remove snap rings.



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



c. Push out piston pin with stick of outer diameter approximately 18 mm (0.71 in).

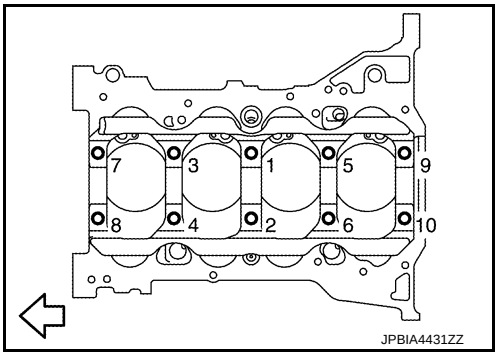


8. Remove main bearing cap bolts.
   - Measure crankshaft end play before loosening main bearing cap bolts. Refer to EM-112, "Inspection".

- Loosen and remove main bearing cap bolts in reverse order as shown in the figure.

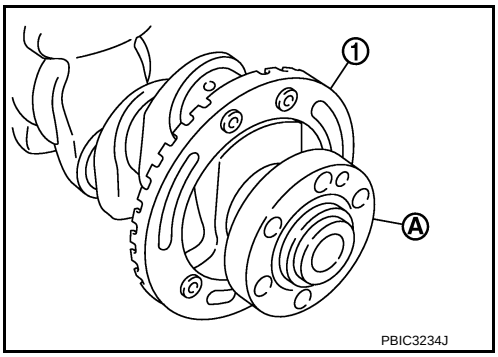
⇦ : Engine front

- Use TORX socket.



9. Remove main bearing caps.
   - Tap main bearing caps lightly with a plastic hammer for removal.
   CAUTION:
   Be careful not to damage the mounting surface.
10. 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.**

   NOTE:
   When removing or installing signal plate, use TORX socket.



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

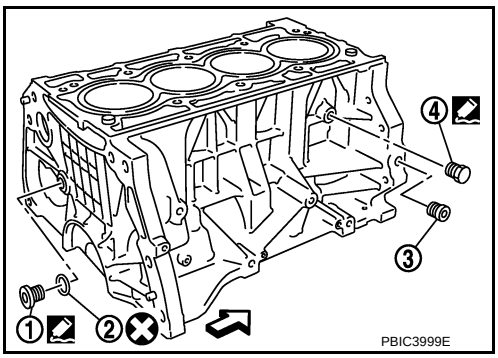
ASSEMBLY

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 each plug to cylinder block as shown in the figure.

2 : Washer

⇦ : Engine front

- Apply liquid gasket to the thread of water drain plug (4).
  Use Genuine Liquid Gasket or equivalent.
- Apply sealant to the thread of plug (1).
  Use genuine high strength thread locking sealant or equivalent.
  NOTE:
  Do not apply liquid gasket or high strength thread locking sealant to the plug (3).



- Tighten each plug as specified below.

Part	Washer	Tightening torque
1	Yes	54.0 N·m (5.5 kg-m, 40 ft-lb)
3	No	19.6 N·m (2.0 kg-m, 14 ft-lb)
4	No	9.8 N·m (1.0 kg-m, 87 in-lb)

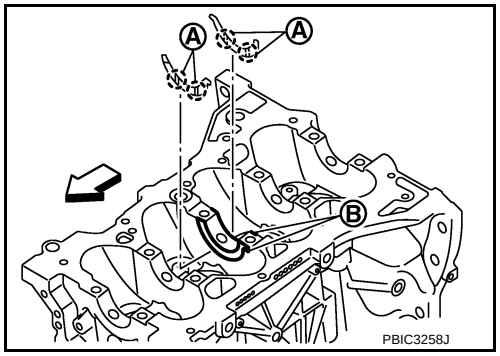
3. Install main bearings and thrust bearings with the following procedure:

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

b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

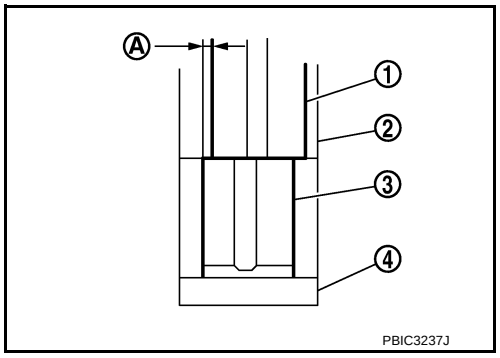
⇦ : Engine front

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

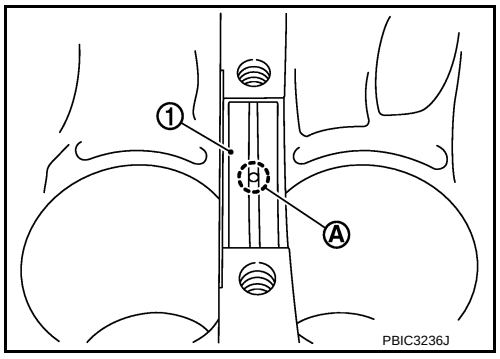


c. Install the main bearings paying attention to the direction.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing to the center position of cylinder block and main bearing cap.
- The difference (A) between main bearing (upper) (1) and main bearing (lower) (3) should be 0.85 mm (0.0335 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.

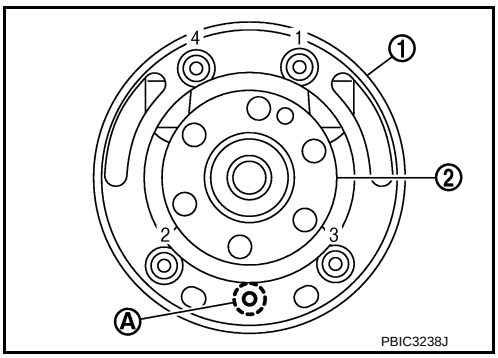


4. Install signal plate to crankshaft if removed.

a. Set the signal plate with the flange facing toward the counter weight side (engine front side) to the crankshaft rear surface.

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

c. Position crankshaft (2) and signal plate (1) using a dowel pin (service part), and tighten mounting bolts in numerical order as shown in the figure using TORX socket.



A : Dowel pin hole

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

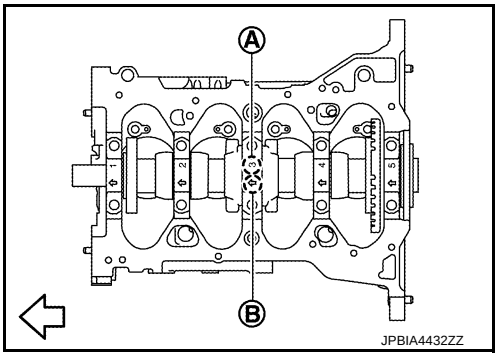
d. Tighten mounting bolts in numerical order as shown in the figure again.

e. Remove dowel pin. (service parts)
CAUTION:
Be sure to remove dowel pin.

5. Install crankshaft to cylinder block.
• While turning crankshaft by hand, check that it turns smoothly.

6. Install main bearing caps with the following procedure:

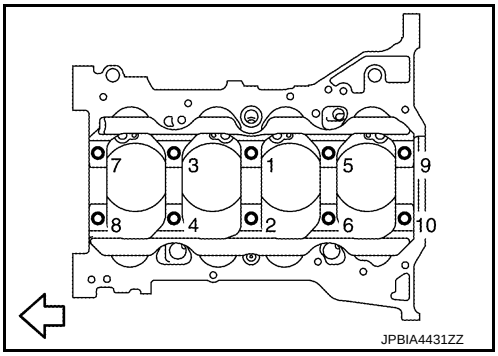
a. Install main bearing caps referring to the journal No. stamp (A) and front mark (B) as shown in the figure.



⇦ : Engine front

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

b. Tighten main bearing cap bolts in numerical order as shown in the figure with the following procedure:



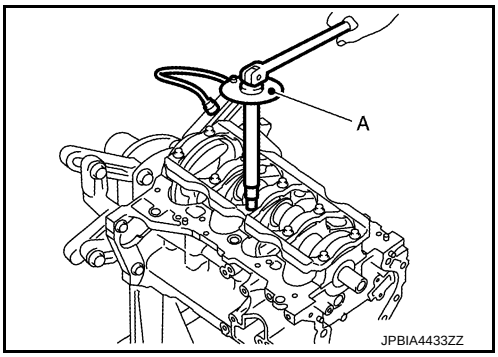
⇦ : Engine front

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

ii. Tighten main bearing cap bolts.

: 34.3 N·m (3.5 kg-m, 25 ft-lb)

iii. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in order from No. 1 to 10 in the figure.
CAUTION:
Confirm the tightening angle by using an angle wrench [SST: KV10112100 (BT8653-A)] (A) or protractor. Never judge by visual inspection without the tool.

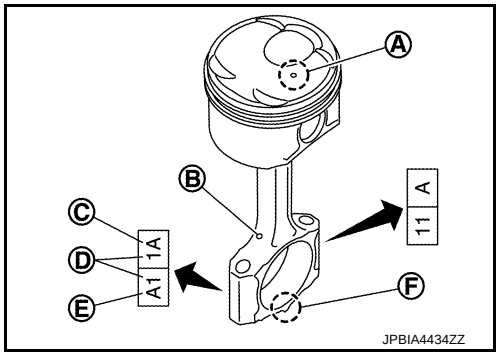


• After installing mounting bolts, check that crankshaft can be rotated smoothly by hand.
• Check crankshaft end play. Refer to EM-112, "Inspection".

7. Install piston to connecting rod with the following procedure:

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

b. Assemble piston to connecting rod.
- Using an industrial use drier or similar 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 (D) on connecting rod are positioned as shown in the figure.

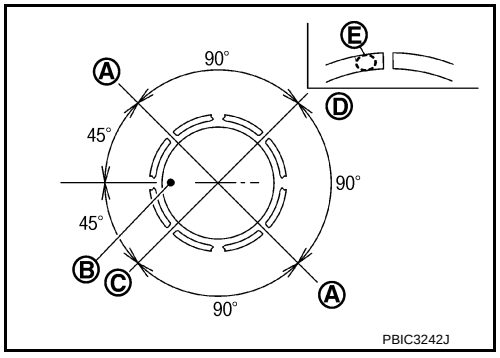


C : Engine type
E : Large end hole diameter grade
F : Front mark (connecting rod)

c. Install new snap ring to the groove of the piston front side.
- Insert it fully into groove to install.
- After installing, check that connecting rod moves smoothly.

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

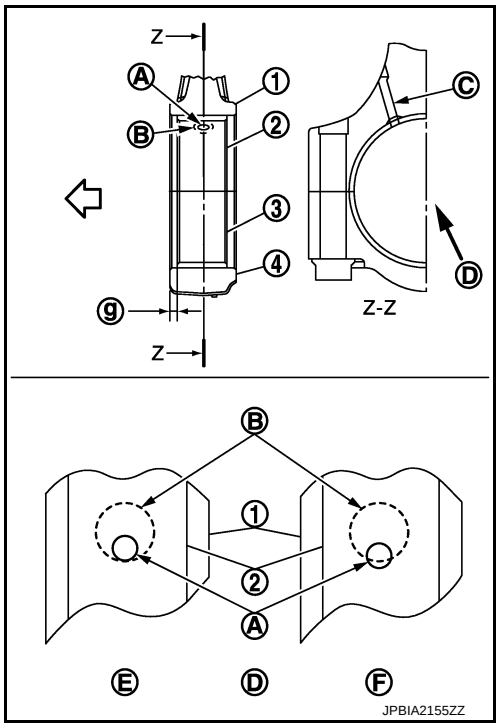
CAUTION:
- **Be careful not to damage piston.**
- **Be careful not to damage piston rings by expanding them excessively.**
- Position each ring with the gap as shown in the figure referring to the piston front mark.



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.

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



C : Oil hole (connecting rod)
D : View D
E : OK
F : NG
g : 2.55 - 2.95 mm (0.1004 - 0.1161 in)
⇦ : Engine front

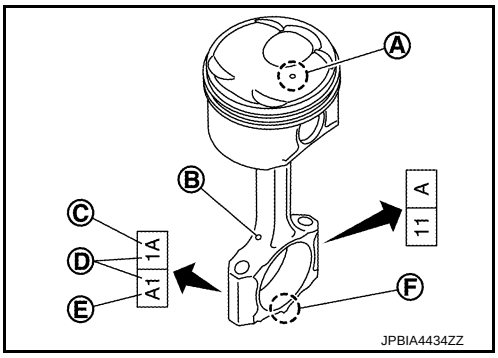
- Install the connecting rod in the dimension shown in the figure.
- Check that connecting rod bearing oil hole (A) is completely in the inside of connecting rod oil hole chamfered area (B).
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply 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 cap as shown in the figure. For service operation, the center position can be checked, visually.

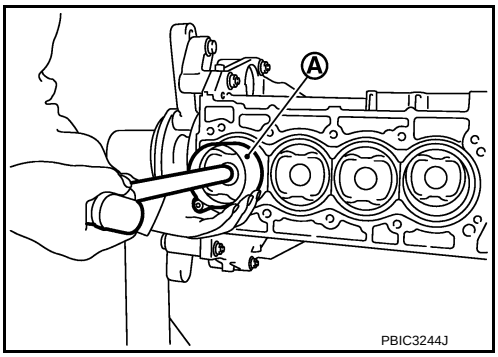
10. Install piston and connecting rod assembly to crankshaft.
    - Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
    - Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
    - Match the cylinder position with the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

      A : Front mark (piston)
      B : Oil hole
      C : Engine type
      E : Large end hole diameter grade
      F : Front mark (connecting rod)

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

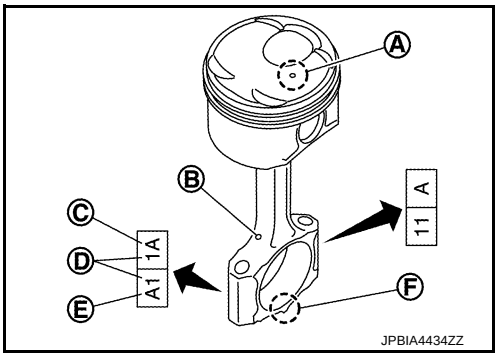


    - Using a piston ring compressor [SST: EM03470000 (J-8037)] (A) or suitable tool, install piston with the front mark on the piston head facing the front of the engine.
      CAUTION:
      Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.

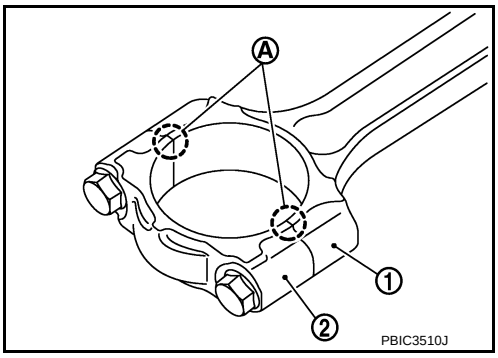


11. Install connecting rod cap.
    - Match the stamped cylinder number marks (D) on connecting rod with those on connecting rod cap to install.

      A : Front mark (piston)
      B : Oil hole
      C : Engine type
      E : Large end hole diameter grade
      F : Front mark (connecting rod)



12. Tighten connecting rod cap bolt with the following procedure:
    CAUTION:
    - **Check that there is no gap in the thrust surface (A) of the joint between connecting rod (1) and connecting rod cap (2) and that these parts are in the correct position. And then, tighten the connecting rod cap bolts.**
    - **If the connecting rod cap bolts are reused, measure the outer diameter. Refer to EM-112, "Inspection".**



a. Apply new engine oil to the threads and seats of connecting rod cap bolts.
b. Tighten connecting rod cap bolts.

    : 27.5 N·m (2.8 kg-m, 20 ft-lb)

c. Completely loosen connecting rod cap bolts.

    : 0 N·m (0 kg-m, 0 ft-lb)

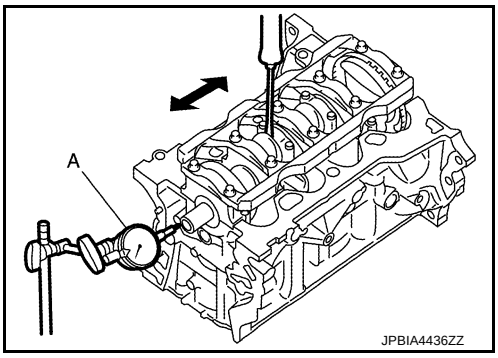
d. Tighten connecting rod cap bolts.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

e. Then turn all connecting rod cap bolts 60 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100 (BT8653-A)] (A) or protractor. Never judge by visual inspection without the tool.



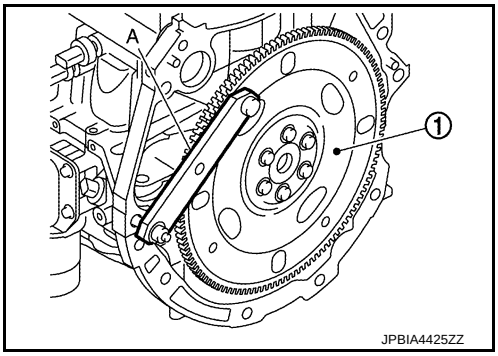
- After tightening connecting rod cap bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-112, "Inspection".

13. Install oil pan (upper). Refer to EM-99, "Exploded View".
    NOTE:
    Install the rear oil seal after installing the oil pan (upper).
14. Install rear oil seal. Refer to EM-88, "REAR OIL SEAL : Removal and Installation".
15. Install flywheel (M/T models) or drive plate (CVT models).

Drive plate (CVT models)

- Secure crankshaft with a stopper plate [SST: KV11105210 (J-44716)], (A) and tighten mounting bolts crosswise over several times.

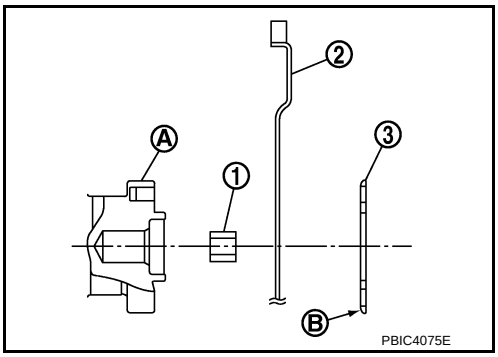
1 : Drive plate



- Install pilot converter (1), drive plate (2), and reinforcement plate (3) as shown in the figure.

A : Crankshaft rear end
B : R

- Using a drift of 33 mm (1.30 in) in dia meter, press-fit pilot converter into the end of crankshaft until it stops.



Fly wheel (M/T models)

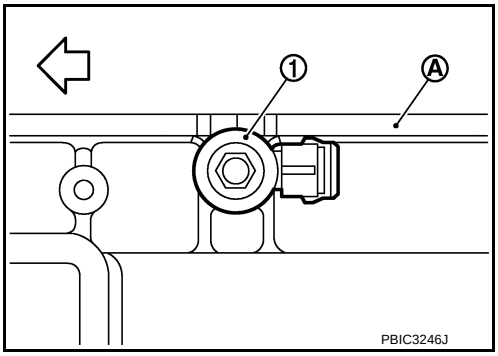
- Secure crankshaft with a stopper plate [SST: KV11105210 (J-44716)] and tighten mounting bolts crosswise over several times.
  NOTE:
  M/T models have no pilot bushing and reinforcement plate.

16. Install knock sensor.

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

A : Cylinder block left side

⇦ : Engine front



CAUTION:

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

NOTE:

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

17. Assemble in the reverse order of disassembly.

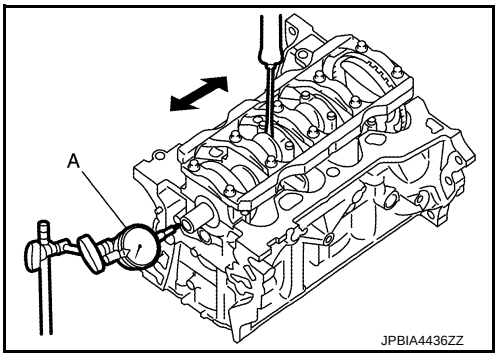
Inspection

INFOID:0000000006337298

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 and Limit : Refer to EM-134, "Cylinder Block".

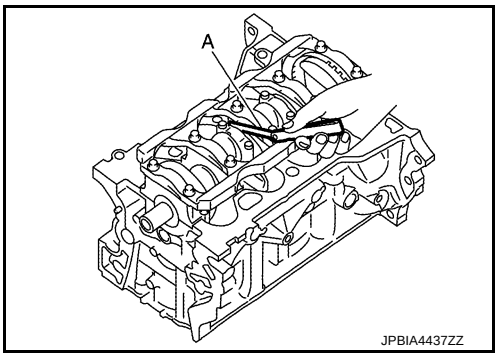


- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

CONNECTING ROD SIDE CLEARANCE

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

Standard and Limit : Refer to EM-134, "Cylinder Block".



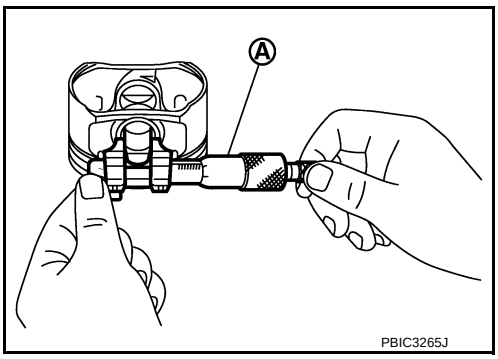
- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

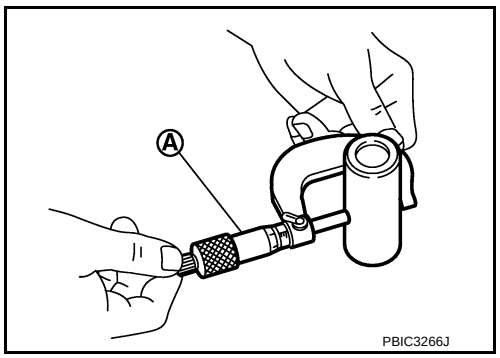
Measure the inner diameter of piston pin hole with an inside micrometer (A).

Standard : Refer to EM-134, "Cylinder Block".



Piston Pin Outer Diameter

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



Standard : Refer to EM-134, "Cylinder Block".

Piston to Piston Pin Oil Clearance

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

Standard : Refer to EM-134, "Cylinder Block".

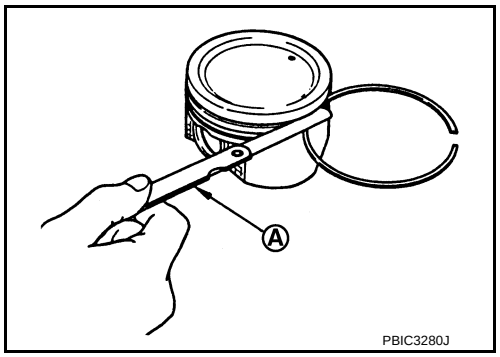
- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to EM-122, "Description".

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).

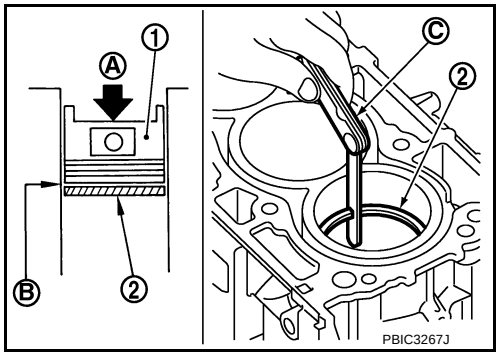


Standard and Limit : Refer to EM-134, "Cylinder Block".

- 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

- Check that cylinder bore inner diameter is within specification. Refer to “PISTON TO CYLINDER BORE CLEARANCE”.
- 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 and Limit : Refer to EM-134, "Cylinder Block".

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, rebore cylinder and use oversized piston and piston rings.

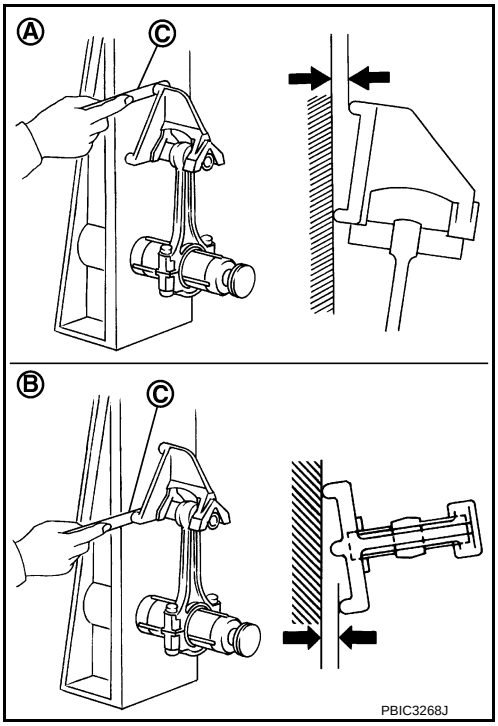
CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

A : Bend
B : Torsion
C : Feeler gauge

Limit : Refer to EM-134, "Cylinder Block".

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

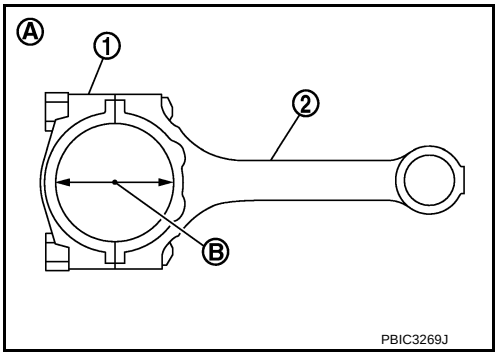


CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to EM-104, "Disassembly and Assembly".

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

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



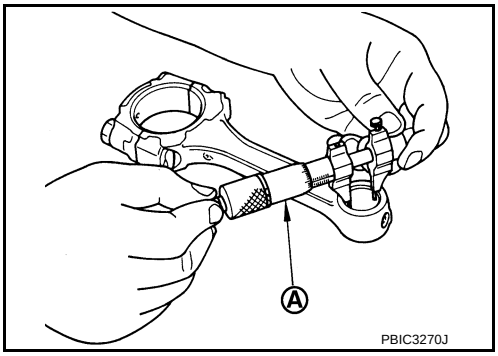
Standard : Refer to EM-134, "Cylinder Block".

- 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).

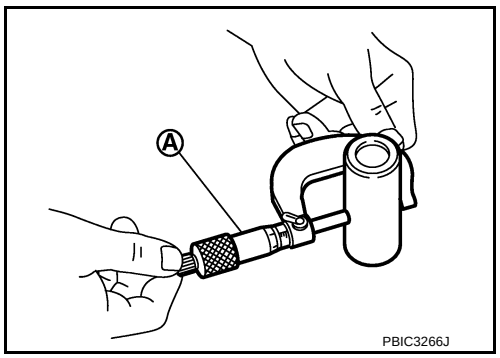


Standard : Refer to EM-134, "Cylinder Block".

Piston Pin Outer Diameter

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

Standard : Refer to EM-134, "Cylinder Block".



Connecting Rod Bushing Oil Clearance

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

Standard and Limit : Refer to EM-134, "Cylinder Block".

- 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. Refer to EM-122, "Piston".
- If replacing connecting rod assembly. Refer to EM-123, "Connecting Rod Bearing".

CYLINDER BLOCK TOP SURFACE DISTORTION

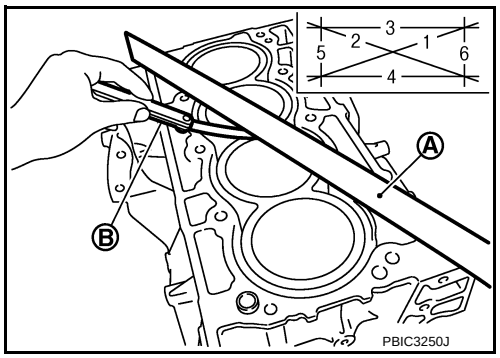
- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

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 : Refer to EM-134, "Cylinder Block".



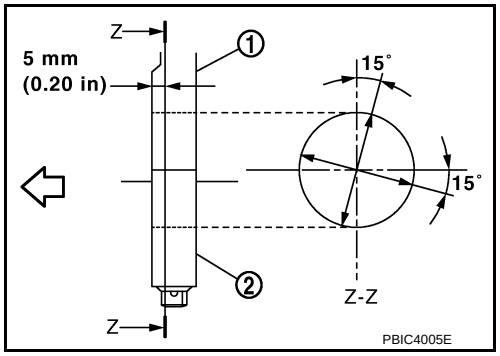
- If it exceeds the limit, replace cylinder block.

MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to EM-104, "Disassembly and Assembly".
- Measure the inner diameter of main bearing housing with a bore gauge.
- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.

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

Standard : Refer to EM-134, "Cylinder Block".



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

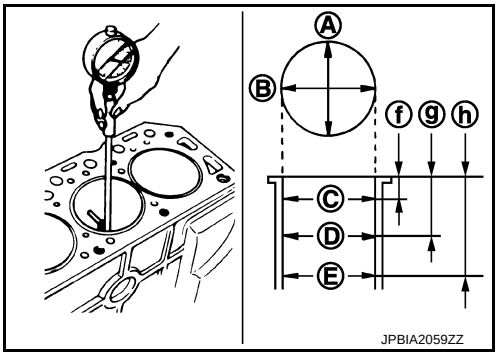
NOTE:

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, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(A) and (B) directions at (C), (D), and (E)] [(A) is in longitudinal direction of engine]



f : 10 mm (0.39 in)
g : 60 mm (2.36 in)
h : 130 mm (5.12 in)

NOTE:
When determining cylinder bore grade, measure the cylinder bore (B) direction at (D) position.

Standard:

Cylinder bore inner diameter

: Refer to EM-134, "Cylinder Block".

Limit:

Out-of-round [Difference between (A) and (B)]

Taper [Difference between (C) and (D)]

: Refer to EM-134, "Cylinder Block".

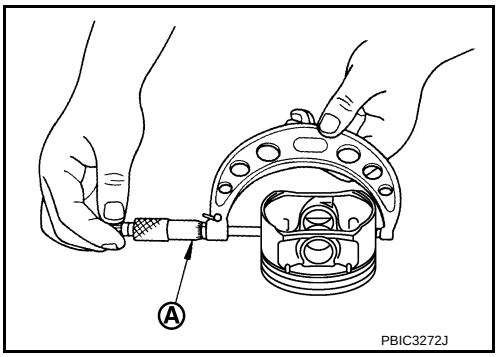
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

NOTE:
Oversize piston is not provided.

Piston Skirt Diameter

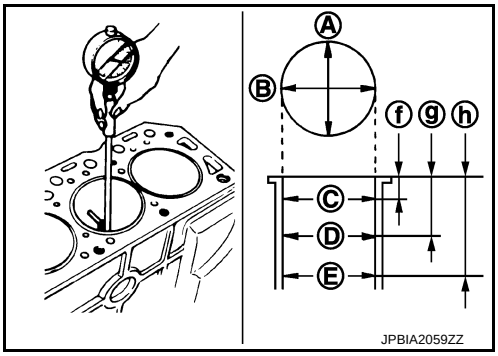
Measure the outer diameter of piston skirt with a micrometer (A).

Standard : Refer to EM-134, "Cylinder Block".



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].



A : Direction A
C : Position C
E : Position E
f : 10 mm (0.39 in)
g : 60 mm (2.36 in)
h : 130 mm (5.12 in)

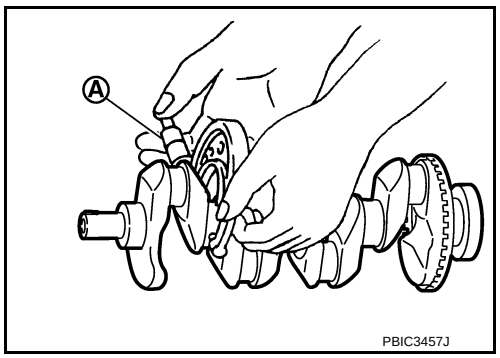
(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard and Limit : Refer to EM-134, "Cylinder Block".

- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to EM-122, "Piston".

CRANKSHAFT MAIN JOURNAL DIAMETER

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



Standard : Refer to EM-134, "Cylinder Block".

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-138, "Main Bearing".

CRANKSHAFT PIN JOURNAL DIAMETER

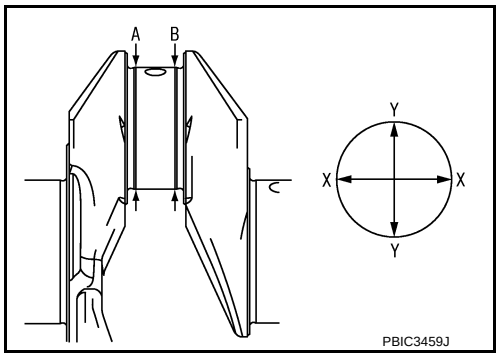
- Measure the outer diameter of crankshaft pin journal with a micrometer.

Standard : Refer to EM-134, "Cylinder Block".

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-138, "Connecting Rod Bearing".

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with 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)]

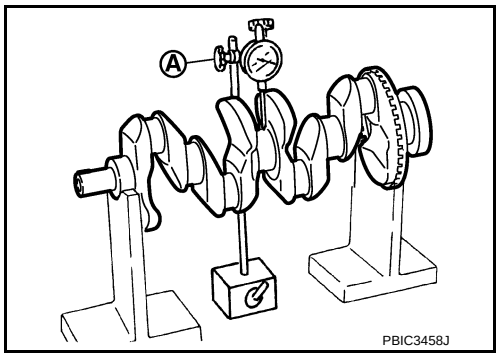
Taper [Difference between (A) and (B)]

: Refer to EM-134, "Cylinder Block".

- 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. Refer to EM-123, "Connecting Rod Bearing" and/or EM-125, "Main Bearing".

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)



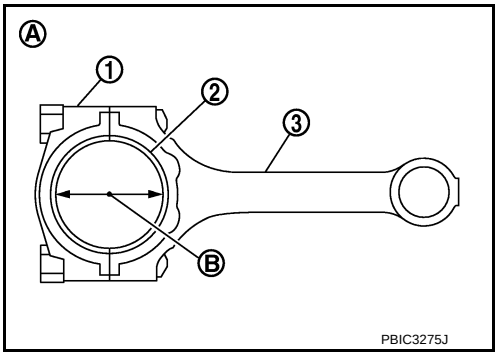
Standard and Limit : Refer to EM-134, "Cylinder Block".

- 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 cap bolts to the specified torque. Refer to EM-104, "Disassembly and Assembly".



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 and Limit : Refer to EM-138, "Connecting Rod Bearing".

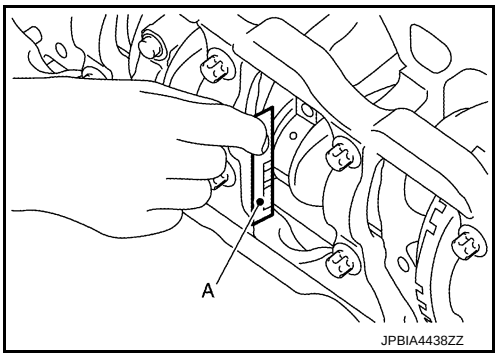
- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to EM-123, "Connecting Rod Bearing".

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 cap bolts to the specified torque. Refer to EM-104, "Disassembly and Assembly".

CAUTION:
Never rotate crankshaft.

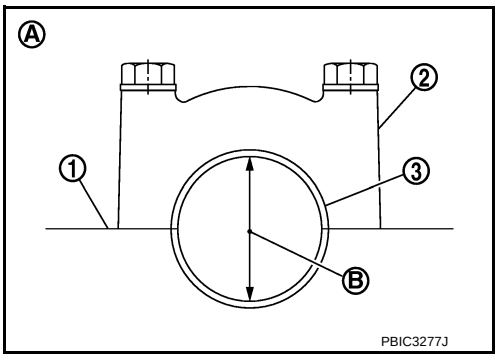
- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.

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 mounting bolts to the specified torque. Refer to EM-104, "Disassembly and Assembly".



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 and Limit : Refer to EM-138, "Main Bearing".

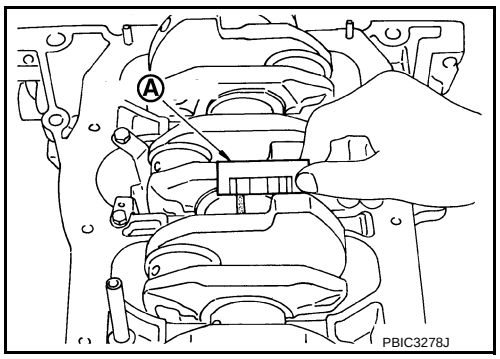
- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to EM-125, "Main Bearing".

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 mounting bolts to the specified torque. Refer to EM-104, "Disassembly and Assembly".

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”.



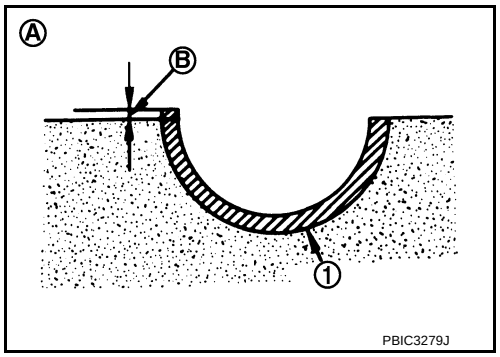
MAIN BEARING CRUSH HEIGHT

- 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-104, "Disassembly and Assembly".

A : Example

Standard : There must be crush height.

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



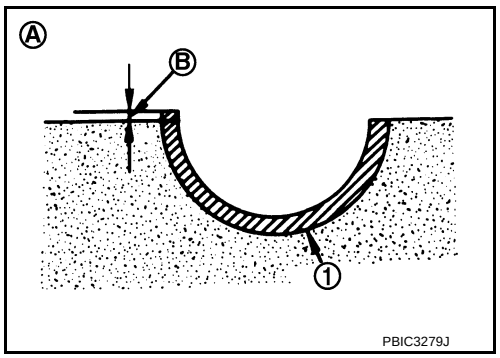
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude (B). Refer to EM-104, "Disassembly and Assembly".

A : Example

Standard : There must be crush height.

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



MAIN BEARING CAP BOLT OUTER DIAMETER

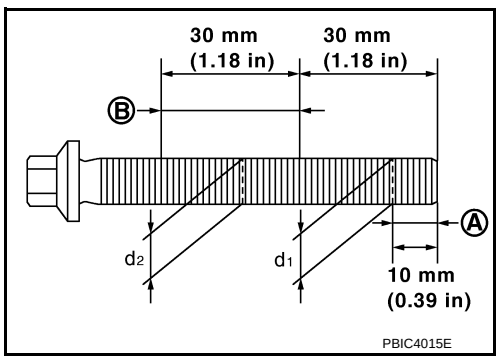
- Measure the outer diameters (d_1) and (d_2) at two positions as shown in the figure.

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 mounting bolt with a new one.

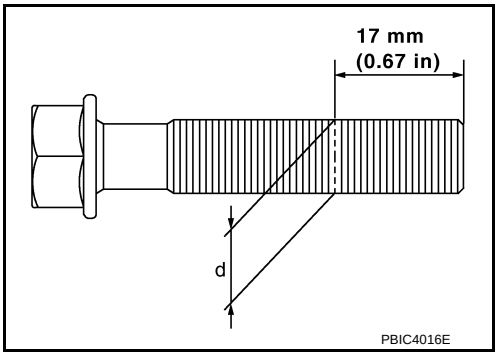


CONNECTING ROD CAP BOLT OUTER DIAMETER

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

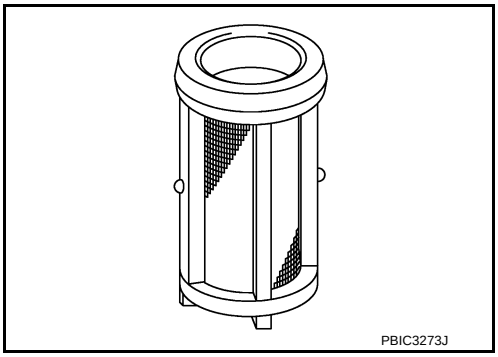
Limit: 7.75 mm (0.3051 in)

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



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

- Check 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.



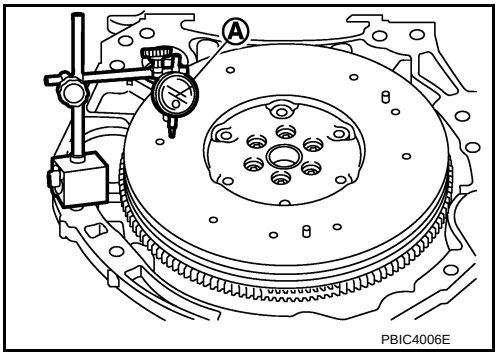
FLYWHEEL DEFLECTION (M/T MODELS)

- Measure the deflection of flywheel contact surface to torque 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.

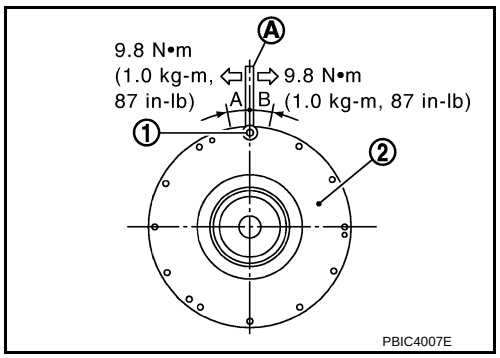
Standard : 1.8 mm (0.071 in) or less

- 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 mounting bolt (1) to clutch cover mounting 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.

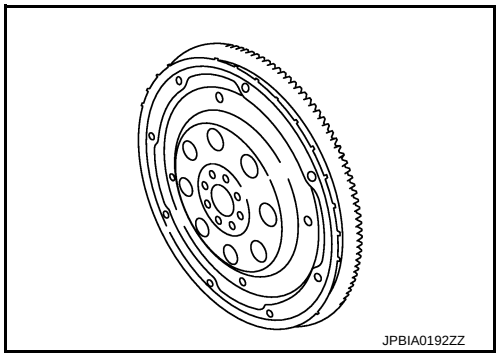


Limit : 33.2 mm (1.307 in) or less.

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

DRIVE PLATE (CVT MODELS)

- Check drive plate and signal plate for deformation or damage.
  CAUTION:
  - **Never disassemble drive plate.**
  - **Never place drive plate with signal plate facing down.**
  - **When handling signal plate, take care not to damage or scratch it.**
  - **Handle signal plate in a manner that prevents it from becoming magnetized.**
- In anything is found, replace drive plate.



HOW TO SELECT PISTON AND BEARING

Description

INFOID:0000000006337299

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, refer to the text.

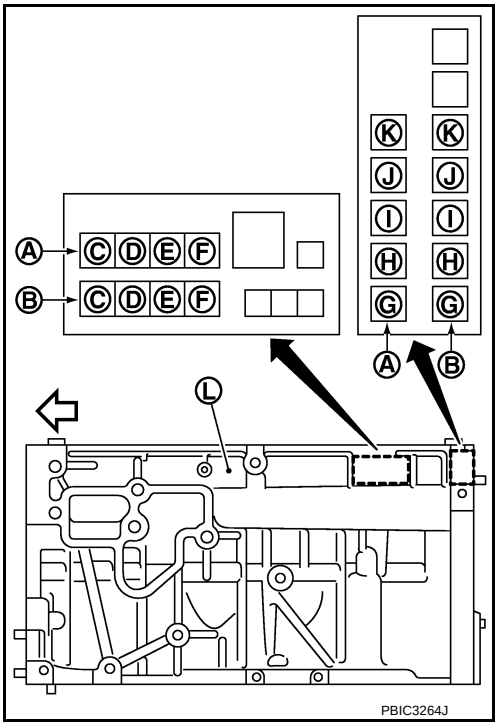
Piston

INFOID:0000000006337300

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

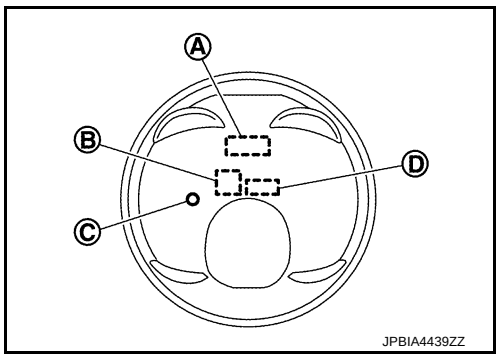


- If there is a correction stamp mark on the cylinder block, use it as a correct reference.

WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter. Refer to EM-134, "Cylinder Block".
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 : Piston grade number
B : Front mark
C : Identification code
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	79.670 - 79.680 (3.1366 - 3.1370)	79.680 - 79.690 (3.1370 - 3.1374)

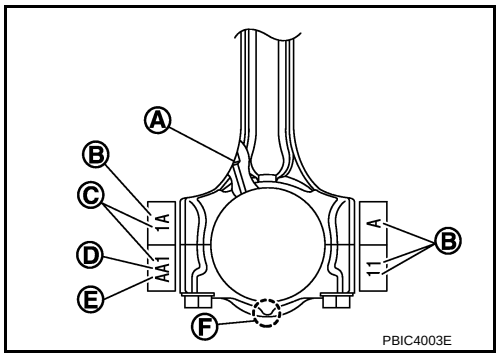
NOTE:
Piston is available together with piston pin as an assembly.

Connecting Rod Bearing

INFOID:0000000006337301

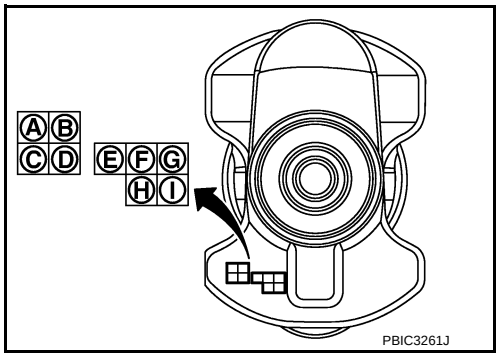
WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

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



A : Oil hole
B : Management code
C : Cylinder number
D : Big end diameter grade
E : Small end diameter grade
F : 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 CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-112, "Inspection".

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

PBIC4077E

CONNECTING ROD BEARING GRADE TABLE

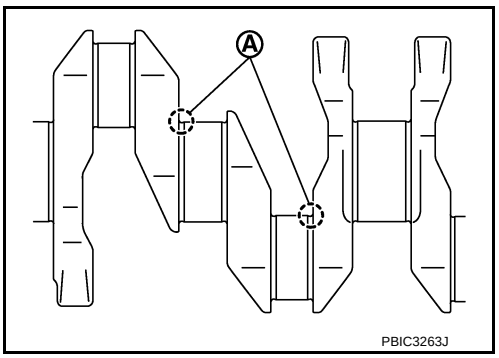
Connecting rod bearing grade table : Refer to EM-138, "Connecting Rod Bearing".

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

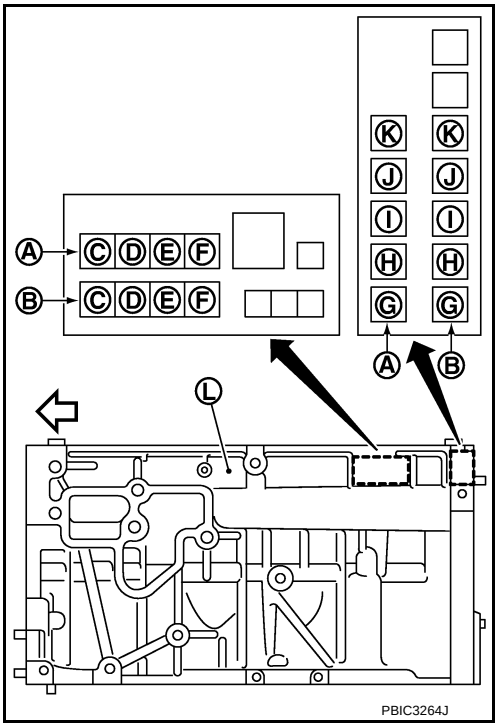
: Refer to EM-138, "Connecting Rod Bearing".

Main Bearing

INFOID:0000000006337302

WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

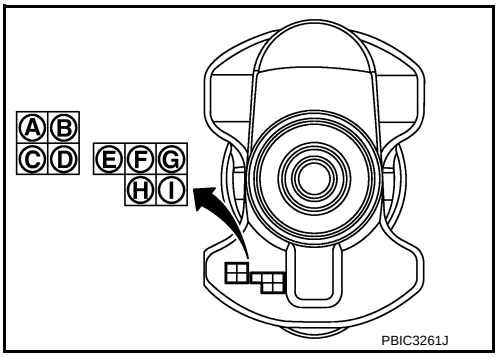
1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear left side of cylinder block (L).



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-112, "Inspection".
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 JOURNAL)

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
Mark	Axle diameter	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)		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

PBIC4078E

MAIN BEARING SELECTION TABLE (No. 2 AND 3 JOURNAL)

Crankshaft main journal diameter Unit: mm (in) / Mark	Axle diameter	Cylinder block main bearing housing inner diameter Unit: mm (in) / Hole diameter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W
			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)

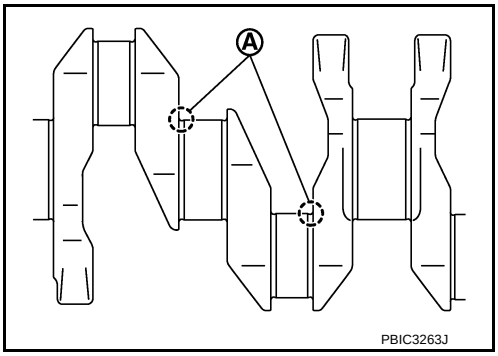
Main bearing grade table (All journals) : Refer to EM-138, "Main Bearing".

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:

Refer to EM-138, "Main Bearing".

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

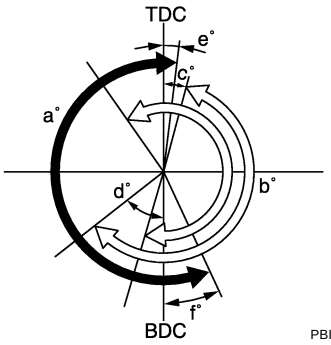
INFOID:0000000006337303

GENERAL SPECIFICATIONS

Engine type		MR16DDT
Cylinder arrangement		In-line 4
Displacement cm^3 (cu in)		-
Bore and stroke mm (in)		84.0×81.1 (3.307×3.193)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.9
Compression pressure kPa (kg/cm^2, psi)/250 rpm	Standard	1,500 (15.3, 217.5)
	Minimum	1,200 (12.2, 174)
	Differential limit between cylinders	100 (1.0, 14.5)

Unit: degree

Valve timing
⇦: Intake valve
⬅: Exhaust valve



PBIC5304E

a	b	c	d	e	f
212	224	8 (–32) ATDC	52 (12) ABDC	7	25

( ): Valve timing control “ON”

Drive Belt

INFOID:0000000006337304

DRIVE BELT

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

Spark Plug

INFOID:0000000006337305

SPARK PLUG

Unit: mm (in)

Make		DENSO
Standard type		FXE20HR11
Gap (Nominal)	Standard	1.1 (0.043)
	Limit	1.4 (0.055)

Exhaust Manifold

INFOID:0000000006337306

EXHAUST MANIFOLD

Unit: mm (in)

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

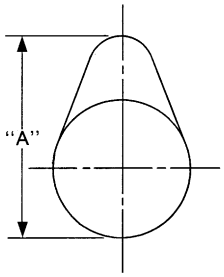
Camshaft

INFOID:0000000006337307

CAMSHAFT

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 - 0.9831)	—
Camshaft end play		0.075 - 0.153 (0.0030 - 0.0060)	0.24 (0.0094)
Camshaft cam height “A”	Intake	44.605 - 44.795 (1.7561 - 1.7636)	44.405 (1.7482)
	Exhaust	43.175 - 43.365 (1.6998 - 1.7073)	42.975 (1.6919)
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)



SEM671

*: Total indicator reading

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 CLEARANCE

Unit: mm (in)

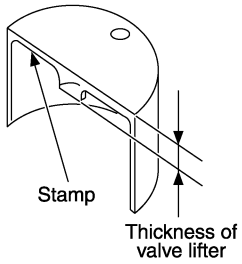
Items	Cold	Hot* (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

AVAILABLE VALVE LIFTER

Unit: mm (in)

Identification mark	Thickness



KBIA0119E

300	3.00 (0.1181)
302	3.02 (0.1189)
304	3.04 (0.1197)
306	3.06 (0.1205)
308	3.08 (0.1213)
310	3.10 (0.1220)
312	3.12 (0.1228)
314	3.14 (0.1236)
316	3.16 (0.1244)
318	3.18 (0.1252)
320	3.20 (0.1260)
322	3.22 (0.1268)
324	3.24 (0.1276)
326	3.26 (0.1283)
328	3.28 (0.1291)
330	3.30 (0.1299)
332	3.32 (0.1307)
334	3.34 (0.1315)
336	3.36 (0.1323)
338	3.38 (0.1331)
340	3.40 (0.1339)
342	3.42 (0.1346)
344	3.44 (0.1354)
346	3.46 (0.1362)
348	3.48 (0.1370)
350	3.50 (0.1378)

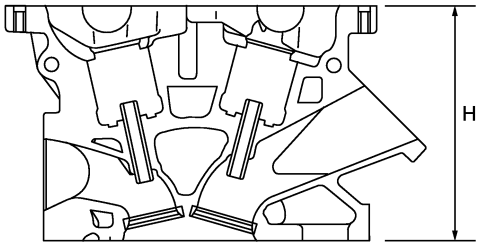
Cylinder Head

INFOID:0000000006337308

CYLINDER HEAD

Unit: mm (in)

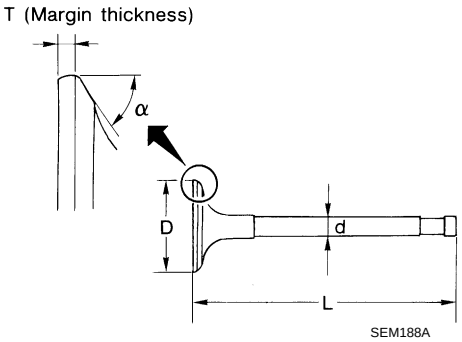
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height “H”	130.9 (5.15)	—



PBIC0924E

VALVE DIMENSIONS

Unit: mm (in)

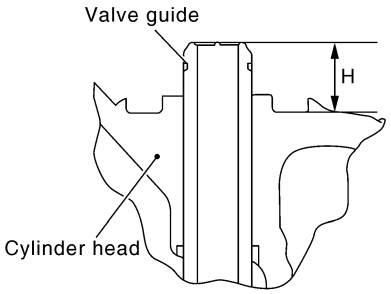


SEM188A

Valve head diameter “D”	Intake	33.8 - 34.1 (1.331 - 1.343)
	Exhaust	27.6 - 27.9 (1.087 - 1.098)
Valve length “L”	Intake	106.27 (4.18)
	Exhaust	105.26 (4.14)
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 GUIDE

Unit: mm (in)



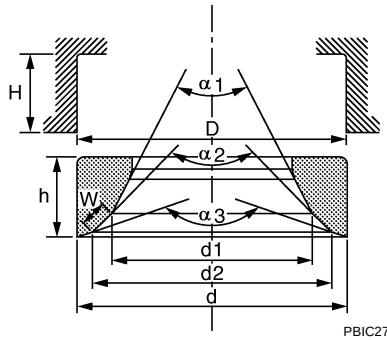
PBIC2187E

Items		Standard	Oversize (service) [0.2 (0.008)]
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 “H”		13.35 - 13.65 (0.5256 - 0.5374)	

VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (service) [0.5 (0.020)]
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		4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"	Intake	6.04 (0.2378)	
	Exhaust	6.05 (0.2382)	

*1: Diameter made by intersection point of conic angles "α1" and "α2"

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

*3: Machining data

VALVE SPRING

Items	Standard	
	Intake	Exhaust
Free height	44.90 - 45.10 mm (1.7677 - 1.7756 in)	45.74 - 45.94 mm (1.8008 - 1.8087 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	151 - 175 N (15.4 - 17.9 kg, 34 - 39 lb)	137 - 159 N (14.0 - 16.2 kg, 31 - 36 lb)
Height during valve open	26.36 mm (1.0378 in)	27.80 mm (1.0945 in)
Load with valve open	333 - 379 N (34.0 - 38.7 kg, 75 - 85 lb)	264 - 299 N (26.9 - 30.5 kg, 59 - 67 lb)
Identification color	White	Orange

Unit: mm (in)

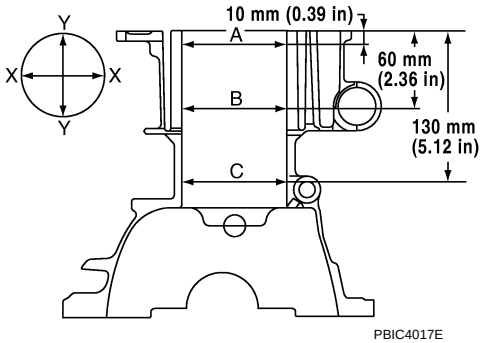
Items	Limit
Valve spring squareness	2.0 (0.079)

Cylinder Block

INFOID:0000000006337309

CYLINDER BLOCK

Unit: mm (in)



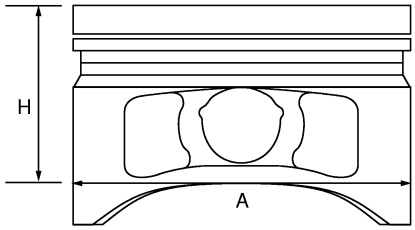
PBIC4017E

Cylinder block 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	Limit		0.015 (0.0006)
Taper			0.010 (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)

AVAILABLE PISTON

Unit: mm (in)



PBIC0188E

Piston skirt diameter “A”	Standard	Grade No. 1	79.670 - 79.680 (3.1366 - 3.1370)
		Grade No. 2	79.680 - 79.690 (3.1370 - 3.1374)
Measure point “H”			43.4 (1.7087)
Piston pin hole diameter			21.993 - 21.999 (0.8658 - 0.8661)
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
Piston ring side clearance	Top	0.04 - 0.08 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.03 - 0.07 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.055 - 0.155 (0.0022 - 0.0061)	—

Piston ring end gap	Top	0.19 - 0.29 (0.0075 - 0.0114)	0.48 (0.0189)
	2nd	0.29 - 0.44 (0.0114 - 0.0173)	0.60 (0.0236)
	Oil (rail ring)	0.15 - 0.45 (0.0059 - 0.0177)	0.76 (0.0299)

PISTON PIN

Unit: mm (in)

Items	Standard	Limit
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	—
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	—

CONNECTING ROD

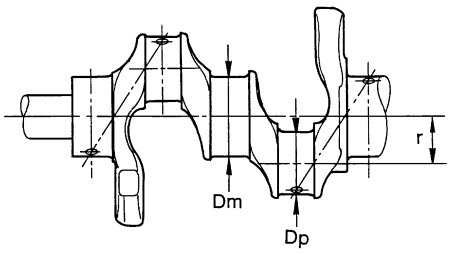
Unit: mm (in)

Center distance		143.44 - 143.54 (5.65 - 5.65)
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*	Standard	20.000 - 20.012 (0.7874 - 0.7879)
Connecting rod bushing oil clearance	Standard	0.005 - 0.023 (0.0002 - 0.0009)
	Limit	0.03 (0.0012)
Connecting rod side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.4 (0.016)
Connecting rod big end diameter grade	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)

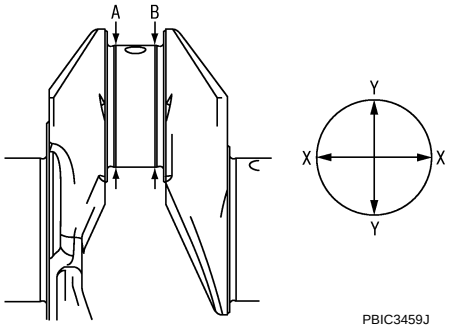
*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



SEM645



PBIC3459J

Center distance “r”	40.41 - 40.49 (1.5909 - 1.5940)

Out-of-round	Limit	0.0035 (0.0001)
Taper	Limit	
Runout [TIR*]	Standard	0.05 (0.0020)
	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)
Crankshaft pin journal diameter “Dp” grade.	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)
Crankshaft main journal diameter “Dm” grade.	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

Connecting Rod Bearing

INFOID:0000000006337310

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	
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 TABLE

Unit: mm (in)

Items	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.

CONNECTING ROD 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)

Main Bearing

INFOID:0000000006337311

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	

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 TABLE

Unit: mm (in)

Items	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.

MAIN 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)

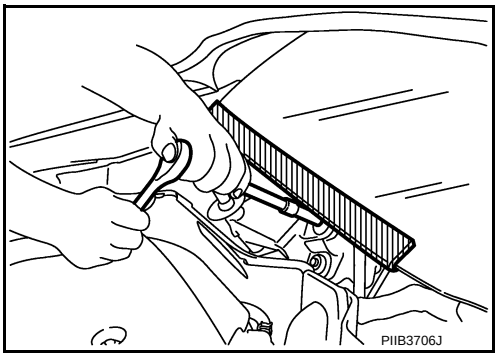
PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

INFOID:0000000006449874

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



Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:0000000006449875

NOTE:
- Before removing and installing any control units, first turn the push-button ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.
If turning the steering wheel is required with the battery disconnected or discharged, follow the operation 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. Turn the push-button ignition switch to ACC position.
   (At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the push-button ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the push-button ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT-III.

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

INFOID:0000000006752512

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

The vehicle may be equipped with a passenger air bag deactivation switch. Because no rear seat exists where a rear-facing child restraint can be placed, the switch is designed to turn off the passenger air bag so that a rear-facing child restraint can be used in the front passenger seat. The switch is located in the center of the instrument panel, near the ashtray. When the switch is turned to the ON position, the passenger air bag is enabled and could inflate for certain types of collision. When the switch is turned to the OFF position, the pas-

senger air bag is disabled and will not inflate. A passenger air bag OFF indicator on the instrument panel lights up when the passenger air bag is switched OFF. The driver air bag always remains enabled and is not affected by the passenger air bag deactivation switch.

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 AIR BAG".**
- **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.**
- **The vehicle may be equipped with a passenger air bag deactivation switch which can be operated by the customer. When the passenger air bag is switched OFF, the passenger air bag is disabled and will not inflate. When the passenger air bag is switched ON, the passenger air bag is enabled and could inflate for certain types of collision. After SRS maintenance or repair, make sure the passenger air bag deactivation switch is in the same position (ON or OFF) as when the vehicle arrived for service.**

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

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

Draining Engine Coolant

INFOID:0000000006449877

Drain engine coolant and engine oil when the engine is cooled.

Disconnecting Fuel Piping

INFOID:0000000006449878

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

Removal and Disassembly

INFOID:0000000006449879

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- 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 in the step.

Inspection, Repair and Replacement

INFOID:0000000006449880

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

Assembly and Installation

INFOID:0000000006449881

- Use torque wrench to tighten bolts or nuts to specification.

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

Parts Requiring Angle Tightening

INFOID:0000000006449882

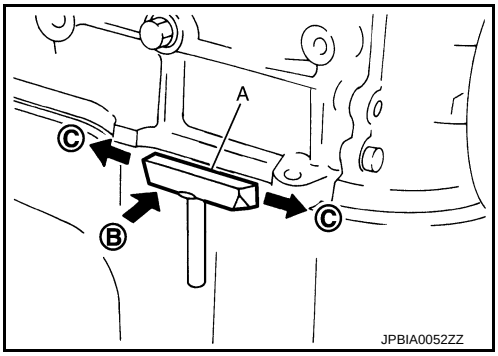
- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
- Camshaft sprocket (INT) bolt
- Cylinder head bolts
- Main bearing cap bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket

INFOID:0000000006449883

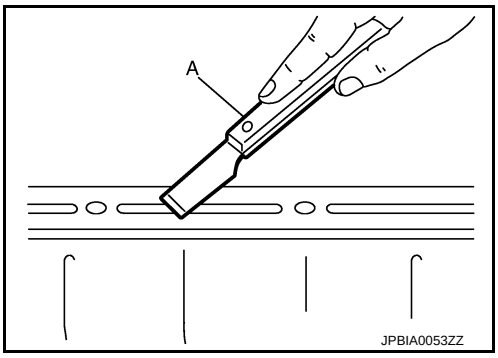
REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.
  CAUTION:
  Be careful not to damage the mating surfaces.
- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.
  CAUTION:
  If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.

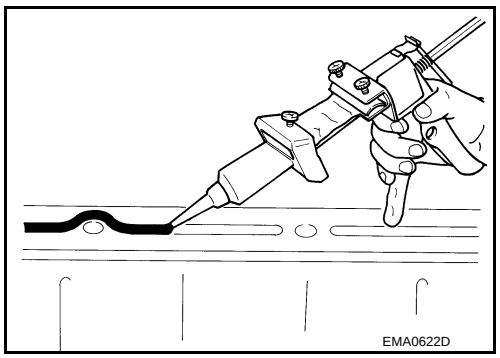


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
   - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



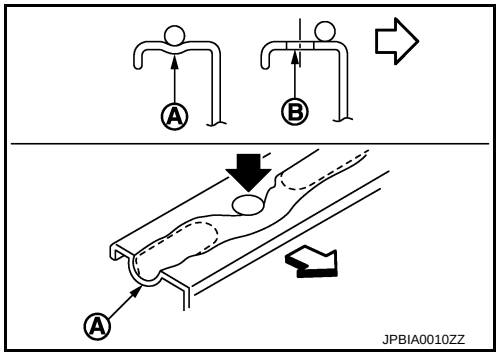
3. Attach liquid gasket tube to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



   - As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

     A : Groove

     ⇦ : Inside



   - Within five minutes of liquid gasket application, install the mating component.
   - If liquid gasket protrudes, wipe it off immediately.
   - Do not retighten mounting bolts or nuts after the installation.
   - After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

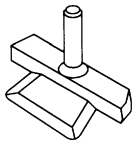
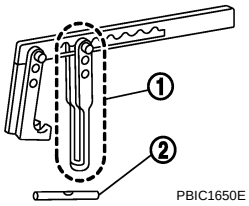
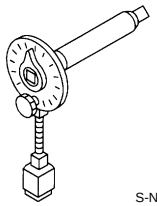
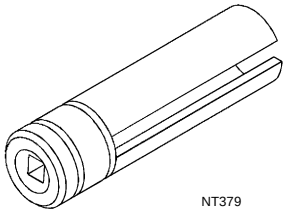
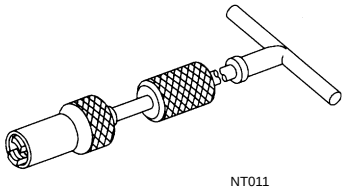
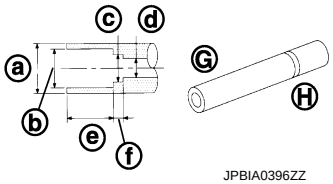
CAUTION:
If there are specific instructions in this manual, observe them.

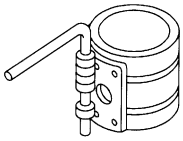
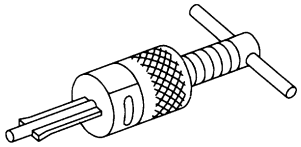
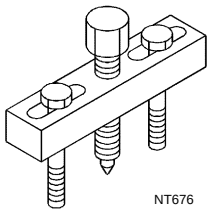
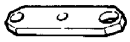
PREPARATION

PREPARATION

Special Service Tools

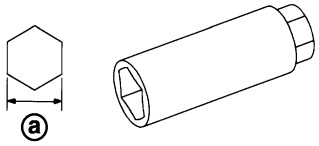
INFOID:0000000006449884

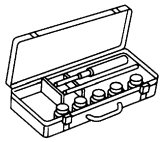
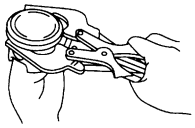
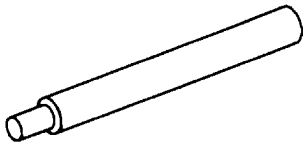
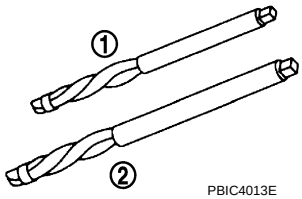
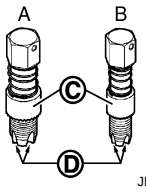
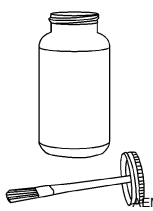
Tool number Tool name	Description
KV10111100 Seal cutter  S-NT046	Removing oil pan (upper and lower) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter  PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench  S-NT014	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 Heated oxygen sensor wrench  NT379	Loosening or tightening air fuel ratio sensor 1 **For 22 mm (0.87 in) width hexagon nut**
KV10107902 Valve oil seal puller  NT011	Removing valve oil seal
KV10115600 Valve oil seal drift  JPBIA0396ZZ	Installing valve oil seal **Use side A (G).** **a: 20 (0.79) dia.** **d: 8 (0.31) dia.** **b: 13 (0.51) dia.** **e: 10.7 (0.421)** **c: 10.3 (0.406) dia.** **f: 5 (0.20)** **H: Side B** Unit: mm (in)

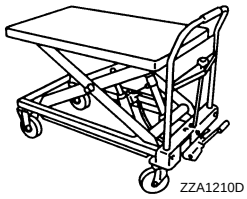
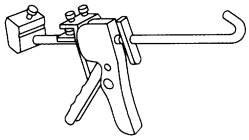
Tool number Tool name	Description
EM03470000 Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 Pilot bushing puller  S-NT045	Removing pilot converter
KV11103000 Pulley puller  NT676	Removing crankshaft pulley
KV11105210 Stopper plate  ZZA0009D	Fixing drive plate

Commercial Service Tools

INFOID:0000000006449885

Tool name	Description
Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room
Spark plug wrench  JPBIA0399ZZ	Removing and installing spark plug a: 14 mm (0.55 in)

Tool name	Description
Pulley holder  ZZA1010D	Crankshaft pulley removing and installing
Valve seat cutter set  S-NT048	Finishing valve seat dimensions
Piston ring expander  S-NT030	Removing and installing piston ring
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
Oxygen sensor thread cleaner  JPBIA0238ZZ	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor (Use with anti-seize lubricant shown below.) **A: [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor** **B: [12 mm (0.47 in) dia.] for titania heated oxygen sensor** C: Mating surface shave cylinder D: Flutes
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

Tool name	Description
Manual lift table caddy  ZZA1210D	Removing and installing engine
Tube presser  S-NT052	Pressing the tube of liquid gasket

BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

Inspection and Adjustment

INFOID:0000000006449886

INSPECTION

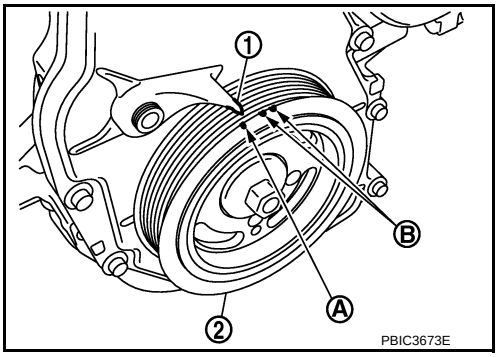
Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to EM-178, "Removal and Installation".
2. Measure the valve clearance with the following procedure:

a. Set No. 1 cylinder at TDC of its compression stroke.

- Rotate crankshaft pulley (2) clockwise and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

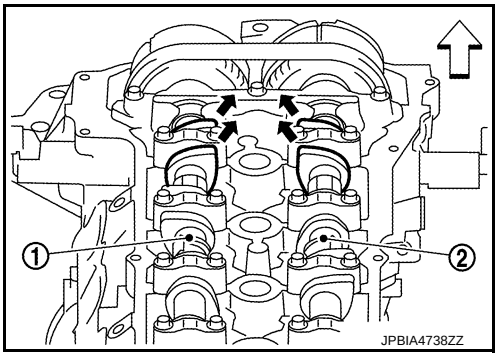
B : White paint mark (Not use for service)



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

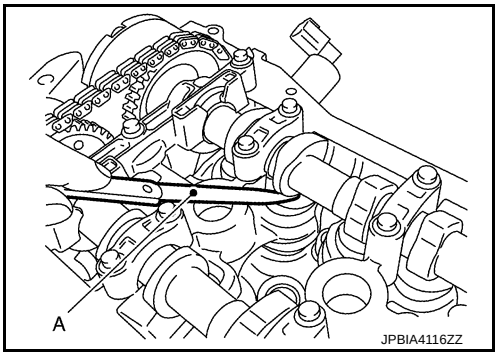
1 : Camshaft (INT)
2 : Camshaft (EXH)
⇦ : Engine front

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

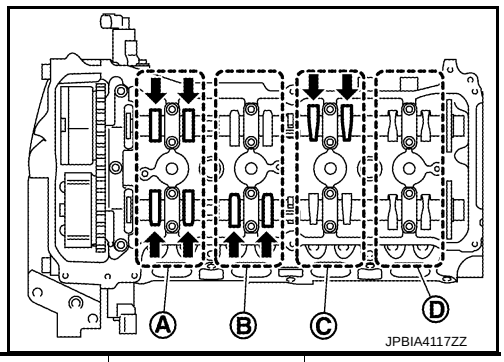


b. Use a feeler gauge (A), measure the clearance between valve lifter and camshaft.

Valve clearance : Refer to EM-251, "Camshaft".



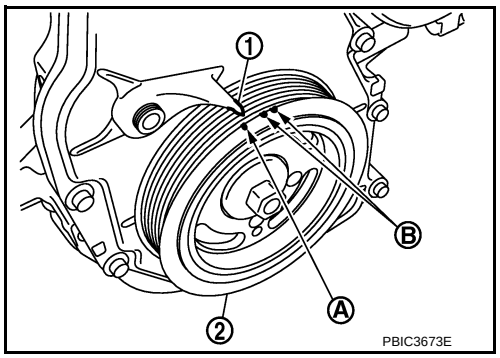
- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below [locations indicated with black arrow (⬅) in the figure] with a feeler gauge.



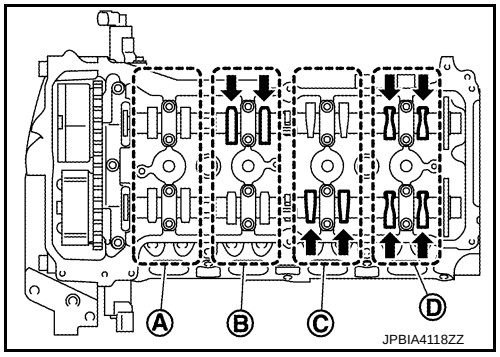
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 1 cylinder at compression TDC	EXH	×		×	
	INT	×	×		

c. Set No. 4 cylinder at TDC of its compression stroke.
- Rotate crankshaft pulley (2) one revolution (360 degrees) and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

B : 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 (⬅) in the figure] with a feeler gauge.



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

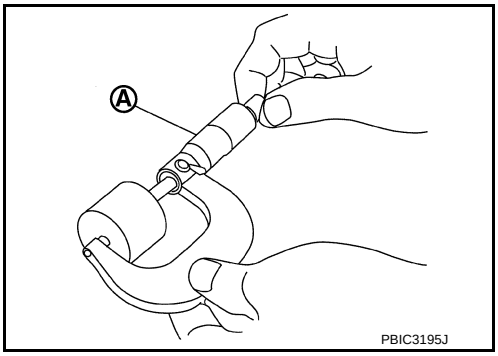
3. If out of standard, perform adjustment. Refer to "ADJUSTMENT".

ADJUSTMENT

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

1. Remove camshaft. Refer to EM-191, "Exploded View".
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

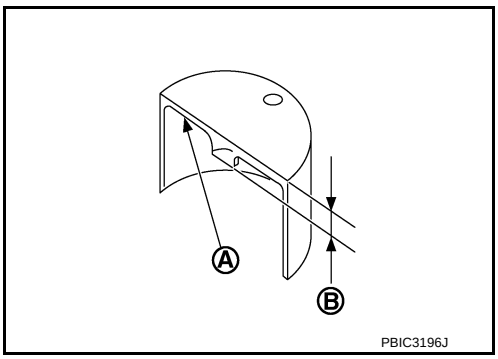
C_1 = Measured valve clearance

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-251, "Camshaft".

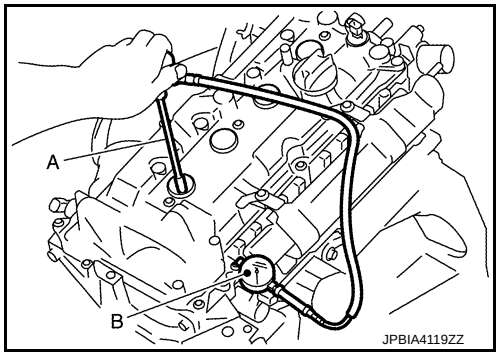
5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-191, "Exploded View".
7. Install timing chain and related parts. Refer to EM-181, "Exploded View".
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to “INSPECTION”.
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

Inspection

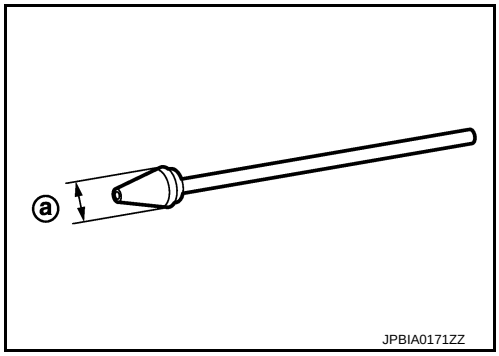
INFOID:0000000006449887

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-551, "Work Procedure".
3. Remove ignition coil and spark plug from each cylinder. Refer to EM-178, "Exploded View".
4. Connect engine tachometer (not required in use of CONSULT-III).
5. Install compression gauge (B) with an adapter (A) (commercial service tool) 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.

a : 20 mm (0.79 in)



6. 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 : Refer to EM-250, "General Specification".

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 the engine speed again with normal battery gravity. Refer to PG-111, "How to Handle Battery".
- If compression pressure is below minimum value, check valve clearances, and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, and cylinder head gasket). After the checking, measure 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 recheck 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 gaskets are leaking. In such a case, replace cylinder head gaskets.

