SECTION EM
ENGINE MECHANICAL

CONTENTS

HR16DE

PRECAUTION

PRECAUTIONS

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

INFOID:0000000009266621

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 SR and SB section of this Service Manual.

WARNING:

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

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

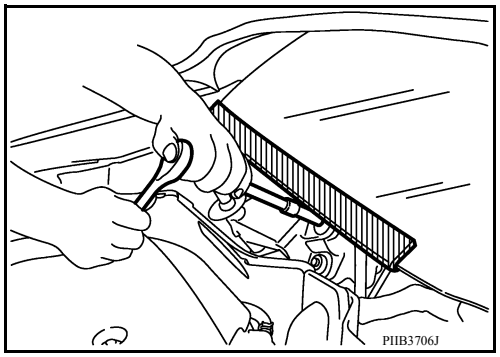
WARNING:

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

Precaution for Procedure without Cowl Top Cover

INFOID:0000000009266622

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



Draining Engine Coolant

INFOID:0000000009266623

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

Disconnecting Fuel Piping

INFOID:0000000009266624

- 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:0000000009266625

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or unin-structed operations.
- Use 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, 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:0000000009266626

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

Assembly and Installation

INFOID:0000000009266627

- Use torque wrench to tighten bolts or nuts to specification.
- Tighten nuts and bolts in order exactly as specified in the procedure. If a tightening order or procedure is not specified, tighten nuts and bolts equally in several different steps. Start with the nuts or bolts in the center and then tighten diagonally starting with the inside and moving to the outside in a spiral pattern.
- 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 restrictions and blockages.
- Avoid damaging sliding or mating surfaces. Before assembling, completely remove foreign materials such as cloth lint or dust, and oil the sliding surfaces.
- After refilling engine coolant, bleed the air from the cooling system.
- After repairing, start the engine and increase engine speed to check for engine coolant leaks, fuel leaks, engine oil leaks, and exhaust gas leaks.

Parts Requiring Angle Tightening

INFOID:0000000009266628

- For the final tightening of the following engine parts use Tool:

Tool number : KV10112100 (BT-8653-A)

- Camshaft sprocket (INT) bolt
- Cylinder head bolts
- Main bearing cap bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (Note an 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.

Precaution for Liquid Gasket

INFOID:0000000009266629

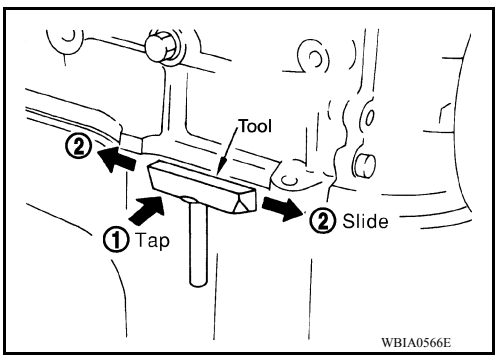
REMOVAL OF LIQUID GASKET SEALANT

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

Tool number : KV10111100 (J-37228)

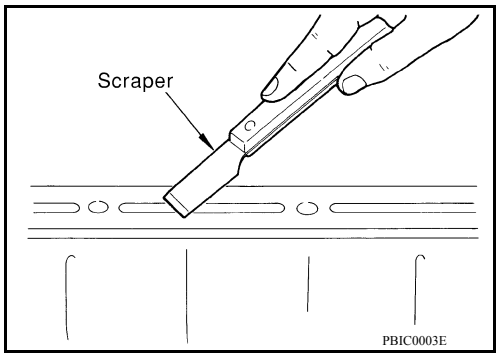
CAUTION:
Do not damage mating surfaces.

- Tap the seal cutter to insert it (1).
- In areas where the Tool is difficult to use, lightly tap to slide it (2).

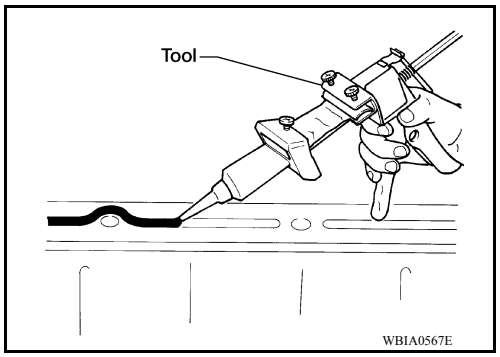


LIQUID GASKET APPLICATION PROCEDURE

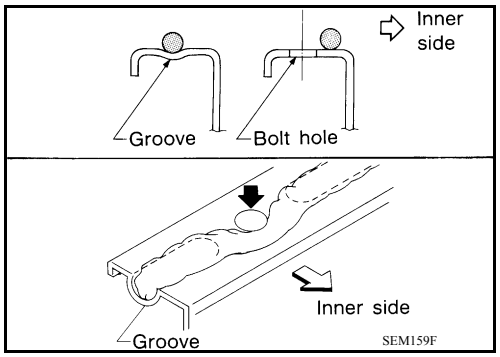
1. Remove the old liquid gasket adhering to the gasket application surface and the mating surface using suitable tool.
   - Remove the liquid gasket completely from the groove of the liquid gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the mating surfaces and remove adhering moisture, grease and foreign material.



3. Attach the liquid gasket tube to the suitable tool.
   Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.



- If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.
- Normally apply the liquid gasket on the inside edge of the bolt holes. Also apply to the outside edge of the bolt holes when specified in the procedure.
- Within five minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- Wait 30 minutes or more after installation before refilling the engine with oil or coolant.



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

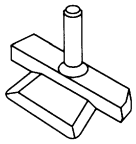
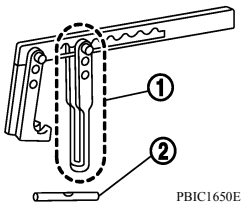
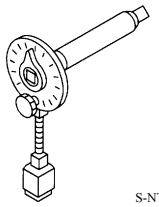
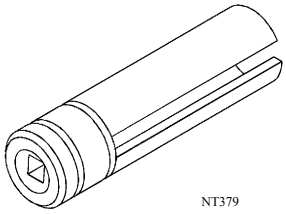
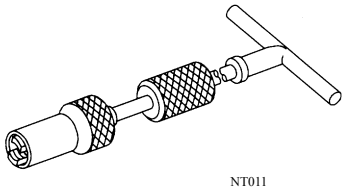
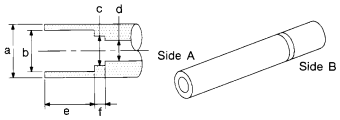
PREPARATION

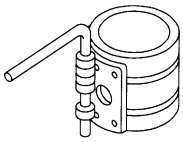
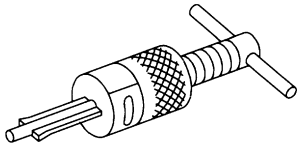
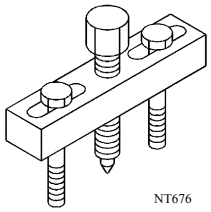
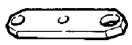
PREPARATION

Special Service Tools

INFOID:0000000009266630

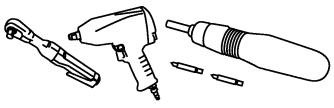
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

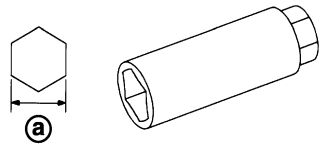
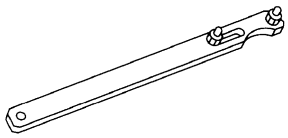
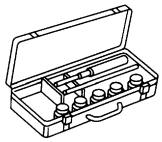
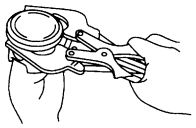
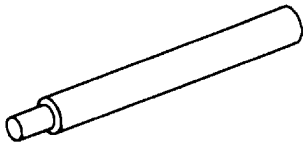
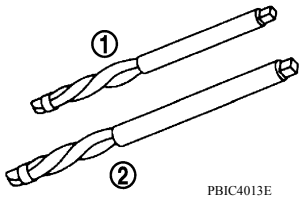
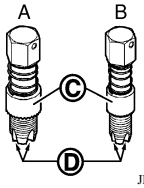
Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter  S-NT046	Removing oil pan (lower and upper) etc.
KV10116200 (J-26336-B) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter  PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 (BT-8653-A) Angle wrench  S-NT014	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 (—) Heated oxygen sensor wrench  NT379	Loosening or tightening heated oxygen 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  S-NT603	Installing valve oil seal **Use side A.** **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)** Unit: mm (in)

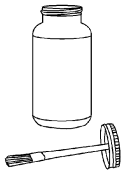
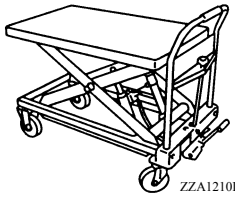
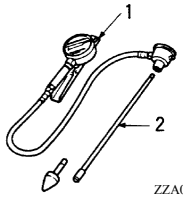
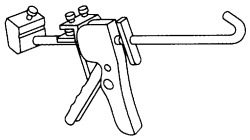
Tool number (Kent-Moore No.) Tool name	Description
EM03470000 (J-8037) Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore
ST16610001 (J-23907) Pulley puller  S-NT045	Removing pilot converter
KV11103000 (—) Pulley puller  NT676	Removing crankshaft pulley
KV11105210 (J-44716) Stopper plate  ZZA0009D	Holding drive plate and flywheel static

Commercial Service Tools

INFOID:0000000009266631

Tool name	Description
Power tool  PIIB1407E	Loosening nuts, screws and bolts
Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room

Tool name	Description
Spark plug wrench  JPBIA0399ZZ	Removing and installing spark plug a: 14 mm (0.55 in)
Pulley holder  NT035	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
(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: [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

Tool name	Description
Acoustic tension gauge  PBIC3881E	Checking drive belt tension
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
1. Compression gauge 2. Adapter  ZZA0008D	Checking compression pressure
Tube presser  S-NT052	Pressing the tube of liquid gasket

BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

Inspection and Adjustment

INFOID:0000000009266632

INSPECTION

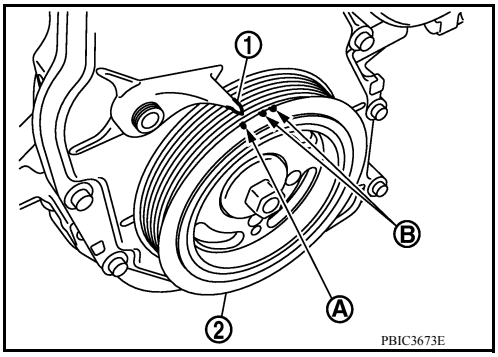
Perform inspection as follows after removal, replacement or installation of camshaft or valve-related parts, or if there are unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to EM-44, "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.

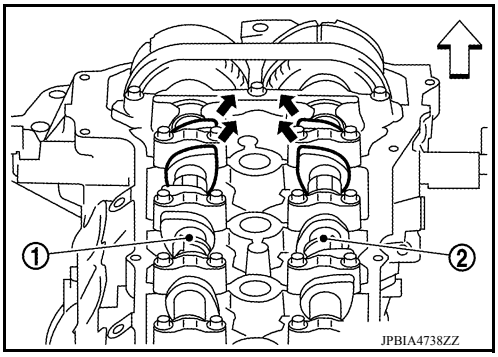
(B) : White paint mark (Not used for service)



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

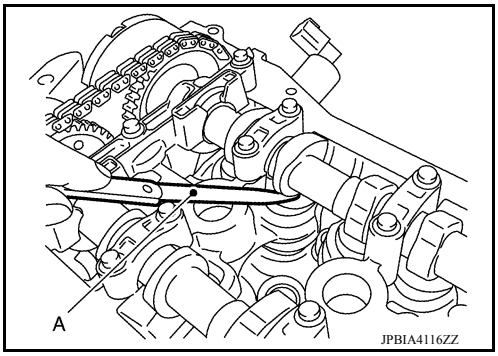
(1) : Camshaft (INT)
(2) : Camshaft (EXH)
⇦ : Engine front

- If the lobes do not face inside, rotate the crankshaft pulley 360 degrees to align as shown.



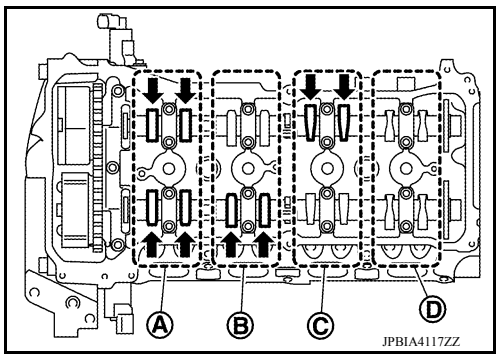
b. Use a feeler gauge (A) to measure the clearance between the valve lifter and camshaft.

Valve clearance : Refer to EM-118, "Camshaft".



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

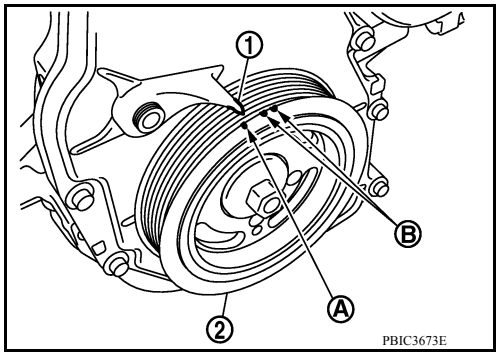
(A) : No. 1 cylinder
(B) : No. 2 cylinder
(C) : No. 3 cylinder
(D) : No. 4 cylinder



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

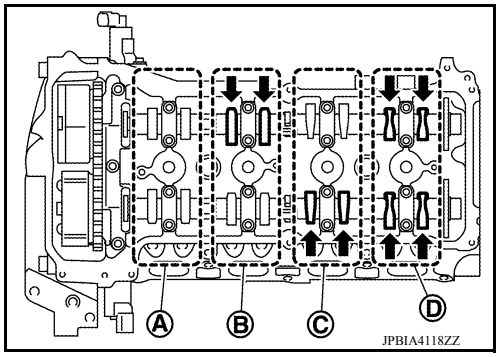
c. Set No. 4 cylinder at TDC of its compression stroke.
- Rotate crankshaft pulley (2) one revolution (360 degrees) and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

(B) : White paint mark (Not use for service)



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

(A) : No. 1 cylinder
(B) : No. 2 cylinder
(C) : No. 3 cylinder
(D) : No. 4 cylinder



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

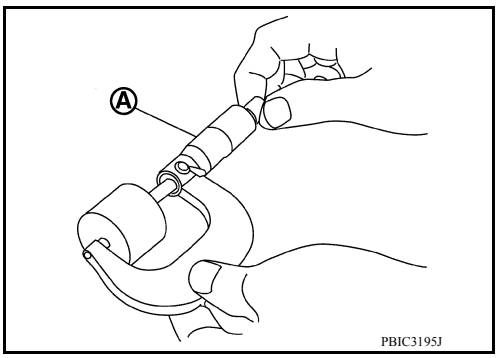
3. If out of the specifications, adjust as necessary. Refer to "ADJUSTMENT".

ADJUSTMENT

NOTE:
Proper valve clearance is obtained by selecting the correct valve lifter head thickness.

1. Remove camshaft. Refer to EM-56, "Exploded View".
2. Remove valve lifters from the locations that are out of specification.

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

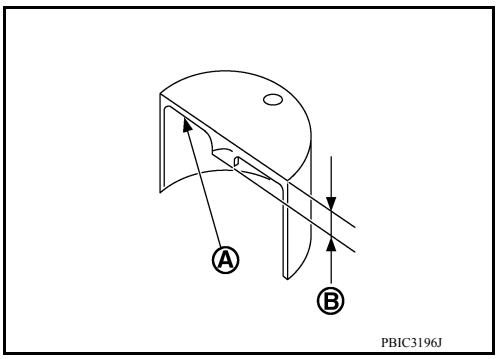
C_1 = Measured valve clearance

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 under side of the lifter.
  NOTE:
  Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.1181 to 0.1378 in) in increments of 0.02 mm (0.0008 in) when manufactured at factory. Refer to EM-118, "Camshaft".
- Stamp mark “302” indicates 3.02 mm (0.1189 in) in thickness.



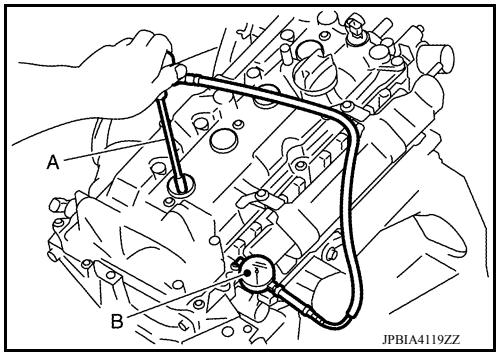
5. Install the correct thickness valve lifter.
6. Install camshaft. Refer to EM-56, "Exploded View".
7. Install timing chain and related parts. Refer to EM-47, "Exploded View".
8. Manually rotate crankshaft pulley a few rotations.
9. Check that valve clearances are within specification. Refer to “INSPECTION”.
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

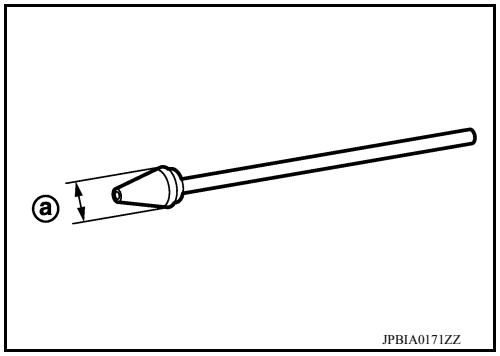
INFOID:0000000009266633

1. Warm up engine and then turn it off.
2. Release fuel pressure. Refer to EC-133, "Work Procedure".
3. Remove ignition coil and spark plug from each cylinder. Refer to EM-44, "Exploded View".
4. Connect engine tachometer (not required in use of CONSULT).
5. Install compression gauge (B) with an adapter (A) (commercial service tool) onto spark plug hole.



- Use an adapter with a diameter (a) smaller than 20 mm (0.79 in). Otherwise, it may be caught by cylinder head during removal.

(a) : Less than 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-117, "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 the battery. Check the engine speed again with a fully charged battery.
- If some cylinders have low compression pressure, pour a small amount of engine oil into the spark plug hole to recheck the compression.
  - If the added engine oil improves the compression, the piston rings may be worn or damaged. Check the piston rings and replace if necessary.
  - If the compression pressure remains low despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat as necessary.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil the head gasket may be leaking, or valves in adjacent cylinders may be damaged. Inspect and repair as required.
- If the compression pressure is below the minimum value, check the valve clearances and parts associated with the combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After repairing, measure the compression pressure again.

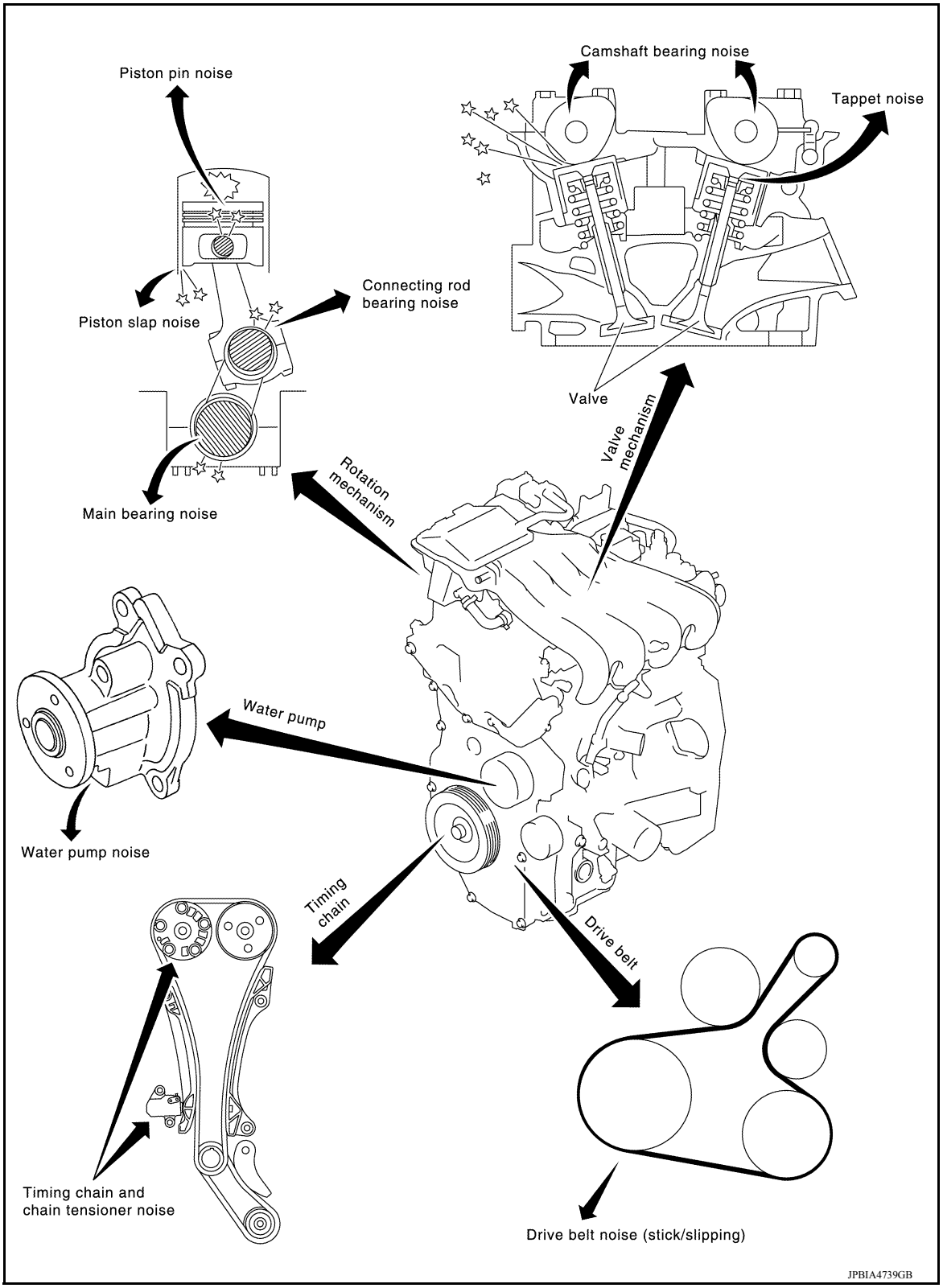
7. After inspection is completed, install removed parts.
8. Start the engine, and ensure that the engine runs smoothly.
9. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-117, "Work Flow".

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH troubleshooting Chart

INFOID:0000000009266634



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-10
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-118
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-122
	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-122
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-122 EM-126
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-125 EM-122
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-47 EM-47
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-117
	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-19

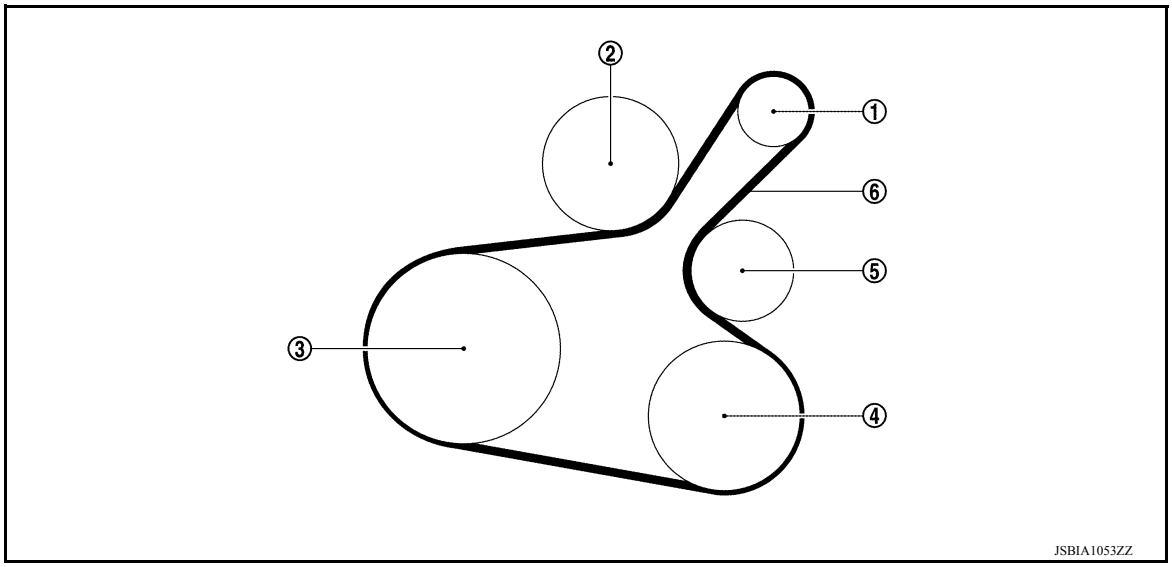
A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

DRIVE BELT

Exploded View

INFOID:0000000009266635



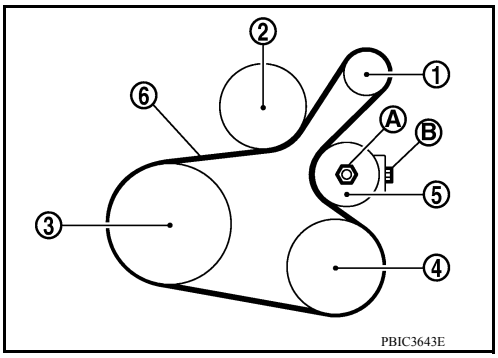
1. Generator
2. Water pump
3. Crankshaft pulley
4. A/C compressor (with A/C models) Idler pulley (without A/C models)
5. Idler pulley
6. Drive belt

Removal and Installation

INFOID:0000000009266636

REMOVAL

1. Remove wheel and tire (RH) using power tool. Refer to WT-39, "Adjustment".
2. Remove the fender protector (RH) front side clip. Refer to EXT-26, "Exploded View".
3. Loosen the lock nut (A), and then release the belt tension by turning the adjusting bolt (B).



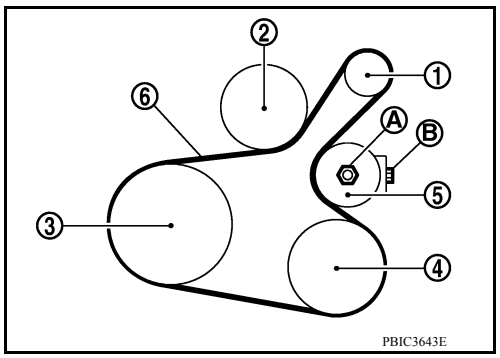
(1) : Generator
(2) : Water pump
(3) : Crankshaft pulley
(4) : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
(5) : Idler pulley
(6) : Drive belt

4. Remove the drive belt.

INSTALLATION

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

Lock nut (A) (Temporary tightening) : 4.4 N·m (0.45 kg-m, 39 in-lb)



(1) : Generator
(2) : Water pump
(3) : Crankshaft pulley
(4) : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
(5) : Idler pulley
(6) : Drive belt
(B) : Adjusting bolt

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

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

3. Adjust drive belt tension by turning the adjusting bolt. Refer to EM-18, "Adjustment".
CAUTION:
- **Perform the belt tension adjustment with the lock nut temporarily tightened to the torque specification listed in step 1 which prevents the idler pulley from tilting.**
- **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 to final tightening specification.

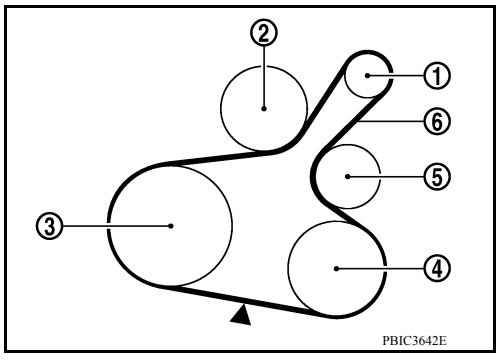
Lock nut (Final tightening) : 34.8 N·m (3.5 kg-m, 26 ft-lb)

5. Check that belt tension is within the specification. Refer to EM-117, "Drive Belt".

Inspection

INFOID:0000000009266637

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



(1) : Generator
(2) : Water pump
(3) : Crankshaft pulley
(4) : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
(5) : Idler pulley
(6) : Drive belt

- Visually check belt for wear, damage, and cracks on inside and edges.
- Turn crankshaft pulley clockwise twice, and check that the tension on all pulleys equalizes before testing.
- When measuring deflection, apply 98.1 N (10 kg, 22 lb) at the (▼) marked point.
- Measure the belt tension and frequency with acoustic tension gauge 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-117, "Drive Belt".

Adjustment

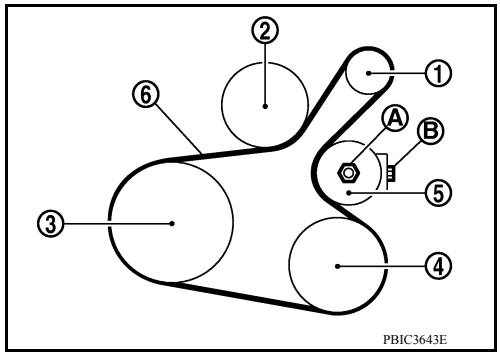
INFOID:0000000009266638

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.**
- **Do not allow oil or engine coolant to get on the belt.**
- **Do not twist or bend the belt strongly.**

1. Remove the fender protector (RH) front side clip. Refer to EXT-26, "Removal and Installation".
2. Tighten lock nut (A) temporarily to the following torque.

Lock nut (A) (Temporary tightening) : 4.4 N·m (0.45 kg-m, 39 in-lb)



(1) : Generator
(2) : Water pump
(3) : Crankshaft pulley
(4) : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
(5) : Idler pulley
(6) : Drive belt
(B) : Adjusting bolt

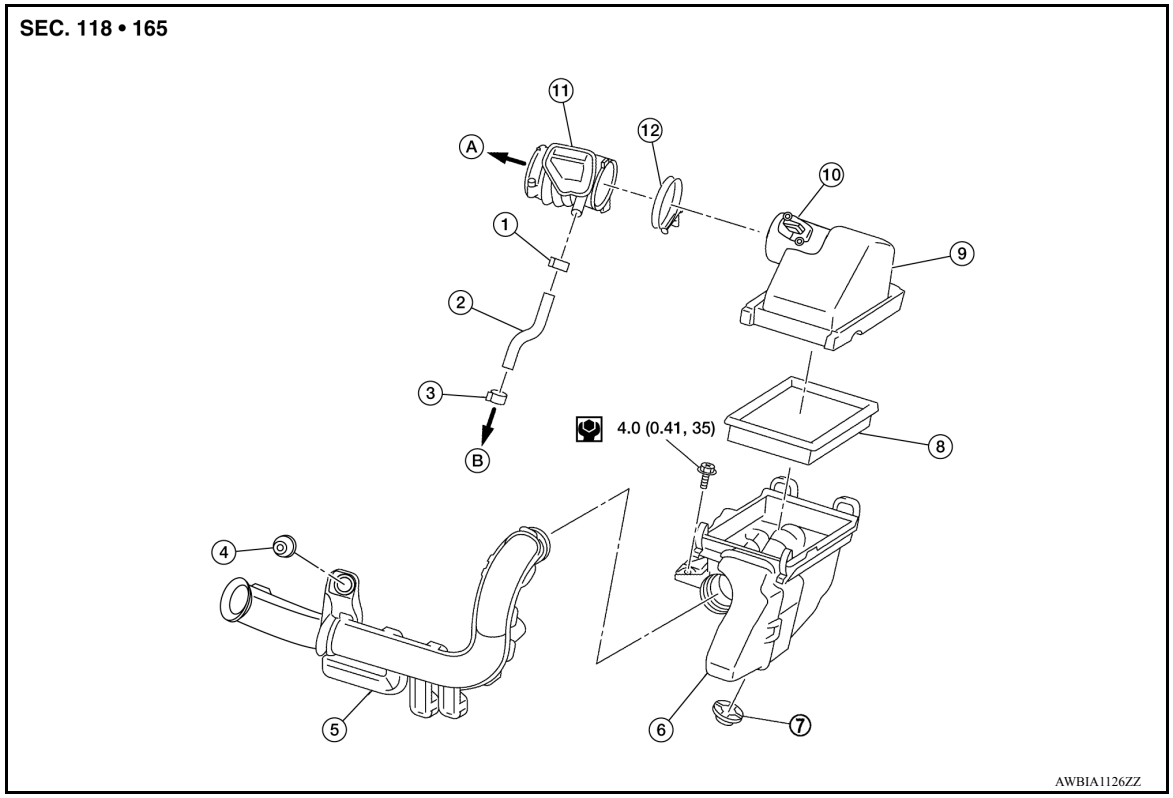
3. Adjust the belt tension by turning the adjusting bolt. Refer to EM-117, "Drive Belt".
CAUTION:
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection 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 temporary tightening, the idler pulley tilts and the correct tension adjustment cannot be performed.**
4. Tighten the lock nut to final tightening specification.

Lock nut (Final tightening) : 34.8 N·m (3.5 kg-m, 26 ft-lb)

AIR CLEANER FILTER

Exploded View

INFOID:0000000009266639



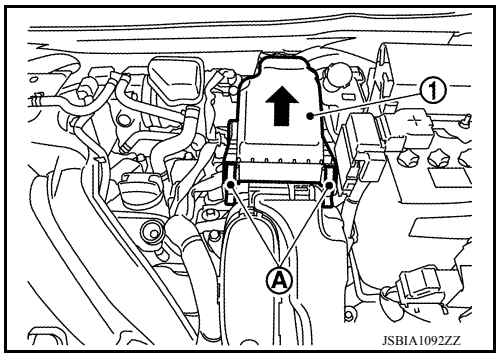
1. Clamp
2. PCV hose
3. Clamp
4. Mount rubber
5. Air duct (inlet)
6. Air cleaner body
7. Grommet
8. Air cleaner filter
9. Air cleaner cover
10. Mass air flow sensor
11. Air duct
12. Clamp
- A. To electric throttle control actuator
- B. To rocker cover

Removal and Installation

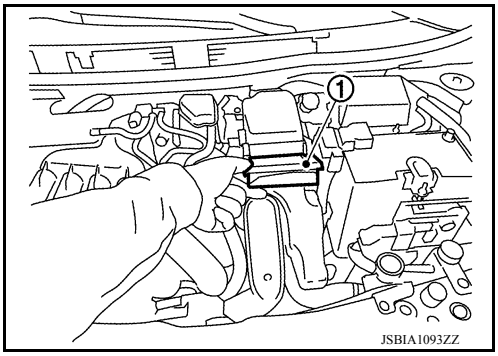
INFOID:0000000009266640

REMOVAL

1. Unhook clips (A) and pull the air cleaner cover upward (1).



2. Remove the air cleaner filter (1) from the air cleaner body.



INSTALLATION

Installation is in the reverse order of removal.

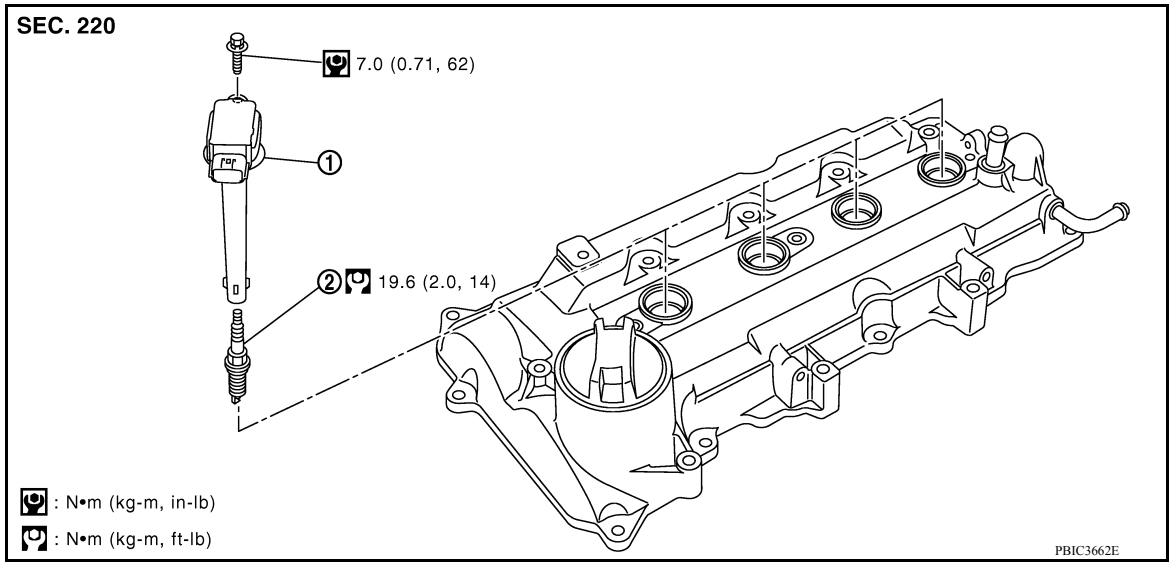
NOTE:

Check that the air cleaner filter is securely placed in the air cleaner body.