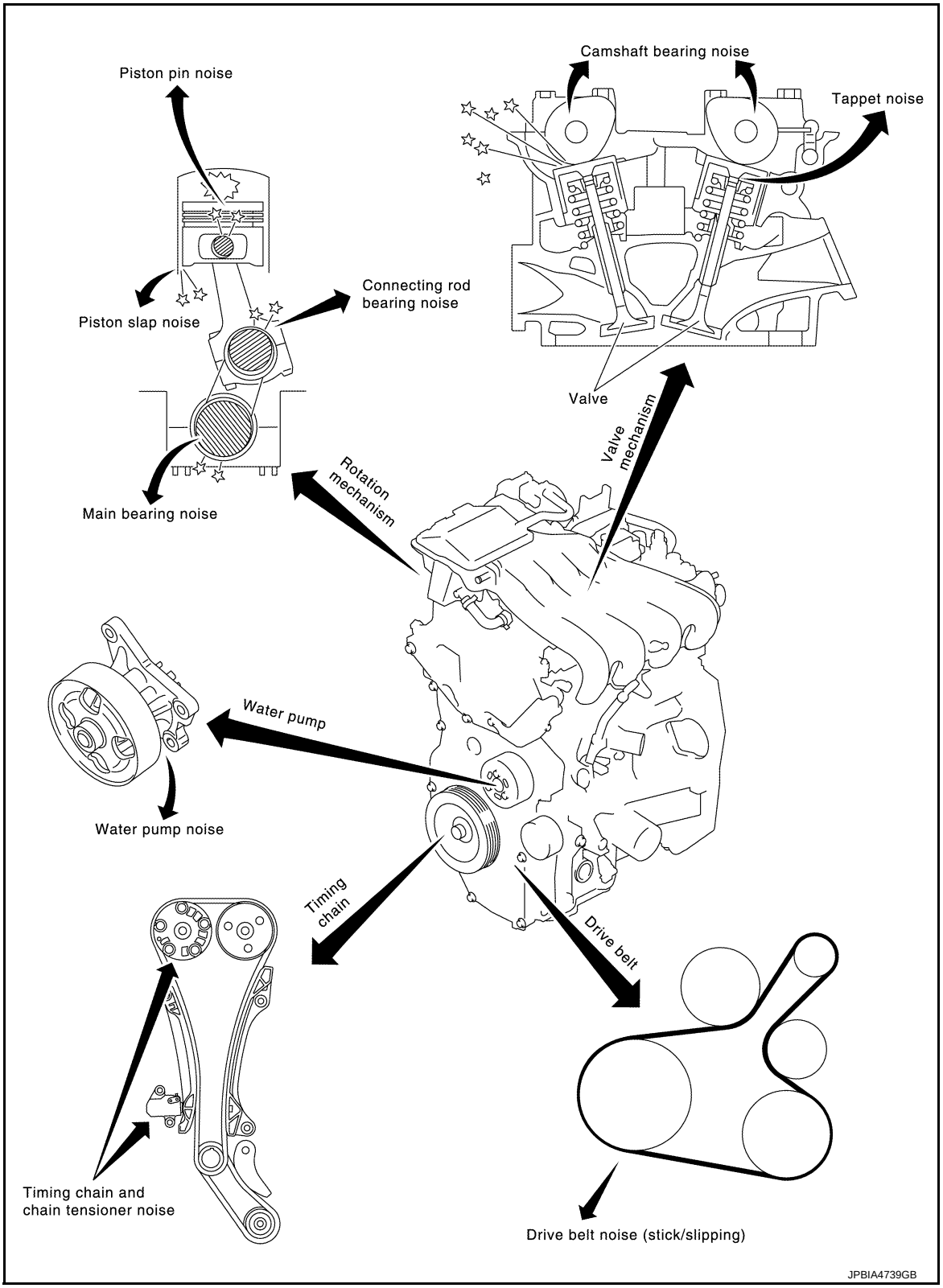
7. After inspection is completed, install removed parts.
8. Start the engine, and check that the engine runs smoothly.
9. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-558, "Description".

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH troubleshooting Chart

INFOID:0000000006449888



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-148
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-251
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-255
	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-255
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-255 EM-258
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-257 EM-255
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-189 EM-181
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-250
	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-22, "Exploded View"

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

PERIODIC MAINTENANCE

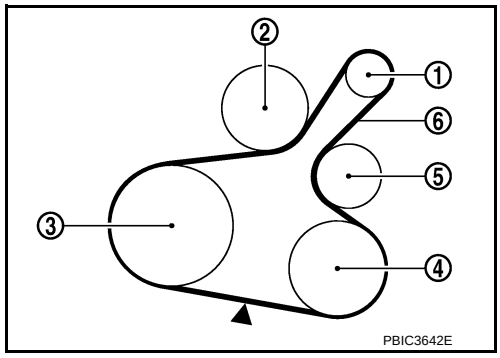
DRIVE BELT

Checking

INFOID:0000000006449889

- Inspection should be done only when engine is cold or over 30 minutes after the engine is stopped.

1 : Alternator
2 : Water pump
3 : Crankshaft pulley
4 : A/C compressor
5 : Idler pulley
6 : Drive belt



- Visually check belts for wear, damage, and cracks on inside and edges.
- Turn crankshaft pulley two time clockwise, and check tension on all pulleys is equal before doing the test.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the (▼) marked point.
- Measure the belt tension and frequency with acoustic tension gauge (commercial service tool) at the (▼) marked point.

CAUTION:
- **When the tension and frequency are measured, the acoustic tension gauge should be used.**
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.**

Belt Deflection/Belt Tension and Frequency: Refer to EM-250, "Drive Belt".

Tension Adjustment

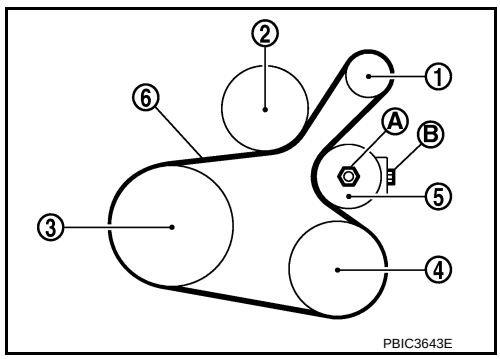
INFOID:0000000006449890

Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

CAUTION:
- **When belt is replaced with new one, adjust belt tension to the value for “New belt”, because new belt will not fully seat in the pulley groove.**
- **When tension of the belt being used exceeds “Limit”, adjust it to the value for “After adjusted”.**
- **When installing a belt, check it is correctly engaged with the pulley groove.**
- **Never allow oil or engine coolant to get on the belt.**
- **Never twist or bend the belt strongly.**

1. Remove front fender protector (RH). Refer to EXT-22, "Exploded View".
2. After loosening lock nut (A) of idler pulley (5) to release from the specified torque state, temporarily tighten the lock nut to the following torque

4.4 N·m (0.45 kg-m, 39 in-lb)



1 : Alternator
2 : Water pump
3 : Crankshaft pulley
4 : A/C compressor
5 : Idler pulley
6 : Drive belt

CAUTION:

- **When the lock nut is loosened excessively, the idler pulley tilts and the correct tension adjustment cannot be performed. Never loosen it excessively (more than 45 degrees).**
- **Put a matching mark on the lock nut (A), and check turning angle with a protractor. Never visually check the tightening angle.**

3. Adjust the belt tension by turning the adjusting bolt (B). Refer to EM-154, "Checking".
CAUTION:
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.**
- **When the tension adjustment is performed, the lock nut should be in the condition at step“ 2”. If the tension adjustment is performed when the lock nut is loosened more than the standard, the idler pulley tilts and the correct tension adjustment cannot be performed.**

4. Tighten the lock nut.

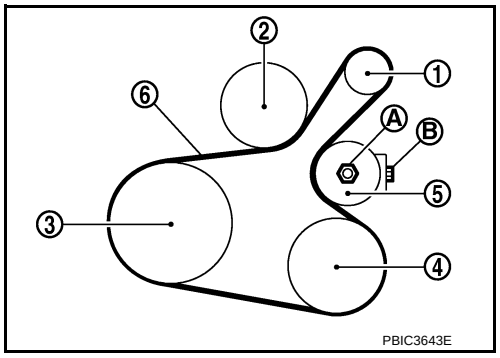
: 34.8 N·m (3.5 kg-m, 26 ft-lb)

Removal and Installation

INFOID:0000000006449891

REMOVAL

1. Remove front fender protector (RH). Refer to EXT-22, "Exploded View".
2. Loosen the lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

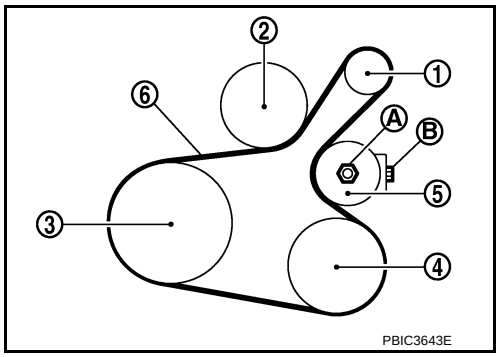


1 : Alternator
2 : Water pump
3 : Crankshaft pulley
4 : A/C compressor
5 : Idler pulley
6 : Drive belt

3. Remove drive belt.

INSTALLATION

1. Pull the idler pulley in the loosening direction, and then temporarily tighten the lock nut (A) to the following torque.



1 : Alternator
2 : Water pump
3 : Crankshaft pulley
4 : A/C compressor
5 : Idler pulley
6 : Drive belt

: 4.4 N·m (0.45 kg-m, 39 in-lb)

NOTE:
Do not move the lock nut from the tightened position. Go to step “2”.

2. Install the drive belt to each pulley.
CAUTION:
- **Check that there is no oil, grease, or coolant, etc. in pulley grooves.**
- **Check that the belt is securely inside the groove on each pulley.**

3. Adjust drive belt tension by turning the adjusting bolt (B). Refer to EM-154, "Tension Adjustment".
CAUTION:

- **Perform the belt tension adjustment with the lock nut temporarily tightened at the step “1” so as not to tilt the idler pulley.**
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.**

4. Tighten the lock nut.

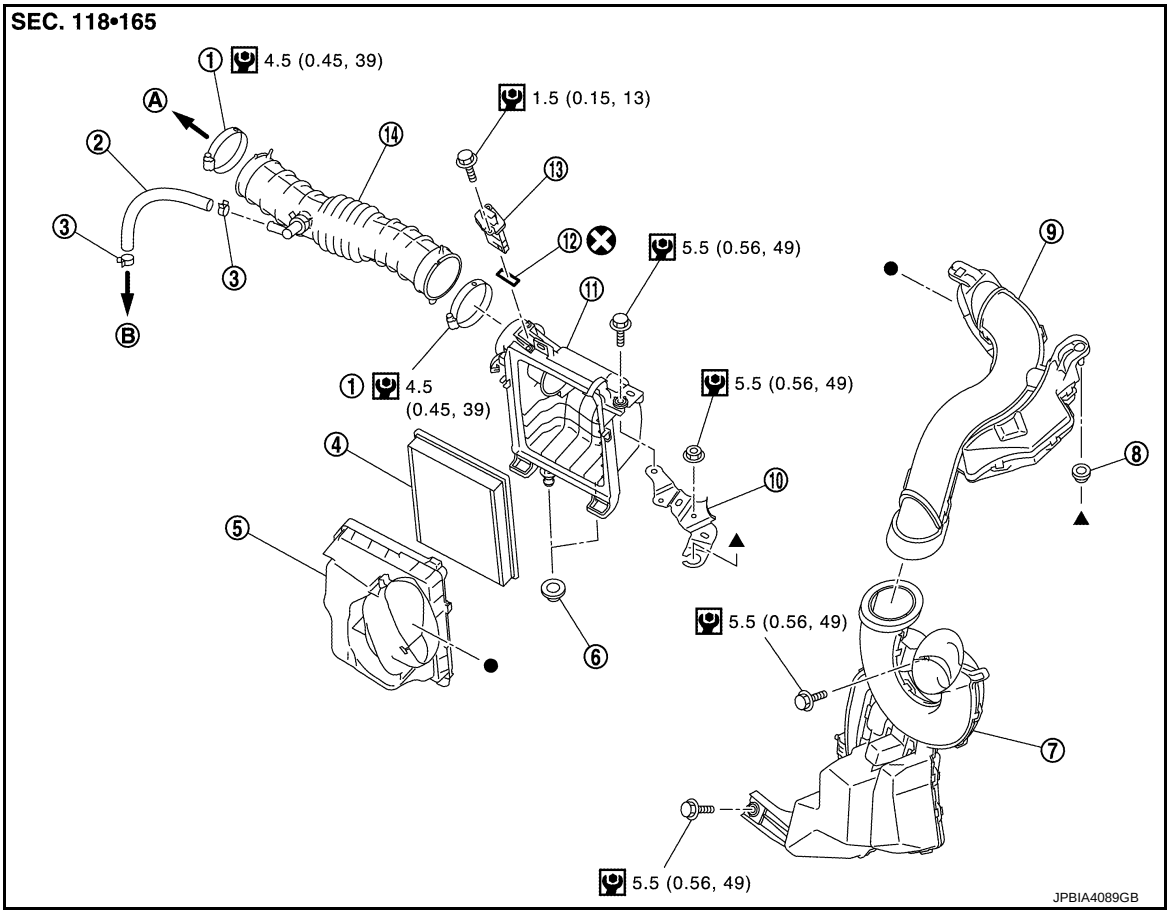
: 34.8 N·m (3.5 kg-m, 26 ft-lb)

5. Check that belt tension of each belt within the standard.

AIR CLEANER FILTER

Exploded View

INFOID:0000000006449892



1. Hose clamp
2. PCV hose
3. Hose clamp
4. Air cleaner filter
5. Air cleaner filter case
6. Grommet
7. Inlet Air duct (lower)
8. Grommet
9. Inlet Air duct (upper)
10. Bracket
11. Air cleaner case
12. O-ring
13. Mass air flow sensor
14. Air duct

A. To electric throttle control actuator
B. To rocker cover

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

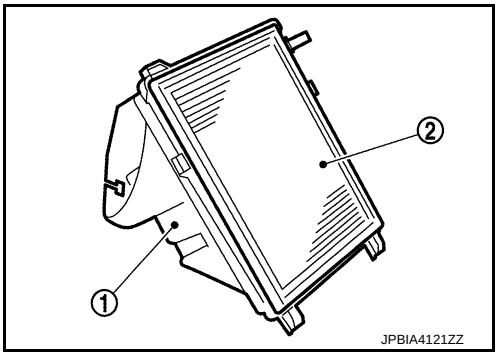
Removal and Installation

INFOID:0000000006449893

REMOVAL

1. Remove the assembly consisting of element case, air cleaner case, and inlet air duct (upper).
2. Remove the air cleaner filter case.

3. Remove the air cleaner filter (2) from the air cleaner case (1).



INSTALLATION

Note the following, and install in the reverse order of removal.

- Check by the feel and the sound that both pawls of the air cleaner case are securely fastened to the element case.

SPARK PLUG

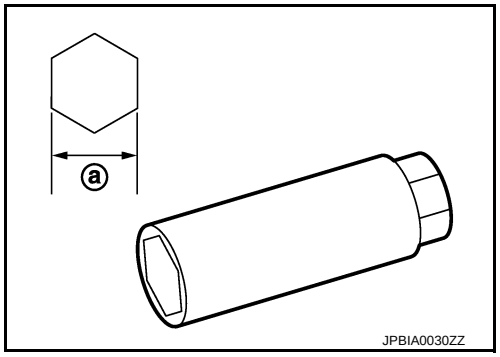
Removal and Installation

INFOID:0000000006449894

REMOVAL

1. Remove ignition coil. Refer to EM-178, "Exploded View".
2. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)



CAUTION:
Never drop or shock spark plug.

INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:0000000006449895

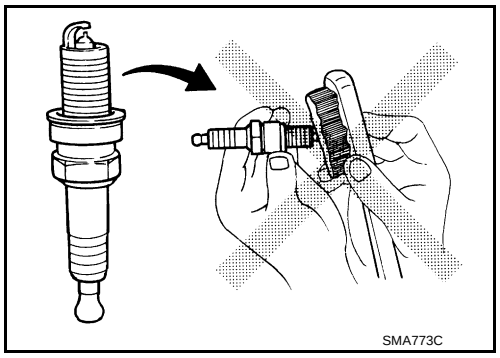
INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

Spark plug (Standard type) : Refer to EM-251, "Spark Plug".

CAUTION:
- **Never drop or shock spark plug.**
- **Never use a wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used.**

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



REMOVAL AND INSTALLATION

DRIVE BELT IDLER PULLEY

Removal and Installation

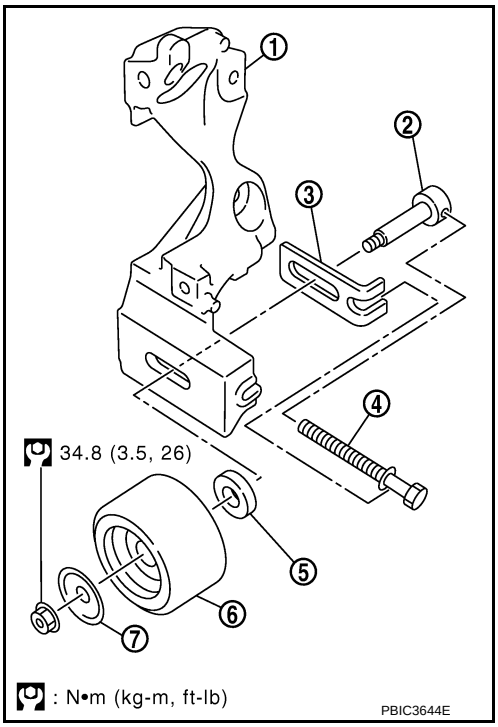
INFOID:0000000006449896

REMOVAL

1. Remove drive belt. Refer to EM-155, "Removal and Installation".
2. Remove the lock nut, and then remove the plate (7), idler pulley (6), and washer (5).

   1 : Alternator bracket

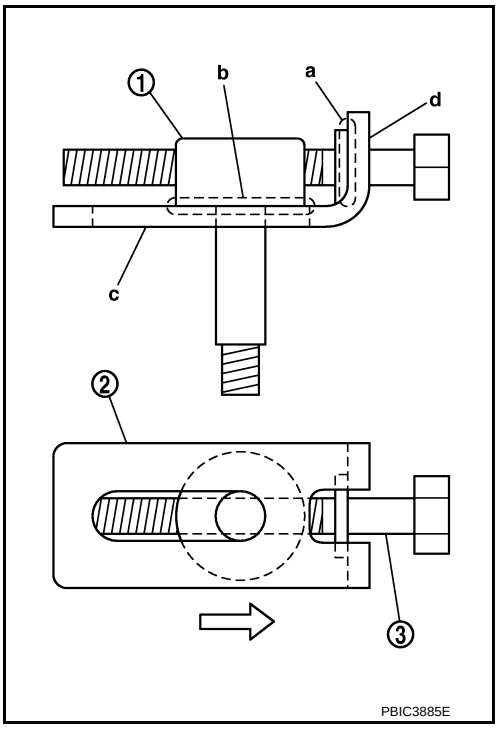
3. Remove the center shaft (2) together with the spacer (3) with inserting the adjusting bolt (4).



INSTALLATION

1. Insert the center shaft (1) into the slide groove of the spacer (2). Fully screw in the adjusting bolt (3) in the belt loosening direction (⇦).
   - At that time, place the flange (a) of the adjusting bolt and the seat (b) of the center shaft on the spacer.
2. Place each surface (c and d) of the spacer on the alternator bracket. Install the washer, idler pulley, and plate, and then temporarily tighten the lock nut.

   : 4.4 N·m (0.45 kg-m, 39 in-lb)

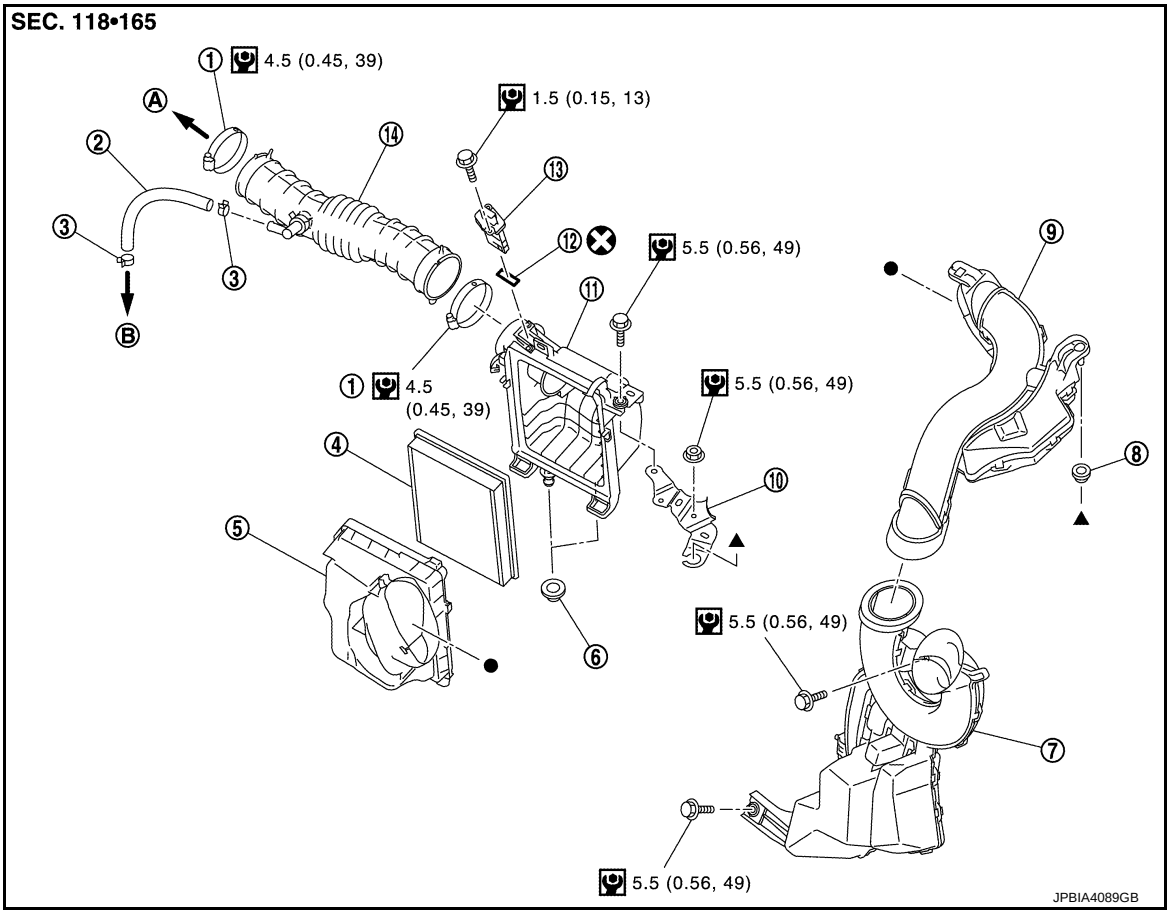


3. Install removed parts in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:0000000006449897



1. Hose clamp
2. PCV hose
3. Hose clamp
4. Air cleaner filter
5. Air cleaner filter case
6. Grommet
7. Inlet air duct (lower)
8. Grommet
9. Inlet air duct (upper)
10. Bracket
11. Air cleaner case
12. O-ring
13. Mass air flow sensor
14. Air duct

A. To electric throttle control actuator
B. To rocker cover

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

Removal and Installation

INFOID:0000000006449898

REMOVAL

NOTE:

Mass air flow sensor is removable under the car-mounted condition.

1. Remove the clip of front fender protector (left) to lift the front fender protector.
2. Remove the front side glille (left) from front bumper.
3. Remove installing bolts from inlet air duct (lower).
4. Disconnect mass air flow sensor harness connector.
5. Loosen the hose clamp of air duct.
6. Remove installing bolts from air cleaner case.
7. Remove inlet air duct (upper) and air cleaner simultaneously.

8. Remove inlet air duct (lower)
9. .Disconnect PCV hose.
10. Remove air duct.
11. Remove mass air flow sensor from air cleaner case, if necessary.

CAUTION:

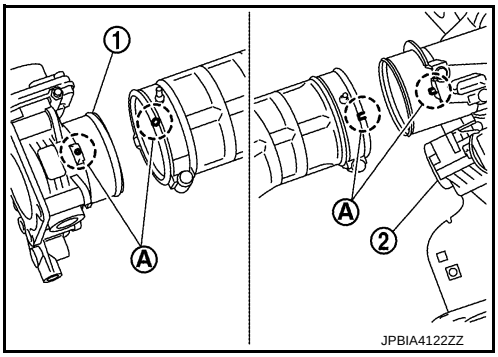
Handle the mass air flow sensor with following cares.

- **Never shock the mass air flow sensor.**
- **Never disassemble the mass air flow sensor.**
- **Never touch the sensor of the mass air flow sensor.**

INSTALLATION

Note the following, and install in the reverse order of removal.

- To install air duct, align the matching marks on both ends with the others.



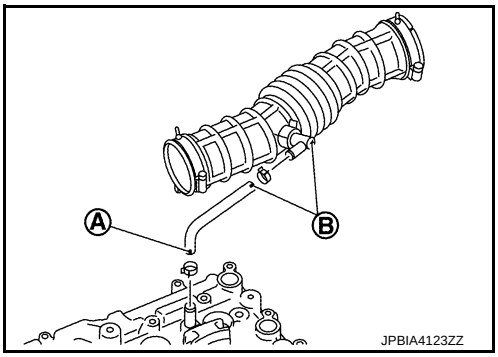
1. : Electric throttle control actuator
2. : Air cleaner case

A. : Matching mark

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

Clamp tightening torque **: 4.5 N·m (0.46 kg-m)**

- Install PVC hose with each matching mark positioned as follows:



A : White mark

B : Matching mark

Air duct side	: Align the matching mark with that of air duct side.
Rocker cover side	: Face the white mark in forward direction of the vehicle.

Inspection

INFOID:0000000006449899

INSPECTION AFTER REMOVAL

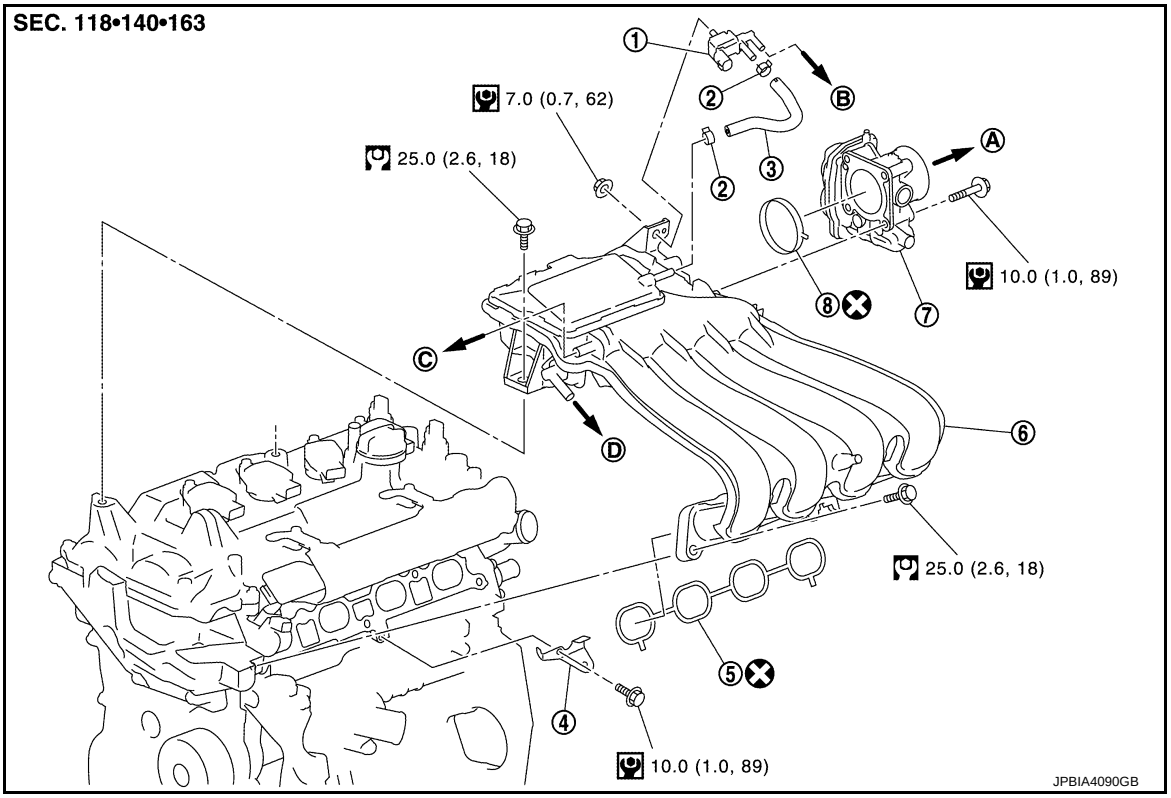
Inspect air duct for crack or tear.

- If anything found, replace air duct.

INTAKE MANIFOLD

Exploded View

INFOID:0000000006449900



1.	EVAP canister purge volume control solenoid valve	2.	Hose clamp	3.	Vacuum hose
4.	Intake manifold support	5.	Gasket	6.	Intake manifold
7.	Electric throttle control actuator	8.	Gasket		
A.	To air cleaner	B.	To centralized under-floor piping	C.	To brake booster
D.	To rocker cover				

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

Removal and Installation

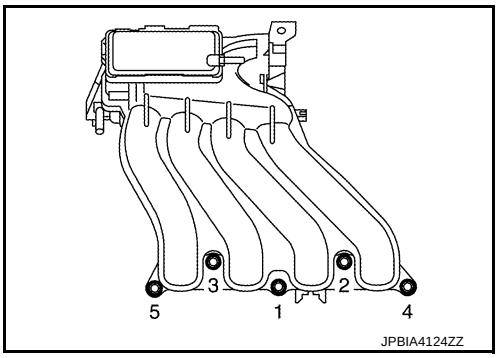
INFOID:0000000006449901

REMOVAL

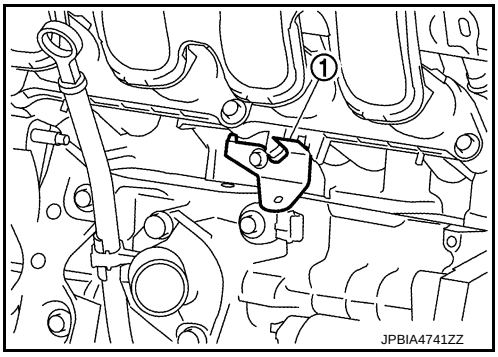
1. Drain engine coolant. Refer to CO-11, "Draining".
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Never spill engine coolant on drive belt.**
2. Remove air duct (inlet) and air duct assembly. Refer to EM-161, "Exploded View".
3. Remove reservoir tank.
4. Pull out oil level gauge.
   CAUTION:
   Cover the oil level gauge guide openings to avoid entry of foreign materials.
5. Disconnect water hoses from electric throttle control actuator as follows:
   - Drain engine coolant from radiator or attach plug to prevent engine coolant leakage when engine coolant is not drained. Refer to CO-11, "Draining".

CAUTION:
Perform this step when the engine is cold.

6. Remove electric throttle control actuator.
   CAUTION:
   - **Handle carefully to avoid any shock to electric throttle control actuator.**
   - **Never disassemble electric throttle control actuator.**
7. Disconnect harness connector and vacuum hose from purge control solenoid valve.
   CAUTION:
   Never impact it.
8. Disconnect vacuum hose for brake booster from intake manifold.
9. Remove mounting bolts of intake manifold. (The joint of intake manifold and rocker cover.)
10. Loosen mounting bolts in reverse order as shown in the figure.
    CAUTION:
    Cover engine openings to avoid entry of foreign materials.



11. Remove intake manifold.
12. Remove EVAP canister purge volume control solenoid valve from intake manifold if necessary.
    CAUTION:
    Never impact it.
13. Remove intake manifold support (1) if necessary.
    CAUTION:
    The intake manifold support functions as a guide for installing the intake manifold.



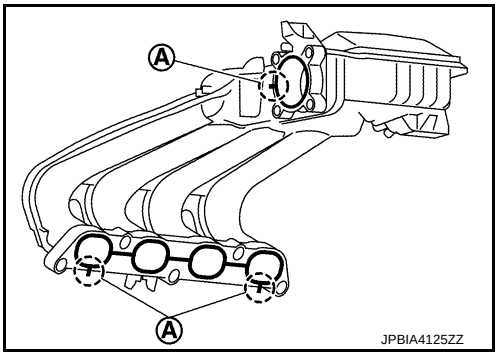
INSTALLATION

Note the following, and install in the reverse order of removal.

Intake Manifold

1. Install the gasket to the intake manifold.
   - Align the protrusions used for checking gasket installation condition with the clearance grooves (A) of the intake manifold mounting groove.

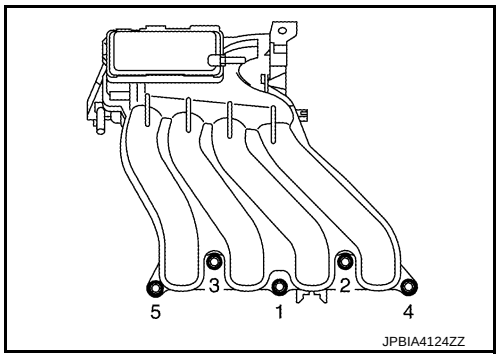
   NOTE:
   Gasket for electronically-controlled throttle can be installed when the electronically-controlled throttle is installed.



2. Place the intake manifold into the installation position.
   CAUTION:

Check that the oil level gauge guide is not detached from the securing clip of the water inlet due to interference of intake manifold.

3. Tighten bolts in the numerical order as shown in the figure.



4. Tighten mounting bolts of intake manifold. (The joint of intake manifold and rocker cover.)

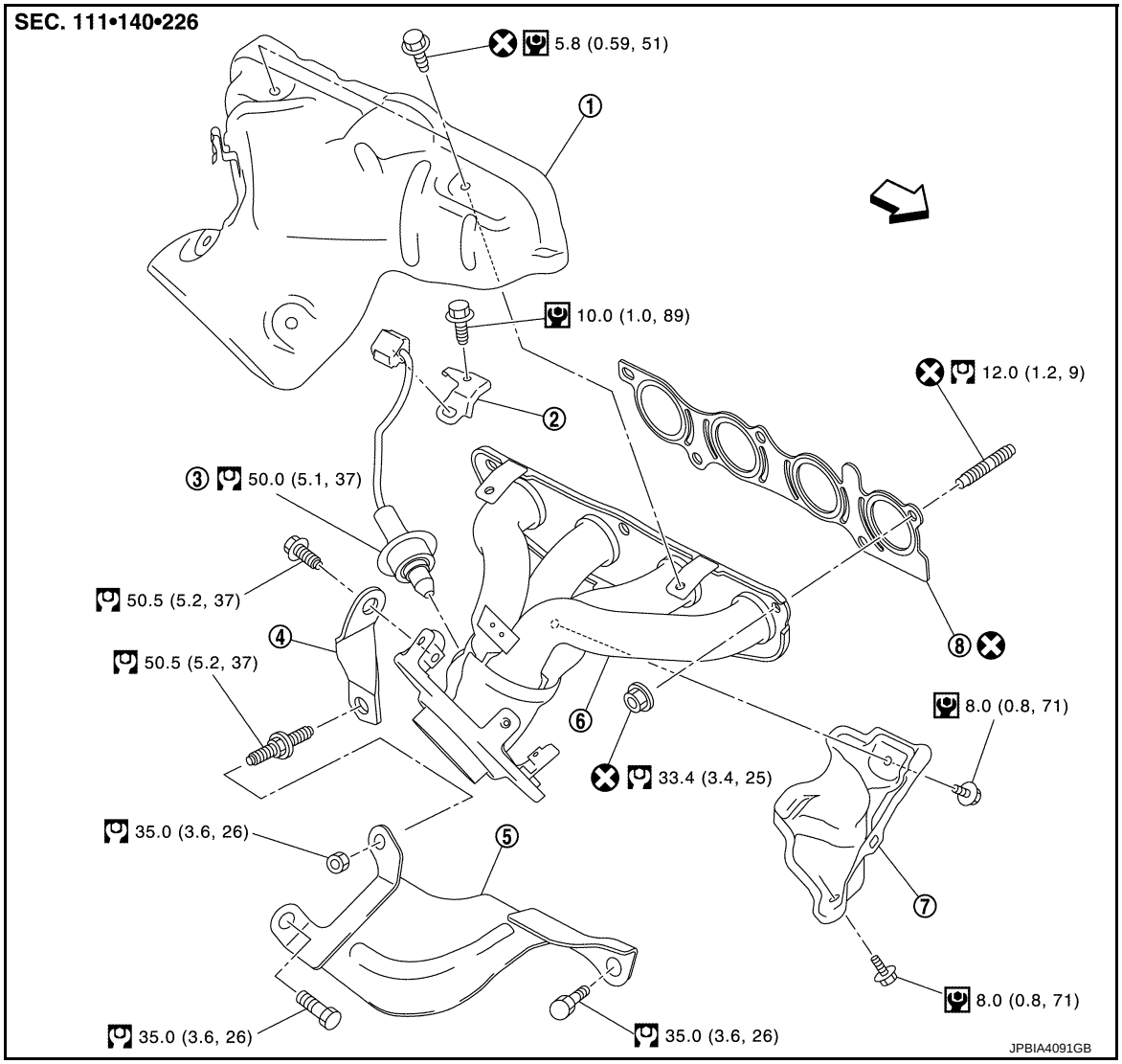
Electric Throttle Control Actuator

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform “Throttle Valve Closed Position Learning” after repair when removing harness connector of the electric throttle control actuator. Refer to EC-543, "Description".
- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer to EC-544, "Description"

EXHAUST MANIFOLD

Exploded View

INFOID:0000000006449902



1. Exhaust manifold cover
2. Harness bracket
3. Air fuel ratio sensor 1
4. Exhaust manifold stay
5. Heat insulator
6. Exhaust manifold
7. Exhaust manifold cover
8. Gasket

⇦ : Engine front

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

Removal and Installation

INFOID:0000000006449903

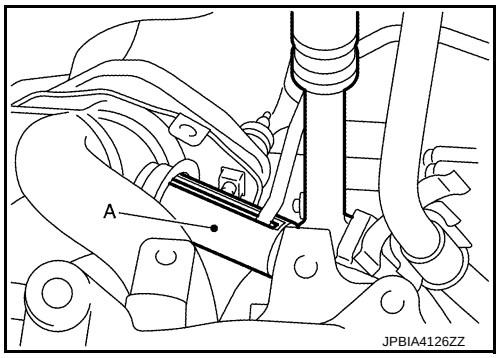
REMOVAL

1. Remove exhaust front tube. Refer to EX-12, "Exploded View".
2. Remove air duct. Refer to EM-161, "Exploded View".
3. Remove the harness bracket fixing the harness connector of the air-fuel ratio sensor from the cylinder head on the rear right side.

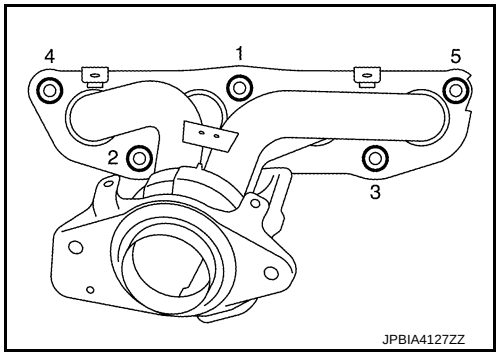
4. Remove exhaust manifold cover.
5. Remove the air fuel ratio sensor 1.
   - Using heated oxygen sensor wrench [SST: KV10117100] (A), remove air fuel ratio sensor 1.

   CAUTION:
   - **If O2 sensor is dropped on to a hard surface like a concrete floor from a height of 0.5 m or more, discard the sensor and use a new one.**
   - **Clean the mounting area of O2 sensor before installing a new O2 sensor.**

   NOTE:
   The exhaust manifold can be removed and installed without removing the air fuel ratio sensor 1 (Disassembly of harness connector is necessary).



6. Remove exhaust manifold side mounting bolt of exhaust manifold stay.
7. Remove the harness bracket of air fuel ratio sensor 1 from cylinder head.
8. Remove exhaust manifold.
   - Loosen nuts in reverse order as shown in the figure.



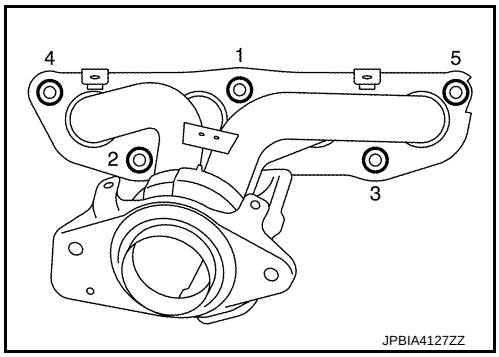
9. Remove stud bolt from cylinder head.
   - Using TORX socket.
10. Remove exhaust manifold cover from exhaust manifold back side.

INSTALLATION

NOte the following, and install in the reverse order of removal.

Exhaust manifold

1. Tighten nuts in numerical order as shown in the figure.



2. Tighten to the specified torque again.

Inspection

INFOID:0000000006449904

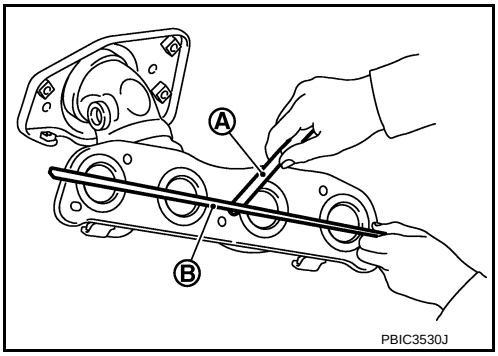
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : Refer to EM-251, "Exhaust Manifold".

- If it exceeds the limit, replace exhaust manifold.

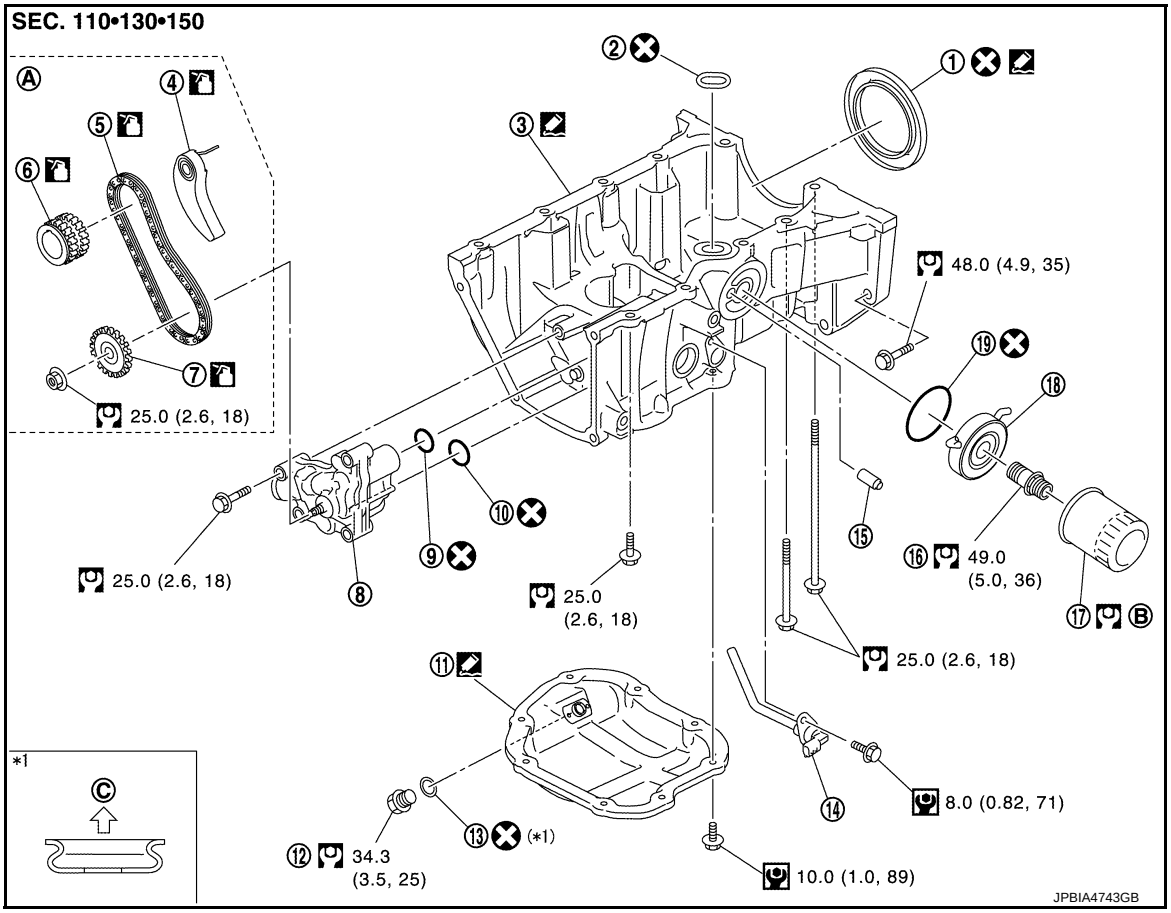


OIL PAN (LOWER)

Exploded View

INFOID:0000000006449905

With Oil Cooler



1.	Rear oil seal	2.	O-ring	3.	Oil pan (upper)
4.	Oil pump chain tensioner (for oil pump drive chain)	5.	Oil pump drive chain	6.	Crankshaft sprocket
7.	Oil pump sprocket	8.	Oil pump	9.	O-ring
10.	O-ring	11.	Oil pan (lower)	12.	Oil pan drain plug
13.	Drain plug washer	14.	Oil level sensor	15.	Relief valve
16.	Connector bolt	17.	Oil filter	18.	Oil cooler
19.	O-ring				
A.	Refer to EM-182	B.	Refer to LU-28	C.	Oil pan (lower) side

: Always replace after every disassembly.

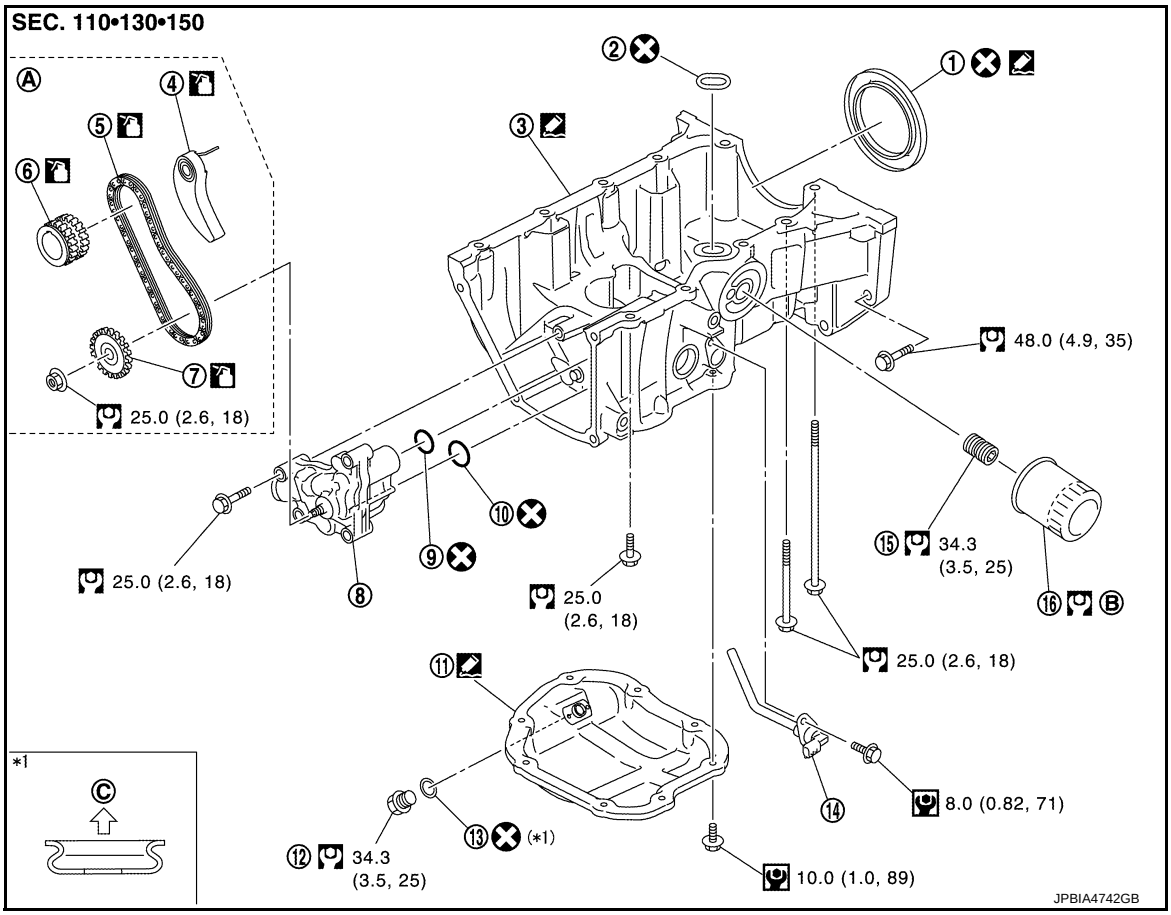
: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

With Out Oil Cooler



1.	Rear oil seal	2.	O-ring	3.	Oil pan (upper)
4.	Oil pump chain tensioner (for oil pump drive chain)	5.	Oil pump drive chain	6.	Crankshaft sprocket
7.	Oil pump sprocket	8.	Oil pump	9.	O-ring
10.	O-ring	11.	Oil pan (lower)	12.	Oil pan drain plug
13.	Drain plug washer	14.	Oil level sensor	15.	Oil filter stud bolt
16.	Oil filter				
A.	Refer to EM-182	B.	Refer to LU-28	C.	Oil pan (lower) side

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

Removal and Installation

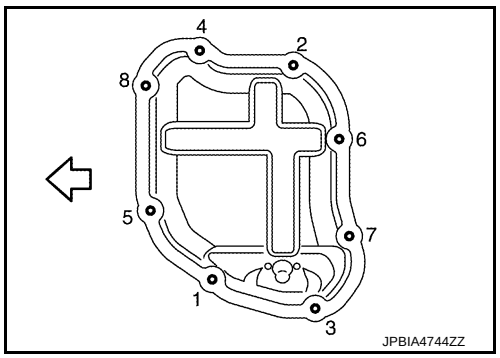
INFOID:0000000006449906

REMOVAL

1. Drain engine oil. Refer to CO-11, "Draining".
2. Remove oil pan (lower) with the following procedure:

a. Loosen mounting bolts in reverse order as shown in the figure.

⇦ : Engine front



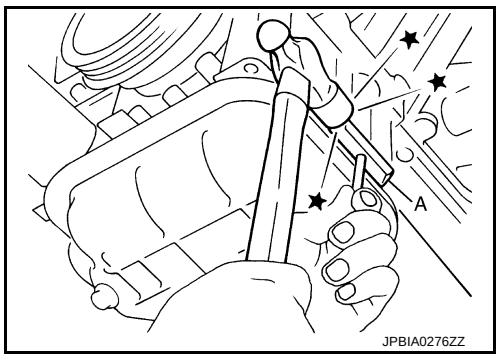
b. Insert seal cutter [SST: KV10111100] (A) between oil pan (upper) and oil pan (lower).

CAUTION:

- **Be careful not to damage the mating surface.**
- **Never insert a screwdriver. This damages the mating surfaces.**

c. Slide the seal cutter [SST: KV10111100] by tapping on the side of tool with a hammer.

d. Remove oil pan (lower).



INSTALLATION

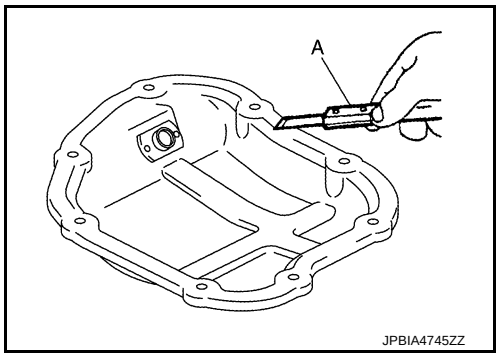
1. Install oil pan (lower) as follows:

a. 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.

CAUTION:

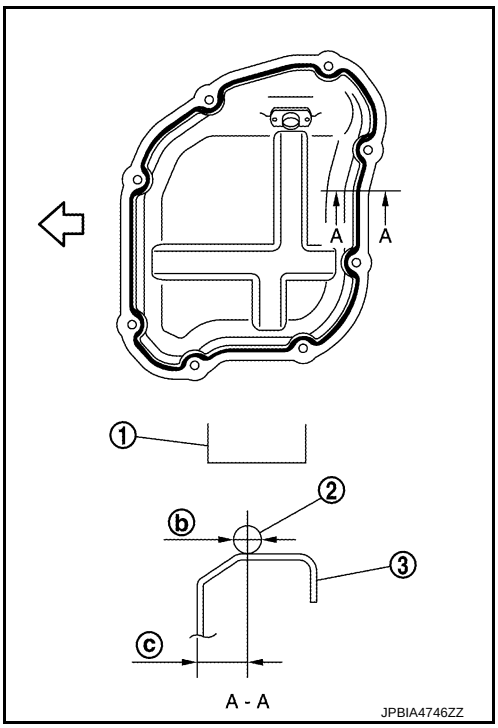
Never scratch or damage the mating surface when cleaning off old liquid gasket.



b. Apply a continuous bead of liquid gasket (B) with a tube presser (commercial service tool) as shown in the figure.

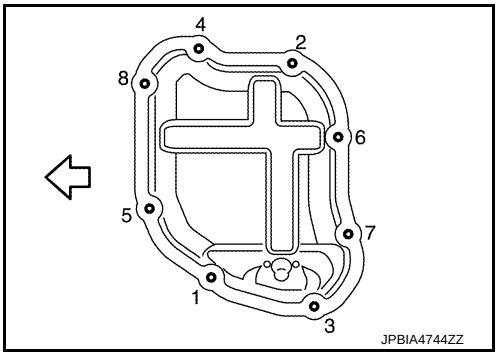
a : 7.5 - 9.5 mm (0.295 - 0.374 in)
c : ϕ4.0 - 5.0 mm (0.157 - 0.197 in)
1 : Oil pan (lower)
⬅ : Engine outside

Use Genuine Liquid Gasket or equivalent.
CAUTION:
Attaching should be done within 5 minutes after liquid gasket application.



c. Tighten bolts in numerical order as shown in the figure.

⇦ : Engine front



2. Install oil pan drain plug.
   • Refer to the figure of components of former page for installation direction of drain plug washer. Refer to EM-169, "Exploded View".
3. Install in the reverse order of removal after this step.
   NOTE:
   Wait at last 30 minutes after oil pan (lower) is installed before pouring engine oil.

Inspection

INFOID:0000000006449907

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

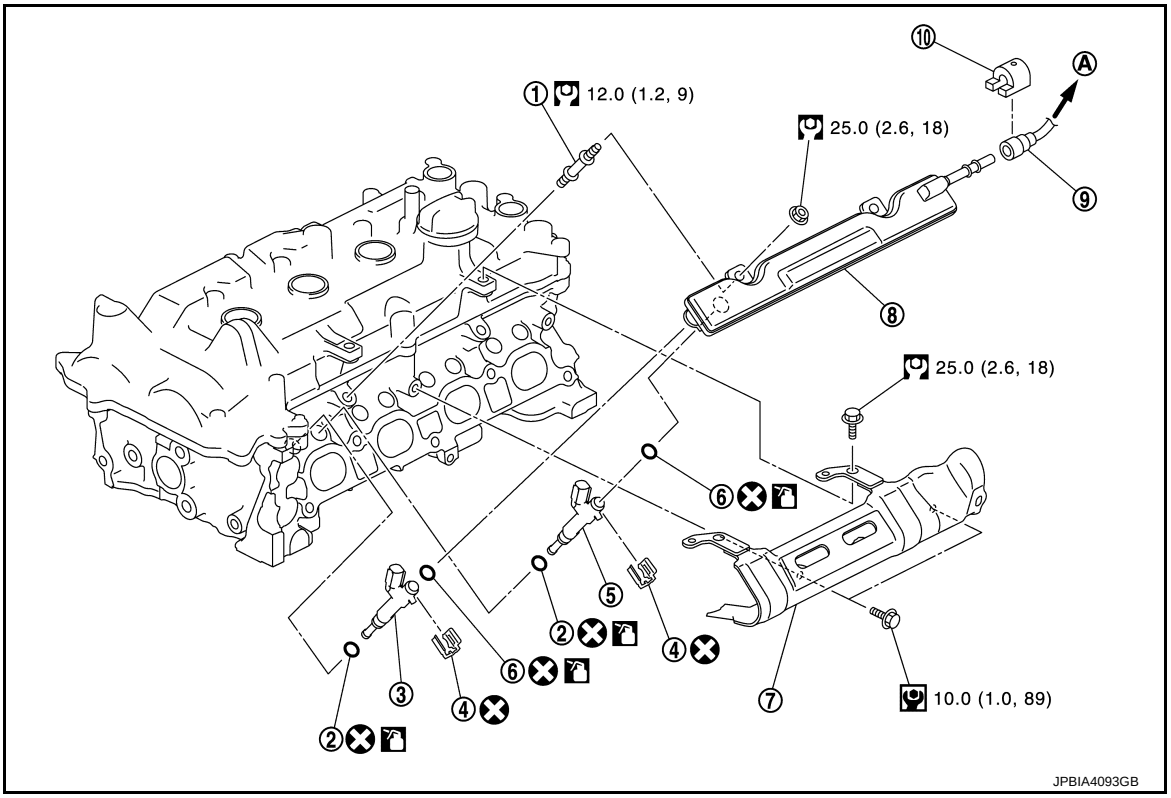
INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to LU-25, "Inspection".
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to LU-25, "Inspection".

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:0000000006449908



1. Stud bolt
2. O-ring (green)
3. Fuel injector (front)
4. Clip
5. Fuel injector (rear)
6. O-ring (black)
7. Fuel tube protector
8. Fuel tube
9. Fuel feed hose
10. Quick connector cap

A. To centralized under-floor piping

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Should be lubricated with oil.

CAUTION:
Never remove or disassemble parts unless instructed as shown in the figure.

Removal and Installation

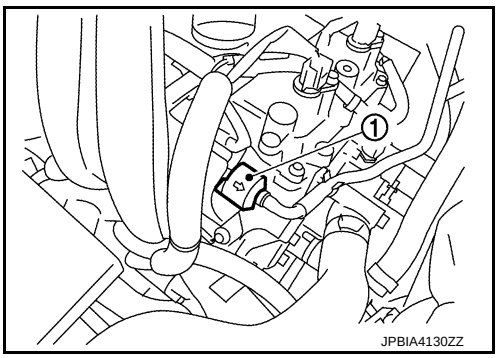
INFOID:0000000006449909

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.**
- **Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.**

REMOVAL

1. Release the fuel pressure. Refer to EC-551, "Work Procedure".
2. Remove intake manifold. Refer to EM-163, "Exploded View".

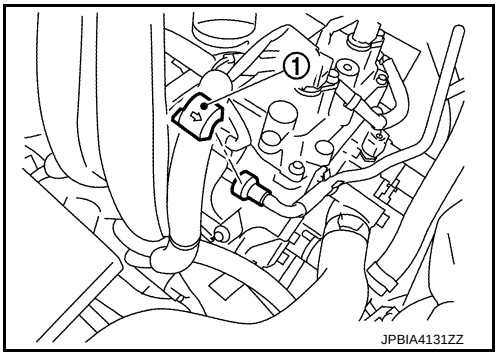
3. Disconnect quick connector with the following procedure. Disconnect fuel feed hose from fuel tube.



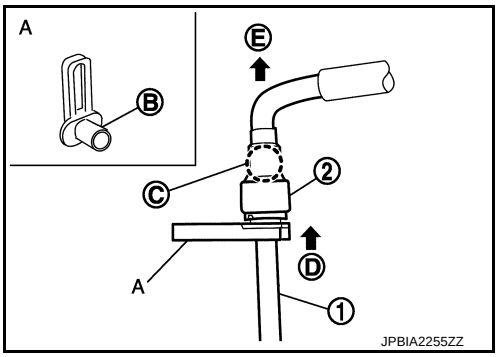
1 : Quick connector cap

NOTE:
There is no fuel return path.

a. Remove quick connector cap (engine side) (1) from quick connector connection.
b. Disconnect fuel feed hose from hose clamp.



c. With the sleeve side of quick connector release facing quick connector, install quick connector release (commercial service tool) onto fuel tube.
d. Insert quick connector release (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold quick connector release on that position.

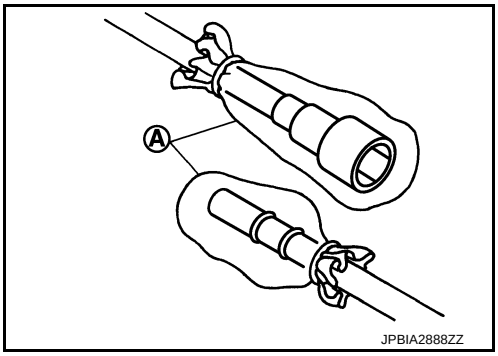


D : Insert and retain

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

e. Draw and pull out quick connector straight from fuel tube (1).

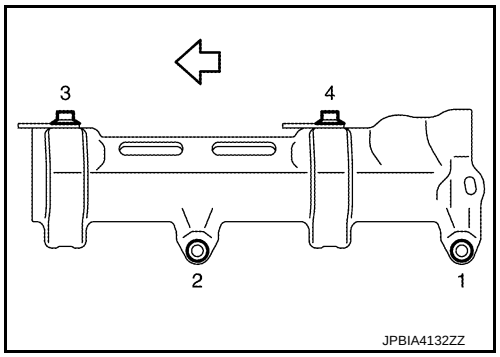
CAUTION:
- **Pull quick connector (E) holding position (C) in the figure.**
- **Never pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leakage out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Never expose parts to battery electrolyte or other acids.**
- **Never bend or twist connection between quick connector and fuel feed tube during installation/removal.**
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.**



4. Disconnect harness connector from fuel injector.

5. Remove fuel tube protector.
   - Loosen mounting bolts in reverse order as shown in the figure.

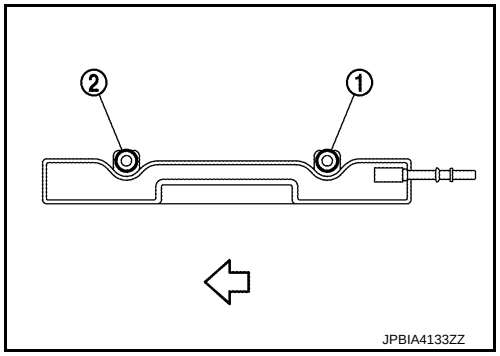
   ⇦ : Engine front



6. Remove fuel tube and fuel injector assembly.
   - Loosen mounting bolts in reverse order as shown in the figure.

   ⇦ : Engine front

CAUTION:
- **When removing, be careful to avoid any interference with fuel injector.**
- **Use a shop cloth to absorb any fuel leakage from fuel tube.**

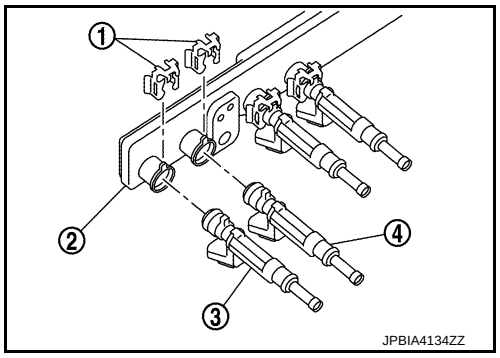


7. Remove fuel injector from fuel tube with the following procedure:

a. Open and remove clip (1).

b. Remove fuel injector (3) and (4) from fuel tube (2) 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.**
- **Check 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 is stretched while installing, never insert it quickly into fuel tube.**
- **Insert O-ring straight into fuel tube. Never decenter or twist it.**

2. Install fuel injector to fuel tube with the following procedure:

a. Insert clip (2) into clip mounting groove on fuel injector (4).

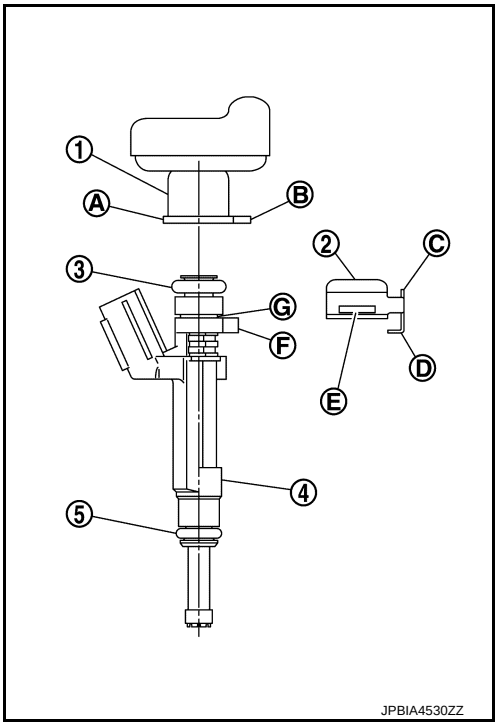
3 : O-ring (black)
5 : O-ring (green)

- Insert clip so that protrusion (F) 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 (1) 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.
- Check that fuel tube flange (A) is securely fixed in flange fixing groove (E) on clip.

c. Check that installation is complete by checking that fuel injector does not rotate or come off.



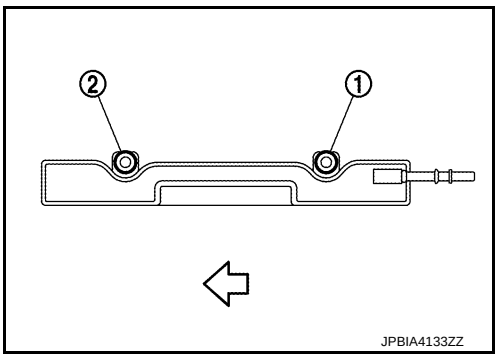
JPBIA4530ZZ

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. Install fuel tube and injector assembly onto cylinder.
- Tighten mounting bolts in numerical order as shown in the figure.

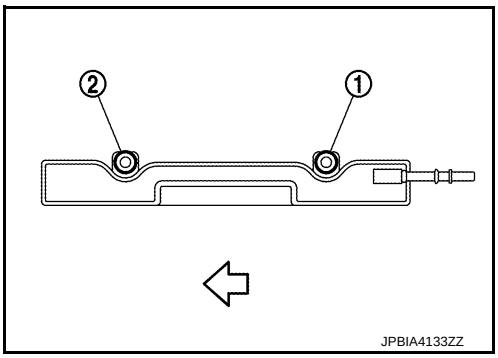
⇦ : Engine front



JPBIA4133ZZ

5. Install fuel tube protector.
- Tighten mounting bolts in numerical order as shown in the figure.

⇦ : Engine front

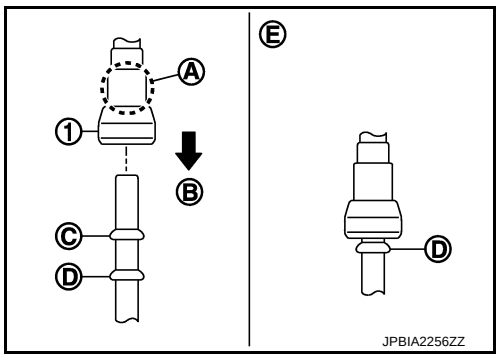


JPBIA4133ZZ

6. Connect harness connector to fuel injector.
7. Connect fuel feed tube with the following procedure.

a. Check for damage or foreign material on the fuel tube and quick connector.
b. Apply new engine oil lightly to area around the top of fuel tube.
c. Align center to insert quick connector straightly into fuel tube.

- Insert quick connector (1) to fuel tube until the top spool (C) on fuel tube is inserted completely and the 2nd level spool (D) is positioned slightly below quick connector bottom end.

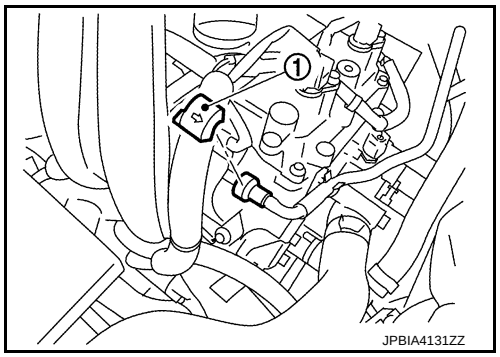


B : Upright insertion
E : Fitted condition

CAUTION:
- **Hold (A) position in the figure when inserting fuel tube into quick connector.**
- **Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.**
- **Insert until you hear a “click” sound and actually feel the engagement.**
- **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**

d. Pull quick connector hard by hand holding position. Check it is completely engaged (connected) so that it does not come out from fuel tube.

e. Install quick connector cap (engine side) (1) to quick connector connection.
- Install quick connector cap (engine side) with the side arrow facing quick connector side (fuel feed tube side).



CAUTION:
- **Check that the quick connector and fuel tube are securely engaged with the quick connector cap (engine side) mounting groove.**
- **Quick connector may not be connected correctly if quick connector cap (engine side) cannot be installed easily. Remove the quick connector cap (engine side), and then check the connection of quick connector again.**

f. Install fuel feed hose to hose clamp.

8. Install remaining parts in the reverse order of removal.

Inspection

INFOID:0000000006449910

INSPECTION AFTER INSTALLATION

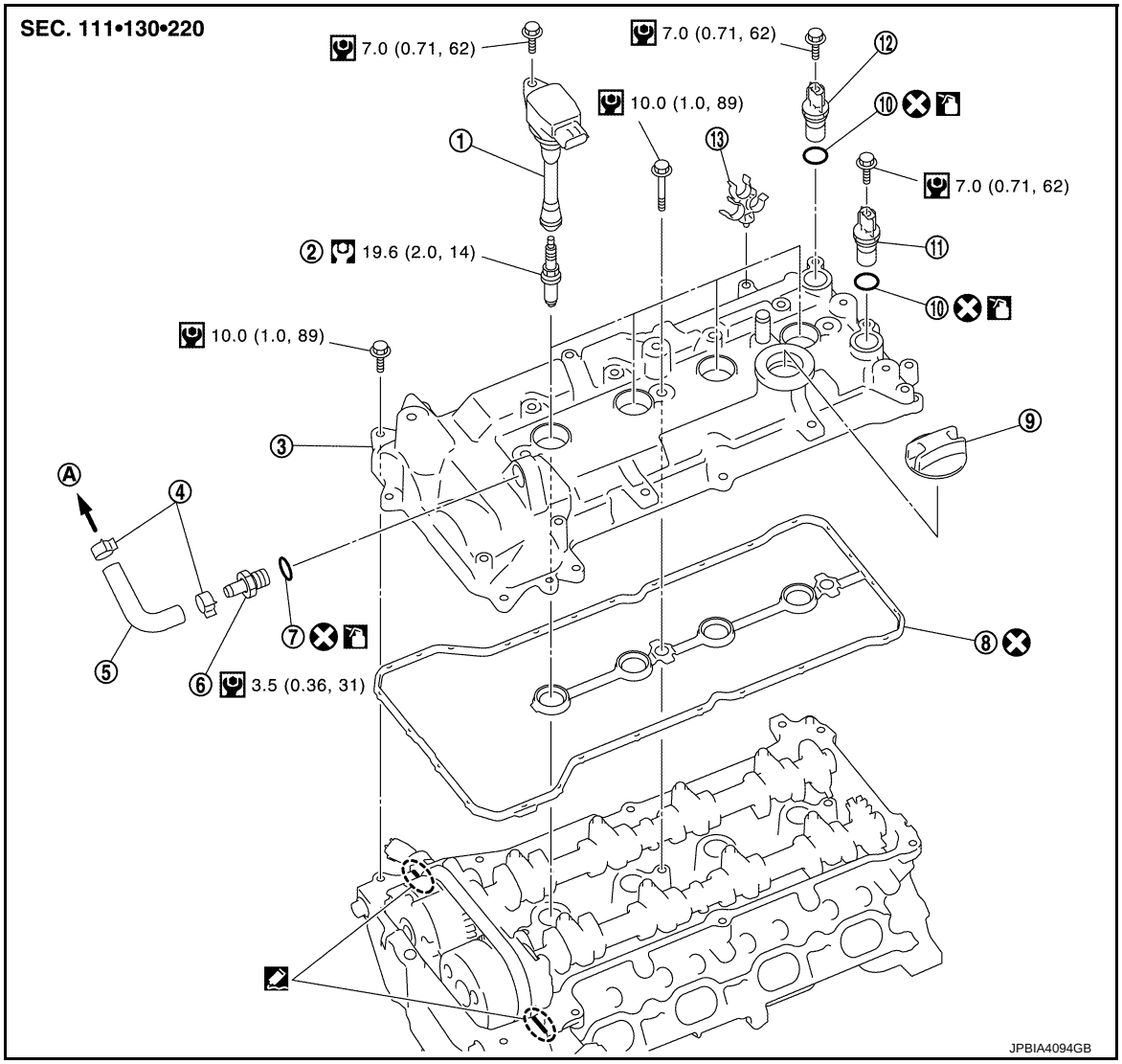
Check on Fuel Leakage

1. Turn ignition switch “ON” (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.
NOTE:
Use mirrors for checking at points out of clear sight.
2. Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.
CAUTION:
Never touch the engine immediately after stopped, as the engine becomes extremely hot.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:0000000006449911



1. Ignition coil
2. Spark plug
3. Rocker cover
4. Hose cramp
5. PCV hose
6. PCV valve
7. O-ring
8. Gasket
9. Oil filler cap
10. O-ring
11. Camshaft position sensor (INT)
12. Camshaft position sensor (EXH)
13. Cramp
A. To intake manifold

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

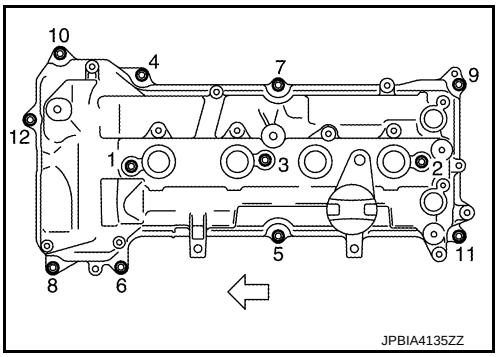
Removal and Installation

INFOID:0000000006449912

REMOVAL

1. Remove intake manifold. Refer to EM-163, "Exploded View".
2. Remove ignition coil.
   CAUTION:
   - **Never drop or shock ignition coil.**
   - **Never disassemble ignition coil.**
3. Remove fuel tube protector. Refer to EM-173, "Exploded View".
4. Remove PCV hose from rocker cover.
5. Remove PCV valve, if necessary.
6. Remove rocker cover.
   - Loosen bolts in reverse order as shown in the figure.

   ⇦ : Engine front

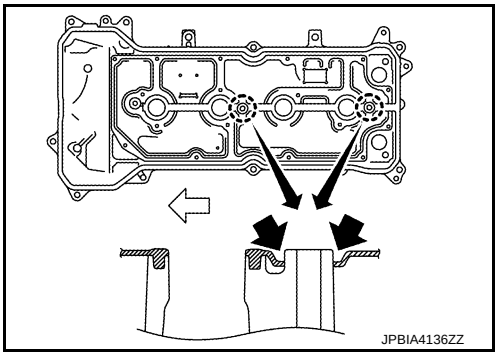


7. Remove rocker cover gasket from rocker cover.
8. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.
   CAUTION:
   Never scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

1. Rocker cover with the following procedure:

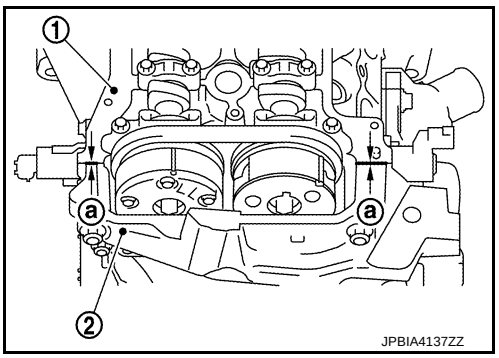
a. Press gasket onto the bosses for the rocker cover bolt holes as shown in the figure to prevent the rocker cover from dropping off.



b. Apply liquid gasket to the position as shown in the figure.

   1 : Cylinder head
   2 : Front cover
   a : ϕ2.5 - 3.5 mm

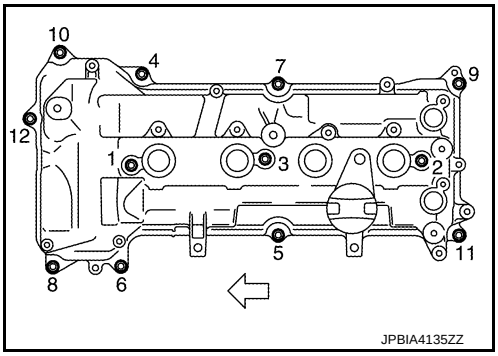
   Use Genuine Liquid Gasket or equivalent.



c. Install rocker cover to cylinder head.
   CAUTION:
   Check the gasket is not dropped.

- Tighten bolts in two steps separately in numerical order as shown in the figure.

⇦ : Engine front

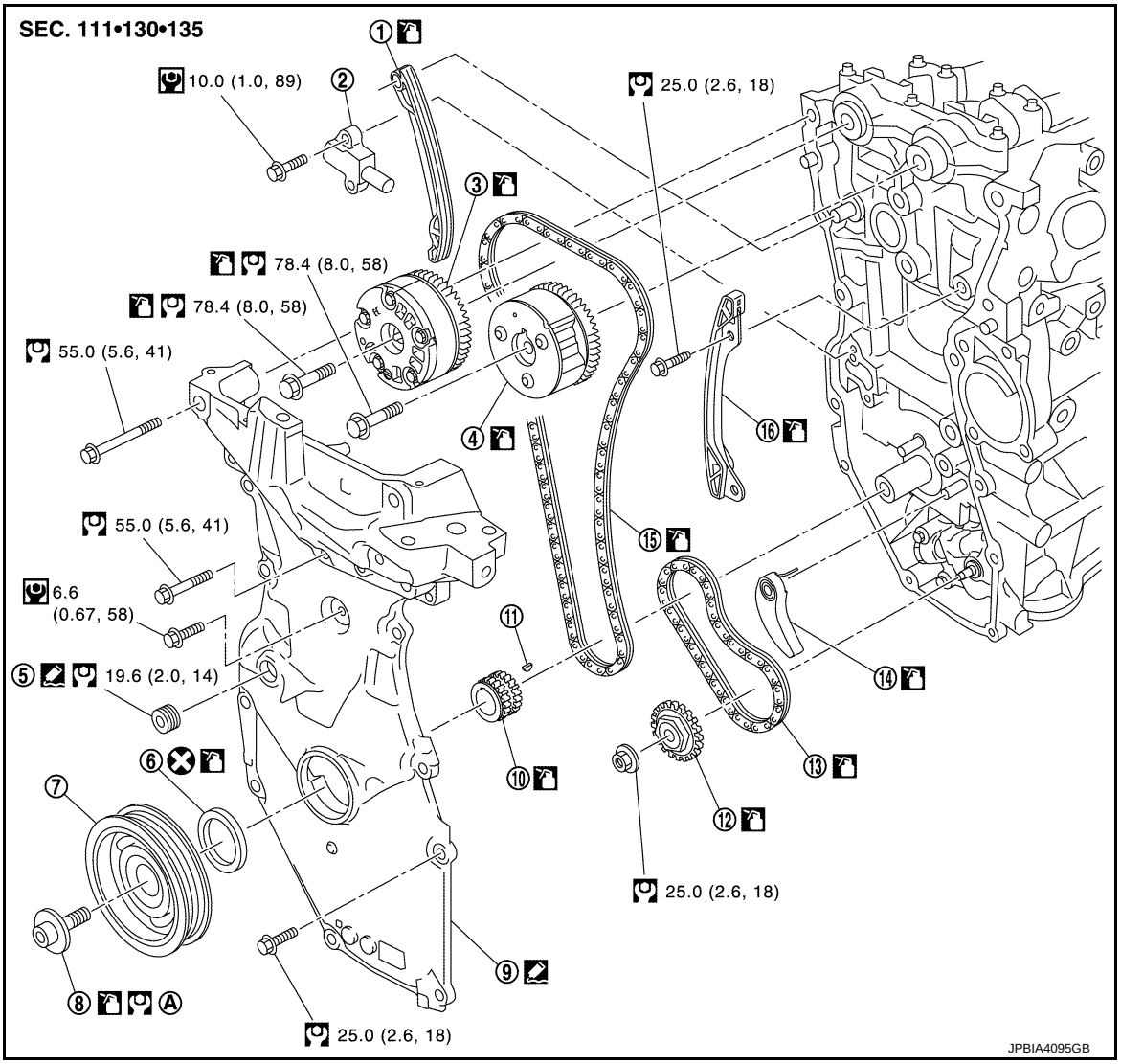


2. Install PCV valve.
   - Insert PCV valve until the flange of PCV valve contact the grommet absolutely.
3. Install in the reverse order of removal, for the rest of parts.