SPARK PLUG

Exploded View

INFOID:0000000009266641



1. Ignition coil
2. Spark plug

Removal and Installation

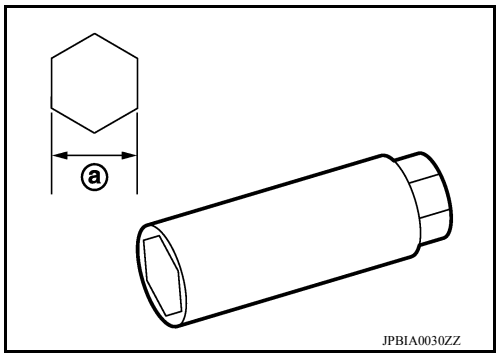
INFOID:0000000009266642

REMOVAL

1. Remove ignition coil. Refer to EM-44, "Removal and Installation".
   CAUTION:
   Do not drop or shock ignition coil.
2. Remove spark plug using a suitable tool.

Diameter (a) : 14 mm (0.55 in)

CAUTION:
Do not drop or shock spark plug.



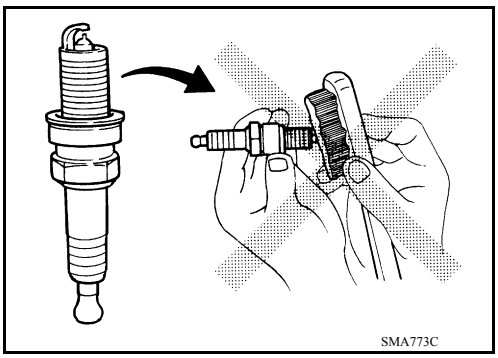
INSPECTION AFTER REMOVAL

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

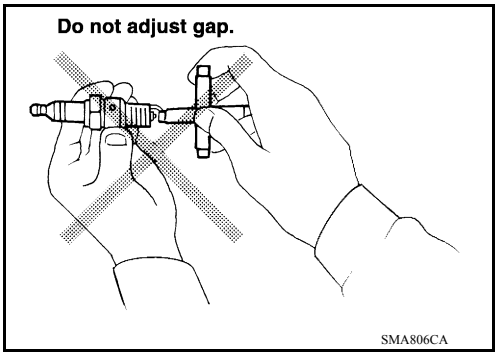
Cleaner air pressure : Less than 588 kPa (6 kg/cm^2, 85 psi)
Cleaning time : Less than 20 seconds

CAUTION:

Do not use a wire brush for cleaning.



- Checking and adjusting spark plug gap is not required between change intervals. Do not adjust the gap; replace the spark plug as necessary if out of specification.



INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

Do not drop or shock the spark plug.

Make	NGK
Standard type*	PLZKAR6A-11
Gap (nominal)	1.1 mm (0.043 in)

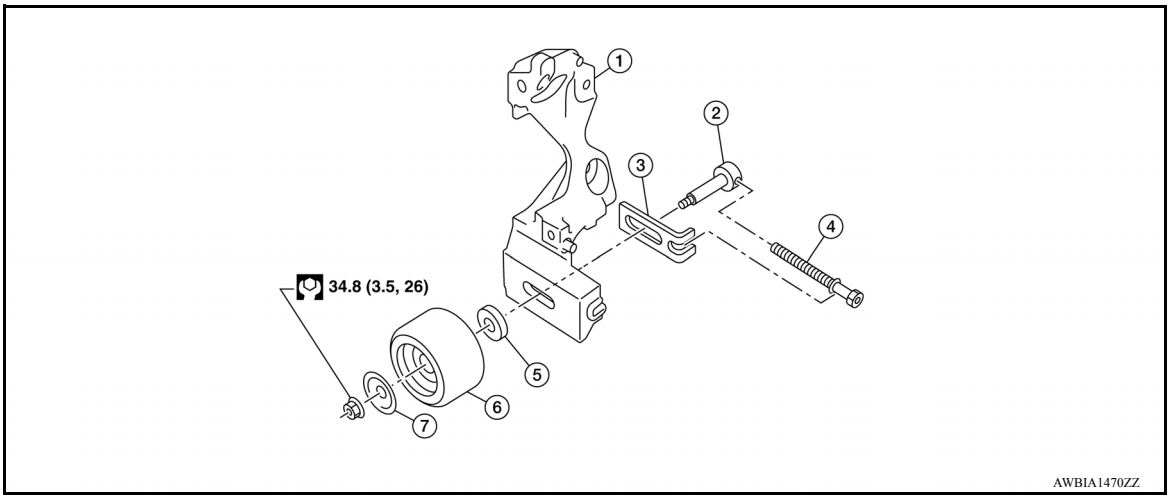
*: Always check with the Parts Department for the latest parts information.

REMOVAL AND INSTALLATION

DRIVE BELT IDLER PULLEY

Exploded View

INFOID:0000000009266643



1. Generator bracket
2. Center shaft
3. Spacer
4. Adjusting bolt
5. Washer
6. Idler pulley
7. Plate

Removal and Installation

INFOID:0000000009266644

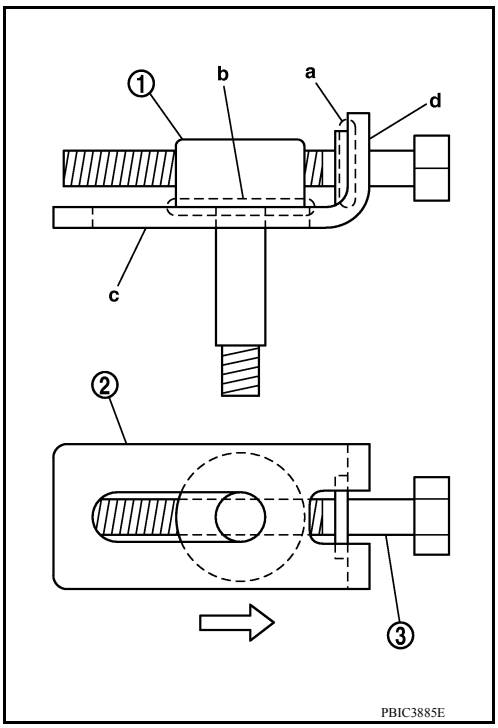
REMOVAL

1. Remove the fender protector (RH). Refer to EXT-26, "Removal and Installation".
2. Remove the air duct inlet assembly. Refer to EM-25, "Removal and Installation".
3. Remove drive belt. Refer to EM-16, "Removal and Installation".
4. Remove the lock nut, and then remove the plate, idler pulley, and washer.
5. Remove the center shaft together with the spacer and the adjusting bolt.

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 generator bracket. Install the washer, idler pulley, and plate, and then temporarily tighten the lock nut.

Lock nut (Temporary tightening) : **4.4 N·m (0.45 kg-m, 39 in-lb)**

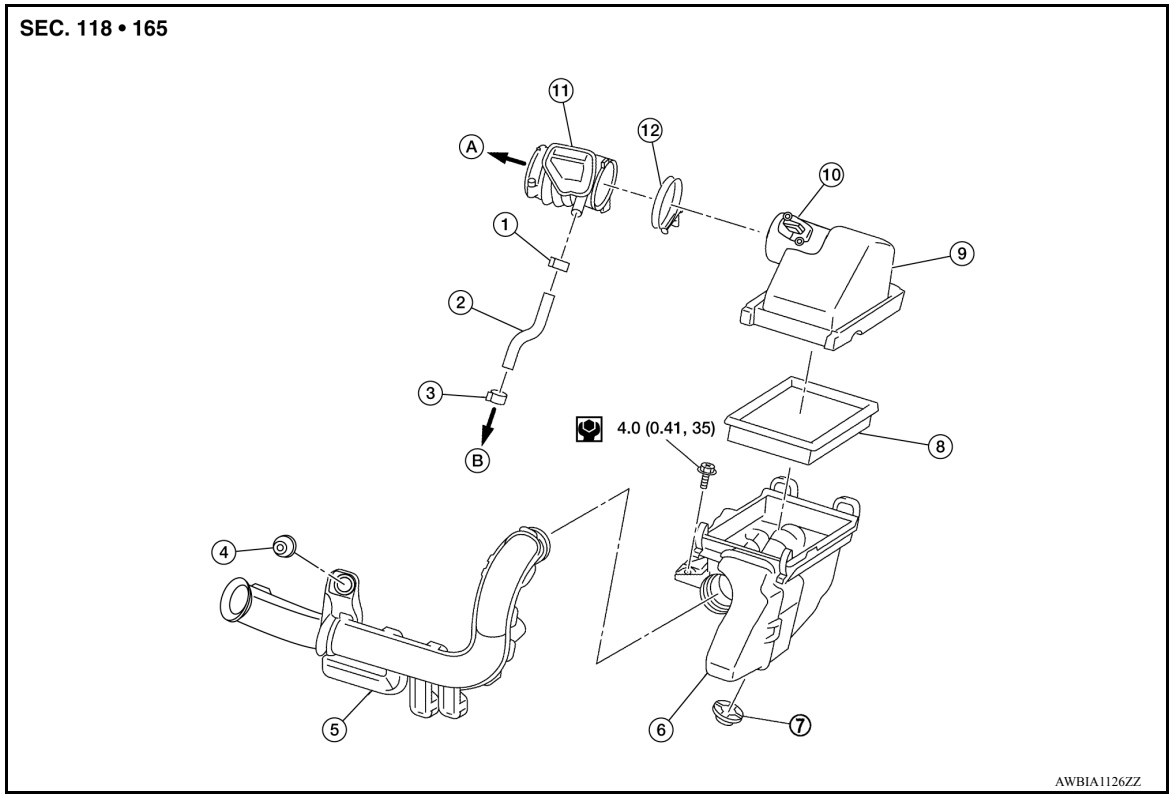


3. Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:0000000009266645



1. Clamp
2. PCV hose
3. Clamp
4. Mount rubber
5. Air duct (inlet)
6. Air cleaner body
7. Grommet
8. Air cleaner filter
9. Air cleaner cover
10. Mass air flow sensor
11. Air duct
12. Clamp
A. To electric throttle control actuator
B. To rocker cover

Removal and Installation

INFOID:0000000009266646

REMOVAL

NOTE:
Mass air flow sensor is removable as an assembly with the air cleaner cover.

1. Remove air duct (inlet) from the air cleaner body.
2. Disconnect PCV hose from the air duct.
3. Remove the air duct (between air cleaner case and electric throttle control actuator).
   • Add matching marks if necessary for easier installation.
4. Remove air cleaner assembly with the following steps:

a. Disconnect the harness connector from mass air flow sensor.
b. Remove the two air cleaner body bolts.
c. Pull up on the air cleaner assembly to disengage it from the grommet and remove the air cleaner assembly.

CAUTION:
- **Do not shock the mass air flow sensor.**
- **Do not disassemble the mass air flow sensor.**
- **Do not touch the sensor of the mass air flow sensor.**

INSPECTION AFTER REMOVAL

Inspect air duct (inlet) and air duct for cracks, tears, or breaks.

Replace air duct (inlet) and air duct if any problems are found.

INSTALLATION

Installation is in the reverse order of removal.

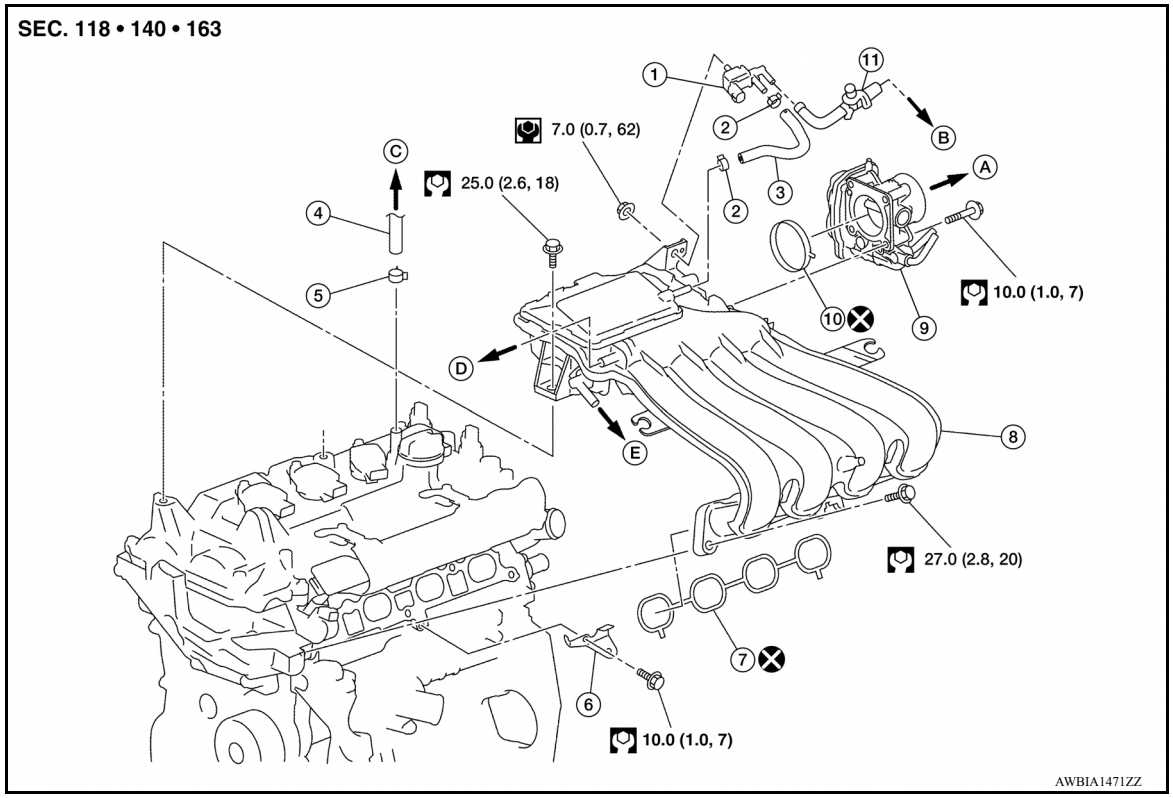
NOTE:

Align marks, attach each joint and screw clamps firmly.

INTAKE MANIFOLD

Exploded View

INFOID:0000000009266647



1. EVAP canister purge volume control solenoid valve	2. Hose clamp	3. Vacuum hose
4. PCV hose	5. Hose clamp	6. Intake manifold support
7. Gasket	8. Intake manifold	9. Electric throttle control actuator
10. Gasket	11. EVAP service port	
A. To air duct	B. To centralized under-floor piping	C. To brake booster
D. To air duct	E. To rocker cover	

Removal and Installation

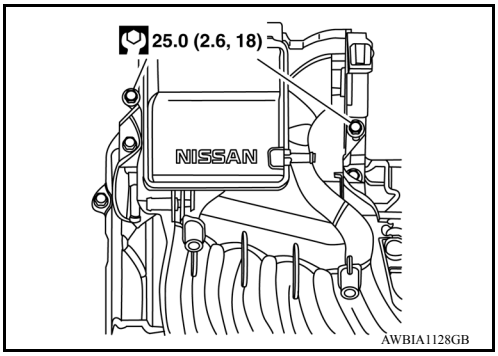
INFOID:0000000009266648

REMOVAL

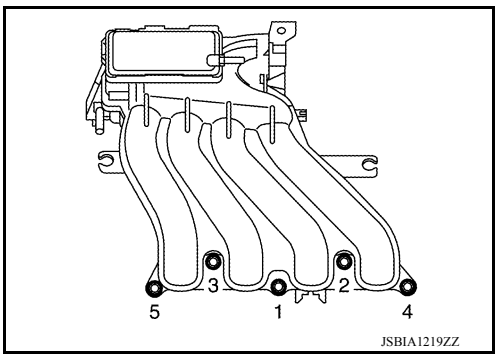
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Remove air duct (inlet), air duct and air cleaner assembly. Refer to EM-25, "Removal and Installation".
2. Disconnect water hoses from electric throttle control actuator.
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belt.**
3. Remove electric throttle control actuator.
   CAUTION:
   - **Handle carefully to avoid any shock to electric throttle control actuator.**
   - **Do not disassemble electric throttle control actuator.**
4. Disconnect harness connector and vacuum hose from EVAP purge control solenoid valve.
   CAUTION:
   Handle EVAP canister purge volume control solenoid valve carefully and avoid impacts.
5. Disconnect vacuum hose for brake booster from intake manifold.

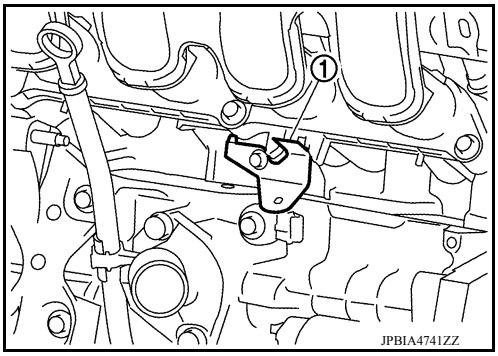
6. Remove intake manifold bolts at the rocker cover.



7. Loosen bolts in reverse order as shown.
CAUTION:
Cover engine openings to avoid entry of foreign materials.



8. Remove intake manifold.
9. Remove EVAP purge control solenoid valve from intake manifold if necessary.
CAUTION:
Handle EVAP canister purge volume control solenoid valve carefully and avoid impacts.
10. Remove intake manifold support (1) if necessary.
CAUTION:
The intake manifold support functions as a guide for installing the intake manifold.



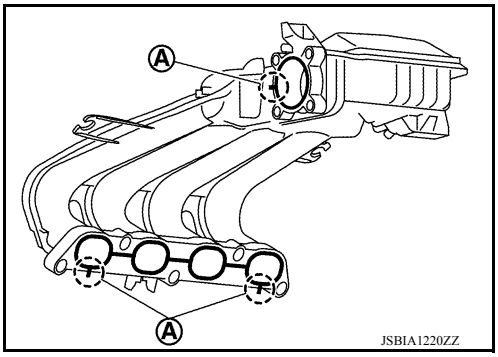
INSTALLATION

Installation is in the reverse order of removal.

Intake Manifold

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

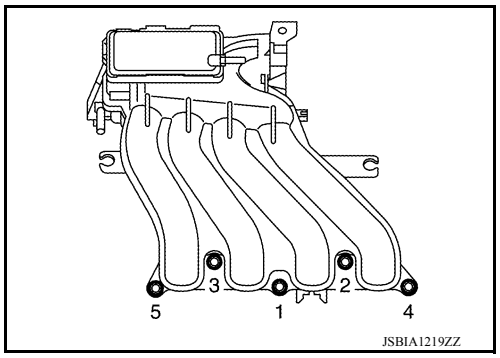
CAUTION:
Do not reuse the gasket.
NOTE:
New gasket for electronically-controlled throttle can be installed when the electronically-controlled throttle is installed.



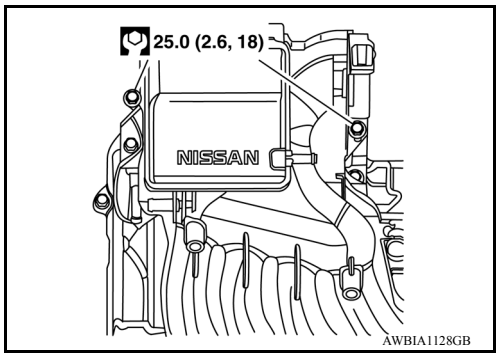
2. Place the intake manifold into position.
CAUTION:

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 the bolts to specification in the numerical order as shown.



4. Tighten the intake manifold bolts to specification at the rocker cover.



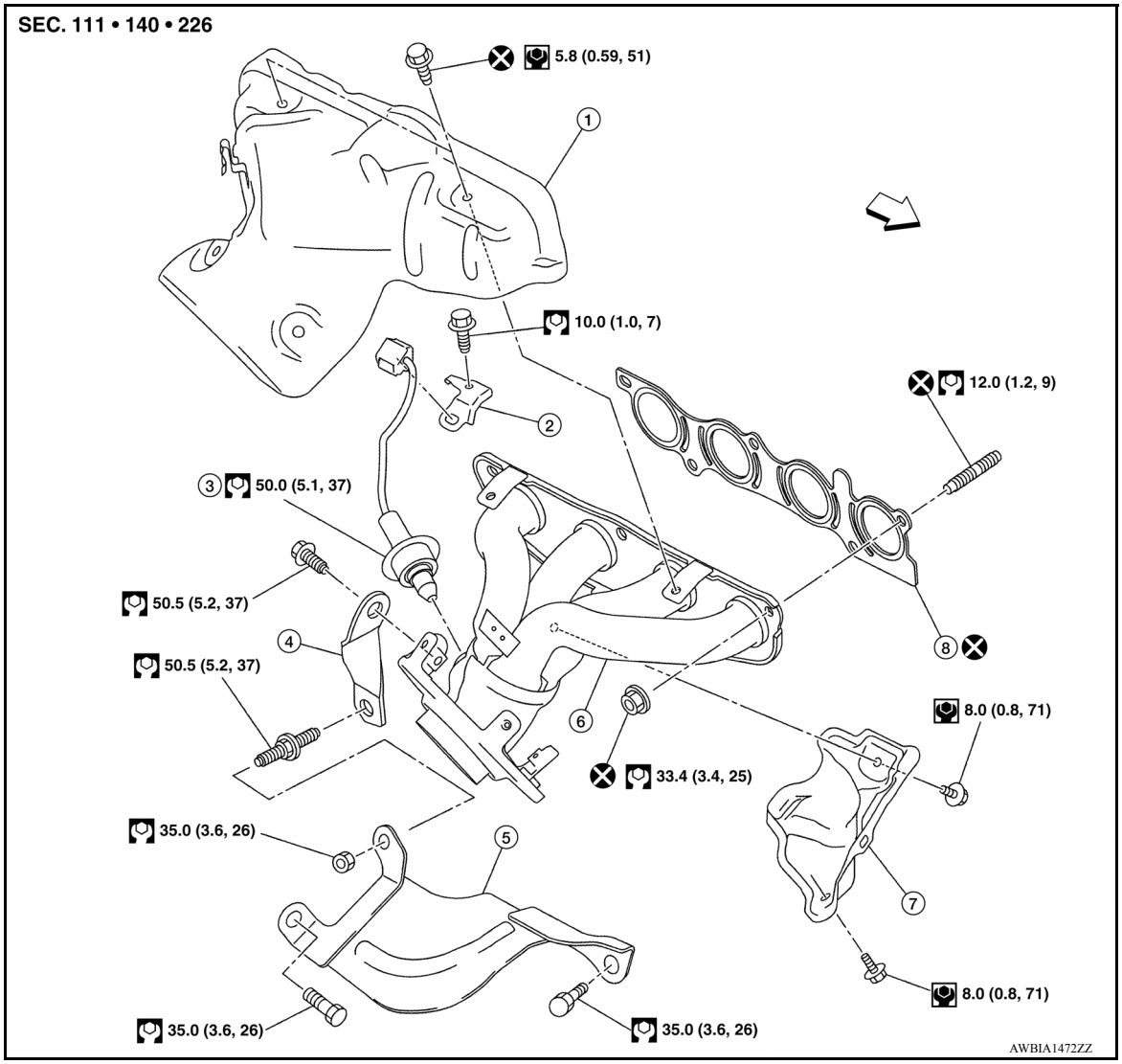
Electric Throttle Control Actuator

- 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-125, "Work Procedure".
- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer to EC-126, "Work Procedure".

EXHAUST MANIFOLD

Exploded View

INFOID:0000000009266649



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

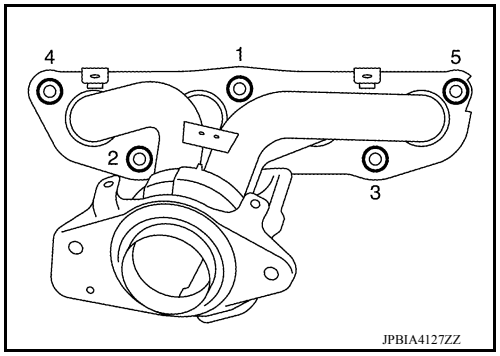
Removal and Installation

INFOID:0000000009266650

REMOVAL

1. Remove air duct (inlet), air duct and air cleaner assembly. Refer to EM-25, "Exploded View".
2. Remove exhaust center tube and front tube. Refer to EX-5, "Exploded View".
3. Remove the air-fuel ratio sensor harness bracket from the cylinder head on the right rear side.
4. Remove exhaust manifold cover.
5. Disconnect the harness from air-fuel ratio sensor 1.
6. Remove exhaust manifold side bolt of exhaust manifold stay.
7. Remove exhaust manifold.

- Loosen nuts in reverse order as shown.

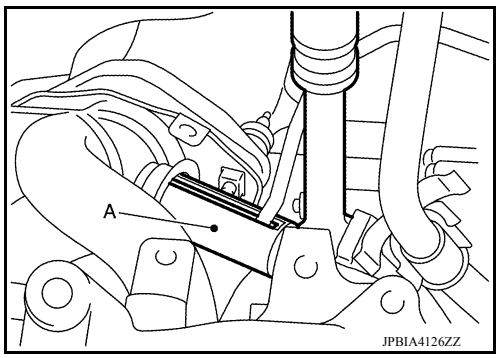


8. Use Tool (A) to remove the air-fuel ratio sensor 1 (if necessary).

Tool number : KV10117100 (—)

CAUTION:

- **Handle the air-fuel ratio sensor carefully and avoid impacts.**
- **Before installing a new air-fuel ratio sensor 1, clean the exhaust tube threads using suitable tool and approved anti-seize lubricant.**
- **If air-fuel ratio sensor is dropped onto a hard surface, such as a concrete floor, from a height of 0.5 m or more, discard the sensor and use a new one.**



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

9. Remove exhaust manifold gasket and discard.
10. Remove stud bolt using suitable tool from cylinder head (if necessary).

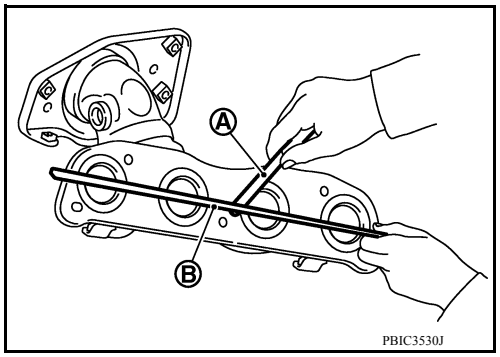
INSPECTION AFTER REMOVAL

Mounting Surface Distortion

- Using suitable tools (A) and (B), check the surface distortion of the exhaust manifold mating surface as shown.

Limit : Refer to EM-118, "Exhaust Manifold".

- Replace exhaust manifold if it exceeds the limit.

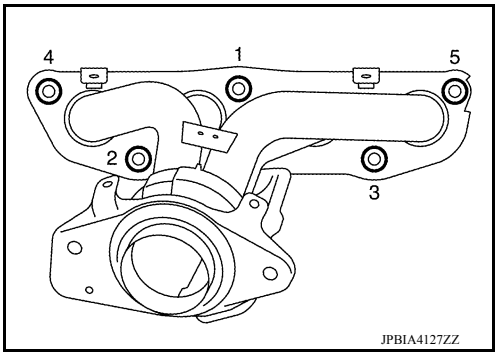


INSTALLATION

Installation is in the reverse order of removal. Note the following:

Exhaust manifold

1. Tighten nuts in numerical order as shown.



2. Tighten nuts in numerical order to the specified torque again.

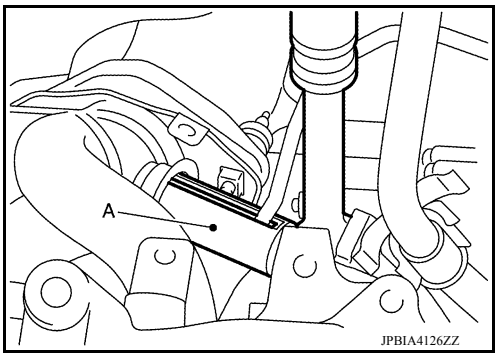
Air-fuel ratio sensor 1

- Use Tool (A) to install the air-fuel ratio sensor 1 (if removed).

Tool number : KV10117100 (—)

CAUTION:

- **Handle it carefully and avoid impacts.**
- **Before installing a new air-fuel ratio sensor 1, clean the exhaust tube threads using suitable tool and approved anti-seize lubricant.**
- **Do not over-tighten the air-fuel ratio sensor 1. Doing so may damage the air-fuel ratio sensor 1, resulting in the MIL coming on.**



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

INSPECTION AFTER INSTALLATION

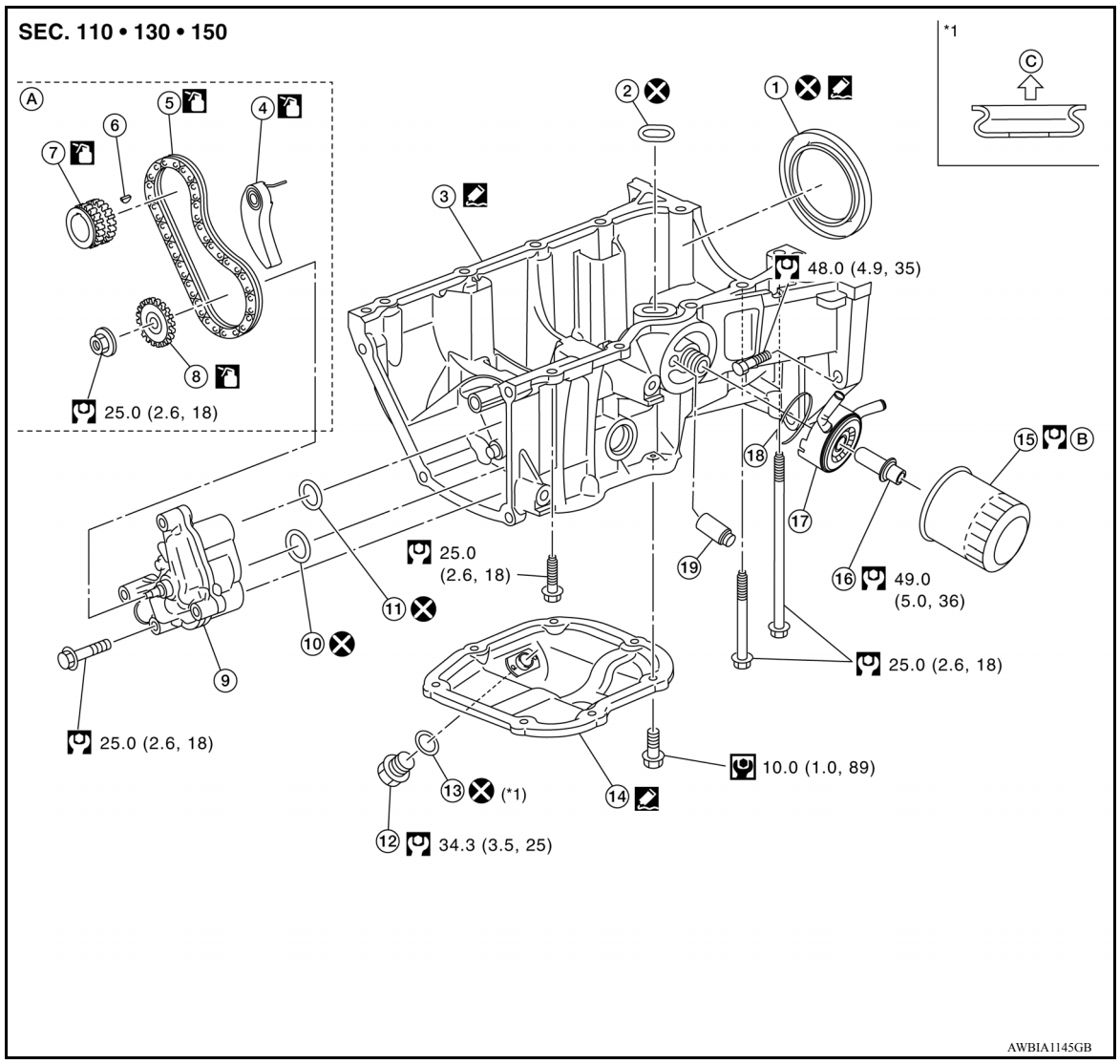
Inspection

- Start engine and raise engine speed to check for exhaust leaks.

OIL PAN (LOWER)

Exploded View

INFOID:0000000009266651



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. Connector bolt
17. Oil cooler
18. O-ring
19. Relief valve
A. Refer to EM-47
B. Refer to LU-11
C. Oil pan (lower) side

Removal and Installation

INFOID:0000000009266652

REMOVAL

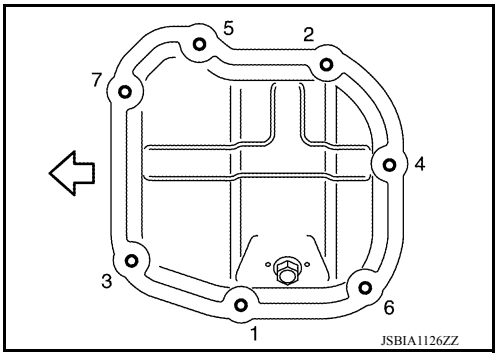
WARNING:

- **Be careful not to get burned, engine coolant and engine oil may be hot.**

- **Prolonged and repeated contact with used engine oil may cause skin cancer; avoid direct skin contact with used oil. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.**

1. Drain engine oil. Refer to LU-9, "Draining".
2. Loosen bolts in reverse order as shown.

⇦ : Engine front

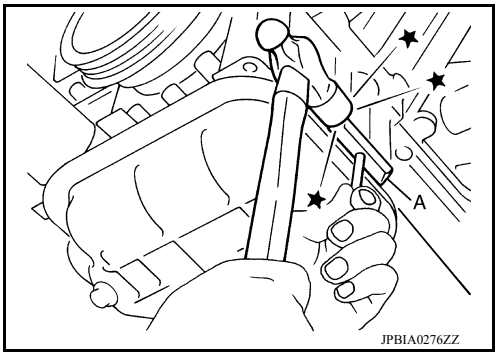


3. Insert Tool (A) between oil pan (upper) and oil pan (lower).

Tool number : KV10111100 (J-37228)

CAUTION:
- **Do not damage mating surfaces.**
- **Do not insert a screwdriver. This damages the mating surfaces.**

4. Slide the Tool (A) by tapping on the side of tool with a suitable tool to loosen the oil pan (lower).
5. Remove oil pan (lower).



INSPECTION AFTER REMOVAL

Clean debris from oil pan (lower) and from the strainer.

INSTALLATION

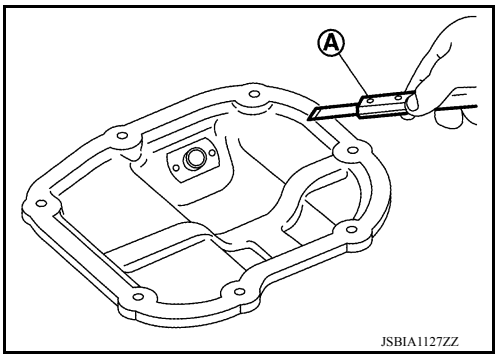
CAUTION:

Do not reuse O-rings or washers.

1. 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:

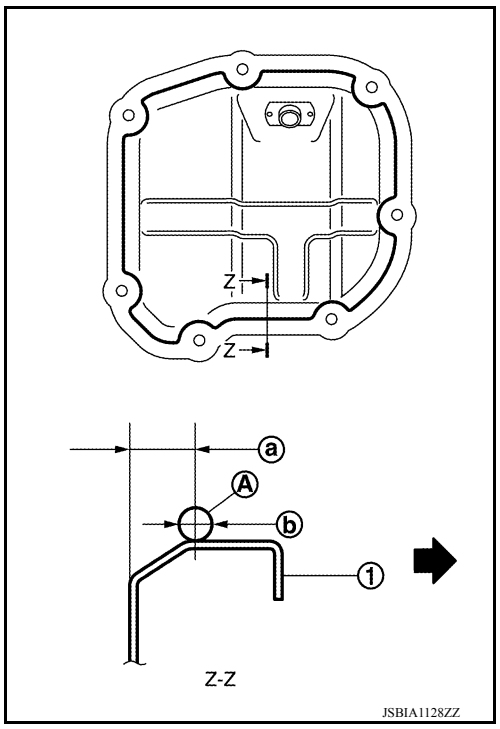
   Do not scratch or damage the mating surface when cleaning off old liquid gasket.



2. Apply a continuous bead of liquid gasket (A) with a tube presser as shown.

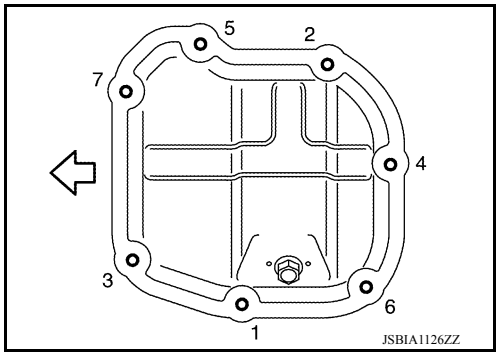
(1) : Oil pan (lower)
(a) : 7.5 - 9.5 mm (0.295 - 0.374 in)
(b) : 4.0 - 5.0 mm (0.157 - 0.197 in) diameter
⬅ : Engine outside

Use Genuine Silicone RTV Sealant or equivalent.
CAUTION:
- **The components must be installed within 5 minutes of the liquid gasket application.**
- **Do not confirm torque after the 5 minutes have elapsed.**
- **Then allow 30 minutes for the liquid gasket to set before adding oil to the engine.**



3. Tighten bolts in numerical order as shown.

⇦ : Engine front



4. Install oil pan drain plug.
   - Refer to the figure for installation direction of drain plug washer. Refer to EM-33, "Exploded View".

CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the oil pan (lower) is installed to allow the sealant to cure.**

5. Add the specified oil after waiting for at least 30 minutes. Refer to MA-12, "Fluids and Lubricants".

INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels, including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-12, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.

- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

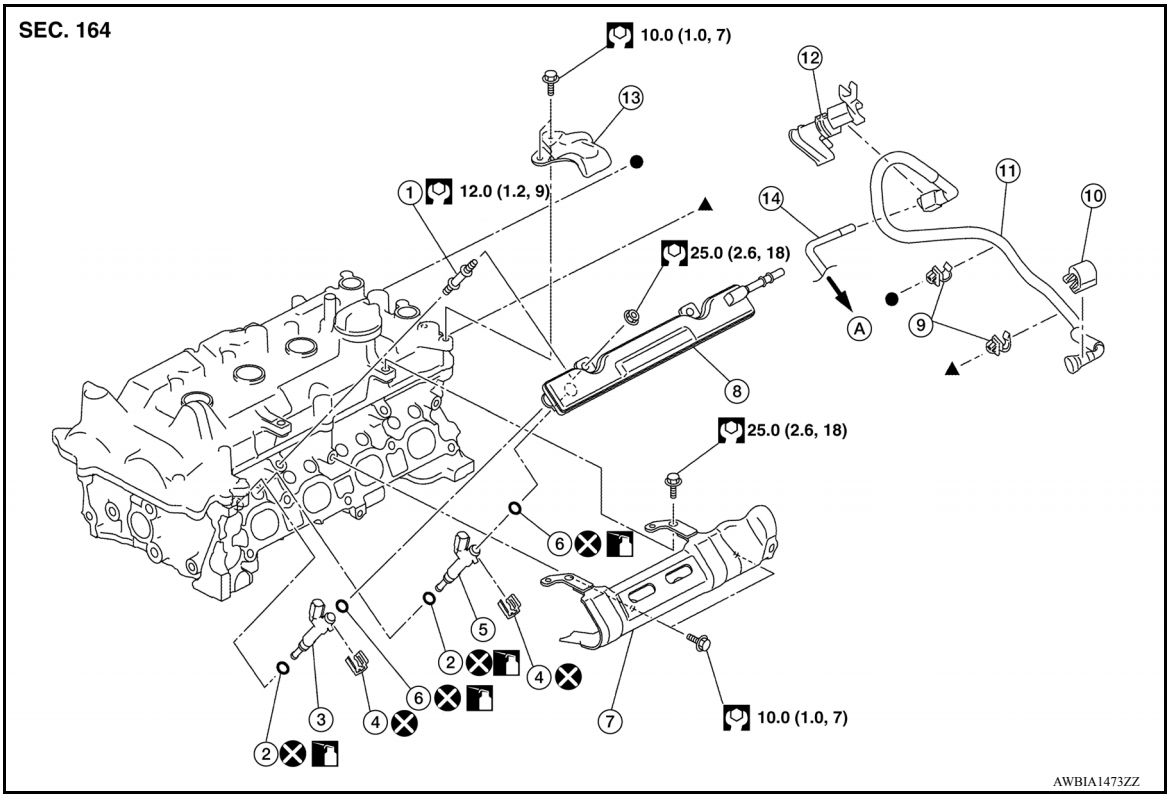
Item		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level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

*Power steering fluid, brake fluid, etc.

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:0000000009266653



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. Clamp
10. Quick connector cap (engine side)	11. Fuel feed hose	12. Quick connector cap (floor piping-side)
13. Fuel connector protector	14. Fuel pipe	A. To centralized under-floor piping

CAUTION:
Do not remove or disassemble parts unless instructed.

Removal and Installation

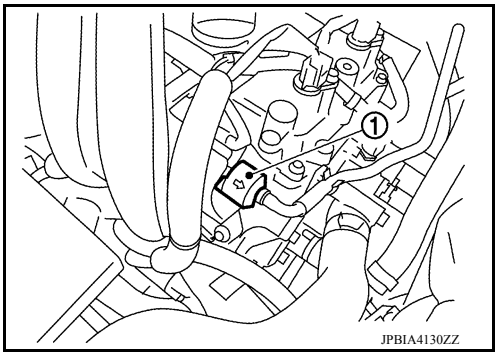
INFOID:0000000009266654

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

REMOVAL

1. Release the fuel pressure. Refer to EC-133, "Work Procedure".
2. Remove intake manifold. Refer to EM-27, "Removal and Installation".

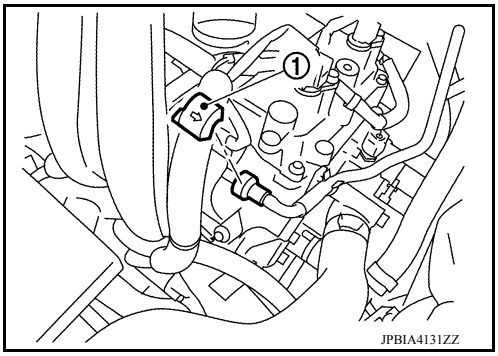
3. Disconnect fuel feed hose from fuel tube. Disconnect quick connector:



(1) : Quick connector cap (engine side)

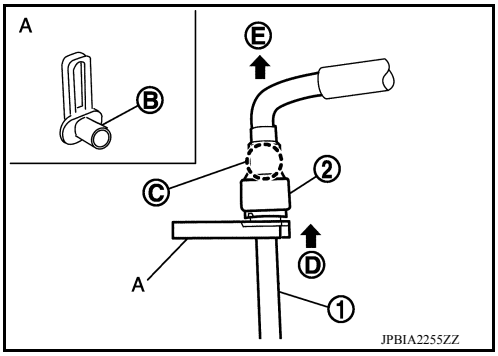
NOTE:
There is no fuel return path.

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



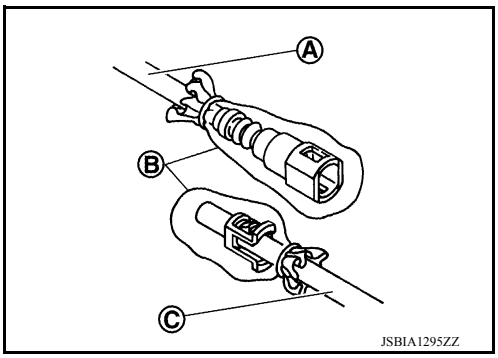
c. With the sleeve (B) side of quick connector release (A) facing quick connector (2), install quick connector release (A) onto fuel tube (1) as shown.
d. Insert quick connector release (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold quick connector release (A) in that position (D).

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 (E) straight up from fuel tube (1).

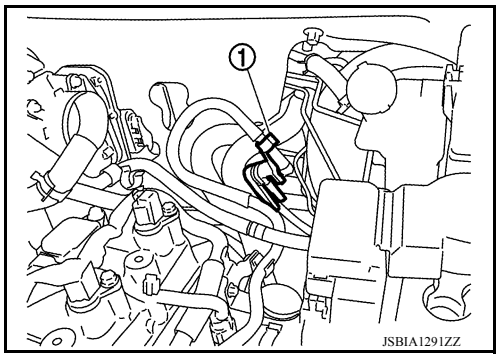
CAUTION:
- **Pull quick connector up (E) from holding position (C) as shown.**
- **Do not pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Do not reuse O-ring.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Be especially careful when welding is performed.**
- **Do not expose parts to battery electrolyte or other acids.**
- **Do not bend or twist connection between quick connector and fuel feed tube during installation or removal.**
- **Be sure to cover openings of disconnected fuel feed hose (A) and fuel tube (C) with plug or plastic bag (B) to avoid fuel leaks and entry of foreign material.**



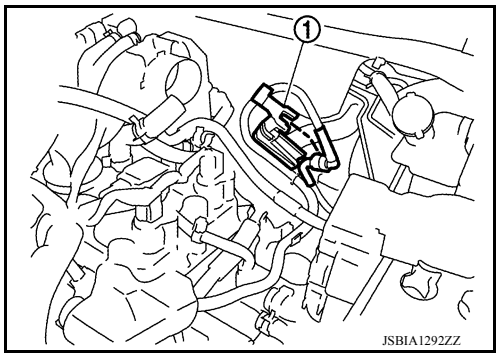
4. Disconnect fuel feed hose from fuel pipe as follows:

NOTE:
There is no fuel return path.

a. Remove quick connector cap (floor piping side) (1) from quick connector connection.

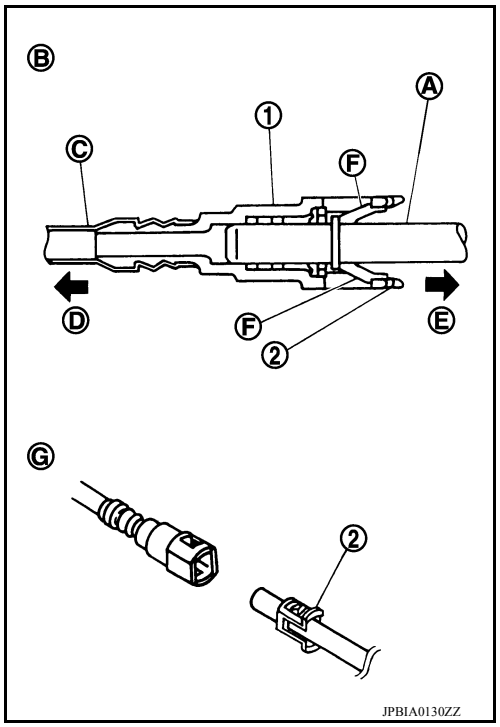


b. Disconnect fuel feed hose from hose clamp (1).



c. Hold the quick connector (1) while pushing in tabs (F), and pull out the hard tube (A).

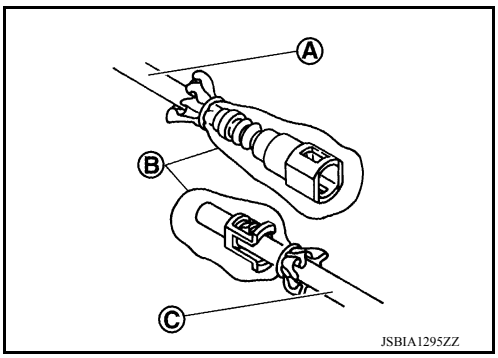
(2) : Retainer
(B) : Connection (cross-section)
(C) : Resin tube
(D) : To under floor fuel line
(E) : To fuel tank
(G) : Disconnection



CAUTION:
- **Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.**
- **The tube can be removed when the tabs are completely depressed. Do not twist it more than necessary.**
- **Do not use any tools to remove the quick connector.**
- **Keep the resin tube away from heat. Be especially careful when welding near the tube.**
- **Prevent acid such as battery electrolyte etc. from getting on the resin tube.**
- **Do not bend or twist the tube during installation and removal.**
- **Remove the remaining retainer only when the tube is replaced.**
- **When the tube is replaced, also replace the retainer.**

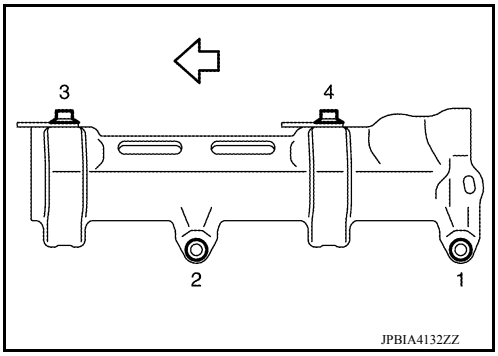
- **Be sure to cover openings of disconnected pipes with plug or plastic bag (B) to avoid fuel leaks and entry of foreign material.**

(A) :Fuel feed hose
(C) :Fuel tube



5. Disconnect harness connector from fuel injector.
6. Remove fuel tube protector.
   - Loosen bolts in reverse order as shown.

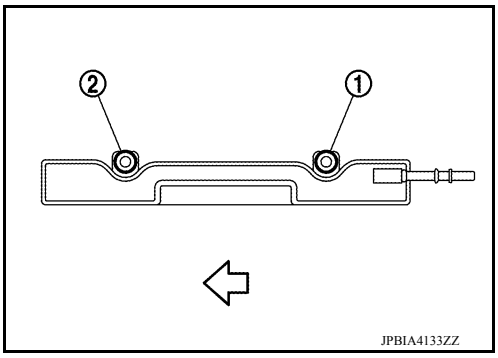
⇦ : Engine front



7. Remove fuel injector and fuel tube assembly:

⇦ : Engine front

a. Loosen two nuts in reverse order as shown.
b. Pull the fuel tube straight out until injector lower O-rings are clear.
c. Remove the nuts and the fuel tube.

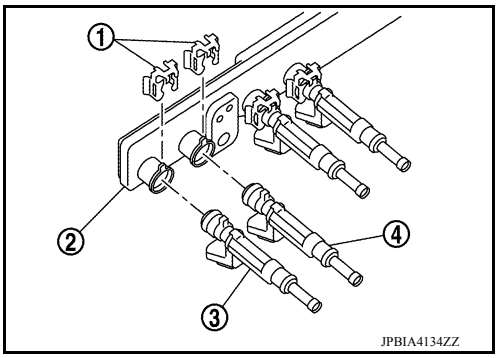


CAUTION:
- **When removing, be careful to avoid interference with fuel injectors.**
- **Use a shop cloth to absorb any fuel leaks from fuel tube.**

8. Remove fuel injector from fuel tube:

a. Open and remove clip (1).
b. Remove fuel injectors (3) and (4) from fuel tube (2) by pulling straight out.

CAUTION:
- **Be careful with remaining fuel that may leak from fuel tube.**
- **Be careful not to damage fuel injector nozzle during removal.**
- **Do not bump or drop fuel injector.**
- **Do not disassemble fuel injector.**
- **Do not reuse O-rings.**



INSTALLATION

CAUTION:
Do not reuse O-rings.

1. Note the following, and install new O-rings on the fuel injector.

CAUTION:

- **Upper and lower O-rings are different. Be careful not to interchange them.**

Fuel tube side	**: Black**
Nozzle side	**: Green**

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Do not 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.**
- **Do not twist or stretch O-ring. If O-ring was stretched while it was being attached, allow it to retract before inserting it into fuel tube.**
- **Insert O-ring straight into fuel tube. Do not angle or twist it.**

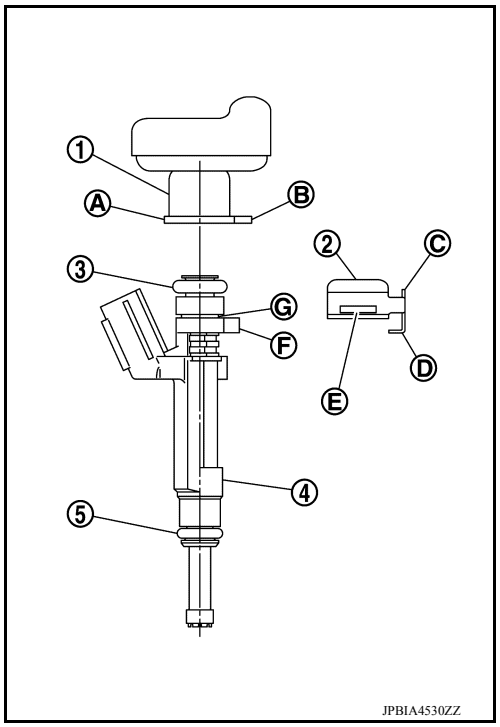
2. Install fuel injector (4) to fuel tube (1):

a. Insert new clip (2) into clip groove (G) on fuel injector (4).
- Insert new clip (2) so that protrusion (F) of fuel injector matches cut-out (D) of clip.

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

CAUTION:
- **Do not reuse clip. Replace it with a new one.**
- **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**

b. Insert fuel injector (4) into fuel tube (1) with clip (2) attached.
- Insert fuel injector (4) while matching it to the axial center.
- Insert fuel injector (4) so that protrusion (B) of fuel tube matches cut-out (C) of clip (2).
- Check that fuel tube flange (A) is securely located in flange groove (E) on clip (2).

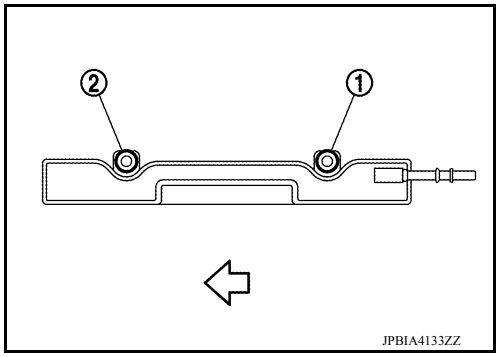


c. Check that installation is complete by checking that fuel injector (4) does not rotate or come off.

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

CAUTION:
For installation, be careful not to interfere with fuel injector nozzle.
- Tighten bolts in numerical order as shown.

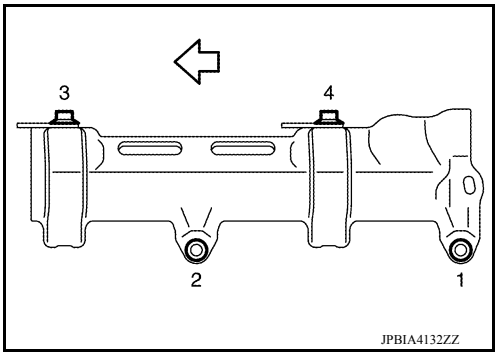
⇦ : Engine front



4. Install fuel tube protector.

- Tighten bolts in numerical order as shown.

⇦ : Engine front



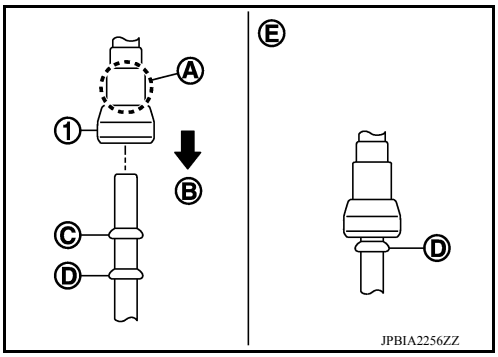
5. Connect harness connector to fuel injector.
6. Connect fuel feed tube (engine side):

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 straight 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.

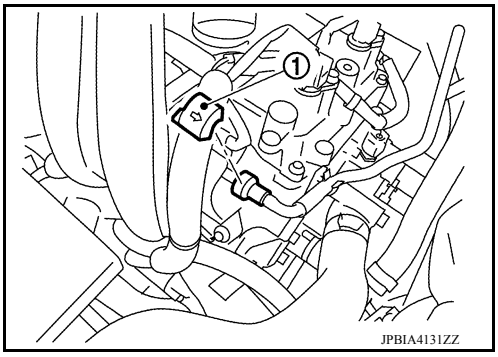
(B) : Upright insertion
(E) : Correctly connected



CAUTION:
- **Hold in position (A) as shown 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.**

d. To avoid misidentification of engagement with a similar sound, pull quick connector hard by hand. 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) (1) with the side arrow facing quick connector side (fuel feed tube side) as shown.



CAUTION:
- **Check that the quick connector and fuel tube are securely engaged with the quick connector cap (engine side) groove.**
- **If the quick connector cap (engine side) cannot be installed easily the quick connector may not be connected correctly. Remove and reconnect.**

f. Install fuel feed hose to hose clamp.

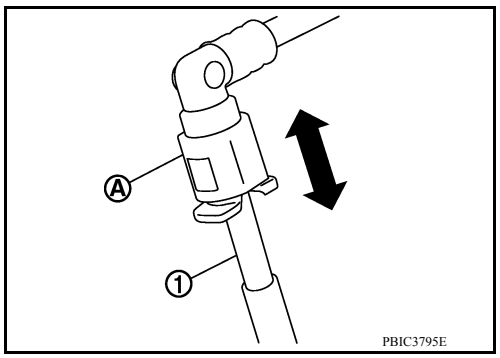
7. Connect fuel feed tube (floor piping side):

a. Check the connection for damage or any foreign materials.

b. Align the quick connector with the tube, then insert the connector straight into the centralized under floor piping until a click is heard.

c. After connecting, check that the connection is secure:
   - Visually confirm that the two retainer tabs are connected to the connector.
   - With the fuel feed hose not fixed to the clamp, pull quick connector (A) hard by hand to check that the quick connector (A) is not disconnected from the centralized underfloor piping (1) and that the quick connector (1) is securely connected.

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



INSPECTION AFTER INSTALLATION

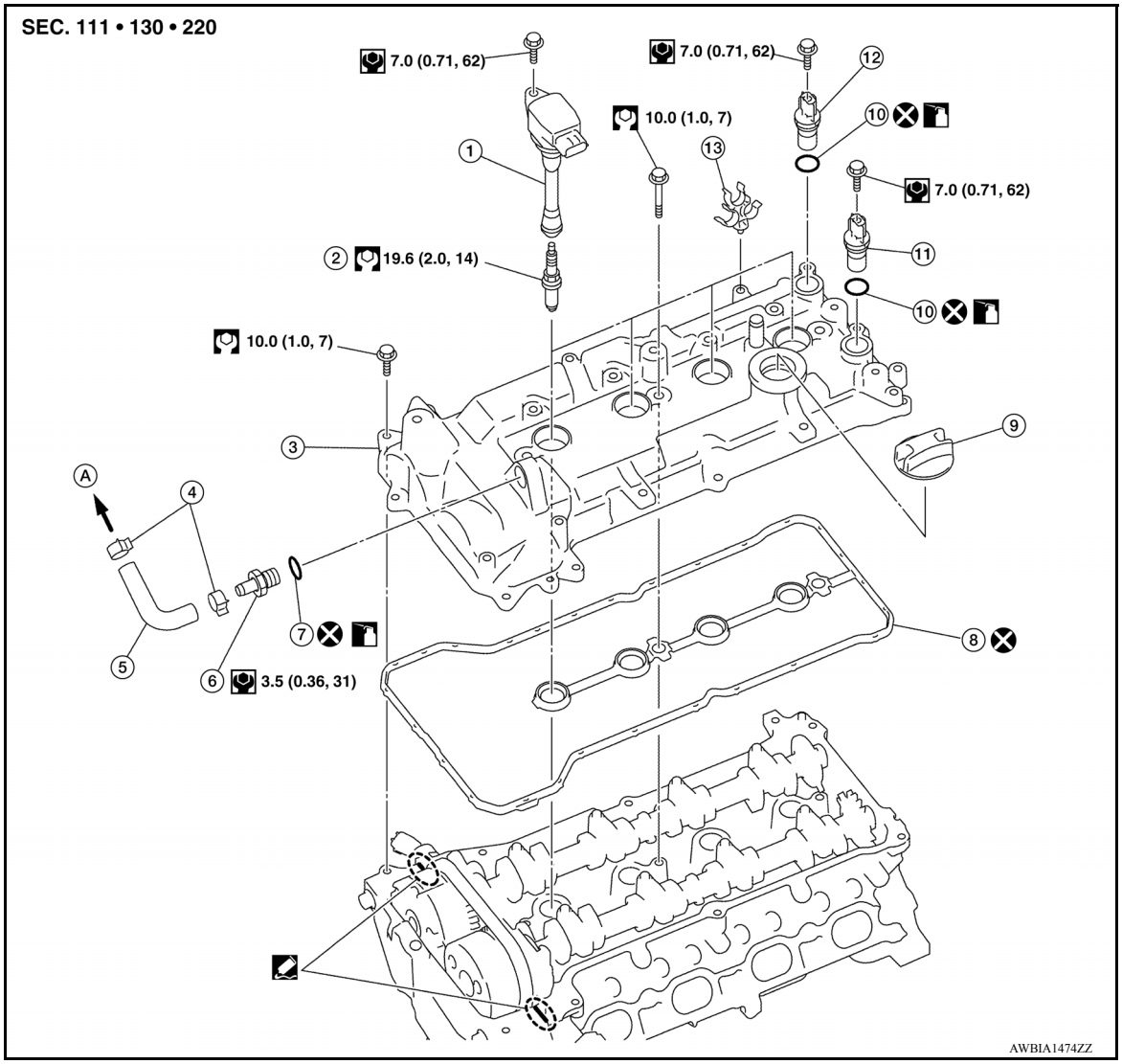
Check on Fuel Leaks

1. Turn ignition switch ON with the engine stopped. Ensure there are no fuel leaks at fuel pipe connection points.
   NOTE:
   Use mirrors for checking points out of clear sight.
2. Start the engine and increase engine speed. Check again that there are no fuel leaks.
   CAUTION:
   Do not touch the engine immediately after stopped, as the engine becomes extremely hot.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:0000000009266655



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. Intake camshaft position sensor
12. Exhaust camshaft position sensor
13. Clip
A. To intake manifold

Removal and Installation

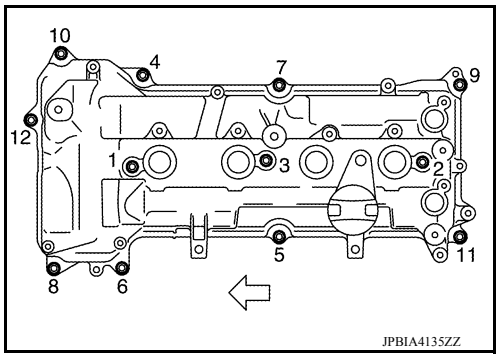
INFOID:0000000009266656

REMOVAL

1. Disconnect the battery negative terminal. Refer to PG-63, "Removal and Installation".
2. Remove intake manifold. Refer to EM-27, "Exploded View".
3. Remove ignition coil.
   CAUTION:
   - **Do not drop or shock ignition coil.**
   - **Do not disassemble ignition coil.**
4. Remove fuel tube protector. Refer to EM-37, "Exploded View".
5. Remove PCV hose from rocker cover.

6. Remove PCV valve, if necessary.
7. Remove rocker cover.
   • Loosen bolts in reverse order as shown.

   ⇦ : Engine front



8. Remove rocker cover gasket from rocker cover.
9. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.
   CAUTION:
   Do not scratch or damage the mating surface when cleaning off old liquid gasket.

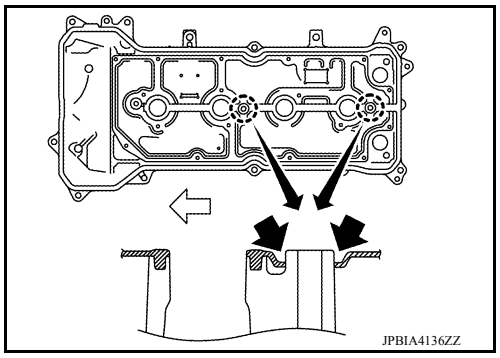
INSTALLATION

CAUTION:
Do not reuse O-ring.

1. Install the rocker cover:

a. Press gasket onto the bosses for the rocker cover bolt holes as shown to prevent the gasket from dropping off.

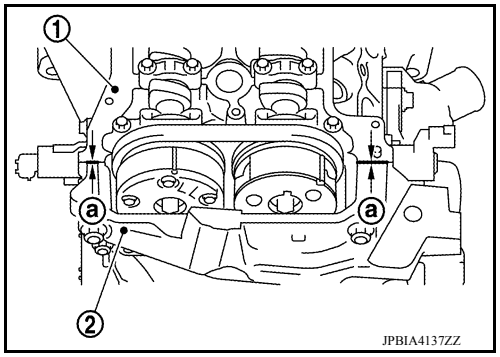
   ⇦ : Engine front



b. Apply liquid gasket to the cylinder head (1) and front cover (2) as shown.

   (a) : 2.5 - 3.5 mm diameter

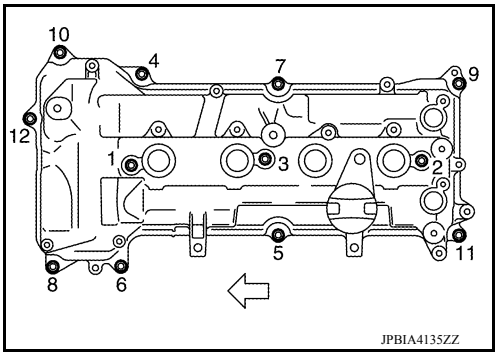
   Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   CAUTION:
   • **The components must be installed within 5 minutes of the liquid gasket application.**
   • **Then allow 30 minutes for the liquid gasket to set before putting oil in the engine.**



c. Install rocker cover to cylinder head.
   CAUTION:
   Check that the gasket has not slipped out of position.

- Tighten bolts in numerical order in two separate stages as shown.

⇦ : Engine front

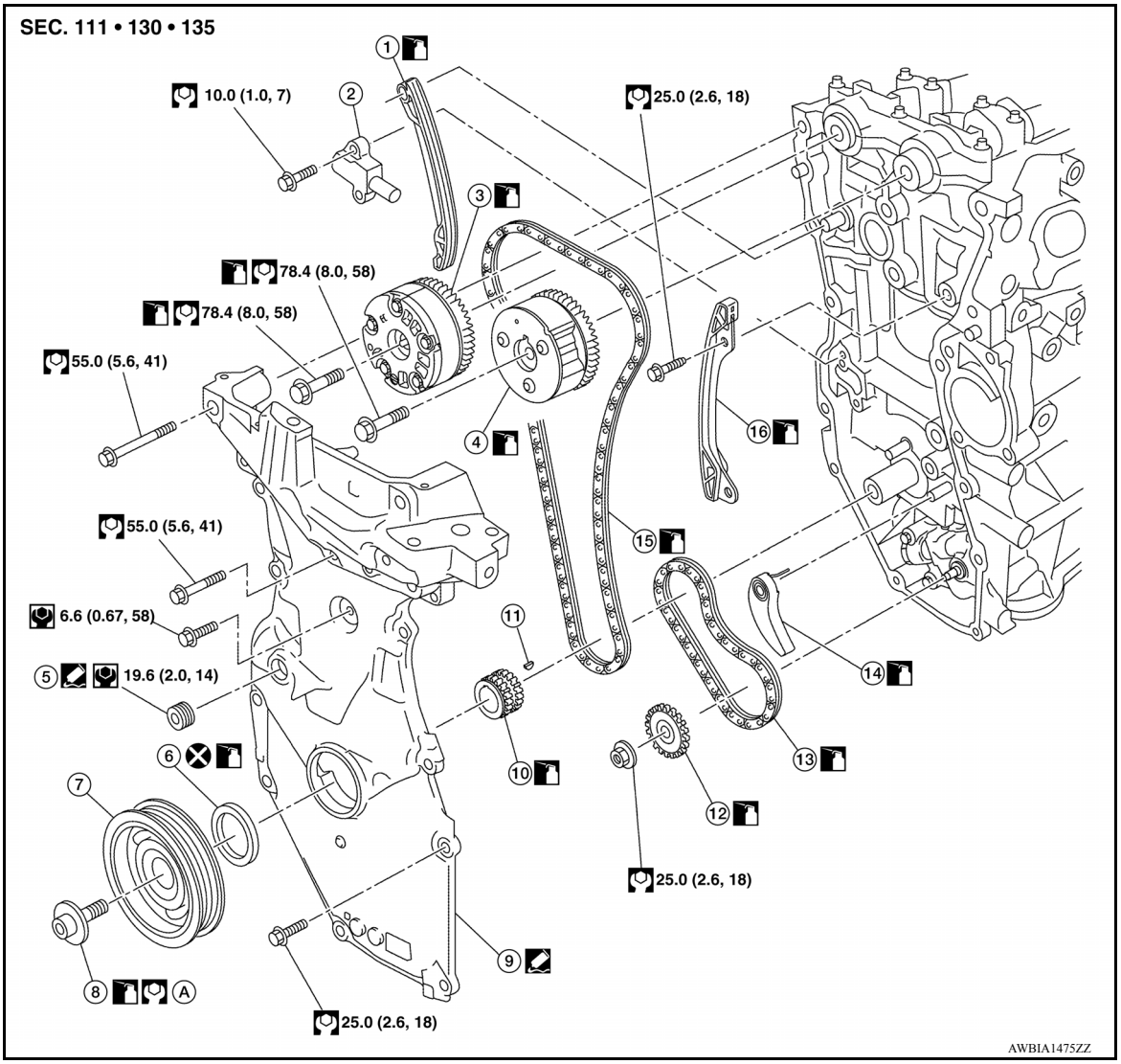


2. Installation of the remaining components is in the reverse order of removal.

TIMING CHAIN

Exploded View

INFOID:0000000009266657



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. Refer to installation procedure. Refer to EM-47

Removal and Installation

INFOID:0000000009266658

CAUTION:
The rotation direction indicated in the text is as viewed from the engine front.
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

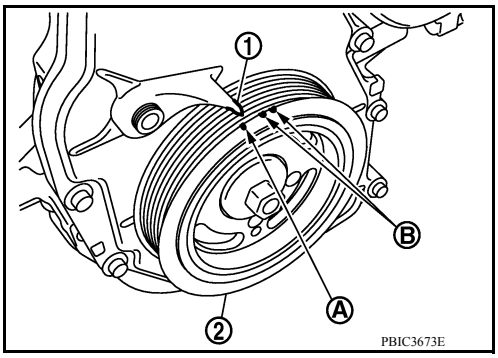
REMOVAL

1. Remove front wheel and tire (RH) using power tool. Refer to WT-39, "Adjustment".

2. Remove front fender protector (RH). Refer to EXT-26, "Removal and Installation".
3. Drain engine oil. Refer to LU-9, "Draining".
   CAUTION:
   - **Perform this step when engine is cold.**
   - **Do not spill engine oil on drive belt.**
4. Drain coolant. Refer to CO-8, "Draining Engine Coolant".
5. Remove the following parts.
   - Intake manifold. Refer to EM-27, "Removal and Installation".
   - Drive belt. Refer to EM-16, "Removal and Installation".
   - Rocker cover. Refer to EM-44, "Exploded View".
   - Water pump pulley. Refer to CO-19, "Removal and Installation".
6. Support the bottom surface of engine using a transmission jack, and then remove the engine bracket and insulator (RH). Refer to EM-82, "Exploded View".
7. Set No. 1 cylinder at TDC of its compression stroke:

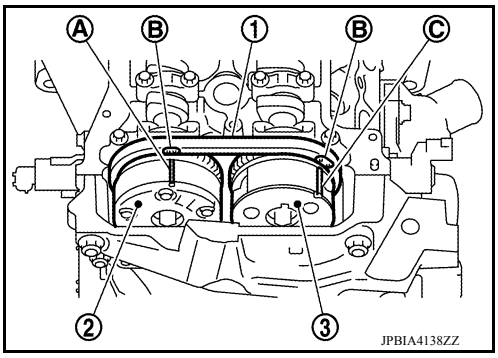
a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

(B) : White paint mark (Not use for service)



b. Check the matching marks on each camshaft sprocket are positioned as shown.