TIMING CHAIN

Exploded View

INFOID:0000000006449913



1. Timing chain slack guide
2. Timing chain tensioner
3. Camshaft sprocket (EXH)
4. Camshaft sprocket (INT)
5. Plug
6. Front oil seal
7. Crankshaft pulley
8. Crankshaft pulley bolt
9. Front cover
10. Crankshaft sprocket
11. Crankshaft sprocket key
12. Oil pump sprocket
13. Oil pump drive chain
14. Oil pump drive chain tensioner
15. Timing chain
16. Timing chain tension guide

A. Tightening must be done following the installation procedure. Refer to EM-182

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

Removal and Installation

INFOID:0000000006449914

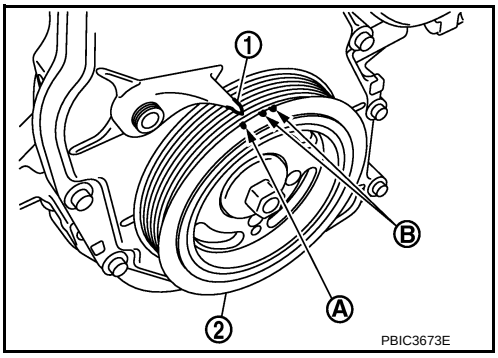
CAUTION:
The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

1. Remove front road wheel (RH).
2. Remove front fender protector (RH). Refer to EXT-22, "Exploded View".
3. Drain engine oil. Refer to LU-26, "Draining".
   NOTE:
   Perform this step when engine is cold.
4. Remove the following parts.
   - Rocker cover: Refer to EM-178, "Exploded View".
   - Drive belt: Refer to EM-155, "Removal and Installation".
   - Water pump pulley: Refer to CO-22, "Exploded View".
5. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to EM-215, "Exploded View".
6. Set No. 1 cylinder at TDC of its compression stroke with the following procedure:

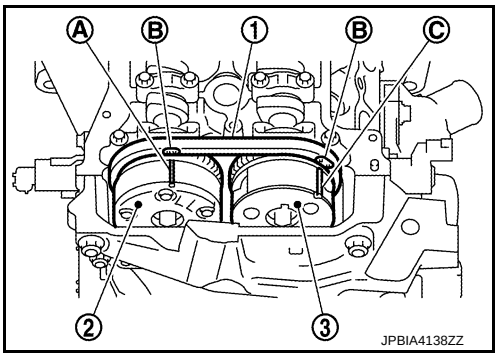
a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

B : White paint mark (Not use for service)



b. Check the matching marks on each camshaft sprocket are positioned as shown in the figure.

1 : Timing chain
2 : Camshaft sprocket (EXH)
3. : Camshaft sprocket (INT)
A : Matching mark (Peripheral knurls)
B : Matching mark (stamp)
C : Matching mark (Peripheral groove)

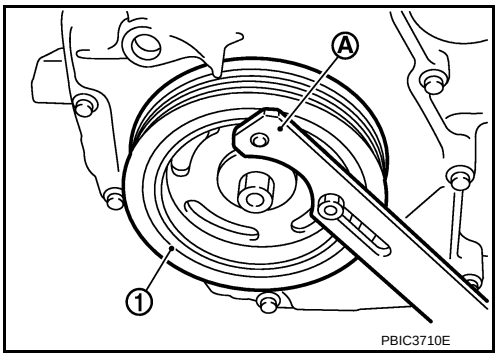


- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.

7. Remove crankshaft pulley with the following procedure:

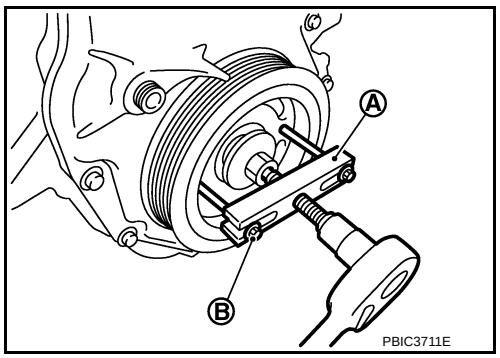
a. Secure crankshaft pulley (1) using a pulley holder (commercial service tool) (A).

b. Loosen and pull out crankshaft pulley bolts.
   CAUTION:
   Never remove the mounting bolts as they will be used as a supporting point for the pulley puller [SST: KV11103000].



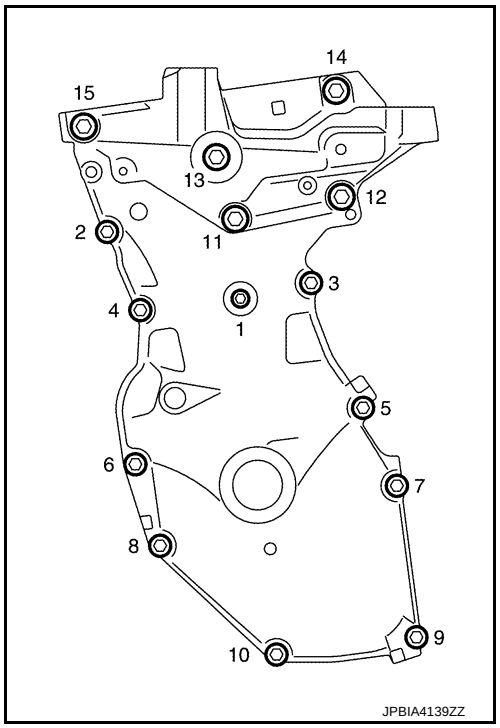
c. Attach a pulley puller [SST: KV11103000] (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

B : M6 bolt

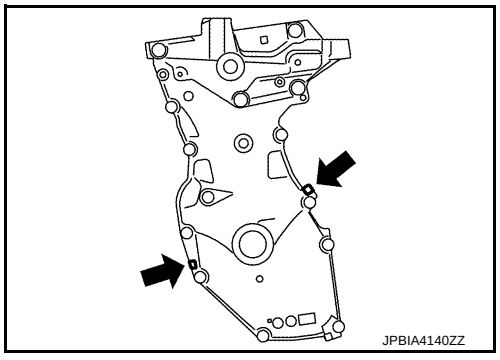


8. Remove front cover with the following procedure:

a. Loosen bolts in the reverse of the order as shown in the figure.



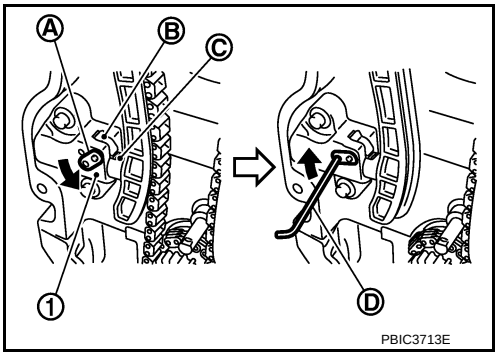
b. Cut liquid gasket by prying the position (⬅) as shown in the figure, and then remove the front cover.



9. Remove front oil seal from front cover.
• Remove by lifting it up using a suitable tool.

CAUTION:
Be careful not to damage the front cover.

10. Remove chain tensioner (1) with the following procedure.



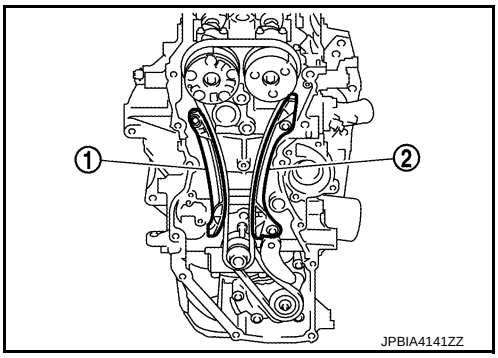
a. Fully push down the chain tensioner lever (A), and then push the plunger (C) into the inside of tensioner.
   - The tab (B) is released by fully pushing the lever down. As a result, the plunger can be moved.

b. Pull up the lever to align its hole position with the body hole position.
   - When the lever hole is aligned with the body hole position, the plunger is fixed.
   - When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.

c. Insert the stopper pin (D) into the body hole through the lever hole, and then fix the lever at the upper position.
   - Figure shows the example that a hexagonal wrench for 2.5 mm (0.098 in) is used.

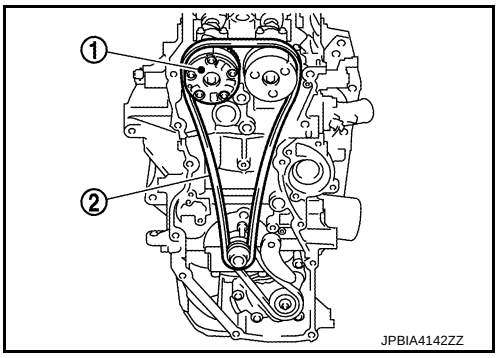
d. Remove chain tensioner.

11. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



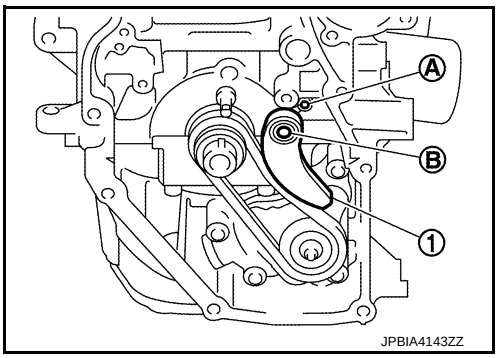
12. Remove the timing chain (2).
    - Pull the looseness of timing chain toward the camshaft sprocket (EXH) (1), and then remove the timing chain and start the removal from camshaft sprocket (EXH) side.

    CAUTION:
    Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.



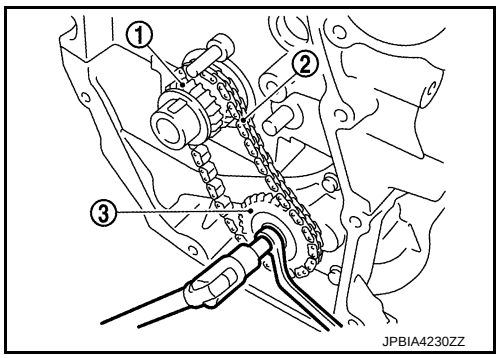
13. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

a. Remove chain tensioner (1).
   - Pull out from the shaft (B) and spring fixing holes (A).



b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then loosen the oil pump sprocket nuts and remove them.

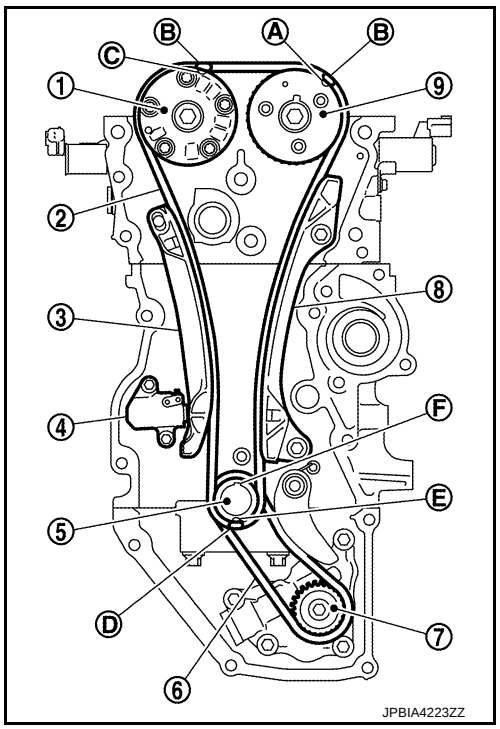
c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.



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 : Camshaft sprocket (EXH)
2 : Timing chain
3 : Timing chain slack guide
4 : Chain tensioner
5 : Crankshaft sprocket
6 : Oil pump drive chain
7 : Oil pump sprocket
8 : Timing chain tension guide
9 : Camshaft sprocket (INT)
A : Matching mark (Peripheral groove)
B : Pink link
C : Matching mark (Peripheral knurls)
D : Orange link
E : Matching mark (stamp)
F : Crankshaft key (point straight up)

1. Install the crankshaft sprocket and the oil pump drive related parts with the following procedure:

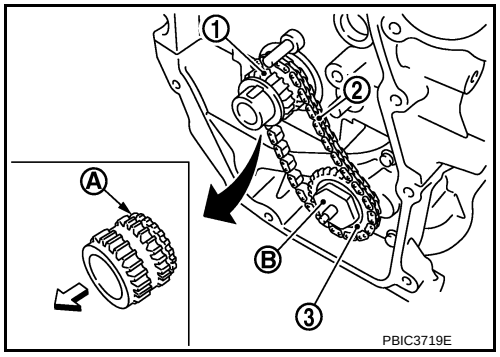
a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇦ : Engine front

- Install the crankshaft sprocket so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket so that its hexagonal surface faces (B) the front of engine.

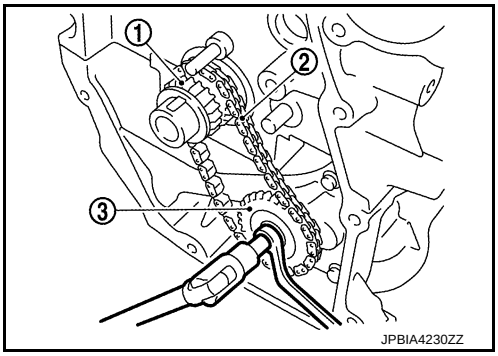
NOTE:

There is no matching mark in the oil pump drive related parts.

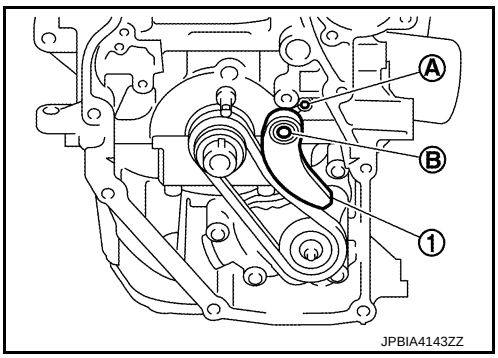


b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then tighten the oil pump sprocket nuts.

1 : Crankshaft sprocket
2 : Oil pump drive chain
3 : Oil pump sprocket



c. Install chain tensioner (1).
- Insert the body into the shaft (B) while inserting the spring into the fixing hole (A) of cylinder block front surface.
- Check that the tension is applied to the oil pump drive chain after installing.

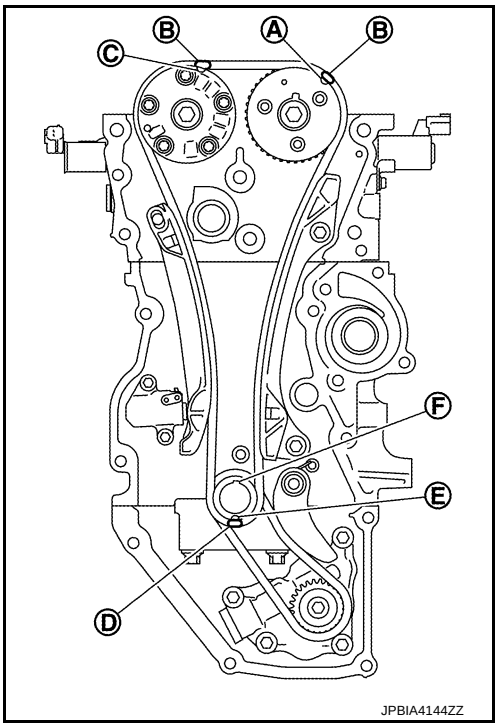


2. Install timing chain with the following procedure.

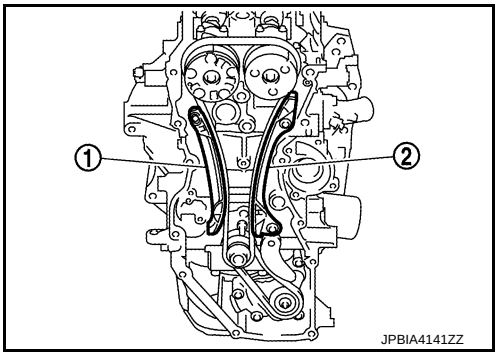
A : Matching mark (Peripheral groove)
B : Pink link
C : Matching mark (Peripheral knurls)
D : Orange link
E : Matching mark (stamp)
F : Crankshaft key (point straight up)

- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

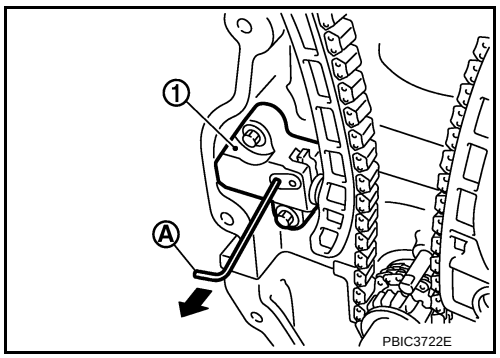
CAUTION:
- **For the following note, after the matching marks are aligned, keep them aligned by holding them with a hand.**
- **To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.**



3. Install timing chain tension guide (2) and timing chain slack guide (1).



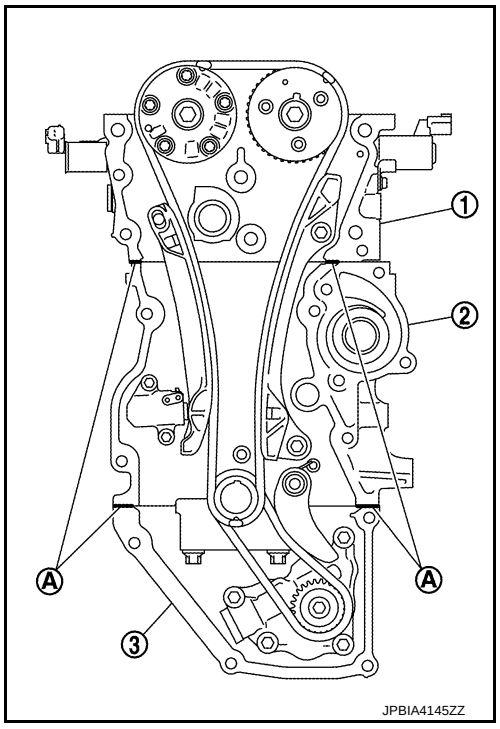
4. Install chain tensioner (1).
   - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
   - Securely pull out the stopper pin after installing the chain tensioner.



5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to EM-206, "FRONT OIL SEAL : Removal and Installation"
7. Install front cover with the following procedure:

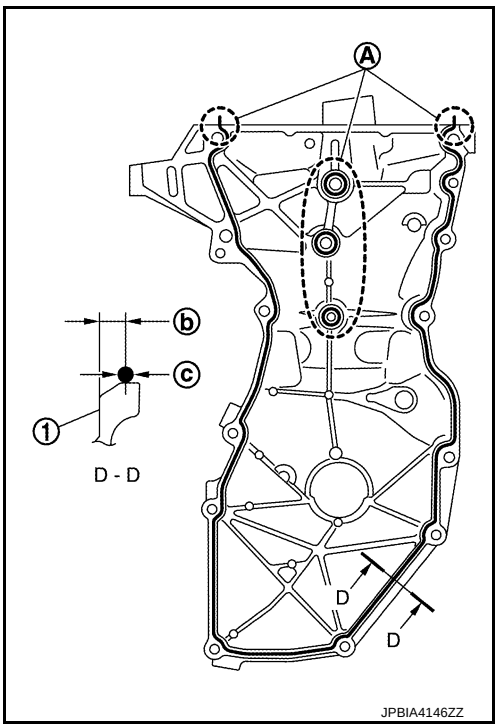
a. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

1 : Cylinder head
2 : Cylinder block
3 : Oil pan (upper)
A : Liquid gasket application area [ϕ3.0 - 4.0 mm (0.12 - 0.16 in)]

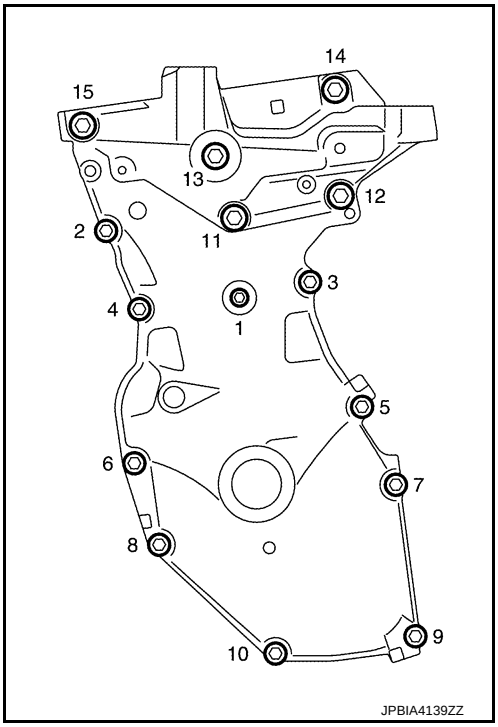


b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

1 : Front cover edge
A : Liquid gasket application area
b : 4.0 - 5.6 mm
c : Liquid gasket application area [ϕ3.0 - 4.0 mm (0.12 - 0.16 in)]



c. Tighten bolts in the numerical order as shown in the figure.
d. After all bolts are tightened, retighten them to specified torque in numerical order as shown in the figure.
CAUTION:
Be sure to wipe off any excessive liquid gasket leaking to surface.



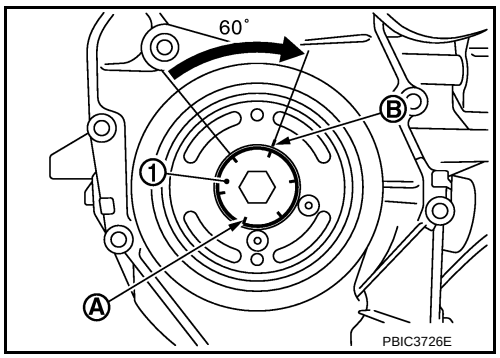
8. Insert crankshaft pulley by aligning with crankshaft key.
• When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
CAUTION:
Install protecting front oil seal lip section from any damage.
9. Tighten crankshaft pulley bolt with the following procedure:
• Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.

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

: 35.0 N·m (3.6 kg-m, 26 ft-lb)

c. Put a paint mark (B) on crankshaft pulley, mating with any one of six easy to recognize angle marks (A) on crankshaft bolt flange (1).

d. Turn another 60 degrees clockwise (angle tightening).
   • Check the tightening angle with movement of one angle mark.



10. Check that crankshaft turns smoothly by rotating by hand clockwise.
11. Install in the reverse order of removal.

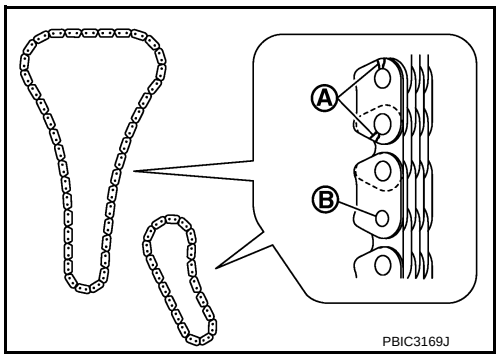
Inspection

INFOID:0000000006449915

INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- 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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

  NOTE:

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

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level

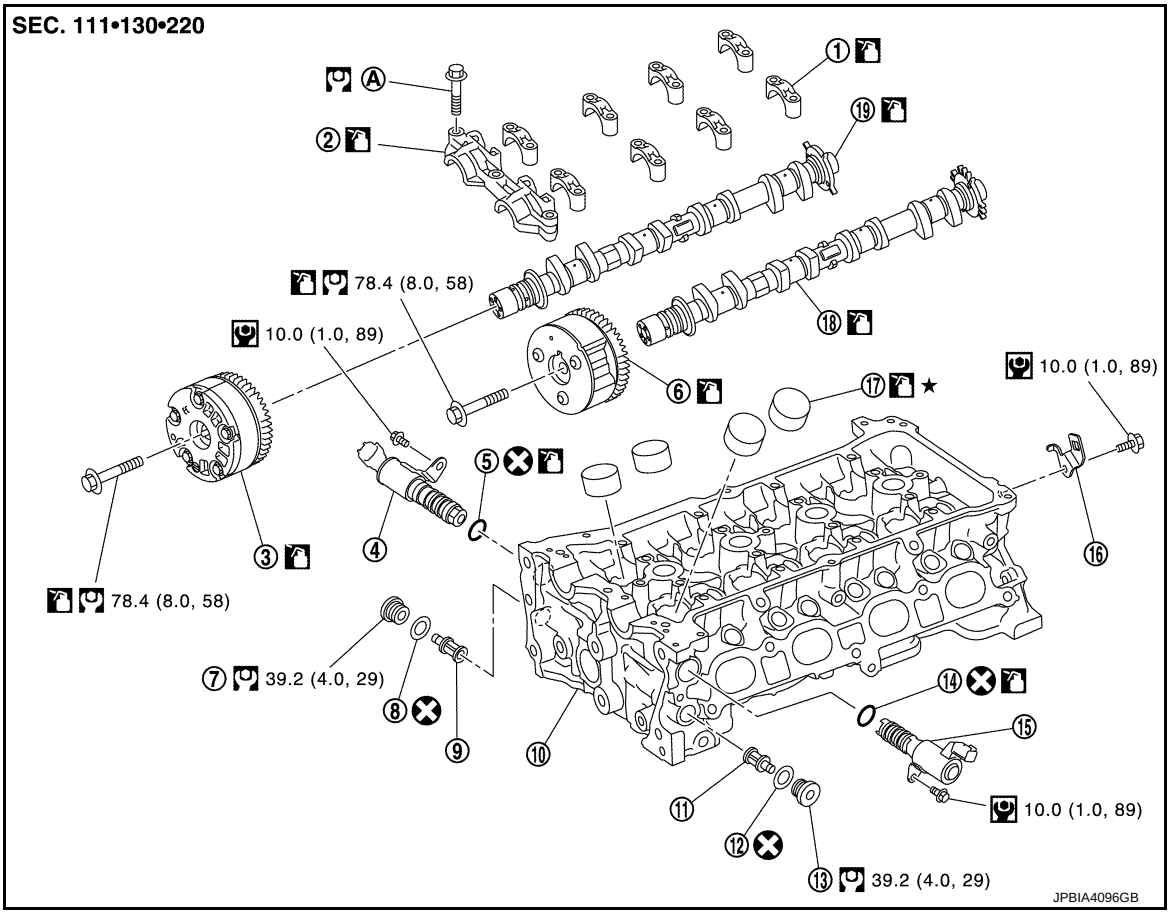
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

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

CAMSHAFT

Exploded View

INFOID:0000000006449916



1.	Camshaft bracket (No. 2 to 5)	2.	Camshaft bracket (No. 1)	3.	Camshaft sprocket (EXH)
4.	Exhaust valve timing control solenoid valve	5.	O-ring	6.	Camshaft sprocket (INT)
7.	Plug (EXH)	8.	Washer (EXH)	9.	Oil filter (for exhaust valve timing control solenoid valve)
10.	Cylinder head	11.	Oil filter (for intake valve timing control solenoid valve)	12.	Washer (INT)
13.	Plug (INT)	14.	O-ring	15.	Intake valve timing control solenoid valve
16.	Bracket	17.	Valve lifter	18.	Camshaft (INT)
19.	Camshaft (EXH)				

A. Tightening must be done following the installation procedure. Refer to EM-191

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Should be lubricated with oil.

★ : Select with proper thickness.

Removal and Installation

INFOID:0000000006449917

CAUTION:

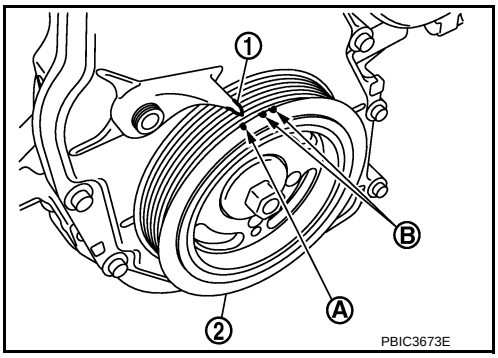
The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

1. Hold the bottom surface of the engine with a jack to remove the right engine mount assembly and the insulator. Refer to EM-215, "Exploded View".
2. Remove rocker cover. Refer to EM-178, "Exploded View".
3. Remove camshaft position sensor from rear end of cylinder head.
   CAUTION:
   Handle it carefully and avoid impacts.
4. Place cylinder No. 1 at TDC of its compression stroke with the following procedure.

a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

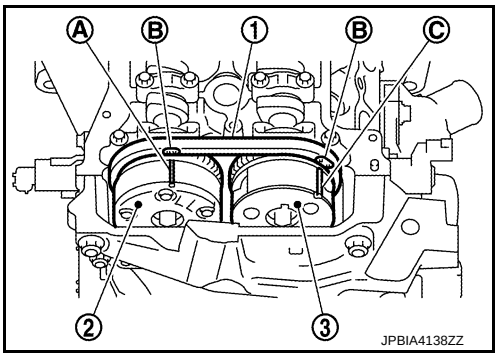
B : White paint mark (Not use for service)



b. Check that the matching marks on each the camshaft sprockets are in the position as shown in the figure.

1. : Timing chain
2. : Camshaft sprocket (EXH)
3. : Camshaft sprocket (INT)

A : Matching mark (Peripheral groove)
B : Matching mark (Stamp)
C : Matching mark (Peripheral groove)



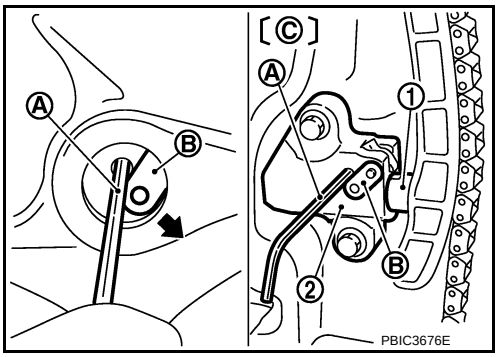
- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.

c. Paint matching marks (A) on the timing chain links

5. Remove crankshaft pulley. Refer to EM-181, "Exploded View".
6. Remove front cover. Refer to EM-181, "Exploded View".
7. Secure the plunger of chain tensioner in the fully compressed position with the following procedure. And then, loosen the timing chain tension.

a. Fully push down the lever (B) of chain tensioner (2) from the plug hole, and then insert the stopper pin (A) into the body side hole and secure the lever at the lowest position.

C : Front cover has been omitted



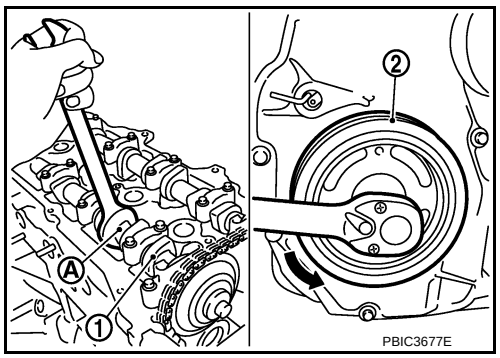
- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

NOTE:
Hexagonal wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.
CAUTION:
The stopper pin must use a shape that cannot fall in the front cover when dropping out.

b. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) fixing. Apply the tension to the timing chain, and then push the plunger of into the inside of chain tensioner.

CAUTION:

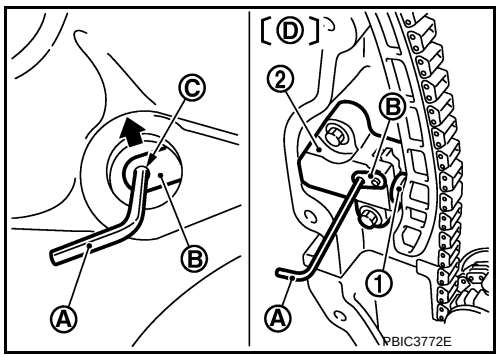
Hold the camshaft hexagonal part (A), and then secure the camshaft.



c. Pull out the stopper pin (A) of chain tensioner (2) side from plug hole. Lift the lever (B) up to align its hole position with the hole of the body.

D : Front cover has been omitted

- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



d. Insert the stopper pin into the body hole through the lever hole, and then fix the lever at the upper position.

8. Remove timing chain.

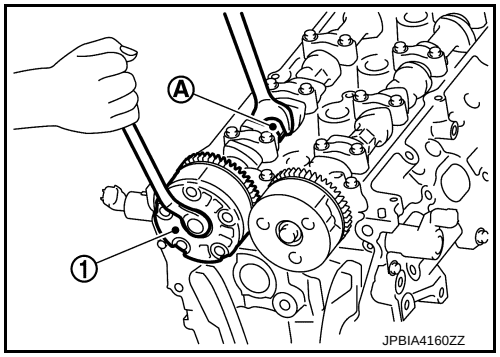
9. Remove camshaft sprocket (EXH) (1).

CAUTION:

- **Hold the camshaft hexagonal part (A), and then secure the camshaft.**
- **Never rotate crankshaft and camshaft separately, so as not to contact valve with piston in the following steps.**

NOTE:

The timing chain with the front cover installed is not disengaged from the crankshaft sprocket and it is not dropped into the front cover. Therefore, the timing chain tension holding device is not necessary.

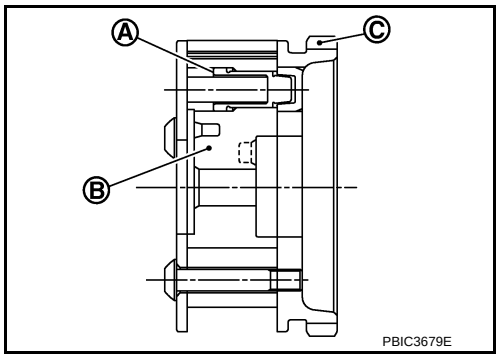


10. Turn the camshaft sprocket (INT) to the most advanced position.

CAUTION:

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position for the following reasons, so check that you follow the procedure exactly.

- **The sprocket (C) and vane (camshaft coupling) (B) are designed to spin and move within the range of a certain angle.**
- **With the engine stopped and the vane in the most retarded angle, it will not spin because it is locked to the sprocket side by the internal lock pin (A).**
- **If the camshaft sprocket mounting bolts are turned in the situation described above, the lock pin will become damaged and cause malfunctions because of the increased horizontal load (cutting force) on the lock pin.**

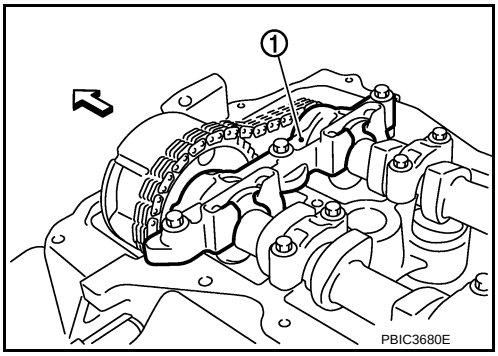


- Put the camshaft sprocket (INT) in the most advance position with the following procedure.

a. Remove camshaft bracket (No. 1) (1).

⇦ : Engine front

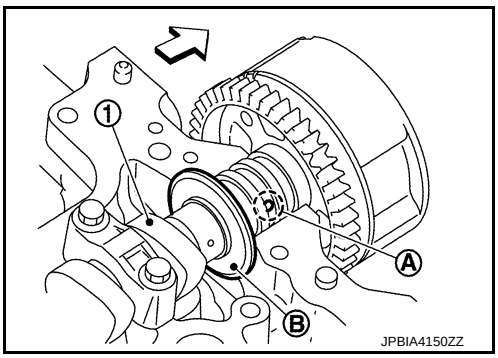
- Loosen the bolts in several steps, and then remove them.



b. Apply the following air pressure to the No. 1 journal oil hole (A) of camshaft (INT) (1) shown in the figure using an air gun.

Pressure : 300 kPa (3.0 bar, 3.1 kg/cm^2, 44psi) or more

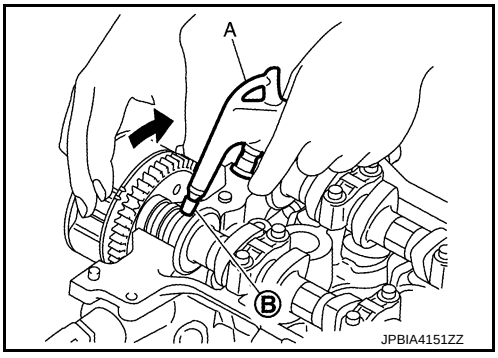
- Apply the air pressure into the oil hole on the second groove from the front of camshaft thrust (B).
- Proceed all the way through step “e” with the air pressure on.



- Attach the rubber nozzle (B) narrowed to the top of the air gun (A) to prevent air leakage from the oil hole. Securely apply the air pressure to the oil hole.

CAUTION:

- **There are other oil holes in the side grooves. Never use the incorrect oil holes.**
- **Be sure not to damage the oil path with the tip of the air gun.**
- **Wipe all the oil off the air gun to prevent oil from being blown all over along with the air, and the area around the air gun should be wiped with a rag when applying air pressure. Eye protection should be worn as needed.**

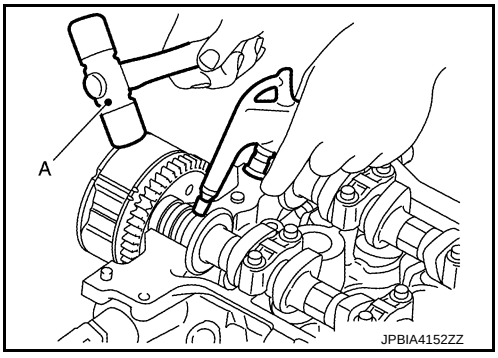


NOTE:

The air pressure is used to move the lock pin into the disengage position.

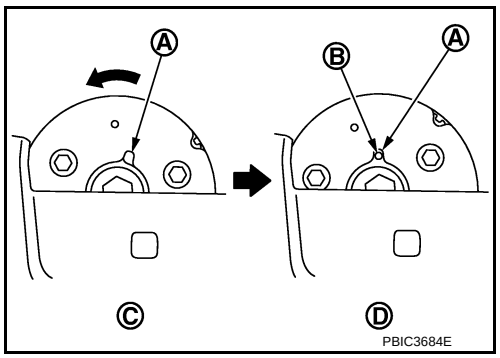
c. Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternatively.

- Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (⬅)].
- Perform the work while applying the air pressure to the oil hole.
- If the lock pin is not released by hands, tap the camshaft sprocket (INT) lightly with a plastic hammer (A).
- If the camshaft sprocket (INT) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.



d. While doing the above, once you hear a click (the sound of the internal lock pin disengaging) from inside the camshaft sprocket (INT), start turning the camshaft sprocket (INT) in the counter-clockwise direction in the most advanced angle position.

C : Lock pin engaged
D : Most advanced angle



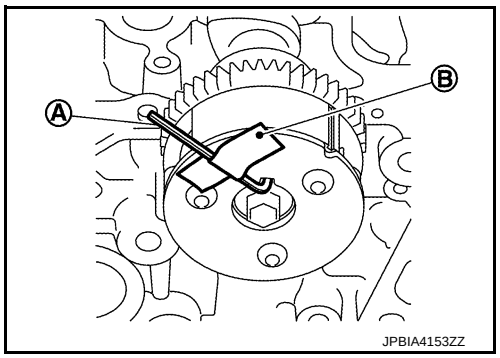
PBIC3684E

- Keep the air pressure on.
- If there is no click, as soon as the vane-side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.
- Check that it is in the most advanced angle position by seeing if the stopper pin groove (A) and the stopper pin hole (B) are matched up as shown in the figure.

e. Complete the applying procedure of air pressure and the holding procedure of camshaft (INT).

f. Insert the stopper pin (A) into the stopper pin holes in the camshaft sprocket (INT) and lock in the most advanced angle position.

CAUTION:
No load is exerted on the stopper pin (spring reaction, etc.). Since it comes out easily, secure it with tape (B) to prevent it from coming out.
NOTE:
The stopper pin in the figure shows one example of a hexagonal wrench for 2.5 mm (0.098 in) [length of inserted section: approximately15 mm (0.59 in)].

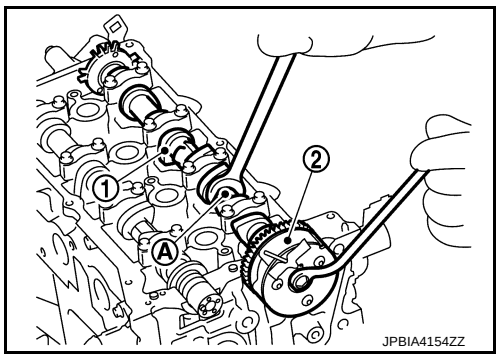


JPBIA4153ZZ

11. Remove the camshaft sprocket (INT) with the following procedure.

a. Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

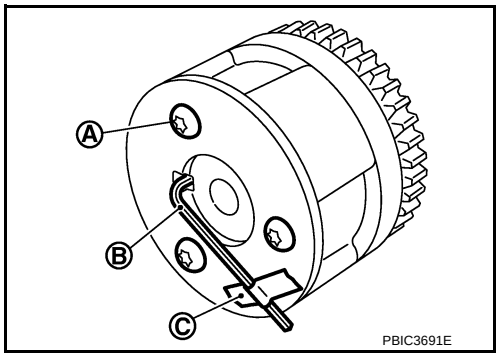
1. Camshaft (INT)



JPBIA4154ZZ

CAUTION:
- **Never drop stopper pin.**
- **Tape (C) the stopper pin (B) so it does not come out.**
- **Never subject it to impact by dropping.**
- **Never disassemble. [Never loosen the three mounting bolts (A)].**

NOTE:
While removing the camshaft sprocket (INT), if you have taken out the stopper pin and the lock pin has been rejoined in the most retarded angle, do the following to restore it.



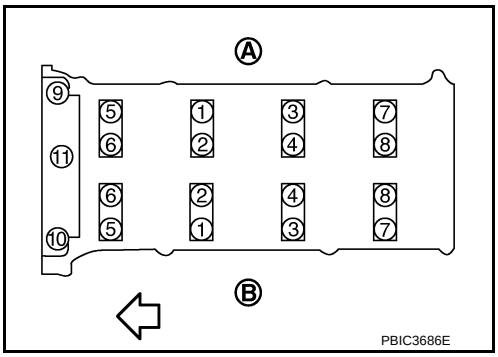
PBIC3691E

i. Install the camshaft (INT) and tighten the mounting bolts enough to prevent air from leaking out.

CAUTION:
The internal lock pin will get damaged, so keep the torque on the mounting bolts to the minimum required to prevent air from escaping.

ii. Apply the air pressure, disengage the lock pin, and turn the vane to the most advanced angle position.
iii. Insert the stopper pin.
iv. Remove camshaft sprocket (INT) from the camshaft.

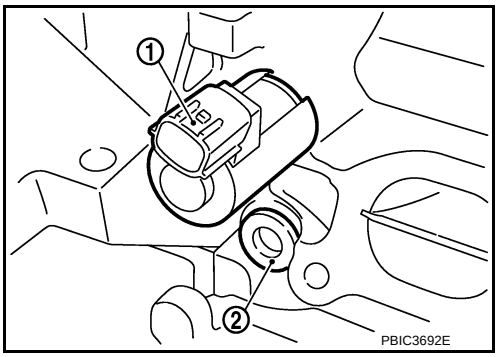
12. Remove camshaft brackets (No. 2 to 5).
    - Loosen bolts in several steps in the reverse of the order as shown in the figure.



A : EXH side
B : INT side
⇦ : Engine front

NOTE:
The camshaft bracket (No. 1) has been already removed.

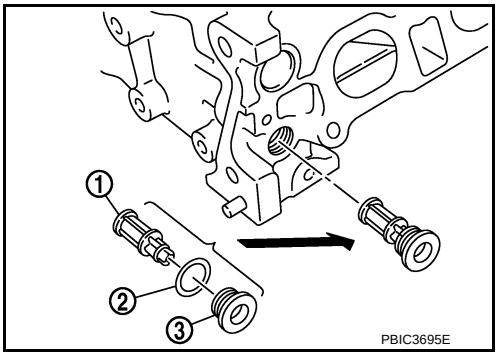
13. Remove camshaft (EXH).
14. Remove camshaft (INT).
15. Remove valve lifter.
    - Identify installation positions, and store them without mixing them up.
16. Remove intake valve timing control solenoid valve (1).
17. Remove the alternator and bracket, remove the plug (2), and then remove the oil filter. Refer to CHG-26, "HR16DE : Exploded View".



18. Remove exhaust valve timing control solenoid valve.
19. Remove the plug on the exhaust valve timing control solenoid valve and the oil filter.Refer to EM-191, "Exploded View".

INSTALLATION

1. Install oil filter (1) (for intake and exhaust valve timing control solenoid valves)
   NOTE:
   The figure shows the intake side as an example.



2 : Washer

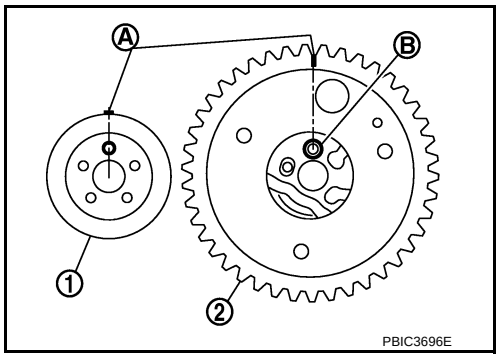
   - The oil filter is assembled to the plug (3), and then install it to the cylinder head.

2. Install intake and exhaust valve timing controlsolenoid valves.
   - Insert it straightly into the cylinder head.
   - Tighten bolts after placing it completely.

3. Install valve lifter.
   - If it is reused, install in its original positions.
4. Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT) with the following procedure.
   NOTE:

It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (INT).

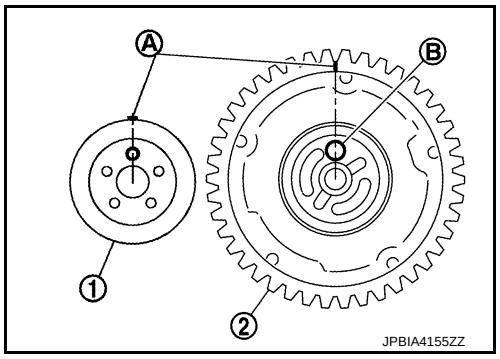
a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.
   • Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)
b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (INT) (2). (The figure shows an example.)
   • Put the marks on the visible position with it installed to the camshaft.



5. Put a matching mark for positioning the camshaft (EXH) and the camshaft sprocket (EXH) with the following procedure.

NOTE:
It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (EXH).

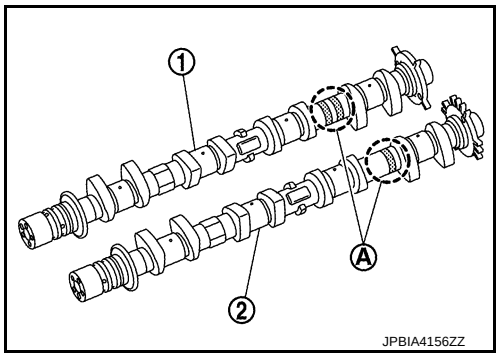
a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (EXH) (1) front surface.
   • Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)
b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (EXH) (2). (The figure shows an example.)
   • Put the marks on the visible position with it installed to the camshaft.



6. Install camshaft.

1 : Camshaft (EXH)
2 : Camshaft (INT)
A : Identification mark

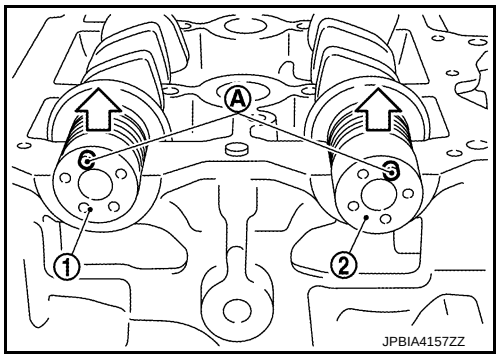
• Distinction between camshaft (INT and EXH) is performed with the different shapes of rear end.



• Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown in the figure.

1 : Camshaft (EXH)
2 : Camshaft (INT)
⇦ : Upper side

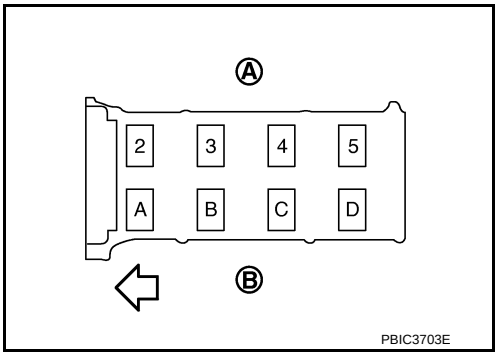
NOTE:
Though camshaft does not stop at the portion as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.



7. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown in the figure.

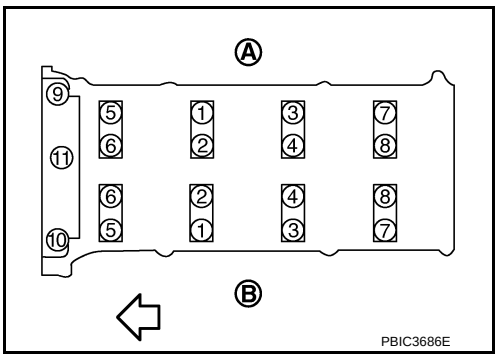
A : EXH side
B : INT side
⇦ : Engine front

- Install so that identification mark can be correctly read when viewed from the INT side.



8. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

A : EXH side
B : INT side
⇦ : Engine front



a. Tighten No. 9 to 11 in numerical order.

: 2.0 N·m (0.2 kg-m, 1 ft-lb)

b. Tighten No. 1 to 8 in numerical order.

: 2.0 N·m (0.2 kg-m, 1 ft-lb)

c. Tighten all bolts in numerical order.

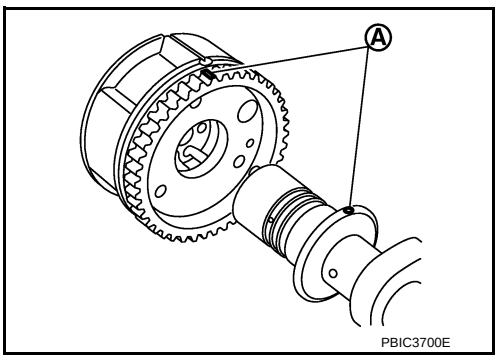
: 5.9 N·m (0.6 kg-m, 4 ft-lb)

d. Tighten all bolts in numerical order.

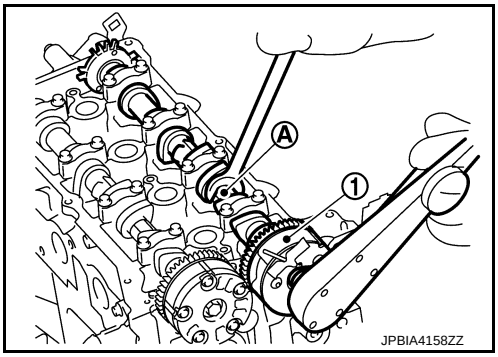
: 10.4 N·m (1.1 kg-m, 8 ft-lb)

9. Install the camshaft sprocket (INT and EXH) to the camshaft (INT and EXH) with the following procedure.

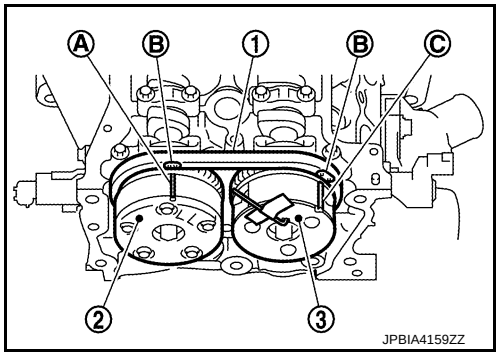
a. Refer to the matching mark (A) put according to step “4”. Securely align the knock pin and the pin hole, and then install them.
NOTE:
The figure shows the intake side as an example.



10. Tighten the camshaft sprocket mounting bolt (INT and EXH).
CAUTION:
Hold the camshaft hexagonal part (A), and then secure the camshaft.



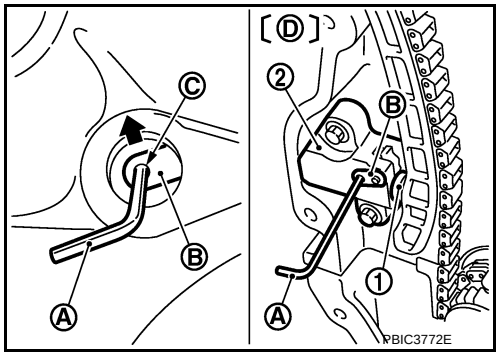
11. Install the camshaft (INT and EXH) to the camshaft sprocket (INT and EXH) (2 and 3) while aligning the matching mark (marked when timing chain is removed) (A) and the matching mark (stamp) (B) of camshaft sprocket (INT and EXH).



1 : Timing chain
C : Matching mark (peripheral stamp line)

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.

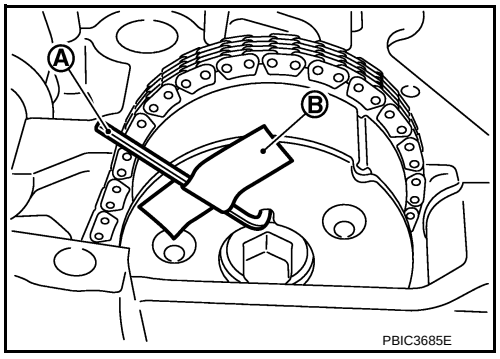
12. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.



1 : Plunger
2 : Chain tensioner
B : Lever
C : Lever hole
D : Front cover has been omitted

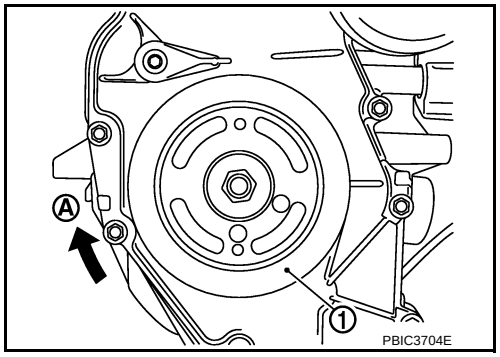
13. Pull out the stopper pin of chain tensioner.
14. Install front cover.
15. Return the camshaft sprocket (INT) in the most retarded position with the following procedure.

a. Remove the stopper pin (A) from the camshaft sprocket (INT).

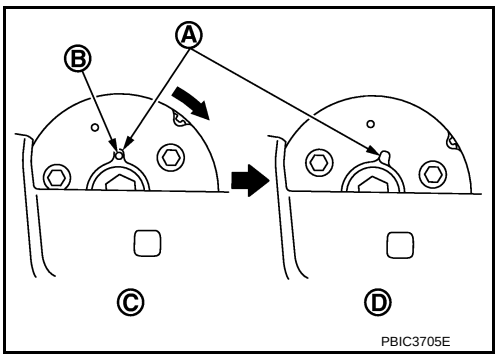


B : Tape

b. Turn the crankshaft pulley (1) slowly clockwise (A) and return the camshaft sprocket (INT) to the most retarded angle position.



- When first turning the crankshaft the camshaft sprocket (INT) will turn. Once it is turned more, and the vane (camshaft) also turns, then it has reached the most retarded angle position.



B : Stopper pin hole
C : Most advanced angle
D : Lock pin engaged

- The most retarded angle position can be checked by seeing if the stopper pin groove (A) is shifted clockwise.
- After spinning the crankshaft slightly in the counterclockwise direction, you can check the lock pin has joined by seeing if the vane (camshaft) and the sprocket move together.

16. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.
    - Tighten bolts with it seated completely.
17. Check and adjust valve clearance. Refer to EM-148, "Inspection and Adjustment".
18. Install in the reverse order of removal.

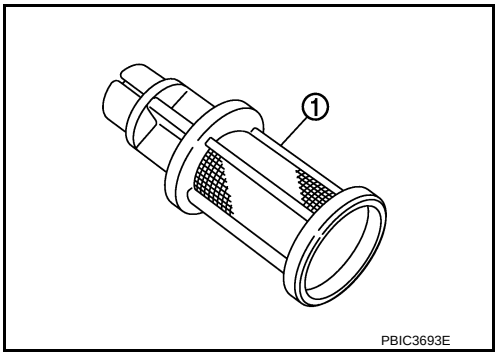
Inspection

INFOID:0000000006449918

INSPECTION AFTER REMOVAL

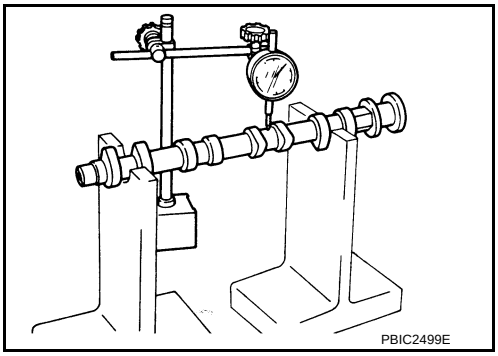
Oil Filter

- Check that there is no foreign material on the oil filter (1) and check it for clogging.
- Check the oil filter for damage.
- If there is some damage, replace the oil filter, the plug, and the washer as a set.



Camshaft Runout

1. Put V-block on a 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. Set a dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on the dial indicator. (Total indicator reading)



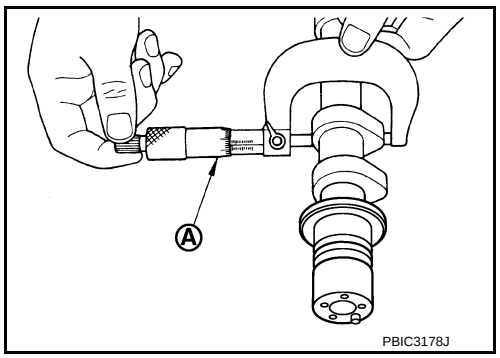
Standard and Limit

: Refer to EM-251, "Camshaft".

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

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



Standard and Limit

Intake
Exhaust **: Refer to EM-251, "Camshaft".**

Cam wear limit:

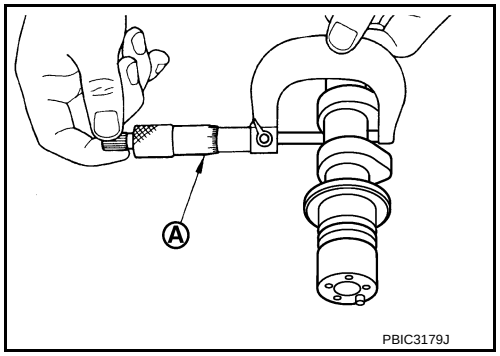
: Refer to EM-251, "Camshaft".

2. If wear exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

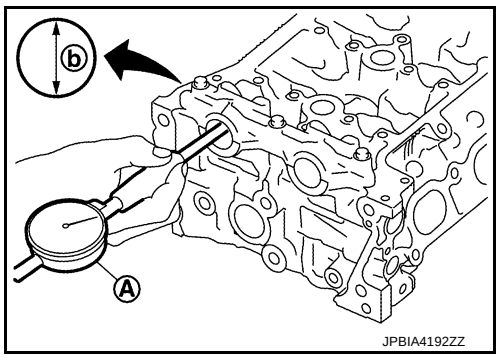
Measure the outer diameter of camshaft journal with a micrometer (A).



Standard: : Refer to EM-251, "Camshaft".

CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).



Standard : Refer to EM-251, "Camshaft".

CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard and Limit : Refer to EM-251, "Camshaft".

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

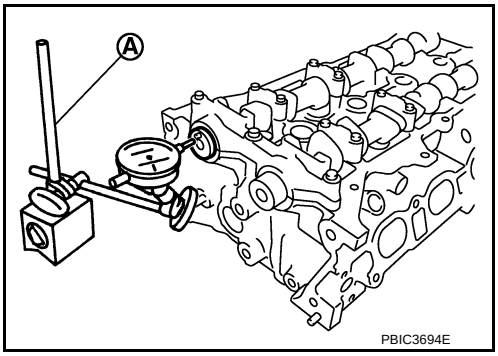
NOTE:
Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to EM-191, "Removal and Installation" for tightening procedure.

2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

Standard and Limit : Refer to EM-251, "Camshaft".



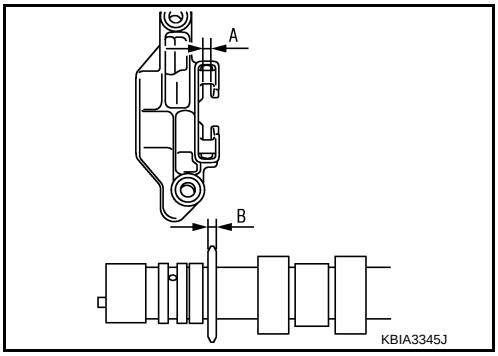
- Measure the following parts if out of the standard.
- Dimension “A” for cylinder head No. 1 journal bearing

Standard : 4.000 - 4.030 mm (0.1574 - 0.1586 in)

- Dimension “B” for camshaft thrust

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

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

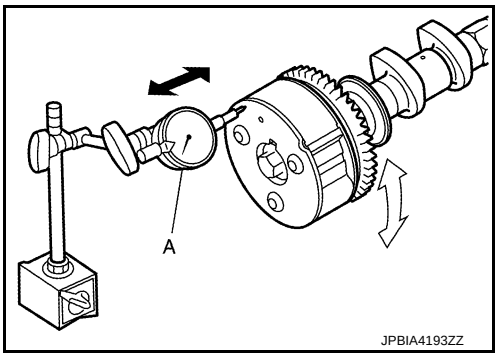


Camshaft Sprocket Runout

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

Limit : 0.15 mm (0.0059 in)

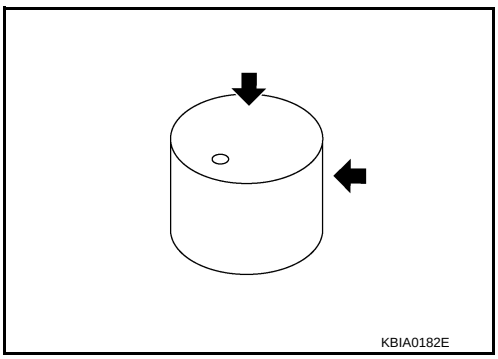
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-251, "Camshaft".

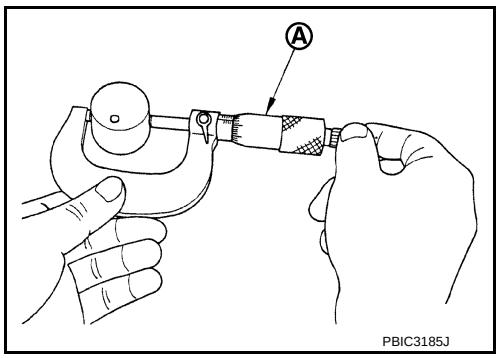


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

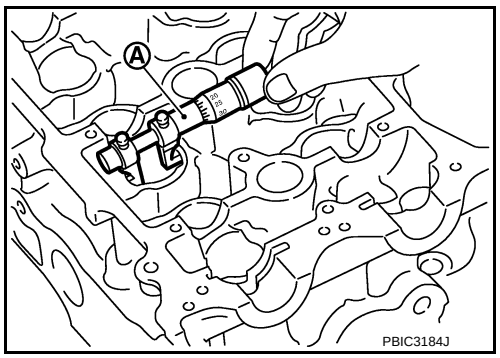
Standard : Refer to EM-251, "Camshaft".



VALVE LIFTER HOLE DIAMETER

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

Standard : Refer to EM-251, "Camshaft".



VALVE LIFTER CLEARANCE

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

Standard : Refer to EM-251, "Camshaft".

- 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.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

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 MA-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

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 check 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:

Items	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 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-571, "Diagnosis Procedure".**
- **Check when engine is cold so as to prevent burns from the splashing engine oil.**

NOTE:

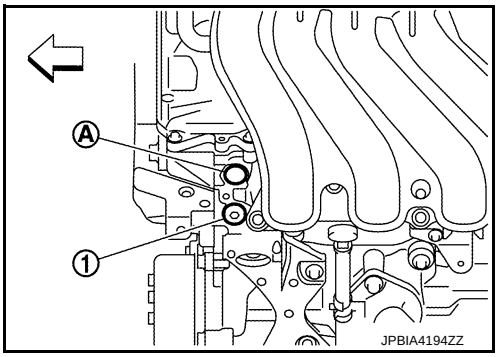
This section provides the inspection method of oil passage of cam sprocket on the intake side. For oil passage on the exhaust side, the inspection procedure must be changed as instructed below:

· Stap 3	: Remove exhaust valve timing control solenoid valve. Refer to EM-191, "Exploded View".
· Step 4	: Crank engine, and then check that engine oil comes out from exhaust valve timing control solenoid valve hole (A). End crank after checking.
·Step 5	Perform the following inspection if engine oil does not come out from exhaust valve timing control solenoid valve oil hole of the cylinder head. • Remove oil filter, and then clean it. Refer to EM-236, "Inspection". • Clean oil groove between oil strainer and exhaust valve timing control solenoid valve. Refer to LU-23, "Engine Lubrication System".
·Step 6	: Remove components between exhaust valve timing control solenoid valve and camshaft sprocket (EXH), and then check each oil groove for clogging.

1. Check engine oil level. Refer to LU-25, "Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release the fuel pressure. Refer to EC-551, "Work Procedure".
b. Remove intake manifold. Refer to EM-163, "Exploded View".
c. Disconnect ignition coil and injector harness connectors. Refer to EM-178, "Exploded View".

3. Remove intake valve timing control solenoid valve. Refer to EM-191, "Exploded View".
4. Crank engine, and then check that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.



1 : Plug
⇦ :Engine front

WARNING:

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

CAUTION:

- **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.**

5. 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, and then clean it. Refer to EM-236, "Inspection".
   - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to LU-23, "Engine Lubrication System".
6. 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-23, "Engine Lubrication System".
7. After inspection, install removed parts in the reverse order.

OIL SEAL

VALVE OIL SEAL

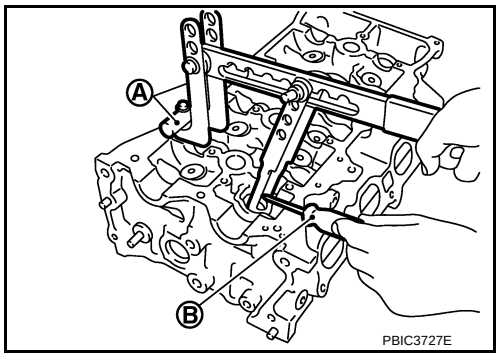
VALVE OIL SEAL : Removal and Installation

INFOID:0000000006449919

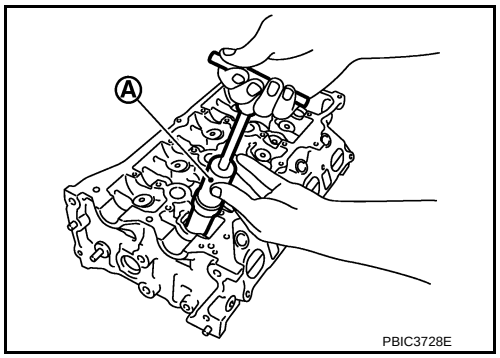
REMOVAL

1. Remove camshafts. Refer to EM-191, "Exploded View".
2. Remove valve lifters. Refer to EM-191, "Exploded View".
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 with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Remove valve collet with magnet hand.

   CAUTION:
   Be careful not to damage valve lifter holes.



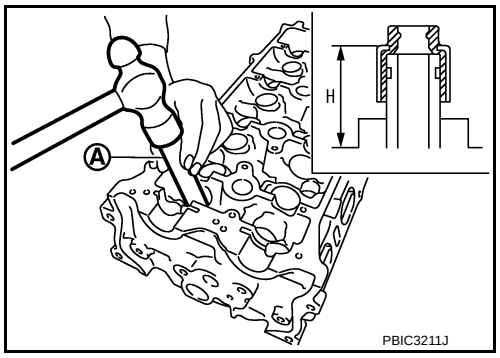
5. Remove valve spring retainer and valve spring (with valve spring seat).
   CAUTION:
   Never remove valve spring seat from valve spring.
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



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 in the figure with the valve oil seal drift [SST: KV10115600] (A).

   Height (H) : 13.2 - 13.8 mm (0.520 - 0.543 in)



3. Install in the reverse order of removal, for the rest of parts.

FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:0000000006449920

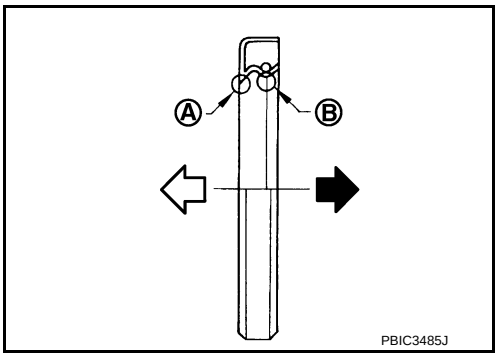
REMOVAL

1. Remove the following parts.
   - Remove fillet mold : Refer to EXT-26, "Exploded View"
   - Front fender protector (RH): Refer to EXT-22, "Exploded View".
   - Drive belt: Refer to EM-155, "Removal and Installation".
   - Crankshaft pulley: Refer to EM-181, "Exploded View".
2. Remove front oil seal with 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 in the figure.

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



   - Press-fit front oil seal using a suitable drift with outer diameter 50 mm (1.97 in) and inner diameter 44 mm (1.73 in).
     CAUTION:
     - **Be careful not to damage front cover and crankshaft.**
     - **Press-fit oil seal straight to avoid causing burrs or tilting.**
3. Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:0000000006449921

REMOVAL

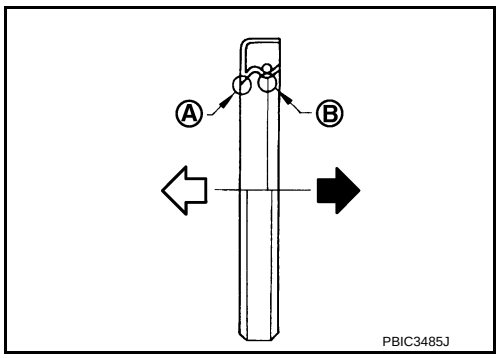
1. Remove transaxle assembly. Refer to TM-30, "Exploded View" (M/T models), TM-508, "Exploded View" (CVT models).
2. Remove clutch cover and clutch disk (M/T models). Refer to CL-29, "EXCEPT FOR K9K : Exploded View".
3. Remove flywheel (M/T models) or drive plate (CVT models). Refer to EM-227, "Exploded View".
4. Remove rear oil seal with a suitable tool.
   CAUTION:
   Be careful not to damage crankshaft and cylinder block.

INSTALLATION

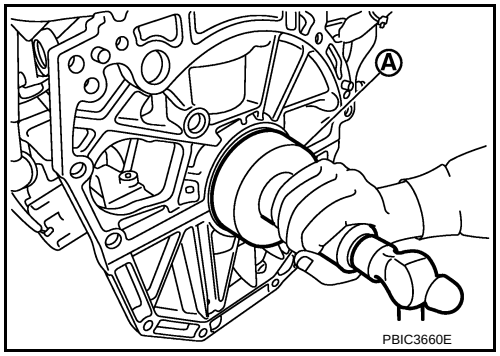
1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
   Use Genuine Liquid Gasket or equivalent.

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

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

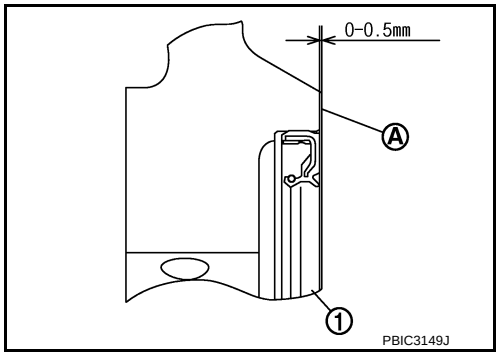


- Press-fit rear oil seal with a suitable drift (A) outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in).
  CAUTION:
  - **Be careful not to damage crankshaft and cylinder block.**
  - **Press-fit oil seal straight to avoid causing burrs or tilting.**
  - **Never touch grease applied onto oil seal lip.**



- Press in rear oil seal (1) to the position as shown in the figure.

A : Rear end surface of cylinder block
b : 0 - 0.5 mm (0 - 0.020 in)



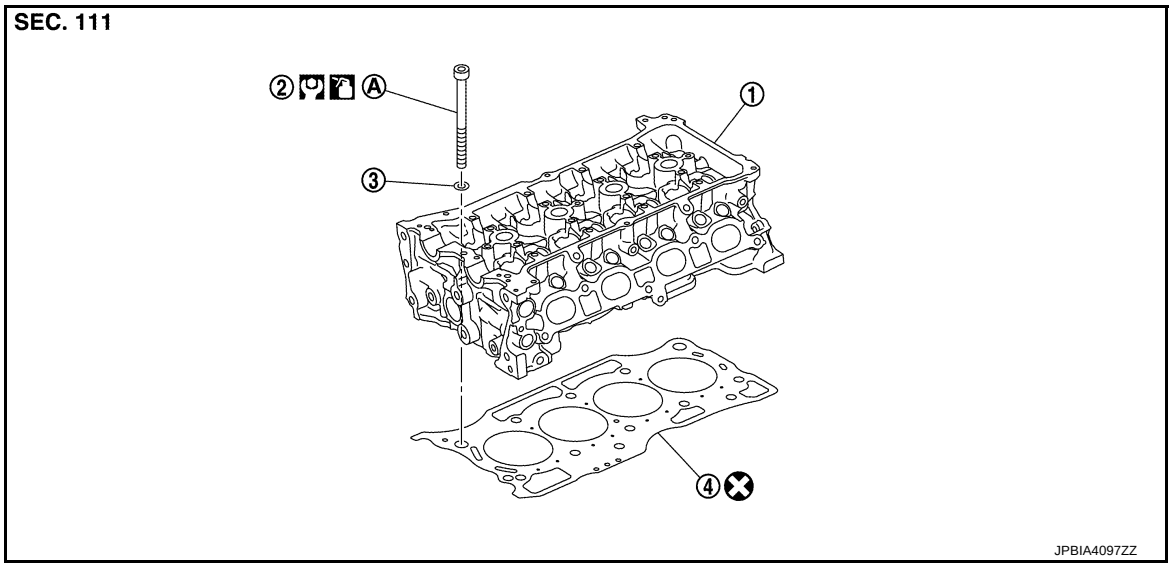
3. Install in the reverse order of removal, for the rest of parts.

CYLINDER HEAD

Exploded View

INFOID:0000000006449922

REMOVAL



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

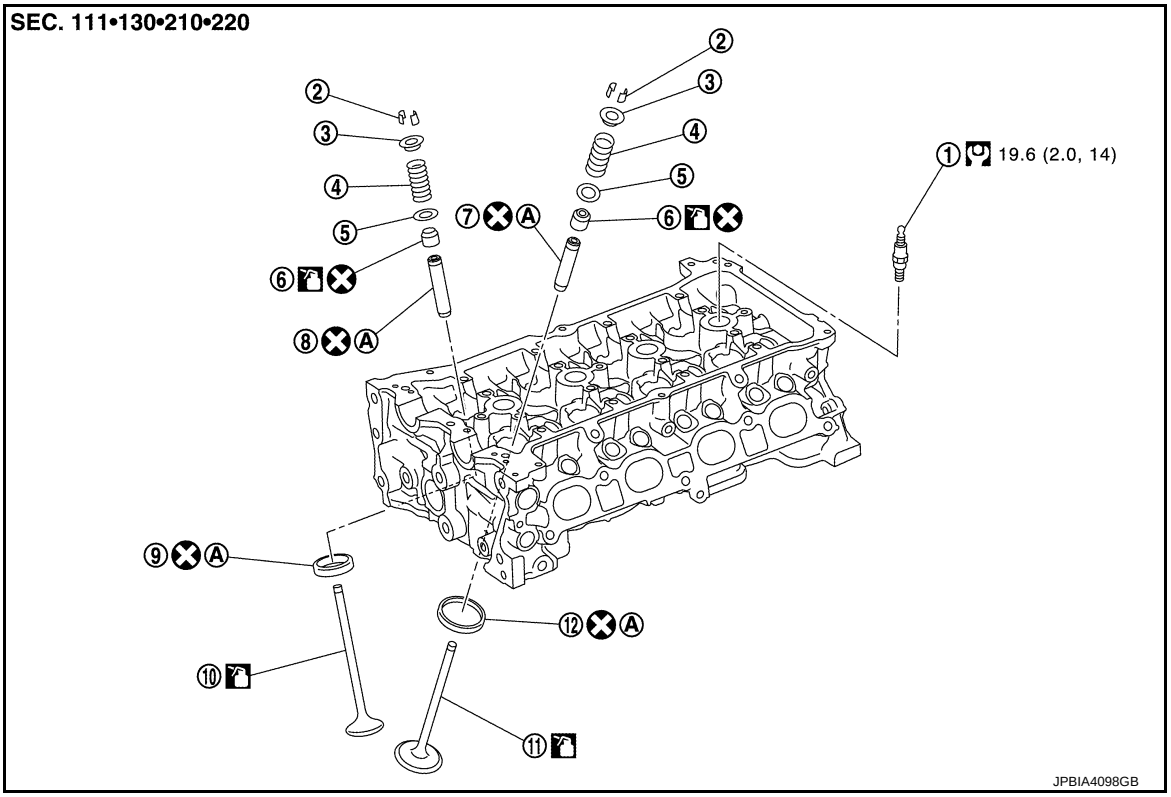
A. Tightening must be done following the installation procedure. Refer to EM-209

: Always replace after every disassembly.