(1) : Timing chain
(2) : Camshaft sprocket (EXH)
(3) : Camshaft sprocket (INT)
(A) : Matching mark (Peripheral groove)
(B) : Pink link
(C) : Matching mark (Peripheral groove)

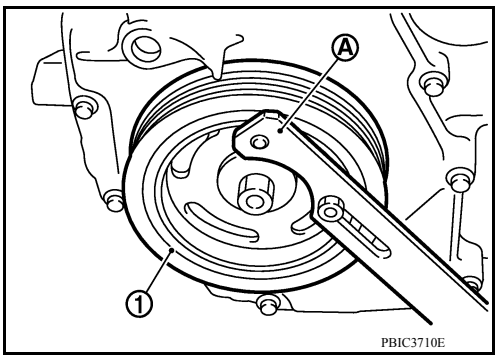


- If not, rotate crankshaft pulley one more turn to align matching marks to the positions.

8. Remove crankshaft pulley:

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

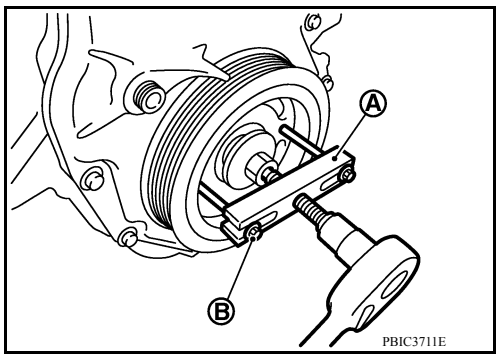
b. Loosen and pull out crankshaft pulley bolt.
   CAUTION:
   Do not remove the bolts as they will be used as a supporting point for the pulley puller.



c. Attach Tool (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

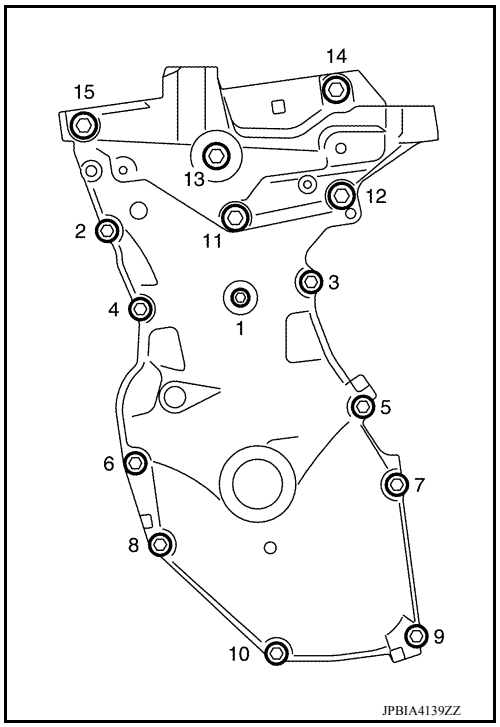
(B) : M6 bolt

Tool number : KV11123000 (—)

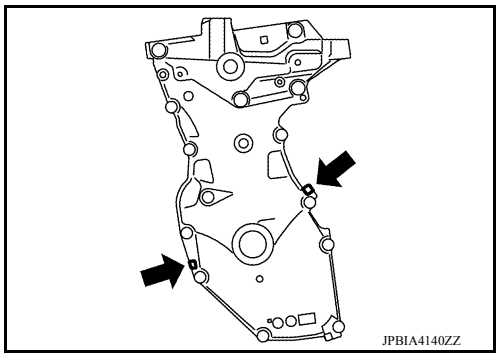


9. Remove front cover:

a. Loosen bolts in the reverse order as shown.



b. Cut liquid gasket by prying the position (⬅) as shown, and then remove the front cover.



10. Remove front oil seal from front cover using a suitable tool.

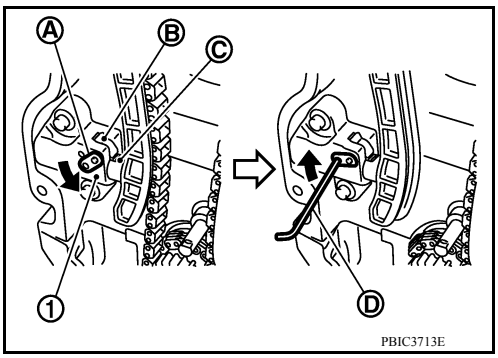
CAUTION:

Be careful not to damage the front cover.

11. Remove chain tensioner (1):

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. Then the plunger can be moved.

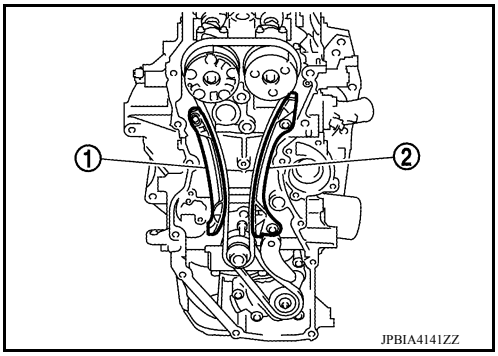
b. Pull up the lever to align its hole position with the body hole position.
   • When the lever hole is aligned with the body hole position, the plunger is secured.
   • When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly 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 secure the lever at the upper position.
   NOTE:
   A hexagonal wrench of 2.5 mm (0.098 in) is used as a stopper pin (D).

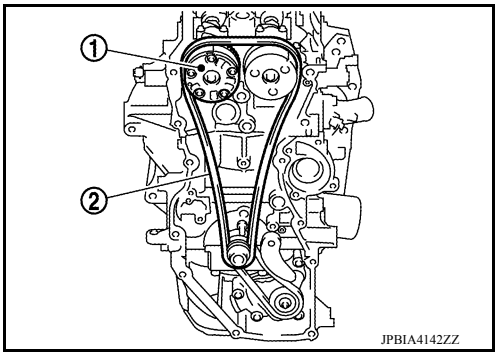
d. Remove chain tensioner.

12. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



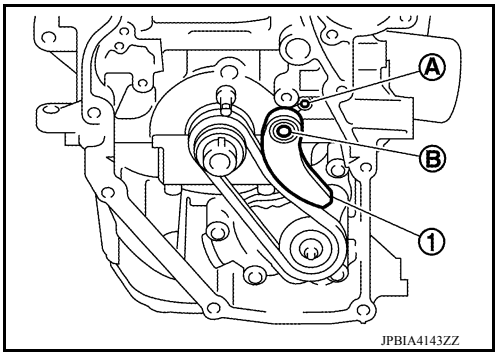
13. Remove the timing chain (2).
   • Pull the timing chain slack toward the camshaft sprocket (EXH) (1), and then remove the timing chain and start the removal from camshaft sprocket (EXH) side.

   CAUTION:
   Do not rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.



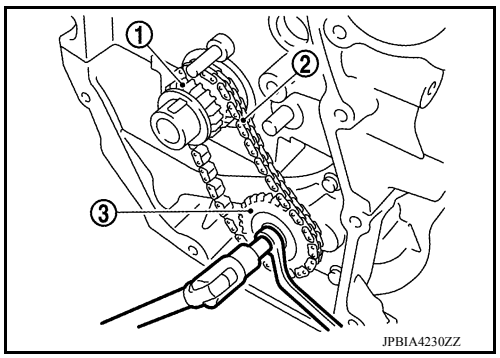
14. Remove the crankshaft sprocket and the oil pump drive related parts:

a. Remove oil pump drive chain tensioner (1).
   • Pull out from the shaft (B) and spring attaching holes (A).



b. Hold the top of the oil pump shaft using the socket (size: E8), and then loosen the oil pump sprocket nut and remove it.

c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

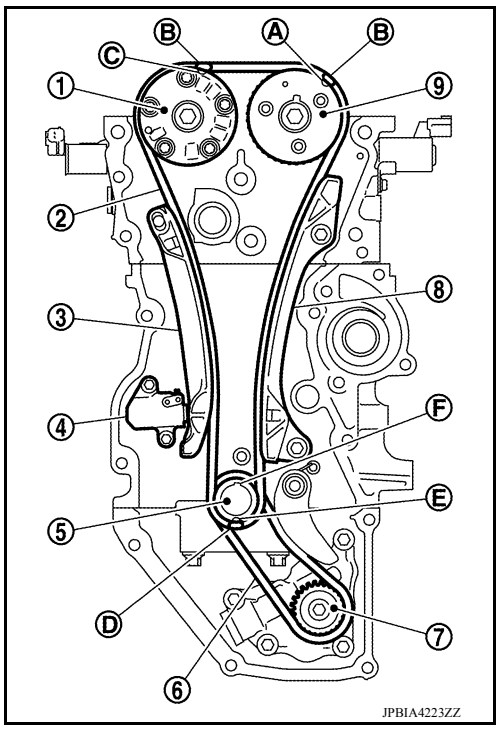


INSTALLATION

NOTE:

For installation follow the relationship between the matching mark on each timing chain and that of 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 groove)
(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:

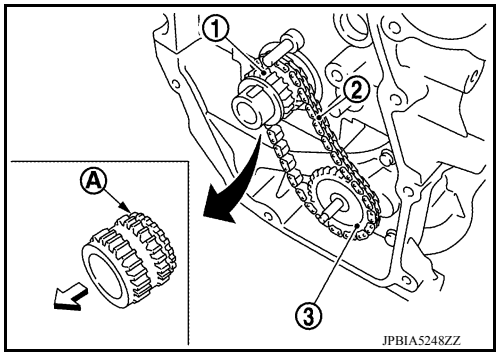
a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇦ : Engine front

- Install the crankshaft sprocket so that its invalid gear area (A) is toward the back of the engine.
- Install the oil pump sprocket so that its protrusion faces the front of engine.

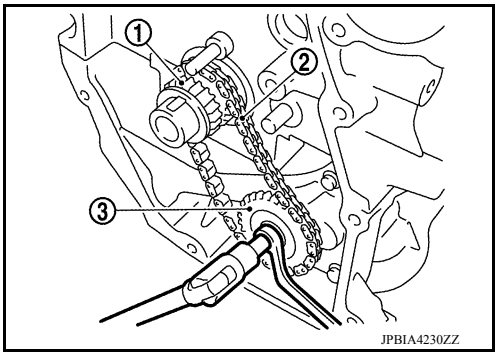
NOTE:

There is no matching mark in the oil pump drive related parts.

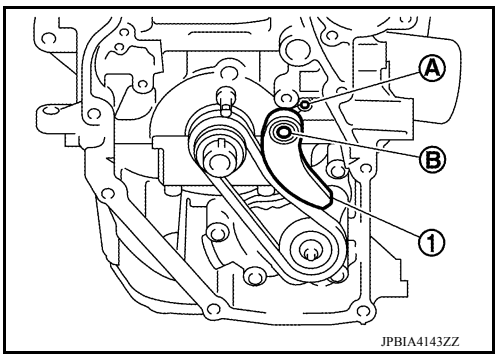


b. Hold the top of the oil pump shaft using the socket (size: E8), and then tighten the oil pump sprocket nut.

(1) : Crankshaft sprocket
(2) : Oil pump drive chain
(3) : Oil pump sprocket



c. Install oil pump drive chain tensioner (1).
- Insert the body into the shaft (B) while inserting the spring into the attaching hole (A) of cylinder block front surface.
- Check that the tension is applied to the oil pump drive chain after installing.

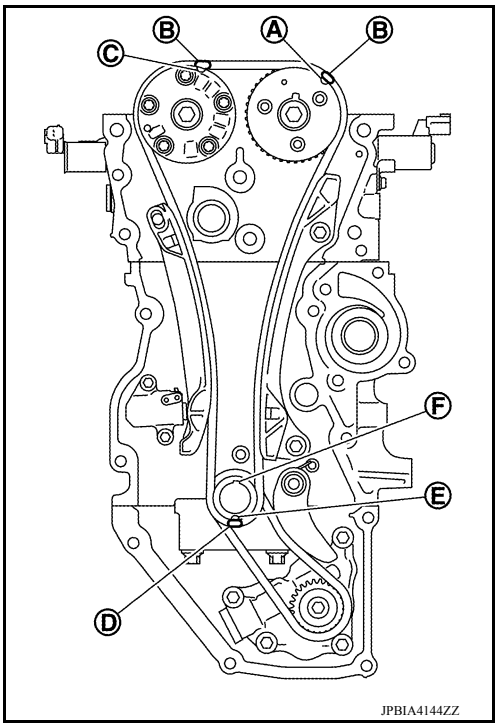


2. Install timing chain:

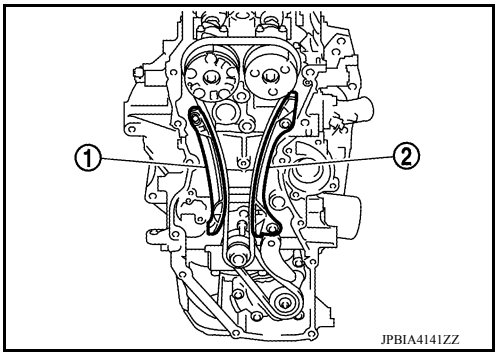
(A) : Matching mark (Peripheral groove)
(B) : Pink link
(C) : Matching mark (Peripheral groove)
(D) : Orange link
(E) : Matching mark (stamp)
(F) : Crankshaft key (point straight up)

- 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.

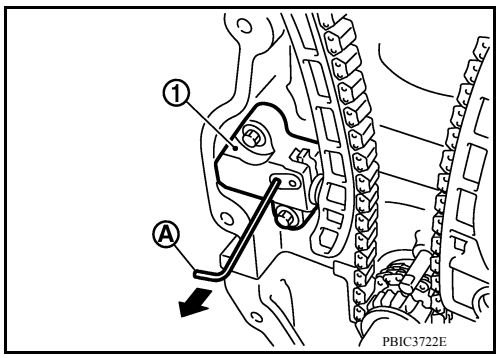
CAUTION:
- **After the matching marks are aligned, keep them aligned by holding them.**
- **To avoid skipped teeth, do not rotate crankshaft and camshaft until front cover is installed.**



3. Install timing chain tension guide (2) and timing chain slack guide (1).



4. Install chain tensioner (1).
   - Secure the plunger at the most compressed position using a stopper pin (A), and then install it.
   - Pull out the stopper pin after installing the chain tensioner.

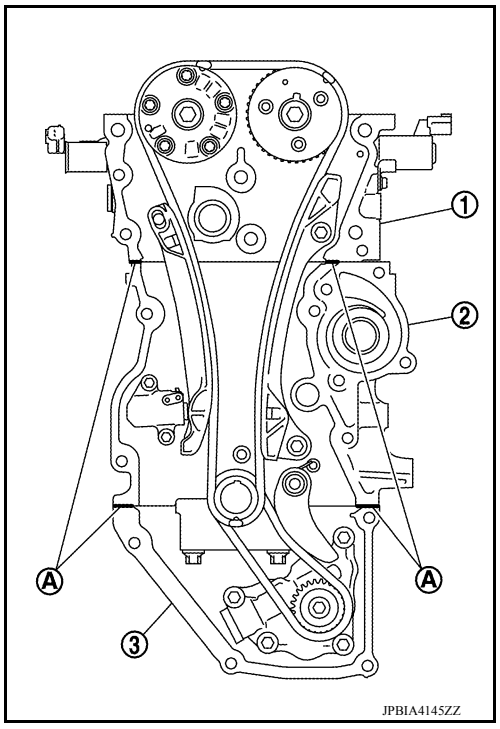


5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to EM-71, "FRONT OIL SEAL : Removal and Installation".
7. Install front cover with the following procedure:

a. Apply a continuous bead of liquid gasket to the front cover as shown.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

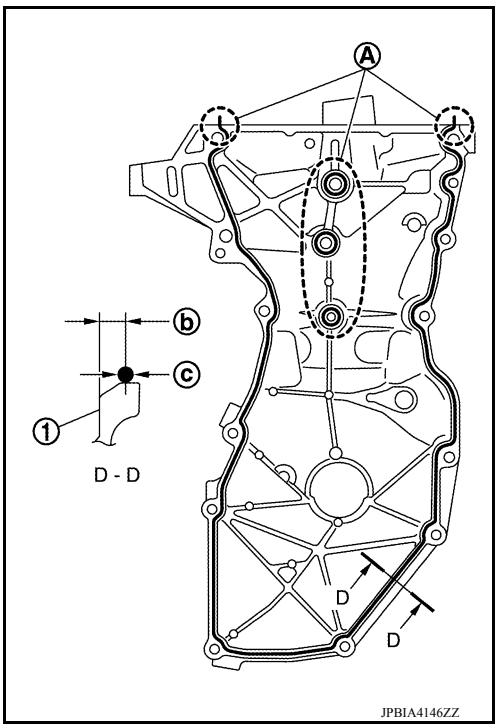
(1) : Cylinder head
(2) : Cylinder block
(3) : Oil pan (upper)
(A) : Liquid gasket application area [3.0 - 4.0 mm (0.12 - 0.16 in) diameter]

Tool number : WS39930000 (—)

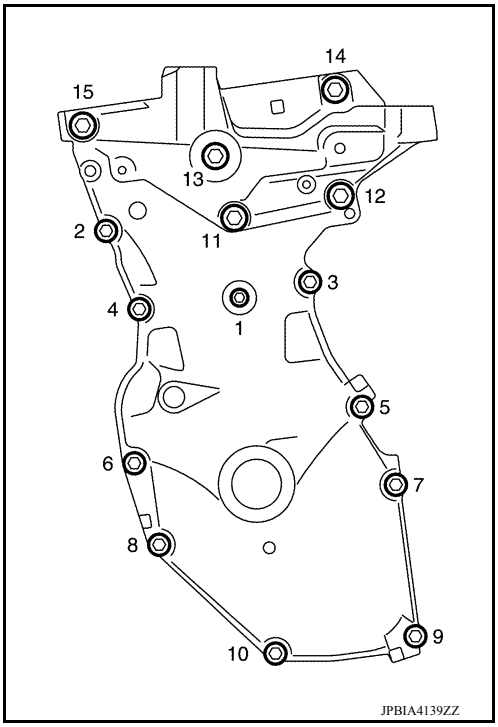


b. Apply a continuous bead of liquid gasket to front cover as shown.
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

(1) : Front cover edge
(A) : Liquid gasket application area
(b) : 4.0 - 5.6 mm
(c) : Liquid gasket application area [3.0 - 4.0 mm (0.12 - 0.16 in) diameter]



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

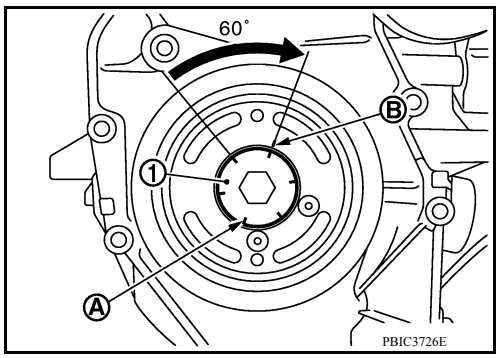


8. Insert crankshaft pulley by aligning with crankshaft key.
• When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
CAUTION:
Do not damage front oil seal lip section.
9. Tighten crankshaft pulley bolt:
• Secure crankshaft pulley with a suitable tool and tighten crankshaft pulley bolt.
a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
b. Tighten crankshaft pulley bolt.

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

INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels, including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-12, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

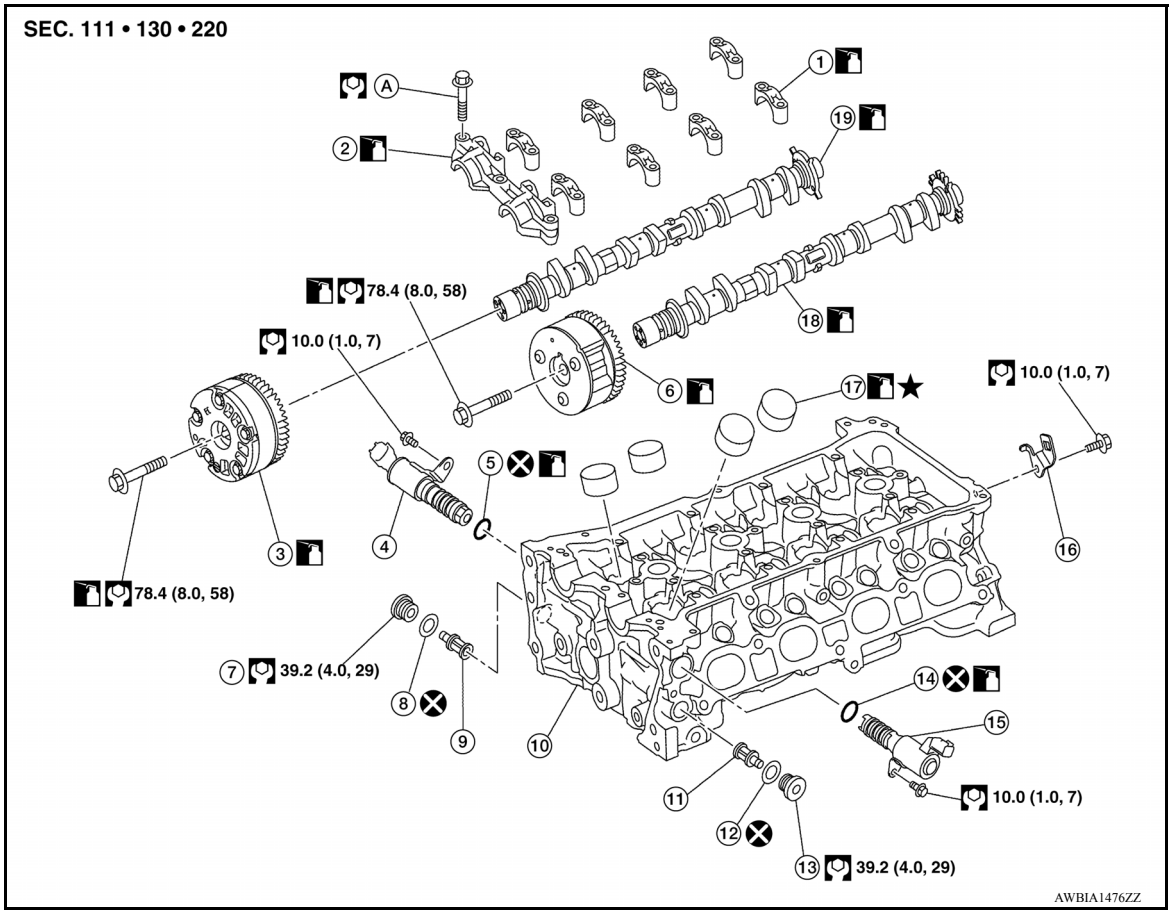
Item		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level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

*Power steering fluid, brake fluid, etc.

CAMSHAFT

Exploded View

INFOID:0000000009266659



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. Refer to EM-56	

Removal and Installation

INFOID:0000000009266660

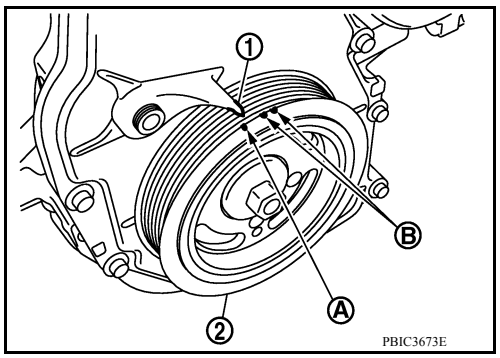
CAUTION:
The rotation direction indicated in the procedure is as viewed from the engine front.

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-82, "Exploded View".
2. Remove rocker cover. Refer to EM-44, "Exploded View".
3. Place cylinder No. 1 at TDC of its compression stroke:

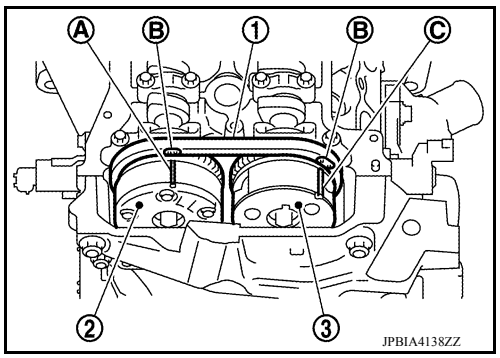
a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

(B) : White paint mark (Not used for service)



b. Check that the matching marks on each of the camshaft sprockets are in the position as shown.

(1) : Timing chain
(2) : Camshaft sprocket (EXH)
(3) : Camshaft sprocket (INT)
(A) : Matching mark (Peripheral groove)
(B) : Pink link
(C) : Matching mark (Peripheral groove)



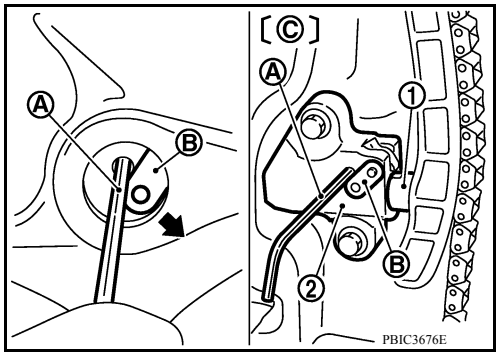
- If not, rotate crankshaft pulley one more turn to align matching marks to the positions as shown.

c. Paint matching marks (A) on the timing chain links.

4. Remove crankshaft pulley. Refer to EM-47, "Exploded View".
5. Remove front cover. Refer to EM-47, "Exploded View".
6. Secure the plunger of chain tensioner in the fully compressed position. 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 removed for clarity.



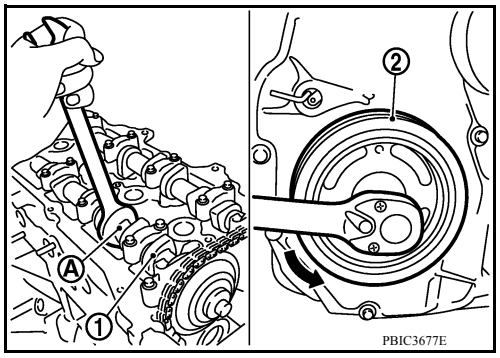
- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

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 if dropped.

b. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) held. Apply the tension to the timing chain, and then push the plunger into the inside of chain tensioner.

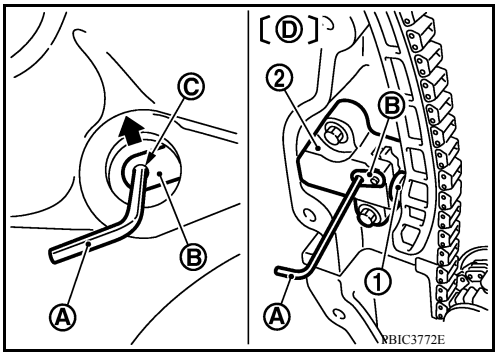
CAUTION:
Hold the camshaft hexagonal part (A), and then secure the camshaft.



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 removed for clarity.

- When the lever hole (C) is aligned with the body hole position, the plunger (1) is secured.
- 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 secure the lever at the upper position.

7. Remove timing chain.

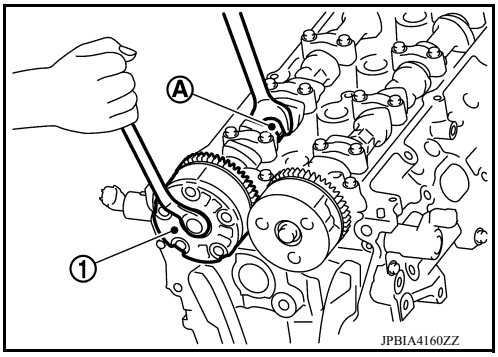
8. Remove camshaft sprocket (EXH) (1).

CAUTION:

- **Hold the camshaft hexagonal part (A), and then secure the camshaft.**
- **Do not rotate crankshaft and camshaft separately, so as not to contact valve with piston.**

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.

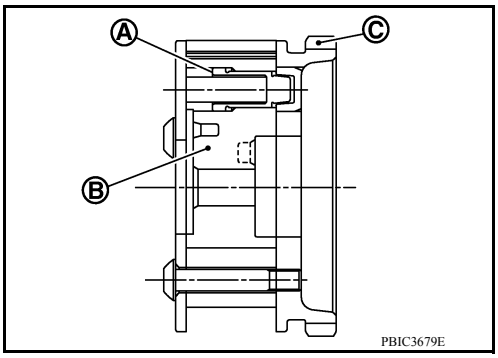


9. Turn the camshaft sprocket (INT) to the most advanced position.

CAUTION:

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position. Make sure to 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 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.**

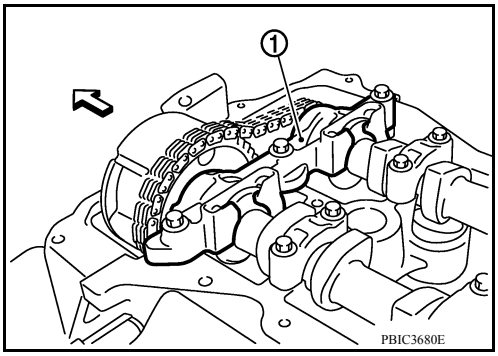


- Put the camshaft sprocket (INT) in the most advanced position:

a. Remove camshaft bracket (No. 1) (1).

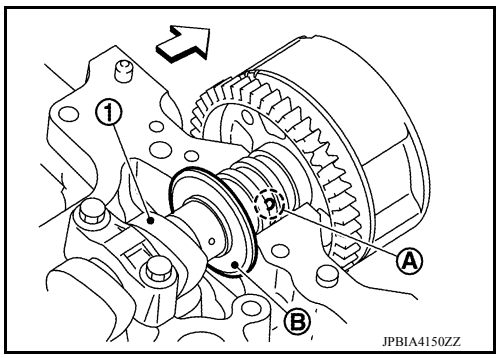
⇦ : Engine front

- 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 using an air gun.

Air pressure : 300 kPa (3.1 kg/cm^2, 44 psi) or more



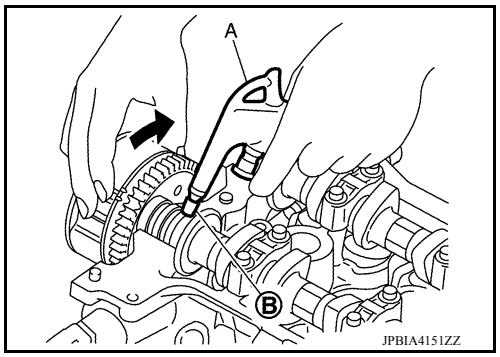
- Apply the air pressure into the oil hole on the second groove from the front of camshaft thrust (B).
- Proceed all the way through step “e” with the air pressure on.
- Attach the rubber nozzle narrowed to the top of the air gun to prevent air leakage from the oil hole (A). Securely apply the air pressure to the oil hole.

WARNING:
Eye protection should be worn as needed.
CAUTION:
- **There are other oil holes in the side grooves. Do not 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.**

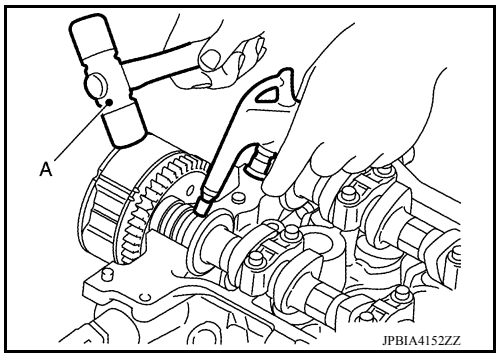
NOTE:
The air pressure is used to move the lock pin into the disengage position.

c. Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternately.

(A) : Air gun
(B) : Rubber nozzle



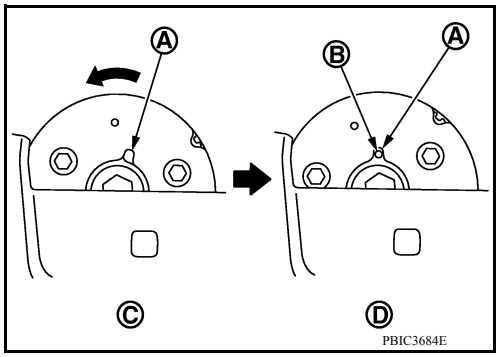
- Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (⬅)].
- Perform the work while continuously applying the air pressure to the oil hole.



- If the lock pin is not released, 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 counterclockwise direction in the most advanced angle position.

(C) : Lock pin engaged
(D) : Most advanced angle



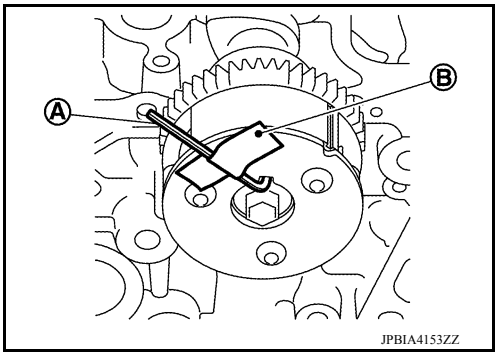
- Keep the air pressure on.
- If there is no click, as soon as the vane side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.

- 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.

e. Stop applying air pressure and release the 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.

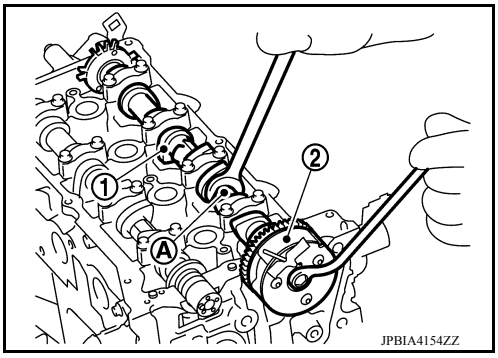
CAUTION:
No load is exerted on the stopper pin (spring reaction, etc.). Since it comes out easily, secure it with tape (B) to prevent it from falling out.
NOTE:
The stopper pin shows one example of a hexagonal wrench for 2.5 mm (0.098 in) [length of inserted section: approximately15 mm (0.59 in)].



10. Remove the camshaft sprocket (INT):

a. Keeping the camshaft hexagonal part (A) in place with the wrench, loosen the bolts for the camshaft sprocket (INT) (2).

(1) Camshaft (INT)

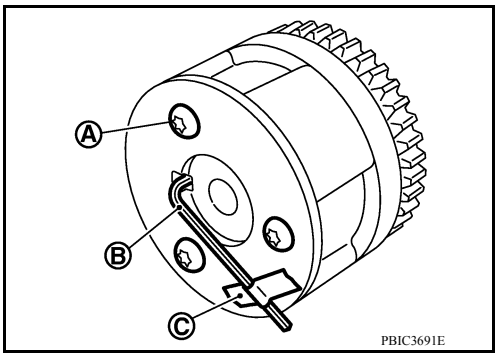


CAUTION:
- **Do not drop stopper pin.**
- **Tape (C) the stopper pin (B) so it does not come out.**
- **Do not subject it to impact by dropping.**
- **Do not disassemble. [Do not loosen the three bolts (A)].**

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.

i. Install the camshaft (INT) and tighten the bolts enough to prevent air from leaking out.

CAUTION:
The internal lock pin will get damaged, so keep the torque on the 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.

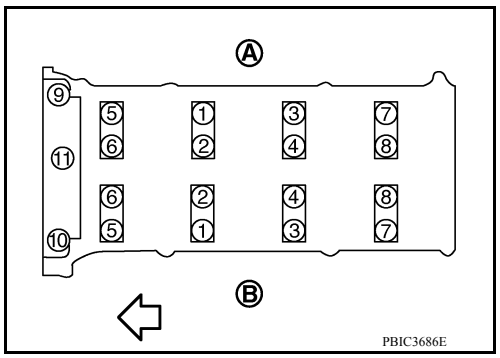
iv. Remove camshaft sprocket (INT) from the camshaft.

11. Remove camshaft brackets (No. 2 to 5).

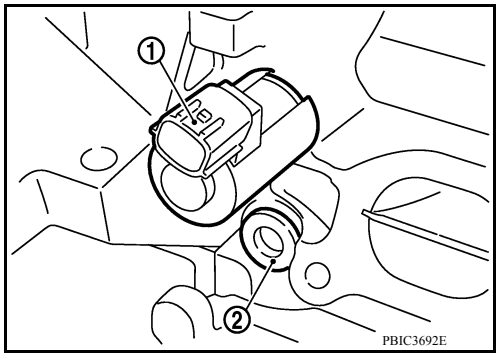
- Loosen bolts in several steps in the reverse order as shown.

(A) : EXH side
(B) : INT side
⇦ : Engine front

NOTE:
The camshaft bracket (No. 1) has been already removed.



12. Remove camshaft (EXH).
13. Remove camshaft (INT).
14. Remove valve lifter.
    - Identify installation positions, and store lifters without mixing them up.
15. Remove intake valve timing control solenoid valve (1).
16. Remove the alternator and bracket, remove the plug (2), and then remove the oil filter. Refer to EM-56, "Exploded View".

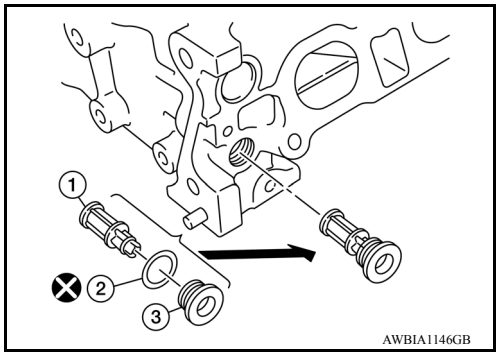


17. Remove exhaust valve timing control solenoid valve.
18. Remove the plug on the exhaust valve timing control solenoid valve and the oil filter. Refer to EM-56, "Exploded View".
19. For component inspection after removal, refer to EM-65, "Inspection".

INSTALLATION

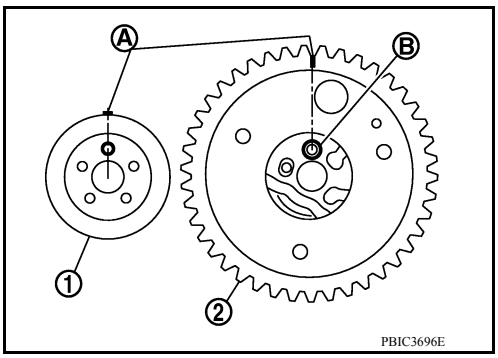
CAUTION:
Do not reuse O-rings or washers.

1. Install oil filter (1) for intake and exhaust valve timing control solenoid valves.
   CAUTION:
   Do not reuse washers.
   NOTE:
   The intake side is shown as an example.
   - The oil filter (1) and washer (2) are assembled to the plug (3), and then install them in to the cylinder head. Refer to EM-56, "Exploded View".



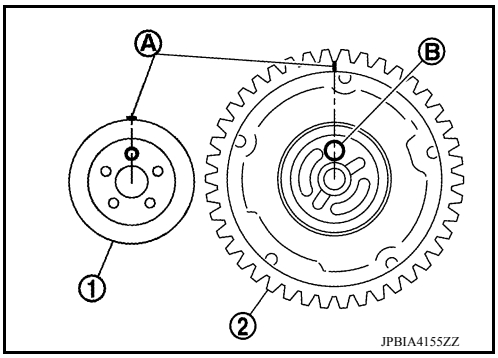
2. Install intake and exhaust valve timing control solenoid valves.
   - Insert it straight into the cylinder head.
   - Tighten bolts.
3. Install valve lifters.
   - If they are reused, install them in the original positions.
4. Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT):
   NOTE:
   This helps prevent 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 as shown.
b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (INT) (2) as shown.
   • 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):
   NOTE:
   This helps prevent the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (EXH).

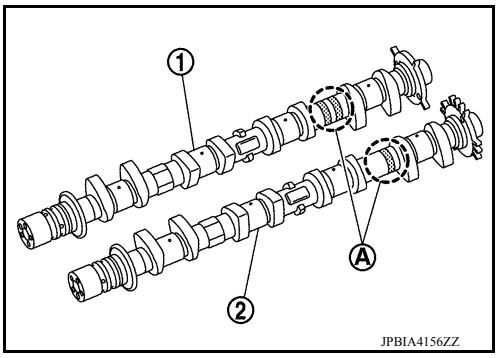
a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (EXH) (1) front surface.
   • Put the marks on the visible position with the camshaft sprocket installed as shown.
b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (EXH) (2) as shown.
   • 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

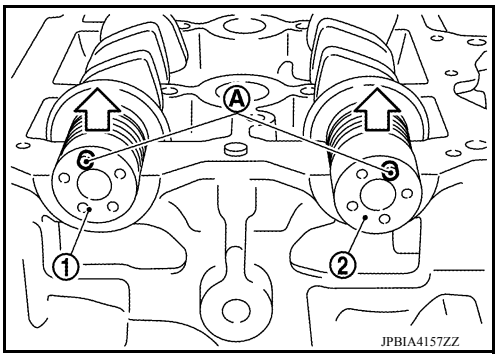
   • Note that the camshafts (INT and EXH) have different shapes at the rear.



   • Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown.

   (1) : Camshaft (EXH)
   (2) : Camshaft (INT)
   ⇦ : Upper side

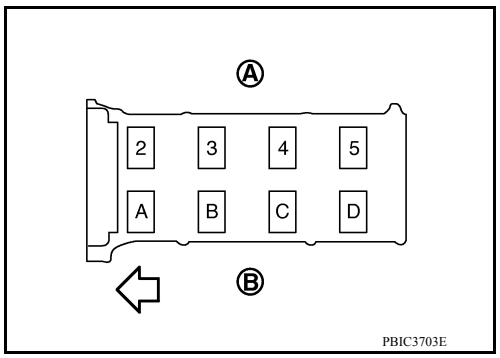
   NOTE:
   Though camshaft does not stop at the portion as shown for the placement of cam nose, it is generally accepted camshaft is placed for the same direction as shown.



7. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown.

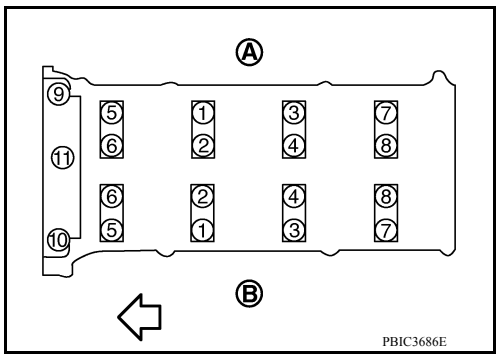
(A) : EXH side
(B) : INT side
⇦ : Engine front

- Install so that identification mark can be correctly read when viewed from the INT side.



8. Tighten bolts of camshaft brackets in the following steps, in numerical order as shown.

(A) : EXH side
(B) : INT side
⇦ : Engine front



a. Tighten No. 9 to 11 in numerical order.

Camshaft bracket bolts : 1.96 N·m (2.0 kg-m, 14 in-lb)

b. Tighten No. 1 to 8 in numerical order.

Camshaft bracket bolts : 1.96 N·m (2.0 kg-m, 14 in-lb)

c. Tighten all bolts in numerical order.

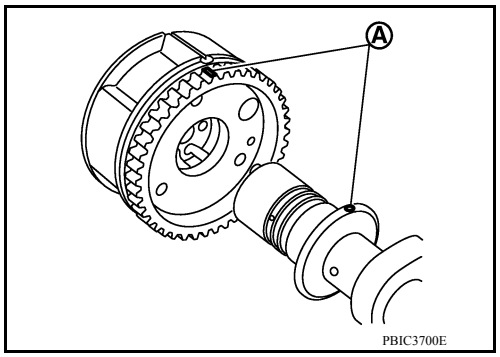
Camshaft bracket bolts : 5.88 N·m (0.60 kg-m, 52 in-lb)

d. Tighten all bolts in numerical order.

Camshaft bracket bolts : 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):

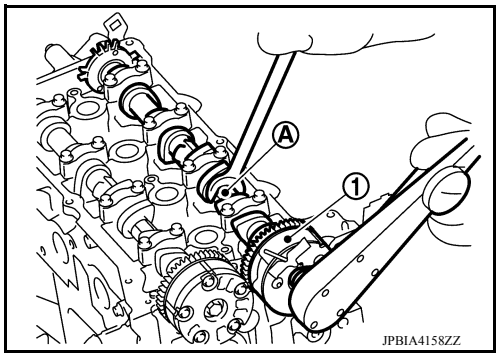
a. Refer to the matching mark (A) added in step 4. Securely align the knock pin and the pin hole, and then install them.
NOTE:
The intake side is shown as an example.



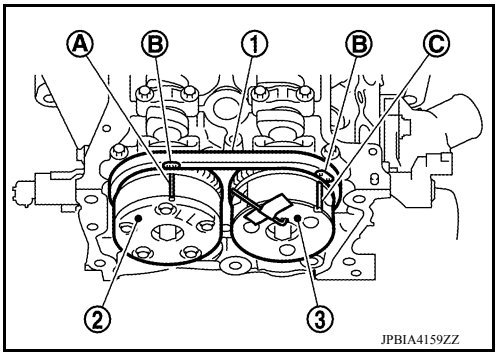
10. Tighten the camshaft sprocket bolt (INT and EXH).

(1) : Camshaft sprocket (EXH)

CAUTION:
Hold the camshaft hexagonal part (A), using a suitable tool to secure the camshaft.



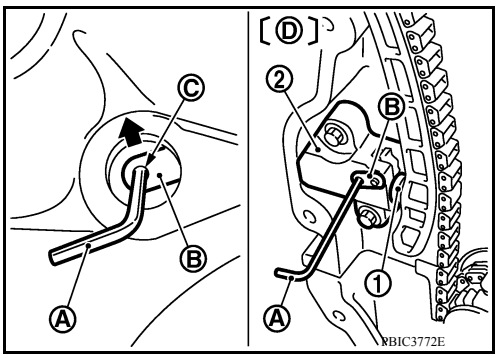
11. Install the camshaft (INT and EXH) to the camshaft sprocket (INT and EXH) (2 and 3) while aligning the matching mark (marked when timing chain is removed) (A) and the pink link (B) of camshaft sprocket (INT and EXH).



(1) : Timing chain
(C) : Matching mark (peripheral groove)

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.

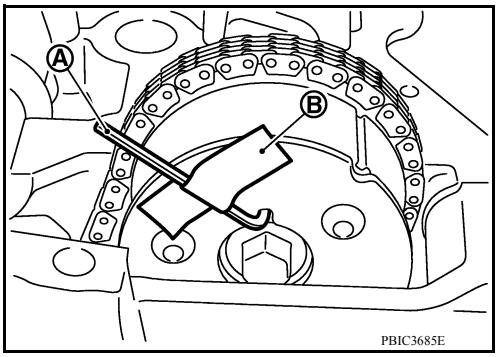
12. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.



(1) : Plunger
(2) : Chain tensioner
(B) : Lever
(C) : Lever hole
(D) : Front cover has been removed for clarity.

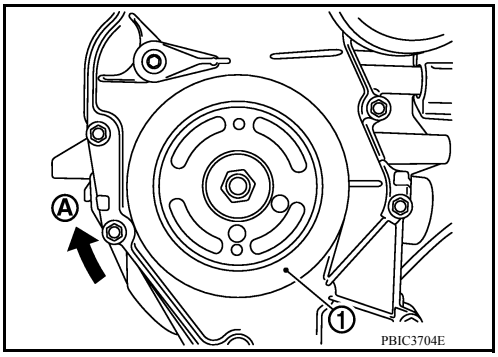
13. Pull out the stopper pin of chain tensioner.
14. Install front cover.
15. Return the camshaft sprocket (INT) in the most retarded position:

a. Remove the stopper pin (A) from the camshaft sprocket (INT).



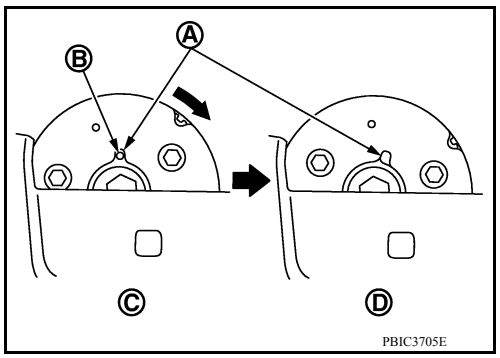
(B) : Tape

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 completely inserted.
17. Check and adjust valve clearance. Refer to EM-10, "Inspection and Adjustment".
18. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels, including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-12, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

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

*Power steering fluid, brake fluid, etc.

Inspection

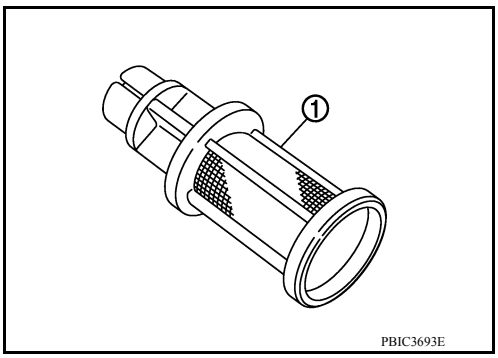
INFOID:0000000009266661

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.

CAUTION:
Do not reuse the washer.

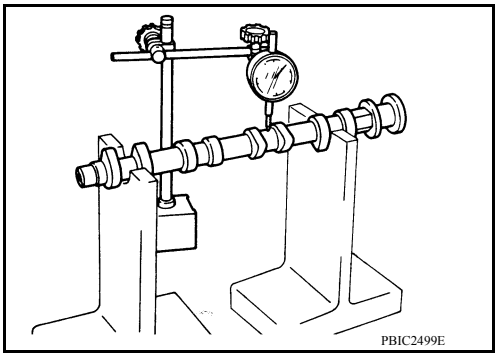


Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 5 journals of camshaft.
   CAUTION:
   Do not 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, and measure the camshaft runout on the dial indicator. (Total indicator reading)

Standard and Limit
: Refer to EM-118, "Camshaft".

4. If it exceeds the limit, replace camshaft.

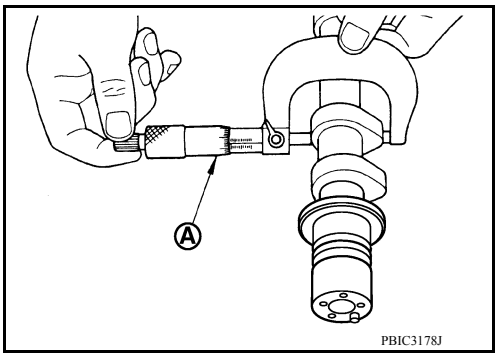


Camshaft Cam Height

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

Standard and Limit
Intake
Exhaust **: Refer to EM-118, "Camshaft".**
Cam wear limit:
: Refer to EM-118, "Camshaft".

2. If wear exceeds the limit, replace camshaft.

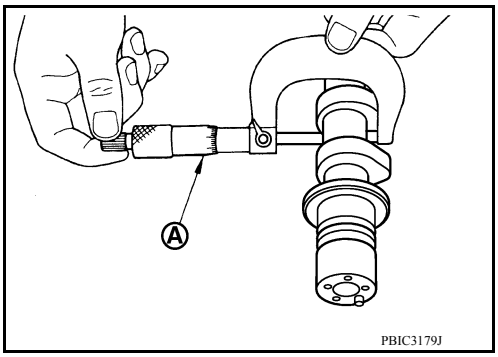


Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

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

Standard: : Refer to EM-118, "Camshaft".

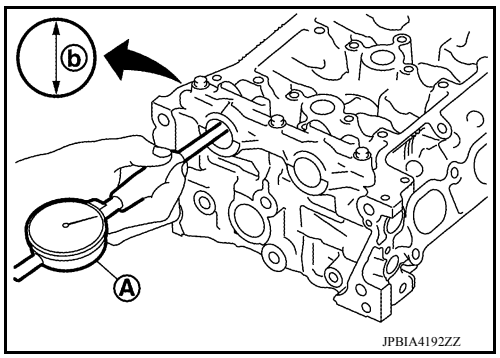


CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts to 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-118, "Camshaft".



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard and Limit : Refer to EM-118, "Camshaft".

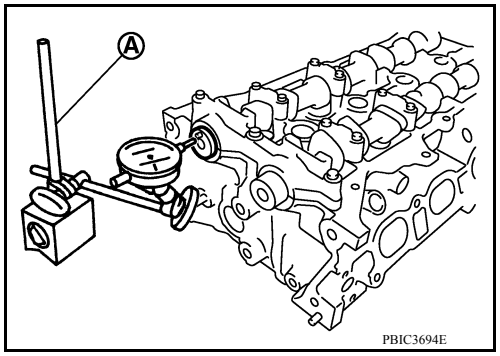
- If it exceeds the limit, replace either or both camshaft and cylinder head.

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-56, "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-118, "Camshaft".



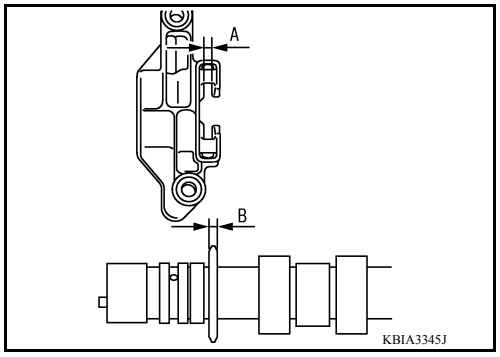
- Measure the following parts if out of the standard.
  - Dimension “A” for cylinder head No. 1 journal bearing

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.

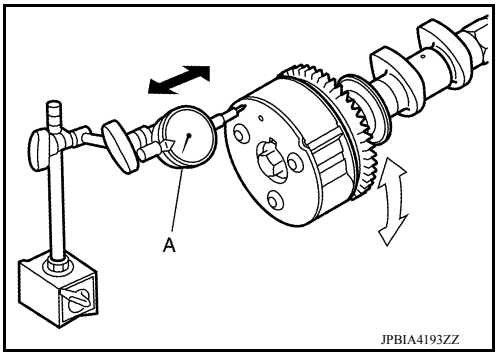


Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

CAUTION:
Do not support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

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



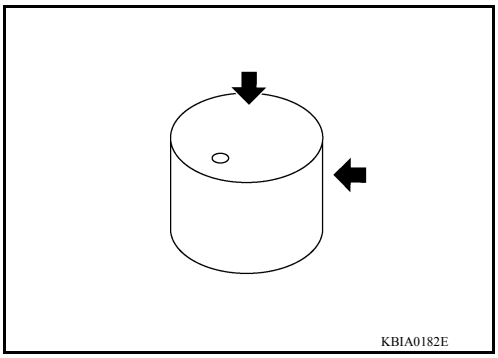
Limit : 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.

Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to EM-118, "Camshaft".

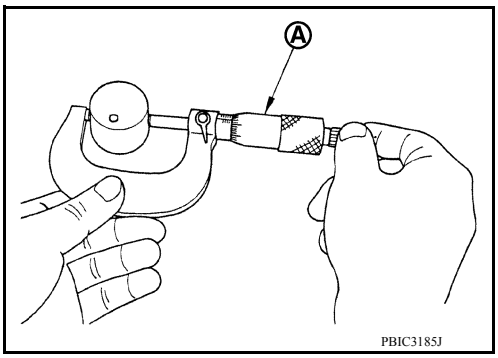


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

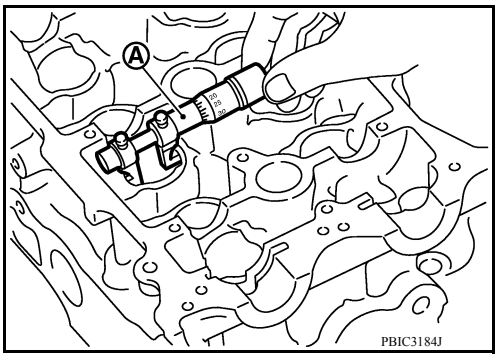
Standard : Refer to EM-118, "Camshaft".



VALVE LIFTER HOLE DIAMETER

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

Standard : Refer to EM-118, "Camshaft".



VALVE LIFTER CLEARANCE

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

Standard : Refer to EM-118, "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 Oil Groove

CAUTION:

- **Perform this inspection only when DTC P0011 or P0014 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to EC-161, "Diagnosis Procedure" (P0011) or EC-165, "Diagnosis Procedure" (P0014).**
- **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:

· Step 3	: Remove exhaust valve timing control solenoid valve. Refer to EM-56, "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-56, "Exploded View". • Clean oil groove between oil strainer and exhaust valve timing control solenoid valve. Refer to EM-56, "Exploded View".
·Step 6	: Remove components between exhaust valve timing control solenoid valve and camshaft sprocket (EXH), and then check each oil groove for clogging.

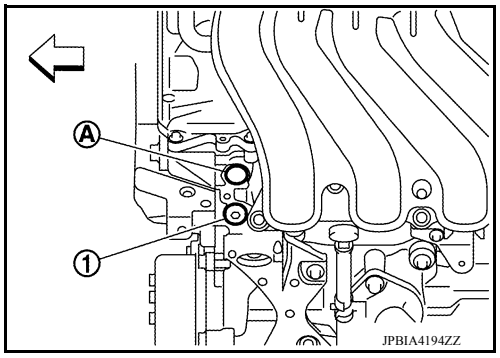
1. Check engine oil level. Refer to LU-8, "Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release the fuel pressure. Refer to EC-133, "Work Procedure".

b. Remove intake manifold. Refer to EM-27, "Exploded View".

c. Disconnect ignition coil and injector harness connectors. Refer to EM-44, "Exploded View".

3. Remove intake valve timing control solenoid valve. Refer to EM-56, "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 to prevent injury from splashing engine oil and so as to prevent engine oil contamination.**
- **Use a shop cloth to prevent engine oil from being splashed to engine and vehicle. Especially be careful not to spill 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 LU-11, "Removal and Installation".
   - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to LU-6, "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-6, "Engine Lubrication System".
7. After inspection, installation of components is in the reverse order of removal

OIL SEAL

VALVE OIL SEAL

VALVE OIL SEAL : Removal and Installation

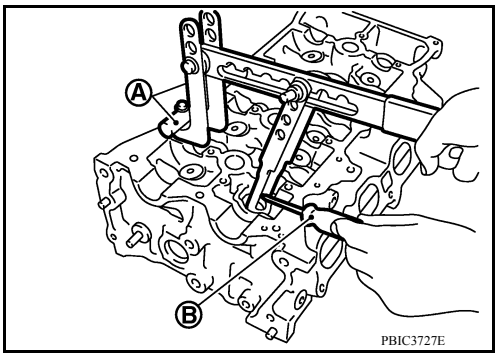
INFOID:0000000009266662

REMOVAL

1. Remove camshafts. Refer to EM-56, "Removal and Installation".
2. Remove valve lifters. Refer to EM-56, "Removal and Installation".
3. Rotate crankshaft, and set piston with valve oil seal to be removed to TDC. This will prevent the 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 Tool (A). Remove valve collet with a magnet hand (B).

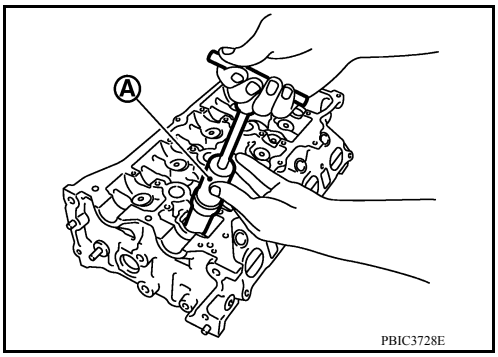
   CAUTION:
   Be careful not to damage valve lifter holes.

   Tool number : KV10116200 (J-26336-B)
   : KV10115900 (J-26336-20)
   : KV10109220 (—)



5. Remove valve spring retainer, valve spring and valve spring seat. Refer to EM-75, "Disassembly and Assembly".
6. Remove valve oil seal with Tool (A).

   Tool number : KV10107902 (J-38959)

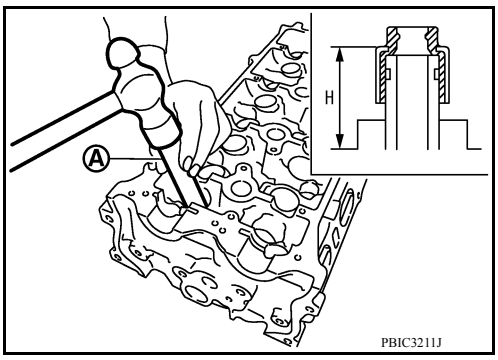


INSTALLATION

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

   Height “H” : 13.2 - 13.8 mm (0.520 - 0.543 in)

   Tool number : KV10115600 (J-38958)



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

FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:0000000009266663

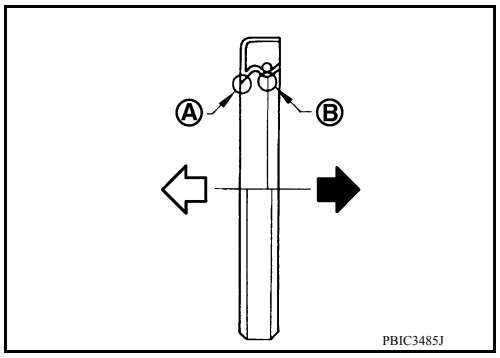
REMOVAL

1. Remove the following parts.
   - Remove wheel and tire. Refer to WT-39, "Adjustment"
   - Front fender protector (RH). Refer to EXT-26, "Removal and Installation".
   - Drive belt. Refer to EM-16, "Removal and Installation".
   - Crankshaft pulley. Refer to EM-47, "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.

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

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:0000000009266664

REMOVAL

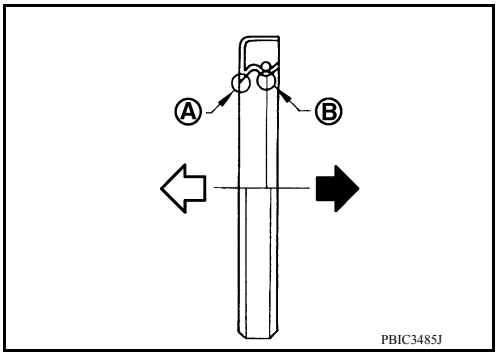
1. Remove transaxle assembly. Refer to TM-27, "Removal and Installation" (M/T models), TM-452, "Removal and Installation" (A/T models), TM-452, "Removal and Installation" (CVT models).
2. Remove clutch cover and clutch disk (M/T models). Refer to CL-18, "Removal and Installation".
3. Remove flywheel (M/T models) or drive plate (A/T or CVT models). Refer to EM-94, "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 Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

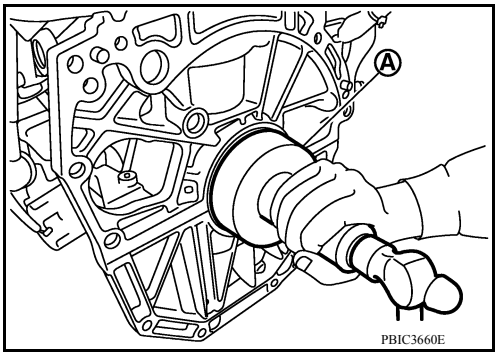
2. Install rear oil seal so that each seal lip is oriented as shown.

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



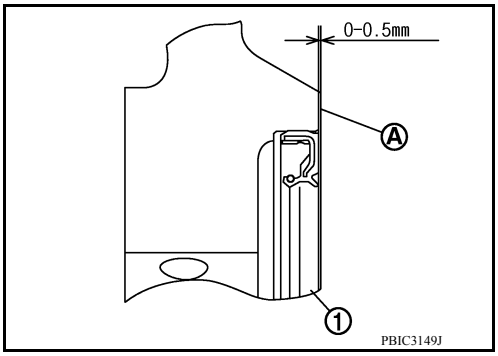
- Press-fit rear oil seal with a suitable drift (A) outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in).

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



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

(A) : Rear end surface of cylinder block
(b) : 0 - 0.5 mm (0 - 0.020 in)



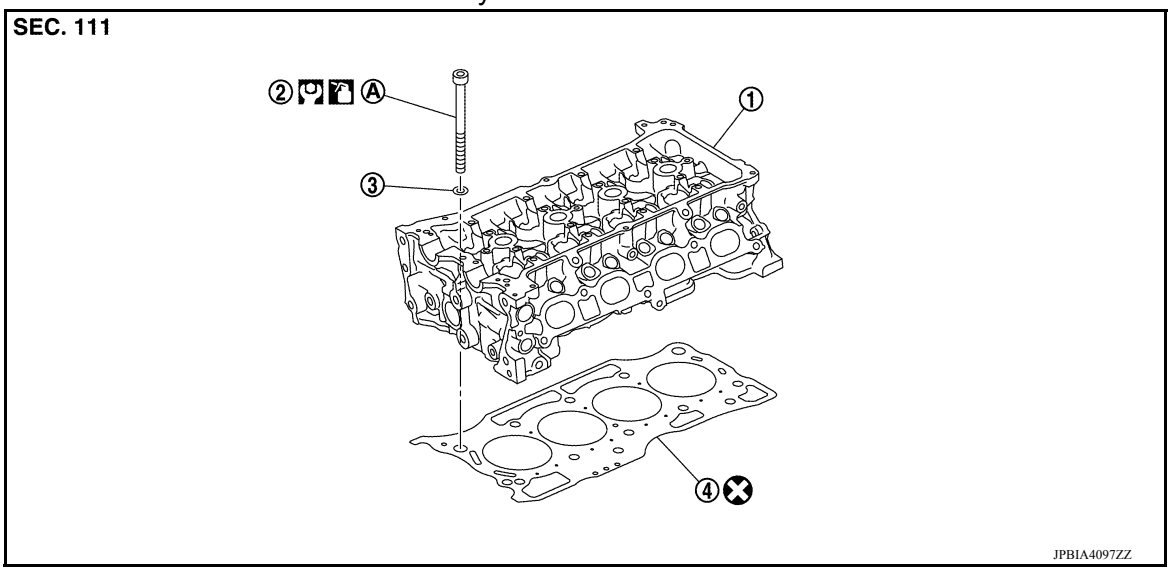
3. Installation of the remaining components is in the reverse order of removal.

CYLINDER HEAD

Exploded View

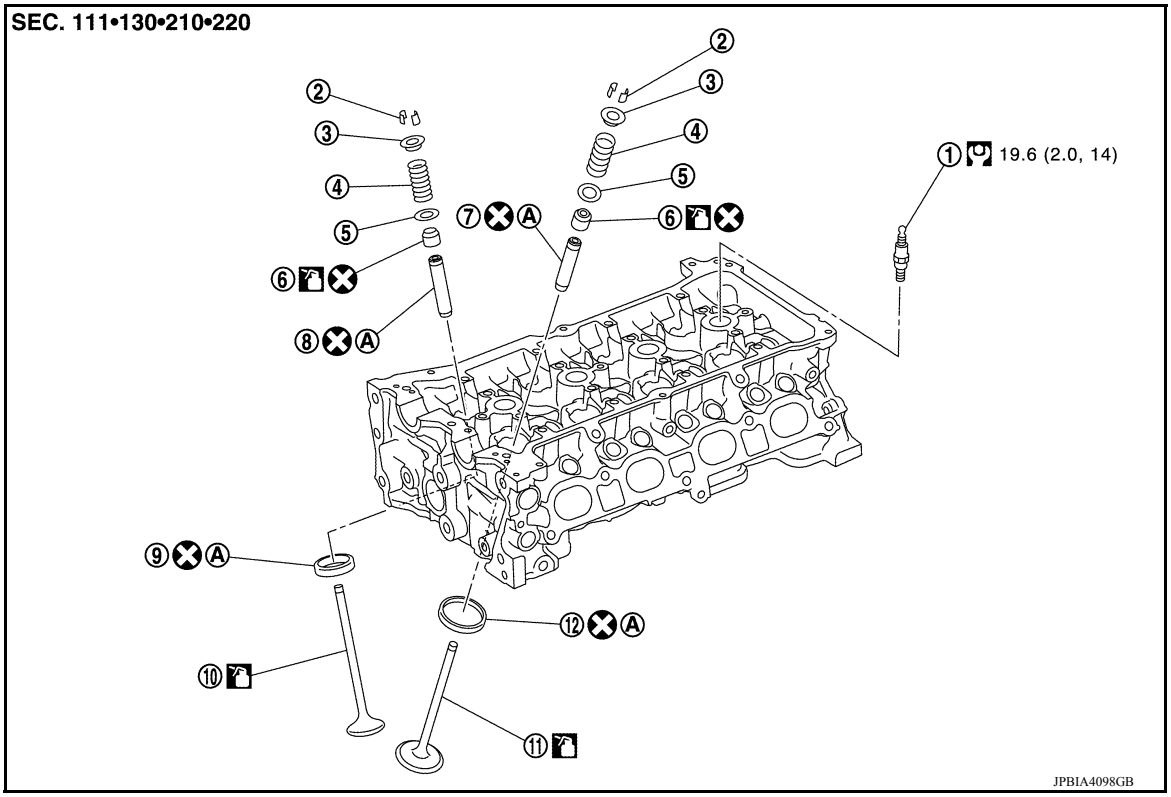
INFOID:0000000009266665

Cylinder Head Bolts



1. Cylinder head assembly
2. Cylinder head bolt
3. Washer
4. Cylinder head gasket
A. Refer to EM-74

Valve Components



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. Refer to EM-75

Removal and Installation

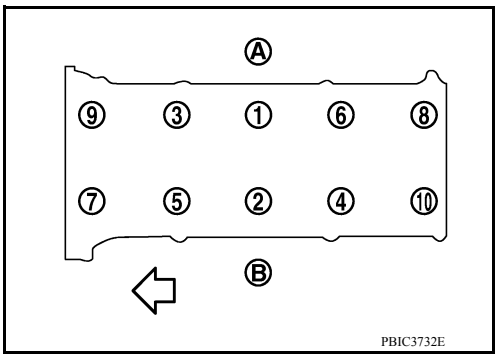
INFOID:0000000009266666

REMOVAL

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

1. Release fuel pressure. Refer to EC-133, "Work Procedure".
2. Remove the following components and related parts.
   - Air duct. Refer to EM-25, "Removal and Installation".
   - Fuel tube and fuel injector. Refer to EM-37, "Exploded View".
   - Water outlet. Refer to CO-25, "Removal and Installation".
   - Exhaust manifold. Refer to EM-30, "Exploded View".
   - Front cover and timing chain. Refer to EM-47, "Exploded View".
   - Camshaft. Refer to EM-56, "Exploded View".
3. Remove cylinder head loosening bolts in reverse order as shown.

(A) : EXH side
(B) : INT side
⇦ : Engine front

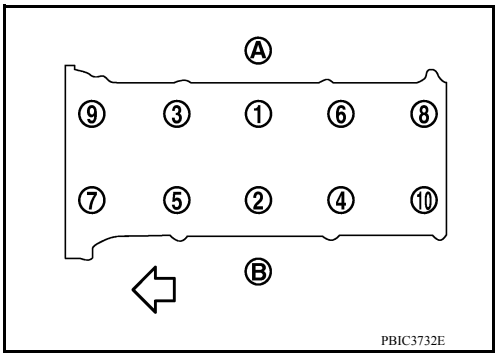


4. Remove cylinder head gasket.

INSTALLATION

1. Install new cylinder head gasket.
2. Tighten cylinder head bolts in numerical order as shown.

(A) : EXH side
(B) : INT side
⇦ : Engine front



CAUTION:
If cylinder head bolts are reused, check their outer diameters before installation. Refer to EM-76, "Inspection".