: N·m (kg-m, ft-lb)

: Should be lubricated with oil.

DISASSEMBLY



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

A. Replacement must be following the disassembly and assembly procedure. Refer to EM-211

: Always replace after every disassembly.

: N·m (kg-m, ft-lb)

: Should be lubricated with oil.

Removal and Installation

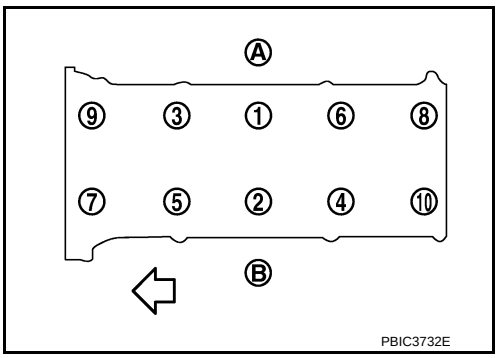
INFOID:0000000006449923

REMOVAL

1. Release fuel pressure. Refer to EC-551, "Work Procedure".
2. Drain engine coolant and engine oil. Refer to CO-11, "Draining" and LU-26, "Draining".
   CAUTION:
   Perform this step when the engine is cold.
3. Remove the following components and related parts.
   - Front road wheel and tire (RH): Refer to WT-7, "Exploded View".
   - Fillet mold: Refer to EXT-26, "Exploded View"
   - Front fender protector (RH): Refer to EXT-22, "Exploded View".
   - Drive belt: Refer to EM-155, "Removal and Installation".
   - Air duct: Refer to EM-161, "Exploded View".
   - Intake manifold: Refer to EM-163, "Exploded View".
   - Fuel tube and fuel injector: Refer to EM-173, "Exploded View".
   - Water outlet: Refer to CO-26, "Exploded View".
   - Exhaust manifold: Refer to EM-166, "Exploded View".
   - Rocker cover: Refer to EM-178, "Exploded View".
   - Front cover and timing chain: Refer to EM-181, "Exploded View".
   - Camshaft: Refer to EM-191, "Exploded View".

4. Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

A : EXH side
B : INT side
⇦ : Engine front

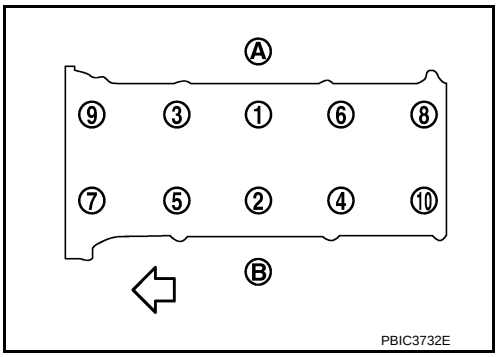


5. Remove cylinder head gasket.

INSTALLATION

1. Install new cylinder head gasket.
2. Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.

A : EXH side
B : INT side
⇦ : Engine front



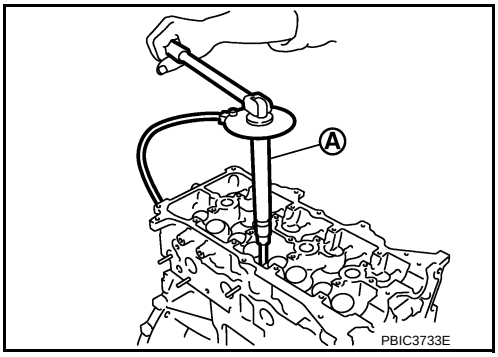
CAUTION:
If cylinder head bolts are reused, check their outer diameters before installation. Refer to "Cylinder Head Bolts Outer Diameter".

a. Apply new engine oil to threads and seating surfaces of mounting bolts.
b. Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

c. Turn all bolts 60 degrees clockwise (angle tightening).

CAUTION:
Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



d. Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:
In this step, loosen bolts in reverse order of that indicated in the figure.

e. Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

f. Turn all bolts 75 degrees clockwise (angle tightening).
g. Turn all bolts 75 degrees clockwise again (angle tightening).

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

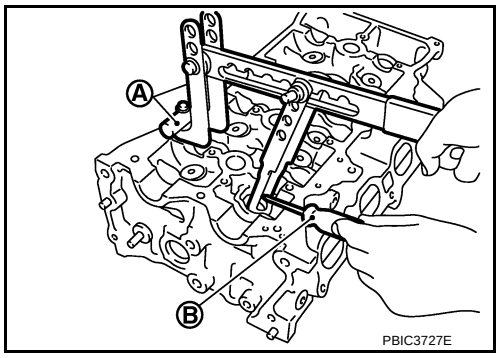
Disassembly and Assembly

INFOID:0000000006449924

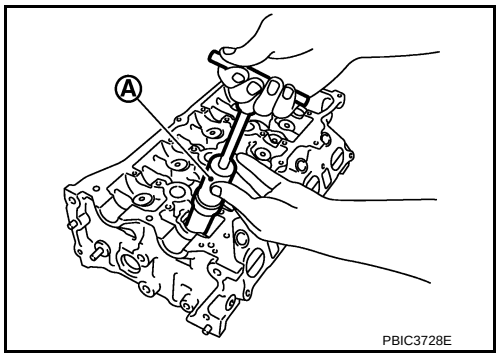
DISASSEMBLY

1. Remove spark plug with a spark plug wrench (commercial service tool).
2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
   - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand (B).

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



4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
   - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).

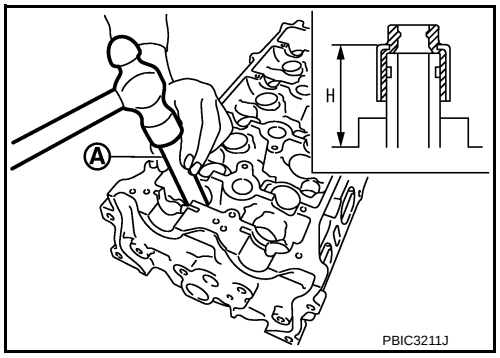


7. Remove valve spring seat.
8. When valve seat must be replaced, refer to EM-212, "Inspection" to removal.
9. When valve guide must be replaced, refer to EM-212, "Inspection" to removal.

ASSEMBLY

1. Install valve guide if removed. Refer to EM-212, "Inspection".
2. Install valve seat if removed. Refer to EM-212, "Inspection".
3. Install valve oil seal.
   - Install with the valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.

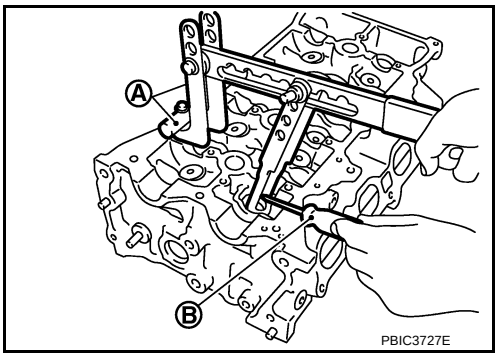
   Height “H” : 13.2 - 13.8 mm (0.519 - 0.543 in)



4. Install valve spring seat.
5. Install valve.

- Install larger diameter to intake side.

6. Install valve spring.
   NOTE:
   It can be installed in either direction.
7. Install valve spring retainer.
8. Install valve collet.
   - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Install valve collet with a magnet hand (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.



9. Install valve lifter.
10. Install spark plug with a spark plug wrench (commercial service tool).

Inspection

INFOID:0000000006449925

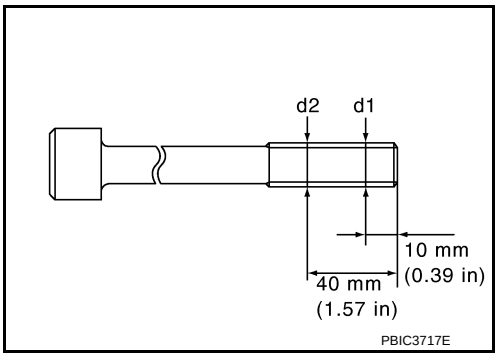
INSPECTION AFTER REMOVAL

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

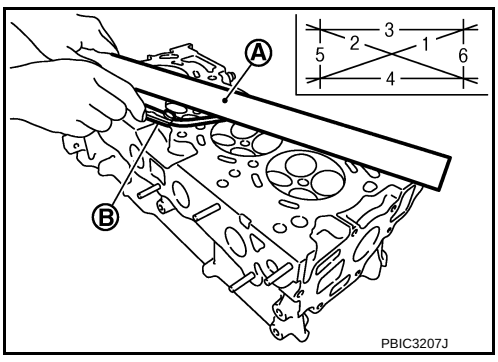
NOTE:
When performing this inspection, cylinder block distortion should be also checking. Refer to EM-236, "Inspection".

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

   A : Straightedge
   B : Feeler gauge

   Limit : Refer to EM-253, "Cylinder head".

   - If it exceeds the limit, replace cylinder head.



INSPECTION AFTER DISASSEMBLY

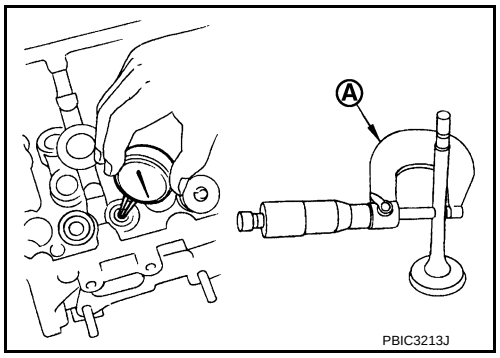
VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to EM-253, "Cylinder head".
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to “VALVE SEAT CONTACT”.

VALVE GUIDE CLEARANCE

Valve Stem Diameter

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



Standard : Refer to EM-253, "Cylinder head".

Valve Guide Inner Diameter

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

Standard : Refer to EM-253, "Cylinder head".

Valve Guide Clearance

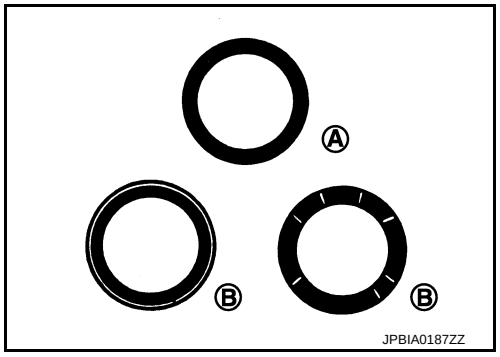
- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

Standard and Limit : Refer to EM-253, "Cylinder head".

- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to EM-211, "Disassembly and Assembly".

VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the 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.

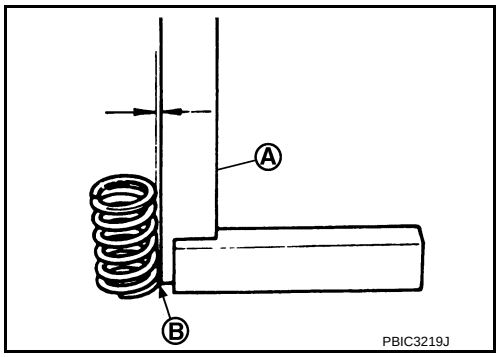


A : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has “NG” conditions (B) even after the recheck, replace valve seat. Refer to EM-211, "Disassembly and Assembly".

VALVE SPRING SQUARENESS

- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance between the top of spring and try square.



B : Contact

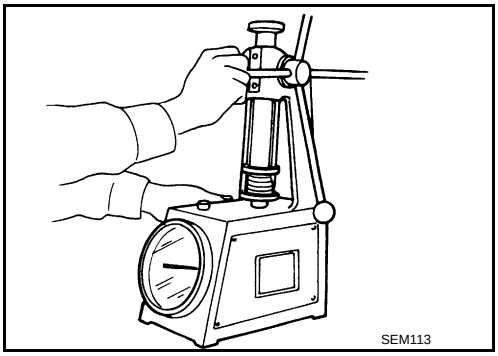
Limit : Refer to EM-253, "Cylinder head".

- If it exceeds the limit, replace valve spring.

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 : Refer to EM-253, "Cylinder head".



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

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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
  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 check 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:

Items	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	—

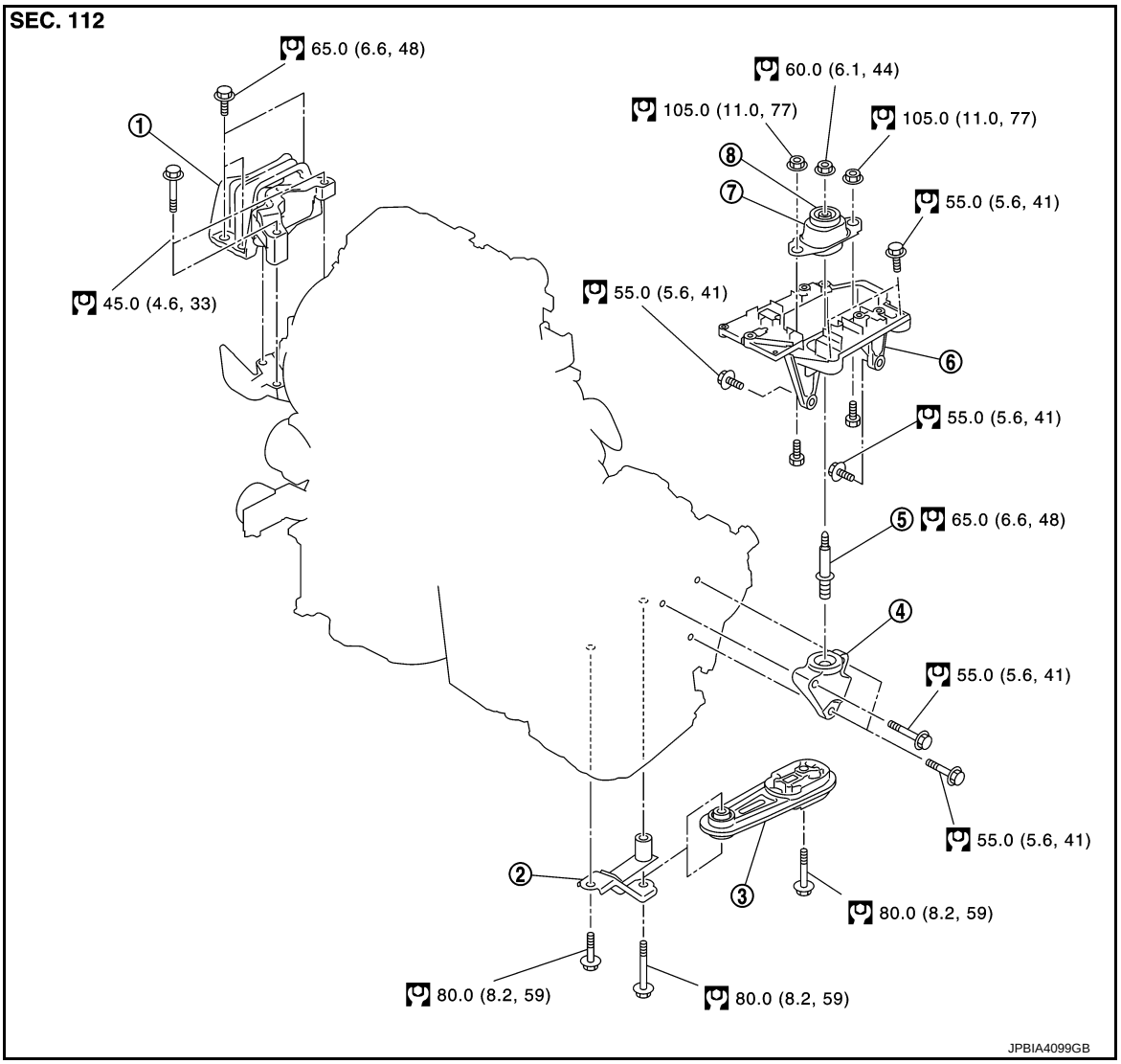
*: Transmission/transaxle fluid, power steering fluid, brake fluid, etc.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:0000000006449926



1. Engine mounting assembly (RH)
2. Rear engine mounting bracket
3. Rear torque rod
4. Engine mounting bracket (LH)
5. Stud bolt
6. Engine mounting bracket (LH)
7. Engine mounting insulator (LH)
8. Mass damper

: N·m (kg-m, ft-lb)

CAUTION:
Check that the stud bolt (*2) is tight at the specified torque before tightening the mounting nut (*1) shown in the figure. [Stud bolt (*2) may be loosened after loosening the mounting nut (*1)]

Removal and Installation

INFOID:0000000006449927

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.**
- **Never start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine section, refer to the applicable sections.**
- **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-36, "Garage Jack and Safety Stand and 2-Pole Lift".**

REMOVAL

Outline

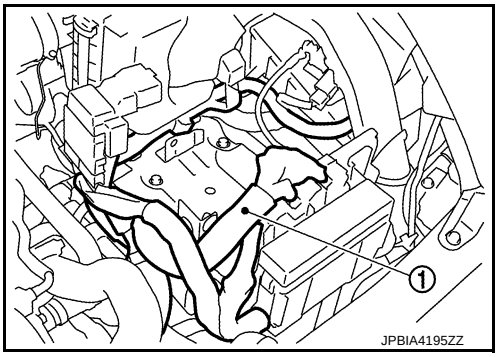
Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. Release fuel pressure. Refer to EC-551, "Work Procedure".
2. Drain engine coolant from radiator. Refer to CO-11, "Draining".
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Never spill engine coolant on drive belts.**
3. Remove the following parts.
   - Engine undercover
   - Front road wheels and tires (RH and LH)
   - Fillet mold: Refer to EXT-26, "Exploded View"
   - Front fender protector (RH and LH): Refer to EXT-22, "Exploded View".
   - Drive belt: Refer to EM-155, "Removal and Installation".
   - Battery and battery tray: Refer to PG-124, "Exploded View".
   - Air duct (inlet), air duct, and air cleaner case assembly: Refer to EM-161, "Removal and Installation".
   - Radiator hose (upper and lower): Refer to CO-17, "Exploded View".
   - Exhaust front tube: Refer to EX-12, "Exploded View".

Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.
   CAUTION:
   Protect connectors using a resin bag against foreign materials during the operation.



2. Disconnect heater hoses. Refer to CO-26, "Exploded View".
3. Disconnect fuel feed hose at engine side. Refer to EM-173, "Exploded View".
4. Disconnect control linkage cable from transaxle. Refer to TM-25, "Removal and Installation" (M/T models), TM-485, "Removal and Installation" (CVT models).
5. Disconnect clutch tube on transaxle side from clutch damper. Refer to CL-24, "Exploded View".

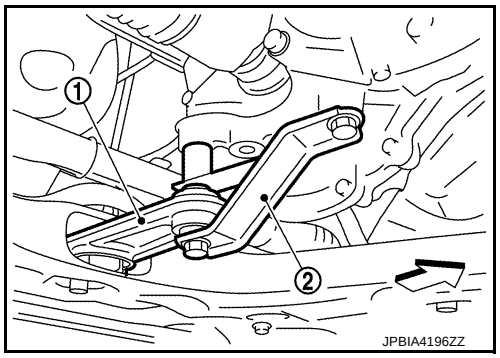
Engine Room RH

1. Remove alternator. Refer to CHG-26, "HR16DE : Exploded View".
2. Disconnect vacuum hose at engine side. Refer to EM-163, "Exploded View".
3. Remove EVAP hoses at engine side. Refer to EM-163, "Exploded View".
4. Remove air conditioner compressor from the engine with the piping connected. Temporarily fix the air conditioner compressor on the vehicle side with a rope without placing a heavy load on the piping.

Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove drive shafts (RH and LH). Refer to FAX-52, "Exploded View".
3. Remove rear torque rod (1).

2 : Rear engine mounting bracket
⇦ : Vehicle front



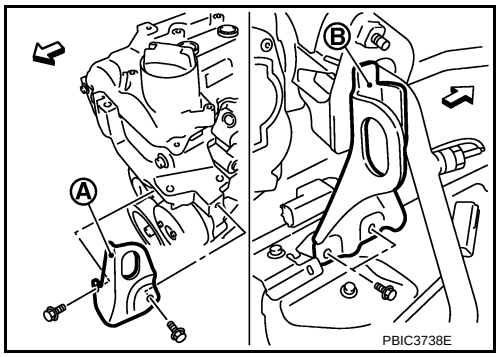
4. Preparation for the separation work of transaxle is as follows:
   • Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to EM-169, "Exploded View".

Removal

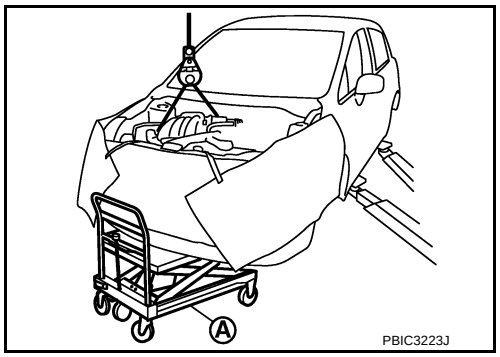
1. When engine can be hoisted, install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.

⇦ : Engine front

Slinger bolts **: 25.0 N·m (2.6 kg-m, 18 ft-lb)**



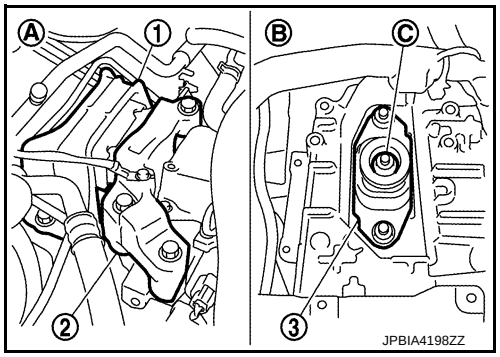
2. Use a manual lift table caddy (commercial service tool) (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.
CAUTION:
Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



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

3 : Engine mounting insulator
A : Engine front side
B : Transaxle side

4. Remove engine mounting through bolt-securing nut (C).



5. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.
CAUTION:
- **Check that no part interferes with the vehicle side.**
- **Before and during this lifting, always check if any harnesses are left connected.**

- **During the removal, 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.**

Separation

1. Remove starter motor. Refer to STR-21, "HR16DE : Exploded View".
2. Lift with a hoist and separate the engine from the transaxle assembly. Refer to TM-30, "Exploded View" (M/T models), TM-508, "Exploded View" (CVT models).

INSTALLATION

Note the following, and install in the reverse order of removal.

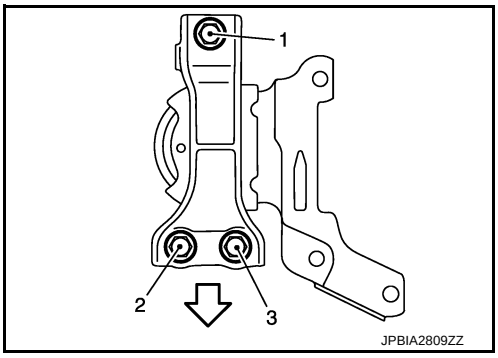
CAUTION:

- **Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.**
- **Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.**
- **When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to EM-215, "Exploded View".**

Engine Mounting Bracket (RH)

- Tighten mounting bolts in the numerical order as shown in the figure.

⇦ : Vehicle front



Inspection

INFOID:0000000006449928

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- 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-13, "Fluids and Lubricants".
- Use procedure below to check for fuel leakage.
- Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check 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:

Items	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.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

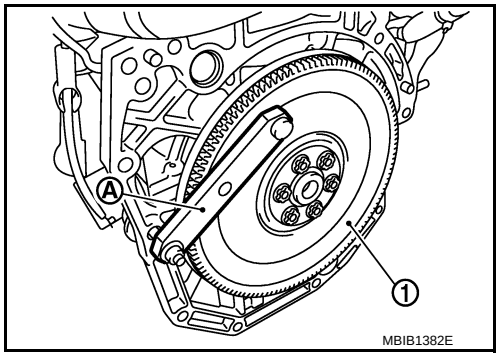
INFOID:0000000006449929

NOTE:
Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

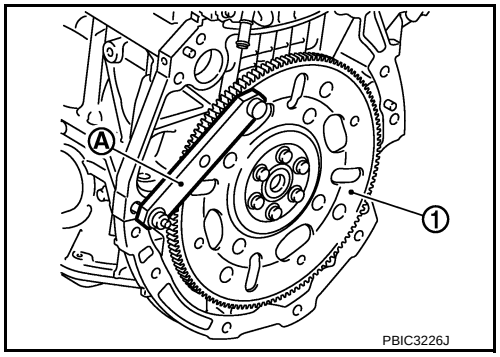
1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to EM-215, "Exploded View".
2. Install engine to engine stand with the following procedure:

a. Remove flywheel or drive plate.

- Secure flywheel (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts (M/T models).

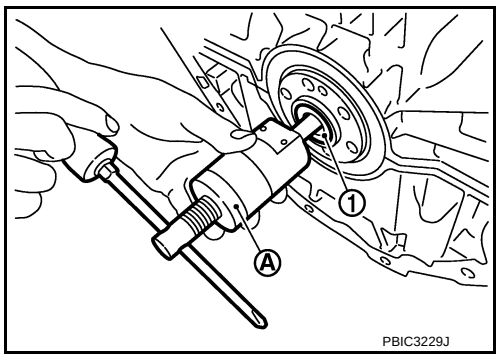


- Secure driveplate (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts (CVT models).



CAUTION:
- **Never disassemble them.**
- **Never place them with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch them.**
- **Handle signal plate in a manner that prevents them from becoming magnetized.**

b. Remove pilot converter (1) from the rear end of the crankshaft. Use a pilot bush puller [SST: ST16610000] (A), if necessary.



c. 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 150 kg (331 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.

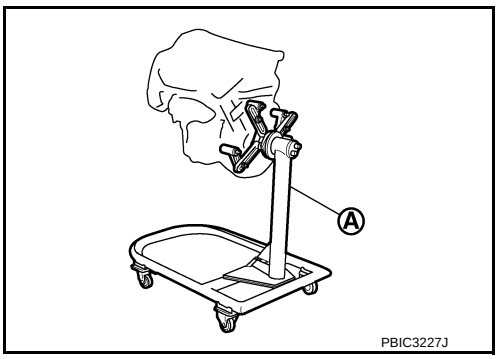
- Intake manifold: Refer to EM-163, "Exploded View".
- Exhaust manifold: Refer to EM-166, "Removal and Installation".
- Rocker cover: Refer to EM-178, "Exploded View".

NOTE:

The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel removed.

CAUTION:

Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.



3. Drain engine oil. Refer to LU-26, "Draining".

CAUTION:

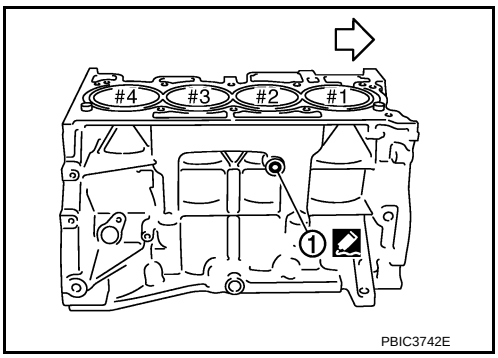
Be sure to clean drain plug and install with new drain plug washer.

4. Drain engine coolant by removing water drain plug (1) from inside of the engine.

⇦ : Engine front

Tightening torque : Refer to EM-227, "Exploded View".

Use Genuine Liquid Gasket or equivalent.



ENGINE UNIT

Disassembly

INFOID:0000000006449930

1. Remove intake manifold. Refer to EM-163, "Exploded View".
2. Remove exhaust manifold. Refer to EM-166, "Exploded View".
3. Remove oil pan (lower). Refer to EM-169, "Exploded View".
4. Remove ignition coil, spark plug, and rocker cover. Refer to EM-178, "Exploded View".
5. Remove fuel injector and fuel tube. Refer to EM-173, "Exploded View".
6. Remove front cover and timing chain. Refer to EM-181, "Exploded View".
7. Remove camshaft. Refer to EM-191, "Exploded View".
8. Remove cylinder head. Refer to EM-208, "Exploded View".

Assembly

INFOID:0000000006449931

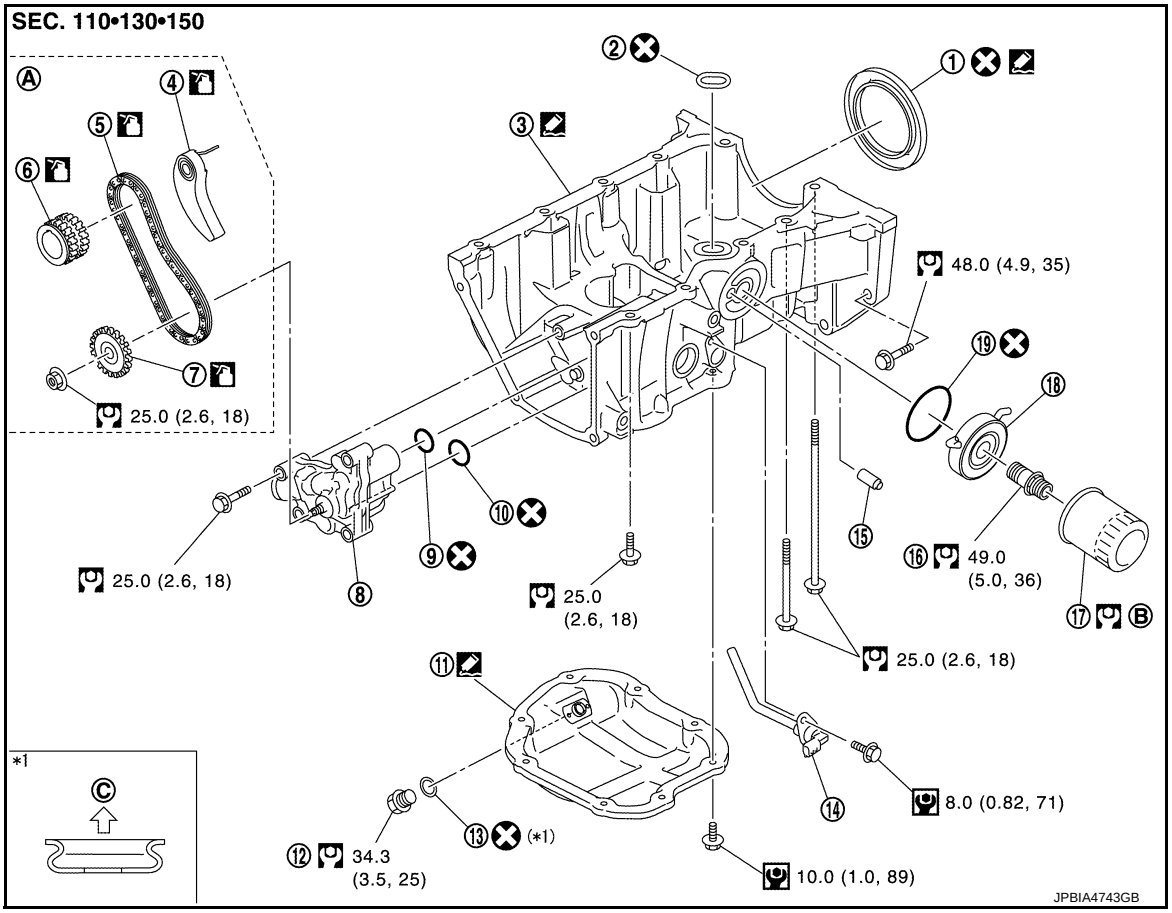
Assemble in the reverse order of disassembly.

OIL PAN (UPPER)

Exploded View

INFOID:0000000006449932

With Oil Cooler



1.	Rear oil seal	2.	O-ring	3.	Oil pan (upper)
4.	Oil pump chain tensioner (for oil pump drive chain)	5.	Oil pump drive chain	6.	Crankshaft sprocket
7.	Oil pump sprocket	8.	Oil pump	9.	O-ring
10.	O-ring	11.	Oil pan (lower)	12.	Oil pan drain plug
13.	Drain plug washer	14.	Oil level sensor	15.	Relief valve
16.	Connector bolt	17.	Oil filter	18.	Oil cooler
19.	O-ring				
A.	Refer to EM-182	B.	Refer to LU-28	C.	Oil pan (lower) side

: Always replace after every disassembly.

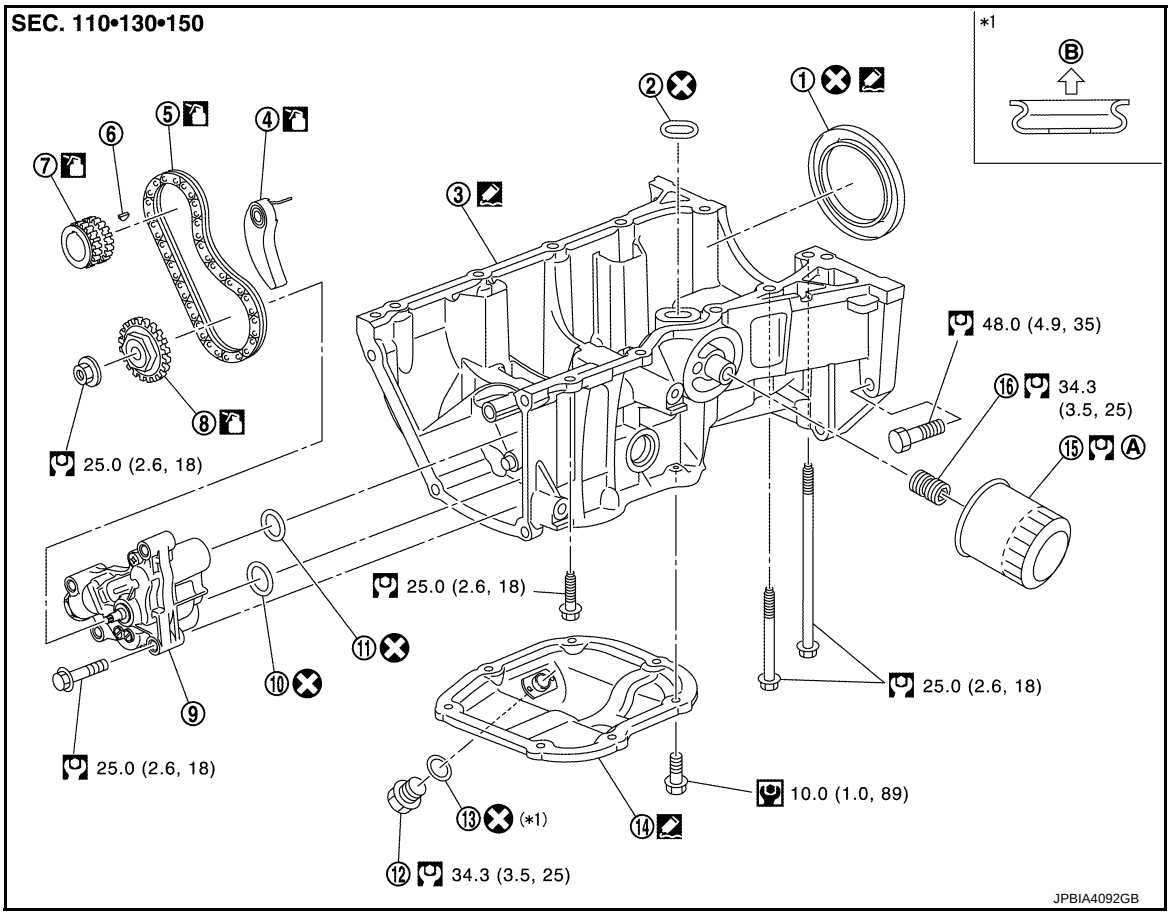
: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

With Out Oil Cooler



1.	Rear oil seal	2.	O-ring	3.	Oil pan (upper)
4.	Oil pump chain tensioner (for oil pump drive chain)	5.	Oil pump drive chain	6.	Crankshaft key
7.	Crankshaft sprocket	8.	Oil pump sprocket	9.	Oil pump
10.	O-ring	11.	O-ring	12.	Oil pan drain plug
13.	Drain plug washer	14.	Oil pan (lower)	15.	Oil filter
16.	Oil filter stud bolt				
A.	Refer to EM-182	B.	Refer to LU-28	C.	Oil pan (lower) side

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

Removal and Installation

INFOID:0000000006449933

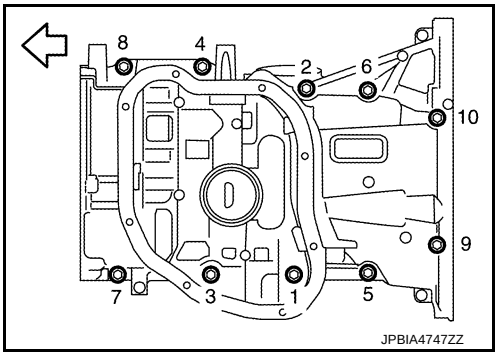
NOTE:
The oil strainer and oil pump are included in the oil pan (upper). Individual disassembly is prohibited.

REMOVAL

1. Remove the oil pan (lower). Refer to EM-169, "Exploded View".
2. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to EM-181, "Exploded View".
3. Remove oil pan (upper) with the following procedure.

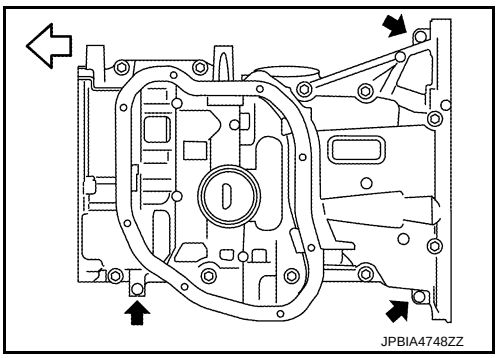
a. Loosen oil pan (upper) mounting bolts in the reverse of the order as shown in the figure.

⇦ : Engine front



b. Insert a flat-bladed offset screwdriver into the arrow (⬅) in the figure and open up a crack between the oil pan (upper) cylinder block.

⇦ : Engine front



c. Insert the seal cutter [SST: KV10111100] between the oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of tool with a hammer.

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 using a screwdriver, etc. outside the indicated location.**
- **Never remove oil pump and oil strainer from oil pan (upper).**

4. Remove rear oil seal from crankshaft.

INSTALLATION

1. Install the oil pan (upper) in the following procedure:

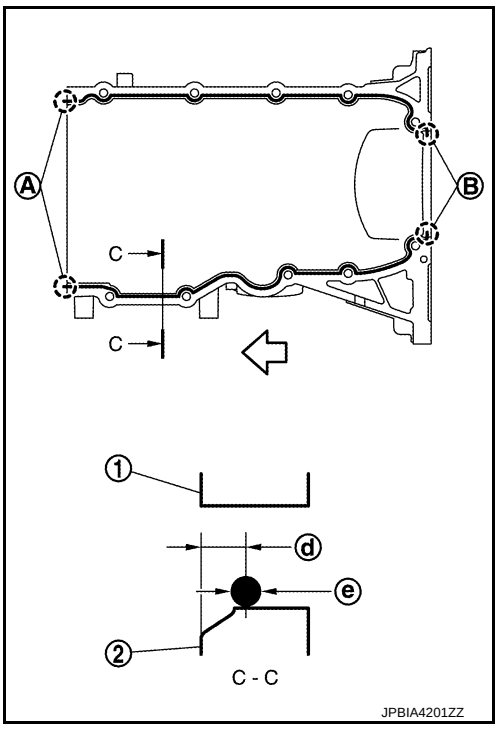
a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove the old liquid gasket from mating surface of cylinder block.
- Remove old liquid gasket from the bolt holes and threads.

CAUTION:

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

b. Install O-ring to the cylinder block.

c. Apply a continuous bead of liquid gasket (C) with the tube presser (commercial service tool) to areas as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

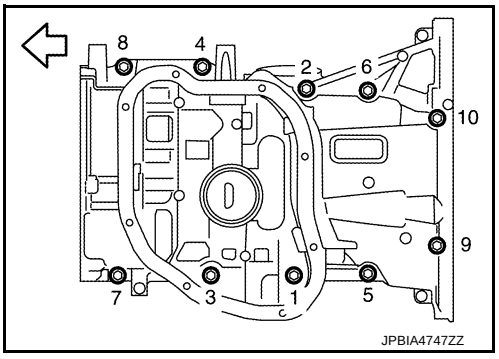


A : 2 mm (0.07 in) protruded to outside
B : 2 mm (0.07 in) protruded to rear oil seal mounting side
d : 5.5 - 7.5 mm (0.217 - 0.295 in)
e : ϕ4.0 - 5.0 mm (0.157 - 0.197 in)
⇦ : Engine front side
⬅ : Engine out side

A : Excess of 2 mm or more outward
B : Excess of 2 mm or more in the rear oil seal mounting direction

CAUTION:
Attaching should be done within 5 minutes after coating.

d. Tighten bolts in the numerical order as shown in the figure.



⇦ : Engine front

CAUTION:
Install avoiding misalignment of both oil pan gasket and O-ring.
- The bolts are different according to the installation position. Refer to the numbers as shown in the figure.

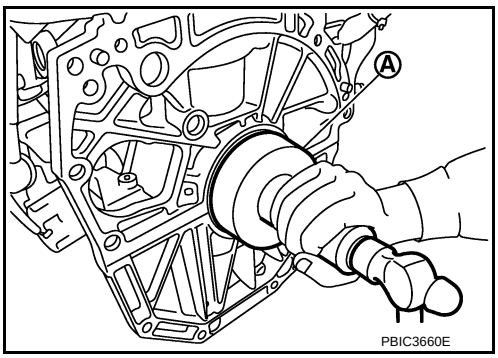
M8×180 mm (7.09 in) : No. 9, 10
M8×25 mm (0.98 in) : No. 3, 4, 7, 8
M8×90 mm (3.54 in) : No. 1, 2, 5, 6

2. 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).**
- **Never touch oil seal lip.**

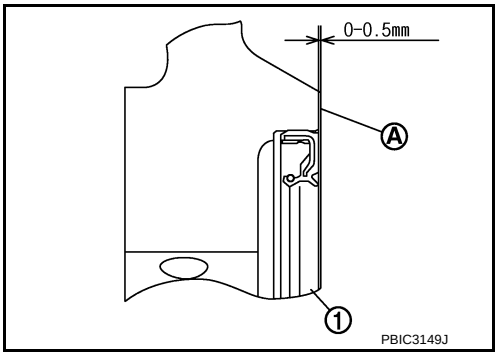
a. Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a spatula.

b. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.

c. Press-fit the rear oil seal using a drift with outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).



- Press-fit to the dimensions specified as shown in the figure.



1 : Rear oil seal
A : Rear end surface of cylinder block
b : 0 - 0.5 mm (0 - 0.020 in)

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 check that oil seal does not curl or tilt.**

d. After press-fitting the rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.

3. Install in the reverse order of removal, for the rest of parts.

Inspection

INFOID:0000000006449934

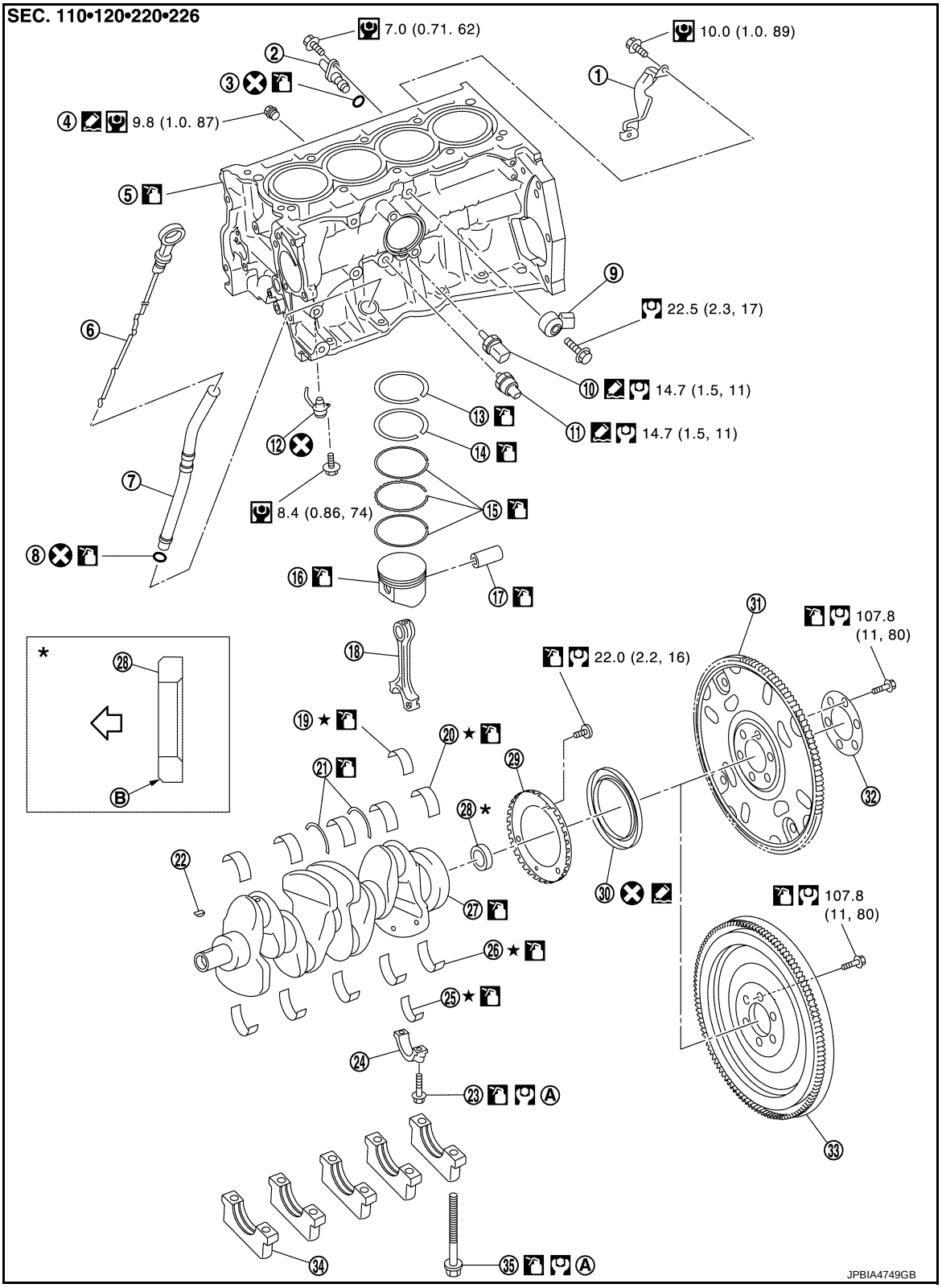
INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to LU-25, "Inspection".
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to LU-25, "Inspection".

CYLINDER BLOCK

Exploded View

INFOID:0000000006449935



1. Crankshaft position sensor (POS) cover
2. Crankshaft position sensor (POS)
3. O-ring
4. Drain plug
5. Cylinder block
6. Oil level gauge
7. Oil level gauge guide
8. O-ring
9. Knock sensor

10. Oil temperature sensor
11. Oil pressure sensor
12. Oil jet
13. Top ring
14. Second ring
15. Oil ring
16. Piston
17. Piston pin
18. Connecting rod
19. Connecting rod bearing (upper)
20. Main bearing (upper)
21. Thrust bearing
22. Crankshaft key
23. Connecting rod bolt
24. Connecting rod cap
25. Connecting rod bearing (lower)
26. Main bearing (lower)
27. Crankshaft
28. Pilot converter (CVT models)
29. Signal plate
30. Rear oil seal
31. Drive plate
32. Rein force plate
33. Fly wheel (M/T models)
34. Main bearing cap bolt

A. Tightening must be done following the assembly procedure. Refer to EM-228
B. Chamfered

⇦ : Crankshaft side

: Always replace after every disassembly.

: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

: Sealing point

: Should be lubricated with oil.

★ : Select with proper thickness.

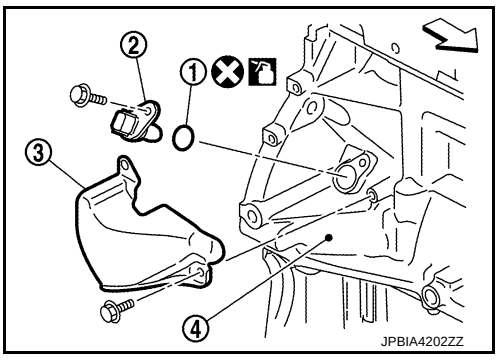
Disassembly and Assembly

INFOID:0000000006449936

DISASSEMBLY

NOTE:
Explained here is how to disassemble with an engine stand supporting mating surface of transaxle. When using different type of engine stand, note with difference in steps and etc.

1. Remove cylinder head. Refer to EM-208, "Exploded View".
2. Remove knock sensor.
   CAUTION:
   Carefully handle knock sensor avoiding shocks.
3. Remove cover, and then crankshaft position sensor (POS).



1. O ring
2. Crank shaft position sensor (POS)
3. Cover

⇦ : Engine front

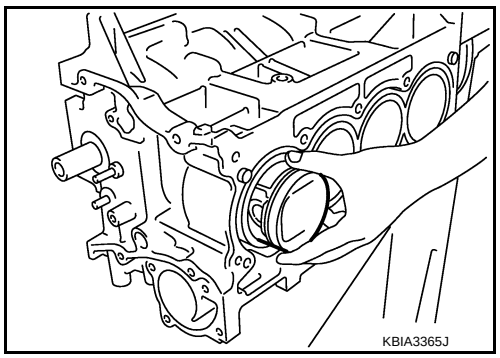
CAUTION:
- **Avoid impacts such as a dropping.**
- **Never disassemble.**
- **Keep it away from metal particles.**
- **Never place the sensor in a location where it is exposed to magnetism.**

4. Remove oil pan (upper and lower). Refer to EM-222, "Exploded View".
5. Remove piston and connecting rod assembly with the following procedure:
   - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-236, "Inspection".

a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
b. Remove connecting rod cap.

c. Using a hammer handle or similar 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.**

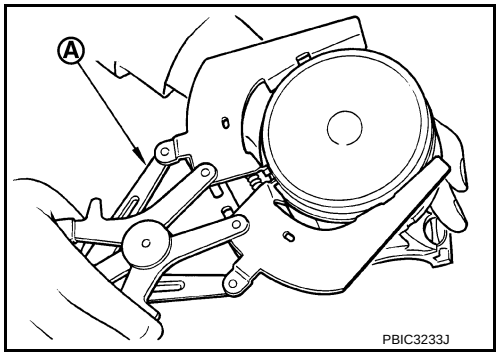

KBIA3365J

6. Remove connecting rod bearings.

CAUTION:
Identify installation positions, and store them without mixing them up.

7. Remove piston rings form piston.
- Before removing piston rings, check the piston ring side clearance. Refer to EM-236, "Inspection".
- Use a piston ring expander (commercial service tool) (A).

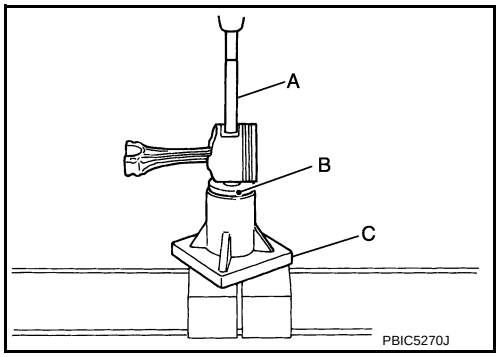
CAUTION:
- **When removing piston rings, be careful not to damage the piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



PBIC3233J

8. Remove piston from connecting rod.
- Use a piston pin press stand (SST) and a press to remove the piston pin.
- For the details of SST, refer to the following.

A : Drift [KV10109730]
B : Center cap [KV10110310]
C : Press stand [ST13030020]



PBIC5270J

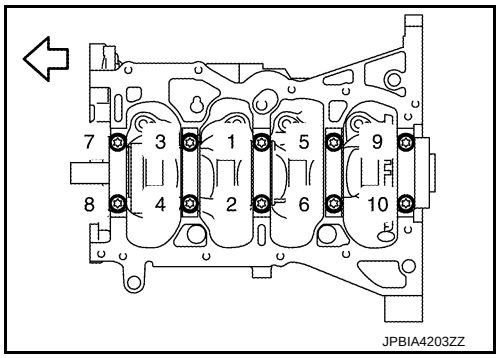
CAUTION:
Be careful not to damage the piston and connecting rod.
NOTE:
The joint between the connecting rod and the piston pin is a press fit.

9. Remove the main bearing cap in the following procedure.
- Measure crankshaft end play before loosening main bearing cap bolts. Refer to EM-236, "Inspection".

a. Loosen and remove bolts in several steps in reverse of the numerical order as shown in the figure.

⇦ : Engine front

- TORX socket (size: E14) can be used.

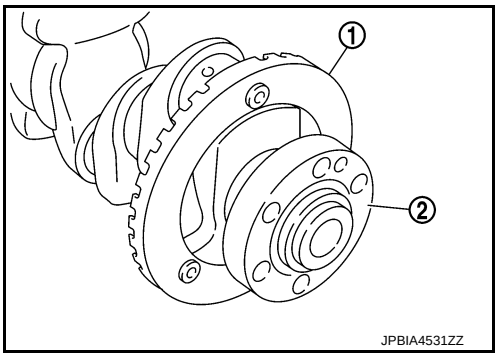


JPBIA4203ZZ

b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

10. Remove crankshaft (2).
CAUTION:
- **Be careful not damage or deform signal plate (1) mounted on crankshaft.**
- **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.**

NOTE:
When removing or installing signal plate, use TORX socket (size T40).



11. Pull rear oil seal out from rear end of crankshaft.
12. Remove main bearing (upper and lower) and thrust bearings from cylinder block and main bearing cap.
CAUTION:
Identify installation positions, and store them without mixing them up.
13. Remove oil jets.
CAUTION:
Insert the dowel pin of oil jet into the cylinder block dowel pin hole to loosen the mounting bolt.

ASSEMBLY

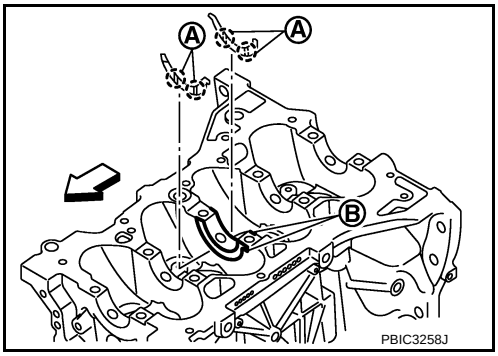
1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.
CAUTION:
Use a goggles to protect your eye.
2. Install oil jets.
3. Install main bearings and thrust bearings with the following procedure:

a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block.

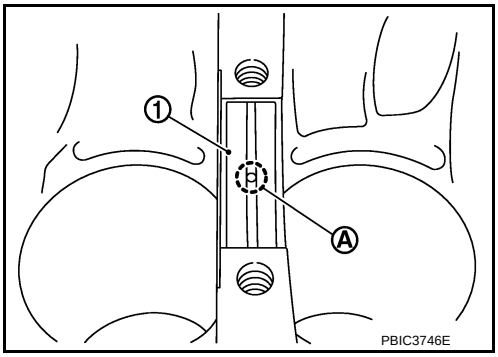
b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

⇦ : Engine front

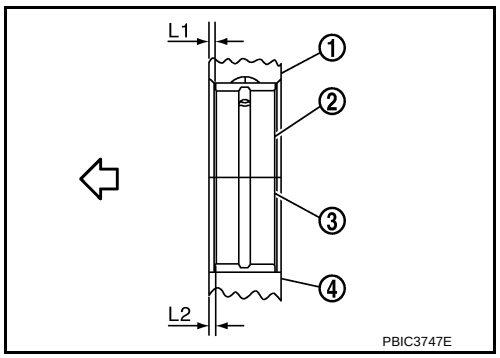
- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).



c. Install the main bearings (1) paying attention to the direction.
- Install the one with oil holes (A) onto cylinder block and the one without oil holes onto main bearing cap.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



- Install the main bearing in the position as shown in the figure.



1 : Cylinder block
2 : Main bearing (upper)
3 : Main bearing (lower)
4 : Main bearing cap
⇦ : Engine front

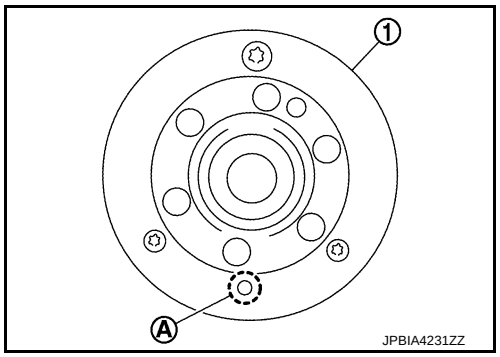
NOTE:
Install the main bearing in the center position with the following dimension. For service operation, the center position can be checked visually.

Journal position	No. 1	No. 2	No. 3	No. 4	No. 5
L1 [Unit: mm (in)]	1.65 - 2.05 (0.064 - 0.080)	1.25 - 1.65 (0.049 - 0.064)	2.30 - 2.70 (0.090 - 0.106)	1.25 - 1.65 (0.049 - 0.064)	1.60 - 2.00 (0.062 - 0.078)
L2 [Unit: mm (in)]	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)	2.30 -2.70 (0.090 - 0.106)	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)

CAUTION:
Dimension L1 of journal No. 3 is the distance from the housing base end surface (bulk) (it is not the distance from the thrust bearing mounting end surface).

4. Install signal plate to crankshaft if removed.

a. Set the signal plate (1) with the flange facing toward the counter-weight side (engine front side) to the crankshaft rear surface.



A : Dowel pin hole

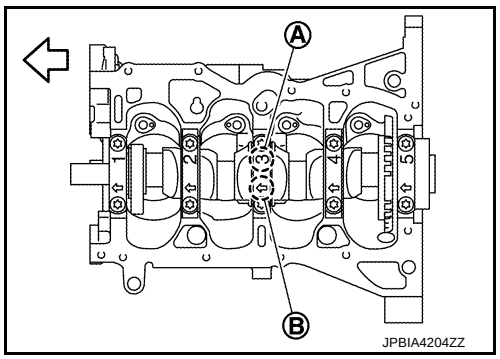
b. After positioning crankshaft and signal plate with positioning dowel pin, tighten bolt.
NOTE:
Dowel pin of crankshaft and signal plate is provided as a set for each.

c. Remove dowel pin.
CAUTION:
Be sure to remove dowel pin.

5. Install crankshaft to cylinder block.
- While turning crankshaft by hand, check that it turns smoothly.

CAUTION:
Never install rear oil seal yet.

6. Install main bearing caps.
- Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

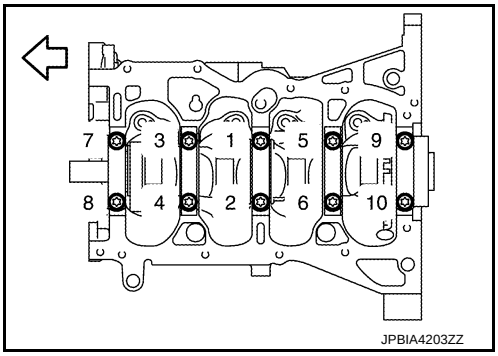


⇦ : Engine front

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

7. Tighten main bearing cap bolts in numerical order as shown in the figure with the following steps.

⇦ : Engine front



a. Apply new engine oil to threads and seat surfaces of the mounting bolts.

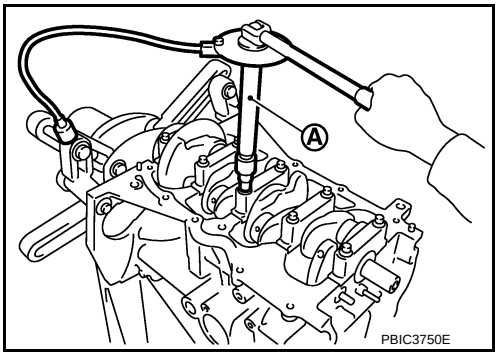
b. Tighten main bearing cap bolts.

: 32.4 N·m (3.3 kg-m, 24 ft-lb)

c. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in numerical order as shown in the figure.

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- After installing the mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to EM-236, "Inspection".

8. Install piston to connecting rod with the following procedure:

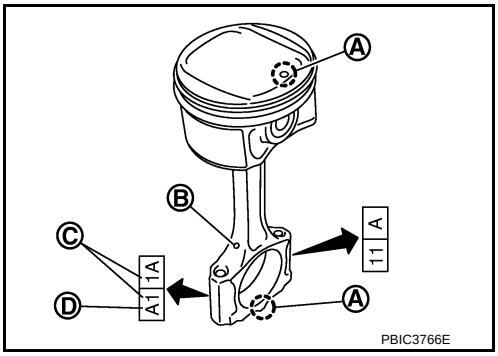
a. Set so that the front mark (A) on the piston head and the cylinder number (C) are in the position as shown in the figure.

B : Oil hole

D : Connecting rod big end grade

NOTE:

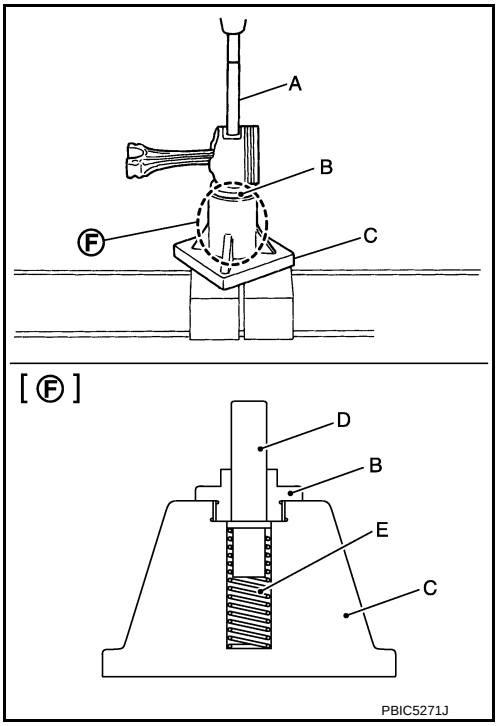
The symbols without notes are for management



b. Press-fit the piston pin using the piston pin press stand (SST).
- For the details of SST, refer to the following.

A : Drift [KV10109730]
B : Center cap [KV10110310]
C : Press stand [ST13030020]
D : Center shaft KV10114120]
E : Spring [ST13030030]
F : Detail

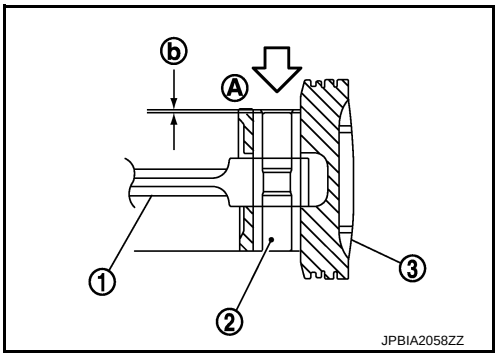
CAUTION:
Press-fit the piston so as not to damage it.
NOTE:
The joint between the connecting rod and the piston pin is a press fit.



- Press-fit the piston pin (2) from piston surface (A) to the depth of 2.35 mm (0.092 in) (b).

1 : Connecting rod
⇦ : Press-fit direction

- After finishing work, check that the piston (3) moves freely.

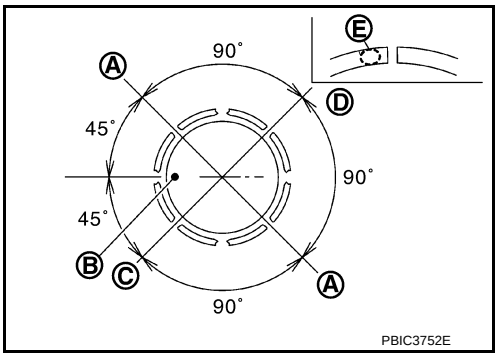


9. Using a piston ring expander (commercial service tool), install piston rings.
CAUTION:
- **Be careful not to damage piston.**
- **Be careful not to damage piston rings by expanding them excessively.**
- Position each ring with the gap as shown in the figure referring to the piston front mark (B).

A : Oil ring upper or lower rail gap (either of them)
C : Second ring and oil ring spacer gap
D : Top ring gap

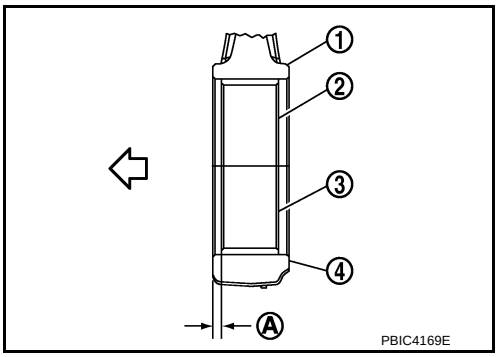
- Install second ring with the stamped mark (E) facing upward.

Stamped mark:
Top ring : 1R
Second ring : 2R



10. Install connecting rod bearings to connecting rod and connecting rod cap.
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Install the bearing in the center position.
NOTE:
There is no stopper tab.

- Check that the oil holes on connecting rod and connecting rod bearing are aligned.
- Install the connecting rod in the dimension as shown in the figure.

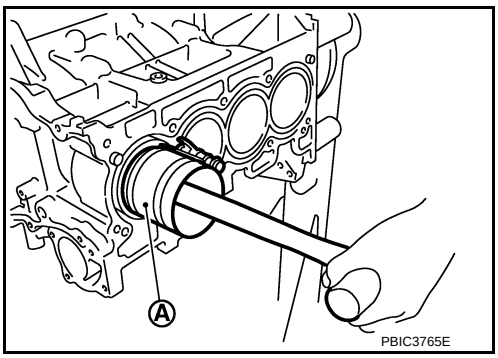


1 : Connecting rod
2 : Connecting rod bearing (upper)
3 : Connecting rod bearing (lower)
4 : Connecting rod cap
A : 1.7 - 2.1 mm (0.067 - 0.083 in)
⇦ : Engine front

NOTE:
Install the connecting rod bearing in the center position with the dimension as shown in the figure. For service operation, the center position can be checked visually.

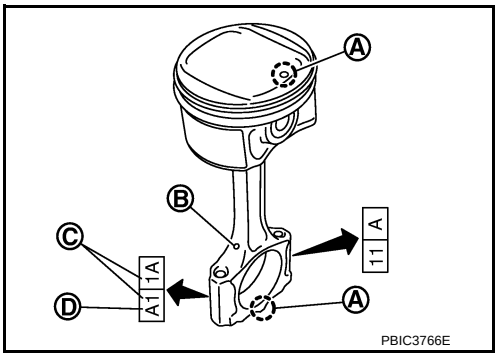
11. Install piston and connecting rod assembly to crankshaft.
- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Using the piston ring compressor [SST: EM03470000] (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 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.**



12. 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
B : Oil hole
D : Connecting rod big end grade



13. Inspect outer diameter of connecting rod bolts. Refer to EM-236, "Inspection".
14. Tighten connecting rod bolt with the following procedure:

a. Apply new engine oil to the threads and seats of connecting rod bolts.
b. Tighten bolts in several steps.

: 27.4 N·m (2.8 kg-m, 20 ft-lb)

c. Completely loosen bolts.

: 0 N·m (0 kg-m, 0 ft-lb)

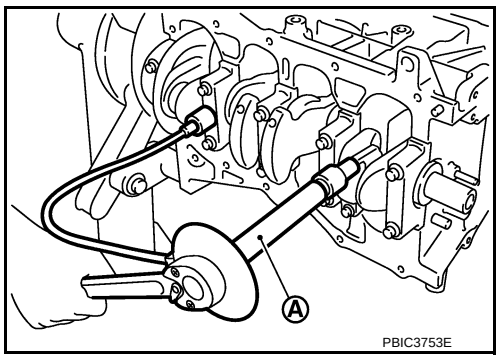
d. Tighten bolts in several steps.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

e. Then turn all bolts 60 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgement by visual inspection without the tool.

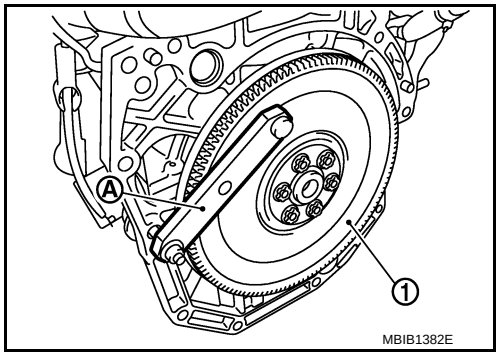


- After tightening connecting rod bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-236, "Inspection".

15. Install oil pan (upper). Refer to EM-222, "Exploded View".
    NOTE:
    Install the rear oil seal after installing the oil pan (upper).
16. Install rear oil seal. Refer to EM-206, "REAR OIL SEAL : Removal and Installation".
17. Install flywheel and drive plate.

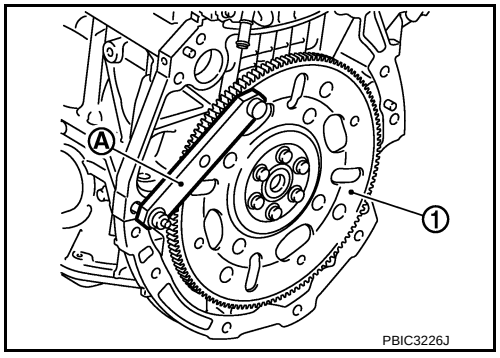
M/T models

- Secure flywheel (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
- Using TORX socket (size E20), loosen mounting bolts.



CVT models

- Secure drive plate (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
- Using TORX socket (size E20), loosen mounting bolts.

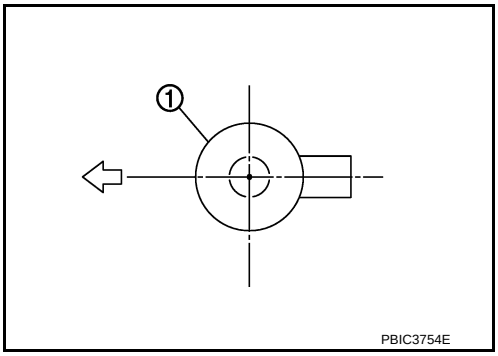


CAUTION:

Be careful not to damage or scratch and contact surface for clutch disc of flywheel.

18. Install knock sensor (1).

⇦ : Engine front



- Install connectors so that they are positioned towards the rear of the engine.

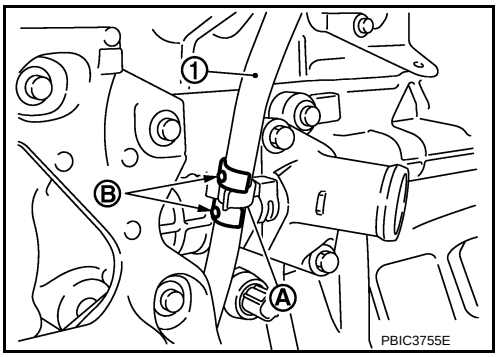
CAUTION:

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

NOTE:

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

19. Install crankshaft position sensor (POS).
    - Tighten bolts with it seated completely.
20. For the oil level gauge guide (1), fix the position (B) shown in the figure to the water inlet clip (A) after inserting to the cylinder block side.



21. Assemble in the reverse order of disassembly after this step.

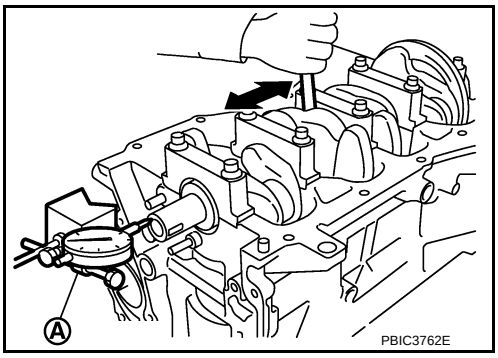
Inspection

INFOID:0000000006449937

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 and Limit : Refer to EM-255, "Cylinder Block".

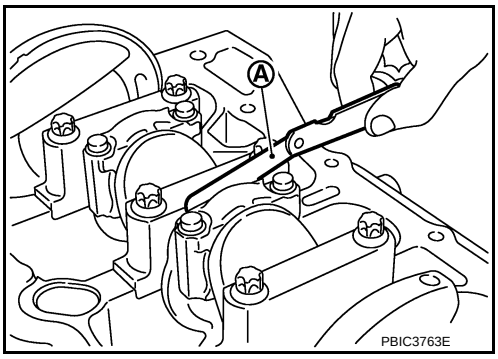


- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

CONNECTING ROD SIDE CLEARANCE

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

Standard and Limit : Refer to EM-255, "Cylinder Block".

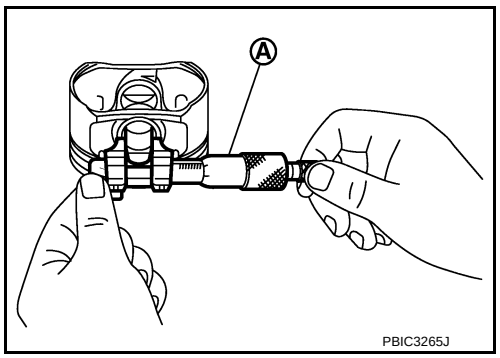


- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

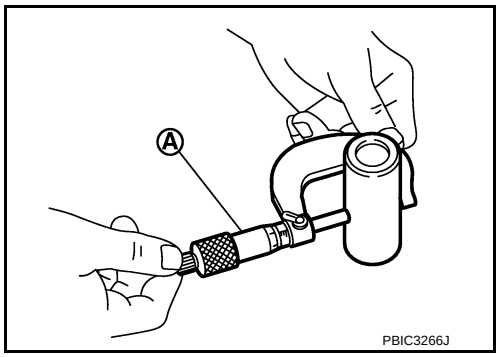
Measure the inner diameter of piston pin hole with an inside micrometer (A).



Standard : Refer to EM-255, "Cylinder Block".

Piston Pin Outer Diameter

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



Standard : Refer to EM-255, "Cylinder Block".

Piston to Piston Pin Oil Clearance

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

Standard : Refer to EM-255, "Cylinder Block".

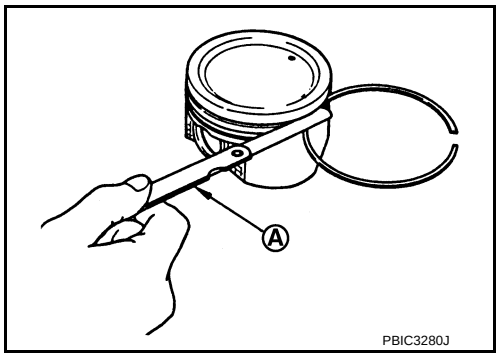
- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to ″″.

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 and Limit : Refer to EM-255, "Cylinder Block".

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

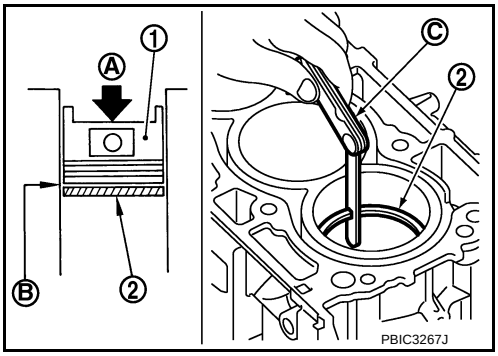
PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to “PISTON TO CYLINDER BORE CLEARANCE”.

- 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 and Limit : Refer to EM-255, "Cylinder Block".

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



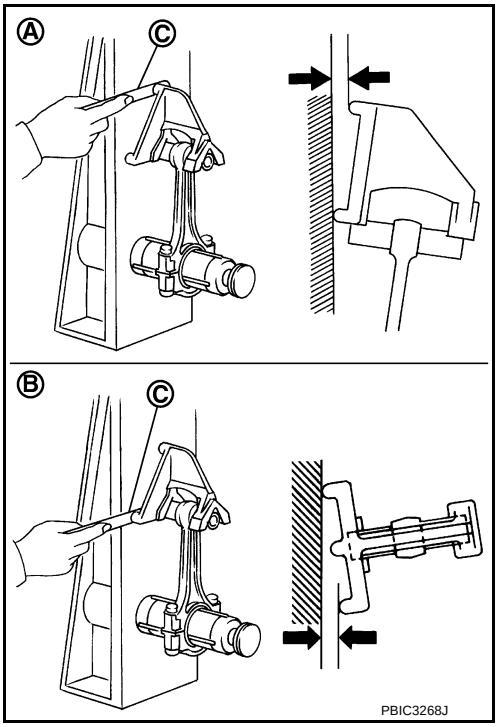
CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

A : Bend
B : Torsion
C : Feeler gauge

Limit : Refer to EM-255, "Cylinder Block".

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



CONNECTING ROD BIG END DIAMETER

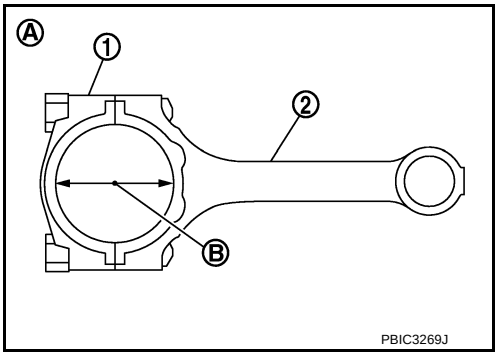
- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to EM-227, "Exploded View".

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 : Refer to EM-255, "Cylinder Block".

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

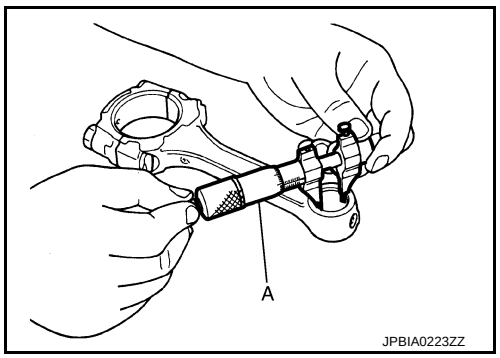


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

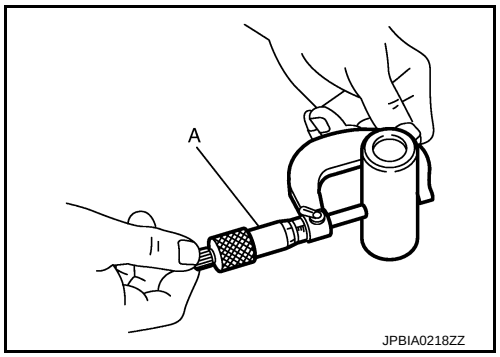
Standard : Refer to EM-255, "Cylinder Block".