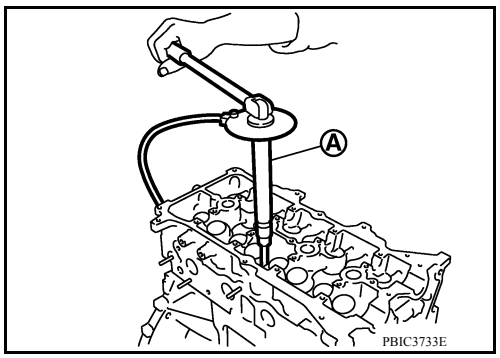
a. Apply new engine oil to threads and seating surfaces of bolts.
b. Tighten all bolts.

Cylinder head bolts : 40.0 N·m (4.1 kg-m, 30 ft-lb)

c. Turn all bolts 60 degrees clockwise (angle tightening) using Tool (A) in the specified order.

CAUTION:
Check and confirm the tightening angle by using Tool (A) or protractor. Avoid judgment by visual inspection without the tool.

Tool number : KV10112100 (BT-8653-A)



d. Completely loosen all bolts.

Cylinder head bolts : 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:
In this step, loosen bolts in reverse order of that indicated as shown.

e. Tighten all bolts.

Cylinder head 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. Installation of the remaining components is in the reverse order of removal.

Disassembly and Assembly

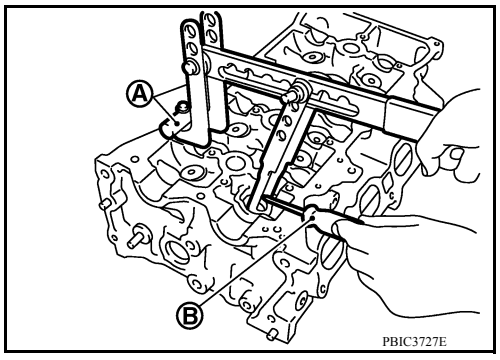
INFOID:0000000009266667

DISASSEMBLY

1. Remove spark plug with a suitable tool.
2. Remove valve lifter.
   - Identify installation positions, and store lifters without mixing them up.
3. Remove valve collet.
   - Compress valve spring with Tool (A). Remove valve collet with a magnet tool (B).

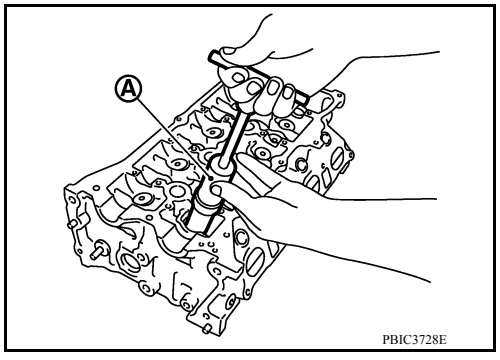
CAUTION:
Be careful not to damage valve lifter holes.

Tool number : KV10116200 (J-26336-B)
: KV10115900 (J-26336-20)
: KV10109220 (—)



4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
   - Identify installation positions, and store without mixing them up.
6. Remove valve oil seal using Tool (A).

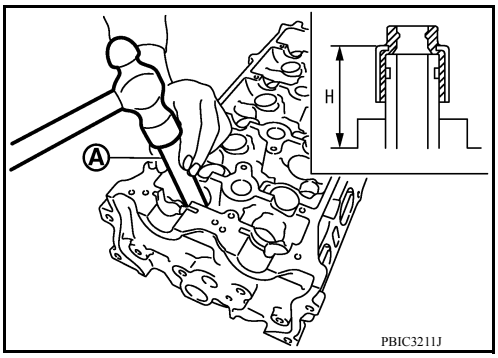
Tool number : KV10107902 (J-38959)



7. Remove valve spring seat.
8. When valve seat must be replaced, refer to EM-76, "Inspection" for removal.
9. When valve guide must be replaced, refer to EM-76, "Inspection" for removal.

ASSEMBLY

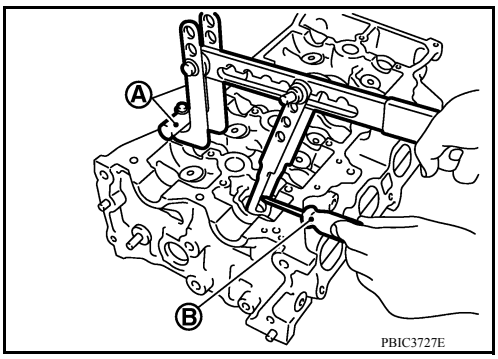
1. Install valve guide if removed. Refer to EM-76, "Inspection".
2. Install valve seat if removed. Refer to EM-76, "Inspection".
3. Install valve oil seal.
   - Install with Tool (A) to match dimension as shown.



Height "H" : 13.2 - 13.8 mm (0.520 - 0.543 in)

Tool number : KV10115600 (J-38958)

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 Tool (A). Install valve collet with a magnet hand (B).
     CAUTION:
     Be careful not to damage valve lifter holes.
   - Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



Tool number : KV10116200 (J-26336-B)
: KV10115900 (J-26336-20)
: KV10109220 (—)

9. Install valve lifter.
10. Install spark plug with a suitable tool.

Inspection

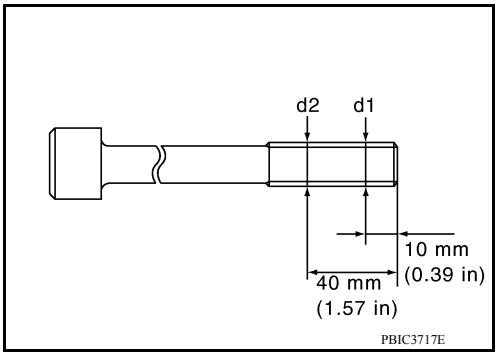
INFOID:0000000009266668

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)



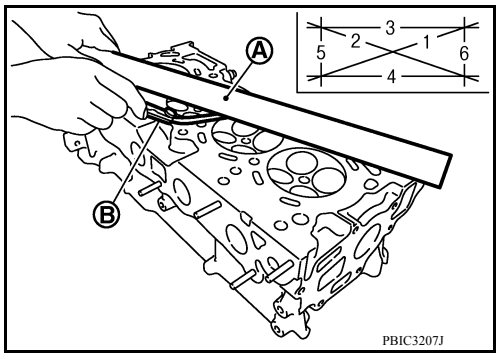
- If reduction of outer diameter appears in a position other than "d2", use it as "d2" point.

Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to EM-103, "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-120, "Cylinder head".

- If it exceeds the limit, replace cylinder head.

INSPECTION AFTER DISASSEMBLY

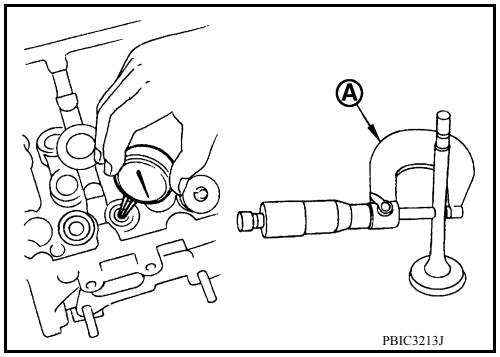
VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to EM-120, "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-120, "Cylinder head".

Valve Guide Inner Diameter

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

Standard : Refer to EM-120, "Cylinder head".

Valve Guide Clearance

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

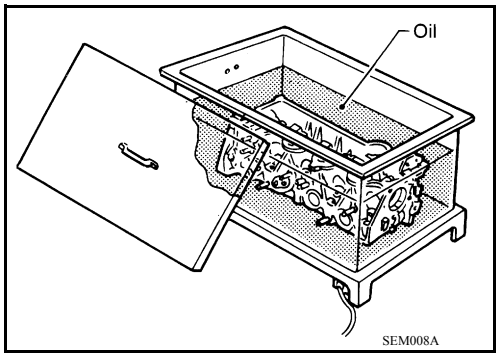
Standard and Limit : Refer to EM-120, "Cylinder head".

- If the calculated value exceeds the limit, replace valve and/or valve guide. Refer to EM-75, "Disassembly and Assembly".

VALVE GUIDE REPLACEMENT

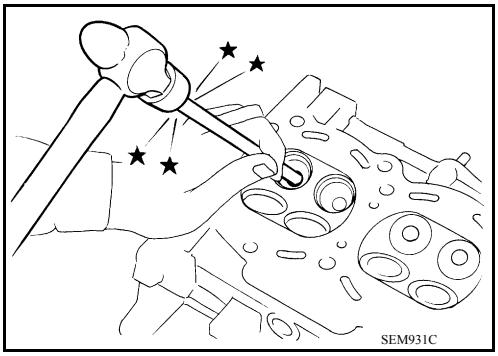
When valve guide is removed, replace with oversized [0.2 mm (0.008 in)] valve guide.

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



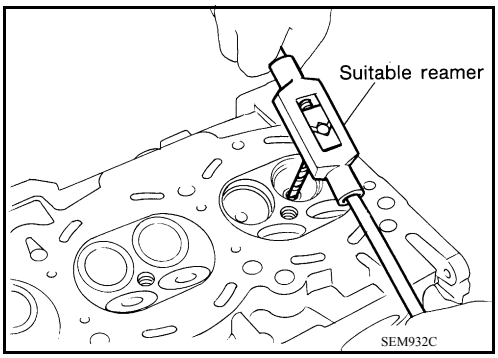
2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 lmp ton) force] or suitable tool.

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

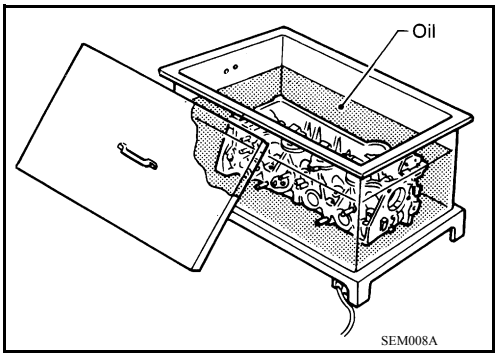


3. Ream cylinder head valve guide hole with a suitable tool.

Valve guide hole diameter (for service parts):
Intake and exhaust
: 9.175 - 9.201 mm (0.3612 - 0.3622 in)



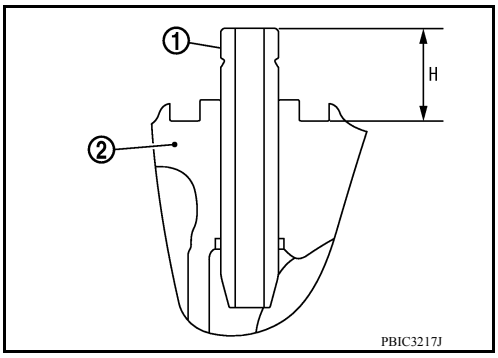
4. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



5. Using a suitable tool, press valve guide (1) from camshaft side to dimensions as shown.

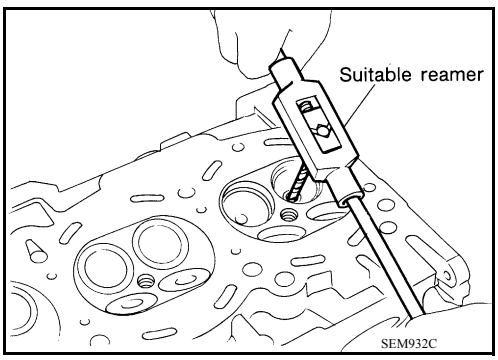
Projection "H": : 11.4 - 11.8 mm (0.448 - 0.464 in)

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



6. Apply reamer finish to valve guide with a suitable tool.

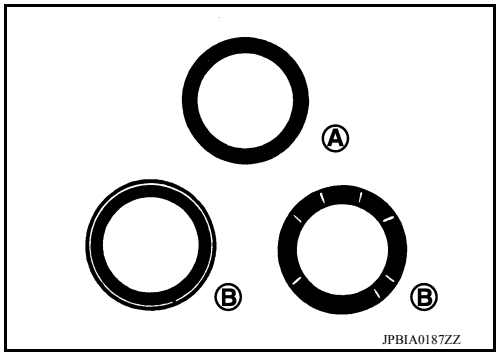
Standard
5.000 - 5.018 mm (0.1968 - 0.1975 in)



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-75, "Disassembly and Assembly".

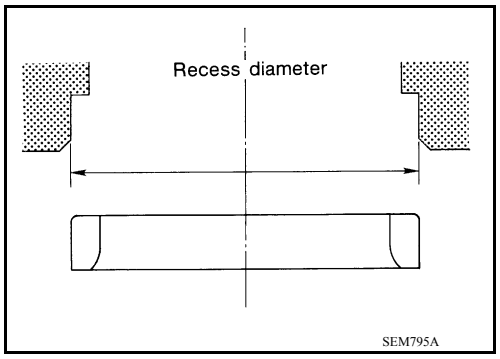
VALVE SEAT REPLACEMENT

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

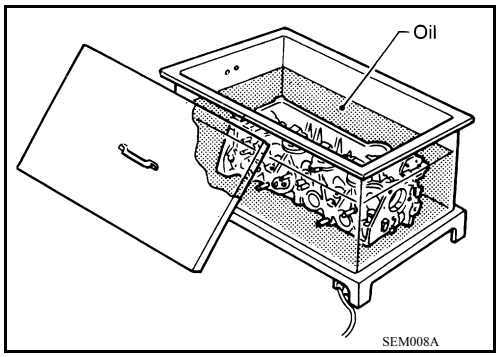
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to MA-12, "Fluids and Lubricants".
   CAUTION:
   Prevent scoring cylinder head by excessive boring.
2. Ream cylinder head recess diameter for service valve seat.

   Oversize [0.5 mm (0.020 in)]
   Intake : 32.500 - 32.527 mm (1.2795 - 1.2805 in)
   Exhaust : 26.400 - 26.427 mm (1.0393 - 1.0404 in)

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

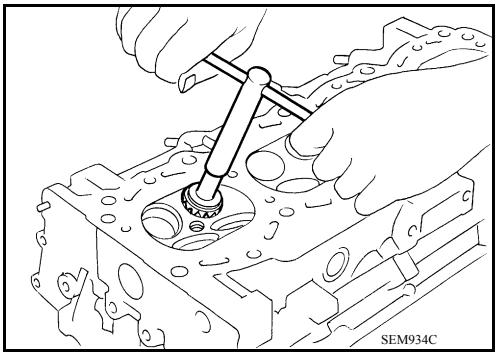


3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



4. Provide valve seats cooled well with dry ice. Press-fit valve seats into cylinder head.
   WARNING:
   Cylinder head contains heat; when working, wear protective equipment to avoid getting burned.
   CAUTION:
   Avoid directly touching cold valve seats.

5. Using a suitable tool a valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to MA-12, "Fluids and Lubricants".
CAUTION:
When using a valve seat cutter, firmly grip the cutter handle with both hands. Then, press the contacting surface evenly around the valve seat to cut in a single attempt. Improper pressure or cutting several times may result in wavy valve seat.



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

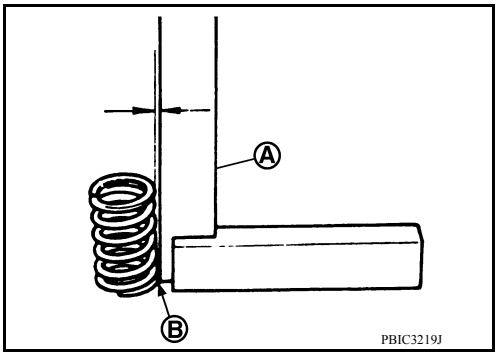
VALVE SPRING SQUARENESS

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

(B) : Contact

Limit : Refer to EM-120, "Cylinder head".

- If it exceeds the limit, replace valve spring.

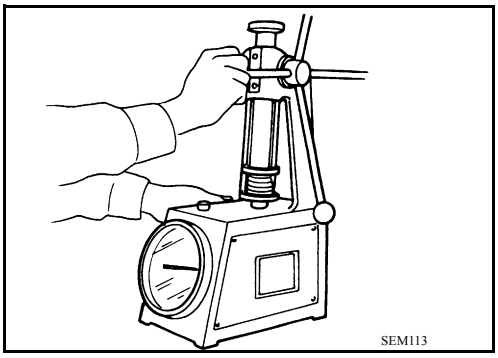


VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure with valve spring seat installed at the specified spring height.
CAUTION:
Do not remove valve spring seat from valve spring.

Standard : Refer to EM-120, "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

- 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-12, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

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

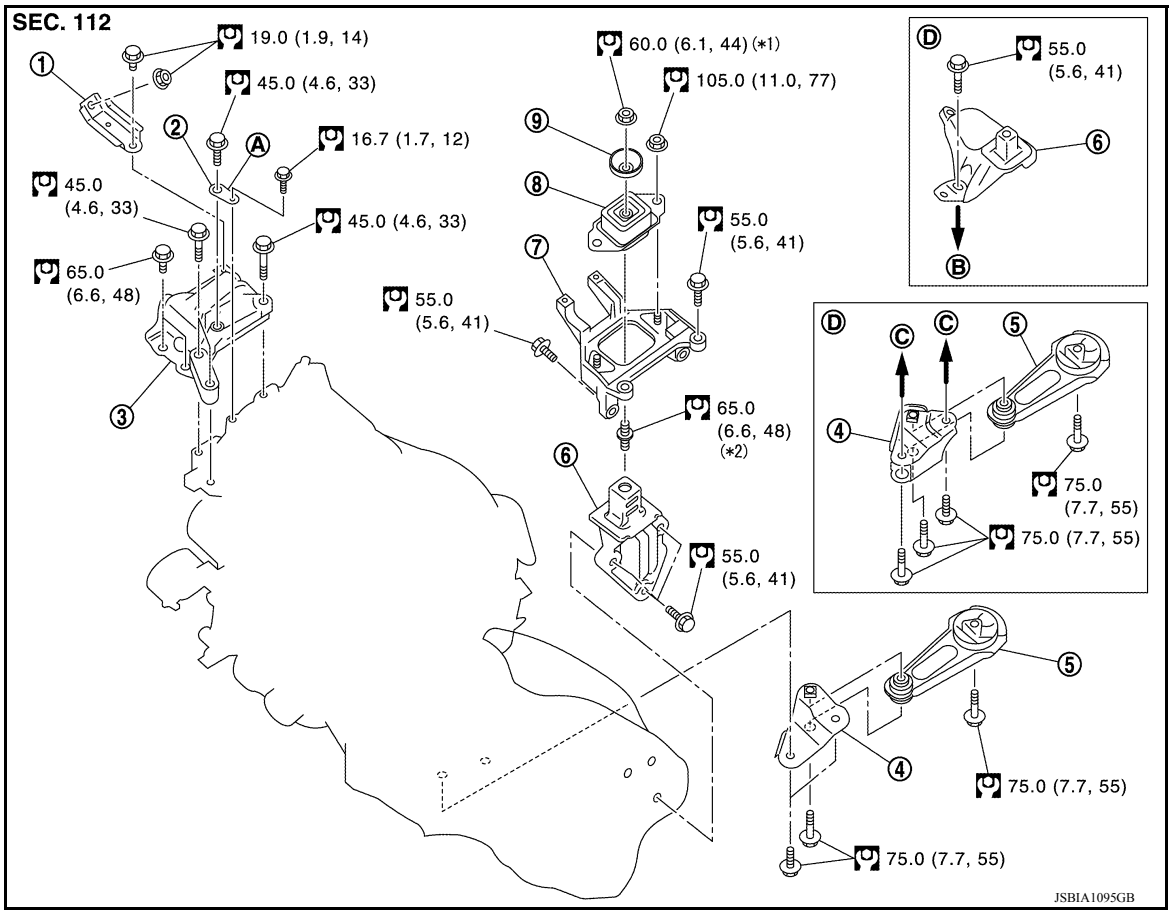
*Power steering fluid, brake fluid, etc.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:0000000009266669



1. Engine mounting (RH) stay
2. Engine mount (RH) stay
3. Engine mounting insulator (RH)
4. Rear engine mounting bracket
5. Rear torque rod
6. Engine mounting bracket (LH)
7. Engine mounting bracket (LH)
8. Engine mounting insulator (LH)
9. Mass damper
A. Front mark
B. Transaxle (upper)
C. Transaxle (lower)
D. M/T models

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

Removal and Installation

INFOID:0000000009266670

WARNING:
- **Position 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 is not already equipped.**

CAUTION:
- **Always be careful to work safely.**
- **Do not 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. If board-on type must be used, support 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-37, "2-Pole Lift".**

NOTE:
- When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.
- Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

REMOVAL

Preparation

1. Release fuel pressure. Refer to EC-133, "Work Procedure".
2. Drain engine coolant from radiator. Refer to CO-8, "Draining Engine Coolant".
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belts.**
3. Remove the following parts:
   - Front road wheels and tires (RH/LH).
   - Front fender protector (RH/LH). Refer to EXT-26, "Exploded View".
   - Drive belt: Refer to EM-16, "Removal and Installation".
   - Battery and battery tray. Refer to CHG-28, "Exploded View".
   - Air duct (inlet), air duct, and air cleaner case assembly. Refer to EM-25, "Removal and Installation".
   - Radiator hose (upper and lower). Refer to CO-14, "Exploded View".
   - Exhaust front tube. Refer to EX-5, "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 against foreign materials during the operation by wrapping in a plastic bag.
2. Disconnect heater hoses. Refer to CO-14, "Exploded View".
3. Disconnect fuel feed hose at engine side. Refer to EM-37, "Removal and Installation".
4. Disconnect control linkage cable from transaxle. Refer to TM-23, "Removal and Installation" (M/T models), TM-236, "Removal and Installation" (A/T models), TM-432, "Removal and Installation" (CVT models).
5. Disconnect clutch tube on transaxle side from clutch damper. Refer to CL-14, "Exploded View".

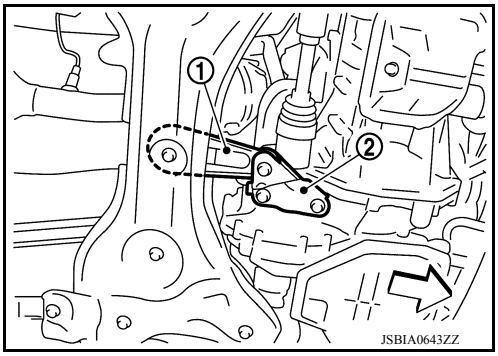
Engine Room (RH)

1. Remove alternator. Refer to CHG-28, "Exploded View".
2. Disconnect vacuum hose at engine side.
3. Remove EVAP hoses at engine side.
4. Remove air conditioner compressor from the engine with the piping connected. Temporarily position 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/LH). Refer to FAX-15, "Exploded View".

3. Remove rear torque rod (1).

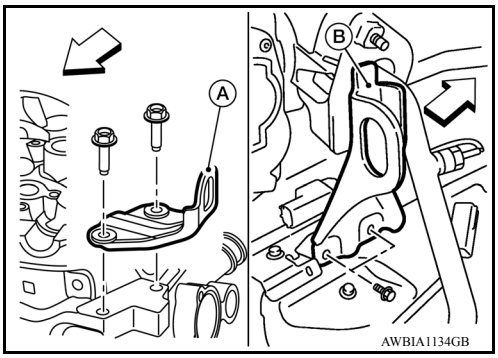


(2) : Rear engine mounting bracket
⇦ : Front

4. Preparation for the work of transaxle is as follows:
• Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to EM-82, "Exploded View".

Removal

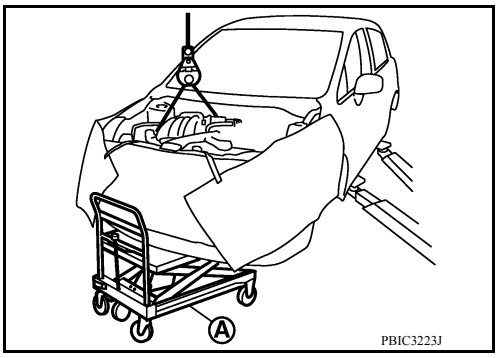
1. When engine can be hoisted, install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a suitable tool.



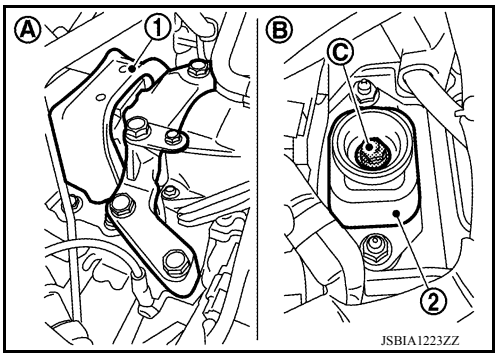
⇦ : Engine front

Slinger (A) bolts : 65.0 N·m (6.6 kg-m, 48 ft-lb)
Slinger (B) bolts : 25.0 N·m (2.6 kg-m, 18 ft-lb)

2. Use a suitable tool (A) to securely support the bottom of the engine and the transaxle assembly.
CAUTION:
Put a piece of wood or an equivalent as the supporting surface and secure in a stable condition.



3. Remove engine mounting insulator (RH) (1).



(2) : Engine mounting insulator (LH)
(A) : Engine front side
(B) : Transaxle side

4. Remove engine through bolt-securing nut (C).

5. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. Observe the following cautions:
CAUTION:
- **Check that no part interferes with the vehicle side.**
- **Before and during lifting, always check if any harnesses are left connected.**

- **During 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-30, "Exploded View".
2. Lift with a hoist and separate the engine from the transaxle assembly. Refer to TM-27, "Exploded View" (M/T models), TM-250, "Exploded View" (A/T models), TM-452, "Exploded View" (CVT models).

INSTALLATION

Installation is in the reverse order of removal.

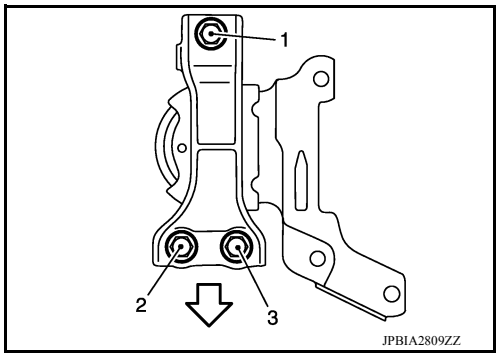
CAUTION:

- **Do not 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 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-82, "Exploded View".**

Engine Mounting Insulator (RH)

- Tighten bolts in the numerical order as shown.

⇦ : Front



INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-12, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

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

*Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

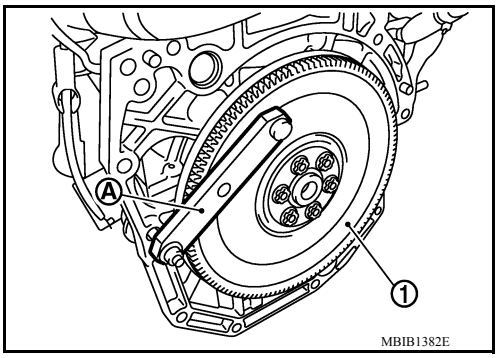
INFOID:0000000009266671

NOTE:
The following procedures explain how to disassemble the engine with the engine stand fastened to the bell housing. Some steps may be different if using a different type of engine stand.

1. Install engine to engine stand:

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

Tool number : KV11105210 (J-44716)



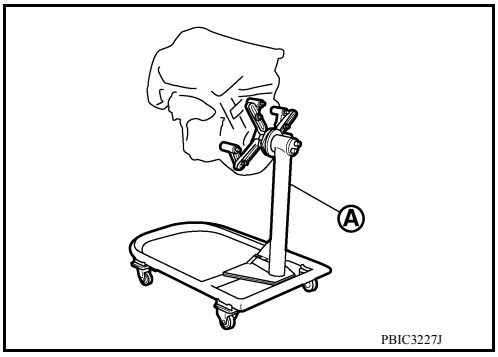
CAUTION:
- **Do not disassemble flywheel.**
- **Do not place flywheel or drive plate with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch it.**
- **Handle signal plate in a manner that prevents it from becoming magnetized.**

b. Lift the engine with a hoist to install it onto a suitable tool.

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-27, "Exploded View".
- Exhaust manifold. Refer to EM-30, "Removal and Installation".
- Rocker cover. Refer to EM-44, "Exploded View".

NOTE:
The figure shows an example of widely used engine stand (A) that can support the mating surface of transaxle with flywheel removed.

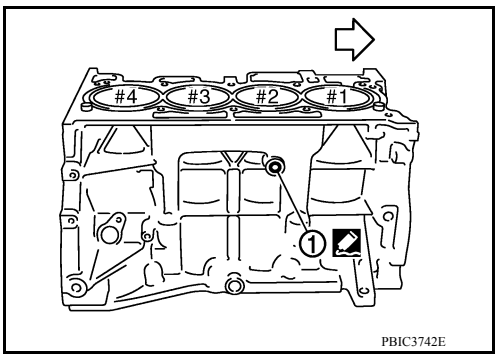


CAUTION:
Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.

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

CAUTION:
- **Be sure to clean drain plug and install with new drain plug washer.**
- **Do not reuse drain plug washer.**

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



⇦ : Engine front

Water drain plug tightening torque : **Refer to EM-94, "Exploded View".**

Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

ENGINE UNIT

Disassembly

INFOID:0000000009266672

1. Remove intake manifold. Refer to EM-27, "Exploded View".
2. Remove exhaust manifold. Refer to EM-30, "Exploded View".
3. Remove oil pan (lower). Refer to EM-33, "Exploded View".
4. Remove ignition coil, spark plug, and rocker cover. Refer to EM-44, "Exploded View".
5. Remove fuel injector and fuel tube. Refer to EM-37, "Exploded View".
6. Remove front cover and timing chain. Refer to EM-47, "Exploded View".
7. Remove camshaft. Refer to EM-56, "Exploded View".
8. Remove cylinder head. Refer to EM-73, "Exploded View".

Assembly

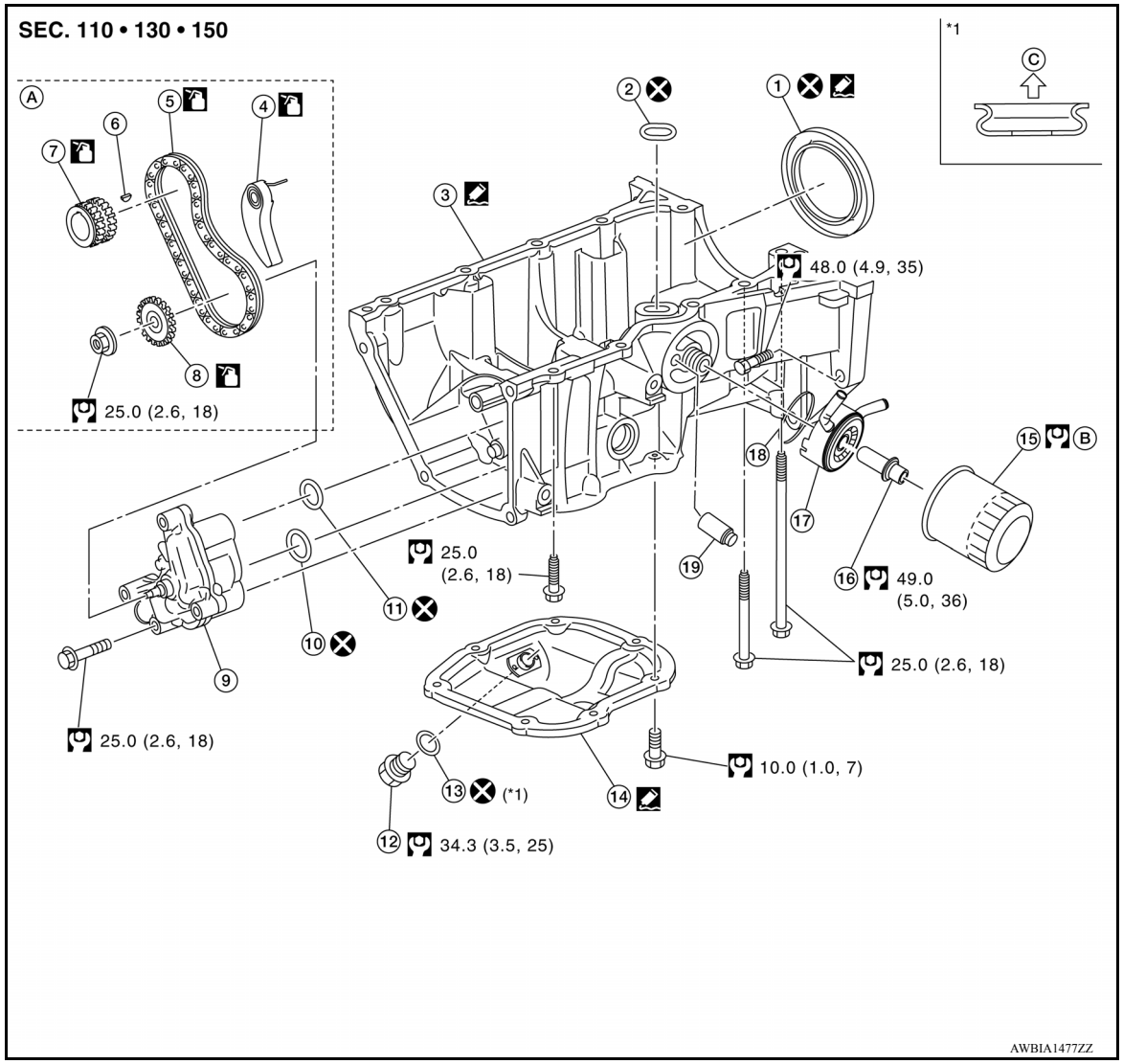
INFOID:0000000009266673

Assembly is in the reverse order of disassembly.

OIL PAN (UPPER) AND OIL STRAINER

Exploded View

INFOID:0000000009266674



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. Connector bolt
17. Oil cooler
18. O-ring
19. Relief valve
A. Refer to EM-47
B. Refer to LU-11
C. Oil pan (lower) side

Removal and Installation

INFOID:0000000009266675

NOTE:
The oil strainer is included in the oil pan (upper) and cannot be removed.

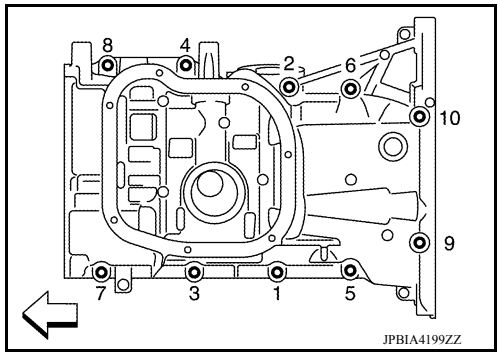
REMOVAL

1. Remove the oil pan (lower). Refer to EM-33, "Exploded View".

2. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to EM-47, "Exploded View".
3. Remove oil pan (upper).

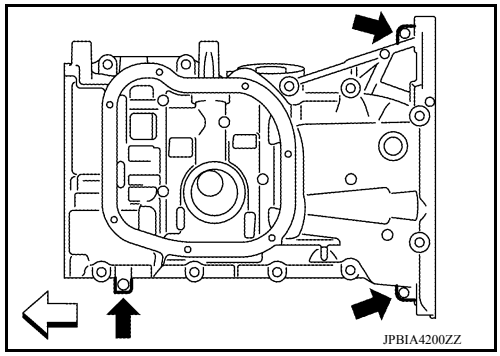
a. Loosen oil pan (upper) bolts in the reverse of the order as shown.

⇦ : Engine front



b. Insert a suitable tool into the arrow (⬅) as shown and open up a crack between the oil pan (upper) cylinder block.

⇦ : Engine front



c. Insert the Tool between the oil pan (upper) and cylinder block. Slide Tool by tapping on the side of Tool with a hammer.

Tool number : KV10111100 (J-37228)

CAUTION:
- **Be careful not to damage the mating surface.**
- **The liquid gasket used at the factory is very strong. Pry only in the areas shown.**
- **Do not remove oil pump and oil strainer from oil pan (upper).**

4. Remove rear oil seal from crankshaft.

INSTALLATION

CAUTION:
Do not reuse O-rings or washers.

1. Install the oil pan (upper):

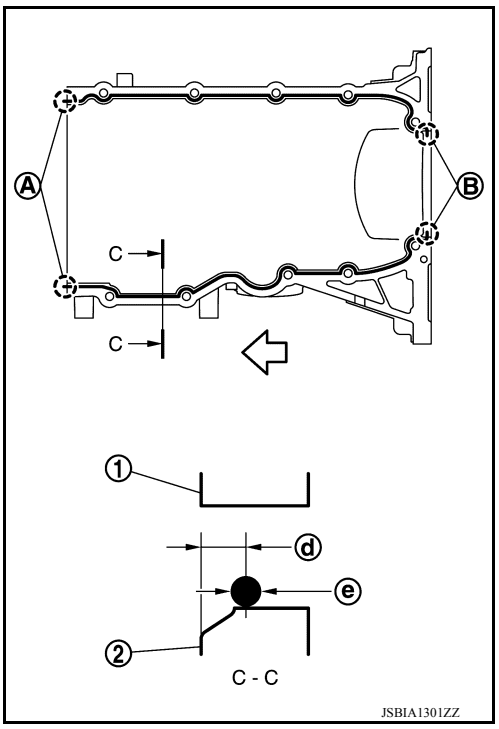
a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove the old liquid gasket from mating surface of cylinder block.
- Remove old liquid gasket from the bolt holes and threads.

CAUTION:
Do not 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 with the Tool or suitable tool to areas as shown.
Use Genuine Silicone RTV Sealant or equivalent. Refer to **GI-21, "Recommended Chemical Products and Sealants"**.

(1) : Cylinder block
(2) : Oil pan (upper)
(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) : 4.0 - 5.0 mm (0.157 - 0.197 in) diameter
⇦ : Engine front side

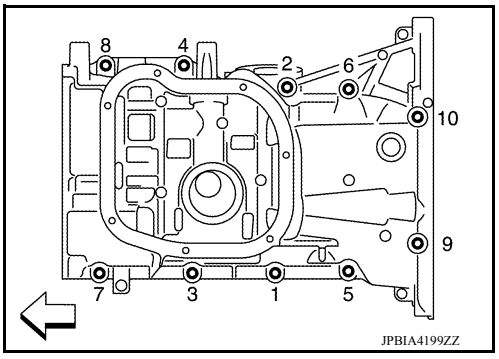


CAUTION:
Attaching should be done within 5 minutes after coating.

d. Tighten bolts in the numerical order as shown.

⇦ : 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.



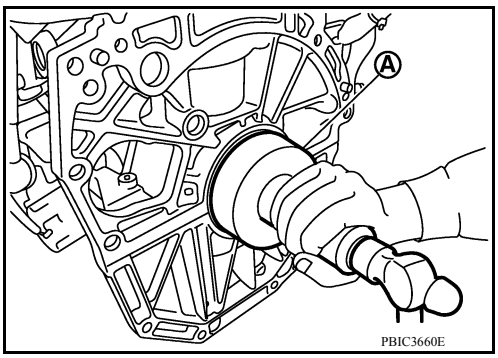
M8×180 mm (7.09 in) : No. 9, 10
M8×25 mm (0.98 in) : No. 4, 7, 8
M8×90 mm (3.54 in) : No. 1, 2, 3, 5, 6

2. Install rear oil seal:
CAUTION:
- **The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).**
- **Do not touch oil seal lip.**

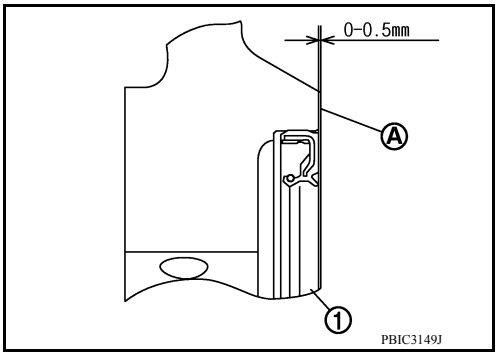
a. Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a suitable tool.

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.



(1) : Rear oil seal
(A) : Rear end surface of cylinder block

CAUTION:
- **Do not 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 and 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. Installation of the remaining components is in the reverse order of removal.
4. Add the specified oil after waiting for at least 30 minutes. Refer to MA-12, "Fluids and Lubricants".

CAUTION:
- **The components must be installed within 5 minutes of the liquid gasket application.**
- **Allow 30 minutes for the liquid gasket to set before adding oil to the engine.**

INSPECTION AFTER INSTALLATION

- Before starting engine, check oil/fluid levels, including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-12, "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 and installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

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

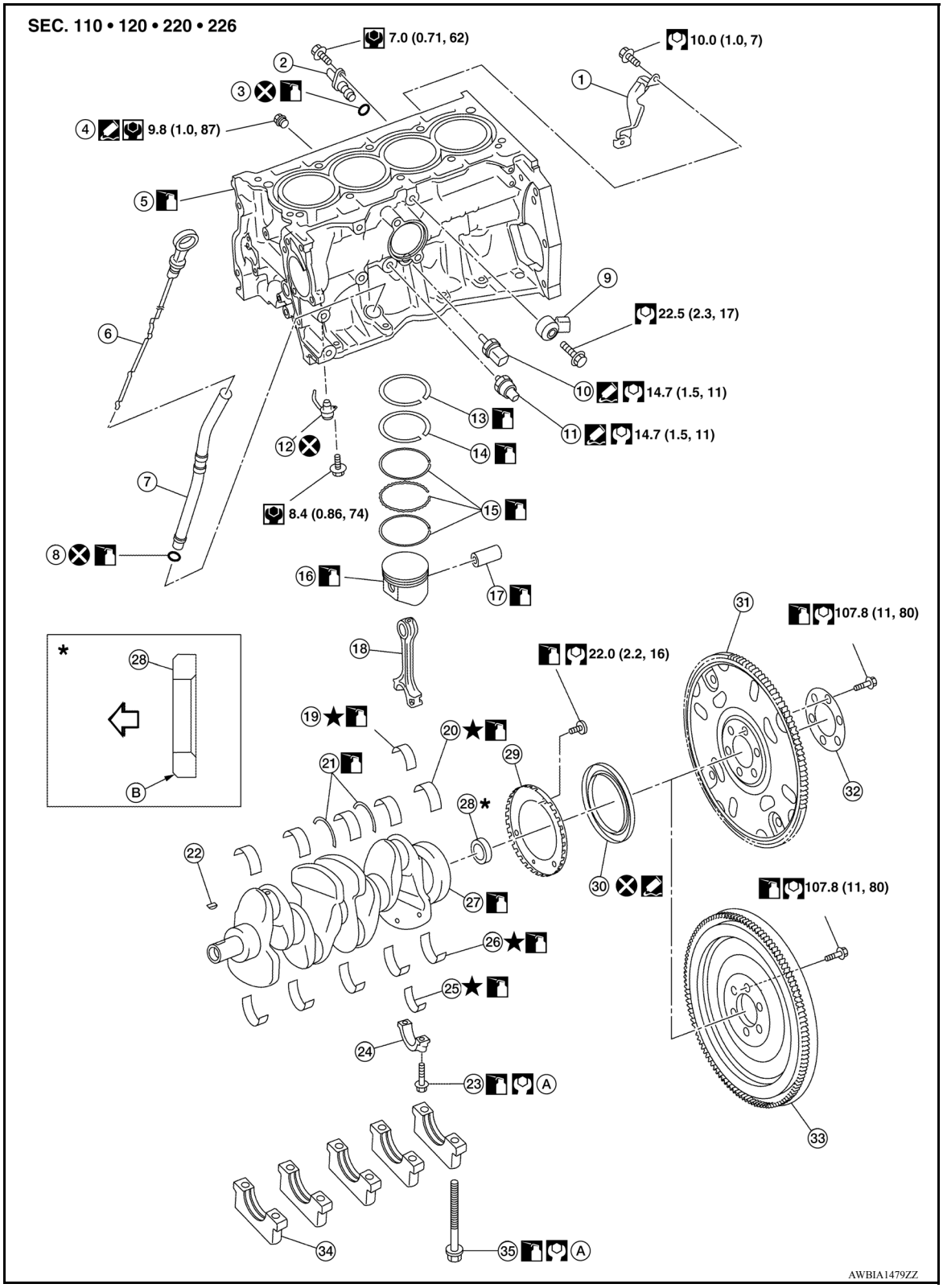
Item	Before starting engine	Engine running	After engine stopped
Fuel	Leakage	Leakage	Leakage
Exhaust gas	—	Leakage	—

*Power steering fluid, brake fluid, etc.

CYLINDER BLOCK

Exploded View

INFOID:0000000009266676



1. Crankshaft position sensor 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 (A/T and CVT models)
29. Signal plate
30. Rear oil seal
31. Drive plate (A/T and CVT models)
32. Reinforce plate (A/T and CVT models)
33. Flywheel (M/T models)
34. Main bearing cap
35. Main bearing cap bolt
A. Refer to EM-95
B. Chamfered
⇦ : Crankshaft side

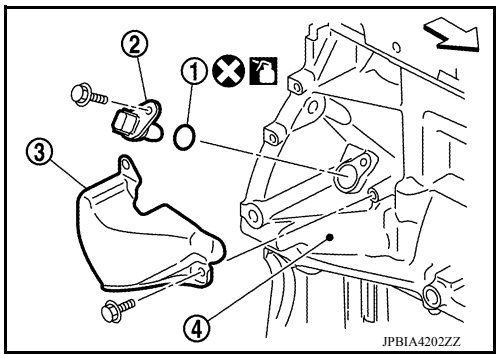
Disassembly and Assembly

INFOID:0000000009266677

DISASSEMBLY

NOTE:
The following procedures explain how to disassemble the engine with the engine stand fastened to the bell housing. Some steps may be different if using a different type of engine stand.

1. Remove cylinder head. Refer to EM-73, "Exploded View".
2. Remove knock sensor.
   CAUTION:
   Carefully handle knock sensor avoiding shocks.
3. Remove the crankshaft position sensor cover (3), and then crankshaft position sensor (POS) (2).

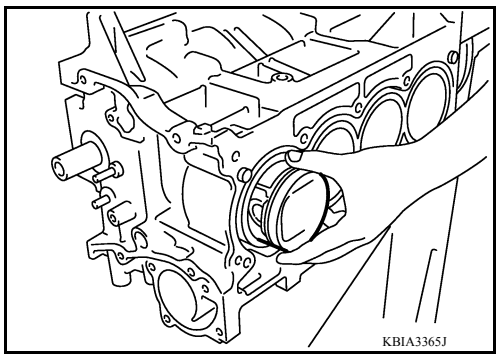


(1) O-ring
(4) Cylinder block
⇦ : Engine front

CAUTION:
- **Avoid impacts such as a dropping.**
- **Do not disassemble.**
- **Keep sensor away from metal particles.**
- **Do not place the sensor in a location where it is exposed to magnetism.**
- **Do not reuse O-ring.**

4. Remove oil pan (upper and lower). Refer to EM-89, "Exploded View".
5. Remove piston and connecting rod assembly:
   - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-103, "Inspection".

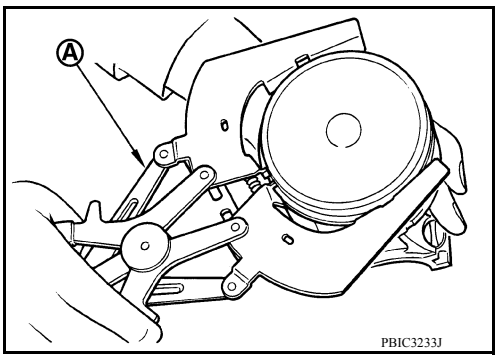
a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
b. Remove connecting rod cap.
c. Using a hammer handle or similar tool, push piston and connecting rod assembly out through the cylinder head side.
   CAUTION:
   - **Be careful not to damage mating surface with connecting rod cap.**
   - **Be careful not to damage the cylinder wall or crankshaft pin.**



6. Remove connecting rod bearings.
   CAUTION:
   Identify original positions for installation, and store the bearings without mixing them up.

7. Remove piston rings from piston.
   - Before removing piston rings, check the piston ring side clearance. Refer to EM-103, "Inspection".
   - Use a suitable tool) (A) as shown.

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

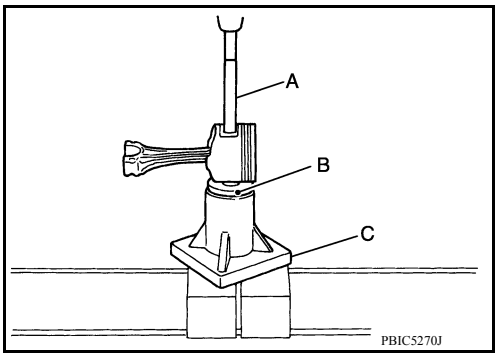


8. Remove piston from connecting rod.
   - Use a Tools (A, B, C) and a press to remove the piston pin.

   Tool Number (A) : KV10109730
   (B) : KV10110310
   (C) : ST13030020

   CAUTION:
   - **Do not damage the piston and connecting rod.**
   - **Do not reuse piston and piston pin after removing piston pin from connecting rod.**
   - **The connecting rod is reusable.**

   NOTE:
   The joint between the connecting rod and the piston pin is a press fit.

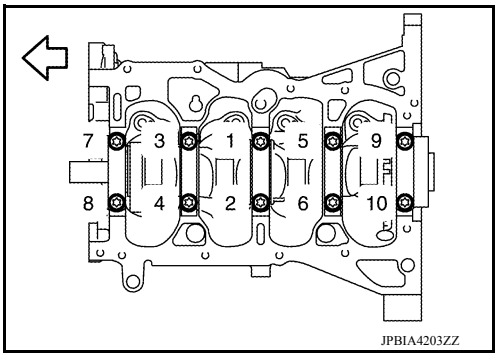


9. Remove the main bearing cap.
   - Measure crankshaft end play before loosening main bearing cap bolts. Refer to EM-103, "Inspection".

a. Loosen and remove bolts in several steps in reverse of the numerical order as shown.

   ⇦ : Engine front

   NOTE:
   When removing or installing signal plate, use socket (size T40).

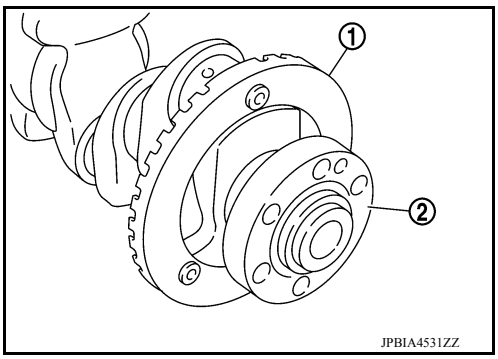


b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

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.**
    - **Do not remove signal plate unless it is necessary to do so.**

    NOTE:
    When removing or installing signal plate, use 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 caps.

    CAUTION:

Identify original installation positions, and store the bearings 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 bolt.

ASSEMBLY

CAUTION:
Do not reuse O-rings.

1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

WARNING:
Use goggles to protect your eyes.

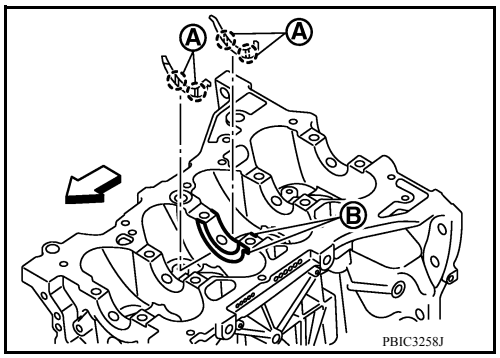
2. Install oil jets.
3. Install main bearings and thrust bearings:

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

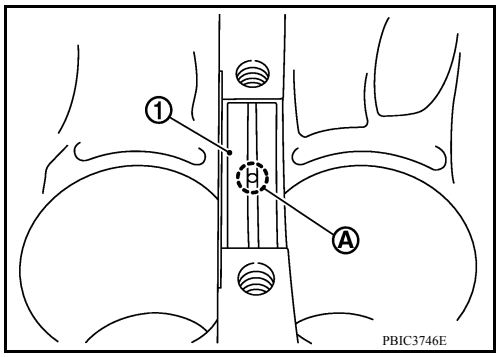
b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

⇦ : Engine front

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



c. Install the main bearings paying attention to the direction.
- 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.
- When installing, align main bearing to the center position of cylinder block and main bearing cap.
- Ensure the oil holes on cylinder block and oil holes (A) on the main bearings (1) are aligned.
  NOTE:
  For assembly, the center position can be visually identified.
- To install the main bearing, obtain a proper fit. Do not allow the main bearing to lie off the cylinder block chamfer.
- To install the main bearing, obtain a proper fit. Do not allow the main bearing to lie off bearing cap chamfer.



4. Install signal plate to crankshaft if removed.

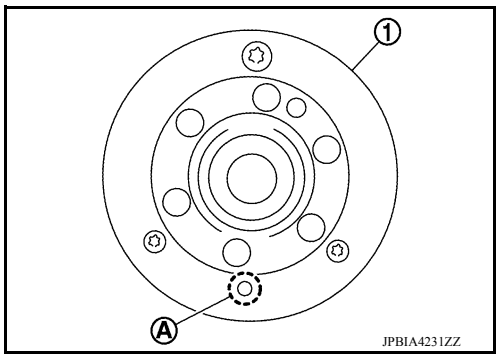
a. Set the signal plate (1) with the flange facing toward the counterweight side (engine front side) to the crankshaft rear surface.

(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.

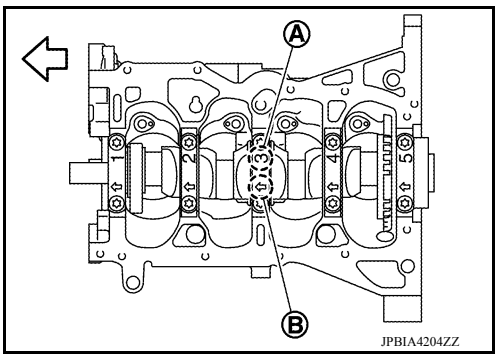


5. Install crankshaft to cylinder block.

• While turning crankshaft by hand, check that it turns smoothly.

CAUTION:
Do not install rear oil seal at this time.

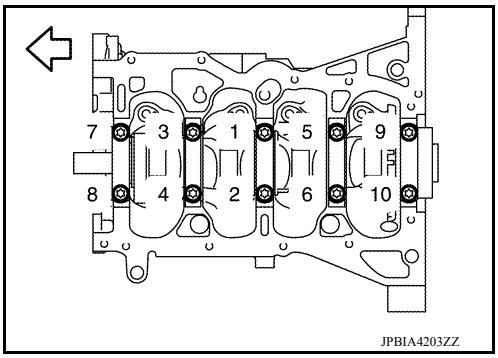
6. Install main bearing caps.
   • Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).



⇦ : Engine front

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

7. Tighten main bearing cap bolts in numerical order as shown with the following steps:



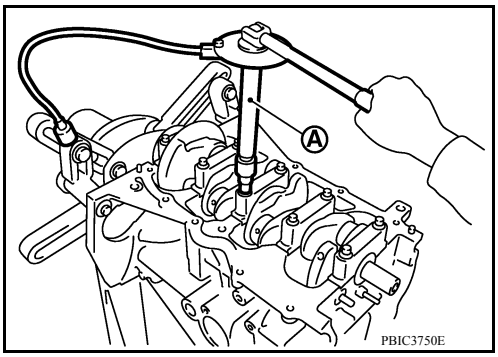
⇦ : Engine front

a. Apply new engine oil to threads and seat surfaces of the bolts.
b. Tighten main bearing cap bolts in numerical order.

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.

CAUTION:
Check and confirm the tightening angle by using the Tool (A) or protractor. Avoid judgment by visual inspection without the Tool.

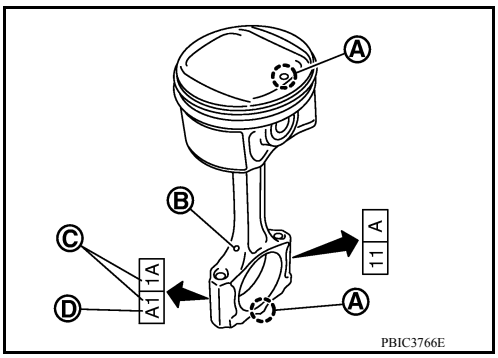


Tool number : KV10112100 (BT-8653-A)

• After installing the main bearing cap bolts, check that crankshaft can be rotated smoothly by hand.
• Check crankshaft end play. Refer to EM-103, "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.

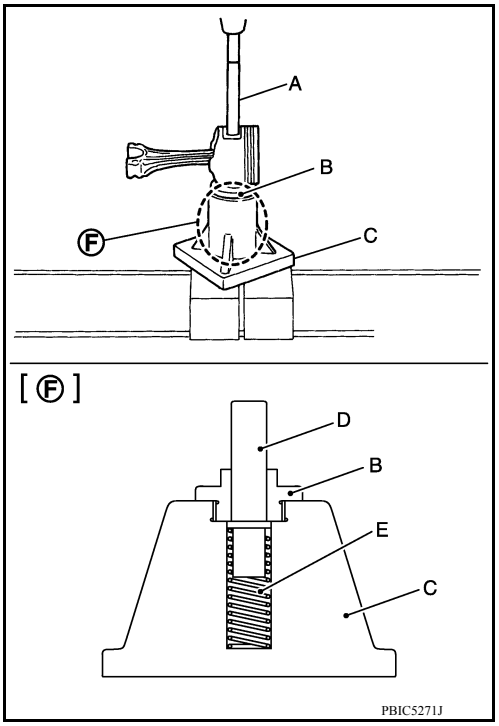


(B) : Oil hole
(D) : Connecting rod big end grade

NOTE:
The symbols without notes are for manufacturing.

b. Press-fit the piston pin using the Tools (A, B, C, D, E).

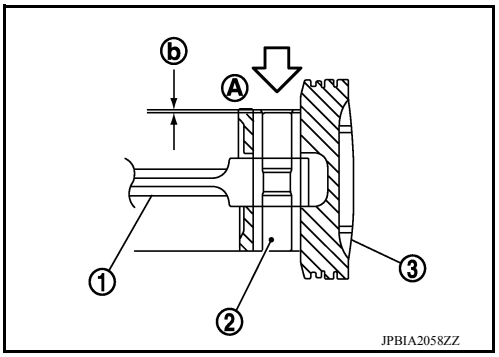
Tool number (A) : KV10109730
(B) : KV10110310
(C) : ST13030020
(D) : KV10114120
(E) : ST13030030
(F) : Detail



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.

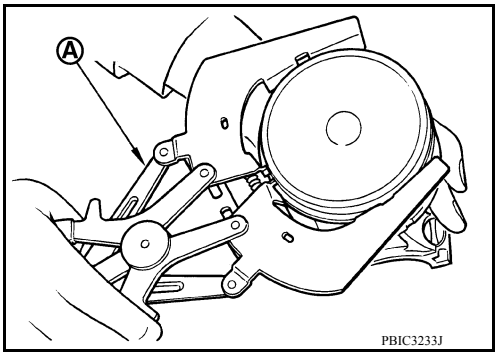
- Press-fit the piston pin (2) from piston surface (A) to the depth of 2.35 mm (0.092 in) (b).

(1) : Connecting rod
⇦ : Press-fit direction



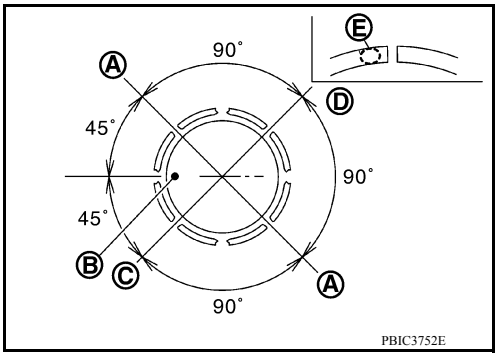
- After finishing work, check that the piston (3) moves freely.

9. Using suitable tool (A), install piston rings.
CAUTION:
- **Be careful not to damage piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



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

(A) : Oil ring upper or lower rail gap (either of them)
(C) : Second ring and oil ring spacer gap
(D) : Top ring gap



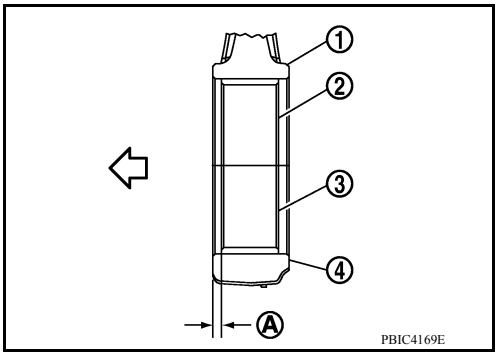
- Install second ring with the stamped mark (E) facing upward.

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 (A) as shown.

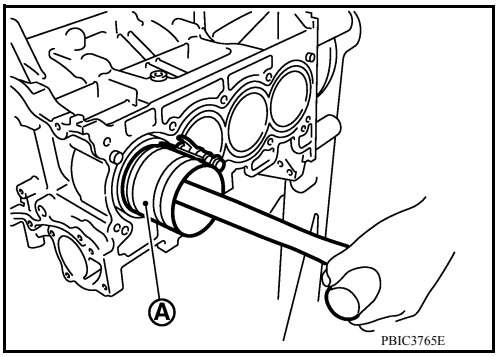


(1) : Connecting rod
(2) : Connecting rod bearing (upper)
(3) : Connecting rod bearing (lower)
(4) : Connecting rod cap
(A) : 1.7 - 2.1 mm (0.067 - 0.083 in)
⇦ : Engine front

NOTE:
Install the connecting rod bearing in the center position with the dimension as shown. For service operation, the center position can be checked visually.

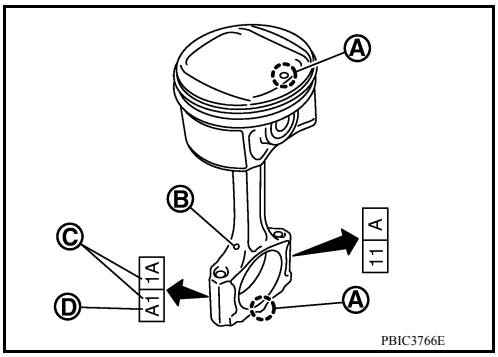
11. Install piston and connecting rod assembly to crankshaft.
    - Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
    - Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
    - Match the cylinder position with the cylinder number on connecting rod to install.
    - Using Tool (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 mating surface with connecting rod cap.**
      - **Be careful not to damage the cylinder wall or crankshaft pin.**

Tool number : EM03470000



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-103, "Inspection".
14. Tighten connecting rod bolt:

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

b. Tighten connecting rod bolts in several steps.

Connecting rod bolts : 27.4 N·m (2.8 kg-m, 20 ft-lb)

c. Completely loosen connecting rod bolts.

Connecting rod bolts : 0 N·m (0 kg-m, 0 ft-lb)

d. Tighten connecting rod bolts in several steps.

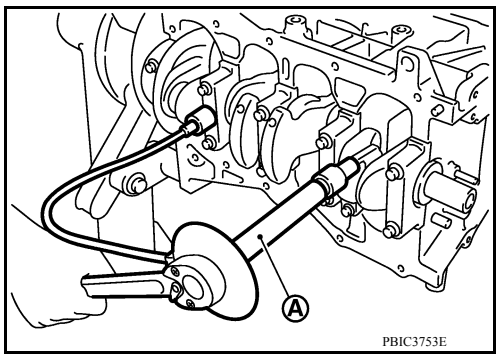
Connecting rod bolts : 19.6 N·m (2.0 kg-m, 14 ft-lb)

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

CAUTION:

Check and confirm the tightening angle by using the Tool (A) or protractor. Avoid judgement by visual inspection without the Tool.

Tool number : KV10112100 (BT-8653-A)



- After tightening connecting rod bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-103, "Inspection".

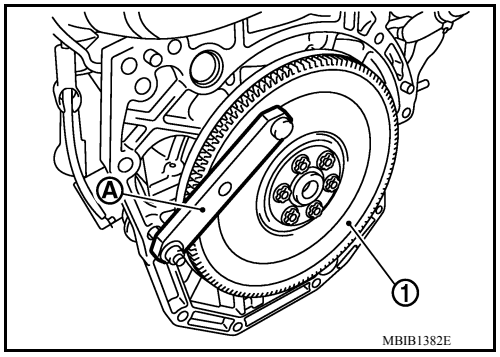
15. Install oil pan (upper). Refer to EM-89, "Exploded View".
    NOTE:
    Install the rear oil seal after installing the oil pan (upper).
16. Install rear oil seal. Refer to EM-71, "REAR OIL SEAL : Removal and Installation".
17. Install flywheel (M/T models) or drive plate (A/T and CVT models).

M/T models

- Secure crankshaft with a stopper plate (A) and tighten bolts crosswise over several times.

(1) :Flywheel

Tool number : KV11105210 (J-44716)

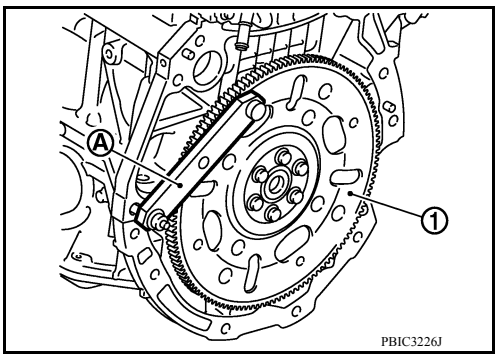


A/T and CVT models

- Secure crankshaft with a stopper plate (A) and tighten bolts crosswise over several times.

(1) :Drive plate

Tool number : KV11105210 (J-44716)



CAUTION:
Be careful not to damage or scratch and contact surface for clutch disc of flywheel.

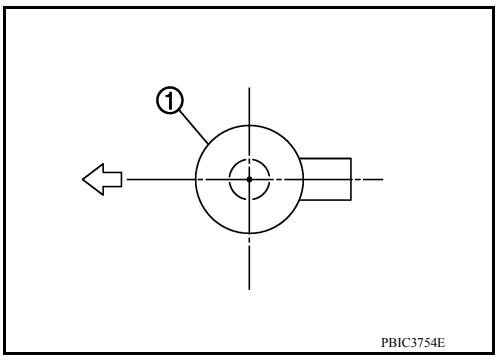
18. Install knock sensor (1).

⇦ : Engine front

- Install connectors so that they are positioned toward the rear of the engine.

CAUTION:
- **Do not tighten bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

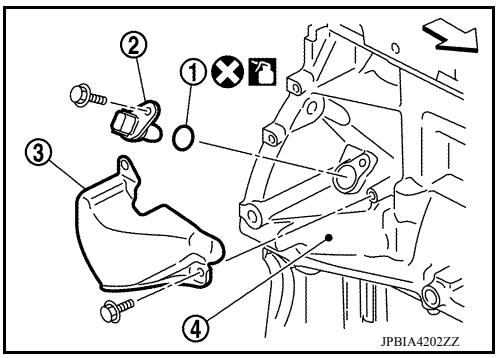
NOTE:
- Check that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Check that knock sensor does not interfere with other parts.



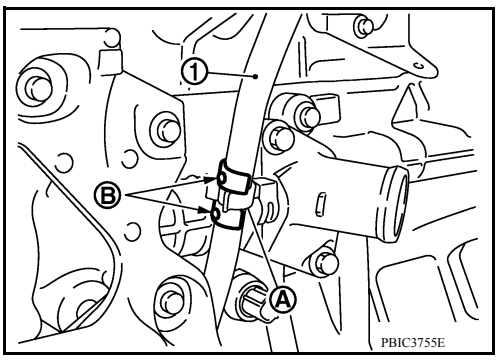
19. Install crankshaft position sensor (POS) (2) using a new O-ring (1) and then install the crankshaft position sensor cover (3) on the cylinder block (4).
- Tighten bolts with sensor inserted completely.

⇦ : Engine front

CAUTION:
- **Avoid impacts such as a dropping.**
- **Do not disassemble.**
- **Keep sensor away from metal particles.**
- **Do not place the sensor in a location where it is exposed to magnetism.**
- **Do not reuse O-ring.**



20. For the oil level gauge guide (1), secure in position (B) shown to the water inlet clip (A) after inserting to the cylinder block side.



21. Assembly of the remaining components is in the reverse order of disassembly.

Inspection

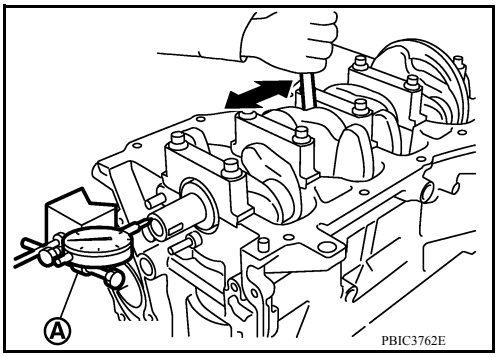
INFOID:0000000009266678

CRANKSHAFT END PLAY

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

Standard and Limit : Refer to EM-122, "Cylinder Block".

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

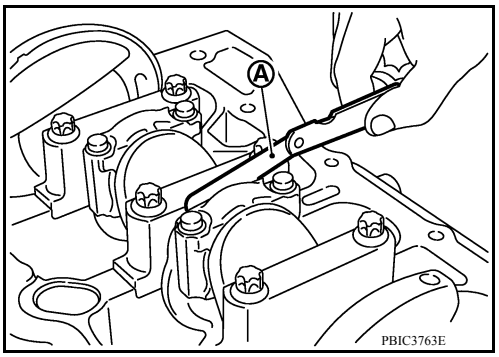


CONNECTING ROD SIDE CLEARANCE

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

Standard and Limit : Refer to EM-122, "Cylinder Block".

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

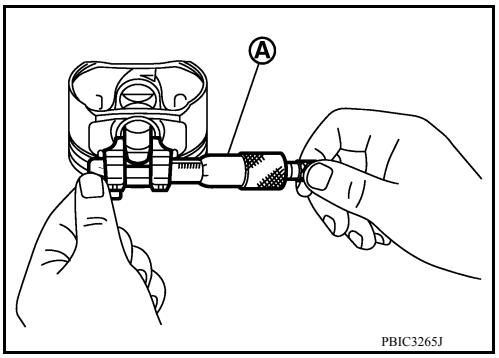


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an suitable tool (A).

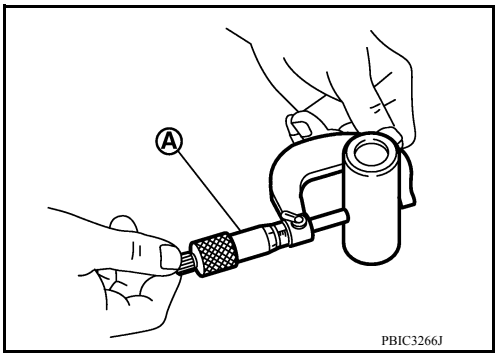
Standard : Refer to EM-122, "Cylinder Block".



Piston Pin Outer Diameter

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

Standard : Refer to EM-122, "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-122, "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-95, "Disassembly and Assembly".

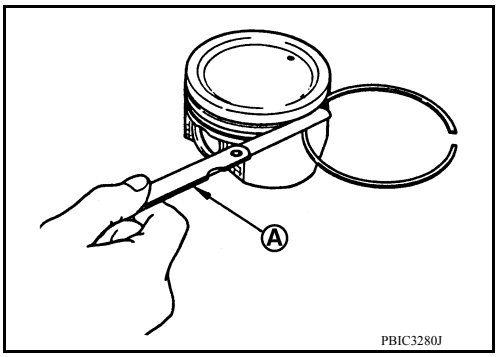
NOTE:
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the factory. For service parts, no grades can be selected. Only grade “0” is available.

PISTON RING SIDE CLEARANCE

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

Standard and Limit : Refer to EM-122, "Cylinder Block".