Piston Pin Outer Diameter

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

Standard : Refer to EM-255, "Cylinder Block".



Connecting Rod Bushing Oil Clearance

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

Standard and Limit : Refer to EM-255, "Cylinder Block".

- 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. Refer to EM-255, "Cylinder Block".
- If replacing connecting rod assembly. Refer to EM-258, "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.

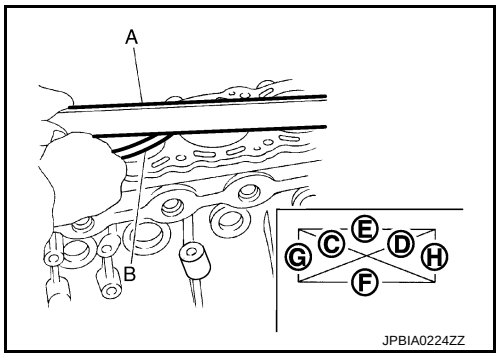
CAUTION:

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 : Refer to EM-255, "Cylinder Block".

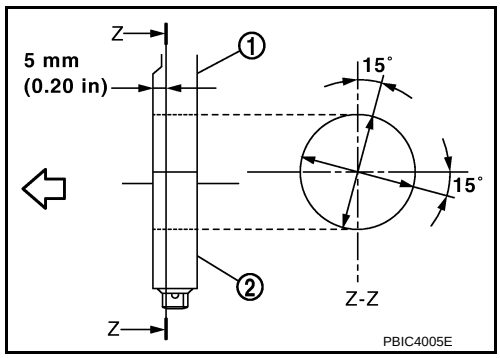
- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to EM-228, "Disassembly and Assembly".
- Measure the inner diameter of main bearing housing with a bore gauge.

- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.



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

Standard : Refer to EM-255, "Cylinder Block".

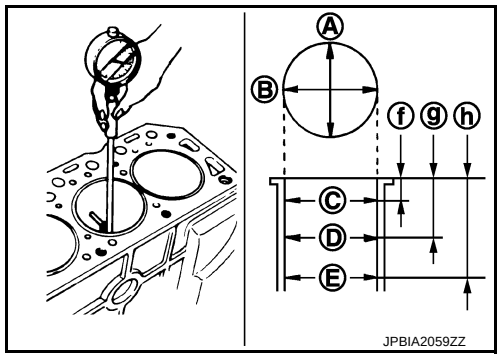
- If out of the standard, replace cylinder block and main bearing caps assembly.

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, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(A) and (B) directions at (C), (D), and (E)] [(A) is in longitudinal direction of engine]



f : 10 mm (0.39 in)
g : 60 mm (2.36 in)
h : 124 mm (4.88 in)

NOTE:
When determining cylinder bore grade, measure the cylinder bore (B) direction at (D) position.

Standard:

Cylinder bore inner diameter

: Refer to EM-255, "Cylinder Block".

Limit:

Out-of-round [Difference between (A) and (B)]

Taper [Difference between (C) and (D)]

: Refer to EM-255, "Cylinder Block".

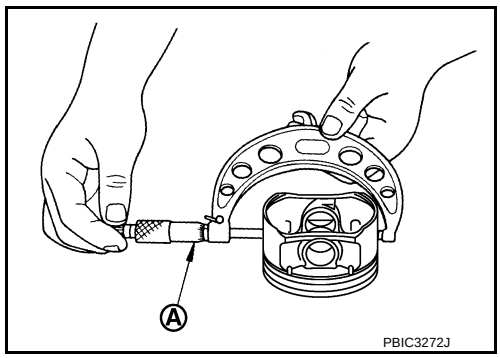
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

NOTE:
Oversize piston is not provided.

Piston Skirt Diameter

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

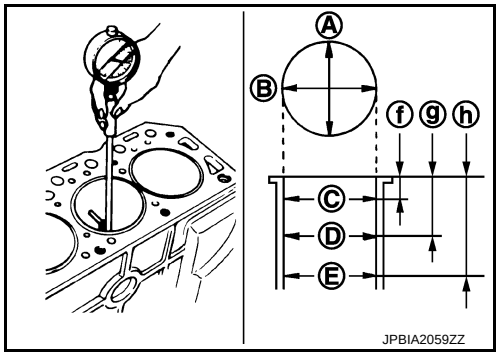
Standard : Refer to EM-255, "Cylinder Block".



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].

A : Direction A
C : Position C
E : Position E
f : 10 mm (0.39 in)
g : 60 mm (2.36 in)
h : 124 mm (4.88 in)



(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard and Limit : Refer to EM-255, "Cylinder Block".

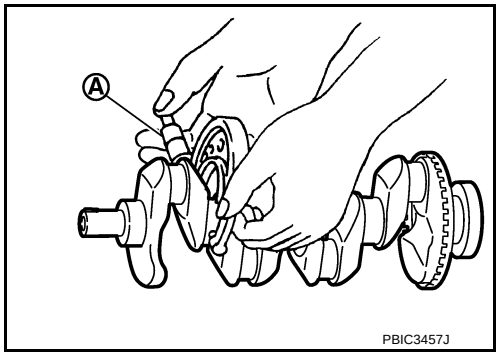
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to EM-255, "Cylinder Block".

CRANKSHAFT MAIN JOURNAL DIAMETER

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

Standard : Refer to EM-255, "Cylinder Block".

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-257, "Main Bearing".



CRANKSHAFT PIN JOURNAL DIAMETER

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

Standard : Refer to EM-255, "Cylinder Block".

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-258, "Connecting Rod Bearing".

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

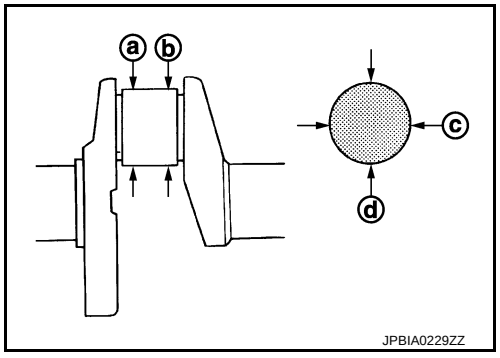
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (a) and (b) at (c) and (d).
- Taper is indicated by the difference in dimension between (c) and (d) at (a) and (b).

Limit:

Out-of-round [Difference between (a) and (b)]

Taper [Difference between (c) and (d)]

: Refer to EM-255, "Cylinder Block".



- 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. Refer to EM-258, "Connecting Rod Bearing" and/or EM-257, "Main Bearing".

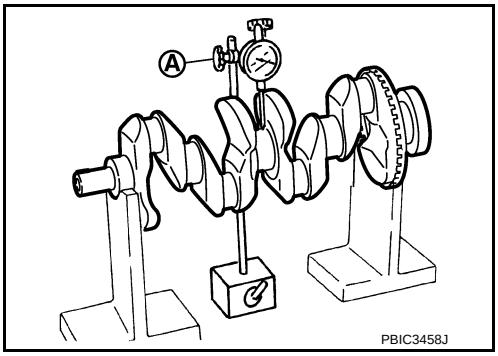
CRANKSHAFT RUNOUT

- 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 and Limit : Refer to EM-255, "Cylinder Block".

- If it exceeds the limit, replace crankshaft.

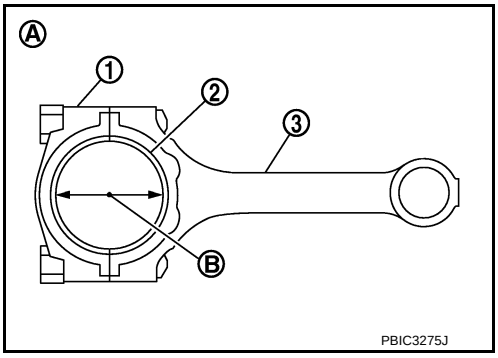


CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to EM-228, "Disassembly and Assembly".

A : Example
B : Inner diameter measuring direction



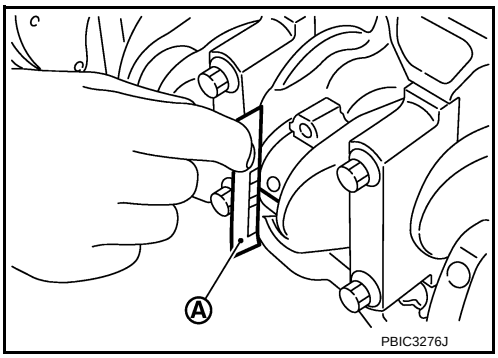
- Measure the inner diameter of connecting rod bearing with an inside micrometer.
  (Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

Standard and Limit : Refer to EM-258, "Connecting Rod Bearing".

- 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-258, "Connecting Rod 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 cap bolts to the specified torque. Refer to EM-228, "Disassembly and Assembly".
  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”.

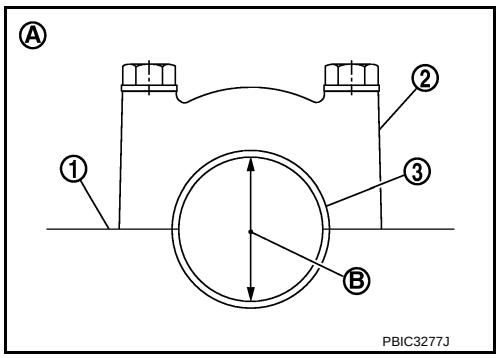


MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to EM-228, "Disassembly and Assembly".

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 and Limit : Refer to EM-257, "Main Bearing".

- 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-257, "Main Bearing".

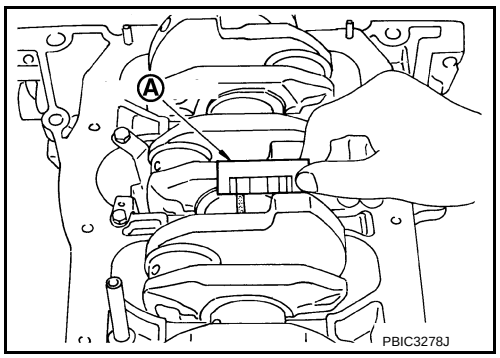
Method of Using Plastigage

- 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 mounting bolts to the specified torque. Refer to EM-228, "Disassembly and Assembly".

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”.



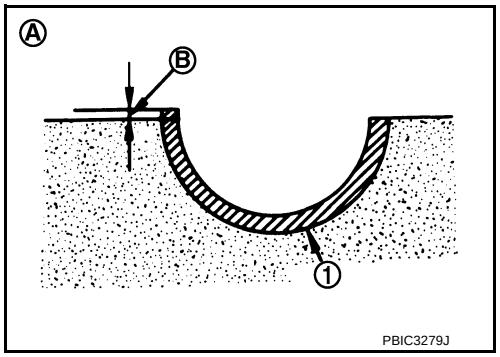
MAIN BEARING CRUSH HEIGHT

- 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-228, "Disassembly and Assembly".

A : Example

Standard : There must be crush height.

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



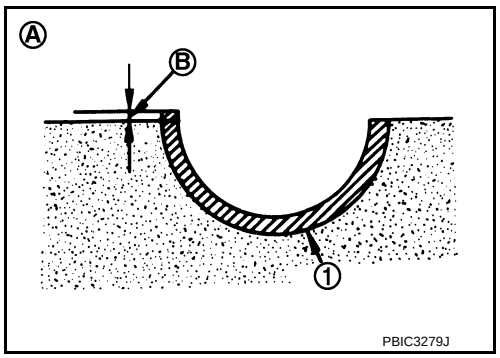
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude (B). Refer to EM-228, "Disassembly and Assembly".

A : Example

Standard : There must be crush height.

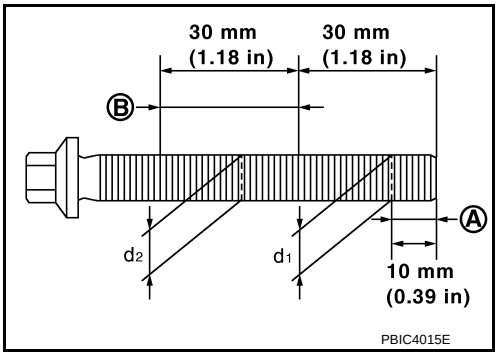
- If the standard is not met, replace connecting rod bearings.



MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (d_1) and (d_2) at two positions as shown in the figure.

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)

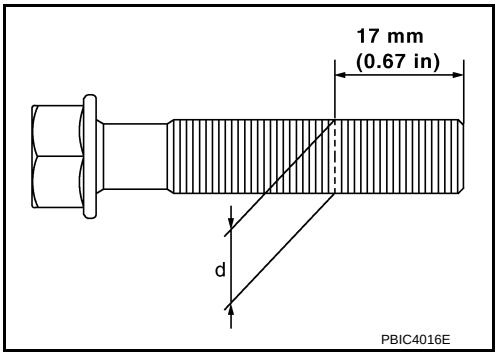
- If it exceeds the limit (a large difference in dimensions), replace main bearing cap mounting bolt with a new one.

CONNECTING ROD CAP BOLT OUTER DIAMETER

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

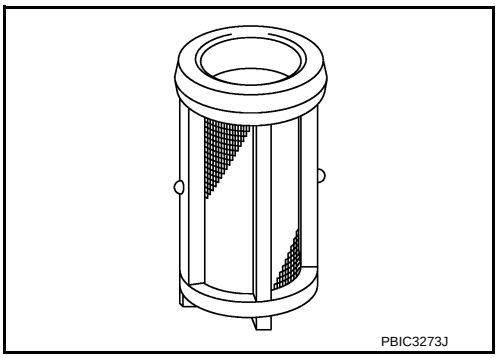
Limit: 7.75 mm (0.3051 in)

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



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

- Check 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.



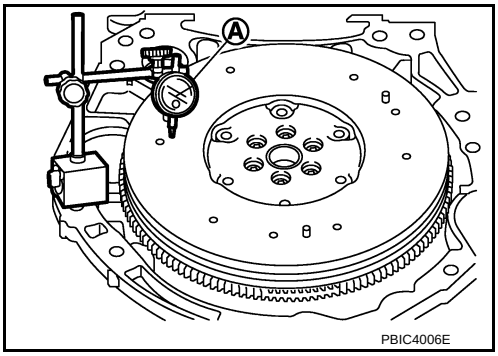
FLYWHEEL DEFLECTION (M/T models)

- Measure the deflection of flywheel contact surface to torque 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.

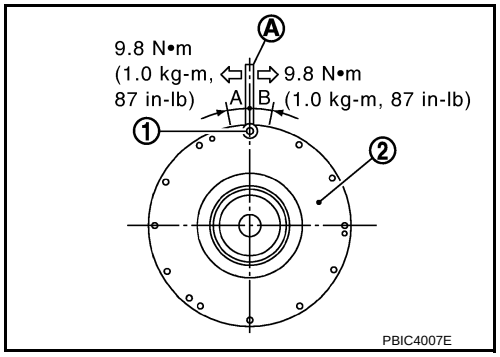
Standard : 1.8 mm (0.071 in) or less

- 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 mounting bolt (1) to clutch cover mounting 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 matching 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.

HOW TO SELECT PISTON AND BEARING

Description

INFOID:0000000006449938

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.

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

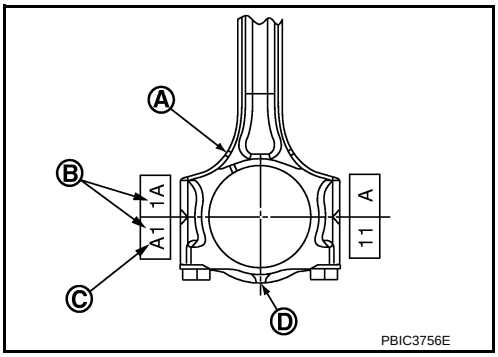
Connecting Rod Bearing

INFOID:0000000006449939

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

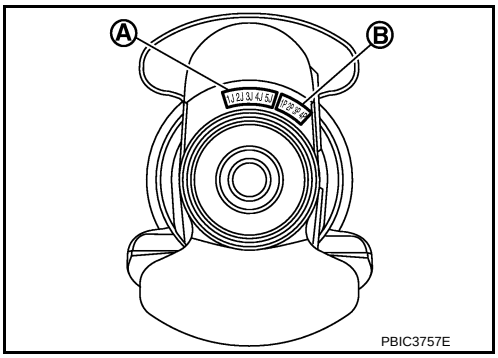
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the “Connecting Rod Bearing Selection Table”.

   A : Oil hole
   B : Cylinder number
   D : Front mark



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

   A : Main journal diameter grade (No. 1 to 5 from left)
   B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



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 CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-236, "Inspection".

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

Connecting rod big end diameter / Crankshaft pin journal diameter	I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N
	Hole diameter Unit: mm (in)	43.000 - 43.001 (1.6929 - 1.6929)	43.001 - 43.002 (1.6929 - 1.6930)	43.002 - 43.003 (1.6930 - 1.6930)	43.003 - 43.004 (1.6930 - 1.6931)	43.004 - 43.005 (1.6931 - 1.6931)	43.005 - 43.006 (1.6931 - 1.6931)	43.006 - 43.007 (1.6931 - 1.6932)	43.007 - 43.008 (1.6932 - 1.6932)	43.008 - 43.009 (1.6932 - 1.6933)	43.009 - 43.010 (1.6933 - 1.6933)	43.010 - 43.011 (1.6933 - 1.6933)	43.011 - 43.012 (1.6933 - 1.6934)	43.012 - 43.013 (1.6934 - 1.6934)
I.D. mark	Axle diameter Unit mm (in)													
A	39.971 - 39.970 (1.5737 - 1.5736)	12	12	12	12	12	2	2	2	23	23	23	3	3
B	39.970 - 39.969 (1.5736 - 1.5736)	12	12	12	12	2	2	2	23	23	23	3	3	3
C	39.969 - 39.968 (1.5736 - 1.5735)	12	12	12	2	2	2	23	23	23	3	3	3	34
D	39.968 - 39.967 (1.5735 - 1.5735)	12	12	2	2	2	23	23	23	3	3	3	34	34
E	39.967 - 39.966 (1.5735 - 1.5735)	12	2	2	2	23	23	23	3	3	3	34	34	34
F	39.966 - 39.965 (1.5735 - 1.5734)	2	2	2	23	23	23	3	3	3	34	34	34	4
G	39.965 - 39.964 (1.5734 - 1.5734)	2	2	23	23	23	3	3	3	34	34	34	4	4
H	39.964 - 39.963 (1.5734 - 1.5733)	2	23	23	23	3	3	3	34	34	34	4	4	4
J	39.963 - 39.962 (1.5733 - 1.5733)	23	23	23	3	3	3	34	34	34	4	4	4	45
K	39.962 - 39.961 (1.5733 - 1.5733)	23	23	3	3	3	34	34	34	4	4	4	45	45
L	39.961 - 39.960 (1.5733 - 1.5732)	23	3	3	3	34	34	34	4	4	4	45	45	45
M	39.960 - 39.959 (1.5732 - 1.5732)	3	3	3	34	34	34	4	4	4	45	45	45	5
N	39.959 - 39.958 (1.5732 - 1.5731)	3	3	34	34	34	4	4	4	45	45	45	5	5
P	39.958 - 39.957 (1.5731 - 1.5731)	3	34	34	34	4	4	4	45	45	45	5	5	5
R	39.957 - 39.956 (1.5731 - 1.5731)	34	34	34	4	4	4	45	45	45	5	5	5	56
S	39.956 - 39.955 (1.5731 - 1.5730)	34	34	4	4	4	45	45	45	5	5	5	56	56
T	39.955 - 39.954 (1.5730 - 1.5730)	34	4	4	4	45	45	45	5	5	5	56	56	56
U	39.954 - 39.953 (1.5730 - 1.5729)	4	4	4	45	45	45	5	5	5	56	56	56	56

JPBIA4823GB

Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to EM-258, "Connecting Rod Bearing".

Undersize Bearings Usage Guide

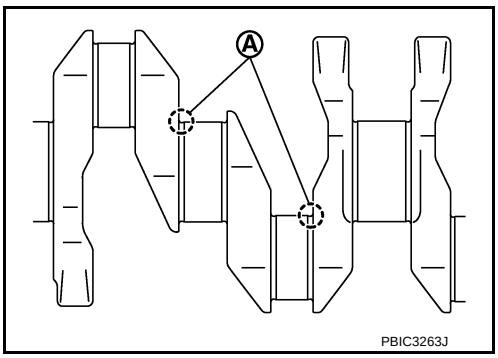
- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind the crankshaft pin so that the connecting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

CAUTION:

In grinding crankshaft pin to use undersize bearings, keep the fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to EM-258, "Connecting Rod Bearing".



Main Bearing

INFOID:0000000006449940

HOW TO SELECT MAIN BEARING

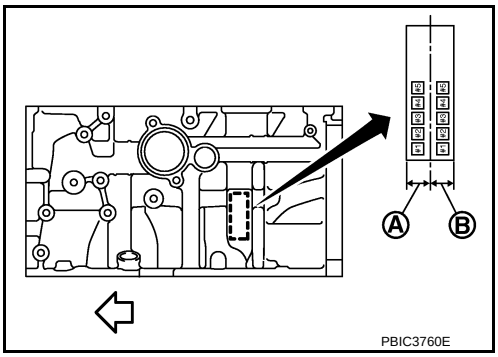
When New Cylinder Block and Crankshaft Are Used

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

   A : Basic stamp mark

   ⇦ : Engine front

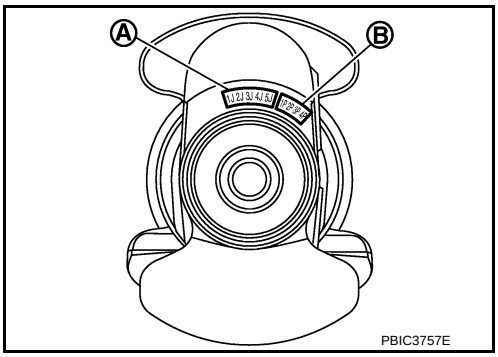
   - If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



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

   A : Main journal diameter grade (No. 1 to 5 from left)

   B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
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-236, "Inspection".
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".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

Main Bearing Selection Table

Crankshaft main journal diameter: I.D. mark	Axle diameter Unit mm (in)	Cylinder block main bearing housing inner diameter: I.D. mark A Hole diameter Unit: mm (in) 51.997 - 51.998 (2.0471 - 2.0472)	B 51.998 - 51.999 (2.0472 - 2.0472)	C 51.999 - 52.000 (2.0472 - 2.0472)	D 52.000 - 52.001 (2.0472 - 2.0472)	E 52.001 - 52.002 (2.0473 - 2.0473)	F 52.002 - 52.003 (2.0473 - 2.0473)	G 52.003 - 52.004 (2.0474 - 2.0474)	H 52.004 - 52.005 (2.0474 - 2.0474)	J 52.005 - 52.006 (2.0474 - 2.0474)	K 52.006 - 52.007 (2.0475 - 2.0475)	L 52.007 - 52.008 (2.0475 - 2.0475)	M 52.0008 - 52.009 (2.0476 - 2.0476)	N 52.009 - 52.010 (2.0476 - 2.0476)	P 52.010 - 52.011 (2.0476 - 2.0476)	R 52.011 - 52.012 (2.0477 - 2.0477)	S 52.012 - 52.013 (2.0477 - 2.0477)	T 52.013 - 52.014 (2.0478 - 2.0478)	U 52.014 - 52.015 (2.0478 - 2.0478)	V 52.015 - 52.016 (2.0478 - 2.0478)	W 52.016 - 52.017 (2.0479 - 2.0479)
A	47.979 - 47.978 (1.8889 - 1.8889)	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23
B	47.978 - 47.977 (1.8889 - 1.8889)	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23
C	47.977 - 47.976 (1.8889 - 1.8888)	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23
D	47.976 - 47.975 (1.8888 - 1.8888)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3
E	47.975 - 47.974 (1.8888 - 1.8887)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3
F	47.974 - 47.973 (1.8887 - 1.8887)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3
G	47.973 - 47.972 (1.8887 - 1.8887)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34
H	47.972 - 47.971 (1.8887 - 1.8886)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34
J	47.971 - 47.970 (1.8886 - 1.8886)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
K	47.970 - 47.969 (1.8886 - 1.8885)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
L	47.969 - 47.968 (1.8885 - 1.8885)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
M	47.968 - 47.967 (1.8885 - 1.8885)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
N	47.967 - 47.966 (1.8885 - 1.8884)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
P	47.966 - 47.965 (1.8884 - 1.8884)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
R	47.965 - 47.964 (1.8884 - 1.8883)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
S	47.964 - 47.963 (1.8883 - 1.8883)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
T	47.963 - 47.962 (1.8883 - 1.8883)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
U	47.962 - 47.961 (1.8883 - 1.8882)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
V	47.961 - 47.960 (1.8882 - 1.8882)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5
W	47.960 - 47.959 (1.8882 - 1.8881)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5

PBIC3759E

Main Bearing Grade Table

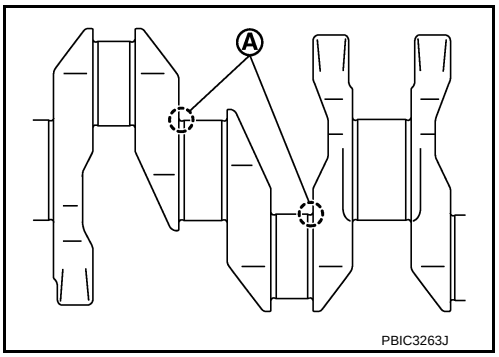
Main Bearing Grade Table : Refer to EM-257, "Main Bearing".

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 fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].



Bearing undersize table:

Refer to EM-257, "Main Bearing".

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000006449941

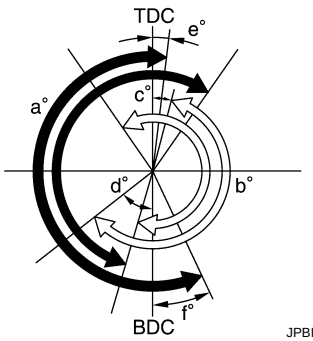
GENERAL SPECIFICATIONS

Engine type		HR16DE
Cylinder arrangement		In-line 4
Displacement	cm^3 (cu in)	1,598 (97.51)
Bore and stroke	mm (in)	78.0×83.6 (3.070×3.291)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		10.7
Compression pressure kPa (bar, kg/cm^2, psi) / 200 rpm	Standard	1,510 (15.1, 15.4, 219)
	Minimum	1,270 (12.7, 12.95, 184)
	Differential limit between cylinders	100 (1.0, 1.0, 14.5)

Valve Timing

Unit: degree

Valve timing
⇦: Intake valve
⬅: Exhaust valve



JPBIA4228ZZ

a	b	c	d	e	f
208	228	22 (–23) ATDC	70 (25) ABDC	3 (53) ATDC	25 (-25) BBDC

( ): Valve timing control “ON”

Drive Belt

INFOID:0000000006449942

DRIVE BELT

Belt Deflection

Location	Deflection adjustment *		Unit: mm (in)
	Used belt		New belt
	Limit	After adjusted	
Drive belt	10 (0.39)	4.8 - 5.3 (0.19 - 0.21)	4.1 - 4.4 (0.16 - 0.17)
Applied pushing force	98 N (10 kg, 22 lb)		

*: When engine is cold.

Belt Tension and Frequency

Location	Tension adjustment *		Unit: N (kg, lb)	Frequency adjustment *		Unit: Hz
	Used belt		New belt	Used belt		New belt
	Limit	After adjusted		Limit	After adjusted	
Drive belt	500 (51.0, 112)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	173	229 - 239	253.5 - 261.5

*: When engine is cold.

Spark Plug

INFOID:0000000006449943

SPARK PLUG (PLATINUM-TIPPED TYPE)

Unit: mm (in)

Make		NGK
Standard type		DILZKAR6A11
Spark plug gap	Standard	1.1 (0.043)

Exhaust Manifold

INFOID:0000000006449944

EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion	0.3 (0.012)

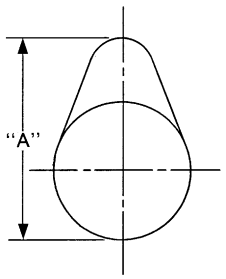
Camshaft

INFOID:0000000006449945

CAMSHAFT

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.0039)



SEM671

Camshaft cam height "A"	Intake	41.705 - 41.895 (1.6419 - 1.6494)	41.505 (1.6341)
	Exhaust	40.915 - 41.105 (1.6108 - 1.6183)	40.715 (1.6029)
Camshaft journal outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9822 - 0.9830)	—
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9842 - 0.9850)	—
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	—
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0011 - 0.0027)	—
Camshaft end play		0.075 - 0.153 (0.0029 - 0.0060)	0.2 (0.0078)
Camshaft sprocket runout [TIR*]		—	0.1 (0.0039)

*: Total indicator reading

Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.977 - 29.987 (1.1801 - 1.1805)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

Valve Clearance

Unit: mm (in)

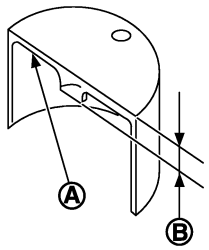
	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

*:Approximately 80°C (176°F)

Available Valve Lifter

Unit: mm (in)

Identification mark (A)	Thickness (B)



JPBIA0170ZZ

300	3.00 (0.1181)
302	3.02 (0.1188)
304	3.04 (0.1196)
306	3.06 (0.1204)
308	3.08 (0.1212)
310	3.10 (0.1220)
312	3.12 (0.1228)
314	3.14 (0.1236)
316	3.16 (0.1244)
318	3.18 (0.1251)
320	3.20 (0.1259)
322	3.22 (0.1267)
324	3.24 (0.1275)
326	3.26 (0.1283)
328	3.28 (0.1291)
330	3.30 (0.1299)
332	3.32 (0.1307)
334	3.34 (0.1314)
336	3.36 (0.1322)
338	3.38 (0.1330)

Identification mark (A)	Thickness (B)
340	3.40 (0.1338)
342	3.42 (0.1346)
344	3.44 (0.1354)
346	3.46 (0.1362)
348	3.48 (0.1370)
350	3.50 (0.1377)

Cylinder head

INFOID:0000000006449946

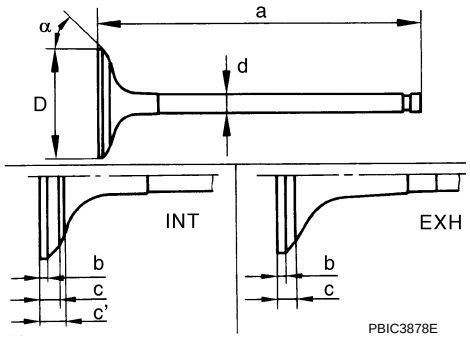
CYLINDER HEAD

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)

Valve Dimensions

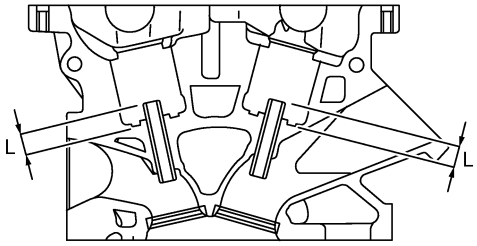
Unit: mm (in)



Valve head diameter “D”	Intake	31.0 - 31.3 (1.220 - 1.232)
	Exhaust	25.3 - 25.6 (0.996 - 1.007)
Valve length “a”	Intake	101.73 (4.01)
	Exhaust	102.49 (4.04)
“b”	Intake	1.0 (0.0393)
	Exhaust	1.0 (0.0393)
“c”	Intake	2.1 - 2.8 (0.0826 - 0.1102)
	Exhaust	2.3 - 3.0 (0.0905 - 0.1181)
“c′”	Intake	3.0 (0.1181)
	Exhaust	–
“d ”	Intake	4.965 - 4.980 (0.1954 - 0.1960)
	Exhaust	4.955 - 4.970 (0.1950 - 0.1956)
Valve seat angle “α”	Intake	45°15′ - 45°45′
	Exhaust	

Valve Guide

Unit: mm (in)

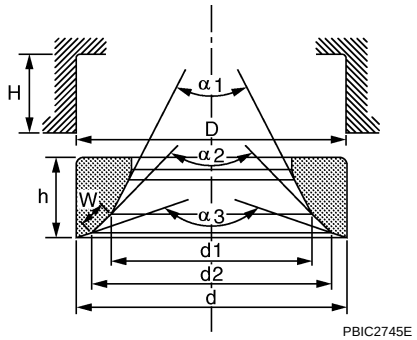


PBIC0184E

Items		Standard part	Service part
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3556)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1968 - 0.1975)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3541)	9.175 - 9.196 (0.3612 - 0.3620)
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)	0.1 (0.004)
Projection length “H”		11.4 - 11.8 (0.448 - 0.464)	

Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter “D”	Intake	31.400 - 31.416 (1.2362 - 1.2368)	31.900 - 31.916 (1.2559 - 1.2565)
	Exhaust	25.900 - 25.916 (1.0196 - 1.0203)	26.400 - 26.416 (1.0393 - 1.0399)
Valve seat outer diameter “d”	Intake	31.497 - 31.513 (1.2400 - 1.2406)	31.997 - 32.013 (1.2597 - 1.2603)
	Exhaust	25.997 - 26.013 (1.0235 - 1.0241)	26.497 - 26.513 (1.0431 - 1.0438)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.081 - 0.113 (0.0032 - 0.0044)	
Diameter “d1”*1	Intake	29.0 (1.141)	
	Exhaust	23.0 (0.905)	
Diameter “d2”*2	Intake	30.6 - 30.8 (1.204 - 1.212)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle “α1”	Intake	60°	
	Exhaust	45°	
Angle “α2”	Intake	89°45′ - 90°15′	
	Exhaust	89°45′ - 90°15′	

Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height “h”	Intake	6.0 (0.236)	5.45 (0.214)
	Exhaust	6.0 (0.236)	5.43 (0.213)
Depth “H”		6.0 (0.236)	

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

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

*3: Machining data

Valve Spring

Standard:

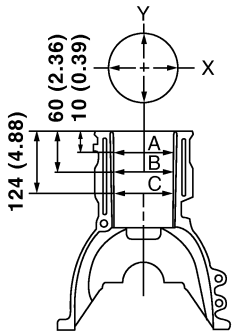
Free height	42.26 mm (1.6637 in)
Installation height	32.40 mm (1.2755 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)

Cylinder Block

INFOID:0000000006449947

CYLINDER BLOCK

Unit: mm (in)



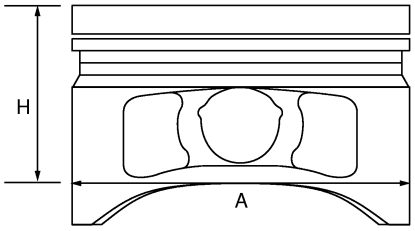
PBIC3924E

Surface distortion		Limit	0.1 (0.004)
Cylinder bore	Inner diameter	Standard	78.000 - 78.015 (3.0708 - 3.0714)
		Wear limit	—
Out-of-round (Difference between “a” and “b”)		Limit	0.015 (0.0006)
Taper (Difference between “c” and “d”)			0.010 (0.0004)

Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0472)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0473)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0474)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0475)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0476)
	Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)
	Grade No. S	52.012 - 52.013 (2.0477 - 2.0477)
	Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)
	Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)
	Grade No. V	52.015 - 52.016 (2.0478 - 2.0478)
	Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

Available Piston

Unit: mm (in)



PBIC0188E

Piston skirt diameter “A”	77.965 - 77.980 (3.0694 - 3.0700)
Piston height “H” dimension	37.1 (1.460)
Piston pin hole diameter	19.006 - 19.012 (0.7482 - 0.7485)
Piston to cylinder bore clearance	0.020 - 0.050 (0.0007 - 0.0019)

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0015 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil (rail ring)	0.045 - 0.125 (0.0017 - 0.0049)	—
End gap	Top	0.20 - 0.30 (0.0078 - 0.0118)	0.50 (0.0196)
	2nd	0.35 - 0.50 (0.0137 - 0.0196)	0.66 (0.0259)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.92 (0.0362)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		18.996 - 19.002 (0.7478 - 0.7481)
Piston to piston pin oil clearance	Standard	0.008 - 0.012 (0.0003 - 0.0004)
Connecting rod bushing oil clearance	Standard	–0.018 to –0.044 (–0.0007 to –0.0017)

Connecting Rod

Unit: mm (in)

Center distance		129.84 - 129.94 (5.1118 - 5.1157)
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*		18.958 - 18.978 (0.7463 - 0.7471)
Side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0138)
Connecting rod big end diameter	Grade No. A Grade No. B Grade No. C Grade No. D Grade No. E Grade No. F Grade No. G Grade No. H Grade No. J Grade No. K Grade No. L Grade No. M Grade No. N	43.000 - 43.001 (1.6929 - 1.6929) 43.001 - 43.002 (1.6929 - 1.6930) 43.002 - 43.003 (1.6930 - 1.6930) 43.003 - 43.004 (1 6930 - 1.6931) 43.004 - 43.005 (1.6931 - 1.6931) 43.005 - 43.006 (1.6931 - 1.6931) 43.006 - 43.007 (1.6931 - 1.6932) 43.007 - 43.008 (1.6932 - 1.6932) 43.008 - 43.009 (1.6932 - 1.6933) 43.009 - 43.010 (1.6933 - 1.6933) 43.010 - 43.011 (1.6933 - 1.6933) 43.011 - 43.012 (1.6933 - 1.6934) 43.012 - 43.013 (1.6934 - 1.6934)

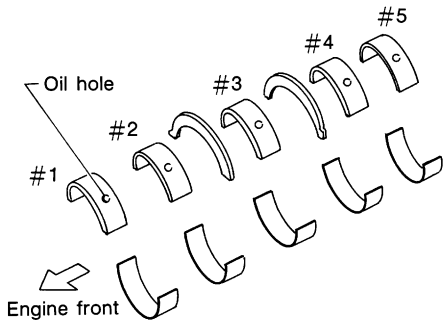
*: After installing in connecting rod

Main Bearing

INFOID:0000000006449948

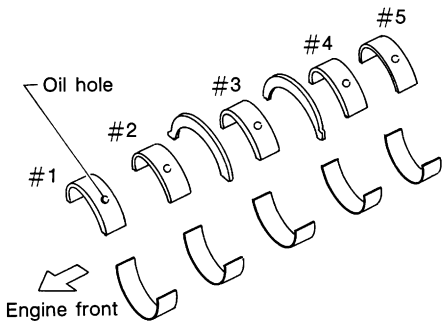
MAIN BEARING

Unit: mm (in)



SEM685D

Grade number	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0785 - 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 - 0.0790)	Yellow	
4	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
5	2.011 - 2.014 (0.0791 - 0.0792)	Pink	



SEM685D

Grade number		Thickness	Identification color	Remarks
01	UPR	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are different for 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 - 0.0790)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
	LWR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
45	UPR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
	LWR	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

Undersize

Unit: mm (in)

Items	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	0.024 - 0.034 (0.0009 - 0.0013)

Connecting Rod Bearing

INFOID:0000000006449949

CONNECTING ROD BEARING

Unit: mm (in)

Grade number		Thickness	Identification color	Remarks
0		1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are the same for upper and lower bearings.
1		1.501 - 1.504 (0.0591 - 0.0592)	Brown	
2		1.504 - 1.507 (0.0592 - 0.0593)	Green	
3		1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
4		1.510 - 1.513 (0.0594 - 0.0596)	Blue	
01	UPR	1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	
12	UPR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	
	LWR	1.504 - 1.507 (0.0592 - 0.0593)	Green	
23	UPR	1.504 - 1.507 (0.0592 - 0.0593)	Green	
	LWR	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
34	UPR	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
	LWR	1.510 - 1.513 (0.0594 - 0.0596)	Blue	

Undersize

Unit: mm (in)

Items	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.627 - 1.635 (0.0640 - 0.0644)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.029 - 0.039 (0.0011 - 0.0015)
	Limit	0.10 (0.0039)

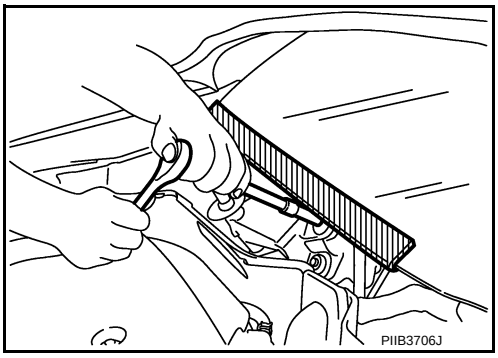
PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

INFOID:0000000006449950

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



Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:0000000006449951

NOTE:
- Before removing and installing any control units, first turn the push-button ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.
If turning the steering wheel is required with the battery disconnected or discharged, follow the operation 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. Turn the push-button ignition switch to ACC position.
   (At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the push-button ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the push-button ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT-III.

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

INFOID:0000000006449952

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 AIR BAG” and “SEAT BELT” 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 that 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 AIR BAG".**
- **Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

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

Draining Engine Coolant

INFOID:0000000006449953

Drain engine coolant and engine oil when the engine is cooled.

Disconnecting Fuel Piping

INFOID:0000000006449954

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

Removal and Disassembly

INFOID:0000000006449955

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- 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 in the step.

Inspection, Repair and Replacement

INFOID:0000000006449956

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

Assembly and Installation

INFOID:0000000006449957

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

Parts Requiring Angle Tightening

INFOID:0000000006449958

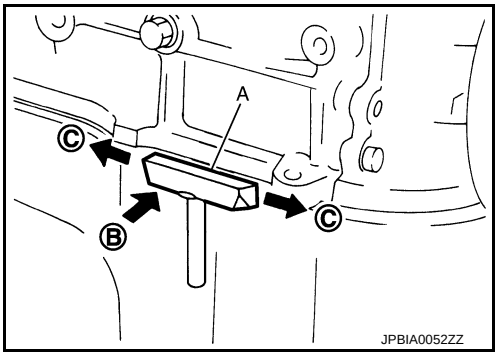
- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
- Cylinder head bolts
- Lower cylinder block bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket

INFOID:0000000006449959

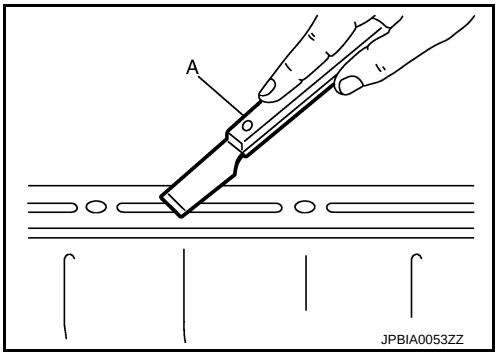
REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.
  CAUTION:
  Be careful not to damage the mating surfaces.
- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.
  CAUTION:
  If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.

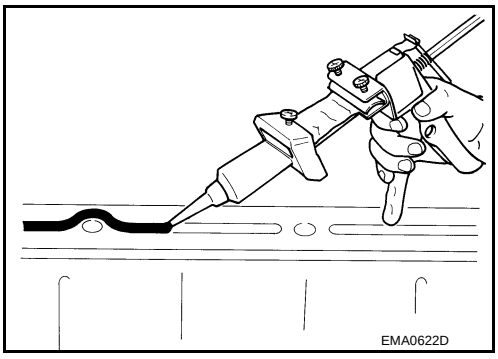


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
   - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



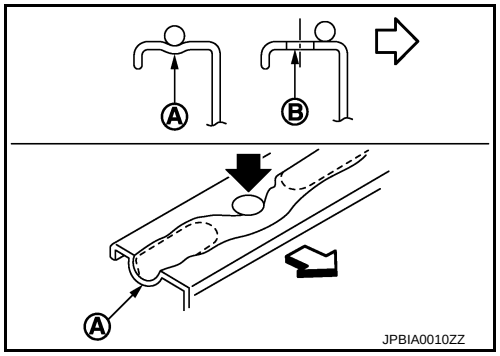
3. Attach liquid gasket tube to the tube presser (commercial service tool).
   Use Genuine Liquid Gasket or equivalent.
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

A : Groove

⇦ : Inside



- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

CAUTION:

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

Precaution for Diesel Equipment

INFOID:0000000006449960

CLEANLINESS

CLEANLINESS INSTRUCTIONS WHICH MUST BE FOLLOWED WHEN WORKING ON THE HIGH PRESSURE DIRECT INJECTION SYSTEM

Risks relating to contamination

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:
- Damage or destruction of the high pressure injection system and the engine,
- Seizing or leaking of a component.

All After-Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) get into the system during dismantling or into the circuits via the fuel unions.

The cleanliness principle must be applied from the filter to the injectors.

WHAT ARE THE SOURCES OF CONTAMINATION?

Contamination is caused by:
- Metal or plastic chips,
- Paint,
- Fibres:
  - Boxes,
  - Brushes,
  - Paper,
  - Clothing,
  - Cloths,
- Foreign bodies such as hair,
- Ambient air,
- Etc.

IMPORTANT: It is not possible to clean the engine using a high pressure washer because of the risk of damaging connections. In addition, moisture may collect in the connectors and create electrical connection malfunctions.

INSTRUCTIONS TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM
- Ensure that you have the plugs for the unions to be opened (bag of plugs sold at the Parts Stores - Nissan part No.: 16830 BN700, Renault part No.: 77 01 206 804). Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.
- Ensure that you have hermetically resealable plastic bags for storing removed parts. Stored parts will therefore be less subject to the risk of impurities. The bags must be used only once, and after use they must be thrown away.
- Lint-free towelettes to be used for injection pump related service purpose. The use of a normal cloth or paper for cleaning purposes is forbidden. These are not lint-free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

INSTRUCTIONS TO BE FOLLOWED BEFORE OPENING THE FUEL CIRCUIT
- For each operation, use new thinner (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not shed its bristles).
- Use a brush and thinners to clean the connections to be opened.

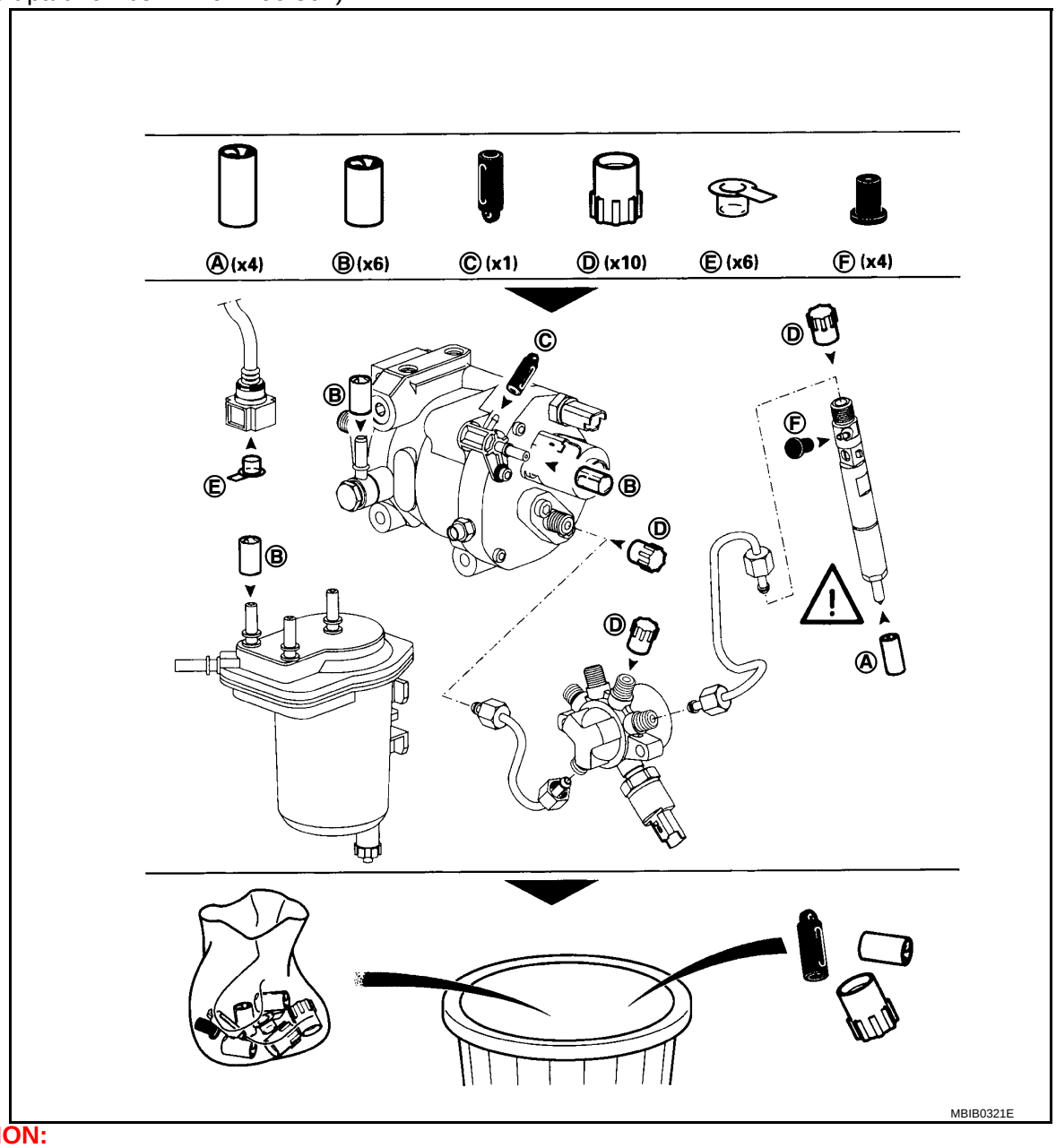
- Blow compressed air over the cleaned parts (tools, cleaned the same way as the parts, connections and injection system zone). Check that no bristles remain adhered.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover these with latex gloves.

INSTRUCTIONS TO BE FOLLOWED DURING THE OPERATION

- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available from the Parts Stores - Nissan part No.: 16830 BN700, Renault part No.: 77 01 206 804. They must not, under any circumstances, be reused.
- Close the hermetically sealed bag, even if it has to be reopened shortly afterwards. Ambient air carries contamination.
- All components of the injection system that are removed must be stored in a hermetically sealed plastic bag once the plugs have been inserted.
- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. These items are likely to allow impurities to enter the system.
- A new component replacing an old one must not be removed from its packaging until it is to be fitted to the vehicle.

Instructions for Fitting the Plugs

Nissan part number: 16830 BN700
(Renault part number: 77 01 206 804)



CAUTION:

- **The engine must not run with:**

- **Diesel containing more than 10% diester**
- **Petrol, even in very small amounts.**

• **The system can inject the diesel into the engine at a pressure of up to 140,000 kPa (1,400 bar, 1,428 kg/cm^2, 20,300 psi). Before carrying out any work, check that the injector rail is no longer pressurized and that the fuel temperature is not too high.**
• **You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.**

SPECIAL FEATURES

CAUTION:

• **The engine must not operate with:**
- **Diesel engine fuel containing more than 10% diester,**
- **Petrol, even in tiny quantities.**

• **The system can inject the diesel into the engine at a pressure up to 1400 bars. Before carrying out any work, check that the injector rail is not under pressure and that the fuel temperature is not too high.**
• **You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.**
• **Removal of the interior of the pump and injectors is prohibited. Only the flow actuator, the fuel temperature sensor and the venturi can be replaced.**
• **For safety reasons, it is strictly forbidden to slacken a high pressure pipe union when the engine is running.**
• **It is not possible to remove the pressure sensor from the fuel rail because this may cause circuit contamination malfunctions. If the pressure sensor fails, the pressure sensor, the rail and the five high pressure pipes must be replaced.**
• **It is strictly forbidden to remove any injection pump pulley marked number 070 575. If the pump is being replaced, the pulley must be replaced.**
• **It is forbidden to repair the wiring connecting the knock sensor (accelerometer) and the CKP sensor (engine speed sensor). If the wiring should fail, it has to be replaced with new wiring.**
• **Applying 12 volts directly to any component in the system is prohibited.**
• **Ultrasonic carbon removal and cleaning are prohibited.**
• **Never start the engine without the battery being connected correctly.**
• **It is essential to replace all the disconnected air inlet plastic pipes.**

There is a 16 digit code on the injectors called individual injector correction. This code is specific to each injector, and takes into account differences in manufacture and specifies the flow injected by each of them.
When an injector is replaced, it is necessary to program the code of the new injector into the ECM. Refer to EC-919, "Diagnosis Procedure".

INSTRUCTIONS FOR HIGH PRESSURE PIPES

CAUTION:

All the high pressure pipe removed must be systematically replaced along with the clips.

TIGHTENING THE HIGH PRESSURE PIPES

NOTE:

fit the pump/rail pipe before the rail/injector pipes.

Rail-pump pipe

• Undo the rail,
• Grease the threads of the high pressure pipe nuts,
• Insert the high pressure pipe olive into the taper of the high pressure pump outlet,
• Insert the high pressure pipe olive into the taper of the high pressure rail inlet.
• Move the nut into position by hand, on the rail side then the pump side,
• Tighten the rail,
• Tighten the high pressure pipe nuts on the rail side then on the pump side.

Rail/injector pipes

• Undo the rail,
• Grease the threads of the high pressure pipe nuts,
• Insert the high pressure pipe olive into the taper of the high pressure injector inlet,
• Insert the high pressure pipe olive into the taper of the high pressure rail outlet,
• Move the nuts into position by hand, on the injector side then the rail side,
• Tighten the rail,
• Ensure that the new clip, supplied with the new high pressure pipe, is fitted,
• Tighten the nuts of the high pressure pipes on the injector side first and then on the fuel rail side.

NOTE:
Before fitting a new high pressure pipe, move back the nuts on the pipe then lightly lubricate the nut threads with the oil from the sachet provided in the parts kit.
CHECKING SEALING AFTER REPAIR
CAUTION:
After any operation, check that there are no diesel leaks.
- Reprime the circuit using the priming pump.
- Start the engine and allow to warm up at idle speed, visually inspecting for any fuel leaks.
- Apply tracing fluid around the high pressure connections of the pipe that has been replaced.
- Once the engine coolant temperature is above **50°C** and provided there are no malfunctions present, carry out a road test, taking the engine speed up to **4000 rpm** at least once to check that there are no leaks.
- Perform a visual inspection after the road test to make sure that there are no high pressure leaks.
- Clean off the tracing fluid.

REPLACING THE INJECTORS
NOTE:
Individual injector correction is a factory calibration carried out on each injector to adjust the flow of each one precisely, taking into account differences in manufacture.
The correction values are written on a label affixed to each injector then entered in the ECM which can then control each injector by taking account of their differences in manufacture.
The system can be programmed “WORK SUPPORT” mode with CONSULT-III.
The correction values (16 digit code) must be replaced after replacing an injector. Refer to EC-919, "Diagnosis Procedure".
- **Entering each injector's individual correction value, when replacing the ECM. Refer to EC-879, "Description".**

Parts To Be Replaced After Removal

INFOID:0000000006449961

- All gaskets
- Flywheel bolts
- Crankshaft bearing bolts
- Camshaft pulley bolt
- Crankshaft pulley bolts
- Big end cap bolts
- Injector holder copper washers
- Fuel injection tubes
- Pipe plugs
- Belts
- Timing belt tension wheel
- Oil jets
- Turbocharger plastic pipes

Installation of Thread Inserts

INFOID:0000000006449962

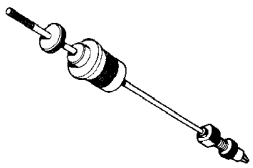
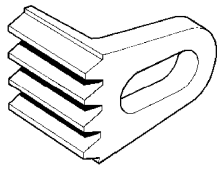
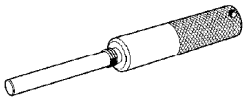
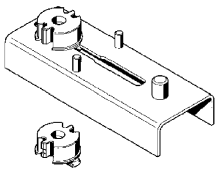
Threaded holes on all engine component parts can be repaired by using thread inserts.

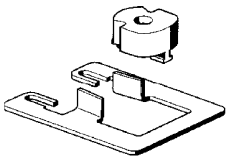
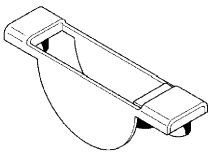
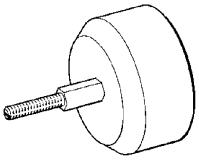
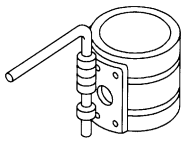
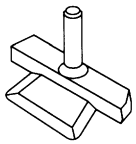
PREPARATION

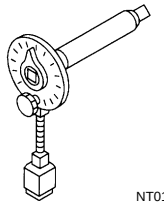
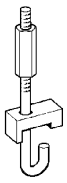
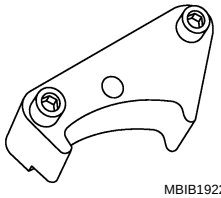
PREPARATION

Special Service Tool

INFOID:0000000006449963

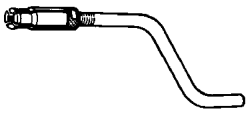
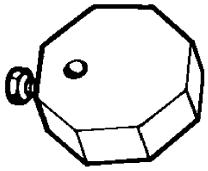
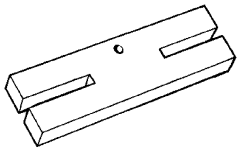
NISSAN tool number (RENAULT tool No.) Tool name		Description
KV113B0020 **(Emb. 880)** **Sliding hammer**	 MBIB0358E	Inertia extractor
KV113B0060 **(Mot. 582-01)** **Ring gear stopper**	 MBIB0363E	Flywheel immobilizing tool.
KV113B0110 **(Mot. 1430)** **TDC set pin**		Set of TDC pins
KV113B0120 **(Mot. 1485-01)** **Oil jet remover**	 MBIB0372E	Tool for removing the piston bottom oil jets
KV113B0130 **(Mot. 1489)** **TDC set pin**	 MBIB0373E	TDC setting pin
KV113B0140 **(Mot. 1492)** **Bearing assembling set**	 MBIB0374E	Tool for installing connecting rod bearing

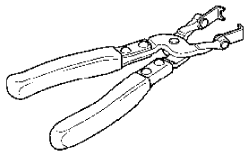
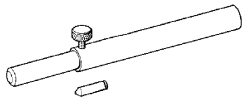
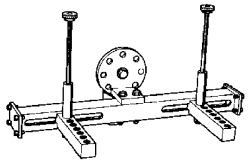
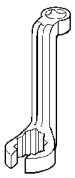
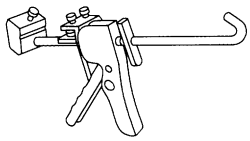
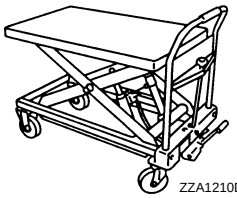
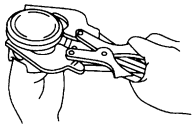
NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0150 **(Mot. 1492-03)** **Bearing assembling adapter**  MBIB0375E	Adaptation kit for installing the detachable cap connecting rod bearing
KV113B0160 **(Mot. 1493-01)** **Bearing insert**  MBIB0376E	Tool for installing main bearing
KV113B0170 **(Mot. 1494)** **Oil jet remover plate**	Tool for removing oil jets
KV113B0190 **(Mot. 1567)** **Clip pliers**	Pliers for exhaust gas recycling pipe clips
KV113B0210 **(Mot. 1585)** **Front oil seal drift**  MBIB0381E	Tool for installing crankshaft seals, flywheel end
KV113B0220 **(Mot. 1586)** **Front oil seal drift set**	Tool for installing crankshaft seals, timing end
KV113B0230 **(Mot. 1632)** **Camshaft seal insert**	Tool for installing inlet camshaft seals
KV113B0240 **(Rou. 15-01)** **Shaft protector**	Internal shaft protector **16 mm (0.63 in) dia.**
EM03470000 **(—)** **Piston ring compressor**  NT044	Installing piston assembly into cylinder bore
KV10111100 **(—)** **Seal cutter**  NT046	Removing oil pan

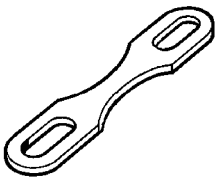
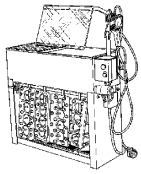
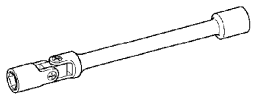
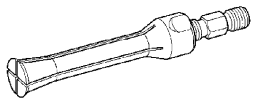
NISSAN tool number (RENAULT tool No.) Tool name		Description
KV10112100 (—) Angle wrench	 NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle
— (Mot. 1638) Belt tension gauge	 MBIB0382E	Setting drive belt tension
— (Mot. 1606-A) Camshaft pulley holder	 MBIB1922E	Tool for locking sprockets for toothed timing belt

Commercial Service Tool

INFOID:0000000006449964

NISSAN tool number (RENAULT tool No.) Tool name		Description
KV113B0030 (Mot. 11) Crankshaft bearing remover	 MBIB0359E	Crankshaft bearing extractor
KV113B0040 (Mot. 251-01) Dial gauge stand set	 MBIB0360E	Gauge stand used with KV113B0050 (Mot. 252-01)
KV113B0050 (Mot. 252-01) Dial gauge stand set	 MBIB0361E	Thrust plate for measuring the protrusion of cylinder liners used with KV113B0040 (Mot. 251-01).

NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0090 (Mot. 1335) Valve seal remover  MBIB0370E	Tool for removing valve stem seals
KV113B0180 (Mot. 1511-01) Valve seal drift  MBIB0378E	Tool for installing valve stem seals
KV113B0200 (Mot. 1573) Cylinder head stand  MBIB0380E	Cylinder head support
KV113E0010 (Mot. 1566) Fuel spill tube spanner  MBIB0379E	Spanner for installing and removing high pressure pipes
WS39930000 (—) Tube presser  NT052	Pressing the tube of liquid gasket
Manual lift table caddy  ZZA1210D	Removing and installing engine
Piston ring expander  NT030	Removing and installing piston ring

NISSAN tool number (RENAULT tool No.) Tool name	Description
(Mot. 588)  MBIB0364E	Liner retaining strap
(664000) Cylinder head test container  MBIB0383E	Tool for testing the cylinder head, including: a tray and the various kits suited for each model of cylinder head (plug, sealing plate, blanking plate).
Torx socket	Standard 1/2" (12.7 mm) square drive 8/12 /14 female torx socket.
(Mot. 1505) (Mot. 1715) Frequency meter  MBIB1423E	Tool for belt tension checking with frequency
Glow plug wrench  MBIB0387E	Articulated wrench for removing and installing the glow plugs
Main bearing wrench  MBIB0388E	Wrench for removing main bearings

BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

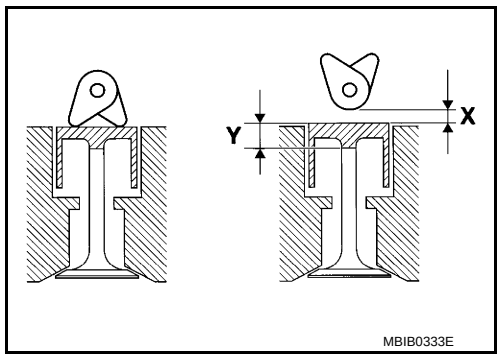
Valve Clearance

INFOID:0000000006449965

CHECKING AND ADJUSTING THE VALVE CLEARANCE

1. Install the tappet.
2. Install the camshaft.
3. Install the camshaft brackets.

: **11 N·m (1.1 kg-m, 8 ft-lb)**



4. Place the valves of the cylinder concerned at the “end of exhaust - beginning of inlet” position and check the clearance (X).
   NOTE:
   Dimension (Y) corresponds to the tappet thickness sizes (there are 25 sizes at the service parts).

1	**4**
3	**2**
4	**1**
2	**3**

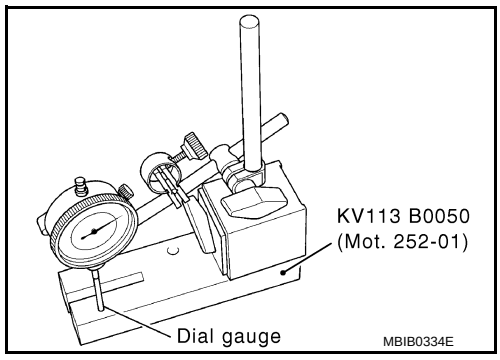
5. Compare the values recorded with the values specified, then replace the tappets which are not within tolerance.

Clearance, when the engine cold:

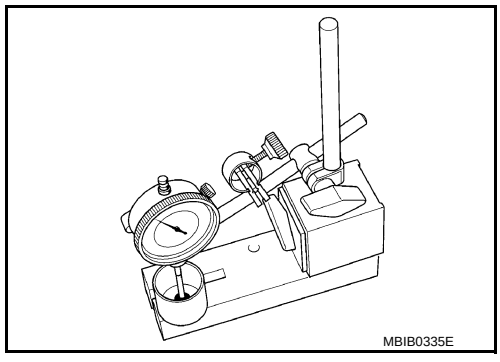
Intake : 0.125 - 0.25 mm (0.0049 - 0.0098 in)

Exhaust : 0.325 - 0.45 mm (0.0128 - 0.0177 in)

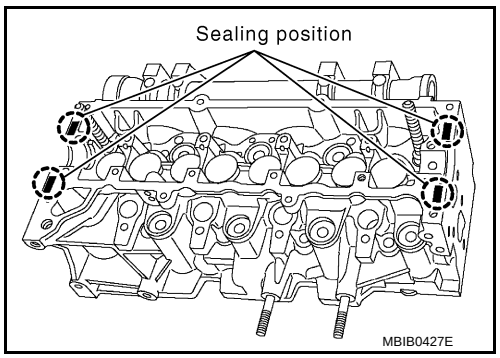
6. Remove the camshaft brackets.
7. Remove the camshaft.
8. Remove the tappet not within tolerance.
   Determining dimension Y.
   Set up the following assembly using KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool and dial gauge, then calibrate the gauge.



9. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.
   - Note dimension (Y) and repeat the operation for the tappets where the valve clearance is not within tolerance.
   - Refer to the Replacement Parts Catalogue for the vehicle concerned to select the various thicknesses of the tappet(s).
10. Check the valve clearance again.
11. Remove the camshaft brackets.
12. Remove the camshaft.
13. Remove the tappet(s) not within tolerance.



14. Grease the underside of the tappets and the camshaft brackets.
15. Degrease the gasket faces (of the cylinder head and brackets 1 and 6). They should be clean, dry and free from grease (in particular, remove finger marks).
16. Lay four beads of Loctite with a width of 1 mm (0.04 in) on brackets 1 and 6 of the cylinder head.
17. Install the camshaft.
18. Install the camshaft brackets (these are numbered from 1 to 6 and bearing (1) should be positioned on the flywheel end).



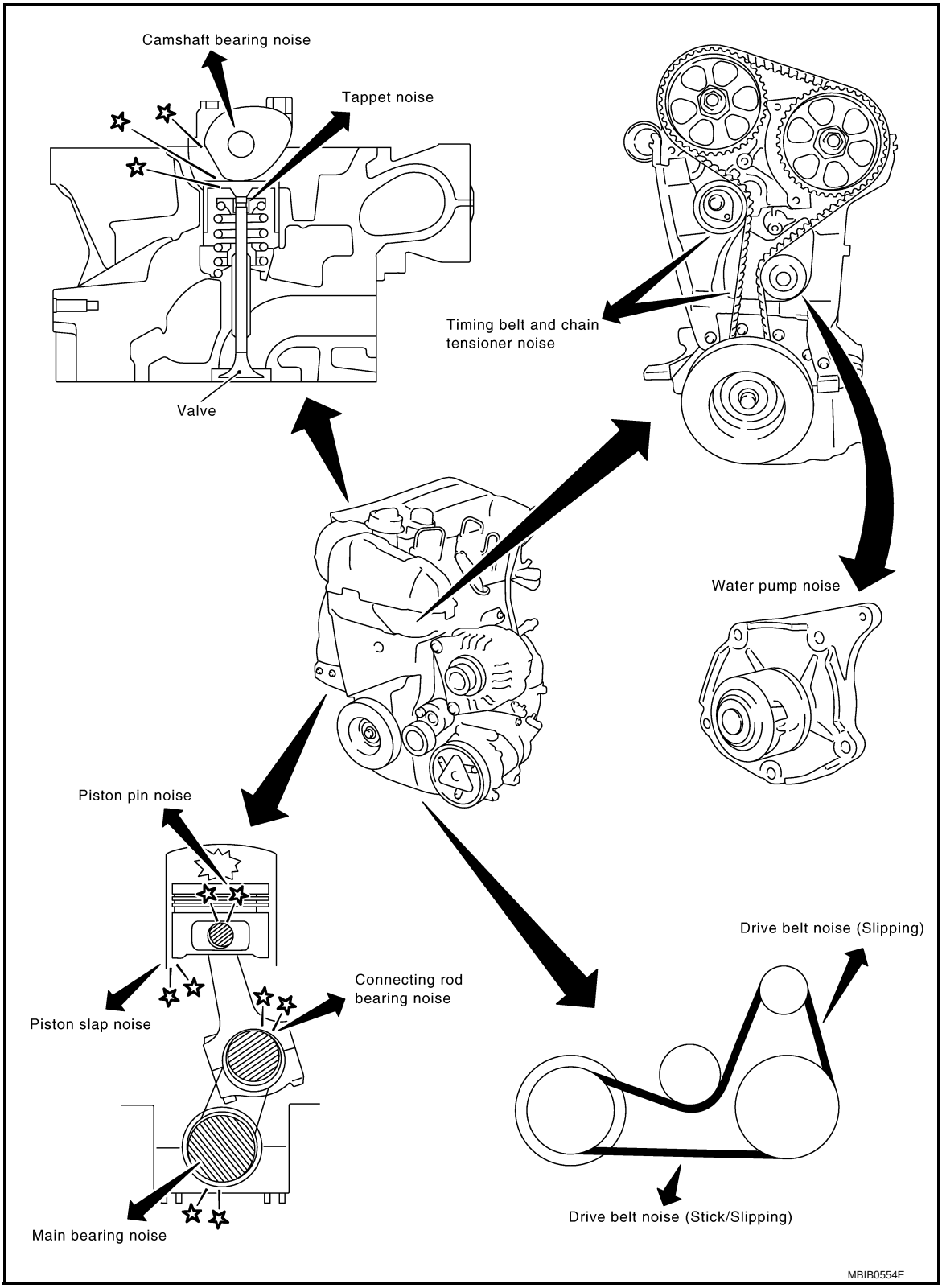
: **11 N·m (1.1 kg-m, 8 ft-lb)**

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:0000000006449966



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

INFOID:0000000006449967

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-272
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring end gap	EM-353
Front of engine Timing belt cover	Tapping or ticking	A	A	—	B	B	B	Timing belt tensioner noise	Timing belt tensioner operation	EM-302
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-276
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-70

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

PERIODIC MAINTENANCE

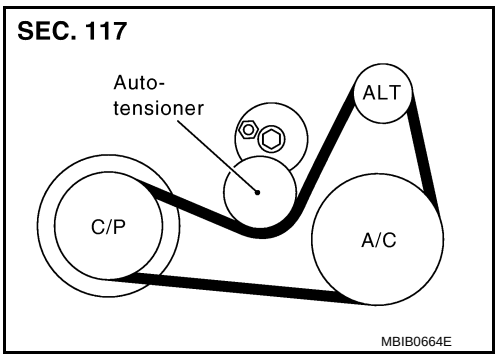
DRIVE BELT

Checking Drive Belts

INFOID:0000000006449968

WARNING:
Be sure to perform when the engine is stopped.

1. Inspect belts for cracks, fraying, wear and oil. If necessary, replace.
2. Evaluate manually if the belt is enough tensioned (tension cannot be measured by way of frequency meter).
   CAUTION:
   Auto-tensioner must be replaced with a new one when the belt is replaced.



Tension Adjustment

INFOID:0000000006449969

Belt tensioning is not necessary, as it is automatically adjusted by auto-tensioner.

Removal and Installation

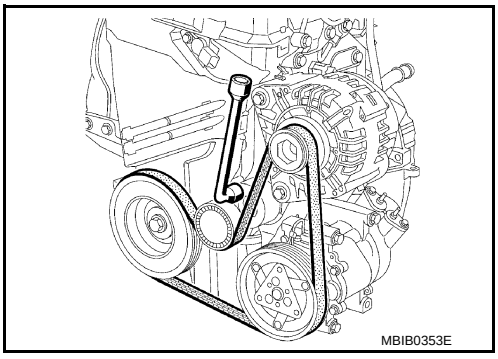
INFOID:0000000006449970

CAUTION:
- **Replace any belt that has been removed with a new one.**
- **Auto-tensioner must be replaced with new ones when the belt is replaced.**
- **Never run the engine without the drive belts to avoid damaging the crankshaft pulley.**

REMOVAL

1. Remove engine undercover.
2. Remove RH front wheel.
3. Remove fender protector RH. Refer to EXT-22, "Exploded View".
4. Remove drive belt.

- Turn clockwise adjusting bolt.



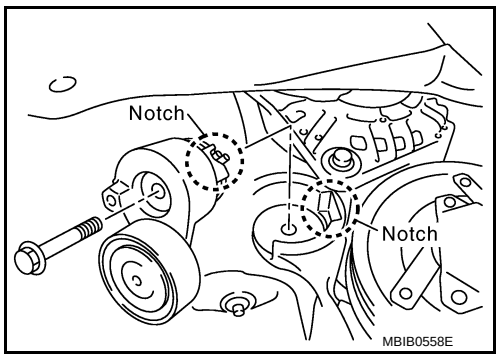
5. If necessary, remove auto-tensioner.

INSTALLATION

1. Install auto-tensioner mounting bolt.

Auto-tensioner mounting bolt : 40 N·m (4.1 kg-m, 30 ft-lb)

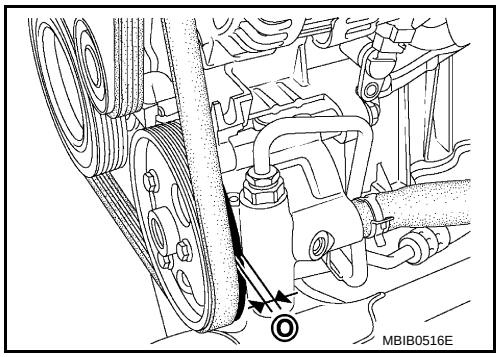
- Align the notch and tighten mounting bolt.



2. Install the drive belt.

CAUTION:

- **Make sure belt is correctly engaged with the pulley groove.**
- **Check for oil and coolant on belt and each pulley groove.**
- **Certain drive belts have five teeth whereas the air conditioning compressor pulley, power-assisted steering pump pulley, and alternator pulley all have six teeth.In this case, it is essential to check that inner tooth (O) of the pulleys remains free when fitting the drive belt.**
  Never turn the engine in the opposite direction to its normal operating direction.
  Use a brush to remove any deposits from the crankshaft pulley V grooves.
  For engines fitted with a mechanical tensioning roller, it is essential to replace the tensioning roller mounting bolts.

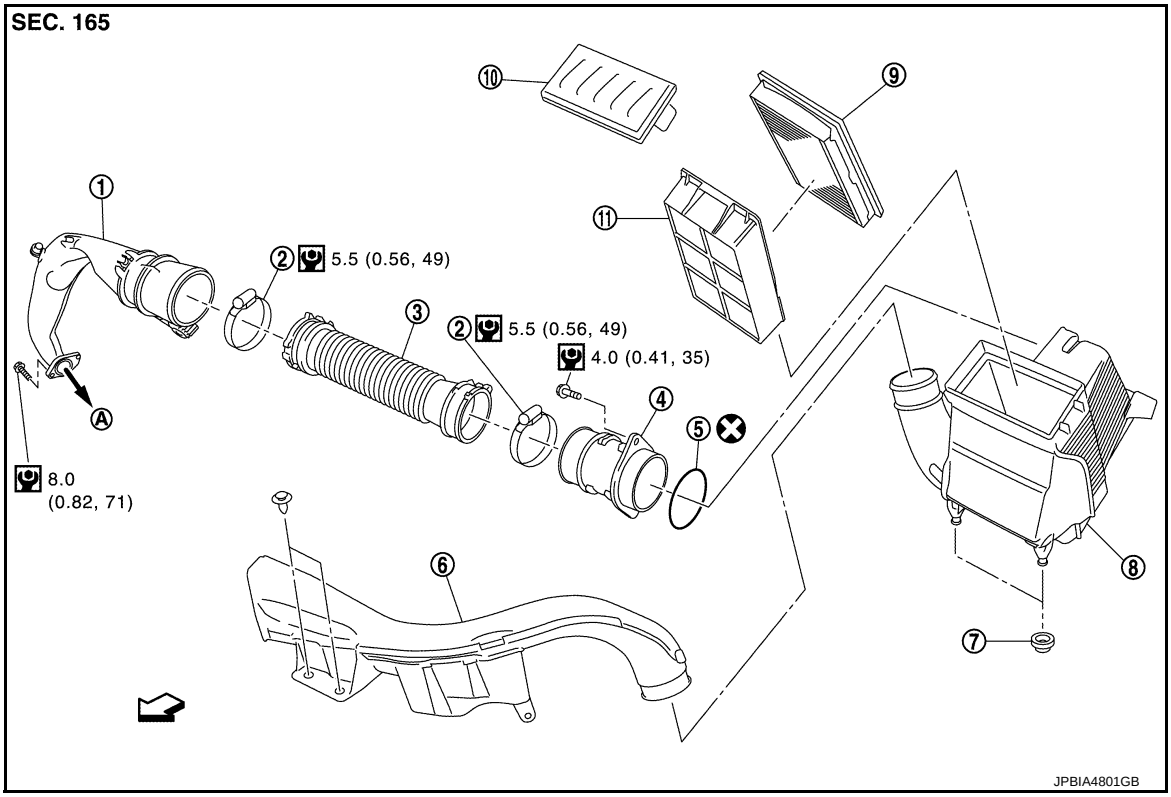


3. Make sure that tension of each belt is within the standard.

AIR CLEANER FILTER

Exploded View

INFOID:0000000006449971



1. Turbocharger air inlet pipe
2. Clamp
3. Air duct (suction)
4. Air mass flow sensor
5. O-ring
6. Air duct (inlet)
7. Grommet
8. Air cleaner case
9. Air cleaner filter
10. Cover
11. Holder

A. : To turbocharger

⇦ : Vehicle front

: N·m (kg-m, in-lb)

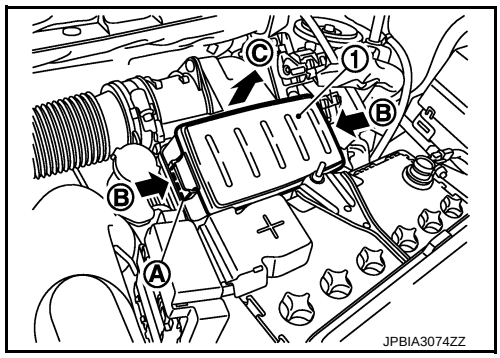
: Always replace after every disassembly.

Removal and Installation

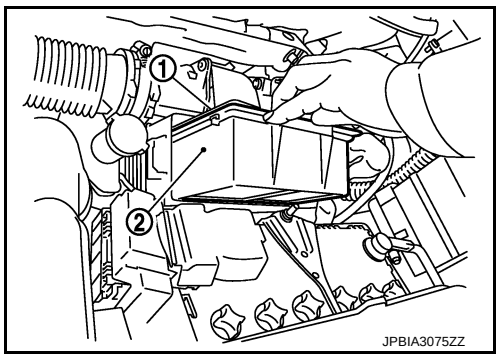
INFOID:0000000006449972

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.



INSTALLATION

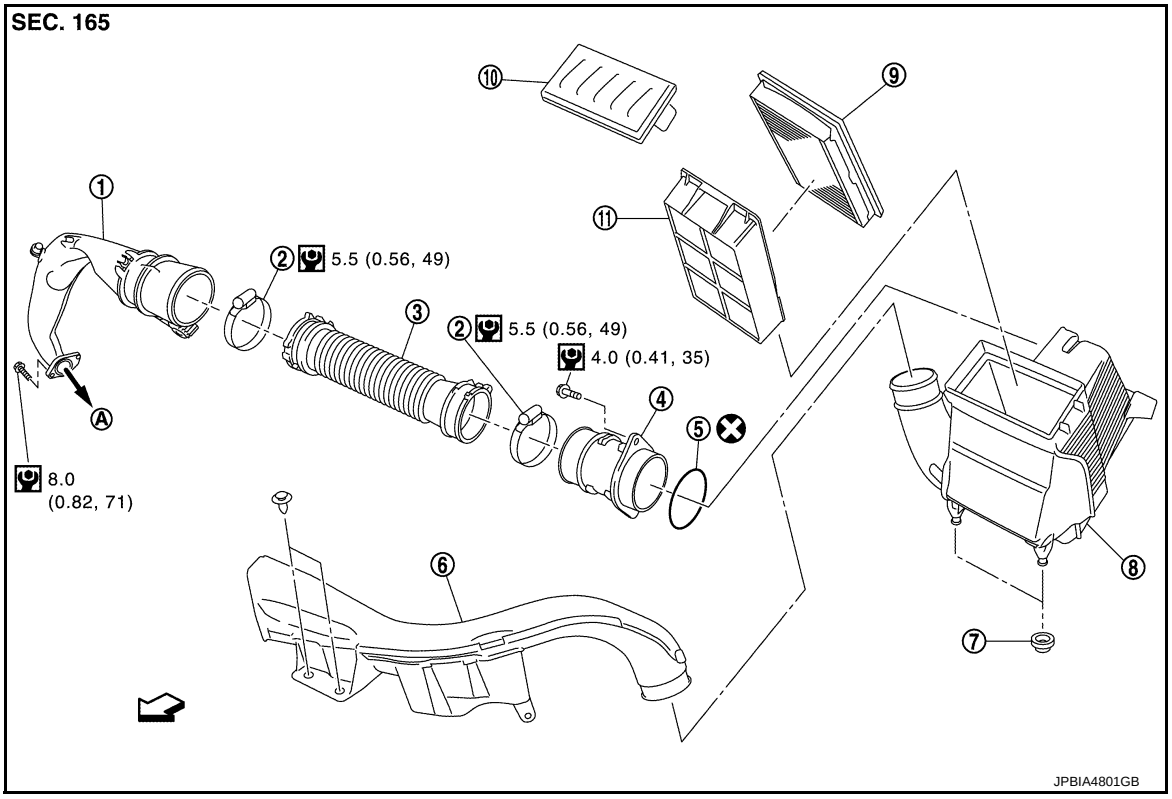
Install in the reverse order of removal.

REMOVAL AND INSTALLATION

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:0000000006449973



1. Turbocharger air inlet pipe
2. Clamp
3. Air duct (suction)
4. Air mass flow sensor
5. O-ring
6. Air duct (inlet)
7. Grommet
8. Air cleaner case
9. Air cleaner filter
10. Cover
11. Holder

A. : To turbocharger

⇦ : Vehicle front

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006449974

REMOVAL

1. Remove resonator.
2. Remove air duct (inlet).
3. Remove battery. Refer to PG-124, "Exploded View".
4. Remove air duct (suction).
5. Disconnect mass air flow sensor harness connector.
6. Remove air cleaner case by sliding the air cleaner case frontward.
   CAUTION:
   Slide the air cleaner case carefully so as not to damage it on the air cleaner case and harness bracket.

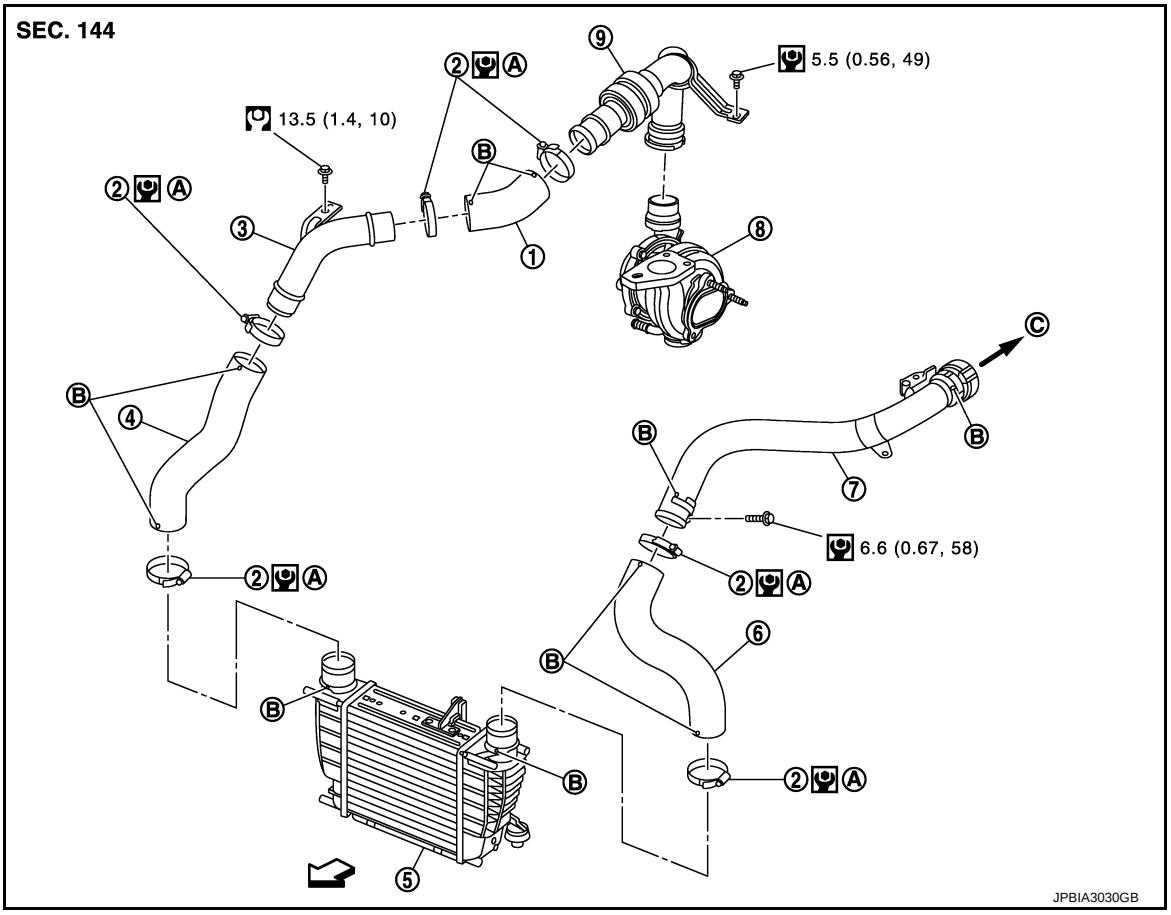
INSTALLATION

- Install in the reverse order of removal.

CHARGE AIR COOLER

Exploded View

INFOID:0000000006449975



1. Air inlet hose	2. Clamp	3. Air inlet tube
4. Air inlet hose	5. Charge air cooler	6. Air inlet hose
7. Air inlet tube	8. Turbocharger	9. Air inlet tube assembly
A. 1st step: 5.0 N·m (0.51 kg-m, 44 ft-lb) 2nd step: 7.0 N·m (0.71 kg-m, 62 ft-lb)	B. Paint mark	C. To electric throttle control actuator

⇦ : Vehicle front

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

Removal and Installation

INFOID:0000000006449976

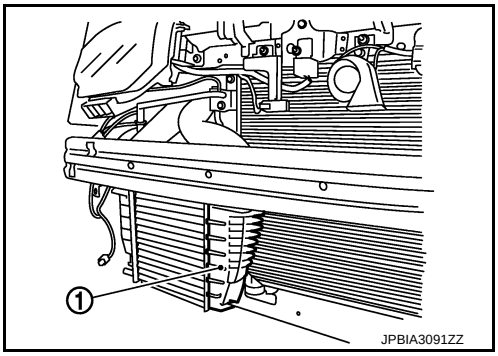
REMOVAL

1. Remove front bumper. Refer to EXT-12, "Exploded View".
2. Remove air guide (RH).
3. Remove air inlet hose between air inlet tube and charge air cooler.

4. Remove charge air cooler (1).

CAUTION:

- **Avoid interference between the charge air cooler and radiator.**
- **When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.**



INSTALLATION

Install in the reverse order of removal paying attention to the following points:

- Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
- Pay attention to identification mark and direction.
- When installing air inlet hoses and tubes. Refer to EM-281, "Removal and Installation".

Inspection

INFOID:0000000006449977

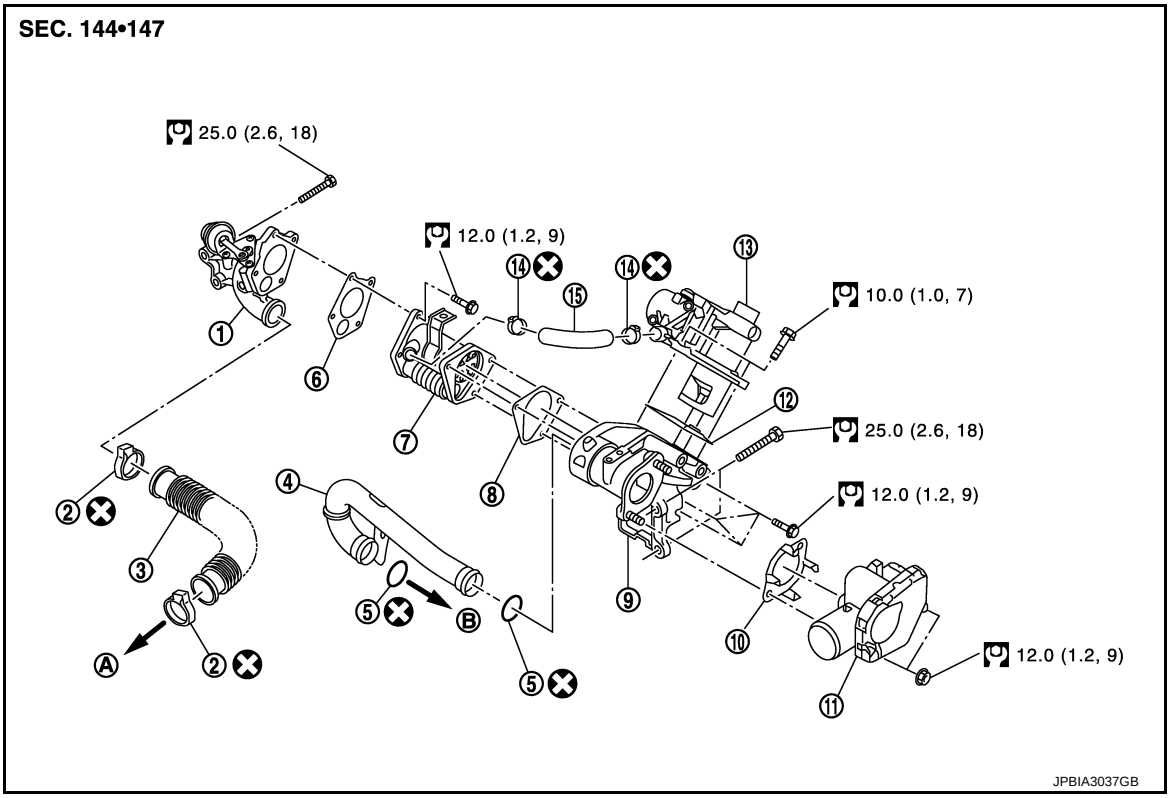
INSPECTION AFTER REMOVAL

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler in necessary.
   - Be careful not to deform core fins.
   - For cleaning procedure of charge air cooler core, refer to CO-59, "Inspection".

EGR VALVE

Exploded View

INFOID:0000000006449978



1. EGR valve assembly
2. Clamp
3. EGR tube
4. Air inlet tube
5. O-ring
6. Gasket
7. EGR cooler
8. Gasket
9. EGR volume control valve housing
10. Gasket
11. Electric throttle control actuator
12. Gasket
13. EGR volume control valve
14. Clamp
15. Cooling hose

A. To exhaust manifold
B. To intake manifold

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006449979

REMOVAL

1. Drain engine coolant. Refer to CO-62, "Draining".
2. Remove air cleaner case. Refer to EM-280, "Exploded View".
3. Remove cowl top extension. Refer to EXT-20, "Exploded View".
4. Remove turbocharger air inlet pipe. Refer to EM-280, "Exploded View".
5. Remove air inlet tube assembly and air inlet tube. Refer to EM-281, "Exploded View".
6. Remove electric throttle control actuator.
7. Disconnect EGR solenoid valve connector.
8. Remove cooling hose.
9. Remove EGR volume control valve housing mounting bolts.
10. Remove EGR assembly.

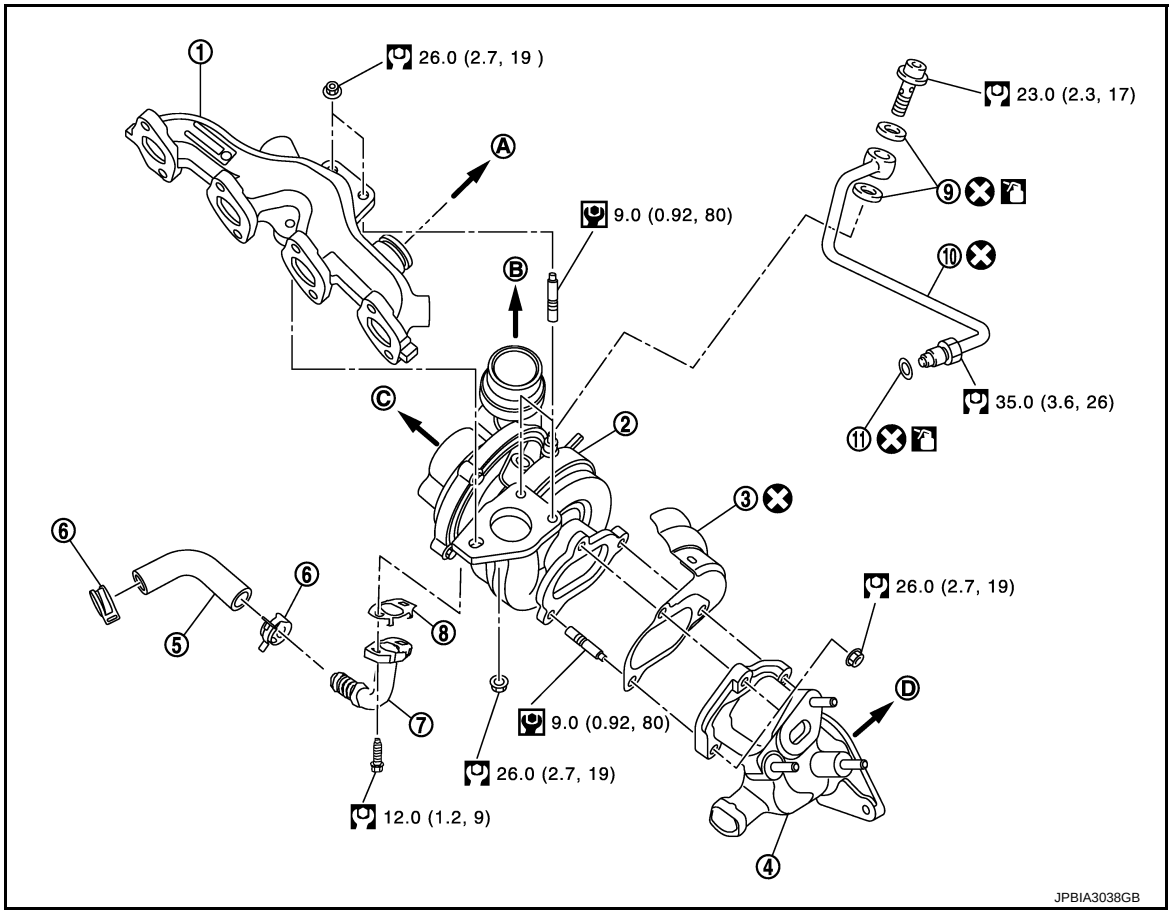
INSTALLATION

- Install in the reverse order of removal.

TURBOCHARGER

Exploded View

INFOID:0000000006449980



1. Exhaust manifold
2. Turbocharger
3. Gasket
4. Turbocharger outlet duct
5. Oil outlet hose
6. Clamp
7. Oil return pipe
8. Gasket
9. Washer
10. Oil supply tube
11. O-ring
A. To EGR tube
B. To air inlet pipe
C. To turbocharge air inlet pipe
D. To diesel particular filter assembly

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

Removal and Installation

INFOID:0000000006449981

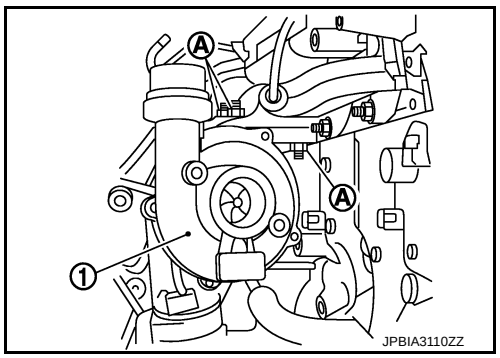
REMOVAL

1. Remove air cleaner case. Refer to EM-280, "Exploded View".
2. Remove cowl top extension. Refer to EXT-20, "Exploded View".
3. Drain engine coolant. Refer to CO-62, "Draining".
4. Remove diesel particular filter assembly. Refer to EX-17, "Exploded View".
5. Remove EGR volume control valve housing. Refer to EM-283, "Exploded View".
6. Remove EGR cooler.

7. Disconnect 5th injector quick connector and harness connector.
8. Remove oil tubes.
9. Remove turbocharger outlet duct bracket.
10. Remove turbocharger assembly (1) as follows:
NOTE:
After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts (A) to remove.

a. Remove turbocharger oil outlet hose.

CAUTION:
Be careful not to deform each turbocharger piping when pulling out the assembly.



11. Remove turbocharger outlet duct.

INSTALLATION

Install in the reverse order of removal.

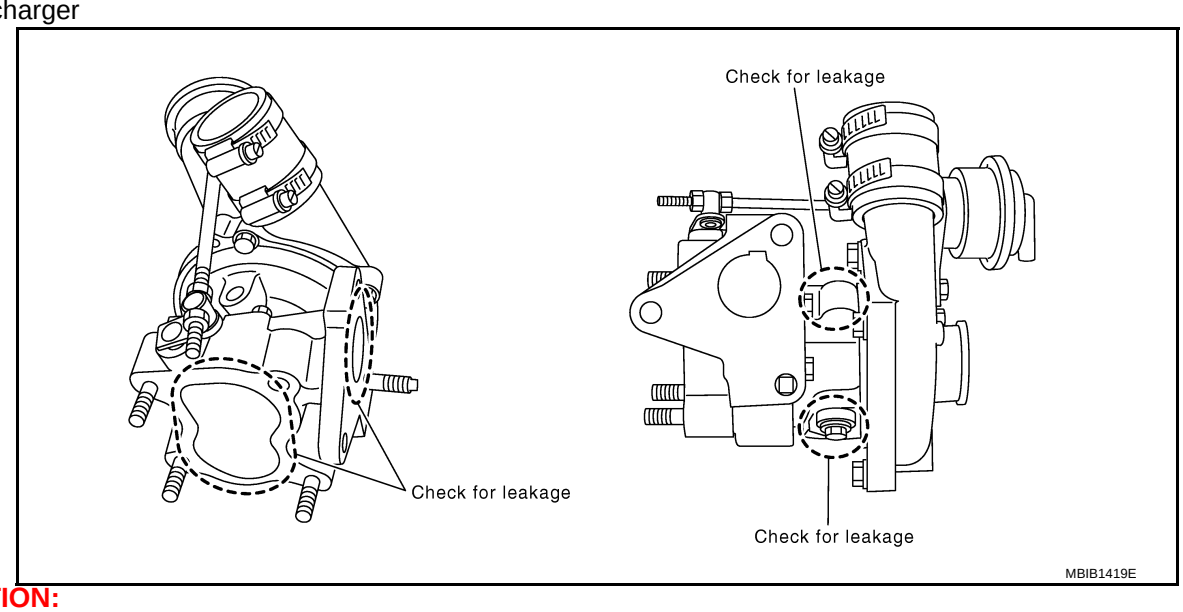
NOTE:
Apply LOCTITE FRENETANCH or equivalent to the threads of the turbocharger oil inlet pipe union to the cylinder head.

Inspection

INFOID:0000000006449982

INSPECTION AFTER REMOVAL

Turbocharger



CAUTION:
When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and air cleaner
Exhaust side : Between turbocharger and outlet duct

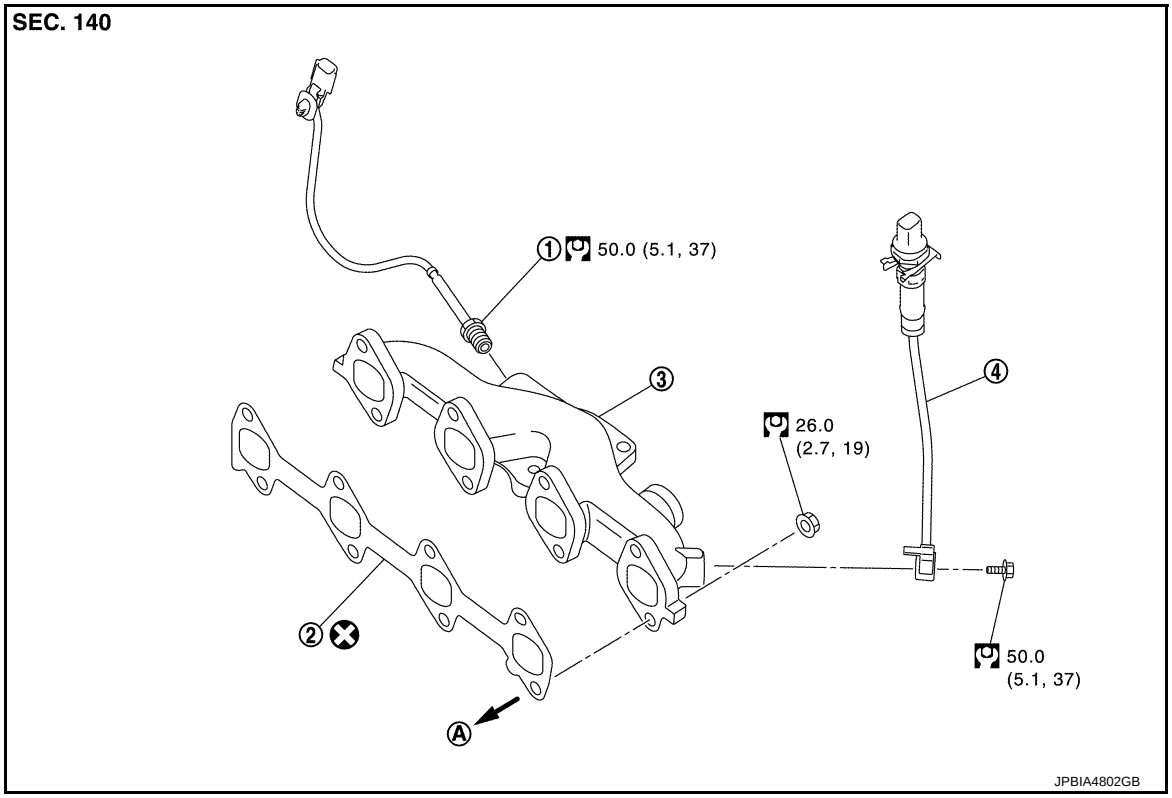
INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

EXHAUST MANIFOLD

Exploded View

INFOID:0000000006449983



1. Exhaust gas temperature sensor 1
2. Gasket
3. Exhaust manifold
4. Exhaust gas pressure sensor 1
A. To cylinder head

: N·m (kg-m, ft-lb)

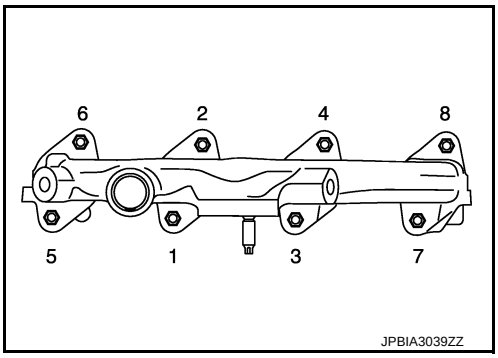
: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006449984

REMOVAL

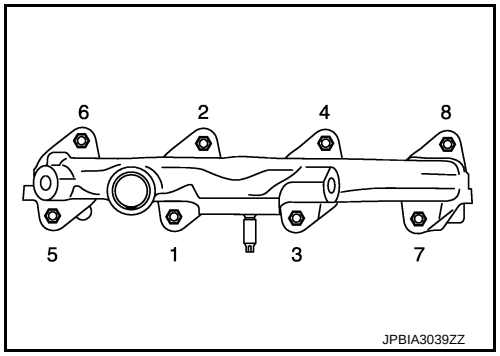
1. Remove turbocharger assembly. Refer to EM-284, "Exploded View".
2. Loosen exhaust manifold mounting nuts in the reverse order as shown.



3. Remove exhaust manifold.

INSTALLATION

1. Tighten the mounting nuts in numerical order as shown.



JPBIA3039ZZ

2. Install in reverse order of removal after this step.

Inspection

INFOID:0000000006449985

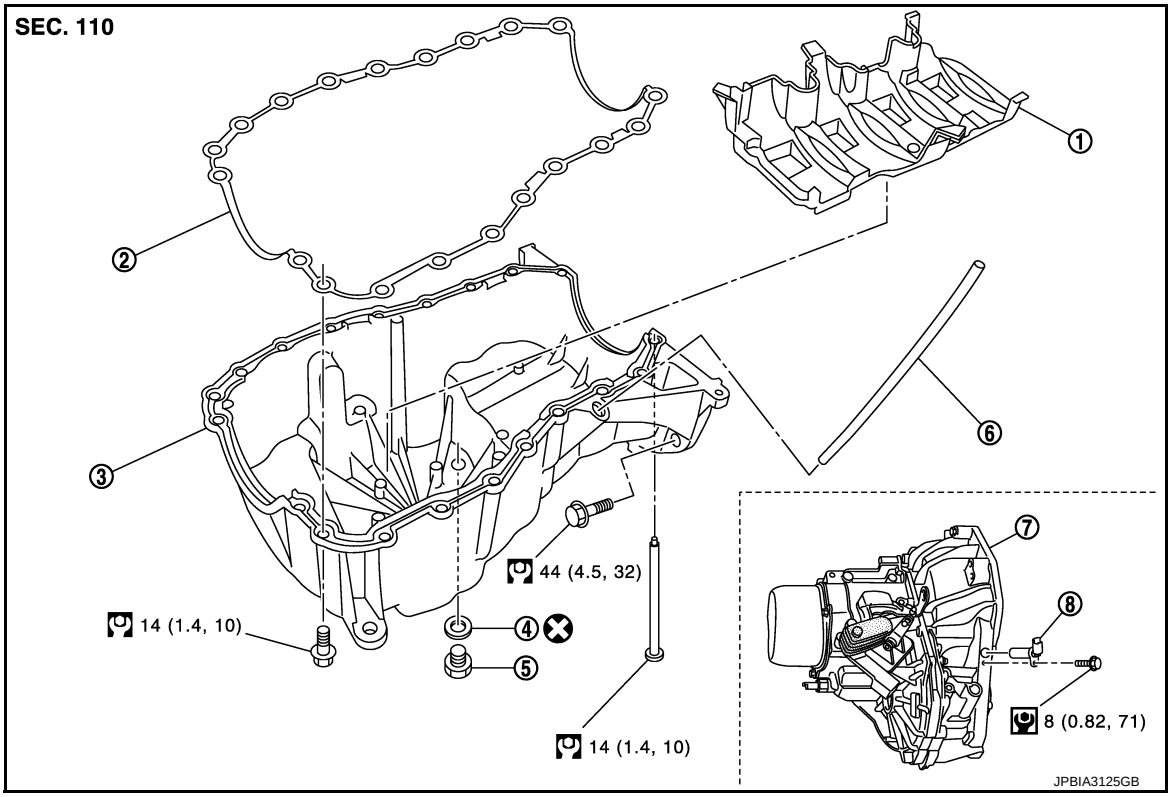
INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

OIL PAN

Exploded View

INFOID:0000000006449986



1. Baffle plate
2. Gasket
3. Oil pan
4. O-ring
5. Drain plug
6. Oil level gauge guide
7. Transaxle
8. Crankshaft position sensor (POS)

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

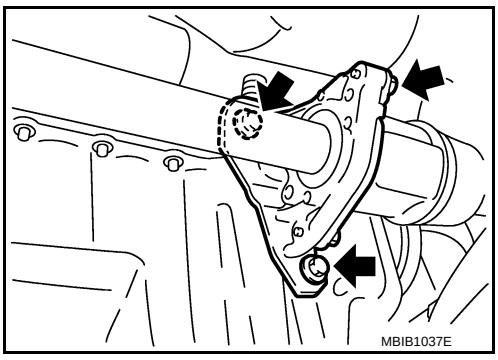
INFOID:0000000006449987

REMOVAL

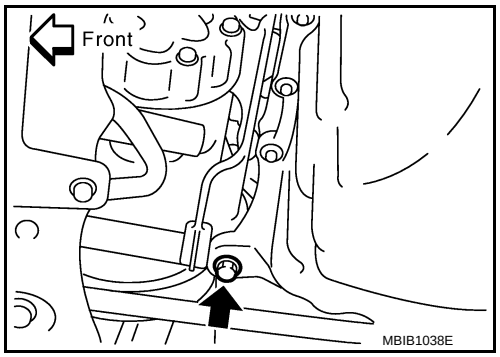
CAUTION:

Never drain engine oil when the engine is hot to avoid the danger of being scalded.

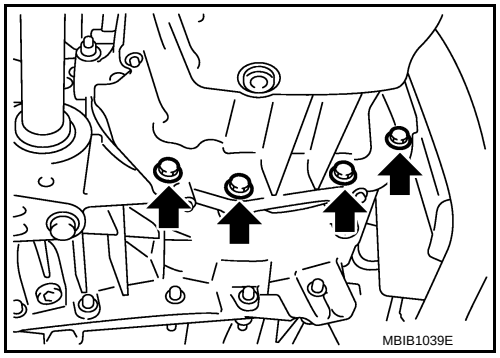
1. Remove engine under cover.
2. Remove RH front wheel. Refer to WT-7, "Exploded View".
3. Remove fender protector RH. Refer to EXT-22, "Exploded View".
4. Remove engine mounting bracket. Refer to EM-326, "Exploded View".
5. Remove center bearing bracket as shown.



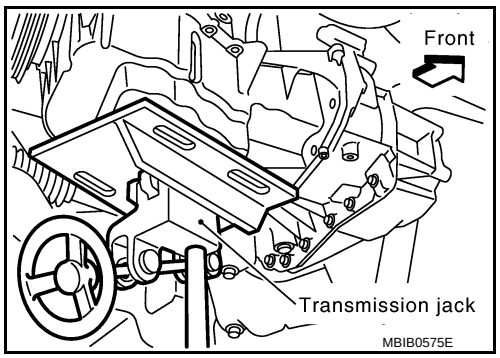
6. Remove A/C compressor bracket mounting bolt as shown.



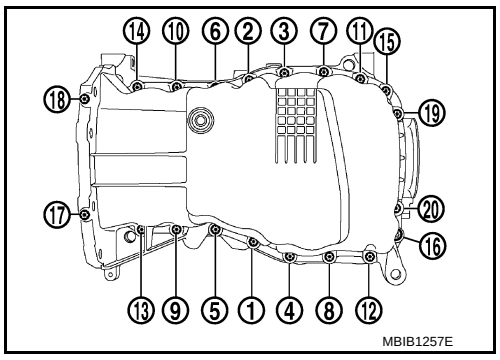
7. Remove oil level gauge guide.
8. Drain engine oil. Refer to LU-34, "Draining".
   CAUTION:
   Perform when engine is cold.
9. Remove oil pan and transaxle joint bolts.



10. Support the engine bottom of the oil pan with a transmission jack etc.

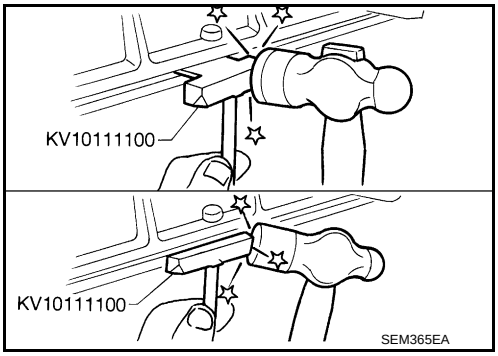


11. Remove oil pan bolt reverse order as shown.



- Insert seal cutter (special service tool) between upper oil pan and cylinder block. Slide tool by tapping on the side of the tool with a hammer.

CAUTION:
Exercise care not to damage mating surface.

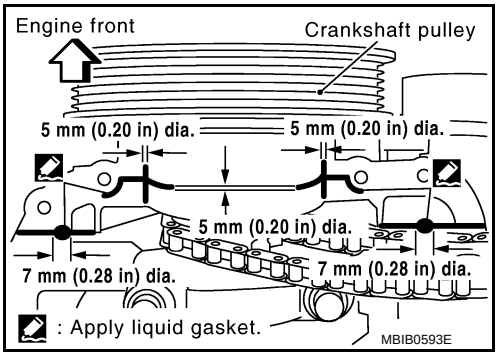


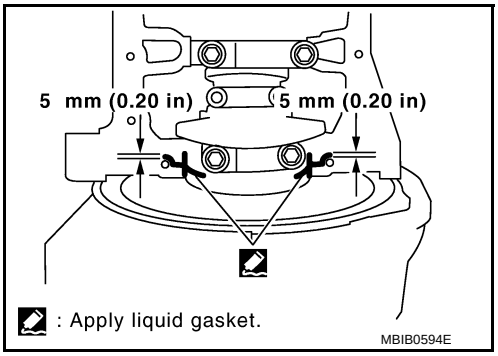
12. Remove oil pan and baffle plate.

INSTALLATION

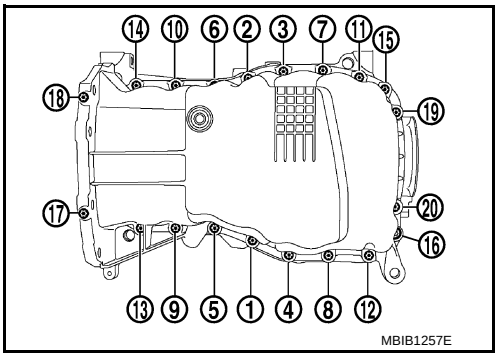
- Install in the reverse order of removal paying attention to the following.

1. Apply liquid gasket as shown.
   - Use Genuine Liquid Gasket or equivalent.





2. Install baffle plate.
3. Install oil pan.
   - Tighten the mounting bolts of oil pan on the clutch housing without locking.
   - Tighten the bolts in the numerical order shown in the figure.



: **14 N·m (1.4 kg-m, 10 ft-lb)**

   - Tighten the mounting bolts of oil pan on the clutch housing.

: **44 N·m (4.5 kg-m, 10 ft-lb)**

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

Inspection

INFOID:0000000006449988

INSPECTION AFTER REMOVAL

Clean oil pump assembly if any object attached.

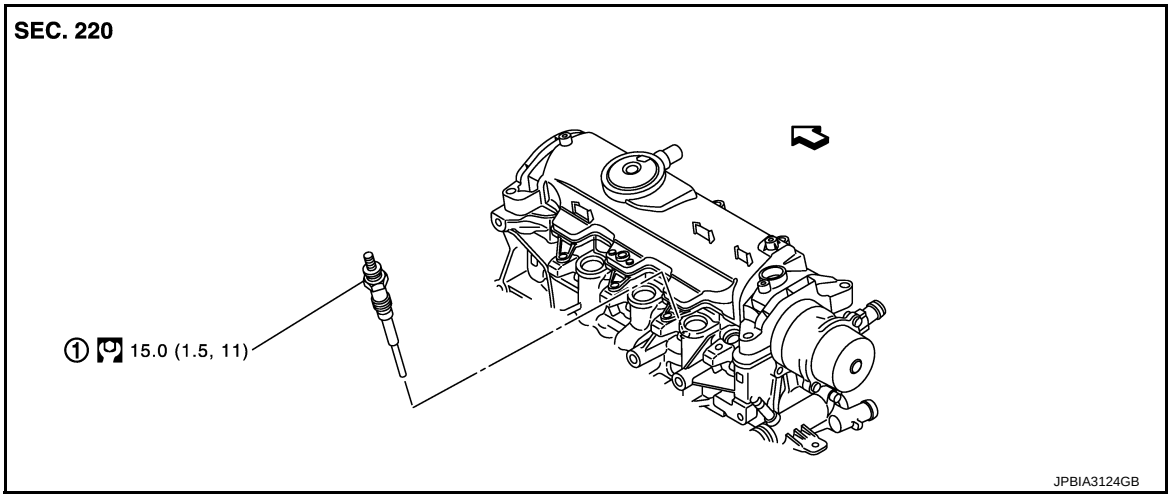
INSPECTION AFTER INSTALLATION

- Inspection the engine oil level. Refer to LU-33, "Inspection".
- Start the engine, and make sure there is no leak of engine oil. Refer to LU-33, "Inspection".

GLOW PLUG

Exploded View

INFOID:0000000006449989



1. Glow plug

⇦ Engine front

: N·m (kg-m, ft-lb)

Removal and Installation

INFOID:0000000006449990

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect the battery cable from the negative terminal.
2. Remove cowl top extension. Refer to EXT-20, "Exploded View".
3. Remove engine under cover.
4. Remove turbocharger air inlet pipe. Refer to EM-280, "Exploded View".
5. Remove air inlet tube assembly and air inlet tube. Refer to EM-281, "Exploded View".
6. Remove High pressure protection cover (upper). Refer to EM-294, "Exploded View".
7. Disconnect harness connector from glow plug.
8. Remove glow plug.

   CAUTION:

   - **When removing or installing, never use such tools as an air impact wrench.**
   - **Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]**

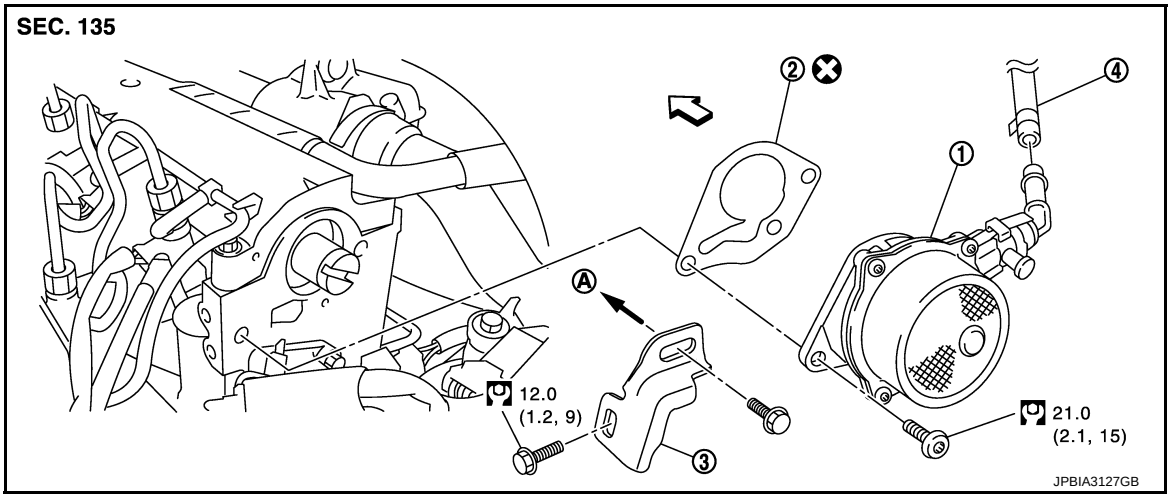
INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in reverse order of removal.

VACUUM PUMP

Exploded View

INFOID:0000000006449991



1. Vacuum pump
2. Gasket
3. Damper valve bracket
4. Vacuum hose
A. To electric throttle control actuator

⇦ Engine front

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006449992

REMOVAL

1. Remove air cleaner case. Refer to EM-280, "Exploded View".
2. Disconnect vacuum hose from vacuum pump side.
3. Remove damper valve bracket.
4. Remove vacuum pump.

INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:0000000006449993

INSPECTION BEFORE REMOVAL

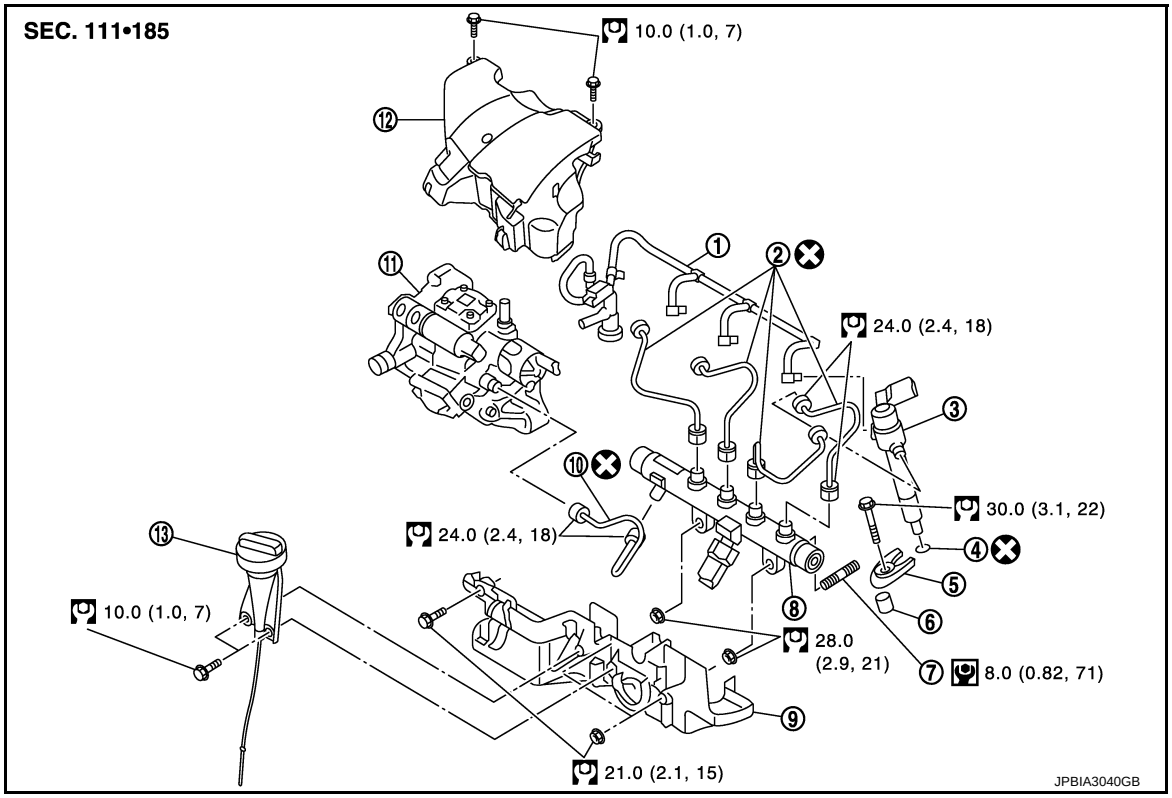
1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
   - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

Standard : -86.6 to -101.3 kPa (-866 to -1,013 mbar, -650 to -760 mmHg, -25.59 to -29.92 inHg)

INJECTION TUBE AND FUEL INJECTOR

Exploded View

INFOID:0000000006449994



1. Spill hose
2. Injection tube
3. Fuel injector
4. Heat protection washer
5. Fuel injector bracket
6. Fuel injector bracket spacer
7. Fuel rail stud bolt
8. Fuel rail
9. High pressure protection cover (lower)
10. Injection tube
11. High pressure supply pump
12. High pressure protection cover (upper)
13. Oil level gauge guide

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:0000000006449995

REMOVAL

CAUTION:

- **Be sure to read “Precautions for Diesel Equipment”. Refer to EM-263, "Precaution for Diesel Equipment".**
- **Wait until the fuel temperature drops before carrying out any work.**
- **Order the special high pressure injection circuit plug kit.**
- **It is forbidden to open an injector. If you open an injector by mistake, you will have to change it. This is because of the manufacturing and installation tolerances and because there is a risk of contaminating the inside of the injector.**
- **The rod filter of the injector must not be removed.**

NOTE:

It is possible to replace a single injection tube.

1. Disconnect the battery cable from negative terminal.

2. Remove air inlet tube assembly and air inlet tube. Refer to EM-281, "Exploded View".
3. Remove oil level gauge guide and plug the hole.
4. Remove injection tube protection cover.
5. Remove the neck located on the fuel rail,
   NOTE:
   Undo the nut on the pump side or the injector side, then the nut located on the rail side. Undo the nuts for each pipe in turn. Move the nut along the pipe keeping the olive in contact with the taper.
6. Remove all the injection tubes.
7. Plug all the holes in the injection circuit.
8. Remove fuel rail.
9. Disconnect fuel return pipe.
10. Manually remove the injector diesel return hose.
    CAUTION:
    Do not force on the diesel injector return hose
11. Plug all the holes of the injection circuit.
12. Disconnect the injector harness connector.
13. Unscrew the injector bracket.
14. Remove the injector.
15. Pull off the flame shield washer.

INSTALLATION

CAUTION:
All the injection tubes removed must be systematically replaced.

1. Clean the injector sockets and the injector bodies, as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose, dipped in clean solvent.
2. Dry off using a different new wipe.
3. Replace the flame shield washer with a new one.
4. Position the injector.
5. Tighten its mounting bracket.

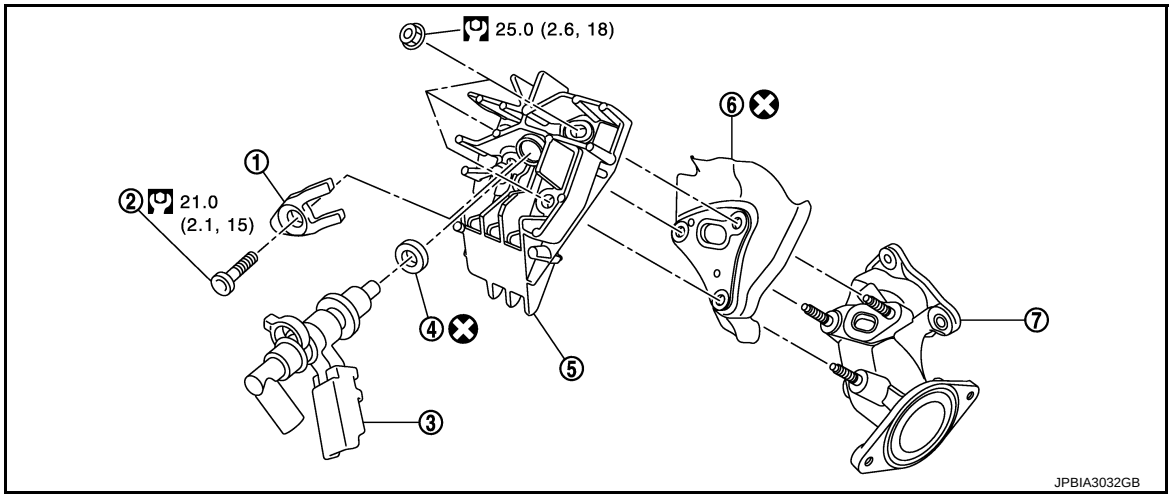
   : 30.0 N·m (3.1 kg-m, 22 ft-lb)
6. Install injection tubes with new one.
7. Finger tightens the nuts.
8. Before fitting the new injection tubes, lightly lubricate the nut threads with the oil from the sachet provided in the new parts kit.
   NOTE:
   Fit the pump/rail pipe before the rail/injector tubes.
9. Fit the pump-rail injection tube as follow:
   - Remove the protective plugs from the high pressure pump outlet, the high pressure rail inlet and the pipe.
   - Insert the injection tube olive into the taper of the high pressure pump outlet,
   - Insert the injection tube olive into the taper of the high pressure rail inlet.
   - Finger tighten the nuts of the injection tube starting with the one located on the rail side.
10. Install the rail-injector injection tube.
11. Tighten the injection tube nut.

    : 24.0 N·m (2.4 kg-m, 18 ft-lb)
12. Connect fuel return pipe.
13. Install in the reverse order to removal for the other refitting operations.

5TH INJECTOR

Exploded View

INFOID:0000000006449996



1. 5th injector retaining bracket
2. 5th injector bolt
3. 5th injector
4. Injector seal
5. Diesel injector cooler
6. Gasket
7. Turbocharger outlet duct

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

Removal and Installation

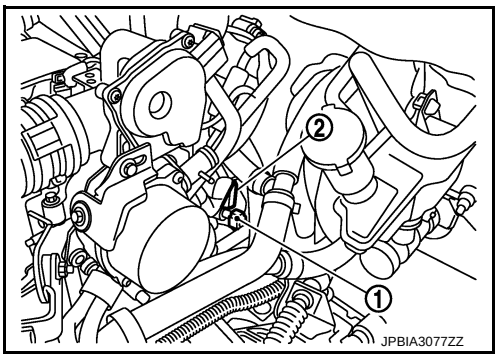
INFOID:0000000006449997

REMOVAL

CAUTION:

- **Be sure to read "Precautions for diesel equipment". Refer to EM-263, "Precaution for Diesel Equipment".**
- **Make preparations for coolant outflow.**

1. Remove air cleaner case. Refer to EM-280, "Exploded View".
2. Disconnect quick connector(1) and harness connector (2).



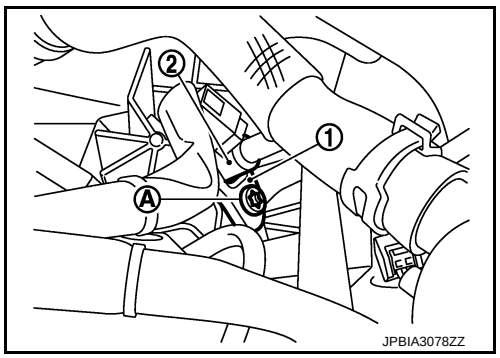
CAUTION:

- **Be careful not to damage the connector.**
- **Be sure to read "Precautions for diesel equipment". Refer to EM-263, "Precaution for Diesel Equipment"**

3. Remove the following parts from the upper side of the engine.

- Remove fixing bolt (A) of 5th injector retaining bracket (1)
- Remove 5th injector retaining bracket (1).

4. Remove the 5th injector (2) and injector seal. Refer to EM-296, "Exploded View"



INSTALLATION

1. Clean the 5th injector:
   - Immerse the 5th injector in a container of diesel.
   - Wipe using clean cloth.

   CAUTION:
   Never clean the 5th injector with:
   - **A wire brush,**
   - **An emery cloth,**
   - **An ultrasonic cleaner.**
2. Always replace the injector seal.
3. Install the 5th injector, injector seal and 5th injector retaining bracket assembly.

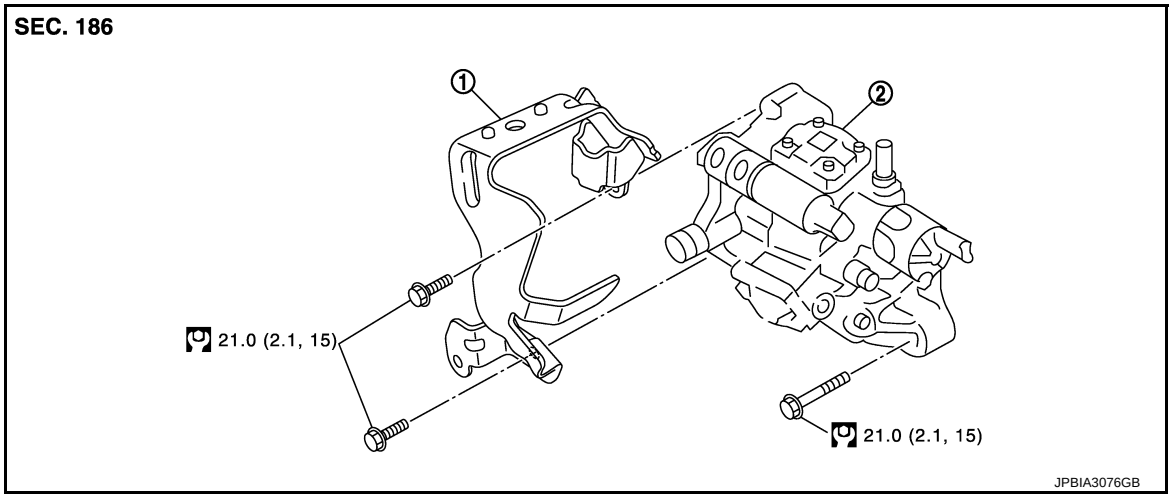
CAUTION:
Before tightening the 5th injector retaining bracket, check that the 5th injector is correctly positioned in relation to the bracket.

4. Install the other parts in the reverse order of the removal.

HIGH PRESSURE SUPPLY PUMP

Exploded View

INFOID:0000000006449998



1. High pressure supply pump protector 2. High pressure supply pump

: N·m (kg-m, ft-lb)

Removal and Installation

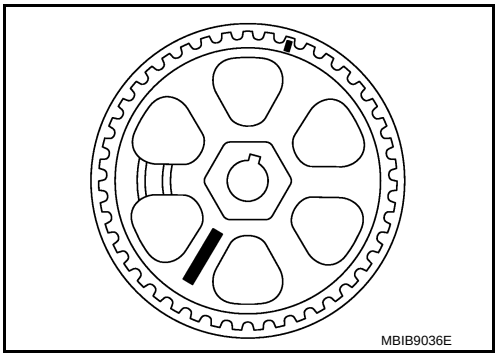
INFOID:0000000006449999

REMOVAL

CAUTION:

- **Be sure to read “Precautions for Diesel Equipment”. Refer to EM-263, "Precaution for Diesel Equipment".**
- **Wait until the fuel temperature drops before carrying out any work.**
- **Order the special high pressure injection circuit plug kit.**
- **In case of the replacement of the high pressure supply pump sprocket, please apply the following tightening torque:**

: 70.0 N·m (7.1 kg-m, 52 ft-lb)



1. Disconnect the battery cable from the negative terminal.
2. Remove cowl top extension. Refer to EXT-20, "Exploded View".
3. Remove turbocharger air inlet pipe. Refer to EM-280, "Exploded View".
4. Remove air inlet tube assembly and air inlet tube. Refer to EM-281, "Exploded View".
5. Remove the timing belt. Refer to EM-302, "Exploded View".
6. Remove the neck located on the fuel rail,
7. Remove the oil level gauge guide and plug the hole.
8. Remove high pressure protection cover. Refer to EM-294, "Exploded View".
9. Carefully disconnect:
   - The connectors from the flow actuator,
   - The connectors from the fuel temperature sensor,
   - On the pump, the fuel supply and return pipes.

- The return pipe connecting the injectors with the pump.

10. Remove the injection tube connecting the pump to the rail. Refer to EM-294, "Exploded View".
11. Plug all the holes of the injection circuit.
12. Remove the three mounting bolts from the high pressure supply pump then remove it.

INSTALLATION

1. Install the pump then position the mounting bolts without tightening them.
2. Before fitting the new injection tube, lightly lubricate the nut threads with the oil from the sachet provided in the new parts kit.
3. Refit the injection tube, to do this:
   - remove the protective plugs,
   - insert the injection tube olive into the taper of the high pressure pump outlet,
   - insert the injection tube olive into the taper of the high pressure rail inlet.
4. Finger tighten the nuts of the injection tube starting with the one located on the rail side.
5. Tighten the mounting bolts on the high pressure pump.

: 21.0 N·m (2.1 kg-m, 15 ft-lb)

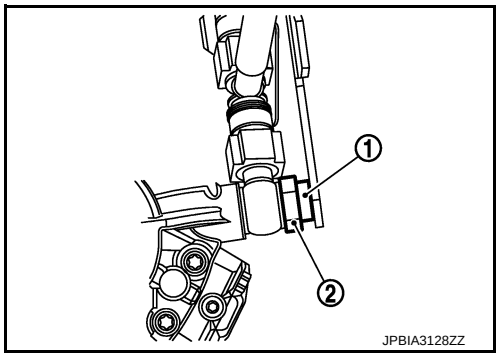
6. Tighten the injection tube nut.

: 24.0 N·m (2.4 kg-m, 18 ft-lb)

7. Refit high pressure supply pump protector.
   CAUTION:
   When refitting high pressure supply pump protector, follow steps below.
   - **Be sure disk rubber (1) is touching bolt head of high pressure supply pump (2) as shown in the figure.**
   - **Tighten bolt with holding protector towards to high pressure supply pump.**

   :21.0 N·m (2.1 kg-m, 15 ft-lb)

   - **Make sure disk rubber (1) is touching with bolt head of high pressure supply pump (2).**

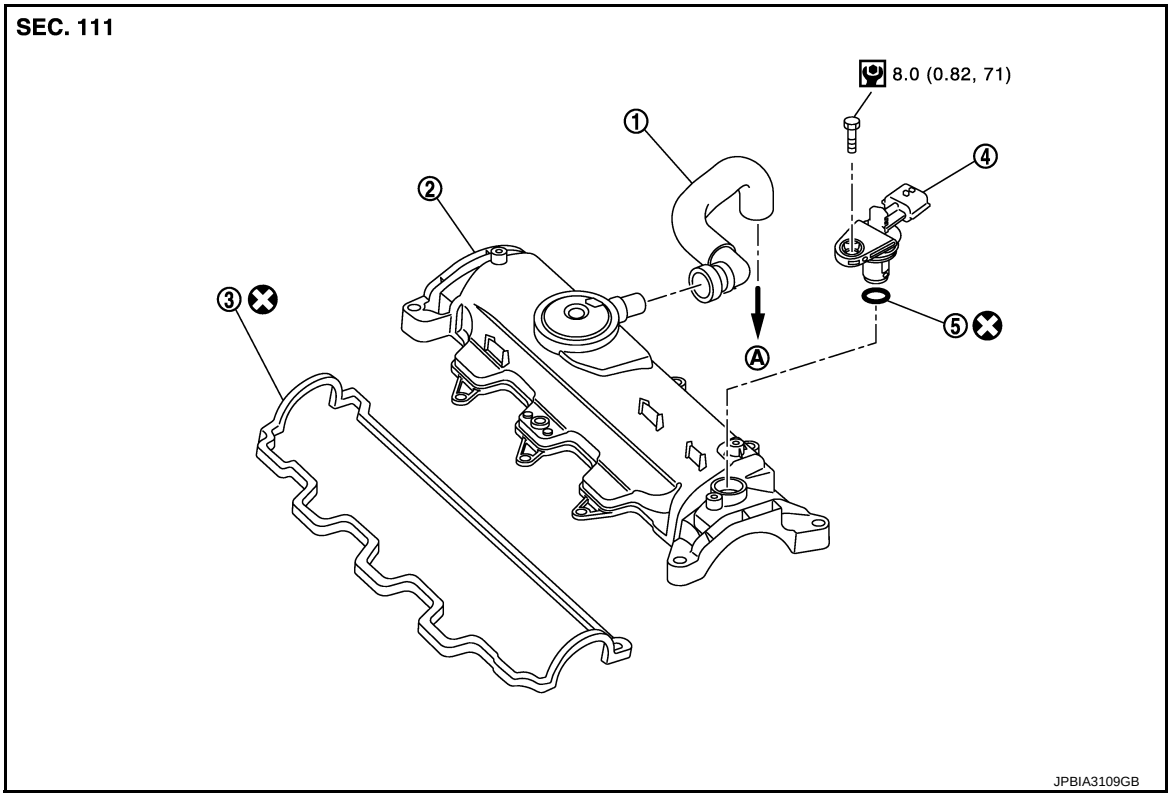


8. Refit in the reverse order to removal for the other refitting operations.
9. Test the sealing of the high pressure after it has been repaired (refer to “SPECIAL FEATURES” in EM-263, "Precaution for Diesel Equipment").

ROCKER COVER

Exploded View

INFOID:0000000006450000



1. Blow-by hose
2. Rocker cover
3. Gasket
4. Camshaft position sensor
5. O-ring
A. To turbocharger air inlet pipe

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

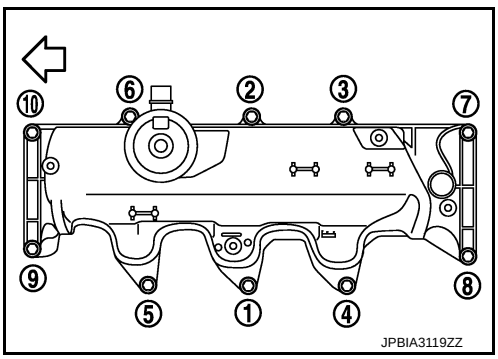
Removal and Installation

INFOID:0000000006450001

REMOVAL

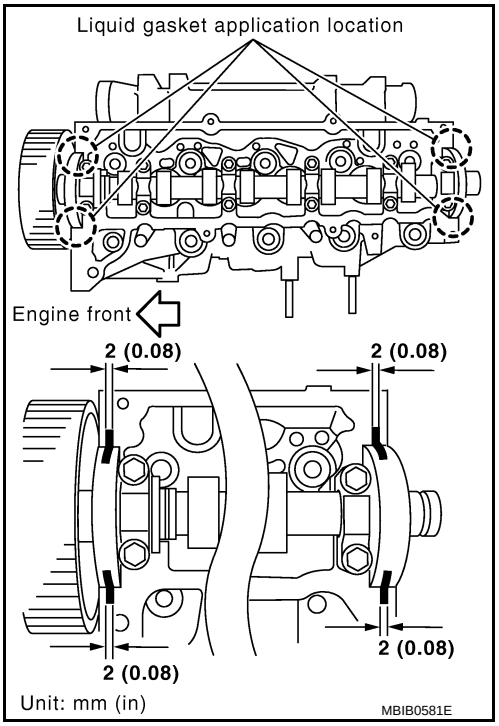
1. Remove air cleaner case. Refer to EM-280, "Exploded View".
2. Remove inlet pipe assembly and air inlet tube. Refer to EM-281, "Exploded View".
3. Remove high pressure protection cover (upper). Refer to EM-294, "Exploded View".
4. Remove electric throttle control actuator.
5. Remove fuel injector. Refer to EM-294, "Exploded View".
6. Remove rocker cover.
   - Loosen holding bolts in the reverse order as shown in the figure and remove.

: Engine front



INSTALLATION

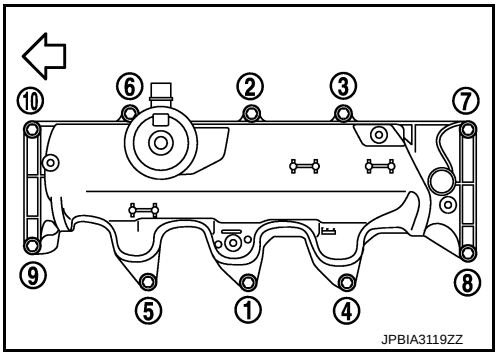
1. Apply liquid gasket on locations shown in the figure.
   - Use Genuine Liquid gasket or equivalent.



2. Tighten holding bolts in the numerical order as shown in the figure.

   ⇦ : Engine front

   : 12 N·m (1.2 kg-m, 9 ft-lb)

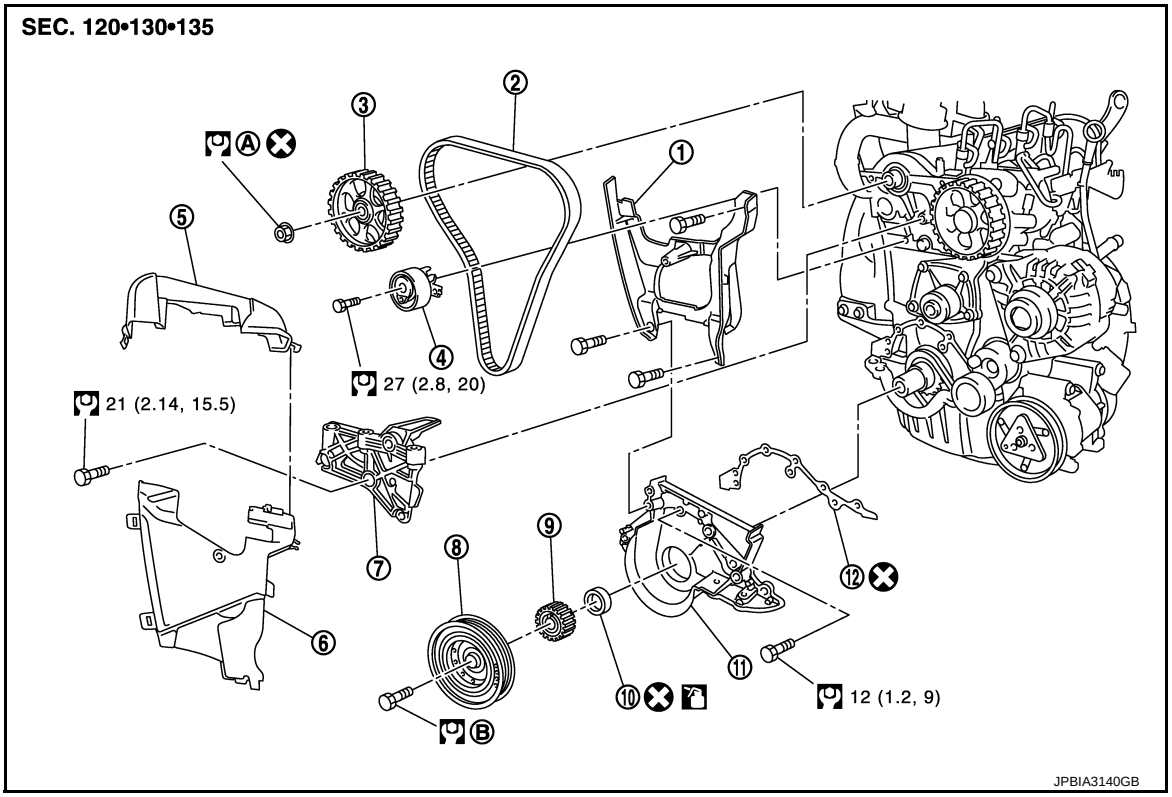


3. Install in the reverse order of removal after this steps.

TIMING BELT

Exploded View

INFOID:0000000006450002



1.	Timing belt inner cover	2.	Timing belt	3.	Camshaft sprocket
4.	Timing belt tensioner	5.	Timing belt upper cover	6.	Timing belt lower cover
7.	Cylinder head suspended bracket	8.	Crankshaft pulley	9.	Crankshaft sprocket
10.	Rear oil seal	11.	Rear oil seal retainer	12.	Gasket
A	Refer to EM-311	B	Refer to EM-302		

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

Removal and Installation

INFOID:0000000006450003

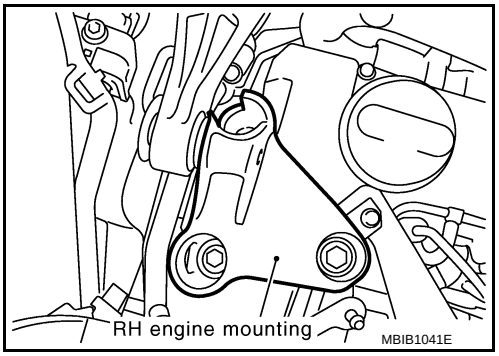
CAUTION:

- **Apply new engine oil to parts marked in illustration before installation.**
- **Replace any belt that has been removed.**
- **Never turn the engine in the direction opposite to that of normal operation.**
- **When replacing the timing belt, be sure to replace the timing belt tensioner.**
- **Never run the engine without the drive belts to avoid damaging the crankshaft pulley.**

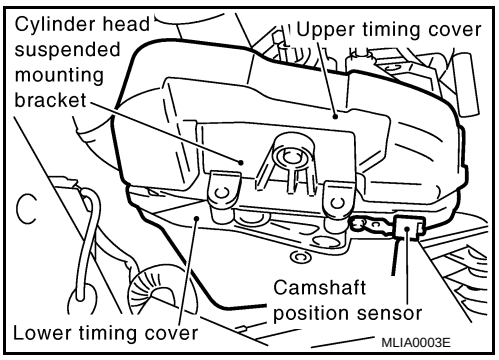
REMOVAL

1. Disconnect battery cable from the negative terminal.
2. Remove engine under cover.
3. Remove front wheel RH.
4. Remove fender protector RH. Refer to EXT-22, "Exploded View"
5. Remove drive belt, and auto-tensioner. Refer to EM-276, "Removal and Installation".
6. Remove RH engine torque rod.

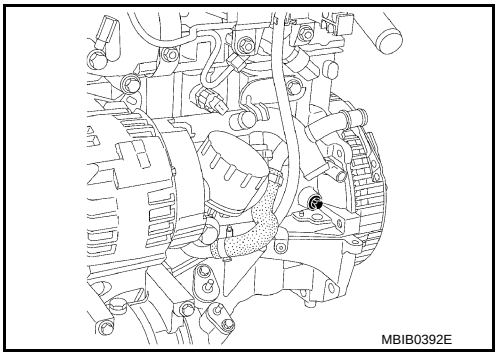
7. Remove RH engine mounting.



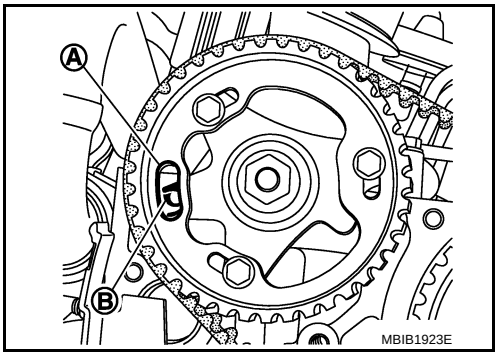
8. Remove RH engine mounting support bracket and RH engine mounting insulator.
9. Remove upper timing cover, camshaft position sensor and cylinder head suspended mounting bracket.



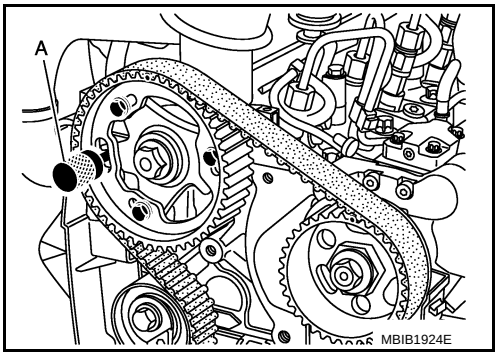
10. Remove timing belt lower cover.
11. Remove the TDC pin bolt.



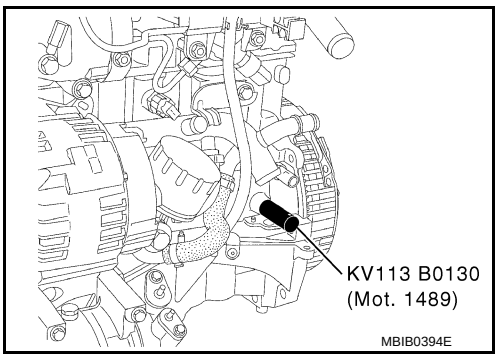
12. Rotate the crankshaft clockwise, until the position (A) of the camshaft pulley becomes opposite of the position (B) on the cylinder head.



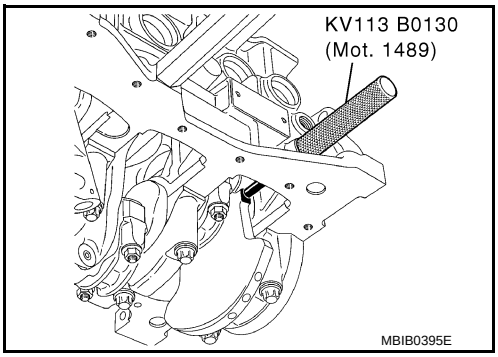
13. Insert TDC set pin [SST: KV113B0110 (Mot. 1430)] (A) into the camshaft pulley and cylinder head hole.



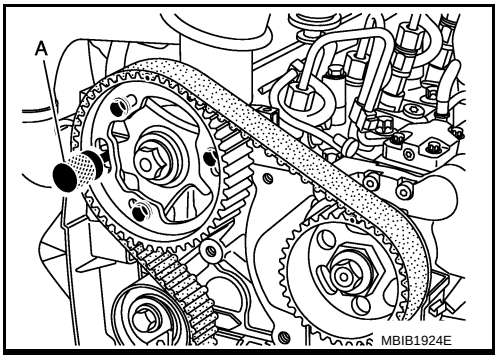
14. Screw in the TDC pin (special service tool).



15. Turn the engine clockwise (timing side) until the crankshaft reaches the TDC pin (special service tool).



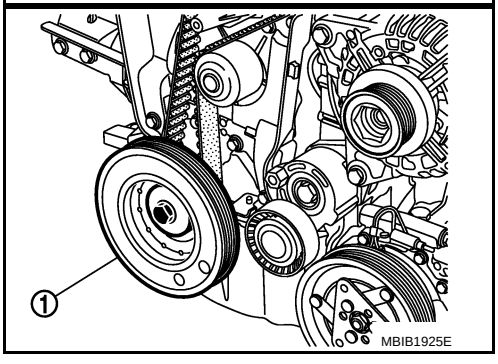
16. The pin [SST: KV113B0110 (Mot. 1430)] (A) must engage in the camshaft pulley and cylinder head holes.



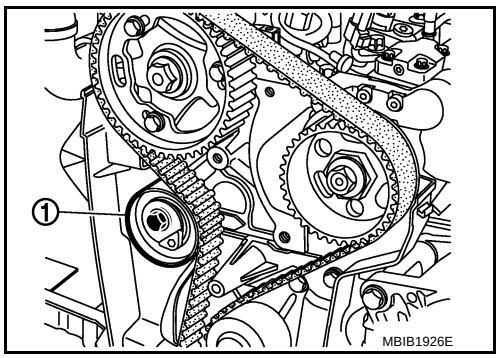
17. Insert flat-bladed screwdriver into the place of crankshaft position sensor to block crankshaft and loosen crankshaft pulley bolt (1).
18. Remove crankshaft pulley.

CAUTION:

Never remove fixing bolts. Keep loosened fixing bolts in place to protect removed crankshaft pulley from dropping.



19. Slacken the timing belt by loosening the bolt of tensioner (1), then remove timing belt.



INSTALLATION

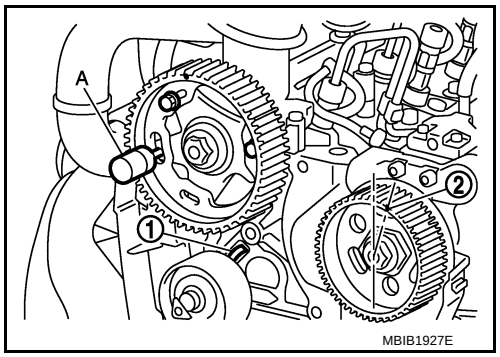
Install in the reverse order of removal paying attention to the following.

TIMING ADJUSTMENT

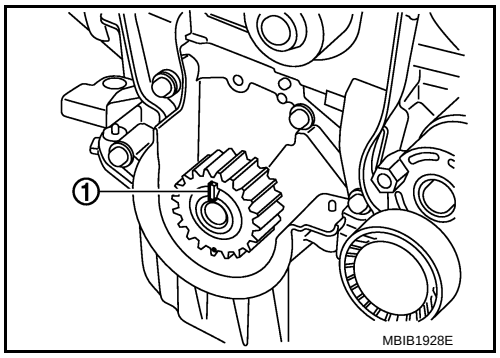
CAUTION:

It is essential to degrease the end of the crankshaft, the bore of the crankshaft sprocket and the bearing faces of the drive belt pulley to prevent any slip between the timing and the crankshaft which would risk destroying the engine.

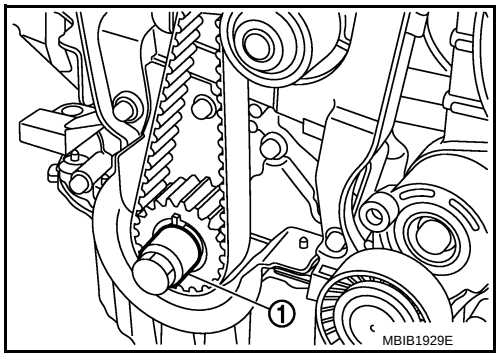
1. Install timing belt tensioner.
   NOTE:
   Put the timing belt tensioner spigot (1) in the cylinder head groove.
2. Insert Tool KV113B0110 (Mot. 1430) (A) in the camshaft pulley and cylinder head holes.
3. Check that the mark on the high pressure pump pulley (2) has shifted one tooth to the right of vertical axle.



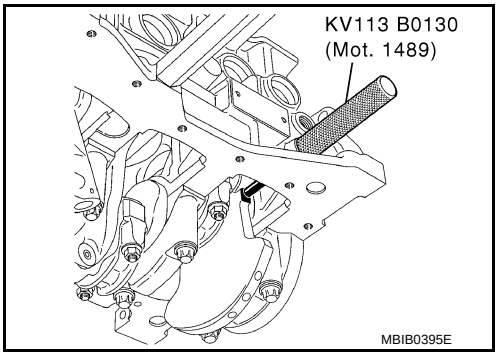
4. Turn crankshaft to set Tool KV113B0130 (Mot. 1489) (the crankshaft groove (1) must be facing upwards).



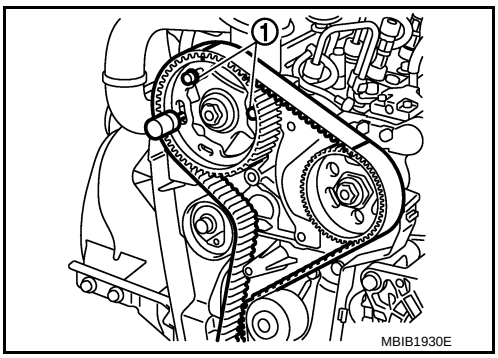
5. Tighten old crankshaft pulley bolt with a spacer (1) (which does not cover the timing sprocket mark).