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

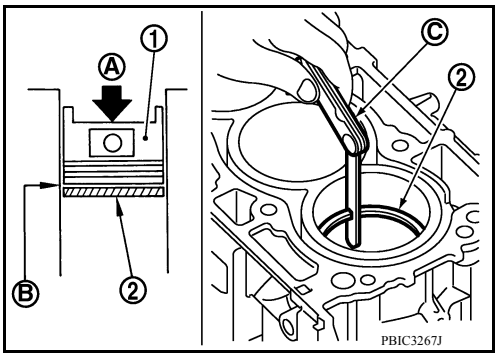


PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to “PISTON TO CYLINDER BORE CLEARANCE”.
- Lubricate piston (1) and piston ring (2) with new engine oil 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-122, "Cylinder Block".

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



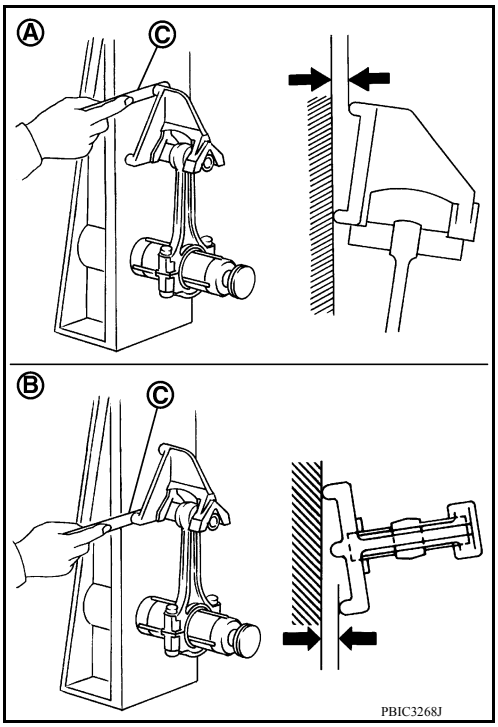
CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

(A) : Bend
(B) : Torsion
(C) : Feeler gauge

Limit : Refer to EM-122, "Cylinder Block".

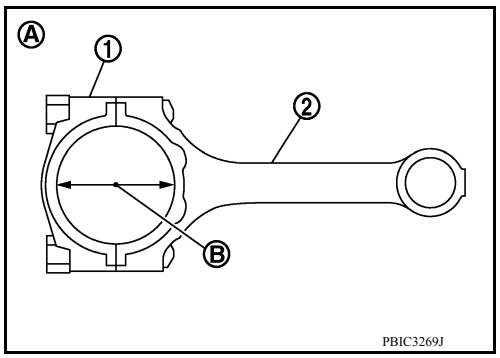
- If it exceeds the limit, replace connecting rod assembly.



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-94, "Exploded View".

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



- Measure the inner diameter (B) of connecting rod big end with a suitable tool.

Standard : Refer to EM-122, "Cylinder Block".

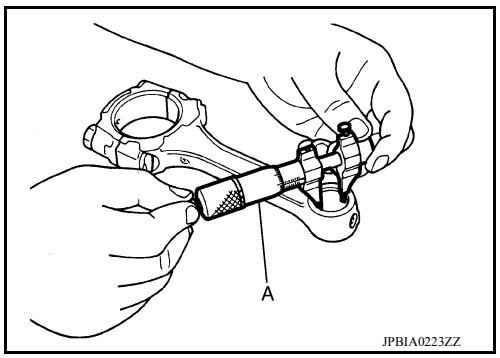
- If out of the standard, replace connecting rod assembly.

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with a suitable tool (A).

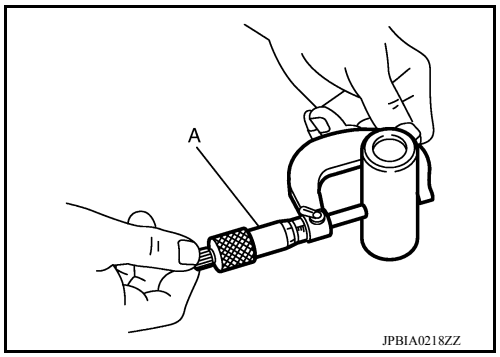
Inner diameter (Standard) : Refer to EM-122, "Cylinder Block".



Piston Pin Outer Diameter

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

Outer diameter (Standard) : Refer to EM-122, "Cylinder Block".



Connecting Rod Bushing Oil Clearance

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

Oil clearance (Standard and Limit) : Refer to EM-122, "Cylinder Block".

- If the measured value is out of the standard range, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to EM-122, "Cylinder Block".
- If replacing connecting rod assembly. Refer to EM-126, "Connecting Rod Bearing".

CYLINDER BLOCK TOP SURFACE DISTORTION

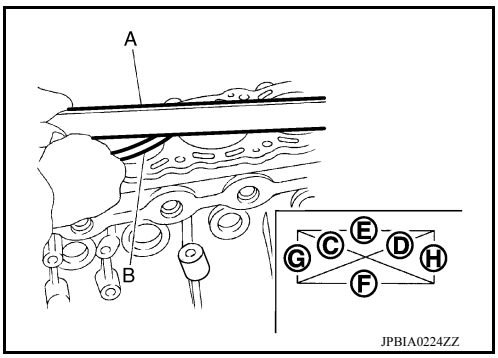
- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

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

- Measure the distortion on the cylinder block upper face at different points in six directions with a suitable tool (A) and (B).

Limit : Refer to EM-122, "Cylinder Block".

- If it exceeds the limit, replace cylinder block.

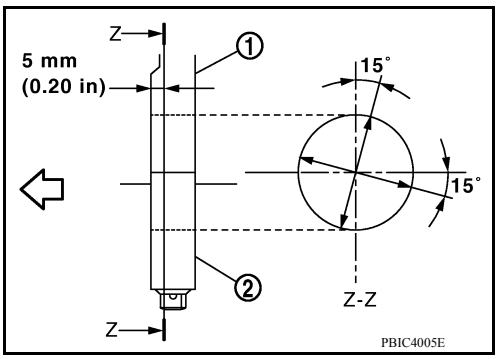


MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".
- Measure the inner diameter of main bearing housing with a suitable tool.
- Measure the position shown [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown. The smaller one is the measured value.

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

Standard : Refer to EM-122, "Cylinder Block".



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

NOTE:
Main bearing caps cannot be replaced individually, because they are machined together with cylinder block.

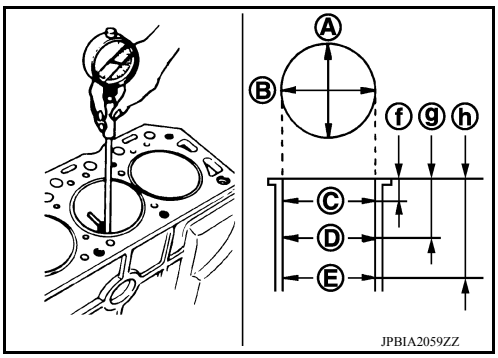
PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using a suitable tool, 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-122, "Cylinder Block".

Limit:
Out-of-round [Difference between (A) and (B)]
Taper [Difference between (C) and (E)]
: Refer to EM-122, "Cylinder Block".

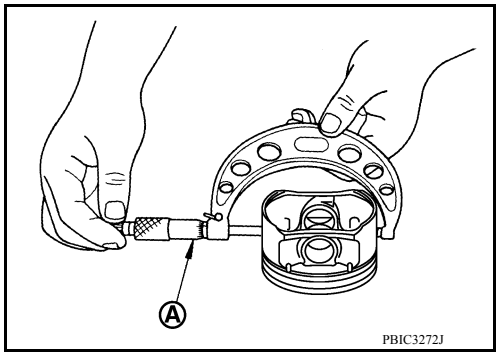
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

NOTE:
Oversize piston is not available.

Piston Skirt Diameter

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

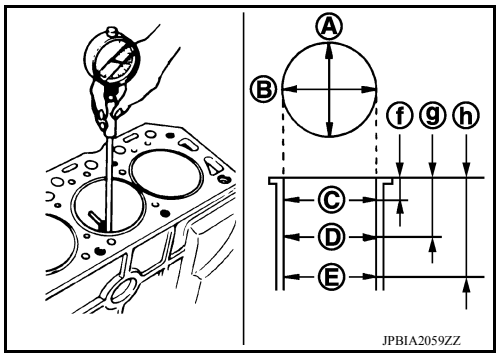
Standard : Refer to EM-122, "Cylinder Block".



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-122, "Cylinder Block".

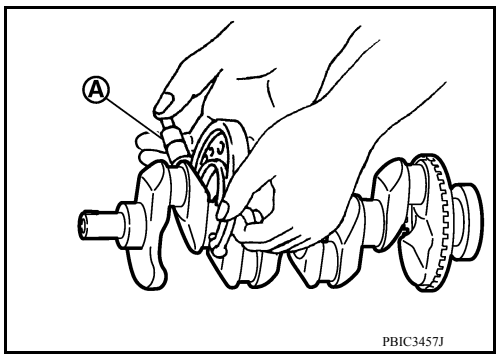
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to EM-122, "Cylinder Block".

CRANKSHAFT MAIN JOURNAL DIAMETER

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

Standard : Refer to EM-122, "Cylinder Block".

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-125, "Main Bearing".



CRANKSHAFT PIN JOURNAL DIAMETER

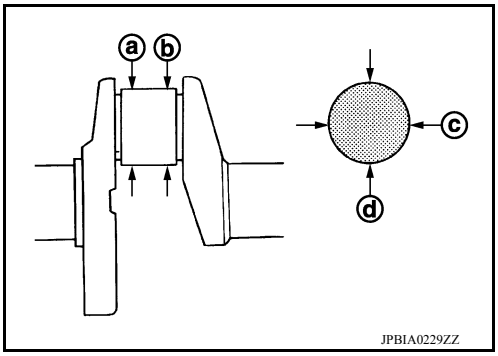
- Measure the outer diameter of crankshaft pin journal with a suitable tool.

Standard : Refer to EM-122, "Cylinder Block".

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-126, "Connecting Rod Bearing".

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure the dimensions at four different points as shown on each main journal and pin journal with a suitable tool.
- 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)]

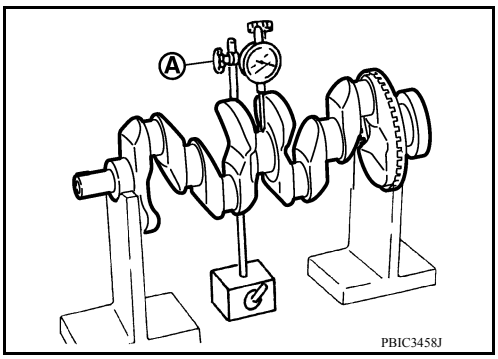
Taper [Difference between (c) and (d)]

: Refer to EM-122, "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-126, "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 both ends of the crankshaft.
- Place a suitable tool (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the suitable tool. (Total indicator reading)



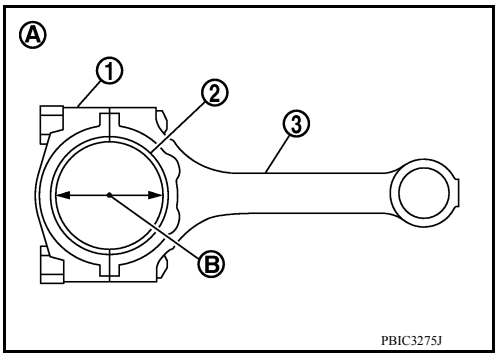
Standard and Limit : Refer to EM-122, "Cylinder Block".

- 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 cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".



(A) : Example

(B) : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with a suitable tool.
  (Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

Standard and Limit : Refer to EM-126, "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-126, "Connecting Rod Bearing".

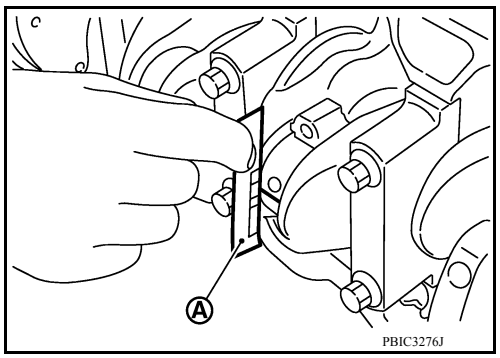
Method of Using Plastigage

- 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-95, "Disassembly and Assembly".

CAUTION:

Do not rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.
  NOTE:
  The procedure when the measured value exceeds the limit is same as that described in the “Method by Calculation”.

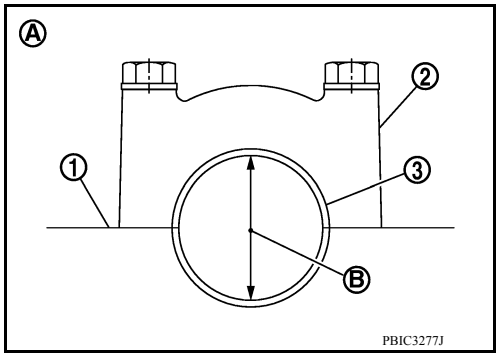


MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".

  (A) : Example
  (B) : Inner diameter measuring direction



- Measure the inner diameter (B) of main bearing (3) with a suitable tool.

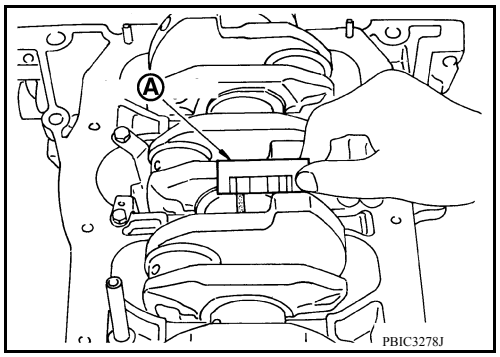
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard and Limit : Refer to EM-125, "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".

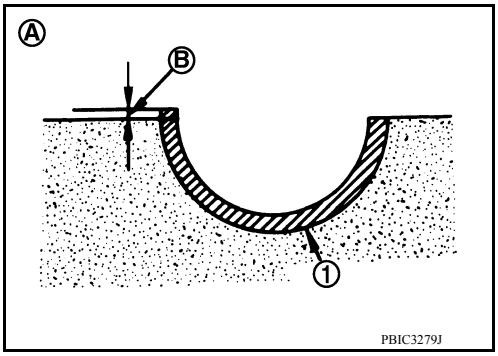
Method of Using Plastigage

- 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 bolts to the specified torque. Refer to EM-95, "Disassembly and Assembly".
  CAUTION:
  Do not 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-95, "Disassembly and Assembly".



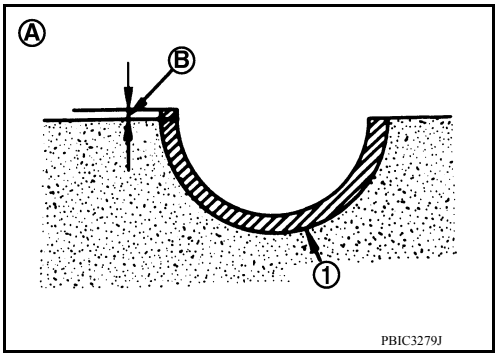
(A) : Example

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-95, "Disassembly and Assembly".



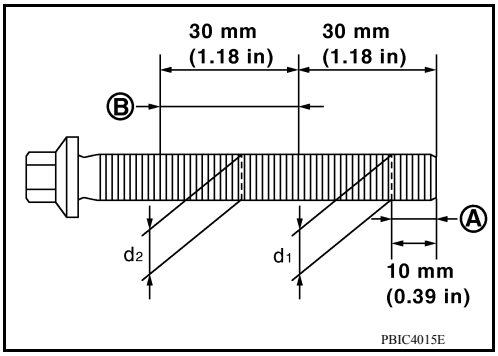
(A) : Example

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.



(A) : (d1) measuring position

(B) : (d2) measuring position

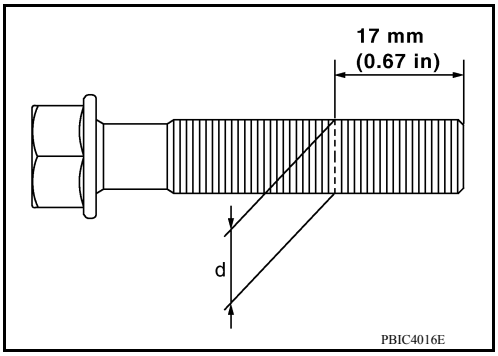
- If reduction appears in places other than (B) range, regard it as (d_2).

Limit [(d_1) – (d_2)]: 0.2 mm (0.0078 in)

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

CONNECTING ROD CAP BOLT OUTER DIAMETER

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



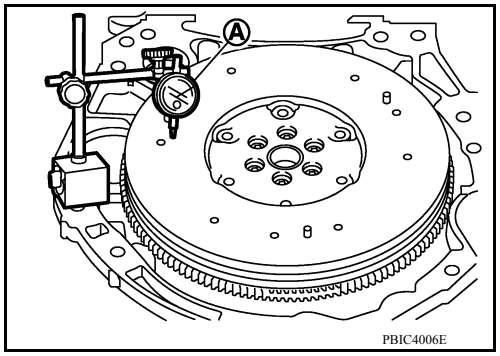
Limit: 7.75 mm (0.3051 in)

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

FLYWHEEL DEFLECTION (M/T models)

- Measure the deflection of flywheel contact surface to torque with a suitable tool (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, clean it with sandpaper.

CAUTION:

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

HOW TO SELECT PISTON AND BEARING

Description

INFOID:0000000009266679

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 for the appropriate part.

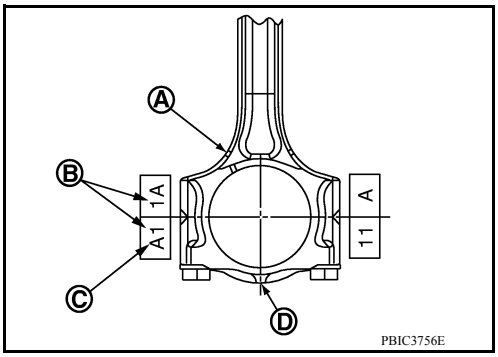
Connecting Rod Bearing

INFOID:0000000009266680

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

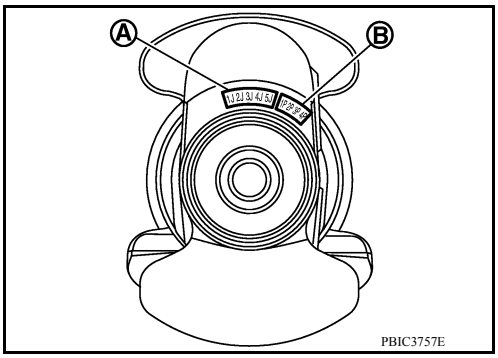
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the “Connecting Rod Bearing Selection Table”.

   (A) : Oil hole
   (B) : Cylinder number
   (D) : Front mark



2. Apply crankshaft pin journal diameter grade stamped 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-103, "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

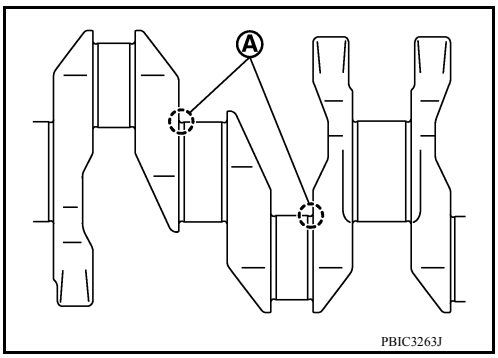
Connecting Rod Bearing Grade Table : Refer to EM-126, "Connecting Rod Bearing".

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-126, "Connecting Rod Bearing".

Main Bearing

INFOID:0000000009266681

HOW TO SELECT MAIN BEARING

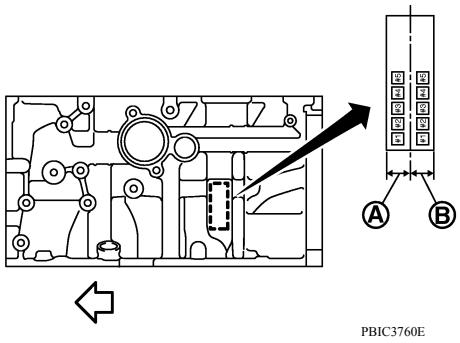
When New Cylinder Block and Crankshaft Are Used

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

   (A) : Basic stamp mark

   ⇦ : Engine front

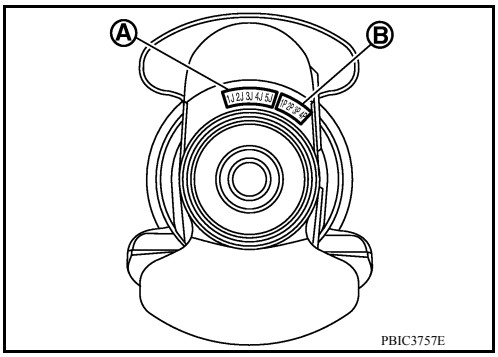
   - If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



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-103, "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	Crankshaft main journal diameter: 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-125, "Main Bearing".

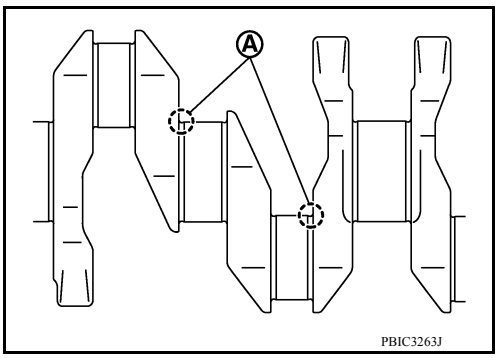
Use Undersize Bearing Usage Guide

- 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 (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table: **Refer to EM-125, "Main Bearing".**



SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000009266682

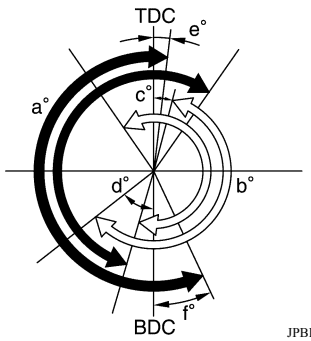
GENERAL SPECIFICATIONS

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 (3.071 ×3.291)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.8
Compression pressure kPa (kg/cm^2, psi) / 200 rpm	Standard	1,510 (15.4, 219)
	Minimum	1,270 (12.95, 184)
	Differential limit between cylinders	100 (1.0, 14.5)

Valve Timing

Unit: degree

Valve timing
⇦: Intake valve
⬅: Exhaust valve



JPBIA4228ZZ

a	b	c	d	e	f
216	228	11 (–27) ATDC	59 (-21) ABDC	-1 (49) ATDC	37 (-13) BBDC

( ): Valve timing control “ON”

Drive Belt

INFOID:0000000009266683

DRIVE BELT

Belt Deflection

Location		Deflection adjustment *		Unit: mm (in)
		Used belt		New belt
		Limit	After adjusted	
Drive belt	With A/C	10 (0.39)	4.9 - 5.2 (0.19 - 0.20)	4.1 - 4.4 (0.16 - 0.17)
	Without A/C	9.1 (0.36)	4.3 - 4.7 (0.17 - 0.19)	3.7 - 3.9 (0.14 - 0.15)
Applied pushing force		98 N (10 kg-f, 22 lb-f)		

*: When engine is cold.

Belt Tension and Frequency

Location		Tension adjustment *		Unit: N (kg-f, lb-f)	Frequency adjustment *		Unit: Hz
		Used belt		New belt	Used belt		New belt
		Limit	After adjusted		Limit	After adjusted	
Drive belt	With A/C	350 (35.7, 78.7)	881 - 951 (89.8 - 97.0, 198.1 - 213.8)	1070 - 1138 (109.1 - 116.0, 240.6 - 255.8)	145.5	230.5 - 239.5	254 - 262
	Without A/C		876 - 964 (89.3 - 98.3, 196.9 - 216.7)	1064 - 1152 (108.5 - 117.5, 239.2 - 259.0)	162	256.5 - 268.5	282.5 - 293.5

*: When engine is cold.

Spark Plug

INFOID:0000000009266684

SPARK PLUG (PLATINUM-TIPPED TYPE)

Make	NGK
Standard type*	PLZKAR6A-11
Gap (nominal)	1.1 mm (0.043 in)

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

Exhaust Manifold

INFOID:0000000009266685

EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion	0.3 (0.012)

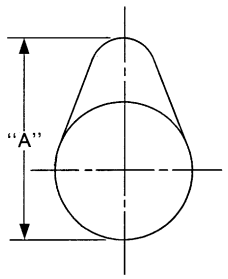
Camshaft

INFOID:0000000009266686

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)	—

Items		Standard	Limit
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[1]	Hot [2]
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)

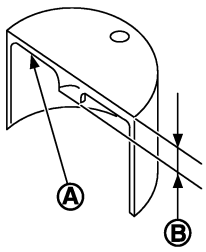
[1]:Approximately 20°C (68°F)

[2]: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)

Identification mark (A)	Thickness (B)
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)
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:0000000009266687

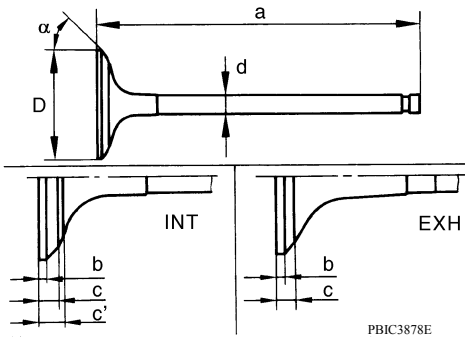
CYLINDER HEAD

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)

VALVE DIMENSIONS

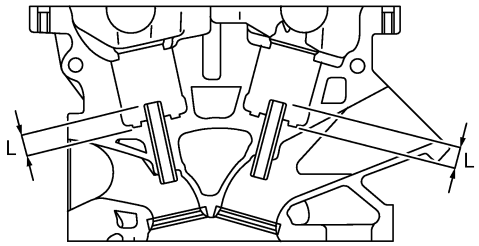
Unit: mm (in)



Valve head diameter “D”	Intake	31.6 - 31.9 (1.244 - 1.256)
	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)

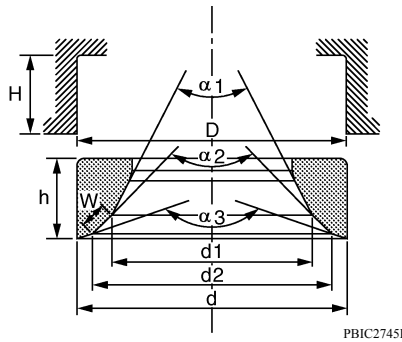


PBIC0184E

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 - 9.001 (0.3533 - 0.3544)	9.175 - 9.201 (0.3612 - 0.3622)
Interference fit of valve guide		0.022 - 0.059 (0.0009 - 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 “L”		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	32.000 - 32.027 (1.2598 - 1.2609)	32.500 - 32.527 (1.2795 - 1.2806)
	Exhaust	25.900 - 25.927 (1.0197 - 1.0207)	26.400 - 26.427 (1.0394 - 1.0404)
Valve seat outer diameter “d”	Intake	32.108 - 32.124 (1.2641 - 1.2647)	32.608 - 32.624 (1.2838 - 1.2844)
	Exhaust	25.991 - 26.007 (1.0233 - 1.0239)	26.491 - 26.507 (1.0430 - 1.0436)
Valve seat interference fit	Intake	0.081 - 0.124 (0.0032 - 0.0049)	
	Exhaust	0.064 - 0.107 (0.0025 - 0.0042)	
Diameter “d1”*1	Intake	29.6 (1.165)	
	Exhaust	23.0 (0.905)	
Diameter “d2”*2	Intake	31.2 - 31.4 (1.228 - 1.236)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle “α1”	Intake	60°	
	Exhaust	45°	

Angle “α2”	Intake	88°45′ - 90°15′	
	Exhaust	88°45′ - 90°15′	
Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.15 - 1.55 (0.0453 - 0.0610)	
Height “h”	Intake	4.7 (0.185)	4.15 (0.163)
	Exhaust	6.0 (0.236)	5.43 (0.213)
Depth “H”	Intake	4.7 (0.185)	
	Exhaust	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

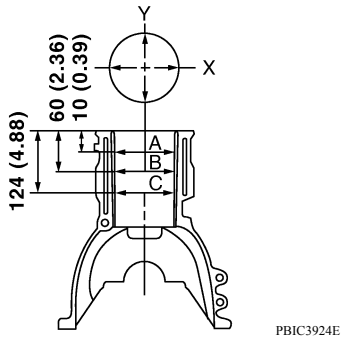
Free height	46.73 mm (1.8398 in)
Installation height	32.40 mm (1.2755 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	242 - 272 N (24.7 - 27.7 kg, 54 - 61 lb)

Cylinder Block

INFOID:0000000009266688

CYLINDER BLOCK

Unit: mm (in)



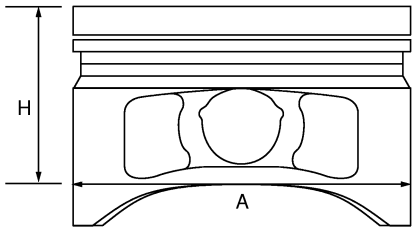
Surface distortion		Limit	0.1 (0.004)
Cylinder bore	Inner diameter	Standard	78.000 - 78.015 (3.0708 - 3.0714)
		Wear limit	—
Out-of-round (Difference between “X” and “Y”)		Limit	0.015 (0.0006)
Taper (Difference between “A” and “C”)			0.010 (0.0004)

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)

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

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 - 0.45 (0.0079 - 0.0177)	0.77 (0.0303)

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)

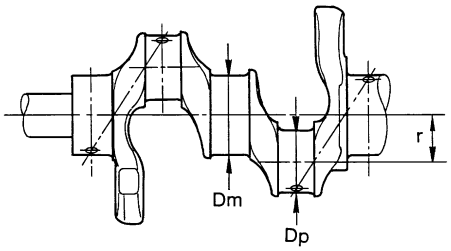
Center distance		129.84 - 129.94 (5.1118 - 5.1157)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*1		18.958 - 18.978 (0.7463 - 0.7471)
Side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0138)
Connecting rod big end diameter grade*2	Grade No. A	43.000 - 43.001 (1.6929 - 1.6929)
	Grade No. B	43.001 - 43.002 (1.6929 - 1.6930)
	Grade No. C	43.002 - 43.003 (1.6930 - 1.6930)
	Grade No. D	43.003 - 43.004 (1 6930 - 1.6931)
	Grade No. E	43.004 - 43.005 (1.6931 - 1.6931)
	Grade No. F	43.005 - 43.006 (1.6931 - 1.6931)
	Grade No. G	43.006 - 43.007 (1.6931 - 1.6932)
	Grade No. H	43.007 - 43.008 (1.6932 - 1.6932)
	Grade No. J	43.008 - 43.009 (1.6932 - 1.6933)
	Grade No. K	43.009 - 43.010 (1.6933 - 1.6933)
	Grade No. L	43.010 - 43.011 (1.6933 - 1.6933)
	Grade No. M	43.011 - 43.012 (1.6933 - 1.6934)
	Grade No. N	43.012 - 43.013 (1.6934 - 1.6934)

*1 : After installing in connecting rod

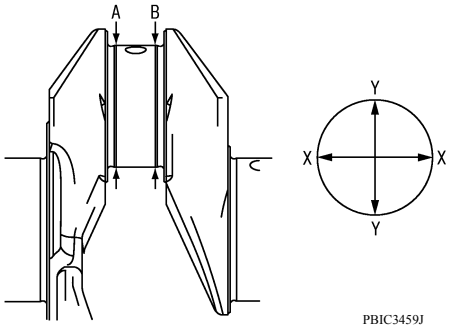
*2 : Always check with the Parts Department for the latest parts information.

CRANKSHAFT

Unit: mm (in)



SEM645



PBIC3459J

Center distance “r”		41.68 - 41.76 (1.6409 - 1.6440)
Out-of-round	Limit	0.003 (0.0001)
Taper	Limit	0.004 (0.0002)
Runout [TIR*1]	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.098 - 0.260 (0.0039 - 0.0102)
	Limit	0.35 (0.0138)

Crankshaft pin journal diameter grade.*2 “Dp”	Grade No. A	39.971 - 39.970 (1.5737 - 1.5736)
	Grade No. B	39.970 - 39.969 (1.5736 - 1.5736)
	Grade No. C	39.969 - 39.968 (1.5736 - 1.5735)
	Grade No. D	39.968 - 39.967 (1.5735 - 1.5735)
	Grade No. E	39.967 - 39.966 (1.5735 - 1.5735)
	Grade No. F	39.966 - 39.965 (1.5735 - 1.5734)
	Grade No. G	39.965 - 39.964 (1.5734 - 1.5734)
	Grade No. H	39.964 - 39.963 (1.5734 - 1.5733)
	Grade No. J	39.963 - 39.962 (1.5733 - 1.5733)
	Grade No. K	39.962 - 39.961 (1.5733 - 1.5733)
	Grade No. L	39.961 - 39.960 (1.5733 - 1.5732)
	Grade No. M	39.960 - 39.959 (1.5732 - 1.5732)
	Grade No. N	39.959 - 39.958 (1.5732 - 1.5731)
	Grade No. P	39.958 - 39.957 (1.5731 - 1.5731)
	Grade No. R	39.957 - 39.956 (1.5731 - 1.5731)
	Grade No. S	39.956 - 39.955 (1.5731 - 1.5730)
	Grade No. T	39.955 - 39.954 (1.5730 - 1.5730)
	Grade No. U	39.954 - 39.953 (1.5730 - 1.5729)
Crankshaft main journal diameter grade.*2 “Dm”	Grade No. A	47.979 - 47.978 (1.8889 - 1.8889)
	Grade No. B	47.978 - 47.977 (1.8889 - 1.8889)
	Grade No. C	47.977 - 47.976 (1.8889 - 1.8888)
	Grade No. D	47.976 - 47.975 (1.8888 - 1.8888)
	Grade No. E	47.975 - 47.974 (1.8888 - 1.8887)
	Grade No. F	47.974 - 47.973 (1.8887 - 1.8887)
	Grade No. G	47.973 - 47.972 (1.8887 - 1.8887)
	Grade No. H	47.972 - 47.971 (1.8887 - 1.8886)
	Grade No. J	47.971 - 47.970 (1.8886 - 1.8886)
	Grade No. K	47.970 - 47.969 (1.8886 - 1.8885)
	Grade No. L	47.969 - 47.968 (1.8885 - 1.8885)
	Grade No. M	47.968 - 47.967 (1.8885 - 1.8885)
	Grade No. N	47.967 - 47.966 (1.8885 - 1.8884)
	Grade No. P	47.966 - 47.965 (1.8884 - 1.8884)
	Grade No. R	47.995 - 47.964 (1.8884 - 1.8883)
	Grade No. S	47.994 - 47.963 (1.8883 - 1.8883)
	Grade No. T	47.963 - 47.962 (1.8883 - 1.8883)
	Grade No. U	47.962 - 47.961 (1.8883 - 1.8882)
	Grade No. V	47.961 - 47.960 (1.8882 - 1.8882)
	Grade No. W	47.960 - 47.959 (1.8882 - 1.8881)

*1: Total indicator reading

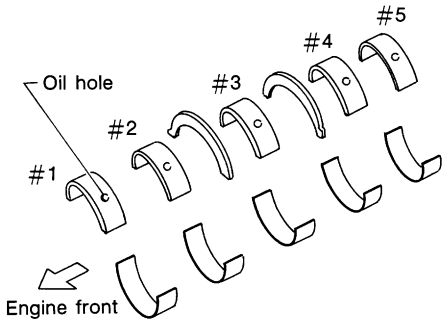
*2: Always check with the Parts Department for the latest parts information.

Main Bearing

INFOID:0000000009266689

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	
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	

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

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:0000000009266690

CONNECTING ROD BEARING

Unit: mm (in)

Grade number*	Thickness	Identification color	Remarks
1	1.501 - 1.504 (0.0591 - 0.0592)	Brown	Grade and color are the same for upper and lower bearings.
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	
5	1.513 - 1.516 (0.0596 - 0.0597)	Pink	

12	UPR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	Grade and color are different between upper and lower bearings.
	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	
56	UPR	1.513 - 1.516 (0.0596 - 0.0597)	Pink	
	LWR	1.516 - 1.519 (0.0597 - 0.0598)	Purple	

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

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	0.020 - 0.030 (0.0008 - 0.0012)
	Limit	0.10 (0.0039)