6. Insert tool KV113B0130 (Mot. 1489) to crankshaft.

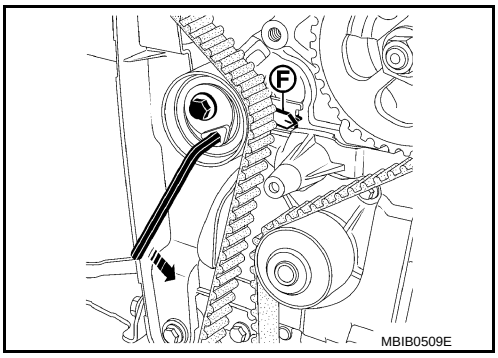


7. Remove one wheel bolt from crankshaft pulley, and then loosen the other two bolts (1).



8. Install the timing belt, aligning the marks on the belt with those on the camshaft and fuel injection pump sprockets (19 teeth spaces on the belt between the marks on the camshaft and pump sprockets).

9. Using a 6 mm (0.24 in) Allen key, move the movable index (F) of the tension wheel into the position shown below, by turning the key counterclockwise.



10. Tighten the tension wheel bolt.

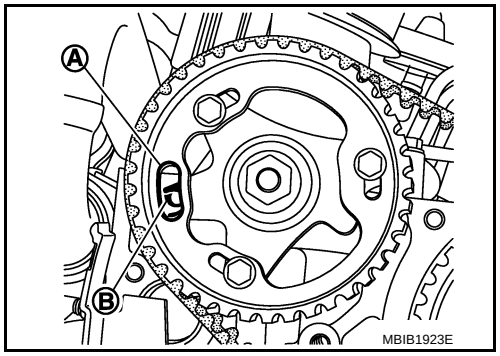
: 27 N·m (2.8 kg-m, 20 ft-lb)

11. Check that the camshaft pulley wheel bolts are not fully up against the camshaft pulley wheel.
12. Install and tighten camshaft pulley wheel bolt.

: 14 N·m (1.4 kg-m, 10 ft-lb)

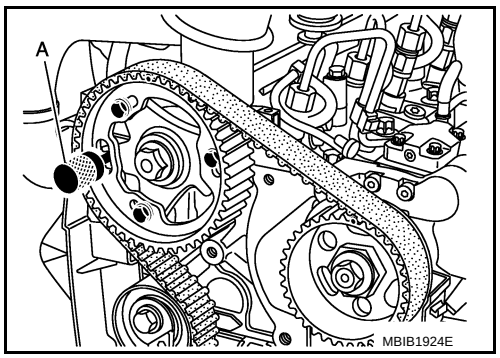
13. Remove Tool KV113B0130 (Mot. 1489) and Tool KV113B0110 (Mot. 1430).

14. Turn the crankshaft two full turns in a clockwise direction (timing side). Just before the hole (A) of the camshaft pulley is opposite the cylinder head hole (B), insert tool KV113B0130 (Mot. 1489) into the cylinder block.
15. Then turn the crankshaft slowly and smoothly against TDC set pin.



16. Insert TDC set pin [SST: KV113B0110 (Mot. 1430)] (A).
If the pin cannot be inserted, perform the following.

a. Remove TDC set pin [SST: KV113B0130 (Mot. 1489)].
b. Loosen camshaft pulley wheel bolts.
c. Turn camshaft pulley to adjust.
d. Confirm that the crankshaft sprocket groove is facing upward.
e. Loosen timing belt tensioner bolt.

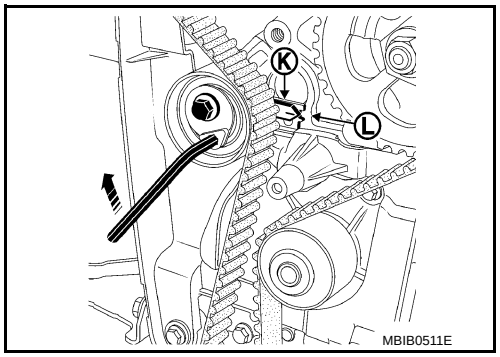


f. Move the movable index of the drive belt tensioner into the position as shown in the figure, by turning the key clockwise.
g. Tighten timing belt tensioner bolt.

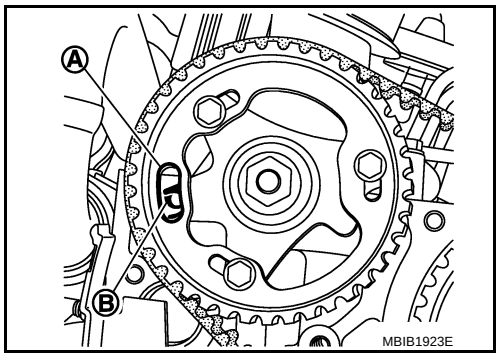
: **27 N·m (2.8 kg-m, 20 ft-lb)**

h. Install and tighten camshaft sprocket wheel bolts.

: **14 N·m (1.4 kg-m, 10 ft-lb)**



i. Turn the crankshaft two revolutions in a clockwise direction (timing side). Just before the hole (A) of the camshaft pulley is opposite the cylinder head hole (B), insert TDC set pin [SST: KV113B0130 (Mot. 1489)] into the cylinder block.
j. Then turn the crankshaft slowly and smoothly against TDC set pin.

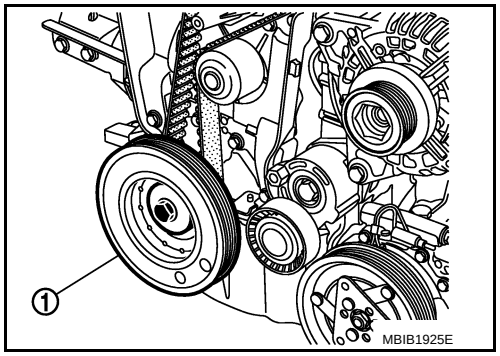


17. Install crankshaft pulley (1), and tighten the bolts as follows:

a. Tighten the bolt.

: **120 N·m (12 kg-m, 89 ft-lb)**

b. Turn the bolt 95 degrees ±15 degrees clockwise (angle tightening).



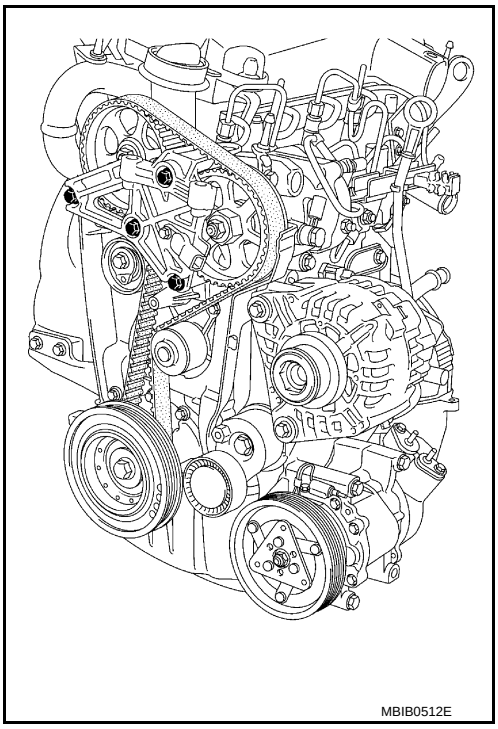
18. Remove TDC set pin [SST: KV113B0130 (Mot. 1489)] and TDC set pin [SST: KV113B0110 (Mot. 1430)].

19. Apply liquid gasket to the thread of TDC pin plug.
20. Install TDC pin plug.

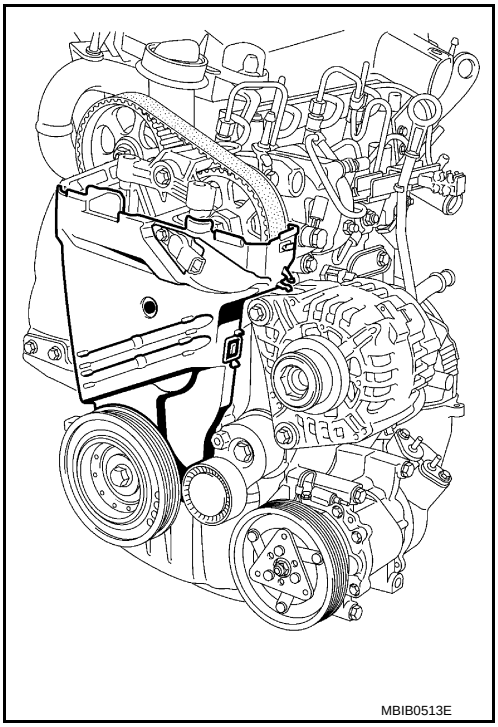
: **20 N·m (2.0 kg-m, 15 ft-lb)**

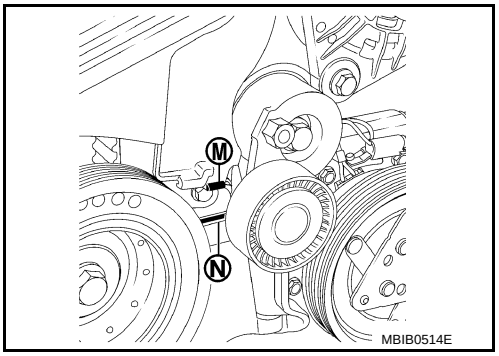
21. Install the cylinder head suspended bracket.

: **21 N·m (2.1 kg-m, 15 ft-lb)**


MBIB0512E

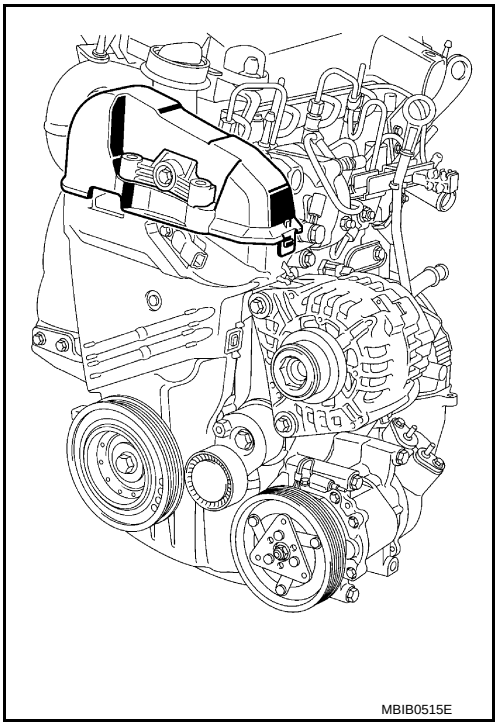
22. Install the lower timing cover by positioning the tab (M) into the hole (N) on the inner timing cover.


MBIB0513E



MBIB0514E

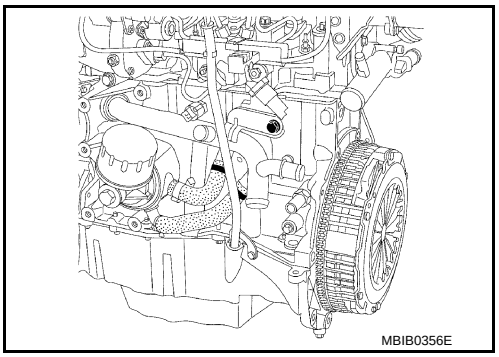
23. Install the upper timing cover.


MBIB0515E

24. Install the water pipe.

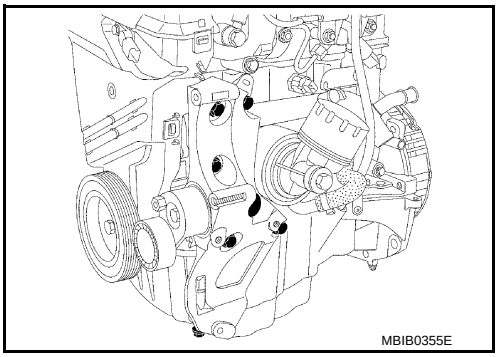
: 22 N·m (2.2 kg-m, 16 ft-lb)

25. Install the two water hoses.

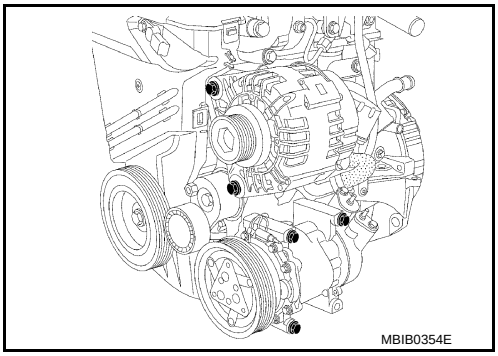

MBIB0356E

26. Install the alternator bracket.

: 44 N·m (4.5 kg-m, 32 ft-lb)


MBIB0355E

27. Install the alternator.



Engine number	Tightening torque
< D051474	: 21 N·m (2.1 kg-m, 15 ft-lb)
>≥≥	: 25 N·m (2.6 kg-m, 18 ft-lb)

28. Install the A/C compressor.

: 21 N·m (2.1 kg-m, 15 ft-lb)

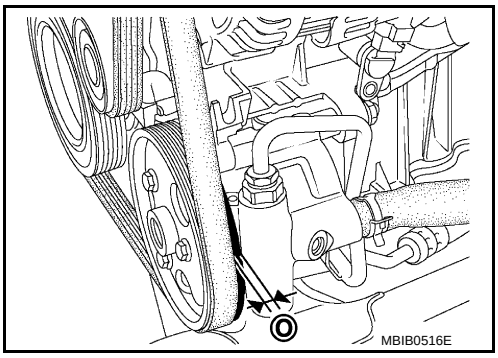
29. Install the power steering pump or the washer which replaces the pulley (if the engine has one).

: 21 N·m (2.1 kg-m, 15 ft-lb)

30. Install the drive belt.

CAUTION:

- **Make sure belt is correctly engaged with the pulley groove.**
- **Check for oil and coolant on belt and each pulley groove.**
- **Certain drive belts have five teeth whereas the air conditioning compressor pulley, power-assisted steering pump pulley, and alternator pulley all have six teeth. In this case, it is essential to check that the inner tooth (O) of the pulleys remains free when fitting the drive belt.**
  Never turn the engine in the opposite direction to its normal operating direction.
  Use a brush to remove any deposits from the crankshaft pulley V grooves.
  For engines fitted with a mechanical tensioning roller, it is essential to replace the tensioning roller mounting bolts.

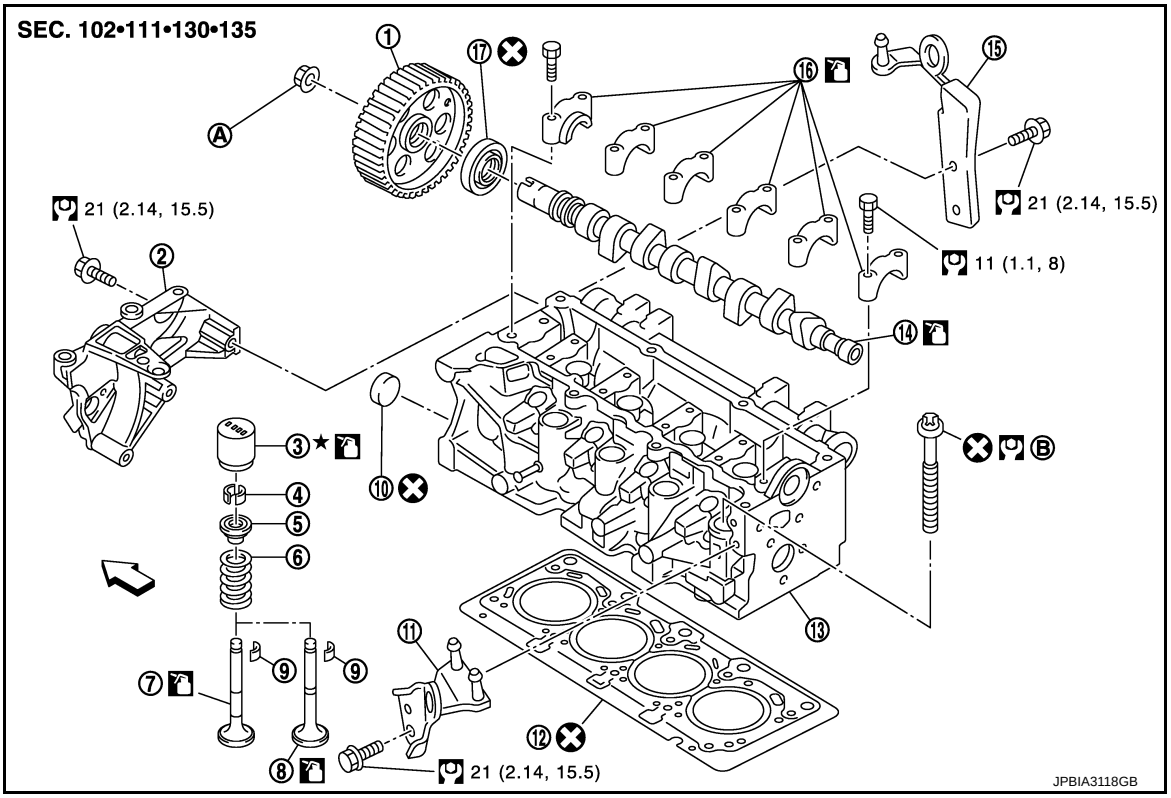


31. Make sure that tension of each belt is within the standard.

CYLINDER HEAD

Exploded View

INFOID:0000000006450004



1. Camshaft sprocket
2. Cylinder head suspended bracket
3. Valve lifter
4. Valve rotator
5. Valve spring retainer
6. Valve spring
7. Exhaust valve
8. Intake valve
9. Valve collet
10. Cap
11. Rear engine slinger
12. Cylinder head gasket
13. Cylinder head
14. Camshaft
15. Front engine slinger
16. Camshaft bracket
17. Oil seal

A : Refer to EM-311.
B : Refer to EM-311

: N·m (kg-m, ft-lb)
: Always replace after every disassembly.
: Should be lubricated with oil.
★ : Select with proper thickness.

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

Removal and Installation

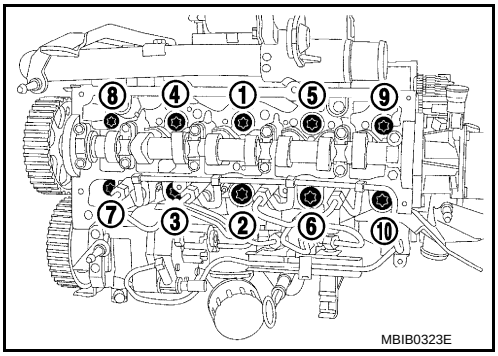
INFOID:0000000006450005

REMOVAL

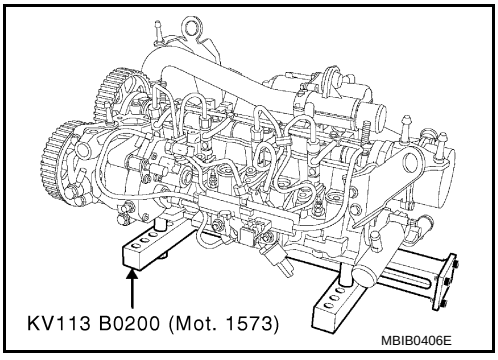
1. Remove the following parts.
   - Battery ground cable
   - Engine undercover
   - RH front wheel
2. Remove fender protector RH.
3. Drain engine coolant. Refer to CO-62, "Draining".
   CAUTION:

Perform when engine is cold.

4. Remove air cleaner case. Refer to EM-280, "Exploded View".
5. Remove radiator upper hose. Refer to CO-66, "Exploded View".
6. Disconnect fuel feed tube and return tube from high pressure supply pump. Refer to EM-298, "Exploded View".
7. Remove oil level gauge guide.
8. Remove harnesses and connectors.
9. Remove heater hoses.
10. Remove turbocharger assembly. Refer to EM-284, "Exploded View".
11. Remove drive belt. Refer to EM-276, "Removal and Installation".
12. Remove rocker cover. Refer to EM-300, "Exploded View".
13. Support underneath of engine by setting a manual lift table caddy (commercial service tool) or equivalent tool.
    CAUTION:
    Put a piece of wood or something similar as supporting surface, secure a completely stable condition.
14. Remove timing belt. Refer to EM-302, "Exploded View".
15. Remove engine support bar.
    CAUTION:
    During the removal operation, always be careful to prevent engine moves downward from the vehicle.
16. Remove cylinder head bolt in the reverse order as shown.

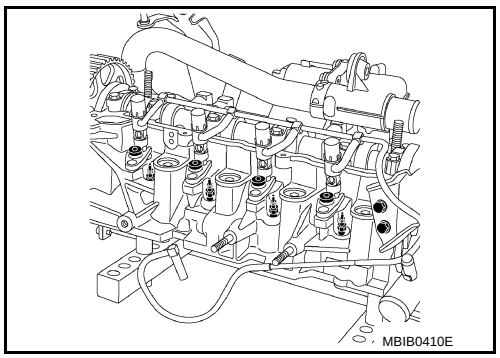


17. Remove cylinder head assembly.
18. Place the cylinder head on Tool KV113B0200 (Mot. 1573) (Commercial service tool) or equivalent tool.
    CAUTION:
    Pay strict attention to the rules regarding cleanliness. Refer to EM-263, "Precaution for Diesel Equipment".

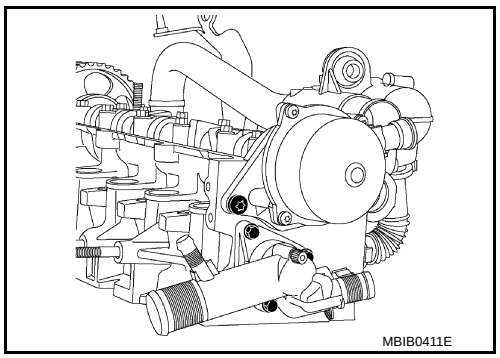


19. Remove high pressure supply pump and related parts. Refer to EM-294, "Exploded View", EM-298, "Exploded View".

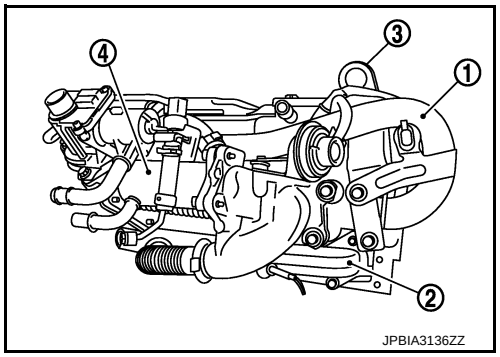
20. Remove the injectors (by marking them in relation to their cylinder), glow plugs using Tool KV113E0010 (Mot. 1566) (Commercial service tool) or equivalent tool, and rear engine slinger.


MBIB0410E

21. Remove the vacuum pump and water outlet.

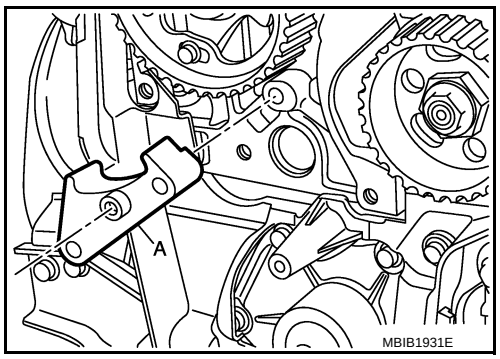

MBIB0411E

22. Remove the air inlet pipe (1), front engine slinger (2), EGR unit (4), and exhaust manifold (3).



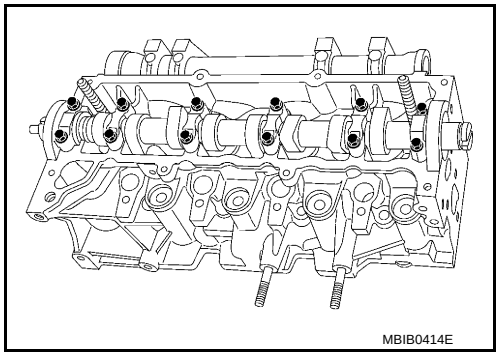
JPBIA3136ZZ

23. Remove the camshaft pulley using sprocket holder [SST: — (Mot. 1606-A)] (A).

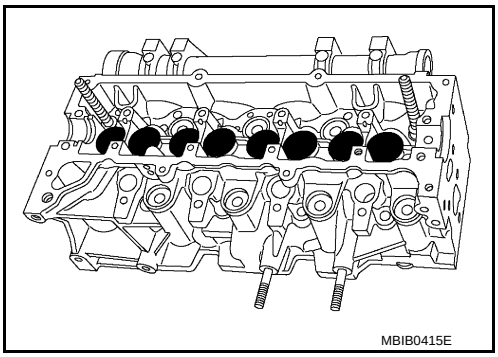


MBIB1931E

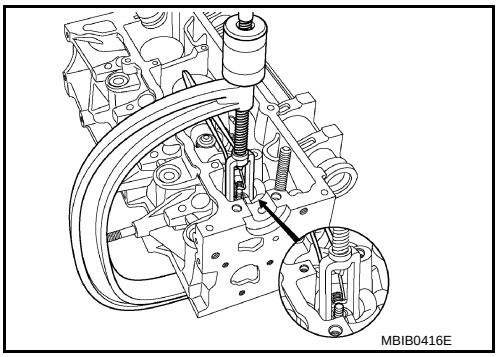
24. Remove the camshaft brackets.


MBIB0414E

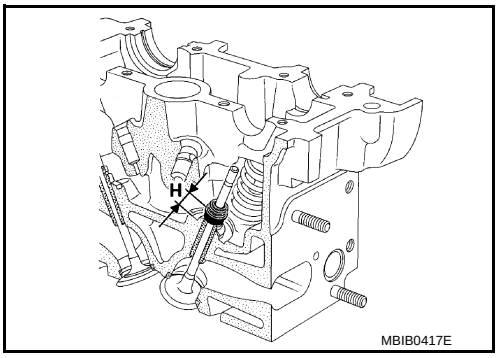
25. Remove the tappets, noting their position.


MBIB0415E

26. Compress the valve springs using the valve lifter.
Remove the keys, upper cups and springs.

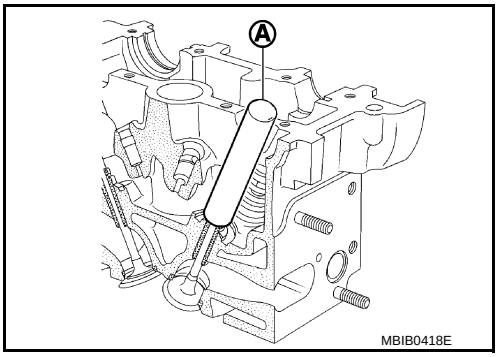

MBIB0416E

NOTE:
Before removing the valves and the valve stem seals, it is vital to measure position "H" of one of the old seals in relation to the cylinder head using Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool.



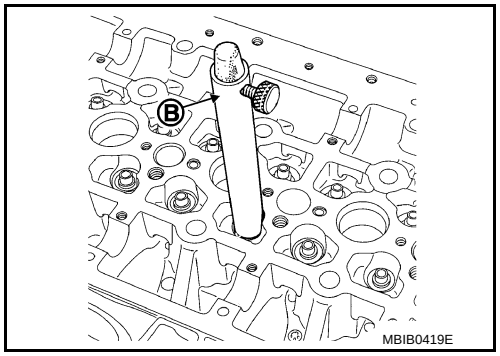
MBIB0417E

27. Install the push rod (A) of Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool on the valve stem seal.
NOTE:
The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve stem seal.



MBIB0418E

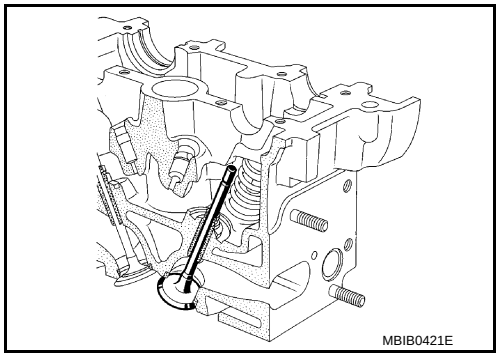
28. Install the guide tube (B) over the push rod until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
29. Remove the guide tube assembly plus push rod, being careful not to loosen the knurled wheel.
30. Remove the valves and valve guide seals using the Tool KV113B0090 (Mot. 1335) (Commercial service tool) or equivalent tool.



ASSEMBLY OF THE CYLINDER HEAD

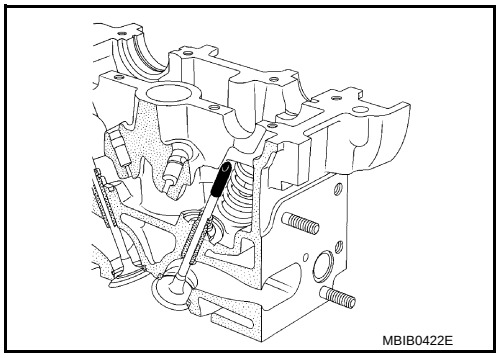
1. Install new valves and grind them gently into their respective seats. Clean all the parts thoroughly, mark them for identification purposes, then carry out the refitting operation.
   Lubricate the inside of the valve guide.
   - It is imperative to fit the valve stem seals using Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool.

   NOTE:
   Never lubricate the valve stem seals before fitting them.

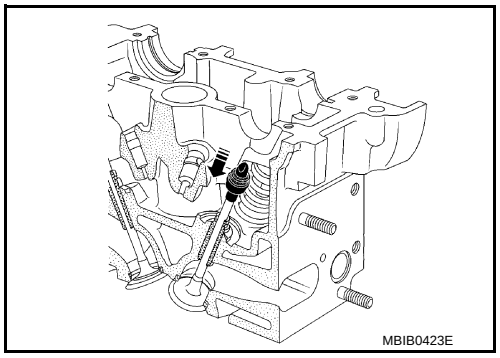


New Valve Stem Seals

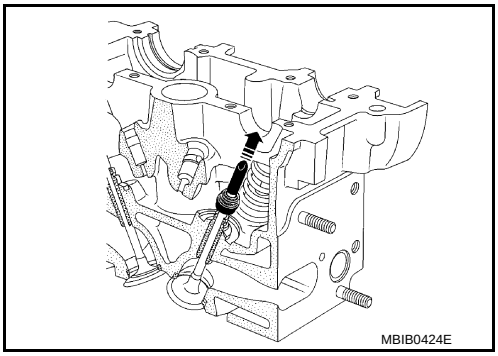
1. Place the valve in the cylinder head.
2. Place the barrel of Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool over the valve stem (the inner diameter of the barrel must be identical to the diameter of the valve stem).



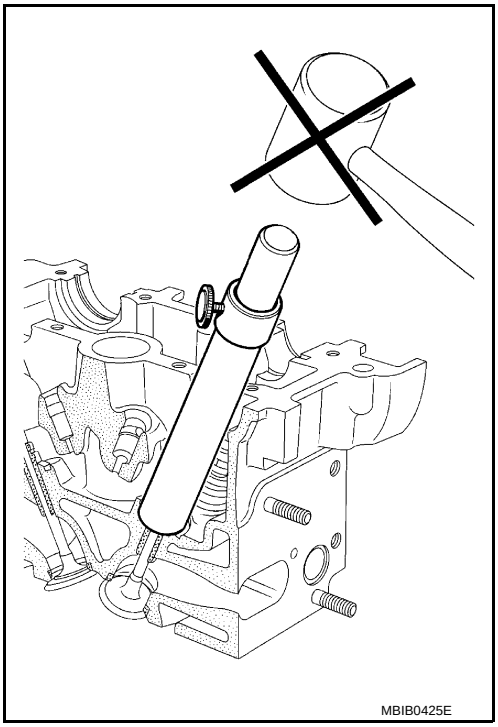
3. Keep the valve pressed against its seat.
4. Place the valve stem seal (not lubricated) over the tool barrel.



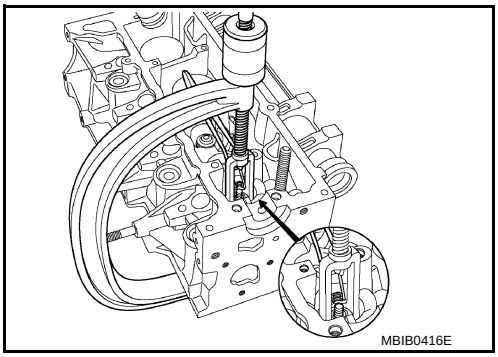
5. Push the valve stem seal past the tool barrel, then withdraw the barrel.


MBIB0424E

6. Place the guide tube plus push rod assembly on the valve stem seal.
7. Push the valve stem seal down by tapping the top of the sleeve with the palm of your hand until the guide tube reaches the cylinder head.
8. Repeat these operations for all the valves.

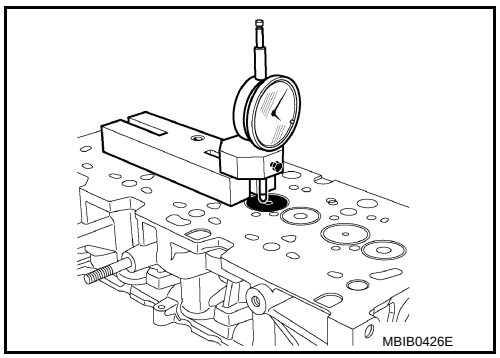

MBIB0425E

9. Install the valve springs and upper cups using valve spring compressor.
10. Install the keys using tweezers.


MBIB0416E

11. Check the valve protrusion using KV113B0040 (Mot. 251-01) (Commercial service tool) or equivalent tool and KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool as shown.

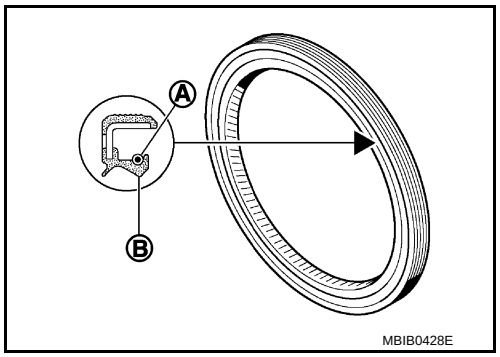
Valve protrusion : –0.07 to 0.07 mm (–0.0028 to 0.0028 in)


MBIB0426E

Camshaft Seal

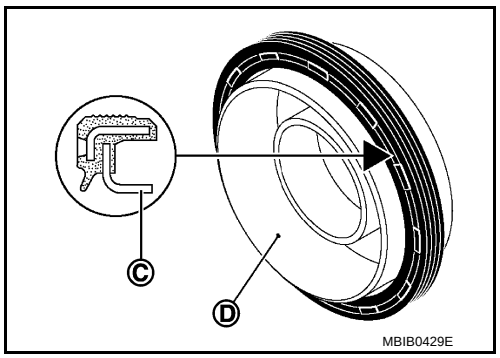
- This engine can be fitted with two different types of seals. Old and new seals are easily recognized.

1. The old rubber seal is installed with a spring (A) and has a “V”-shaped sealing lip (B).



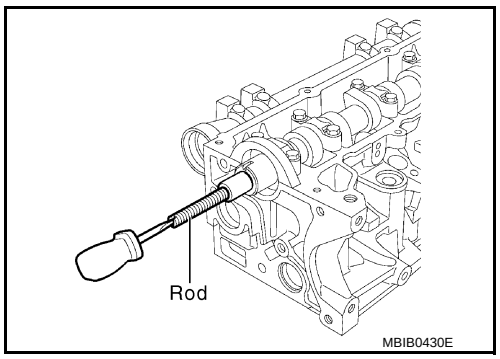
MBIB0428E

2. The new rubber seal has a flat sealing lip (C) and a protector (D) which also assists in installing the seal to the engine.



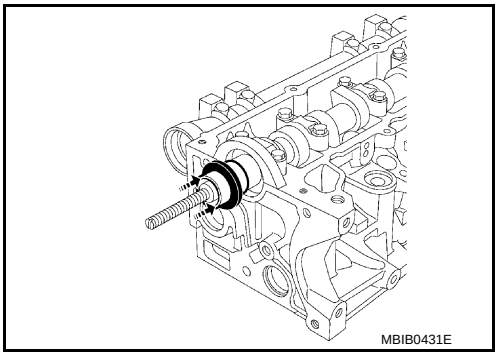
MBIB0429E

3. Screw the shouldered rod of Tool KV113B0230 (Mot. 1632) onto the stud of the camshaft.
4. Install the old seal on the camshaft.

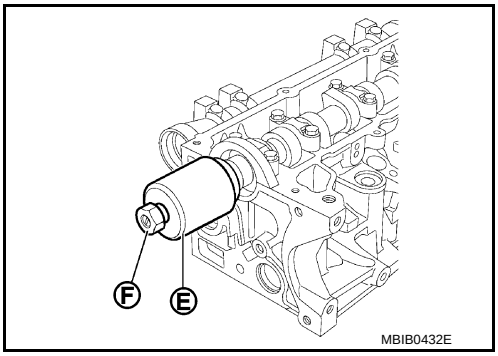


MBIB0430E

5. For the new seal, put the protector with the seal on the camshaft, taking care not to touch the seal.

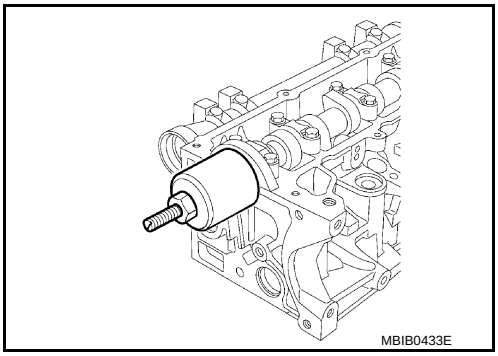

MBIB0431E

6. Install the cover (E) and the collar nut (F) of Tool KV113B0230 (Mot. 1632).



MBIB0432E

7. Screw the collar nut until the cover reaches the cylinder head.

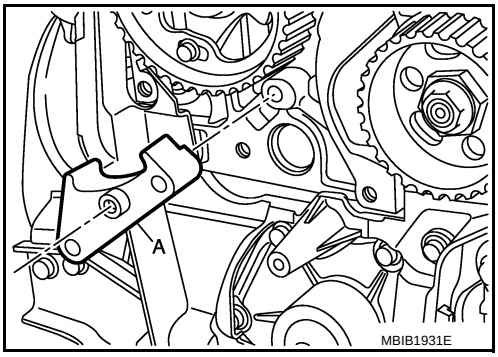

MBIB0433E

8. Remove the nut, the cover, the protector and the shouldered rod.
9. Install the camshaft pulley, and tighten the new nut as follows:

a. Tighten the new nut.

: 30 N·m (3.1 kg-m, 22 ft-lb)

b. Turn the bolt 86 degrees clockwise (angle tightening) using sprocket holder [SST: - (Mot. 1606-A)] (A).



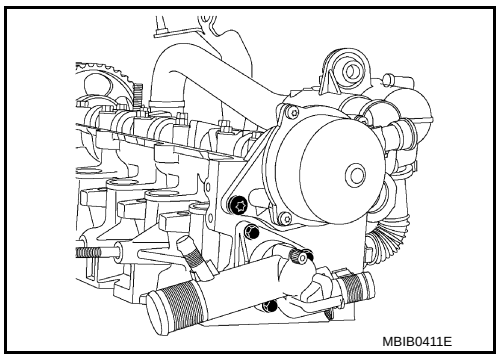
MBIB1931E

10. Install the vacuum pump with a new gasket

: 21 N·m (2.1 kg-m, 15 ft-lb)

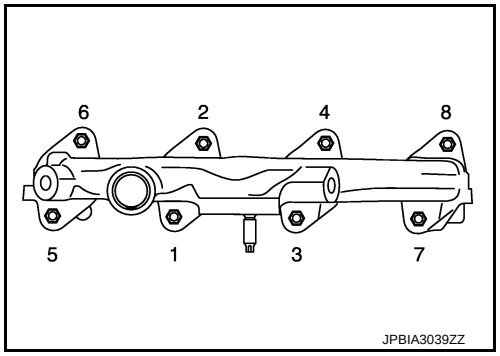
11. Install water outlet unit with a new gasket.

: 11 N·m (1.1 kg-m, 8 ft-lb)


MBIB0411E

12. Install the exhaust manifold with new gasket. Tighten the bolts in the numerical order as shown.

: 26 N·m (2.7 kg-m, 19 ft-lb)



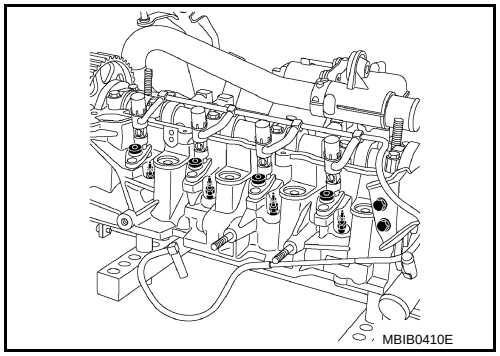
JPBIA3039ZZ

13. Install the EGR unit with new clips. Tighten the mounting bolts of the valve to a torque of 21 N·m (2.1 kg-m, 15 ft-lb), then tighten the clips of the pipe using Tool KV113B0190 (Mot. 1567).
14. Install the air inlet pipe with a new seal.
15. Install the front engine slinger.
16. Clean the injector sockets and the injector bodies, as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose) dipped in clean solvent.
Dry off using a different new wipe.
Replace the compression washer with a new washer.
17. Install the injectors (using the marks made during removal).

: 28 N·m (2.9 kg-m, 21 ft-lb)

18. Install the glow plugs.

: 15 N·m (1.5 kg-m, 11 ft-lb)


MBIB0410E

19. Install the rear engine slinger.
20. Install high pressure supply pump and related parts. Refer to EM-294, "Exploded View", EM-298, "Exploded View".

INSTALLATION

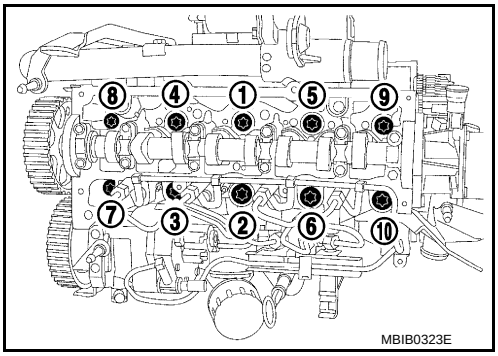
- Install in the reverse order of removal paying attention to the following.

INSTALLATION OF THE CYLINDER HEAD

1. Position the pistons at mid-stroke.
2. Install the cylinder head gasket using the centering dowels of the cylinder block.
3. Tighten the cylinder head to the following procedure.
CAUTION:
All bolts must always be changed after removal. Never oil the new bolts.
NOTE:
Use a syringe to remove any oil which may have entered the cylinder head mounting bolt holes to achieve correct tightening of the bolts.

a. Tighten all the bolts in the numerical order as shown.

: 25 N·m (2.6 kg-m, 18 ft-lb)



b. Check that all the bolts are correctly tightened to 25 N·m (2.6 kg-m, 18 ft-lb), then angle tightening of 245 to 265 degrees.

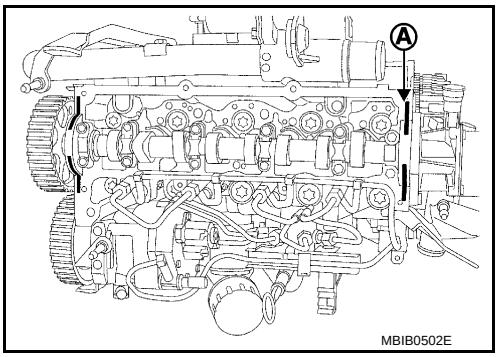
CAUTION:

- **Use an angle wrench (special service tool) to check tightening angle.**
- **Never retighten the cylinder head bolts after preforming this procedure.**

NOTE:

The gasket faces (cylinder head and rocker cover) must be clean, dry and free from grease (in particular, remove finger marks).

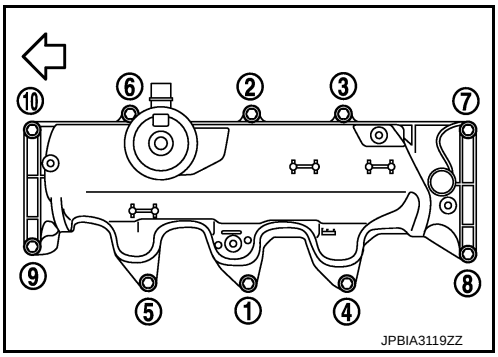
4. Lay four beads (A) of liquid gasket, with a diameter of 2 mm (0.08 in).
   - Use Genuine Liquid Gasket or equivalent.



5. Install the rocker cover, tighten the bolts in numerical order as shown.

⇦ : Engine front

: 12 N·m (1.2 kg-m, 9 ft-lb)

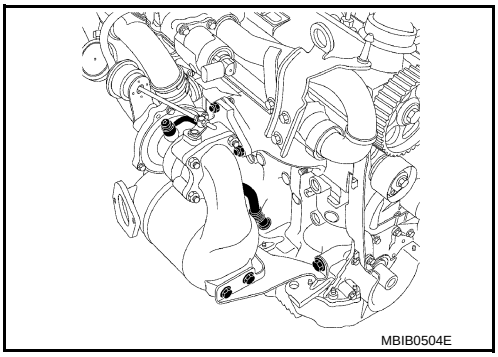


6. Put new seals on the pipe ends and install the turbocharger oil return pipe.
7. Install the turbocharger.

: 26 N·m (2.7 kg-m, 19 ft-lb)

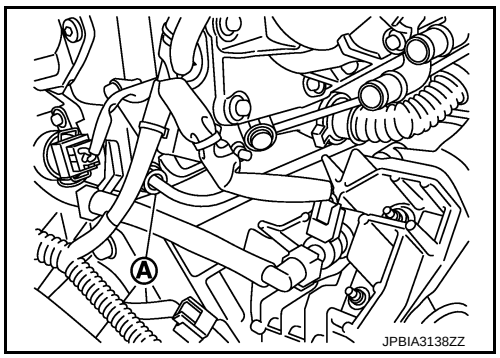
8. Install the turbocharger oil supply pipe.
9. Tighten the bolts of the turbocharger oil return pipe.

: 12 N·m (1.2 kg-m, 9 ft-lb)

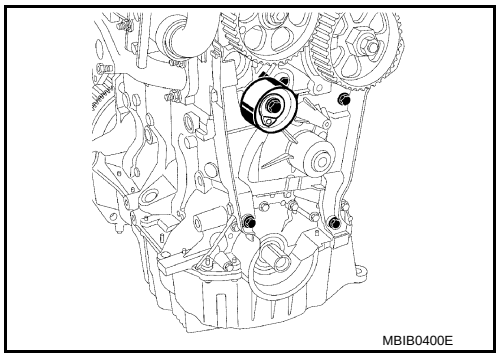


10. Tighten the nut and the bolt of the turbocharger oil supply pipe (A).

: 23 N·m (2.3 kg-m, 17 ft-lb)



11. Install the oil vapor rebreathing pipe.
12. Install the new turbocharger air ducts.
13. Install the inner timing cover.
14. Install the timing tensioner.



Cleaning

INFOID:0000000006450006

- It is very important not to scratch the gasket faces of any aluminium components.
- Use suitable tool to dissolve any part of the seal which remains stuck to the metal surface.
- Apply the dissolving product to the part to be cleaned, wait approximately 10 minutes, then remove it using a wooden spatula.
- Wear gloves while carrying out this operation.
- Do not allow this dissolving product to drip on to the paintwork.
- **Great care should be taken when performing this operation, to prevent foreign objects from entering the pipes taking oil under pressure to the camshafts (pipes in both the cylinder head and its cover) and the oil return pipes.**
- **Failure to follow these instructions could lead to the blocking of the oilways, resulting in rapid and serious damage to the engine.**

Inspection

INFOID:0000000006450007

INSPECTION AFTER REMOVAL

GASKET FACE

- Inspect mating surface bow using a ruler and a set of shims.

Maximum bow : 0.05 mm (0.0020 in)

- Test the cylinder head to detect possible cracks using the cylinder head test tools (comprising a tray and a kit suited to the cylinder head, plug, sealing plate and blanking plate). The approval number of the cylinder head test container (commercial service tool) is 664000.

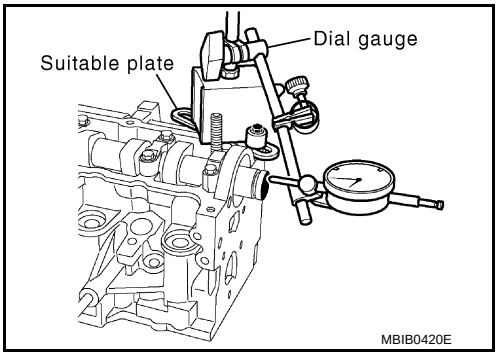
CAMSHAFT END PLAY

NOTE:

Set the dial gauge to the cylinder head and inspect following dimensions:

Outer diameter : 18 mm (0.71 in)
Height : 15 mm (0.59 in)

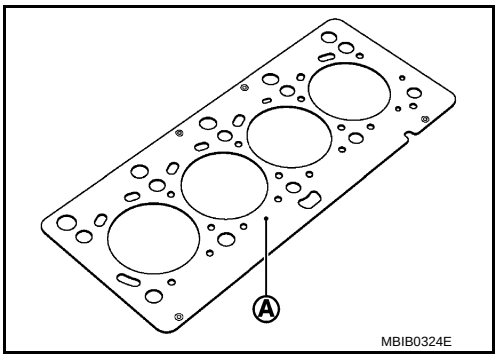
1. Install the camshaft.
2. Install the camshaft brackets (positioning them correctly with bracket 1 on the flywheel end), then tighten the bolts to a torque of 11 N·m (1.1 kg-m, 8 ft-lb).
   Check the end play, which must be between 0.08 mm (0.0031 in) and 0.178 mm (0.0070 in).
   Remove the camshaft brackets and the camshaft.



THICKNESS OF THE CYLINDER HEAD GASKET

- The thickness of the cylinder head gasket is measured at (A):

Thickness : 0.75 - 0.81 mm (0.0295 - 0.0319 in)



VALVE DIMENSIONS

Stem diameter:
- **Intake : 5.969 - 5.985 mm (0.2350 - 0.2356 in)**
- **Exhaust : 5.955 - 5.971 mm (0.2344 - 0.2351 in)**

Face angle:
- **Intake and exhaust : 90°**

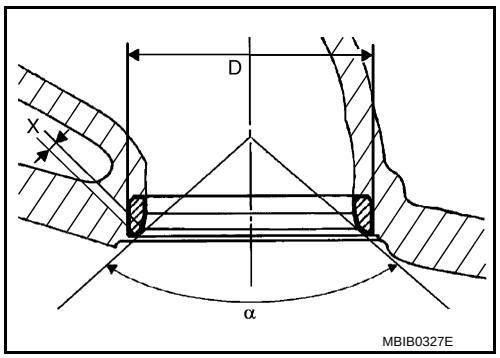
Head diameter:
- **Intake : 33.38 - 33.62 mm (1.3142 - 1.3236 in)**
- **Exhaust : 28.88 - 29.12 mm (1.1370 - 1.1465 in)**

Valve length:
- **Intake : 100.73 - 101.17 mm (3.9657 - 3.9831 in)**
- **Exhaust : 100.53 - 100.97 mm (3.9579 - 3.9752 in)**

Max. valve lift:
- **Intake : 8.015 mm (0.3156 in)**
- **Exhaust : 8.595 mm (0.3384 in)**

Protrusion of valves in relation to the cylinder head gasket face:
- **Intake and exhaust : –0.7 to 0.7 mm (–0.028 to 0.028 in)**

VALVE SEAT



Seat angle (α):

Intake and exhaust : 89°30′

Contacting width (X):

Intake and exhaust : 1.8 mm (0.071 in)

Seat outer diameter (D):

Intake : 34.444 - 34.460 mm (1.3561 - 1.3567 in)

Exhaust : 30.034 - 30.050 mm (1.1824 - 1.1831 in)

Diameter of the housing in the cylinder head:

Intake : 34.444 - 34.474 mm (1.3561 - 1.3572 in)

Exhaust : 29.955 - 29.985 mm (1.1793 - 1.1805 in)

VALVE GUIDE

Length:

Intake and exhaust : 40.35 - 40.65 mm (1.5886 - 1.6004 in)

Guide outer diameter:

Standard : 11.044 - 11.062 mm (0.4348 - 0.4355 in)

Guide inner diameter:

Intake and exhaust

Not machined : 5.50 - 5.62 mm (0.2165 - 0.2213 in)

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

*** This dimension is measured with the guide fitted in the cylinder head.**

Diameter of the housing in the cylinder head:

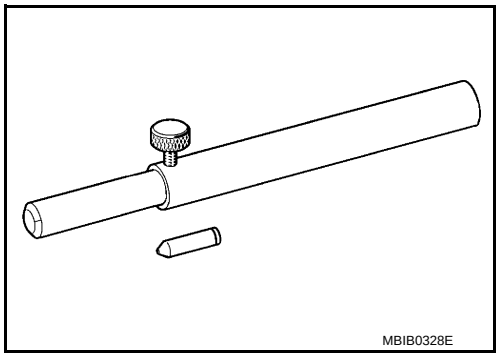
Standard : 10.9925 - 11.0075 mm (0.4328 - 0.4334 in)

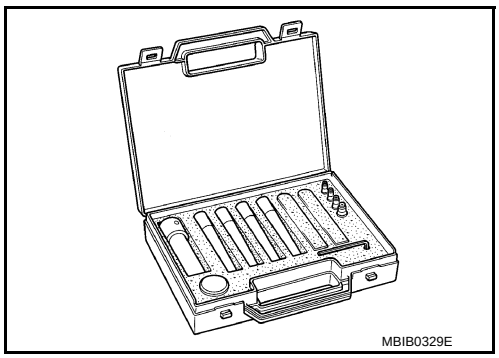
The intake and exhaust guides have valve stem seals which must be changed each time the valves are removed.

It is imperative to fit the valve stem seals using Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool.

NOTE:

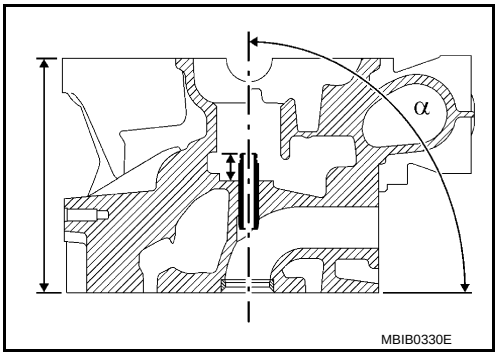
Do not lubricate the valve stem seals before fitting them.




MBIB0329E

Angle of the intake and exhaust guides (in degrees)

Intake and exhaust : α = 90

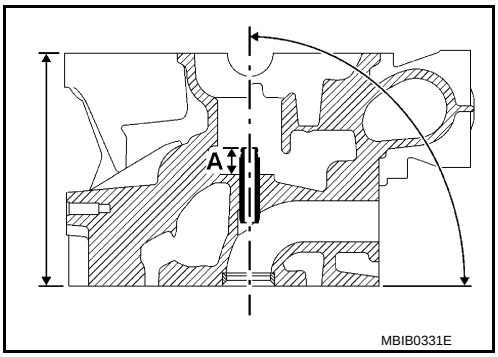


MBIB0330E

Position of the intake and exhaust valve guides

Intake : A = 14 mm (0.55 in)

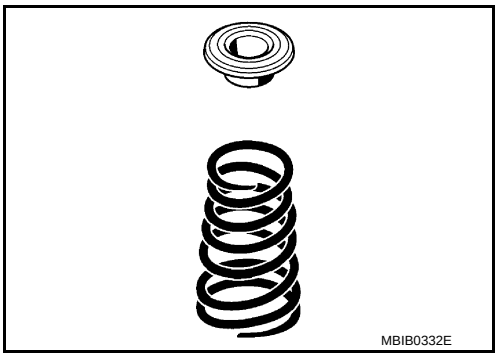
Exhaust : A = 14.2 mm (0.559 in)



MBIB0331E

VALVE SPRING

The valve springs are tapered (ensure the correct direction of fitting).


MBIB0332E

Free height: : 43.31 mm (1.7051 in)

Length under a load of

230 N (23.5 kg, 51.7 lb) : 33.80 mm (1.3307 in)

500 N (51.0 kg, 112.4 lb) : 24.80 mm (0.9764 in)

Joined spires: : 23.40 mm (0.9213 in)

Wire diameter: : 3.45 mm (0.1358 in)

Inner diameter:

Bottom : 18.78 - 18.82 mm (0.7394 - 0.7409 in)

Top : 13.90 - 14.30 mm (0.5472 - 0.5630 in)

Outer diameter:

Bottom : 25.50 - 25.90 mm (1.0039 - 1.0197 in)

Top : 20.8 - 21.2 mm (0.819 - 0.835 in)

WARNING:

This engine does not have any valve spring lower washers.

PISTON

Piston outer diameter	**: 34.965 - 34.985 mm (1.3766 - 1.3774 in)**
Diameter of the housing in the cylinder head	**: 35.00 - 35.04 mm (1.3780 - 1.3795 in)**

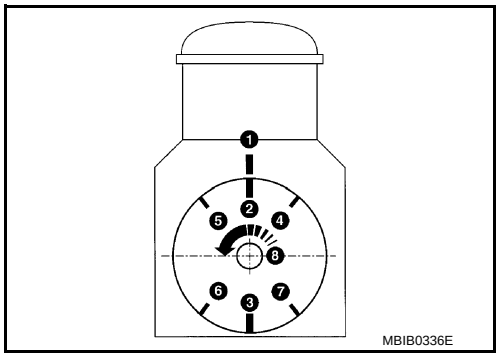
CAMSHAFT

End play	**: 0.08 - 0.178 mm (0.0031 - 0.0070 in)**
Number of bearings	**: 6**
Diameter of the camshaft bearings	
On the camshaft:	
Bearings 1, 2, 3, 4, 5	**: 24.979 - 24.999 mm (0.9834 - 0.9842 in)**
Bearing 6	**: 27.979 - 27.999 mm (1.1015 - 1.1023 in)**
On the cylinder head:	
Bearings 1, 2, 3, 4, 5	**: 25.04 - 25.06 mm (0.9858 - 0.9866 in)**
Bearing 6	**: 28.04 - 28.06 mm (1.1039 - 1.1047 in)**
Timing diagram	
Intake opening retard *	**: –9**
Intake closing retard	**: 20**
Exhaust opening advance	**: 27**
Exhaust closing advance **	**: –7**

* As the intake opening retard is negative, the valve is opened after TDC.

** As the exhaust closing advance is negative, the valve is closed before TDC.

1	Cylinder block TDC fixed mark
2	Flywheel TDC moving mark
3	Flywheel BDC moving mark
4	Intake Opening Retard
5	Exhaust Closing Advance
6	Intake Closing Retard
7	Exhaust Opening Advance
8	Direction of engine rotation (flywheel end).

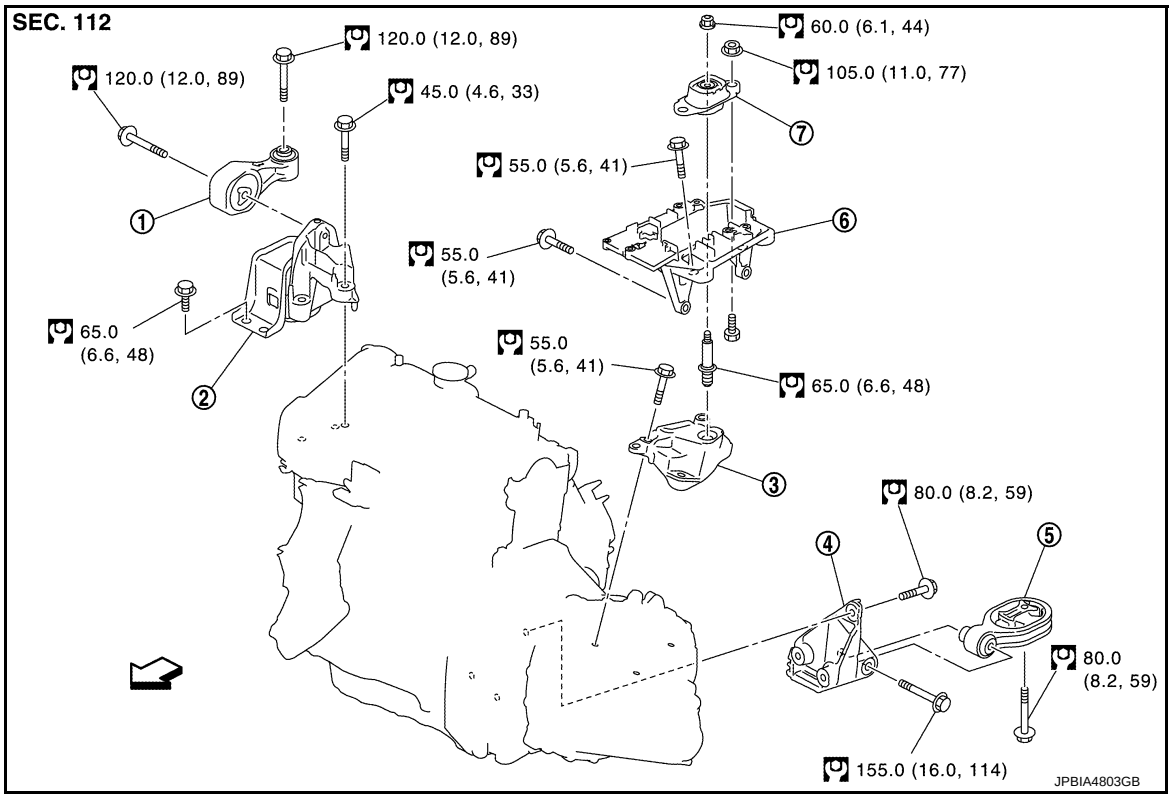


UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:0000000006450008



1. Engine torque rod
2. Engine mounting insulator
3. Engine mounting stay
4. Transaxle mounting stay
5. Engine mounting rear bracket
6. Transaxle torque rod
7. Transaxle mounting upper bracket
8. Transaxle mounting insulator

⇦ : Vehicle front

: N·m (kg-m, ft-lb)

Removal and Installation

INFOID:0000000006450009

WARNING:
- **Situate vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.**

CAUTION:
- **Always be careful to work safely, avoid forceful or uninstructed operations.**
- **Never start working until exhaust system and coolant are cool enough.**
- **If items or work required are not covered by the engine main body section, refer to the applicable sections.**
- **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 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-37, "Board-On Lift".**

REMOVAL

Description of work

Remove engine and transaxle assembly from vehicle down ward. Separate engine and transaxle.

Preparation

1. Remove the following parts.
   - Battery ground cable.
   - Engine undercover.
   - LH/RH front wheel. Refer to WT-7, "Exploded View".
   - LH/RH fender protector. Refer to EXT-22, "Exploded View".

Engine room

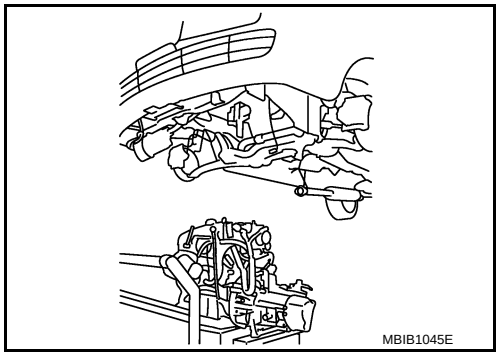
2. Drain engine coolant. Refer to CO-62, "Draining".
   CAUTION:
   Perform when engine is cold.
3. Remove air cleaner case. Refer to EM-280, "Exploded View".
4. Remove turbocharger air inlet pipe. Refer to EM-280, "Exploded View".
5. Remove reservoir tank hoses. Refer to CO-66, "Exploded View".
6. Remove radiator upper hose. Refer to CO-66, "Exploded View".
7. Remove cooling fan shroud assembly. Refer to CO-68, "Exploded View".
8. Remove alternator.
9. Remove vacuum hose. Refer to EM-293, "Exploded View".
10. Disconnect heater hoses.
11. Disconnect engine room harness from the engine side and set it aside for easier work.
12. Disconnect transaxle side harness and clutch tube.
13. Disconnect shift cable and select cable. Refer to TM-78, "Exploded View".
14. Disconnect all the body-side vacuum hoses and air hoses at engine side.
15. Disconnect fuel feed and return hoses, and plug it to prevent fuel from draining.

Vehicle underbody

16. Remove radiator lower hose. Refer to CO-66, "Exploded View".
17. Disconnect thermo plunger connector and earth cable. Refer to CO-72, "Exploded View".
18. Remove thermo plunger unit stay, and set thermo plunger unit aside for easier work.
19. Remove drive shaft lock pin and lock nut. Refer to FAX-77, "Exploded View".
20. Remove strut lower bolts.
21. Remove drive shaft assembly RH and LH. Refer to FAX-77, "Exploded View".
22. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it.
23. Remove altarnator bracket.
24. Remove diesel particulate filter assembly. Refer to EX-17, "Exploded View".
25. Remove engine rear mounting bracket.

Removal

26. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a jack or trestle. Securely support bottom of engine and transaxle.
    CAUTION:
    Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.
27. Remove RH and LH engine mounting bolts.
28. Remove engine and transaxle assembly from vehicle downward by carefully operating supporting tools.
    CAUTION:
    - **During the operation, make sure that no part interferes with body side.**
    - **Before and during this lifting, always check if any harnesses are left connected.**
    - **During the removal operation, always be careful to prevent vehicle from falling off the lift due to changes in the center of gravity.**
    - **If necessary, support vehicle by setting a jack or equivalent tool at the rear.**



Separation Work

CAUTION:

During the operation, secure support the engine by placing a piece of wood under the engine oil pan, transaxle oil pan and suspended the engine slinger by baby crane (movable hoist) etc.

29. Remove starter motor.
30. Separate engine and transaxle.
31. Lift with the hoist and separate the engine from the transaxle assembly.

INSTALLATION

Install in the reverse order of removal.

- Do not allow oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to components illustration.
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.

Inspection

INFOID:0000000006450010

INSPECTION AFTER INSTALLATION

- Before starting engine check the levels of coolant, lubrications and working oils. If less than required quantity, fill to the specified level.
- Before starting engine, bleed air from fuel piping. Refer to FL-50, "Air Bleeding".
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, working oil, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines.

UNIT DISASSEMBLY AND ASSEMBLY

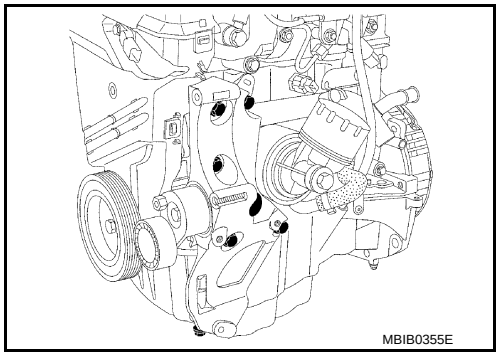
ENGINE STAND SETTING

Preparing the engine to be on the stand

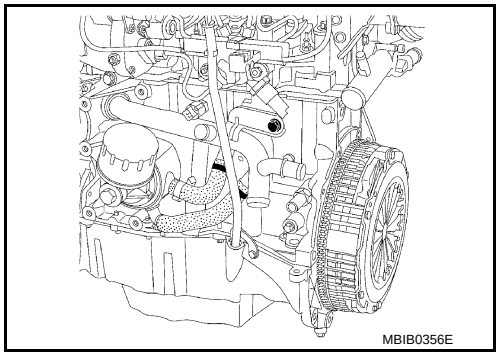
INFOID:0000000006450011

Before the engine is mounted on the engine sub-attachment, the engine's electrical harness must be removed and the engine oil drained.

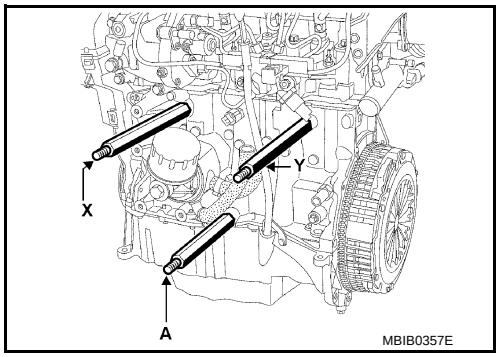
1. Remove the multifunction support.


MBIB0355E

2. Remove the coolant inlet pipe on the water pump.


MBIB0356E

3. Place the rods (**A**), (**X**), (**Y**) on the cylinder block.



MBIB0357E

CYLINDER BLOCK

Disassembly and Assembly

INFOID:0000000006450012

PREPARING USED ENGINE

The engine should be cleaned and drained (oil and water).

Leave on the used engine or include in the return box:
- Oil filter
- Oil pressure switch
- Water pump
- Fuel injection pump
- Rail
- Injectors
- Glow plugs
- Oil level gauge
- Vacuum pump
- Flywheel

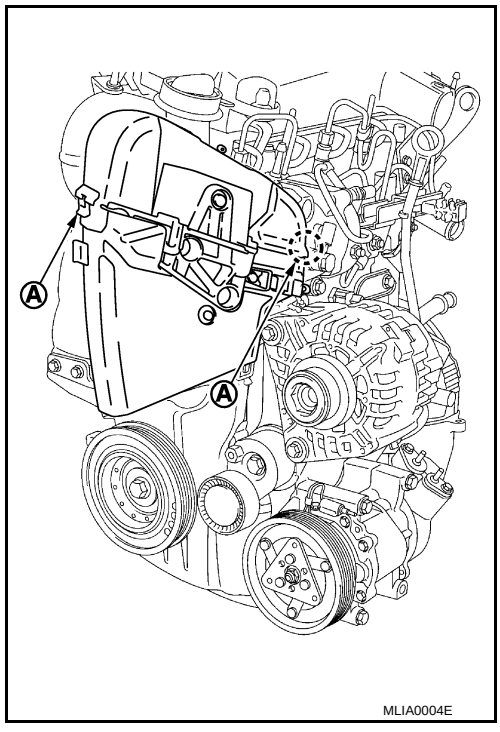
Remember to remove:
- All coolant pipes
- Exhaust manifold
- Alternator
- Power steering pump
- A/C compressor
- Alternator bracket
- Oil level sensor
- Cylinder head coolant outlet unit

The used engine should be secured to the base under the same conditions as the overhauled engine:
- Plastic plugs and covers fitted
- Cardboard cover over the assembly

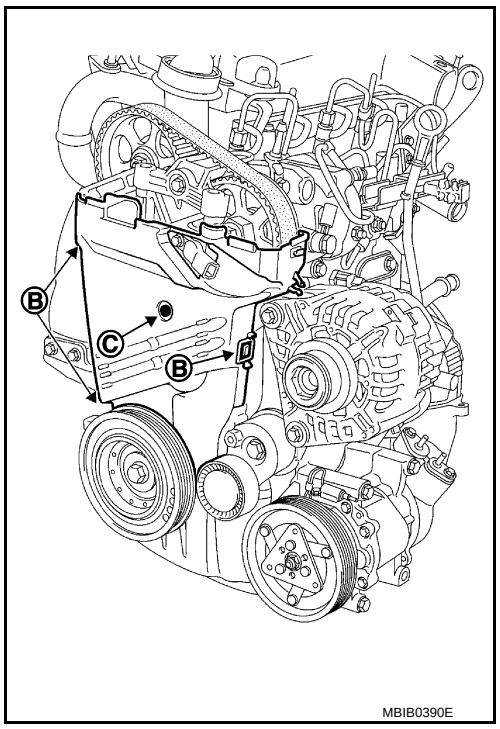
DISASSEMBLY

REMOVING THE UPPER ENGINE

1. Remove the upper timing cover by unclipping the two tabs (A).

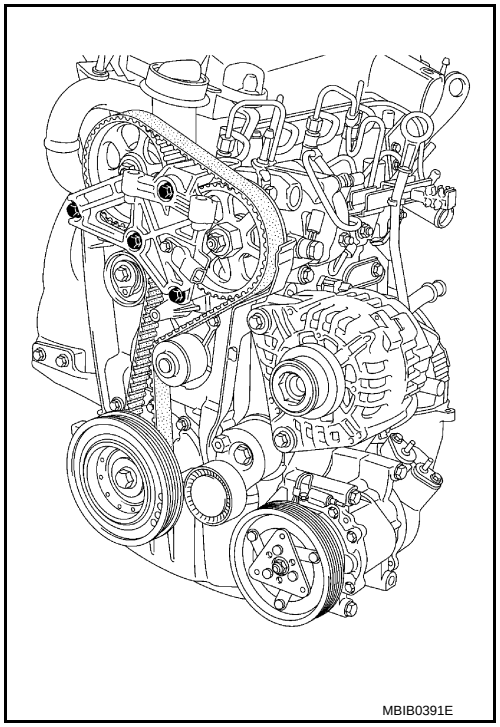


2. Remove the lower timing cover by unclipping the three tabs (B) and pulling out the plastic bolt (C).

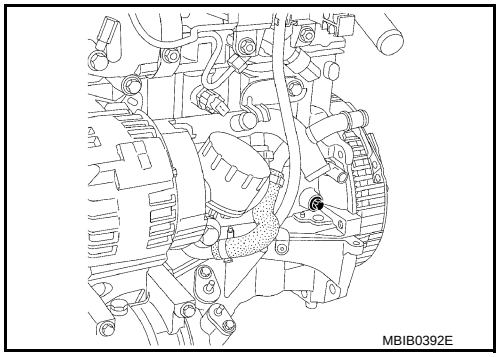


MBIB0390E

3. Remove the cylinder head suspended mounting bracket and high pressure pump position sensor.

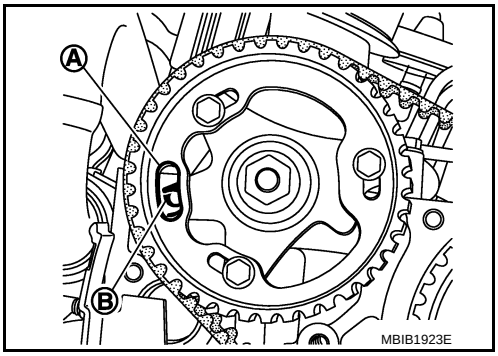

MBIB0391E

4. Remove the TDC pin cap.

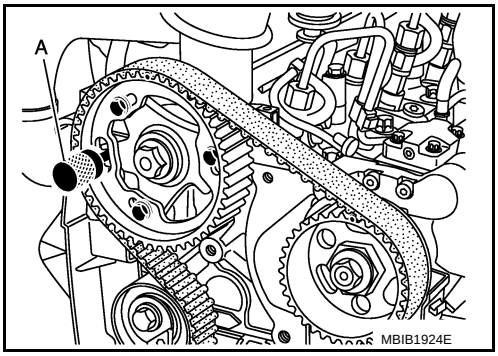

MBIB0392E

POSITIONING THE BELT AT THE TIMING POINT

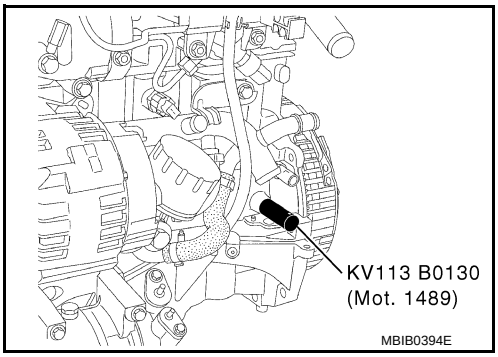
1. Rotate the crankshaft clockwise, until the position (A) of the camshaft pulley becomes opposite of the position (B) on the cylinder head.



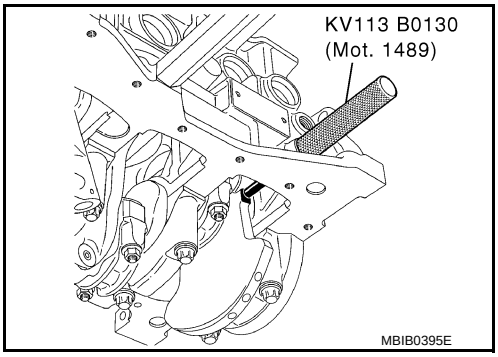
2. Insert TDC set pin [SST: KV 113B0110 (Mot. 1430)] (A) into the camshaft pulley and cylinder head.



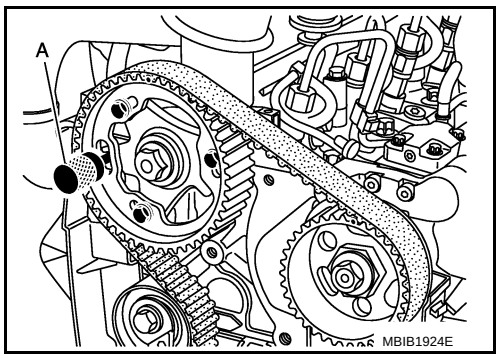
3. Screw in the Tool KV113B0130 (Mot. 1489).



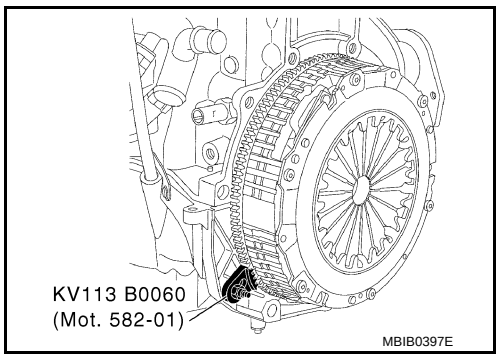
4. Turn the engine clockwise (timing side) until the crankshaft reaches the Tool KV113B0130 (Mot. 1489).



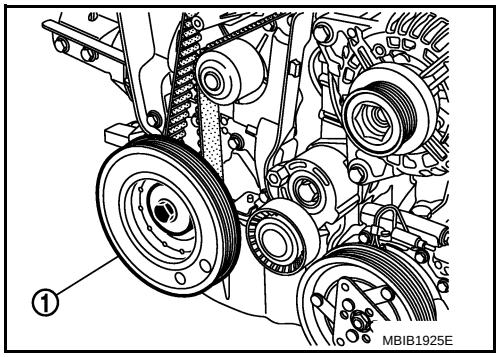
5. The Tool KV113B110 (Mot. 1430) (A) must engage in the camshaft pulley and cylinder head holes.
6. Remove Tool KV113B0130 (Mot. 1489).



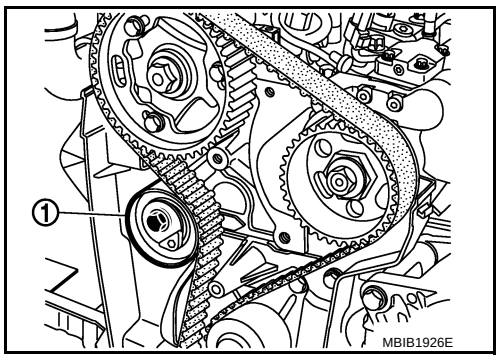
7. Install the Tool KV113B0060 (Mot. 582-01).



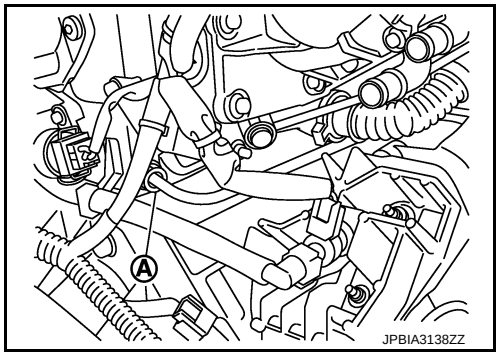
8. Remove the crankshaft pulley (1).



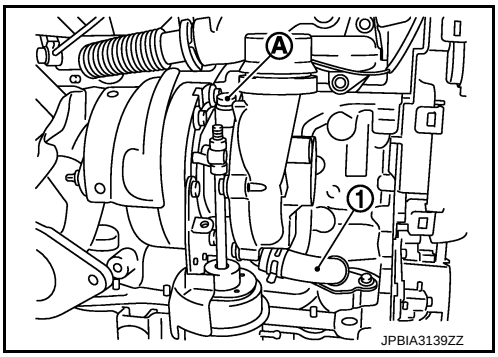
9. Slacken the timing belt by loosening the bolt of the tensioner (1), then remove the timing belt.
10. Remove the timing belt tensioner and inner timing cover.
11. Remove air cleaner case. Refer to EM-278.



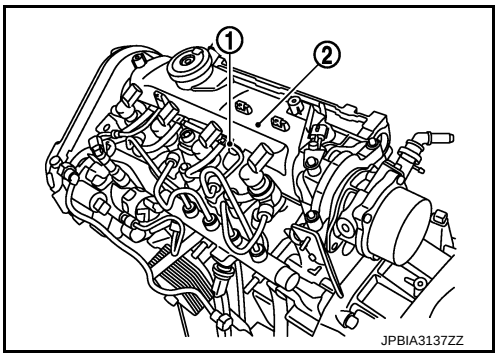
12. Remove the turbocharger oil supply pipe (A) on the cylinder head side.



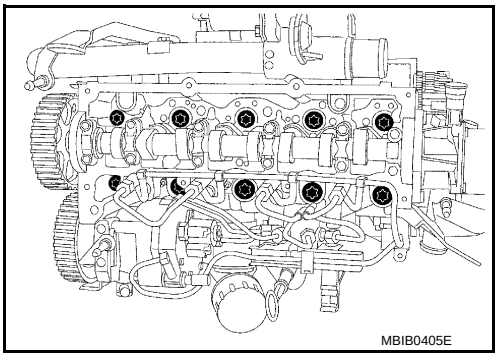
13. Remove the turbocharger oil supply pipe on the turbocharger side, nuts (A) and the torx bolt of the turbocharger flange, and turbocharger oil outlet hose (1).



14. Unclip the fuel return pipe from the cylinder head cover at the fuel spill tube (1), then remove the rocker cover (2).



15. Remove the oil level gauge guide and cylinder head.

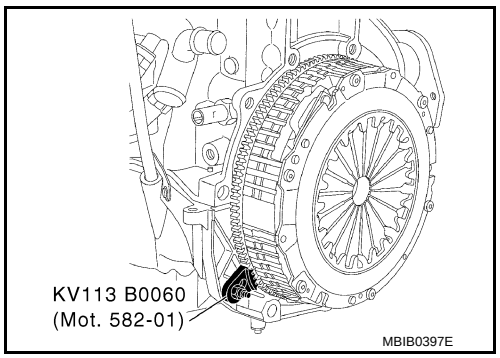


CLEANING

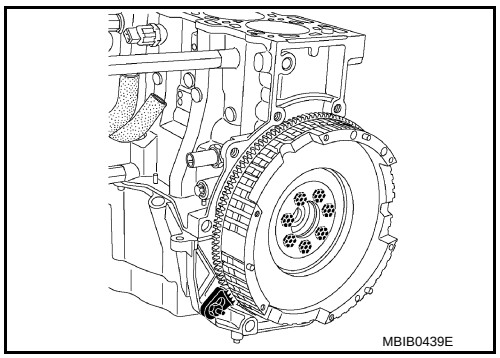
- It is very important not to scratch the gasket faces of any aluminium components.
- Use suitable tool to dissolve any part of the seal which remains stuck to the metal surface.
- Apply the dissolving product to the part to be cleaned, wait approximately 10 minutes, then remove it using a wooden spatula.
- Wear gloves while carrying out this operation.
- Do not allow this dissolving product to drip on to the paintwork.
- **Great care should be taken when performing this operation, to prevent foreign objects from entering the pipes taking oil under pressure to the camshafts (pipes in both the cylinder head and its cover) and the oil return pipes.**
- **Failure to follow these instructions could lead to the blocking of the oilways, resulting in rapid and serious damage to the engine.**

DISASSEMBLY OF THE BOTTOM ENGINE

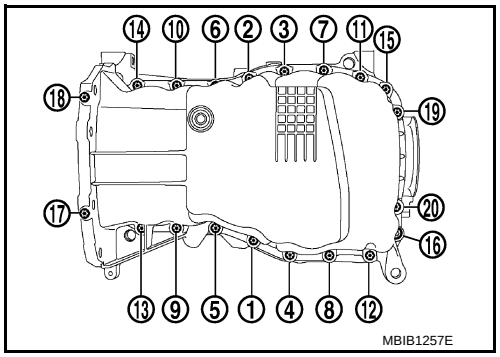
1. Install the Tool KV113B0060 (Mot. 582-01).



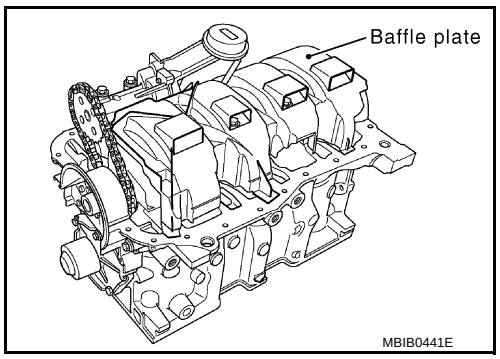
2. Remove the clutch housing.
3. Remove the flywheel.



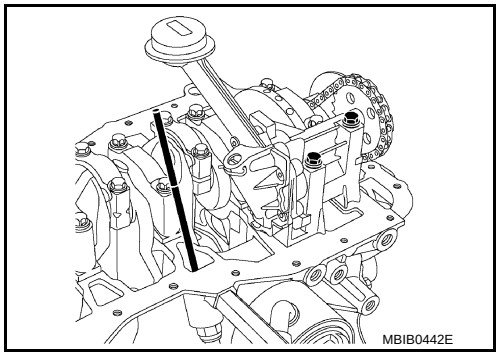
4. Remove the oil pan bolt in reverse order as shown.



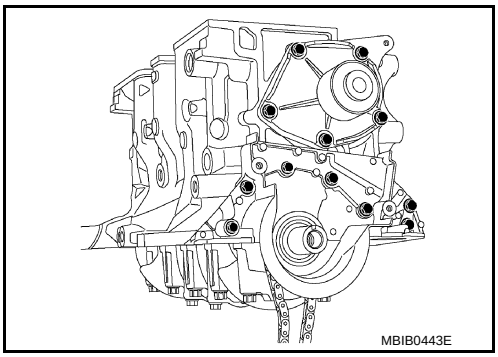
5. Remove the baffle plate.



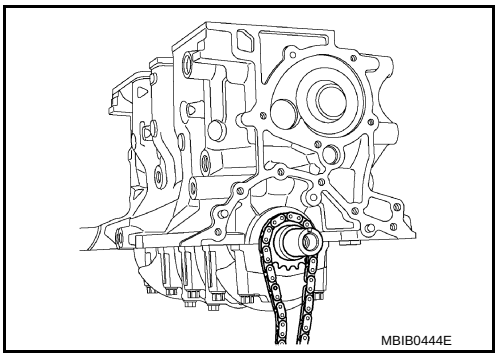
6. Remove the oil level sensor.
7. Remove the oil pump.



8. Remove the rear oil seal retainer.
9. Remove the water pump.

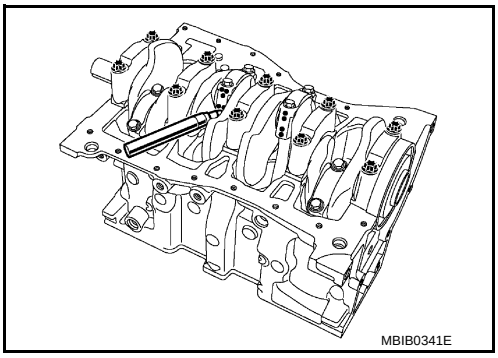

MBIB0443E

10. Remove the oil pump chain.
11. Remove the oil pump drive sprocket.

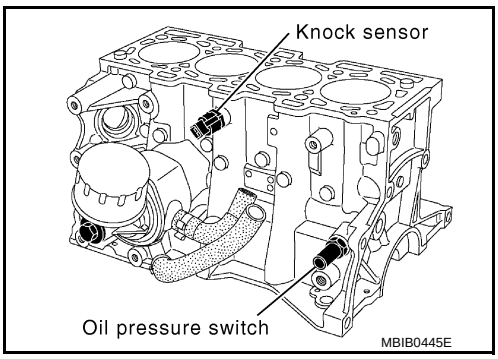

MBIB0444E

WARNING:
Never use a sharp point to mark the bearing caps in relation to their connecting rods to avoid starting a crack in the rod. Use a permanent marker pen.

12. Remove the big end cap bolts and the connecting rod/piston assemblies.
    NOTE:
    It is essential to mark the position of the main bearing cap, as the category may be different for each bearing.
13. Remove the main bearing caps.
14. Remove the crankshaft.

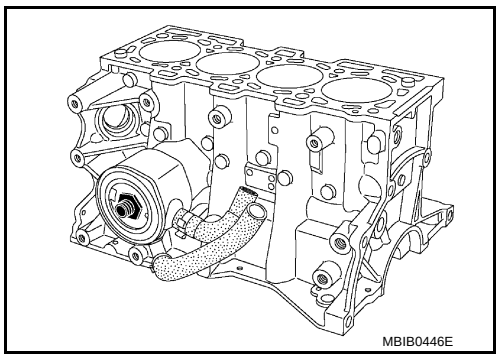

MBIB0341E

15. Remove the oil pressure switch, the knock sensor and oil filter bracket connecting bolt.



MBIB0445E

16. Remove the oil cooler connecting bolt.

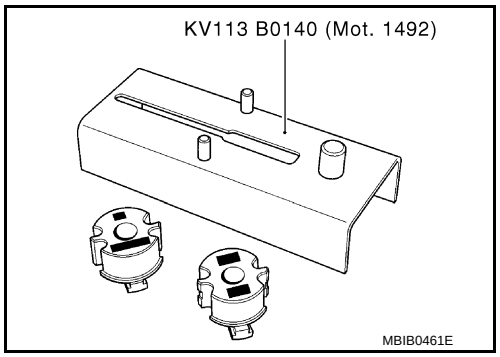

MBIB0446E

REMOVING THE PISTON PINS

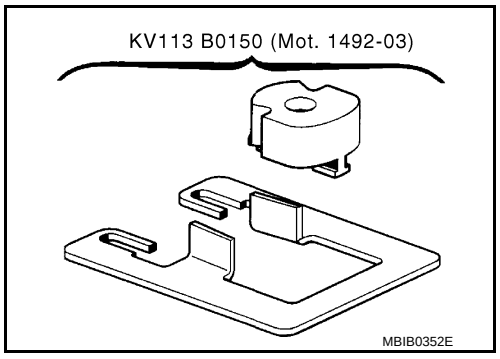
NOTE:
It is imperative to mark the connecting rod to match it to its piston, because the piston height classes in the same engine may be different (see Technical Specifications section).
To remove the piston pin, remove the snap ring using a screwdriver, then release the pin.

CONNECTING ROD BEARING

- The connecting rod bearing are installed using Tool KV113B0140 (Mot. 1492) and Tool KV113B0150 (Mot. 1492-03).



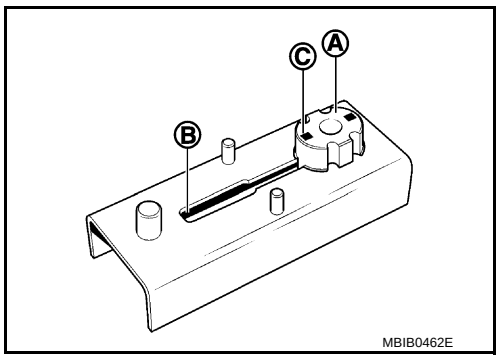
MBIB0461E



MBIB0352E

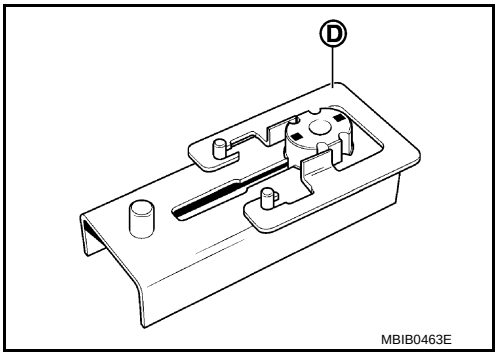
ON THE CONNECTING ROD BODY

1. Slide the connecting rod bearing support (A) of Tool KV113B0150 [Mot. 1492-03 (positioning the engraved mark (B) as shown in the figure)] into the groove (C) of the base of Tool KV113B0140 (Mot. 1492).

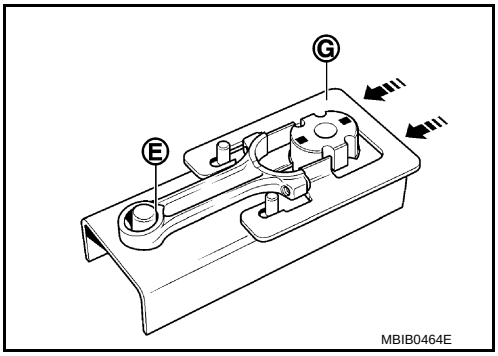


MBIB0462E

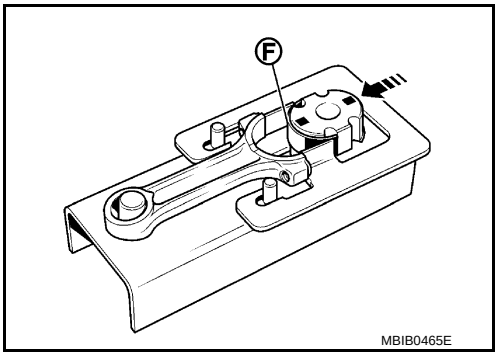
2. Install the guide (D) of Tool KV113B0150 (Mot. 1492-03) onto the base (as shown in the figure).



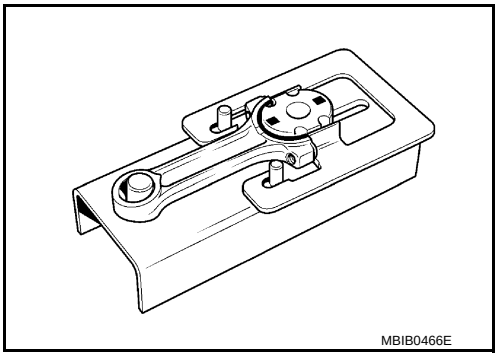
3. Lay the body of the connecting rod on the base of the tool (as shown in the diagram). Check that the lower part (E) of the small end is touching the centering pin and push the guide (G) in the direction of the arrow.



4. Lay the connecting rod bearing [with a width of 20.625 mm (0.8120 in)] (F) on the connecting rod bearing support, then push it in the direction of the arrow (as shown in the figure).

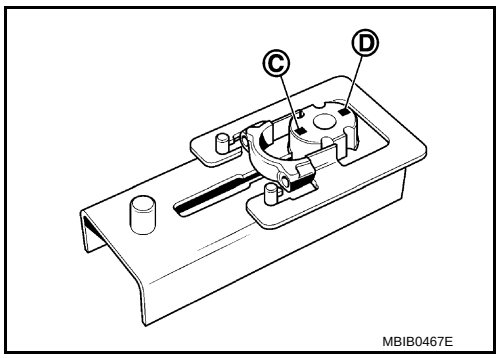


5. Bring the connecting rod support up against the base of the connecting rod body.
6. Remove the connecting rod body support and repeat the operation for the remaining connecting rod bodies.

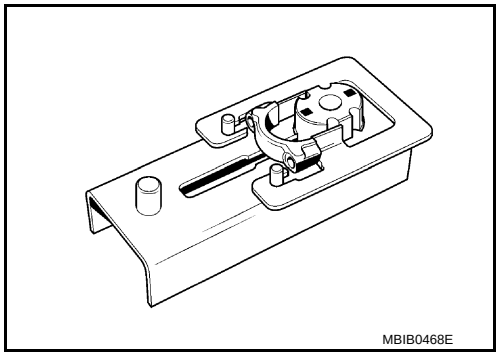


ON THE CONNECTING ROD CAP

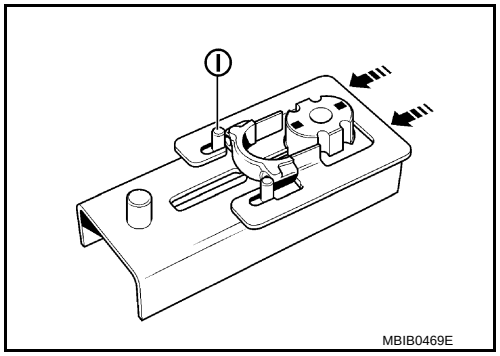
1. Position the connecting rod bearing support either on the engraved mark (C) if the width of the connecting rod bearing is equal to 20.625 mm (0.8120 in).
2. Position the connecting rod bearing support either on the engraved mark (D) if the width of the connecting rod bearing is equal to 17.625 mm (0.6939 in).



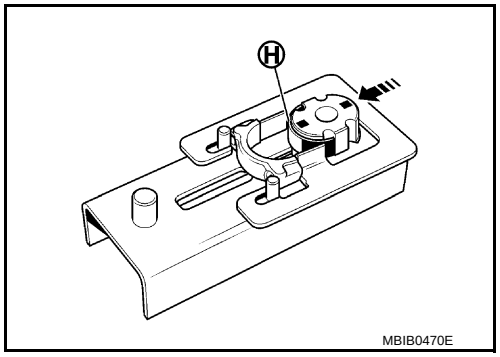
3. Install the connecting rod cap as shown in the figure.



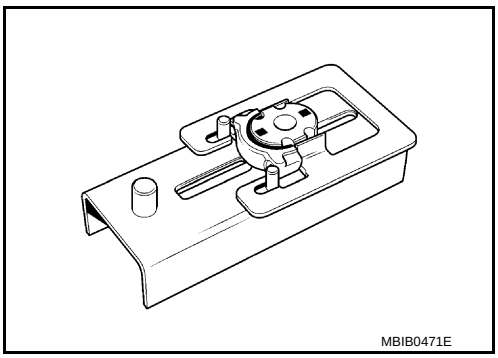
4. Push the guide (in the direction of the arrow) until the connecting rod cap is in contact with the pins (I) on the base of the tool.



5. Install the connecting rod bearing (H) on the bearing support, then push it in the direction of the arrow (as shown in the figure).



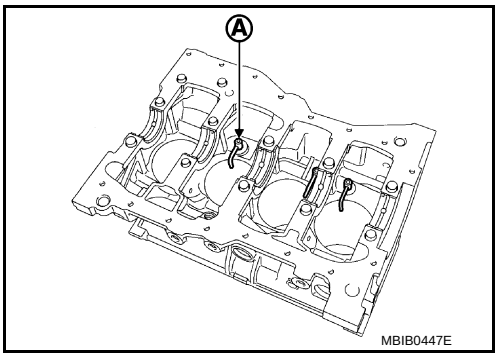
6. Bring the connecting rod bearing support up against the base of the connecting rod cap.
7. Remove the connecting rod bearing support and repeat the operation for the remaining connecting rod caps.


MBIB0471E

REPLACEMENT OF THE OIL JETS

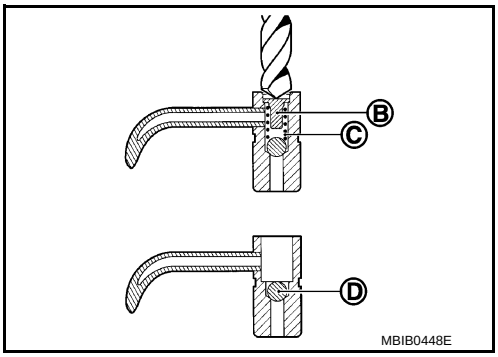
Removal

1. To remove the oil jets (A), they must be drilled with a 7 mm (0.28 in) diameter drill. This is necessary in order to remove the spring stop (B) and the spring (C).



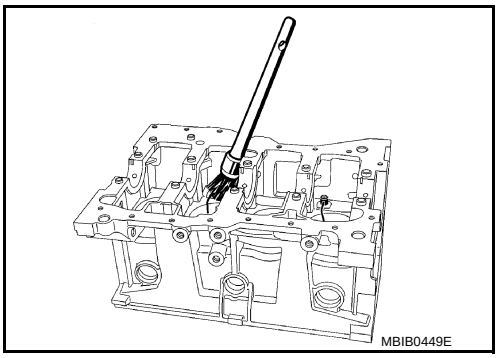
MBIB0447E

NOTE:
Do not remove the ball (D) to prevent from entering the cooling circuit.

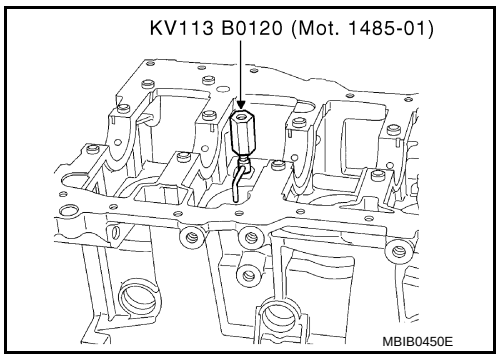


MBIB0448E

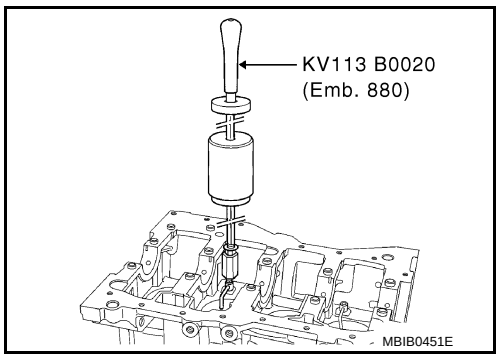
2. Remove the chippings and spring using a suitable brush.


MBIB0449E

3. Screw Tool KV113B0120 (Mot. 1485-01) in the drilled out jets using a 6 mm (0.24 in) Allen key which must slide into the tool.



4. Screw Tool KV113B0020 (Emb. 880) onto KV113B0120 (Mot. 1485-01) and remove the oil jet.

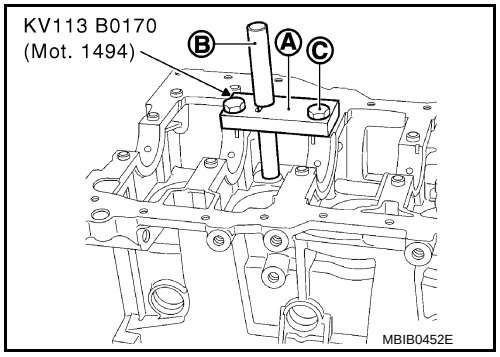


ASSEMBLY

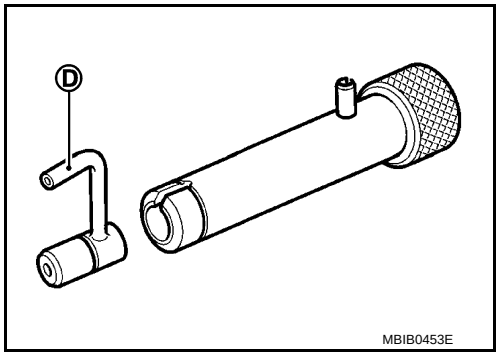
INSTALLATION OF OIL JETS

Installation of The Oil Jets For No.1 and No.3 Cylinders

1. Install plate (A) of Tool KV113B0170 (Mot. 1494) onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
2. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
3. Tighten the two bolts (C).
4. Remove the guide rod.

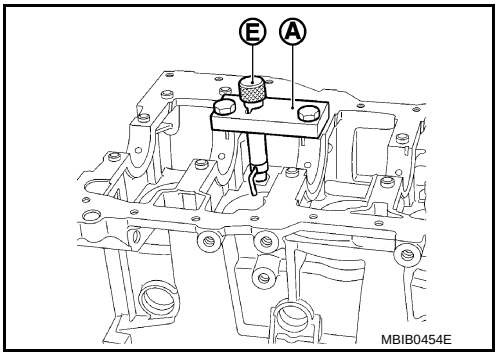


5. Install the push rod instead of the guide rod, then insert the oil jet into the push rod.
   NOTE:
   Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



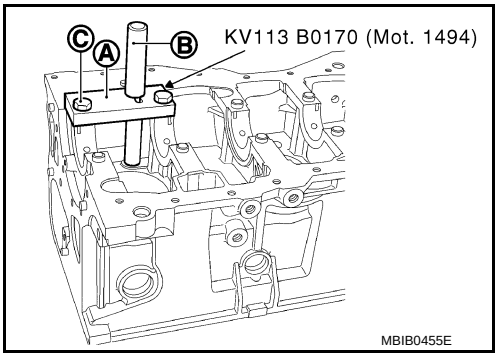
6. The oil jets must be installed using Tool KV113B0170 (Mot. 1494).

7. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).

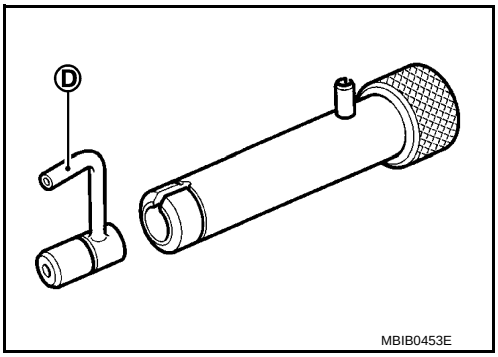


Installation of The Oil Jets For No.2 and No.4 Cylinders

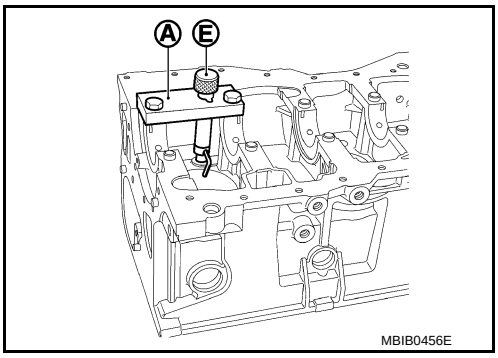
1. Fit plate (A) of Tool KV113B0170 (Mot. 1494) onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
2. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
3. Tighten the two bolts (C).
4. Remove the guide rod.



5. Position the push rod instead of the guide rod, then insert the oil jet into the push rod.
   NOTE:
   Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



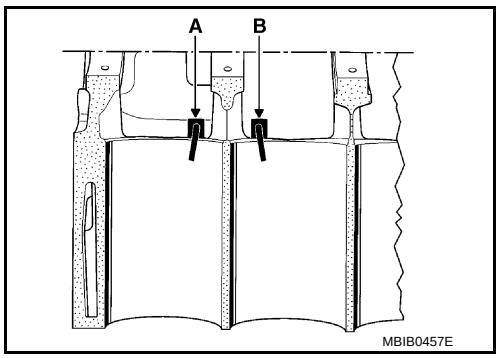
6. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



Orientation Of The Oil Jets (See Diagram Below)

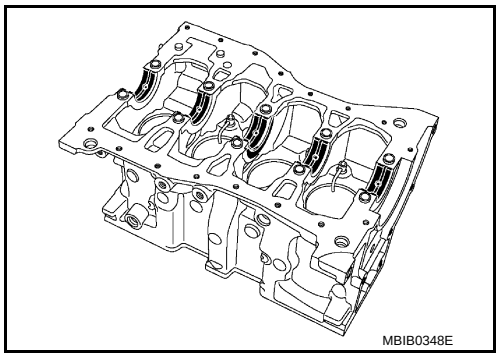
- Clean the cylinder block and crankshaft by passing a wire through the lubrication channels.

A	Orientation of the oil jets of No. 2 and No. 4 cylinders
B	Orientation of the oil jets of No. 1 and No. 3 cylinders

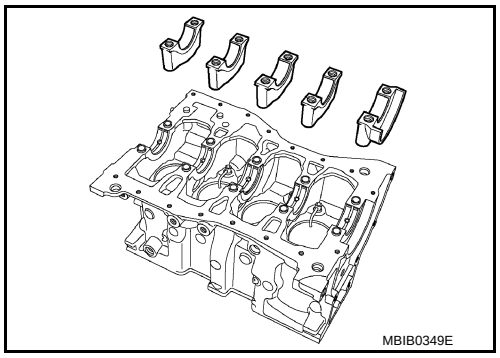


INSTALLATION OF MAIN BEARING

1. Position the grooved main bearings on the cylinder block.



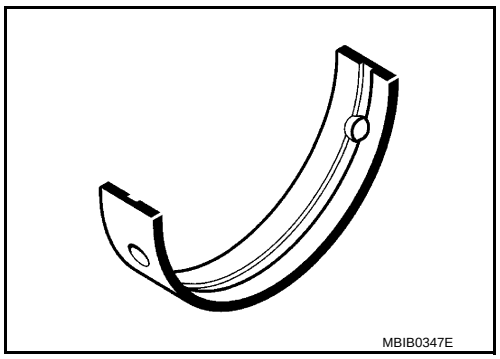
2. Install the smooth bearings on the bearing caps.



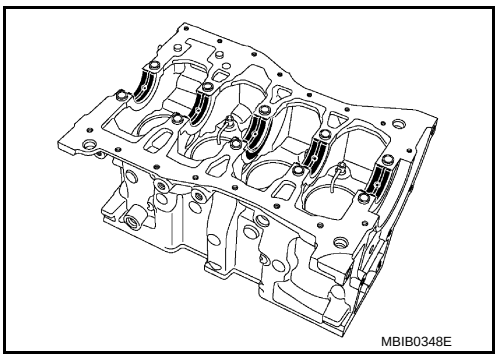
MAIN BEARING

- **The engine is installed with main bearing without a locator notch.**

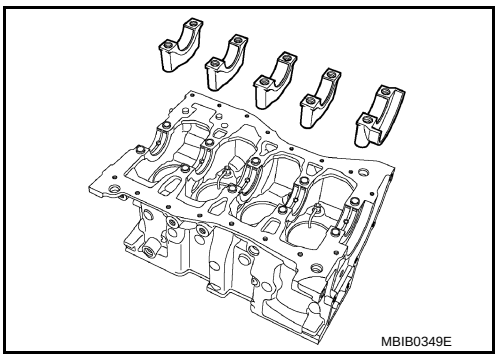
1. The main bearings are installed on the cylinder block and on the bearings using Tool KV113B0160 (Mot. 1493-01).



2. For direction of installation on the cylinder block, install grooved main bearing on all the bearings.

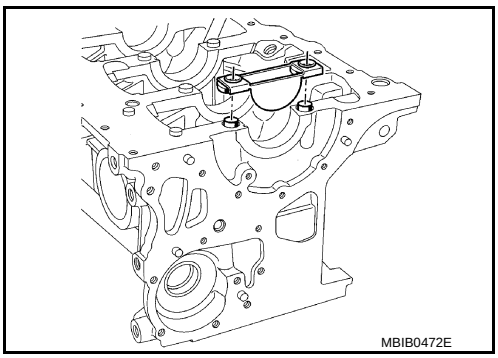

MBIB0348E

3. For direction of installation on the bearing caps, install non-grooved main bearing.

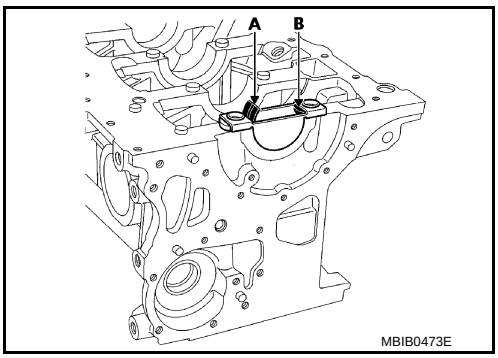

MBIB0349E

ON THE CYLINDER BLOCK

1. Position tool KV113B0160 (Mot. 1493-01) on the cylinder block.


MBIB0472E

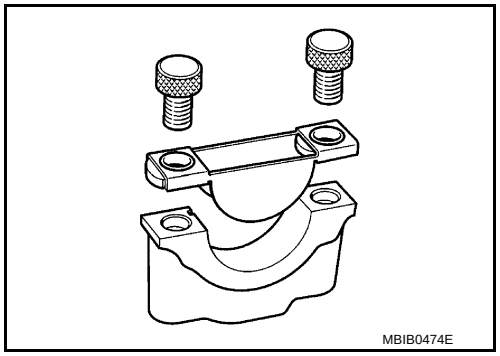
2. Press at (A) until the bearing cap is touching at (B) with KV113B0160 (Mot. 1493-01).



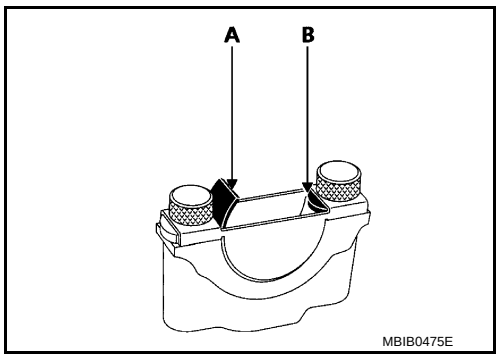
MBIB0473E

ON THE BEARING CAPS

1. Position Tool KV113B0160 (Mot. 1493-01) on the bearing cap.



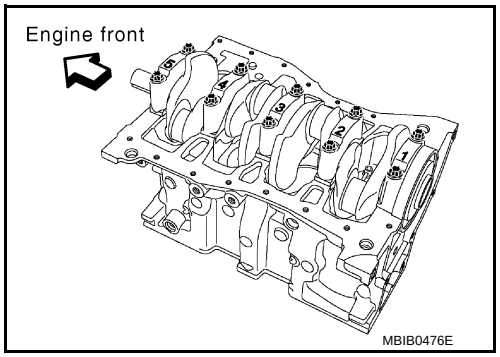
2. Install the main bearing in Tool KV113B0160 (Mot. 1493-01), then press at (A) until the main bearing is touching at (B) with Tool KV113B0160 (Mot. 1493-01).



3. Oil the main bearing.
4. Install the crankshaft.
5. Install the lateral shims on bearing No. 3, putting the grooves on the crankshaft side.
6. Install the main bearing caps on bearing cap No. 1 (these are numbered from 1 - 5 and these numbers should be positioned opposite the water pump), and tighten the bolts as follows:

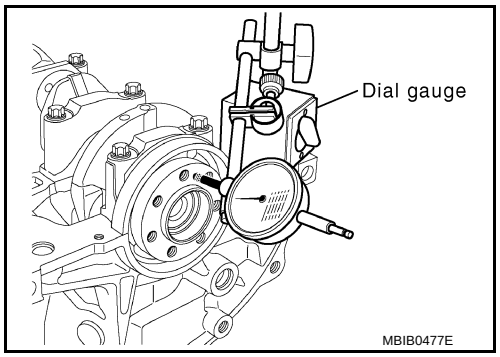
a. Tighten the bolts.

: 25 N·m (2.6 kg-m, 18 ft-lb)



b. Turn the bolt 47 degrees ±± 6 degrees clockwise (angle tightening).

7. Check the lateral clearance of the crankshaft which should be without wear on lateral shims: 0.045 - 0.252 mm (0.0018 - 0.0099 in)
8. Check the lateral clearance of the crankshaft which should be with wear on the lateral shims: 0.045 - 0.852 mm (0.0018 - 0.0335 in)

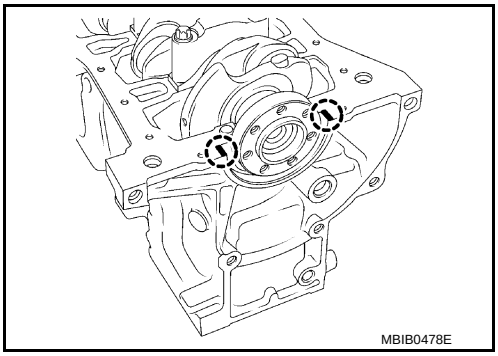


INSTALLATION OF NO. 1 BEARING

1. **Degrease the gasket faces (of the cylinder block and bearing No. 1). They should be clean, dry and free from grease (in particular, remove finger marks).**
2. Lay two beads of liquid sealant with a width of 1 mm (0.04 in) on bearing No. 1 of the cylinder block.
   Tighten the bolts of bearing cap No. 1, and tighten the bolts as follows:

a. Tighten the bolts.

: 25 N·m (2.6 kg-m, 18 ft-lb)


MBIB0478E

b. Turn the bolt 47 degrees ±± 6 degrees clockwise (angle tightening).

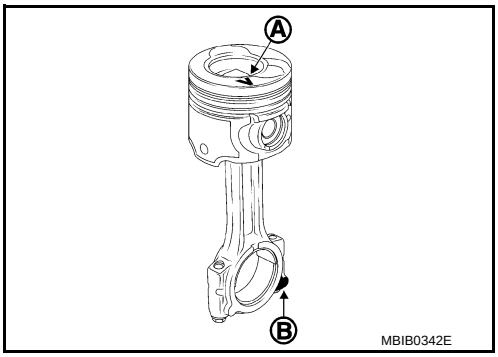
CONNECTING RODS / PISTON ASSEMBLY

- The pistons have a mark engraved on their heads indicating the engine rear side.

1. Oil the piston pin.
2. Check that the piston pins rotate correctly in the new piston and in the matching connecting rod.

Direction Of Installation Of The Connecting Rod In Relation To The Piston

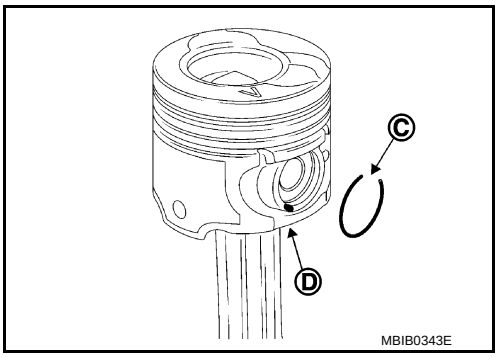
- Point the mark (A) engraved on the top of the piston upwards and the flat (B) of the big end downwards as shown in the figure.



MBIB0342E

DIRECTION FOR INSTALLATION THE SNAP RINGS ON THE PISTON

- Position the opening (C) of the snap rings opposite the removal and fitting channel (D).



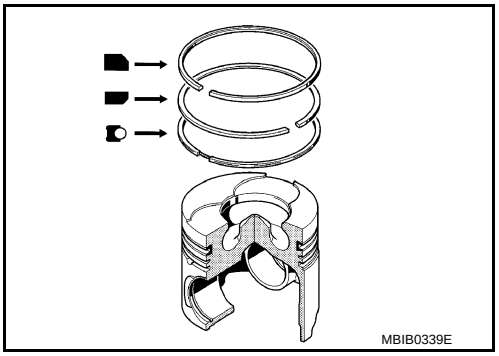
MBIB0343E

INSTALLATION OF THE SNAP RINGS

1. Rings set to their original adjustment must be free within their channels.
2. Ensure the snap rings are fitted the correct way, with the word TOP pointing upwards.

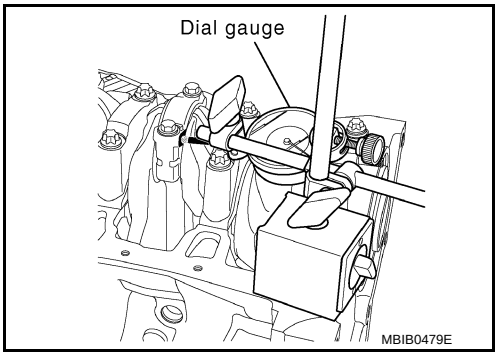
Orientation Of The Piston Rings In The Piston

1. Ensure the break in each piston ring is correctly oriented as shown in the figure.



2. Apply new engine oil to the pistons.
3. Install the connecting rod/piston assemblies into the cylinder block using the ring, being careful to fit them the right way round (mark towards the flywheel).
4. Install the connecting rods onto the oiled crankshaft pins of the crankshaft.
5. Install the connecting rod caps, ensuring they are correctly matched.
6. Tighten the big end cap bolts to a torque of 20 N·m (2.0 kg-m, 15 ft-lb), plus an angle tightening of 45°±6°.

: 20 N·m (2.0 kg-m, 15ft-lb)



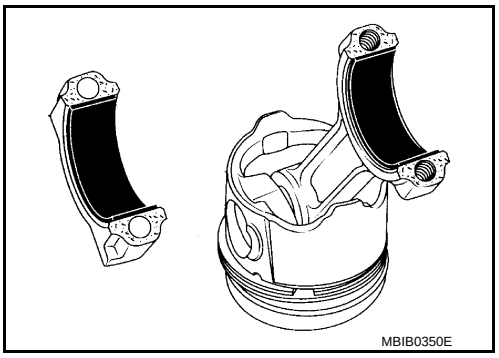
7. Inspect that the big ends have the correct lateral clearance of 0.205 to 0.467 mm (0.0081 to 0.0184 in).

CONNECTING ROD BEARING

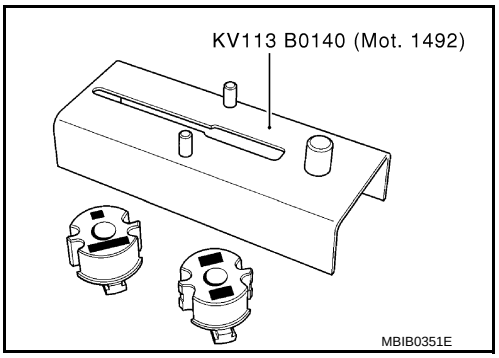
- **The engine is installed with connecting rod bearing without a locator notch.**
  NOTE:
  The upper and lower connecting rod bearing are not the same width.

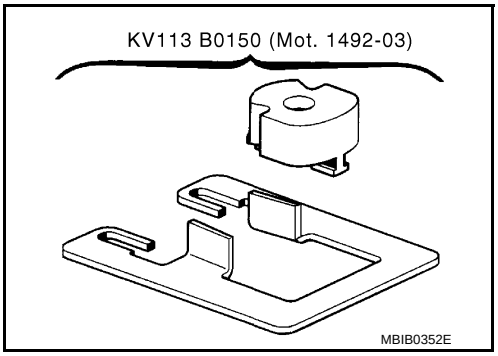
Connecting rod bearing width:

Upper bearing	**: 20.625 mm (0.8120 in)**
Lower bearing	**: 17.625 mm (0.6939 in)**



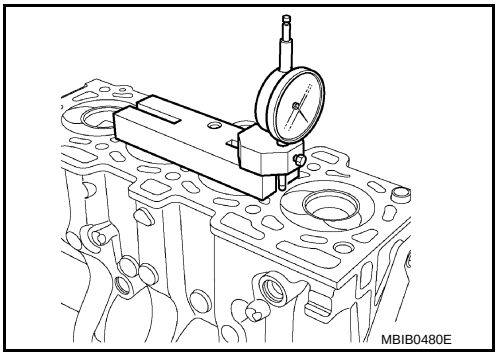
- The connecting rod bearing are installed using Tool KV113B0140 (Mot. 1492) and Tool KV113B0150 (Mot. 1492-03).

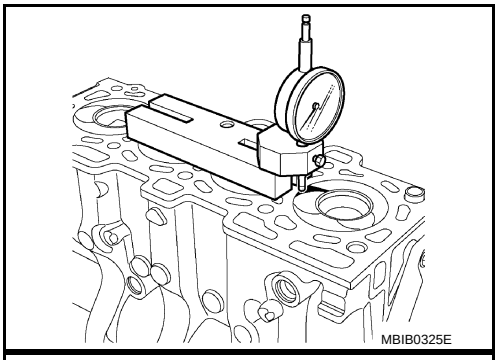




CHECKING PISTON PROTRUSION

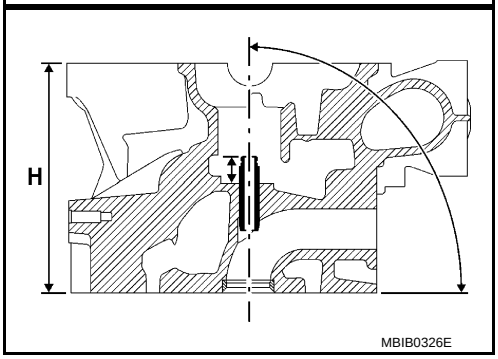
1. Clean the piston head.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Install Tool KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool on the piston.
4. Install Tool KV113B0040 (Mot. 251-01) (Commercial service tool) or equivalent tool equipped with a gauge on support plate KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool, and find TDC.
   NOTE:
   All measurements must be carried out along the longitudinal axis of the engine, in order to eliminate any errors due to tilting of the piston.
   WARNING:
   The gauge follower must not be in the valve clearance.
5. Inspect the piston protrusion which must be 0.099 to 0.285 mm (0.0039 to 0.0112 in).





Height of the cylinder head:
H = 127 mm (5.00 in)

Gasket face bow:
Cylinder head : 0.05 mm (0.0020 in)
Cylinder block : 0.03 mm (0.0012 in)

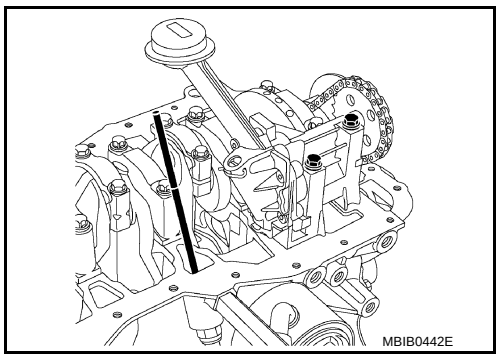


NO REGRINDING IS AUTHORIZED
Test the cylinder head to detect possible cracks using the cylinder head test container (comprising a tray and a kit suited to the cylinder head, plug, sealing plate and blanking plate).

INSTALLATION OF REAR OIL SEAL RETAINER AND OIL PUMP

1. Tighten the knock sensor.

: 20 N·m (2.0 kg-m, 15ft-lb)


MBIB0442E

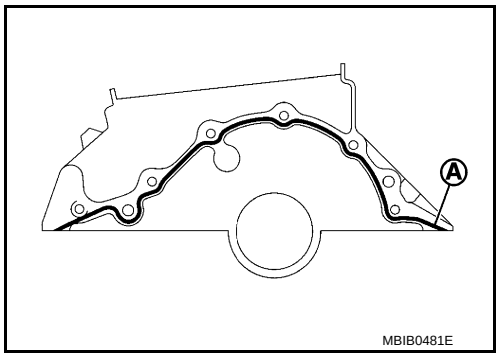
2. Tighten the oil pressure sensor.

: 25 N·m (2.6 kg-m, 18ft-lb)

3. Install the oil pump sprocket and chain.

: 25 N·m (2.6 kg-m, 18ft-lb)

NOTE:
The gasket faces (cylinder block, rear oil seal retainer and water pump) must be clean, dry and free from grease (in particular, remove finger marks).
The rear oil seal retainer should be applied with liquid gasket. The bead (A) must be 1.5 to 2 mm (0.059 to 0.079 in) wide and be applied in accordance with the figure.
- Use Genuine Liquid Gasket or equivalent.



MBIB0481E

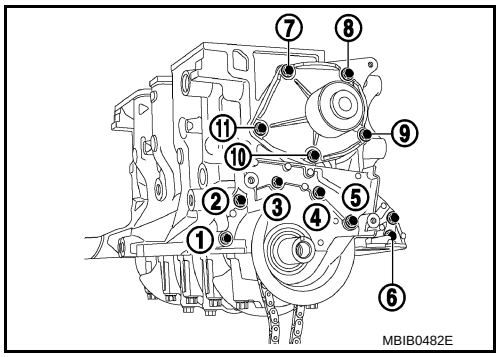
4. Install the rear oil seal retainer. Tighten bolts (No.1 to 6) as shown in the figure.

: 12 N·m (1.2 kg-m, 9ft-lb)

5. Put a new gasket to water pump face and install the water pump. Put a drop of locking sealant on the bolts (No.7 to 11) in the numerical order as shown in the figure.

: 11 N·m (1.1 kg-m, 8ft-lb)

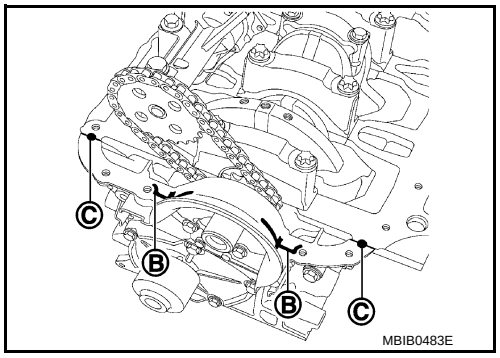
- Use Genuine thread locking sealant or equivalent.



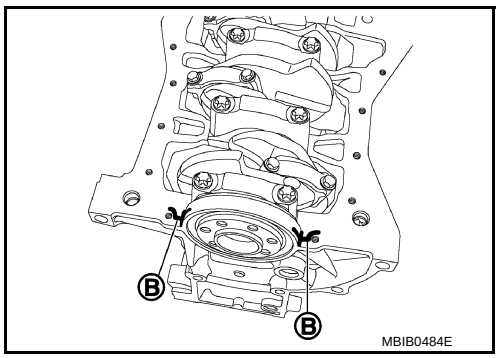
MBIB0482E

NOTE:
The gasket faces (cylinder block and rear oil seal retainer) must be clean, dry and free from grease (in particular, remove finger marks).

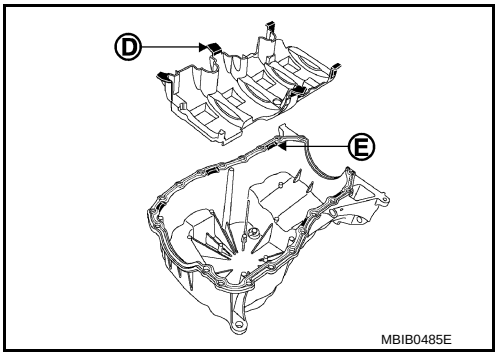
6. Apply four beads (B) of liquid gasket, with a diameter of 5 mm (0.20 in).
7. Apply two drops (C) of liquid gasket, with a diameter of 7 mm (0.28 in) at the intersection of the rear oil seal retainer and the cylinder block.
- Use Genuine Liquid Gasket or equivalent.



MBIB0483E

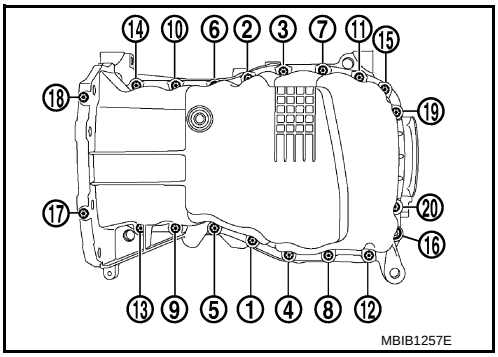


8. When installing the oil pan, ensure that the tabs (D) of the baffle plate are correctly positioned in the slots (E).
9. When installing the oil pan, ensure that the cylinder block and the oil pan are correctly aligned on the flywheel side, to prevent the clutch housing from being damaged when installing the transaxle.
10. Install the baffle plate.



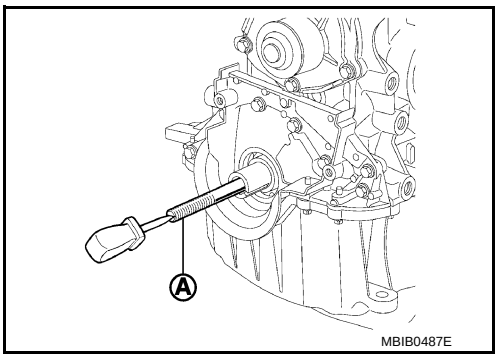
11. Install the oil pan, and tighten the bolts in the numerical order as shown in the figure

: **14 N·m (1.4 kg-m, 10ft-lb)**

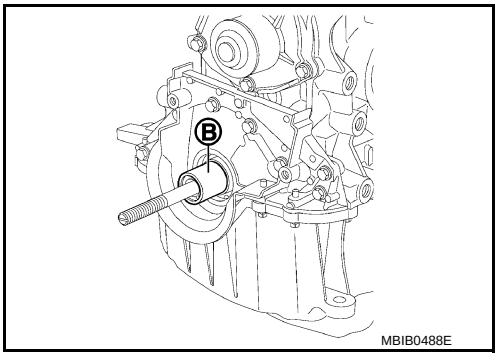


INSTALLATION OF THE CRANKSHAFT SEAL GASKETS

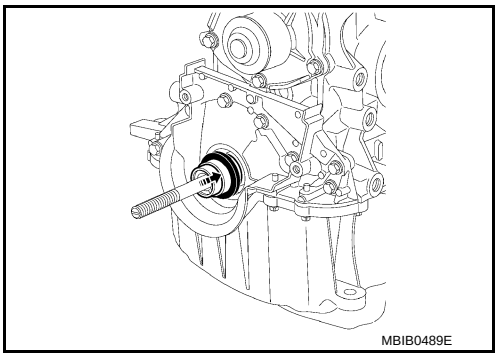
1. Crankshaft elastomer seal, timing side.
2. Screw the threaded rod (A) of Tool KV113B0220 (Mot. 1586) into the crankshaft.



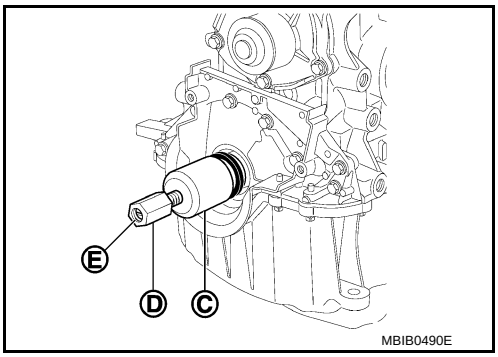
3. Position the spacer (B) of Tool KV113B0220 (Mot. 1586) on the crankshaft.



4. Install the protector complete with the seal onto the spacer, taking care not to touch the seal.

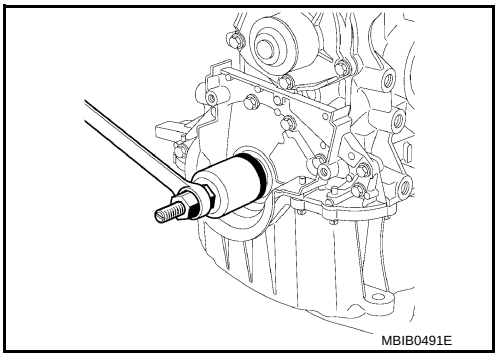

MBIB0489E

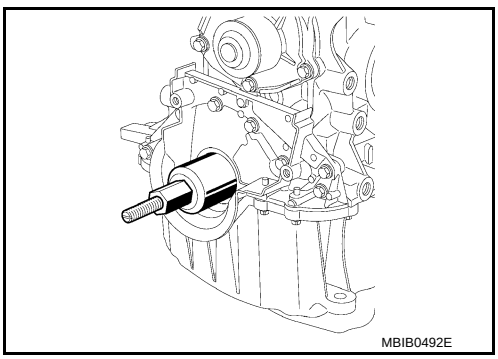
5. Install the cover (A) and the nut (B) (putting the threaded part (C) of the nut on the side away from the engine) of Tool KV113B0220 (Mot. 1586).



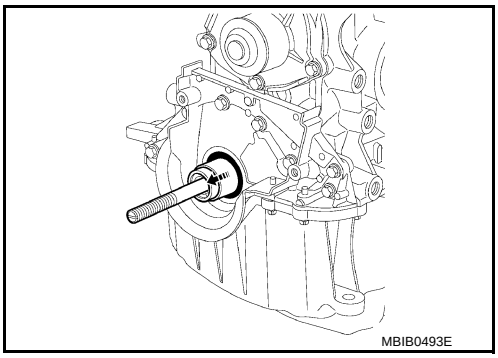
MBIB0490E

6. Tighten the nut until the cover touches the spacer.

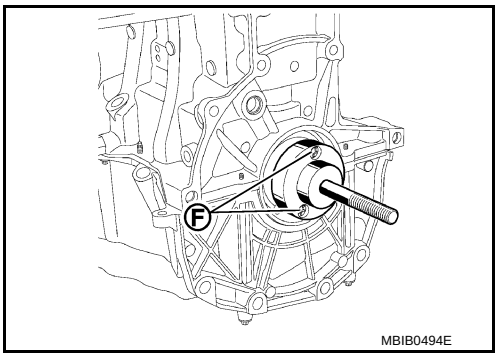

MBIB0491E


MBIB0492E

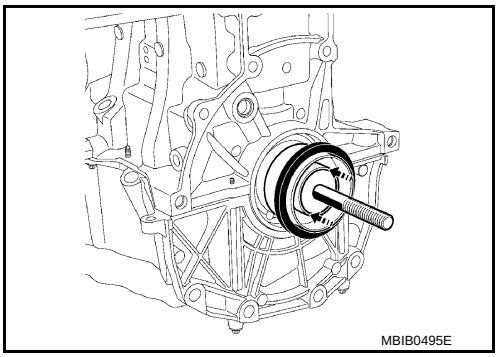
7. Remove the nut, the cover, the protector and the threaded rod.


MBIB0493E

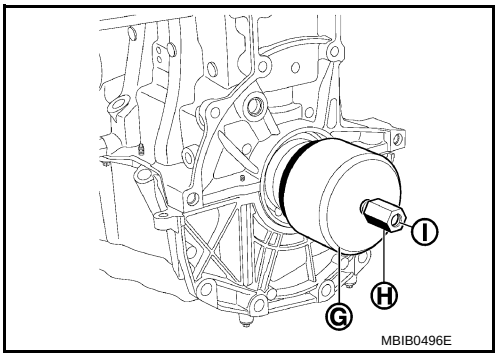
8. Crankshaft elastomer seal, flywheel side.
9. Install Tool KV113B0210 (Mot. 1585) on the crankshaft, securing it with bolts (F).



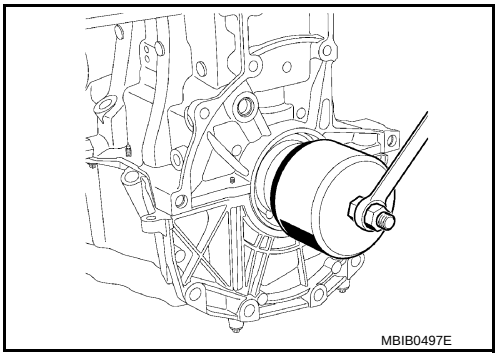
10. Put the protector complete with the seal on Tool KV113B0210 (Mot. 1585), being careful not to touch the seal.

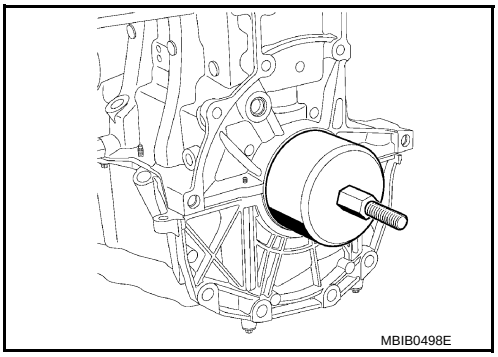


11. Install the cover (G) and nut (H) (putting the threaded part (I) of the nut on the side away from the engine) of Tool KV113B0210 (Mot. 1585).

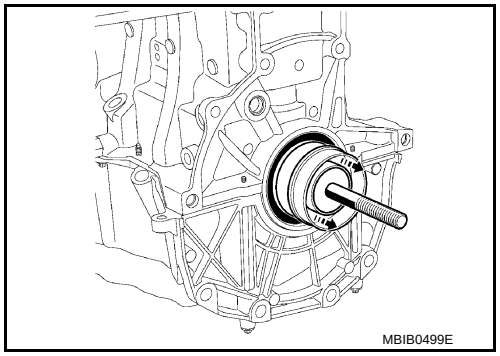


12. Tighten the nut until the cover touches the cylinder block.



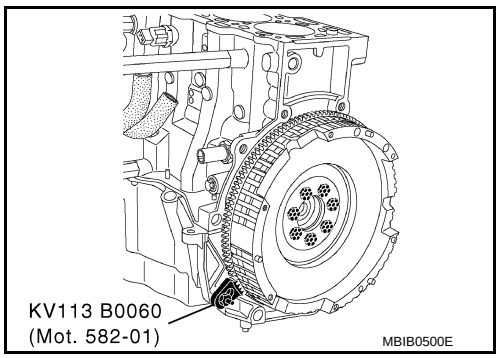


13. Remove the nut, the cover, the protector and the threaded rod.


MBIB0499E

14. Install Tool KV113B0060 (Mot. 582-01) and tighten the new bolts.

: **50 - 60 N·m (5.1 - 6.1 kg-m, 37 - 44 ft-lb)**

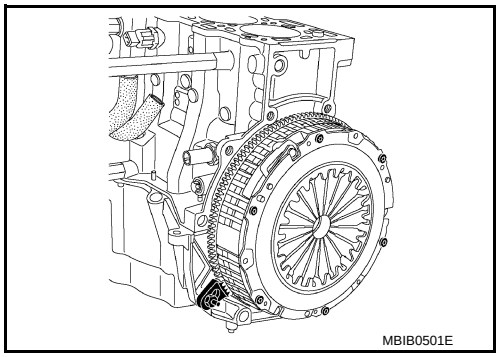


MBIB0500E

15. Install the clutch housing, tightening the bolts to the torque.

M6 bolt : 13 - 16 N·m (1.3 - 1.6 kg-m, 10 - 12 ft-lb)
M7 bolt : 18 - 22 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)

16. Remove Tool KV113B0060 (Mot. 582-01).


MBIB0501E

METHOD FOR INSTALLING THE OIL COOLER AND OIL FILTER

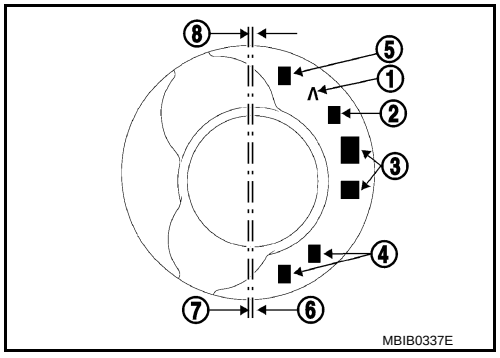
1. Install oil cooler. Refer to LU-37, "Exploded View".
2. Install oil filter. Refer to LU-35, "Exploded View".

Inspection

INFOID:0000000006450013

PISTON MARKING

1	Direction of fitting of the piston mark towards the flywheel
2	Height between the piston pin and the top of the piston (see table below).
3	Used by the supplier only
4	Used by the supplier only
5	Used by the supplier only
6	Piston axis of symmetry
7	Piston pin hole axis
8	Offset between the hole axis (7) and the piston's axis of symmetry (6) is 0.3 mm (0.012 in)



MBIB0337E

TABLE OF PISTON PIN HEIGHT

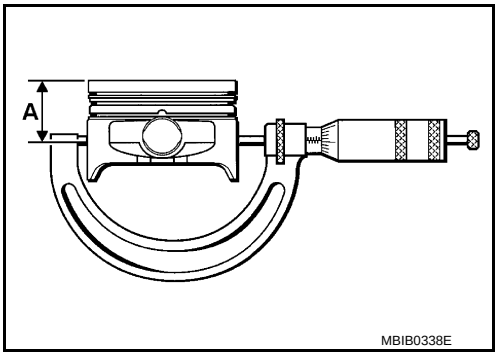
Unit: mm (in)

* Mark on piston	Piston pin height
K	41.667 (1.6404)
L	41.709 (1.6421)
M	41.751 (1.6437)
N	41.793 (1.6454)
P	41.835 (1.6470)

The tolerance on the piston pin heights is ±0.02 mm (±0.0008).
*** The different piston pin heights are exclusively reserved for the engine assembly plant.**
The service parts will only supply piston classes (height) L, M, N.
NOTE:
- **If the engine is installed with a K class piston, an L class piston must be installed as a replacement.**
- **If the engine is installed with a P class piston, an N class piston must be installed as a replacement.**

MEASURING THE PISTON DIAMETER

The piston diameter must be measured at height A = 56 mm (2.20 in).



Piston diameter : 75.933 - 75.947 mm (2.9895 - 2.9900 in)

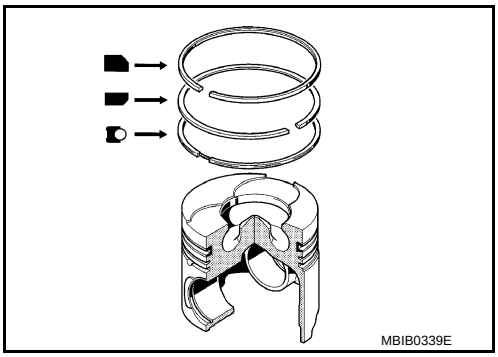
Piston pin:

Length : 59.7 - 60.3 mm (2.350 - 2.374 in)

Outer diameter : 24.8 - 25.2 mm (0.976 - 0.992 in)

Inner diameter : 13.55 - 13.95 mm (0.5335 - 0.5492 in)

PISTON RING



Thickness:

Top ring : 1.97 - 1.99 mm (0.0776 - 0.0783 in)

2nd ring : 1.97 - 1.99 mm (0.0776 - 0.0783 in)

Oil ring : 2.47 - 2.49 mm (0.0972 - 0.0980 in)

The piston rings are supplied ready adjusted.

PISTON RING END GAP

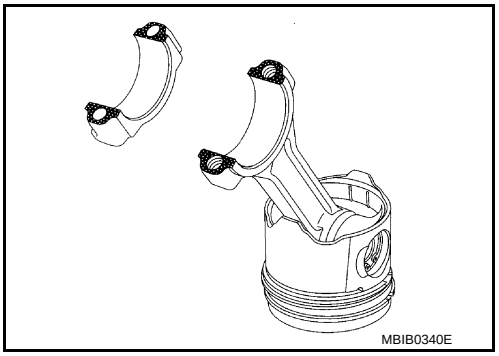
Top ring : 0.20 - 0.35 mm (0.0079 - 0.0138 in)

2nd ring : 0.70 - 0.90 mm (0.0276 - 0.0354 in)

Oil ring : 0.25 - 0.50 mm (0.0098 - 0.0197 in)

CONNECTING ROD

The connecting rod is of the detachable cap type.


MBIB0340E

WARNING:

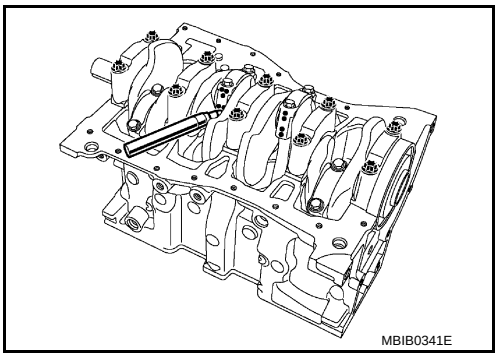
- **The bolts must be coated with engine oil under the heads and on the threads when the connecting rods are installed in the engine.**
- **The big end caps are positioned on the connecting rod by irregularities on the parting line.**
- **The occurrence of impacts or a foreign body between the body - cap mating surfaces will lead to rapid rupture of the connecting rod.**

Lateral big end play	**: 0.205 - 0.467 mm (0.0081 - 0.0184 in)**
Diametrical big end play	**: 0.035 - 0.045 mm (0.0014 - 0.0018 in)**
Center distance between the big end and small end	**: 133.75 mm (5.2657 in)**
Diameter of the big end	**: 47.610 - 47.628 mm (1.8744 - 1.8751 in)**
Diameter of the small end	
(without ring)	**: 27.24 - 27.26 mm (1.0724 - 1.0732 in)**
(with ring)	**: 25.013 - 25.025 mm (0.9848 - 0.9852 in)**

NOTE:

The connecting rod small end rings cannot be replaced.

The maximum weight difference for the connecting rod, piston and piston pin assemblies for the same engine must be 0.245 N (25 g, 0.88 oz).

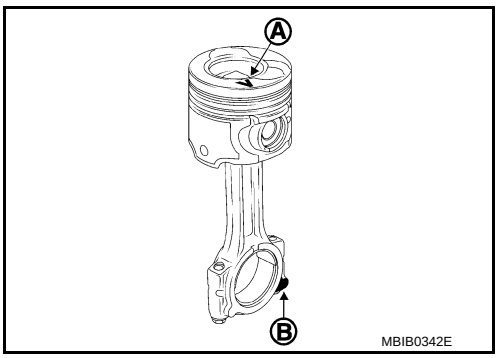

MBIB0341E

WARNING:

- **To avoid initiating a crack in the connecting rod, Never use a sharp point to mark the big end caps in relation to their connecting rod.**
- **Use a permanent marker pen.**

DIRECTION OF INSTALLATION OF THE CONNECTING ROD IN RELATION TO THE PISTON

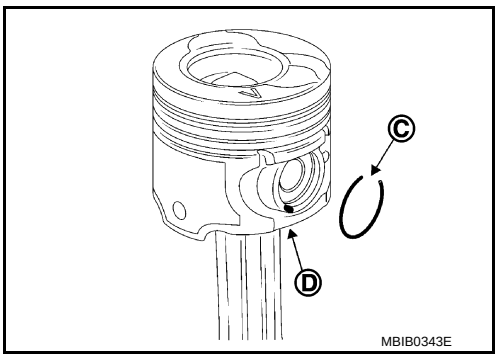
- Point the mark (A) engraved on the top of the piston upwards and the machined flat (B) of the big end downwards as shown in the figure.



MBIB0342E

DIRECTION FOR INSTALLATION THE SNAP RINGS ON THE PISTON

- Position the opening (C) of the snap rings opposite of the removal and installation channel (D).



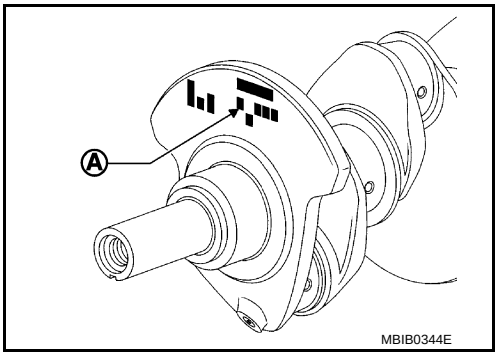
CRANKSHAFT

Number of main journals	**: 5**
Crankshaft side clearance:	
Without wear on side shims	**: 0.045 - 0.252 mm (0.0018 - 0.0099 in)**
With wear on side shims	**: 0.045 - 0.852 mm (0.0018 - 0.0335 in)**
Crankshaft diametrical clearance:	
Journals	**: 0.027 - 0.054 mm (0.0011 - 0.0021 in)**
Crankshaft pins	**: 0.035 - 0.045 mm (0.0014 - 0.0018 in)**
Journal diameter:	**: 47.99 - 48.01 mm (1.8894 - 1.8902 in)**
Crankshaft pin diameter:	**: 43.96 - 43.98 mm (1.7307 - 1.7315 in)**

- The lateral shims are located on bearing No. 3.
- No rectifications are allowed.

WORKING OUT THE CLASS OF MAIN BEARING (ORIGINAL FITMENT)

Marking (A) On The Crankshaft
- Detail of the marking (A):
  Number of journals



1*	2	3	4	5	Classes of journal diameters A = D1 B = D2 C = D3
B	B	C	C	B	

* Flywheel end.

Table Of Journal Diameter Classes

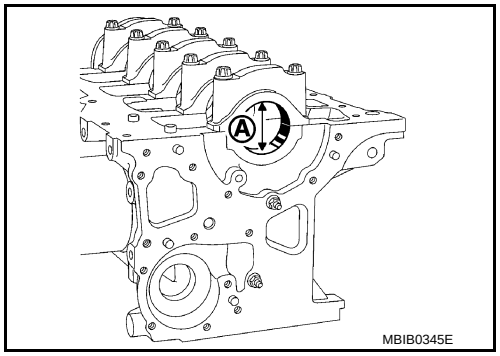
Unit: mm (in)

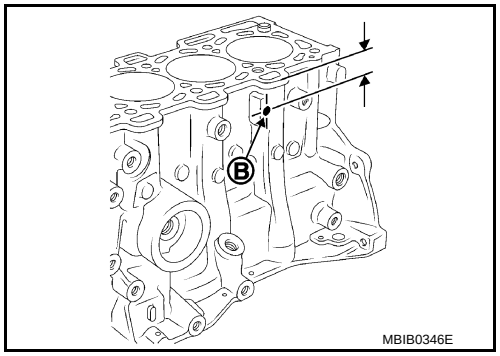
Journal class mark on the crankshaft	Journal diameter
A = D1	47.990 - 47.996 (1.8894 - 1.8896)
B = D2	47.997 - 48.003 (1.8896 - 1.8899)
C = D3	48.004 - 48.010 (1.8899 - 1.8902)

CYLINDER BLOCK

ENGINE IDENTIFICATION

The diameters of the bearings (A) of the cylinder block are marked by a hole on the block (B) located above the oil filter.





ENGINE IDENTIFICATION

Identification is by means of an engraved plate on the cylinder block which carries:

- A: engine type
- B: engine type approval letter
- D: code
- E: engine suffix
- F: engine serial number
- G: engine assembly plant

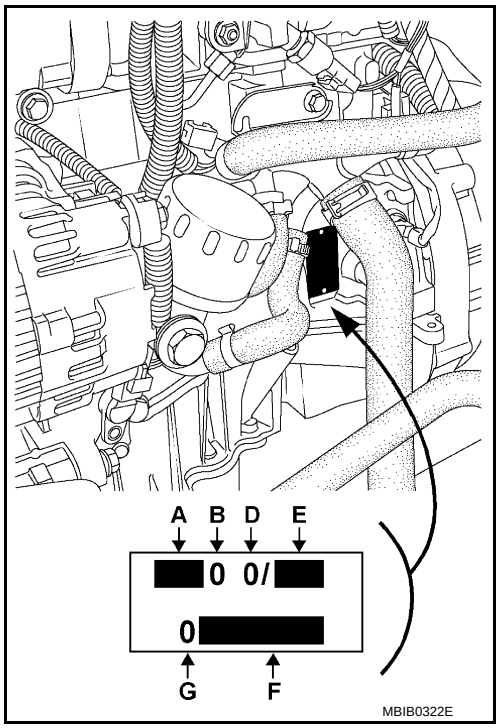


TABLE OF CYLINDER BLOCK MAIN BEARING HOUSING INNER DIAMETERS

Hole position (B)	Class reference	Cylinder block main bearing housing inner diameter
X = 33 mm (1.30 in)	1 or blue	51.936 - 51.942 mm (2.0447 - 2.0450 in)
Y = 43 mm (1.69 in)	2 or red	51.942 - 51.949 mm (2.0450 - 2.0452 in)

NOTE:
The marking zone includes:

• X - Y gives the diameter class of bearings A or B.

MATCHING THE MAIN BEARING

	Journal diameter class		
	D1	D2	D3
1*	C1 1.949 - 1.955 mm (0.0767 - 0.0770 in) yellow	C2 1.946 - 1.952 mm (0.0766 - 0.0769 in) blue	C3 1.943 - 1.949 mm (0.0765 - 0.0767 in) black
2*	C4 1.953 - 1.959 mm (0.0769 - 0.0771 in) red	C1 1.949 - 1.955 mm (0.0767 - 0.0770 in) yellow	C2 1.946 - 1.952 mm (0.0766 - 0.0769 in) blue
	Bearing thickness and class		

* Cylinder block main bearing diameter class.

NOTE:

The service parts will only supply class C2 (blue).

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000006450014

Engine	Compression ratio	Bore and stroke mm (in)	Displacement cm^3 (cu in)	Compression pressure kPa (bar, kg/cm^2, psi)
K9K	18.25/1	76 x 80.5 (2.992 x 3.169)	1,461 (89.15)	Maximum pressure must be least 1,800 (18, 18.36, 261)

Tightening torque

INFOID:0000000006450015

UPPER ENGINE

Unit: N·m (kg-m, ft-lb)

Tightening torque	Cylinder head	: *1
	Camshaft bracket	: 11 (1.1, 8)
	Vacuum pump	: 21 (2.1, 15)
	Cylinder head coolant outlet unit	: 11 (1.1, 8)
	Exhaust manifold	: 26 (2.7, 19)
	Glow plug	: 15 (1.5, 11)
	Rocker cover	: 12 (1.2, 9)
	Turbocharger-manifold mounting	: 26 (2.7, 19)
	Turbocharger oil return pipe	: 12 (1.2, 9)
	Turbocharger oil supply pipe	: 23 (2.3, 17)
	Timing tensioner	: 27 (2.8, 20)
	TDC cap	: 20 (2.0, 15)
	Cylinder head suspended mounting bracket	: 21 (2.1, 15)

*1: Refer to tightening procedure in the text.

BOTTOM ENGINE

Unit: N·m (kg-m,ft-lb)

Tightening torque	Oil cooler connector bolt	: 45 (4.6, 33)
	Oil filter bracket	: 45 (4.6, 33)
	Main bearing cap	: 25 (2.6, 18) + 47°±6° (Angle tightening)
	Connecting rod	: 20 (2.0, 15) + 45°±6° (Angle tightening)
	Knock sensor	: 20 (2.0, 15)
	Oil level sensor	: 25 (2.6, 18)
	Oil pump	: 25 (2.6, 18)
	Oil pan	: *1
	Water pump	: 11 (1.1, 8)
	Flywheel	: 50 - 55 (5.1 - 5.6, 37 - 40)
	Crankshaft pulley	: 60 (6.1, 44) + 100°±10° (Angle tightening)/M12 bolt. :120 (12, 89) + 95°±15° (Angle tightening)/M14 bolt.
	Water pump inlet pipe	: 22 (2.2, 16)
	Alternator bracket	: 44 (4.5, 32)
	Alternator	: 21 (2.1,15) for engine number < D051474,
		: 25 (2.6, 18) for engine number ≥ D051474
	A/C compressor	: 21 (2.1, 15)

*1: Refer to tightening procedure in the text.